EARTHWORKS MANAGEMENT PLAN

Rangitoopuni Development
Riverhead, Auckland

CIVIL ENGINEERING ▾ SURVEYING ▾ LAND DEVELOPMENT

PROJECT INFORMATION

CLIENT:	Rangitoopuni Developments Limited Partnership
PROJECT:	147007 and 147016

DOCUMENT CONTROL

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APPROVED BY	[redacted] [redacted] Project Manager

[redacted]

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1. INTRODUCTION

1.1 PROJECT

The purpose of this report is to provide an Earthworks Management Plan for the proposed earthworks in support of the redevelopment of the Riverhead Forest on behalf of Rangitoopuni Developments Limited Partnership. The intended development will see Lot 1 developed for 208, 1 ha countryside living lots; with Lot 2 developed for a Retirement Village supporting 260 Villas, 36 care-units and associated amenities.

The information provided herein outlines the methodology associated with the proposed sediment and erosion control for the project, and is broken down into, relevant earthwork stages, which are developed around the staging for the countryside living subdivision and retirement village. Specific mention is also provided for the Forestry Road extension (road to vest).

This Earthworks Management Plan provides information in support of a Fast Track resource consent application made under the Fast Track Approvals Act 2024. This report is to be read in conjunction with the engineering drawings, and the documents referred to hereon, which includes the Streamworks Management Plan prepared by Maven.

The erosion and sediment control measures have been prepared in accordance with GDO5.

This Earthworks Management Plan sets out a generic process to the implementation of all earthworks approved under the consent. The solution ensures sediment and erosion control will be suitably managed during time of construction. Final design may alter slightly subject to contractor and/or detailed design processes. Final Erosion Sediment Control Plans (ESCP) will be a condition of consent prior to construction commencing.

1.2 CODE OF CONDUCT STATEMENT

Although this is not a hearing before the Environment Court, I record that I have read and agree to comply with the Environment Court's Code of Conduct for Expert Witnesses as specified in the Environment Court's Practice Note 2023. I confirm that this report is within my area of expertise, except where I state that I rely upon the evidence or reports of other expert witnesses lodged forming part of the project's application material. I have not omitted to consider any material facts known to me that might alter or detract from the opinions expressed.

1.3 LEGAL DESCRIPTION

Applicant	Rangitoopuni Developments Limited Partnership
Record of Title	1129815 and 1129816
Legal Description	Lots 1 and 2 DP 590677
Site Area	222.75 ha (Lot 1), 173.6 ha (Lot 2)

1.4 SITE DESCRIPTION

The subject site forms part of the wider Riverhead (Rangitoopuni) Forest holdings. The site is located between Riverhead Township to the east, and Kumeu/Huapai to the south-west. The site is well connected, having ease of connections to SH16 and the Northwestern motorway.

The site features frontage and access from Old North Road (to the south), Deacon Road and Forestry Road. The majority of the site has been recently felled and is intended to be developed for residential purposes.

The site features moderate to steep rolling topography, with prominent ridgelines, gullies and identified streams contained within. The site is contained within two stormwater catchments – Lot 1 straddles the Kaipara Catchment (western half), with the eastern area in the Riverhead Catchment. Lot 2 is wholly contained within the Riverhead Catchment. The streams in the Riverhead Catchment flow east, to the rear of the Township, before discharge into the Rangitopuni River upstream of the Riverhead-Coatesville Highway bridge.

There are no existing buildings within the site. The site is benefited from several lawful and existing vehicle crossings and forestry roads within, of which is formed to a rural road standard.

The location of the subject site is shown below in Figure 1.

