

# Whirinaki Drain Stopbank Upgrade Design Report

✦ Prepared for

Hawke's Bay Regional Council

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PATTLE DELAMORE PARTNERS LTD  
Level 2, 134 Oxford Terrace  
Christchurch Central, Christchurch 8011  
PO Box 389, Christchurch 8140, New Zealand

Tel +64 3 345 7100  
Web [www.pdp.co.nz](http://www.pdp.co.nz)



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DOCUMENT CONTRIBUTORS

Prepared by

SIGNATURE

Tylan Collings, Izak Breytenbach and Annika Gibson

Reviewed by

SIGNATURE

Philip Claassens

Approved by

PP

Martina Groves

Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Hawke's Bay Regional Council and others not directly contracted by PDP for the work, including Hastings's District Council, Civil & Transportation Design Limited, Cirtex Limited. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

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## Executive Summary

Hawke's Bay Regional Council has identified the proposed upgrade of the existing Whirinaki stopbank as part of the Whirinaki Flood Resilience project to improve flood resilience for the communities and industries to the east of the Whirinaki Drain. This work follows the widespread flooding in the Whirinaki area caused by Ex-Tropical Cyclone Gabrielle (ETC-Gabrielle) in February 2023.

The resilience work includes a proposed stopbank upgrade and construction of a new stopbank to provide flood protection in line with the revised levels of service and to improve overall flood resilience. The work will consist of:

- ∴ Whirinaki Stopbank, which consists of the construction of a new stopbank from the north side of the Esk River mouth to State Highway 2 in the north. The total length of the work area is approximately 1,260 m, which includes approximately 1,144 m of new stopbank to provide flood protection up to a 100-year level of services (inclusive of climate change) and a 700 mm freeboard. The work includes localised raising of North Shore Road to allow unimpeded access over the stopbank where it crosses North Shore Road.
- ∴ Pan Pac Stopbank consists of the construction of a new stopbank (approximately 550 m) and the upgrade of an existing stopbank (approximately 1,141 m). The total length of the work area is approximately 1,690 m and includes raising the State Highway 2 to allow traffic over the proposed stopbank crossing with State Highway 2 (note: work done by others). The proposed stopbank will provide flood protection up to a 500-year level of service (inclusive of climate change) and a freeboard consisting of 900 mm east of State Highway 2, 700 mm between State Highway 2 and Burden Road, and 500 mm from Burden Road to the end of work.

The purpose of this report is to present the investigation, assessment, and design work completed by Pattle Delamore Partners Ltd to support the consent application being prepared by Stradegy Ltd on behalf of Hawke's Bay Regional Council.

The document presents the following information:

- ∴ Existing Environment;
- ∴ Whirinaki Flooding Background;
- ∴ Proposed Flood Resilience Project;
- ∴ Flood Modelling completed as part of the work;

- ∴ Investigations completed as part of the work consisting of:
  - Geotechnical; and,
  - Survey.
- ∴ Proposed preliminary design including drawings;
- ∴ Assessment of effects; and,
- ∴ Construction overview.

This document should be read in conjunction with the relevant documents as listed within the document register.

## Table of Contents

SECTION	PAGE
<b>Executive Summary</b>	<b>ii</b>
<b>1.0 Introduction</b>	<b>1</b>
<b>2.0 Location</b>	<b>1</b>
<b>3.0 Existing Environment</b>	<b>2</b>
3.1 Esk River Catchment	2
3.2 Land Use and Development	4
3.3 Site of Significance	5
3.4 Key Existing Infrastructure	5
<b>4.0 Whirinaki Flooding Background</b>	<b>6</b>
4.1 Aerial Imagery	6
4.2 History of Flooding and Drainage Scheme	7
<b>5.0 Proposed Flood Resilience Project</b>	<b>8</b>
5.1 Level of Service Upgrade	8
5.2 Scope of Whirinaki Flood Resilience Works	10
<b>6.0 Flood Modelling</b>	<b>11</b>
6.1 Modelling Overview	11
6.2 Key Considerations for the Model Calibration	12
6.3 Elevation Data	13
6.4 Railway Embankment	13
6.5 Model Inputs	13
6.6 Sediment Concentration Analysis	14
6.7 Summary of Model Calibration Results	14
6.8 Freeboard Assessment	15
6.9 Summary of Design Modelling Results	16
<b>7.0 Investigations</b>	<b>16</b>
7.1 Geotechnical	17
7.2 Topographical Survey	19
<b>8.0 Preliminary Design</b>	<b>19</b>
8.1 Basis of Design	20
8.2 Preliminary Design Drawings	20
8.3 Overview	20
8.4 Proposed Whirinaki Stopbank	22
8.5 Proposed Pan Pac Stopbank	25
8.6 Stopbank Geotechnical Design	33
8.7 Stopbank Scour and Erosion Protection	36
8.8 Flood Wall for Petāne Urupā	36

<b>9.0</b>	<b>Assessment of Effects</b>	<b>37</b>
<b>9.1</b>	<b>Flooding Effects</b>	<b>37</b>
<b>9.2</b>	<b>Stormwater Effects</b>	<b>39</b>
<b>9.3</b>	<b>Erosion and Scour Effects</b>	<b>40</b>
<b>10.0</b>	<b>Construction</b>	<b>40</b>
<b>10.1</b>	<b>Stockpile/Laydown Sites &amp; ESC</b>	<b>40</b>
<b>10.2</b>	<b>Site Establishment</b>	<b>41</b>
<b>10.3</b>	<b>Temporary Stream Crossings</b>	<b>42</b>
<b>11.0</b>	<b>Document Register</b>	<b>42</b>
<b>12.0</b>	<b>References</b>	<b>45</b>
<b>13.0</b>	<b>Limitations</b>	<b>45</b>

## Table of Figures

Figure 1: Proposed mixed level of service stopbank	2
Figure 2: Key sites around Whirinaki and existing flood resilience infrastructure.	4
Figure 3: OiC Area and proposed stopbank location	10
Figure 4: Model extent and terrain elevations derived from LiDAR.	12
Figure 5: Freeboard Assessment Sections.	15
Figure 6: Proposed Whirinaki Flood Resilience Work	21
Figure 7: Flood Difference in a 100-year event with climate change to RCP 8.5 2074	38
Figure 8: Flood Difference in a 500-year event with climate change to RCP 8.5 2074	39

## Table of Tables

Table 1: Existing Underground Services near the SH2 Crossing	6
Table 2: Existing Underground Services near the North Shore Road Crossing	6
Table 3: Recommended freeboard	16
Table 4: Recommended freeboard	19
Table 5: Preliminary Drawing Sets	20

Table 6: Liquefaction Summary	33
Table 7: Lateral Spread Summary	34
Table 8: Document Register for Key PDP Deliverables	43

## Appendices

Appendix A: Figures

Appendix B: Whirinaki Stopbank Design Drawings

## 1.0 Introduction

Pattle Delamore Partners Limited (PDP) was engaged by Hawke's Bay Regional Council (HBRC) to design the upgrade and extension of the existing Whirinaki Drain stopbank, located north of Bayview in Hawke's Bay. This work forms part of the Whirinaki Flood Resilience Project under the land categorisation programme.

The stopbank is being upgraded, and a new section will be constructed to provide flood protection in line with the revised levels of service and to improve overall flood resilience. This work follows the widespread flooding in the Whirinaki area caused by Ex-Tropical Cyclone Gabrielle (ETC-Gabrielle) in February 2023.

This report provides a summary of the design process and should be read in conjunction with the specific reports listed in the Document Register (Refer to Section 11.0).

## 2.0 Location

The Whirinaki Drain runs from upstream of the Pan Pac Forest Products facility, crosses beneath State Highway 2 (SH2) via a double concrete culvert, and feeds into the Esk River, where the Esk River mouth flows into the ocean.

The location of the proposed Whirinaki Flood Resilience Project is shown in Figure 1.

The project site is part of Lot 1 DP 28357, Section 62 Block XII Puketapu SD, Lot 1 DP 28162, Lot 1 DP 344267, Lot 3-12 DP506130, Lot 2 DP 562586 PT, Lot 1 DP 4741, Lot 1 DP 562586, and Lot 3 DP 562586.

Refer to the land acquisition plans in series 000 included in Appendix B.

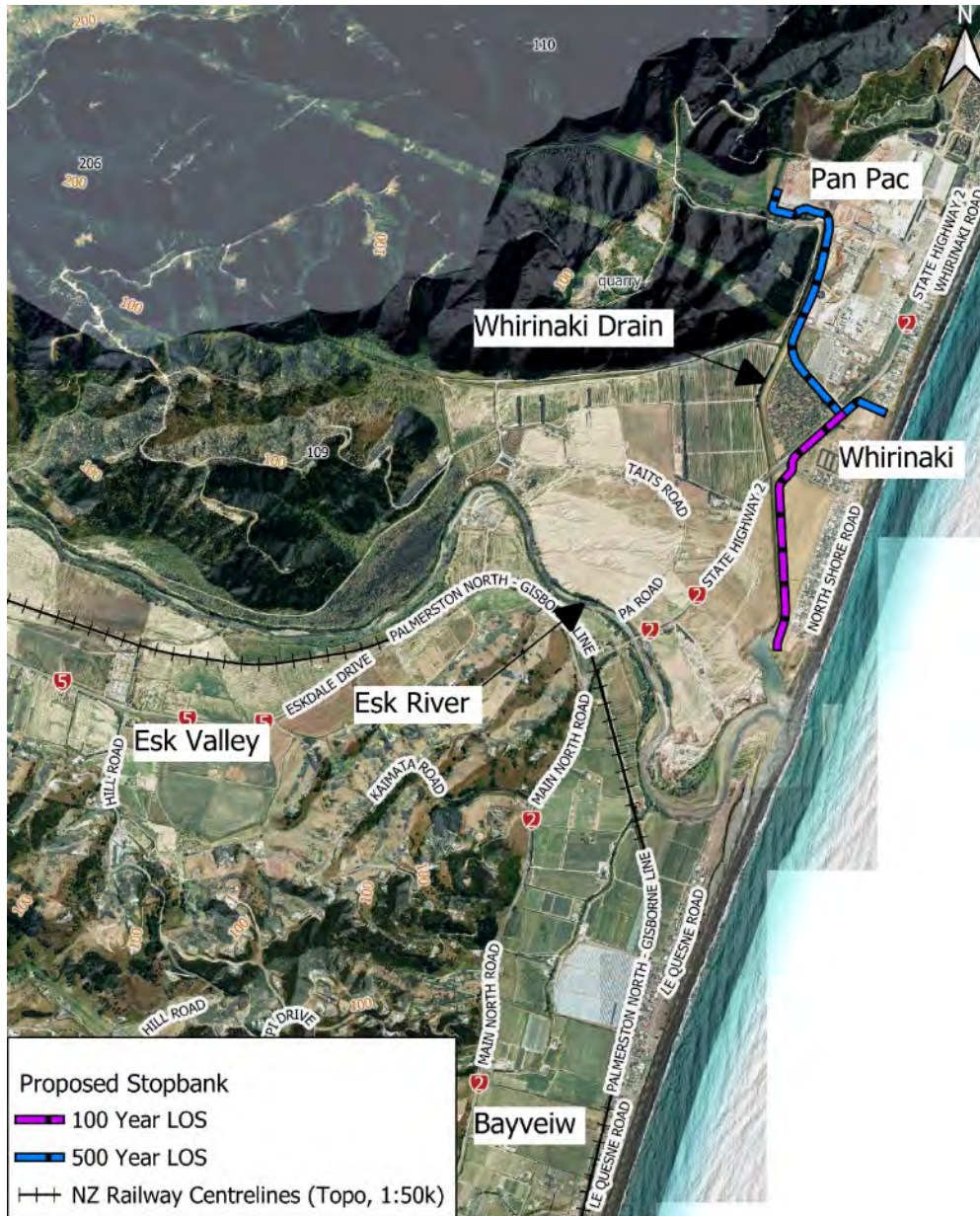


Figure 1: Proposed mixed level of service stopbank

### 3.0 Existing Environment

#### 3.1 Esk River Catchment

The Esk River is one of Hawke's Bay's smaller rivers, with a catchment area of approximately 252 km<sup>2</sup>. The Esk River flows south from Taraponui in the Maungaharuru Range before turning east to reach Hawke Bay 10 km north of State Highway 5 (Hastings District).

Before the 1931 Hawke's Bay earthquake, the Esk River flowed south through Bayview into the northern end of Ahuriri Lagoon when the beach outlet was blocked – the earthquake raised the area blocking that flow path. That old southern branch of the river forms the northern boundary of urban development in Napier.

The Whirinaki Drain is a modified drain that has followed the current alignment since at least 1943, with only modifications at the confluence with the Esk River since. The Whirinaki Drain is predominantly located in the Esk River floodplain and flows into the Esk River at the Esk River mouth.

Refer to Figure 2 for the location of the Esk River and Whirinaki Drain.

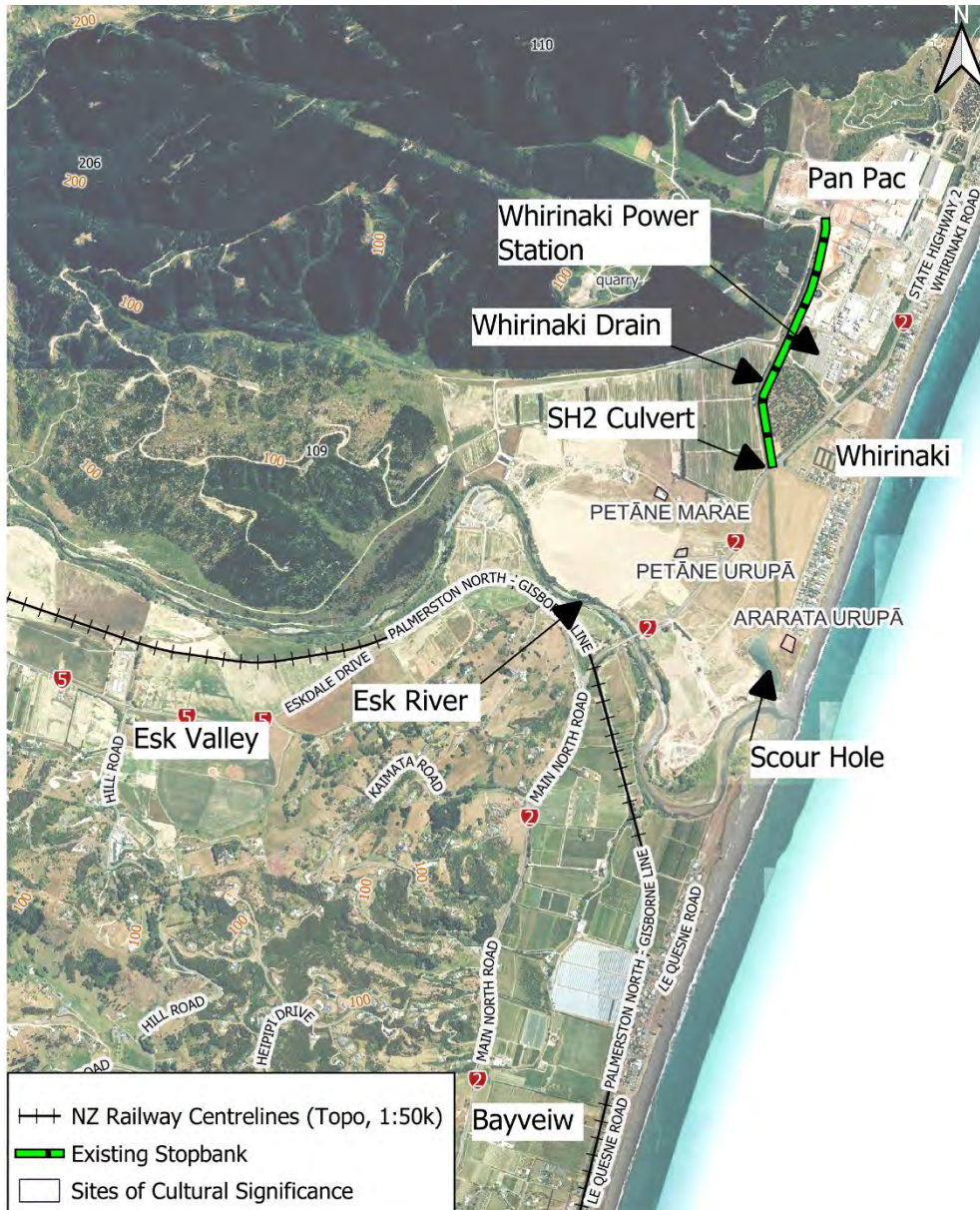


Figure 2: Key sites around Whirinaki and existing flood resilience infrastructure.

### 3.2 Land Use and Development

The lower Esk River catchment is known for its vineyards, orchards, and farmland, and more recently, residential housing and lifestyle blocks associated with the development of the Whirinaki Coastal settlements, as shown in historic to current imagery included in Appendix A.

The area was largely agricultural (pastoral and horticultural) up until the construction and operation of the Pan Pac Forest Products Ltd (Pan Pac) facility

(i.e., the Mill) in the 1970s. From that point onwards, smaller land development occurred along the coastal corridor and to the east of the Whirinaki Drain.

### 3.3 Site of Significance

There are various significant facilities /in the vicinity of the project area. The key facilities are shown in Figure 2 and are discussed below. These facilities are of industrial, economic, and cultural importance. These are described below:

- ∴ Pan Pac's timber and wood pulp mill (the Mill), one of Hawke's Bay's largest industrial plants, is located in Whirinaki.
- ∴ The Contact Energy diesel-powered Whirinaki Power Station opened next to the Mill in 1978 and is operated as a backup "peaker plant" at times of low generation capacity on the national grid. The adjacent Transpower Whirinaki Substation supplies power to Pan Pac and is the grid entry point for generation from the Whirinaki Power Station. At the time of writing (2025), the three sites comprise approximately \$2 billion worth of critical industrial and infrastructural assets.
- ∴ The Esk Water Treatment Plant is located nearby at 74 Eskdale Drive. Pan Pac has their treatment facility on-site, situated adjacent to the existing Whirinaki Drain stopbank.
- ∴ There are two urupās in the vicinity of the site: Petāne and Ararata.
  - Petāne urupā is located at the junction of Pa Road and Taits Road.
  - Ararata urupā is located downstream in the catchment near the confluence of Whirinaki Drain with the Esk River.
- ∴ Petāne marae is also located further north of Petāne urupā along Taits Road.

### 3.4 Key Existing Infrastructure

The proposed stopbank involves two road crossings, one at SH2 (Waka Kothai asset) and another at North Shore Road (Hasting District Council asset). The road corridors act as service corridors as well.

The existing services near the SH2 crossing are shown in Table 1, and the services near the North Shore Road crossing are shown in Table 2.

Existing services within the Pan Pac area have also been identified based on the service layout drawings provided by Pan Pac. Refer to the existing services drawings included in Appendix B.

<b>Table 1: Existing Underground Services near the SH2 Crossing</b>			
<b>Service Type</b>	<b>Service Provider</b>	<b>Diameter (m)</b>	<b>Approx. Depth to Top of Service (m)</b>
Watermain	Hastings District Council	0.15	0.8
Gas Main	Powerco	0.225	1
Six Telecommunications	Chorus	-	0.6

<b>Table 2: Existing Underground Services near the North Shore Road Crossing</b>			
<b>Service Type</b>	<b>Service Provider</b>	<b>Diameter (m)</b>	<b>Approx. Depth to Top of Service (m)</b>
Watermain	Hastings District Council	0.15	0.8
Five Telecommunications	Chorus	-	0.6

## 4.0 Whirinaki Flooding Background

### 4.1 Aerial Imagery

A desktop review of available historical aerial photographs dating from 1943 to 1988 was sourced from Retrolens, while more recent imagery was obtained via Google Earth Pro. The reviewed imagery is presented in Appendix A, Figures A1–A4.

Analysis of the historical photographs indicates that the Whirinaki Drain has maintained a consistent alignment since at least 1943. The most notable changes observed over time have occurred near the confluence with the Esk River, where progressive deposition and placement of fill material were evident. These modifications continued until the impact of Cyclone Gabrielle, which caused significant scour and reshaping of the area.

The imagery also documents the gradual development of Whirinaki, including the establishment of the Pan Pac industrial facility and the urbanisation of coastal areas adjacent to the beach. These changes reflect the transformation of the region from a predominantly rural landscape to a more industrial and residential setting.

## 4.2 History of Flooding and Drainage Scheme

### 4.2.1 Historical Flooding

Records of flooding in the Hawke's Bay region date back almost 130 years. The details of the most significant events are summarised below:

- ∴ **1897:** This is the earliest recorded flood in the area, which the recorded flood was reported as the largest disaster in the region's history. These floods were caused by excessive heavy rainfall that led to the flooding of the low-lying lands near Napier, due to multiple rivers in the area flooding and breaking their banks.
- ∴ **1938:** The flooding of the Esk Valley was the next big event that recorded flooding in the area, which left up to 3 m of silt covering its expanse. This caused widespread devastation as Napier was cut off due to the washout of the Waitangi Bridge; 54 bridges in the region needed to be replaced, and a significant loss of livestock occurred.
- ∴ **1988:** Cyclone Bola left Napier underwater as the Esk and Mohaka rivers overflowed, bringing down large volumes of debris. Every bridge from Petāne (now Bayview) to Taupō was damaged.
- ∴ **March 2018:** This was a heavy rainfall event, where up to 329 mm of rain fell in 24 hours, damaging approximately 80 homes in the Esk Valley and Rissington.
- ∴ **February 2023:** Cyclone Gabrielle caused the latest devastating flood. HBRC is still working on the data from that event to estimate its scale. All the river level monitoring stations in the Esk catchment were destroyed, so there is little hydrological data. The National Institute of Water and Atmospheric Research (NIWA) has estimated that 450 mm of rain fell during the event, and 30,000 ha of land from the Esk River to Kotemaori in Northern Hawke's Bay was severely affected by erosion and sedimentation. The residential area of Whirinaki and Pan Pac suffered extensive damage during and following the event, with damages to Pan Pac over \$300,000,000, and, unfortunately, a loss of life at Whirinaki.

### 4.2.2 Existing Esk – Whirinaki Scheme

The Esk and Whirinaki flood control scheme (the Scheme) was established in 1996 to reduce overland flow or ponding in times of flood, reduce loss of land from bank erosion, and ensure channels remain clear and free flowing. The Scheme is part of a wider group of small schemes administered by HBRC.

The Scheme purpose is encapsulated within the Asset Management Plan<sup>1</sup> (AMP). HBRC's Asset Management Group (HBRC AMG) is responsible for the management of the Scheme and its assets.

The Esk River channel conveys flood events up to an estimated two-year return period flood (215 m<sup>3</sup>/s) within the confines of the active river channel. Note that the effect of ETC-Gabrielle could see that the standard was revised.

In 1972, an engineering consultancy (unknown name) was engaged in designing and building a drainage scheme that would provide flood protection to a five-year Return Period, based on the rainfall data, design standards. The work consisted of the construction of 4.7 km of new drains and 1.7 km of new stopbank and forming the basis of the Scheme that exists today.

The level of services as per the AMP has been defined as 1 in 100-year Return Period, but there was a proposal to increase this by either upgrading the culvert under SH2 or increasing the freeboard of the Whirinaki Drain stopbank. Both these works have progressed, with the preliminary design reported in this document.

It is important to note that the Level of Service (LoS) can change after every flood due to changes in the river's morphology. New survey data is used to update the flood model to determine the effect of silt build-up on the river berm on flood protection standards.

## 5.0 Proposed Flood Resilience Project

### 5.1 Level of Service Upgrade

Following the effects of ETC-Gabrielle, HBRC is undertaking a series of infrastructure repair and upgrade projects to restore flood resilience in alignment with the Hawke's Bay Recovery Plan.

#### 5.1.1 Current Level of Service:

The Whirinaki Drain stopbank along Pan Pac was designed to protect a 1-in-500-year flood event, without considering freeboard, climate change, or ETC-Gabrielle event data. The existing stopbank currently extends along the eastern side of the Whirinaki Drain from north of SH2 to the western Pan Pac boundary.

Noting that in practice, as it would not achieve this level of service as the stopbank terminates at the state highway, and flood events can flood over the state highway outflanking the stopbank towards the confluence with the Esk River.

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<sup>1</sup> Esk River and Whirinaki Drainage Flood Control Scheme Asset Management Plan 20 July 2021 Hawkes Bay Regional Council Publication No. 5547\_7

### 5.1.2 Proposed Level of Service:

The stopbank is being upgraded with a mixed level of service protecting Pan Pac for events up to a 500-year flood and Pohutakawa Drive up to a 100-year flood. The proposed stopbank has a mixed freeboard for different sections based on uncertainty and has been designed for climate change to 2044 RCP 8.5 (Refer to *PDP, Esk River Climate Change Assessment V2, October 2024*)

The Whirinaki Drain stopbank along Pohutakawa Drive is closely linked to land categorisation work in several ways:

- ∴ **Risk Mitigation:** Enhancing flood protection for industrial and residential areas.
- ∴ **Land Reclassification:** Improved flood protection allows properties currently classified as Land Category (LC)<sup>2</sup> 2C (high risk) to be reclassified to LC1 (low risk).
- ∴ **Community Resilience:** By enhancing flood protection, the project increases the overall resilience of the community and key industrial areas, including Pan Pac.
- ∴ **Environmental Impact:** The work includes infrastructure improvements such as enhancing the SH2 culvert and increasing the capacity of the Whirinaki Drain. These improvements help manage water flow and reduce the likelihood of flooding.

The Severe Weather Emergency Recovery (Hawke's Bay Flood Protection Works) Order 2024 is an Order in Council (OiC) requested by the Hawke's Bay Regional Recovery Agency that came into effect on 7 June 2024. The delineated area for Whirinaki to which the OiC applies is presented in Figure 3. Approximately 1,050 m of the stopbank is outside the OiC area with approximately 500 m of the 1,050 m is in the upper Pan Pac site.

The flood protection works proposed for the Whirinaki Drain, to improve flood resilience and associated upgrades, are detailed in Section 5.2 below.

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<sup>2</sup> Categorisation framework has been developed for the region following ETC-Gabrielle and is documented in 'Hawke's Bay Regional Council's Land Categorisation Process and Framework following Cyclone Gabrielle' (HBRC, 2023).

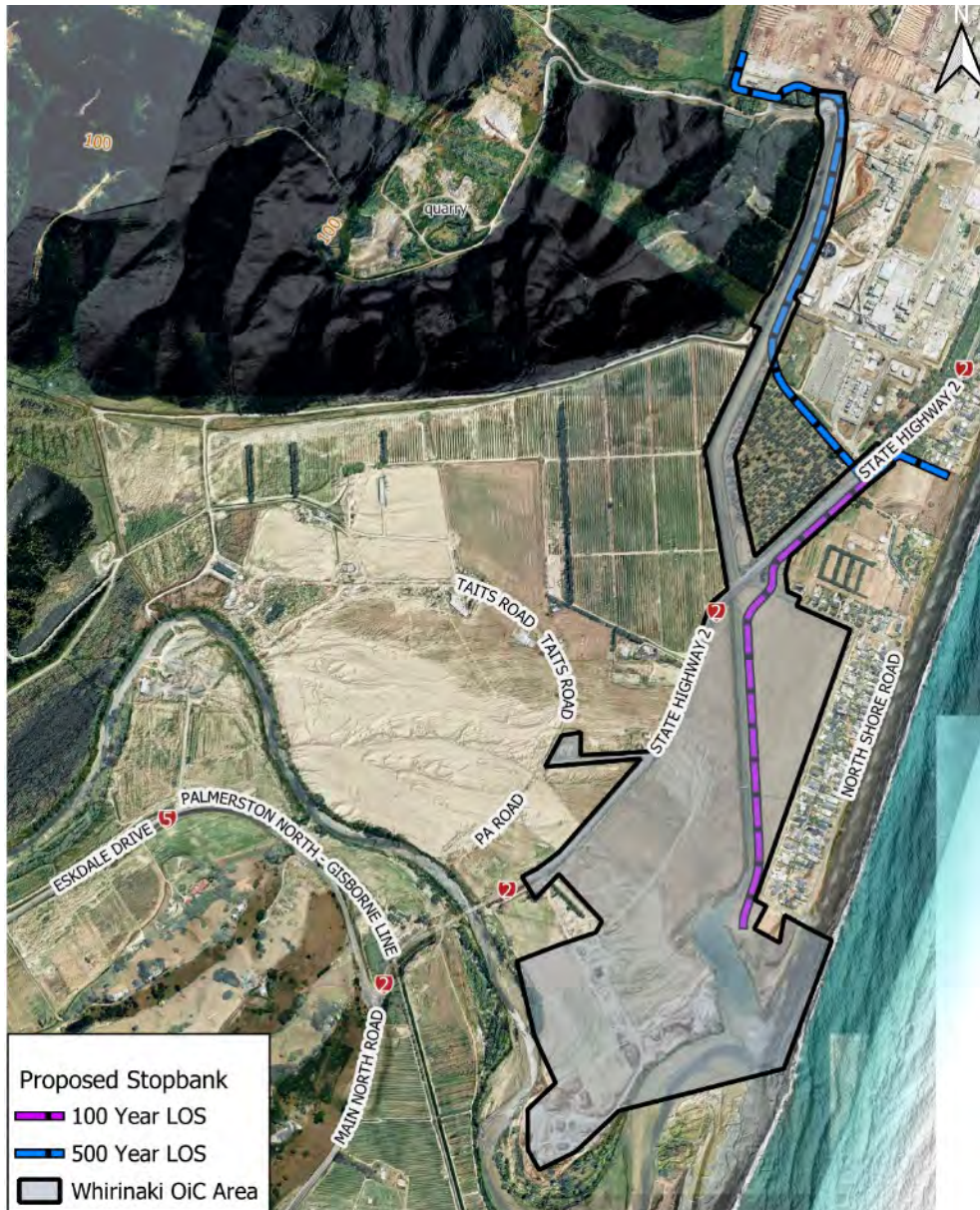


Figure 3: OIC Area and proposed stopbank location

## 5.2 Scope of Whirinaki Flood Resilience Works

The scope of the proposed upgrades to achieve the proposed level of service (LoS) is detailed below, with the proposed work extent as per the drawings included in Appendix B. The materials will be sourced off site.

- ∴ It is proposed to upgrade the Whirinaki Drain stopbank to meet a new mixed level of service design standard plus freeboard. The proposed stopbank is located along the eastern banks of the Whirinaki Drain from adjacent to the Pan Pac facility to approximately 0.9 km downstream

from SH2, where the drain discharges into the sea. The concept design for the proposed drain upgrades has been undertaken by PDP.

- ∴ The stopbank upgrades and new stopbanks are proposed for the following sections:
  - 100-year LoS Stopbank (Whirinaki Portion)
    - Construct a new 100-year level of service stopbank from SH2 to the coast (approximately 1.1 km).
  - 500-year LoS Stopbank (Pan Pac Portion)
    - Construct a new 500-year level of service stopbank from the beach across SH2 to the existing stopbank (approximately 0.55 km)
    - Raise the existing stopbank to the Burden Road culvert (approximately 0.6 km)
    - Extend the stopbank from the Burden Road culvert to the western boundary of the Pan Pac log storage yard (approximately 0.55 km).
- ∴ It is proposed to raise SH2 and North Shore Road to accommodate the proposed stopbank. The concept road design has been completed by others (Civil & Transportation Design Ltd).
- ∴ To mitigate ponding at the toe of the proposed stopbank and enable effective cross-drainage toward the Whirinaki Drain, the installation of new cross-drainage infrastructure is proposed.
- ∴ Localised realignment or retention of existing services (e.g., council services, comms, gas, etc.) will be completed along the footprint of the proposed stopbank.

Note that existing culverts crossing the Whirinaki Drain are not expected to be upgraded as part of the scope of work.

## 6.0 Flood Modelling

### 6.1 Modelling Overview

PDP prepared a hydraulic model for the Esk River for the purpose of determining the design height for a suite of proposed stopbanks to improve flood protection following ETC-Gabrielle. This was originally assessed for flood protection from flooding in the 1% Annual Exceedance Probability (AEP) event with climate change allowances. Further modelling work has been undertaken that built on this original work, with an increased level of service.

The design hydraulic model is described below, with the full flood model design report referenced in the document register.

A hydrodynamic model was developed using Tuflow for the primary purpose of deriving the stopbank heights along the Whirinaki Drain. The model extent, LiDAR, and location of boundary conditions are shown in Figure 4. **Error! Reference source not found..** For the full modelling report, refer to 'HB010500006R019 – Esk Valley: Design Model Build Report' (PDP, 2025); a summary of the modelling undertaken is provided below.

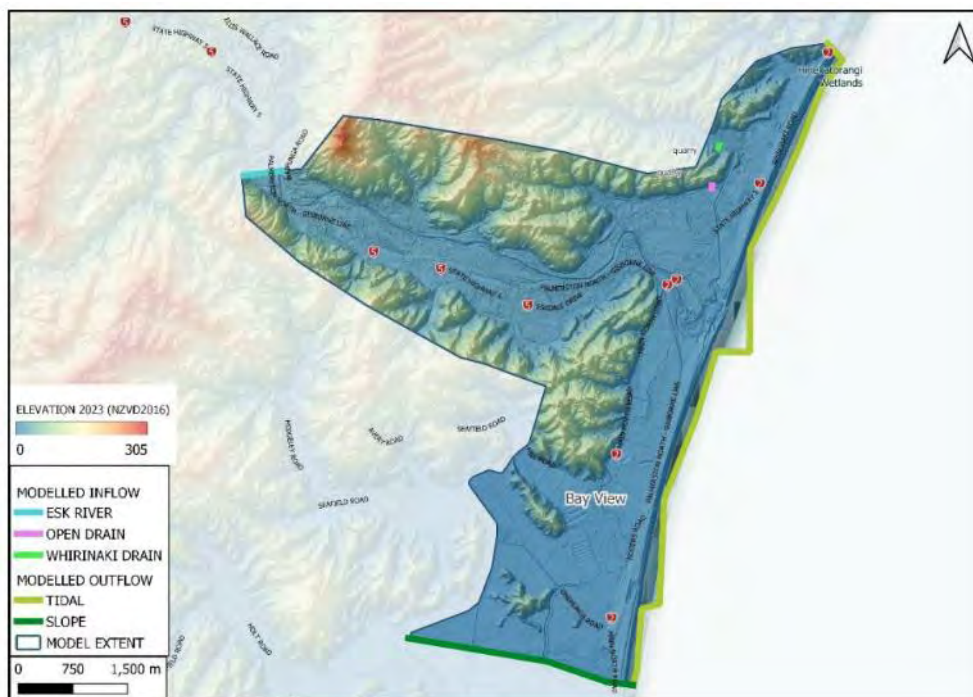


Figure 4: Model extent and terrain elevations derived from LiDAR.

