**BEFORE THE WESTLAND DISTRICT COUNCIL**

**IN THE MATTER** **of the Resource Management Act 1991**

**AND**

**IN THE MATTER** **of resource consent applications 220120 & 230030 at 117 Arthurstown Road, Hokitika**

**BY** **Forest Habitats Ltd**

# STATEMENT OF EVIDENCE OF STUART CHARLES CHALLENGER

**8 April 2024**

## 1 QUALIFICATIONS AND EXPERIENCE

1.1 My full name is Stuart Charles Challenger. I hold the qualifications Bachelor of Science in Mathematics (Canterbury University), and a Bachelor of Engineering in Natural Resource Engineering (Canterbury University). I am an Engineering NZ Chartered Member, a Chartered Professional Engineer and an International Professional Engineer/APEC Engineer.

1.2 I have worked in the field of civil engineering since 1995. During that period, I have worked various consultancies and local authorities throughout New Zealand. I was branch manager of the Eliot Sinclair Hokitika Office from 2008 to 2023.

## 2 INTRODUCTION & SCOPE

2.1 Forest Habitats engaged Eliot Sinclair in 2022, to assess the sites natural hazards and to determine the minimum foundation requirements for future dwellings (Eliot Sinclair Subdivision Site Suitability Report reference 510714 dated 30 September 2022, included in Appendix A). I also prepared the Eliot Sinclair response to the WDC request for further information with regard to finished floor levels and amended no-build zone, dated 16 February 2023. That report relied on information from the Hutchinson Consulting Engineers Report dated 4 October 2022, both of which are included in Appendix B.

2.2 I left Eliot Sinclair and began working as a Civil and Environmental Engineer for Chris J Coll Surveying in May 2023.

2.3 To maintain continuity with the engineer who undertook the work, Forest Habitats engaged Chris J Coll Surveying to update the Eliot Sinclair report with regard to a change to the Scheme Plan that was brought about by a Landscape Plan and additional Civil Engineering investigation, and to respond to questions raised by the Council planners. That report used information from the Hutchinson Consulting Engineers Report dated 7 September 2023, both of these reports are included in Appendix C.

2.4 I have not repeated any information from my earlier reports in this evidence. This Statement of Evidence is a response to the questions raised in the consultant planners Natural Hazards section of the S42 report. I am happy to provide clarification on any items of my earlier reports if requested. My references "*4.17*" etc. are references to the Council's Consultant Planner Report.

## 3 EXPERT WITNESS STATEMENT

3.1 I have read the Consolidated Practice Note for expert witnesses. I confirm that in the preparation of this evidence, I have complied with the requirements of the Practice Note.

## 4 NATURAL HAZARDS

Paragraph 4.17
Comments: -

4.1 The Section 42 report notes that the NEMA information has not been provided. Appendix D includes a screen grab of the National Emergency Management Agency, Tsunami Evacuation zones for Hokitika and the applicant's site.

4.2 To provide better clarity on the potential threat from a tsunami on the proposed subdivision I have overlaid the Tsunami Evacuation zones on the Subdivision Layout and Landscape proposal. Shown on Figure 1, below.

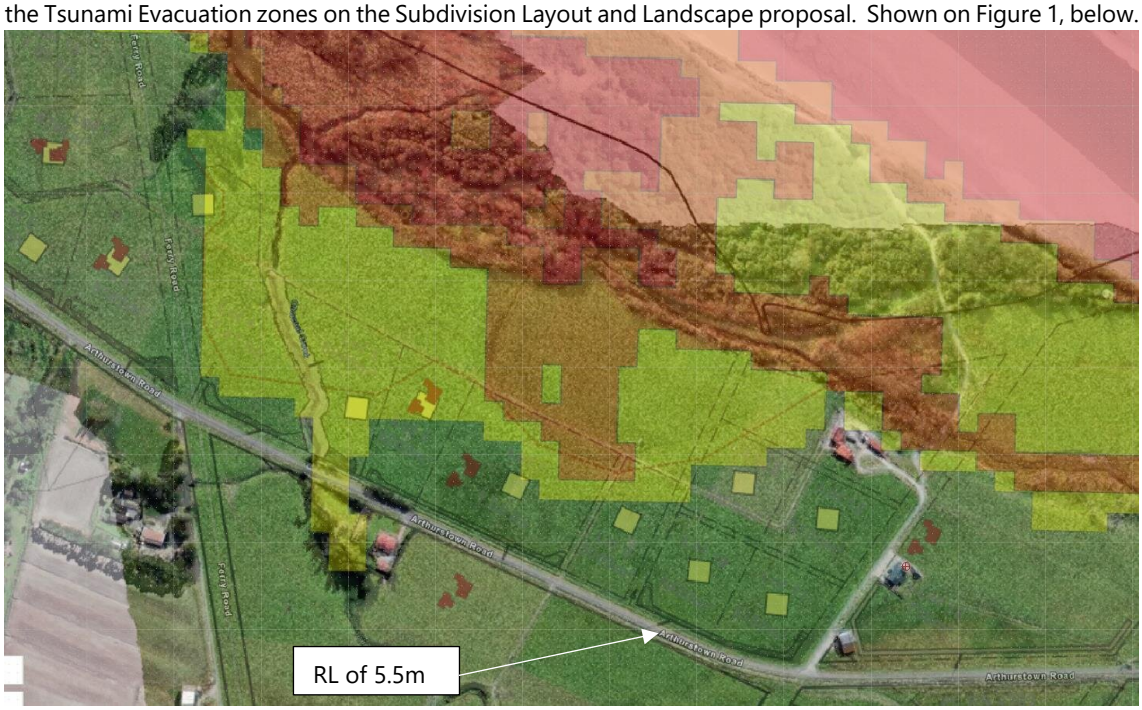



**Figure 1. Subdivision Layout and Landscape proposal overlayed by Tsunami Evacuation Zones.**

4.3 Figure 1 shows the projected tsunami threat based on the current ground profile, as potentially impacting building platforms on Lots 4, 5 and 6, which are shown as being in yellow evacuation zone (greater than 5m tsunami wave threat). However, once the building platforms have been completed, they will be above the evacuation zone so they will not be at risk. The building platforms will be at a similar level to the height of Arthurstown road about 50m west of its intersection with East Road.

4.4 The proposed Lots will be accessed from Arthurstown Road and East Road, which are not shown as being in a Tsunami Evacuation zone. It is recommended however, that the driveway to lot 5 be raised in order that safe access can be provided in the event of tsunami.

4.5 From a review of the NEMA Tsunami Evacuation zones map in Appendix D it can be seen that the part of Hokitika on the seaward side of Fitzherbert Street (State Highway 6) and the majority of houses northeast of Jollie Street between Stafford Street and Gibson Quay are in the yellow evacuation zone. The majority of the part of Hokitika south of Stafford Street and west of Fitzherbert Street is in the Orange evacuation zone, 1-5m tsunami wave threat. The building platforms in the subdivision are all in the yellow tsunami zone.

Paragraph 4.18.
Comments: -

4.6 The hazard classifications used in the Land River Sea Consulting Hazard Map are developed from a product of the depth of water and the waters velocity based on the current land contours. Following the construction of the building platforms, the area around the dwellings will be above the flood level, so the hazard category will drop to 0 or H1, allowing for a small amount of surface water. It is accordingly not appropriate to use the hazard categories based on the predeveloped site when assessing the hazard for the developed site.

Paragraph 4.19.
Comments: -

4.7 In paragraph 4.19 of the Section 42 report, it is suggested that there is insufficient access to the proposed lots in a flood event. From the peak depth map prepared by Land River Sea Consulting, during the 100 year flood event including climate change (2100 RCP Scenario 6.0, 1m Sea Level Rise, 0.4m Storm Surge), the peak depth of the water in Arthurstown Road, adjacent to the applicant's site, will be up to 1m in depth, with the majority being less than 0.5m deep. Any dwelling in the property will be above the flood water. As the majority of new dwellings have an internal garage, there will be drive on access to the dwelling that will rise up from Arthurstown Road, but depending on the location, access to Arthurstown Road may be limited. It is possible to traverse up to 1m depth of water in a 4WD vehicle or truck. The lots all have sufficient legal and physical access for the purposes of section 106 RMA.

4.8 The modelling also shows that Fitzherbert Street (State Highway 6) will have a water depth of between 1 and 2m from Hampden Street to the Hokitika Bridge Sewell Street and Tancred Street, south of Weld Street, will have greater than 2m of water. Parts of upper Arthurstown Road (toward the Kaniere Bridge) will be subject to 1-2m of inundation and parts of Kaniere road will be subject to 0.5 to 1m of inundation. It is unlikely that it would be possible to traverse 1-2m deep flood waters in a 4WD vehicle or truck.

4.9 From this review, it is considered that there is no issue with access any greater than currently exists and there is better access than will be available in other parts of Hokitika.

Paragraph 4.21
Comments: -

4.10 In paragraph 4.21 of the Section 42 Report, it is correctly noted that compaction and hard surfacing may occur as the site is developed, and that this will have an effect on runoff. However, because of the size of the Hokitika River catchment, the change in runoff due to hard surfacing and compaction in this site will have no effect on the depth of flooding, as once the river breaches its banks there is no runoff, as the rainwater falls on the floodwaters, not on the ground.

Paragraph 4.22
Comments: -

4.11 The bunding, as shown in the Rough Milne Mitchell landscape plans, is intermittent to facilitate passing of floodwater plus there will be access to each of the lots from Arthurstown Road, which will allow the water to spread naturally, albeit at a slightly delayed rate. Because of the width of flooding at the site, and delay caused by the bunding and planting will be negligible.

Paragraphs 4.23-4.25
Comments: -

4.12 The Section 42 report contains a 1943 RetroLens aerial photograph and a 2023 Google Earth aerial photograph. It is difficult, and can be misleading, to have different age aerial photographs with erosion lines that cannot be directly compared. Appendix E includes Historic photographs of the site, with the approximate location of the 1943 riverbank transposed to the images, and for the images from 2006 onward, the 2006 riverbank has also been transposed onto them.

**4.13** Most lowland rivers go through erosion and accretion cycles as part of the river's sinusoidal movement toward the sea. This can often be seem as an 'erosion bite' moving down the river. From a review of the photograph sequence, it can be see that the bite shown in the 1943 aerial photograph is moving downstream toward the mouth of the river. Infilling behind the bite is part of the natural river process. The bite appears to have halted, following erosion protection works to protect the Hokitika River Bridge, but accretion is still occurring. The riverbank adjacent to the property has gained nearly 200m of land since 2006. This is a cyclic process, and it is likely that erosion will take back the land that has been gained. However, the elevation of the land, where the dwellings are proposed, is two terraces back from the active riverbed, so if the river starts to cut to the south again, there will be plenty of warning before it gets anywhere near the buildings such that the rating district could be expanded, or the owners start their own rating district to protect the site.

## 5 INFRASTRUCTUCE AND SERVICING

Comments: -

5.1 In The original Section 42 Report in Paragraph 8.29 it states "It has been acknowledged that each wastewater treatment system will require additional resource consent the West Coast Regional Council pursuant to the Land and Water Plan Rule 79 due to the high water table and soil category of the site.

5.2 That is in my view not correct, the main criteria that would cause rule 79 to not be complied with are:

- Proximity to a water body, the land application bed must be a minimum of 50m from a water body, or 20m from a drain.
- The base of the land application bed must be more than 1m from the ground water table.
- The soil must be a soil category 1, 2 or 3 in terms of NZS1547.

5.3 Most of the sites will be sufficient distance from the waterbodies, Lots 4 and 5 have Charcoal Creek running between them, but they are each of sufficient size that a land application bed can be located more than 50m from the Creek and the Hokitika River.

5.4 The Eliot Sinclair site investigation found the underlying soils to be silt with sand over sands and ground water was encountered at about 3.1m below the surface. As sea level rises, so will the groundwater level, while the site is sufficient distance from the coast that there will not necessarily be a 1m rise in groundwater, taking a conservative approach and allowing for the full 1m rise, there will be 2.1m from the surface to the ground water table. A typical bed will be 600mm deep, the depth can increase depending on the location of the bed; for gravity systems, there has to be a fall to the bed, so the further from the septic tank the deeper the bed. To ensure that the depth of the land application bed does not breach Rule 79, by being closer than 1m to the groundwater table, it is recommended that the land application bed is a raised mound that is pump dosed. This will provide the maximum possible separation from the groundwater table and meet Rule 79 requirements.

5.5 I would classify the underlying silt with sands as being a category 3 soil, in terms of AS/NZS1547: 2012

5.6 As the site may be subject to flooding, I would recommend that the septic tank is located on the raised building platform to prevent water ingress and that the land application bed be located as high as possible.

5.7 From the above, I consider that a site specific designed on-site wastewater treatment and land application system for each Lot will comply with rule 79 of the WCRC Land and Water plan, and as-such resource consent from the West Coast Regional Council is not required.

## 6 COMMENTS ON DRAFT CONDITIONS

**Subdivision Consent RC230120**

6.1 Consent Notices condition 3. g) 23. g) and 42. g) The reduced Level needs to be expressed in a standard form for repeatability and consistency, the site survey and Land River Sea Consultants report are in terms of NZVD 2016

Proposed new conditions 3. g) 23. g) and 42. g):

*The minimum finished floor levels of any dwelling on site shall be designed, constructed and thereafter maintained to a minimum height of Reduced Level (RL) 6m in terms of NZVD 2016.*

6.2 Access and Roading condition 8, condition 27, . The sealing of the road or access is necessary for no more than 10m, to prevent loose gravel tracking onto the road. Once the entranceways have been formed and approved, they become part of the Westland District Council roading asset and should be maintained by the Council.

Proposed new condition 8:

*The entrance ways to Lots 1, 2 and 3 and any associated right of way shall be formed to Council standard and sealed for a minimum of 10m from the edge of the existing sealed carriageway. All costs of works shall be met by the consent holder.*

*Applicant will need to submit a Corridor Access Request (CAR) to the Westland District Council District Assets Department prior to undertaking works in the legal road reserve.*

Proposed new condition 27:

*The entrance ways to Lots 4, 5, 6 and 7 and any associated right of way shall be formed to Council standard and sealed for a minimum of 10m from the edge of the existing sealed carriageway. All costs of works shall be met by the consent holder.*

*Applicant will need to submit a Corridor Access Request (CAR) to the Westland District Council District Assets Department prior to undertaking works in the legal road reserve.*

Proposed new condition 47:

*The entrance ways to Lots 8, 9, 10, 11, 12 and 13 and any associated right of way shall be formed to Council standard and sealed for a minimum of 10m from the edge of the existing carriageway. All costs of works shall be met by the consent holder.*

*Applicant will need to submit a Corridor Access Request (CAR) to the Westland District Council District Assets Department prior to undertaking works in the legal road reserve.*

**Land use Consent RC230020**

6.3 Access condition 5, this is as per 6.2 above, the sealing of the road or access is necessary for no more than 10m to prevent loose gravel tracking onto the road. Once the entranceways have been formed and approved, they become part of the Westland District Council roading asset and should be maintained by the Council. Any roading inside the property is to be maintained by the future owner of each Lot.

Proposed new condition 5:

*Where not already achieved, the entranceway to each Lot or right of way shall be formed to Council standard and sealed for a minimum of 10m from the edge of the existing carriageway. All costs of works shall be met by the consent holder.*

*Applicant will need to submit a Corridor Access Request (CAR) to the Westland District Council District Assets Department prior to undertaking works in the legal road reserve.*

6.4 Engineering condition 7, as per 6.1 above,

*The minimum finished floor levels of any dwelling on site shall be designed, constructed and thereafter maintained to a minimum height of Reduced Level (RL) 6m in terms of NZVD 2016.*

6.5 Engineering condition 9, additional requirements proposed to ensure that the systems can operate in time of flooding:,

Proposed new condition 9:

*A site specific investigation is to be undertaken for the wastewater treatment and land application design to comply with rule 79 of the WCRC Land and Water Plan for each new proposed dwelling at building consent stage. Sewerage effluent is to be disposed of in accordance with the requirements of the relevant New Zealand standard for wastewater treatment and management. The septic tank is to either have a sealed lid, to prevent water ingress, or is to be located on the raised building platform adjacent to the dwelling. Unless otherwise proven in the site specific investigation, the land application bed shall be designed for a category 3 soil, in terms*

*of AS/NZS1547: 2012. The bed is to be located as high as practical on each lot, which may require that the effluent is pump dosed to the land application bed.*

## 7 CONCLUSION

7.1 Whilst the site is identified as being subject to natural hazards in the proposed Te Tai o Poutini Plan, mitigation to the extent of avoidance of those hazards is achieved by raising the floor levels of any future dwellings to ensure that any future buildings and residents are above the risk.

7.2 The risk could be exacerbated by climate change; however, the proposed floor levels have been determined from modelling, undertaken by Land River Sea Consultants Ltd, that is based on the best available data and incorporates projected climate change (2100 RCP Scenario 6.0, 1m Sea Level Rise, 0.4m Storm Surge).

7.3 Access to the future lots will be from Arthurstown Road and East Road, these are not shown as being subject to any Tsunami threat. It will be necessary that the access to the building platform on Lot 5 is elevated to ensure that access to that lot is available in the event of a Tsunami.

7.4 In a 100 year flood event, including climate change, sea level rise and storm surge, the modelling shows that Arthurstown Road and East Road could be subject to up to 1m of inundation with the majority being less than 0.5m deep. This is nowhere as significant as will occur elsewhere in the district with projected depths of over 2m for parts of Hokitika near the river mouth, and 1-2m depths for Fitzherbert Street (State Highway 6) between Hampden Street and the Hokitika Bridge. It is possible to traverse up to 1m depth in a 4WD vehicle or truck. It is unlikely that it would be possible to traverse 1-2m in a 4 WD vehicle or truck.

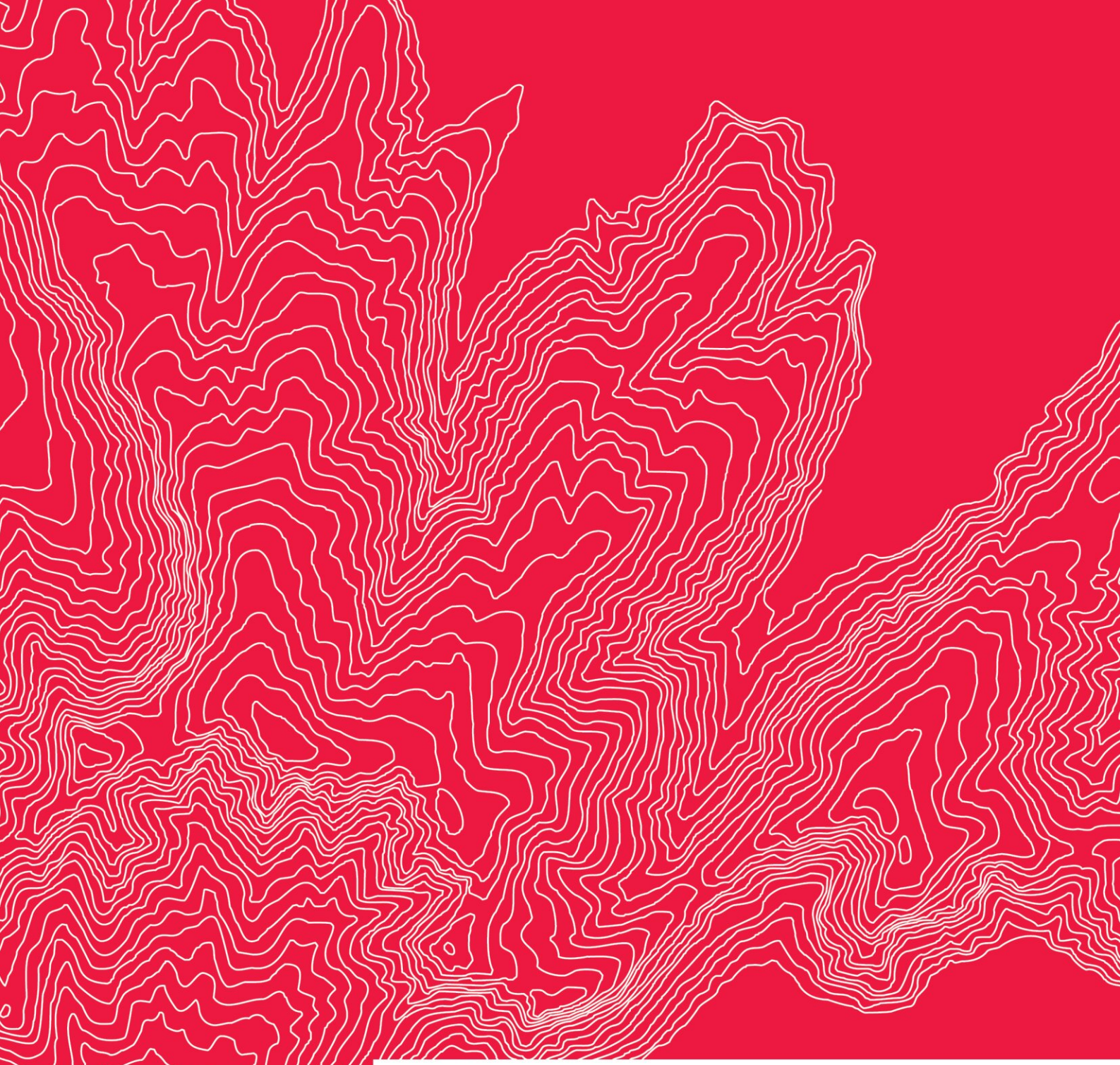
7.5 Any issues with access to the proposed lots in a 100 year flood event are not unsurmountable and are no greater, and generally less, than will occur elsewhere in the immediate area.

7.6 An on-site wastewater treatment and land application system that complies with Rule 79 of the West Coast Regional Council Land and Water Plan can be designed for each lot at building consent stage.

STUART CHARLES CHALLENGER

8 April 2024
Date

Appendix A: Eliot Sinclair Subdivision Site Suitability Report reference 510714 dated 30 September 2022



# Subdivision Suitability Report

**117 Arthurstown Road, Hokitika**

Prepared for Forest Habitats Ltd

510714

eliot sinclair

# Subdivision Suitability Report

117 Arthurstown Road, Hokitika

Prepared for Forest Habitats Ltd

510714

**Quality Control Certificate**

Eliot Sinclair & Partners Limited

eliotsinclair.co.nz

| Action | Name | Signature | Date |
|---|---|---|---|
| **Prepared by:** | Shannon Hopkins<br>Survey Technician |  | 29 August 2022 |
| **Reviewed by:** | Paul Sykes<br>Geotechnical Engineer<br>BE(Hons) Mining MEngNZ |  | 22 September 2022 |
| **Directed and approved for release by:** | Stuart Challenger<br>Civil Engineer \| Branch Manager, Hokitika<br>BE NatRes BSc CMEngNZ CPEng |  | 28 September 2022 |
| **Status:** | B | | |
| **Release date:** | 30 September 2022 | | |
| **Distributed to:** | Forest Habitats Ltd | | |

## Version History

| Status | Description | Author | Release Date |
|---|---|---|---|
| A | First issue of document | Shannon Hopkins | September 2022 |
| B | Updated scheme plan Figure 2 | Cushla Stone | 30 September 2022 |

# Contents

# 1. Introduction

## 1.1. Scope of Works

Eliot Sinclair has been engaged by Forest Habitats Ltd to undertake a geotechnical investigation on 117 Arthurstown Road, Hokitika. The purpose of the investigation was to:

- Assess the site's natural hazards to determine site suitability for subdivision and ensure future dwellings would be safe from hazards, and
- Investigate the shallow ground conditions to determine minimum foundation requirements for future dwellings.

# 2. Site Description

## 2.1. Legal Description

The legal description of the site is Lots 8 – 29 DP 142, RS 1602, 1603, 1421, 1588 and Pt RS 1589. The properties to be subdivided are held in four separate titles with a title area of approximately 19.55 ha. Arthurstown Road can be accessed off State Highway 6 to the west of the site which it intersects approximately 300m south of the Hokitika bridge. Figure 1 below illustrates an overview of the site location.


**Figure 1. Figure showing location of site (Eliot Sinclair, 2022)**

## 2.2. Proposed Subdivision

We understand it is proposed to subdivide the site into fifteen lots with two multi lane accessways and a single right of way to access the proposed lots. Figure 2 below is a copy of the proposed subdivision scheme plan.

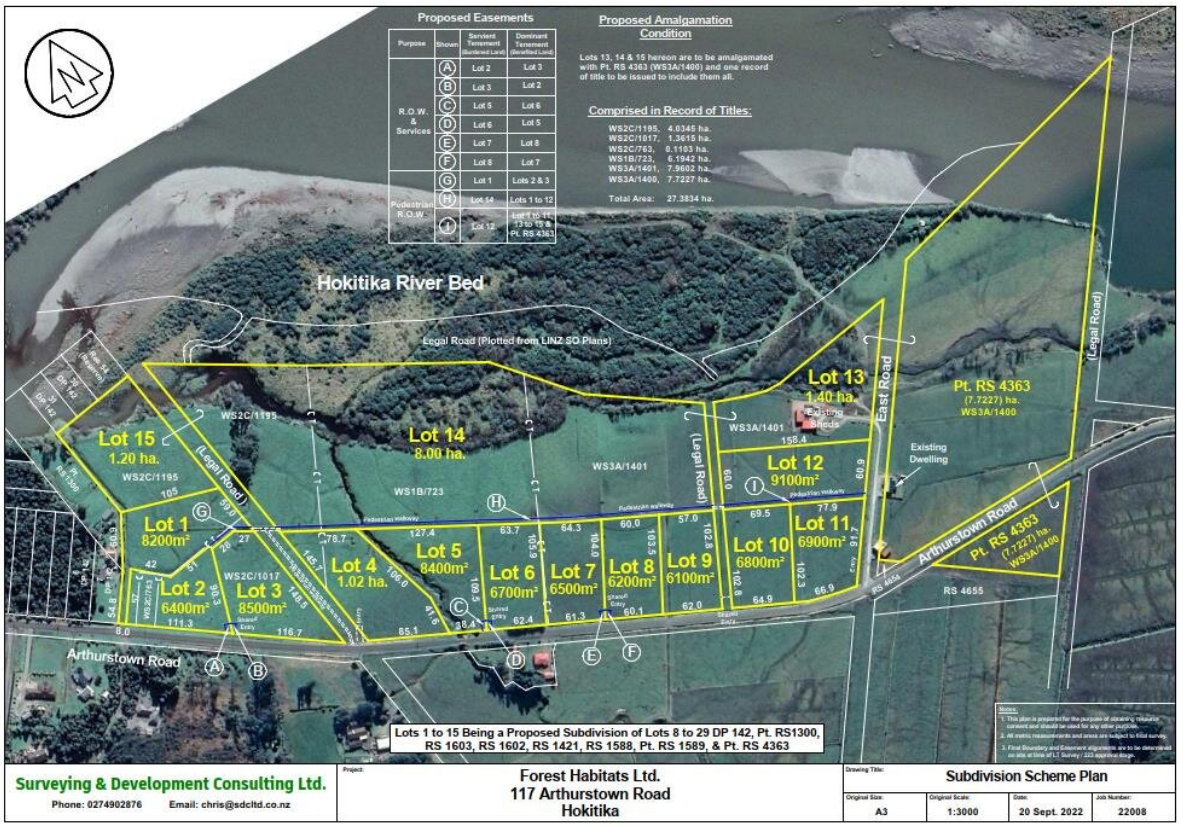



**Figure 2. Copy of the proposed subdivision scheme plan (Surveying & Development Consulting Ltd, Sept 2022).**

# 3. Geological Review

## 3.1. Engineering Geology

Geological mapping[1] of the area notes most of the site is underlain by Holocene Era river deposits (Q1a) of gravel, sand and silt.

## 3.2. Active Faults

The GNS database[2] indicates the closest active fault is the Alpine Fault approximately 23km south-east of the site. The site is not in any known fault hazard avoidance areas. The area is in the NZS3604: 2011 Zone 3 earthquake rating zone.

[1] Nathan, S., Rattenbury, M.S., Suggate, R.P. (compliers) 2002. Geology of the Greymouth area. Institute of Geological and Nuclear Sciences 1: 250 000 geological map 12. 1 sheet + 58p. Lower Hutt, New Zealand. Institute of Geological and Nuclear Sciences Limited

[2] https://data.gns.cri.nz/af/

### 3.3. Topography

The site is located approximately 400m south of the Hokitika River, at a level between 2.5m – 5.5m above sea level, and around 1.5km east of the coastline. The closest waterways are Charcoal Creek which runs through the site and the Hokitika River which is located just to the north of the property. The site has an elevated area located at the eastern and western ends and adjacent to Arthurstown Road. There is an area of lower elevation located in the central, northern area of the property, this lower area has not been covered in this report.

## 4. Geotechnical Investigation

### 4.1. Overview

On 7th September 2022 a site investigation was undertaken to determine the soil profile and bearing capacity. The investigation included eight test pits, in a grid like pattern across all proposed lots, and 12 dynamic cone penetrometer tests. The results from these tests can be found in Appendix B.

We did not undertake any testing in Lot 13, 14 or 15. Lot 13 has the existing dairy shed, plus we consider that the results from Lot 12 will be applicable to that lot. Lot 14 is a large lot and will require site-specific investigation. We consider that the results from lot 1 will be applicable to Lot 15.

Whilst we did not test every lot, we believe from the tests undertaken on site we have gained a reliable understanding of the soil profile across the site and can make informed recommendations about the soil types encountered.

A visual-tactile field classification of the soils encountered during the shallow investigation was carried out in general accordance with '*Guidelines for the Field Classification and Description of Soil and Rock for Engineering Purposes*' (NZGS, 2005) and DCP testing was carried out in accordance with NZS 4402:1988, Test 6.5.2, '*Dynamic Cone Penetrometer*'.

### 4.2. Test Pit Excavations

The general profile encountered by the test pits was a typical of alluvial deposits and comprised a surficial layer of silty topsoil with rootlets approximately 0.2m thick, overlying silts and sands with some organics to a maximum depth of 4.3m below ground level (bgl).

We did not encounter any expansive soils (clay-like), highly organic soils (peat) or significant deposits of uncontrolled fill during our investigation.

### 4.3. Groundwater

Static ground water was encountered at test locations 3, 4 and 6 at depths of between 3.1m and 3.3m bgl.

### 4.4. Dynamic Cone Penetrometer (DCP) Testing

Below the topsoil, DCP resistances generally revealed at least 2 blows per 100mm penetration within the underlying insitu layers of silt and sandy silt to a depth of around 0.8m bgl. Below 0.8m the blow counts at the test locations increased with increasing depth.

## 4.5. Geotechnical Ultimate Bearing Capacity

We have inferred an index ultimate bearing capacity of only 200kPa to around 0.8m bgl. From about 1.0m depth, the relative density of the soils met the requirements of good ground to around 2m depth where the testing was terminated. We have inferred an index ultimate bearing capacity of at least 300kPa from 0.8m to around 2m bgl.

The assessment of bearing capacity given here is the *index* geotechnical ultimate bearing capacity (GUBC) using the DCP blow count profile method given in the MBIE Residential Guidance Section 3.4.


**Figure 3. Approximate test locations (Eliot Sinclair, 2022)**

# 5. Natural Hazards Risk Assessment

## 5.1. Introduction

Council can refuse subdivision consent if there is a significant risk from natural hazards. To determine whether there is a significant risk from natural hazards, decision-makers are guided by the requirements of RMA Section 106(1A). This requires a combined assessment of:

- The **likelihood** of natural hazards occurring (whether individual or in combination); and
- The **consequences** (material damage) that would result from natural hazards to land where the consent is sought, other land, or structures; and
- Any **likely subsequent use** of the land where the consent is sought that would **accelerate, worsen, or result in material damage**.

Decision-makers are required to consider the magnitude of risk of natural hazards, including natural hazards that have a high impact but low probability of occurrence. This aligns the assessment with the definition of '*effect*' Section 3 of the RMA.

The RMA defines natural hazards as: *Any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire, or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment.*

Hazard identification is a key component of any site-specific risk assessment. The risk assessment for relevant natural hazards at the site is presented below, which considers the likelihood and consequences of the hazard at the site in the context of the proposed activity (rural residential subdivision) as compared against the current site context.

We have considered the risk of falling debris, subsidence, wind, drought, fire, geothermal activity, sedimentation, climate change, sea level rise, and volcanic activity and conclude these are very unlikely to pose an unacceptable risk to life at this site.

In relation to other potential natural hazards, we comment as follows:

## 5.2. Risk Assessment

### 5.2.1. Earthquake Shaking

New Zealand is a seismically active country. New buildings and infrastructure will be designed, consented, and built to acceptable industry standards and New Zealand Building Code requirements and as such will be designed for any likely shaking as detailed in the current design codes, which will address the risk.

### 5.2.2. Earthquake Fault Rupture

There are no recorded active fault traces across the site. The site is not located within a fault hazard area or fault avoidance zone. The closest active fault is the Alpine Faultline, which lies approximately 23km south-east of the site.

### 5.2.3. Erosion

An investigation of aerial photography dating back to 1943 shows that the low area within the site was riverbed in 1943. Aggradation occurred to the extent that the area of riverbed was almost completely reclaimed as pasture by 1951. Some erosion occurred between 1970 and 1984 in the western area, at and around the mouth of Charcoal Creek. This area has subsequently aggraded with the most recent aerial photography showing vegetation well beyond the river boundary location shown on survey plans dating back as far as 1874.

We consider that the current land between the proposed building locations on the higher elevated areas will not be subject to erosion and that erosion will not materially affect buildings on the new allotments assuming modern design methods and our construction recommendations are followed.

### 5.2.4. Flooding

As part of this natural hazards assessment we have reviewed the report titled '*Hokitika River, Hydraulic Modelling and Food Hazard Mapping'*[3]. Figure 4 is an excerpt of flood hazard mapping for a 100-year event including climate change (2100), representative concentration pathway (RCP) scenario 8.5, 1.4m sea level rise, 0.4m storm surge.

The vast majority of the site is coloured yellow (H5) which represents water velocities that are '*Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure'*.

The south eastern portion of the site are coloured light and dark blue (H2 and H1) which represents water velocities that are '*Unsafe for small vehicles'* (H2) and '*Generally safe for vehicles, people and buildings' (H1)*.

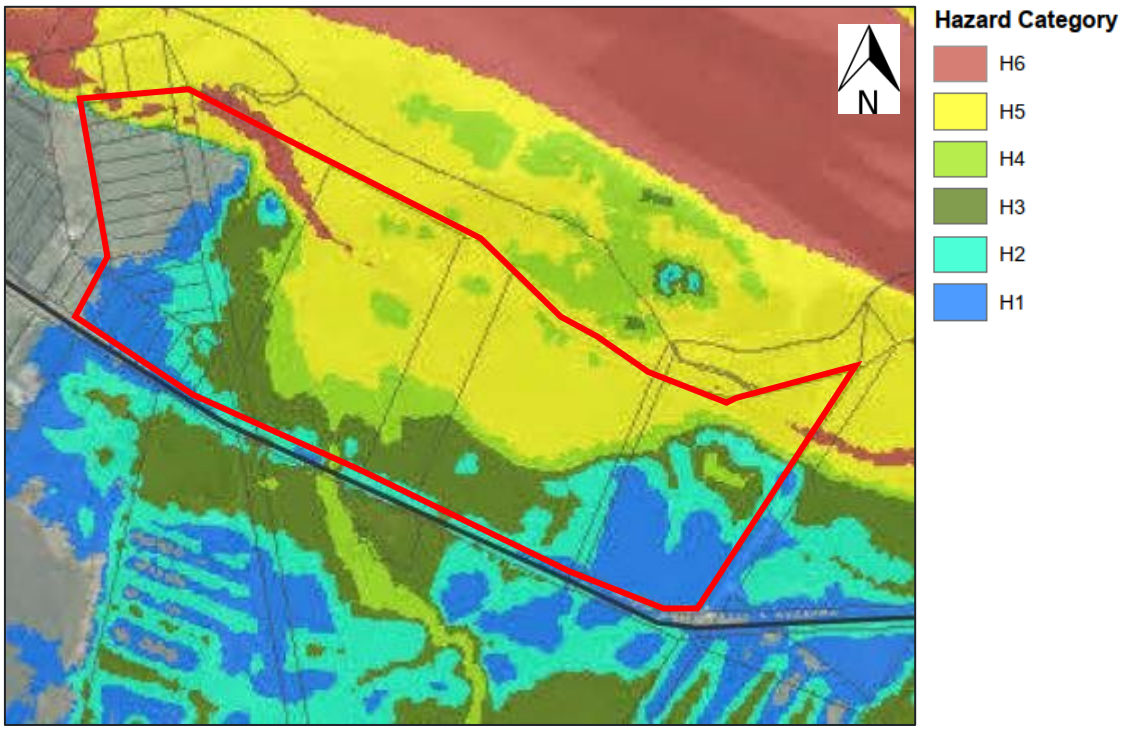



**Figure 4. Flood hazard modelling map showing water velocities**

Figure 5 indicates the flood peak water depth for a 1 in 50-year event, a 1m sea level rise and 0.4m storm surge. The water depths are generally between 0.1m to 0.5m and deeper at the margins of Charcoal Creek to the west.

