Stormwater Effects on Wetlands

Tauriko West

Tauranga City Council

Prepared by:

SLR Holdings NZ

Level 12, The Todd Building, 95 Customhouse
Quay, Wellington 6011, New Zealand

SLR Project No.: 820.030322.00001

21 March 2024

Revision: v5.0

Making Sustainability Happen

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
V1.0	31 January 2024	Deborah Maxwell	Keren Bennett & Charlotte Lockyer	Charlotte Lockyer
V2.0	1 February 2024	Deborah Maxwell	Keren Bennett & Charlotte Lockyer	Charlotte Lockyer
V3.0	13 February 2024	Deborah Maxwell	Keren Bennett & Charlotte Lockyer	Charlotte Lockyer
V5.0	14 March 2024	Deborah Maxwell	Keren Bennett & Charlotte Lockyer	Charlotte Lockyer
V5.0	21 March 2024	Deborah Maxwell	Keren Bennett & Charlotte Lockyer	Charlotte Lockyer

Basis of Report

This report has been prepared by SLR Holdings NZ (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Tauranga City Council (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

Table of Contents

1.0 Introduction 3
2.0 Site information 3
2.1 Physiographic characteristics 3
2.2 Wetland types present 7
2.3 Development Plan 9
3.0 Potential effects and management options 11
3.1 Hydrological Management 11
3.2 Enhancement opportunities 14
4.0 Discussion and Conclusion 17
5.0 References 18

1.0 Introduction

Tauranga City Council (TCC) is preparing a resource consent for the discharge of stormwater from the future developed Tauriko West Urban Development Area (the Site). Stormwater runoff will be managed through a low impact design (LID) approach, consistent with regional guidance, to manage runoff volume and the water quality of discharges.

There are a number of existing wetlands across the site. Some of these may be modified by the development process in accordance with approvals that will be sought by the parties undertaking the development. Where wetland areas are retained, the LID approach seeks to interface with, and incorporate, these existing natural wetlands into the development's long term stormwater management regime.

TCC has engaged SLR Consulting to demonstrate that the adverse effects of impervious area and future stormwater discharges from the finished development can be managed to ensure the viability of the wetlands that are retained following development.

The approach taken to this assessment is as follows:

- A site visit/inspection of key wetlands on the site to get an appreciation of their types, hydrological setting and state;
- The development of a set of high-level management approaches to assist in protecting and mitigating potential adverse effects of long-term stormwater discharges on wetlands; and
- Consideration of examples where such management outcomes, including restoration, have been achieved in other areas.

This assessment has been prepared to support TCC's stormwater discharge consent application and as such focusses on the management of potential effects on wetlands associated with long term stormwater discharges. It is recognised that phases of the development process – for example earthworks and land-recontouring – have the potential to affect wetlands and their values and some wetlands may be modified through this process. Relevant resource consents for earthworks and any consequential wetland modification and effects are the responsibility of the parties undertaking or commissioning those works in accordance with the requirements of the National Environmental Standards for Freshwater (NES-F) and the Bay of Plenty Regional Natural Resources Plan (PNRP) and include consideration of matters such as the effects management hierarchy.

Accordingly, this assessment focusses on the *post-development regime*. That is, the approaches and techniques that are available to manage post-development stormwater discharges to the wetlands that are retained to ensure their long term viability.

2.0 Site information

2.1 Physiographic characteristics

The Tauriko West Urban Development Area is located approximately 10km south-west of Tauranga City, between the Wairoa River to its west and State Highway 29 to its east (**Figure 1**). The site covers an area of 330ha.

Much of the site is low-lying and susceptible to flood inundation from the Wairoa River (**Figure 2**). When high tides coincide with flood events in the Wairoa River, water can flow back up into the catchment, exacerbating flooding (pers. comm. Project Leader: Urban Planning, Tauranga City Council, August 2023).

The elevation of the site is from <10m asl in the valley floor. The surrounding escarpments/terraces rise steeply to the higher elevation areas 40-60m asl. These elevated terrace areas are incised by alluvial valleys which drain west toward the Wairoa River.

The area receives approximately 1700-1750mm of rainfall per annum, most of which falls during autumn and winter months. As such, there are a number of permanently and intermittently flowing watercourses throughout the site, many of which have been channelised in places to support agriculture and are highly modified. PDP (2020) suggests that flows tend to persist during drier months, likely due to groundwater discharges sustaining these flows.

