PART 5: STORMWATER AND LAND DRAINAGE

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EQUATIONS

5.1 REFERENCED DOCUMENTS

Planning and Policy

- Timaru District Revenue & Financing Policy
- Timaru District Consolidated Bylaw 2018
- Timaru District Council Stormwater Services Activity Management Plan 2021-2031

Design

- Christchurch City Council Streamside Planting Guide
- New Zealand Fish Passage Guidelines
- Timaru District Council Acceptable Solutions No. 1
- Christchurch City Council Waterways, Wetlands and Drainage Guide: Part B
- Ministry of Business, Innovation and Employment Acceptable Solutions and Verification Methods for the New Zealand Building Code Clause E1 Surface Water
- Auckland Council Stormwater management devices in the Auckland region. Auckland Council guideline document, GD2017/001
- Waikato Regional Council Waikato Stormwater Management Guideline, Technical Report TR2020/07
- Construction Industry Research and Information Association Infiltration Drainage – manual of good practise (R156)
- New Zealand Water Environment Research Foundation On-site Stormwater Management Guideline

Construction

- Timaru District Council – Land Transport Unit Backfill & Reinstatement Requirements Guide
- Timaru District Council Construction Standard Specifications

Where a conflict exists between any Standard and the specific requirements outlined in the Infrastructure Design Standard (IDS), the IDS takes preference (at the discretion of the Council).

5.1.1 Source documents

This Part of the IDS is based on Part 4 of NZS 4404:2010, by agreement, and with the consent of Standards New Zealand.

5.1.2 Definitions and Abbreviations

Annual Recurrence Interval (ARI)	The average number of years that it is predicted will pass before an event of a given magnitude occurs. For example, a 1 in 20 year ARI event would on average happen once every 20 years.
Catchment area	An area of land where surface water from rain and melting snow or ice converges to a single point at a lower elevation, usually where the water joins another waterbody e.g. a river, lake, reservoir, estuary, wetland, sea, or ocean.

Certification	Applied in the context of Stormwater Discharge Certification, this refers to the process by which a stormwater discharge may be approved by TDC for entry to the reticulated stormwater network
Council	The local authority Timaru District Council.
Critical duration	The duration of a specific storm event which either results in the highest stormwater runoff rate or the duration of a storm event that results in the greatest downstream flooding.
Design storm	The theoretical rainfall event that the analysis is based on for a particular AEP. It is based on certain assumptions about rainfall depth, intensity, and or critical duration.
Development area	Any individual area within a site or sites that is undergoing development and construction activities.
Environment Canterbury / ECan	Canterbury Regional Council.
Erosion and Sediment Control (ESC) Plan	A plan to manage soil carefully when the land is disturbed (during development construction activities) in order to protect slopes from erosion, protect against loss of soil from a site and protect waterways.
Hazardous Activities and Industries List (HAIL)	A compilation of activities and industries that are considered likely to cause land contamination resulting from hazardous substance use, storage or disposal. The HAIL is intended to identify most situations in New Zealand where hazardous substances could cause, and in many cases have caused, land contamination.
HIRDS	The High Intensity Rainfall Design System is a web-based programme that can estimate rainfall frequency at any point in New Zealand (maintained by NIWA). It can be used to estimate rainfall depths for hydrological design purposes, and to assess the rarity of observed storm events.
Impervious surface	an area with a surface which prevents or significantly reduces the soakage or filtration of water into the ground. It includes: • Roofs; • Paved areas including driveways and sealed or compacted metal parking areas and patios; • sealed outdoor sports surfaces • Sealed and compacted-metal roads; • Engineered layers such as compacted clay. It excludes: • Grass or bush areas; • Gardens and other landscaped areas; • Permeable paving and green roofs; • Permeable artificial surfaces, fields or lawns; • Slatted decks; • Swimming pools, ponds and dammed water; and • Rain tanks
Listed Land Use Register (LLUR)	The Listed Land Use Register is a publicly available database that identifies sites where hazardous activities and industries have been located throughout Canterbury.
Reticulated Stormwater Network	A network of pipes, swales, drains, kerbs and channels owned or operated by a network utility operator that collects stormwater within areas used or proposed to be used for rural lifestyle and urban-residential, commercial or industrial purposes and conveys that stormwater to any device, wetland, retention or detention pond or infiltration basin for the treatment of stormwater, prior to a discharge to land, groundwater or surface water. It excludes any drainage system that has been constructed for the primary purpose of collection, conveyance or discharge of drainage water, or any natural waterbody

Stormwater	Run-off that has been intercepted, channelled, diverted, intensified or accelerated by human modification of a land surface, or run-off from the surface of any structure, as a result of precipitation and includes any contaminants contained within
Stormwater Management Area	The urban catchment extent within which Council manages a reticulated stormwater system. May include areas identified for future development.
Stormwater Management Plan (SMP)	A plan prepared to address the management of stormwater within a Stormwater Management Area, prepared and lodged as part of a stormwater discharge consent application.
Stormwater neutrality	Management of stormwater runoff from the site during one or more specific rainfall events to restrict post-development peak flows and/or volumes to pre-development flows and/or volumes. post development stormwater runoff volumes generated on the site do not exceed the pre-development stormwater volumes off the site
Stormwater Neutrality Device	A device or natural system which retains (re-use) or detains the stormwater discharge from the site, and slows the release of the stormwater at a rate that is no more than the site's original discharge
TDC	Timaru District Council.
Time of concentration	A hydrological term that describes the response time of a catchment to rainfall. It represents the time period required for runoff from the furthest point of the catchment to reach a given point.
WSUD	Water Sensitive Urban Design is an engineering design approach which integrates the water cycle into urban design to minimise environmental degradation and improve aesthetic and recreational appeal

5.2 INTRODUCTION

This Part of the IDS covers the design and construction requirements of stormwater and land drainage works for land development and subdivision, including capital works projects.

5.2.1 Philosophy

The management of stormwater is critical in the urban environment for the safety of the community and the protection of public and private property. If not effectively collected and drained, stormwater can become a significant hazard and can cause damage to structures and properties. However, the discharge of stormwater also has the potential to cause adverse effects on the environment and subsequently the well-being of communities. The natural attributes of rivers, lakes and other freshwater bodies can be degraded by excessive sediment and contaminant inputs or by the flow rates and volumes of stormwater discharges. Timaru District Council (TDC) has a responsibility to ensure that urban stormwater is managed in a manner that sustainably supports the environmental, social, cultural and economic well-being of the communities it serves.

Timaru District faces significant challenges in Planning and Regulation, Asset Management, Managing the receiving environment and stakeholder engagement and education. In order to overcome these broad issues and their individual challenges TDC has set out a stormwater management framework through this Design Standard and the TDC Construction Standard Specifications (CSS).

The National Policy Statement for Freshwater Management 2020 Policies will guide Timaru DC Stormwater practices. These policies are outlined below:

Policy 1: Freshwater is managed in a way that gives effect to Te Mana o te Wai
Policy 2: Tangata whenua are actively involved in freshwater management (including decision-making processes), and Māori freshwater values are identified and provided for.
Policy 3: Freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole-of-catchment basis, including the effects on receiving environments.
Policy 4: Freshwater is managed as part of New Zealand's integrated response to climate change.
Policy 5: Freshwater is managed through a National Objectives Framework to ensure that the health and well-being of degraded water bodies and freshwater ecosystems is improved, and the health and well-being of all other water bodies and freshwater ecosystems is maintained and (if communities choose) improved.
Policy 6: There is no further loss of extent of natural inland wetlands, their values are protected, and their restoration is promoted.
Policy 7: The loss of river extent and values is avoided to the extent practicable.
Policy 8: The significant values of outstanding water bodies are protected.
Policy 9: The habitats of indigenous freshwater species are protected.
Policy 10: The habitat of trout and salmon is protected, insofar as this is consistent with Policy 9.
Policy 11: Freshwater is allocated and used efficiently, all existing over-allocation is phased out, and future over-allocation is avoided.
Policy 12: The national target (as set out in NPS-FW 2020: Appendix 3) for water quality improvement is achieved.
Policy 13: The condition of water bodies and freshwater ecosystems is systematically monitored over time, and action is taken where freshwater is degraded, and to reverse deteriorating trends.
Policy 14: Information (including monitoring data) about the state of water bodies and freshwater ecosystems, and the challenges to their health and well-being, is regularly reported on and published.
Policy 15: Communities are enabled to provide for their social, economic, and cultural well- being in a way that is consistent with this National Policy Statement.

5.2.2 Objectives

The design of Timaru District's stormwater management reticulation endeavours to provide a network with sufficient capacity to contain the stormwater up to the design rain events without overflows. The *2018-2048 Timaru District Stormwater Strategy* establishes objectives for the stormwater network. These objectives include but are not limited to the need to minimise the adverse effects of stormwater on communities and freshwater systems, increase resilience and maintain affordability of stormwater services, and ensure the agreed level of service is maintained to the satisfaction of the Council and community. To satisfy the latter, remedial or mitigation works will often need to be incorporated within the stormwater drainage system.