[3] Hokitika River, Hydraulic Modelling and Food Hazard Mapping', dated June 2020, for West Coast Regional Council prepared by Matthew Gardner

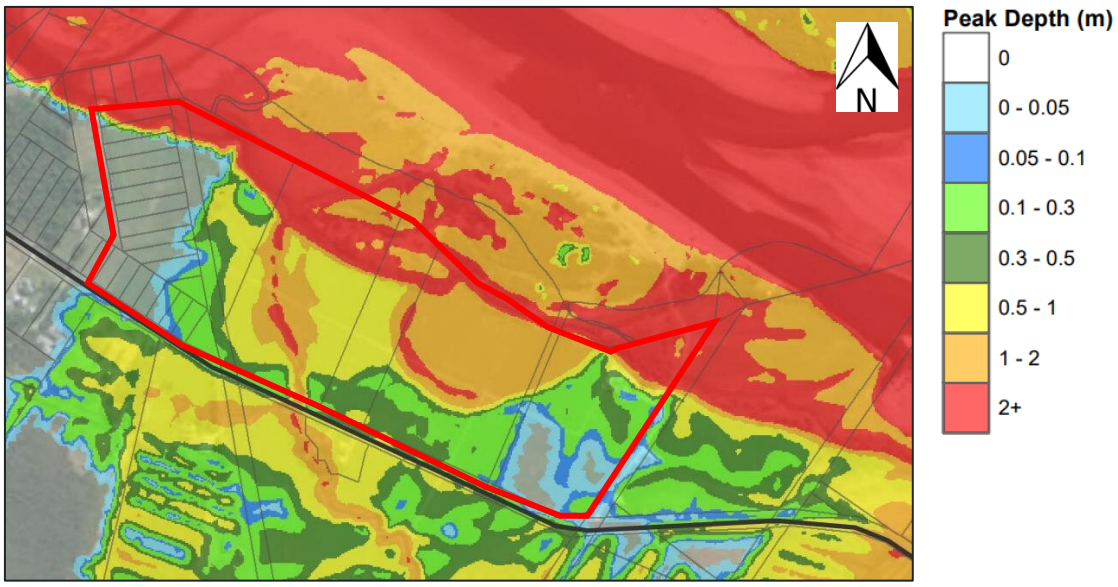



**Figure 5. Flood water depth during 1:50-year event**

We recommend any future dwellings within these lots are located towards the south side of the lots close to Arthurstown Road. The minimum floor heights for any proposed dwellings within the subdivision should be above the modelled water depth plus freeboard. Westland District Council should advise on the final floor levels for dwellings within the proposed subdivision as part of the consenting process.

### 5.2.5. Liquefaction

Strong seismic shaking can result in liquefaction in areas where the water table is within 5 metres of the ground surface[4]. If liquefaction occurs at less than about 10m below surface there is likely to be surface deformation and expression at the surface (sand boils), deeper occurrence will likely have less impact. Coastal areas and river flood plains are usually suspectable to liquefaction, which results in ground deformation and/or lateral spreading.

The site is classified in the West Coast Regional Liquefaction Assessment[5] as being in an area where liquefaction damage is possible. The assessment indicates (figure 2-2) that the site has a high-moderate susceptibility to liquefaction.

We consider it is likely that the site could be affected by liquefaction. Measures to mitigate the risk of liquefaction will need to be undertaken, this includes the strengthening of any engineered gravel pad with geo grid or supporting proposed dwellings on piles embedded within suitable and non-liquefiable strata. Provided the preliminary recommendations in Section 6 are followed then we consider that liquefaction potential and the risk of structural and land damage is low.

### 5.2.6. Tsunami

Due to the location of the site (adjacent to the Hokitika River and 1.5km from the Tasman Sea) it is susceptible to Tsunamis on a larger scale. Below is the Tsunami Hazard Map showing areas of the site being in the orange and yellow zones. The yellow zone covers the largest area that would need to be evacuated in the event of a maximum-impact tsunami, the orange zone shows areas to be evacuated in a 1m to 5m event.

[4] PJ Glassey, DW Heron 2012. Amplified ground shaking and liquefaction susceptibility, Invercargill City. GNS Science Consultancy Report 2012/014.
[5] Beca Limited. West Coast Regional Liquefaction Assessment, 1 November 2021


**Figure 6. Tsunami Evacuation Zones ( https://www.civildefence.govt.nz/get-ready/get-tsunami-ready/tsunami-evacuation-zones/)**

Most intended building sites are outside of the yellow zone, but it is important that the occupants are aware of the Civil defence recommendations that should be followed '*this area must be evacuated if there is a long or strong earthquake. The earthquake may be the only warning of a tsunami, so people are advised not to wait for further instructions, notifications or advice, immediate evacuation is required after shaking has stopped*'.

## 6. Foundation Recommendations

Based on our geotechnical investigation, we can confirm the site contains firm silts capable of supporting a building and have a geotechnical ultimate bearing capacity of 300kPa from around 0.8m below the surface.

Due to the likelihood of flooding over the site in the future the floor level for any future buildings will be required to be elevated above ground level. We consider there are three feasible options for foundations for residential dwellings constructed on each lot. These are described below.

## 6.1. Gravel raft with TC2 slab foundation

To reduce the risk of liquefaction-induced settlement occurring to shallow foundations and to address the weak soils in the upper layers, we recommend shallow ground improvement be undertaken to remediate the upper 1.2m shallow soil profile. This can be achieved by excavation and construction of a geogrid reinforced compacted gravel raft.

A suitably qualified geotechnical engineer should inspect the exposed excavated subgrade before placing any geogrid to confirm the soil profile and bearing resistances. The exposed subgrade should not contain any obvious organic matter, topsoil, buried logs, or any other very soft or unsuitable materials. A layer of geogrid should be placed across the base of the excavation and up the sides, such as Triax TX160 or equivalent. It is important that the grid is sufficiently tensioned to remove any wrinkles, bulges, folds etc. prior to placing the gravel fill on top of the geogrid.

AP40 or AP65 or river-run sandy gravel can then be used as controlled fill providing there are no large cobbles or boulders (particle size > 60mm). If compaction is an issue, then a layer of no fines fill (ballast) can be placed across the base of the excavation to provide a suitable base from which to proceed the backfilling.

Sandy gravel fill shall be placed and compacted in ~200mm thick layers, in accordance with the requirements of NZS4431:2022. A minimum of two layers of geogrid spaced 400mm apart should be placed within the gravel raft below existing ground level. The compacted dry densities achieved by the filling work shall exceed 95% of the maximum dry density of the sandy gravel.

The compacted gravel above ground should be battered at an angle no steeper than 3:1. The landscaping design for the site will need to take into account the elevated building platforms in order to achieve suitable driveway and footpath gradients.

## 6.2. Gravel raft with Type 2A surface structure

Following the geogrid reinforced gravel raft construction as above, the in-ground slab should bear 0.1m into the gravel raft and can be designed assuming an ultimate bearing capacity of at least qu=300kPa. The in-ground slab should protrude a minimum of 50mm above the upper surface of the gravel raft.

A geotechnical strength reduction factor of Φbc=0.5 should be adopted by the foundation design engineer when assessing the effects of both long-term static loads and short-term seismic loads.

The crawl space around the perimeter of the outer piles should be clad and braced with painted plywood as per Figure 15.21 Part C of the MBIE Guide. See Figure 7 for a copy of the plywood stiffening for the Type 2A surface structure.

***Figure 15.21: Detail of plywood stiffening to Type 2 surface structure (Type 2A illustrated)***

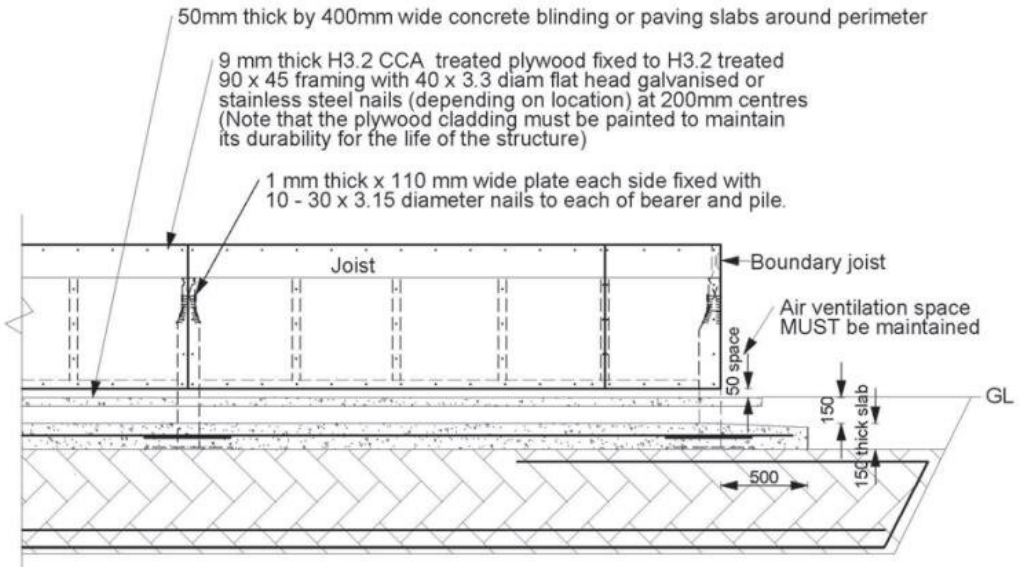



**Figure 7. An excerpt from the MBIE Guide illustrating the plywood bracing**

## 6.3. Driven timber piles

Another option is a driven timber pile foundation, whilst the minimum bearing resistance required for driven timber piles under NZS3604: 2011 was met at around 0.8m, it is necessary that the piles be driven a minimum of 1.2m below the surface. The piles will need to extend above the surface to ensure the dwelling is not subject to inundation. Westland District Council are to advise on final floor levels for dwellings within the subdivision.

## 6.4. Restricted Building Area (RBA)

A restricted building area is recommended to ensure that all dwellings constructed on sites as part of this subdivision are protected against both inundation and erosion, see figure 8 below. Any future building in the area as shown in red will require a specific foundation investigation undertaken by a suitably qualified individual, it is expected that the foundation investigation would also provide measures for the mitigation of any potential liquefaction and flooding hazard.


**Figure 8. Area to be restricted from building (Eliot Sinclair 2022)**

# 7. Infrastructure Requirements

## 7.1. Potable Water

There is no Council reticulated water available to the site. Rainwater tanks will be required for water supply. We recommend a minimum of 45m$^3$ of water storage onsite to allow for residential supply and firefighting purposes. It is also recommended that a leaf diverter and a first flush diverter be installed.

## 7.2. Wastewater

There is no Council sewer available to the site. Onsite wastewater treatment and disposal will be required. Most of our test pits did not encounter groundwater within 3.5m of the ground surface. Standing water was found in test pits 3, 4 and 6 at between 3.1 and 3.3m bgl. We consider that the soil category, in terms of AS/NZS1547: 2012, to be category 4. Category 4 soils have limited permeability and it is recommended that specifically designed secondary wastewater treatment systems be used.

Category 4 soils do not meet the requirements of rule 79 in the West Coast Regional Council's Land and Water Plan for permitted activity and the land application (discharge) of wastewater will therefore require a resource consent from the West Coast Regional Council.

### 7.3. Stormwater

There are no Council storm reticulation in the local area, stormwater overflow from the rainwater tank will need to be discharged appropriately without causing erosion or ponding. If onsite stormwater disposal is required, the underlying silts may be a limiting infiltration layer and will need to be considered appropriately.

### 7.4. Vehicle Access

There is currently access to the site from Arthurstown Road.

All future access will be off Arthurstown Road, either directly from the road or via easements/access strips.

## 8. Conclusion

Based on our geotechnical investigation, we consider the site on Arthurstown Road suitable for subdivision into fifteen Lots as proposed. Our geotechnical investigation on each of the proposed lots confirmed the presence underlying silts which have sufficient load carrying capacity for residential use. Dwellings shall be founded on an engineered gravel raft or on driven timber piles, with a floor height above the surrounding ground level. The final floor heights and freeboard will be determined by Westland District Council as part of the consenting process. We consider the site can be subdivided and that any natural hazard can be mitigated to ensure the safety of both dwellings and people.

## Disclaimer

This report has been prepared by Eliot Sinclair & Partners Limited ("Eliot Sinclair") only for the intended purpose as a Natural Hazards Risk Assessment. Our analysis is based on our inspection of the site and geotechnical testing.

The report is based on:

- Information shown on the NZGD, Westmaps and GNS's Active Faults Database.
- Ministry of Business, Innovation and Employment's (MBIE) December 2012 guidelines.

Where data supplied by Forest Habitats Ltd or other external sources, including previous site investigation reports, have been relied upon, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Eliot Sinclair for incomplete or inaccurate data supplied by other parties.

Whilst every care has been taken during our investigation and interpretation of the subsurface conditions to ensure that the conclusions drawn, and the opinions and recommendations expressed are correct at the time of reporting, Eliot Sinclair has not performed an assessment of all possible conditions or circumstances that may exist at the site. Variations in conditions may occur between investigatory locations and there may be conditions such as subsoil strata and features that were not detected by the scope of the investigation that was carried out or have been covered over or obscured over time. Additionally, on-going seismicity in the general area may lead to deterioration or additional ground settlement that could not have been anticipated at the time of writing this report. Eliot Sinclair does not provide any warranty, either express or implied, that all conditions will conform exactly to the assessments contained in this report.

The exposure of conditions that vary from those described in this report, or occurrence of additional strong seismicity, or any future update of MBIE's guidelines may require a review of our recommendations. Eliot Sinclair should be contacted to confirm the validity of this report should any of these occur.

This report has been prepared for the benefit of Forest Habitats Ltd and Westland District Council for the purposes as stated above. This report is specifically prepared for the proposed subdivision and should not be used to support any future consent application without prior review and approval by Eliot Sinclair. No liability is accepted by Eliot Sinclair or any of their employees with respect to the use of this report, in whole or in part, for any other purpose or by any other party.

# Appendix A. Site Photographs

Figure 1. Photo of test pit 01

Figure 2. Photo of test pit 03

**Figure 3. Photo of test pit 04**

**Figure 4. Photo of test pit 06**

**Figure 5. Photo of test pit 07**

**Figure 6. Photo of test pit 09**

**Figure 7. Photo of test pit 10**

**Figure 8. Photo of test pit 12**

**Figure 9. Photo of Charcoal Creek, looking towards river from bridge on site**

**Figure 10. Photo of Charcoal Creek, looking towards Arthurstown Road from bridge on site**

**Figure 11. Photo of site looking west from Charcoal Creek**

**Figure 12. Photo of site looking east from Charcoal Creek**

**Figure 13. Photo looking west across site east to west**

**Figure 14. Photo looking east from low area of site**

**Figure 15. Photo looking west from low point on site**

# Appendix B. Site Investigation Records

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

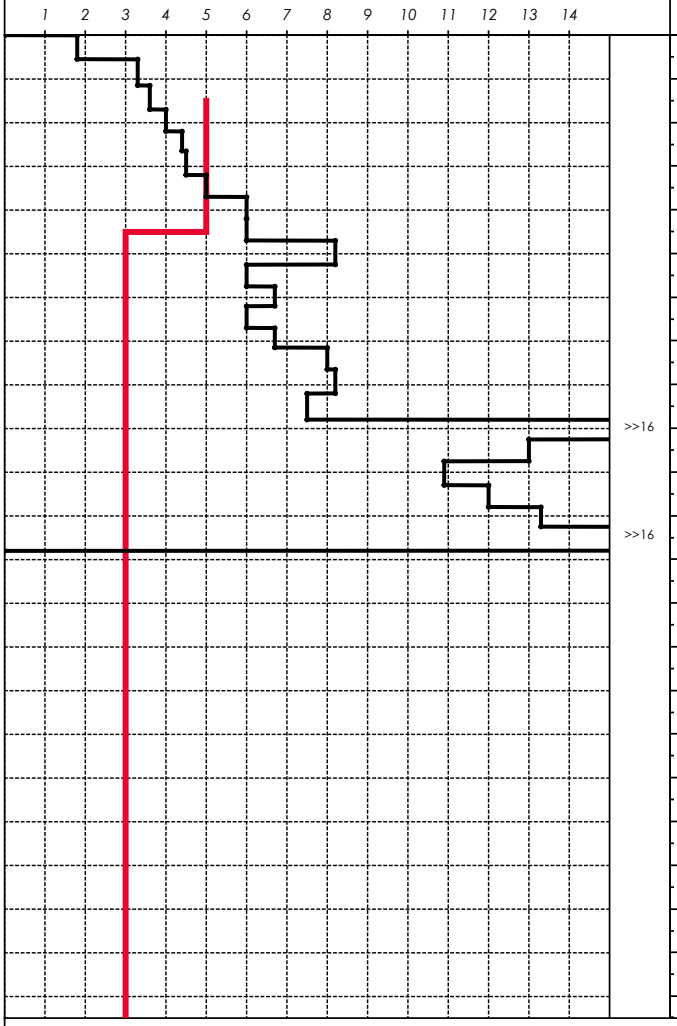
**Technical Category:** N/A

**Lot:** 23 **D.P.:** 142

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1 **Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




01

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Soil Profile

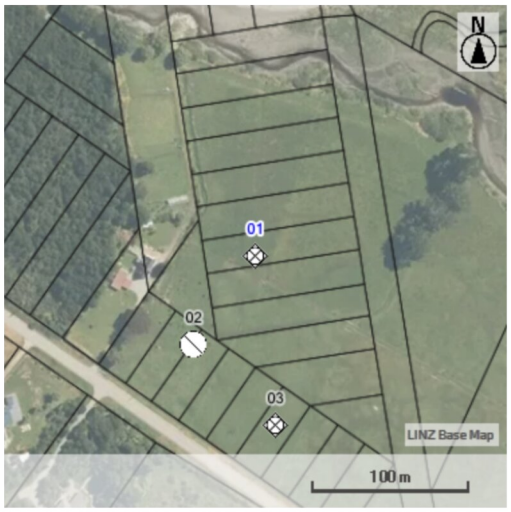
**Test Location 01**

| | |
|---|---|
| TS | SILT; dark brown. Rootlets. |
| | SILT; grey . Large organics and logs. |
| | SILT, with minor sand; grey . Damp. |

**Water**

Groundwater Not Encountered

## Site Plan: (Not to Scale)




## Comments:

Dynamic Cone Penetrometer: Lot 1

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:** 10 9

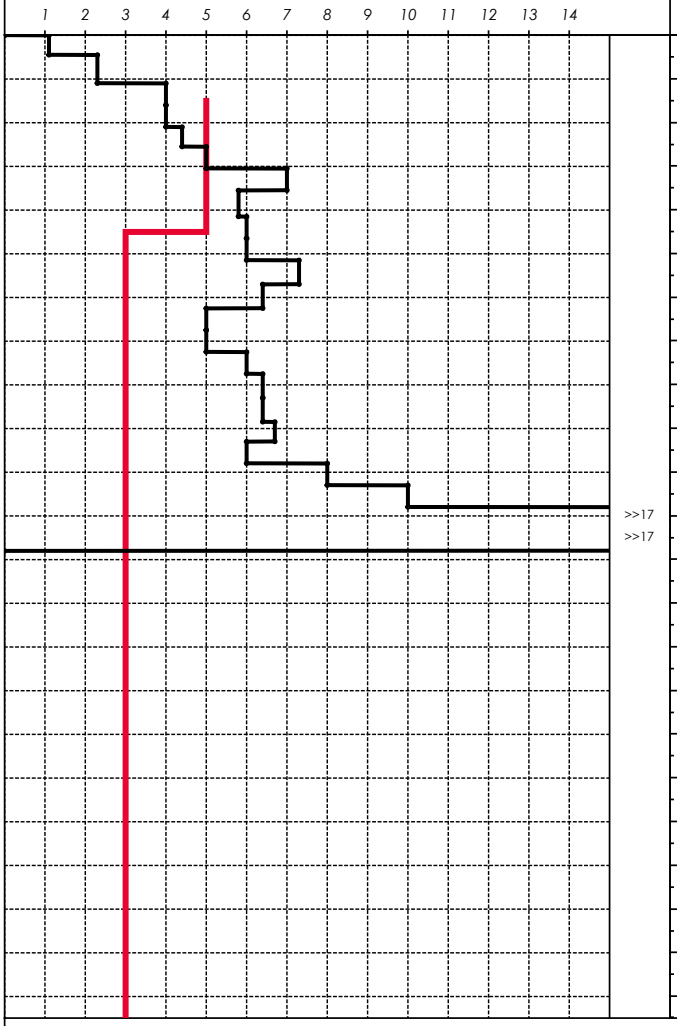
**D.P.:** 142, 142

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results



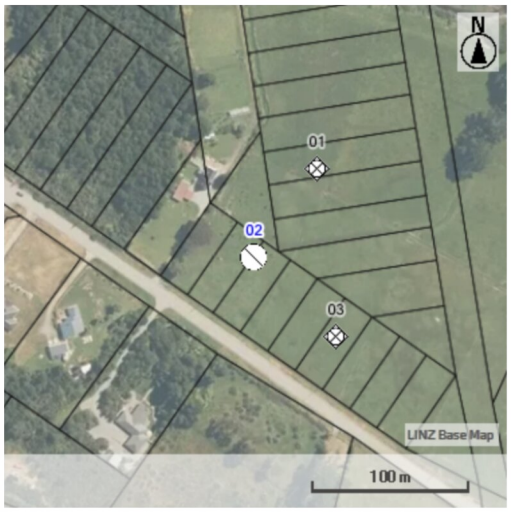

## Soil Profile

Water

02

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

**Site Plan:** (Not to Scale)




## Comments:

Dynamic Cone Penetrometer: Lot 2

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☐ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

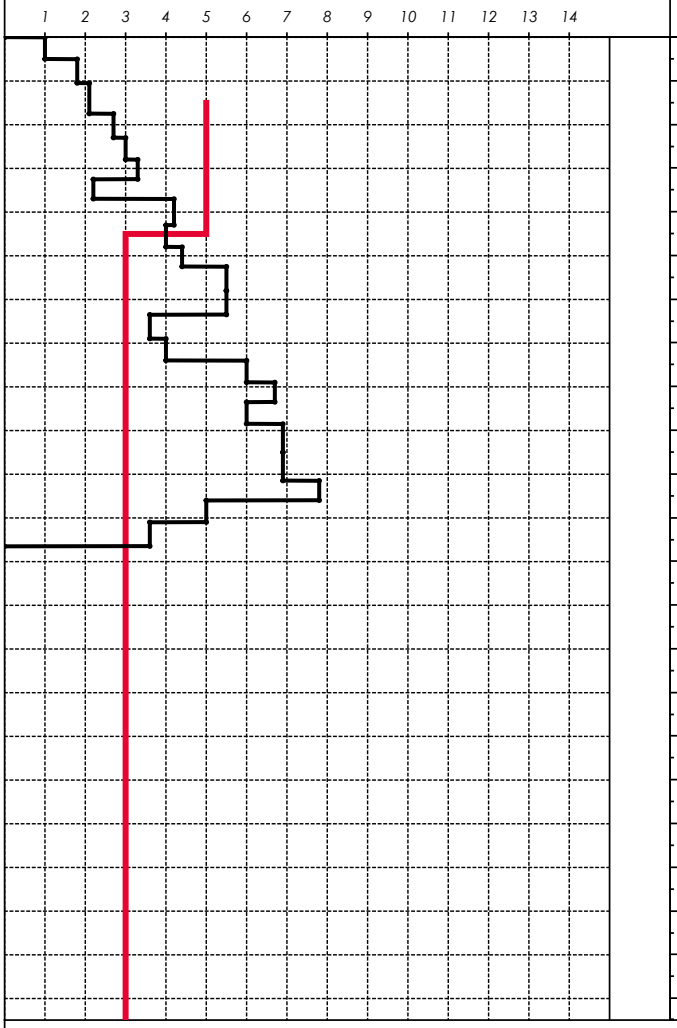
**Technical Category:** N/A

**Lot:** 13 **D.P.:** 142

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1 **Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




03

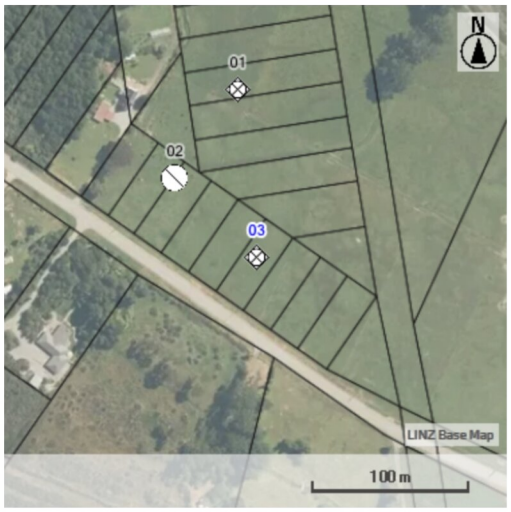
Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Soil Profile

**Test Location 03**

| Depth (m) | Description | Water |
|---|---|---|
| 0.0 | TS | |
| 0.2 | SILT; dark brown. Wet; Rootlets. | |
| 0.4 | SILT, with minor sand; brown . Firm; damp; Rootlets. | |
| 0.6 | SILT, with minor sand; grey . Firm; damp. | |
| 2.8 | 2.70m - 2.70m: Buried log | |
| 3.2 | SAND, with minor silt; grey . Damp to saturated; saturated at 3.3m. | 3.3m |
| 4.4 | | |

## Site Plan: (Not to Scale)




## Comments:

Dynamic Cone Penetrometer: Lot 3

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

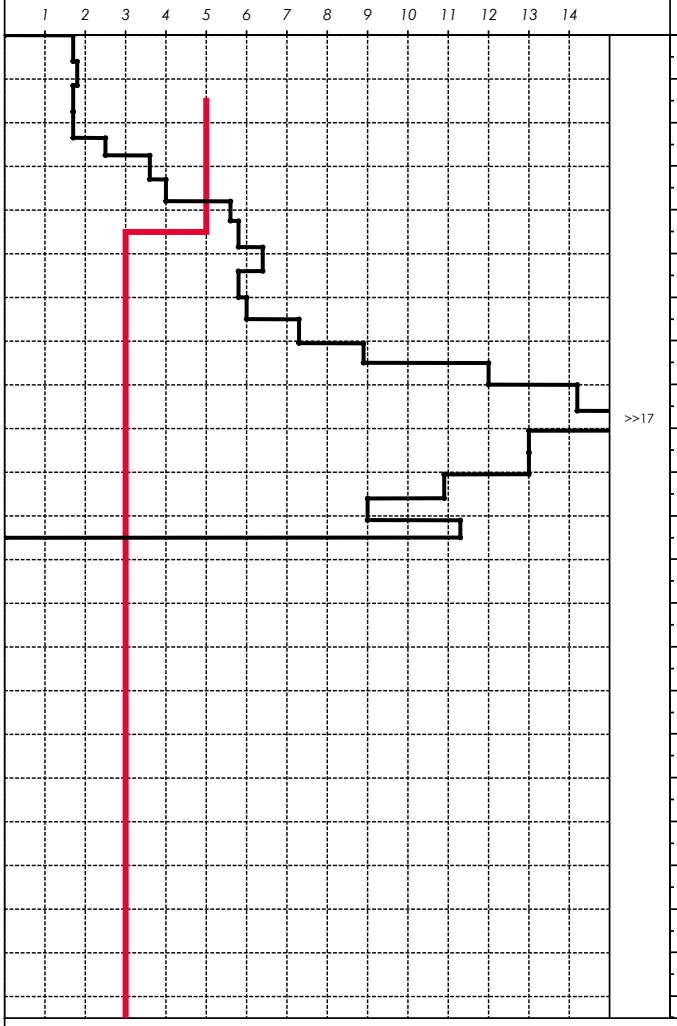
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




04

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Soil Profile

**Test Location 04**

| Depth (m) | Description |
|---|---|
| 0.0 | TS |
| 0.0 – 0.5 | SILT; dark brown. Wet; Rootlets. |
| 0.5 – 1.8 | SILT, with minor sand; brownish grey. Damp; Rootlets to 0.5m bgl. |
| 1.8 – 3.2 | Fine SAND, with minor silt; grey . Damp to saturated. |
| 3.2 | 3.20m - 3.20m: Becoming saturated |

Water: 3.2m

## Comments:

Dynamic Cone Penetrometer: Lot 4

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

## Site Plan: (Not to Scale)


*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

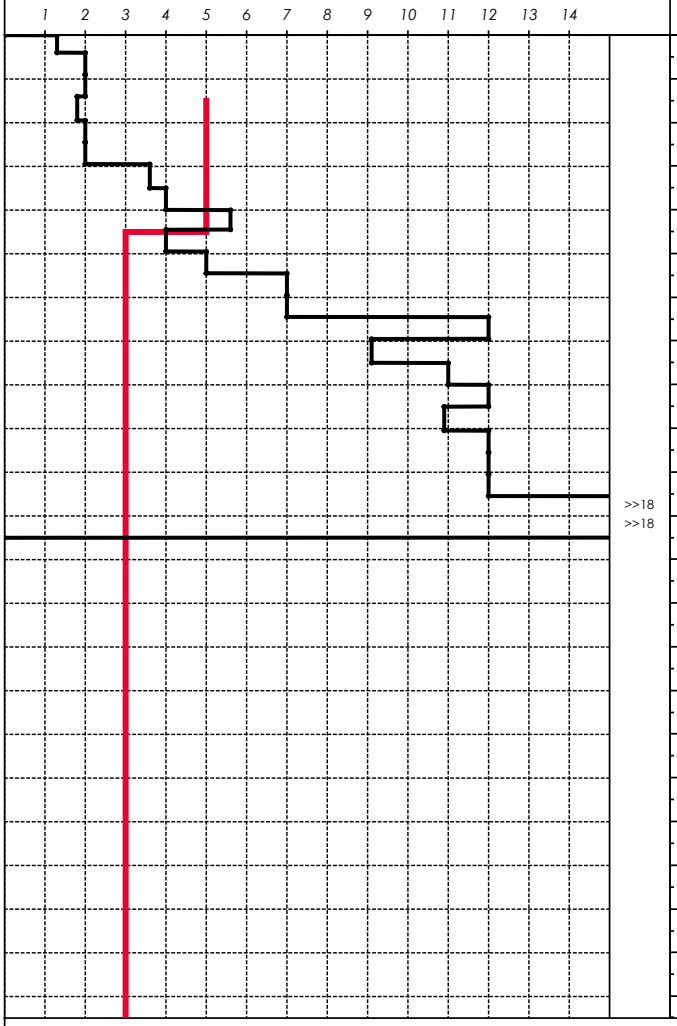
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




## Soil Profile

Water

05

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Site Plan: (Not to Scale)


## Comments:

Dynamic Cone Penetrometer: Lot 5

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☐ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

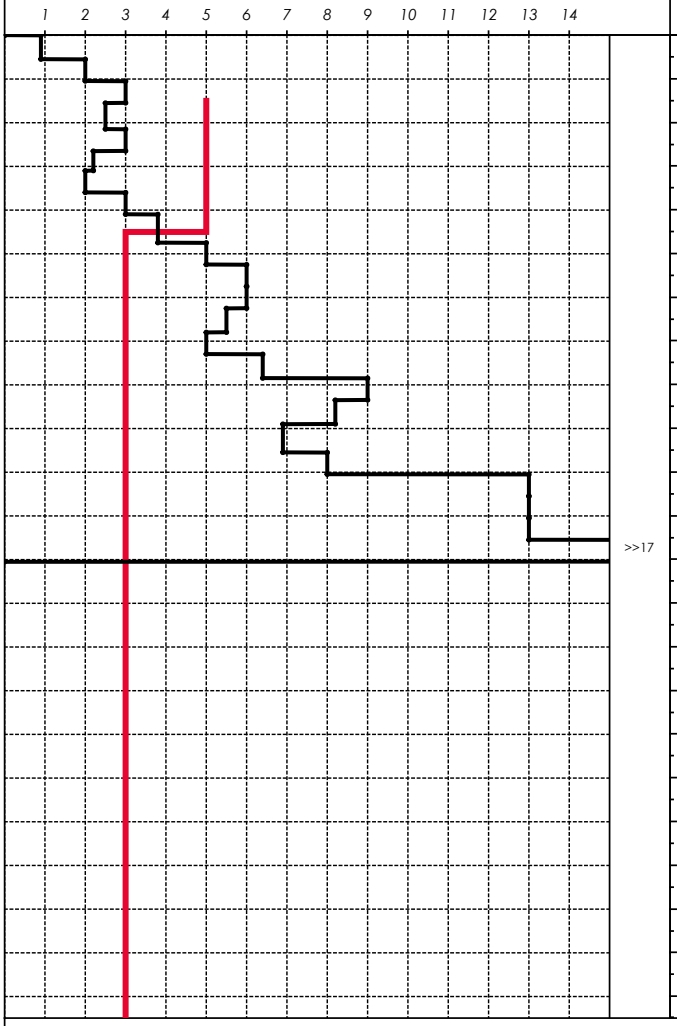
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




06

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Soil Profile

**Test Location 06**

| | Water |
|---|---|
| TS SILT; dark brown. Rootlets. | |
| SILT, with minor sand; brownish grey. Firm; damp. | |
| SILT, with minor sand; grey . Damp. | |
| SAND, with minor silt; grey . Damp to saturated. | |
| SAND, with some gravel; grey . Saturated; gravel, fine; Pea gravels. Becoming saturated at 3.1m bgl. | ▽ 3.1m |

## Comments:

Dynamic Cone Penetrometer: Lot 6

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

## Site Plan: (Not to Scale)


*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

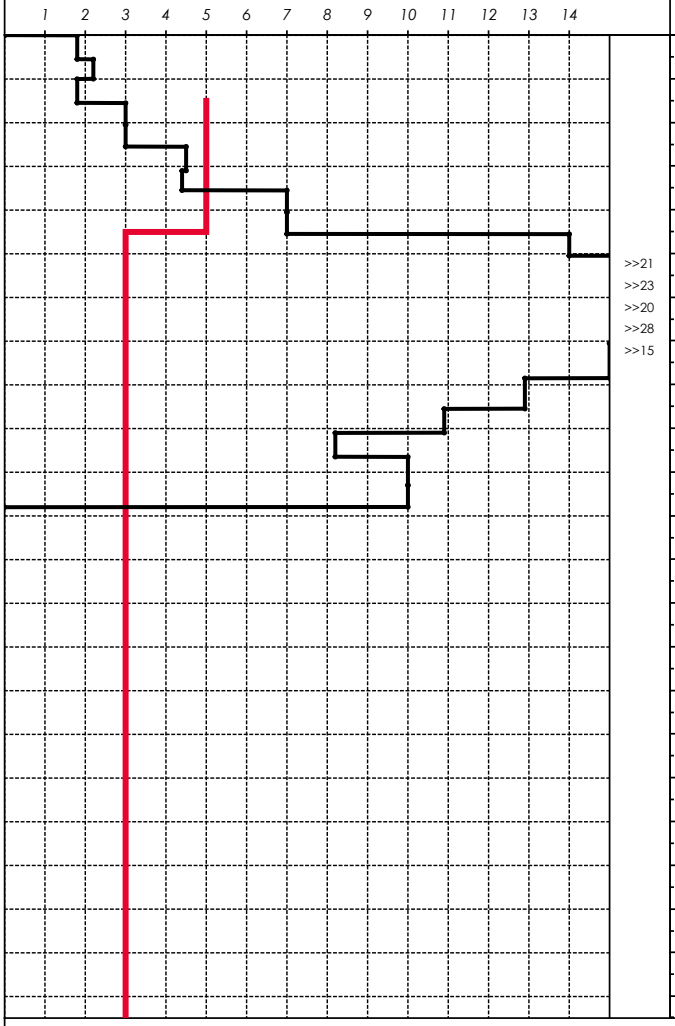
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




