

8 July 2025



Christchurch City Council
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Dear Joe

Correction to Resource Consent Decision

Record Number: CRC252424
Applicant Name: Christchurch City Council
Activity Description: To discharge water and contaminants to land and water from the stormwater network.

It has come to our attention that there was an error in the above consent. As such, please destroy the document currently in your possession and replace it with the enclosed corrected decision document.

Error identified

In an email dated 1 July 2025, the applicant noted that two 'definition' pages were missing from the decision documents. These pages appeared in a previous iteration of this consent, CRC231955, but have been erroneously omitted from the decision documents for CRC252424.

Correction

A new set of decision documents has been generated with the definition pages included.

Queries

For all queries please contact our Advisory Team quoting your CRC number above.

Yours sincerely

Gabrielle Lynch
Regulatory Support Officer

RESOURCE CONSENT CRC252424

Under Section 104 of the Resource Management Act 1991

The Canterbury Regional Council (known as Environment Canterbury)

GRANTS TO:	Christchurch City Council
A DISCHARGE PERMIT (S15):	To discharge water and contaminants to land and water from the stormwater network.
COMMENCEMENT DATE:	20 Dec 2019
DATE CONSENT NUMBER ISSUED:	20 Jan 2025
EXPIRY DATE:	20 Dec 2044
LOCATION:	Global, Christchurch

SUBJECT TO THE FOLLOWING CONDITIONS:

ADVISORY NOTE - *The following conditions for the Christchurch City Comprehensive Stormwater Network Discharge Consent have been prepared according to the agreed practices of the Joint Christchurch City Council & Canterbury Regional Council Stormwater Management Protocol, Report U10/12 (the Protocol). The Protocol establishes how Canterbury Regional Council and Christchurch City Council will work together to achieve integrated catchment wide stormwater management in Christchurch. The Protocol records the understanding between Canterbury Regional Council and Christchurch City Council but does not create legal obligations that are enforceable by either party. Appendix 4 of the Protocol sets out responsibilities pertaining to compliance and operations and notes the role of the Water Issues Management (WIM) Group in any enforcement matters.*

ACTIVITY

Purpose and Location

- 1 Except where excluded under Condition (2), this consent authorises the discharge of stormwater onto or into land or into surface water which:
 - a. is generated from within the territorial boundaries of Christchurch City Council; or
 - b. enters the stormwater network from outside the Christchurch City Council boundary.

Exclusions

- 2 This consent excludes discharges:
 - a. Emanating from land within Banks Peninsula that is outside the Settlement Areas of Banks Peninsula; and
 - b. From private stormwater systems that bypass the stormwater network and discharge into the Coastal Marine Area; and

- c. Emanating from hardstand areas of non-residential existing sites discharging onto or into land via private networks unless the discharge has been previously authorised by the Christchurch City Council; and
- d. From any activity not existing at the commencement of this resource consent, re-development, or development site on the Canterbury Regional Council's Listed Land Use Register that is considered by the Christchurch City Council to pose an unacceptably high risk of surface water or groundwater contamination; and

Advice Note: *The identification of unacceptable high risk is detailed in the Transition Plan.*

- e. Emanating from any stage of a development site with a total area of disturbance exceeding 5 hectares on flatland or 1 hectare on hill land; and
- f. From any site listed on the attached Schedule (1) 'Sites excluded from the Christchurch City Council Comprehensive Stormwater Network Discharge Consent':
 - i. at commencement of this resource consent; or
 - ii. as a result of the process set out in Condition (3) below; or
 - iii. as a result of the process set out in Condition (47).

Development of Risk Matrix and Transition Plan for Excluded Sites Post 2025

- 3 Discharge into the stormwater network from the sites excluded by Conditions (2)(d), (2)(e) or (2)(f) are authorised under this consent on 1 January 2025, or when current discharge permits expire or are surrendered for those sites, whichever is the latest, unless through the transitional arrangements set out below, or through the audits described in Condition (47), the Consent Holder determines that the discharge poses an unacceptably high risk of surface water or groundwater contamination. The transitional arrangements are:
- a. Within 6 months of the commencement of this resource consent, the Consent Holder shall engage with the Canterbury Regional Council to obtain full details of all of the consented discharges excluded from this consent until 2025, including information on site activities, conditions and compliance records;
 - b. Within 30 months of the commencement of this resource consent, the Consent Holder shall draft a risk matrix to identify and rate the risk associated with each of the stormwater discharges where information has been provided under Condition (3)(a), and those discharges described in Condition (2)(d) and (2)(e). The criteria used to identify and rate the risk associated with each discharge shall be clear and objective. The risk matrix shall be developed as follows:
 - i. within 18 months of the commencement of this consent, the Consent Holder shall prepare a draft risk matrix and provide it to the Industry Liaison Group for comment;
 - ii. the Consent Holder shall invite the Industry Liaison Group to provide comment within 2 months of providing the draft risk matrix to them for comment;
 - iii. within 3 months of receiving the comment referenced in Condition (3)(b)(ii), the Consent Holder shall prepare a memo and/or revised risk matrix addressing that

- comment and circulate it to the Industry Liaison Group along with an invitation to an Industry Liaison Group meeting;
- iv. within one month of the meeting held under Condition (3)(b)(iii), the Consent Holder shall circulate minutes, including points of agreement and disagreement between the parties;
 - v. any changes to the draft risk matrix shall be provided to the Industry Liaison Group for feedback no less than 2 months prior to being submitted to Canterbury Regional Council.
- c. Within 4 years of the commencement of this consent, the Consent Holder shall provide to the Canterbury Regional Council a Transition Plan for the discharges excluded by Conditions (2)(d), (2)(e) and (2)(f) that includes, but is not limited to:
- i. a description of the regulatory methods that will be used by the Consent Holder to ensure that previously excluded discharges will be subject to standards that achieve required environmental outcomes as described in Condition (3)(e);
 - ii. the risk matrix prepared under Condition (3)(b);
 - iii. a description of site-specific monitoring plans for particular sites from which the discharge is rated high in the risk matrix;
 - iv. a description of the process that the Consent Holder will use to determine, in collaboration with Canterbury Regional Council and through engagement with affected site owners and/or operators, whether a site will remain excluded from authorisation under this consent due to its discharge posing an unacceptably high risk of surface water or groundwater contamination;
- d. If as a result of the risk matrix and process set out in Condition (3)(b) it is determined that the discharge poses an unacceptably high risk of surface water or groundwater contamination then that discharge will remain excluded from this consent and listed on the attached Schedule (1);
- e. The Consent Holder shall ensure that all other sites referred to in Condition (3)(a) are, from the date on which the discharges are authorised under this resource consent, subject to standards that result in the same or better environmental outcomes for the quality and quantity of the discharge as those that were in the relevant site specific resource consent issued by the Canterbury Regional Council.

Advice Note: *Discharge into the stormwater network will still require approval from Christchurch City Council, as owner and operator of the stormwater network, following the surrender or expiry of discharge permits for the sites noted above, or from 1 January 2025, whichever is the latest.*

Stormwater Management Plans

- 4 The Consent Holder shall, in consultation with:
- a. Papatipu Rūnanga;
 - b. The relevant Zone Committee(s) (or successor organisation);
 - c. The relevant Community Board(s) (or successor organisation);
 - d. The Department of Conservation; and

e. The CRC Regional Engineer and any relevant Rating District Liaison Committee; develop, and as necessary update, Stormwater Management Plans (SMPs) in accordance with the programme set out in Table 1 and submit each SMP to Canterbury Regional Council, Attention: Regional Leader – Monitoring and Compliance for certification that it contains the matters required by Condition (7) and is consistent with the purpose of SMPs in Condition (6).

5 SMPs shall be reviewed and submitted for certification to Canterbury Regional Council, Attention: Regional Leader – Monitoring and Compliance every 10 years from the date of the certification of the SMP, except that:

- a. The Styx SMP shall be reviewed and submitted by 20 December 2023, and then 10-yearly after its certification; and
- b. The Halswell SMP shall be reviewed and submitted by 20 December 2021, and then 10-yearly after its certification.

Table 1: SMP Programme

SMP Area	Date SMP Operative	Date Submitted to Canterbury Regional Council
Otakaro/ Avon River Area Christchurch		30 June 2024
Puharakekenui/ Styx River Area Christchurch	30 June 2014	
Huritini / Halswell River Area Christchurch	30 June 2016	
Opawaho/ Heathcote River Area Christchurch		Within 24 months of the commencement of this consent
Estuary and Coastal Area Christchurch		Within 30 months of the commencement of this consent
Otukaikino/ Outer Area Christchurch		30 June 2023
Te Pātaka o Rākaihautū / Banks Peninsula Settlements		30 July 2025

6 The purpose of the SMPs is to:

- a. Contribute to meeting the overall contaminant load reduction standards set in Condition (19) and (20);
- b. Set a contaminant load reduction target(s) for each catchment in that SMP area in order to demonstrate the commitment of the Consent Holder to the improvement of stormwater discharge quality over time;
- c. Demonstrate the means by which:
 - i. the quality of stormwater discharges will be progressively improved towards meeting the Receiving Environment Objectives and Attribute Target Levels for

waterways, coastal waters, groundwater and springs set out in the conditions of this consent and in Schedules (7) to (9); and

ii. receiving Environment Objective and Attribute Target Levels for water quantity in Schedule (10) will be met;

- d. Provide for discharge of stormwater to land infiltration systems where reasonably practicable as the means to demonstrate that stormwater contribution to groundwater and spring-fed stream flows will be maintained;
- e. Demonstrate the means by which Christchurch City Council stormwater infiltration facilities constructed by, or on behalf of, the Consent Holder, after the commencement of this consent will be designed, located and operated to avoid, remedy or mitigate adverse effects of groundwater mounding on other land in anything more frequent than the critical 2% AEP Event;
- f. Plan the works required to mitigate the effects of stormwater discharges to the extent required by this resource consent;
- g. Implement the conditions of this consent as they apply to each catchment, including the best practicable option for weed management in the Puharakekenui/Styx River as determined under Schedule (4)(w).

7 SMPs submitted to Canterbury Regional Council after the commencement of this resource consent shall include but not be limited to the information set out in Schedule (2).

8 Prior to submitting a SMP or any reviewed SMP or any amendment to a SMP to the Canterbury Regional Council, other than an amendment agreed with Canterbury Regional Council as making minor changes and corrections, the Consent Holder shall:

- a. In early development stages for a possible SMP, provide a briefing to and invite comments from the parties listed in Condition (4).
- b. Following completion of a draft SMP, provide a draft copy to the parties listed in Condition (4), inviting feedback within a time frame of not less than 40 working days:
- c. Give public notice of the draft SMP and invite written feedback within a timeframe of not less than 40 working days.
- d. Have regard to the feedback in clauses (b) and (c).
- e. Prepare a summary of feedback received, and a brief explanation of whether and how comments have been incorporated into the SMP.

9 The Consent Holder shall amend the SMPs as it considers necessary to respond to:

- a. The results of the Christchurch Contaminant Load Model (C-CLM) or MEDUSA Model and contaminant load reduction targets set within the SMPs, or any revisions thereof;
- b. The results of monitoring, including any investigations or outcomes in relation to the responses to modelling and monitoring under Conditions (56) to (59);
- c. Outcomes of investigations and trials carried out under Conditions (39) and (40) and Schedules (3) and (4);

- d. Any changes to relevant national, and/or regional planning documents including those that result from the LWRP sub-regional chapter development process;
- e. The use of new technologies, new opportunities for additional mitigation (such as for infill areas or retro-fit) or new constraints on the implementation of mitigation due to changes in developer plans; and
- f. New environmental data and research including updated international and national best practice technologies.

- 10 Any amendments to SMPs, other than those agreed with Canterbury Regional Council as making minor changes and corrections, shall not replace the previous version until the amendments have been certified by the Canterbury Regional Council as containing the matters required by Condition (7) and as being consistent with the purpose of SMPs in Condition (6). For the avoidance of doubt, any amendments shall not reduce the likelihood of meeting the Receiving Environment Objectives and Attribute Target Levels.

Implementation Plan

- 11 The purpose of an Implementation Plan is to give effect to certified SMPs and to include the matters set out in Condition (12). An Implementation Plan shall be:
- a. Prepared by the Consent Holder, through engagement with Papatipu Rūnanga under Condition (13)(a), and with the Department of Conservation, within 18 months after the commencement of this resource consent;
 - b. Updated to give effect to new, reviewed or amended SMPs within 12 months of SMPs being certified;
 - c. Reviewed by the Consent Holder every 3 years, with reference to the Christchurch City Council Long Term Plan; and
 - d. Made available to Canterbury Regional Council and Papatipu Rūnanga on request.
- 12 The Implementation Plan shall include but not be limited to:
- a. A list and map of proposed stormwater mitigation methods and devices;
 - b. A programme of stormwater works for Christchurch City Council and anticipated private development;
 - c. A plan for regulatory, investigative, educational and preventative activities or programmes relating to stormwater discharges, including activities undertaken under Conditions (39) and (40) and Schedules (3) and (4);
 - d. Details of budgets for capital works or resourcing that is linked to the Christchurch City Council Long Term Plan.

Engagement with Papatipu Rūnanga

- 13 The Consent Holder shall engage with Papatipu Rūnanga:
- a. In the development and review of the SMPs required under Conditions (4) and (8), and other amendment to SMPs, and the development of the Implementation Plan required under Conditions (11) and (12);

- b. During the planning for stormwater treatment facilities with regard to wāhi tapi and taonga;
- c. By providing six monthly reports to Mahaanui Kurataiao Ltd on stormwater developments, projects and monitoring under this resource consent;
- d. By the engagement required by Conditions (56) to (58) on responses to modelling;
- e. By providing the investigation report required by Condition (59) on responses to monitoring; and
- f. By holding an annual meeting with Mahaanui Kurataiao Ltd to discuss stormwater works under this resource consent, and Papatipu Rūnanga input predicted for the next 12 month period.

Advice Note: *The Christchurch City Council is committed to working in partnership with Papatipu Rūnanga through the implementation of the resource consent. This is aimed at achieving the goals of the resource consent and providing for the ongoing involvement of mana whenua as well as identifying and reflecting mana whenua values and interests in the management of stormwater. While the partnership approach needs to be confirmed with Papatipu Rūnanga, it may involve the establishment and resourcing of a joint CCC/Papatipu Rūnanga Stormwater Working Party along with relevant technical support involving Mahaanui Kurataiao Ltd as well as Te Rūnanga o Ngāi Tahu. It is envisioned that the working party would meet not less than annually and provide a forum for advising on resource consent implementation.*

Stormwater Technical Peer Review Panel

- 14 The Consent Holder shall establish, at its own cost, the Stormwater Technical Peer Review Panel (Stormwater TPRP), for the purpose of providing scientific and technical review of:
- a. The draft risk matrix required by Condition (3)(b) of this resource consent and any subsequent amendments of the risk matrix; and
 - b. Each Draft SMP, including those being reviewed as required under Conditions (4) and (5) of this resource consent or being amended under Condition (9), and provide technical advice to the Consent Holder as to whether it is fit for purpose and meets the requirements of Conditions (6) and (7) of this resource consent; and
 - c. The scope of the feasibility studies and investigations required by Condition (39) and Schedule (3) (actions a - h) and Condition (40) and Schedule (4) (actions d, e, j, k, r and s) of this resource consent; and
 - d. The scope of assessments and investigations required by Condition (57) of this resource consent; and
 - e. The outcomes of the feasibility studies and investigations to ensure that actions arising from them incorporate best practicable options.
- 15 The Consent Holder shall:
- a. Obtain a review of the draft risk matrix from the Stormwater TPRP, and attach a copy of the review to the draft risk matrix provided to the Canterbury Regional Council; and

- b. Obtain a review of the draft SMP from the Stormwater TPRP, attach a copy of the review to the draft SMP, and provide a description within the SMP of the Consent Holder's response to that review; and
- c. Obtain a review of the relevant feasibility study or investigation from the Stormwater TPRP, and attach a copy of the review to the relevant feasibility study or investigation provided to Canterbury Regional Council.

Advice Note: *The technical reviews under Condition (15) shall be provided by the relevant experts from the Stormwater TPRP and not the whole panel.*

- 16 The Consent Holder shall appoint independent Stormwater TPRP members with expertise which could include but not be limited to the following:
- a. Stormwater engineering and hydrological/flood modelling;
 - b. Freshwater and coastal water quality and ecology;
 - c. Hydrogeology;
 - d. Contaminated site/land management;
 - e. Erosion and sediment control; and
 - f. Mātauranga Māori and mahinga kai.
- 17 If the Stormwater TPRP does not have expertise in any of the areas which it is required to advise the Consent Holder on, it shall inform the Consent Holder who may engage the services of a suitably qualified and independent expert to advise it on the matter.
- 18 The Consent Holder shall provide any administrative support necessary for the Stormwater TPRP to carry out its functions.

Advice Note: *The Christchurch City Council intend for development of the SMPs to be a collaborative process with input from key stakeholders. During development of SMPs, Papatipu Rūnanga, CWMS Zone Committees and Canterbury Regional Council technical staff will be invited to all technical presentations and will have opportunity to review and comment on draft SMP documents. Presentations will be made at public meetings of both the Banks Peninsula and Christchurch-West Melton Zone Committees. Once all documented feedback has been considered and addressed, the finalised SMP documentation will be submitted to the Canterbury Regional Council.*

STANDARDS AND RESTRICTIONS

Stormwater Contaminant Load Modelling

- 19 The Consent Holder shall install stormwater mitigation facilities and devices that achieve the contaminant load reduction standards specified in Table 2 below as derived by the *Golder Associates (NZ) Limited 2018 Christchurch Contaminant Load Model (C-CLM) or MEDUSA Model* report which is attached to these conditions as Schedule (5).
- 20 The Consent Holder shall use best practicable options to achieve the contaminant load reduction targets specified in the SMPs derived from the C-CLM or MEDUSA or subsequent improved modelling methods and best available information.

Table 2: Reductions in stormwater contaminant load

	Contaminant load compared to no treatment as at 2018	5 years from 2018 compared to no treatment (as at 2023)	10 years from 2018 compared to no treatment (as at 2028)	25 years from 2018 compared to no treatment (as at 2043)
TSS	12 %	21 %	25 %	27 %
Total Zinc	10 %	15 %	18 %	20 %
Total Copper	16 %	23 %	28 %	30 %

- 21 The Consent Holder shall provide a report to the Canterbury Regional Council, Attention: Regional Leader, Monitoring and Compliance at five yearly intervals from commencement of this resource consent on whether the contaminant load reduction standards under Condition (19) and targets developed through the SMPs are being met.

Advice Note: The C-CLM and MEDUSA is the primary means of assessing the City-wide standards for the relative reduction in contaminant loads for copper, zinc and TSS which would enter the receiving environment as a result of the structural measures used by the Council.

Water Quality and Quantity Standards

- 22 For any development or redevelopment within a catchment which does not have a certified SMP, stormwater quality and quantity mitigation shall meet the General City conditions as specified in Schedule (6).
- 23 The Consent Holder shall use best practicable options to mitigate the effects of the discharge of stormwater on:
- Surface water quality, instream sediment quality, aquatic ecology health and mana whenua values. The extent of mitigation of effects shall be measured by the Receiving Environment Objectives and Attribute Target Levels monitoring described in Schedules (7) and (8);
 - Groundwater and spring water quality. The extent of mitigation of effects shall be measured by the Receiving Environment Objectives and Attribute Target Levels monitoring described in Schedule (9); and
 - Water quantity. The mitigation of effects shall be measured against achievement of the Receiving Environment Objective and Attribute Target Levels monitoring described in Schedule (10).

Advice Note: The requirements under Condition (23)(c) apply in addition to the Full Flood Attenuation requirement in Condition (29)(b).

- 24 The Consent Holder shall use all reasonably practicable measures to ensure that operational phase stormwater quality and quantity mitigation is implemented for all development and re-development (where required) prior to issuing certification under the relevant legislation.
- 25 The Consent Holder shall provide retrofit water quality and quantity mitigation for existing development where practicable.

- 26 Until the commencement of the targeted trial required by Schedule (4)(w), when the dry weather base flow water level in the Puharakekenui/Styx River is at or above Reduced Level 10.1m Christchurch Drainage Datum, as measured at the Lower Puharakekenui/Styx water level gauge, the Consent Holder shall ensure that the Puharakekenui/Styx River is the next river from which weed is harvested and that this will commence no later than 40 days following the measurement date.

Design of Facilities and Devices

- 27 Water quality and quantity mitigation facilities and devices shall be designed in general accordance with:
- a. The *Christchurch City Council's Waterways, Wetlands and Drainage Guide, Infrastructure Design Standard, Construction Standard Specifications, Christchurch Rain Garden Design Criteria, Christchurch Stormwater Tree Pit Design Criteria and Stormfilter™ Design Rainfall Intensity Criterion Report* or their respective successor document(s); and
 - b. Other national and international best practice design criteria adopted by the Christchurch City Council over the duration of this resource consent.
- 28 To ensure the risk of bird strike is minimised, the following design requirements shall apply to facilities within 3 kilometres of Christchurch International Airport:
- a. Stormwater infiltration basins shall fully drain within 48 hours of the cessation of a 2% AEP stormwater event;
 - b. Sufficient rapid soakage overflow capacity shall be provided to minimise the ponding of stormwater outside of the infiltration area(s); and
 - c. Landscape design shall limit attractiveness to birds through the use of suitable non-bird attracting species.
- 29 The Consent Holder shall ensure:
- a. That all stormwater quality mitigation facilities and devices servicing greenfield development after commencement of this resource consent are designed to treat the first flush; and
 - b. Within the Puharakekenui/Styx River catchment, all stormwater quantity mitigation facilities serving greenfield development discharging to surface water authorised by the Consent Holder after commencement of this consent, provide Full Flood Attenuation. 'Authorised by the consent holder' means the written authorisation given by the Consent Holder to operate under this consent.
- 30 For all water quality mitigation facilities and devices constructed after commencement of this resource consent to service re-development, or retrofit water quality mitigation facilities for existing development, the Consent Holder shall design facilities to treat as much of the first flush as reasonably practicable.
- 31 All stormwater mitigation facilities and devices constructed after commencement of this consent shall meet any other specific requirements as specified within the Implementation Plan when prepared in accordance with Condition (11).

- 32 Christchurch City Council stormwater infiltration facilities constructed after the commencement of the resource consent shall be located to maintain the following separation distances from domestic and community drinking water supply wells that exist prior to the construction of the infiltration facility:
- a. Infiltration devices that only discharge roof water from a single building or that discharge stormwater generated from an impervious area less than 2,000 square metres (including roof area), shall maintain a separation distance from any domestic and community drinking water supply well equivalent to the protection areas specified in Table S1A of Schedule (1) of the LWRP, unless, in the case of private drinking water bores, the Consent Holder has made a reticulated water supply available to the property.
 - b. Infiltration devices for larger discharges than those described in (a) above shall maintain a separation distance of 2,000 metres when located up-gradient of domestic and community drinking water supply wells, and a separation distance of 500 metres when located down-gradient or cross-gradient of domestic and community drinking water supply wells, unless, in the case of private drinking water bores, the Consent Holder has made a reticulated water supply available to the property.
 - c. Or as an alternative to (a) and (b), a shorter separation distance may be utilised based on an assessment of site specific information undertaken by the Consent Holder and certified by the Canterbury Regional Council, Attention: Regional Leader – Monitoring and Compliance that it will have a less than minor adverse effect on domestic and community drinking water supply wells.
 - d. Within 24 months of this resource consent commencing, a site-specific assessment of contamination risk and appropriate mitigation shall also be undertaken for any existing stormwater infiltration basins that do not comply with the separation distances defined in (b) above. This assessment shall be provided to the Canterbury Regional Council, Attention: Regional Leader – Monitoring and Compliance.
- 33 Christchurch City Council stormwater mitigation facilities constructed after the commencement of this resource consent shall have secondary flow paths to the downstream stormwater network.
- 34 Christchurch City Council stormwater mitigation facilities constructed after commencement of this resource consent shall include best practice features designed to capture and contain as much as reasonably practicable any spills of contaminants entering the stormwater facility.
- 35 Design of stormwater mitigation facilities serving sub-catchments greater than 20 hectares shall include computer modelling for detailed hydraulic analysis. The outlet hydrograph for the 2% AEP critical duration design storm generated by modelling of the final design for these facilities shall then be used in the water quantity model for the corresponding river catchment to demonstrate consistency with water quantity objectives in the SMP.
- 36 All Christchurch City Council stormwater mitigation facilities and devices constructed after commencement of this resource consent shall have an Operations and Maintenance Manual which shall be made available on request.

Stormwater Quality Investigations

- 37 The Consent Holder shall investigate and implement methods to improve the management of stormwater quality and assess and reduce stormwater effects on the receiving environment (Stormwater Quality Investigation Programme).

- 38 The purpose of the Stormwater Quality Investigation Programme is to:
- a. Monitor the performance of selected stormwater treatment facilities and devices;
 - b. Assess the potential for the application of new technologies and management strategies; and
 - c. Investigate using various models and techniques of water quality improvement strategies and options.
- 39 The Consent Holder shall undertake the actions set out in Schedule (3) for the investigation required by Condition (37).

Other Actions

- 40 The Consent Holder shall undertake the actions set out in Schedule (4) for the purposes of improved stormwater management through: source control methods; communication, education and awareness; and Puharakekenui/Styx River channel weed management.

Erosion and Sediment Control

- 41 The Consent Holder shall use reasonably practicable measures to ensure that a site specific Erosion and Sediment Control Plan (ESCP):
- a. Is prepared and implemented for development sites that discharge to the Council's network;
 - b. Is prepared by a suitably qualified and experienced professional prior to commencement of stripping of vegetation or earthworks;
 - c. Is prepared in accordance with the *Erosion and Sediment Control Toolbox for Canterbury* (or successor document); and
 - d. Adopts a Best Practicable Option approach.
- 42
- a. Construction-phase stormwater discharges that do not comply with a Council approved Erosion and Sediment Control Plan (ESCP) will be excluded from this consent if the consent holder considers that the site operator is not appropriately mitigating risk of sediment discharge.
 - b. Copies of ESCP's submitted to or prepared by/for the Consent Holder shall be made available to the Canterbury Regional Council on request.
- 43 The Consent Holder shall develop Sediment Discharge Management Plan (SDMP) and present it to the Canterbury Regional Council, Attention: Regional Leader –Monitoring and Compliance within twelve months of the operative date of this resource consent, for certification that it is consistent with the purpose and required content of the SDMP.
- 44 The purpose of the SDMP is to set out reasonably practicable processes and practices to be implemented to manage the discharges of stormwater from development sites into the stormwater network to mitigate adverse effects of discharges from the stormwater network on the receiving environment's water clarity and aquatic biota. The effectiveness of the processes and practices will be measured against the fine sediment and TSS Attribute Target Levels for waterways and coastal areas within Schedules (7) and (8).

