

4th May 2023

Sonja Perrin
Sonja Perrin Town Planners
18 Marsden Street, Heathcote Valley
CHRISTCHURCH

Dear Sonja,

**APPLICATION FOR RESOURCE CONSENT RMA/2023/597
ADDRESS 130 BOWENVALE AVENUE**

Thank you for your application for resource consent for 35 lot fee simple subdivision on the above site, which we received on 11th April 2023.

I have assessed your proposal and found that the following additional information is required before your application can be considered further:

Planning

1. Please provide an amended subdivision plan, which identifies dimensions of the proposed allotments.

This is to confirm compliance of the allotments' dimensions under Rule 8.6.1

Refer to plans SC-06 with lot dimensions.

2. Are the defined patios areas on Lot 35 going to become decks or terraces? If yes please specify if they will be 800mm over existing ground level.

This is to determine setback and site coverage compliance.

Dwelling is on hold

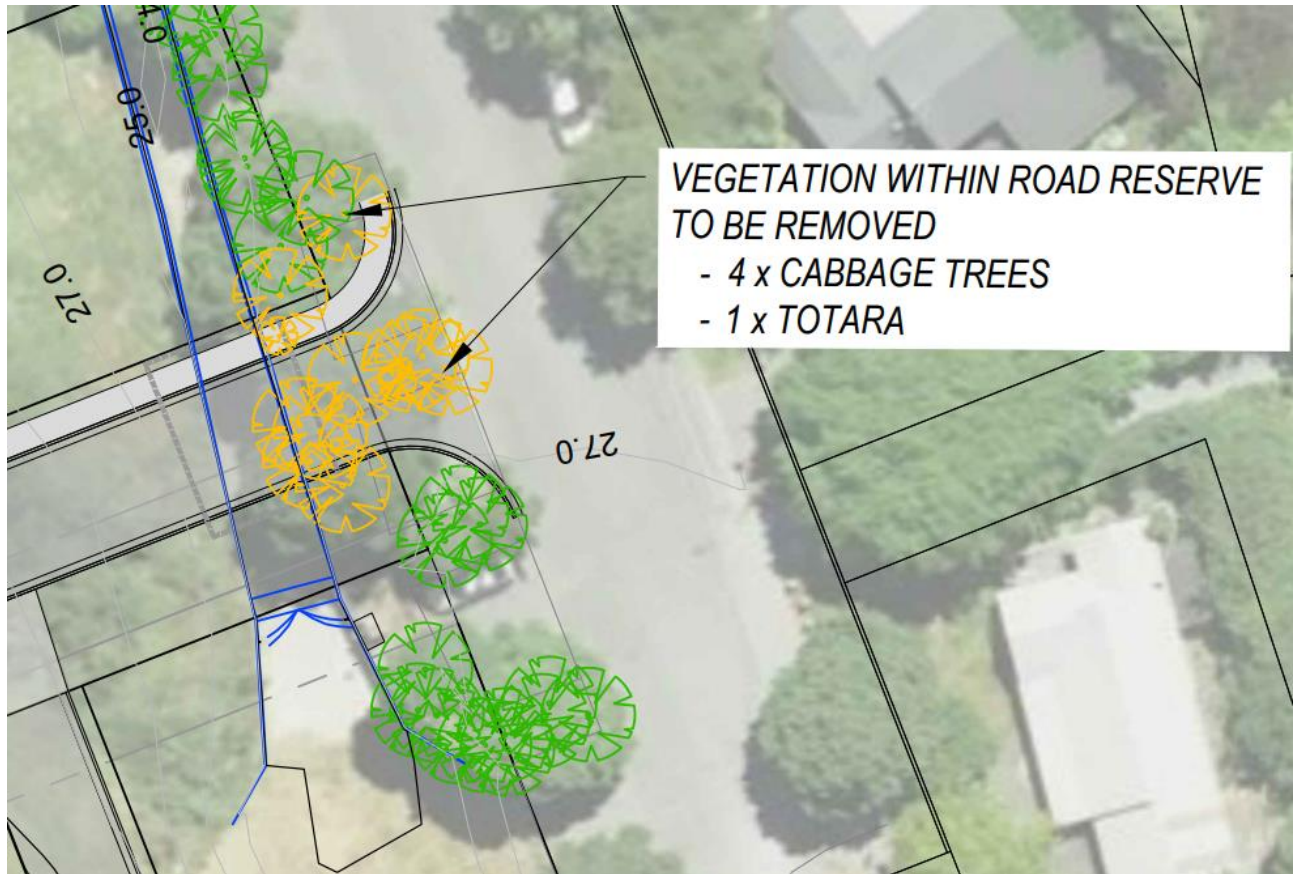
3. Please confirm the proposed fencing heights of Lot 34 along the road boundaries

Dwelling is on hold

4. In the below engineering image it appears more than five street trees are proposed to be removed. Please can this be clarified?



There are only 5 trees within the road reserve as shown on plan EN-110 and as per the Arboricultural report. The remaining trees to be removed are located within the applicant's property and therefore are not street trees. Refer to snippet below.



5. Has the applicant investigated further in terms of the caveat removal?

The developer have investigated the caveat and has an agreement in place with the neighbour. This process will start once resource consent has been obtained.

6. In terms of the residents society agreement proposed, please provide the following clarification;
- Is the document meant to include the following definition "society - *Society means Linwood Ave Residents Society Incorporated or any successor or replacement entity.* This was an error and has since been rectified to read "Bowenvale Ave Residents Incorporated
 - What happens if the society gets dissolved/liquidated or bankrupt (or similar);"
In the unlikely event that the society is dissolved/liquidated or bankrupt, there will be nobody to enforce the society rules. This would not be in the interests of any of the parties (Council or residents) however, which is why it is so unlikely.
 - Is it likely the managing party will be a legal firm whose costs are accounted for annually?
The managing party would be a body corporate management company. The management of the development would be similar to the management of a unit title development – annual meetings, raising levies etc. The costs would be accounted for annually. The obligations of members to pay levies is set out in paragraph 6 of the constitution. The required for members to pay of levies is supported by encumbrance instrument on the title.
 - What are the recommended conditions from the applicant on this application which will make the existence and its retention of the society enforceable by Council?
Refer attached draft Encumbrance document. For reference - CCC Encumbrance Instrument.

Please note this will be reviewed by Council's legal team when the above answers are provided.

Geotechnical and earthworks

7. Please provide the following in terms of the proposed retaining walls/gabion baskets on Lot 34, access lots and adjacent to proposed roads;
- Cross sections of the retaining walls/gabion baskets if these have not already been provided;
 - Location on a site plan of where all retaining walls are to be located;
 - How access to the adjoining lots can occur with the retaining in place. This can be shown in a cross section;
 - How drainage will occur in these areas
 - How will the retaining/gabion baskets interact with the Hill Waterways

This is to understand the effects of retaining walls within the site and whether access can be obtained for certain sites.

As provided per email dated 20/10/23

8. Please confirm whether the levels/contours provided have been prepared by a licenced surveyor?

The existing site levels are a combination of lidar and topographical survey prepared by a licensed surveyor.

9. Please provide a statement of professional opinion on the suitability of subdivision by suitably qualified and experienced Geotechnical Engineer.

The on hold day is backdated to the 21st March 2023, when this was originally requested.

SOPo provided – email dated 20/10/23

10. The geotechnical and earthwork aspects are yet to be reviewed by the subdivision engineer due to workloads. Further questions may be asked once the review has been completed. Please note the application will remain on hold until this matter has been resolved. **Separate RFI has been responded to.**

11. Does the recommended maintenance considerations in s8.4 of the geotech need to be undertaken by a geotechnical engineer? Are these maintenance matters going to be included in the legal maintenance agreement? **As addressed per email dated 20/10/2023**
12. It is likely large amounts of earthworks will be required post subdivision i.e. for establishing residential units on the allotments?

Due to the slope of the site, all future dwellings will require specify design and will require some earthworks. The extent of the earthworks is dependent on the design of the dwelling and if consents are triggered, they will need to be applied for at building consent stage.

Ecology

13. Are the mitigation measures proposed by wildlands being adopted by the applicant? If yes, how are these to occur? How will they be protected into the future?

Yes they are. Please refer to the draft EMP provided by BECA which addresses these items. The EMP includes a a Lizard Management Plan, Avifauna Management Plan, Invertebrate Plan and Restoration Planting Plan. Each plan details how these mitigation measures are being adopted, how they will occur and how they will be protected in the future

Table 5: Potential significance of ecological effects if effective mitigation is implemented as recommended above.

Effect	Level of Effect Without Mitigation	Level of Effect With mitigation
Vegetation clearance (not including scrub pōhuehue vineland)	Less than minor	Net gain

Effect	Level of Effect Without Mitigation	Level of Effect With mitigation
Loss of indigenous lizard habitat (including scrub pōhuehue vineland).	More than minor	More than minor
Disturbance (including death and injury) and harm to indigenous birds.	More than minor	Less than minor
Loss of indigenous bird habitat	Minor	Minor
Disturbance (including death and injury) and harm to lizards.	More than minor	Minor
Disturbance during bridge construction	Minor	Less than minor
Breeding failure/displacement to lizards.	Minor	Less than minor
Increased predation to lizards.	Minor	Less than minor
Fragmentation of lizard habitats.	More than minor	Minor
Loss of invertebrate habitats.	Minor	Less than minor
Mortality to terrestrial invertebrates during earthworks	More than minor	Less than minor

14. Please provide detailed landscaping plans which clearly identify;
- The mitigations as outlined by the wildlands report (if proposed);
 - Where replacement trees are proposed to be located (approximately)

Refer amended Landscape Plan. Rev D

15. In the Wildlands report, has *Carex virgata* been misidentified as *Carex diandra*?

Wildlands have recorded Carex diandra on the site, which would be significant find because this species is not known to occur in the Banks Ecological Region.

Refer Ecology RFI Response Letter

16. Within the water body setbacks, please quantify:
- The total area of impervious surfaces proposed (including roads, building, retaining walls etc)
 - The total length of the waterways being piped.
 - Please quantify how the development will mitigate effects of the above, with respect to the relevant objectives and policies within Section 6.6 of the District Plan.

17. Please clarify the degree of stormwater treatment prior to discharge into Sibleys Drain. This includes providing details of pipe sections and initial sediment filtration from the site.

A high level of treatment is proposed in accordance with CCC requirements due to the receiving environment. The proposed treatment devices will consist of proprietary devices, first defense and filter system to achieve the required contamination removal prior to discharge. The details will be determined at the detailed engineering stage.

18. Please clarify whether the upstream area of Sibleys Drain will be planted out as part of the development?

Sibleys Drain will be planted up to our boundary as per the supplied Landscape Plan Rev D.

Further comment from the specialists will be provided in due course in relation to this. Note that the planting palette will need to be confirmed with Council terrestrial ecologists and landscape architects prior to plans being finalised.

19. Please provide a lizard relocation/release plan for this application

While this information will be provided with the DOC permit, due to the activity proposed and density of lizards identified on site, this needs to be assessed as part of this application.

Refer Ecology RFI Response Letter

20. Please confirm whether a like for like replacement of the indigenous vegetation is going to occur on the site.

Scrub pōhuehue vineland present on site will be providing valuable habitat for indigenous lizard species. Pōhuehue is the number one plant for attracting Lepidoptera (moths and butterflies; nationwide 80+ species feed on the foliage, in the stems, mine the leaves or feed on the flowers and fruit: Brian Patrick, Wildland Ecologist, Christchurch) which provides a large food source for locally occurring fauna. If areas of lizard habitat (including scrub and vineland) are to be destroyed/damaged during construction, compensation actions will also be required to offset these actions (compensation should be recorded in the sites LMP and be reviewed by DOC).

Refer Ecology RFI Response Letter

21. Please further assessment on the presence/absence of Jewelled geckos and the impact the subdivision could have on this species.

*Jewelled geckos (*Naultinus gemmeus*) are an arboreal (tree dwelling) species of lizard found here in Canterbury. The assessment of ecological effects report stipulates that scrub habitat at this site has been regenerating on site since c. 1980 (20+ years ago), and that however no visual survey for this species has been undertaken. Jewelled geckos have recently (2017) been sighted within the Bowenvale area (≤ 1 km from the project footprint). A survey by a herpetologist with expertise in location arboreal geckos should have been undertaken.*

Refer Ecology RFI Response Letter

22. If one has been prepared, please provide the lizard management plan for the site.

The council herpetologist has noted without the LMP, it is difficult to determine the effects on lizards. The herpetologists makes the following comments “*This report states that “The proposed development will result in the potential local extirpation or fragmentation of a moderately sized peri-urban lizard population” – however later in the report it is also stated that “Site development with the implementation of a LMP would result in a minor adverse effect on lizards” as there is no LMP provided this statement cannot be assessed. Causing a potential local extinction (through the actions of construction and salvage/relocation) of a currently fragmented population of lizards is more than minor (in my opinion), however as previously mentioned I do not have the LMP so cannot weigh up the compensation/mitigation actions against the number of lizards (individuals and number of different species) that will require relocation work.*”

Refer Ecology RFI Response Letter

Transport

23. Please provide tracking for 8 metre and 10.3 metre long rigid truck on the proposed roads?

Tracking is currently being prepared and will be provided once available.

24. For the access lots, where will be bins be proposed to be collected from?

Bin locations are limited down the ROW's. Private collection of bins will be arranged with a private contractor.

25. Please demonstrate that 85th percentile manoeuvring can occur on the access lots.

Addressed in the attached TSA (Item 2.4).- Reference - rep bowenvale preliminary design

26. Is the access lot easement compliant with queuing spaces?

Yes, the queuing length is over 6m in accordance with Table 7.5.8.1. There is also additional queuing space within the road reserve due to the boundary setback from the vehicle crossing.

27. Please identify the gradients of the proposed roads and access lots?

Refer to longsection plan 1036 EN-201 Rev A submitted with the application.

Cultural

28. The activity is a non-complying activity therefore it is considered an assessment of the matters of discretion in Rule 9.5.5 (sub-chapter 9.5 Ngāi Tahu Values) of the District Plan is required. I note that your application does not address these provisions. In order to address the matters of discretion, which among other things, requires an assessment of any effects on Ngāi Tahu cultural values, it will be necessary to consult with the relevant papatipu rūnanga, i.e. the rūnanga having guardianship (kaitiaki) for the area within which the site is located.

Assessment to be provided

Policy 9.5.2.2.5 (Engagement with Rūnanga) stipulates that where an applicant has not engaged with the relevant rūnanga, the Council will consult with them. I have engaged with the local Rūnanga on behalf of the applicant. Please note that as the Council consults on your behalf, the costs are currently borne by the Council as part of an agreement with MKT. The application will remain on hold until this matter is resolved.

Request that the application be referred back to MKT with the amended application and response to RFIs and when assessment of provided.

Stormwater

29. Please provide analysis of flows that the drains/pipes are expected to carry as part of this development.

Refer to preliminary assessment of the existing overland flow paths and calculation of minimum pipe sizes. The culvert sizes are a minimum and will likely be upsized to provide additional flow capacity.

30. Is a debris rack upstream of the upper culvert grills required as part of the stormwater infrastructure on the site?

Debris racks upstream of the culvert inlets will assist in reducing the likely of blockage at the inlet and frequency of maintenance so we recommend these are incorporated into the design. Details to be agreed with CCC at detailed design stage.

31. Please provide a comprehensive analysis of the stormwater mitigation proposed and the

effect on the Heathcote River Floodplain. This should include hydraulic/hydrological modelling to compare pre and post development flows from the site for a selection of storms up to the 50 year, 27 hour storm (critical for the lower Heathcote)

We have completed preliminary calculations of the proposed increase in peak flows and volume as a result of the development for the 2, 20 and 50 year ARI storms – refer to enclosed Stormwater Runoff Calculations.

The increase in impervious area (Road and ROW's) for the development is 4,250m². The future dwellings will be mitigated back to pre-development rates by implementing storage tanks on each lot and therefore the lots have been modelled with a runoff coefficient of 0.3.

The peak flow increase is 51.32l/s for the 50-year ARI with a 10-minute storm duration. Based on a 27 hour storm the peak flow increase is 4.96l/s based on a rainfall intensity of 7mm/hr (HIRDS V4 RCP8.5).

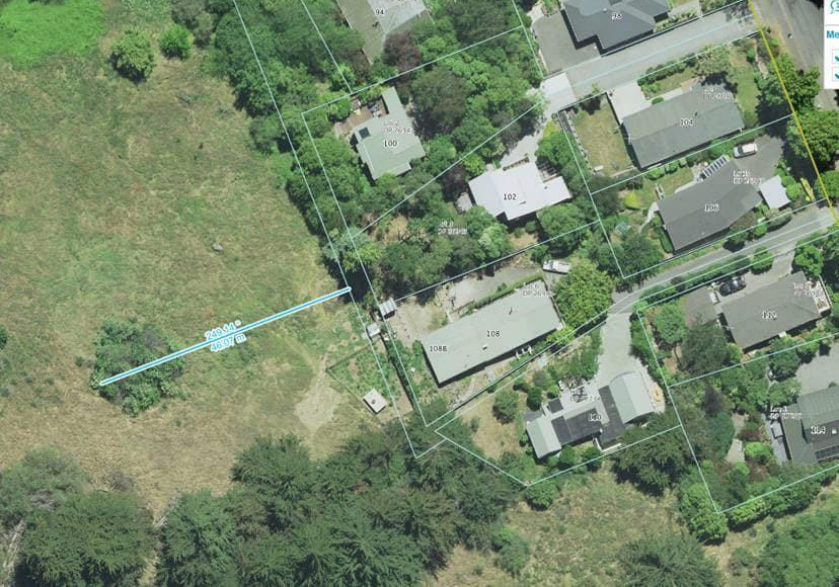
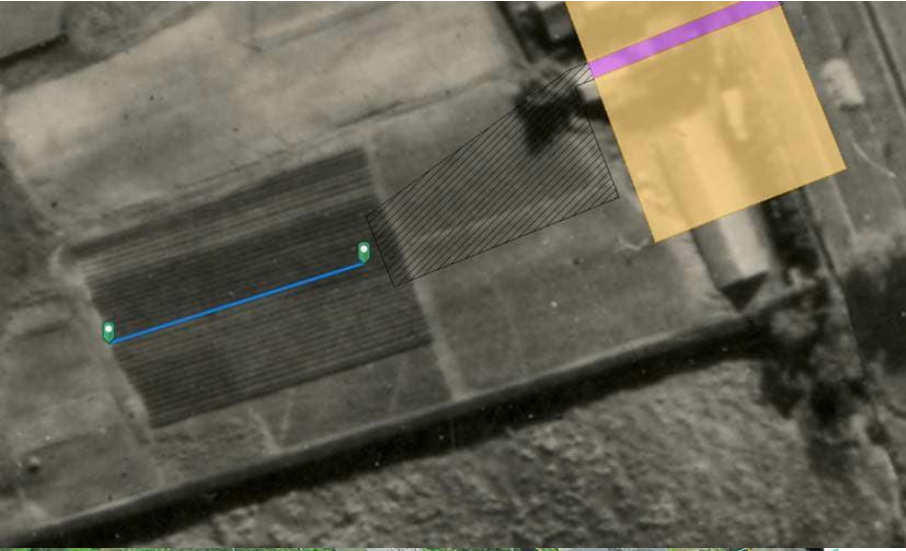
Due to the size of the contributing catchment approx. 340 hectares, the increase in flows and volume generated from an additional 4,250m² of impervious area (0.125% of the total catchment) will have minimal effect on flood levels.

Environmental Health

32. Aerial photos from 1945-1949 have been reviewed as part of the environmental health officers assessment. It appears that part of a market garden is located within the application site. Please can a suitably qualified and experienced practitioner further investigate this area?

Attached DSI.

Resource consent is required as a Restricted Discretionary Activity under the NES.



Comments and recommendations – not part of the formal RFI

I will be undertaking a site visit in the next few weeks. I will be in touch about the site visit shortly.

I have received some comments from three waters about the waterways and stormwater. I have summarised these comments below:

Waterways

- The current setback proposed from of the Hill waterway is not accepted by the specialists. It would be optimal for the compliant setback to apply (20m total area measured from the centreline of the waterway to 10m out on both sides), however a further discussion is recommended on this matter;
- The piping of the hill waterway from the proposed road within the development site is not supported due to the steepness and terrain of the area; **The subdivision design has been amended to retain the two southern hill waterways and only pipe where required under the road and ROW. The lower section of Sibleys Branch drain No. 15 cannot be retained due to the alignment being at the location of the existing legal access to the neighbouring properties and proposed future road.**

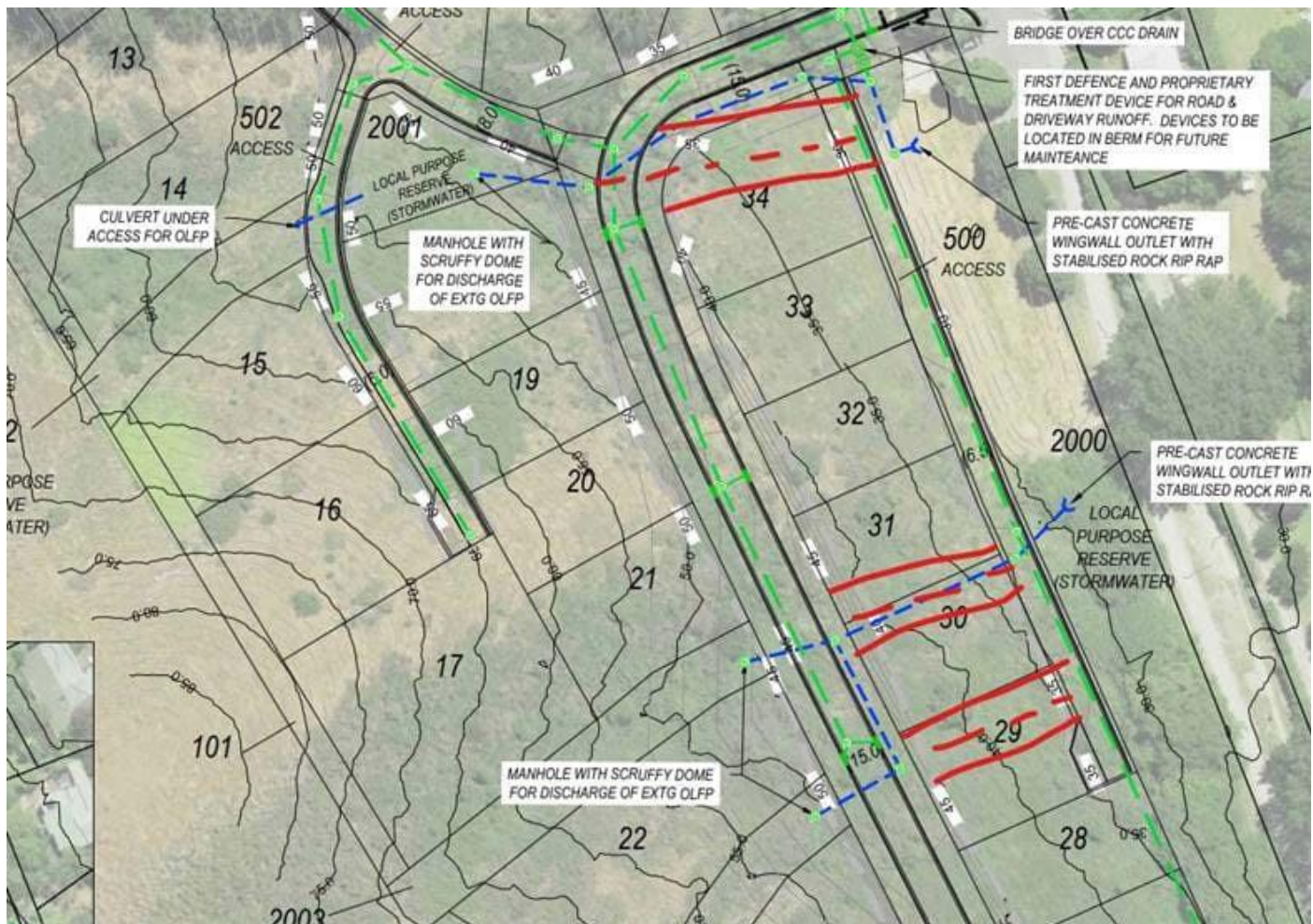
The total setback for any dwelling is 10m either side of the waterway.

- While the planting palette proposed is acceptable, a 2m riparian buffer is not an adequate outcome it is recommended that a 4m wide planting buffer is proposed for the Hill waterways. This is due to the increase of impervious surfaces occurring through the proposed development. Although the tributaries of Sibleys Drain (excluding Sibley's drain) are ephemeral, native plantings within the setback can reduce soil erosion, reduce downstream flood risk through hydrological buffering, and create ecological corridors (per Policy 6.6.2.1.2 a. i). In addition, Policy 6.6.2.1.2 a. vi. b. recognises that Hill waterway setbacks have the function of maintaining or enhancing habitat for terrestrial and aquatic animals and plants.
4m accepted

Stormwater

- It is considered the Lots fronting Sibleys Drain can be adequately protected from flooding;
- It is preferred that the drain within Lot 35 remains in private ownership with an easement in gross over the drain. **As shown on the subdivision plan.**
- The applicant is proposing to get the three natural gulleys into a pipe system and direct those under roads, through private property, and into Sibleys Drain. The applicant has not provided any analysis of the flows that these drains could be expected to carry, but their catchments are significant (Sibleys Drain Branch No. 15 is 770m long to the top of the spur). In general WWDG Chapter 7 provides guidance for hill waterways:
 - *Many hillside waterways discharge into pipe systems upon arriving at the valley floor. Inlets at this point are susceptible to debris related blockage, leading to downstream property flooding and damage.*
 - *Discharge of hill waterways into piped systems is undesirable; it is preferable that flow be kept in an open waterway*
- The risk of blockages causing significant flows onto the roading network (and potentially into private property) needs to be considered more carefully. The Council officer's recommendation is that the gulleys are kept as open waterways for their entire length through the application site, and that culverts (or bridges) be significantly oversized and fitted with large grates (inlet only) to intercept debris. The applicant should also consider whether a debris rack upstream of the upper culvert grills is required (an engineering matter). Guidance is that grill areas should be at least 20x the culvert cross section.

Refer to OLFP assessment and amended subdivision layout to retain as much of the drains as possible. We agree with the requirement for debris rack upstream of the culvert inlets.



- The application discusses the use of rain tanks for stormwater retention, which is what was recommended in the pre-app, mainly because storing water on the hills presents significant issues and risks. They have referred to the Council's Onsite Stormwater Management Guide which really only applies to sites up to 5,000m². The applicant needs to present a comprehensive analysis of the mitigation proposed so that we can understand effects on the Heathcote River floodplain. They should undertake some hydraulic/hydrological modelling to compare pre- and post-development flows from the site for a selection of storms up to the 50-year, 27-hour storm (critical for the lower Heathcote). Council officers need to be able to quantify the effects of extra discharges. **Refer to preliminary stormwater calculations dealing the increase in peak flows and volumes.**
- The applicant is proposing retaining walls along Lot 2000. These need to be located 100% within the ROW and not on Council reserve, as they will be privately maintained. **The wall will be within the ROW for private ownership and maintenance.**
- Council officers are further considering the re-direction of the northern gully flow discharge upstream of the weir and whether it will be required to be discharged downstream. Further comment will be provided at a later date

Please note that your application will be placed on hold until the all of the requested information has been received.

Please respond in writing within 15 working days of the date of this letter (i.e. by 25th May 2023) with one of the following:

- (a) The information requested above; or
- (b) Confirmation that you agree to provide the information, and the date by which you intend to provide it; or
- (c) Advice that you refuse to provide the requested information.

The Resource Management Act requires the Council to **publicly notify** your application if you do not provide the requested information before the date mentioned above (or an alternative date agreed with the Council), or if you refuse to provide the information. It is therefore important that you contact me promptly to discuss an alternative timeframe if you are unable to provide the information within 15 working days of the date of this letter.

The provision of the further information requested above may reveal the need for you to obtain written approvals from affected parties in order for the application to be processed on a non-notified basis. If that is the case, I will contact you again after I have received the information to confirm which, if any, written approvals will be required.

Please also note that if the provision of the information requested above raises any additional areas of uncertainty or matters requiring further clarification, your application will remain on hold until sufficient information has been provided to enable processing to continue.

If you are submitting amended plans as part of the further information requirements for this resource consent and you also have a current building consent application lodged with the Council, the amended plans should also be forwarded to the relevant building consent officer.

If you have any queries regarding this letter or your application please contact me.

Yours sincerely



Rachel Cottam
Senior Planner
04/05/2023 01:03 pm

Form 18

Encumbrance instrument

(Section 100 Land Transfer Act 2017)

Land registration district

Canterbury

Record of Title (unique identifier)	All/part	Area/description of part
[] to [] inclusive	All	

Encumbrancer *Surname(s) must be underlined.*

Bowenvale GCO Limited

Encumbrancee *Surname(s) must be underlined.*

Christchurch City Council

Estate or interest to be encumbered *Insert, eg, fee simple, leasehold in lease number, etc.*

Fee Simple

Encumbrance memorandum number

N/A

Nature of security *State whether sum of money, annuity, or rentcharge, and amount.*

\$2,000.00 (two thousand dollars) per annum.

Operative clause *Delete words in [], as appropriate.*

The **Encumbrancer encumbers for the benefit of the Encumbrancee** the land in the above record of title(s) **with** the above sum of money, annuity, or rentcharge to be raised and paid in accordance with the terms set out in the Annexure Schedule(s) **and** so as to incorporate in this encumbrance the terms and other provisions set out in the Annexure Schedule(s) for the better securing to the Encumbrancee the payment(s) secured by this encumbrance, and compliance by the Encumbrancer with the terms of this encumbrance.

Annexure Schedule 1

Terms

Continue on additional Annexure Schedule(s) if required.

1	Length of term	999 years commencing on the date of registration of this instrument
2	Payment date(s)	See Annexure Schedule 2
3	Rate(s) of interest	See Annexure Schedule 2
4	Event(s) in which the sum, annuity, or rentcharge becomes payable:	See Annexure Schedule 2
5	Event(s) in which the sum, annuity, or rentcharge ceases to be payable:	See Annexure Schedule 2

Covenants and conditions

Continue on additional Annexure Schedule(s) if required.

See Annexure Schedule 2

Modification of statutory provisions

Continue in additional Annexure Schedule(s) if required.

See Annexure Schedule 2

Annexure Schedule 2 *Continue in additional Annexure Schedule(s) if required.*

Background

- A. The Encumbrancer is the registered owner of the land comprised in the Records of Title described above (the "Land").
- B. The Encumbrancer has developed the Land and has established a residents' association for the purpose of owning and administering an access lot, rockfall protection lot and other common areas being the land comprised in Record of Title XXX being Lot XXX on Deposited Plan XXX to be utilised by the Land (the "Access and Rockfall Lots"). The rockfall protection is a requirement of the Encumbrancer under the resource consent for the subdivision of the Land.
- C. The registered owner from time to time of each lot described herein ("Lot") comprising the Land is required to become and, for so long as they continue to be the registered owner of a Lot, remain a member of the residents' association and abide by the constitution of the residents' association ("Constitution").
- D. The Encumbrancer has agreed to encumber each Lot severally for the better performance of the obligations of the registered owner from time to time of a Lot to the Encumbrancee.

Covenants

1. The Encumbrancer hereby encumbers the Land and each Lot severally for the benefit of the Encumbrancee for the Term with an annual rent charge in respect of each Lot being the greater of:
 - (a) \$2,000.00 plus GST per annum; and
 - (b) Three times the amount of the Member's Proportion of the Operating Expenses for the relevant Expense Year (as defined in the Constitution of the Encumbrancee) plus GST applicable to that Lot.
2. The Encumbrancer covenants for itself and its successors in title with the Encumbrancee during the Term

of this Encumbrance that upon becoming the registered owner of a Lot the Encumbrancer shall join as a member of the Encumbrancee, and remain a member while owing the Lot, and fulfil and continue to fulfil the obligations of a member as set out in the Constitution of the Encumbrancee (including, if required by the Encumbrancee, ensuring that any transferee of a Lot executes a Deed of Covenant in favour of the Encumbrancee agreeing to be bound by the Constitution as a member of the residents' association).

3. Notwithstanding anything contained in clause 1 of this Encumbrance, for so long as the owner of a Lot fully complies with the obligations of a member pursuant to the Constitution, the rent charge reserved by this Encumbrance shall not apply to that Lot.

Encumbrance Consent

4. The Encumbrancee hereby consents to the registration of any of the following instruments executed by the Encumbrancer in respect of the Lot:
- (a) The creation, variation or surrender of an easement (sections 109(3) and 112(4) of the Land Transfer Act 2017);
 - (b) The variation of a mortgage instrument or priority of mortgages (section 101(4) of the Land Transfer Act 2017);
 - (c) The registration of a lease, a lease variation instrument or a surrender of a lease (sections 91(4) and 94(4) of the Land Transfer Act 2017); and
 - (d) The disposal of a licence or shares to which the licence relates (sections 130(1) and 130(2) of the Land Transfer Act 2017). This consent shall be deemed to be the consent of the mortgagee (which term includes the Encumbrancee) as specified in the Land Transfer Act 2017, to the registration of a particular instrument specified in sub-paragraphs (a) to (c) above.

Implied Terms

5. Without prejudice to the Encumbrancee's rights of action at common law as rent charger or Encumbrancee, and with the exceptions of sections 203, 204, 288, 289 and 302 of the Property Law Act 2007 and section 208 of the Land Transfer Act 2017, none of the rights, powers, remedies and implied covenants provided pursuant to the Property Law Act 2007 and the Land Transfer Act 2017 shall apply to this Encumbrance.
6. References to the Encumbrancer shall mean the initial encumbrancer named in this instrument and its successors in title to the land, and the terms of this Encumbrance shall bind the Encumbrancer only for as long as the Encumbrancer is the registered owner of the Land.

GCO Group
Floor 26, 188 Quay Street,
Auckland Central,
Auckland, 1010,
New Zealand

20 October 2023

Attention: Cameron McCarthy

Dear Cameron

Ecology RFI Response Letter

15. In the Wildlands report, has *Carex virgata* been misidentified as *Carex diandra*?

*Wildlands have recorded *Carex diandra* on the site, which would be significant find because this species is not known to occur in the Banks Ecological Region.*

A site visit was undertaken on 6 October 2023 and a Beca ecologist was not able to detect any *Carex diandra* plants along the stream (within Vegetation Type 2 - Crack Willow Forest) as noted by Wildlands within the AEE. However, several *Carex secta* was observed at a location within the local purpose stormwater reserve near a bridge. There appear to be no site works planned in the stormwater reserves, where the *Carex* plants are located in, and thus no local impact by the project on *Carex sp.* Without exact location of the *C. diandra* provided in the Wildlands report, it is difficult to determine whether *C. diandra* is present with confidence.



19. Please provide a lizard relocation/release plan for this application

While this information will be provided with the DOC permit, due to the activity proposed and density of lizards identified on site, this needs to be assessed as part of this application.

A lizard management plan (LMP) detailing lizard relocation/release plans has been prepared and forms Section 2 of the Ecological Management Plan attached. This LMP follows the nine principles of lizard salvage prepared by the Department of Conservation in 2019.

A project-specific Wildlife Act Authority from the Department of Conservation will also be applied for, to authorize the relocation of lizards from sites of impact to alternate sites.

20. Please confirm whether a like for like replacement of the indigenous vegetation is going to occur on the site.

Scrub pōhuehue vineland present on site will be providing valuable habitat for indigenous lizard species. Pōhuehue is the number one plant for attracting Lepidoptera (moths and butterflies; nationwide 80+ species feed on the foliage, in the stems, mine the leaves or feed on the flowers and fruit: Brian Patrick, Wildland Ecologist, Christchurch) which provides a large food source for locally occurring fauna. If areas of lizard habitat (including scrub and vineland) are to be destroyed/damaged during construction, compensation actions will also be required to offset these actions (compensation should be recorded in the sites LMP and be reviewed by DOC).

Indigenous vegetation that provides habitat for native lizards and invertebrates will be replanted on Lot 100 post-works. This includes Scrub pōhuehue vineland, as well as other plant species (mix of grasses, tussocks, and divaricating shrubs) that align with the native plant communities of the Port Hills and provide good fauna habitat.

Details of the indigenous vegetation planting (including location and extent, and species selection) are outlined in the Restoration Planting Plan which forms Section 5 of the Ecological Management Plan.

21. Please further assessment on the presence/absence of Jewelled geckos and the impact the subdivision could have on this species.

*Jewelled geckos (*Naultinus gemmeus*) are an arboreal (tree dwelling) species of lizard found here in Canterbury. The assessment of ecological effects report stipulates that scrub habitat at this site has been regenerating on site since c. 1980 (20+ years ago), and that however no visual survey for this species has been undertaken. Jewelled geckos have recently (2017) been sighted within the Bowenvale area (≤1 km from the project footprint). A survey by a herpetologist with expertise in location arboreal geckos should have been undertaken.*

Trent Bell, Senior Ecologist (Herpetology) at Beca, undertook a jewelled gecko survey using visual encounter searches (VES) and a DJI Mavic 3 Enterprise drone with 4K quality video footage. Recent advances in *Naultinus* spp. survey methodologies indicate that drones are highly effective for the detection of jewelled gecko (Knox, 2023 unpublished data and pers. comm).

Scrub pōhuehue, large-leaved pōhuehue scrub/vineland, and Japanese honeysuckle vineland were systematically surveyed twice for basking jewelled geckos on 5 October and 6 October during optimal weather and temperature conditions (with flights during the morning and afternoon outside of the peak heat of the day). Drone flights were operated at 25 – 26 m off the ground with care taken to avoid shadow casting from the sun or blowdown. The drone was directed at heights and angles relative to sun position where basking gecko emergence was likely. The camera was operated at 10 – 20× zoom with constant visual calibration of environment cues and searching for visual anomalies that may represent geckos. Post-survey review of the video footage was also undertaken. This was followed up by visual surveys in accessible sections of the habitat. No geckos were detected and therefore no further assessment of adverse effects is needed.

The most feasible explanation, given the presence of jewelled geckos elsewhere in the Bowenvale area, is that vegetation at the site was previously unsuitable and isolated from known local populations. This would have prevented any jewelled gecko from moving into the site despite the vegetation having since regenerated into more suitable gecko habitat.

However, a precautionary approach should still be adopted as jewelled geckos are At Risk - Declining and survey effort was constrained both time-wise and by the dense vegetation. As such, the LMP will include incidental discovery protocols for jewelled gecko and recommendations on suitable relocation and post-relocation management.

22. If one has been prepared, please provide the lizard management plan for the site.

The council herpetologist has noted without the LMP, it is difficult to determine the effects on lizards. The herpetologists makes the following comments "This report states that "The proposed development will result in the potential local extirpation or fragmentation of a moderately sized peri-urban lizard population" – however later in the report it is also stated that "Site development with the implementation of a LMP would result in a minor adverse effect on lizards" as there is no LMP provided this statement cannot be assessed. Causing a potential local extinction (through the actions of construction and salvage/relocation) of a currently fragmented population of lizards is more than minor (in my opinion), however as previously mentioned I do not have the LMP so cannot weigh up the compensation/mitigation actions against the number of lizards (individuals and number of different species) that will require relocation work."

A lizard management plan has been prepared and forms Section 2 of the Ecological Management Plan attached.

Yours sincerely,



Trent Bell
Senior Associate Ecologist

on behalf of
Beca Limited

Email: trent.bell@beca.com



Sarah Busbridge
Ecologist

on behalf of
Beca Limited

Phone Number: 021964783
Email: Sarah.Busbridge@beca.com

NOTES:

1. SCHEME PLAN ONLY, AREAS & DIMENSIONS ARE APPROXIMATE & SUBJECT TO FINAL SURVEY.
2. ADDITIONAL EASEMENTS FOR PUBLIC INFRASTRUCTURE WILL BE REQUIRED. LOCATION TO BE CONFIRMED AT DETAILED ENGINEERING STAGE.