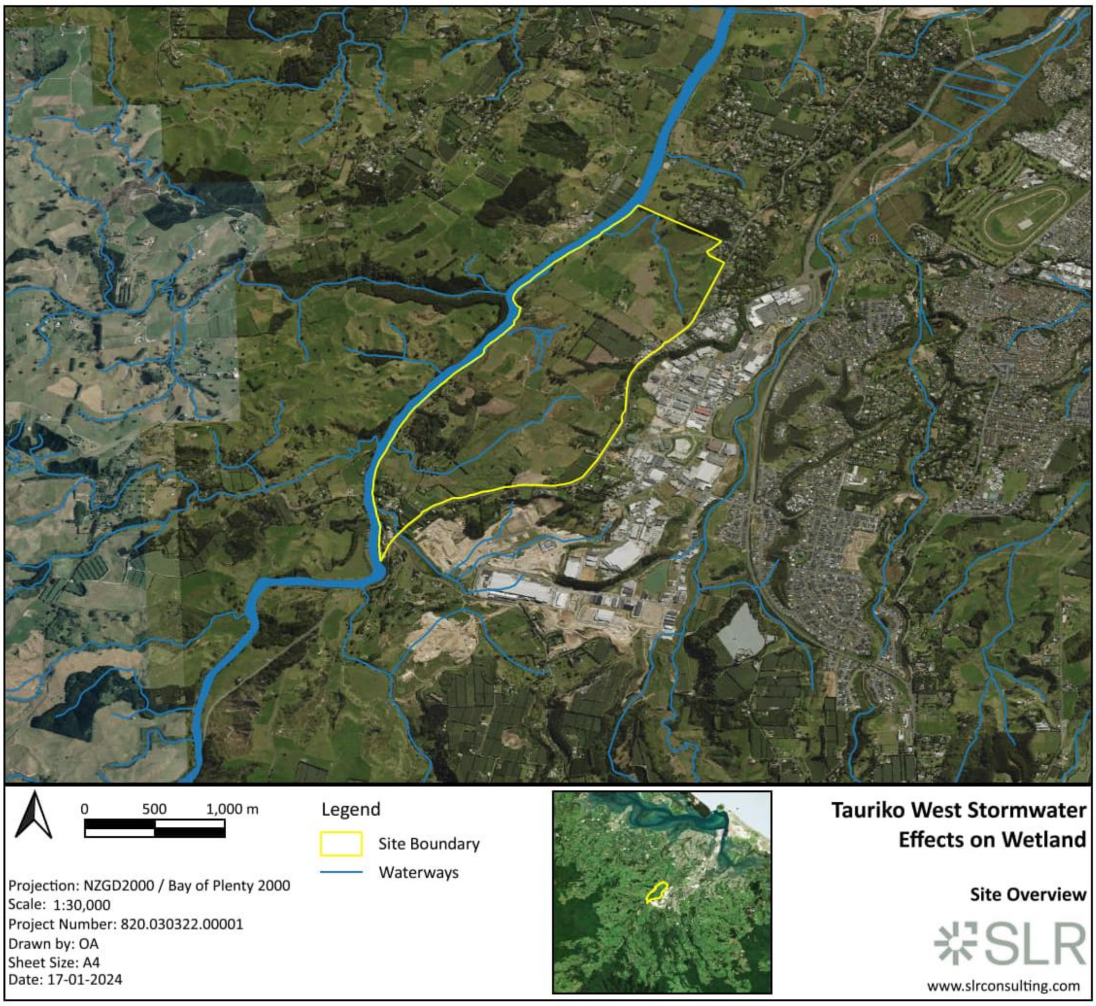

Figure 1. Location of Tauriko West Urban Development Area

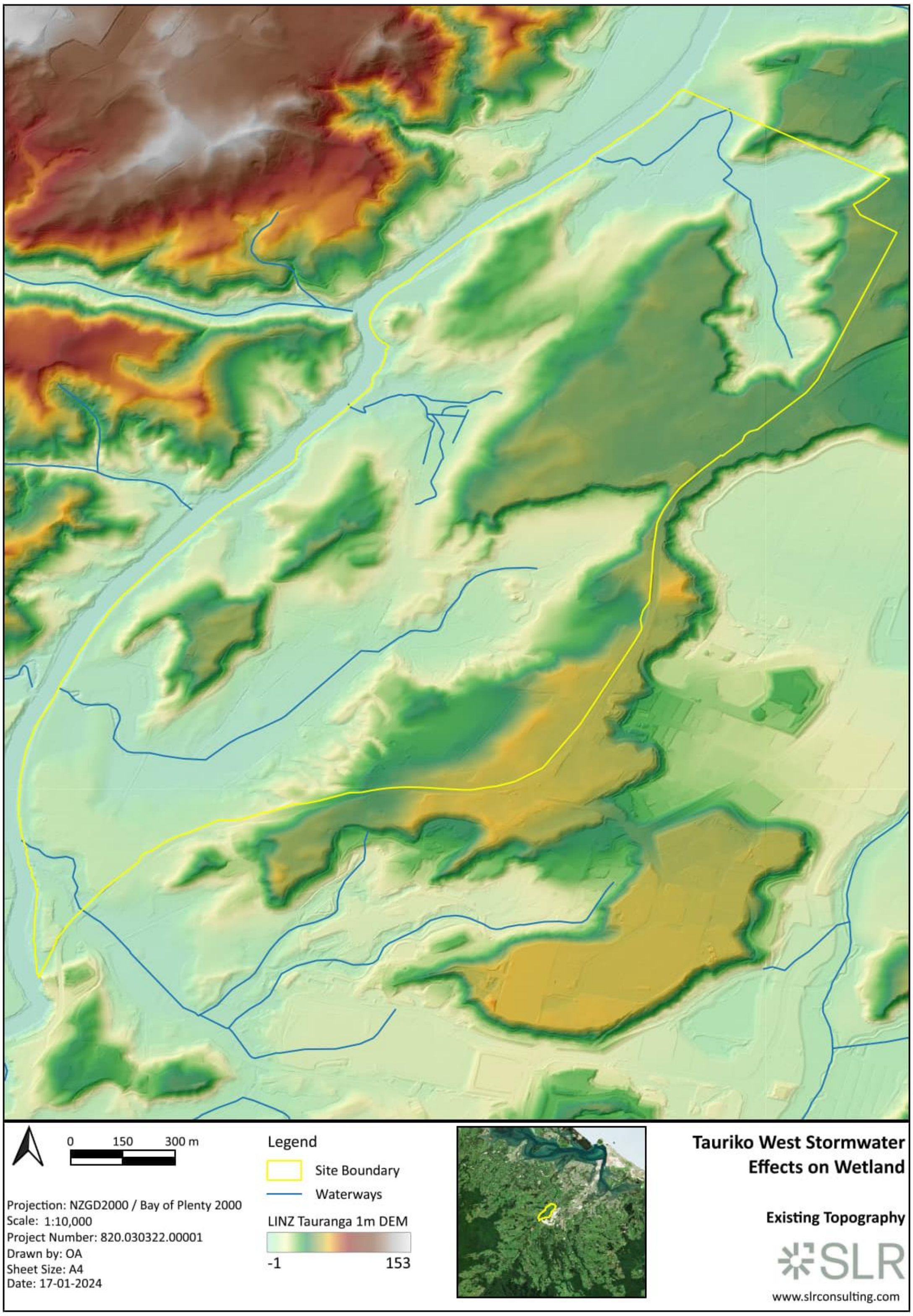

Figure 2. Topography and waterways

The elevated areas in the east of the site are comprised of Te Ranga ignimbrite. These areas have typically deep groundwater levels, with static groundwater levels in excess of 40m below ground level. Alluvial deposits cover the valley floors (PDP, 2020).