Depth (m)

0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4

## Soil Profile

**Test Location 07**

| | |
|---|---|
| TS | SILT; dark brown. Rootlets. |
| | SILT; brown . Damp to wet; Some rootlets. |
| | SILT, with minor sand; grey . Damp. |
| | SAND, with minor silt; grey . Damp. |

**Water**

Groundwater Not Encountered

07

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Site Plan: (Not to Scale)


## Comments:

Dynamic Cone Penetrometer: Lot 7

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

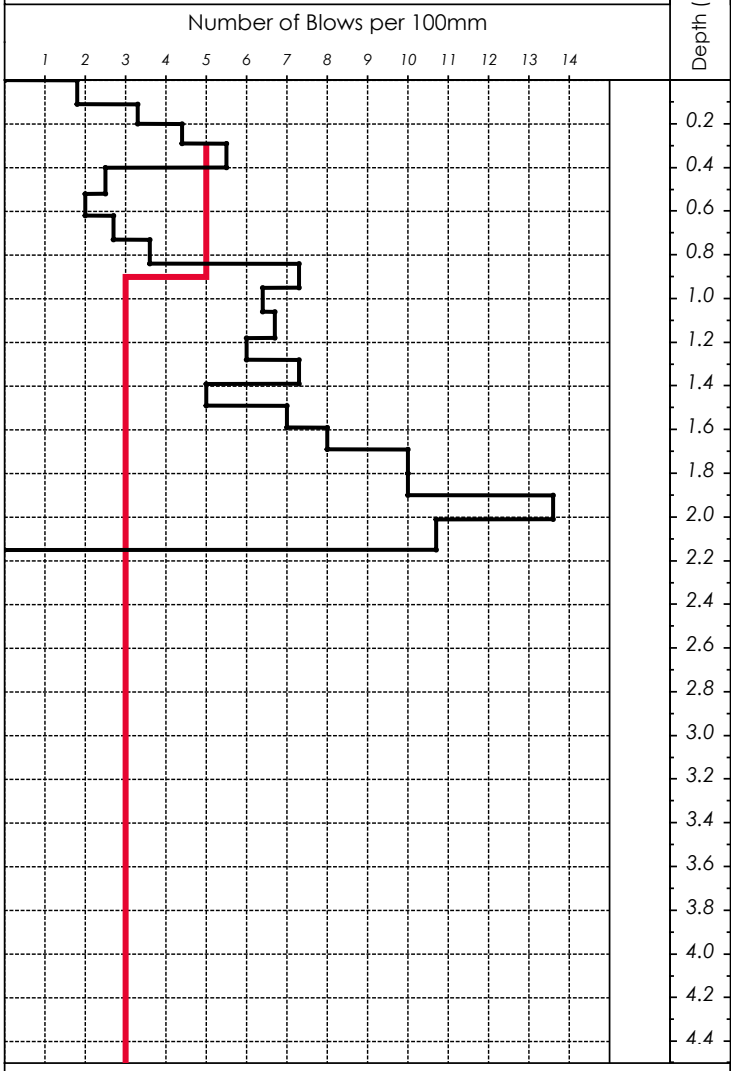
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




## Soil Profile

Water

08

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Site Plan: (Not to Scale)


## Comments:

Dynamic Cone Penetrometer: Lot 8

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☐ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

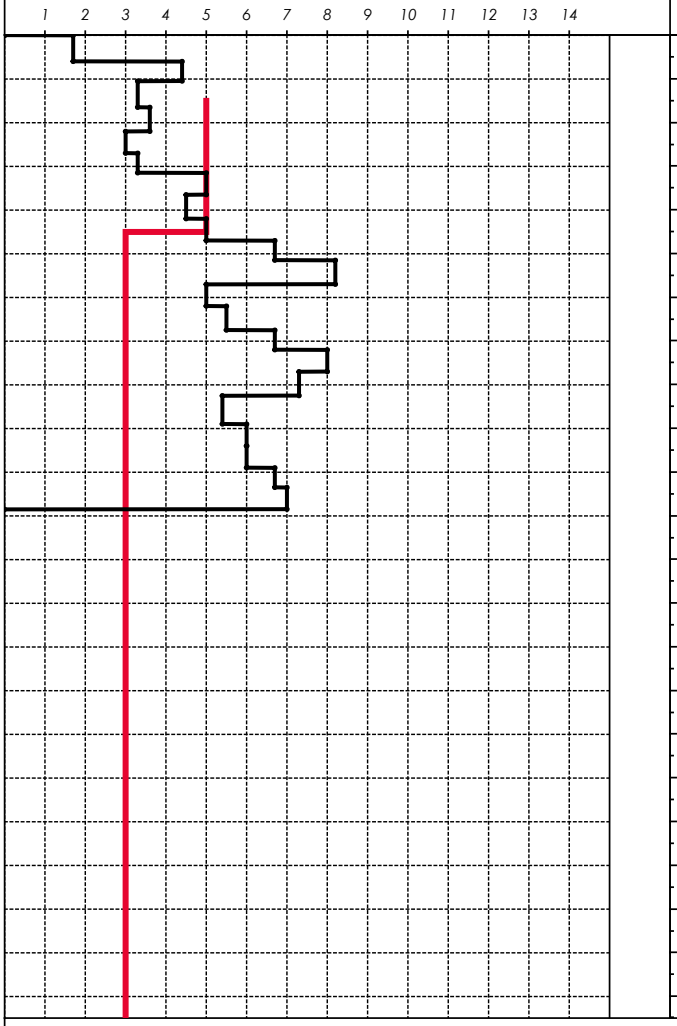
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




09

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Soil Profile

**Test Location 09**

| Depth (m) | Description |
|---|---|
| 0.0 | TS |
| 0.0 – 0.2 | SILT; dark brown. Damp to wet; Rootlets. |
| 0.2 – 0.6 | SILT; brown . Damp. |
| 0.6 – 2.6 | SILT, with minor sand; grey . Damp; Buried log at 2.6m bgl. |
| 2.6 – 3.4 | SAND, with minor silt; grey . Damp. |

**Water:** Groundwater Not Encountered

## Site Plan: (Not to Scale)


## Comments:

Dynamic Cone Penetrometer: Lot 9

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

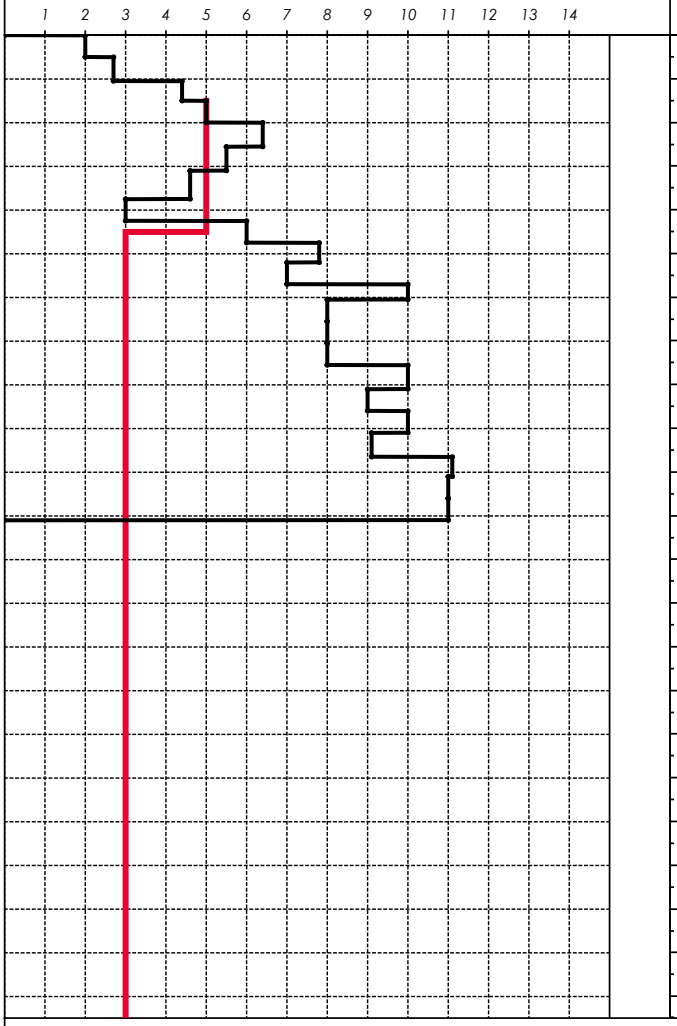
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




10

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Soil Profile

**Test Location 10**

| | |
|---|---|
| TS | SILT; dark brown. Wet. |
| | SILT; brown . Damp. |
| | SILT, with minor sand; grey . Damp. |
| | SAND, with minor silt; grey . Damp. |

**Water:** Groundwater Not Encountered

## Site Plan: (Not to Scale)


## Comments:

Dynamic Cone Penetrometer: Lot 10

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

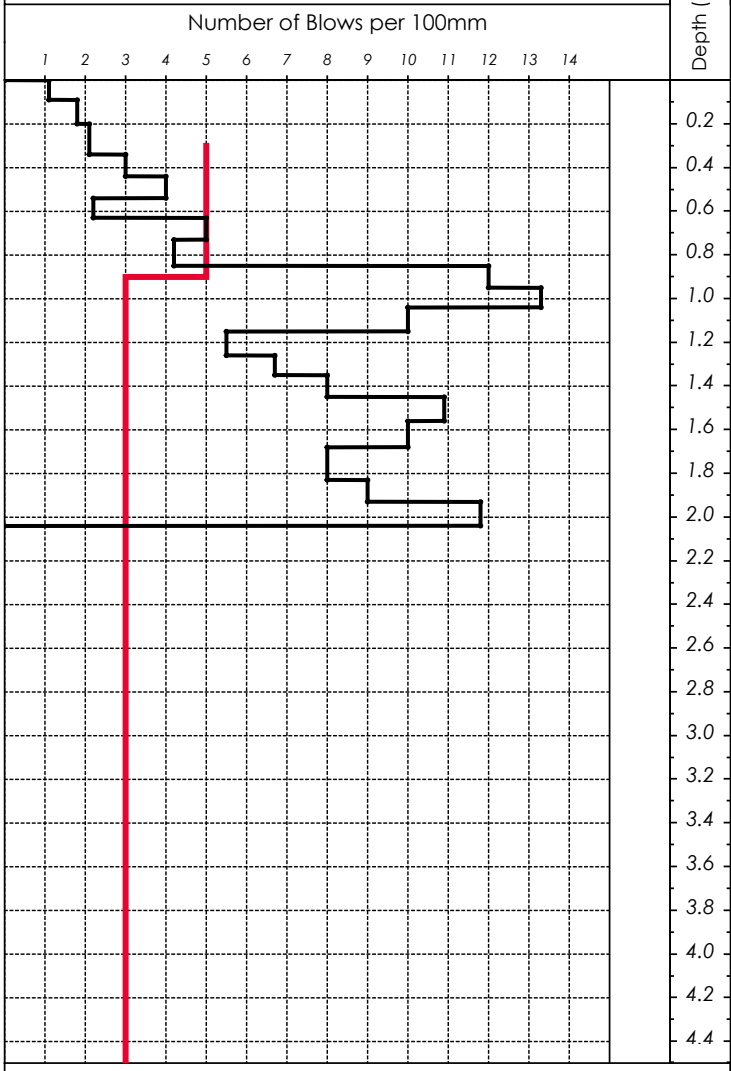
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results



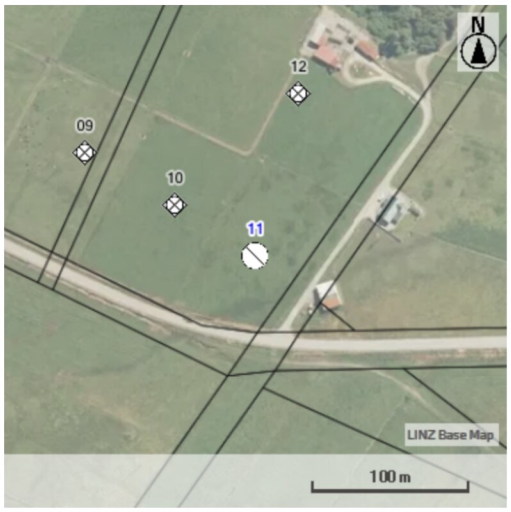

## Soil Profile

Water

11

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Site Plan: (Not to Scale)




## Comments:

Dynamic Cone Penetrometer: Lot 11

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☐ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

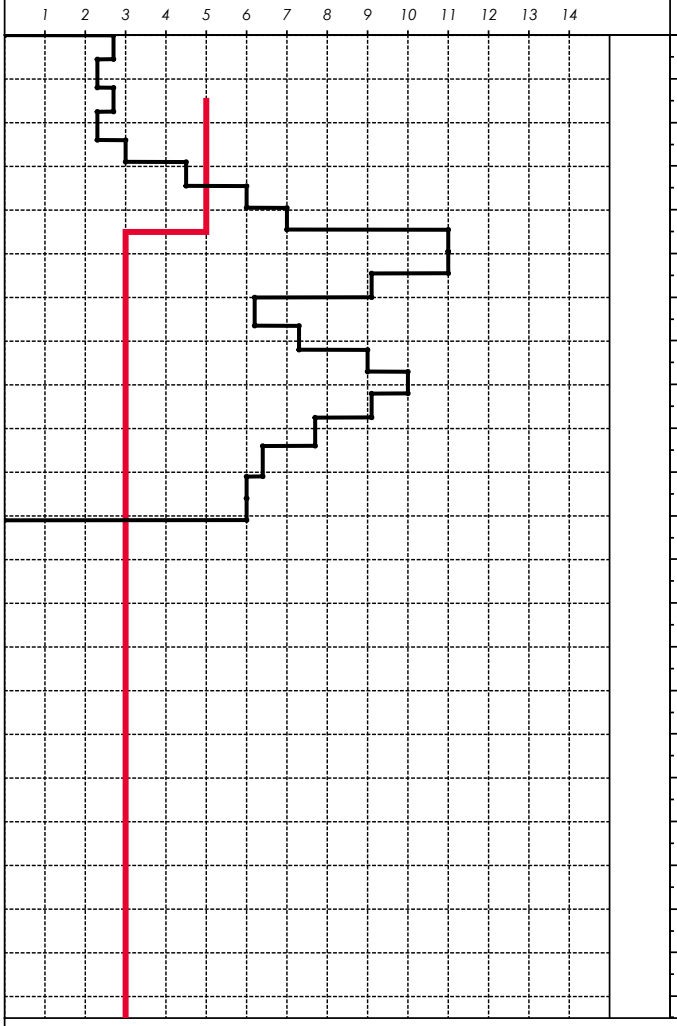
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




12

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Soil Profile

**Test Location 12**

| | |
|---|---|
| TS | SILT; dark brown. Damp to wet; Rootlets. |
| | SILT, with minor sand; grey . Damp. |
| | SAND, with minor silt; grey . Damp. |

**Water**

Groundwater Not Encountered

## Comments:

Dynamic Cone Penetrometer: Lot 12

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

## Site Plan: (Not to Scale)


*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Appendix C. 1.2m Structural Gravel Raft Specification

# Structural Gravel Raft Specification with Single Layer of Geogrid

- The excavation is to extend down to "Good Ground", or as specified in our report, below the building foundations and 1.0m beyond the footprint of the building.
- The base of the excavation shall be clear of any loose material and if necessary, shall be benched and compacted.
- The sides of the excavation are to be no steeper than 2 vertical to 1 horizontal.
- If the excavation base is benched, level the base with compacted AP65 in no more than 200mm thick layers.
- Install one layer of geogrid (Tensar TX160 or similar) to the base of the excavation, extend to the walls of the excavation. Adjacent sheets are to lap a minimum of 450mm.
- Clean sandy gravel AP65 is to be placed and compacted in maximum 200mm thick layers over the geogrid until the required level is achieved.
- The total depth of fill must be a minimum of 1.2m
- When the fill is to be brought above the surrounding ground level, the fill shall be battered at least 1.0m from the building foundation and at a slope no steeper than 1 in 3 (1 vertical to 3 horizontal).
- If the backfill material has not been previously tested, the Contractor shall have a 25kg sample of the backfill material tested at an accredited laboratory for maximum dry density and optimum moisture content. The test results shall be supplied to the engineer for approval at least 24 hours prior to starting backfilling.
- Each layer shall be compacted to a minimum density of 92% and an average of no less than 95% of the maximum dry density achieved in the laboratory tests before the subsequent layer is placed. The test method is the vibrating hammer compaction (NZS 4402: 1988 – Test 4.1.3)

The following inspections are required:

1. Completed excavation prior to placing geogrid;
2. Placed geogrid to ensure laps are correct and it is fully tensioned;
3. Mid depth of compacted gravels; and
4. Completion of the final compacted gravel layer.

The contractor is to contact the engineer 24 hours before they start the excavation so we can arrange the inspections.

The Engineers Contact details are:

Eliot Sinclair & Partners Ltd
Como House 51 Tancred Street
PO Box 298
Hokitika 7842

Phone 03 755 8184 cell 027 224 2635

Email stuart.challenger@eliotsinclair.co.nz

# Appendix D. Statement of Professional Opinion

# SCHEDULE 2A

**STATEMENT OF PROFESSIONAL OPINION ON SUITABILITY**

**OF LAND FOR BUILDING CONSTRUCTION**

Development: Fifteen Lot Subdivision

Developer: Forest Habitats

Location: Arthurstown Road, Hokitika

I, **Stuart Challenger** of **Eliot Sinclair, Hokitika**

Hereby confirm that:

1. I am a geo-professional as defined in section 1.2.2 of NZS 4404:2010 and was retained by the developer as the geo-professional on the above development.
2. The extent of my site investigations are described in the **Eliot Sinclair** report number **510714** dated **29 September 2022**, and the conclusions and recommendations of that document have been re-evaluated in the preparation of this certification.
3. In my professional opinion, not to be construed as a guarantee, I consider that council is justified in granting consent incorporating the following conditions (delete as appropriate):

   ~~(a) The earth fills shown on the attached Plan No. ..... have been placed in compliance with the requirements of the ..... Council and my specification.~~

   ~~(b) The completed works take into account land slope and foundation stability considerations, subject to the appended foundation recommendations and earthworks restrictions as set out in this report.~~

   (c) Subject to 3(a) and 3(b) of this Schedule, the original ground not affected by filling is suitable for erection of buildings designed according to NZS 3604 provided that:

      **i) The recommendations provided in Section 6 of Eliot Sinclair's report reference 510714 dated 29 September 2022 are followed. (Copied below)**

      **ii)** ……..

   ~~(d) Subject to 3(a) and 3(b) of this Schedule, the filled ground is suitable for erection of buildings designed according to NZS 3604 provided that:~~

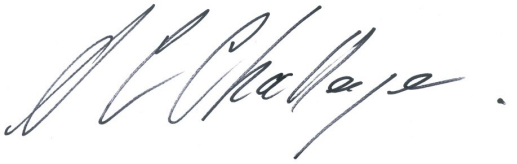
      ~~i) .....~~

      ~~ii) .....~~

   (e) The original ground (not affected by filling) is not subject to erosion, subsidence, or slippage in accordance with the provisions of Section 106 of the Resource Management Act 1991 provided that:

      **i) The recommendations provided in Eliot Sinclair's report reference 510714 dated 29 September 2022 are followed. (Copied below)**

      **ii)** ……..
4. This professional opinion is furnished to the **Westland District Council** and the developer for their purposes alone on the express condition that it will not be relied upon by any other person and <u>does not remove the necessity for the normal investigation and inspection of foundation conditions at the time of erection of buildings.</u>
5. This certificate shall be read in conjunction with Eliot Sinclair's geotechnical report referred to in clause 2 above and shall not be copied or reproduced except in conjunction with the full report.



Signed ..... Date: 29 September 2022

Stuart Challenger

BE (Nat Res) BSc CMEngNZ CPEng Reg. No. 171997.

We recommend any future dwellings within these lots are located towards the south side of the lots close to Arthurstown Road. The minimum floor heights for any proposed dwellings within the subdivision should be above the modelled water depth plus freeboard. Westland District Council should advise on the final floor levels for dwellings within the proposed subdivision as part of the consenting process.

Foundations shall comprise of one of the following systems:

Gravel raft with TC2 slab foundation

Gravel raft with Type 2A surface structure

Driven timber piles

Appendix B: Eliot Sinclair response to the WDC request for further information and Hutchinson Consulting Engineers Report dated 4 October 2022

Hokitika Office
Como House
51 Tancred Street
PO Box 298
Hokitika 7810
+64 3 755 8184
eliotsinclair.co.nz

16 February 2023

Forest Habitats Limited
C/- MacDonell Consulting Limited
17 Cliffs Road
St Clair
Dunedin 9012

Our reference: 510714

Via Email: barry@macdonellconsulting.co.nz

Dear Barry

## 117 Arthurstown Road Request for Further Information

We respond to the Westland District Council RFI as follows:

Natural Hazards

18. Whilst our report demonstrates that there could be a risk, that risk will be mitigated by having a no build line so that no dwellings are built in the area of greatest risk, and by having the floor levels on the remaining sites being at least 400mm above the projected flood level.

    Through this review we have slightly amended our no-build zone increasing the area that we do not recommend building in from our report dated 30 September 2022. The amended no-build zone is attached with this letter.

    The flood level chosen is that modelled by Land River Sea in 2018 for the 1 in 100 year event including climate change (2100) RCP Scenario 6.0 with a 1m sea level rise and 0.4m Storm Surge. To this we have added a 400mm free board.

    The recommend minimum floor heights are shown in Table 1, below. To calculate these, we divided the site into 100m grids and assessed the flood height (based on Sheet GE- 06 from the Hutchison report), to be conservative we took the highest flood height in each quadrant and added 400mm free board, which gives the minimum floor height in that quadrant.

**Table 1. Recommended minimum Finished floor heights for each Lot.**

| Lot | Finished floor height. m | Height above ground level (highest contour on lot) m |
|---|---|---|
| 1 | 5.02 | 0.0 |
| 2 | 5.15 | 0.15 |
| 3 | 5.15 | 0.65 |
| 4* | 5.75 | 1.25 |

| Lot | Finished floor height. m | Height above ground level (highest contour on lot) m |
|---|---|---|
| 5* | 5.75 | 1.25 |
| 6 | 5.70 | 1.20 |
| 7 | 5.70 | 1.2 |
| 8 | 5.66 | 1.16 |
| 9 | 5.66 | 1.16 |
| 10 | 6.04 | 1.04 |
| 11 | 6.13 | 1.13 |
| 12 | 6.04 | 1.04 |

* We recommend that the building for Lots 4 and 5 be located as close to Arthurstown Road as practical.

19 We do not consider it appropriate to designate building platforms to each lot as the lot areas are all greater than 0.6Ha, and future purchasers may decide to build in a different location or to a different shape or size to that approved. We feel it is better to prescribe a minimum finished floor level and let the future purchasers decide where they will build.

20 As part of the subdivision works, there will be minimal earthworks undertaken, being formalisation of entranceways and minor roading improvements. As pointed out in our response to point 19, it is not proposed to form the building platforms as part of the subdivision development.

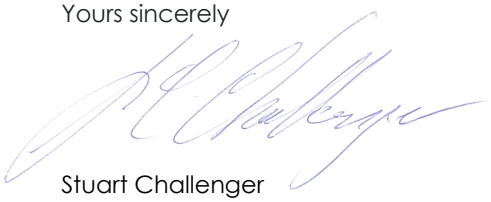
Whilst it is possible to form building platforms by excavation and backfilling, as the height above the surround ground would range from 0m to 1.25m it may be better for some of the dwellings to be on a suspended timber floor on driven timber piles, so excavation and backfilling may not be necessary. Should the potential purchaser wish to build a dwelling with a concrete floor, then an excavation and backfill would be required. This work would be undertaken following the subdivision of the land and in order to comply with the permitted activity status the minimum volume of earthworks will depend on the lot size, but for the smallest lot 0.61Ha, the annual volume of earthworks shall be less than 3050m³ (Rule 3 of the WCRC Land and Water Plan). Allowing for a total depth of fill of 2.4m (1.2m down and 1.2m up) means that a building platform with an area of at least 1,000m² can be formed on the site as part of the permitted activities. Any such excavation and backfilling would also need to comply with the sediment control measures, however, those works would not be undertaken as part of the subdivision.

21 As stated in point 20, there will be minimal earthworks as part of the subdivision, and we do not anticipate that any erosion control measures will be required. However, in case we find that earthworks are required as part of the road formation then a stabilised entrance will be prepared and if necessary silt fences installed. We enclose an typical

details for Erosion and sediment control to demonstrate what will be undertaken as part of the subdivision if required.

Please contact me if you require any further information.

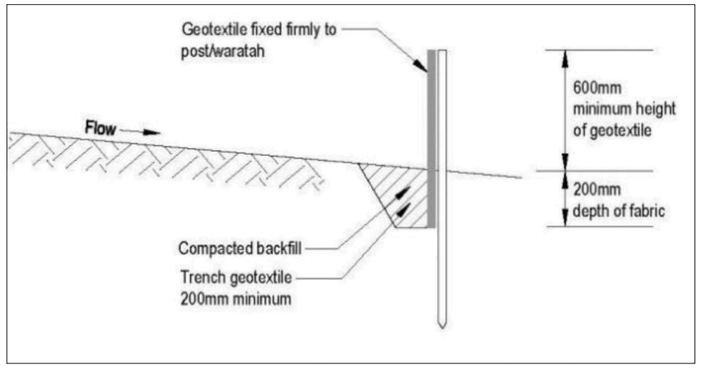
Yours sincerely



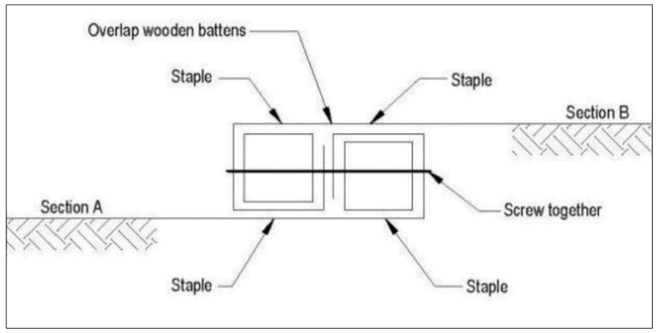
Stuart Challenger
Civil Engineer | Branch Manager, Hokitika
BE NatRes BSc CMEngNZ CPEng
stuart.challenger@eliotsinclair.co.nz

Encl. Erosion and Sediment Control Details

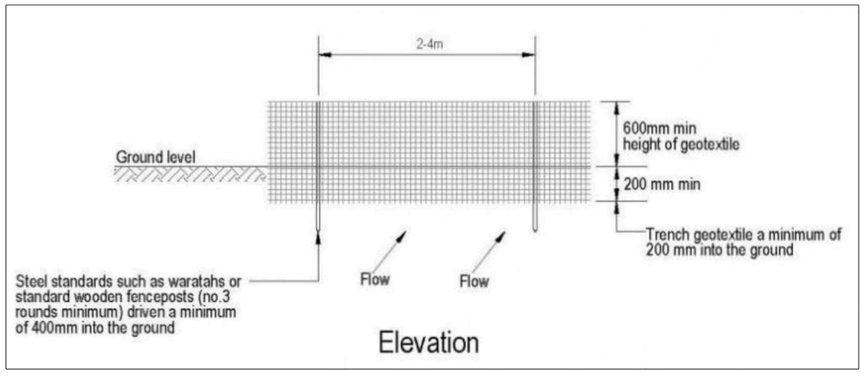
Amended No-Build Zone



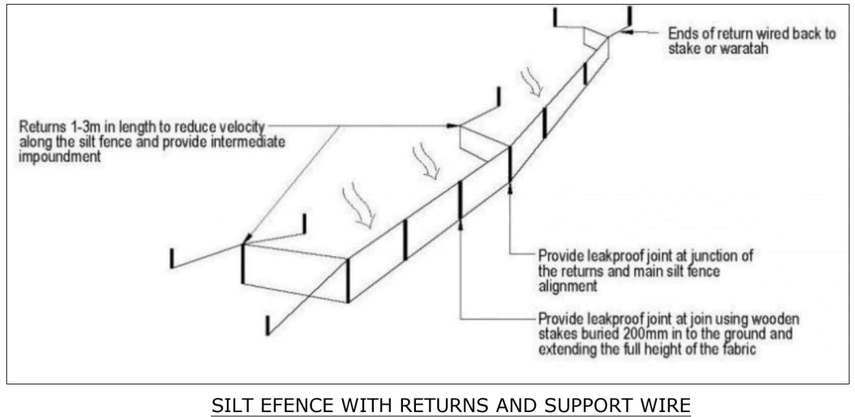

SILT FENCE CROSS SECTION



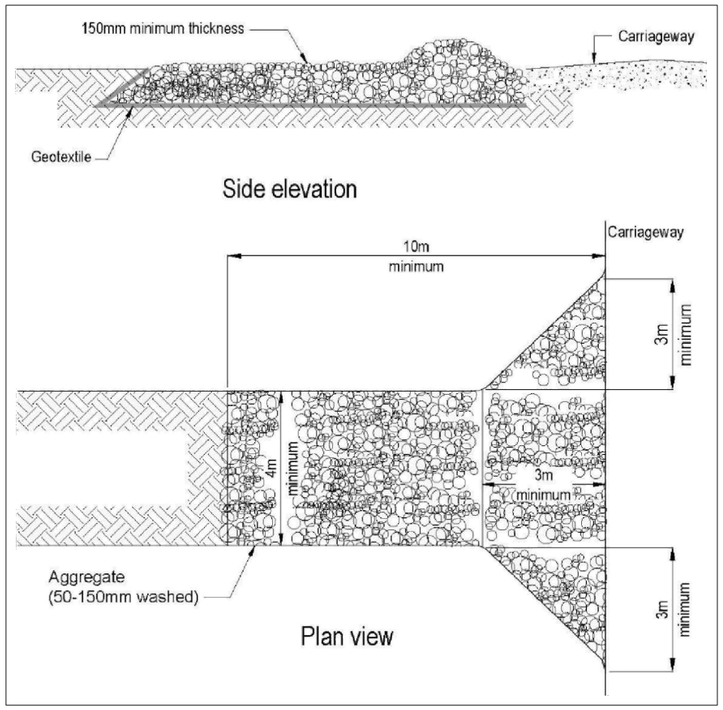

SILT FENCE STANDARD FABRIC JOINT



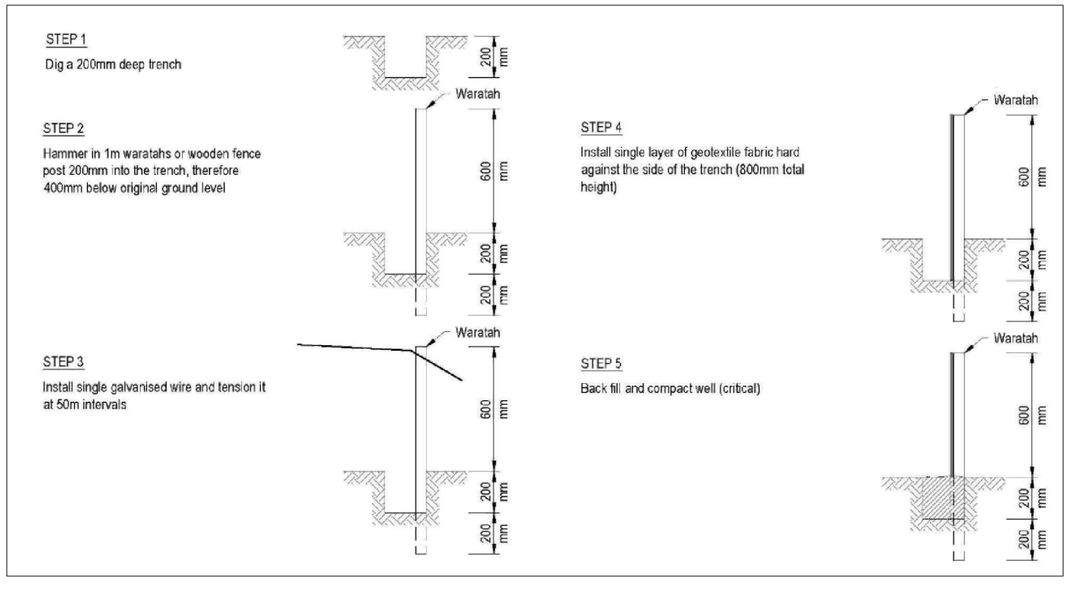

SILT FENCE ELEVATION




SILT EFENCE WITH RETURNS AND SUPPORT WIRE




STABILISED SITE ENTRANCE




SILT FENCE INSTALLATION



NOTES
1. Contractors to verify all dimensions and the location of all underground services on site prior to commencing work.
2. Unless noted otherwise, all work shall be undertaken in accordance with the NZBC and any relevant Territorial Authority Engineering Standards and Specifications as a minimum standard.

GENERAL EROSION SEDIMENT NOTES:

1. ALL EROSION AND SEDIMENT CONTROL MEASURES MUST BE INSTALLED IN ACCORDANCE WITH THE ENVIRONMENT CANTERBURY EROSION AND SEDIMENT CONTROL TOOLBOX FOR CANTERBURY & COMPLY WITH ALL RESOURCE CONSENT CONDITIONS RELATING TO THE PROJECT.
2. EROSION AND SEDIMENT CONTROL MEASURES TO BE INSTALLED PRIOR TO COMMENCEMENT OF EARTHWORKS.
3. ALL PERSONNEL INCLUDING SUB-CONTRACTORS, MUST BE FAMILIAR WITH ALL RELEVANT CONSENT AND PLAN REQUIREMENTS. A COPY OF THE EROSION AND SEDIMENT CONTROL PLAN MUST BE KEPT ON SITE AT ALL TIMES.
4. ALL EROSION AND SEDIMENT CONTROL STRUCTURES ARE TO BE INSPECTED EACH WORKING DAY AND MAINTAINED IN GOOD WORKING ORDER. THE EFFECTIVENESS OF THE MEASURES IS TO BE REVIEWED IMMEDIEALITY AFTER ANY SIGNIFICANT RAIN.
5. IF NECESSARY, SEDIMENT CONTROL MEASURES MUST BE ALTERED TO PREVENT EXCESS SEDIMENT DISCHARGING OFF SITE.

DUST CONTROL NOTES:

1. THE CONTRACTOR IS TO HAVE ACCESS TO A SUITABLE WATER SUPPLY ONSITE TO BE USED TO MITIGATE DUST. WHERE APPROPRIATE CONTROL DUST BY SPRAYING WATER LIGHTLY ON EXPOSED AREAS OF SOIL.
2. NATURAL OR CONSTRUCTED WIND BREAKS OR BARRIERS CAN REDUCE WIND VELOCITY THROUGH A SITE AND THEREFORE REDUCE THE POSSIBILITY OF SUSPENDED PARTICLES. WIND BREAKS CAN COMPRISE OF TREES OR SHRUBS LEFT IN PLACE DURING SITE CLEARING OR CONSTRUCTED BARRIERS SUCH AS A WIND FENCE, TARP CURTAIN, HAY BALES, CRATE WALL OR SEDIMENT FENCE.
3. STABILISED MATRIX CHEMICALS ARE A QUICK AND EFFECTIVE METHOD TO PROVIDE MEDIUM TERM SOLUTIONS TO DUST CONTROL. THIS METHOD REQUIRES THE SPREADING OF CHEMICALS TO GLUE SMALLER SOIL PARTICLES TOGETHER, TO FORM LARGER WIND RESISTANT PARTICLES. THERE ARE VARIOUS DUST SUPPRESSANT CHEMICALS AVAILABLE, HOWEVER ONLY CHEMICALS THAT HAVE BEEN GRANTED A GLOBAL RESOURCE CONSENT BY ECAN SHALL BE USED ON THIS SITE.

STOCKPILE NOTES:

1. STOCKPILE LOCATIONS TO BE CONFIRMED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
2. STOCKPILES WILL NEED TO BE MOISTENED BY IRRIGATION OR STABILISED USING POLYMER CHEMICAL DUST SUPPRESSANTS OR VEGETATION UNTIL THEY ARE CONSOLIDATED TO A SUFFICIENT DEGREE TO PREVENT EROSION OR DUST.
3. THE SIDE SLOPE WILL BE KEPT TO A MINIMUM BUT WILL NOT BE GREATER THAN THE NATURAL SLUMP ANGLE OF THE DRY MATERIAL.