BUILDING PLATFORM
 BDY OFFSET - 4m (FRONT) & 1.8m (SIDE & REAR)

- 1 STAGE NUMBER
--- WATERWAY TO BE RETAINED

STAGING:

- | | |
|---|--|
| 1 | Lots 1, 29-35, 500, 2000, 2005, 2006 & Part 1000 |
| 2 | Lots 2-13, 501 & Part 100 |
| 3 | Lots 14-18, Part 100, 101, 502, 2001 & 2002 |
| 4 | Lots 19-28, 102, 103, Part 1000, 2003 & 2004 |

MEMORANDUM OF EASEMENTS

Nature	Burdened Land (Servient)		Benefited Land (Dominant)
	Lot No.	Shown	
Right of Way & All Services	500	A	29-34
	501	B	3-21
	502	C	14-21
	503	D	4-13
Right for Access & Maintenance	2002	F	1-35
	2003	I	1-35
	2004	J	1-35
	100	G	1-35
	101	H	1-35
	102	K	1-35
	103	L	1-35

SCHEDULE OF EASEMENTS IN GROSS

Nature	Burdened Land (Servient)		Grantee
	Lot No.	Shown	
Right to Drain Water	35	E	Christchurch City Council

REV	DATE	REVISION DETAILS	ISSUED
N	16/10/23	LOTS 19-21 ROW EASEMENT	TL
M	06/09/23	WATERWAYS RETAINED	TL
L	23/02/23	BUILDING PLATFORMS	TL
K	1/02/23	TURNING HEADS JOALS	TL
J	17/01/23	STAGING ADDED	TL



CLIENT

BOWENVALE GCO LTD

PROJECT

130 BOWENVALE AVE

DRAWING TITLE

PROPOSED SUBDIVISION OF PARTS
LOT 2 DP 33462

STATUS

FOR INFORMATION

SCALE

1:750

SIZE

A1

PROJECT

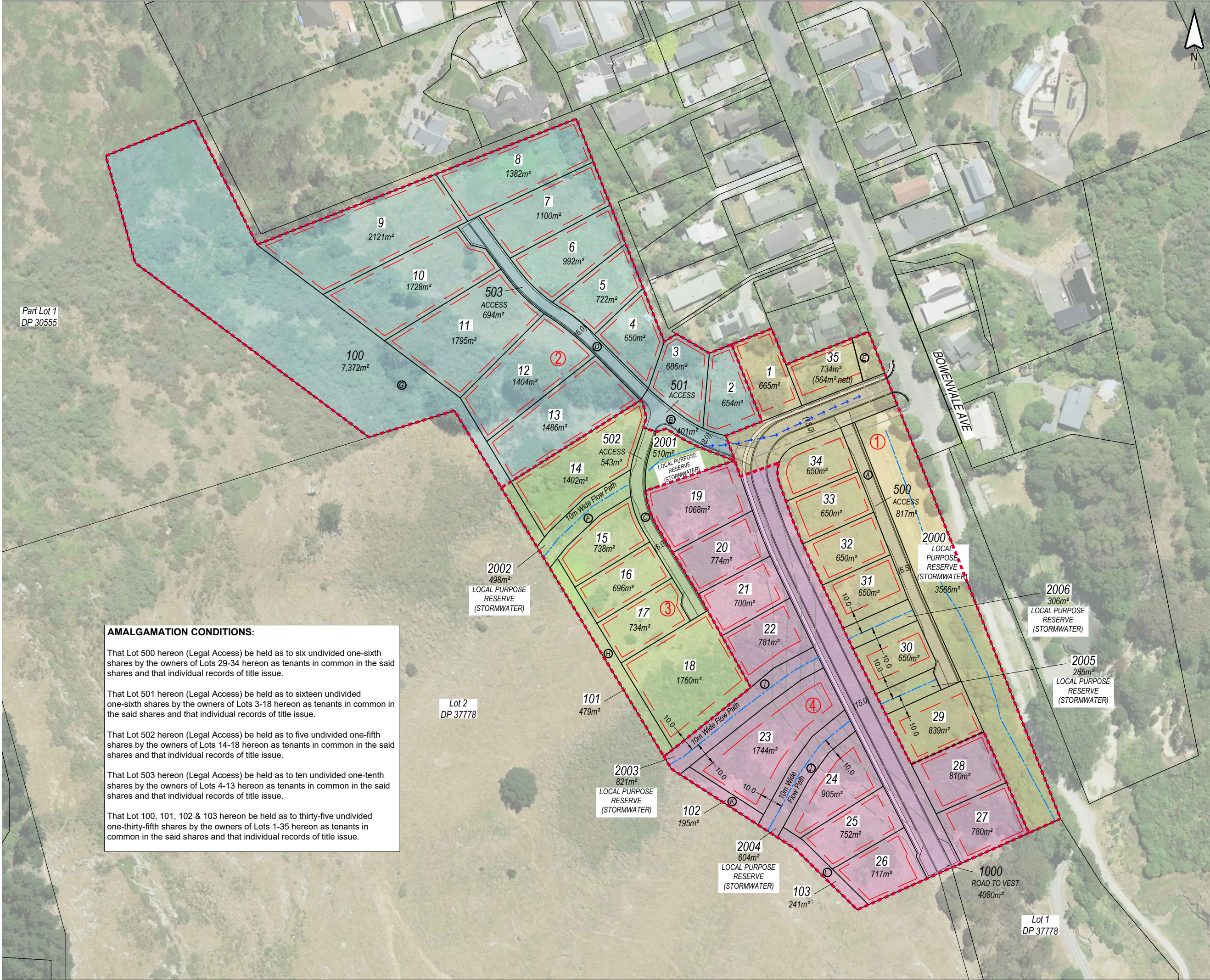
1037

DRAWING NO

SC-01

REVISION

N



AMALGAMATION CONDITIONS:

That Lot 500 hereon (Legal Access) be held as to six undivided one-sixth shares by the owners of Lots 29-34 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 501 hereon (Legal Access) be held as to sixteen undivided one-sixth shares by the owners of Lots 3-18 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 502 hereon (Legal Access) be held as to five undivided one-fifth shares by the owners of Lots 14-18 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 503 hereon (Legal Access) be held as to ten undivided one-tenth shares by the owners of Lots 4-13 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 100, 101, 102 & 103 hereon be held as to thirty-five undivided one-thirty-fifth shares by the owners of Lots 1-35 hereon as tenants in common in the said shares and that individual records of title issue.



LEGEND:

- 24.0 - MAJOR CONTOUR - CCC LIDAR CONT
- MINOR CONTOUR - CCC LIDAR CONT
- EXTENT OF EARTHWORKS
- 24.0 - MAJOR CONTOUR - DESIGN CONT
- MINOR CONTOUR - DESIGN CONT (1.0m)
- RETAINING WALL - HEIGHT 1.0 - 2.0m
- GABION STABILISED BATTER

REV	DATE	REVISION DETAILS	ISSUED
A	2/02/23	FOR INFORMATION	TL
B	4/10/23	LOT AMENDMENT	TL
C	16/10/23	GABIONS ADDED	TL



CLIENT	BOWENVALE GCO LTD		
PROJECT	130 BOWENVALE AVE		
DRAWING TITLE	PROPOSED CONTOUR PLAN		
SCALE	1:500	SHEET	A3
PROJECT NO	1036	DRAWING NO	EN100
REVISION			C

DRAFT



LEGEND:

- 1.0 CUT AREA & DEPTH CONTOURS (1m INTERVAL)
- 1.0 FILL AREA & DEPTH CONTOURS (1m INTERVAL)

NOTES:

- EXISTING CONTOURS HAVE BEEN DERIVED FROM LIDAR DATA.
- CUT & FILL CONTOURS ARE DEPTHS FROM EXISTING LIDAR SURFACE TO FINISHED DESIGN SURFACE.

REV	DATE	REVISION DETAILS	ISSUED
A	02/02/23	FOR INFORMATION	TL
B	22/09/23	LAYOUT REVISED	TL
C	16/10/23	SW BENCH ADDED	TL



CLIENT
BOWENVALE GCO LTD

PROJECT
130 BOWENVALE AVE

DRAWING TITLE
EARTHWORKS CUT/FILL PLAN

STATUS FOR INFORMATION	SCALE 1:100	SIZE A3
PROJECT 1036	DRAWING NO EN101	REVISION C

DRAFT



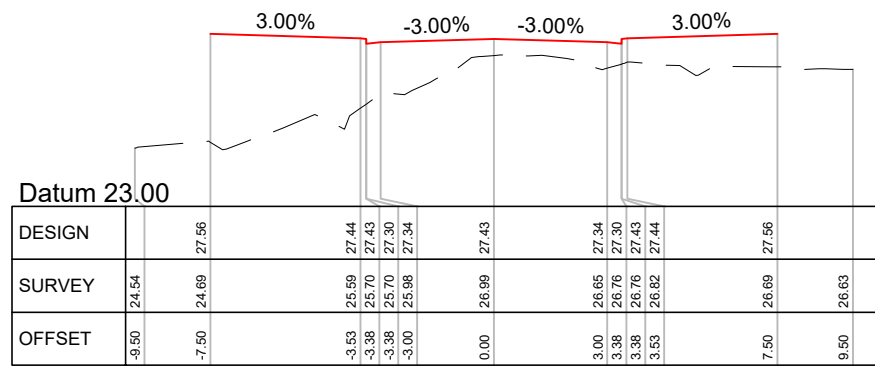
LEGEND:

1. ALL WORKS ARE TO BE IN TERMS OF THE CCC CSS AND IDS WHERE APPLICABLE
2. ALL CONCRETE FOR KERB AND FLAT CHANNEL TO HAVE A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 20MPa.
3. ALL CONCRETE KERB AND CHANNEL TO BE IN ACCORDANCE WITH CCC CODES AS SPECIFIED.
4. CARRIAGEWAY MINIMUM CBR TO MEET APPLICABLE STANDARDS IN CCC IDS PART 8 - ROADING. ENGINEER TO INSPECT SUBGRADE BEFORE ANY METAL PLACEMENT
5. BENKLEMAN BEAM TESTING TO MEET APPLICABLE STANDARDS IN CCC IDS PART 8 - ROADING.
6. CAMBER FOR ALL ROADS AND ROWS TO BE IN ACCORDANCE WITH CSS PART 2:1992 SD 243.

REV	DATE	REVISION DETAILS	ISSUED
A	03/02/23	FOR INFORMATION	TL



CLIENT		
BOWENVALE GCO LTD		
PROJECT		
130 BOWENVALE		
DRAWING TITLE		
ROAD LAYOUT PLAN		
STATUS	SCALE	SIZE
FOR INFORMATION	1:1000	A3
PROJECT	DRAWING NO	REVISION
1036	EN-200	A



DESIGN	24.54	24.69	27.56	27.44	27.43	27.34	27.30	27.34	27.43	27.44	27.56	26.63
SURVEY	24.54	24.69	27.56	27.44	27.43	27.34	27.30	27.34	27.43	27.44	27.56	26.63
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CHAINAGE 20

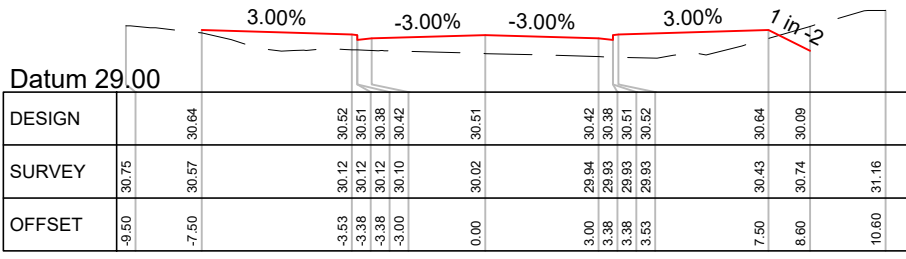
SCALE HORIZ=1:200 VERT=1:200



DESIGN	39.84	40.49	40.41	40.29	40.28	40.15	40.19	40.28	40.29	40.41	45.42	46.48
SURVEY	39.84	40.49	40.41	40.29	40.28	40.15	40.19	40.28	40.29	40.41	45.42	46.48
OFFSET	-9.83	-7.83	-7.50	-3.53	-3.38	-3.00	0.00	3.00	3.38	3.53	7.50	12.39

CHAINAGE 100

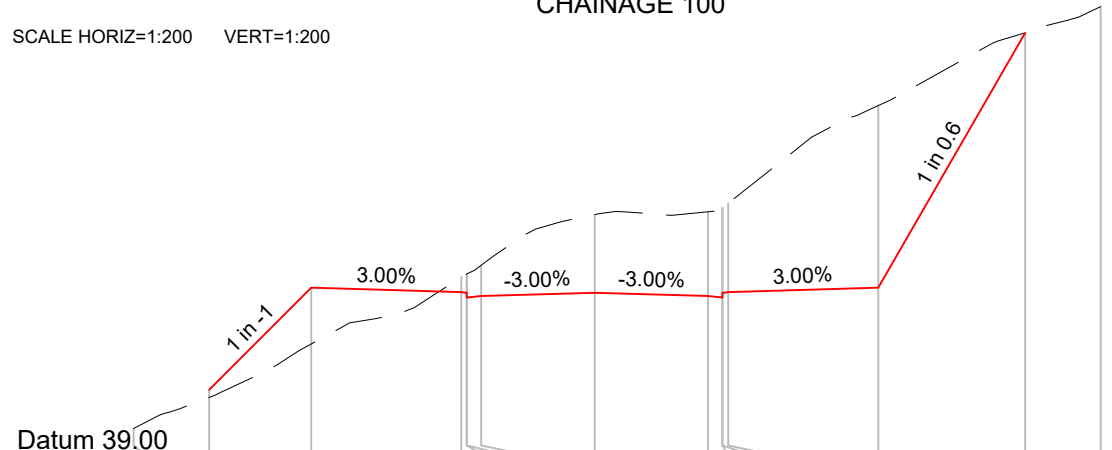
SCALE HORIZ=1:200 VERT=1:200



DESIGN	30.75	30.64	30.52	30.51	30.42	30.51	30.42	30.51	30.42	30.09	31.16
SURVEY	30.75	30.64	30.52	30.51	30.42	30.51	30.42	30.51	30.42	30.09	31.16
OFFSET	-9.50	-7.50	-3.53	-3.38	0.00	3.00	3.38	3.53	7.50	8.60	10.60

CHAINAGE 40

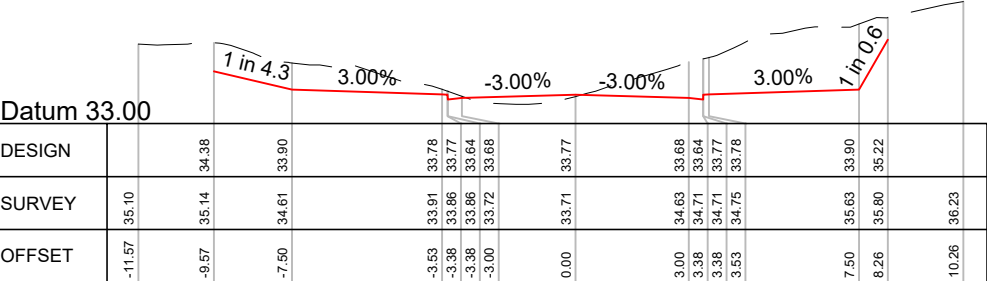
SCALE HORIZ=1:200 VERT=1:200



DESIGN	40.67	43.37	43.25	43.24	43.11	43.15	43.24	43.15	43.37	50.12	50.81
SURVEY	40.67	43.37	43.25	43.24	43.11	43.15	43.24	43.15	43.37	50.12	50.81
OFFSET	-12.20	-10.20	-7.50	-3.53	-3.38	-3.00	0.00	3.00	3.38	3.53	11.39

CHAINAGE 120

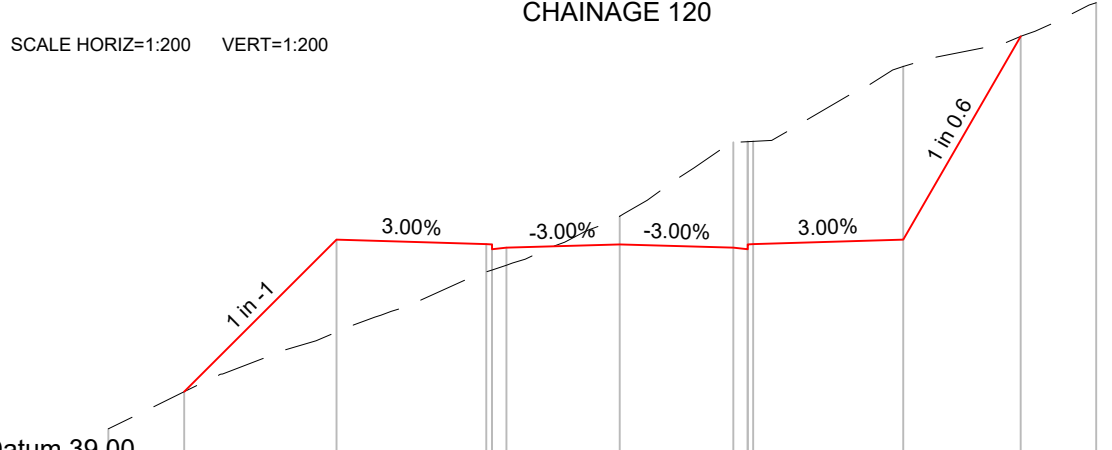
SCALE HORIZ=1:200 VERT=1:200



DESIGN	35.10	34.38	33.90	33.78	33.77	33.68	33.64	33.77	33.68	33.90	35.22	36.23
SURVEY	35.10	34.38	33.90	33.78	33.77	33.68	33.64	33.77	33.68	33.90	35.22	36.23
OFFSET	-11.57	-9.57	-7.50	-3.53	-3.38	-3.00	0.00	3.00	3.38	3.53	8.26	10.26

CHAINAGE 60

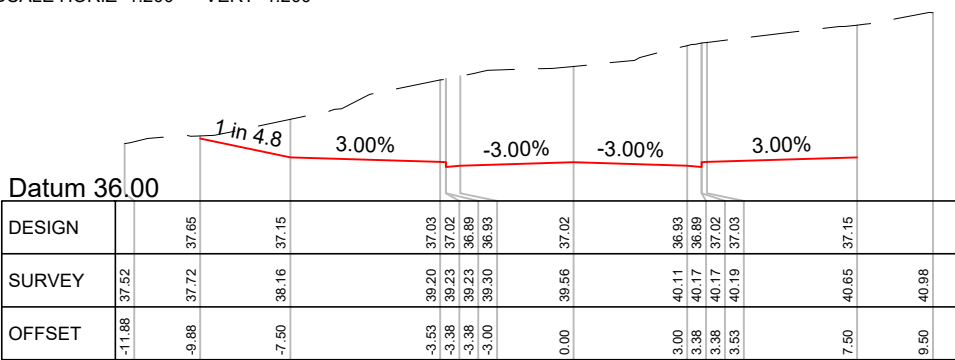
SCALE HORIZ=1:200 VERT=1:200



DESIGN	40.85	44.87	44.76	44.75	44.62	44.66	44.75	44.66	44.87	50.25	51.14
SURVEY	40.85	44.87	44.76	44.75	44.62	44.66	44.75	44.66	44.87	50.25	51.14
OFFSET	-13.53	-11.53	-7.50	-3.53	-3.38	-3.00	0.00	3.00	3.38	3.53	12.60

CHAINAGE 140

SCALE HORIZ=1:200 VERT=1:200



DESIGN	37.52	37.65	37.15	37.03	37.02	36.89	37.02	37.03	37.15	40.98
SURVEY	37.52	37.65	37.15	37.03	37.02	36.89	37.02	37.03	37.15	40.98
OFFSET	-11.88	-9.88	-7.50	-3.53	-3.38	-3.00	0.00	3.00	3.38	9.50

CHAINAGE 80

SCALE HORIZ=1:200 VERT=1:200

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BOWENVALE GCO LTD

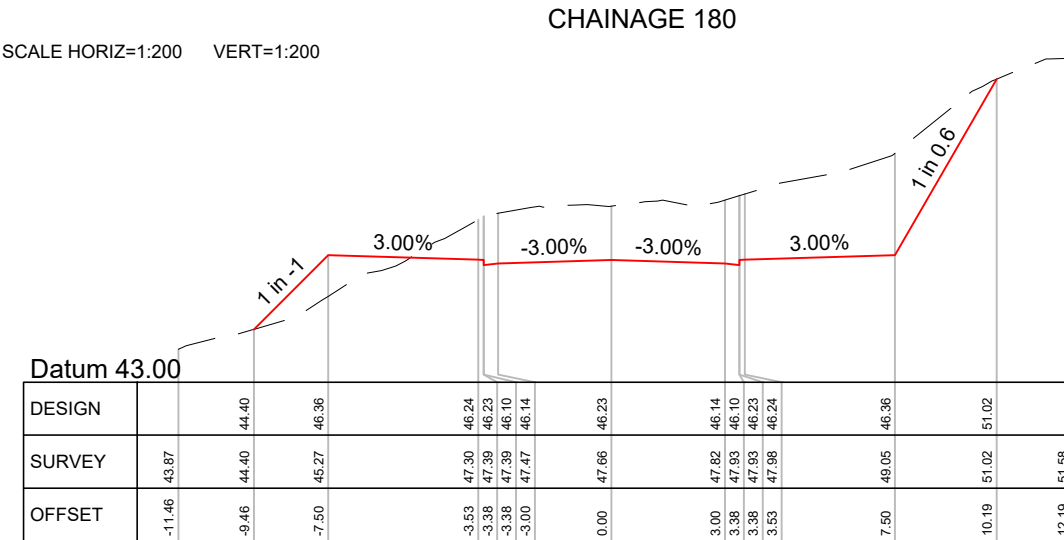
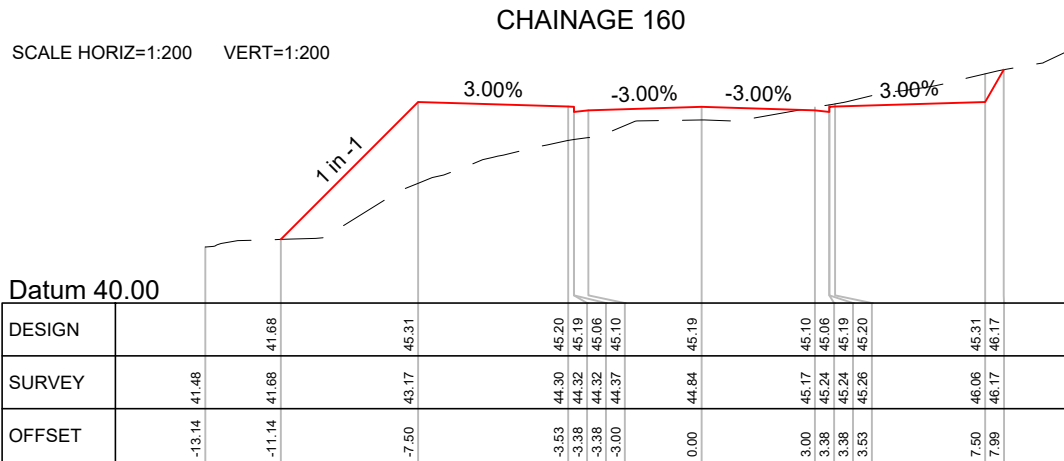
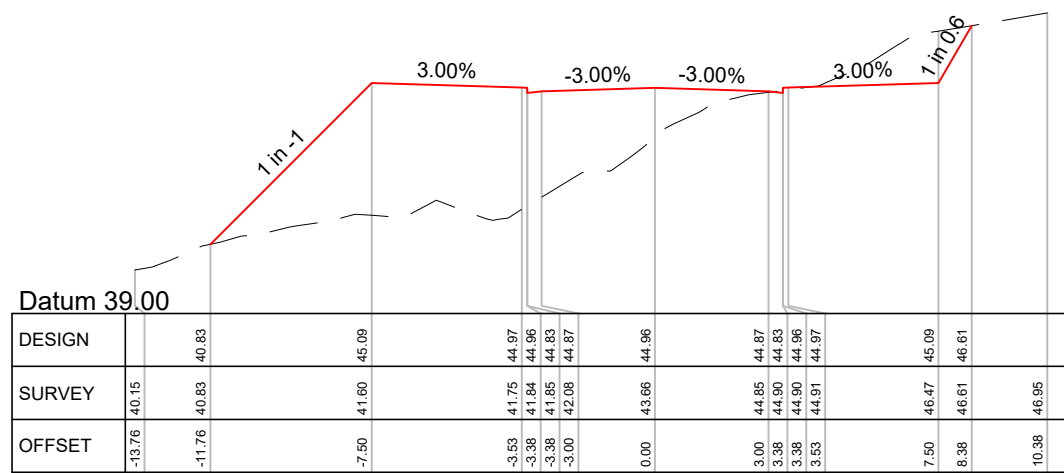
PROJECT
130 BOWENVALE AVENUE



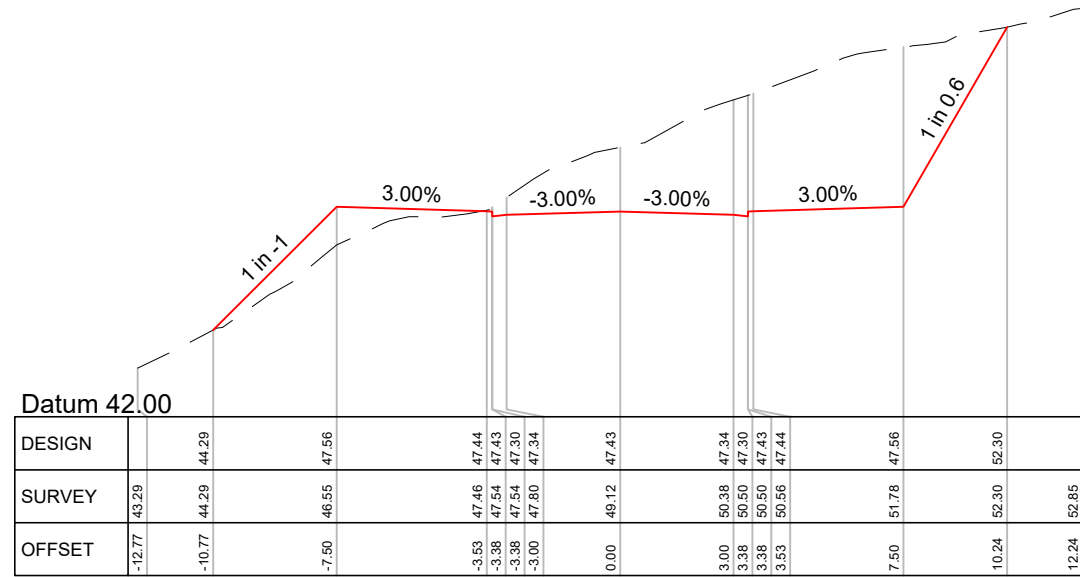
REV	DATE	REVISION DETAILS	ISSUED	DRAWING TITLE
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				SCALE SIZE
				FOR INFO AS SHOWN A3
				PROJECT NO. DRAWING NO. REVISION
A	12/09/23	FOR INFORMATION	CWH	1037 EN-203 A

DRAFT

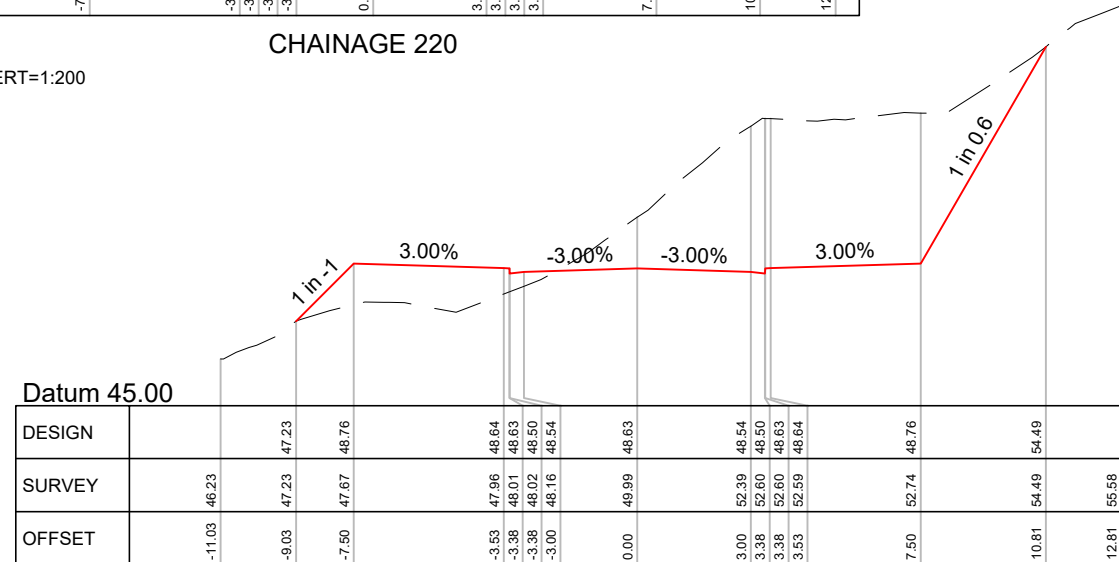
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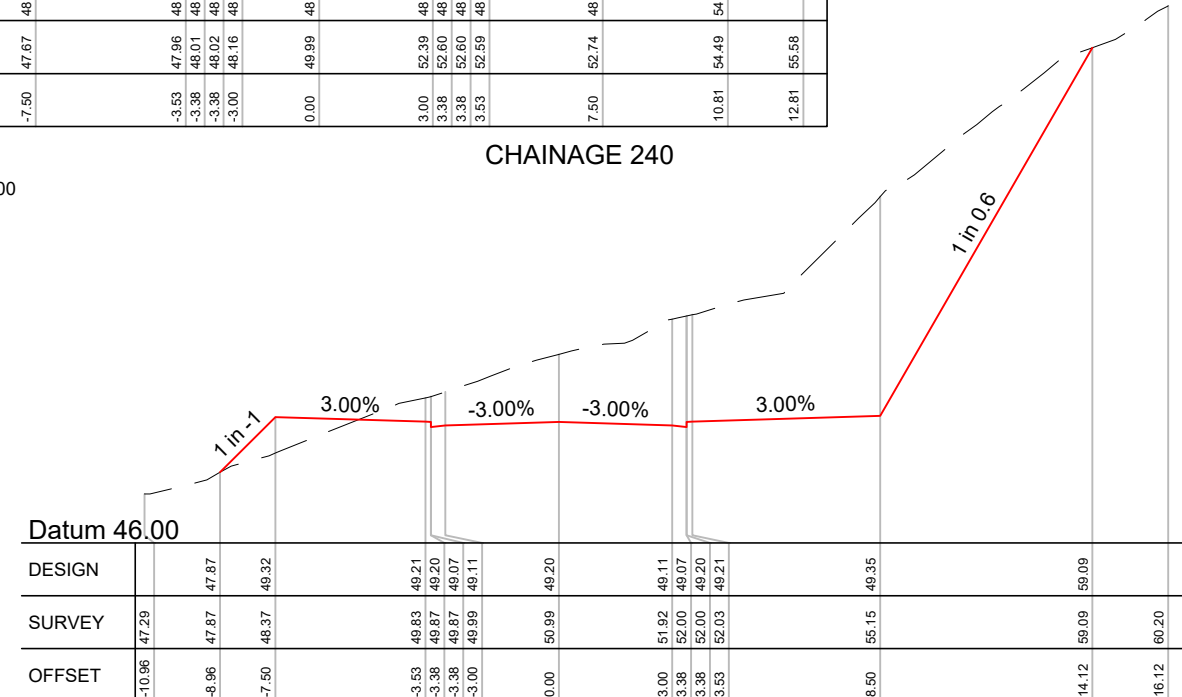
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SCALE HORIZ=1:200 VERT=1:200



SCALE HORIZ=1:200 VERT=1:200



SCALE HORIZ=1:200 VERT=1:200

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CLIENT
BOWENVALE GCO LTD

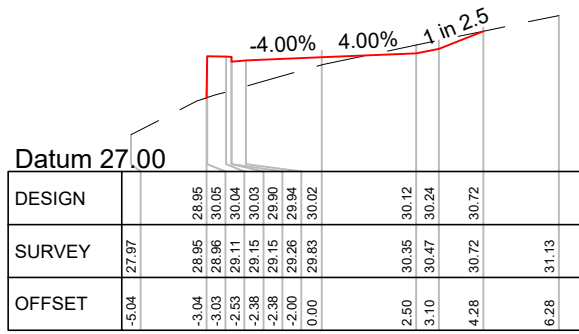
PROJECT
130 BOWENVALE AVENUE



REV	DATE	REVISION DETAILS	ISSUED	DRAWING TITLE
				PROPOSED ROAD CROSS SECTIONS SHEET 2 OF 2
				SCALE
				SIZE
				FOR INFO AS SHOWN A3
				PROJECT NO 1037
				DRAWING NO EN-204
				REVISION A
A	12/09/23	FOR INFORMATION	CWH	

DRAFT

c:\users\lomiemon_2pwn\1\capturelandclients - documents\gco\1037 - 130 bowenvale ave\cad\civil\1037 en-203 road cross sections rev b

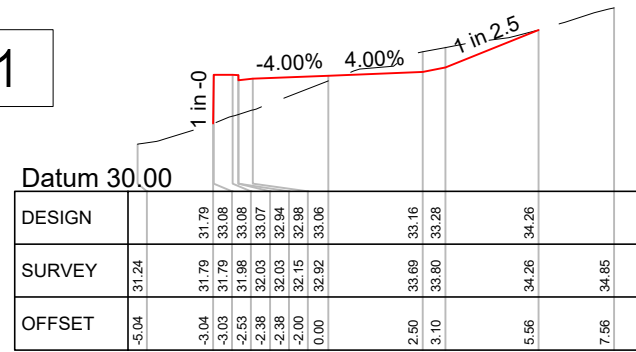


ROW 1

DESIGN	28.95	30.05	30.04	30.03	29.90	29.94	30.02	30.12	30.24	30.72
SURVEY	27.97	28.95	29.11	29.15	29.15	29.26	29.83	30.35	30.47	30.72
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CHAINAGE 20

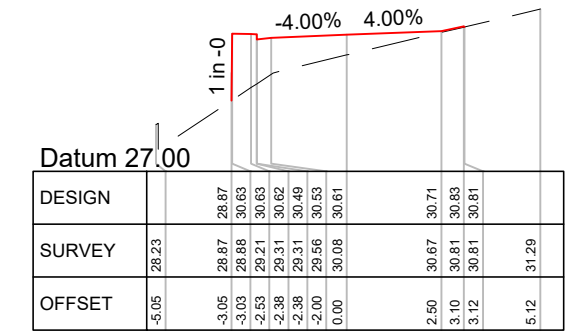
SCALE HORIZ=1:200 VERT=1:200



DESIGN	31.79	33.08	33.08	33.07	32.94	33.06	33.16	33.28	34.26	34.85
SURVEY	31.24	31.79	31.98	32.03	32.94	32.96	33.69	33.80	34.26	34.85
OFFSET	-5.04	-3.04	-2.53	-2.38	-2.38	-2.00	2.50	3.10	5.56	7.56

CHAINAGE 100

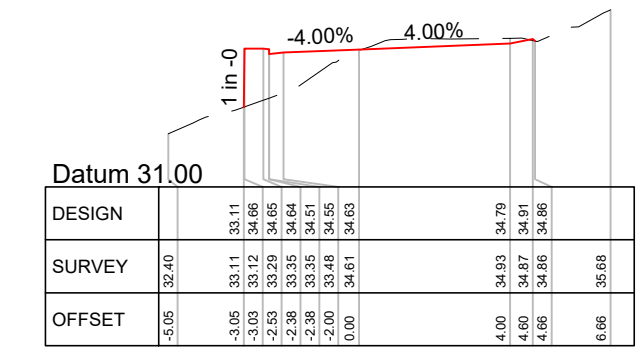
SCALE HORIZ=1:200 VERT=1:200



DESIGN	28.87	30.63	30.63	30.62	30.49	30.61	30.71	30.83	30.81	31.29
SURVEY	28.23	28.87	28.88	29.21	29.31	29.56	30.67	30.81	30.81	31.29
OFFSET	-5.05	-3.05	-3.03	-2.38	-2.38	-2.00	2.50	3.10	3.12	5.12

CHAINAGE 40

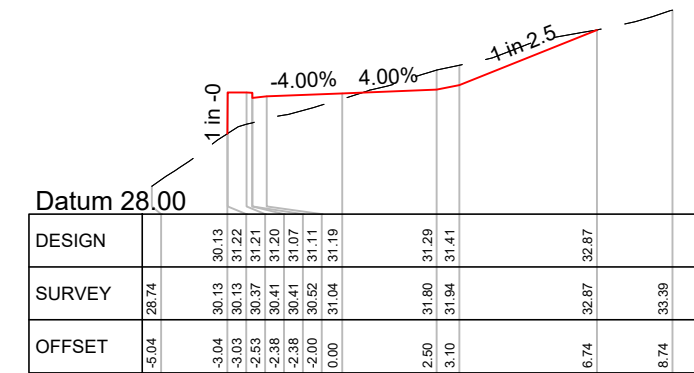
SCALE HORIZ=1:200 VERT=1:200



DESIGN	33.11	34.66	34.66	34.65	34.51	34.63	34.79	34.91	34.86	35.68
SURVEY	32.40	33.11	33.12	33.29	33.35	33.45	34.93	34.87	34.86	35.68
OFFSET	-5.05	-3.05	-3.03	-2.38	-2.38	-2.00	4.00	4.60	4.66	6.66

CHAINAGE 120

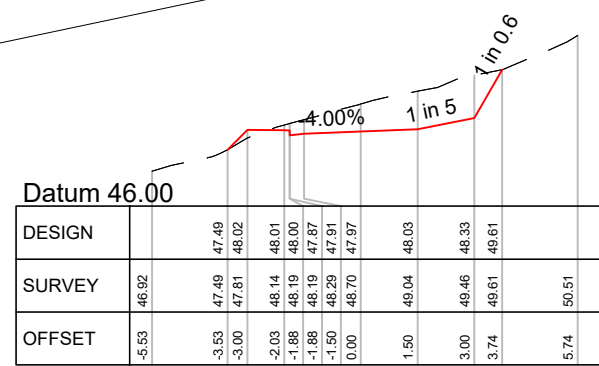
SCALE HORIZ=1:200 VERT=1:200



DESIGN	30.13	31.22	31.21	31.20	31.07	31.19	31.29	31.41	32.87	33.39
SURVEY	28.74	30.13	30.37	30.41	30.41	30.52	31.94	31.41	32.87	33.39
OFFSET	-5.04	-3.04	-2.53	-2.38	-2.38	-2.00	3.10	3.10	6.74	8.74

CHAINAGE 60

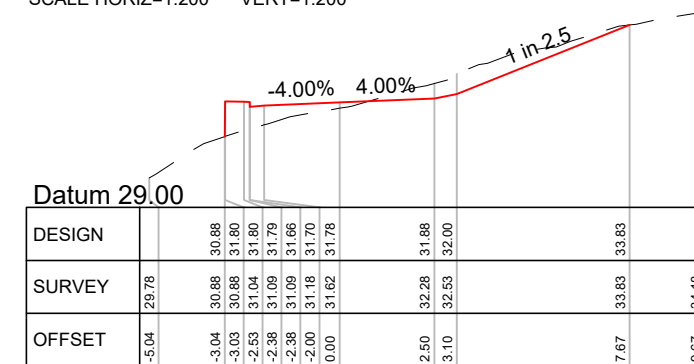
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DESIGN	47.49	48.02	48.01	48.00	47.87	47.97	48.03	48.33	49.61	50.51
SURVEY	46.92	47.81	48.14	48.19	48.19	48.29	49.04	49.46	49.61	50.51
OFFSET	-5.53	-3.53	-2.03	-1.88	-1.88	0.00	1.50	3.00	3.74	5.74

CHAINAGE 20

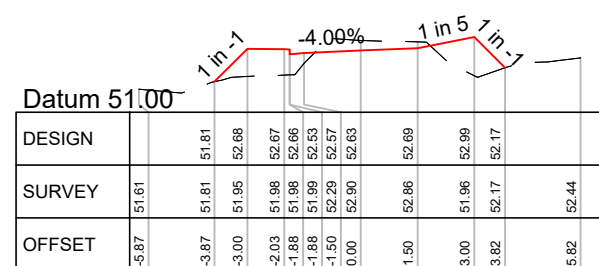
SCALE HORIZ=1:200 VERT=1:200



DESIGN	30.88	31.80	31.79	31.66	31.70	31.78	31.88	32.00	33.83	34.18
SURVEY	29.78	30.88	31.04	31.09	31.09	31.62	32.28	32.53	33.83	34.18
OFFSET	-5.04	-3.04	-2.53	-2.38	-2.38	-2.00	2.50	3.10	7.67	9.67

CHAINAGE 80

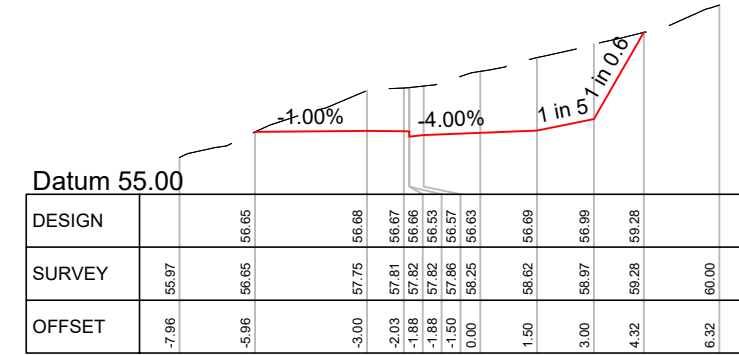
SCALE HORIZ=1:200 VERT=1:200



DESIGN	51.81	52.68	52.67	52.66	52.53	52.63	52.69	52.99	52.17	52.44
SURVEY	51.61	51.95	51.98	51.98	51.99	52.57	52.86	51.96	52.17	52.44
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CHAINAGE 40

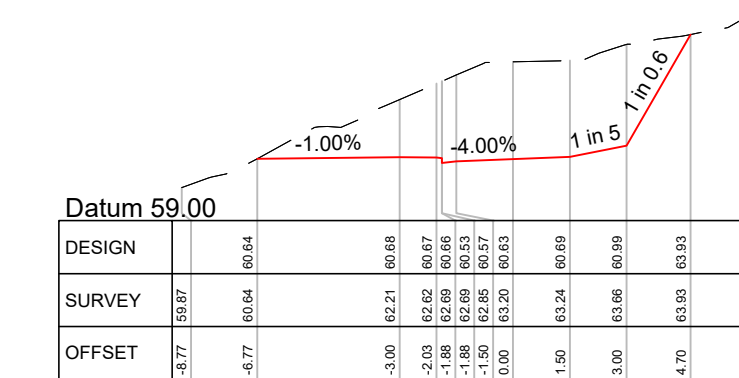
SCALE HORIZ=1:200 VERT=1:200



DESIGN	56.65	56.68	56.67	56.66	56.53	56.63	56.69	56.99	59.28	60.00
SURVEY	55.97	56.65	57.75	57.81	57.82	57.86	58.25	58.62	59.28	60.00
OFFSET	-7.96	-5.96	-3.00	-2.03	-1.88	-1.50	0.00	1.50	3.00	6.32

CHAINAGE 60

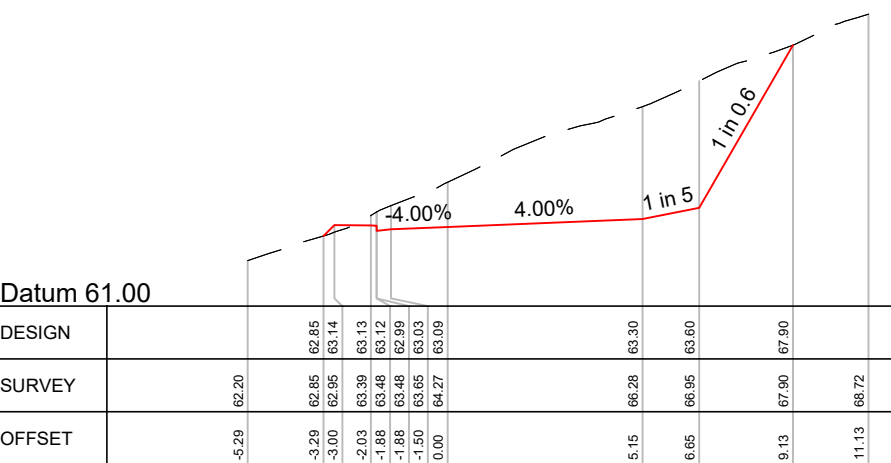
SCALE HORIZ=1:200 VERT=1:200



DESIGN	60.64	60.68	60.67	60.66	60.53	60.63	60.69	60.99	63.93	64.70
SURVEY	59.87	60.64	62.21	62.62	62.69	62.85	63.24	63.66	63.93	64.70
OFFSET	-8.77	-6.77	-3.00	-2.03	-1.88	-1.50	0.00	1.50	3.00	6.70