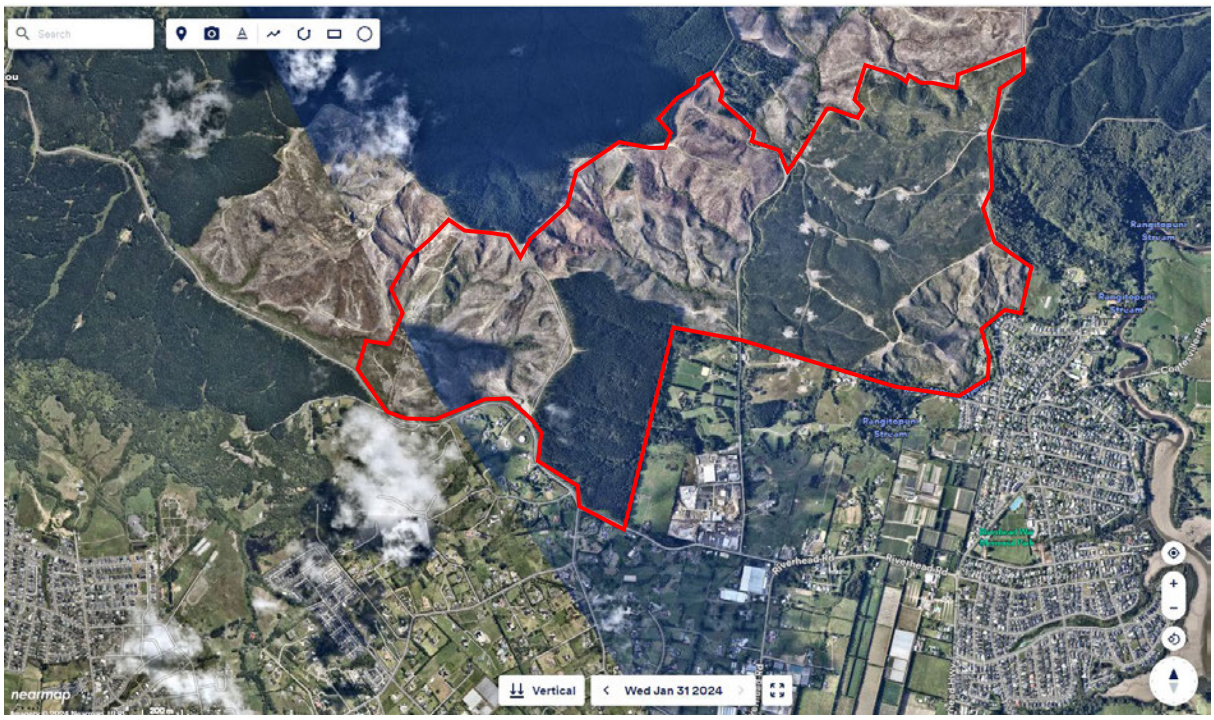

FIGURE 1: SITE LOCALITY PLAN (APPROXIMATE LOT 1 AND 2 BOUNDARIES SHOWN IN RED).

1.5 PROPOSED EARTHWORKS

Earthworks will be undertaken as required throughout the proposed development area and allows for the partial recontouring of the site to enable the proposed countryside living subdivision within Lot 1; and the Retirement Village contained within Lot 2.

110.4ha of the site will be earthworked. The extent of earthworks is located within 20m of identified streams, and there are various culverts which require upgrading and/or modification as part of this

consent to enable the construction of the JOALs, private accessways and the Forestry Road extension (public road to vest).

Whilst considerable effort has been made to avoid streamworks; culvert upgrades are a necessity due to topography, provision of access and downstream flooding mitigation.

Construction represents the period when the most significant impact on the downstream receiving environment can occur due to erosion and sedimentation from disturbed land. Erosion and sediment control measures are to be implemented to mitigate downstream impacts.

The Engineering Drawings (attached as Appendix B) detail the extent of works and sediment control measures.

1.6 GEOTECHNICAL INVESTIGATION

Please refer to the Geotech Reports prepared by ENGEO, report references (20190.000.001). The report outlines that topsoil depths vary between 200-400mm. East Coast Bays Formation soils were encountered within all investigation's boreholes underlying existing fill, Alluvial soils and Albany Conglomerate. Underlying the residually weathered soils of the East Coast Bays Formation comprised extremely weak, to very weak interbedded sequences of siltstone and sandstone.

ENGEO have identified the need for inground improvements to ensure suitable factor of safety is achieved. The required improvements inclusive of building line setbacks, inground palisade walls and/or additional drainage improvements are detailed within the ENGEO reporting, and within Maven C110 Concept plan sets, C150 Scheme plan sets and C200 Earthworks plan sets. The final design will be subject to further geotechnical assessment, detailed design by ENGEO and Maven and building consent and/or Engineering Plan Approval from Auckland Council.

ENGEO will be engaged during construction to undertake earthwork monitoring. Upon completion of the proposed earthworks an Earthworks Completion Report will be prepared by the Geotechnical Engineer. This report will certify the adequacy of the earthworks and make recommendations on bearing strengths for foundation design purposes.

