planscapes (nz) ltd.
Surveying and Resource Management

Ref RM200488 and RM200489

8 June 2021

Tasman District Council
Resource Consents
By email: amy.bennetts@tasman.govt.nz

Attn: Amy Bennetts

Dear Amy

RE: Further Information Request for Resource Consent Applications – RM200488 – To disturb land and rehabilitate for the purpose of gravel extraction. RM200489 – To erect signage and use an unformed legal road for traffic purposes.

I refer to your letter dated 3 July 2020 requesting further information in respect of the above applications. Please find below and attached responses to these requests.

1. **It is unclear whether the proposed activity will cause changes to flow patterns, water levels or potential land erosion when the river is in flood across the proposed working area. Please provide hydraulic modelling to demonstrate the effects of excavation on river flow in the event the Motueka River floods, and an assessment of scour on the berm or flood plain surrounding the pits, any potential localised change in water levels in flood conditions, and any effect of this on the stopbank.**

   Please find attached at Appendix A, a report prepared by Tonkin and Taylor that addresses this request. The report concludes that:

   'The proposed gravel extraction works are not expected to affect the stability/function of the existing stopbank surrounding Peach Island'.

2. **It states in your application that the noise levels will comply with the limits of the TRMP with at least a 5dB factor of safety. While this may be the case, the activity itself is not permitted and is not an activity that fits within the character of permitted activities in a rural 1 zone. There is also a duty on occupiers in section 16 of the Resource Management Act 1991 to adopt the best practicable option for controlling noise. It is unclear from your application how noise will be managed on site. Please provide a Noise Management Plan detailing what best practicable options will be utilised to manage noise on site.**

   Please find attached at Appendix B a Noise Management Plan prepared by Hegly Acoustic Consultants addressing this request.

3. **An assessment of groundwater levels is key in assessing the potential effects of the proposed excavation below current land surface level given you will "not extract material from below the water table and will maintain an appropriate freeboard". Groundwater levels vary from east to west over the proposed area and are also affected by river stage and the Peach Island bypass channel (when there is overflow during floods).**

   The groundwater assessment from Envirolink provided with the application does not account for the likely variability of groundwater levels over the site and does not adequately show groundwater flow direction and head (contour). Our water scientist, has queried the use of the river stage levels and the datum reference at Woodman's bend to inform groundwater levels on site considering the

recharge area (to groundwater) for the site is upstream and the river is the principal source of groundwater recharge to Peach Island.

Please provide the following information:

a. **A ground survey which shows contours across the site referenced to a common datum.**

b. **A piezometric survey which shows groundwater contours across the site referenced to a common datum and its variation between seasons (high and low).**

c. **Defined water table levels across site referenced to a common datum. The water table can vary up to around two metres so please explain how you have determined this level.**

d. **The maximum depth of excavation across the site and how this will be monitored and complied with.**

Please find attached at Appendix C a plan prepared by Kelly Norris of Mapazzo showing ground levels across the site based on Lidar data. The plan also shows mean winter groundwater level contours across the site, based on the results of piezometric data obtained in 2020. It is understood from our previous discussions that mean winter groundwater levels are sufficient, rather than the full seasonal variation, on the basis that excavations are not proposed below the mean winter groundwater level.

The Mapazzo plan includes a section through the proposed Stage 1 extraction area showing ground surface levels and mean winter groundwater levels. These are both referenced to the NZVD (2016) datum. It is envisaged that conditions of consent will require excavations to be regularly surveyed to ensure that they do not extend below the mean winter groundwater levels that have been established. This information will be recorded and provided to Council at agreed intervals.

4. **You state backfill material may include up to 10% organic matter. Please provide the following information regarding backfill material:**

   a. **What material will you use?**

   b. **What effects will backfill have on groundwater quality, other groundwater users, and the water quality of the Motueka River? We note that the hydrographs attached with your assessment show pumping effects on your two bores monitored.**

   c. **Is any groundwater level and quality monitoring being considered e.g. upstream and downstream of the site – to monitor effects before /during and post excavation?**

These matters are addressed in the Groundwater Quality Assessment undertaken by Envirolink, included at Appendix D. The report concludes that:

'Overall, the proposed activity poses a low risk to groundwater and surface water quality.''

The report includes groundwater quality monitoring recommendations, which are anticipated to be included as conditions of consent.

5. **Your application states you intend to carry out amenity planting, please provide a planting plan which includes species, timing and management etc.**

Canopy have prepared a Landscape Mitigation Plan to address this request. Please find attached at Appendix E.

planscapes (nz) ltd.

Yours sincerely
PLANSCAPES (NZ) LTD

Hayden Taylor
Resource Management Consultant

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Document1

Tonkin+Taylor

Job No: 1015514.0000R
16 December 2020

CJ Industries Ltd
34 Hau Road
Motueka
New Zealand

Attention: Richard Deck | Business Development Manager

Dear Richard,

Peach Island Gravel Extraction

1 Introduction

CJ Industries Ltd has engaged Tonkin & Taylor Ltd (T+T) to provide advice on the implications of gravel extraction at Peach Island, Motueka on flooding (e.g., peak water depth, velocity) and geotechnical (e.g. scour, seepage) risk to the Peach Island stopbanks. This letter report outlines our findings in relation to the geotechnical and flood hazard investigations T+T have undertaken on your behalf. The purpose of these investigations is to support the resource consent application for gravel extraction at Peach Island, Motueka. Our full scope of assessment is detailed in our letter of engagement dated 8 October 2020 (T+T reference #1015514).

2 Context

We understand that CJ Industries have applied for a resource consent to authorise the extraction of gravel, stockpiling of topsoil, and reinstatement of quarried land alongside associated amenity planting, signage, and access formation at 134 Peach Island Road, Motueka (refer Figure 1). Our report only covers aspects related to the flood hazard and geotechnical components.

Our assessment is based on the following design and site operation assumptions:

- Extraction areas are located a minimum of 20 m horizontal distance from the toe of the stop bank;
- The maximum depth of excavation is 5 m with a maximum width of excavation of 30 m and the maximum excavation length is 100 m;
- Extraction (borrow) areas will only be open on one side of the stop bank at any given time and
- Only one extraction area (stage) will be operation at any one time
- Gravel extraction borrows will be broadly orientated parallel to the direction of river flow.

Further details can be found in the Resource Consent application and Assessment of Environmental Effects prepared by Planscapes (NZ) Ltd (dated 15th June 2020).

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P +64-3-546 6339 F +64-9-307 0265 E nel@tonkintaylor.co.nz

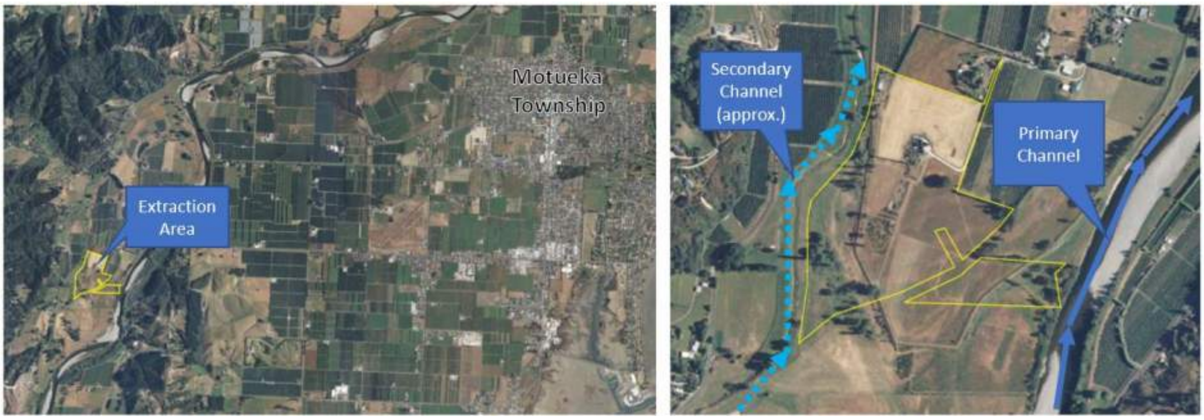

Figure 1: Locality diagram (left plate) and application site and immediate environs (right plate). Modified from AEE prepared by Planscapes (2015)

2.1 Flood Hazard Modelling

The purpose of undertaking flood hazard modelling is to satisfy the requirements noted in section G Flood Risk Assessment in Annexure K S88 Return Notice issued by Tasman District Council[1]. Following review of materials supplied by CJ Industries Ltd, the flood hazard assessment was carried out for only the area identified as stage 1, as both stages 2 and 3 are protected by the Peach Island stop banks and are therefore not subject to flood hazard (refer Figure 2). No other significant local flood hazard (e.g., overland flowpaths) were identified inside the stopbanks in stage 2 & 3.

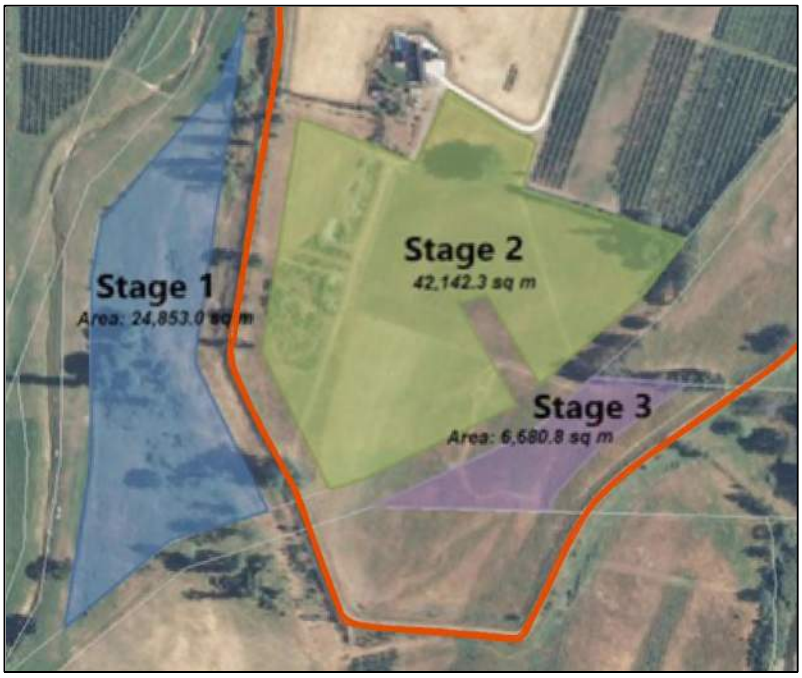

Figure 2: Peach Island Gravel Extraction Staging. Figure shows maximum operational extent of each stage. Stopbank crest shown (red). Modified from AEE prepared by Planscapes (2015)

The baseline TuFlow hydraulic model used in our assessment is detailed in full in Appendix 3 of the Motueka, Brooklyn and Riuwaka Flood Mitigation Study - Summary Report[2]. Because only a single excavation borrow will be operational at any given time, two separate model surfaces (ground

[1] See Annexure K S88 issued 17th July 2019, application number RM190818
[2] See Motueka, Brooklyn and Riuwaka Flood Mitigation Study - Summary Report T+T job number 1004543.6010

surface) were prepared, one each for the north and south of the stage 1 extent (see Figure 3). Each borrow is 30 m x 100 m and extends 5 m below the existing LiDAR ground level. These borrows are offset approximately 20 m from the toe of the stop banks and orientated parallel to the direction of flow. No further changes to the model have been made.

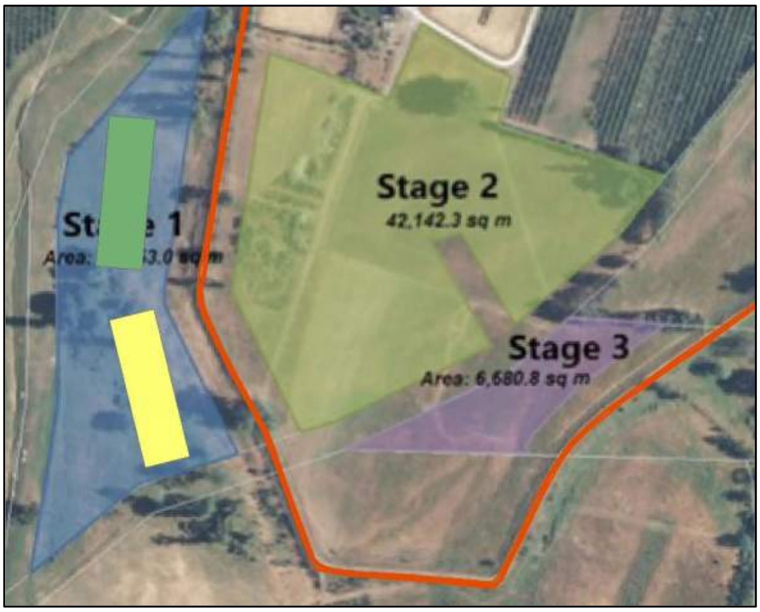

Figure 3: Modelled Borrow locations

Due to the proximity to the stopbanks these two locations are considered representative of the potential risk to the stopbanks as a result of the proposed activity. The run matrix below identifies the flood scenarios assessed, due to the relatively short consent duration (<15 years) no allowance for climate change or any additional upstream development has been allowed for.

Table 2-1: Flood model run matrix

Scenario	Excavation	Critical Duration (hr)
Existing Development 10-year ARI	North	48
Existing Development 10-year ARI	South	48
Existing Development 100-year ARI	North	48
Existing Development 100-year ARI	South	48

Note: ARI-: Annual Recurrence Interval

For each model run the following model outputs were extracted and the outputs between pre- and post-development were compared:

- Peak Depth
- Peak Level
- Peak Velocity

2.2 Slope Stability Modelling

The purpose of undertaking a geotechnical stability assessment is in response to feedback[3] provided by Giles Griffith (Tasman District Rivers and Coastal Engineer). Our geotechnical stability assessment is based on the following design assumptions:

- Extraction areas are located a minimum of 20 m horizontal distance from the toe of the stopbank
- Maximum depth of excavation is 5 m, maximum width of excavation is 30 m.
- Extraction areas will only be open on one side of the stopbank at any given time.
- The underlying ground conditions comprise sands and gravels deposited by the Motueka River, based on previous MWH and T+T ground investigations for the eastern stopbanks of the Motueka River.

Based on assessment of the assumptions above and the proposed activity it was concluded that no analysis of seepage related failure was required for the following reasons:

- Alluvial, dense, sandy gravel soils are expected to be encountered at approximately 2.0 m depth below existing ground level at the extraction pit locations, based on MWH and T+T test pit information for the eastern stopbanks of the Motueka River. These gravel soils are expected to have a low susceptibility to internal erosion.
- Excavation of the borrow pits will not impact on the general ground water levels in the area
- General groundwater flows will continue to flow under the stopbanks after the pits have been dug, no differently to the existing situation.
- Excavation of the borrow pits will locally destabilise the sides of the pit walls. Due to the 20 m offset from the toe of the stopbank there is very low risk of this affecting the stopbanks (see Appendix 2 for supporting calculations)
- In a major flood flow, failure through seepage could still occur when the water level gets up to near the crest level of the stopbanks. The presence of the borrow pits should not impact on potential seepage paths through the stopbanks and therefore the pits should not impact on the stability of the stopbanks.

3 Results and Conclusions

3.1 Flood Hazard Modelling

3.1.1 Flood Depth & Extent

The maximum flood extents and levels estimated by the hydraulic model indicates that outside of the immediate (i.e., 300 m) excavation borrow extent no changes in post development peak flood depths or extents were observed for all scenarios except for the Stage 1 South Pit in the 10-year ARI event (Appendix A). As shown in Appendix A 1015514.000-F3 there is a decrease in flood depth of 0.11 m, upstream of the gravel pit, to a maximum distance of 40 m away from the south end. As expected, flood depths inside the footprint of the excavation borrow pits are >5m in all post development scenarios.

[3] See correspondence dated 21st September 2020 regarding scope of assessment

3.1.2 Velocity

The modelling predicts only minor differences in flood flow velocities in the immediate vicinity of the proposed extraction borrows[4]. The peak differences in velocities across the wider site are generally minor with the largest difference in the order of 0.1 – 0.2 ms^{-1} increase (South Pit 100 yr ARI) to the south of the pit. At this location max velocities are between 0.7 to 0.8 ms^{-1} (in the 100 yr ARI flow). Differences in peak flood flow velocities decrease with increasing distance from the excavation borrows. Within the pits and to the east and west a reduction in flood flow velocity was observed with in the model, including a reduction in velocity at the stopbank face. Overall, the velocities observed include:

- South Pit: Minor increase (0.1-0.2 ms^{-1}) of flood flows velocity into the pit. This is accompanied by a commensurate reduction in flood flow velocities within the pit and the immediate vicinity;
- North Pit: reduction of flood flow velocities to the west and east of the pit and reduction in velocity downstream of the pit in the order of 0.3 - 0.4 ms^{-1};
- Stopbank: reduction of flood flow velocities at the face of the stopbank.

Based on these results, in particular the reduction in flood flow velocities at the face of the stopbank, the existing risk associated with flood flows at the stopbanks is not being made worse by this activity.

3.1.3 Flood risk assessment Conclusions

The modelling results indicate that the greatest affect may be almost indiscernible attenuation of flood flows if the excavation was inundated during the operation of the borrow pit. Based on our assessment of modelled changes in depth, level and velocity there is no evidence to suggest this activity will worsen existing flood risk, impact natural drainage patterns during our modelled flood flow scenarios or negatively impact the flood plain storage or conveyance capacity. Provided the gravel extraction operates as currently proposed it is unlikely that the activity will generate adverse effects on floodplain dynamics, in particular erosion in this area. There is no indication that there are any offsite effects. Following the excavation of material, the borrow pits will be backfilled and therefore will act in a similar manner to the pre-excavation floodplain.

3.2 Geotechnical Stability Modelling

3.2.1 Methodology

We have checked the geotechnical stability of the borrow pits and the likelihood of a failure of the wall of the pit affecting the stability of the stopbank.

Geotechnical stability was checked using the industry accepted software package, SLOPE/W for one side of the stopbank. Although the slope stability analysis was only undertaken on one side of the embankment, the results of the analysis are appropriate for the stability of excavation on either side of the existing stopbank as we have adopted a conservative groundwater level for the static design case and have assumed fully saturated ground conditions for the elevated groundwater design case.

3.2.2 Design Criteria

SLOPE/W has been used to check the stability of the stopbank with excavation pits in place against the following industry accepted conditions and Factor of Safety (FoS) values:

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[4] It is worth noting that our assessment of the peak difference for velocity is likely to be conservative. This is due to the timing of the peak velocity between the pre- and post-development scenarios. We believe it is likely there will be little to no difference in flood flow velocities once the excavation is flooded.

- Static Condition: - FoS > 1.5
- Elevated Groundwater Conditions: - FoS > 1.3
- Earthquake Condition: Ultimate Limit State (ULS i.e., a 1/500 year ARI seismic event) – there should be less than 200 mm expected horizontal displacement, assuming an Importance Level 2 Structure in accordance with NZS1170, which is described as having a medium consequence for loss of human life, or considerable economic, social or environmental consequences.

3.2.3 Slope Stability Design Sections

Three typical design sections were produced based on the design assumptions in Section 2 above. The existing ground level is based on TDC LiDAR. These sections are shown in Figures 5 to 7 below.

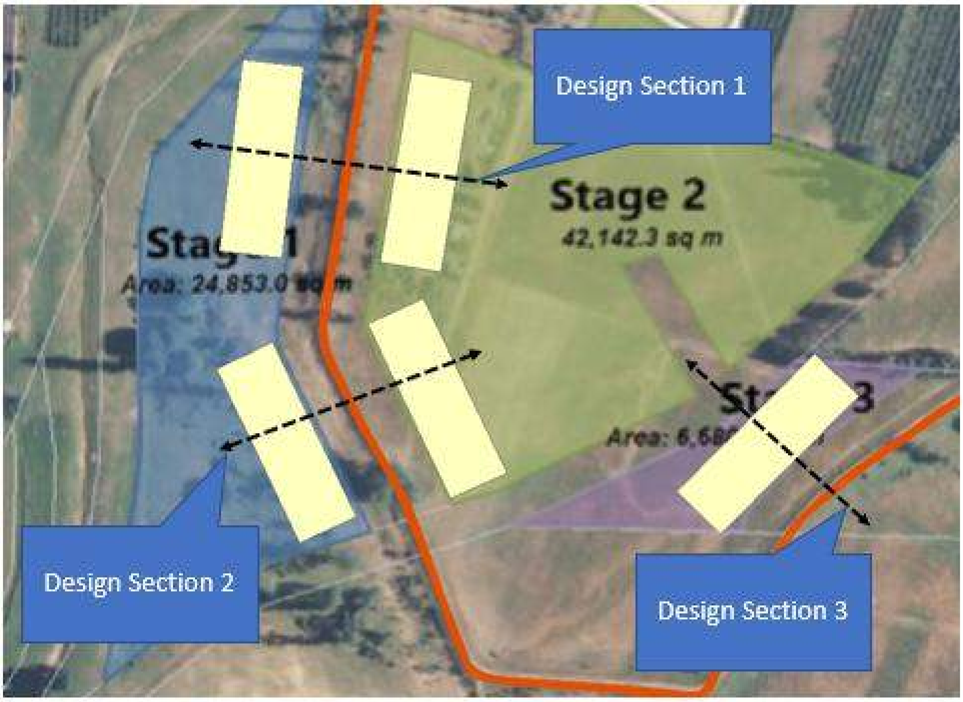

Figure 4: Site Location Plan showing design sections used in slope stability analysis

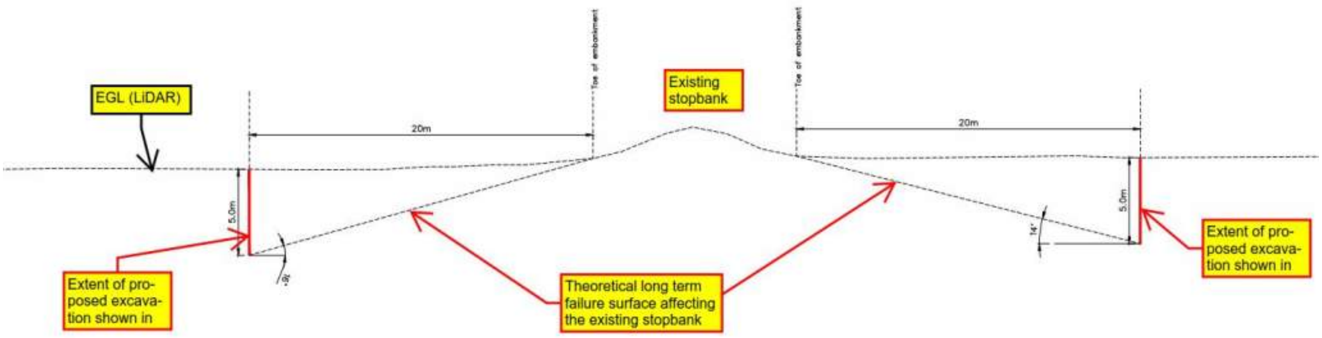

Figure 5: Design Section 1

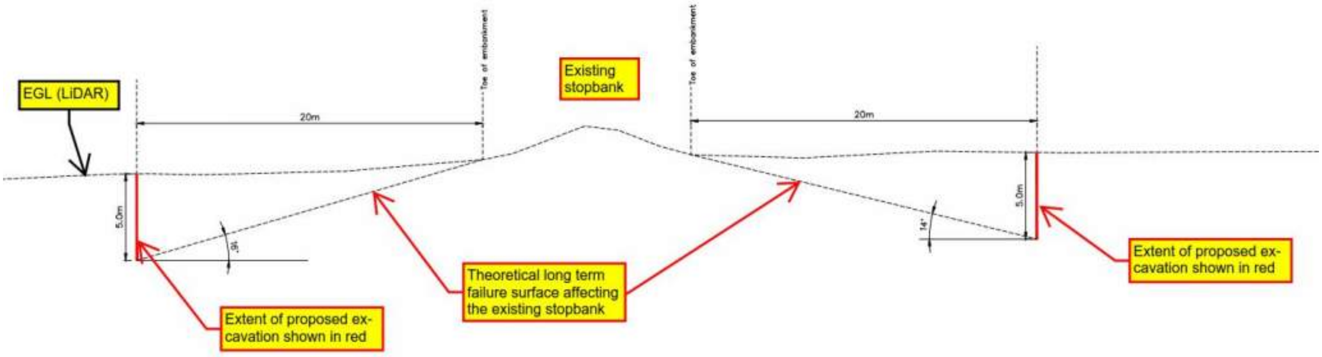

Figure 6: Design Section 2

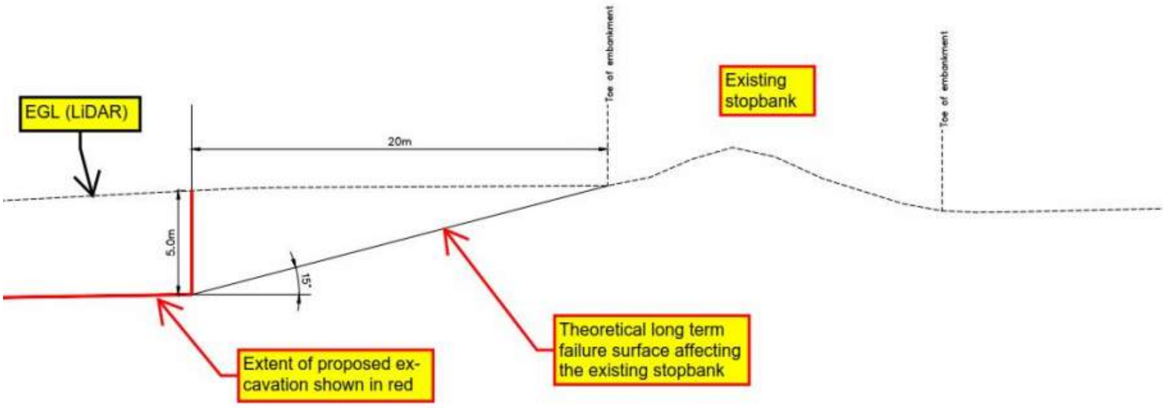

Figure 7: Design Section 3

The worst-case design section (Design Section 2) was adopted for the slope stability analysis, based on the steepest angle (from horizontal) from the base of the proposed excavation to the toe of the existing stopbank, as this is the critical failure mechanism which could impact on the functionality of the stopbank.

3.2.4 Ground model

An indicative ground model has been developed based on MWH test pit investigation results carried out in 2008. The assumed model consists of the following strata:

- 0-2 m depth below existing ground level – Alluvial Silts/Sands (loose to medium dense)
- 2 m – 10 m+ below existing ground level – Alluvial Gravel (dense to very dense)
- Stopbank filling assumed to be 3.0 m deep. A typical stopbank profile was used for the purposes of this analysis. Stopbank fill generally consists of silts and sands or a mixture thereof, based on test pit investigations carried out through the crest of the stopbank.
- During excavation works for the borrow pit, the water level is expected to drawdown locally to the base of the borrow pit.