Well designed and maintained alternative systems that replicate the pre-development hydrological regime can not only mitigate adverse environmental effects but also enhance amenity and ecological values. The Council is seeking to have a stormwater system that is capable of accommodating stormwater from rainfall events in an efficient and sustainable way whilst ensuring that the cultural, economic, ecological, recreational values and natural structures of waterways are recognised and enhanced.

The Timaru District Plan seeks to manage land uses to avoid or mitigate potential effects, and to support integrated management of the freshwater resource within the Canterbury region. For stormwater, this can be achieved through water sensitive urban design (WSUD); using natural processes to protect water quality and the aquatic habitat and enhance liveability through cultural significance, connectivity and recreation.

The purpose of the Stormwater Management Chapter is to:

- Assist Council in meeting their obligations under the Resource Management Act through the appropriate implementation of their Stormwater Management Plans and associated stormwater consents.
- Provide guidance on what a new development, or re-development, must achieve in order to be granted Certification from Council to discharge stormwater to the Council stormwater network.
- Outline and demonstrate the preferred approach for stormwater management in commercial, industrial and residential development in the district.
- Provide a selection of methods and tools to mitigate the effects of stormwater runoff from developments.

5.2.3 Stormwater Strategy 2018-2048

Stormwater management is a complex activity that involves the participation of a wide range of stakeholders including national and local government, private business sector, property owners and Takata Whenua.

In the Timaru District, TDC has the lead role in providing and managing urban stormwater services. Timaru District Council has developed the Stormwater Strategy 2018-2048 to provide direction to TDC's decision-makers on stormwater using an integrated management approach. The Strategy establishes:
1) TDC's stormwater management goals for the next 30 years and beyond; and
2) What TDC will do to achieve those goals.

5.2.4 The Regional and District Context

The Timaru District Stormwater Strategy 2018-2048[1] is the overarching framework for stormwater management in the district. The stormwater strategy is based on the vision set out in the Long Term Plan[2], and provides direction for the stormwater

[1] TDC, 2017. Timaru District Stormwater Strategy 2018 – 2048. Timaru District Council, June 2017.
2 TDC, 2021. Together we can thrive – Long Term Plan 2021 – 2031. Timaru District Council, August 2021.

management provisions of the District Plan. The goals of the Stormwater Strategy sit across four themes: receiving environment, planning and regulation, asset management, and stakeholder engagement and education

These goals are incorporated into the Stormwater Management Plans. Stormwater Management Plans (SMPs) provide a holistic view of stormwater management within a catchment. This planning framework enables the potential cumulative effects of stormwater discharges on receiving environments to be considered and managed. SMPs will soon be in place for urban catchments across the Timaru District. These include:

- Geraldine Stormwater Management Plan
- Pleasant Point Stormwater Management Plan
- Temuka Stormwater Management Plan
- Timaru Stormwater Management Plan
- Washdyke Stormwater Management Plan
- Washdyke Industrial Expansion Zone (WIEZ) Stormwater Management Plan

The SMP provides 'best practice' strategies for stormwater management and enables a single resource consent for stormwater discharge to replace existing consents (where present) within a catchment. The consent provides a framework for the approval of appropriate discharges without requiring further resource consents to be sought from the Regional Council, as the impacts of the development of the catchment have already been considered as a whole. Catchment wide consents are referred to as 'Global' consents. These enable TDC to authorise, and exercise control, over stormwater discharges into its reticulated network to manage effects on the environment in accordance with the SMPs.

The Timaru District Plan has been developed to support the principles and purpose of the Resource Management Act 1991, Local Government Act 2002 and subsequent hierarchy of regulations including the National Policy Statement for Freshwater Management 2020[3] (NPSFM), National Environmental Standards (NES) and the New Zealand Coastal Policy Statement 2010[4] (NZCPS). The National Policy Statement for Freshwater Management 2020 Policies will guide stormwater practices in the Timaru district. Te Mana o te Wai 6 principles relating to the roles of tangata whenua and other New Zealanders in the management of freshwater are to be considered and integrated into the design of all stormwater systems. These policies and principles are summarised in further detail in the TDC IDS.

5.2.5 Te Mana o te Wai

The information below is sourced from the National Policy Statement for Freshwater Management 2020. See the link below to the factsheet from the Ministry for the

[3] MfE, 2020. National Policy Statement for Freshwater Management 2020. New Zealand Government, Ministry for the Environment, August 2020.
[4] DoC, 2010. New Zealand Coastal Policy Statement 2010. New Zealand Government, Department of Conservation, December 2010.

Environment for further details.

https://environment.govt.nz/assets/Publications/Files/essential-freshwater-te-mana-o-te-wai-factsheet.pdf

Fundamental concept – Te Mana o te Wai
Concept
(1) Te Mana o te Wai is a concept that refers to the fundamental importance of water and recognises that protecting the health of freshwater protects the health and well-being of the wider environment. It protects the mauri of the wai. Te Mana o te Wai is about restoring and preserving the balance between the water, the wider environment, and the community.
(2) Te Mana o te Wai is relevant to all freshwater management and not just to the specific aspects of freshwater management referred to in this National Policy Statement.

Framework
(3) Te Mana o te Wai encompasses 6 principles relating to the roles of tangata whenua and other New Zealanders in the management of freshwater, and these principles inform this National Policy Statement and its implementation.

(4) The 6 principles are:
(a) *Mana whakahaere*: the power, authority, and obligations of tangata whenua to make decisions that maintain, protect, and sustain the health and well-being of, and their relationship with, freshwater
(b) *Kaitiakitanga*: the obligation of tangata whenua to preserve, restore, enhance, and sustainably use freshwater for the benefit of present and future generations
(c) *Manaakitanga*: the process by which tangata whenua show respect, generosity, and care for freshwater and for others
(d) *Governance*: the responsibility of those with authority for making decisions about freshwater to do so in a way that prioritises the health and well-being of freshwater now and into the future
(e) *Stewardship*: the obligation of all New Zealanders to manage freshwater in a way that ensures it sustains present and future generations
(f) *Care and respect*: the responsibility of all New Zealanders to care for freshwater in providing for the health of the nation.

(5) There is a hierarchy of obligations in Te Mana o te Wai that prioritises:
(a) first, the health and well-being of water bodies and freshwater ecosystems
(b) second, the health needs of people (such as drinking water)
(c) third, the ability of people and communities to provide for their social, economic, and cultural well-being, now and in the future.

5.3 CONSENT AND COMPLIANCE ISSUES

Timaru District Council holds a number of network discharge consents throughout its territory which it may use to authorise the discharge of stormwater from third party developments into its network. Compliance with relevant consent conditions may require on-site stormwater mitigation (treatment and/or attenuation/disposal).

If Council does not authorise the stormwater discharge under one of its global consents, separate authorisation from Canterbury Regional Council (ECAN) may be required unless the activity meets the permitted activity thresholds in the *Canterbury Land and Water Regional Plan*. Both a land use consent (Council) and a discharge consent (ECAN) are generally required for subdivisions and capital works projects and when significant water quantity and quality issues need to be addressed.

Consult with Council prior to consent application. If separate ECAN consent is required, it is good practice for Council and ECAN to process subdivision and water-related resource consents simultaneously and deal with land and water issues at a joint hearing pursuant to section 102 of the RMA.

Typical conditions will reflect the Council's network stormwater consent and stormwater management plans including:

- An erosion and sediment control plan is required for all activities involving land disturbance (*Appendix F – Construction Stormwater Management*).
- Sediment generated by the activity must be contained within the work site.
- Sumps collecting runoff from new hardstand areas must be fitted with suitable treatment devices.
- Site management and spill procedures are required for sites where the occupier engages in hazardous activities.

Additional conditions may include:

- An assessment of water quantity effects, and provision of on-site stormwater storage or network upgrade may be required.
- No discharge onto or into land where the average site slope exceeds 5 degrees.
- First flush treatment is required for stormwater runoff from new hardstand areas in excess of 30 m^2 for all activities except for residential
- Treatment will be required for stormwater runoff from buildings with uncoated metal roofs. No new discharge from zinc or copper materials will be accepted.

Requirements in the *Timaru District Consolidated Bylaw 2018: Chapter 15 Water Services* must be met.

5.3.1 Legislation

The Resource Management Act (RMA) is the principal statute that controls land development, including stormwater drainage aspects.

5.3.2 Consent from the Canterbury Regional Council

Other activities often associated with stormwater drainage works which must be authorised by ECAN include: the diversion of natural water during construction work;

the permanent diversion of natural water as a consequence of the development; activities in the bed or on the banks of a natural waterway; damming waterways; permanent or construction related dewatering.

5.3.3 Exercising consents

Discharge to water and water take consents and land use consents required during construction must be applied for by, and exercised in the name of, the developer.