1.7 RESOURCE CONSENT REQUIREMENTS

These matters are subject to Resource Consent for Earthworks accordingly. The conditions of consent will require that erosion and sediment control measures are implemented and maintained in accordance with these guidelines to ensure that the receiving environment is protected during the construction phase.

Proposed measures for erosion and sediment control have been designed in accordance with Auckland Council design manual GD05 Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region.

1.8 SITE SPECIFIC CONSTRAINTS

The total area contained within the subject sites are circa 400ha. A catchment of this size features a variety of constraints, of which require specific attention and consideration during time of construction.

An Ecological Impact Assessment ('EcIA') and watercourse survey has been undertaken by Bioresearches. Please refer to the EcIA for further details. In summary, a total of 28.8km of stream flows through the Site, of which 11.3km of stream is intermittent and 17.5km of stream is permanent.

The streams, wetlands and associated riparian margins have been identified on the appended engineering drawings, and for the most part works are removed from these areas.

Streamworks are required for the installation of culverts within the development and a Streamworks Management Plan has been prepared by Maven Associates.

1.9 CONSTRUCTION PROGRAM

Earthworks will commence when all necessary consents are in place. It is proposed to establish in the 2025 earthworks season for works within the Stages 1-3 Countryside Living subdivision. Subject to market demand it is expected for construction to continue with Stages 4 and 5 in the following season(s).

The overall timeframe for the proposed development is circa 10-years for completion.

Pending approvals, these works may be undertaken as part of the ongoing winter works program, subject to approval by Auckland Council.

2. EARTHWORK VOLUMES

Below is an extract from the appended engineering drawings. A summary of the proposed earthworks is included within:

