169-171 PEKA PEKA ROAD, WAIKANAE

WAIKANAE NORTH DEVELOPMENTS LTD (WNDL)

ENGINEERING & INFRASTRUCTURE REPORT

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This report has been prepared to meet the requirements for a specific site and event and to support an application for consents under the Fast Track Approvals Act 2024.

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GLOSSARY

LDA08	Land Drainage Act 1908
NZS 4404:2010	Code of practice for Land Development and Subdivision Infrastructure
NZS 4431:2022	Code of Practice for Earthfill for Residential Development
LDMR22	Kāpiti Coast District Council Land Development Minimum Requirements 2022
SNZ PAS 4509:2008	New Zealand Fire Service Firefighting Water Supplies Code of Practice

1.0 EXECUTIVE SUMMARY

This Engineering & Infrastructure Report supports an application for consents under the Fast-track Approvals Act 2024 (FTAA) for a proposed development at 169-171 Peka Peka Road, Waikanae, by Waikanae North Developments Ltd (WNDL).

The proposal comprises approximately 1,200 residential lots delivered in stages, along with a mixed-use local centre, open space networks, and supporting infrastructure. The development applies a water-sensitive urban design approach and integrates wetland protection, high-quality landscaping, and ecological restoration. It is intended to establish a benchmark community within the Kāpiti Coast District.

This Engineering & Infrastructure Report confirms:

- Water supply will be delivered via staged reticulated connections to the Kāpiti Coast District Council (KCDC) public network, supported by council-led modelling and phased infrastructure agreements. The small 7-lot area serviced from Paetawa Road will not be connected to a reticulated system and will have roof water collection;
- Wastewater will be managed via a gravity system with two on-site pump stations discharging to the KCDC network, with capacity confirmed through modelling and liaison with KCDC. The small 7-lot area serviced from Paetawa Road will have on-site treatment and disposal systems;
- Stormwater will be managed through a catchment-based approach incorporating storage, swales, bioretention devices, soakage, and integrated wetland areas, as described in the Stormwater Management Plan, prepared by Landlink;
- Site flood management has been assessed using detailed modelling assessment led by AWA Consultants and the outcome of that assessment has determined minimum site development levels to achieve required protection from flooding and minimum flood storage/flow management requirements to avoid increased flooding on upstream and downstream neighbours;
- Extensive earthworks will be carried out to create the surface suitable for development, free from flood risk, meeting the KCDC requirements for road grades etc and delivering the urban design outcomes sought. The earthworks will be staged and targeted to address necessary peat removal, hazard resilience, and erosion control, with methods guided by geotechnical recommendations, NZ standards and GWRC guidelines;
- The infrastructure strategy is coordinated with the site's ecological and natural constraints, and developed in alignment with supporting reports covering stormwater, geotechnics, and transport and the bulk infrastructure connectivity to the site will be implemented in coordination with KCDC.

Ongoing collaboration with Kāpiti Coast District Council has included technical engagement on all three waters servicing matters, and a formal letter of support is provided (attached in Appendix 1) confirming this coordinated approach.

Expert Witness Code of Conduct

This report has been prepared by Ray OCallaghan and Joseph Harris. Ray O'Callaghan holds a BE (Civil) & Dip Hydraulics (Delft) and is a Chartered Professional Engineer and a Fellow of Engineering New Zealand. Joseph Harris holds a BE (Hons), Civil Engineering and is a practicing civil engineer. Both are experienced in civil engineering, 3-waters and land development *infrastructure. Both confirm that they have read and agree to comply with the Code of Conduct for Expert Witnesses set out in the Environment Court Practice Note 2023. This report has been prepared in accordance with that Code. The opinions expressed are within the area of expertise, of both authors and both authors confirm that they have not omitted to consider material facts known to them that might alter or detract from the opinions and statements set out in this report. Both authors confirm that, to the best of their knowledge, they are not subject to any conflict of interest in providing this assessment.*

2.0 INTRODUCTION

2.1 Purpose of Report

This report outlines the engineering, infrastructure and servicing strategy for a proposed master-planned development at 169-171 Peka Peka Road, and 105 Paetawa Road Waikanae, to support an application for resource consents under the Fast-track Approvals Act 2024. It outlines the three waters, transport, earthworks, utilities, associated structures and compliance frameworks necessary to enable the staged subdivision and urban development on the site to progress.

2.2 Background and Context

The site has been comprehensively master-planned for residential use, with a supporting commercial hub and extensive green space integration.

The proposed layout of development within the site is shown in Figure 1 below to give some context to engineering matters.

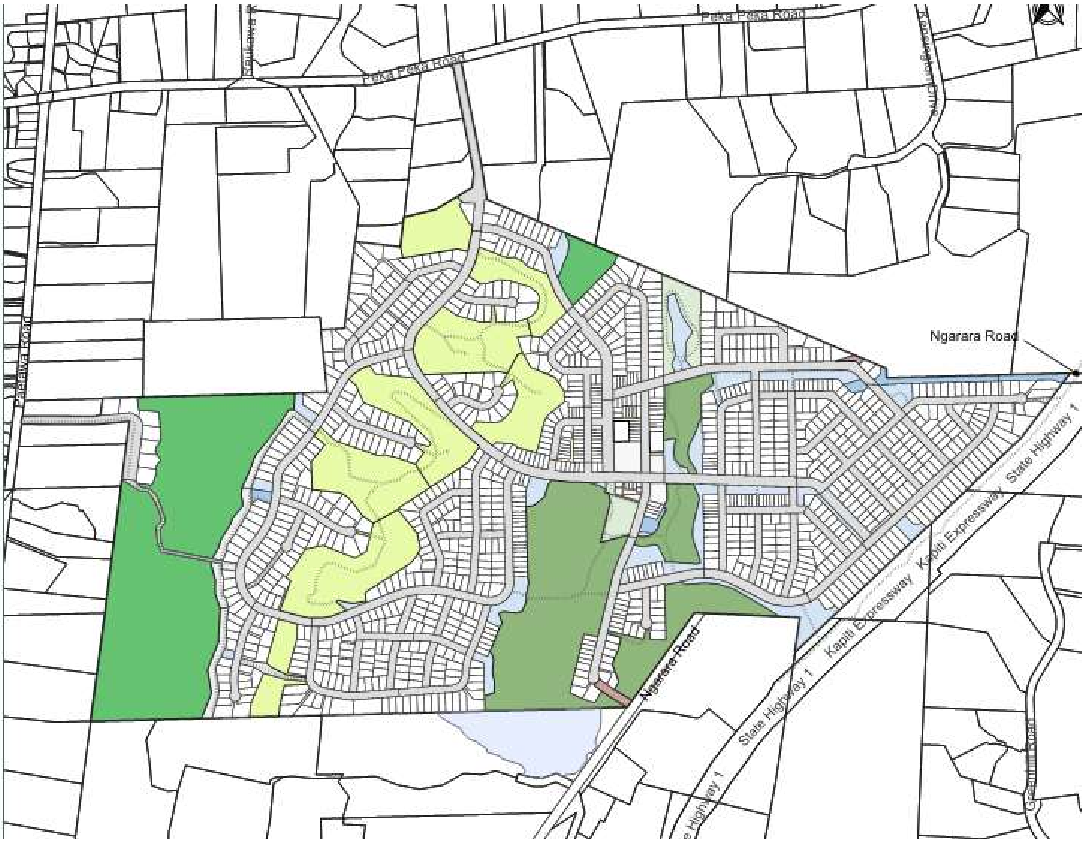


Figure 1 Development Concept

Key characteristics:

- Proposed yield: Approx. 1,200 residential lots, supported by a local centre and public open space.
- Topography: Predominantly flat to gently undulating, with coastal dune landforms in the west.
- Water features: Multiple wetland areas and drainage channels exist on the site. Some of these will be deleted, some will be modified, some protected, some restored and some

new wetlands will be created, and these combined features will be integrated with stormwater functions. The Te Harakeke Swamp is a notable wetland feature in the western part of the site. Ngarara Stream enters the site at the north-eastern corner then runs through the middle of the site and exits to the south. Ngarara Stream has been modified by farming operations over several decades, presumably to assist drainage of the site for farming purposes.

- Other features: A section of the main North Island DC power network crosses the site, from the southern boundary to the northern boundary and includes several power pylons located within the site. Appropriate setbacks have been incorporated into the project layout.
- Access: Access to the main development will be via Peka Peka Road, with potential future connections to eastern and western road corridors provided for, enabling future connections into the site. The small 7-lot part of the development in the western corner will be accessed from Paetawa Road.

The development strategy has been informed by technical input across urban design, infrastructure, flood management, ecology, and geotechnical disciplines and a collaborative engagement with Kāpiti Coast District Council, including review of capacity modelling and bulk servicing options.

3.0 TECHNICAL REPORTS AND INTERDEPENDENCIES

This Engineering & Infrastructure Report is supported by a suite of technical assessments that collectively inform the design and implementation of servicing, earthworks, transport, and environmental mitigation. These reports demonstrate integration across engineering, urban design, planning, and environmental disciplines.

The following technical reports inform this report:

- Urban Design Masterplan (Local, McIndoe Urban and Urbacity): Establishes the neighbourhood layout, street hierarchy, lot density, and integration of the local centre and green spaces;
- Stormwater Impact Assessment (AWA Environmental): Provides site-wide hydraulic modelling, including downstream effects and integration with the wider district stormwater model. This assessment has established minimum development levels in the lower areas of the site that provide appropriate flood protection;
- Hydrological Report (OCDL): Sets out an assessment of hydrological issues associated with the site and the proposed development to inform expected groundwater impacts, stormwater neutrality and inter-connectivity of surface water levels, groundwater levels, wetland soil moisture and flood ponding influences on these;
- Stormwater Management Plan (Landlink): Sets out the proposed stormwater management strategy by catchment, including primary and secondary flow management, treatment, and attenuation;
- Geotechnical Assessment (CGW): Assesses peat depth, liquefaction risk, foundation design parameters, and slope stability to inform the earthworks and land development strategy;
- Wastewater Development Impact Assessment (HAL): Previous models of wastewater flow from the site confirms proposed pump stations and rising main can be aligned with downstream network capacity;

- Water Supply Assessment (Stantec): Provides demand calculations and confirms that the proposed staging can be serviced by the existing KCDC network, subject to coordination and upgrade triggers;
- Ecological and Wetland Assessment (RMA Ecology): Identifies wetlands for retention, integrates with proposed earthworks, flood assessment and hydrological assessment to maximise wetland enhancement, sets recommended buffer widths, and outlines restoration opportunities consistent with the masterplan;
- Erosion and Sediment Control & Construction Management Plan (Landlink): Details the erosion and sediment control methodology, sequencing of works, access arrangements, and strategies to manage environmental effects during construction;
- Landscape and Visual Assessment (Local): Identifies key landform features and visibility considerations, informing the landscape integration and protection of open space character;
- Integrated Transport Assessment (Stantec): Assesses the effects of development traffic on the surrounding transport network and confirms the performance of the proposed internal roading layout and connectivity.

Together, these reports confirm that the development is technically feasible, will meet appropriate technical standards, facilitate an appropriately staged development, and ensure the development is integrated with both the natural site features and existing infrastructure.

<u>Council Coordination Letters</u>

In addition to the above, consultation with Kāpiti Coast District Council confirms:

- That the water, wastewater, and stormwater strategies align with council's network modelling and longer-term network strategies;
- That sufficient downstream capacity exists or is planned to accommodate the proposal; and,
- That the proposed phasing and servicing solutions are supported in principle.

4.0 NATURAL HAZARDS

4.1 Hazards Overview

A range of natural hazards are present within the development site at 169-171 Peka Peka Road. These include geotechnical, hydrological, and seismic risks, which have been identified through a combination of district hazard mapping and site-specific investigations.

4.2 Seismic Hazards – Fault Trace

The site is located within a mapped inferred active fault trace area, as identified by the supporting Geotechnical Assessment based on work undertaken by GNS Science. The fault risk has been considered as part of the development layout and is addressed through site-specific design measures.

The Geotechnical Assessment prepared by CGW identified the nearby side splay as Figure 4 in their report and is shown in Figure 2 below:

Figure 4: Location of the Ohariu Fault and associated splay relative to the site.

Figure 2 Inferred Fault

The Geotechnical Assessment has concluded:

- No fault lines have been identified within the site that have an influence on site development, and
- the final subdivision layout and conditions provide an appropriate mitigation of potential seismic risk.

4.3 Geotechnical Hazards – Peat and Liquefaction

The site includes areas of peat and compressible soils, particularly in the central and eastern catchments. GWRC hazard mapping has identified a moderate liquefaction risk at a macro level.

Site specific geotechnical investigations have been carried out to confirm specific solutions to manage liquefaction risk on the site. The Geotechnical Assessment has concluded that liquefaction risk is best managed by removing the peat where it is within the development footprint and replacing it with engineered fill conforming with NZS4431. This recommendation has been incorporated into the proposed earthworks on the site, as discussed in Section 5: Earthworks. The Geotechnical Assessment has also considered the risk of lateral spreading and associated soil instability adjacent to the Ngarara Stream and potential instability adjacent to slope crests. The design solutions have responded to the assessment and ensure site stability is achieved, in accordance with the recommendations of the Geotechnical Assessment.

4.4 Hydrological Hazards – Ponding and Flood Storage

KCDC flood hazard mapping shows existing areas of the site are subject to localised ponding and flooding. The proposed development involves earthworks to address liquefaction risks, earthworks to raise parts of the site above flood ponding levels and the reconstruction of parts of the existing Ngarara Stream that runs through the site.

The proposed reshaping of the lower areas of the site, and the new stream channel through that area of the site has been the subject of detailed flood modelling by Awa Consulting, to determine flood water levels and hence required minimum building platform levels. The purpose of the modelling was two-fold: confirm appropriate development levels above estimated flood water level (including allowance for free board, allowance for vegetation bulk within the storage zone and potential effects of climate change) and assess the resulting potential effects on flood flows and flood levels on neighbouring property.

The hydraulic proposals include the construction of a downstream flow control structure to achieve a greater flood water ponding level within the site to compensate for the loss of flood storage resulting from some of the existing storage area being raised by mass earthworks fill to create the development area. The Awa modelling included this downstream flow control structure in the model.

The modelling of the pre-development and post-development scenarios estimates the pre-developed flood storage volume in a 2030 100-year design event (2030 1% AEP) is approximately 150,000m^3. The post-development storage volume within the site for the 2130 1%AEP is estimated to be approximately 180,000m^3. This estimate includes an allowance of 15% for loss of storage volume due to vegetation volume/bulk occurring when the proposed revegetated program is well established. The modelling to determine minimum site development levels included this allowance of 15% loss of storage volume for vegetation bulk.

The increased storage volume is achieved with the construction and operation of the proposed downstream flow control structure at the southern part of the development. The Awa modelling assessment has confirmed that the design solutions for stormwater and flood management for the development achieve greater flood storage to avoid increased flooding on upstream and downstream neighbours.

The results from the Awa modelling are described in the Awa Flood Hazard Assessment of Effects Report and are described in Section 7 of this report.

Stormwater runoff from the development within the site will be collected and managed with a variety of low-impact stormwater elements to achieve appropriate stormwater management outcomes and is described in the SMP, prepared by Landlink and summarised in Section 7 of this report.

A hydrological assessment of the site has been carried out by OCDL to link the surface stormwater runoff from the site, the macro catchment wide flooding effects and the expected effects on groundwater behaviour resulting from mass earthworks together. This assessment has assisted the ecological assessment of expected wetland performance and required wetland, stormwater and flood protection outcomes.

4.5 Summary

Natural hazards have been systematically assessed and addressed through the technical reports accompanying this application. The design and staging of development respond to these constraints, and mitigation measures are embedded within the earthworks, flood management, ecological mitigation and servicing strategies.

5.0 EARTHWORKS

Earthworks are required to establish suitable development platforms, manage peat soils, and enable construction of roading and infrastructure networks. The strategy for earthworks has been developed in coordination with urban design and landscape objectives, considering flood protection, geotechnical, ecological, landscape and stormwater constraints.

Key information driving the earthworks design and construction strategy is set out below to demonstrate the depth of analysis carried out for this project. This preliminary design process is essential for this site because the earthworks required to achieve the design outcomes are significant in both scale and potential impacts on hydrological elements. The earthworks will be staged over several years and involve significant peat removal and therefore require a robust construction methodology which is described in the Construction and Environment Management Plan (CEMP) prepared by Landlink and the sections below. Relevant layout and design information is shown in the development plans submitted with this application. These plans are also discussed in the sections below.

5.1 Existing Landform and Soils

The site exhibits a range of landform and soil conditions as described in the Geotechnical Report. In general, peat and silty soils are present across the central and eastern parts of the site. The peat will be removed from development areas, and replaced with structural fill material, to achieve a suitable building foundation for both houses and roads. The sandy and silty soils are suitable for structural fill. Earthworks cut material, including additional borrow cut material will be used to raise the developed site to the required levels and for replacing the excavated peat with compacted fill material. The quantity of the design earthworks cut material in the development is insufficient to raise the complete eastern development area to the required flood protection height and replacing the peat material. Additional fill material will be sourced from the borrow area at the northwestern corner of the site to achieve a cut/fill balance. The excavated material from the borrow site will be replaced with excavated and dried peat and shaped to re-create the dune form at the borrow area.

There are large areas of existing low-lying land within the eastern part of the site and several existing drainage channels cross this area. This area is prone to flooding in large rainfall events and is shown as a flood hazard area in the KCDC Hazard Maps. The Ngarara Stream that runs through the site has a large upstream catchment on the eastern side of the Kāpiti Expressway. The Ngarara Stream has long been modified as a “straight” channel running east to west for approximately 400m into the site, then a further 500m downstream turns through a 90-degree bend to the south and runs for approximately 700m as a straight channel to the southern boundary. The Stream is shown as the blue line in the 1948 aerial photograph below in Figure 3. A typical section of the Stream channel is also shown below:

Figure 3 – Ngarara Stream

The hydraulic capacity of the existing Ngarara Stream is limited in places, and this leads to surface water ponding on some areas of the site in large rainfall events. It is proposed to reconstruct this channel into a more natural stream channel, with curves and variable cross section to achieve better hydraulic control, a more natural character and improved habitat outcomes. This is discussed in more detail in the Hydrological Report, the Ecological Report and the Awa Flood Modelling Report.

Some of the existing smaller constructed drains across the eastern area of the site will be reconstructed as open channels, but in an alignment that fits with the proposed development pattern. Some sections of these constructed drains will be piped.

The western area of the site contains sandy loam and coastal dune landforms. Some areas are steep and require earthworks to create roads and development platforms/surfaces. The sandy loam and dune sands are suitable for use as structural fill. It is proposed to use additional cut material from this zone for raising the development areas in the eastern part of the site to achieve appropriate flood protection for the eastern development areas. There are a series of dune hilltops in the central/western parts of the site. The majority of these will be unaffected by earthwork activities and will remain in their existing natural state. The dune landform at the northwest corner, by the entrance to the site will be used as a borrow cut site to provide the complete fill volume required. This excavation zone will be backfilled with dried peat to recreate the dune landform at completion of the cut/fill operation.