- 45 The required content of the SDMP shall include, but not be limited to, the following means to achieve the purpose:
- a. A risk assessment to determine the TSS concentration trigger levels for the discharge of stormwater into the stormwater network from development sites. The risk assessment will include factors of slope, soil type, whether the discharge will be treated downstream by a Council treatment facility prior to reaching the receiving environment, and the sensitivity of the receiving environment.
 - b. In the event of a trigger level exceedance, a feedback process to identify and implement any changes to the erosion and sediment control practices in place on the development site. These may include reducing the area exposed to erosion by stabilisation or improving the efficiency of sediment laden water treatment.
 - c. A description of the process for how TSS concentration trigger levels will be included in authorisations by the Christchurch City Council for discharges into the network from individual sites.
 - d. A process for monitoring the erosion and sediment control management and sediment discharges from development sites.
 - e. Determination of a rainfall intensity which will trigger monitoring of sediment discharges from development sites into the Council's network.
 - f. Details of how records will be kept (such as site TSS concentration trigger level exceedance, compliance monitoring and enforcement action), with records made available to the Canterbury Regional Council on request.
 - g. A description of the process that the consent holder will use to determine how a development site shall be excluded from authorization under this consent due to it failing to comply with Condition (42)(a).
- 46 The Consent Holder may review and amend the SDMP so as to better achieve the purpose of the SDMP and in response to any updates to the relevant Attribute Target Levels. Any amendments to the SDMP shall not replace the previous version until the plan has been certified by the RMA Compliance and Enforcement Manager of the Canterbury Regional Council as being consistent with the purpose and required content of the SDMP.

Industrial Site Management

- 47 The Consent Holder shall, in collaboration with the Canterbury Regional Council:
- a. Maintain a desktop-based identification of industrial sites that ranks sites for risk relative to stormwater discharge and identifies the industrial sites that pose the highest risk;
 - b. Audit at least 15 sites per year, of which at least 10 are sites agreed with the Canterbury Regional Council;
 - c. Vary the annual number of site audits in Condition (47)(b) if agreed by the Canterbury Regional Council under Schedule (4)(l);
 - d. Inform the site owner and operator and notify the Canterbury Regional Council, Attention: Regional Leader– Monitoring and Compliance if the audit process and monitoring of a site determines that the site presents an unacceptably high risk to the receiving environment.

- 48 If the Consent Holder considers, following further engagement with the site operator and the Canterbury Regional Council, that the site is not appropriately mitigating that unacceptably high risk, the Consent Holder may, upon agreement with Canterbury Regional Council, add the site to Schedule (1).

MONITORING AND REPORTING

Environmental Monitoring Programme

- 49 The Consent Holder shall implement the EMP attached to this consent, with the purpose of monitoring whether the Receiving Environment Objectives and Attribute Target Levels are being met.
- 50 The Consent Holder may review and amend the EMP for the purposes of improved monitoring and/ or to better determine whether the Receiving Environment Objectives and Attribute Target Levels are being met.
- 51 Any amendments to the EMP shall not replace the previous version until the EMP has been certified by the Canterbury Regional Council, Attention: Regional Leader – Monitoring and Compliance as complying with the requirements of Condition (49).
- 52
- a. The Attribute Target Levels in Schedule (7) for hardness modified copper, lead and zinc concentrations in Banks Peninsula surface water shall be calculated for each monitored waterway following the collection of one year of monitoring data.
 - b. Hardness modified values for copper, lead and zinc for all surface water monitoring sites (including Banks Peninsula sites) within the EMP shall be reviewed every five years, with the first review being undertaken within 2 years of the commencement of this resource consent.
 - c. Hardness modified values shall be calculated using the *ANZECC (2000)* methodology outlined in the EMP. Should a new method of modifying metal concentrations become appropriate, this new methodology and any subsequent change in Attribute Target Levels shall be applied. Updated values shall be incorporated into the certified EMP as an amendment, in accordance with Condition (50).
- 53 The Attribute Target Levels in Schedules (7) to (8) are taken from relevant regional and national guideline levels. Should these guideline levels be updated, upper limit concentrations in the Attribute Target Levels shall be updated to reflect this. Updated values shall be incorporated into the certified EMP as an amendment, in accordance with Condition (50).
- 54 The Attribute Target Levels in Schedules (7) and (8) for the Waterway Cultural Health Index, Marine Cultural Health Index and State of Takiwā scores shall be developed in collaboration with Papatipu Rūnanga by 30 March 2023. The associated mana whenua values monitoring sites and methodology in the EMP shall be developed for each catchment, in collaboration with Papatipu Rūnanga, prior to the first monitoring round, in accordance with the schedule in Appendix D of the EMP. Updated Attribute Target Levels, sites and methodology shall be incorporated into the certified EMP as an amendment, in accordance with Condition (50).
- 55 The water quantity/flood model(s) for the Puharakekenui / Styx, Otakaro / Avon, Opawaho / Heathcote and Huritini / Halswell Rivers shall be updated as necessary to reflect changes in development patterns or modelling parameters at least every 5 years following the

commencement of this resource consent. The results of model updates and a description of how they demonstrate compliance with Schedule (10) shall be included in the annual report required under Condition (61) on a 5-yearly basis following commencement of this resource consent.

Responses to Contaminant Load Modelling

- 56 Where the modelling results reported in accordance with Condition (21) show that the percentage contaminant reductions required by the standards in Table 2 in Condition (19), and/or by the targets derived under each catchment-specific SMP are not met, the Consent Holder shall undertake the following:
- a. Investigate the reasons for not achieving the modelled contaminant load reductions and describe what measures will be implemented (if necessary) to improve stormwater discharge quality;
 - b. Assess whether best practicable options to mitigate the adverse effects of stormwater have been carried out;
 - c. If the assessment in (b) determines that best practicable options have not been carried out, assess options for correction / remediation to mitigate any adverse effects, and provide a timeline for the implementation of correction / remediation options (if necessary); and
 - d. Submit a report to Canterbury Regional Council, Attention: Regional Leader – Monitoring and Compliance and Papatipu Rūnanga (via Mahaanui Kurataiao Ltd), detailing the matters set out in (a) to (c) above.

Responses to Flood Modelling

- 57 Where the flood modelling results show that the attribute target levels in Schedule (10), and/or water level reductions or tolerances for increases for the critical 2% and 10% AEP events set in SMPs, are not met, the Consent Holder shall:
- a. Investigate the reasons for not achieving the attribute target levels within Schedule (10) and/or the water level reductions or tolerances for the critical 2% and 10% AEP events set in SMPs, and describe what measures will be implemented (if necessary) to meet the attribute target levels within Schedule (10) and/or the water level reductions or tolerances in the SMPs. The investigation will include, but not be limited to, whether the state of waterways, including changes to channels, obstructions and sedimentation, is causing or contributing to the non-achievement;
 - b. Assess whether best practicable options to avoid or mitigate the adverse effects of flooding have been carried out;
 - c. If the assessment in (b) determines that best practicable options have not been carried out, assess options for correction / remediation to mitigate any adverse effects, and provide a timeline for the implementation of correction / remediation options (if necessary). The options to be assessed will include waterway maintenance and remediation; and
 - d. Submit a report to Canterbury Regional Council, Attention: Regional Leader – Monitoring and Compliance, and Papatipu Rūnanga (via Mahaanui Kurataiao Ltd), detailing the matters set out in (a) to (c) above.

- 58 If, upon submittal of the report, where required by Condition (56) or (57), agreement between Christchurch City Council and Canterbury Regional Council cannot be reached regarding any aspects, the Consent Holder shall consult with the WIM group, or successor group, in accordance with the Joint Christchurch City Council and Canterbury Regional Council Stormwater Management Protocol or subsequent revisions to the Protocol, and in accordance with any agreements entered into between the Consent Holder and Papatipu Rūnanga; and implement any actions or changes identified as necessary by the WIM group, or successor group, through the consultation.

Advice Note: *Discussions should be undertaken with the Canterbury Regional Council prior to and following investigations, to try to establish agreed approaches prior to submitting the report.*

Responses to Monitoring

- 59 If the monitoring results identify that the TSS, copper, lead and zinc Attribute Target Levels in surface water, as set out in Schedules (7) and (8), and Escherichia coli, copper, lead and zinc in groundwater, as set out in Schedule (9), are not being met, the Consent Holder shall:
- a. Engage with the Canterbury Regional Council about conducting an investigation into whether this is due to the effects of stormwater discharges authorised under this resource consent, with site investigations prioritised for areas with high levels of contaminants, or with sensitive or high value receiving environments;
 - b. Carry out an investigation if required under Condition (59)(a) and compile the results of such an investigation into a report to be submitted to the Canterbury Regional Council and Papatipu Rūnanga (via Mahaanui Kurataiao Ltd);
 - c. Include in the report, at a minimum:
 - i. An evaluation of whether the monitoring results are due to stormwater discharges authorised under this resource consent or not;
 - ii. An assessment of options for correction/remediation if effects are likely due to stormwater discharges authorised under this resource consent;
 - iii. A timeline of implementation of corrective action/remediation if effects are a result of discharges authorised under this resource consent;
 - d. If, upon submittal of the above report, agreement between Christchurch City Council and Canterbury Regional Council cannot be reached regarding any aspects of the report referenced in (c) above, the Consent Holder shall consult with the WIM group, or successor group, in accordance with the Joint Christchurch City Council and Canterbury Regional Council Stormwater Management Protocol or subsequent revisions to the Protocol, and in accordance with any agreements entered into between the Consent Holder and Papatipu Rūnanga and implement any actions or changes identified as necessary by the WIM group, or successor group, through the consultation;
 - e. The sites triggering an investigation for a given monitoring year shall be identified in the annual report referred to in Condition (61), and the subsequent investigation report shall be provided with the following annual monitoring report twelve months later; and
 - f. Implement any actions or changes identified as necessary by the WIM group, or successor group, through the consultation under (d) above.

Advice Note: *Discussions should be undertaken with the Canterbury Regional Council prior to and following investigations, to try to establish agreed approaches prior to submitting the report.*

Reporting

- 60 The Consent Holder shall maintain relevant records including, but not limited to, detailed design drawings and reports, details of site-specific assessments undertaken, maps and any engineering design and construction certificates issued for any water quality or quantity mitigation facilities constructed. These records are to be made available to Canterbury Regional Council on request.
- 61 The Consent Holder shall provide a report to the Canterbury Regional Council, Attention: Regional Leader – Monitoring and Compliance, Banks Peninsula and Christchurch-West Melton Zone Committees, and Papatipu Rūnanga (via Mahaanui Kurataiao Ltd) by 30 June every two years following the previous two calendar years reported on. The first of these reports shall be submitted in 2026 and shall cover 2024 and 2025 calendar years. This report shall also be made available on the Christchurch City Council website and shall include, where appropriate:
- a. A summary of the outcomes of monitoring, investigations and other actions, in accordance with Conditions (23), (39), (40), (49), (54), and the 5-yearly report required under Condition (55). This summary shall be presented in such a way as to assess compliance with the resource consent conditions and trigger the responses required;
 - b. A summary of the C-CLM or MEDUSA results and contaminant load reduction targets set within SMPs, including any amendments to the model and consequential changes to expected contaminant load reductions;
 - c. A summary of any discussions, consultation or responses carried out under Conditions (56) - (59);
 - d. A summary of Canterbury Regional Council records of consent compliance and where any non-compliances of this resource consent occurred;
 - e. A summary of flood modelling results (if applicable) for development in greenfield areas;
 - f. Any updates to Schedule (1);
 - g. An update on the timetable for construction and activation of Christchurch City Council stormwater mitigation systems for each SMP area, and/or any changes to the implementation of SMP requirements;
 - h. Records of developments authorised under this consent;
 - i. Report on any collaboration with Papatipu Rūnanga and any activities relating to the protection or enhancement of mana whenua values;
 - j. A summary of the stormwater quality investigations undertaken during the year;
 - k. A summary of any additional monitoring or investigations undertaken beyond those specified in the EMP, including those undertaken on industrial sites in accordance with Condition (47), that have been initiated to inform the Consent Holder on stormwater management effectiveness;
 - l. Reporting of the alignment of the consent with the Christchurch-West Melton sub-regional section of the Canterbury LWRP;
 - m. Any changes to the regulatory framework that may warrant changes to the SMPs; and

- n. Any complaints or observations received by the Consent Holder regarding spring flow and/or quality.

Administration

- 62 The Consent Holder shall engage with Papatipu Rūnanga to collaboratively consider the conditions of this consent on a 5-yearly basis from the date of granting of this resource consent.
- 63 The Canterbury Regional Council may, on any of the last five days of March or September each year, serve notice of its intention to review the conditions of this resource consent for the purposes of:
 - a. Dealing with any adverse effect on the environment which may arise from the exercise of this resource consent;
 - b. Complying with the requirements of a relevant rule in an operative regional plan;
 - c. Achieving consistency of this resource consent in regard to catchment management planning and stormwater management with the provisions of the Christchurch--West Melton Sub-regional Section of the Canterbury LWRP within five years of the notification of the sub-regional section;
 - d. Providing alternative Receiving Environment Attribute Target Levels for water quantity;
 - e. Ensuring that improvements of the quality of the stormwater discharge occur over the duration of this resource consent to reduce any adverse effect on the environment;
 - f. To provide alternative standards for the expected city-wide percentage contaminant load reductions in Condition (19), or targets for the contaminant load reductions set within SMPs that become apparent through the C-CLM or alternative methods developed by the Consent Holder.
- 64 Prior to the exercise of this resource consent, the following resource consents shall be surrendered:
 - a. CRC120223; and
 - b. CRC131249.
- 65 If this resource consent is not given effect to before 30 June 2024, then it shall lapse in accordance with Section 125 of the Resource Management Act 1991.

Issued at Christchurch on 20 January 2025

Canterbury Regional Council

Definitions

For the purpose of this consent the following definitions and abbreviations apply to all conditions:

Annual Exceedance Probability (AEP) is the chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a peak flood discharge of 40 cubic metres per second has an AEP of 2%, it means there is a 2% chance (i.e., one-in-fifty) of a peak flood discharge of 40 cubic metres a second or larger being equalled or exceeded in any year. AEP is the inverse of return period expressed as a percentage.

Area of disturbance means an area where site clearance or earthworks are actively taking place and where the land has not been stabilised.

Banks Peninsula means the area within Banks Peninsula as defined by the operative Christchurch District Plan (or successor).

Best Practicable Option is as defined under the Resource Management Act 1991.

Christchurch Contaminant Load Model (C-CLM) means the Golder Associates (NZ) Ltd 2018 Christchurch Contaminant Load Model (C-CLM). The C-CLM report is attached to these conditions as Schedule 5.

Critical duration means the time taken during a storm event for peak water levels to be reached in the receiving waters.

Design storm is the theoretical rainfall event that an analysis is based on for a particular probability. The design storm is based on certain assumptions, including rainfall distribution and intensity, and the storm rainfall profile shape for the critical duration.

Development site means any individual area within a site or sites that is undergoing construction and/or earthworks activities but excludes sealed pavement repair where base course is not exposed.

Device means a street or property-scale installation for the purpose of removing contaminants from stormwater in a situation where storage capacity is limited. Examples include a rain garden or a proprietary treatment system.

EMP means Environmental Monitoring Programme.

Existing site means any site that discharges its stormwater into the stormwater network at the date of commencement of this resource consent.

Extra-Over Detention means attenuating sufficient stormwater to control peak flow rates from a developed site back to pre-developed flow rates for storms up to and including the critical 2% AEP design storm event.

Facility means a constructed method of holding or attenuating stormwater, at a larger scale than a device, for the purpose of reducing discharge rates or removing contaminants.

Examples include a sedimentation basin, a constructed wetland, a wet pond, an attenuation basin and/or an infiltration basin.

First flush means either:

- (a) The stormwater runoff generated from the first 25 millimetres of rain falling on impervious areas of a site; or
- (b) The stormwater flow rate generated from up to 5mm/hr rainfall intensity on impervious areas of a site; or
- (c) The stormwater runoff generated from the first 20 millimetres of rain falling on impervious areas of a site discharging to rain gardens or tree pits.

Flat land means any land where the average slope across the site is 5 degrees or less.

Full Flood Attenuation for the Pūharakekenui/Styx River Catchment means a design of a stormwater quantity mitigation facility which captures the stormwater generated from a 2% AEP storm of 48 hours duration assuming predicted rainfall increase due to climate change over the next 100 years, with controlled release of that captured stormwater over a minimum of 96 hours from full, such that the resulting discharge flow rates from the contributing catchment(s) do not exceed predicted flow rates immediately prior to development for storms up to and including the 2% AEP storm of 48 hours duration.

Greenfield means agricultural, forest or grass land that is to be used for urban purposes, for example construction of residential or industrial subdivision, buildings, roads and associated services.

High-use site means a site that:

- (a) has an expected average daily traffic (ADT) count equal to or greater than 250 vehicles per day; or
- (b) is used for petroleum storage or transfer in excess of 5,000 litres per year, not including delivered heating oil; or
- (c) is used for storage or maintenance of 10 or more heavy vehicles (trucks, buses, trains, heavy equipment, etc.).

Hill land means any land where the average slope across the site exceeds 5 degrees.

Industrial site means:

- (a) Any premises used for the manufacturing, assembly, wholesaling or storage of products or the processing of raw materials and other ancillary activities; or
- (b) Any premises used for the storage, transfer, treatment, or disposal of waste materials or for other waste-management purposes, or used for composting organic materials; or
- (c) Any other premises from which a contaminant is discharged in connection with any industrial or trade process - but does not include any land under agricultural production.

Industry Liaison Group means a group of representatives from various industries, which will include the Oil Industry Environmental Working Group, Lyttelton Port Company and Ravensdown Limited, invited by Christchurch City Council to attend an annual meeting to discuss stormwater discharges under this resource consent.

LWRP means Canterbury Land and Water Regional Plan.

Papatipu Rūnanga means the six Ngāi Tahu Papatipu Rūnanga within the Christchurch area, namely: Te Ngai Tūāhuriri Rūnanga, Te Hapū o Ngāti Wheke/ Rāpaki Rūnanga, Te Rūnanga o Koukourārata, Ōnuku Rūnanga, Wairewa Rūnanga, and Te Taumutu Rūnanga, as represented by Mahaanui Kurataiao Ltd or its successor organisation.

Partial Detention means storage within first flush basins plus additional storage through flooding of wetland areas to an average depth of 500mm discharging over a minimum of 96 hours for the critical 2% AEP design storm event.

QMCI means Quantitative Macroinvertebrate Community Index.

Re-development means a change to a developed site or a site activity that results in a stormwater discharge that has the potential to increase the scale, intensity or contaminant content of the discharge that existed prior to the commencement of this resource consent.

River Care Liaison Group means a group of representatives from organisations with a particular interest in the protection and restoration of the natural environment of the Christchurch rivers and their tributaries including wetlands, and that are invited by Christchurch City Council to attend an annual meeting to discuss stormwater discharges under this resource consent.

Settlement Areas of Banks Peninsula means those areas within Banks Peninsula that are within the following zones, or equivalent zones if they are renamed, under the Christchurch District Plan:

- Residential Banks Peninsula
- Residential Small Settlement
- Residential Large Lot
- Commercial Banks Peninsula
- Open Space Metropolitan Facilities
- Specific Purpose (Lyttelton Port)
- Industrial General
- Specific Purpose (School)
- Specific Purpose (Cemetery)
- Open Space Community Parks
- CCC owned and operated stormwater network within Papakāinga/Kainga Nohoanga Zones
- CCC owned and operated roads within Transport Zones

Site means an allotment title or other legally defined parcel of land held in a single certificate of title and any balance land or adjacent land with title(s) held by the same owner or ownership with an affiliated interest. In the case of greenfield and re-development, site means the area of land defined by the boundaries of proposed land disturbance.

SMP means Stormwater Management Plan.

Stabilised means an area of land sufficiently covered by erosion-resistant material such as grass, mulch, weed matting, bark, sand/aggregate, or paving by asphalt, concrete, paver blocks, etc., in order to prevent erosion of the underlying soil.

Stage of development means a part of a development area which is completed prior to any other stage of that development commencing. A stage of development is deemed to be finished following the completion of construction activities and when the development area has been stabilised.

Stormwater means runoff water and entrained contaminants arising from precipitation on the external surface of any structure or any land modified by human action, and that has been channelled, diverted, intensified or accelerated by human intervention. Stormwater excludes discharges of groundwater, spilled or deliberately released hazardous substances and/or wash down activities.

Stormwater network means a network owned or operated by the Christchurch City Council of pipes, swales, drains, kerbs and channels that collects stormwater, and includes any device or facility owned or operated by the Christchurch City Council for the treatment of stormwater, prior to a discharge to land, groundwater or surface water. Stormwater network excludes any system that has been constructed for the primary purpose of collection, conveyance or discharge of groundwater.

Sub-catchment means part of a catchment.

Surface water means water in rivers, watercourses and artificial waterbodies, lakes, wetlands, springs, or coastal waters, but excludes groundwater and atmospheric water.

TSS means Total Suspended Solids.

WIM means the Water Issues Management Group, or its successor. The WIM is a forum of senior managers of Christchurch City Council and Canterbury Regional Council established to meet the outcome of on-going communication as detailed in the 'Joint Christchurch City Council and Environment Canterbury Stormwater Management Protocol (March 2006, Revised September 2008 and November 2010) .

References

ANZECC (Australian and New Zealand Environment and Conservation Council, ANZECC, and Agriculture and Resource Management Council of Australia and New Zealand, ARMCANZ), 2000. Australian and New Zealand guidelines for fresh and marine water quality. Volume 1: The guidelines. ANZECC & ARMCANZ, Artarmon, New South Wales.

ANZECC (Australian and New Zealand Environment and Conservation Council, ANZECC, and Agriculture and Resource Management Council of Australia and New Zealand, ARMCANZ) (2018). Australian and New Zealand guidelines for fresh and marine water quality. ANZECC & ARMCANZ, Artarmon, New South Wales.
<http://www.waterquality.gov.au/anz-guidelines>. Accessed 22 November 2018.

Christchurch City Council & Canterbury Regional Council 2014. Memorandum of Understanding for Stormwater Discharges in Christchurch City.

Crowe, A. & Hay, J. 2004. Effects of fine sediment on river biota. Report No. 951, prepared for Motueka Integrated Catchment Management Programme. Cawthron Institute, Nelson.

Harding, J.S., 2005. Impacts of metals and mining on stream communities, in Metal Contaminants in New Zealand, T.A. Moore, A. Black, J.A. Centeno, J.S. Harding & D.A. Trumm (Editors), p. 343-357. Resolutionz press, Christchurch.

Ryan, P.A., 1991. Environmental effects of sediment on New Zealand streams: a review. New Zealand Journal of Marine and Freshwater Research 25: 207-221.

