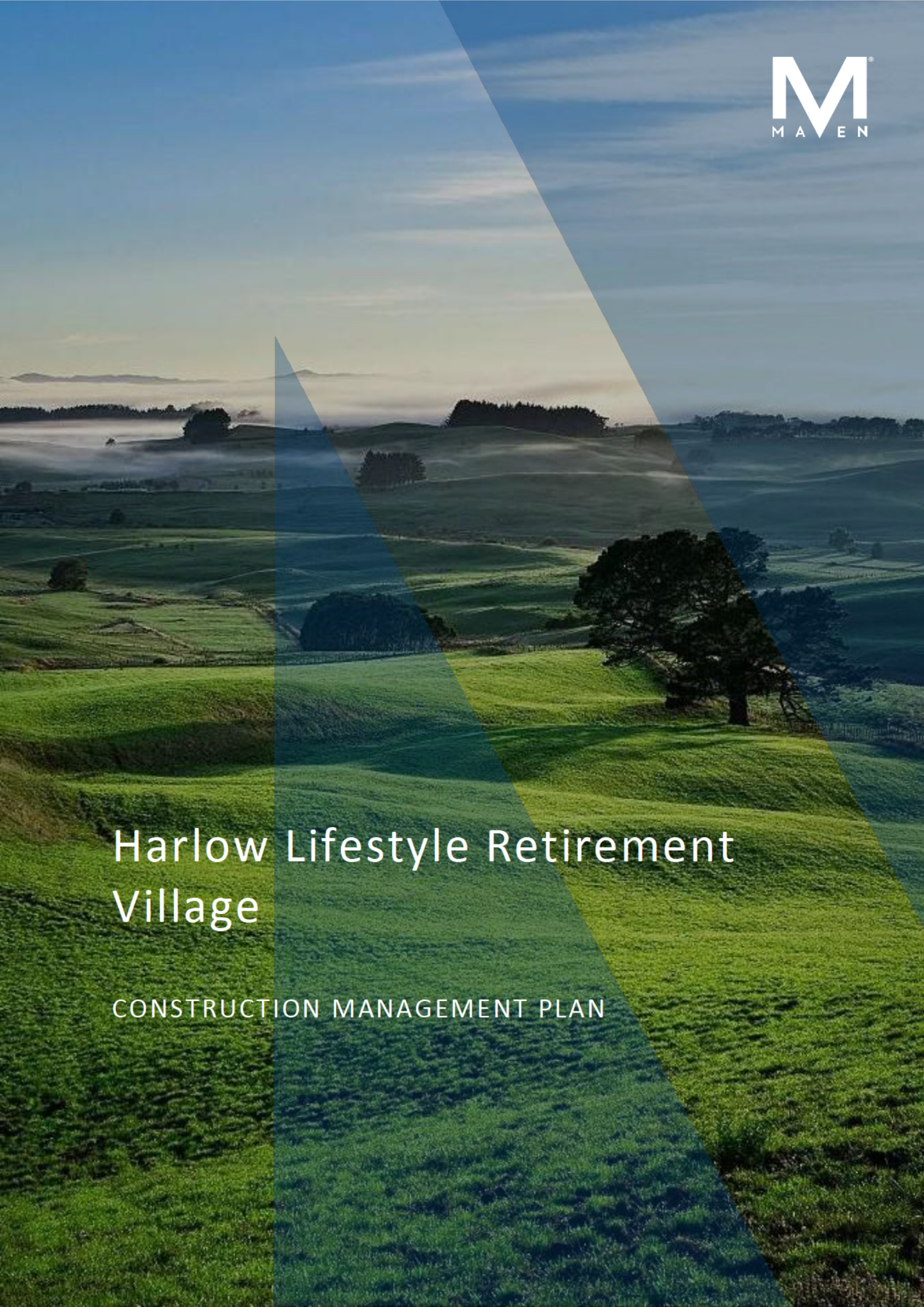
Appendix 19c – Construction Management Plan



Harlow Lifestyle Retirement Village

CONSTRUCTION MANAGEMENT PLAN

PROJECT INFORMATION

CLIENT	Harlow Lifestyle Village Ltd
PROJECT	411001

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APPROVED BY	[redacted] Dean Morris Regional Director

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Contents

1. STATEMENT OF EXPERIENCE 5
2. Introduction 6
   2.1. Background 6
   2.2. Purpose of this Report 6
   2.3. Site Description 6
3. Proposed Earthworks 7
   3.1. Geotechnical Investigation 7
   3.2. Bulk Earthworks 9
   3.3. Site Constraints 10
      3.3.1. Earthworks within Existing Flood Plain 10
      3.3.2. Earthworks within Adjacent to Existing Wetlands 11
      3.3.3. Existing Artificial Farm Drain Ponds 12
      3.3.4. Culvert Construction 13
      3.3.5. Significant Natural Area (SNA) 14
   3.4. Consent Condition and Council Involvement 14
   3.5. Program of Works 14
   3.6. Earthworks Summary 15
      3.6.1. Stage 1 Earthworks 16
      3.6.2. NZTA Corridor Earthworks 16
      3.6.3. Stage 2 Earthworks 17
      3.6.4. Stage 3 Earthworks 17
      3.6.5. Stage 4 Earthworks 17
4. Earthworks Operation 17
   4.1. Environmental Aspects 17
      4.1.1. General Environmental Outcomes and Targets 18
      4.1.2. General Environmental Risks & Opportunities 18
      4.1.3. Environmental Monitoring 20
   4.2. Health and Safety 21
   4.3. Access/Haul Roads 21
      4.3.1. Stage 1 Access 22
         4.3.1.1. Stage 1 Truck Movements 22
      4.3.2. Stage 2 Access 23
         4.3.2.1. Stage 2 Truck Movements 23
      4.3.3. Stage 3 Access 23
         4.3.3.1. Stage 3 Truck Movements 23
      4.3.4. Stage 4 Access 23
         4.3.4.1. Stage 4 Truck Movements 24
   4.4. Working Hours 24
   4.5. Complaints 24
   4.6. Vibration Control 24
   4.7. Noise Control 24
   4.8. Weed Management 25

4.9. Sediment Control 25
4.9.1. Stabilized Site Entrances 25
4.9.2. Dust Control 25
4.9.3. Cut-off Drains/Bunds 27
4.9.4. Decanting Earth Bunds/Sediment Retention Ponds 27
4.9.5. Chemical Treatment 27
4.9.6. Silt Fences 28
4.9.7. Wellpoint Dewatering Devices 28
4.9.8. Topsoil Management 28
4.9.9. Sediment Control Performance Monitoring & Maintenance 29
4.10. Fill Compaction 30
4.11. Traffic Management 30
4.12. Community and Stakeholder Engagement 31
5. Construction Methodology and Sequence of Works 31
5.1. Artificial Stormwater Wetlands Construction Methodology & Sequence of Works 32
5.1.1. Artificial SW Wetland A 32
5.1.2. Artificial SW Wetland B 32
5.1.3. Artificial SW Wetland C 33
5.1.4. Artificial SW Wetland D 34
5.1.5. Artificial SW Wetland E 35
5.2. Wastewater Pumpstation Construction Methodology & Sequence of Works 36
5.2.1. Wastewater Pumpstation A 36
5.2.2. Wastewater Pumpstation B 36
6. Conclusion 37
6.1. Post Construction Monitoring and Maintenance 37
Appendix A –Earthworks Drawings 38

1. STATEMENT OF EXPERIENCE

Author

My name is Sean McDonald. I am a Senior Engineer and Team Leader at Maven Waikato Ltd ("Maven"), a firm of consulting engineers and surveyors based in Hamilton. I have been employed by Maven since 2025. I hold a Bachelor of Engineering Technology (Highways) which I graduated form in 2006, hold a New Zealand Certificate of Engineering "Civil" (NZCE) and I am a member of Engineering New Zealand.

I have over 29 years of experience in the field of civil engineering including as a civil engineering technician, New Zealand army engineer, council engineer and consulting engineer, with over 20years' of experience post degree. Since obtaining my degree I have worked on a variety of civil projects including State Highway works, 3 Waters Infrastructure works, Residential Land Development, Commercial and Harlow LRV Land Development and major Infrastructure projects such as the upgrade of the Port Botany (Sydney) Naphtha Storage Facilities, the Transpower upgrade and extension of the Whakamuru Substation, the Central Government Rotorua Youth Justice Facility and Contact Energy's new Tauhara Geothermal power station.

I confirm that I have read and understood the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023, and agree to comply with its requirements.

I acknowledge that, as an expert, I have an overriding duty to assist the decision-maker impartially on matters within my area of expertise. In preparing this report, I have exercised my independent professional judgement, and the opinions expressed in this report are my own. I understand that my duty as an expert is not to advocate for the interests of the applicant or any other party.

I confirm that the matters addressed in this report are within my area of expertise, except where I expressly identify that I have relied upon information, assessments or opinions provided by others. I have made all reasonable enquiries and have not knowingly omitted any material facts known to me that might alter or detract from the opinions expressed in this report.

Reviewer

I am Min Shon, a Senior Civil Engineer and Team Leader at Maven Waikato Ltd. I hold a Master of Civil Engineering from the University of Auckland and am a Chartered Professional Engineer (CPEng) registered with Engineering New Zealand. I have over six (6) years of professional experience in civil engineering, with particular experience in land development, including earthworks, roading, and three waters infrastructure design.

I confirm that I have read and understood the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023, and agree to comply with its requirements.

I acknowledge that, as an expert, I have an overriding duty to assist the decision-maker impartially on matters within my area of expertise. In preparing this report, I have exercised my independent professional judgement, and the opinions expressed in this report are my own. I understand that my duty as an expert is not to advocate for the interests of the applicant or any other party.

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2. Introduction

2.1. Background

Maven Waikato Ltd have been engaged to undertake Civil Design in support of the substantive application for the Harlow Lifestyle Retirement Village Development (Harlow LRV or the Project) under the Fast-track Approvals Act 2024 (FTAA).

2.2. Purpose of this Report

The purpose of this report is to provide a construction management plan (CMP) for the Harlow LRV Development at 2025 Ōhaupō Road, Te Awamutu. The information provided herein outlines the methodology associated with the proposed earthworks and infrastructure onsite. This report is to be read in conjunction with the engineering drawings and is to accompany the Substantive Application under the FTAA.

2.3. Site Description

The site consists of circa 25.78 hectares of land located to the west of Ōhaupō Road (SH3) and on the northern fringe of the Te Awamutu urban boundary. The site is currently used as rural land mainly as a dry stock farm however current State Highway access restrictions prevent the site from more extension farming operations. The landholding includes two parcels held in One Record of Title, Part Lot 1 Deposited Plan 35654 and Lot 1 Deposited Plan 36696 with a combined area of circa 25.78ha.

The Project seeks approval for a substantive application under the FTAA for a comprehensively master planned and staged Residential development. This includes all necessary resource consents under the Resource Management Act 1991.