Other discharge and water permits required for works that are to be transferred to the Council upon completion, must be applied for by, and exercised in the name of the developer. Discuss with the Council any application involving consents intended to transfer to the Council. The Council must approve these prior to application as it will not accept the transfer of a consent unless it has previously approved the conditions of that consent.

5.4 STORMWATER DISCHARGE IN TIMARU DISTRICT

This chapter provides specific detail on how to meet the TDC requirements for stormwater certification when undertaking new development within a catchment area subject to a global consent.

Figure 1 below describes the overall process by which a development application will be considered and accepted by TDC.

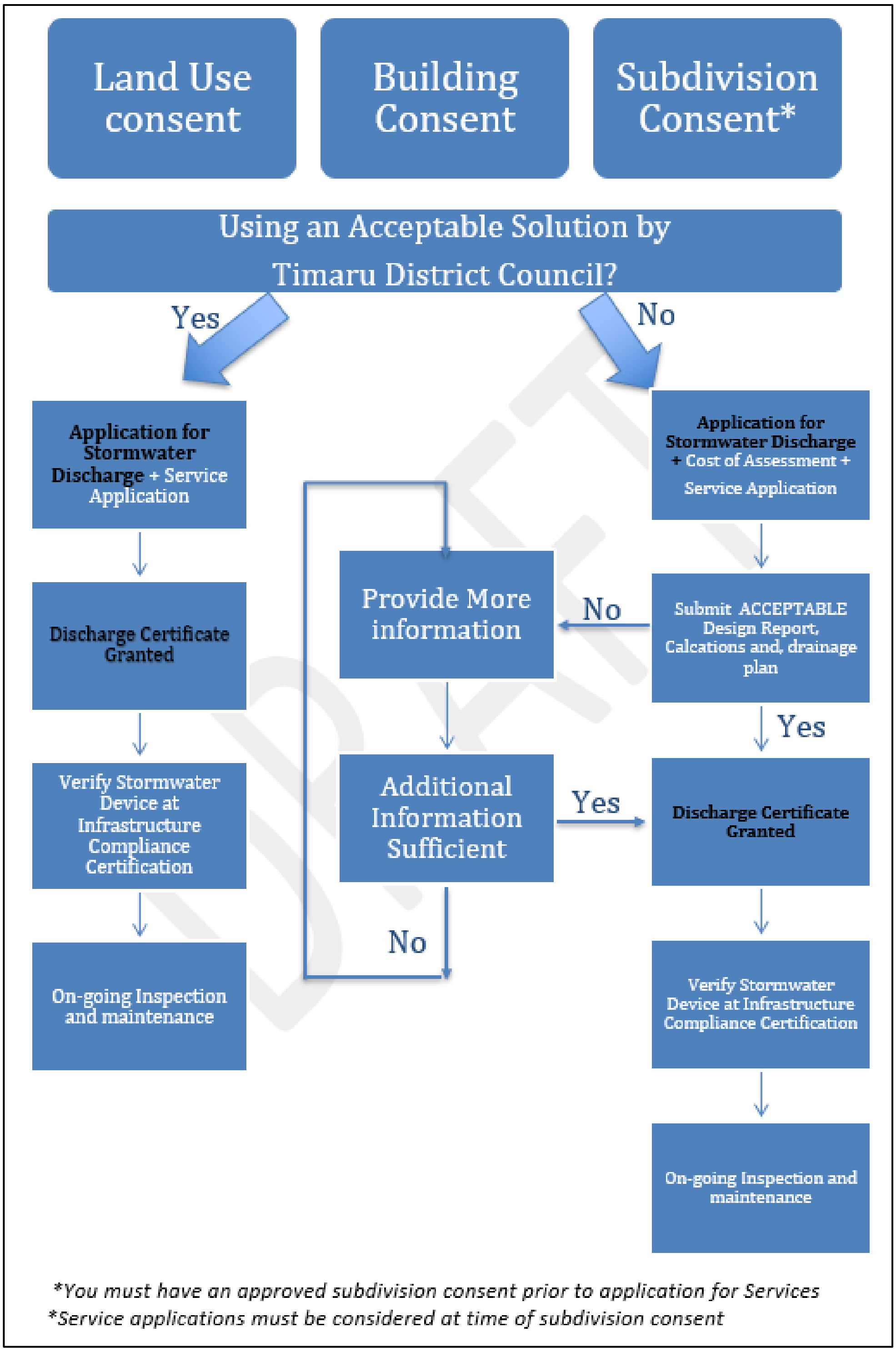

Figure 1 Overall process for development applications to TDC

5.4.1 Stormwater Discharge Certification

Stormwater certification applies all discharges to the reticulated network, or to stormwater assets which will be vested with Council. Under the Timaru District Plan - Stormwater Chapter , written permission is required from the owner of the reticulated stormwater network to allow entry of stormwater to the network. This approval (termed Certification) from TDC is largely based on two factors;

- Treatment of stormwater to remove contaminants, and,
- Restriction of the quantity of stormwater discharged, by limiting the post-development discharge to the pre-development rate/volume (termed stormwater neutrality).

Figure 2 provides a visual overview of the key considerations for certification. A Certification Application Form can be found on TDC's website.

Following submission of the certification documentation, TDC will review the application. The application may also go through a peer review process, prior to issuing certification. Certification may be withheld by TDC if certification requirements are not adequately addressed.

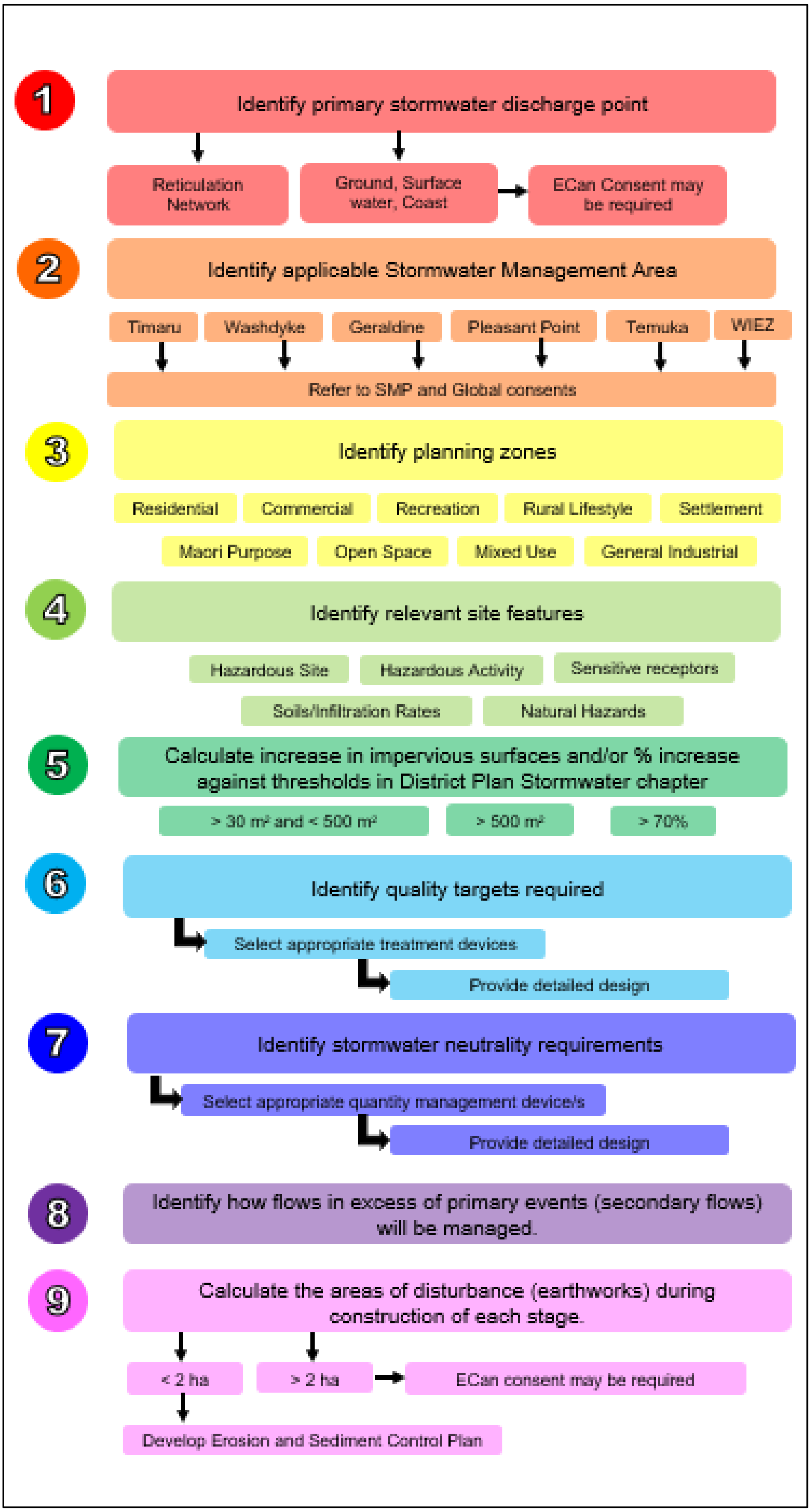

Figure 2 Overview of TDC Stormwater Certification Requirements

5.4.2 Acceptable Solutions vs. Engineered Design

Where discharges are managed through an Acceptable Solution[5], the Application for Stormwater Discharge is processed by TDC to achieve Discharge Certification. Where discharges are not proposed to be managed through an Acceptable Solution, a design report, calculations and drainage plan will be processed through the TDC Engineering Approval process.

