IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of the hearing (Stage 1) by the Waikato District Council on the Proposed Waikato District Plan

# STATEMENT OF EVIDENCE OF HAYDEN VINK (WAINUI ENVIRONMENTAL LTD)

Dated: 29 January, 2021

# Introduction

- 1. My full name is Hayden John Vink
- 2. I am a Civil and Environment Engineer employed by Wainui Environmental Ltd

# **Qualifications and Experience**

- 3. I have the qualifications and experience described in the following paragraphs.
- 4. I have a Bachelor of Engineering (Civil) from Auckland University
- 5. I am a registered member of Engineering New Zealand (MEngNZ).

# Code of Conduct

- 6. I have read the Environment Court's Code of Conduct for Expert Witnesses in the Environment Court of New Zealand and I agree to comply with it. My qualifications and experience as an expert are set out above. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.
- 7. The evidence that I give in these proceedings is within my area of expertise, except when I rely on the evidence of another witness or other evidence, in which case I have explained that reliance.

# Scope of evidence

- 8. The purpose of my evidence statement is to summarise my assessment of 3 waters engineering requirements for the planned site/development activities with a key focus on stormwater management. These requirements and suggested 3 waters management options are outlined in further detail within the Wainui Environmental Ltd Water Impact Assessment report.
- 9. In my evidence I address the following issues:
  - a. Summary of site/receiving environment
  - b. Statutory context

- c. Stormwater management issues and options
- d. Water supply
- e. Wastewater

# Site/Receiving Environment

10. The following key site characteristics/attributes are noted.

# Contour/Geology

11. Site contour comprises undulating to moderate slopes falling in a south to north direction towards Lake Puketirini. Geology within the Rotowaro Block is understood to comprise overburden filling of clay and silt material excavated from the historic Weavers Coal Mine. Geology within the Weavers Crossing Block is understood to comprise natural, in-situ clay material. Geotechnical investigations at the site have not included soakage testing of site soils however the identified soil types are considered to indicate limited soakage potential.

# Vegetation

12. The site has a more or less 100% pasture cover with no areas of notable/native vegetation. Areas of reeds within the sites are likely to indicate areas of saturated soils/seepage within the site.

# Drainage

13. All site drainage occurs as surface flows across the existing pasture cover with no defined watercourses within the site. There is one gully feature at the eastern end of the Rotowaro Block which drains via a culvert under the Lake Puketirini carpark to discharge to the lake. The balance of the Rotowaro Block drains as sheet flow into the adjacent reserve land eventuating in Lake Puketirini. Surface flows from the Weavers Crossing Block are collected within the Weavers Crossing Road open drain, discharging via an existing culvert under the road to a tributary stream just upstream of its entry point to Lake Puketirini.

# Lake Puketirini

14. Lake Puketirini comprises an artificial lake feature formed in the 1990's through flooding of the former Weavers Coal Mine pit. The lake is approximately 64m deep and comprises a valuable recreational resource for various contact recreation activities as

well as pedestrians/cyclists using the lake perimeter track. These values can largely be attributed to the lake's high water quality conditions which are likely attributed to a number of factors including:

- The lake's significant depth avoiding potential thermal stratification effects and maintaining recharge of clean/cold groundwater from the lakes depths;
- Reduced potential for adverse effects from koi carp burrowing contributing to sediment mobilisation; and
- Reduced catchment area with limited inputs from intensive dairy farm operations reducing nutrient inputs.
- 15. By contrast, the numerous natural, shallow lakes of the North Waikato area have been found to exhibit adverse water quality conditions which can be attributed to their physical condition (shallow, open water bodies) combined with both catchment inputs from agricultural landuses (nutrient inputs) and the impacts of introduced invasive flora and fauna including pest fish species (koi carp), water fowl (faecal inputs) and invasive aquatic weed species. Adverse effects in these systems include nutrient saturation/eutrophication and sedimentation deeming these systems unsuitable for contact recreation purposes.
- 16. The water quality values maintained within Lake Puketirni highlight the importance to ensure that the proposed development does not contribute to reduced/adverse water quality conditions in this lake.

# **Statutory Context**

- 17. Development of the subject site and in particular any discharges from the site development activities are subject to consideration/assessment under various statutory documents including:
  - Resource Management Act 1991;
  - National Policy Statement for Freshwater Management 2020;
  - Waikato Regional Policy Statement;
  - Waikato Regional Plan (WRP);
  - Waikato District Plan (WDP); and
  - Waikato River Vision & Strategy.

- 18. In addition, the following best practice engineering design guideline documents are identified to inform the design and installation of an appropriate stormwater management system for the site to avoid adverse discharge effects within the Lake Puketirini receiving environment.
  - Waikato Stormwater Management Guidelines 2020;
  - Waikato Regional Infrastructure Technical Standards 2018.
- 19. The intention is that the site's 3 waters infrastructure will be designed and implemented in accordance with these relevant guideline documents to ensure that any potential adverse effects are appropriately managed to avoid adverse effects. On this basis, it is considered that adherence to the relevant objectives and policies of the identified higher level planning documents will be maintained.
- 20. It is notable that stormwater discharge activities from the development site will be subject to detailed assessment through specific resource consent processes under the WRP and WDP to ensure compliance with these requirements.
- 21. As water supply and wastewater discharges from the development area are planned to utilise existing municipal connections, additional consent authorisations for these activities under the WRP are not relevant or necessary. However, design of water and wastewater infrastructure will again adhere to the best practice design/management methods outlined in the RITS and will be assessed as part of the subdivision consent process under the WDP.

# **Stormwater Management**

- 22. Potential stormwater discharge effects of the proposed development are noted as a key matter given the high values attributed to the Lake Puketirini receiving environment.
- 23. The existing agricultural use of the site is likely contributing to some adverse water quality impacts within Lake Puketirini associated with runoff from the site's pasture surfaces and associated stock grazing activities i.e nutrients (nitrogen/phosphorous), sediment and faecal matter/bacterial inputs. Similarly, conversion of the site to urban landuses presents a potential to contribute to adverse water quality effects with agricultural contaminants (nutrients/sediment) being replaced by urban generated

contaminants which are generally dominated by hydro-carbons and heavy metals associated with vehicular derived contaminants deposited on road surfaces.

24. The establishment of a formalised drainage system within the site presents an opportunity for capture and treatment of site runoff prior to discharge to Lake Puketirini. In this respect, a preferred stormwater management system for the site is described as comprising the following components:

# Primary Reticulation

25. The primary reticulated drainage network throughout the proposed development will comprise a piped network sized to provide a 10-year ARI level of service in accordance with the RITS.

# Secondary Overland Flow

26. Secondary overland flow paths will convey flows up to the 100-year ARI event safely through the site via the roading/reserve networks to Lake Puketirini.

# Sub-catchment Wetlands

- 27. Stormwater flows from the reticulated network will be conveyed to two stormwater wetland devices located within designated drainage reserve areas adjacent to Lake Puketirini. The wetland devices will be designed to provide full water quality treatment of all catchment flows in accordance with the design requirements of the WRC and RITS guideline documents.
- 28. Design of the wetland devices to provide specific attenuation/detention of increased stormwater flows to address potential downstream flooding/channel erosion effects is not warranted based upon all discharges occurring to the large capacity, quiescent Lake Puketirini receiving environment.
- 29. The use of sub-catchment wetland devices has been chosen as the preferred stormwater management method for the subject site for the following reasons:
  - The site has sufficient space to accommodate wetlands as the stormwater solution;
  - Wetlands have shown to be efficient and superior at improving water quality from urban developments in comparison to other stormwater treatment devices;

- They moderate the temperature of water through the dense planting associated with them (in comparison to stormwater ponds which have large areas of open water);
- They mimic natural processes of capture, settlement and biofiltration of catchment runoff prior to entering open water bodies as particularly prevalent within the North Waikato area;
- They provide multiple services/benefits including providing terrestrial and aquatic ecological values, and having positive amenity benefits as they provide recreational opportunities with walkways/cycleways as well as landscape/visual enhancement values.
- 30. The use of constructed wetland type systems for treatment of urban stormwater runoff discharges to aquatic receiving environments is widely accepted as best practice water quality management for these activities including numerous development sites and high volume roading catchments where development discharges occur to lakes or other high value receiving environments (e.g coastal harbours) including within the Waikato District and broader Waikato Region.
- 31. In the long term, the stormwater network including the wetland devices will be vested with the Waikato District Council for ongoing operation and maintenance to ensure the system's effective function in managing all potential urban stormwater effects.