The Harlow LRV Development provides for the establishment of approximately 414 units, together with infrastructure devices including centralised raingardens, artificial wetlands, 3 water drainage infrastructures and roading. The Harlow LRV Development is underpinned by a series of design principles, with a focus on creating a well-connected, legible, and diverse residential area on Te Awamutu's northern fringe. This is supported via a coordinated and connected roading and pedestrian/cycle network, and stormwater outcomes, as well as varying retirement unit sizes and types, in conjunction with the serviced apartments, managed care facility and community facilities which have been proposed to meet the growing and changing needs of the greater Waikato retirement lifestyle market.

The Harlow LRV Development includes substantial enabling works to establish developable land, including:

- bulk earthworks across the site;
- retaining structures
- roading networks
- new wastewater and water supply infrastructure including new wastewater pumpstations;
- an integrated stormwater management system consisting of conveyance systems such as piped stormwater infrastructure, as well as integrated detention/attenuation and treatment devices that will be combined into artificial wetlands.

Access and integration with the surrounding Te Awamutu area is provided through connected transport framework, including the establishment of intersections, roading, and walking and cycle networks, along with upgrades to existing transport infrastructure. The Harlow LRV development is proposed to be serviced via a coordinated strategy, including the construction of a new 4-arm roundabout on

Ōhaupō Road (SH3), public/private roading networks, existing footpath upgrades, and installation of appropriate infrastructure.

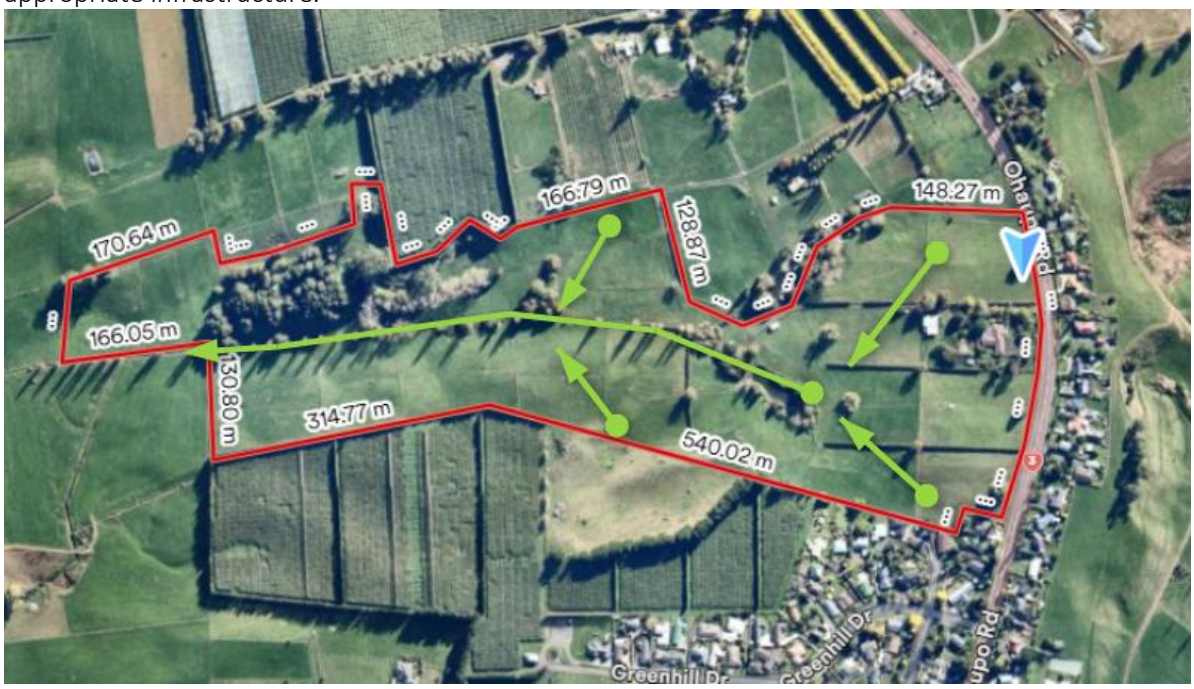


Figure 1: Site Locality

3. Proposed Earthworks

Earthworks will be undertaken as required throughout the proposed development area in different development phases and will include cut to fill operations for the following activities;

- Construction of building platforms
- Construction of structural retaining walls
- Construction of roading corridors & intersections
- Construction of artificial stormwater wetland ponds & raingardens
- Excavations for road pavement construction
- Excavation for stormwater pipe networks
- Excavations for wastewater pipe networks
- Excavations for wastewater pumpstations
- Excavations for water supply networks
- Excavations for services & utilities trenches

The Harlow LRV Development will be constructed in 5 earthwork stages. Within each development stage, the earthworks areas will be further divided into different sub-catchment areas where specific erosion and sediment control measures are to be adopted (refer to the EWMP for further detail).

3.1. Geotechnical Investigation

A Geotechnical Suitability Report has been prepared by Titus Consulting Engineers (Ref No: C3102) and BTW Company (Ref No: Rev A – 24/11/2022) for the Harlow Lifestyle Village. The site is characterised by rolling hill with Walton Subgroup (Hamilton Ash) and the low-lying areas consisting of Holocene swamp deposits (Alluvium) and saturated clay. The investigations confirm that compressible ground conditions are present across the low-lying portions of the site.

The geotechnical assessment showed that fill-induced settlement within the low-lying areas could be significant with preliminary predicted settlements of approximately up to 40mm without mitigation or preloading. Ground Improvement pf up to 5m of backfill is recommended for the low-lying areas of the site to avoid any surface expression of liquefaction. No ground improvement is necessary for the rolling hills.

Backfilling will be undertaken progressively within the identified soft-ground areas. Settlement monitoring will be established prior to loading and maintained throughout the earthworks, duration and removal subject to geotechnical review and agreed hold points. The observational approach allows the surcharge programme to be refined in response to measured settlement behaviour and ground conditions meaning throughout the phase a refined approach of backfill will be incorporated into the phasing of earthworks.

The general site geological composition, from greatest to least %, is as follows:

- Hamilton ash formation; stiff to very stiff clayey silt, with varying degrees of clay and silt
- Walton subgroup; weathered residual soil of very stiff silt with clay and/or fine sand and weathered pumice gravel
- Hinuera formation; low-density sandy soils over denser sand layers
- Low density colluvium at slope toes, gullies and stream channels
- Expected historic farm filling

The Hamilton ash formation soils encountered on site have been assessed for re-use suitability and are generally suitable to achieve the requirements to be re-used as engineered fill across site. For further information of the existing soil typology and suitability, see Appendix E in the Infrastructure Report.

From the desktop hazard review by MAVEN, the geohazards and mitigation measures in are shown Table 1 below.

Geotechnical Hazard	Description	Area Affected	Assessment Outcome	Mitigation Measure
Construction Risks	Excavatability	Building Platforms	Given the site is being Cut down, excavation is expected to be readily achieved with normal earthworks plant. In Areas of Engineered Fill placement, compaction is expected to be achieved with normal earthworks plant	Construction monitoring by geotechnical engineers to ensure good earthworks practices.
	Retaining Structures	Building Platforms, Road Corridor and Artificial Wetland Ponds	Given the site material and height of the proposed Retaining structures it is expected that the Retaining structures can be constructed	Construction monitoring by geotechnical engineers to ensure good construction practices and slope stability is maintained

	Sediment Retention Ponds	Building Platforms	Depending on their size sediment retention ponds may require geotechnical input at design stage to ensure batter stability is achievable.	Consideration given to batter stability of proposed ponds at design and construction phase. Noting Several Ponds require Fill Retaining Structures
	Artificial Wetland Ponds	Building Platforms and Retaining Walls	Given their location to retaining structures ponds may required geotechnical input at design stage to ensure retaining wall loading is correctly applied	Consideration given to Retaining Wall loading at Wetland pond locations at design stage and construction phase Ponds require Fill Retaining Structures.
	Subgrade Preparation	Building Platforms and Road Alignment	Topsoil and existing vegetation within the building footprints and road alignments will be cleared as part of the proposed development of earthworks.	Undercut to remove topsoil and roots and other materials. For saturated subgrade, allow to dry or undercut and replace.
	Service Trenches	Building Platforms and Road Alignment	Trench collapse may occur in surficial soils if proposed service trenches extend below GW level.	Mitigation should be considered in the form of trench support, temporary dewatering, in the form of regular spaced pumps.
	Low Road/Pavement Subgrade Strengths	Roads and Paths	Low subgrade strengths and/or saturation of pavement subgrade.	Further site investigations and specific pavement design is required.

Table 1: Summary of Geohazards & Mitigation Measures

3.2. Bulk Earthworks

The total bulk earthworks for whole site is summarized in table 2 below:

Bulk Subgrade Earthworks (topsoil stripping inclusive)	
Total area of ground disturbance	201,522 m^2 (20.15ha)
Total volume of CUT	271,320 m^3
Total volume of FILL	115,153 m^3
Total Volume of FILL with Compaction Factor (1.25)	143,942 m^3
Maximum CUT and FILL depth	7.0m FILL / 6.5m CUT
Total Volume (Excess Cut)	127,378 m^3

Bulk Topsoil Volumes	
Topsoil stripping (200 mm)	48,253 m^3
Topsoil Respread (150mm)	38,336 m^3
Total Excess Topsoil	9,917 m^3
Assumed Cut to Waste Volumes	
Assumed Cut to Waste Unsuitable	45,146 m^3
Assumed Cut to Waste Clean fill Material	82,232 m^3
Other	
Assumed Imported Granular Pavement	26,846 m^3

Table 2: Summary of Total Earthworks

3.3. Site Constraints

3.3.1. Earthworks within Existing Flood Plain

The Harlow LRV Development site contains areas of natural vegetation, existing wetlands, artificial farm drains, artificial farm ponds and an area identified as Significant Natural Area (SNA). These features also comprises multiple interconnected overland flow paths and ponding areas dictated by the existing topography of the surface, surrounding rural land uses and primary drainage with hydrology conditions as assumed in the model.