Schedule 1: Sites Excluded from the Comprehensive Stormwater Network Discharge Consent

Sites excluded from the South West SMP Area

Street Address	Street Number	Legal Description	CCC Prupi
Alloy Street	2	Lot 2 DP 64248	704537
Ballarat Way	2	Lot 1 DP 466471	618251
Ballarat Way	10	Lot 2 DP 466471	618252
Blenheim Road	412	Part Lot 3 DP 15178	466207
Blenheim Road	4/455	Lot 1 DP 489573	923053
Branston Street	96	Lot 2 DP 352288	587825
Canterbury Street	7	Lot 10 DP 2899, Lot 9 DP 2899, Lot 11 DP 2899, Lot 12 DP 2899, Lot 1 DP 21916	716119
Carmen Road	106G	Lot 3 DP 338441	582584
Chappie Place	17	Lot 1 DP 443257	908779
Halswell Junction Road	515	Lot 2 DP 358423, Lot 3 DP 358423	587860, 587861
Hayton Road	115	Lot 3 DP 353897	585855
Hayton Road	137	Lot 2 DP 343321	584430
Hayton Road	79 & 79A	Lot 1 DP 481286, Lot 2 DP 481286	924341, 924342
Main South Road	222	Lot 1 DP 14716, Lot 1 DP 51993	750576
Main South Road	243 & 245	Pt Lot 2 DP 6604, RS 39034, Lot 1 DP 78344, Lot 2 DP 78344	516213, 520964, 408547, 510731
McAlpine Street	18	Lot 8 DP 36831	429004
McAlpine Street	67	Lot 9 DP 30936	428578
Parkhouse Road	59	Lot 1 DP 25818	485608
Springs Road	254	Lot 1 DP 358423	587859
Waterloo Road	60	Lot 1 DP 80063	407540
Wigram Close	15	Lot 1 DP 51889, Lot 2 DP 324467	504628, 579847
Wigram Road	120	Lot 2 DP 493335	625647
Wigram Road	122	Lot 4 DP 475888	621028
Wigram Road	120A	Lot 1 DP 493335	625646
Wilmers Road	10	Lot 4 DP 20669	817675
Wilmers Road	50	Lot 5 DP 447519	615860
Partial Site Exclusions			
Street Address	Street Number	Legal Description	CCC Prupi
Carmen Road	112	Section 27 SO 459717	629404
Halswell Junction Road	600	Lot 7 DP 404845	609872
Harvard Avenue	45	Lot 1 DP 81480	565026
Main South Road	282	Lot 10 DP 1391	750597

Sites excluded from the Pūharakekenui/Styx SMP Area

Street Address	Street Number	Legal Description	CCC Prupi
Barnes Road	79-87	Lot 1 DP 346683	586324
Belfast Road	30	Lot 2 DP 37063	425217
Broughs Road	6	LOT 15 DP 36871	814749
Broughs Road	7	LOT 2 DP 36871	714473
Broughs Road	15	LOT 3 DP 36871	804901
Broughs Road	23	LOT 4 DP 36871	874832
Cavendish Road	150	Lot 2 DP 401108	609557
Cavendish Road	158	Lot 1 DP 360822	587685
Dickeys Road	13	Pt Lot 1 DP 23890, Lot 1 DP 25116	437651, 438723
Export Avenue	1	LOT 6 DP 83863	861839
Export Avenue	2	LOT 2 DP 304904	861835
Export Avenue	3	LOT 5 DP 83863	861838
Export Avenue	6	LOT 3 DP 83863	861836
Export Avenue	8	LOT 4 DP 83863	861837
Johns Road	480	Sec 62 SO 460822	620075
Johns Road	530	PT LOT 1 DP 51000	870081
Johns Road	544	PT LOT 1 DP 23615	857821
Johns Road	550	Sec 8 SO 494743, Sec 21 SO 494743	628638, 628647
Johns Road	568	LOT 2 DP 51000	832492
Johns Road	600	PT RS 40862	870083
Logistic Drive	10	LOT 10 DP 375764	891559
Logistic Drive	11	LOT 9 DP 375764	891558
Logistic Drive	12	LOT 1 DP 412022	900821
Logistic Drive	14	LOT 12 DP 375764, LOT 2	900822
Logistic Drive	15	LOT 8 DP 375764	891557
Logistic Drive	16	LOT 13 DP 375764	891562
Logistic Drive	17	LOT 7 DP 375764	891556
Logistic Drive	18	LOT 100 DP 412877	900774
Logistic Drive	19	LOT 6 DP 375764	891555
Logistic Drive	20	LOT 101 DP 412877	900775
Logistic Drive	21	LOT 5 DP 375764	891554
Logistic Drive	23	LOT 4 DP 375764	891553
Logistic Drive	24	LOT 102 DP 412877	900776
Logistic Drive	25	LOT 3 DP 375764	891552
Logistic Drive	26	LOT 103 DP 412877	900777
Logistic Drive	27	LOT 2 DP 375764	891551
Logistic Drive	28	LOT 104 DP 412877	900778
Logistic Drive	29	LOT 1 DP 375764	891550
Logistic Drive	31	LOT 17 DP 375764	891566
Logistic Drive	15L	LOT 19 DP 375764	891573
Logistic Drive	29L	LOT 20 DP 375764	891574
Lower Styx Road	361	Lot 1 DP 508689	629529
McLeans Island Road	2	LOT 16 DP 375764	891565
McLeans Island Road	12	LOT 15 DP 375764	891564
McLeans Island Road	14	LOT 1 DP 304904	865337

McLeans Island Road	16	LOT 2 DP 79639	754142
Nathan Place	1	PT LOT 2 DP 55072	870082
Nathan Place	7	LOT 3 DP 55072	864585
Nathan Place	11	LOT 1 DP 70619	864584
Radcliffe Road	301	Lot 4 DP 313448	584569
Sawyers Arms Road	527	LOT 1 DP 55072	836526
Sawyers Arms Road	530	PT LOT 1 DP 51000	870081
Sawyers Arms Road	533	LOT 1 DP 45800	858525
Sawyers Arms Road	540	LOT 1 DP 36870	817420
Sawyers Arms Road	565	LOT 2 DP 64781	771301
Sawyers Arms Road	575	LOT 1 DP 64781	771302
Spencerville Road	25	Lot 2 DP 53987	419068
Turners Road	50	Lot 3 DP 83312	568085
Wairakei Road	656	Lot 1 DP 6411	414964

Schedule 2: Condition 7 - Matters to be included within SMPs

- (a) Specific guidelines for implementation of stormwater management to achieve the purpose of SMPs;
- (b) A definition of the extent of the stormwater infrastructure, that forms the stormwater network within the SMP area for the purposes of this consent;
- (c) A contaminant load reduction target(s) for each catchment within that SMP area and a description of the process and considerations used in setting the contaminant load reduction target(s) required by Condition 6(b) using the best reasonably practicable model or method and input data;
- (d) A description of statutory and non-statutory planning mechanisms being used by the Consent Holder to achieve compliance with the conditions of this consent including the requirement to improve discharge water quality. These mechanisms shall include:
 - (i) Relevant objectives, policies, standards and rules in the Christchurch District Plan;
 - (ii) Relevant bylaws; and
 - (iii) Relevant strategies, codes, standards and guidelines;
- (e) Mitigation methods to achieve compliance with the conditions of this resource consent including the requirement to improve discharge water quality under Condition 23, and to meet the contaminant load reduction targets for each catchment as determined through the SMPs and the standards for the whole of Christchurch set in Condition 19. These methods shall include:
 - (i) Stormwater mitigation facilities and devices;
 - (ii) Erosion and sediment control guidelines;
 - (iii) Education and awareness initiatives on source control systems and site management programmes;
 - (iv) Support for third party initiatives on source control reduction methods;
 - (v) Prioritising stormwater treatment in catchments: that discharge in proximity to areas of high ecological or cultural value, such as habitat for threatened species or Areas of Significant Natural Value under the Regional Coastal Environment Plan (Canterbury Regional Council, 2012); and areas with high contaminant loads;
- (f) Locations and identification of Christchurch City Council water quality and water quantity mitigation facilities and devices; including a description and justification for separation distances between mitigation facilities or devices and any contaminated land;
- (g) Identification of areas planned for future development and a description of the Consent Holder's consideration to retrofit water quality and quantity mitigation for existing catchments through these developments where reasonably practicable;
- (h) Identification of areas subject to known flood hazards;
- (i) A description of how environmental monitoring and assessment of tangata whenua values have been used to develop water quality mitigation methods and practices;
- (j) Results from and interpretation of water quantity and quality modelling, including identification of sub-catchments with high levels of contaminants;
- (k) Mapping of existing information from Canterbury Regional Council and the Consent Holder showing locations where discrete spring vents occur;
- (l) Consideration of any effects of the diversion and discharge of stormwater on baseflow in waterways and springs and details of monitoring that will be undertaken

of any waterways and springs that could be affected by stormwater management changes anticipated within the life of the SMP;

- (m) A cultural impact assessment;
- (n) A summary of outcomes resulting from any collaboration with Papatipu Rūnanga on SMP development;
- (o) An assessment of the effectiveness of water quality or quantity mitigation methods established under previous SMPs and identification of any changes in methods or designs resulting from the assessment;
- (p) Assessment and description of any additional or new modelling, monitoring and mitigation methods being implemented by the Consent Holder;
- (q) A summary of feedback obtained in accordance with Condition 8 and if / how that feedback has been incorporated into the SMP;
- (r) If the Consent Holder intends to use land not owned or managed by the Consent Holder for stormwater management, a description of the specific consultation undertaken with the affected landowner;
- (s) Identification of key monitoring locations in addition to those identified in Schedule 10 where modelled assessments of water levels and/or volumes shall be made. For all monitoring locations, water level reductions or tolerances for increases shall be set for the critical 2% and 10% AEP events in accordance with the objective and ATLs in Schedule 10 and shall be reported with the model update results required under Condition 55;

Advice Note: *For the avoidance of doubt, changes to the Receiving Environment Objective and Attribute Target Levels set out in Schedule 10 can only be made through an application to change the conditions of consent pursuant to s127 of the Resource Management Act 1991.*

- (t) Procedures, to be developed in consultation with Christchurch International Airport Limited, for the management of the risk of bird strike for any facility owned or managed by the Christchurch City Council within 3 kilometres of the airport;
- (u) A description of any relevant options assessments undertaken to identify the drivers behind mitigation measures selected; and
- (v) An assessment of the potential change to the overall water balance for the SMP area arising from the change in pervious area and the stormwater management systems proposed.

Schedule 3 – Stormwater Quality Investigation Programme

<u>Stormwater Quality Investigation Actions</u>	<u>Action Start Date</u>	<u>Action Completion Date</u>
a. Investigate the feasibility of developing an instream contaminant concentration model. Consideration shall be given to: (i) How applicable the model will be to - • Water quality management generally • The resource consent specifically (ii) Timelines (iii) Costs (iv) What data CCC would need to collect	Within 6 months of the commencement of the resource consent	Within 18 months of the commencement of the resource consent
b. Develop instream contaminant concentration model if the Consent Holder feasibility study in (a) provides sufficient merit.	Within 2 years of the commencement of the resource consent	Within 4 years of the commencement of the resource consent
c. If the instream contaminant concentration model is developed, carry out investigations and monitoring to validate and refine assumptions within the model, to improve the accuracy of model predictions.	Within 4 years of the commencement of the resource consent	Ongoing
d. Conduct a feasibility study to establish the existing knowledge base and investigate the feasibility of robustly predicting the responses of the receiving environment to changes in network contaminant loads and resulting in-stream concentrations. Consideration shall be given to how and when the receiving environment might respond to changes in contaminant concentrations, how much work would be involved to predict results, what sort of models are possible, how would monitoring to obtain real world results be carried out, how long would it take the biological community to respond (i.e. lag effects), and gaps of knowledge.	Within 12 months of the commencement of the resource consent	Within 4 years of the commencement of the resource consent
e. If the Consent Holder considers that the feasibility study under (d) shows sufficient merit, and the Council considers it warranted, instigate a programme of research, monitoring and/or modelling to quantify expected responses in the receiving environment. For example: Undertake selected monitoring of discharges at "end of pipe", into the receiving environment to assist model development and calibration.	Within 4 years of the commencement of the resource consent	Ongoing

f. Investigate improvements to the accuracy of inputs and outputs of the C-CLM, or investigate alternative contaminant load modelling tools to more accurately and effectively estimate contaminant load reductions resulting from stormwater facilities and source control measures and to characterise the relationship between contaminants loads, concentrations and the receiving environment and the processes which influence that relationship.	Within 1 year of the commencement of the resource consent	Ongoing
g. Investigate the feasibility of techniques for remediating adverse effects of stormwater sediment discharges on receiving environments. This shall include consideration of sediment cover of the bed, and copper, lead, zinc and PAHs contamination.	Within 1 year of the commencement of the resource consent	Within 4 years of the commencement of the resource consent
h. If the Consent Holder determines that it is feasible, instigate an instream sediment remediation programme.	Within 4 years of the commencement of the resource consent	Ongoing
i. Monitor the actual TSS, zinc and copper reduction performance of selected stormwater treatment facilities and devices in order to improve certainty of performance values relating to TSS, zinc and copper in contaminant load modelling. Report findings and outcomes in annual report to CRC.	Within 6 months of the commencement of the resource consent	Ongoing
j. Apply the monitoring output, along with other stormwater modelling and monitoring data being gathered, to inform the planning and design of stormwater systems and facilities, including in the development of Implementation Plans and reviews of SMPs, IDS and WWDG.		
k. Carry out targeted wet weather monitoring of surface water in selected receiving environments, to improve knowledge of the state of the receiving environment, contaminant inputs and treatment efficiency, and to inform mitigation options under the SMPs. Selected areas may include new stormwater developments and retrofits and known existing hotspots of contaminants.	Within 6 months of the commencement of the resource consent	Ongoing

Schedule 4: Other Actions by Consent Holder

<u>Other Actions</u>	<u>Activity Start Date</u>	<u>Activity Completion Date</u>
Source Control		
a. Lodge a submission to central government seeking national measures and industry standards to reduce the discharge of contaminants including zinc and copper from metal roofs, car tyres and brake linings.	Within 6 months of the commencement of the resource consent	Within 1 year of the commencement of the resource consent
b. Conduct a cost/benefit analysis of options for carrying out a targeted trial for contaminant reduction from increased level of selective street sweeping and sump cleaning (For consideration as part of Council Annual Planning process).	Within 6 months of the commencement of the resource consent	Within 1 year of the commencement of the resource consent
c. If the Consent Holder Determines that the cost/benefit analysis under Item(b) shows that it is warranted, carry out trials for increased targeted/selective street sweeping and sump cleaning.	Within 1 year of the commencement of the resource consent	Within 4 years of the commencement of the resource consent
d. Conduct a cost/benefit analysis of options of alternate methods of stormwater treatment and discharge including consideration of redirection to sewer and Managed Aquifer Recharge/Discharge (For consideration as part of Council Annual Planning process).	Within 6 months of the commencement of the resource consent	Within 18 months of the commencement of the resource consent
e. If the Consent Holder determines that the cost/benefit analysis under Item (d) shows that it is warranted, carry out trials for alternate methods of stormwater treatment and discharge.	Within 2 years of the commencement of the resource consent	Within 4 years of the commencement of the resource consent
f. Apply the results of trials on street sweeping, sump cleaning and alternate methods of stormwater treatment (actions b and c above), along with results from other stormwater modelling and monitoring data being gathered, to the planning and design of stormwater systems and facilities, including in the development and review of SMPs, IDS and WWDG.		
g. If the Consent Holder determines it warranted as a result of the trials in Item (c) above, increased frequency of street sweeping of selected areas.	Within 5 years of the commencement of the resource consent	Ongoing
h. If the Consent Holder determines it warranted as a result of the trials in Item (c) above, increased frequency of sump cleaning at selected locations.	Within 5 years of the commencement of the resource consent	Ongoing
i. Instigate, in the building consent approval and inspection process, a requirement for and process for approval and inspection of erosion and sediment control measures prior to site clearances commencing and throughout the	Within 6 months of the commencement of the resource consent	Ongoing

construction process.		
j. Develop a programme for operational inspection of a sample of private stormwater treatment and/or retention devices on non-industrial sites for the purposes of ensuring proper function and maintenance.	Within 2 years of the commencement of the resource consent	Ongoing
k. Conduct a cost/benefit analysis of options to further improve source control that considers: (i) allocation of staff/resources to undertake industrial site audits (ii) expected contamination risk and possible risk reduction of industrial sites; and (iii) other source control measures in Schedule 4 as required by Condition 40.	Within 6 months of the commencement of the resource consent	Within 18 months of the commencement of the resource consent
l. Apply, through agreement between the Consent Holder and Canterbury Regional Council, the results of the cost/benefit analysis under Item (k) above to prioritise source control measures in SMPs and the Implementation Plan and to determine the number of audits conducted under Condition 47(b).	Within 2 years of the commencement of the resource consent	Ongoing
Communication, Education and Awareness		
m. Make reasonable endeavours to establish a community waterways engagement programme through the Community Waterways Partnership (involving Council, Canterbury Regional Council, Ngai Tahu, DoC, MfE, Universities, industry representatives and Community Groups) with the objective of collective actions to reduce stormwater contaminant discharges and improve waterways through source control and behaviour change. Possible initiatives of the Community Waterways Partnership engagement programme are: (i) Co-ordinate aligned waterways projects through constructive relationships between value adding partners to minimise impact and maximise resilience of the waterways and immediate areas associated with them; (ii) Implement a sustainable behaviour change programme. Actions aimed at stopping contaminants getting into the stormwater network, such as: sediment, litter, bacterial contaminants; (iii) Undertaking a wider educational programme for schools and community; (iv) Seeking industry behaviour change; and (v) Providing information property owners on quick actions that they can undertake around the home to stop contaminants from entering stormwater.	Within 6 months of the commencement of the resource consent	Ongoing

n. The Consent Holder shall convene the Community Waterways Partnership meeting at least once annually. At each meeting the Consent Holder shall update the Community Waterways Partnership and receive feedback on matters relating to the exercise of this resource consent, including but not limited to: (i) Relevant capital and maintenance works completed in the past year and currently programmed by the Consent Holder; (ii) Development and refinement of the C-CLM or MEDUSA and flood modelling; (iii) Any new technologies in stormwater contaminant reduction or preventative measures; and (iv) Compliance and monitoring results as reported under Condition 61.	Within 1 year of the commencement of the resource consent	Ongoing
o. Minutes of the Community Waterways Partnership Meeting shall be circulated by the Consent Holder to the Community Waterways Partnership within four weeks of the meeting.		
p. The Consent Holder shall provide the Industry Liaison Group with a report at least once annually. This report shall update the Industry Liaison Group on matters relating to the exercise of this resource consent, including but not limited to: (i) Development of the risk matrix required under Condition 3(b) (ii); (ii) Implementation of the industrial site audit process under Condition 47; (iii) Any new technologies in stormwater contaminant reduction or preventative measures; and (iv) Compliance and monitoring results as reported under Condition 61.	Within 1 year of the commencement of the resource consent	Ongoing

Pūharakekenui/Styx River Weed Management		
q. Investigate the degree to which various options in river channel weed (macrophyte) management practices mitigate flood effects on the Pūharakekenui/Styx River under a range of river flow scenarios. Factors to be considered shall include: (i) International weed management practices in similar settings; and (ii) The factors which promote or suppress growth of the specific prolific weed species in the Pūharakekenui/Styx River, including sediments, dry weather flows, stormwater discharges covered by the resource consent, other discharges, shading and climatic factors.	Within 6 months of the commencement of the resource consent	Within 3.5 years of the commencement of the resource consent
r. Based on the results of the investigation under Item (q) above, and through engagement with Canterbury Regional Council, the Consent Holder shall identify the best practicable options for mitigating flooding through river channel weed management. Factors to be considered shall include: (i) A range of river flow scenarios including dry weather (spring-fed) flows and storm flows where operational/maintenance management will be beneficial; (ii) A range of riverchannel operational/maintenance management scenarios (iii) Flooding effects including level, extent and duration; (iv) Available technical knowledge; (v) Potential for practical implementation of options; (vi) Costs for implementing options; (vii) Available regulatory mechanisms; (viii) Consideration of ecological effects; and (ix) Consideration of overlapping powers and responsibilities between Canterbury Regional Council and Christchurch City Council under other legislation.	Within 2 years of the commencement of the resource consent	Within 4 years of the commencement of the resource consent
s. Conduct a cost/benefit analysis of the identified best practicable options for carrying out a targeted trial for achieving reduced flooding from changes in the weed management of the Pūharakekenui/Styx River.	Within 4 years of the commencement of the resource consent	Within 5 years of the commencement of the resource consent
t. Determine the best approach to incorporating the variable weed condition within the Pūharakekenui/Styx River hydraulic model and resulting design flood scenarios.	Within 4 years of the commencement of the resource consent	Within 5 years of the commencement of the resource consent

u. Test the Pūharakekenui/Styx River model calibration against other storm events, as they arise, to calibrate/validate model sensitivity to varying weed conditions.	Within 4 years of the commencement of the resource consent	Within 5 years of the commencement of the resource consent
v. Apply, through engagement with the Canterbury Regional Council, the results of the cost benefit analysis in a targeted trial for the selected best practicable options for weed management of the Pūharakekenui/Styx River river channel.	Within 5 years of the commencement of the resource consent	Within 6 years of the commencement of the resource consent
w. If the Consent Holder determines it warranted as a result of the trials in Item (v) above, implement the selected best practicable option within the Pūharakekenui/Styx River Area SMP.	Within 6.5 years of the commencement of the resource consent	Ongoing

Schedule 5: Christchurch Contaminant Load Model Report



REPORT

Assessment of Current and Future Stormwater Contaminant Load for Christchurch

CLM Modelling Report - Best Practice Infrastructure

Submitted to:

Christchurch City Council

53 Hereford Street
Christchurch 8013

Submitted by:

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July 2018



C-CLM Modelling
Report 2018 - Best
Practice

Distribution List

Graham Harrington | Christchurch City Council

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APPENDICES

APPENDIX A

Report Limitations

APPENDIX B

C-CLM Stormwater Subcatchments and Predicted Loads

APPENDIX C

Projected City-wide Annual Contaminant Loads for Best Practice Infrastructure Scenario

APPENDIX D

Projected Annual Contaminant Loads for Best Practice Infrastructure Scenario Maps

1.0 INTRODUCTION

1.1 Background

Most of Christchurch's stormwater runoff will enter urban streams and any dissolved or suspended contaminants will affect stream water quality. Christchurch City Council (CCC) has resource consents from Environment Canterbury for stormwater discharged for several main urban river catchments. Stormwater Management Plans (SMPs) are operative under these consents, which specify how the stormwater contaminant load is managed to minimise adverse water quality effects. These consents are to be renewed and CCC has opted to amalgamate individual resource consent and associated SMPs under a new global consent for stormwater discharge to urban streams in Christchurch.

Contaminant management is a key component of the SMPs. Stormwater contaminants in urban catchments derive from a number of sources including road surfaces, building roofs and walls, industrial sites and other impervious surfaces, including pavements, driveways and parking areas, as well as atmospheric deposition. Contaminant composition and quantity varies according to land use. Contaminant loads are typically greater in urban sub-catchments (i.e., residential, commercial and industrial land uses) and in sub-catchments with roads carrying high vehicle numbers compared with rural sub catchments.

The renewal and amalgamation of the stormwater resource consents required an assessment of effects, which includes a review whether the instream water quality will meet the limits set in the Land and Water Regional Plan. The CCC and Canterbury Regional Council (CRC) have agreed upon stormwater treatment performance criteria. As a result, the CCC has committed to achieving an overall improvement of the quality of the stormwater runoff in the next 35 years, but no specific target for improving the instream water quality will be set.

Therefore, CCC needs to provide an assessment of the current stormwater contaminant load and the expected reductions over the next 35 years. This assessment should also provide information of the efficacy of various measures to reduce the stormwater contaminant load.

1.2 Objectives

The main objective of this investigation is to assess the expected current and future annual contaminant load that enters urban streams in Christchurch's four main river catchments, which are the Styx, Avon, Heathcote and Halswell River catchments. This investigation provides the following results:

- An assessment of the expected annual stormwater contaminant load of sediments (as total suspended solids, or TSS), total zinc and total copper, that enters the urban streams, for the current situation, in 5 years' time, 10 years' time and 35 years' time.
- An assessment of reduction of stormwater contaminant load that could reasonably be expected to be achieved by stormwater treatment in Christchurch in the next 35 years.

These assessments are to be included in the Comprehensive Stormwater Network Discharge Consent (CSNDC) application.

1.3 Approach

The assessment is based on the Christchurch Contaminant Load Model (C-CLM) that was developed from the Auckland Regional Council (ARC) Microsoft Excel Contaminant Load Model, Version 2.0 (2010), which is an annual stormwater contaminant load model. The model has adaptations incorporated in the Avon SMP

contaminant load modelling project (Golder 2014). Land use information as per January 2017, including areas earmarked for future development was provided as GIS files by CCC.

The C-CLM developed for this project assesses annual stormwater contaminant loads, by multiplying the land use type surface area with the contaminant load rate per land use type, and summarising this per stormwater sub-catchment. Land use type groups considered include, grass lands, roofs, roads and paved areas, which are further subdivided to produce a total of 18 land use categories, with contaminant load rates for TSS, total zinc and total copper specified. A total of 89 stormwater sub-catchments across the four main river catchments (Styx, Avon, Heathcote and Halswell) were identified, for which the annual contaminant loads were assessed.

A full description of the stormwater catchments is included in Section 2.0. A general overview of measures to reduce the contaminant load in stormwater runoff before it enters urban streams, is included in Section 3.0. The C-CLM description and underlying assumptions is given in Section 4.0, with modelling results presented in Section 5.0.

1.4 Report Limitations

Your attention is drawn to the document, “Report Limitations”, attached in Appendix A. The statements presented in that document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks to which this report relates which are associated with this project. The document is not intended to exclude or otherwise limit the obligations necessarily imposed by law on Golder Associates (NZ) Limited, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

2.0 CATCHMENT DESCRIPTION

2.1 General

The total area considered in the investigation covers 27,211 ha and includes the main stems of the Styx, Avon, Heathcote and Halswell catchments (Figure 1). The area stretches roughly from State Highway 1 in the west of the city, to the sea in the east of the city. The Port Hills and Halswell catchment form the southern boundary and the Avon and Styx River catchment boundaries form the northern boundary. The C-CLM Area is predominantly urbanised, although some rural land is included, such as farmland to the north and west of the city, and also the Port Hills sub-catchments.

Stormwater from all areas west and north of State Highway 1 are mainly rural and predominantly discharged to ground. It is assumed that these areas do not contribute to the contaminant load entering the urban streams within the four main catchments mentioned above. Therefore, these areas are excluded from the C-CLM. The Otukaikino Creek and catchment to the north, between the Waimakariri River and Styx catchment, are also not part of the C-CLM catchment area. The total C-CLM catchment area and the catchment areas of the individual four main river catchments included in the C-CLM are listed in Table 1.

Table 1: C-CLM and four main river catchment areas.

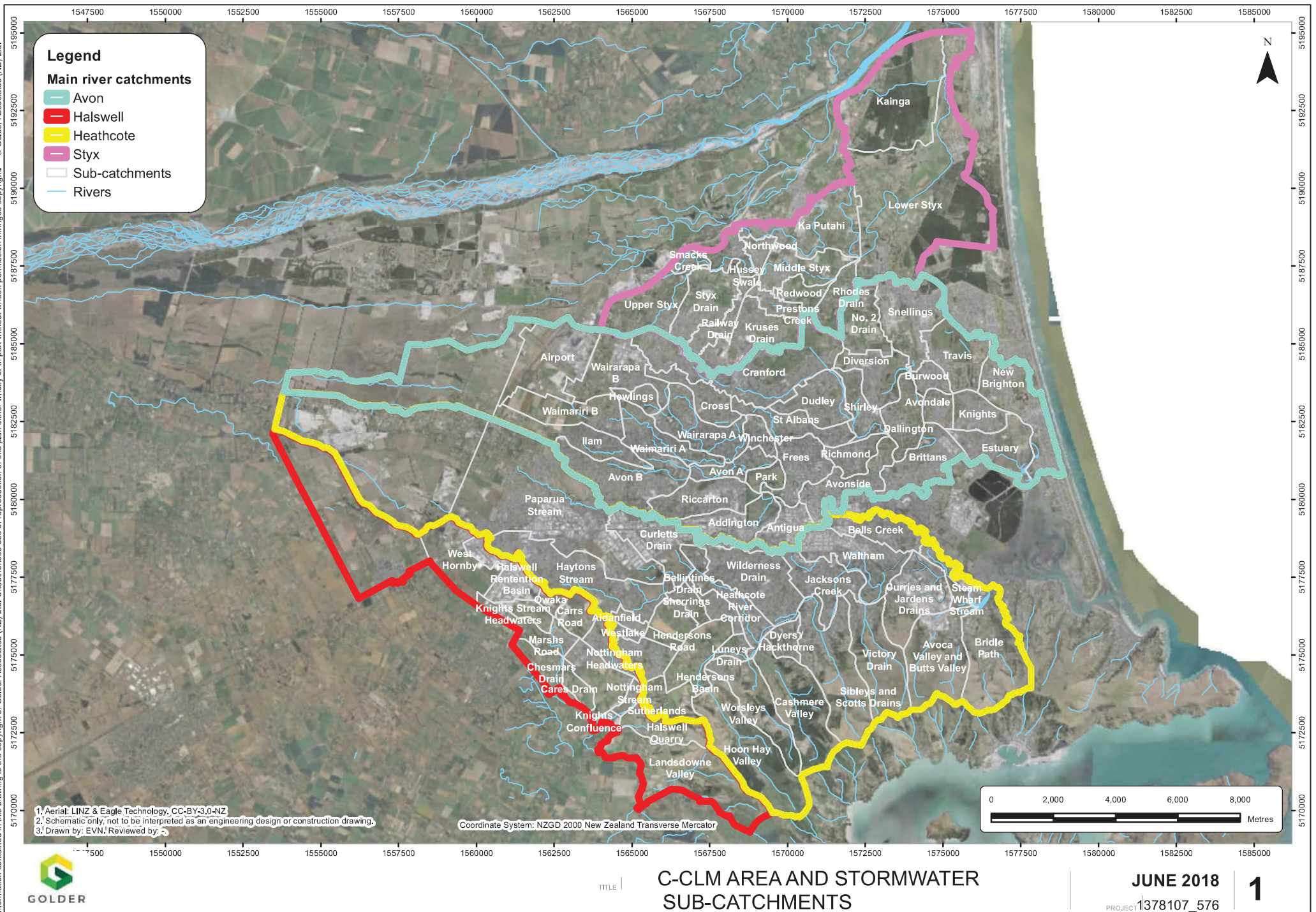
Main River Catchment	Area (ha)
Styx	5,305
Avon	9,204
Heathcote	9,969
Halswell	2,733
Total CLM catchment	27,212

2.2 Stormwater Sub-catchments

A total of 89 stormwater sub-catchments have been identified for the purpose of this study. The delineation of the sub-catchments was based on the following information:

- Styx River sub-catchments: GIS information provided by CCC on 18 December 2017;
- Avon River sub-catchments: these are the same as used in Golder (2014);
- Heathcote River sub-catchments: these are the same as used in PDP (2017) and;
- Halswell River sub-catchments: these are the same as used in Golder Kingett Mitchell (2007).