CHAINAGE 80

SCALE HORIZ=1:200 VERT=1:200



DESIGN	62.85	63.14	63.13	63.12	62.99	63.03	63.09	63.30	63.60	67.90	68.72
SURVEY	62.20	62.85	63.39	63.48	63.48	63.65	64.27	66.28	66.95	67.90	68.72
OFFSET	-5.29	-3.29	-3.00	-2.03	-1.88	-1.50	0.00	5.15	6.65	9.13	11.13

CHAINAGE 97.13

SCALE HORIZ=1:200 VERT=1:200

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CLIENT	BOWENVALE GCO LTD
PROJECT	130 BOWENVALE AVENUE



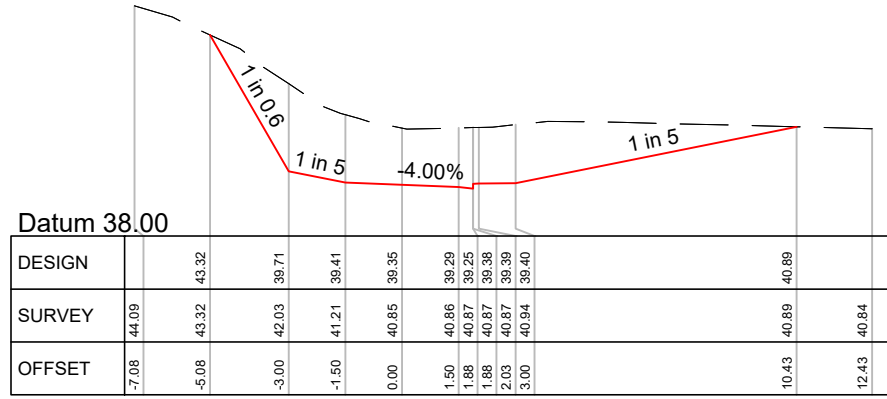
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A	16/10/23	FOR INFORMATION	TE	PROPOSED ROW CROSS SECTIONS SHEET 1 OF 2

STATUS	SCALE	SIZE
FOR INFO	AS SHOWN	A3
PROJECT NO	REV NO	REVISION
1037	EN-205	A

DRAFT

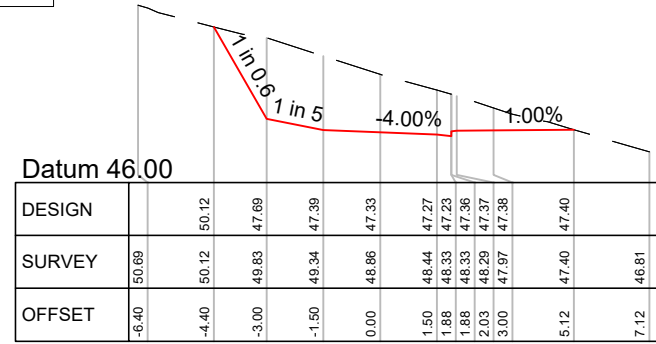
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ROW 2



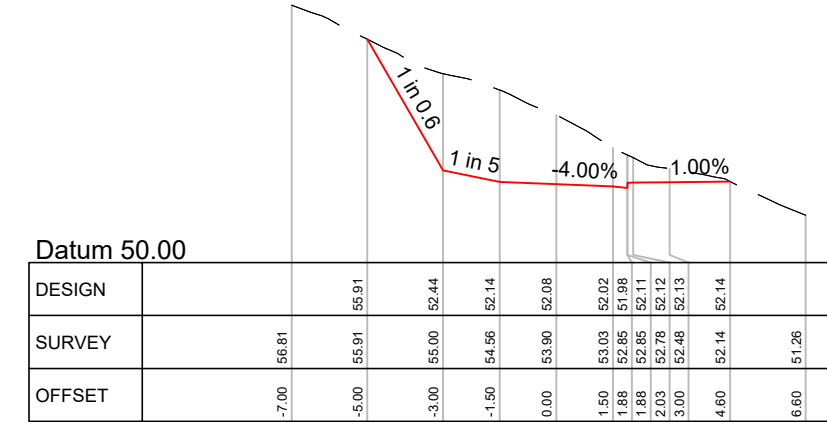
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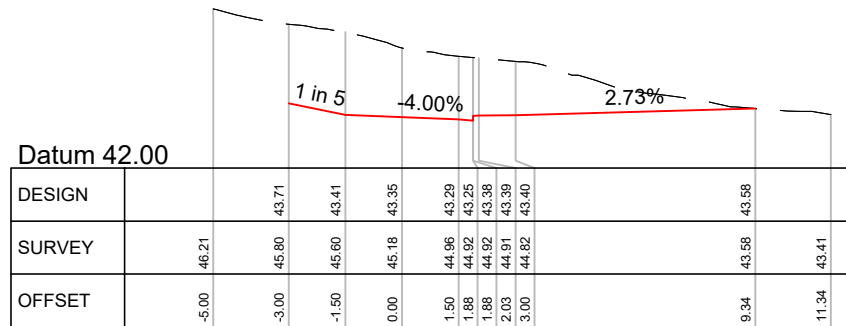
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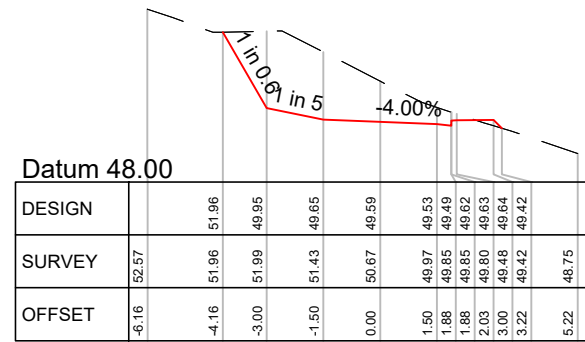
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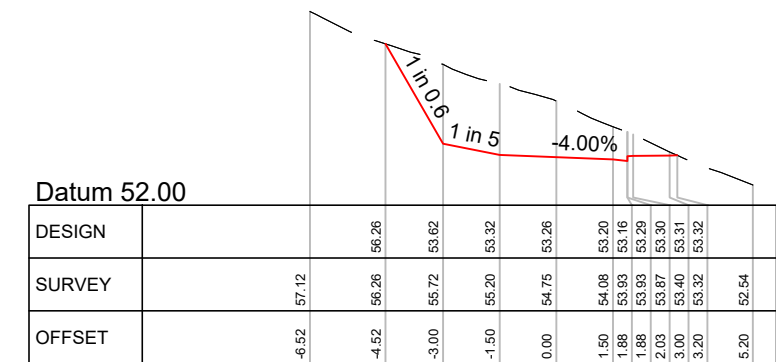
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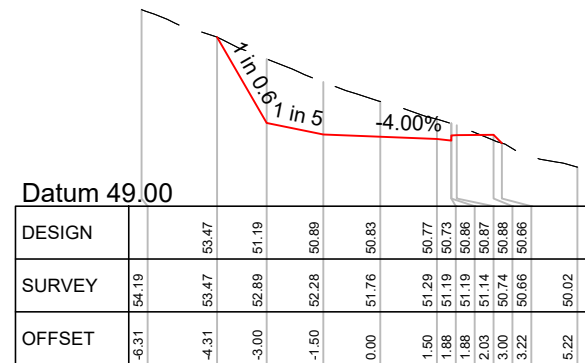
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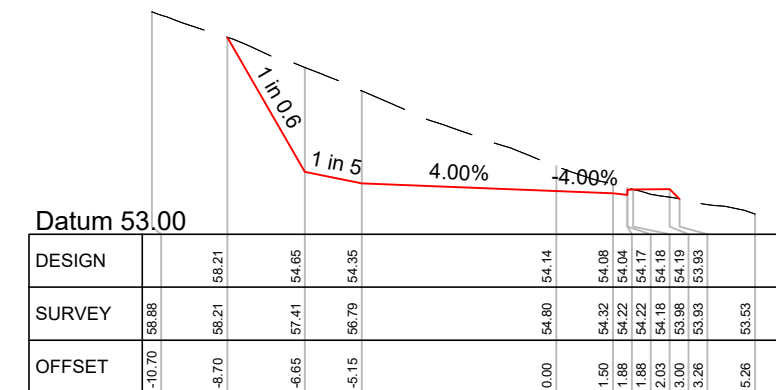
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CHAINAGE 100

SCALE HORIZ=1:200 VERT=1:200



CHAINAGE 160

SCALE HORIZ=1:200 VERT=1:200

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CLIENT

BOWENVALE GCO LTD

PROJECT

130 BOWENVALE AVENUE



REV	DATE	REVISION DETAILS	ISSUED	DRAWING TITLE
				PROPOSED ROW CROSS SECTIONS SHEET 2 OF 2
				STATUS SCALE SIZE
				FOR INFO AS SHOWN A3
				PROJ. CT. NO. REVISION
				1037 EN-206 A

DRAFT

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Capture Land Ltd
OLFP Assessment

Job Number: 1037
Client: Bowenvale GCO Ltd
Site Details: 130 Bowenvale Ave, Cashmere

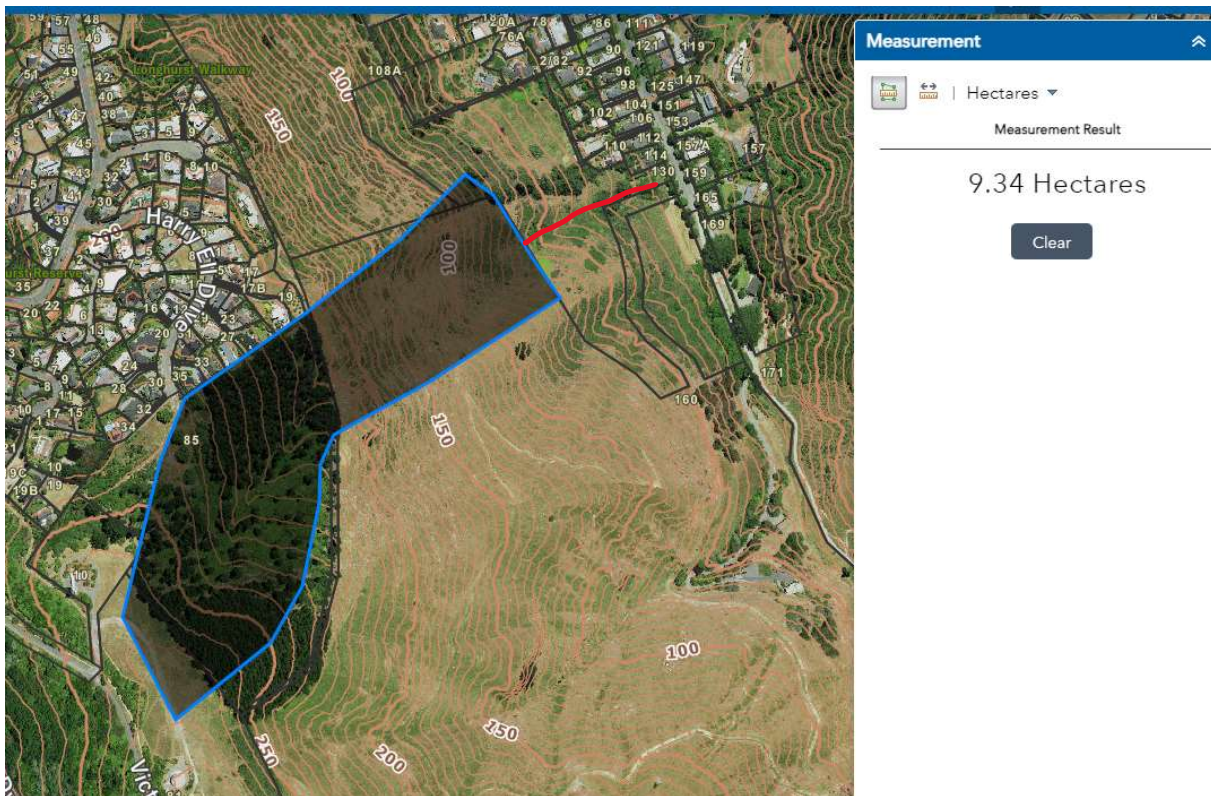
Date: 17/10/2023

Catchments:

There are three identified waterways running through the subject site, as detailed below.

a) **Waterway A - Sibleys Drain Branch No. 15**

- Area = 9.34ha
- Length = 700m
- Slope = 31%



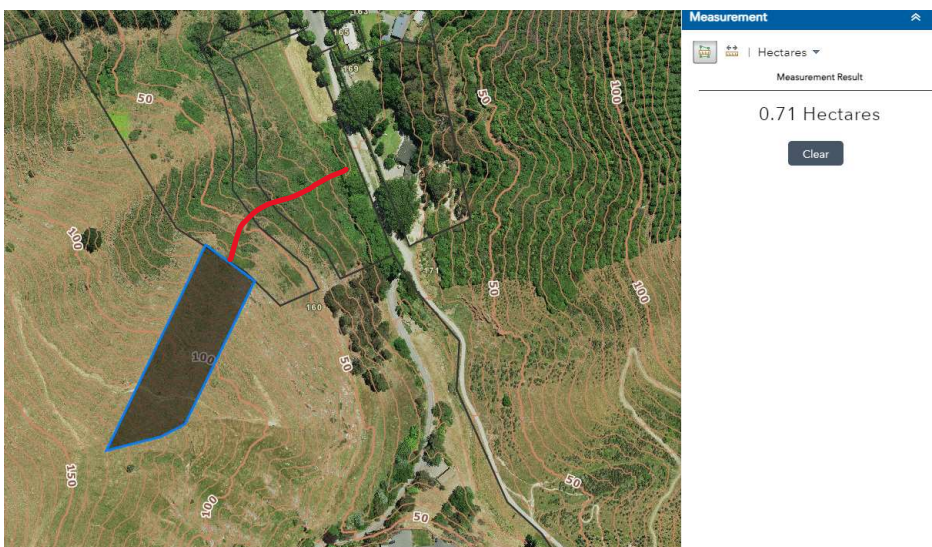
b) Waterway B - Hillside waterway (north)

- Area = 4.92ha
- Length = 460m
- Slope = 41%



c) Waterway C - Hillside waterway (south)

- Area = 0.71ha
- Length = 170m
- Slope = 45%



Rainfall - (HIRDS V4 – RCP8.5 2081-2100)

Runoff Coefficient

- Pre-development - Pervious – 0.3

Summary of Results

Rational formula calculation – preliminary for RC only.

20% AEP (5 year) Peak Flows

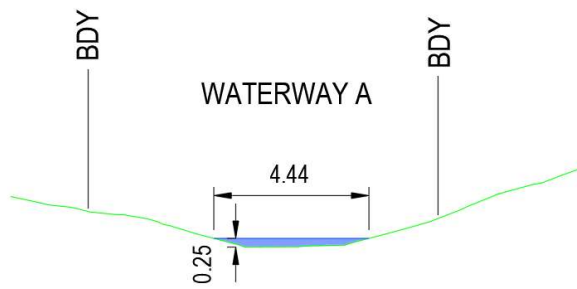
TABLE 2		20% AEP EVENT (5 yr)				
		Waterway A	Waterway B	Waterway C		
Storm duration (hours)	Rainfall intensity (mm/hour)	pre-dev flow (l/s)	pre-dev flow (l/s)	pre-dev flow (l/s)		
0.17	36.70	285.88	150.59	21.73		
0.33	29.70	231.35	121.87	17.59		
0.50	26.00	202.53	106.69	15.40		
1.00	20.40	158.91	83.71	12.08		
2.00	15.40	119.96	63.19	9.12		
6.00	9.24	71.98	37.91	5.47		
12.00	6.43	50.09	26.38	3.81		
24.00	4.34	33.81	17.81	2.57		
27.00	4.16	32.37	17.05	2.46		

2% AEP (50 year) Peak Flows

TABLE 1		2% AEP EVENT (50 yr)				
		Waterway A	Waterway B	Waterway C		
Storm duration (hours)	Rainfall intensity (mm/hour)	pre-dev flow (l/s)	pre-dev flow (l/s)	pre-dev flow (l/s)		
0.17	72.40	563.96	297.08	42.87		
0.33	57.80	450.24	237.17	34.23		
0.50	50.10	390.26	205.57	29.67		
1.00	38.60	300.68	158.39	22.86		
2.00	28.70	223.56	117.76	16.99		
6.00	16.80	130.86	68.94	9.95		
12.00	11.50	89.58	47.19	6.81		
24.00	7.59	59.12	31.14	4.49		
27.00	7.00	54.53	28.72	4.14		

Preliminary Overland Flow Path Calculations

We have modelled the peak flows in the largest overland flow path (Waterway A - Sibleys Drain Branch No. 15) to determine the flooded width extents, which are fully contained within the proposed waterway boundaries. Preliminary results and Mannings calculation below.



Section 1	
Parameters	Values
Mannings Roughness (n)	0.3
Flow Area (A)	0.82
Wetted perimeter (P)	4.5
Hydraulic Radius R = A/P	0.182
Slope S = H/L	0.32
Velocity (V)	0.606
Flow (Q)	0.50
0.5% AEP catchment flow	0.450
Channel capacity >= Catchm	OK

Preliminary Inlet/Culvert Calculations

- Waterway A = 525mm diameter
- Waterway B = 375mm diameter
- Waterway C = 300mm diameter

Calculation summary

Catchment	Culvert	Peak Flows (m ³ /s)							
		5yr (20% AEP)	50yr (2% AEP)						
WW A	1	232	450						
WW B	2	122	237						
WWC	3	18	34						
Proposed Culvert Parameters									
Entry Type: Socket end with wingwall									
Catchment	Culvert	Diameter D(m)	Soffit Head H(m)	Headwater HW(m)	HW/D(m)	Gradient	Capacity CPAA Chart		
WW A	1	0.525	0.75	1.275	2.43	2%	0.65m ³ /s	(Ok for 2% AEP*)	
WW B	2	0.375	0.75	1.125	3.00	2%	0.32m ³ /s	(Ok for 2% AEP*)	
WWC	3	0.300	0.75	1.05	3.50	2%	0.20m ³ /s	(Ok for 2% AEP*)	

These are preliminary sizes only and will be subject to detailed assessment at engineering plan stage.

**BOWENVALE GCO LIMITED - 130 BOWENVALE AVE
STORMWATER RUNOFF CALCULATIONS**

Stormwater flows are calculated using the Rational Formula with criteria derived from the CCC Waterways, Wetlands and Drainage Guide

The storage volume is based upon carrying the flow from a range of storms up to 2% AEP, with up to 27-hours duration

Total area: Development Site - 130 Bowenvale Ave

5.6 ha

Rainfall Intensities from HIRDS V4 - RCP8.5 2081-2100
Design Storm Duration - assumed TC of 20mins

Pre-development:

Surface	Area (ha)	C value
Pervious	5.6	0.3
Impervious	0	0.9
TOTAL	5.6	0.3

Post-development

Surface	Area (ha)	C value	Sum CA
Pervious	5.175	0.3	1.5525
Impervious	0.425	0.9	0.3825
TOTAL	5.6		1.935

Lots modelled as pervious due to onsite detention to pre-development levels

CALCULATION OF PRE-DEVELOPMENT & POST-DEVELOPMENT FLOW RATES & VOLUME

TABLE 1 2% AEP EVENT (50 yr)

Storm duration (hours)	Rainfall intensity (mm/hour)	pre-dev flow (l/s)	post-dev flow (l/s)	Increase in flow (l/s)	Extra volume (m ³)
0.17	72.40	338.14	389.46	51.32	30.67
0.33	57.80	269.95	310.92	40.97	48.68
0.50	50.10	233.99	269.50	35.52	63.93
1.00	38.60	180.28	207.64	27.36	98.51
2.00	28.70	134.04	154.39	20.35	146.49
6.00	16.80	78.46	90.37	11.91	257.25
12.00	11.50	53.71	61.86	8.15	352.18
24.00	7.59	35.45	40.83	5.38	464.88
27.00	7.00	32.69	37.66	4.96	482.34

Assume 27 hour storm duration

TABLE 2 5% AEP EVENT (20 yr)

Storm duration (hours)	Rainfall intensity (mm/hour)	pre-dev flow (l/s)	post-dev flow (l/s)	Increase in flow (l/s)	Extra volume (m ³)
0.17	56.70	264.81	305.01	40.19	24.02
0.33	45.50	212.50	244.76	32.25	38.32
0.50	39.60	184.95	213.02	28.07	50.53
1.00	30.70	143.38	165.14	21.76	78.35
2.00	23.00	107.42	123.72	16.30	117.39
6.00	13.60	63.52	73.16	9.64	208.25
12.00	9.33	43.57	50.19	6.61	285.73
24.00	6.22	29.05	33.46	4.41	380.97
27.00	5.70	26.62	30.66	4.04	392.76

TABLE 3 20% AEP EVENT (5 yr)

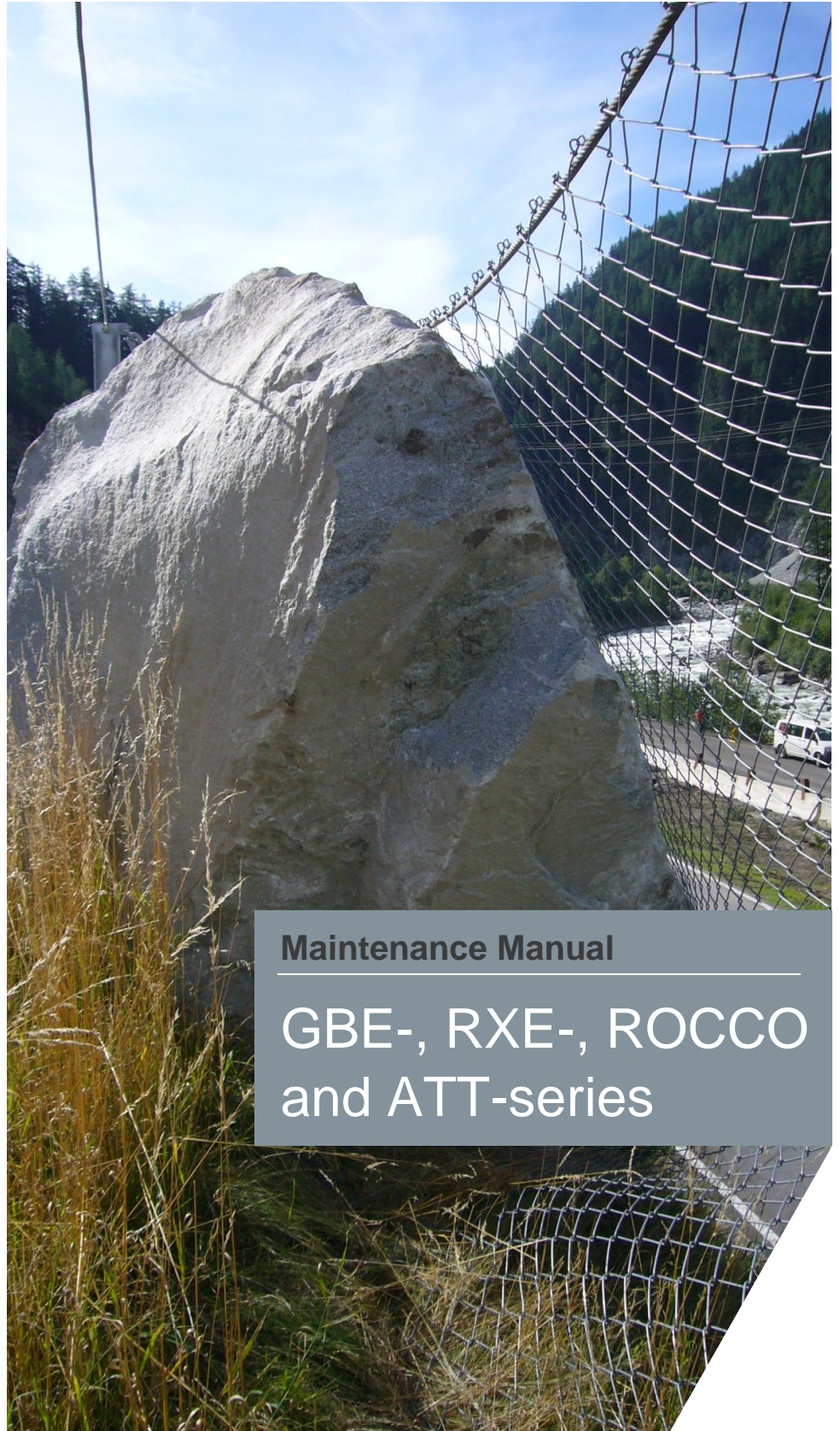
Storm duration (hours)	Rainfall intensity (mm/hour)	pre-dev flow (l/s)	post-dev flow (l/s)	Increase in flow (l/s)	Extra volume (m ³)
0.17	36.70	171.40	197.42	26.02	15.55
0.33	29.70	138.71	159.77	21.05	25.01
0.50	26.00	121.43	139.86	18.43	33.18
1.00	20.40	95.28	109.74	14.46	52.06
2.00	15.40	71.92	82.84	10.92	78.60
6.00	9.24	43.15	49.70	6.55	141.49
12.00	6.43	30.03	34.59	4.56	196.92
24.00	4.34	20.27	23.35	3.08	265.82
27.00	4.10	19.15	22.06	2.91	282.51

GBE-100A
GBE-100A-R
GBE-500A
GBE-500A-R
GBE-1000A
GBE-1000A-R
GBE-2000A
GBE-3000A

RXE-500
RXE-500-LA
RXE-1000
RXE-2000
RXE-3000
RXE-5000
RXE-8000
RXE-10000

ROCCO-1000
ROCCO-2000
ROCCO-3000

ATT-20
ATT-40
ATT-60
ATT-80



Maintenance Manual

GBE-, RXE-, ROCCO and ATT-series

Date: 26.08.2022

Issue: 12

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8590 Romanshorn

PURPOSE AND ORGANIZATION OF THE MAINTENANCE MANUAL

This maintenance manual is intended for the proper maintenance and repair of a rockfall protection system, in order to ensure a long lifespan for the barrier, and its unrestricted and safe functioning following impacts and throughout its lifespan. The maintenance manual is to be understood as a recommendation. Only standard situations are described. In the event of unusual situations, this manual may under certain circumstances be inappropriate or inadequate for servicing or repairing the barrier. In certain cases, it is recommended that technical advice is obtained from the manufacturer.

This maintenance manual consists of the following sections:

- Lifespan
- Inspections
- Criteria for repairs and replacement
- Emptying and clearing of barriers
- Repairing and replacing components
- Inspection checklist
- ISO 9001 certificates

No claims are made that this document is complete. It is designed for general standard applications and does not take into account project-specific parameters. GeobruGG cannot be held liable for any extra costs that may be incurred for special cases. In the event of uncertainty, please contact the manufacturer. The General Terms of Business of GeobruGG AG apply.

RESPONSIBLE FOR THE CONTENT:

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Geohazard Solutions
Aachstrasse 11
CH-8590 Romanshorn, Switzerland
info@geobruGG.com
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Romanshorn, 26.08.2022



GeobruGG AG
Aachstrasse 11
CH-8590 Romanshorn
Switzerland

(Stamp / legally valid signatures)

I AREA OF APPLICATION

This maintenance manual applies for the Geobruugg rockfall barrier systems of the GBE, RXE, ROCCO and ATT series. Reference is made to the corresponding system drawings:

GBE-100A	(100 kJ)	System drawing GS-1218
GBE-100A-R	(100 kJ)	System drawing GS-1131
GBE-500A	(500 kJ)	System drawing GS-1100
GBE-500A-R	(500 kJ)	System drawing GS-1122
GBE-1000A	(1000 kJ)	System drawing GS-1104
GBE-1000A-R	(1000 kJ)	System drawing GS-1128
GBE-2000A	(2000 kJ)	System drawing GS-1109
GBE-3000A	(3000 kJ)	System drawing GS-1113
RXE-500	(500 kJ)	System drawing GS-1196
RXE-500-LA	(500 kJ)	System drawing GS-1216
RXE-1000	(1000 kJ)	System drawing GS-1142
RXE-2000	(2000 kJ)	System drawing GS-1150
RXE-3000	(3000 kJ)	System drawing GS-1157
RXE-5000	(5000 kJ)	System drawing GS-1125
RXE-8000	(8000 kJ)	System drawing GS-1138
RXE-10000	(10000 kJ)	System drawing GS-1552
ROCCO-1000	(1000 kJ)	System drawing GS-1225
ROCCO-2000	(2000 kJ)	System drawing GS-1222
ROCCO-3000	(3000 kJ)	System drawing GS-1228
ATT-20		System drawing GS-1556
ATT-40		System drawing GS-1567
ATT-60		System drawing GS-1568
ATT-80		System drawing GS-1569

II QUALITY OF THE SYSTEM COMPONENTS

Geobruugg AG, Romanshorn, has been certified according to the quality management system requirements (ISO 9001: 2008) under registration number CH-34372 since August 22, 1995. The certifying body is the Swiss Association for Quality and Management Systems (SQS), a member of IQNet. The quality manual describes in full how the individual system parts (input material, commercial products and end products) are comprehensively checked in order to exclude inadequate quality.

III FUNCTIONAL EFFICIENCY OF THE BARRIER SYSTEMS

The system functionality is based on rockfall tests that replicate real-life conditions, performed in Walenstadt (SG), Switzerland, in accordance with the European Guideline EAD-340059-00-0106-2018 "Falling Rock Protection Kits" and the Swiss Guidance for Practice "Basics for the Quality Assessment of Rockfall Protection Nets and their Foundation". In the rockfall tests under real-life conditions, the rocks are thrown vertically into the central field of a three-field barrier with a 10 m distance between the posts of each field. An impact speed of at least 25 m/s is achieved. These investigations are inspected by notified testing centres and obtain European approval, known as ETA (European Technical Assessment), as well as partly a Swiss inspection certificate from the Federal Office for the Environment (FOEN).

IV QUALITY CONTROL FOR MAINTENANCE

An inspection of damage should be made using the checklist in the maintenance manual. The maintenance manual describes in detail the individual steps for how the barriers must be maintained by local contractors. The recording of damage is, however, always subject to subjective criteria. In the event that doubts should arise for this reason, the manufacturer should be contacted in order to ensure the continued quality and functional efficiency of the barrier.

V PRODUCT LIABILITY

Rockfall, landslides, debris flows or avalanches are sporadic and unpredictable. The cause may be human (buildings etc.), for example, or forces beyond human control (weather, earthquakes, etc.). The multiplicity of factors that may trigger such events means that guaranteeing the safety of persons and property is not an exact science.

However, the risks of injury and loss of property can be substantially reduced by appropriate calculations that apply good engineering practices, and by using predictable parameters along with the corresponding implementation of flawless protective measures in identified risk areas.

The monitoring and maintenance of such systems is an absolute requirement to ensure the desired safety level. System safety can also be compromised through events, natural disasters, inadequate dimensioning or failure to use standard components, systems and original parts, but also through corrosion (caused by environmental pollution or other man-made factors as well as other external influences).

In contrast to the 1:1 rockfall tests, which indeed test an extreme load case but still only demonstrate a standardized situation, in the field the layout and design of a protection system can vary greatly because of the topography. The influence of such alterations and adaptations cannot always be determined exactly. Critical points are, for example, post spacing, changes in direction, placement angle of the rope anchors, and the direction and velocity of impact.

Geobrugg can assist with estimating the influence of larger deviations and special situations and can offer recommendations for feasible solutions. Geobrugg cannot, however, guarantee the same behaviour as in the 1:1 rockfall tests. In critical cases, it is advisable to reinforce particular components as compared with the standard barrier.

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EXPLANATIONS OF THE SYMBOLS USED



Safety note: Must be followed



Note / reminder so that the system is easily and properly installed as well as maintained



Consultation with Geobruigg is recommended



Upslope



Downslope

1 HAZARD NOTES

QUALIFICATION OF THE GROUP LEADER



Only a qualified group leader may be put in charge of the maintenance.

TENSIONED ROPES



Ropes will be tensioned. When installing and pretensioning ropes, ensure that there are no persons within in the danger area.

RELEASING TENSIONED PARTS



Releasing or separating tensioned parts should be avoided wherever possible. If this is necessary, however, please exercise the utmost caution.

2 LIFESPAN

2.1 Lifespan of the components in general

2.1.1 Individual parts

The lifespan of an individual part is defined by its load-bearing capacity. This includes e.g. the ropes, the rod anchors, the securing splints for the U-brake bolts etc.

2.1.2 Assemblies

The lifespan of an assembly is defined by its load-bearing capacity as well as by its mechanical functional efficiency. Typical assemblies include e.g. the installed barrier itself, the U-brakes and the running wheel groups.

2.1.3 Safety factors



If the functional efficiency or load-bearing capacity of the components is reduced as a result of damage or corrosion, such that the minimum required safety factors can no longer be fulfilled, the components must be replaced.



In order to ensure that no damage or advanced corrosion impairs the functional efficiency or load-bearing capacity of the components such that the minimum required safety factors can no longer be fulfilled, regular inspections of the barriers must be carried out.

3.1 Regular inspections

The first inspection is the factory acceptance. During the factory acceptance, the signature of the expert from the manufacturer GEOBRUGG confirms the professional installation of the flexible safety structure and the legal warranty for the work begins in full. We would like to point out that construction and/or assembly errors can lead to functional errors which have a negative effect on the protective effect of the entire securing structure.

3.1.1 Interval for regular inspections

The appropriate interval depends primarily on the following parameters:

- Frequency of rockfall
- Corrosion class of the region / microclimate
- Vegetation
- Weather events

3.1.2 Minimum number of inspections

Under normal environmental conditions, one inspection per year is sufficient. If rockfall occur frequently, more inspections are appropriate. These should be carried out before the onset of winter or after the end of winter.

Digital monitoring devices on the flexible safety structures, such as the GUARD from Geobrugg AG, provide 24/7 access to the most important information about the current condition of the barrier, and any necessary maintenance measures can be reliably defined. GUARD ensures that the condition of the flexible safety structures is monitored between inspections.

Further information on our website www.geobrugg.com/guard

A useful aid for the systematic checking of the barrier is the “Barrier Inspection” checklist in the Annex.

3.2 Inspection following incidents



An inspection must be carried out immediately following any notified or recorded incidents.

A useful aid for the systematic checking of the barrier is the “Barrier Inspection” checklist in the Annex.

3.3 Accessibility



The barrier must be accessible so that all the components to be checked can be inspected without the risk of accidents. The infrastructure required for this depends on the terrain.

4 CRITERIA FOR REPAIR AND REPLACEMENT



If the functional efficiency or load-bearing capacity of the components is reduced as a result of damage or corrosion, such that the minimum required safety factors can no longer be fulfilled, the components must be replaced. In order to be able to assess the condition and effectiveness of these flexible safety structures, a basic knowledge of the individual components, their function and the interaction as an overall system is required. This is what the CONSYS expert course offered by Geobruigg AG teaches. More information on the requirements for participation and registration at <https://www.geobruigg.com/en/Training-for-experts-167821,104865.html>

On the current expert database of our website you will find the certified experts with their main topics, certainly also in your area: https://www.geobruigg.com/en/Expertdatabase-172717.html?formular_submit=1

4.1 Debris in the barrier



Any debris that accumulates in the barrier should not exceed a maximum of a third of the barrier height. Routine clearing of the barriers is essential to ensure unimpeded functioning.

4.2 Remaining usable height following an incident

The remaining usable height of the barrier following an incident is an initial indicator of the level of damage that has occurred. Clear sagging of the support rope or the net and a significant change in the angle of the posts indicate an elongation of one or more U-brakes, which may need to be replaced.

4.3 U-brake

In the course of the EOTA certification tests, depending on their installation position the U-brakes became elongated to varying degrees. Accordingly, following several minor incidents their energy absorption capacity for a subsequent maximum incident varies.

Type	Maximum Elongation before replacement
U-150	30 cm
U-300	60 cm
U-400 / U-500	80 cm

If the initial elongation exceeds this value, the brake must be replaced. Once the U-brakes have become elongated, the usable height of the barrier has decreased. By re-tightening the support ropes, the usable height can be restored to its original value.

4.4 Meshes and nets

Even in the case of distorted wires or strands, as a rule it is not necessary to replace whole fields.

4.4.1 TECCO

If there are compressed, heavily distorted or torn mesh loops, these areas should be repaired.

4.4.2 SPIDER

If there are compressed, heavily distorted or superficially or completely torn mesh loops, these areas should be repaired.

4.4.3 ROCCO

If individual wires have slipped out of a clip, they should be secured with a wire rope clip of a suitable size.

If there are compressed, heavily distorted, superficially or completely torn rings, these areas should be repaired.

4.4.4 Wire mesh

If there are compressed, heavily distorted or torn mesh loops, these areas should be repaired.

4.5 **Ropes as per the rope assembling drawings**

4.5.1 Corrosion

Replacement of the rope, or a section thereof, is necessary if more than approx. 10% of the cross-section is affected.

4.5.2 Mechanical damage

Mechanical damage is indicated by sharp kinks and squashed or torn outer wires. Within a few years, the rope becomes brittle and loses the required load-bearing capacity. In cases of doubt, a section of the rope must be cut out in order to test the breaking strength of the rope. In the event of a poor test result, the entire rope must be replaced. If one or more strands are torn, the rope, or this section thereof, must be replaced.

4.6 **Posts**

The posts hold the upper support ropes at the corresponding height and thus determine the usable height of the barrier. Slightly bent posts up to an angle of 15° do not need to be replaced.

4.7 **Hinge bolt between post and base plate**

In the event of impacts into the post, the hinge bolt between the post and the base plate may be bent or broken (predetermined breaking point, in order to avoid damage to the base plates and anchors). Bent or broken hinge bolts must be replaced.

4.8 **Base plate**

Plastic deformations to the base plate do not impair the functioning of the base plate significantly. Attention should therefore be focused on the weld seams. If weld seams are torn, the base plate must be replaced.

4.9 **Rod anchor of the base plate or post foot**

If a rod anchor (GEWI anchor) is significantly bent (>15°), if cracks are visible, or if the anchor is pulled out of the ground by more than 3cm, it must be replaced, since under certain circumstances its load-bearing capacity may no longer be sufficient.

4.10 **Spiral rope anchor**

Spiral rope anchors need only be replaced if there is serious damage to wires. If a steel pipe of an anchor head is damaged, this does not reduce the loading limit. However, this may lead to a shorter lifespan, because of the reduced corrosion protection. If the anchor is pulled out of the ground by more than 3 cm, it must be replaced, since under certain circumstances its load-bearing capacity may no longer be sufficient.

5 CLEARING THE BARRIER

Various methods may be used for clearing stones, rubble or soil from rockfall barrier systems. The optimum method depends on the local framework conditions and the quantity and type of material in the nets.



A filled barrier is always under tension. The greatest care should be taken when releasing or separating components.

The barrier can be cleared using hand tools or a machine (e.g. a front-loader or similar). Care must be taken that the net is not damaged, and it must be ensured that stones rolling down the slope do not cause any damage (see illustration below).

Dug channels or large plastic pipes are useful for directing stones, debris and rubble safely towards the valley.



Lowering stones safely (secured with a rope)

5.1 Breaking stones down

Large blocks that cannot be lifted out or transported away must be broken down. Depending on the situation, the following methods can be considered:

- Manual
- Explosives (see following illustration)
- Expanding cement (“cold explosives”). For this, the stones are drilled into and filled with the “propellant” (e.g. that manufactured by Betonamit) and water is added. After about one day, the stone is broken and can be cleared away.



Breaking a block down using explosives

If a crane is available, the stones can be fitted with a haulage anchor and brought down to the valley safely.



Fitting the block with haulage hooks



Lifting the block out with the aid of a crane

The following tools should be kept available for servicing:

- One or two six-meter ladders
- Two cable pulley devices with 30 kN tensile strength (e.g. HABEGGER)
- Two cable winch hoist, with 7.5 kN tensile strength (e.g. LUG-ALL®)
- Various slings, each 1 meter in length
- Shackles according the barrier type
- Torque wrench, range 25 – 400 Nm (see tightening torque required for wire rope clips and base plate fastening nuts)
- Socket wrench set with ratchet or open-ended wrench set
- Hammer, flat-nose pliers, roll of adhesive tape
- Auxiliary ropes
- 30 – 50 m measuring tape
- Inclinator
- Cutting-Off wheel
- Two rope clamps, small 8 – 16 mm
- Four rope clamps, large 14 – 26 mm

7 USE OF WIRE ROPE CLIPS



Wire rope clips have to be retightened biannually until the settlement behaviour has finished.



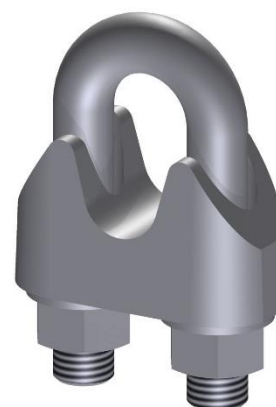
In 2016 Gebrugg switched from wire rope clip EN 13411-5 type 1 to type FF-C-450 type 1 class 1. It is important to use the correct installation details.

7.1 Type EN 13411-5 type 1 (old type)

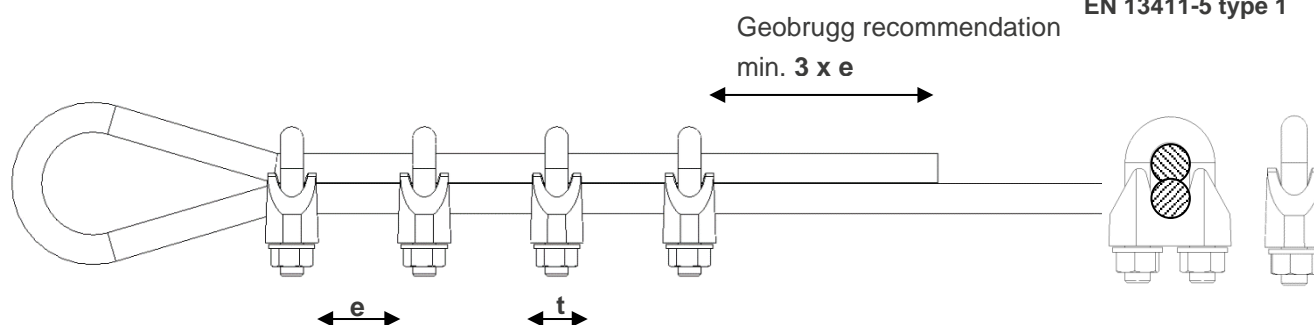
The distance e between the wire rope clips should be at least $1.5 \times t$ but no more than $3 \times t$, where t is the width of the clamping jaws.