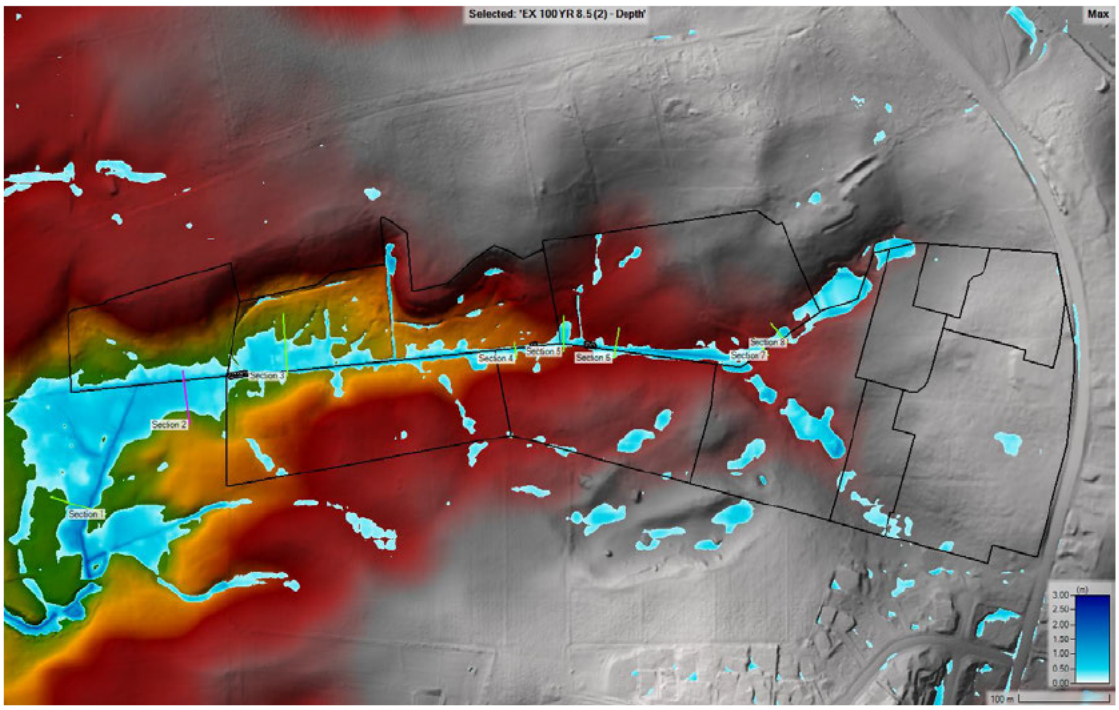


Figure 2: Existing Flood Extent in the 1% AEP Event

Construction within the development area is of particular importance due to the presence of the SNA area, existing wetlands, existing flood prone areas and overland flow paths. The raingardens, artificial wetlands, stormwater storage areas, culvert structures and high flow bypass networks have been designed to manage existing and post development runoff conveyance across the site. These features will contribute to the reduction in extent and duration of ponding currently experienced downstream of the site by attenuating flows including events up to the 100-year CC design event.

Earthworks themselves have been designed to either avoid works within the sensitive wetland/flood basin areas or minimised by the use of retaining structures adjacent to these areas to minimise the earthworks footprint, while raising the habitable areas above the 100-yr CC flood level.

Where possible existing groundwater flows will continue to be directed to both the existing wetlands or existing artificial farm drains and ponds through the use of subsoils drains included in the retaining wall structures and under the deep wastewater lines and via drainage blankets where appropriate. Overland flows have also been considered and have been designed to overflow to important key existing wetlands, the central artificial farm drain or the existing artificial farm pond at the top of the central drainage corridor, which will help to maintain existing base line flows within the existing central drainage corridor network.

3.3.2. Earthworks within Adjacent to Existing Wetlands

Construction adjacent to the existing wetlands will be carefully managed to avoid encroaching on the 10m wetland off set buffer wherever possible, with any works encroaching within the buffer generally restricted to fill retaining wall structures. Erosion & Sediment Controls (ESC) will minimise upstream flows from entering these work areas and the retaining structure will be constructed prior to fill being placed behind the walls, to limit both sediment runoff and adverse compression pressure placed on the existing wetlands. Retaining Structure subsoil drains in these locations will discharge to the existing wetlands to maintain existing ground water baseline flows. The name, location and impact of construction of the existing wetland ponds are detailed in figure 3 and table 3 below.



Figure 3: Existing Wetlands Pond Names & Locations (Refer to Ecologist Report)

WETLAND	EW within Wetland (WL) Yes/No	EW within 10m Buffer Zone (BZ) Yes/No	Approx % of Area effected	Type of Activity within Area
ADWL -1	No	Yes	10% BZ	• Road 11 Retaining Structure (Fill)
ADWL-2	No	Yes	5% BZ	• PU 2198/2199 Building Platform Retaining Structure (Fill) • Road 01 Retaining Structure (Fill
ADWL -3	Yes	Yes	1% WL 5% BZ	• Road 13 Retaining Structure (Fill) • Culvert 1 Installation works
WL-5	No	No	NA	• NA
WL-6	No	No	NA	• NA
WL-7	No	No	NA	• NA
WL-8	No	Yes	30% BZ	• PU 2200 Building Platform Retaining Structure (Fill))
WL-9	Yes	Yes	100% WL 100% BZ	• Construction of Artificial Wetland Pond B, refer to ecological report for mitigation of loss
WL-11	No	Yes	10%	• Footpath Retaining Structure (Fill) • Artificial Wetland Pond E Retaining Structure (Fill)
WL-12	No	Yes	10%	• Footpath Retaining Structure (Fill)
WL-13	No	Yes	10%	• Artificial Wetland Pond E Retaining Structure (Fill)

Table 3: Summary of EW Impact on Existing Wetland's

3.3.3. Existing Artificial Farm Drain Ponds

The Harlow LRV Development proposed earthworks design requires that two of the four artificial farm ponds be removed as part of both the road corridor network and building platform construction. The design has considered layout options that retained these ponds, however due to the site constraints around both contours and protecting the exiting wetlands and central drainage corridor features, this was not feasible.

It is noted that these ponds were formed in the past by farmers "damming" the groundwater flows, as such as part of the construction works, the ponds will be emptied (to the nearest SRP structure) and drainage blankets and/or subsoil drainage networks will be installed to ensure that the ground water flows will continue to be conveyed to the downstream drainage corridor (refer to the geotechnical report). To offset the loss of eel habitat with the remove of these two artificial farm ponds, the proposed Wetland B has been modified to accommodate additional eel habitat (refer to ecological report).

Both ponds are located with the proposed Stage 1 earthworks, and the closest SRP to facilitate the draining of the ponds is SRP 1D (refer to ESC plans).

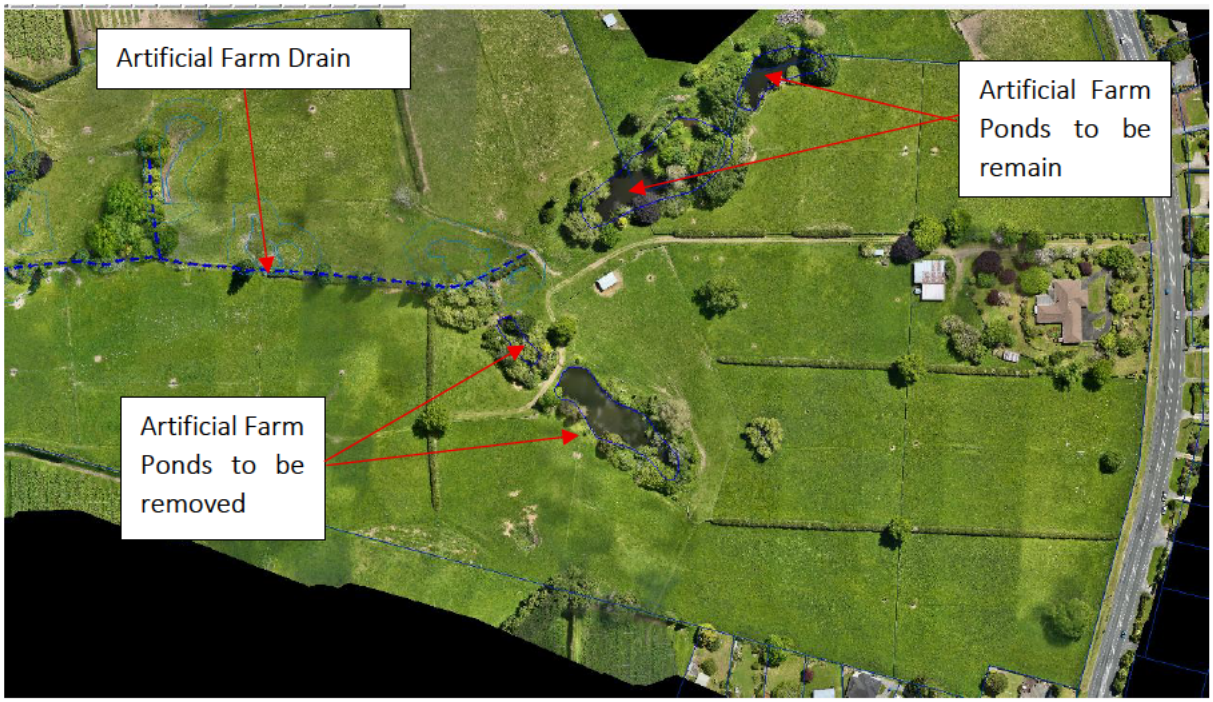


Figure 4: Existing Artificial Farm Pond Names & Locations (Refer to Ecologist Report)

3.3.4. Culvert Construction

The proposed culvert crossings form an important component of the overall stormwater and flood management strategy by maintaining conveyance of channel/drain flows through the site while supporting the proposed transport network. The hydraulic assessment confirms that the crossings can accommodate the required design flows while maintaining the function of the existing drainage system and supporting the broader objectives of the WRC.

There are three road main crossings (Culvert 1, 2 and 3) and one footpath crossing (Culvert 4) proposed where the development road/ footpath network intersects existing drainage channels traversing the site, though it is noted one road crossing is a for maintenance access to Wetland Pond B and not for regular daily traffic flows. The purpose of the culverts is to maintain the existing hydraulic connectivity of the stream system while enabling the construction of the proposed collector roads and associated infrastructure.

There are 1 Box culvert, and 3 circular culverts proposed mainly to allow conveyance of the rerouted stream and the discharge from proposed wetlands. Refer to drawing C400 for location of the culvert crossing locations.

Culvert	Dimension	Gradient	Type	Earthworks Stage
Culvert 1	3m x 1m	0.9%	Open Base Concrete Box Culvert	Stage 2
Culvert 2	1.5 m dia	3.7%	Concrete Class 4 RRJR Pipe	Stage 2
Culvert 3	1.5 m dia	0.8%	Concrete Class 4 RRJR Pipe	Stage 2
Culvert 4	1.2 m dia	8.5%	Concrete Class 4 RRJR Pipe	Stage 1

Table 4: Culvert details

The proposed culvert installation methodology that has been utilised successfully with WRC approval is detailed below:

- Sediment and Erosions Control measures for the culvert installation and reinstatement works will be as follows.
  - Clean Water Diversion Bund will be formed on the either side of the proposed culvert removal site to direct accessway surface water away from the work area.
  - Silt Fences will be installed as required for an earthworks cut/fill activities to prevent fines/sediment entering the watercourse.
  - A stabilised "Sump "will be constructed and filled with clean aggregate Rip Rap (such as AP100) upstream of the proposed earthworks extents.
  - OVERPUMPING of the watercourse/drain for the full duration of the Culvert removal and reinstatement:
    - Note appropriately sized pump will be required that can safely run for the duration of the works.
    - Works should be timed with the weather to avoid any adverse rain events occurring during the period of works.
    - Provision for a Emergency Standby Pump to be available should be allowed for.
  - Once the culvert has been installed, the culvert embankment stabilised and channel reformed to suit existing water course levels (if required), any exposed areas to be stabilised to the satisfaction of the Waikato Regional Council inspector/representative.
    a. Note channel reinstatement to be achieved by securely "Pinning" a geofabric such as BidimA19 or similar (with either end anchored minimum 500mm deep to prevent water encroaching under the geofabric) and lined with 150mm to 250mmØ clean RIP RAP.
    b. RIP RAP to extend 300mm either side of the new channel proposed normal flow water level.

