Christchurch City Council
ATTACHMENTS - UNDER SEPARATE COVER

Date: Wednesday 19 June 2024
Time: 9.30 am
Venue: Council Chambers, Civic Offices,
53 Hereford Street, Christchurch

TABLE OF CONTENTS NGĀ IHIRANGI **PAGE**

Submissions received on the draft Ōtākaro Avon SMP, February - April 2024

Would like to speak to the hearings panel

ID	Do you have any feedback on the proposed goals?	Do you have any other comments?	Name - Organisation
15341	The Waitai Coastal-Burwood-Linwood Community Board fully supports the proposed goals and actions.	However, the Board wishes to emphasise that development along the river corridor prioritises river water quality and ecological health. The Board strongly supports the use of wetlands and swales to keep stormwater out of rivers. The Board would like to see dredging to remediate flooding be undertaken if that would be beneficial to the river (as long as it is not counterproductive). The Board supports that high risk industrial sites are audited regularly. The Board also would like the Council to continue to advocate for restrictions on the use of pollutant materials, such as zinc and copper.	Paul McMahon – Waitai Coastal Burwood Linwood Community Board
Staff response 15341 The Board is thanked for the positive feedback. The SMP does not drive development along the river corridor other than to provide for stormwater treatment basins & wetlands within the OARC. Treatment facilities improve the health of the river but with a downside of accumulating contaminants. Dredging is undertaken in the Ōtākaro Avon River from time to time when channel surveys indicate that there is a buildup of sediment.			
15377	The Waihoro Spreydon-Cashmere-Heathcote Community Board agrees with the goals and actions contained in the plan. In particular taking action on controlling the zinc and copper contaminants of storm water, which are the predominant source of concern in the Board's waterways in this plan.	1. The Community Board is pleased to see that the Addington Brook catchment has been prioritised for retrofitting of a high level of treatment, via biofiltration, in the near term. 2. The other waterway in the Community Board area, Baxter's Creek, presumably has similar issues in terms of stormwater levels of zinc and copper, as it shares a similar environmental geography. The Community Board is interested to understand whether similar treatment will be applied to Baxter's Creek in the future?	Callum Ward - Waihoro Spreydon-Cashmere-Heathcote Community Board
Staff response 15377 Ther is no plan to treat stormwater in Baxters Creek within the LTP term. However Baxters Creek is a possible candidate for treatment in the next Ōtākaro Avon SMP.			
15388	The Board generally supports the proposed goals and actions proposed for the Ōtākaro Avon Stormwater Management Plan, subject to the points offered below. The Board recognises the importance of controlling the contaminants in stormwater in reference to the key environmental objectives sought to be achieved. Water quality is important, not just to ecological health, but also to the cultural values, which the Board supports being acknowledged. The Board considers that having such a Stormwater Management Plan is worthy of tremendous support because restoring clean, clear water and natural environment complete with native aquatic life will be a huge attribute to the future of Ōtautahi. The Board generally agree with mitigating the major sources of contaminants using the methods marked as effective and practical, but with the following recommendations: Copper: The plan advises that copper surfaces, spouting and downpipes are currently a very low	The "red zone" river area from city to sea is a golden opportunity to create a world class natural environment that serves the many life forms including the people who live there by providing a healthy and recreative space to commune with nature. There are residents who feel strongly that this can be achieved by a simple approach - native plantings, reviving riparian flood areas, and limiting human intervention to bike paths, bird stands, and toilets (i.e.: minimum cost, maximum effect) - particularly in the area between Fitzgerald Ave and Gloucester St/Gayhurst Rd. It is strongly felt that commercial farming leases and practices should be reduced or eliminated, and thereby aid the reduction of nitrogen and phosphorus runoff (among other things). Finally, the Board has particularly heard from residents in recent years around the issue of surface flooding and has made it a priority to advocate for them in its Community Board Plan 2023-25. Specifically, the Board highlighted the below points in its Plan as reflecting what it has heard, seeking that any opportunities to reflect these aspects be addressed where possible in this context. "Flooding in the Waipapa Papanui-Innes-Central Board	Emma Norrish – Waipapa Papanui-Innes-Central Community Board

Submissions received on the draft Ōtākaro Avon SMP, February - April 2024

ID	Do you have any feedback on the proposed goals?	Do you have any other comments?	Name - Organisation
	contributor to copper contamination, but are a fast-growing source (albeit from a low base). Most of the existing copper parts were probably built before this was a known problem. For these two reasons it would seem unfair to apply Goal 3.2 (“The Council does not permit stormwater discharges into the network from unprotected copper cladding, spouting or downpipes”) to those structures. The cost of compliance could significantly outweigh the small proportion of contamination that this source contributes. For reasons of fairness and affordability it may be appropriate to exempt existing structures, but stridently apply this rule to new builds and upgrades. The plan advises that brake pads are a high source of contaminant city wide, so moves toward copper-free brake pads are encouraged. However, care should be taken not to impose a regressive “tax” upon low-income car owners if copper-free pads become significantly more expensive than what they are replacing. It is encouraged that this be part of the conversation with the motor trade and regulators. E.Coli: Support the reduction and/or elimination of introduced invasive species including ducks and geese. Would furthermore add measures to reduce (introduced) pigeons and reduce or discourage European starlings, which are both resident contributors of significant density of faecal defecation on and around their nesting sites. (Central city buildings from pigeons, and seasonal nesting sites like Dudley Street from starlings). Encourage creative community approaches to achieve these. Nitrogen and Phosphorus: There are residents who feel strongly that commercial farming leases and practices should be reduced or eliminated from the Ōtākaro Avon River Corridor “red zone”. Flooding: Apply ample consideration to previously discussed ideas of holding lakes in the lower reaches of the catchment to provide flood ‘overflow’ storage, wetland habitat, recreational resource and added water security.	"Why this matters: "The community board is well aware of the community concern about localised surface flooding experienced in parts of the board area and across the city caused by the record-breaking rain events of July 2022, and indications that with climate change such events may become more frequent. At a community meeting the residents sought assurances from the community board that the drainage network is working and being maintained as effectively as possible to drain stormwater away rapidly during and after significant rain events. Residents also expressed the need for quicker road closures and more education about the effects on drinking water in flooded areas. "What the board will do: Advocate for the prioritisation and inclusion of required flood mitigation projects by identifying in the board submission what options for flood mitigation represent the best value for money, prioritising community safety and wellbeing while recognising that some street flooding in significant rain events is part of a functional drainage network that avoids inappropriately creating property flooding downstream. Advocate for a community adverse-weather resource which will be available for residents to download showing what flooding plans are already in place, what would trigger a Civil Defence response, and what the responsibilities of other government agencies are. Advocate for a resource that helps communities understand what to do, what not to do, and support them more generally in flood events. Advocate for mitigation options to be considered ahead of significant rain events especially around, but not limited to, Francis Avenue, Edgeware Village, Emmett Street, and Harris Crescent. Advocate that all residential and commercial impacts are considered when flood mitigation projects are being considered, including in setting levels of service. Advocate that the Council continues to investigate the use of permeable surfaces/rain gardens where applicable. Re-engage with business owners and residents to see what is required from the Edgeware Village Master Plan looking at streetscape improvements in Edgeware Village. Explore options for an initiative to provide advance notifications to residents in advance of any significant rain events. Consider the goals of the Ōtautahi Christchurch Climate Resilience Strategy in all decision making. "We will measure our success by:	

Submissions received on the draft Ōtākaro Avon SMP, February - April 2024

ID	Do you have any feedback on the proposed goals?	Do you have any other comments?	Name - Organisation
		The inclusion of flood mitigation projects in the LTP. The creation of a resource to assist the community in responding to flooding and measure the number of downloads. Residents will be well informed and understand the flooding response in their area, and where they can find information about what may be planned or is outside the scope of work. The number of temporary pumps deployed during a rain event and frequency. The introduction of an alert system before any significant rain events. The goals of the Ōtautahi Christchurch Climate Resilience Strategy has been considered." Finally, this Stormwater Management Plan's scope is by-and-large the CSNDC targets. There are other contaminant and management considerations beyond what is stipulated in the CSNDC (including, but not limited to, plastic particulates). The Board hopes that Council's ambitions for restoration of the river corridor's ecology will expand beyond this plan, and that support and resources will be used to encourage the many community led-initiatives (including those within the Ōtākaro Avon River Network) that will help our city restore this priceless asset.	
Staff response 15388 The Board is thanked for the feedback. 1. Restrictions on uncoated copper cladding and spouting apply to new copper surfaces and are not applied retrospectively. Staff are aware that elected members have a strong interest in flooding and the Council's flood response. It is important that operational (i.e. on-the-ground) responses are prioritised before and during events. Capital projects to alleviate flooding arise out of flood responses and flood modelling. Projects considered to have priority are put to the Council for funding decisions and this can result in priorities changing.			
15392	*See submission attachment 15392*	*See submission attachment 15392*	Colleen Philip – Sustainable Ōtautahi Christchurch
Staff response 15392 Thank you for your submission. You comment that an implementation plan (the proposed Surface Water Implementation Plan) has not yet been completed. It would assist with planning and prioritising. SOC may be aware that the Council employs a full-time person (Georgina St John-Ives) to run engagement and education programmes and maintain the Community Waterways Partnership. This person engages in a wide range of activities. Your suggestion to make citizens aware of positive solutions for individuals is a good one and will be followed up with Georgina. A booklet of interventions/options is a possibility. The Council agrees with SOC about nature-based solutions. However, the use of wetlands is problematic because of the deliberate accumulation of toxins in these facilities. Ecologists advising the Council are moving to exclude freshwater life from treatment facilities.			
15389	*See submission attachment 15389*	*See submission attachment 15389*	Hayley Guglietta – Avon Ōtākaro Network INC
Staff response 15389 AvON is thanked for a thoughtful submission. Firstly, a link between the SMP and the OARC will become apparent in the final SMP; the final SMP will contain 4 additional facilities that will be within the OARC – on sites in Avondale, Wainoni, Pages Road (Knights Basin) and Waitaki Street. These facilities are provided for in the LTP although the link to the LTP is not made explicitly in the SMP. A further 20-something facilities will be developed in time.			

Submissions received on the draft Ōtākaro Avon SMP, February - April 2024

ID	Do you have any feedback on the proposed goals?	Do you have any other comments?	Name - Organisation
Secondly, a comment about what a stormwater management plan is. “Stormwater Management Plans” (SMPs) are generated from a consent condition and the name is conferred by a consent condition and the content of a SMP is determined by consent conditions. The name is misleading in that SMPs could but do not necessarily deal with everything related to stormwater. Consent conditions allow for a wide range of potential content addressing a potentially wide range of activities. However, the actual content of SMPs is constrained by the (staff and capital and maintenance) resources the Council is able to dedicate to them and by the limits of the Council’s powers to regulate under the Local Government Act. The scope of SMPs has limits and it is the intention that other Council plans and activities should also contribute to healthy environmental outcomes. Funding constraints may mean that progress is slower than many would like. Funding priorities will result in many issues being addressed over a longer term than many would prefer. As your submission points out this puts a heavier reliance on the community to assist with education and resourcing. Matters such as addressing public awareness of sediment and erosion control, controls on sources of contaminants, and education generally are considered by the Council against a wide range of Council activities and determinations about resourcing are made at Annual Plan and Long Term Plan stage. The submitter may (and likely does) submit to these planning processes. The Council employs a full-time person to run engagement and education programmes and maintain the Community Waterways Partnership. This person engages in a wide range of activities. The Council is making steady progress in some areas including erosion and sediment control on building sites: inspectors are being trained in sediment control methods and enabled to monitor sites. The submission requests further funding to support a range of projects. Funding community projects is not the role of SMPs and this still needs to be addressed through applications for funding which may be contestable.			
15386	*See submission attachment 15386*	*See submission attachment 15386*	Jesse Aimer – Christchurch International Airport Limited
Staff response 15386 *See staff response attachment 15386*			
14160	The addition of benchmarking and data collection tools such as Contaminate sensors will be extremely beneficial in the monitoring requirements to support your plan. I would love to see more emphasis on the digital tools used to capture this information and be shared to the public. I.e. Connection to the Otakaro Digital Twin program lead by CCC and University of Canterbury. This will then be able to demonstrate how the proposed improvements to filtering and reducing contaminants to progressing. Community health and Mauri as indicators of improvement need to be included in the plan. Ngatahi Research Institute have specific tools that help identify the Mauri of a waterway in relation to the Te Mana O Te Wai frameworks that must be considered in a holistic approach. People eat from the river affecting health of people and species biodiversity.	There is a great program of work lead by Michael Healy in CCC that have tools to promote this work but needs funding to support ambitions like the Stormwater plan. Stronger emphasis on how the public will know the stormwater plan is working must be demonstrated. The Otakaro Digital Twin project will be able to do this.	Kerri Gray – WSP
Staff response 14160 There is a good deal of interest in new means of data collection. Reliable, low-maintenance monitoring instruments are likely to be implemented when they become available and approved. Mana whenua indicators of ecological health are being collected under the Environmental Monitoring Programme.			
15375	My submission would be simple. Get on with it. Don't do what was done in Harewood, spending $4.3 million on arguments. We have to just agree to agree. To be quite honest, I don't know much about this space but I am quite confident that some of you do. I saw some plans presented by CCC staff at the car boot sale, they look amazing. We do need to manage storm water moving forward, that is obvious. We do need to stop the talk and actually pick up shovels, that's my only objection. I leave it up to others of you who have been working on this for years to hone the detail, but I ask you to agree, to concede where needed and get focus on getting moving on the ground a bit faster.		Don Gould

Submissions received on the draft Ōtākaro Avon SMP, February - April 2024

ID	Do you have any feedback on the proposed goals?	Do you have any other comments?	Name - Organisation
Staff response 15375 Thank you for your submission			
15395	I think it is a good plan for addressing the consent conditions, but good go further. (For example, contaminants like plastic micro-particles appear not to be a condition of the consent and are not addressed in this plan. I think that existing copper building surfaces (currently a very minor contributor to this particular contaminant) should be exempted, but new copper surfaces be discouraged or mitigated as per the plan. Similar consideration might be applied to zinc surfaces, especially if there is a risk that painting them will replace one contaminant (zinc) with another (plastic paint particles).	There are community initiatives toward restoring the river corridor's ecology. I'd like to see these plans and initiatives supported. We have a golden opportunity to have a world-class natural and native environment in the east, where such an asset would deliver massive amenity and improvement to wellbeing for flora, fauna and people. I'm concerned about commercial farming leases and effects on the river and riparian zones.	John Miller
Staff response 15395 The Council has limited knowledge about microplastics and their prevalence in stormwater and has not included microplastics in the SMP. There is some monitoring for microplastics in stormwater but more is being done elsewhere (internationally) than in Christchurch. A similar comment applies to other emerging contaminants. Council staff are aware of microplastics and some other substances as emerging issues and thank you for your comments. Existing buildings with copper cladding are exempted, at least for now. New copper cladding must be coated to avoid copper leakage into stormwater runoff. The Council has its own river corridor ecology initiatives and supports community initiatives, although at a modest scale.			
10004		*See submission attachment 10004*	Gregory Partridge
Staff response 10004 Thank you for your submission. Your concerns about land stability and loss of trees are understood. At this time the proposed facilities are still more than 10 years in the future and are not being dealt with by the SMP which has a 10 year term. The issues are equally relevant to planning for the Ōtākaro Avon River Corridor and future SMPs and may be dealt with under either programme. Stability and tree cover will be taken into account when the proposed Avonside Drive facilities are designed. Liquefaction and lateral movement is considered in geotechnical analyses, and basins may be stabilised or relocated if stabilisation is not possible. The loss of trees will also be considered and discussed with city arborists and possibly the wider community. These matters do not form part of the current SMP because they are not funded to occur within the 10 year term of the SMP. They will be dealt with in planning for the OARC or in a subsequent Ōtākaro Avon SMP at a time that will coincide with funding provision in the Long Term Plan.			

Organisations / Businesses

ID	Do you have any feedback on the proposed goals?	Do you have any other comments?	Name - Organisation
10001	*See submission attachment 10001*	*See submission attachment 10001*	Andy Thompson – DOC

Submissions received on the draft Ōtākaro Avon SMP, February - April 2024

ID	Do you have any feedback on the proposed goals?	Do you have any other comments?	Name - Organisation
Staff response 10001 The Department is thanked for the submission. The Council looks forward to engaging with the Department on activities that affect conservation values.			
10002	*See submission attachment 10002*	*See submission attachment 10002*	Tanya Jenkins – Avon-Heathcote Estuary Ihutai Trust
Staff response 10002 The Trust is thanked for the submission. There is awareness both within the Council and generally about the effects of various contaminants and methods that could be used to reduce contaminant discharges. As the Trust has indicated there are many other ways to reduce contaminant discharges. The SMP deals with contaminants mostly by planning to treat stormwater in basins and wetlands. Construction of basins is something the council can and must do, and is able to do effectively. As can be seen in the Long Term Plan there is significant funding for stormwater treatment. Other means of contaminant reduction are expected to take longer to bring into effect and involve ongoing costs that must share funding with many other activities. The Council employs a full-time person to run engagement and education programmes and maintain the Community Waterways Partnership. This person engages in a wide range of liaison and education activities. Sediment discharged from construction sites is receiving attention and is being addressed through erosion and sediment control plans and onsite sediment mitigation. This is an important activity for the Council. The Trust's comments about metals, pathogens, organic material and nutrients are noted. The Council liaises with the Ministry for the Environment, in conjunction with other councils, regarding urban metals. Stormwater contamination generally is important but may be addressed over time as one of many priorities for the Council.			
10003	*See submission attachment 10003*	*See submission attachment 10003*	Brendon Liggett – Kainga Ora
Staff response 10003 Thank you for your submission. Bird strike provisions in the draft plan were inserted at the request of Christchurch International Airport Ltd on the basis of reducing a risk for airport users who include Christchurch citizens. It is acknowledged that the provisions could be onerous if applied inequitably or without regard to the size or location of an individual basin. You will be contacted about the basin referred to in the submission with a view to reviewing how the bird strike provisions were applied in the situation you refer to.			
15399	Reducing Vehicle Kilometres Travelled (VKT) would reduce the amount of contamination from vehicles getting into our waterways. Spokes encourages the Council to prioritise active and public transport as an effective way to reduce zinc, copper, rubber, PM2.5, oils, grease, rust, sediments, heavy metals, and the many other contaminants from vehicles that pollute our water. Another large source of water contamination is leaking underground fossil fuel storage tanks which is not mentioned. Nitrates are also not mentioned. Both should have associated actions. In general, preventing water pollution from motor vehicles by prioritising and appropriately funding cycling and walking is much cheaper than cleaning up the pollution itself.		Anne Scott – Spokes Canterbury
Staff response 15399 Your submission presumably refers to research which suggests a close relationship between VKT and metals emitted from vehicles. Reducing the amounts of vehicular pollutant emissions is a desirable source control. The Council addresses this to a small extent by installing cycleways, as you will know. However, the SMP deals with contaminants mostly by planning for the treatment of stormwater. Controls at source are affected through other means including a stormwater bylaw, a Sediment Discharge Management Plan and a Community Waterways Partnership that encourages community action and education. The SMP does not address contamination from underground tanks because this activity is regulated by Environment Canterbury. Nitrates may have little mention in the SMP because they are not thought of as a contaminant of stormwater and the Council is not required to deal with them. It appears more likely that nitrates arise from groundwater and nutrients applied to lawns and gardens. It is acknowledged that nitrates appear to be contributing to eutrophication in the Estuary and that either the Council or Environment Canterbury should be taking some action toward reducing nitrate use or discharges.			

Individuals

Submissions received on the draft Ōtākaro Avon SMP, February - April 2024

ID	Do you have any feedback on the proposed goals?	Do you have any other comments?	Name
14150	Hi there - love the graphic, very helpful! Could Council also look at the possibility if implementing nets such as these on stormwater pipes that lead to the ocean? Seems like a simple way to reduce the amount of litter going into the ocean/waterways. I've seen them in Sydney. https://www.uscargocontrol.com/collections/stormwater-system-drainage-nets		Naomi Ambrose
Staff response 14150 The Council manages litter by providing and emptying litter bins, street sweeping, street sum grates and bylaws. The council organisation is aware of nets such as those suggested but has not implemented them for reasons that include the cost of installation and maintenance, and the perceived negative appearance of nets within river/stream corridors.			
14153	I support the goals and actions. In particular, auditing of high risk industrial sites needs to be a well-resourced & ongoing focus in order to help clean up the city's waterways, and minimise the introduction of new contaminants into them. Goal 2 (control zinc contaminants) is also a very worthwhile goal, even if it will be challenging given existing galvanised zinc roofs. Community education is also important to help protect our waterways - including letting people know they can contact council if they see any chemicals/paint etc. being discharged into waterways.	Managing flooding and ensuring we don't allow new developments in flood-prone areas needs to be a priority. We're a low-lying swampy city, and are particularly vulnerable to the coming sea-level rises. Related to this, liquefaction prone areas (such as Bexley) need to remain as areas where no development (or only small numbers of very well-engineered buildings with minimal horizontal infrastructure is installed - i.e. no subdivisions) is allowed to occur.	Robbie Peacocke
Staff response 14153 Council planning is generally carried out in a way that aligns with this submission			
14163	Focusing on reducing vehicle safety (by reducing the effectiveness and life of brake pads) is not something I will ever support. Moving roads away from rivers is a better option. I also would support having a very specific and detailed long-term plan for agreed before too much money is spent (e.g. retreat vs Holland style)	Biofilters are a really expensive long term option, I would rather more land was taken up by wetlands to achieve this effect. I am also concerned that stopbanks will block the rainwaters path to the sea and result in the need for multiple pump stations to get the water out. all will need back up diesel generators because if they fail the city will flood.	Mark Penrice
Staff response 14163 The submission is acknowledged. A Coastal Hazard Adaptation Planning project is under way to consider community responses to the sea level rise and provision for protection or retreat. Biofilters are a good option in areas where space for a wetland is unavailable. The submitter raises a good criticism of stop banks, which have both benefits and drawbacks.			
14174	The proposed plan appears well grounded despite the limited actions Council can take alone in some areas. I support it.	I'd be interested to know what I can do as a homeowner/car owner to support this.	Andrew D
Staff response 14174 A homeowner can make a positive contribution; you can: 1. Keep your roof paint in good condition (to reduce the amount of zinc leaking into stormwater), 2. Ultimately, choose a non-metal roof type,			

Submissions received on the draft Ōtākaro Avon SMP, February - April 2024

3. Replace vehicle brake pads with non-copper or low-copper brake pads, 4. Wash your car in a place where the dirty water runs onto a lawn 5. Ensure that moss killers and exterior house surface cleaners do not run down the downpipe and into the stormwater network (although this may not be easy to achieve)			
14186	Goal 5.1 By 2025.. 'to enable the public to take action to stop contaminants at source'. Let's start today. "Community education" is going to be part of the solution. That's good as I have been awaiting exactly this education. Twice I have asked Council to report back on the weight of heavy metals that are released during the excessive fireworks displays over Hagley Park, The Avon and surrounding properties. Apparently, fireworks can contain Zinc, Copper, Lead, Titanium, Strontium, Aluminium, Lithium, Magnesium, Barium and Sodium. So far, Council has not replied to either of my requests as to how many kilos of each element has been released in the past six months. Or even just the total tonnage of fireworks released. It's great that Council has chosen to release some of the toxins directly into the ocean at the end of November, rather than firstly into the groundwater and stormwater systems. That saves it contaminating to our roofs, car and bicycle brake pads and tyres.	Walking my dog in Hagley Park, I have to watch that he doesn't chew on firework debris. Scatted to the four winds are plastic firework tubes and caps that he is very fond of chewing. He also likes the big (12cm across) charred cardboard fireworks balls. The clay plugs..not so much. I don't want him eating sharp plastic, but I guess the fall-out on the ground is just as bad. The debris gets cut up by the mowers and disappears into the turf. Out of sight, out of mind. Judging by the volume of spent fireworks cylinders and balls, I expect that North Hagley Park will qualify for your proposed list of contaminated industrial sites. Perhaps the topsoil on the playing fields should be removed? *See submission attachment 14186*	Vanessa Merritt
Staff response 14186 The council does not have this information because it has not considered that the information needs to be requested from fireworks contractors. Among other things the byproducts released by fireworks would be thought to fall mainly onto land and to be adsorbed into soil. The information is likely to be difficult for any person in this country to obtain. The submission has been passed on to the Council's Events Team which contracts fireworks displays. The Events Team may contact you to discuss your information, or alternatively you may like to contact the Events Team. Fireworks will not be considered in the SMP because the contaminants are mostly not contaminants the council is required by consent conditions to deal with.			
14322	I'm assuming this is user error but I couldn't find the full SMP. So my comments may be covered. in the full document. I think the Flooding management and contamination control could be directly aligned (for certain contaminant sources). It's well known that planting can be used to help control contaminants, this may require special treatment of plant material, but it can also work as flood protection which would result in increase cost/benefit. Related, contamination control could also be used to guide types of verge plantings as well as roadway trees as they will help with air/soil contamination. I understand that will be in the investigation stage but think it's important to link the public's knowledge that certain plants help solve multiple problems. There is opportunity for community members to easily contribute with education. If it is wetland planting/removal of stopbanks it may also have a benefit on sea level rise.		Carissa Ptacek

Submissions received on the draft Ōtākaro Avon SMP, February - April 2024

	I'd like to see the stopbanks removed and a more natural wetland network returned, this is likely to mitigation multiple future problems. It's likely if this approach is taken that an alternative for rowing would need to be provided to ensure buy-in from key stakeholders. For flood managment is restricting build infrastructure being considered? Or an offset scheme? Increased footprints will impact the function of available floodplain which at a certain point will endanger older homes that were built to a now outdated flood level. Also it's unclear to me how the types of fencing used in NZ may impact the damage of flooding. I welcome more control on construction activities, but if there is no enforcement this is unlikely to improve sediment/contaminaten control. Funding would need to be set aside for enforcement.		
Staff response 14322 Flood management and contaminant control are aligned in greenfields developments where basins and wetlands serve both purposes. It is doing so in the Heathcote, Halswell and Styx catchments. Large facilities are more difficult to install in built-up areas. However, building densification near the city centre is in line with a Council strategy intended to keep the city centre alive, make efficient use of infrastructure and potentially to reduce vehicle use. Contaminants and increased stormwater runoff from intensifying areas will need to be managed. The Council is more likely to introduce offset scheme (i.e. flood storage elsewhere) than to restrict building development and intensification. A likely future strategy in the Avon catchment will be to obtain land within built-up areas and create new stormwater storage areas. Sediment control on construction sites is controlled via a Sediment Discharge Management Plan 2022. Inspectors and enforcement officers are being trained to maintain effective sediment controls.			
14539	Is any thought being given to controlling the ballooning numbers of Canadian Geese that are now in & around the river in there hundreds especially with the redzone , there faeces cover the ground in these area's & also local parks. They are a listed "pest" but it appears that no action is being taken to reduce the impact .		Darryl Freeman
Staff response 14539 Faecal matter from geese does affect rivers but is judged not to be a component of stormwater and is not controlled by the Council's discharge consent. The Parks Unit works in co-operation with other organisations to manage Canada Goose populations in Christchurch. This mostly happens by rendering eggs non-viable with some targeted control of adult and immature birds. In most years more than 1000 are removed from the population, as well as a large number of eggs controlled in their breeding areas at larger wetlands. However large numbers of geese migrate to the city as part of their annual cycle. These originate from upcountry areas where there are fewer controls. Canada Geese are not listed as a pest; they would be easier to control if that were the case.			
15324	I doubt that public education on many of these issues would be as effective as working with designers, architects, garages, ie gatekeepers. Interesting that all the s not covered by the SMP/consenting requirements. So where is this issue dealt with?	Please integrate this SMP with the OARC plan and initiatives. The CCC staff at the briefing I went to had no idea what was in the OARC plan: doesn't anyone at CCC talk to people in other teams?	Eric Pawson
Staff response 15324 Designers and architects get exposure to these matters through Council feedback and consent conditions on projects. However it is probably correct that a one-on-one approach could be more effective. The second part of your submission is unclear, sorry. The SMP is integrated quite well with the OARC Plan. The SMP plans for treatment facilities within the OARC and funded in the Council's Long Term Plan.			
15376	It is so important that we protect our river as it is one of the most important natural assets we have!		Stephen East

Submissions received on the draft Ōtākaro Avon SMP, February - April 2024

Staff response 15376 Thank you for your submission			
15378	In principle I agree with the plan but I do not think it goes far enough, we have a biodiversity crisis in our waterway, this body of water starts at the fringe of the city and runs through the heart of the city we need to do better. Nothing has been done to manage the Urban pollutants, yes there has been work to manage the flooding in Flockton basin but we are still not seeing investment in the key management infrastructure for a number of years. There is no alignment with the work being done on the OARC which suggests that there is not a joined up approach and it does not appear to be much alignment with the LTP	Additional things I would like to see progressed with haste. Investment in greater compliance to fine the developers who are breaching the standards More funding and resources to support community groups doing the lions share of the work on riparian, rubbish collection and education More effective control of the Canadian Geese population Important Infrastructure to manage pollutants brought forward	Hayley Guglietta
Staff response 15378 Thank you for your submission. There is a great deal to be done to improve ecological values and biodiversity in the city's waterways. The Council is aware of the need to reduce or capture urban contaminants and has assigned considerable funds toward that activity in the Long Term Plan. Water quantity and quality mitigation projects to a combined value of approximately $100 million per year are installed. However it is agreed that the task is large and that some may consider that progress could be faster. The scope of SMPs has limits and it is the intention that other Council plans and activities should also contribute to healthy environmental outcomes. However, Council programmes over a wide range of activities are prioritised according to community wishes and values and funding constraints may mean that progress is slower than many would like. Funding priorities will result in many issues being addressed over a longer term than many would prefer.			
15379	Happy to see my money go towards stormwater quality improvement and indigenous ecosystem restoration initiatives across Ōtautahi. Great mahi with so many secondary benefits for our people and ecosystems. As long as our waterways are in a more degraded state than before people arrived here then there is work to be done.	While it would be challenging to achieve, I would love to see incentives for use/installation of residential stormwater treatment systems. People wash down cars, do home diy, cleaning with miscellaneous chemicals etc which all also contribute negatively. Many people want to do the right thing and periodically have the opportunity to re-landscape and install new treatment systems on their property. Living next to the Ōtākaro, I'm very aware of the coarse (mainly plastic packaging) rubbish strewn through the river when Kayaking and walking alongside it. Would love to see greater control to limit the entry of this rubbish into the stormwater network. Kia ora, As a follow up to my submission, here is a photo I took in 2020 on the Ōtākaro highlightingthe importance of minimising human waste entering the waterways. Tragic. *See submission attachment 15379*	Sam Millar
Staff response 15379 Thank you for your submission			
15398		- I think that to reduce the run off from large vehicles such as cars we should be prioritising more cycleways and active travel improvements which will get those vehicles off the road (reducing VKT) Not only that, but there are multiple other benefits to leading a more active lifestyle and reducing cars on the roads so this is a WIN - WIN - To manage flooding, we should be encouraging more rain barrels off roofs to reduce the amount of water heading into our storm water drains. Supporting local groups and funding/subsidising this by using the money that is being collected through the excess water charge would be a good start too. - Ensuring that businesses are doing the right thing by encouraging. Finding what we can	George Laxton

Submissions received on the draft Ōtākaro Avon SMP, February - April 2024

		do to encourage them to do the right thing, while still auditing too. - It is much cheaper to prevent contamination than to clean it up afterwards so the majority of our efforts should be in the prevention space (ie ambulance at the bottom of the cliff vs the guard rail at the top vs building and alternate route that doesn't go near the cliff edge...)	
Staff response 15398 Your submission presumably refers to research which suggests a close relationship between VKT and metals emitted from vehicles. Reducing the amounts of vehicular pollutant emissions is a desirable source control. The Council addresses this to a small extent by installing cycleways, as you will know. However, the SMP deals with contaminants mostly by planning for the treatment of stormwater. Rain barrels collecting roof runoff should divert contaminants onto land where they could be absorbed by soil. However small storage devices are generally not found to play a significant role in reducing flooding due to their limited capacity. It is agreed that controls at source are considered more effective than stormwater treatment.			
15393	looks like y'all have done the research, looks good, just please make more wetlands :)		Layling Stanbury
Staff response 15393 Thank you for your submission			

Submission attachment 10001

Department of Conservation
Te Papa Atawhai

DOC-75687659

12 March 2024

Paul Dickson
Drainage Engineer
Christchurch City council
PO Box 73016
Christchurch 8154

Email: paul.dickson@ccc.govt.nz

Tena koe Paul

Comments on the Draft Ōtākaro-Avon Stormwater Management Plan

Thank you for your emails dated 13 and 23 February 2024 and the opportunity to provide feedback on the "*Draft Ōtākaro-Avon Stormwater Management Plan*" (SMP). I note Christchurch City Council is also undertaking public consultation on the SMP at this time, so a copy of this letter has been emailed to the "LetsTalk" contact as well.

Department of Conservation (DOC) has no major issues with the draft SMP and provides the following high-level comments:

1. **Executive Summary (page 10)**
   DOC supports in general the purpose of the SMP "*to reduce the adverse effects of stormwater discharges on surface water quality and quantity.*" However, DOC seeks that 'groundwater' is also included in the purpose statement so as to align with the aim of the Comprehensive Stormwater Network Discharge Consent (CSNDC) as stated in the second paragraph of Section 2.1 "Purpose and Scope" (Page 12):
   "The aim of the CSNDC is to limit the adverse effects of stormwater discharges on surface and groundwater quality and quantity."

2. **Surface Water Implementation Plan (SWIP) (page 12)**
   DOC seeks that the Surface Water Implementation Plan (SWIP) aligns with the various ecological restoration initiatives that play an important part in the restoration and protection of biodiversity across Christchurch city. This includes the Ōtākaro Avon River Corridor.

3. **6.4 Aquatic and Riparian habitat, 6.5 Aquatic Invertebrates and 6.6 Fish (pages 34-38)**
   DOC acknowledges that there is a breadth of freshwater values that are of interest to DOC across the catchment, including Threatened and At Risk species of flora and fauna, as well as public conservation land. As such, DOC welcomes the continued engagement with the Council on any particular activities that may affect conservation values.

Mahaanui Office
PO Box 11089
Sockburn 8443
Christchurch

www.doc.govt.nz

Submission attachment 10001

4. **6.7 Actions to Improve Waterway Health (pages 38-39)**
   DOC supports the comments from the ecological information reviewer and the suggested areas where further investment can be considered. As such, DOC considers that any ecological issues will be resolved at Council level through the engagement with Council's Principal Ecologist and Ornithologist with respect to the development of the protection and mitigation measures from indigenous freshwater values, including those of fish and bird habitats, etc. If there are any matters or outstanding issues that arise, DOC is happy to engage with the Christchurch City Council to help resolve these.

As a matter of courtesy, a copy of this letter has also been provided to Te Ngāi Tūāhuriri Rūnanga for their information.

Please contact Michelle Lambert, Ranger Lead Community, in the first instance if you wish to discuss any of the matters raised in this feedback (cellphone: [redacted] or email: mlambert@doc.govt.nz).

Naku noa, na

Andy Thompson
Operations Manager, Mahaanui

cc. Samantha Smith
Engagement Advisor
Christchurch City Council
Email: LetsTalk@ccc.govt.nz

Joseph Hullen
Te Ngāi Tūāhuriri Rūnanga
Email: joseph.hullen@ngaitahu.iwi.nz

Arapata Reuben
Te Ngāi Tūāhuriri Rūnanga
Email: arapata.reuben@ngaitahu.iwi.nz

Submission attachment 10002

Avon-Heathcote Estuary Ihutai Trust

Draft Ōtākaro-Avon Stormwater Management Plan
April 2024

Foreword

1. The Avon Heathcote Estuary Ihutai Trust (AHEIT, The Estuary Trust) is a charitable society registered in 2003. It was formed as a result of community requests for an organisation committed to environmental improvement and with representation from the community, statutory bodies, tāngata whenua and other agencies.