Where applications do not fit the requirements for stormwater discharge certification, the developer will need to apply for their own Discharge Consent from ECan. Additionally, the developer is likely to have to construct, operate and maintain their own infrastructure. In the event that the discharge is into the TDC network, approval from TDC will still need to be obtained.

Additionally, this Guideline also provides broader guidance applicable to all stormwater management in the district, regardless of its ultimate discharge location. This document and Timaru District Council Construction Standard Specifications (CSS) form the primary references. Additional guidance can be sought from the following publications:

- Christchurch City Council Waterways, Wetlands and Drainage Guide (WWDG)
- Ministry of Business, Innovation and Employment, Acceptable Solutions and Verification Methods for New Zealand Building Code Clause E1 Surface Water
- Auckland Council Guidance Document 01 (GD01), Stormwater Management Devices in the Auckland Region
- Waikato Regional Council Technical Report 2020/07, Waikato Stormwater Management Guideline.
- Construction Industry Research and Information Association (CIRIA) Infiltration Drainage - Manual of Good Practise
- New Zealand Water Environment Research Foundation (NZWERF), On-site Stormwater Management Guideline.

5.5 QUALITY ASSURANCE REQUIREMENTS AND RECORDS

Provide quality assurance records that comply with the requirements in Part 3: Quality Assurance, during design and throughout construction.

5.5.1 The designer

The designer of all stormwater reticulation systems that are to be taken over by Timaru District Council and the person undertaking the catchment analysis must be suitably experienced. Their experience must be to a level to permit membership in the relevant professional body. Refer to clause 2.7.1 – Investigation and design (General Requirements) for further information.

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[5] TDC, 2021. Stormwater Management: Acceptable Solution No. 1.
https://www.timaru.govt.nz/__data/assets/pdf_file/0010/580789/Acceptable-Solutions-No.1-wTank-Details.pdf

The design peer reviewer must have at least equivalent experience to the designer.

5.5.2 Information to be provided

Design and as-built information must be supplied in New Zealand Transverse Mercator 2000 (NZTM2000) projection and Lyttelton (1937) vertical datum.

All plans are required to state the datum used. All levels are to be stated in height above Mean Sea Level (in metres).

Refer to the *CSS* for further information.

Specific information to be provided with any concept drawings or Resource Consent plans must include:

- the location of any natural waterways, springs, bores, wells or wetlands within the site or in close proximity to a boundary. The location in plan and level of the water's edge and shoulder of the banks must be indicated;
- the location of existing drainage pathways;
- representative pre-existing and post development cross-sections through any natural waterways or wetlands, including the areas immediately adjacent to the proposed development;
- catchment boundaries defined by surface levels (where the location of the catchment boundary is uncertain, the developer must define the boundary by survey);
- summaries of hydrological and hydraulic modelling as required by the (see *Appendix C – Stormwater Quantity*), including design parameters and assumptions;
- estimates of catchment imperviousness and the basis for its derivation (*see Appendix C – Table 4.4: Runoff Coefficients)*;
- the proposed proximity of buildings to the water's edge and/or shoulder of the banks;
- clear identification of the extent of any existing and post-development river or coastal floodplains on or in close proximity to the site and overland flow paths within the site;
- secondary flow paths;
- identification of any natural or artificially created basins;
- the impact of any proposed filling or excavation on existing surface drainage pathways;
- existing services and easements;
- details of any contaminated ground or historical filling;
- notable trees, other significant vegetation and other features to be protected and retained (e.g. natural landforms, ecological protection areas);
- details of any investigations such as ground water levels, profiles, infiltration testing and effects on the environment and geological or water quality assessments.

The Timaru District Plan maps should be referenced for details on flood assessment areas, including overland flow paths, and notable trees.

5.5.3 Design records

Provide the following information to support the Design Report (*see 3.3.2*):

- details and calculations that demonstrate that levels of service required by the *TDP* will be achieved;
- detailed calculations and drawings where applying to build within a flood assessment areas, which determine the floodplain boundaries and levels relative to building floor levels (see *SMPs* and the Building Act);
- details and calculations that clearly indicate any impact on adjacent areas or catchments that the proposed works may have;
- details of a Safety in Design (SiD) assessment completed for the stormwater infrastructure designed;
- draft versions of operations and maintenance manuals for any water quantity or quality control structures;
- landscape and planting drawings complying to the approved landscape management plan.

Design checklists, to aid this process, are available in *Appendix C: Design Checklists*.

Provide the following additional information for detention basins and swales:

- the design return period;
- the design rate of discharge at each discharge point;
- the design water level;
- the design volume, where there is a storage function.

5.5.4 Construction records

Provide the information detailed for Completion Documentation (*see 2.12.2*) and for required by the *CSS* including:

- Environment Canterbury compliance monitoring reports;
- all performance test results;
- CCTV records;
- material specification compliance test results;
- compaction test results;
- subgrade test results;
- infiltration test results;
- completed Stormwater Discharge Certificate.

Provide the Council with a certificate for each pipeline tested including the date, time and pressure of the test. Provide details of the pipes in a form complying with the requirements of the *CSS*, including manufacturer, diameter, type, class, jointing and contractor who laid the pipe.

5.6 CATCHMENT MANAGEMENT PLANNING

Carry out stormwater planning on a coordinated and comprehensive catchment-wide basis. Although this is primarily the responsibility of the Council, consider catchment-wide issues at the concept design stage and comply with the catchment management plan, if one exists.

The implications of future upstream development on the site, and the cumulative effects of land development on water quality and flooding downstream, are important considerations. The larger the scale of the development the more significant the catchment management planning issues are likely to be.

Discuss any catchment management planning issues with the Council at an early stage.

5.6.1 Stormwater Management Principles

The preferred approach to managing stormwater in the Timaru District is through the use of natural soil and plant processes and topography, with the overall aim to enhance urban liveability. Water Sensitive Urban Design (WSUD) is an engineering design approach which integrates natural processes into urban design to minimise environmental degradation. The terms low impact design, sustainable urban drainage or green infrastructure all refer to similar approaches which aim to:

- Minimise impervious areas
- Manage stormwater as close to source as practical
- Preserve and utilise natural site features
- Account for biodiversity, cultural values, amenity and water quality
- Hydraulic neutrality - limit the post-development flows to the pre-development rate

In practise, the following should be applied:

- Use on-site disposal (soakage/infiltration) where practicable
- Restore any degraded or piped streams
- Maintain sufficient water flows to protect aquatic life
- Apply bio-engineering practises, which integrate plant, soil and ecological features into traditional engineering approaches
- Protect and enhance riparian vegetation
- Incorporate practises to remove contaminants from stormwater
- Store runoff and release it slowly (attenuation)

Stormwater management in the Timaru District is governed by a number of documents, including Stormwater Management Plans, Infrastructure Design Standards, National Standards such as NSZ4404, the New Zealand Building Code, with guidance also given in the District Plan.

The key measurable outcomes for stormwater management in the Timaru District refer to;

1. Stormwater Quality – achieving a specific removal rate for particular

contaminants
2. Stormwater Quantity – achieving stormwater neutrality for appropriate design events
3. Secondary Flow paths – providing safe conveyance of flows in excess of the primary system

Notwithstanding the functionality of a stormwater system, it must also consider additional values such as cultural, recreational, ecological and landscape aesthetics. The above have to be achieved in an economically sustainable manner to ensure the system is financially viable to construct and maintain through its full lifecycle.

Discharging stormwater to ground is the preferred option for quantity management. This has the advantages of reducing the overall volume of water discharged off site, managing the runoff close to the source, thereby reducing costs and resources for conveyance (pipes, swales etc). Discharging to ground can also assist in quality management though the filtering effect of soils. However, discharge to ground is not appropriate for all sites.

The following sections step through factors which influence the selection of stormwater management tools; such as size, geography, geology and land use. Furthermore, this forms the basis of the information to be provided for Certification from TDC to discharge to the reticulated network or vest a stormwater system. The completion of the Stormwater Discharge Certification Application Form is required to accompany discussions with TDC.

5.6.2 Location and size

The site location determines which Stormwater Management Area (SMA) it falls under. Maps for SMAs are provided in Appendix C. Each SMA has different characteristics which may influence how stormwater is managed in that area. These requirements are set out in the SMPs and Global Consents that accompany the SMPs.