VEHICLE ACCESS NOTES:

1. ANY TRACKING OF MATERIAL MUST BE AVOIDED AND IF THIS DOES OCCUR IT MUST BE CLEANED UP AS SOON AS POSSIBLE.
2. SHAKER RAMPS CAN BE USED PROVIDED THEY ARE A MINIMUM OF 5 M LONG TO ALLOW AT LEAST ONE FULL REVOLUTION OF A TRUCK TYRE. THE SHAKER RAMP MUST BE DEEP ENOUGH SO THAT THE MATERIAL DROPPED FROM ONE VEHICLE IS NOT PICKED UP BY THE NEXT.

| REV. | DRAWN | DATE | NOTE |
|---|---|---|---|
| A | sccc | 15.02.23 | Preliminary |

CLIENT

**FOREST HABITATS LIMITED**

| | |
|---|---|
| DESIGNED | scc |
| DRAWN | scc |
| REVIEWED | jf |
| APPROVED | 15.02.23 scc |
| STATUS | PRELIMINARY |
| SCALE | N.T.S. |

## Proposed Subdivision

117 Arthurstown Road
RC 220120

**Erosion and Sediment Control Measures Typical Details**

| PROJECT | SET | SHEET | REV. |
|---|---|---|---|
| 510714 | C1 | 01 | A |

eliot sinclair


Ferry Road
Arthurstown Road
Juan Road
East Road

# FOREST HABITATS LTD

# 117 ARTHURSTOWN ROAD, HOKITIKA

**Prepared for Forest Habitats Ltd**

**October 2022 Ref L24312c**

Hutchinson
CONSULTING ENGINEERS

# Forest Habitats Ltd

# Engineering Report
# 12 Lot Rural Residential Subdivision

# 117 Arthurstown Road
# Hokitika


Prepared by Matt Symons
**ENGINEER**

Hutchinson Consulting Engineers Ltd
P O Box 150, Orewa 0946
154 Centreway Road, Orewa 0931

Reviewed by Paige Farley
**CIVIL MANAGER**

+64 9 426 5702
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www.hc.co.nz

Approved by Ian Hutchinson
**MANAGING DIRECTOR**



**Date** 04 October 2022
**Status** Version 3

**Contents**

Our Ref: L24312c

04 October 2022

MacDonell Consulting Ltd
17 Cliffs Road
St Clair
Dunedin 9012

Dear Barry

**RE: 12 LOT RURAL RESIDENTIAL SUBDIVISION AT 117 ARTHURSTOWN ROAD, HOKITIKA**
**FOR FOREST HABITATS LTD**

## 1.0 Introduction

Further to your request, this office has investigated the engineering requirements for the proposed rural residential subdivisional development at 117 Arthurstown Road, Hokitika.

It is proposed to subdivide 12 lots varying in size from 6223 m² to 10253 m² from the underlying parcels of land. All lots aside from one are serviced from Arthurstown Road with Lot 12 gaining access from East Road.

## 2.0 Site

The 19 hectare (or there-about) site is located on the northern side of Arthurstown Road approximately 1.0 km east of its intersection with Ruatapu Road (SH6), Hokitika. The property is on the southern side of the Hokitika river mouth. The site comprises pastural grazing and is relatively level at an elevation of between around RL3.0m and RL5.0m. The site drains gently towards the north to the Hokitika River. The site is subject to flood inundation during peak river flood flows.

## 3.0 Earthworks

As part of the proposed development, flood free building platforms will be created on each lot. Based on the flood flow analysis detailed in Section 5.0 of this report the peak flood flow is expected to reach a maximum elevation of around RL5.5m. The building platforms should be constructed to at least this elevation.

Given that the natural ground levels vary from around RL3.0m to RL5.0m the earthfilling requirements will average around 1200m³ per site to form a 30m x 30m flood free building platforms to RL5.5m on each lot. Given that there are 12 platforms to be constructed a total earthworks compacted fill volume of around 14,000m³ will be required.

## 4.0 Stormwater

The only stormwater works to be completed on the site is the installation of the roadside culvert crossings to accommodate the new entranceways into the individual lots and the clearing out of original farm drains to improve surface drainage.

## 5.0 Potential Inundation

We have reviewed the West Coast Regional Council report Hokitika River Hydraulic Modelling and Flood Hazard Mapping dated 10th June 2020.

https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Westland%20District/Hokitika/2020_LRS_Hokitika%20River_Hydraulic%20modelling%20and%20flood%20hazard%20mapping_v2-10-12-2020%20optimized%20for%20web.pdf

Assuming Scenario 6 for the flood mapping reporting, 100 Year, Climate Change Scenario RCP6.0 (2100), 1m Sea Level rise including 400mm of storm surge the site will be in the range of around existing ground level to around 2m below water during the peak flood flow events.

The topographical survey plan of this site prepared by Chris J Coll Surveying Ltd indicates the majority of the site is around RL3.0m to RL5.0m. The Hokitika River Flood Modelling report indicates that the November 2018 Flood Debris Levels in the vicinity of the site were to an elevation of RL4.83 (refer Appendix A), essentially a good part of the subdivision site remained flood free during this storm. Refer attached engineering plan A3-24312 RC GE-04.

The reason for the conservative flood free building platform level of RL5.5m is that the flood modelling takes into effect sea level rise, global warming and storm surge contemporaneously.

The 1 in 100 year event including climate change (2100) RCP Scenario 6.0 with a 1m sea level rise and 0.4m Storm Surge the site inundates to 0.0m to 2.0m flood depth, refer Appendix B.

The flood depth model has been superimposed over the topographical model of the proposed subdivision and flood elevations typically range from around RL4.5m at the western end of the proposed development to around RL5.5m at the eastern end of the proposed development. There are outlier peaks of up to around RL6.0m in certain areas however this is not representative of the RL5.5m average over the site.

Flood free building platforms should be constructed to a minimum elevation of RL5.5m. Finished floor levels of habitable space should be set no lower than RL6.0m however all future building sites should be assessed at the time of building consent to ensure the higher modelled flood levels above RL5.5 are not applicable to that particular site. Finished floor levers of future

habitable dwellings should be constructed no lower than 500mm above the inundation level for that particular site.

The same flood modelling report defines flood risk on the Hazard Map for most of the site as H1 and H2, generally safe for vehicles, people buildings, and unsafe for small vehicles respectively, refer Appendix C.

Given the inundation potential for the site and intended use the proposed development is appropriate and the potential flood risk to the activity is low particularly given the building sites will be elevated above the flood risk.

This office has prepared an existing ground level above RL4.0m plan, refer A3-24312 RC GE-08. This plan indicates the land area that is most suitable for development to provide platform levels to a minimum elevation of RL5.5m.

Although the imperviousness of the future sites will increase from pasture to portions of increased impermeability, any adverse effect will be mitigated in that the site is at the lowest portion of the catchment close to the discharge point and any analysis of increased discharge would be offset by the flood plain evident in any peak flood flow event bring discharged before the time of concentration is reached. Imperviousness has little effect if the site is theoretically already flooded also.

## 6.0 Roading

The proposed subdivisional development will be serviced from Arthurstown Road and East Road, Arthurstown Road is formed and sealed however East Road is unsealed. East Road should be upgraded to a sealed standard to the entrance to the proposed Lot 12.

The roadway will be constructed to a 500mm deep roading pavement, 200mm compacted depth of basecourse over 300mm compacted depth of subbase over a subgrade with a CBR of at least 3.

## 7.0 Summary

The site is suitable for its intended use provided flood free building platforms are constructed to a minimum elevation of RL5.5m and any future habitable space is constructed no lower than RL6.0m.

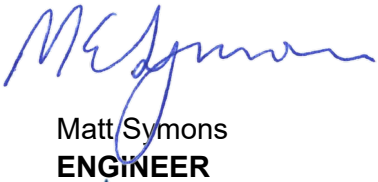
Consideration should be given to certain areas of the site where theoretical flood levels are above RL5.5m and the minimum finished floor levels adjusted accordingly.

Should you wish to discuss any aspects of the above information, please contact this office.

We trust this meets with your approval.

Yours faithfully,

**HUTCHINSON CONSULTING ENGINEERS LTD**



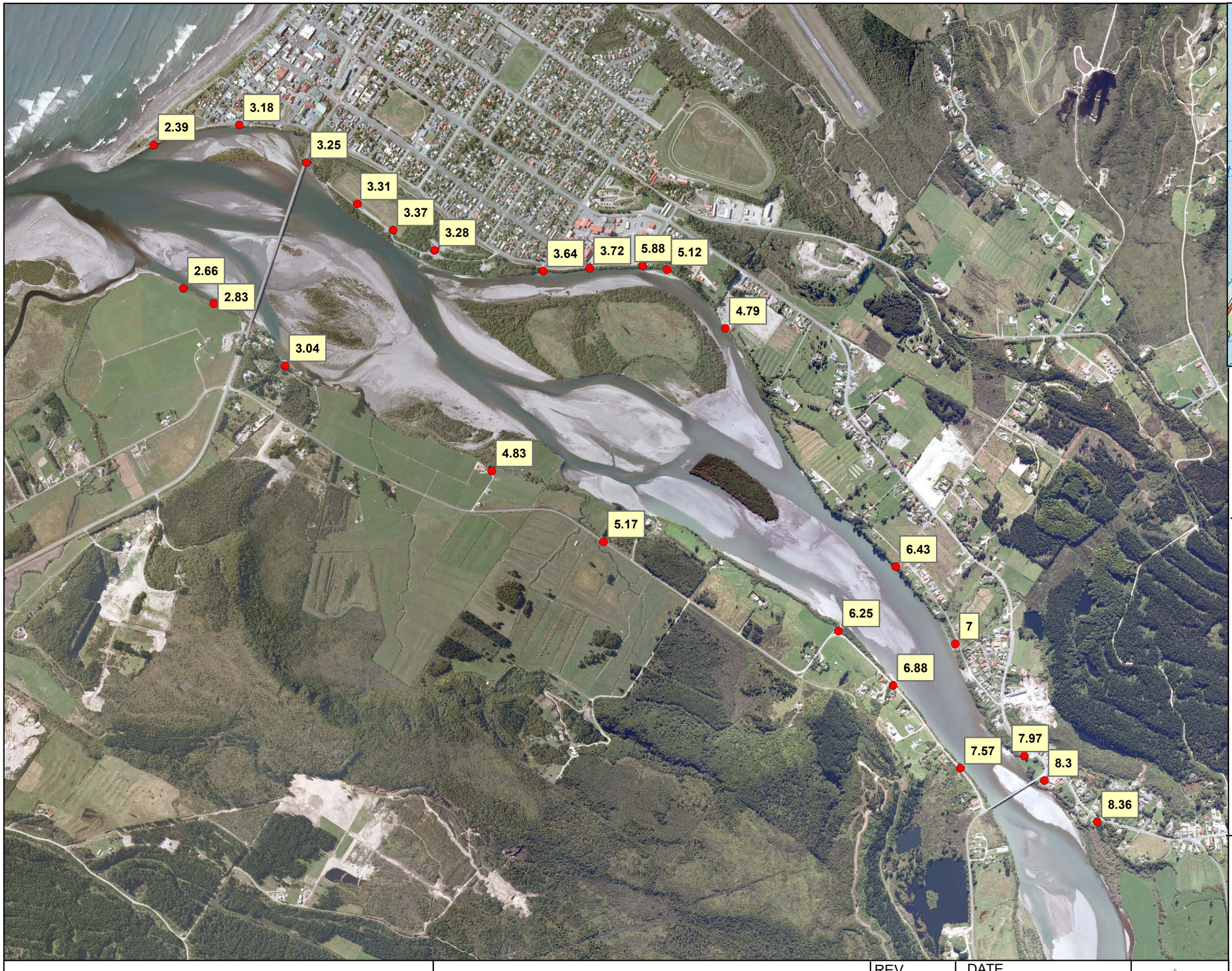
Prepared by Matt Symons
**ENGINEER**

Reviewed by Paige Farley
**CIVIL MANAGER**

Approved by Ian Hutchinson
**MANAGING DIRECTOR**

**APPENDIX A**

Hokitika River Flood Modelling – Debris Level November 2018 Flood Event





LANDRIVERSEA CONSULTING

## Legend

- Debris Levels (Nov 2018)



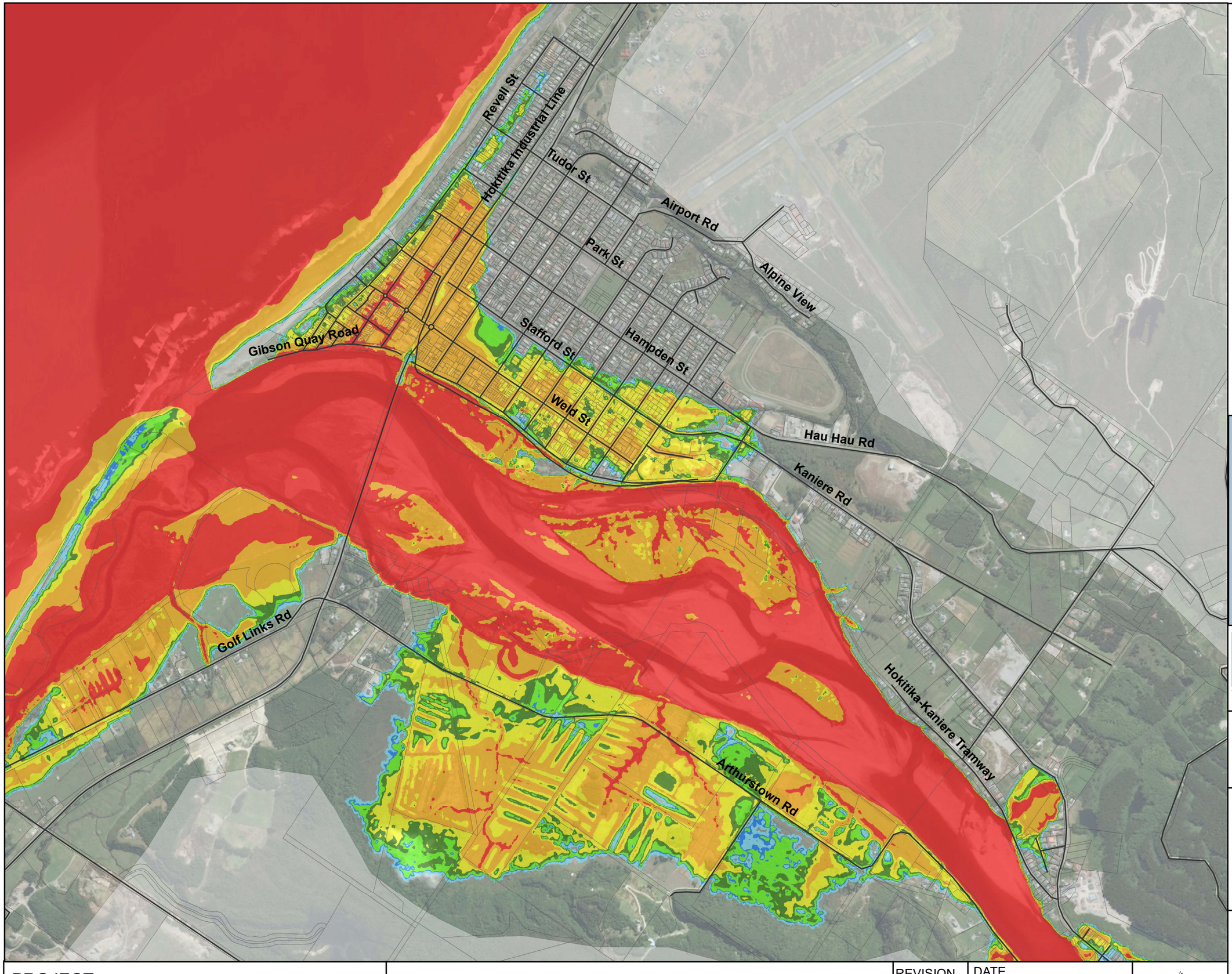
PROJECT
**Hokitika River Flood Modelling**

MAP TITLE **Recorded Debris Levels from November 2018 Flood Event**

| REV | DATE |
|---|---|
| **01** | **16 September 2019** |
| A3 SCALE **1:15,000** | AUTHOR **Matthew Gardner** |

N

**APPENDIX B**
Hokitika River Flood Modelling – Peak Depth Map




# Legend

Roads

Property Boundary

**Peak Depth (m)**

- 0
- 0 - 0.05
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2+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THE WEST COAST REGIONAL COUNCIL

Map1 of 3

0 0.25 0.5 1

Kilometers



PROJECT
**Hokitika River Flood Modelling**

MAP TITLE
**PEAK DEPTH MAP**
**1 in 100 year event including climate change (2100)**
**RCP Scenario 6.0, 1m Sea Level Rise, 0.4m Storm Surge**

| REVISION | DATE |
|---|---|
| **01** | **02 June 2020** |
| A3 SCALE | AUTHOR |
| **1:16,000** | **Matthew Gardner** |

N

**APPENDIX C**
Hokitika River Flood Modelling – Hazard Map

H1 - Generally safe for vehicles, people and buildings
H2 - Unsafe for small vehicles
H3 - Unsafe for vehicles, children and the elderly
H4 - Unsafe for vehicles and people
H5 - Unsafe for vehicles and people
All buildings vulnerable to structural damage
Some less robust buildings subject to failure
H6 - Unsafe for vehicles and people
All building types considered vulnerable to failure

Revell St
Hokitika Industrial Line
Tudor St
Airport Rd
Park St
Alpine View
Gibson Quay Road
Stafford St
Hampden St
Weld St
Hau Hau Rd
Kaniere Rd
Golf Links Rd
Hokitika-Kaniere Tramway
Arthurstown Rd

# Legend

Roads

Property Boundary

**Hazard Category**

H6
H5
H4
H3
H2
H1


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THE WEST COAST REGIONAL COUNCIL

**Map 1 of 3**

0 0.25 0.5 1
Kilometers



PROJECT
**Hokitika River Flood Modelling**

MAP TITLE **HAZARD MAP**
**1 in 100 year event including climate change (2100)**
**RCP Scenario 6.0, 1m Sea Level Rise,0.4m Storm Surge**

REVISION **01**
DATE **10 December 2020**
A3 SCALE **1:16,000**
AUTHOR **Matthew Gardner**

N

**APPENDIX D**
Drawings

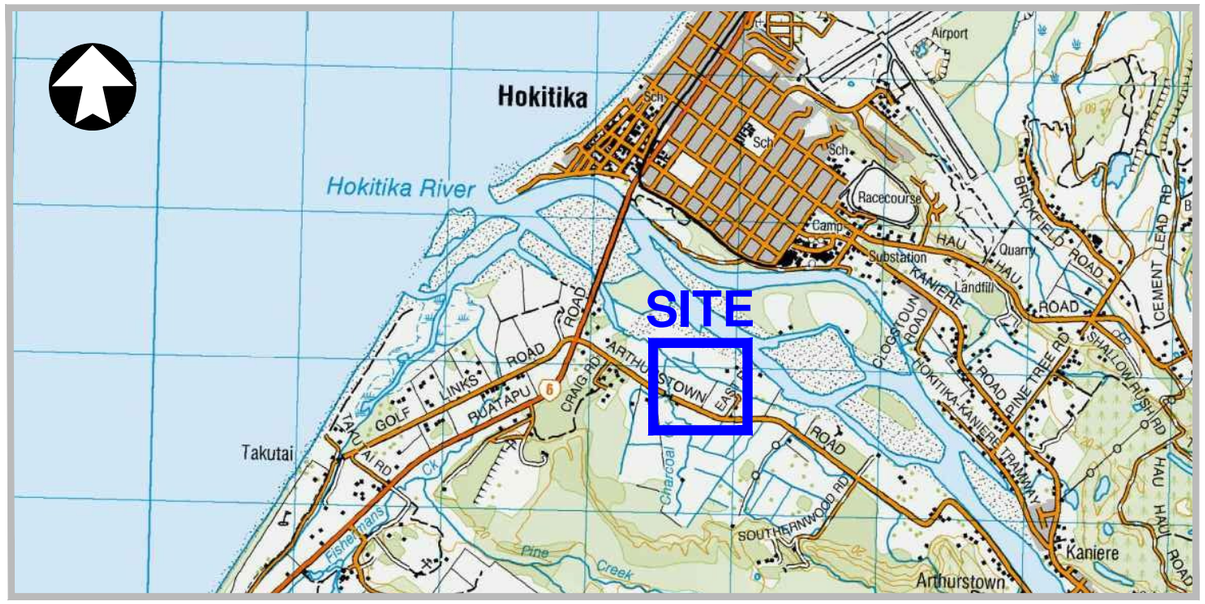
# FOREST HABITATS LTD
# PROPOSED SUBDIVISION
# 117 ARTHURSTOWN ROAD
# HOKITIKA

Hutchinson
CONSULTING ENGINEERS

154 Centreway Road
Orewa
Auckland

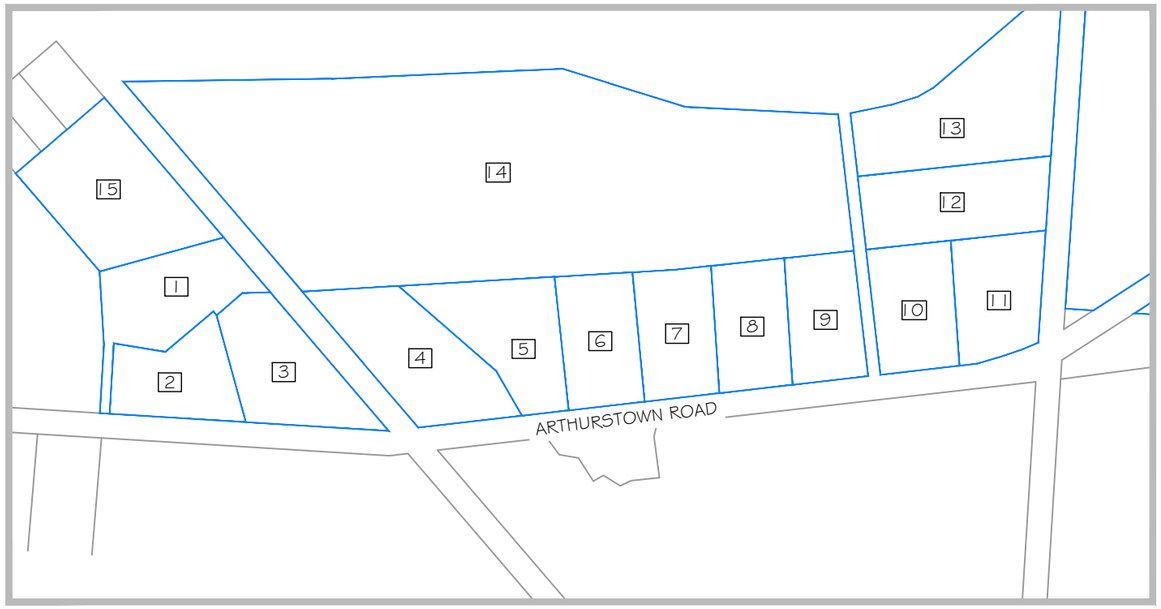
P.O. Box 150
Orewa
Auckland

Telephone (09) 426-5702
Email info@hc.co.nz



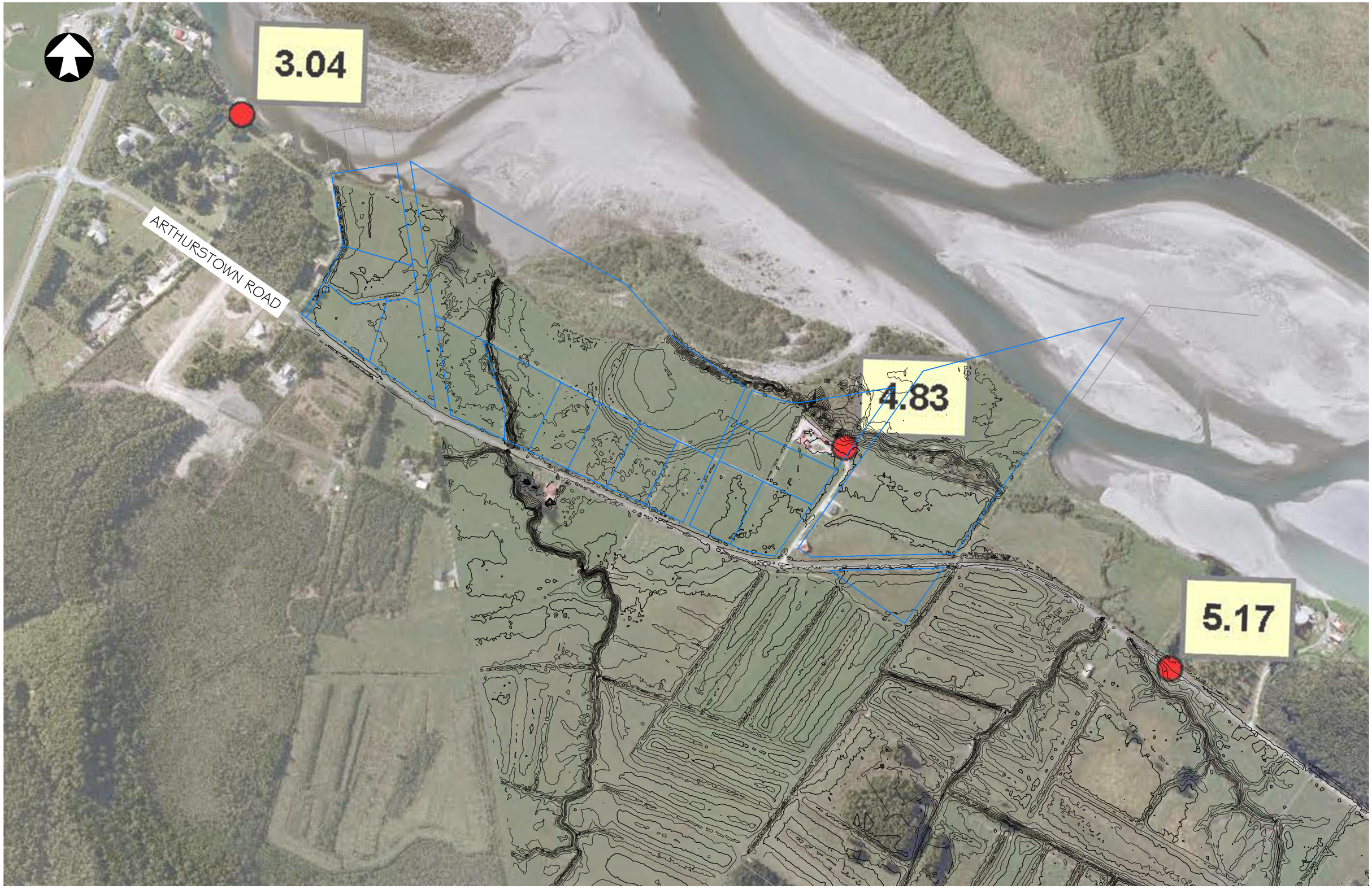

## DRAWINGS - GE






FOR RESOURCE CONSENT ONLY
NOT FOR CONSTRUCTION

**24312 GE-01**
**OCTOBER 2022**

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154 Centreway Road, Orewa 0931
Ph: 09 426 5702 **www.hc.co.nz**

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| Design | M. SYMONS | OCT 2022 |
| Drawn | M. SYMONS | OCT 2022 |
| Checked | P. FARLEY | OCT 2022 |
| Approved | I. HUTCHINSON | OCT 2022 |
| Scale | 1:5000 @ A3 | |
| Scale vert. exag. | | |

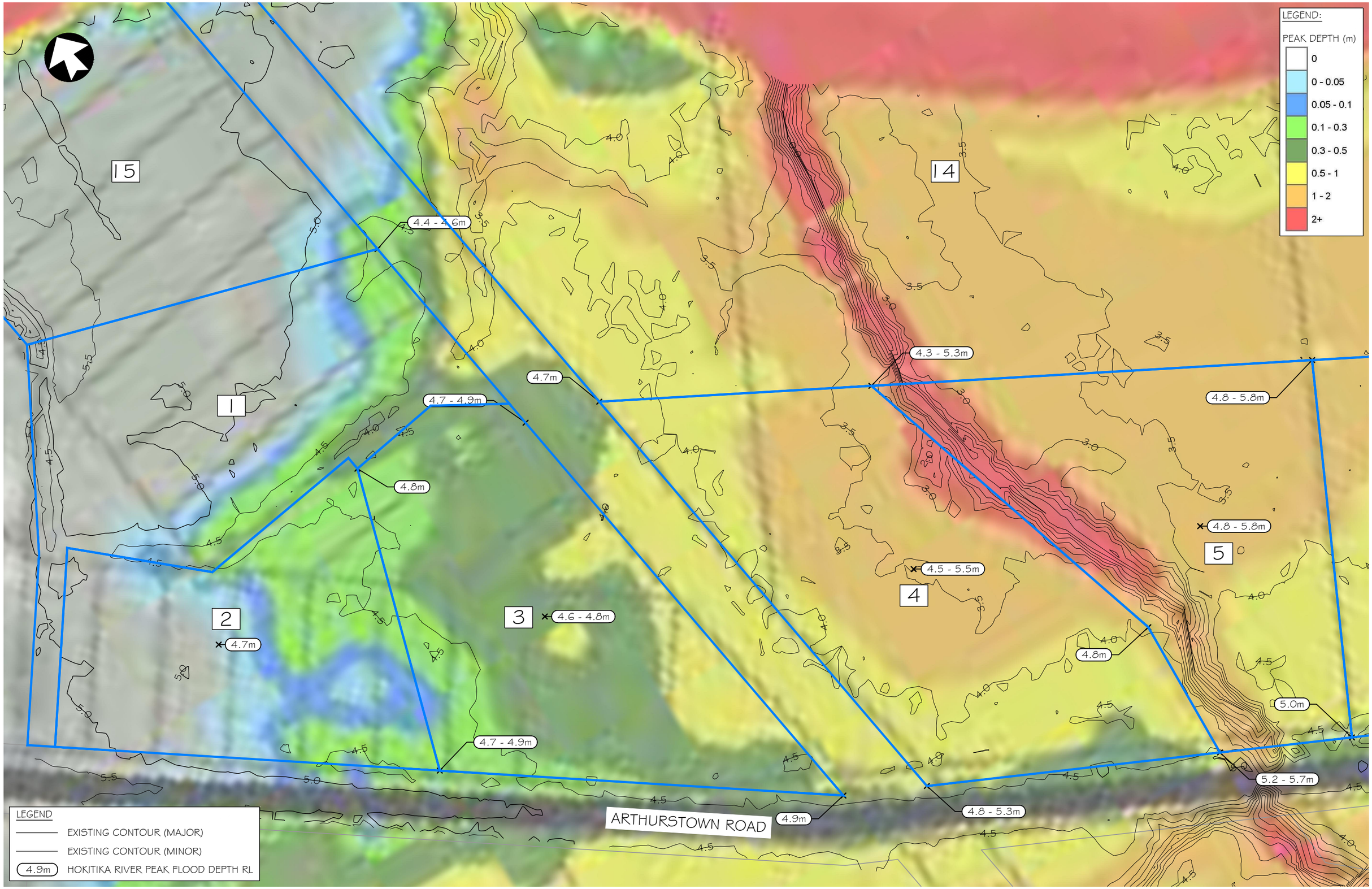
Project
**FOREST HABITATS LTD**
**PROPOSED SUBDIVISION**
**117 ARTHURSTOWN ROAD**
**HOKITIKA**

Title
**HOKITIKA RIVER DEBRIS LEVELS (2018)**

Sheet No.
**GE-02**

Job No.
**A3-24312 RC**

Rev.
**-**

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| Checked | P. FARLEY | OCT 2022 |
| Approved | I. HUTCHINSON | OCT 2022 |
| Scale | 1:1000 @ A3 | |
| Scale vert. exag. | | |

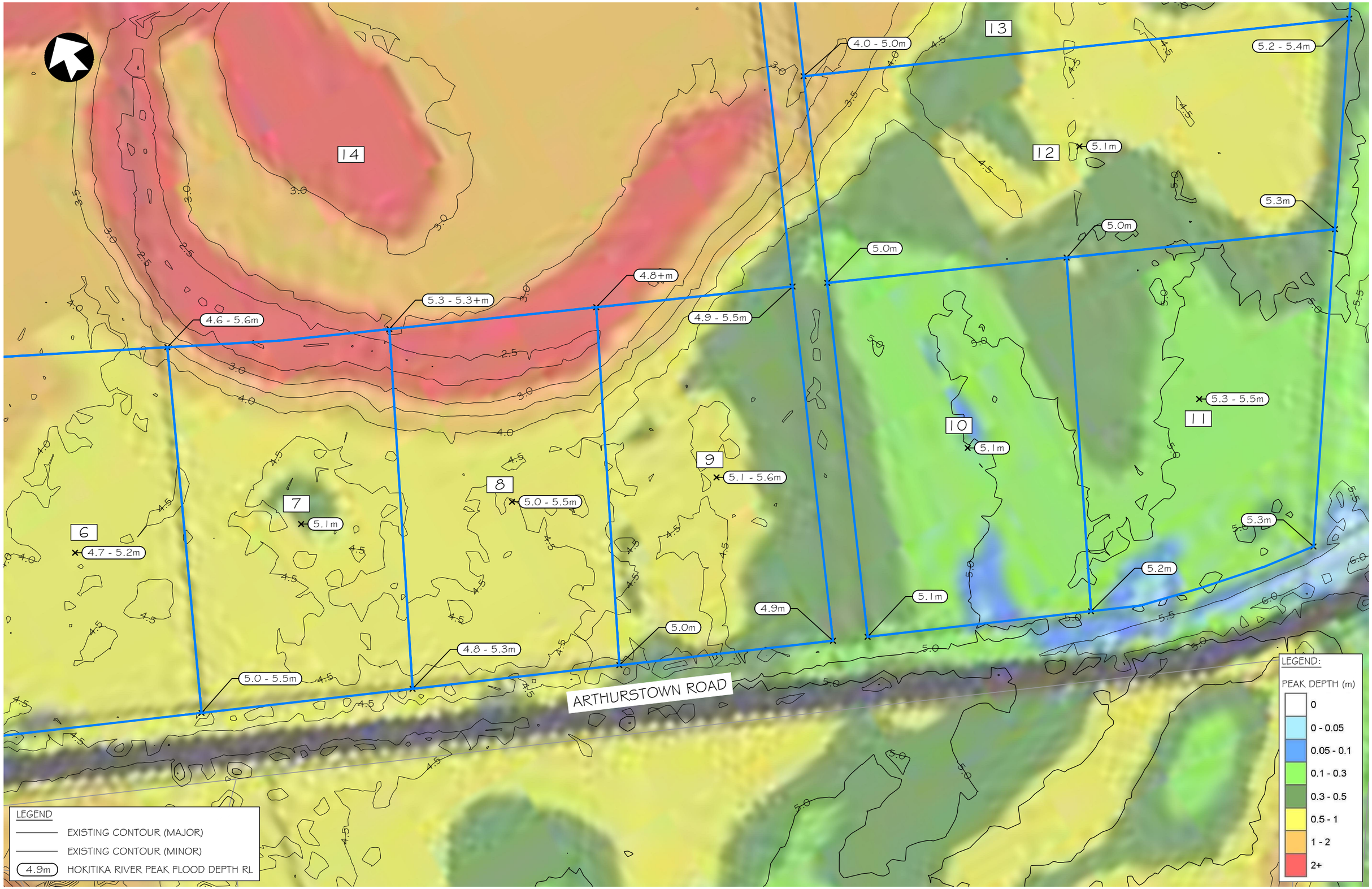
Project
**FOREST HABITATS LTD**
**PROPOSED SUBDIVISION**
**117 ARTHURSTOWN ROAD**
**HOKITIKA**

Title
**HOKITIKA RIVER PEAK FLOOD DEPTHS - SHEET 1 OF 2**

Job No.
**A3-24312 RC**

Sheet No.
**GE-03**

Rev.
**-**

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| Checked | P. FARLEY | OCT 2022 |
| Approved | I. HUTCHINSON | OCT 2022 |
| Scale | 1:1000 @ A3 | |
| Scale vert. exag. | | |