3.3.5. Significant Natural Area (SNA)

No works shall occur or be allowed to occur within the SNA with out express written consent by Waikato Regional Council representatives. The proposed Harlow LRV development earthworks have been designed to exclude this SNA area completely, and it is not anticipated that ANY work will be undertaken within this area.

3.4. Consent Condition and Council Involvement

For an earthwork operation of this scale, it is expected that WRC earthworks consent will be obtained. The EW consent conditions will address the potential adverse effects generated during the earthwork and construction phase.

No earthworks will be undertaken prior to pre-construction conditions being satisfied and the sediment and erosion control has been established on site to meet Waikato Regional Council's (WRC) Guide for Soil Disturbing Activities TR2009/02.

3.5. Program of Works

Earthworks will be undertaken in stages, and it is envisaged that all earthworks will be completed within five to six (5-6) earthworks seasons depending on overall project staging and earthwork season weather. Applications for Winter Works will only be lodged if required.

It is proposed that the bulk earthworks operation will comprise of five separated work sections (Stage 1, 2, 3, 4, and NZTA Corridor). Stage 1 will be run concurrently with the NZTA corridor works, with Stage 1 works completion dependant on the completion of the NZTA corridor works. Excess material from Stage 1 can be stockpiled on Stage 2 to be removed off-site once both Stage 1 and the NZTA Corridor works are complete if required. It is anticipated that the combined duration of the NZTA Corridor works and the Stage 1 Earthworks will take 18 to 24months to complete.

Stage 2,3 and 4 can run independently of each other and/or concurrently, however critical culvert crossings and associated earthworks within Stage 2 will need to be completed prior to either Stage 3 or 4 commencing. It is anticipated that each of the 2 will take 12 to 18months to complete, however stg age 3 and 4 are anticipated to take approximately 12months each to complete.

Works are intended to be carried out in the following steps:

- Install silt control measures, as shown on Engineering Drawings or agreed plans provided at Preconstruction meeting
    - Installation of stabilized site entrances, sediment retention ponds, decanting earth bunds, clean and dirty water diversion bunds, silt fencing and wellpoint dewatering devices.
- Cut/Fill bulk earthworks to areas outside of the NZTA Corridor
- Formation of either temporary SH3 traffic diversion or partial construction of proposed 4-arm SH3 roundabout
- Once SH3 traffic is diverted – the bulk earthworks within the NZTA Corridor
- Once SH3 proposed 4-arm SH3 roundabout completed all traffic rediverted to new SH3 alignment and completion of Stage 1 Cut/Fill earthworks
- Installation of Structural Retaining walls
- Installation of deeper drainage infrastructure
    - Wastewater Pumpstations
    - Artificial Stormwater Wetland Ponds
- Install drainage infrastructure systems, outlets, and riprap
- Form channel and building platform areas concurrently as site is stabilised
- Stabilise Road corridors by placing the subgrade improvement layer of grey/brown rock ready for civil construction to place
- Removal of any stockpiled material
    - If stockpiled on Stage 2
- Retain and maintain silt control measures until completion.

3.6. Earthworks Summary

As mentioned in the above section, the bulk earthworks on site will be divided into five separate work sections. These are from Stage 1, 2, 3, 4, and NZTA Corridor including artificial stormwater wetlands, and wastewater pumpstations. Please refer to the earthworks drawings for detail attached in Appendix A.

- Stage 1
    - Bulk Earthworks
    - New SH3 Road Corridor/Roundabout (Partial offline construction)
    - Structural Retaining Walls
    - Artificial Stormwater Wetland A construction

    - Culver Construction
    - Eastern Wastewater Pumpstation (A) construction
- NZTA Corridor
    - Bulk Earthworks
    - New SH3 Road alignment/tie in
    - New Roundabout (Partial online construction)
    - Stormwater treatment/attenuation basin (dry)
- Stage 2
    - Bulk Earthworks
    - Structural Retaining Walls
    - Artificial Stormwater Wetland B & C construction
    - Culvert Construction
- Stage 3
    - Bulk Earthworks
    - Structural Retaining Walls
    - Artificial Stormwater Wetland E construction
- Stage 4
    - Bulk Earthworks
    - Structural Retaining Walls
    - Artificial Stormwater Wetland D construction

3.6.1. Stage 1 Earthworks

Subgrade Earthworks (topsoil stripping exclusive)	
Total area of ground disturbance	89,211 m^2 (8.92ha)
Total volume of CUT	153,967m^3
Total volume of FILL	62,189 m^3
Total Volume of FILL with Compaction Factor (1.2)	77,736 m^3
Maximum CUT and FILL depth	7.0m FILL / 6.5m CUT
Total Volume (surplus of CUT)	76,231 m^3
Others	
Topsoil stripping (200 mm)	19,753 m^3

Table 5: Summary of Stage 1 Earthworks

3.6.2. NZTA Corridor Earthworks

Subgrade Earthworks (topsoil stripping exclusive)	
Total area of ground disturbance	8,953 m^2 (0.86ha)
Total volume of CUT	8,111m^3
Total volume of FILL	35 m^3
Total Volume of FILL with Compaction Factor (1.2)	44 m^3
Maximum CUT and FILL depth	0.5 FILL / 2.0m CUT
Total Volume (shortfall of FILL)	8,067 m^3
Others	
Topsoil stripping (300 mm)	NA

Table 6: Summary of NZTA Corridor Earthworks

3.6.3. Stage 2 Earthworks

Subgrade Earthworks (topsoil stripping exclusive)	
Total area of ground disturbance	76,471 m^2 (7.65ha)
Total volume of CUT	72,506m^3
Total volume of FILL	42,340 m^3
Total Volume of FILL with Compaction Factor (1.2)	52,924 m^3
Maximum CUT and FILL depth	4.0m FILL / 5.0m CUT
Total Volume (shortfall of FILL)	19,582 m^3
Others	
Topsoil stripping (300 mm)	19,016 m^3

Table 7: Summary Stage 2 Earthworks

3.6.4. Stage 3 Earthworks

Subgrade Earthworks (topsoil stripping exclusive)	
Total area of ground disturbance	22,460 m^2 (2.25ha)
Total volume of CUT	29,089m^3
Total volume of FILL	7,706 m^3
Total Volume of FILL with Compaction Factor (1.2)	9,633 m^3
Maximum CUT and FILL depth	3.5m FILL / 5.0m CUT
Total Volume (shortfall of FILL)	19,456 m^3
Others	
Topsoil stripping (300 mm)	7,269 m^3

Table 8: Summary of Stage 3 Earthworks

3.6.5. Stage 4 Earthworks

Subgrade Earthworks (topsoil stripping exclusive)	
Total area of ground disturbance	9,092 m^2 (0.91ha)
Total volume of CUT	18,376m^3
Total volume of FILL	2,883 m^3
Total Volume of FILL with Compaction Factor (1.2)	3,604 m^3
Maximum CUT and FILL depth	3.0m FILL / 4.5m CUT
Total Volume (surplus of CUT)	14,772 m^3
Others	
Topsoil stripping (300 mm)	2,216 m^3

Table 9: Summary of Stage 4 Earthworks

4. Earthworks Operation

4.1. Environmental Aspects

This section details the minimum requirements for environmental management processes and procedures to be implemented on site, to mitigate actual and potential risks associated with the construction of the Harlow LRV Development project.

4.1.1. General Environmental Outcomes and Targets

Environmental objectives and targets relating to this CMP are described in the table below and will be confirmed with the contractor.

Outcome	Target	Proposed KPI
Environmental Compliance Ensure the Project operates in accordance with all Resource Consent Conditions and relevant environmental related legislation.	Zero enforcement action.	Number of warning or pre-enforcement letters. Percentage of compliance with conditions of Consent
Earthworks Compliance Ensure the Project operates in accordance with WRC's TR2009/02 guidelines for ESCPs and ESC in accordance with WRC Site Scoring System.	Good earthworks performance on site, reduced potential for enforcement actions, better environmental outcomes, enhance opportunity for flexibility in earthworks programme.	Number of 1 (fully compliant) scores Percentage of 2-4 scores
Training Train Project personnel in environmental management.	Implement training & awareness programs that promote compliance, improving environmental performance & skill base of staff and workers on the Project and minimise environmental risk.	100% of relevant Project staff receiving environmental training.
Flora, Fauna and Receiving Environments Manage effects of construction activities to minimise impacts on flora, fauna and receiving environments	No unauthorised impact to flora, fauna and receiving environments from construction.	Number of flora, fauna and receiving environments items impacted.
Community Manage community and stakeholder relationship to minimise impacts from construction activities	Engage directly with sensitive receivers, key stakeholders, and relevant community groups. Respond to complaints within a reasonable of receipt	Number of complaints and time taken to resolve issues Number of complaints managed effectively within nominated timeframe
Quality Ensure environmental & related audit actions are closed out within the agreed timeframes.	No overdue audit actions.	Number overdue audit actions. Percentage of audit actions completed on time

Table 10: Potential environmental objectives and targets

4.1.2. General Environmental Risks & Opportunities

The table below presents indicators of key environmental performance issues identified in initial desk top risk assessments undertaken for the purpose of developing this plan. Confirmation of the final risks with the contractor will be undertaken prior to works commencing. The risks identified in initial reviews and site visits will be used to inform and update, where necessary, environmental aspects and impacts which are described in the table below:

Aspect/Risk	Potential Impact
Erosion and Sediment Control	Uncontrolled discharge of sediment to receiving environment Pollution or degradation Loss of reputation Additional costs to remediate Potential delays
Water Quality	Uncontrolled discharge of concrete wash out / slurry Pollutant discharge to receiving environment Uncontrolled discharge of sediment to receiving environment Environmental damage Loss of reputation Additional costs to remediate Potential delays
Noise	Excessive noise generated by the project activities Loss of reputation Additional costs to remediate Potential delays
Unidentified Archaeology	Items, structures, locations of cultural significance damaged or destroyed by project activities. Loss of reputation Additional costs to remediate Potential delays
Landscape	Landscaping elements do not achieve desired coverage, become weed infested, fail, do not achieve ecological or urban design outcomes. Extended maintenance/re-planting programme Revegetation Restoration objectives not achieved Additional costs to remediate Loss of reputation
Vibration	Excessive vibration caused by project activities Degradation of property outside site Loss of reputation Additional costs to remediate Potential delays
Air Quality (Dust)	Dust created by work activities Pollution or degradation that has impacts on the community and / or environment Loss of reputation Additional costs to remediate Potential delays
Contamination	Uncontrolled cross contamination of site due to ground contamination

	Health and safety implications Environmental damage Loss of reputation Additional costs to remediate Potential delays
Hazardous Substances / Dangerous Goods	Uncontrolled release of hazardous substances / dangerous goods Health and safety implications Environmental damage Loss of reputation Additional costs to remediate Potential delays
Waste	Waste management activities not in accordance with regulatory and project requirements Environmental damage Loss of reputation Additional costs to remediate Potential delays
Behaviours	Poor uptake of project values and behaviours by staff Negative perception of company / project in wider stakeholder community
Culverts and Stream Diversion	Environmental damage (e.g., sediment impacts on water quality) Fauna lost, through disruption of aquatic fauna plant strike Poor design and/or construction leading to inadequate aquatic habitat Flora dieback/lost Loss of reputation Negative perception of company / project in wider stakeholder community Potential delays

Table 11: Identified Key Risks and Potential Impacts

These aspects/risks identified in the table above and subsequent risk assessment with the contractor will be used to inform the preparation of site-specific method statements.