Hazards or features onsite which may affect how stormwater is managed must also be considered. These will generally be identified within District Planning Maps. Consideration should also be given to activities, hazards and ecological receptors in the surrounding area which may affect stormwater management, such as historic or active landfills, drinking water bores, mātaitai reserves or areas of cultural significance.

The size of the site and the extent of site disturbance will also have implications. Limitations are set on the size of development from which stormwater construction-phase discharges can be accepted within global consents. The global consent relevant to the SMA will detail area limitations.

Thresholds are set in the Proposed District Plan - Stormwater Chapter[6] for areas of increased impervious surface. This refers to 'minor' developments – those where the additional impervious area is between 30 m² and 500 m² in size, and with a resultant impervious area covering less than 70 % of the site. Where the increase in impervious area is equal to or greater than 500 m², this is termed a 'major' development. Tables 3-1 and 3-2 below summarise the neutrality requirements for these two development types for different activity zones.

Table 3-1: Summary of Minor Development requirements for Stormwater Neutrality

Zone	**Residential (GRIZ, MDEZ, SZ, MPZ, RLZ)**	**Commercial (all)**	**Industrial (GIZ)**	**Other (NOZ, OSZ, SPRZ)**
Activity	>30 m² and <500 m² <70% impervious	>50 m² and <500 m²	>30 m² and <500 m²	
Stormwater Neutrality	1 in 10 year	1 in 50 year	1 in 50 year	1 in 50 year
Event Duration	1 hour	1 hour	1 hour	1 hour

Table 3-2: Summary of Major Development requirements for Stormwater Neutrality

Zone	**Residential (GRIZ, MDEZ, SZ, MPZ, RLZ)**	**Commercial (all)**	**Industrial (GIZ)**	**Other (NOZ, OSZ, SPRZ)**
Activity	>500 m²			
Stormwater Neutrality	1 in 10 year	1 in 50 year	1 in 50 year	1 in 50 year
Event Duration	24 hours	24 hours	24 hours	24 hours

Thresholds are also set in the District Plan - Stormwater Management Chapter for minimum stormwater treatment requirements. Different activity zones trigger different expectations on contaminant removal (Table 3- 3).

Table 3-3: Minimum Target Contaminant Removal Rates

Zone	**Residential (GRIZ, MDEZ, SZ, MPZ, RLZ)**	**Commercial (all)**	**Industrial (GIZ)**	**Other (NOZ, OSZ, SPRZ)**
Activity	Non-residential Activity (including roads) >30 m²	>50 m²	>30 m²	>30 m²

[6] Proposed Timaru District Plan – He Po. He Ao. Ka Awatea

First Flush	10 mm/hr 21 mm depth	10 mm/hr 21 mm depth	10 mm/hr 21 mm depth	10 mm/hr 21 mm depth
Suspended Solids	> 80 %	> 80 %	> 80 %	> 80 %
Total zinc	> 70 %	> 70 %	> 80 %	> 70 %
Total copper	> 70 %	> 70 %	> 80 %	> 70 %
Total Petroleum Hydrocarbons	> 70 %	> 70 %	> 70 %	> 70 %
Nutrients (Nitrogen, Phosphorus)	> 50 %	> 50 %	> 50 %	> 50 %

5.6.3 Effects of land use on receiving waters

Impervious surfaces and piped stormwater drainage systems associated with urban development have a major effect on catchment hydrology. Faster run-off of polluted storm flows, reduction in base flows and accelerated channel erosion and depositions alter the hydrology and adversely affect the quality of receiving waters. This in turn reduces the diversity of the aquatic biological community, unless the effects of development are managed and mitigated.

The effects of rural development on receiving waters are generally less significant where riparian margins are protected. The modification to stream hydrology is generally minor. However, any reduction in riparian vegetation increases sediment loads and nutrient concentrations are likely to reduce aquatic biodiversity.

Consult with ECAN at an early stage to identify likely adverse effects of land use on receiving waters.

5.6.4 Catchments and off-site effects

All drainage systems, including waterways, must provide for the collection and controlled disposal of surface and ground water from within the land being developed, together with run-off from upstream catchments. In designing downstream facilities, consider the upstream catchment to be fully developed and comply with any Catchment Management Plan. Consult the Council about mechanisms for assigning costs associated with off-site effects.

Ground water is a precious resource. Carry out development in a way that avoids adverse effects on ground water quality and levels. Refer to clause 4.5 - Ground Investigations (Geotechnical Requirements).

For all land development works (including projects involving changes in land use or coverage), include an evaluation of stormwater run-off changes on upstream and downstream properties. This evaluation will generally be required at the resource consent stage. Development must not increase catchment flood levels, unless any increase is negligible and can be shown to have no detrimental effects.

Investigate downstream impacts including changes in flow peaks and patterns, flood water levels, contamination levels, erosion or silting effects, and effects on the existing stormwater drainage system. Where such impacts are considered detrimental, mitigation measures (e.g. peak flow attenuation, velocity control, contamination reduction facilities) on or around the development site, or the upgrading of downstream stormwater disposal systems will be required, at the developer's expense.

Consider the impact of climate change on coastal areas, rainfall intensity, and the upstream effect on groundwater levels and flooding when designing stormwater basins and infrastructure. Refer to clause 2.5.7 - Coastal Hazards for further information. Consideration should also be given to the impact any infrastructure may have on local flora and fauna.

5.7 DRAINAGE SYSTEM DESIGN

Stormwater drainage is the total system protecting people, land, infrastructure and improvements against flooding. It consists of a primary drainage system of pipes and controlled flood plains, natural ponding areas and flow paths. These are utilised in conjunction with the setting of building levels to ensure that buildings remain free of inundation up to the minimum protection standard. Protection standards are set by the RMA, the *District Plan* and the Building Act.

The primary system that is required must cater for the more frequent rainfall events including the 10% AEP storm (new designs). The secondary system (secondary flow path) must convey over-design events without inundation hazard to house floors and building platforms at least to the 2% AEP storm, including occasions when there are blockages in the primary drainage system.

Consider the following aspects and include in the design, where appropriate:

- Te Mana o te Wai 6 principles relating to the roles of tangata whenua and other New Zealanders in the management of freshwater;
- Adherence to safety in design principles for all assets;
- size (or sizes) of the surface water drainage pipework throughout the proposed reticulation system;
- selection of appropriate pipeline material type(s) and class;
- mains layout and alignment including: route selection, topographical and environmental aspects, easements, foundation aspects, clearances and shared trenching requirements, provision for future system expansion;
- hydraulic adequacy including acceptable flow velocities;
- property service connection locations and sizes;
- seismic design - all structures must be designed with adequate flexibility and special provisions to minimise risk of damage during earthquake. Provide specially designed flexible joints at all junctions between rigid structures (e.g. reservoirs, pump stations, bridges, buildings, manholes) and natural or made ground;

- geotechnical investigations - take into account any geotechnical requirements determined under Part 4: Geotechnical Requirements;
- major reticulation and its potential for significant traffic disruption. Discuss at an early stage with Council;
- provide confirmation that ECAN Regional Policy Statement compliant habitable floor heights are achievable in a 0.5% AEP event.

5.7.1 Integrated stormwater systems to achieve the Te Mana o te Wai 6 principles

Integrated stormwater systems are both the optimum and preferred method of stormwater treatment. When these systems need to be considered, discuss their use with the Council at an early stage..

Well-designed and well-maintained integrated systems, which replicate the pre-development hydrological regime, can not only mitigate adverse environmental effects, but also enhance local amenity, water quality and ecological values. These systems are designed in accordance with Te Mana o te Wai 6 principles (see 5.2.4 – Te Mana o te Wai).

5.7.2 Secondary flow paths

Overland flow paths should be provided to convey secondary flows, in excess of the capacity of primary drainage system. Shape lots generally so that they fall towards roadways, which may be used as secondary flow paths. Secondary flow velocities must be sub-critical except where it is unavoidable on hillsides. On hillsides, convey secondary flows safely and as directly as possible into permanent open waterways.

Where secondary flow paths cannot, with good design, be kept on roads, they should be kept on public land such as accessways, parks, and reserves. Secondary flow paths over private land are the least desirable option and will require protection by legal easements.

Design secondary flow paths so that erosion or land instability caused by the secondary flows will not occur. Where necessary, incorporate special measures (armouring, reinforced turf, dissipation structures, etc.) to protect the land against such events.

In most circumstances, limit ponding or secondary flow on roads in height and velocity such that the carriageway is passable.

The secondary flow path sizing and location must be supported by adequate analysis, taking into account extreme events, to show:

- that it is of adequate capacity to cope with the anticipated flow;
- that it discharges to a location that does not detrimentally affect others and can safely dissipate via a controlled disposal system as the storm peak passes.