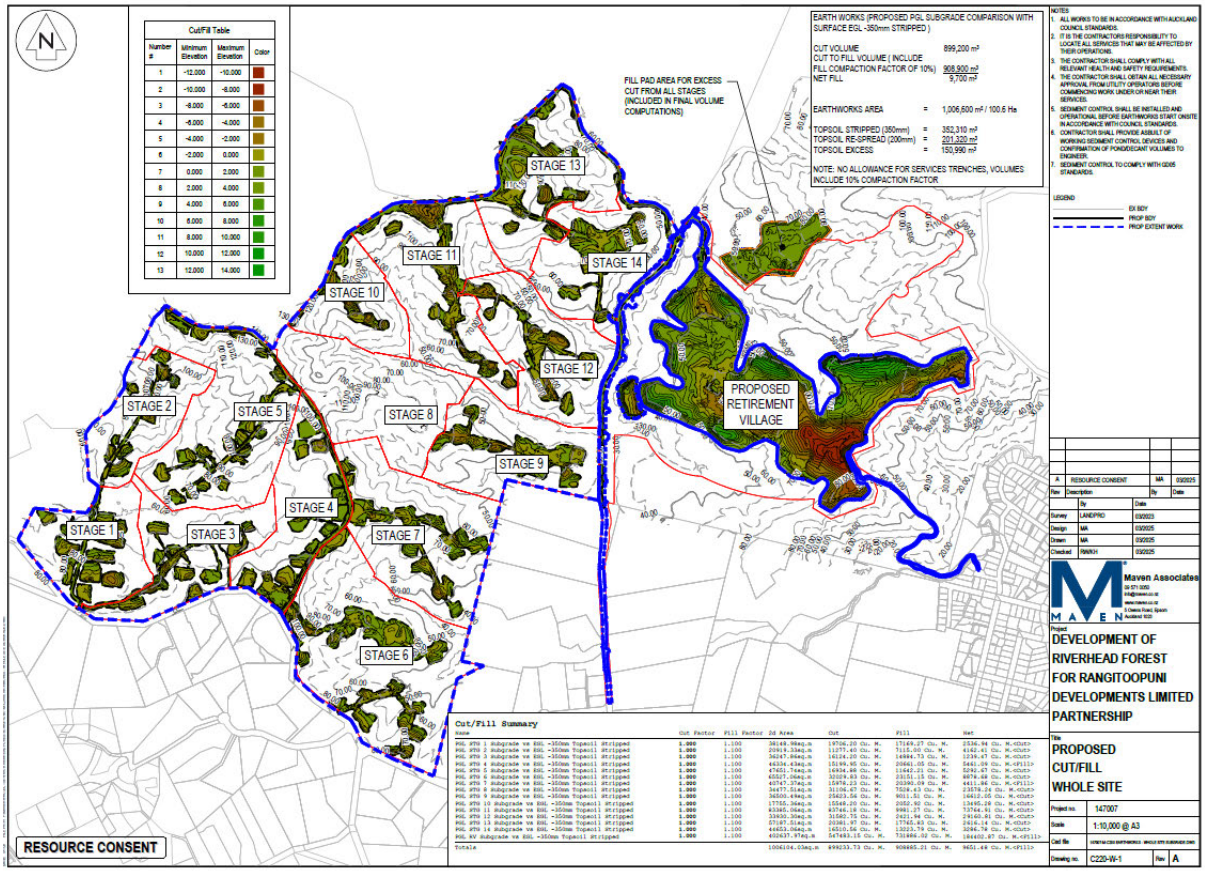

FIGURE 2: OVERALL SITE CUT/FILL PLAN

2.1 Countryside Living Subdivision

2.1.1 Total Countryside Living Subdivision

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to 100mm PGL Subgrade

Total area of ground disturbance = 60.34ha

- Total volume of cut = 351,750 m³
- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 176,999 m³
- Total volume of cut (surplus) = 174,751 m³

A more detailed breakdown of each stage of the Countryside Living subdivision is provided within the following sections.

2.1.2 Stage 1

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to PGL Subgrade

Total area of ground disturbance = 3.81 ha

- Total volume of cut = 19,700 m³
- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 17,200 m³
- Total volume of cut (surplus) = 2,500 m³
- Maximum cut and fill depth = 7m Fill, 5m Cut

Others

- Topsoil stripping (350 mm) = 13,400 m³

2.1.3 Stage 2

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to PGL Subgrade

Total area of ground disturbance = 2.09 ha

- Total volume of cut = 11,300 m³
- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 7,100 m³
- Total volume of cut (surplus) = 4,200 m³
- Maximum cut and fill depth = 5m Fill, 4m Cut

Others

- Topsoil stripping (350 mm) = 7,300 m³

2.1.4 Stage 3

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to PGL Subgrade

Total area of ground disturbance = 3.62 ha

- Total volume of cut = 16,100 m³
- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 14,900 m³
- Total volume of cut (surplus) = 1,200 m³

- Maximum cut and fill depth = 3m Fill, 5m Cut

Others

- Topsoil stripping (350 mm) = 12,700 m³

2.1.5 Stage 4

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to PGL Subgrade

Total area of ground disturbance = 4.63 ha

- Total volume of cut = 15,200 m³
- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 20,700 m³
- Total volume of fill (surplus) = 5,500 m³
- Maximum cut and fill depth =4m Fill, 5m Cut

Others

- Topsoil stripping (350 mm) = 16,200 m³

2.1.6 Stage 5

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to PGL Subgrade

Total area of ground disturbance = 4.77 ha

- Total volume of cut = 16,900 m³
- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 11,600 m³
- Total volume of cut (surplus) = 5,300 m³
- Maximum cut and fill depth = 6m Fill, 3m Cut

Others

- Topsoil stripping (350 mm) = 16,700 m³

2.1.7 Stage 6

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to PGL Subgrade

Total area of ground disturbance = 6.55 ha

- Total volume of cut = 32,000 m³
- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 23,200 m³
- Total volume of cut (surplus) = 8,800 m³
- Maximum cut and fill depth = 4m Fill, 5m Cut

Others

- Topsoil stripping (350 mm) = 22,900 m³

2.1.8 Stage 7

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to PGL Subgrade

Total area of ground disturbance = 4.07 ha

- Total volume of cut = 16,000 m³
- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 20,400 m³
- Total volume of fill (surplus) = 4,400 m³
- Maximum cut and fill depth = 4m Fill, 5m Cut

Others

- Topsoil stripping (350 mm) = 14,300 m³

2.1.9 Stage 8

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to PGL Subgrade

Total area of ground disturbance = 3.44 ha

- Total volume of cut = 31,100 m³
- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 7,500 m³
- Total volume of cut (surplus) = 23,600 m³
- Maximum cut and fill depth = 3m Fill, 5 m Cut

Others

- Topsoil stripping (350 mm) = 12,000 m³

2.1.10 Stage 9

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to PGL Subgrade

Total area of ground disturbance = 3.65 ha

- Total volume of cut = 25,600 m³
- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 9,000 m³
- Total volume of cut (surplus) = 16,600 m³
- Maximum cut and fill depth = 4m Fill, 5m Cut