## 6.2 Key Considerations for the Model Calibration

The model was validated for the February 2023 ETC-Gabrielle flood event. Some key factors that complicated the calibration of this model are identified as follows:

- ∴ **Flow:** the peak flow of the ETC-Gabrielle event is unknown as the recorder ceased operating at some time before the peak of the event.
- ∴ **Sediment concentration:** the sediment load was likely high due to substantial upstream slope failures, which can result in non-Newtonian flows (HEC, 2020).
- ∴ **Geomorphometry:** pre- and post-Gabrielle LiDAR shows significant sediment deposition and erosion throughout the floodplain and river

channel. The form of the terrain surface at the peak of the flood event is unknown.

- ∴ **River mouth:** There are anecdotal reports that the river mouth may have been closed during the event. The sensitivity of the model to the river mouth condition was tested by PDP in a previous model iteration (2023) and was found to have a limited effect on flood levels.
- ∴ **Railway:** the railway line, which hydraulically acts as an informal embankment, failed at multiple locations. This essentially controls the rate of flow from the Esk River into the Bayview area.
- ∴ **SH2 bridge blockage:** due to the large debris load, the SH2 bridge may have been partially blocked, which could influence hydraulics and flood levels.

### 6.3 Elevation Data

The upstream model extent begins at the recorder site (i.e., Esk River at Waipunga Bridge) and terminates at the coast.

Two topographic LiDAR sets were obtained in 2021 (pre-cyclone) and 2023 (post-cyclone), noting that the 2023 data provided by WSP was limited but preferred due to its increased accuracy.

### 6.4 Railway Embankment

The railway foundation and ballast were washed out in several locations during ETC-Gabrielle. Whilst this did not impact flood levels for Whirinaki Drain, preliminary model runs showed that flood levels in Bayview were sensitive to the assumptions regarding the railway condition.

### 6.5 Model Inputs

The key model input parameters are summarised as follows:

- ∴ The **maximum resolution of the model** was determined by testing the cell size convergence as per TUFLOW recommendations. A value of 5 m resolution was adopted for the study.
- ∴ Roughness represents the friction losses incurred by the water body as it traverses topography. The **model roughness** was determined by utilising multiple sources to define land cover, e.g., LINZ road parcels and building footprints, and aerial imagery. Manning's roughness value 'n' associated with each land cover was adopted for the model and tested for sensitivity.
- ∴ **Boundary conditions** define how water enters and exits the model. Three boundary conditions were required for this model:

- Upstream boundary conditions, flow vs time, are required at Esk River at Waipunga Bridge, Whirinaki Drain at Pan Pac, and an Open Drain (tributary of the Whirinaki Drain).
  - Downstream boundary condition, head vs stage, set as the tidal boundary condition for the 1% AEP storm surge and provided by T+T (September 2023 via email).
  - A normal flow boundary condition at the end of the Bayview residential area to prevent glass walling and allow water to exit at the model boundary.
- ∴ As the Esk River flow recorder ceased operating before the peak of the ETC-Gabrielle event, to account for the uncertainty associated with the **inflow**, three flows were considered and fitted to a synthetic hydrograph profile.
  - ∴ The model has four **structures**: the SH2 bridge, the SH2 Whirinaki culvert, and two culverts in Whirinaki Drain by the Pan Pac site.

Note that several simulations were necessary to encapsulate uncertainty in the model inputs associated with the ETC-Gabrielle event.

## 6.6 Sediment Concentration Analysis

Sediment concentration of the flood waters during ETC-Gabrielle was completed and determined a sediment mobilisation total of 9,500,000 m<sup>3</sup>. For sediment concentrations to have a significant impact on flow (become non-Newtonian), they require a 30% sediment concentration by volume. For the total sediment released by ETC-Gabrielle volume gives an approximate 7% sediment concentration. For the concentration to exceed 30%, PDP estimates that >80% of the sediment would have to be released over a three to four-hour period. Therefore, it is considered possible, however unlikely, that sediment concentrations were high enough to produce non-Newtonian flows.

## 6.7 Summary of Model Calibration Results

The model calibration results showed that:

- ∴ The railway washout significantly impacts flood levels in Bayview and Pohutukawa Drive but has minimal effects elsewhere.
- ∴ The condition of the river mouth (open or closed) influences flood levels at Bayview but does not substantially affect other areas.
- ∴ Modelled water levels are sensitive to roughness, flow assumptions, and terrain conditions, reinforcing the need for a balanced calibration approach.

- ∴ The best calibration results were obtained using a peak flow of 2,175 m<sup>3</sup>/s, medium roughness values, and the 2023 terrain dataset.

### 6.8 Freeboard Assessment

PDP has assessed the freeboard requirements for the entire stopbank over two separate memos, one assessing the Haulage road freeboard (Pattle Delamore Partners, March 2025) and another assessing the freeboard for the rest of the stopbank (Pattle Delamore Partners, June 2025). The freeboard was assessed over 5 distinct sections of the stopbank, as shown in Figure 5. The recommended freeboards for each section, and as accepted by HBRC, are shown in Table 3. The two memos are referenced in the document register.



Figure 5: Freeboard Assessment Sections.

<b>Section</b>	<b>Level of Service</b>	<b>Freeboard requirement</b>
Whirinaki Drain Mouth to North Shore Road	100-year	700 mm
North Shore Road to SH2	100-year	700 mm
SH2 to Gravel Beach	500-year	900 mm
SH2 to Haulage Road	500-year	700 mm
Haulage Road	500-year	500 mm

## 6.9 Summary of Design Modelling Results

The design model assessed the effectiveness of the proposed stopbank in providing flood protection up to a 500-year event for Pan Pac and up to a 100-year event for Pohutukawa Drive, and showed that:

- ∴ The proposed stopbank design effectively mitigates flood risks for Pohutukawa Drive, North Shore Road, up to a 100-year event.
- ∴ Pan Pac and the Whirinaki industrial area are protected in up to a 500-year event.
- ∴ Sensitivity tests were undertaken and confirmed that the model is mostly influenced by LiDAR data (pre or post ETC-Gabrielle), while factors such as culvert blockages and local rainfall have a minimal effect on predicted flood levels.
- ∴ The mixed freeboard provides a conservative margin for uncertainties in hydrological estimates and climate change impacts, allowing for more freeboard where uncertainties are highest.

The assessment of flooding effects from the proposed upgrade has been separately investigated and is discussed in Section 9.1 of this report.

## 7.0 Investigations

Aside from assessments in relation to ecological values and potential soil contamination, reported elsewhere, the following sections provide a comprehensive summary of the investigations undertaken by PDP in support of the design for the proposed Whirinaki Flood Resilience Project.

- ∴ For the ecological investigation and assessment of potential ecological impacts, refer to '*HB010500001R001 – Ecological Impact Assessment for the Proposed Upgrade to the Whirinaki Stopbank*';

- ∴ For the preliminary site investigation (PSI) has been undertaken by PDP described in '*HB010500004L04 - Preliminary Site Investigation at Whirinaki Stop Bank*'.

These investigations were essential to inform and enhance the design of the stopbank upgrade and the construction of a new stopbank. Note that the hydraulic modelling undertaken to inform the design is discussed in Section 6.0 of this report.

## 7.1 Geotechnical

A geotechnical assessment was completed for the overarching stopbank upgrade and is reported in *HB010500002R003 - Geotechnical Assessment Report for the Proposed Upgrade to the Whirinaki Stopbank (Revised Alignment), Hawke's Bay*. Below is a summary of the investigation:

### 7.1.1 Investigation Works

Geotechnical investigation work for the stopbank was done on multiple occasions to supplement project updates. Work was done in January 2024, July 2024, October 2024, and June 2025. Further work was also done at the SH2 culvert in October 2024; however, this portion of the work was cancelled as part of one of the project updates. Geotechnical work included the following:

- ∴ Desktop studies of existing and available information.
- ∴ Visual site walkover work before invasive site investigation work.
- ∴ Hand augers with supplementary handheld shear vane or dynamic cone penetrometer (DCP or Scala), depending on material types encountered (i.e., cohesive vs granular).
- ∴ Cone penetrometer tests (CPT).
- ∴ Geophysical testing to assess the existing stopbank integrity, including ground penetrating radar (GPR) and multi-channel analysis of surface waves (MASW – seismics).
- ∴ Further geophysical work (i.e., GPR) at the Ararata Urupa, where invasive testing was initially not allowed.
- ∴ Work done at the cancelled SH2 culvert site included CPT and sonic boreholes.

### 7.1.2 Geology

The geology along the stopbank alignment is dominated by Holocene-aged marine sediments, which can be divided into two distinct types: interbedded sediments (i.e., sand, silt, and clay) and underlying sandy gravel. There are also localised recent alluvial deposits, as well as flood silt and debris resulting from

Cyclone Gabrielle. Various types of fill material were also encountered as follows:

- ∴ Clean fill is found close to the coast at the clean fill operation and occurs on both sides of the Whirinaki drain, near the confluence with the Esk River (i.e., proposed Whirinaki Stopbank Chainages 0 m to  $\pm$  150 m).
- ∴ The existing stopbank was constructed using fill, presumably sourced from digging the adjacent drain between SH2 and Pan Pac Stopbank chainage 1200 m.
- ∴ The existing section of the Pan Pac Stopbank adjacent to the truck wash bay (i.e., Pan Pac Stopbank Chainages 1350 m to 1500 m) consists of organic fill (i.e., a mixture of soil and wood chips).
- ∴ Between approximate chainages 1150 m and 1350 m on the Pan Pac Stopbank, the layer works for existing roads and access tracks coincides with the stopbank alignment.
- ∴ Between Pan Pac Stopbank alignment (approximate) chainages 900 m and 1150 m, the stopbank is flanked by a large wood chip stockpile on the eastern side. It was established that this is underlain by an embankment, which consists of mixed soil materials that were presumably pushed (i.e., bulldozed) and compacted to form the edge of Pan Pac's working area.

### 7.1.3 Geomorphology

The geomorphology and recent geology (i.e., following the 1931 earthquake) are continuously developing and evolving with time, and often see shifts in river channels. Geomorphological landforms are still young and continue to develop. The banks of the Whirinaki Drain (i.e., proposed Whirinaki Stopbank between chainage 0 m and  $\pm$  150 m) have also been modified historically. This directly impacts erosion and sedimentation along and next to the Whirinaki drain.

The Whirinaki drain flows out into the Esk River mouth, an outlet which is susceptible to deposition (i.e., becoming blocked) and has shifted multiple times in recent decades, though avulsion has not occurred commonly. The river mouth was historically physically opened (i.e., excavated) periodically to maintain outflow into the ocean. In addition, the land along the proposed Whirinaki Stopbank portion has been subjected to significant flooding events, including events like Cyclone Gabrielle, Cyclone Bola, and the 1938 flood. These flood events, in particular, added new alluvial deposits to the soil profile while simultaneously eroding the stream channel.

With the uplifted marine gravel bar creating a slightly elevated topography parallel to the coast, the Whirinaki Drain is flanked by a flat plain, which is

confined to the east. This flat plain hosts numerous shallow, braided channels, best observed on LiDAR imagery.

#### 7.1.4 Groundwater

No regional groundwater monitoring points are present close to the project site. Nevertheless, it was accepted that the Whirinaki Drain forms a temporary base level. In addition, experience has shown that the marine gravel forms a tidally responsive aquifer, which is hydraulically very strongly connected to the ocean and highly permeable. This is particularly relevant for the proposed Pan Pac Stopbank between chainages 0 m and ± 200 m, where the stopbank footprint is directly underlain by this highly permeable gravel and may be affected by tidal groundwater fluctuations.

#### 7.1.5 Ground Models

Ground models were derived for numerous sections along the proposed stopbank alignments. These ground models are included and discussed in the geotechnical report (refer to the document register).

## 7.2 Topographical Survey

To assist in the stopbank design, various surveys have been used these are shown in Table 4 with the description, date provided to PDP, and the surveyor.

Table 4: Recommended freeboard		
Description	Date provided	Surveyor
Supplementary topographical survey along the existing Whirinaki stopbank.	15/08/2024	Cheal
LiDAR and topographical survey of the project area.	1/05/2024	WSP
Pan Pac Services Plan.	14/06/2024	Pan Pac
Bathymetric survey of erosion protection area.	30/08/2024	WSP
Survey of the new stopbank alignment, including 220kV line heights.	24/06/2025	Surveying The Bay

## 8.0 Preliminary Design

The following sections provide a comprehensive summary of the design work undertaken by PDP to date. All relevant preliminary design drawing sets are provided in Appendix B of this report.

### 8.1 Basis of Design

A basis of design memo (HB010500006M019 - PDP, Whirinaki Flood Resilience Project – Design Philosophy (Rev02)) was prepared and submitted to HBRC for approval and acceptance. Refer to the document register for the basis of design memo.

### 8.2 Preliminary Design Drawings

The following drawing sets are included in Appendix B.

Table 5: Preliminary Drawing Sets	
Drawings Series	Description
Drawing set - 000	General drawings including: <ul style="list-style-type: none"> <li>- Cover sheet</li> <li>- Drawing list</li> <li>- General Notes</li> <li>- Project Layout</li> <li>- Land Acquisition</li> <li>- Existing services</li> </ul>
Drawing set - 100	Establishment works & ESCP
Drawing set - 200	General arrangement drawings & long sections
Drawing set - 300	Cross-sections & typical details
Drawing set - 400	Cross-drainage
Drawing set - 500	North Shore Road Raising
Drawing set - 600	SH2 Raising
Drawing set - 700	Pan Pac Haulage Roads

### 8.3 Overview

The proposed stopbank upgrade and construction as part of the Whirinaki Flood Resilience Works are described as two portions:

- ∴ Portion 1: 100-year LoS stopbank (i.e., proposed Whirinaki Stopbank)
  - This portion consists of the 100-year LoS stopbank from the Esk River to SH2. This portion of the stopbank was designed to meet the 100-year LoS (inclusive of climate change) with a 700 mm freeboard.

- ∴ Portion 2: 500-year LoS stopbank (i.e., proposed Pan Pac Stopbank)

This portion consists of the 500-year LoS stopbank extended from the gravel beach at the coast to the east, across SH2, and to the west of Pan Pac. This portion of the stopbank was designed to meet the 500-year LoS (inclusive of climate change) and have a range of freeboard as described in Table 3.

Refer to Figure 6 for the location and extent of the respective portions.

The preliminary design of the proposed Whirinaki Flood Resilience Project is described in the sections below and consists of the following:

- ∴ Proposed flood resilience work;
- ∴ Cross-drainage;
- ∴ Roothing; and,
- ∴ Existing services.



Figure 6: Proposed Whirinaki Flood Resilience Work

## 8.4 Proposed Whirinaki Stopbank

### 8.4.1 Proposed Flood Resilience Work

The proposed Whirinaki Stopbank will extend from the mouth of the Esk River and follow the true left of the Whirinaki Drain to the north, where it will cross North Shore Road and follow an alignment to the east of SH2 to approximately the entrance of the Whirinaki Power Plant.

The stopbank will have a 100-year LoS (inclusive of climate change) and 700 mm freeboard. The stopbank will have an importance level (IL) 2 and a design life of 50 years, as confirmed by HBRC.

Refer to the general arrangement drawing set 200 and cross-section and typical detail drawing set 300 included in Appendix B.

The proposed Whirinaki Stopbank will have the following properties:

- ∴ The stopbank will tie in with the natural ground level at approximately CH116.
- ∴ The total stopbank length will be approximately 1,144 m.
- ∴ Flood resilience work will be an earth stopbank with the following properties:
  - Earth stopbank with a granular engineered fill and low-permeability outer layer.
  - The stopbank will have a topsoil finish and be grassed.
  - The stopbank will have a 3.5 m crest and 1V:2H side slopes.
- ∴ Stopbank height:
  - The 100-year LoS plus freeboard level ranges from 5.70 mRL at the confluence with the Esk River to 7.50 mRL at the SH2.
  - The average stopbank height will be approximately 1.5 m.
  - The maximum stopbank height will be approximately 2.20 m between CH450 to CH600.

### 8.4.2 Cross-drainage

The cross-drainage for this portion is described within the *HB010500007R005 - PDP, Whirinaki Stopbank Cross-Drainage – Preliminary Design (August 2025)*. Refer to the document register.

Refer to drawing set 400 included in Appendix B for the cross-drainage drawings.

A summary of the proposed cross-drainage infrastructure is reported below for the proposed Whirinaki Stopbank.

### **Cross-drainage between Esk River & North Shore Road:**

Stormwater runoff draining towards the stopbank and the Whirinaki Drain will be managed as follows:

- ∴ Existing infrastructure:
  - The existing DN375 watermain scour pipe (size TBC) is to partially remain in place up to a new scruffy dome at CH215, while the remainder is abandoned and replaced with a DN450 (Outfall-01).
  - The existing Novacoil pipe from Pohutukawa Drive will remain and tie into a new manhole at approximately CH430, where it will drain via subsoil drains to Outfall-02.
- ∴ Three grassed swales with a maximum depth of 0.3 m will capture runoff towards the stopbank and direct runoff towards cross-drainage infrastructure through the proposed stopbank (i.e., Outfall-01 and Outfall-02). The swales will have the following characteristics:
  - Trapezoidal shape with 0.5 – 1.5 m base and maximum side slopes of 1V:4H.
  - Subsoil drains where slopes are less than 1V:200H.
  - Grassed via hydroseeding.
  - Note that due to space constraints, all swales have top widths of less than 4 m, and this will result in some being undersized. However, due to no nearby existing infrastructure, ponding during rainfall events will not pose any further flood risk.
- ∴ Scruffy domes are shown on layout drawing HB010500006-CI-401 and 402, included in Appendix B, and consist of the following:
  - SWMH-01: DN900 scruffy dome approx. at CH215.
  - SWMH-02: DN1050 scruffy dome approx. at CH430.
  - SWMH-03: DN1500 scruffy dome approx. at CH510.
- ∴ The proposed inlet structures (e.g., scruffy domes) will discharge captured runoff into the Whirinaki Drain via the following proposed cross-drainage outfalls:
  - Outfall-01: DN450 RCRRJ Class 4 pipe at CH215; and,
  - Outfall-02: DN825 RCRRJ Class 4 pipe at CH510.
- ∴ All services through the stopbank are to have a filter collar as per the details.

### North Shore Road Culvert

The stormwater draining to the junction of North Shore Road and SH2 will be managed as follows:

- ∴ Two grassed swales (one upstream and one downstream of the North Shore Road culvert) with maximum depths of 0.3 m will capture runoff towards the junction and direct runoff towards cross-drainage infrastructure through the raised road. The swales will have the following characteristics:
  - Trapezoidal shape with 1.5 m base and maximum side slopes of 1V:5H.
  - DN100 subsoil drain.
  - Grassed via hydroseeds.
- ∴ Cross-drainage piped infrastructure through North Shore Road at approx. CH900: DN375 RCRRJ Class 4 pipe laid at 1% grade with a traversable headwall at both ends.

### North Shore Road to SH2

No cross-drainage is required for this section of proposed flood resilience work.

#### 8.4.3 Raising of North Shore Road

The existing North Shore Road between Pohutukawa Drive and SH2 will be raised to allow access over the proposed Whirinaki Stopbank from the SH2 end. The road will need to be raised by approximately 1.4 m.

The road design will be completed in accordance with the Hastings District Council standards and Waka Kotahi at the intersection with SH2.

Refer to drawing set 500 included in Appendix B.

The road will have the following properties:

- ∴ The stopbank will extend through the proposed North Shore Road, raising to the edge of the seal to match the proposed Whirinaki Stopbank height at the point of intersection.
- ∴ The proposed stopbank will have a lower permeability outside layer to the edge of the seal to prevent flood water from filtering through the stopbank.
- ∴ The stopbank will be tied into the proposed road surface at a maximum slope of 1V:5H to reduce potential scour with additional protection provided by turf matting.
- ∴ Subject to detailed design, the road is expected to have:

- Maximum vertical alignment grade of 4.3%.
- Maximum cross-fall of 3%.
- Verge sloped at 1V:6H.
- Tie in with the stopbank profile at 1V:5H outside of the verge.
- Embankments to be grassed as per the stopbank detail.

#### 8.4.4 Existing Services

Limited existing services are encountered along the proposed Whirinaki Stopbank, with existing stormwater and drainage infrastructure covered in Section 8.4.2. The majority of existing services are located within the North Shore Road corridor.

It is proposed to retain the existing services through the North Shore Road corridor where the proposed Whirinaki Stopbank crosses the road. To ensure the integrity of the proposed stopbank is maintained, existing services will be exposed, and the trench on the land side will be reinstated to include a filter collar to manage seepage.

Refer to drawing set 800 for details of the existing services to be retained.

## 8.5 Proposed Pan Pac Stopbank

### 8.5.1 Proposed Flood Resilience Work

The proposed Pan Pac Stopbank will extend from the gravel beach to the east of SH2, cross SH2 approximately at the Whirinaki Power Station while heading west towards the Whirinaki Drain and existing Whirinaki Stopbank. At the intersection with the existing Whirinaki Stopbank, the proposed alignment will follow and upgrade the existing stopbank to meet the new level of service towards the existing Pan Pac haulage roads (Burden Road). The existing stopbank from the haulage roads will be upgraded to meet the new level of service required.

The stopbank will have a 500-year LoS (inclusive of climate change) and a range of freeboard (Refer to Section 6.8):

- ∴ Gravel beach to SH2 – 900 mm.
- ∴ SH2 to Haulage Roads (Burden Road) – 700 mm.
- ∴ Haulage Roads – 500 mm.

The stopbank will have an importance level (IL) 3 and a design life of 50 years, as confirmed by HBRC.

Refer to the general arrangement drawing set 200 and cross-section and typical detail drawing set 300 included in Appendix B.

The proposed flood resilience work is described in the following three sections:

- ✧ Gravel Beach to SH2.
- ✧ SH2 to Haulage Roads (Burden Road).
- ✧ Haulage Roads.

#### 8.5.1.1 Gravel Beach to SH2

The proposed stopbank will have the following properties:

- ✧ The stopbank will have a 900mm freeboard for this section.
- ✧ The stopbank will tie in with the natural ground level at approximately CH16.5.
- ✧ The total stopbank length will be approximately 200 m to the intersection with SH2.
- ✧ Flood resilience work will be an earth stopbank with the following properties:
  - Earth stopbank with a low-permeability material, including an outer layer.
  - The low-permeability material will extend below the stopbank to act as a cutoff to manage seepage underneath the stopbank due to the presence of gravel in this area.
  - The stopbank will have a topsoil finish and be grassed.
  - The stopbank will have a 3.5 m crest and 1V:2H side slopes.
- ✧ Stopbank height:
  - The 500-year LoS plus freeboard level will be approximately 7.74 mRL for this portion.
  - The average stopbank height will be approximately 2.7 m.
  - The maximum stopbank height will be approximately 2.80 m between CH100 and CH150.

#### 8.5.1.2 SH2 to Haulage Roads

The proposed stopbank will have the following properties:

- ✧ The stopbank will have a 700mm freeboard for this section.
- ✧ The total stopbank length will approximately be 200 m long from the intersection with SH2 to the haulage road, of which:
  - Approximately 400m (between CH216 to CH600) will be a new stopbank; and,

- Approximately 50m (between CH600 and CH1150) will be an upgrade (i.e., raising) of the existing stopbank.
- ∴ Flood resilience work will be an earth stopbank with the following properties:
  - The stopbank will have a topsoil finish and be grassed.
  - The stopbank will have a 3.5 m crest and 1V:2H side slopes.
- ∴ A portion of the stopbank between CH950 and CH1050 will consist of existing compacted soil that is underneath the existing burner fuel pile. Note that the tie-in position will be confirmed as part of the detailed design.
- ∴ The stopbank construction will consist of:
  - A granular engineered fill with low-permeability material on the outside for the new portion of the stopbank; and,
  - A low-permeability material only construction for the upgraded stopbank portion.
- ∴ The upgrading of the existing stopbank will be done by stripping away topsoil and existing material and keying the new material into the existing stopbank profile.
- ∴ Stopbank height:
  - The 500-year LoS plus freeboard level will be approximately 7.74 mRL at SH2 and gradually increase to 8.28 mRL at the Haulage Road end.
  - The average stopbank height will be approximately 2.7 m along the new portion of the stopbank and approximately 1.4 m increase in height to the existing stopbank.

#### 8.5.1.3 Haulage Roads

Upstream of Burden Road (i.e., Haulage Road), it is expected that the stopbank will be comprised of a block wall and low-height earth stopbank in locations where there is enough space. To allow for the water to pass over the roads, they are proposed to be raised to a level lower than the design level. The upper haulage road is at approximately the 500-year flood level, and the lower haulage road is at approximately the 20 to 50-year flood level. To achieve the required level of service, flood gates will be used across the road.

The proposed stopbank will have the following properties:

- ∴ The stopbank will have a 500mm freeboard for this section.

- ∴ The total stopbank length will approximately be 540 m long from the lower haulage road to the western edge of the Pan Pac site and consist of:
  - Approximately 300m (between CH1150 to CH1450) will be an upgrade (i.e., raising) of the existing stopbank by a blockwall (or similar type) stopbank; and,
  - Approximately 240m (between CH1450 and CH1690) will be an upgrade (i.e., raising) of the existing stopbank by means of an earth stopbank.
- ∴ The proposed blockwall stopbank will consist of:
  - Modular blockwall type retaining all on both sides of the stopbank.
  - The stopbank will consist of excavating the existing stopbank material to a wide enough footprint and level to install the blockwall.
  - The fill between the outer block walls will be a low-permeability material.
  - A crest width of approximately 3.5 m where vehicle access is required.
- ∴ The proposed earth stopbank upgrade of the existing will consist of:
  - The upgrading of the existing stopbank will be done by stripping away topsoil and existing material and keying the new material into the existing stopbank profile.
  - A low-permeability material only construction for the upgraded stopbank portion.
  - The stopbank will have a topsoil finish and be grassed.
  - A crest width of 3.5 m maximum and 1V:2H maximum side slopes.
- ∴ The proposed stopbank crosses two haulage roads (at CH1173 and CH1357). It is proposed that the existing haulage roads be raised and that a flood gate (or similar type) be installed. The flood gate will be closed during rainfall events, which could result in flooding within the Whirinaki Drain. Refer to the drawings set 700 included in Appendix B.
- ∴ Stopbank height:
  - The 500-year LoS plus freeboard level will be approximately 8.28 mRL at the lower haulage road (downstream end) and gradually increase to 11.13 mRL at the end of the proposed works.

- The average stopbank height will be approximately 1.0 m along the blockwall portion of the stopbank and approximately 0.5 m increase in height to the existing stopbank.
- The haulage road levels will increase by:
  - 0.7 m at the lower haulage road (note that the proposed flood gate will be 0.5 m high here) and total stopbank height being 1.2 m.
  - 0.76 m at the upper haulage road (note the proposed flood gate will be 0.85 m high here) and the total stopbank height being 1.6 m.

#### 8.5.2 Cross-drainage

The cross-drainage for this portion is described within the *B010500007R005 - PDP, Whirinaki Stopbank Cross-Drainage – Preliminary Design (August 2025)*. Refer to the document register.

Refer to drawing set 400 included in Appendix B for the cross-drainage drawings.

A summary of the proposed cross-drainage infrastructure is reported below for the proposed Pan Pac Stopbank.

##### **SH2 to Gravel Beach**

Cross-drainage is required for the 500-year LoS stopbank from SH2 to the gravel beach, as it cuts off the existing overland flow path to the downstream catchments that discharge into Whirinaki Drain.

The proposed drainage design is a soak pit upgradient of the stopbank and a double culvert through the stopbank to provide secondary flow in larger events, described in more detail below.

Soakage is considered feasible in the location due to shallow (less than 2 m thick) silts overlaying beach gravels. The beach gravels are expected to have a very high infiltration and are subject to confirmation by means of a soakage test before construction.

The soak pit is designed to capture and discharge to the ground the 10% AEP 1-hour flows as per the Acceptable Solutions and Verification Methods of the E1 Surface Water building code clause.

The proposed infrastructure will consist of the following:

- ∴ DN1050 scruffy dome located within the existing overland flow path and low point, inset 0.2 m below the natural ground level.
- ∴ Soak pit with a base area of approx. 190 m<sup>2</sup> with the following details:
  - Soak pit to be offset min. 5 m from toe of stopbank.

- Allow for the soak pit to be excavated min. 1 m into natural gravels (beach gravels).
  - Soak pit to be filled with washed and clean 100 mm to 150 mm rock.
  - Subsoil drains (DN200) connected to the DN1050 scruffy dome to disperse runoff through the soak pit media.
  - Bidim geotextile to be installed around the top and sides (not bottom) of the rock media.
- ∴ Overflow channel towards stopbank culvert at CH 125 with depth of 0.2 m and base width of 1.5 m.
  - ∴ Twin DN300 RCRRJ Class 4 pipes, with headwalls, to cross-drain runoff above 10% AEP event. All services through the stopbank are to have a filter collar as per the details.
  - ∴ It is estimated that some ponding will occur for events above a 10% AEP. Due to the lay of the land, this ponding is not likely to increase the flood risk of nearby properties.

### SH2 to Pan Pac

Stormwater from the Pan Pac site is collected and treated onsite by Pan Pac's internal stormwater infrastructure and discharged to the Whirinaki Drain as part of the consented activities.

For existing stormwater cross-drainage, it is proposed to upgrade the existing DN300 stormwater outfall (approximately at CH700) to a DN450 pipe:

- ∴ Replace the existing DN300 stormwater pipe with a DN450 RCRRJ Class 4 pipe at CH700 with the following additional components:
  - DN1200 scruffy dome to capture surface runoff from the southern end of the Pan Pac site;
  - Outlet fitted with headwall, flap gate, and riprap; and,
  - Stormwater rising main from API to be installed in the same trench (OD355 PE100 pipe).

For pumped discharge (Pan Pac consent), it is proposed to install Pan Pac issued OD355 HDPE stormwater rising mains at CH700 (API Rising Main) and CH915 (Central Rising Main):

- ∴ Install Pan Pac issued OD355 PE100 HDPE rising main at CH700 (API Rising Main) and CH915 (Central Rising Main) with the following components:
  - Pipework (supplied by Pan Pac) will be OD355 PE100 HDPE welded (electro fusion (EF) jointed, or similar) pipes;

- All services through the stopbank are to have a filter collar as per the details.
- Outlet fitted with headwall, flap gate, and riprap; and,
- Isolation valves on either side (by others).

### 8.5.3 Raising of SH2

The road design is being completed by others, with the proposed design to be completed in accordance with the relevant Waka Kotahi standards. A brief overview of the proposed SH2 road raising is provided below.

The existing SH2 will be raised to allow access over the proposed Pan Pac Stopbank. The road will need to be raised by approximately 1.9 m. The preliminary design for the proposed SH2 road raising is included as drawing set 600 in Appendix B.

The road will have the following properties:

- ∴ The stopbank will extend through the proposed SH2, raising with the edge of the seal to match the proposed Pan Pac Stopbank height at the point of intersection.
- ∴ The proposed stopbank will have a lower permeability outside layer to the edge of the seal to prevent flood water from filtering through the stopbank.
- ∴ The stopbank will be tied into the proposed road surface at a maximum slope of 1V:5H to reduce potential scour, with additional protection provided by turf matting.
- ∴ Subject to detailed design, the road is expected to have:
  - Maximum vertical alignment grade of 2.1%.
  - Maximum cross-fall of 3%.
  - Verge sloped at 1V:6H.
  - Tie in with the stopbank profile at 1V:5H outside of the verge.
  - Embankments to be grassed as per the stopbank detail.

### 8.5.4 Existing Services

Limited existing services are encountered along the proposed Pan Pac Stopbank, with existing stormwater and drainage infrastructure covered in Section 8.4.2. The majority of existing services are located within the SH2 corridor as well as along the existing stopbank.

## SH2

It is proposed to retain the existing services through the SH2 corridor where the proposed Pan Pac Stopbank crosses the road. To ensure the integrity of the proposed stopbank is maintained, existing services will be exposed, and the trench on the land side will be reinstated to include a filter collar to manage seepage.

The existing potable water (DN150 HDPE) water supply will be raised along the proposed SH2 footprint. The potable water trunk main is owned by Hastings District Council.

The proposed realignment will consist of the following:

- ∴ Realignment through installation of a new DN150 HDPE PN16 (TBC) pipeline.
- ∴ The total length of the pipeline to be realigned will be approximately 200 m in length.
- ∴ Existing hydrants will be replaced like-for-like along the realigned section.
- ∴ The existing pipeline will be decommissioned by removing or filling the pipe with flowable fill.
- ∴ The proposed alignment will be located within the verge of the road and cross the crest of the stopbank within the 700 mm freeboard. This is likely to result in reduced cover, and a concrete cap will be installed where the cover is less than 900 mm.
- ∴ Allowance will be made for the installation of isolation valves on either side of the stopbank.

## Pan Pac

Existing services crossing through the current (e.g., existing) stopbank will be retained.

Allowance is made for the following future proofing for the Pan Pac's planned renewal of the existing Pan Pac raw water supply pipeline at CH925:

- ∴ Install Pan Pac issued 2 x OD355 PE100 HDPE rising main at CH925 with the following components:
  - Pipework (supplied by Pan Pac) will be 2 x OD355 PE100 HDPE welded (electro fusion (EF) jointed or similar) pipes;
  - All services through the stopbank are to have a filter collar as per the details.
  - Pipe to be capped with a blank flange.