Groundwater discharge occurs from laterally extensive volcanic aquifers in locations where the ground surface intersects the water table, generally at topographic low points. Modelling by PDP (2020) has confirmed that groundwater discharges predominantly to the Wairoa River along the western margin of the site, and to the Kopurererua Valley in the east (**Figure 3**). The presence of flow in water courses year-round indicates the presence of groundwater, which is typical of small water courses in the Western Bay of Plenty. In the vicinity of the site, groundwater discharges are simulated to occur around northern valley, in the central part of the catchment where Wetland 9 is located, and within the southern valley (PDP, 2020).

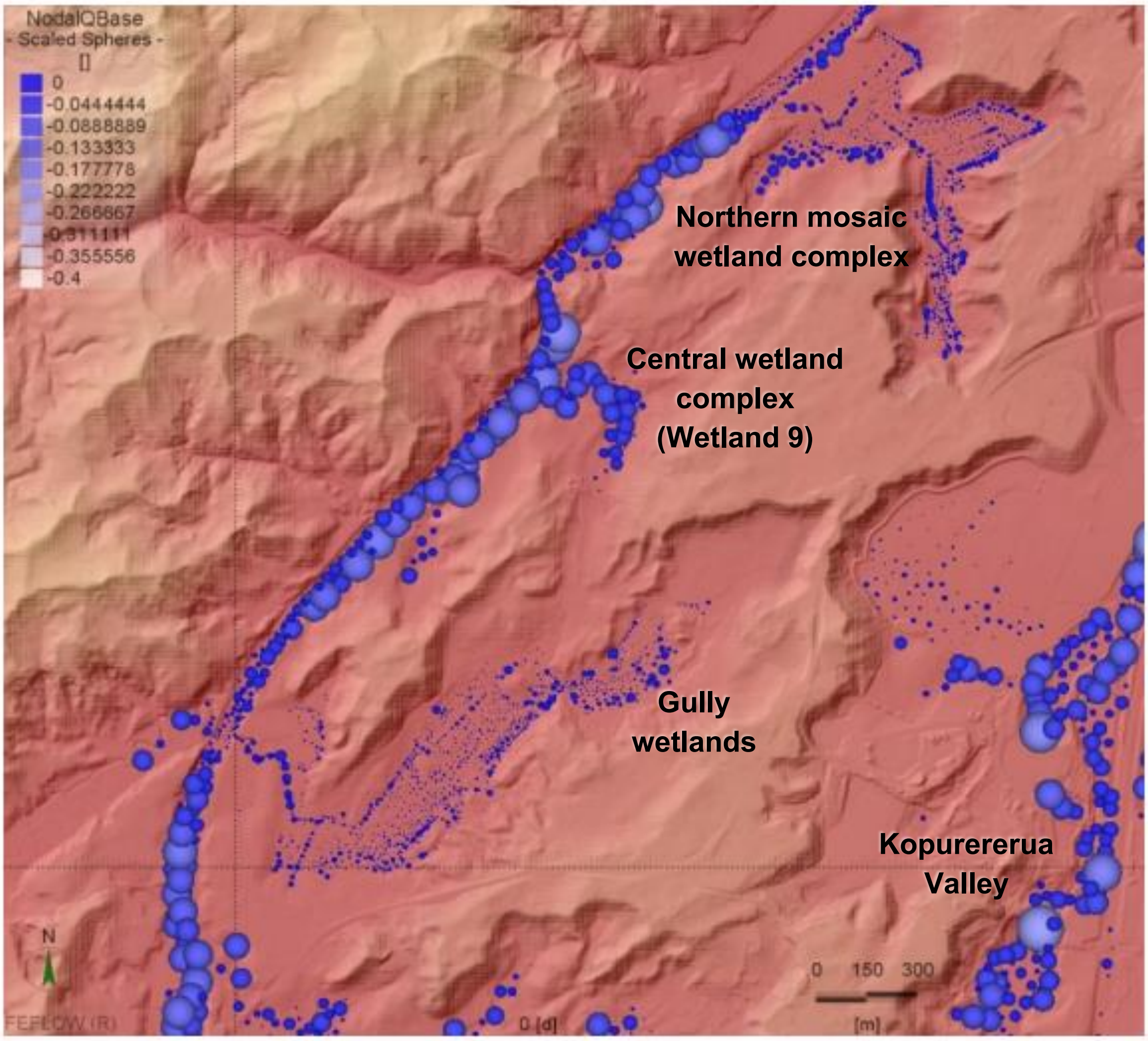

Figure 3. Groundwater discharge distribution, average recharge conditions (taken from PDP, 2020, Figure 7).

2.2 Wetland types present

An ecological assessment was undertaken by Boffa Miskell (2023). This assessment was based on the results/descriptions from several site visits, as well as existing data sets, reports, and aerial imagery with significance assessments and ecological valuations carried out for all habitats. It did not include detailed delineation of wetlands. However, over 40 features were identified with the potential to meet the *natural inland wetland* definition under the NPS-FM, including 25 that have a high likelihood and an additional 16 that have a moderate likelihood as being classified as natural wetlands (**Figure 4**).

There is a large wetland mosaic feature (16.84 ha) located in the northern gully section in which it is estimated at least 50% of the area would be considered natural inland wetland habitat, if detailed delineation was to occur. There is an extensive network of drainage channels and numerous springs and seepages present.

There are several areas within the mosaic that have a high likelihood of being a natural inland wetland. These are largely located in headwater areas of the gully at the base of the escarpment, although some appear to be perched above the valley floor.

The central wetland complex is made up of several potential wetland areas, including Wetland 9 which is considered to have moderate ecological value.