If you are using a thimble in the loop structure, the first wire rope clip must be attached directly to the thimble.

The clamping brackets (U brackets) must always be fitted to the unstressed end of the rope and the clamping jaws (saddle) must always be fitted to the stressed rope (“never saddle a dead horse”).



EN 13411-5 type 1



Tab. 1

Nominal size ^{*)} [mm]	Distance “e” [mm]	Required tightening torque ^{**)} [Nm]	Required number of wire rope clips	Width across flats [mm]
13	50 - 80	35	4	19
16	50 - 90	55	4	22
19	50 - 90	75	4	22
22	50 - 90	120	5	24
22 GEOBINEX	50 - 90	120	10	24

^{*)} Nominal size describes max. rope diameter

^{**)} Only applies to lubricated wire rope clips

When establishing the connection and before commissioning, the union nuts must be tightened to the tightening torque specified in the table.

The recommended tightening torques apply to wire rope clips with lubricated bearing surfaces and nut threads.

After the control structure has been installed, check and readjust the tightening torque of the rope connections again.

The recommended tightening torques are 10% higher than the torques specified in the standard. This is because of the tolerance that applies in standard torque wrenches.

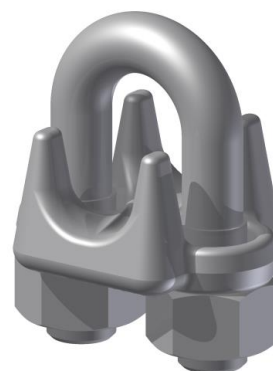
7.2 Type FF-C-450 type 1 class 1 (new type)

Instructions below apply to all wire rope clips according FF-C-450 type 1 class 1 (similar EN 13411-5 type 2) delivered by Geobrugg AG.

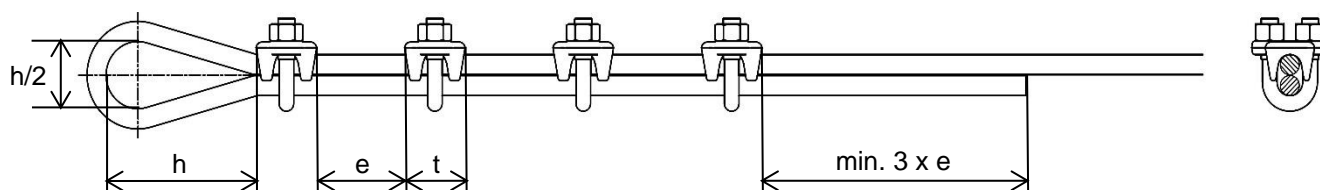
The distance e between the wire rope clips should be at least $1 \times t$ but not exceed $2 \times t$, where t is the width of the clamping jaws. The loose rope end has to be $3 \times e$ at a minimum. Geobrugg recommends looping up the remaining free section and fixing it directly behind the last wire rope clip on the tightened rope.

If you are using a thimble in the loop structure, the first wire rope clip must be attached directly next to the thimble. For loops without a thimble the length h between the first wire rope clip and the point of load incidence must minimally be 15-time the nominal diameter of the rope. In unloaded condition the length h of the loop should be not less than the double of the loop width $h/2$.

The clamping brackets (U-brackets) must always be fitted to the unstressed end of the rope, the clamping jaws (saddle) must always be fitted to the strained rope („never saddle a dead horse“).



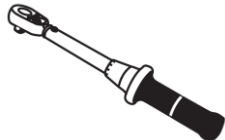
FF-C-450 type 1 class 1



The required tightening torques with lubrication apply to wire rope clips whose bearing surfaces and the threads of the nuts have been greased with Panolin CL 60 multipurpose lubricant spray (or an equivalent lubricant).

During tightening the nuts have to be tensioned equally (alternately) until the required tightening torque is reached.

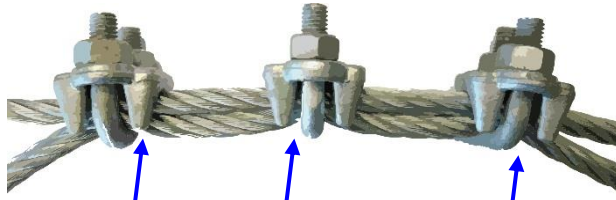
Wire rope diameter [mm]	Size of the wire rope clip	Required amount of wire rope clips	Required tightening torque lubricated [Nm]	Required tightening torque unlubricated [Nm]	Wrench size [mm]
3 - 4	1/8"	2	4	8	10
6 - 7	1/4"	2	10	25	15
8	5/16"	3	20	50	18
9 - 10	3/8"	3	30	75	19
11 - 12	7/16"	3	40	110	22
14 - 15	9/16"	3	50	150	24
16	5/8"	3	90	170	24
18 - 20	3/4"	4	90	180	27
22	7/8"	4	150	330	32
22 GEOBINEX	7/8"	5	150	330	32



After the first load application the tightening torque has to be checked and if not fulfilled adjusted to the required value.



A visible contusion of the wire ropes positively indicates that the wire rope clips have been tightened to the required tightening torque.



Undamaged wire rope clips could be reused. Especially the threads and clamping jaw have to be checked.



Wire rope clips always have to be installed and used with the required tensioning torque.

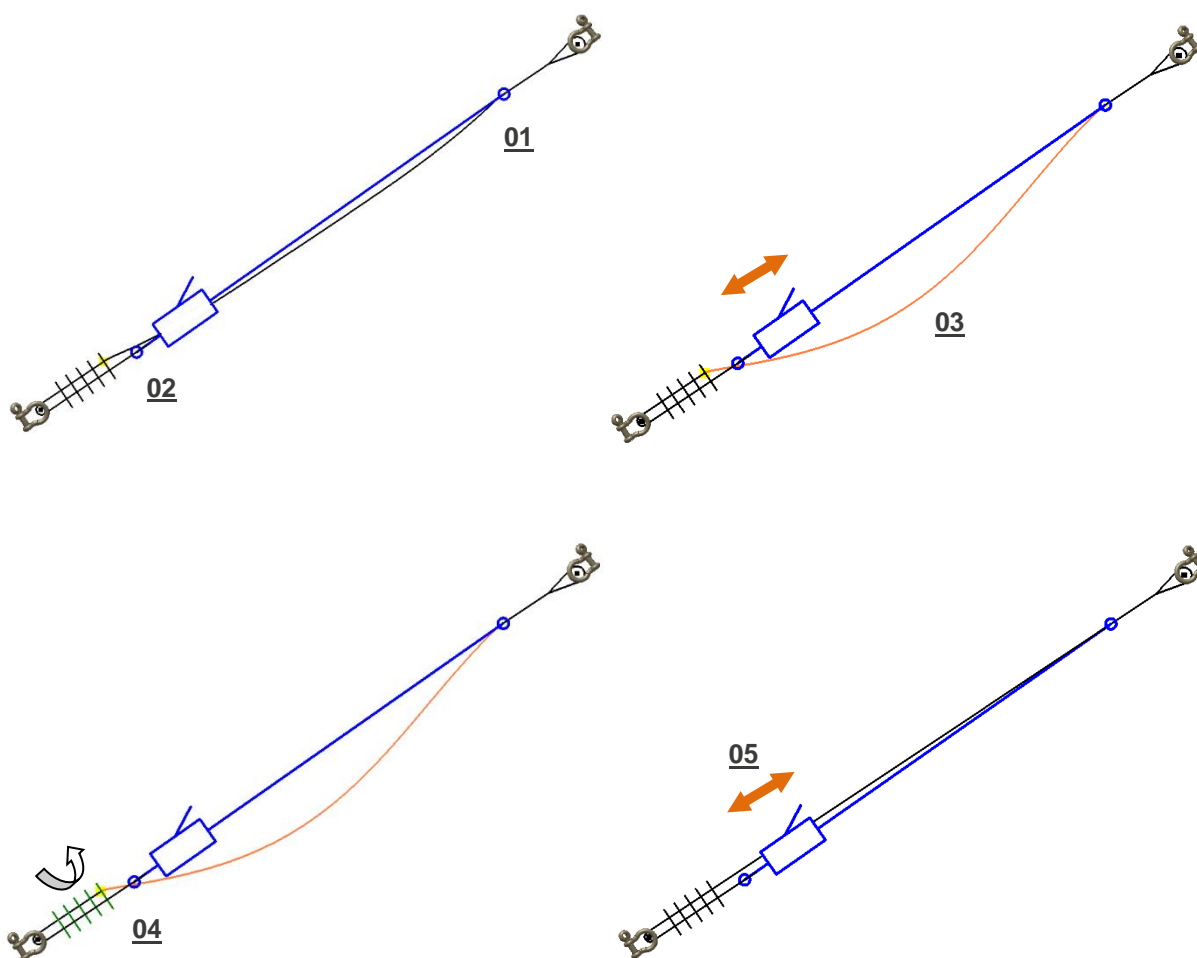
8 REPAIRING AND REPLACING COMPONENTS

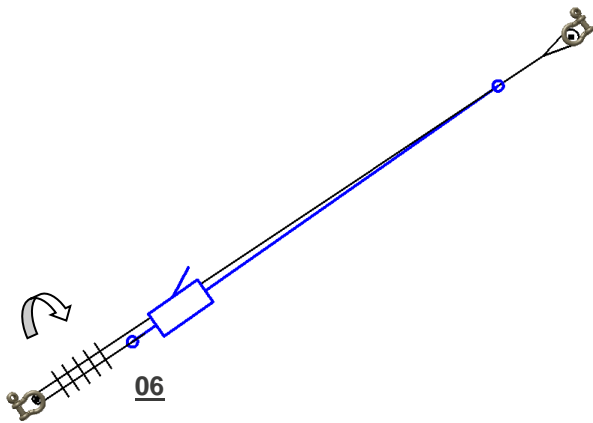
8.1 Geometrical arrangement of the components



When carrying out repairs, the geometrical condition of the barrier must be restored to match that on initial acceptance. If this is no longer possible, a technically acceptable solution must be agreed with Geobru gg. The correct geometrical arrangement of the individual components can be found in the product manual.

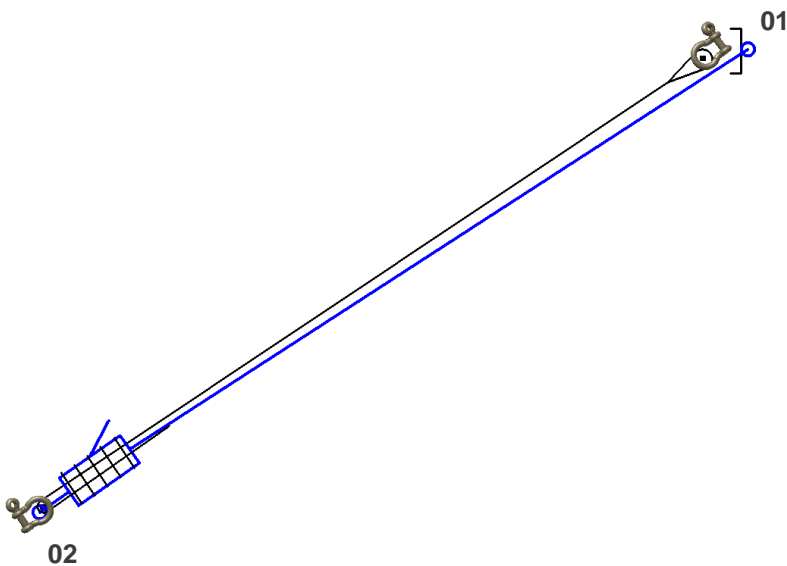
8.2 Tightening sagging ropes





- Fasten the clips of the cable pulley device on the rope **01** and its shackled end loop **02**.
- Actuate the cable pulley device until it is taut **03**.
- Release the wire rope clips of the rope **04**.
- Actuate the cable pulley device until the rope is tightened as desired **(05)**.
- Tighten the wire rope clips of the rope with the required tightening torque **(06)**.
- Detach the cable pulley device.

8.3 Replacing ropes



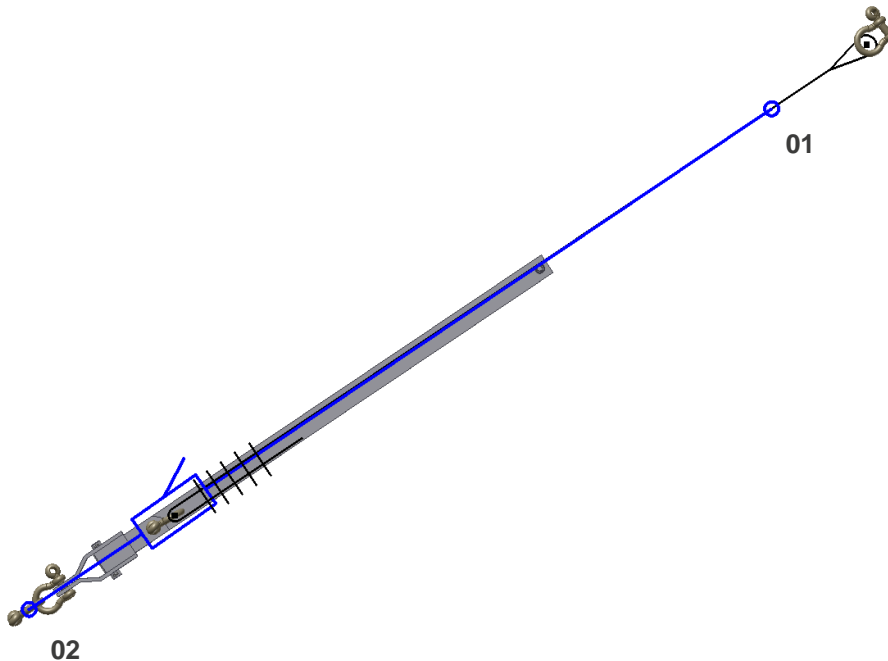
- Fit the clips of the cable pulley device to the post (e.g. with the auxiliary strap) **01** and to the fastening of the U-brake (e.g. rope anchor) **02**.

Carry out the remaining steps as described in section 8.2:

- Actuate the cable pulley device until the rope that is to be replaced is loose.
- Release the wire rope clips of the rope and remove them.
- Fit the new rope.
- Tighten the wire rope clips for the new rope with the required tightening torque.

- Release the cable pulley device so that the tensile force is transferred to the new rope.
- Detach the cable pulley device.

8.4 Replacing U-brakes



- Fit the clips of the cable pulley device to the rope of the U-brake 01 and the fastening of the U-brake (e.g. rope anchor) 02.

Carry out the remaining steps as described in section 8.28.1:

- Actuate the cable pulley device until the entire tensile force is on the cable pulley device.
- Remove the shackle of the U-brake from the loop of the rope.
- Replace the U-brake and return the shackle to the loop.
- Release the cable pulley device so that the tensile force is transferred to the U-brake rope.
- Detach the cable pulley device.

8.5 Repairing nets and meshes

8.5.1 TECCO: repairing smaller mesh areas

If the mesh loops of a smaller mesh area have been pulled along in sympathy, a correspondingly small mesh can be laid over the damaged area and fastened to the intact mesh loops with shackles.

Care must be taken to ensure that the mesh loops are aligned horizontally as they are for intact meshes.

8.5.2 SPIDER: repairing smaller net areas

If the mesh loops of a smaller net area have been pulled along in sympathy, a correspondingly small net can be laid over the damaged area and fastened to the intact mesh loops with shackles.

Care must be taken to ensure that the mesh loops are aligned horizontally as they are for intact meshes.

8.5.3 ROCCO: repairing smaller net areas

If the rings of a smaller net area have been pulled along in sympathy, a correspondingly small net can be laid over the damaged area and fastened to the intact rings with shackles.

Care must be taken to ensure that each ring has four connection points to the next ring.

8.5.4 Secondary mesh: repairing smaller mesh areas

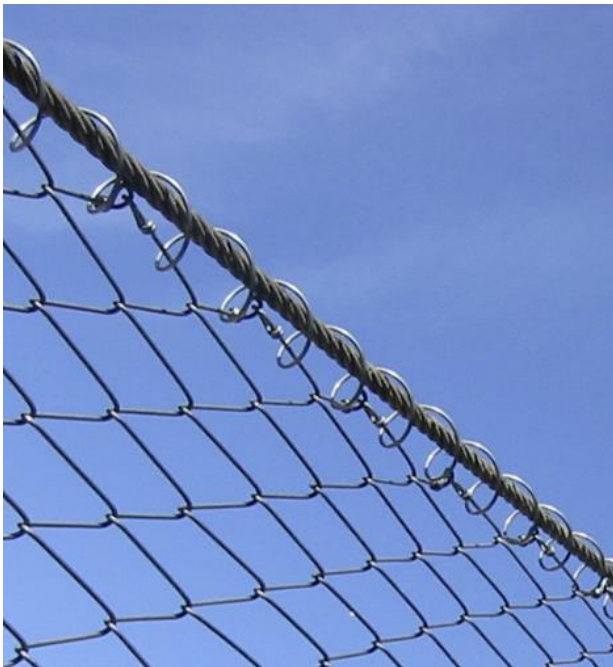
If the mesh loops of a smaller mesh area have been pulled along in sympathy, a correspondingly small mesh can be laid over the damaged area and fastened to the intact mesh loops with wire binders.

8.6 Replacing nets and meshes

8.6.1 TECCO: replacing a mesh field

As a basic principle, TECCO meshes are replaced in the same way as SPIDER nets. The replacement procedure is described in detail in 8.6.2 below.

- a) Relieve the strain on the outermost spiral of the damaged area.
- b) Open up the eyelet connection of the outermost spiral.
- c) Unscrew the outermost spiral. ⇒ A separation is produced in the mesh area.
- d) Cut open the mesh loops of the damaged mesh along the support rope and remove the damaged mesh.



- e) Fasten the mesh loops of the new mesh to the support ropes with HELIX spirals (or shackles).
- f) Connect the new mesh to the intact adjacent meshes with a TECCO spiral (or with shackles).
- g) Connect the eyelets of the two TECCO spirals with a shackle and remove the strain relief.

8.6.2 SPIDER : replacing a net field

The SPIDER net is replaced by unscrewing the outermost spirals of the damaged area, inserting the new net, and joining this to the intact nets with two new spirals (or with shackles).



a) Relieve the strain on the outermost spiral of the damaged area



b) Cut open the eyelet connection of the outermost spiral



c) Unscrew the outermost spiral



A separation is produced in the net area

- d) Cut open the mesh loops of the damaged net along the support rope and remove the damaged net.
- e) Fasten the mesh loops of the new net to the support ropes with shackles.



f) Connect the new net to the intact adjacent nets with a spiral (or with shackles).



g) Connect the eyelets of the two spirals with a shackle and remove the strain relief.



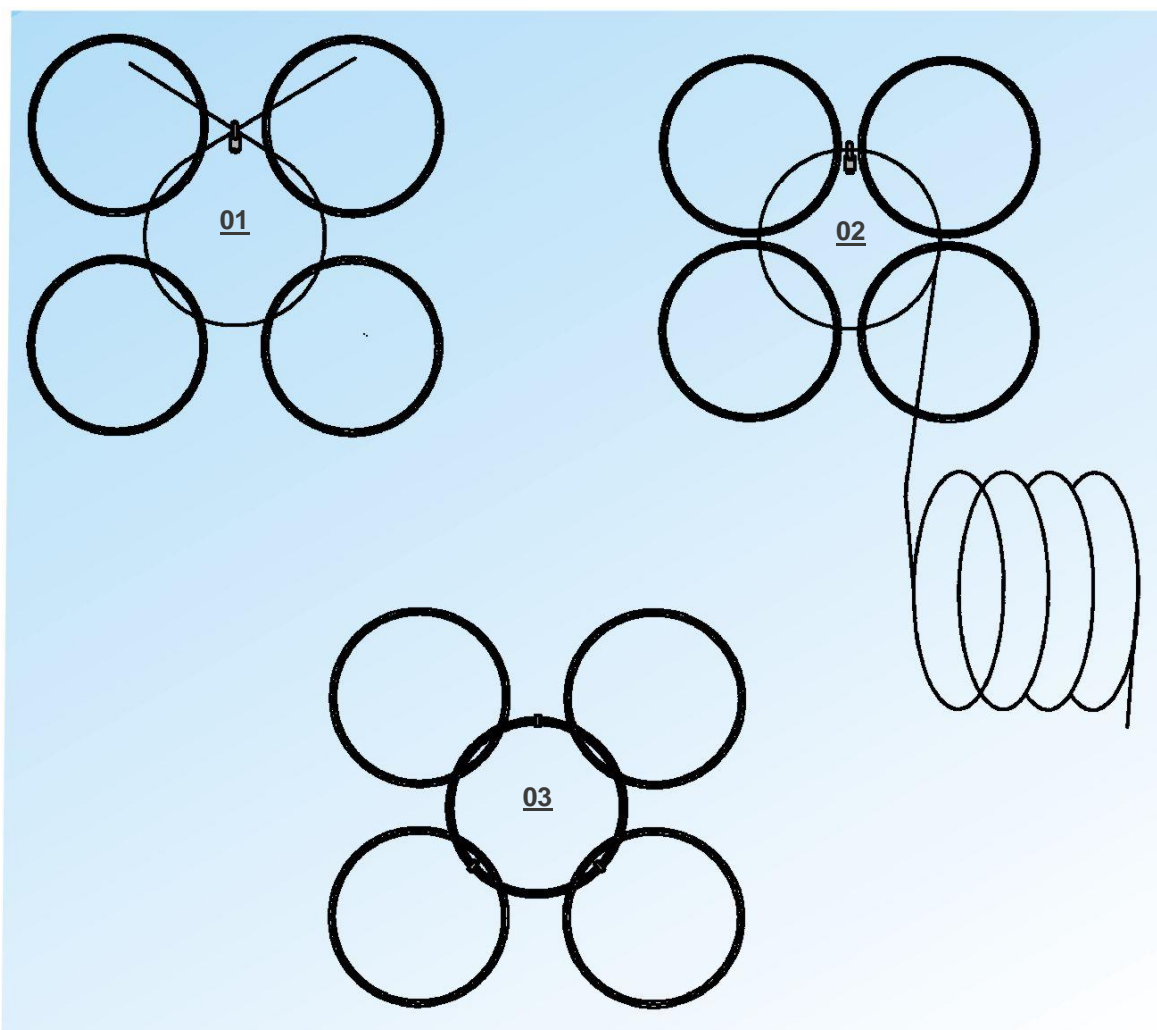
8.6.3 ROCCO: replacing individual rings



The easiest way to replace individual rings is by fitting a replacement ring into the net with shackles. Corresponding prefabricated rings can be obtained via Geobrugg. The new ring is fastened to the adjacent rings with four shackles before the damaged ring is cut out.

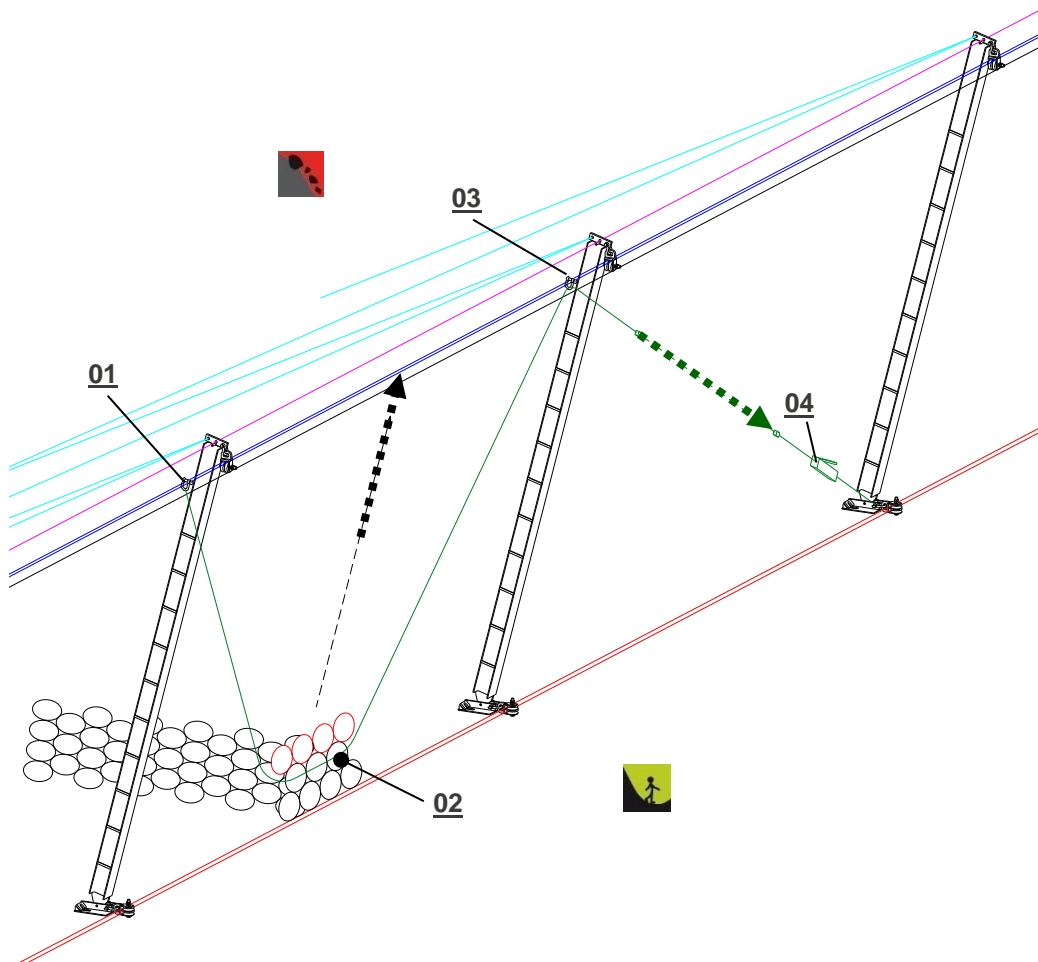
If a ring is to be incorporated into the net, the following procedure is recommended:

- a) Pull a piece of rope with a diameter of 4-8 mm through the 4 rings adjacent to the damaged ring and tighten it such that its diameter becomes smaller than that of the ring that is to be replaced.
- b) Secure the piece of rope that has been threaded through with a wire rope clip **01**.
- c) Guide a piece of wire with a diameter of 3 mm and a tensile strength of at least 1770 N/mm² along the piece of rope that was threaded through and through the four rings **02**.
- d) Repeat this until the number of turns of the adjacent rings has been reached.
- e) Fix the circular shape of the resulting ring bundle with three wire rope clips **03** (7 turns: WRC 1/4" / NG 6.5; 12 turns: WRC 5/16" / NG 8; 16 turns: WRC 7/16" / NG 13; 19 turns: WRC 9/16" / NG 16).
- f) Remove the piece of rope that was threaded through.



8.6.4 ROCCO: replacing a net field

- a) Release the shackles to the adjacent nets.
- b) Cut open the rings on the support ropes and the arrestor cables and remove the damaged net.
- c) Lay the replacement net, still bundled, on the mountain side, between the two posts. The rows of rings for the support ropes and arrestor cables are marked in colour. Do not cut open the tied-up rows of rings yet.
- d) Using a shackle, fasten an auxiliary rope to the top support rope next to the adjacent posts **01**, pull it through the rings in the second row of the replacement net **02**, and guide it through a second shackle **03** on the top support rope next to the other post, to the cable pulley device **04**. Tighten the rope until the first row of rings of the net is at the same height as the top support rope. Whilst pulling up, gradually cut open the tied-up rows of rings of the net.
- e) Pull up the net like a curtain, and, using the corresponding shackles, join the net rings to the support ropes, the adjacent net fields and the arrestor cables.
- f) Take care to ensure that the correct number of rings is fastened to the right and left of the post, not on the support ropes, but on the U-Ropes. Detailed information can be found in the corresponding product manual.



8.6.5 Wire mesh: replacing a length of mesh

- a) Cut open the wire binders of the damaged length of mesh and remove the length of mesh.
- b) Restore the geometric state of the barrier by e.g. tightening ropes, replacing U-brakes, etc.
- c) Using wire binders, fasten the new length of mesh to the main net in accordance with the product manual.

8.7 **Repairing ropes**

As a basic principle, ropes are replaced rather than repaired.

8.8 **Replacing ropes**

Ropes must be replaced if the rope is damaged according to section 4.5. Often, only the elongated U-brakes need to be replaced.

Depending on the situation, replacement is done in accordance with sections 8.2 / 8.3 / 8.4.

The required tightening torques are listed in section 7.

8.9 **Replacing posts**

8.9.1 Replacing middle posts

In most cases, the middle post can be replaced without dismantling the net or the ropes.

- a) Secure the faulty post with auxiliary ropes.
- b) Dismount the shackle with the running wheel on the post head.
- c) Remove the hinge bolt of the post.
- d) Lift the post out of the base plate using a winch, and place it, secured, on the ground on the mountain side.
- e) Transfer the retaining ropes from the faulty post to the new post.
- f) Place the post foot into the base plate and fit the hinge bolt.
- g) Erect the post in a secured manner.
- h) Refit the running wheel to the post head.
- i) Remove the securing ropes.

8.9.2 Replacing edge posts

The lateral ropes brace the entire barrier via the edge posts on the slope. It is therefore essential to loosen the lateral ropes when replacing an edge post. Depending on the situation, the subsequent middle posts can be used to perform the function of the edge posts during repairs. In this case, the middle post is secured on the valley side and the lateral ropes are fixed to the middle post using suitable equipment. The edge post is then replaced as described in section 8.9.1. If this is not possible, a certain number of fields or the entire barrier must first be laid securely facing up the mountain until the edge post can be replaced.

8.10 Replacing the hinge bolt between post and base plate

The post is raised using a winch and the faulty bolt is removed and replaced by a new hinge bolt.

8.11 Replacing a base plate

It is not possible to replace a base plate while it is still connected to the post. For this reason, first of all the post is removed as described in section 8.9. The running wheel of the bottom support rope is also dismantled. The faulty base plate is then replaced by a new one and the barrier is refitted.

8.12 Replacing base plate anchors

Replacing base plate anchors requires the base plate and the post to be removed in accordance with section 8.9 / 8.10 / 8.11. Depending on the type of damage to the foundation or the anchors, it may be necessary to recreate the foundation in a suitable location nearby in accordance with the product manual and the anchor forces sheet.

8.13 Replacing spiral rope anchors

To replace a rope anchor, it must first be relocated in a suitable location nearby in accordance with the product manual and the anchor forces sheet.

9 FINAL CHECK

After servicing has been completed, above all the following points must be checked:

- a) Are the support ropes and arrestor cables, as well as the lateral bracing, joined to the correct anchors?
- b) Are the rope guides at the foot and head of the post laid out correctly?
- c) Has the correct number of mesh loops or rings been left free to the left and right of the posts?
- d) Is the net fitted correctly to the support ropes or U-Ropes?
- e) If support ropes have been separated, are the bottom support ropes joined to the corresponding anchor and not to the base plate?
- f) Is the number of wire rope clips on the rope end connections correct?
- g) Are the wire rope clips fitted correctly?
- h) Has the correct tightening torque been applied to the wire rope clips?
- i) Have the nets been connected to one another correctly?
- j) Have the border nets been fastened to the vertical ropes correctly?
- k) Is the slack of the top support rope less than 3% of the post spacing?

“BARRIER INSPECTION” CHECKLIST

This checklist is intended for the inspection of a barrier. Please enter your observations, tick the corresponding boxes, and take photographs or video recordings.

The paragraph numbers next to the boxes (e.g. no. 4.1) are reference numbers for the corresponding description in this maintenance manual.

The paragraph describes the criteria for repair and replacement.

Location:

General remarks:	Impact area:

Objects in the barrier

Leaves / soil / wood	Up to 20 cm	<input type="checkbox"/>	
Rubble / pebbles	> 20 cm	<input type="checkbox"/>	4.1
Stones	Up to 100 kg	<input type="checkbox"/>	
	> 100 kg	<input type="checkbox"/>	4.1
	> 500 kg	<input type="checkbox"/>	4.1/ 4.2
	<input type="checkbox"/>	

Stones up to approx. 35 cm in size

Stones over 60 cm in size

Visible damage:

A) Support and transmission ropes / U-brakes

Deformed rope	Yes	<input type="checkbox"/>	4.5.2
	No	<input type="checkbox"/>	
Net sags between posts	Up to 20 cm	<input type="checkbox"/>	
	> 20 cm	<input type="checkbox"/>	4.2 / 4.3
	> 50 cm	<input type="checkbox"/>	4.2 / 4.3
	> 1 m	<input type="checkbox"/>	4.2 / 4.3
Elongated brakes	Up to 30 cm	<input type="checkbox"/>	4.3
	> 30 cm	<input type="checkbox"/>	4.3
	> 60 cm	<input type="checkbox"/>	4.3
	> 80 cm	<input type="checkbox"/>	4.3

B) Retaining ropes

Deformed rope	Yes	<input type="checkbox"/>	4.5.2
	No	<input type="checkbox"/>	
Angle between post and ground	approx. 70°	<input type="checkbox"/>	
	approx. 80°	<input type="checkbox"/>	4.2 / 4.3
	> 90°	<input type="checkbox"/>	4.2 / 4.3

APPENDIX I

Statement of Professional Opinion on the Suitability of Land for Subdivision

ISSUED BY: ENGEO Ltd
(Geotechnical engineering firm or suitably qualified Geoprofessional)

TO: Christchurch City Council
(Territorial authority)

TO BE SUPPLIED TO: GCO Ltd
(Owner/Developer)

IN RESPECT OF: Residential Subdivison
(Description of infrastructure/land development)

AT: 130 Bowenvale Avenue, Cashmere, Christchurch

(Address)

I Richard Justice on behalf of
(Geoprofessional)
ENGEO Ltd
(Geotechnical engineering firm)

hereby confirm:

1. I am a suitably qualified and experienced Geoprofessional employed by ENGEO Ltd and the geotechnical firm named above was retained by the owner/developer as the Geoprofessional on the above proposed development.

2. The geotechnical assessment report, dated 07/10/2022 has been carried out in accordance with the Ministry of Business, Innovation and Employment *Part D - Guidelines for the geotechnical investigation and assessment of subdivisions in the Canterbury region* and the Christchurch City Council *Infrastructure Design Standard – Part 4: Geotechnical Requirements* and includes:

- (i) Details of and the results of my/the site investigations.
- (ii) A liquefaction and lateral spread assessment.
- (iii) An assessment of rockfall and slippage, including hazards resulting from seismic activity.
- (iv) An assessment of the slope stability and ground bearing capacity confirming the location and appropriateness of building sites.
- (v) Recommendations proposing measures to avoid, remedy or mitigate any potential hazards on the land subject to the application, in accordance with the provisions of Section 106 of the Resource Management Act 1991.



LANDSCAPE CONCEPT PLAN

130 BOWENVALE AVENUE SUBDIVISION
FOR S5 CONSULTING GROUP

24 October 2023
Project no. 2022_053
REVISION D



LEGEND

- A Asphalt Road
- B Flush paving
- C 1.5m Asphalt Footpath
- Existing Tree
- - - Site Boundary
- Proposed Tree
Totara (*Podocarpus totara*)
- Grass / Berm
- Flow Path / SW Planting
- Streetscape Planting
190m²
- Proposed 1.5m high 'rod top' open style fence (replace existing fence)
- Possible entrance sign location
- Approximate location of rockfall fence



A. LANDSCAPE CONEPT PLAN

client / project name: S5/ 130 BOWENVALE AVE SUBDIVISION
drawing name: LANDSCAPE CONCEPT PLAN
designed by: CD/CG
drawn by: CD/CG
original issue date: 6/12/2022
scale: NOT TO SCALE

revision no:	amendment:	approved	date
A	FOR COMMENT	CG	6/12/2022
B	ROCKFALL FENCE ADDED	CG	16/12/2022
C	NOTES ADDED	CG	09/02/2023
D	RFI UPDATES	CG	24/10/2023



DCM URBAN DESIGN LIMITED
10/245 ST. ASAPH STREET
CHRISTCHURCH 8011
WWW.DCMURBAN.COM

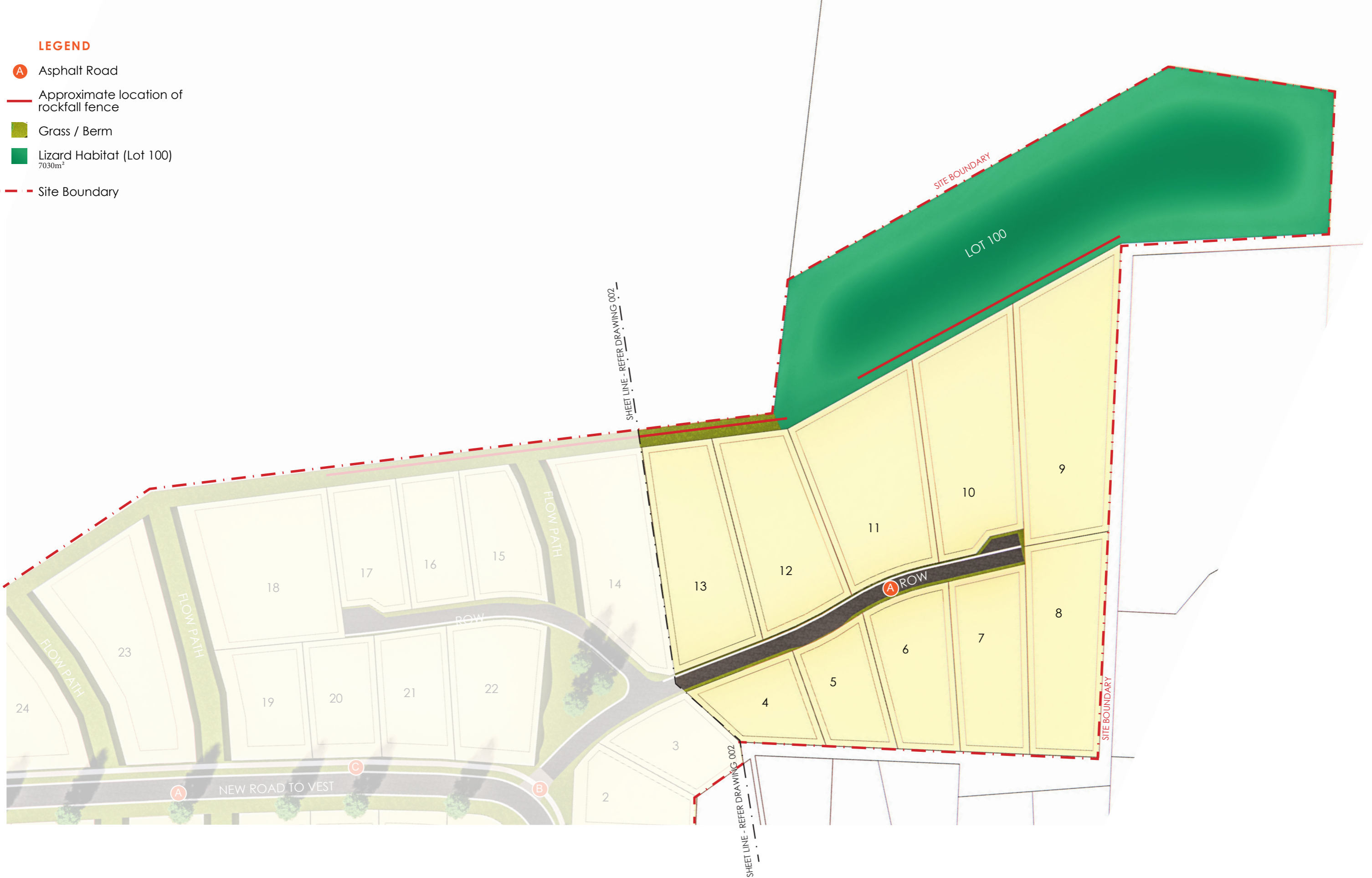


project no / drawing no: **2022_053 / 002**

revision: D

LEGEND

- Ⓐ Asphalt Road
- Approximate location of rockfall fence
- Grass / Berm
- Lizard Habitat (Lot 100)
7030m²
- - - Site Boundary



A. LANDSCAPE CONEPT PLAN

client / project name: S5/ 130 BOWENVALE AVE SUBDIVISION
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project no / drawing no: **2022_053 / 003**

revision: D

ROAD LANDSCAPE SHRUBS, GRASSES AND GROUNDCOVERS



NZ Iris
(*Libertia ixiodes*)



Silver tussock
(*Poa cita*)



Pohuehue
(*Muehlenbeckia axillaris*)



Miniature toetoe
(*Chionochloa flavicans*)



Koromiko / Hebe
(*Hebe 'Wiri Mist'*)



Wind Grass
(*Anemanthele lessoniana*)



Totara
(*Podocarpus totara*)

STORMWATER FLOW PATHS SHRUBS, GRASSES AND GROUNDCOVERS



Koromiko / Hebe
(*Hebe strictissima*)



Mountain flax
(*Phormium cookianum*)



Silver tussock
(*Poa cita*)



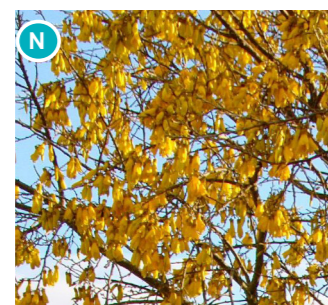
Cabbage Tree
(*Cordyline australis*)



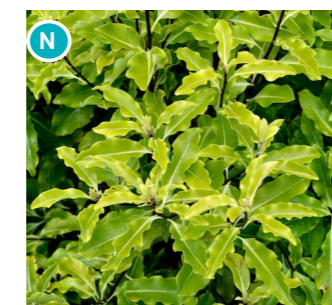
Lancewood
(*Pseudopanax crassifolius*)



Kanuka
(*Kunzea robusta*)



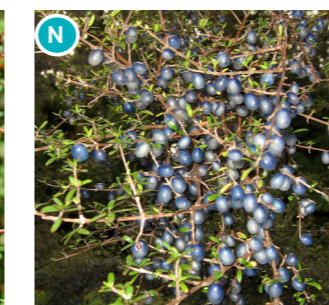
South Island kōwhai
(*Sophora microphylla*)



Tarata Lemonwood
(*Pittosporum eugenoides*)

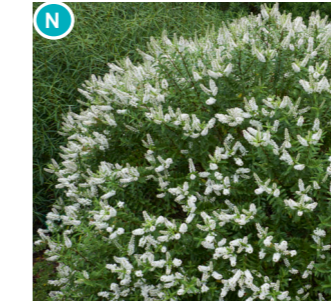


shrub pohuehue
(*Muehlenbeckia astonii*)



Mingimingi
(*Coprosma propinqua*)

STORMWATER LOT 2000 SHRUBS, GRASSES



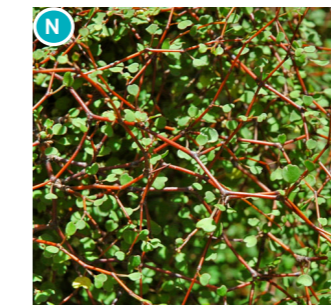
Koromiko / Hebe
(*Hebe strictissima*)



Mountain flax
(*Phormium cookianum*)



Lancewood
(*Pseudopanax crassifolius*)



shrub pohuehue
(*Muehlenbeckia astonii*)



Silver tussock
(*Poa cita*)



Tarata Lemonwood
(*Pittosporum eugenoides*)

A. PLANT PALETTE

client / project name: S5/ CASS BAY SUBDIVISION
drawing name: MATERIAL AND PLANT PALETTE
designed by: CD / CG
drawn by: CD / CG
original issue date: 10/10/2022
scale: NOT TO SCALE

revision no:
A
B
C
D

amendment:
FOR COMMENT
ROCKFALL FENCE ADDED
NOTES ADDED
RFI UPDATE

approved
CG
CG
CG
CG

date
6/12/2022
12/12/2022
09/02/2023
24/10/2023



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project no / drawing no: 2022_053 / 004

revision: D

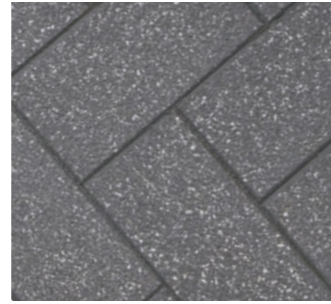
MATERIALS



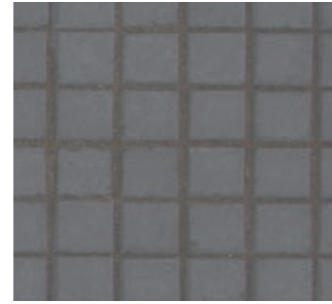
Asphalt
(Carriageway/ footpath)



Crusher Dust grit path
(Informal footpath)



Holland Paving -
Hammered Finish, 45
degree herringbone
pattern, Colour -TBC
(Flush threshold in
carriageway)



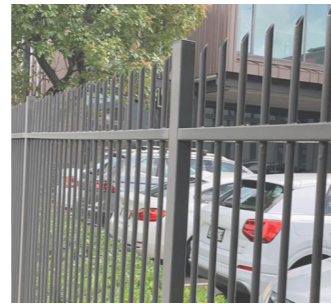
Holland Sett Paving -
Plain Finish, 90 degree
herringbone pattern,
Colour - TBC
(Flush threshold in
carriageway)



Split face basalt
columns
(Bridge entrance)



Corten Entrance Sign
(Fixed to gabion basket
retieing wall)



Open styele fence with
Rod Top
(Boundary fecning for
Stormwater Lot 2000)

LIZARD HABITAT LOT 100 SHRUBS, GRASSES



Mingimingi
(*Coprosma propinqua*)



Karamu
(*Coprosma robusta*)



Pōhuehue
(*Muehlenbeckia complexa*)



Porcupine Shrub
(*Melicytus alpinus*)



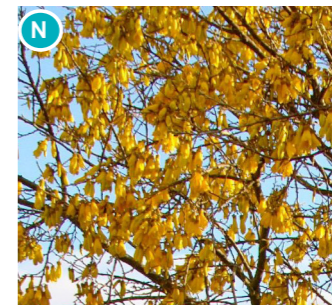
Toetoe
(*Austroderia richardii*)



Large-leaved pōhuehue
(*Muehlenbeckia australis*)



Common Broom
(*Carmichaelia australis*)



South Island kōwhai
(*Sophora microphylla*)



Lancewood
(*Pseudopanax crassifolius*)



Miniature Toetoe
(*Chinochloa flavicans*)



Broad-leaved Poa
(*Poa anceps*)

*Lizard habitat plant list to be confirmed by herpetologist

A. HARDSCAPE MATERIALS & LIZARD HABITAT PLANT PALETTE

client / project name: S5/ CASS BAY SUBDIVISION
drawing name: MATERIAL AND PLANT PALETTE
designed by: CD / CG
drawn by: CD / CG
original issue date: 10/10/2022
scale: NOT TO SCALE

revision no:	amendment:	approved	date
A	FOR COMMENT	CG	6/12/2022
B	ROCKFALL FENCE ADDED	CG	12/12/2022
C	NOTES ADDED	CG	09/02/2023
D	RFI UPDATE	CG	24/10/2023



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project no / drawing no: 2022_053 / 005

revision: D



130 Bowenvale Avenue

Ecological Management Plan

Prepared for GCO Group
Prepared by Beca Limited

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20 October 2023



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everyday
better.