## 8.6 Stopbank Geotechnical Design

### 8.6.1 Liquefaction Assessment

Following discussions and agreement with HBRC, a design life of 50 years was assumed for seismic analyses using NZS1170.0 (2002), despite the actual design life being 75 years. In addition, the project scope specifies the importance levels (IL) for seismicity analyses of the stopbanks as follows:

- ∴ Whirinaki Stopbank: This section of stopbank is to provide a 100-year Level of Service (LoS) and is considered **IL2**.
- ∴ Pan Pac Stopbank: The second section will provide 500-year LoS flood protection and is considered **IL3**.

In accordance with Bay of Plenty Regional Council Guidelines (BoPRC, 2021) and based on NZS 1170.0 (2002) and Module 1 of the earthquake geotechnical engineering practice manual (MBIE, 2021a), the following applies to Napier:

- ∴ Importance Level 2, 50-year Design Life:
  - SLS: 1/25 years (0.12g PGA; 6.4M)
  - ULS: 1/500 years (0.58g PGA; 7.1M)
- ∴ Importance Level 3, 50-year design Life:
  - SLS: 1/25 years (0.12g PGA; 6.4M)
  - ULS: 1/1000 years (0.78g PGA; 7.1M)

Liquefaction analyses were performed according to the New Zealand Geotechnical Society (NZGS) and Ministry of Business, Innovation and Employment Module 3 (MBIE, 2021b).

The outcome of the liquefaction assessment is discussed in the geotechnical report (refer to the document register). The results can be summarised as follows:

Table 6: Liquefaction Summary					
Stopbank	Importance Level	LPI Range	LSN Range	Vertical Settlement Range (SLS)	Vertical Settlement Range (ULS)
Whirinaki	2	0 - 25	0 - 28	<5 mm to 20 mm	<5 mm to 100 mm
Pan Pac	3	1 - 35	1 - 34	<5 mm to 15 mm	<5mm to 150 mm
<p><i>Notes:</i></p> <ol style="list-style-type: none"> <li>1. LSN classes: 0-10 little to no liquefaction; 10 – 20 minor liquefaction; 20-30 moderate; &gt;30 moderate to severe liquefaction</li> <li>2. LPI classes: 0-5 low risk; 5-15 high risk; &gt;15 very high risk</li> </ol> <p><i>Note that the description for LPI and LPN presented in the table varies from that in the MBIE Module 3 guidance.</i></p>					

The maximum vertical displacement under ULS conditions for Whirinaki Stopbank and Pan Pac Stopbank was 100 mm and 150 mm, respectively. These values fall within the HBRC limits.

### 8.6.2 Lateral Spread

The latter spreading analysis is discussed in detail in the geotechnical report. The results can be summarised as follows:

Table 7: Lateral Spread Summary			
Stopbank	Importance Level	Lateral Spread Range (SLS)	Lateral Spread Range (ULS)
Whirinaki	2	5 mm to 155 mm	565 mm to 3950 mm
Pan Pac	3	<5 mm to 215 mm	110 mm to 6225 mm

Notes:  
 1. Settlement estimations are rounded to the nearest 5 mm.

The results were considered in terms of HBRC requirements, which state:

*“The acceptability criteria will need to be considered on a case-by-case basis, but in general, any ULS vertical settlement greater than 200 mm and/or any lateral spread of more than 500 mm would be considered damage” in respect of stopbanks. If this level of displacement is determined by analysis, then further analysis of the SLS event will be required to determine the potential displacement in a relatively minor event. Any “damage” in an SLS event will be unacceptable and mitigation will be required”.*

Given that the 500 mm lateral displacement threshold is exceeded under ULS conditions, the lateral spread under SLS conditions was assessed. The estimated lateral spread for SLS conditions for both stopbanks was less than 500 mm. This is well below the 500 mm threshold set by HBRC.

It should be taken into account that the stopbanks are essentially unreinforced earth bunds and are not expected to withstand ULS seismic events.

### 8.6.3 Static Settlement

At the time of reporting, the detailed design of the stopbank was still under way and hence the foundation pressures were not yet confirmed. Nevertheless, the foundation pressures will also be variable along the length of the stopbanks, as they will have variable height and footprint dimensions, depending on the crest height build-up.

Preliminary analyses were done based on a conservative loading of 200 kPa (unfactored) on an assumed foundation width of 12 m. 30 mm static settlement

was calculated for this scenario, anticipating 75 years for creep settlement. The majority (i.e., 25 mm) of the settlement was shown to be primary settlement.

#### 8.6.4 Differential Settlement

Differential settlement will need to be assessed once the design geometry has been finalised. The key consideration for differential settlement analyses is whether settlement in the newly keyed-in material (i.e., to raise the existing stopbank) will experience differential settlement. As the existing stopbank footprint is essentially pre-loaded, it is expected to experience less primary settlement compared with newly added sections of the expanded footprint.

#### 8.6.5 Ground Bearing Capacity

According to HBRC requirements, sufficient available bearing capacity for a new stopbank under different scenarios requires the following factors of safety:

- ∴ Normal Conditions – 2.0
- ∴ Saturated Foundation – 1.8
- ∴ Saturated Embankment and unsaturated foundation – 1.5

Based on preliminary design drawings, the maximum unfactored foundation pressures at the highest crest heights for the two stopbanks (based on assumed dimensions and material densities) are conservatively estimated to be 100 kPa at the maximum crest height.

Based on handheld shear vane tests and Scala penetrometers at discrete points along the stopbank alignments, available bearing capacities are adequate to accommodate this, depending on the safety factor applied to the load.

#### 8.6.6 Slope Stability

Slope stability analyses were undertaken for the scenarios required by HBRC and based on the preliminary design drawings. The findings are reported in the document HB010500002R003. It should be noted that HBRC specified batter angles for the stopbank, and the stability assessment reports the calculated safety factors as well as their acceptability in terms of project requirements.

Stability analyses revealed that none of the sections analysed complied with the specified Factor of Safety (FoS) of 1.2 under ULS seismic conditions. This matter has been discussed with HBRC throughout the project, and indeed for other stopbank projects in Hawke's Bay. We understand HBRC's approach is to take a 'repair-when-damaged' approach in the event of a ULS seismic event.

### 8.6.7 Stopbank Integrity Assessment

The geophysical work undertaken as part of the stopbank integrity assessment identified minor features, none of which are considered fundamentally problematic.

## 8.7 Stopbank Scour and Erosion Protection

A large scour hole formed along the lower reach of the Whirinaki Drain where it drains into the Esk River during Cyclone Gabrielle. The scour hole was formed due to high velocities along this portion of the drain and scouring out natural and historically placed material. The extent of the scour is from approximately CH250 to the confluence with the Esk River.

A scour and erosion protection concept design was completed for the portion of the proposed Whirinaki Stopbank approximately between CH150 and CH250 and in close proximity to the Whirinaki Drain scour hole. Refer to '*HB010500006R002 – Whirinaki Flood Resilience Project: River Engineering Concept Design*' (PDP, 2025).

The change in level of service along Whirinaki Drain means that failure in a 100-year event at the scour hole is relatively low consequence. It was recommended to monitor the condition at the mouth and encourage plant growth, and if further erosion is observed hard engineering solutions should be considered further.

## 8.8 Flood Wall for Petāne Urupā

Based on the options assessment for flood protection of the Petāne urupā, the flood wall option has been progressed. Refer to *HB010500008M02 – Tait's Road Cemetery – Long List Options* and the document register.

The proposed design for the flood wall is shown in the HB010500008M02 Drawings (refer to GN-005 for the proposed layout and long section and GN-010 for typical cross-sections). The alignment for the flood wall is generally proposed to be along the site boundary, noting that deviation further towards the existing urupā is proposed from CH-90 to CH-107 to avoid clashes with the existing 11kV overhead lines at the southwestern corner of the site. The flood wall is proposed to encompass the existing urupā and the proposed urupā site extension to the north. Flood wall options using concrete and timber have both been considered at this stage of the design. The design for a concrete or timber flood wall is summarised below:

- ∴ The proposed design LoS is for a 500-year ARI event with a 300 mm freeboard.
- ∴ The flood wall will be approximately 178 m long.

- ∴ The wall will be embedded up to one-third of the wall's height into the ground with a 25 MPa concrete surround.
- ∴ 200-300 m high earth bunds will be provided along both sides of the wall with 1V:2H side slopes.
- ∴ **Engineered concrete wall:** 150mm thick precast concrete slabs will be bolted to steel H-sections spaced at 2 m.
- ∴ **Timber wall:** H5 timber planks fixed to DN150 H5 poles spaced at 1.5 m.

## 9.0 Assessment of Effects

### 9.1 Flooding Effects

Flooding effects from the proposed stopbank upgrade were investigated for up to the 0.2% AEP event with climate change allowances. For the full report, refer to 'HB010500006R020 – Assessment of Effects on Flooding for Proposed Whirinaki Stopbank' (PDP, 2025); a summary of the flooding effects is provided below.

The new alignment is set further back from the Whirinaki Drain and therefore provides more space for "out of bank" flow and the conveyance of flood waters. Generally, when compared with the previous alignment, the new alignment results in lower flood levels across the model. Drawing on the findings within the 'HB010500006R020 – Assessment of Effects on Flooding for Proposed Whirinaki Stopbank' the changes are most pronounced within the Whirinaki Drain.

In summary:

In a 500-year event (with climate change RCP8.5 2074), the flood level differences are:

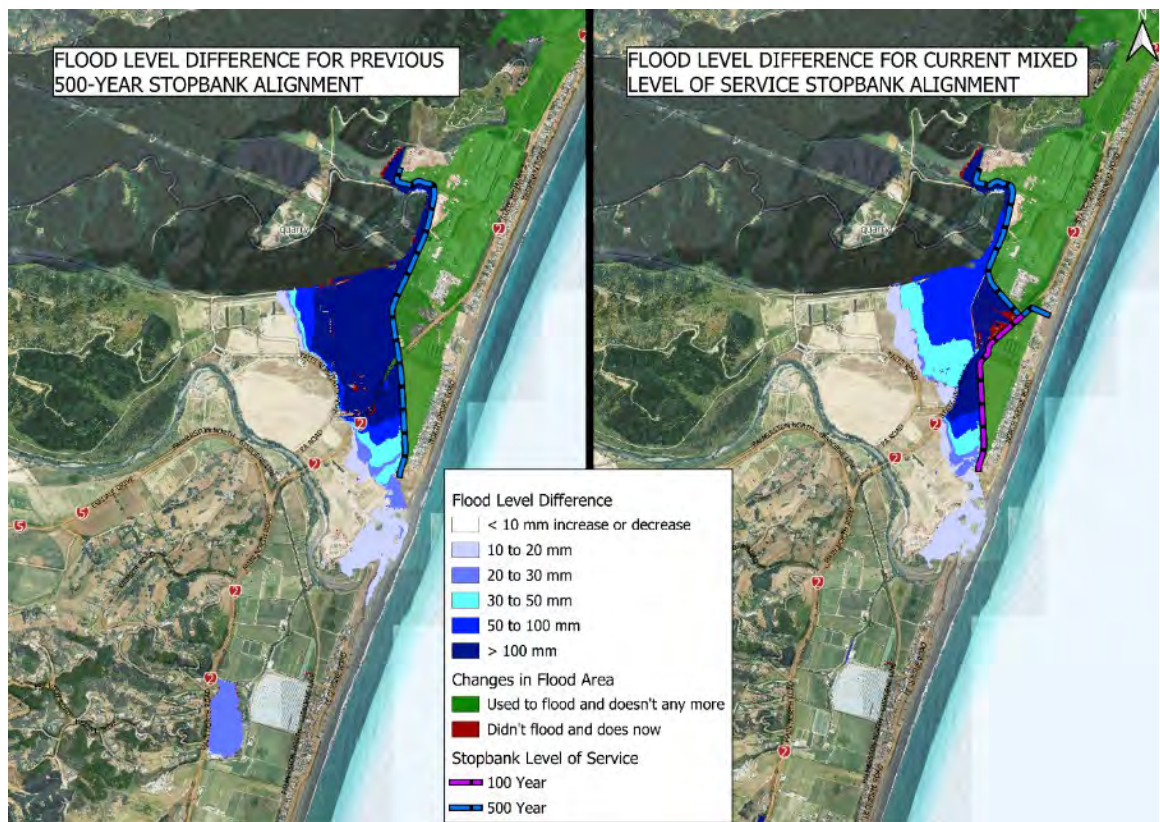
- ∴ Upstream of SH2, flood Levels are reduced by up to 500 mm,
- ∴ Downstream of SH2, flood Levels are reduced by up to 150 mm.

In a 100-year event (with climate change RCP8.5 2074), the flood level differences are:

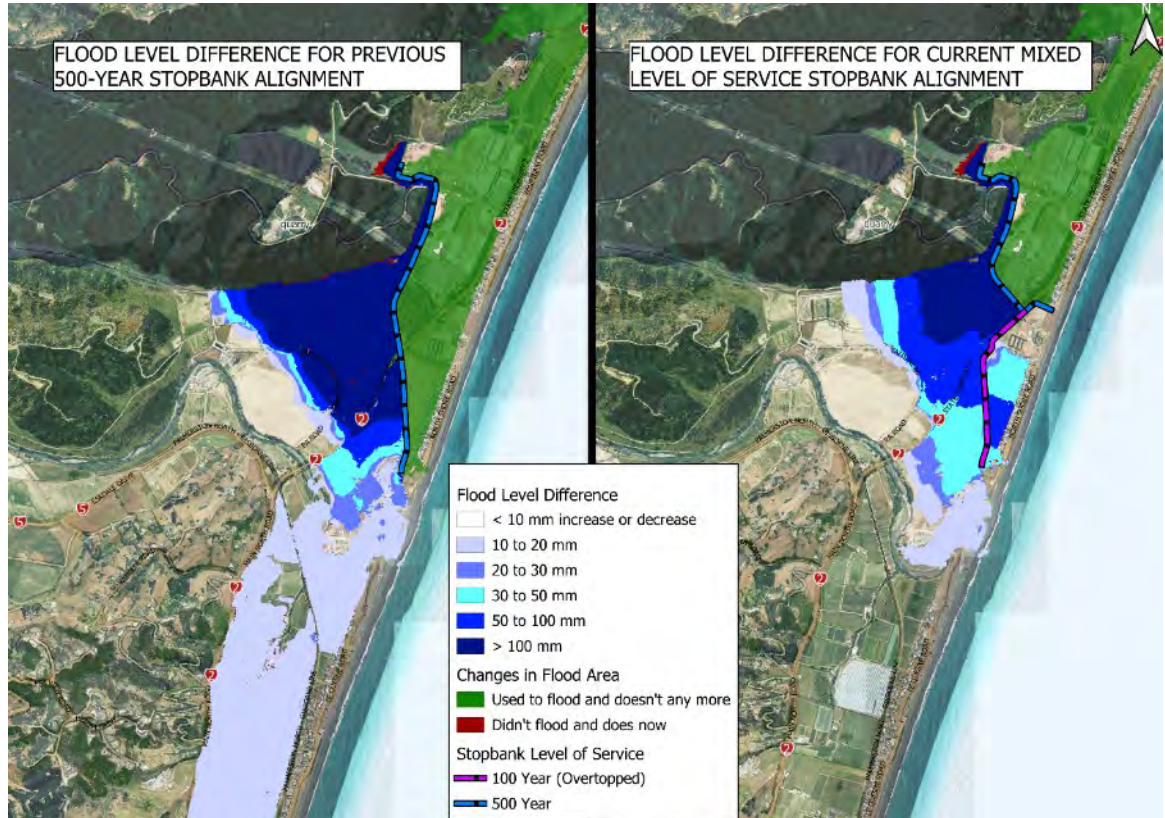
- ∴ Upstream of SH2, flood Levels are reduced by up to 220 mm,
- ∴ Downstream of SH2, there is no significant difference in flood levels.

A comparison of flood differences for the previous and current alignments in the 100-year and 500-year events with climate change RCP8.5 to 2074 is shown in Figure 7 and Figure 8, respectively. Flood differences have been obtained by subtracting the pre-construction flood levels from the post-construction flood levels.

- ∴ Figure 7 shows that aside from the Pan Pac nursery, flood levels are generally lower across the flood model.
- ∴ Figure 8 shows that flood levels are typically lower across the flood model than in the old alignment. The decreases in effects are predominantly due to the elimination of the SH2 raising at the Whirinaki Drain. The exception to this is in-between the 500-year and 100-year level of service stopbanks there is an increase in flood levels in the 500-year event. The increase in flood levels is up to 100mm.



**Figure 7: Flood Difference in a 100-year event with climate change to RCP 8.5 2074**



**Figure 8: Flood Difference in a 500-year event with climate change to RCP 8.5 2074**

## 9.2 Stormwater Effects

The construction of the stopbank will cut off several overland flow paths that, under pre-development conditions, would discharge into Whirinaki Drain. The main cut-off points lie along the 100-year LoS stopbank, south of North Shore Rd, and where the stopbank runs from SH2 to the gravel beach.

Without means of discharge, runoff will pond landside of the stopbank and increase the flood risk of nearby properties in smaller rainfall events. Therefore, cross-drainage infrastructure is required to facilitate drainage to Whirinaki Drain.

The proposed cross-drainage is designed for the 20% AEP rainfall event, with some ponding expected for larger events. Flapgates are to be installed at the drainage outlets to ensure there is no risk of flooding from Whirinaki Drain in much larger events.

Refer to 'HB010500007R005 – Whirinaki Stopbank Cross-Drainage – Preliminary Design' (PDP, 2025) for the design report and attached drawings.

### 9.3 Erosion and Scour Effects

#### 9.3.1 Stormwater Outfalls

Stormwater runoff will be facilitated via cross drainage through the stopbank, designed for a 20% AEP event. To reduce the risk of erosion and scour, the outfalls will be stabilised and fitted with rip rap where the outfall velocities exceed 2 m/s.

Refer to '*HB010500007R005 – Whirinaki Stopbank Cross-Drainage – Preliminary Design*' (PDP, 2025) for the design report and attached drawings.

#### 9.3.2 Stopbank Erosion Protection

Following completion of the stopbank upgrade works, the condition of the stopbank along Section 1 (i.e., chainage from the coast to SH2) will be routinely monitored in accordance with an approved inspection and maintenance schedule and following significant storm events.

If the monitoring identifies adverse scouring/eroding of the stopbank that may undermine the adequate functioning of the stopbank, then remedial action shall be undertaken. As remedial works, erosion protection for the stopbank should be provided by installing rock rip rap and a rock revetment along the areas of the drain identified as adversely affected by scouring. Additionally, consideration should be given to protection works for areas identified as at high risk of scouring during the design event, as discussed in Section 8.6.

## 10.0 Construction

Detail associated with the proposed construction of the stopbank, and associated work will be refined with the contractor as part of preparing the Construction Environmental Management Plan (CEMP). The following will be considered:

- ∴ Stockpile / laydown sites and erosion and sediment control (ESC);
- ∴ Site establishment works; and,
- ∴ Temporary drain crossings.

### 10.1 Stockpile/Laydown Sites & ESC

A laydown and two primary stockpile locations are proposed. Refer to drawing series CI-100. Additional stockpile areas may be proposed as part of preparing the CEMP.

PDP was engaged by HBRC to prepare an Erosion and Sediment Control Plan (ESCP) for the stockpile site and work area. Refer to '*HB010500007R007.2 – Erosion and Sediment Control Plan – Whirinaki Stockpile & Stopbank*' (PDP, 2025) for the design report.

The plan was prepared in accordance with the HBRC's '*Hawke's Bay Waterway Guidelines – Erosion and Sediment Control*' (HBRC, 2009), and aims to protect and minimise adverse environmental effects on receiving environments and ecosystems from sediment-laden stormwater generated onsite and dust from wind erosion. The proposed works will be contained within Lot 1 DP 562586 between North Shore Road and Pohutukawa Drive.

The erosion and sediment control measures will generally involve:

- ✦ **Common Controls** to stabilise the site are outlined as follows:
  - Stockpile stabilisation – use appropriate dust control measures.
  - Stabilised entranceway and wheel wash – minimise dust generation and the sediment tracking off-site.
  - Stabilised roads – compacted hardfill haulage roads.
  - Silt fences – intercept cross-boundary run-off.
- ✦ **Dirty Water Diversion Channels** to capture sediment-laden runoff onsite and divert to the sediment retention pond (SRP). These channels have been designed in accordance with the HBRC guidelines and run along the main site boundaries.
- ✦ **Clean Water Diversion Bunds** to divert clean runoff from upstream catchments away from the site. These bunds have been designed in accordance with the HBRC guidelines and run along parts of the site boundary and discharge into Whirinaki Drain.
- ✦ **Sediment Retention Pond (SRP)** to treat sediment-laden runoff generated onsite and discharge into Whirinaki Drain. The SRP will have a water surface footprint of approximately 890 m<sup>2</sup> and a water depth of 2 m, with stable earth bunds on all sides and an emergency spillway to Whirinaki Drain. The SRP has been sized in accordance with the HBRC guidelines.

## 10.2 Site Establishment

Site establishment work will generally involve:

- ✦ Removal of existing fencing along the construction areas;
- ✦ Removal of vegetation (including trees) along the construction areas,
- ✦ Installation of temporary fencing;
- ✦ Construction of stabilised exit and entry points onto North Shore Road from the stockpile/laydown area;
- ✦ Potholing for existing services;
- ✦ Site building establishment (temporary buildings/containers); and,

- ∴ Establishment of temporary bypass roads.

### 10.3 Temporary Stream Crossings

There will be two temporary stream crossings installed for haulage, one to the south of SH2 and one west of the Pan Pac water treatment plant. The preference is for these crossings to be via a temporary bridge. If this is not practicable, culverts may need to be installed under crossings and should adhere to the following:

- ∴ Culvert will be open bottom or embedded 25%; and
- ∴ Culvert span should be  $1.2 \times \text{bank full width} + 0.6 \text{ m}$ .<sup>3</sup>

### 11.0 Document Register

A document register for the PDP deliverables for the Whirinaki Drain stopbank upgrade and associated works is provided in Table 8.

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<sup>3</sup>For Whirinaki Drain (bed width 1.5 – 2.5 m), this can be achieved with a 2.4 – 3.6 m diameter culvert.

**Table 8: Document Register for Key PDP Deliverables**

Document No.	Title	Author(s)	Date of Issue
HB010500001R001	Ecological Impact Assessment for the Proposed Upgrade to the Whirinaki Stopbank, Napier	Nicki Papworth, Gemma Scott, Duncan Gray, Wayne Westcott	09/09/2025
HB010500002L001	Whirinaki Stopbank Upgrade Material Investigation	Izak Breytenbach	20/06/2024
HB010500006L001	Pan Pac Borrow Site – Material Investigation	Izak Breytenbach	04/03/2025
HB010500002R003	Geotechnical Assessment Report for the Proposed Upgrade to the Whirinaki Stopbank (Revised Alignment), Hawke's Bay	Izak Breytenbach	25/07/2025
HB010500004L001	Preliminary Site Investigation at Whirinaki Stop Bank	Sally McKinnon	02/07/2025
HB010500004R001	Contaminated Site Management Plan for Proposed Stop Bank Upgrade and Extension Works on Whirinaki Drain	Nicole Bidart	17/02/2025
HB010500004L002	Detailed Site Investigation at Whirinaki Borrow Site	Nicole Bidart	21/2/2025
HB010500005L001	Whirinaki Stopbank Construction Layout Plan	Izak Breytenbach	20/06/2024
HB010500006M004	Whirinaki Flood Resilience Project - River Engineering Options Assessment	Tylan Collins, Philip Claassens	18/11/2024
HB010500007R005	Whirinaki Stopbank Cross-Drainage – Preliminary Design	Annika Gibson	01/08/2025
HB010500007R007.1	Erosion and Sediment Control Plan – Whirinaki Borrow Area	Sarah McKenzie, Tylan Collins	03/10/2024
HB010500007R007.2	Erosion and Sediment Control Plan – Whirinaki Stockpile & Stopbank	Annika Gibson	01/08/2025
HB010500008M002	Taits Road Cemetery – Long List Options	Oliver Saunders, Philip Claassens	08/11/2024

**Table 8: Document Register for Key PDP Deliverables**

<b>Document No.</b>	<b>Title</b>	<b>Author(s)</b>	<b>Date of Issue</b>
HB010500006M017	Whirinaki Stopbank-Freeboard Assessment	Tylan Collins, Ben Throssell	11/06/2025
HB010500006M018	Whirinaki Haulage Road Stopbank Short List Assessment	Tylan Collins, Philip Claassens	23/06/2025
HB010500006R019	Esk Valley: Design Model Build Report	Tylan Collins, Ben Throssell	26/06/2025
HB010500006R020	Assessment of Effects on Flooding for Proposed Whirinaki Stopbank	Tylan Collins, Ben Throssell	26/06/2025
HB010500006L021	Whirinaki Flood Resilience Project – Flood Assessment Report Queries	Tylan Collins	26/06/2025

## 12.0 References

- BOPRC: Bay of Plenty Regional Council (2021): Stopbank design and construction guidelines (version 1.2), March 2021. ISSN: 1179 9609 (Online)
- MBIE Ministry of Business, Innovation & Employment (2021a). Earthquake geotechnical engineering practice Module 1 Overview of guidelines. ISBN (online) 978-0-947497-51-4.
- MBIE Ministry of Business, Innovation & Employment (2021b). Guidelines for earthquake geotechnical engineering practice - Module 3. Identification, assessment and mitigation of liquefaction hazards.
- NZS 1170: 0 (2002). Structural design actions – Part 0: General Principles. Published by Standards New Zealand, Wellington

## 13.0 Limitations

This report presents preliminary findings and is intended to inform the early stages of the Whirinaki Flood Resilience Project design. It is important to note that changes are expected as the project progresses through the detailed design phase. Accordingly, the information and recommendations provided herein should be considered indicative and subject to further refinement.

Stability analyses reported in this document are based on conditions assessed along the stopbank alignment, a proposed design geometry and understandings of material sources. Any changes to these factors—including, but not limited to, alterations in alignment, embankment geometry, loading conditions, borrow material source, or geotechnical properties—will require a reassessment of the stability model to ensure the design remains robust and fit for purpose. Additionally, this report does not address the full range of construction risks, environmental constraints, or consent-related obligations, which will be addressed as part of the detailed design documentation and subsequent environmental and planning approvals.

Users of this report should be aware that reliance on preliminary findings without further validation during the detailed design and construction phases may result in unforeseen issues or design inefficiencies.

## Appendix A: Figures



Figure A1: Proposed Whirinaki stopbank layout.



Figure A2: Pre Cyclone Gabrielle (2021) Whirinaki Drain condition and proposed stopbank layout.



Figure A3: 1988 Esk River and Whirinaki Drain condition.



Figure A4: 1943 Esk River and Whirinaki Drain condition.

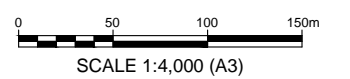
## Appendix B: Whirinaki Stopbank Design Drawings



KEY:	
	EXISTING PROPERTY BOUNDARY
	STOP BANK CENTRELINE
	DRAIN / WATER COURSE
<b>PROPOSED</b>	
	TOP OF BANK
	BOTTOM OF BANK
	STOP BANK CENTRELINE
	STORMWATER SWALE
	STORMWATER PIPE
	ROAD WORKS

**NOTES**

1. REFER TO GENERAL NOTES ON DRG HBO10500006-GN-005



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A	PRELIMINARY ISSUE	AUG 25	

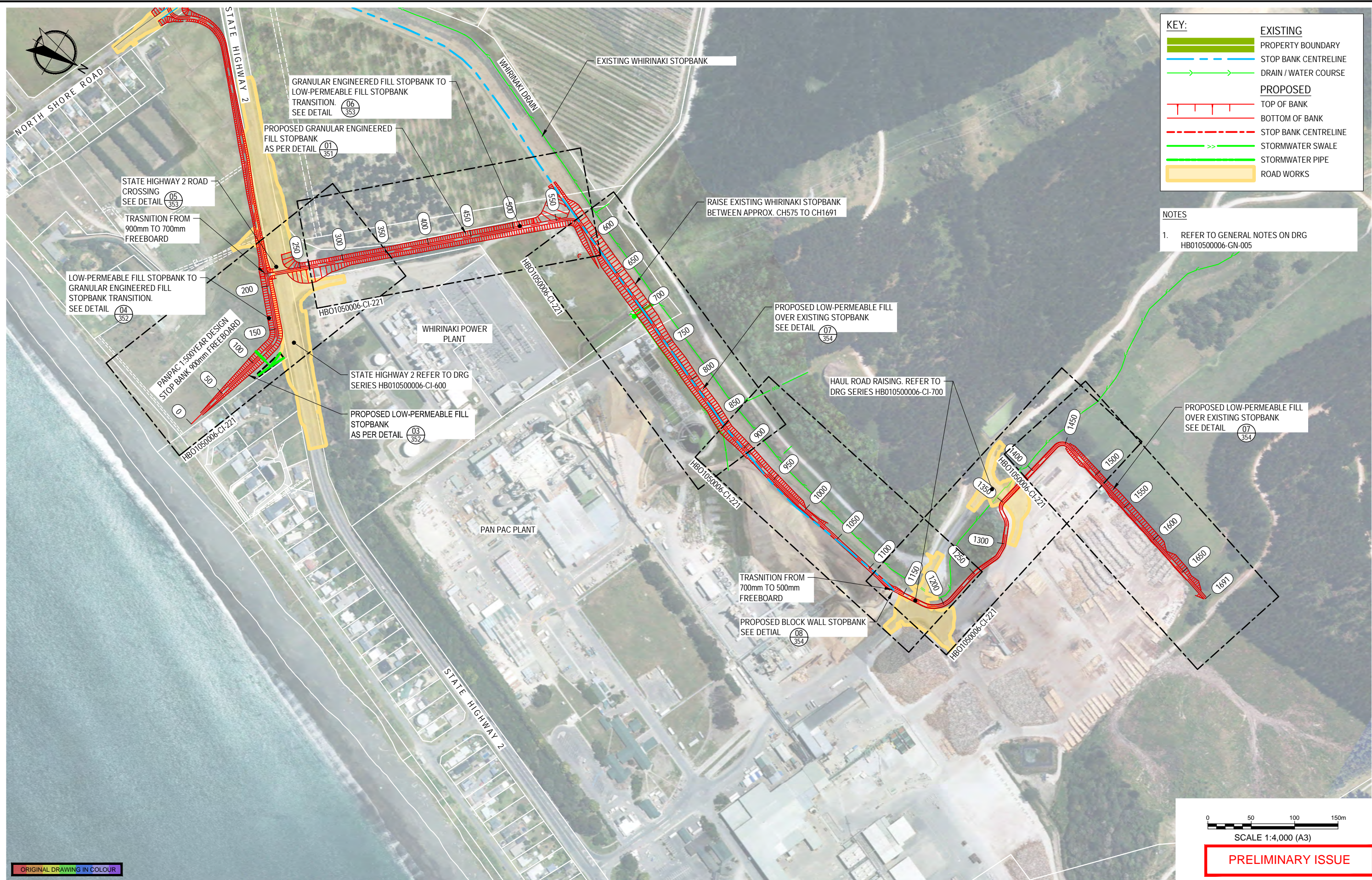


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PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

PROPOSED WHIRINAKI STOPBANK OVERVIEW PLAN (LoS 100-YEAR)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HBO10500006-CI-201	REV: A



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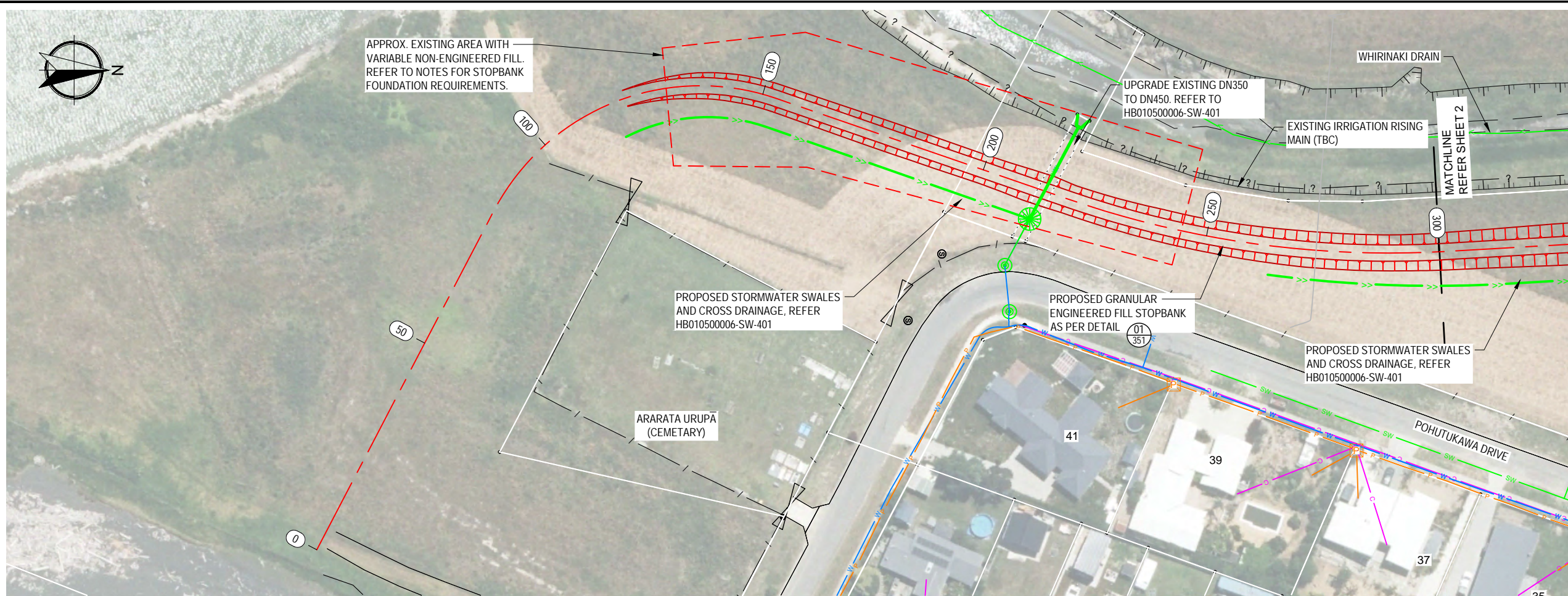
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PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE
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PROPOSED PANPAC STOPBANK OVERVIEW PLAN (LoS 500-YEAR)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-202	REV: A

A	PRELIMINARY ISSUE	AUG 25	
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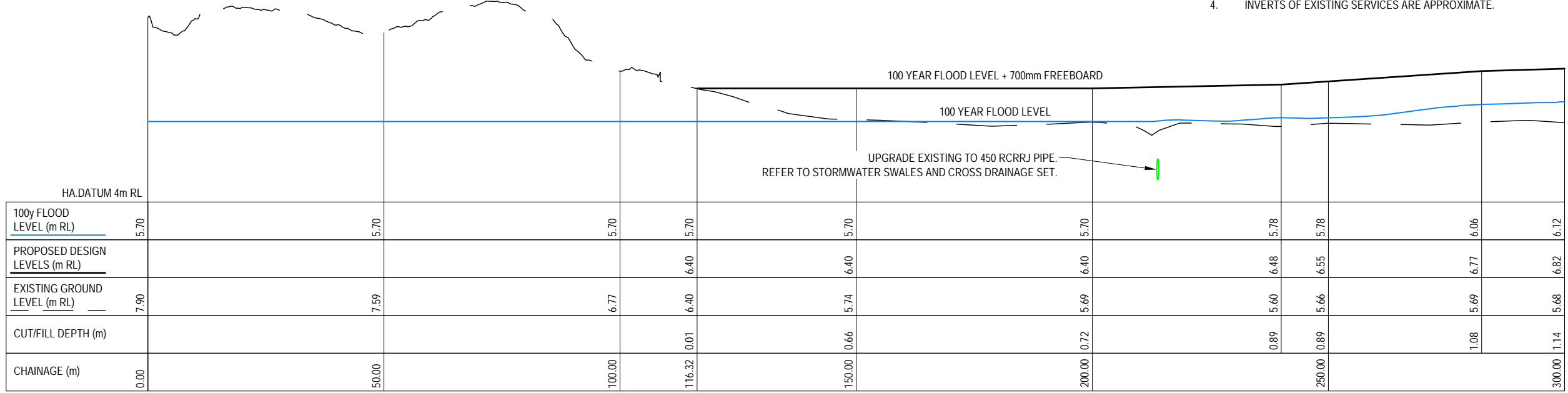


KEY:	
	EXISTING PROPERTY BOUNDARY
	STOP BANK CENTRELINE
	STORMWATER
	WASTEWATER
	WASTEWATER RISING MAIN
	CHORUS CABLE GIS
	CHORUS CABLE DIGITIZED
	TRANSPOWER FIBRE OPTIC
	PAN PAC COMM/DATA
	GAS PIPE - POWERCO
	POWER OVERHEAD
	POWER BELOW GROUND
	POWER POLE
	POWER ENCLOSURE
	POWER PYLON
	DRAIN / WATER COURSE
	WATER PIPE
	PROCESS WATER PIPE
	VALVE, HYDRANT, METER
	UNKNOWN SERVICE
	FENCE
	TOP OF BANK
	TOP OF BANK
	STOP BANK CENTRELINE
	STORMWATER SWALE
	STORMWATER PIPE
	STORMWATER MANHOLE
	STORMWATER SCRUFFY DOME
	STORMWATER WINGWALL

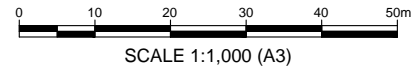
PROPOSED STOPBANK PLAN CH.0.00 TO CH.300  
SCALE 1: 1,000

NOTES

1. DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATES IN TERMS OF NZTM.
3. LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.
4. INVERTS OF EXISTING SERVICES ARE APPROXIMATE.