# At-source Treatment Measures

- 32. There is a potential for further enhancement of stormwater treatment efficiencies within the development network if deemed necessary through provision of additional atsource stormwater treatment measures incorporated within the roading network such as raingardens or proprietary filtration devices. However, the need for these additional measures needs to be balanced against the additional operation and maintenance costs associated with provision of multiple, additional treatment devices.
- 33. In this instance, provision of these additional measures is not considered necessary on the basis that the catchment area does not comprise a high risk catchment for contaminant generation (i.e industrial/commercial) with the Lake Puketirini receiving

environment not known to have any existing water quality issues. However, it is recommended that consideration be given to the potential to incorporate these additional at-source measures within any higher traffic volume areas (e.g commercial carpark areas etc) as part of the detailed engineering design process.

#### Weavers Crossing Block Stormwater Management

34. The Weavers Crossing Village Zone development block presents a reduced potential for adverse stormwater effects based upon a significantly reduced development catchment area and reduced development densities. Stormwater management within this area is expected to utilise typical private, on-site stormwater management measures for this type of development including provision of a treatment swale device for accessway runoff and onsite attenuation/re-use systems (tanks) for lot development surfaces.

# Water Supply

- 35. The development site intends to establish water supply connection via extension of the existing WDC municipal supply network which currently extends to the western outskirts of Huntly in proximity to the site. Multiple existing water supply lines are identified which extend in proximity to the development site including along the boundary of the Weavers Crossing Block.
- 36. Initial consultation with Watercare Services Ltd did not identify any concerns or constraints in regards to connection to the existing water supply network. However, further investigations will be required to determine an appropriate water supply connection point for the development and any potential network capacity restrictions.

#### Wastewater

37. The Rotowaro Block residential development site intends to establish wastewater connection via extension of the existing WDC municipal supply network which currently extends to the western outskirts of Huntly in proximity to the site. Installation of a centralised wastewater pump station is anticipated to convey wastewater from the site up to the existing gravity flow reticulation network. Further investigations will be required to determine an appropriate wastewater connection point for the development and any potential network capacity restrictions.

- 38. There is no municipal wastewater connection in proximity to the Weavers Crossing Block which presents a feasible option for extension/connection to this area and hence wastewater treatment/disposal for the proposed Village Zone development lots will be required to implement on-site treatment/disposal methods.
- 39. The existing/adjacent rural residential lots within this area comprise established residential sites of around 1,000m<sup>2</sup> in area and are understood to discharge domestic wastewater via traditional septic tank treatment methods to ground disposal which suggests feasible conditions for these disposal methods.
- 40. This area will be subject to further geotechnical investigations to inform appropriate wastewater system design in accordance with both WRC and WDC requirements which will also comprise key information in determining the finalised Village Zone development lot number/sizes.

# Conclusion

- 41. The proposed residential development site/activities have been assessed to determine the ability to provide appropriate 3 waters servicing in accordance with relevant statutory requirements and design standards.
- 42. Potential stormwater discharge effects have been identified as a key concern based upon the high recreational/amenity values attributed to the Lake Puketirini receiving environment. Feasible stormwater management design options are identified to avoid adverse water quality effects in Lake Puketirni.
- 43. The existing WDC water and wastewater municipal reticulation networks extend in proximity to the site on the western outskirts of Huntly West providing opportunity for extension/connection into the subject site. Further assessment is anticipated in conjunction with Watercare Services Ltd to confirm specific design requirements and appropriate connection points.
- 44. Onsite wastewater treatment/disposal will be required for the Weavers Crossing Block Village Zone development area. Detailed design requirements for wastewater treatment/disposal will comprise a key aspect in determining finalised lot yield/configuration within this area.

45. Overall, the subject site area is considered to present feasible opportunities for 3 waters servicing to enable the planned residential development activities.

Dated: 17/2/21

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Hayden Vink

Attachment 1:

Lake Puketirini Residential Development – Water Impact Assessment

# LAKE PUKETIRINI RESIDENTIAL DEVELOPMENT - WAIKATO DISTRICT PLAN REZONING

WATER IMPACT ASSESSMENT

Terra Firma Resources Ltd



# **Document history and status**

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#### **1** INTRODUCTION

Terra Firma Resources Ltd (Terra Firma) are the owners of a number of land parcels located around the southern shores of Lake Puketirini, Huntly accessed via Rotowaro Rd and Weavers Crossing Rd. The subject land parcels are located on the western outskirts of the existing Huntly urban area. The main land parcel accessed off Rotowaro Rd (the Rotowaro Block - Pt Lot 2 DPS 61669 - 26.1ha) currently has a recreation zoning under the OWDP and a rural zoning under the PWDP. A smaller land parcel accessed off Weavers Crossing Rd (the Weavers Crossing Block - Lot 1 DPS 61669 & Allot 9C Pepepe Parish – 1.94ha) has a rural zoning under both the OWDP and PWDP.

Terra Firma has a submission on the Proposed Waikato District Plan to establish a residential zoning on the Rotowaro and Weavers Crossing Blocks. The hearings process requires the presentation of sufficient information to confirm that the site is able to be serviced by appropriate 3 waters infrastructure

(stormwater/water/water/water) to enable sustainable development outcomes in line with both district and regional council engineering requirements. In addition, discharges of urban stormwater runoff to the Lake Puketirini receiving environment have been flagged as a key issue to be addressed based upon strong community interest in the lake environment and its water quality.

This report investigates the existing site and receiving environment characteristics, outlines the proposed development concept and identifies the options available for 3 waters servicing to enable the development activities. The report presents a key focus upon the potential stormwater discharge effects within the Lake Puketirini receiving environment and outlines the stormwater management options available to ensure that potential adverse effects are avoided.

Context is also provided regarding legislative requirements relating to land development within the Waikato Region and key guideline documents which aim to ensure urbanisation is managed so as to ensure adverse effects from associated changes in stormwater runoff are avoided and minimised.

# 2 PROPOSED DEVELOPMENT

Terra Firma is proposing to construct a residential subdivision within their 26ha site adjacent to Lake Puketirini on the western outskirts of Huntly, Waikato - refer Figure 1.



#### Figure 1. Huntly Township with indicated Terra Firma site. (red outline).

The overarching vision for the project is that of an environmentally sensitive development which is sympathetic to the proximal lake as well as integrating it as a key feature.

Within the main land parcel (Rotowaro Block - Pt Lot 2 DPS 61669), residential development is at this point proposed to be confined to the easternmost half of the block only comprising an approximate 19ha development area. Development within the western half of the block is currently considered to be constrained by geotechnical settlement issues and with development favoured within the eastern area based upon its proximity to the existing Huntly urban area. Development within this area will incorporate an extensive residential roading network to provide access to the planned residential development with typical lots ranging in size from 450m<sup>2</sup> up to 600m<sup>2</sup> with potential for some larger lot development along the lake reserve frontage. A localised area of commercial development is proposed at the eastern end of the Rotowaro Block in proximity to the existing Lake Puketirini Reserve area which is anticipated to be utilised for a café and offices to support both the proposed development and adjacent reserve area.

Development within the smaller 2ha Weavers Crossing Block is proposed to comprise larger lot Village Zone rural residential development due predominantly to 3 waters servicing limitations (particularly wastewater) and to maintain consistency with the existing, adjacent Weavers Crossing development area to the north.

Development within the larger scale/higher density Rotowaro Block development area is proposed to incorporate best practice stormwater management philosophies in the form of establishing centralised drainage reserve areas along the northern site boundary adjacent to Lake Puketirini. Each reserve is proposed to incorporate a constructed stormwater wetland which will be planted throughout with native wetland and terrestrial species providing for stormwater management functions, enhanced amenity and recreational pedestrian connections between the development area and the lake frontage. Water and wastewater service connections for this area are expected to utilise existing WDC service connections which currently extends in proximity to the site within the existing Huntly West urban area.