2. The vision of the Trust is -

Communities working together for	Toi tū te taonga ā iwi
Clean Water	Toi tū te taonga ā Tāne
Open Space	Toi tū te taonga ā Tangaroa
Safe Recreation,	Toi tū te iwi
and Healthy Ecosystems	
that we can all enjoy and respect	

General remarks

1. The Estuary Trust appreciates that within the Draft SMP the Avon-Heathcote Estuary/Ihutai is recognised as the receiving environment of the Ōtākaro-Avon River and that the reduction or capture of contaminants within the river catchment could improve the ecological state of the estuary.
2. The Trust congratulates the council in producing clear consultation documents. In particular we appreciated the tables on pages 10 to 13 in the summary publication "Korero Mai; Let's talk about improving our waterways – The Draft Ōtākaro-Avon Stormwater Management Plan".
3. The objectives (and goals and actions) as presented on page 82 to 90 of the full document are laudable and are all supported by the Trust. In addition, we have listed below ;
   a. specific new actions that the Council should undertake
   b. or priorities for action.

Submission attachment 10002

Specific Remarks

Our comments as below reflect the headings used in the consultation summary document (pages 10 to 13).

Sediment

1. Sedimentation (the settlement of fine sediment particles to the seabed) as evidenced by the area of soft and very soft sediment (Hollever and Bolton-Ritchie, 2016) and the monitoring data (Berthelesen et al, 2022) is occurring within the estuary. Terrestrial sediment, monitored as TSS (total suspended solids), is a significant contaminant within the stormwater with multiple sources within the catchment (Draft SMP Table 5). There are also a range of potential TSS mitigation methods (Draft SMP Table 5) including catchpit filters and street sweeping. We note that these two mitigation measures provide good removal of sediment particles larger than 100 µm (sand size) (Draft SMP Table 6). However, it is the sediment particles smaller than 100 µm that settle and accumulate on the river and estuary bed that are contributing to their degradation in ecological health.

   We would like to see CCC investigate methods to minimise the quantity of sediment particles smaller than 100 µm being discharged via the stormwater into the freshwater within the Ōtākaro-Avon River Catchment.

2. Construction sites (including housing) are a recognised source of the terrestrial sediment that gets into stormwater (Draft SMP Table 5). Based on personal observations of the efficacy of the erosion and sediment control measures that are put in place at these sites, these control measures leave a lot to be desired (even on flat land) especially as the state of them typically breaks down/declines through the period of construction.

   We would like to see CCC undertake frequent monitoring of the erosion and sediment control measures at all construction sites throughout the construction period.

References

- Berthelsen A, Clark D, Pavanato H. 2022. The sediments and biota within Te Ihutai/Avon Heathcote Estuary 2007-2021. Prepared for Environment Canterbury. Cawthron Report No. 3825. 89 p. plus appendices.
- Hollever, J. and Bolton-Ritchie, L. 2016. Broad scale mapping of the Estuary of the Heathcote and Avon Rivers/Ihutai. Environment Canterbury unpublished report.

Zinc

We strongly suggest the Council

1. Seek ways to work with architects, designers and the building industry in general, to encourage the use of mitigation methods
2. Treat runoff from high-usage roads and other hard surfaces; this treatment may include using existing wetlands or creating new wetlands

Submission attachment 10002

Copper

We strongly suggest the Council.

1. Be active in advocating for legislation to ban copper in brake pads.
2. Work with the automobile industry to encourage use of copper-free brake pads.
3. Treat runoff from high-usage roads and other hard surfaces; this treatment may include using existing wetlands or creating new wetlands .
4. Be active in advocating for legislation to reduce the contamination from copper roofs, cladding, spouting and downpipes.
5. Introduce rules in the District Plan to restrict copper roofs, cladding, spouting and downpipes, or at least to confine contaminants from those sources.

Pathogens/bacteria

We strongly suggest the Council

1. Work with other agencies to reduce the number of non-indigenous waterfowl.
2. Continue improving waste-water networks so as to reduce overflows.

Other organic material

We strongly suggest the Council
1. Work with other agencies to reduce the number of non-indigenous waterfowl

Nitrate and nitrite

1. There is eutrophication in the Avon-Heathcote Estuary/Ihutai. The Ōtākaro/Avon and the Ōpāwaho/Heathcote rivers are a significant source of the dissolved inorganic nitrogen (DIN) concentrations within the estuary. While we acknowledge that the groundwater feeding the rivers has elevated nitrate concentrations, we note that CCC do not have data on the stormwater contribution of nitrogen (and phosphorus) to river water (SMP Table 5)

   We urge the CCC to quantify the stormwater contribution of nitrogen (from industrial and urban fertiliser sources) to the river. Having such data could help with the long-term management of DIN concentrations in the river water and hence into the estuary.

Yours sincerely, Kit Doudney

Chair, Avon Heathcote Estuary Ihutai Trust

Contact details for the Estuary Trust are
info@estuary.org.nz Cell phone; [redacted]

Submission attachment 10003

Kāinga Ora
Homes and Communities

Christchurch South Office
192 Moorhouse Avenue, Sydenham
PO Box 1074, Sydenham
Christchurch 8140

0800 801 601
www.kaingaora.govt.nz

22 April 2024

Samantha Smith

Ōtākaro Avon Stormwater Management Plan

Christchurch City Council

Feedback provided via email: letstalk@ccc.govt.nz

Feedback on the Ōtākaro Avon Stormwater Management Plan

Kāinga Ora – Homes and Communities ("**Kāinga Ora**"), at the address for service set out below, thanks Christchurch City Council for the opportunity to submit on the Ōtākaro Avon Stormwater Management Plan "Ōtākaro Avon SMP"). This letter provides the substantive detail of Kāinga Ora's submission on the Ōtākaro Avon SMP.

Background

1. Kāinga Ora was established in 2019 as a statutory entity under the Kāinga Ora-Homes and Communities Act 2019 and is required to give effect to Government policies. Kāinga Ora has two core roles:

    a) Being a world class public housing landlord; and
    b) Leading and co-ordinating urban development projects

2. Kāinga Ora's statutory objective requires it to contribute to sustainable, inclusive, and thriving communities that:

    a) Provide people with good quality, affordable housing choices that meet diverse needs; and
    b) Support good access to jobs, amenities and services; and
    c) Otherwise sustain or enhance the overall economic, social, environmental and cultural well-being of current and future generations.

3. Kāinga Ora is focused on delivering quality urban developments by accelerating the availability of build-ready land, and building a mix of housing including public housing, affordable housing, homes for first home buyers, and market housing of different types, sizes and tenures.

4. Kāinga Ora owns or manages approximately 63,800 properties throughout New Zealand comprising of rental properties, community group and transitional housing.

Submission attachment 10003

Kāinga Ora
Homes and Communities

Christchurch South Office
192 Moorhouse Avenue, Sydenham
PO Box 1074, Sydenham
Christchurch 8140

0800 801 601
www.kaingaora.govt.nz

5. Despite consenting several hundred new dwellings in the past three years in Christchurch City, the current wait list in Christchurch continues to grow and there are now approximately 1,998 applicants[1]. Christchurch City is identified as an area to reconfigure and grow Kāinga Ora's housing stock to provide efficient and effective public and affordable housing that is aligned with current and future residential demand in the area, and the country as a whole.

6. In terms of its role as a public landlord, there has been a marked change in the type of housing that is required by Kāinga Ora's tenant base:

   a) Demand in particular for the Christchurch City area has increased for apartments, terraced housing and for single and 2 bedroom housing required for single persons/couples. Currently the demand for a 1 bedroom typology sits at 62% of the waiting list total. The demand for a 2 bedroom typology sits at 23% of the waiting list total[2]. This means that some 85% of wait list demand is for 1-2 bedroom units.
   b) As a result, the size of many public houses does not match the changing demand for public housing, with a large proportion of the Kāinga Ora's current housing typologies comprising of 3-4 bedroom homes on large lots; this can be too large for smaller households and potentially considered not fit for purpose for some tenants.

7. As such, in addition to its role as a public housing provider, landowner, landlord, rate payer and developer of residential housing, Kāinga Ora will play a greater role in urban development more generally. The legislative functions of Kāinga Ora illustrate this broadened mandate and outline two key roles of Kāinga Ora in that regard:

   a) Initiating, facilitating and/or undertaking development not just for itself, but in partnership or on behalf of others; and
   b) Providing a leadership or coordination role more generally.

8. Notably, Kāinga Ora's statutory functions in relation to urban development extend beyond the development of housing (which includes public housing, affordable housing, homes for first home buyers, and market housing) to the development and renewal of urban environments, as well as the development of related commercial, industrial, community, or other amenities, infrastructure, facilities, services or works.

9. Kāinga Ora is interested in all issues that may affect the supply and affordability of housing and has a shared interest in the community as a key stakeholder, alongside local authorities. These interests include:

   a) Minimising regulatory barriers that constrain the ability to deliver housing development;
   b) The provision of public housing to persons who are unable to be sustainably housed in private sector accommodation;
   c) Leading and co-ordinating residential and urban development projects;
   d) The provision of services and infrastructure and how this may impact on Kāinga Ora's existing housing, planned residential and community development and Community Group Housing ("CGH") providers; and

[1] As at December 2023
[2] As at March 2022

Submission attachment 10003

Kāinga Ora
Homes and Communities

Christchurch South Office
192 Moorhouse Avenue, Sydenham
PO Box 1074, Sydenham
Christchurch 8140

0800 801 601
www.kaingaora.govt.nz

e) Working with local authorities to ensure that appropriate services and infrastructure are delivered for its developments.

Outline of Submission on the Ōtākaro Avon SMP

10. Kāinga Ora thanks the Council for the opportunity to provide submission on the Ōtākaro Avon SMP.

11. In particular, Kāinga Ora supports:

a) The Council's goals to reduce contaminants entering waterways and improve the ecological health of waterways within the Ōtākaro Avon Catchment.
b) The recognition in the Ōtākaro Avon SMP of the importance of the cultural values associated with the Ōtākaro Avon Catchment.
c) The Council's goal to improve the management of stormwater across the city and agrees that effective stormwater management is an important tool in managing flood risk.
d) Continued reference, and use of the Christchurch City Council's 'Onsite Stormwater Mitigation Guide'.

12. Kāinga Ora has some concerns, and would like to work with Council further on:

a) Management options for specific contaminants.
b) Preference for on-site attenuation. Generally, all stormwater management options should be considered on comprehensive development sites, and the best solutions are selected as appropriate to that site.
c) Practicalities around the establishment of stormwater basins on non-Council land by developers (including Kāinga Ora), in relation to ECan's approach to groundwater/ stormwater basins.

13. The aspects of the Ōtākaro Avon SMP that Kāinga Ora does not support relate specifically to the extent of the 13km Bird Strike Management Area shown in Figure 12 of the Ōtākaro Avon SMP. Kāinga Ora notes that the 13km radius includes multiple waterways such as the Waimakariri River, The Groynes, Brooklands Lagoon, Travis Wetland, Council Oxidation Ponds, Heathcote River, Ōtākaro Avon River and the Heathcote/ Ōtākaro Avon Estuary. These are large waterbodies where there is significant bird life already. Kāinga Ora does not consider that smaller scale stormwater basins or stormwater management areas on development sites alongside these existing significant water bodies would materially increase the risk of bird strike overall. In light of this the effectiveness of the current practice of imposing onerous bird strike management conditions for stormwater basins should be reviewed.

14. Recently, Kāinga Ora has received conditions on a subdivision consent (where a stormwater basin was being constructed) relating to bird strike for a development located in Opawa, some 12km from the airport and in close proximity to both the Heathcote River and Avon Heathcote estuary. It is the view of Kāinga Ora, that conditions to manage bird strike in suburbs such as Opawa are both unnecessary and overly restrictive. The reasons for this are outlined in (13) above.

15. Overall, Kāinga Ora is supportive of the approach taken in the Ōtākaro Avon SMP and want to work with Council on the issues discussed in paragraphs 12-14.

Submission attachment 10003

Kāinga Ora
Homes and Communities

Christchurch South Office
192 Moorhouse Avenue, Sydenham
PO Box 1074, Sydenham
Christchurch 8140

0800 801 601
www.kaingaora.govt.nz

16. Should you have any questions in relation to the matters outlined above, please do not hesitate to contact me.

Dated 22/04/2024

Brendon Liggett

Manager – Development Planning

National Planning, Urban Design and Planning Group

Kāinga Ora – Homes and Communities

ADDRESS FOR SERVICE:

Kāinga Ora – Homes and Communities

PO Box 74598, Greenlane, Auckland 1546

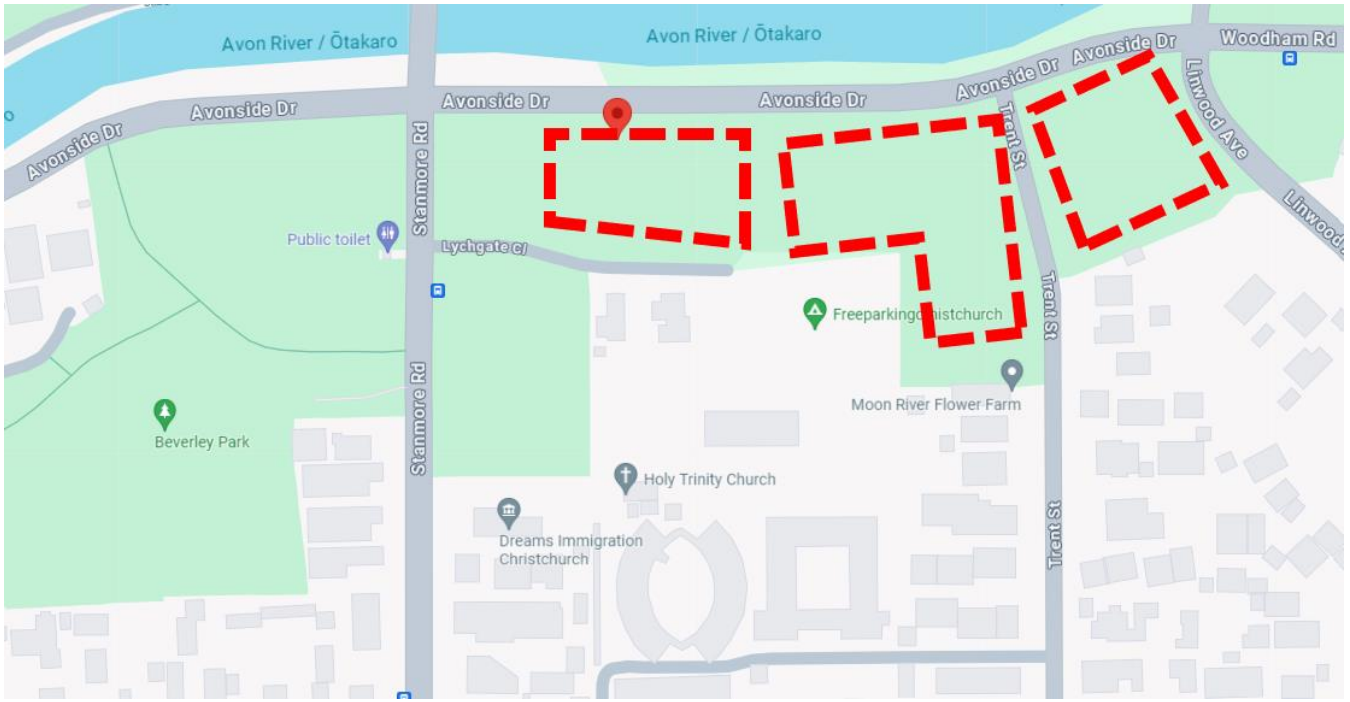
Email: developmentplanning@Kāingaora.govt.nz

Submission attachment 10004

Submission to the Otakaro Avon Stormwater Plan

By: Greg Partridge, Richmond, Christchurch

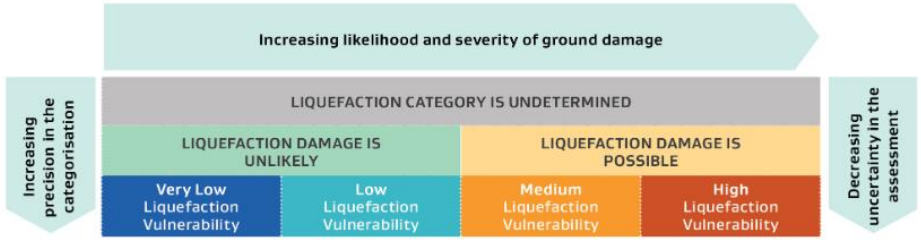
The CCC have proposed to construct stormwater detention ponds on the southern side of Avonside Drive, between Stanmore Road and Linwood Avenue, as indicated approximately by the red dotted shapes on the following map, according to Council in formation.

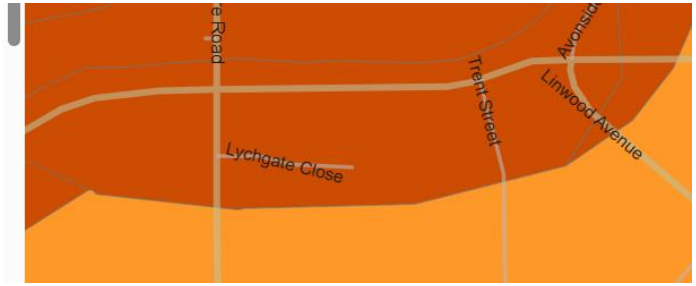


Submission attachment 10004

The land beneath the earmarked location for these ponds has however, as you can see in the following map where it is a dark orange colour, has been identified as being of **High Liquefaction Vulnerability** and of **increased likelihood and severity of ground damage.**
For reference purposes, the Christchurch Liquefaction Information map from which this information was sourced, was compiled by Tonkin + Taylor, and it was commissioned by the Christchurch City Council.
For reference the Christchurch Liquefaction Information map can be readily accessed through:

- the following link Christchurch Liquefaction Information (canterburymaps.govt.nz)
- or via the website https://apps.canterburymaps.govt.nz/ChristchurchLiquefactionViewer/





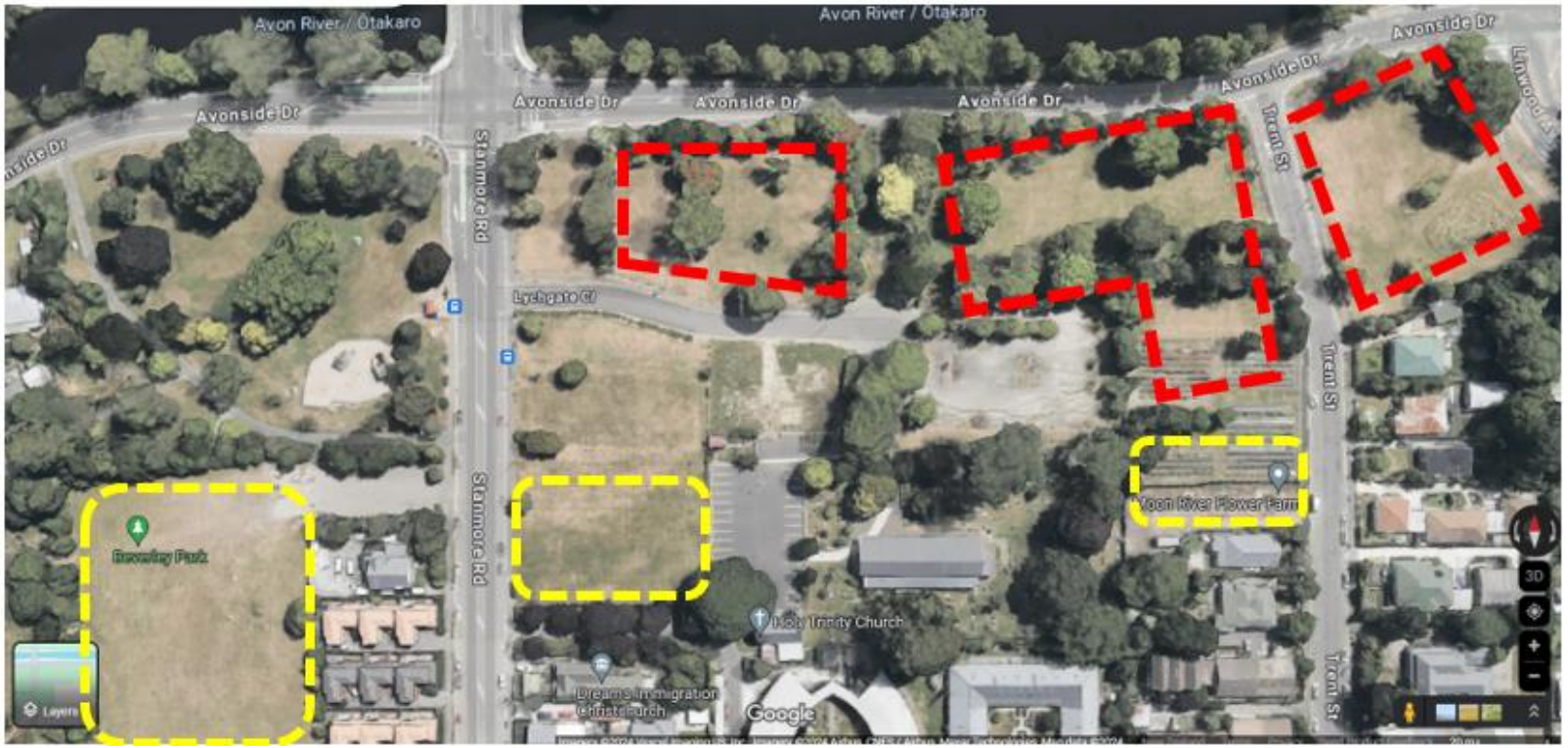
Situating the stormwater detention ponds, or other Council owned infrastructure on this type of land, fully exposes the Council to future financial risk.

In addition to that, constructing detention ponds on the indicated land, which again has been currently earmarked by the CCC for that purpose, will result in numerous established trees and shrubs being clear-felled or removed at considerable expense to Christchurch Rate Payers, and be detrimentally costly to the natural environment.

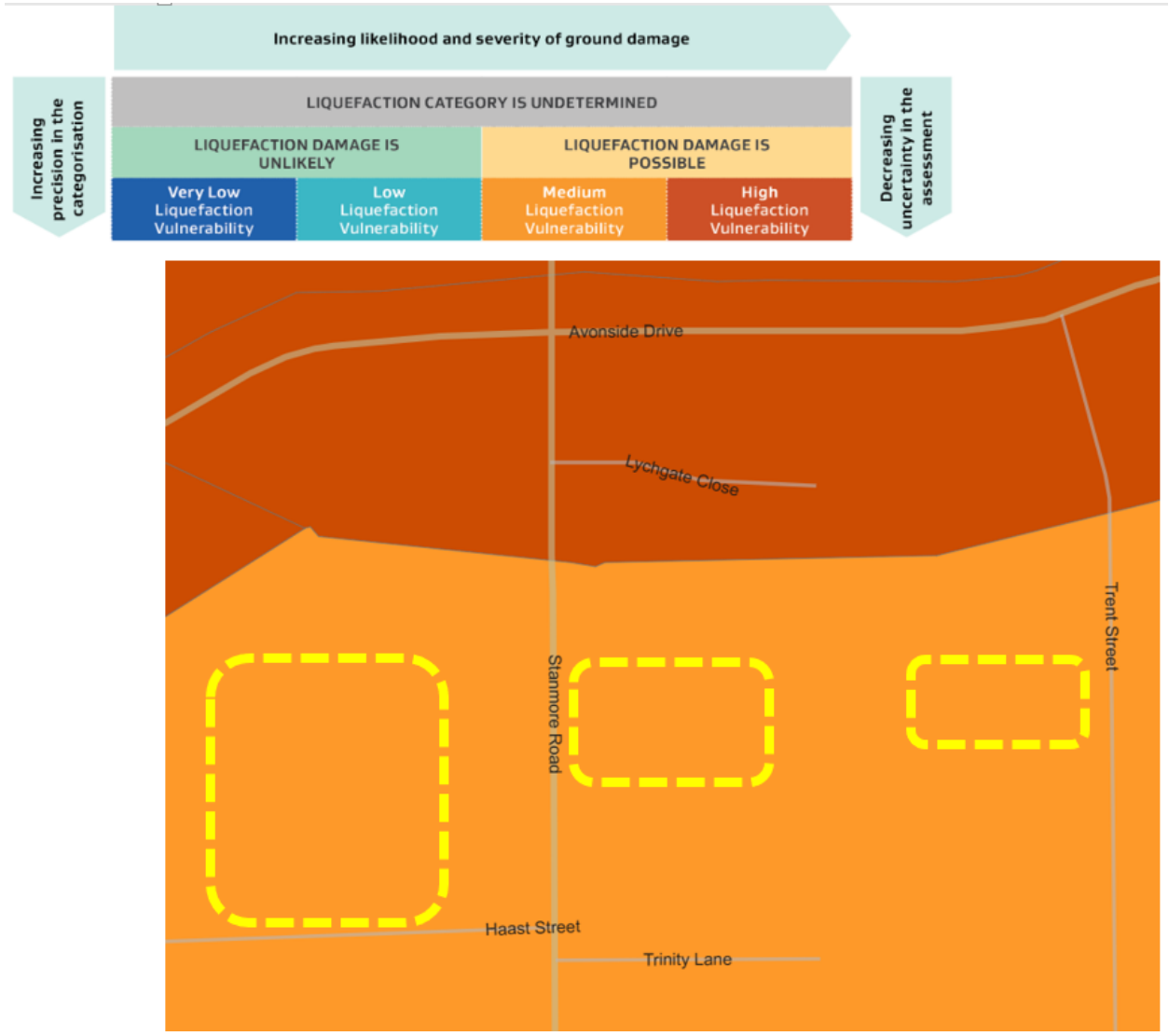
Submission attachment 10004

In order to avoid future financial risk to the Council, and to retain the existing tree canopy coverage of the area, there are several viable alternative locations for the stormwater detention ponds to be located quite nearby, as demonstrated with the three yellow rectangles depicted on the following map.

Not only are these locations blocks of land publicly owned but they are completely barren of existing trees. In addition to that, as you can see on the map on the Christchurch Liquefaction Information Map on the following page, the land has been identified as being of only medium risk to liquefaction vulnerability, meaning there is less likelihood and severity of ground damage, therefore minimising the financial risk to which the CCC would be exposed as well as possible damage to the stormwater detention ponds in future seismic events, of which Christchurch is vulnerable.



Submission attachment 10004

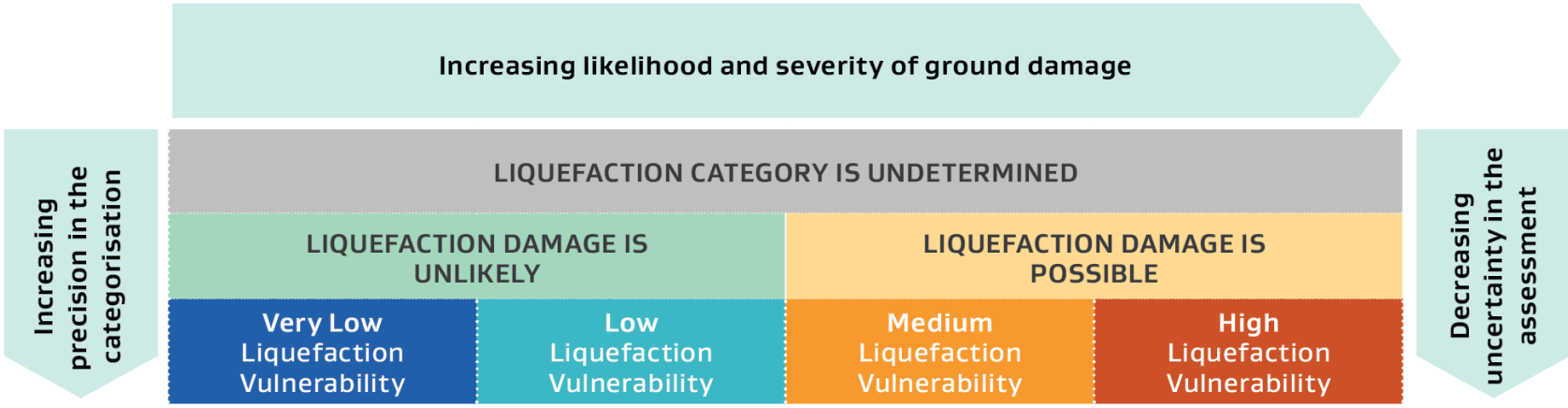


Plan indicating alternative, and arguably environmentally better locations for stormwater detention ponds to be situated that expose the CCC to less financial risk.

Submission attachment 10004

In relation to the Christchurch City Council commissioned Tonkin + Taylor Liquefaction Vulnerability Map, it is important to note that it follows the most recent national liquefaction guidance.

The map uses the seven categories shown in the table below to describe the vulnerability of the land to liquefaction-induced damage. As well as describing the likelihood and severity of ground damage, the categories also show where there is more or less certainty about the ground conditions. For example, in some areas there is enough information to distinguish between areas of "Medium" and "High" vulnerability. But in other areas where there is less information it might only be possible to conclude that "Liquefaction Damage is Possible". When more detailed information becomes available in future (e.g. new ground investigations), this might show that the actual vulnerability is "Medium" or "High", or in some cases perhaps even "Low".



There was already a substantial amount of previous information available about the liquefaction hazard in Christchurch, and the results of this latest assessment broadly align with what was previously known. This updated map makes improvements to the previous understanding of liquefaction vulnerability by:

- Analysing the extensive collection of ground investigation data now available on the New Zealand Geotechnical Database.
- Using observations of land damage caused by the Canterbury earthquakes to help calibrate predictions of future land damage.
- Drawing on improved scientific understanding for analysis of liquefaction triggering and the resulting consequences.
- Using the improved geology and groundwater maps that are now available, to better define areas of similar land performance.
- Providing coverage of the entire Christchurch City territorial land area.
- Using the consistent framework from the new national guidance to standardise the assessment methodology.

Submission attachment 10004

It is important that the Christchurch City Council give serious consideration to these facts, and to not put its financial stability, nor publicly owned infrastructure at risk when it can be avoided unnecessarily at risk.

I support the aspiration of the CCC to improve the Stormwater Management Plan for the Otakaro Avon River catchment, but I do not agree with the exposing itself or publicly owned infrastructure which is yet to be constructed, at risk, therefore do not construct the stormwater detention ponds along Avonside Drive on land that is susceptible to high liquefaction vulnerability.

I also wish to point out that if the CCC are wanting to adhere to the Community Outcomes and the Councils Strategic Framework of wanting to protect and regenerate the environment, especially our water bodies and tree canopy, the Council should not be constructing the proposed Stormwater detention ponds on the land currently earmarked by the Council due to the fact it will result in established trees being felled when there is vacant, barren publicly owned land within very close proximity on which the stormwater detention ponds could be constructed without any further reduction of the existing tree canopy cover of the area.

Submission attachment 10004

Reference Material

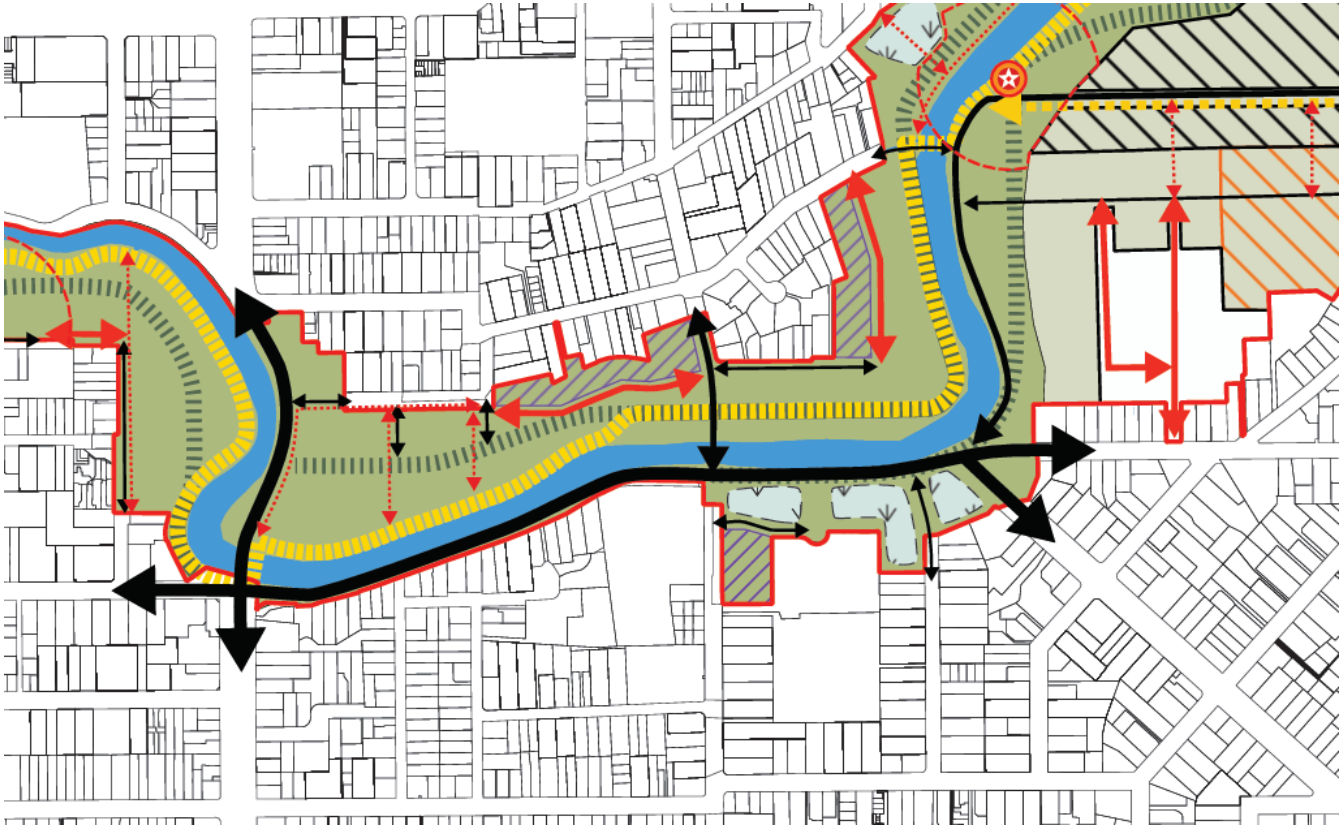
Page 4 of the Draft LTP 2024

Community Outcomes and Strategic Framework

A green, liveable city	Our neighbourhoods and communities are accessible and well-connected, supporting our goals to reduce emissions, build climate resilience and protect and regenerate the environment, especially our biodiversity, water bodies and tree canopy. What this means for our district: • We have well-connected communities and neighbourhoods: Our city is designed so people can take fewer and shorter trips to access goods and services and have access to safe and reliable low-emission travel choices. • We reduce emissions: Christchurch has net zero emissions by 2045. • We build climate resilience: We understand and are preparing for the ongoing impacts of climate change; we have a just transition to an innovative, low-emission economy. • Biodiversity is supported: Ecosystems supporting biodiversity are protected and restored. • We improve the water quality of water resources to protect ecosystem health and provide for contact recreation, food gathering, mahinga kai and cultural values. • Our urban forest thrives with healthy, diverse and resilient trees.