Wetland 9 is defined by a wide depression in the topography. Historically it appears to have been a persistent feature within the landscape and provides a source population for a range of wetland-affiliated species. It provides a buffer between upstream inputs and the Wairoa River, via filtration and flood mitigation. The wetland maintains moisture levels compared to other wetland areas on the site. This is partly because it is supported by upstream artificial watercourses (Boffa Miskell, 2023).

There is another smaller linear potential wetland feature south of Wetland 9 along the western boundary.

There are also a series of small gully features along the escarpment near the south-eastern boundary of the site and some low-lying areas, springs and watercourse channels that have been identified as having a mix of low to high likelihood of being natural inland wetlands. Being located further away from the Wairoa River these are likely to be less connected to river fluctuations (referred to in **Figure 4** as Gully Wetlands).

In the southern-most extent of the site is a small feature that has a high likelihood of meeting the natural inland wetland definition. This feature is situated adjacent to SH29.

There are several other potential wetland features identified in Boffa Miskell (2023) that were assessed as low likelihood to meet the wetland definition, or that required further investigation.

It should be noted that the ecological assessment only identified Wetland 9 of the central wetland complex as having moderate ecological value; all other wetlands were assessed as having negligible ecological value (Boffa Miskell, 2023). Further assessment will be required to confirm the status of wetlands across the site.

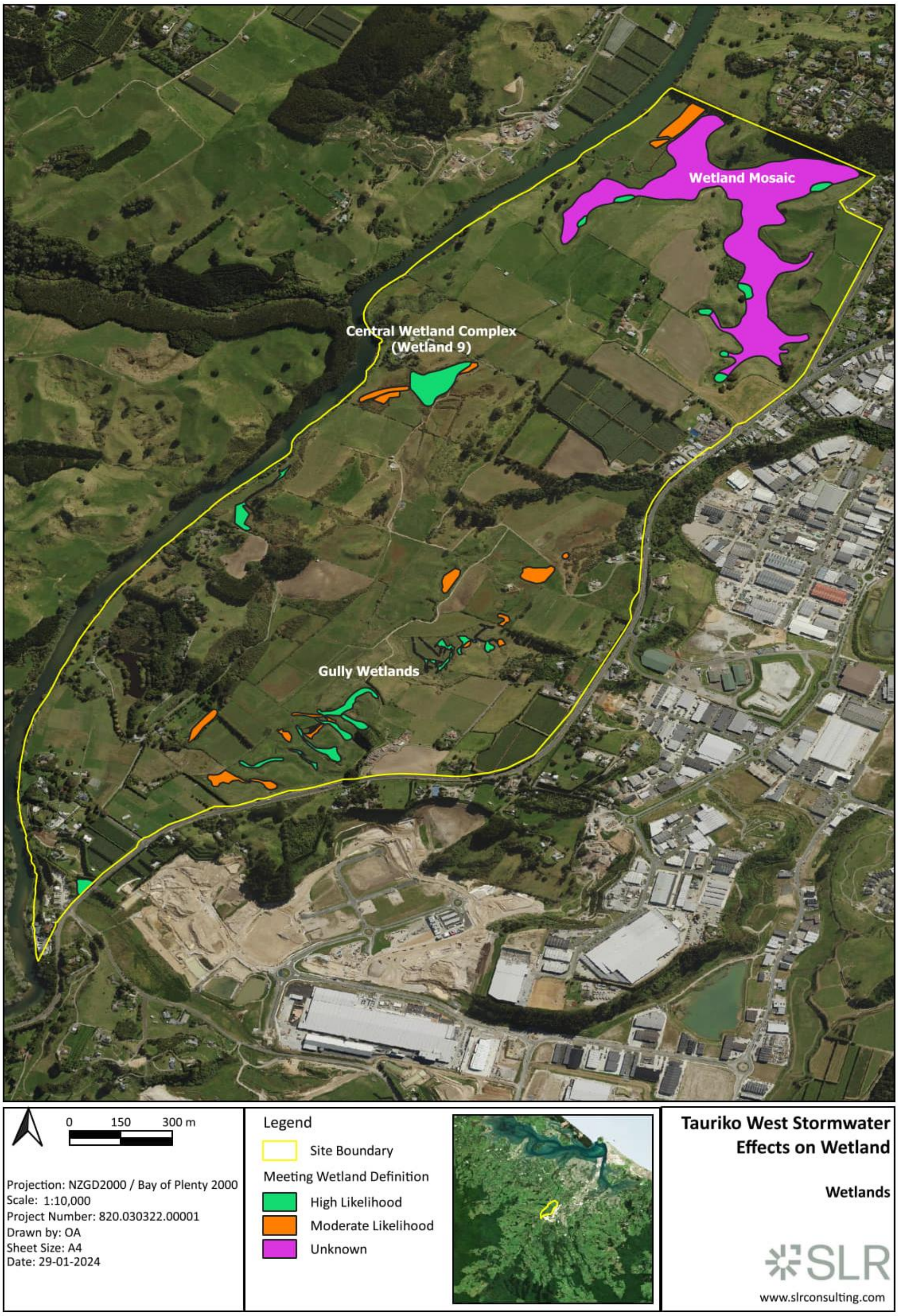

Figure 4. Wetlands – Moderate to high likelihood

2.3 Development Plan

The Tauriko West Urban Development Area aims to provide 3600 to 4000 homes, over three development sites. Approximately 155ha of the 330ha site is to be developed with a maximum imperviousness for residential sites of 70%.

Given the variable topography across the site, significant bulk earthworks will be required to create level building platforms outside of potential flood prone areas and maximise developable land to help meet Tauranga City's housing needs. Several concept landforms have been proposed with the aim to optimise developable land and achieve the Objectives for the Urban Growth Area while integrating with, and minimising effects on, the natural environment (WSP, 2023). The most recent concept landform design has been named Option 5 (**Figure 5**), which is presented in more detail in the stormwater management plan (SMP – WSP 2023).

In some locations areas of low lying (floodable) land are proposed to be raised above specified flood hazard levels for housing development. Hence filling in some watercourses (modified stream and farm drains) and potential wetlands is likely to be required.

