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Stormwater Management Plan

Sleepyhead Estate
Ambury Properties Ltd
30/11/2019
FINAL

Document Control

Project Number	P19-140
Project Name	Stormwater Management Plan
Client	Ambury Properties Ltd
Date	30/11/2019
Version	V1
Issue Status	FINAL - For Information
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Executive Summary

The Sleepyhead Estate development area is located in a rural environment located in Ohinewai, Waikato, directly adjacent to State Highway 1 and is bounded by Balemi Road to the north and Tahuna Road to the south. The current land use on site is rural pasture, with the site being used for dairy farming.

This stormwater management plan has been developed for the Sleepyhead Estate development area based on Waikato Regional Council's Stormwater Management Guidelines, statutory considerations, site considerations and best practice.

The overarching objectives for the Sleepyhead Estate SMP are to:

1. Incorporate a water sensitive design approach that manages the impact of land use change from predominantly rural/farmland to urban. The proposed approach promotes at source stormwater management which is in line with Waikato Regional Council's Stormwater Management Guidelines.
2. Account for flood risk areas and provide for development without creating adverse effects on the neighbouring properties or result in increases to the water level in the receiving Lake Environment.
3. Provide stormwater quality treatment for roads and carparks and avoidance of high contaminant yielding roof and cladding materials.
4. Minimise the adverse effects on the water quality and ecological values of the receiving environment through the implementation of stormwater management devices to be selected using a toolbox approach.
5. Reduction of nitrogen and phosphorus in stormwater runoff considering the eutrophic/hyper eutrophic status of Lakes Rotokawau and Waikare.

The stormwater management framework for the development has been split into zones based on the proposed land use within the site. These are as follows:

1. Industrial
2. Business
3. Residential

As part of the stormwater management plan, no discharges are proposed to the Balemi Road and Tahuna Road drains associated with the Waikato Regional Council's Land Drainage Scheme.

Modelling has been carried out to determine the existing floodplain extent under existing conditions, i.e., future rainfall, existing landform and existing impervious coverages. The modelling shows that there is no increase in water levels in the downstream flood extents (lake environment) in the 100 year + climate change storm event as a result of the proposed development.

This can be attributed to the extent of the existing floodplain downstream being large at approximately 35 km^2 (3500ha.). Any increases in runoff volume resulting from development/filling in of existing floodplain storage on site results in no increase in flood depths downstream of the site.

All model results show that post development roads and dwellings are outside of the 100 year + climate change floodplain.

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1. Introduction

1.1. Background

Woods have been engaged by Ambury Properties Limited (APL) to prepare a Stormwater Management Plan (SMP) for the Ohinewai Structure Plan (OSP). The OSP is a planning tool to support a rezoning request to the Proposed Waikato District Plan (PWDP) for Sleepyhead Estate.

Sleepyhead Estate is a mixed-use master planned community proposed to be located on a site adjacent to State Highway 1 (Waikato Expressway) and the North Island Main Trunk (NIMT) railway at Ohinewai.

APL are the property holding associate of the New Zealand Comfort Group Limited (NZCG), the manufacturer of Sleepyhead, Sleepmaker, Serta, Tattersfield and Design Mobel Beds along with Dunlop Foams and Sleepyhead flooring underlay. They also produce a wide range of related products including pillows, mattresses, drapes, furniture and other soft furnishings. The manufacturing operations are currently based at several locations in Auckland. Ambury has been investigating options to consolidate all of their manufacturing operations onto one site. It has searched extensively in Auckland and the Waikato for a suitable site.

Ambury has found a suitable property on the corner of Lumsden Road and Tahuna Road, Ohinewai (Allotment 405, Lots 1 and 2 DPS 29288 and Lots 1-3 474347). The property is zoned Rural in the operative and proposed Waikato District Plans.

The proposed NZCG 100,000m^2 factory will be the major industrial anchor for the project. It will be accommodated in a 63ha industrial hub with rail siding access from the NIMT. The project will also include 8.7ha of commercial development including a service station, local convenience stores and factory outlet shops. 52 hectares of residential land for approximately 1100 new houses will also be provided, together with approximately 55ha of public open space.

Ambury has lodged a submission on the Proposed Waikato District Plan (PWDP) requesting that the land be rezoned to a mix of industrial, residential and business zone to accommodate the mixed-use community. To support the proposed rezoning, Ambury are seeking to embed the OSP within the (Proposed) Waikato District Plan. The OSP will provide a framework for the development of the wider site, outlining the location of activities, the indicative road network and the general location of the open space that will provide for recreation, ecological enhancement and the management of stormwater.

This report has been prepared in support of the rezoning request.

1.2. Purpose

The overall purpose of this SMP is to provide guidance to the Applicant and inform Waikato Regional and District Councils on the stormwater management framework that will be utilised for the Sleepyhead Estate Structure Plan area.

This SMP will provide support to the re-zoning request by APL by providing confirmation that the proposed development can be serviced appropriately with a stormwater management framework that meets WRC requirements. Future development within the OSP area will also be developed to be consistent with this SMP.

This report has been prepared in accordance with Waikato Regional Council's Stormwater Management Guidelines and the Waikato Stormwater Runoff Modelling Guidelines. Consultation has taken place with Waikato Regional Council and Waikato District Council as part of the preparation of this report.

1.3. Objectives

The overarching objectives for the Sleepyhead Estate SMP are to:

1. Incorporate a water sensitive design approach that manages the impact of land use change from predominantly rural/farmland to urban. The proposed approach promotes at source stormwater

management which is consistent with Waikato Regional Council's Stormwater Management Guidelines.

2. Account for flood risk areas and provide for development without creating adverse effects on the neighbouring properties or result in increases to the water level in the receiving floodplain/ lake environment.
3. Provide stormwater quality treatment for roads and carparks and avoidance of high contaminant yielding roof and cladding materials.
4. Minimise the adverse effects on the water quality and ecological values of the receiving environment through the implementation of stormwater management devices to be selected using a toolbox approach.
5. Reduction of nitrogen and phosphorus in stormwater runoff considering the eutrophic/hyper eutrophic status of Lakes Rotokawau and Waikare.

1.4. Report Scope

The scope of this SMP is as follows:

- Outline currently known information about the catchments.
- Identify key receiving environments for the catchments.
- Identify constraints and opportunities for development.
- Identify the statutory framework and technical guidelines for stormwater management in the Waikato Region.
- Presentation of an integrated stormwater management framework to guide future development.

2. Subject Site

2.1. Site Location

The Sleepyhead Estate development area encompasses 52-56 Lumsden Road, 88 Lumsden Road and 231 Tahuna Road, Ohinewai. The site is approximately 178 ha in area.

The development site lies to the east of the Waikato Expressway and the Waikato River. There are two farm drains/ open channels associated with the Lower Waikato Land Drainage Scheme in the vicinity of the property. One is known as the Balemi Road drain and the other is the Tahuna Road drain.

The margins of Lake Rotokawau encroach along the eastern property boundary of the development area.

2.2. Existing Land Use

The site is in a predominantly rural pasture farmed area. The site holds four farmsteads, one active milking shed and two old inactive milking sheds. The predominant land use been dairy farming, as determined through historical aerial photographs.

Land use to the south is similar in terms of being predominantly rural pasture. The land use determines that the catchments are largely undeveloped with low levels of impervious coverages.

The area of the development site (178 hectares) relative to the contributing catchment discharging into Lake Waikare (20,800 hectares) is small. Relative to the size of the contributing catchment area discharging to Lake Waikare, the volume of water generated by the developed site is likely to be insignificant. The site location relative to the contributing catchments to Lake Waikare can be seen in Figure 1.

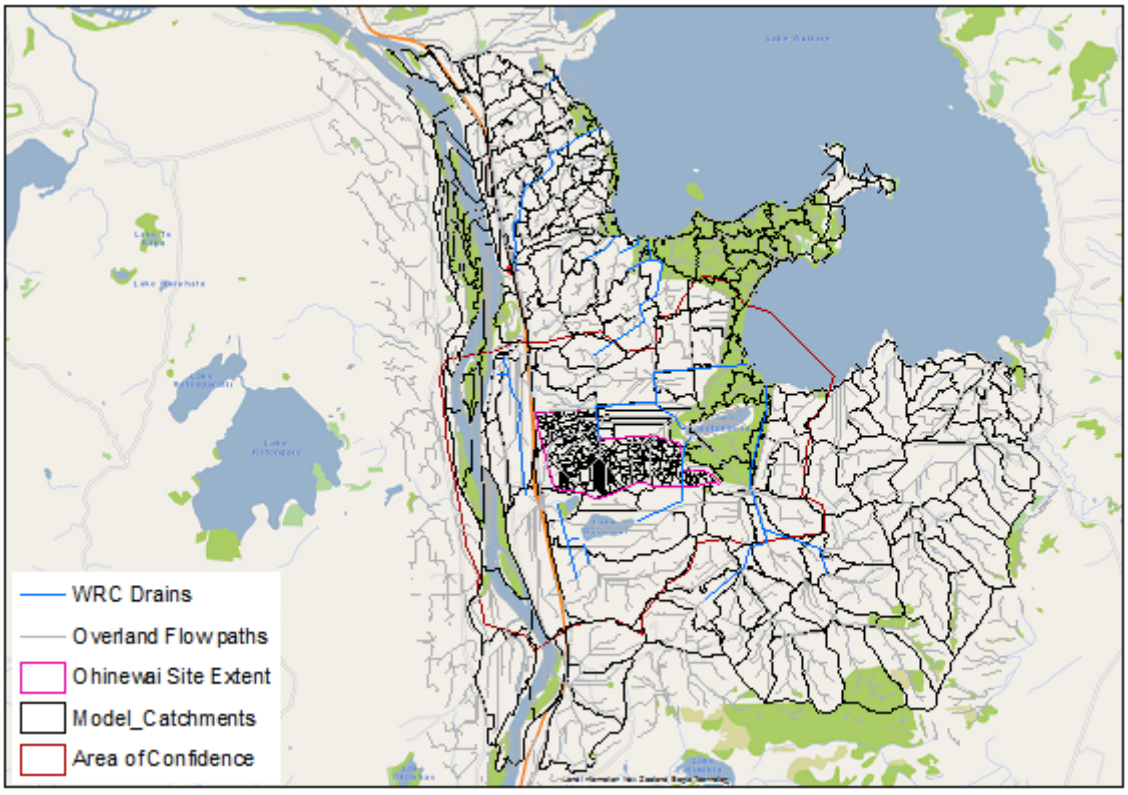

Figure 1: Site area and contributing catchment area

2.3. Topography

The pre-developed site ranges in height from 6.00 mRL along the eastern boundary, rising to 10.00 mRL along the western and northern property boundary. A set of contour plans can be found in Appendix A. Contours based on LiDAR information are shown in Figure 2.

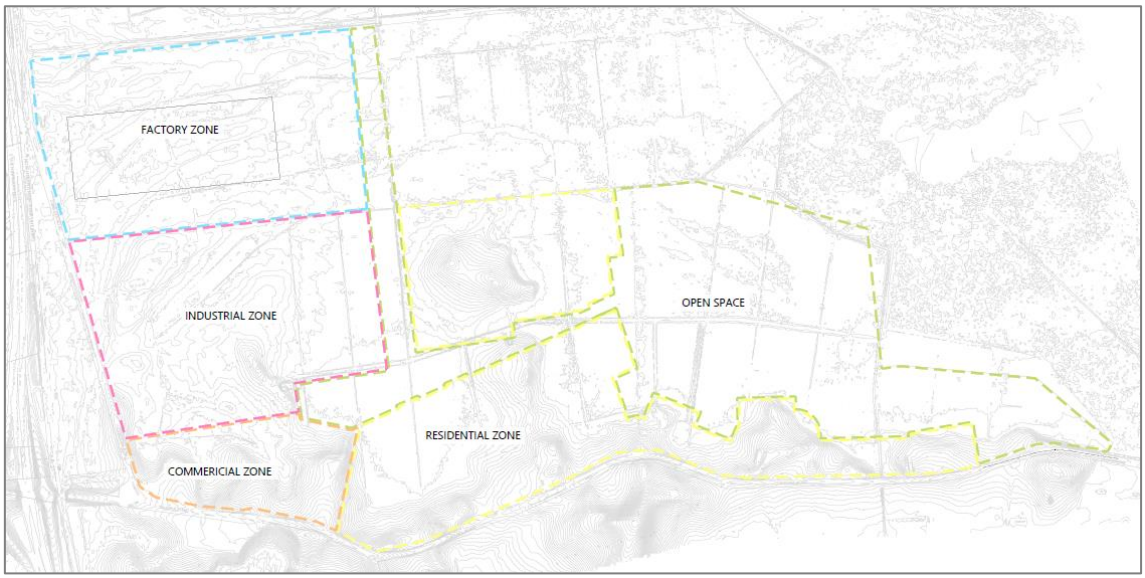

Figure 2: Existing site contours

2.4. Existing Flooding

At the time of this SMP being drafted, Waikato Regional Council are in the process of finalising Flood Hazard Mapping for this region. To progress flood analysis to inform this SMP, Woods have built a site-specific flood model to:

- Quantify existing flood depths and floodplain extents in the pre-development scenario,
- Quantify post development flood depths and floodplain extents with Sleepyhead Estate impervious coverages and landform in place,
- Allow for finished floor levels to be set out with adequate flood risk protection, and
- Understand the residual risk posed to the development by modelling a breach of the Waikato River stop bank to the west of the site. This will inform any Emergency Management Plans (EMPs) to implement on site.

Further information on existing flooding (pre-development) can be found in the Ohinewai Flood Assessment Report produced by Woods, which is included in the plan change documents.

2.5. Groundwater

At the time of this report being written, a hydrogeological survey/analysis has not been carried out on the site. It is anticipated that this will be carried out as part of the preliminary design to determine groundwater levels. It is noted that the site is typically filled 1-1.5m and therefore groundwater influence could be minimal.

2.6. Watercourses and Ecology

There are no mapped watercourses or water bodies within the site according to the Waikato Regional Council's online mapping system, except for the Tahuna Road drain and its notation of being 'Indigenous Fish Habitat'.

The site is characterised by two large mapped drainage channels conveying surface flow from Lake Ohinewai and groundwater from the site to Lake Rotokawau.

The predominant land use on site is agricultural, comprising of dry stock farming activities. An ecological opportunities and constraints investigation undertaken by Ecology New Zealand has identified the site as having highly modified and degraded freshwater and terrestrial ecosystems. The mapped drainage channels are fed by numerous small, artificial farm drains that contain no natural portions from their confluence to

their headwaters. Vegetation cover across the site is dominated by pasture grass with scattered exotic tree and indigenous fern specimens.

Ecology New Zealand have stated that the surrounding area is known to be inhabited by threatened and at-risk species including bats, lizards and fish. Further ecological investigations are scheduled to better understand the sites current utilisation by these species.

2.7. Land Drainage Scheme

Two farm drains run on the boundary of the site, both of which fall under the Franklin-Waikato Drainage Scheme, which is managed by Waikato Regional Council. The Balemi Road drain runs along the north eastern property boundary along Balemi Road and then runs north to discharge directly into Lake Waikare.

The Tahuna Road drain drains water from Lake Ohinewai to Lake Rotokawau. This drain passes under Tahuna Road, through the site and discharges directly into Lake Waikare.