As described in the Geotechnical Report, there is a layer of peat soil across most of the low-lying eastern area. This peat layer varies in thickness from 0.5 – 1.5m with a few pockets up to 2.5m thick. The top of the peat is typically 0.5 – 1m below the surface. This peat material will be removed within the development footprint so that suitable foundation conditions for houses and roads can be created. This will require the excavation and disposal of approximately 475,000m^3 of peat material. This will require replacement of the excavated peat material with suitable cut material from other parts of the site.

5.2 Proposed Earthworks - Overview

The construction of the proposed development on the existing landform requires significant earthworks to re-shape the existing surface to suit the proposed development layout. The earthworks solution must:

- incorporate the roading and housing layout;
- achieve appropriate heights above flood risk areas;
- achieve suitable gradients for roads and gravity infrastructure such as wastewater and stormwater drains;
- respect maximum stable cut batter slopes for the predominantly sandy soil;
- achieve the desired urban design goals (to the extent possible);
- respect key landscape constraints and sensitivities;
- achieving a general balance between earthworks cut and fill volumes (allowing for an additional 10% cut material for compaction of fill material);
- dealing with the removal (and replacement) of approximately 475,000m^3 of peat material;
- all within the constraints of achieving an economic and financially viable earthworks solution.

In practice this is achieved through an iterative design process, incorporating the various issues, amending the footprint and levels of the emerging development layout, refining road alignments and gradients and confirming where house sites are feasible and where they are not.

There have been several design iterations for this development, and the proposed design surface has been created with the use of 12D and associated design modelling software so that accurate information on levels, volumes, gradients, flood capacity, etc can be confirmed.

The earthworks design process has been based on a maximum stable batter slope of 1 vertical:3 horizontal for cut and fill batters in dune sand. This may be increased to 1V: 2.5H during detailed design in areas where there is a greater silt content in the silty sand cut and fill areas, with geotechnical input. In constrained areas (e.g. near boundaries or wetland buffers), 1:1.5 batters may be used where soils permit or where geotechnical fabric retaining solutions are incorporated. These areas will be subject to specific design, including geotextile reinforcement or engineered fill, and confirmed as suitable by a geotechnical professional.

5.3 Earthworks Volumes

The proposed cut and fill areas, with associated peat removal are indicated on drawing 2911-ALL-EW-200. The table on the drawing shows cut, fill, peat and total earthworks volumes. The earthworks will also require stripping of topsoil, stockpiling topsoil and respread of topsoil.

The preliminary design estimates for earthworks are summarised in Table 1 below. These volumes have been rounded from the quantities listed on drawing 2911-ALL-EW-200.

Earthworks Type	***Quantity of area***
Topsoil strip	139,000m^3
Total cut volume as per design surface	1,210,000m^3
Fill to raise to design levels	665,000m^3
Fill material to replace excavated peat	475,000m^3
Total fill volume	1,145,000m^3
Respread topsoil	135,000m^3
% cut volume for compaction	10%
Earthworks area	934,000m^2

Table 1 Earthworks

As shown in Table 1, at this preliminary design stage, an additional cut volume of 10% is provided for to achieve the required fill activity, allowing for compaction effects. Experience in similar sandy/silty soils in the Kapiti area indicates this proportion of additional cut material is required to achieve the required compaction standards. Table 1 also shows a shortfall of cut volume of approximately 50,000m^3 would be required to achieve the design surface. This additional cut material will be sourced from a borrow area. However, these estimated volumes are based on the assessment of average depths of peat and topsoil in specific zones of the site and experience indicates these volumes might vary during construction, which would influence the final cut volume required to achieve a balance cut/fill volume for each phase of earthworks. This balance process will be achieved using the borrow cut area where sufficient cut material is available if the full additional 50,000m^3 cut material is required. This borrow area is indicated in Figure 4 below, which is an insert of the northern corner of the earthworks zone in Phase 9 shown on drawing 2911-ALL-EW-219:

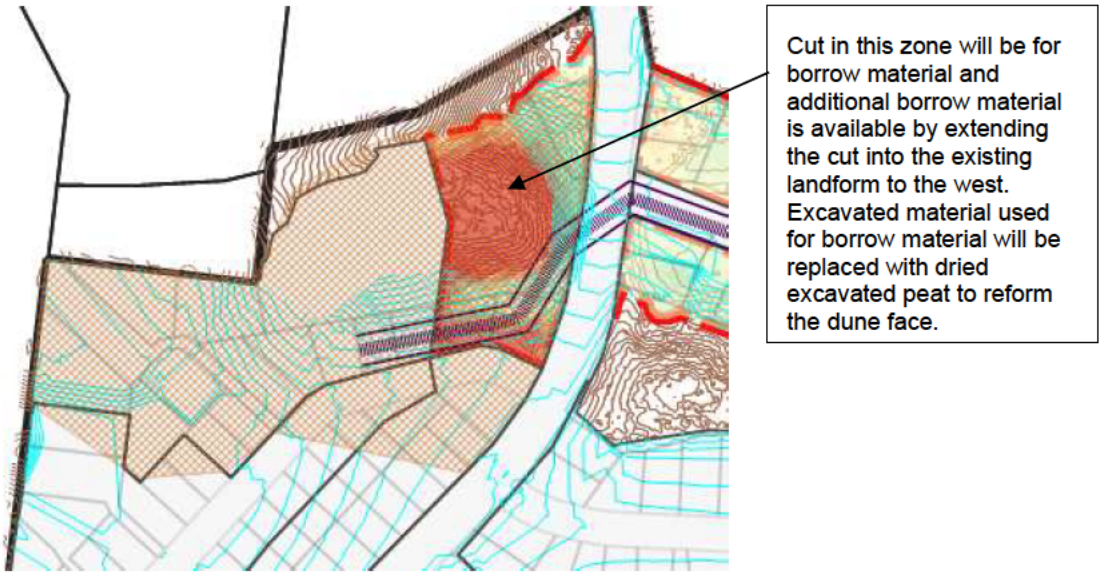


Figure 4 Borrow Cut Area

5.4 Organic Layer Stripping, Topsoil Demand and Formation Layer Adjustments

Additional modelling has been undertaken to refine the bulk earthworks estimate and quantify the effects of organic layer stripping, topsoil demand, and pavement formation layers. These refinements sit alongside the finished-surface to finished-surface cut–fill model shown on Drawing 2911-ALL-EW-200 and provide a more representative view of the actual material movements expected during construction.

Basis for Organic Layer Stripping Depths

Organic stripping depths were assigned using the geomorphic zones described in the CGW Geotechnical Assessment (21512-RPT-G-004). CGW note that material described as “topsoil” within the dune systems is predominantly clean sand beneath a thin surface root mat. Only this thin organic mat is unsuitable for engineered fill.

The adopted stripping depths reflect this and these are shown in Table 2 below:

Geomorphic Zone	Description	Adopted Strip Depth	Rationale
Upper dune crests	Clean dune sand, minimal organics	75 mm	Thin root mat only
Mid/eastern dune belt	Sand with shallow organic staining	100 mm	Slightly deeper organic layer
Low-lying eastern land	True topsoil over peat	200 mm	Consistent with CGW ~180 mm average thickness

Table 2 Topsoil depths

These depths were intersected with earthworks phase boundaries to estimate strip volumes. In areas underlain by peat, the adopted depths remain consistent with the peat modelling assumptions already embedded in the bulk earthworks model.

Topsoil Demand for Finished Surfaces

Topsoil requirements for final landscaping have been included based on likely end use. For this purpose, “topsoil” includes any approved topsoil/peat blend suitable for planting. The adopted design depths are shown in Table 3 below:

Land-Use Category	Adopted Topsoil Depth	Coverage Basis
Residential lots	150 mm	100% of lot area
Local purpose reserves / open space	300 mm	Full reserve area
Stormwater & ecological reserves	300 mm	Supports restoration planting and peat/topsoil reuse
Commercial and MDRS blocks	100 mm	Interim capping during bulk earthworks
Road reserves (berms/pervious margins)	150 mm	30% of road reserve area treated as landscape berms

Table 3 Design Topsoil Depths

Pavement and Footpath Formation Layer Adjustments

Finished-surface to finished-surface earthworks modelling assumes road and footpath areas contain compacted site-won fill beneath the pavement. In practice, these structures are built using imported pavement and pipe-zone materials. To reflect this, the model applies a representative formation layer reduction across paved surfaces. These adjustments include:

- Berms/pervious areas (30% of road reserve):
  Allocated 150 mm topsoil (already captured in the topsoil demand).
  No pavement reduction applied.

- Paved / impervious surfaces (remaining 70%):
  Representative pavement/footpath depth of 0.35 m applied as a volume reduction.
- Service trenching has not been separately modelled as a bulk cut component, as trenches are anticipated to be backfilled with site won sand bedding.
- Outputs – Organic Layer, Topsoil and Formation Adjustments

Table 4 summarises the supplementary material movements associated with stripping, topsoil placement, and pavement formation adjustments.

Phase*	Topsoil demand (m^3)	Formation reduction (m^3)	Stripped area (m^2)	Mean strip depth (mm)	Strip volume (m^3)
1B	16,534	30,582	129,509	144	17,147
2	12,728	21,810	116,612	155	16,639
3	19,930	26,083	129,945	172	19,739
4	9,126	13,115	66,536	100	6,956
5	22,572	31,740	142,463	155	19,047
6	10,159	14,383	68,052	103	9,529
7	9,731	15,557	75,377	125	13,408
8	16,758	21,150	105,898	144	19,402
9	17,319	21,425	99,850	108	17,244

Table 4 – Organic Strip, Topsoil Demand and Formation Adjustments
**Phase 1A volumes are not included in this table as they are minor in extent and relate to a discrete work area. Phase 1A is described separately in Section 5.6.*

These adjustments sit alongside the core cut, fill and peat volumes and will be incorporated into the refined bulk earthworks balance.

Consistency with Peat Modelling

The peat removal volumes shown on Drawing 2911-ALL-EW-202 are already embedded within the surface-to-surface earthworks model. The updated topsoil and organic stripping methodology is aligned with that model by:

- using strip depths consistent with CGW geomorphic zones;
- maintaining the distinction between true topsoil and organically stained sand;
- treating clean sand above peat as suitable engineered fill, except where shallow peat prevents practical separation;
- enabling reuse of dried peat for non-structural landscape areas.

This avoids double-counting unsuitable material and keeps the modelling assumptions coherent across all earthwork components.

Integration into the Earthworks Balance

These refinements provide a more representative estimate of the actual material demands and reductions across the development. In summary, the adjustments:

- quantify organic material to be removed prior to placement of structural fill;
- identify the topsoil/growing-media volumes required at completion;

- account for imported pavement and footpath layers that displace site-won fill;
- support the reuse of dried peat where appropriate;
- provide a transparent structure for reconciling final cut–fill at detailed design.

This methodology aligns with standard subdivision practice and is grounded in the site-specific geotechnical model and earthworks staging developed to date.

5.5 Peat Removal

As indicated in Section 5.3, the earthworks activity will involve the excavation of approximately 475,000m^3 of peat from beneath the developed areas of the site. The areas of the site containing peat and the assessment of peat thickness are shown on drawing 2911-ALL-EW-202, an insert of which is shown as Figure 5 below:

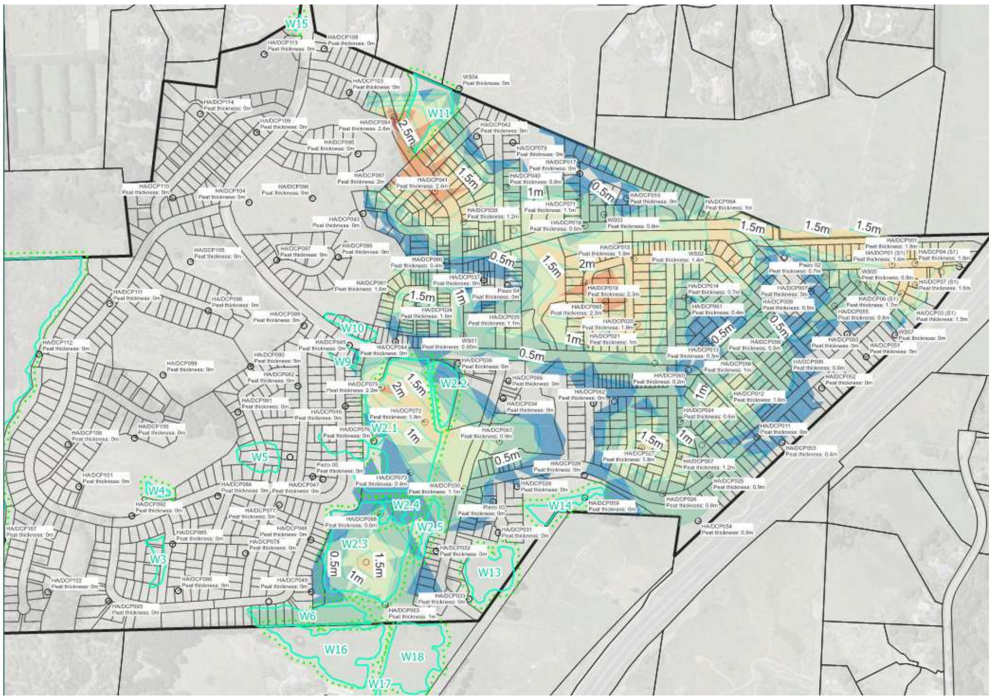


Figure 5 Peat Areas

The average thickness of the peat is approximately 1m, but it varies in thickness from nothing to up to 2.5m. The top of the peat is generally just below the surface. The peat beneath the development areas must be removed to enable suitable building foundations to be constructed.

The groundwater monitoring results described in the Geotechnical Report and the Hydrological Report confirms that groundwater is present within the peat layer. Therefore, excavation and removal of the peat will be carried out within the groundwater system. This will necessitate a peat removal methodology involving working within a limited area, excavating the peat and replacing it with compacted fill material generally within the same working day. This process minimises the volume of groundwater pumping (de-watering) from the active excavation zone to a manageable scale because the area of available flow path for the groundwater to flow to is relatively small (less than 2,000m^2) at any one time and the dewatering pumps only have to operate for a few hours per day (if required) until the fill material is placed and compacted to above the groundwater level. In the areas where the peat is thin (<0.5 – 0.7m) it is expected that only the bottom zone of the peat will be within the groundwater system. The de-watering pumps will discharge pumped water to the nearest Sediment Retention Pond (**SRP**) as required by the ESCP for that activity. The process is repeated each day (weather permitting) until the full peat area is removed within that stage of earthworks. These issues are included in Section 3 of the CEMP.

Excavated peat will initially be placed in drying areas. Based on preliminary geotechnical input and experience with similar materials, a reduction in volume of approximately 35–50% is expected once dried. This will involve spreading the peat over an area to a thickness of approximately 0.4 – 0.5m so that warm weather can dry it. It is expected that it will be turned during the drying process. Windrows of excavated peat are also likely to be used as part of the drying process.

Dried peat will be transported to a temporary stockpile on the flat area of the site, immediately on the eastern side of the inlet road where it enters the site (shown on the earthworks phasing plans PH1B EW 211 – PH8 EW 218).The temporary stockpile will operate as a peat handling area where newly dried peat is stockpiled and older dried peat is used at completed phases of earthworks for landscape fills, mixing with topsoil and re-used as topsoil respread. The stockpile will be removed as part of the Phase 9 earthworks as described in Section 5.5.

5.6 Earthworks Phasing

The full extent of earthworks required to complete the development is expected to be carried out over 10 phases (1A, 1B, 2-9). These phases have been conceived to reflect likely development staging, material balances for each phase (which will include some borrow cut operation for some phases), capacity to complete a phase of earthworks with one earthworks season and expected Ngarara Stream reconstruction phasing. It is possible that two phases might be carried out in the same earthworks season if demand and available resources allow.

The phasing has been strongly influenced by cut/fill balancing for each phase. However, the final volumes for fill in the low-lying central and eastern area will be dictated by the final volumes of peat removal within each phase, which is influenced by peat thickness. Peat thickness varies over the site and average thickness in specific areas has been used for the estimate of peat volume removal required for each stage. The earthworks strategy includes the use of a borrow area on the western side of the inlet road, which is shown as the phase 8 & 9 cut area. It is possible that some borrow material will be excavated from this area in the earlier phases of earthworks if that phase does not have sufficient cut material for final fill volume requirements. However, borrow material in the earlier phases of earthworks is also expected to be taken from an adjacent earthworks stage area if it is more convenient and cost effective to do so.

The haul road system to enable access to the borrow area and from west to east, is shown on the individual phase plans. Assessment of the cut areas and the borrow area has confirmed all required cut volume, including for peat replacement, is available within the site and within the earthworks footprint shown on the earthworks plans.

The earthworks volumes involved in each of the 10 phases are shown on drawing 2911-ALL-EW-200. Each phase of earthworks is shown on drawings 2911-ALL-EW-210 – 219. These are described below:

Phase 1A

The earthworks required to implement the 7-lot western area accessed off Paetawa Road (Phase 1A) are minor in scale and are not described in detail below. Phase 1A comprises a small, discrete work area (approximately 1.6 ha) that can be managed as a single earthworks area in accordance with the staged CEMP/ESCP certification requirements and the GWRC Erosion and Sediment Control Guidelines.