These sub-catchments do not necessarily represent actual current hydrological catchments within which all stormwater is routed towards a single discharge point. Christchurch' urban stormwater system changes over time with on-going developments and redevelopments, hence the sub-catchments are ever changing. The C-CLM stormwater catchments used in this investigation are listed in Appendix B. An overview map is included in Figure 1.



3.0 TREATMENT SYSTEMS

3.1 General

A reduction of the contaminant load in stormwater runoff can be achieved in various ways. Generally, two main categories of load reduction can be identified:

- Source control options
- Treatment systems

This report addresses the reduction of stormwater contaminant through treatment systems.

3.2 Treatment Systems

Stormwater can be captured and treated, before discharging to a stream. Various studies by Charters and Cochrane (2017), ECan (2016), Golder (2014), CCC (2012) and CCC (2007), show a reasonable removal of contaminants can be achieved via stormwater treatment systems. A photo of an example of a detention basin type treatment system in Christchurch is shown in Figure 2.



Figure 2: Wigram detention basin (After CCC 2012).

CCC (2012) reports that the primary aim of stormwater treatment for mature urban catchments (i.e. those that are not major sources of sediment) should be to remove the highly contaminated fine particulate matter, reduce dissolved contaminant concentrations and reduce the bioavailability of residual dissolved contaminants. Various treatment system types are available and already in operation in Christchurch and it is planned to expand these over time, to achieve the CCC stormwater contaminant reduction targets. The treatment systems considered in this investigation are the following:

- Basin and wetland
- Rain garden

- Stormfilter
- Wet pond
- First flush basins
- Wetland
- Soil adsorption basin
- Swale
- Discharge to ground

Further details on their efficiency to remove certain contaminants and how this is accounted for in the CLM model is included in Section 4.5.3.

4.0 CONTAMINANT LOAD MODEL DESCRIPTION

4.1 General

As discussed in Section 1.3, the C-CLM is based on the Contaminant Load Model (Version 2.0 March 2010) developed by the Auckland Regional Council (ARC) and used by Golder (2014) for the Avon SMP contaminant load study. The C-CLM used in this study is a GIS based database with spatial information on land use, stormwater catchment and future developments, which correlates to a Microsoft Excel based model to assess the annual contaminant load of sediment (total suspended solids, TSS), total zinc and total copper for each of the identified stormwater sub-catchments (Section 2.0).

The C-CLM comprises a series of source areas within the catchment which are assigned annual contaminant yields. The source area categories used in the model are as follows:

- Grasslands;
- Roofs;
- Roads; and
- Paved surfaces (other than roads).

Each of the source areas are sub-categorised into type of material, or use, for example, the sub-category for roofs includes different roof materials and the sub-category for roads includes ranges for the numbers of vehicles per day.

There is a treatment component of the C-CLM, which allows for runoff from portions of a sub-catchment to be treated by one or more stormwater treatment device, or by source control measures (e.g., painting of roofs). The C-CLM applies a reduction factor to the contaminant load for the source areas within the treatment catchment. This is based on the source area category and the specified treatment method.

The C-CLM produces sub-catchment and catchment wide contaminant yields representing the accumulated annual contaminant load (i.e., tonnes/year or kilograms/year).

The model outputs provide a means of evaluating the effects of urban development and land use change, as well as the effectiveness of proposed mitigation measures (e.g., catchment modification or stormwater treatment), on the basis of comparing contaminant loads for a 'base case', which is the January 2017 situation, and future land use cases in 5, 10 and 35 years' time.

The annual contaminant load is calculated in two steps:

- 1) The total load of each individual stormwater sub-catchment (Section 2.0) is calculated by summarizing land use type areas for each sub-catchment and multiplying this with the contaminant load rate for that land use type. This provides the total load before treatment.
- 2) Treatment systems, such as first flush basins, stormfilter, swales or wetlands, have their own catchment within each stormwater sub-catchment. These are incorporated in the C-CLM as such, and a removal load based on the treatment system's removal efficiency factor is calculated. The total sub-catchment load after treatment is calculated by subtracting the removed loads by the treatment system(s), within each individual catchment.

4.2 Limitations of the C-CLM

The projected loads should be considered as indications for comparison and are not intended to be used as a precise measurement of contaminant loads entering the downstream receiving environment. However, the projections provide valuable comparisons of potential contaminant increases after development, and how stormwater treatment can mitigate these increases.

It is also important to emphasise that the relationship between the annual catchment-wide stormwater contaminant load and the instream water quality of the receiving urban streams is complex. Processes such as resuspension of stream bed sediments, scouring of stream banks and groundwater inflow contaminant contribution, all have an impact on the stream water quality.

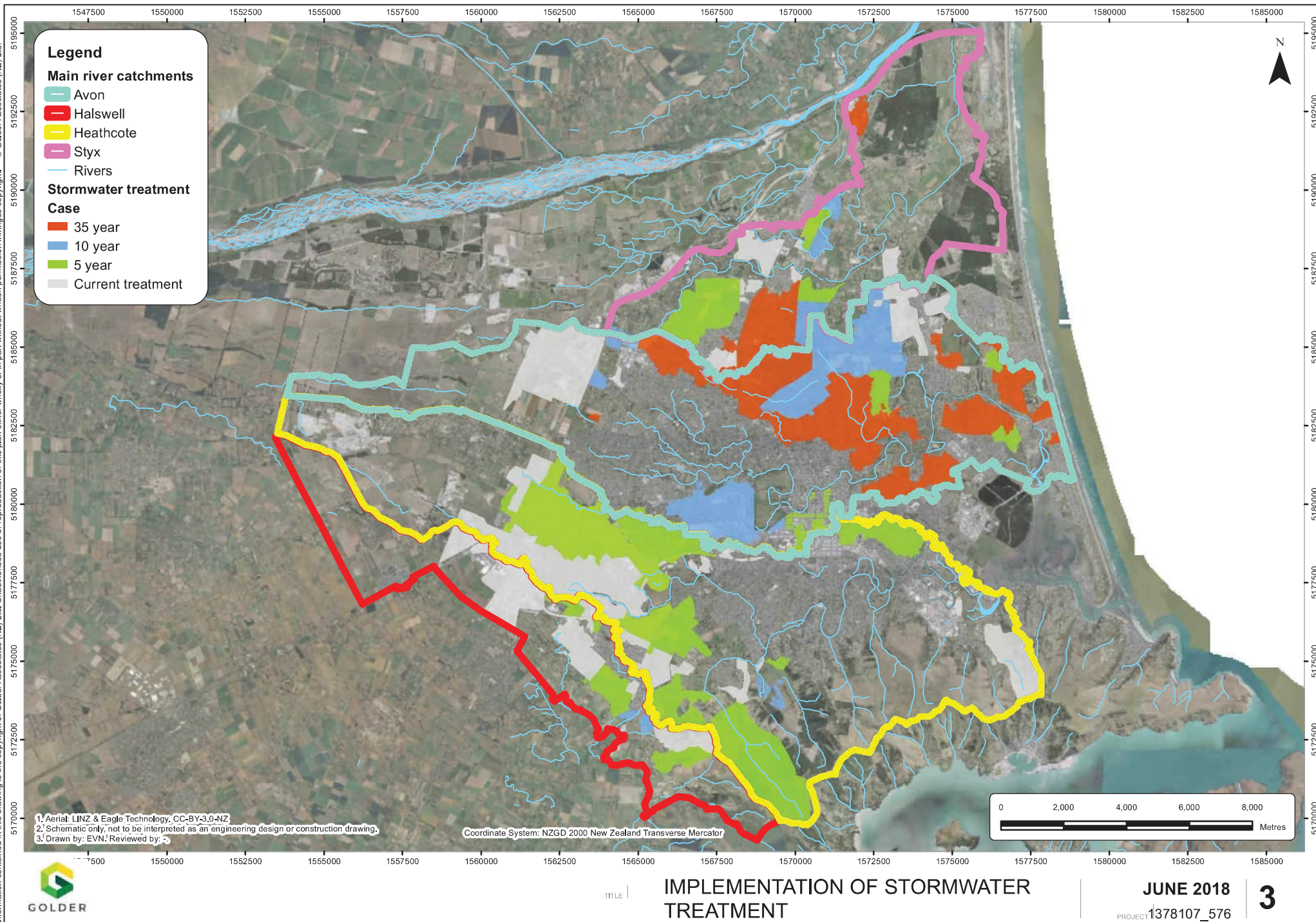
Because the C-CLM model only predicts annual mass loadings of contaminants it cannot be used to assess the instream water quality. However, it can be used to predict long term average improvement in stormwater quality due to land-use changes and employment of stormwater treatment systems.

4.3 Best Practice Infrastructure Scenario

The C-CLM has been developed so that it can be evaluated for multiple scenarios to enable comparison of various catchment modifications or stormwater treatment methods and the net impact they are likely to have on the overall catchment contaminant loads.

This report only describes a 'Best Practice Infrastructure' scenario. In this scenario the current situation (base case) and expected future developments, with currently planned treatment systems for the next 35 years are incorporated (Figure 3). In the Best Practice Infrastructure scenario it is assumed that roofs on buildings that are 70 years or older are replaced by a pre-painted steel¹ roof.

¹ Pre-painted steel is a factory painted steel cladding manufactured to AS 1397:2011 (Continuous hot-dip metallic coated steel sheet and strip – coatings of zinc and zinc alloyed with aluminium and magnesium). In the C-CLM model this is referred to as 'ColorSteel'.



The Best Practice Infrastructure scenario entails the implementation of best of practice stormwater treatment measures in 'greenfield' developments (i.e., grassland being developed into new residential or business areas). This scenario also includes a gradual implementation of practical measures for improvement of stormwater management within existing urban areas (e.g., planned upgrades of the road corridor, council reserves and parks, brownfield developments). Under this scenario the fraction of city's catchment area that would be subject to stormwater treatment would increase from approximately 10 % to around 40 % over a 35 year period.

In the Best Practice Infrastructure scenario the following cases (time periods) have been assessed:

- Base case
- 5 years
- 10 years
- 35 years

These cases include changes in treatment as well as urban development, as described in the following sections.

4.4 GIS Based Spatial Land Use Data Set

The spatial land use data set provided by CCC was used as key input into the C-CLM model. The database was modified to accommodate the stormwater subcatchments of all four rivers and of all individual treatment systems identified by CCC. In effect, the CCC's spatial database was divided along the stormwater and treatment sub-catchment boundaries and all relevant information of these added to the database. No other modifications have been applied.

The resulting file is called 'LandUse-BaseCase-V3.shp' and includes the following information, which is described in more detail in following sections:

- **Land use type:** identifier for each individual item in the CCC database (e.g., grassland, roof, road or paved area)
- **Road hierarchy:** for those areas classed as 'road' this identifies the road class.
- **Roof material:** for those areas classed as 'roof' this identifies the roof type.
- **Building age:** for those areas classed as 'roof' (i.e., a building) this identifies the age group, which is based on cadastral information.
- **Land use zone group:** this identifies areas and each land use type within it as residential, commercial or industrial area.
- **LiDAR infra-red information:** this information is used to identify whether an area is either grass land or paved areas. Buildings (i.e., roofs) and roads are already identified and categorised in the CCC spatial database, but no distinction is included for grassland and paved areas.
- **Future land use:** this identifies if an area that is planned for future development such as residential densification.
- **Current and future treatment systems:** treatment system type and name for the base case and future cases (5, 10 and 35 years) are indicated, as well as the year they become operational, whether future

systems replace existing systems, or will operate as a 'treatment train', and how much of the stormwater runoff within the treatment catchment is routed through the treatment system.

- **Stormwater sub-catchment and main river catchment:** this indicates in which stormwater sub-catchment and main river catchment each land area is located.
- **Area:** this is the surface area (in m²) of each individual item in the CCC spatial database. Golder has calculated this with ARC GIS.

The information provided by CCC does not exactly match the land use and treatment system types identified in the C-CLM model. Therefore, several filters have been incorporated into the C-CLM model to convert land use and treatment system types to those used in the C-CLM model before contaminant load calculations are undertaken. This is further described in the following sections.

4.5 Model Assumptions

Various assumptions underpin the C-CLM model as follows:

- Contaminant load rates per land use type (including iron roof distribution and roof replacement on older buildings)
- Areas under construction
- Treatment system contaminant removal rates
- Rate of future land use change
- Contaminant source reductions for various scenarios

4.5.1 Contaminant yields

Contaminant load rates (or 'contaminant yields') for total suspended solids (TSS), total zinc (Zn), and total copper (Cu), are produced by the model based on estimates of contaminants generated per square metre from each of the C-CLM land use types on an annual basis. These contaminant load rates are the same as used by Golder (2014) and ARC (2011) and are presented in Table 2.

Table 2: Assumed contaminant load rates ('contaminant yields') in C-CLM.

Source Area		TSS (g/m ² /year)	Zinc (g/m ² /year)	Copper (g/m ² /year)
Grass land	Urban	27	0.0016	0.0003
	Rural	12.6	0.0007	0.0001
Roofs	Concrete	9.6	0.02	0.0033
	Galvanised Steel (unpainted)	3	2.24	0.0003
	Galvanised Steel (poorly painted)	3	1.34	0.0003
	Galvanised Steel (well painted)	3	0.2	0.0003
	Decramastic	7.2	0.28	0.0017
	Color Steel	3	0.02	0.0016
	ZincAlume	3	0.2	0.0009
	Unknown	6	0.02	0.002
Roads	Private Road	12.6	0.0044	0.0015
	Local Road	16.8	0.0266	0.0089
	Collector	31.8	0.1108	0.0369
	Minor Arterial	57.6	0.2574	0.0858
	Major Arterial	94.8	0.4711	0.157
Paved	Residential	19.2	0.195	0.036
	Commercial	19.2	0	0.0294
	Industrial	13.2	0.59	0.107
Construction		1500	0.088	0.018

Roofs

Roof types were determined via the roof material attribute included in the cadastral information for each land parcel. Most roof type match the categories defined in the C-CLM, as listed in Table 2. However, some roof types did not match, and these were converted to C-CLM roof types as listed in Table 3.

Table 3: Roof type information conversion into C-CLM categories.

CCC roof material classification	CLM roof material designation (ARC-CLM equivalent)
Brick	Concrete
Concrete	
Fibrous cement or asbestos	
Stone	
Tiles	
Iron	Galvanised and ColorSteel (i.e., Pre-painted Steel)
Plastic	Unknown
Roughcast	
Fabric, bitumen and butyl rubber in all forms	
Glass	
Wood in all forms	
Aluminium	ZincAlume

It is noted that the definition of 'iron' roof types within the CCC data includes all types of galvanised roofing, along with zinc and some aluminium roofs. The condition of the iron roofs is unknown and has been assumed to be broadly represented by the 'poorly painted galvanised' category for commercial/industrial roofs described in Golder (2014). Residential iron roofs (as well as a proportion of the tile roofs, and aluminium roofs) were split into five categories including galvanised steel unpainted/poorly painted/well painted, decramastic tile, and pre-painted steel. The proportions of different roof materials were assumed to be the same as the average reported in Golder (2014), in which four residential sub-catchments in Auckland were surveyed for roof type:

- 8 % unpainted galvanised steel,
- 41 % poorly painted galvanised steel,
- 15 % well painted galvanised steel,
- 20 % decramastic tile and
- 16 % pre-painted steel (i.e. ColorSteel).

Roads

The road hierarchy classes were identified in the CCC spatial land use database and it is assumed that these are based on road length, a nominal width and the estimated vehicles per day (VPD), as listed in Table 4 (based on Golder 2014).

Table 4: Road hierarchy categories.

Road hierarchy class	Vehicles per day	Nominal width (m)
Pedestrian	<1,000	17
Private		
Local	1,000 – 5,000	17
Collector	5,000 – 20,000	17
Minor arterial	20,000 – 50,000	21
Major arterial	>50,000	24

Paved areas and grassland

Land parcels were determined from property data provided by the CCC and represent the ‘current’ land use as per January 2017. Land parcels in the CLM represent all areas within the C-CLM catchment, which do not fall into the roof or road categories.

Imperviousness information from LiDAR data from Christchurch for the January 2017 situation was used to categorise the land parcels (excluding roads) into the following categories:

- Grassland
 - Urban
 - Rural
- Paved
 - Residential
 - Commercial
 - Industrial

The imperviousness study provides a high-level estimate of grassland and paved areas. The survey is a graded layer covering the whole C-CLM catchment, which applies a value of 1 – 100 for any given point within the catchment, where 1 is highly pervious and 100 is highly impervious. Through interrogation of the layer, and calibration with aerial photos, Golder (2014) determined that the following banding best represented the land use of the catchment:

- 0 – 50 as urban and rural grassland;
- 50 – 80 as residential paved area; and
- 80 – 100 as commercial and industrial paved area.

Distinction between urban and rural grassland and between commercial and industrial paved areas was made by applying the land zoning for each land parcel.

Waterways

The C-CLM is used to provide an indication of the relative benefit of stormwater treatment and changes to land use and does not address instream erosion. The banks within the waterway corridors have been assumed to be grassland (based on the imperviousness study) and the water surface has been excluded from the model.

4.5.2 Construction sites

Construction sites typically produce the highest sediment yields within a given catchment. CCC provided information on building consent applications for the period 2000 – 2017 and this data was further analysed (Figure 4).

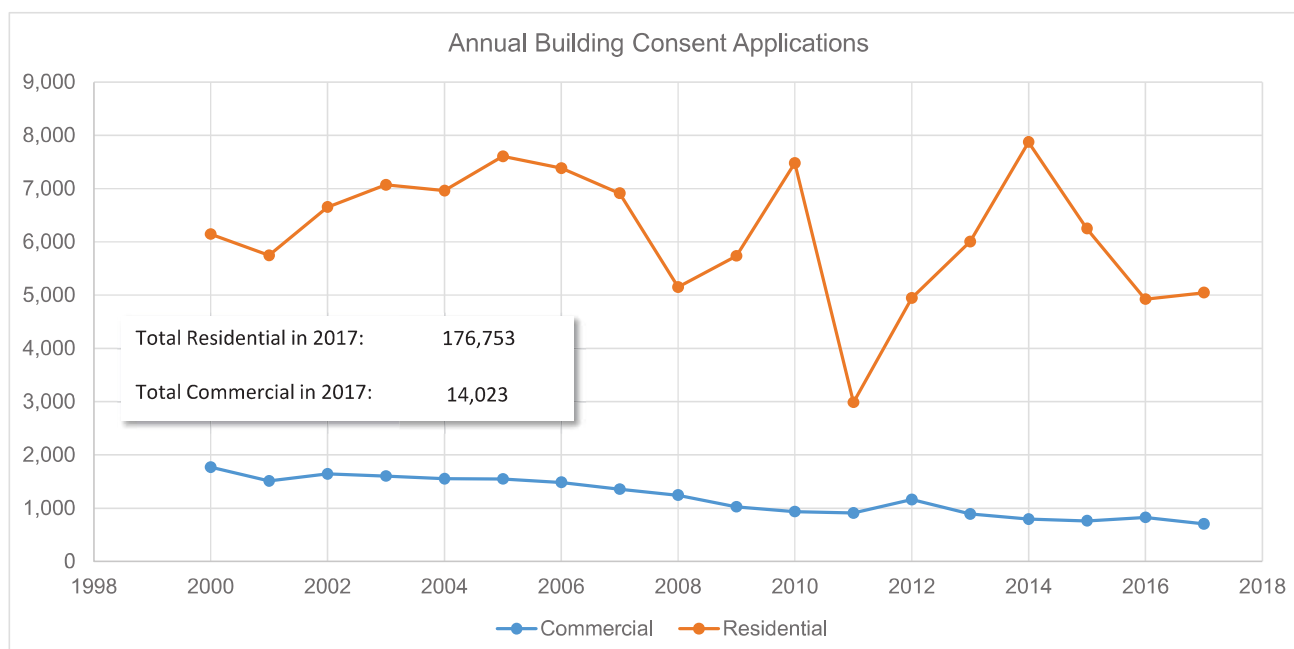


Figure 4: Annual building consent application in Christchurch in 2000 - 2017 (provided by CCC).

It is noted that not all construction sites involve major earthworks and it was assumed that 10 % of each building consent application will involve major earthworks. Based on this, the proportion of the C-CLM catchment, which was classed as under construction with major earthworks has been estimated as follows:

- 0.6 % of Commercial and Industrial properties; and
- 0.3 % of Residential properties.

4.5.3 Treatment

The C-CLM includes 'load reduction factors' for treatment facilities used in a catchment. The load reduction factors are applied to individual source areas (e.g., roads, roofs) within a treatment catchment in the model allowing multiple treatment methods to be applied throughout a given sub-catchment. Where an area receives treatment from multiple devices, such as a treatment train, the load reduction factors are applied sequentially. This means the treatment efficiency of the second device in a treatment train is only applied to

the remaining contaminant load after the treatment efficiency of the first device has been applied. Formulae for determining load reduction factors from treatment efficiencies of multiple devices are provided in Table 5.

Table 5: Treatment efficiency for treatment trains.

Number of treatment devices		Load reduction factors
1		$LRF = T_1$
2		$LRF = T_1 + (1 - T_1) \cdot T_2$
3		$LRF = T_1 + (1 - T_1) \cdot T_2 + [1 - (T_1 + [1 - T_1] \cdot T_2)] \cdot T_3$
Where:	$LRF = \text{Load reduction factor}$ $T_1 = \text{Treatment efficiency of device 1}$ $T_2 = \text{Treatment efficiency of device 2}$ $T_3 = \text{Treatment efficiency of device 3}$	

Several treatment systems as discussed in Section 3.2 were modelled. Load reduction factors for each of the treatment devices are shown in Table 6. CCC have identified several treated areas in which two treatment systems are combined into a 'treatment train', but not more than two systems. These combined systems are also included in Table 6. The C-CLM treatment efficiencies are based on ARC (2011), NPRPD (2007), Hallock (2007) and Weiss et al. (2005).

The load reduction factors for treatment devices that are reported in the literature have a wide range due to differences in catchment soil, vegetation, topography, device design, hydraulic loading etc. The load reduction factors used in the C-CLM model are the largest reductions that could be expected for well designed, installed and maintained devices.

Stormwater can in some areas be discharged to ground via soakage pits or infiltration basins. It is assumed that no contaminants from stormwater that is discharged to ground will reach the urban streams. Therefore, the treatment efficiency of areas that discharge to ground is assumed to be 100 %.

4.5.4 Future developments

CCC provided information regarding expected future land development in Christchurch based on the long-term plan (LTP). Subsequently the following land use development categories were included in the C-CLM model:

- Residential development;
- Commercial and industrial development (i.e., business development) and;
- Residential intensification.

Table 6: Treatment systems and efficiencies assumed in the C-CLM.

Treatment system	TSS treatment efficiency (% removal)				Zinc treatment efficiency (% removal)				Copper treatment efficiency (% removal)			
	Roofs	Roads	Paved Surface	Grassland	Roofs	Roads	Paved Surface	Grassland	Roofs	Roads	Paved Surface	Grassland
Single treatment systems												
Basin & wetland	50.0	80.0	80.0	80.0	25.0	60.0	60.0	60.0	30.0	70.0	70.0	70.0
Rain garden	70.0	80.0	80.0	80.0	60.0	70.0	70.0	70.0	70.0	75.0	75.0	75.0
Stormfilter	50.0	75.0	75.0	75.0	15.0	40.0	40.0	40.0	20.0	65.0	65.0	65.0
Wet pond	10.0	75.0	75.0	75.0	5.0	30.0	30.0	30.0	5.0	40.0	40.0	40.0
Basin	10.0	60.0	60.0	60.0	5.0	20.0	20.0	20.0	5.0	30.0	30.0	30.0
First flush Basin	10.0	60.0	60.0	60.0	5.0	20.0	20.0	20.0	5.0	30.0	30.0	30.0
Wetland	50.0	80.0	80.0	80.0	25.0	60.0	60.0	60.0	30.0	70.0	70.0	70.0
Soil adsorption basin	89.0	89.0	89.0	89.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0
Swale	30.0	75.0	75.0	75.0	15.0	40.0	40.0	40.0	20.0	50.0	50.0	50.0
Combined treatment systems												
Basin and basin & wetland	55.0	92.0	92.0	92.0	28.8	68.0	68.0	68.0	33.5	79.0	79.0	79.0
Basin and First flush basin	19.0	84.0	84.0	84.0	9.8	36.0	36.0	36.0	9.8	51.0	51.0	51.0
Rain garden and basin and wetland	85.0	96.0	96.0	96.0	70.0	88.0	88.0	88.0	79.0	92.5	92.5	92.5
Swale and basin and wetland	65.0	95.0	95.0	95.0	36.3	76.0	76.0	76.0	44.0	85.0	85.0	85.0
Swale and first flush Basin	37.0	90.0	90.0	90.0	19.3	52.0	52.0	52.0	24.0	65.0	65.0	65.0

Each land parcel in the land use database, is identified as being earmarked, or not, for changes to any of the above categories. All land parcels within a sub-catchment earmarked for future development are summarised and the land use types (or source types) redistributed as described below.

Earmarked land parcels will be fully developed in the 35-year case. However, there will be a gradual change over time, and only a portion of those areas will already be developed in the 5 and 10-year cases. For each of these land parcels a linear growth towards the 35-year full development case is assumed in the C-CLM model.