Consultation with the WRC Land Drainage Team confirmed that the drains are frequently at capacity and are unable to adequately convey flows resulting from a lack of grade. The lack of grade and standing water has created water quality issues exacerbated by sedimentation and submerged macrophytes. A copy of the meeting minutes from this consultation can be found in Appendix B.

A schematic showing these drains in relation to the site can be seen in Figure 3.

Figure 3: Land drainage scheme drains

2.7.1. Balemi Road Drain

The Balemi Road drain runs along Balemi Road before turning 90 degrees to the north and finally discharging into Lake Waikare. Early consultation with the Land Drainage Team has confirmed that the portion of the Balemi Road drain, which runs along the northern property boundary is to be decommissioned. The drain is currently unable to provide the desired level of service for the land parcels that drain to it. The Balemi Road drain always has standing water resulting from sedimentation and submerged macrophytes. A portion of it, close to the development site, is also pumped to allow flows to drain into Lake Waikare.

2.7.2. Tahuna Road Drain

The Tahuna Road drain is currently culverted under Tahuna Road. The drain conveys runoff from Lake Ohinewai to Lake Rotokawau. It is understood that this drain also has pumps to facilitate drainage into Lake Rotokawau. The culvert under Tahuna Road acts as a flow restriction. Consequently, the Tahuna Drain has standing water issues resulting from culvert performance, which encourages the growth of submerged macrophytes. This further exacerbates the culvert conveyance capacity.

2.8. Receiving Environment

2.8.1. Lake Rotokawau

Lake Rotokawau has been classified as a peat lake, with an area of approximately 22 hectares and average depth of 1.2 metres.

Lake Rotokawau has been identified as part of the largest wetland surrounding a lake in the Lower Waikato and is hydraulically connected to Lake Waikare, being located on the south western side of Lake Waikare. All drains in the area currently discharge through Lake Rotokawau into Lake Waikare.

Lake Rotokawau is classified as hyper-eutrophic in TR2011/05 – Significant Natural Areas of the Waikato Region: Lake Ecosystems, with poor water quality.

2.8.2. Lake Waikare

Lake Waikare encompasses approximately 3400 hectares within the lower Waikato catchment. Lake Waikare has been classified as a riverine lake and was likely formed when alluvial deposits diverted from the original path of the Waikato River, leaving blocked valleys and tributaries.

The Lake is part of the Lower Waikato Waipa Flood Control Scheme (LWWFCS) and is generally managed between depths of 1.5 – 1.8 metres. As part of the LWWFCS, the lake levels are controlled through outlet structures into the Pungarehu Canal, which discharges into the Whangamarino Wetlands and through the Te Onetea Stream, which discharges into the Waikato River at Rangiriri.

Lake Waikare is hypertrophic and has poor water quality, with particularly high levels of nitrogen and phosphorus. The lake harbours high levels of suspended solids, possibly due to erosion within the adjacent Matahuru catchment. The Matahuru catchment discharges directly into Lake Waikare and is thought to influence resuspension of lakebed sediments due to wave action. The high levels of sedimentation may also be caused by lowering of the average lake level as part of the LWWFCS.

2.9. Lower Waikato-Waipa Flood Control Scheme

The Lower Waikato-Waipa Flood Control Scheme falls under the Lower Waikato Management Zone and is a comprehensive river control scheme designed to provide flood protection within the floodplains of the Lower Waikato and Waipa rivers. The scheme comprises stop banks, pump stations, floodgates and river channel improvement work which commenced in 1961 and were completed in 1982.

The Lower Waikato River starts at Ngaruawahia and extends to the Waikato Heads. Lake Waikare acts as the first of two flood storage areas and receives flows from the confluence of the Waikato River and the Waipa River at Ngaruawahia.

There is one inlet into Lake Waikare located at the Rangiriri spillway from the Waikato River. The Rangiriri spillway discharges flows from the Waikato River into Lake Waikare when the River reaches 8.8mRL. The Rangiriri spillway in conjunction with stop banks along the segment of the Waikato River which adjoins the Sleepyhead Estate site have been designed to effectively manage floodwaters from the River in a controlled way.

This will ensure that in the event of the Waikato river flooding, floodwater would bypass the site to the north at Rangiriri. Te Onetea Control Gate (located at Rangiriri Spillway) operates when Waikato River level is above Lake Waikare and above 7.0mRL.

There are two outlets from Lake Waikare, which are as follows:

- The Waikare spillway into the Whangamarino Wetland; and
- The Waikare Gate, which operates separately to the Waikare Spillway and discharges flows into the Whangamarino via the Pungarehu Canal

The Waikare spillway operates when the levels in Lake Waikare exceed 7.37 m.

The gate from Lake Waikare into the Pungarehu Canal is varied daily to manage lake levels but is closed when the Whangamarino control gate at Meremere is closed. The Whangamarino control gate is discussed in the following paragraphs.

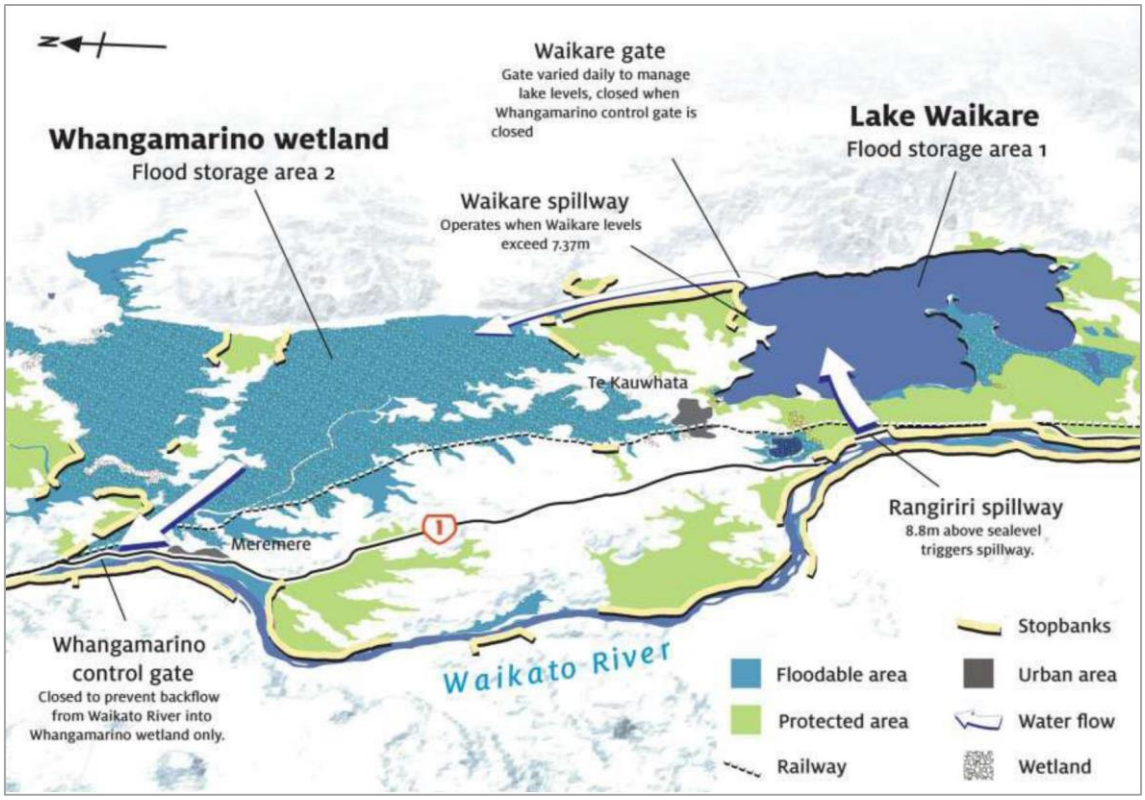

Figure 4: The Lower Waikato Waipa Flood Control Scheme

The Pungarehu Canal discharges into the Whangamarino Wetlands, which acts as the second of two flood storage areas. The Whangamarino Wetland discharges into the Waikato River through the Whangamarino control gate at Meremere. This gate remains closed to prevent backflow into the Whangamarino Wetland.

As part of the development, flood hazard modelling has been undertaken to quantify the effects of development on Lake Waikare's water levels and flood extents on existing land adjacent to the development.

2.10. Geotechnical

A geotechnical assessment undertaken by Geosciences Ltd has found the following with respect to geology on site:

- The site is generally underlain by a surficial layer (3 to 13 m thick) of alluvial soils comprising recently deposited sands (Taupo Pumice Alluvium) and very soft clays/silts and peat (Rotokawau Formation). Older alluvial soils (interbedded sands, silts, clays and peat) of the Karapiro, Puketoka and Whangamarino Formations underlie these surficial soils. The basement rock (interbedded claystone, sandstone, siltstone and coal measures) known as the Te Kuiti Formation occurs at a depth of approximately 100 m below ground level.
- Groundwater is present from near surface levels (0.5 to 1.0 m depth)

- Low lying areas of the site (below RL 7.5 m) are typically mantled by between 5 and 10 m of highly compressible soils (Rotokawau Formation). Areas of the site with higher ground surface elevations (RL 9.0 m or higher) are directly underlain by more competent soils (Karapiro & Puketoka Formation).

Further geotechnical information including plans showing soil types and the results of groundwater testing can be found as part of the Infrastructure Report.

2.11. Potential Contaminated Land

A geotechnical investigation in accordance with the Ministry for Environment's Contaminated Land Management Guidelines found that while there are minor hotspots of contamination identified on site, there was no obvious evidence of gross contamination which could significantly impact on the proposed development.

The report recommends carrying out the required detailed, intrusive investigations in a staged manner as the development progresses, with approval by Council required prior to developing any area identified as 'contaminated' according to the MfE Guidelines. It is anticipated that this will occur during detailed design.

2.12. Knowledge Gaps

The Department of Conservation (DoC) is responsible for managing Lake Rotokawau which is located adjacent to the site. Consultation has been attempted with DoC, however as of November 2019, DoC have not been able to meet with APL or their representatives. Ideally, consultation with DoC would be productive given that Lake Rotokawau is directly downstream of proposed outfalls within the site. Discussions with DoC on the management of the future enhanced wetlands and stormwater management will continue to be attempted.

3. Statutory Framework and Policy Guidance

A review of the statutory framework, relevant stormwater guidelines and policies was carried out to inform the appropriate stormwater and flooding requirements to adopt in the SMP for Sleepyhead Estate. The relevant documents are summarised below with the adopted criteria presented in Section 5.3

3.1. Resource Management Act 1991

Part 2, Section 5 of the Resource Management Act (RMA) 1991, sets out the purpose of the RMA and requires a broad judgment as to whether a proposal would promote the sustainable management of natural and physical resources.

The SMP is intended to provide guidance around stormwater management with consideration given to matters of national importance as outlined in section 6 of the RMA:

- The SMP will ensure that stormwater discharge will not inappropriately alter the natural character of any waterways or wetlands. Appropriate stormwater mechanisms and measures are inherently proposed within this SMP to ensure that any actual and/or potential effects on water quality can be appropriately avoided or mitigated;
- The relationship of Maori with the culture and traditions of their ancestral lands, water, sites, waahi tapu, and other taonga has been recognised and provided for through early engagement the Tangata Whenua Governance Group (TWGG). Ongoing engagement is expected to strengthen the understanding of the site and support for stormwater management mechanisms outlined and proposed in this SMP, e.g. reduction of nutrients from current land use and appropriate management of urban stormwater utilising a low impact design philosophy.
- The SMP appropriately considers significant risks posed from potential flooding hazards which include the event of Waikato River flooding and provide for development without creating adverse effects on the neighbouring land.

The SMP has given regard to the following matters identified under section 7 of the RMA:

- The SMP will either maintain or enhance the quality of the receiving lake and wetland environment through the implementation of stormwater management devices and the reduction of nitrogen and phosphorus into these receiving environments via stormwater runoff;
- The SMP has acknowledged the kaitiakitanga role (which is also a form of stewardship) of the local iwi - TWGG, by engaging them for preliminary feedback of the Sleepyhead Estate development and the proposed stormwater management of the site. The SMP also acknowledges the kaitiakitanga role of Woods in our design of this SMP, through incorporating a water sensitive design approach that manages the impact of land use change from predominantly rural/farmland to urban land. In doing this, the SMP has given regard to the intrinsic values of ecosystems.

With regards to section 8 of the RMA, the SMP has considered the principles of the Treaty of Waitangi, namely the principle of Partnership. Consultation with Tangata Whenua arises from this principle of partnership. Consultation has been given to this principle in the preparation of this SMP, through early engagement with the relevant iwi/hapū through the Tangata Whenua Governance Group (TWGG). The formal consultation process will continue to seek ongoing input from Tangata Whenua regarding specific values of significance, namely the importance of protecting or enhancing the mauri (life supporting capacity) of water through stormwater management within the site and the receiving lake and wetland environments.

3.2. National Policy Statement for Freshwater Management

The National Policy Statement for Freshwater Management (NPSFM) sets out the statutory framework for the management of freshwater across New Zealand. The NPSFM requires Regional Councils to recognise the

national significance of freshwater. Overall, freshwater quality within a region must be maintained or improved.

The NPSFM places a focus on water quality, water quantity and integrated management of freshwater in New Zealand. The NPSFM also recognises the key importance of iwi/hapū and community interests in freshwater in addition to the need to protect the significant values of Wetlands, understanding the integral role they play within ecosystems.

The NPSFM requires "freshwater quality to be maintained at its current level (where community values are currently supported) or improved (where community values are not currently supported)". This is to be carried out through monitoring plans at strategic sites by Regional Council.

The objectives in the NPSFM relevant to the proposal include safeguarding the life-supporting capacity (mauri), ecosystem processes and indigenous species including their associated ecosystems, of fresh water in sustainably managing the use and development of land, and of discharges of contaminants.

Key underpinning Objectives and Policies in the NPSFM relevant to the SMP for the proposed development which relate to water quality are listed under Objectives A1, A2 and A4 and Policy A4. The proposed development is in general accordance with these overarching Objectives and Policies of the NPSFM for the following reasons:

- The SMP will provide for the reduction of nitrogen and phosphorus from stormwater runoff from the site which will help to contribute to the enhancement of the water quality of the receiving Lake and Wetland environments.
- Stormwater discharges from the site will be adequately treated through onsite treatment mechanisms and as such are not anticipated to have any effects on the health of people and communities as affected by their secondary contact with freshwater. Furthermore, it is considered that the proposed stormwater management framework does not provide for adverse effects on the mauri (life supporting capacity) of any freshwater body and any associated ecosystems.
- In seeking to ensure the overall quality of fresh water within a freshwater management unit, and the receiving Lake and Wetland environments within them are maintained or improved, the significant values of Wetlands will be protected.