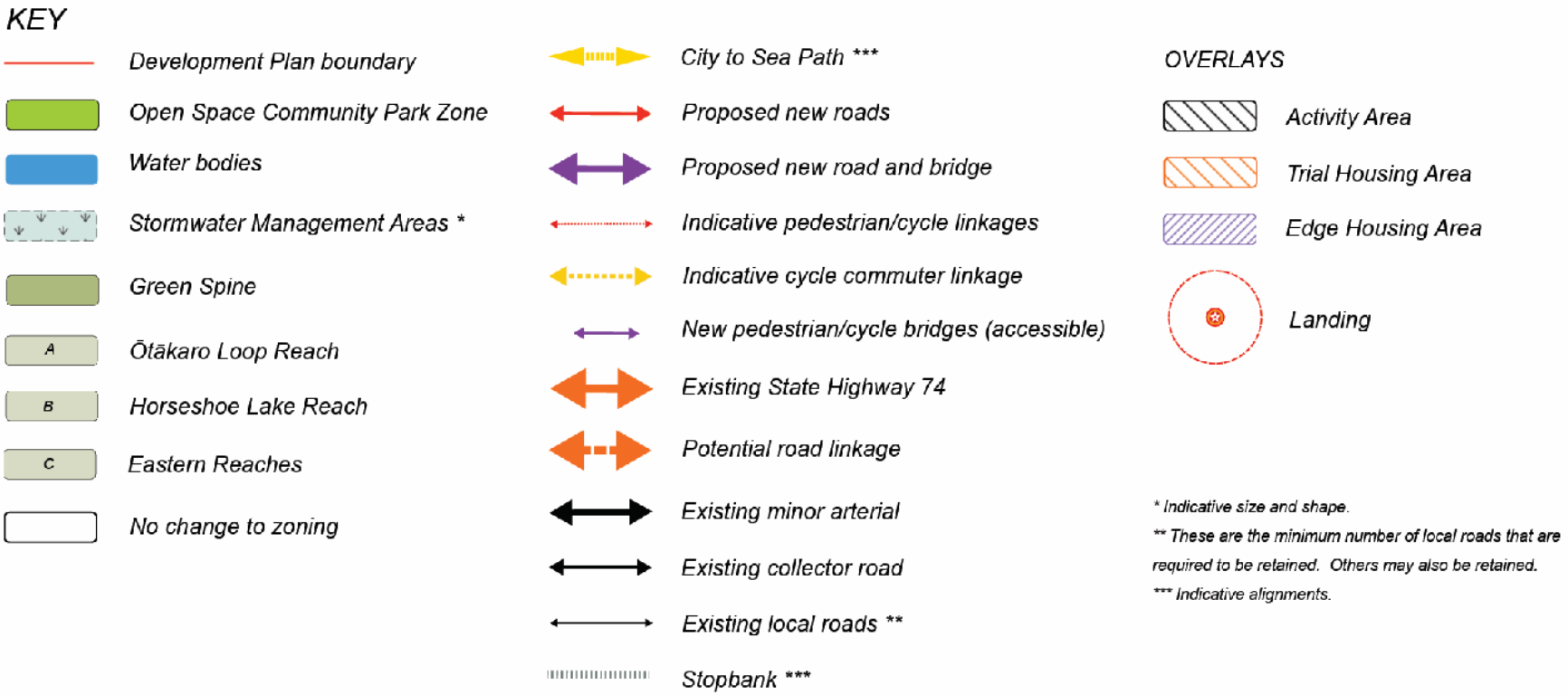
Submission attachment 10004

CCC's proposed plan for the Otakaro Avon River Corridor



Key on the following page

Submission attachment 10004



Submission attachment 14186

Submission attachment 15379

Submission attachment 15386

Written Submission on Draft Ōtākaro Avon Stormwater Management Plan

To: Christchurch City Council

1. **Name of submitter:** Christchurch International Airport Limited ("CIAL")

2. **This is a submission on the** Draft Ōtākaro Avon Stormwater Management Plan (Draft OASMP) 2024**.**

3. **Submitter Details:**

Christchurch International Airport Limited
PO Box 14001,
Christchurch 8544.

Attention: Jesse Aimer, Senior Environment and Planning Advisor.
Phone: [redacted]
Email: jesse.aimer@cial.co.nz

Signature:

Dated: 17 April 2024.

Submission attachment 15386

Introduction

CIAL owns and operates Christchurch International Airport (Christchurch Airport). Christchurch Airport is the largest airport in the South Island and the second largest airport in New Zealand. It connects Canterbury and the wider South Island to destinations in New Zealand, Australia, Asia and the Pacific. Accordingly, it has national, regional and district social and economic significance.

Just under seven million travelling passengers and their associated "meeters and greeters" passed through Christchurch Airport annually prior to the Covid-19 pandemic. In 2022, Christchurch Airport had 4.6 million passengers, most of which were domestic passengers, as the recovery of international travel only started in the second half of 2022 with the reopening of New Zealand's borders. All projections are that pre-pandemic numbers will return to Christchurch Airport.

Over 9,000 people are employed on the Christchurch Airport campus in full-time, part-time or casual roles, making it the largest single centre of employment in the South Island. Christchurch Airport also facilitates various non-passenger services, including as the primary freight hub for the South Island, playing a strategic role in New Zealand's international trade as well as the movement of goods domestically. Airfreight is becoming increasingly important due to decreased viability, considerable delays and record high prices associated with land transport.

CIAL welcomes the opportunity to submit on the Draft Ōtākaro Avon Stormwater Management Plan.

Summary of Key Submission Points

Christchurch International Airport Limited's interests within the area of land covered by the Draft Ōtākaro Avon Stormwater Management Plan (draft OASMP) relate to consideration of bird strike in the planning for, and specific design of, stormwater management basins within the area covered by the draft OASMP. CIAL is supportive of the references to bird strike within the Plan, and is appreciative of the ongoing dialogue between CCC and CIAL in respect of bird strike issues.

Given the location of the Ōtākaro Avon catchment directly underneath the flight path of departing and arriving aircraft to Christchurch Airport, CIAL has a particular interest in ensuring that bird strike risk is effectively managed. The key relief that CIAL seeks on the draft OASMP is:

1. Recognition of the bird strike risk within the catchment
2. Specific reference to bird strike be made in the objective and policy framework.
3. The inclusion of bird strike risk within the summary document (if this is intended to be available post completion of the final management plan).

A table setting out the full package of relief sought by CIAL is set out in **Appendix A**.

CIAL considers that the Plan is an important tool for educating and informing persons undertaking stormwater management within the Ōtākaro Avon catchment of bird strike risk and how it can be avoided or mitigated appropriately. CIAL also sees the OASMP as providing a pathway whereby CIAL can work with CCC and landowners/ developers to address this issue. It considers that this is particularly critical given the number of treatment facilities proposed within the catchment.

Overall, CIAL strongly supports the recognition of bird strike within the draft SMP.

CIAL wishes to acknowledge CCC for recognising the importance of including information and design guidance to raise awareness, and reduce the risk, of bird strike in the stormwater management plans that have been developed for the various catchments within the City.

Bird Strike

Introduction

Bird strike is defined in the Christchurch District Plan as when a bird or flock of birds collide with an aircraft. This can cause damage to the aircraft, which compromises safety and, in many instances, forces an emergency landing.

Submission attachment 15386

It is of concern in the Ōtākaro Avon catchment, as the majority of the catchment falls within the 3km, 8km and 13km radii from the airport runway thresholds.

Bird Strike Risk

Bird strike risk is increased by flocks of birds flying across flight paths between different parts of the city. Birds fly across the city every day between roosting areas, feeding areas, and areas of standing water. The more activities / sites near the Airport that attract birds, the more likely it is that birds will fly across flight paths between these activities / sites and increase the risk that bird strike will occur at or near the Airport. New activities which will attract birds may need to be managed to ensure that they will not increase bird strike risk at the Airport. There are three main elements to how an off-airport bird attracting land use contributes to strike risk:

a) *Identification of air space aircraft share with bird (3, 8 and 13km radii)*

b) *Identification of high – risk bird species (size and behaviour of species), and*

c) *Identification of where there is potential for collision with aircraft.*

Given the location of the catchment directly within flight paths, planes and birds in this area will share airspace. Therefore, it is critical for the safety and function of CIAL's operations that bird strike risk within the Ōtākaro Avon catchment is managed appropriately, and any risk is avoided and minimised as far as possible.

The CAA data (which includes a review and update to include CIAL's records) shows monthly strikes and near strikes at CIA from 2013 to June 2021. Statistics for the three years ending 31 December 2020 indicate that Christchurch has higher levels of bird strike than Auckland or Wellington airports[1].

Management of Bird Strike Risk

Bird strike is a significant safety risk which requires diligent management and CIAL collaboration with local government and surrounding landowners. CIAL has a responsibility (including legal duties as in CAA Rule 139.71) to provide a safe airport operating environment and therefore must actively work to minimise the threat and incidence of bird strike around Christchurch Airport as well as on the airfield and land controlled by CIAL. Bird strike that occurs, for example through the creation of water bodies, refuse dumps, landfills, sewage treatment and disposal and agricultural activities, will affect the ability of CIAL to provide this safe environment.

The Council is required under the CSNDC to manage bird strike risk. Condition 28 of CRC 231955 states:

'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 nonbird attracting species.

Condition 6 of this consent, which prescribes the purpose of Stormwater Management Plan (SMP's), requires Council to '*Implement the conditions of this consent as they apply to each catchment'.*

CIAL consider that Condition 28 expressly requires CCC, through this SMP, to ensure that the risk of bird strike is minimised through appropriate acknowledgement and reflection of Condition 28.

In addition, Condition 7 of the consent requires that SMPs shall include, but not be limited to, the information set out in Schedule 2. Schedule 2(t) states '*Procedures, to be developed in consultation with Christchurch International Airport Limited, for the management of the bird strike for any facility owned or managed by Christchurch City Council within 3 kilometres of the airport*'.

[1] Evidence of F Blackmore, Hearings on Proposed Selwyn District Plan, September 2021.

Submission attachment 15386

National Airports Safeguarding Framework

The Australian Government has developed a National Airports Safeguarding Framework (NASF)[2] which is considered to be the most comprehensive guide to incompatible land uses around airports. This categorises land use types into wildlife attraction risk categories (high, moderate, low and very low) and determines actions (incompatible, mitigate, monitor, no action) for existing and proposed developments within radial distances from the aerodrome (3, 8 and 13kms).

The 13-km circle was originally based on a statistic that 95% of bird strikes occur below 2,000 ft, and that an aircraft on a normal approach would descend into this zone at approximately 13-km from the runway. An assumption was made that birds would remain overhead the attraction (at up to 2,000 ft) and that overflying aircraft would be at risk. In essence, this only looks at the site risk which is only one of the three elements of an off-airport hazard. Like the site risk, the flight path risk will generally become greater the closer the bird attracting habitat is to the airport[3]. CIAL considers that the NASF guidelines provide appropriate guidance for the management of the risk of bird strike.

To this extent, the CCC District Plan includes specific planning provisions to assist with managing off airport bird strike risk. CIAL has also worked with an Ecologist with Ornithological expertise in birdstrike risk management and with CCC in the development of a CCC internal practice note which is intended to provide assistance to planning staff and application of the birdstrike provisions within the CDP. It outlines the need, and how to consider bird strike when processing applications within proximity of CIAL, for the types of land uses that have the potential to create or increase bird strike risk.

Conclusion

CIAL consider it an integral part of its function to be involved in matters relating to bird strike risk in a strategic manner, to ensure the development of land uses (such as stormwater retention basins) in specific areas are designed in such a way as to limit attractive habitat to birds. CIAL are happy to work with CCC and landowners/ developers in this area to manage any bird strike related risks appropriately.

CIAL supports the recognition of bird strike within the draft SMP.

CIAL's Detailed Submission

CIAL's detailed submission is contained as **Appendix A.**

[2] DIRD [Department of Infrastructure and Regional Development, Australian Government] (2012) NASF Guideline C. https://www.infrastructure.gov.au/aviation/environmental/airport_safeguardin g/nasf/nasf_principles_guidelines.aspxv Accessed 19/7/21 (as referred to in the evidence of P Shaw, referenced above).

[3] Source: Extracts of Evidence of P Shaw, Hearings on the Proposed Selwyn District Plan

Submission attachment 15386

Appendix A: CIAL's Detailed Submission

Text changes to the draft OASMP (Draft Ōtākaro Avon Stormwater Management Plan) sought as part of this submission are shown as strikeout for text to be deleted and **bold underlined** for text to be added. CIAL also request that any other related and appropriate amendments are made to the Plan to give effect to this request.

Chapter / provision	CIAL's reasons for submission	Relief sought
Overall	CIAL is a nationally significant facility located within the area covered by the provisions of the draft OASMP. CIAL acknowledges and is supportive of the recognition of bird strike, which is an issue which has the potential to affect the safe and efficient operation of the airport and the aircraft which utilise this. The majority of the catchment falls within the 8 or 13km radii of the airport runway threshold, with some also falling within the 3km radii. CIAL requests that the references to bird strike within the Plan are further extended to provide clarity and consistency for plan users.	Retain and expand upon references to bird strike within the Plan.
Terminology/ abbreviations	The Plan does not contain any reference to bird strike in the terminology/ abbreviations. This is inconsistent with the recent SMPs, such as the Pūharakekenui Styx SMP.	Include the term ***'Christchurch International Airport Bird Strike Management Areas'***
Executive Summary	CIAL request that specific reference is made to bird strike in the Executive Summary to the document.	Add a new fourth paragraph to the Executive Summary as follows: ***Considered design of stormwater facilities, as per Appendix I, within the identified Bird Strike Radii is required to ensure that these do not increase the risk of bird strike for aircraft use associated with Christchurch International Airport'.***
7 Land Use 7.1 Present Situation	CIAL requests that an acknowledgement of the location of the catchment within the 13km radii from the airport runway thresholds to acknowledged. It considers that this will aid in placing the bird strike issue in context. This would ensure consistency with section 12.2 and Figure 12, which reference the 13km radii.	Add the following sentence to the end of 7.1 Present Situation: '***The catchment is located within the 13km radii of the airport runway thresholds'***.
Treatment Facilities 12.1 New facilities sizing and land contamination	CIAL requests that an additional sentence be added at the end of this section referencing the requirement to consider bird strike risk when designing new bird strike facilities.	Add a sentence at the end of section 12.1 stating: ***'Specific consideration should also be given to design requirements of such facilities to ensure that the risk of bird strike is minimised (see section 12.2 below)'***.
Treatment Facilities	CIAL strongly supports the inclusion of section 12.2 of the Plan. CIAL supports the reference to the importance of considering bird strike risk for	Retain section 12.2.

Submission attachment 15386

Chapter / provision	CIAL's reasons for submission	Relief sought
12.2 Designing basins to minimise bird-strike on aircraft	any new stormwater basin within the 13km radii, and the recommendation that persons developing stormwater facilities within 13km of airport runway thresholds consult with CIAL. There is a minor error reference to the bird strike guidelines in the Plan – the section refers to an incorrect Appendix number within which the guidelines are contained.	Amend the second to last sentence of the last paragraph of Section 11.6.2 as follows: 'Guidance Material is contained as Appendix ~~I~~ ***H***'.
Figure 12 Bird Strike Management Zones	CIAL supports the inclusion of the bird strike management guidelines in Figure 12. However, it requests that the 8km radii is also included in Figure 12. CIAL also notes that the text box containing the description of the 3km radii obscures part of the image showing the Ōtākaro Avon catchment, and request that this be moved to the right of the image to ensure that the Figure is user-friendly.	Add the 8km radii into Figure 12. Ensure that the text box descriptions of the radii do not obscure any part of the image within the Ōtākaro Avon catchment.
Appendix H	CIAL strongly support the inclusion of bird strike guidelines within the Plan.	Retain Appendix H.
Section 13 – Plan Objectives New objective	CIAL consider that the bird strike provisions of the plan should be reinforced by the inclusion of an objective relating to bird strike.	Add a new Objective 8 as follows: '***Our goals are*** ***1. To minimise the potential risk of bird strike to aircraft through consideration of the location and design of stormwater facilities.*** *2.* ***To collaborate with CIAL to ensure that (1) is achieved'***. **Action Plan for Bird Strike** **Goal** / **Action** / **Mechanism** / **Action Components** / **Timing** 8.1 / Promotion of bird strike guidelines / Inclusion of guidance notes. Referral of matters relating to stormwater facility design within 13km / Keep records of stormwater basins developed within catchment area. / Immediate and ongoing

Submission attachment 15386

<table>
<tr><th>Chapter / provision</th><th>CIAL's reasons for submission</th><th>Relief sought</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td></td><td></td><td>radii of airport runway threshold to CIAL.</td><td>Provide records to CIAL at annual intervals upon CIAL request.</td><td></td></tr>
<tr><td>8.2</td><td>Ongoing liaison with CIAL</td><td>Meetings with CIAL and CCC to discuss bird strike.</td><td></td><td>As above.</td></tr>
</table>
</td></tr>
<tr><td>14
Conclusion</td><td>CIAL considers that recognition of bird strike should be made in the conclusion section of the document.</td><td>Add an additional bullet point to the second paragraph as follows:

• <u>'Reduce the threat of birdstrike through consideration of appropriate stormwater facility location and design'</u>.</td></tr>
<tr><td>Summary document</td><td>CIAL appreciate the acknowledgement of bird strike within the Plan, however, note that there is no reference to bird strike within the summary document. If the summary document is intended to be utilised post the submission period on this plan (ie as a quick User Guide for CCC staff or persons wishing to utilise the CSNDC), CIAL requests that reference to bird strike is included in this document.</td><td>(i) 'What we're going to do' section:

Add a new sentence after the statement 'These options can be implemented by the Council using its powers under the Local Government Act':

'<u>We also need to ensure that the threat of birdstrike to aircraft operating in the airspace in the catchment is reduced through consideration of appropriate stormwater facility location and design'</u>

(ii) 'Our Goals' section:

7. Bird Strike

Our goals are:

7.1 <u>To minimise the potential risk of bird strike to aircraft through consideration of the location and design of stormwater facilities.</u>

<u>7.2 To collaborate with CIAL to ensure that 7.1 is achieved'.</u></td></tr>
</table>

Submission attachment 15389

Submission to the Ōtākaro Avon Storm Water Management Plan

On behalf of Avon-Ōtākaro Network (AvON)

We wish to be heard

Primary Contact: Hayley Guglietta, Network Manager, Avon-Ōtākaro Network
[redacted]

Submission attachment 15389

AvON and our vision for the Ōtākaro Avon River Corridor

Avon-Ōtākaro Network (AvON) was founded in 2011 to promote a popular vision for the future of the Ōtākaro Avon River corridor (OARC), including what was formerly known as the Avon River residential red zone.

Our vision is for:

A MULTIPURPOSE CITY-TO-SEA RIVER PARK THAT MEETS DIVERSE COMMUNITY NEEDS ***WITH*** THE MAXIMUM POSSIBLE RESTORATION OF INDIGENOUS ECOSYSTEMS

Our 2020 5 year strategic objectives are;

1. Future governance of the Ōtākaro Avon River Corridor (OARC) that supports the Vision.
2. People, both locally and beyond, are connected with the OARC as a whole.
3. Organisational sustainability.

The level of support for this vision remains extremely high.

Now that the Red Zone has a District Plan project assessment framework in place and the co-governance committee is well underway, AvON has shifted its focus to the entire catchment area and how we can support, resource and fund communities, groups and individuals who are participating in rubbish collection, waterway health, riparian planting, advocacy and biodiversity projects around the catchment.

Our organisation alone in the last 12 months has achieved the following;

- We have lifted 5 tonnes of rubbish out of the river bed, 50% diverted from landfill and includes 120 road cones, 5 Trolleys, 3 lime scooters amongst an array of other interesting items. We work with other individuals who are active in this space and work with a school group at least once a month to help us with the sorting. We are collecting data to help inform the Christchurch City Council and Environment Canterbury about trouble spots and to build a picture of where the rubbish is coming from.
- We work with 7 schools currently in the catchment area to activate spaces, riparian planting and kaitiaki particular areas.
- We participate in the annual Mother of all Clean Ups organising committee and we are responsible for hosting and catering the health and safety and post clean up events.
- We participate in the Community Waterways Partnership and steering committee where we are currently working on an impact action plan.
- We hold regular network meetings to bring people together over submissions, challenges and a shared goal of a swimmable river.
- We support the Riverlution Ōtākaro Trapping project to create a virtual fence around our river network.
- We have 4 planting sites that we progress and maintain with volunteers.

Submission attachment 15389

- We have spoken about the OARC developments and education around Stormwater at 4 public groups, 4 events and 5 walking/cycling tours.
- We support 3 community gardens across the OARC in order for them to avoid setting up another committee and simply focus on their project.

For more info: www.avonotakaronetwork.org.nz

The draft Ōtākaro-Avon Stormwater Management Plan (SMP)

We are not doing a very good job as a city managing the health of our urban waterways therefore it is finally great to see some action on this issue. On principle, we support the concepts and regulation behind the draft Ōtākaro Avon Stormwater Management Plan, however we would like to see more reference and action to the following;

- The Ōtākaro-Avon (OA) catchment runs from Addington and Avonhead through to the estuary, although this draft plan outlines in some detail the management of sediment and contaminants upstream, there does not seem to be a joined up approach to the stormwater basins and stopbank work happening in the former Residential Red Zone (OARC) What happened to ICM? (Integrated Catchment Management).

- The OA is both a Taonga and centre of pride for the people of Christchurch and traditionally an important source of mahinga kai for local iwi, therefore we would expect that the critical treatment systems infrastructure that is required would be held in high priority and brought forward in the LTP rather than solely reliant on controlling contaminants at the source as is the focus of this management plan.

- As above there is nothing in this document tying to the LTP specifically, i.e. relying on it being the other way around.

- In our opinion the action items in this SMP are not specific enough and so do not set out aggressive enough targets for the elimination of sediment and contaminants.

- How will we address public awareness and response to flooding issues, sediment/erosion control, zinc, and copper contamination on private properties and the impact residents are having with use of house & garden products, property maintenance, driving etc.

Submission attachment 15389

- There is no implementation plan in place to deliver against the 'Engagement and Education' goal 5.1. Community education is mentioned but no action plan, funding, or resourcing to support this.

- There is a heavy reliance on the community to assist with education and resourcing without any explicit ways in which this plan will assist the key community groups with funding or resourcing.

- If treatment systems are pushed out in the LTP and this plan relies on control at the source, how will the quality and compliance team do this? What resources will be given to the compliance team to do this? This needs to be stated more clearly.

- Greater incentives put in place to stop developers and businesses releasing sediment and contaminants into the stormwater system.

- There is no connection between this plan and the Community Waterways Partnership, it would be great to see how the Community Waterways Partnership can be resourced to assist with the delivery of this plan.

- There was no community consultation to assist with the writing of this SMP.

Leadership role we (AvON) can take in this SMP

As we have outlined at the beginning of this submission we (AvON) are already taking action on controlling contaminants at the source with our work streams and advocacy. We wish to take an even greater role in improving the health of our waterways with actions aligned to this plan, the Climate Action Strategy, Regeneration Plan and Strengthening Communities Strategy. To help us achieve this we wish you to consider;

- Supporting our In River Clean project for at least another 12 months so we can see a real shift from old rubbish to new and identify the next steps.

- Action any recommendations we have from the data we present from the In River Clean Project. (i.e additional smaller booms or catches, socks on outlets etc)

- Retain the Sustainability fund to help support the work and projects that we do and that align with this action plan, particularly when testing new ideas.

- Consider changing the criteria of the Urban Biodiversity fund to not be restricted to private land in order for organisations like ours to apply for funding.

Submission attachment 15389

- Consider a waterways non contestable fund to help long standing groups like AvON to consistently deliver the outcomes aligned with this plan and other council strategies listed above.

- Support us with resources to help educate the general public about our stormwater systems and how they interconnect with our waterways.

- Support and participate as we bring the entire catchment together regularly to form a shared set of goals to collectively improve the health of our waterway.

- Support further development of the Community Waterways Partnership to build capacity in undertaking the actions in this plan.
- Continue to support the Stormwater Super Hero Trailer.

- Continue to support the Mother of All Clean Up's and associated campaigns and projects.

Submission attachment 15392

sustainable
ōtautahi christchurch

Submission to the Avon-Ōtākaro Stormwater Management Plan

From:
Sustainable Ōtautahi Christchurch (SOC)
PO Box 1796
Christchurch 8140
www.sustainablechristchurch.org.nz

SOC formed in 2005 from the merger of Sustainable Cities Trust and Christchurch-Ōtautahi Agenda 21 Forum. Former members of both those groups are involved, along with a new generation of Ōtautahi-Christchurch people, who work towards the bold vision of Ōtautahi-Christchurch people "practising, living and demonstrating sustainability in all that they do."

We do wish to speak to our submission.

Primary Contact:
Colleen Philip, Chairperson
info@sustainablechristchurch.org.nz
[redacted]

Firstly, we wish to record our support for the submissions from The Avon-Heathcote Estuary Ihutai Trust and the Avon Ōtakaro Network.

We also wish to submit as follows…

As an organisation involved with education about sustainability issues including issues around water sensitivity we are very concerned at the lack of an implementation plan to deliver against the Engagement and Education goal 5.1.

Heavy reliance on the community/third sector for educating citizens must be matched by support for those you ask to help with this.

SOC have done education and awareness raising about on-site solutions (e.g rain gardens, collection tanks etc) to stormwater management and would like to see citizens more aware and more enabled to do things themselves on private property that are positive. Education needs to be about positive options, not just an attempt to stop the negative behaviours.

We found many people showed interest in and a real desire to progress these on -site solutions when they were made more aware of them. There are then the questions of how, and at what cost? SOC would like CCC to consider the "How can we help?" question in regard to this.

SOC strongly support nature- based solutions to be used wherever possible, when the evidence supports them. We note though that The Avon Ōtākaro SMP proposes a number of bio filters which are better than retention basins at removing metal contaminants. (90% as compared with 50-60%.) Both while necessary mitigation are less desirable than stopping contaminants at source hence the need for ongoing education and awareness raising.

Submission attachment 15392

When Council and developers do multipurpose things like wetlands however, we would ask that good design be provided not just for human need, but for the needs of the wildlife that we want to inhabit these places.

Circular paths around a full perimeter of e.g. a wetland where people and dogs can run and recreate at will is not an example of good design for wildlife, creating stress and disturbance. It is important that people have access to these sites and the opportunity to connect with nature. It is also fine to allow dogs to recreate with them. We just need to design these places more sensitively. We should also have more regulation in some places. The instruction “dogs under effective control” is a concern as it is overused and used in some very inappropriate places. We believe the instruction “dogs on lead” could and should be used more widely in ecologically sensitive places.

One of the best things you can do to improve the marine environment adjacent to our city is to sweep the streets more often.

Copper claddings. Just say NO! (3.2) But where it is already in situ we strongly support 2.5.

In conclusion ,there is the ‘bigger conversation’. The city needs to be committed to building healthy thriving waterways. People need to understand what the issues are and how they can help and be able to access the tools to enable that.

Comprehensive Stormwater Network Discharge Consent (CRC231955)

Mahere Wai āwhā
Stormwater Management Plan for the Ōtākaro-Avon Catchment
DRAFT

Christchurch City Council

February 2024

Christchurch City Council

Internal Document Review and Approval

Prepared By	Reviewed By	Approved By	Signature	Date
Jig Dhakal Paul Dickson				April 2024
This Version: 0.7 0.1 Initial Draft, report still to be completed by author 0.5 Draft, for verification/fact checking by team leader/manager 0.7 Draft, for review and approval by manager / head of department 1.0 Published >				**TRIM 24/0895142**

Table of Contents

List of Figures

List of Tables

List of Abbreviations

Abbreviation	Definition
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	Average recurrence interval; long-term average interval between floods
ATL	Attribute Target Level
BMP	Best Management Practice
CCC	Christchurch City Council
CFU	Colony Forming Units
CHI	Cultural Health Index
CLM	Contaminant Load Model
DIN	Dissolved Inorganic Nitrogen
DRP	Dissolved Reactive Phosphorus
ECan	Environment Canterbury
E. coli	*Escherichia coli*
EMP	Environmental Monitoring programme
HAIL	Hazardous Activities and Industries List
IPCC	Intergovernmental Panel on Climate Change
ISQG	Interim Sediment Quality Guidelines
LLUR	Listed Land Use Register
LTP	Long Term Plan
LWRP	Land and Water Regional Plan
ppb	parts per billion
PAH	Polycyclic Aromatic Hydrocarbon
QMCI	Quantitative Macroinvertebrate Community Index
RMA	Resource Management Act
SMP	Stormwater Management Plan
UDS	Greater Christchurch Urban Development Strategy
WQI	Water Quality Index

1 Executive Summary

A Stormwater Management Plan (SMP) for the Ōtākaro-Avon River catchment is required by the Comprehensive Stormwater Network Discharge Consent (CRC231955). Its purpose is to reduce the adverse effects of stormwater discharges on surface water quality and quantity and on groundwater. The SMP sets out methods the Council will implement to meet water quality and quantity targets in the consent.

Water quality and ecological health in the catchment vary between Good in some western tributaries such as Waimairi Stream to Poor in Dudley Creek. Waterway values have declined as a result of changes in the catchment including urban and industrial activities.

Water quality improvements will largely be achieved through treating stormwater in basins, wetlands and biofilters. Because the catchment is mostly developed the facilities proposed in the SMP will treat stormwater from existing areas. The SMP proposes to retrofit stormwater treatment for the five already developed areas of Addington, Riccarton, Upper Dudley Creek, Avondale and Wainoni. Proposed biofilters for Addington and Riccarton will provide a high standard of treatment for particles (sediment), copper and zinc. Stormwater from any new developments will also be treated in new facilities. Metals, which mainly come from unpainted roofs, vehicle tyres and vehicle brakes would be better controlled at source, but the Council does not have powers to enable such controls to be put into effect at this time.

Most developed areas are adequately protected from flooding by the drainage network but into the future it will become increasingly important that buildings are elevated above flood levels rather than that flood water is quickly removed. This is because the river upstream of and within the city centre has limited ability to accept additional peak flows. The Council will need to plan for stormwater detention within built-up areas in order to manage the effects of ongoing infill development.

Information used in developing this SMP suggests that controlling contaminants at source is more sensible than removing them from stormwater through treatment systems. However, the control or elimination of contaminants at source will affect our buildings, means of transport, household products and the ways we do things, and will be difficult to implement. Source control is a journey that all of us - tangata whenua, community groups, regulators, researchers, and local, regional and central government - will need to travel together to better protect the environment.

Part One: Plan Initiation

2 Background to the Stormwater Management Plan

2.1 Purpose and Scope

The purpose of a Stormwater Management Plan (SMP) is defined in condition 6 of the Comprehensive Stormwater Network Discharge Consent (CSNDC), CRC231955, and includes contributing to meeting contaminant load reduction standards, setting (and meeting) additional contaminant load reduction targets and demonstrating the means by which stormwater discharges will be progressively improved toward meeting receiving environment objectives and targets.

The aim of the CSNDC is to limit the adverse effects of stormwater discharges on surface and groundwater quality and quantity. The CSNDC promotes progressive water quality improvement toward targets in the Land and Water Regional Plan through the use of best practicable options for stormwater quality improvement and peak flow mitigation.

SMPs set out the means by which the Council will comply with conditions in the CSNDC. However, due to governance and regulatory processes, the SMP cannot address all potential environmental improvement targets. The SMP is given effect through the Council's Long Term Plan (LTP), which is a statutory process. SMPs follow rather than lead the LTP and must be developed within resourcing provided by the LTP. This mostly limits SMPs to established programmes and does not permit this SMP to commit to unfunded, new initiatives to achieve aspirational targets.

The SMP process includes:

1. Identify the existing state of the environment in the catchment.
2. Identify the contributions by existing and future activities to stormwater quality and quantity.
3. Estimate trends on water quality and quantity from urban growth, technology, lifestyle, climate, etc.
4. Develop measures to control or mitigate effects (including planning, education, enforcement, source control, etc as funded in the LTP).
5. Estimate the effectiveness of chosen mitigation measures through contaminant load and flood modelling.

Over time a district-wide Surface Water Implementation Plan (SWIP) will be developed with the intention to encompass a wider a wider range of water quality goals and activities. The SWIP development process will include:

1. Prepare a plan that is aimed at improving environmental outcomes and the health of the district's water bodies by a range of measures including education, collaboration and controlling contaminants at source.
2. Engage with Council teams and external stakeholders responsible for contaminant generating activities; obtain agreement about improved control measures.
3. Introduce new funding initiatives for consideration in the Long Term Plan.

2.2 The Term of the SMP

The term of the Ōtākaro-Avon SMP is 10 years from the date of acceptance by the Canterbury Regional Council.

2.3 Stormwater Management Plan Catchments

This SMP is one of seven plans being prepared over the period 2020 to 2024 for the Ōpāwaho-Heathcote, Huritini-Halswell, Ihūtai-Estuary and Coastal and Ōtūkaikino catchments, Settlements of Te Pātaka-o-Rākaihautū-Banks Peninsula, and Ōtākaro-Avon and Pūharakekenui-Styx catchments. Figure 1 illustrates the boundaries for each SMP catchment.

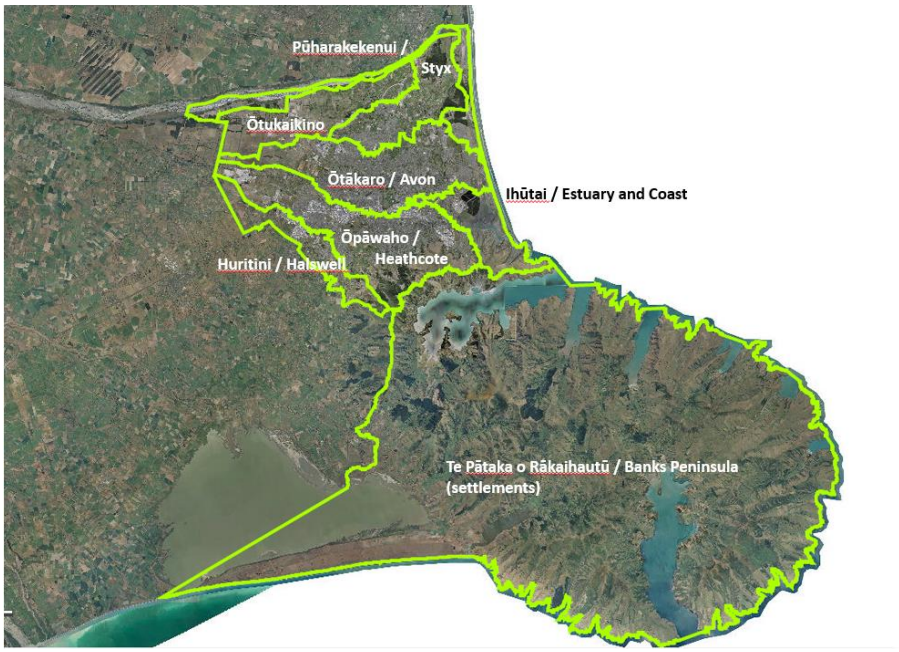


Figure 1: Area covered by the Comprehensive Stormwater Network Discharge Consent

2.4 Regional Planning Requirements

2.4.1 Canterbury Regional Policy Statement

The Canterbury Regional Policy Statement (CRPS) sets out how natural and physical resources are to be sustainably managed in an integrated way. The needs of current and future generations can be provided for by maintaining or improving environmental values. The CRPS requires that objectives, policies and methods are to be set in regional plans, including the setting of minimum water quality standards.

2.4.2 Land and Water Regional Plan

The Land and Water Regional Plan 2015 encourages the development of SMPs under Rule 5.93. The intention of the rule is that SMPs will be developed to show how a local authority will meet the relevant policy on water quality.

2.4.3 Greater Christchurch Urban Development Strategy

The Greater Christchurch Urban Development Strategy (UDS) Partnership has been working collaboratively for over a decade to tackle urban issues and manage the growth of the city and its surrounding towns.

The strategy was prepared under the Local Government Act 2002, and it is to be implemented through various planning tools, including:

- Amendments to the CRPS;
- Changes to regional and district plans to reflect the CRPS changes.
- Stormwater planning to give effect to the LWRP; and
- Outline Development Plans for new development areas ('Greenfield areas') and existing re-development areas ('Brownfield areas').

Preparation of this SMP plays a part in implementing the UDS.

2.5 Non-Statutory Documents

- Integrated Water Strategy 2019
- Surface Water Implementation Plan (to be developed)
- Mahaanui Iwi Management Plan 2013
- Ngāi Tahu Freshwater Policy Statement (Te Rūnanga O Ngāi Tahu 1999)
- Infrastructure Design Standard (Christchurch City Council 2010)
- Waterways, Wetlands and Drainage Guide (Christchurch City Council 2003)
- Erosion and Sediment Control Toolbox for Canterbury (Environment Canterbury)
- Estuary Management Plan 2020 – 2030 (Avon-Heathcote Estuary Ihūtai Trust)

2.6 The Council's Strategic Objective for Water

The Christchurch City Council has adopted community outcomes to promote community wellbeing.

The Water Outcome Healthy Environment includes:

Healthy water bodies: *"Surface water quality is essential for supporting ecosystems, recreation, cultural values and the health of residents."*

2.7 The District Plan

The Christchurch District Plan promotes responsible stormwater disposal through Policy 8.2.3.4 – Stormwater Disposal, which states:

District-wide:

- Avoid any increase in sediment and contaminants entering water bodies resulting from stormwater disposal.