PROPOSED STOPBANK LONGSECTION CH.0.00 TO CH.300  
HORIZONTAL SCALE 1: 1,000  
VERTICAL SCALE 1: 100



SCALE 1:1,000 (A3)  
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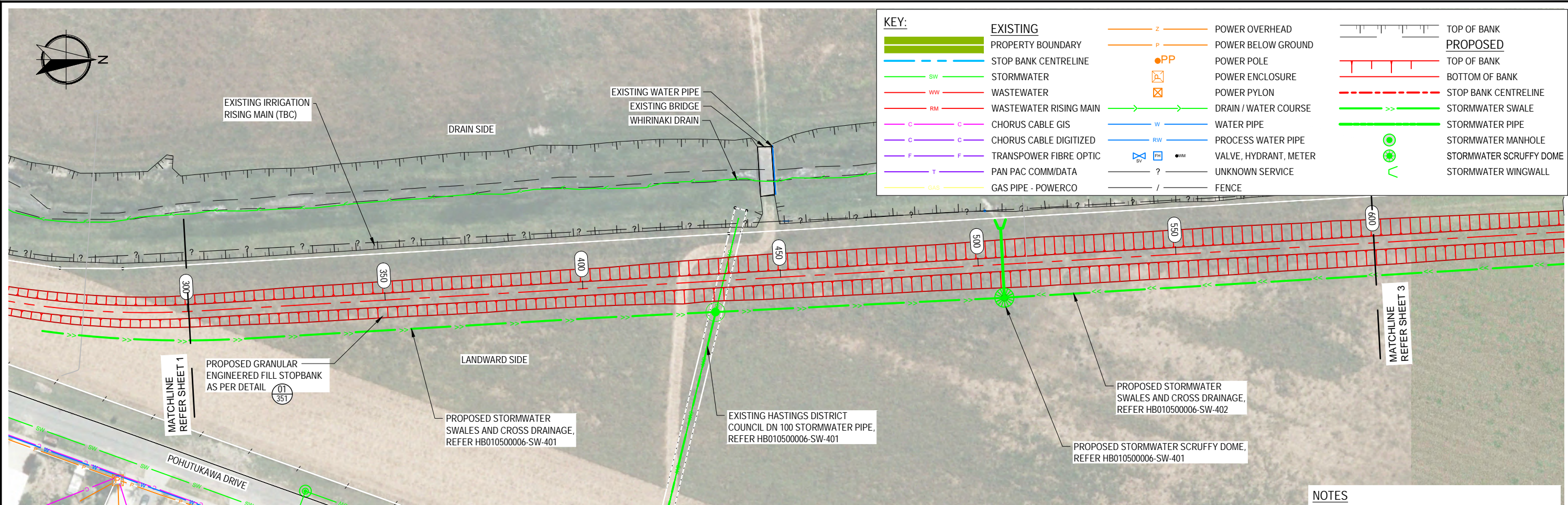
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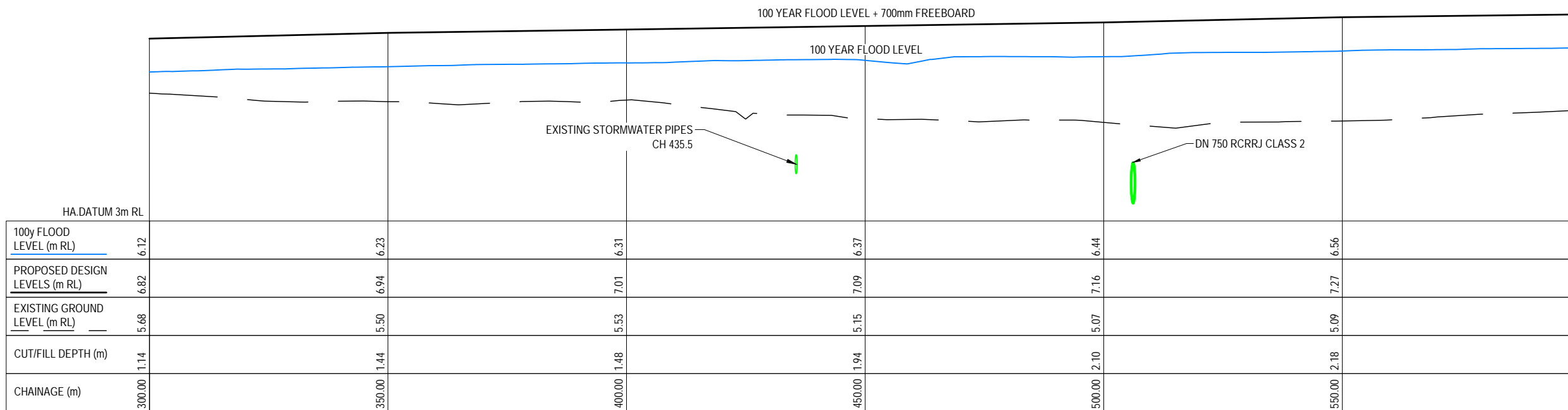
CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C.	DESIGN REVIEW P.C.	DATE JULY 25	APPROVED
DRAWN D.F.P.	DRAWING CHECK	DATE JULY 25	DATE
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PROPOSED WHIRINAKI STOPBANK (LoS 100-YEAR) LAYOUT PLAN (SHEET 1 of 5) 5		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-211	REV: A

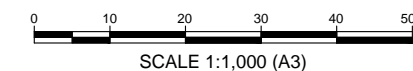


**PROPOSED STOPBANK PLAN CH.300 TO CH.600**  
SCALE 1: 1,000

- NOTES**
1. DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
  2. COORDINATES IN TERMS OF NZTM.
  3. LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.
  4. INVERTS OF EXISTING SERVICES ARE APPROXIMATE.



**PROPOSED STOPBANK LONGSECTION CH.300 TO CH.600**  
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VERTICAL SCALE 1:100



**PRELIMINARY ISSUE**

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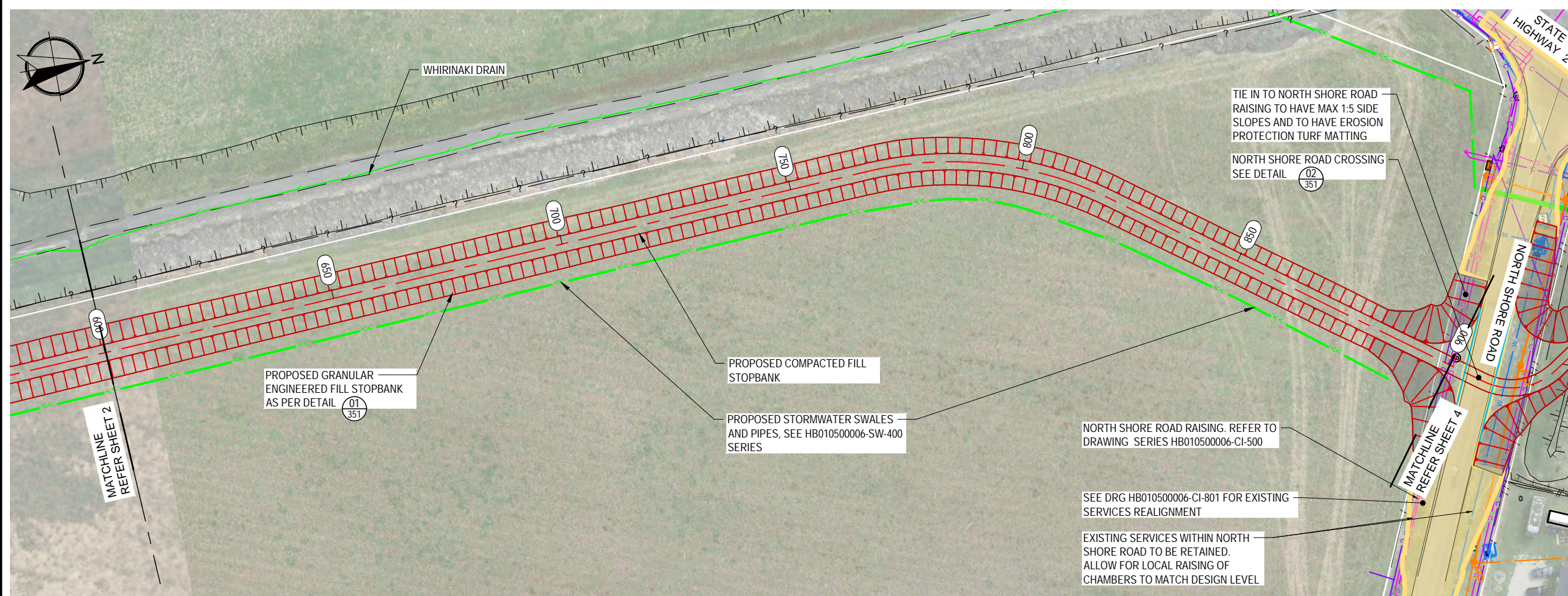
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A	PRELIMINARY ISSUE	AUG 25	



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CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

PROPOSED WHIRINAKI STOPBANK (LoS 100-YEAR) LAYOUT PLAN (SHEET 2 of 5)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-212	REV: A



**KEY:**

	EXISTING PROPERTY BOUNDARY
	STOP BANK CENTRELINE
	STORMWATER
	WASTEWATER
	WASTEWATER RISING MAIN
	CHORUS CABLE GIS
	CHORUS CABLE DIGITIZED
	TRANSPOWER FIBRE OPTIC
	PAN PAC COMM/DATA
	GAS PIPE - POWERCO
	POWER OVERHEAD
	POWER BELOW GROUND
	POWER POLE
	POWER ENCLOSURE
	POWER PYLON
	DRAIN / WATER COURSE
	WATER PIPE
	PROCESS WATER PIPE
	VALVE, HYDRANT, METER
	UNKNOWN SERVICE
	FENCE
	TOP OF BANK
	PROPOSED TOP OF BANK
	BOTTOM OF BANK
	STOP BANK CENTRELINE
	STORMWATER SWALE
	STORMWATER PIPE
	STORMWATER MANHOLE
	STORMWATER SCRUFFY DOME
	STORMWATER WINGWALL
	ROAD WORKS

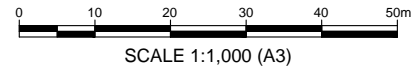
**PROPOSED STOPBANK PLAN CH.600 TO CH.900**  
SCALE 1: 1,000

100 YEAR FLOOD LEVEL + 700mm FREEBOARD

	100 YEAR FLOOD LEVEL					
HA.DATUM 4m RL						
100y FLOOD LEVEL (m RL)	6.63	6.70	6.76	6.79	6.79	6.79
PROPOSED DESIGN LEVELS (m RL)	7.33	7.40	7.46	7.49	7.49	7.49
EXISTING GROUND LEVEL (m RL)	5.32	5.62	5.71	5.86	5.86	5.97
CUT/FILL DEPTH (m)	2.00	1.78	1.75	1.63	1.63	1.52
CHAINAGE (m)	600.00	650.00	700.00	750.00	800.00	850.00

EXISTING DN 100 PVC CHORUS CONDUIT (SIZE ASSUMED)

**PROPOSED STOPBANK LONGSECTION CH.600.00 TO CH.900**  
HORIZONTAL SCALE 1:1,000  
VERTICAL SCALE 1:100



- NOTES**
- DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
  - COORDINATES IN TERMS OF NZTM.
  - LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.

**PRELIMINARY ISSUE**

ORIGINAL DRAWING IN COLOUR

A	PRELIMINARY ISSUE	AUG 25	
NO.	REVISION	DATE	APP.

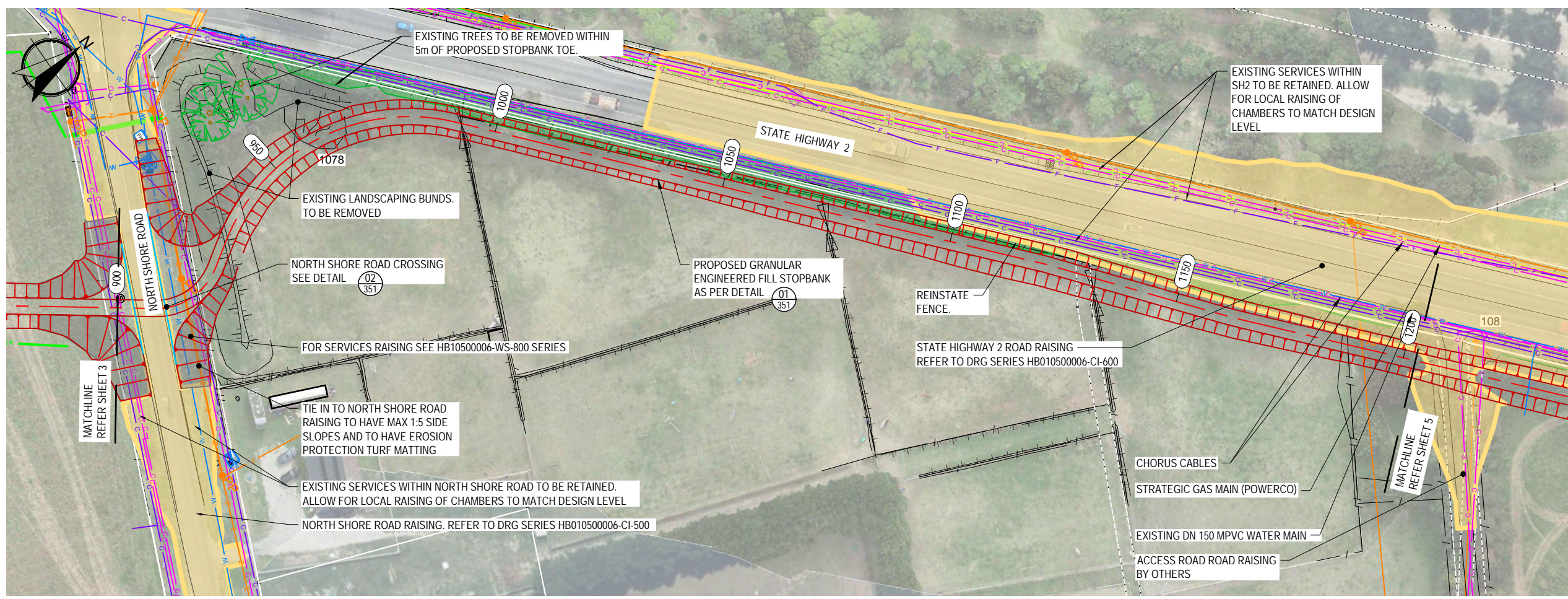


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CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

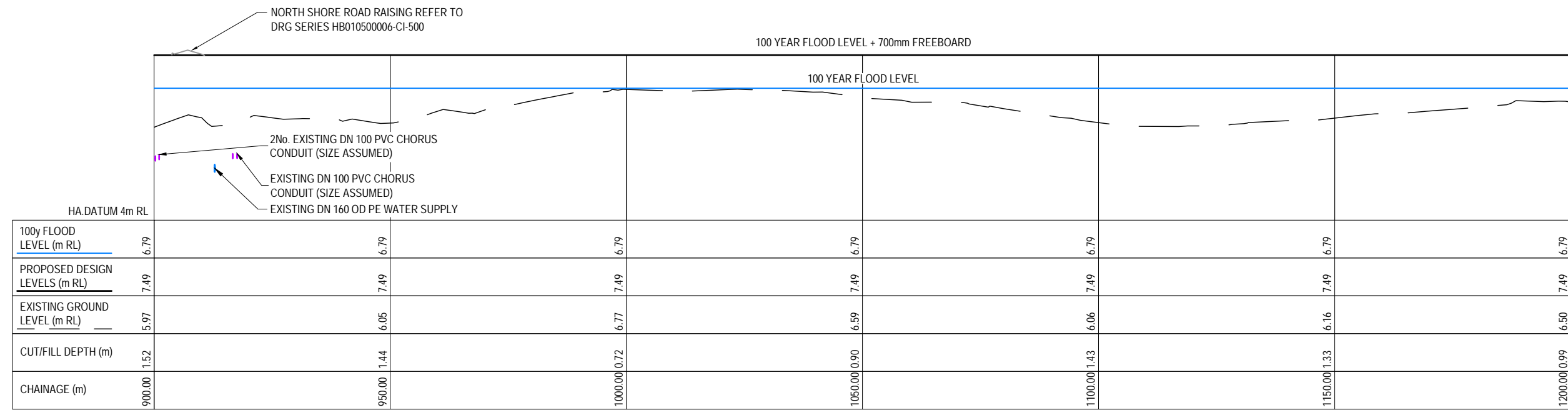
PROPOSED WHIRINAKI STOPBANK (LoS 100-YEAR) LAYOUT PLAN (SHEET 3 of 5)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-213	REV: A



**KEY:**

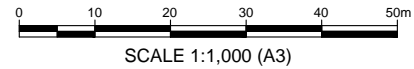
	EXISTING PROPERTY BOUNDARY
	STOP BANK CENTRELINE
	STORMWATER
	WASTEWATER
	WASTEWATER RISING MAIN
	CHORUS CABLE GIS
	CHORUS CABLE DIGITIZED
	TRANSPOWER FIBRE OPTIC
	PAN PAC COMM/DATA
	GAS PIPE - POWERCO
	POWER OVERHEAD
	POWER BELOW GROUND
	POWER POLE
	POWER ENCLOSURE
	POWER PYLON
	DRAIN / WATER COURSE
	WATER PIPE
	PROCESS WATER PIPE
	VALVE, HYDRANT, METER
	UNKNOWN SERVICE
	FENCE
	TOP OF BANK
	BOTTOM OF BANK
	STOP BANK CENTRELINE
	STORMWATER SWALE
	STORMWATER PIPE
	STORMWATER MANHOLE
	STORMWATER SCRUFFY DOME
	STORMWATER WINGWALL
	ROAD WORKS

PROPOSED STOPBANK PLAN CH.900 TO CH.1200  
SCALE 1: 1,000



PROPOSED STOPBANK LONGSECTION CH.900 TO CH.1200  
HORIZONTAL SCALE 1:1,000  
VERTICAL SCALE 1:100

- NOTES**
- DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
  - COORDINATES IN TERMS OF NZTM.
  - LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.



SCALE 1:1,000 (A3)  
**PRELIMINARY ISSUE**

ORIGINAL DRAWING IN COLOUR

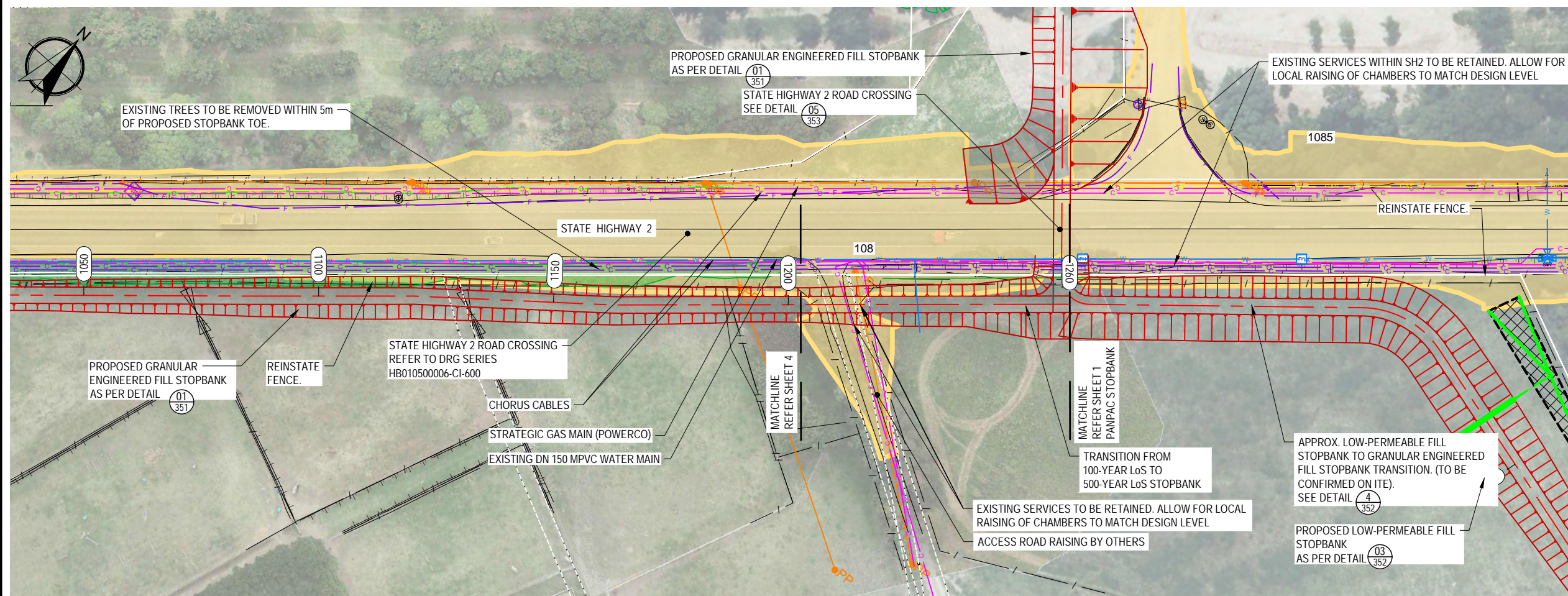
NO.	REVISION	DATE	APP.
A	PRELIMINARY ISSUE	AUG 25	



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CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

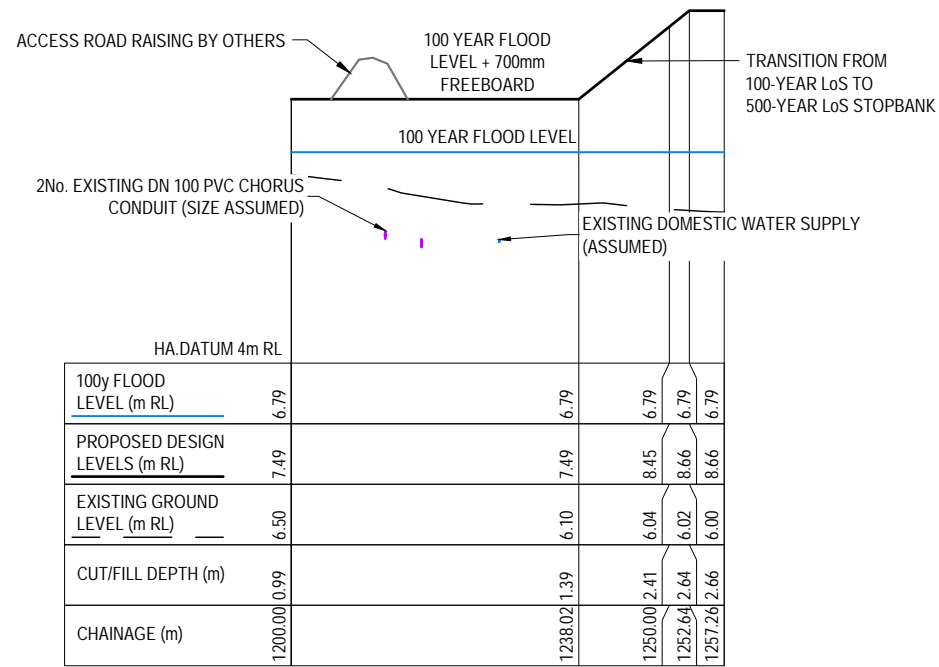
PROPOSED WHIRINAKI STOPBANK (LoS 100-YEAR) LAYOUT PLAN (SHEET 4 of 5)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-214	REV: A



**KEY:**

EXISTING	
	PROPERTY BOUNDARY
	STOP BANK CENTRELINE
	STORMWATER
	WASTEWATER
	WASTEWATER RISING MAIN
	CHORUS CABLE GIS
	CHORUS CABLE DIGITIZED
	TRANSPOWER FIBRE OPTIC
	PAN PAC COMM/DATA
	GAS PIPE - POWERCO
	POWER OVERHEAD
	POWER BELOW GROUND
	POWER POLE
	POWER ENCLOSURE
	POWER PYLON
	DRAIN / WATER COURSE
	WATER PIPE
	PROCESS WATER PIPE
	VALVE, HYDRANT, METER
	UNKNOWN SERVICE
	FENCE
	TOP OF BANK
	BOTTOM OF BANK
	STOP BANK CENTRELINE
	STORMWATER SWALE
	STORMWATER PIPE
	STORMWATER MANHOLE
	STORMWATER SCRUFFY DOME
	STORMWATER WINGWALL
	ROAD WORKS

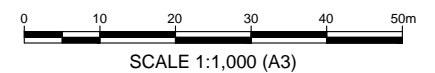
PROPOSED STOPBANK PLAN CH.1200 TO CH.1257  
SCALE 1: 2,000



PROPOSED STOPBANK LONGSECTION CH.1200 TO CH.1257  
HORIZONTAL SCALE 1:1,000  
VERTICAL SCALE 1:100

**NOTES**

1. DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATES IN TERMS OF NZTM.
3. LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.
4. EXISTING TREES TO BE REMOVED WITHIN 5m OF PROPOSED STOPBANK TOE.



**PRELIMINARY ISSUE**

ORIGINAL DRAWING IN COLOUR

NO.	REVISION	DATE	APP.
A	PRELIMINARY ISSUE	AUG 25	

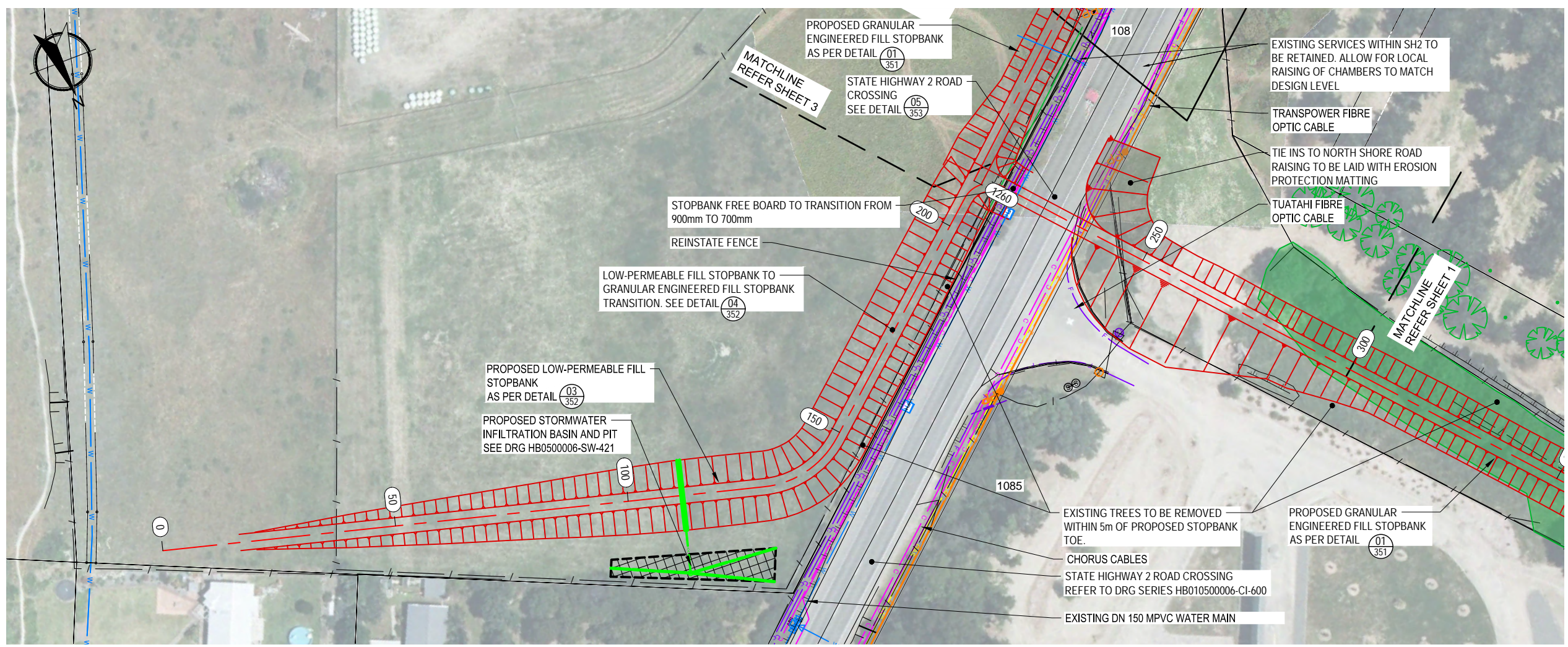
HAWKES BAY REGIONAL COUNCIL  
TE KAUNIHERA Ā-ROHE O TE MATAU-A-MĀUI

PDP  
PATTLE DELAMORE PARTNERS

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CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

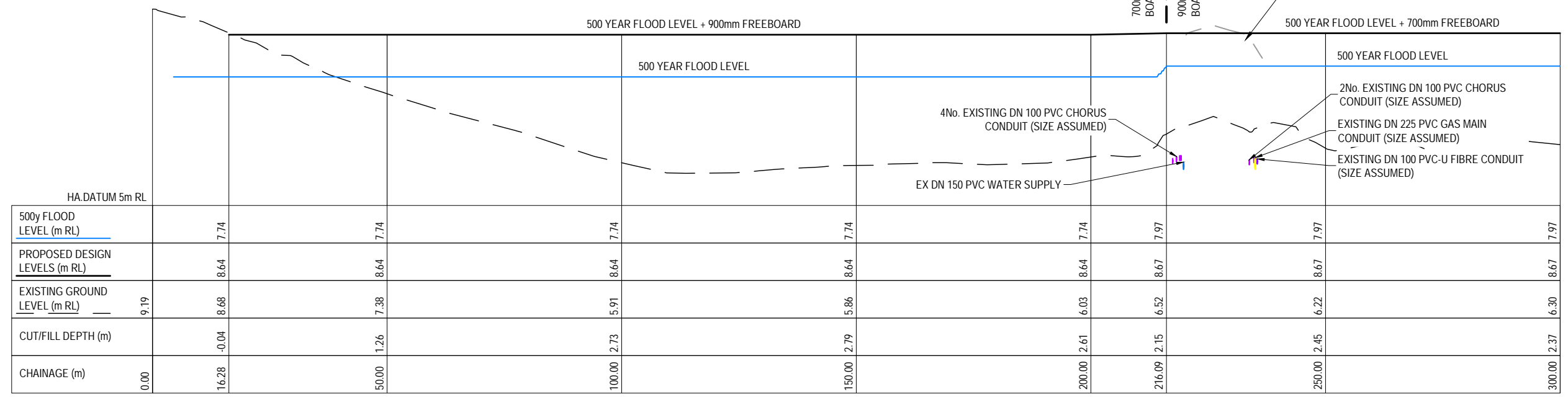
PROPOSED WHIRINAKI STOPBANK (LoS 100-YEAR) LAYOUT PLAN (SHEET 5 of 5)		
SCALE:	DRAWING NO.:	REV.:
AS SHOWN (A3)	HB010500006-CI-215	A



**KEY:**

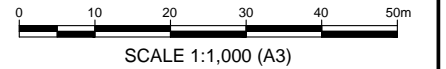
	<b>EXISTING</b>	PROPERTY BOUNDARY
		STOP BANK CENTRELINE
		STORMWATER
		WASTEWATER
		WASTEWATER RISING MAIN
		CHORUS CABLE GIS
		CHORUS CABLE DIGITIZED
		TRANSPOWER FIBRE OPTIC
		PAN PAC COMM/DATA
		GAS PIPE - POWERCO
		POWER OVERHEAD
		POWER BELOW GROUND
		POWER POLE
		POWER ENCLOSURE
		POWER PYLON
		DRAIN / WATER COURSE
		WATER PIPE
		PROCESS WATER PIPE
		VALVE, HYDRANT, METER
		UNKNOWN SERVICE
		FENCE
	<b>PROPOSED</b>	TOP OF BANK
		BOTTOM OF BANK
		STOP BANK CENTRELINE
		STORMWATER SWALE
		STORMWATER PIPE
		STORMWATER MANHOLE
		STORMWATER SCRUFFY DOME
		STORMWATER WINGWALL

PROPOSED STOPBANK PLAN CH.00 TO CH.300  
SCALE 1: 1,000



PROPOSED STOPBANK LONGSECTION CH.0.00 TO CH.300  
HORIZONTAL SCALE 1:1000  
VERTICAL SCALE 1:100

- NOTES**
- DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
  - COORDINATES IN TERMS OF NZTM.
  - LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.