3.3. Waikato Regional Policy Statement

The Waikato Regional Policy Statement identifies significant resource management issues in the Waikato Region and sets out the objectives, policies and methods to address these issues. As part of formulating this SMP, consideration has been given to the following aspects of the Waikato RPS:

- Built Environment (Ngā Wāhi Ka Whakawhanakehia)
    - Requires that subdivision, use and development of the built environment occurs in an integrated and coordinated way that is sustainable, affordable and planned; and
    - Recognises the historical, cultural and social importance of marae and papakāinga and provides for their ongoing use and development as part of the built environment.
- Fresh Water Bodies (Ngā Huinga Waimāori)
    - Seeks to maintain and enhance the values of freshwater bodies in the region, manage the allocation and use of fresh water and manage lakes, riparian areas and wetlands to promote water quality, biodiversity, cultural values and public access;
    - Recognises Te Ture Whaimana o Te Awa o Waikato - the Vision and Strategy for the Waikato River as the primary direction setting document for the Waikato River;
    - Acknowledges the special relationship that tangata whenua have with water resources; and

- Promotes a catchment based approach to water quality interventions to ensure the integrated management of water resources.

- Natural Hazards (Ngā Pūmate Ā-Taiao)
  - Promotes a regionally consistent approach to managing natural hazard risks through district and regional plans;
  - Advocates for collaboration between organisations and the sharing of information. A Regional Natural Hazards Forum has been established to promote organisational integration and sharing across jurisdictional and plan boundaries;
  - Takes a risk based approach to the management of natural hazards; and
  - Requires that local authorities consider the potential effects of high impact, low probability natural hazard events and plan ahead.

3.4. Te Ture Whaimana o Te Awa o Waikato

The Vision and Strategy for the Waikato River (Te Ture Whaimana o Te Awa o Waikato) responds to four fundamental issues, which are as follows:

1. The degradation of the Waikato River and its catchment has severely compromised Waikato River iwi in their ability to exercise mana whakahaere or conduct their tikanga and kawa;
2. Over time, human activities along the Waikato River and land uses through its catchments have degraded the Waikato River and reduced the relationships and aspirations of communities with the Waikato River;
3. The natural processes of the Waikato River have been altered over time by physical intervention, land use and subsurface hydrological changes. The cumulative effects of these uses have degraded the Waikato River; and
4. It will take commitment and time to restore and protect the health and wellbeing of the Waikato River

It should be noted that the while the development site does not discharge directly to the Waikato River, the Vision and Strategy has been considered as part of this SMP given that Lake Rotokawau and Lake Waikare ultimately form part of the Waikato River's significant catchment.

The document outlines objectives and strategies to achieve the objectives for the Waikato River. The following objectives have been considered as part of this SMP:

- The recognition and avoidance of adverse cumulative effects, and potential cumulative effects, of activities undertaken both on the Waikato River, and in particular those effects that threaten serious or irreversible damage to the Waikato River;
- The recognition that the Waikato River is degraded and should not be required to absorb further degradation as a result of human activities; and
- 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.

The following strategies to meet the above objectives have also been considered as part of this SMP:

- Ensure that the highest level of recognition is given to the restoration and protection of the Waikato River;
- Encourage and foster a 'whole of river' approach to the restoration and protection of the Waikato River, including the development, recognition and promotion of best practice methods for restoring and protecting the health and wellbeing of the Waikato River; and
- Ensure that the cumulative adverse effects on the Waikato River of activities are appropriately managed in statutory planning documents at the time of their review.

3.5. Waikato Regional Plan

The Waikato Regional Plan identifies stormwater discharges into water to be a permitted activity, subject to the following conditions:

a) The discharge shall not originate from a catchment that includes any high risk facility[1], contaminated land*, operating quarry or mineral extraction site unless there is an interceptor system* in place.
b) Any erosion occurring as a result of the discharge shall be remedied as soon as practicable.
c) The catchment shall not exceed one hectare for discharges that originate from urban areas.)
d) There shall be no adverse increase in water levels downstream of the discharge point which causes flooding on neighbouring properties, as a result of the discharge.
e) The discharge shall comply with the suspended solids standards in Section 3.2.4.6.
f) The discharge shall not contain any material which will cause the production of conspicuous oil or grease films, scums or foams, or floatable suspended materials at any point downstream that is a distance greater than three times the width of the stream at the point of discharge.
g) The discharge shall not contain concentrations of hazardous substances that may cause significant adverse effects on aquatic life or the suitability of the water for human consumption after treatment.
h) There shall be no discharge to any Significant Geothermal Feature.

For the purposes of conditions a) and g) levels of hazardous substances in stormwater or sediments that comply with the following guidelines and standards, in relation to the substances that they address will be deemed to be complying with the conditions:

i. Licences under the Hazardous Substances and New Organisms Act 1996 for the use of the substance in New Zealand specifying discharge and receiving water standards for the substance.
ii. Health and Environmental Guidelines for Selected Timber Treatment Chemicals (Ministry for the Environment, Ministry of Health, 1997).
iii. Environmental Guidelines for Water Discharges from Petroleum Industry Sites in New Zealand (Ministry for the Environment, 1998).
iv. Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (Ministry for the Environment, August 1997).
v. Australian/New Zealand Water Quality Guidelines For Fresh And Marine Waters, (Australian & New Zealand Environment & Conservation Council, 2001).

For the purposes of this Rule, 'urban area' includes the inner city or town and built up environments, irrespective of local body administrative boundaries, that are serviced by roads where the speed limit is 80 kilometres an hour or less.

3.6. Lake Waikare and Whangamarino Wetland Catchment Management Plan

The Lake Waikare and Whangamarino Wetland Catchment Management Plan (WWCMP) forms part of a broader lower Waikato catchment management planning and implementation work programme led by the Waikato Regional Council.

The WWCMP has been developed to help address issues and opportunities identified within the Lake Waikare and Whangamarino wetland catchment and provide a framework to be utilised to guide future work programmes of all those involved with the catchment's management and development.

The WWCMP's purpose is:

'Conserve, enhance and, where appropriate, restore the river, land and wetland environment through effective land, water and resource planning across the Lake Waikare and Whangamarino wetland catchment; through a coordinated, collaborative approach'

While primarily a Regional Council led work programme, given the Sleepyhead Estate's location within the catchment of the WWCMP, the implications of stormwater management on the catchment, a summary of the proposed development in the context of the WWCMP's management areas is outlined below.

CMP Implementation

- APL support the implementation of the WWCMP and are committed to working with key stakeholders in a proactive and constructive manner.

Water, Soil and Land Management

- APL through the implementation of the SMP and the master planned development provide for the sustainable management of water and soil and land resources within the catchment. In particular:
    - The development provides for the retirement of a 137ha dairy farm on the margins of Lake Rotokawau with associated reductions in nutrient runoff and reductions in soil loss.
    - The stormwater management provisions outlined in this SMP will provide for best practice treatment for runoff from roads within the development and the industrial, business and residential land uses.
    - Approximately 55ha of open space is provided within the development that will include extensive opportunities for ecological enhancement, including increasing the amount of wetland habitat within the WWCMP area.
    - The development will not affect the LWWFCS.

Biodiversity

- The development provides for a significant opportunity for biodiversity enhancement in the catchment via providing for extensive habitat creation.
- Development phases will be managed in line with best practice to ensure downstream receiving environments are not affected and any native species are monitored and managed as appropriate.

Economic, social and cultural values

- The development looks to recognise and protect people's relationship with the area.
- Significant enhancement opportunities are available for the ecology of the area and social and economic matters due to the provision of employment opportunities and housing.
- Partnerships with tangata whenua have been forged and the wider community have been engaged to build community awareness and ongoing relationships.

4. Stakeholder Engagement

Stakeholder engagement has been a key aspect for formalising the stormwater management framework for Sleepyhead Estate. The sections below set out the consultation and engagement undertaken with various parties and outcomes for the SMP.

4.1. Iwi

As part of the Iwi consultation process, a Hui presenting the proposed stormwater management strategy has been undertaken with the Tangata Whenua Governance Group (TWGG).

At the time of the presentation, the details around flood hazard modelling and the displacement of stormwater were yet to be finalised, however preliminary model results and findings were discussed. A copy of the meeting minutes from the Hui can be found in Appendix C.

4.2. Waikato Regional Council

As discussed previously, Woods have consulted with the Land Drainage Scheme Management Team to understand the drivers around the Land Drainage Scheme. Meeting Minutes have been included in Appendix B.

Consultation with Rick Liefting has been carried out prior to the flood modelling being. As part of this consultation process, the objectives and parameters of the modelling exercise were established. A peer reviewer was also assigned to ensure that the modelling carried out is in line with WRC's objectives. This is further discussed in the Ohinewai Flood Assessment Report.

Consultation with the Consenting Team at WRC was also carried out. Discussions around stormwater identified the need to consult with DoC and Fish and Game given the site's proximity to Lake Rotokawau/Lake Waikare. Also included in the discussion was the strategy around not proposing attenuation prior to discharge into the receiving environment given the site's proximity to Lake Rotokawau/Lake Waikare. The meeting minute have been included in Appendix D.

5. Technical Document Review Summary

5.1. Technical Guidance

The development approach for stormwater management within Sleepyhead Estate is aligned with Waikato Regional Council's Waikato Regional Plan document, i.e., the objectives and policies identified in Section 3.

5.2. Guidance Documents

A summary of the technical guidance documents used in preparation of the SMP is outlined in Table 1 – Guidance Summary.

Table 1 – Guidance Summary

Guidance Document	What it says	Relevance for Sleepyhead Estate SMP
Resource Management Act (1991)	Overarching environmental legislation.	Yes
National Policy Statement for Freshwater Management (2014)	National Statement outlining objectives for managing freshwater in New Zealand and policies for Regional Councils to adopt in order to meet these objectives.	Yes
Waikato Regional Policy Statement	Document outlining key objectives for the Waikato Region	Yes
Vision and Strategy for the Waikato River	Document outlining key objectives for the Waikato River specifically and strategies/policies to achieve those objectives	Yes
WRC TR2018/01 – Stormwater Management Guideline	Benchmark document for technical guidance and design criteria for stormwater management devices	Yes
WRC TR2018/02 – Waikato Stormwater Runoff Modelling Guideline	Guideline document for hydrology in the Waikato Region	Yes
Regional Infrastructure Technical Specifications (RITS)	Standards for the design and construction of public infrastructure within Waikato District. The RITS document gives precedence to the WRC Stormwater Management and	Yes

Guidance Document	What it says	Relevance for Sleepyhead Estate SMP
Resource Management Act (1991)	Overarching environmental legislation.	Yes
National Policy Statement for Freshwater Management (2014)	National Statement outlining objectives for managing freshwater in New Zealand and policies for Regional Councils to adopt in order to meet these objectives.	Yes
Waikato Regional Policy Statement	Document outlining key objectives for the Waikato Region	Yes
Vision and Strategy for the Waikato River	Document outlining key objectives for the Waikato River specifically and strategies/policies to achieve those objectives	Yes
	Stormwater Runoff Modelling Guidelines	
NZS4404 – Land development and Subdivision Infrastructure	Provides detail on stormwater management including WSD, flood risk management, freeboard allowance etc	Yes
WRC TR2011/05 – Significant Natural Aras of the Waikato Region – Lake Ecosystems	Provides guidance on the prioritisation of natural areas for biodiversity management. Contains Lake water levels.	Yes
ARC TP10 – Stormwater Management Devices: Design guidelines manual	Superseded document for technical guidance and design criteria for stormwater management devices.	Yes – provides guidance in technical design for sizing of stormwater management devices
Auckland Council - Guideline Document 2017/001 Version 1 - Stormwater Management Devices in the Auckland Region	Based on ARC's TP10 document. Document for technical guidance and design criteria for stormwater management devices.	Yes – provides guidance in technical design for sizing of stormwater management devices

5.3. Design Criteria

Table 4-3 from TR2018/01 has summarised stormwater issues based on the receiving environment and identifies the following as drivers for discharge to Lake systems:

- **Flooding issues:** Yes - if increased stormwater runoff increases lake water levels.
- **Stream erosion issues:** Tributary and outlet channel stability needs to be considered. Erosion is to be considered on a flow rate and volume basis. Outlet protection also recommended.
- **Water quality:** High priority.

5.3.1. Source Control Requirements

Source control as per TR2018/01 comprises the following elements:

1. Volume reduction via water reuse where possible,
2. Managing contaminants through treatment devices close to where contaminants are generated; this includes managing thermal effects resulting from increases in impervious coverage, and
3. Erosion control measures built into the device.

5.3.1.1. Contaminant Removal

Contaminant removal efficiency can be maximised with a treatment train approach for managing stormwater runoff. The contaminant load model will be used to quantify contaminant removal efficiency based on the methodology outlined in Chapters 6 and 12 of TR2018/01.

The contaminant removal efficiencies of any recommended treatment train are to be calculated according to the equations outlined in section 6.2.6.1 based on Tables 6-10 and 6-11, which quantify removal rates for total suspended solids and nutrients of concern.

5.3.2. Peak Flow Management

TR2018/01 recommends attenuation of runoff as follows:

- To 80% of pre-development rates for the 1% AEP storm event. This is dependent on proximity to discharge point.
- The intermediate storm events (50% AEP and 10% AEP) also require attenuation to pre-development peak runoff rates.

It is understood from TR2018/01 that the drivers behind attenuation in the small to mid-range storm events (50% AEP and 10% AEP) is stream erosion. Given that the development does not discharge to any streams or land drainage schemes, the proposed stormwater management framework does not include attenuation for these storm events.

Given the site is located close to Lake Rotokawau, no attenuation is recommended for the 1%, 50%, 10%AEP storm events.

5.3.3. Design Criteria Summary

The design stormwater management design criteria for the Sleepyhead Estate is provided in Table 2 – Design Criteria.

Table 2 - Design Criteria

Item	**Design Criteria**	
Rainfall Depths (climate change scenario RCP 6.0)	2 year (50% AEP) 10 year (10% AEP) 100 year (1% AEP)	67.2 mm over 24 hours[1)] 105 mm over 24 hours 166 mm over 24 hours
Volume Reduction	Reuse of roof runoff is recommended for water reuse is recommended. TR2018/01 encourages reuse for the volume difference in the 2 year storm event between the pre and post development scenarios. Where this is not possible, reuse of the runoff generated in 1/3 of the 2 year rainfall event is recommended.	
Quality	No high contaminant yielding roofing or cladding materials are recommended. At source treatment of roads and carparks. Refer to Table 6-6 of TR2015/01 to determine contaminant loading units and the degree of treatment required. Design to 1/3 of the 2year event where the 2 year event cannot be accommodated. A treatment train approach of at least two treatment devices. The centralised park to be the second tier of treatment prior to discharge into the receiving environment. Stormwater runoff generated from any outdoor Industrial Trades Activity to be managed in accordance with the nature of the industrial activity, the type of waste generated and discharge point.	
Erosion Protection	Reuse of roof runoff for the difference in volume between pre and post development in the 2 year storm event is recommended. Where this is not possible, design to the difference in volume between pre and post development in 1/3 of the 2 year storm event (water quality volume) should be implemented.	
	Design to extended detention volume where retention/water reuse is not possible. Detention of the difference in pre and post development volumes for the 2 year event is recommended.	