# **3 EXISTING SITE CHARACTERISTICS**

The site is located approximately 1.5km from the main Huntly town centre to the west of the Waikato River. The topography is gently sloping to undulating with level areas to the south of the property, becoming steeper towards the lake, and then flattening out to wetland areas adjoining the Puketirini Reserve to the north. The aspect of the site is generally north to north-west facing with views over the lake to rural land beyond.

The site was purchased from Solid Energy by Terra Firma in 2018 when it came up for tender. Prior to 2018 the site was part of the former Weavers Opencast Mine site which closed in 1993. Subsequent to mine closure in 1993, the site has been subjected to a multitude of rehabilitation processes. This has included contouring and soil placement on the overburden dumps, riparian planting and filling of the final pit void to create the adjacent Lake Puketirini. As such, the lake is artificial and comprises very different characteristics to the neighbouring natural, shallow Lake Waahi, as well as in comparison to other lakes in the region.



#### Figure 2. Subject Site.

In its current state, the site is managed as a drystock lease block with the predominant land cover being pasture. See below images for typical site characteristics.



Figure 3. Western view from the southern boundary of the site.



Figure 4. North-western view from the southern boundary of the site.



Figure 5. North-eastern view from the southern boundary of the site.



Figure 6. Western view of site with Lake and walking/cycling track.

As indicated within the site photos, site vegetation comprises an almost 100% pasture cover with only one localised area of gorse/scrub located at the central/northern boundary as well as some areas of rushes interspersed through the pasture land.

There are no watercourses located within the site area with drainage from the pasture surfaces generally occurring as surface runoff via a number of separate drainage catchments which are described as follows.

The main drainage catchment within the site comprises an approximate 13ha catchment area draining surface runoff from the upper terrace eastward into a narrow gully feature to discharge to Lake Puketirini in proximity to the existing boat ramp. Runoff is collected from the upper terrace within a narrow drainage channel which extends eastward dropping into the gully feature which widens into an area of saturated soils prior to concentrating into a 300mm culvert outlet extending from the site boundary, under the reserve carpark to discharge into the lake adjacent to the boat ramp.

Drainage from the northern slopes occurs as a number of separate, small, subcatchment areas with runoff within each subcatchment occurring as surface flows across the pasture slopes discharging across the northern boundary into the lake reserve area. Runoff from a number of these subcatchments is collected within an established wetland area located within the reserve area at the lake margin prior to discharging to the lake.

The only watercourse located in proximity to the site comprises a small stream which drains a rural catchment to the south and flows along the western site boundary parallel to Weavers Crossing Road prior to discharging into Lake Puketirini. This watercourse currently receives runoff from a small subcatchment area within the site at the western end of the Rotowaro development block as well as from the Weavers Crossing Block via a small culvert under Weavers Crossing Road directly upstream of the lake outlet.

A preliminary geotechnical assessment has been undertaken however is yet to be received by Wainui Environmental for review. Nonetheless, on the basis of the site soils within the main Rotowaro Block development area comprising overburden filling from historic coal mining activities (where soils are dominated by clays and silts), along with observations of surface seepage zones and ponding within the site, soakage potential within the site is considered to be low.

#### 4 RECEIVING ENVIRONMENT

Lake Puketirini, a 42ha man-made lake formed out of the final void of the worked-out coalmine, is the receiving environment for the site. As mentioned above, the lake was formed after the closure of Weavers Opencast Mine, reaching its maximum depth in 2005 of 64m. In 2006 the Waikato District Council acquired the lake and surrounding land from Solid Energy, forming the Lake Puketirini Recreational Reserve. The lake is a highly valued local resource for amenity and recreational activities, with the lake used for swimming, scuba dive training, kayaking, waka ama, boating and water skiing. There is also a 3.5km walking and cycleway trail around the periphery of the lake. These activities are able to occur as the lake maintains good water quality, as shown by water quality monitoring undertaken by the Waikato Regional Council which confirm lake water quality as maintaining suitable conditions for human contact recreation (refer water quality data summary presented at ww.lawa.org.nz).

The good water quality characteristics associated with the lake contributing to its high recreational and aesthetic values are considered to be attributed to a number of key features of this artificial lake system. In particular the lake's significant depth (64m compared to the adjacent, natural Lake Waahi maximum depth of 5m which is prone to adverse water quality conditions), provides significant water quality benefits in comparison to the other nearby shallow lakes including:

- Reduced potential for the lake to experience adverse thermal/nutrient enrichment effects experienced by the other nearby shallow lakes in the region;
- Reduced potential for establishment and associated impacts of exotic fish and water fowl species including the impacts of koi carp grubbing the lake bed/margins during feeding (sediment mobilisation) and nutrient/faecal effects of water fowl;
- Increased recharge of groundwater into the lake from deep aquifers contributing to improved water quality inputs.

In addition, the lake's catchment area at 260ha is relatively small and dominated by dry stock grazing contributing to reduced nutrient inputs compared to larger catchments dominated by more intensive dairy grazing landuses which impact adversely upon water quality within many other lakes in the Waikato Basin.

The ability of Lake Puketirini to maintain positive water quality values under all climatic conditions due to these features when compared to the directly adjacent Lake Waahi natural lake feature is clearly evident in numerous aerial images of the site area as presented in Figure 7.



Figure 7. Lake Puketirini water quality comparison to the adjacent Lake Waahi shallow lake

Lake Puketirini outflows via a narrow outlet channel at its western end discharging directly into the adjacent Lake Waahi shallow lake environment with an eventual outlet from this lake to the Waikato River at the northern end of Huntly West in proximity to the Genesis Energy Power Station.

# **5 STATUTORY CONTEXT**

Development of the subject site and in particular, 3 waters management is subject to assessment under various statutory provisions to ensure that any potential adverse environmental effects are appropriately avoided, remedied or mitigated. In addition, there are a number of guideline documents particularly relating to best practice stormwater management methods which will be utilised to inform the stormwater management design process for the site. The key statutory and guideline documents in relation to 3 waters management and particularly stormwater management at the subject site are identified and summarised as follows.

#### 5.1 Resource Management Act 1991 (RMA)

All activities that affect or manage a natural resource are directed by the RMA, which sets expectations for what is and is not permissible and how New Zealand's natural resources should be sustainably managed. Section 5 of the RMA defines 'sustainable management' as follows:

In this Act, "sustainable management" means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while—

- (a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
- (b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
- (c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment.

To this end, the starting point of the proposed development is to avoid as far as possible any adverse effects on the environment. The stormwater management approach for the site will include strategies which will ensure the development occurs within the natural limitations of the site, by way of managing the stormwater in a way which ensures the life supporting capacity of the receiving environment is not degraded, with the local environment enhanced where possible. This will be balanced with providing for the communities social, economic and cultural wellbeing as well to ensure sustainable development outcomes in line with the overarching principle of the RMA.

#### 5.2 National Policy Statement: Freshwater 2020

The NPS-FW has policies and objectives that direct local government to manage water in an integrated and sustainable way while providing for economic growth within specified water quality and quantity limits. The NPS-FW requires regional councils to develop standards to safeguard the life supporting capacity of water bodies, with



the objective that water quality will be maintained or improved. An updated version of this National Policy Statement came into effect on the 3<sup>rd</sup> September 2020.

Some key changes introduced through the NPS-FW 2020:

- The Te Mana o te Wai framework has been strengthened with a change to the hierarchy of obligations. The new hierarchy places the health and wellbeing of water bodies and freshwater ecosystems first, followed by human health (such as drinking water), and finally the social, economic, and cultural wellbeing of people.
- Expectations and direction about involving Māori in freshwater decision-making has been strengthened.
- New compulsory values and attributes have been included.
- There is now a requirement for regional councils to map, monitor and manage wetlands and obstacles to fish passage.

There is now but one objective in the NPS-FW, which is as follows:

The objective of this National Policy Statement is to ensure that natural and physical resources are managed in a way that prioritises:

- (a) first, the health and well-being of water bodies and freshwater ecosystems
- (b) second, the health needs of people (such as drinking water)

(c) third, the ability of people and communities to provide for their social, economic, and cultural wellbeing, now and in the future.

There are 15 policies that support this objective and provide direction to regional councils as to expectations around freshwater management across all regions. The overarching goal being that our freshwater systems (inclusive of watercourses and wetlands) are to experience no further loss or degradation and should in the long term be enhanced.