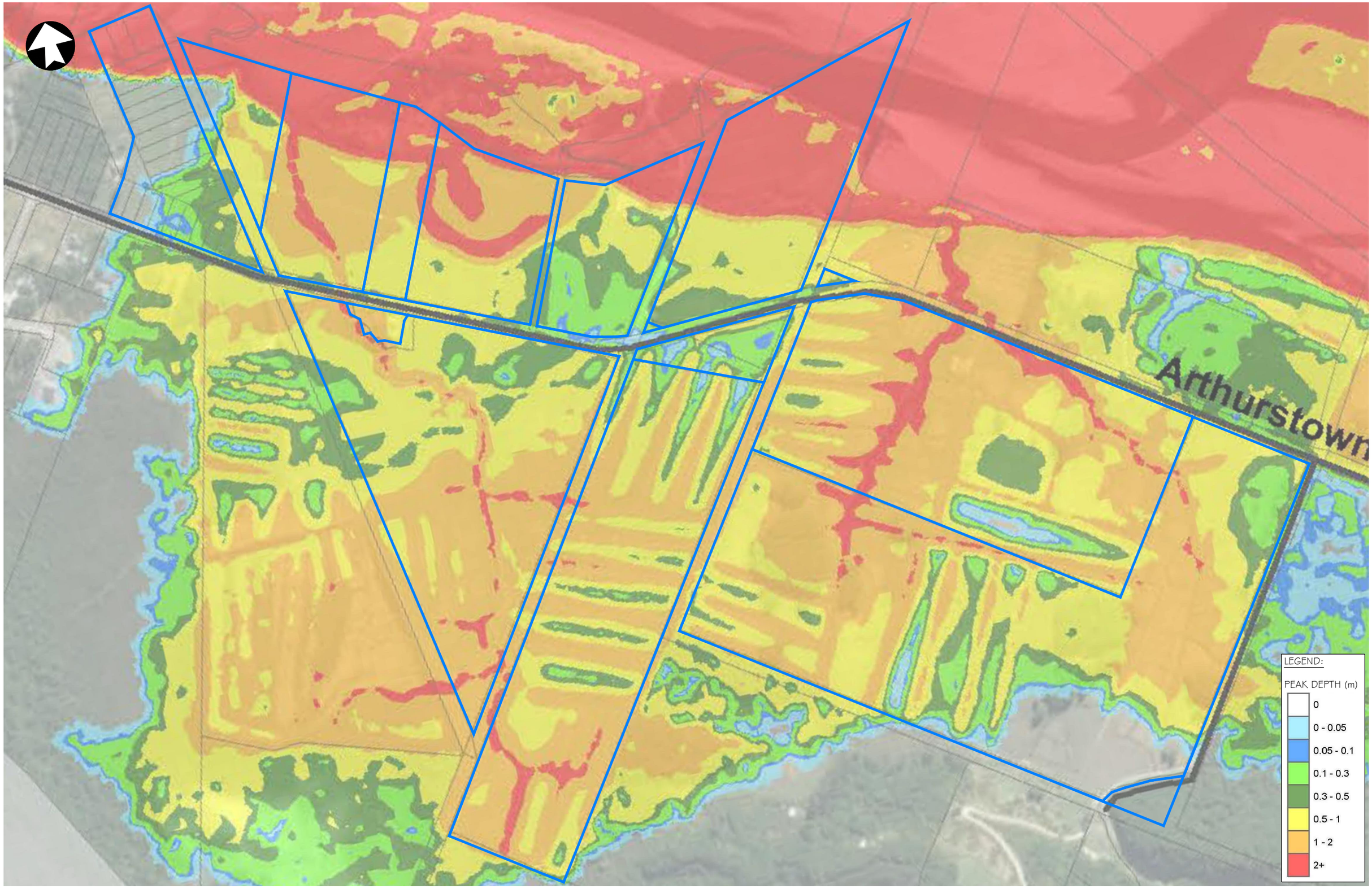
Project
**FOREST HABITATS LTD**
**PROPOSED SUBDIVISION**
**117 ARTHURSTOWN ROAD**
**HOKITIKA**

Title
**HOKITIKA RIVER PEAK FLOOD DEPTHS - SHEET 2 OF 2**

Job No.
**A3-24312 RC**

Sheet No.
**GE-04**

Rev.
**-**

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| Checked | P. FARLEY | OCT 2022 |
| Approved | I. HUTCHINSON | OCT 2022 |
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| Scale vert. exag. | | |

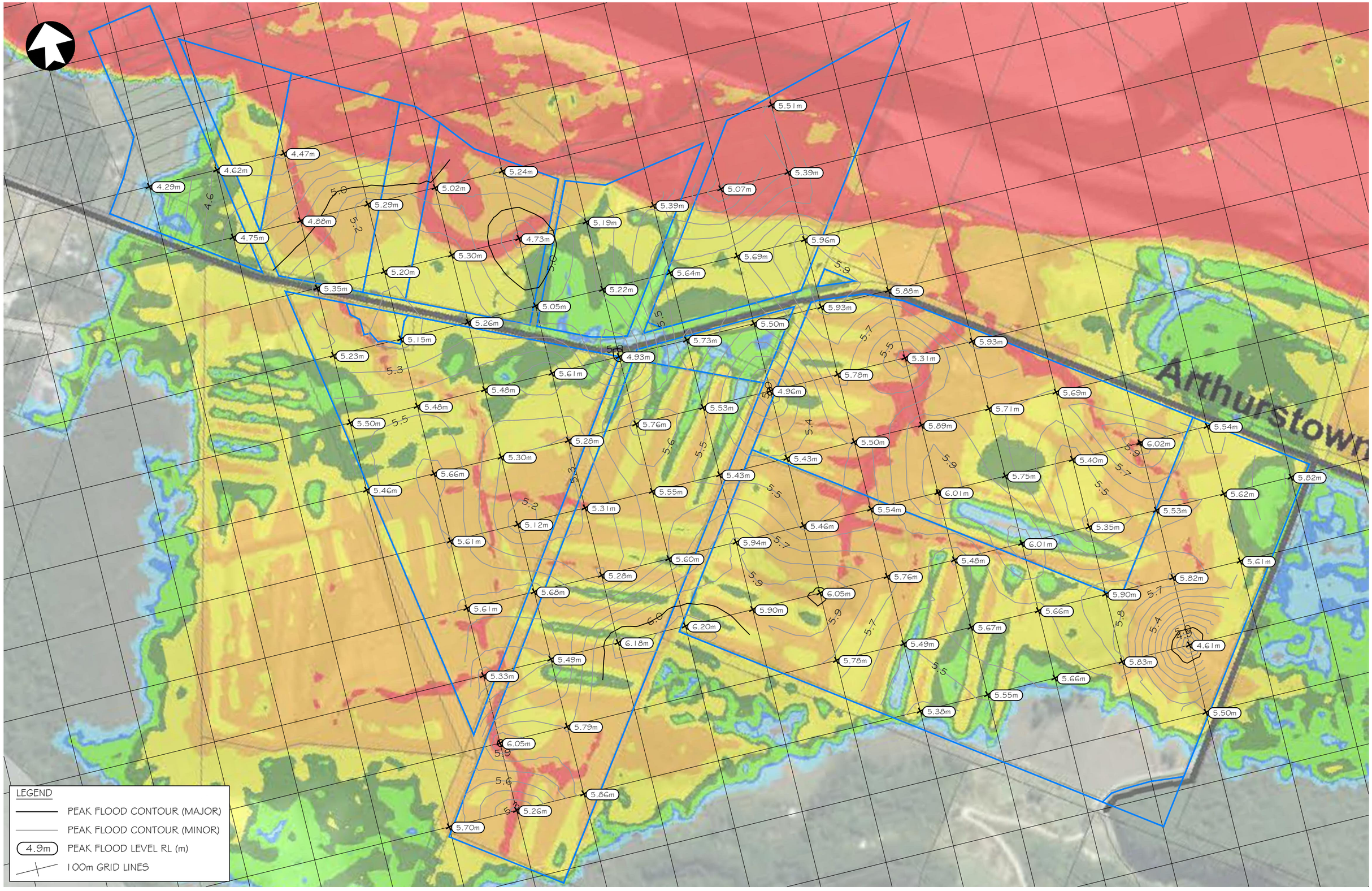
Project
**FOREST HABITATS LTD**
**PROPOSED SUBDIVISION**
**117 ARTHURSTOWN ROAD**
**HOKITIKA**

Title
**117 ARTHURSTOWN BLOCK - HOKITIKA RIVER PEAK FLOOD DEPTHS**

Sheet No.
**GE-05**

Job No.
**A3-24312 RC**

Rev.
**-**

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| Approved | I. HUTCHINSON | OCT 2022 |
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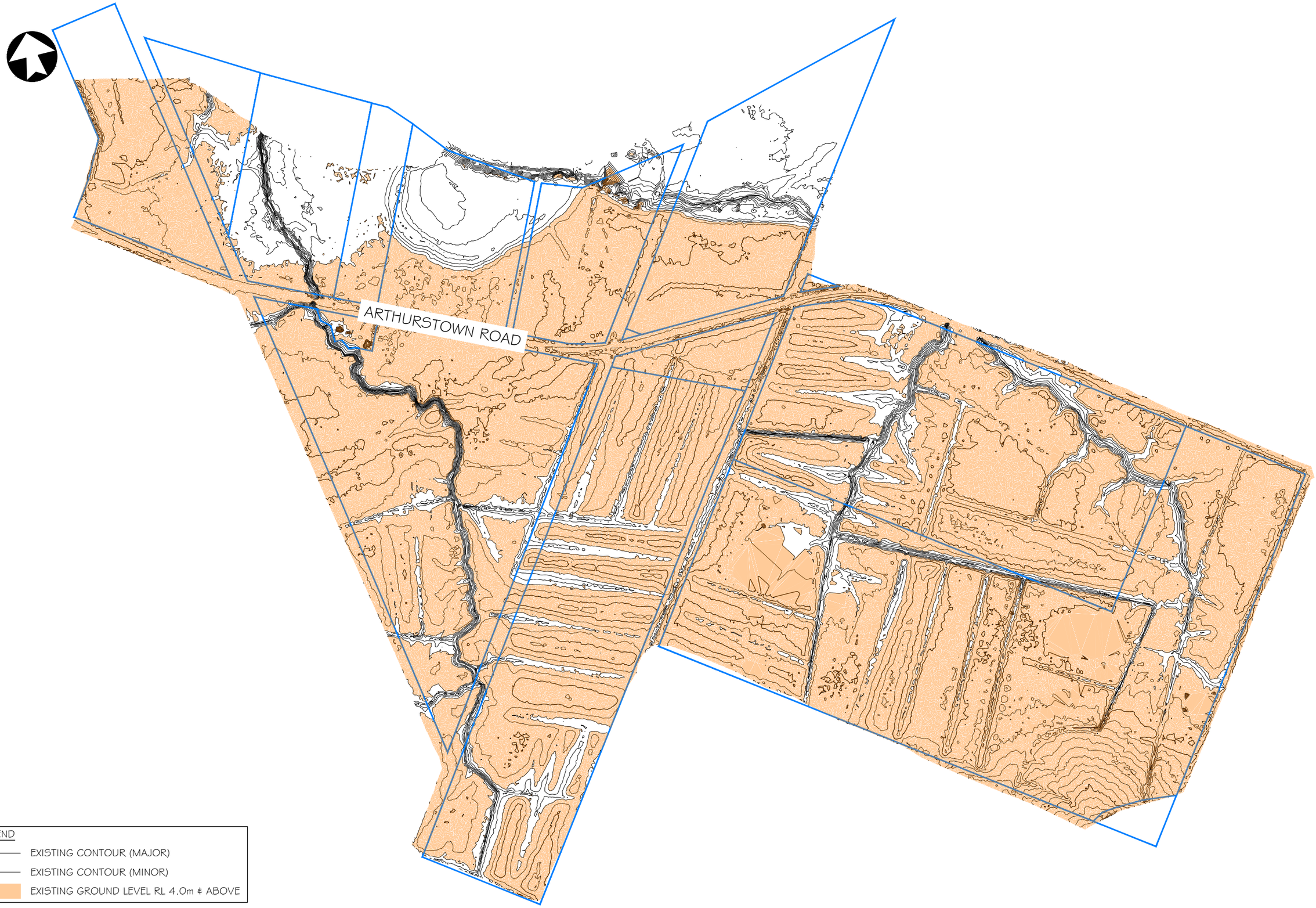
Project
**FOREST HABITATS LTD**
**117 ARTHURSTOWN ROAD**
**HOKITIKA**

Title
**117 ARTHURSTOWN BLOCK - HOKITIKA**
**RIVER PEAK FLOOD LEVELS**
**(100m GRID)**

Sheet No.
**GE-06**

Job No.
**A3-24312 RC**

Rev.
**-**




LEGEND

EXISTING CONTOUR (MAJOR)

EXISTING CONTOUR (MINOR)

EXISTING GROUND LEVEL RL 4.0m & ABOVE

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| Checked | P. FARLEY | OCT 2022 |
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Project
**FOREST HABITATS LTD**
**117 ARTHURSTOWN ROAD**
**HOKITIKA**

Title
**EXISTING GROUND LEVEL ABOVE RL 4.0m**

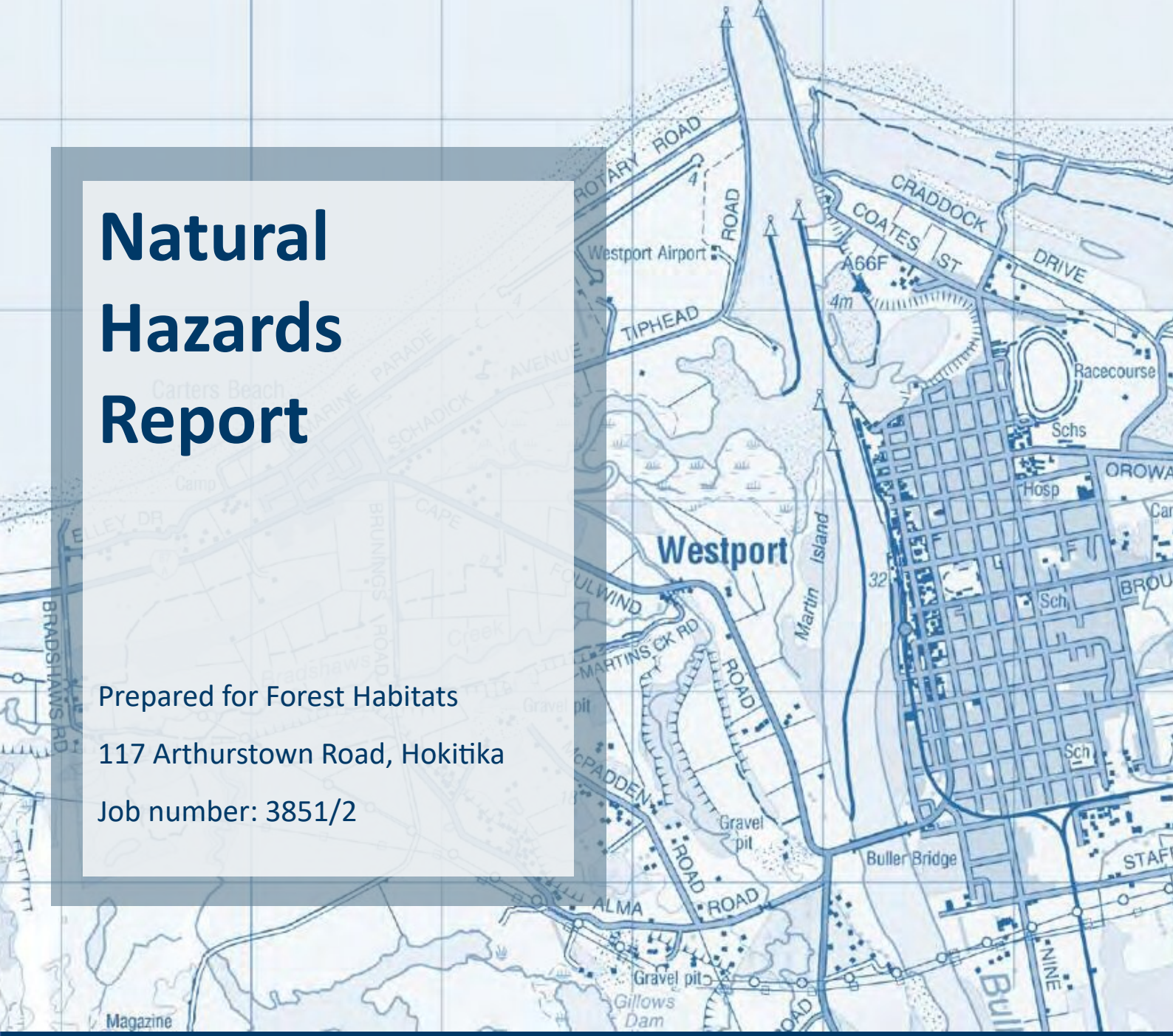
Sheet No.
**GE-07**

Job No.
**A3-24312 RC**

Rev.
**-**

Appendix C: Chris J Coll Surveying Ltd Natural Hazards Report 3851/2 dated 28 September 2023, and Hutchinson Consulting Engineers Report dated 7 September 2023

# Natural Hazards Report




Prepared for Forest Habitats

117 Arthurstown Road, Hokitika

Job number: 3851/2

**Chris J Coll Surveying Limited**

**Authorised by: Stuart Challenger**

CHRIS J COLL
SURVEYING
LTD

SURVEYORS | PLANNERS | ENGINEERS

Contents

# 1. Introduction

## 1.1. Scope of Work

Chris J Coll Surveying Ltd has been engaged by Forest Habitats to update the Eliot Sinclair & Partners Limited Subdivision Suitability Report (Eliot Sincliar reference 510714) with regard to a change to the Scheme Plan that was brought about by a Landscape Plan and additional Civil Engineering investigation, and to respond to questions raised by the Council planners. Chris J Coll Surveying Ltd are undertaking this work as Stuart Challenger, who approved the Eliot Sinclair Report, now works for Chris J Coll Surveying Ltd

# 2. Site Description

## 2.1. Legal Description

The legal description of the site is Lots 8 – 29 DP 142, RS 1602, 1603, 1421, 1588 and Pt RS 1589. The properties to be subdivided are held in four separate titles with a title area of approximately 19.55 ha. Arthurstown Road is accessed off State Highway 6 to the west of the site, which it intersects approximately 300m south of the Hokitika bridge. Figure 1 below illustrates an overview of the site location.


**Figure 1. Site Location with current sections boundaries highlighted in white.**

## 2.2. Proposed subdivision

We understand it is proposed to subdivide the site into seventeen lots including two multi lane accessways. Of the seventeen Lots, twelve will be new buildable lots varying in size from 5,000 m² to 14,000 m² from the underlying parcels of land. The proposed lots are to be serviced from Arthurstown Road, East Road and two unformed legal roads.

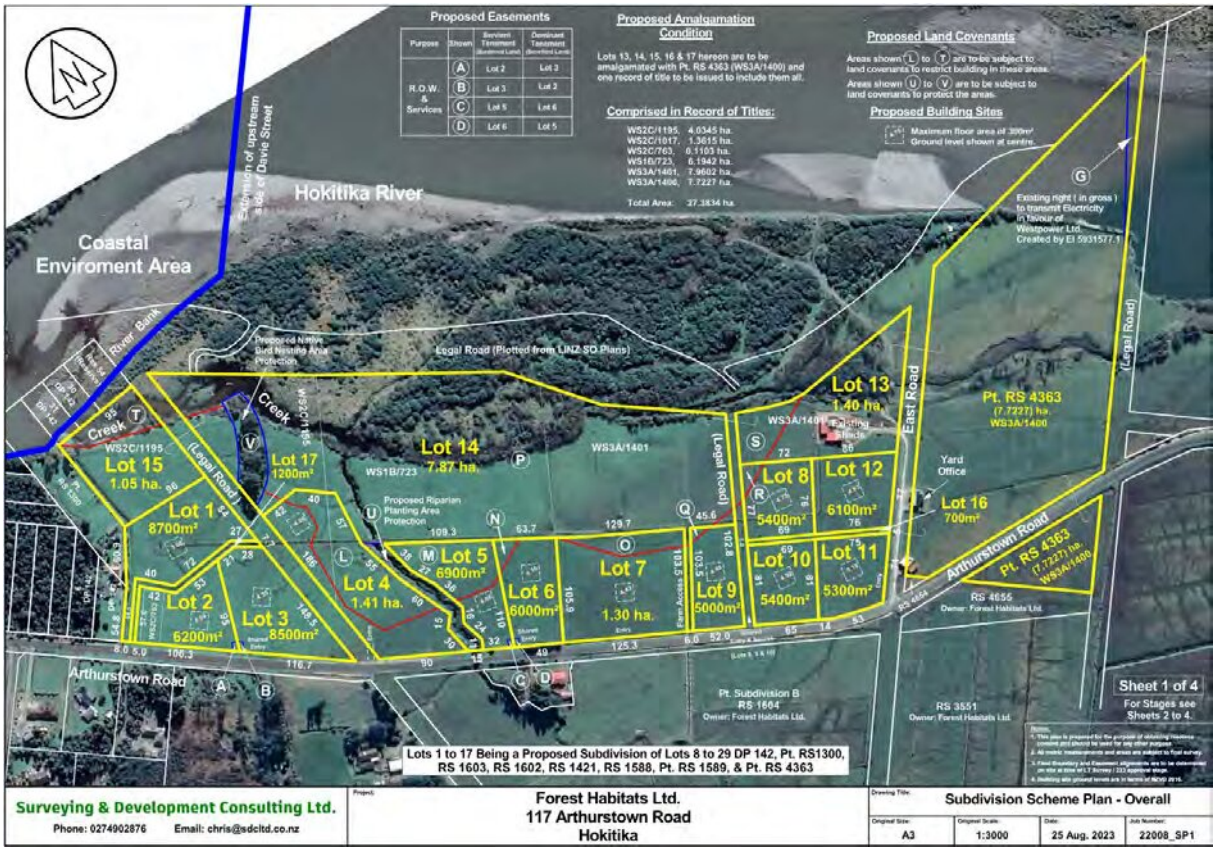



Figure 2. Proposed scheme plan of subdivision

### 2.3. Site Geology and Topography

Geological mapping[1] of the area notes that the site is underlain Holocene Era river deposits (Q1a) comprising of gravel, sand, and silt. The GNS Active Faults Database[2] indicates the closest active fault is the Alpine Fault approximately 23km south-east of the site. The site is not in any known fault hazard avoidance areas.

The site is about 1.5km east of the coastline and is on the south side of the Hokitika River, separated by a strip of unformed legal road. The site is elevated at the eastern and western ends and adjacent to Arthurstown Road, there is an area of lower elevation located in the central, northern area of the property, with site levels between around RL 3.0m and RL 5.0m (NZVD 2016). The closest waterways are Charcoal Creek which runs through the site and the Hokitika River which is located just to the north of the property.

## 3. Site Investigation

Eliot Sinclair undertook a site investigation on 7th September 2022 to determine the soil profile and bearing capacity. The investigation included eight test pits, in a grid like pattern across all proposed lots, and 12 dynamic cone penetrometer tests. The results from those tests are included in Appendix A. Testing was only undertaken in the lots that are being considered for future dwellings.

[1] Nathan, S., Rattenbury, M.S., Suggate, R.P. (compliers) 2022. Geology of the Greymouth area. Institute of Geological and Nuclear Sciences 1: 2500 000 geological map 12. 1 sheet +58p. Lower Hutt, New Zealand. Institute of Geological and Nuclear Sciences Limited.
[2] Data.gms.cri.nz/af/

A visual-tactile field classification of the soils encountered during the shallow investigation was carried out in general accordance with 'Guidelines for the Field Classification and Description of Soil and Rock for Engineering Purposes' (NZGS, 2005) and DCP testing was carried out in accordance with NZS 4402:1988, Test 6.5.2, 'Dynamic Cone Penetrometer'.

### 3.1. Test Pit Excavations

The general profile encountered by the test pits was typical of alluvial deposits and comprised a surficial layer of silty topsoil with rootlets approximately 0.2m thick, overlying silts and sands with some organics to a maximum depth of 4.3m below ground level (bgl).

### 3.2. Groundwater

Static ground water was encountered at test locations 3, 4 and 6 at depths of between 3.1m and 3.3m below the existing ground surface.

### 3.3. Dynamic Cone Penetrometer (DCP) Testing

Below the topsoil, DCP resistances generally revealed at least 2 blows per 100mm penetration within the underlying in-situ layers of silt and sandy silt to a depth of around 0.8m bgl. Below 0.8m the blow counts at the test locations increased with increasing depth.

### 3.4. Interpretation of site tests

Whilst the scala penetrometer tests showed that bearing to meet the requirements of good ground was encountered in most of the test pits between about 0.7 and 1.0m below the surface, test pit 1 encountered organics until a depth of 2.5m and test pit 3 encountered a log at 2.7m below the surface, in addition saturated sands were encountered, so the site does not comply with the definition of good ground in the New Zealand Building Code. Specific foundation design is therefore considered necessary. Options are discussed in the Section 5 Foundation Recommendations.


**Figure 3. Locations of Eliot Sinclair Site Testing**

## 4. Suitability for Subdivision

Council can refuse subdivision consent if there is a significant risk from natural hazards. To determine whether there is a significant risk from natural hazards, decision-makers are guided by the requirements of RMA Section 106(1A). This requires a combined assessment of:

- The likelihood of natural hazards occurring (whether individual or in combination).
- The material damage that would result from natural hazards to land where the consent is sought, neighbouring land, or structures.
- Any likely subsequent use of the land where the consent is sought that would accelerate, worsen, or result in material damage of the kind referred to in the previous point.

Decision-makers are required to consider the magnitude of risk of natural hazards, including natural hazards that have a high impact but low probability of occurrence. This aligns the assessment with the definition of 'effect' Section 3 of the RMA.

The RMA defines natural hazards as: Any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, drought, fire, or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment.

Hazard identification is a key component of any site-specific risk assessment. The risk assessment for relevant natural hazards at the site is presented below, which considers the likelihood and consequences of the hazard at the site in the context of the proposed activity (residential subdivision) as compared against the current site context.

We have considered the risk of falling debris, wind, drought, fire, geothermal activity, sedimentation, climate change, sea level rise, and volcanic activity and conclude these are very unlikely to pose an unacceptable risk to life at this site. In relation to other potential natural hazards, we comment as follows.

### 4.1. Earthquake Shaking

New Zealand is a seismically active country. New buildings and infrastructure will be designed, consented, and built to acceptable industry standards and New Zealand Building Code requirements and as such will be designed for any likely shaking as detailed in the current design codes, which will address the risk. As the site is underlain by recent Holocene sediments, which are saturated we consider that the site soil class, in terms of calculating bracing demand, is a soil class D – deep soils.

### 4.2. Earthquake Fault Rupture

There are no recorded active fault traces across the site. The site is not located within a fault hazard area or fault avoidance zone. The closest active fault is the Alpine Faultline, which lies approximately 23km south-east of the site. Based on available data the site is outside the minimum 20m fault avoidance zone recommended by the Ministry for the Environment[3].

### 4.3. Erosion

An investigation of aerial photography dating back to 1943 shows that the low area within the site was riverbed in 1943. Aggradation occurred to the extent that the area of riverbed was almost completely reclaimed as pasture by 1951. Some erosion occurred between 1970 and 1984 in the western area, at and around the mouth of Charcoal Creek. This area has subsequently aggraded with the most recent

[3] Planning for Development of Land on or Close to Active Faults: A Guideline to Assist Resource Management Planners in New Zealand (Publish July 2013)

aerial photography showing vegetation well beyond the river boundary location shown on survey plans dating back as far as 1874.

We consider that the current land between the proposed building locations on the higher elevated areas will not be subject to erosion and that erosion will not materially affect buildings on the new allotments assuming modern design methods and our construction recommendations are followed.

### 4.4. Liquefaction

The site is classified in the West Coast Regional Liquefaction Assessment[4] as being in an area where liquefaction damage is possible. From the Eliot Sinclair investigation, which showed underlying saturated sands, over saturated gravels, we agree with this assessment and consider that liquefaction might affect any dwelling on this site.

When considering the likely effect of liquefaction on this site, as it takes significant seismic shaking for gravels to liquefy, because the pore spaces are larger, making it significantly harder to develop pore pressures sufficient to cause liquefaction, we consider that the likely impacts of liquefaction on this site will be low. However, without further deep testing, it is recommended that the site be treated as a TC2 equivalent site, and measures developed following the Canterbury series of earthquakes should be implemented to mitigate the risk of liquefaction affecting any future dwellings.

### 4.5. Subsidence

Whilst there is the possibility of subsidence due to the saturated sands and buried organic matter, provided the measures proposed to address liquefaction are implemented, they will also reduce the likelihood of subsidence affecting any future dwelling to less than minor.

### 4.6. Flooding

Flood modelling has been undertaken by Land River Sea, which shows that the site is likely to be affected by flooding, particularly when the effects of climate change are considered. Hutchinson Consulting Engineers have reviewed the modelling information and contour survey of the site and have designated flood free building platforms that will ensure any future dwellings will not be affected by flood waters in events up to the 100 year flood, climate change scenario RCP6 (2100), 1m sea level rise and 0.4m storm surge. The methodology is described in their report "Forest Habitats Ltd, September 2023", Ref L24312c Rev B, with the platforms identified on their *Existing Contour & Building Platform Plan*, Job No. A3-24312 RC, Sheet No. GE-08 and GE-09. The formation of these flood free areas requires that a building platform is prepared with a minimum level of RL5.5m (NZVD2016), this is between 0.32m and 1.5m above the existing ground level, with the finished floor heights 0.5m higher at RL6.0m (NZVD2016). We consider that this will mitigate the risk of flooding to an acceptable level.

### 4.7. Tsunami

Part of the site is shown on the National Emergency Management Agency (NEMA) Tsunami Evacuation Zones website[5] as being in an evacuation zone for a > 5m Tsunami. However, the proposed building platforms are located outside the hazard zone, so are not considered to be at risk.

[4] Beca Limited. West Coast Regional Liquefaction Assessment, 1 November 2021

[5] https://www.arcgis.com/apps/MapSeries/index.html?appid=56e898a420fd4285ae288881b3a393eb

## 5. Foundation Requirements

As noted in the previous sections, the land does not comply with the definition of good ground and may be subject to liquefaction. This does not preclude building on the site but does require that specific foundation design is undertaken. Measures developed following the Canterbury series of earthquakes will address both the liquefaction and good ground issues. Options are detailed in the following sections.

### 5.1. Driven Timber Pile Foundation

Whilst the scala penetrometer testing indicated that suitable bearing for a piled foundation would be encountered in the upper 1.5m, this is above the liquefaction zone, so if liquefaction were to occur, any building on piles would be affected. While any such building can be relevelled reasonably simply, by jacking and packing between the bearers and piles to bring the building back to level, it is considered more prudent to found the piles below the saturated sands in the underlying gravel layer, which is less likely to be affected by liquefaction. This would require that piles were driven around 3.2m to 4.3m below the surface. As the buildings floor levels will be of the order of 0.8m and 2.0m above the ground, piles longer than 6m in length may be necessary.

### 5.2. Gravel raft with TC2 slab foundation

To reduce the risk of liquefaction-induced settlement occurring to shallow foundations and to address the weak soils in the upper layers, an alternative recommendation to piles is the use of shallow ground improvement to remediate the upper 1.2m shallow soil profile, in conjunction with a more resilient foundation. This can be achieved by excavation and construction of a geogrid reinforced compacted gravel raft.

A suitably qualified geotechnical engineer should inspect the exposed excavated subgrade to confirm the soil profile and bearing resistances before any remediation is started. The exposed subgrade should not contain any obvious organic matter, topsoil, buried logs, or any other very soft or unsuitable materials. A layer of geogrid (Triax TX160 or equivalent) should be placed across the base of the excavation and up the sides. It is important that the grid is sufficiently tensioned to remove any wrinkles, bulges, folds etc. prior to placing the gravel fill on top of the geogrid.

Sandy gravel fill shall be placed and compacted in ~200mm thick layers, in accordance with the requirements of NZS4431:2022. A second layer of geogrid shall be placed 400mm above the first layer. Gravel fill shall continue to be placed and compacted in layers up to the desired finished surface. The gravel fill shall be compacted so that the average dry density achieved is greater than 95% of the maximum dry density (MDD) of the sandy gravel, with no readings less than 92% MDD, before the next layer of fill is placed. If compaction is an issue at the base of the excavation, then a layer of no fines fill (ballast) can be placed across the base of the excavation to provide a suitable base to lay the first layer of Geogrid and the backfill.

The landscaping design for the site will need to consider the elevated building platforms in order to achieve suitable driveway and footpath gradients.

The building foundation shall either be a TC2 waffle slab foundation, or an NZS3604: 2011 suspended timber floor on concrete encased piles, embedded into the gravel raft.

### 5.3. Impact of Elevated Building Platforms

As some of the proposed finished floor levels are required to be up to 2.0m above the existing surface, it may not be practicable to use piles, because of access and egress issues with steps up from the car parking area, and therefore a raised platform will be required.

Hutchinson Consulting Engineers Limited have assessed the formation of building platforms and calculate that a total volume of 8074m³ will extend into the flood storage area. From the Land River Sea modelling it is assessed that the river would be about 850m wide to flood the lots, the property is about 500m long, so at the proposed subdivision this is a surface area of about 425,000m². A loss of flood storage of 8074m³ will require that the depth of water increases by a proportional amount of storage volume divided by area distributed over = 8074/425000, which is an increase in flood depth of about 19mm (say 20mm or 2cm). So, by building up the land there would be a minor increase in depth of flood water. It is, however, possible to mitigate this effect by sourcing the gravel from shallow cuts on Lot 14, toward the Hokitika River channel. Rather than backfilling the cuts with the soft silts excavated from the building platforms, they would just be contoured and grassed, thereby providing an equivalent volume of flood storage on Lot 14 to that which is lost from forming the building platforms. As the additional flood storage created is at lower level to the proposed building platforms, this would also have the benefit of providing a small reduction in the flood level until the water level reaches the building platform, when there would be negligible effect.

The excavated fill from the building platforms would be disposed of off site in a suitable flood free area. An erosion and sediment control plan will be formulated and implemented for the excavation zones once further investigation into the depth of gravel available on site, and hence the area required, has been undertaken. It is not envisaged that the entire area would be cleared, and all the gravel stockpiled in one go, but rather as properties sell and building platforms are prepared only the necessary area of ground would be cleared and gravel excavated. This would minimise any areas of bare ground and stockpiles of material, so they can be protected from soil erosion and remediated (shaped and sown in grass) as soon as practicable after excavation has been completed.

The use of elevated building platforms can mean that during a flood event access to and from any dwellings might be restricted. The site is on a flood plain, as is the whole of the Hokitika township, which will be subject to a gradual flooding and not flash flooding or a dam breach event, so if flooding were to occur there will be warning to occupants. The Civil defence advice on what to do in a flood is: *Do not try to walk or drive through flood water. Don't go sightseeing through flooded areas*.

If the occupants are away from their property, and it is inundated, then they should not drive through the flood waters to get back to the property. If it is an emergency during a flood event that requires that one of the dwellings occupants is evacuated safely, this can be achieved by trucks, excavators, or boats, depending on the circumstances and depth of flood waters. However, the likelihood of an emergency occurring at the same time as an extreme flood event is considered less than minor.

Any change in land use will have an effect on stormwater runoff characteristics, it is proposed that overflows from roof water tanks and surface runoff from roads go into soak pits. This method will maintain the runoff leaving the site at the same volume as currently occurs, in rain events up to the 1hour duration 10% AEP event, as this is the NZBC required standard. In rain events larger than a 10% AEP event that do not result in riverbank breach, there may be an increase in runoff as a result of the subdivision. In these cases, increases in runoff flows may be detained by vegetation, surface depressions and infiltration. However, in the case of riverbank breaches, run off flows post-development would be the same as those pre-development and would not increase as a result of the subdivision. In these cases, rainfall will enter directly to water (i.e., to the river not onto land) in the same manner as would be the case in the absence of subdivisional development.

There are currently stop banks on the northern side of the Hokitika River that provide protection for up to the 50 year flood event. These are to be upgraded to provide protection for up to the 100-year flood event to the properties north of the stop bank. As part of the design for the upgrade, Matt Gardiner, of Land River Sea, modelled the effect the raising of stop banks on the North side of the

Hokitika River would have on the South Side. This modelling showed that there would be minimal impact on the south side from the increase in height of the north side stop banks.