Phase 1B

Phase 1B involves the excavation of approximately 112,000m^3 from the areas shown in Figure 6 below (drawing 2911-PH1B-EW-211):

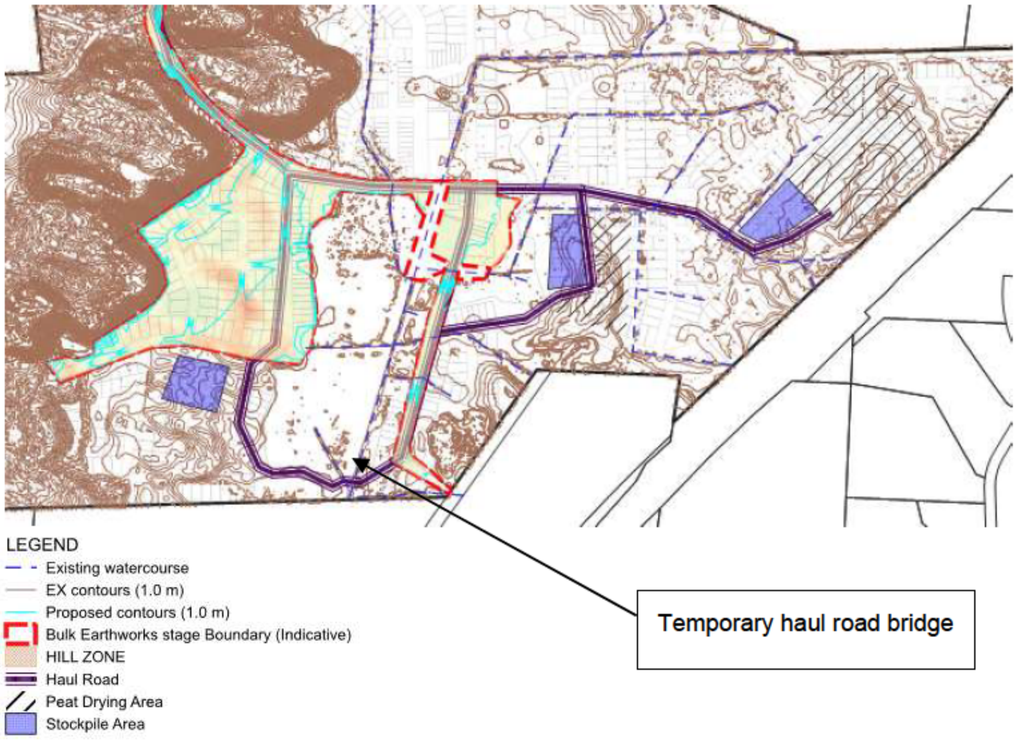


Figure 6 Phase 1B Earthworks

As indicated by Figure 6, most of the cut area is the main access or inlet road corridor and the central zone, immediately south of the inlet road. This earthworks phase will include the placement of approximately 60,000m^3 of fill material to raise the land in the central zone where existing ground is below the design level and in the proposed local centre for the establishment of infrastructure there, and its associated infrastructure corridor to the south. In addition, peat removal in the fill area at the local centre will require the placement of approximately 20,000m^3 of fill material. Excess cut material from the Phase 1B earthworks zone, resulting from final excavation down to the finished design surface within the Phase 1B earthworks works area will be stockpiled in the positions indicated by the blue hatched areas Figure 6. The stockpiled cut material will be used for compacted fill in the Phase 2 earthworks activity. The Phase 1B works will also require the excavation of the peat and temporary management of it in the peat drying areas, indicated by the cross-hatching on Figure 6.

Temporary Bridge Across Ngarara Stream

The Phase 1B earthworks activity is expected to require a southern haul road that crosses the Ngarara Stream near the southern boundary of the site, as shown in Figure 6 above. This will require a temporary bridge across the Ngarara Stream. This haul road is required for phases 1B, 2, & 3 of earthworks to provide southern access for efficient material movement.

The construction and operation of the temporary bridge requires avoidance of potential adverse effects on the Ngarara Stream, particularly given that the development incorporates several ecological benefits that must not be compromised by this temporary engineering structure.

Therefore, the temporary bridge will be constructed and operated such that it does not affect the bed of the stream, the flow in the stream and will avoid erosion of the stream banks. This will be achieved with the use of an industry "best practice" temporary bridge that well exceeds the width of the stream such that the abutments are set back several metres from the sides of the stream. The Ngarara Stream has a water surface width of typically 3m and the width across the top of the banks is expected to be approximately 7m. The temporary bridge to be used at the site is expected to be a 14m span bridge deck structure placed on horizontal steel abutment members that sit on a layer of compacted 65-down graded metal. This form of construction has been used by local contractors on other sites in Kapiti. The construction avoids any contact with the stream and does not impede stream flows.

The temporary bridge is expected to be in place for approximately 3 years to facilitate the Phase 1B, 2 & 3 earthworks. It is possible (in fact likely) that the Ngarara Stream will experience a flood event during this period that would result in the stream water level exceeding the channel depth and spilling over around the abutments of the temporary bridge. The temporary bridge envisaged for this site is a solid steel structure that is designed to support a 55-tonne loaded dumper truck and, as such, is sufficiently heavy to resist movement when inundated from relatively slow flowing Ngarara Stream flood flows. The bridge abutment areas would be surrounded with super silt fence as part of the ESCP covering the bridge area and this would also assist with avoidance of scour or erosion at the temporary bridge.

Hence it is expected that the haul road can incorporate a temporary bridge that completely avoids any potential adverse effect on the Ngarara Stream.

Phase 2

Phase 2 will involve the excavation of approximately 167,000m^3 of cut, 94,000m^3 of fill and 57,000m^3 of peat replacement. These are indicated by Figure 7 below (drawing 2911-PH2-EW-212):

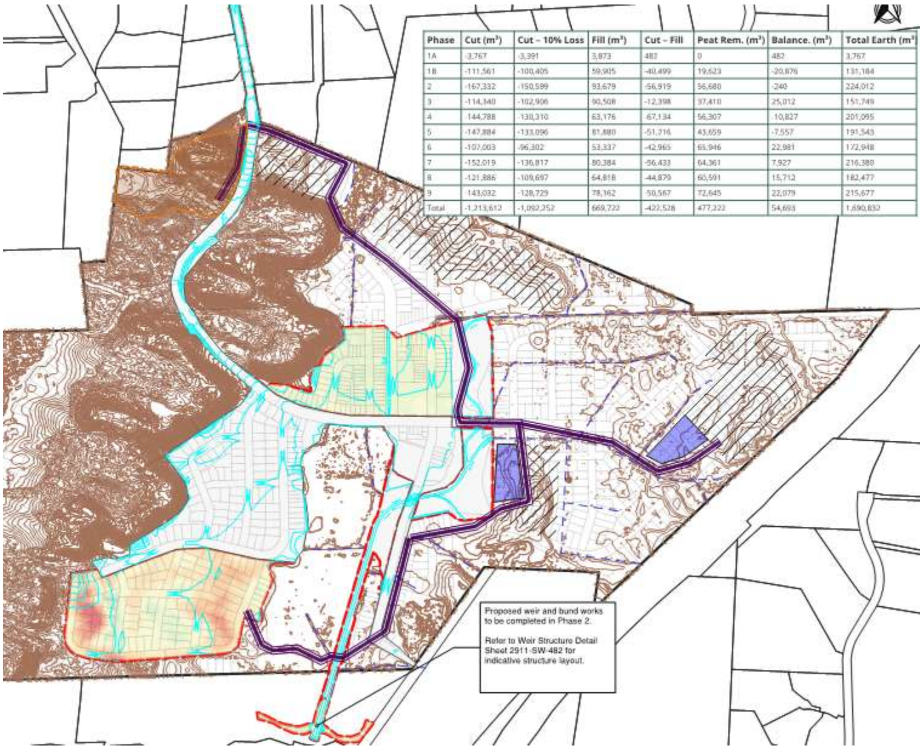


Figure 7 Phase 2 Earthworks

The main cut fill areas are the area south and north of the Phase 1B works. Peat removal will be required under the northern area of the works, and the excavated peat will be processed for drying in the peat drying areas used as part of the Phase 1B works.

The earthworks cut and fill activity south of Phase 1B will include the operation of the Phase 1B haul road to the east, near the site southern boundary, to facilitate transportation of cut material to the east and future fill material to the east. This will involve the continued use of the temporary bridge formed over the Ngarara Stream as part of the Phase 1B works.

By completion of Phase 2 a total of approximately 75,000m^3 of peat will have been excavated and dried. The dried peat is expected to reduce to about 50% of excavated volume. The dried peat will be moved to a temporary stockpile on the flat area of the site, immediately on the eastern side of the inlet road where it enters the site. This area has capacity to stockpile up to approximately 100,000m^3 of dried peat.

<u>Realignment of the Ngarara Stream Reach</u>

As described in Section 7, the re-alignment of the central section of the Ngarara Stream will be carried out at the same time as the Phase 2 earthworks so that the eastern side of the Phase 2 low-lying filling area within the existing Ngarara Stream corridor can be filled.

<u>Downstream Flow Control Structure</u>

The downstream flow control structure incorporating the twin box culvert and overflow weir will also be constructed as part of the Phase 2 earthworks so that flood storage can be increased on the site to off-set loss of existing flood storage volume resulting from the Phase 1B and Phase 2 filling in the low-lying central and eastern areas.

Phase 3

Phase 3 earthworks will involve the excavation of approximately 114,000m^3 of cut, 90,000m^3 of fill and 37,000m^3 of peat replacement. These are indicated by Figure 8 below (drawing 2911-PH3-EW-213):

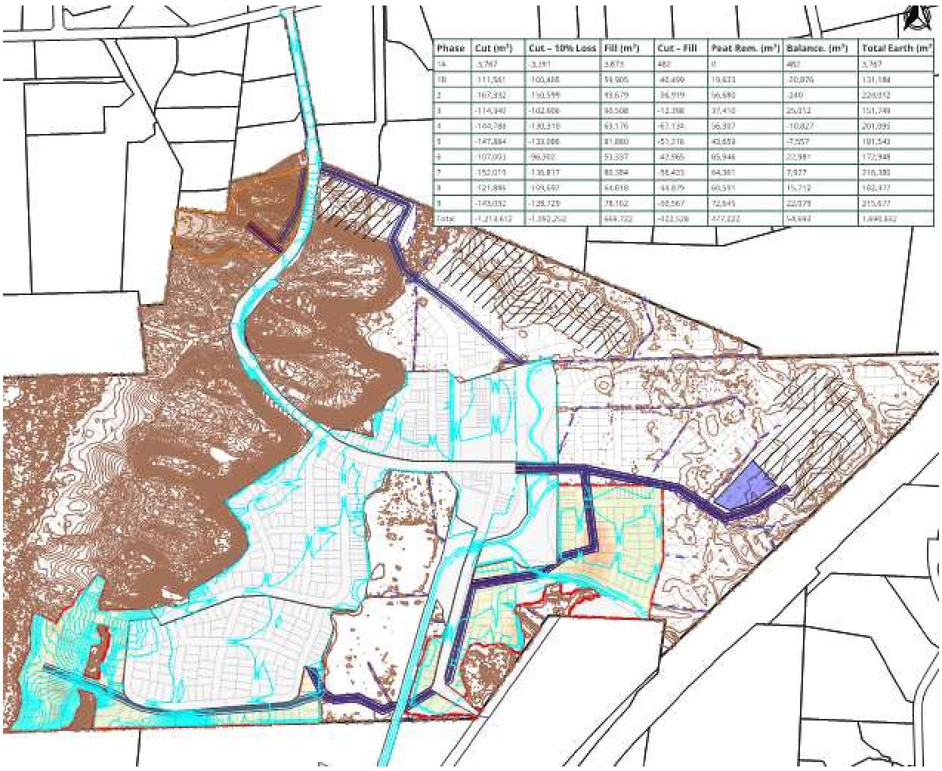


Figure 8 Phase 3 Earthworks

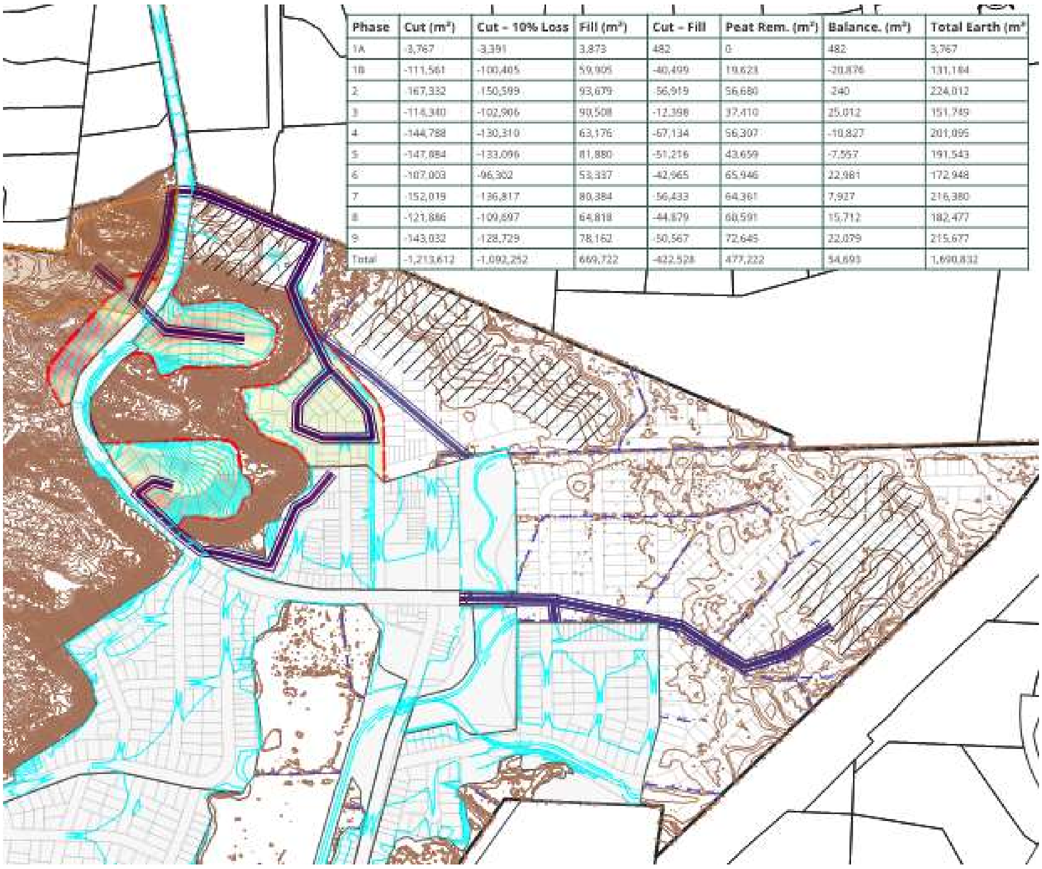
This phase is structured to complete the earthworks in the south-western part of the site so that the cut material from this part of the site can be transported to the eastern part of the site via the southern haul road. Once Phase 3 is completed the southern haul road will be reinstated to the intended land-use, part of which includes wetland restoration and the temporary bridge on the southern haul road will be removed.

The cut material will be used to raise the land in the south-eastern part of the site. The earthworks filling in this one is adjacent to wetlands W13 & W14 and once it is completed, restoration of these 2 wetlands can be carried out, as discussed in the Wetland Restoration Management Plan. The previous excess cut material stockpiled on the site will be used to complete the Phase 3 filling and peat replacement.

As described in Section 7, the section of Ngarara Stream between the downstream end of the re-aligned section to the new control system at the downstream end of the Stream within the project works will be modified to provide the required stream hydraulics as part of the Phase 3 works.

Phase 4

Phase 4 earthworks will involve the excavation of approximately 145,000m^3 of cut, 63,000m^3 of fill and 56,000m^3 of peat replacement. These are indicated by Figure 9 below (drawing 2911-PH4-EW-214):



Phase	Cut (m³)	Cut – 10% Loss	Fill (m³)	Cut – Fill	Peat Rem. (m³)	Balance. (m³)	Total Earth (m³)
1A	-3,767	-3,391	3,873	482	0	482	3,767
1B	-111,561	-100,405	59,906	-40,499	19,623	-20,876	131,184
2	-167,332	-150,599	93,679	-56,919	56,680	-240	224,012
3	-114,340	-102,906	90,508	-12,398	37,410	25,012	151,749
4	-144,788	-130,310	63,176	-67,134	56,307	-10,827	201,095
5	-147,884	-133,096	81,880	-51,216	43,659	-7,557	191,543
6	-107,003	-96,302	53,337	-42,965	65,946	22,981	172,948
7	-152,019	-136,817	80,384	-56,433	64,361	7,927	216,380
8	-121,886	-109,697	64,818	-44,879	60,591	15,712	182,477
9	-143,032	-128,729	78,162	-50,567	72,645	22,079	215,677
Total	-1,213,612	-1,092,252	669,722	-422,528	477,222	54,693	1,690,832

Figure 9 Phase 4 Earthworks

This phase will complete the earthworks on the dunes on the eastern side of the inlet road and used to raise the land in the northern part of the low-lying northern part of the site. The cut material will be transported via the northern and central haul road system.

Phase 5

Phase 5 earthworks will involve the excavation of approximately 148,000m^3 of cut, 82,000m^3 of fill and 44,000m^3 of peat replacement. These are indicated by Figure 10 below (drawing 2911-PH5-EW-215):

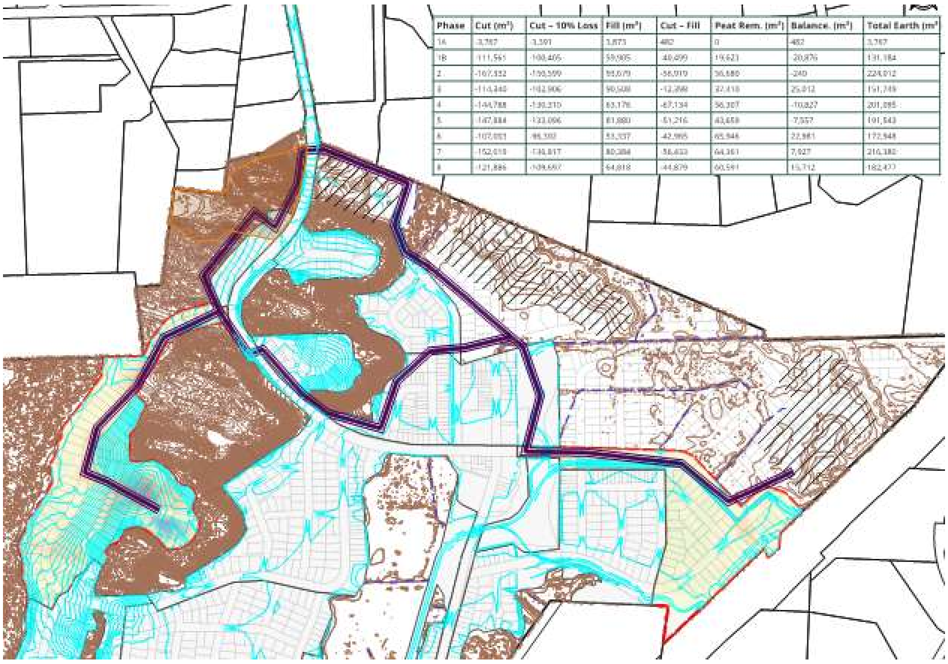


Figure 10 Phase 5 Earthworks

This phase will complete the earthworks in the western part of the side adjacent to the Te Harakeke Swamp and continue the progressive filling operation on the low-lying eastern area.

Part of the filling on the western fringe of the earthworks zone may comprise some landscape fill material where it is beyond the building footprint. The landscape fill material will consist of a mix of dried peat and topsoil.