Others

- Topsoil stripping (350 mm) = 12,800 m³

2.1.11 Stage 10

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to PGL Subgrade

Total area of ground disturbance = 1.77 ha

- Total volume of cut = 15,500 m³
- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 2,000 m³
- Total volume of cut (surplus) = 13,500 m³
- Maximum cut and fill depth = 2m Fill, 5m Cut

Others

- Topsoil stripping (350 mm) = 6,200 m³

2.1.12 Stage 11

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to PGL Subgrade

Total area of ground disturbance = 8.34 ha

- Total volume of cut = 83,700 m³
- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 10,000 m³
- Total volume of cut (surplus) = 73,700 m³
- Maximum cut and fill depth = 3m Fill, 7m Cut

Others

- Topsoil stripping (350 mm) = 29,200 m³

2.1.13 Stage 12

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to PGL Subgrade

Total area of ground disturbance = 3.39 ha

- Total volume of cut = 31,600 m³
- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 2,400 m³
- Total volume of cut (surplus) = 29,200 m³
- Maximum cut and fill depth = 2m Fill, 5m Cut

Others

- Topsoil stripping (350 mm) = 11,900 m³

2.1.14 Stage 13

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to PGL Subgrade

Total area of ground disturbance = 5.72 ha

- Total volume of cut = 20,400 m³
- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 17,800 m³
- Total volume of cut (surplus) = 2,600 m³
- Maximum cut and fill depth = 6m Fill, 4m Cut

Others

- Topsoil stripping (350 mm) = 20,000 m³

2.1.15 Stage 14

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to PGL Subgrade

Total area of ground disturbance = 4.47 ha

- Total volume of cut = 16,500 m³

- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 13,200 m³
- Total volume of cut (surplus) = 3,300 m³
- Maximum cut and fill depth = 4m Fill, 5m Cut

Others

- Topsoil stripping (350 mm) = 15,600 m³

2.2 Retirement Village (Incl. Forestry Road Extension, Town Centre, Fill Pad Area, Village and Walkway)

Bulk Subgrade Earthworks 350mm EGL Topsoil Stripped to PGL Subgrade

Total area of ground disturbance = 40.26 ha

- Total volume of cut = 547,483 m³
- Total volume of fill (Incl. Fill Compaction Factor of 10%) = 731,886 m³
- Total volume of fill (surplus) = 184,402 m³
- Maximum cut and fill depth = 12m Fill, 12m Cut

Others

- Topsoil stripping (350 mm) = 140,920 m³

2.3 Other Matters

The following table outlines other key aspects of the proposed earthworks:

	Area (m²)	Cut (m³)	Fill (m³) with Fill Compaction Factor 10%	Max Cut (m)	Max Fill (m)
Steeper than 10º	329,280	142,207	260,842	7.73	12.05
Sediment Protection Yard	208,663	8,3067	271,550	5.72	12.05
Riparian Yard	31,432	4,061	31,341	3.78	10.843
Flood Plain	37,787	6,867	63,088	4.56	11.99

TABLE 1: EARTHWORK VOLUMES AND AREAS FOR SPECIFIC REASONS FOR CONSENT

2.4 National Grid Corridor Overlay

The proposed shared path from the Retirement Village to Riverhead township is located wihtin proximity to the National Grid Corridor and an existing pylon. Please refer to the appended earthwork drawings for further detail, however, an extract is provided below; alongside an assessment against the permitted standards of the AUP:

FIGURE 3: PROPOSED EARTHWORKS AND SETBACK FROM NATIONAL GRID PYLON

An assessment against the relevant permitted standards of E12 are set out below:

> *(8) Land disturbance around Transpower NZ Ltd electricity transmission lines towers must: be no deeper than 300mm within 6m of the outer visible edge of a transmission tower support structure; and be no deeper than 3m between 6-12m from the outer visible edge of a transmission tower support structure.*
>
> The setback from the nearest Pylon is 15m, complies.
>
> *(9) Land disturbance within 12m of a Transpower NZ Ltd electricity transmission line pole or tower must not: create an unstable batter that will affect a transmission support structure; or result in a reduction in the ground to conductor clearance distances as required by New Zealand Electrical Code of Practice for Electrical Safe Distances NZECP34:2001.*
>
> The setback from the nearest Pylon is 15m, complies.

2.5 General Earthwork Standards of the AUP

Please refer to Appendix C for the assessment of the relevant standards of E11 and E12 of the AUP which relate to bulk earthwork activities.