This ground model was applied to the critical design section 2. Industry accepted limit state stability software (Slope/W) was used to check the stability of this maximum theoretical long-term failure surface under fully saturated conditions for an elevated groundwater design case. A theoretical groundwater profile was adopted for static and seismic conditions, based on groundwater levels noted in water bores within the area as it is unlikely that a flood event and ULS seismic event will coincide.

The assumed ground model is represented in Figure 8 below:

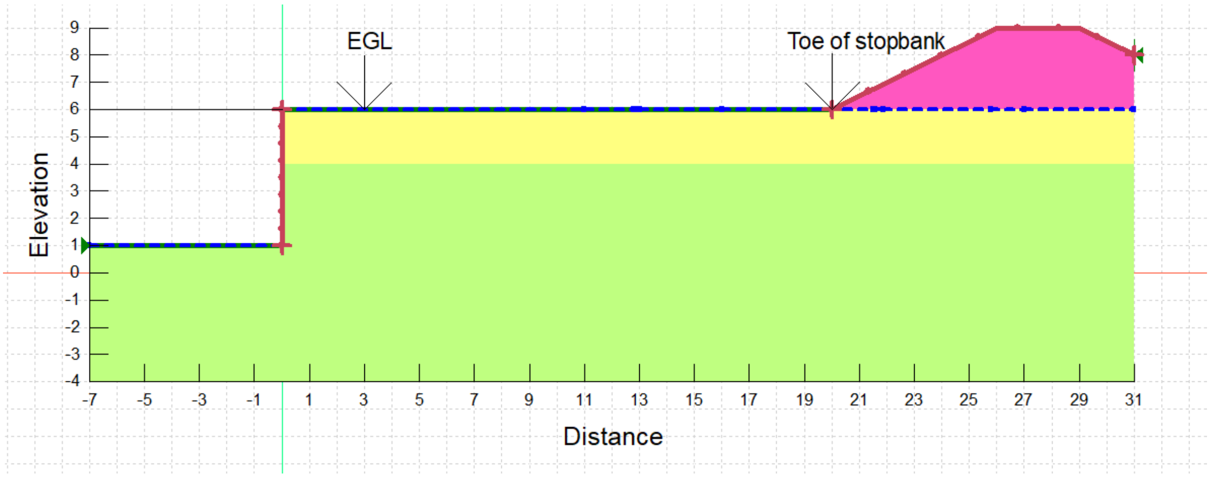

Figure 8: Ground Model – Elevated groundwater design case

3.2.5 Design geotechnical soil parameters

Soil strength parameters were assigned to each strata by comparing Scala blow counts with common correlations (based on both MWH and T+T Scala penetrometer testing).

The inferred geotechnical soil parameters are as shown in Figure 9 below:

Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
(green)	Alluvial Gravel	Mohr-Coulomb	19	1	36
(yellow)	Alluvial Silts/Sands	Mohr-Coulomb	19	1	32
(pink)	Stopbank Fill	Mohr-Coulomb	18	2	32

Figure 9: Assumed Slope/W geotechnical soil parameters

3.2.6 Seismic

Seismic design assumptions are as follows for design:

- Site Subsoil Class = C (shallow soil site) (from NZS1170)
- Importance Level (IL) = 2 (from NZS1170)
- $C_{0,1000}$ = 0.475 (from NZTA Bridge Manual, 2014, Figure A.1)
- Site Response Factor (f) = 1.33 for Subsoil class C (from NZS1170)
- Return period factor (R_u) = 0.25 (SLS) for IL2 (from NZS1170)
- Return period factor (R_u) = 1 (ULS) for IL2 (from NZS1170)
- Magnitude (M) = 5.9 (from NZTA Bridge Manual, 2014, Figure A.5)

$a_{max} = C_{0,1000} R_u / 1.3\ f\ g$

$a_{max} = 0.12g$ (SLS)

$a_{max} = 0.49g$ (ULS)

3.2.7 Results

The slope stability results from Slope/W are represented in Figures 10 to 11 and summarised in Table 1 below:

Table 2: Design Results Summary

Design Case	Design Criteria/Requirement	Results	Meets Requirements?
Static	FoS > 1.5	FoS exceeds 2.0	Yes
Elevated Groundwater	FoS > 1.3	FoS = 1.74	Yes
Seismic	Less than 200mm horizontal displacement	< 10 mm horizontal displacement expected	Yes

In addition to the design criteria above it is noted that the seismic yield acceleration (i.e., the seismic acceleration at which slope failure starts to occur) is 0.45g and this exceeds the Serviceability Limit State (SLS) design seismic acceleration and therefore no displacement is expected under SLS.

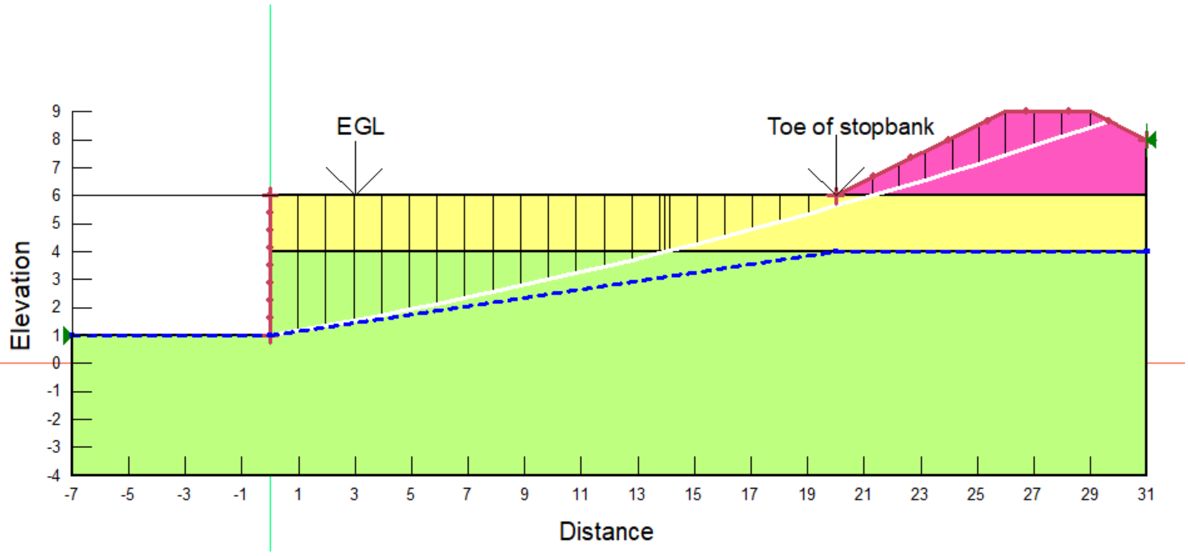

Figure 10: Static ground conditions. FoS exceeds 2.0

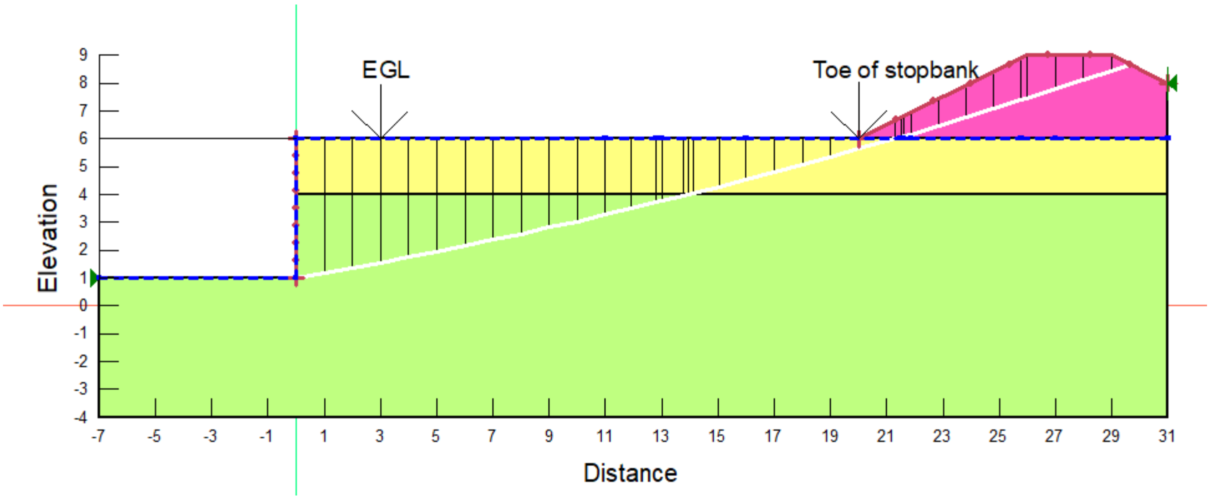

Figure 11: Fully saturated ground conditions. FoS = 1.73

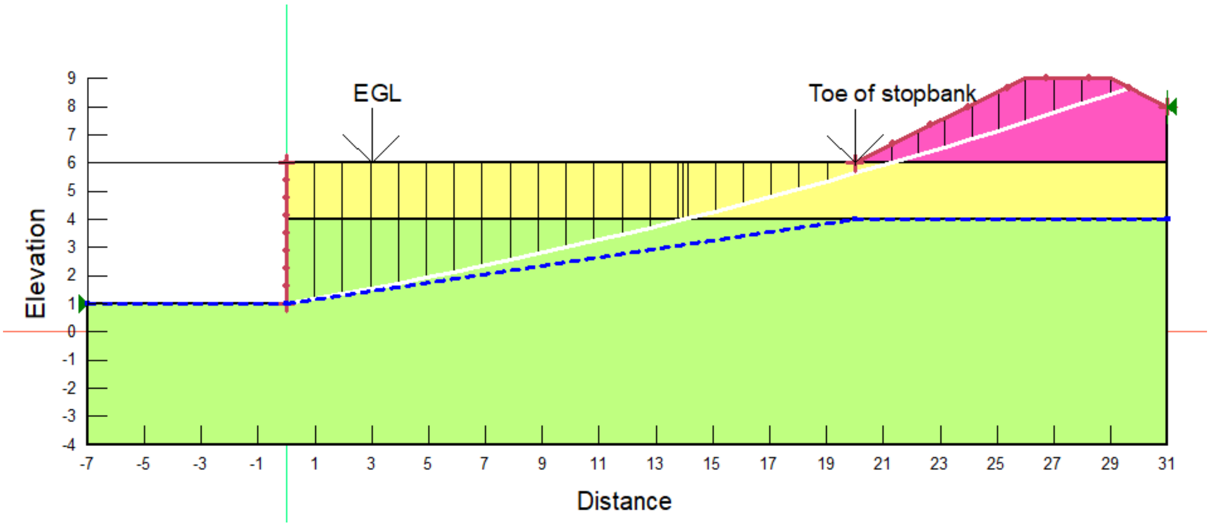

Figure 12: Seismic Yield (FoS = 0.99, a= 0.45g)

3.2.8 Slope Stability Analysis Conclusions

The results have shown that for the critical failure surface which affects the stopbank, the slope stability exceeds design requirements and the expected seismic displacements during a (1/500 year seismic event) are within acceptable tolerances.

The proposed gravel extraction works are not expected to affect the stability/function of the existing stopbank surrounding Peach Island. No seismic displacements are expected under the SLS. On the basis of these conclusions, we believe we have satisfactorily responded to concerns raised by Tasman District Council.

4 Applicability

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

We understand and agree that this report will be used by Tasman District Council in undertaking its regulatory functions in connection with Peach Island Gravel Extraction.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:

....

Simon James Aiken
Senior Water Resources Scientist

Authorised for Tonkin & Taylor Ltd by:

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Neville Laverack
Project Director

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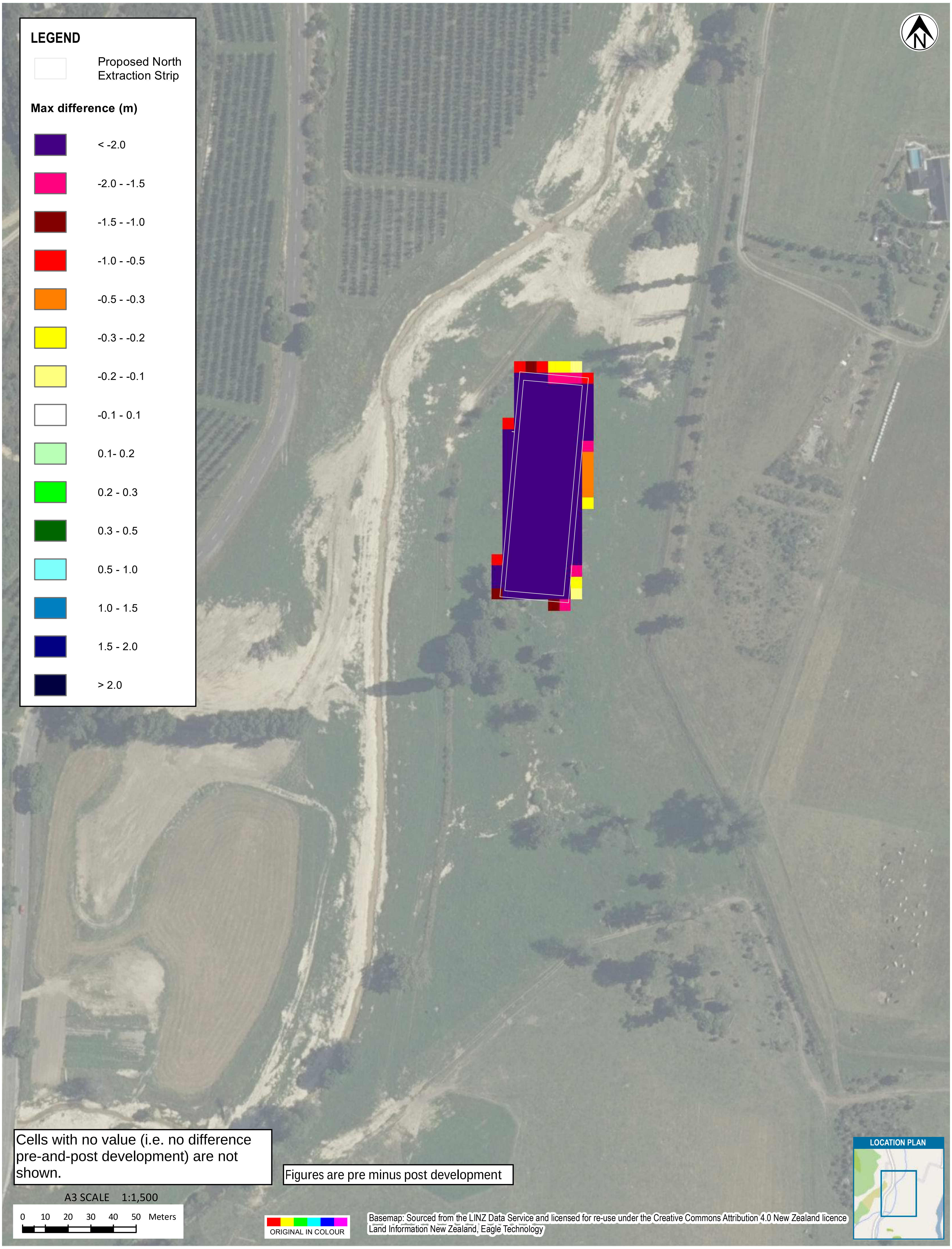
Appendix A: Flood Hazard Modelling



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www.tonkintaylor.co.nz
Exceptional thinking together

NOTES:
Difference plot is pre minus post works, postive number shows decrease in max value. Refer to Peach Island gravel extraction letter report December 2020 for more information.

REV	DESCRIPTION	GIS	CHK	DATE	APPROVED	DATE
0	First version	EMCF	SIAI	11/12/20		

PROJECT No. 1015514.0000

DESIGNED	EMCF	DEC.20
DRAWN	EMCF	DEC.20
CHECKED	SIAI	DEC.20

CLIENT **CJ INDUSTRIES LTD**
PROJECT **PEACH ISLAND GRAVEL EXTRACTION**
TITLE NORTH PIT
MAX DEPTH DIFFERENCE 10 YR ARI

SCALE (A3) 1:1,500 FIG No. 1015514.000 - F1 REV 0

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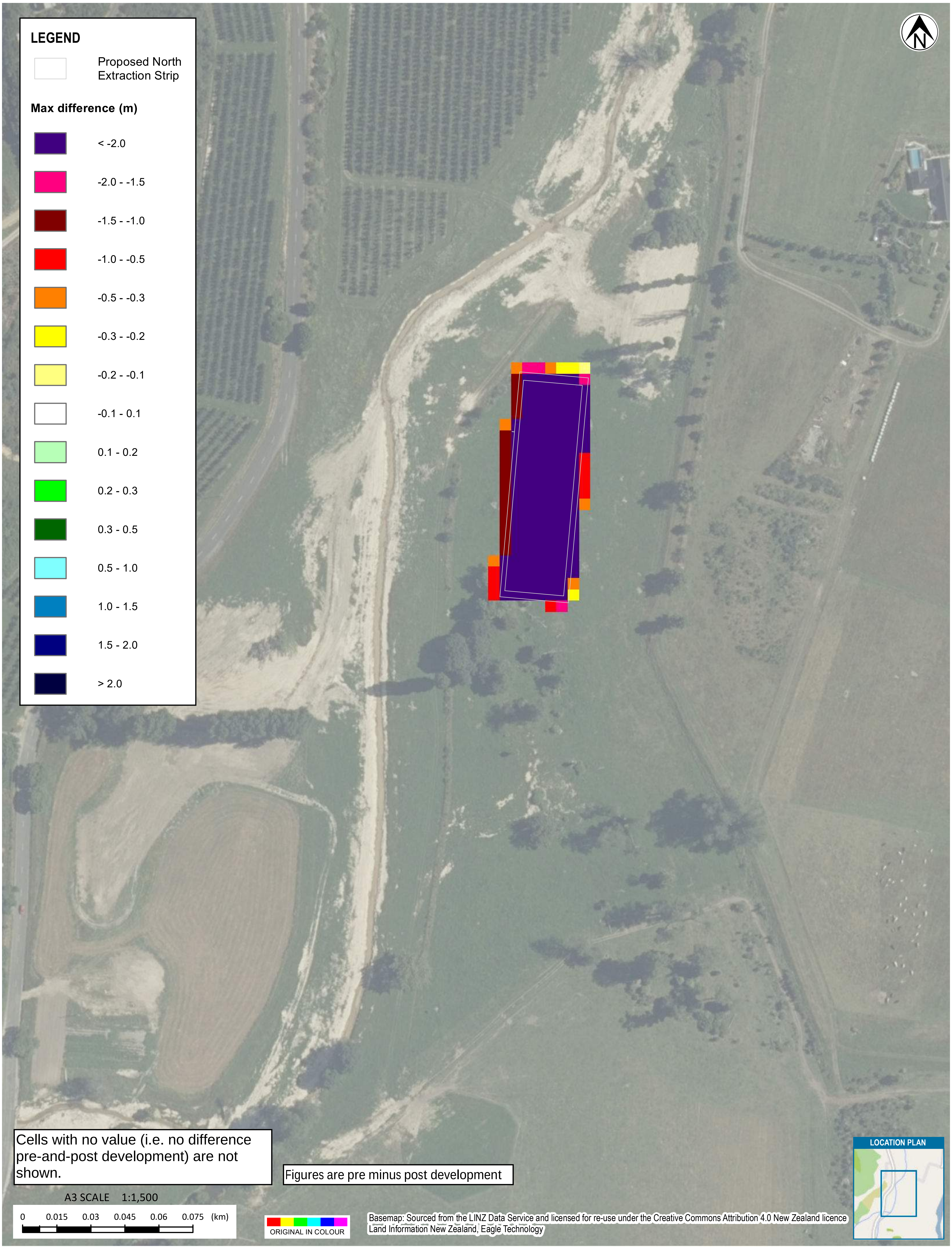

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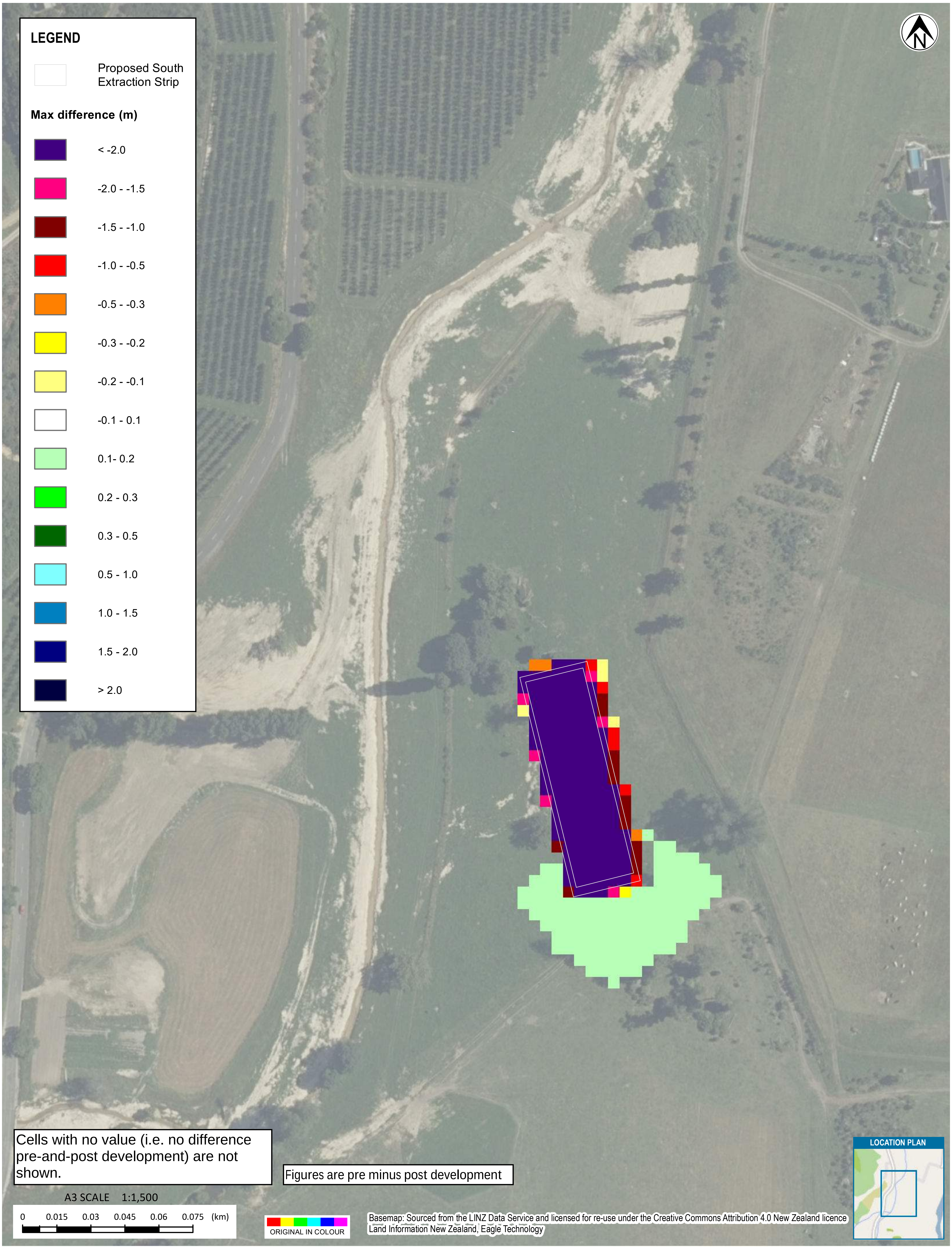
PROJECT No.	1015514.0000	
DESIGNED	EMCF	DEC.20
DRAWN	EMCF	DEC.20
CHECKED	SIAI	DEC.20

CLIENT **CJ INDUSTRIES LTD**
PROJECT **PEACH ISLAND GRAVEL EXTRACTION**
TITLE NORTH PIT
MAX DEPTH DIFFERENCE 100 YR ARI
SCALE (A3) 1:1,500 FIG No. 1015514.000 - F2 REV 0



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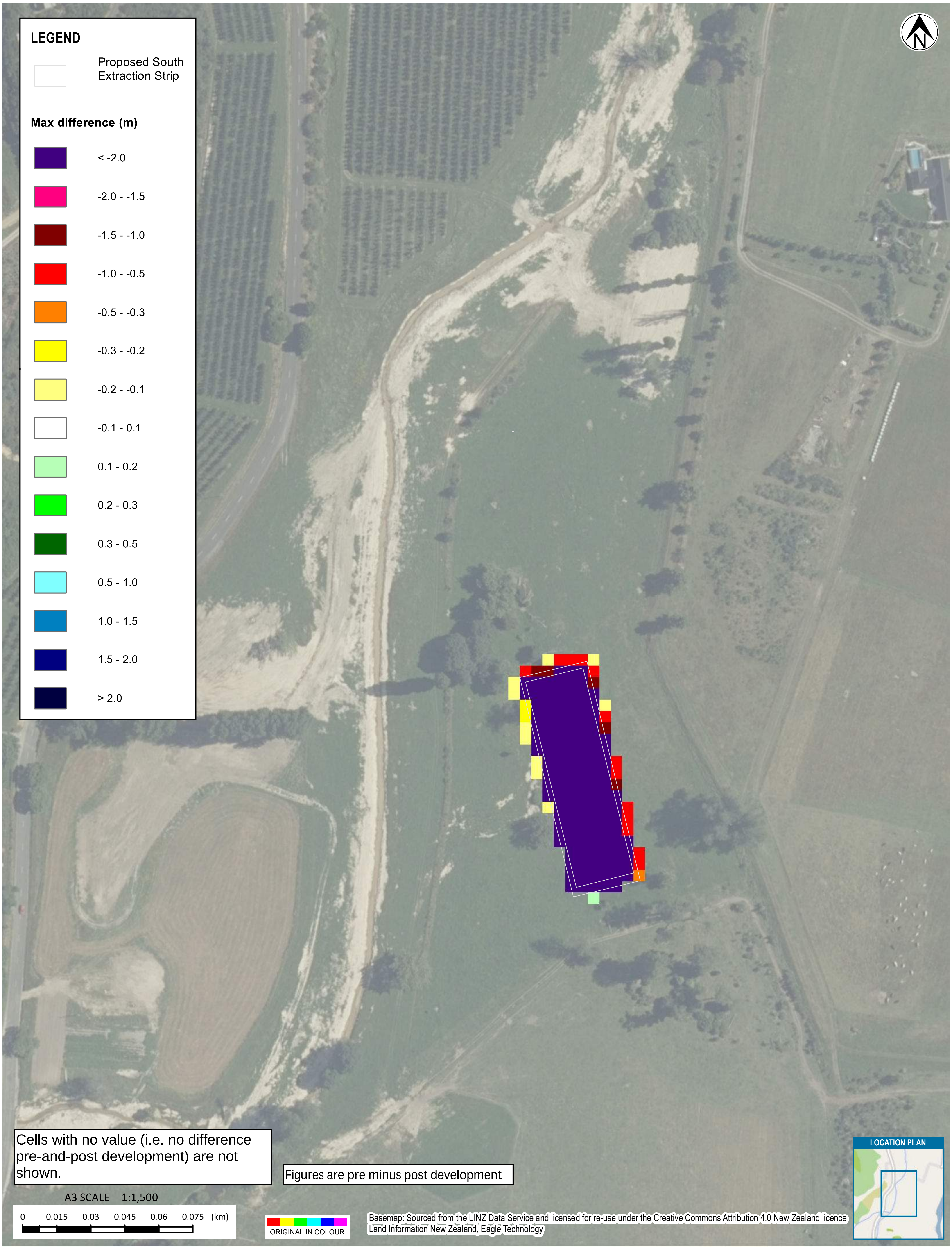
PROJECT No.	1015514.0000	
DESIGNED	EMCF	DEC.20
DRAWN	EMCF	DEC.20
CHECKED	SIAI	DEC.20