Phase 6

Phase 6 earthworks will involve the excavation of approximately 107,000m^3 of cut, 53,000m^3 of fill and 66,000m^3 of peat replacement. These are indicated by Figure 11 below (drawing 2911-PH6-EW-216):

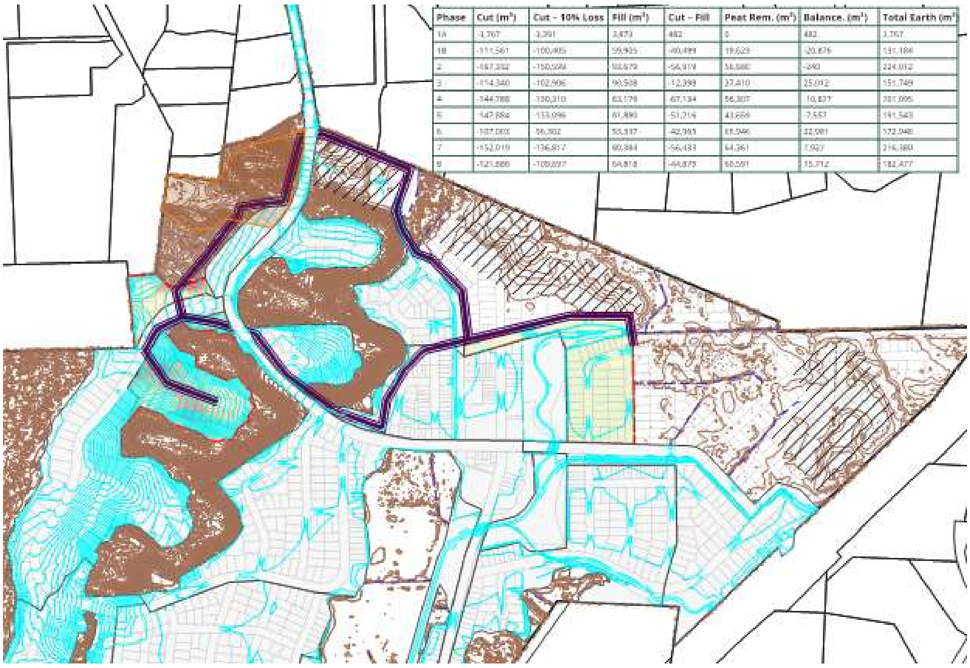


Figure 11 Phase 6 Earthworks

This phase extends the cut operation on the western part of the site and progresses the fill operation on the eastern part of the site.

As described in Section 7, the section of Ngarara Stream at the northern edge of Phase 6 will be constructed as part of the Phase 6 earthworks.

Phase 7

Phase 7 earthworks will involve the excavation of approximately 152,000m^3 of cut, 80,000m^3 of fill and 64,000m^3 of peat replacement. These are indicated by Figure 12 below (drawing 2911-PH7-EW-217):

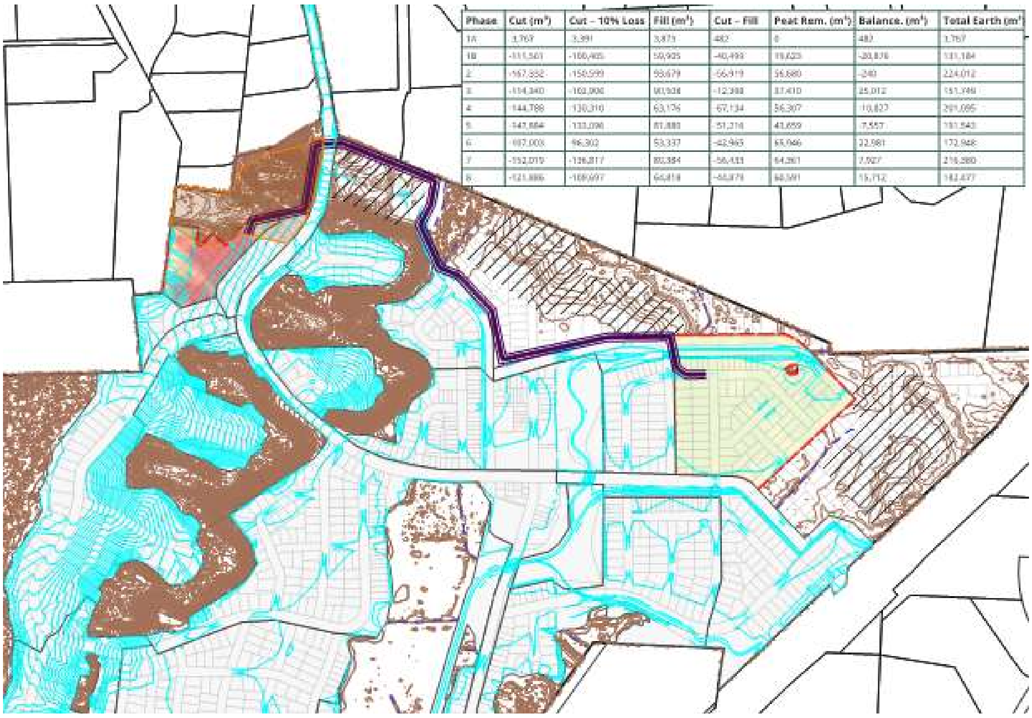


Figure 12 Phase 7 Earthworks

This phase extends the cut operation on the western part of the site and progresses the fill operation on the eastern part of the site. The northern haul road is the only access between the cut and fill zones and remains for the completion of all earthworks.

The section of Ngarara Stream along the northern edge of Phase 7 earthworks will be reconstructed as part of the Phase 7 earthworks.

Phase 8

Phase 8 earthworks will involve the excavation of approximately 122,000m^3 of cut, 65,000m^3 of fill and 61,000m^3 of peat replacement. These are indicated by Figure 13 below (drawing 2911-PH8-EW-218):

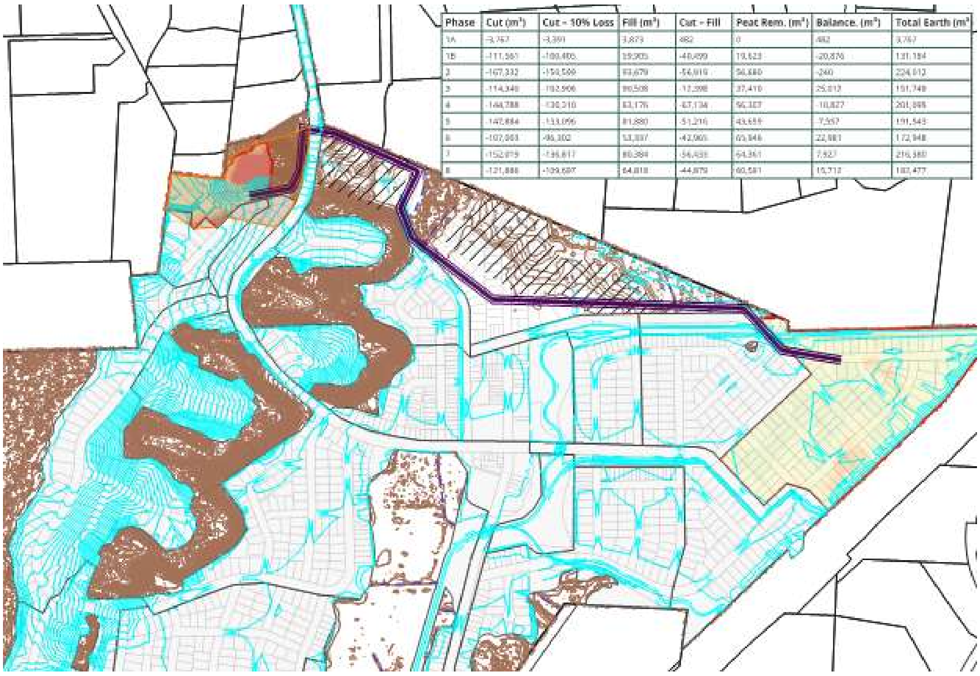


Figure 13 Phase 8 Earthworks

This phase of earthworks completes the majority of the development in the northwestern corner and the filling in the eastern zone of the site.

This phase will include the formation of the secondary flow path for the Ngarara Stream along the northeastern boundary of the site where the Ngarara Stream channel runs parallel just a few metres to the north in neighbouring property.

Phase 8 will include further borrow excavation into the dune on the western side of the inlet road, immediately inside the site as a source of cut material. This excavation zone will create capacity for final peat disposal as part of Phase 9 earthworks.

Phase 9

Phase 9 earthworks will involve the excavation of approximately 143,000m^3 of cut, 78,000m^3 of fill and 73,000m^3 of peat replacement. These are indicated by Figure 14 below (drawing 2911-PH9-EW-219):

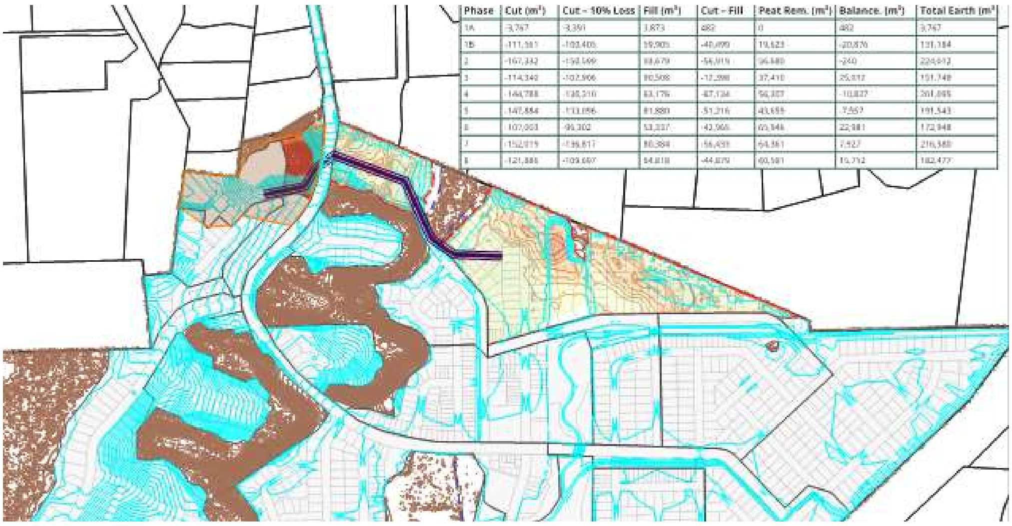


Figure 14 Phase 9 Earthworks

This phase will complete the earthworks on the site. It will include removal of all stockpiled dried peat and relocating it on the western side of the inlet road to reform the dune into a natural shape. The final quantity of excavation from the dune for fill material will be balanced with the fill requirement to ensure all material is sourced on site.

5.7 Compliance and Certification

Earthworks will be designed and executed in accordance with:

- The approved earthworks design and associated specification;
- The conditions of the planning approval;
- The approved CEMP and associated ESCP;
- NZS 4404:2010 – Land development and subdivision infrastructure;
- NZS 4431:2022 – Code of Practice for Earth Fill for Residential Development; and
- GWRC Erosion and Sediment Control Guide (2021).

All works will be tested and overseen by a suitably qualified geotechnical engineer, with associated “hold points” for inspection and sign-off. This will include inspection of areas where peat has been removed to ensure the subgrade below the new fill is suitable, cut and fill batters comply with design specifications, on-site testing confirms compaction of fill meets the standards set out in NZS4431and testing of natural ground confirms compliance with NZS3604 requirements.

Subsoil drains will be constructed where directed by the Certifying Engineer to ensure placed fill material is protected from blockage of natural groundwater movement, and associated natural groundwater movement is retained.

Certification that the earth fills meet the requirements of the NZ Standard 4431 and sites meet the requirements of NZS4404 and/or NZS3604 will be issued as part of each completed phase of work, as required by the conditions of the planning approval.

5.8 Erosion and Sediment Control

The erosion and sediment control strategy is described in the CEMP and the Erosion and Sediment Control Plan (ESCP) prepared by Landlink and preliminary ESCP proposals for earthworks phase 1B are shown in drawings 2911-PH1B-EC-220 – 232. The strategy is based on the use of approved ESCPs for each phase of the earthworks, each ESCP complying with the GWRC Erosion and Sediment Control Guide for Land Disturbing Activities (2021) and the Kāpiti Coast District Council Land Development Minimum Requirements (2022) and the Overview ESCP submitted as part of the Application providing a guide/outline of what each ESCP will prescribe. A detailed ESCP for each development stage will be prepared, for certification, prior to works commencing for that stage.

Key features of each ESCP are set out in the draft ESCP contained in the Application.

In general, the site can be separated into four work/soil types/earthworks activities when considering ESC objectives. These are:

- Western and central dune areas – these are distinctive in that there are no streams or water courses, very thin topsoil cover, soils are largely dune sand with some silt mix, and they are generally upstream of wetland areas. The ESCP focus will therefore be use of appropriate devices complying with the GWRC ESC Guidelines (2021) for managing what will be runoff that will generally be free from very fine-grained materials, less need for cutoff devices (limited upstream runoff), and use of diffuse outlets from sediment ponds to vegetated areas separated from wetland areas;

- Low-lying central and eastern areas – these areas are distinctive in that they have a moderate thickness of topsoil that will need removal, are very flat, require peat removal, are adjacent to farm drains/water courses, are in places prone to flooding in moderate to large flood events, and require raising with compacted earth fill. Earthworks filling, at least up to a level above the groundwater level is expected to be carried out in a small area at a time, in conjunction with the peat removal methodology from that small area, as described in Section 5.4. It is therefore envisaged that the ESCP focus for this area of the site will be the use of appropriate devices complying with the GWRC ESC Guidelines designed for a relatively small catchment area prior to stabilisation. It is possible that the final filling operation up to the final design levels will be carried out over a wider area, which will be considered and covered by the final detailed ESCP prepared for that activity. It is anticipated that diffuse outlets from sediment ponds to vegetated areas separated from wetland areas will be used to protect the downstream/adjacent wetland areas prior to earthworks stabilisation. It is also expected that the detailed ESCP prepared for this area of the site will utilise protective bunds to separate the active earthworks areas from adjacent farm drains and watercourses if those areas are exposed to flooding from smaller rainfall events likely to occur during the earthworks activities.
- Peat removal and peat drying areas – As described in Section 5.5, there are large areas where peat removal is required. The localised work area where removal and refill will be carried out is expected to be relatively small on a day-by day basis (approximately 1,000m^2) as it is planned to refill an area excavated in the same day that excavation is carried out. This methodology reduces the scale of groundwater dewatering to relatively minor and manageable. Potential risk of erosion and sediment runoff from this localised area is therefore relatively low during this specific activity. However, once the filling activity extends above the groundwater system the raising of the land to final design levels then becomes covered under the bullet point above. Peat drying areas are expected to be relatively large as a thin layer of peat is required to achieve effective drying. It is anticipated that detailed ESCP covering the peat drying areas will incorporate the use of bunds to contain the peat drying area where they are exposed to flooding. They will be surrounded by silt fences to prevent any sediment laden runoff from the drying area being discharged to near-by farm drains or water courses.
- Ngarara Stream diversion and culvert construction – the project works require the realignment of a section of the Ngarara Stream, reconstruction of the Stream channel in other sections, reconstruction of the stream channel of some unidentified farm drains, the construction of the downstream flow control box culverts and associated overflow weir and the construction of other culverts within existing waterways. These activities create a risk of erosion and/or sediment release to watercourses, and these risks will be managed by specific ESCPs prepared for these activities. Section 7 sets out the proposed methodology for earthworks associated with the Ngarara Stream diversion and the proposed timing of this diversion. It is intended to construct most of the new channel in isolation from existing Stream flows and so the risk of sediment release from this activity is relatively low. The focus for the ESCP dealing with the Stream diversion will be dealing with control of the earthworked area during construction and managing erosion and sediment runoff from the reconstructed stream channel/banks after commissioning of the new channel but before full vegetative cover is achieved (i.e. dealing with potential scour from low/moderate flood flows when new vegetation is at risk of scour/erosion). This is expected to involve the use of temporary silt fences installed at right angles to the Stream alignment at 15 – 20m spacings and maintained for 1 – 2 years adjacent to the channel to control bank velocities, as has been used successfully in similar situations (e.g. Duck Creek, Whitby). Each proposed culvert construction site will be incorporated into the ESCP dealing with that phase of the construction and will set out proposed culvert construction methodology and associated proposed ESC processes.

The detailed ESCP developed for each of these work areas, within their associated construction phase, will be prepared for certification prior to construction of that phase.

The draft ESCP for the Phase 1B works, includes detailed drawings numbered 2911-PH1B-EC-220 – 236. These drawings show the preliminary ESCP devices proposed for this phase of construction and include solutions for the issues outlined above.

5.9 Indicative Planting Program

Replanting will be carried out after completion of each phase of earthworks to advance site remediation, wetland restoration and terrestrial ecology restoration. This planting will be staged to coordinate with earthworks to achieve optimum environmental outcome. An indicative phasing for replanting is shown by Figure 15 below:

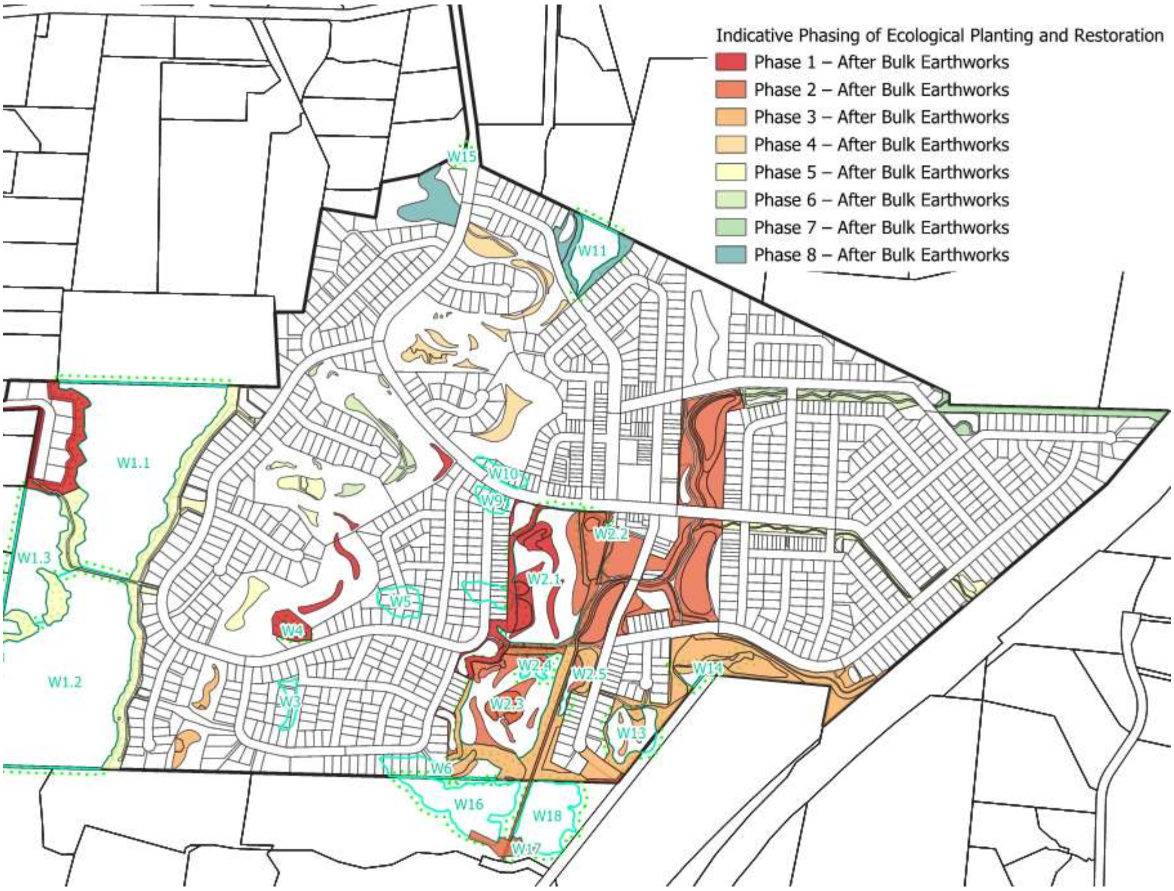


Figure 15 Indicative Planting Program

5.10 Construction Management Considerations

Construction activities will be coordinated with the use of a certified Construction Environmental Management Plan (CEMP) to ensure construction related effects are appropriately managed. The aim of the CEMP is to bring the various Management Plans (e.g. ESCP, Stormwater Management Plan, Wetland Restoration Management Plan, Landscape Management Plan etc) and construction activities (e.g. earthworks including peat removal and topsoil handling, stream diversions, discharges, culverts, roading, wetland reconstruction, landscape work, stormwater devices, bulk infrastructure activities) together to achieve appropriate control of construction related activities and prevention of adverse effects not permitted by the planning approval conditions.