- Ensure that stormwater is disposed of in a manner which maintains or enhances the quality of surface water and groundwater.
- Ensure that any necessary stormwater control and disposal systems and the upgrading of existing infrastructure are sufficient for the amount and rate of anticipated runoff.
- Ensure that stormwater is disposed of in a manner which is consistent with maintaining public health.

Outside the central city:

- Encourage stormwater treatment and disposal through low-impact or water-sensitive designs that imitate natural processes to manage and mitigate the adverse effects of stormwater discharges.
- Ensure stormwater is disposed of in stormwater management areas so as to avoid inundation within the subdivision or on adjoining land.
- Where feasible, utilise stormwater management areas for multiple uses and ensure they have a high-quality interface with residential activities or commercial activities.
- Incorporate and plant indigenous vegetation that is appropriate to the specific site.
- Ensure that realignment of any watercourse occurs in a manner that improves stormwater drainage and enhances ecological, mahinga kai and landscape values.
- Ensure that stormwater management measures do not increase the potential for bird-strike to aircraft in proximity to the airport.
- Encourage on-site rain-water collection for non-potable use.
- Ensure there is sufficient capacity to meet the required level of service in the infrastructure design standard or if sufficient capacity is not available, ensure that the effects of development are mitigated on-site.

District Plan Policies 8.9.2.2 and 8.9.2.3 make earthworks subject to a consent. Conditions of consent for earthworks over a threshold include the requirement for an Erosion and Sediment Control Plan (ESCP). An ESCP is submitted and approved with a consent application and its implementation is verified by building consent officers.

2.8 Bylaws

The reviewed Stormwater and Land Drainage Bylaw 2022 restricts discharges of any material, hazardous substance, chemical, sewage, trade waste or other substance that causes or is likely to cause a nuisance, into the stormwater network. Minimum standards can be applied by resolution of the Council.

The Traffic & Parking Bylaw 2017 allows the Council to require an offender to remove material spilled onto roads.

2.9 Building Act

The Council can use powers under the Building Act to require ESCPs to be submitted when an associated land use consent is not required.

2.10 Integrated Water Strategy

Objectives 3 and 4 of the Christchurch City Council's draft Integrated Water Strategy are summarised as *"enhancement of ecological, cultural and natural values and water quality improvement."*

The preferred strategy option for achieving the objectives is to *"continue … the implementation of the current approach to stormwater management (embodied by the development of the Stormwater Management Plans) …"*

2.11 Mahaanui Iwi Management Plan

The Mahaanui Iwi Management Plan *"… is an expression of kaitiakitanga and rangatiratanga…(It) provides a values-based, … policy framework for the protection and enhancement of Ngāi Tahu values, and for achieving outcomes that provide for the relationship of Ngāi Tahu with natural resources across Ngā Pākihi Whakatekateka o Waitaha and Te Pātaka o Rākaihautū (the Canterbury Plains and Banks Peninsula)"*. The Ōtākaro-Avon SMP acknowledges the Iwi Management Plan policies and can contribute to policies which fall within the scope of a SMP.

2.12 Infrastructure Design Standard

The Infrastructure Design Standard 2016 (IDS) is the Council's development code and is a revision of the Christchurch Metropolitan Code of Urban Subdivision 1987. The IDS promotes environmental protection via a values-based design philosophy and consideration of biodiversity and ecological function (IDS, section 5.2.3 Four Purposes)

2.13 Goals and Objectives for Surface Water Management

The Ōtākaro-Avon SMP and the Surface Water Implementation Plan will together be consistent with the *Integrated Water Strategy 2019* which identifies overall goals and objectives for surface water management. Jointly these plans will support so far as is practicable the *Mahaanui Iwi Management Plan* objectives for the Ihutai/Avon-Heathcote Estuary catchment (Jolly et al, 2013).

The Council's high-level goals in the Integrated Water Strategy are:

GOAL 1: The multiple uses of water are valued by all for the benefit of all;

GOAL 2: Water quality and ecosystems are protected and enhanced;

GOAL 3: The effects of flooding, climate change and sea level rise are understood, and the community is assisted to adapt to them; and

GOAL 4: Water is managed in a sustainable and integrated way in line with the principles of kaitiakatanga.

Te Rūnanga o Ngāi Tahu Freshwater Policy (Ngāi Tahu, 1999) lists several water quality and water quantity policies that apply throughout the Ngāi Tahu Takiwā. The *Iwi Management Plan* (Jolly et

al, 2013) has objectives for the Ihūtai catchment that are directly relevant to the Ōtākaro SMP. These are objectives numbered:

4) Discharges of wastewater and stormwater to waterways in the urban environment are eliminated, and a culturally appropriate alternative to the discharge of urban wastewater to the sea is developed.

7) Urban development reflects low impact design (LID) principles and a strong commitment to sustainability, creativity and innovation with regard to water, waste and energy issues.

The CSNDC sets freshwater outcomes based on Land and Water Regional Plan targets. The CSNDC Environmental Monitoring Programme (EMP) will assess the ecological and cultural health of waterways and coastal areas, and progress made under the SMP. The EMP assesses a range of parameters, and progress can be measured against LWRP guidelines for macroinvertebrate indices, macrophytes, periphyton, siltation and a range of water quality parameters.

The SMP programme will contribute toward delivery on these objectives through improving water quality in the rivers and streams. Other plans and programmes must play a part in restoring riparian margins and protecting and restoring springs and mahinga kai site to deliver on tangata whenua and LWRP objectives.

Stormwater quantity effects considered in this SMP include mitigation of additional runoff generated by urban intensification.

Other sources and reports that have informed the SMP include:

- State of the Takiwā;
- Surface water and sediment quality monitoring;
- Listed Land Use Register (contaminated sites database, ECan);
- Groundwater and springs study;
- Ecological survey;
- Contaminant load model.

3 Principal Issues

Waterways in this catchment are spring fed and predominantly urban. Water quality and ecological health in the Ōtākaro and its tributaries have declined greatly during 160 years of urban development. Metals in stormwater can harm many instream species, sediment smothers habitat for biota and can be anoxic or contaminated, and *E. coli* poses a risk to human health during contact recreation.

Failure to meet indicator values in the LWRP for urban spring-fed plains rivers is reported in annual monitoring reports and in water quality, sediment quality and ecological surveys carried out for the SMP (Section 5). Contaminants of concern include sediment, zinc, copper and *E. coli* (an indicator of faecal contamination). Suspended sediment, zinc and copper levels are high especially during wet weather. Elevated levels of the nutrients nitrogen and phosphorus, which are partially derived from sources other than stormwater, can result in excessive aquatic weed growth.

Contaminants of concern at the levels recorded have an adverse effect on biota, result in excessive aquatic weed growth, or pose a risk to contact recreation, depending on the contaminant. A significant challenge to the SMP is how to reverse the decline in surface water quality and ecological health of waterways in the Ōtākaro-Avon catchment despite continuing urban development.

The Ōtākaro-Avon River is connected to and is a major contributor of contaminants into Ihūtai – the Estuary. There is commentary on the state of the estuary in the Ihūtai-Estuary and Coastal SMP 2022. Reduction or capture of contaminants within the catchment can be expected to improve the ecological state of the estuary.

Land subsidence during the 2010/11 earthquakes increased the flooding vulnerability of many properties, particularly properties on the eastern side of the city, and properties near the river. Impacts of the earthquakes on increasing vulnerability to flooding have been investigated through the Land Drainage Recovery Programme with the aim of returning the flooding risk to houses to levels that existed before the earthquakes. A floodplain and river model continues to be developed to improve understanding of the risks to houses on the floodplain. The model will better represent the effects of sea levels rise over the SMP planning period.

Potential rezoning to permit increased housing density will lead to increased imperviousness in some areas, more so near the city centre, and stormwater runoff will increase and may affect flood levels in the river unless it is detained at or near source.

Part Two: The Catchment

4 Catchment Description

4.1 Geography

The Ōtākaro-Avon Catchment covers an area of approximately 10,000 hectares. The river begins at a spring-fed source in Avonhead and discharges to the sea via the mouth of Te Ihūtai / The Estuary of the Heathcote and Avon Rivers.

The catchment has traditionally been a significant source of mahinga kai, and a focus of natural, cultural and heritage values since earliest settlement over 600 years ago.

Ongoing development and extensive settlement within the catchment over the last two centuries, combined with the more recent earthquakes of 2010/2011 has seen a degradation of catchment values including reduced water quality due to pollution and siltation, reduced hydraulic capacity, loss of terrestrial vegetative cover and decreased in-stream habitat for fish and invertebrates.

The catchment is largly urbanized, which accounts for 84% of the total area, in a mix of residential, industrial, amenity, and transportation land uses. A small percentage (16%) of the catchment is rural, mostly west of the airport but including a small area in Marshland.

4.2 Catchment extent

The river extends for approximately 26 kilometres from its spring-fed source in Avonhead to its mouth at Te Ihutai / The Estuary. There are several spring-fed tributaries in the upper catchment, including the, Wairārapa, Waimairi and Okeover), that combine at Mona Vale to create the main stem of the Ōtākaro-Avon River. The main downstream tributaries (St Albans Creek, Dudley Creek, Shirley Stream and Waikākāriki / Horseshoe Lake) contribute to the river's lower reaches below Fitzgerald Avenue.

In addition to spring-fed tributaries there are 74 kilometres of stormwater drains that contribute to both the quality and quantity of water the river receives.

4.3 Geology

4.3.1 Canterbury Plains

The Canterbury Plains are a complex of coalescing fans deposited by eastward-flowing rivers emerging from the foothills of the Southern Alps. During glacial periods valley glaciers reached almost to the foothills, and meltwater rivers built alluvial fans.

The Canterbury Plains are formed on more than 500 m of gravel deposited during the late Tertiary and Quaternary periods (the last 5 million years). At the coast the gravel is shallower, being underlain at 240 m by clay, sand, silt, peat and interbedded gravel deposited in an ancient coastal environment. Basement rock is generally at a depth of 1.5 to 2 km, although rock occurs at shallower levels near the Banks Peninsula hills.

Accumulating progressively downstream, the alluvial fans extended to a coast which was several kilometres east of the present shoreline. Successive glaciations deposited gravel layers that are generally 10 – 20 m, but up to 40 m thick. During interglacial periods the rising sea created deposition areas for blue, brown and yellow sand, silt and clay with inter-bedded shell, peat and

wood layers in the vicinity of the present-day city. Successive climate cycles have laid down six or more gravel layers separated by significantly less permeable fine sediment (aquitards). Layers can be identified in some of the 10,711 well logs in the area. Inland from Christchurch the nature of the aquitards changes to more leaky and heterogenous strata.

The Fendalton gravel lobe is identified with a geological model of Holocene gravel and marine sediments under Christchurch City in the geographic area that includes the locations of most Avon River springs. The Waimakariri River probably deposited the Fendalton gravel lobe after flowing through areas referred to as the Harewood and Airport Floodways. Avon River spring flow is supported by recharge from the Waimakariri River and by recharge from rainfall (White, 2009).

4.3.2 Soils

Ōtākaro-Avon catchment soils vary greatly, from typical light, silty Canterbury Plains soils in the west, to deep, wet soils in the centre, and sandy soils near the coast. West of about Ilam are Waimakariri soils which are stony and can be shallow, in north-west/south-east trending strips separated by abandoned water courses that mark ancient overflow channels of the Waimakariri River. The soils are freely to excessively draining according to the depth of fine material that lies over the gravels and the abundance of stones in the profile.

Between Upper Riccarton and Linwood is a large block of Kaiapoi deep sandy loam with areas of wetter Taitapu deep silt loam in a wide band from Riccarton to Phillipstown and a flattish basin (Richmond and Shirley) north of the city centre. These soils become progressively wetter as the land surface and the water table start to converge.

Much of the soil in Dallington and Linwood, and a band along the Ōtākaro-Avon River to Ihūtai-the Estuary is Taitapu deep silt loam.

Burwood, Parklands, Westhaven and Bromley are elevated areas built up from of sand dunes as the sea retreated approximately 6000 years ago. The soil is Waikuku loamy sand formed on dune sand accumulated during this phase of dune building. A coastal strip including North and South New Brighton, Wainoni and Aranui consists of Kairaki sand. Kairaki sand is formed on raw dune sands devoid of colloid coatings and does not have a distinct topsoil. Near the shore the dunes support marram grass and pingao. A large area of Kairaki sand has been built over mainly for housing.

4.4 Drainage Network

4.4.1 Streams and Drainage Channels

The upper Avon stream network developed with water emerging from gravel fans deposited by the Waimakariri River. Gravel-bed tributary streams converge into the Ōtākaro-Avon mainstem west of Hagley Park. Further east are several remnant basins where wetlands (e.g. the Riccarton Basin) and swamps with not-very-well defined waterways were developed and drained as settlement progressed. Numerous open drains have been created, and these mostly became lined or piped to facilitate urban development. The capacity of these tributaries is limited to between a 5 and 10 year average recurrence interval (ARI) event, so surface flooding can occur, infrequently, on the flat floodplains.

4.4.2 Stormwater System

The public stormwater network starts in road-side channels which receive discharges from private property and the carriageway. The primary function of side channels is to maintain dry traffic lanes. Side channels lead to street sumps (catchpits) which discharge into the pipe network. The pipe network's level of service is that road drainage will avoid traffic hazards in a 5 year ARI rainfall. Occasional road and property flooding occurs due to sump blockage or system capacity.

Most stormwater discharges within the Ōtākaro SMP area are to surface water.

4.5 Groundwater – Physical

The Christchurch aquifer system has been formed from glacial and river-derived gravels, deposited during the alternating glacial and inter-glacial periods over the last 500,000 years.

Alluvial gravels occur near the surface in the west of the catchment and extend toward the coast along the lines of old river channels. These typically represent the most permeable near-surface strata. Alluvial sand and silt deposits of lower permeability occur through central and eastern parts of the catchment and are present between river channels. The surface low permeability layer is referred to as the Christchurch Formation.

The gravel aquifers are primarily recharged by seepage from the Waimakariri River north-west of the city and by infiltrating rainfall on the plains to the west of the city resulting in a pattern of groundwater contours plotted in

Figure 2: Groundwater Piezometric Contours. (PDP, 2023). The direction of groundwater flow in the shallowest aquifer is perpendicular to contours, and generally trends eastwards.

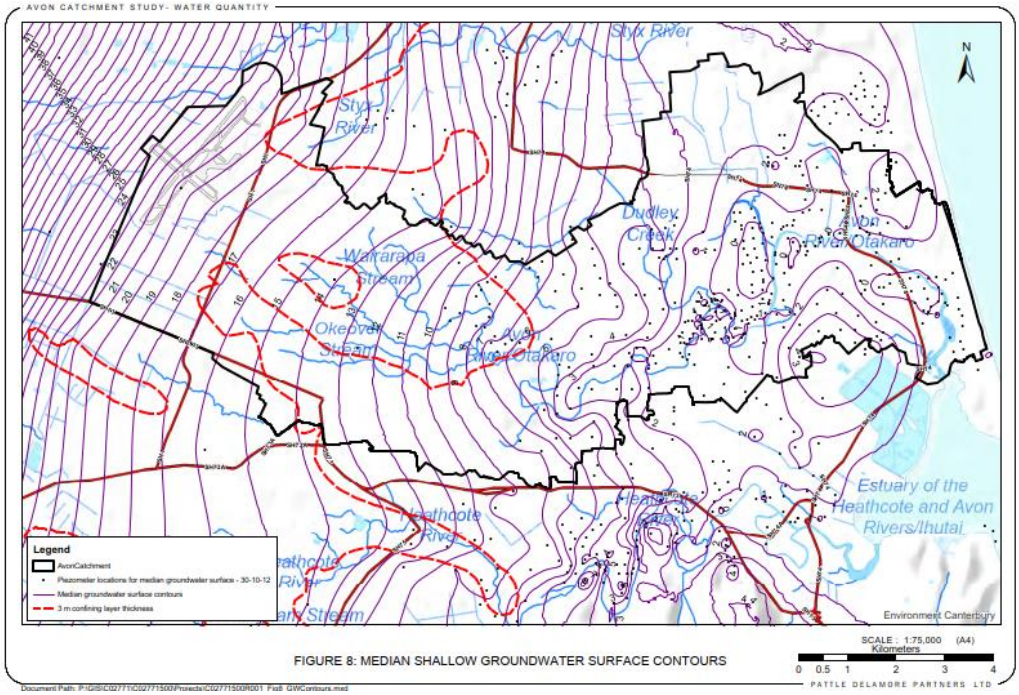


Figure 2: Groundwater Piezometric Contours.

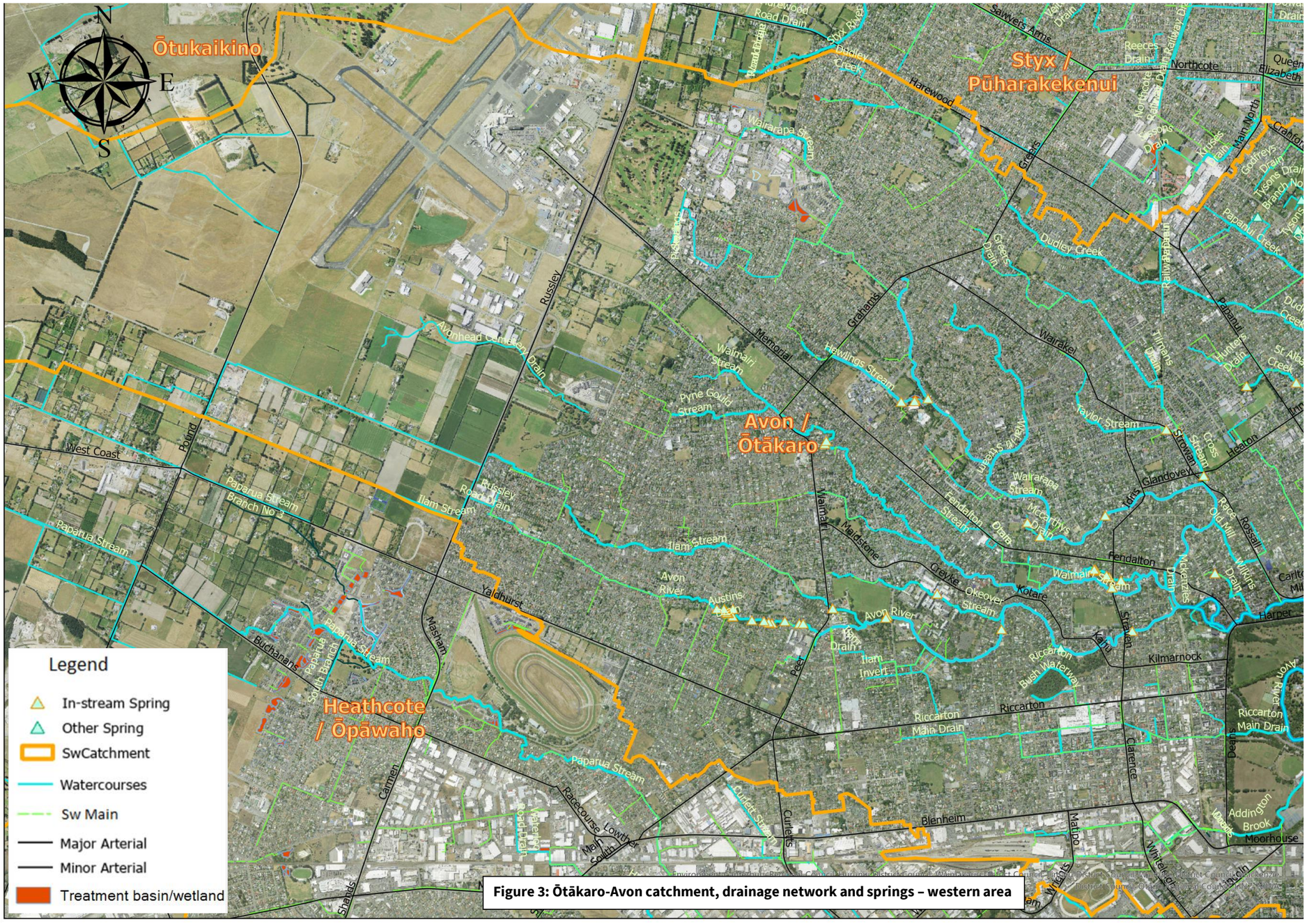


Figure 3: Ōtākaro-Avon catchment, drainage network and springs – western area

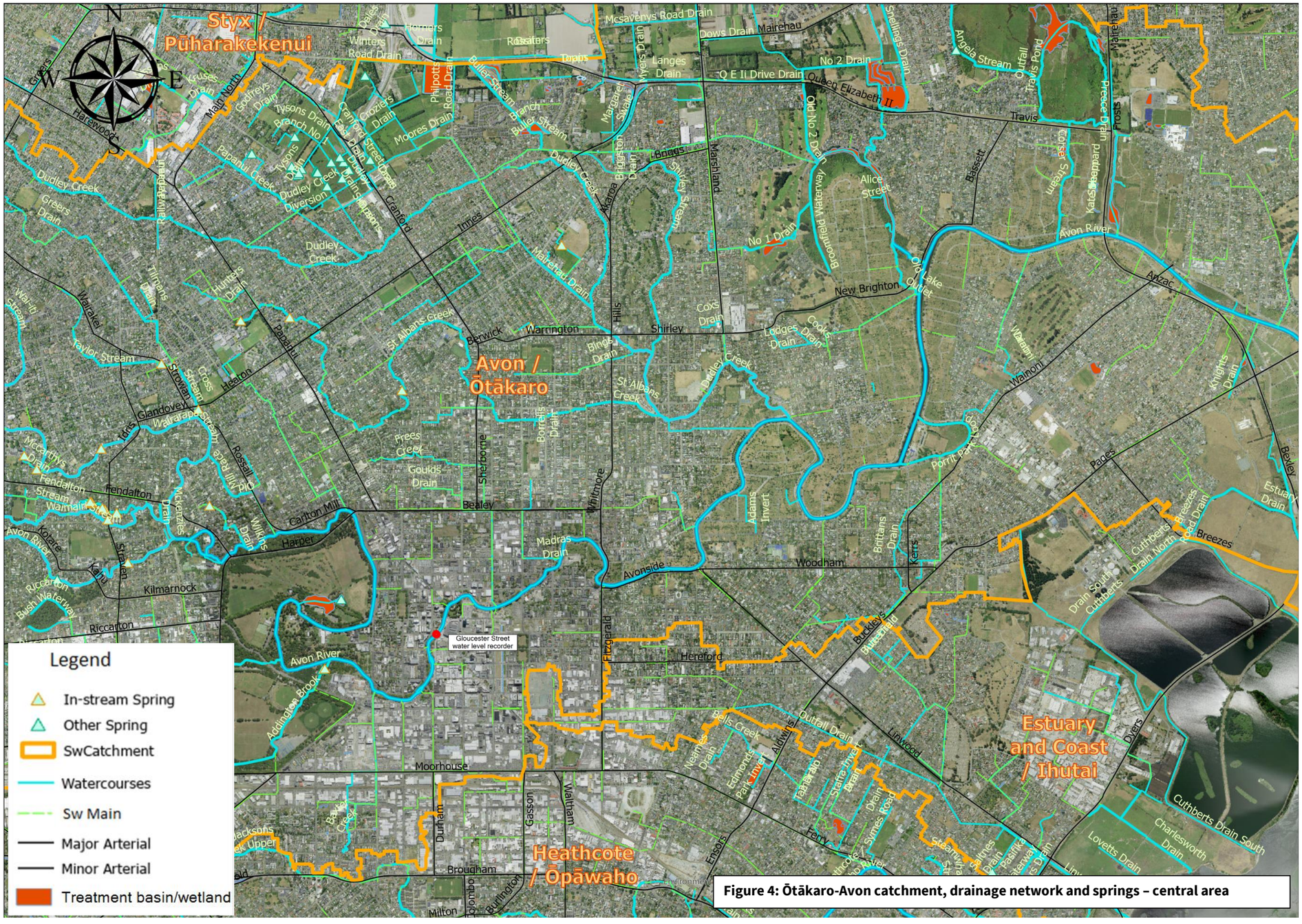


Figure 4: Ōtākaro-Avon catchment, drainage network and springs – central area

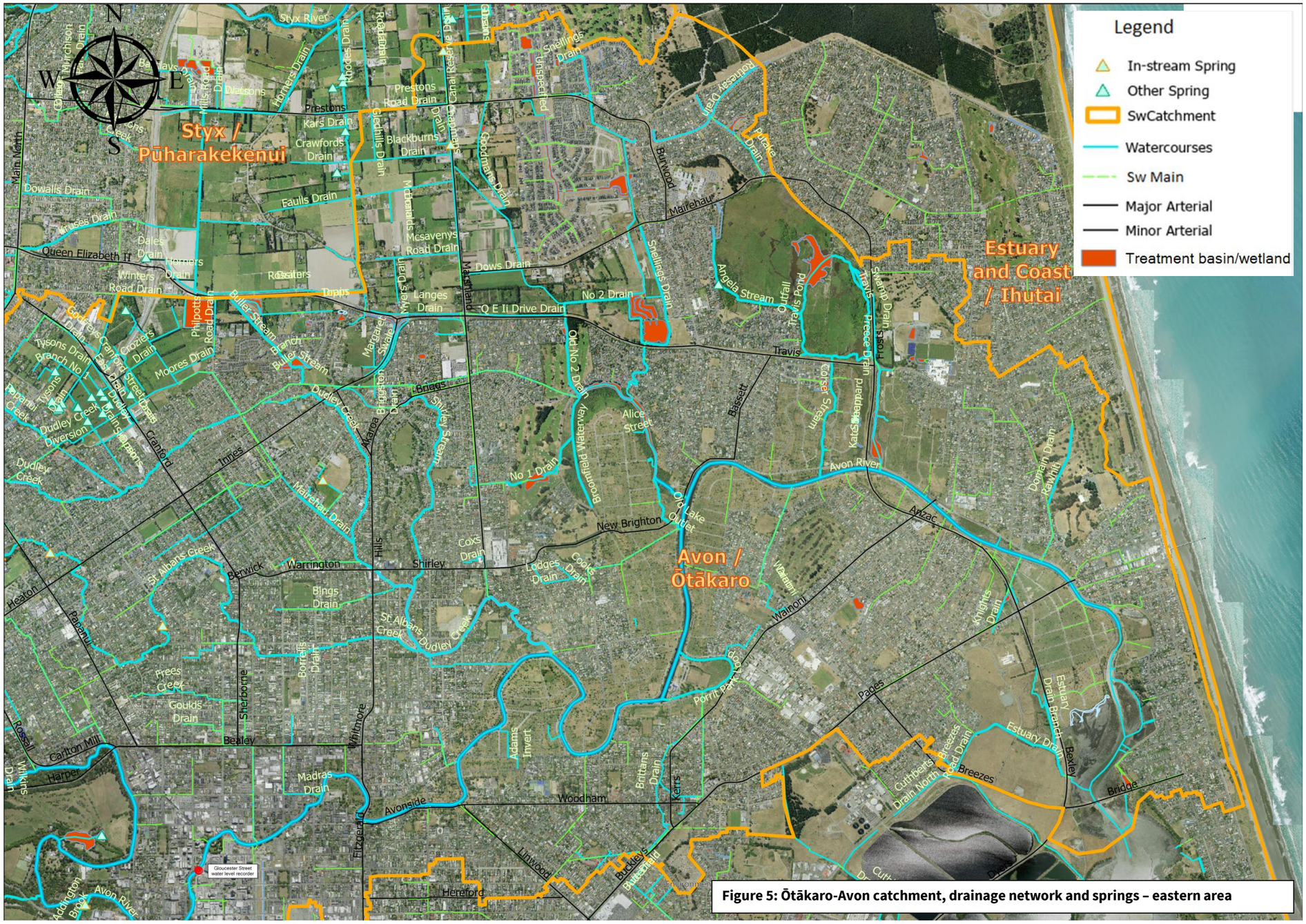


Figure 5: Ōtākaro-Avon catchment, drainage network and springs – eastern area

4.5.1 Depth to groundwater

Groundwater is generally shallow, between 1 and 3 metres deep over much of the catchment as evidenced by spring flows and areas of wet ground in the central city and east. Groundwater becomes deeper, up to 6 metres deep (PDP 2013) in the west. Regularly measured groundwater level monitoring wells show a stable long-term trend (PDP 2013).

4.5.2 Springs

Shallow (unconfined) groundwater mostly emerges into spring-fed waterways. Groundwater levels respond to the rate of recharge entering the groundwater system and the permeability of the aquifers. It is deepest at the western end of the catchment (typically around 6 m deep) and becomes shallower moving east, coming within 1.5 to 2 metres of ground level where springs feed the tributaries, and shallower nearer the coast. Groundwater levels are thought to be maintained artificially low by seepage into gravel bedding around the city's pipe network.

The distribution of springs is controlled by the distribution and characteristics of the confining layer over the upper confined aquifer. Artesian pressure can force groundwater up through this layer until it emerges as springs. Springs in some tributaries and drains and the Cranford Basin are mapped in Figures 3 - 5.

4.5.3 Baseflow

A stage recorder and rated flow record at Gloucester Street Bridge is the continuous flow recorder site for the Ōtākaro-Avon River. The location of this recorder is shown in Figure 4: Ōtākaro-Avon catchment, drainage network and springs – central area This recorder is maintained by NIWA, and data are available from 1980 onwards.

A baseflow analysis for the Avon River undertaken by GNS (White et al, 2007) considered the flow record and inflow from tributaries downstream of Gloucester Street. They estimated a baseflow of approximately 2,200 L/s at the Avon River Mouth (at the estuary), made up of 1,669 L/s at Gloucester Street and 531 L/s from tributary contributions (such as Dudley Creek) flowing into the Avon River downstream of Gloucester Street.

5 Tangata Whenua Cultural Values

5.1 Wai Maori

Ko te wai te oranga o ngā mea kātoa

Water is the life giver of all things

Water is a significant cultural element that connects Ngāi Tahu to the landscape and the culture and traditions of tūpuna. All water originated from the separation of Rangi and Papatūānuku and their mourning for one another. Rain is Rangi's tears for his beloved Papatūānuku and mist is regarded as Papatūānuku's tears for Rangi.

For tāngata whenua, the current state of cultural health of the waterways and groundwater is evidence that water management and governance in the takiwā has failed to protect freshwater resources. Surface and groundwater resources are over-allocated in many catchments and water quality is degraded as a result of urban and rural land use. This has significant effects on the relationship of Ngāi Tahu to water, particularly with regard to mauri, mahinga kai, cultural wellbeing and indigenous biodiversity.

"A significant kaupapa that emerges from (the Mahaanui Iwi Management Plan) is the need to rethink the way water is valued and used, including the kind of land use that water is supporting, and the use of water as a receiving environment for contaminants such as sediment and nutrients. Fundamental to tāngata whenua perspectives on freshwater is that water is a taonga, and water management and land use should reflect this importance. Because of the fundamental importance of water to all life and human activity, Ngāi Tahu maintain that the integrity of all waterways must be jealously protected. This does not preclude the responsible use of water, but merely states the parameters which Ngāi Tahu believe any such use should remain within. The utilisation of any resource for the benefit of the wider community is encouraged, providing that it is done with the long-term welfare of both the community and the resource in mind." (Mahaanui Iwi Management Plan, Part 5.3 Wai Māori).

5.2 Ngāi Tahu Site Specific Cultural Values

5.2.1 Historic Values

Waitaha were the first people to settle the South Island. They were followed by Ngāti Mamoe, and Ngāi Tahu, who migrated from the East Coast of Te Ika a Maui/The North Island. The Ōtākaro was highly regarded as a mahinga kai by Waitaha, Ngāti Māmoe and Ngāi Tahu.

The Waitaha pā of Puari once nestled on its banks. In later years, Tautahi (the chief after whom our city takes its name) made kai gathering forays down Ōtākaro from Koukourarata on Horomaka (Banks Peninsula) to take advantage of the abundant bounty offered up by its waters.

Pātiki (flounder) were speared, eels (tuna), ducks, whitebait (inaka) and native trout were also caught.

Ōtākaro, meaning the place of a game, is so named after the children who played on the river's banks as the food gathering work was being done. In Tautahi's time few Māori would have lived in the Ōtākaro area itself. Those that did were known to Māori living outside the region as Ō Roto Repo (swamp dwellers). Most people were seasonal visitors to Ōtākaro. Fish and birds were preserved for use over the winter months when fresh kai was in short supply.

Springs feeding into the river were used by tohunga for healing purposes. These were sited in the Ōrakipaoa (Fendalton) area in the Wairarapa and Waiwhetū streams.

5.2.2 Whakapapa

The concept of whakapapa underpins all others and gives rise to the context in which all other Maori life-ways find their meaning. Whakapapa may be loosely translated as the genealogical relationships that bind and connect both human and non-human worlds. It establishes the origins of all things and connects people to their ancestors and the land and natural resources around them. Natural elements including people are believed to have originated from the atua (gods); all parts of the Māori world are unified by spiritual connections and common ancestry, binding tangata whenua to the natural environment.

Whakapapa binds tangata whenua to the mountains, lands, waters, and other resources in their rohe. Impacts on any element or resource connected with tangata whenua have a cultural impact.

The whakapapa of a waterway determines its use in Tohunga (spiritual), Waiwhakaheketupapaku (burial sites), Waitohi (Tohunga use i.e. removal of Tapu), Waimataitai (coastal mix of fresh and salt water, estuaries), Waiora (Tohunga healing water), and Mahinga kai (food source).

5.2.3 Mauri

Mauri is the physical life force inherent in each element of the natural world. The mauri of individual entities is inter-dependent on the mauri of the greater system. A Māori view of environmental management sees that protection of the mauri of natural systems is essential for their survival. It is also seen as reflecting on the mana of the people who are associated with it. Mauri can be harmed by the actions of people. The overall purpose of resource management for Ngāi Tahu is the maintenance of the mauri of natural and physical resources, and to enhance mauri where it has been degraded by the actions of humans.

5.2.4 Ki Uta Ki tai

Ki Uta Ki Tai (from the mountains to the sea) is a holistic approach to resource use by Ngāi Tahu. It is best expressed by considering the environment as a whole rather than discrete parts. From a Māori perspective this also includes cultural and spiritual dimensions.

5.2.5 Past and Current Values

The Ōtākaro-Avon is a significant waterway and was once an important mahinga kai for Ngāi Tūāhuriri. Foods gathered from the river include tuna (eel), kanakana (lampreys), Kēkewai

(freshwater crayfish), as well as other native fish, plants and waterfowl. Mahinga kai practices within the catchment continue today.

Ihutai-The Estuary is a significant part of the catchment and an important mahinga kai where a variety of shellfish, fish and plants can be gathered. In 1868 the High Court created 10 mahinga kai reserves ("Fenton Reserves" after Justice Fenton) in Canterbury in response to a claim by Ngāi Tahu about the insufficiency of reserves and the loss of wetlands and food-gathering territory. Ihūtai Reserve (MR 900) located near the mouth of the Ōtākaro - Avon River was one such reserve. Ihūtai Reserve was acquired by the Christchurch Drainage Board in 1956 under the Public Works Act, against the owners' will, and used for a wastewater treatment pond.

5.3 Te Ngāi Tūāhuriri Rūnanga Position Statement / Cultural Impact Assessment

Te Ngāi i Tuahuriri Rūnanga is the papatipu rūnanga for the Ōtākaro-Avon catchment. Te Ngai Tuahuriri Rūnanga neither approves nor criticises the SMP but provides a statement of the rūnanga's views and position (a Position Statement) on matters specific to this catchment that arise from the Mahaanui iwi Management Plan.

A Position Statement will be delivered after the final SMP has been considered by the rūnanga.

5.4 Cultural Monitoring

Cultural monitoring enables the Council and Ngāi Tāhu to compare present and potential future conditions against the State of the Takiwā Report (Ngāi Tahu, 2007). Cultural monitoring will be carried out as part of the Environmental Monitoring Programme. Sites will be sampled five-yearly in conjunction with the monitoring of surface water quality, instream sediment quality and aquatic ecology.

The first round of cultural monitoring in Ōtākaro-Avon Catchment is expected to start in 2023 and depending on report writing and approval by Te Ngāi Tuahuriri Rūnanga may be ready for inclusion in the final SMP.