Considering the subject site against the NPS-FW, it is notable that the entire site comprises an area of topography formed entirely through placement of mine overburden with all site drainage features only being established following completion of the overburden contouring in the mid1990s. In this respect the site does not present any natural watercourse or wetland features which could be impacted by the intended development activities.

Furthermore, discharges of urban stormwater runoff from the planned site development activities will be managed in accordance with best practice water quality treatment methods to ensure that the health and wellbeing of the Lake Puketirini receiving environment and all downstream watercourses are not adversely impacted.

#### 5.3 Waikato Regional Policy Statement

Section 104(1)(b)(v) of the RMA requires consideration of any relevant provisions of a regional policy statement or proposed regional policy statement.

The Waikato Regional Policy Statement (RPS) was made operative in May 2016 and is a mandatory document that provides an overview of the resource management issues in the Waikato region, and the ways in which integrated management of the region's natural and physical resources will be achieved. By connecting people across diverse communities and jurisdictional boundaries, and supporting regional development, the RPS sets the overall regional direction for the Waikato by providing a sustainable framework to help achieve community aspirations over a ten-year period. It provides policies and a range of methods to achieve integrated outcomes for the region across resources, jurisdictional boundaries and agency functions, and guides development of sub-ordinate plans (including the WRP and Waikato/Waipa DPs) and consideration of resource consents.

Key issues in the RPS relating to this proposal are the 'State of Resources' (Issue 1.1), 'Managing the Built Environment' (Issue 1.4), the 'Relationship of Tangata Whenua with the Environment' (Issue 1.5) and the 'Health and Wellbeing of the Waikato River Catchment' (Issue 1.6). Objective 3.1 addresses "Integrated Management" of natural and physical resources, recognising the inter-relationship between water body catchments, riparian areas, wetlands, the coastal environment, the Hauraki Gulf and the Waikato River. The objective highlights that resources need to be managed in a way that recognises natural processes and interactions, while taking into account the needs of future generations as well.



Objective 3.2 allows for resource use and development to occur in a way which ensures the natural environment (inclusive of soils, water and ecosystems) is maintained and where appropriate enhanced, which ties in with Objective 3.10 which states that resources will be used in a sustainable and efficient way.

Policy 4.1.2 relates to land use change and intensification, and states the following:

Waikato Regional Council will work with territorial authorities to identify and manage the adverse effects of large-scale land use change or intensification, by taking account of:

- a. the potential to adversely affect the range of natural and physical resources, including effects occurring off site;
- b. the potential cumulative effects;
- c. opportunities to manage adverse effects in collaboration with territorial authorities, tāngata whenua, industry, landowners and other stakeholders; and
- d. options for managing adverse effects including:
  - i. regulatory and non-regulatory methods;
  - ii. education and advocacy; and
  - iii. use of economic instruments.

Furthermore, Policy 6.1 calls for subdivision, use and development to occur in a planned and co-ordinated manner, again taking into account possible cumulative effects and being sufficiently informed to allow consideration of potential long-term effects.

Part of Policy 8.3 which relates to all freshwater bodies, that are relevant to this development include a. i) which states:

Manage the effects of activities to maintain or enhance the identified values of freshwater bodies and coastal water including by:

a) reducing:

*i)* sediment in freshwater bodies and coastal water (including bank instability) that is derived from human based activities; ...

as well as d. ii) and e. i and ii):

d) avoiding:

...ii) inappropriate development in flood plains; and

e) managing:

i) groundwater and surface water flow/level regimes, including flow regime variability;

ii) linkages between groundwater and surface water; ...

These directives through Policy 8.3 can be related to stormwater management on new developments and the potential this has in affecting water quality and flow regimes. The future sections of this report provide information to confirm how the potential stormwater effects of the development activities can be appropriately managed to ensure that they are avoided within the downstream receiving environment thus maintaining consistency with this relevant policy of the RPS.

#### 5.4 Waikato Regional Plan

The WRP contains objectives, policies and rules which aim to guide decision-making around the use, development and protection of natural and physical resources in the Waikato region. The key objectives and policies contained in the WRP that are relevant to this proposal are those relating to water resources with specific policies relating to stormwater discharges which encourage at-source management and treatment of stormwater discharges to reduce water quality and water quantity effects of discharges on receiving waters.

It is a key aspect that the development of the site for residential landuses will be subject to obtaining specific resource consent authorisation under the WRP for the discharge of urban stormwater into the Lake Puketirini receiving environment. This consent process will include a thorough assessment by the WRC of the proposed stormwater management design to ensure that any potential adverse water quality effects are avoided through the implementation of best practice stormwater treatment methods. The preliminary stormwater management concepts outlined in the further stages of this report are considered to be in-line with those typically required through WRP resource consent processes to enable the development activities to proceed under the WRP.

As water supply and wastewater discharges from the development area are planned to utilise existing municipal connections, additional consent authorisations for these activities under the WRP are not relevant or necessary.

# 5.5 Waikato District Plan

This Water Impact Assessment has been prepared to support a submission to the Proposed Waikato District Plan seeking a zone change that enables future residential development of the site, with the purpose of outlining appropriate 3 waters servicing options availability.

Beyond rezoning approval, development of the site will also be subject to subdivision consent authorisation under the WDP which will include presentation and assessment of the detailed 3 waters management engineering design for the development site to confirm adherence to WDC best practice engineering design standards. Again, the preliminary stormwater management concepts outlined in the further stages of this report are considered to be in line with those typically required through WDP subdivision consent processes to enable the development activities to proceed under the WDP.

# 5.6 Vision and Strategy

The Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act 2010 was enacted in May 2010 with the purpose of implementing co-management of the Waikato River. The overarching purpose of the Act is to restore and protect the health and wellbeing of the Waikato River for future generations. Through this piece of legislation, it is intended to implement the "Vision and Strategy" for the River and consequently aims to meet the objectives of Waikato Tainui for the Waikato River by:

- a) the restoration and protection of the health and wellbeing of the Waikato River;
- b) the restoration and protection of the relationship of Waikato Tainui with the Waikato River, including their economic, social, cultural and spiritual relationships;
- c) the restoration and protection of the relationships of Waikato Iwi according to their tikanga and kawa with the Waikato River, including their economic, social, cultural and spiritual relationships;
- d) the restoration and protection of the Waikato Region's communities, with the Waikato River, including their economic, social, cultural and spiritual relationships;
- e) the integrated, holistic and coordinated approach to management of the natural, physical, cultural and historic resources of the Waikato River;
- f) the adoption of a precautionary approach towards decision that may result in significant adverse effects on the Waikato River, and in particular those effects that threaten serious or irreversible damage to the River;
- g) The recognition and avoidance of adverse cumulative effects, of activities undertaken both within the Waikato River and within its catchments on the health and wellbeing of the Waikato River;
- h) The recognition that the Waikato River is degraded and should not be required to absorb further degradation as a result of human activities;
- i) The protection and enhancement of significant sites, fisheries, flora and fauna;
- The recognition that the strategic importance of the Waikato River to New Zealand's social, cultural, environmental and economic wellbeing, requires the restoration and protection of the health and wellbeing of the Waikato River;
- k) The restoration of water quality within the Waikato River so that it is safe for people to swim in and take food from over its entire length;
- I) The promotion of improved access to the Waikato River to better enable sporting, recreational, and cultural opportunities;
- m) The application of the above of both matauranga Maaori and the latest available scientific methods.

The Vision and Strategy forms part of the Waikato Regional Policy Statement and is given effect through the plans administered by regional and territorial authorities along the river. The settlement also provides for joint management agreements between Waikato-Tainui and the local authorities; participation in river-related resource consent decision-making; recognition of a Waikato-Tainui environmental plan; provision for regulations relating to fisheries and other matters managed under conservation legislation and an integrated river management plan.

A key consideration coming out of case law surrounding the implementation of the Vision & Strategy comprises the need for development projects to contribute to the betterment of the river catchment environment through implementation of sustainable design and environmental enhancement initiatives either within the site or surrounding catchment area. In this instance, the conversion of the site from rural grazing activities to urban



landuses will result in a change in the nature and scale of contaminants generated within site runoff. However, the inclusion of stormwater treatment methods in the form of planted wetland devices will contribute to enhancement of water quality generated from the site along with contributing to enhanced ecological conditions and amenity where these devices interface with the adjacent Lake Puketirini reserve area. Based upon implementation of these measures, it is considered that the stormwater management proposal for the site will be consistent with the provisions of the Vision & Strategy.