3. SEDIMENT CONTROL

3.1 General

There are several key elements to the erosion and sediment control methodology as stipulated in GD-005. These include identifying erosion and sediment risks, establishing control measures, monitoring, maintenance, and reporting.

The first step is to identify the erosion and sediment risks associated with the earthwork's activities. This includes assessing – the nature of the site (refer Section 3 above), the soil types (refer Section 5 above and the Geotechnical Report), the topography, (refer Section 3 above), proximity to waterways, refer to Figure 3 Based on the factors identified above, the following control measures can be established to manage the risks:

- Employ sediment retention measures
    - A detailed description of the devices proposed for this site given its specific features are outlined within Section 8.6.

- Engage a contractor with proven experience with E&S control practices.
    - Contractor feedback will be received on the Maven design plans; and contractor input including constructability will be factored into the final plan set issued for approval from Auckland Council.

- The ESC Plan should remain flexible
    - Work with Auckland Council to approve the final ESC plan. It is anticipated that regular site visits, weekly contractor meetings, and meetings with the council officers will ensure that the measures planned on site are robust, and up to date with the works program.

- Assess and adjust the ESC measures
    - In conjunction with the controls above, ESC measures need to be inspected, monitored and maintained. E&S control will be an item on the contractors weekly site meeting agenda for discussion. Weather patterns will also be monitored during the earthworks period, and any urgent preparations will be implemented prior to incoming inclement weather.

3.2 Site Specific Considerations

The following principles have been considered with respect to the site, in the preparation of this report and plans.

- Minimize disturbance – only the areas necessary to be earth worked to support the land use application, are proposed. The proposed earthworks utilise the existing contour as far as practical, and the cut/fill areas are planned to occur as close as possible to transport material the shortest distance possible.

- Seasonal Earthworks - The earthworks are anticipated to occur during the earthworks season only, unless the consent holder applies for approval from the Council to undertake certain earthworks outside the earthworks season and approval is given.

- Staged construction approach – The proposal has been split into different sub-catchments, in accordance with the stages proposed. The staged approach relates to both stages of the development, but also smaller earthwork areas which are in many instances their own isolated catchments. This allows for earthwork areas to be stabilised quickly, whilst minimizing exposed areas within the site.

- Methodology for steeper topography – The site features steep terrain and ridgelines upon which earthworks are proposed. In these areas additional stabilization methods have been included in the design, and will be monitored during construction as necessary under the direction of the geotechnical engineer and in compliance with GD05 standards. Methodologies implemented to reduce risk in steeper areas has been done by reducing the size of catchments, with cutoff drains included in larger catchments which feature significant gradient throughout.

- Watercourse Protection - All watercourses, wetlands and associated riparian margins are shown on all earthwork plans (C200 Series) appended. The ESC plans show that streams and wetlands will be protected through the water management controls.

- Streamworks Methodology - A Streamworks Management Plan has been prepared by Maven Associates for the culvert upgrades and installation of riprap. This methodology avoids adverse impacts on the stream(s).

3.3 Water Management and Control

To manage the flow of water through and around the earthwork areas, the following design protocols will be used:

- A series of clean water and dirty water diversion bunds will be installed as detailed within the C230-1 series of engineering plans.

- Clean water from outside of the earthwork areas will be excluded from works areas by clean water diversion bunds.

- Dirty water diversion bunds will be sized to convey flows from the 5% AEP storm event with a freeboard of 300mm and will be established prior to earthworks commencing.

- Regular monitoring of the bunds will be undertaken to identify any areas of actual/potential erosion.

- Overland flow paths will be required to be protected and maintained during construction. Where velocities are calculated to be greater than 2m³/s, the surface shall be stabilised with cloth and riprap protection.

3.4 Sediment Control Approach

The overall erosion and sediment control strategy is broken down into construction stages; and provides specific approach to dealing with sediment control during construction.

The following section details the erosion and sediment control solutions for the various workstreams contained within the overall development.

3.4.1 Countryside Living Subdivision

The countryside living subdivision is broken down into 14 stages, and sediment control is provided for each stage; so that each stage can be undertaken in separation.

Each subdivision stage has been broken down into smaller catchments (given the nature of the site, and existing contour, there are too many catchments to list for the CSL development), which utilizes the below sediment and erosion control methodology to achieve compliance with GD-05 is listed below:

- Stabilized vehicle entrances which largely follow the existing Forestry Roads and crossings from Old North Road.