Consider the secondary flow path under conditions of total inlet blockage at critical culverts and other critical structures.

Avoid shaping roads to create basins with piped outlets. Where basins are created a higher level of service for the primary system may be required. The desirable standard for ponding or secondary flow on roads is that they are passable to light vehicles in the 2% AEP (annual exceedance probability) event and to 4WD vehicles in a more extreme event.

5.7.3 Location and design of basins and swales

Ponding basins are being used throughout the district as stormwater treatment and detention devices to improve water quality and to mitigate increased stormwater flows. These structures are important landscape features in public open space. Carefully consider their location, design, construction, and ongoing maintenance requirements and access to structures during the early stages of planning.

From a landscape perspective, these types of basins are often very specifically designed and managed in order to optimise their primary functions (e.g. stormwater storage capacity, soil infiltration). Design solutions should build on the features of the local landscape, features associated with the proposed development and the wider planning context. As the Council will generally take on the responsibility for these structures, it needs to have input into the design of these structures from the outset.

Co-locate basins with public open space having a similar appearance and maintenance approach (i.e. road reserves and recreation reserves with a garden approach to maintenance). Basins should not be located in areas that are being managed primarily for their ecological values (such as esplanade reserves). The management approach for ecological areas aims to support natural processes through encouraging natural regeneration with limited maintenance that focuses predominantly on managing for weed species.

Where there is co-location of stormwater features with reserves, open space or streetscapes the requirements consultation must be undertaken with Council’s Parks and Reserves Unit at the planning and design stages.

Design and construct swales and basins so that they replicate natural landforms. Avoid regular shapes, 'bathtubs' and even slopes: instead create organic, undulating landforms with sinuous inverts and mid-slope terraces. Avoid slopes that have a gradient steeper than one-in-four. Round off all tops and toes of slopes to blend imperceptibly with adjoining landforms. For safety reasons, ensure open sightlines from surrounding public and private land. Provide sufficient areas of land to achieve this land shaping and to enable public access, as well as to provide for stormwater capacity.

Refer to *Appendix B* for specific design criteria regarding the design of basins and stormwater treatment systems. Note that underdrain systems should not have topsoil detailed over the soakage media as this impedes filtration.

Council encourages preserving and adding life-containing materials such as humus in the soils of soakage basins. Soil structure and permeability can be maintained and improved by soil biological communities.

5.7.4 Design standards for new developments

Design all new stormwater and land drainage systems to design storms in accordance with *Appendix L – Rainfall Intensity*.

For the protection of buildings, design and build the stormwater system of secondary flow pathways and ponding areas so that every new building platform is above the 0.5% annual exceedance probability (AEP) risk of flooding. Include a minimum freeboard height above computed flood levels as shown in Figure 3, complying with Table 1. Any relevant building floor protection specified in the *District Plan* must also apply. Both the building platform and the floor level can be individually placed higher than these minimum levels, so long as their heights comply with the requirements of the Building Code.

Figure 3 Minimum floor levels

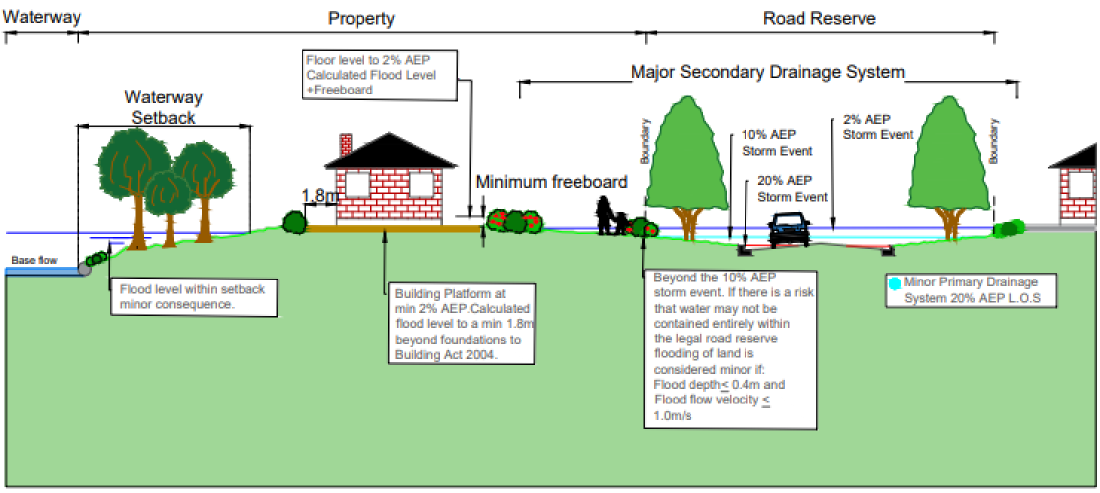

Table 1 Minimum freeboard

Building type	Minimum freeboard height (m)
Habitable building floors	0.3
Commercial and industrial buildings	To Be Determined by developer
Habitable building platforms	0.15

Note:
1) Freeboard is the provision for flood level design estimate imprecision, construction tolerances and natural phenomena (e.g. waves, debris, aggradations, channel transition and bend effects) not explicitly included in the calculations.
2) Discuss commercial and industrial developments with special circumstances with the Council.
3) In circumstances where ponded water on the crown of roads will

exceed 100mm, a greater freeboard may be required.

Discuss protection standards in tidal areas with ECAN and Council at an early stage. Storm surge and tsunami hazards, climate change and sea level rise must be considered, and a precautionary design approach is required.

5.7.5 Bridges and culverts

Design all bridges and culverts to enhance the visual qualities of the site. Bridges must have an attractive appearance. Refer to the *Bridge Manual* and *Appendix B* for waterway design at bridges and culverts.

5.7.6 Protection of road subgrade

The potential risk of carriageway damage from a saturated sub-base is a design issue. Early discussion with the Council is needed when the maximum level of detained water at the lowest point of any ponding area is higher than 200mm below any carriageway or right of way within a horizontal distance of 80 metres. Provide evidence that the road subgrade will not be compromised. Special pavement or pond design may be necessary.

5.7.7 Outfall water levels

The Council may provide the start water level at the point of connection to the public stormwater system or at some point downstream where design water levels are known, as a subdivision consent parameter.

When a tributary drain or a waterway flows into a much larger drain or a much larger waterway, the peak flows generally do not coincide. Check both the situation where the tributary has reached peak flow but the receiving waterway has not and where the receiving waterway is at peak flow but the tributary has passed it. Take the worst case as the design case.

5.7.8 Alternative technologies

Alternative technologies will be considered on a case by case basis. These may include bio-retention devices (rain gardens and stormwater tree pits) or proprietary in-line filtration devices.

Consult with Council on proposed technologies to be included in a design prior to lodging an application for Engineering Design Acceptance.

5.7.9 Stormwater pumping

Permanent stormwater pumping will only be permitted under exceptional circumstances.

5.7.10 Liquefaction

Reference Section 4: Earthworks for geotechnical design requirements.

5.8 LAND DRAIN DESIGN

Design land drains in accordance with the guidance set out in *Appendix B*.

Maintain fish and invertebrate passage, unless otherwise authorised by Council or by ECAN.

Provide access along at least one side of any land drain for maintenance, taking into account the "reach" of cleaning machinery. Maintenance access should be designed two ended or at a minimum with a turning area to reduce the likelihood of reverse manoeuvring out of any land drains.

Vegetate berms and banks and lay at slopes that are stable, not prone to scour in flood flows and maintainable.

5.8.1 Constructed land drains

Design constructed waterways to meet the aesthetic and amenity criteria of the Council (see *Appendix B*). These waterways must form part of a surface water management system.

Protect constructed waterways, which will be maintained by the Council, by easement where they will not be placed in public ownership.

5.8.2 Natural land drains

Restore the natural character and enhance amenity values of highly modified natural waterways wherever possible.

Where it is possible, avoid the piping or filling in of natural waterways. Where the activity is unavoidable, a resource consent from Council, ECAN and the National Environmental Standard for Freshwater will be required for this activity.

Provide for drainage, landscape, ecology, heritage, recreation and cultural values when enhancing these waterways. Consultation with local iwi may contribute to an understanding of the principles underpinning these values and for information about specific criteria. A landscape management plan will be required to be reviewed and accepted by Council prior to onsite work.

Create Local Purpose (Esplanade) Reserves around significant natural land drains.

5.8.3 Hill watercourses

Hill watercourses are not suitable on longitudinal slopes greater than 8%. All hill watercourses that will receive stormwater discharges from development must be stabilised with permanent materials. Permanent materials include suitably bedded and stabilised rock lined channels and pipes.

Traditional approaches to bed and bank stabilisation entail structural approaches, however, design emphasis has changed to consider a wider range of values. Approaches for stream bed stabilisation include: altering the stream bed substrate, forming riffles, runs and pools, or structural stabilisation in hillside applications. Approaches for bank protection include: bank regrading to 1 in 3 or flatter, vegetating banks with low-maintenance planting, or structural lining such as bank terracing, gabion and retaining walls.