Item	Design Criteria	
	If this volume is not able to be accommodated within stormwater management devices, then design to 1/3 of the 2 year storm event is recommended.	
Flood Protection	Residential floor levels	0.5 m freeboard to 2% AEP event flood levels. This is in accordance with the Waikato Regional Infrastructure Specifications (RITS).
	Offsite properties (downstream catchments)	No increase in inundation of buildings up to the 1% AEP event. Increases in peak flood levels to be minor or less than minor.
Conveyance	Primary network	10% AEP event (include allowance for climate change)
	Secondary network	1% AEP event (include allowance for climate change)

(1) *Based on 24 hour rainfall depths for RCP6.0 for the period 2081-2100 as discussed with technical specialists at WRC.*

6. Proposed Development

The proposed development comprises a large manufacturing factory, which is the anchor for the development, comprised within 63ha of industrial zoned land. Approximately 52 hectares of land is allocated for residential development intended to house Sleepyhead employees and other parts of the market as demand dictates. A commercial development area is included in the masterplan with the intention of using the space for a service station and convenience stores. Approximately 55ha of the development is allocated to open space that will include recreational facilities, ecological enhancement and stormwater management provisions.

The Sleepyhead Estate Masterplan (that informed the Ohinewai Structure Plan) has been informed by stormwater management requirements. The plan outlined in Figure 4 below outlines two designated stormwater management areas – the Central Park area and the Wetland Park area.

These areas have been identified as areas to include stormwater management provisions. The intention is to enhance the planting in these areas with local flora. It is also intended to use these areas to meet the stormwater treatment requirements. Further details of these areas are outlined in Section 7 below.

Figure 5: Ohinewai Masterplan overlain with proposed stormwater management areas

6.1. Primary Stormwater Network

The primary network is to be designed to the 10% AEP + climate change scenario. Owing to the lack of grade in the area, the drainage is proposed to be a combination of open channel swales and piped network.

Open channel swales to convey runoff in the primary storm event poses an opportunity to accommodate treatment as part of the conveyance strategy in swales. This will aid in the stormwater management strategy for the site and is in alignment with Waikato Regional Council's treatment train approach.

6.2. Secondary Stormwater Network

The secondary network is to be designed to the 1% AEP + climate change scenario. It is intended that the road network be used to convey runoff in the 1% AEP + climate change scenario to the central park stormwater management area, which will then discharge into the Wetland Park area.

6.3. Waikato Regional Council Land Drainage Scheme

6.3.1. Balemi Road Drain

As outlined in Section 4.2 above, consultation with WRC has confirmed that it is preferable that the Balemi Road drain be diverted into the proposed Central Park/Wetland Park area within the development.

All post development runoff from the proposed foam factory location will be directed into the central park stormwater management area, which will drain to the wetland park area and then into Lake Rotokawau.

6.3.2. Tahuna Road Drain

The proposed eastern residential area currently will be built over a section of the Tahuna Road drain.

As outlined in Section 4.2 above, discussions with the Land Drainage Team at Waikato Regional Council have indicated that any conveyance structures through the development would ideally be easily accessible structures (such as arch culverts or bridge structures) to allow for access to and clearing of submerged macrophytes within the Tahuna drain.

6.4. Flood Hazards

Flood modelling scenarios to establish and quantify the effects of development has been summarised in the Ohinewai Flood Assessment Report.

The pre-development model has been built on existing impervious coverages and existing landform. The pre-development model results establish a baseline understanding of existing flood depths and floodplain extents within and around the site. The pre-development model results allow for any changes in flood depth or floodplain extent to be quantified, which may have resulted from the site being developed.

Two post development scenarios have been run, which are summarised as follows:

1. Scenario 2 - Post development with only the site set to MPD impervious coverages and landform, and
2. Scenario 3 - Post development with only the site set to MPD impervious coverages and landform. Surrounding sites set to MPD impervious coverages.

A summary of the key findings for the 100 year storm event is outlined below:

- Pre-development flood levels on site are 8.00 mRL.
- Post development flood levels on site are 8.00 mRL.
- Flood levels have been reported at 8 locations within and downstream of the site. There is no increase in flood levels as a result of site development for the 100 year flood for all reported locations except for one location within the site. This location is to the west near the Lumsden Road Culvert. The model predicts ponding to the west of Lumsden Road for both the pre and post development scenarios. This is caused by the model representation in this area, which does not include the culvert under the existing road. It is anticipated that including the culvert in the model extent will not cause the ponding observed at this area. The culvert under Lumsden Road will be addressed at the detailed design stage.

The flood modelling has found no changes to predicted flood levels on site. It is anticipated that this results from the downstream floodplain encompassing an area of approximately 3,466 hectares. Any increases in runoff volume resulting from the development in the 100 year storm event will result in little to no increases in predicted flood depths, as the increase in volume will have to be spread over an area of 3,466 hectares.

Pre and post development floodplain extents can be found in the Ohinewai Flood Assessment Report.

6.4.1. 2 Year and 10 Year Scenarios

Runoff in the 2 and 10 year future rainfall scenarios show a similar result to the 100 year flood results in that there are no increases in water levels on and downstream of the site. The results can be summarised as below:

- Pre-development flood level on site are 8.00 mRL.
- Post development flood levels on site are 8.00 mRL.
- Flood levels at the 8 reported locations are the same between pre and post development scenarios, except for the location near Lumsden Road, which shows ponding resulting from the Lumsden Road culvert not being included in the model extents. This will be resolved at the detailed design stage.

6.5. Emergency Management Planning

A stop bank breach scenario was modelled in order to understand the residual risk of providing for development at the site that, although unlikely, may be subject to flooding in a catastrophic breach event. Details of the modelling exercise are outlined in the Sleepyhead Flood Assessment Report.

A brief summary of the stop bank breach modelling has been included as follows.

The results of the stop bank breach scenario model identified three breach locations based on water level differences between the Waikato River and Lake Waikare and overland flow paths. The extent of the breaches is summarised in Table 3.

Table 3: Emergency Management Plan model breach locations

Breach Location	**Address**	**Description of breach**
1	Ohinewai North Road	Breach is located to the north of the site. Breach flows approach the site from the north western property boundary. Flooding is observed along the Balemi Road drain. Flows encroach upon the proposed factory site. Depths along the western boundary have been reported at a maximum of 650 mm. Depths near the Balemi Road drain have been reported at 100 mm or less.
2	Ohinewai Landing Road	Breach is located to the south of the site. Breach flows are contained to the west of the Thermal Explorer Highway and do not affect the proposed development.
3	Ohinewai South Road	Breach is located to the south of the site. Breach flows are directed along the existing overland flow paths towards Lake Ohinewai, which is located to the south of Tahuna Road. Breach flows do not affect the proposed development.

6.5.1. Implications of stop bank breaches on development

While an unlikely event, the modelling has shown that a stop bank breach has the potential to affect the development in the following ways:

- Within the proposed site, the residential and commercial zones are unaffected by stop bank breach flooding. All proposed internal roads are also outside of the flooding extents.
- The model predicts flood depths of up to 650 mm encroaching at the north western boundary of the Sleepyhead Village site, flood depths of 600 mm at the north western corner of the proposed factory and 100 mm east of the proposed factory.
- The north western and eastern parts of the factory would not be accessible by car in the breach event, however access to/ from the factory is possible via the south.

- It is recommended that an evacuation plan can be drafted at detailed design of the factory to ensure that employees are provided safe egress to higher ground. As previously stated, safe egress is possible from the south of the factory site, as this part of the site remains unaffected by stop bank breach.

- It is important to note that the stop bank breach has no influence on the stormwater management plan framework.

7. Stormwater Management Approach

The approach for stormwater management for the Ohinewai Structure Plan area is to focus on options which provide treatment and erosion control measures for stormwater runoff on site as appropriate to the site opportunities and constraints, and relevant guidance documents.

The stormwater management approach is largely influenced by the Waikato Regional Council's Low Impact Design Matrix and an associated point scoring system that assigns a development a score for incorporating Low Impact Design elements. This is discussed in the following sections.

7.1. Stormwater Management Zones

The stormwater management plan has been developed to meet the objectives and design criteria set out in Section 5.3. The stormwater management approach divides the Sleepyhead Estate into three separate zones, each with an approach that is unique to the topography, discharge point and land use characteristics. The zones are:

1. Industrial Zone.
2. Business/ Commercial Zone.
3. Residential Zone.

The zones can be seen as the development areas and contributing catchments that are managed for quality and quantity and are described in greater detail below.

Each zone will discharge to one of two park areas that provide for further management prior to ultimately discharging off site at the boundary with Lake Rotokawau. These areas are known as the Central Park Area and Wetland Park Area.

The framework schematic can be seen in Figure 6.

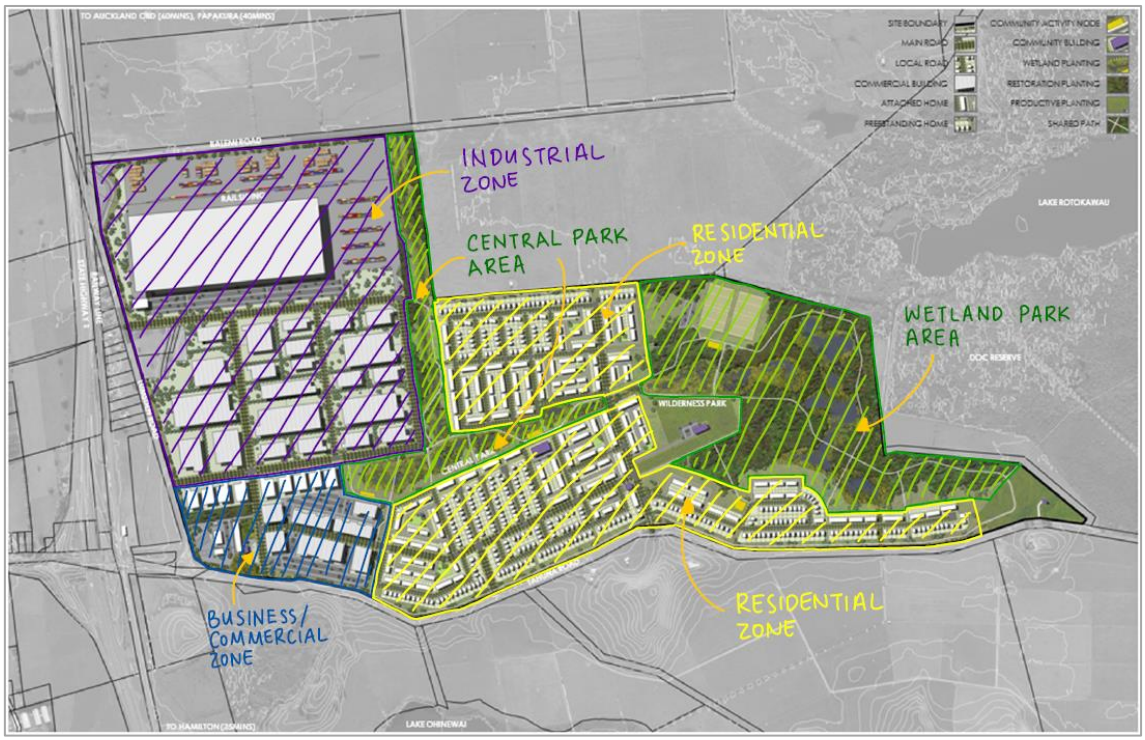

Figure 6: Stormwater management zones

A series of stormwater management devices (treatment train) is recommended in order to meet the water quality and erosion control requirements outlined in TR2018/01 for development within any of the stormwater management zones. The stormwater management strategy within each of the zones is discussed in the following sections.

7.1.1. Industrial Zone

The industrial zone discharges to the 'Central Park' area within the site, as shown in Figure 6 above. The recommended stormwater management strategy within this zone is summarised as follows:

1. Non potable reuse of roof runoff for the difference in volume between the pre and post development scenarios for the 2-year storm event. Where this volume cannot be accommodated, the water quality volume (1/3 of the 2 year + climate change storm event) is recommended as a reuse volume.
2. Water quality treatment will be required for roads and parking areas.

   It is recommended that Table 6-6 from TR2018/01 is consulted prior to determining the stormwater management device. The proposed device must be designed based on vehicle movements per day, which is directly linked to how much contaminant is generated on the road.
3. Detention and slow release of the volume difference between the pre and post development scenarios for the 2 year storm event over 24 hours is recommended. Where this volume cannot be accommodated in a stormwater management device, the volume generated in the 1/3 of the 2 year storm event is recommended as an erosion control measure.

   It should be noted that where both water quality and erosion control measures are to be designed into the same device, a 50% reduction in the water quality volume is recommended.
4. Non-contaminant generating roofing and cladding material to be used on the buildings.
5. Industrial contaminants in stormwater runoff from specific sites is to be managed in accordance with the nature of the industrial activity, the type of contaminant generated and the nature of the receiving environment.
6. Peak flow control is not considered necessary as the influence of additional flows into the downstream receiving environment is not significant (refer to the Woods Ohinewai Flood Assessment report).

7.1.2. Business/Commercial Zone

The business/commercial zone discharges to the 'Central Park' area within the site. The recommended stormwater management strategy within this zone is summarised as follows:

1. Non potable reuse of roof runoff for the difference in volume between the pre and post development scenarios for the 2 year storm event. Where this volume cannot be accommodated, the water quality volume (1/3 of the 2 year + climate change storm event) is recommended as a reuse volume.
2. Water quality treatment will be required for roads and parking areas.

   It is recommended that Table 6-6 from TR2018/01 is consulted prior to determining the stormwater management device. The proposed device must be designed based on vehicle movements per day, which is directly linked to how much contaminant is generated on the road.
3. Detention and slow release of the volume difference between the pre and post development scenarios for the 2 year storm event over 24 hours is recommended. Where this volume cannot be accommodated in a stormwater management device, the volume generated in the 1/3 of the 2 year storm event is recommended as an erosion control measure.

   It should be noted that where both water quality and erosion control measures are to be designed into the same device, a 50% reduction in the water quality volume is recommended.
4. Non-contaminant generating roofing and cladding material is proposed to be used on all buildings.
5. Contaminants generated by business/commercial activities are to be managed in accordance with the nature of the industrial activity, the type of contaminant generated and the nature of the receiving environment.

6. Peak flow control is not considered necessary as the influence of additional flows into the downstream receiving environment is not significant (refer to the Woods Ohinewai Flood Assessment report).

7.1.3.Residential Zone

The proposed residential area has two discharge points within the development. The western portion discharges to the Central Park stormwater management area and the eastern portion discharges to the wetland park stormwater management area. This can be seen in Figure 7. Stormwater management strategies have been determined based on the discharge points.

Figure 7: Eastern and western residential areas

Stormwater management provisions for both the western and eastern residential areas are identical and are described below.

1. Non potable reuse of roof runoff for the difference in volume between the pre and post development scenarios for the 2 year storm event. Where this volume cannot be accommodated, the water quality volume (1/3 of the 2 year + climate change storm event) is recommended as a reuse volume.
2. Water quality treatment will be required for parking areas.

   It is recommended that Table 6-6 from TR2018/01 is consulted prior to determining the stormwater management device. The proposed device must be designed based on vehicle movements per day, which is directly linked to how much contaminant is generated on the road.
3. Erosion protection measures prior to discharge into the receiving environment. These are discussed below:

   i. Central Park Stormwater Management Area:

   Where reuse of runoff cannot be accommodated, the same criteria as above applies. Detention and slow release of the volume difference between the pre and post development scenarios for the 2 year storm event over 24 hours is recommended. Where this volume cannot be accommodated in a stormwater management device, the volume generated in the 1/3 of the 2 year storm event is recommended as an erosion control measure.

ii. Wetland Park Stormwater Management Area:

An additional treatment approach is recommended prior to discharge into the Wetland Park Area. This is because only the first tier of the treatment train approach can be accommodated within the residential area.