Creative people together transforming our world

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Appendices

Appendix A – Incidental Discovery Protocol for Lizards

DRAFT

Revision History

Revision N°	Prepared By	Description	Date
1	Gaby Marshall Sarah Busbridge Sandy Huang Trent Bell	Draft for Client Review	19/10/23

Document Acceptance

Action	Name	Signed	Date
Prepared by	Gaby Marshall Sarah Busbridge Sandy Huang Trent Bell		19/10/23
Reviewed by	Claire Webb		20/10/2023
Approved by	Claire Webb		20/10/2023
on behalf of	Beca Limited		

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1 Ecological Management Plan

S5 Consultants, on behalf of their client Bowenvale GCO Limited, are applying for resource consent to undertake a subdivision and development of 35 residential allotments within a 5.09-hectare site at 130 Bowenvale Avenue, Cashmere, Christchurch.

The proposed development includes the following works:

- Subdivision of 35 lots in four stages and associated earthworks.
- Extension and installation of new infrastructure services.
- The construction of two access roads.
- The construction of a bridge across the existing stormwater and culvert system that will serve as the main access to the subdivision.
- The construction of a rockfall protection area across Lots 100-103.
- Vegetation clearance and landscaping.

Beca Limited (Beca) has been engaged by Bowenvale GCO Limited to prepare an Ecological Management Plan (EMP) for the proposed subdivision. An application for resource consent has been lodged, however a request for further information pursuant to Section 91(1) of the Resource Management Act 1991 (RMA) was issued on 4 of May 2023 and included a request for a Lizard Management Plan (LMP) for the site. The Lizard Management Plan forms Section 2 of this EMP, with other remaining management recommendations outlined in the Assessment of Ecological Effects (AEE) for the site (Wildland Consultants, 2023) are addressed in Section 3 (Avifauna Management Plan), Section 4 (Invertebrate Management Plan) and Section 5 (Restoration Planting Plan).

1.1 Purpose and objectives

The purpose of the Ecological Management Plan (EMP) is to guide the implementation of the effects management recommended in the Assessment of Ecological Effects report that was prepared by Wildland Consultants Limited (Wildlands).

1.2 Roles and responsibilities

Table 1 identifies the roles and responsibilities for the implementation of actions identified in this Ecological Management Plan. Responsibilities for specific actions are also identified in the sections below.

Table 1 Identified project roles and responsibilities for EMP implementation.

Title	Responsibility
Project Owner – Bowenvale GCO Limited	<ul style="list-style-type: none"> • Delivery of the Project, including overall compliance with resource consents, EMP and subsequent WAA conditions to be issued for the project.
Project Engineer(s) – (TBC)	<ul style="list-style-type: none"> • Project engineering, landscape/restoration planning, project management and delivery. • Liaison between contractors and ecologists. • Implementing actions where responsibility has been identified. • Confirm implementation of EMP and WAA requirements. • Confirm compliance with EMP and WAA.

Title	Responsibility
Contractor/Construction Site Manager	<ul style="list-style-type: none"> • Compliance with EMP and subsequent WAA issued for the project. • Implementation of actions required by the EMP and WAA including the following: <ul style="list-style-type: none"> – Reading and understanding the EMP and WAA requirements. – Facilitating a project start-up meeting with the Project Engineers, Project Ecologists and Contractors before construction commences. – Maintaining clear lines of communication with both the Project Engineer, Project Ecologist and Contractors regarding changes to the works schedule. – Implementing actions where responsibility has been identified. – Briefing new personnel about the contractor's responsibilities under this EMP.
Project Ecologist	<p>The Project Ecologist will:</p> <ul style="list-style-type: none"> • Support the implementation of the EMP during construction and design. • Update the EMP as required. • Where necessary, assist with contractor training. • Lead ecological management specified in this EMP and make sure that suitably qualified and experienced personnel under fauna management protocols for lizards, birds and invertebrates. • Complete required compliance and monitoring reporting.
Project Herpetologist – Authorised Personnel on the WAA (Trent Bell)	<p>The Project Herpetologist will:</p> <ul style="list-style-type: none"> • Implement the LMP • Ensure any required WAA permits are attained and on hand during site works. • Where necessary, assist with contractor training specific to lizards. • Undertake salvage site and release site set up in accordance to the LMP. • Implement the salvage programme, capturing, handling, and transferring lizards. • Design and supervise lizard habitat enhancement. • Design and undertake post-release monitoring of lizards. • Complete required compliance and monitoring reporting.
Specialist Contractors – Various companies TBD	<p>The Contractor(s) will be engaged by the Project Owner to implement the Project. The Contractor(s) will report to the Project Engineer; but work daily with the Contractor/ Construction Site Manager.</p> <p>The Contractor(s) will:</p> <ul style="list-style-type: none"> • Set up and operate a pest management regime at the lizard/invertebrate release site. • Implement habitat enhancement requirements at the release site. • Implement remediation requirements, such as rectifying plant establishment failure. • Assist the Project Ecologist with compliance and monitoring reporting.

1.3 EMP structure

This EMP encompasses a suite of management plan units, each tailored to address specific ecological effects identified by Wildland Consultants Limited in the AEE. These smaller management units include:

- Section 2: Lizard Management Plan (LMP)
- Section 3: Avifauna Management Plan (AMP)
- Section 4: Invertebrate Management Plan (IMP)
- Section 5: Restoration and Planting Plan (RPP)

This overarching EMP document brings together the various management plans above, so the management actions are consistent and complementary to each other.

1.4 Associated documents

This EMP has been informed by the following documents:

- Wildland Consultants. (2023). Assessment of Ecological Effects of a Proposed Subdivision at Bowenvale Avenue, Cashmere. Contract Report No. 6587b. Prepared for Bowenvale GCO Ltd.
- Wildland Consultants. (2022). Bowenvale Avenue Subdivision Lizard Habitat Assessment Memo. Prepared for S5 Consulting Ltd.

Summary of Ecological Values and Effects

As outlined above, ecological values identified within the project footprint were initially assessed in the Assessment of Ecological Effects (Wildlands, 2023). These ecological values have been summarised below.

1.5 Ecological context

The proposed Bowenvale residential subdivision (hereafter referred to as 'the site') is located within the Port Hills Ecological District (ED) (McEwen, 1987). Prior to development, vegetation on the northern slopes would have been predominately lowland short tussock land with scattered mixed scrub and flax (*Phormium* sp.). Large patches of podocarp/hardwood forests would have occurred in the main gullies, while mixed hardwood forests covered the ridge crests. Similar vegetation was present on slopes facing Lyttleton, including *Leptospermum* species, flax and larger, continuous areas of gully forest. The district has since been significantly modified for agricultural purposes and urban development.

The site is in an area that is classified under Threatened Environment Classification as having 10-20% indigenous cover left (Cieraad *et al.*, 2015). These environments are characterised by severe indigenous biodiversity loss and only small patches of sparsely-distributed remnant vegetation remain.

1.6 Vegetation

1.6.1 Vegetation values

Vegetation and habitat identification and mapping was undertaken by Wildlands (2023). There were eleven vegetation and habitat types identified across the site, with 43 indigenous and 73 exotic species recorded (Figure 1). The vegetation / habitat types and their extent are summarised in Table 2 below.

Table 2. Vegetation and habitat types identified and mapped on site by Wildland Consultants Limited (2023).

Vegetation / Habitat Type	Extent
Macrocarpa forest	c. 0.43 ha
Crack willow forest	c. 0.23 ha
Tree lucerne forest	c. 0.86 ha
Mixed forest	c. 0.14 ha
(Tree lucerne)-(kōhūhū)/blackberry-gorse-banana passionfruit scrub	c. 1.60 ha
Scrub pōhuehue vineland	c. 0.11 ha
Blackberry-large-leaved pōhuehue gorse vineland/scrub	c. 0.30 ha
Old man's beard vineland	c. 0.04 ha
Japanese honeysuckle vineland	c. 0.04 ha
Cocksfoot-(fennel) grassland	c. 1.97 ha
Mixed exotic grassland herbfield	c. 0.12 ha

The only indigenous-dominated vegetation type on site was identified as scrub pōhuehue (*Muehlenbeckia complexa* var. *complexa*) vineland. This vegetation type was most common towards the southern boundary but was found scattered in patches across the entire project footprint. Overall, the site contained a relatively high number of indigenous species, but these were often isolated individuals growing in habitats dominated by exotic pasture or pest plants.

Additionally, there was a single kānuka (*Kunzea robusta*, Threatened – Nationally Vulnerable) tree identified.

Multiple species listed as pest plants in Environment Canterbury's Regional Pest Management Plan (CRPMP; 2018-2038) or National Pest Plant Accord (NPPA) were also recorded on site (Table 3).

Table 3. Pest plants and Organisms of Interest (PEST, Ool), listed in CRPMP, the NPPA and by councils outside of the Canterbury Region (OC) that were recorded at 130 Bowenvale Drive. Taken from Wildlands Consultants Limited (2023).

Scientific Name	Common Name(s)	Growth Form	Pest Status
<i>Acacia mearnsii</i>	black wattle	tree	OC
<i>Acer pseudoplatanus</i>	sycamore	tree	Ool
<i>Chamaecytisus palmensis</i>	tree lucerne	tree	Ool
<i>Chrysanthemoides monilifera</i>	boneseed	shrub	PEST NPPA
<i>Cirsium arvense</i>	Californian thistle	monocot herb	OC
<i>Clematis vitalba</i>	old man's beard	vine	PEST NPPA
<i>Conium maculatum</i>	hemlock	dicot herb	Ool
<i>Cotoneaster glaucophyllus</i>	bright bead cotoneaster	shrub	Ool
<i>Cytisus scoparius</i>	scotch broom	shrub	PEST
<i>Dryopteris filix-mas</i>	male fern	fern	OC
<i>Iris foetidissima</i>	stinking iris	monocot herb	OC
<i>Lonicera japonica</i>	Japanese honeysuckle	vine	NPPA
<i>Passiflora 'Tacsonia'</i> subgroup	banana passionfruit	vine	PEST NPPA

<i>Rhamnus alaternus</i>	evergreen buckthorn	shrub	NPPA
<i>Rosa rubiginosa</i>	sweet briar, briar rose	shrub	Ool
<i>Rubus fruticosus</i>	blackberry	shrub	Ool
<i>Salix cinerea</i>	grey willow	tree	NPPA
<i>Salix x fragilis</i>	crack willow	tree	NPPA
<i>Tradescantia fluminensis</i>	tradescantia	dicot herb	NPPA
<i>Trachycarpus fortunei</i>	fan palm, hemp palm	tree	OC
<i>Ulex europaeus</i>	gorse	shrub	PEST

1.6.2 Ecological effects and effects management

Most of the vegetation, including all 0.11 ha of scrub pōhuehue vineland, will be cleared as part of works for the subdivision. However, Lot 100 is proposed to be retained behind a rock fall protection fence.

Effects management will be undertaken by replanting native species within any reserve areas created on the site, amenity areas, and within the 10 m wide flow paths designed on the site. Furthermore, Lot 100 will be cleared of existing pest plants, and the resulting gaps will be replanted with native species reflective of plant communities that would have existed on the Port Hills in the past, including Scrub pōhuehue vineland.

The clearance of pest plants from the site and replanting of the suggested areas with native plant species, will result in a net gain for indigenous vegetation.



Figure 1. Vegetation and habitat types identified on site by Wildlands. Source: Wildland Consultants (2023).

1.7 Herpetofauna

1.7.1 Lizard values

Wildlands (2023) undertook both a desktop review and lizard survey for the site. Department of Conservation BioWeb Herpetofauna Database observations within 10 kilometres of the site, within the last 20 years, were assessed by Wildlands to provide context for lizard fauna recorded within the site and inform an assessment of ecological values for the site.

Five lizard species were found in this review of the BioWeb Herpetofauna database records. These include the southern grass skink (*Oligosoma* aff. *polychroma* Clade 5; At Risk - Declining), McCann's skink (*O. maccanni*; Not Threatened), Canterbury spotted skink (*O. lineoocellatum*; Threatened – Nationally Vulnerable), jewelled gecko (*Naultinus gemmeus*; At Risk – Declining), and Waitaha gecko (*Woodworthia* cf. *brunnea*; At Risk-Declining) (Hitchmough et al. 2021).

The site contains potential lizard habitat throughout the site, particularly mixed exotic rank grassland, scrub pōhuehue vineland and rock outcrops. Terrestrial skinks such as southern grass skink or McCann's skink are found in rank grasslands while the mixed indigenous-exotic scrub and treeland on site includes large areas of scrub/scrambling pōhuehue (*Muehlenbeckia complexa* var. *complexa*), large-leaf pōhuehue (*Muehlenbeckia australis*), tree lucerne (*Chamaecytisus palmensis*), blackberry (*Rubus fruticosus*) and gorse (*Ulex europaeus*), which may support jewelled gecko.

A lizard survey was subsequently undertaken of the site by Wildlands (2023). Pitfall trapping was undertaken over four days (three nights) in warm conditions (c.19°C) between 6 December and 9 December 2022 (Wildlands 2023). Forty-seven pitfall traps were set up within the site. These were baited with tinned pear and rank grass was added to protect lizards from desiccation, predation from mice or becoming stressed. The pitfall traps were checked daily. Limited manual searching was undertaken in rock stacks, crevices and under rocks. Pitfall traps were placed throughout the site in representative habitats throughout each stage of the subdivision (Wildlands 2023).

This survey confirmed the presence of McCann's skink (four individuals), and southern grass skink (18 individuals). These two species are present on site within the rank grassland and are widespread throughout the Canterbury region and often persist in areas of complex grassland habitat comprising of rank grass, scrub and woody debris (Wildlands 2023).

Waitaha gecko, jewelled gecko, or Canterbury spotted skink were not recorded during the Wildlands surveys. Wildlands noted that lizard survey methods sometimes have poor detection rates because of typically low population densities, species' cryptic colouration, difficulty in surveying preferred habitats and behaviour/activity patterns. As such, even intensive lizard surveys are unlikely to detect all individuals in the population or, possibly, all species present. If any of these species are present, they are likely to be present only at low densities. However, this is considered highly unlikely.

It is possible that Waitaha geckos are present in where there is rocky habitat present, such as outcrops or boulder field. Wildlands considered it is highly unlikely that remnant jewelled gecko populations are present, as the predominant land use of the site since the 1940s has been that of pasture, and all of the scrub habitat suitable for jewelled gecko has regenerated recently (c.1980s) (Wildlands 2023). The Canterbury spotted skink are becoming increasingly rare throughout Canterbury and are unlikely to have persisted in the highly modified environment at the site.

In general, Canterbury lizards are highly fragmented and poorly connected with acute and chronic threats arising from habitat loss, predators, and climate change. Some species such as McCann's skink and southern grass skink are more resilient than others, such as Canterbury spotted skink, however, all species are equally legally protected and require management in land development projects where they are present and affected.

1.7.2 Jewelled gecko survey

A jewelled gecko survey was completed in October 2023 using visual encounter searches (VES) and a DJI Mavic 3 Enterprise drone with 4K quality video footage. Recent advances in *Naultinus* spp. survey methodologies indicate that drones are highly effective for the detection of jewelled gecko (Carey Knox, pers. comm. 2023). Scrub pōhuehue, large-leaved pōhuehue scrub/vineland, and Japanese honeysuckle vineland were systematically surveyed twice on 5 October and 6 October during optimal weather conditions for basking jewelled geckos. Post-survey review of the video footage was also undertaken. This was followed up by ground-based visual surveys in accessible sections of the habitat. No geckos were detected and therefore no further assessment of adverse effects is needed.

Jewelled geckos are highly unlikely to be present at the site as it appears that the optimal habitat present for jewelled gecko habitat has regenerated in total isolation from other habitat containing jewelled gecko populations. Thus, jewelled geckos are unlikely to have been able to colonise this habitat. The jewelled gecko survey results appear to confirm Wildlands' (2023) assessment that this species is unlikely to be present. However, the LMP will include precautionary planning actions to survey for, and relocate, jewelled geckos to a suitable alternate site, if any are found.



Figure 2. Rank exotic grassland at the northern end of the site at 130 Bowenvale Avenue (Source: Wildland Consultants, 2023)



Figure 3. Mixed indigenous-exotic scrub with patches of rank grassland in the central area of the site at 130 Bowenvale Avenue (Source: Wildlands, 2023).

1.7.3 Ecological effects on lizards

Identified adverse effects of the proposed works of the site on indigenous lizards can be summarised as:

- Disturbance, injuries and/or deaths of lizards during vegetation clearance and associated earthworks.
- Temporary or permanent displacement and social disturbance of lizards and their populations.
- Permanent loss and modification of 5.09 ha of lizard habitat.
- Increased predation risk to lizards by introduced predators due to increased lizard movements/displacement.
- Disturbance during construction including dust/vibration and noise.

Most of the adverse impacts on lizards will arise from the clearance of potential lizard habitat (grassland, and mixed indigenous-exotic shrubland) on site to make way for the new subdivision and require effects management as discussed in Section 10.3 of the Assessment of Ecological Effects report (Wildlands, 2023).

Losses and injuries of McCann's skink and southern grass skink may be in terms of 1000s of individuals with the possibility that there are other not-yet-detected species are also present (i.e., Waitaha gecko, jewelled gecko and Canterbury spotted skink). Effects management to avoid and minimise adverse effects are discussed below.

1.7.4 Effects management recommendations

Where vegetation clearance is planned, it is usually difficult to efficiently avoid or minimise impacts on lizards using conventional mitigation techniques (such as salvage-and-relocation programmes). This is because lizard behaviour makes it difficult to capture all individuals within the existing population. For example, when inactive, the skinks can be well-hidden in thick shrubland or grassland habitat, and skinks can be difficult to catch when active. Some lizard species are mobile and/or have a 'homing' instinct, making it difficult to keep lizards from returning to work sites.

It is likely that in addition to a typical lizard salvage and relocation programme, there may need to be elements of offsetting or compensation to address residual effects of the project on lizards.

The project requires implementation of a Lizard Management Plan (see Section 4) along with a Wildlife Act Authority, to address adverse effects of the project on lizards.

1.8 Avifauna

1.8.1 Avifauna values

The avifauna values within the project footprint were assessed via the following methods:

- A desktop assessment of species recorded within a one-kilometre radius of the site from January 2021 to February 2023 (New Zealand eBird, 2023).
- An avifauna survey was undertaken on 19 January 2023. All bird species seen and heard within a continuous transect around the perimeter and throughout the site were recorded.

The desktop assessment found 32 avifauna species in total, including 15 indigenous and 17 exotic species (Table 4). Pihoihoi/New Zealand pipit (*Anthus novaeseelandiae*; At Risk-Declining) was recorded and is potentially present at site. One exotic species, ruru nohinoi/little owl (*Athene noctua*; Introduced and Naturalised) is partially protected and is potentially present at site.

During the site walkover, eight indigenous and ten exotic species were observed, none of which were classified as 'Threatened' or 'At-Risk' but are noted in Table 4.

Table 4. Bird species table adapted from Wildland Consultants Limited (2023), includes species recorded in the desktop assessment and during the site visit. Common names, species names, and conservation status are from Robertson et al., (2021). The likelihood of occurrence for each species is given based on site visit observation and their known habitat preferences and distribution in the area.

Common name	Scientific name	Conservation status	Likelihood of presence
Indigenous Species			
Black-billed gull/tarāpuka	<i>Chroicocephalus bulleri</i>	At Risk - Declining	Highly unlikely
Black shag/Māpunga	<i>Phalacrocorax carbo novaehollandiae</i>	At Risk - Relict	Highly unlikely
New Zealand pipit/pihoihoi	<i>Anthus novaeseelandiae novaeseelandiae</i>	At Risk - Declining	Possible
Bellbird/korimako	<i>Anthornis melanura melanura</i>	Not Threatened	Seen
Grey duck X mallard hybrid	<i>Anas superciliosa × platyrhynchos</i>	Not Threatened	Possible
Grey warbler/rīroriro	<i>Gerygone igata</i>	Not Threatened	Seen
New Zealand kingfisher/kōtare	<i>Todiramphus sanctus vagans</i>	Not Threatened	Seen
New Zealand pigeon/kererū	<i>Hemiphaga novaeseelandiae</i>	Not Threatened	Highly likely
Paradise shelduck/pūtangitangi	<i>Tadorna variegata</i>	Not Threatened	Possible
Shining cuckoo/pīpiwharaua	<i>Chrysococcyx lucidus lucidus</i>	Not Threatened	Possible
Silvereye/tauhou	<i>Zosterops lateralis lateralis</i>	Not Threatened	Seen
South Island fantail/piwakawaka	<i>Rhipidura fuliginosa fuliginosa</i>	Not Threatened	Seen
Southern black-backed gull/karoro	<i>Larus dominicanus dominicanus</i>	Not Threatened	Seen
Spur-winged plover	<i>Vanellus miles novaehollandiae</i>	Not Threatened	Possible
Swamp harrier/kāhu	<i>Circus approximans</i>	Not Threatened	Seen
Welcome swallow/waroua	<i>Hirundo neoxena neoxena</i>	Not Threatened	Seen
Exotic Species			
Australian magpie/makipai	<i>Gymnorhina tibicen</i>	Introduced and Naturalised	Seen
California quail/tikaokao	<i>Callipepla californica</i>	Introduced and Naturalised	Likely
Chaffinch/pāhrini	<i>Fringilla coelebs</i>	Introduced and Naturalised	Highly likely
Cirl bunting	<i>Emberiza cirlus</i>	Introduced and Naturalised	Possible
Common redpoll	<i>Acanthis flammea</i>	Introduced and Naturalised	Seen
Dunnock	<i>Prunella modularis</i>	Introduced and Naturalised	Seen
Eurasian blackbird/manu pango	<i>Turdus merula</i>	Introduced and Naturalised	Seen
Goldfinch/kōurarini	<i>Carduelis carduelis</i>	Introduced and Naturalised	Seen
Greenfinch	<i>Chloris chloris</i>	Introduced and Naturalised	Seen
House sparrow/tiu	<i>Passer domesticus</i>	Introduced and Naturalised	Seen
Little owl/ruru nohinohi	<i>Athene noctua</i>	Introduced and Naturalised	Possible
Ring-necked pheasant/peihana	<i>Phasianus colchicus</i>	Introduced and Naturalised	Possible
Rock pigeon/kererū aropar	<i>Columba livia</i>	Introduced and Naturalised	Unlikely
Skylark/kairaka	<i>Alauda arvensis</i>	Introduced and Naturalised	Likely
Song thrush/manu-kai-hua-rakau	<i>Turdus philomelos</i>	Introduced and Naturalised	Seen
Starling/tāringi	<i>Sturnus vulgaris</i>	Introduced and Naturalised	Seen
Yellowhammer/hurukōwhai	<i>Emberiza citrinella</i>	Introduced and Naturalised	Seen

1.8.2 Ecological effects on avifauna

Identified adverse effects on avifauna that meet the effects management thresholds can be summarised as:

- Injury and mortality to native and protected avifauna species.
- Loss of native bird habitat.
- Disturbance to native and protected avifauna during construction.

1.9 Invertebrates

1.9.1 Invertebrate values

The invertebrate values within the project footprint were assessed by Wildlands (2023) via the following methods:

- A desktop assessment of terrestrial invertebrates recorded within a five-kilometre radius of the site using the Global Biodiversity Information Facility (GBIF, 2023).
- A walk-through invertebrate survey was undertaken on 8 December 2022. Any sightings of notable invertebrates or potential habitat were recorded.

The desktop assessment found mostly exotic invertebrate fauna and three notable species; ground beetle (*Holcaspis angustula*, Not Assessed), rō/New Zealand mantis (*Orthodera novaezealandiae*, At Risk – Declining) and kahukura/New Zealand red admiral butterfly (*Vanessa gonerilla*, Not Assessed).

The dominance of exotic invertebrate fauna on site was supported by the survey results, with buff-tailed bumblebee (*Bombus terrestris*), cabbage white butterfly (*Pieris rapae*) and several other exotic species observed. Indigenous species observed were copper butterflies (*Lycaena* sp.) and native bees (*Leioproctus* sp.). A population of trapdoor spiders (*Cantuarina* sp.) was also found and is considered a notable invertebrate on a precautionary basis, as some trapdoor spider species are 'At Risk – Naturally Uncommon' and generally only occur within small areas of New Zealand.

Table 5. Notable invertebrate species adapted from Wildland Consultants Limited (2023), includes species recorded in the desktop assessment and the walk-through survey. Likelihood of presence for each species is given based on site visit observation, their known habitat preferences and distribution in the area.

Common name	Scientific name	Conservation status	Likelihood of presence
Rō/New Zealand mantis	<i>Orthodera novaezealandiae</i>	At Risk – Declining (Buckley <i>et al.</i> , 2012)	Highly likely
Trapdoor spider	<i>Canturia</i> sp.	At Risk – Naturally Uncommon ¹ (Sirvid <i>et al.</i> , 2021)	Seen
Ground beetle	<i>Holcaspis angustula</i>	Not Assessed but there are limited records	Unlikely
Kahukura/New Zealand red admiral butterfly	<i>Vanessa gonerilla</i>	Not Assessed but recent declines in numbers have been recorded (Sanger, 2022)	Highly likely

1.9.2 Ecological effects on invertebrates

The potential adverse effects on invertebrates that meet effects management thresholds can be summarised as follows:

- Injury and/or mortality to invertebrates.
- Loss of invertebrate habitat.

¹ Note: there is a data deficiency regarding trapdoor spiders and only some species are classified as 'At Risk'. Furthermore, it is too difficult to tell species apart without dissection and DNA sequencing.

2 - Lizard Management Plan

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2 Lizard Management Plan

2.1 Introduction

This LMP is intended to address the lizard management requirements for the 5.09-hectare subdivision site, providing management solutions for the lizard species discovered onsite. This will be achieved through mitigation measures. These activities have been determined as comprising the best approaches to address the adverse effects of the development of the site for residential housing on lizards. The implementation of this LMP and an application for a Wildlife Act Authorisation for the project will satisfy requirements under the relevant legislation (Resource Management Act 1991 and Wildlife Act 1953) and the National Policy Statement – Indigenous Biodiversity.

The structure of this LMP generally follows guidelines provided by the Department of Conservation (Department of Conservation 2019). It is also intended to assist in the acquisition of a Wildlife Act Authority (WAA) that permits:

- The application of mechanisms that mitigate or remedy adverse impacts (disturbance, injury, or mortality; and habitat loss) on indigenous lizards resulting from the development of the site for residential housing.
- Incidentally to kill individuals of indigenous lizard species, where unavoidable.

Table 6. Overview of Lizard Management Plan

Category	Overview
Purpose	This section outlines protocols needed to avoid, remedy, or mitigate adverse impacts on indigenous lizards in accordance with the Resource Management Act (1991) and Wildlife Act (1953).
Objective and Target species	<p>This LMP provides a lizard management programme consisting of direct mitigation activities along with a habitat enhancement/pest management component at the release site. This LMP provides management for the below species.</p> <ul style="list-style-type: none"> • McCann's skink (<i>Oligosoma maccanni</i>) • Southern grass skink (<i>O. polychroma</i> Clade 5) <p>Waitaha gecko (<i>Woodworthia</i> cf. <i>brunnea</i>) and jewelled geckos (<i>Naultinus gemmeus</i>) will be released offsite into reserves that have congener populations and already have extensive pest animal management.</p> <p>If Threatened species (eg. Canterbury spotted skink, <i>O. lineoocellatum</i>) are found, the Department of Conservation will be notified immediately, and the project will follow the Department's guidance.</p>
Lizard Management Overview	<p>Mitigation measures involving the below actions:</p> <ul style="list-style-type: none"> • Habitat enhancement measures establishing new lizard habitat at release site. • Establishment and protection of release site. • Habitat reduction (via sheep) to improve trappability of lizards. • Lizard trapping and relocation prior to vegetation clearance.

Category	Overview
	<ul style="list-style-type: none"> Lizard salvage and relocation during supervised vegetation clearance, including systematic destructive habitat searches. Pest animal control (5 years).
Monitoring	Population monitoring
Reporting	<p>A lizard salvage and relocation report, including Amphibian and Reptile Distribution Scheme (ARDS cards), will be submitted to the Department of Conservation after the completion of construction work.</p> <p>This will be followed by five consecutive years of lizard population/habitat enhancement reports for the relocation site.</p> <p>Any other reporting requirements outlined in consent conditions and/or the Wildlife Act authorisation issued for the project will be adhered to.</p>

2.2 Lizard management

2.2.1 Timing

Lizard salvage and release work is seasonal and should only be undertaken in the warmer months of the year (between September and May). Warmer weather and higher activity levels mean that lizards are both easier to locate and trap, and have an increased chance of surviving the relocation process. Table 7 describes the indicative timeline for lizard management at 130 Bowenvale Avenue.

Table 7. Indicative timeline for lizard management programme at 130 Bowenvale Avenue.

Action	Indicative timeline and effort
Avoidance (Section 2.2.7-2.2.10, 5)	<ul style="list-style-type: none"> Lot 100 set aside.
Mitigation (Section 2)	<ul style="list-style-type: none"> Live capture traps set up immediately prior to commencement of trapping programme. Day searching and live capture trapping undertaken concurrently during accepted lizard season (1 September – 30 May). Scheduled for the 2024 season. Site clearance can proceed immediately on conclusion of lizard salvage programme, with supervised clearance.
Remediation (Section 2.2.9, 5)	<ul style="list-style-type: none"> Habitat creation in Lot 100 commences in 2024. Pest animal programme for 5 years. Sustainable pest management options beyond this will be investigated (Predator Free Cashmere / Predator Free Port Hills). Lizard population/habitat monitoring operates during the first five years of remediation programme (2025-2029).
Incidental Discovery Protocol (see Appendix A)	<ul style="list-style-type: none"> Throughout lifetime of the Project development.

2.2.2 Targeted lizard habitat

At 130 Bowenvale Avenue, southern grass skink is present in the exotic vegetation habitat present throughout the site. This species is expected to be at moderate abundances. McCann's skinks are likely to be similarly distributed throughout the site. The lizards are likely to be found within the following vegetation types:

- Scrub pōhuehue vineland
- Blackberry-large-leaved pōhuehue gorse vineland/scrub
- Cocksfoot-(fennel) grassland
- (Tree lucerne)-(kōhūhū)/blackberry-gorse-banana passionfruit scrub

The below lizard salvage programme will focus on these habitat types.

2.2.3 Salvage methodology

a) Systematic Day-Searching

A minimum of 16 person hours will be spent searching for lizards using standard day searching methods as described in the Department of Conservation Inventory and Monitoring Toolbox, including destructive hand-searching of terrestrial habitat (particularly rank exotic grassland and shrubland). Systematic day searching is not always the most effective method. This is especially the case for skinks, which can be fast and difficult to capture, or remain hidden deep within complex vegetation. This is why this will be supported by live capture trapping.

Responsibility: Project Lizard Ecologist.

b) Live Capture Trapping

Live capture trapping will be carried out across the extent of the site prior to commencement site works using standard methods as described in the Department of Conservation Inventory and Monitoring Toolbox. 200 Gee's minnow traps will be set for 10 trap days (2,000 trap days) to capture and relocate lizards from within the project footprint. Traps will be used at pre-identified sites containing rank grasslands or complex ground cover habitat, including sites where lizards have been confirmed present. Where possible, these traps will be set out at a minimum distance of 5 metres within contiguous habitat types. A piece of canned pear or banana (as bait), a wetted cloth, and some vegetation are provided (as hiding places for trapped lizards) within the traps. Traps will be operated during periods of warm, dry, settled weather conditions, but daily weather may be variable. All traps will be checked daily (within a 24-hour period). After ten checks, the site will be cleared immediately.

Responsibility: Project Lizard Ecologist.

2.2.4 Supervision of habitat reduction and removal

Destructive searching of lizard habitat is required to assist in the discovery and relocation of individual animals from the site. Where rank exotic grassland or shrubland occurs within the Project's footprint, grazing sheep, a scrub bar or mower will be used where possible to cut back the vegetation.

Sheep will be used to graze back the grass over large areas with 4 × 30 m × 30 m central stock-proof pens using wire and post fences located in the centre of the paddock. The grazing sheep will progressively reduce lizard habitat and drive lizards towards remaining grassland areas within these four pens or to edge habitats, where a network of live capture traps (see Section 2.2.3 (b)x) will be systematically located

in a 5 × 5 array for a 10 day salvage programme prior to final habitat removal using mechanical means below. Note that the gorse and blackberry habitat will be difficult to remove manually, because of prickles, and the terrain will make it unsafe to operate machinery in order to clear this habitat type.

Where mechanical means are used, sequential mowing or scrub-barring will be undertaken to encourage lizards to move out of the clearance area and/or to remove remaining habitat during salvage operations. The following methods will be used:

- Day one: cut pōhuehue and grass at high settings (to 10 cm above the ground),
- Day two: cut lower (to 5 cm above the ground) and finally;
- Day three: cut as close to the ground as possible.

The habitat reduction using mechanical means will involve appropriately qualified and experienced supervising herpetologists/ ecologists to capture and relocate lizards.

Sequential mowing/scrub-barring is recommended to be carried out over warm days in summer or autumn, when lizards are most likely to be active, and able to move out of harm's way.

Pōhuehue brush and large trees removed and dissected will be relocated to the Lot 100 release site as part of the habitat enhancement effort (see Section 5). This will enhance the new habitat at that location for lizards.

Responsibility: Contractors and Project Lizard Ecologist

2.2.5 Lizard capture, handling and release methods

Any lizards seen will be captured and handled by skilled field staff trained by the Project Lizard Ecologist following best practice protocols. Salvaged lizards will be held in cloth bags out of any sun or heat, i.e., kept in the shade, during salvage operations. A small amount of lightly misted grass from the capture site and a wetted cloth will be placed inside the cloth bags with the lizards to prevent dehydration. These cloth bags will be placed carefully in secure ventilated hard-sided containers (to prevent accidental crushing), also kept out of sun or heat, before being transported to the adjacent Lot 100 for release. Captured lizards will be released as soon as practicable into the release site (within eight hours).

Following capture, the following data will be collected:

- Species identification.
- Habitat types in which the lizards are observed will be noted, and individual lizard capture locations will be recorded on a hand-held GPS.
- Weather conditions during the salvage programme will be recorded.
- Data will be collected for individual lizards, including sex/life stage, morphometric measurements, and capture method. Identification photographs will also be taken.
- Trap return or lizards captured per person hour will be recorded, giving an indication of local and overall abundance for each species.
- The release of lizards into the release site will be on the same day as capture.
- The release location for each individual lizard will be recorded on a hand-held GPS. This data will be reported to the Department of Conservation by 30 June 2024. All records will be submitted to the Amphibian and Reptile Distribution Scheme (ARDS), which feeds into the Department of Conservation's BioWeb Herpetofauna database.

Responsibility: Project Lizard Ecologist

2.2.6 Accidental harm

If an individual is injured during the salvage programme or site works, the following actions apply:

- If the injuries are not survivable, the animal will be killed with blunt force trauma to the head.
- If injuries are potentially survivable, the animal should be captured and taken to Orana Wildlife Park for rehabilitation and released at Lot 100 after rehabilitation.
- The client or the Project Lizard Ecologist will undertake all the necessary steps to enable transportation of the animal to the veterinarian in a timely manner.
- If the individual animal is able to be released after care and rehabilitation, all necessary steps will be undertaken to enable release.
- If the veterinarian determines that euthanasia is necessary for the injured animal, then the veterinarian may administer sodium barbiturate to the injured animal. The body should be retained for research purposes (including possible lodgement into Te Papa Tongawera Museum of New Zealand).

Responsibility: Project Lizard Ecologist.

2.2.7 Release sites

Different release sites have been proposed for different species, as described below.

Southern grass skink and McCann's skink: A c. 0.7-hectare section (Lot 100) of the 130 Bowenvale Avenue subdivision (see map in Section 5) has been selected as the primary release site for the two skink species confirmed present. This area is:

- To be protected from future development (see Section 4.2.10).
- Of sufficient size and habitat complexity, and contains biophysical characteristics (i.e., receiving appropriate sunlight and humidity) required to provide all the life history needs of relocated lizards.
- Located close to the source population (i.e., is genetically appropriate).
- After the Restoration Planting Plan has been implemented (see Section 7), Lot 100 will contain similar habitats and climatical environments to the impact site (i.e., is ecologically appropriate).

Each individual lizard will be released across Lot 100 under the following release procedure:

- At a minimum of 10 metres from other released animals.
- A small (<50 centimetre tall) barrier fence will be erected to form a physical barrier between Lot 100 and the Project footprint, to prevent lizards returning to the works site. This is the 'lizard barrier fence'.
- Animals will be released into natural refugia within habitat types considered by expert herpetologists as suitable for the species, i.e., similar to habitat types that they were originally captured.
- Animals will be 'hard-released'. The term 'hard-release' means the direct release of lizards into the wild without a soft-release pen in place. This is because the lizards will remain in the contiguous resident population and do not require establishment.

Jewelled gecko and Waitaha gecko: These two species will be released into Sugarloaf Scenic Reserve/Te Heru o Kahukura administered by the Christchurch City Council, or similar reserves, where congener gecko populations are known to exist. These geckos will be released at sites already under intensive pest animal management, such as those managed by Predator Free Banks Peninsula.

Canterbury spotted skink: Because of the Threatened status of the Canterbury spotted skink, release site and site management cannot be determined at this stage. Section 4.2.12 indicates that the Department of Conservation will be notified immediately on discovery of any Threatened species, and that a LMP revision and a permit variation or a new permit will be required in the event of discovery.

Responsibility: Project Lizard Ecologist and Contractor (for barrier fence).