This requirement may be waived where the development consists of a small number of residential properties whose hard surface runoff is attenuated though a suitably sized rain tank and distribution system and that discharges at least 5 metres inside the boundary of each property, such that overland flow will not be increased over the natural rate of runoff.

5.8.4 Operations and maintenance manual

Provide an Operations and Maintenance Manual in accordance with *Appendix F* and *H* for any water quantity and/or quality control structures or formed features such as ponds. The manual must describe the design objectives of the structure, describe all the major features, identify all the relevant references set out in Appendix E and identify key design criteria (including any conditions attached to the relevant resource or other consents).

A separate section must explain operations such as the recommended means of sediment removal and disposal and identify on-going management and maintenance requirements such as landscape establishment, vegetation control and nuisance control.

Submit the manual for engineering acceptance as part of the Design Report.

5.8.5 Fencing

Council approval is required for the erection of a fence across a land drain. Fences must not significantly impede flood flows up to the minimum protection standards.

5.9 STORMWATER DISPOSAL

5.9.1 Approved outfall

The discharge for a development must be authorised by ECAN. This can be achieved by conforming to the Environment Canterbury Land Water Regional Plan (LWRP), a Stormwater Management Plan obtained by the developer or complying with the conditions of the discharge consent held by Council.

The outfall for a development must be either the public stormwater drainage system or an approved alternative stormwater disposal system.

A suitable outfall and if required a dissipating structure must be constructed at the outlet to ensure no erosion occurs in the immediate vicinity of the waterway. No obstruction that will impede the natural flow may be placed in the channel.

When designing outfalls, consider:

- the surrounding land use now and in the future;
- maintenance of the outfall including its potential for siltation;
- geotechnical constraints including the site's bearing capacity, potential groundwater movement and seismic effects;
- fish passage;
- backflow prevention;
- structural design where vertical heights are over 1.5m.

CSS contains acceptable outfall details.

5.9.2 Discharge to ground

Surface water infiltration systems may be used for developments in rural areas or for developments in urban areas, if connection to the public system is not feasible and ground conditions are suitable for soakage (Refer to *Appendix B*). Carry out a geotechnical assessment when considering the large-scale use of infiltration systems.

A discharge consent may be required from ECAN for discharge to soakage.

Design and locate infiltration systems to allow easy access for maintenance. Refer to the *CSS* for guidance.

5.9.3 Stormwater tanks

Stormwater tanks on private properties can regulate stormwater discharge from connected impervious areas such as roofs, hardstand areas and driveways to achieve pre-development discharge rates to Council’s system. The Council may require a stormwater tank when:

- New subdivision creates additional impervious cover and a global attenuation system (retention pond, shared tank, etc.) is not provided;
- the public stormwater system downstream has no capacity for a new connection and it is uneconomic to upgrade it;
- direct discharge to a hill, gully or slope is likely to cause erosion.

Refer to the *District Plan* and *Acceptable Solution 1* for guidelines on sizing and configuration.

The Council may approve a request from a private property owner to install a stormwater tank for water conservation or other reasons.

5.10 RETICULATION LAYOUT

5.10.1 Topographical considerations

In steep terrain, the location of pipes is governed by topography. Gravity pipelines operating against natural fall create a need for deep installations, which can be very expensive. They can also create basins with piped outlets.

The pipe layout must conform to natural fall as far as possible. Where basins are created, provide a fail-safe outlet. At basins consideration must be given to the capacity of the downstream primary system. Greater attenuation levels for longer periods of time may be required.

5.10.2 Location and alignment of stormwater pipelines
Locate stormwater pipeline mains within the legal road (outside of live traffic lanes) or within other public land. Allow for access for construction or future maintenance.

Position pipes as follows:
- within berms and footpaths of the road reserve, under parking bays as a last option,
- within public land with the approval the Council,
- within drainage reserves,
- within private property (if unavoidable) adjacent to, and if possible parallel to boundaries.

Make crossings of roads, railway lines, creeks, drains and underground services at right angles, as far as practicable.

Allow for possible future building plans when locating proposed pipes and avoid maintenance structures within the property. This may include specifying physical protection of the pipe within or adjacent to the normal building areas or any engineering features (existing or likely) on the site e.g. retaining walls.

5.10.3 Clearances from other services or structures
Clause 9.5.3 – Typical services layout and clearances (Utilities) summarises clearances for utility services. Confirm these clearances with the network utility operators, before deciding on any utility layout or trench detail.

Locate pipes that are adjacent to existing buildings and structures clear of the “zone of influence” of the building foundations. If this is not possible, undertake a specific design covering the following:
- protection of the pipeline;
- long term maintenance access for the pipeline;
- protection of the existing structure or building.

Specify the protection on the engineering drawings.

5.10.4 Curved pipelines
The straight-line pipe is usually preferred as it is easier and cheaper to set out, construct, locate and maintain in the future.

Curved pipes must be to the manufacturer’s design and CSS and be used only where approved by the Council.

5.10.5 Building over pipelines
The Timaru District Consolidated Bylaw 2018 – section 1515.1. Building over or

adjacent to network infrastructure services defines the Council's requirements and protection for the drainage works.

5.10.6 Easements

Easements are required for constructed drains and in those instances when there are secondary flow paths through private property. Provide easements for public pipelines and public subsoil drains through private property or where private pipelines serving one property cross another.

Equation 1 Easement width

The easement width is the greater of:

- 2 x (depth to invert) + OD
- 3.0m

where OD = outside diameter of pipe laid in easement.

The easement registration must provide the Council with rights of occupation and access and ensure suitable conditions for operation and maintenance.

5.11 RETICULATION DETAILING

5.11.1 Pipeline connections

Make pipeline connections in accordance with *CSS*.

Design the stormwater drainage system as a separate system (i.e. with no inter-connections whatsoever with the wastewater system).

5.11.2 Minimum pipe sizes

The minimum diameter Council stormwater pipe to be designed is an internal diameter 225mm.

5.11.3 Minimum cover

Minimum cover is to be designed in accordance with the *CSS* and Council's Standard Drawings.

Where the minimum cover to Council's specifications is not achieved, pipelines must be adequately protected from external loadings. Council approval of the pipeline protection must be obtained.

5.11.4 Gradients and acceptable flow velocities

Minimum gradients in flat terrain should be as steep as possible to insure silt deposition does not occur. The minimum velocity should be at least 0.6 m/s at the flow of half the 50% AEP design flow. For flow velocities greater than 3.0 m/s, best management practices are to be designed into the system.

5.11.5 Structures

Design inlets and outlets in accordance with *Appendix A*. Install debris grills where blockage is a potential problem. Provide for operational requirements.

Consider the effects of inlet and tailwater controls when designing culverts.

Take backflow effects into account in design. Consider outlet design and water level conditions in the design of discharges to existing stormwater systems, drains and waterbodies and incorporate backflow prevention if necessary.

Where pipes discharge onto land or into a drain outlet, design structures to dissipate energy and minimise erosion or land instability. Ensure velocities are non-scouring at the point of discharge. Acceptable outlet velocities will depend on soil conditions, but should not exceed:

- 0.5m/s where the substrate is cohesive; or
- velocities given in *Appendix A*.

5.11.6 Manholes

Construct manholes in accordance with the *CSS*.

Manholes are chambers located at regular intervals along a pipeline to facilitate access and changes in direction. The preference is for manholes to be located in roads to enable access for maintenance.

Consult the Council before embarking on any part of the system design where the velocity is such that the flow will not progress *smoothly* through the manhole into the discharge pipe.

*Note: **Smoothly** refers to flow that is unimpeded or generating turbulence within the structure.*

Check the effects of turbulence or hydraulic grade on pressure within manholes. Where pressures may expel manhole covers, assess options to maintain public safety e.g. by installing safety grates or fixing down the manhole cover. No feature should impede flow through a manhole. Secure manholes against uplift in accordance with *CSS*.

The flow deviation angle between the inlet and outlet pipes must not be greater than 90 degrees, as shown in Figure 1 in clause 6.6.1 – Location and spacing (Wastewater). If circumstances necessitate such a feature, widen the cross section of the manhole to counteract any potential head loss. The design must be accepted by the Council.

Where a special manhole cannot be constructed with a standard riser the lid must:

- meet the *CSS* requirements for structural design, as confirmed by a Design Certificate;
- have minimum concrete strength and cover of 40 MPa and 50mm

respectively;
- conform to the geometric requirements of SD 5302, whichever is relevant.

5.11.7 Sumps
Council seeks the use of slam lock sump grates as detailed in *CSS* Standard Detail 5302 where they meet the requirements of that site. All sumps within the kerb and channel shall have a back entry as detailed in the *CSS* and the use of splay pits in high intake scenarios is a reasonable approach to mitigate ponding.