CLIENT CJ INDUSTRIES LTD
PROJECT PEACH ISLAND GRAVEL EXTRACTION
TITLE SOUTH PIT
MAX DEPTH DIFFERENCE 10 YR ARI
SCALE (A3) 1:1,500 FIG No. 1015514.000 - F3 REV 0



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NOTES:
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REV	DESCRIPTION	GIS	CHK	DATE	APPROVED	DATE
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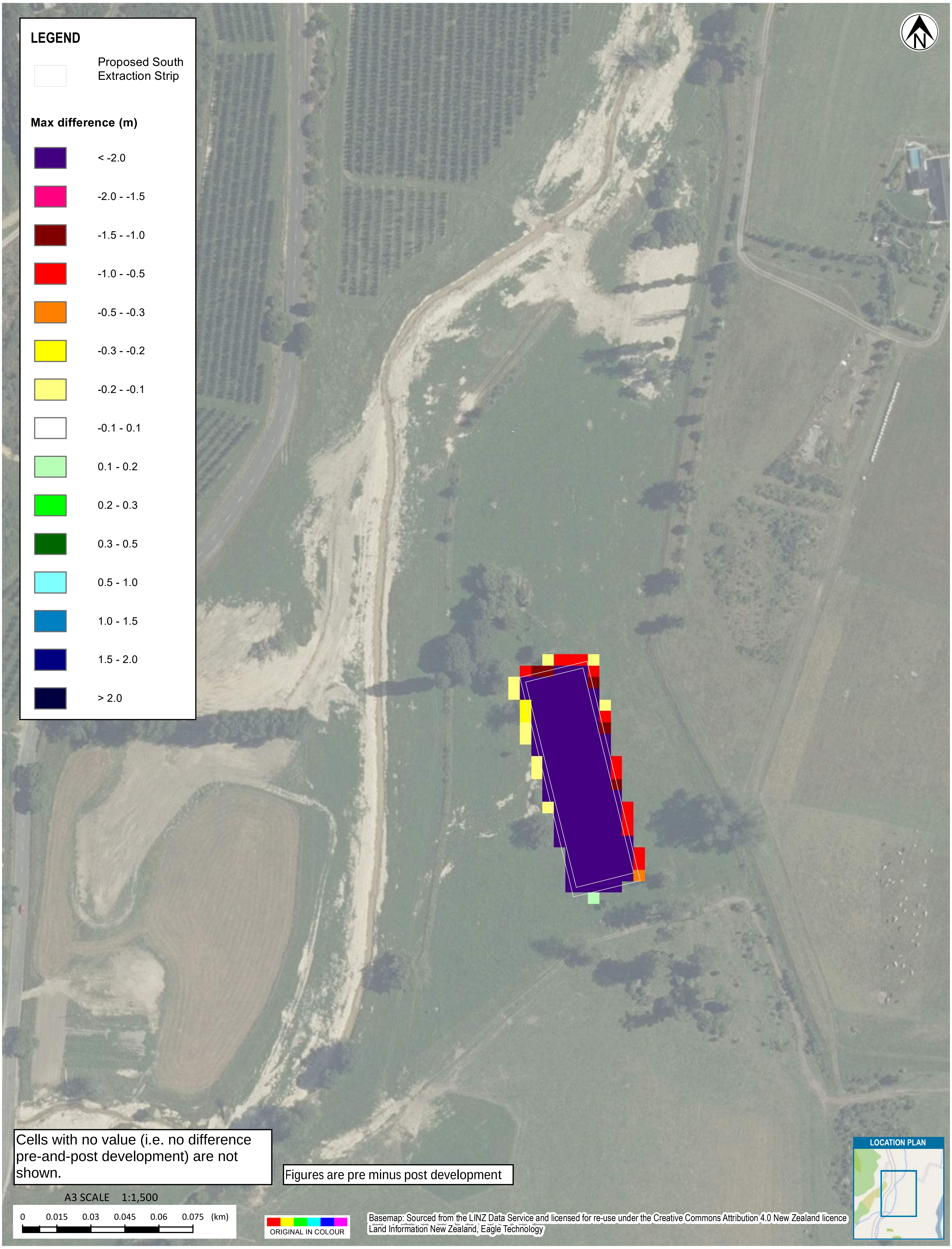
PROJECT No.	1015514.0000	
DESIGNED	EMCF	DEC.20
DRAWN	EMCF	DEC.20
CHECKED	SIAI	DEC.20

CLIENT **CJ INDUSTRIES LTD**
PROJECT **PEACH ISLAND GRAVEL EXTRACTION**
TITLE SOUTH PIT
MAX DEPTH DIFFERENCE 100 YR ARI
SCALE (A3) 1:1,500 FIG No. 1015514.000 - F4 REV 0



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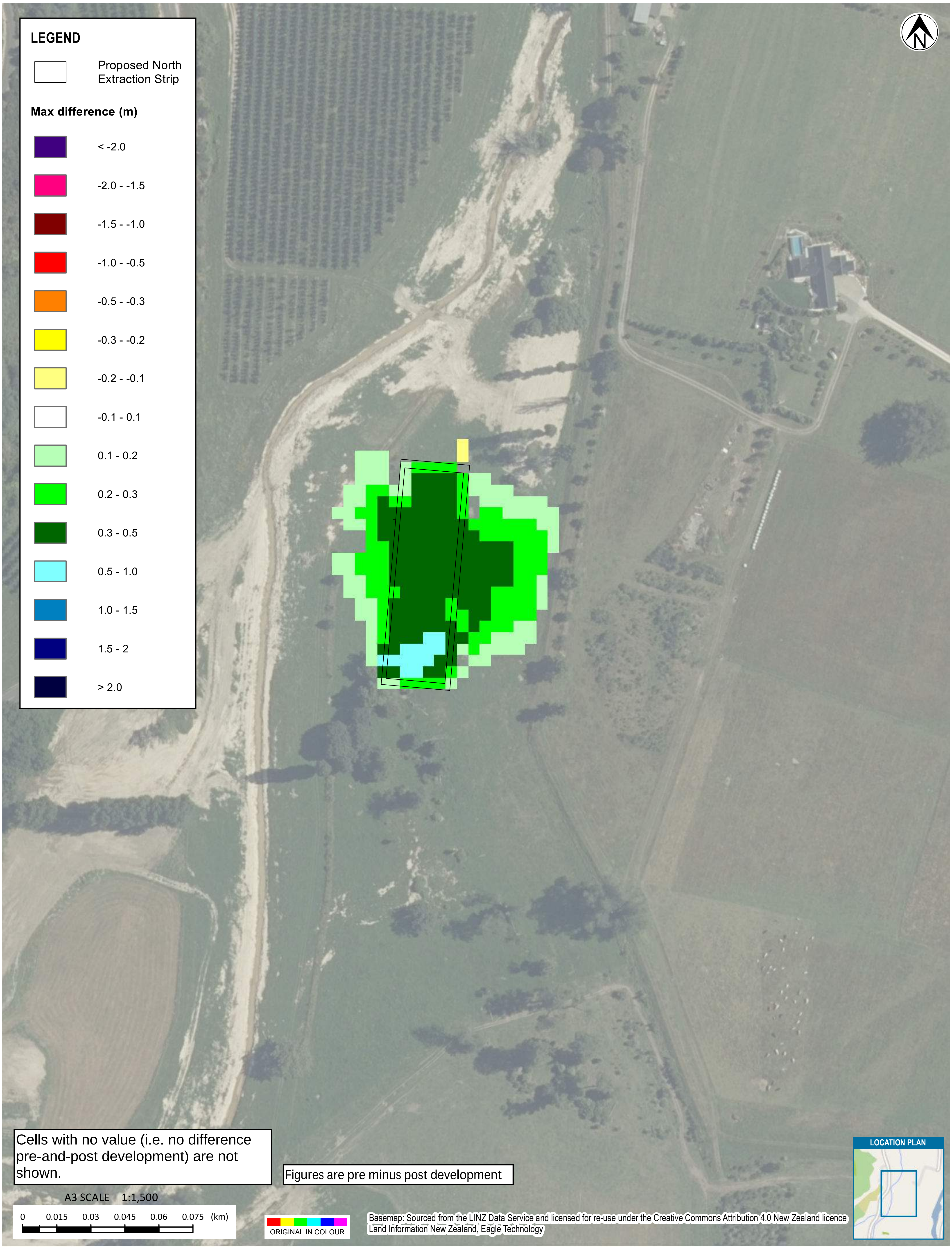
NOTES:
Difference plot is pre minus post works, postive number shows decrease in max value. Refer to Peach Island gravel extraction letter report December 2020 for more information.

REV	DESCRIPTION	GIS	CHK	DATE	APPROVED	DATE
0	First version	EMCF	SIAI	9/12/20		

PROJECT No. 1015514.0000

DESIGNED	EMCF	DEC.20
DRAWN	EMCF	DEC.20
CHECKED	SIAI	DEC.20

CLIENT **CJ INDUSTRIES LTD**
PROJECT **PEACH ISLAND GRAVEL EXTRACTION**
TITLE SOUTH PIT
MAX DEPTH DIFFERENCE 100 YR ARI
SCALE (A3) 1:1,500 FIG No. 1015514.000 - F4 REV 0



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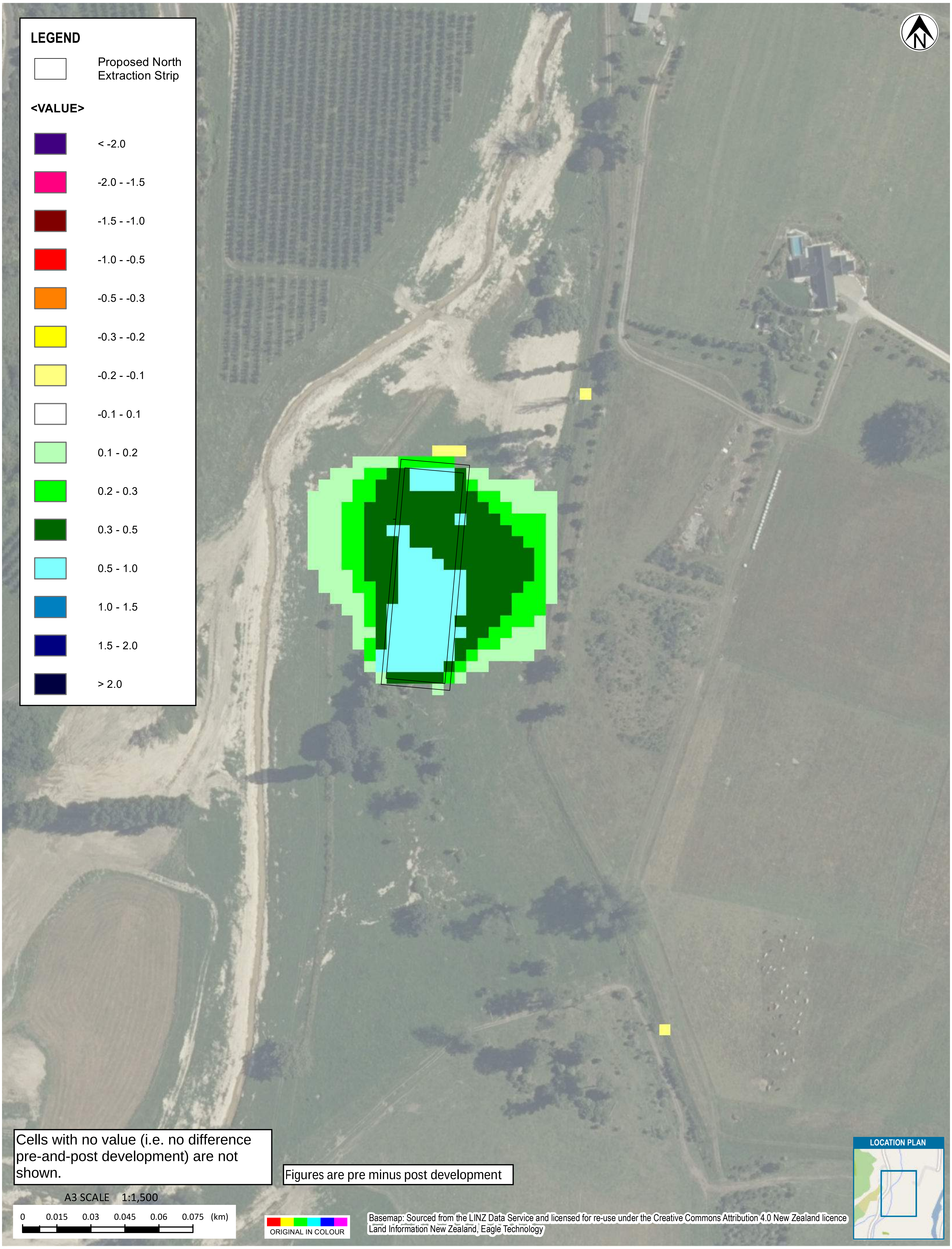
REV	DESCRIPTION	GIS	CHK	DATE	APPROVED	DATE
0	First version	EMCF	SIAI	11/12/20		

PROJECT No.	1015514.0000	
DESIGNED	EMCF	DEC.20
DRAWN	EMCF	DEC.20
CHECKED	SIAI	DEC.20

CLIENT CJ INDUSTRIES LTD
PROJECT PEACH ISLAND GRAVEL EXTRACTION
TITLE NORTH PIT
MAX VELOCITY DIFFERENCE 10 YR ARI

SCALE (A3) 1:1,500 FIG No. 1015514.000 - F5 REV 0



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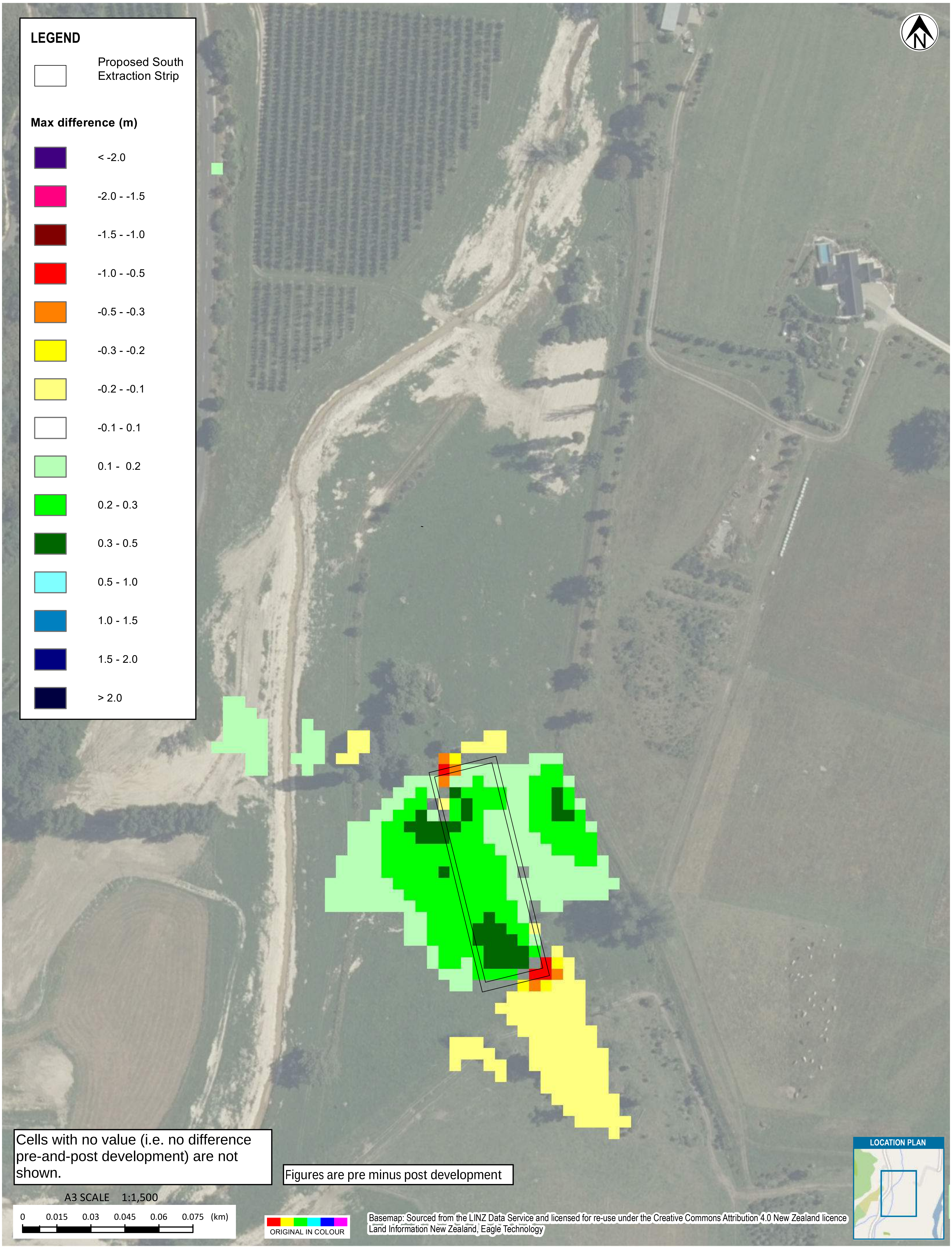
REV	DESCRIPTION	GIS	CHK	DATE	APPROVED	DATE
0	First version	EMCF	SIAI	11/12/20		

PROJECT No. 1015514.0000

DESIGNED	EMCF	DEC.20
DRAWN	EMCF	DEC.20
CHECKED	SIAI	DEC.20

CLIENT **CJ INDUSTRIES LTD**
PROJECT **PEACH ISLAND GRAVEL EXTRACTION**
TITLE NORTH PIT
MAX VELOCITY DIFFERENCE 100 YR ARI

SCALE (A3) 1:1,500 FIG No. 1015514.000 - F6 REV 0



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DESIGNED	EMCF	DEC.20
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CHECKED	SIAI	DEC.20

CLIENT CJ INDUSTRIES LTD
PROJECT PEACH ISLAND GRAVEL EXTRACTION
TITLE SOUTH PIT
MAX VELOCITY DIFFERENCE 10 YR ARI
SCALE (A3) 1:1,500 FIG No. 1015514.000 - F7 REV 0

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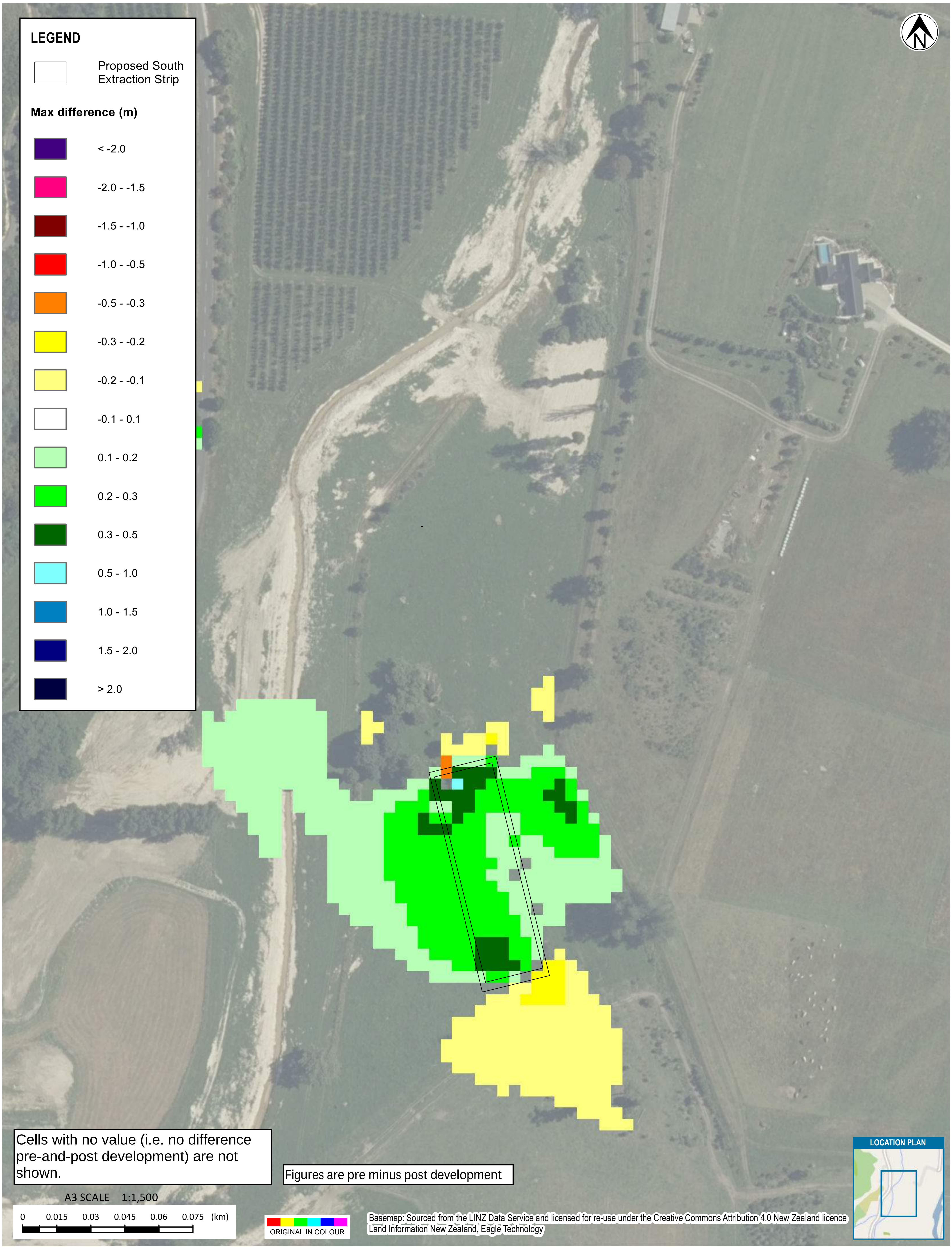

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PROJECT No.	1015514.0000	
DESIGNED	EMCF	DEC.20
DRAWN	EMCF	DEC.20
CHECKED	SIAI	DEC.20

CLIENT **CJ INDUSTRIES LTD**
PROJECT **PEACH ISLAND GRAVEL EXTRACTION**
TITLE SOUTH PIT
MAX VELOCITY DIFFERENCE 100 YR ARI

SCALE (A3) 1:1,500 FIG No. 1015514.000 - F8 REV 0

HEGLEY ACOUSTIC CONSULTANTS

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NOISE MANAGEMENT PLAN

THE EXTRACTION OF AGGREGATES FROM 134 PEACH ISLAND

Report No. 19213NMP

Prepared for:
CJ Industries

May 2021

Prepared by: ....

Rhys Hegley

CONTENTS

1. INTRODUCTION

This Noise Management Plan (NMP) has been prepared for CJ Industries Ltd and in relation to the Resource Consent Application RM20048 & RM200489. The purpose of this NMP is to describe the process by which noise from the extraction of aggregate will be managed to the surrounding environment. Specifically, the NMP addresses the requirements of section 16 (1) of the Resource Management Act 1991 which states that every occupier of land (including any premises and any coastal marine area), and every person carrying out an activity in, on, or under a water body or the coastal marine area, shall adopt the best practicable option to ensure that the emission of noise from that land or water does not exceed a reasonable level.

2. OPERATION

2.1. OPERATING HOURS

Volunteered condition 12

> *Processes relating to the extraction and movement of aggregate shall only be carried out between the hours of 7.00 am and 5.00 pm weekdays, excluding public holidays.*

2.2. NOISE CRITERIA

The resource consent provides the following limits for noise:

> *Noise generated by the activities authorised by this consent, when measured at or within the notional boundary of any dwelling in a Rural 1 zone shall not exceed:*
> *L_{eq} 55 dBA*

Where the notional boundary is a line 20m from any side of a dwelling, or the legal boundary where this is closer to the building.

3. Overview

3.1. Aggregate extraction and movement at extraction site and surrounding areas

The aggregate will be extracted from a pit a maximum size of 30 x 100m and stockpiled behind the stock bank, and trucks loaded behind this bund. It is planned to excavate this stockpile area to provide screening to the closest neighbours, and also mitigate visual effects. Figure 1 below shows that layout of the site.

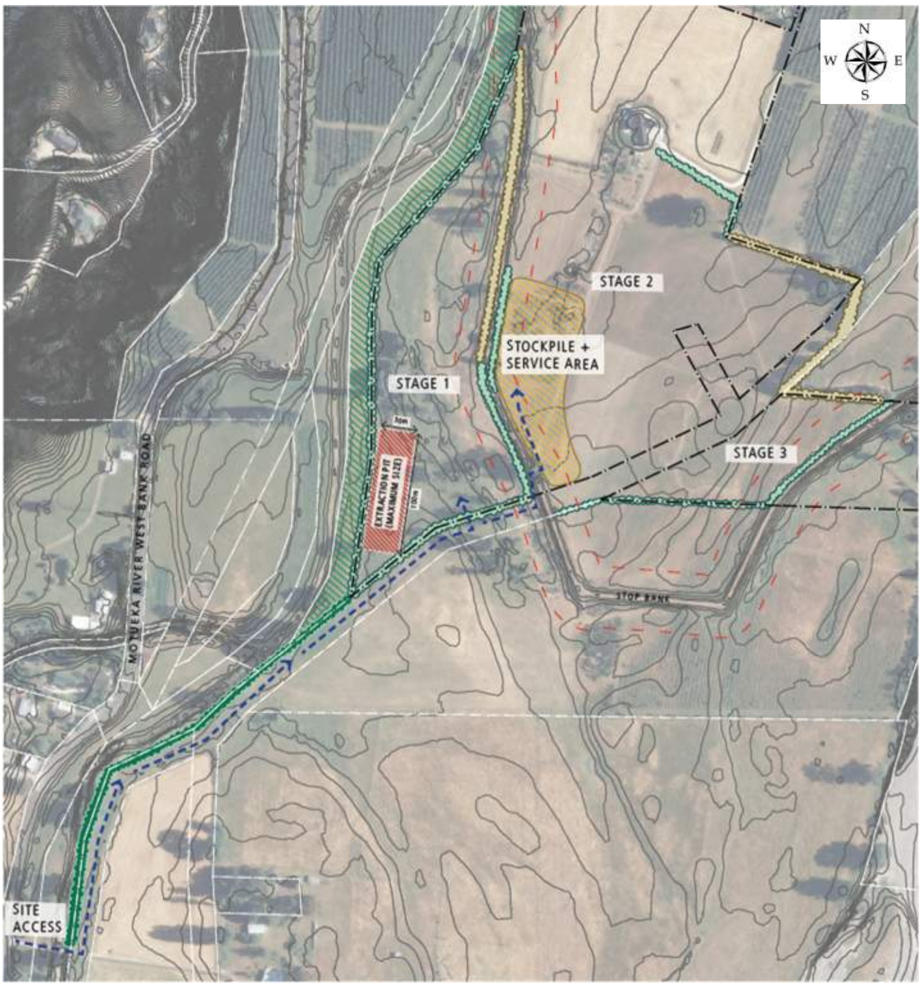


Figure 1. Site Layout

Figure 2 below shows the various parts of the sites (in yellow, blue and orange) and the surrounding, noise sensitive dwellings.