**PRELIMINARY ISSUE**

ORIGINAL DRAWING IN COLOUR

A	PRELIMINARY ISSUE	AUG 25	
NO.	REVISION	DATE	APP.

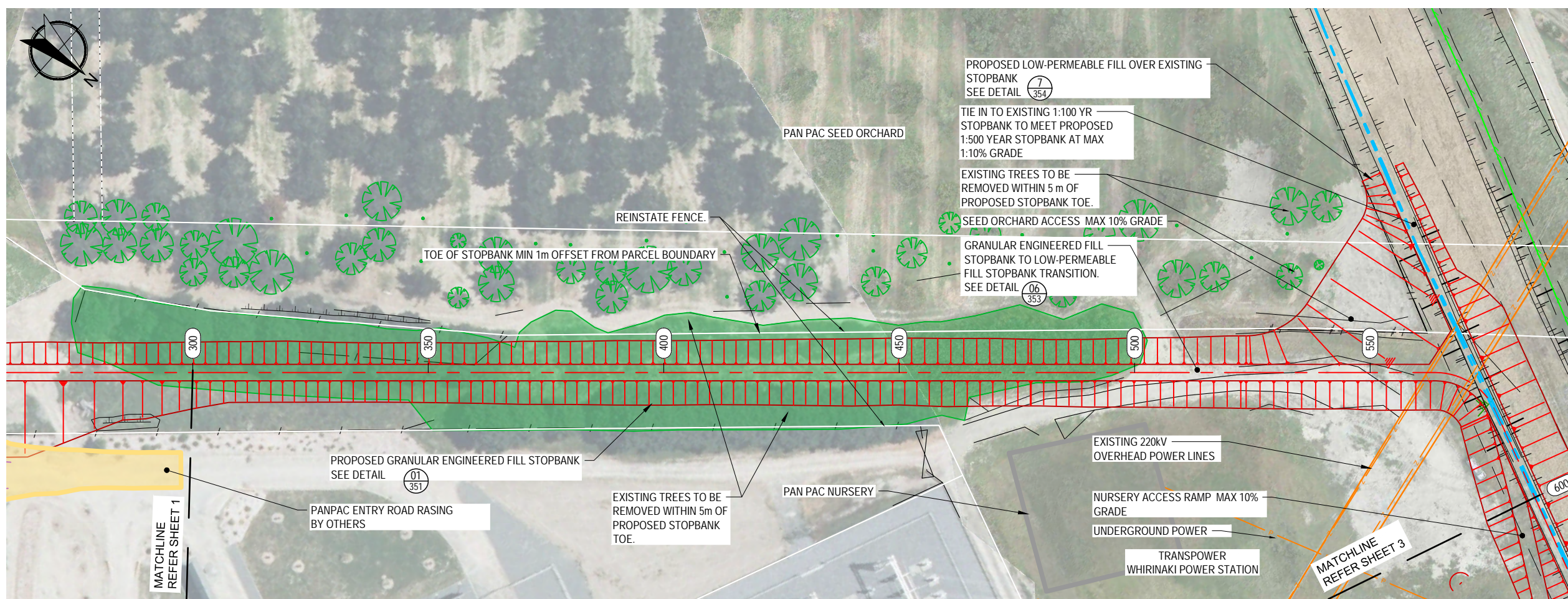


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CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

PROPOSED PAN PAC STOPBANK (LoS 500-YEAR) LAYOUT PLAN (SHEET 1 of 6)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-221	REV: A



KEY:	
	EXISTING PROPERTY BOUNDARY
	STOP BANK CENTRELINE
	STORMWATER
	WASTEWATER
	WASTEWATER RISING MAIN
	CHORUS CABLE GIS
	CHORUS CABLE DIGITIZED
	TRANSPOWER FIBRE OPTIC
	PAN PAC COMM/DATA
	GAS PIPE - POWERCO
	POWER OVERHEAD
	POWER BELOW GROUND
	POWER POLE
	POWER ENCLOSURE
	POWER PYLON
	DRAIN / WATER COURSE
	WATER PIPE
	PROCESS WATER PIPE
	VALVE, HYDRANT, METER
	UNKNOWN SERVICE
	FENCE
	TOP OF BANK
	PROPOSED TOP OF BANK
	BOTTOM OF BANK
	STOP BANK CENTRELINE
	STORMWATER SWALE
	STORMWATER PIPE
	STORMWATER MANHOLE
	STORMWATER SCRUFFY DOME
	STORMWATER WINGWALL

PROPOSED STOPBANK PLAN  
SCALE 1: 1,000

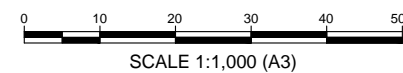
500 YEAR FLOOD LEVEL + 700mm FREEBOARD

		500 YEAR FLOOD LEVEL									
		EXISTING 1:100 YEAR STOP BANK									
HA.DATUM 5m RL											
500y FLOOD LEVEL (m RL)	7.97	7.97	7.97	7.97	7.98	7.98	7.98	7.97	8.05	8.11	8.14
PROPOSED DESIGN LEVELS (m RL)	8.67	8.67	8.67	8.68	8.68	8.68	8.67	8.79	8.81	8.84	8.84
EXISTING GROUND LEVEL (m RL)	6.30	6.35	6.08	5.97	5.84	5.84	5.77	5.74	5.73	7.56	7.56
CUT/FILL DEPTH (m)	2.37	2.32	2.59	2.70	2.84	2.84	2.89	3.04	3.08	1.28	1.28
CHAINAGE (m)	300.00	350.00	400.00	450.00	500.00	545.17	550.00	550.99	600.00		

PROPOSED STOPBANK LONGSECTION CH.300.00 TO CH.600  
HORIZONTAL SCALE 1:1,000  
VERTICAL SCALE 1:100

NOTES

- DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
- COORDINATES IN TERMS OF NZTM.
- LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.



**PRELIMINARY ISSUE**

ORIGINAL DRAWING IN COLOUR

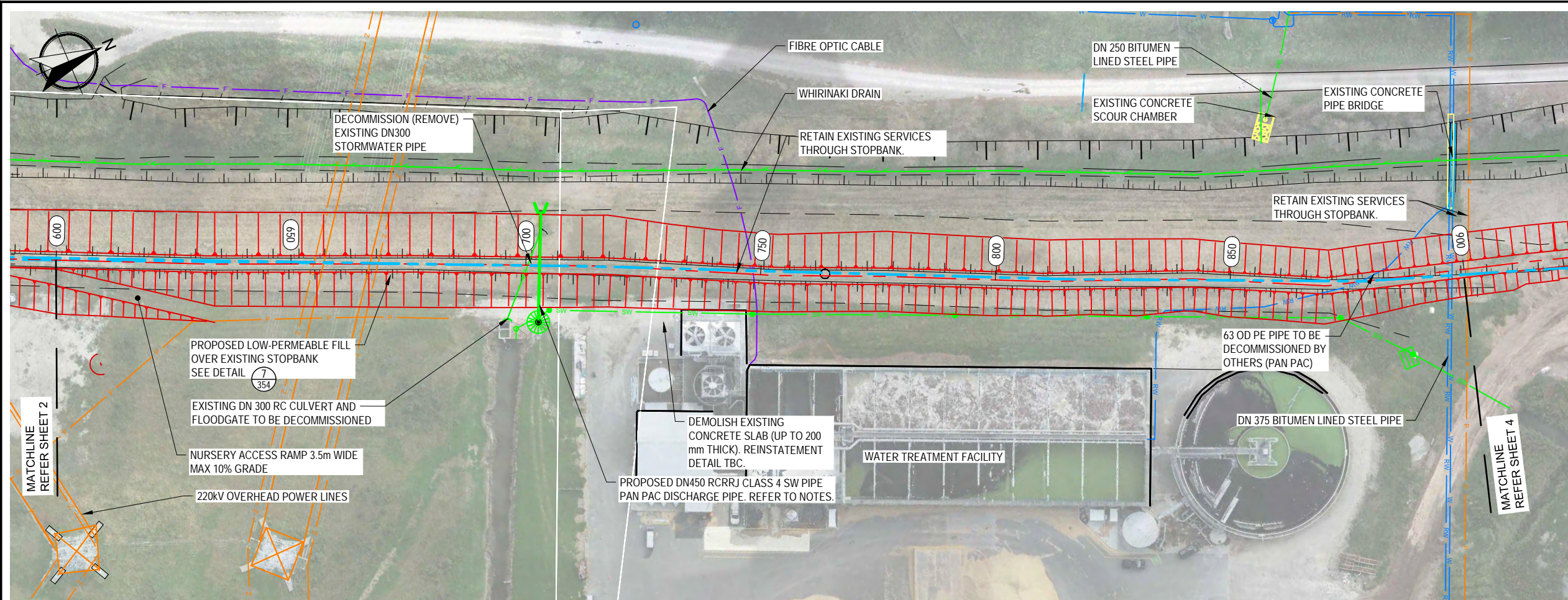
NO.	REVISION	DATE	APP.
A	PRELIMINARY ISSUE	AUG 25	



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CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE

PROPOSED PAN PAC STOPBANK (LoS 500-YEAR) LAYOUT PLAN (SHEET 2 of 6)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-222	REV: A



KEY:	
	EXISTING PROPERTY BOUNDARY
	STOP BANK CENTRELINE
	STORMWATER
	WASTEWATER
	WASTEWATER RISING MAIN
	CHORUS CABLE GIS
	CHORUS CABLE DIGITIZED
	TRANSPOWER FIBRE OPTIC
	PAN PAC COMM/DATA
	GAS PIPE - POWERCO
	POWER OVERHEAD
	POWER BELOW GROUND
	POWER POLE
	POWER ENCLOSURE
	POWER PYLON
	DRAIN / WATER COURSE
	WATER PIPE
	PROCESS WATER PIPE
	VALVE, HYDRANT, METER
	UNKNOWN SERVICE
	FENCE
	TOP OF BANK
	BOTTOM OF BANK
	STOP BANK CENTRELINE
	STORMWATER SWALE
	STORMWATER PIPE
	STORMWATER MANHOLE
	STORMWATER SCRUFFY DOME
	STORMWATER WINGWALL

PROPOSED STOPBANK PLAN CH.600 TO CH 900  
SCALE 1:1000

500 YEAR FLOOD LEVEL + 700mm FREEBOARD

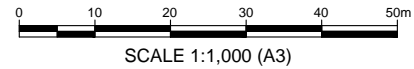
HA.DATUM 6m RL		500y FLOOD LEVEL		EXISTING AND PROPOSED SERVICES - BELOW SECTION DATUM		EXISTING SERVICES TO BE RETAINED (INDICATIVELY SHOWN)	
500y FLOOD LEVEL (m RL)	8.14	8.15	8.15	8.15	8.15	8.15	8.18
PROPOSED DESIGN LEVELS (m RL)	8.84	8.84	8.84	8.84	8.86	8.87	8.87
EXISTING GROUND LEVEL (m RL)	7.56	7.59	7.46	7.55	7.53	7.68	7.30
CUT/FILL DEPTH (m)	1.28	1.25	1.38	1.29	1.33	1.19	1.57
CHAINAGE (m)	600.00	650.00	700.00	750.00	800.00	850.00	900.00

PROPOSED STOPBANK LONGSECTION CH.600.00 TO CH.900

HORIZONTAL SCALE 1:1,000  
VERTICAL SCALE 1:100

NOTES

- DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
- COORDINATES IN TERMS OF NZTM.
- LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.
- PAN PAC DISCHARGE PIPE:
  - ALLOW FOR INSTALLATION ONLY OF 355 OD PE100 EF PIPE IN SHARED TRENCH.
  - PIPE TO BE SUPPLIED BY OTHERS.
  - CONTRACTOR TO NOTIFY PAN PAC PRIOR TO INSTALLATION OF DISCHARGE PIPE.
  - TRENCH BACKFILL TO BE AS PER DETAIL DRG HB010500006-SW-426
  - CONTRACTOR TO ALLOW FOR TEST AND COMMISSIONING OF PIPE.
  - INSTALL HEADWALL AND RIPRAP AS PER DRG HB010500006-SW-426



PRELIMINARY ISSUE

ORIGINAL DRAWING IN COLOUR

NO.	REVISION	DATE	APP.
A	PRELIMINARY ISSUE	AUG 25	



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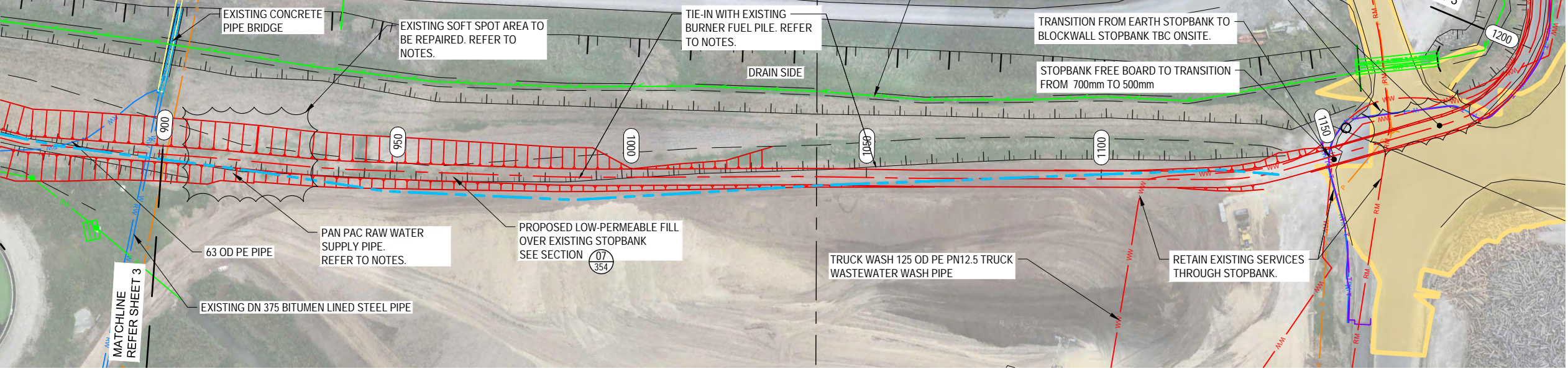
CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

PROPOSED PAN PAC STOPBANK (LoS 500-YEAR) LAYOUT PLAN (SHEET 3 of 6)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-223	REV: A

www.pdp.co.nz  
DO NOT SCALE DRAWING  
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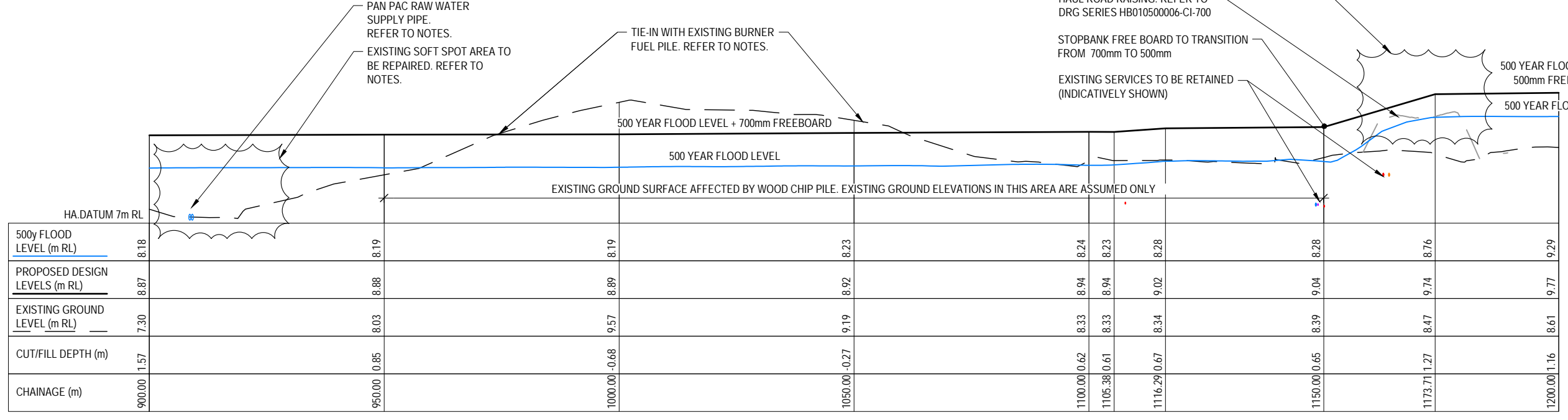
**KEY:**

EXISTING		PROPOSED	
	PROPERTY BOUNDARY		TOP OF BANK
	STOP BANK CENTRELINE		TOP OF BANK
	STORMWATER		BOTTOM OF BANK
	WASTEWATER		STOP BANK CENTRELINE
	WASTEWATER RISING MAIN		STORMWATER SWALE
	CHORUS CABLE GIS		STORMWATER PIPE
	CHORUS CABLE DIGITIZED		STORMWATER MANHOLE
	TRANSPOWER FIBRE OPTIC		STORMWATER SCRUFFY DOME
	PAN PAC COMM/DATA		STORMWATER WINGWALL
	GAS PIPE - POWERCO		WATER PIPE
	POWER OVERHEAD		PROCESS WATER PIPE
	POWER BELOW GROUND		VALVE, HYDRANT, METER
	POWER POLE		UNKNOWN SERVICE
	POWER ENCLOSURE		FENCE
	POWER PYLON		
	DRAIN / WATER COURSE		

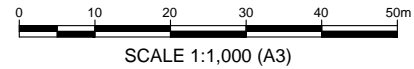


- NOTES**
- DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
  - COORDINATES IN TERMS OF NZTM.
  - LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.
  - PAN PAC RAW WATER PIPE:
    - ALLOW FOR INSTALLATION ONLY OF 2No. 355 OD P100 EF PIPE IN SHARED TRENCH.
    - PIPE TO BE SUPPLIED BY OTHERS.
    - CONTRACTOR TO NOTIFY PAN PAC PRIOR TO INSTALLATION OF THE RAW WATER PIPES.
    - TRENCH BACKFILL TO BE AS PER DETAIL XXX.
    - CONTRACTOR TO ALLOW FOR TEST AND COMMISSIONING OF PIPE.
    - PIPE TO BE CAPPED WITH BLANK FLANGE ON EACH SIDE.
  - SOFT SPOT AREA
    - EXTENT OF SOFT AREA TO BE CONFIRMED ONSITE BY CONTRACTOR EXPOSING STOPBANK TO WHERE SOUND MATERIAL IS FOUND. TO BE CONFIRMED BY ENGINEER.
    - ALLOW FOR INSTALLATION OF A CUT-OFF DRAIN TO INTERCEPT WATER AND DIRECT TOWARDS PAN PAC ON-SITE STORMWATER.
    - REINSTATEMENT OF SOFT SPOT TO BE AS PER DETAIL XXX.
  - TIE-IN WITH EXISTING BURNER FUEL PILE.
    - CONTRACTOR TO REMOVE EXISTING WOODCHIP DOWN TO EXISTING FILL MATERIAL.
    - CONTRACTOR TO RECORD HEIGHTS OF EXISTING FILL MATERIAL AND DEMARCATATE POINTS WHERE FILL IS HIGHER THAN PROPOSED STOPBANK HEIGHT.
    - CONTRACTOR TO TEST MATERIAL AS PER SPECIFICATIONS.
    - CONTRACTOR TO RETAIN EXISTING FILL WHERE HIGHER THAN PROPOSED STOPBANK PENDING APPROVAL BY ENGINEER.
  - LOWER HAUL ROAD FLOODGATE.
    - FLOODGATE TO BE INSTALLED ACROSS HAULAGE ROAD.
    - FLOODGATE TO BE SWING GATE TYPE.
    - FLOODGATE TO BE CERTIFIED AND TESTED.
    - FLOODGATE TO BE 10 m WIDE BY MIN. 500 mm HIGH.

**PROPOSED STOPBANK PLAN CH.900 TO CH 1200**  
SCALE 1:1000



**PROPOSED STOPBANK LONGSECTION CH.900.00 TO CH.1200**  
HORIZONTAL SCALE 1:1,000  
VERTICAL SCALE 1:100



SCALE 1:1,000 (A3)  
**PRELIMINARY ISSUE**

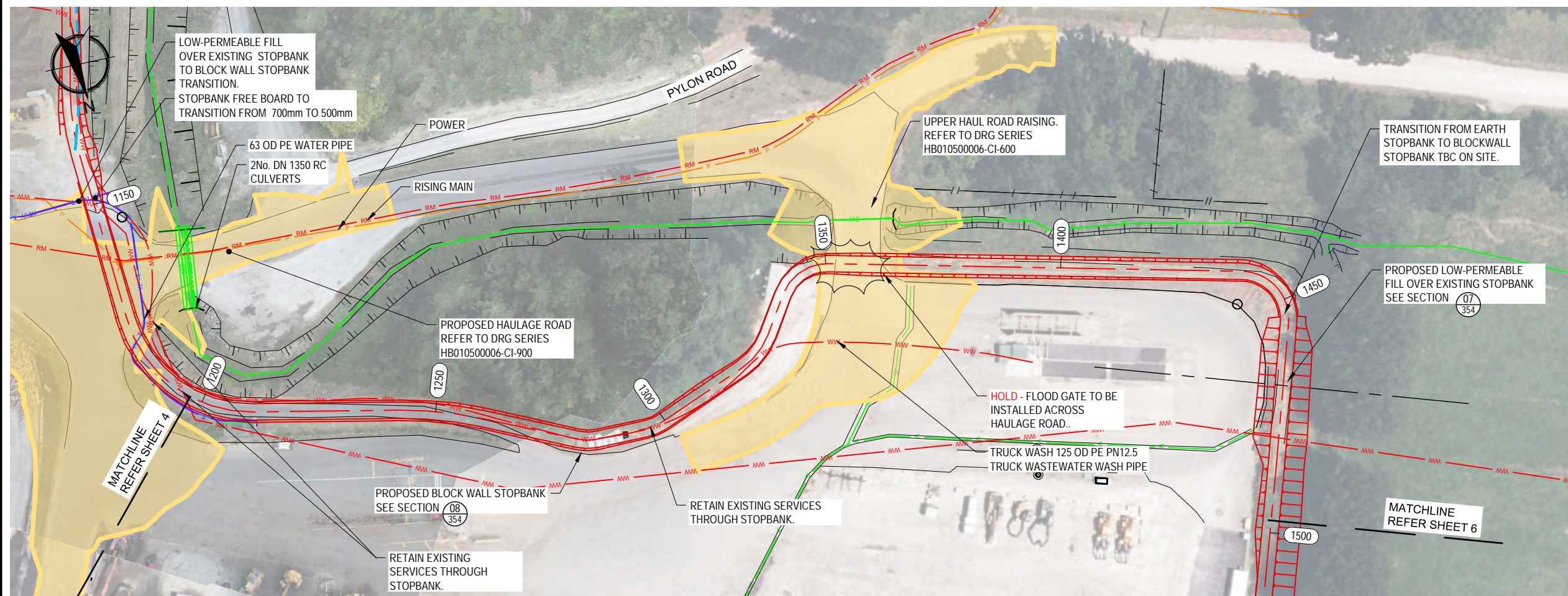
NO.	REVISION	DATE	APP.
A	PRELIMINARY ISSUE	AUG 25	



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CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

PROPOSED PAN PAC STOPBANK (LoS 500-YEAR) LAYOUT PLAN (SHEET 4 of 6)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-224	REV: A

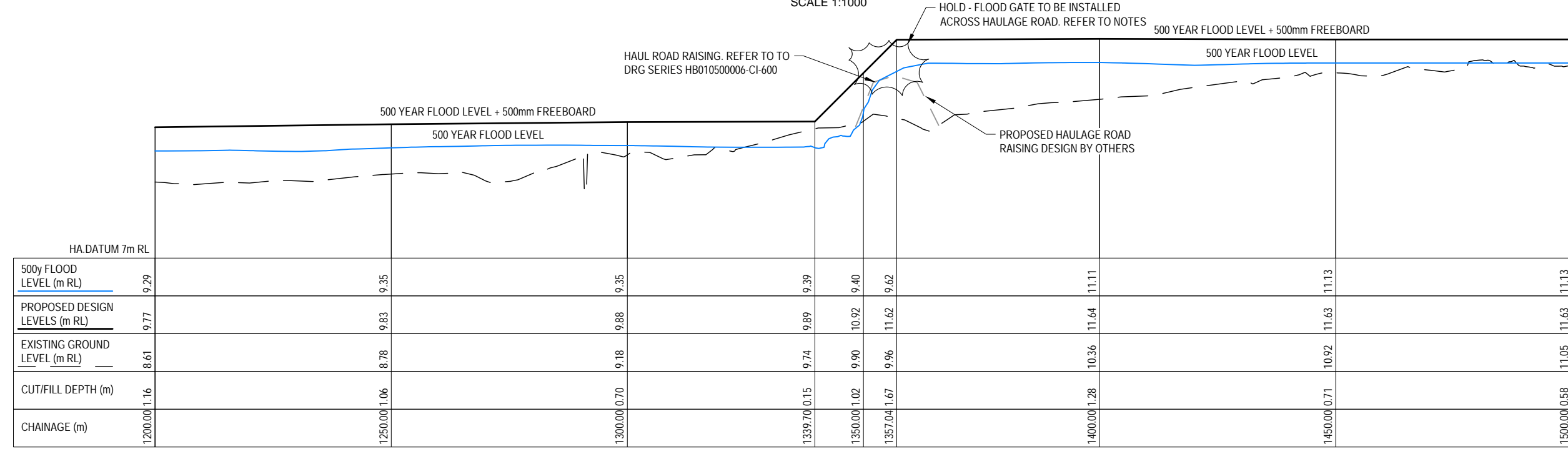


**KEY:**

EXISTING	
	PROPERTY BOUNDARY
	STOP BANK CENTRELINE
	STORMWATER
	WASTEWATER
	WASTEWATER RISING MAIN
	CHORUS CABLE GIS
	CHORUS CABLE DIGITIZED
	TRANSPOWER FIBRE OPTIC
	PAN PAC COMM/DATA
	GAS PIPE - POWERCO
	POWER OVERHEAD
	POWER BELOW GROUND
	POWER POLE
	POWER ENCLOSURE
	POWER PYLON
	DRAIN / WATER COURSE
	WATER PIPE
	PROCESS WATER PIPE
	VALVE, HYDRANT, METER
	UNKNOWN SERVICE
	FENCE
	TOP OF BANK
	PROPOSED TOP OF BANK
	BOTTOM OF BANK
	STOP BANK CENTRELINE
	STORMWATER SWALE
	STORMWATER PIPE
	STORMWATER MANHOLE
	STORMWATER SCRUFFY DOME
	STORMWATER WINGWALL

**PROPOSED STOPBANK PLAN CH.1200 TO CH.1500**

SCALE 1:1000

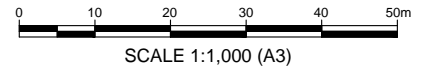


**PROPOSED STOPBANK LONGSECTION CH.1200 TO CH.1500**

HORIZONTAL SCALE 1:1,000  
VERTICAL SCALE 1:100

**NOTES**

- DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
- COORDINATES IN TERMS OF NZTM.
- LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.
- UPPER HAUL ROAD FLOODGATE
  - FLOODGATE TO BE INSTALLED ACROSS HAULAGE ROAD.
  - FLOODGATE TO BE SWING GATE TYPE.
  - FLOODGATE TO BE CERTIFIED AND TESTED.
  - FLOODGATE TO BE 10 m WIDE BY MIN. 1,000 mm HIGH.



SCALE 1:1,000 (A3)  
**PRELIMINARY ISSUE**

ORIGINAL DRAWING IN COLOUR

A	PRELIMINARY ISSUE	AUG 25	
NO.	REVISION	DATE	APP.



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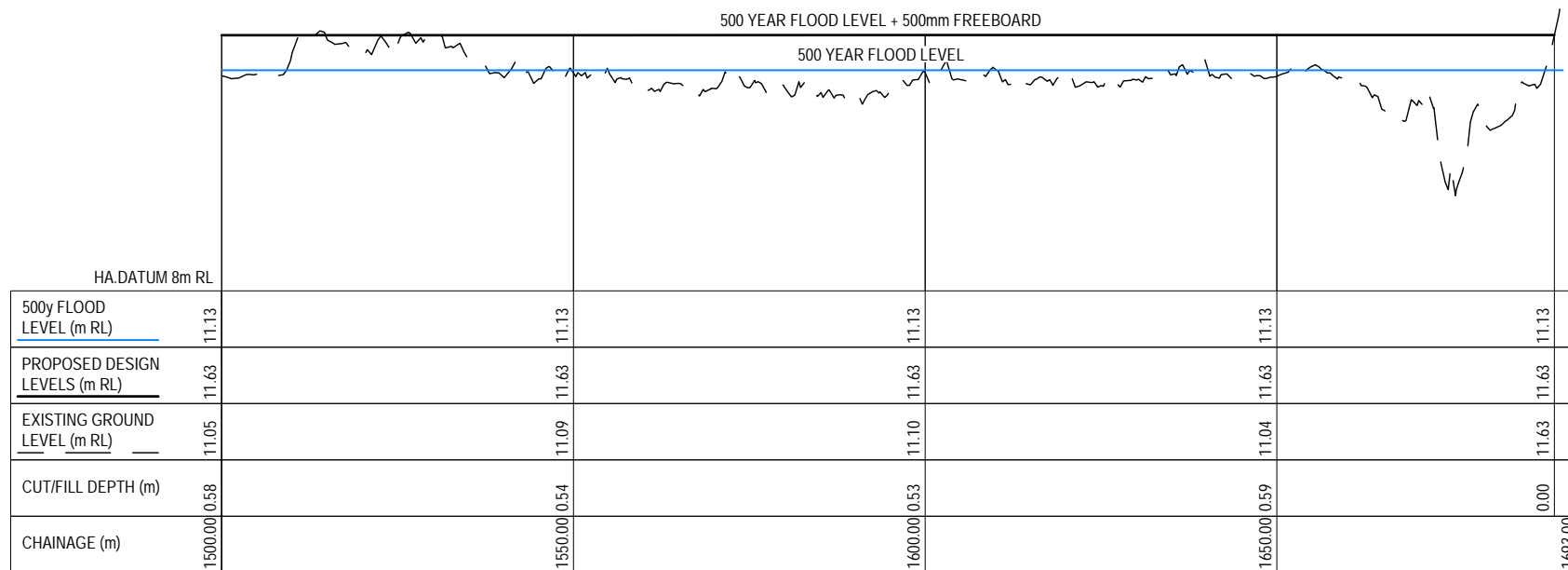
CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C.	DESIGN REVIEW P.C.	DATE JULY 25	APPROVED
DRAWN D.F.P.	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

PROPOSED PAN PAC STOPBANK (LoS 500-YEAR) LAYOUT PLAN (SHEET 5 of 6)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-225	REV: A



KEY:	
	EXISTING PROPERTY BOUNDARY
	STOP BANK CENTRELINE
	STORMWATER
	WASTEWATER
	WASTEWATER RISING MAIN
	CHORUS CABLE GIS
	CHORUS CABLE DIGITIZED
	TRANSPOWER FIBRE OPTIC
	PAN PAC COMM/DATA
	GAS PIPE - POWERCO
	POWER OVERHEAD
	POWER BELOW GROUND
	POWER POLE
	POWER ENCLOSURE
	POWER PYLON
	DRAIN / WATER COURSE
	WATER PIPE
	PROCESS WATER PIPE
	VALVE, HYDRANT, METER
	UNKNOWN SERVICE
	FENCE
	TOP OF BANK
	BOTTOM OF BANK
	STOP BANK CENTRELINE
	STORMWATER SWALE
	STORMWATER PIPE
	STORMWATER MANHOLE
	STORMWATER SCRUFFY DOME
	STORMWATER WINGWALL

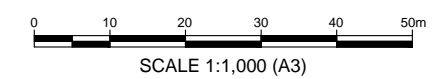
PROPOSED STOPBANK PLAN CH.1500 TO CH 1693  
SCALE 1:1000



PROPOSED STOPBANK LONGSECTION CH.1500 TO CH.1693  
HORIZONTAL SCALE 1:1,000  
VERTICAL SCALE 1:100

NOTES

- DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
- COORDINATES IN TERMS OF NZTM.
- LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.