## 6. Infrastructure Requirements

### 6.1. Potable Water

There is no Council reticulated water available to the site. Rainwater tanks will be required for water supply. We recommend a minimum of 45m3 of water storage onsite to allow for residential supply and firefighting purposes. It is also recommended that a leaf diverter and a first flush diverter be installed.

### 6.2. Wastewater

There is no Council sewer available to the site. Onsite wastewater treatment and disposal will be required. Most of the test pits did not encounter groundwater within 3.5m of the ground surface. Standing water was found in test pits 3, 4 and 6 at between 3.1 and 3.3m bgl. Eliot Sinclair consider that the soil category, in terms of AS/NZS1547: 2012, to be category 4. Category 4 soils have limited permeability and it is recommended that specifically designed secondary wastewater treatment systems be used.

Category 4 soils do not meet the requirements of rule 79 in the West Coast Regional Council's Land and Water Plan for permitted activity and the land application (discharge) of wastewater will therefore require a resource consent from the West Coast Regional Council.

We recommend that the septic tank be located in the gravel pad formed for the building platform, so that it is above any possible flood waters.

### 6.3. Stormwater

There is no Council stormwater reticulation in the local area, stormwater overflow from the rainwater tank will need to be discharged appropriately without causing erosion or ponding. To minimise any effect from the change in runoff characteristics for the development, roof water overflows should be to a soakage pit designed in accordance with clause E1 of the New Zealand Building Code.

## 7. Conclusion

Based on our review of the Eliot Sinclair geotechnical investigation, it is considered the site on Arthurstown Road is suitable for subdivision to form 12 new buildable lots as proposed. The site is at risk from flooding and may be subject to subsidence and liquefaction. These hazards can be mitigated with appropriate building locations and foundation treatments. Hutchinson Consulting Engineers Limited have identified suitable building platforms on their *Existing Contour & Building Platform Plan*, Job No. A3-24312 RC, Sheet No. GE-08 and GE-09, with finished floor heights no lower than RL6.0m (NZVD2016).

To mitigate the risk of subsidence and liquefaction, dwellings shall be founded on an engineered gravel raft or on driven timber piles, with a finished floor height no lower than RL6.0m. We consider with these measures implemented the site can be subdivided and that any natural hazard can be mitigated to ensure the safety of both dwellings and people.

Date issued: 28 September 2023

| Prepared by: | Signature: | Date: |
|---|---|---|
| Stuart Challenger<br>Civil & Environmental Engineer<br>BE NatRES, BSc, CMEngNZ, CPEng |  | 28/09/2023 |

**Reviewed by:**

| | | |
|---|---|---|
| Jan Coll<br>Engineering Associate & Office Manager<br>MS+SNZ, REA, NZCE(Civil) |  | 28/09/2023 |

## 8. Disclaimer

This report has been prepared for Forest Habitats in relation to the proposed subdivision of Lots 8 – 29 DP 142, RS 1602, 1603, 1421, 1588 and Pt RS 1589.

This report provides a hazard assessment of the land under application in accordance with Section 106 of the RMA. The report makes professional recommendations in relation to the subdivision.

This report is valid from the date of signing for a period of two years. Professional comment and recommendations are based on visual inspection of the site undertaken on 1st August 2023 and Eliot Sinclair investigation of 2022.

Professional care was taken during site inspection and investigation of subsurface features and conditions. However, it may be that pertinent subsoil strata and features/conditions are present on the site that were not identified given the limited investigation of the site and the information available at the time the report was prepared. No warranty is included, either explicit or implicit, that actual conditions across the entire site will conform the assessment provided in the report.

Any future changes to the site and its surroundings (such as but not limited to significant seismic events), relevant laws or regulations and guidelines (such as but not limited to the New Zealand Building Code) or detection of subsurface features not formerly identified may necessitate revision of our site suitability recommendations and, should any of these occur, this report can no longer be used for the purpose for which it was prepared. In such instances, we recommend that Chris J Coll Surveying Limited be contacted regarding this report for confirmation that findings and recommendations are still applicable.

This report has been prepared for the exclusive use of the Forest Habitats and the Westland District Council, and it may not be relied on for any other purpose or by any person other than Forest Habitats without our prior written agreement. Neither Chris J Coll Surveying Limited nor any of its employees accept any liability with respect to this report and its use by any persons, company, or organisation other than Forest Habitats. Chris J Coll Surveying Limited does not authorise or contemplate this report being used by any other party for any other purpose.

# Appendix A. Eliot Sinclair Site Investigation Records.

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

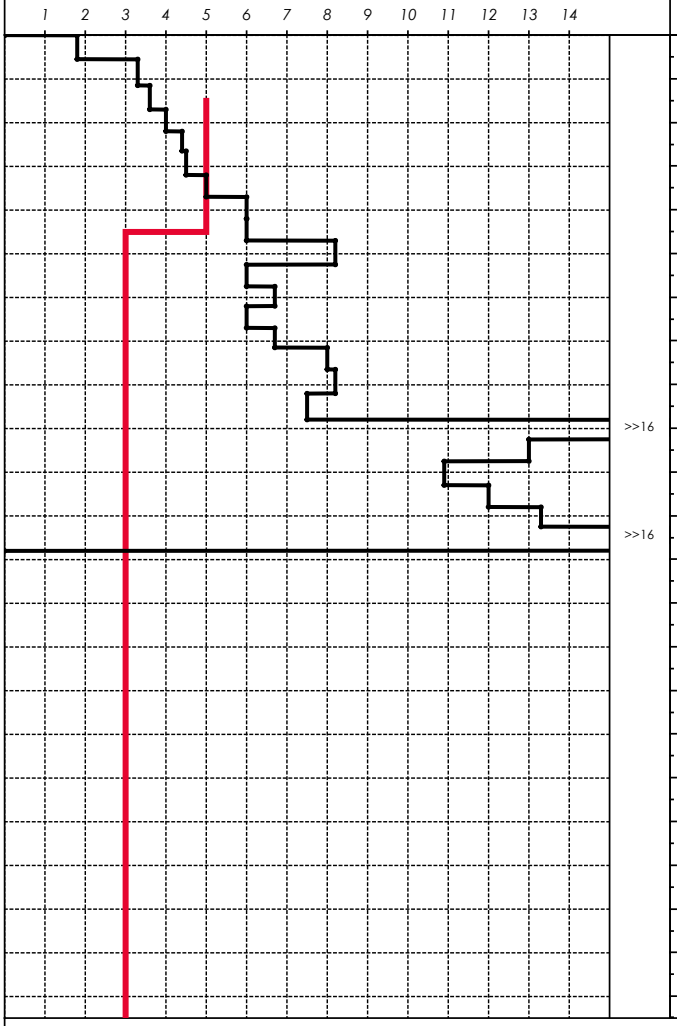
**Technical Category:** N/A

**Lot:** 23 **D.P.:** 142

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1 **Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




01

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Soil Profile

**Test Location 01**

| | |
|---|---|
| TS | SILT; dark brown. Rootlets. |
| | SILT; grey . Large organics and logs. |
| | SILT, with minor sand; grey . Damp. |

**Water:** Groundwater Not Encountered

## Site Plan: (Not to Scale)


## Comments:

Dynamic Cone Penetrometer: Lot 1

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:** 10 9

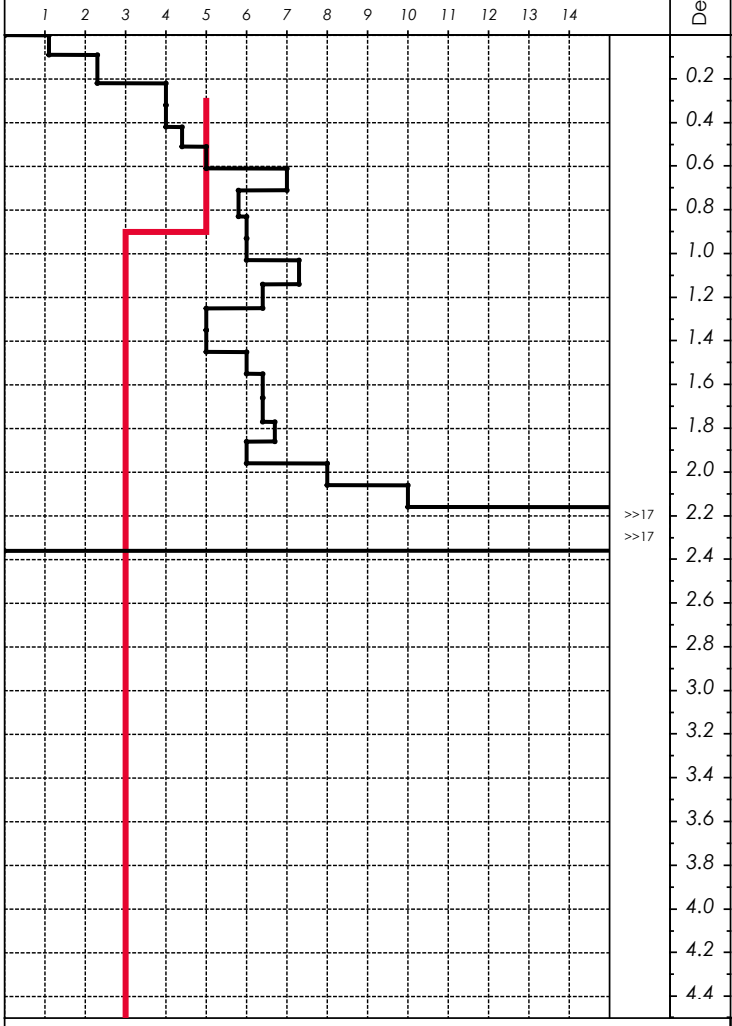
**D.P.:** 142, 142

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




## Soil Profile

Water

02

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

**Site Plan:** (Not to Scale)


## Comments:

Dynamic Cone Penetrometer: Lot 2

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☐ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

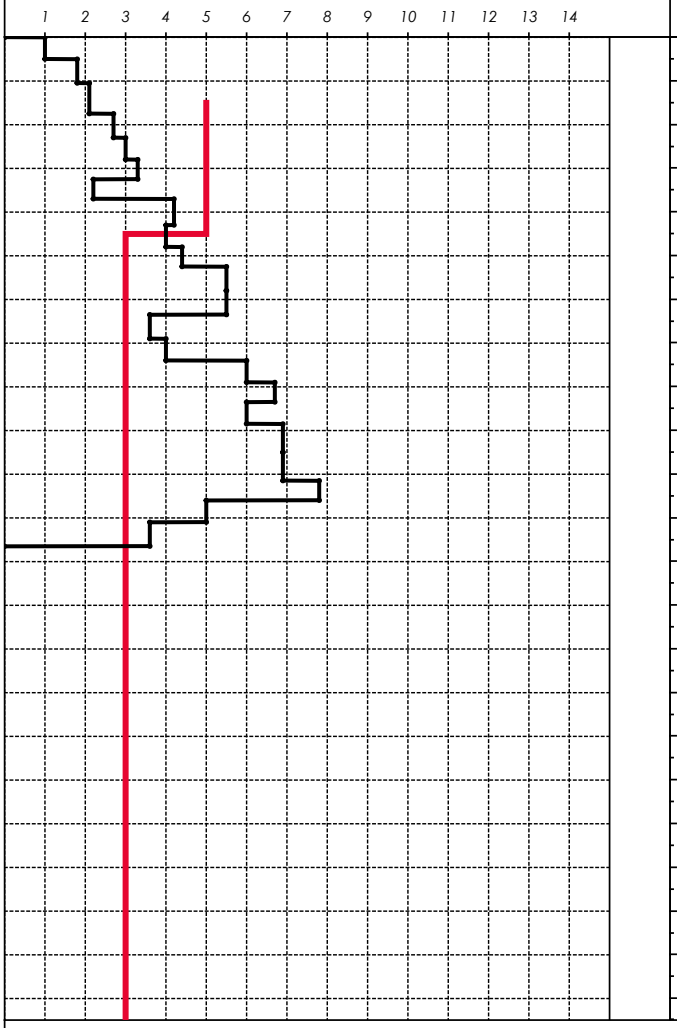
**Technical Category:** N/A

**Lot:** 13 **D.P.:** 142

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1 **Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




03

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Soil Profile

**Test Location 03**

| | Water |
|---|---|
| TS SILT; dark brown. Wet; Rootlets. | |
| SILT, with minor sand; brown . Firm; damp; Rootlets. | |
| SILT, with minor sand; grey . Firm; damp. | |
| 2.70m - 2.70m: Buried log | |
| SAND, with minor silt; grey . Damp to saturated; saturated at 3.3m. | ▽ 3.3m |

## Site Plan: (Not to Scale)


## Comments:

Dynamic Cone Penetrometer: Lot 3

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

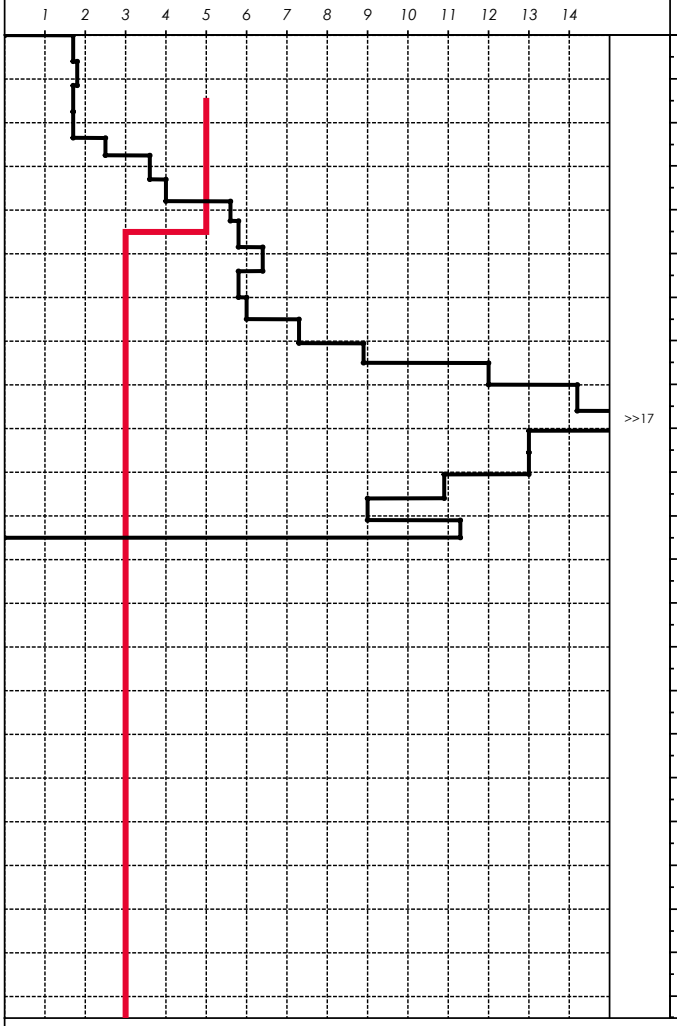
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




04

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Soil Profile

**Test Location 04**

| | Water |
|---|---|
| TS SILT; dark brown. Wet; Rootlets. | |
| SILT, with minor sand; brownish grey. Damp; Rootlets to 0.5m bgl. | |
| Fine SAND, with minor silt; grey . Damp to saturated. | |
| 3.20m - 3.20m: Becoming saturated | ▽ 3.2m |

## Comments:

Dynamic Cone Penetrometer: Lot 4

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

## Site Plan: (Not to Scale)


*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

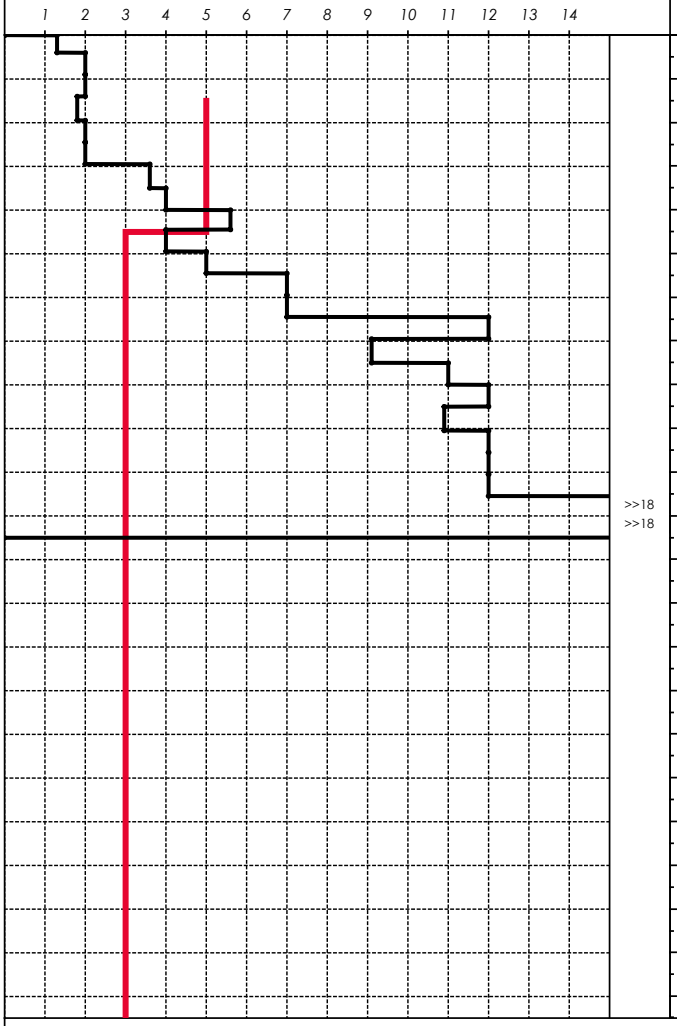
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




## Soil Profile

Water

05

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Site Plan: (Not to Scale)


## Comments:

Dynamic Cone Penetrometer: Lot 5

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☐ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

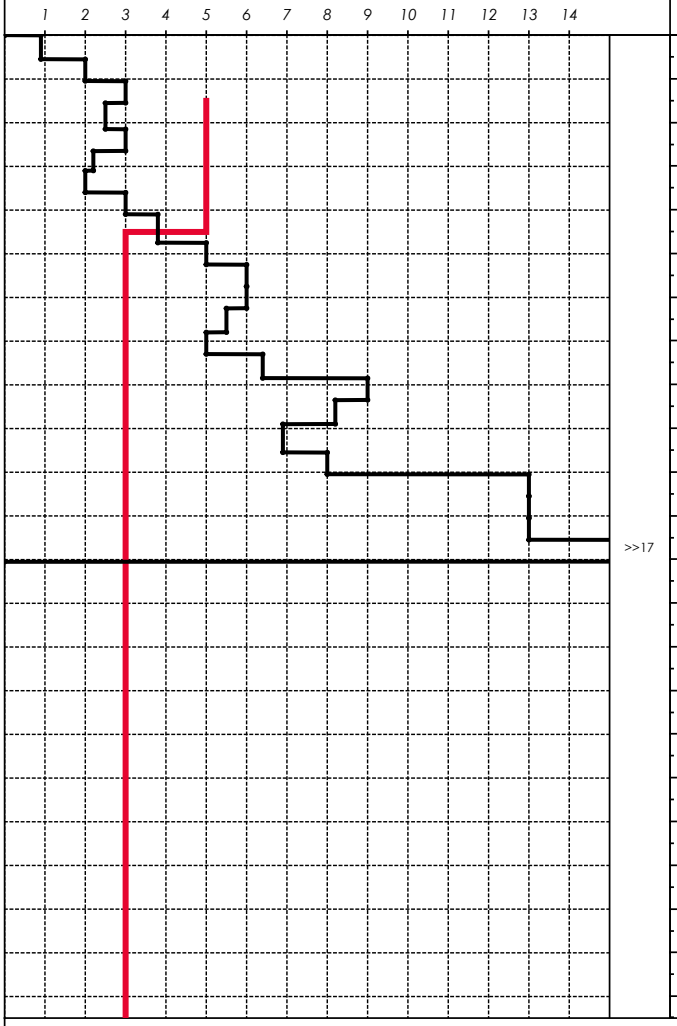
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




06

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Soil Profile

**Test Location 06**

| Depth (m) | Description |
|---|---|
| 0.2 | TS SILT; dark brown. Rootlets. |
| 0.8 | SILT, with minor sand; brownish grey. Firm; damp. |
| 2.4 | SILT, with minor sand; grey . Damp. |
| 3.2 | SAND, with minor silt; grey . Damp to saturated. |
| | SAND, with some gravel; grey . Saturated; gravel, fine; Pea gravels. Becoming saturated at 3.1m bgl. |

Water: ▽ 3.1m

## Comments:

Dynamic Cone Penetrometer: Lot 6

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

## Site Plan: (Not to Scale)


*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

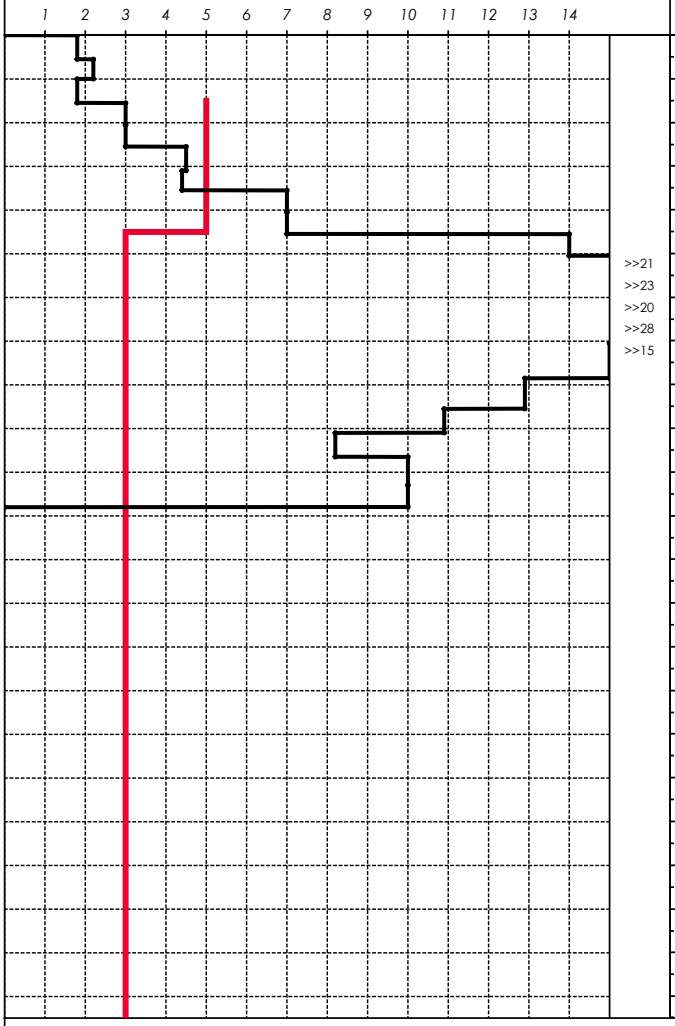
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




Depth (m)

0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4

## Soil Profile

**Test Location 07**

| | |
|---|---|
| TS | SILT; dark brown. Rootlets. |
| | SILT; brown . Damp to wet; Some rootlets. |
| | SILT, with minor sand; grey . Damp. |
| | SAND, with minor silt; grey . Damp. |

**Water**

Groundwater Not Encountered

07

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

**Site Plan:** (Not to Scale)


## Comments:

Dynamic Cone Penetrometer: Lot 7

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

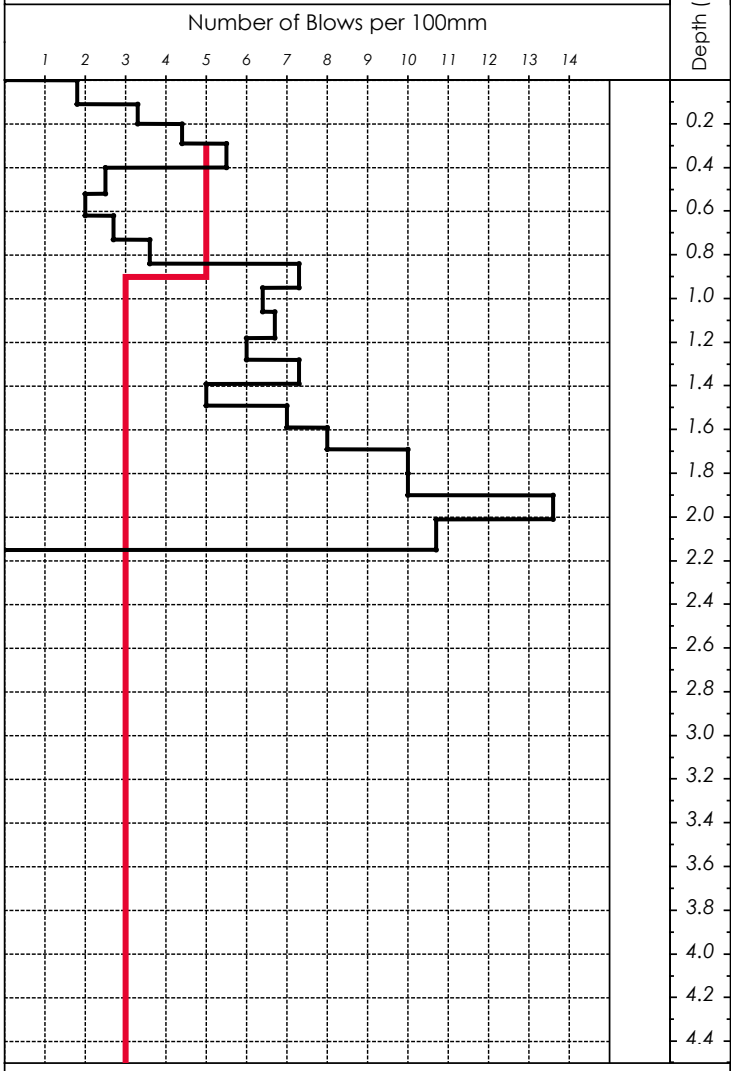
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




## Soil Profile

Water

08

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Site Plan: (Not to Scale)


## Comments:

Dynamic Cone Penetrometer: Lot 8

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☐ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

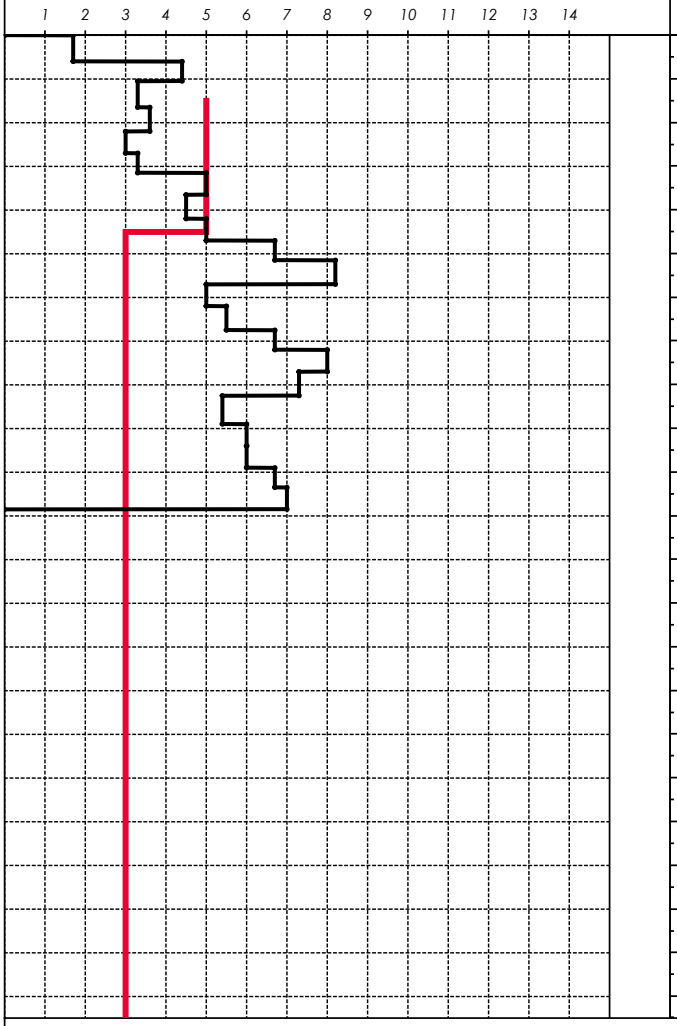
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




09

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Soil Profile

**Test Location 09**

| | |
|---|---|
| TS | SILT; dark brown. Damp to wet; Rootlets. |
| | SILT; brown . Damp. |
| | SILT, with minor sand; grey . Damp; Buried log at 2.6m bgl. |
| | SAND, with minor silt; grey . Damp. |

**Water**

Groundwater Not Encountered

## Comments:

Dynamic Cone Penetrometer: Lot 9

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

## Site Plan: (Not to Scale)


*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

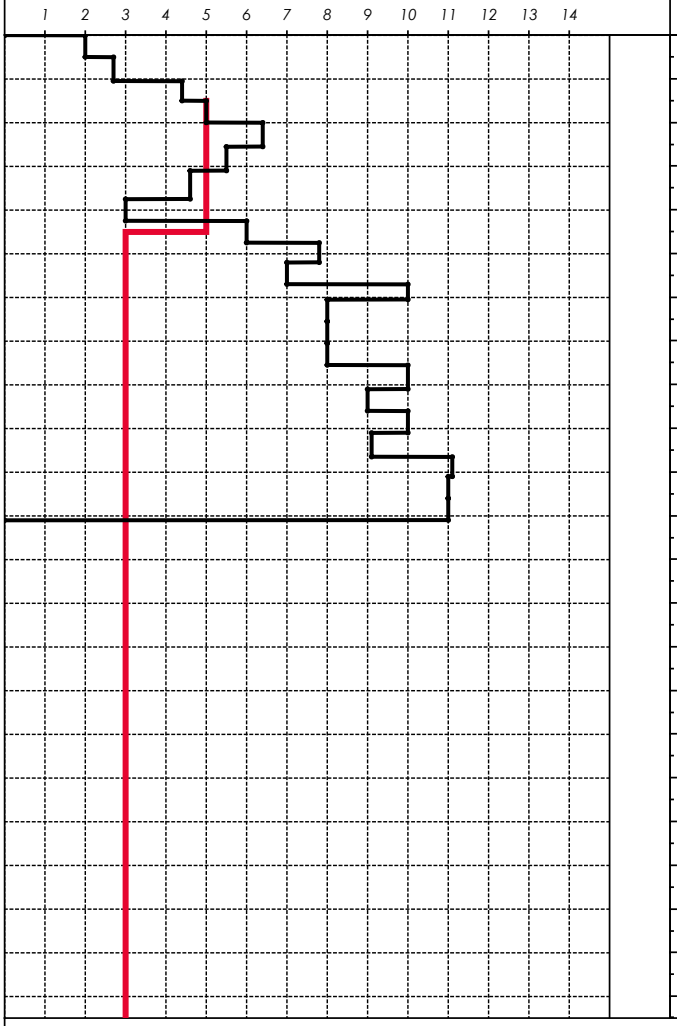
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




10

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Soil Profile

**Test Location 10**

| | |
|---|---|
| TS | SILT; dark brown. Wet. |
| | SILT; brown . Damp. |
| | SILT, with minor sand; grey . Damp. |
| | SAND, with minor silt; grey . Damp. |

**Water:** Groundwater Not Encountered

## Site Plan: (Not to Scale)


## Comments:

Dynamic Cone Penetrometer: Lot 10

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

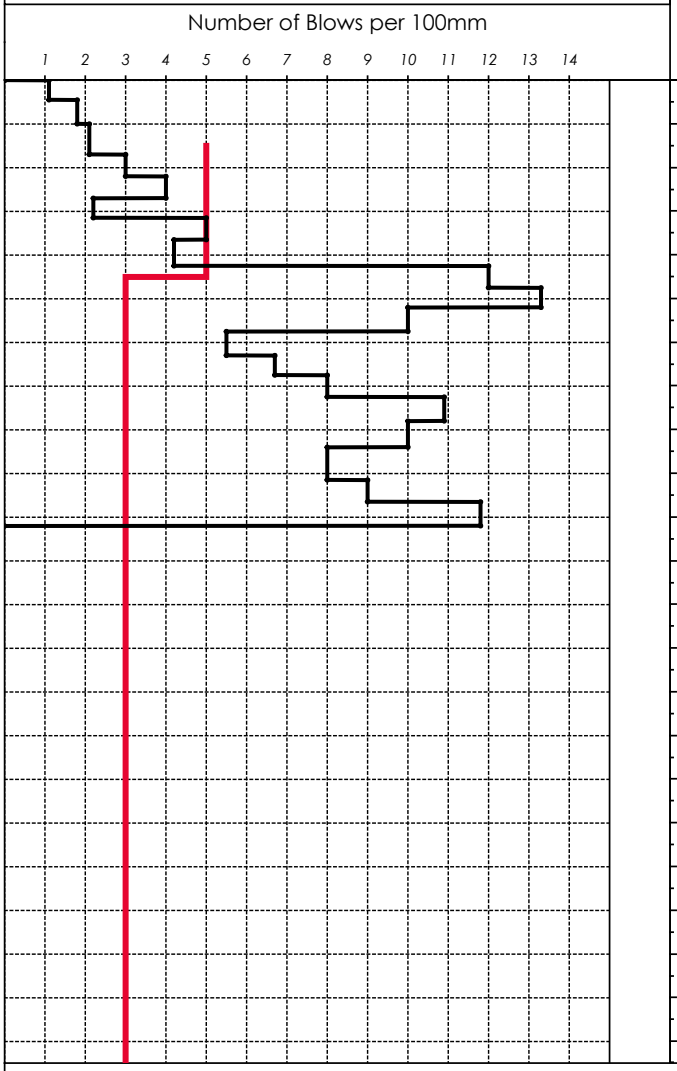
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




## Soil Profile

Water

11

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Site Plan: (Not to Scale)


## Comments:

Dynamic Cone Penetrometer: Lot 11

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☐ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*

# Site Investigation Record

**Client:** Forest Habitats Ltd

**Site:** Arthurstown Road, Hokitika

**Technical Category:** N/A

**Lot:**

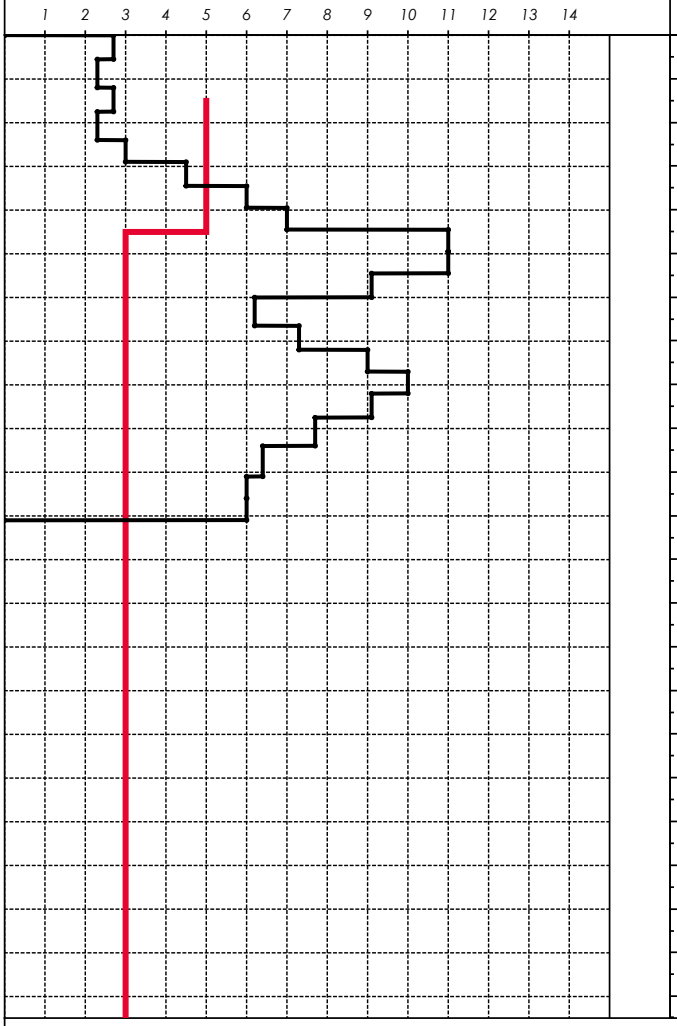
**D.P.:**

**Date Tested:** 7-Sep-2022

**Log Sheet No.:** 1 of 1

**Project No.:** 510714

## Dynamic Cone Penetrometer (DCP) Test Results




12

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for 'Good Ground' as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