Second tier treatment is proposed to be provided via engineered wetlands that will be constructed on the fringes of the Wetland Park Area, the design and placement of these wetlands will be determined at the detailed design stage.

These engineered wetlands can be designed to accommodate the detention or volume reduction requirements i.e. slow release of the volume difference between the pre and post development scenarios for the 2 year storm event over 24 hours is recommended. Where this volume cannot be accommodated in a stormwater management device, the volume generated in the 1/3 of the 2 year storm event is recommended as an erosion control measure.

It should be noted that where both water quality and erosion control measures are to be designed into the same device, a 50% reduction in the water quality volume is recommended.

4. Non-contaminant generating roofing and cladding material to be used on the buildings.

7.2. Stormwater Management Parks

Each stormwater management zone as described above discharges to either the Central Park area or the Wetland Park Area. The purpose of these parks is to provide the second tier of treatment for the treatment train approach prior to discharge into the receiving environment.

7.2.1. Central Park Area

The Central Park area runs through the middle of the site and is intended to receive runoff from both industrial and business/commercial zones within the development and part of the residential zone.

As part of the proposed stormwater management strategy, the Central Park Area is designated for the second tier of the treatment train approach outlined in TR2018/01 for the Industrial Zone, Business Zone and western part of the Residential Zone.

It is anticipated that wetland swales will be used within the Central Park Area for the second tier of the treatment train approach, however this is to be confirmed at the detailed design stage, once groundwater levels and internal treatment configuration has been confirmed.

A high level volume calculation has been undertaken for the sizing of the proposed central park area to ensure it has enough capacity to accommodate the second tier of stormwater management devices. These volume calculations are based on an average depth of 1-1.5m.

The proposed pre and post development runoff volumes for the equivalent of 1/3 of the 2 year storm event is summarised below. The calculation methodology is as outlined in TR2018/01.

It should be noted that pre-development site conditions have been represented with soil group B and a pervious curve number of 61, as per Table 5-2 of TR2018/02. Post development runoff calculations assume a curve number of 74 and 98 for pervious and impervious components respectively. Rainfall depths have been used for the RCP scenario of 6.0.

A copy of the preliminary calculation sheets can be found in Appendix E.

Peak flow rates and volumes have been calculated for the pre and post development scenarios for the whole site and for the proposed zones. These have been summarised in Table 4 to Table 5.

Table 4: Pre and post development peak runoff rates

Location	Post development areas (ha)		Water Quality (m^3/s)		2 Year (m^3/s)	
	Pervious	Impervious	Pre Dev	Post Dev	Pre Dev	Post Dev
Factory	0.00	31.46	0.66	0.74	1.99	2.22
Industrial	0.96	67.05	1.43	1.60	4.29	4.80
Business/Commercial	2.95	12.19	0.32	0.36	0.96	1.07
Residential	17.85	48.27	1.39	1.56	4.17	4.67
Total	**21.76**	**158.97**	**3.80**	**4.25**	**11.40**	**12.75**

Table 5: Pre and post development peak runoff volumes

Location	Water Quality Volume (m^3)		2 Year (m^3)	
	Pre Dev	Post Dev	Pre Dev	Post Dev
Factory	1,322	6,516	3,966	19,548
Industrial	2,857	13,901	8,571	41,704
Business/Commercial	636	2,625	1,908	7,876
Residential	2,778	10,728	8,334	32,185
Pre and Post Development Volume Difference (m^3)	**26,178**		**78,533**	

The Central Park area encompasses approximately 10.63 hectares. At a maximum device depth of 1.5 metres, the central park area can accommodate approximately 159,000 m^3 of volume. This is much larger than the minimum volume of approximately 26,000 m^3 of runoff to be accommodated within this device.

It is anticipated that runoff in 1/3 of the 2 year + climate change storm event for the contributing catchment discharging to it can be accommodated in the central park wetland area prior to discharge into the receiving environment.

7.2.2. Wetland Park Area

The Wetland Park area is in a low-lying part of the site, close to Lake Rotokawau. This ground in this area is peaty and it is anticipated that construction in this area will require a high level of ground remediation.

As part of the proposed stormwater management strategy, a second tier treatment is required for the eastern part of the Residential Zone. Given the nature of the ground in the Wetland Park area, this stormwater management plan recommends that engineered stormwater management devices be constructed on the fringes of the Wetland Park Area, close to the eastern residential area.

The design and placement of these devices will be determined at the detailed design stage. At the time of this SMP being written, the available area for stormwater infrastructure on the fringes of the Wetland Park area is unknown and is to be determined at detailed design.

7.3. Best Practicable Options (Stormwater Management Toolbox)

The stormwater management devices that form the treatment train approach that will be utilised across Sleepyhead Village. This toolbox provides several options and devices that can be utilised within the development.

The toolbox is summarised in Table 6, with the stormwater device nutrient removal capabilities outlined in Table 7.

Table 6: Stormwater Management Toolbox

Stormwater Device	Typical Applications	Water Quality Treatment	Erosion Control	Flood Attenuation
Rain tanks	Roof areas. Applicable in residential, commercial or industrial zones.	NA	Yes	No
Inert roofing material	Roof areas. Applicable in residential, commercial or industrial zones	NA	No	No
Living roofs	Roof areas. Applicable in residential, commercial or industrial zones.	NA	No	No
Bioretention devices[1]	Roofs, carparks, driveways, footpaths. Applicable in residential, commercial or industrial zones.	Yes	Yes	No
Permeable pavement[1]	Carparks, driveways, footpaths, cycleways. Applicable in residential, commercial or industrial zones.	Yes	No	No
Swales[1]	Carparks, driveways, roads, parking bays, footpaths. Applicable in residential, commercial or industrial zones.	Yes	No	No
Filter strips	Applicable in residential, commercial or industrial zones.	Yes	No	No
Wetland swales	Open space areas. Applicable to residential, commercial or industrial zones.	Yes	Yes	No
Dry pond with extended detention[3,4]	Applicable to residential, commercial or industrial zones. Accommodated in open space areas.	No	Yes	Yes
Wet pond with extended detention[3,4]	Applicable to residential, commercial or industrial zones. Accommodated in open space areas.	Yes	Yes	Yes
Wetlands[3,4]	Accommodated in open space areas.	Yes	Yes	Yes
Proprietary devices such as StormFilters or cellular storage	Roofs, carparks, driveways, roads, parking bays, footpaths. Applicable in residential, commercial or industrial zones.	Yes, depending on device	Yes, depending on device	No

Notes:

1. *The use of devices such as raingardens, swales and permeable pavement are limited in application for slopes greater than 5%.*
2. *Sizing of devices will require refinement during detailed design depending on in-situ ground conditions.*
3. *Wetlands can be used for water quality treatment volume, extended detention volume and flood attenuation for the 2, 10 and 100 year storm events. The driver for what design criteria (i.e., water quality/extended detention and peak flow control for which return period) is dependent on the discharge point.*
4. *Flood attenuation of peak flows is required if the discharge point is to an open channel which is part of the WRC Land Drainage Scheme or ends up in any drains part of WRC's Land Drainage Scheme.*

Table 7: Stormwater device capabilities

Device	Peak flow control	Water Quality Treatment			
		Sediment Removal	Metal Removal	Total Petroleum Hydrocarbons (TPH) Removal	Nutrient Removal
Dry pond with extended detention	High	Moderate	Pb – Moderate Cu – Low Zn – Low	Low	P – Low N – Low
Wet pond with extended detention	High	High	Pb – High Cu – Moderate Zn – Moderate	Low	P – Moderate N – Low
Wetland	High	High	Pb – High Cu – High Zn – High	High	P – High N – High
Filter systems	Low	High	Pb – High Cu – Moderate Zn – Low	High	P – Moderate N – Low
Raingarden	Low	High	Pb – High Cu – High Zn – High	High	P – High N – Moderate
Infiltration devices	Moderate	High	Pb – High Cu – High Zn – High	High	P – High N – Moderate
Swales and filter strips	Low	High	Pb – High Cu – Moderate Zn – Moderate	Moderate	P – Moderate N – Low
Rain tank	Moderate – only useful during smaller, frequent rainfall events	None	None	None	None
Permeable Pavement	Low	Low	Low	Low	Low
Living Roofs	Low	Low	Low	Low	Low

7.4. Road Runoff Management

To quantify the degree of stormwater treatment that any proposed roads might require, it is recommended that Table 6-6 of TR2018/01 be considered. This table quantifies the contaminant loads generated resulting from vehicle movements per day. A screenshot of this table from TR2018/01 can be seen in Figure 8.

Table 6-6: Contaminant loads for various daily traffic counts

Vehicles/day	Contaminant unit loadings for various contaminants			
	Sediment ($g/m^2/yr$)	Zinc ($g/m^2/yr$)	Copper ($g/m^2/yr$)	Total Petroleum Hydrocarbons ($g/m^2/yr$)
<1,000	4	0.021	0.0070	0.11
1,000-5,000	30	0.107	0.0349	0.54
5,000-20,000	150	0.537	0.1744	2.68
20,000-50,000	299	1.068	0.3472	5.34
50,000-100,000	300	2.281	0.7414	11.41
>100,000	300	3.532	1.1480	17.66

Figure 8: Contaminant loadings based on vehicle movements per day

Table 8 outlines the estimated vehicle movements per day based on road typology within the development.

Table 8: Vehicle movements based on road typology

Proposed Road Topology	Estimated ADT range (vehicles/day)
Primary Industrial Collector	3500 – 4500 vpd
Secondary Industrial Road	1500 – 2500 vpd
Primary Residential Collector	2000 – 3000 vpd
Secondary Residential Road	500 – 1500 vpd
Residential Garden Street	<500 vpd

The topography within the site is proposed to be at a relatively flat grade and at the time of this stormwater management plan being written, it is anticipated that the primary stormwater network is likely to feature a combination of a traditional piped system and grassed swales. In the instance that grassed swales are used for primary conveyance, a level of treatment for the first flush of runoff will be provided within the swales.

For roads seeing vehicle movement less than 1500 vehicles per day, treatment of road runoff is not proposed. This is due to the amount and type of contaminants generated on roads seeing this level of vehicle movement. It is understood that contaminants of concern within Lakes Waikare and Rotokawau are Phosphorus and Nitrogen. Roads with vehicle movements less than 1500 are not expected to generate high levels of this type of contaminant given that these roads are for the residential areas.

It is anticipated that the level of treatment provided within the secondary treatment areas (i.e. central park or engineered wetlands) will treat roads seeing less than 1500 vehicle movements per day. Wetlands and raingardens provide a high degree of sediment and TPH removal. Swales provide high levels of sediment removal and moderate levels of TPH removal.

For roads seeing movements between 1500 to 5,000 vehicle movements day, treatment may be required dependent on whether swales are proposed as a means of primary conveyance and the type of land use. If swales are recommended in lieu of traditional piped network, treatment devices are not required. If the road is serviced by a traditional piped network, a stormwater treatment device is recommended. The type of device is to be guided by location, available depth, device removal efficiencies and the amount of contaminants generated on roads. This is proposed to be detailed further during detailed design stage, alongside the primary network design.

For roads seeing greater than 5,000 vehicle movements per day, it is proposed that treatment is provided.

7.5. Peak Flow Management

It should be noted that the site is located very close to Lake Rotokawau and Lake Waikare. On this basis, the use of attenuation prior to discharge into Lake Rotokawau has been informed by the post development flood modelling being undertaken to support this stormwater management plan.

The post development model was run with maximum probable development impervious coverages on site as well as post-development landform. The proposed landform allowed for a degree of storage within the proposed central park area to accommodate for stormwater management devices.

The post development model runs show no changes to the post development flood depths and floodplain extents downstream of the site (east of the site). This can be attributed to the size of Lake Waikare and the downstream floodplain. The increase in runoff volume combined with the displaced storage volume on site can be distributed over the existing floodplain area with negligible increases in flood level.

No attenuation in the 100, 10 storm event is recommended prior to discharge into Lake Rotokawau. Detention of the 2 year storm event (or less) is proposed within the Central Park area as guided by TR2018/01.

7.6. Low Impact Design Scoring Matrix

Chapter 6.1.3 of TR2018/01 outlines a low impact design scoring matrix. The scoring matrix is intended to encourage low impact design in the stormwater management approach for proposed developments within Waikato. The minimum acceptable score for developments with existing streams/gullies or native bush is 15.

Based on the proposed stormwater management zones outlined in this document, two LID scoring matrices have been populated – one for the industrial and commercial areas and the second for the residential development. These can be seen in Table 9 and Table 10.

It should be noted that the scores in this stormwater management plan are a high level indicator of the scores for the proposed zones. These are likely to change at the time of detailed design being undertaken. Scores which are dependent on percentage runoff capture have been estimated based on the proposed stormwater management plan. This is also true for scores around the preservation or enhancement of existing native bush areas within the site.

Table 9: Low impact device scoring matrix for industrial/commercial areas

Implementation Elements	**Typical Components**	**Maximum Individual Score**	**Total score for each item**
Source control maximised	Water re-use	0-4 depending on % of runoff capture	3
	Site disturbance reduced from a conventional development approach	0-3 depending on % of runoff capture	2
	Impervious surfaces reduced from a traditional approach	0-3 depending on % of runoff capture	3
	Use of building or site material that do not contaminate	0 or 1 for residential 0-3 for commercial or industrial	1
	Existing streams and gullies located on site	0 or 3	NA

Implementation Elements	Typical Components	Maximum Individual Score	Total score for each item
	(including ephemeral) are protected and enhanced. The entire stream other than possible crossings shall be protected to qualify for points		
	Riparian corridors are protected, enhanced or created	0-3	NA
	Protection and future preservation of existing native bush areas	0-2 depending on percentage of site area	1 (to be confirmed following detailed design)
LID stormwater device/practice used	Infiltration devices to reduce runoff volume	0-6 depending on % of runoff capture	3
	Revegetation of open space areas as bush	0-3 depending on % of runoff capture	
	Bioretention	0-6 depending on % of runoff capture	
	Swales and filter strips	0-3 depending on % of runoff capture	3
	Tree pits	0-6 depending on % of runoff capture	
Traditional mitigation	Constructed wetlands	0-4 depending on % of runoff capture	
	Wet ponds	0-1 depending on % of runoff capture	
	Innovative devices	0-1 depending on % of runoff capture	1
	Detention ponds (normally dry)	0	
Urban design	Stormwater management is designed to be an integral and well considered part of the urban design	0-2	2
Total score			**18**

Table 10: Low impact device scoring matrix for residential areas

Implementation Elements	Typical Components	Maximum Individual Score	Total score for each item
Source control maximised	Water re-use	0-4 depending on % of runoff capture	3
	Site disturbance reduced from a conventional development approach	0-3 depending on % of runoff capture	2
	Impervious surfaces reduced from a traditional approach	0-3 depending on % of runoff capture	3
	Use of building or site material that do not contaminate	0 or 1 for residential 0-3 for commercial or industrial	3
	Existing streams and gullies located on site (including ephemeral) are protected and enhanced. The entire stream other than possible crossings shall be protected to qualify for points	0 or 3	
	Riparian corridors are protected, enhanced or created	0-3	
	Protection and future preservation of existing native bush areas	0-2 depending on percentage of site area	
LID stormwater device/practice used	Infiltration devices to reduce runoff volume	0-6 depending on % of runoff capture	3
	Revegetation of open space areas as bush	0-3 depending on % of runoff capture	
	Bioretention	0-6 depending on % of runoff capture	
	Swales and filter strips	0-3 depending on % of runoff capture	3
	Tree pits	0-6 depending on % of runoff capture	

Implementation Elements	Typical Components	Maximum Individual Score	Total score for each item
Traditional mitigation	Constructed wetlands	0-4 depending on % of runoff capture	
	Wet ponds	0-1 depending on % of runoff capture	
	Innovative devices	0-1 depending on % of runoff capture	1
	Detention ponds (normally dry)	0	
Urban design	Stormwater management is designed to be an integral and well considered part of the urban design	0-2	2
Total score			**21**

8. Conclusion

This stormwater management plan for the Sleepyhead Estate area has been developed based on the Waikato Regional Council's Stormwater Management Guideline (TR2018/01). The stormwater management plan follows a low impact design approach.