4.1.3. Environmental Monitoring

Monitoring of environmental performance and regulatory compliance with resource consents conditions are required during the construction phase of the project. The contractor will identify a program which defines, at a minimum, general site monitoring (scheduled and unscheduled); environmental training; and site inductions along with incident response and reporting.

4.2. Health and Safety

A site-specific Health and Safety Plan will be provided by the Contractor prior to start of any works. This document will encapsulate routine monitoring measures, emergency response protocols, along with the requisite documentation. The Health and Safety Plan will be a dynamic document, updated regularly to address emerging health and safety concerns.

To ensure the safety of all, a protective barrier in the form of safety fencing will be erected around the work extent excluding the NZTA road corridor. Access points to the site will be monitored and controlled by a gate and perimeter fencing. Relevant signage will be affixed to this fencing for clear communication. All construction-related vehicular movement will be streamlined through distinct, predetermined, and well-marked access points.

During the NZTA 4-arm roundabout construction work, and the associated realignment and reconstruction off the old highway to new local road standards, the contractor will be expected to provide NZTA specific safety plan, based around their proposed roundabout construction methodology for NZTA to approve with regards to vehicular, public transport, pedestrian and cyclist access and safety as well as maintaining safe access for existing residents along Ōhaupō Road (SH3) impacted by the new roundabout construction works.

To maintain a continuous dialogue about health and safety measures, weekly toolbox meetings will be convened on-site. These meetings will be centred around discussions of potential risks associated with the week's scheduled activities and the strategies to mitigate them.

All personal involved in this site construction work, including visitors, are required to complete site induction every year to ensure on-going familiarity with risks present on this construction site. Visitors to the construction site will be obliged to comply with the requirements of the site-specific Health and Safety Plan upon entry and shall be escorted by a nominated contractor representative throughout their visit.

4.3. Access/Haul Roads

The site will have one main accessway which will be utilised based on specific earthworks operation on site. This main entrance is located at the existing Ōhaupō Road (SH3) farm entrance. Once the new Ōhaupō Road (SH3) 4-arm roundabout has been constructed, then the western leg of the new roundabout will form the new site access.

The overall site is proposed to have a singular spine haul road that will run east to west with multiple internal haul roads that service the individual earthworks areas/catchments, refer to the ESC plans for further details.

- The track will be a metal road approximately 3m to 5m wide with drainage swales beside the road formations as required, which will act as a cut-off to divert runoff.
    - Passing bays will be located at critical locations to allow truck passing movements to occur
    - Cut-out/Soakage pits will be installed ever 50m along the haul road where steeper contours require additional contours due to run-off velocities
- Upon cessation of site work the track will be removed.
- A stabilised construction entrance with a wheel wash facility will be installed at these access points.

4.3.1. Stage 1 Access

The initial farm access site distance is less than ideal, prior to major works commencing enabling works such as vegetation removal and lowering of the general landform in the vicinity of the farm access will improve both the site distance and safety of the existing farm entrance prior to more extension construction activities commencing.

The majority of the proposed roundabout intersection will be constructed offline and as part of Stage 1 bulk earthworks. Once the majority of the roundabout is constructed then the State Highway traffic can be diverted through the temporary roundabout works, as the remainder of the roundabout and the access road to the existing eastern SH3 properties (Road 02) are constructed.

Once the new Ōhaupō Road (SH3) 4-arm roundabout has been constructed, then the western leg of the new roundabout will form the new site access.

Excess material from Stage 1 earthworks activities will be stockpiled in Stage 2 (refer to ESC plans) until such time as the Ōhaupō Road (SH3) roundabout is full formed and operation, as to prevent excess truck movements onto the State Highway network:

It is recommended that the proposed Collector Road 01 within Stage 1 once formation is completed be utilised as the Haul Road/access for subsequent stages. In acknowledgement that the completed collector road will be utilised the main "haul road" for each subsequence staging, the final pavement design of Collector Road 01 should reflect this initial heavy truck/percentage of heavy traffic in its final design considerations.

4.3.1.1. Stage 1 Truck Movements

Within Stage 1 bulk earthworks and associated pavement construction the following truck movements are anticipated:

OPERATION	Large Truck & Trailer (assumed 16m³ per Load) Movements	Standard Truck & Trailer (assumed 14m³ per Load) Movements
Cut to Waste – Unsuitable Off Site	253	290
Cut to Waste – Clean Fill Off Site	251	287
Granular Pavement Importation	530	606

Table 12: NZTA Corridor Bulk EW & Pavement Construction Truck Movements

OPERATION	Large Truck & Trailer (assumed 16m³ per Load) Movements	Standard Truck & Trailer (assumed 14m³ per Load) Movements
Cut to Waste – Unsuitable Off Site	1,443	1,650
Cut to Waste – Clean Fill Off Site	3,321	3,795
Granular Pavement Importation	485	555

Table 13: Stage 1 Bulk EW & Pavement Construction Truck Movements

Noting that it is anticipated that Stage 1 bulk earthworks will take 18 to 24months to complete with truck movements anticipated to be 27 Truck & Trailer Loads per day based on the following assumptions:

- Round Trip = 1.5hrs
  - 6 Loads per 10hr working day/per Truck
    - Assume 1 hr. for Breaks/Stoppages
- 3 Trucks Load per Hour (one load per 20mins)

- Equates to 27 Truck & Trailer Movements per 10hr working day
  - Assume 1 hr. for Breaks/Stoppages

4.3.2. Stage 2 Access

The Stage 2 Access will be via the extension Collector Road 01 (as noted above). Within Stage 2 the 3 road crossing culverts will require installation which will facilitate access to Stages 3 and 4 over the existing farm drain.

It is recommended that the proposed local road 11 and 13 completed in the Stage 2 earthworks area be utilised as the Haul Road/access for subsequent stages.

4.3.2.1. Stage 2 Truck Movements

Within Stage 1 bulk earthworks and associated pavement construction the following truck movements are anticipated:

OPERATION	Large Truck & Trailer (assumed 16m³ per Load) Movements	Standard Truck & Trailer (assumed 14m³ per Load) Movements
Cut to Waste – Unsuitable Off Site	680	770
Cut to Waste – Clean Fill Off Site	544	622
Granular Pavement Importation	507	580
Total	1,732	1,978

Table 14: Stage 2 Bulk EW & Pavement Construction Truck Movements

Noting that it is anticipated that Stage 2 bulk earthworks will take 12 to 18months to complete with truck movements anticipated to be 27 Truck & Trailer Loads per day (refer to section 4.3.1.1 above)

4.3.3. Stage 3 Access

The Stage 3 Access will be via the extension Loca Road 11 (as noted above), with the culvert access completed within Stage 2, the Stage 3 works should be sufficiently separated from the existing development to function independently both in term of public access and security.

4.3.3.1. Stage 3 Truck Movements

Within Stage 1 bulk earthworks and associated pavement construction the following truck movements are anticipated:

OPERATION	Large Truck & Trailer (assumed 16m³ per Load) Movements	Standard Truck & Trailer (assumed 14m³ per Load) Movements
Cut to Waste – Unsuitable Off Site	273	312
Cut to Waste – Clean Fill Off Site	943	1078
Granular Pavement Importation	73	83

Table 15: Stage 3 Bulk EW & Pavement Construction Truck Movements

Noting that it is anticipated that Stage 3 bulk earthworks will take 12months to complete with truck movements anticipated to be 27 Truck & Trailer Loads per day (refer to section 4.3.1.1 above)

4.3.4. Stage 4 Access

The Stage 3 Access will be via the extension Loca Road 13 (as noted above), with the culvert access completed within Stage 2, the Stage 4 works should be sufficiently separated from the existing development to function independently both in term of public access and security.

4.3.4.1. Stage 4 Truck Movements

Within Stage 1 bulk earthworks and associated pavement construction the following truck movements are anticipated:

OPERATION	Large Truck & Trailer (assumed 16m³ per Load) Movements	Standard Truck & Trailer (assumed 14m³ per Load) Movements
Cut to Waste – Unsuitable Off Site	172	197
Cut to Waste – Clean Fill Off Site	751	858
Granular Pavement Importation	82	94

Table 16: Stage 4 Bulk EW & Pavement Construction Truck Movements

Noting that it is anticipated that Stage 4 bulk earthworks will take 12months to complete with truck movements anticipated to be 27 Truck & Trailer Loads per day (refer to section 4.3.1.1 above)

4.4. Working Hours

All construction activities will adhere strictly to the approved consent hours of work generally set at 7.30 a.m. to 6.00 p.m. Monday to Friday, and 8.30 a.m. to 4:30 p.m. Saturday. No work will occur Sundays or public holidays.

4.5. Complaints

Complaints will be addressed first-hand by the site construction manager and proactively followed up on. There will be a complaint register record for detailing the investigation and response. The key contact personnel will be available at site entrances for the public to contact in case of emergency or complaint lodgement.

4.6. Vibration Control

The effects of vibration during construction are expected to have less than minor effects on any surrounding receiver and will be reasonable in terms s16 of the Resource Management Act.

Some of the mitigation methods for vibration control are:

- Residents will be advised prior to construction activities being undertaken near their buildings.
- The lightest practicable model of vibration inducting plant shall be used within 30m of any dwellings.
- Compaction shall be performed using the lightest practical compaction equipment with the highest practicable vibration frequency to achieve specified compaction.
- Excavator operators shall avoid banging buckets on the ground and workers will be advised on minimising vibration.

4.7. Noise Control

Modern plants and equipment are all fitted with exhaust mufflers and soundproofing that are designed to reduce plant noise and have been manufactured to meet international standards. All items of plant are subject to periodic maintenance checks to ensure they can be operated safely and as intended. If complaints are received, they will be taken seriously, and every effort made to minimise disturbance e.g., continue work in that area at a time that might be more amenable to the complainant(s). Any noise complaints will be followed up with the complainant and will also be discussed at project site meetings. They will also become subject matter at the weekly site toolbox meetings.

If it noise levels are at allowable limits, then an alternative methodology may need to be deployed. The implementation of additional options will be undertaken in consultation with the regulatory authorities, Principal, and Engineer, including, if required and instructed, engaging a noise monitoring specialist to measure and report on-site construction activity to ensure compliance with NZS6803 (NZ Standard for Acoustics – Construction Noise).

4.8. Weed Management

The protocols outlined in the Waikato Regional Council factsheet will be used to minimise the adverse effects on biosecurity.