## Soil Profile

**Test Location 12**

| | |
|---|---|
| TS | SILT; dark brown. Damp to wet; Rootlets. |
| | SILT, with minor sand; grey . Damp. |
| | SAND, with minor silt; grey . Damp. |

**Water**

Groundwater Not Encountered

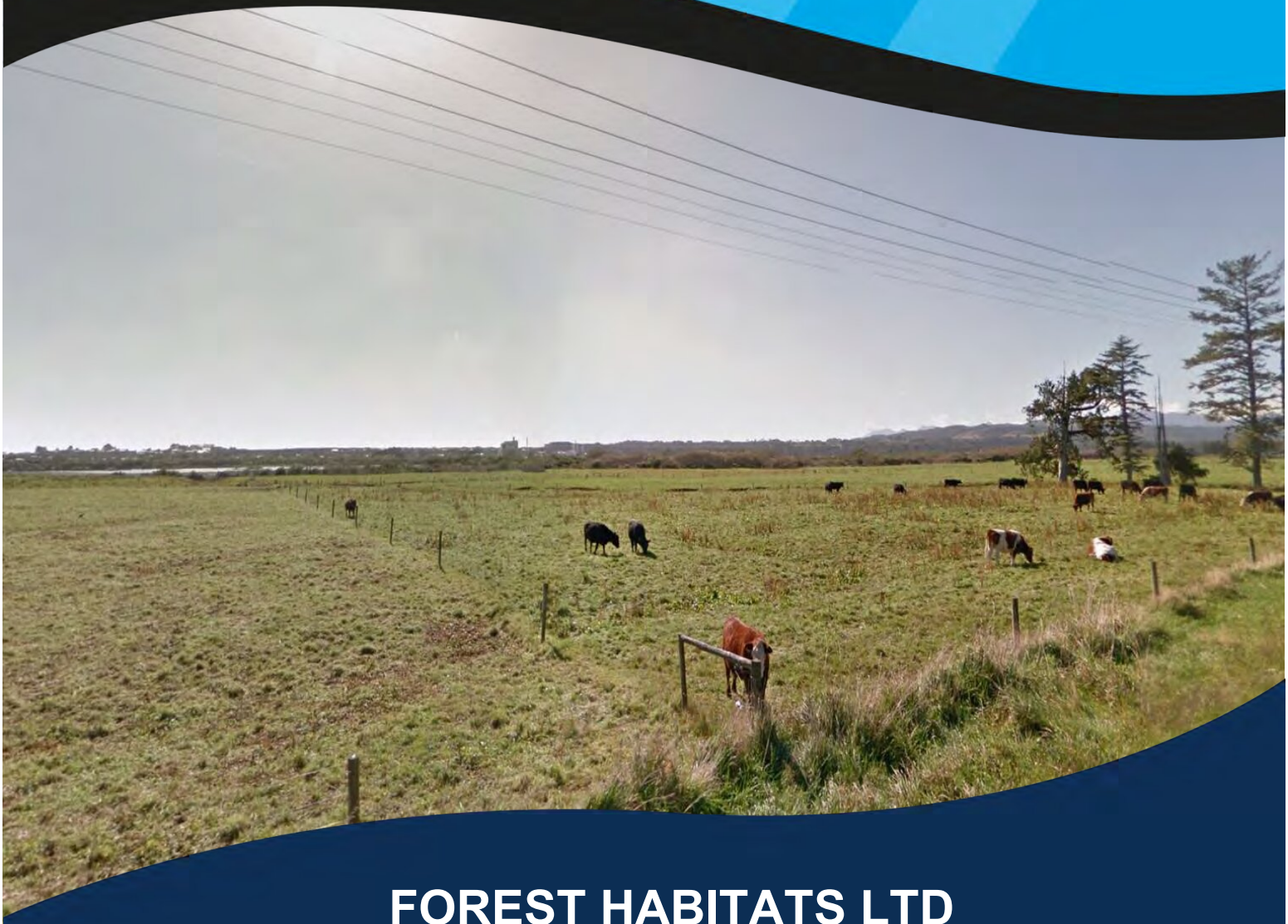
## Comments:

Dynamic Cone Penetrometer: Lot 12

| Field Staff: | Prepared By: | Soil Profile From: |
|---|---|---|
| SJH, JAG | JAG | ☑ Hand Auger |
| **Job Manager:** | **Approved By:** | ☐ Spade Hole |
| SCC | SCC | ☐ Test Pit |

## Site Plan: (Not to Scale)


*Note: This record identifies the geotechnical conditions encountered at the noted test location(s) only. It is possible that ground conditions could be different away from the point(s) of testing.*



# FOREST HABITATS LTD

# 117 ARTHURSTOWN ROAD, HOKITIKA

**Prepared for Forest Habitats Ltd**

**September 2023 Ref L24312c Rev B**

Hutchinson
CONSULTING ENGINEERS

# Forest Habitats Ltd

# Engineering Report
# 12 Lot Rural Residential Subdivision

# 117 Arthurstown Road
# Hokitika


Prepared by Matt Symons
**ENGINEER**

Hutchinson Consulting Engineers Ltd
P O Box 150, Orewa 0946
154 Centreway Road, Orewa 0931

Reviewed by Paige Farley
**CIVIL MANAGER**

+64 9 426 5702
info@hc.co.nz
www.hc.co.nz

Approved by Ian Hutchinson
**MANAGING DIRECTOR**



**Date** 07 September 2023
**Status** Version 3

**Contents**



**Appendix**

Our Ref: L24312c Rev B

07 September 2023

MacDonell Consulting Ltd
17 Cliffs Road
St Clair
Dunedin 9012

Dear Barry

**RE: 12 LOT RURAL RESIDENTIAL SUBDIVISION AT 117 ARTHURSTOWN ROAD, HOKITIKA**
**FOR FOREST HABITATS LTD**

## 1.0 Introduction

Further to your request, this office has investigated the engineering requirements for the proposed rural residential subdivisional development at 117 Arthurstown Road, Hokitika.

This updated version of the original report has been provided to comment on a revised scheme layout in which all 12 new lots include a nominated building platform.

It is proposed to subdivide the existing block to include 12 new buildable lots varying in size from 5,000 m² to 14,100 m² from the underlying parcels of land. The proposed lots are serviced from Arthurstown Road and East Road.

## 2.0 Site

The 19 hectare (or there-about) site is located on the northern side of Arthurstown Road approximately 1.0 km east of its intersection with Ruatapu Road (SH6), Hokitika. The property is on the southern side of the Hokitika river mouth. The site comprises pastural grazing and is relatively level at an elevation of between around RL3.0m and RL5.0m. The site drains gently towards the north to the Hokitika River. The site is subject to flood inundation during peak river flood flows.

## 3.0 Earthworks

As part of the proposed development, a flood free building platform will be created on each lot in a nominated location once titles have issued. Based on the flood flow analysis detailed in Section 6.0 of this report the peak flood flow is expected to reach a maximum elevation of around RL5.5m. The building platforms should be constructed to at least this elevation.

Given that the natural ground levels around the proposed platform locations vary from around RL4.0m to RL5.2m earth filling will be required to form a 17.5m x 17.5m flood free building platform to a minimum elevation of RL5.5m on each lot.

Borrow material to form each platform should be sourced from within the flood plain extents to achieve a neutral effect on the current flood storage.

## 4.0 Nominated Building Platforms

The nominated building platforms will comprise a 17.5m x 17.5m level platform with 1v : 8h earth fill batters grading down to existing ground levels.

Below is a table outlining the proposed building platform level and fill volumes required to construct the platform:

| Lot Number | Existing Ground Level at Platform Location (m) | Fill Depth to Achieve RL5.5m Platform (m) | Fill Volume ($m^3$) (level to nearest 0.1m) |
|---|---|---|---|
| 1 | 5.08 | 0.42 | 172.0 |
| 2 | 4.59 | 0.91 | 551.0 |
| 3 | 4.35 | 1.15 | 887.0 |
| 4 | 4.00 | 1.50 | 1316.0 |
| 5 | 4.00 | 1.50 | 1316.0 |
| 6 | 4.10 | 1.40 | 1161.0 |
| 7 | 4.43 | 1.07 | 765.0 |
| 8 | 4.75 | 0.75 | 459.0 |
| 9 | 4.48 | 1.02 | 653.0 |
| 10 | 4.92 | 0.58 | 300.0 |
| 11 | 5.18 | 0.32 | 119.0 |
| 12 | 4.83 | 0.67 | 375.0 |
| | | **Total Volume** | **8074.0** |

*Table 1: Building Platform Earthworks*

## 5.0 Stormwater

The only stormwater works to be completed on the site is the installation of the roadside culvert crossings to accommodate the new entranceways into the individual lots and the clearing out of original farm drains to improve surface drainage.

## 6.0 Potential Inundation

We have reviewed the West Coast Regional Council report Hokitika River Hydraulic Modelling and Flood Hazard Mapping dated 10th June 2020.

https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Westland%20District/Hokitika/2020_LRS_Hokitika%20River_Hydraulic%20modelling%20and%20flood%20hazard%20mapping_v2-10-12-2020%20optimized%20for%20web.pdf

Assuming Scenario 6 for the flood mapping reporting, 100 Year, Climate Change Scenario RCP6.0 (2100), 1m Sea Level rise including 400mm of storm surge the site will be in the range of around existing ground level to around 2m below water during the peak flood flow events.

The topographical survey plan of this site prepared by Chris J Coll Surveying Ltd indicates the majority of the site is around RL3.0m to RL5.0m. The Hokitika River Flood Modelling report indicates that the November 2018 Flood Debris Levels in the vicinity of the site were to an elevation of RL4.83 (refer Appendix A), essentially a good part of the subdivision site remained flood free during this storm. Refer attached engineering plan A3-24312 RC GE-04.

The reason for the conservative flood free building platform level of RL5.5m is that the flood modelling takes into effect sea level rise, global warming and storm surge contemporaneously.

The 1 in 100 year event including climate change (2100) RCP Scenario 6.0 with a 1m sea level rise and 0.4m Storm Surge the site inundates to 0.0m to 2.0m flood depth, refer Appendix B.

The flood depth model has been superimposed over the topographical model of the proposed subdivision and flood elevations typically range from around RL4.5m at the western end of the proposed development to around RL5.5m at the eastern end of the proposed development. There are outlier peaks of up to around RL6.0m in certain areas however this is not representative of the RL5.5m average over the site.

Flood free building platforms should be constructed to a minimum elevation of RL5.5m. Finished floor levels of habitable space should be set no lower than RL6.0m however all future building sites should be assessed at the time of building consent to ensure the higher modelled flood levels above RL5.5 are not applicable to that particular site. Finished floor levels of future habitable dwellings should be constructed no lower than 500mm above the inundation level for that particular site.

The same flood modelling report defines flood risk on the Hazard Map for most of the site as H1 and H2, generally safe for vehicles, people buildings, and unsafe for small vehicles respectively, refer Appendix C.

Given the inundation potential for the site and intended use the proposed development is appropriate and the potential flood risk to the activity is low particularly given the building sites will be elevated above the flood risk.

This office has prepared an existing ground level above RL4.0m plan, refer A3-24312 RC GE-07. This plan indicates the land area that is most suitable for development to provide platform levels to a minimum elevation of RL5.5m.

Although the imperviousness of the future sites will increase from pasture to portions of increased impermeability, any adverse effect will be mitigated in that the site is at the lowest portion of the catchment close to the discharge point and any analysis of increased discharge would be offset by the flood plain evident in any peak flood flow event bring discharged before the time of concentration is reached. Imperviousness has little effect if the site is theoretically already flooded also.

## 7.0 Roading

The proposed subdivisional development will be serviced from Arthurstown Road and East Road, Arthurstown Road is formed and sealed however East Road is unsealed. East Road should be upgraded to a sealed standard to the entrance to the proposed Lot 12.

The roadway will be constructed to a 500mm deep roading pavement, 200mm compacted depth of basecourse over 300mm compacted depth of subbase over a subgrade with a CBR of at least 3.

## 8.0 Summary

The site is suitable for its intended use provided flood free building platforms are constructed to a minimum elevation of RL5.5m and any future habitable space is constructed no lower than RL6.0m.

Consideration should be given to certain areas of the site where theoretical flood levels are above RL5.5m and the minimum finished floor levels adjusted accordingly.

We trust this meets with your approval.

Yours faithfully,

**HUTCHINSON CONSULTING ENGINEERS LTD**

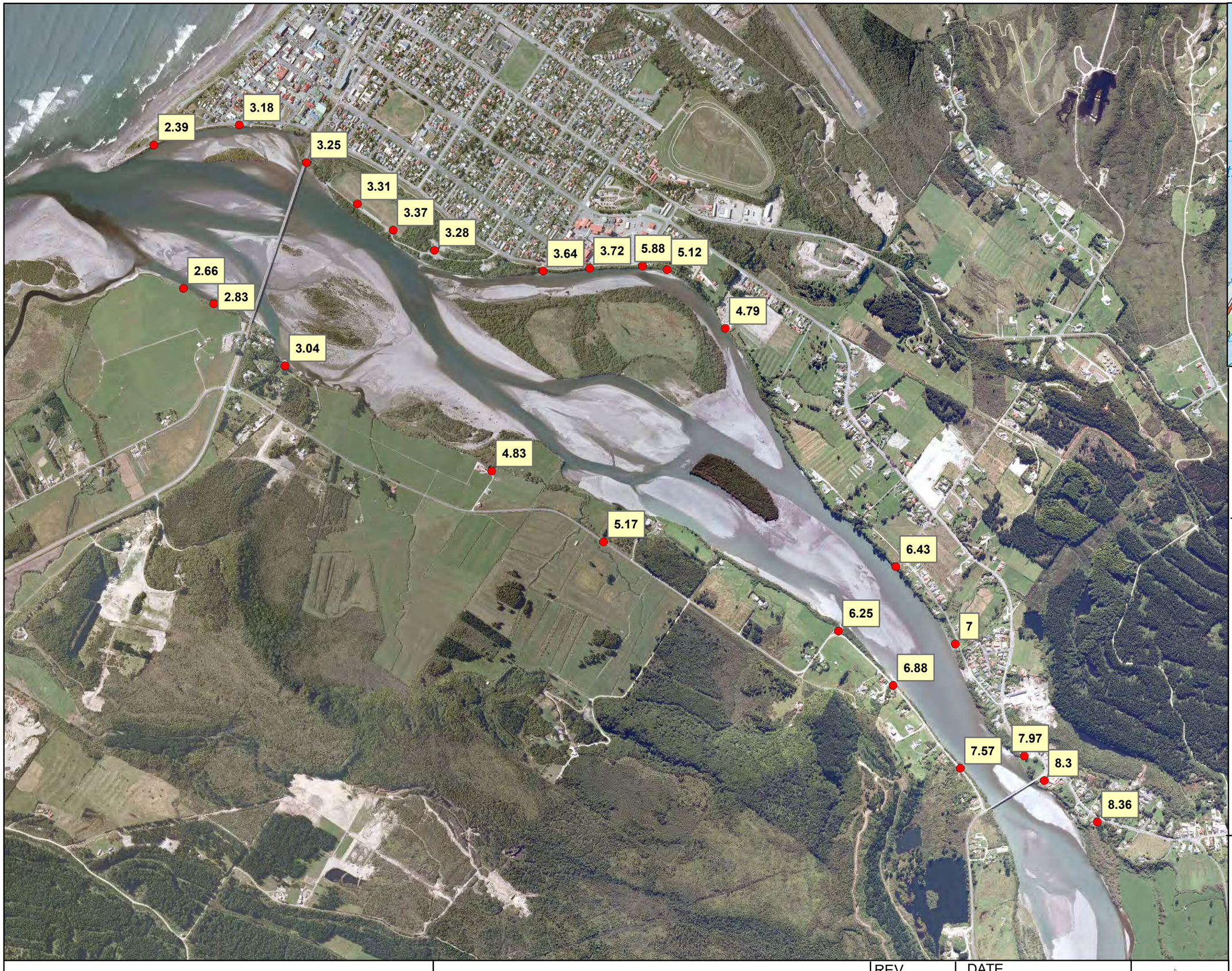
Prepared by Matt Symons
**ENGINEER**

Reviewed by Paige Farley
**CIVIL MANAGER**

Approved by Ian Hutchinson
**MANAGING DIRECTOR**

**APPENDIX A**

Hokitika River Flood Modelling – Debris Level November 2018 Flood Event





LANDRIVERSEA CONSULTING

## Legend

- Debris Levels (Nov 2018)



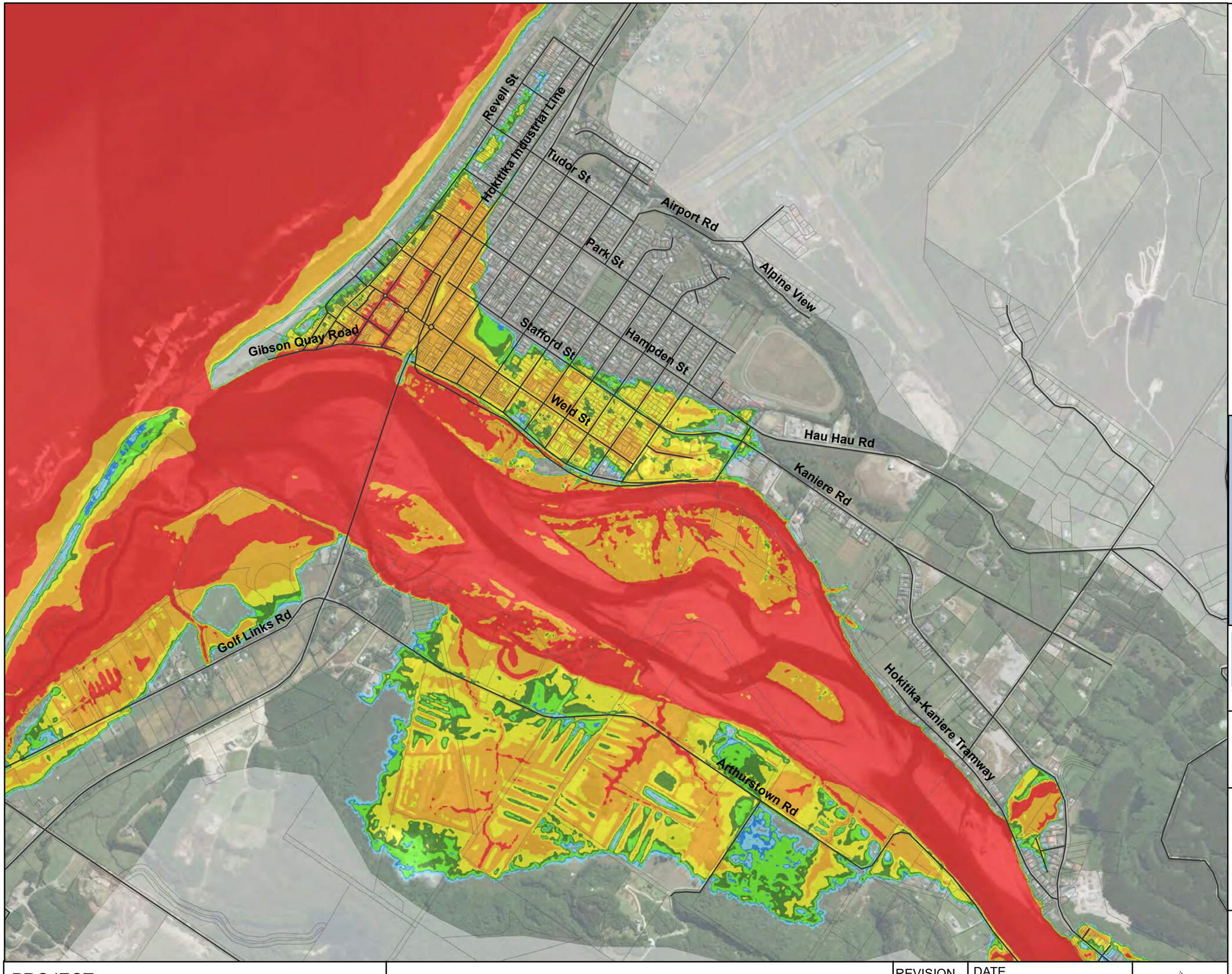
PROJECT
**Hokitika River Flood Modelling**

MAP TITLE **Recorded Debris Levels from November 2018 Flood Event**

| REV | DATE |
|---|---|
| **01** | **16 September 2019** |
| A3 SCALE **1:15,000** | AUTHOR **Matthew Gardner** |

N

**APPENDIX B**
Hokitika River Flood Modelling – Peak Depth Map




# Legend

Roads

Property Boundary

**Peak Depth (m)**

- 0
- 0 - 0.05
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2+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THE WEST COAST REGIONAL COUNCIL

Map1 of 3

0 0.25 0.5 1

Kilometers



PROJECT
**Hokitika River Flood Modelling**

MAP TITLE
**PEAK DEPTH MAP**
**1 in 100 year event including climate change (2100)**
**RCP Scenario 6.0, 1m Sea Level Rise, 0.4m Storm Surge**

| REVISION | DATE |
|---|---|
| **01** | **02 June 2020** |
| A3 SCALE | AUTHOR |
| **1:16,000** | **Matthew Gardner** |

N

**APPENDIX C**
Hokitika River Flood Modelling – Hazard Map

H1 - Generally safe for vehicles, people and buildings
H2 - Unsafe for small vehicles
H3 - Unsafe for vehicles, children and the elderly
H4 - Unsafe for vehicles and people
H5 - Unsafe for vehicles and people
All buildings vulnerable to structural damage
Some less robust buildings subject to failure
H6 - Unsafe for vehicles and people
All building types considered vulnerable to failure

Revell St
Hokitika Industrial Line
Tudor St
Airport Rd
Park St
Alpine View
Gibson Quay Road
Stafford St
Hampden St
Weld St
Hau Hau Rd
Kaniere Rd
Golf Links Rd
Hokitika-Kaniere Tramway
Arthurstown Rd

# Legend

Roads

Property Boundary

**Hazard Category**

H6
H5
H4
H3
H2
H1


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THE WEST COAST REGIONAL COUNCIL

**Map 1 of 3**

0 0.25 0.5 1
Kilometers



PROJECT
**Hokitika River Flood Modelling**

MAP TITLE
**HAZARD MAP**
**1 in 100 year event including climate change (2100)**
**RCP Scenario 6.0, 1m Sea Level Rise,0.4m Storm Surge**

REVISION **01**
DATE **10 December 2020**
A3 SCALE **1:16,000**
AUTHOR **Matthew Gardner**

N

**APPENDIX D**
Hutchinson Consulting Engineers Drawings

# FOREST HABITATS LTD
# PROPOSED SUBDIVISION
# 117 ARTHURSTOWN ROAD
# HOKITIKA

Hutchinson
CONSULTING ENGINEERS

154 Centreway Road
Orewa
Auckland

P.O. Box 150
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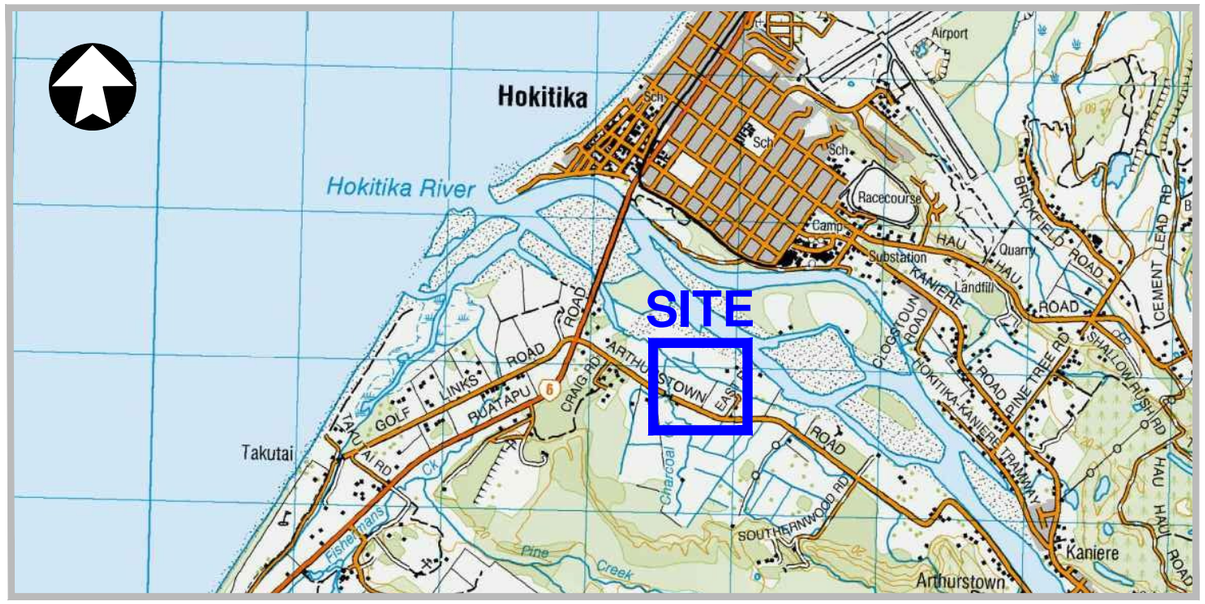
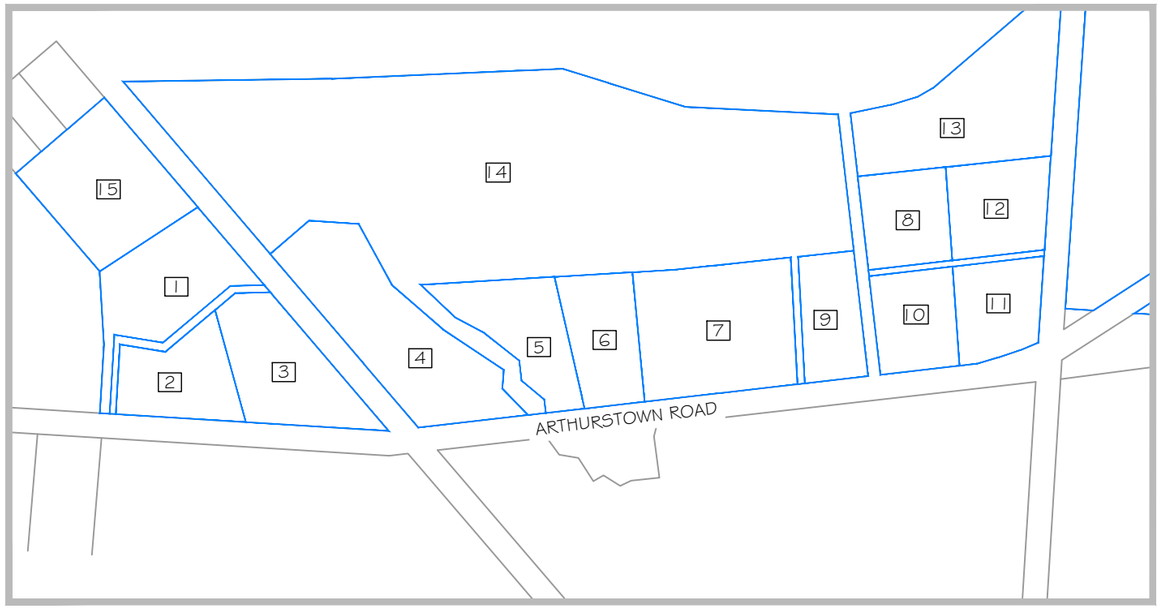
Telephone (09) 426-5702
Email info@hc.co.nz



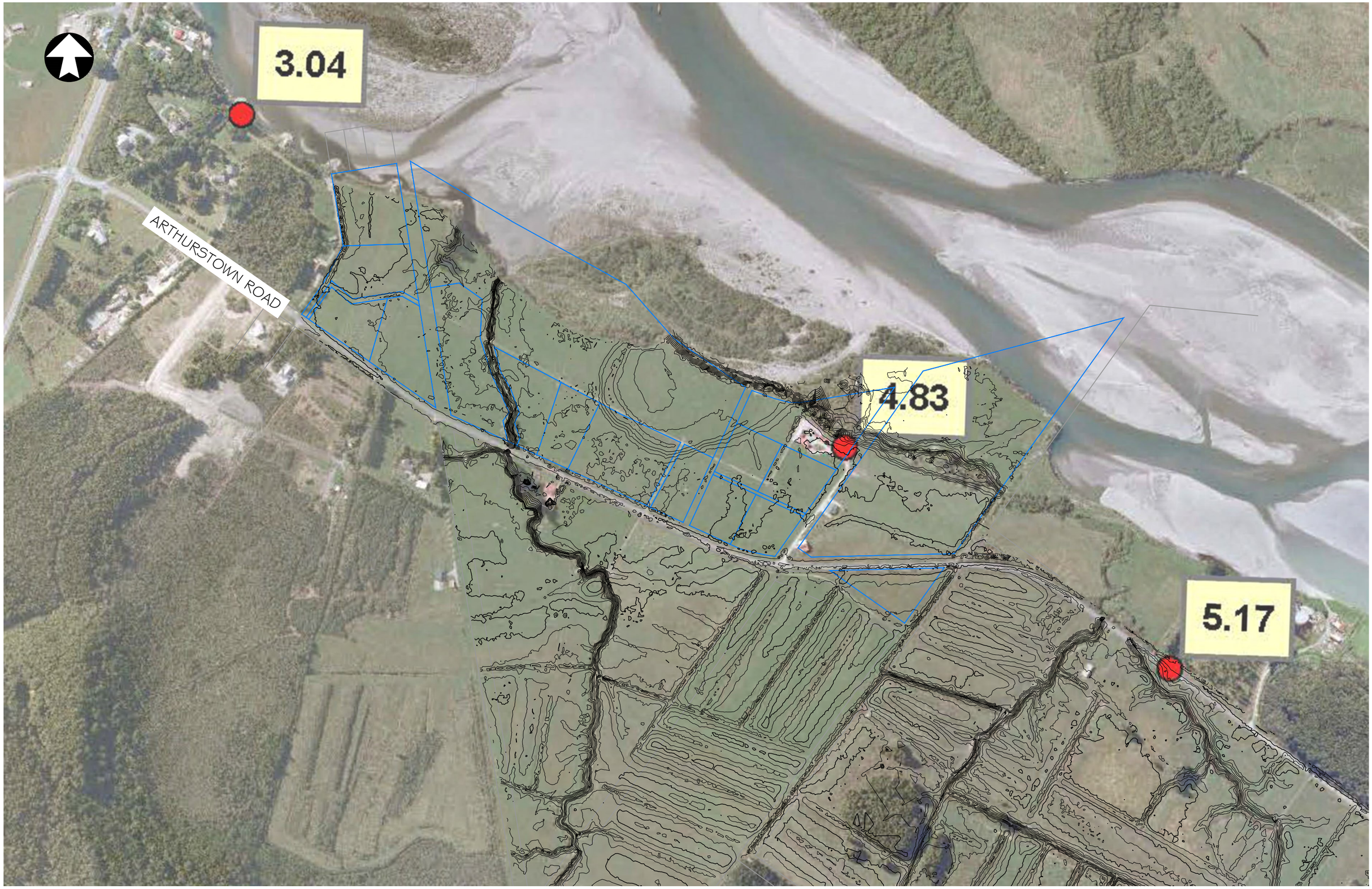

## DRAWINGS - GE






FOR RESOURCE CONSENT ONLY
NOT FOR CONSTRUCTION

**24312 GE-01**
**OCTOBER 2022**

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| Design | M. SYMONS | OCT 2022 |
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| Checked | P. FARLEY | OCT 2022 |
| Approved | I. HUTCHINSON | OCT 2022 |
| Scale | 1:5000 @ A3 | |
| Scale vert. exag. | | |

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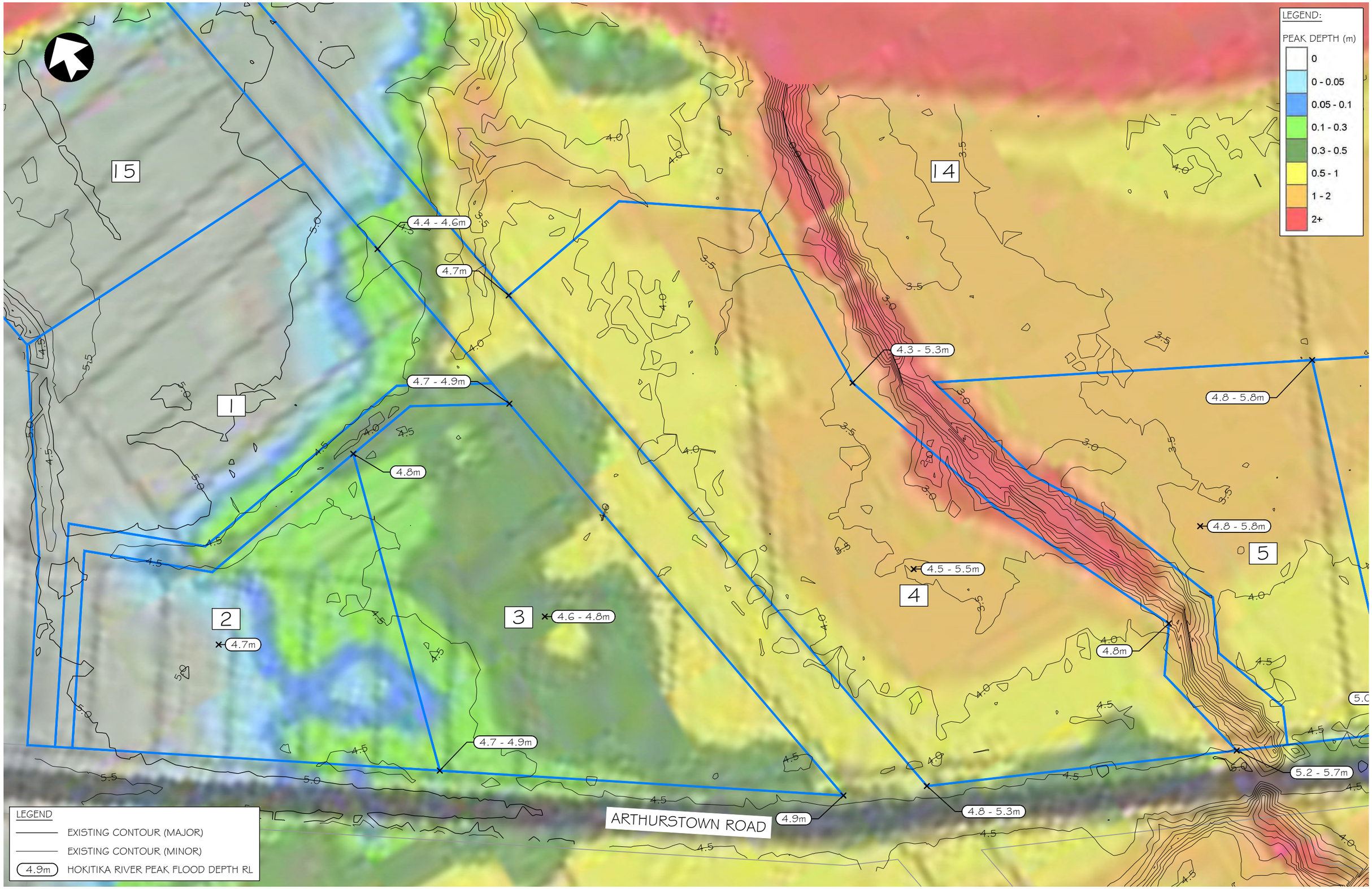
**117 ARTHURSTOWN ROAD**
**HOKITIKA**