6 The Receiving Environment

6.1 Monitoring Sites

The Council monitors water quality monthly at 13 sites in the Ōtākaro-Avon Catchment as outlined in Table 1 and Figure 6. All sites are located within waterways classified in the Land and Water Regional Plan as 'spring-fed – plains'.

Table 1: Water Quality Monitoring Sites

Site Name	Site ID	Monitoring Instigated
Avon River at Pages/Seaview Bridge	AVON01	January 2007
Avon River at Bridge Street	AVON02	January 2007
Avon River at Dallington Terrace/Gayhurst Road	AVON03	January 2007
Avon River at Manchester Street	AVON04	July 2008
Wairarapa Stream	AVON05	January 2007
Waimairi Stream	AVON06	January 2007
Avon River at Mona Vale	AVON07	January 2007
Riccarton Main Drain	AVON08	October 2008
Addington Brook	AVON09	October 2008
Dudley Creek	AVON10	October 2008
Horseshoe Lake Discharge	AVON11	October 2008
Avon River at Carlton Mill Corner	AVON12	October 2008
Avon River at Avondale Road	AVON13	October 2008

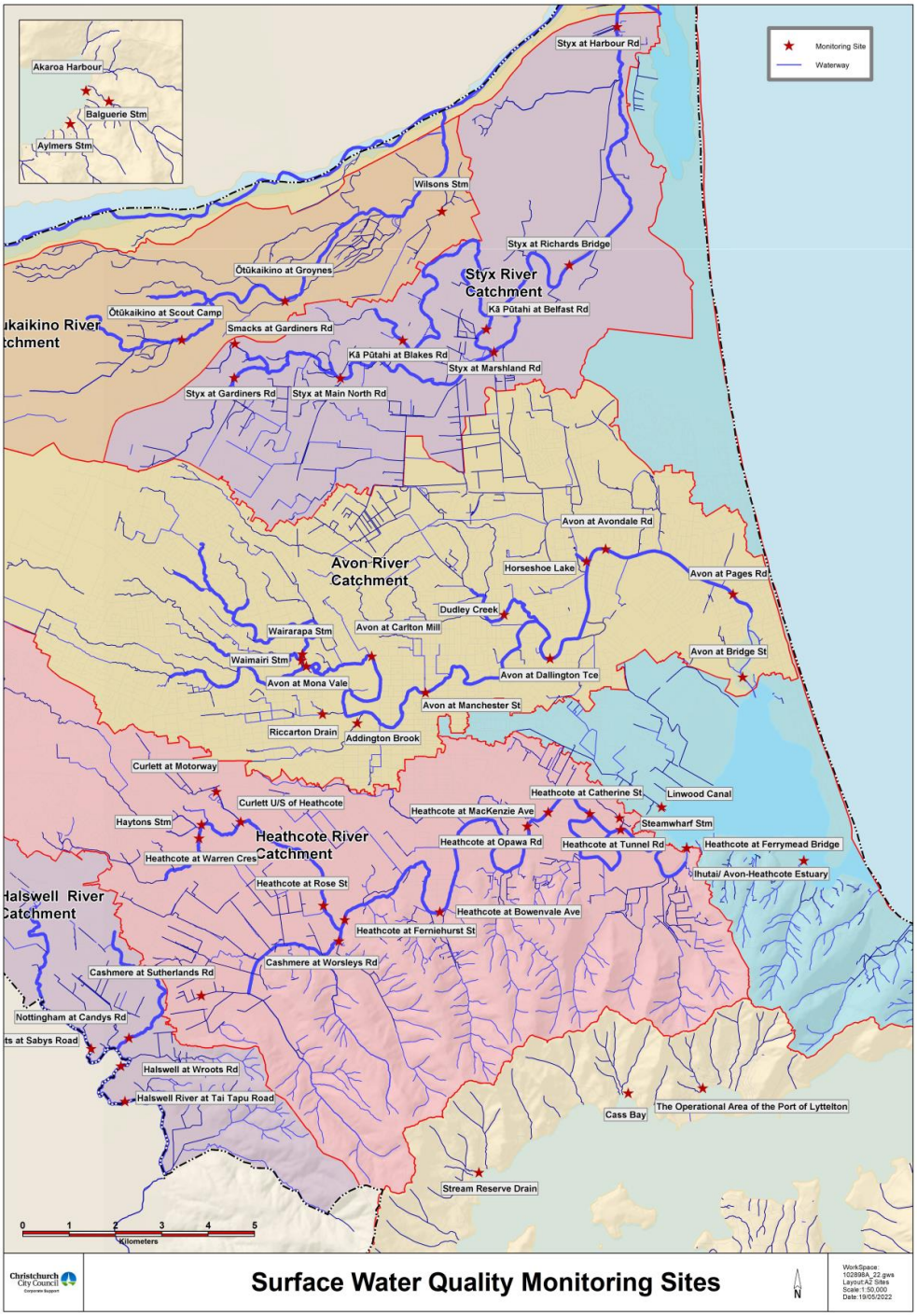


Figure 6: Council Water Quality Monitoring Sites Margetts and Poudyal (2023).

6.2 Water Quality

The Council monitors water quality monthly at 47 waterway sites across the district, including 13 sites in the Ōtākaro-Avon catchment (Figure 6). Most sites have been monitored since approximately 2007. Monitoring is more likely to occur during dry weather and does not always directly reflect the effects of stormwater discharges. The most recent summary of monitoring data was presented by Margetts and Poudyal (2023) which covered data up to the end of 2022. The following paragraphs summarise relevant results from Margetts and Poudyal (2023).

Council water quality samples are analysed for over 20 individual water quality parameters. A Water Quality Index (WQI) is used to summarise data from 11 individual water quality parameters into a single index value that ranges from 0 to 100, with 100 representing high water quality. The WQI is comprised of the following parameters: dissolved copper, dissolved zinc, pH, total suspended solids, dissolved oxygen, temperature, 5-day biochemical oxygen demand, total ammonia, nitrate-nitrogen, dissolved reactive phosphorus, and the faecal pollution indicator Escherichia coli (*E. coli*).

In 2022, WQI scores in the Ōtākaro catchment ranged from 59.1 in Dudley Creek, indicative of 'poor' water quality, to 89.5 in Waimairi Stream, indicative of 'good' water quality (Figure 2). Overall, the median WQI score across all sites in the Ōtākaro catchment was 76, down from 83 in 2021 (Margetts and Poudyal 2023), reducing the median score from 'good' to the 'fair' water quality category. Of the five major catchments monitored by Council in Christchurch City, the Ōtākaro scored the second highest WQI in 2022, second only to the Ōtūkaikino catchment, which recorded a median score of 82. Of the 47 waterway sites regularly monitored by Council, only two showed significant trends in the WQI, including a site on Dudley Creek in the Ōtākaro catchment, where the WQI showed a significant deteriorating trend. The WQI at the Dudley Creek site declined, on average, 2% per year, over the analysed period of 2016–2022.

The WQI is affected by the number of component water quality parameters that exceed the relevant guidelines. Within the Ōtākaro catchment, the *E. coli* guideline of ≤550 CFU/100 ml (95th percentile) was not met at all 13 sites, the dissolved reactive phosphorus guideline of ≤0.016 mg/L was not met at seven sites, the dissolved copper guideline of ≤0.0018 mg/L (95th percentile) was not met at six sites, the dissolved zinc guideline of ≤0.02951 mg/L (95th percentile) was not met at four sites, and the dissolved oxygen guideline of ≥70 % was not met at two sites.

The CSNDC EMP requires that Council assesses monitoring results for key urban stormwater contaminants against the consent Objectives and Attribute Target Levels (ATLs), namely total suspended solids, copper, lead, and zinc. Failure to meet any of the ATLs triggers investigations to determine whether the water quality is due to stormwater inputs. In total, 36 of the sites monitored across the district did not meet at least one the ATLs in 2022, including 10 of the 13 sites in the Ōtākaro catchment. Of these 10 sites, five failed to meet multiple ATLs. All non-compliances with ATLs in the Ōtākaro catchment in 2022 were due to elevated concentrations of the dissolved metals copper and zinc, which are common urban contaminants.

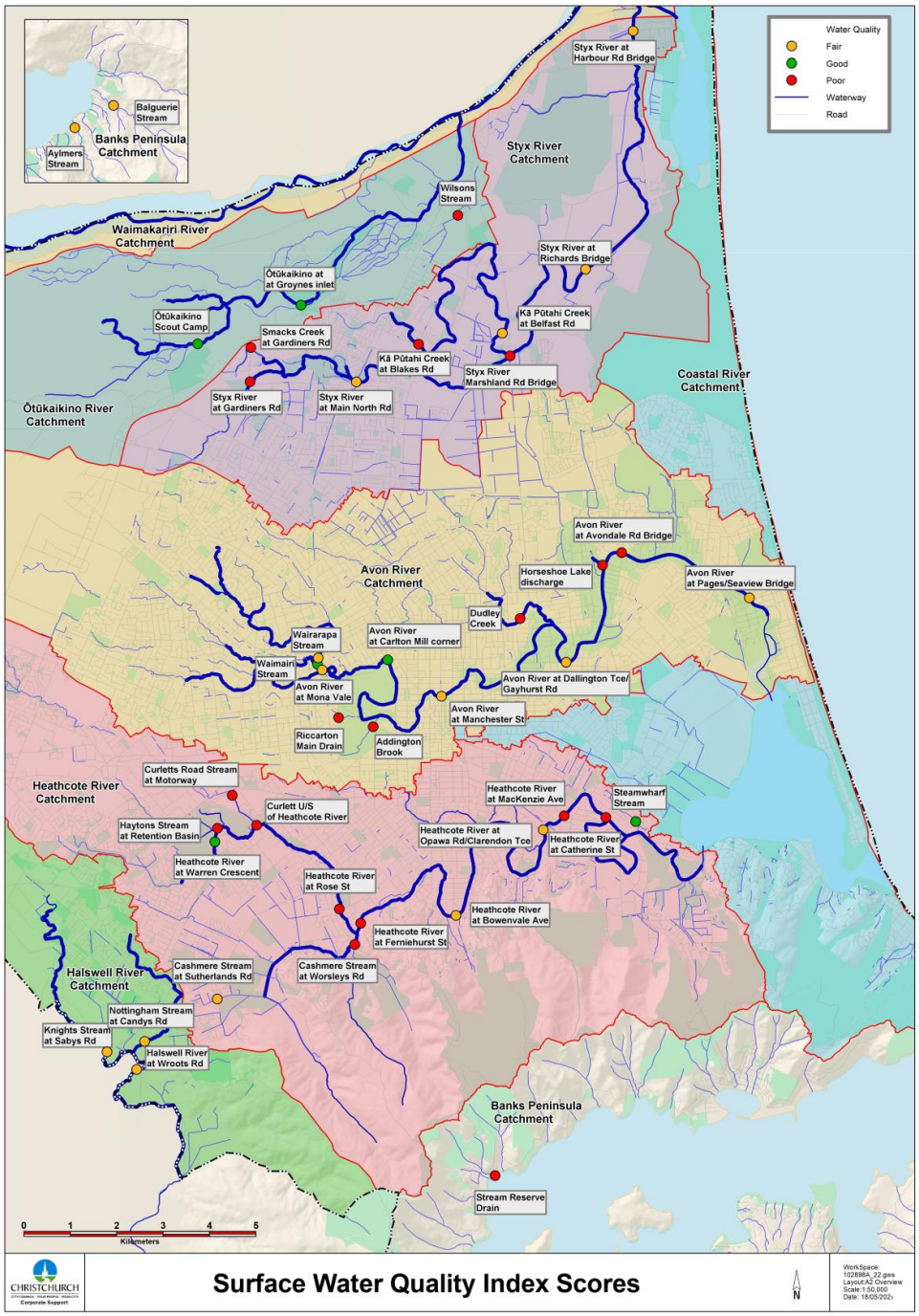


Figure 7: Water Quality Index (WQI) categories for 2022 at the Christchurch City Council surface water quality monitoring sites (Margetts and Poudyal, 2023).

6.3 Sediment Quality

Stormwater contaminants such as metals can accumulate in stream bed sediments and can adversely affect the health of invertebrates and fish. The most recent summary of sediment monitoring data from the Ōtākaro catchment was presented by Instream Consulting (2019), which included data collected from 14 sites at varying intervals from 1980 to 2019. Sediments were analysed for common stormwater contaminants, including copper, lead, zinc, and Polycyclic Aromatic Hydrocarbons (PAHs). While concentrations of these contaminants exceeded ANZECC & ARMCANZ (2020) guidelines at 13 of the sites in 2019, there was no indication of increasing trends at most sites.

Lead and zinc were the most elevated sediment contaminants, exceeding guidelines at most of the sampling sites (Figure 3), whereas exceedances for copper (one site) and PAHs (four sites) were rare. Sediment lead concentrations have greatly reduced at most sites since 1980, reflecting the discontinuation of leaded petrol for cars. Instream Consulting (2019) identified zinc as the contaminant of greatest concern in Ōtākaro catchment sediments, as zinc was elevated at most locations and was the only sampled parameter to exceed the high guideline value. Sediment zinc concentrations exceeded the high guideline value at three locations; Addington Brook, Avon River at Armagh Street, and Avon River at Manchester Street, which are worthy of further investigation. High concentrations of zinc in the sediments of the Ōtākaro catchment can be attributed to a legacy of untreated stormwater discharges, as well as ongoing contamination from unpainted and poorly galvanised steel roofs, and road runoff containing zinc abraded from tyres.

6.4 Aquatic and Riparian Habitat

The most recent comprehensive monitoring of the aquatic and riparian habitat condition of the Ōtākaro catchment was the five-yearly monitoring completed in 2019 (Instream Consulting 2019). This involved sampling 18 sites across the Ōtākaro catchment, including 15 wadeable and three non-wadeable sites, with results compared to the two previous survey rounds (2009 and 2013). Instream Consulting (2019) concluded that there were few habitat changes at the monitoring sites since the previous round, with the Ōtākaro continuing to provide poor quality habitat, when compared to the less urbanised Pūharakekenui–Styx River and Ōtūkaikino catchments.

Surrounding land-use is a mixture of residential properties, reserves, and roadsides, as in the previous monitoring round. Riparian buffers are minimal (at <2 m) and often highly maintained for aesthetic reasons. The upper reaches of the Ōtākaro mainstem, as well as its tributaries, are generally narrow and shallow and often lined with stone or timber. Overhead shade is variable at the monitored sites in these reaches with the highest shading recorded in Okeover Stream, provided by a near-complete canopy of native trees and shrubs. In comparison the lower Ōtākaro mainstem is broader and deeper, with natural banks and low levels of shading. The most downstream, tidally-influenced, reaches of the river are bordered by stopbanks, which confine the riparian zone to an artificially narrow strip.

Substrates are generally coarse at the upper catchment sites, dominated by cobbles and pebbles. Bed cover with fine sediment is also low at most of the upper catchment sites, with 10 of the 15 wadeable sites complying with the ATL of ≤30% cover.

Figure 8: Lead and zinc in sediments (Burrell, 2019).

This was an improvement from the 2013 survey round, where only 5 out of 15 of the wadeable monitoring sites complied with the same guideline. Total macrophyte cover and long filamentous algae was also low at the wadeable sites, with 11 of the 15 wadeable sites complying the ATL of ≤60% for total macrophyte cover, and all 15 complying the ATL of 30% for long filamentous algae cover. Artificial widening and a lack of shade is associated with nuisance aquatic weed growth in the lower river. Consequently, Council contractors remove aquatic weed from the river 2 to 3 times per year.

Localised improvements to habitat quality have occurred in the catchment through numerous enhancement and restoration projects. Projects have often involved riparian planting, with some also including instream habitat additions and realignments of lengths of waterway. Specific examples of such projects include, but are not limited to: Avon River Precinct, involving instream habitat additions, riffle creation, sediment removal, and native plantings (Boffa Miskell 2020); Dudley Creek, involving channel reshaping, native plantings, and installation of constructed eel

habitats; Buller Stream, involving replacement of the timber lining with natural banks and addition of instream habitat features; and No. 1 Drain, involving naturalisation and realignment of the concrete channel, riparian planting, instream habitat additions, and the creation of an inline pond system (Instream Consulting 2023). In addition, restoration of Addington Brook in Hagley Park is scheduled for 2023–24 and it will involve channel realignment, riparian planting, and instream habitat additions.

6.5 Aquatic Invertebrates

Invertebrates are animals that lack backbones, such as worms, snails and insect larvae. Some aquatic invertebrates are sensitive to pollution, so their relative abundance can be used as an indicator of waterway health. Examples of pollution-sensitive invertebrates include the 'EPT taxa', which are the larvae of aquatic insects belonging to the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). The Quantitative Macroinvertebrate Community Index (QMCI) measures the relative abundance of pollution-sensitive species at a site, with higher QMCI scores reflecting higher dominance of pollution-sensitive species, and therefore water and habitat of better quality. The CSNDC has an ATL of 3.5 for QMCI scores in the Ōtākaro catchment, however, the National Policy Statement for Freshwater Management (Ministry for the Environment 2020) has set a National Bottom Line of 4.5. As such, this ATL will need to be updated to comply with the National Bottom Line in the future.

The most recent round of routine aquatic invertebrate monitoring in the Ōtākaro catchment was carried out in 2019, involving 18 sites across the catchment, Figure 9 below, including the mainstem and seven of its tributaries (Instream Consulting 2019). Instream Consulting (2019) recorded an invertebrate community dominated by pollution-tolerant snails and crustaceans, consistent with the previous 2013 monitoring round. Calculated QMCI scores ranged from 2.3 at Avon River at Pages/Seaview Bridge to 4.7 in Dudley Creek. The QMCI ATL of 3.5 was met at 14 of the 18 sites, however, most sites had QMCI values indicative of poor to fair quality (i.e., score less than 5; Figure 4). Furthermore, only nine of the 18 monitored sites meet the more stringent QMCI National Bottom Line of 4.5. There were no clear trends in QMCI values, when compared to the previous two monitoring rounds (2009 and 2013).

A total of 12 EPT taxa were recorded across the monitoring sites in 2019, represented solely by caddisflies (Instream Consulting 2019). Caddisflies have consistently been the only EPT taxon recorded in the Ōtākaro over the last decade (McMurtrie 2009; Boffa Miskell Limited 2014; Instream Consulting 2019; Boffa Miskell 2020), since the local extinction of mayflies, which were last recorded in the late 1980s (Robb 1992). Abundance and diversity of EPT taxa in the Ōtākaro catchment in 2019 was lower than in the less urbanised Ōtūkaikino Creek and Pūharakekenui–Styx River, but slightly higher than the Ōpāwaho–Heathcote River. Recent efforts to enhance habitat and aquatic values in the Ōtākaro catchment have had limited success at substantially improving macroinvertebrate values, which may be attributed to a lack of source populations for locally extinct taxa, including mayflies, and ongoing water quality issues (Boffa Miskell 2020; Instream Consulting 2023).

Kākahi – freshwater mussels (Echyridella menziesii) are an At Risk (Grainger et al. 2018) macroinvertebrate species that are present in the Ōtākaro catchment. In the Ōtākaro mainstem,

kākahi have been recorded as far upstream as Mona Vale, and as far downstream as the Waikākāriki–Horseshoe Lake outlet (Instream Consulting 2021). Kākahi are relatively sparse and patchy in the mainstem, compared to other known populations in Christchurch City, such as the Pūharakekenui or Cashmere Stream. However, a substantial population of kākahi is known to exist in Waikākāriki (Instream Consulting 2020b). The Council has recently established a monitoring programme for kākahi in Christchurch City, including monitoring of the Ōtākaro population. Wai kōura – freshwater crayfish (Paranephrops zealandicus) are another At Risk macroinvertebrate (Grainger et al. 2018), which have been recorded in all other major catchments in Christchurch City, including the Ōtukaikino, Pūharakekenui, Ōpawaho, and Huritini–Halswell Rivers, however, there are no records of this species in the Ōtākaro.

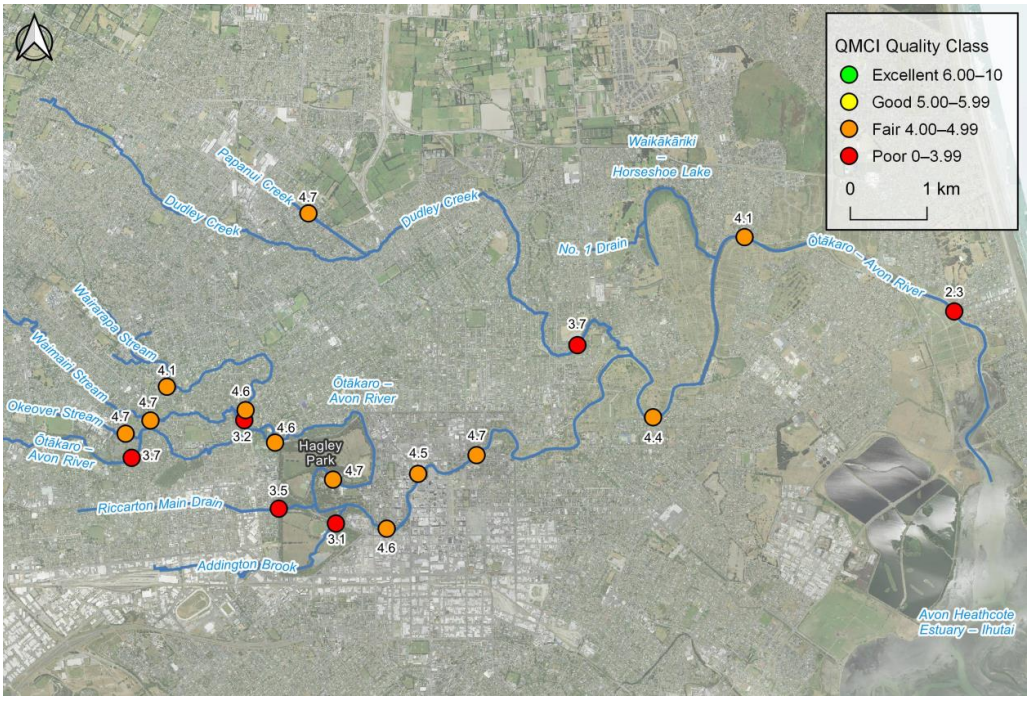


Figure 9. Quantitative Macroinvertebrate Community Index (QMCI) scores for the 18 aquatic invertebrate monitoring sites across the catchment (Burrell, 2019).

6.6 Fish

Instream Consulting (2019) reported a total of 10 fish species in the Ōtākaro catchment, comprising nine native species and one introduced species (brown trout; *Salmo trutta*). Shortfin eel (*Anguilla australis*) was the most widespread species, recorded at 16 of the 18 sampled sites. Longfin eel (*Anguilla dieffenbachii*) was the second most widespread species, recorded at 15 sites, but they were less abundant. Bullies were widespread and abundant, represented primarily by common bullies (*Gobiomorphus cotidianus*) and upland bullies (*Gobiomorphus breviceps*). In general, the fish community composition was comparable to that in other major Christchurch City catchments.

Fish species reported by Instream Consulting (2019) with an At Risk or Threatened conservation ranking (Dunn *et al.* 2018) included longfin eel, inanga (*Galaxias maculatus*), giant bully (*Gobiomorphus gobioides*), and bluegill bully (*Gobiomorphus hubbsi*), which all have an At Risk threat status. In addition to these species, low numbers of kanakana – lamprey (*Geotria australis*), torrentfish (*Cheimarrichthys fosteri*), and smelt (*Retropinna retropinna*) were also recorded in 2017 during monitoring associated with the Avon River Precinct restoration project, however, none of these species were recorded in the latest monitoring round (Boffa Miskell 2020). Torrentfish have an At Risk conservation status, while kanakana have a Threatened status (Dunn *et al.* 2018).

Factors affecting the distribution and abundance of fish in the Ōtākaro catchment include distance from the coast, barriers to fish passage (e.g., tide gates, weirs, and culverts), access to suitable habitat for adults, juveniles and spawning, water quality, and river flows. Instream Consulting (2019) reported that fish species richness was higher closer to the coast. Fish species richness naturally declines with distance from the coast, due to the dominance of diadromy (i.e., species that migrate between marine and freshwater habitats to complete their life histories) in New Zealand's freshwater fish fauna. However, fish migration barriers are also a factor contributing to this distribution. Identification, prioritisation, and remediation of such barriers in the Christchurch District is being addressed by the Council through an ongoing programme of fish passage projects (e.g., Instream Consulting 2020a; Instream Consulting 2022). In the Ōtākaro catchment, this programme has most notably resulted in the remediation of the Mona Vale weir, involving the replacement of the existing step weir with a fish-friendly rock riffle in early 2023. Follow-up monitoring has not yet been conducted to assess the success of this remediation, and thus, impacts on fish distributions in the catchment are not yet known. Similarly, the tide gates associated with the outlet to Waikakariki–Horseshoe Lake were also remediated in January 2019, including the installation of a fish-friendly tide gate. Unrelated monitoring upstream in No. 1 Drain has reported high abundances of migratory species, including inanga, indicating that the fish are able to successfully pass through these gates (Instream Consulting 2023).

The Ōtākaro catchment is known to provide habitat for species with specialised spawning habitat requirements, including inanga and brown trout. Inanga spawn amongst riparian vegetation that is inundated during spring high tides. In the Ōtākaro catchment, inanga spawning currently occurs along a section of the river between Anzac Drive bridge and Niven Street along Kerrs Reach, although with sea level rise, the limits of the spawning reach are likely to migrate upstream to include the Porritt Park Loop area (Orchard and Measures 2017). Brown trout spawn in stream gravels by excavating an oval gravel mound in which the eggs are laid, and where they develop until hatching (Taylor *et al.* 2012). Trout spawning in the Ōtākaro catchment is common in the mainstem upstream of Barbadoes Street, but also occurs in upstream tributaries, including Wairarapa Stream and Waimairi Stream (Taylor *et al.* 2012). The Council holds records of inanga and trout spawning areas in Christchurch City, which they use to update a publicly accessible database[1]. Waterway maintenance activities such as aquatic weed removal and riparian vegetation control are avoided in these areas during critical fish spawning periods.

[1] https://gis.ccc.govt.nz/portal/apps/webappviewer/index.html?id=a3486dbd58d7426b85bfd4b63d481c3

Few trends in fish populations have been reported in the Ōtākaro catchment in recent years. Instream Consulting (2019) reported that the fish community remained largely unchanged in 2019, when compared to the previous 2013 monitoring round. The notable exception to this was the distribution and abundance of brown trout in the catchment, which had appreciably declined. The decline of brown trout in the Ōtākaro catchment has been tracked since the 1990s via spawning surveys, with the siltation of spawning habitat suggested to be a factor to the local decline of this species (Taylor *et al.* 2012). Conversely, monitoring associated with enhancement projects in the catchment provide some evidence that native fish values may be improving in some areas. Boffa Miskell (2020) reported increased native fish abundance at monitoring sites associated with the Avon River Precinct enhancement project, especially at sites where riffle habitat had been enhanced, when compared to control reference sites. Similarly, increases in fish diversity and abundance have been reported in No. 1 Drain, following a restoration project involving naturalisation of flowing reaches and the installation of a pond system including floating wetlands (Instream Consulting 2023b).

6.7 Actions to Improve Waterway Health

The overall ecological health of the Ōtākaro catchment can, at best, be considered 'fair'. All aspects of the ecology in the catchment are impacted by the surrounding urban land use to varying degrees. However, there are localised examples of improving ecological values associated with enhancement projects completed in the catchment. Ongoing investment is needed to further enhance ecological values, while protecting those that remain.

Areas where further investment can be considered include:

- Increasing the length and width of riparian vegetative buffers to improve stream shading, filtering of contaminants in surface runoff, providing habitat for fish and invertebrates, and reducing the reduce the need for mowing grass down to the water's edge.
- Promoting the protection and enhancement of riparian corridors on private land, through public education, and either a strengthening of District Plan rules, or better adherence to existing waterway setback rules.
- Ongoing commitment to restoration and enhancement projects, including monitoring of new, existing, and historic waterway restoration projects, to better inform future decisions about where to invest restoration money.
- Investigating sources of contamination in waterways with impacted water and/or sediment quality.
- Monitoring of locally significant species and their habitats.
- Continued identification, prioritisation, and remediation of migratory fish barriers, including monitoring of remediation success to inform future decision making.

It is worth mentioning the major ecological restoration projects currently being planned within the Ōtākaro–Avon River Corridor. These projects are within former residential land along the lower river that was 'red zoned' – cleared of houses and deemed unfit for rebuilding on – following the Canterbury earthquakes of 2010–11. Chapter 13.14 (Ōtākaro-Avon River Corridor Zone) of the Christchurch District Plan has a priority outcome of significant areas of restored natural environment and a predominance of natural and open spaces in this area. The 'Green Spine' overlay of the District Plan follows the river and envisions an area '…largely free of built

development, providing a continuous area of public open space with trails, paths and footbridges, extending from the central city to the sea.' Significant restoration projects currently being planned or underway within the Green Spine include: Dallington Landing (native forest and wetland restoration); Avon Park wetland restoration; and Bexley wetland restoration.

6.8 Groundwater Quality

Groundwater quality has been considered with reference to nitrate N, electrical conductivity, bacterial indicators and metals. The two councils regularly monitor deep groundwater that is used for drinking but information about shallow groundwater quality is limited.

6.8.1 Nitrate

Nitrate concentrations generally increase in a southerly direction, with the lowest values occurring in bores north of the catchment, and the highest values occurring to the south and west. Three deep bores between the airport and Hagley Park have nitrate concentrations between 1 – 5 mg/L. Bores with higher nitrate concentrations that exceed the NZDWS of 11.3 mg/L, are both located close to Hornby, to the west of the city.

This pattern of concentrations reflects both land-use activities upgradient of the catchment and the source of groundwater recharge; the bores located to the north of the catchment have low nitrate concentrations due to the greater influence of seepage of high quality water from the Waimakariri River, whereas the bores located to the south and west of the Avon catchment are affected by nitrate leaching from agricultural activities further inland. The two bores with the highest concentrations occur in the vicinity of waste pits associated with the former Islington freezing works. Higher nitrate concentrations are restricted to bores less than 60 m deep.

6.8.2 Electrical conductivity

Electrical conductivity has a broadly similar distribution to nitrate concentrations with higher values to the south and west of the catchment, and lower values closer to the Waimakariri River. Some isolated occurrences of high conductivities are present close to Ihūtai-the Estuary and are related to seawater intrusion. There is a pattern of low conductivity values across the northern part of Christchurch due to the infiltration of relatively uncontaminated water from the Waimakariri River (ECan, 2015). Higher conductivities are generally seen in shallower bores (PDP 2013) indicating the potential for urban activities to influence groundwater. Deeper bores (>60 m) typically show conductivities of less than 20 mS/m, with the exception of bores around the estuary.

6.8.3 Bacterial indicators

Faecal coliform / *E. coli* distributions have a broadly similar pattern to nitrate and electrical conductivity; the highest number of faecal coliform and *E. coli* detections are typically observed in bores located to the south and west with generally lower, or no counts observed in bores located to the east. Any detections are generally seen in shallower bores, less than 30 m deep, reflecting that bacterial decay and die-off occurs during the longer travel times required to reach deeper bores.

7 Land Use

7.1 Present Situation

The largest land use type in this catchment is residential (58%). Other land zonings include commercial and industrial 6%, airport 5%, parks and open space 15% and rural 16%.

The catchment is located within the 13km radii of airport runway thresholds, which introduces a risk of bird strike on aircraft. Provisions in the SMP relate to minimization of the risk of bird strike.

7.2 Development and Trends

7.2.1 Residential Growth

Information available for the draft SMP are city-wide growth projections by StatsNZ (Monitoring & Research, 2023). A city growth model is in development and results are expected in late 2024. Between 2024 and 2034 the population of the city is projected to grow by around 32,560 people (+8%) and 11,621 households (+6%) reaching an estimated population of 432,920. Provision has been made in the District Plan by way of zoning changes permitting intensification to occur near the city centre. Growth is occurring in both developed areas and greenfields but the split is unable to be quantified at this time. Continuing infill growth within the Ōtākaro-Avon catchment can be anticipated after greenfields growth ceases.

Growth is expected to affect stormwater runoff more significantly in the Residential Medium Density Zone where individual site imperviousness can reach or exceed 70% (PDP, 2023). Site imperviousness may reach 50-60% in the residential Suburban Density Transition Zone. These zones are shown in Figure 10.

7.2.2 Industrial Growth

An industrial area near the airport is the only developing industrial land in the catchment.

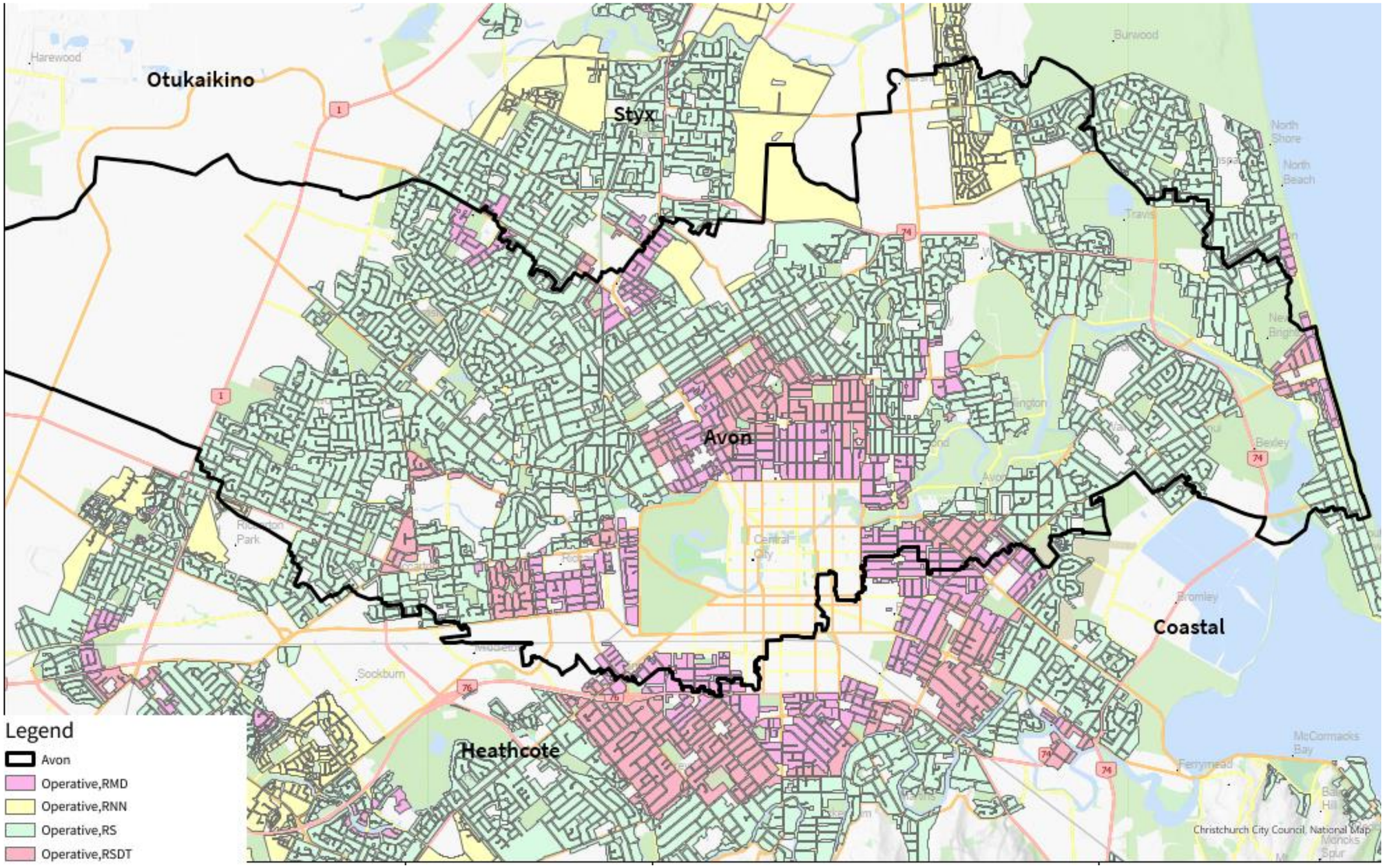


Figure 10: District Plan Zones

7.3 Contaminated Sites and Stormwater

7.3.1 Background

Contaminants may be released from two types of sites:

- Sites with in-ground contaminants that may be entrained in stormwater, typically when soil is disturbed and;
- Sites where on-site activities, usually industrial in nature, may release chemical or metal contaminants into stormwater (or into the ground).