New residential development

New residential areas have been identified by CCC. These developments have been included in the model with a standardized distribution of source areas for residential areas as identified by Golder (2014).

Table 7: Redistribution of land use types for new residential development areas.

Source Area		Proportion
Urban Grassland		51.9 %
Roofs	Pre-painted Steel (i.e., ColorSteel)	17.1 %
	Other Materials	2.1 %
Roads	Private Road (< 1000 VPD)	9.0 %
	Local Road (1,000 - 5,000 VPD)	4.6 %
	Collector (5,000 - 20,000 VPD)	1.9 %
	Minor Arterial (20,000 - 50,000 VPD)	0.5 %
Paved Residential		12.6 %
Construction		0.3 %

New business development

Several new business development sites have been identified in the C-CLM area. These developments have been included in the model with a standardized distribution of source areas for commercial and industrial areas as identified by Golder (2014). The proportion of each source area is provided in Table 8.

Table 8: Redistribution of land use types for new business development areas.

Source area		Proportion
Urban Grassland		20 %
Roofs	Concrete	5 %
	ZincAlume	20 %
	Other	5 %
Roads	Private Road (< 1000 VPD)	2 %
	Local Road (1,000 - 5,000 VPD)	6 %
	Collector (5,000 - 20,000 VPD)	10 %
	Minor Arterial (20,000 - 50,000 VPD)	2 %
Paved	Commercial	15 %
	Industrial	15 %

Residential intensification

Intensification of areas earmarked as such is simulated by replacing the existing source areas with new source areas based on an existing fully developed sample area described in Golder (2014). Roads are not included in the estimation of residential intensification. Residential intensification is estimated to account for an increase of impervious area. Source area proportions used for residential intensification are provided in Table 9.

Table 9: Residential intensification assumptions in C-CLM.

Source area		Proportion
Urban Grassland		15 %
Roofs	Pre-painted Steel (i.e., ColorSteel)	29 %
	Unknown	4 %
Paved Residential		52 %

It is noted that the areas identified as likely to experience residential intensification are a current 'best estimate' and may change as the city planning develops. The identified areas are considered to be a snapshot of the current planning process and represent a reasonable quantity and distribution of residential intensification.

Roof replacement

Regular roof replacement on individual houses does occur, although there is no specific information available to assess what portion of roofs have been replaced. It is the decision of the individual property owner to replace their roofs and the point in time this occurs will vary significantly. For this study it is assumed that each roof is replaced by a pre-painted steel roof whenever a building becomes 70 years of age. The building age category in CCC's land use database is used to assess this for each of the future cases (5, 10 and 35 year).

5.0 PROJECTED CATCHMENT CONTAMINANT LOADS

5.1 Introduction

The CLM was used to predict the loads of TSS, total copper, and total zinc for each case in the Best Practice Infrastructure scenario. The projected annual contaminant loads for each contaminant for this scenario are listed in tables in Appendix C. A series of maps for each contaminant for each case in the Best Practice Infrastructure scenario is included in Appendix D.

The following subsections include a description of the effects of land use changes and treatment within the Best Practice Infrastructure scenario. The results of the depicted in graphs in which the treatment system types are coded for legibility reasons. The treatment system types and their abbreviation are listed in Table 10.

Table 10: Treatment system types and their abbreviations.

Abbreviation	Treatment system type
B&W	Basin and wetland
RG	Rain garden
SF	Stormfilter
WP	Wet pond
Bas	Basin only
FF Bas	FF Basin only
Wtl	Wetland
SAB	Soil adsorption basin
Sw	Swale
Bas + Bas&Wtl	Basin only and Basin and wetland
Bas + FF Bas	Basin only and FF Basin only
RG + Wtl	Rain garden and Basin and wetland
Sw + Bas&Wtl	Swale and Basin and wetland
Sw + FF Bas	Swale and FF Basin only
Gr	To ground

5.2 Best Practice Infrastructure

The results of expected changes in urban development and planned implementation of treatment systems is shown in Figure 5, Figure 6 and Figure 7. Each of the cases are presented in these graphs, as well as the contribution of various treatment systems to the total contaminant load.

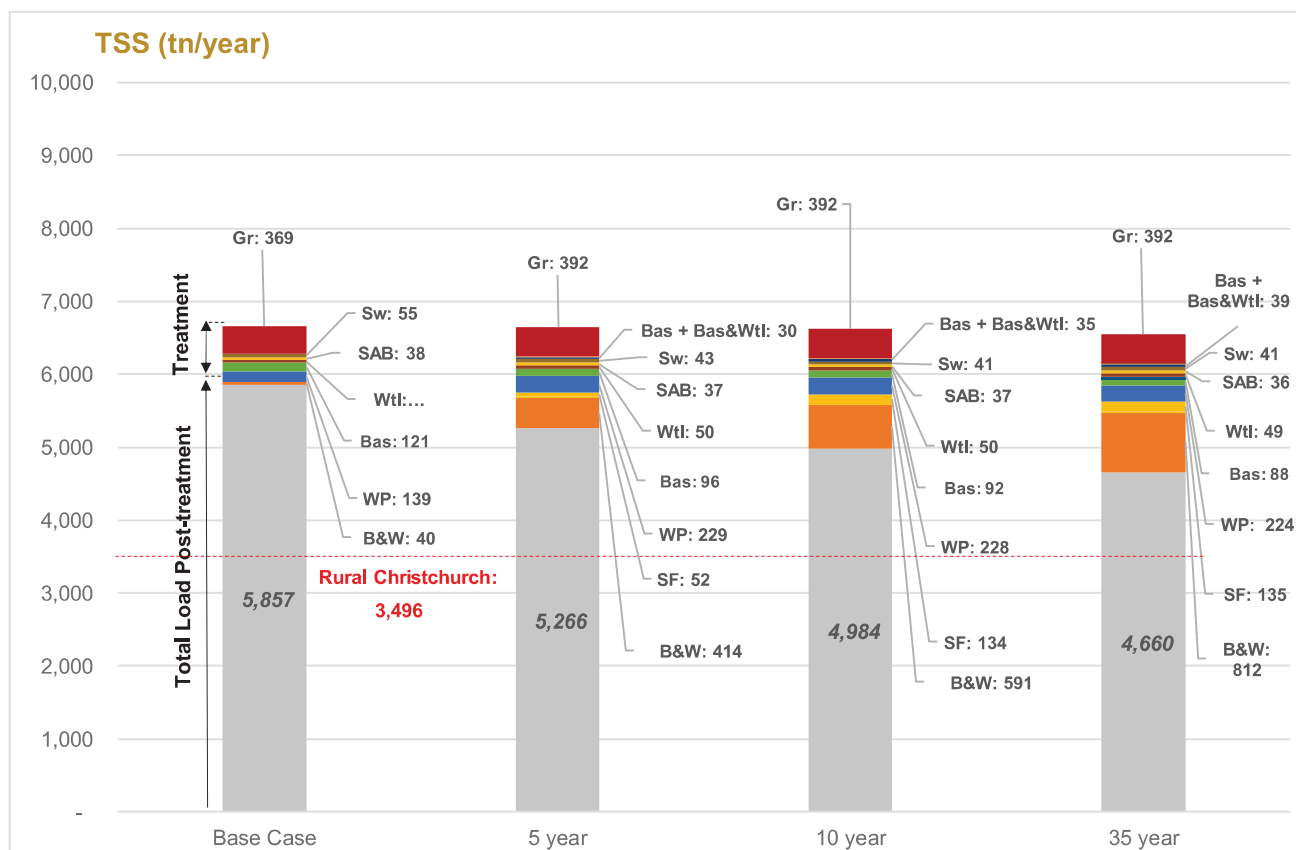


Figure 5: Modelled TSS in Best Practice Infrastructure scenario.

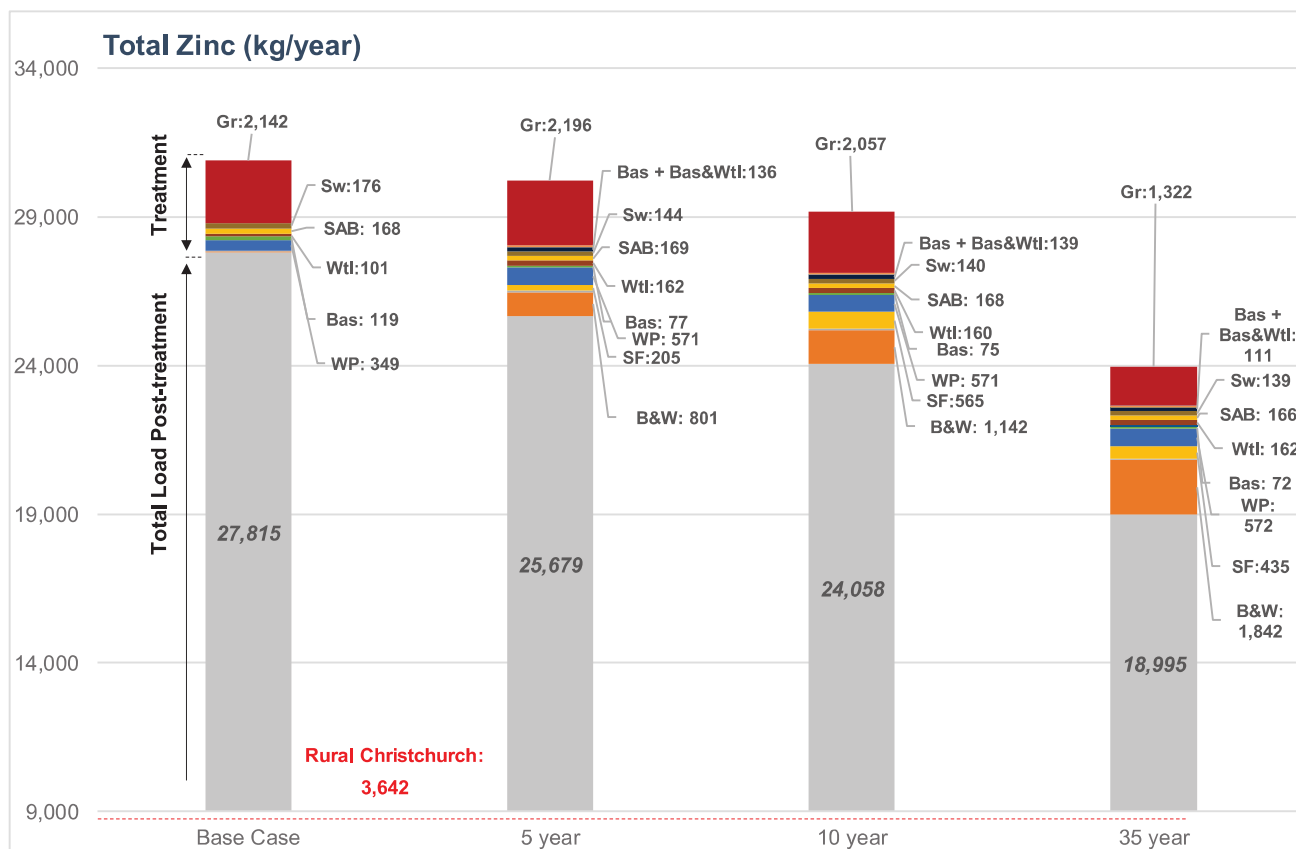


Figure 6: Modelled total zinc in Best Practice Infrastructure scenario.

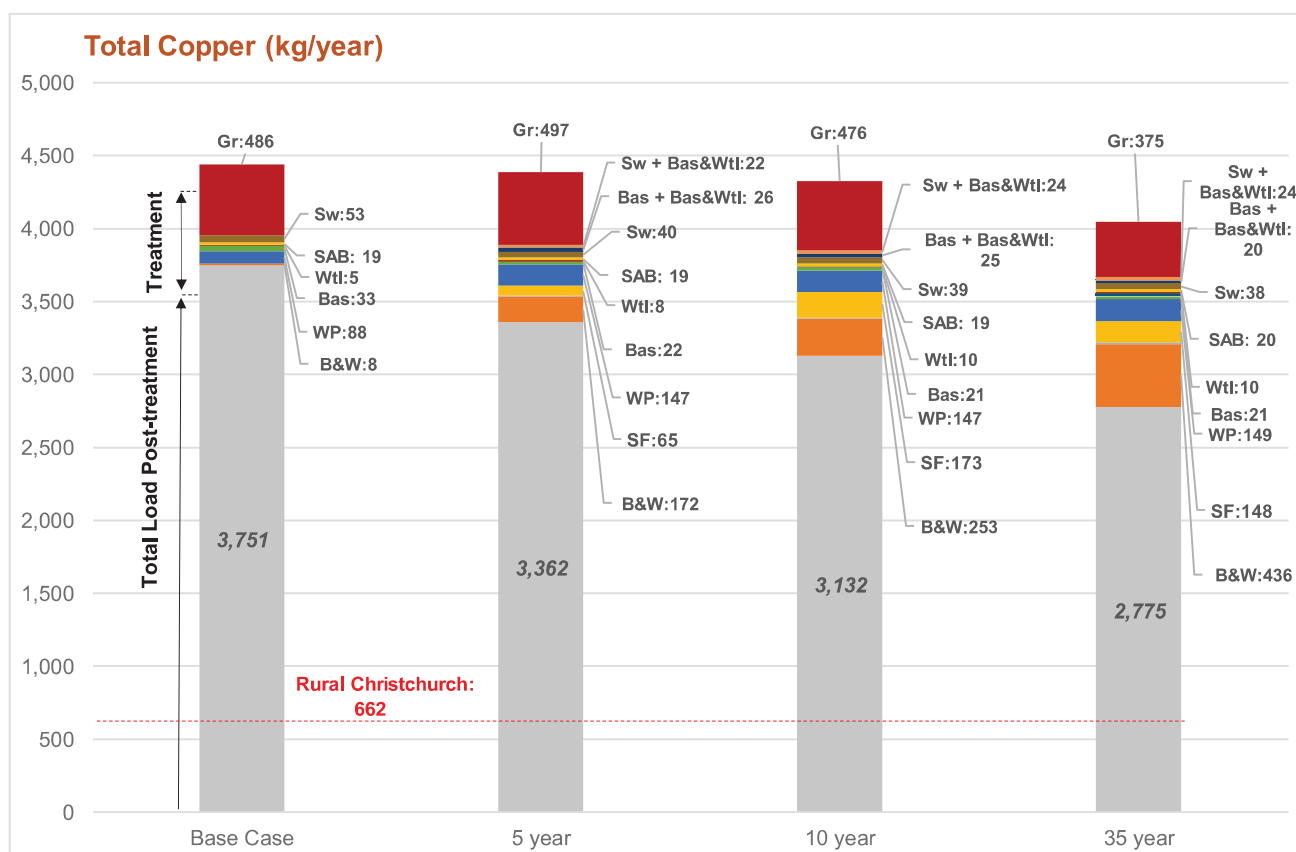


Figure 7: Modelled total copper in Best Practice Infrastructure scenario.

Urban development (renewal and densification) is estimated to lead to about 2 % in reduction of TSS, without additional treatment. This is 9 % for total copper and 22 % for total zinc (reduction in bare soil and better roofs). Routine roof replacement to pre-painted steel (not related to urban renewal) is estimated to cause about 11 % reduction of total zinc load. This is much less for TSS and total copper. Stormwater treatment is expected to remove about 29 % of TSS, 31 % of total copper and 21 % of total zinc after full implementation in the next 35 years.

As a reference, the contaminant load for a 'rural Christchurch' based on C-CLM model calculations is included in the graphs. If Christchurch was an entirely rural catchment, the load of TSS, total zinc and total copper that would reach the streams would be lower than in an urban developed Christchurch.

5.3 Roof Replacement

Roofs are the main source of total zinc in the Christchurch urban area (i.e., C-CLM catchment) and roof replacement could therefore in theory result in total zinc load reduction. However, on-going roof replacement by individual property owners (assumed to be whenever a building is 70 years of age) with either pre-painted steel roofs or tile roofs, is expected to result in little improvement of the total zinc load, as depicted in Figure 8.

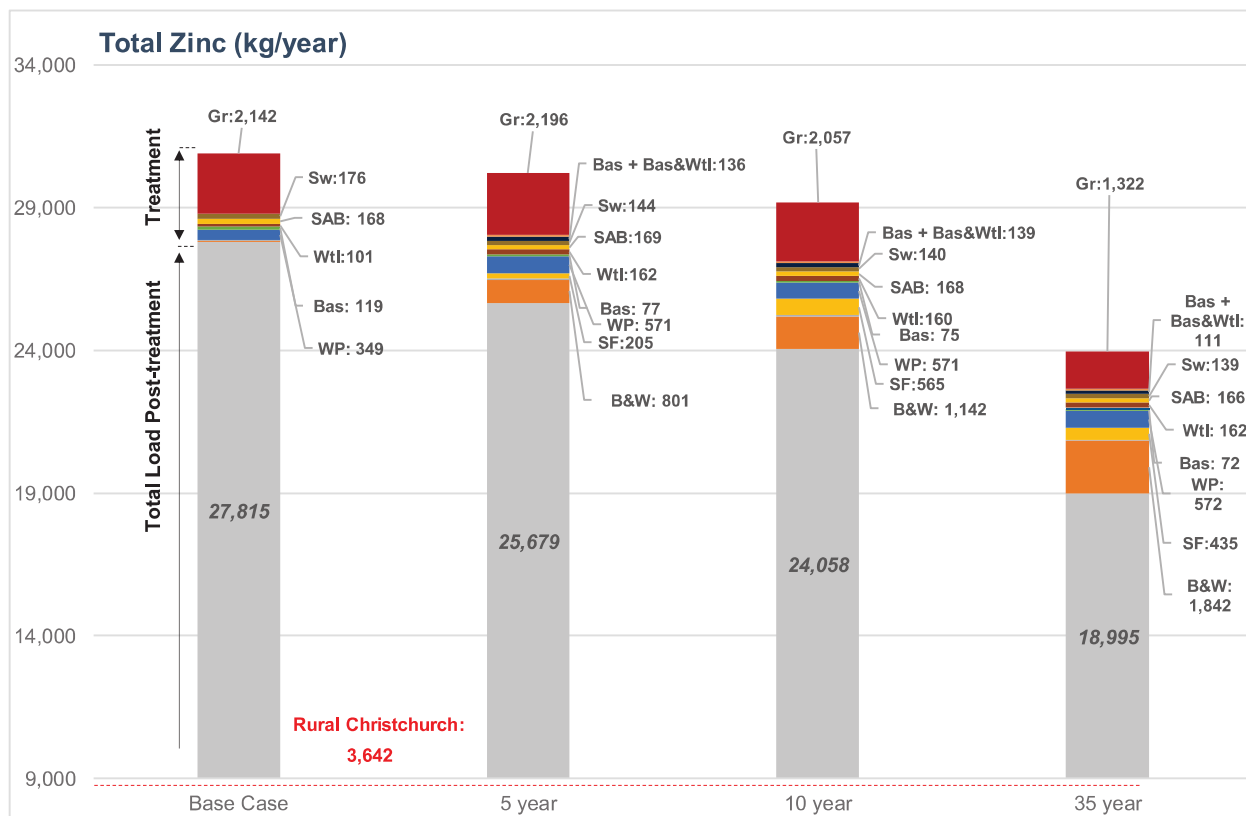
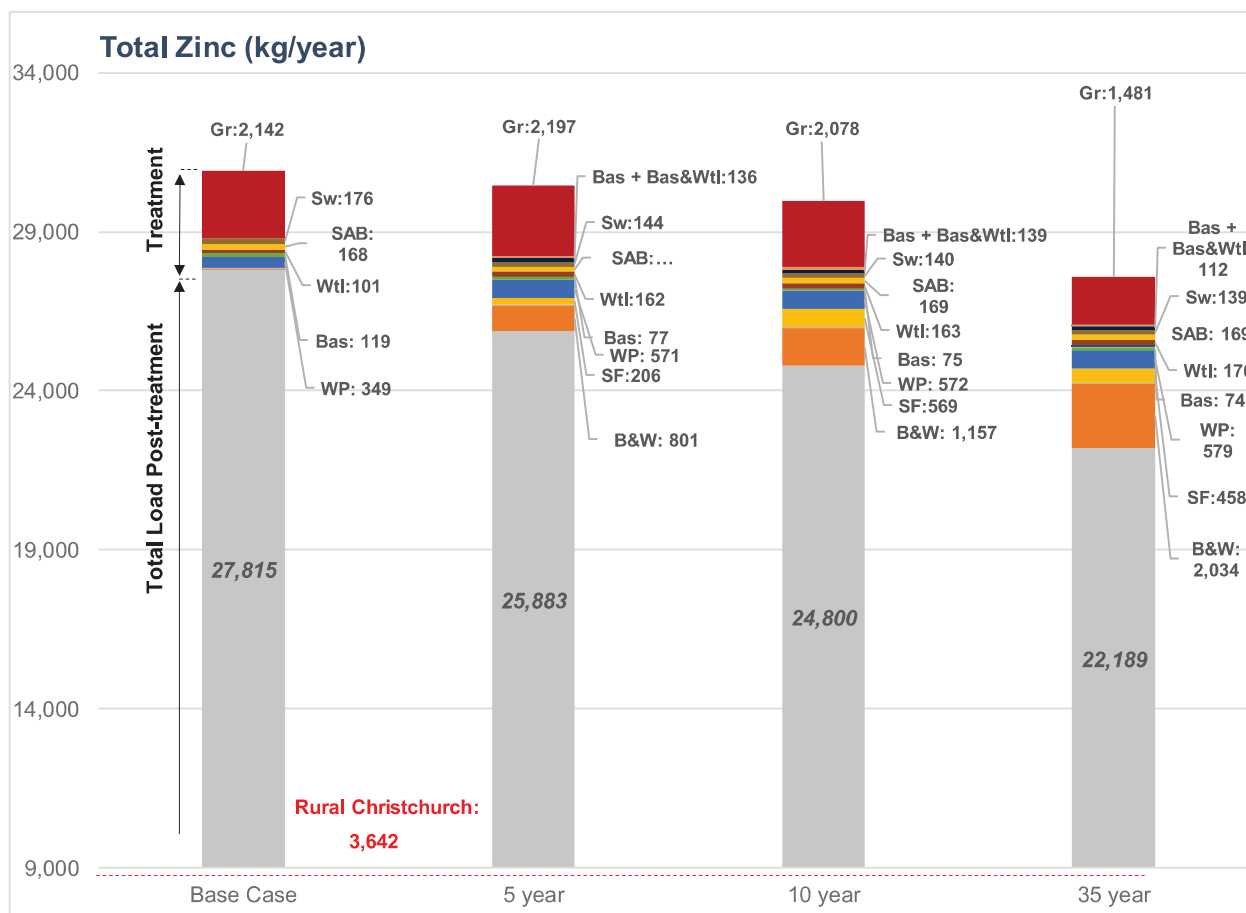


Figure 8: Modelled routine roof replacement effect (top pane: no routine roof replacement; bottom pane: roof replacement in Best Practice).

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 General

A reduction of the contaminant load in stormwater runoff can be achieved in various ways, either by source control options or stormwater treatment. The Christchurch contaminant load model (C-CLM) has been used in this study to assess the annual contaminant load of sediment (total suspended solids, TSS), total zinc and total copper for each of the identified stormwater sub-catchments. The C-CLM was used to evaluate a reduction of catchment-wide contaminant loads in the next 35 years for a Best Practice Infrastructure scenario.

6.2 Conclusions

From the C-CLM modelling and high-level literature review the following conclusions can be drawn regarding Christchurch's stormwater contaminant loadings to the city's four main streams/river systems:

- **Best Practice Infrastructure:** Urban development (renewal and densification) is expected to result in approximately 2 % in reduction of TSS due to a reduction in areas of bare soil, without additional treatment. Total copper and total zinc loads are expected to reduce by 9 % and 22 % respectively mainly because of use of improved roof types. Routine roof replacement of existing and remaining roofs to a pre-painted steel roof under the Best Practice Infrastructure development scenario (not related to urban renewal), will cause about 11 % reduction of total zinc load. Much less reduction effects are expected for TSS and total copper. Stormwater treatment will remove about 29 % of TSS, 31 % of total copper and 21 % of total zinc after full implementation of currently planned treatment systems in the next 35 years.

6.3 Recommendations

It is recommended that the C-CLM model predictions in this report are used to indicatively assess the relative benefits that land use and treatment changes offers with respect to the CCC achieving future stormwater contaminant load reduction targets. Furthermore, it is recommended that the model can be used as a screening tool for prioritising sub-catchments and sources of contaminants. This could inform a more detailed analysis of priority sub-catchments, as well as monitoring programme development, and assessment of stormwater management infrastructure.

It is considered that the C-CLM is appropriate for the above recommended uses and for projecting annual average contaminant load reductions for various catchments throughout Christchurch City, for the purpose of setting targets for the CSNDC.