- Construction traffic during construction will utilize existing forestry roads which are well surfaced and provide year round access.

- A series of cleanwater diversion bunds will also be located above the workstream areas. The existing culverts will provide cleanwater diversion through the works areas, where possible

- The earthworks areas will be supported by silt fences, Decanting Earth Bunds ('DEBs') and/or Sediment Retention Ponds ('SRPs') depending on the size of the resulting catchment and associated existing contour and falls. Effort has been made to rationalise the number of devices, however, contours prohibits large SRPs for lots of earthwork areas.

- Topsoil will be stockpiled within the earthwork sediment control areas. This topsoil will be respread over the finished building platforms and within the cut and fill batters which will form the basis of the revegetation proposed.

- Supersilt fences will be located below earthwork areas, along stream and/or wetland margins. This will ensure a further line of defence prior to discharge of the most sensitive areas.

- All culvert upgrade and streamworks will be completed in accordance with the Streamworks Management Plan prepared by Maven Associates and will be supported by the project ecologist as required.

3.4.2 Retirement Village

The retirement village development is broken down into 6 primary catchments, referred to Catchments 1-6. Sediment control consists of the following:

- Stabilised vehicle entrance from Forestry Road.

- Construction traffic during construction will utilise existing forestry roads which are well surfaced and provide year round access, inclusive of existing culverts.
- Cleanwater diversion bund will also be located above the workstream area in C6.

- Dirty water diversions will be in place throughout the earthwork areas, and this will direct dirty water to the six SRPs.

- Minor sheet flows from batters are serviced by supersilt fences, or if the catchment exceeds allowable threshold will be via way of DEBs, which are detailed on the drawing PN 147016 C230-1.

- Supersilt fences and clean water diversions bunds will be used in support of the shared path down to Riverhead Township. Refer drawing PN 147016 C230-6.

- All culvert upgrade and associated streamworks will be completed in accordance with the Streamworks Management Plan prepared by Maven Associates and will be supported by the project ecologist as required.

3.4.3 Forestry Road Extension

The Forestry Road extension will be supported by super silt fencing along the low side of the road embankment.

A series of cleanwater diversion bunds will also be located above the workstream area. The existing culverts will provide cleanwater diversion through the works area.

The earthwork areas will be supported by several DEBs, which will treat water prior to discharge into the adjoining stream.

All culvert upgrade and streamworks will be completed in accordance with the Streamworks Management Plan prepared by Maven Associates and will be supported by the project ecologist as required.

3.5 Fill Area

The overall earthworks result in net cut throughout the entire development. A fill pad has been designed in Lot 2, to the north of the Retirement Village. This is supported by ease of vehicle movements (within the site, so no off-site movements) and would enable the additional fill to be placed in a suitable and contained area away from any identified streams and associated riparian margins.

We note that the total volume suggests net fill, however, this is due to the fill platform being overdesigned to allow further margin and spoil, above the current modelled volumes. An earthworks cut/fill balance will, however, be achieved as part of the civil earthworks operation.

3.6 Topsoil Strategy

Geotech reporting has assumed that an average of 350mm topsoil is likely over the earthwork areas. This topsoil will be stockpiled within the extents of the sediment controls. The topsoil will then be respread over the completed platforms and batters, and any excess will be placed within the wider revegetation area prior to being planted. This ensures topsoil is not carted around the site, will ensure speed of stablisation and will also aid the planting program which forms an integral part of the proposal.

3.7 Inground Improvements

As is indicated in the ENGEO reporting, some isolated areas within the development site requires inground improvement works are to ensure global stability issues can be contained within accepted risk allowances. These works include palisade walls, reworking areas for improved grades and the installation of counterfort drains. Specific sediment control design has not been included at time of issue, as the actual extent and final solution will be subject to further geotech assessment, detailed design and likely approvals by Auckland Council.

As such, specific sediment and erosion control for the final rework areas will be prepared and installed in support of the work areas. The methodology will follow the same general methodology of this EMP.

3.8 Forestry Slash

As the site history as a commercial forestry operation, the construction phase will require the removal of slash to enable platform and road constructions. The slash is going to be chipped onsite and will be used for the stabilisation and planting strategy. This will also ensure that the risk of slash being washed down into culverts and stream networks will be removed.

4. ADDITIONAL INFORMATION

Silt control measures will need to be installed onsite, checked, and confirmed acceptable by the Engineer before works commence. During earthworks, the sediment control measures will be maintained such that they function as proposed. Refer to section 4.0 of this report for further details in this regard.