The overarching objectives for the Sleepyhead Estate SMP are to:

1. Incorporate a water sensitive design approach that manages the impact of land use change from predominantly rural/farmland to urban. The proposed approach promotes at source stormwater management which is in line with Waikato Regional Council's Stormwater Management Guidelines.
2. Account for flood risk areas and provide for development without creating adverse effects on the neighbouring properties or result in increases to the water level in the receiving environment.
3. Provide stormwater quality treatment for roads and carparks and avoidance of high contaminant yielding roof and cladding materials.
4. Minimise the adverse effects on the water quality and ecological values of the receiving environment through the implementation of stormwater management devices to be selected using a toolbox approach.
5. Reduction of nitrogen and phosphorus in stormwater runoff considering the eutrophic/hyper eutrophic status of Lakes Rotokawau and Waikare.

The design criteria for the Sleepyhead Estate development area is summarised as follows:

- Water Quality
    - Reduction of nitrogen, phosphorus, total suspended solids, total petroleum hydrocarbons from runoff through at source treatment for high contaminant generating activities such as carparks and roads.
    - A treatment train approach of at least two devices prior to discharge into the receiving environment is recommended. This is comprised of at-source treatment options and with devices within the Central Park and Wetland Park Area.
    - No high contaminant yielding cladding or roofing materials are recommended.
- Erosion Protection
    - Volume reduction is recommended through either detention or reuse. Reuse of the difference in volume between the pre and post development runoff volumes in the 2 year storm event to be carried out where possible. Alternatively, detention or reuse of the difference in volume for the pre and post development runoff volumes in 1/3 of the 2 year storm event to be carried out.
- Flood Protection
    - Development to have adequate freeboard above the 1% AEP floodplain.
    - It is recommended that stormwater flows be 'passed forward' in the 1% AEP event.

Stormwater is to be managed via a suite of options available for each of the Industrial, Business and Residential Zones. Further treatment is provided by the Central Park area within the site. A portion of the eastern residential zone will require treatment, which is proposed to be on the fringes of the eastern residential zone within the Wetland Park area.

Discharge of stormwater is not proposed to either the Balemi Road or the Tahuna Road drain. A portion of the Balemi Road drain (along the western boundary of the proposed foam factory location) will be incorporated into the Central Park stormwater area, while the Tahuna Road drain will be piped under the eastern residential area and form part of the wider Wetland Park stormwater area.

Modelling has been carried out to determine the floodplain extent under existing conditions, and for post development scenarios. The flood modelling shows that there is no increase in water levels in the downstream floodplains in the 100 year + climate change storm event. This can be attributed to the extent

of the existing floodplain downstream being large at approximately 3,466 hectares. Any increases in runoff volume resulting from development/filling in of existing floodplain storage on site results in no increase in flood depths downstream of the site in the 100yr event.

All model results show that post development roads and dwellings are outside of the 100 year + climate change floodplain.

APPENDIX A

EXISTING AND PROPOSED CONTOURS

REVISION DETAILS		INT	DATE	SURVEYED	RH
1	ISSUED FOR INFORMATION	BP	20/11/2019	DESIGNED	MC
				DRAWN	BP
				CHECKED	BP
				APPROVED	

231 TAHUNA ROAD
& 88 LUMSDEN ROAD
OHINEWAI
WAIKATO

WOODS.CO.NZ

the comfort group

SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS

MASTER PLAN EXISTING CONTOURS

N

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:7500 @ A3, 1:3750 @ A1	1
COUNCIL	WAIKATO DISTRICT COUNCIL	
DWG NO	P19-137-00-1015-SK	

LEGEND

PROPOSED CONTOURS — 23.0

ZONE BOUNDARY

REVISION DETAILS		INT	DATE	SURVEYED	RH
1	ISSUED FOR INFORMATION	BP	20/11/2019	DESIGNED	MC
				DRAWN	BP
				CHECKED	BP
				APPROVED	

231 TAHUNA ROAD
& 88 LUMSDEN ROAD
OHINEWAI
WAIKATO
WOODS.CO.NZ

the comfort group

SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS

MASTER PLAN PROPOSED CONTOURS

N

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:7500 @ A3, 1:3750 @ A1	1
COUNCIL	WAIKATO DISTRICT COUNCIL	
DWG NO	P19-137-00-1016-SK	

VOLUMES

CUT	=	500 000 m³
FILL	=	2 450 000 m³
AREA	=	176 Ha

LEGEND

EXISTING CONTOURS 23.0

CUT AREAS

FILL AREAS

ZONE BOUNDARY

REVISION DETAILS		INT	DATE	SURVEYED	RH
1	ISSUED FOR INFORMATION	BP	20/11/2019	DESIGNED	MC
				DRAWN	BP
				CHECKED	BP
				APPROVED	

231 TAHUNA ROAD
& 88 LUMSDEN ROAD
OHINEWAI
WAIKATO
WOODS.CO.NZ

the comfort group

SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS

MASTER PLAN CUT & FILL DEPTH POLYGONS

N

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:7500 @ A3, 1:3750 @ A1	1
COUNCIL	WAIKATO DISTRICT COUNCIL	
DWG NO	P19-137-00-1017-SK	

APPENDIX B

LAND DRAINAGE MEETING MINUTES

To

Waikato Regional Council
Russell Powell

From

Woods
Sakti Gounder – Associate Engineer

W-REF: P19-140
23 October 2019

Meeting Minutes - 23/10/2019

Site / Project Name

Location				
Time & Date	1:15PM	23/10/2019	**Taken by**	Sakti Gounder
Attendees	**Initials**	**Name**		**Company**
	RP	Russell Powell		Waikato Regional Council
	MK	Michael Knight		Waikato Regional Council
	PW	Pranil Wadan		Woods
	SP	Stu Penfold		BBO
Apologies	**Initials**	**Name**		**Company**
	BP	Ben Pain		Woods

Proposal / Introduction

This meeting was centred around the open water channels that form the Land Drainage Scheme, which falls under the jurisdiction of Waikato Regional Council.

Minutes

1) RP and MK advised that the Balemi Road drain does not discharge into Lake Rotokawau directly east as per drains shown on land drainage maps on WRC GIS. The drainage portion which would enable discharge into Lake Rotokawau is a private drain. There are pumps that drive flow towards the north to discharge directly into Lake Waikare. This drain travels north and then east before discharging into Lake Waikare.

2) RP and MK advised that the Balemi Road drain is currently unable to adequately convey flows into Lake Waikare. This is due to a lack of grade in the channel. Siltation issues also results in lateral drains being unable to perform to the level of service that is expected of them.

3) Woods and WRC have come to the agreement that base flows from the site do not need to be maintained within the Balemi Road drain that runs along the boundary of Parcel ID: 425757, ALLOT 405 WHANGAMARINO PARISH. This is on the basis that the Balemi Road drain is currently struggling with conveyance capacity issues. Drainage within Sleepyhead Estate will drain to the 'Central Park' area within the proposed scheme plan, which works with the earthworks and proposed grades within the site.

4) The Tahuna Road drain is currently culverted under Tahuna Road and discharges to within the Ambury Properties site. Woods have indicated that there is potential for an extension of the culvert under the proposed residential properties on this part of the site. WRC have indicated that this culvert frequently sees drainage issues resulting from weed growth within the standing

water in the culvert. RP indicated that he would prefer a bridge rather than a culvert under Tahuna Road. PW advised that the resource consent application will mention this as an option to be confirmed at detailed design stage.

5) RP advised that DOC permission is required if Woods are to propose any outlets within the Lake Rotokawau boundary. SP has advised that any outlet structures will be constructed within Ambury Property's land within the 'Wetland Park' area.

Sakti Gounder

Associate Engineer

Approved as true and accurate record of meeting

APPENDIX C

TANGATA WHENUA GOVERNANCE GROUP

MEETING MINUTES

AMBURY PROPERTIES LTD

OHINEWAI DEVELOPMENT

TANGATA WHENUA GOVERNANCE GROUP

MEETING # 4 MINUTES

Meeting	Ohinewai TWGG				
Objectives	Ambury Properties Ohinewai development				
Location	Waahi Whaanui Trust offices, Parry Street, Huntly West				
Date	22 October 2019	Start Time	10.00am	Finish Time	12.00pm
Attendees	Tawera Nikau (Matahuru Marae), Hori Awa (Waahi Whaanui), James Whetu (Whetu Consultancy Group), Aotea Maipi, Robert Tukiri (Waikare Marae) David Gaze (Ambury Properties), Stuart Penfold (BBO), Sam Foster (BBO) Pranil Wadan (Woods), Ben Pain (Woods)				
Apologies	Glenn Tupuhi (Nga Muka), Huki Nepia (Te Riu o Waikato), Taroi Rawiri (Waikato Tainui), Chris Dawson (BBO), John Olliver (BBO), Craig Turner (The Comfort Group)				
Distribution	All members				

Agenda Item	Discussion / Key Points	Action By	Action Date
AP1	Prepare timeline and flow chart / graph of priorities	DG	13 Nov
AP2	TWWG to hui with mana whenua to discuss restoration goals including appropriate planting and to introduce the recognition of historical use of the area.	TWWG	13 Nov?
AP3	Letter of continuation of Stage 1 earthworks process: TWWG are meeting Fri to finalise and provide the following week.	TWWG	30 Oct
AP4	BBO to provide reports relating to Stage 1 earthworks and Factory consents in Dropbox folders.	BBO	Ongoing
AP5	TWWG mandate letter and MOU to be finalized and sent to applicant. To be finalized 25th of Oct and a date organized for signing.	TWWG	1 Nov

Agenda Item	Discussion / Key Points	Action By	Action Date
AP6	CIA or CVA will be required for whole of project. Will not be required for earthworks consent		
AP7	David Gaze to invite Craig and Graham Turner to meeting for signing in co-ordination with TWWG.	DG	1 Nov
AP8	Project team to provide programme chart of project to TWWG	DG	1 Nov
AP9	BBO to provide update on potential alternative Haul Road once known.	SP	1 Nov
AP10	Project team to provide summary of Impact v Status Quo of development, including improvements	BBO	15 Nov
AP11	TWWG to discuss position on provision for stormwater, water supply and wastewater (3 Waters) and provide feedback at next hui	TWWG	20 Nov
AP12	Project team to consult with WRC Freshwater Management Unit	PW	1 Nov

1. Karakia/Mihimihi – Hori Awa

2. Opening
   - MOU is still being worked through by the TWWG
   - TWWG would appreciate a timeline of all stages of the project to understand what is involved across the lifetime of the project.

3. Priority
   a) Stage 1 Earthworks Consent.
   b) MOU for wider project.
   c) Foam Factory Consent – Likely to be lodged in the next 3 – 4 months. Technical Reports will be provided to TWWG.
   d) Re-zoning/ submission to the Waikato District Council Proposed Plan

4. Woods Three Waters presentation
   A. Flooding Assessment
   - See Presentation attached.
   - Questions related to:
     - Can the team provide a stocktake regarding the current situation of the site i.e. flora/fauna/N and P and an idea of where we are going? (AP1)

- TN raised the idea of having tuna (eel) farms within the wetlands. DG to investigate (AP2)
- More detail is requested regarding the displacement of stormwater and flooding. Summary document to be provided to TWGG for discussion with Marae and whanau (AP10).
- MH requested more detail regarding the BPO (Best Practicable Option) (AP10).
- JW outlined the importance that the Waikato River Vision and Strategy is addressed, reminder of focus on "betterment" (AP10).
- AM discussed concerns regarding scouring and erosion (AP10)
- Opportunities for whanau to input into design for Vision and Strategy (AP11)
- MH outlined the importance of Woods project team and T&T as peer reviewers are talking to the right people in WRC i.e Freshwater Management Units (AP12)
- Request to integrate stormwater flooding reports with ecology.

B. Water Supply

- See Presentation attached.
- TWWG to discuss bore supply option and provide feedback (AP11).
- Woods to provide more detail on water supply capacity.

C. Wastewater

- See presentation attached.
- Woods to supply draft reports to TWGG (AP11).

5. Review of last meeting notes and action points
   - Action point update in table included in minutes.

6. Earthworks Resource Consent application

   - Still working on further information response to WDC/WRC.
   - Potential haul road option with farm to address Lumdsen Road community concerns regarding truck movements.
   - Spoil is more than likely coming from Gleeson's Quarry approx. 200,000m^3 for Stage 1 over 4.5 months.
   - SP to keep group updated as this option is developed (AP9).
   - TWWG to provide letter supporting the continuation of process (AP3).

7. Stage 1 Foam Factory consent application update
   - Design is still developing.
   - Reports will be provided as completed (AP4).

8. Lumsden Road Community
   - Still in discussions with neighbours.
9. Information Day – 31 October 2019
   - To be held at Ohinewai Community Hall.

- Provide information of plan change to community.
- TN and HA to attend.
- Possible Marae open day later in the process for iwi.

10. Timeline
    - TWWG requested timeline of all developments (AP8).

11. Any other Business
    - TR and TN have begun discussions on nursery and will prepare feasibility and costings.

The next TWGG meeting will be:

Wednesday 20 November 2019 at 10.00 am at Waahi Whaanui, Parry Street, Huntly West.

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- Detention requirements to be confirmed – given position in lower catchment, option may be to not detain and release asap to avoid peak flows from upstream catchment (pass flows forward)
- Draft flood modelling and stormwater management reports anticipated end of this week

7. Other matters

- Residual risk was mentioned – meeting have been undertaken with Rick Leifting and others on this. Flooding reporting/ modelling underway and will be included in plan change submission documentation.

APPENDIX D

CONSENTING TEAM

MEETING MINUTES

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SLEEPYHEAD VILLAGE, OHINEWAI

Waikato Regional Council

3 Waters consenting considerations meeting – Notes

PREPARED BY:	Stuart Penfold			
PLACE OF MEETING:	WRC Hamilton	**DATE OF MEETING:**	12 November 2019 230pm – 415pm	
ATTENDEES:	David Gaze	Gaze Commercial (for APL)	Donna Jones	WRC TL Water allocation
	John Olliver	BBO	Brian Richmond	WRC - SW specialist
	Stuart Penfold	BBO	Stuart Beard	WRC – WW specialist
	Ben Pain	Woods	Hugh Keane	WRC TL Industry & Infrastructure
	Brent Sinclair	WRC – Manager Industry & Infrastructure	Cameron King	WRC Water allocation specialist

1. Introductions – around the table
   - **BS** introduced his role and the team leader roles. He is consents manager so has an overall responsibility for consenting and acts as conduit to governance. Important for a project of this size for him to get across the issues and be across the customer requirements.
   - Discussed the need for a WRC project representative to be across the multifaceted project as a single point of contact – consenting and policy. **BS** to advise post meeting if this can be arranged.
   - **BS/ JO** discussed representative from APL on planning and consenting is **JO** at BBO.
   - **DG** is Applicant's representative for overall project management/ governance.
   - Joint Management Agreements may mean in future that iwi are invited to pre-application meetings where Vision and Strategy matters are key.