For example, within Option 5, some wetland areas are to be kept intact and the watercourses in the central area are replaced by a recreated stream (Boffa Miskell, 2023). It is noted that where the extent or values of wetland habitats/rivers are to be affected , the application of the effects management hierarchy may be required to manage potential adverse effects.

As indicated previously, necessary authorisations for earthworks and physical modification of wetlands and rivers will be sought by the parties undertaking the development. This may result in the loss of some wetland areas, but potentially the expansion and enhancement of other wetland areas (in accordance with the application of the effects management hierarchy under the NES-F).

While it is not the subject of this assessment, it is noted that the proposed district plan provisions for the site (variation 1 to Plan Change 33 to the Tauranga City Plan) require subdivision and development to incorporate low impact design practices including: utilising existing site elements such as topography, soil, and drainage patterns to inform subdivision and development layout, adopting a treatment train approach and integrating and interface with natural freshwater receiving environments. Further the SMP provides a toolbox of measures that can be adopted to achieve this. Additionally, the Design Philosophy Statement for Tauriko West (DPS – TCC, June 2023), requires that any stormwater directed into natural wetlands are either subject to low impact design or are treated, such that the natural wetland is not used as a treatment device but rather receives 'clean' stormwater runoff.

Hence the focus of this assessment is to demonstrate that the potential effects of the long term, post development stormwater discharge on the retained/enhanced wetlands can be managed using common approaches and measures to ensure the long term viability and retention of wetland values.

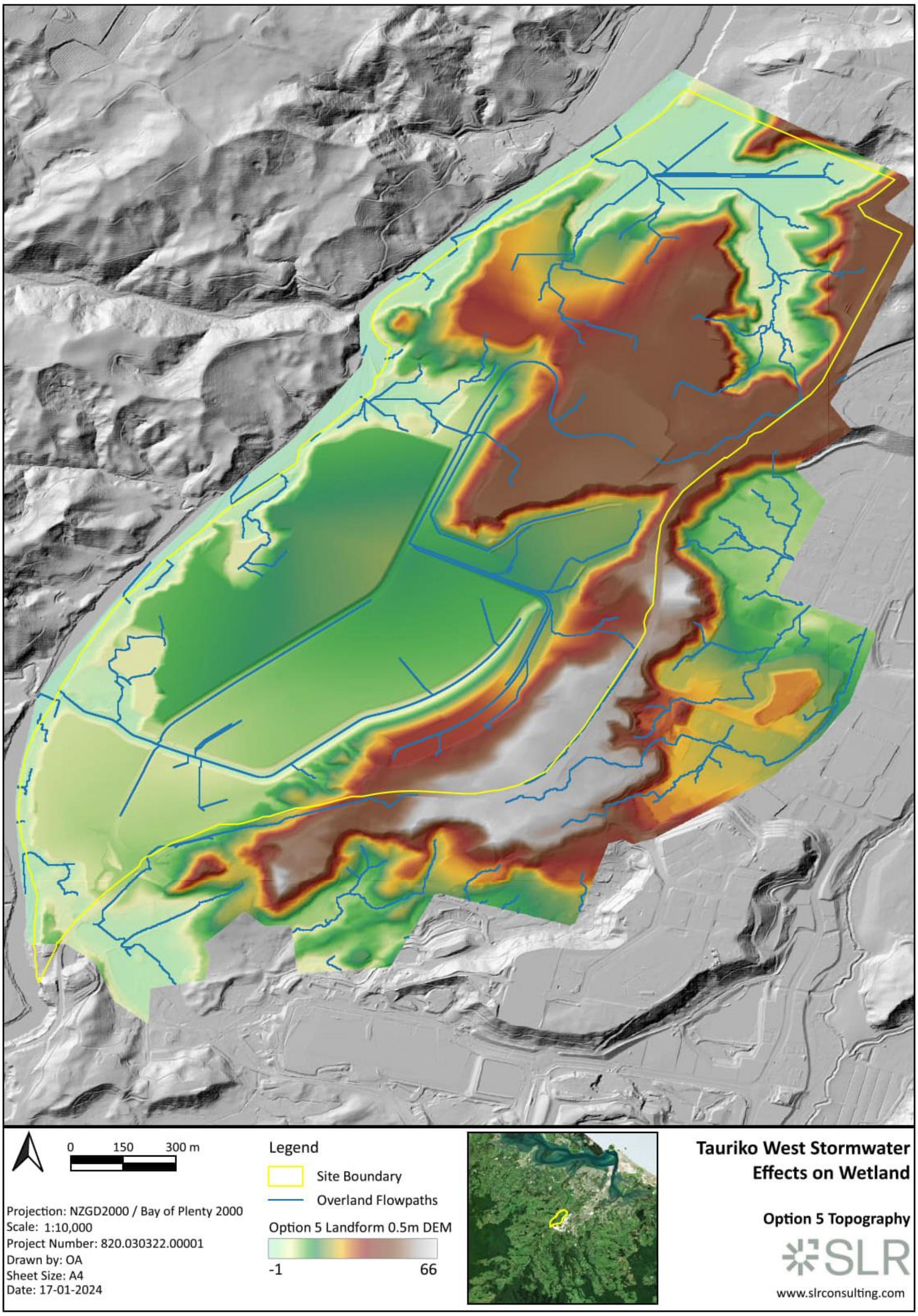

Figure 5. Proposed Landform Design Option – Option 5

3.0 Potential effects and management options

3.1 Hydrological Management

Stormwater discharges from the post-development landform and impervious surfaces will differ from that which existed pre-development. Key changes include:

- 'Flashier' runoff – greater volumes of runoff delivered more quickly via piped infrastructure;
- Reduced baseflows as a result of reduced infiltration.

Management of the hydrological regime is likely to be the most important component in maintaining the wetlands that are retained and ensuring their successful long-term functioning. This should be considered through all phases of the development process to ensure that wetlands post development are able to receive sufficient water (either via stormwater discharges or other sources such as surface streams, springs etc) to maintain their functionality.