The National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health Regulations (NES) help to identify potentially hazardous activities and industries which are listed in the Hazardous Activities and Industries List (HAIL).

Such sites are listed in a Listed Land Use Register when they become known to the Regional Council either through a consent application (to ECan or the CCC) or through investigations. Sampling, excavation, subdivision, removal of fuel storage tanks and changing land use on these sites may require a resource consent and remedial action.

7.3.2 Low Risk Sites

A Memorandum of Understanding (MoU) was agreed between the Council and ECan in July 2014 to allow stormwater discharges from low-risk residential rebuild sites listed on the LLUR and/or identified as having had HAIL activities to be processed by the Council rather than ECan. It is anticipated that as confidence grows over time in the operation of the MoU, the list of "low risk" situations that the Council can process will be extended. For example, sites on the LLUR, where only a portion of the site has had a hazardous activity and the construction will not disturb that part of the site, are considered low risk.

A site at low risk will have contaminants 'at or below background concentrations' or 'below NESCS guidelines for residential use'. The determination must be made by a qualified person.

Parts of the Ōtākaro-Avon Catchment are listed on the LLUR because of old landfills, asbestos in residential properties and chemical storage. Persistent chemicals may be associated with those sites, however they are generally at low risk of discharging contaminants into stormwater unless the sites are disturbed (e.g., during development). Many of these sites have been investigated as part of subdivision and site development and remediated as necessary.

7.3.3 Higher Risk Sites

"High risk" is generally a reference to sites with persistent or hazardous chemicals in the soil or in use on site. High-risk sites include contaminated sites and some industrial sites.

Many contaminants adhere to sediments and can be mobilised into surface or groundwater when soils are disturbed. These contaminants can be managed by maintaining a stable site, using good sediment control during earthworks and taking care with where soil is disposed of. More specific measures, including on-site treatment, may be needed for more mobile contaminants that cannot be controlled by typical sediment control practices.

All land-use consent applications are checked against the LLUR. Where development is proposed on a site listed in the Listed Land Use Register the application is referred to the Council's Environmental Health Team. Conditions are attached to the resource consent to deal with short term and long-term exposure of contaminants, often requiring site remediation.

Proposals to infiltrate stormwater into the ground must be referred to Environment Canterbury for consenting.

7.3.4 Industrial Sites

Industrial sites will be managed in accordance with CRC231955 (the CSNDC) Conditions 47 and 48 in a process that will occur in parallel to SMPs. The Council will:

- Gather information about and develop a desktop-based identification of industrial sites, ranking sites for risk relative to stormwater discharge;
- Audit at least 15 (principally high-risk) sites per year;
- Inform audited industries of the results of audits and work closely with these industries to achieve outcomes in line with the Stormwater Bylaw;
- Communicate with industries about stormwater discharge standards and the means of meeting these standards.

The Council will be empowered to do these actions by the Stormwater and Land Drainage Bylaw 2022.

7.3.5 Historic Landfills

There are approximately 30 closed landfills in the Ōtākaro catchment, spread across the area from Pound Road in the west to the coast (Tonkin & Taylor, 2014)

The nature (size, depth and likely materials) of the closed landfills means that the risks to groundwater quality associated with groundwater mounding are likely to be low. It is not anticipated that large-scale infiltration basins will be installed near the old landfills. An exception to this is a future stormwater treatment facility planned in the vicinity of Waikakariki – Horseshoe Lake where landfilling occurred historically.

The Bexley landfill discharges groundwater and leachate into the Ōtākaro-Avon River via Estuary Drain. The discharge contains measurable nutrients, metals and hydrocarbons. The discharge is consented and monitored annually.

7.3.6 Facilities Built Near Contaminated Sites

The CSNDC requires consideration of soil contamination from landfills or industrial or farming activities (e.g. industrial or agricultural chemicals) and lead paint or asbestos associated with old buildings .

Table 14, Appendix E contains comments about the proximity of proposed mitigation facilities to sites where land contamination might be present.

8 Contaminants in Stormwater

8.1 Introduction

Urban activities cause environmental effects either by shedding more or faster stormwater runoff or by discharging contaminants into stormwater that are harmful to the environment. Most urban surfaces have some form of coating (e.g. paint or galvanising) and a transient layer of wind-blown dust, combustion products, cleaning compounds, etc. Most of these substances are soluble or slightly soluble in rainwater and are transported in dissolved and particulate form into the stormwater network.

8.2 Contaminants and Contaminant Sources

The Christchurch City Council and Environment Canterbury monitor rivers, streams and stormwater for a range of water quality indicators. These include total suspended solids (dust, sediment, grit, and particles of all types), heavy metals, a range of hydrocarbons, bacteria and dissolved oxygen among other indicators. From time to time the Council samples for newly discovered ("emerging") contaminants, and both councils are aware of the likelihood that there are unknown, harmful substances in stormwater.

The Council's monitoring programme is largely based on the Land and Water Regional Plan's

- Schedule 5 Table S5A and Table S5B Indicators and Toxicants, and
- Schedule 8 Region-wide Water Quality Limits

Contaminants of most concern in the Christchurch District are:

- Dust, sediment, grit and particles of all types capable of being transported in stormwater, referred to as total suspended solids (TSS). TSS include metal particles, aggregates of metallic compounds, and charged (e.g. clay) particles with attached metal ions.
- Dissolved and particulate zinc
- Dissolved and particulate copper
- Polycyclic aromatic hydrocarbons (PAHs)
- Pathogens
- Nutrients (mostly phosphorus)

Lesser contaminants, which generally do not exceed LWRP Table S5B guidelines, are:

- Hydrocarbons (oil and grease)
- Cadmium and lead

8.3 Suspended Solids

Particle sources include streambank erosion, animal waste, construction activity, land cultivation, combustion, industrial products, tyre and brake wear and paint coating breakdown. Some

particles are natural and some such as paint chips are artificial. Natural soil particles contain metals and may carry adsorbed chemicals.

Suspended solids are damaging because they deposit on stream beds and fill the spaces between stones, greatly reducing the refuge options for instream life. Fine particles can release attached toxic compounds which harm the food chain.

The most important sources of particles in waterways in this catchment are likely to be road surface abrasion, wind-blown dust, vehicle emissions, construction site discharges.

8.1 Zinc

Zinc is used as a protective coating for steel on corrugated iron roofs, rooftop ventilators, chain link fencing, lighting poles and various barriers and fences. Although a zinc layer is long-lived it is slowly being dissolved by rainwater. Industrial and farm buildings often have unpainted galvanised roofs and can be large sources of zinc. Residential areas typically have painted or tile roofs, but many of these have older paint coatings in poor condition and can be a significant source of zinc.

Roofs create approximately 75% of urban zinc. Roads create approximately 25%, much of which is from tyres. Zinc makes up about 0.8% by weight of tyres in which zinc oxide is a vulcanising catalyst. Zinc released onto roads is very fine which can dissolve easily and be transported readily in stormwater. Other zinc sources include galvanised fencing and posts, fungicides, paint pigments and wood preservatives.

Many sources such as Timperley et al (2005) report that tyre-derived zinc is transported onto other surfaces, including roofs, by wind. Stormwater sampling in Christchurch supports this, showing zinc runoff from nominally zinc-free surfaces such as concrete tile roofs.

8.2 Copper

The predominant copper source in urban stormwater is thought to be vehicle brake pad wear. Copper exceeds LWRP Table S5B guidelines at a number of monitoring sites during some rainfalls.

8.3 Polynuclear aromatic hydrocarbons

Polycyclic Aromatic Hydrocarbons (PAHs) are created when products like coal, oil, gas, and garbage are incompletely burned. PAHs are a concern because they do not break down very easily and can stay in the environment for long periods of time. PAHs may come from coal tar sealants and diesel or industrial combustion.

8.4 Pathogens

This section is for information. *E. coli* are not required to be controlled under the consent. *E. coli* counts are usually caused by waterfowl (ESR, 2015). Potential sources in this catchment could include farm animals and dogs.

8.5 Nutrients

This section is for information. *E. coli* are not required to be controlled under the consent.

International research indicates that important nutrient sources include decaying leaves, sediment, fertiliser and bird and animal faeces. Nutrients can lead to excessive aquatic plant growth (Margetts, Poudyal, 2023).

9 Waterway Capacity and Flooding

9.1 History

As development occurred near the central city swamps were drained, firstly with open drains and later with pipes. Fewer flooding problems were experienced than in the adjacent Ōpāwaho-Heathcote catchment because the Ōtākaro-Avon River channel is larger, but parts of Mairehau and St Albans were notable for being inundated by prolonged rainfalls. The Christchurch Drainage Board began to give greater attention to stormwater control in the 1960s after significant floods, and various flood control projects were built. The Dudley Creek Diversion, completed in 1989, routed water from the Upper Dudley Creek and Papanui through Cranford Basin and into the Dudley Creek Diversion Pipe via a pumping station. Pipelines to relieve flooding in St Albans and Merivale were installed in the 1980s. Stopbanking along the lower river, from Dallington to Bexley, was constructed between the late 1970s and mid-1980s to alleviate the threat of tidal inundation to developing areas such as Avondale and Wainoni.

The stopbanks subsided in places during the 2010-11 earthquakes and were temporarily raised in early 2011. Planning for stopbank replacement is proceeding in tandem with the Ōtākaro Avon River Corridor plan. The width of the Corridor will permit stopbanks to be moved to more stable ground further from the river, with landscaping.

Surface flooding is not a major threat in the Ōtākaro-Avon catchment but can occur in three main ways:

1. Rainfall will nominally exceed the capacity of side channels and pipes a 5 year ARI storm, and begin to accumulate on streets, greenspace and private property. Surface flooding can be expected during more severe rainfalls.

2. Water that reaches waterways during and after rain can be conveyed for some distance and then leave the waterway at a bottleneck which may be a culvert or a section of stream channel or floodplain that was partially filled as a result of development. On leaving the waterway the flood water is likely to flow through private properties and may cause flooding.

3. High tides flow into the lower river through the estuary to a level that is higher than some surrounding land. Extreme tides would flood tens of hectares adjacent to the lower river if not excluded by stopbanks.

9.2 Flood Prediction and Modelling

Hydraulic models have been developed to estimate the likely extent of flooding. An earlier (c2012) Avon model of the river channel underwent a rebuild in 2016-2018 with the objective of incorporating the entire drainage network and developing an accurate picture of flooding on the floodplain. The model is now highly detailed and features roads, all pipes 300 mm diameter and larger, pumping stations, and infiltration into the ground.

During 2016-2018 the model was configured to represent the 2014 catchment condition and calibrated to the March 2014 flood event. Since 2018 the infiltration methodology has been

improved from a simpler Hortons infiltration to a more realistic 'infiltration with capacity' model with a constant infiltration rate but finite infiltration capacity.

The model currently runs on DHI version 2020 software, 3-way coupled in Mike Flood. Design rain event modelling uses HIRD v4 rainfall intensities and a range of storm durations with a 'max of max' summarisation of flood risks for ARIs of 10, 50, 200 and 500 years. This latest work is summarised in the "LDRP097 Multi-Hazard Baseline Modelling Report", 15 July 2022 and in the "Model Status Report – Avon/Estuary" Rev 7, July 2022.

Significant model updates were completed during 2020-2022 to resolve gaps and inconsistencies in the mapped flood extents and include major stormwater infrastructure projects since 2014. These projects included Cranford Basin bunding, Lower Dudley Creek improvements, improvements to six pumping stations, new flood mitigation basins, as built stopbank levels and inclusion of Southshore bunds (following some planned work to complete this protection). The new Prestons subdivision and Northern Corridor motorway were partially represented from the limited data available. Flood results in these two latter areas remain to be improved but the large-scale flooding patterns around them are expected to be valid.

Model results indicate that most urban waterways are at capacity in a 10 year ARI event. In the 10 year ARI current (c2020) model scenario flooding is mostly restricted to road reserves, greenspaces, waterways and wetlands. Areas indicated to have worse than normal flooding in such an event include;

- near the airport, west of Russley Road, (although this western area may have much higher infiltration rates and lower runoff rates than are modelled)
- Kyle St, Riccarton (noting this area is presently under further investigation with historic evidence that the model is overpredicting flood risks here)
- St Albans, Flockton Ave area (the improvement projects are not predicted to fully resolve the 10 year ARI flood risks here with some deep road flooding and probable floor level flooding still predicted there)
- Canon St, Edgeware southeast of Fresh Choice and its small commercial precinct.

A 10 year ARI modelled event is displayed in Figure 11. The 10 year ARI is a useful view of flooding risk being a significant but not too infrequent event. In a present day 50 year ARI scenario ponding patterns generally reflect the 10 year ARI, with water a little deeper.

Modelled scenarios include expected future conditions at intervals out to year 2150. Future conditions are based on forecast spatial changes in urban housing density and population projections. The 50 year ARI result for 2060 shows generally minor incremental worsening in flood risk (due to increased rainfall with climate change and predicted increased imperviousness).

Modelling of future scenarios has not included network capacity upgrades. It is thought more likely that increased runoff will be mitigated by storage than by extra capacity. In developing greenfield areas there is expected to be full mitigation of additional runoff up to 50 year ARI, and the flood risk should not change up to that recurrence interval. In areas of brownfield intensification there is potential for the risk of flooding to increase unless stormwater runoff is managed well.

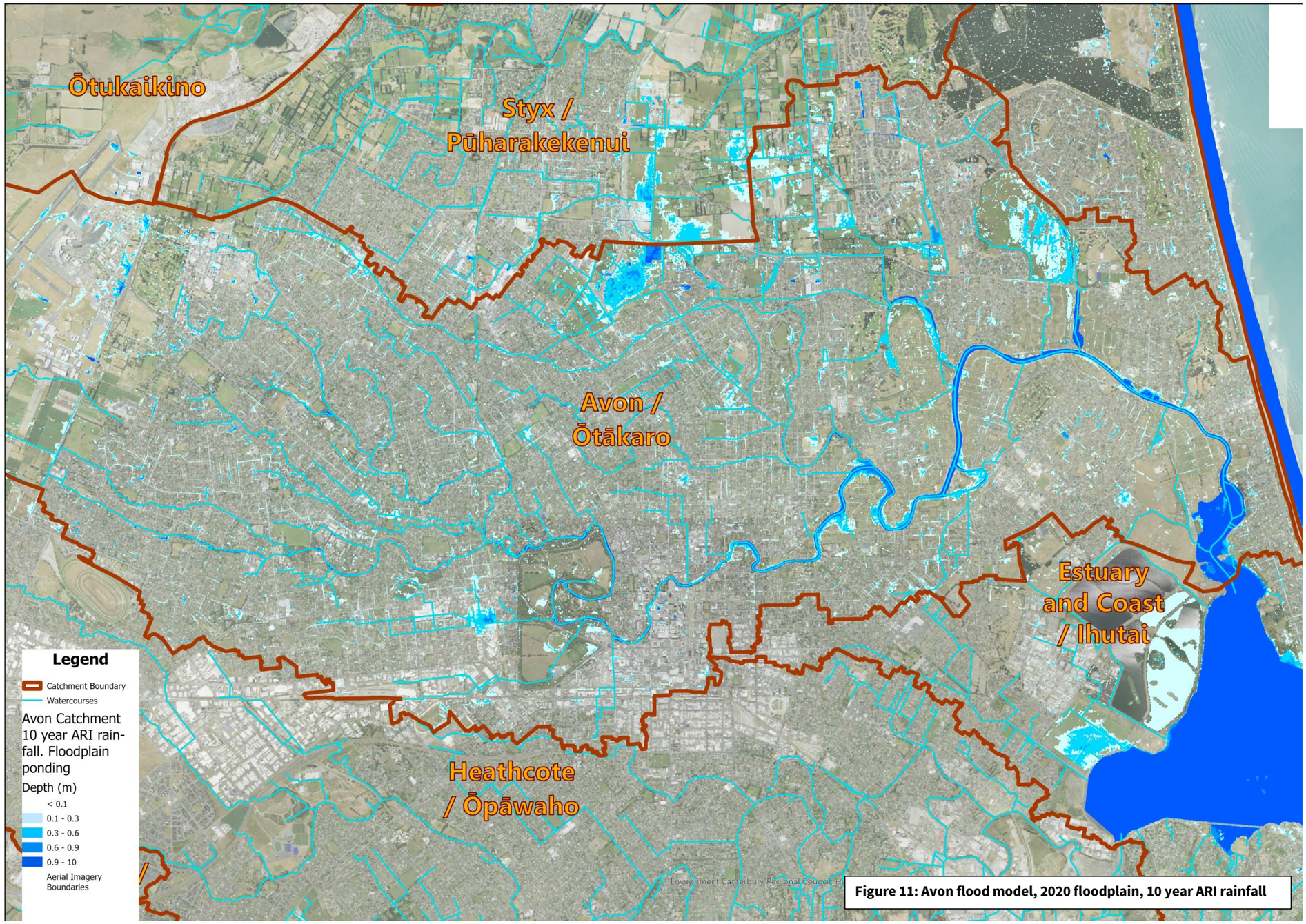


Figure 11: Avon flood model, 2020 floodplain, 10 year ARI rainfall

9.3 Flooding Levels of Service

The city's drainage systems are principally designed to serve the expectations of safe vehicle travel and flood-free housing. The network of side channels, pipes and drains keep traffic lanes free of ponded water in frequent events. In more extreme rainfalls the lower lying parts of roads and private properties store water in excess of system capacity until it can be drained away. Houses are expected to be built sufficiently high to remain dry in all but the most extreme events.

Guidelines in the Infrastructure Design Standard and Waterways Wetlands and Drainage Guide incorporate or provide the Council's drainage levels of service.

- Road drainage, pipes and minor drains are designed so that the 5 year annual recurrence interval rainfall does not cause a nuisance to traffic.
- Hillside drainage must ensure that a 20 year annual recurrence interval rainfall does not endanger property.
- Stopbanks along the lower river currently (temporarily, in the repair phase following earthquake damage) are at a height of the 100 year ARI extreme tide plus an additional "freeboard".
- Within Flood Ponding Management Areas minimum floor levels are set 400mm above the 200 year annual recurrence interval flood level. FMAs are those areas covered by the 200 year ARI flood level plus a 250mm safety margin (freeboard). (400 mm floor height above flood level includes the 250 mm freeboard plus an assumed 150 mm minimum foundation height above the natural ground.)
- There are proposed development restrictions for "High Flood Hazard Management Areas" (HFHMA) defined as areas where, in a 500 year annual recurrence interval flood the water would be more than 1m deep or the product of velocity times depth is greater than 1.
- Otherwise, a 50 year annual recurrence interval event is used to set the minimum floor levels as required by the Building Act.

It is noted that a natural catchment responds to excess rainfall by storing water on its floodplain; likewise in urban areas excess rainfall is discharged from roofs and paving to accumulate on streets, low-lying land and secondary flow paths. This will occur in occasional, severe rain events that exceed network capacity. Normal urban planning provides for house floor levels to be elevated above flood levels in such rare events.

9.4 Managing risks to dwellings

Properties within the District Plan Flood Management Area are required to install their floor level to provide protection from the predicted 1 in 200 year flood level. The Flood Management Area locations were identified during the District Plan process though modelling of the highest flood impacted locations.

Since 2014 all new house floors have been assigned floor levels safe from flooding, as determined from hydraulic modelling.

The flooding risk from waterways and drains is dealt with by:

- Avoidance: built-up areas are located on high ground or on the outer side of stopbanks.
- District Plan rules.
- Rules under the Building Act 2004
- New builds within Flood Hazard Management Areas are required to have a floor level above the 200 year average recurrence interval (ARI) flood level plus 400 mm. (A full definition including tidal influences found in the Christchurch District Plan section 5.4).
- Outside the Fixed Minimum Floor Level Overlay all new builds are required to have a floor level that is above the modelled 50-year ARI flood level plus 400 mm.
- An appropriately designed and managed stormwater network where pipes and drains should have capacity to convey a 20% annual exceedance probability rain event.

9.5 Planning for Flood Level Compliance

Schedule 10 in the CSNDC is a compliance measure for water quantity management. Schedule 10 requires the Council to balance water level increases caused by development with water level reductions brought about by mitigation. To comply the Council must use best practicable options to manage stormwater in such a way that the modelled 50 year ARI flood level, in the absence of climate change, should not increase by more than 50 mm at the Gloucester Street water level recorder. Schedule 10, Appendix G, has more detail.

The modelling project is yet to deliver a model specific to schedule 10 compliance. The relevant model version when available will omit climate change and will facilitate appropriate consideration of current, planned and potential additional flood mitigations and improved certainty of urban development factors including dwelling intensification and the associated rules and permitted activities. A model version and associated analysis that includes the above factors will not be completed until after this SMP is delivered.

With the developed model version, and improved certainty of urban planning requirements and assessment of options for mitigation, Council will be better to identify the best practicable options for mitigation to meet compliance target levels, which will then feed into future planning including Annual Plans and Long Term Plans.

9.6 Key Water Level Monitoring Locations

Schedule 2(s) in the CSNDC requires the SMP to propose more ‘key water level monitoring locations’ in addition to Gloucester Street to provide more opportunities to monitor effects over time.

Table 2 proposes three additional key monitoring locations at sites on important tributaries where modelled assessments of water levels and volumes could be of value.

Table 2: Key monitoring locations for Schedule 10 Water Level Compliance

Key monitoring locations for Schedule 10 Water Level Compliance					
Receiving Environment	**Monitoring Location**	**Baseline Year**	**Annual Exceedance Probability**	**Maximum allowable increase**	**Modelled increase by 2034**
Ōtākaro-Avon River	Gloucester Street Bridge	2014	2%	50 mm	uncertain
Ōtākaro-Avon River	Railway corridor	2014	2%	80 mm (placeholder)	uncertain
St Albans Stream	Stapletons Road	2014	2%	100 mm (placeholder)	uncertain
Wairarapa Stream	Railway corridor	2014	2%	100 mm (placeholder)	uncertain

9.7 Planning for Resilience

Developing greater resilience to flooding and maintaining well-functioning urban environments

Growth planning for Ōtautahi Christchurch encourages greater intensification of existing neighbourhoods near the central city to reduce the need for further significant expansion into rural areas and to make efficient use of infrastructure. Infilling in residential and business areas is expected to be accompanied by increases in impermeable surface area. Without appropriate mitigation measures this can exacerbate flood risk through increased peak runoff and event runoff volume.

The Citywide Surface Water Hydraulic Model accounts for anticipated changes in urban housing density, resulting increases in impervious surfaces, increasing storm intensity from climate change and resulting rates of urban runoff. Interim results indicate a mostly acceptable situation on the floodplain as a whole for present day urban density with heavy rainfalls tending to pond on streets rather than on private properties, for storms of up to 10-20 year average recurrence interval (ARI). The model confirms vulnerabilities to heavy rainfalls in some areas, typically in shallow depressions where water from surrounding areas can accumulate. This is more so the case in storms exceeding 20 year ARI. However, a precautionary approach suggests the possibility of increasing flood levels in waterways following development. Flooding could arise around streams west of the central city and in parts of the central city. Rainfall-induced flooding is less likely in the river east of the central city due to adequate channel capacity.

Risks of flooding are expected to increase in most areas where more intensive development increases the rate and total volume of stormwater runoff. Without sufficient mitigation, on-street and on-property flooding may become deeper in large storms as neighbourhoods densify. Increased stormwater runoff from infill can be difficult to mitigate because is not always desirable

to improve network capacity and transfer greater peak flows into already full waterways. Current forms of mitigation such as on-site storage (e.g. rain tanks) may have limited effectiveness as they can reach capacity part-way through larger rainfall events. However, they can be an important mitigation method to manage smaller events.

To better inform the Council's response to current and potential flood risk from intensification, more detailed network infrastructure and local area urban planning will be undertaken when confirmation of District Plan changes provides more certainty and when hydraulic model improvements are completed. More detailed planning will test a range of urban development scenarios against potential infrastructure and land development solutions.

Potential mitigation measures could include:

1. a move to larger onsite stormwater storage systems with more complex or electronically-controlled outlet systems;
2. more frequent use of pumped systems allowing the use of underground storage;
3. requirements to reduce sealed surfaces by the use of permeable pavement, green roofs and open-slat decking for outdoor living;
4. constructing stormwater storage basins within developing areas;
5. storage basins constructed within existing neighbourhoods;
6. elevating floor levels;
7. increased discharge to ground where practicable

Mitigation options are being considered through an integrated approach that includes planning and investment for greenspace, recreation and transport, and alongside improvements to meet sustainable surface water objectives. Local area (growth) planning and more detailed network planning will be undertaken in a prioritised manner, having regard to need, growth demand and alignment with other Council planning and investment programmes as identified under the Long Term Plan.

The Avon floodplain model will continue to be refined after the SMP is delivered and results will be used to improve Table 2. Interim provision has been made in the Long Term Plan for continuing work on the model. Provision has also been made in the Long Term Plan for new infrastructure that could be expected to arise from planning for flood mitigation. However, the appropriate type and degree of mitigation cannot be determined at this stage, as that will be dependent on the density and spatial distribution of urban intensification. Those factors become defined through anticipated central Government directives and Council responses through changes to the District Plan. Once the appropriate mitigations can be confirmed from these planning changes, and if the mitigations depart from those currently identified, the Avon SMP could be updated accordingly.

9.8 River Defences

The river east of Fitzgerald Avenue is tidal and some riverside land is near or below the level of high tides. Stopbanks were built during the 1970s and 1980s to protect riverside roads and to permit reclamation and development of pre-existing wetlands in Avondale/Wainoni/Bexley areas. Most stopbanks were located on the river edge. The original stopbank height provided protection against a nominal 100 year ARI tide, although consolidation of foundations and sea level rise reduced that level of protection up to the time of the earthquakes. By 2010/11 the stopbank crests were providing protection against a 50 year ARI tide, with a safety margin.

The earthquakes caused parts of the stopbanks to subside due to riverbank movement. An urgent programme of temporary repairs re-established the river defences in February and March 2011 before anticipated spring tides. These remain in place as the present day temporary stopbanks extending from the Estuary up to Swanns Road. The temporary stopbanks contain what is approximately a 100 year ARI tide: they are constructed to a level of at least 11.4m CDD in the lower reaches. In the medium term the stopbanks will be relocated further from the riverbanks within the Ōtākaro Avon River Corridor.

The Ōtākaro Avon River Corridor (OARC) Regeneration Plan ("the Plan") provides a blueprint for future development and community activities within the area formerly known as the Avon Residential Red Zone. As well as large areas of planting and park-like areas, the Plan provides for new stopbanks set back from the river's edge up to and beyond the Fitzgerald Avenue Bridge. Stopbanks will be future proofed so that they can be modified in the future as sea levels rise and the climate changes. The first implementation of the long-term stopbanks is in the Waitaki Street area and is currently being constructed. Once finished it will have a crest level of at least 12.26m CDD and will be wide enough for the crest level to be raised by another 0.5m in the future. The crest level allows for a 1% AEP event, freeboard, future sea level rise, vertical land movement, construction tolerances and a survey tolerance. Depending on the onset of relative sea level rise the stopbank crest will need to be raised within the next 50 years. Future stopbanks will need to be delivered in stages with interim stopbank works to manage flood risk within existing budgets over the life of the temporary stopbanks.

The Plan also shows stormwater management areas on the landward side of the stopbank to improve stormwater quality. In many places stormwater will need to be pumped to provide ongoing drainage for residential areas adjoining the OARC as sea levels rise. Long term, most of the outfalls draining into the river will need to be pumped if existing land use is to be maintained without significant modification. Stormwater pumping has already been installed for many of the catchments downstream of Pages Road and elsewhere. Further study on when pumping will be required is underway and planned.

9.9 Sea Level Rise

Chapter 11 *Natural Hazards* in the Canterbury Regional Policy Statement 2013 recommends:

"As of 2012, Ministry for the Environment guidance for local authorities is to plan for the effects of 0.5m sea level rise out to the year 2100 and to assess the effects of 0.8m sea level rise."

Subsequent 2017 MfE advice recommends a risk-based approach considering adaptation pathways over time. The advice also includes the information on rates of sea level rise depending on how climate change is managed worldwide.

Sea level rise trends and post-earthquake land settlement trends are being monitored. High tide statistics have been recently reviewed with the sea level rise trend isolated so that tidal variability and sea level rise can be considered independently. A trend of 4-5 mm/year land subsidence has been observed in South New Brighton over the last 8 years (Survey, Otago, 2023). A trend of 1 mm/year has been observed in coastal North New Brighton. Land subsidence will be additive to sea level rise effects.

9.9.1 Effects of Sea Level Rise on Land

The greatest potential impacts of sea level rise include:

- increased risk of storm inundation associated with extreme tidal events,
- the need to progressively raise stopbanks,
- progressive retreat of the shoreline in low lying areas.

9.9.2 Effects of Sea Level Rise on the Stormwater Network

Rising sea levels will reduce the effectiveness of gravity stormwater drainage in tidally influenced areas. Effects are being quantified with the assistance of computer modelling, and have been included within the scope of a city-wide stormwater network model which nearing completion . Sea level rise will be perceived in increased tidal flooding of streets and rising groundwater levels. It will affect the land drainage network by:

- Increasing the requirement for tidal backflow prevention
- Increasing the demand for stormwater pumping stations
- Leading in the long term to a need for pumping to lower groundwater levels

Natural hazard planning processes are under way through the Coastal Hazard Adaptation Planning project which will consider a range of options including engineering solutions, planning solutions and retreat, as the Council has done in several instances to alleviate property flooding in the lower Ōpāwaho-Heathcote River. Future retreat may be managed differently according to future circumstances.

Council operations staff have access to detailed tide forecasting about 2 days ahead enabling tidal flooding preparations to be made.

Part Three: Objectives and Principles

10 Developing a Water Quality Approach

10.1 Introduction

Mitigation options have been considered for contaminants specified in consent conditions:

- TSS (sediment and particulates, by means specified in consent conditions)
- Copper and zinc
- And also oils, cleaning compounds, nitrates/nitrites, chemicals, etc in industrial discharges (considered in section 11.4)

Metals typically exceed water quality targets for relatively short periods during and after rainfall. It is generally understood that they affect ecosystem health but the relationship between concentrations, durations and effects is extremely complex, variable and difficult to quantify. The Council is collaborating with other councils and NIWA to initiate research into acute contaminant effects on aquatic life.

The Environmental Monitoring Programme reports levels of these contaminants against the Consent (Schedules 7 – 9) guidelines in an annual report.

10.2 Contaminant model

Consent conditions require SMPs to estimate present day annual contaminant loads and develop means of reducing the loads over time. Loads are estimated via an annual contaminant load model (CLM) developed by Golder Associates for the Comprehensive Stormwater Discharge Consent hearing. The model is a version of the Auckland Regional Council CLM adjusted for Christchurch conditions. "Adjusted" means that TSS loads per hectare are judged to be 60% of Auckland loads due to proportionately lower rainfall in Canterbury. Modelled Christchurch TSS loads were reduced in the ratio of Christchurch annual rainfall to Auckland annual rainfall, nominally 600mm to 1000mm. The model assigns an annual load of TSS, zinc and copper to each impervious urban surface and calculates the total annual load of the three contaminants in each sub-catchment. Unit annual loads used in the Christchurch contaminant load model (C-CLM) are in Appendix C. Copper and zinc loads are unchanged from the Auckland CLM.

The C-CLM estimates the annual load of three contaminants, total suspended solids (TSS), copper and zinc for each of the 31 sub-catchments mapped in Appendix B. These sub-catchments are the same sub-catchments as defined in the draft 2013 Avon SMP. (Present day sub-catchment outlines are a little altered and model data for some of the present-day sub-catchments is not available.) The C-CLM estimates the contaminant load reduction from treatment and from an estimated zinc load reduction through the predicted renewal of old zinc roofs at age 70 years.

1. The C-CLM is used as a guide to the expected contaminant load reductions through treatment facilities proposed in this SMP. Sub-catchments proposed to be treated within the term of this SMP are listed in

Table 3. Considerations in selecting these sub-catchments for treatment are:

2. Addington is the most contaminated sub catchment. Riccarton is moderately contaminated.
3. Avondale and Wainoni facilities are funded in the Long Term Plan and are retrofitting existing catchments and therefore high priority for facilities construction.
4. Cranford facility is funded and substitutes for a facility at Waikakariki which is postponed with consenting difficulties due to an old landfill, and design difficulties due to a high water table.

Table 3: Sub-catchments to be treated under this SMP.

C-CLM Sub-catchment 2013 and 2018 (Map in Appendix B)	Present Day Sub-catchment equivalents	Type of Treatment Facility
Addington	Addington	Biofilter
Riccarton	Riccarton	Biofilter
Cranford	Cranford and Dudley Creek Above the Diversion, and Middle Dudley Creek west of Philpotts Road	Basins and wetlands
Avondale	PS 220, Loop	Basin and wetland
Knights	Part of Avon River Corridor East	Basins, wetlands and biofilter

C-CLM results for treated and untreated sub catchments are reported in Table 12 Appendix D.

The Council has commissioned DHI to develop a MEDUSA[2] model for each catchment in the Christchurch District. Development has taken longer than expected because of complications in defining the catchments draining to treatment facilities. Results from the new model will be available for subsequent SMPs.

10.3 Comment on Contaminant Load Model Results

Table 13 summarises expected annual contaminant load reductions through treatment facilities in this SMP. Table 13 indicates that facilities modelled by the C-CLM in the five sub-catchments are expected to reduce annual contaminant loads in the Ōtākaro-Avon catchment by:

TSS 11.2%

Zinc 9.3%

Copper 10.6%

[2] **M**odelled **E**stimates of **D**ischarges for **U**rban **S**tormwater **A**ssessments, by the University of Canterbury

The reduction is expressed as a percentage of the modelled annual load in the 2018 (base) year.

Table 12 (Appendix D) lists C-CLM results for all sub catchments. The model suggests that annual loads of TSS are within an order of magnitude in most sub-catchments, driven significantly by the proportion of greenspace, on the assumption that vegetated areas deliver significant amounts of contaminants. Areas with busy roads are likely to generate more TSS than quieter areas. The annual load estimate of zinc is highest from Addington sub catchment, reflecting the predominance of bare zinc or zinc/aluminium commercial/industrial roofs. However much of the Avon catchment is mature, and older residential and industrial areas can both deliver similar zinc loads. The model could under-estimate the zinc load from older housing depending on the accuracy of input data. The annual load estimate of copper is highest from Addington subcatchment, probably reflecting higher vehicle-kilometres per year, (the assumption being that copper load is proportional to vehicle-kilometres per year (Kennedy et al, 2002)).

Table 12 shows small annual contaminant load reductions for some subcatchments where treatment facilities are not proposed. Such minor changes are likely to arise from assumptions in the C-CLM about the transition of greenspace to impervious areas and the modelled replacement of old galvanised roofs.

10.4 Lessons from Monitoring of Treatment Basins

Wet weather monitoring of some treatment facilities has been carried out since 2018. Basins and wetlands on Knights Stream and Prestons have been monitored by Pattle Delamore Partners since 2018, picking up 9 events. Haytons and Curlett Streams were monitored by NIWA in 2021, and in 2023 Coxs-Quaifes basins and wetlands were monitored in a student project. Reductions in contaminant concentrations through facilities were measured on many but not all occasions, and percentage reductions were variable. Reduced treatment performance appears to be correlated with low pre-treatment contaminant concentrations, (PDP, 2024). This is in line with international findings. Treatment efficiencies obtained from 2020/21 wet weather monitoring of Curletts and Wigram, facilities (NIWA, 2022) indicate the potential for a better percentage of TSS and metals removal where influent concentrations are higher. A recent performance assessment of Coxs-Quaifes Facility (Robertshaw, Mercer, 2023) reports moderate effluent contaminant reductions with mid-range influent contaminants. Monitoring is to continue.

A comment on limited earlier monitoring is made in a memorandum titled Inferences from Performance of Treatment Basins 1993-2020 (TRIM 22/490757).