Figure 2. Neighbouring Properties

4. Mitigation

The underlying approach for controlling the effects of construction on the surrounding environment will be through the adoption of the Best Practicable Option (BPO). This means that regardless of the magnitude of effects from the activity, mitigation of that activity will still be considered and implemented where it is found to be both practicable and effective.

Regardless of the noise resulting from an activity or an item of plant and whether that noise will comply with the noise limits identified in Section 2.2, quarry management will endeavour to adopt the BPO with respect to the control of noise. This will include the consideration of and, where practicable, the implementation of mitigation, which could include, but is not limited to:

a) Consider site layout and the location of activities within the site with respect to sensitive receivers.

   1. Wherever excavation is undertaken, a bund comprising of topsoil will be created between the excavation and the nearest neighbour (Figure 2).

   2. The storage and loading area will be located behind the stop bank.

b) Identify plant options for undertaking specific work and consider the noise from each during selection, including:

   - larger loaders / excavators will make for quicker loading;

   - HPMV Trucks / trailers will require less visits to the site.

   - Trucks exporting material from site will be fitted with a sound deadening, plastic deck liner.

   - Ensure all plant is well maintained; all plant has a monitored maintenance schedule and a daily pre-start check. Any maintenance issues that will create noise are to be immediately addressed.

c) Turn vehicle engines/ plant off when not in use.

d) Use plant appropriately; all plant will be used within their supplier's specifications and for the purposes they have been designed for.

e) Any maintenance of equipment that creates noise, will be moved off site for repair if practicable.

f) Tonal warning/ reversing alarms on plant will be replaced with broad band alarms.

g) Drivers will be instructed be considerate when closing tail gates so that they do not slam.

h) The first bucket load on the truck will be the noisiest and will be tipped from as low a level as possible to both minimise noise and wear on the plant. Care will be taken before 8am, when background noise is lower.

5. TRAINING OF STAFF

CJ Industries Ltd. (section 10) will be responsible for ensuring that all personnel working on site are appropriately inducted onto the site. In relation to the control of noise effects, a suitable induction will include the following:

a) The roles of all those working on site with respect to controlling the adverse effects of noise.

b) The individual's responsibility to control noise.

c) The noise limits that construction noise must comply with (section 2).

d) The location of the neighbours, shown on Figure 2.

e) Identify activities likely to result in high levels of noise.

f) Confirm that any mitigation installed on equipment by the original equipment manufacturer (OEM) is installed and operated as intended (section 6);

g) Information about practical methods of controlling adverse effects (section 4).

h) Procedure for dealing with noise complaints (section 8).

i) Approach to dealing with any activities that it is suspected, or demonstrated, may breach the criteria (section 9).

6. Equipment Maintenance

CJ Industries Ltd. shall be responsible for ensuring that all plant used on site, including that of subcontractors, is properly maintained. Any mitigation introduced by the original equipment manufacturer must be installed and operated as intended. Usual prestart and maintenance schedule to be followed.

7. Neighbour Liaison

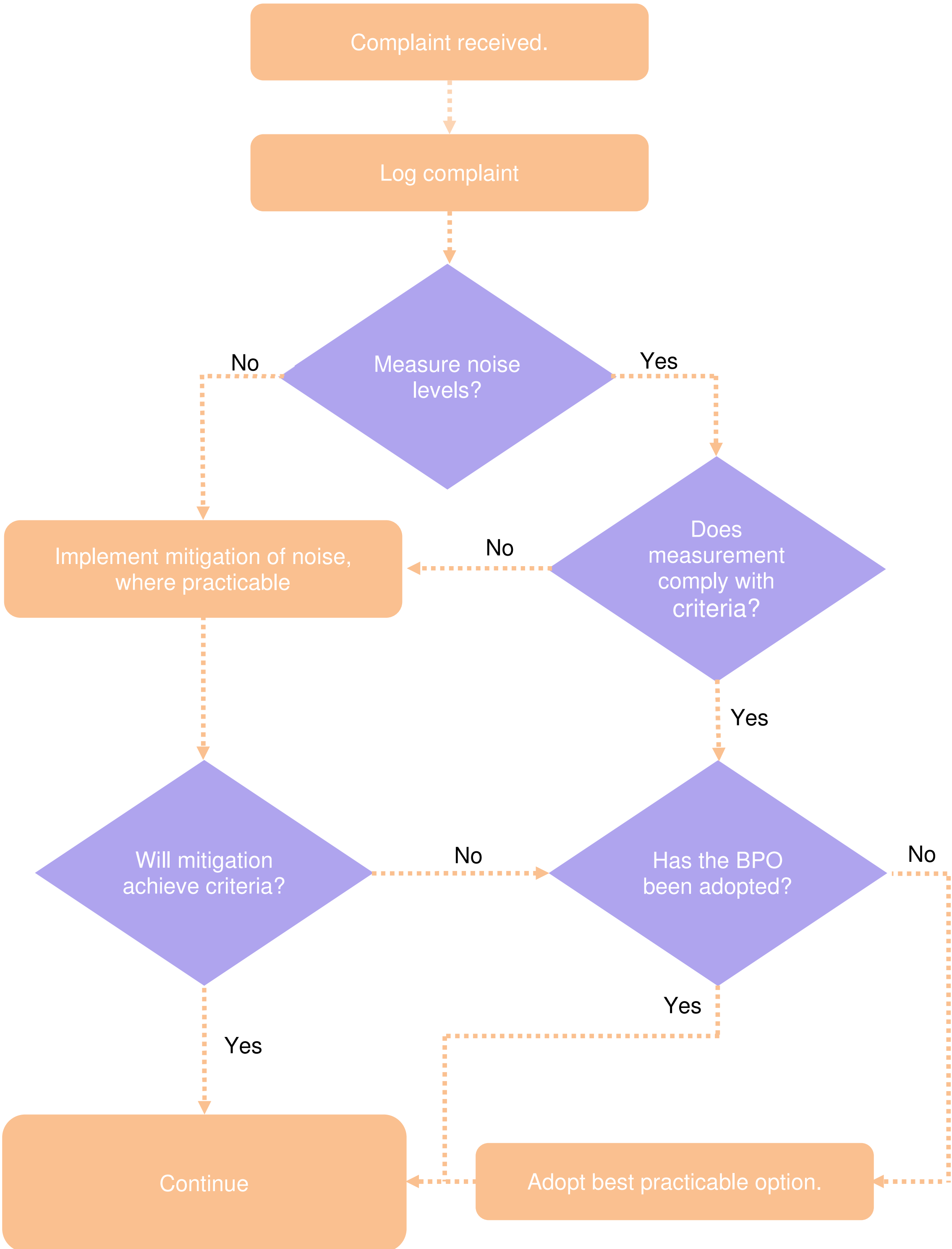
CJ Industries Ltd. shall ensure there is a contact person available on-site during work hours.

8. Complaints

Any complaints received will be the responsibility of Tim Corrie-Johnston (Section 11) to address. Should the compliant not be resolved it will, where necessary, be escalated to the Directors of CJ Industries Ltd.

The flow chart below sets out the procedure by which any complaints will be addressed. The flow chart includes information such as the day, date and time of the complaint, nature of the complaint, location of the complaint and if available the complainant's address to allow the contractor to inform the person of the outcome of the complaint.

Figure 3. Chart for Addressing Complaints



Monitoring shall be undertaken:

1. When required to do so because of a request from TDC.

2. At the commencement of any activity that is expected to approach or exceed the noise limits identified in section 2.2.

9. Contingency Plan

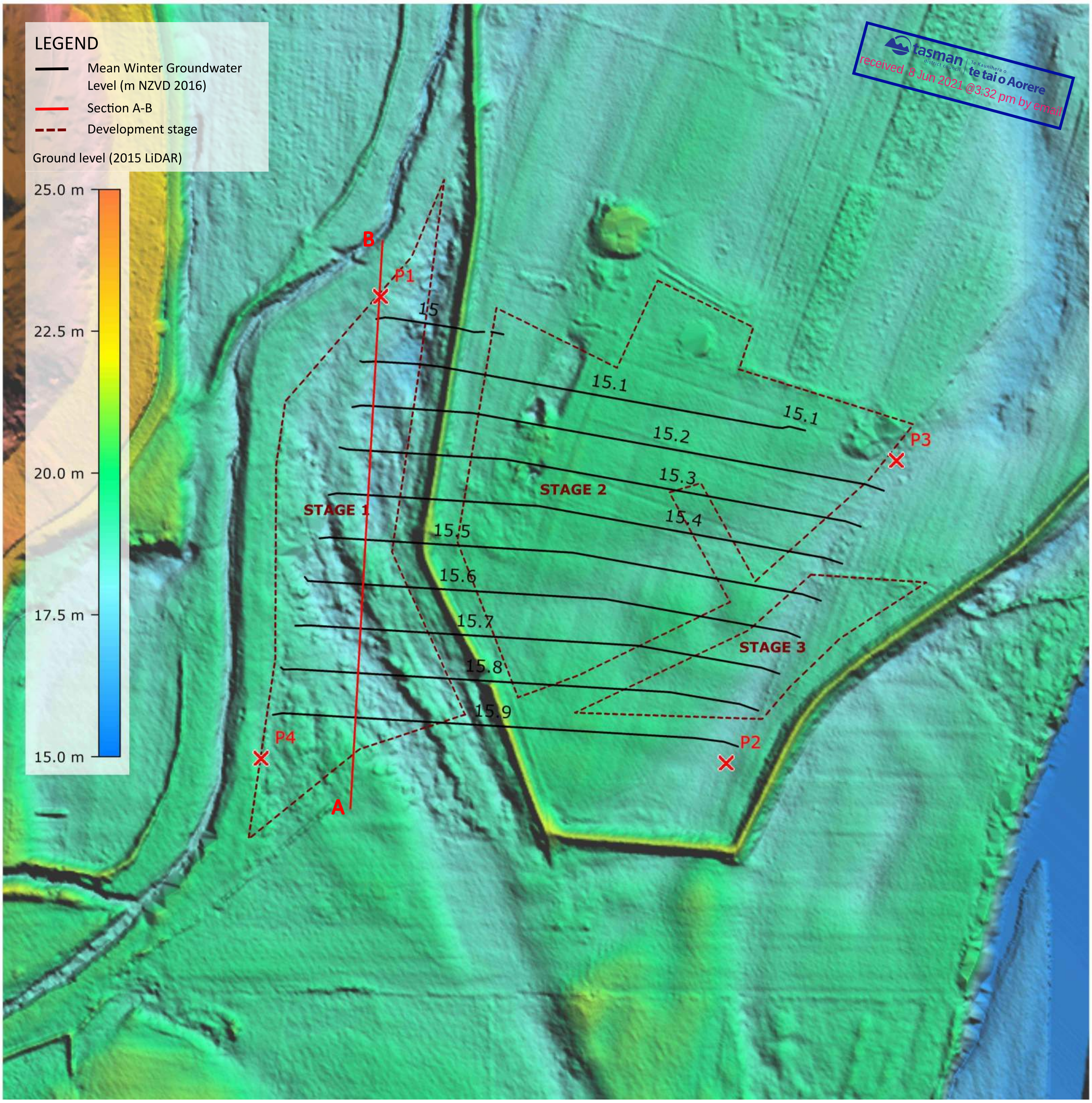
If noise from the activity is found to exceed the limits of section 2.2, the activity shall be modified as soon as it is practical to do so. CJ Industries, and any relevant sub-contractor, shall assess the activity to determine what, if any, mitigation can be implemented.

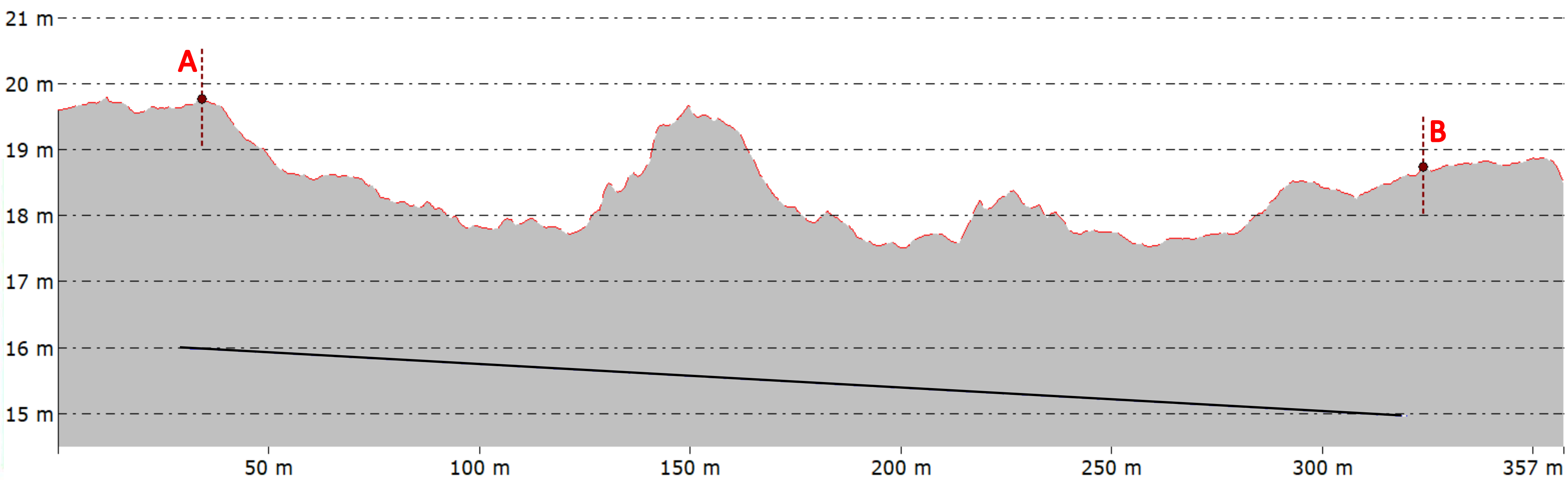
If it is not considered practicable for an activity to comply with the construction criteria, Council shall be informed with the intent of gaining a dispensation of the noise and/ or vibration criteria for the activity. Such a request will include the reason for the application, the duration of the activity, the resulting noise level and those that will be affected by the elevated levels.

10. KEY PERSONNEL AND THEIR RESPONSIBILITIES

Tim Corrie-Johnston will be the principal point of contact and responsible for the implementation of the NMP. His role will include:

a) Develop and implement suitable mitigation strategies for specific items of plant and/or construction activities (section 4).
b) Ensure all contractors receive appropriate site inductions (section 5).
c) Ensure all equipment is adequately maintained (section 6).
d) Responsible for neighbour liaison (section 7).
e) Responsible for receiving and actioning complaints (section 8).
f) Organise all necessary monitoring (section 9); and
g) Develop any contingency plans (section 10).





#2002 CJ Industries - Peach Island

Mean winter groundwater level, 2015 Lidar DEM

1 : 2500 at A3

0 50 100

mappazzo

revised 12 May 2021

envirolink
Nga tangata ki pūtaiao

Quarry proposal - 134 Peach Island Road, Motueka

Groundwater Quality Assessment

Report prepared for CJ Industries Ltd

By:

Fleur Tiernan

Reviewed by:

Tony Hewitt

Envirolink Ltd

4 June 2021

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Providing Service and Solutions in Hydrology and the Environment

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1 INTRODUCTION

CJ Industries Ltd (the Applicant) have applied for a resource consent to extract gravel at a property on Peach Island Road, Motueka. The property is 13.5 ha in size and located on the left bank of the Motueka River approximately 4.5 km west of Motueka town (Figure 1).

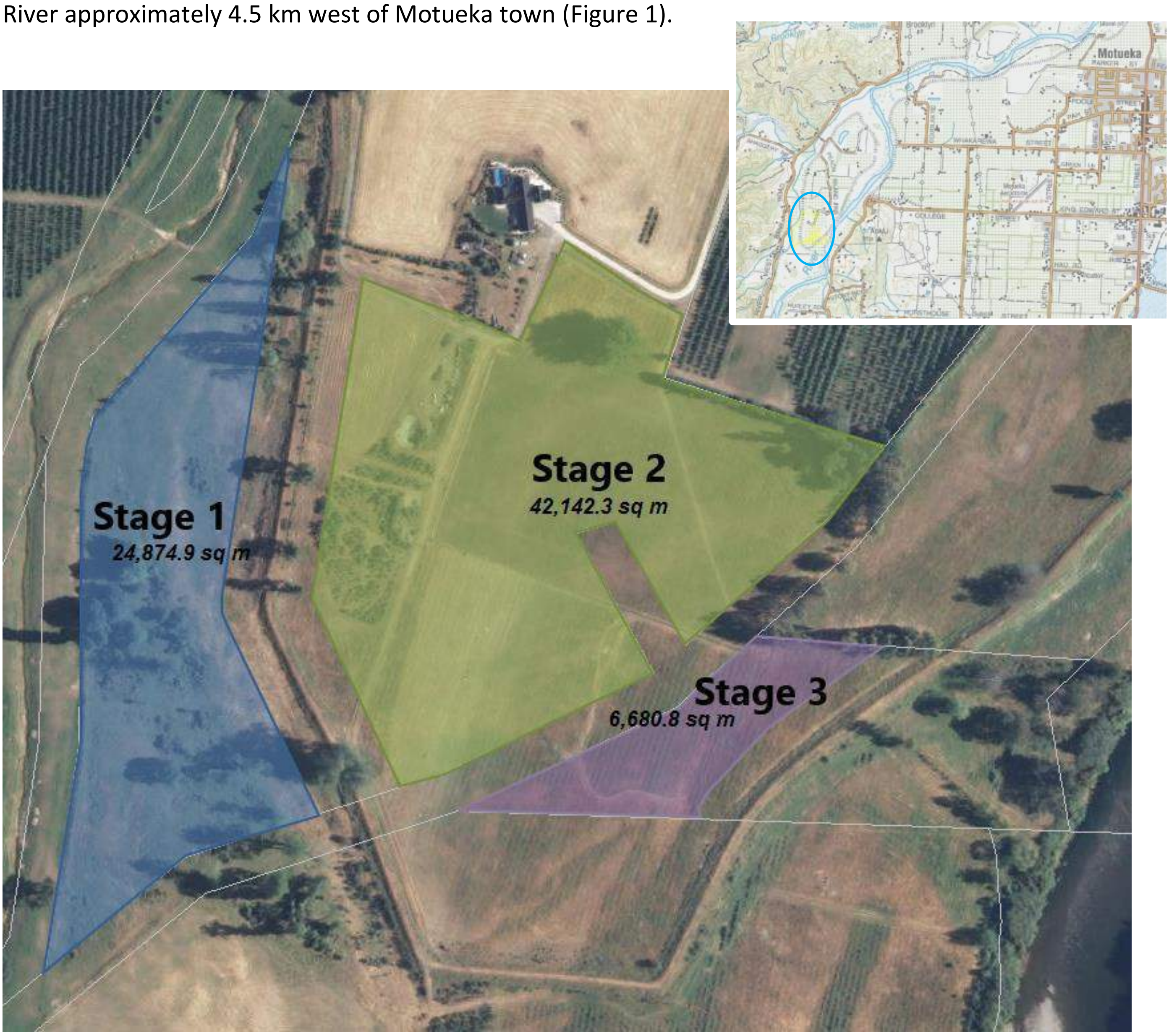

Figure 1: Proposed extraction locations and staging

A Section 92 Request for Further Information (FIR) was issued on the 3rd July 2020 by Tasman District Council (TDC).

As part of the FIR an assessment of the activity on groundwater was required in paragraphs 3 and 4 as follows:

3. *An assessment of groundwater levels is key in assessing the potential effects of the proposed excavation below current land surface level given you will "not extract material from below the water table and will maintain an appropriate freeboard".*

Groundwater levels vary from east to west over the proposed area and are also affected by river stage and the Peach Island bypass channel (when there is overflow during floods).

The groundwater assessment from Envirolink provided with the application does not account for the likely variability of groundwater levels over the site and does not adequately show groundwater flow direction and head (contour). Our water scientist, has queried the use of the river stage levels and the datum reference at Woodman's bend to inform groundwater levels on site considering the recharge area (to groundwater) for the site is upstream and the river is the principal source of groundwater recharge to Peach Island.

Please provide the following information:

> *a. A ground survey which shows contours across the site referenced to a common datum.*
>
> *b. A piezometric survey which shows groundwater contours across the site referenced to a common datum and its variation between seasons (high and low).*
>
> *c. Defined water table levels across site referenced to a common datum. The water table can vary up to around two metres so please explain how you have determined this level.*
>
> *d. The maximum depth of excavation across the site and how this will be monitored and complied with.*

4. *You state backfill material may include up to 10% organic matter. Please provide the following information regarding backfill material:*

> *a. What material will you use?*
>
> *b. What effects will backfill have on groundwater quality, other groundwater users, and the water quality of the Motueka River? We note that the hydrographs attached with your assessment show pumping effects on your two bores monitored.*
>
> *c. Is any groundwater level and quality monitoring being considered e.g. upstream and downstream of the site – to monitor effects before /during and post excavation?*

A follow-up email from the Council clarified the requirements in Paragraph 4 of the FIR as follows:

> *This is not just about establishing a baseline/monitoring, this is about assessing the potential effect. Therefore, a qualitative analysis should be included to look at how water quality may be affected by the proposed work, i.e. what potential contaminants may enter groundwater/surfacewater, what area may be affected/how far will these contaminants travel etc.*

1.1 The Proposal

The proposal includes the extraction of gravel, stockpiling of topsoil and the reinstatement and replanting of the quarried land. On average the gravel surface is 0.5 to 1 m below ground level and up to 5 m thick before reaching groundwater. No excavations are proposed below the groundwater level at the time of extraction and no excavation will occur within 20 m of stop banks.

Gravel will be extracted progressively in an upstream direction starting at the downstream end of the property, and all excavation will occur in strips (30 m wide x 100 m long) which are aligned parallel to the general direction of flood flow. At any one time no more than 3,000 m^2 will be exposed, resulting in each excavation strip yielding up to 15,000 m^3 of gravel matrix.

1.2 Potential Contaminants Associated with the Activity

The resource consent application states that '*no hydrocarbon fuels, lubricants, or hydraulic fluids will be stored on the river side of the stop banks. No refuelling or machinery maintenance will take place in locations where hydrocarbon (or other) spills may enter water, either directly or indirectly*'.

Backfill material will comprise of cleanfill material. Cleanfill material is generally inert and non-contaminated. Cleanfill material has a requirement for metal concentrations to be below a certain concentration, these concentrations are stipulated in a document by Cavanagh (2015).

Cavanagh (2015) states the following:

Cleanfill thresholds should:

- *be less than the guideline values that could be used to define significant adverse effects for the most sensitive receptor class*
- *allow an adequate margin for error, so that exceeding a cleanfill threshold by a minor margin will not inadvertently allow deposition of contaminated soil*
- *not be lower than the 95th percentile of the local background range.*

Cleanfill material does not contain agrichemicals. Cleanfill material does not contain organic material in sufficient quantities that would result in excess BOD, nitrogen or phosphorus concentrations. Furthermore, the resource consent application states that organic material will comprise a maximum of 10% (by volume) of material brought onto the site and will be thoroughly mixed with inert fill. A 10% mix of organic material, by volume, is unlikely to result in a leachate containing BOD, nitrogen or phosphorus in sufficient quantities that would result in adverse downgradient effects.

2 SITE LOCATIONS

As a response to the FIR, four piezometers (Piezo 1 - 4) were installed at the site in August 2020 to monitor groundwater levels within the site. An existing gravel extraction activity is located approximately 2 km downstream at Douglas Road. Two private bores are located within the vicinity of the site (WWD3003; WWD4582). The locations of these are shown in Figure 2 and described in Table 1.

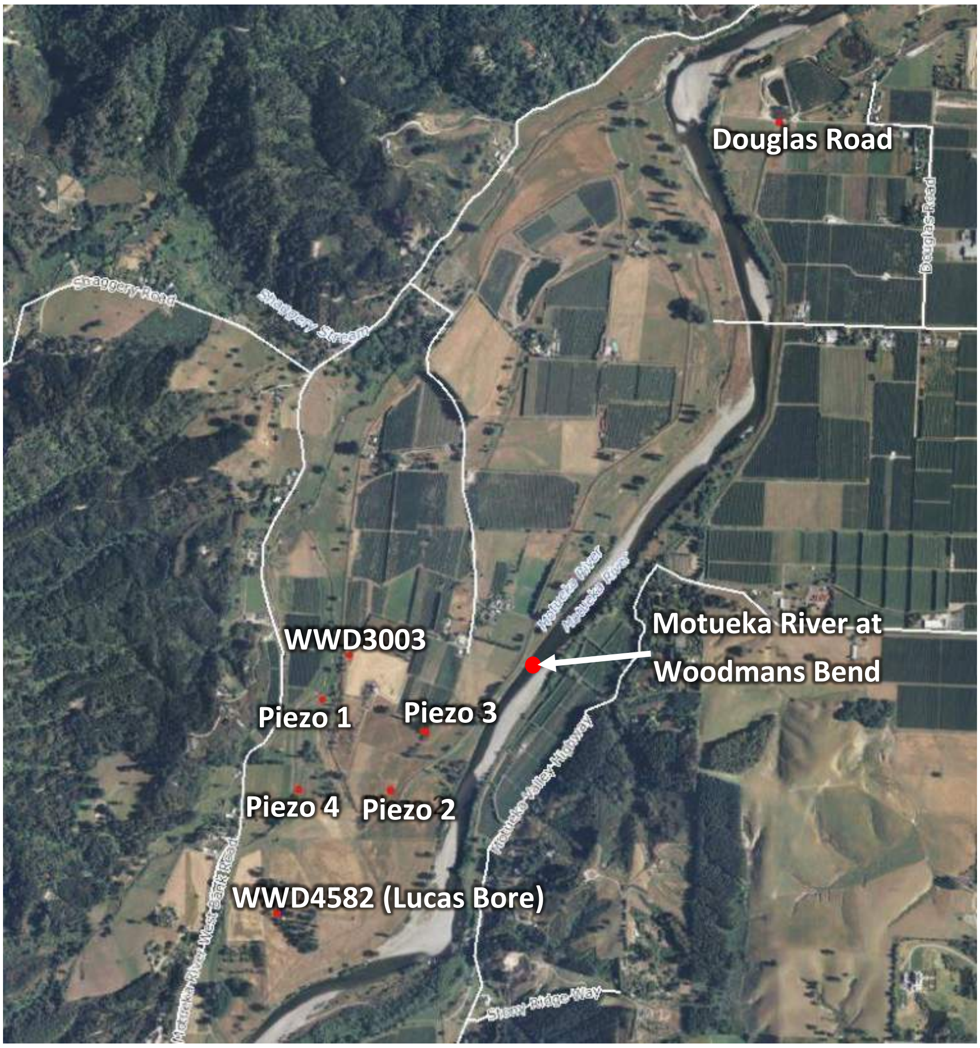

Figure 2: Bore location plan

Table 1: Bore locations and description of monitoring undertaken

Site ID	Discrete Samples	Continuous data	Easting (NZTM)	Northing (NZTM)
Piezo 1		Temperature, Conductivity, Water Level	1595755	5447345
Piezo 2		Temperature, Water Level	1595972	5447052
Piezo 3		Temperature, Water Level	1596079	5447242

Site ID	Discrete Samples	Continuous data	Easting (NZTM)	Northing (NZTM)
Piezo 4	9-Sep-20 5-Oct-20 21-Jan-21	Temperature, Conductivity, Water Level	1595680	5447055
Douglas Road	9-Sep-20 5-Oct-20 21-Jan-21	Conductivity	1597220	5449178
WWD4582 (Lucas Block)		Temperature, Conductivity, Water Level	1595626	5446656
WWD3003 (Peach Island)		Temperature, Water Level	1595838	5447489

3 RESULTS

3.1 Discrete Samples

The bore at Douglas Road and Piezo 4 were sampled on three occasions between September 2020 and January 2021. The dates of sampling are shown against water level for the Motueka River at Woodmans Bend in Figure 3.