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APPENDIX A

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APPENDIX B

**C-CLM Stormwater
Subcatchments and Predicted
Loads**

River	Sub-catchment	Area (ha)	TSS in Base Case (tonne/year)	Zinc in Base Case (kg/year)	Copper in Base Case (kg/year)	TSS in 5 Year Case (tonne/year)	Zinc in 5 Year Case (kg/year)	Copper in 5 Year Case (kg/year)	TSS in 10 Year Case (tonne/year)	Zinc in 10 Year Case (kg/year)	Copper in 10 Year Case (kg/year)	TSS in 35 Year Case (tonne/year)	Zinc in 35 Year Case (kg/year)	Copper in 35 Year Case (kg/year)
Styx	Hussey Swale	141	24	69	9	24	69	9	24	69	9	24	69	10
Styx	Ka Putahi	497	102	604	99	93	435	66	77	319	43	77	230	32
Styx	Kainga	907	163	465	80	163	421	73	164	373	65	154	123	19
Styx	Kruses Drain	389	94	554	78	94	551	78	83	477	76	24	246	30
Styx	Lower Styx	1781	402	207	70	402	206	70	402	201	70	402	191	72
Styx	Middle Styx	274	62	148	20	61	153	20	60	157	21	56	177	24
Styx	Northwood	73	2	36	4	2	36	4	2	35	4	2	33	4
Styx	Prestons Creek	90	23	119	14	23	120	14	18	113	14	5	45	5
Styx	Railway Drain	148	34	288	35	34	287	35	33	278	35	33	215	35
Styx	Redwood	118	35	56	8	18	54	7	12	52	6	6	34	4
Styx	Rhodes Drain	169	29	33	3	29	33	3	29	31	3	29	25	3
Styx	Smacks Creek	57	13	28	5	13	28	5	13	27	5	13	25	5
Styx	Styx Drain	343	82	330	33	28	213	13	28	209	13	26	137	16
Styx	Upper Styx	380	83	290	45	71	251	39	68	205	28	68	140	25
Avon	Addington	289	75	572	94	75	563	94	47	431	54	47	372	54
Avon	Airport	518	1	5	2	1	5	2	1	5	2	1	5	2
Avon	Antigua	174	43	417	54	31	363	40	31	349	40	30	262	40
Avon	Avon A	149	38	197	25	38	187	24	37	179	24	37	154	23

River	Sub-catchment	Area (ha)	TSS in Base Case (tonne/year)	Zinc in Base Case (kg/year)	Copper in Base Case (kg/year)	TSS in 5 Year Case (tonne/year)	Zinc in 5 Year Case (kg/year)	Copper in 5 Year Case (kg/year)	TSS in 10 Year Case (tonne/year)	Zinc in 10 Year Case (kg/year)	Copper in 10 Year Case (kg/year)	TSS in 35 Year Case (tonne/year)	Zinc in 35 Year Case (kg/year)	Copper in 35 Year Case (kg/year)
Avon	Avon B	537	132	744	112	127	729	109	126	699	108	124	557	108
Avon	Avondale	106	28	85	11	28	85	11	28	85	11	19	39	6
Avon	Avonside	293	79	418	67	71	393	59	71	385	59	67	311	56
Avon	Brittans	345	86	635	82	85	622	81	85	613	81	56	414	57
Avon	Burwood	95	23	145	18	23	144	18	23	134	18	23	121	18
Avon	Cranford	798	186	894	90	185	869	91	127	739	73	40	339	32
Avon	Cross	200	49	284	25	48	274	25	48	261	25	47	206	25
Avon	Dallington	235	67	159	21	67	156	21	67	145	21	59	88	15
Avon	Diversion	262	68	306	42	56	251	39	36	188	24	36	165	24
Avon	Dudley	270	65	459	48	65	447	48	48	373	37	45	341	36
Avon	Estuary	318	78	348	66	70	336	63	70	330	63	70	305	62
Avon	Frees	277	71	558	77	71	539	77	71	520	77	71	396	76
Avon	Hewlings	84	23	96	14	23	96	14	23	94	14	22	65	14
Avon	Ilam	310	63	319	35	63	319	35	63	317	35	62	263	35
Avon	Knights	183	46	267	43	42	253	40	41	243	40	13	120	17
Avon	New Brighton	433	95	671	83	92	655	83	92	640	82	79	544	74
Avon	No. 2 Drain	267	50	82	17	50	82	17	17	51	6	17	49	7
Avon	Park	85	28	20	6	28	20	6	28	20	6	28	20	6
Avon	Riccarton	321	76	552	60	75	523	59	34	382	27	33	273	27
Avon	Richmond	149	37	264	29	37	249	29	37	232	29	27	96	20
Avon	Shirley	181	46	182	22	44	173	22	42	158	21	38	147	21

River	Sub-catchment	Area (ha)	TSS in Base Case (tonne/year)	Zinc in Base Case (kg/year)	Copper in Base Case (kg/year)	TSS in 5 Year Case (tonne/year)	Zinc in 5 Year Case (kg/year)	Copper in 5 Year Case (kg/year)	TSS in 10 Year Case (tonne/year)	Zinc in 10 Year Case (kg/year)	Copper in 10 Year Case (kg/year)	TSS in 35 Year Case (tonne/year)	Zinc in 35 Year Case (kg/year)	Copper in 35 Year Case (kg/year)
Avon	Snellings	439	68	307	40	68	309	40	66	305	39	65	288	40
Avon	St Albans	235	52	500	45	52	484	45	51	470	45	47	371	43
Avon	Travis	319	93	231	36	88	230	36	88	228	36	80	190	31
Avon	Waimariri A	262	70	350	38	70	345	38	70	324	38	69	243	37
Avon	Waimariri B	329	68	160	16	68	160	16	68	157	16	65	121	16
Avon	Wairarapa A	357	91	395	42	91	386	42	90	361	41	90	320	41
Avon	Wairarapa B	398	84	834	128	84	798	121	76	664	89	76	466	75
Avon	Winchester	88	20	135	17	20	129	17	20	116	17	20	77	16
Heathcote	Aidanfield	54	5	108	6	2	72	2	2	71	2	2	68	2
Heathcote	Avoca Valley and Butts Valley	529	115	355	59	115	353	59	115	348	59	115	335	59
Heathcote	Ballintines Drain	102	25	119	10	25	119	10	24	100	10	24	63	10
Heathcote	Bells Creek	241	61	544	72	24	391	30	24	380	30	24	290	29
Heathcote	Bridle Path	630	133	368	58	133	367	58	133	363	58	133	345	58
Heathcote	Cashmere Valley	544	115	74	12	111	73	12	108	71	12	108	64	12
Heathcote	Curletts Drain	356	91	1074	157	41	634	63	41	624	62	41	577	62
Heathcote	Curries and Jardens Drains	404	94	959	147	93	946	146	93	927	144	93	820	135
Heathcote	Dyers / Hackthorne	105	28	111	8	28	107	8	28	103	8	27	91	8

River	Sub-catchment	Area (ha)	TSS in Base Case (tonne/year)	Zinc in Base Case (kg/year)	Copper in Base Case (kg/year)	TSS in 5 Year Case (tonne/year)	Zinc in 5 Year Case (kg/year)	Copper in 5 Year Case (kg/year)	TSS in 10 Year Case (tonne/year)	Zinc in 10 Year Case (kg/year)	Copper in 10 Year Case (kg/year)	TSS in 35 Year Case (tonne/year)	Zinc in 35 Year Case (kg/year)	Copper in 35 Year Case (kg/year)
Heathcote	Halswell	177	29	225	22	26	225	21	26	222	22	25	197	23
Heathcote	Haytons Stream	672	41	211	29	36	200	27	36	201	27	36	180	28
Heathcote	Heathcote River Corridor	242	62	292	45	59	270	40	58	259	40	58	213	39
Heathcote	Hendersons Basin	279	53	34	6	44	32	6	44	31	6	43	31	7
Heathcote	Hendersons Road	134	40	45	12	11	31	5	11	34	5	10	37	6
Heathcote	Hoon Hay Valley	701	153	38	5	47	28	3	47	29	3	47	29	3
Heathcote	Jacksons Creek	355	82	674	64	82	640	64	82	602	63	82	422	62
Heathcote	Luneys Drain	64	15	35	3	15	35	3	15	35	3	14	25	3
Heathcote	Milns	42	13	4	1	2	3	0	2	4	1	2	8	1
Heathcote	Paparua Stream	1558	244	1850	255	174	1635	200	173	1617	200	171	1533	202
Heathcote	Sherrings Drain	84	23	86	9	20	75	7	20	73	7	20	39	7
Heathcote	Sibleys and Scotts Drains	662	182	326	19	182	320	19	181	310	19	181	255	19
Heathcote	Steam Wharf Stream	97	28	108	18	28	107	18	28	106	18	28	97	17
Heathcote	Sutherlands	191	52	25	3	18	20	2	18	21	3	16	27	4

River	Sub-catchment	Area (ha)	TSS in Base Case (tonne/year)	Zinc in Base Case (kg/year)	Copper in Base Case (kg/year)	TSS in 5 Year Case (tonne/year)	Zinc in 5 Year Case (kg/year)	Copper in 5 Year Case (kg/year)	TSS in 10 Year Case (tonne/year)	Zinc in 10 Year Case (kg/year)	Copper in 10 Year Case (kg/year)	TSS in 35 Year Case (tonne/year)	Zinc in 35 Year Case (kg/year)	Copper in 35 Year Case (kg/year)
Heathcote	Victory Drain	496	143	139	14	143	136	14	143	127	14	143	106	14
Heathcote	Waltham	415	99	1051	124	97	1009	117	97	988	117	96	821	115
Heathcote	Westlake	39	4	62	5	4	62	5	4	61	5	4	46	5
Heathcote	Wilderness Drain	480	113	931	100	112	907	99	112	882	99	111	765	98
Heathcote	Worsleys Valley	374	76	78	3	71	78	3	65	78	3	64	79	4
Halswell	Cares Drain	81	14	7	1	14	7	1	14	7	1	14	6	1
Halswell	Carrs Road	132	17	90	16	8	35	7	8	33	7	8	24	6
Halswell	Chesmars Drain	154	26	19	2	26	18	2	26	18	2	26	14	2
Halswell	Creamery Stream	258	57	71	10	29	74	10	29	79	11	27	100	15
Halswell	Halswell Quarry	219	41	65	6	38	62	6	32	58	5	31	54	7
Halswell	Halswell Rentention Basin	240	36	1010	136	36	1004	135	36	1003	135	36	985	135
Halswell	Knights Confluence	34	6	4	1	6	4	1	6	4	1	6	4	1
Halswell	Knights Stream Headwaters	89	15	177	32	15	162	29	15	148	27	16	74	14
Halswell	Landsdowne Valley	736	133	54	6	116	51	5	116	50	5	116	46	6
Halswell	Marshs Road	203	25	61	12	25	59	12	25	57	11	25	42	10

River	Sub-catchment	Area (ha)	TSS in Base Case (tonne/year)	Zinc in Base Case (kg/year)	Copper in Base Case (kg/year)	TSS in 5 Year Case (tonne/year)	Zinc in 5 Year Case (kg/year)	Copper in 5 Year Case (kg/year)	TSS in 10 Year Case (tonne/year)	Zinc in 10 Year Case (kg/year)	Copper in 10 Year Case (kg/year)	TSS in 35 Year Case (tonne/year)	Zinc in 35 Year Case (kg/year)	Copper in 35 Year Case (kg/year)
Halswell	Nottingham Headwaters	130	31	269	29	31	269	29	31	267	29	31	237	29
Halswell	Nottingham Stream	52	16	60	8	15	59	8	12	57	8	12	53	8
Halswell	Owaka	53	11	248	46	7	118	22	7	106	20	8	44	9
Halswell	West Hornby	360	58	936	172	59	851	157	59	764	141	63	331	64

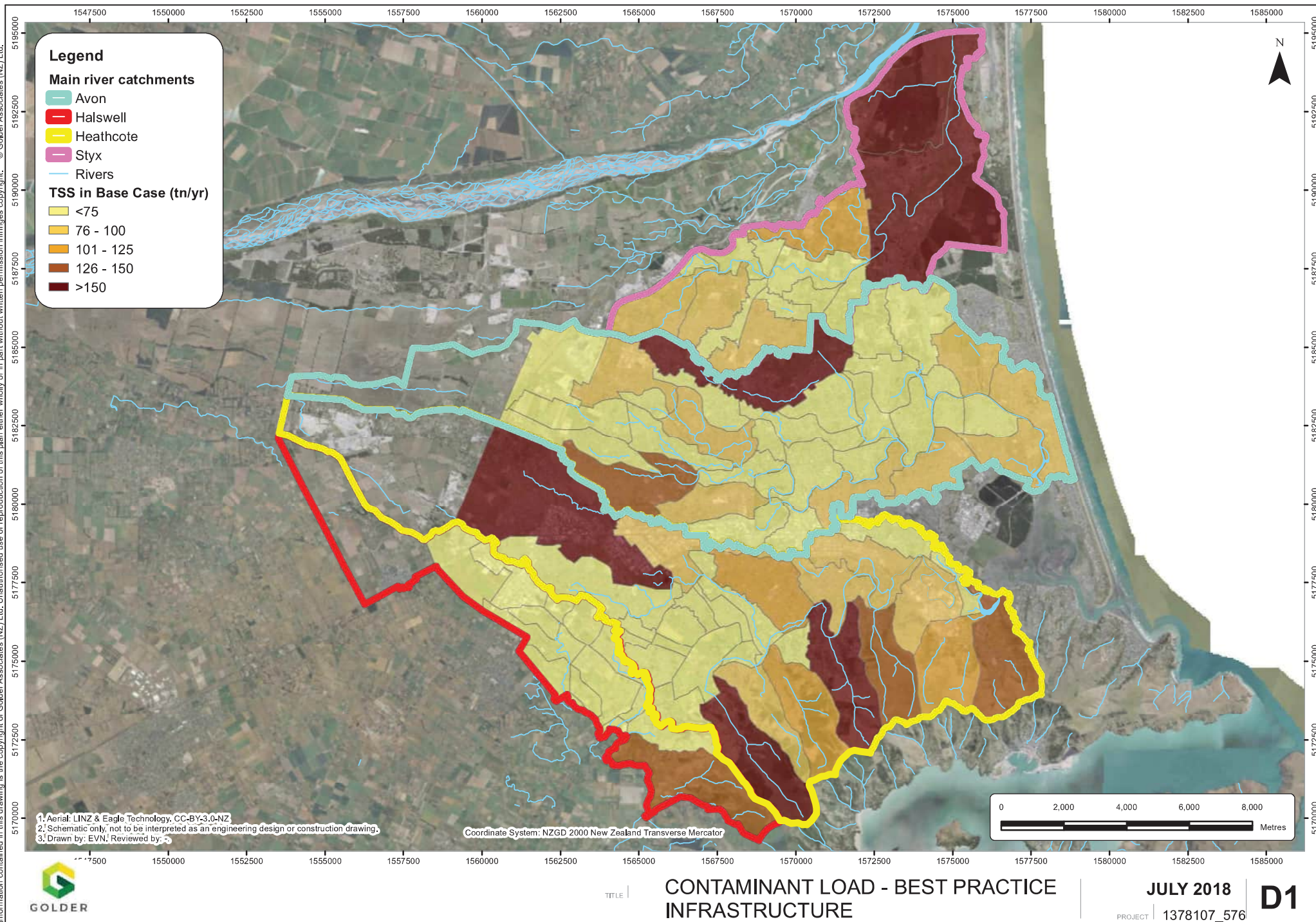
APPENDIX C

**Projected City-wide Annual
Contaminant Loads for Best
Practice Infrastructure Scenario**

TSS (t/yr)				
Scenario	Year	Total Load without Treatment	Total Load Post-treatment	% Removed
Base Case	Jan-2017	6,657	5,857	12%
5 year	Jan-2022	6,642	5,266	21%
10 year	Jan-2027	6,619	4,984	25%
35 year	Jan-2052	6,546	4,660	29%
ZINC (kg/yr)				
Scenario	Year	Total Load without Treatment	Total Load Post-treatment	% Removed
Base Case	Jan-2017	30,925	27,815	10%
5 year	Jan-2022	30,239	25,679	15%
10 year	Jan-2027	29,180	24,058	18%
35 year	Jan-2052	23,978	18,995	21%
COPPER (kg/yr)				
Scenario	Year	Total Load without Treatment	Total Load Post-treatment	% Removed
Base Case	Jan-2017	4,444	3,751	16%
5 year	Jan-2022	4,387	3,362	23%
10 year	Jan-2027	4,328	3,132	28%
35 year	Jan-2052	4,045	2,775	31%

APPENDIX D

**Projected Annual Contaminant
Loads for Best Practice
Infrastructure Scenario Maps**



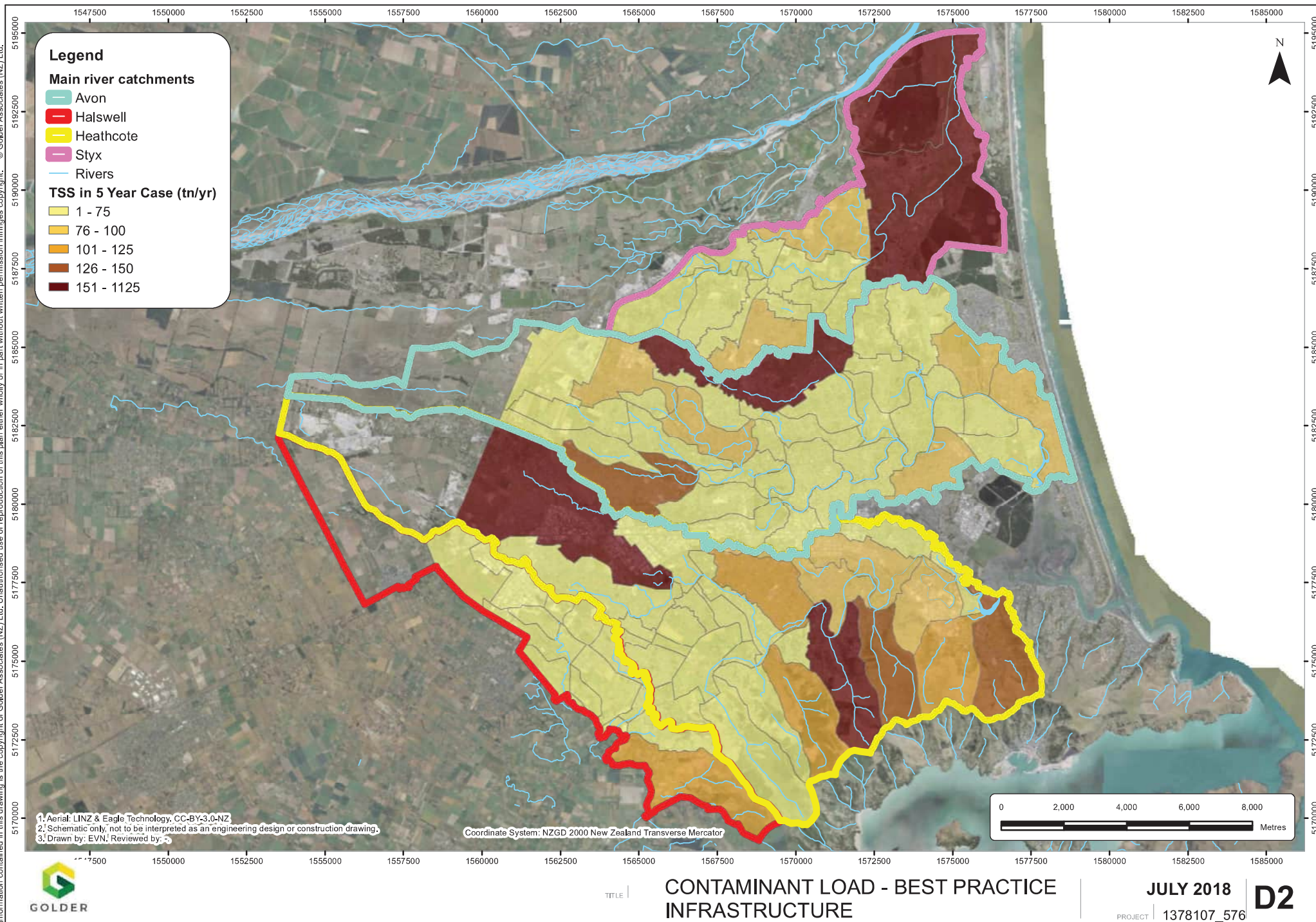
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**CONTAMINANT LOAD - BEST PRACTICE
INFRASTRUCTURE**

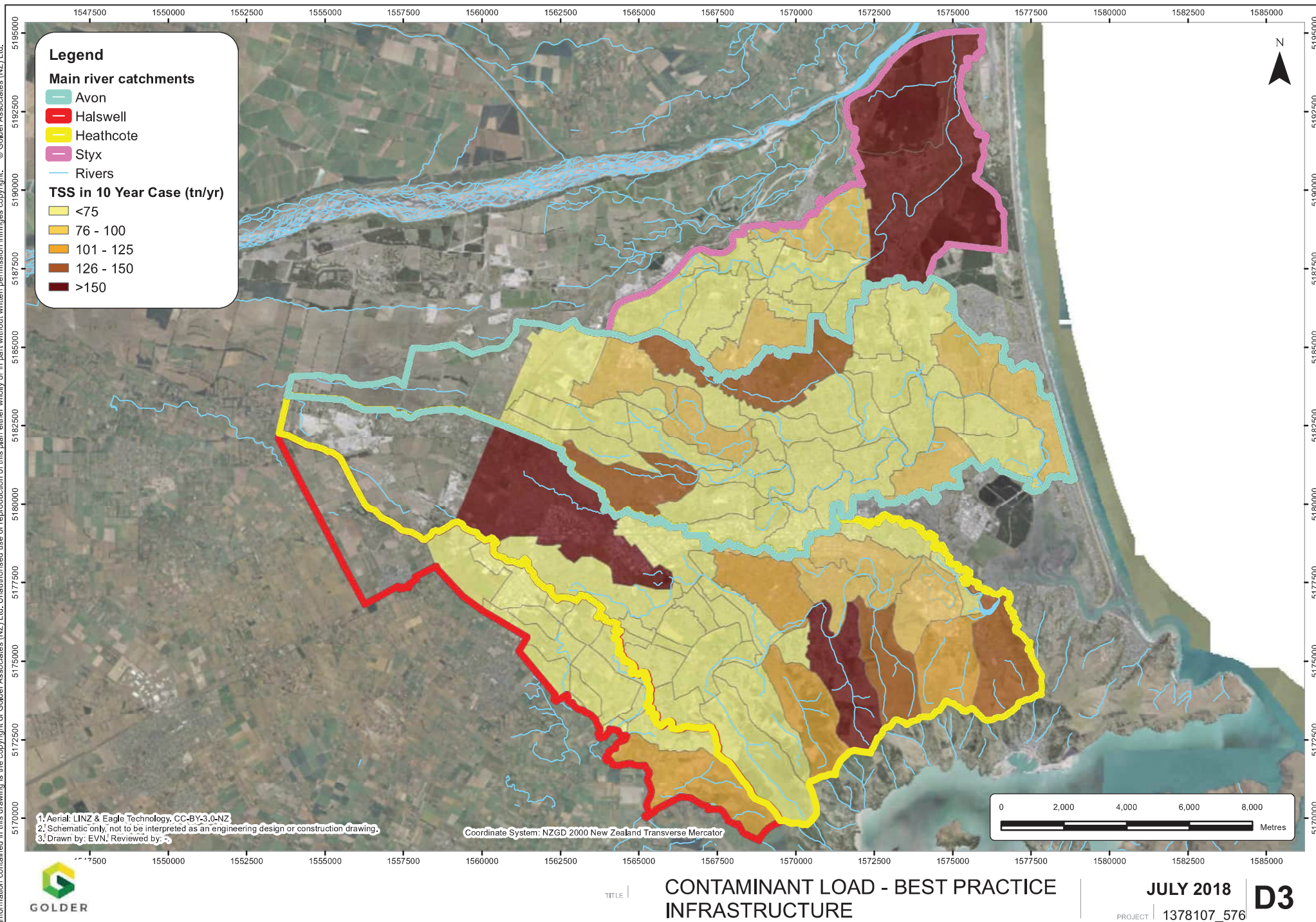
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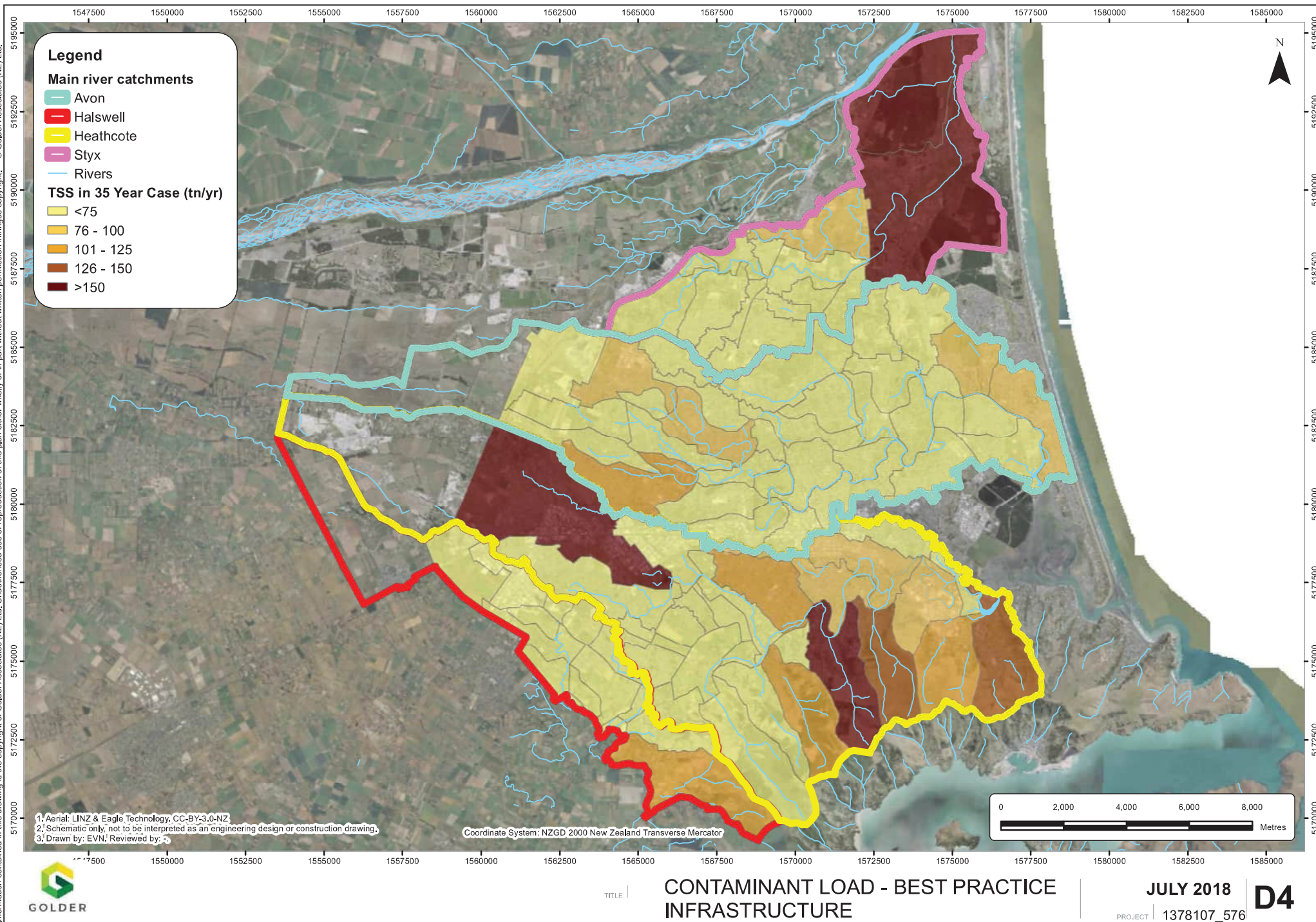
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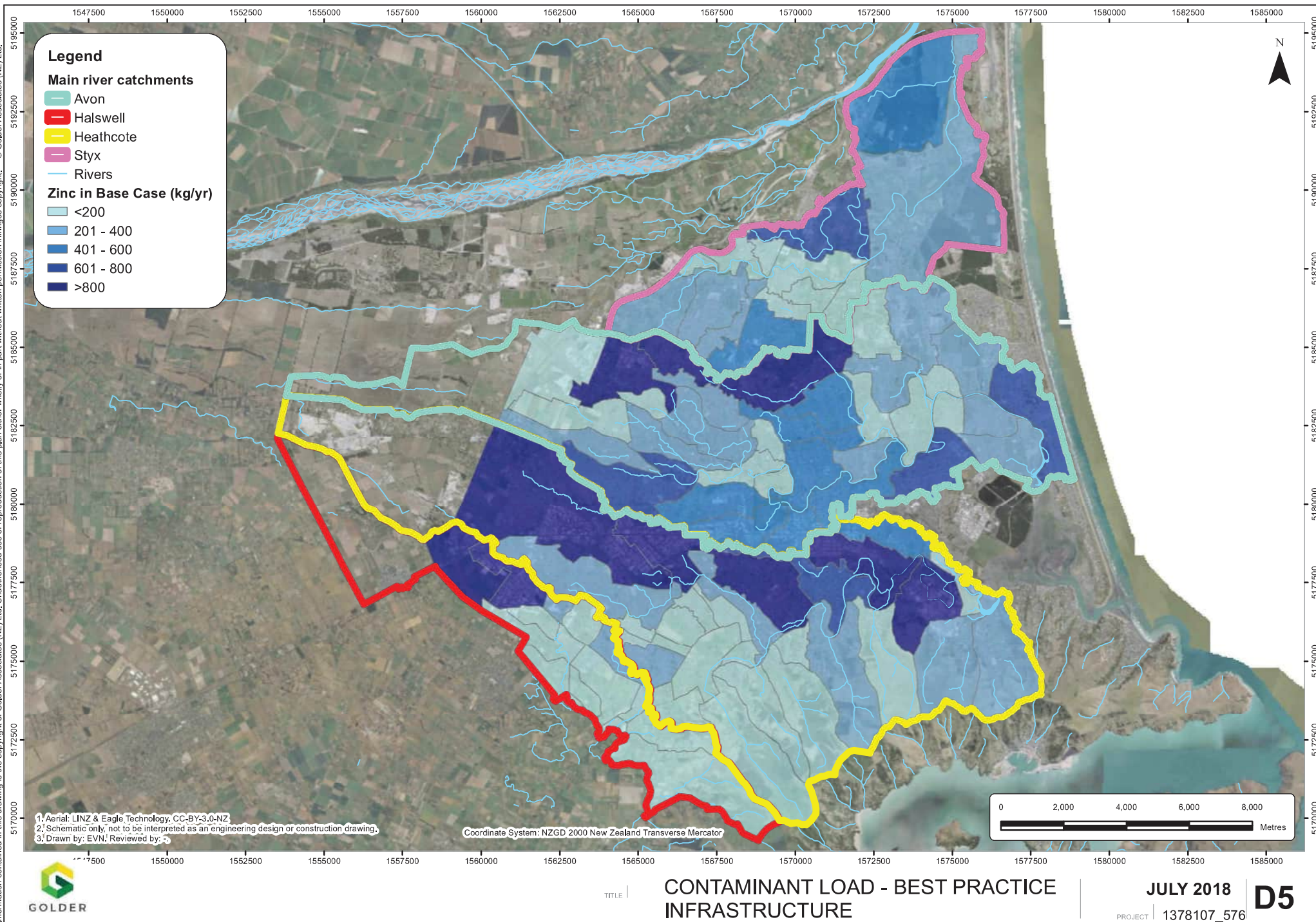