# 5.7 Stormwater Management Guidelines

There are two stormwater management guideline documents that are commonly used to guide best practice stormwater management on urban development sites within the Waikato comprising the Waikato Stormwater Management Guidelines 2020 (TR2020/07) and the Waikato Regional Infrastructure Technical Standards 2018 (RITS).

TR2020/07 has been developed by the WRC based on Auckland Council's Technical Publication 10 (TP10) 'Stormwater Management Devices Design Guidelines Manual' (Auckland Regional Council, 1992 and 2003) and replaces use of this guideline within the Waikato Region. There are multiple stormwater issues explored in this guideline, however the key focus is on design and management of stormwater management systems to protect downstream receiving environments from adverse water quality and quantity effects. Design processes outlined are generally based upon undertaking a detailed assessment of the downstream receiving environment and tailoring a stormwater management approach to address any potential effects.

The RITS comprises a more comprehensive guideline document developed by multiple participating district councils within the Waikato Region to provide a comprehensive guideline/standard for all aspects of land development engineering. For stormwater management, the RITS provides both guidance and standards for service delivery design for stormwater assets which are ultimately to be vested with the relevant territorial authority along with outlining best practice design processes for stormwater management infrastructure to protect downstream receiving environments from adverse water quality and quantity effects.

The environmental management design approaches promoted within both of these guideline documents is generally consistent and include the adoption of low impact design principles for subdivision layout, use of atsource stormwater management methods where necessary to reduce runoff rates and provide pre-treatment of runoff along with use of more centralised stormwater management devices to provide both treatment, attenuation and detention of stormwater as required to prevent adverse downstream effects.

The stormwater management design philosophies and methods outlined within both of these technical guideline documents form the basis for both the preliminary stormwater management methods outlined within this assessment and also will be utilised to direct the future detailed stormwater management design processes associated site development.

# 6 3 WATERS ASSESSMENT

The following sections aim to assess the ability to provide appropriate 3 waters servicing for the proposed development site in line with both WRC, WDC and best practice design standards to ensure that practical and sustainable servicing options are available to enable the planned development activities.

Again, the key focus of this assessment is upon the stormwater management options available at the site on the basis that discharges will occur directly to the highly valued Lake Puketirini receiving environment.

#### 6.1 Stormwater

#### 6.1.1 Stormwater Effects

Changes in landuse from rural to urban activities is generally considered to present two key hydrological changes which need to be considered in developing an appropriate stormwater management system for the development site comprising:

Water Quantity effects – including increased volumes and rates of runoff due to increased site
imperviousness and implementation of concentrated drainage systems resulting in point source discharges
to downstream receiving environments. Potential effects include increased downstream flooding and erosion
within natural receiving environments (particularly channelised stream environments) contributing to adverse
effects upon both downstream properties and aquatic habitats.

 Water Quality effects – including changes in catchment derived water quality contaminants from agricultural based contaminants (nutrients/sediment) to urban – particularly vehicular derived – contaminants including hydrocarbons and heavy metals.

In this instance, the discharge of all site runoff to the Lake Puketirini receiving environment is considered to negate the potential for adverse water quantity effects on the basis that increases in runoff rates/volumes will be easily absorbed within the large capacity/quiescent lake receiving environment without contributing to any potential increases in adverse flooding or channel erosion effects. On this basis, the focus of this assessment is upon the potential for the development sites urban stormwater runoff to contribute to adverse water quality effects within the Lake Puketirini receiving environment.

#### 6.1.1.1 Water Quality Issues

Land under different uses presents various management issues that need to be considered when managing the runoff from a site. Whether it be horticultural, agricultural, urban, forestry, recreational, or industrial, these landuses have associated contaminants which, if not managed appropriately, can have adverse effects on the downstream receiving environment. See below table which gives an indication of the variation seen in contaminant loads under different land uses.

Table 1. Contaminant loading ranges for different land uses. Figures are in kg/ha/yr except for FC which is no./ha/yr)

Land use	TSS	TP	TN	Pb (median)	Zn	Cu	FC	COD
Road	281-723	.59-1.5	1.3-3.5	.49-1.1	.1845	.0309	1.8E+08	112-289
Commercial	242-1369	.6991	1.6-8.8	1.6-4.7	1.7-4.9	1.1-3.2	5.6E+09	306-1728
Residential (low)	60-340	.4664	3.3-4.7	.0309	.0720	.0927	9.3E+09	NA
Residential (high)	97-547	.5476	4.0-5.6	.0515	.1133	.1545	1.5E+10	NA
Terraced	133-755	.5981	4.7-6.6	.35-1.05	.1751	.1734	2.1E+10	100-566
Bush	26-146	.1013	1.1-2.8	.0103	.0103	.0203	4.0E+09	NA
Grass	80-588	.0125	1.2-7.1	.0310	.0217	.0204	1.6E+10	NA
Pasture	103-583	.0125	1.2-7.1	.004015	.0217	.0204	1.6E+10	NA

#### Source: Auckland Councils TP10

As the subject site is currently under an agricultural landuse, and is proposed to become residential, the typical water quality issues associated with these two types of landuses are explored in the sub-sections below.

#### Agricultural Land Uses

There have been multiple studies undertaken that have investigated the link between agricultural land use and freshwater quality. The common findings are that Nitrogen (N) and Phosphorus (P) are the two main nutrients synonymous with agricultural landuses that place stress on waterways (Chrystal, 2019). Dairy farming seems to contribute more greatly when investigating these two nutrients, however this could be symptomatic of the expansion of dairy farms across NZ rendering it a dominant landuse (PCE, 2015), as well as the high stocking rates (intensity) often seen on dairy farms (in comparison to dry stock farms).

Eutrophication is a significant problem affecting many freshwater bodies in New Zealand where an estimated 32% of lakes greater than 1 ha in area (n > 1000) are classified as eutrophic or hypertrophic and consequently have very poor water quality (PCE, 2015). Eutrophication occurs when freshwater bodies become overly nutrient enriched, which encourages excessive plant and algal growth. This is exacerbated in shallow lakes which suffer from thermal effects which also encourages prolific algal growth. Empirical studies and experiments have shown that both N- and P- limitation of phytoplankton growth occurs widely in New Zealand lakes which highlights the need for dual control of N and P discharges from New Zealand lake catchments. Intensification of land use resulting in increased external nutrient loads has been a trend for decades, particularly from New Zealand's increasingly intensive agricultural land. Sources of N and P in the agricultural landscape include fertilisers, urine, land application of effluent, cropping and higher stocking rates. Added to these farming practices, environmental conditions also dictate the ability and quantity of nutrient loss from farms, including climate, geology and topography.





Figure 7. Conceptual diagram of transport pathways for contaminants from land to water. The size of each contaminant indicates the importance of the pathway to that contaminant (Chrystal, 2019).

The above diagram reinforces that nitrogen is a key contaminant associated with agricultural landuses. This is due to its solubility which means it is more readily available for transport as it is water soluble. Phosphorus on the other hand is less soluble and thus more associated with erosion and sediment movement, with phosphorus attached to soil particles and thus mobilised through soil movement.

#### Waikato Lakes

The Waikato region has over 100 lakes which range in size and state and include the largest lake in the country, Lake Taupo. It has been reported that many of the shallow lakes in the region have declining water quality predominantly due to an increase in nutrient inputs to the lake from land use practices (Waikato Stormwater Guidelines, 2020). Indeed, a study that evaluated the condition of 52 lakes using submerged plant indicators found that two lakes were classified as being in excellent condition, four lakes were in high condition, 11 in moderate condition, eight in poor condition, and the remaining 27 lakes were devoid of vegetation (Edwards, *et al.* 2009).