2.2.8 Lot 100 release site habitat enhancement

Lizards will be released into pre-determined release microsites that satisfy all life history needs of the relocated lizards. As open habitat generalists, southern grass skink and McCann's skink both require sunny areas of complex groundcover. The skinks will be directly released into grassland/low stature shrubland within Lot 100.

If lizards are placed into habitats where resident lizards are currently present, or are relocated into habitat without adequate refuges, individuals may become displaced and are then vulnerable to predation. To increase habitat complexity and carrying capacity, enhancement of habitat will need to be undertaken within the release site. Natural and artificial cover objects/refugia as well as inputs from vegetation (such as brush and foliage) are important for providing shelter and food resources to lizards. Both southern grass skink and McCann's skink readily live in newly created habitat, including man-made objects, such as corrugated iron, dead wood, or Onduline.

Scrub pōhuehue brush from the other lots will be removed and relocated to Lot 100 to create lizard habitat. The brush will not survive as living plants, but will contribute increased terrestrial habitat complexity while the restoration plantings establish.

Any felled trees will be dissected into manually-handleable sections and relocated and re-distributed throughout Lot 100 to create lizard habitat.

Loose rocks that are manually-handleable unearthed during earthworks in the new lots will be relocated to Lot 100 at a location identified by the Project Lizard Ecologist, whom will instruct a suitable rock boulderfield design suitable for supporting local lizard populations. If rock piles are formed, these should have numerous entry points, utilise flat rock slabs on top of other rocks, with interstices clear of loose soil.

The addition of refuges created by the utilisation of brush, logs and rocks, will provide relocated lizards with immediate protection from predators and reduce interspecific competition by ensuring lizards are released into micro-habitats not already occupied by lizards. This will enhance survival both for resident lizards and relocated lizards.

The Restoration Planting Plan for Lot 100 has been developed to create new lizard habitat throughout this lot. Specifically, gorse will be cut and left to break down, enabling the opening-up of a shrubland/grassland habitat mosaic consisting of pōhuehue, large-leaved pōhuehue, *Melicactus alpinus*, *Cortaderia richardii*, *Chionochloa flavicans*, *Carmichaelia australis*, *Coprosma propinqua*, *C. robusta*, *Poa anceps*, as well as *Pseudopanax crassifolius* and *Sophora microphylla*. Please refer to Section 7 for details.

A five-year post-release lizard and habitat enhancement monitoring programme will be implemented.

Responsibility: Project Lizard Ecologist.

2.2.9 Lot 100 pest animal control

To ensure that relocated lizards survive post-release and establish in their new locations, pest animal management will need to include control of known predators of lizards. This is especially important as lizard numbers are usually at reduced habitat carrying capacity due to predation by pest animals. Therefore, the influx of any new lizards into a habitat with resident lizards may expose the new lizards to a heightened risk of predation.

Habitat enhancement and predator control strategies should be tailored to suit the needs of the lizard species that are salvaged. Pest animal control is a common management requirement when releasing lizards into new sites. Short-term pest animal management is usually undertaken to ensure the survival and establishment of individual lizards post-release. It is noted that at small scales, pest animal management will have a relatively limited effect for lizards at the population level.

Targeted pests include rodents, mustelids, and hedgehogs. Traps and bait stations will be installed three months prior to the commencement of the Project. The distribution of kill traps and bait stations throughout the site should be as follows:

- Five DOC250 traps spaced every 50 metres within Lot 100. These traps will target mustelids and hedgehogs. DOC250 trap box entrances will be widened to allow entry by ferrets and hedgehogs. Traps will be baited with hen eggs and fresh rabbit meat.
- Twenty-four (24) run-through bait stations targeting rodents spaced every 20 metres. These will contain the bait bromadiolone, first pulsed 4 weeks, then annually, with diphacinone supplied monthly.
- Pest traps and bait stations should be checked monthly during the summer and every two months between March-August (nine checks per annum).
- A pest control programme should be in place for a minimum of three months prior to release of lizards.
- The pest control programme will operate for at least five years from receiving the WAA authorising lizard management.
- Concurrent pest animal monitoring, using best practice tracking tunnel methods for rodents will be used. Ideally, pest animal control should be undertaken using up-to-date best practice, with periodical review from time-to-time to ensure that best practices and cost-effective methods are being used. Records of pest animal operations will follow industry best practice, and reported to the Department of Conservation by 1 July each year.
- If appropriate, the pest management programme may potentially be transferred to Predator Free Cashmere or Predator Free Port Hills operators after five years.

Responsibility: Contractor (any suitably experienced pest control contractor).

2.2.10 Lot 100 site protection

Lot 100 will be covenanted as to ensure legal protection of the lot into perpetuity. Release of lizards into legally protected sites (such as significant natural areas (SNAs), parks, reserves or covenanted sites) is a requirement for lizard mitigation projects involving salvage and release programmes.

Wire and post fencing will be installed to further protect Lot 100, from risks such as accidental clearance or grazing.

Responsibility: Bowenvale GCO Ltd.

2.2.11 Threatened Species

Due to the highly modified nature of the site, 'Threatened' lizard species are highly unlikely, and therefore are not expected. However, the Department of Conservation will be consulted how to proceed should a 'Threatened' lizard species be found. A revised LMP along with either a Wildlife Act permit variation or a new permit application may be required.

The most likely Threatened species is the Canterbury spotted skink (Threatened – Nationally Vulnerable).

2.2.12 Avoidance of Doubt

For avoidance of doubt, the Wildlife Act Authority, once issued for the project would complement, and where conflict exists, supersede this LMP.

2.2.13 Authorised Personnel

For the purposes of management and implementation of the requirements of this Lizard Management Plan and the Wildlife Act-authorized personnel operating as the Project Lizard Ecologist would be:

- Trent Bell, Senior Ecologist (Herpetology)

The Authorised Personnel will directly supervise and manage any other appropriately qualified and experienced ecologists implementing project requirements relating to lizard management.

Authorised Personnel should be responsible for implementing the LMP and reporting to the Department of Conservation and other Territorial Authorities.

2.3 Monitoring

To determine whether the lizard relocation is successful, a post-release monitoring programme is often required as a condition of Wildlife Act Authorities. However, the feasibility of monitoring of lizards at post-release sites will depend on the number of lizards found during the salvage programme, the nature of the release, and the purpose of the post-release monitoring programme. Given that lizards can be difficult to monitor, a post-release monitoring programme is usually recommended only if (a) sufficient individuals are found during the salvage, (b) post-release monitoring is feasible, and (c) there is potential management or conservation value in knowing post-release outcomes.

In lieu of a post-release capture-mark recapture population study, a monitoring programme that investigates population-level response by lizards to newly created habitat over time, thus helping determine the value of these enhancements on site, is of value for outcome reporting. At present, there is little known about the use of habitat enhancement by salvaged lizards, although this is often used as a mitigation tool. A simple periodic monitoring survey using a pitfall trap array across Lot 100 (a minimum of 120 pitfall traps checked 7×) will be undertaken to determine whether southern grass skink and McCann's skink utilise newly created habitat within Lot 100. Reference sites will be included, if available. This monitoring will be undertaken by an experienced and qualified herpetologist.

The objective of this lizard population monitoring is to record colonisation and $\geq 10\%$ increase in local abundance of lizards within newly created habitats in Lot 100 through at least three of the four-stage success criteria, using a Before-After-Control-Impact study. The four-stage success criteria developed by Herbert (2020) are as follows:

- Habitat use.
- Reproduction evident.
- Population benefit.
- Self-sustaining population.

These monitoring programmes will involve the use of statistical analyses analysing population status and trend over five years. Lizards captured in pitfall traps will be counted and measured (snout-vent length, tail length, tail base width), weighed, and sexed. Such monitoring will be undertaken once a year for five consecutive years.

A monitoring report will be prepared for each of the five monitoring years, due 30 June each year. This report should assess the value of habitat enhancement for lizards. The monitoring work helps advance knowledge in lizard mitigation strategy, informing resource management practitioners on lizard management outcomes using habitat enhancement strategies.

Responsibility: Project Lizard Ecologist.

2.4 Contingency

In the event that monitoring indicates that the habitat creation in Lot 100 fails (planting failure) or lizards have not responded in number within the 5-year period, this failure will be remediated through additional pest animal control and habitat creation work in Lot 100 until the Project Ecologist is satisfied that, through evidence-based monitoring, a lizard population has increased by at least 10% within Lot 100 and the planting targets have been met. This additional work will be developed through a revised site management plan addressing the identified factors (such as failure of a particular plant species to establish, leading to substitution with another suitable species; or changing pest control methodologies).

Additionally, Bowenvale GCO Ltd will share all data with the Department of Conservation, including:

- Details of the pest management and pest monitoring outcomes.
- Data on the lizard habitat enhancement programme.
- Data from the lizard population monitoring programme.

This will ensure that all stakeholders are able to learn from the project, whether it has been a success or a failure, and to ensure that the knowledge acquired as a result of the effort is able to be applied elsewhere. Sharing of results and knowledge is especially important as relatively little is known about appropriate strategies to ensure successful outcomes when mitigating human-wildlife conflict for lizards.

2.5 Reporting

A lizard salvage and relocation report, including Amphibian and Reptile Distribution Scheme (ARDS cards), will be submitted to the Department of Conservation after the completion of salvage and relocation work.

This will be followed by five consecutive years of lizard population/habitat enhancement reports for the relocation site.

Any other reporting requirements outlined in consent conditions and/or the Wildlife Act authorisation issued for the project will be adhered to.

2.6 Key Principles for Lizard Management

The Department of Conservation's Lizard Technical Advisory Group has produced best practice guidelines for lizard salvage and relocation activities required to mitigate effects of land development projects on lizards (Department of Conservation 2019). These guidelines contain nine key principles for these activities and Wildlife Act permit applications, along with the management plans, are now closely assessed by the Department's Permissions Team using these principles.

Table 8 below lists the nine key principles and related guidance notes for lizard mitigation, the responses provided in this LMP, and the sections in this report where each matter is addressed

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Table 8. Nine key principles for lizard salvage transfer in Aotearoa New Zealand (Department of Conservation 2019), guidance notes, the approach proposed for the 130 Bowenvale Avenue subdivision project, and sections in this report where these matters are addressed.

Principle No.	Principle	Guidance Notes	Response	Report Sections
1	Lizard species' values and site significance must be assessed at both the impact (development) and receiving sites.	<ul style="list-style-type: none"> BioWeb Herpetofauna database search, BioWeb caveats noted. Expert input on BioWeb records. Latest threat classifications used. Survey effort quantified and mapped with sufficient effort and adequately qualified personnel. Impact and receiving site(s) both surveyed. Habitat assessment undertaken. Precautionary approach taken. Formal species and site significance assessment relating to lizards/assemblage, e.g. EIANZ's EclA; also regional/territorial authorities (Regional Policy Statements, Regional Plans and/or District Plans) and iwi (taonga/management documents). Early engagement with the Department. 	<ul style="list-style-type: none"> BioWeb database search has been undertaken, with input for an expert herpetologist. Hitchmough et al.(2021) threat classifications used. Habitat assessment undertaken. Lizard survey undertaken in 2022 and 2023. Precautionary approach taken with consideration for potential presence of threatened species (highly unlikely) Reporting and evaluation during the consent process included significance assessments. EIANZ guidelines were used. No engagement with the Department as of yet for this project. 	3 (lizards and their habitats identified)
2	Actual and potential development related effects and their significance must be assessed.	<ul style="list-style-type: none"> All development-related effects involving disturbance and possible death are considered significant and require a WAA. Scope and detail must reflect scale and significance of likely effects, and be context specific. AEE must be free of bias, and predicted impacts clearly identified, uncertainties identified. Direct and indirect effects considered. Cumulative effects also need to be considered. Development effects may include: afforestation; deforestation; domestic stock exclusion; dust and vibration; earthworks; fire; flooding; grazing; habitat relocation; herbicides; irrigation; light/glare; pesticides; ploughing/cultivation; quarrying/rock removal; roading/realignments; salvage and transfer; tourism/visitor impacts; vegetation clearance; weed encroachment. Effects may include habitat loss; habitat quality reduction; habitat/population fragmentation; habitat change; trampling; displacement; disturbance; injury; death; change in predator guilds; decreased survival, sub-lethal and lethal effects (herbicides, pesticides); overheating, overcrowding, competition, injury, death (captive management); poaching; reduction in reproductive output; diet change 	<ul style="list-style-type: none"> Impact assessment undertaken. Scope and detail reflect scale and significance, and specific to possible lizard species present. Detailed information presented for effects, scale, and impact types. 	3.3.3 and 3.3.4 (effect identification, assessment)
3	Alternatives to moving lizards must be considered	<ul style="list-style-type: none"> Need to consider mitigation hierarchy: Avoidance Remediation 	<ul style="list-style-type: none"> Avoidance has been partially met by setting aside Lot 100 for ecological restoration and lizards. 	4.2 (LMP)

		<ul style="list-style-type: none"> Mitigate Offset/Compensate Need to ensure no-net-loss Need to justify actions/non-actions in hierarchy 	<ul style="list-style-type: none"> Mitigation is being addressed by lizard salvage and transfer to Lot 100. Five years of pest animal control and habitat enhancement at Lot 100 will be undertaken, supported by a population study. 	
4	Threatened species require more careful consideration than less-threatened species.		<ul style="list-style-type: none"> Threatened species are highly unlikely to be present. Threatened species, if discovered, and their management requirements will be addressed either under a permit variation or a new WAA application. 	11 (Threatened species require LMP revision and permit variation or specific LMP and WAA if discoverable)
5	Lizard salvage, transfer and release must use the best available methodology	<ul style="list-style-type: none"> Need to ensure existing populations are protected by successfully re-establishing elsewhere. Should follow DOC's translocation permitting process. Describe why salvage is needed, the salvage techniques proposed, an assessment of release site, and post-release management. Determine objectives of salvage and how much this contributes to attainment of no-net-loss in lizard values. Consider multiple 'salvage events', which should stop only after at least 3 unsuccessful salvage attempts under appropriate field conditions. Involve experienced, skilled herpetologists. High proportion of lizards will still remain undetected; need to address residual effects through offsetting/compensation. Consider: pre-clearance searches/trapping; destructive searches; post-clearance searches. Follow guidelines for conservation-led translocations (DOC 2019). These provide detail on methods for capture, temporary holding, and release of lizards. 	<ul style="list-style-type: none"> Salvage will be required, as all lizard habitats cannot be avoided. Lizards will be salvaged and released into Lot 100, thereby re-established elsewhere on the same site, and likely to supplement resident population. Salvage programme will involve experienced, skilled herpetologists working with trained personnel. Salvage effort will include multiple pre-clearance methods and techniques, 200 live capture traps set out in appropriate locations, each trap checked 10x (2000 trap days) during optimum lizard survey conditions between October and April. Incidental discovery protocols in place for lizards discovered outside of the salvage programme. Translocation guidelines and process will be followed as set out in this LMP. Not a translocation event, as salvaged lizards are to be released locally. Residual effects will be addressed through expanding the pest animal management, and habitat enhancement within an ecologically restored area (Lot 100). A population study investigating habitat enhancement uptake will be undertaken. 	4.2 (Salvage/release, release site management) Appendix A (Incidental discovery protocol)
6	Receiving sites and their carrying capacity must be suitable in the long term.	<ul style="list-style-type: none"> Release sites: <ul style="list-style-type: none"> Must be ecologically appropriate and have long-term security/must be suitable through time for the species; resident lizards, their abundances and habitat use must be understood, and assurance that there will be sufficient animals for a genetically viable population; must be sufficiently distanced from impact site or exclusion fences and traps used, but as close as possible so that they are released into similar microhabitat and climate; post-release monitoring must be achievable, if appropriate; 	<ul style="list-style-type: none"> Release site has been identified: Lot 100 of the subdivision. The Lot 100 section is located immediately adjacent to the Project lizard populations; therefore, the site is ecologically, climatically, and genetically appropriate. All salvaged lizards will be released into discrete locations throughout Lot 100 in habitat suitable for the species. Resident lizards and their relative abundances are likely to be in moderate number. Predator and habitat management programme will be implemented at Lot 100. 	4.2.5 (Release)

		<p>must be within the species' natural geographic range, no mixing of genetically structured populations.</p> <ul style="list-style-type: none"> Habitat must be suitable for the species/habitat should be predominantly indigenous vegetation sufficiently large and continuous that it will support the lizards and the eventual established population; it must contain sufficient resources (food, cover, retreats), buffers from climatic extremes (drought, cold), and not prone to flooding or erosion; must be sufficient resources for both resident and translocated lizards, or enhanced to ensure these resources are available; ongoing management must improve this habitat for lizards over timeframes that are ecologically relevant. Site must provide protection from predators/habitat must be secure from predators or effective pest control place is in place to allow lizards to establish; if predators are eradicated, there needs to be appropriate biosecurity procedures to prevent reinvasion. Site must be protected legally from future human disturbance/via long term protection. 	<ul style="list-style-type: none"> Lot 100 will be covenanted and fenced for protection. 	
7	Monitoring is required to evaluate the salvage operation.	<ul style="list-style-type: none"> Post-release monitoring requires clear objectives prior to initiation and is needed to inform and test salvage methods. 	<ul style="list-style-type: none"> In lieu of post-release monitoring, a study assessing lizard numbers will be undertaken in Lot 100. 	4.3 (Lizard monitoring)
8	Reporting is required to communicate outcomes of salvage operations and facilitate process improvements.	<ul style="list-style-type: none"> Detailed reporting required and must be sent to DOC and iwi. For large projects involving multiple species and/or significant sites, interim reports and/or liaison appropriate to ensure milestones and performance standards in WAA have been met – these should also include progress reporting against lizard mitigation/management plan objectives, including post-release monitoring objectives. All lizard location data must be sent to herpetofauna@doc.govt.nz for inclusion in the BioWeb Herpetofauna database. 	<ul style="list-style-type: none"> Annual reports are to be provided with reports on salvage (1st year), and annual pest control and population monitoring reports for the first five years of management. 	4.5 (Reporting)
9	Contingency actions are required when lizard salvage and transfer activities fail	<ul style="list-style-type: none"> There is an obligation to ensure no-net-loss of lizard populations and lizard habitat post-development in the event of mitigation failure. Contingency actions are now essential in management plans. Contingency actions require the same scrutiny as any mitigation event. Contingency requires careful thoughtful design and commitment to implementation, if needed. 	<ul style="list-style-type: none"> Remediation work within Lot 100 in the event of failure will be continue until the Project Lizard Ecologist is satisfied with the quality of habitat for lizards, and there is at least an 10% increase in lizard numbers. Pest management and pest monitoring outcomes and lizard management outcomes will be shared with DOC and other relevant partners. 	4.4 (Contingency)

2.7 Likely Effects After Lizard Management

Table 9. Summary of the potential adverse effects for indigenous lizards as a result of the subdivision of 130 Bowenvale Avenue, Cashmere, following mitigation.

Potential Effects	Ecological Feature Affected	Ecological Value	Timescale of Effect	Magnitude of Effect	Initial Level of Effect	Measure to Address Effect	Final Level of Effect
Disturbance and harm to indigenous lizards; habitat loss; displacement; predation	Southern grass skink	High	Permanent	High	Very High	Salvage and relocation, release site management (including habitat enhancement), pest animal control, lizard population monitoring, compensation	Low
Disturbance and harm to indigenous lizards; habitat loss; displacement; predation	McCann's skink	Moderate	Permanent	High	Moderate	Salvage and relocation, release site management (including habitat enhancement), pest animal control, lizard population monitoring, compensation	Low

3 - Avifauna Management Plan

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3 Avifauna Management Plan

3.1 Introduction

This Avifauna Management Plan (AMP) is intended to address the avifauna management requirements for the currently undeveloped 5.09 ha site, providing management solutions for the avifauna species discovered onsite.

All native avifauna on site are protected by the Wildlife Act 1953, and the Resource Management Act 1991 (RMA) affords protection to significant habitats of indigenous fauna. Furthermore, the desktop assessment identified several species that may be potentially present on site and are classified as 'Threatened' or 'At-Risk' under the Department of Conservation (DOC) National Threat Classification System (NZTCS) (Robertson, et al., 2021). Game birds and introduced species are not protected by the Wildlife Act 1953 (Schedule 1 & 5).

Table 10. Overview of Avifauna Management

Category	Overview
Purpose	The purpose of the Avifauna Management Plan (AMP) is to manage adverse effects on native avifauna
Objective and Target Species	This AMP provides an avifauna management programme consisting of direct mitigation activities and harm minimisation protocols. This AMP provides management for all native species identified in Section 3.4.1, including Threatened and At-Risk species, pīhoihoi/New Zealand pipit and ruru nohinohi/little owl.
Avifauna Management Overview	Pre-construction surveys, nest, and roost searches prior to vegetation clearance (with restrictions possible based on findings), and incidental kill and harm minimisation protocols.
Monitoring	Not required.
Reporting	Completion of a compliance summary report detailing any species detected, numbers relocated, and the release location.

3.2 Avifauna Management

Measures to avoid, minimise and mitigate potential effects of the proposed works on native avifauna are set out below, and follow best practice management of avifauna.

3.2.1 Timing

Vegetation clearance and habitat removal during the peak bird breeding season (August to January inclusive) will be avoided.

Where extraordinary circumstances arise which require vegetation clearance during this season, the Project Ecologist shall be consulted, and nesting bird surveys must be undertaken. These surveys must be carried out by a suitably qualified and experienced ecologist for a maximum of three days prior to the commencement of works.

Nest surveys can be conducted throughout the day provided that light conditions permit the location of nests. Surveys should not be undertaken during poor weather conditions such as heavy rain or high winds as bird detectability is reduced.

3.2.2 Pre-construction surveys

3.2.2.1 Ground-based nest surveys

Ground-based searches for the ground nests of pihoihoi/New Zealand pipit and other species will be undertaken by a suitably qualified ecologist using the following methodologies adopted from Strategic Resource Solutions (2015).

- Pre-determined transects should be passively surveyed to search for nests and nesting behaviour. Team members should remain within visual distance and walk in parallel to survey within the vegetation clearance areas and 20 m beyond the boundary in any suitable habitat.
- Track-logs of the survey transect will be recorded using a GPS device. All nests that are identified should be documented and the following details included:
 - The nest location (using the hand-held GPS for accuracy).
 - The species attributable to the nest (if possible).
 - The general habitat characteristics (e.g., vegetation species, nest position; and dominant vegetation cover).
 - Adult bird behaviour (e.g., nest building, incubating, or brooding).
 - The nest status (e.g., active, or inactive). If an adult bird flushes from an area that is suspected of being potential bird nesting habitat, the surveyor(s) should briefly search the immediate area for a nest.
- To avoid nest abandonments, disturbance of nest areas must be minimised where possible and if nests are not immediately located, surveyors should exit the area to observe any further nesting behaviour / nest guarding behaviour using binoculars from a concealed location.

3.2.2.2 *Ruru nohinohi/little owl nest surveys*

A suitably qualified ecologist will undertake a survey for ruru nohinohi/little owl nests present on site using the following methodologies:

- Identify all potential nesting habitat within the site, this includes mature trees, piles of woody debris, and old buildings/structures.
- Each identified area should be thoroughly checked for cavities/holes – sometimes very small cavities are utilised that may be hard to visually inspect.
- Climbing arborists may be required to assist with the survey where trees are too tall or dense to effectively assessed from the ground.
- All potential nests that are identified should be marked with flagging tape, recorded using a GPS device and all relevant details should be documented.

3.2.2.3 *Determining nest status*

Nests detected during the surveys will be assessed to determine whether they are currently active or not. Derelict condition or lack of obvious indicators (e.g., nearby adult birds, empty shells) are characteristic of inactive nests. Active nests can be indicated by new nesting material, observations of adult bird territorial behavior and calls, and visible eggs and/or chicks. If unclear, a precautionary approach should be adopted, and nests should be given a tentative active status.

It is only after two observation periods of approximately one hour each, on two separate day visits, that a potentially active nest can be designated as inactive.

3.2.2.4 *Establishing a no-clearing nest buffer*

Nest buffers should be established around all confirmed active nests and suspected nest areas with significant evidence of breeding. Buffers will ensure as best as possible, that any clearing outside of the buffer will not render a nest ineffective or cause it to become inactive.

The size and shape of the buffer will depend on several factors, including site topography, proximity of the nest to naturally open areas, surrounding vegetation characteristics and the ecology and behaviour of the species encountered.

It is up to the professional judgement of a suitably qualified and experienced ecologist to determine the size and implement the nest buffer.

In general, for 'Not Threatened' avifauna species the active nesting site should be left cordoned off until nesting birds have fledged, or nests naturally abandoned, as verified by the suitably experienced ecologist. If an active nest is detected that is thought to belong to an 'At Risk' or 'Threatened' species, then a 30 m buffer of vegetation are to be left *in situ*, clearly marked, and cordoned off until nesting birds have fledged or nests naturally abandoned, as verified by the suitably experienced ecologist.

3.2.3 Accidental Discovery

If a bird nest, eggs and/or chicks are discovered during vegetation clearance by site contractors or anyone working on site, the following protocols will be followed:

- The contractor or individual who has discovered the bird nest, egg or juveniles will contact the Project Ecologist immediately.
- If the Project Ecologist determines that the nest is attributable to a threatened or protected species, and the nest is deemed active, then individual trees and immediate surrounding habitat (within 30 m) are to be left *in situ*, clearly marked, and cordoned off from any works and machinery until chicks have fledged or nests have been naturally abandoned, as confirmed by a suitably qualified ecologist.
- No works should occur in the exclusion zone until the ecologist has confirmed the chicks have fledged or nests has been naturally abandoned.
- No personnel should be allowed to enter this exclusion zone until the area is deemed free of active nests.
- The contractor may be required to assist with bird nest checks where vegetation is too tall or dense to properly assess.
- Once the area is deemed free of active nests by the ecologist, vegetation clearance or other works may continue the same day.

3.2.4 Accidental Harm

In the event of finding a dead or injured native bird during construction of the proposed works, the following procedures will be implemented:

- Injured birds will be taken immediately to a vet approved by the Department of Conservation (DOC) for assessment.
- Birds will be placed in a cool, dark, material-lined container or under the direction of a suitably qualified ecologist to ensure that the bird is handled appropriately.
- The local DOC office or DOC hotline (if after hours) will be contacted no longer than two hours after the injured or dead bird is found. The DOC hotline is 0800 DOC HOT (0800 362 468). Only threatened or at-risk
- DOC will advise the name and information of the approved contact in the event of native bird injury or mortality.
- DOC and veterinary advice shall be sought in conjunction with a suitably qualified ecologist when considering the rehabilitation requirements of any injured birds. Following the veterinary assessment, the ecologist will determine any rehabilitation action required and the longer-term future for the bird/s.
- If the bird is dead or euthanised by the vet, and is native, it must be taken to the local DOC office as soon as practicable.

3.3 Monitoring

No post-survey monitoring is required under the AMP.

3.4 Reporting

The results of pre-construction surveys and any accidental discovery or harm should be documented in a compliance summary report which will be submitted to council.

Furthermore, all observations should be submitted to New Zealand eBird.

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4 - Invertebrate Management Plan

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4 Invertebrate Management Plan

4.1 Introduction

The purpose of this Invertebrate Management Plan (IMP) is to manage potential adverse effects on notable invertebrates for the subdivision at 130 Bowenvale Avenue, Cashmere, Christchurch. Notable invertebrates are defined as any invertebrate that is locally endemic, threatened, protected, or are a recently discovered species (Wildland Consultants, 2023).

It should be noted that while kahukura/New Zealand red admiral butterfly (*Vanessa gonerilla*) have been identified as likely to be present within the site, managing the risk of injury and/or mortality is not deemed necessary as no suitable host plants (native stinging nettle) are present for larvae, and adults will be able to disperse if present during construction.

Table 11. Overview of Invertebrate Management.

Category	Summary
Purpose	This Invertebrate Management Plan (IMP) outlines the protocols to manage potential adverse effects on notable invertebrates.
Objective and Target Species	The objective of this IMP is to minimise impacts (i.e., injury/mortality and loss of habitat) on resident populations of: <ul style="list-style-type: none"> - Trapdoor spiders (<i>Cantuaria</i> sp.) - Rō/New Zealand mantis (<i>Orthodera novaezealandiae</i>) - Indigenous ground beetle (<i>Holcaspis angustula</i>)
Invertebrate Management Overview	Stacking of cleared vegetation to allow invertebrates to disperse. Salvage and relocation of ground beetles and trapdoor spiders. Habitat enhancement.
Monitoring	Not required.
Reporting	Completion of a compliance summary report detailing any notable species detected, numbers relocated, and the release location.

4.2 Invertebrate Management

To address potential adverse effects on invertebrates, best practice management protocols have been adapted for local site conditions and the notable species identified as present, or likely to be present. Protocols include: pre-clearance checks, salvage, relocation, stacking of cleared vegetation, and habitat enhancement.

4.2.1 Pre-clearance salvage and relocation

Prior to any vegetation clearance, a suitably qualified and experienced ecologist will be present on site and will undertake a salvage and relocation of trapdoor spiders and ground beetles within areas of suitable habitat

4.2.1.1 Ground beetle salvage and relocation.

Wildlands (2023) notes that the presence of the indigenous ground beetle (*Holcaspis angustula*) on site is doubtful given the species habitat preferences but recommends management as a precautionary measure. On this basis, it is recommended that an initial site assessment is completed prior to vegetation clearance

whereby any suitable areas of habitat are mapped. A study has found *H. angustula*, tend to be more abundant in areas with high canopy cover, high moisture content, and where there is a high proportion of bare rock (Bowie et al., 2018). Wildlands (2023) also notes they may use areas of open soil as hunting grounds.

If no suitable habitat is identified, ground beetle management is not required.

If any suitable habitat is identified, a combination of pitfall traps and wooden discs will be installed in these mapped areas using methods described in the *DOCCM-248862 Invertebrates: pitfall trapping v1.0* guidance document (Sherley & Stringer, 2016) and *A practical technique for non-destructive monitoring of soil surface invertebrates for ecological restoration programmes* (Bowie & Frampton, 2004). Wooden discs should be installed within any areas of suitable habitat as soon as possible to allow sufficient time for invertebrates to colonise.

Wooden discs should be checked in spring which has found to be the best season for Carabidae with 3.5-fold more beetles found compared to winter (Bowie & Frampton, 2004). Pitfall traps should be installed and checks timed to coincide with checks of wooden discs. Little is known about the diet of *H. angustula*, so the Project Ecologist will evaluate whether pitfall traps should be baited. No preservative solution is to be used in pitfall traps as beetles must be captured alive. Instead some leaves can be placed in the bottom of traps to provide insects a place to hide. Pitfall traps will need to be checked daily as occasionally small pitfall traps may catch lizards (Sherley & Stringer, 2016). Where possible, checking of pitfall traps and wooden discs may be coordinated with lizard salvage works for efficiency.

The project ecologist will evaluate how many nights of pitfall trapping is required, based on the results of initial checks of pitfall traps and wooden discs.

4.2.1.2 Trapdoor spider salvage and relocation

A population of trapdoor spiders (*Cantuaria* sp.) are noted by Wildlands (2023) as inhabiting a clay bank beneath the macrocarpa forest on site (Vegetation Type 1; see Figure 1). An initial site survey should take place (in conjunction with the habitat assessment for ground beetles described above) to determine exact locations of trapdoor spider populations where management is required. Burrows should be marked using a fluorescent stake, or stake with flagging tape. The project ecologist will select the most appropriate relocation method from the following proposed methods:

- Use of tethered mealworm beetles will be used to lure trapdoor spiders out of their burrows and capture them in accordance with the methods developed and described by Smith et al., (2015). 'Beetling' should be undertaken at night time and ideally when conditions are warm.
- Digging to directly remove spiders from burrows.

4.2.2 Capture, handling and transport

Any notable invertebrates captured will be collected and relocated into habitat that will not be affected by vegetation removal or earthworks (either Lot 100, Bowenvale Reserve, or Victoria Park). Spiders will be relocated to an area that contains suitable clay banks.

The following steps will be undertaken by the qualified ecologist to ensure appropriate handling and salvage of invertebrates:

- Invertebrates will be captured by hand (using gloves) and temporarily stored in modified containers with small holes for ventilation and leaf litter/vegetation to provide refuges.
- Trapdoor spiders will be held individually in containers to minimise any aggressive or territorial behaviour.

4.2.3 Stacking cleared vegetation

As recommended by Wildlands (2023), any cleared vegetation, with the exception of tall trees, should be stacked near remaining living vegetation. As the dying vegetation dries out, invertebrates such as New Zealand mantis should disperse to new habitat. The vegetation stacks should be left out over multiple days or weeks until the plants are brittle and losing leaves and can then be removed from site.

Ideally, this process should occur during warm temperatures (i.e. spring-summer) as the heat facilitates invertebrate movement and vegetation desiccation.

4.2.4 Habitat enhancement

Landscaping and planting of the proposed subdivision should, where possible, include eco-sourced indigenous plantings and other refugia that are appropriate for the notable species identified.

For example, rō/New Zealand mantis are known to deposit their oothecae/eggs on native plants with unshaded trunks (Bowie & Bowie, 2003), including kowhai (*Sophora microphylla*), native broom (*Carmichaelia* sp.), lancewood (*Pseudopanax crassifolius*) and cabbage tree (*Cordyline australis*).

If ground beetle are discovered during pre-clearance surveys and released in Lot 100, some felled logs should be relocated to this to enhance habitat, following vegetation clearance.

4.3 Monitoring

Monitoring of invertebrate relocations is not proposed due to difficulties in obtaining meaningful data as both abiotic and biotic factors affecting the fauna are complex. Further, monitoring results typically inform adaptive management which is not required from an effects management perspective for this project. It is reasonable to assume that the actions described above within the IMP will ensure a Low – Very Low level of effect on notable invertebrates.

4.4 Reporting

The project ecologist should record any notable invertebrates salvaged and the number of individuals relocated. These results should be documented in a compliance summary report which will be submitted to council. The compliance summary report should also detail the location where salvaged invertebrates were released, and confirm adherence to the methodology described in this EMP.

5 - Restoration Planting Plan

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5 Restoration Planting Plan

5.1 Purpose and Objective

The purpose of the Restoration Planting Plan (RPP) is to mitigate for the loss of native vegetation, as well as provide and enhance habitat for native fauna (herpetofauna, avifauna, and invertebrates) for the subdivision at 130 Bowenvale Avenue, Cashmere, Christchurch. This RPP is consistent with the Landscape Concept Plan created by DCM Urban Design Limited (2023) for the subdivision, which provides the list of species to be planted in the designated amenity and flow path areas.

5.2 Planting Methodology

5.2.1 Planting Location and Extent

Where possible and practical, existing areas of native vegetation or individual native plants should be kept, with restoration planting undertaken around them (as noted below for Lot 100). Similarly, it is preferred if plants can be sourced and transplanted from other areas of the site that have been planned for development (where they would need to be removed anyway).

Restoration will be undertaken within designated amenity areas and the flow paths (i.e., 2 m width planting at top of the bank), as well as in Lot 100 :

- **Amenity areas and the flow paths:** The planting locations for the amenity areas and the flow paths are shown in Figure 4. These areas total up to approximately xxx m² of planting.
- **Lot 100:** An adaptive approach will be undertaken for this location to focus vegetation removal efforts on pest plant species, and to retain any existing native vegetation and habitat for native lizards as much as possible. The planting location for Lot 100 is shown in Figure 5.

Based on the vegetation habitat survey from Wildlands Consultants Limited (2023), this will likely result in the removal and replanting of most of the areas mapped as Tree lucerne forest (0.046 ha), (Tree lucerne)-(Kohuhu)/Blackberry-gorse-banana passionfruit scrub (0.076 ha). However, the areas mapped as Cocksfoot-(fennel) grassland will be retained, as while most of it is dominated by grass species that are exotic but not pests (though some pest plants are present), and it provides good lizard habitat. The area extent of Macrocarpa forest will also be retained, but the vine pest plants (e.g., banana passionfruit, and old man's beard) should be removed as much as possible.

The total area of planting in Lot 100 is estimated to be 0.123 ha, based on the removal of the pest plant dominated habitat types stated above. However, the final amount of area planted may be slightly lower if restoration contractors are able to retain any existing patches of native vegetation scattered throughout those areas.

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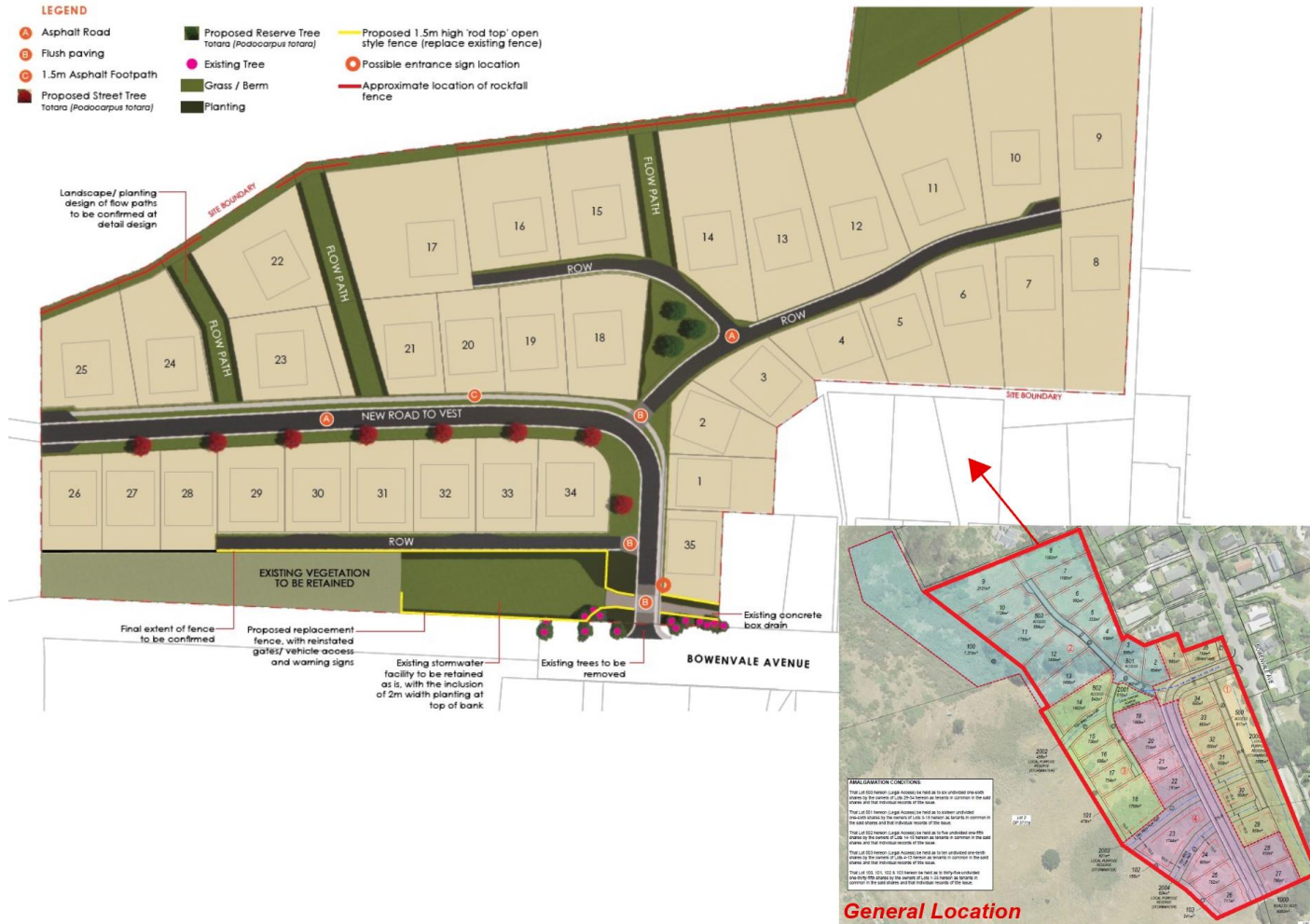


Figure 4. Proposed planting locations of the designated amenity areas and flow paths. Taken from the Landscape Concept Plan by DCM Urban Design Limited (2023).

5.2.2 Site Preparation

Site preparation of the planting locations will be undertaken, including the following:

- Control of any pest plants listed in the CRPMP (2018-2038), NPPA, and Department of Conservation's environmental weed list. Where possible, manual removal should be used to limit the use of herbicides. herbicides are used, and cut and paste, and spot spraying methods should be used in the first instance. If spray is used, it should be undertaken in cool, overcast conditions.
- The cutting back of pest plants to expose sunlight on the grass and groundcover will also enhance the lizard habitat provision of the site, in preparation for lizard relocation.
- Enhancement of lizard habitat in Lot 100 using materials created during pest plant removal or construction activities (see Section 4.2.8 of the Lizard Management Plan for more detail). This includes:
 - The creation of log piles from cutting down trees in Lot 100. In particular, the gorse cutting from pest plant removal can be left on Lot 100 to provide lizard habitat.
 - The creation of rock piles from retaining any rocks found while digging / developing the site in Lot 100 or in other areas.
 - If practical at this stage, the relocation of Scrub pōhuehue vineland from other locations to Lot 100.

Site preparation for all planting locations should be undertaken prior to the first planting season starting in May. Site preparation for Lot 100 must also occur prior to any native lizard relocation (see Section 5.4. for programme of works).

5.2.3 Plant Selection

Plant species selection was guided by Assessment of Ecological Effects (Wildlands, 2023), and in general, included the following considerations:

- Existing and historical native plant communities at the Site (including *Scrub pōhuehue vineland*).
- Provision of habitat for notable birds, lizards, and invertebrates:
- Likelihood of establishment based on immediate in-situ conditions.
- Revegetation species that ensure quick re-establishment of canopy cover; and
- Stock availability.

The planting schedule outlined below in **Table 7** is provided as a base template for species selection and quantity.

For Lot 100, the planting of *Muehlenbeckia australis* and *M. complexa* will be prioritised to encourage the growth of the *Scrub pōhuehue vineland* habitat type. However, other plant species known to provide lizard and invertebrate habitat have also been recommended, to avoid creating a large monoculture area.

It is recommended that experienced revegetation contractors undertake this planting work and be afforded the opportunity to make appropriate changes to species selection, site preparation and timing based on site specific conditions, when deemed necessary.

Table 7. The recommended schedule detailing species and quantities for restoration planting.