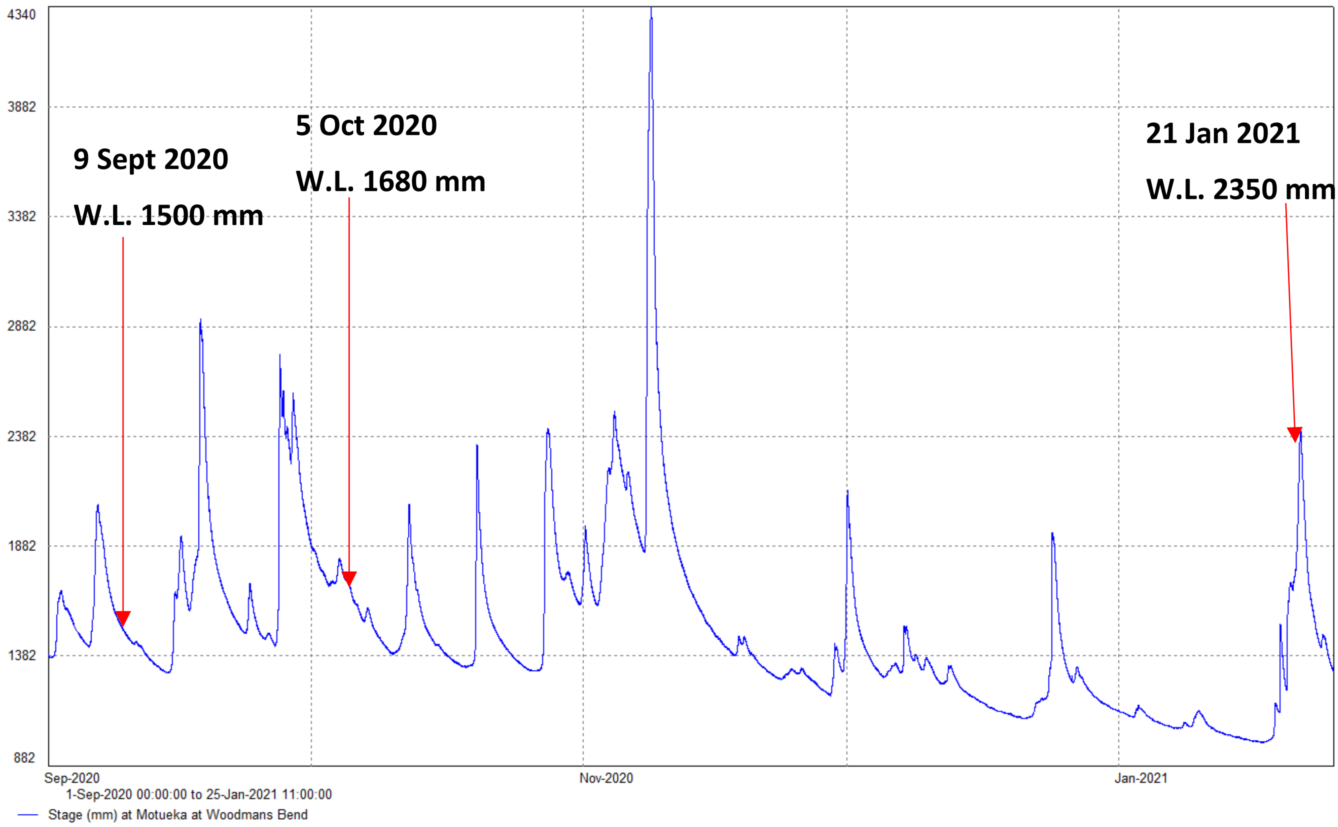

Figure 3: Water level for the Motueka River as measured at Woodmans Bend

Groundwater samples, from the two sites on the three different occasions, were sent to Hill Laboratories and analysed for a range of parameters. The full Hill Laboratories results are attached in Appendix 1.

Results for a suite of organochlorine pesticides showed concentrations below the detection limits for all samples.

Results for Chemical Oxygen Demand (COD) were also all below the detection limits for all samples. Results for Carbonaceous Biochemical Oxygen Demand ($cBOD_5$) were below the detection limits for all samples at Piezo 4, one sample (5th October 2020) from Douglas Road had a $cBOD_5$ concentration of 6 g/m^3.

Sulphate concentrations are typically between 5.5 g/m^3 and 7.5 g/m^3 for the two sites, however a higher concentration of 10.2 g/m^3 was recorded on the 5th October 2020 from Piezo 4 and a low concentration of 0.6 g/m^3 was recorded on the 21st January 2021 from Piezo 4. The low concentration on the 21st January 2021 corresponded to an elevated manganese concentration (0.0088 g/m^3). The sulphate concentrations recorded are typical for groundwater concentrations for the Motueka Gravel Aquifer.

Copper, lead and zinc concentrations all increased significantly at both sites on the 21st January 2021, however the increases were more pronounced at the Douglas Road bore. Elevated river levels at this time suggest this is due to increased rainfall and runoff. Iron concentrations changed little at both sites for the sampling period.

Copper concentrations at Douglas Road exceeded the ANZ guidelines[1] for freshwater ecosystems (0.0014 g/m^3) on all occasions. Copper concentrations exceeded the ANZ guidelines on one occasion (21st January 2021) at Peach Island (Piezo 4).

Lead concentrations were all below the ANZ guideline (0.0034 g/m^3) at both sites for all sampling occasions.

Zinc concentrations were above the ANZ guideline (0.008 g/m^3) on all occasions at Douglas Road and above the ANZ guideline for Peach Island (Piezo 4) on two occasions (9th Sept 2020; 21st Jan 2021).

A summary of water quality results and comparisons with the ANZ guidelines are shown in Figures 4 to 6.

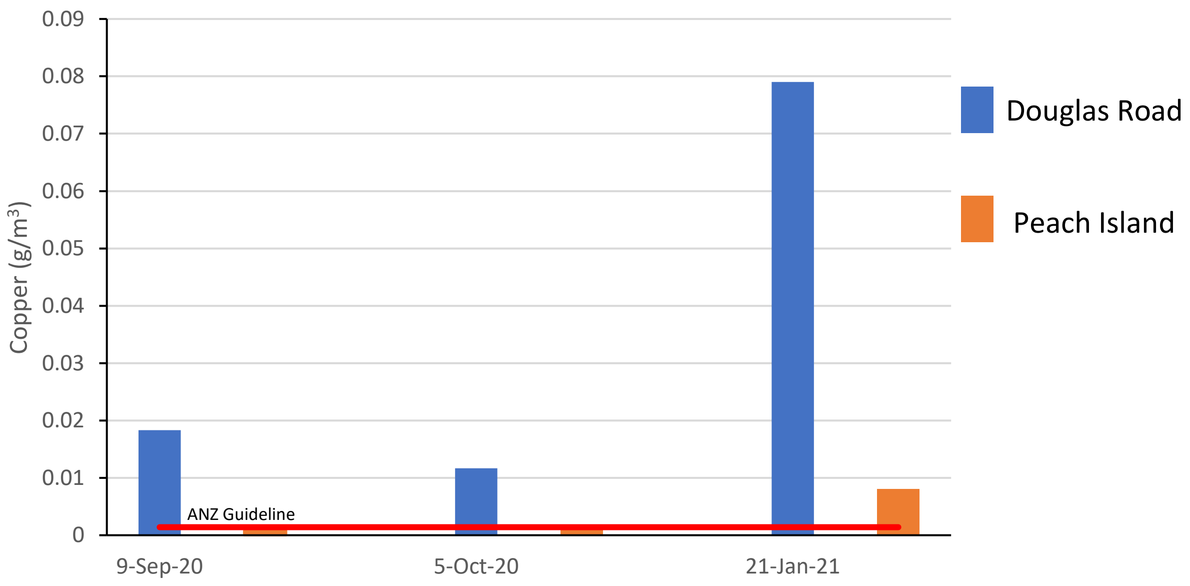

Figure 4: Copper concentrations recorded at Peach Island (Piezo 4) and Douglas Road in relation to the ANZ guideline

[1] https://www.waterquality.gov.au/anz-guidelines/
95% level of species protection, recommended for application for slightly to moderately disturbed ecosystems.

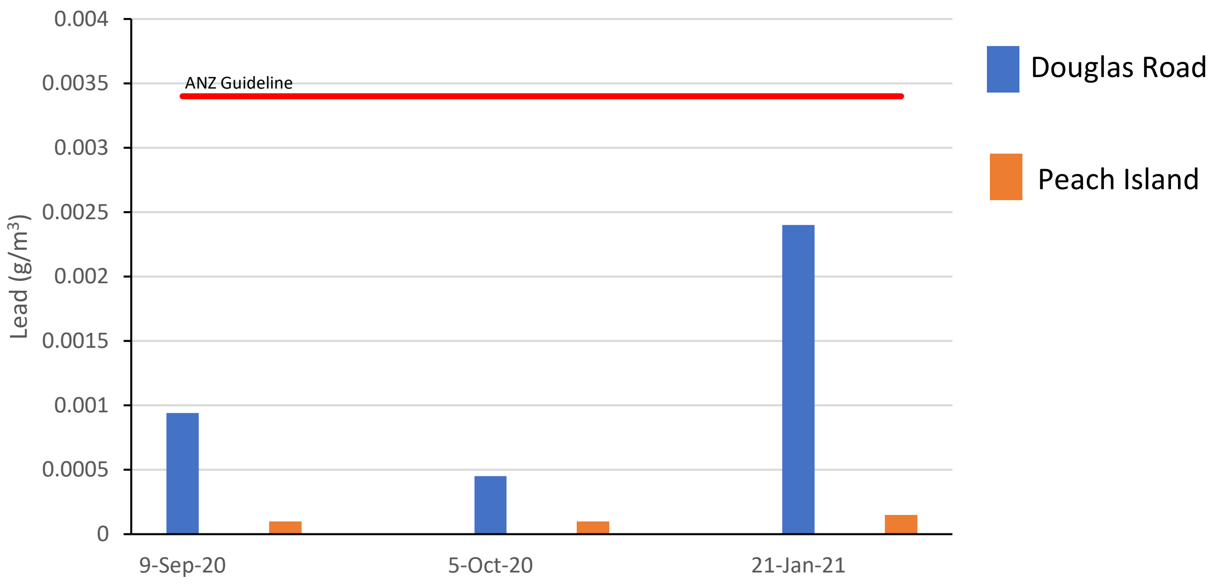

Figure 5: Lead concentrations recorded at Peach Island (Piezo 4) and Douglas Road in relation to the ANZ guideline

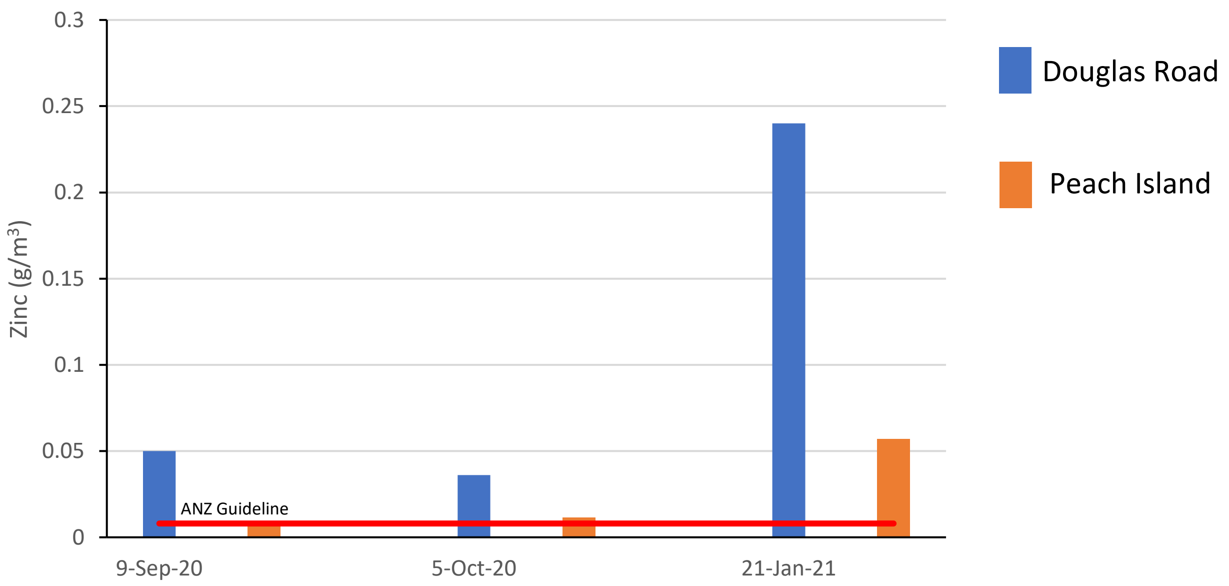

Figure 6: Zinc concentrations recorded at Peach Island (Piezo 4) and Douglas Road in relation to the ANZ guideline

3.2 Continuous Measurements

Conductivity measurements at Douglas Road show the narrowest range in conductivity, generally between 120 µS/cm and 130 µS/cm. There is limited data available from the Lucas Bore, however it appears to show a greater variation and appears to be correlated with water level in the Motueka River. Conductivity at Piezo 1 also appears to be correlated with water level in the Motueka River, as does conductivity at Piezo 4, however there appears to be a greater time lag at Piezo 1 between water level in the Motueka River and conductivity measurements at Piezo 1 compared with conductivity measured at Piezo 4 (Figure 7).

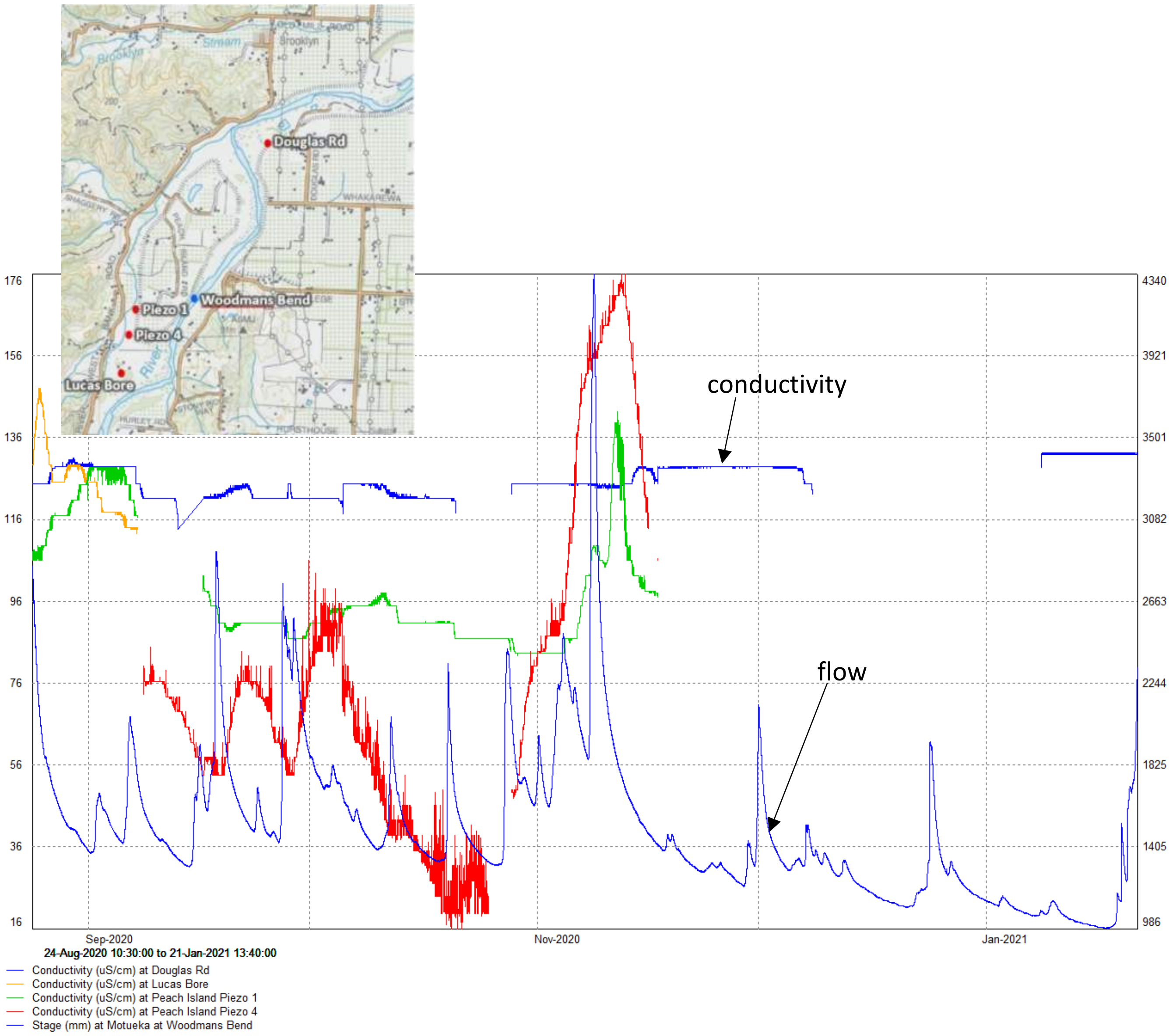

Figure 7: Conductivity measurements at four bore locations compared with water level in the Motueka River, insert map shows site locations

3.3 Drinking Water Guidelines

The New Zealand Drinking Water Guidelines were revised in 2018 (DWSNZ, 2018). Based on the characteristics of the proposed fill (cleanfill & 10% organics) and the groundwater monitoring to date the results were compared with the relevant drinking water standards (Table 2). The results show that concentrations of potential contaminants are all below the relevant drinking water standards.

Table 2: Drinking water standards (DWSNZ, 2018) compared with recorded groundwater quality

Parameter	Standard	Comments	Recorded Results	Compliance
Copper	1 mg/L	Staining of laundry and sanitary ware	0.0008 mg/L – 0.0183 mg/L	✓
	2 mg/L	MAV (health significance)		✓
Iron	0.2 mg/L	Staining of laundry and sanitary ware	<0.02 mg/L – 0.02 mg/L	✓
Lead	0.01	MAV (Health significance)	<0.0001 mg/L – 0.0024 mg/L	✓
Manganese	0.04	Staining of laundry	<0.0005 – 0.0088 mg/L	✓
	0.1	Taste threshold		✓
	0.4	MAV (Health significance)		✓
Sulphate	250 mg/L	Taste threshold	0.6 mg/L – 10.2 mg/L	✓
Zinc	1.5 mg/L	Taste threshold. May affect appearance from 3 mg/L	0.0068 mg/L – 0.24 mg/L	✓

* MAV = maximum acceptable value

4 ASSESSMENT OF EFFECTS OF PROPOSED ACTIVITY

Water quality results show that certain contaminants can be elevated and exceed ANZ guideline values for freshwater under some conditions. This is particularly evident with the heavy metals, copper and zinc.

From an analysis of the water quality data available it would appear that copper and zinc and the primary contaminants of concern. Data shows that copper and zinc concentrations already exceed the ANZ guidelines for freshwaters under certain conditions.

Monitoring of groundwater from the site and of groundwater from a nearby activity showed concentrations of metals and other parameters well within the drinking water standards.

4.1 Geology and Soils

The published site geology from the GNS Science web map for New Zealand shows the site is underlain with Holocene River deposits (Figure 8) comprising well sorted gravels, forming modern flood plains and young fan gravels.

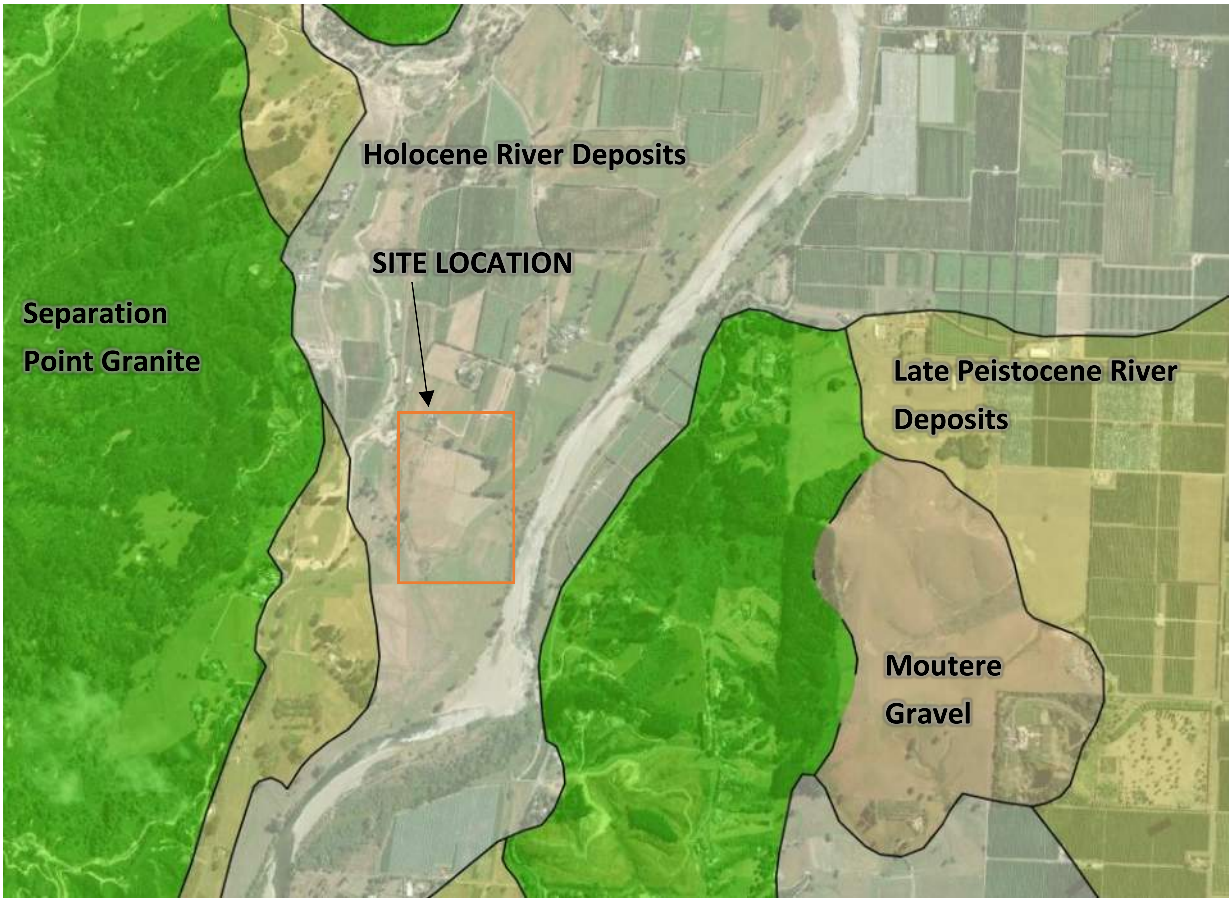

Figure 8: Geology of the site (from: https://data.gns.cri.nz/geology/)

The Moutere Gravel Aquifer underlies the site. The contact with Separation Point Granite defines the western boundary, while the eastern boundary is against the upward-faulted east Nelson Ranges (Stewart and Thomas, 2002).

Soils are classed as Fluvial Recent (https://soils-maps.landcareresearch.co.nz/). There is no further data from s-maps available for the soils at Peach Island. Recent soils are described as weakly developed, showing limited signs of soil-forming processes, with most less than 2,000 years old. A distinct topsoil is present but a B horizon is either absent or only weakly expressed.

4.2 Groundwater Flow Direction

Groundwater level has been measured at the four piezometers shown in Figure 2 from the 18th August 2020 to the 17th November 2020.

Figure 9 shows the fluctuation in groundwater levels for the period monitored at each of the piezometers, relative to the average ground level and to the water level in the Motueka River at Woodmans Bend for the monitoring period. The average ground level within the areas of the four piezos is 19.1 m (i.e. G.L at Piezo 1 = 18.78 m; Piezo 2 = 19.32 m; Piezo 3 = 18.35 m; Piezo 4 = 20.13 m).

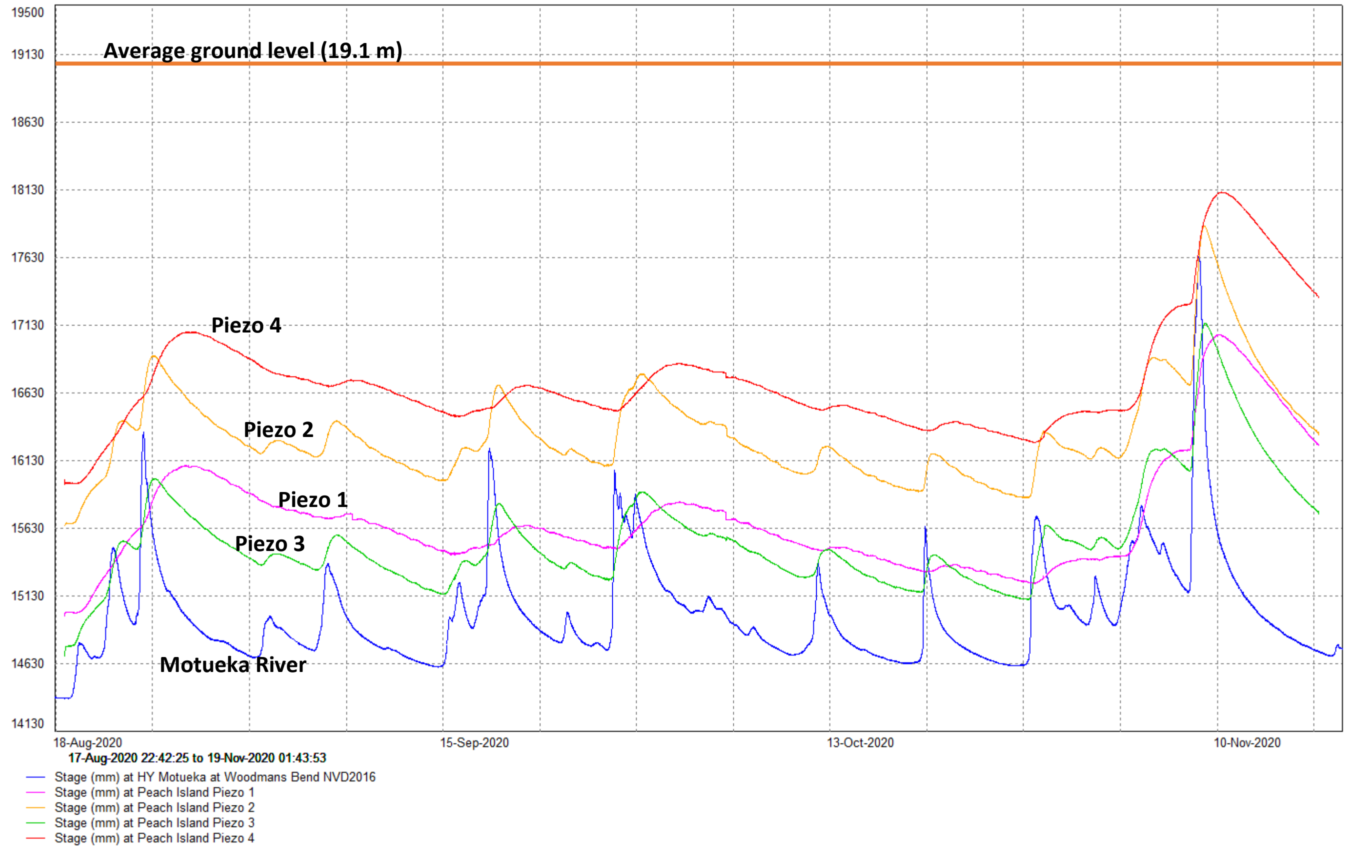

Figure 9: Groundwater levels recorded at the four piezometers on Peach Island in relation to water level recorded in the Motueka River and average ground level

Water levels recorded at the four piezometers were correlated with water level for the Motueka River at Woodmans Bend in order to derive a relationship between river levels and groundwater levels (Appendix 2). The correlations were used to assess long term fluctuations in groundwater levels.