The Waikato Regional Council also undertakes monitoring of shallow lakes in the region. Shallow lakes are defined as generally having an average depth of less than 3m, are able to support submerged aquatic plants over large areas of the lakebed and are not stratified due to their shallow depths (WRC, 2020). The Waikato region's shallow lakes are largely nutrient enriched, are subject to higher water temperatures, and have high levels of phosphorus and nitrogen. The amount of nutrients entering a lake from its contributing catchment mainly determines its trophic state. Nutrient enrichment results in poor water quality and a high trophic state. Most of the 12 shallow lakes monitored by WRC are highly to extremely nutrient enriched (a trophic status of eutrophic, supertrophic or hypertrophic), which means they have high nutrient levels and poor water clarity (WRC, 2020). In contrast lakes with low-to-moderate nutrient levels and clear water are classed as oligotrophic or mesotrophic. Nutrients can also be recycled from the bottom sediments of shallow lakes, adding to the levels found in the overlying water. Farmland now surrounds most shallow lakes in the region.

The below graphs show how many of a group of 12 shallow lakes are currently found in each nutrient enrichment category, and for seven of these lakes there is enough information to measure any changes in water quality over time. The data was collected between 1995 and 2020.



Figure 8. Nutrient enrichment in 12 Waikato lakes (2014 - 2020) - Source: WRC, 2020.



#### Figure 9. Long-term trends in seven Waikato lakes (1995 - 2020) - Source: WRC, 2020.

It was found that there was no change in water quality found in Lake Hakanoa and Lake Waahi between 2002 and 2020. Water quality in Lake Rotomanuka showed deterioration for Secchi depth (clarity/visibility) and total nitrogen concentration. While total phosphorus concentrations in Lake Waikare improved between 1998 and 2020, total nitrogen and chlorophyll-a concentrations showed deterioration (WRC, 2020). Lake Serpentine North showed deterioration for Secchi depth and total nitrogen concentrations but improvements in chlorophyll-a concentrations.

Specifically, relevant to the subject site, Lake Waahi is a large shallow riverine lake adjacent to Lake Puketirini. Lake Waahi is the third largest lake in the Waikato region, with an area of 522ha and maximum depth of 5m (LERNZ, 2020). The lake has a contributing catchment of 91.2km<sup>2</sup> of predominantly pastoral landuse as well as historic mining activity. The lake is considered supertrophic (saturated in phosphorus and nitrogen) with high levels of phytoplankton, low water clarity from high sediment inputs, thermal effects from its shallow depth, and

high nutrient levels (WRC, 2019). The poor water quality of the lake is attributed to both pastoral and mine drainage that has resulted in high loads of sediment and nutrients entering the lake. The high turbidity experienced by the lake renders it undesirable for recreational use. Conversely, Lake Puketirini has high water quality and is currently used for a multitude of recreational activities, including scuba diving training, kayaking, waka ama, and cycling/walking around its periphery. There is therefore a need to ensure that landuses around Lake Puketirini do not have a detrimental effect upon the water quality of the lake.

#### Urban Landuses

Stormwater runoff from roads and impervious areas is known to contain contaminants such as metals, hydrocarbons and sediment. A number of these contaminants, if allowed to enter the environment, will accumulate in the sediments of the receiving environment and may reach levels which are toxic to biota. The highest potential source of contaminants within an area of new development is likely to be from roading surfaces where vehicle use can result in the deposition of heavy metals and hydrocarbons from tyre/brake wear, exhaust fumes and fuel/lubricant leaks onto road surfaces. Other development catchment contaminants can include gross pollutants (i.e rubbish/debris) and sediments from development and landscaped surfaces as well as nutrient input from gardening/landscaping activities and possible sewer overflows/illegal connections. As contaminants often become attached to sediment particles, removal of suspended sediment provides partial treatment of stormwater in urban areas. Indeed, concentrations of total phosphorus are generally as high in urban streams as in agricultural streams owing the perseverance of TP in the environment through its attachment to soil, and subsequent remobilisation when soil is moved for landscaping purposes, or erosion continues to occur.

Contaminants from urban landuses generally reach the receiving environment via overland flow and through the stormwater network due to the increase in impermeable areas which means infiltration into soils dramatically decreases.



# Figure 10. Illustration showing the impacts of landuse change on the natural drainage cycle (Waikato Stormwater Guidelines, 2020)

As the illustration above shows, the majority of contaminants are no longer able to infiltrate soils and therefore groundwater when a site/area experiences urbanisation due to the increase in imperviousness. This highlights the importance of capturing stormwater and treating it appropriately prior to it entering the receiving environment.

Studies have shown that while nutrients such as nitrogen and phosphorus can be at lower levels in urban stormwater, there is generally greater levels of contaminants such as E.coli, zinc, and copper, and lower levels of dissolved oxygen.

A report by the Ministry for the Environment which relates to managing urban water quality (MfE, 2013) undertook a literature review of other New Zealand studies, with a summary of the key findings as follows (MfE, 2013):



- Historically, urban stormwater in NZ has generally had little or no treatment, contains sediments and bacteria, as well as persistent contaminants.
- There is substantial evidence that urban development is harming the very water bodies beside which New Zealand's cities were founded.
- As the proportion of pastoral and/or urban landcover increases, water quality and macroinvertebrate health tend to decline while nuisance periphyton and macrophyte growth increases
- Many urban waterways remain highly polluted from the effects of overflowing sewer pipes, stormwater runoff from surfaces such as roads and discharges from processing facilities, including wastewater treatment plants
- The severity of the effect that stormwater run-off has is usually proportional to the area of urban land use. Drainage systems need to be designed to reduce the amount of impervious surface area causing stormwater
- Stormwater in our urban, semi-urban and rural environments needs to be managed differently

This assessment has identified that both agricultural and urban runoff have contributed to adverse water quality effects within aquatic receiving environments in New Zealand and hence there is a potential for adverse effects to occur within Lake Puketirini under either its current landuse or the planned urban development. It is clear that runoff from urban and rural environments needs to be managed differently. Current methods available for management of agricultural runoff effects are generally limited to farm management and landuse practices such as controlling stocking rates, fertiliser application, effluent management etc. By comparison, implementation of a formalised drainage system associated with urban development presents an opportunity for capture and treatment of site runoff within specifically designed systems which can also contribute to other site benefits such as ecological and amenity enhancement effects.

As previously described, there is a suite of legislation and guideline documents which provide direction as to how natural resources should be protected and managed in such a way so as to minimise adverse effects from urban stormwater runoff – providing the platform that directs how stormwater should be managed. This is discussed in section 6.1.2 below.

#### 6.1.2 Proposed Stormwater Solution Concept

The above sections serve to demonstrate the multitude of policies, plans and guidelines that are used in the consenting process to ensure that development occurs in a managed and sustainable way. There is a process applied to the consenting of activities which ensures that the effects of activities on the environment are managed in such a way so as to avoid and minimise adverse effects. This is undertaken on a case by case basis taking into consideration the existing condition of the site, and the sensitivity of the receiving environment. The following section presents the recommended stormwater solution for the Lake Puketirini site which is based on the principles, objectives and site conditions outlined in the above chapters.

#### 6.1.2.1 Discharge Parameters

The following discharge parameters and stormwater management principles have formed the basis for development of the site's stormwater management system.

- Maintain natural drainage catchments/subcatchments to the greatest extent possible within the site;
- Discharge of stormwater to ground soakage is not expected to be feasible based upon existing/observed site soil/drainage conditions;
- Treatment of stormwater runoff from all development surfaces to address any potential water quality effects;
- Attenuation/extended detention of stormwater flows is not considered necessary based upon all discharges occurring to the Lake Puketirini receiving environment;
- Provision for conveyance of overland flows and greater than design events to prevent potential flooding/inundation with the subject development area;
- Maximise landscape and amenity values and public awareness of stormwater management devices; and
- Minimise operation and maintenance requirements.

#### 6.1.2.2 Water Quality Treatment Criteria

Proposed water quality treatment criteria are outlined below in accordance with Table 4-3 of the RITS:



- Total suspended solids (TSS) (75% removal of post development loads taken as being at the discharge point from site).
- Total Metals (copper, zinc) to achieve maximum practical removal possible;
- Temperature (<25°C);
- Nutrients (total nitrogen, total phosphorus and ammoniacal nitrogen) to achieve maximum practical removal rates;
- Hydrocarbons to achieve maximum practical removal rates;
- Removal of gross pollutants (litter and commercial waste).