NOTE: The details for Road Landscape, Stormwater flow paths, Stormwater Lot 2000, and Street tree are taken from the Landscape Concept Plan (DCM Urban Design Limited, 2023). The plant quantities for Lot 100 are based on a pest plant removal area of 0.123 ha, but the final quantities may vary if restoration contractors are able to retain any existing patches of native vegetation scattered throughout those areas or are able to transplant native vegetation taken from other areas of the site planned for development.

Common Name	Scientific Name	Growth Form	Grade	Spacing	Qty	Notes
ROAD LANDSCAPE						
Miniature toetoe	<i>Chionochloa flavicans</i>	Groundcover/Grass/herb	0.5			Provides habitat for invertebrates
NZ Iris	<i>Libertia ixiodes</i>	Groundcover/Grass/herb	0.5			
Pōhuehue	<i>Muehlenbeckia axillaris</i>	Groundcover/Grass/herb	0.5			Provides food and habitat for invertebrates
Silver tussock	<i>Poa cita</i>	Groundcover/Grass/herb	0.5			
Wind Grass	<i>Anemanthele lessoniana</i>	Groundcover/Grass/herb	0.5			
Koromiko / Hebe	<i>Hebe 'Wiri Mist'</i>	Shrub	0.5			
STORMWATER FLOW PATHS						
Mountain flax	<i>Phormium cookianum</i>	Groundcover/Grass/herb	1			Provides food and habitat for birds and invertebrates.
Silver tussock	<i>Poa cita</i>	Groundcover/Grass/herb	0.5			
Koromiko / Hebe	<i>Hebe strictissima</i>	Shrub	0.5			
Kanuka	<i>Kunzea robusta</i>	Tree	1			Provides food and habitat for birds and invertebrates.
South Island kōwhai	<i>Sophora microphylla</i>	Tree	1			Provides food and habitat for birds and invertebrates.
Lancewood	<i>Pseudopanax crassifolius</i>	Tree	1			Provides habitat for invertebrates.
STORMWATER LOT 2000						
Mountain flax	<i>Phormium cookianum</i>	Groundcover/Grass/herb	0.5			Provides food and habitat for birds and invertebrates.
Shrub pōhuehue	<i>Muehlenbeckia astonii</i>	Groundcover/Grass/herb	0.5			Provides food and habitat for invertebrates
Silver tussock	<i>Poa cita</i>	Groundcover/Grass/herb	0.5			
Koromiko / Hebe	<i>Hebe strictissima</i>	Shrub	0.5			
STREET TREE						
Lancewood	<i>Pseudopanax crassifolius</i>	Tree	25+			Provides habitat for invertebrates
Cabbage tree	<i>Cordyline australis</i>	Tree	25+			Provides habitat for invertebrates
South Island kōwhai	<i>Sophora microphylla</i>	Tree	25+			Provides habitat for invertebrates
Totara	<i>Podocarpus totara</i>	Tree	25+			

Commented [SH3]: For Landscape architect to provide Grade, Spacing and Qty.
or for them to provide sqm of each area, in which case I can back calculate it.

Commented [SH4]: Not in the current landscaping plan, however have discussed with landscape architect a and he is happy to add these.

I have however taken out my suggestion of the cabbage trees upon discussion with the landscape architect to reduce amount of leaves falling into the system and causing blockages.

Commented [SH5]: Not in the current landscaping plan, however have discussed with landscape architect a and he is happy to add these.

Common Name	Scientific Name	Growth Form	Grade	Spacing	Qty	Notes
LOT 100 *						
Broad-leaved poa	<i>Poa anceps</i>	Groundcover/Grass/herb	Seed / 0.5	0.5	176	Provides habitat for lizards.
Large-leaved pōhuehue	<i>Muehlenbeckia australis</i>	Groundcover/Grass/herb	0.5	0.5	264	Creating <i>Scrub pōhuehue vineland</i> . Provides food and habitat for lizards and invertebrates.
Miniature toetoe	<i>Chionochloa flavicans</i>	Groundcover/Grass/herb	0.5	0.5	176	Provides habitat for lizards and invertebrates.
Pōhuehue	<i>Muehlenbeckia complexa</i>	Groundcover/Grass/herb	0.5	0.5	264	Creating <i>Scrub pōhuehue vineland</i> . Provides food and habitat for lizards and invertebrates.
Toetoe	<i>Cortaderia richardii</i>	Groundcover/Grass/herb	0.5	0.5	176	Provides habitat for lizards and invertebrates.
Common Broom	<i>Carmichaelia australis</i>	Shrub	1	1	88	Provides food and habitat for invertebrates.
Karamu	<i>Coprosma robusta</i>	Shrub	1	1	176	Species already present in Lot 100 (i.e., within habitat type <i>Marcrocarpa</i> forest).
Mingimingi	<i>Coprosma propinqua</i>	Shrub	1	1	176	Species already present in Lot 100 (i.e., within habitat type <i>Marcrocarpa</i> forest). Provides food and habitat for lizards.
Porcupine shrub	<i>Melicytus alpinus</i>	Shrub	1	1	176	Provides food and habitat for lizards and invertebrates.
Lancewood	<i>Pseudopanax crassifolius</i>	Tree	1	1	88	Species already present in adjacent area to Lot 100. Provides habitat for invertebrates
South Island kōwhai	<i>Sophora microphylla</i>	Tree	1	1	88	Species already present in adjacent area to Lot 100. Provides food and habitat for birds and invertebrates

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or for them to provide sqm of each area, in which case I can back calculate it.

*Plant quantities for Lot 100 were estimated based on a total plant number of 1845 and planting area of 0.123 ha. The total plant number accounts for the different plant spacings (e.g., a spacing of 1 m = 1 plant / m², and spacing of 0.5 m = 3 plants / m²). The plant numbers per species accounts for the recommended planting pattern of each species, including a high frequency for *Muehlenbeckia* spp, and a moderate frequency for other groundcover/grass/herb species, and a low frequency for the tree species.

5.2.4 Source of Plants

Plants to be used will be of good quality and eco-sourced from the Port Hills Ecological District. Eco-sourcing is key to ensure plants are well adapted to local conditions, increasing survivorship through to establishment. Plants purchased should also be of pure stock with no hybrids used. It is recommended that experienced professional ecological restoration contractors undertake this planting work and be afforded the opportunity to make appropriate changes to species selection, site preparation, and timing based on site specific conditions, when deemed necessary.

Optimal plant stock to be used in the planting will have following attributes:

- Healthy, vigorous, and free from obvious signs of disease and pests;
- Of at least average size for the specified pot/plastic bag size
- Well-developed root system with a high amount of new root growth;
- Not root bound; and
- Well-branched and symmetrically shaped.

The above will be checked upon delivery by the nursery / supplier and by the contractor. Plants considered by the contractor to be of poor quality will be rejected and will need to be replaced by the nursery.

Where possible and practical, plants can be also sourced and transplanted from other areas of the site that have been planned for development (since they would need to be removed anyway). This will reduce the need to purchase plants and the biosecurity and genetic risk of introducing new plants to the area.

5.2.5 Biosecurity Measures

Plantings will include kānuka; which are from the Myrtaceae family, and are susceptible to myrtle rust. Myrtle rust is a fungal disease that attacks plants from this family which can result in slower plant growth, or plant death.

Prior to the above Myrtaceae species being delivered to the site, a signed Myrtle Rust Nursery Management Declaration must be provided to the contractor by the nursery to indicate that the plant producer has implemented the New Zealand Plant Producers Incorporated Myrtle Rust Nursery Management Protocol.

5.2.6 Plant Layout and Density

Plant will generally be planted in clusters of one or more species, while avoiding the creation of large areas of open ground, to replicate the natural process of seed dispersal and establishment. The exception is *Muehlenbeckia spp.* which should be planted together in clusters of three to five to help create patches of *Scrub pōhuehue* vineland.

Poa anceps seeds can be scattered and spread around areas where gorse cuttings have been left behind to promote establishment of long grass, and enhance lizard habitat.

Planting grades to be used should generally be of 0.5 L (groundcovers, grasses, small shrubs) and 1 – 3 L (large shrubs and trees) grades. This takes into consideration the greater success of transplanting smaller plants, the larger root mass to leaf area ratio, and the economics of large-scale planting.

Planting is to be undertaken at an average density of 1 m² (1 plant per 1 square metre); however, groundcovers and grasses should be planted at a higher density of 0.5 m² (3 plants per 1 square metre). This density will enable canopy closure to be achieved quickly where required and the understorey to be re-instated as quickly as possible.

5.2.7 Planting Methodology

Plantings will predominately be carried out late-autumn to mid-winter (May – August) due to higher soil moisture. Planting directly

into damp soil will benefit the plants both through water availability, but also through soil compressibility, getting a good packing of soil around exposed roots.

Holes will be dug approximately twice the size of the root ball. Hand dug holes are preferred, but machinery can be used (e.g., motorised auger) as long as the walls of each hole are scarfed to facilitate root penetration. Plant roots will be slightly loosened at the base of the root mass to aid roots to grow outward once planted, rather than remain in a tight root ball.

Care must be taken when removing plants from bags / pots to minimise root disturbance, and plants will need to be pressed/heeled in firmly once in the ground to minimise air pockets around the root system.

5.3 Post-planting Maintenance

Upon completion of the initial works, all plantings will be periodically maintained for a minimum period of five years, and will be periodically monitored for a minimum of the first three years.

5.3.1 Pest Plant Control

Pest plants can smother and inhibit the growth of native species, typically by outcompeting for space and resources until the native planting is established and dominant. Control of all pest plants as per the CRPMP (2018-2038), NPPA, and Department of Conservation's environmental weed list will be required (Howell, 2008).

Pest plant maintenance involves releasing grass and pest plants immediately around the plants, and removing any individual pest plants present within the Site. Manual removal is recommended and should be used where possible instead of applying herbicides. If herbicides are determined to be needed, then spot spraying, and cut and paste methods should be used in the first instance. Spraying would need to be restricted to cool, overcast weather conditions, where lizard and invertebrate activity is limited. This is to reduce the potential impact of herbicides on lizard and invertebrate populations.

If required, mulch can be applied to help suppress pest plants and / or maintain moisture in the soil. This involves spreading an approximately 5 – 10 cm layer of mulch evenly around the plant after the grass and pest plants have been removed. Ensure a gap of 5 – 10 cm is left between the plant and mulch, around the base of the plant stem.

5.3.2 Infill and Enrichment Planting

To ensure that native coverage is achieved and that gaps do not develop (allowing weeds to enter the planting area), plantings will be inspected twice a year, once in spring and once in autumn for the first three years post-planting. The timing of the inspections can be aligned with any compliance monitoring for revegetation success.

Plants that do not survive are to be replaced with either the same species or an alternative appropriate species from **Table 7**, (or a similar species as determined by the ecological restoration contractor), in the following planting season.

5.4 Programme of Works

The suggested timing of planting, maintenance and monitoring is shown in the Table below.

To tie the RPP in with the timing of the lizard management (see Section 2.2.1), it is suggested to start the site preparation and initial planting of Lot 100 in March 2024 and May 2024, respectively. This will allow for enough spring growth to enhance the lizard habitat provision of Lot 100 before the lizards are relocated and released there in 2025.

Table 8. Annual maintenance cycle as part of the restoration planting.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Year 1			#	#	□#	□	□	□	#	#		
Year 2				*	■	■	■	■	#	#*		
Year 3				*	■	■	■	■	#	#*		
Year 4				*	■				#	*		
Year 5					■				#			

- = Initial planting
- = Infilling and enhancement planting
- # = Weed control and plant release
- * = Monitoring for planting requirements and success of vegetation establishment

5.5 Monitoring

Upon completion of the initial works, the planting will be periodically monitored for at least the following three years. This includes an annual site walkover by an appropriately qualified ecologist to survey the following:

- Identify weeds and animal damage;
- Estimate planting survival and infill/replacement planting needed; and
- Estimate canopy closure.

Successful vegetation establishment is demonstrated by 90% species survival rate and 80% canopy closure.

Findings will be used to inform planting management requirements, including weed control, for the next subsequent year.

5.6 Reporting

On the completion of the 5-year works programme, a compliance summary report will be submitted to council to confirm that works have been completed in accordance with this RPP.

6 Conclusions

S5 Consultants, on behalf of their client Bowenvale GCO Limited, have applied for resource consent to undertake a subdivision and development of 35 residential allotments within a 5.09-hectare site at 130 Bowenvale Avenue, Cashmere, Christchurch.

Beca Limited (Beca) were engaged by Bowenvale GCO Limited to prepare an Ecological Management Plan (EMP) for the proposed subdivision. The purpose of the Ecological Management Plan (EMP) is to guide the implementation of the effects management recommended in the Assessment of Ecological Effects report that was prepared by Wildland Consultants Limited (Wildlands).

Wildlands (2023) identified that the proposed works may have adverse ecological effects on the following ecological features/values: herpetofauna, avifauna, invertebrates and terrestrial vegetation.

Any potential lizard populations onsite are likely to be adversely impacted by the project. Effects on lizards are likely to include disturbance, injury, mortality, and habitat loss. Lizard management using a salvage and relocation programme, habitat enhancement and pest animal and plant control in Lot 100 and population monitoring is to be implemented over a five-year period, with the objective of increasing lizard numbers within Lot 100 by at least 10%. A contingency has been included where remedial action will be undertaken to ensure these targets are met. If the measures outlined in this LMP are implemented in full, the anticipated level of effects, following effects management, is likely to be **Low**, because of the pest control programme and habitat enhancement in Lot 100, to which local lizard populations are expected to respond in number.

The proposed works may have adverse impacts on any native or protected (in the case of ruru nohinohi/little owl) avifauna present on site. Effects on avifauna are likely to include disturbance, injury, mortality, and habitat loss. The implementation of the methodologies set out in the Avifauna Management Plan, i.e., avoidance of breeding season for clearance and/or pre-construction surveys, should appropriately manage any adverse effects on native and protected avifauna on site.

Vegetation clearance and the removal of topsoil as part of clearance, landscaping, and earthworks in preparation for construction may adversely affect any notable invertebrates on site. Effects on notable invertebrates include injury, mortality, and loss of habitat. The implementation of pre-clearance checks, salvage, relocation, stacking of cleared vegetation, and habitat enhancement, will manage ecological effects on any notable invertebrates on site.

Most of the vegetation, including all 0.11 ha of scrub pōhuehue vineland, will be cleared as part of works for the subdivision. The methodologies set out in the Restoration Planting Plan mitigate for the loss of native vegetation, as well as provide and enhance habitat for native fauna (herpetofauna, avifauna, and invertebrates),

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8 Limitations

This report has been prepared by Beca Ltd solely for GCO Group Limited (the client). This report is prepared solely for the purpose of outlining methodology for the management of potential ecological effects of the proposed works (Scope). The report has been prepared to support a resource consent application and may be used by the Client and others in subsequent processes to consider the application to which the assessment pertains. The contents of this report may not be used by the Client for any purpose other than in accordance with the stated Scope.

This report is confidential and is prepared solely for the Client. Beca accepts no liability to any other person for their use of or reliance on this report, and any such use or reliance will be solely at their own risk.

This report contains information obtained by inspection, sampling, testing or other means of investigation. Unless specifically stated otherwise in this report, Beca has relied on the accuracy, completeness, currency and sufficiency of all information provided to it by, or on behalf of, the Client or any third party, including the information listed above, and has not independently verified the information provided. Beca accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the information provided.

The contents of this report are based upon our understanding and interpretation of current legislation and guidelines ("Standards") as consulting professionals and should not be construed as legal opinions or advice. Unless special arrangements are made, this report will not be updated to take account of subsequent changes to any such Standards.

This report should be read in full, having regard to all stated assumptions, limitations and disclaimers.

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Appendix A – Incidental Discovery Protocol for Lizards

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INCIDENTAL DISCOVERY PROTOCOL FOR LIZARDS

INTRODUCTION

An Incidental Discovery Protocol (IDP) has been developed for the discovery of lizards outside of the lizard salvage programme by contractors during the proposed works at 130 Bowenvale Avenue, Cashmere, Christchurch.

Where lizard habitat occurs, lizards should always be assumed to be present, and where site works may adversely affect lizards, these should always be assessed and managed by suitably qualified and experienced ecologists, with management plans and wildlife permits in place.

This IDP has been prepared specifically for a project where lizards are unexpectedly encountered during site works in the absence of the Project Lizard Ecologist. This IDP enables the correct actions to be undertaken should any unexpected discoveries be made.

INCIDENTAL DISCOVERY PROTOCOLS

Overview

Incidental discovery protocols are set out below for construction staff and contractors, and are to be followed if any lizards are discovered during activities at the site at 130 Bowenvale Avenue.

Where lizards might usually be found:

Normally, lizards could be present and encountered in and on vegetation such as shrubs and trees, and in grassland habitat. They may also bask in sunny exposed spots such as rock faces. They may be revealed when disturbed by habitat clearance or earthworks.

Where lizards might be found unexpectedly:

Lizards occasionally colonise man-made structures or man-made debris surrounding natural lizard habitat such as corrugated iron, wood piles, or discarded rubbish.

Incidental Discovery Protocols

Following the incidental discovery of a lizard:

- Immediately (as soon as discovery of a lizard is made) restrict activities to beyond 25 metres of the place of discovery.
- If possible, capture the lizard and place in a container with grass. Ensure to create breathing holes in the container for the lizard. Hold the lizards in captivity in a cool, shady location out of sun until a decision is made about where to relocate them.
- If lizards are unable to be captured and/or photographed, note as much detail as possible. For example, was it a gecko or skink; what colour was it (including colour patterns), approximate size? Also, describe the habitat it was found in. You will need to describe these details to your manager and the Project Lizard Ecologist.
- Immediately inform the environmental manager/operations manager on-site who will then follow the protocol outlined in below.

- The environmental/operations manager should immediately notify the Project Lizard Ecologist, and follow the instructions provided.
 - Document:
 - Date and time.
 - Weather conditions.
 - Observer name(s).
 - Photographs of the animal (if possible) and the location where it was found. Photograph the lizard from above trying to show the head and any markings on the upper body or back. A cell-phone picture is adequate for this and will help with identification of species.
 - Location (GPS coordinates)
 - Habitat types in which the lizard(s) were observed.
 - Species (can be confirmed by experts).
- If injured:**
- What part of the animal is injured? (Photograph the injury).
 - Time since injury (if known).
 - Probable cause of injury (if known).
 - Injured lizards should be delivered immediately to Orana Wildlife Park.
- If a carcass is found:**
- Condition of carcass.
 - Probable cause of death (if known).
 - Notify the Council, which will notify the Department of Conservation and ask for advice on how to proceed.
 - If the carcass is in good condition (i.e., recently deceased), arrange for it to be sent to Museum of New Zealand Te Papa Tongarewa immediately. However, if the lizard is a threatened species and/or is obviously diseased and necropsy is required, the carcass may need to be sent to Wildbase (06 350 5329), Massey University, in Palmerston North, unless advised otherwise by the Department of Conservation.
- All captured lizards will be released by the Project Lizard Ecologist or a suitably qualified and experienced ecologist elsewhere on the same property, likely Lot 100, unless it is not a southern grass skink or McCann's skink. Animals will be released into natural refugia in habitat types considered as suitable for the particular species. The release site will be:
 - Protected from future development.
 - Of sufficient size, habitat complexity and containing biophysical characteristics (i.e., receiving appropriate sunlight and humidity) required to provide all the life history needs of relocated lizards.
 - Located close to the source population (genetically appropriate).
 - Within similar habitats and climatical environments (ecologically appropriate).
 - The Project Lizard Ecologist will determine the release sites.
- If the species encountered has a Threat Classification status of 'Threatened' (a higher conservation threat status than 'At Risk') then all works must cease immediately (as soon as the discovery is made), until an assessment is made of the risk the works programme poses to the lizard population,

and any specific management that is required, including avoidance. This is highly unlikely to be required.

- Should a nationally 'Threatened' lizard species be encountered, the Project Lizard Ecologist will immediately consult with the Department of Conservation to ask for advice on how to proceed. Further works may not be able to proceed until approval has been granted to continue or a lizard management plan has been drafted for the relevant species. This is also highly unlikely to be required.
- The Project Lizard Ecologist will ensure records are submitted to the Amphibian and Reptile Distribution Scheme (ARDS), which feeds into the Department of Conservation's BioWeb Herpetofauna database.

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BOWENVALE AVENUE SUBDIVISION
PRELIMINARY DESIGN ROAD SAFETY AUDIT

PREPARED FOR BOWENVALE GCO LIMITED

15 December 2022

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Bowenvale Avenue Subdivision Preliminary Design Road Safety Audit

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APPENDICES

Appendix A Preliminary Roding Plans

1. Introduction

1.1 Safety Audit Definition and Purpose

A road safety audit is a term used internationally to describe an independent review of a future road project to identify any safety concerns that may affect the safety performance. The audit team considers the safety of all road users and qualitatively reports on road safety issues or opportunities for safety improvement.

A road safety audit is therefore a formal examination of a road project, or any type of project which affects road users (including cyclists, pedestrians, mobility impaired etc.), carried out by an independent competent team who identify and document road safety concerns.

A road safety audit is intended to help deliver a safe road system and is not a review of compliance with standards.

The primary objective of a road safety audit is to deliver a project that achieves an outcome consistent with Safer Journeys and the Safe System approach, which is a safe road system increasingly free of death and serious injury. The road safety audit is a safety review used to identify all areas of a project that are inconsistent with a Safe System and bring those concerns to the attention of the client so that the client can make a value judgement as to appropriate action(s) based on the risk guidance provided by the safety audit team.

The key objective of a road safety audit is summarised as:

'to deliver completed projects that contribute towards a safe road system that is free of death and serious injury by identifying and ranking potential safety concerns for all road users and others affected by a road project.'

A road safety audit should desirably be undertaken at project milestones such as:

- concept stage (part of business case);
- scheme or preliminary design stage (part of pre-implementation);
- detail design stage (pre-implementation or implementation); or
- pre-opening or post-construction stage (implementation or post-implementation).

A road safety audit is not intended to be a technical or financial audit and does not substitute for a design check of standards or guidelines. Any recommended treatment of an identified safety concern is intended to be indicative only, and to focus the designer on the type of improvements that might be appropriate. It is not intended to be prescriptive and other ways of improving the road safety or operational problems identified should also be considered.

In accordance with the procedures set down in the NZTA Road Safety Audit Procedures for Projects Guidelines - Interim release May 2013 the audit report should be submitted to the client who will instruct the designer to respond. The designer should consider the report and comment to the client on each of any concerns identified, including their cost implications where appropriate, and make a recommendation to either accept or reject the audit report recommendation.

For each audit team recommendation that is accepted, the client will make the final decision and brief the designer to make the necessary changes and/or additions. As a result of this instruction the designer shall action the approved amendments. The client may involve a safety engineer to provide commentary to aid with the decision.

Decision tracking is an important part of the road safety audit process. A decision tracking table is embedded into the report format at the end of each set of recommendations. It is to be completed by the designer, safety engineer, and client for each issue, and should record the designer's response, client's decision (and asset manager's comments in the case where the client and asset manager are not one and the same) and action taken.

A copy of the report including the designer's response to the client and the client's decision on each recommendation shall be given to the road safety audit team leader as part of the important feedback loop. The road safety audit team leader will disseminate this to team members.

1.2 The Project

The project is a residential subdivision of land zoned 'Residential Hills' at the end of Bowenvale Avenue, as outlined in **Figure 1-1** below.

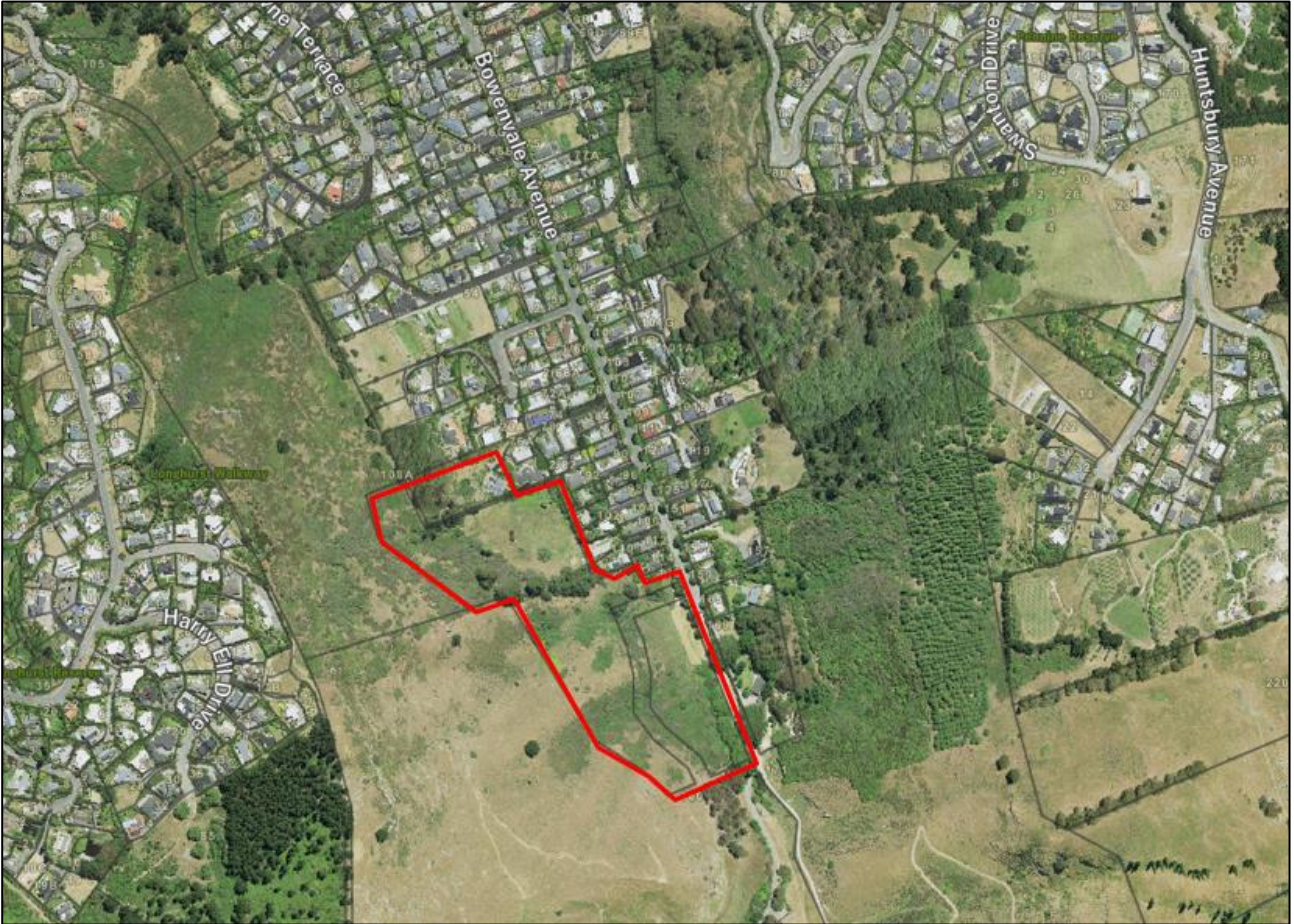


Figure 1-1. Site Outline

The proposed 45 lot subdivision layout is shown in **Figure 1-2**. One new road with an intersection on Bowenvale Avenue (Road 1) is proposed along with several rights of way for property access.

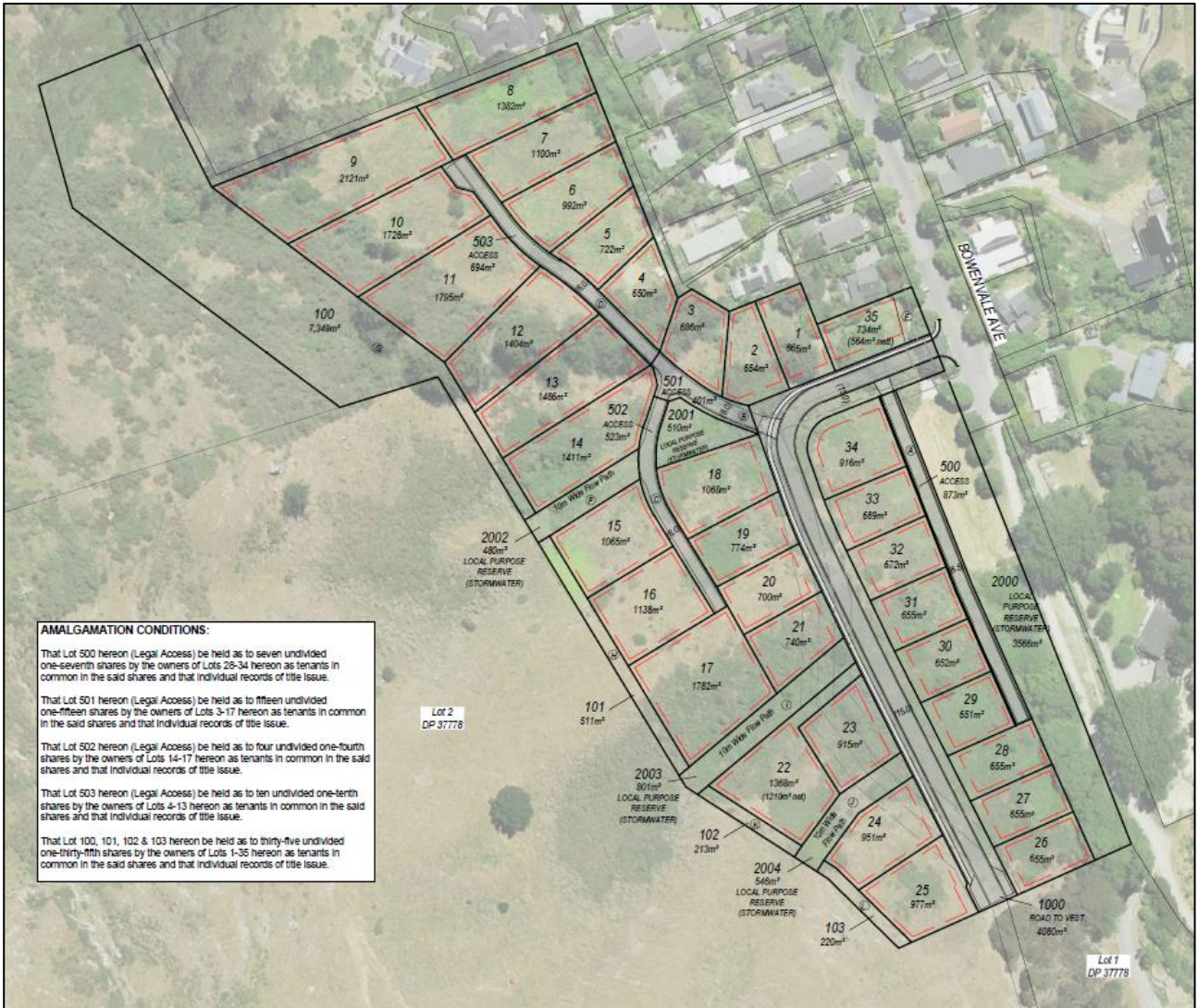


Figure 1-2. Proposed Subdivision Layout

1.3 The Road Safety Audit Team

This road safety audit has been carried out in accordance with the NZTA Road Safety Audit Procedure for Projects Guidelines – Interim release May 2013, by:

- Chris Rossiter, Principal Transportation Engineer, Stantec NZ; and
- Andrew Leckie, Senior Transportation Engineer, Stantec NZ.

The safety audit team visited the site on Monday 5 December 2022.

1.4 Previous Road Safety Audits

No previous road safety audits have been carried out for this proposed subdivision.

1.5 Scope of this Road Safety Audit

This road safety audit covers all transport-related elements of the proposed subdivision, including the Bowenvale Avenue intersection and frontage.

1.6 Report Format

The potential road safety problems identified have been ranked as follows.

The expected crash frequency is qualitatively assessed on the basis of expected exposure (how many road users will be exposed to a safety issue) and the likelihood of a crash resulting from the presence of the issue. The severity of a crash outcome is qualitatively assessed on the basis of factors such as expected speeds, type of collision, and type of vehicle involved.

Reference to historic crash rates or other research for similar elements of projects, or projects as a whole, have been drawn on where appropriate to assist in understanding the likely crash types, frequency and likely severity that may result from a particular concern.

The frequency and severity ratings are used together to develop a combined qualitative risk ranking for each safety issue using the concern assessment rating matrix in Table 1-2. The qualitative assessment requires professional judgement and a wide range of experience in projects of all sizes and locations.

In ranking specific concerns, the auditors have considered the objectives of the Safe System approach, i.e. to minimise fatal or serious injury crashes.

In undertaking this assessment, the Safety Audit Team have utilised the following descriptor tables to enable a fair and reasonable rating of the risks.

Table 1-1: Crash Frequency Descriptor

Crash Frequency	Indicative Description
Frequent	Multiple crashes (more than 1 per year)
Common	1 every 1-5 years
Occasional	1 every 5-10 years
Infrequent	Less than 1 every 10 years

Crash Severity is determined on the likelihood of a crash resulting in death or serious injury. The reader is advised that the severity of an injury is determined in part by the ability of a person to tolerate the crash forces. An able-bodied adult will have a greater ability to recover from higher trauma injuries, whereas an elderly person may have poor ability to recover from high trauma injuries. The auditors consider the likely user composition, and hence the likely severity of injury to that user.

Table 1-2: Concern Assessment Rating Matrix

Severity (likelihood of death or serious injury)	Frequency (probability of a crash)			
	Frequent	Common	Occasional	Infrequent
Very likely	Serious	Serious	Significant	Moderate
Likely	Serious	Significant	Moderate	Moderate
Unlikely	Significant	Moderate	Minor	Minor
Very unlikely	Moderate	Minor	Minor	Minor

While all safety concerns should be considered for action, the client or nominated project manager will make the decision as to what course of action will be adopted based on the guidance given in this ranking process with consideration to factors other than safety alone. As a guide a suggested action for each concern category is given in Table 1-3.

Table 1-3: Concern Categories

Concern	Suggested action
Serious	Major safety concern that must be addressed and requires changes to avoid serious safety consequences.
Significant	Significant safety concern that should be addressed and requires changes to avoid serious safety consequences.
Moderate	Moderate safety concern that should be addressed to improve safety.
Minor	Minor safety concern that should be addressed where practical to improve safety.

In addition to the ranked safety issues, it is appropriate for the safety audit team to provide additional comments with respect to items that may have a safety implication but lie outside the scope of the safety audit. A comment may include items where the safety implications are not yet clear due to insufficient detail for the stage of project, items outside the scope of the audit such as existing issues not impacted by the project or an opportunity for improved safety but not necessarily linked to the project itself. While typically comments do not require a specific recommendation, in some instances suggestions may be given by the auditors.

1.7 Documents Provided

The SAT was provided with the following Survus Consultants plans for this audit:

- 'Proposed Subdivision of Parts Lot 2 DP 33462' Drawing SC-01 Rev H
- 'Roading Plan' Drawing EN-101 Rev A
- 'Road Details Plan' Drawing EN-202 Rev A
- 'Road Longsection Plan' Drawing EN-201 Rev A

1.8 Disclaimer

The findings and recommendations in this report are based on an examination of available relevant plans, the specified road and its environs, and the opinions of the SAT. However, it must be recognised that eliminating safety concerns cannot be guaranteed since no road can be regarded as absolutely safe and no warranty is implied that all safety issues have been identified in this report. Safety audits do not constitute a design review nor are they an assessment of standards with respect to engineering or planning documents.

Readers are urged to seek specific technical advice on matters raised and not rely solely on the report.

While every effort has been made to ensure the accuracy of the report, it is made available on the basis that anyone relying on it does so at their own risk without any liability to the safety audit team or their organisations.

2. Safety Concerns

2.1 Bowenvale Avenue Intersection

Moderate

Road 1 is proposed to meet Bowenvale Avenue at a T-intersection (**Figure 2-1**). It is considered that a basic T-intersection will be appropriate however there will be several matters to be considered through the detailed design stage.

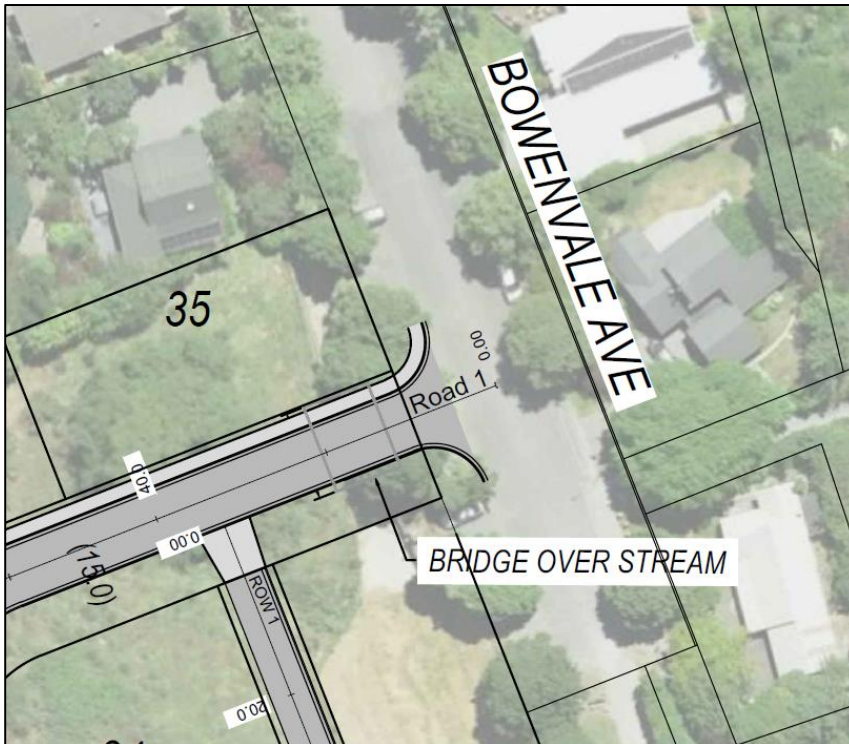


Figure 2-1: Bowenvale Avenue / Road 1 Intersection

The intersection location is near the end of Bowenvale Avenue, where there is 90-degree car parking on the western side of the road and kerbside parking available on the eastern side of the road (**Photograph 2-1**).



Photograph 2-1: Bowenvale Avenue Looking North at Proposed Intersection Location

The footpaths on Bowenvale Avenue stop north of a turning head outside 114 Bowenvale Avenue (**Photograph 2-2**). It is considered that the existing footpath on the western side of the road should be extended to connect to the Road 1 footpath to provide a safe and convenient link for pedestrians.



Photograph 2-2: Existing Turning Head at 114 Bowenvale Avenue

It may be necessary to remove the turning head so that a footpath can be provided. The turning head may not be required once the subdivision road is constructed (as turning should be provided for on that road) however the need for a turning head and its location should be considered further.

Whether the car parking between the new intersection and the existing footpath (and other car parking in the vicinity of the intersection) can be retained will need to be addressed at the detailed design stage. Considerations should include the space required for a footpath but also the interaction of vehicles

entering and exiting parking spaces in close proximity to the intersection that may conflict with vehicles turning into and out of Road 1.

Photograph 2-3 shows the sightline to the right from the approximate intersection location. The trees visible could obstruct visibility to the right, particularly to a cyclist who has just ridden out of the park. It will be necessary through the intersection detailed design to ensure that suitable visibility is available to vehicles and cyclists. Narrowing Bowenvale Avenue at the intersection by having kerbs extend out into the existing carriageway can be considered to provide improved sightlines and traffic calming benefits.



Photograph 2-3: Trees to Right of Intersection

Recommendation(s)

1. Provide a footpath connection from the subdivision to the existing footpath network
2. Consider whether a turning head is still required on Bowenvale Avenue and its appropriate location
3. Consider interaction between on-street car parking and turning vehicles when carrying out the detailed design of the intersection
4. Ensure suitable sightlines to vehicles and cyclists are available at the intersection during the detailed design

Frequency Crashes are likely to be occasional	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	<p>As mentioned by the RSA, these items are considered detailed design elements that need to be work through with CCC roading engineer. Our initial feedback to these items are:</p> <ol style="list-style-type: none"> 1) Agree a footpath connection from the subdivision to the existing footpath network on the western side of Bownevale Ave should be provided. There is scope to enhance the existing road configuration through this area. The current road formation width in this area from the eastern kerb to the timber log barriers is approximately 17-18m, which provides ample space for traffic lanes, parking and pedestrian access. Roding configuration to be agreed with CCC. 2) Our recommendation is to remove the turning head as the new road intersection provides turning ability if required for larger infrequent vehicle movements. Alternative option would be to move the last parking bays to providing turning at the end of the Bowenvale Ave formation. 	

Recommendation(s)

- 3) We anticipate some of the parking bays will need to be removed to provide adequate separation from the proposed intersection. Item to be worked through with CCC road engineer.
- 4) The trees shown in Photo 2-3 are to be removed to provide for the new intersection as per the snippet below.



Safety Engineer comment

Insert comment

Client decision

Insert comment

Recommendation(s)

Action taken	Insert comment
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2.2 ROW Passing Bays

Minor

ROW 1 is proposed with a carriageway width suitable for one-way travel, and with two passing bays midway along it. There is a concern that if there are opposing drivers who meet over the initial length of the driveway (**Figure 2-2**), one may reverse back onto Road 1. It is acknowledged that vehicle speeds would be slow in this location given the proximity to the Bowenvale Avenue intersection and the narrow carriageway. However, reversing vehicles are hazards to all road users including vulnerable road users such as cyclists.

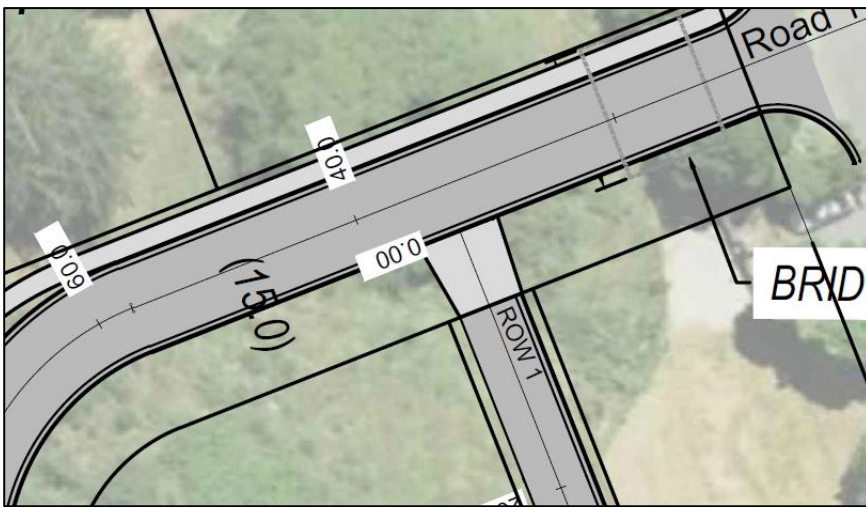


Figure 2-2: Initial Length of ROW 1

ROW 2 is proposed with a carriageway wide enough for two-way traffic movements up to the ROW 3 intersection (**Figure 2-3**). However, at the Road 1 / ROW 2 intersection, a combination of the narrow road width and narrow ROW width may mean that there is not enough space for a driver to turn right into ROW 2 while there is a vehicle waiting to turn left out. If there is not room for either vehicle to make their turn, one driver will need to reverse which would present a hazard to other road users, particularly vulnerable users. The grades of the ROW will also make stopping and manoeuvring more difficult for drivers.