The CEMP triggers all workers on the site to better understand the requirements and proposed procedures developed for environmental control of construction relate activities and provides a framework for monitoring, reporting, review and adaptive management of these.

The project will be constructed in phases, and a CEMP will be developed for each stage, as required by conditions. A draft CEMP for a generic stage of construction is contained in the Application. This sets out the keys areas to be covered by the final CEMP, which will be completed after detailed design of each stage is completed and a contractor for that stage has been selected.

6.0 ROADING AND UTILITIES

<u>Roads</u>

The assessment of Transport is described in the Integrated Transport Assessment Report prepared by Stantec. The internal roading system servicing the development is shown by the concept plan on drawing 2911-ALL-P-1 and the detailed legal road widths are shown on the scheme plans P10 – P98. Further detail for the roads is provided in the supporting urban design and landscape plans.

The project includes the upgrading of the intersection with Peka Peka Road, as shown in the Integrated Transport Assessment Report.

The legal road widths have been designed to achieve an appropriate urban design outcome and generally comply with KCDC LDMR 2022. The proposed roading network provides safe and efficient access within the development and to the wider transport system. It supports multimodal movement, public transport readiness, and integration with existing roads.

The Design Report describes the principles and objectives of the proposed walkway and cycleway layout for the development. The final approved road pavement design will comply with KCDC LDMR 2022 design requirements and will be finalised once subgrade testing is completed after earthworks in each phase.

<u>Pedestrian Bridges</u>

The development includes 5 pedestrian bridges, which form part of the walkway network through the development. These are shown on drawing 2911-ALL-EW-205, and an insert of this drawing is shown in Figure 16 below:

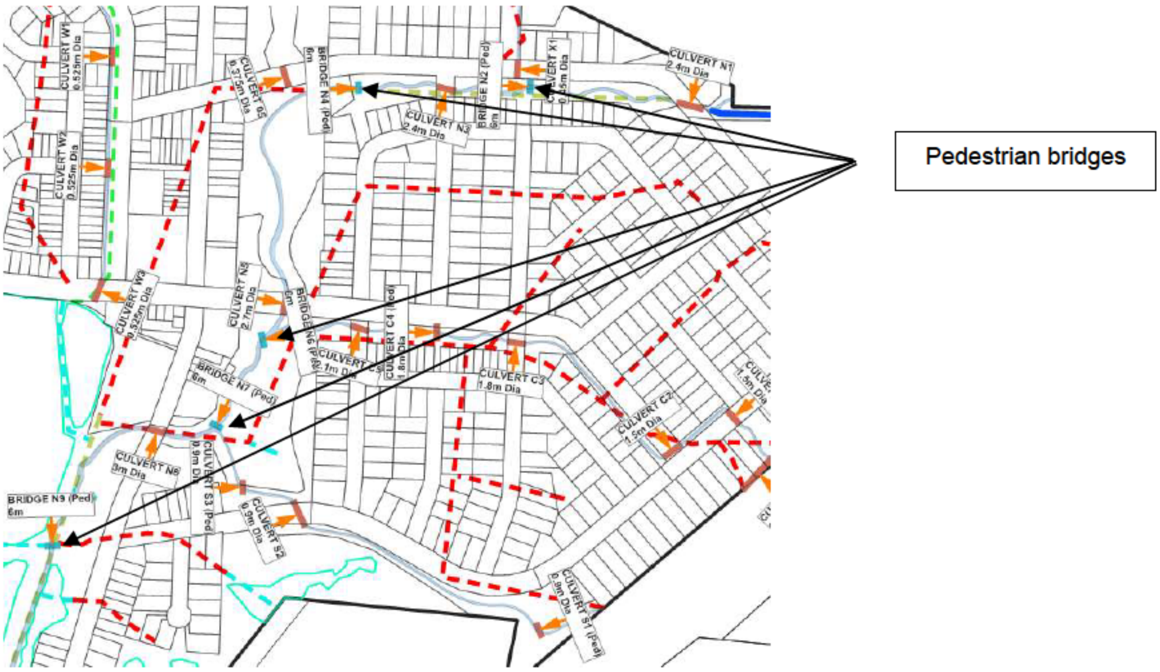


Figure 16 Pedestrian Bridges

These structures are anticipated to span the Ngarara Stream, with an indicative span of approximately 6 m. Conceptually, the bridge type is shown in the Figure 17 below.

Figure 17 Conceptual pedestrian bridge form

At this stage, the bridges are presented at a concept level to confirm feasibility, location, and integration with the wider access network. The final form and detailing of each bridge will be developed during detailed design, with consideration of structural requirements, durability, constructability, and visual integration with the surrounding environment.

Implementation is intended to be undertaken by a specialist bridge supplier, with detailed design and construction aligned to relevant standards and best practice at the time of delivery.

Boardwalks

The development includes the construction of two boardwalks crossing wetlands, one across the central wetland and one crossing the Te Harakeke Swamp that will provide pedestrian access to Paetawa Road. The construction of these boardwalks is designed to be carried out with minimum disturbance to the wetland. The design will involve timber poles at approximately 1.5 - 2m spacing, timber bearers across each pair of poles, timber joists and timber decking. The height above ground will be less than 1m and so handrails will not be required. However, raised timber edgings will be used to avoid push chairs and buggies are prevented from travelling over the edge. The timber poles will be installed using a small excavator (not greater than 2-tonne) to drive or vibrate the timber poles into the ground, working from a completed section of boardwalk. Once the poles are driven, the remaining timber members would be installed for that 1.5 – 2m bay and the excavator can then move forward on the boardwalk to install the poles for the next bay.

This construction methodology avoids the use of large heavy excavators working beside the boardwalk, which minimises soil and vegetation disturbance adjacent to the boardwalk. This will minimise disturbance to the wetland from boardwalk construction.

Services

Utility services will be coordinated within the road corridor in accordance with KCDC LDMR22 trenching and separation standards.

Gravity stormwater and wastewater infrastructure (including mains and manholes) will generally be located within the road carriageway.

Water supply, power, telecommunications and fibre will generally be located within the footpath and berms.

This layout provides for staged servicing, safe separation of utilities, and efficient long-term maintenance access. All services will be installed in accordance with NZS 4404:2010, KCDC LDMR 2022, and utility provider guidelines.

7.0 STORMWATER AND FLOOD PROTECTION

Stormwater management and flood protection for the developed area of the site have been designed to achieve functional, resilient, and low-impact outcomes and avoid adverse effects both within and beyond the site. The design responds to existing flooding on the site, existing topography, natural drainage patterns, wetland features, and proposed stream hydraulic performance and wetland enhancement. These matters are described below.

7.1 Existing Hydrology

The site hydrology is described in the Hydrological Report prepared by OCDL. As described in that report, there are several informal and farm drains and the Ngarara Stream running through the site, in combination with natural depressions and wetland features. Multiple sub-catchments have been identified, each with distinct hydrological characteristics. The western part of the site is underlain by permeable dune soils, the raised central area is predominantly silty sand with no peat beneath, and the low-lying eastern areas include flat depressions, large areas subject to ponding and a 0.5 – 2.5m thick layer of peat beneath the surface.

The Hydrological Report sets out the various issues influencing hydrological factors, for each catchment type, and assesses how they are expected to be affected by the proposed development.

7.2 Flood Risk Management

The site has areas of low-lying land that are exposed to flooding during even modest rainfall events. Flood risk on the site has been described and assessed by Awa Consultants, as set out in their Flood Hazard Assessment of Effects Report. The existing Ngarara Stream channel has limited hydraulic capacity, and extensive existing flooding occurs on the site and the neighbouring land. This provides flood attenuation for downstream areas, and this flood storage extent and function has been incorporated into the design solutions for the site to avoid increased flooding risk on neighbouring land.

The key elements of the proposed flood management strategy are:

- Improve the hydraulic capacity of the Ngarara Stream within the site to manage Stream flows within the site;
- Re-align a section of the Ngarara Stream within the site to achieve a more naturalised stream alignment and improved variability in hydraulic gradient;
- Raise the invert level of sections of the Ngarara Stream within the site to enhance wetland soil moisture and raise groundwater levels in parts of the site to enhance ecological outcomes within the site;
- Construct a flow control structure in the Ngarara Stream so that flood levels within the site can be raised to off-set loss of ponding volume from earthworks fill placed in parts of the existing flood storage area;
- Ensure the downstream flood flow control system (twin box culvert with high level overflow weir) has been set at the correct level to prevent increased flood ponding upstream and downstream of the site;

- Ensure the new proposed building levels adjacent to the flood storage areas are sufficiently high to provide a safe building foundation that meets the required flood protection standards, including an allowance for free board and future potential climate change;
- Incorporate low impact stormwater solutions into the stormwater design for the development to ensure it is consistent with the flood management solutions adopted for the site and archives stormwater neutrality, and
- Design the surface of the developed areas and associated lot layout to manage secondary flows such that they are not directed onto private property.

The Awa Report has responded to this strategy, assessed existing and future flood flows for the 2-year, 10-year, 50-year and 100-year flood flows from the Ngarara catchment with extensive hydraulic modelling and determined anticipated flood water levels across the site for these events. The modelling has incorporated the design surface, after earthworks detailed in the earthworks drawings referred to in Section 5. The flood modelling has also incorporated the hydraulic details of the proposed downstream twin box culvert and high-level overflow weir so that appropriate flood levels calculated from the modelling can be used to determine the minimum development levels adjacent to flood prone areas of the site.

The Awa modelling has been through several rounds of iteration, with adjustments made for revised ground profiles and downstream weir level adjustment and the final proposal achieves the balance of achievable ground levels, acceptable earthworks fill volumes, improved on-site flood storage/attenuation and avoidance/minimisation of increased flood extent and risk to upstream and downstream neighbours as much as is reasonably possible.

The final model output assesses expected floodwater depth within and beyond the site to confirm the potential adverse effects on the neighbours. The output for the 2130 100-year event model simulation is shown by Figure 18 below:

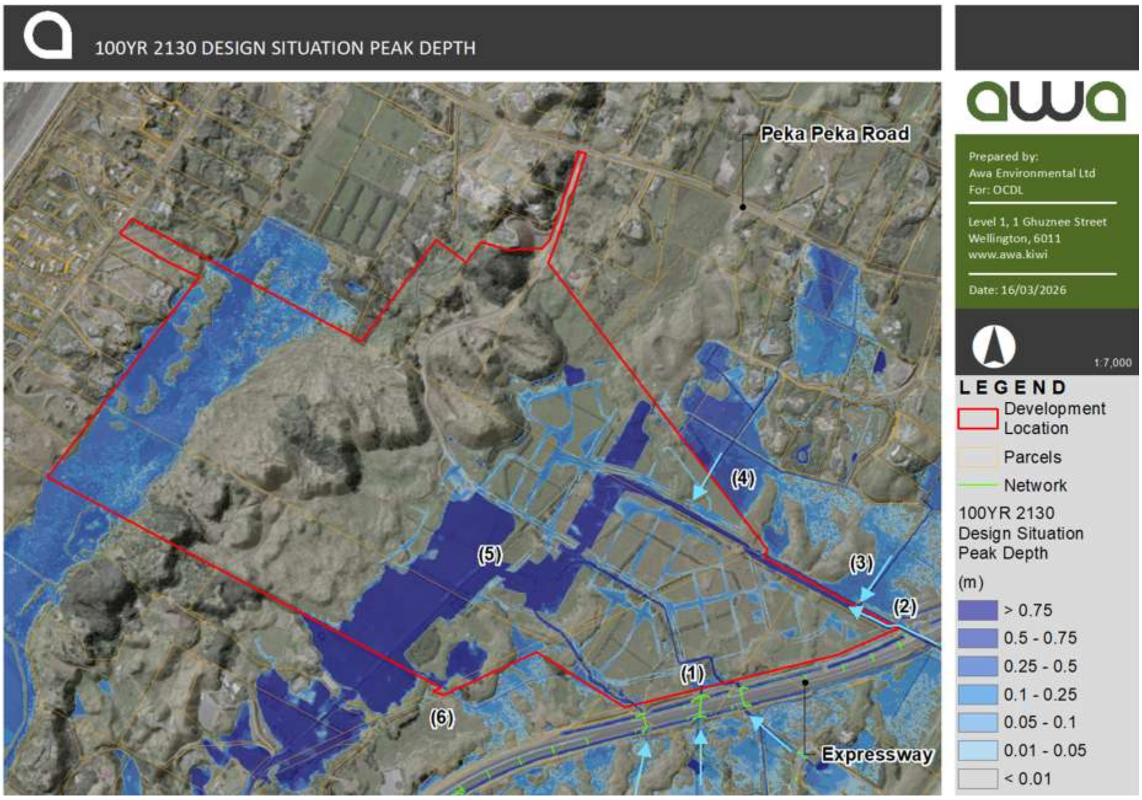


Figure 18 Awa Model Output For 2130 1 AEP Event

Awa have compared these predicted top water levels with pre-developed water levels for the same design event to assess expected changes in water depth resulting from the development. That assessment is shown by Figure 19 below:

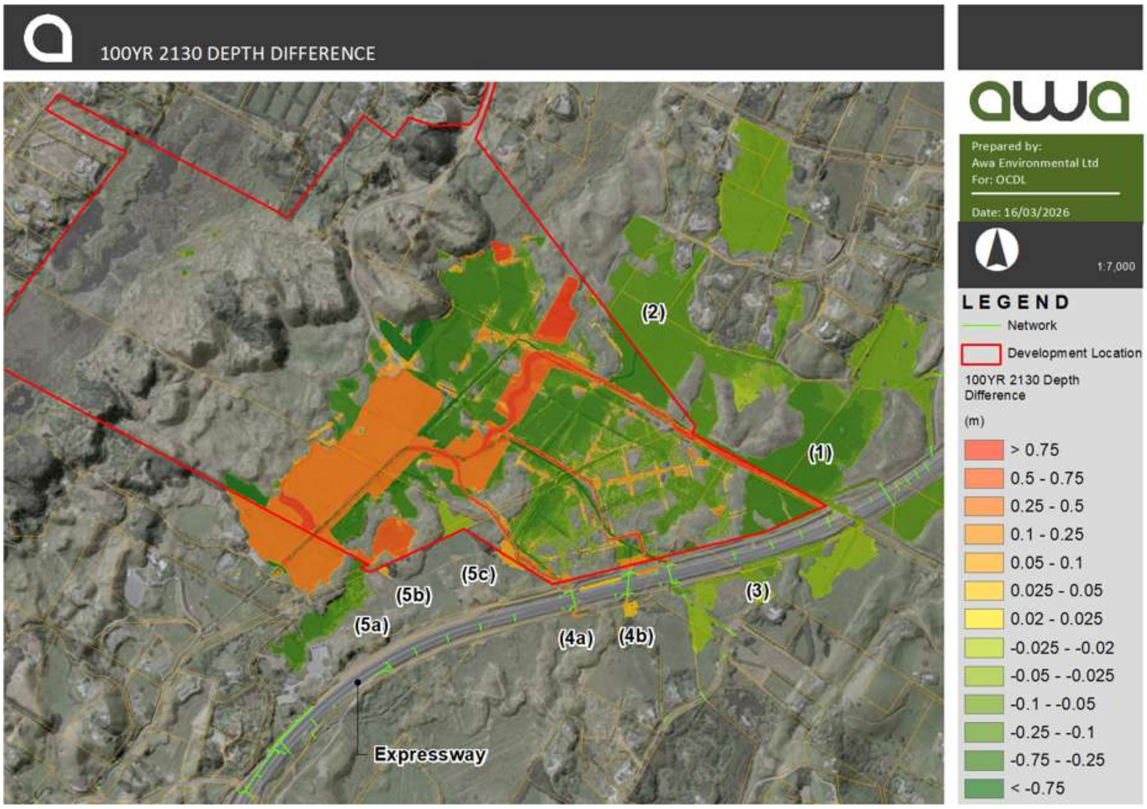


Figure 19 Predicted Changes in Flood Water Level

As can be seen from Figure 19, the ponding depth beyond the project site (area 5 to the south is considered within the project site with regard to flood assessment because it is part of the planned/controlled flood storage system and has landowner approval secured by way of an easement to use this area for floodwater storage) has a reduction in expected flood water depth (green) except for areas 4(a), 4(b), 5(b) & 5(c) notated on Figure 18. These minor increases are discussed in the Awa report. The area of potential additional ponding at 5(c) is influenced by the existing surface at the common boundary. It is envisaged that detailed design of the final finished surface in this area will include a low bund along the boundary to prevent ponded water within the development spilling over the boundary into the neighbouring property.

The areas of additional ponding at 4(a) and 4(b) are influenced by flow through the existing culverts beneath the Kapiti Expressway and the stream channel/culverts immediately downstream, within the development site. Modelling results indicate improvements in reducing hydraulic head loss in these downstream sections can be achieved at detailed design by slight increases in channel cross sectional area of the side drains. These improvements are expected to reduce the depth of additional ponding (and could eliminate it all together) that the existing model output has estimated at 4(a) and 4(b).

The final design surface, produced at detailed design stage will be used for final flood modelling, as part of the Engineering Approval process to confirm the changes/refinements incorporated as part of detailed design reduce any additional flooding on neighbouring property as much as is reasonably achievable.

The Awa Report concludes that the subdivision can largely be implemented with less than minor effects on surrounding flood levels.