The mean winter groundwater level and percentiles were calculated from the correlated dataset for each of the piezometers. The full datasets are shown in Appendix 3. Mean and median data are summarised in Table 3.

Table 3: Mean and median winter groundwater levels for the four piezometers

	Piezo 1	Piezo 2	Piezo 3	Piezo 4
Mean (m)	14.954	15.951	15.126	16.003
Median (m)	14.886	15.889	15.062	15.936

Piezometers 2 and 3 show the greatest fluctuation with regard to groundwater levels. The bores furthest from the River (Piezos 1 and 4) show less fluctuation in terms of groundwater level.

A ground survey, showing the mean winter groundwater level, was completed by Mapazzo Ltd using lidar and data from the four piezometers. The mean winter groundwater level was determined using simple triangulation to determine groundwater contours using Global Mapper software. Groundwater direction is shown to flow in a south-northwards direction towards the Motueka River (Appendix 4). The mean winter groundwater level varies from 15 m to 16 m (NZVD2016 datum) within the proposed excavation area.

4.3 Simplified Risk Assessment

A source-pathway-receptor model is a common method of identifying potential environment risks associated with an activity that has the potential to introduce contaminants into the environment. The occurrence of an activity at a specified location does not necessarily result in a detrimental effect on the environment as any potential effects are contingent on:

1. The presence and concentration of a contaminant;
2. The presence of receptors which are at risk of adverse effects from the contaminant; and
3. A means (pathway) through which the contaminant has the potential to move from the source to the receptor.

Based on the likely contaminants associated with the proposed activity and the environmental setting a simplified risk assessment (conceptual) model was devised (Table 4).

The conceptual model has been developed to represent the characteristics of the site in a simplified format based on the current knowledge of the site. Potential contaminants, pathways and receptors associated with the site are identified and a determination made as to their significance with regard to human health and the wider environment.

Table 4: Simplified risk assessment model for potential effects from the activity on the environment

Source: Cleanfill materials used for backfilling (10% organic material; inert materials)				
Potential contaminants	**Pathways**	**Receptors**	**Risk**	**Justification**
BOD	Permeable gravels Groundwater flow towards Motueka River	Shallow groundwater	Low	Low concentrations Attenuation through dilution and aeration
		Motueka River (150 m at nearest point)	Low	Low concentrations Attenuation through dilution and aeration
Heavy Metals		Shallow groundwater	Low	Concentrations below Drinking Water Standards
		Motueka River (150 m at nearest point)	Low	Concentrations recorded above ANZ guidelines in groundwater, however dilution within the Motueka River deems risk to environment as low
Sediment		Shallow groundwater	Low	Attenuation and filtration. No works will be undertaken below the groundwater table at the time of excavations
		Motueka River (150 m at nearest point)	Low	Attenuation and filtration through subsurface flows. No works will be undertaken below the groundwater table at the time of excavations

5 CONCLUSIONS AND RECOMMENDATIONS

Groundwater quality at a nearby gravel extraction works at Douglas Road has been compared with groundwater quality at the proposed site in order to determine what potential effects could be expected from the proposed activity.

$cBOD_5$ and COD were not found to be contaminants of concern at either site. Sampling showed all but one sample (from Douglas Road) were below detection limits. $cBOD_5$ recorded at Douglas Road was just above the detection limit. The low amount (<10%) of organic material proposed to be transported to the site means that neither $cBOD_5$ or COD will be generated in sufficient quantities to result in an adverse effect on groundwater or surface water quality. Similar organic quantities (<10%) are currently transported to the Douglas Road site, where no issues with $cBOD_5$ or COD are noted.

No organochlorine pesticides were detected in any samples. It is highly unlikely that residual pesticides, in sufficient quantities, would be present in any fill material that would result in an adverse effect in groundwater or surface water quality.

Sulphate, iron and manganese concentrations were all found to be within expected ranges for groundwater at the locations monitored, these parameters are indicators of the redox state of the groundwater.

Overall, the proposed activity poses a low risk to groundwater and surface water quality. The following recommendations are made to quantify any potential environmental effects that may arise as a result of the proposed activity.

Recommendations

Quarterly monitoring of a bore upstream and downstream of the quarrying activities.

Groundwater samples to be analysed for the following:

- Dissolved copper
- Dissolved lead
- Dissolved zinc

6 REFERENCES

ANZ Guidelines https://www.waterquality.gov.au/anz-guidelines

Cavanagh, J. (2015) Background concentrations of trace elements and options for managing soil quality in the Tasman and Nelson Districts. Envirolink Advice Grant: 1555-TSDC110

Stewart, M. K. and Thomas, J. T. (2002) Moutere Valley Groundwater: Nature and Recharge from Isotopes and Chemistry. Institute of Geological & Nuclear Sciences science report 2002/22. 28p.

DWSNZ (2018). Drinking-water Standards for New Zealand 2005 (revised 2018). Wellington: Ministry of Health 2018. ISBN 978-1-98-853978-2 (print) ISBN 978-1-98-853979-9 (online).

Appendix 1

Hill Laboratories Results

Hill Laboratories
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Certificate of Analysis

Client:	Envirolink Limited	Lab No:	2449929 SPv1
Contact:	Tony Hewitt	Date Received:	06-Oct-2020
	C/- Envirolink Limited	Date Reported:	19-Oct-2020
	PO Box 25	Quote No:	106632
	Mapua 7048	Order No:	PO 1552
		Client Reference:	CJ Industries
		Submitted By:	Tony Hewitt

Sample Type: Aqueous

Sample Name:		Peach Island 4 05-Oct-2020 1:00 pm	Douglas Road 05-Oct-2020 2:40 pm			
Lab Number:		2449929.1	2449929.2			
Individual Tests						
Dissolved Copper	g/m³	0.0009	0.0117	-	-	-
Dissolved Iron	g/m³	< 0.02	< 0.02	-	-	-
Dissolved Lead	g/m³	< 0.00010	0.00045	-	-	-
Dissolved Manganese	g/m³	0.0014	< 0.0005	-	-	-
Dissolved Zinc	g/m³	0.0116	0.036	-	-	-
Chloride	g/m³	4.4	5.6	-	-	-
Sulphate	g/m³	10.2	6.0	-	-	-
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	g O_2/m³	< 2	< 2	-	-	-
Chemical Oxygen Demand (COD)	g O_2/m³	< 6	< 6	-	-	-
Organochlorine Pesticides Trace in water, By Liq/Liq						
Aldrin	g/m³	< 0.000005	< 0.000005	-	-	-
alpha-BHC	g/m³	< 0.000010	< 0.000010	-	-	-
beta-BHC	g/m³	< 0.000010	< 0.000010	-	-	-
delta-BHC	g/m³	< 0.000010	< 0.000010	-	-	-
gamma-BHC (Lindane)	g/m³	< 0.000010	< 0.000010	-	-	-
cis-Chlordane	g/m³	< 0.000005	< 0.000005	-	-	-
trans-Chlordane	g/m³	< 0.000005	< 0.000005	-	-	-
2,4'-DDD	g/m³	< 0.000010	< 0.000010	-	-	-
4,4'-DDD	g/m³	< 0.000010	< 0.000010	-	-	-
2,4'-DDE	g/m³	< 0.000010	< 0.000010	-	-	-
4,4'-DDE	g/m³	< 0.000010	< 0.000010	-	-	-
2,4'-DDT	g/m³	< 0.000010	< 0.000010	-	-	-
4,4'-DDT	g/m³	< 0.000010	< 0.000010	-	-	-
Total DDT Isomers	g/m³	< 0.00006	< 0.00006	-	-	-
Dieldrin	g/m³	< 0.000005	< 0.000005	-	-	-
Endosulfan I	g/m³	< 0.000010	< 0.000010	-	-	-
Endosulfan II	g/m³	< 0.000010	< 0.000010	-	-	-
Endosulfan sulfate	g/m³	< 0.000010	< 0.000010	-	-	-
Endrin	g/m³	< 0.000005	< 0.000005	-	-	-
Endrin aldehyde	g/m³	< 0.000005	< 0.000005	-	-	-
Endrin ketone	g/m³	< 0.000010	< 0.000010	-	-	-
Heptachlor	g/m³	< 0.000005	< 0.000005	-	-	-
Heptachlor epoxide	g/m³	< 0.000005	< 0.000005	-	-	-
Hexachlorobenzene	g/m³	< 0.00004	< 0.00004	-	-	-
Methoxychlor	g/m³	< 0.000005	< 0.000005	-	-	-

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Organochlorine Pesticides Trace in water, By Liq/Liq	Liquid / liquid extraction, GC-ECD analysis. In-house based on US EPA 8081.	0.000005 - 0.00006 g/m³	1-2
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter. Performed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch.	-	1-2
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m³	1-2
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m³	1-2
Dissolved Lead	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.00010 g/m³	1-2
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m³	1-2
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m³	1-2
Chloride	Filtered sample from Christchurch. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m³	1-2
Sulphate	Filtered sample from Christchurch. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m³	1-2
Carbonaceous Biochemical Oxygen Demand (cBOD₅)	Incubation 5 days, DO meter, nitrification inhibitor added, seeded. Analysed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch. APHA 5210 B (modified) 23rd ed. 2017.	2 g O_2/m³	1-2
Chemical Oxygen Demand (COD), trace level	Dichromate/sulphuric acid digestion in Hach tubes, colorimetry. Trace Level method. APHA 5220 D 23rd ed. 2017.	6 g O_2/m³	1-2

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 08-Oct-2020 and 19-Oct-2020. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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Kim Harrison MSc
Client Services Manager - Environmental

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Certificate of Analysis

Page 1 of 2

SPv1

Client:	Envirolink Limited	**Lab No:**	2433956
Contact:	Tony Hewitt C/- Envirolink Limited PO Box 25 Mapua 7048	**Date Received:**	09-Sep-2020
		Date Reported:	18-Sep-2020
		Quote No:	106632
		Order No:	PO 1552
		Client Reference:	CJ Industries
		Submitted By:	Tony Hewitt

Sample Type: Aqueous

Sample Name:		Peach Island 2 09-Sep-2020 12:00 pm	Douglas Road 09-Sep-2020 12:00 pm			
Lab Number:		2433956.1	2433956.2			
Individual Tests						
Dissolved Copper	g/m³	0.0008	0.0183	-	-	-
Dissolved Iron	g/m³	0.02	< 0.02	-	-	-
Dissolved Lead	g/m³	< 0.00010	0.00094	-	-	-
Dissolved Manganese	g/m³	0.0017	< 0.0005	-	-	-
Dissolved Zinc	g/m³	0.0068	0.050	-	-	-
Chloride	g/m³	4.6	5.7	-	-	-
Sulphate	g/m³	7.2	6.9	-	-	-
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	g O_2/m³	< 2	< 2	-	-	-
Chemical Oxygen Demand (COD)	g O_2/m³	< 6	< 6	-	-	-
Organochlorine Pesticides Trace in water, By Liq/Liq						
Aldrin	g/m³	< 0.000005	< 0.000005	-	-	-
alpha-BHC	g/m³	< 0.000010	< 0.000010	-	-	-
beta-BHC	g/m³	< 0.000010	< 0.000010	-	-	-
delta-BHC	g/m³	< 0.000010	< 0.000010	-	-	-
gamma-BHC (Lindane)	g/m³	< 0.000010	< 0.000010	-	-	-
cis-Chlordane	g/m³	< 0.000005	< 0.000005	-	-	-
trans-Chlordane	g/m³	< 0.000005	< 0.000005	-	-	-
2,4'-DDD	g/m³	< 0.000010	< 0.000010	-	-	-
4,4'-DDD	g/m³	< 0.000010	< 0.000010	-	-	-
2,4'-DDE	g/m³	< 0.000010	< 0.000010	-	-	-
4,4'-DDE	g/m³	< 0.000010	< 0.000010	-	-	-
2,4'-DDT	g/m³	< 0.000010	< 0.000010	-	-	-
4,4'-DDT	g/m³	< 0.000010	< 0.000010	-	-	-
Total DDT Isomers	g/m³	< 0.00006	< 0.00006	-	-	-
Dieldrin	g/m³	< 0.000005	< 0.000005	-	-	-
Endosulfan I	g/m³	< 0.000010	< 0.000010	-	-	-
Endosulfan II	g/m³	< 0.000010	< 0.000010	-	-	-
Endosulfan sulfate	g/m³	< 0.000010	< 0.000010	-	-	-
Endrin	g/m³	< 0.000005	< 0.000005	-	-	-
Endrin aldehyde	g/m³	< 0.000005	< 0.000005	-	-	-
Endrin ketone	g/m³	< 0.000010	< 0.000010	-	-	-
Heptachlor	g/m³	< 0.000005	< 0.000005	-	-	-
Heptachlor epoxide	g/m³	< 0.000005	< 0.000005	-	-	-
Hexachlorobenzene	g/m³	< 0.00004	< 0.00004	-	-	-
Methoxychlor	g/m³	< 0.000005	< 0.000005	-	-	-

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked * or any comments and interpretations, which are not accredited.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Organochlorine Pesticides Trace in water, By Liq/Liq	Liquid / liquid extraction, GC-ECD analysis. In-house based on US EPA 8081.	0.000005 - 0.00006 g/m^3	1-2
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-2
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-2
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-2
Dissolved Lead	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.00010 g/m^3	1-2
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-2
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-2
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	1-2
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	1-2
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	Incubation 5 days, DO meter, nitrification inhibitor added, seeded. Analysed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch. APHA 5210 B (modified) 23rd ed. 2017.	2 g O_2/m^3	1-2
Chemical Oxygen Demand (COD), trace level	Dichromate/sulphuric acid digestion in Hach tubes, colorimetry. Trace Level method. APHA 5220 D 23rd ed. 2017.	6 g O_2/m^3	1-2

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 11-Sep-2020 and 18-Sep-2020. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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Carole Rodgers-Carroll BA, NZCS
Client Services Manager - Environmental

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Certificate of Analysis

SPv1

Client:	Envirolink Limited	**Lab No:**	2512566
Contact:	Tony Hewitt	**Date Received:**	22-Jan-2021
	C/- Envirolink Limited	**Date Reported:**	29-Jan-2021
	PO Box 25	**Quote No:**	106632
	Mapua 7048	**Order No:**	PO 1552
		Client Reference:	CJ Industries
		Submitted By:	Tony Hewitt

Sample Type: Aqueous

Sample Name:		Peach Island 4 21-Jan-2021 1:58 pm	Douglas Road 21-Jan-2021 2:43 pm			
Lab Number:		2512566.1	2512566.2			
Individual Tests						
Dissolved Copper	g/m^3	0.0081	0.079	-	-	-
Dissolved Iron	g/m^3	< 0.02	< 0.02	-	-	-
Dissolved Lead	g/m^3	0.00015	0.0024	-	-	-
Dissolved Manganese	g/m^3	0.0088	< 0.0005	-	-	-
Dissolved Zinc	g/m^3	0.057	0.24	-	-	-
Chloride	g/m^3	3.1	5.4	-	-	-
Sulphate	g/m^3	0.6	7.5	-	-	-
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	g O_2/m^3	< 2	< 2	-	-	-
Chemical Oxygen Demand (COD)	g O_2/m^3	< 6	< 6	-	-	-
Organochlorine Pesticides Trace in water, By Liq/Liq						
Aldrin	g/m^3	< 0.000005	< 0.000005	-	-	-
alpha-BHC	g/m^3	< 0.000010	< 0.000010	-	-	-
beta-BHC	g/m^3	< 0.000010	< 0.000010	-	-	-
delta-BHC	g/m^3	< 0.000010	< 0.000010	-	-	-
gamma-BHC (Lindane)	g/m^3	< 0.000010	< 0.000010	-	-	-
cis-Chlordane	g/m^3	< 0.000005	< 0.000005	-	-	-
trans-Chlordane	g/m^3	< 0.000005	< 0.000005	-	-	-
2,4'-DDD	g/m^3	< 0.000010	< 0.000010	-	-	-
4,4'-DDD	g/m^3	< 0.000010	< 0.000010	-	-	-
2,4'-DDE	g/m^3	< 0.000010	< 0.000010	-	-	-
4,4'-DDE	g/m^3	< 0.000010	< 0.000010	-	-	-
2,4'-DDT	g/m^3	< 0.000010	< 0.000010	-	-	-
4,4'-DDT	g/m^3	< 0.000010	< 0.000010	-	-	-
Total DDT Isomers	g/m^3	< 0.00006	< 0.00006	-	-	-
Dieldrin	g/m^3	< 0.000005	< 0.000005	-	-	-
Endosulfan I	g/m^3	< 0.000010	< 0.000010	-	-	-
Endosulfan II	g/m^3	< 0.000010	< 0.000010	-	-	-
Endosulfan sulfate	g/m^3	< 0.000010	< 0.000010	-	-	-
Endrin	g/m^3	< 0.000005	< 0.000005	-	-	-
Endrin aldehyde	g/m^3	< 0.000005	< 0.000005	-	-	-
Endrin ketone	g/m^3	< 0.000010	< 0.000010	-	-	-
Heptachlor	g/m^3	< 0.000005	< 0.000005	-	-	-
Heptachlor epoxide	g/m^3	< 0.000005	< 0.000005	-	-	-
Hexachlorobenzene	g/m^3	< 0.00004	< 0.00004	-	-	-
Methoxychlor	g/m^3	< 0.000005	< 0.000005	-	-	-

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Organochlorine Pesticides Trace in water, By Liq/Liq	Liquid / liquid extraction, GC-ECD analysis. In-house based on US EPA 8081.	0.000005 - 0.00006 g/m^3	1-2
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-2
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-2
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-2
Dissolved Lead	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.00010 g/m^3	1-2
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-2
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-2
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	1-2
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	1-2
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	Incubation 5 days, DO meter, nitrification inhibitor added, seeded. Analysed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch. APHA 5210 B (modified) 23rd ed. 2017.	2 g O_2/m^3	1-2
Chemical Oxygen Demand (COD), trace level	Dichromate/sulphuric acid digestion in Hach tubes, colorimetry. Trace Level method. APHA 5220 D 23rd ed. 2017.	6 g O_2/m^3	1-2

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 27-Jan-2021 and 29-Jan-2021. For completion dates of individual analyses please contact the laboratory.

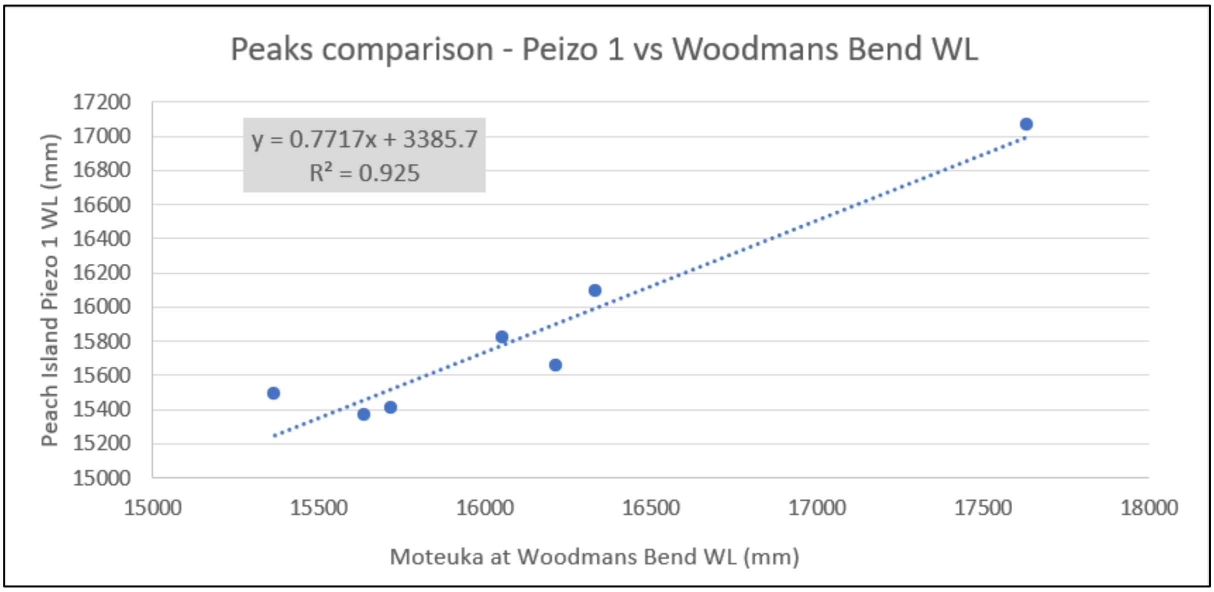
Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

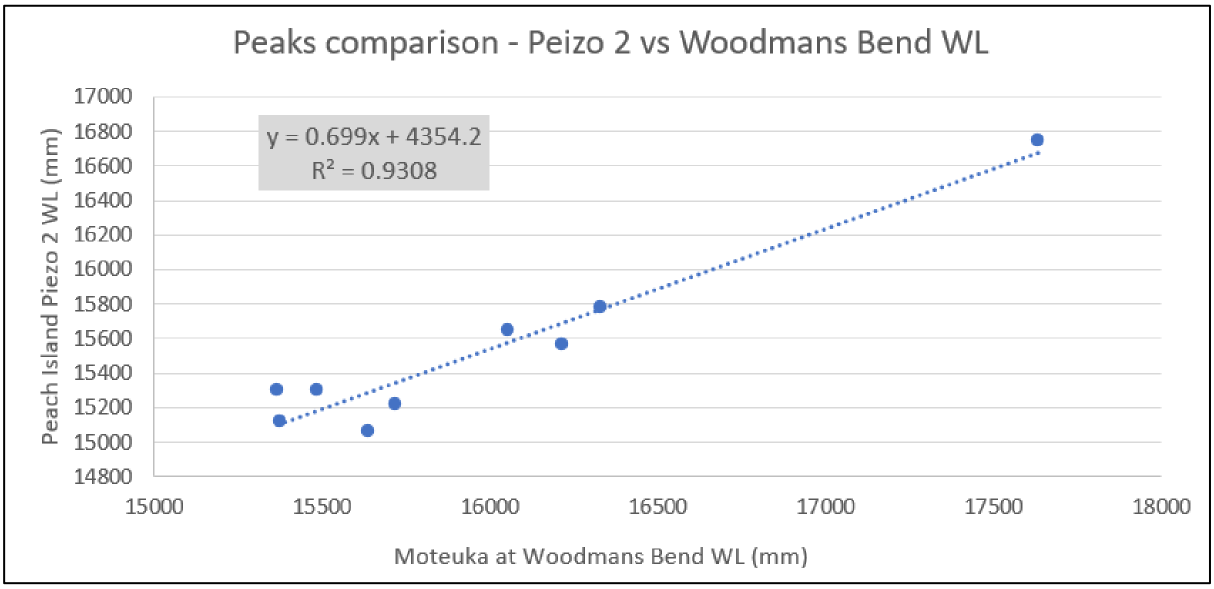
This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

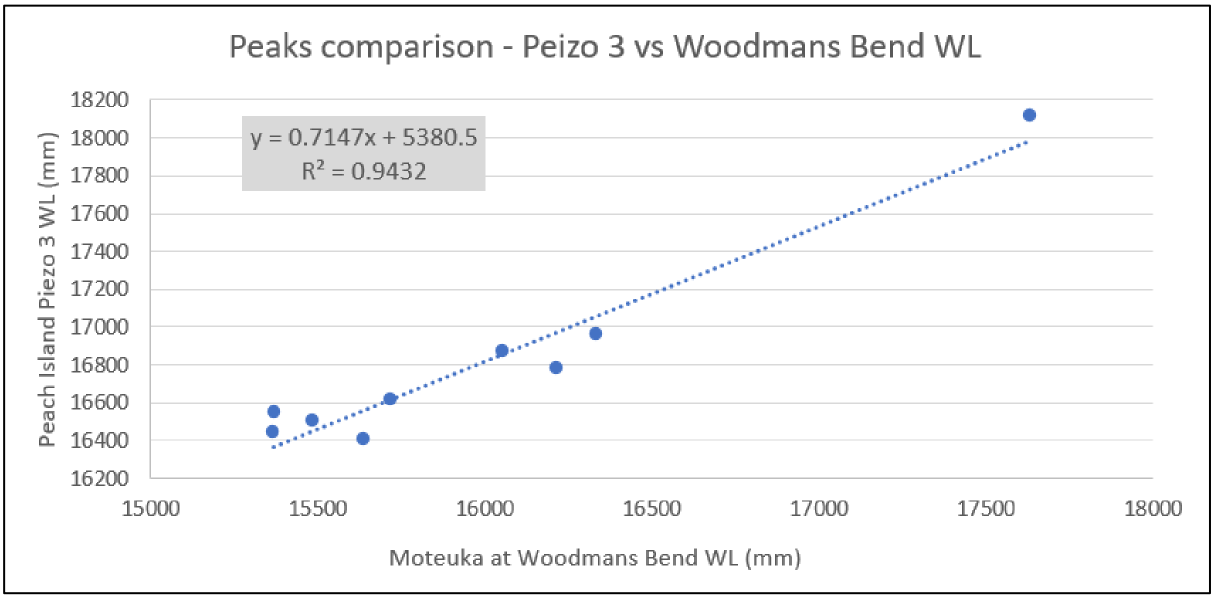
Ara Heron BSc (Tech)
Client Services Manager - Environmental