#### 6.1.2.3 Stormwater Quantity Criteria

- Again, attenuation/extended detention of stormwater flows is not considered necessary based upon all discharges occurring to the Lake Puketirini receiving environment;
- Provision of appropriate erosion/scour protection at all discharge outlet points.

#### 6.1.3 Stormwater Management Strategy

Based upon the above assessment of the downstream receiving environment and associated stormwater discharge parameters/criteria, a stormwater management strategy has been developed for the site which comprises the following features:

#### 6.1.3.1 Stormwater Conveyance Systems

#### Primary Reticulation

The primary reticulated drainage network throughout the proposed development will comprise a piped network sized to provide a 10-year ARI level of service in accordance with the RITS. Reticulation will generally extend along the development roading network with appropriate lot connections and will convey flows to each of the centralised wetland devices.

#### Secondary Overland Flow

Secondary overland flow paths are required to convey flows up to the 100-year ARI event safely though the site.

Where possible overland flows will discharge to the road corridors where they will be conveyed to or around the proposed wetland via the designated reserve areas. Where this cannot be achieved overland flow-paths will be required. These will be designed at detailed engineering stage.

#### 6.1.3.2 Subcatchment Wetlands

The primary stormwater treatment system proposed to manage potential water quality effects upon the Lake Puketirini receiving environment comprises the design, construction and maintenance of two subcatchment stormwater wetland devices.

Stormwater treatment wetlands are considered appropriate for implementation at the subject site for the following reasons:

- The site has sufficient space to accommodate wetlands as the stormwater solution;
- Wetlands have shown to be efficient and superior at improving water quality from urban developments in comparison to other stormwater treatment devices;
- They moderate the temperature of water through the dense planting associated with them (in comparison to stormwater ponds which have large areas of open water);
- They mimic natural processes of capture, settlement and biofiltration of catchment runoff prior to entering open water bodies as particularly prevalent within the North Waikato area
- They provide multiple services/benefits including providing terrestrial and aquatic ecological values, and having positive amenity benefits as they provide recreational opportunities with walkways/cycleways as well as landscape/visual enhancement values.

Stormwater treatment processes in constructed wetlands include:

• Capture of gross sediment particles and attached contaminants within a front end/inlet forebay providing an area for regular/routine maintenance;

- Settlement of finer sediment particles and attached contaminants within the quiescent, vegetated central wetland cells;
- Biofiltration of soluble stormwater contaminants through biological uptake within the densely planted central wetland cells;
- Controlled discharge outlet system to ensure stabilised outlet system and avoidance of erosion and scour effects at the discharge point to Lake Puketirini.

The use of constructed wetland type systems for treatment of urban stormwater runoff discharges to aquatic receiving environments is widely accepted as best practice water quality management for these activities including numerous development sites and high volume roading catchments where development discharges occur to lake receiving environments. Within the Waikato District, this includes development catchments where discharges have been authorised to occur via these types devices to both high quality natural receiving environments as well as highly impacted/low water quality lake receiving environments with a number of key examples outlined as follows:

- Large scale Lakeside residential development in Te Kauwhata where residential stormwater discharges occur via constructed treatment wetland devices to the highly impacted, adjacent Lake Waikare receiving environment;
- Rangitahi residential development in Raglan where residential stormwater discharges occur via constructed treatment wetland swales and basins to the highly valued/high quality Whaingaroa Harbour depositional receiving environment;
- Waikato Expressway Huntly Section where high volume expressway runoff discharges via treatment swale devices (reduced level of treatment compared to wetlands) to the highly impacted Lake Kimihia receiving environment;

These existing authorised developments confirm the use/acceptance of these types of systems as appropriate for management of potential stormwater quality effects within both existing degraded and high value receiving environments.

The below are examples of completed stormwater wetlands that are comparable to the type of devices proposed as part of this development.



Figure 11. Rototuna (Hamilton) residential subdivision with vegetated stormwater wetland treatment device.





Figure 12. St Kilda (Cambridge) residential subdivision with stormwater wetland treatment device



Figure 13. Kay Road (Hamilton) residential subdivision with stormwater wetland treatment device

#### Wetland Design Requirements

The design of the proposed wetland devices will occur in accordance with the methods and guidance outlined within the WRC TR2020/07 guideline and the RITS. Key features of the wetland design are outlined as follows.

• Wetland Drainage Reserve Area

The drainage reserve areas identified on the preliminary site development plans have been identified and sized based upon being able to accommodate a wetland within a reserve area sized at 5% of the preliminary, contributing stormwater catchment area based upon typical stormwater wetland drainage reserve area requirements.

#### • Wetland Forebay

A sediment forebay is required at the inlet of each wetland. The sediment forebay is provided to capture coarse sediments and is located to ensure ease of access to remove sediment accumulation. The forebay shall be designed to provide minimum 30% of the adjusted Water Quality Volume in accordance with WRC requirements.

#### • Water Quality Treatment

The main wetland body will be designed to attenuate the full calculated water quality volume for catchment runoff in accordance with the TR2020/07 methods.

Banded bathymetry will be provided within the wetland as a series of raised bunds which are proposed to maximise contact with vegetation and prevent short-circuiting. Wetland bathymetry will be designed in accordance with the RITS and to ensure minimum 80% vegetated area.

#### • Outlet Structure and Spillway

The wetland will discharge via a manhole primary spillway outlet structure (manhole) connected to the final discharge outlet pipe.

In the event the main outlet structure and pipe becomes blocked or overwhelmed an emergency spillway will be provided to convey 100 year ARI flows to the outlet point.

#### Wetland Planting/Landscaping

Landscaping of the constructed wetlands will be undertaken in general accordance with the RITS Section 4.2.24 including Table 4-35 – Approved Plant Species.

A planting plan and planting schedule will be prepared as part of the detailed design process. Planting will be undertaken below the permanent water levels of the wetland (submerged zone) to meet a target of 80% vegetative cover.

Specimen trees such as rimu, cabbage tree and kahikatea can be incorporated around the wetland to shade areas of open water, to reduce thermal warming effects and contribute to enhanced amenity around the wetland feature.

#### Habitat Enhancements

Constructed stormwater wetlands provide a range of feeding, nesting, brood rearing and resting sites for native birds and fish (e.g eels). Opportunities also exist to create habitat for native skinks by planting species that provide optimal habitat structure i.e. dense, low growing vegetation. Skinks also appreciate a range of conditions from shady to dry and sunny. Habitat potential is proposed to be enhanced by placing logs and snugs around the perimeter of the wetland amongst vegetation and along pathways to provide skink refugia. Rock mounds can be incorporated to allow for basking next to dense grasses and shrubs.



#### 6.1.3.3 Stormwater Operation and Maintenance

An operation and maintenance manual will be prepared for the entire stormwater network including the wetland devices as part of the detailed design process.

Forebay access and maintenance tracks will be incorporated into the wetland design in accordance with the RITS. Pedestrian and vehicle access to the remainder of the wetland will be in accordance with the RITS.

In the long term, the stormwater network including the wetland devices will be vested with the Waikato District Council for ongoing operation and maintenance in accordance with this manual to ensure this system's effective function in managing all potential urban stormwater effects.

#### 6.1.4 At-source Treatment

There is a potential for further enhancement of stormwater treatment efficiencies within the development network through provision of additional at-source stormwater treatment measures incorporated within the roading network. Typical at-source treatment devices which have been utilised on other residential developments and may be able to be utilised at the site include the use of raingarden bio-filtration devices or proprietary mechanical filtration devices installed at key points within the drainage network to provide additional/pre-treatment prior to conveyance of flows to the wetland devices.

At this point, the use of these measures is not considered to be warranted based upon the scale and nature of the proposed residential development and anticipated relatively low levels of urban stormwater contaminants from this type of development along with the high level of stormwater treatment likely to be provided via the proposed wetland devices. Furthermore, the need for additional/multi-level stormwater management measures at the site must also be balanced against the additional operation and maintenance requirements/costs associated with multiple measures which again, in this instance is not considered to be warranted.

Nonetheless, further consideration can be given to the need for these additional treatment measures at the detailed design stage with a potential to incorporate such measures for any identified areas of higher volume traffic usage and associated contaminants e.g commercial block carpark areas etc.