The small 7-lot area accessed from Paetawa Road has a part of the road within the 2130 1% AEP mapped flood zone. The Awa model has confirmed a floodwater level of RL3.76 (1953 VD) in the area. The Awa model estimates the depth of water occupied by the part of the road is an average of approximately 0.25m and the area of development within the ponding area is approximately 4,000m^2. This area is to be raised by filling to form the road servicing the lots. The proposed earthworks will result in the loss of less than 1,000m^3 of existing flood storage, which is considered negligible when compared with the total storage capacity of the Te Harakeke Swamp area. The proposed lots are greater than 0.3m above the 100-yr flood water level (including allowance for climate change) and therefore are not at risk of flooding.

7.3 Improved Hydraulic Capacity of Ngarara Stream

As described in previous sections, the proposal includes reconstruction of some sections and re-alignment of another section of Ngarara Stream to achieve improved hydraulic control, increased flood management and ecological enhancement outcomes.

The proposed reconstructed cross section of the Stream and adjacent to the Stream are shown by drawings 2911-ALL-SW-432 - 434 (inserts below). The section of the upper reach where the Ngarara Stream is a few metres on the northern side of the site boundary is shown in Figure 20 below. This reach will include a new secondary flow channel formed within the development that will operate when the existing stream channel overflows.

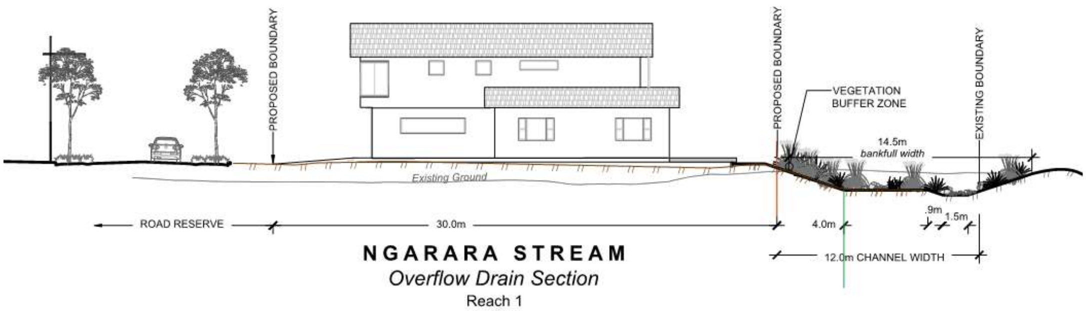


Figure 20 Upper Reach – Secondary Flow Channel

The secondary flow channel will merge with the Ngarara Stream where the stream enters the site, approximately 400m downstream from the Kapiti Expressway. This reach is shown by Figure 21 below:

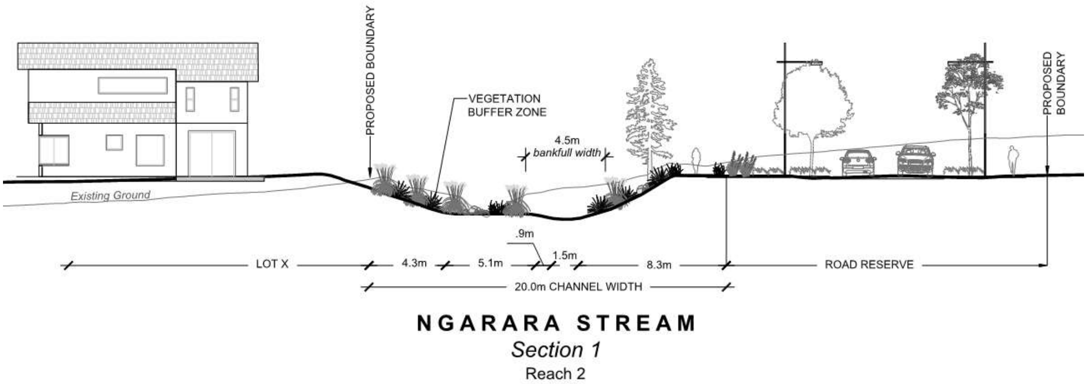


Figure 21 Proposed Ngarara Stream Cross Section - Reach 2

In the reach of Ngarara Stream from approximately 800m downstream from the Kapiti Expressway to approximately 1,350m, the Ngarara Stream will be re-aligned to the corridor beneath the power transmission lines as shown on drawing 2911-ALL-SW430. In this section of stream, the cross section will be as shown in Figure 22 below:

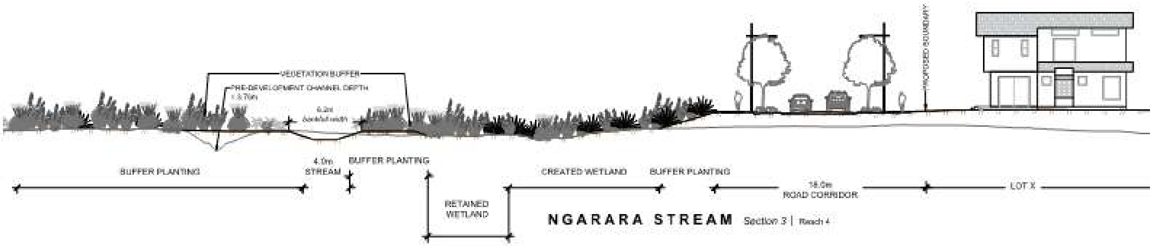


Figure 22 Proposed Ngarara Stream Cross Section 800 – 1350m

Below the realigned section of Ngarara Stream the reconstruction of the Stream banks is aimed at improving hydraulic control and the typical cross section is shown Figure 23 below:

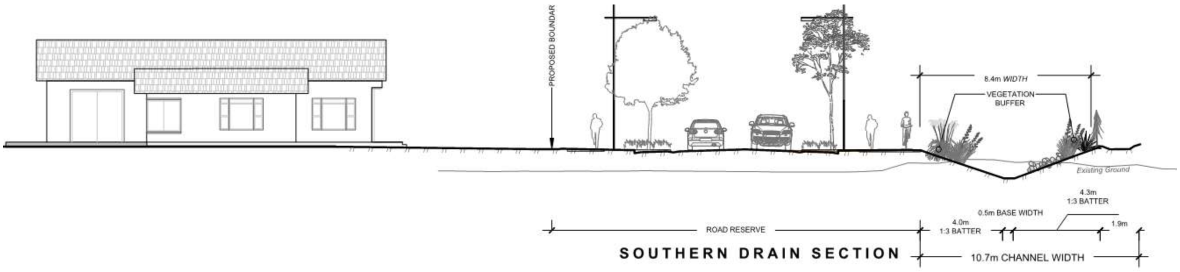


Figure 23 Proposed Ngarara Stream Cross Section 1400 – 1750m

As indicated in Section 5.6, it is proposed to construct the re-aligned section of Ngarara Stream and the associated downstream flow control structure as part of the Phase 2 earthworks. This phasing is to achieve an appropriate improvement in flood control for the site as progressive earthworks filling within the existing flood prone areas of the site takes place. The existing flood volume in a 2030 100-year design event is approximately 150,000m^3. The completion of the Phase 1 earthworks described in Section 5.6 will result in the loss of 6.4% of the existing flood storage. This is considered relatively minor when compared to the low probability of a 100-year flood event occurring within a small time period between phase 1B and phase 2 earthworks. Phase 2 earthworks filling will reduce existing flood storage by approximately 18%. This is considered a notable change in the existing situation and therefore the stream re-alignment and the construction of the downstream flow control structure will occur as part of the phase 2 works. This will result in an increase in available storage to approximately 210,000m^3, which will reduce over time to a minimum of 180,000m^3 as revegetated areas within the flood storage area develop to maturity and replace storage volume with vegetation bulk.

As outlined in the Hydrological Report, the realignment of the Ngarara Stream and construction of the downstream flow control system will result in an increase in the normal dry weather flow water level within the stream by approximately 0.3 - 0.4m through much of the Stream length within the site. This has been developed into the design of the Stream remedial works to achieve improved ecological outcomes.

The construction of the Ngarara Stream realignment section can be carried out “in the dry” for most of the works. This is indicated by Figure 24 below:

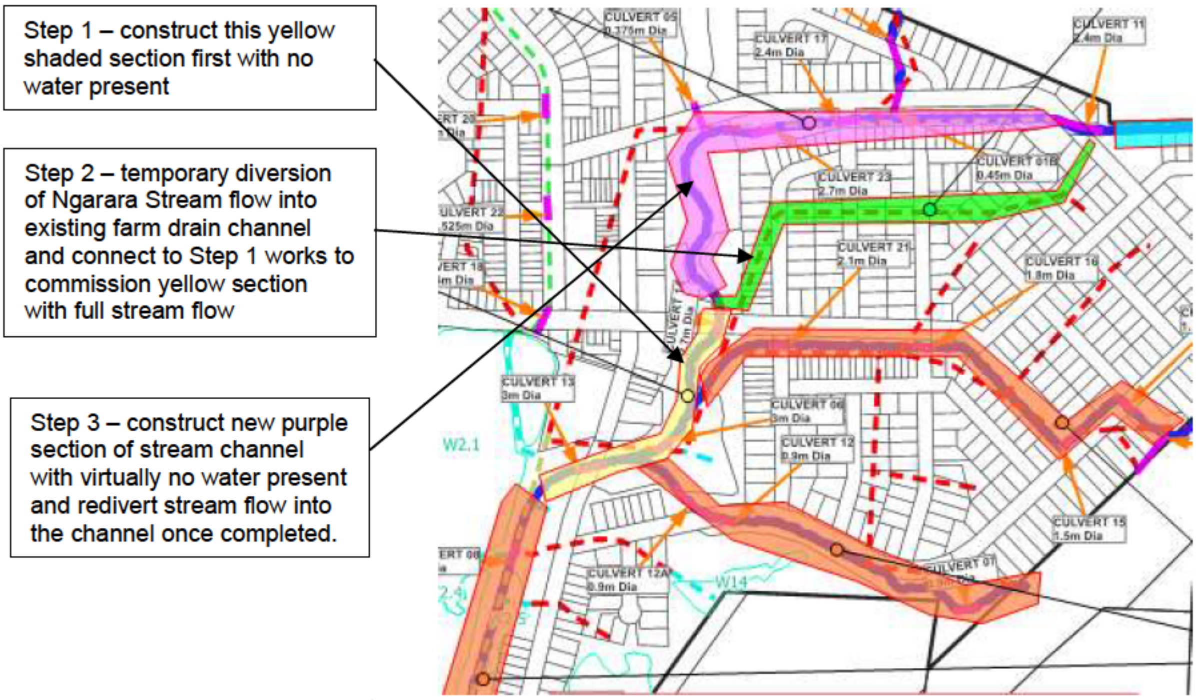


Figure 24 Phasing of Ngarara Stream Works

The section of Ngarara Stream downstream of the realigned section (orange/flesh colour shaded section) would be remediated in the Phase 3 earthworks phase, as would the other two existing farm drains shaded orange/flesh colour in the diagram above.

The top reach of the Ngarara Stream channel (shaded blue in Figure 23 above) is located on the adjacent property a few metres northeast of the site boundary. This channel is relatively small and the Ngarara Stream overflows its banks in this reach in minor rainfall events. The development includes the formation of a secondary overflow channel within the development footprint to manage secondary flows from the Stream. This secondary flow channel is shown in Figure 17 and is expected to be formed as part of the Phase 7 earthworks program.

This phasing of the Stream realignment works has been structured to minimise physical excavation within a flowing watercourse and to maximise erosion and sediment control outcomes. All work associated with the stream realignment will be carried out to the requirements of the CEMP and ESCP associated with these works.

7.4 Downstream Flow Control

The fundamental flood protection solution for this site is to construct and operate a downstream flow control system where the Ngarara Stream exits the project area in a manner that flood water is detained on the site, utilising a very large ponding volume (approximately 210,000m^3 in the 2130 100-year design event, excluding allowance for loss from vegetation bulk as remediation planting gets established) to manage flood flows such that they do not create any additional risk, scale or extent to upstream and downstream neighbours. This site is unique, due to its very extensive low-lying areas and this facilitates the adoption of this form of flood control for this development.

The flow control system consists of a twin box culvert, using 2m wide * 0.8m flow depth concrete culverts and a high-level overflow weir that will operate in the extreme flood events. The box culvert structure will be formed with a box culvert with an internal height of 1.2m and embedded 0.4m to provide greater than 25% minimum embedment for fish passage. This structure is shown by drawing 2911-ALL-SW-482. An insert of the drawing is shown by Figure 25 below:

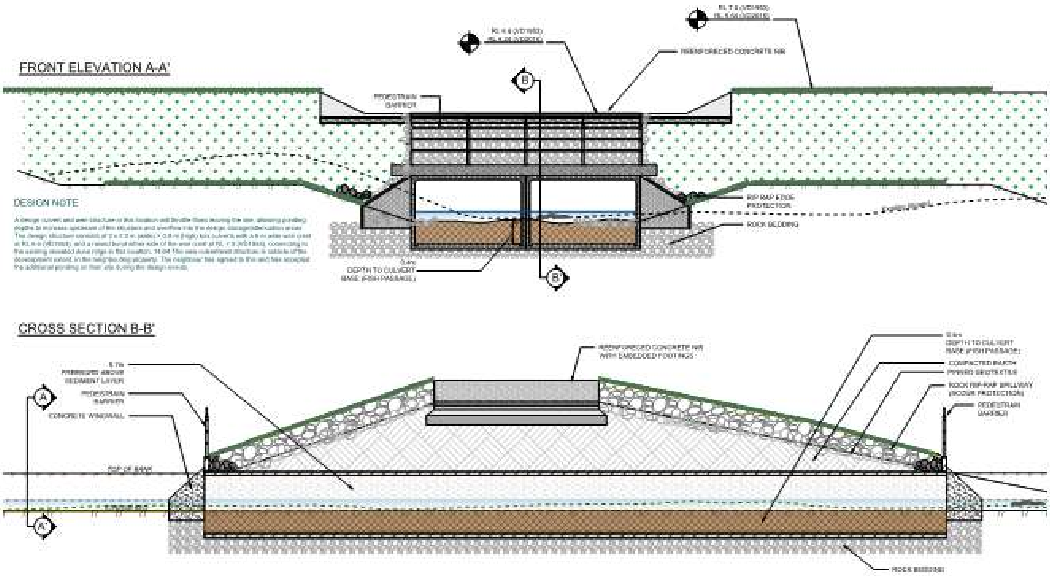


Figure 25 Ngarara Stream Flow Control System

To give an indication of flow condition in the 2130 100-year design event, the Awa model estimates a flow of 4m^3/s flowing through each box culvert and a flow of approximately 0.75m^3/s over the weir in the design event, as shown by Figure 26 below. The depth of flow over the weir would reach almost 0.2m at peak flow.

100YR 2130 DESIGN twin box culvert structure discharges and weir discharge.

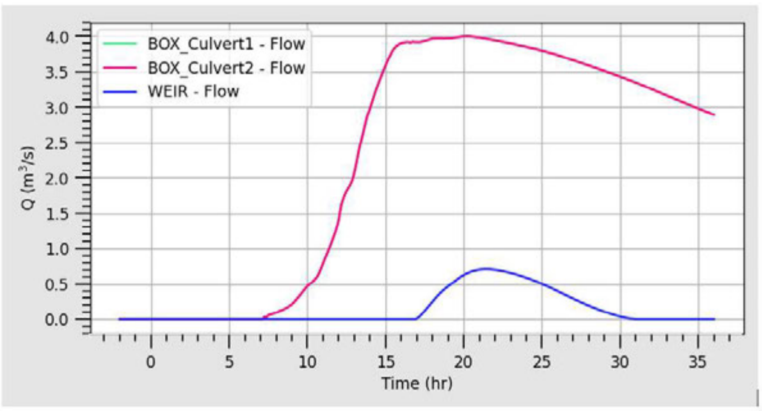


Figure 26 Flow Condition at Ngarara Stream Control System

The level of the weir (RL6.65(VD1953) = approx. RL6.3 (NCD 2016)) has been set to control the top water level of the flood water in design event. This then dictates the minimum new surface within the developed area to achieve the required protection from flooding, incorporating a freeboard allowance of 0.3m as a contingency for flood model error, safety factor etc. The modelling has also incorporated an allowance of 15% bulk for vegetation mass within the ponded volume during the 2130 1% AEP design event.

As described in the Ecological and Hydrological Reports, the remediation works in the Ngarara Stream includes the placement of gravel in the bed and the creation of some vertical gradient variation to provide some habitat variability.

Consideration has been given to the potential for gravel build up in the box culverts and thus the potential concern relates to possible gravel build up leading to higher water levels than desired in the upstream Ngarara Stream. The velocity in the stream channel is less than 0.5m/s in the re-graded Ngarara Stream at normal to modest rainfall event flows. There is minimal gravel in the existing Ngarara Stream within the site. The proposed realignment and upgrading of the Ngarara

Stream within the site will include the placement of gravel in the bed to improve habitat diversity. The velocities in the reconstructed Ngarara Stream, even at a 50% AEP event are estimated to be less than 0.7m/s and these are sufficiently low to not initiate bed movement of the mixed gravel bed. Therefore, there will not be a supply of gravel to the box culvert to trigger gravel build up. Notwithstanding this, the annual flow in the Ngarara Stream in a 100% AEP event (i.e. annual event) is expected to be approximately 500l/s. This flow will be passed through the twin box culvert at a velocity of approximately 0.8m/s. This velocity is higher than the velocity upstream and so it is expected that any bed material transported to the box culverts will be transported through the box culvert during that event because the velocities in the box culvert will be higher than the velocities in the upstream Ngarara Stream.

7.5 Stormwater Management Strategy For On-site Runoff

Stormwater management for the surface water generated within the site is based on a coordinated catchment-based strategy that incorporates treatment, conveyance, and attenuation, to achieve a low-impact stormwater solution for the project that will achieve stormwater neutrality.

The SMP, prepared by Landlink, describes the sub-catchments within the site, how stormwater runoff from developed areas will be collected, conveyed, treated and discharged using a range of technical solutions to achieve a low-impact stormwater outcome. These have been incorporated into the hydrological assessment of the site, as described in the Hydrological Report, prepared by OCDL.

The SMP confirms:

- All road runoff and direct-discharge sub-catchments receive water-quality treatment via bioretention basins/swales sized from a representative 1Ha post-development model run;
- Site-wide hydraulic neutrality is achieved overall;
- Primary conveyance (10% AEP) sits within road corridors; exceedance (1% AEP) follows mapped overland paths to Ngarara Stream, site drains and wetland corridors;
- Device layouts follow GD04/WSUD principles and the SMP template structure (resources, constraints, framework, responses), integrating with ecology and hydrology strategies;
- Groundwater treatment devices fit within reserve footprints. Where seasonal groundwater is high, lined bioretention with underdrains is adopted; where still constrained, proprietary filtration (e.g. Hynds Up-Flo, SPELFilter, Atlan) provides equivalent treatment in the same or smaller footprint. Device selection will be confirmed at detailed design informed by ongoing groundwater monitoring.

The SMP sets out the strategy and design basis for the stormwater solutions adopted, sub-catchment characteristics, performance criteria to be met, treatment devices to be used, preliminary design sizing of treatment devices and operation and maintenance considerations.