2. **DG/SP/JO** outlined the development and submission process

   - Consultant reports and AEE due 29th November 2019. Hearing mid 2020.
   - The ability for the development to be serviced is critical and with the potential for options for wastewater, stormwater and water supply dependent on consenting, it is important for the development project team to get feedback on potential options from the WRC regulatory team.
   - While this meeting is primarily concept level, the development project team will seek pre-application meetings for specific applications.

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- Depending on scale of activities, consent applications may be led by different staff.
- **BS** mentioned that WRC policy is involved in Plan Change hearing as submitter. WRC representative to be confirmed.

3. **CK** ran through water allocation matters quickly (in absence of **DG** and **BP**) and reference correspondence to Marcel Bear.
   - No water allocation available, queue for applications
   - Groundwater and surface water viewed the same
   - Can arrange for water allocation transfers between parties who hold valid allocation ('credits') and those who do not.
   - TK Water Association, Wairakei Pastoral have credits.
   - Council can facilitate planning process (via s127) – allocation transfer to be arranged by parties themselves
   - Wairakei Pastoral have a user group that facilitates the relatively straight forward transfers
   - Point was made that restrictions on water takes from the River are only from October to April (May to September not a problem).
4. Discussion around consenting update for Stage 1 earthworks and Factory
   - Stage 1 earthworks lodged, with amended plans shortly being lodged.
   - Stage 1 Factory pre-app suggested in a few months.
   - Haul Road discussed
   - Stage 1 Factory SW would be provided for with temporary stormwater pond
5. Discussion around options for Wastewater
   - High quality effluent discharge to Lake possible, however non-complying activity and cultural effects hurdles
   - Disposal to Waikato River is Discretionary
   - Disposal to land as seen as the ideal, however this is land hungry and not likely to be BPO due to cost/ inability to find land area outside flood zone and with suitable infiltration rates
   - Consent term length dependent on quality of discharge. High quality effluent may achieve 35 year consent.
   - Disposal to demonstrate that discharge is better than existing discharges and the receiving environment for both SW and WW.
6. Stormwater discussion for re-zoning
   - Management options report being developed
   - Options available
   - Drainage scheme acknowledged
   - Disposal to Lakes may need input from DoC, Fish and Game
   - BR noted need to offset any lost flood storage capacity - Flood modeling results will determine whether any mitigation is required
   - SP mentioned iwi's stance on flooding as being a positive

APPENDIX E

RUNOFF CALCULATIONS

Waikato Regional Council Stormwater Calculations

WORKSHEET 1: RUNOFF PARAMETERS AND TIME OF CONCENTRATION - OLFP

Catchment Details

Total Area (ha)	Atotal =	200.39	
Pervious Area (ha)	Aper =	200.39	
Impervious Area (ha)	Aimp =	0.00	
Channelisation factor	C =	0.8	0.8 engineered grassed channels.
Catchment Length (m)	L =	2443.00	0.6 piped stormwater system.
Catchment Slope	Sc =	0.005	
Rise from bottom to top of catchment (m)	H =	13.000	

ASSUMPTIONS (IF ANY)

Whole site pre development

RUNOFF CURVE NUMBER (CN) AND INITIAL ABSTRACTION (Ia)

Soil Name & Classification	Cover Desctiption (cover type, treatment and hydrological condition)	Curve number	Area (ha)	Product CN x Area
Group C	Pervious	61	200.39	12224.04
Group C	Impervious	98	0.00	0.00
		Total	**200.39**	**12224.04**

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{12224.04}{200.3941}$ = **61**

Ia (weighted) = 0.05*S = **8.119672**

TIME OF CONCENTRATION

Runoff Factor = $\frac{CN}{200 - CN}$ = 0.438849

Tc = 0.0195*(L^3/H)^0.385 = 59.45906 hrs = **3567.543485** mins

WORKSHEET 2 : GRAPHICAL PEAK FLOW RATE

1. Catchment Area (km2) = 2.00

2. Storage, S = 25.4 x [(1000/CN) - 10] = 162.3934426

		WQV	2YR	10YR	100YR
3. Annual Recurrence Interval (ARI)					
4. 24 hour rainfall depth, P24 (mm)		20.13	60	93	200
5. Compute C* =	$\frac{P24 - 2Ia}{P24 - 2Ia + 2S}$ (mm)	0.03989	0.12	0.19	0.36
6. specific flow rate q*		0.035	0.105	0.105	0.105
7. Peak flow rate, q_p = q^*AP_{24} (m^3/sec)		4.23563	12.71	19.61	42.08
8. Runoff depth, Q_{24} =	$\frac{(P_{24} - Ia)^2}{(P_{24} - Ia) + S}$ (mm)	4.242584	12.73	29.25	103.93
9. Runoff Volume, V_{24} = 1000 x $Q_{24}A$ (m^3)		8501.888	25505.66	58615.72	208260.47

Waikato Regional Council Stormwater Calculations

WORKSHEET 1: RUNOFF PARAMETERS AND TIME OF CONCENTRATION - OLFP

Catchment Details

Total Area (ha)	Atotal =	200.39	
Pervious Area (ha)	Aper =	41.42	
Impervious Area (ha)	Aimp =	158.97	
Channelisation factor	C =	0.6	0.6 piped stormwater system.
Catchment Length (m)	L =	2443.00	0.8 engineered grassed channels.
Catchment Slope	Sc =	0.005	
Rise from bottom to top of catchment (m)	H =	13.000	

ASSUMPTIONS (IF ANY)

Whole site post development

RUNOFF CURVE NUMBER (CN) AND INITIAL ABSTRACTION (Ia)

Soil Name & Classification	Cover Desctiption (cover type, treatment and hydrological condition)	Curve number	Area (ha)	Product CN x Area
Group C	Pervious	74	41.42	3065.27
Group C	Impervious	98	158.97	15579.21
		Total	**200.39**	**18644.48**

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{18644.48}{200.3941}$ = **93.03906543**

Ia (weighted) = 0.05*S = **0.95018**

TIME OF CONCENTRATION

Runoff Factor = $\frac{CN}{200 - CN}$ = 0.869842

Tc = 0.0195*(L^3/H)^0.385 = 59.45906 hrs = **3567.543485** mins

WORKSHEET 2 : GRAPHICAL PEAK FLOW RATE

1. Catchment Area (km2) = 2.00

2. Storage, S = 25.4 x [(1000/CN) - 10] = 19.00360212

		WQV	2YR	10YR	100YR
3. Annual Recurrence Interval (ARI)					
4. 24 hour rainfall depth, P24 (mm)		21.9417	66	106	234
5. Compute C* =	$\frac{P24 - 2Ia}{P24 - 2Ia + 2S}$ (mm)	0.209044	0.63	0.73	0.86
6. specific flow rate q*		0.035	0.105	0.105	0.105
7. Peak flow rate, q_p = q^*AP_{24} (m^3/sec)		4.616837	13.85	22.20	49.15
8. Runoff depth, Q_{24} =	$\frac{(P_{24} - Ia)^2}{(P_{24} - Ia) + S}$ (mm)	16.7256	50.18	88.47	215.08
9. Runoff Volume, V_{24} = 1000 x $Q_{24}A$ (m^3)		33517.11	100551.33	177291.63	431010.19

Waikato Regional Council Stormwater Calculations

WORKSHEET 1: RUNOFF PARAMETERS AND TIME OF CONCENTRATION - OLFP

Catchment Details

Total Area (ha)	Atotal =	31.46	
Pervious Area (ha)	Aper =	31.46	
Impervious Area (ha)	Aimp =	0.00	
Channelisation factor	C =	0.8	0.6 piped stormwater system.
Catchment Length (m)	L =	843.70	0.8 engineered grassed channels.
Catchment Slope	Sc =	0.002	
Rise from bottom to top of catchment (m)	H =	2.000	

ASSUMPTIONS (IF ANY)

Factory pre development

RUNOFF CURVE NUMBER (CN) AND INITIAL ABSTRACTION (Ia)

Soil Name & Classification	Cover Desctiption (cover type, treatment and hydrological condition)	Curve number	Area (ha)	Product CN x Area
Group C	Pervious	61	31.46	1919.23
Group C	Impervious	98	0.00	0.00
		Total	**31.46**	**1919.23**

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{1919.234}{31.46285}$ = **61**

Ia (weighted) = 0.05*S = **8.119672**

TIME OF CONCENTRATION

Runoff Factor = $\frac{CN}{200 - CN}$ = 0.438849

Tc = 0.0195*(L^3/H)^0.385 = 35.80018 hrs = **2148.011045** mins

WORKSHEET 2 : GRAPHICAL PEAK FLOW RATE

1. Factory Area (km2) = 0.31

2. Storage, S = 25.4 x [(1000/CN) - 10] = 162.3934426

		WQV	2YR	10YR	100YR
3. Annual Recurrence Interval (ARI)					
4. 24 hour rainfall depth, P24 (mm)		20.13	60	93	200
5. Compute C* =	$\frac{P24 - 2Ia}{P24 - 2Ia + 2S}$ (mm)	0.03989	0.12	0.19	0.36
6. specific flow rate q*		0.035	0.105	0.105	0.105
7. Peak flow rate, q_p = q*AP_{24} (m^3/sec)		0.665015	2.00	3.08	6.61
8. Runoff depth, Q_{24} =	$\frac{(P_{24} - Ia)^2}{(P_{24} - Ia) + S}$ (mm)	4.242584	12.73	29.25	103.93
9. Runoff Volume, V_{24} = 1000 x $Q_{24}A$ (m^3)		1334.838	4004.51	9202.95	32697.91

Waikato Regional Council Stormwater Calculations

WORKSHEET 1: RUNOFF PARAMETERS AND TIME OF CONCENTRATION - OLFP

Catchment Details

Total Area (ha)	Atotal =	31.46	
Pervious Area (ha)	Aper =	0.00	
Impervious Area (ha)	Aimp =	31.46	
Channelisation factor	C =	0.6	0.6 piped stormwater system.
Catchment Length (m)	L =	843.70	0.8 engineered grassed channels.
Catchment Slope	Sc =	0.002	
Rise from bottom to top of catchment (m)	H =	2.000	

ASSUMPTIONS (IF ANY)

Factory post development

RUNOFF CURVE NUMBER (CN) AND INITIAL ABSTRACTION (Ia)

Soil Name & Classification	Cover Desctiption (cover type, treatment and hydrological condition)	Curve number	Area (ha)	Product CN x Area
Group C	Pervious	74	0.00	0
Group C	Impervious	98	31.46	3083.36
		Total	**31.46**	**3083.36**

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{3083.359}{31.46285}$ = **98**

Ia (weighted) = 0.05*S = **0.259184**

TIME OF CONCENTRATION

Runoff Factor = $\frac{CN}{200 - CN}$ = 0.960784

Tc = 0.0195*(L^3/H)^0.385 = 35.80018 hrs = **2148.011045** mins

WORKSHEET 2 : GRAPHICAL PEAK FLOW RATE

1. Catchment Area (km2) = 0.31

2. Storage, S = 25.4 x [(1000/CN) - 10] = 5.183673469

		WQV	2YR	10YR	100YR
3. Annual Recurrence Interval (ARI)					
4. 24 hour rainfall depth, P24 (mm)		21.9417	66	106	234
5. Compute C* =	$\frac{P24 - 2Ia}{P24 - 2Ia + 2S}$ (mm)	0.287667	0.86	0.91	0.96
6. specific flow rate q*		0.035	0.105	0.105	0.105
7. Peak flow rate, q_p = q^*AP_{24} (m^3/sec)		0.724866	2.17	3.49	7.72
8. Runoff depth, Q_{24} =	$\frac{(P_{24} - Ia)^2}{(P_{24} - Ia) + S}$ (mm)	20.25401	60.76	100.30	228.27
9. Runoff Volume, V_{24} = 1000 x $Q_{24}A$ (m^3)		6372.49	19117.47	31558.14	71820.18

Waikato Regional Council Stormwater Calculations

WORKSHEET 1: RUNOFF PARAMETERS AND TIME OF CONCENTRATION - OLFP

Catchment Details

Total Area (ha)	Atotal =	68.01	
Pervious Area (ha)	Aper =	68.01	
Impervious Area (ha)	Aimp =	0.00	
Channelisation factor	C =	0.8	0.6 piped stormwater system.
Catchment Length (m)	L =	1121.60	0.8 engineered grassed channels.
Catchment Slope	Sc =	0.003	
Rise from bottom to top of catchment (m)	H =	3.000	

ASSUMPTIONS (IF ANY)

Industrial area pre development

RUNOFF CURVE NUMBER (CN) AND INITIAL ABSTRACTION (Ia)

Soil Name & Classification	Cover Desctiption (cover type, treatment and hydrological condition)	Curve number	Area (ha)	Product CN x Area
Group C	Pervious	61	68.01	4148.36
Group C	Impervious	98	0.00	0.00
		Total	**68.01**	**4148.36**

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{4148.362}{68.00594}$ = **61**

Ia (weighted) = 0.05*S = **8.119672**

TIME OF CONCENTRATION

Runoff Factor = $\frac{CN}{200 - CN}$ = 0.438849

Tc = 0.0195*(L^3/H)^0.385 = 42.55061 hrs = **2553.036768** mins

WORKSHEET 2 : GRAPHICAL PEAK FLOW RATE

1. Catchment Area (km2) = 0.68

2. Storage, S = 25.4 x [(1000/CN) - 10] = 162.3934426

		WQV	2YR	10YR	100YR
3. Annual Recurrence Interval (ARI)		20.13	60	93	200
4. 24 hour rainfall depth, P24 (mm)					
5. Compute C* =	$\frac{P24 - 2Ia}{P24 - 2Ia + 2S}$ (mm)	0.03989	0.12	0.19	0.36
6. specific flow rate q*		0.035	0.105	0.105	0.105
7. Peak flow rate, q_p = q^*AP_{24} (m^3/sec)		1.437408	4.31	6.66	14.28
8. Runoff depth, Q_{24} =	$\frac{(P_{24} - Ia)^2}{(P_{24} - Ia) + S}$ (mm)	4.242584	12.73	29.25	103.93
9. Runoff Volume, V_{24} = 1000 x $Q_{24}A$ (m^3)		2885.209	8655.63	19891.89	70675.48

Waikato Regional Council Stormwater Calculations

WORKSHEET 1: RUNOFF PARAMETERS AND TIME OF CONCENTRATION - OLFP

Catchment Details

Total Area (ha)	Atotal =	68.01	
Pervious Area (ha)	Aper =	0.96	
Impervious Area (ha)	Aimp =	67.05	
Channelisation factor	C =	0.6	0.6 piped stormwater system.
Catchment Length (m)	L =	1121.60	0.8 engineered grassed channels.
Catchment Slope	Sc =	0.003	
Rise from bottom to top of catchment (m)	H =	3.000	