#### 6.1.5 Weavers Crossing Block Stormwater Management

Potential stormwater effects associated with development of the Weavers Crossing Block are considered to present a significantly reduced risk for adverse effects based upon the much smaller catchment and reduced development density associated with Village Zone type development. Nonetheless, consideration must be given to this matter with the following options/opportunities identified for managing any potential stormwater quality/quantity effects from this area.

Collection and treatment of stormwater runoff from the site accessway (to be formed within the existing
narrow access lot alignment) within a roadside swale drain with controlled discharge from this swale either
eastward into the existing Weavers Crossing Road table drain to Lake Puketirni or westward into the existing
rural gully feature to Lake Waahi;

- Collection of all roof runoff from the development lots within individual on-lot detention tanks to provide both an opportunity for water re-use and controlled release to discharge from the development lots into the Weavers Crossing Road table drain at pre-development levels;
- Discharges of all stormwater via the existing Weavers Crossing Road culvert to the adjacent stream directly upstream of Lake Puketirini consideration for any culvert upgrade/improvement requirements to be determined as part of the detailed stormwater design.

# 6.2 Water Supply

#### 6.2.1 Rotowaro Block

The development site intends to establish suitable water connection via extension of the existing WDC municipal supply network which currently extends to the western outskirts of Huntly in proximity to the site. In particular, review of the existing WDC Utilities Maps identifies the following existing water supply reticulation in proximity to the development site:

- Existing 150mm watermain extending along Rotowaro Road (approx. 115m to site boundary); and
- Existing 250mm watermain extending up to Porritt Ave/Mary St intersection (approx. 250m to site boundary).

The RITS outlines the level of service to be achieved with regards to on-demand water supply in Chapter 6, detailing the following standards to be achieved via the reticulation network:

- a) The residual pressure and flow at point of supply to residential lots shall be a minimum of 200 kPa (20m) and 25 L/min. Some specific areas may require a higher level of service this is to be confirmed with WDC.
- b) The minimum fire supply service level shall be FW2 for residential areas and FW3 for all other areas. Some specific areas may require a higher level of service.
- c) To protect level of service of new subdivisions, no more than 150 residential lots shall be serviced, at any point from a single ended 150mm diameter watermain (unless water modelling proves that DN100 will be sufficient, but then no more than 40 residential lots). Connectivity of the water network is to be confirmed prior to further lots being brought forward for 224(c) release.

For the purpose of pipeline design, the maximum static pressure at ground level for each lot shall be considered to be 1000 kPa. Therefore the design pressure range for specific pipeline design is 100 kPa to 1000 kPa (10-100m).

Initial consultation has been undertaken with Watercare Services Ltd (Watercare) which has confirmed the above identified potential water supply connection points to the site. It is understood that Watercare holds water supply network models which can be utilised to assess the potential effects of the increased water demand upon the existing network, any potential need for network upgrades and appropriate connection points to be extended into the development area. Terra Firma are willing to work in consultation with Watercare to assist in this network modelling exercise to confirm a sustainable supply option for the development.

Within the proposed subdivision a 150mm main and 63mm rider main will be installed along the length of the proposed road within the subdivision. Each lot will be provided with metered service connections. All water supply design and construction works will be in accordance with the RITS.

#### 6.2.2 Weavers Crossing Block

It is noted that the existing municipal watermain fed by the header reservoir to the south of Rotowaro Road opposite the site extends westward to service the existing rural residential lots located on Weavers Crossing Road, via a 63mm rider main running directly along the boundary of the proposed Village Zone development area. Despite this potential supply option, the preferred supply for these larger rural residential lots comprises individual/private roof water tank with potential for metered trickle feed top up from the adjacent network.

#### 6.3 Wastewater

#### 6.3.1 Rotowaro Block

The main Rotowaro Block development area is able to establish suitable wastewater connection via extension of the existing WDC municipal wastewater network which currently extends to the western outskirts of Huntly in



proximity to the site. In particular, review of the existing WDC Utilities Maps identifies the following existing wastewater reticulation in proximity to the development site:

- Existing 150mm wastewater gravity main within Cobham Cres (approx. 550m to site boundary);
- Existing 150mm wastewater gravity main within Porritt Ave (approx. 380m to site boundary);
- Existing 200mm wastewater gravity main within Te Wananga O Aotearoa property opposite the site (approx. 200m to site boundary) subject to landowner agreement;

Again, initial consultation has been undertaken with Watercare which has confirmed the above identified potential wasetwater connection points to the site. Watercare wastewater network models can again be utilised to assess the potential effects of the developed site wastewater flows upon the downstream network and treatment plant to identify any potential network constraints and the need for network upgrades. Terra Firma are again willing to work in consultation with Watercare to assist in this network modelling exercise to confirm a sustainable wastewater discharge option for the development.

All internal wastewater infrastructure will be designed and constructed in accordance with the RITS based upon design catchment flows. The internal site network is anticipated to comprise a gravity network draining to a single, vested wastewater pump station located within the vicinity of the northern site boundary to the reserve carpark area. Given its proximity to the lake reserve area, the pump station design must incorporate sufficient emergency storage to mitigate the risks of wastewater overflows to the lake.

A rising main extending from the pump station up to Rotowaro Road is anticipated to establish a connection to the municipal gravity network. The finalised connection point would be established in consultation with WDC/Watercare.

Consideration should be given at the detailed design stage to any possible future development within the balance land and adjacent property to the west of the Rotowaro Block.

#### 6.3.2 Weavers Crossing Block

There is no municipal wastewater connection in proximity to the Weavers Crossing Block that presents a feasible option for extension/connection to this area and hence the proposed Village Zone development lots will be required to implement on-site wastewater treatment/disposal methods.

The existing/adjacent rural residential lots within this area comprise established residential sites of around 1,000m<sup>2</sup> in area and are understood to discharge domestic wastewater via traditional septic tank treatment methods to ground disposal which indicates feasible conditions for these disposal methods.

This area will be subject to further geotechnical investigations to inform appropriate wastewater system design which will comprise key information in determining the finalised Village Zone development lot number/sizes. The use of advanced on-site wastewater treatment systems and disposal via drip irrigation presents a potential for higher density development within this area. All on-site systems will be subject to detailed, site specific design to ensure appropriate treatment and disposal methods are utilised to avoid adverse impacts upon groundwater and downstream surface water systems.

# 7 CONCLUSION

Terra Firma Resources Ltd has lodged a submission on the Proposed Waikato District Plan to re-zone two parcels of land on the western outskirts of Huntly to enable residential land development activities. The rezoning hearings process requires the presentation of sufficient information to confirm that the site is able to be serviced by appropriate 3 waters infrastructure (stormwater/water/wastewater) to enable sustainable development outcomes in line with both district and regional council engineering requirements. In addition, discharges of urban stormwater runoff to the Lake Puketirini receiving environment have been flagged as a key issue to be addressed based upon strong community interest in the lake environment and its water quality.

Site development and associated 3 waters design will be subject to assessment under various statutory documents to ensure sustainable development outcomes and to maintain and enhance the values of the Lake Puketirini receiving environment.

A stormwater management system for the main Rotowaro Block residential development site is recommended comprising capture and diversion of all urban runoff via a reticulated piped network discharging into two stormwater treatment wetlands designed in accordance with both WRC and WDC best practice guideline documents. Stormwater management in accordance with this method is considered appropriate to ensure that any potential adverse water quality effects within Lake Puketirini are avoided.

The existing WDC municipal water and wastewater networks are identified as extending in proximity to the Rotowaro Block development site with opportunity for these networks to be extended to service the development area. Confirmation of these service connections will be subject to further consultation and assessment with Watercare Services Ltd to confirm the preferred service connection points and any potential downstream network constraints which may require upgrading to accommodate the additional development demands.

Development within the Weavers Crossing Block Village Zone development area will utilise typical private, on-lot 3 waters management methods with identified potential for trickle feed supplementary water supply which will be subject to individual detailed design processes.

Overall, the subject site area is considered to present feasible opportunities for 3 waters servicing to enable the planned residential development activities.

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# Attachment 2:

Lake Puketirini Residential Development Plans

- 1. Zoning Plan
- 2. Subdivision Concept Plan
- 3. Subdivision Concept Plan with Contours
- 4. Subdivision Scheme Plan
- 5. Subdivision Scheme Plan with Contours