Wet weather monitoring has not yet shown clear trends in treatment facility performance. For now the council does not have sufficient reason to amend treatment efficiencies in the C-CLM (Golder, 2018). These treatment efficiencies were sourced from WWDG chapter 6 guidelines, Auckland Regional Council guidelines, and the International Stormwater BMP Database. It is anticipated that more recent wet weather results will be used in the MEDUSA model that is being developed and will in time replace the C-CLM.

It is noted that treatment basins perform both treatment and peak flow limitation functions, both of which are necessary. The dual functions are a reason for preferring detention facilities to alternatives such as filters where flow attenuation is needed.

10.5 Role of Monitoring and Tangata Whenua Values in Setting Targets

10.5.1 Environmental Drivers

Waterways in the catchment are in an ecological condition described as Fair. Sub-catchments containing industrial areas are identified in monitoring by both Councils as the most contaminating. Accordingly Addington and Riccarton sub-catchments have been prioritised to be retrofitted with the best available technology, which is biofiltration, in the near term. Biofiltration will be carried out by pumping stormwater into on-ground Filterra™ units sized for the sub-catchment. A unit serving Riccarton sub-catchment is provisional pending consent to install it within Hagley Park.

10.5.2 Mahaanui Iwi Management Plan Objectives

This plan recognises and is intended to help support the policies and objectives for water and the environment for the catchment of Ihūtai in the Mahaanui Iwi Management Plan 2013 as detailed in Table 4.

Table 4: Response to the Mahaanui Iwi Management Plan

Iwi Management Plan	Ōtākaro-Avon SMP response
Policy IH3.1 To improve water quality in the Ihutai Estuary catchment by consistently and effectively advocating for a change in perceptions of waterways: from public utility to wāhi taonga.	A *Community Water Partnership* programme is carrying out an education and advocacy role with one full time employee.
Policy IH3.2 To require that waterways and waterbodies (including Te Ihutai) are managed to achieve and maintain a water quality standard consistent with food gathering.	The SMP can contribute toward this to the extent indicated by the Goals in section 12.1.
Policy IH3.3 To require that local authorities eliminate sources of contaminants to waterways in the Ihutai/Estuary catchment, primarily: (a) Sewage overflows in the Ōpāwaho and Ōtakaro Rivers; (b) Stormwater discharges into all waterways, including small headwater and ephemeral streams, and drains; (c) Run-off and discharges into waipuna;	The SMP is a management tool for reducing contaminant discharges into waterways. The Council does not see an alternative to stormwater discharge into waterways in the near term. The Council can protect individual waipuna but cannot currently prohibit discharges into a waterway that flows past/over waipuna. Improving stormwater quality generally is the

	only approach that seems to be open to the Council in the foreseeable future. (It is acknowledged that wastewater overflows degrade the mauri of Ōtākaro. Wastewater overflows are consented separately under CRC182203.)
Policy IH3.4 To advocate for the following methods for improving water quality in the catchment: (a) Avoiding the infiltration of stormwater into the sewage systems, which results in overflow discharges to the rivers and estuary; (b) Protect and retain margins and set back areas along waterways, and ensure that these are of appropriate width and planted with indigenous species; (c) Restoration of degraded springs and wetlands; and (d) Requiring on site and closed stormwater treatment and disposal techniques (that do not discharge to water) for urban developments, public lands and parks.	(Measures are being implemented to reduce wastewater overflows). Waterway margins are generally protected by the District Plan. Restoration of degraded springs is an initiative in the proposed Healthy Water Bodies Plan. Onsite disposal to infiltration is preferred by the Council. However, high groundwater and impermeable soils seem to make this unfeasible in many parts of the city. Treatment is required for new development, (although the Council is aware that even best practice treatment is not fully effective.) The volume of stormwater seems to make closed systems not practicable: however the Council is working to remove contaminants of stormwater in the long term.
Policy IH5.1 To require that the waipuna in the catchment are recognised and managed as wāhi taonga, as per general policy on wetlands, waipuna and riparian margins (Section 5.3, Issue WM13), with particular attention to: (a) Ensuring that waipuna are protected from the discharge of contaminants; (b) Ensuring that there are appropriate and effective setbacks from waipuna, to protect from urban development or re-development;	The SMP may not be the right way to control discharges to waipuna and restoration of waipuna. District Plan rules may be more effective. Management of waipuna is a District Plan matter. The Council manages and seeks to prevent direct discharges into waipuna through section 8.7.4.6 of the District Plan. Discharges are controlled by consent conditions. Development near waipuna is referred to MKT and is subject to resource consent. Generally a 15 m setback is applied. Waipuna are difficult

(c) Restoring degraded waipuna; and (d) Enabling flow to return to waterways in naturalised channels.	to protect if there is filling or excavation without a consent application.
IH6.2 To require that any physical works on waterways in the urban environment occurs in a manner that does not reduce the width of margins or riparian plantings, and is consistent with the re-naturalisation of the waterway.	Controls re applied through District Plan waterway setbacks and the Stormwater and Land Drainage Bylaw 2022, rather than through the SMP. However RMA provisions do not always permit full control.

10.6 Potential Controls

Table 5: Contaminant Sources, Significance and Possible Mitigation Methods.

Mitigation methods colours define effectiveness:

Green = Likely to be effective, Yellow = Sometimes effective, Red = Difficult or slow getting effects.

Source	Contribution	Possible Mitigation Methods
Sediment		
Farm animals trample stream banks	Significant	Stock exclusion (by fencing waterways)
Construction sites	Unknown, mitigated to some extent	Sediment & erosion controls First flush basins Wetlands As conditions on subdivision, resource or building consents Minimum Requirements for Developed Sites
Road works	Low; sometimes in-adequately controlled	On-site sediment controls
Atmospheric deposition	Low	Riparian tree cover
Plants (leaves, etc.)	Low (seasonal)	None
Vehicle emissions	Low	Treat road runoff
Visitor activity (stream access)	Medium	Signage
Deposition on roads via vehicles, pedestrians, private property runoff and wind.		Rain Garden (generic in-ground bio-filter) Cartridge filters (e.g. Stormfilter by Stormwater 360) (effective for particulates, less so for dissolved metals) Filterra (proprietary in-ground bio-filter) Catchpit filter (e.g. Litta Trap) Street sweeping
Zinc		

Source	Contribution	Possible Mitigation Methods
Bare galvanised roofs	Relatively few galv. roofs discharging to waterways in this catchment. (High city-wide.)	Replace with alternative roofing material (clay tile or non-metal roofs ideal; alternatively pre-coated Zn-Al, or paint with low-zinc paint) Downpipe filters (e.g. Storminator by University of Canterbury) Divert first flush to the wastewater network
Ageing painted roofs	High city-wide. Could be an issue as new pre-coated roofs age.	Replace with alternative roofing material (clay tile or non-metal roofs ideal; alternatively pre-coated Zn-Al, or paint with low-zinc paint)
Bare Zn-Al roofs	Moderate in this catchment due to limited roof numbers.	Paint roofs
Vehicle tyres	High city-wide.	Treat runoff from busiest roads, carparks and manoeuvring areas using biofilters, basins & wetlands First flush basins Rain Garden (generic in-ground bio-filter) Cartridge filters (e.g. Stormfilter by Stormwater 360) Filterra (proprietary in-ground bio-filter) Catchpit filter (e.g. Litta Trap) Street sweeping
Industrial discharges (inferred from monitoring)	Medium	Industrial site management plan Monitoring discharges Enforcement
Copper		
Brake pads	High city-wide.	Advocate to NZ Government for legislation change for copper-free brake pads. (Note: copper content of brake pads anticipated to reduce from 2025 following USA legislation.)

Source	Contribution	Possible Mitigation Methods
		Educate local auto industry and residents about the value of low/no copper brake pads, noting some low-Cu pads are currently available in NZ market.
Particulate deposition on roads		Treat runoff from busiest roads, carparks and manoeuvring areas using: Wetlands First flush basins Rain Garden (generic in-ground bio-filter) Cartridge filters (e.g. Stormfilter by Stormwater 360) Filterra (proprietary in-ground bio-filter) Catchpit filter (e.g. Litta Trap) Street sweeping
Roofs, cladding, spouting, downpipes	Low but slowly increasing	Advocate with NZ Government for legislation on copper cladding. Investigate the feasibility of a District Plan rule to discourage the use of copper claddings. Divert first flush to the wastewater network Educate residents Onsite treatment of the copper stormwater runoff (e.g. runoff filters through grass prior to entering SW system, or retrofit planter box to treat runoff) Transparent sealer applied to copper surfaces
Lead		
Paint flakes/chips from old buildings	Unknown but more likely to contaminate soil than water	Site remediation during development
Lead flashings on roofing	Low	Education
Building material in older homes (pipes, roofing)	Low. As homes are renovated, demolished and maintained the quantity of lead is reducing.	Wait for lead to be superseded
Pathogens/ bacteria		

Source	Contribution	Possible Mitigation Methods
Ducks, geese	Major bacteria source	Reduce waterfowl numbers. Would need to be implemented outside the SMP. CCC not empowered by the consent to control waterfowl
Farm animals' faeces enter waterways	Unknown	Stock exclusion (by fencing waterways and dense planting)
Wastewater overflows	Major	CCC Wastewater team are actively reducing wastewater overflow with controls such as renewals, capacity upgrades, reduction of vented manhole and CSS: 2022 (code of practice) guidelines.
Dog Access	Unknown	Signage and education
Other Organic Material		
Ducks, geese	Major source	Reduce waterfowl numbers. Would need to be implemented outside the SMP. CCC not empowered by the consent to control waterfowl
Leaf Litter and Grass Clipping	Minor	Education
Industrial discharges		
Deliberate spills or poorly controlled sites	Unknown	Regulation, monitoring and enforcement
Polynuclear aromatic hydrocarbons		
(Old) coal tar street surfaces.	Some known streets e.g. Shirley area	Encapsulation (cover with asphalt). Removal.
Combustion	Likely low	Monitor
Nitrate and nitrite		
Probable agricultural sources (via groundwater)	Moderate	Investigate sources Education and enforcement
Garden fertiliser	Believed low	Education
Phosphate		
Industrial sources	Moderate	Enforcement

Source	Contribution	Possible Mitigation Methods
Garden fertiliser	Believed to be a minor source	Education
Leaf Litter and Grass Clipping	Unknown contribution	Education

Table 6: Assessing options as potential Best Practicable Options

Mitigation Option		Contaminants Treated	Assessment as a Best Practicable Option
First flush basins		TSS, Cu, Zn	Combines TSS removal with essential flow detention. Some metals removal. Traditional treatment approach.
First flush basins and wetlands		TSS, Cu, Zn, hydrocarbons	Good removal of TSS, metals and other contaminants. Combines treatment with essential flow detention. Most widely used current method.
Methods above this line more suitable for developments where land is readily available. Methods below this line have smaller footprints and are more suitable for use within redevelopments.			
Rain Garden or biofilter		TSS, Cu, Zn, hydrocarbons	Good TSS and metals removal. Appears to be a more expensive means of removing metals than basin + wetland
Cartridge filters (e.g. Stormfilter by Stormwater 360)		TSS, Cu, Zn, hydrocarbons	Good TSS removal. Appears to be a more expensive means of removing metals than basin + wetland Higher metals removal cost than rain garden
Filterra (proprietary in-ground bio-filter)		TSS, Cu, Zn, hydrocarbons	Good TSS and metals removal. Better suited to new or re-development.
Catchpit filter (e.g. Litta Trap)		TSS, some Cu & Zn, litter, organic material	Good removal of particles larger than 100 µm (sand size). Some particulate metals removal. Better suited to new or re-development
Street sweeping		TSS, particulate Cu & Zn	Good removal of particles larger than 100 µm (sand size). Some metals removal.

Downpipe filters (e.g. Storminator™ by University of Canterbury)		Zn, roof-sourced TSS	Very good zinc removal. Council can require downpipe treatment in some cases.
Roof painting		Zn	Very good barrier to zinc discharge. Council does not have powers to require roof painting.
Low-copper brake pads		Cu	Potentially the most effective and efficient copper mitigation. Government support needed.

10.7 Option Selection

Options potentially available for consideration as water quality mitigation options are listed in Table 5Table 5.

The limited number of new areas (such as Prestons development and land at the west end of Memorial Ave) will be treated through basins and wetlands or infiltration. In addition, the Council has purchased Cranford Basin and acquired the Red Zone where land is set aside to treat some existing residential areas in new facilities. Facilities such as basins and wetlands remove TSS effectively although they remove dissolved metals from roofs and roads less effectively. As TSS and metals are discharged in some measure from every impervious urban surface, basins can be useful controls where they treat extensive areas. Biofilters, as are proposed to treat the Addington, Riccarton and Wainoni area sub-catchments appear from testing to remove a higher proportion of most contaminants.

The Council has considered various levels of mitigation and has prioritised eight treatment facilities in its Draft Long Term Plan. A balance of stormwater treatment and other services is made pursuant to the Council's powers under the Local Government Act to set funding priorities and rates. The Council considers that the funding allocated to stormwater treatment city-wide is what is practicable and as such sets the funding envelope within which the best practicable options for mitigation must be developed.

Some sediments are reduced at source by District Plan rules and best practice controls on subdivision, building sites and road works. Contaminants (including metal contaminants) could in principle be eliminated at source by substitution of non-contaminating materials. This could involve methods in Table 5 such as substitution of building materials, substitution for zinc oxide in tyres, or low-copper brake pads. However, high evidential thresholds must be passed before the Council can deal directly with the effects of building materials. There is no present-day way forward to remove zinc contaminants from vehicle tyres (Ira, ACC, 2021). An apparent trend toward low-copper brake pads may be a best practicable option for copper. The Council's powers to require these forms of mitigation are limited, and new legislation is expected to be needed before the Council can use them. Other contaminants could be reduced at or near source by, for

example, painting or repainting roofs, or treating roof runoff at the downpipe but are subject to similar constraints.

Street sweeping picks up litter, stones and sand but is less effective at removing fine particles that contain the majority of metal contaminants (Depree, 2011). A street sweeping trial has occurred under Condition 7, Schedule 4 c. and when results are available, they may influence future options selection.

Sump inserts (filter bags) are being trialled. Sump inserts are known to effectively trap litter and stones but have variable effectiveness trapping fine contaminants and are unlikely to remove dissolved contaminants.

Some contaminant discharges can be reduced voluntarily through education. An engagement and education programme is under way through the Community Waterways Partnership. Education is expected to have effects in the long term, but to be more effective for some contaminants (e.g. domestic chemicals, dog poo) than for others such as vehicle emissions.

Although mitigation at source should be more effective than treatment of stormwater there are significant barriers to implementing source controls. In the present day the government or local and regional authorities are likely to have to demonstrate that source controls to be effected by land owners are both necessary and the best practicable option. The Council proposes an economic analysis of the costs and benefits of stormwater treatment city-wide to try to answer this question.

More information, such as the long-term costs and benefits of maintaining roof coatings, substituting roof materials or installing stormwater filters, will need to be developed for the economic analysis so that the Council can evaluate, consult on and select best practicable options.

10.8 Changes in Response to Public Submissions

The draft Ōtākaro-Avon SMP was released for public consultation between mid February and mid April 2024. Twenty seven submissions were received. Submissions covered a wide range of issues both from the draft SMP and external to it including contaminants and contaminant sources of concern to submitters, how to mitigate the effects of contaminants, and support for improving the natural environment.

There was good agreement between submissions and various council plans and strategies such as the Integrated Water Strategy and the draft Healthy Water Bodies Plan. There was support for stormwater treatment facilities, development in the Ōtākaro-Avon River Corridor, erosion and sediment control, surveillance of industrial sites and education and engagement. Many of the submissions reflected SMP actions in some way. Many submissions urge that the SMP adopt a wider range of actions.

The SMP will carry out a range of activities listed immediately above but within constraints: the scope of works is constrained by capital works provision in the Long Term Plan, and staff and maintenance resources provided for in the Annual Plan. Constraints do not permit an expansion of the works and activities already proposed, although enhancements to biodiversity, natural areas, rivers and wetlands and mahinga kai will be carried out through other plans such as the

Healthy Water Bodies Plan and Biodiversity Strategy. More education and engagement activities are happening than submitters generally realise.

A number of initiatives proposed by submitters could be desirable. These include:

- additional erosion and sediment control,
- litter trapping at pipe outlets,
- road sweeping and additional treatment of road runoff,
- control of contaminants at source and advocacy by the Council to the government for contaminant control at source,
- attention to microplastics, *E. coli* and nitrates.

These are potential future activities, as discussed in Section 10.7, and could be considered for adoption in future Long Term Plans, informed by cost/benefit analyses.

10.9 Technical Peer Reviews

The SMP was reviewed by technical reviewers under conditions 14 to 18 of the CSNDC. Reviewers appointed had specialist knowledge in ecology, hydraulic modelling and groundwater. Reviewers' comments and the Council's responses are summarised below.

10.9.1 Ecologist's comments

The ecologist felt that the SMP adequately sets out the means to achieve reductions in annual contaminant loads. Clarifications were added where requested. The reviewer requested inclusion of additional material on a range of subjects such as a closer link between state of the environment and mitigation actions, the reason for governance constraints on budgets, more detailed explanation of contaminant reduction targets, and which targets can or cannot be achieved. In general, the Council declined to add information into the SMP because information provided is intentionally chosen to be sufficient without being excessive. In some cases, such as a link between the state of the environment and mitigation options the links are understood qualitatively but are not able to be quantified due to limited scientific information. Governance decisions are made through a process that does not provide explanatory material for inclusion in the SMP. The Council disagreed that contaminant targets do not receive sufficient explanation. The SMP as presented is principally a compliance document for ECan and is comprehensible to ECan staff who are familiar with the consent. It was also understandable to public submitters who did not request additional information.

10.9.2 Hydraulic modeller's comments

The hydraulic modeller made a number of comments which were mostly agreed to.

10.9.3 Groundwater specialist's comments

The groundwater reviewer requested provision of additional information in many SMP sections. Where information was incorrect, omitted or pertinent it was added. The reviewer requested detailed material about the state of groundwater and the effects of a range of SMP activities on groundwater. CSNDC conditions may suggest to the reviewer that one of the purposes of the SMP is general groundwater protection. However the council believes it is required to mitigate the effects of its stormwater discharges on receiving waters (condition 6), be they surface water or

groundwater. Groundwater protection is seen to be a role of Environment Canterbury. In this catchment the council proposes to discharge all network stormwater to surface water. As no discharge into the ground is proposed the consideration of effects on groundwater has not been included in the SMP.

10.10 Contaminant Mitigation Targets

The SMP proposes that TSS and dissolved copper and zinc will be targeted through treatment facilities as a best practicable option. Other contaminants will be addressed as in section 12: Objectives.

Contaminant load reduction targets were developed from the contaminant load model as required by Condition 6a. The target is based on results from the contaminant load model in Appendix D. These annual contaminant load reductions targets for the Ōtākaro-Avon (below) will contribute, with similar targets in the Ōpāwaho-Heathcote, Huritini-Halswell and Pūharakekenui-Styx SMPs to meeting the city-wide standards for contaminant load reduction as listed in Table 2, Condition 19 of the CSNDC.

Contaminant load reduction targets by proposed facilities in the Addington, Riccarton, Cranford, Avondale and Knights sub catchments for the 10 year term of the SMP term are:

TSS	11.2%
Zinc	9.3%
Copper	10.6%

The targets are a percentage annual contaminant load reduction from the annual contaminant loads in the consent year 2018.

10.11 Other Contaminants

Contaminants not required to be addressed by consent conditions are sometimes detected. These include:

- *E. coli*: implies a risk of other pathogens harmful to humans. (There are no pathogen targets in the consent. Pathogen controls are likely to be considered in the Surface Water Improvement Plan).
- Polycyclic aromatic hydrocarbons (PAHs): no consent targets. Do not exceed LWRP Table S5B guidelines.
- Nitrate and nitrite: no direct consent targets. Non-stormwater sources.
- Phosphorus: no direct consent target. Believed to be predominantly animal sources in this catchment.
- Ammonia: no consent target. Does not exceed LWRP Table S5B guidelines.

E. coli can exceed guidelines but is considered to have a non-urban source. Nutrients do not have a mitigation strategy because they are considered to have a rural source.

11 Mitigation Plan

11.1 New Development

Growth in this catchment is expected to be mostly infill housing. New housing has new factory-painted roofs that are less contaminating than older residential or bare steel commercial/industrial roofs. Increased traffic volumes are likely to increase road contaminant loadings somewhat. However, stormwater volume increases could be of greater concern than increased contaminant loads. Contaminants, particularly sediments, generated by development will be controlled by:

- actions and requirements of this SMP.
- rules in the district plan,
- the Stormwater Bylaw 2021,
- the Erosion and Sediment Control Toolbox for Canterbury

To comply with section 8.7.4.3.c in the Christchurch District Plan, stormwater from newly developed large sites (> 1,500 sq.m. area) must be treated and detained so that peak flow discharges do not exceed pre-development.

Stormwater should be discharged into the ground by infiltration where practicable, after suitable treatment. This reduces the load on the stormwater network and contributes to maintaining groundwater levels and baseflows in waterways. Infiltration into the ground should be most practicable west of the university and in New Brighton but can be achieved in other places. A map titled *City Stormwater Disposal Options* (TRIM 09/465669 and available on request) gives guidance on disposal options for various parts of the city.

11.2 Mitigating individual site stormwater

Individual developments are required to treat stormwater to mitigate any change in quantity or quality arising from the development. The minimum standard for stormwater treatment is in Table 7 which is an update of the Onsite Stormwater Mitigation Guide (CCC, 2021). The guide includes information about on-site storage and treatment for small to medium sites.

Infiltration of stormwater into the ground is encouraged where ground permeability permits.

Roof stormwater from residential sites may be infiltrated into the ground via (fast flow) soakage chambers if all roofs are painted or non-steel. Refer to WWDG Figure 6-6.

Stormwater from residential sites may be infiltrated into the ground via

a. specially designed infiltration swales or basins with at least a 300 mm deep vegetated soil infiltration layer. Refer to WWDG Figure 6-12.

b. approved filtration devices.

Stormwater to be infiltrated into the ground from industrial sites must be consented by Canterbury Regional Council.

Table 7: Minimum Requirements for New Development Sites.

Source of Stormwater Discharge(s)	Total area of disturbance does not exceed 1,000m²	Total area of disturbance equals or is greater than 1,000 m²
From/during land disturbance activities	An approved Erosion and Sediment Control Plan is required	An approved Erosion and Sediment Control Plan is required
From new / re-development **residential** roof and hardstand areas	No discharge onto or into land where the slope exceeds 5 degrees. Sumps collecting runoff from new hardstand areas shall be fitted with submerged or trapped outlets wherever practicable. Sites increasing impervious by 150m² or more to a total coverage in excess of 70% are required to mitigate water quantity effects according to the Christchurch City Council On-site Mitigation Guide (5 m³ rain tank installed). An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required for sites in the flat (2). On-site rainwater storage is required for new and redevelopment sites on the hills.	No discharge onto or into land where the 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 (1). Sites increasing impervious by 150m2 or more to a total coverage in excess of 70% are required to mitigate water quantity effects according to the Christchurch City Council On-site Mitigation Guide (5 m³ rain tank installed). An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required for sites in the flat (2). On-site rainwater 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 the 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	No discharge onto or into land where the 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 (3) galvanised roofs or guttering/spouting and high-use sites

Source of Stormwater Discharge(s)	Total area of disturbance does not exceed 1,000m²	Total area of disturbance equals or is greater than 1,000 m²
	Sites increasing impervious by 150m² or more to a total coverage in excess of 70% are required to mitigate water quantity effects according to the Christchurch City Council On-site Mitigation Guide. An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required (4) Site management and spill procedures required for sites that engage in hazardous activities (5)	Sites increasing impervious by 150m² or more to a total coverage in excess of 70% are required to mitigate water quantity effects according to the Christchurch City Council On-site Mitigation Guide. An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required (4) Site management and spill procedures required for sites that engage in hazardous activities (5)
Any land use with Canterbury Land and Water Regional Plan Schedule 3 activities.	An application for approval under the Stormwater and Land Drainage Bylaw 2022 must be made to authorise connection and discharge into the Council network.	An application for approval under the Stormwater and Land Drainage Bylaw 2022 must be made to authorise connection and discharge into the Council network.

Explanatory notes:

1. *The first flush is the first 25 mm of runoff.*
2. *The Council has discretion to waive the requirement for first-flush treatment of hardstand areas on large residential sites with a low impervious percentage where the amount of pollution-generating hardstand being added is considered to have less than minor effect.*
3. *"Uncoated" means without a painted or enamelled coating. Council has discretion to waive the requirement for first flush treatment of hardstand areas on large residential sites where the amount and type of pollution-generating hardstand being added is considered to have a less than minor effect.*
4. *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 Council considers an increase (including cumulative increases) has a more than minor effect, on-site 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.*
5. *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.*

11.3 Operational controls on stormwater and sediment

The management of sites which may experience erosion and/or discharge sediment during development works is controlled by conditions of either resource consents or building consents, as applicable, for earthworks and building. The Stormwater and Land Drainage Bylaw 2022 specifies some standards for activities not controlled by consents.

Standards for sediment discharges are set by the Sediment Discharge Management Plan 2021 (SDMP). The sediment discharge management process should work as follows:

1. Allowable TSS (total suspended solids) concentration trigger levels for discharges to the stormwater network are set by the SDMP.
2. An erosion and sediment control plan (ESCP) is prepared by a 'suitably qualified and experienced professional' as determined by a site risk assessment
3. The TSS concentration trigger levels for the site are included in authorisations or conditions where possible.
4. The ESC measures are implemented on site and monitored.

11.4 Industries and High-Risk Site Discharges

The Council will manage industrial sites through its Stormwater and Land Drainage Bylaw 2022. The bylaw requires industrial contaminants to be controlled to meet best practice. The Christchurch City Council's expectation is that stormwater entering its network is managed according to best practice, especially where the discharge occurs directly into a waterway. On-site pre-treatment may be required unless contaminant levels are less than LWRP Schedule 5 standards.

Where industrial site occupiers do not meet the required standards for discharge into the network, the site will be removed from the CSNDC and will require a separate resource consent from ECan for its discharge. A condition is included in the CSNDC for this process and all industrial sites excluded from the resource consent will be listed on Schedule 1 attached to the consent.

In managing high-risk sites the Council will:

8. Audit at least 15 high-risk sites per year;
9. Inform audited industries of the results of audits and work closely with these industries to achieve outcomes in line with the Stormwater Bylaw;
10. Communicate with industries about stormwater discharge standards and the means of meeting these standards.

Change will be sought through a combination of education and enforcement.

11. Education will be carried out through an industry liaison group.
12. Enforcement will happen as pollution prevention officers identify and visit high-risk industrial sites and work with industries to improve site management.

Contamination risks are limited to a degree by acceptance of trade wastes into the wastewater system. This is authorised through Trade Waste Consents and the monitoring of consents permits a degree of oversight and site control.

Future needs include:

13. More interaction with industries by the Council; communication, awareness and education
14. Improved knowledge of the environmental effects of compounds discharged by industrial sites
15. Ongoing site checks until the Council is confident that all risky sites are controlled adequately
16. Upgrades on non-compliant sites

11.5 New Treatment Facilities

The catchment is mostly developed with most future development expected to be infill. Some greenfield development is continuing in Prestons area, and small industrial zones near the airport are developing or yet to develop. Stormwater from new developments will be treated, and stormwater from new development to the west of the city is expected to be discharged into the ground after treatment.

Eight major treatment facilities are proposed to treat stormwater from present-day sub-catchments of:

17. Addington Brook - treated via a biological filter located to the west of Deans Avenue.
18. Riccarton Stream - is proposed to be treated through a biological filter within Hagley Park, subject to obtaining the relevant consent(s)
19. Upper Dudley Creek + Middle Dudley Creek + Cranford - treated in the greater Cranford Basin in basins west and east of Cranford Street.
20. Loop and PS 220 (previously called Avondale) - treated in a basin and wetland
21. Avon River Corridor East (previously called Knights) will be treated in 3 facilities - Knights Basin, Wainoni Biofilter and Waitaki Street basin and wetland.

Stormwater from other new developments will be treated within those developments.

12 Treatment Facilities

12.1 New Facilities Sizing and Land Contamination

Where possible new facilities will treat the runoff from a first flush of 25 mm rainfall. Proposed council facilities are listed in Table 8 with recommended basin sizing based on the intended contributing area.

The Council's preferred means of stormwater discharge is by infiltration into the ground after a high standard of treatment that will protect groundwater quality and values. This will contribute to maintaining spring flows and baseflows. Some private facilities in the west of the catchment may be infiltration facilities, however new Council facilities are expected to be detention basins discharging to surface water. Ground conditions in the east of the catchment where facilities are planned to be located do not permit disposal by infiltration.

Some facilities will be built on land that has been filled and is or may be contaminated. Condition 7, Schedule 2(f) requires a description and justification for separation distances between proposed storm-water facilities and contaminated sites. Contaminated sites are identified as sites appearing in the Environment Canterbury Listed Land Use Register. A schedule of basins, sites and known land contamination is in Table 14, Appendix H.

It should be noted that there is limited flexibility in where basins and wetlands can be sited. For functional reasons a basin is normally located at or near the low point of the contributing sub-catchment. Land must be available for acquisition. Known or suspected contaminated sites are avoided if practicable. However, appropriate levels of site testing are undertaken during planning and design of all basins. Site investigations will be undertaken, and contaminated soils will be dealt with according to the National Environment Standard for assessing and managing contaminants in soil to protect human health, and National Environment Protection Council Guidelines 2013.

Specific consideration should be given to design requirements of such facilities to ensure that the risk of bird strike is minimized (see section 12.2 below)

Table 8: Recommended sizing of proposed treatment facilities

Sub-catchment	Contributing area	Land Use	Runoff Rate coeff. (1)	Runoff rate from 5 mm/hr rainfall (mm/hr)	Indicative flow rate for biofilter treatment	References / comments
Riccarton	265 Ha	Res Subn 75 ha	0.38	1.9	1.66 m^3/s	biofilter
		Res Subn Dens Trans 112 ha	0.47	2.4		
		Res Med Dens 30 ha	0.56	2.8		
		Commercial 30ha	0.73	3.7		
		Park 18 Ha	0	0		
Addington	140 Ha	Res Med Dens 18 ha	0.56	2.8	1.24 m^3/s	biofilter
		Commercial 108 ha	0.73	3.7		
		Park 14 ha	0	0		
Wainoni	119.7 Ha	Res Sub 110.4 Ha Park 9.3 Ha	0.38 0	1.9	0.58 m^3/s	biofilter
Dudley Ck Above Diversion	265 Ha	Res Subn 180.3ha Res Med Dens 41.0 ha Commercial 10.9 ha Park 32.8 ha	0.6 0.67 0.95 0	35,900 m^3	West of Cranford Street 30-50,000 m^3	

Cranford	234 Ha	Res Subn 46.0 ha Res Med Dens 72.0 ha Commercial 10.0 ha Basin 83.0 ha	0.53 0.67 0.95 0	21,300 m^3	Within Cranford Basin Active Management area 35-45,000 m^3	Additional flood storage up to 150,000 m^3 in Cranford basin Active Management area.
Middle Dudley Ck west of Philpotts Road	110 Ha	Res Subn 108.7 ha Industrial 1.3 Ha	0.53 0.95	16,600 m^3		
Avondale	84.8 Ha	Res Subn 51.2 Ha Park 33.6 Ha	0.53 0	6,780 m^3	~6-7,000 m^3 as space is available	
Knights	25.8 Ha	Res Subn 10 Ha Park 21.7 Ha	0.53 0	1,330 m^3	~1,800 m^3	
Waitaki	42.4 Ha	Res Subn 34.4 Ha Park 2 Ha	0.53 0	4,785 m^3	4,880 m^3	

Notes:

(1) Runoff volume coefficient from WWDG Table 6-10

(2) Wetlands may be flooded up to an additional depth of 500 mm in events exceeding 10 year ARI. Over-flooding increases effective detention storage without significant compromise to wetland treatment effectiveness.

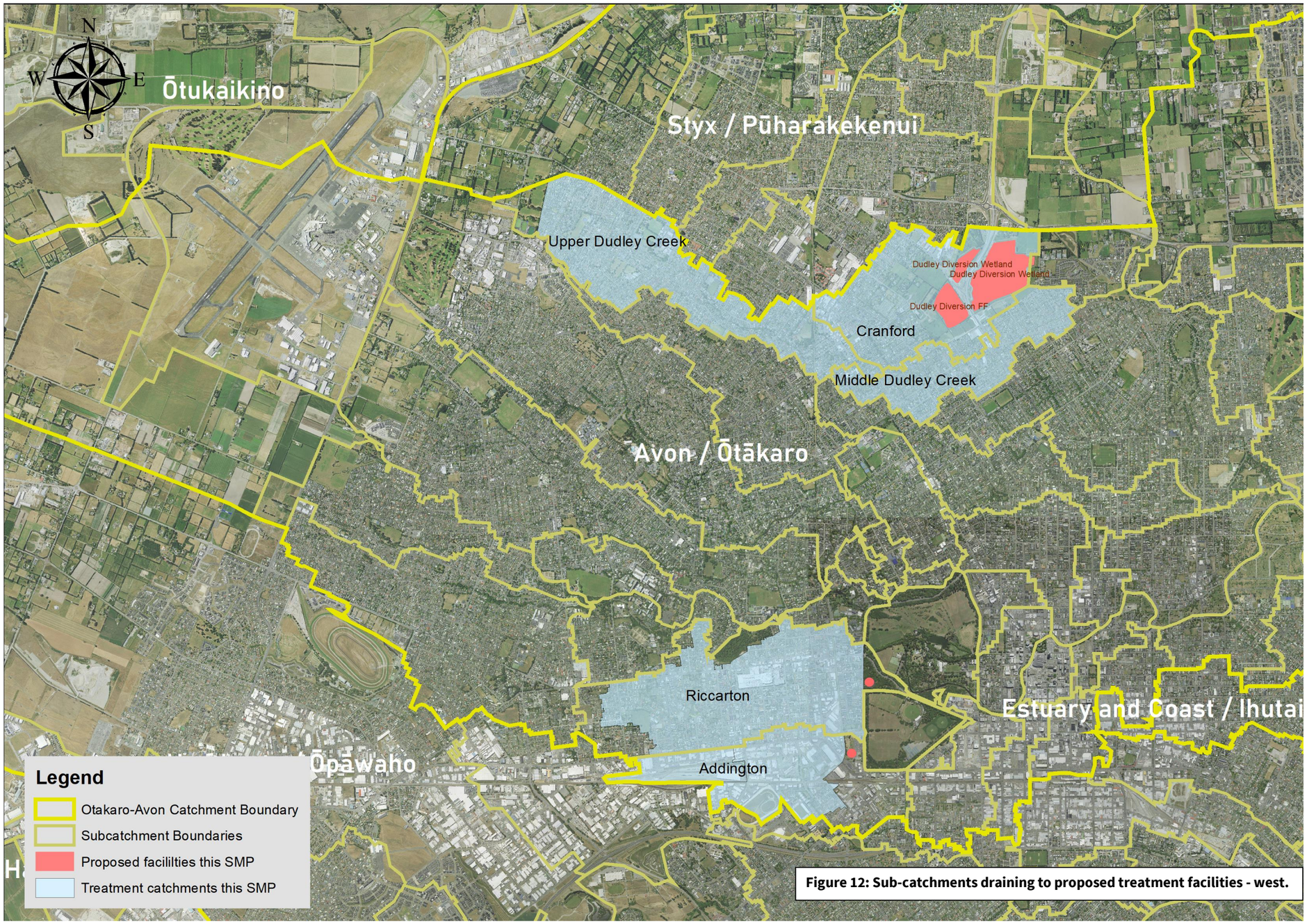


Figure 12: Sub-catchments draining to proposed treatment facilities - west.