It is important that the hydrologic regime of the wetland – including the wetland's water supply (the relevant contribution of surface water, groundwater or both) and seasonal and annual fluctuations in water levels and flows – is understood. This will help identify the future stormwater management options so that actions can be applied to sustain wetland hydrology to support the wetland. Examples of how these attributes may be identified can be found in, for example, Bay of Plenty Wetlands Forum (2007), Northland Regional Council (2020), and GWRC (2009).

Table 1 lists some of the key hydrological management options which may be applied to the management of wetlands that are retained in the final Tauriko West development. To some extent, the role of stormwater in contributing to the wetland's hydrological regime is dependent on the nature of change that results from earthworks and land modification. In sub-catchments where surface water and groundwater components are able to be largely retained, the requirements for stormwater may be less. In contrast, in sub-catchments subject to significant modification (which is likely to be the case in some instances), wetland hydrology is more likely to be dominated by stormwater inputs and may require a greater level of intervention/management to sustain the wetlands in the long term.

The actions that are presented (other than those relating to enhancement) are aimed at sustaining wetland extent and values. Given the existing wetlands have been identified as having relatively low values, there is potential that the actions may result in an improved wetland management regime and, when combined with the enhancement actions (**Section 3.2**), could lead to improve wetland health and functioning.

It should be noted that the actions that can be applied will be dependent on the location and hydrologic characteristics of the wetland, and objectives for management. It is recommended that a wetland management plan be adopted for the post-development wetlands that includes on-going monitoring of the wetland (for a set period of time). This enables post-development management actions to be 'tweaked' or amended to respond to changes in wetland function, if necessary. This provides further assurance that the suite of tools can be adapted to the circumstances and ensure good long term wetland outcomes. Examples of wetland monitoring and assessment can be found in the NZ Landcare Trust Wetland Monitoring and Assessment Kit (2012[1]) and Clarkson (2012).

[1] WETMAK (Wetlands Monitoring and Assessment Kit) https://landcare.org.nz/resource/wetmak/

Table 1. Hydrological management tools

Water Quantity and Quality management tools/actions
• Maintaining hydraulic connections: – The future wetland will be influenced and largely driven by earthworks and landform/hydrological modification. Once this has been determined the remaining natural hydrological inputs need to be understood and retained. – If surface water fed, ensure streams (natural and modified, intermittent or perennial) continue to flow, and flows into wetlands are maintained by restoring natural channels or removing artificial drainage channels within and/or to wetlands. – If groundwater fed, retain connections with the existing springs/seeps by raising water-levels and/or ensuring not too much or too little water is draining from the wetland. – If flood flows from Wairoa River are an important component of flow regime, maintain hydrological connection between the wetlands and lower valley to the Wairoa River during larger events and design any downstream drainage or conveyance channels (or modifications to existing drainage) so as not to increase drainage from wetland areas whereby changing their hydrologic regime. *Example: Dunearn peat bog, Southland[2]; Otairua/Hannah's Bay Wet land, Rotorua[3].*
• Allow for regular wetting and drying to increase the amounts of nutrients released from sediment and to promote decay of plant material by: – Allowing the water level to rise and fall naturally, where possible. – Controlling the release of stormwater into the wetland. Design extended detention devices to manage the flow of stormwater into the wetland. This could include installing multiple flow outlets at various heights to allow smaller events to be released from the extended detention device, providing some hydrologic variability in the wetland flow regime. – Restoring natural channels or removing artificial drainage channels within and/or to wetlands so some of the natural flow regime is maintained or enhanced. *Example: Otairua/Hannah's Bay Wetland, Rotorua[3].*
• Control the volume and speed of flood flows by: – Naturalising channels and waterways. – Forebay/energy dissipation to reduce velocities entering the wetland. – Where peak flows (velocity and magnitude) and volumes have the potential to affect the wetland, consider installing high-flow bypasses. – Restore or create channels within the wetland for stormwater flows. *Example: BOPRC, 2012[4]; Christchurch City Council[5].*

[2] White M and McNutt K (2003) Dunearn Peat Bog: Restoration and Monitoring. SRC Publication No 2003-12. Environment Southland and Department of Conservation, Invercargill

[3] Campbell, D, 2012. Chapter 7: Hydrology. In: Wetland restoration: a handbook for New Zealand freshwater systems. Edited by Monica Peters and Beverley Clarkson. Lincoln, N.Z.: Manaaki Whenua Press, 2010. https://www.landcareresearch.co.nz/publications/wetland-restoration/

[4] BOPRC, 2012. Stormwater Management Guidelines for the Bay of Plenty Region. https://www.boprc.govt.nz/media/520746/guidelines-2012-01-stormwater-management-guidelines-for-the-bay-of-plenty-region2.pdf

[5] Christchurch City Council, 2003. Chapter 6: Stormwater Treatment Systems in Waterways, Wetlands and Drainage Guide. https://ccc.govt.nz/assets/Documents/Environment/Water/waterways-guide/10.-Restoring-Wetlands.pdf

Water Quantity and Quality management tools/actions
• Maintaining water levels or control conveyance between the wetland and downstream drainage channels through: – Use of artificial water level control within the wetland, for example using a weir, ensuring fish passage is maintained where appropriate. – Use of the extended detention devices to control the rate of release of stormwater into wetlands. – Blocking or filling in ditches or drains, building a low bund, weir or dam, or other earthworks (GWRC) if you need to increase water levels. – Checking and clearing any artificial obstructions to the passage of native fish. *Example: Bullock Creek, Westland (Sorrell, 2004)[6]; Dunearn peat bog, Southland[2]; Whangamarino Wetland, Department of Conservation[7];*
• Improving or maintaining water quality by: – Establishing functional and beneficial riparian vegetation throughout retained and created watercourses that connect with wetland habitats. – Monitoring sediment build-up and replanting where vegetation is lost. – LID and treating stormwater from key sources before discharging to a natural wetland (as proposed). – Considering construction of a forebay to encourage additional settling of pollutants prior to entering the wetland, and regular maintenance of the forebay to maintain function. – Ongoing maintenance to remove litter, control weeds and remove pest species. *Example: Ōtuwharekai, Canterbury[8]; Awarua-Waituna, Southland[9]; Opuatia Wetland, Waikato[10]*

As detailed above, there are a range of tools and approaches available to manage the hydrological and water quality regime in the wetlands that are retained post-development. It is noted that some of these tools necessitate consideration during the earthworks/land modification phase and the design of the stormwater system – including the hydrological design of the extension detention devices. Once the design and construction phase is complete the options for sustaining the wetlands become more limited and are primarily refinements of the hydrological regime and actions such as water level control, weed/pest control and maintenance of wetland planting etc.