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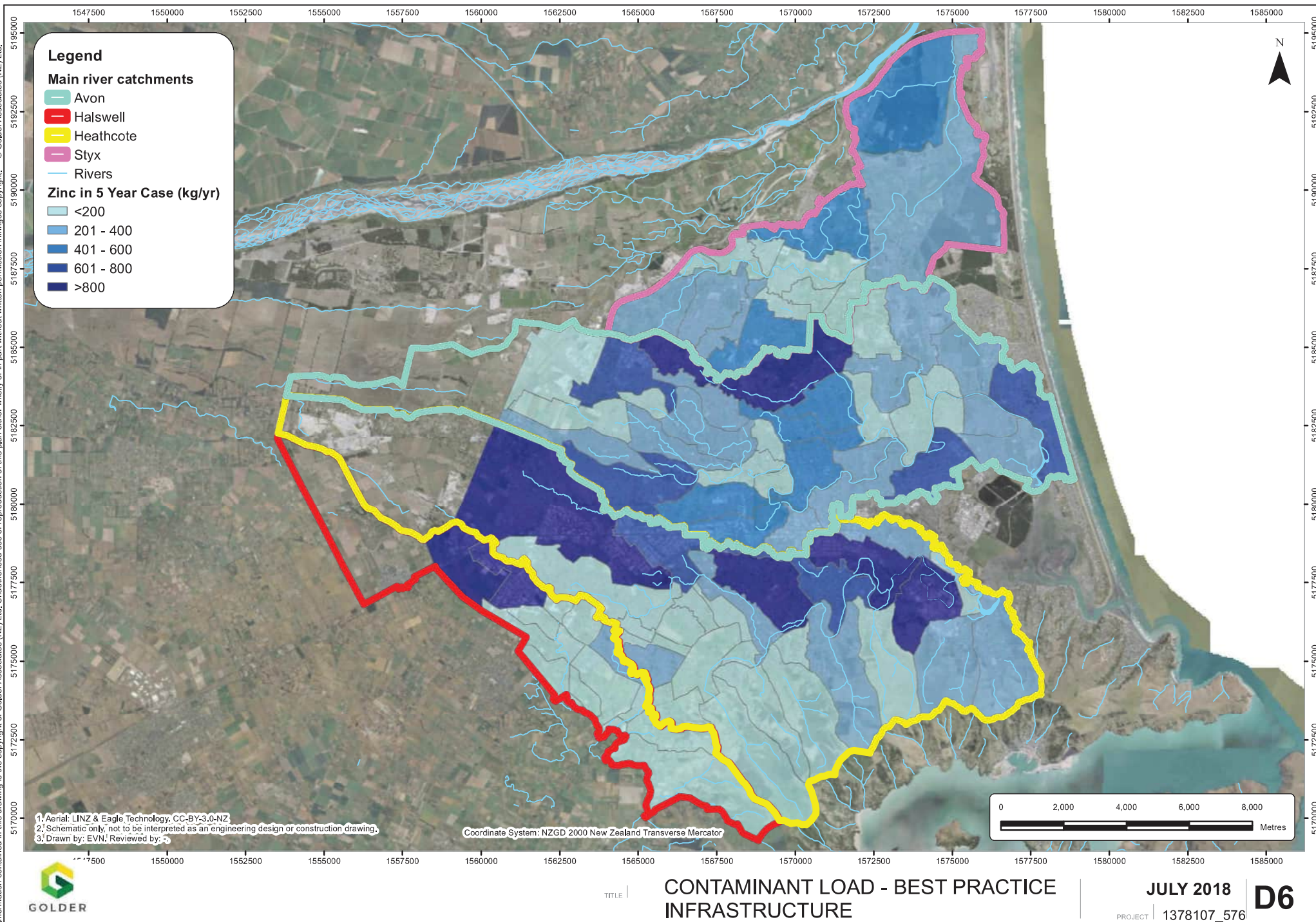
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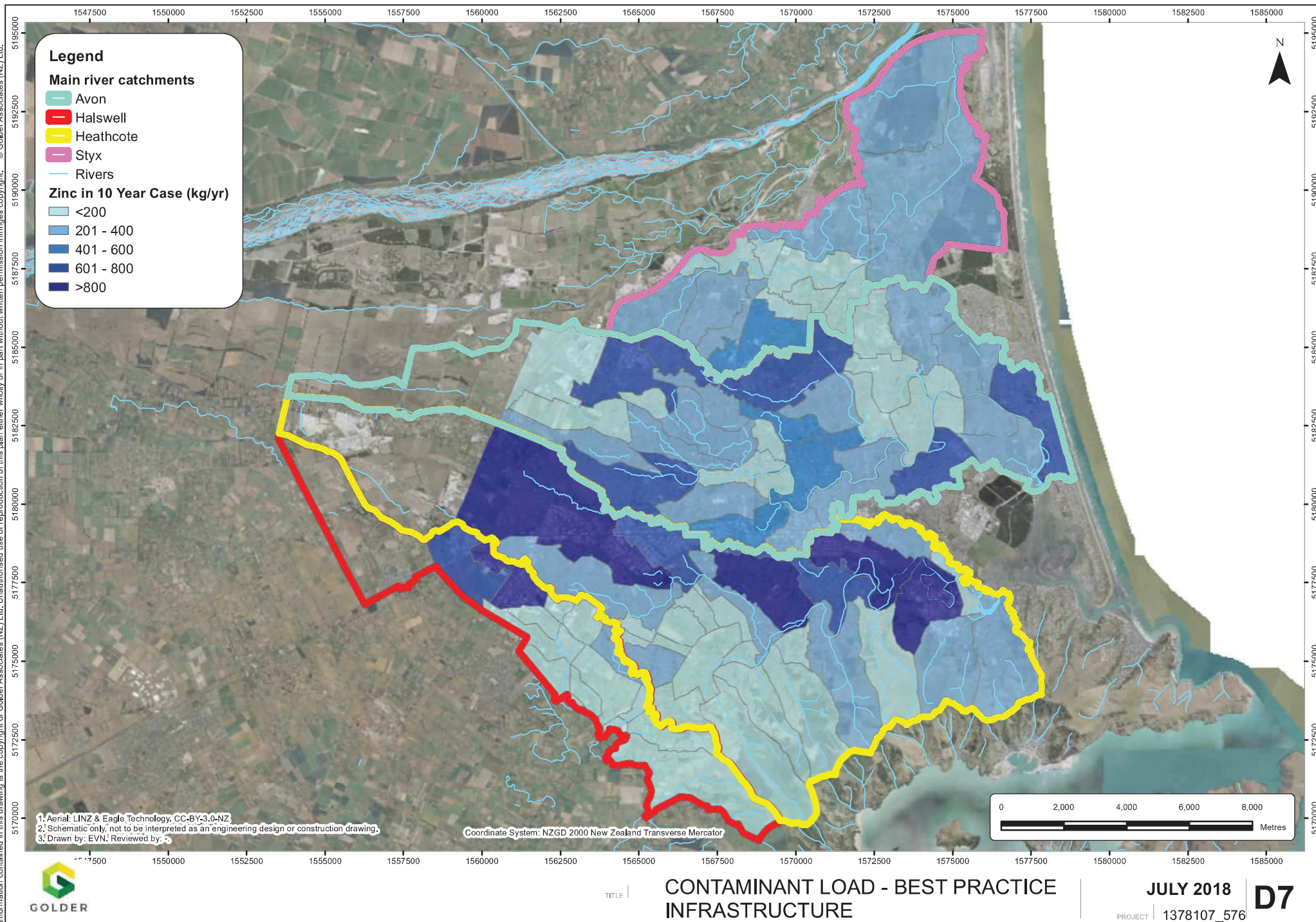
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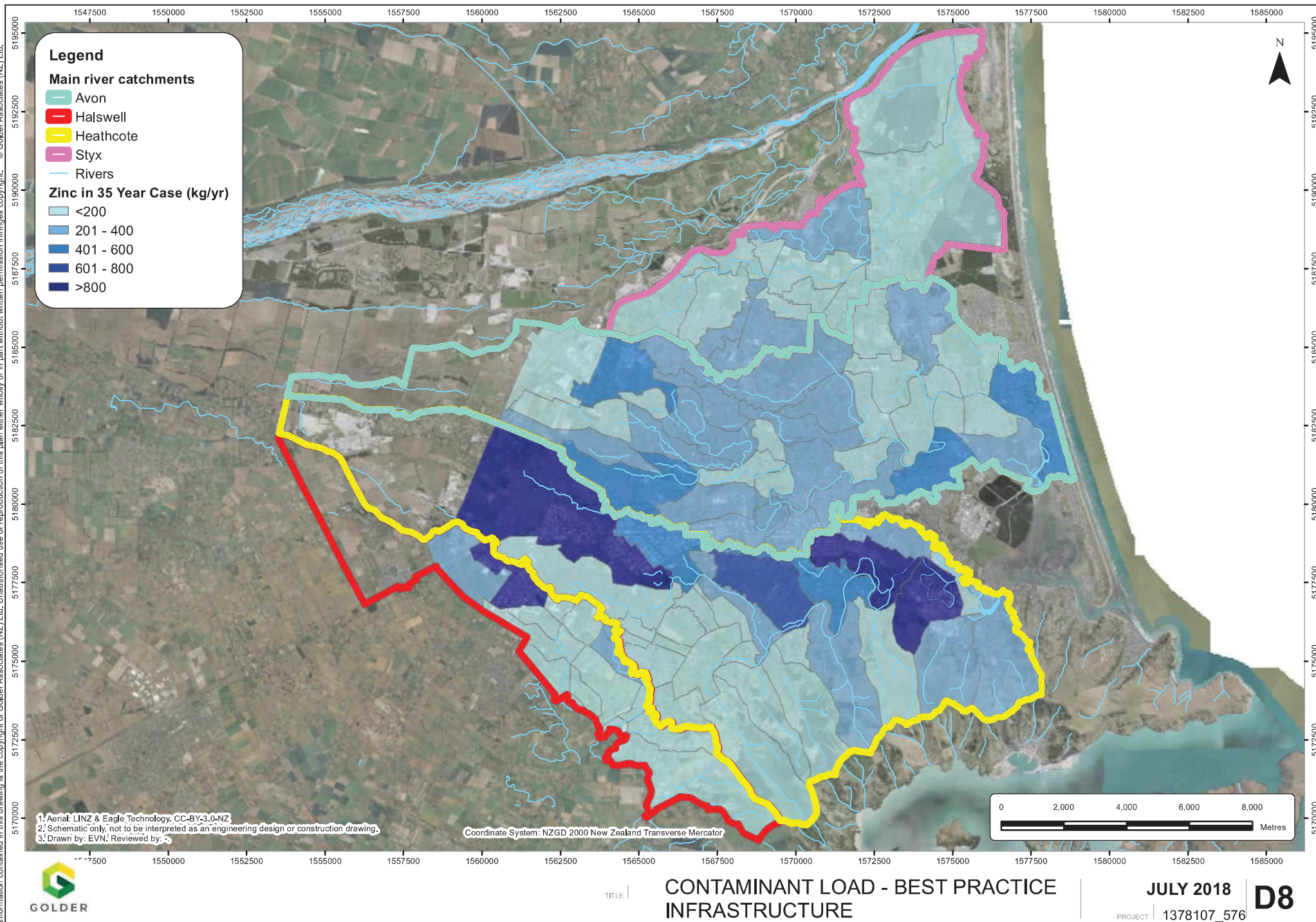
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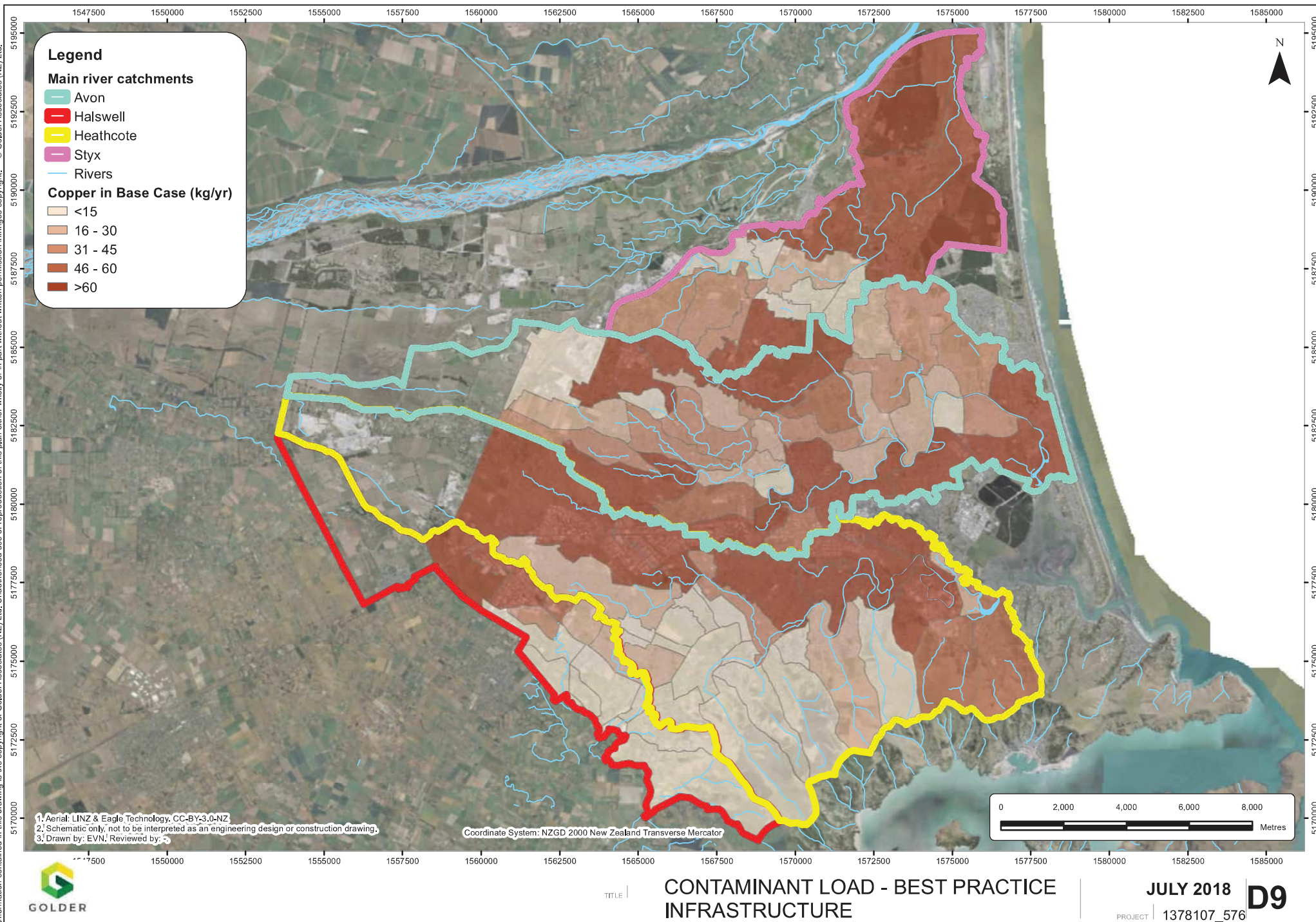
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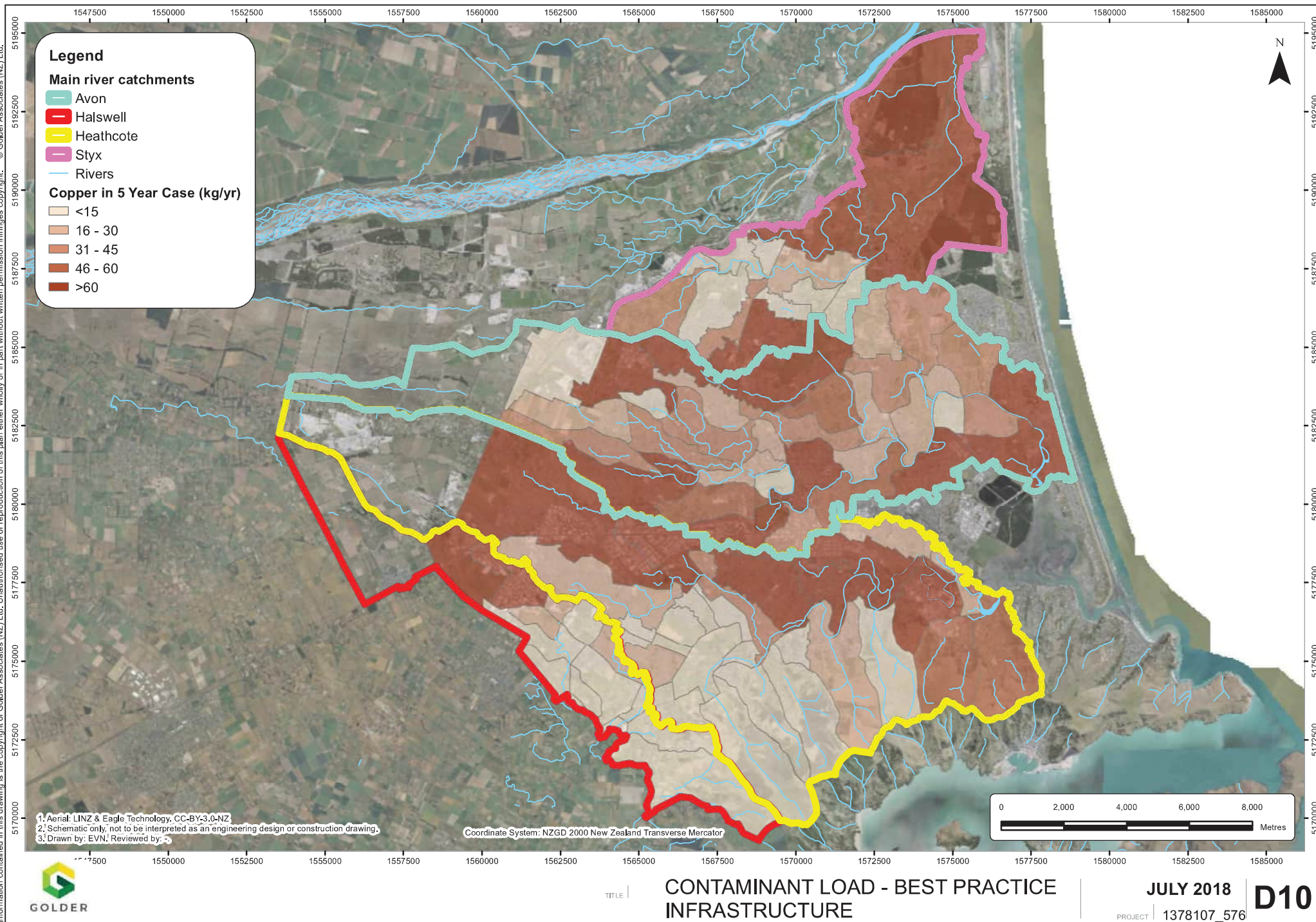
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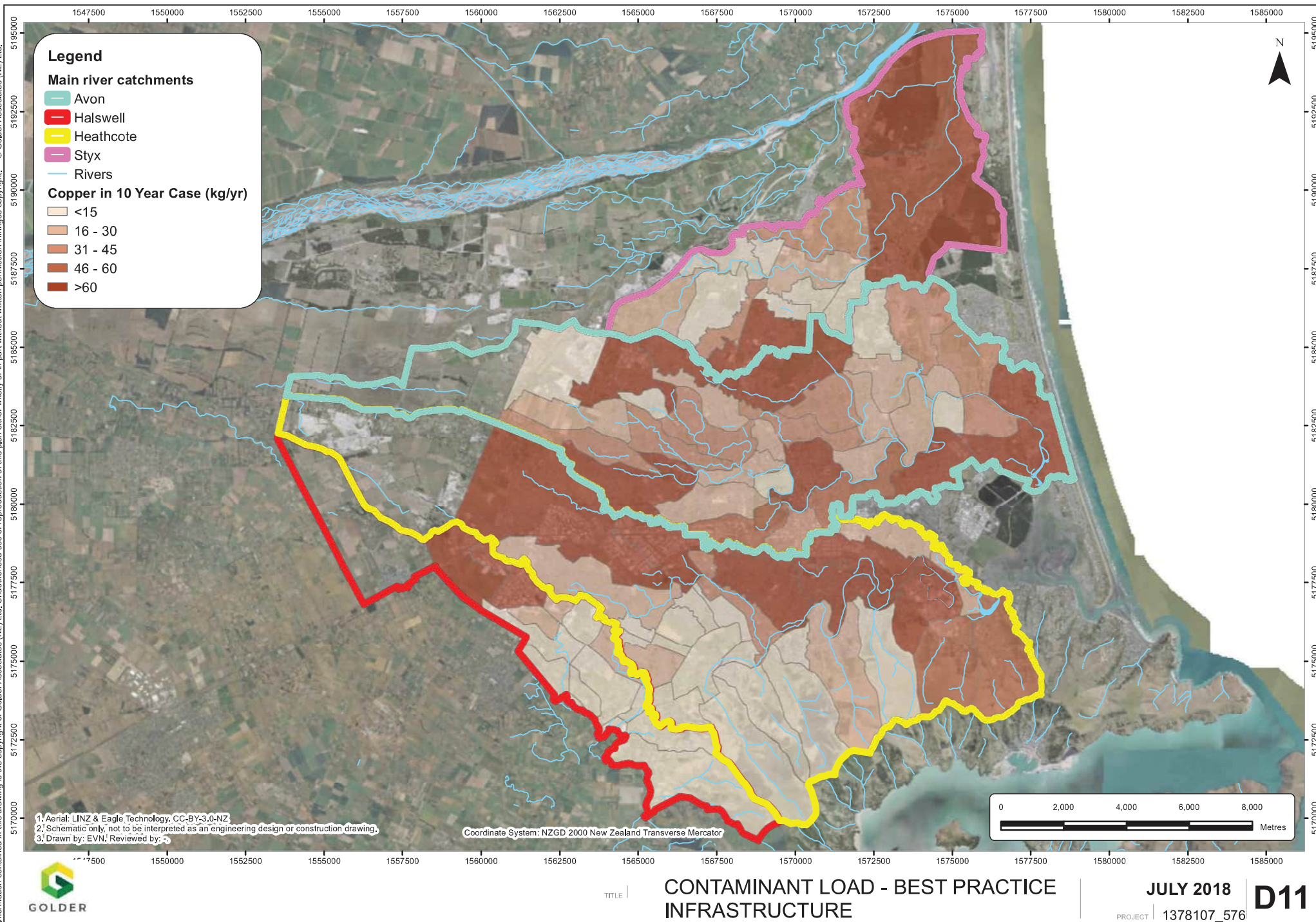
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**CONTAMINANT LOAD - BEST PRACTICE
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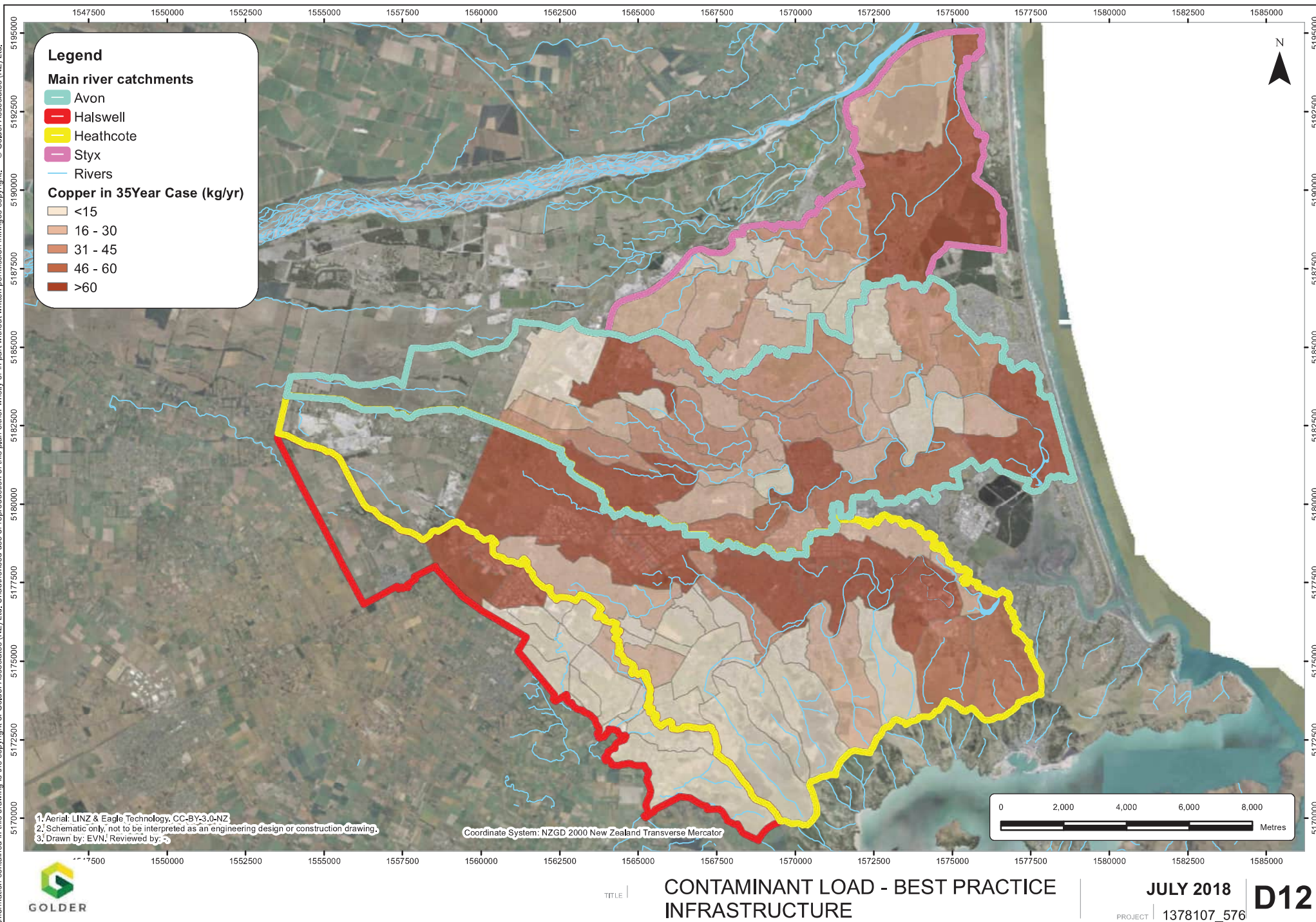


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INFRASTRUCTURE

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Schedule 6: General City Conditions – Water Quality and Quantity

This table indicates minimum requirements to enable discharges under this consent from greenfield developments and re-developments in areas not yet covered by a Stormwater Management Plan. Until 1 January 2025, for any development where the Christchurch City Council (CCC) considers there are factors that require Canterbury Regional Council input it can choose to not accept a proposed discharge to its network, and therefore a consent from the Regional Council would be required. The CCC may also require a higher standard than is represented in the table below in order to mitigate effects on the network or if any special conditions exist.