Expected stormwater runoff from the developed areas of the site have been assessed with HEC-HMS modelling of a 1Ha typical area and extrapolated over the various sub-catchments. The assessment has been used to size stormwater treatment devices and primary pipe sizing.

As described in the Hydrological Report, management of stormwater runoff from within the site has been structured to enhance wetland ecological outcomes. This has led to a proposed strategy where there is a different stormwater disposal system for different parts of the site. As shown in Table 5.1 of the SMP Report, some areas of the development will discharge stormwater runoff from roof areas direct to a conveyance system terminating adjacent to the low-lying central and eastern wetland areas and will have on-lot water re-use storage but will not have additional attenuation or treatment volume. These are referred to as “direct-discharge lots” in the SMP Report. Attenuation and treatment will be at centralised basins as shown on the design plans (green shaded lots discharging to yellow shaded treatment basins shown in Figure 27 below (drawing 2911-ALL-SW-401)) for these lots.

Figure 27 Lot Discharge Types

A second grouping of lots is described in the SMP Report as attenuated/treated discharge lots. These are the purple lots shown in Figure 27 above and have on-lot attenuation and/or soakage as part of the on-lot stormwater disposal solution.

There are some small groups of lots in the northwest and western area of the site where there is no public network connection for stormwater (orange shaded area in Figure 27 above) and these will discharge to soakage for the 1%AEP design event.

The treatment devices include bioretention basins, bioretention swales and bioretention basins with soakage. These devices have been sized to achieve the required Water-Quality Volume design storm. The SMP Report sets out the method of sizing these devices.

The above solutions are shown on drawings 2911-ALL-SW-402 - 429, an insert of sheet 402 is shown in Figure 28 below:


Figure 28 Stormwater Catchments and Features

Further technical detail, including design parameters, treatment performance, and model results, is provided in the supporting SMP Report appended to the application.

7.6 Management of secondary Flow

Secondary flow will occur when the primary stormwater system capacity is exceeded. The key principle of management of secondary flow is to direct and contain the secondary flow in flow paths that avoid undesirable flooding and/or damage. As a priority it is better to contain secondary flow to flow paths in roads and public space, rather than private property. The design process combining the potential influence from surface profile, stormwater elements and private lot layout can achieve the required outcomes for management of secondary flow.

The management of secondary flow for the proposed development will ensure that secondary flow is not directed onto private property. The Overall Stormwater Management Plan (drawing 2911-ALL-SW-402) shows the direction and position of the secondary flow paths, and an insert of this drawing is shown as Figure 28 above.

As can be seen from drawing 2911-ALL-SW-402, secondary flow paths direct secondary flow along roads and open space areas to the stormwater treatment basin areas, to the flood storage areas and to open space areas. Thus, private property is protected from secondary flow.

8.0 WASTEWATER

8.1 General Reticulation

Wastewater servicing for the development will consist of a reticulated gravity network draining to two on-site wastewater pump stations and a twin rising main connection to the Kāpiti Coast District Council network. The 7-lot one accessed off Paetawa Road will not connect to the public wastewater reticulation system and will have on-site wastewater disposal.

All wastewater infrastructure will be designed in accordance with:

- NZS 4404:2010 – Section 5;
- KCDC LDMR22 Schedule 5; and

An overview of the proposed network is shown on drawing 2911-ALL-WW-500, indicated by Figure 29 below:

Figure 29 Wastewater Network

Drawings 2911-ALL-WW-501 – 515 show the full proposed wastewater network layout.

It is proposed that all wastewater reticulation (except private laterals) and the two pump stations with associated rising mains will become public infrastructure at time of issue of 224(c) certification for the progressive stages containing this wastewater infrastructure.

The gravity wastewater reticulation system will comprise industry standard pipe materials, manholes and lateral connections all complying with NZS4404:2010 and KCDC design standards. This compliance also includes minimum cover to pipes and clearance from other services. Because large areas of the site are quite flat, minimum grades recommended in NZS4404:2010 (Table 5.4) will be used where necessary and will be complied with. Slightly steeper gradients will be used where possible to achieve improved minimum velocities. Clause 5.3.5.6 of NZS4404:2010 deals with managing potential adverse hydraulic conditions when velocities in gravity mains exceed 3m/s. It recommends adoption of design solutions set out in the Australian Standard WSA02 where velocities approach and/or exceed 3m/s. We confirm that there are no sections of gravity wastewater reticulation that will operate with a velocity approaching or greater than 3m/s because the pipe grades are not steep enough to generate these velocities.

8.2 Wastewater Pump Stations

The topography of the site dictates the need for two wastewater pump stations: a smaller pump station in the western area servicing approximately 180 dwellings that will pump to a central main wastewater pump station designed to collect the wastewater from the remaining 1,020 dwellings (approximate) and convey all wastewater to KCDC wastewater network approximately 1,600m to the south (see Section 8.3).

The expected design flows for these pump stations are shown in Table 5 below:

Design population per dwelling unit =	3					
Average daily flow/person =	250	l/p/d	(i.e. in dry weather)			
Wet weather peaking factor for Main PS	4		Is expected to be less but much of the site is flat, groundwater is shallow in places and some pipes are deep, so design for additional I&I over time.			
Commercial flow rate =	0.5	l/s	per Ha			
Catchment	No of Lots	Area	Population	Aver. Daily DW Flow (m3)	ADWF (l/s)	PWWF (l/s)
Main Central Pump Station						
Residential dwellings	1,020		3,060	765	8.9	35.4
Commercial		0.5		22	0.3	1.0
Total	1,020		3,060	787	9.1	36.4
Western Pump Station	lower wet weather flow peaking factor (higher sites, sandy soils etc) PWWF =3 * ADWF					
Western Area	180		540	135	1.6	4.7
20 hrs ADWF emergency storage				113		
Combined Flow at Main PS	**1,200**	**0.5**	**3,600**	**922**	**10.7**	**41.1**
20 hrs ADWF emergency storage (m^3)				**768**		

Table 5 Design flows for wastewater pump stations

The proposed wastewater reticulation in the western area of the site will discharge to a western pump station shown on drawing 2911-ALL-WW-507 (Figure 30 below). This wastewater pump station will discharge to a rising main that will connect to the reticulation system under the main inlet road and flow by gravity to the main wastewater pump station near the local centre.

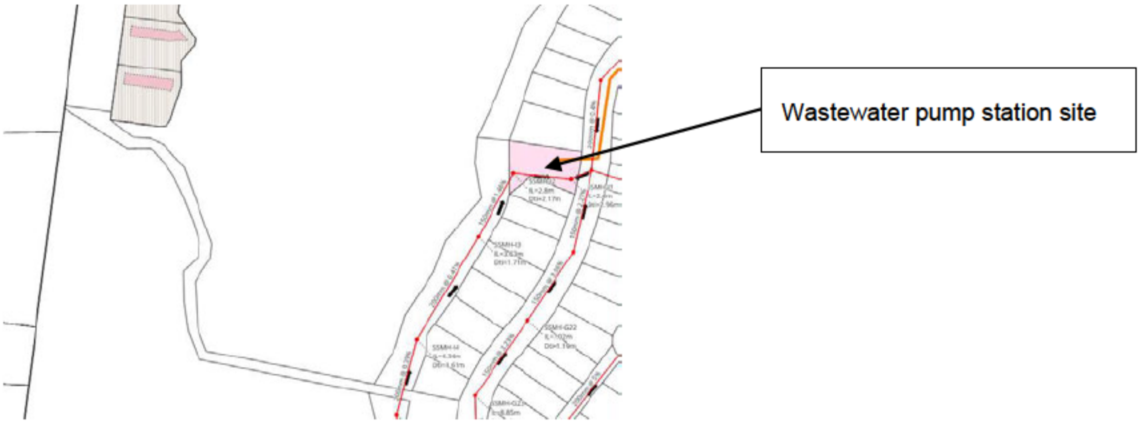


Figure 30 Western Wastewater Pump Station

As indicated by Table 5 above, this pump station is expected to have an emergency storage volume of approximately 115m^3 to provide storage for 20 hours normal ADWF. This is expected to be achieved with the use of a 17m length of horizontal 2.1m diameter concrete storage pipes.

The wet well is expected to be constructed using 2.4m diameter vertical concrete pipe sections to a depth of approximately 4.5m. The pump station will contain a duty and standby pump arrangement.

The wastewater reticulation servicing the central, northern and eastern areas of the site will operate by gravity and will discharge to the main wastewater pump station near the local centre.

The location of the main wastewater pump station near the local centre is indicated by Figure 31, which is an insert of drawing 2911-ALL-WW-509 below:

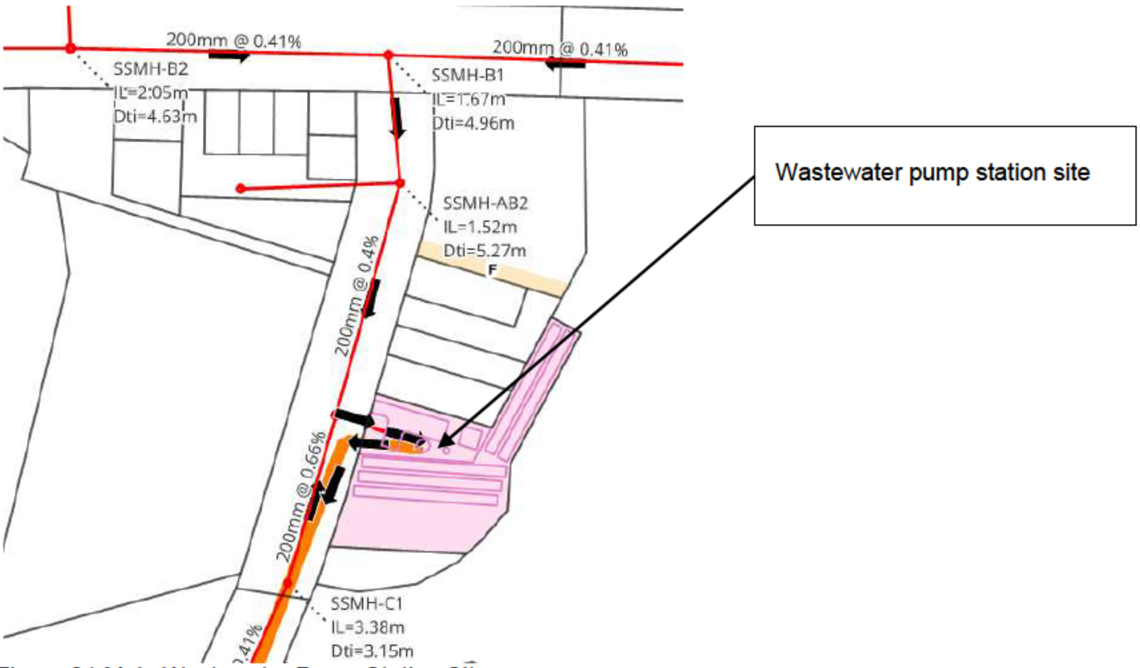


Figure 31 Main Wastewater Pump Station Site

The main wastewater pump station is a medium size pump station in industry terms. The peak wet weather flows into the pump station, including flows from the western pump station, are expected to be approximately 40 L/s at full development. This estimate is based on a potential wet weather infiltration and inflow (I&I) multiplier of approximately 4 (i.e. PWWF ≈ 4 × ADWF). NZS 4404 derives wet weather design flows by combining dry weather peaking factors with a separate allowance for dilution and infiltration, rather than prescribing a single overall multiplier. The adopted value is considered consistent with this methodology. On this site, a portion of the wastewater reticulation connected to the main pump station will be constructed below the groundwater level, with some sections at significant depth (up to approximately 4.5 m). These factors increase the risk of infiltration into the network and have influenced the adoption of a precautionary allowance for potential wet weather I&I. In practice, it will be several years before full build-out of the development is reached, and actual I&I will be monitored as part of normal pump station operation (via flow metering). It is anticipated that pump upgrading and/or replacement in the final stages of development can be refined at that time to reflect observed flows, if lower than currently provided for.

The main pump station will require approximately 770m^3 of emergency storage to provide 20 hours storage at ADWF conditions. This will be provided in 2 stages. The first stage is expected to involve the construction of 2 storage tanks, each comprising a 34m long section of 2.4m diameter concrete pipe, laid almost flat, giving a storage volume of approximately 300m^3 in addition to an extra 10m^3 provided in the wet well above normal pump operation when 2 pumps are running. The stage 2 emergency storage tank system is expected to comprise three similar sized 2.4m diameter pipes, 34m long, giving a further 455m^3 storage.

The multiple pipe storage system requires appropriate clearance between pipes to enable sufficient access for construction, access manholes for observation and maintenance, flow distribution and an ability to construct the stage 2 system in a deep, wide excavation without disturbing existing infrastructure. The concept layout shown in Figure 32 below addresses these matters.

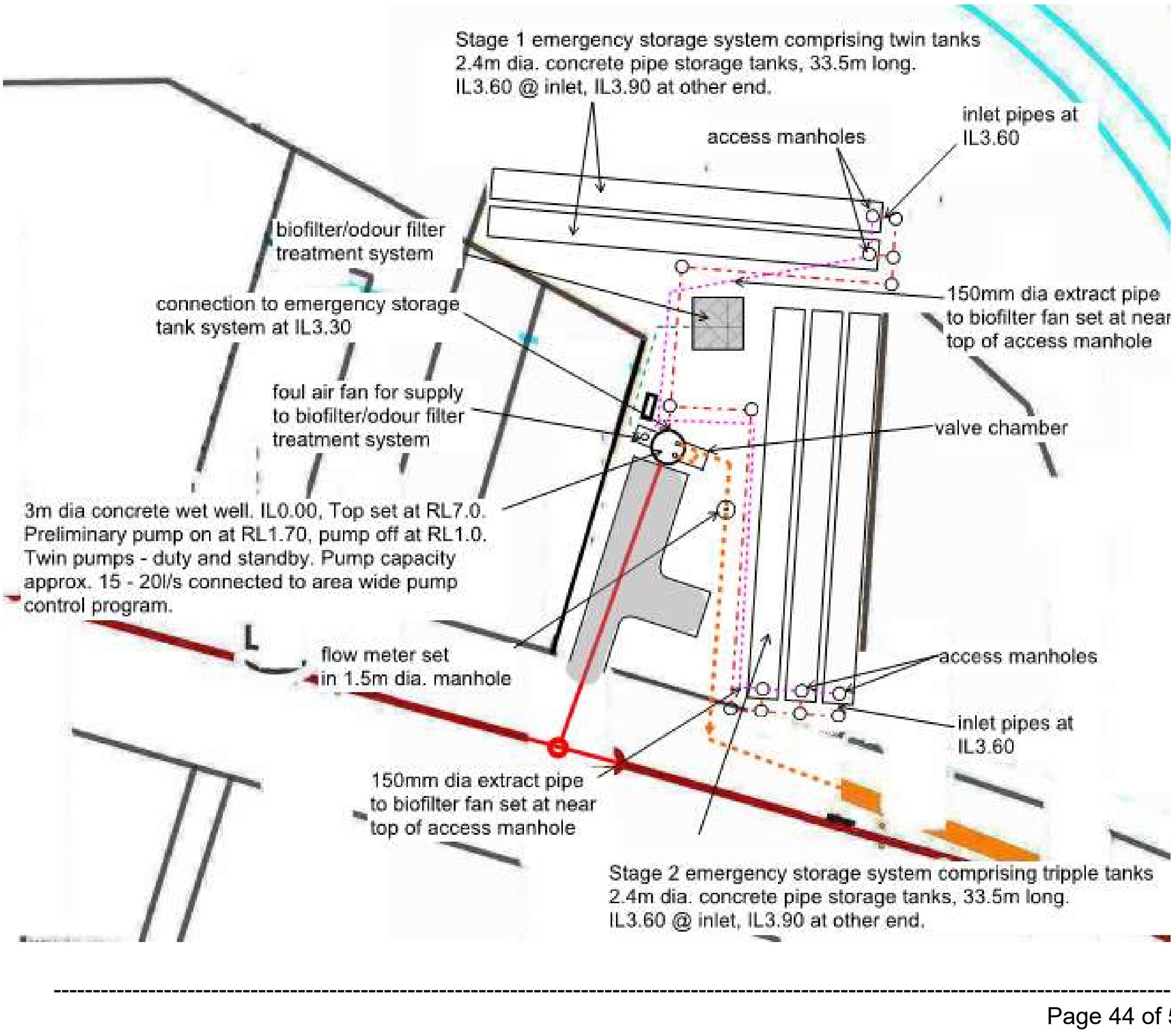


Figure 32 Concept layout of main wastewater pump station

As shown in Figure 32, the wet well is expected to be constructed as a 3m diameter chamber with a depth of approximately 7m deep. There will be a 2-pump arrangement, being duty and stand-by. As the flows will be relatively low in the first few years of the development, we anticipate one of these pumps will have a smaller capacity matched to the lessor flows (approximately 10l/s pump capacity). Once the development has extended beyond 60 – 70% it is expected that pump sizing would be reviewed and pumps resized or modified to deal with a full flow design capacity. That assessment would be in 10 – 15 years' time and would consider other network operational issues to arrive at an efficient pumping regime for the system.

The pump station has a large wet well and significant storage, which raises the potential for foul air, containing some corrodible contaminants causing undesirable corrosion of the concrete structures. This will be controlled by a foul air extraction system that will discharge collected air from the chambers to a specifically design bio-filter odour bed treatment system. This is indicated on Figure 32 above.

It is expected that the operation of this pump station will be coordinated with other main pump stations in the area to optimise peak wet weather flows to the network. The storage provided at this pump station is equivalent to 5 hours of full wet weather flow (40l/s) with no pump operation. As there will be some pump operation during this period, we are confident the flows from this pump station can be appropriately managed without compromising the capacity of the downstream network.

The final design of the pump station will be in accordance with KCDC design standards and in accordance with good industry practice. Relevant layout and design information is shown in the development plans submitted with this application.