Central to this is a Wetland Management Plan, that includes inspection and monitoring of vegetation, sediment build up etc, to either confirm that the wetland health is tracking positively or otherwise to identify remedial actions that are necessary.

---

[6] Sorrell BK, Partridge TR, Clarkson BR, Jackson RJ, Chagué-Goff C, Ekanayake J, Payne J, Gerbeaux P and Grainger NPJ (submitted 2004). Soil environmental and vegetation responses to hydrological restoration in a partially drained polje fen in New Zealand. Wetlands Ecology and Management.

[7] Department of Conservation. https://www.doc.govt.nz/our-work/freshwater-restoration/arawai-kakariki-wetland-restoration/sites/whangamarino/restoring-whangamarino/)

[8] Department of Conservation. https://www.doc.govt.nz/our-work/freshwater-restoration/arawai-kakariki-wetland-restoration/sites/otuwharekai/restoration-otuwharekai/

[9] Department of Conservation. https://www.doc.govt.nz/our-work/freshwater-restoration/arawai-kakariki-wetland-restoration/sites/awarua-waituna-wetlands/restoring-awarua-waituna/

[10] Waikato Regional Council. https://waikatoregion.govt.nz/council/about-us/shovel-ready-projects/opuatia-wetland-restoration/

Otaiura / Hannah's Bay Wetland, Rotorua

The goal of the restoration is to re-establish and maintain the natural ecosystem processes and the indigenous character of the Otauira wetland. From a hydrological perspective, this meant restoring and retaining higher water levels within the wetland by redirecting surface runoff and other airport-derived water and by "fixing" other areas where water was being lost.

Project actions to restore and enhance the wetland include:

- Identification of an ecologically acceptable route for a stormwater channel to pass through it.
- Large-scale weed control.
- Restoration planting over 5 seasons (>27 000 plants).
- Water levels monitored using a staff gauge and 4 piezometers.

Campbell, D, 2012. Chapter 7: Hydrology. In: Wetland restoration: a handbook for New Zealand freshwater systems. Edited by Monica Peters and Beverley Clarkson. Lincoln, N.Z.: Manaaki Whenua Press, 2010. https://www.landcareresearch.co.nz/publications/wetland-restoration/

3.2 Enhancement opportunities

As assessed by Boffa Miskell, the majority of the wetlands on the site have low/very low ecological value. Even Wetland 9, which was assessed as having the highest values, has scope for enhancement to improve values.

In light of the approach specified in the DPS, it is unlikely that water quality from the new urban areas will be a significant issue. However, if necessary, actions can be undertaken to further minimise contaminant discharge into the natural wetland.

Table 2 lists some of the enhancement tools and actions which may be applied to the Tauriko West development. It should be noted that the number and range of options suitable for implementation at a given site, post-construction, will be site-specific.

Table 2. Enhancement tools

Enhancement tools/actions
• Enhance wetland values (e.g. wetland health, condition, permanence etc.) through weed control and planting of wetland vegetation species to encourage wetland restoration and improve biodiversity values in other wetland areas over the site. Choose plant species that are specific to the area and appropriate for the hydrologic regime of the wetland. Planting guides include: – Wetland restoration guide: Preserving and re-creating our wildlife water wonderlands in the Bay of Plenty[11]. – Wetland restoration: a handbook for New Zealand freshwater systems. Chapter 10: Revegetation[12]. – Wetland planting guide[13] . – Wetlands Restoration Guide[14]. • Establish functional and beneficial riparian vegetation throughout retained and created watercourses that connect with wetland habitats. • Restore or re-form natural channels or remove artificial drainage channels within and/or to wetlands so some of the natural flow regime is maintained or enhanced. • Create new wetland habitat or expand the size and spatial extent of existing wetlands. • Use extended detention devices to feed into wetlands to support the hydrologic regime. • Provide a buffer zone to protect wetland values and to encourage plants to regenerate. • Remove unwanted exotic species, including willow, broom and gorse and undertake planting of native wetland species to encourage wetland restoration and improve biodiversity values. Consider a staged approach to allow natives to establish before willow are removed. • Providing enough seasonal variation in flows to improve wetland health and diversity. • Consider providing a buffer zone around the wetland for protection and to encourage plants to regenerate. • Ongoing maintenance to remove litter, control weeds and remove pest species. • Monitor sediment build-up, vegetation state and condition. • Replant where vegetation has been lost. *Example: Waiatarua Reserve, Auckland[15]; Awarua-Waituna, Southland[9]; Opuatia Wetland, Waikato[10]; Te Rapaura Wetland, Marlborough[12].*

[11] Bay of Plenty Wetlands Forum, 2007. Wetland Restoration Guide: Preserving and recreating our wildlife water wonderlands in the Bay of Plenty.