ASSUMPTIONS (IF ANY)

Industrial area post development

RUNOFF CURVE NUMBER (CN) AND INITIAL ABSTRACTION (Ia)

Soil Name & Classification	Cover Desctiption (cover type, treatment and hydrological condition)	Curve number	Area (ha)	Product CN x Area
Group C	Pervious	74	0.96	70.73
Group C	Impervious	98	67.05	6570.91
		Total	**68.01**	**6641.64**

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{6641.642}{68.00594}$ = **97.66266824**

Ia (weighted) = 0.05*S = **0.303945**

TIME OF CONCENTRATION

Runoff Factor = $\frac{CN}{200 - CN}$ = 0.954321

Tc = 0.0195*(L^3/H)^0.385 = 42.55061 hrs = **2553.036768** mins

WORKSHEET 2 : GRAPHICAL PEAK FLOW RATE

1. Catchment Area (km2) = 0.68

2. Storage, S = 25.4 x [(1000/CN) - 10] = 6.078906904

		WQV	2YR	10YR	100YR
3. Annual Recurrence Interval (ARI)					
4. 24 hour rainfall depth, P24 (mm)		21.9417	66	106	234
5. Compute C* =	$\frac{P24 - 2Ia}{P24 - 2Ia + 2S}$ (mm)	0.280957	0.84	0.90	0.95
6. specific flow rate q*		0.035	0.105	0.105	0.105
7. Peak flow rate, q_p = q^*AP_{24} (m^3/sec)		1.566774	4.70	7.53	16.68
8. Runoff depth, Q_{24} =	$\frac{(P_{24} - Ia)^2}{(P_{24} - Ia) + S}$ (mm)	19.98612	59.96	99.45	227.37
9. Runoff Volume, V_{24} = 1000 x $Q_{24}A$ (m^3)		13591.75	40775.24	67633.02	154626.14

Waikato Regional Council Stormwater Calculations

WORKSHEET 1: RUNOFF PARAMETERS AND TIME OF CONCENTRATION - OLFP

Catchment Details

Total Area (ha)	Atotal =	15.14	
Pervious Area (ha)	Aper =	15.14	
Impervious Area (ha)	Aimp =	0.00	
Channelisation factor	C =	0.8	0.6 piped stormwater system.
Catchment Length (m)	L =	207.60	0.8 engineered grassed channels.
Catchment Slope	Sc =	0.063	
Rise from bottom to top of catchment (m)	H =	13.000	

ASSUMPTIONS (IF ANY)

Commercial area pre development

RUNOFF CURVE NUMBER (CN) AND INITIAL ABSTRACTION (Ia)

Soil Name & Classification	Cover Desctiption (cover type, treatment and hydrological condition)	Curve number	Area (ha)	Product CN x Area
Group C	Pervious	61	15.14	923.47
Group C	Impervious	98	0.00	0.00
		Total	**15.14**	**923.47**

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{923.468}{15.13882}$ = **61**

Ia (weighted) = 0.05*S = **8.119672**

TIME OF CONCENTRATION

Runoff Factor = $\frac{CN}{200 - CN}$ = 0.438849

Tc = 0.0195*(L^3/H)^0.385 = 3.447974 hrs = **206.8784527** mins

WORKSHEET 2 : GRAPHICAL PEAK FLOW RATE

1. Catchment Area (km2) = 0.15

2. Storage, S = 25.4 x [(1000/CN) - 10] = 162.3934426

		WQV	2YR	10YR	100YR
3. Annual Recurrence Interval (ARI)					
4. 24 hour rainfall depth, P24 (mm)		20.13	60	93	200
5. Compute C* =	$\frac{P24 - 2Ia}{P24 - 2Ia + 2S}$ (mm)	0.03989	0.12	0.19	0.36
6. specific flow rate q*		0.035	0.105	0.105	0.105
7. Peak flow rate, q_p = q*AP_{24} (m^3/sec)		0.319982	0.96	1.48	3.18
8. Runoff depth, Q_{24} =	$\frac{(P_{24} - Ia)^2}{(P_{24} - Ia) + S}$ (mm)	4.242584	12.73	29.25	103.93
9. Runoff Volume, V_{24} = 1000 x $Q_{24}A$ (m^3)		642.2771	1926.83	4428.14	15733.09

Waikato Regional Council Stormwater Calculations

WORKSHEET 1: RUNOFF PARAMETERS AND TIME OF CONCENTRATION - OLFP

Catchment Details

Total Area (ha)	Atotal =	15.14	
Pervious Area (ha)	Aper =	2.95	
Impervious Area (ha)	Aimp =	12.19	0.6 piped stormwater system.
Channelisation factor	C =	0.6	0.8 engineered grassed channels.
Catchment Length (m)	L =	207.60	
Catchment Slope	Sc =	0.063	
Rise from bottom to top of catchment (m)	H =	13.000	

ASSUMPTIONS (IF ANY)

Industrial area post development

RUNOFF CURVE NUMBER (CN) AND INITIAL ABSTRACTION (Ia)

Soil Name & Classification	Cover Desctiption (cover type, treatment and hydrological condition)	Curve number	Area (ha)	Product CN x Area
Group C	Pervious	74	2.95	218.38
Group C	Impervious	98	12.19	1194.40
		Total	**15.14**	**1412.78**

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{1412.778}{15.13882}$ = **93.3215561**

Ia (weighted) = 0.05*S = **0.90886**

TIME OF CONCENTRATION

Runoff Factor = $\frac{CN}{200 - CN}$ = 0.874793

Tc = 0.0195*(L^3/H)^0.385 = 3.447974 hrs = **206.8784527** mins

WORKSHEET 2 : GRAPHICAL PEAK FLOW RATE

1. Catchment Area (km2) = 0.15

2. Storage, S = 25.4 x [(1000/CN) - 10] = 18.17720173

		WQV	2YR	10YR	100YR
3. Annual Recurrence Interval (ARI)					
4. 24 hour rainfall depth, P24 (mm)		21.9417	66	106	234
5. Compute C* =	$\frac{P24 - 2Ia}{P24 - 2Ia + 2S}$ (mm)	0.212589	0.64	0.74	0.86
6. specific flow rate q*		0.035	0.105	0.105	0.105
7. Peak flow rate, q_p = q*AP_{24} (m^3/sec)		0.34878	1.05	1.68	3.71
8. Runoff depth, Q_{24} =	$\frac{(P_{24} - Ia)^2}{(P_{24} - Ia) + S}$ (mm)	16.90514	50.72	89.11	215.83
9. Runoff Volume, V_{24} = 1000 x Q_{24}A (m^3)		2559.238	7677.71	13489.84	32674.27

Waikato Regional Council Stormwater Calculations

WORKSHEET 1: RUNOFF PARAMETERS AND TIME OF CONCENTRATION - OLFP

Catchment Details

Total Area (ha)	Atotal =	66.12	
Pervious Area (ha)	Aper =	66.12	
Impervious Area (ha)	Aimp =	0.00	
Channelisation factor	C =	0.8	0.6 piped stormwater system.
Catchment Length (m)	L =	2048.40	0.8 engineered grassed channels.
Catchment Slope	Sc =	0.006	
Rise from bottom to top of catchment (m)	H =	13.000	

ASSUMPTIONS (IF ANY)

Residential area pre development

RUNOFF CURVE NUMBER (CN) AND INITIAL ABSTRACTION (Ia)

Soil Name & Classification	Cover Desctiption (cover type, treatment and hydrological condition)	Curve number	Area (ha)	Product CN x Area
Group C	Pervious	61	66.12	4033.50
Group C	Impervious	98	0.00	0
		Total	**66.12**	**4033.50**

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{4033.496}{66.12289}$ = **61**

Ia (weighted) = 0.05*S = **8.119672**

TIME OF CONCENTRATION

Runoff Factor = $\frac{CN}{200 - CN}$ = 0.438849

Tc = 0.0195*(L^3/H)^0.385 = 48.51214 hrs = **2910.73** mins

WORKSHEET 2 : GRAPHICAL PEAK FLOW RATE

1. Catchment Area (km2) = 0.66

2. Storage, S = 25.4 x [(1000/CN) - 10] = 162.39

		WQV	2YR	10YR	100YR
3. Annual Recurrence Interval (ARI)					
4. 24 hour rainfall depth, P24 (mm)		20.13	60	93	200
5. Compute C* =	$\frac{P24 - 2Ia}{P24 - 2Ia + 2S}$ (mm)	0.03989	0.12	0.19	0.36
6. specific flow rate q*		0.035	0.105	0.105	0.105
7. Peak flow rate, q_p = q^*AP_{24} (m^3/sec)		1.397606	4.19	6.47	13.89
8. Runoff depth, Q_{24} =	$\frac{(P_{24} - Ia)^2}{(P_{24} - Ia) + S}$ (mm)	4.242584	12.73	29.25	103.93
9. Runoff Volume, V_{24} = 1000 x $Q_{24}A$ (m^3)		2805.319	8415.96	19341.09	68718.51

Waikato Regional Council Stormwater Calculations

WORKSHEET 1: RUNOFF PARAMETERS AND TIME OF CONCENTRATION - OLFP

Catchment Details

Total Area (ha)	Atotal =	66.12	
Pervious Area (ha)	Aper =	17.85	
Impervious Area (ha)	Aimp =	48.27	
Channelisation factor	C =	0.6	0.6 piped stormwater system.
Catchment Length (km)	L =	2048.40	0.8 engineered grassed channels.
Catchment Slope	Sc =	0.006	
Rise from bottom to top of catchment (m)	H =	13.000	

ASSUMPTIONS (IF ANY)

Residential area post development

RUNOFF CURVE NUMBER (CN) AND INITIAL ABSTRACTION (Ia)

Soil Name & Classification	Cover Desctiption (cover type, treatment and hydrological condition)	Curve number	Area (ha)	Product CN x Area
Group C	Pervious	74	17.85	1321.05
Group C	Impervious	98	48.27	4730.54
		Total	**66.12**	**6051.59**

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{6051.594}{66.12289}$ = **91.52041465**

Ia (weighted) = 0.05*S = **1.176685**

TIME OF CONCENTRATION

Runoff Factor = $\frac{CN}{200 - CN}$ = 0.843665

Tc = 0.0195*(L^3/H)^0.385 = 48.51214 hrs = **2910.728694** mins

WORKSHEET 2 : GRAPHICAL PEAK FLOW RATE

1. Catchment Area (km2) = 0.66

2. Storage, S = 25.4 x [(1000/CN) - 10] = 23.53370761

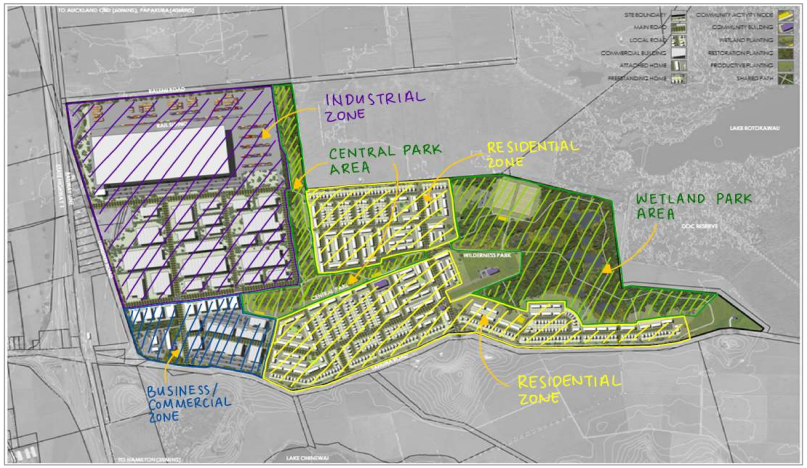
		WQV	2YR	10YR	100YR
3. Annual Recurrence Interval (ARI)					
4. 24 hour rainfall depth, P24 (mm)		21.9417	66	106	234
5. Compute C* =	$\frac{P24 - 2Ia}{P24 - 2Ia + 2S}$ (mm)	0.1914	0.57	0.69	0.83
6. specific flow rate q*		0.035	0.105	0.105	0.105
7. Peak flow rate, q_p = q^*AP_{24} (m^3/sec)		1.523391	4.57	7.32	16.22
8. Runoff depth, Q_{24} =	$\frac{(P_{24} - Ia)^2}{(P_{24} - Ia) + S}$ (mm)	15.79843	47.40	85.12	211.05
9. Runoff Volume, V_{24} = 1000 x $Q_{24}A$ (m^3)		10446.38	31339.14	56286.19	139554.60

WOODS
Engineers. Surveyors. Planners.

Ohinewai Catchment Area (ha)

Proposed Site Impervious Coverages							
Typology	**Lot Area**	**Road Area**	**Lot Impervious**	**Road Impervious**	**Impervious Area**	**Pervious Area**	**Weighted Impervious**
Factory	31.46		100%		31.46	0.00	100%
Industrial	61.63	6.37	100%	85%	67.05	0.96	99%
Commercial	13.61	1.53	80%	85%	12.19	2.95	81%
Residential	52.89	13.23	70%	85%	48.27	17.85	73%
Open Space	19.66		0%		0.00	19.66	0%
Total	**179.26**	**21.14**			**158.97**	**41.42**	
	SUM	**200.39**			**SUM**	**200.39**	

Total site area	200.39	ha
Total impervious area	158.97	ha
Total pervious area	41.42	ha
Overall site imperviousness	79%	
Open space	10%	
Conventional site disturbance	100%	
Actual site disturbance	90%	
Wetland park area	9.04	ha
%wetland park	4.5%	
Central park area	10.63	ha
% central park	5.3%	



WOODS
Engineers. Surveyors. Planners.

Rainfall Intensity Calculation Sheet – With Climate Change

PROJECT NUMBER:
ADDRESS:
BY:
DATE:

Percentage Increase in 24-hour Design Rainfall Depth

Sourced from Table 4.1, page 17 of 83 in Code of Practice for Land Development and Subdivision Chapter 4 – Stormwater, Version 2.0, 1 November 2015

Annual Exceedance Probability (AEP)	ARI	Percentage Increase in 24-Hour Design Rainfall Depth Due to Future Climate Change*
50%	2 year	9.0%
20%	5 year	11.3%
10%	10 year	13.2%
5%	20 year	15.1%
2%	50 year	16.8%
1%	100 year	16.8%

* Assuming 2.1 degree increase in temperature

Rainfall depth with climate change

ARI	Rainfall Depth (mm) - From TP108	Rainfall Depth + Climate Change Allowance (mm)
2 year	60	65.83
5 year		0.00
10 year	93	105.50
20 year		0.00
50 year		0.00
100 year	200	233.60

Rainfall intensity with no allowance climate change

ARI	Rainfall Intensity (mm/hr) - 10 mins
2 year	40.77
5 year	0.00
10 year	62.92
20 year	0.00
50 year	0.00
100 year	135.02

Rainfall intensity with allowance for future climate change

ARI	Rainfall Intensity (mm/hr) - 10 mins
2 year	45.73
5 year	0.00
10 year	73.29
20 year	0.00
50 year	0.00
100 year	162.29