Title
**HOKITIKA RIVER DEBRIS LEVELS (2018)**

Sheet No.
**GE-02**

Job No.
**A3-24312 RC**

Rev.
**-**

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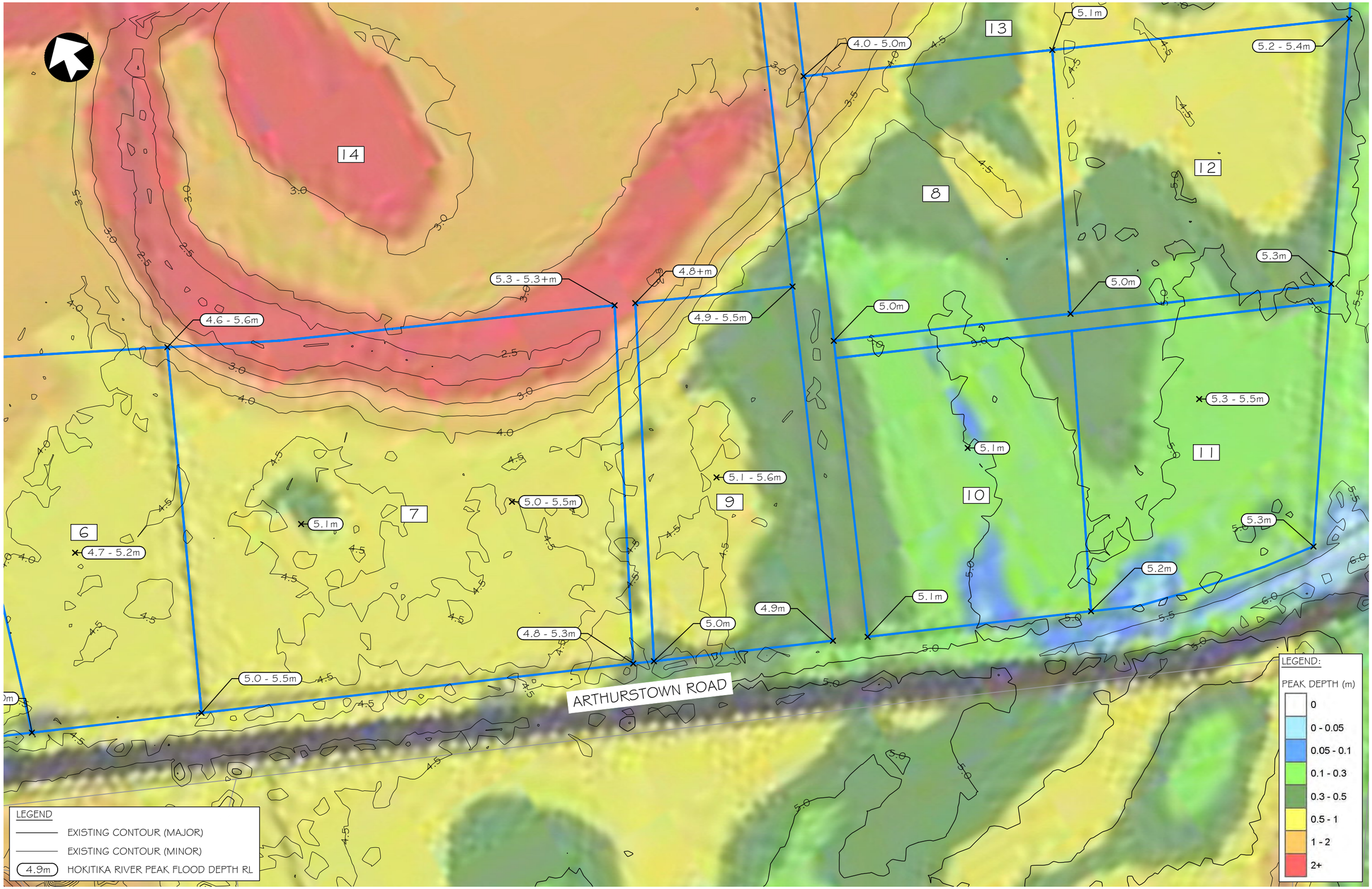
**117 ARTHURSTOWN ROAD**
**HOKITIKA**

Title
**HOKITIKA RIVER PEAK FLOOD DEPTHS - SHEET 1 OF 2**

Job No.
**A3-24312 RC**

Sheet No.
**GE-03**

Rev.
**-**

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Title
**HOKITIKA RIVER PEAK FLOOD DEPTHS - SHEET 2 OF 2**

Job No.
**A3-24312 RC**

Sheet No.
**GE-04**

Rev.
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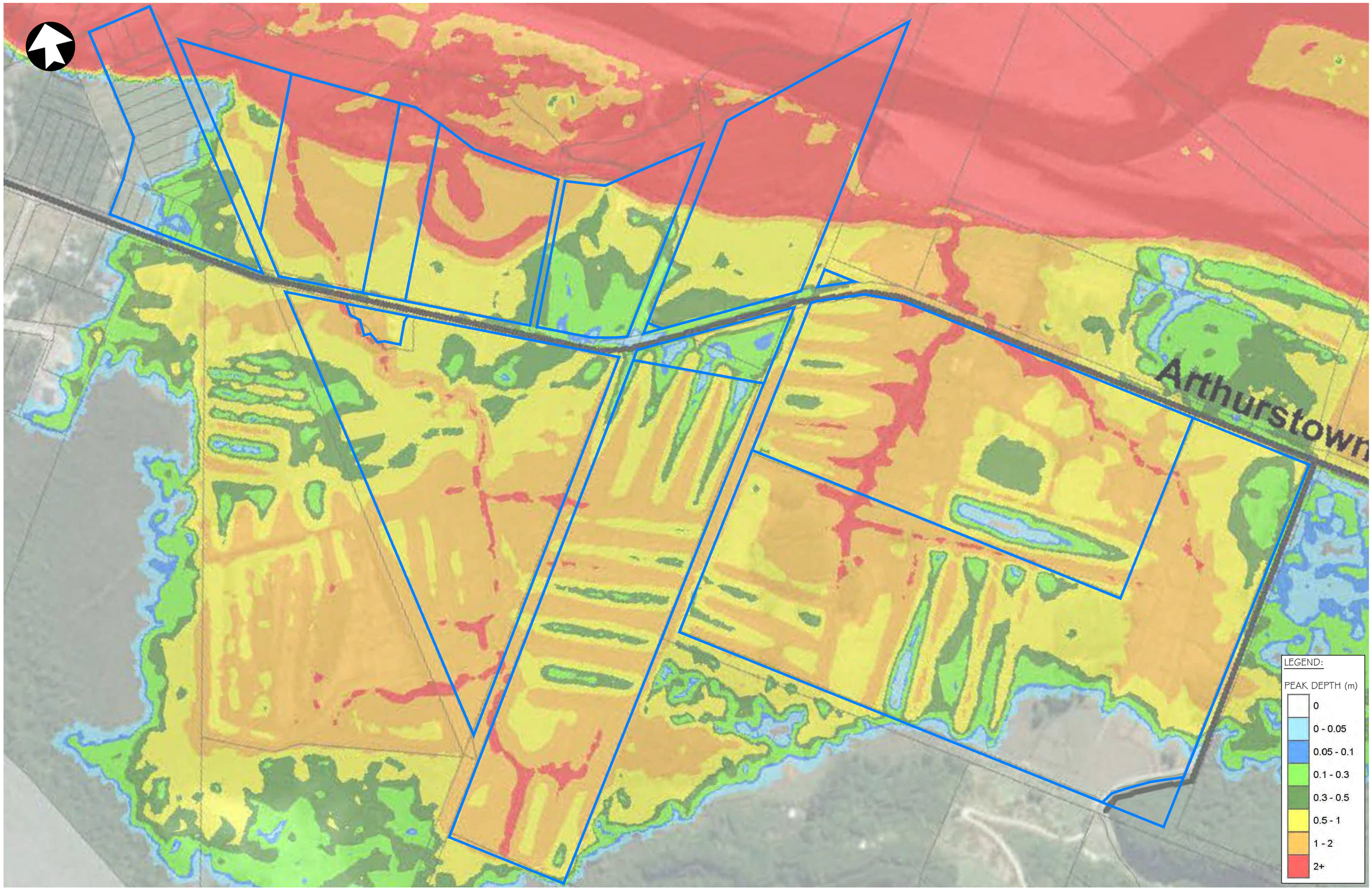


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Title
**117 ARTHURSTOWN BLOCK - HOKITIKA RIVER PEAK FLOOD DEPTHS**

Sheet No.
**GE-05**

Job No.
**A3-24312 RC**

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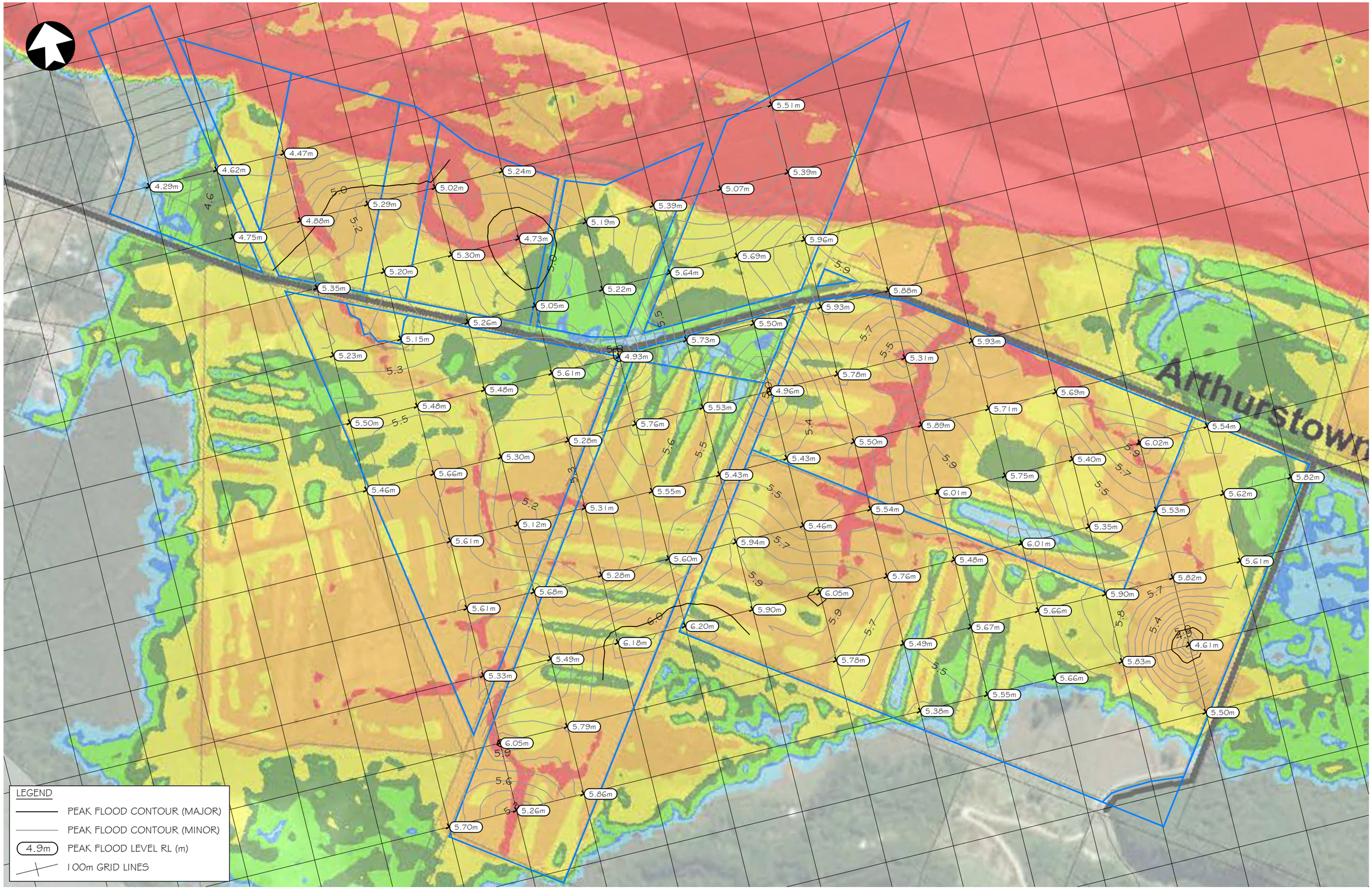
**-**

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Title
**117 ARTHURSTOWN BLOCK - HOKITIKA RIVER PEAK FLOOD LEVELS (100m GRID)**

Sheet No.
**GE-06**

Job No.
**A3-24312 RC**

Rev.
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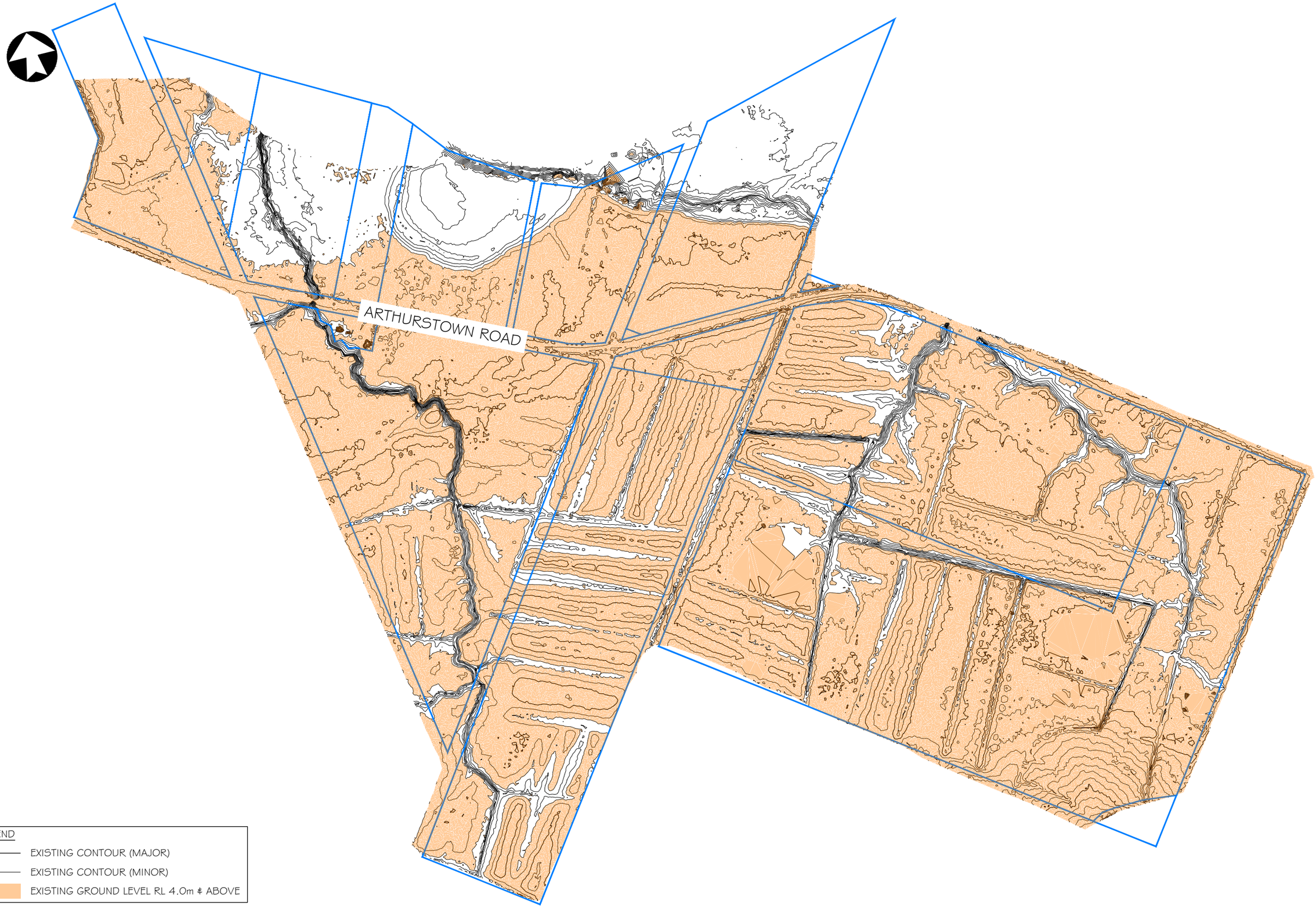


LEGEND

EXISTING CONTOUR (MAJOR)

EXISTING CONTOUR (MINOR)

EXISTING GROUND LEVEL RL 4.0m & ABOVE

| No. | Revision | Drawn | Chk. | Appd. | Date |
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**117 ARTHURSTOWN ROAD**
**HOKITIKA**

Title
**EXISTING GROUND LEVEL ABOVE RL 4.0m**

Sheet No.
**GE-07**

Job No.
**A3-24312 RC**

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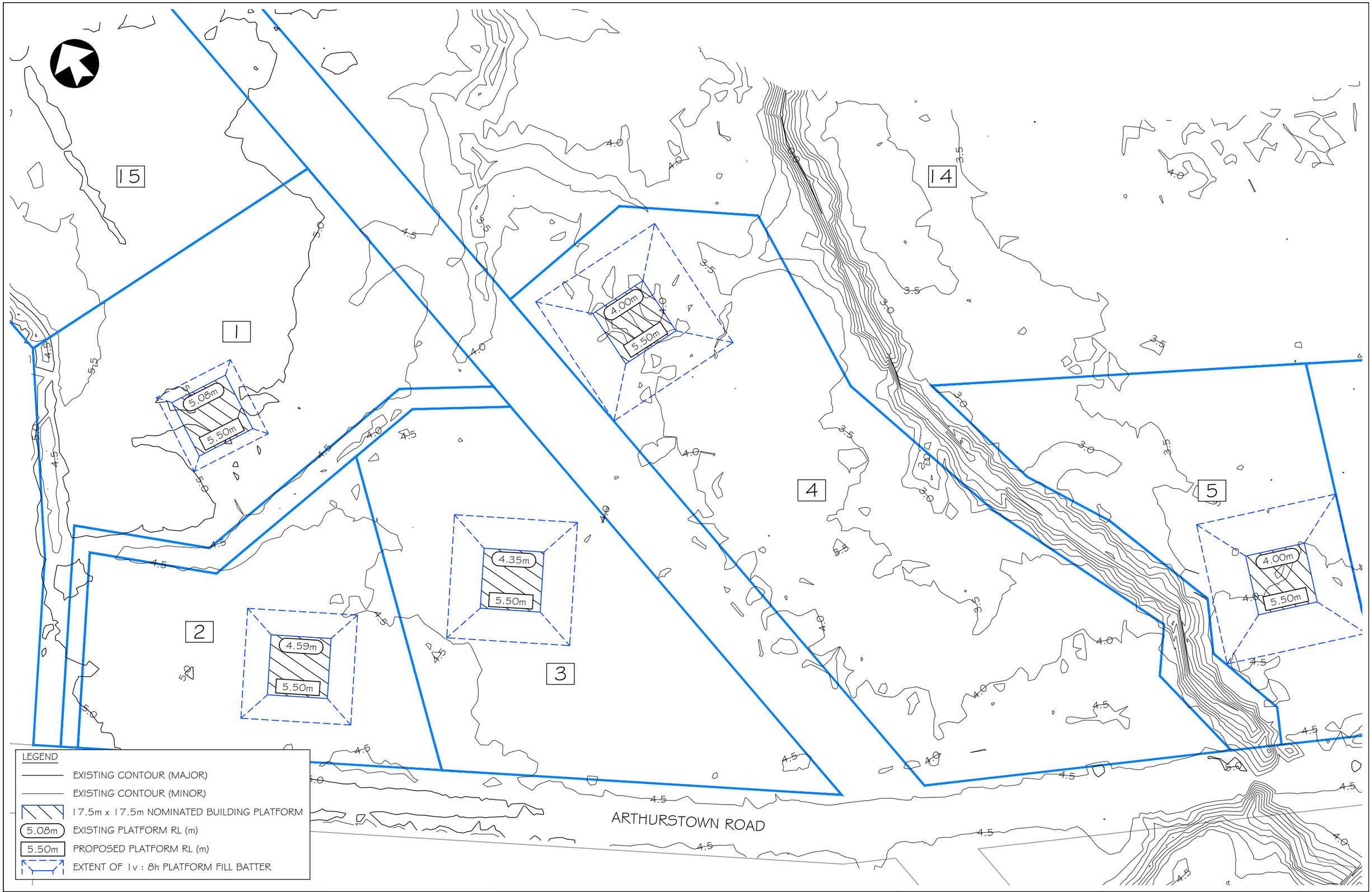
**-**

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| Approved | I. HUTCHINSON | SEP 2023 |
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| Scale vert. exag. | | |

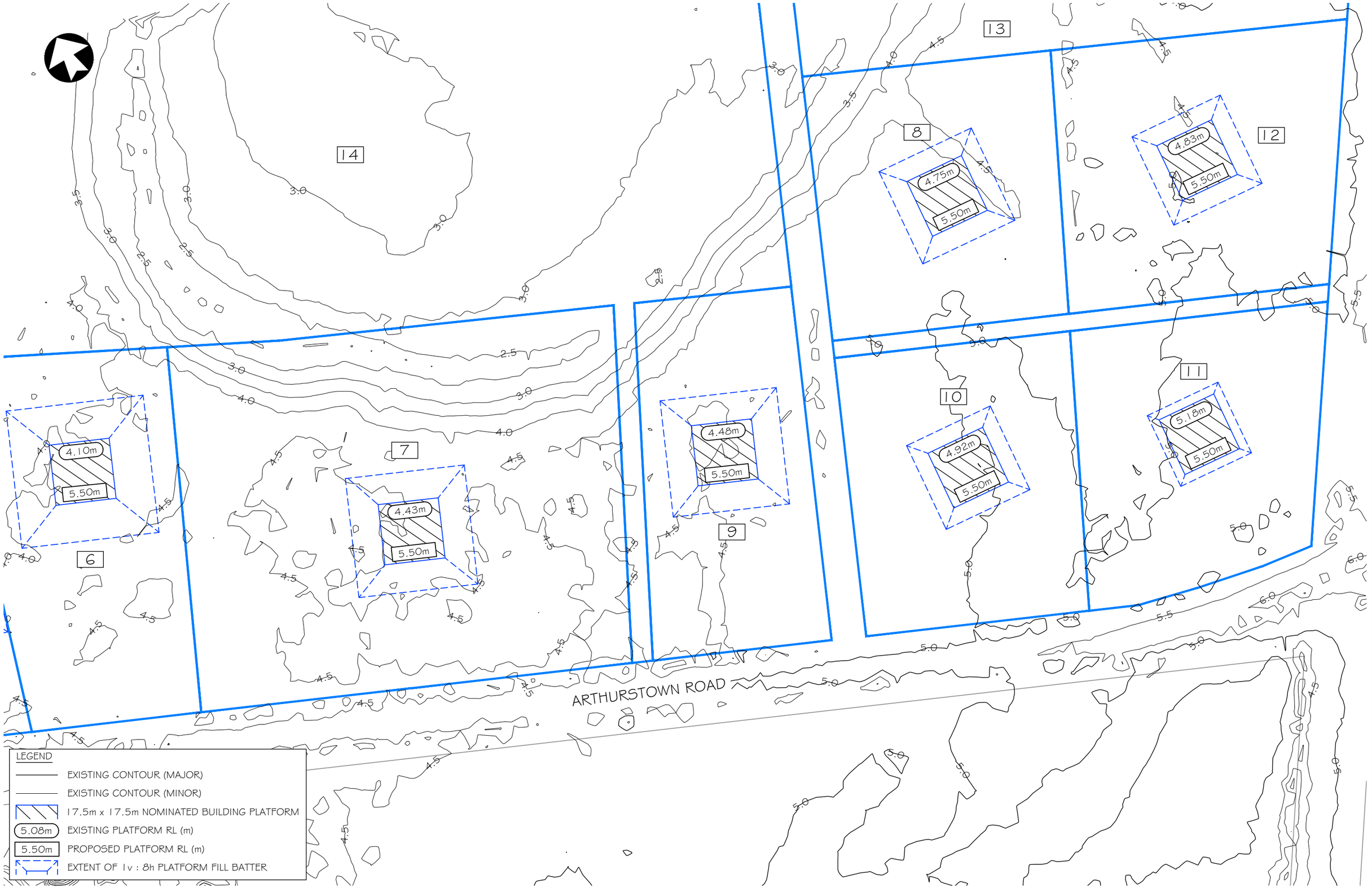
Project
**FOREST HABITATS LTD**
**PROPOSED SUBDIVISION**
**117 ARTHURSTOWN ROAD**
**HOKITIKA**

Title
**EXISTING CONTOUR & BUILDING PLATFORM PLAN - SHEET 1 OF 2**

Sheet No.
**GE-08**

Job No.
**A3-24312 RC**

Rev.
**-**




| No. | Revision | Drawn | Chk. | Appd. | Date |
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| Checked | P. FARLEY | SEP 2023 |
| Approved | I. HUTCHINSON | SEP 2023 |
| Scale | 1:1000 @ A3 | |
| Scale vert. exag. | | |

Project
**FOREST HABITATS LTD**
**PROPOSED SUBDIVISION**
**117 ARTHURSTOWN ROAD**
**HOKITIKA**

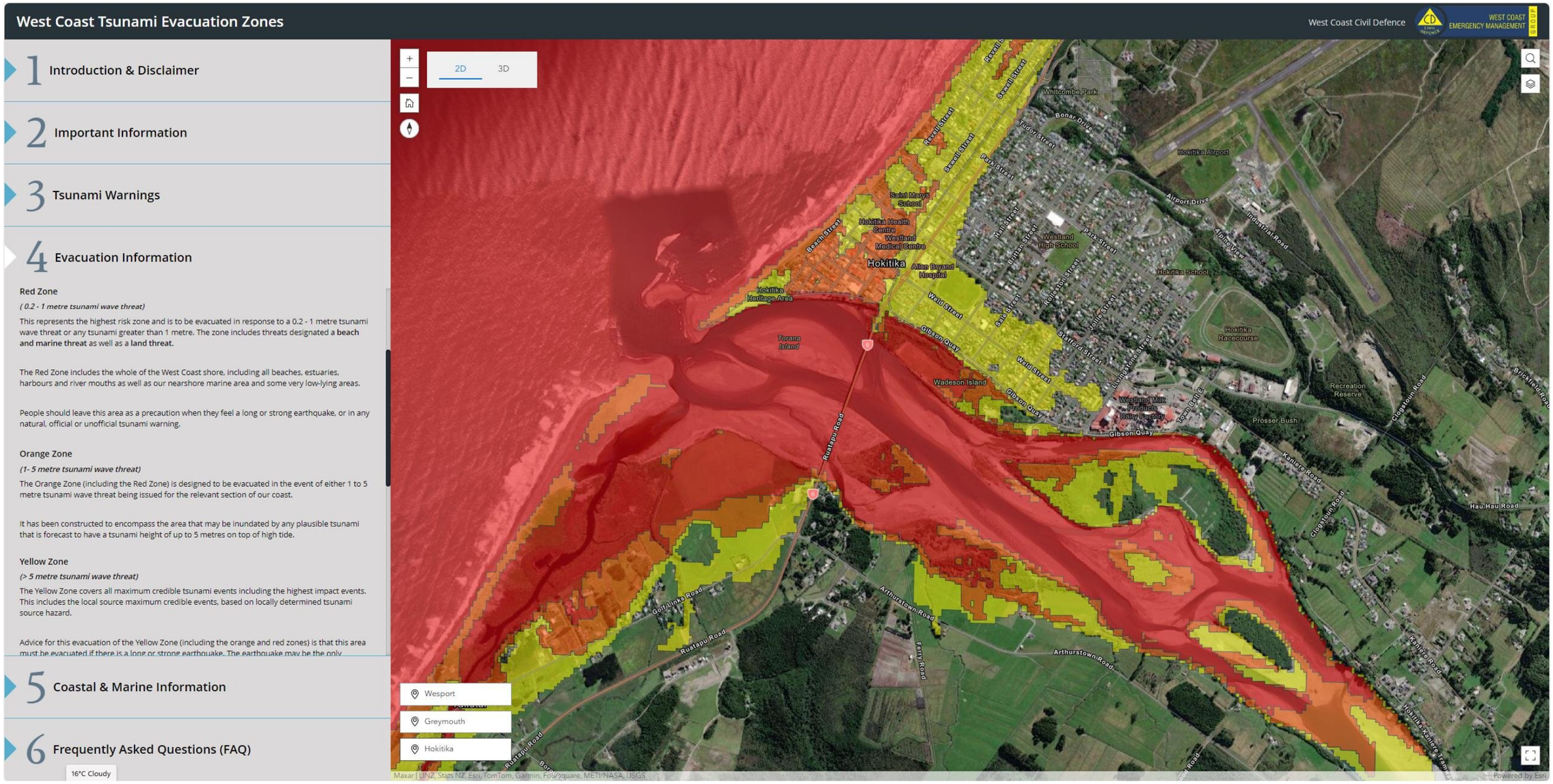
Title
**EXISTING CONTOUR & BUILDING PLATFORM PLAN - SHEET 2 OF 2**

Job No.
**A3-24312 RC**

Sheet No.
**GE-09**

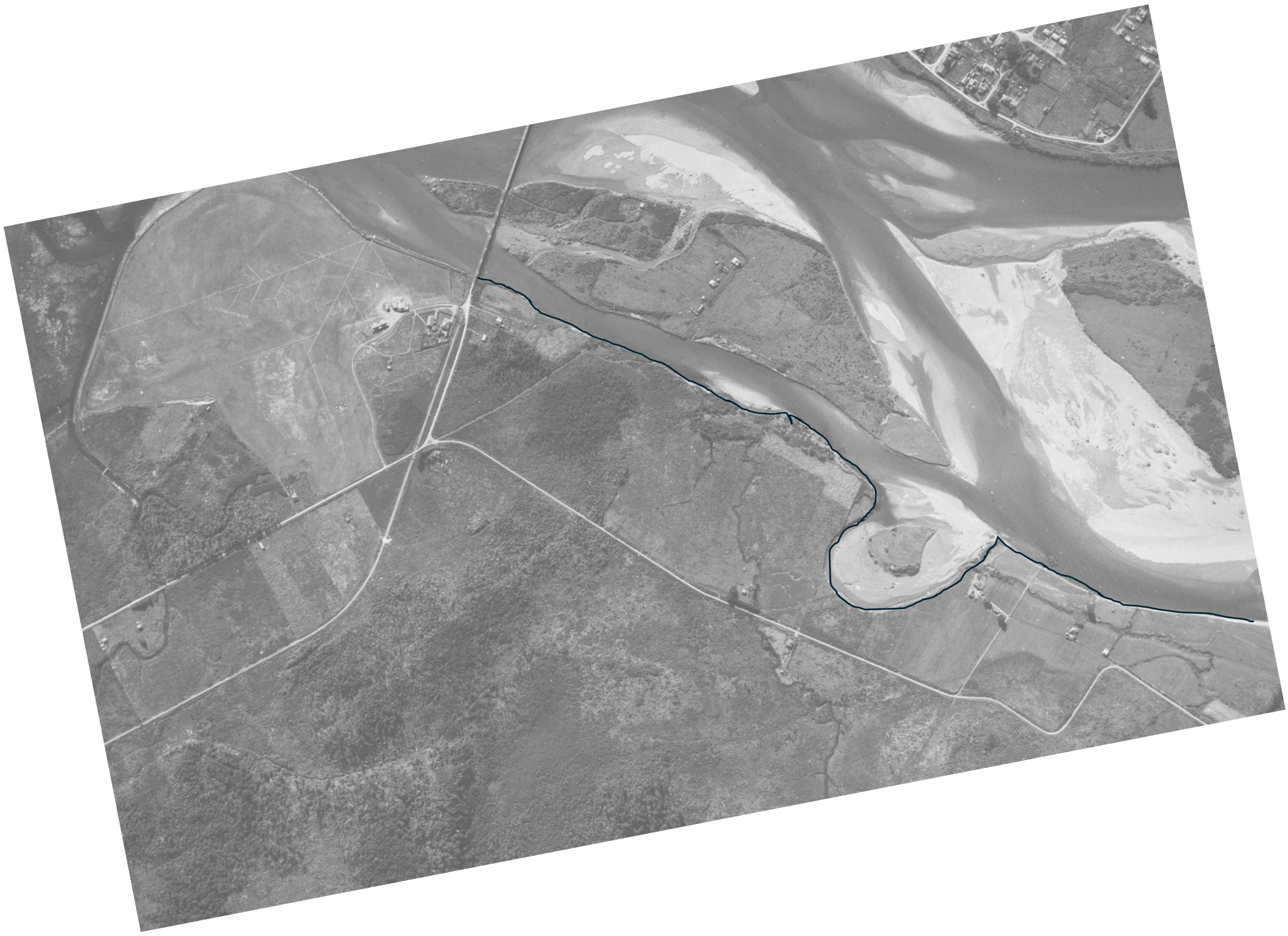
Rev.
**-**

Appendix D: National Emergency Management Agency, Tsunami Evacuation zones for Hokitika




Tsunami Evacuation Zones from: [West Coast Tsunami Evacuation Zones (arcgis.com)]

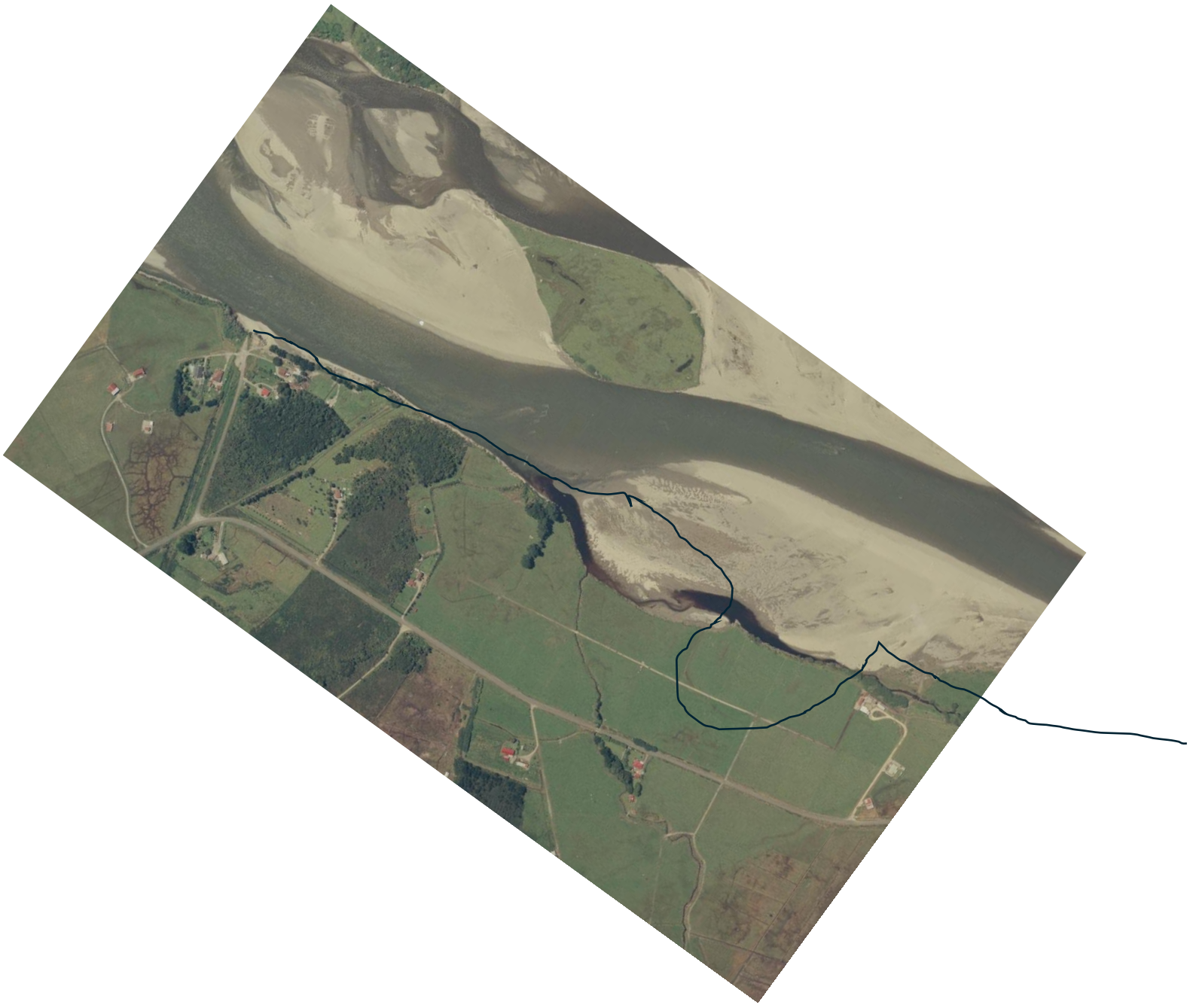
## Appendix E: Historic photographs of the site



4 May 1943 (RetroLens)

21 November 1970 (RetroLens)

24 March 1984 (RetroLens)



15 January 1988 (RetroLens)


15 July 2006 (Google Earth)


15 March 2009 (Google Earth)


17 August 2013 (Google Earth)

25 December 2015 (Google Earth)


22 August 2018 (Google Earth)


7 March 2019 (Google Earth)


25 January 2021 (Google Earth)


28 March 2023 (Google Earth)