Recommendation(s)

1. Provide a passing opportunity at the start of ROW 1
2. Widen the initial section of ROW 2 if required to accommodate a right turn in from Road 1 while a vehicle is waiting to exit
3. Ensure that opposing drivers will be able to negotiate the ROW 2 / ROW 3 intersection safely
4. Ensure emergency vehicle access to ROW 3 will be possible

Frequency Crashes are likely to be occasional	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	<ol style="list-style-type: none"> 1. A passing bay will be provided at the start of ROW 1 2. ROW 2 has a 5.5m carriageway width at the start so there should be enough room to accommodate a right turn in from Road 1 while a vehicle is waiting to exit. This will be confirmed at detailed design stage with vehicle tracking. 3. To be confirmed at detailed design stage with vehicle tracking. There is scope to widen the ROW 2/3 intersection if required. 4. To be confirmed at detailed design stage with vehicle tracking. 	
Safety Engineer comment	Insert comment	
Client decision	Insert comment	
Action taken	Insert comment	

2.3 Road 1 Bridge Details

Moderate

A bridge is proposed over the stormwater drain on Road 1, as visible in Figure 2-1. No details on the bridge are available at this stage. Appropriate edge protection for pedestrians and road users will need to be considered through the detailed design stage.

Recommendation(s)

1. Ensure that appropriate edge protection is provided for all footpath and road users

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	Appropriate edge treatment/protection will be provided on the bridge for road and footpath users.	
Safety Engineer comment	Insert comment	
Client decision	Insert comment	
Action taken	Insert comment	

2.4 ROW Turning Heads

Minor

No turning heads are proposed at the ends of ROW 1 and ROW 3 (**Figure 2-4**). If a driver gets to the end of one of the ROWs and needs to turn around, they may need to reverse over some distance. This would present a hazard to other ROW users, particularly any pedestrians. The concern is exacerbated given the steep topography, where individual property driveways may not be convenient for people unfamiliar with the area to use to turn around.

It is acknowledged that there would be a low demand for turning at the end of the ROWs since drivers would be expected to be able to turn at the properties they are visiting.



Figure 2-4: Ends of ROW 1 and ROW 3

A turning head is indicated at the end of ROW 2 (Figure 2-5). Its size does not look standard and if a vehicle cannot use it to turnaround, the same safety concerns as raised for ROWs 1 and 3 would exist.



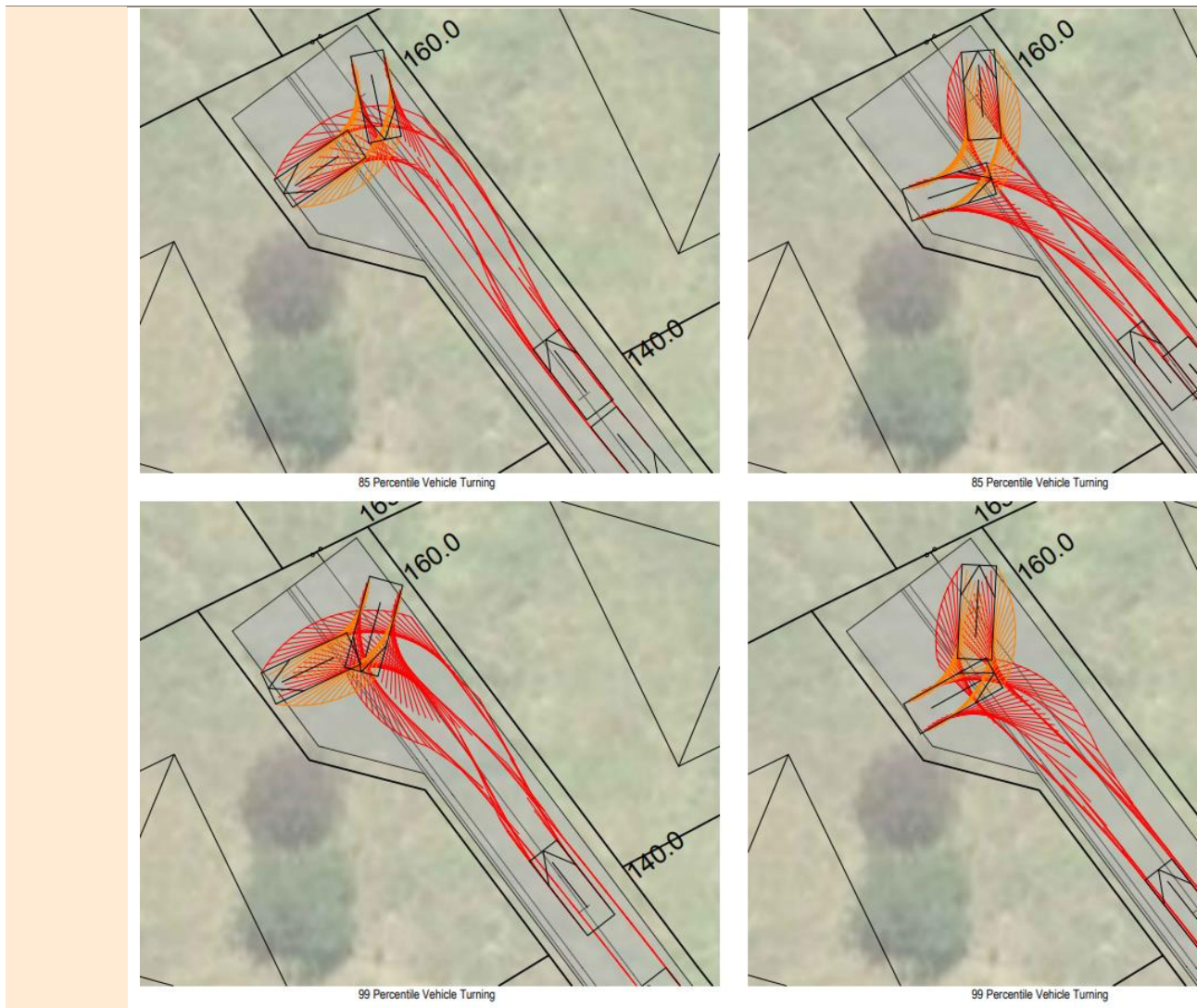
Figure 2-5: End of ROW 2

Recommendation(s)

1. Provide turning heads on all three ROWs and confirm the appropriate design vehicle for the turning manoeuvre e.g. a small delivery truck

Frequency	Severity	Rating
Crashes are likely to be infrequent	Death or serious injury is unlikely	The safety concern is minor
Designer response	The turning head at the end of ROW 2 has been designed to cater for an 85 & 95 percentile vehicle in accordance with CCC Appendix 8.10.2 Access Standard 4. Refer to tracking below. Same sized turning heads will be incorporated at the end of ROW 1 and 3.	

Recommendation(s)



Safety Engineer comment	Insert comment
Client decision	Insert comment
Action taken	Insert comment

2.5 Road 1 Turning Head

Moderate

The Road 1 turning head (**Figure 2-6**) is indicated to be approximately 14m wide and 12m long. This is smaller than a standard turning head in a residential area (typically 19m diameter as per NZS4404). There is a concern that a rubbish truck will not be able to turn around at the end of the road and may be required

to reverse over a long distance. A reversing truck is a hazard to all road users and particularly vulnerable road users.

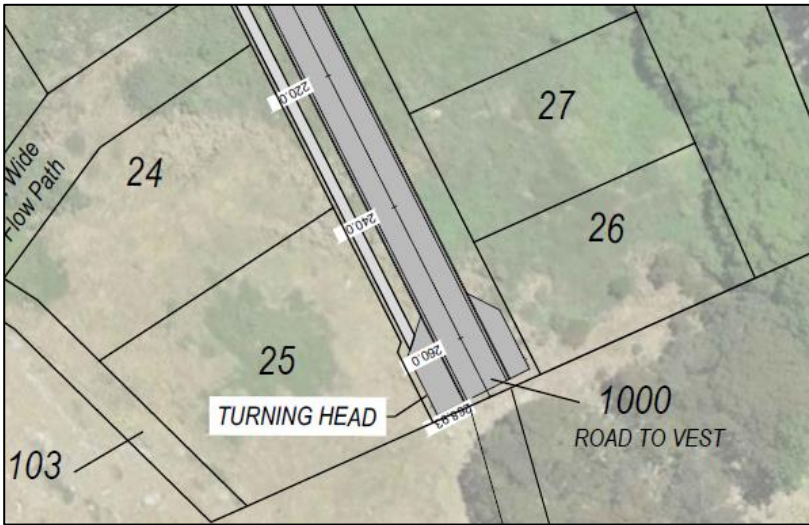


Figure 2-6: End of Road 1

Recommendation(s)

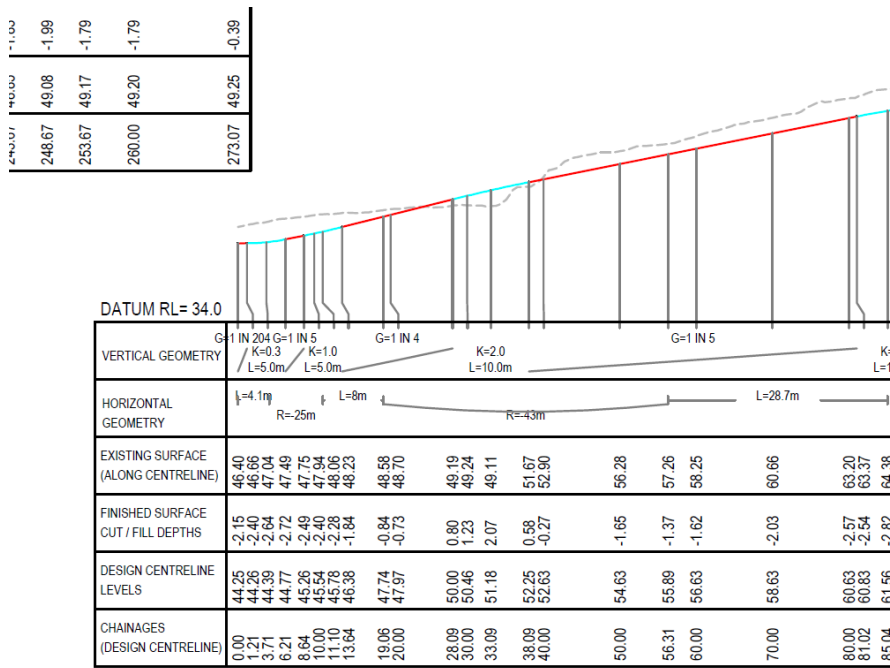
1. Confirm adequate manoeuvring space for a rubbish truck will be available at the end of Road 1

Frequency Crashes are likely to be occasional	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	It is envisaged the legal road will be extended at some point and therefore a temporary turning head has been provided at the end of Road 1. The dimensions for the turning head have been adopted from Auckland Transports TDM GD0006 which accommodates a 10.3m rigid truck.	
Safety Engineer comment	Insert comment	
Client decision	Insert comment	
Action taken	Insert comment	

2.6 ROW Gradients

Moderate

ROW 2 has a centreline gradient of 1 in 5 and ROW 3 has a section with a centreline gradient of 1 in 4 (Figure 2-7). These are steep gradients and the driveways may be difficult to access by vehicle or foot in icy conditions. Drivers could lose control of their vehicles or pedestrians could fall over.



ROW 3 LONGSECTION (CENTRELINE LEVEL)

Figure 2-7: Proposed ROW 3 Longsection

It is acknowledged that the District Plan allows up to 1 in 4 grades over short lengths of up to 20m for residential activities.

It is noted that ROW 3 has a curve in its alignment and the gradient will be steeper around the inside of the curve than it will along the centreline. Gradients should be within acceptable bounds across the full width of the ROW to reduce the chance of vehicle scraping and to reduce the safety risks associated with steep driveways.

On a related note, individual property accesses will need to be well designed to avoid vehicle scraping and to ensure adequate visibility between driveway users and both road users and pedestrians.

Recommendation(s)

1. Investigate options to reduce maximum gradients
2. Provide high-friction surfaces for steep sections of driveway
3. Ensure acceptable gradients are provided around the insides of curves as well as along centrelines
4. Design individual property accesses to have acceptable grade transitions and visibility to / from the driveway

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	<ol style="list-style-type: none"> 1. Gradients will be reviewed at detailed design stage, however due to the slope of the land it's likely maximum allowable gradients will be required. 2. High-friction surfaces can be adopted for gradients at 20% and over. 3. To be confirmed at detailed design stage. 4. The location of the individual property accesses will be determined as part of the house design and will be controlled through the building consent process. 	
Safety Engineer comment	Insert comment	
Client decision	Insert comment	
Action taken	Insert comment	

2.7 Edge Protection

Moderate

The topography of the site means that there will be locations with steep drops from roads and driveways.

With the steep grades on ROW 2 and ROW 3, there is the potential for a driver to lose control of their vehicle in wet or icy conditions. There is a concern that an out-of-control vehicle could continue off the end of ROW 3 or ROW 2 into a property below. **Figure 2-8** indicates locations where vehicle barriers should be considered (noting these are indicative and a full design will be required to determine the length of need at these locations).

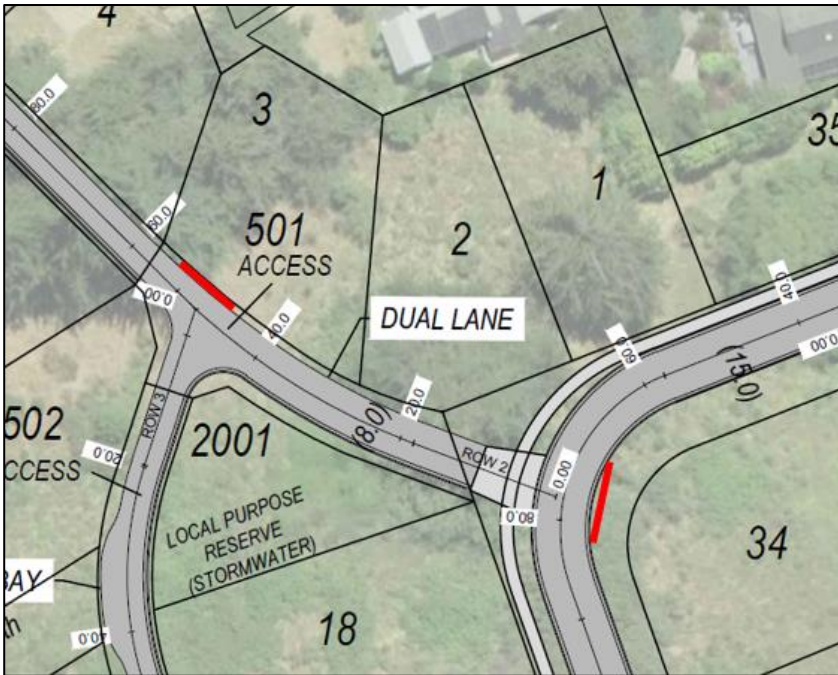


Figure 2-8: Indicative Edge Protection Opposite ROWs

ROW 1 (**Figure 2-9**) is proposed to run along the ridge above the existing stormwater area shown in **Photograph 2-4**. This has steep sides and there are concerns that a vehicle, pedestrian or other road users could fall off the ROW. Also vehicles being manoeuvred out of Lots 29-34 could be mistakenly driven off the edge. The stormwater channel has steep, non-recoverable gradients and in the event that high levels of water are present, there is a risk of drowning. The form of edge protection and its purpose, i.e. to stop vehicles or to keep pedestrians out, should be considered.

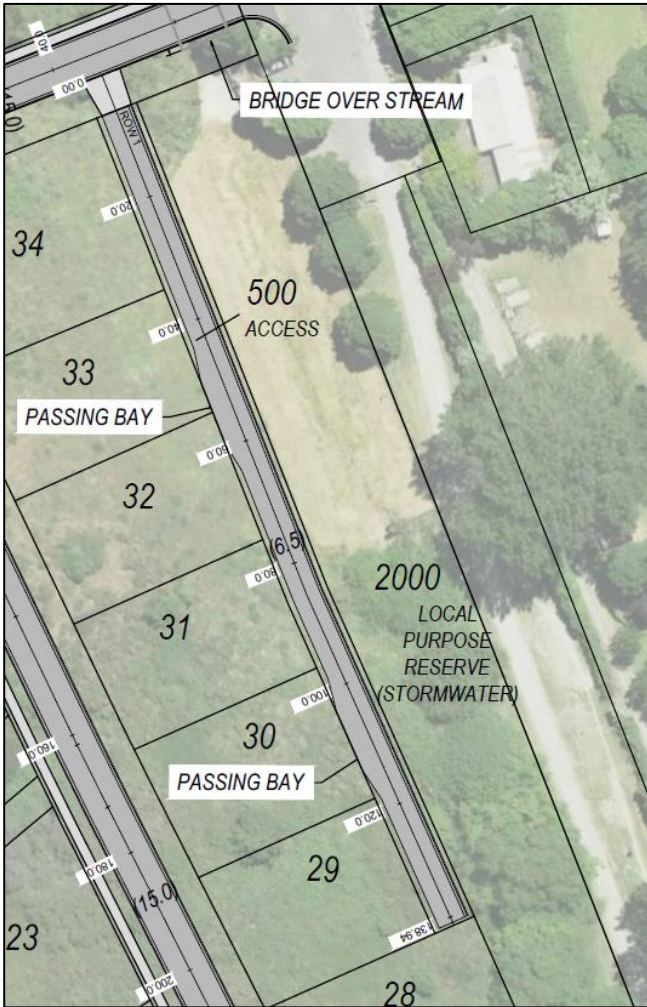


Figure 2-9: ROW 1



Photograph 2-4: Stormwater Area Adjacent to ROW 1

Other locations have been identified, such as those two highlighted below, where it appears that the level of the road will be above the level of the surrounding ground. A review of the subdivision design should be carried out, with locations for edge protection to be identified and considered further through detailed design.

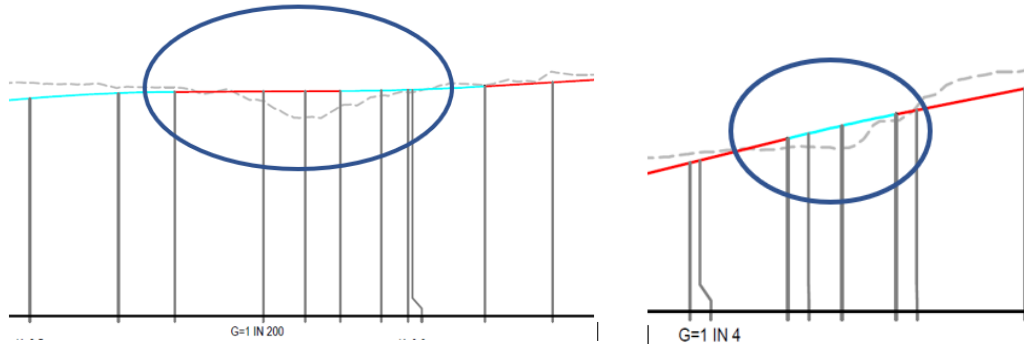


Figure 2-10: Instances of Road Level above Surrounding Ground Level- Road 1 Left, ROW 3 Right

Recommendation(s)

1. Provide vehicle barriers opposite the ends of ROW 2 and ROW 3 to stop any vehicles crashing into the properties below
2. Provide edge protection / barriers along ROW 1
3. Confirm gradients either side of the ROWs and locations of edge protection / barriers.

Frequency Crashes are likely to be occasional	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	The requirement and location for vehicle barriers will be determined at detailed design stage. Edge protection in the form of a vertical kerb will be provided along the eastern side of ROW 1 and a pedestrian barrier/fence along the ROW boundary to eliminate people from falling from the retaining wall and entering the stormwater reserve.	
Safety Engineer comment	Insert comment	
Client decision	Insert comment	
Action taken	Insert comment	

2.8 Road 1 Curve

Moderate

Road 1 is proposed to have a 20m radius curve where it intersects with ROW 2, visible in Figure 2-8.

Any car parking on the inside of the curve would potentially obstruct forward visibility around the curve for drivers. This could increase the risk of a crash on the corner, and this would especially be a concern if a vehicle hit a pedestrian or cyclist who was obscured from view.

Vehicle tracking with a rubbish truck and an opposing light vehicle should be checked in case further car parking restrictions (e.g. on the outside of the curve) or curve widening are necessary to accommodate the vehicle manoeuvres. If a rubbish truck cannot manoeuvre around the curve, it may need to reverse back out to Bowenvale Avenue which would be a safety concern for all road users, particularly vulnerable users, and particularly given the steep gradient on Road 1 in this location.

If the curve is not wide enough for two-way car movement, one driver would need to give way when opposing vehicles meet. A vehicle stopped or a reversing vehicle on the steep gradient would be a

hazard to other road users. However, it is acknowledged that this would occur relatively infrequently given the small number of lots accessed off Road 1 to the south of the curve and vehicle speeds would be slow.

Recommendation(s)

1. Include no-stopping lines around the inside of the curve to preserve forward visibility
2. Confirm that the Road 1 carriageway width and gradient is adequate for two-way movement of a waste collection vehicle and light vehicle

Frequency Crashes are likely to be occasional	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	No-stopping lines around the inside of the curve will be added at detailed design stage. Vehicle tracking around the curve will be completed at detailed design stage. There is scope to widen the curve on both sides if required.	
Safety Engineer comment	Insert comment	
Client decision	Insert comment	
Action taken	Insert comment	

2.9 Road 1 Width

Minor

Road 1 is proposed with an approximately 6.7m wide carriageway, as shown in **Figure 2-11**. The adoption of a narrow carriageway is supported from a road safety perspective as it will encourage slow vehicle speeds. It is noted that a narrower 6m width could be adopted and still achieve two-way vehicle movement.

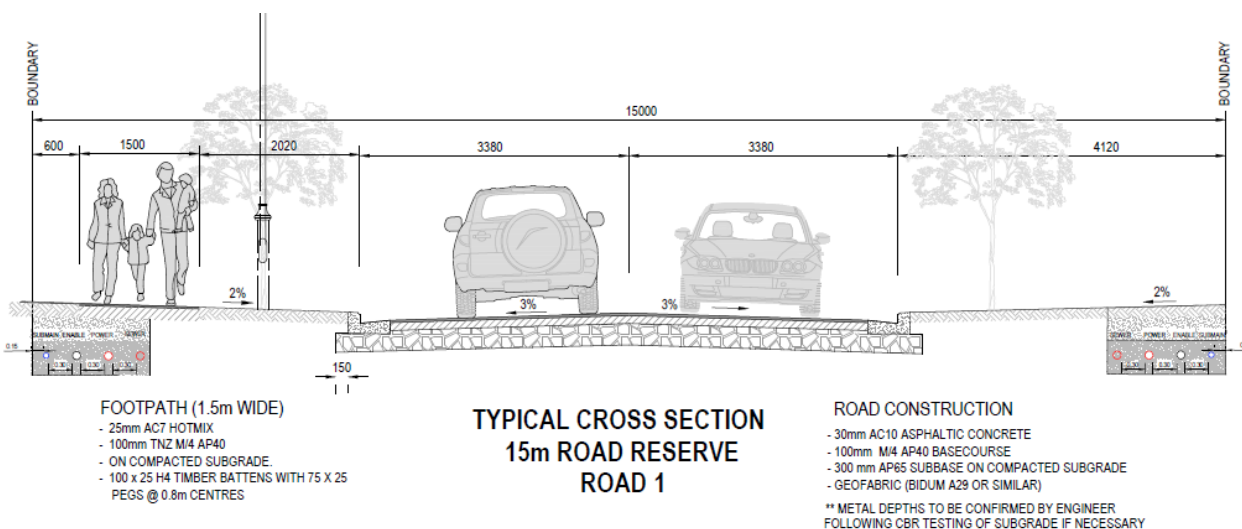


Figure 2-11: Proposed Road 1 Cross-Section

The proposed road width will be wide enough for two-way traffic movement along straight sections of the road or one-way movement at a time past a parked vehicle, which is considered appropriate for what will

be a low volume road. There is a concern that uncontrolled car parking on both sides of the road could restrict vehicle access by larger vehicles, including potentially emergency vehicles.

Recommendation(s)

1. Consider restricting car parking to one side of the road so that there is always clear width for emergency vehicle access

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	Adopting no stopping line along one side of the road along with inclusion of vehicle crossings will ensure access for emergency vehicles.	
Safety Engineer comment	Insert comment	
Client decision	Insert comment	
Action taken	Insert comment	

3. Comments

The following comments are either:

- of a general nature; or
- cannot be related to any specific safety concern; or
- relate to previous safety concerns that may have been misinterpreted; or
- relate to subsequent design developments that could become safety concerns in a future safety audit; or
- relate to safety concerns that the designers are already aware of; or
- relate to design elements where the safety implications are not yet clear due to insufficient detail for the stage of the project.

These comments are included for the consideration of the designers and the client. Decision tracking tables are included to record responses, as attention paid to the comments may contribute to improving overall road safety.

3.1.1 Footpath Widths

The Road 1 footpath is proposed 1.5m wide which is acknowledged to be a typical width in residential subdivisions. It is recommended to consider a 1.8m width to provide extra space for the full range of footpath users that can be expected including pedestrians but also cyclists, scooter riders etc.

Designer response	A 1.8m wide footpath can be adopted, but will be subject to approval from CCC roading engineer.
Safety Engineer comment	Insert comment
Client decision	Insert comment
Action taken	Insert comment

3.1.2 Rubbish Collection

It is understood that residents along the ROWs would bring their rubbish bins to Road 1 for collection. There are relatively large numbers of lots along the ROWs, meaning there will potentially be large numbers of rubbish bins placed on Road 1 on rubbish collection days. It should be considered whether dedicated areas are provided for rubbish bin placement so they do not obstruct footpaths, driveways etc.

Designer response	Private rubbish collection is proposed for the lots accessed via rights of way.
Safety Engineer comment	Insert comment
Client decision	Insert comment
Action taken	Insert comment

3.1.3 External Effects on Bowenvale Avenue

It is understood that there are concerns related to high vehicle speeds on Bowenvale Avenue currently, made possible by the long, straight and wide carriageway formation. The development of the subdivision will increase the number of vehicles travelling the full length of Bowenvale Avenue, possibly exacerbating any existing concerns. Similarly, there are delays and queuing on Centaurus Road which impact the performance of the Bowenvale Avenue intersection.

Given the site is zoned for residential development, it is considered that these concerns fall outside of the scope of this road safety audit. As discussed earlier, the new intersection on Bowenvale Avenue can be designed to encourage slow vehicle speeds, however it will not slow vehicles between Centaurus Road and the new intersection. It is recommended that CCC implement traffic calming measures along Bowenvale Avenue to serve existing and future residential areas if the concerns are deemed to warrant them.

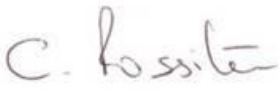
Designer response	This is outside the scope of the development, however we do support traffic calming devices being implemented along Bowenvale Ave.
Safety Engineer comment	Insert comment
Client decision	Insert comment
Action taken	Insert comment

4. Audit Statement

We declare that we remain independent of the design team, and have not been influenced in any way by any party during this road safety audit.

We certify that we have used the available plans, and have examined the specified roads and their environment, to identify features of the project we have been asked to look at that could be changed, removed or modified in order to improve safety.

We have noted the safety concerns that have been evident in this audit, and have made recommendations that may be used to assist in improving safety.

Signed 
.....

Date 15 December 2022
.....

Chris Rossiter, Principal Transportation Engineer, Stantec NZ

Signed 
.....

Date 15 December 2022
.....

Andrew Leckie, Senior Transportation Engineer, Stantec NZ

5. Response and Decision Statements

System designers and the people who use the roads must all share responsibility for creating a road system where crash forces do not result in death or serious injury.

5.1 Designer's Responses

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this road safety audit report and I have responded accordingly to each safety concern with the most appropriate and practical solutions and actions, which are to be considered further by the safety engineer (if applicable) and project manager.



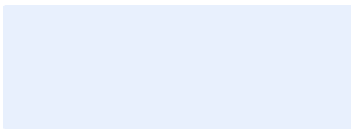
Signed

Date 15 February 2023

.....
[Designer's name, qualification, position, company]

5.2 Safety Engineer's Comments (if applicable)

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this road safety audit report together with the designer's responses. Where appropriate, I have added comments to be taken into consideration by the project manager when deciding on the action to be taken.



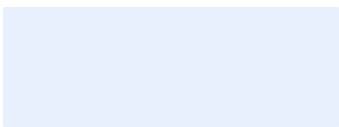
Signed

Date

.....
[Safety Engineer's name, qualification, position, company]

5.3 Project Manager's Decisions

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this road safety audit report, together with the designer's responses and the comments of the safety engineer (if applicable), and having been guided by the auditor's ranking of concerns have decided the most appropriate and practical action to be taken to address each of the safety concerns.



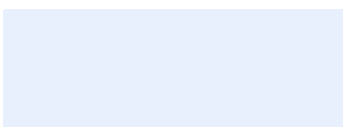
Signed

Date

.....
[Project Manager's name, qualification, position, company]

5.4 Designer's Statement

I certify that the project manager's decisions and directions for action to be taken to improve safety for each of the safety concerns have been carried out.



Signed

Date

.....
[Designer's name, qualification, position, company]

5.5 Safety Audit Close Out

The project manager is to distribute the audit report incorporating the decisions to the designer, safety audit team leader, safety engineer, and project file.

Date:.....

Appendices



NO
VEHICLES
PAST THIS POINT

Bowenvale Reserve
Mountain bike tracks
Walking tracks

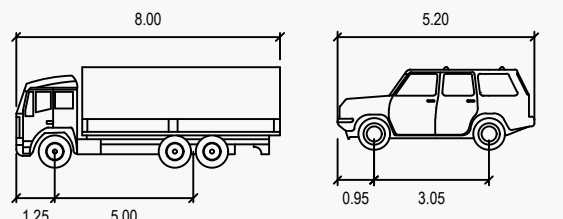
Christchurch City Council

Appendix A Preliminary Rooding Plans

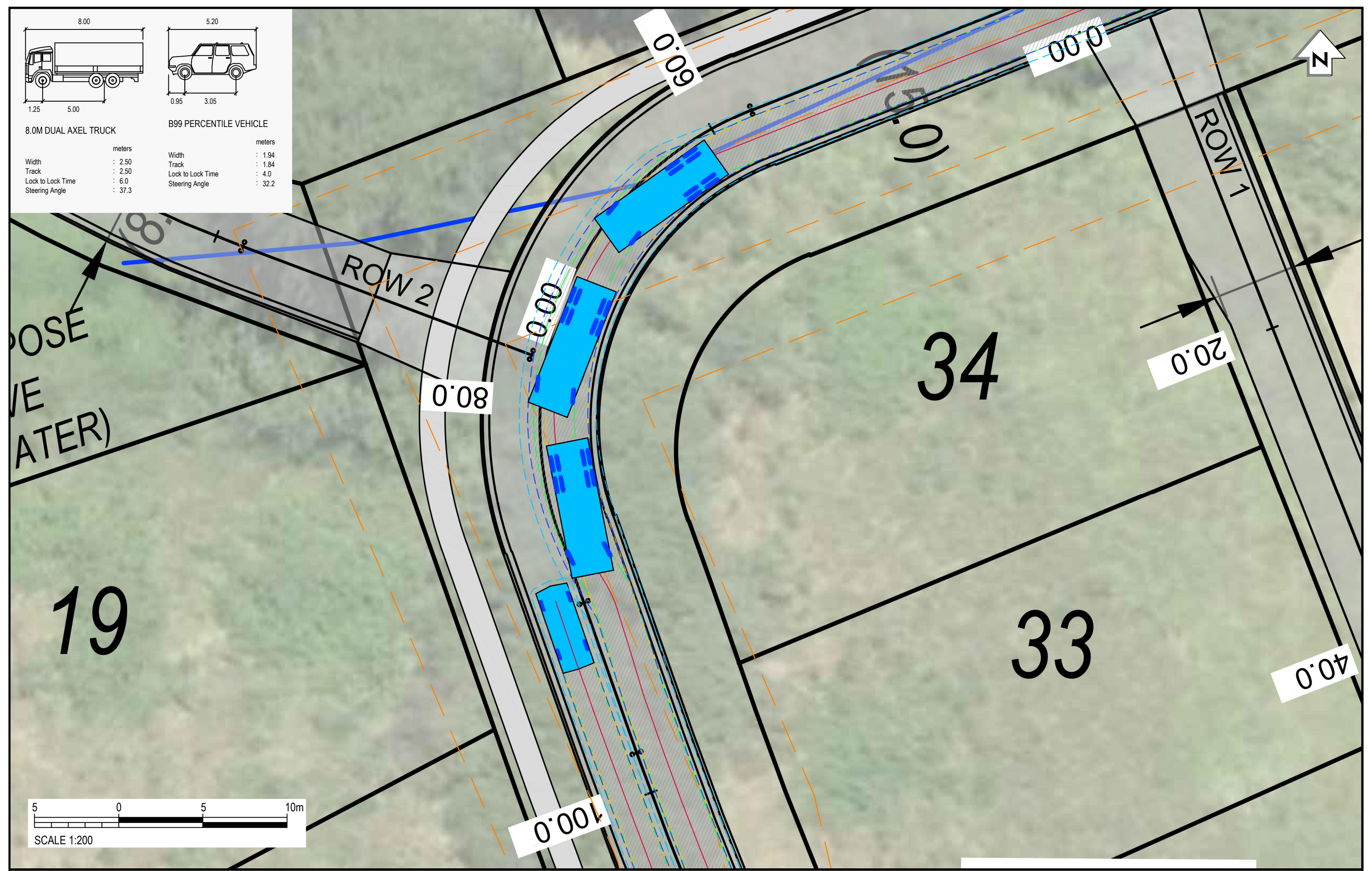
Christchurch

Hazeldean Business Park, Level 2, 2 Hazeldean Road
Addington, Christchurch 8024
PO Box 13-052, Armagh
Christchurch 8141
Tel +64 3 366 7449
Fax +64 3 366 7780

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Stantec design with community in mind.



8.0M DUAL AXEL TRUCK		B99 PERCENTILE VEHICLE	
	meters		meters
Width	: 2.50	Width	: 1.94
Track	: 2.50	Track	: 1.84
Lock to Lock Time	: 6.0	Lock to Lock Time	: 4.0
Steering Angle	: 37.3	Steering Angle	: 32.2



REV	DATE	DRN	DESCRIPTION
A	27/10/23	AKJ	ISSUED FOR INFORMATION

130 BOWENVALE AVENUE
VEHICLE TRACKING

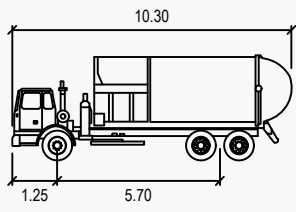
CLIENT LOGO



FOR INFORMATION

SCALE: 1:200 @ A3	FIGURE No. TR2
DRAWN: ALEX JAGODZINSKI	
DATE: 27/10/2023	
DESIGN: ANDREW LECKIE	OF A

U:\310205259\technical\04_drawings\CAD\310205259_C001.dwg



10.3M REAR STEER SIDE LOADER GARBAGE TRUCK

meters	
Width	: 2.55
Track	: 2.55
Lock to Lock Time	: 6.0
Steering Angle	: 47.0



25

27

26

TURNING HEAD

**1000
ROAD TO VEST**

240.0

260.0

268.93

14



REV	DATE	DRN	DESCRIPTION
A	27/10/23	AKJ	ISSUED FOR INFORMATION

130 BOWENVALE AVENUE
VEHICLE TRACKING

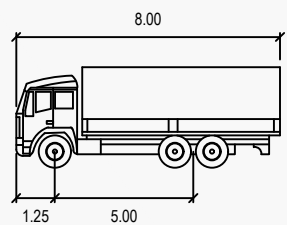
CLIENT LOGO



FOR INFORMATION

SCALE:	1:200 @ A3
DRAWN:	ALEX JAGODZINSKI
DATE:	27/10/2023
DESIGN:	ANDREW LECKIE

FIGURE No.
TR3
OF
A



8.0M DUAL AXEL TRUCK

meters

Width : 2.50

Track : 2.50

Lock to Lock Time : 6.0

Steering Angle : 37.3



25

27

26

TURNING HEAD

1000
ROAD TO VEST

240.0

260.0

268.93

14



REV	DATE	DRN	DESCRIPTION
A	27/10/23	AKJ	ISSUED FOR INFORMATION

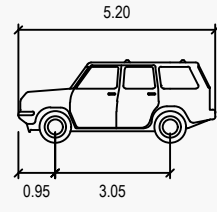
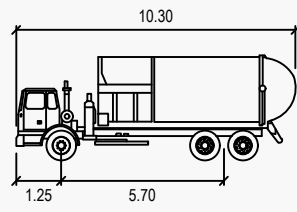
130 BOWENVALE AVENUE
VEHICLE TRACKING



FOR INFORMATION

SCALE: 1:200 @ A3	FIGURE No.
DRAWN: ALEX JAGODZINSKI	TR4
DATE: 27/10/2023	
DESIGN: ANDREW LECKIE	OF
	A

U:\310205259\technical\04_drawings\CAD\310205259_C001.dwg

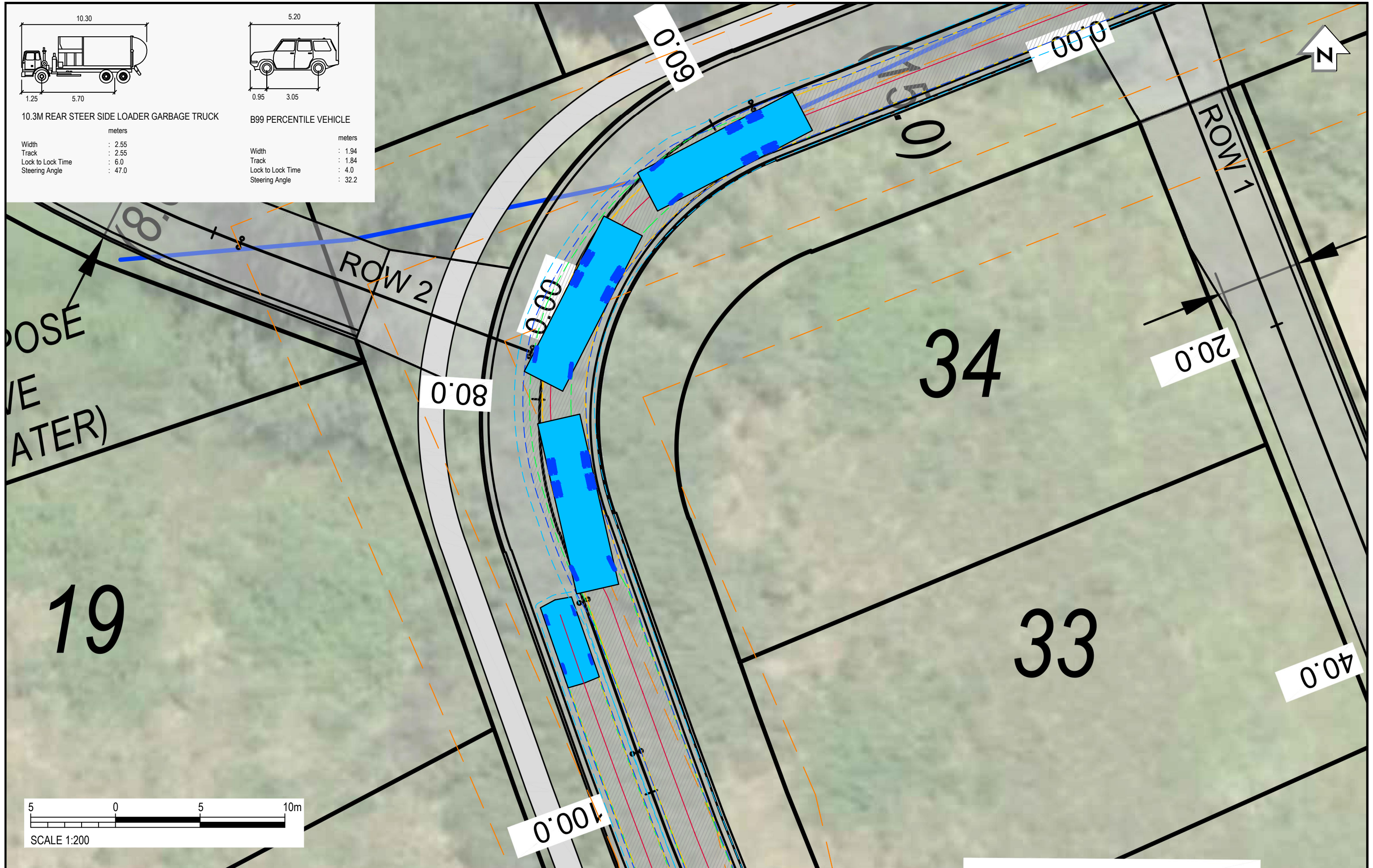


10.3M REAR STEER SIDE LOADER GARBAGE TRUCK

B99 PERCENTILE VEHICLE

meters	
Width	: 2.55
Track	: 2.55
Lock to Lock Time	: 6.0
Steering Angle	: 47.0

meters	
Width	: 1.94
Track	: 1.84
Lock to Lock Time	: 4.0
Steering Angle	: 32.2



REV	DATE	DRN	DESCRIPTION
A	27/10/23	AKJ	ISSUED FOR INFORMATION

130 BOWENVALE AVENUE
VEHICLE TRACKING

CLIENT LOGO



FOR INFORMATION

SCALE: 1:200 @ A3
DRAWN: ALEX JAGODZINSKI
DATE: 27/10/2023
DESIGN: ANDREW LECKIE

FIGURE No.
TR1

OF
A