[12] Clarkson, B and Peters, M, 2012. Chapter 10: Revegetation. In: Wetland restoration: a handbook for New Zealand freshwater systems. Edited by Monica Peters and Beverley Clarkson. Lincoln, N.Z.: Manaaki Whenua Press, 2010. https://www.landcareresearch.co.nz/publications/wetland-restoration/

[13] Waikato Reginal Council: https://waikatoregion.govt.nz/assets/WRC/Services/publications/other-publications/Wetland-factsheet-3-Planting-guide.pdf

[14] Auckland Council: https://www.aucklandcouncil.govt.nz/environment/plants-animals/plant-for-your-ecosystem/Documents/wetlandsrestorationguide.pdf

[15] Ōrakei Local Board: Auckland Council. https://infocouncil.aucklandcouncil.govt.nz/Open/2019/09/OR_20190919_AGN_7729_AT_files/OR_20190919_AGN_7729_AT_Attachment_71654_1.PDF

Waiatarua Reserve, Auckland

The 20ha wetland in Waiatarua Reserve is the largest urban constructed wetland in New Zealand, located on the site of a previously drained lake. It is mainly a stormwater-treatment system where drains, weirs, bunds and sediment traps remove pollutants from waterways, but also has important biodiversity and amenity values.

Project actions to improve the wetland include:

- Improving how sediment is captured early in the wetland system to reduce the rate that the rest of the wetland was becoming filled with sediment and reduce disturbance by maintenance machinery.
- Wetland planting in conjunction with weed control.
- Removing short-circuits of flows and increasing sunlight infiltration to improve water quality.
- Having a joined-up approach to maintenance in the perimeter and centre of the wetland
- Animal pest control.

Ōrakei Local Board: Auckland Council https://infocouncil.aucklandcouncil.govt.nz/Open/2019/09/OR_20190919_AGN_7729_AT_files/OR_20190919_AGN_7729_AT_Attachment_71654_1.PDF

4.0 Discussion and Conclusion

TCC is preparing a resource consent for the discharge of stormwater from the future developed Tauriko West Urban Development Area. Stormwater runoff will be managed through a LID approach which seeks to incorporate existing natural wetlands into the development. Wetlands that remain following land recontouring and development will receive stormwater from the proposed development, with the potential for stormwater runoff to impact natural wetlands onsite unless appropriately managed.

The aim of this assessment was to demonstrate that the adverse effects of development can be managed using available approaches and techniques such that the wetlands can be sustained in the long term and become integral and valued features of the future developed area.

Management of the hydrological regime is likely to be the most important component in maintaining wetland values and ensuring its successful long-term functioning, including managing water levels, flow regimes and water quality. To a large degree, this requires consideration at the earthwork/land modification and stormwater network design stages so that the hydrological contributions to the wetlands, and the requirements for stormwater management, are understood and incorporated into the design of the stormwater network and associated devices.

As a result of the development, there are likely to be significant opportunities for enhancement of wetlands including planting of native wetland species to encourage wetland restoration and improve wetland values, restoring natural channels and removing willow, broom and gorse species. Again, this restoration/enhancement is likely to occur during the land development phase, and the focus of the long-term stormwater management regime is to sustain the enhanced wetlands and associated values.

Accordingly, the focus of the post-development management of stormwater is primarily associated with the monitoring of key wetland parameters and health indicators to ensure that the health and functioning of the wetland is being sustained and where necessary, intervention measures to improve on-going management. In respect of the latter, key post-development management actions include:

- Maintaining water level control or controlling conveyance between the wetland and downstream drainage channels.
- Allowing water level to rise and fall naturally, where possible.
- Naturalising channels within and/or to wetlands.
- Using extended detention devices to manage the flow of stormwater into the wetland through, for example, by-passing flows, if necessary.
- Establishing functional and beneficial riparian vegetation throughout retained and created watercourses that connect with wetland habitats.
- LID and treating stormwater from key sources before discharging to a natural wetland (as proposed).
- Ongoing maintenance to remove litter, control weeds and remove pest species.

The integration of the built and natural environment is a key component of a LID approach that is proposed for Tauriko West. While it is anticipated that landform and hydrological modification will be undertaken (in accordance with authorisations that will be sought by the land developers), some natural wetlands will be retained on the site and become part of the wider stormwater system. These may be modified from their current state – consistent with the direction of the National Policy Statement for Freshwater Management to achieve no net loss of wetland extent and values – and some may be enhanced to mitigate/offset effects elsewhere.

As outlined above, there is a range of commonly utilised tools and techniques available to ensure that the health and values of the wetlands that are retained post-development can be sustained in the long term and enable the wetlands to become an integral and valued feature of the future development. As indicated above, these approaches/tools have been successfully applied elsewhere.

Central to this is a wetland management and monitoring plan, that is designed to assess the health of the wetland and identify any necessary changes or additional mitigation necessary to maintain or enhance the heath of the wetland. Accordingly, we recommend the adoption of a condition of consent requiring such a plan to be prepared and implemented following development.

Subject to this management plan and subject to the implementation of commonly used remedial/corrective actions (if necessary), we consider that the post-development stormwater discharges can be managed to sustain the wetlands that are retained/enhanced and support their on-going healthy functioning.

5.0 References

Boffa Miskell Limited, 2023. Ecology assessment: Tauriko West Structure Plan. Report prepared by Boffa Miskell Limited for Tauranga City Council.

Bay of Plenty Wetlands Forum, 2007. Wetland Restoration Guide: Preserving and recreating our wildlife water wonderlands in the Bay of Plenty.

GWRC, 2009. A beginner's guide to wetland restoration. GW/EP-G-09/122

Clarkson B.R. 2012. Chapter 13: Monitoring. In: Wetland restoration: a handbook for New Zealand freshwater systems. Edited by Monica Peters and Beverley Clarkson. Lincoln, N.Z. : Manaaki Whenua Press, 2010.

Northland Regional Council, 2020. Looking after your wetland.

PDP, 2020. Tauriko West – Preliminary Groundwater Discharge Assessment.

PDP, 2023. Tauriko West – Preliminary Groundwater Discharge Assessment – Addendum: Option 5.

Rayman. L., Saecker-Battley. P., Clarke. C., 2023. Tauriko West Study Report (P04082) Morphum Environmental Limited.

WSP, 2023. Tauriko West Urban Growth Area - Stormwater Management Plan.

Making Sustainability Happen