The site will be progressively stabilised with topsoil, mulch, and or gravel as earthwork levels are achieved. Silt control measures will only be removed once the site is considered stable in terms of silt run-off by Auckland Council and the Engineer.

4.1 Monitoring

All sediment control measures will be checked regularly, to ensure that they are performing as intended by design.

A site walk over shall be undertaken daily before leaving the site to identify any corrective maintenance required. A more thorough inspection will be undertaken at the end of each week, or before and after a forecast major storm event, to identify any preventative and/or corrective maintenance required.

A regular program of sediment, debris and trash removal will be undertaken to ensure sediment control measures do not become blocked and ensure they function as proposed. Any large floating matter including any organic matter, i.e. fallen tree litter, reaching the pond or discharge structures is to be removed immediately.

Specific monitoring and maintenance of each mitigation method is included below:

4.1.1 SRPS and DEBs

- Inspect every day and before every forecasted rainfall event. Inspect for correct operation after every runoff event. Immediately repair any damage caused by erosion or construction equipment.

- Inspect Level Spreaders after every rainfall until vegetation is established and promptly undertake any necessary repairs. Ensure vegetation is kept in a healthy and vigorous condition.
- Clean out before the volume of accumulated sediment reaches 20% of the total volume. To assist in gauging sediment loads, clearly mark 20% volume height on the riser.
- Clean out with high-capacity sludge pumps, or with excavators (long reach excavators if needed) loading onto sealed tip trucks or to a secure area.
- Deposit the sediment in such a location so that is does not lead to a direct discharge to receiving environments. Stabilise all disposal sites as required.

4.1.2 Diversion Drains/ Clean Water cut-off bunds

- Inspect after every rainfall event and during periods of prolonged rainfall for scour and areas where they may breach.
- Repair immediately if required to ensure that the design capacity is maintained.
- Remove any accumulated sediment deposited in the Runoff Diversion Channel / Bund due to low gradients and velocities.
- Carefully check outlets to ensure that these remain free from scour and erosion.

4.1.3 Silt Fence

- Inspect Silt Fences at least once a week and after each rainfall. Make any necessary repairs when bulges occur or sediment accumulation reaches 20% of the fabric height.
- Any areas of collapse, decomposition or ineffectiveness need to be immediately replaced.
- Remove sediment deposits as necessary to continue to allow for adequate sediment storage and reduce pressure on the Silt Fence. Ensure that the sediment is removed to a secure area.
- Do not remove Silt Fence materials and sediment deposition until the catchment area has been appropriately stabilised. Stabilise the area of the removed Silt Fence.

4.1.4 Stabilised Vehicle Entrance

- Maintain the Stabilised Construction Entrance in a condition to prevent sediment from leaving the construction site. After each rainfall inspect any structure used to trap sediment for the Stabilised Construction Entrance and clean out as necessary.

4.2 Fill Compaction

Each and every layer of material shall be compacted by approved compacting machinery throughout its whole area and depth to achieve:

(i) not less than the following percentages of maximum dry density obtainable for the material by standard compaction at optimum moisture content determined by NZS 4402, Pt 2P: Test 14:-

		Clays and Silty Clays	Sands and Gravel
A.	Within 500mm of the finished carriageway sub grade levels and within		

	3m of batter edges	98%	100%
B.	Elsewhere	95%	97%
(ii)	Volcanic Ash/Clays		
		Air Voids % (as defined NZS 4402: Part 1)	Undrained Shear (measured by in situ vane)
A.	Within 500mm of road subgrade levels and within 3 metres	Average value less than 8% (any 10 tests) Maximum single Value 10%	Average value not less than 170 KPa Minimum single value 140KP
B.	General Fill	Average value less than 10% (any 10 tests) Maximum single Value 12%	Average value not less than 150 KPa Minimum single value 110 KPa
C.	Reserve Areas deeper than 600mm below finished formation level	Maximum value 15%	Minimum value 75KPa

5. Summary and Conclusions

This Earthworks Management Plan has set out the sediment and control methodology that will support the earthworks associated with the intended development.

The methodology contained within accords with the Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region, June 2016.

Final design of the ESCP will be undertaken following on from detailed design stage, and contractor engagement, and will be confirmed at the pre-start meeting as per conditons of consent issued.

The design has taken into consideration the possible impact of the proposed development and has minimised impacts to the receiving environment using accepted engineering practices.