4.9. Sediment Control

Throughout the duration of the earthworks, these sediment control measures will be consistently maintained and closely monitored to ensure they function as required. Removal of silt control measures will only be considered once the site is deemed to be stable in terms of silt runoff, to be agreed by the Waikato Regional Council Representative and the Site Engineer.

The following silt and sediment control protection measures are being proposed:

4.9.1. Stabilized Site Entrances

The contractor shall ensure that all entrances to the site are constructed upon establishment or prior to any intended use. Entrances shall be an area of stabilised and well compacted aggregate constructed and maintained for heavy vehicle use. These entrances shall be constructed in accordance with the agreed, proposed (as per C240 Erosion & Sediment Control drawings), and WRC's TR2009/02 guidelines, an example of which can be found within the appended standard details.

4.9.2. Dust Control

To avoid nuisance dust emissions, the following preventive measures shall be implemented:

- Dampening down of potential dust generation areas with a water truck;
- Mulching and grassing stockpiles and built levels where or when practicable;
- Chemical dust suppressants, used as per manufacturer recommendations as a method of sealing problematic or largely unfinished areas, if the previously mentioned methods fail to mitigate the dust appropriately.
- Ensuring that surfaces are constructed to their final design requirement and are stabilised as quickly as practicable; and
- Controlling reduced vehicle speeds.

Wind conditions will be monitored to assist in daily planning of works to minimise the potential for excessive dust generation.

The water supply required for dust suppression has been calculated with by applying the WRC 5mm/m²/day (or 50m³ per Hectare per day) guidelines. It has been assessed that a 100m³ onsite storage and/or take from the existing well would be sufficient to supplement the existing council supply located on Benson Road, approximately 1.2km to the south of the site. A water take consent has been applied for to accommodate this requirement. Refer to table X below for more detail

STAGE	AREA		WATER REQUIREMENTS (m^3/day)	LOCATE COUNCIL CONNECTION - m^3/day	ONSITE STORAGE
	HA	m^2	5mm/m^2/day	(2 x 10,000L per hour)	Min Requirement
1A	2.6179	26179	130.895	160	-29.105
1B	2.4541	24541	122.705	160	-37.295
1C	1.4491	14491	72.455	160	-87.545
1D	2.2219	22219	111.095	160	-48.905
1E	0.2174	2174	10.87	160	-149.13
STAGE 1 SUBSTAGES					
1A / 1C	4.067	40670	203.35	160	43.35
1B/1D/1E	4.8934	48934	244.67	160	84.67
1A/1B/1C/1D/1E	8.9604	89604	448.02	160	288.02

Table 16: Stage 1 Dust Suppression Water Calculations

Noting that it is anticipated that construction methodology will limit the exposed area to only either 1A/1C catchments or 1B/1D/1E catchments (refer to the ESC plans for catchment naming) as such 100m³ has been adopted for the water take consent.

STAGE	AREA		WATER REQUIREMENTS (m^3/day)	LOCATE COUNCIL CONNECTION - m^3/day	ONSITE STORAGE
	HA	m^2	5mm/m^2/day	(2 x 10,000L per hour)	Min Requirement
2A	2.576	25760	128.8	160	-31.2
2B	3.3499	33499	167.495	160	7.495
2C	0.5966	5966	29.83	160	-130.17
2D	0.0792	792	3.96	160	-156.04
STAGE 1 SUBSTAGES					
2A/2D	3.1726	31726	158.63	160	-1.37
2B/2C	3.4291	34291	171.455	160	11.455
2A/2B/2C/2D	6.6017	66017	330.085	160	170.085

Table 17: Stage 2 Dust Suppression Water Calculations

Noting that it is anticipated that construction methodology will limit the exposed area to only either 2A/2D catchments or 2B/2C catchments (refer to the ESC plans for catchment naming) as such 100m³ has been adopted for the water take consent above in stage 1 will be sufficient and/or a council main will be extended by this time such that a council connection could be sought to supply water for dust suppression.

	AREA		WATER REQUIREMENTS (m^3/day)	LOCATE COUNCIL CONNECTION - m^3/day	ONSITE STORAGE
STAGE	HA	m^2	5mm/m^2/day	(2 x 10,000L per hour)	Min Requirement
3	2.2041	22041	110.205	160	-49.795
4	1.36	13600	68	160	-92

Table 18: Stage3 & 4 Dust Suppression Water Calculations

Noting that it is anticipated that construction methodology will limit the exposed area to only either 3 catchments or 4 catchments (refer to the ESC plans for catchment naming) as such 100m³ has been adopted for the water take consent above in stage 1 will be sufficient and/or a council main will be extended by this time such that a council connection could be sought to supply water for dust suppression.

4.9.3. Cut-off Drains/Bunds

Compacted earth bunds will be placed along the top of batter slopes to divert "clean" runoff away from the earthwork area. Compacted earth bunds placed at the bottom of the cut batter slopes to divert generated "dirty" runoff to the nearest local Decant Earth Bund (DEB) / Sediment Retention Pond (SRP). Cut-off drains shall be formed at the bottom of shallow batters where bunding alone will not likely contain expected flows. The purpose of the bund/drain is to prevent any surface water flowing over the newly formed batter faces, into stabilised areas of the site, and to divert flows around the site perimeter to the nearest low point where a DEB / SRP is to be located, if required.

4.9.4. Decanting Earth Bunds/Sediment Retention Ponds

Site run-off will be directed by cut-off drains and bunds to the natural low point within each bund's catchment area prior to discharge onto existing stabilised ground. The locations proposed shall be verified and agreed onsite during a pre-construction meeting and as-builts of decant bund's size/location shall be provided to the Compliance Officer, if required.

Decanting earth bunds (DEB) will serve as the primary treatment for the works. DEBs will be sized by volume to 2-3% of the catchment area as per appended calculations. The details of the DEBs recommended layout can be found online via Waikato Region Council Erosion & Sediment Control Guidelines for Soil Disturbing Activities (TR-0902), or other equivalent guidelines, such as Auckland Council GD05 guideline and appended standard details. Where possible, a DEB & SRP will be constructed with a length to width ratio between 3:1 – 5:1, however this may be constrained by site space limitations. Typically, the outlet structure of these DEBs & SRPs will comprise of a floating T-Bar dewatering device (decanting arm with anti-seep collar, as shown in standard details within engineering plans) which discharges to stabilised ground. Where possible, the discharge end of the pipe will be perforated to disperse flows past the working area to stabilised or undisturbed ground.

If chemical treatment is required, the decant bar shall be lifted above the expected storage volume to enable treatment to take place, before being lowered post storm event treatment whereby the storage volume is discharged.

4.9.5. Chemical Treatment

To improve water quality treatment within sediment control devices throughout the construction phase, the use of chemical flocculants is strongly recommended for all DEBs and SRPs.

The method of treatment is variable and dependant on ground conditions and catchment area, this will be confirmed onsite during establishment works and bench testing.

It is proposed that an approved flocculation method will be implemented; the available methods can be found outlined in Table 19:

Flocculation Method	Time Frame	Treatment Area
Floc Blocks for DEBs	Short and Long Term	Up to 5,000 m^2
Batch Dosing for DEB's & SRPs	Short Term	Up to 50,000 m^2
Continuous Dosing of DEBs & SRPs	Long Term	Up to 50,000 m^2

Table 19: Proposed Flocculation Method

Once the DEB & SRP have been flocculated the water quality will be assessed by either measuring the suspended sediment or checking clarity. If the water quality is acceptable the DEB or SRP is emptied by unblocking the outlet, and earthworks within its catchment can continue accordingly.

In cases where a pump is required to empty treated water from the DEB and SRP due to differences in ground level, the installation of a manhole is necessary. The pump is exclusively permitted to extract water from the manhole structure. The discharged water from the pump will then be directed towards a grass swale to further refine the water quality by removing any potential suspended solids captured during the pumping operation.

4.9.6. Silt Fences

Silt fences will be installed as a treatment measure where sheet flows are considered likely. Such as the toe of fill embankments, where it is not practical to divert flows to a DEB. Alternatively, they may be used in locations where newly generated sheet flows from stabilised areas may concentrate and result in scour of existing natural ground, in this situation a silt fence will impede and aid in mitigating excessive flow velocity.

4.9.7. Wellpoint Dewatering Devices

Prior to and during earthworks in areas with high groundwater levels, wellpoint dewatering devices will be employed. The purpose of these devices is to ensure the stability and safety of excavation faces by lowering the water table. This not only ensures safety but also expedites the construction process. However, it is important to note that the extracted water might contain suspended solids, which could be detrimental to the receiving environment. To mitigate this, the water will first be directed to DEB or SRP for treatment. Once treated, the water will be discharged into the existing stormwater channel.

4.9.8. Topsoil Management

Efficient topsoil management is a core component of this project's environmental strategy. The topsoil will be removed from each earthwork area and stockpiled for later use. Any surplus topsoil, forecasted to exceed project requirements, will undergo screening to make it available for sale to the wider public.

To address sediment and erosion control at the stockpile location, preventative measures will be employed. This includes the use of mulching and grass seeding to facilitate the establishment of grass cover on the topsoil stockpile. These practices help maintain the integrity of the topsoil stockpile, prevent soil erosion, and ensure minimal topsoil loss throughout the project.

Soil rehabilitation will be implemented in landscaping areas as required to reverse compaction effects and to improve near surface soakage prior to placement of topsoil and planting.

4.9.9. Sediment Control Performance Monitoring & Maintenance

All sediment control measures will be checked regularly, to ensure that they are performing as intended by design. The site Construction Manager in conjunction with the Project Engineer will be responsible for actively monitoring installed erosion and sediment control devices. Periodic audits will be undertaken and tabled at regular progress meetings.

A site walk over shall be undertaken weekly 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 required. 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.

Stabilised Vehicle Entrance

- Maintain the Stabilised Vehicle 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 Vehicle Entrance and clean out as necessary.

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.

Decant Earth Bunds/Sediment Retention Ponds

- Inspect after every rainfall event to confirm water clarity or organise sediment testing.
- Release stored flows if/when required to ensure that the DEB capacity is maintained prior to any future rain event.
- Muck out and remove collected sediment whenever 1/3 of the dead storage is reached, or bi-monthly, as required.

Chemical Treatment

- Inspect stored chemical volumes after every rainfall event and during periods of prolonged rainfall.
- Refill or repair any systems immediately if required to ensure that the design capacity is maintained.

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 50% of the fabric height.
- Any areas of collapse, decomposition or ineffectiveness need to be immediately replaced.

- Remove sediment deposits as necessary to ensure adequate sediment storage and reduce pressure on the Silt Fence. Remove accumulated sediment from the area to an appropriate secure location.
- Do not remove Silt Fence materials and sediment deposition until the catchment area has been appropriately stabilised.

Sediment control and other environmental issues, health and safety matters, and construction-related Resource Consent condition compliance requirements will be integrated into fortnightly on-site client/engineer/contractor progress meetings as a proactive construction management tool. These meeting discussions are recorded with decisions and agreed courses of action to be followed up on.

4.10. Fill Compaction

Each layer of material shall be compacted by approved compacting machinery throughout the whole area and depth to achieve the specification listed below or as specified by a qualified Geotechnical Engineer.