Do not locate sumps in kerb crossings. Where sumps are located in this position consider the relocation of either the sump or crossing.

Where sumps are the primary collection system, they should be spaced such that the flow draining to a single inline sump does not exceed 10 L/s, typically spaced no more than 90 metres apart. This capacity allows for partial blockage of the sump grating.

In hillside sumps, high flow velocities can cause difficulties in flow interception and erosive damage. The maximum capacity of the hillside sump is 80 L/s.

Where a manhole or sump is likely to experience differing movement from the pipeline under seismic loading, replace the yield joints with flexible joints (see *CSS* for detail). These may mitigate the potential for damage by allowing some longitudinal movement at the structure.

In applications where catchments may generate hydrocarbons or floatables, submerged outlets on sumps are preferred. Sumps on kerb and channel should be located to avoid access crossings.

5.11.8 Subsoil drains
Design subsoil drains, which are installed to control groundwater levels, in accordance with engineering best practice.

Refer to manufacturer’s literature for information on pipe materials, filter fabrics, bedding and filter design.

5.11.9 Pipelines in permeable ground
Where a buried pipeline is likely to encounter an underground source of water, ensure that the groundwater in the water bearing layers will not be diverted to a new exit point through the backfill. Specify backfill material with the same permeability as the surrounding ground and detail water migration barriers at any change of ground permeability.

5.11.10 Steep gradients
Provide adequate anchorage for the pipes, through designing thrust or anchor blocks or by utilising restrained pipe systems.

Specify water stops on all pipelines with gradients of 1:5 and steeper. Where lime stabilised fill or similar 'firm mix' fill is used for haunching, water stops are not required. *Appendix B* and the *CSS* details the design criteria to consider before installing concrete water stops, additional to those relating to permeable ground. Specify water stops constructed to comply with *CSS*.

5.12 CONNECTION TO THE PUBLIC SYSTEM

5.12.1 Individual lots and developments

The connection of individual lots and developments to the public system must meet the following requirements:

- Connection must be by gravity flow via laterals to mains or waterways, or to a roadside kerb or swale or rain tanks, or (in certain situations) on-site detention tanks;
- Provide all new urban lots with individual service laterals, located at least one metre from the top of the vehicle crossing cutdown if kerb and channel outlets;
- Each connection must be capable of serving the entire building/impervious surface area of the lot (unless approval is obtained from the Council to do otherwise);
- Provide stormwater connections at such depth at the boundary of urban lots that a drain is able to be extended from the connection, at grades and cover complying with the Building Act, to the farthest point on the lot;
- The minimum diameter of connections must be:
  - 100mm for residential lots.
  - 150mm for commercial/industrial lots.
  - 150mm for connections serving three or more dwellings or premises (unless otherwise approved by the Council);
- Where the public system is outside the lot to be served, extend a connection pipeline a minimum of 0.6m into the net site area of the lot;
- Connection to features such as vegetated swales, soakpits, or soakage basins is acceptable provided the system is authorised by ECAN or approved by Council under a Global Discharge Consent and adverse effects and potential nuisances are addressed;
- Seal all connections to pipelines or manholes by removable caps at the upstream end, until such time as they are required.

5.12.2 Connection of lateral pipelines to mains

Connections of laterals to mains must be in accordance with *CSS*.

5.13 MEANS OF COMPLIANCE

5.13.1 Surface water

Surface water hydrology must be in accordance with *Appendix C*.

5.13.2 Estimation of surface water run-off – peak flow rate
Estimation of the peak flow rate must be in accordance with *Appendix C*.

5.13.3 Estimation of surface water run-off – volume
Estimation of volumes must be in accordance with *Appendix C*.

5.13.4 Sizing of the stormwater drainage system
Drainage system hydraulics must be in accordance with *WWDG Chapter 22*.

5.13.5 Soakage systems
Design of the soakage systems must be in accordance with the associated SMA requirements and the requirements of the Canterbury Land and Water Regional Plan.

5.13.6 Pipe flow
Determine pipe diameters, flows and gradients as prescribed in *NZS 4404:2010*.

For pipes not flowing full use Manning's equation adopting 'n' values from *NZS 4404:2010*.

5.13.7 Energy loss through structures
Refer to *NZS 4404:2010* for guidance on energy loss through structures.

5.13.8 Determination of water surface profiles
Design stormwater drainage systems in accordance with *WWDG Chapter 22* and *NZS4404:2010*, by calculating or computer modelling backwater profiles from the specified outfall water level set by the Council as stated in clause 5.6.7 - Outfall water levels. On steep gradients, both inlet control and hydraulic grade line analysis must be used, and the more severe, relevant condition adopted for design purposes. For pipe networks at manholes and other nodes, water levels computed at design flow must not exceed finished ground level while allowing existing and future connections to function satisfactorily.

An example of stormwater system analysis including a backwater calculation is provided in *WWDG Part B: Appendix 5*[7].

Stormwater pipelines generally operate in a surcharged condition at full design flow. Pipe diameters chosen on the basis of pipe flow graphs, such as *NZS4404:2010* (which uses pipeline gradient rather than hydraulic gradient), are likely to be conservative in parts affected by free outfall conditions.

[7] CCC, 2020. WWDG Part B: Appendix 5, https://ccc.govt.nz/assets/Documents/Environment/Water/waterways-guide/WWDG-Appendices-June-2020.pdf

5.13.9 Stormwater quality
Design stormwater management systems to achieve quality standards in accordance with or exceeding the requirements of the Stormwater Management Plan for the catchment. Stormwater treatment must be designed to reduce the level of all contaminants with potential to be generated by the development to a level that will no longer have negative impacts on the receiving waterbody.

An effective method of removing contaminants from stormwater is to utilize a series of treatment devices to provide management of various contaminants. This combination of treatment devices established in a specified sequence is referred to as a “Treatment Train”. Refer to the *Appendix D – Stormwater Quality* and the *CSS* for further detail on devices and construction requirements.

Many treatment options involving discharges of stormwater to ground require a consent to discharge to land and/or water from ECAN. Refer to clause 5.3 - Consent and compliance issues for further information.

Ensure the design considers the ongoing maintenance requirements and costs. Specify verification through testing and commissioning that the constructed option achieves design infiltration rates, treatment levels and volumes specified.

The designer may propose alternative design elements with supporting evidence from recognised authorities.

5.13.10 Fish Passage
Land drains and stormwater systems to be designed in accordance with New Zealand Fish Passage Guidelines.

5.14 CONSTRUCTION
Construction must be carried out in accordance with *CSS*.

Wherever works are installed within existing legal roads, the developer must obtain a Works Access Permit (WAP) for that work. Apply for a Corridor Access Request (CAR) at www.beforeudig.co.nz . The works must comply with requirements as set out in *CSS* for this type of work.

5.14.1 Reducing waste
When designing the development, consider ways in which waste can be reduced:
- Plan to reduce waste during site clearance e.g. minimise earthworks, reuse excavated material elsewhere.
- Design to reduce waste during construction e.g. prescribe waste reduction as a condition of contract.
- Select materials and products that reduce waste by selecting materials with minimal installation wastage.
- Use materials with a high recycled content e.g. recycled concrete subbase.

See the Resource Efficiency in the Building and Related Industries (REBRI) website for guidelines on incorporating waste reduction in your project www.rebri.org.nz/.

5.14.2 Materials

All materials must comply with those listed in the *CSS* which provides a guide when specifying materials.

Proposed pipes and concrete structures that are likely to lie in aggressive groundwater will need specific design and additional protection such as an external plastic wrapping membrane.

5.14.3 Bedding, haunching and backfill

Design bedding, haunching and backfill to conform to clause 6.14 – Haunching and Backfill (Wastewater Drainage) including clauses 6.14.2 – Difficult Ground Conditions and clause 6.14.3 – Scour. Bedding and haunching materials must comply with *CSS* and *BRRG* and the pipe manufacturer's specifications.

Where works will produce redundant in-ground piping or manholes, specify treatment of the potential void as detailed in clause 6.14.4 – Redundant infrastructure (Wastewater Drainage).

Specify wrapping of the joints in all concrete rubber ring jointed pipes with a geotextile that complies with TNZ F/7 strength class C. Wrapping of joints is not required in *'hillside'* trenches backfilled with lime stabilised material. Select a geotextile that will prevent the infiltration of backfill or natural material into the stormwater system where pipes break under seismic loading.

Specify wrapping of the haunching for plastic pipes and laterals in liquefaction prone areas with a geotextile that complies with TNZ F/7 strength class C. This may improve the longitudinal strength of the pipeline, reducing potential alterations in grade.

Specify backfill materials individually through the layers of reinstatement. The material used must be capable of achieving the backfill compaction requirements set out in *CSS* and *BRRG*. Any deviation from the standards set in the Council *CSS* and *BRRG* will require acceptance from Council.

5.15 AS-BUILT INFORMATION

Present as-built information which complies with Part 12: As-Builts and this Part.