PRELIMINARY ISSUE

ORIGINAL DRAWING IN COLOUR

NO.	REVISION	DATE	APP.
A	PRELIMINARY ISSUE	AUG 25	

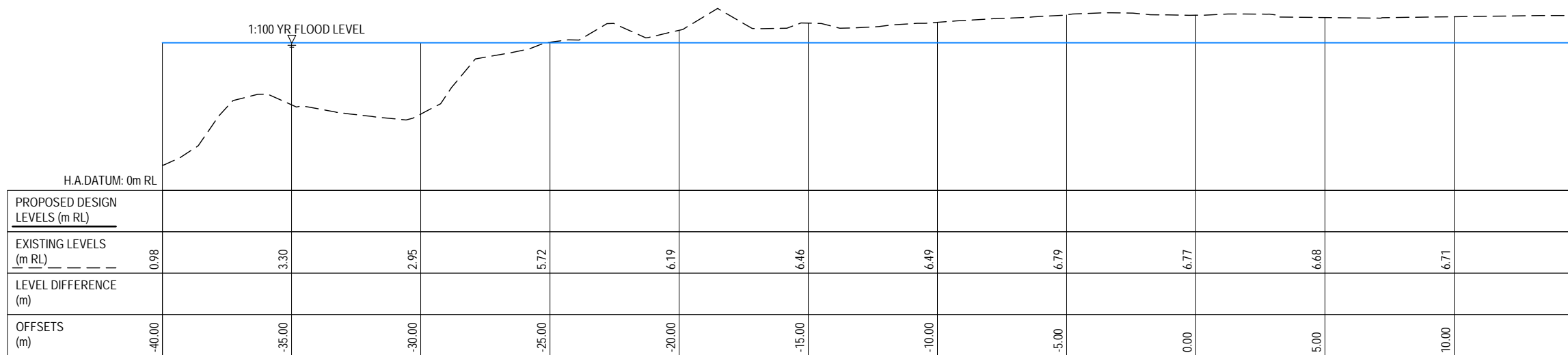


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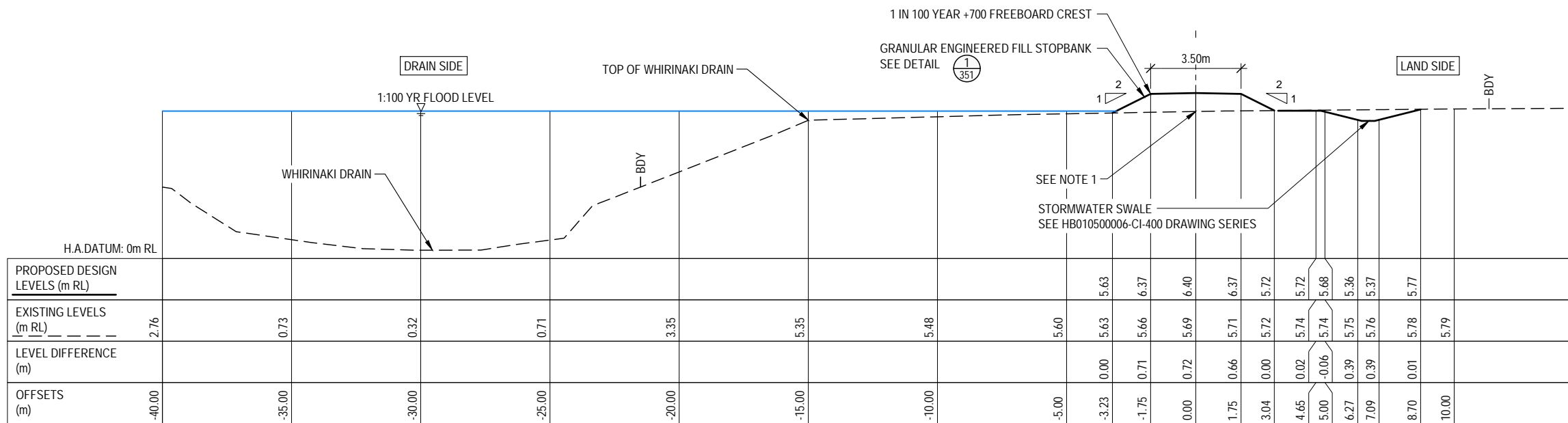
CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

PROPOSED PAN PAC STOPBANK (LoS 500-YEAR) LAYOUT PLAN (SHEET 6 of 6)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-226	REV: A

- NOTES**
1. STOPBANK FOOTPRINT TO BE CLEARED OF ALL VEGETATION AND TOPSOIL REMOVED TO STOCKPILE AREA TO BE TO BE COMPACTED IN-SITU IN PREPARATION FOR EARTH FILL FOR STOPBANK.
  2. ALL EARTHWORKS TO BE COMPACTED TO 95% STANDARD NZ COMPACTION (HEAVY).
  3. ALL EARTHWORKS TO BE OVERFILLED, COMPACTED AND TRIMMED BACK TO DIMENSIONS GIVEN ON THE DRAWINGS.
  4. ALL EARTHWORKS VOLUMES TO BE MEASURED TO DIMENSIONS ON DRAWINGS.
  5. CADASTRAL INFORMATION AS AT 01/04/2024 DATE OF LINZ PROPERTY UPDATE.



XSEC A01 (CH:100)  
SCALE 1:200



XSEC A02 (CH:200)  
SCALE 1:200



**PRELIMINARY ISSUE**

ORIGINAL DRAWING IN COLOUR



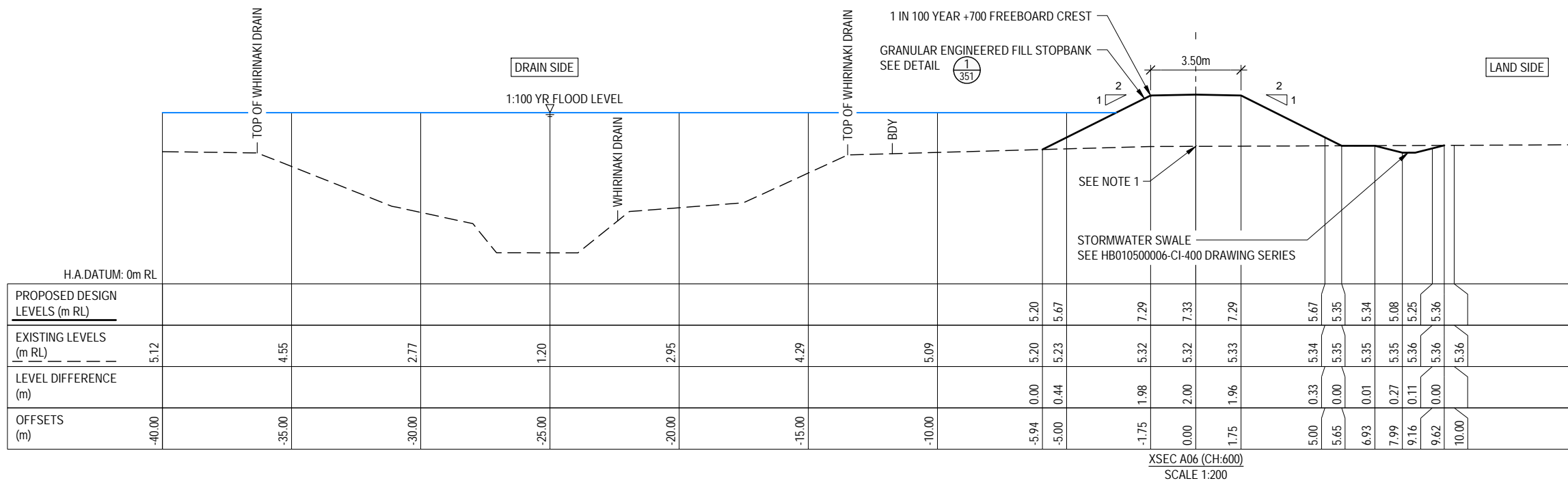
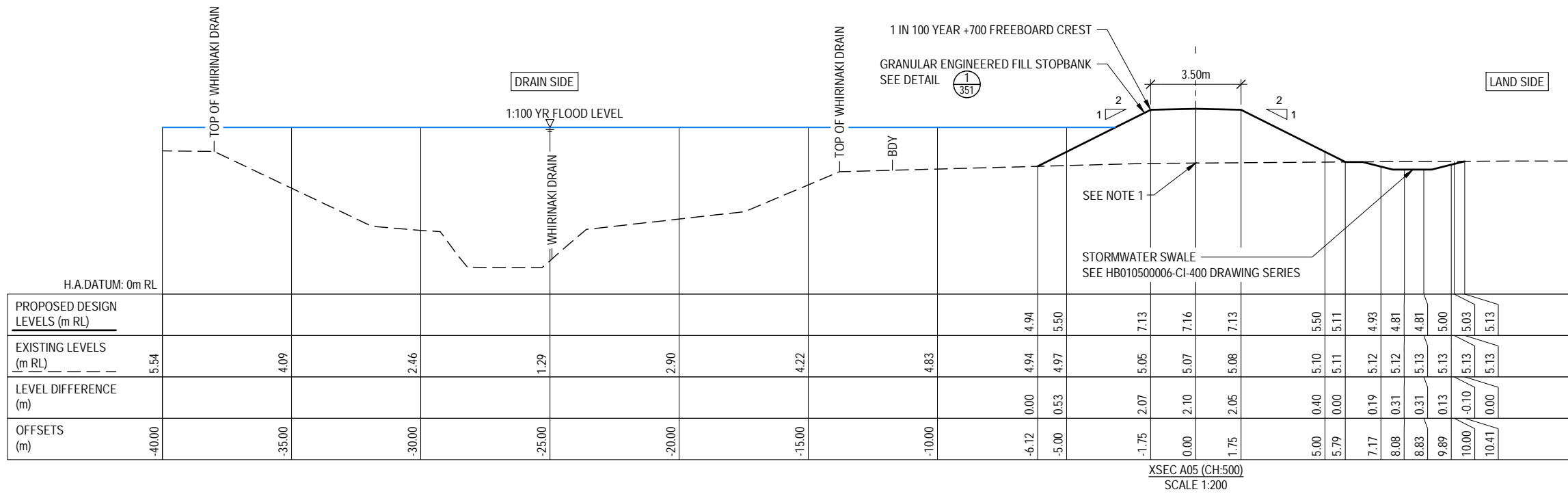
**ACE MEMBER**  
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CLIENT: <b>HAWKES BAY REGIONAL COUNCIL</b>			
PROJECT: <b>WHIRINAKI STOPBANK</b>			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

PROPOSED WHIRINAKI STOPBANK (LoS 100-YEAR) CROSS SECTION (SHEET 1 of 6)		
SCALE: AS SHOWN (A3)	DRAWING NO. : HB010500006-CI-301	REV : A



- NOTES**
1. STOPBANK FOOTPRINT TO BE CLEARED OF ALL VEGETATION AND TOPSOIL REMOVED TO STOCKPILE AREA TO BE TO BE COMPACTED IN-SITU IN PREPARATION FOR EARTH FILL FOR STOPBANK.
  2. ALL EARTHWORKS TO BE COMPACTED TO 95% STANDARD NZ COMPACTION (HEAVY).
  3. ALL EARTHWORKS TO BE OVERFILLED, COMPACTED AND TRIMMED BACK TO DIMENSIONS GIVEN ON THE DRAWINGS.
  4. ALL EARTHWORKS VOLUMES TO BE MEASURED TO DIMENSIONS ON DRAWINGS.
  5. CADASTRAL INFORMATION AS AT 01/04/2024 DATE OF LINZ PROPERTY UPDATE.



**PRELIMINARY ISSUE**

ORIGINAL DRAWING IN COLOUR

NO.	REVISION	DATE	APP.
A	PRELIMINARY ISSUE	AUG 25	

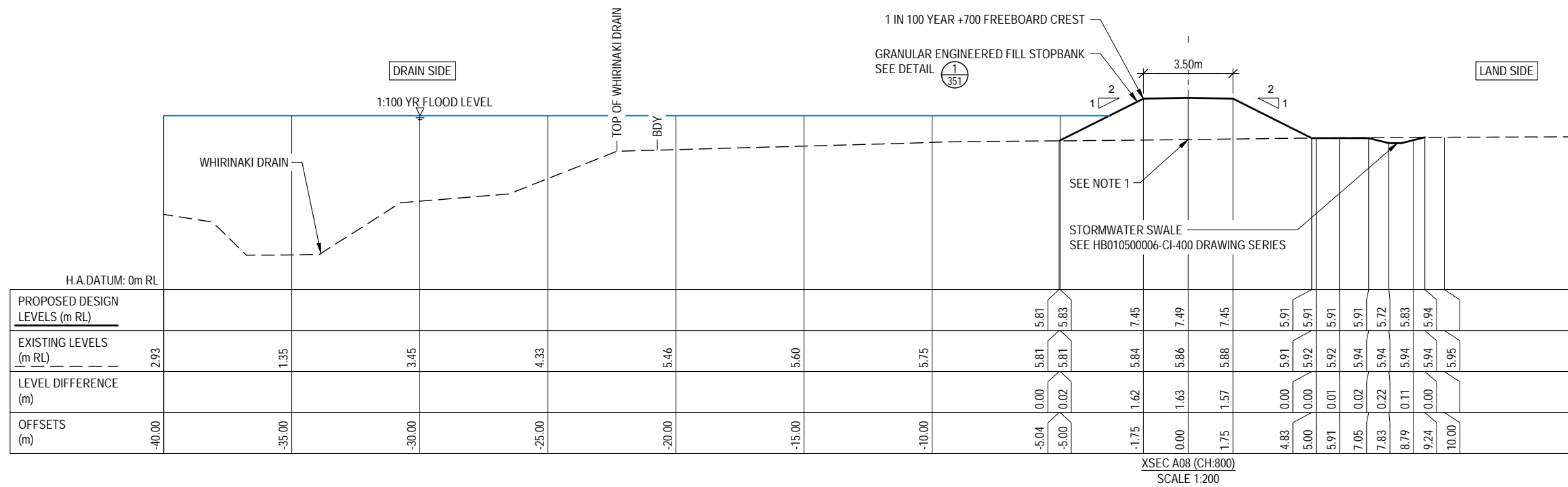
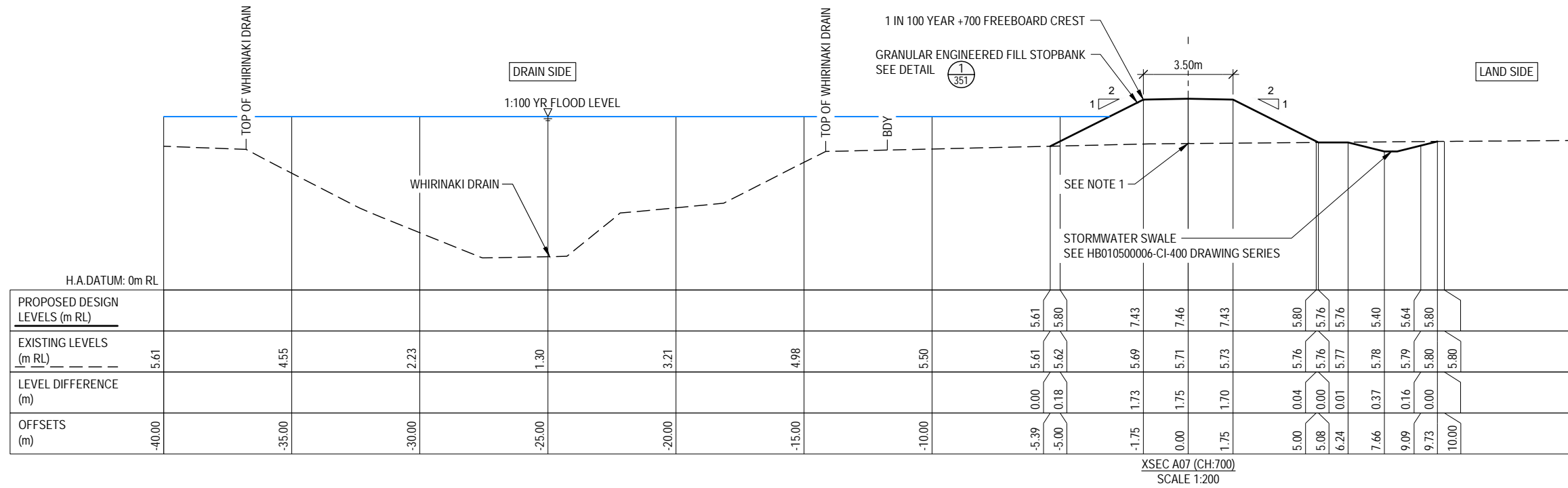


**ACE MEMBER**

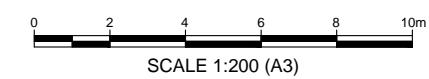
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CLIENT: <b>HAWKES BAY REGIONAL COUNCIL</b>			
PROJECT: <b>WHIRINAKI STOPBANK</b>			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

PROPOSED WHIRINAKI STOPBANK (LoS 100-YEAR) CROSS SECTION (SHEET 3 of 6)		
SCALE:	DRAWING NO.:	REV.:
AS SHOWN (A3)	HB010500006-CI-303	A



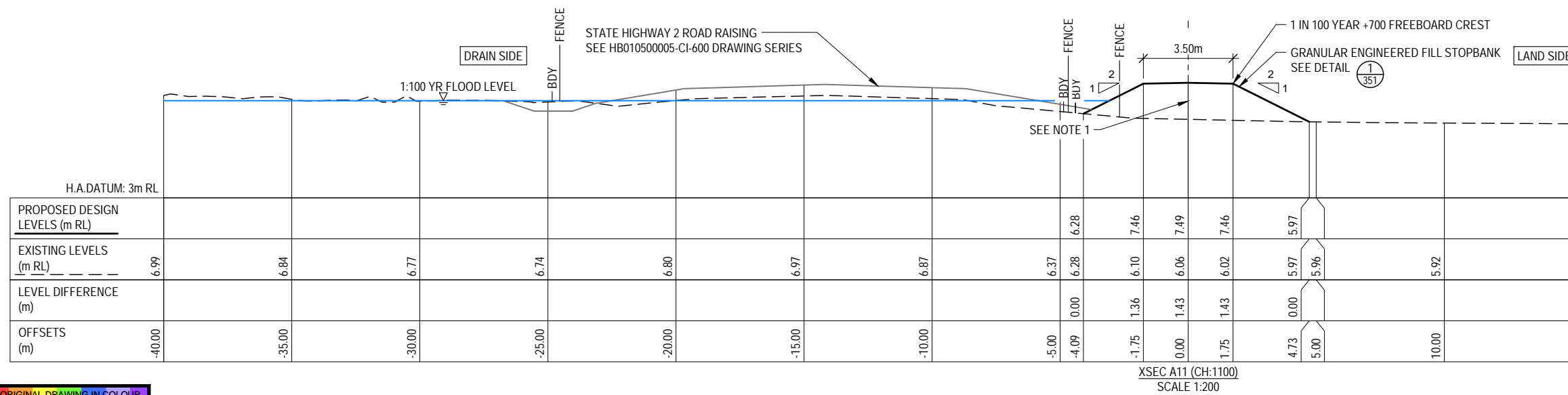
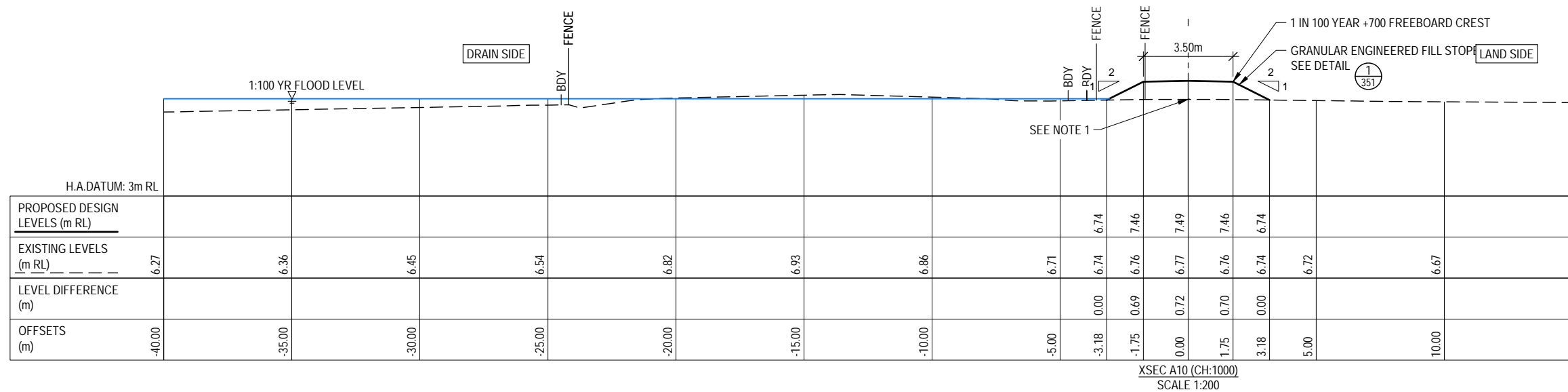
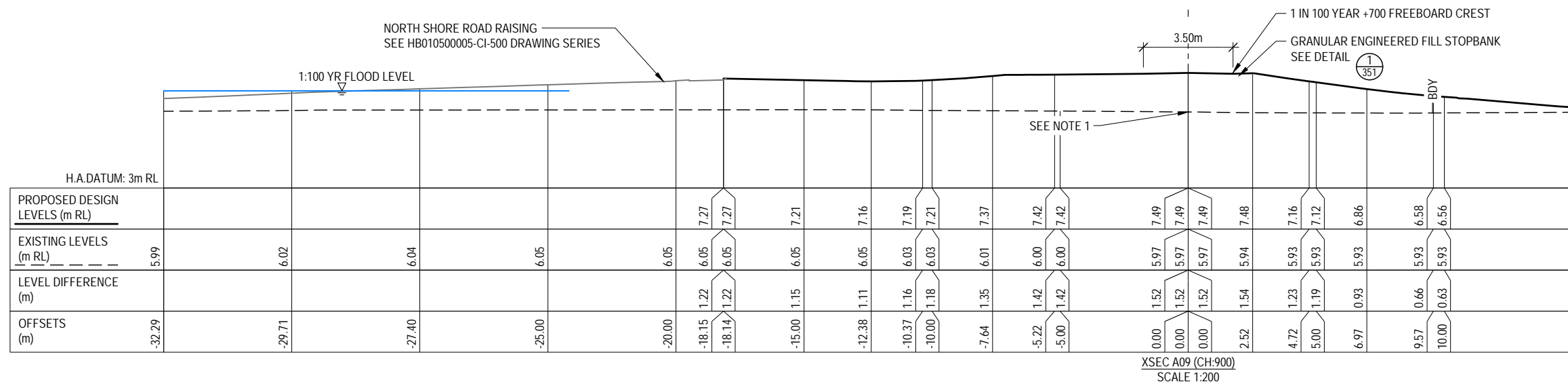
- NOTES**
1. STOPBANK FOOTPRINT TO BE CLEARED OF ALL VEGETATION AND TOPSOIL REMOVED TO STOCKPILE AREA TO BE TO BE COMPACTED IN-SITU IN PREPARATION FOR EARTH FILL FOR STOPBANK.
  2. ALL EARTHWORKS TO BE COMPACTED TO 95% STANDARD NZ COMPACTION (HEAVY).
  3. ALL EARTHWORKS TO BE OVERFILLED, COMPACTED AND TRIMMED BACK TO DIMENSIONS GIVEN ON THE DRAWINGS.
  4. ALL EARTHWORKS VOLUMES TO BE MEASURED TO DIMENSIONS ON DRAWINGS.
  5. CADASTRAL INFORMATION AS AT 01/04/2024 DATE OF LINZ PROPERTY UPDATE.



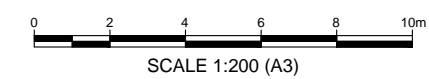
**PRELIMINARY ISSUE**

ORIGINAL DRAWING IN COLOUR

<p><b>HAWKES BAY REGIONAL COUNCIL</b> TE KAUNIHĒRA Ā-ROHE O TE MATAU-A-MĀUI</p>	<p><b>PDP</b> PATTLE DELAMORE PARTNERS</p>	<p><b>ACE MEMBER</b></p>	<p>CLIENT: <b>HAWKES BAY REGIONAL COUNCIL</b></p> <p>PROJECT: <b>WHIRINAKI STOPBANK</b></p>				<p><b>PROPOSED WHIRINAKI STOPBANK (LoS 100-YEAR) CROSS SECTION (SHEET 4 of 6)</b></p>		
			THIS DRAWING REMAINS THE PROPERTY OF PATTLE DELAMORE PARTNERS LTD AND MAY NOT BE REPRODUCED OR ALTERED WITHOUT WRITTEN PERMISSION. NO LIABILITY SHALL BE ACCEPTED FOR UNAUTHORIZED USE OF THE DRAWINGS	DESIGNED T.C DRAWN D.F.P	DESIGN REVIEW P.C DRAWING CHECK	DATE JULY 25 DATE JULY 25	APPROVED THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED	DATE	SCALE: AS SHOWN (A3)



- NOTES**
1. STOPBANK FOOTPRINT TO BE CLEARED OF ALL VEGETATION AND TOPSOIL REMOVED TO STOCKPILE AREA TO BE TO BE COMPACTED IN-SITU IN PREPARATION FOR EARTH FILL FOR STOPBANK.
  2. ALL EARTHWORKS TO BE COMPACTED TO 95% STANDARD NZ COMPACTION (HEAVY).
  3. ALL EARTHWORKS TO BE OVERFILLED, COMPACTED AND TRIMMED BACK TO DIMENSIONS GIVEN ON THE DRAWINGS.
  4. ALL EARTHWORKS VOLUMES TO BE MEASURED TO DIMENSIONS ON DRAWINGS.
  5. CADASTRAL INFORMATION AS AT 01/04/2024 DATE OF LINZ PROPERTY UPDATE.



**PRELIMINARY ISSUE**

ORIGINAL DRAWING IN COLOUR

NO.	REVISION	DATE	APP.
A	PRELIMINARY ISSUE	AUG 25	



**ACE MEMBER**

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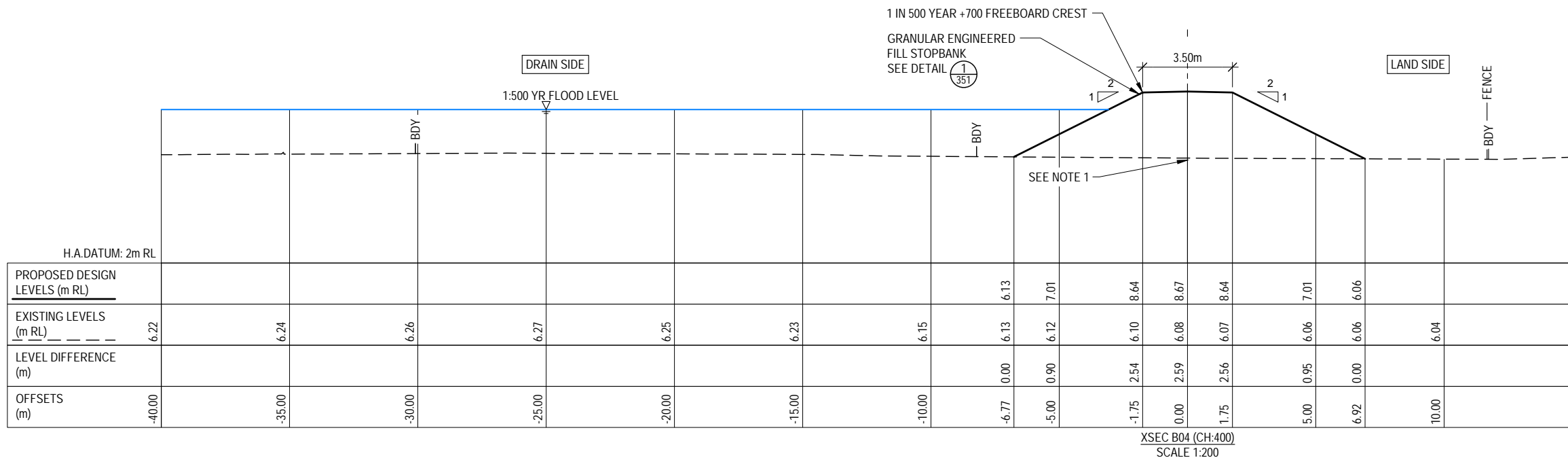
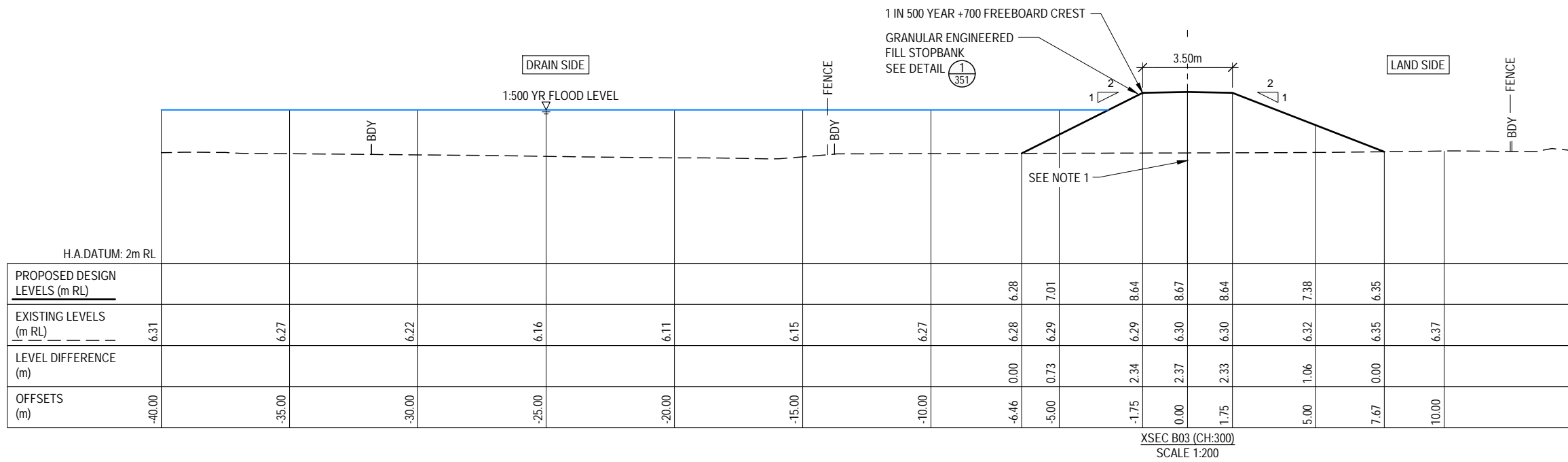
CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C.	DESIGN REVIEW P.C.	DATE JULY 25	APPROVED
DRAWN D.F.P.	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

PROPOSED WHIRINAKI STOPBANK (LoS 100-YEAR) CROSS SECTION (SHEET 5 of 6)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-305	REV: A





- NOTES**
1. STOPBANK FOOTPRINT TO BE CLEARED OF ALL VEGETATION AND TOPSOIL REMOVED TO STOCKPILE AREA TO BE TO BE COMPACTED IN-SITU IN PREPARATION FOR EARTH FILL FOR STOPBANK.
  2. ALL EARTHWORKS TO BE COMPACTED TO 95% STANDARD NZ COMPACTION (HEAVY).
  3. ALL EARTHWORKS TO BE OVERFILLED, COMPACTED AND TRIMMED BACK TO DIMENSIONS GIVEN ON THE DRAWINGS.
  4. ALL EARTHWORKS VOLUMES TO BE MEASURED TO DIMENSIONS ON DRAWINGS.
  5. CADASTRAL INFORMATION AS AT 01/04/2024 DATE OF LINZ PROPERTY UPDATE.