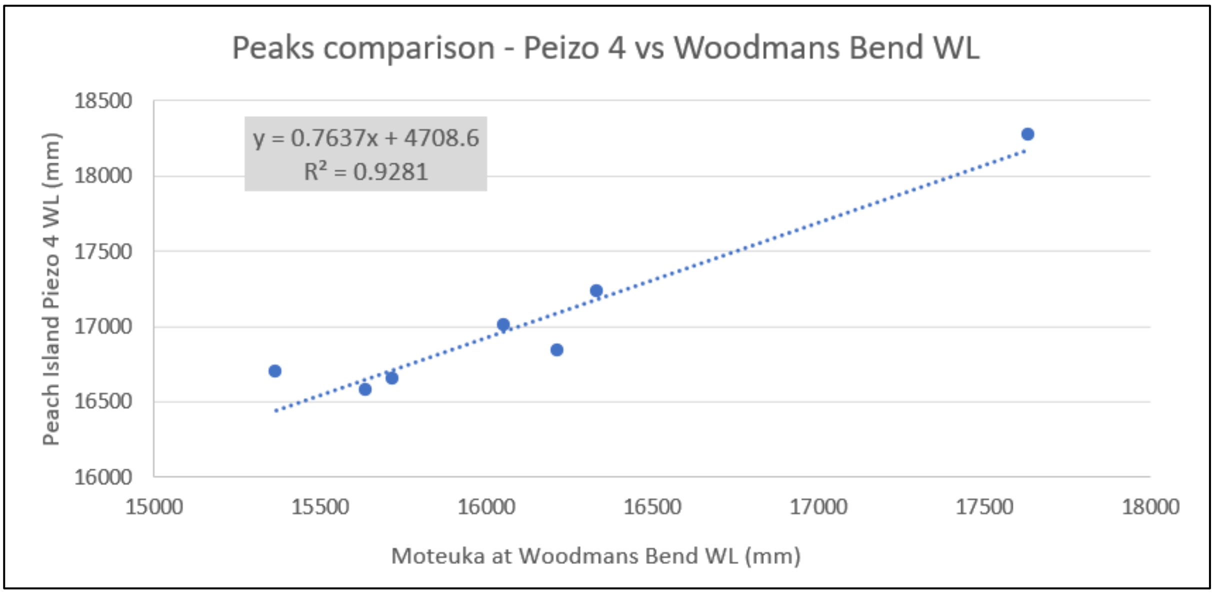
Appendix 2

Peak Water Level Correlations for the four Piezometers Vs Water Level in the Motueka River at Woodmans


Peaks comparison - Peizo 1 vs Woodmans Bend WL
y = 0.7717x + 3385.7
R² = 0.925
Peach Island Piezo 1 WL (mm)
17200
17000
16800
16600
16400
16200
16000
15800
15600
15400
15200
15000
15000
15500
16000
16500
17000
17500
18000
Moteuka at Woodmans Bend WL (mm)


Peaks comparison - Peizo 2 vs Woodmans Bend WL
y = 0.699x + 4354.2
R² = 0.9308
Peach Island Piezo 2 WL (mm)
17000
16800
16600
16400
16200
16000
15800
15600
15400
15200
15000
14800
15000
15500
16000
16500
17000
17500
18000
Moteuka at Woodmans Bend WL (mm)


Peaks comparison - Peizo 3 vs Woodmans Bend WL
y = 0.7147x + 5380.5
R^2 = 0.9432
Peach Island Piezo 3 WL (mm)
Moteuka at Woodmans Bend WL (mm)
18200
18000
17800
17600
17400
17200
17000
16800
16600
16400
16200
15000
15500
16000
16500
17000
17500
18000


Peaks comparison - Peizo 4 vs Woodmans Bend WL
y = 0.7637x + 4708.6
R^2 = 0.9281
Peach Island Piezo 4 WL (mm)
Moteuka at Woodmans Bend WL (mm)
18500
18000
17500
17000
16500
16000
15000
15500
16000
16500
17000
17500
18000

Appendix 3

Winter Groundwater Level Summary Statistics for the four Piezometers normalised for the period 2001 – 2021 using Woodmans Bend Correlation

Piezo 1 **Winter PDIST** - Water Level data based on correlation with Woodmans Bend WL (NZVD 2016 datum)

```
~~~ Hilltop Hydro ~~~ Version 6.48                                          11-May-2021
~~~ PDist ~~~

Source is W:\HilltopData\CJ Industries Revised 20210511.hts
<Stage (mm)>*0.7717 + 3386 at Motueka at Woodmans Bend RL
From  7-Feb-2001 16:30:00 to 25-Feb-2021 11:00:00
Piezo 1
Month Filter: May-Oct


Exceedance percentiles for 0 Average
            0        1        2        3        4        5        6        7        8        9

   0 17373.83 16048.56 15836.56 15704.68 15616.04 15548.79 15496.84 15453.54 15415.23 15380.61
  10 15349.55 15321.85 15296.51 15271.66 15248.37 15228.13 15208.44 15190.56 15173.89 15158.72
  20 15144.54 15131.01 15117.14 15103.87 15091.64 15079.60 15068.63 15057.65 15047.38 15037.61
  30 15028.26 15019.54 15011.07 15002.74 14994.96 14987.24 14979.41 14971.74 14964.45 14957.01
  40 14949.19 14941.79 14934.86 14928.08 14921.61 14915.21 14908.95 14902.71 14896.94 14891.28
  50 14885.69 14880.21 14875.10 14869.40 14863.96 14858.94 14853.69 14847.97 14842.55 14836.96
  60 14831.27 14825.75 14820.36 14814.86 14809.50 14804.32 14799.17 14793.79 14788.56 14783.21
  70 14777.84 14772.87 14768.11 14763.15 14758.44 14753.55 14748.59 14742.42 14736.40 14730.55
  80 14724.87 14718.57 14712.60 14706.71 14700.14 14693.03 14683.63 14675.02 14665.47 14655.02
  90 14640.99 14627.41 14615.02 14603.88 14590.95 14577.37 14561.69 14539.36 14512.05 14483.75
 100 14380.41

  Mean = 14953.85  Std Deviation = 312.76
 3679 days 09:00:00 hhmmss of data analysed
    0 days 15:00:00 hhmmss of missing record
The distribution was calculated over 2000 classes in the range 14466.23 to 16278.59
```

Piezo 2 **Winter PDIST** - Water Level data based on correlation with Woodmans Bend WL (NZVD 2016 datum)

```
~~~ Hilltop Hydro ~~~ Version 6.48                                          11-May-2021
~~~ PDist ~~~

Source is W:\HilltopData\CJ Industries Revised 20210511.hts
<Stage (mm)>*0.7008 + 5446 at Motueka at Woodmans Bend RL
From  7-Feb-2001 16:30:00 to 25-Feb-2021 11:00:00
Piezo 2
Month Filter: May-Oct


Exceedance percentiles for 0 Average
            0        1        2        3        4        5        6        7        8        9

   0 18148.70 16945.19 16752.65 16632.89 16552.45 16491.33 16444.15 16404.85 16370.03 16338.67
  10 16310.39 16285.25 16262.23 16239.64 16218.52 16200.14 16182.21 16166.02 16150.89 16137.13
  20 16124.22 16111.93 16099.36 16087.24 16076.21 16065.28 16055.29 16045.31 16035.98 16027.11
  30 16018.68 16010.64 16002.98 15995.49 15988.33 15981.43 15974.23 15967.31 15960.73 15953.86
  40 15946.88 15940.04 15933.85 15927.68 15921.73 15915.94 15910.35 15904.69 15899.35 15894.18
  50 15889.10 15884.14 15879.49 15874.30 15869.38 15864.81 15860.05 15854.86 15849.93 15844.86
  60 15839.70 15834.70 15829.79 15824.94 15820.07 15815.29 15810.59 15805.79 15801.05 15796.20
  70 15791.31 15786.73 15782.43 15777.86 15773.56 15769.11 15764.61 15759.03 15753.63 15748.39
  80 15743.14 15737.35 15731.93 15726.59 15720.62 15714.16 15705.79 15697.82 15689.15 15679.66
  90 15666.93 15654.60 15643.35 15633.24 15621.50 15609.17 15594.95 15574.67 15549.75 15524.22
 100 15430.30

  Mean = 15951.05  Std Deviation = 284.03
 3679 days 09:00:00 hhmmss of data analysed
    0 days 15:00:00 hhmmss of missing record
The distribution was calculated over 2000 classes in the range 15510.04 to 17153.84
```

Piezo 3 **Winter PDIST** - Water Level data based on correlation with Woodmans Bend WL (NZVD 2016 datum)

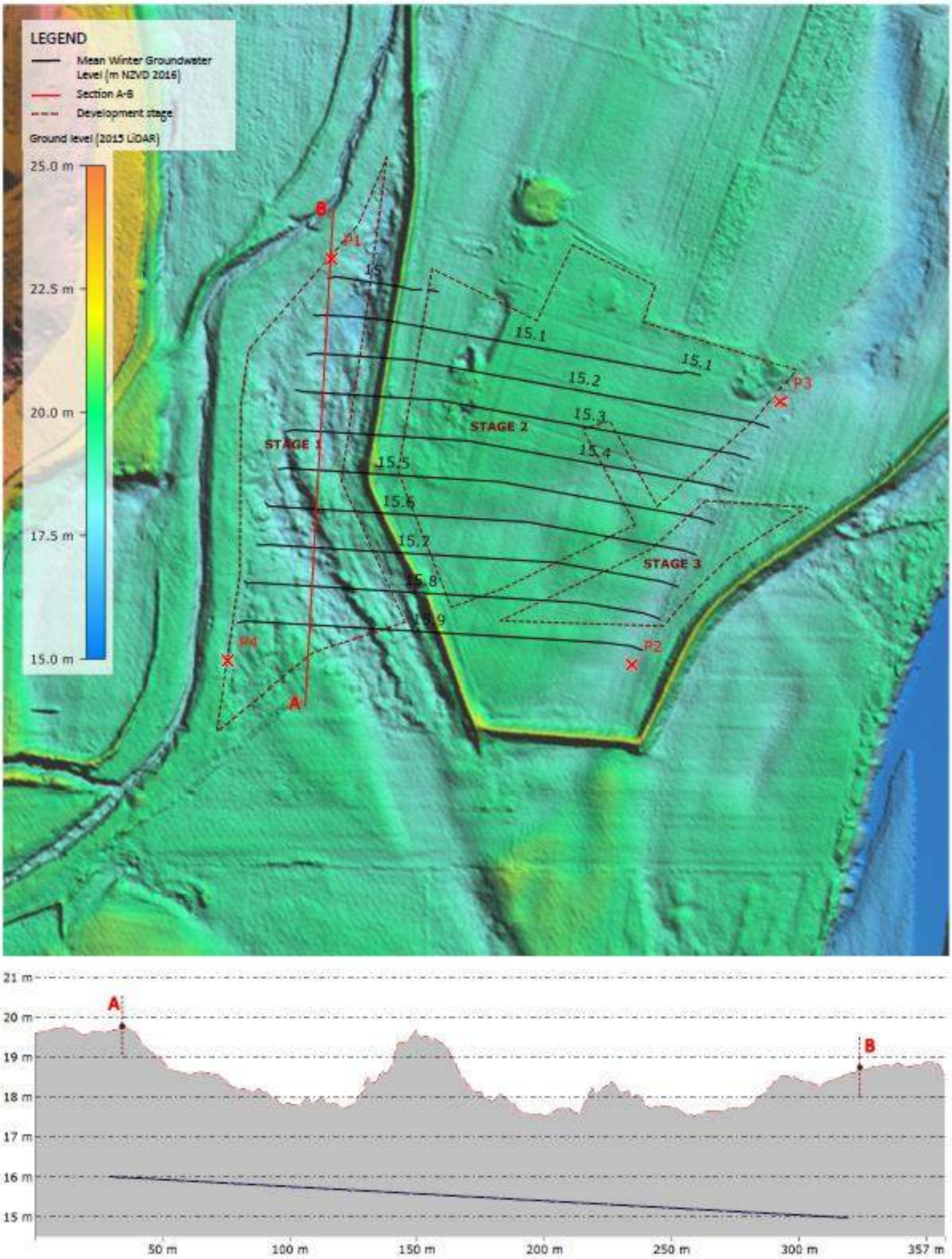
```
~~~ Hilltop Hydro ~~~ Version 6.48                                          11-May-2021
~~~ PDist ~~~

Source is W:\HilltopData\CJ Industries Revised 20210511.hts
<Stage (mm)>*0.7257 + 4248 at Motueka at Woodmans Bend RL
From  7-Feb-2001 16:30:00 to 25-Feb-2021 11:00:00
Piezo 3
Month Filter: May-Oct


Exceedance percentiles for 0 Average
            0        1        2        3        4        5        6        7        8        9

  0 17402.04 16155.76 15956.38 15832.38 15749.06 15685.79 15636.93 15596.22 15560.19 15527.64
 10 15498.42 15472.37 15448.55 15425.15 15403.27 15384.24 15365.73 15348.90 15333.23 15318.96
 20 15305.62 15292.90 15279.86 15267.38 15255.88 15244.55 15234.30 15223.96 15214.29 15205.05
 30 15196.27 15188.06 15180.12 15172.27 15164.96 15157.68 15150.35 15143.10 15136.36 15129.25
 40 15121.99 15114.94 15108.43 15102.14 15095.97 15089.95 15084.07 15078.32 15072.80 15067.44
 50 15062.17 15057.03 15052.22 15046.84 15041.74 15037.01 15032.08 15026.70 15021.60 15016.35
 60 15011.00 15005.82 15000.74 14995.70 14990.66 14985.71 14980.96 14975.87 14970.95 14965.96
 70 14960.91 14956.23 14951.66 14947.04 14942.52 14937.87 14933.23 14927.55 14921.91 14916.40
 80 14910.96 14904.95 14899.33 14893.87 14887.89 14880.92 14872.31 14864.24 14855.02 14845.24
 90 14831.99 14819.48 14807.53 14797.04 14785.21 14772.13 14757.44 14736.66 14710.89 14684.10
100 14587.05

  Mean = 15126.31   Std Deviation = 294.12
 3679 days 09:00:00 hhmmss of data analysed
    0 days 15:00:00 hhmmss of missing record
The distribution was calculated over 2000 classes in the range 14666.40 to 16372.02
```

Piezo 4 **Winter PDIST** - Water Level data based on correlation with Woodmans Bend WL (NZVD 2016 datum)

```
~~~ Hilltop Hydro ~~~ Version 6.48                                          11-May-2021
~~~ PDist ~~~

Source is W:\HilltopData\CJ Industries Revised 20210511.hts
<Stage (mm)>*0.7634 + 4560 at Motueka at Woodmans Bend RL
From  7-Feb-2001 16:30:00 to 25-Feb-2021 11:00:00
Piezo 4
Month Filter: May-Oct


Exceedance percentiles for 0 Average
            0        1        2        3        4        5        6        7        8        9

  0 18397.39 17086.37 16876.64 16746.18 16658.48 16591.97 16540.57 16497.76 16459.83 16425.65
 10 16394.89 16367.46 16342.38 16317.82 16294.77 16274.72 16255.26 16237.61 16221.15 16206.15
 20 16192.02 16178.69 16165.00 16151.80 16139.78 16127.87 16116.98 16106.11 16095.94 16086.28
 30 16077.09 16068.44 16059.98 16051.83 16044.03 16036.51 16028.67 16021.17 16013.95 16006.56
 40 15998.86 15991.46 15984.68 15977.94 15971.45 15965.21 15959.06 15952.89 15947.07 15941.43
 50 15935.89 15930.49 15925.45 15919.86 15914.48 15909.58 15904.35 15898.74 15893.38 15887.85
 60 15882.21 15876.75 15871.41 15865.98 15860.68 15855.55 15850.46 15845.13 15839.96 15834.67
 70 15829.35 15824.44 15819.72 15814.81 15810.17 15805.33 15800.42 15794.32 15788.36 15782.51
 80 15776.82 15770.67 15764.84 15759.00 15752.51 15745.45 15736.14 15727.64 15718.18 15707.85
 90 15693.83 15680.55 15668.27 15657.27 15644.48 15631.04 15615.54 15593.43 15566.26 15538.43
100 15436.16

  Mean = 16003.43   Std Deviation = 309.40
 3679 days 09:00:00 hhmmss of data analysed
    0 days 15:00:00 hhmmss of missing record
The distribution was calculated over 2000 classes in the range 15520.21 to 17313.99
```

Appendix 4

Groundwater Flow Direction



#2002 CJ Industries - Peach Island
Mean winter groundwater level, 2015 Lidar DEM

1 : 2500 at A3
0 50 100

mappazzo
revised 12 May 2021

CJ INDUSTRIES

134 PEACH ISLAND ROAD, MOTUEKA

LANDSCAPE MITIGATION PLAN

10 AUGUST 2020

canopy
LANDSCAPE ARCHITECTS

LEGEND

SITE BOUNDARY

ACCESS INTO THE SITE

20m SETBACK FROM STOPBANK
-PLANTING CAN EXTEND ONTO STOPBANK

ADJOINING MARGINAL CONSERVATION STRIP

STOCKPILE + SERVICE AREA

<u>MITIGATION PLANTING</u>

(AREA A) ALL SPECIES
-PLANTING TO BE A MIX OF THE FOLLOWING LIST BELOW, PLANTED AT 1.5/2m SPACINGS FOR SHRUBS WITH RT SHRUB GRADE SOURCED LOCALLY, AND 4.5m SPACINGS FOR TREES WITH PB18 SPECIMEN TREE GRADE. REFER DIAGRAM BELOW

(AREA B) NO POPULUS 'CROWS NEST'
-PLANTING TO BE A MIX OF THE FOLLOWING LIST BELOW MINUS POPULUS 'CROWS NEST', PLANTED AT 1.5/2m SPACINGS FOR SHRUBS WITH RT SHRUB GRADE SOURCED LOCALLY, AND 4.5m SPACINGS FOR TREES WITH PB18 SPECIMEN TREE GRADE. REFER DIAGRAM BELOW

(AREA C) INFILL UNDERSTOREY PLANTING
-PLANTING TO BE A MIX OF THE UNDERSTOREY SPECIES, PLANTED AT 1.5/2m SPACINGS FOR SHRUBS WITH RT SHRUB-GRADE SOURCED LOCALLY, AND 4.5m SPACINGS FOR TREES WITH PB18 SPECIMEN TREE GRADE.

TALL TREES
EUCALYPTUS NITENS - SHINING GUM
POPULUS 'CROWS NEST' - CROWS NEST POPLAR (AREA A)

UNDERSTOREY
SOPHORA MIRCROPHYLLA - KOWHAI
PSEUDOPANAX ARBOREUS - FIVE FINGER
CORDYLINE AUSTRALIS - CABBAGE TREE
PITTOSPORUM TENUIFOLIUM - KOHUHU
PITTOSPORUM EUGENIOIDES - LEMONWOOD
PHORMIUM TENAX - SWAMP FLAX
DODONAEA VISCOSA - AKE AKE
COPROSMA RUBUSTA - KARAMU

MAINTENANCE & ESTABLISHMENT PLAN

TIMING
1. Planting to be undertaken between the months of April and October to take advantage of optimum rainfall and climatic conditions best suited to plant growth.

PREPARATION
2. The contractor shall carry out the works to protect the existing subsoil structures and prevent excessive soil structure damage. Ensure at least 50mm of topsoil present.

3. Prepare planting area by spraying planting zone areas as required to reduce initial weed and grass growth.

4. Plants should be of the species on the drawings. Plants shall be vigorous, well established, hardened off, of good form consistent with the specie or varieties, not soft or forced, free from disease and insect pests, with large healthy root systems and no evidence of being restricted or damaged. The trees shall have a single leading shoot.

SETOUT
5. The planting hole shall be twice the root ball width and twice the root ball depth. Planting holes , except for wetland plants, shall be loosened for at least 75mm each side of the under plant prior to planting.

6. Each plant shall be watered thoroughly after planting, ensuring that the moisture has penetrated to the full depth of the root ball (initial watering is also important to settle the soil around the roots).

PEST MANAGEMENT
7. To minimise rabbit damage to plants apply telgrow foliage spray after planting and as required after heavy rain (or) install rabbit protector sleeves around plants.

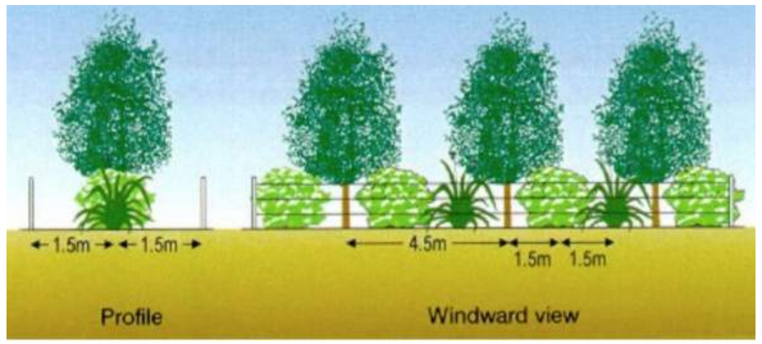
8. Plant pests to be controlled by continual weeding and regularly monitored for a period of three years or until plant specimens become fully sufficiently established.

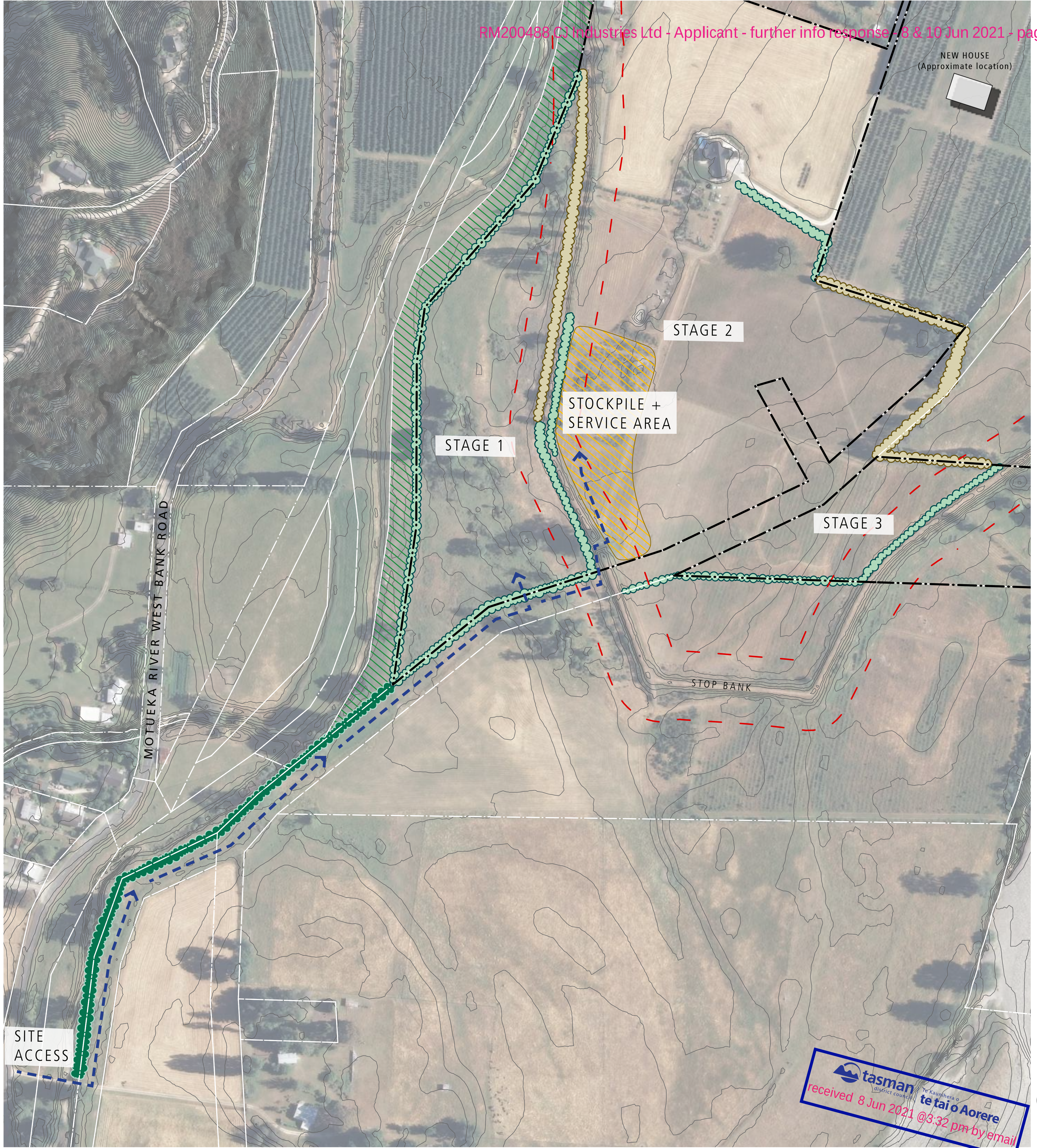
9. All planting next to stock paddocks to be fenced off.

MAINTENANCE
9. General maintenance shall include watering, weed removal, plant trimming, cultivation, insect and disease control, checking stakes and ties, pruning and other accepted horticultural operations to ensure normal and healthy plant establishment and growth.

10. Any plants that fail are to be replaced and planted during the next available planting season as defined above.

SHELTERBELT FORMATION TO BE USED





canopy

PEACH ISLAND

LUC & Soil Survey

Peach Island Road Motueka Valley

CJ Industries

May 2021

LandVision Ltd

Whanganui

1 Summary

A soil and LUC survey was undertaken on Peach Island, Motueka Valley at 1:6000 scale for the purpose of consenting for gravel extraction. The total area mapped was 9.98 ha.

To add certainty to the survey an EM (electromagnetic) sensor was run over the survey area sampling about 2000 points per hectare at two depths - 1.5m and 0.5m. The results from this were used to determine where soil pits or auger holes were investigated.

Six dominant soil types were recorded on the property and these were formed from alluvium derived from greywacke sands, gravels and finer material. Some soil types were more dominant than others and some were derivatives of others. In general those soils formed on gravels it was the depth to the gravels that differentiated them. This depth also differentiated the LUC unit present.

The LUC classification is based on five inventory factors including rock type, soil type, slope, erosion and vegetation. For this survey slope, erosion and vegetation did not change and were not assessed. In total there were six different LUC units present and these ranged from class III to class VI land. About 36% is class III land, 23% class IV land, 15% class V land and the remaining area class VI land.

Of the 9.98 ha mapped about 7.74 ha occurs inside the stopbank and 2.55 ha outside the stopbank. The area outside the stopbank has the potential for occasional flooding and this limits the landuse opportunities. Only about 2.0 ha of land inside the stopbank is classified as class III land and this has a soil (shallow depth to gravel) limitation that limit the versatility of the land. None of the soils or land should be classified as highly versatile. Some soil or land could be marginally highly productive but the range of crops this applies to is very limited.

2 TABLE OF CONTENTS

3 PURPOSE

CJ Industries want a detailed LUC map of about 11 ha of land up the Motueka Valley for the purpose obtaining resource consent for gravel extraction.

To achieve this LandVision Ltd undertook a LUC/soil survey of the property and for part of the process an EM (electromagnetic) Sensor was used to give more clarity beneath the surface.