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%
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 meters	Average value less than 8% (any 10 tests) Maximum single value 10%	Average value not less than 170 KPa minimum single value 140 KPa
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 75 KPa

Table 20: Fill Compaction Requirements by Soil Types

4.11. Traffic Management

A comprehensive Traffic Management Plan (TMP) will be required from the contractor to be submitted and approved by NZTA prior to the commencement of works. The TMP will address all construction-related vehicle movements, with particular attention to minimising disruption to surrounding residents and maintaining safe traffic operations.

Key measures include:

- Designated Access Points: Entry and exit to the construction site shall occur via the existing farm entrance and/or the newly constructed 2025 Ōhaupō Road (SH3) roundabout western access leg.

- Any 2025 Ōhaupō Road (SH3) temporary traffic diversions shall be approved by NZTA
- Vehicle Control Measures: Construction accessways will be controlled with security gates with entry restricted to authorised vehicles.
- Dust and Debris Management: Receiving road network will need to be monitored for debris being carried into the local roading network. Vehicle wheel wash facilities maybe required at exits to prevent debris onto public roads.
- Traffic Safety: All traffic management measures will comply with Waka Kotahi (NZTA) Code of Practice for Temporary Traffic Management (CoPTTM) requirements.
- Public Notification: Residents along haul routes will be notified in advance of any significant truck movements or temporary road works. A letter drop will be undertaken by the nominated contractor prior to construction works commencing.

Temporary traffic signage, traffic controllers, and restricted construction hours may be employed during peak traffic periods to further minimise disruption.

4.12. Community and Stakeholder Engagement

The following are to be implemented:

- Pre-Construction letter drop will inform residents and businesses of the construction schedule, accessways, and key project contacts.
- Complaints Register: A designated Site Liaison Officer will be appointed to manage complaints and queries. Contact information will be displayed at all site entrances.
- Response Protocol: Complaints will be acknowledged within 24 hours and notified to the local authority (WDC) with a follow-up and action plan provided within 72 hours.

Maintaining positive relationships with locals is a priority to ensure the project proceeds with minimal disruption and community support.

5. Construction Methodology and Sequence of Works

As highlighted in the previous section, the earthworks operations at the Harlow LRV Development will be categorized into five (5) sections. These sections have been segregated based on the stages of development.

To provide comprehensive guidance for the earthwork activities within this domain, an overarching earthwork principle has been formulated. This principle serves as a unifying framework, guiding the execution of earthworks across these sections. Summarized below are the key principles of earthworks for this area:

i. Establish Temporary Stormwater Diversion:

ii. Sediment and Erosion Control Establishment:

iii. Minimize the Earthworks Area:

iv. Stabilize Earthworks:

Earthwork's methodology is dynamic and adapted to suit the local environment, ensuring that each earthwork area within these sections have specific construction methodology based on the principles mentioned above, which are essential to protect the sensitive receiving environment.

The construction methodology for each respective work section is detailed below.

5.1. Artificial Stormwater Wetlands Construction Methodology & Sequence of Works

5.1.1. Artificial SW Wetland A

The earthwork plan for SW Wetland A has been devised to occur in Stage 1 (Earthworks Stage). The construction methodology for this area is as follows:

Artificial SW Wetland A:

- Establish erosion and sediment control
- Carry out earthworks within stage 1 (earthworks stage), including all retaining structures associated with the proposed SW Wetlands
- Construct Geosynthetic Lined (GSL) SW Wetland A
    - Noting that Wetland A is majority constructed within engineered fill and as such groundwater and/or uplift forces on the proposed Wetland Linear will be negatable.
    - Temporary flow control devices will be required to control Wetland water levels while plants are established (such as a Floating Decant arm that can be raised/lowered as per a SRP outlet – care to be taken not to the GSL)

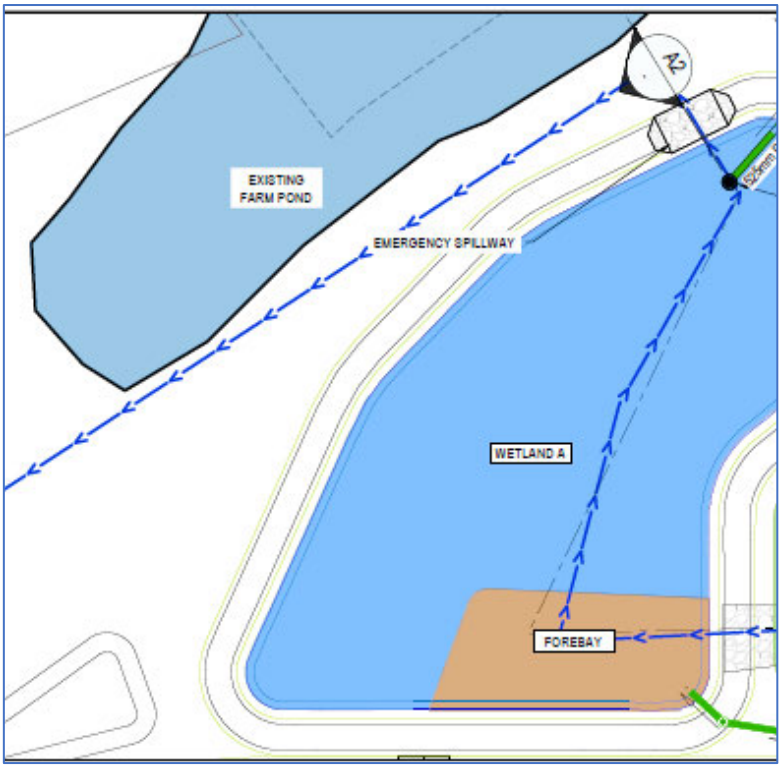


Figure 5: SW Wetland A

5.1.2. Artificial SW Wetland B

The earthwork plan for SW Wetland B has been devised to occur in Stage 2 (Earthworks Stage). The construction methodology for this area is as follows:

Artificial SW Wetland B:

- Establish erosion and sediment control
- Carry out earthworks within stage 2 (earthworks stage), including all retaining structures associated with the proposed SW Wetlands

- Construct Unlined SW Wetland B
    - Noting that Wetland B is majority in Insitu cut, and as such groundwater and/or dewatering maybe required in the construction of the Wetland
    - Temporary flow control devices will be required to control Wetland water levels while plants are established (such as a Floating Decant arm that can be raised/lowered as per a SRP outlet)
    - Noting connectivity to existing farm drain will be required and associated ESC as per a culvert installation will apply.

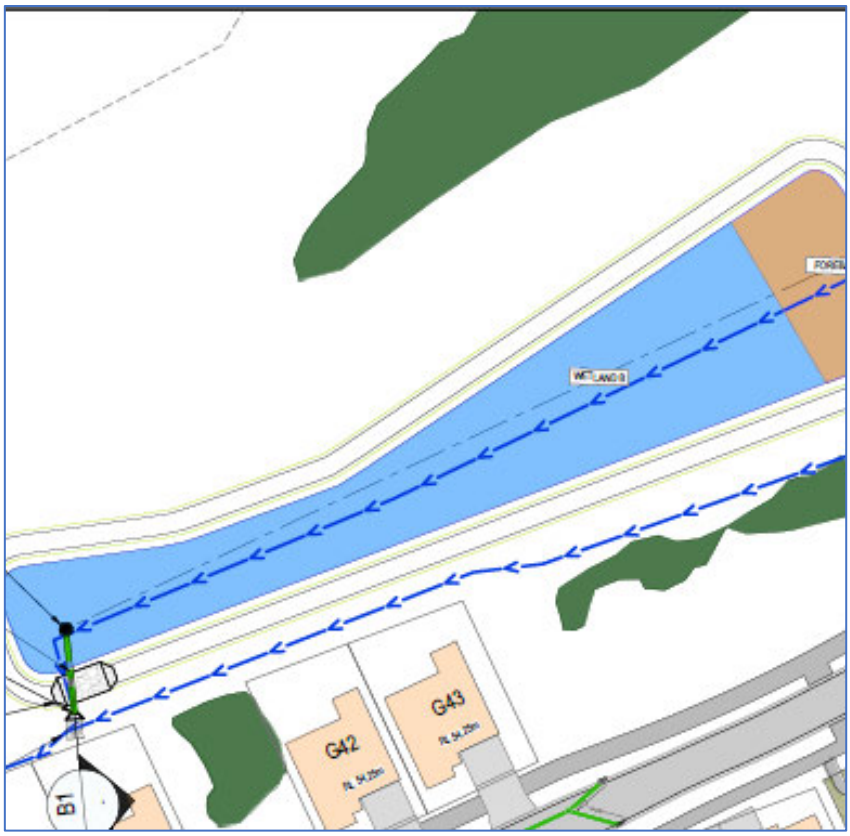


Figure 6: SW Wetland B

5.1.3. Artificial SW Wetland C

The earthwork plan for SW Wetland C has been devised to occur in Stage 2 (Earthworks Stage). The construction methodology for this area is as follows:

Artificial SW Wetland C:

- Establish erosion and sediment control
- Carry out earthworks within stage 2 (earthworks stage), including all retaining structures associated with the proposed SW Wetlands
- Construct Geosynthetic Lined (GSL) SW Wetland C
    - Noting that Wetland A is majority constructed within engineered fill and as such groundwater and/or uplift forces on the proposed Wetland Linear will be negatable.

- Temporary flow control devices will be required to control Wetland water levels while plants are established (such as a Floating Decant arm that can be raised/lowered as per a SRP outlet – care to be taken not to the GSL)

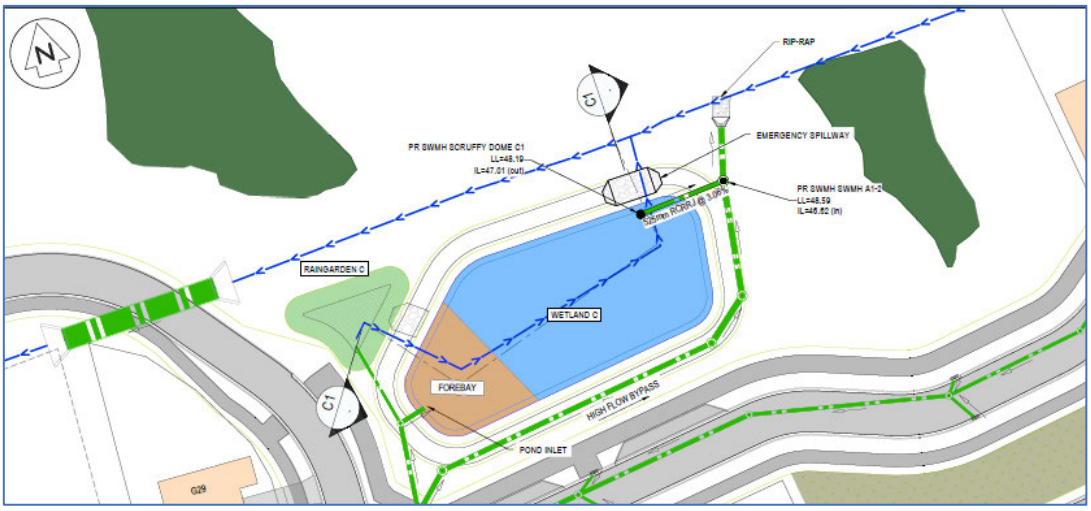


Figure 7: SW Wetland C

5.1.4. Artificial SW Wetland D

The earthwork plan for SW Wetland D has been devised to occur in Stage 4 (Earthworks Stage). The construction methodology for this area is as follows:

Artificial SW Wetland D:

- Establish erosion and sediment control
- Carry out earthworks within stage 4 (earthworks stage), including all retaining structures associated with the proposed SW Wetlands
- Construct Geosynthetic Lined (GSL) SW Wetland D
    - Noting that Wetland D is majority constructed within engineered fill and as such groundwater and/or uplift forces on the proposed Wetland Linear will be negatable.
    - Temporary flow control devices will be required to control Wetland water levels while plants are established (such as a Floating Decant arm that can be raised/lowered as per a SRP outlet – care to be taken not to the GSL)

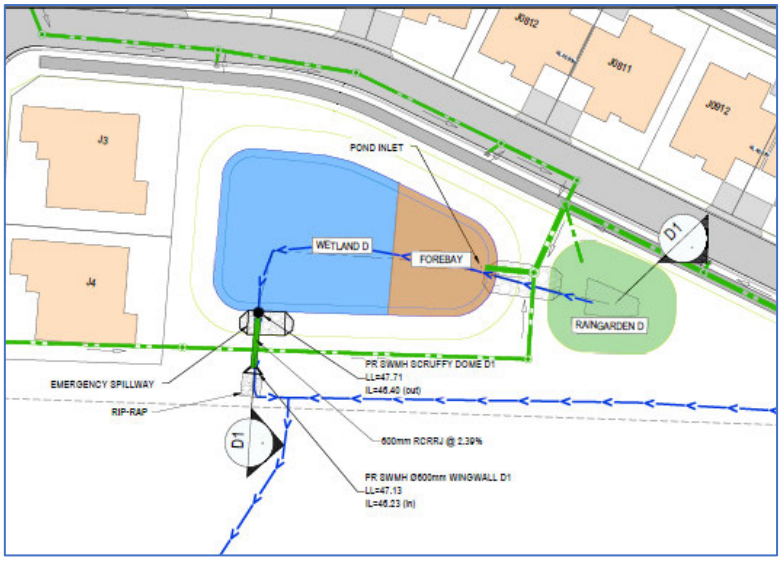


Figure 8: SW Wetland D

5.1.5. Artificial SW Wetland E

The earthwork plan for SW Wetland E has been devised to occur in Stage 3 (Earthworks Stage). The construction methodology for this area is as follows:

Artificial SW Wetland E:

- Establish erosion and sediment control
- Carry out earthworks within stage 3 (earthworks stage), including all retaining structures associated with the proposed SW Wetlands
- Construct Geosynthetic Lined (GSL) SW Wetland E
    - Noting that Wetland E is majority constructed within engineered fill and as such groundwater and/or uplift forces on the proposed Wetland Linear will be negatable.
    - Temporary flow control devices will be required to control Wetland water levels while plants are established (such as a Floating Decant arm that can be raised/lowered as per a SRP outlet – care to be taken not to the GSL)

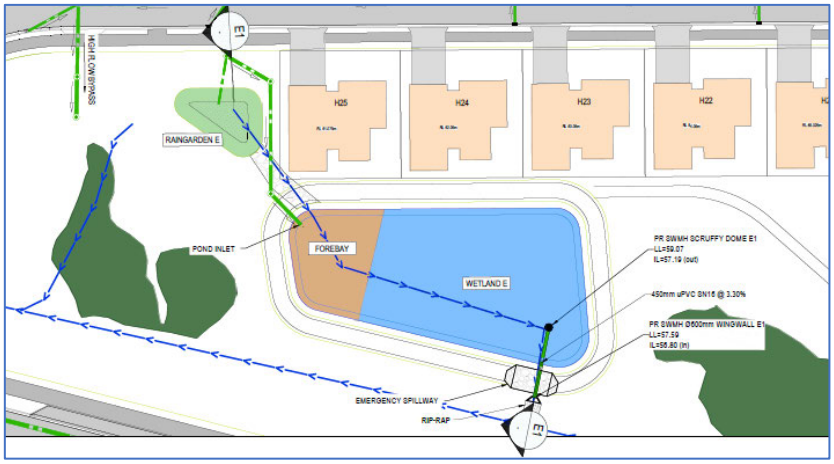


Figure 9: SW Wetland E

5.2. Wastewater Pumpstation Construction Methodology & Sequence of Works

5.2.1. Wastewater Pumpstation A

The earthwork plan for WW pumpstation A has been devised to occur in Stage 1 (Earthworks Stage). The construction methodology for this area is as follows:

Wastewater Pumpstation A (WWPS A):

- Establish erosion and sediment control
- Carry out earthworks within stage 1 (earthworks stage)
- Construct WW Pumpstation A
    - Noting that WWPS A is majority constructed within engineered fill and as such excavation into Insitu ground has been assessed by WGA to not encounter groundwater as part of the WWPS A installation,
        - therefore, dewatering for this WWPS A is not anticipated (refer to WGA Groundwater Effect report)

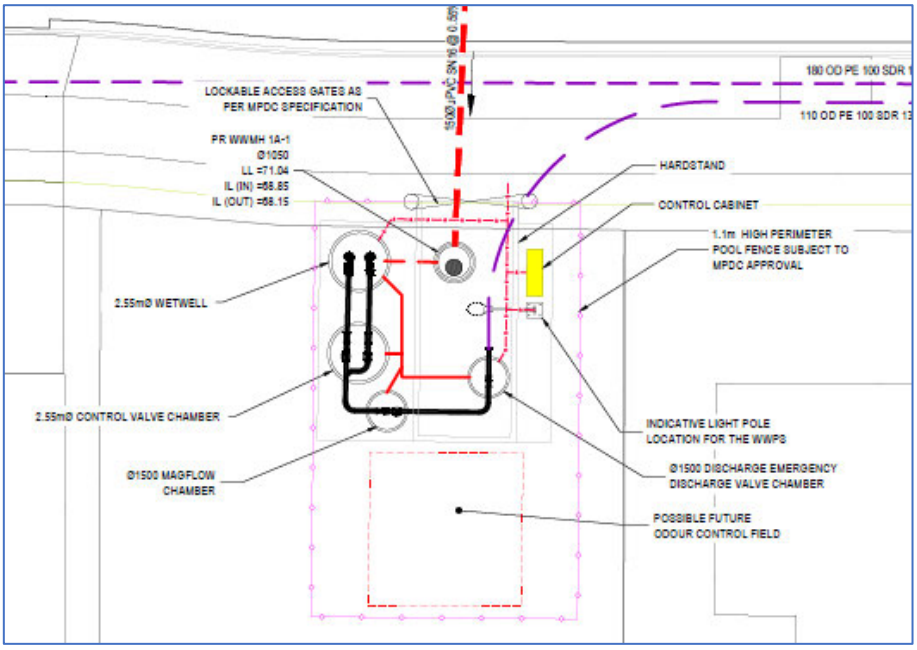


Figure 10: WW Pumpstation A

5.2.2. Wastewater Pumpstation B

The earthwork plan for WW pumpstation B has been devised to occur in Stage 2 (Earthworks Stage). The construction methodology for this area is as follows:

Wastewater Pumpstation B (WWPS B):

- Establish erosion and sediment control
- Carry out earthworks within stage 1 (earthworks stage)
- Construct WW Pumpstation B
    - Noting that WWPS B is majority constructed within Insitu cut, and as such groundwater is expected to be encountered as part of the WWPS B construction.

- therefore, dewatering for this WWPS B is anticipated to be required (refer to WGA Groundwater Effect report)

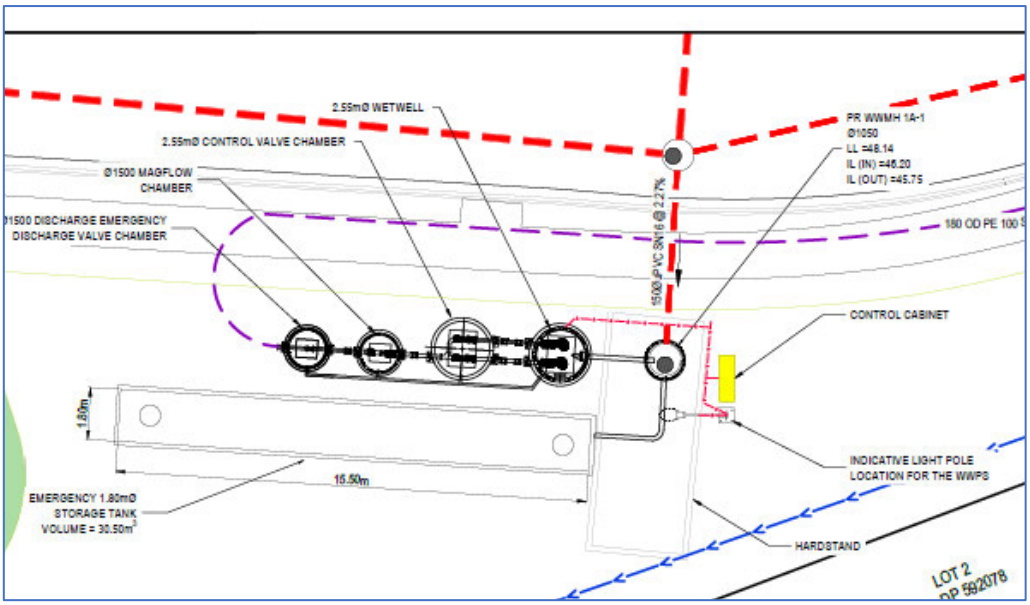


Figure 11: WW Pumpstation B

6. Conclusion

The proposed construction management plan has been designed to facilitate the required infrastructure for the Harlow LRV Development.

Careful consideration is given to mitigate possible impacts of the proposed development to the receiving environment through implementation of accepted engineering practices.

6.1. Post Construction Monitoring and Maintenance

Following completion of bulk earthworks and infrastructure works, ongoing monitoring and maintenance will be undertaken to ensure compliance with consent conditions and environmental conditions. This period will coincide with the Defects Liability Period.

Activities include:

- Erosion and Sediment Control Decommissioning: Progressive removal of sediment control devices once full site stabilisation is achieved, subject to approval by WRC at indicated hold points i.e. waiting for stabilisation 80% grass strike coverage on grassed topsoil.
- Vegetation Establishment: Monitoring of grass and landscape planting success, with remedial planting undertaken as necessary.
- Defect Liability Period Inspections: Periodic site inspections will be undertaken during the defect liability period to address erosion, sedimentation, or settlement issues.
- Final Certification: A completion report, including 'as-built' plans and compliance certificates, will be submitted to WDC as part of the 224c process.

The above will ensure that long-term environmental and infrastructure outcomes are maintained beyond construction.

Appendix A –Earthworks Drawings