**PRELIMINARY ISSUE**

ORIGINAL DRAWING IN COLOUR



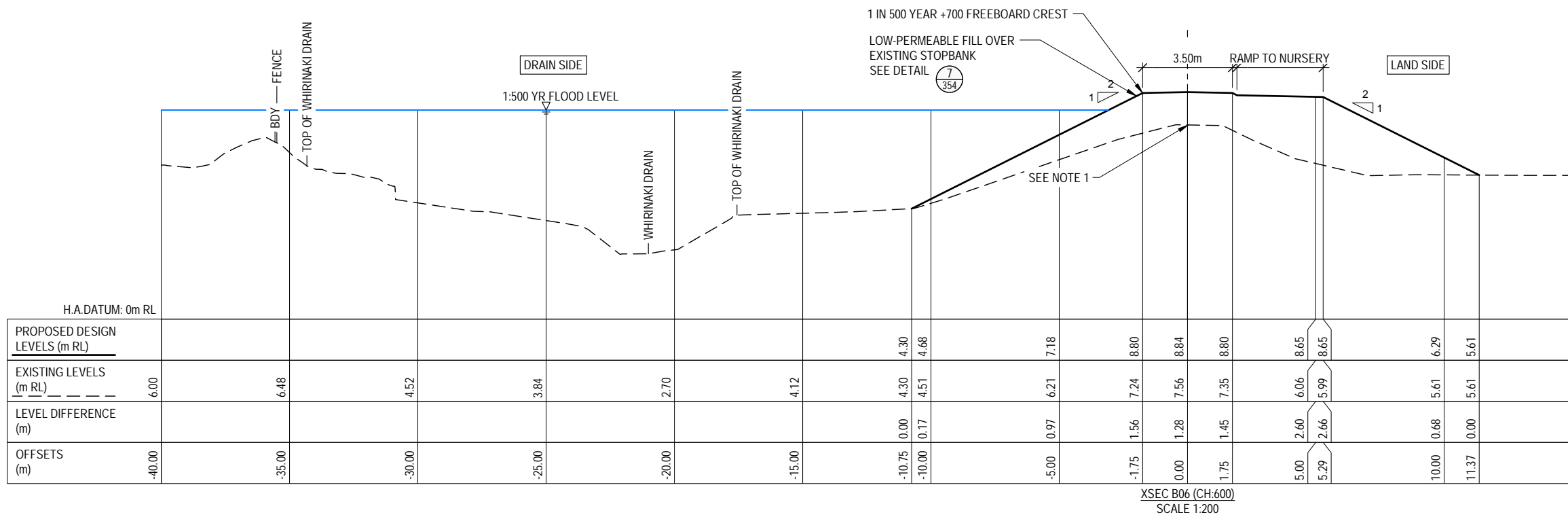
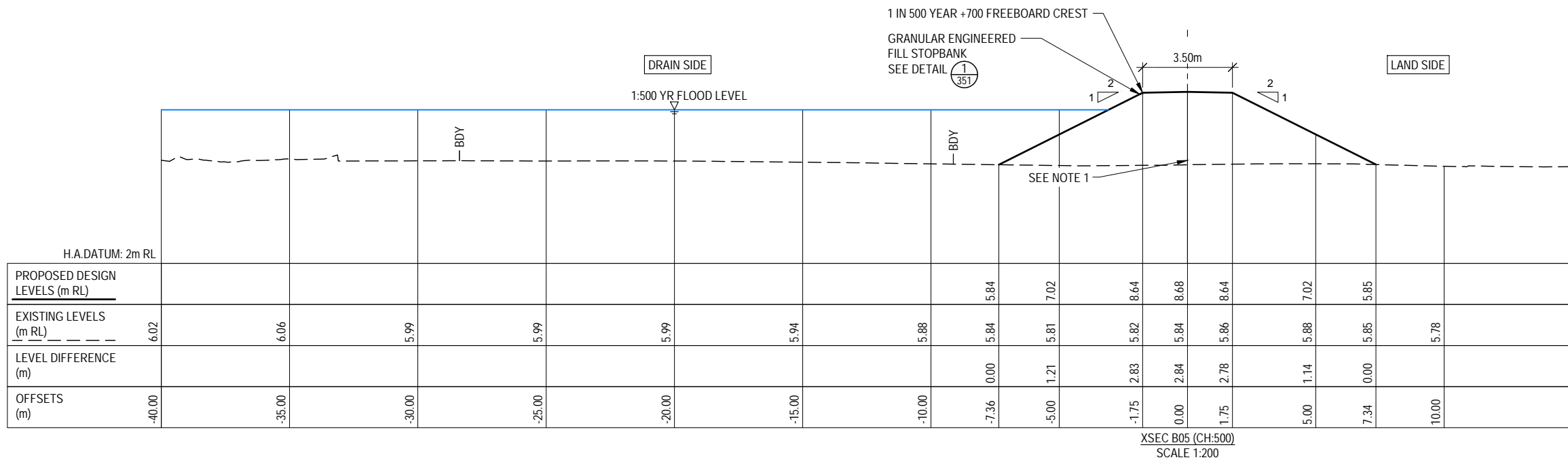
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CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

PROPOSED PAN PAC STOPBANK (LoS 500YEAR) CROSS SECTION (SHEET 2 of 8)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-312	REV: A

- NOTES**
1. STOPBANK FOOTPRINT TO BE CLEARED OF ALL VEGETATION AND TOPSOIL REMOVED TO STOCKPILE AREA TO BE TO BE COMPACTED IN-SITU IN PREPARATION FOR EARTH FILL FOR STOPBANK.
  2. ALL EARTHWORKS TO BE COMPACTED TO 95% STANDARD NZ COMPACTION (HEAVY).
  3. ALL EARTHWORKS TO BE OVERFILLED, COMPACTED AND TRIMMED BACK TO DIMENSIONS GIVEN ON THE DRAWINGS.
  4. ALL EARTHWORKS VOLUMES TO BE MEASURED TO DIMENSIONS ON DRAWINGS.
  5. CADASTRAL INFORMATION AS AT 01/04/2024 DATE OF LINZ PROPERTY UPDATE.

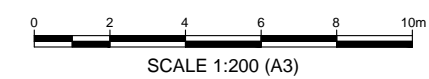
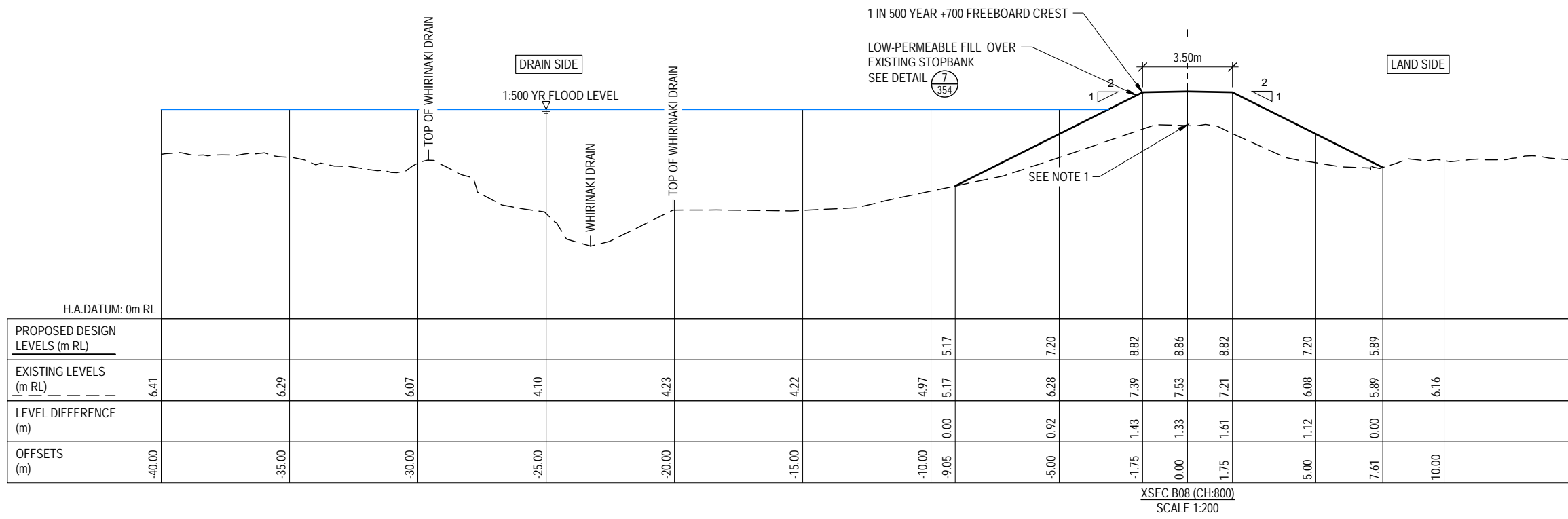
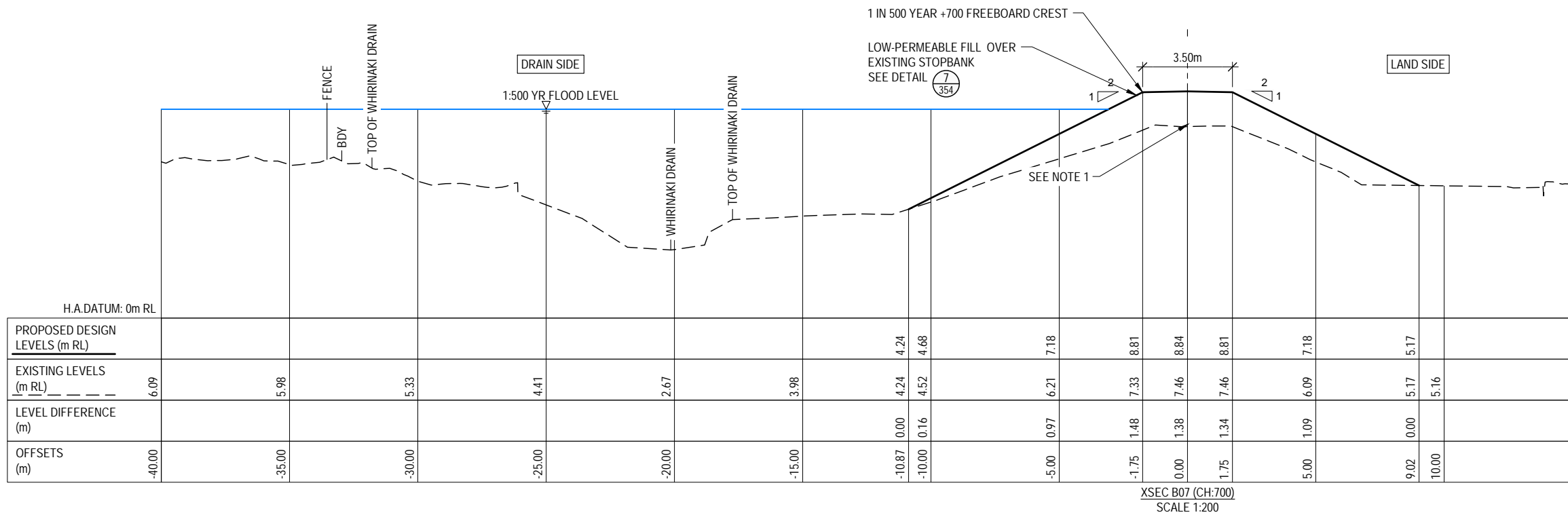


**PRELIMINARY ISSUE**

ORIGINAL DRAWING IN COLOUR

						CLIENT: HAWKES BAY REGIONAL COUNCIL PROJECT: WHIRINAKI STOPBANK				PROPOSED PAN PAC STOPBANK (LoS 500YEAR) CROSS SECTION (SHEET 3 of 8)			
THIS DRAWING REMAINS THE PROPERTY OF PATTLE DELAMORE PARTNERS LTD AND MAY NOT BE REPRODUCED OR ALTERED WITHOUT WRITTEN PERMISSION. NO LIABILITY SHALL BE ACCEPTED FOR UNAUTHORIZED USE OF THE DRAWINGS		DESIGNED T.C. DRAWN D.F.P.		P.C. DRAWING CHECK		DATE JULY 25 DATE JULY 25		APPROVED DATE		SCALE: AS SHOWN (A3)		DRAWING NO.: HB010500006-CI-313	REV: A

- NOTES**
1. STOPBANK FOOTPRINT TO BE CLEARED OF ALL VEGETATION AND TOPSOIL REMOVED TO STOCKPILE AREA TO BE TO BE COMPACTED IN-SITU IN PREPARATION FOR EARTH FILL FOR STOPBANK.
  2. ALL EARTHWORKS TO BE COMPACTED TO 95% STANDARD NZ COMPACTION (HEAVY).
  3. ALL EARTHWORKS TO BE OVERFILLED, COMPACTED AND TRIMMED BACK TO DIMENSIONS GIVEN ON THE DRAWINGS.
  4. ALL EARTHWORKS VOLUMES TO BE MEASURED TO DIMENSIONS ON DRAWINGS.
  5. CADASTRAL INFORMATION AS AT 01/04/2024 DATE OF LINZ PROPERTY UPDATE.



**PRELIMINARY ISSUE**

ORIGINAL DRAWING IN COLOUR



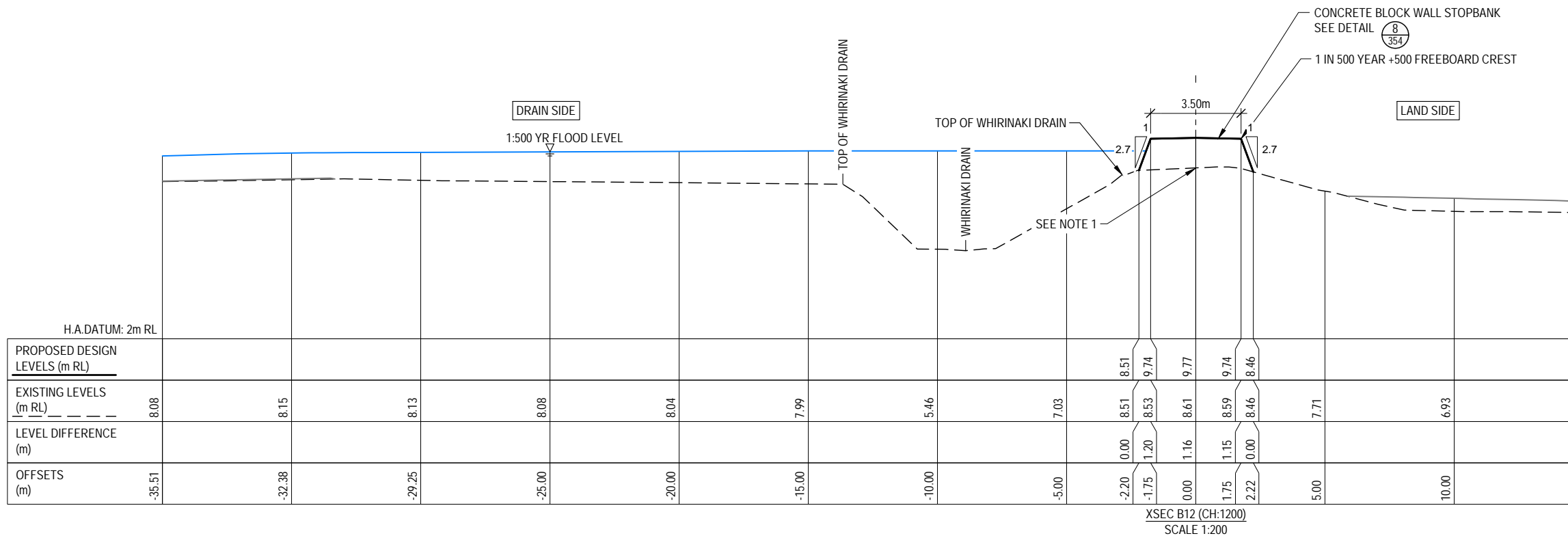
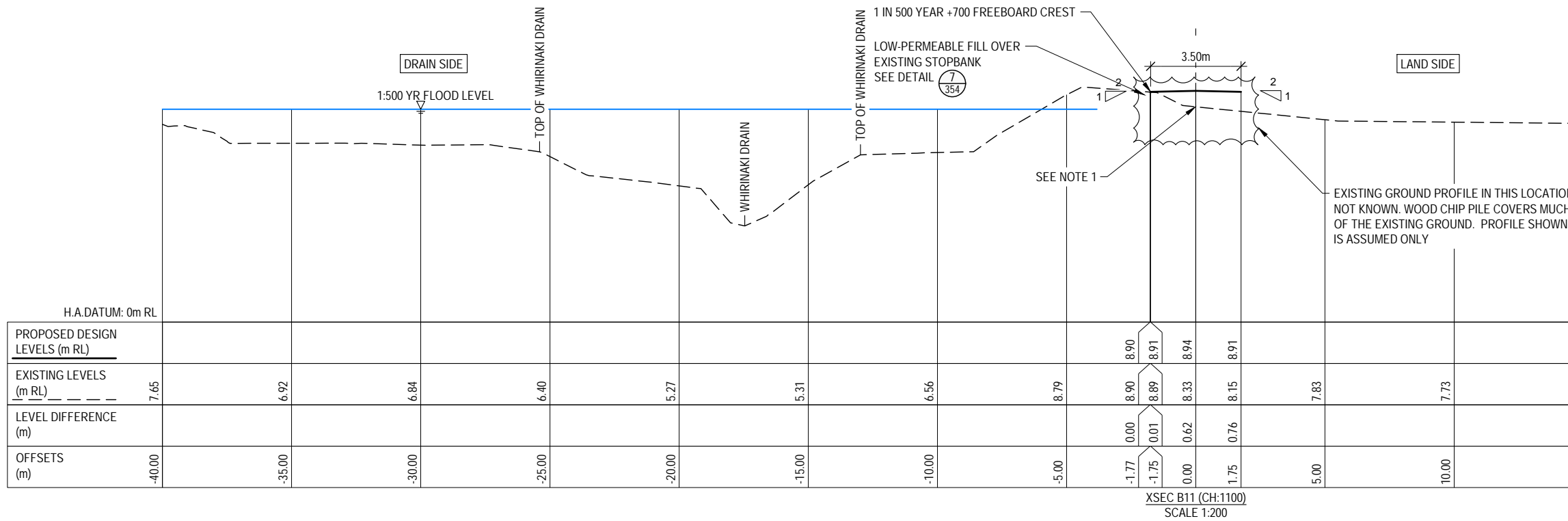
**ACE MEMBER**  
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CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

PROPOSED PAN PAC STOPBANK (LoS 500YEAR) CROSS SECTION (SHEET 4 of 8)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-314	REV: A



- NOTES**
1. STOPBANK FOOTPRINT TO BE CLEARED OF ALL VEGETATION AND TOPSOIL REMOVED TO STOCKPILE AREA TO BE TO BE COMPACTED IN-SITU IN PREPARATION FOR EARTH FILL FOR STOPBANK.
  2. ALL EARTHWORKS TO BE COMPACTED TO 95% STANDARD NZ COMPACTION (HEAVY).
  3. ALL EARTHWORKS TO BE OVERFILLED, COMPACTED AND TRIMMED BACK TO DIMENSIONS GIVEN ON THE DRAWINGS.
  4. ALL EARTHWORKS VOLUMES TO BE MEASURED TO DIMENSIONS ON DRAWINGS.
  5. CADASTRAL INFORMATION AS AT 01/04/2024 DATE OF LINZ PROPERTY UPDATE.



**PRELIMINARY ISSUE**

ORIGINAL DRAWING IN COLOUR

NO.	REVISION	DATE	APP.
A	PRELIMINARY ISSUE	AUG 25	



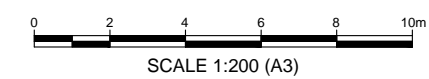
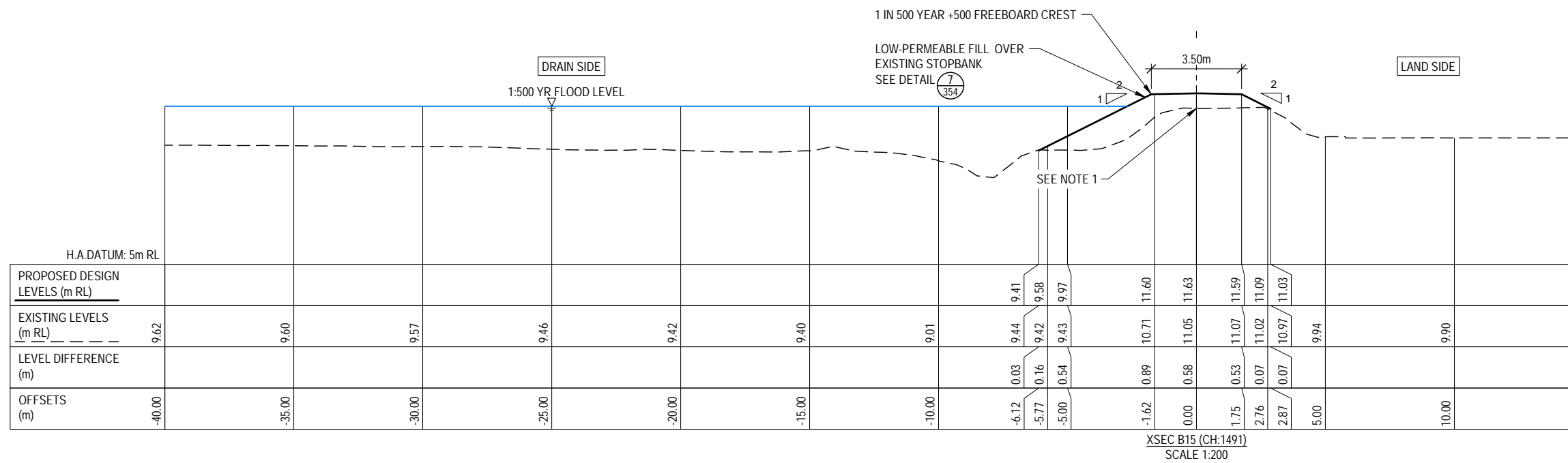
**ACE MEMBER**  
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CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

PROPOSED PAN PAC STOPBANK (LoS 500YEAR) CROSS SECTION (SHEET 6 of 8)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-316	REV: A



- NOTES**
1. STOPBANK FOOTPRINT TO BE CLEARED OF ALL VEGETATION AND TOPSOIL REMOVED TO STOCKPILE AREA TO BE TO BE COMPACTED IN-SITU IN PREPARATION FOR EARTH FILL FOR STOPBANK.
  2. ALL EARTHWORKS TO BE COMPACTED TO 95% STANDARD NZ COMPACTION (HEAVY).
  3. ALL EARTHWORKS TO BE OVERFILLED, COMPACTED AND TRIMMED BACK TO DIMENSIONS GIVEN ON THE DRAWINGS.
  4. ALL EARTHWORKS VOLUMES TO BE MEASURED TO DIMENSIONS ON DRAWINGS.
  5. CADASTRAL INFORMATION AS AT 01/04/2024 DATE OF LINZ PROPERTY UPDATE.

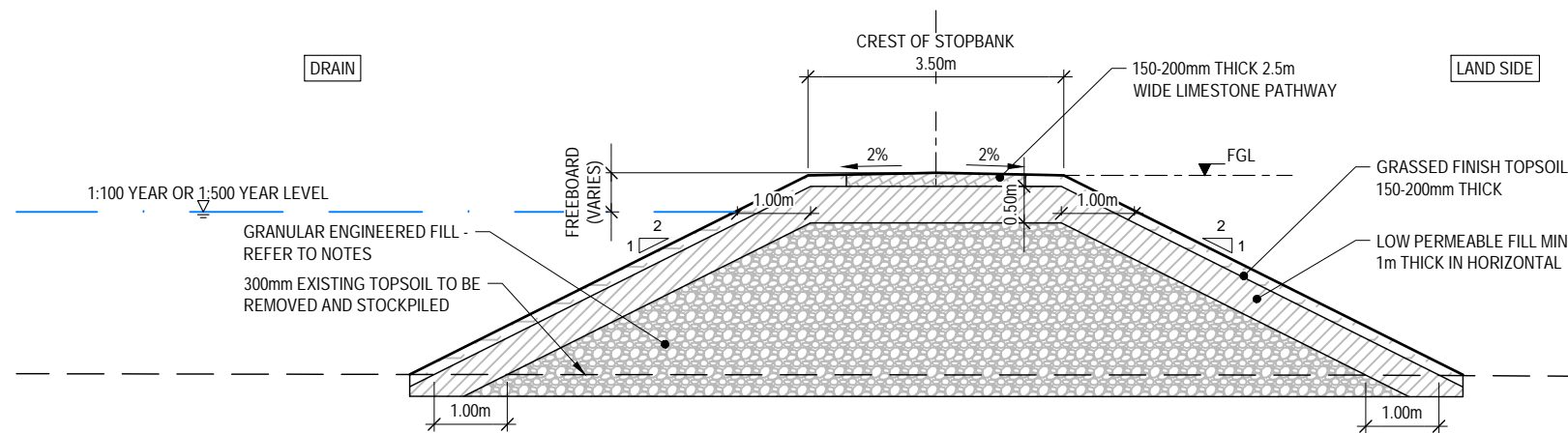


**PRELIMINARY ISSUE**

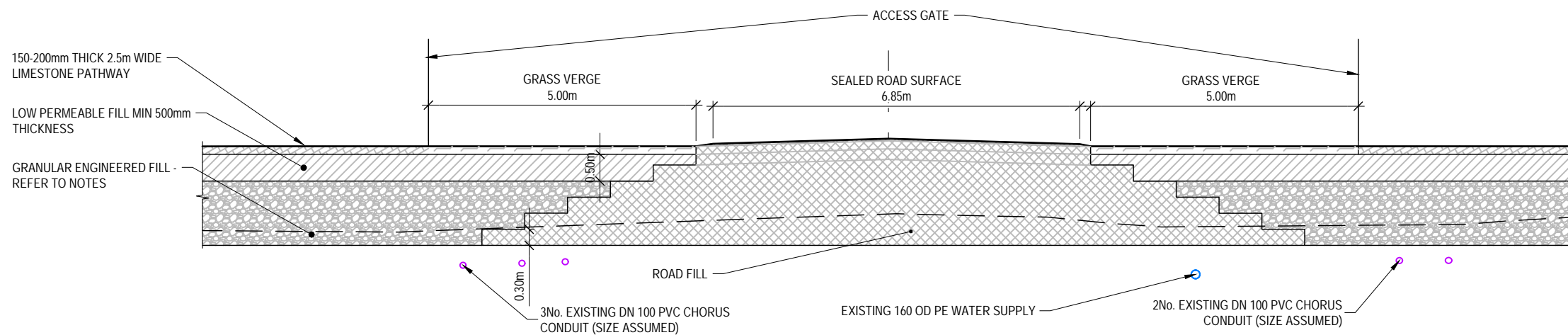
ORIGINAL DRAWING IN COLOUR

	 TE KAUNIHERA Ā-ROHE O TE MATAU-A-MĀUI		 THIS DRAWING REMAINS THE PROPERTY OF PATTLE DELAMORE PARTNERS LTD AND MAY NOT BE REPRODUCED OR ALTERED WITHOUT WRITTEN PERMISSION. NO LIABILITY SHALL BE ACCEPTED FOR UNAUTHORIZED USE OF THE DRAWINGS	CLIENT: HAWKES BAY REGIONAL COUNCIL PROJECT: WHIRINAKI STOPBANK	PROPOSED PAN PAC STOPBANK (LoS 500YEAR) CROSS SECTION (SHEET 8 of 8)
DESIGNED T.C	DESIGN REVIEW P.C	DATE JULY 25	APPROVED	DATE	SCALE :
DRAWN D.F.P	DRAWING CHECK	DATE JULY 25	THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED		DRAWING NO. :
NO. REVISION		DATE	APP.	AS SHOWN (A3)	HB010500006-CI-318
				REV :	A

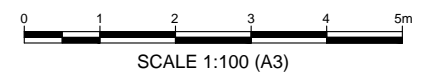
- NOTES:**
1. DIMENSIONS IN METRES UNLESS OTHERWISE SHOWN.
  2. LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.
  3. ALL EARTHWORKS VOLUMES TO BE MEASURED TO DIMENSIONS ON THE DRAWINGS.
  4. STOPBANK FOOTPATH TO BE CLEARED OF ALL VEGETATION AND TOPSOIL REMOVED TO STOCKPILE. AREA TO BE COMPACTED IN-SITU IN PREPARATION FOR EARTH FILL FOR STOPBANK.
  5. ALL FILL TO BE PLACED IN MAXIMUM 200mm LIFTS TO AT LEAST 95% OF MAXIMUM DRY DENSITY (HEAVY).
  6. ALL EARTHWORKS TO BE OVERFILLED, COMPACTED AND TRIMMED BACK TO DIMENSIONS GIVEN ON THE DRAWINGS.
  7. COMPACTED SURFACE TO BE SCARIFIED AFTER APPROVAL OF THE TEST RESULTS BEFORE THE NEXT LAYER IS APPLIED.
  8. TOPSOIL SHALL ONLY BE USED AS BACKFILL WITHIN 200mm OF THE SURFACE TO HELP REINSTATE VEGETATION WHERE REQUIRED.
  9. COMPACTED LIMESTONE PATHWAY 2.5m WIDE WITH NOMINAL DEPTH OF 250mm FORMED BY PLACING COMPACTED 100mm OF LIMESTONE ON 150mm GAP40 CRUSHED AGGREGATE BASE COURSE. LIMESTONE TO BE WETTED AND ROLLED WITH AT LEAST A DOUBLE VIBRATING DRUM ROLLER TO ACHIEVE A SMOOTH COMPACTED SURFACE WITH A 2% CAMBER FALL.



GRANULAR ENGINEERED FILL TYPICAL DETAIL 1 -  
SCALE 1:100 201 202



NORTH SHORE ROAD CROSSING TYPICAL DETAIL 2  
SCALE 1:100 201



PRELIMINARY ISSUE

ORIGINAL DRAWING IN COLOUR



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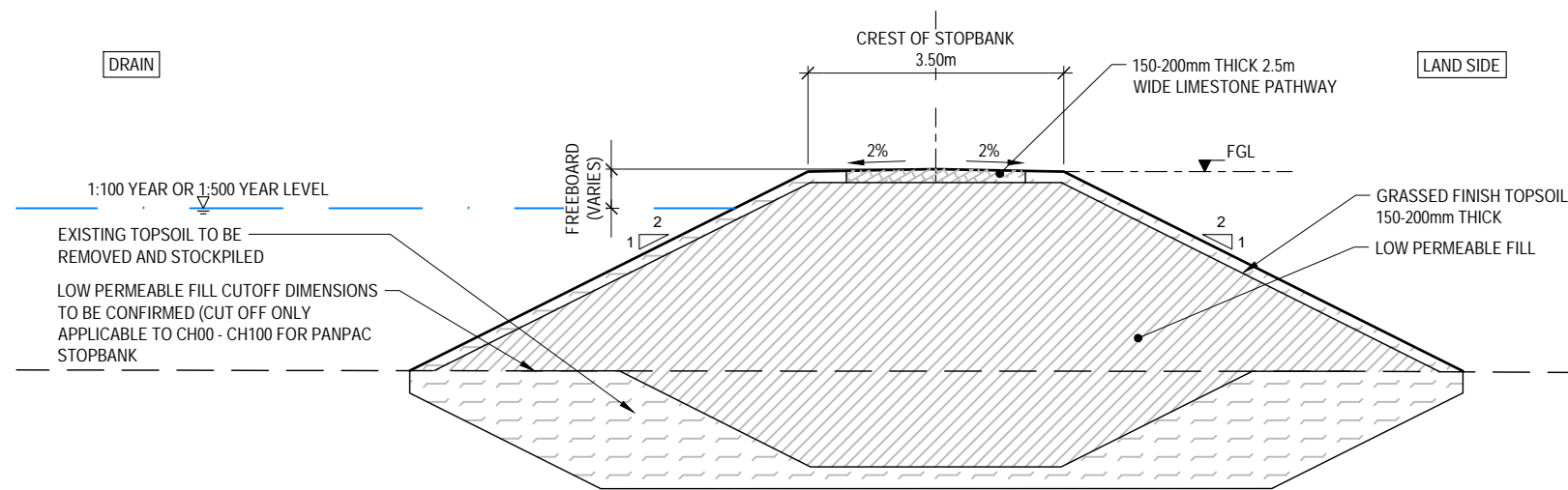
CLIENT: HAWKES BAY REGIONAL COUNCIL

PROJECT: WHIRINAKI STOPBANK

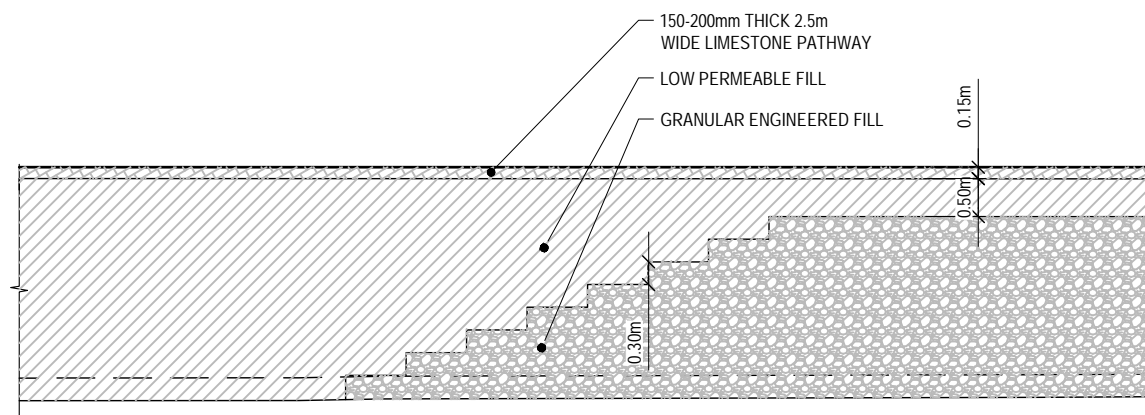
DESIGNED A.G	DESIGN REVIEW P.C	DATE JULY 25	APPROVED	DATE
DRAWN C.P	DRAWING CHECK	DATE JULY 25	THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED	

TYPICAL CROSS SECTION (SHEET 1 of 4)

SCALE :	DRAWING NO. :	REV :
AS SHOWN (A3)	HB010500006-CI-351	A

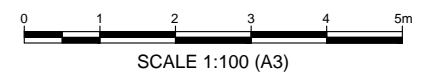


LOW PERMEABLE FILL STOPBANK TYPICAL DETAIL 3 - 201 202  
SCALE 1:100



LOW PERMEABLE FILL TO GRANULAR ENGINEERED FILL TIE-IN TYPICAL DETAIL 4 202  
SCALE 1:100

- NOTES:**
- DIMENSIONS IN METRES UNLESS OTHERWISE SHOWN.
  - LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.
  - ALL EARTHWORKS VOLUMES TO BE MEASURED TO DIMENSIONS ON THE DRAWINGS.
  - STOPBANK FOOTPATH TO BE CLEARED OF ALL VEGETATION AND TOPSOIL REMOVED TO STOCKPILE. AREA TO BE COMPACTED IN-SITU IN PREPARATION FOR EARTH FILL FOR STOPBANK.
  - ALL FILL TO BE PLACED IN MAXIMUM 200mm LIFTS TO AT LEAST 95% OF MAXIMUM DRY DENSITY (HEAVY).
  - ALL EARTHWORKS TO BE OVERFILLED, COMPACTED AND TRIMMED BACK TO DIMENSIONS GIVEN ON THE DRAWINGS.
  - COMPACTED SURFACE TO BE SCARIFIED AFTER APPROVAL OF THE TEST RESULTS BEFORE THE NEXT LAYER IS APPLIED.
  - TOPSOIL SHALL ONLY BE USED AS BACKFILL WITHIN 200mm OF THE SURFACE TO HELP REINSTATE VEGETATION WHERE REQUIRED.
  - COMPACTED LIMESTONE PATHWAY 2.5m WIDE WITH NOMINAL DEPTH OF 250mm FORMED BY PLACING COMPACTED 100mm OF LIMESTONE ON 150mm GAP40 CRUSHED AGGREGATE BASE COURSE. LIMESTONE TO BE WETTED AND ROLLED WITH AT LEAST A DOUBLE VIBRATING DRUM ROLLER TO ACHIEVE A SMOOTH COMPACTED SURFACE WITH A 2% CAMBER FALL.