8.3 Connection To Existing Wastewater Network

It is proposed to construct the rising main from the main wastewater pumping station near the local centre to discharge to an existing KCDC wastewater manhole (KWWN001460) in Ngarara Road, near the driveway entrance to 298 Ngarara Road. The bulk wastewater main is a 525mm diameter at this connection point. This connection is shown on drawing 2911-ALL-WW-550 and an insert of this drawing is shown by Figure 33 below:

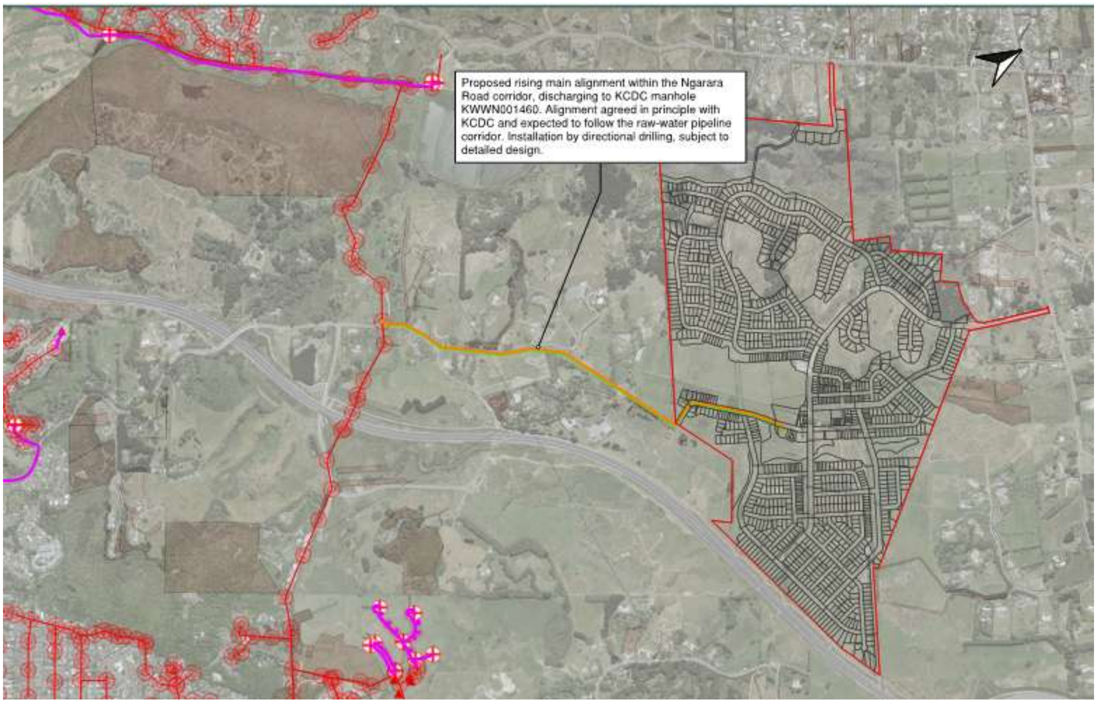


Figure 33 Bulk wastewater connection to KCDC network

The estimated design flows for the development are set out in Table 5 above. The rising main from the local centre pump station to the KCDC termination manhole will be approximately 1,600m long and will be constructed with HDPE (SDR17 PN10) pipe. The design flows for the development increase over the years as more occupied dwellings become connected to the system. This creates some difficulty for large developments serviced by a pump station because there are other technical factors that need to be managed, such as maintaining minimum velocities and limiting retention in the rising main in the early phase of development when the flows are relatively small.

Preliminary design assessment indicates a likely twin rising main solution to deal with these matters. Both rising main pipes would be installed at the commencement of construction. In the first few years the first stage rising main is expected to be a 125mm OD HDPE DN10 pipe that will pass a flow of 10l/s with a head loss of approximately 32m, at a velocity of 1.05m/s. These operational parameters are within normal industry standards and minimise retention time in the rising main.

Once flows into the pump station begin to exceed the capacity of the Stage 1 pumping system, which is expected to be at about 50% of development occupancy, assuming only reasonably modest I&I in the earlier years (i.e. multiplier of about 2) the second rising main can be commissioned. The second rising main is expected to be a 180mm OD HDPE DN10 pipe that will pass 20l/s at a velocity of 1.01m/s and a head loss of 20m over the length of the rising main. It is anticipated that the larger rising main might be operated as the sole rising main (i.e. the smaller rising main is temporarily isolated) for the phase of the project up to about 900 dwelling units, depending on actual I & I flow.

In the ultimate situation, both rising mains can be operated with a combined flow of 40l/s at a head loss of 42m if the full wet weather I & I flow turned out to be as indicated in Table 5. Conversely, the pumps could operate at a lower combined flow with a corresponding lower head loss if I & I was less than shown in Table 5.

The assessment of the final pump selection would be done at detailed design stage.

An assessment of the capacity of the KCDC wastewater network downstream of the proposed connection point was carried out by Hydraulic Analysis Limited (HAL) in 2022 for KCDC. Their assessment considered a medium density development (500 lots) and a high-density development (1,000 lots). The proposal has now been refined to up to 1,200 residential lots (including apartment units) and so the HAL Report should be considered with the focus on the high-density projections.

The HAL report concluded that the proposed development, in conjunction with other planned development within the catchment through to 2051, will require the upgrading of the pumping system at the Waikanae pump station and upgrading a storage pond facility. The upgrading required includes increasing the capacity of the pumping equipment to the Rauparaha pump station from the existing 90l/s to something greater than 130l/s, in association with the second rising main from the Rauparaha rising main being commissioned. The work is also expected to include lining the Waikanae pond to utilise it for wet weather overflow storage.

We understand KCDC intend to update the HAL assessment, with inclusion of design flows from the WNDL project and other known projects that have progressed since the previous HAL assessment. KCDC has a planned upgrade program in place, and the planned works incorporate capacity for the proposed development, incorporating the findings of the previous HAL assessment and are expected to include on-going assessment information. These works will ensure the receiving KCDC network has sufficient downstream capacity to accommodate the development. The proposed wastewater solution for the development therefore integrates with Council's long-term infrastructure planning. KCDC's 3-Waters team has reviewed the servicing approach and provided technical input to support the proposed approach.

<u>Planning Considerations:</u>

The proposed duplicate rising main alignment from the site to the discharge manhole on Ngarara Road includes sections that traverse areas identified in the District Plan as stream corridors and ponding areas. As a result, the works do not meet the permitted activity standards of Rule INF-PNU-R5 and are therefore considered as a restricted discretionary activity under Rule INF-PNU-R13. The non-compliance is limited to these identified flood-related overlays. The alignment does not coincide with other areas referenced in Rule INF-PNU-R5, including ecological sites, outstanding natural features and landscapes, and heritage areas.

The rising mains are anticipated to be installed using horizontal directional drilling (HDD) along the unformed sections of the route, generally aligning with the existing raw water bore infrastructure. Within the formed sections of Ngarara Road, installation is expected to be undertaken using conventional trenching methods, with reinstatement of ground levels and surface conditions following installation. The pipes will be fully sealed, with no permanent above-ground structures within the identified flood areas, other than minor appurtenances (e.g. air valves), which will be located and designed to avoid adverse effects.

The design approach ensures that the installation of the rising mains will not alter flood storage capacity, flow paths, or flood levels. HDD installation through unformed flood-prone areas will minimise ground disturbance, while trench backfilling and reinstatement within formed areas will maintain existing ground contours and hydraulic performance. Above-ground appurtenances will be appropriately located and detailed to avoid obstruction of flow paths. Accordingly, no measurable change to flood behaviour is anticipated.

The effects of the proposed works have been assessed having regard to the characteristics of the receiving environment, the nature of the works, and the temporary and localised extent of construction activities. On this basis, the installation of the bulk rising mains along the proposed route is considered to result in no more than negligible adverse effects.

9.0 WATER RETICULATION

9.1 Connection to the Existing Water Reticulation Network

The proposed development will be connected to the KCDC water reticulation system. There are options for where and when the connections will be constructed, depending on other KCDC and private development progress over the next 1 – 2 years. Both options are expected to be ultimately constructed to provide connectivity and resilience in the water supply network. Therefore, the choice of option is more about which option best fits with the initial 200 – 250 lots at the development, with the second option being implemented as phase 2 bulk water infrastructure.

KCDC have confirmed that there is sufficient water supply available and the main variable is which pipeline connection progresses first.

The project has been progressed with two confirmed viable options for connection, each incorporating a connecting pipeline in legal road so that there are no third parties involved in land access approval.

New bulk water infrastructure is progressing along the old SH, towards the north to service other developments. This option is therefore currently seen as the most likely option for connecting the first phase of development at the WNDL site. This option is shown by drawing 2911-PH1-WS 650 and an insert of this drawing is shown by Figure 34 below:

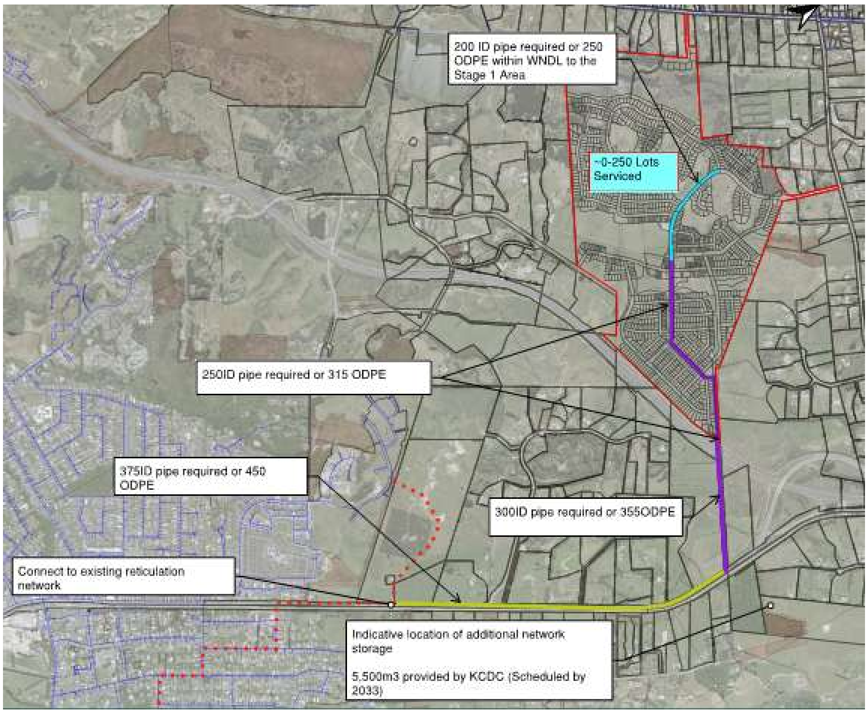


Figure 34 Phase 1 Bulk water supply connection to the development

This Phase 1 connection would service up to approximately 250 lots, beyond which it is considered that a second connection would be required to provide security of supply in the event of a shutdown or failure of the initial supply pipe system. However, the Phase 1 pipes have been sized to provide sufficient flow and pressure to a wider developed area and form part of a greater future network.

Phase 2 would involve elements shown on drawing 2911-PH2-WS 651 and an insert of this drawing is shown by Figure 35 below:

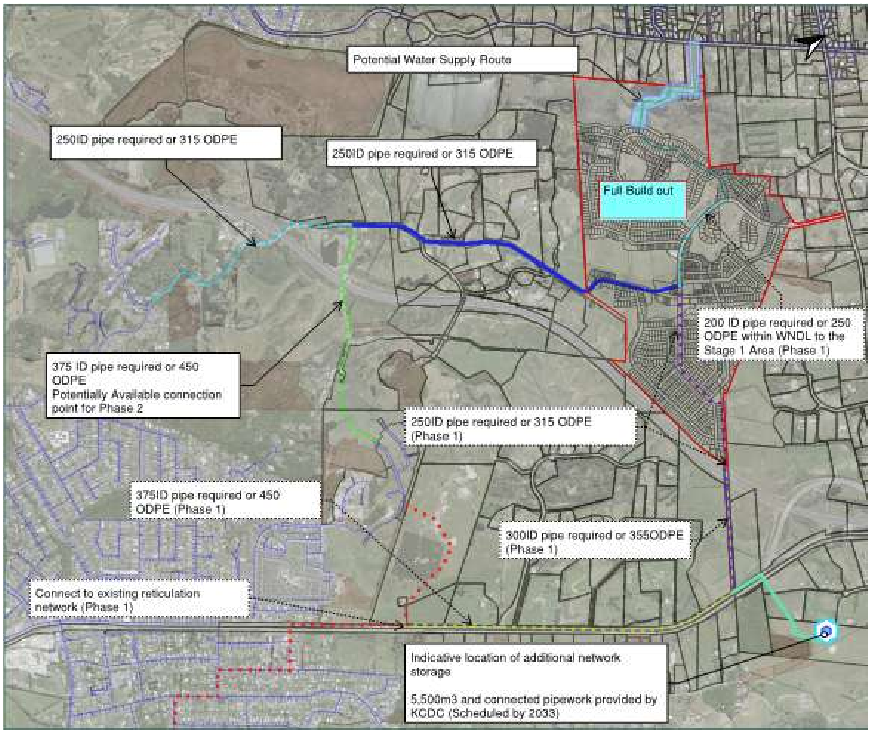


Figure 35 Phase 2 Bulk Water Connection

The Phase 2 expansion of the bulk water connection to the site involves a connection to the existing water network in Ngarara Road, or alternatively a connection to the network at Manu Park, if KCDC has progressed reticulation extension in that area. Either option will provide the required resilience connectivity.

Figure 35 also shows a new reservoir on the eastern side of the Kapiti Expressway. Current KCDC planning is aiming to commission this reservoir by 2033, assuming current development activity continues. KCDC has now identified and secured the reservoir site and is expected to progress the design and construction of the reservoir to match the pace of development demand.

KCDC operates a water network model of the reticulation system and uses this model to refine expansion and upgrades to the network. KCDC engaged Stantec to assess the network requirements for the WNDL proposal in 2022 to confirm general upgrade pipe sizing and locations considered necessary to supply the proposed development. Stantec set out their assessment in their report dated 7 October 2022. The Stantec assessment also considered how water supply and pressure to other Waikanae and Peka Peka properties might be improved. The Stantec report concluded that network upgrading will be required as part of the proposed development. The Stantec Report assessed some watermain routes but not all options. Discussions with KCDC have agreed that another round of detailed water network modelling will be carried out at time of detailed design to confirm final pipe sizing and routes, taking into account progressive upgrade works that are currently being planned and/or constructed. This is a sensible, pragmatic and efficient process for on-going expansion of the water supply network.

9.2 Proposed Infrastructure

The proposed water reticulation layout within the development is shown by drawing 2911-ALL-WS-600. Additional drawings 601 – 613 show the proposed reticulation in greater detail throughout the development. An insert of drawing 600 is shown by Figure 36 below:


Figure 36 Water Reticulation Layout

Final design pipe sizing will be carried out at the detailed design stage and approved by KCDC before construction commences. The design will comply with KCDC design requirements and NZS4404.

Preliminary work and discussions with KCDC Engineering staff have confirmed that suitable flow and pressure can be delivered to the development to meet all standards, including fire-fighting requirements. The preliminary solutions, timing and costs have been incorporated into the draft Developer Agreement with KCDC.

9.3 Bulk Watermain Alignment – Planning Considerations

The bulk servicing pipeline routes represent the preferred solution for the ultimate servicing of the development and form a key component of the wider KCDC network build-out to support growth in the district. The proposed bulk watermain routes to the site, as presented in Section 9.1, include sections of pipeline that traverse areas identified in the District Plan as stream corridors and ponding areas.

As a result, the works do not meet the permitted activity standards of Rule INF-PNU-R5 and are therefore considered as a restricted discretionary activity under Rule INF-PNU-R13. The non-compliance is limited to these identified flood-related overlays. The pipeline route does not coincide with other areas referenced in Rule INF-PNU-R5, including ecological sites, outstanding natural features and landscapes, and heritage areas.

The pipeline will be installed below ground using conventional trenching methods, with reinstatement of ground levels and surface conditions following installation. The pipe will be fully buried and sealed, with no permanent above-ground structures within the identified flood areas, other than minor appurtenances (e.g. valves), which will be located and designed to avoid adverse effects.

The design approach ensures that the installation of the pipeline will not alter flood storage capacity, flow paths, or flood levels. Trench backfilling and reinstatement will maintain existing ground contours and hydraulic performance. Along Ngarara Road, the pipeline is anticipated to be installed within the road corridor, generally aligned with existing KCDC water infrastructure. In constrained locations, trenchless methods such as horizontal directional drilling (HDD) may be utilised to further reduce disturbance within flood-prone areas. Accordingly, no measurable change to flood behaviour is anticipated.

The effects of the proposed works have been assessed having regard to the characteristics of the receiving environment, the nature of the works, and the temporary and localised extent of construction activities. On this basis, the installation of the bulk watermain within the proposed routes is considered to result in no more than negligible adverse effects.

9.4 Water Demand Management

A Water Demand Management Assessment has been prepared for the Waikanae North development and is included as Appendix 2.

The assessment demonstrates that the proposed development achieves the Kāpiti Coast District Plan requirement to reduce household water demand by at least 30% relative to the 2007 summer average baseline. This is primarily achieved through universal water metering and the use of water-efficient fittings, with empirical data indicating reductions in the order of 48–53%.

Rainwater re-use tanks are incorporated across the development to provide non-potable supply to toilets and outdoor taps. A proportionate, lot-area-based approach to tank sizing is adopted, reflecting the relationship between available outdoor area and irrigation demand.

The proposed regime is summarised as follows:

- 101–200 m² lots: 1,000 L rainwater re-use tanks
- 201–300 m² lots: 2,000 L rainwater re-use tanks
- 301–400 m² lots: 5,000 L rainwater re-use tanks
- 400 m² lots: 10,000 L rainwater re-use tanks (or 4,500 L tank with greywater system)

This approach aligns with Kāpiti Coast District Council's indicative storage guidance and is supported by the assessment, which confirms that the combined effect of metering, fittings, and proportionate storage achieves the required demand reduction while appropriately managing peak network demand.

10.0 UTILITIES

The provision of third-party utilities is coordinated with the road corridor design described in Section 6.6. Services will be installed in accordance with KCDC LDMR trenching standards and utility provider requirements.

10.1 Power and Telecommunications

Underground power will be provided by Electra through transformers located within the site.

Fibre telecommunications will be installed by Chorus, Tuatahi First Fibre or an approved UFB provider.

Ducting will be coordinated within the berm, in alignment with water and transport services

10.2 Gas

No reticulated gas is currently proposed. Provision for future network extension may be included subject to market demand.

11.0 CONCLUSION

This Engineering & Infrastructure Report has been prepared in support of a planning approval application under the Fast-track Approvals Act for the proposed subdivision and urban development of 169-171 Peka Peka Road, Waikanae by Waikanae North Developments Ltd.

The proposed infrastructure and civil works design has been:

- Informed by technical assessments across geotechnical, stormwater, wastewater, water supply, transport, ecology, landscape and urban design;
- Coordinated with the development layout and staging strategy;
- Tested and verified through modelling, council consultation, and detailed design inputs.

The servicing approach:

- Aligns with Kāpiti Coast District Council's standards (LDMR 2022, NZS4404:2010);
- Responds to natural hazard and environmental constraints;
- Incorporates low-impact design principles and wetland integration;
- Is supported in principle by KCDC, with confirmation of network capacity and agreement to ongoing coordination.

All infrastructure is capable of being delivered in a staged, efficient, and resilient manner, ensuring that each phase of development is fully supported by appropriate servicing.

This report demonstrates that infrastructure requirements can be met to a high standard and that the proposed development is feasible, coordinated, and ready for implementation under the fast-track process.

APPENDIX 1

Correspondence From KCDC Confirming Infrastructure Capacity

APPENDIX 2

Water Demand Management Assessment