4 BACK GROUND INFORMATION

4.1 VERSATILE SOILS AND LAND VS PRODUCTIVE SOILS AND LAND

The terms "soil" and "land" are often misinterpreted and misused interchangeably. There are numerous different definitions and opinions of each of these words but in short soil is only one factor of land.

Both soil and land can then be described as "versatile" and/or "productive". In other areas of New Zealand they are described as "high-class", "high value", "elite" or "fertile". The following sections describe both.

4.1.1 SOIL

Soil is defined by the United States Department of Agriculture (2017) as "a natural body comprised of solids (minerals and organic matter), liquid, and gases that occurs on the land surface, occupies space, and is characterized by one or both of the following: horizons, or layers, that are distinguishable from the initial material as a result of additions, losses, transfers, and transformations of energy and matter or the ability to support rooted plants in a natural environment."

a. Productive Soils

Productive soils have the ability to provide water and nutrients high yields. A soil being productive or not is dependent on the soil properties such as soil texture, structure, soil organic matter, and drainage.

b. Versatile Soils

The best soils in New Zealand are coined to be "versatile" or "high-class". A versatile soil is one that is capable of many uses and has excellent physical properties that needs to be deep, fine-textured, good moisture holding capability, free-draining, loamy, and have organic-rich topsoil. These properties best enable plant roots to take up nutrients, water and oxygen, and get enough support for rapid growth. .

Versatile soils in New Zealand are rare (found in only 5.5% of New Zealand) and are therefore of very high value for food and crop production. These soils should be protected and reserved for agriculture and horticulture use.

Soil can be productive but not necessarily versatile. Soils that are both productive and versatile are of high value or elite soils

4.1.2 LAND

Land is "the entire complex of surface and near surface attributes of the solid portions of the earth surface, which are significant to human activities" (Collins, 2001). It generally includes a wide variety of attributes including soil, ecosystems (both native and exotic) as well as urban settlements.

a. **Productive Land**

Productive land is land which is said have very few to no limitations, whether that be climate, erosion, wetness or soil. This land, even more particularly highly productive land, would be highly fertile and have the potential to produce significant yields of plants and other products.

The productivity of land in New Zealand is loosely based on the Land Use Capability system which is described in the next section. This is different to the land versatility which takes in a wide range of bio-physical, social and economic factors.

b. **Versatile Land**

The term versatile land is not limited to land that has versatile soils but instead it includes a number of different physical and social factors. Versatile land is land "which supports the production and management of a wide range of crops. It is characterised by certain soil and physical characteristics, which have few to no limitations like poor drainage, low soil nutrient status or slope instability. In the agriculture sense versatile land is also characterised by its proximity to services and transport" Chapman (2010).

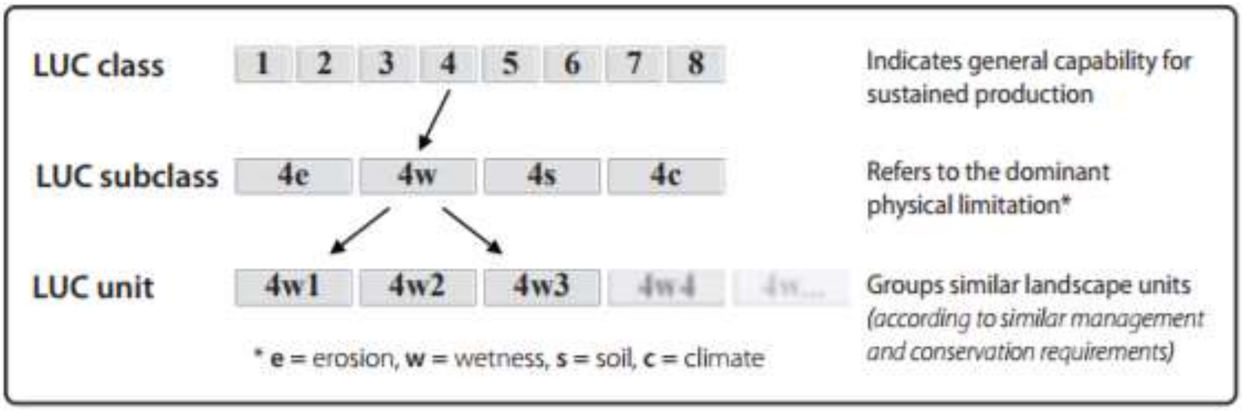
4.2 CLASSIFYING LAND USING THE LAND USE CAPABILITY CLASSIFICATION SYSTEM

New Zealand adopted the land use capability classification system in the mid 1960's for the purpose of soil conservation. Since this time the whole of New Zealand has been mapped at the 1:50,000 scale and the system is commonly used for both regulatory planning by councils and farm planning throughout the country.

The LUC system is comprised of two key components:

1. Land Resource Inventory (LRI): the compilation of five physical factors which include underlying rock type, the soil type, slope, erosion type and severity, and dominant vegetation. These five factors are considered to be critical for land use and management.

2. Land Use Capability: The five LRI factors described above are used to determine the land use capability classification (LUC). There are three components to the LUC system and these are shown in the following figure and described in the sections below.



4.2.1 LUC CLASS

The LUC class system is based on the level of limitation for arable and pastoral use. The classes go from I to VIII where classes I to IV are suitable for arable use (and pastoral or forestry), classes V to VII are suitable for pastoral or forestry use (not arable) and class VIII land is only suited for retirement or protection forestry.

The following diagram shows the landuse suitability with respect to LUC class.

Increasing limitations to use ↓

LUC Class	Arable cropping suitability†	Pastoral grazing suitability	Production forestry suitability	General suitability
1	High	High	High	Multiple use land
2	↓	↓	↓	
3				
4	Low			
5	Unsuitable			Pastoral or forestry land
6				
7		Low	Low	
8		Unsuitable	Unsuitable	Conservation land

Decreasing versatility of use ↓

The definitions of the eight different LUC classes are broadly described below:

Class I land

LUC Class I is the most versatile multiple-use land with **minimal physical limitations for arable use**. It has high suitability for cultivated cropping (many different crop types), berry production, pastoralism, tree crops and production forestry.

Class 1 land is flat or undulating (0-7°), has deep (>90 cm) resilient and easily worked soils, and there is minimal risk of erosion. Soils are characterised as being fine textured (silt loam, or fine sandy loam), well drained, not seriously affected by drought, well supplied with plant nutrients, and responsive to fertilisers. Climate is favourable for the growth of a wide range of cultivated crops, and for pasture or forest, and does not significantly limit yields.

Land which has a slight limiting physical characteristic such as wetness, risk of flooding, or drought can be included in LUC Class I, where that limitation is removable by permanent works. Waterways associated with Class 1 land may have slight streambank erosion.

Class II land

This is very good land with **slight physical limitations to arable use**, readily controlled by management and soil conservation practices.

Class III land

Class III land has **moderate physical limitations to arable use**.

Class IV Land

Class IV land has **severe physical limitations to arable use**.

Class V land

This is high-producing land with physical limitations that make it unsuitable for arable cropping, but only negligible to slight limitations or hazards to pastoral, vineyard, tree crop or production forestry use.

Class VI land

Class VI land is not suitable for arable use, and has slight to moderate physical limitations and hazards under a perennial vegetative cover.

Class VII land

Class 7 land is unsuitable for arable use, and has severe physical limitations or hazards under perennial vegetation.

Class VIII Land

Class 8 land has very severe to extreme physical limitations or hazards which make it unsuitable for arable, pastoral, or commercial forestry use.

Generally the only horticultural crop that breaks these definitions above on LUC classes V to VII is viticulture which can produce very well in very stony soils.

4.2.2 LUC SUBCLASS

The LUC subclass is the subcategory of the LUC class which identifies the main limitation to land use. Four limitations are used in the classification system and include:

1. "**erodibility**" – land susceptible to erosion.
2. "**wetness**" – high water table, slow internal drainage, and/or flooding are main limitations.
3. "**soil**" **–** limitation is within the soil (stoniness, shallow profiles, salinity etc.).
4. "**climate**" – climate is main limitation. Could include: summer drought, high rainfall, high winds etc.

4.2.3 LUC UNIT

The LUC unit groups together areas mapped with similar land inventories (factors) which require the same kind of management; the same kind of conservation treatment; or which are suitable for the same crops. For examples LUC class IIs1 is class 2 land, with a soil limitation, that requires very little management for maximum production.

4.3 MAPPING SCALE

The LUC classification used by the Tasman District Council is based on 1:50,000 scale information. Under LUC mapping protocols a sample or observation should be taken every square cm on the map irrespective of the mapping scale. Hence if the LUC survey is 1:50,000 scale then one square cm on the map represents 25 ha. Therefore the property may or may not have an observation on it considering the land in question is about 11 ha.

The paddock scale mapping, ie 1:7000 scale, there should be an observation approximately every 0.5 ha over the survey area. This is significantly greater than regional scale mapping and is more fit for purpose.

An EM survey undertakes about 2-5,000 readings or observations per hectare. The results dictate where soil profiles should be dug for the soil survey.

5 EM Mapping Process

The EM Sensor consists of a transmitting coil that sends an electrical current into the soil six times per second to two depths (0.5m and 1.5m) and this is reflected back to a receiving coil in the sensor. The reflectance determines the 'apparent electrical conductivity' of the soil and there is a strong relationship between the apparent electrical conductivity and soil texture, soil water and salinity.

As the EM sensor is dragged across the surface behind a quad bike a sub-inch GPS accurately records the position of where the impulse was transmitted along with the apparent electrical conductivity from that impulse.

Over a hectare about 2000 data points for the two different depths were recorded. This raw data is then processed to generate polygons of similar apparent electrical conductivity for the two depths. In conjunction with the elevation data generated from the GPS the EM data from the two depths is then used to determine where physical soil investigations should be undertaken. At these points soil profiles are examined for soil physical properties. It is these soil physical properties that are used for further extrapolation to derive a soils map.

6 Results

6.1 Underlying Geology

The underlying geology across the block varied from alluvial gravels and sands through to finer alluvium material. This material was laid down in the last 500-1000 years as a result of the Motueka River swinging back and forth across the river terrace during flood events. The coarseness of the material deposited would have been dependent on the location of the river channel and flow velocities at the time of deposition.

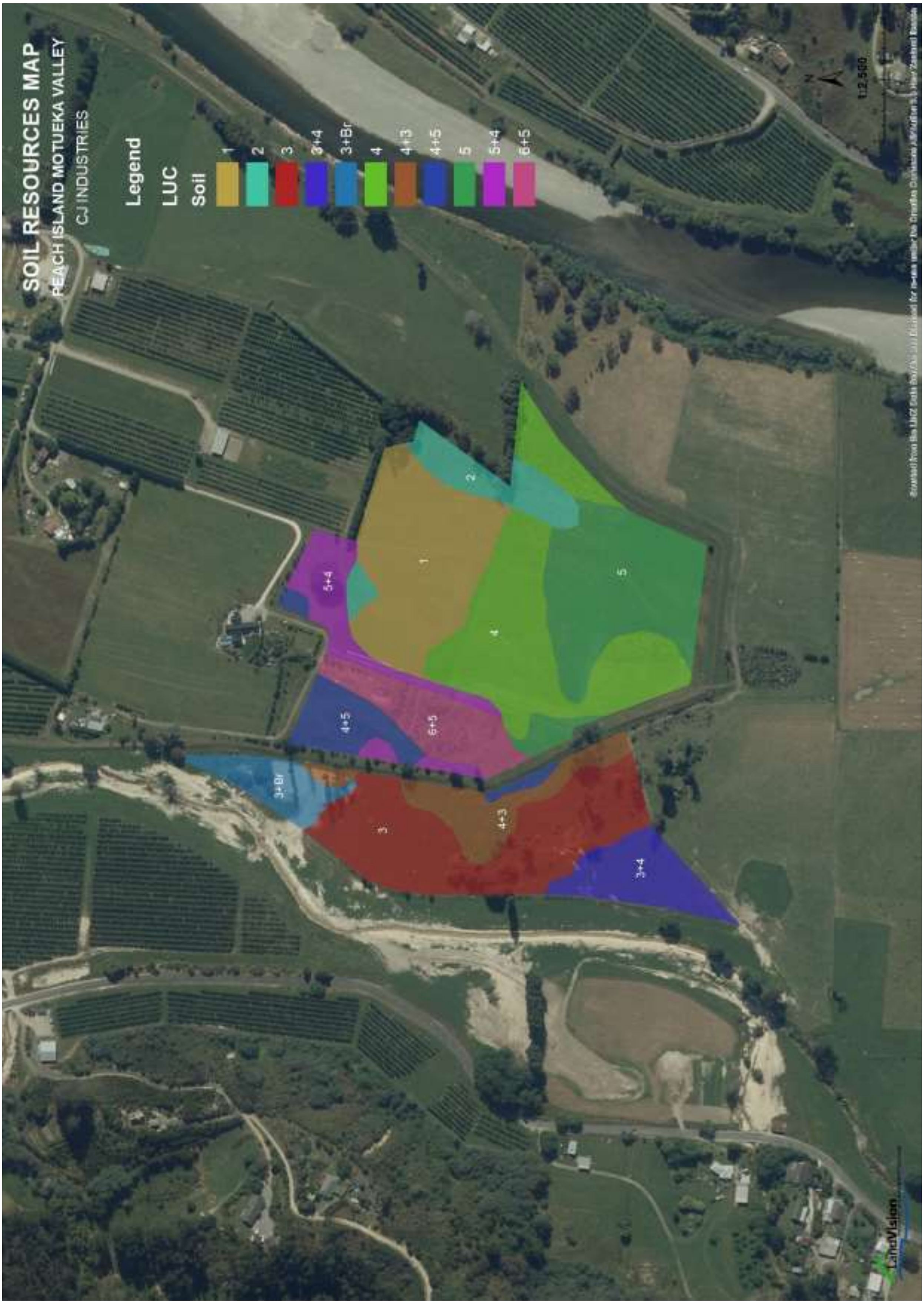
6.2 Soil Resources

A combination of the EM survey (both deep and shallow surveys), surface observations and a multitude of holes or auger sampling were used to derive the soils across the property. Six different soil types were identified and these are described in the following table and their extent is shown on the Soil Resources Map. Some of the soils are variations of the same soil type and the only difference is the depth to the underlying parent material or gravels vs sands.

	**Name**: **Soil 1** **LUC map symbol**: **1** **Parent material**: Alluvium over sands over gravels. **Drainage status**: Well drained. **Soil consistence**: Friable when moist **Degree of topsoil development**: Weakly developed. **Profile description:** 20 cm brown (10YR 4/3) weakly developed nutty sandy loam; on 80 cm dark greyish brown (2.5YR 4/2) weakly developed blocky to structureless sandy loam and becoming a loamy sand with depth; on yellowish brown (10YR 5/4) loose single grain sand.
	**Name: Soil 2** **Soil map symbol: 2** **Parent material:** Alluvial gravels. **Drainage status:** Well drained to excessively well drained. **Soil consistence:** with stones removed, friable when moist, plastic when wet. . **Degree of topsoil development:** Weakly to moderately developed. **Profile description**. 15 cm weakly developed fine nutty crumb silt loam to silty clay loam, friable when moist and plastic when wet. Can be sticky when wet. On 15 cm weakly developed fine nutty crumb sandy silt loam. On alluvial gravels.

	**Name: Soil 3** **LUC map symbol: 3** **Parent material:** Alluvium over gravels. **Drainage status:** Moderately well drained. **Soil consistence:** Friable when moist, plastic when wet. **Degree of topsoil development:** Moderately developed. **Profile description:** 14 cm of moderately developed dark brown (10YR 4/3) moderately to weakly developed fine nutty crumb silt loam, many roots, indistinct boundary; on 18 cm weakly developed dark brown (10YR 4/3) weakly developed fine crumby silt loam, friable, many roots, indistinct boundary; on small to medium gravels and sand.
	**Soil 4** **LUC map symbol**: 4 **Parent material:** Alluvium over alluvial gravels. **Drainage status:** Well drained. **Soil consistence:** Non plastic when moist. **Degree of topsoil** development: Weakly developed. Profile description: 20 cm weakly developed fine granular crumb silt loam with some small round stones (10YR 5/4), over 20+ cm weakly developed fine granular silt with many small stones and rock fragments (10YR 5/4), over gravels.
	**Name .5** **Soil map symbol: 5** **Parent material:** Alluvial gravels**.** **Drainage status:** Moderately well to well drained. **Soil consistence:** Friable when moist, plastic when wet. **Degree of topsoil development:** weakly to moderately developed**.** **Profile description**. 10 cm weakly to moderately developed, fine to medium crumb and nut, friable when moist, plastic when wet, very dark black brown (SO 2a)silt loam with many small to medium gravels. On: weakly developed, fine to medium crumb and nut, friable to loose when moist, non-plastic when wet, dusky strong orange (SO 3d) gravelly silt loam with many small to large gravels. On alluvium and gravels.
	**Name: Soil 6** **LUC Symbol: 6** **Parent material:** Alluvial gravels. **Drainage status:** Well drained. **Soil consistence:** Non plastic when moist. **Degree of topsoil development:** Weakly developed. **Profile description:** 15 cm weakly developed, fine crumb and nut, friable when moist, very dark black brown (SO 2a) sandy silt loam with many small to medium gravels. On 8cm weakly developed, fine to medium crumb and nut, friable to loose when moist, non-plastic when wet, dusky strong orange (SO 3d) gravelly silt loam with many small to large gravels. On gravels.

6.3 SOIL RESOURCE MAP



6.4 LUC CLASSIFICATION

To determine the LUC classification requires the five land resource inventory factors (rock type, soil type, slope, erosion and vegetation) to be mapped.

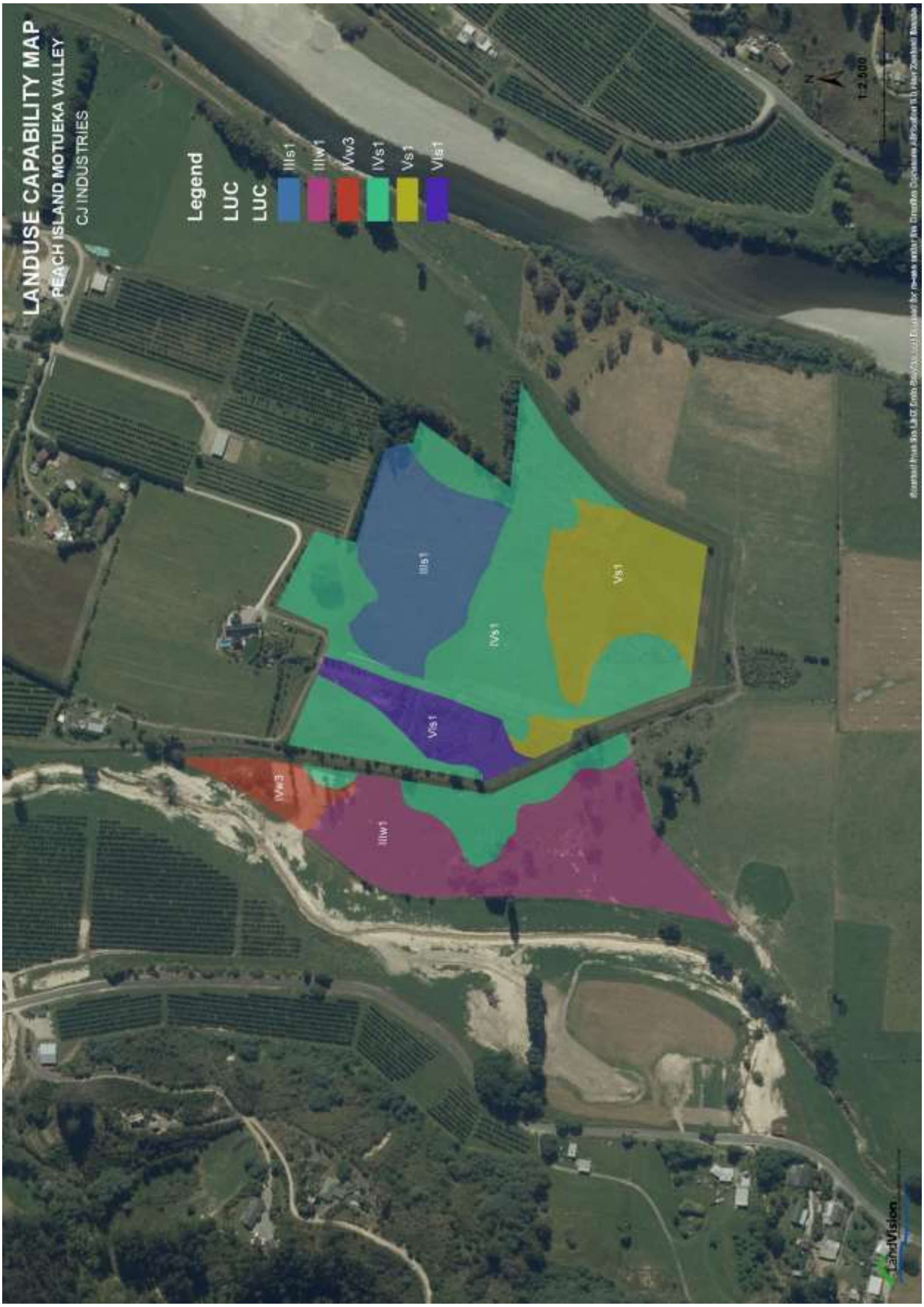
The rock type present is either alluvial gravels or sands. The slope class is generally flat or flat to undulating and the only erosion present is a small amount of deposition in one corner. Vegetation for this survey has no influence on the LUC unit. The only real variation in the five inventory factors is the soil type and in this situation the LUC unit is dependent on whether the soils are formed from gravels, sands or finer alluvium. If it is formed from gravels then the depth to the gravel layer will dictate the LUC class.

The following table shows the LUC units found on the mapping area and their description.

Landuse capability table.

	Description	Area (ha)	Underlying parent material	Soil type	Comments
	**IIIw1** Flat to undulating floodplains and low terraces with moderately deep sandy loam to clay loam textured soils where the depth to the low chroma colours, gleying or mottling is greater than 45cm, and/or a moderately high watertable for part of the year.	2.19	Finer alluvium and alluvial sands.	3, 3+4	The soils are reasonably well developed finer material with good structure but have a moderate wetness limitation during the winter and spring periods. They are prone to pugging and treading damage when wet. The moderate wetness limitation makes this unit class III land.
	**IIIs1** Flat to undulating floodplains with moderately shallow (30-45cm) and stony silt loam or sandy loam textured recent soils in mild moderate rainfall areas.	1.45	Alluvial sands over gravels.	1	Generally well drained soils with gravels below the plough layer. Top soil development is very weak and as a consequence this unit will not handle repeated cultivation. There is the potential for wind erosion under cultivation or if the vegetative cover is removed. There is often a fine to coarse sand horizon (with no structure) at about 25-30 cm over the gravels. The depth to the gravels can vary. The moderate limitations to arable use make this unit a LUC class III unit.
	IVw3 Flat to undulating floodplains and low terraces with moderately deep sandy loam to clay loam textured soils where the depth to the low chroma colours, gleying or mottling is less than 45cm, and/or a moderately high watertable for part of the year.	0.36	Finer alluvium and alluvial sands.	3+Br	Similar to IIIw1 but more prone to flooding and deposition. They are prone to pugging and treading damage by heavy cattle when wet.

	**IVs1** Flat to undulating floodplains, low terraces and fans with moderately shallow (15-30cm) and stony silt loam or sandy loam textured recent soils in mild moderate rainfall areas.	3.89	Alluvial gravels.	2 4 4+5 4+3	The gravels are closer to the surface and can influence the cultivation techniques undertaken. The topsoil is very weakly developed indicating the soil is not suited to repeated cultivation and also prone to wind erosion when the vegetation cover is removed. The stone content and depth is a severe limitation to arable use.
	**Vs1** Flat to gently rolling floodplains and fans with recent silt loam to sandy loam textured soils. The gravels are at or near the surface which makes them unsuitable for cultivation.	1.49	Alluvial gravels.	5	Low natural fertility and prone to drying out during the summer months. Reasonably resistant to pugging and treading damage by heavy cattle and on this property they make an excellent standoff area for heavy cattle.
	**VIs1** Flat to gently rolling floodplains and fans with recent silt loam to sandy loam textured soils with boulders on the surface.	0.6	Alluvial gravels and boulders.	6, 6+5,	Boulders on the surface inhibit cultivation.


LANDUSE CAPABILITY MAP
PEACH ISLAND MOTUEKA VALLEY
CJ INDUSTRIES
Legend
LUC
LUC
IIIs1
IIIw1
IVw3
IVs1
Vs1
VIs1
IIIs1
IVs1
Vs1
VIs1
IVw3
IIIw1
1:2,500
LandVision

7 Discussion Points

1. Distribution of LUC Units

The following table shows the distribution of the LUC units across the area mapped. This is further broken down into the area inside and the area outside the stopbank.

LUC Unit	Area outside the stopbank (ha)	Area inside the stopbank (ha)	Total area (ha)
IIIs1	-	1.45	**1.45**
IIIw1	1.63	0.55	**2.19**
IVs1	0.55	3.33	**3.89**
IVw3	0.36	-	**0.36**
VIs1	-	0.60	**0.60**
Vs1	-	1.49	**1.49**
Total	**2.55**	**7.43**	**9.98**

The table above shows that of the 9.98 ha mapped about 7.74 ha occurs inside the stopbank and 2.55 ha outside the stopbank. The area outside the stopbank has the potential for occasional flooding.

Furthermore this there is only 1.63 and 2.0 ha of class III land that is outside and inside the stopbank respectively. The opportunities for the class III land outside the stopbank are limited due to flooding and the soils are naturally quite wet. The small area of the class III land inside the stopbank significantly limits the land use opportunities for an economic unit.

2. Highly productive soils

Productive soils have the ability to provide water and nutrients high yields. A soil being productive or not is dependent on the soil properties such as soil texture, structure, soil organic matter, and drainage. The soils found on the mapped area could be highly productive for a small handful of crops (arable, vegetable and horticultural) but not enough to be classified as highly productive soils.

3. Highly versatile soils

A versatile soil is one that is capable of many uses and has excellent physical properties that needs to be deep, fine-textured, good moisture holding capability, free-draining, loamy, and have organic-rich topsoil. Under the LUC classification system highly versatile soils occur in LUC classes I and II and some classes III LUC units.

The table above shows that there was no LUC classes I and II land mapped and about 1.45 ha of IIIs1 and 2.19 ha of IIIw1 land. The drainage characteristics of IIIw1 land is not good enough to be classified as highly versatile soil. This drainage limitation restricts the crop types (including arable, vegetable and horticultural crops). The depth to the gravels and the weak soil structures of the soils occurring in IIIs1 land is very marginal at best to be called highly versatile soil.

All other LUC units present on the mapped area do not fall into the category of versatile soils.

4. Highly productive and versatile land

Productive land is land which is said have very few to no limitations, whether that be climate, erosion, wetness or soil. This land, even more particularly highly productive land, would be highly fertile and have the potential to produce significant yields of plants and other products.

The LUC class III land present could be argued as being highly productive for a few crops but the soil properties present mean that the land is not highly versatile to be called 'elite land' that should be reserved only for food production.

8 REFERENCES

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