PRELIMINARY ISSUE

ORIGINAL DRAWING IN COLOUR

NO.	REVISION	DATE	APP.
A	PRELIMINARY ISSUE	AUG 25	

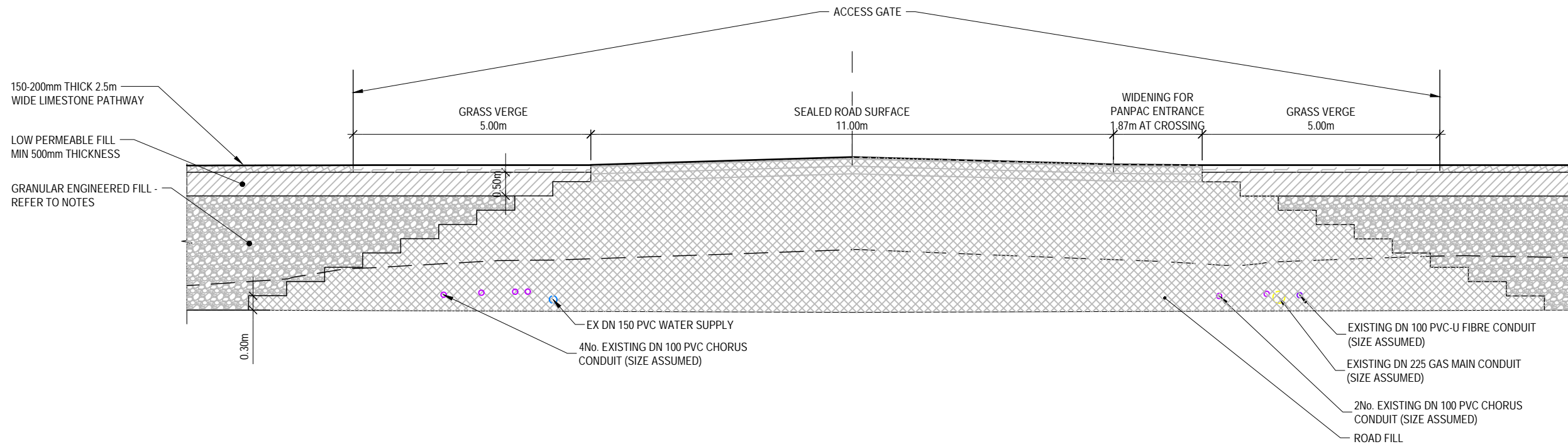


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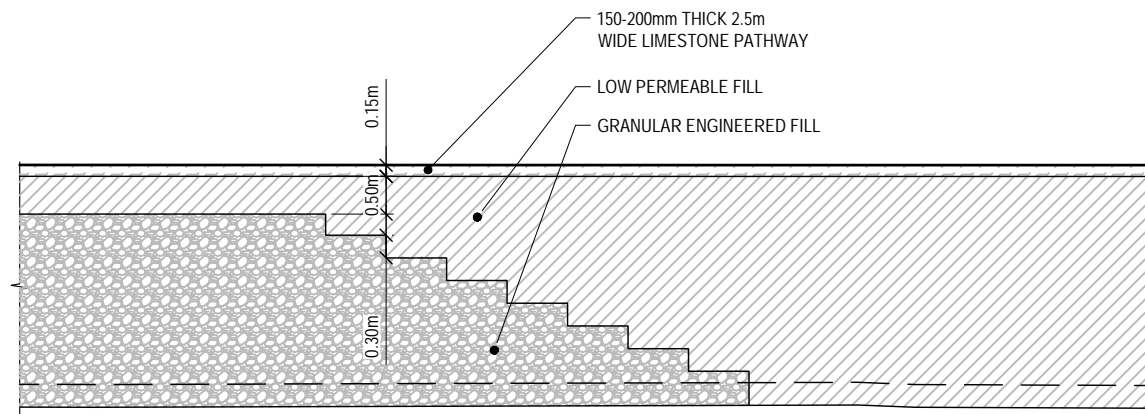
CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED A,G	DESIGN REVIEW P,C	DATE JULY 25	APPROVED
DRAWN C,P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

TYPICAL CROSS SECTION (SHEET 2 of 4)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-352	REV: A



HIGHWAY 2 CROSSING TYPICAL DETAIL 5 -  
SCALE 1:100 201 202

- NOTES:
1. DIMENSIONS IN METRES UNLESS OTHERWISE SHOWN.
  2. LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.
  3. ALL EARTHWORKS VOLUMES TO BE MEASURED TO DIMENSIONS ON THE DRAWINGS.
  4. STOPBANK FOOTPATH TO BE CLEARED OF ALL VEGETATION AND TOPSOIL REMOVED TO STOCKPILE. AREA TO BE COMPACTED IN-SITU IN PREPARATION FOR EARTH FILL FOR STOPBANK.
  5. ALL FILL TO BE PLACED IN MAXIMUM 200mm LIFTS TO AT LEAST 95% OF MAXIMUM DRY DENSITY (HEAVY).
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  8. TOPSOIL SHALL ONLY BE USED AS BACKFILL WITHIN 200mm OF THE SURFACE TO HELP REINSTATE VEGETATION WHERE REQUIRED.
  9. COMPACTED LIMESTONE PATHWAY 2.5m WIDE WITH NOMINAL DEPTH OF 250mm FORMED BY PLACING COMPACTED 100mm OF LIMESTONE ON 150mm GAP40 CRUSHED AGGREGATE BASE COURSE. LIMESTONE TO BE WETTED AND ROLLED WITH AT LEAST A DOUBLE VIBRATING DRUM ROLLER TO ACHIEVE A SMOOTH COMPACTED SURFACE WITH A 2% CAMBER FALL.



GRANULAR ENGINEERED FILL TO LOW PERMEABLE FILL TIE-IN TYPICAL DETAIL 6  
SCALE 1:100 202



PRELIMINARY ISSUE

ORIGINAL DRAWING IN COLOUR

A	PRELIMINARY ISSUE	AUG 25	
NO.	REVISION	DATE	APP.

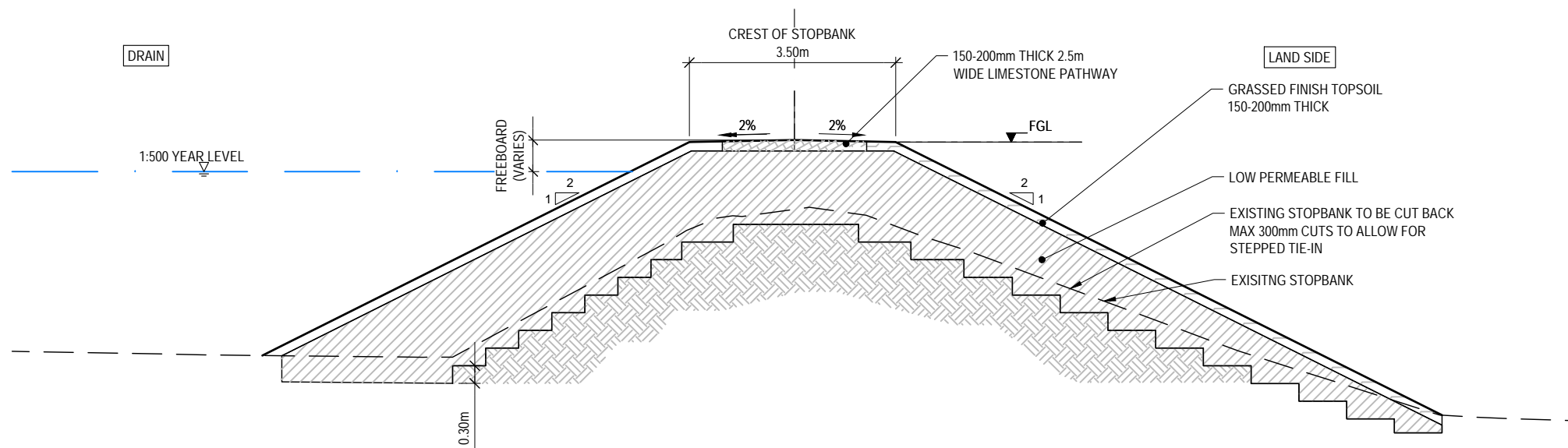


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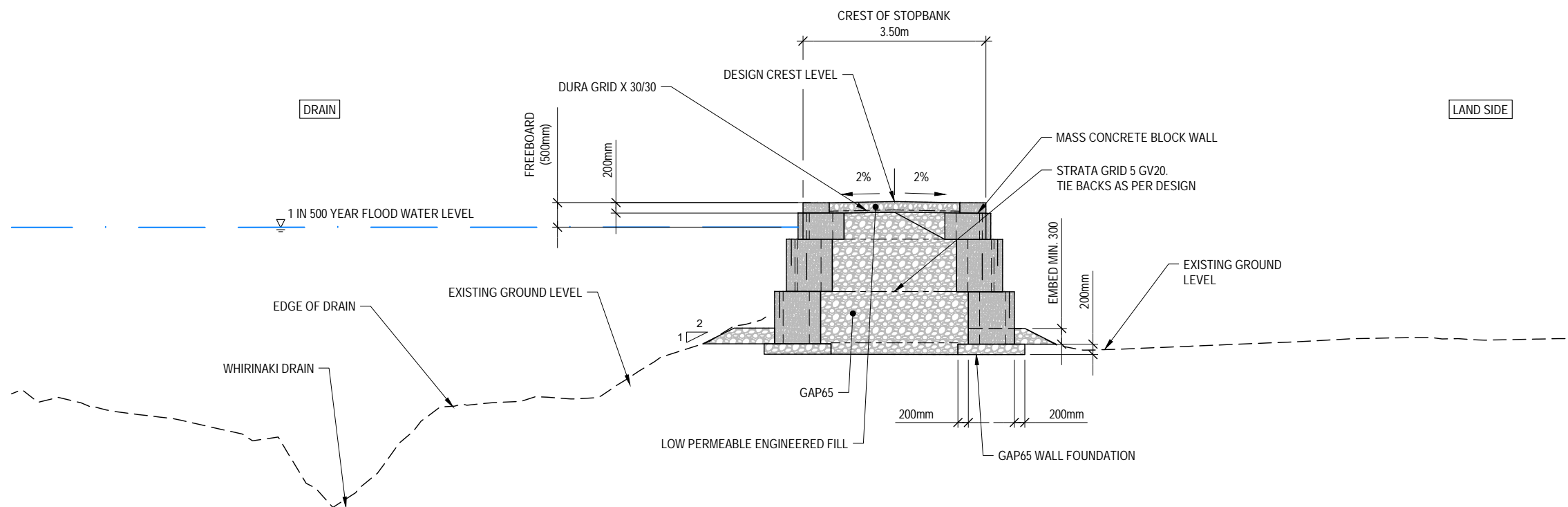
CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED A.G	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN C.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

TYPICAL CROSS SECTION (SHEET 3 of 4)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-353	REV: A



LOW PERMEABLE FILL OVER EXISTING STOPBANK TYPICAL DETAIL 7  
SCALE 1:100 202

- NOTES:
- DIMENSIONS IN METRES UNLESS OTHERWISE SHOWN.
  - LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.
  - ALL EARTHWORKS VOLUMES TO BE MEASURED TO DIMENSIONS ON THE DRAWINGS.
  - STOPBANK FOOTPATH TO BE CLEARED OF ALL VEGETATION AND TOPSOIL REMOVED TO STOCKPILE. AREA TO BE COMPACTED IN-SITU IN PREPARATION FOR EARTH FILL FOR STOPBANK.
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  - TOPSOIL SHALL ONLY BE USED AS BACKFILL WITHIN 200mm OF THE SURFACE TO HELP REINSTATE VEGETATION WHERE REQUIRED.
  - COMPACTED LIMESTONE PATHWAY 2.5m WIDE WITH NOMINAL DEPTH OF 250mm FORMED BY PLACING COMPACTED 100mm OF LIMESTONE ON 150mm GAP40 CRUSHED AGGREGATE BASE COURSE. LIMESTONE TO BE WETTED AND ROLLED WITH AT LEAST A DOUBLE VIBRATING DRUM ROLLER TO ACHIEVE A SMOOTH COMPACTED SURFACE WITH A 2% CAMBER FALL.



CONCRETE BLOCK WALL TYPICAL DETAIL 8  
SCALE 1:100 202



PRELIMINARY ISSUE

ORIGINAL DRAWING IN COLOUR

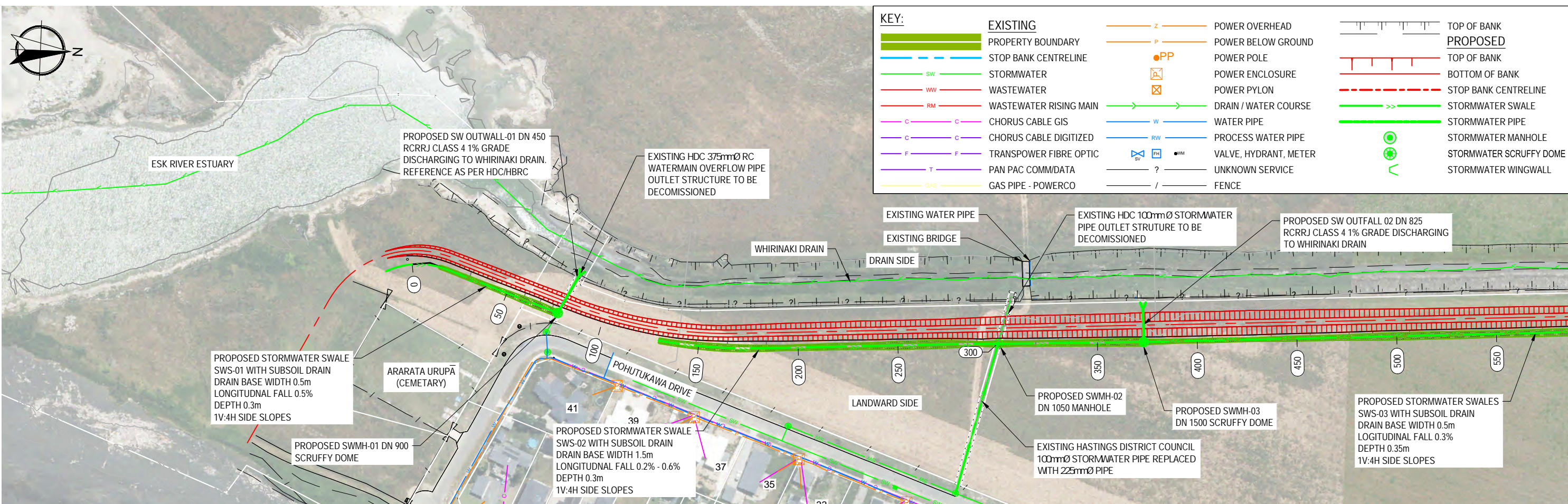


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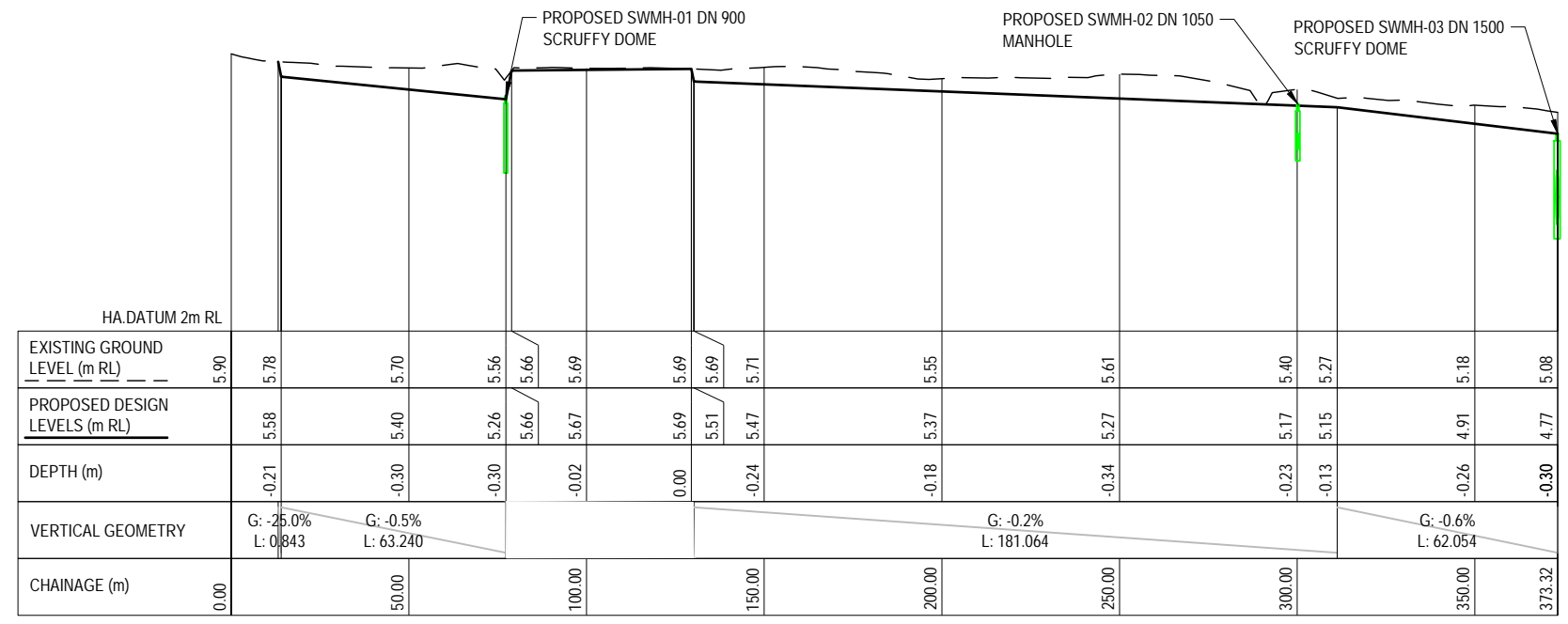
CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED A.G	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN C.P	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

TYPICAL CROSS SECTION (SHEET 4 of 4)		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-354	REV: A

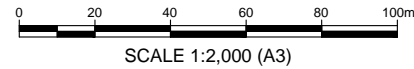


PROPOSED SWALE PLAN CH.00 TO CH.373  
SCALE 1: 2,000

- NOTES**
- REFER TO GENERAL NOTES.
  - DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
  - COORDINATES IN TERMS OF NZTM.
  - LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.
  - REFER TO HASTINGS DISTRICT COUNCIL STORMWATER STANDARD CONSTRUCTION DETAILS.
  - SWALES LESS THAN 1:200 SLOPE TO HAVE SUBSOIL DRAINS.
  - REFER TO TYPICAL DETAILS.



PROPOSED 1 IN 100 SWALE LONGSECTION CH.250 TO CH.500  
HORIZONTAL SCALE 1:2,000  
VERTICAL SCALE 1:100



**PRELIMINARY ISSUE**

ORIGINAL DRAWING IN COLOUR

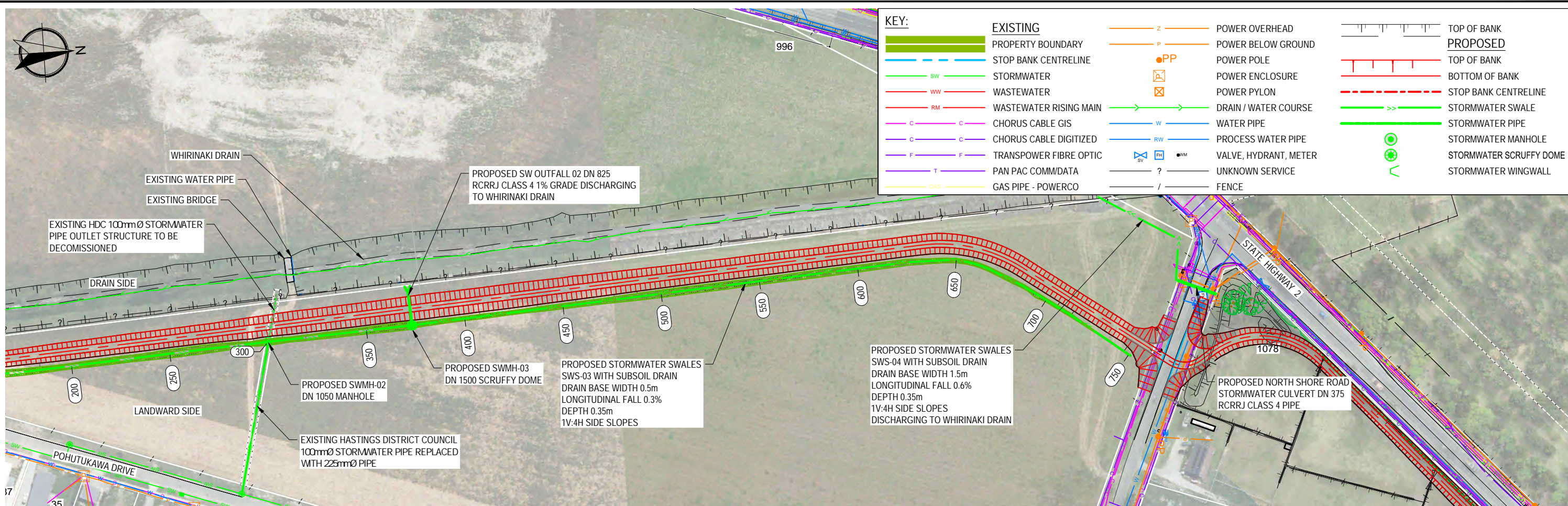
NO.	REVISION	DATE	APP.
A	PRELIMINARY ISSUE	AUG 25	



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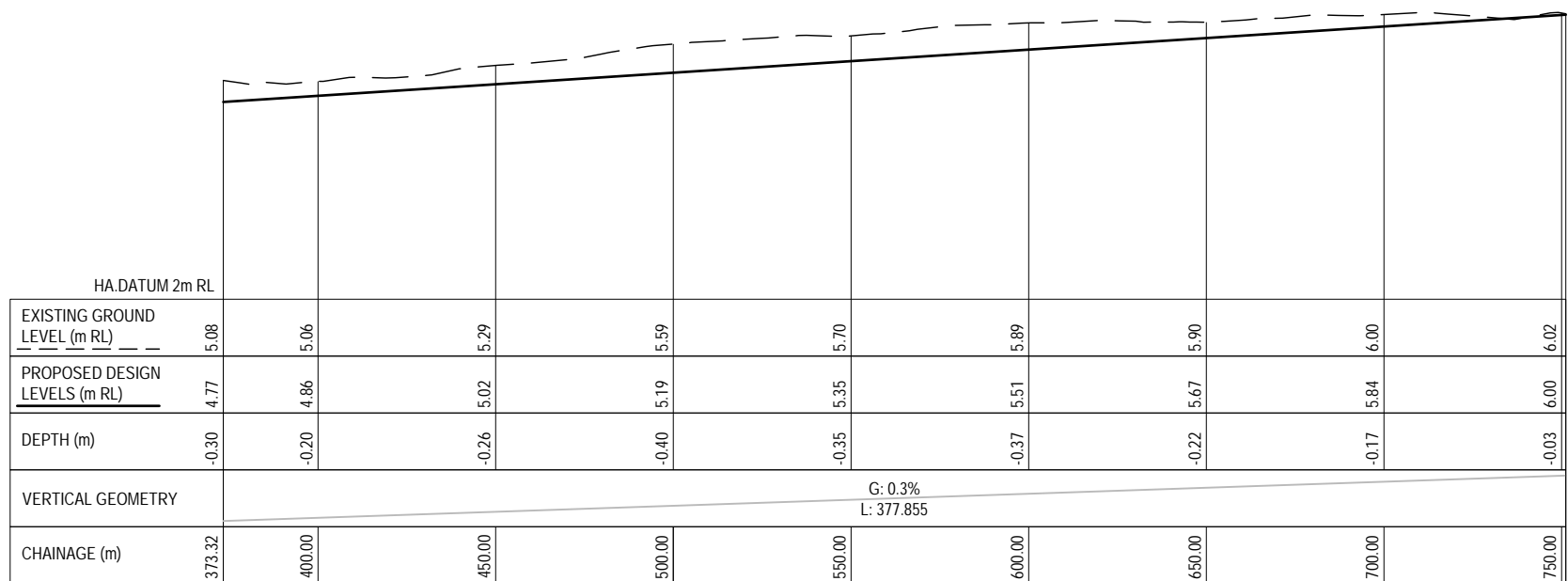
CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED A.G	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN A.E	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

PROPOSED SWALE LAYOUT PLAN SHEET 1		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-401	REV: A

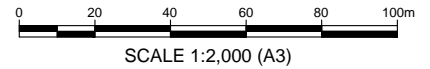


PROPOSED SWALE PLAN CH.373 TO CH.750  
SCALE 1: 2,000

- NOTES**
- REFER TO GENERAL NOTES.
  - DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
  - COORDINATES IN TERMS OF NZTM.
  - LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.
  - REFER TO HASTINGS DISTRICT COUNCIL STORMWATER STANDARD CONSTRUCTION DETAILS.
  - SWALES LESS THAN 1:200 SLOPE TO HAVE SUBSOIL DRAINS.
  - REFER TO TYPICAL DETAILS.



PROPOSED 1 IN 100 SWALE LONGSECTION CH.500 TO CH.750  
HORIZONTAL SCALE 1:2,000  
VERTICAL SCALE 1:100



**PRELIMINARY ISSUE**

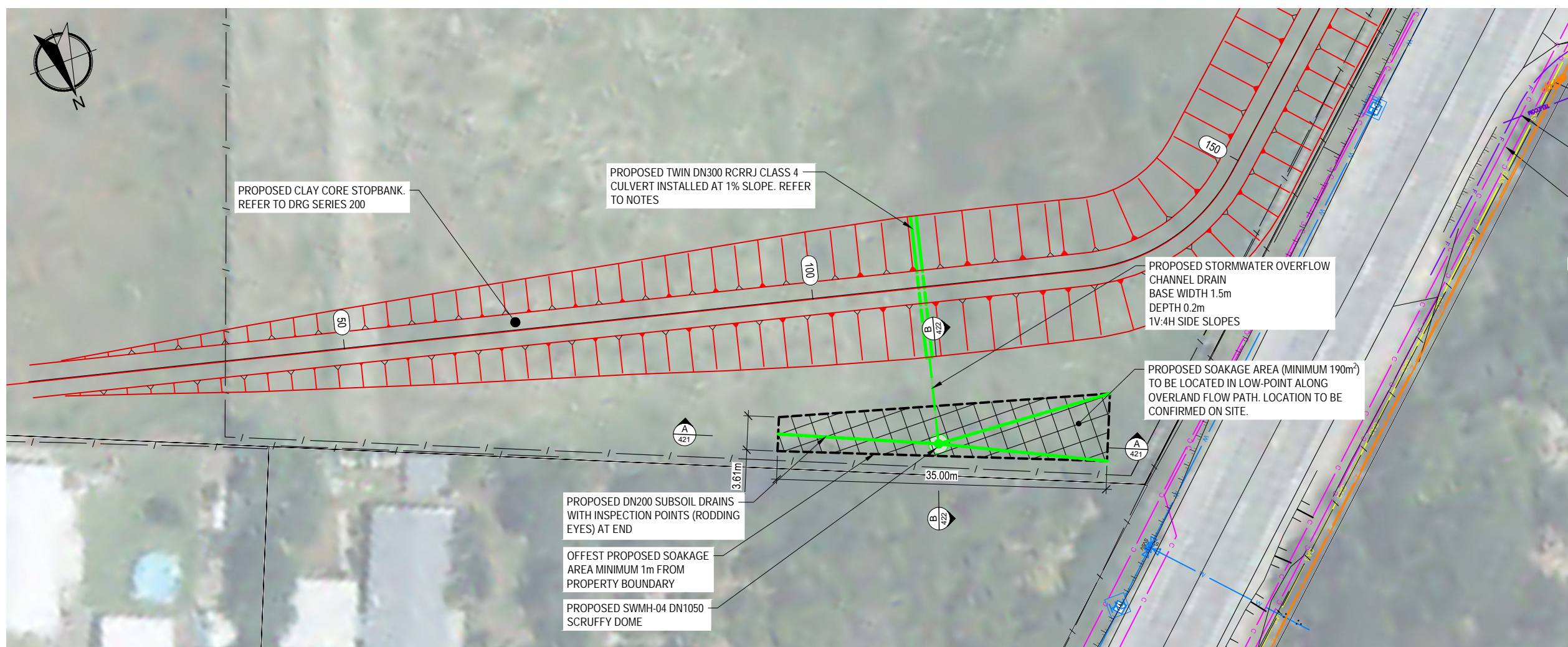
NO.	REVISION	DATE	APP.
A	PRELIMINARY ISSUE	AUG 25	



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CLIENT: <b>HAWKES BAY REGIONAL COUNCIL</b>			
PROJECT: <b>WHIRINAKI STOPBANK</b>			
DESIGNED A.G	DESIGN REVIEW P.C	DATE JULY 25	APPROVED
DRAWN A.E	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

PROPOSED SWALE LAYOUT PLAN SHEET 2		
SCALE: AS SHOWN (A3)	DRAWING NO.:	REV.:
	HB010500006-CI-402	A

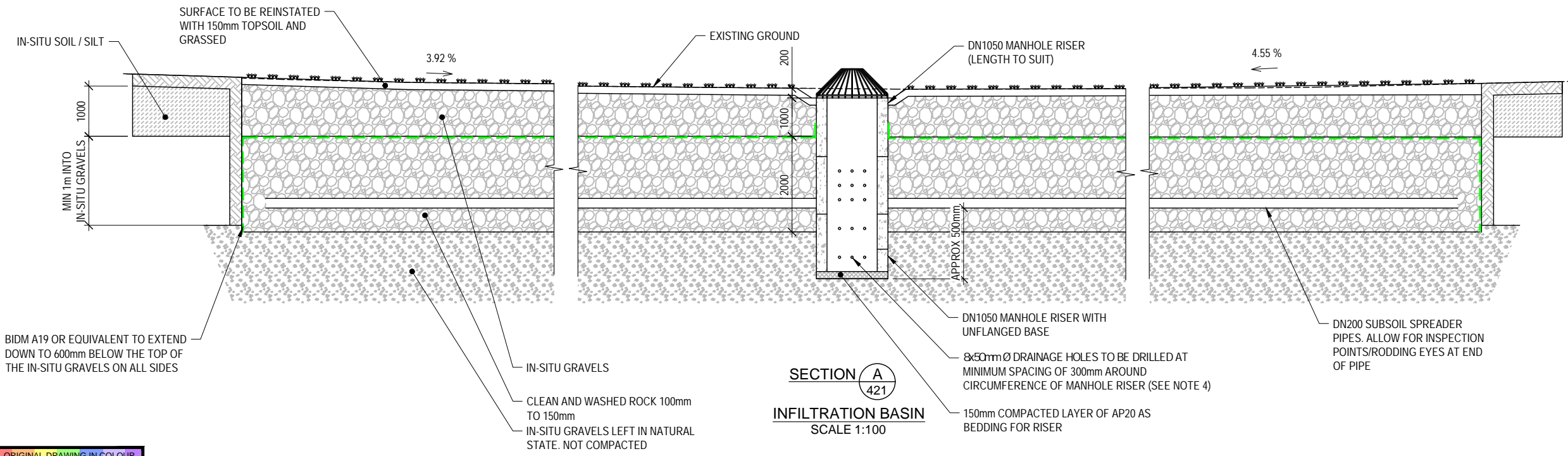


**KEY:**

EXISTING	
[Green Line]	PROPERTY BOUNDARY
[Blue Dashed Line]	STOP BANK CENTRELINE
[Green Line]	STORMWATER
[Red Line]	WASTEWATER
[Red Line]	WASTEWATER RISING MAIN
[Purple Line]	CHORUS CABLE GIS
[Purple Line]	CHORUS CABLE DIGITIZED
[Purple Line]	TRANSPOWER FIBRE OPTIC
[Purple Line]	PAN PAC COMM/DATA
[Yellow Line]	GAS PIPE - POWERCO
[Orange Line]	POWER OVERHEAD
[Orange Line]	POWER BELOW GROUND
[Orange Circle]	POWER POLE
[Orange Square]	POWER ENCLOSURE
[Orange Square]	POWER PYLON
[Green Arrow]	DRAIN / WATER COURSE
[Blue Arrow]	WATER PIPE
[Blue Arrow]	PROCESS WATER PIPE
[Blue Square]	VALVE, HYDRANT, METER
[Blue Circle]	UNKNOWN SERVICE
[Black Line]	FENCE
[Black Line]	TOP OF BANK
[Red Line]	PROPOSED TOP OF BANK
[Red Line]	BOTTOM OF BANK
[Red Dashed Line]	STOP BANK CENTRELINE
[Green Circle]	MANHOLE
[Green Square]	SOAKPIT
[Green Line]	STORMWATER PIPE
[Green Line]	STORMWATER CHANNEL

**PROPOSED STOPBANK AND SOAK PIT PLAN**  
SCALE 1: 500

- NOTES**
- REFER TO GENERAL NOTES.
  - DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
  - COORDINATES IN TERMS OF NZTM.
  - LEVELS IN TERMS OF NZVD2016 VERTICAL DATUM.
  - REFER TO HASTINGS DISTRICT COUNCIL STORMWATER STANDARD CONSTRUCTION DETAILS.
  - GRAVELS TO BE WASHED AND 100 TO 150mm IN SIZE.
  - ALLOW FOR EXCAVATION 1m INTO NATURAL GRAVELS.
  - ALLOW FOR A SOAKAGE TEST TO BE COMPLETED PRIOR TO BACKFILL AT THE BASE OF THE PROPOSED SOAKPIT. TEST RESULTS TO BE PROVIDED TO ENGINEER AND APPROVED PRIOR TO COMPLETION OF WORK.
  - REFER TO TRENCH DETAIL HB010500006-CI-425 FOR SERVICES THROUGH A STOPBANK.



**SECTION A-421**  
**INFILTRATION BASIN**  
SCALE 1:100

**PRELIMINARY ISSUE**

**WORKING PLOT**  
1/08/2025



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CLIENT: HAWKES BAY REGIONAL COUNCIL			
PROJECT: WHIRINAKI STOPBANK			
DESIGNED A.G.	DESIGN REVIEW P.C.	DATE JULY 25	APPROVED
DRAWN A.E.	DRAWING CHECK	DATE JULY 25	DATE
THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED			

INFILTRATION BASIN & SOAKPIT DETAILS		
SCALE: AS SHOWN (A3)	DRAWING NO.: HB010500006-CI-421	REV: A

A	PRELIMINARY ISSUE	AUG 25	
NO.	REVISION	DATE	APP.