Source of Stormwater Discharge(s)	SMALL SITES Total area of disturbance does not exceed 1,000m ²	LARGE SITES Total area of disturbance equals, or is greater than 1,000m ²
From/during land disturbance activities	Erosion and Sediment Control Plan is required	Erosion and Sediment Control Plan is required
From new / re-development residential roof and hardstand areas	No discharge onto or into land where average site slope exceeds 5 degrees Sumps collecting runoff from new hardstand areas shall be fitted with submerged or trapped outlets wherever practicable An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required for sites in the flat** On-site rain water storage is required for new and redevelopment sites on the hills	No discharge onto or into land where average site slope exceeds 5 degrees First flush treatment is required for stormwater runoff from new hardstand areas in excess of 150m² and buildings with copper or uncoated galvanised metal roofs or guttering/spouting* An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required for sites in the flat** On-site rain water storage is required for new and redevelopment sites on the hills
From new / re-development non-residential roof and hardstand areas	No discharge onto or into land where average site slope exceeds 5 degrees First flush treatment is required for stormwater runoff from new hardstand areas in excess of 150m², buildings with copper or uncoated galvanised roofs or guttering/spouting and high-use sites An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required** Site management and spill procedures required for sites that engage in hazardous activities***	No discharge onto or into land where average site slope exceeds 5 degrees First flush treatment is required for stormwater runoff from new hardstand areas in excess of 150m², buildings with copper or uncoated galvanised roofs or guttering/spouting and high-use sites An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required** Site management and spill procedures required for sites that engage in hazardous activities***

* CCC has discretion to waive the requirement for first flush treatment of hardstand areas on large residential sites where the amount of pollution-generating hardstand being added is considered to have less than minor effect. "Uncoated" means without a painted or enamelled coating.

** Quantity assessment and mitigation - The effects of the discharge on the stormwater network capacity and/or the extent or duration of flooding on downstream properties are to be assessed. Where CCC considers an increase (including cumulative increases) has a more than minor effect, onsite stormwater attenuation or stormwater network upgrade shall be provided. The details of storage volume and peak discharges or network capacity required to mitigate effects on flooding or network capacity constraints shall be determined by the Christchurch City Council Planning Engineer.

*** Site management and spill procedures – Procedures are to be implemented to prevent the discharge of hazardous substances or spilled contaminants discharging into any land or surface waters via any conveyance path.

Schedule 7: Receiving Environment Objectives and Attribute Target Levels for Waterways

- The EMP outlines the methodology for the monitoring of Attributes and how these will be compared against Attribute Target Levels.
- TBC-A = To Be Confirmed once a full year of monitoring allows hardness modified values to be calculated, in accordance with Condition 51.
- TBC-B = To Be Confirmed following engagement with Papatipu Rūnanga, through an update to the EMP, in accordance with Condition 53.

Objective	Attribute	Attribute Target Level	Basis for Target
Adverse effects on ecological values do not occur due to stormwater inputs	QMCI	Lower limit QMCI scores: • Spring-fed – plains – urban waterways: 3.5 • Spring-fed – plains waterways: 5 • Banks Peninsula waterways: 5	QMCI is an indicator of aquatic ecological health, with higher numbers indicative of better quality habitats, due to a higher abundance of more sensitive species. QMCI scores are taken from the guidelines in Table 1a of the LWRP (Canterbury Regional Council, 2018). This metric is designed for wade able sites and should therefore be used with caution for non-wade able sites. These targets can be achieved through reducing contaminant loads and waterway restoration.
Adverse effects on water clarity and aquatic biota do not occur due to sediment inputs	Fine sediment (<2 mm diameter) percent cover of stream bed TSS concentrations in surface water	Upper limit fine sediment percent cover of stream bed: • Spring-fed – plains – urban waterways: 30% • Spring-fed – plains waterways: 20% • Banks Peninsula waterways: 20% Upper limit concentration of TSS in surface water: 25 mg/L No statistically significant increase in TSS concentrations in surface water	Sediment (particularly from construction) can decrease the clarity of the water, and can negatively affect the photosynthesis of plants and therefore primary productivity within streams, interfere with feeding through the smothering of food supply, and can clog suitable habitat for species. The sediment cover Target Levels are taken from the standards for the original Styx and South-West Stormwater Management Plan consents, and are based on Table 1a of the LWRP (Canterbury Regional Council, 2018). These targets should be used with caution at sites that likely naturally have soft-bottom channels. These targets can be achieved through reducing contaminant loads (particularly using erosion and sediment control) and instream sediment removal.
Adverse effects on aquatic biota do not occur due to copper, lead and zinc inputs in surface water	Zinc, copper and lead concentrations in surface water	Upper limit concentration of dissolved zinc: • Ōtākaro/ Avon River catchment: 0.0297 mg/L • Ōpāwaho/ Heathcote River catchment: 0.04526 mg/L • Cashmere Stream: 0.00724 mg/L • Huritini / Halswell River catchment: 0.01919 mg/L • Pūharakekenui/ Styx River catchment: 0.01214 mg/L • Ōtūkaikino River catchment: 0.00868 mg/L • Linwood Canal: 0.146 mg/L • Banks Peninsula catchments: TBC-A	These metals can be toxic to aquatic organisms, negatively affecting such things as fecundity, maturation, respiration, physical structure and behaviour. The CCC has developed these hardness modified trigger values in accordance with the methodology in the 'Australian and New Zealand Environment and Conservation Council, and Agriculture and Resource Management Council of Australia and New Zealand' (ANZECC, 2000) guidelines, and the species protection level relevant to each waterway in the LWRP (Canterbury Regional Council, 2017). This calculation document can be provided on request. These targets can be achieved primarily through reducing contaminant loads.

Objective	Attribute	Attribute Target Level	Basis for Target
		Upper limit concentration of dissolved copper: • Ōtakaro/ Avon River catchment: 0.00356 mg/L • Ōpāwaho/ Heathcote River catchment: 0.00543 mg/L • Cashmere Stream: 0.00302 mg/L • Huritini / Halswell River catchment: 0.00336 mg/L • Pūharakekenui/ Styx River catchment: 0.00212 mg/L • Ōtūkaikino River catchment: 0.00152 mg/L • Linwood Canal: 0.0175 mg/L • Banks Peninsula catchments: TBC-A Upper limit concentration of dissolved lead: • Ōtakaro/ Avon River catchment: 0.01554 mg/L • Ōpāwaho/ Heathcote River catchment: 0.02916 mg/L • Cashmere Stream: 0.00521 mg/L • Huritini / Halswell River catchment: 0.01257 mg/L • Pūharakekenui/ Styx River catchment: 0.00634 mg/L • Ōtūkaikino River catchment: 0.00384 mg/L • Linwood Canal: 0.167 mg/L • Banks Peninsula catchments: TBC-A No statistically significant increase in copper, lead and zinc concentrations	
Excessive growth of macrophytes and filamentous algae does not occur due to nutrient inputs	Total macrophyte and filamentous algae (>20 mm length) cover of stream bed	Upper limit total macrophyte cover of the stream bed: • Spring-fed – plains – urban waterways: 60% • Spring-fed – plains waterways: 50% • Banks Peninsula waterways: 30% Upper limit filamentous algae cover of the stream bed:	Macrophyte and algae cover are indicators of the quality of aquatic habitat. Targets are taken from Table 1a of the LWRP (Canterbury Regional Council, 2018). Improvement towards these targets can be achieved by reduction in nutrient concentrations and riparian planting to shade the waterways.

Objective	Attribute	Attribute Target Level	Basis for Target
		- Spring-fed – plains – urban waterways: 30% - Spring-fed – plains waterways: 30% - Banks Peninsula waterways: 20%	
Adverse effects on aquatic biota do not occur due to zinc, copper, lead and PAHs in instream sediment	Zinc, copper, lead and PAHs concentrations in instream sediment	Upper limit concentration of total recoverable metals for all classifications: - Copper = 65 mg/kg dry weight - Lead = 50 mg/kg dry weight - Zinc = 200 mg/kg dry weight - Total PAHs = 10 mg/kg dry weight No statistically significant increase in copper, lead, zinc and Total PAHs	Meta Metals can bind to sediment and remain in waterways, potentially negatively affecting biota. These trigger values are based on the ANZECC guidelines (ANZECC, 2018). These targets can be achieved through reducing contaminant loads and instream sediment removal.
Adverse effects on Mana Whenua values do not occur due to stormwater inputs	Waterway Cultural Health Index and State of Takiwā scores	Lower limit averaged Waterway Cultural Health Index and State of Takiwā scores for all classifications: - Spring-fed – plains – urban waterways: TBC-B - Spring-fed – plains waterways: TBC-B - Banks Peninsula waterways: TBC-B	The Waterway Cultural Health Index assesses cultural values and indicators of environmental health, such as mahinga kai (food gathering). These indices are on a scale of 1 - 5, with higher scores indicative of greater cultural values. No guidelines are available currently for the different types of waterways, so these targets will be developed specifically for this consent, with higher targets for waterways with higher values. These targets can be achieved through reducing contaminant loads and habitat restoration.

Schedule 7: Receiving Environment Objectives and Attribute Target Levels for Waterways

- The EMP outlines the methodology for the monitoring of Attributes and how these will be compared against Attribute Target Levels.
- Refer to the EMP for the most up to date Attribute Target Levels.

Objective	Attribute	Attribute Target Level	Basis for Target
Adverse effects on ecological values do not occur due to stormwater inputs	QMCI	Lower limit QMCI scores: • Spring-fed – plains – urban waterways: 3.5 • Spring-fed – plains waterways: 5 • Banks Peninsula waterways: 5	QMCI is an indicator of aquatic ecological health, with higher numbers indicative of better quality habitats, due to a higher abundance of more sensitive species. QMCI scores are taken from the guidelines in Table 1a of the LWRP (Canterbury Regional Council, 2018). This metric is designed for wade able sites and should therefore be used with caution for non-wade able sites. These targets can be achieved through reducing contaminant loads and waterway restoration.
Adverse effects on water clarity and aquatic biota do not occur due to sediment inputs	Fine sediment (<2 mm diameter) percent cover of stream bed TSS concentrations in surface water	Upper limit fine sediment percent cover of stream bed: • Spring-fed – plains – urban waterways: 30% • Spring-fed – plains waterways: 20% • Banks Peninsula waterways: 20% Upper limit concentration of TSS in surface water: 25 mg/L No statistically significant increase in TSS concentrations in surface water	Sediment (particularly from construction) can decrease the clarity of the water, and can negatively affect the photosynthesis of plants and therefore primary productivity within streams, interfere with feeding through the smothering of food supply, and can clog suitable habitat for species. The sediment cover Target Levels are taken from the standards for the original Styx and South-West Stormwater Management Plan consents, and are based on Table 1a of the LWRP (Canterbury Regional Council, 2018). These targets should be used with caution at sites that likely naturally have soft-bottom channels. These targets can be achieved through reducing contaminant loads (particularly using erosion and sediment control) and instream sediment removal.
Adverse effects on aquatic biota do not occur due to copper, lead and zinc inputs in surface water	Zinc, copper and lead concentrations in surface water	Upper limit concentration of dissolved zinc: • Ōtākaro/ Avon River catchment: 0.0295 mg/L • Ōpāwaho/ Heathcote River catchment: 0.0396 mg/L • Cashmere Stream: 0.0063 mg/L • Huritini / Halswell River catchment: 0.0743 mg/L • Pūharakekenui/ Styx River catchment: 0.0117 mg/L • Ōtūkaikino River catchment: 0.0091 mg/L • Stream Reserve Drain & Alymers Stream: 0.0029 mg/L • Balquerie Stream (Banks Peninsula): 0.0025 mg/L	These metals can be toxic to aquatic organisms, negatively affecting such things as fecundity, maturation, respiration, physical structure and behaviour. The CCC has developed these hardness modified trigger values in accordance with the methodology in the 'Australian and New Zealand Environment and Conservation Council, and Agriculture and Resource Management Council of Australia and New Zealand' (ANZECC, 2000) guidelines, and the species protection level relevant to each waterway in the LWRP (Canterbury Regional Council, 2017). This calculation document can be provided on request. These targets can be achieved primarily through reducing contaminant loads.

Objective	Attribute	Attribute Target Level	Basis for Target
		Upper limit concentration of dissolved copper: • Ōtākaro-Avon and Ōpāwaho-Heathcote River catchments: 0.018 mg/L • Cashmere Stream and Banks Peninsula: <0.001 mg/L • Huritini-Halswell, Pūharakekenui-Ōtūkaikino River catchment: 0.0014 mg/L Upper limit concentration of dissolved lead: • Ōtākaro-Avon River catchment: 0.01539 mg/L • Ōpāwaho-Heathcote River catchment: 0.0239 mg/L • Cashmere Stream: 0.0027 mg/L • Huritini-Halswell River catchment: 0.0109 mg/L • Pūharakekenui-Styx River catchment: 0.0060 mg/L • Ōtūkaikino River catchment: 0.0041 mg/L • Stream Reserve Drain and Aymers Stream: 0.0014 mg/L • Balguerie Stream: 0.0011 mg/L No statistically significant increase in copper, lead and zinc concentrations.	
Excessive growth of macrophytes and filamentous algae does not occur due to nutrient inputs	Total macrophyte and filamentous algae (>20 mm length) cover of stream bed	Upper limit total macrophyte cover of the stream bed: • Spring-fed – plains – urban waterways: 60% • Spring-fed – plains waterways: 50% • Banks Peninsula waterways: 30% Upper limit filamentous algae cover of the stream bed:	Macrophyte and algae cover are indicators of the quality of aquatic habitat. Targets are taken from Table 1a of the LWRP (Canterbury Regional Council, 2018). Improvement towards these targets can be achieved by reduction in nutrient concentrations and riparian planting to shade the waterways.

Objective	Attribute	Attribute Target Level	Basis for Target
		- Spring-fed – plains – urban waterways: 30% - Spring-fed – plains waterways: 30% - Banks Peninsula waterways: 20%	
Adverse effects on aquatic biota do not occur due to zinc, copper, lead and PAHs in instream sediment	Zinc, copper, lead and PAHs concentrations in instream sediment	Upper limit concentration of total recoverable metals for all classifications: - Copper = 65 mg/kg dry weight - Lead = 50 mg/kg dry weight - Zinc = 200 mg/kg dry weight - Total PAHs = 10 mg/kg dry weight No statistically significant increase in copper, lead, zinc and Total PAHs	Meta Metals can bind to sediment and remain in waterways, potentially negatively affecting biota. These trigger values are based on the ANZECC guidelines (ANZECC, 2018). These targets can be achieved through reducing contaminant loads and instream sediment removal.
Adverse effects on Mana Whenua values do not occur due to stormwater inputs	Waterway Cultural Health Index and State of Takiwā scores	Lower limit averaged Waterway Cultural Health Index and State of Takiwā scores for all classifications: - Spring-fed – plains – urban waterways: 5 - Spring-fed – plains waterways: 5 - Banks Peninsula waterways: 5	The Waterway Cultural Health Index assesses cultural values and indicators of environmental health, such as mahinga kai (food gathering). These indices are on a scale of 1 - 5, with higher scores indicative of greater cultural values. No guidelines are available currently for the different types of waterways, so these targets will be developed specifically for this consent, with higher targets for waterways with higher values. These targets can be achieved through reducing contaminant loads and habitat restoration.

Schedule 8: Receiving Environment Objectives and Attribute Target Levels for Coastal Waters

- The EMP outlines the methodology for the monitoring of Attributes and how these will be compared against Attribute Target Levels.
- Refer to the EMP for the most up to date Attribute Target Levels.

Objective	Attribute	Attribute Target Level	Basis for Target
Adverse effects on water clarity and aquatic biota do not occur due to sediment inputs	TSS concentrations in surface water	No statistically significant increase in TSS concentrations	Elevated levels of TSS in the water column decrease the clarity of the water and can adversely affect aquatic plants, invertebrates and fish. For example, sediment can affect photosynthesis of plants and therefore primary productivity, interfere with feeding through the smothering of food supply, and can clog suitable habitat for species. There is no guideline available for this parameter, so no change in concentrations is proposed to be conservative. The target will be achieved by reducing contaminant loads (particularly using erosion and sediment control measures).
Adverse effects on aquatic biota do not occur due to copper, lead and zinc inputs in surface water	Copper, lead and zinc concentrations in surface water	Maximum dissolved metal concentrations for all classes (with the exception of the Operational Area of the Port of Lyttelton): • Copper: 0.001 mg/L • Lead: 0.004 mg/L • Zinc: 0.008 mg/L No statistically significant increase in copper, lead and zinc concentrations	Metals, in particular, copper, lead and zinc, can be toxic to aquatic organisms, negatively affecting such things as fecundity, maturation, respiration, physical structure and behaviour (Harding, 2005). These targets are taken from the ANZECC (2000) guidelines for the protection of 95% of species. The Operational Area of the Port of Lyttelton is affected by direct discharges from boats that will make monitoring of the effects of stormwater difficult, therefore the targets are not applicable to this area. These targets will be achieved by reducing contaminant loads.
Adverse effects on Mana Whenua values do not occur due to stormwater inputs	Marine Cultural Health Index and State of Takiwā scores	Minimum averaged Marine Cultural Health Index and State of Takiwā scores for all classes: • 5	The Marine Cultural Health Index and State of Takiwā scores assesses cultural values and indicators of environmental health, such as mahinga kai (food gathering). These indices are on a scale of 1 - 5, with higher scores indicative of greater cultural values. No guidelines are available currently for coastal areas, so this target will be developed specifically for this consent. These targets can be achieved through reducing contaminant loads.

Schedule 9: Receiving Environment Objectives and Attribute Target Levels for Groundwater and Springs

- The EMP outlines the methodology for the monitoring of Attributes and how these will be compared against Attribute Target Levels

Objective	Attribute	Attribute Target Level	Basis for Target
Protect drinking water quality	Copper, lead, zinc and <i>Escherichia coli</i> concentrations in drinking water	Concentration to not exceed: - Dissolved Copper: 0.5 mg/L - Dissolved Lead: 0.0025 mg/L - Dissolved Zinc: 0.375 mg/L No statistically significant increase in the concentration of <i>Escherichia coli</i> at drinking water supply wells	The most important use of Christchurch groundwater is the supply of the urban reticulated drinking water supply. Contaminants in stormwater that infiltrate into the ground could impact on the quality of water supply wells and/or springs. The compliance criteria for a potable and wholesome water supply are specified in the Drinking Water Standards for New Zealand 2005 (Revised 2008). Metals and <i>E.coli</i> were chosen for these targets, as these are contaminants present in stormwater. The target values for copper and lead are a quarter of the Maximum Acceptable Value (MAV) or Guideline Value (GV) taken from the Drinking Water Standards for New Zealand 2005 (revised 2008). This is to ensure investigations occur before the water quality limits in the LWRP are exceeded, which are that concentrations are not to exceed 50% of the MAV. An equivalent criteria has also been applied to the zinc target, which is not included in the LWRP water quality limits, but has a guideline in the drinking water standards.
Avoid widespread adverse effects on shallow groundwater quality	Electrical conductivity in groundwater	No statistically significant increase in electrical conductivity	Contaminants in stormwater that infiltrate into the ground could impact on groundwater quality. Long term groundwater quality at monitoring wells is undertaken by Canterbury Regional Council. Those monitoring points that occur within the urban area could be impacted by CCC stormwater management activities. Electrical conductivity is to be used as an indicator for identifying any general changes in groundwater quality related to recharge.

Schedule 10: Receiving Environment Attribute Target Levels for Water Quantity

MODELLLED CATCHMENTS				
<u>Objective for the management of stormwater quantity:</u> To mitigate the risk of inundation, damage to downstream property or infrastructure or human safety through management of stormwater run-off volumes and peak flows. The extent of mitigation shall be assessed against the achievement of attribute target levels for each receiving environment.				
<u>Attribute Target Level:</u> Modelled flood levels for the relevant AEP for the assessment year critical duration event shall not increase more than the Maximum Increase listed below when compared to the same modelled AEP for the baseline year impervious scenario critical duration, as determined using CCC flood models. The baseline year scenario and assessment year scenario shall be identical except for changes to the impervious area, mitigation measures and the inclusion of any new network(s) that has arisen between the dates of the two scenarios and within the city limits. All non-variant scenario parameters shall be as at the assessment year scenario. The critical duration shall be assessed at the monitoring location of the attribute target level. Non-variant scenario parameters include, but are not limited to, channel cross-sections, roughness and floodplain shape. Prior to undertaking the assessment, the appropriateness of the non-variant scenario parameters shall be assessed and updated if necessary.				
WATER LEVEL REDUCTIONS OR TOLERANCES FOR INCREASES				
Receiving Environment	Monitoring Location	Baseline Year	Annual Exceedance Probability	Maximum Increase (mm)
Ōtakaro/ Avon River	Gloucester Street Bridge	2014	2%	50
Pūharakekenui/ Styx River	Harbour Road Bridge	2012	2%	100
Ōpāwaho/ Heathcote River	Ferniehurst Street	1991	2%	30
Huritini/ Halswell River	Minsons Drain confluence*	2016	2%	0

NON-MODELLED CATCHMENTS			
Receiving Environment	Attribute Target Level	Basis for Target	Notes
Ōtūkaikino River	Discharges from all new greenfield development into the Christchurch City Council network are mitigated using the "Partial Detention" strategy outlined in the Pūharakekenui/ Styx SMP until such time as a monitoring location can be set during review of the SMP	As measured through the CCC discharge authorisation compliance process for Resource and Building Consents until such time as a Baseline Year can be set during review of the SMP	CCC has just begun monitoring the Ōtūkaikino at Dickey's Road Bridge. Council does not currently model flooding in the Ōtūkaikino River. Flooding occurs primarily due to backwater effects in the Waimakariri River. Therefore, a best practice approach to

			mitigation of development will be implemented until such time as Maximum Increase can be set during review of the SMP.
Banks Peninsula (Various)	Discharges from all new greenfield development within settlement areas of Te Pātaka o Rākaihautū/ Banks Peninsula into the Christchurch City Council Network are mitigated using the "Extra-Over Detention" strategy	As measured through the CCC discharge authorisation compliance process for Resource and Building Consents	Receiving environments within Te Pātaka o Rākaihautū/ Banks Peninsula Settlements are primarily coastal. The strategy behind "Extra- Over Detention" is to mitigate peak flows from development sites back to pre-development flow rates in order to mitigate effects of flooding and waterway channel erosion. Therefore, a best practice approach to mitigation of development will be implemented.

* The Minsons Drain confluence with the Huritini/Halswell River represents the southerly extent of inputs from Christchurch City catchments, but also contains discharges from Selwyn District. Inputs from catchments outside of the city shall be isolated in the CCC stormwater model for compliance assessment purposes.