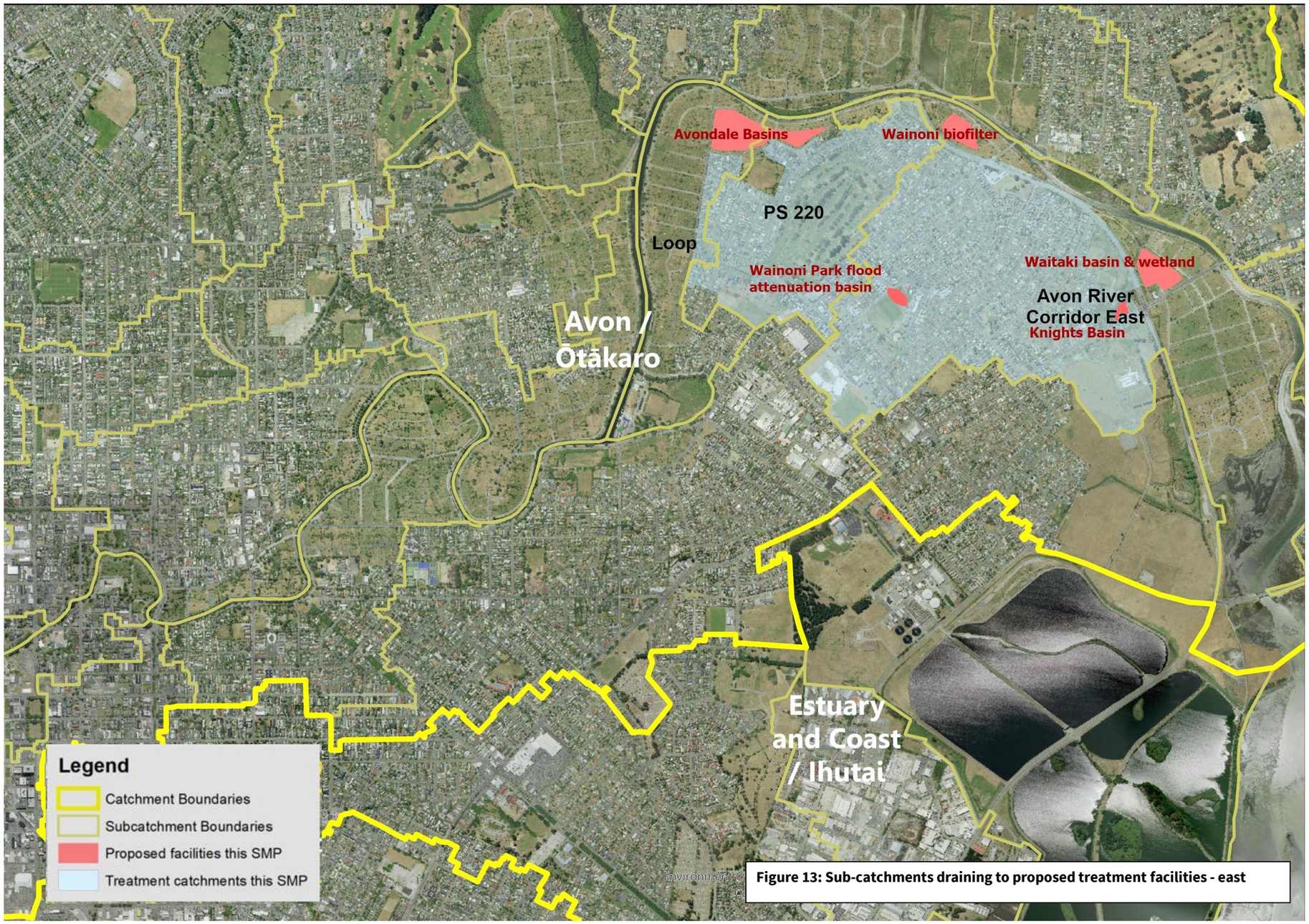


Figure 13: Sub-catchments draining to proposed treatment facilities - east

12.2 Designing basins to minimise bird-strike on aircraft

Christchurch District Plan Policy 6.7.2.1.2 – *Avoidance or mitigation of navigational or operational impediments* – is a policy to avoid or mitigate the potential effects of activities that could interfere with the safe navigation and control of aircraft, including activities that could interfere with visibility or increase the possibility of bird-strike. Plan provisions include:

1. 5 Natural Hazards - for activities and earthworks in the Waimakariri Flood Management Area (5.4.3.3 RD3, matter k.);

2. 8 Subdivision - general matters of control in relation to new ponding areas (8.7.4.3(f)) and Policy 8.2.3.4(b., vi.) Stormwater Disposal;

3. 8 Subdivision - Development Requirements for stormwater for South Masham and Yaldhurst ODP areas (Appendices 8.10.5.D(5)(b) and 8.10.28.D(a)(5)(d));

4. 11 Utilities - matters of discretion for new ponding areas (11.10.6(j))

New stormwater facilities within the Christchurch International Airport Bird Strike Management Area, a defined zone extending 3 km from airport runway thresholds (mapped in District Plan Appendix 6.11.7.5) must meet activity standards in section 6.7.4.3 of the Christchurch District Plan.

Assessments should consider actual or potential effects relating to bird strike where relevant to an application, regardless of whether the proposal is located within the Bird Strike Management Area (6.7.3(c.)). Depending on the facts of the particular application:

1. Strategic objective 3.3.12 Infrastructure, policy 6.7.2.1.2 Avoidance or mitigation of navigational or operational impediments, and policy 8.2.3.4 Stormwater disposal, are relevant to activities that have the potential to increase the risk of bird strike whether they are within or outside of the Christchurch International Airport Bird Strike Management Area;

2. Chapters 5, 6, 8, 11, 13 & 17 contain matters of assessment or control to manage bird strike risk for particular activities; Bird strike risk may be a relevant consideration when the Council considers a discretionary or non-complying activity.

Basin planners and designers are also required to consider the potential for new water bodies within 13 kilometres of airport runway thresholds to increase the risk of bird strike. New water bodies can provide habitat that will attract waterfowl and high-risk species and bring their flight lines into intersection with aircraft flight lines. The risk potential should be quantified and, where required, managed in a manner indicated via a Bird Strike Risk Assessment carried out by a person with suitable ornithological training. Guidance material is contained as Appendix H. Persons developing stormwater facilities within 13 km of airport runway thresholds (identified in Figure 14) should consult with CIAL.

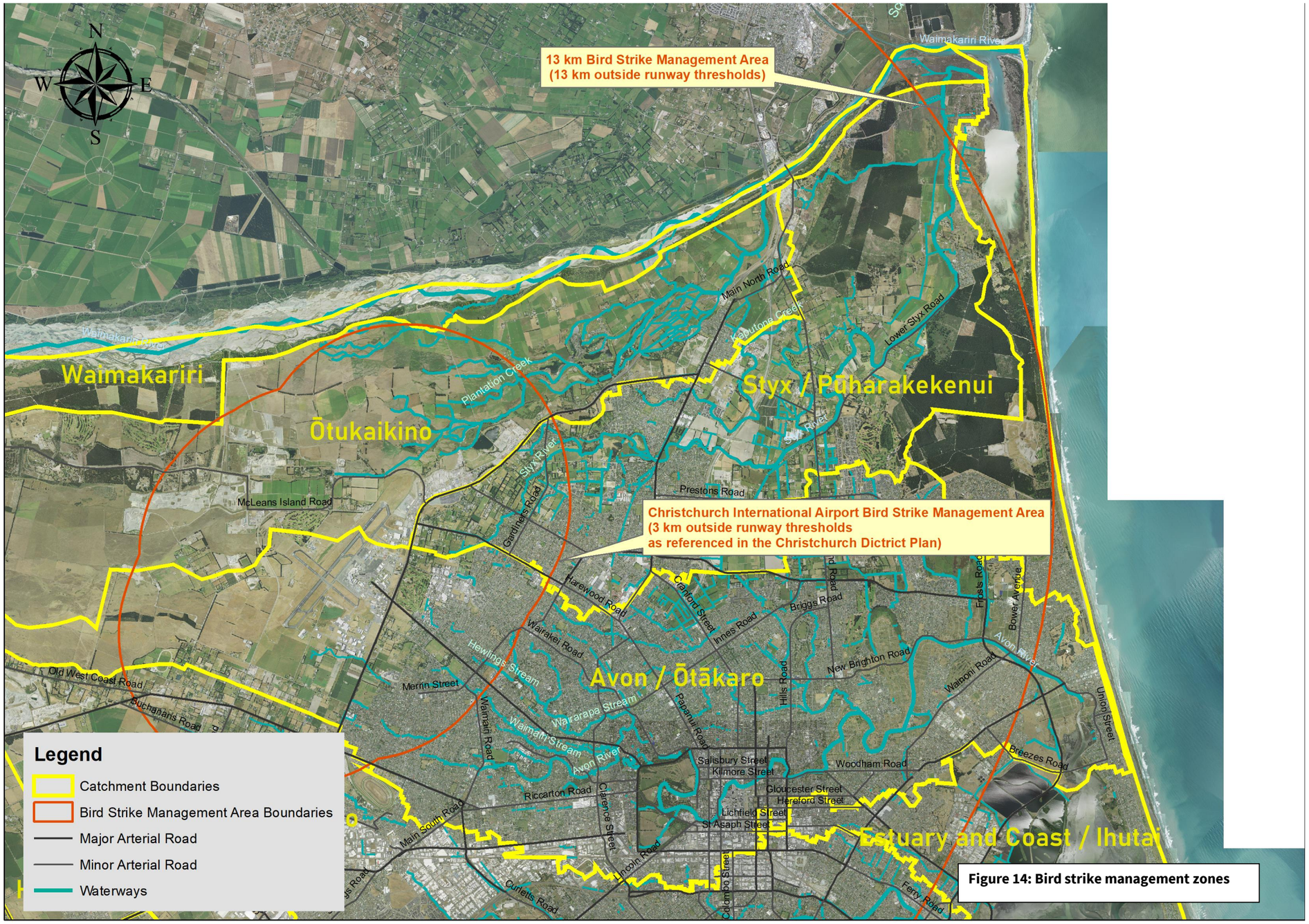


Figure 14: Bird strike management zones

12.3 Avoiding groundwater mounding beneath infiltration basins

The Council does not expect to install infiltration basins of significant size in this catchment. Groundwater mounding is not considered to be relevant to this SMP.

12.4 Effects of stormwater on groundwater

A variety of stormwater management systems is possible depending on ground conditions and the availability of land. The Council promotes the use of infiltration basins city-wide where practicable but its proposed treatment facilities in this catchment will be in areas of poor permeability and high groundwater and will discharge to surface water. Current and future private stormwater treatment facilities in the west of the catchment should discharge into the ground. These infiltration systems are expected to be relatively small. Provided they are appropriately constructed and located away from community drinking water supply protection zones (as per CSNDC Condition 32) and landfills the effects on groundwater are expected to be very limited.

12.5 Changes to springs and baseflow

Anticipated urban growth in this catchment is mostly from intensification/infill, which typically increases the amount of impervious coverage. The consent requires that effects on springs and baseflow be considered.

The major source of groundwater recharge into the catchment is from seepage losses out of the Waimakariri River between Halkett and Harewood Crossbank. Rainfall infiltration on the free-draining gravels to the west of the city provides some recharge, as does rainfall within the catchment boundary. The major loss of groundwater within the catchment occurs through springs feeding the headwaters of streams.

Pattle Delamore Partners (PDP) was asked to estimate the effects of development, both new and infill, on groundwater quantity (PDP, 2024). Two specified scenarios were considered. Both scenarios are intended to be indicative of foreseeable trends.

1. All residential areas are infilled from a presumed 50% impervious to a higher level of imperviousness.
2. The Council proactively introduces stormwater treatment facilities that discharge into the ground in permeable areas (typically west of the university).

[Note: At the time of writing an urban growth model for the city is under way but not completed and PDP could not be supplied with time-related infill development projections.]

Because the amount of expansion development is small and is expected to occur on both permeable land (in the west near the airport) and impermeable land (in the east) there is expected to be only a very small decrease in recharge after expansion development. It appears that the Council could offset the decrease by recharging stormwater into the ground from a catchment of less than 20 Ha. This option is a possible future mitigation scenario.

Infill development, which is provided for in the District Plan, will also increase the amount of stormwater runoff and reduce groundwater recharge.

Within the (10 year) term of the SMP a relatively small amount of infill is expected. PDP's analysis indicates that rainfall recharge could be reduced by less than 1% within the term. As a proportion of total recharge, including inflows from the Waimakariri River the reduction could be of the order of 0.1%. Into the future, beyond the term of this SMP, the reduction in rainfall recharge could ultimately approach 10% and the reduction as a proportion of total recharge (including Waimakariri River inflows) could be 0.4%.

Considerable infill is likely to occur within a few kilometres of the city centre. In this vicinity groundwater is generally shallow and groundwater recharge can have negative effects such as waterlogging. In the central and eastern parts of the catchment reduced infiltration may be beneficial. Less infill will occur to the north-west of Riccarton where groundwater recharge occurs more readily due to permeable ground. In this area it may be of more significance that groundwater recharge sustains baseflows.

The predicted changes are small, but not insignificant, as they represent trends. Over time the Council should mitigate the potential for reduced groundwater recharge by facilitating infiltration into the ground through its Ōtautahi Christchurch Development Plan, by incorporating infiltration into Area Plans where ground conditions are suitable.

12.6 Monitoring Baseflows

Although only a minor decrease in baseflow is thought to be likely the council will monitor baseflows at the Gloucester Street recorder site.

12.7 Emerging Contaminants

Potential contaminants known as emerging contaminants are becoming of interest, and they are sometimes sampled for. Emerging contaminants include microplastics, hormones, herbicides, cleaning products, and 6PPD-quinone (an antioxidant in tyres). Effects of these chemicals have been detected in waterways overseas and limited sampling has occurred in Christchurch. It would be desirable if emerging contaminants could be included in monitoring programmes.

13 Plan Objectives

These objectives address the issues arising from Sections 3 and 5 through 11.

13.1 Objective 1. Control Sediment Discharges

Our goals are:

1.1 Ensure the quality of stormwater from all new development sites or re-development sites is treated to best practice (with Table 7, section 11.2, being the minimum standard)

1.2 All stormwater treatment facilities contributing to contaminant load mitigation targets in Section 10.10 (consent condition 6b) are constructed and conform to WWDG standards.

1.3 Sediment from 95% of consented construction activities on the flat is treated to best practice by 2025

1.4 Analyse options for carrying out street sweeping, sump cleaning, and diversion to wastewater trials from 2021-25 (Schedule 4b & d)

Action Plan for Urban Sediment				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
Sediment (urban)				
1.1 New developments	Plan and oversee installation of detention basins, wetlands & swales	District Plan (Development contributions) and Long Term Plan	Normal planning processes.	Ongoing
1.2 New treatment facilities	Ensure new facilities are built to best practice	Designs should conform to the Infrastructure Design Standard	Normal Council planning, design and procurement process.	Ongoing
1.3 Construction & excavation sites	On-site sediment and erosion control effected through Erosion and Sediment Control Plans	Council enforcement powers under the Building Act 2004.	Train Building Inspectors. Implement an enforcement process. Contractor(s) on standby for clean-up when breaches occur.	ESC now part of resource consents for earthworks and building

Action Plan for Urban Sediment				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
1.4 Road runoff contains sediment	Investigate & develop methods to treat runoff from arterial roads,	Increase frequency of street sweeping, rain gardens	Street sweeping trials. Construct rain gardens where feasible.	Commenced 2021

Recommended for consideration through the Surface Water Implementation Plan

1.5 Road sediment is reduced by a best practicable option determined by the results of street sweeping, sump cleaning and alternative treatment trials (Schedule 4c, f, g & h.)

13.2 Objective 2. Control Zinc Contaminants

Our goals are:

2.1 [repeats Goal 1.1 & 1.2] All the facilities required to meet the Section 10.10 targets are constructed and conform to WWDG standards.

2.2 The Council continues to investigate zinc mitigation measures and works toward carrying out cost/benefit analyses toward identifying their effectiveness as best practicable options.

2.3 By 2028 the Council has consulted with key stakeholders toward identifying a long-term zinc strategy consistent with current technologies.

2.4 The CCC collaborates with local and regional government in a joint submission to central government seeking national measures and industry standards to reduce the discharge of building and vehicle contaminants.

Action Plan for Zinc				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
Zinc				
2.1 Same as 1.1 & 1.2				
2.2 & 2.3 Bare steel roofs emit zinc	Investigate/consult acceptable material for new roofs. (Choices non-metallic or pre-painted zinc/aluminium.)	District Plan rule (if possible) otherwise investigate Regional Rule or legislation	Investigate environmental harm and costs/benefits of alternative materials. Consult widely.	Under way
2.3 Ageing Colorsteel® likely to emit zinc	Research zinc emissions from ageing Colorsteel®	Sampling roof runoff	Sample runoff from ageing roofs, monitor trends, liaise with industry.	
2.4 Vehicle (tyre) zinc	Research and implement best practicable means of zinc removal from busy roads	Catchment scale filtration systems. Wetlands & rain	Research and trials	Under way 2022

Action Plan for Zinc				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
		gardens if space is available		
2.4 National measures and industry standards	National measures and industry standards to reduce the discharge of building and vehicle contaminants.	Represent Council position to Ministry for the Environment	Regular meetings with MfE staff	ongoing

Recommended for consideration through the Surface Water Implementation Plan

2.5 The Council engages in research and trials into means of trapping roof-sourced zinc on site.

2.6 The Council adopts a zinc limitation strategy based on identified best practicable options.

13.3 Objective 3. Control Copper Contaminants

Our goals are:

3.1 The Council consults with the government, through the Ministry for the Environment, about legislation to limit the copper content in vehicle brake pads.

3.2 The Council does not permit stormwater discharges into the network from unprotected copper cladding, spouting or downpipes.

3.3 The Council will investigate the feasibility of a district plan rule to discourage the use of copper claddings.

Action Plan for Copper				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
Copper				
3.1 Vehicle brake pads	Request legislation requiring low/no copper in brake pads	Combined regional and local authority approach to government re legislation to apply nation-wide.	Liaison between local and regional councils. Representation to government via NZTA, MfE	Unknown
3.2 & 3.3 Architectural copper (roofs, spouting, downpipes)	Prohibit the use of unprotected architectural copper. Seek to limit or eliminated the use of architectural copper.	District Plan rule; NZ-wide legislation; and possible District Plan rule; other-wise investigate Regional Rule	Liaise with government thru MfE. Investigate and consult.	Unknown

13.4 Objective 4. Control Industrial Site Contaminants

Our goals are:

4.1 A database of industrial sites considered to be medium or high risk is compiled, based on the best available information, by 2025

4.2 High risk industrial sites are audited by the approved procedure under the CSNDC

Action Plan for Industrial Sites				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
4.1 Information about industrial sites.	Continue to improve database of industrial site information.	Desktop analysis, questionnaires, Chamber of Commerce	Desktop analysis, mailouts, questionnaires, industry liaison	ongoing
4.2 Industries unaware of effects of discharges to stormwater	Develop awareness among all industries of the harmful effects of contaminated discharges.	Educate via mail-outs. Educate during site audits.	Inspect sites in risk order. Communicate results and expectations	ongoing
4.3 Some industries failing to control harmful substances	Ensure that harmful substances are contained, tracked, and disposed of safely	Audit sites and follow up with education and enforcement.	Protocols for site controls developed jointly by CCC, ECan and industry. Site audits.	ongoing
4.4 Non-compliant discharges	Trace and eliminate discharges	Audit sites and follow up with education and enforcement.	Communicate the issue to industry & visit industries. Generate improvement plans. Engage and obtain compliance.	ongoing

13.5 Objective 5. Engagement and Education

Our goals are:

5.1 By 2024 the Council is working with community groups to engage with the public to educate participants about current stormwater practice and enable the public to take action to stop contaminants at source.

5.2 By 2025 the Council will be engaging regularly with the Ministry for the Environment to collaborate on contaminant reduction initiatives.

Action Plan for Engagement and Education				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
5.1 Valuing Water Resources	Education and engagement to empower community groups Each new generation values waterways	Joint partnership programme to effectively co-ordinate existing education and engagement of community groups	Partner delivery (Council, ECan, Ngāi Tahu, CWMS) with stream care and other community groups	Ongoing
5.1 Communication strategy	Develop a long term communication strategy	Strategy development	Understand community thinking about waterways. Agree message and means of communicating.	Ongoing
5.1 Promote community action	Encourage supportive community groups	Seek to provide more direct support for active groups. Provide information and involve in planning	Assist groups to develop goals and action plans. Share Council planning. Fund and track funding. Monitor results.	Ongoing
5.2 CCC and MfE engaged re heavy metals reduction.	CCC to seek regular contact with relevant MfE planning team(s).	The anticipated mechanism is regulation or national education campaign.	Council to contact MfE, starting at executive level, progessing to staff level contacts	Ongoing

13.6 Objective 6. Manage Flooding

Our goals are:

6.1 The quantity of stormwater from all new development sites or re-development sites will be attenuated to at least the minimum standard of section 11.1 and 11.2.

6.2 Protection for property will continue to be achieved through controls on development and controls on new floor levels.

Action Plan for Flooding				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
6.1 Control extra stormwater from new development	Limit the increase in peak stormwater runoff.	Stormwater from new subdivisions is controlled through full storm detention. Stormwater from larger individual sites attenuated on site. New impervious areas > 150 m2 > 70% impervious captured by rain tanks.	Normal planning processes	Ongoing
6.2 Minimise flooding caused by city growth & change	Monitor changes to impervious areas and stormwater network capacity and compensate if necessary	Regular computer-based flood modelling.	Keep models up-to-date as the city changes. Compare models with flood events. Plan for flood mitigation as necessary.	Ongoing

13.7 Objective 7. Maintain Base Flows

Our goals are

7.1 Stormwater will be infiltrated into the ground where practicable, after treatment, to maintain as much as possible the pre-development water balance.

Note: Infiltration of stormwater into the ground, after acceptable treatment, is the Council's preferred means of stormwater discharge.

Action Plan for Springs and Base Flows				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
7.1 Maintain base flows	Infiltrate stormwater into ground where practicable.	Prioritise detention and infiltration for stormwater networks in new development.	Incorporate into strategic planning processes	Ongoing

14 Conclusion

The purpose of the Comprehensive Stormwater Network Discharge Consent is to plan for actions that will progressively improve the quality and quantity of stormwater discharges.

Actions the Council can take through the SMP must be accompanied by other actions if the Council's Community Outcome (Healthy Environment) and the Mahaanui Iwi Management Plan objectives are to be realised. Potential further actions, by the Council and others, include:

- Raise awareness and educate citizens on how to stop contaminants from entering stormwater at source.
- Eliminate or reduce contaminants at source (e.g. by choosing or specifying non-contaminating building materials).
- Remove contaminants from stormwater before they enter natural water.
- Restore waterway corridors to a natural state.
- Restore and plant riparian margins.
- Improve instream habitat by sediment removal, riparian tree planting (for temperature control, bank stability and shelter).
- Improve biodiversity to improve food sources for instream life.
- Performance monitoring of treatment facilities.

Information used in developing the SMP suggests that controlling contaminants at source is more sensible than removing them from stormwater through treatment systems. However, the control or elimination of contaminants at source will affect our buildings, means of transport, household products and the ways we do things. Source control is a journey we will need to travel together to protect the environment; tangata whenua, community groups, regulators, researchers, and local, regional and central government.

Progressive improvement can occur through further activities in Table 9.

Table 9: Areas for Improvement Outside of the SMP

Activity	Motivation for the Activity
The Council regulating and acting under regulations to stop the discharge of contaminants.	As required by conditions of CRC231955 (CSNDC)
The Council investigating new means of controlling contaminants at source (e.g. by materials substitution or innovative means of treatment).	As required by conditions of CRC231955 (CSNDC)
The Council and others implementing new or improved contaminant mitigation practices.	Through the proposed Surface Water Implementation Plan (in development - referred to in section 2.1)

The Council and others making progressive environmental improvements such as restoring waterways and their corridors to a natural state.	Community Outcome (Healthy Environment)
Citizen-based awareness and advocacy for clean water and improved biodiversity.	Kaitiakatanga
Advocacy by Ngāi Tahu for the mana of water and waterways.	Kaitiakatanga. Kawanatanga. Mahaanui Iwi Management Plan

15 References

ANZECC & ARMCANZ (2020). 'Australian and New Zealand guidelines for fresh and marine water quality,'. (Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand: Canberra.) Available at: https://www.waterquality.gov.au/anz-guidelines

Boffa Miskell (2020). Avon River Precinct aquatic ecology: Six years' post-rehabilitation activities. Report prepared by Boffa Miskell Limited for Christchurch City Council, July 2020.

Boffa Miskell Limited (2014). Ecological Values of the Avon River Catchment: An ecological survey of the Avon SMP catchment. Report prepared by Boffa Miskell Limited for Christchurch City Council, May 2014.

Christchurch City Council (2017). Pūharakekenui / Styx River Catchment Vision and Values. Christchurch: Christchurch City Council. Retrieved from TRIM 17/435575

Christchurch City Council (2021). OnsiteStormwater Mitigation Guide June 2021.

Dunn, N. R., Allibone, R. M., Closs, G. P., Crow, S. K., David, B. O., Goodman, J. M., Griffiths, M., Jack, D. C., Ling, N., Waters, J. M., and Rolfe, J. R. (2018). Conservation status of New Zealand freshwater fishes, 2017. New Zealand Threat Classification Series 24.

ECan (2015). Christchurch Groundwater Quality Monitoring 2015. Environment Canterbury.

Grainger, N., Harding, J., Drinnan, T., Collier, K., Smith, B., Death, R., Makan, T., and Rolfe, J. (2018). Conservation status of New Zealand freshwater invertebrates, 2018. Department of Conservation New Zealand Threat Classification Series 28.

GHD (2016) Knights Drain Stormwater Management Preliminary Site Investigation and Groundwater Analysis.

GHD (2017). Knights Drain Treatment Facility Issues and Options Report

Instream Consulting (2019). Avon River catchment aquatic ecology 2019. Report prepared for Christchurch City Council, August 2019.

Instream Consulting (2022). Christchurch fish barriers update. Draft report prepared for Christchurch City Council, June 2023.

Instream Consulting (2020a). Fish passage barriers in Christchurch city waterways. Report prepared for Christchurch City Council, April 2020.

Instream Consulting (2021). Kākahi (freshwater mussel) monitoring in Christchurch City. Report prepared for Christchurch City Council, December 2021.

Instream Consulting (2020b). Kākahi (freshwater mussels) in Christchurch Waterways. Report prepared for Christchurch City Council, September 2020.

Instream Consulting (2023). No . 1 Drain restoration ecological monitoring 2023. Draft report prepared for Christchurch City Council, August 2023.

Ira, S., Auckland Council (2021) Freshwater Management Tool: A Total Economic Evaluation Approach to Understanding Costs and Benefits of Intervention scenarios - Part 2 Urban Source Control Costs.

Kennedy, P., Gadd, J., Moncrieff, I. (2002). Emission Factors for Contaminants Released by Motor Vehicles in New Zealand.

Manaaki Whenua / Landcare Research. (2023, January 19). S-Maps Online. Online Map. Christchurch, Canterbury, New Zealand: Manaaki Whenua / Landcare Research. Retrieved from https://smap.landcareresearch.co.nz/maps-and-tools/app/

Margetts, B., and Poudyal, S. (2023). Christchurch City surface water quality annual report 2022. Prepared to meet the requirements of CRC231955. Christchurch City Council Report, July 2023.

McMurtrie, S. (2009). Long-term monitoring of aquatic invertebrates in Christchurch's waterways: Avon River catchment 2009. EOS Ecology Report No. 06064-CCC02-02, prepared for Christchurch City Council, October 2009.

Ministry for the Environment (2020). National Policy Statement for Freshwater Management 2020 (NPS-FM).

Monitoring & Research, (2023). Revised Citywide Population & Household Projections for the 2024 Long Term Plan. Monitoring & Research Team, CCC, November 2023.

NIWA (2022). Targeted wet weather monitoring of Curlett and Haytons Streams, 2021

Orchard, S., and Measures, R. (2017). Sea level rise impacts in the Avon Heathcote Estuary Ihutai. Salinity intrusion and inanga spawning scenarios. Report prepared for Christchurch City Council by Waterlink Ltd, November 2017.

School of Surveying, (2023) Christchurch City Ground Height Monitoring. Vertical Land Motion in Eastern Christchurch. School of Surveying, Otago University.

Pattle Delamore Partners Ltd. (2013). Groundwater Quantity Effects for the Avon Catchment. from TRIM 13/1210141

Pattle Delamore Partners Ltd. (2021). Prestons and Knights Stream Stormwater Facility Monitoring 2020-2021 Annual Report. September 2021

Pattle Delamore Partners Ltd. (2024). Prestons and Knights Stream Stormwater Facility Monitoring 2022-2023 Annual Report. February 2024

Pattle Delamore Partners Ltd. (2024). Anticipated Baseflow and water Balance Changes Resulting from thje Stormwater Management Pan for the Ōtākaro/Avon River Catchment, February 2024

Renard, T., Meurk, C., Phillips, C., & Barrabe, A. (2004). Land Cover and Land Use Mapping of the Styx River Catchment. Lincoln: Manaaki Whenua / Landcare Research.

Robb, J. A. (1992). A biological re-evaluation of the Avon River catchment 1989-90. Report prepared by the Christchurch Drainage Laboratory for the Christchurch City Council, May 1992.

Robertshaw, T.J., Mercer, O.M., (2023) Performance Assessment of Cox's Quaifes Stormwater System. TRIM 24/110471

Silvera, F., (2020, unpublished). Stormwater Monitoring Programme at Wigram Retention Basin – 2nd stage.

Taikoro Nukurangi NIWA. (2021). Interim report: Weed management and flooding in the Pūharakekenui/Styx River. Hamilton: National Institute of Water & Atmospheric Research Ltd.

Taylor, M., Burdon, F., and Blair, W. (2012). An update on trout spawning in the Avon River, and notes on the effects of seismic activity on physical habitat. Environment Canterbury Report U12/3, February 2012.

Tonkin & Taylor (2014) Closed Landfills in Christchurch, Location Map TRIM 14/708417

White, P.A. (2009) Avon River springs catchment, Christchurch City, New Zealand. Aust. J. Earth Sci. Feb. 2009

White, P.A., Goodrich, K., Cave, S., Minni, G. (2007). Waterways, Swamps and Vegetation of Christchurch in 1856 and baseflow discharge in Christchurch City Streams. GNS Science Report 2007/13 May 2007

Appendix A Schedule 2 Responses

Table 10: Schedule 2 matters to be included in SMPs: CRC231955 Condition 7

No.	Matters for inclusion in SMPs	Addressed in which Section of the SMP
a	Specific guidelines for implementation of stormwater management to achieve the purpose of SMPs;	The SMP is the guideline
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;	4.2
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;	10.10
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: Relevant objectives, policies, standards and rules in the Christchurch District Plan; Relevant bylaws; and Relevant strategies, codes, standards and guidelines;	2.3 through 2.11
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: Stormwater mitigation facilities and devices; Erosion and sediment control guidelines;	10.7,10.10, 11, & 12

No.	Matters for inclusion in SMPs	Addressed in which Section of the SMP
	Education and awareness initiatives on source control systems and site management programmes; Support for third party initiatives on source control reduction methods; 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;	11.5, Section 12, Figure 12, Figure 13
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;	11.1
h	Identification of areas subject to known flood hazards;	9.2, Figure 11: Avon flood model, 2020 floodplain, 10 year ARI rainfall
i	A description of how environmental monitoring and assessment of tangata whenua values have been used to develop water quality mitigation methods and practices;	10.5
j	Results from and interpretation of water quantity and quality modelling, including identification of sub-catchments with high levels of contaminants;	10.4 and Appendix D
k	Mapping of existing information from Canterbury Regional Council and the Consent Holder showing locations where discrete spring vents occur;	Figures 3, 4 and 5
l	Consideration of any effects of the diversion and discharge of stormwater on base-flow in waterways and springs and details of monitoring that will be undertaken of any waterways and	12.5

No.	Matters for inclusion in SMPs	Addressed in which Section of the SMP
	springs that could be affected by stormwater management changes anticipated within the life of the SMP;	
m	A cultural impact assessment;	5.3
n	A summary of outcomes resulting from any collaboration with Papatipu Rūnanga on SMP development;	MKT advised that the Position Statement is sufficient.
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;	10.4
p	Assessment and description of any additional or new modelling, monitoring and mitigation methods being implemented by the Consent Holder;	10.2
q	A summary of feedback obtained in accordance with Condition 8 and if / how that feedback has been incorporated into the SMP;	10.8
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 land owner;	Not applicable; no non-Council or non-vested land to be used for stormwater management.
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;	9.6, Table 2
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;	12.2, Appendix H

No.	Matters for inclusion in SMPs	Addressed in which Section of the SMP
u	A description of any relevant options assessments undertaken to identify the drivers behind mitigation measures selected; and	10.7
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.	12.5

Appendix B Sub-catchments Map for the C-CLM

Figure 15: Ōtākaro-Avon sub-catchments in the C-CLM (2018)

Appendix C C-CLM Unit Contaminant Loads

Table 11: Unit Contaminant Loads used in the 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

Appendix D Contaminated Load Model (C-CLM) Results

Table 12: C-CLM Results

		Annual Contaminant Load (ACL)								
		CSNDC Base Case (2018)			**CSNDC 10 year case. ACL After proposed year 1 to 10 facilities built**			**CSNDC 25 year case. ACL After proposed year 11 to 25 facilities built**		
C-CLM Subcatchments	Area	TSS in base case	Zn in base case	Cu in base case	TSS in 10 yr case	Zn in 10 yr case	Cu in 10 yr case	TSS in 25 yr case	Zn in 25 yr case	Cu in 25 yr case
	(Ha)	(t/yr)	(kg/yr)	(kg/yr)	(t/yr)	(kg/yr)	(kg/yr)	(t/yr)	(kg/yr)	(kg/yr)
Addington	289	75	572	94	47	431	54	47	372	54
Airport	518	1	5	2	1	5	2	1	5	2
Antigua	174	43	417	54	31	349	40	30	262	40
Avon A	149	38	197	25	37	179	24	37	154	23
Avon B	537	132	744	112	126	699	108	124	557	108
Avondale	106	28	85	11	28	85	11	19	39	6
Avonside	293	79	418	67	71	385	59	67	311	56
Brittans	345	86	635	82	85	613	81	56	414	57
Burwood	95	23	145	18	23	134	18	23	121	18
Cranford	798	186	894	90	127	739	73	40	339	32
Cross	200	49	284	25	48	261	25	47	206	25
Dallington	235	67	159	21	67	145	21	59	88	15
Diversion	262	68	306	42	36	188	24	36	165	24
Dudley	270	65	459	48	65	447	48	45	341	36
Estuary	318	78	348	66	70	330	63	70	305	62
Frees	277	71	558	77	71	520	77	71	396	76
Hewlings	84	23	96	14	23	94	14	22	65	14
Ilam	310	63	319	35	63	317	35	62	263	35
Knights	183	46	267	43	13	120	17	13	120	17
New Brighton	433	95	671	83	92	640	82	79	544	74
No 2 Drain	267	50	82	17	50	82	17	17	49	7
Park	85	28	20	6	28	20	6	28	20	6
Riccarton	321	76	552	60	34	382	27	33	273	27
Richmond	149	37	264	29	37	232	29	27	96	20
Shirley	181	46	182	22	42	158	21	38	147	21
Snellings	439	68	307	40	66	305	39	65	288	40
St Albans	235	52	500	45	51	470	45	47	371	43
Travis	319	93	231	36	88	228	36	80	190	31
Waimairi A	262	70	350	38	70	324	38	69	243	37
Waimairi B	329	68	160	16	68	157	16	65	121	16
Winchester	88	20	135	17	20	116	17	20	77	16
All Avon	8551	1924	10362	1335	1678	9155	1167	1437	6942	1038

Table 12 is the best available estimate of contaminant loads in the catchment before and after treatment.

The following table is derived from Table 12 and summarises the anticipated annual contaminant load reductions after the construction of treatment facilities proposed in this SMP. Annual contaminant load reduction targets in Section 10.10 are based on Table 13: Estimated annual contaminant load reductions by proposed SMP facilities

Table 13: Estimated annual contaminant load reductions by proposed SMP facilities

		Annual Contaminant Load						Comments
		CSNDC Base Case (2018)			After proposed Ōtākaro-Avon SMP facilities are built			
C-CLM (2018) Sub-catchment	Area	TSS in base case	Zn in base case	Cu in base case	TSS in 10 yr case	Zn in 10 yr case	Cu in 10 yr case	Proposed facilities named below are funded in the 2024-34 Long Term Plan.
	(Ha)	(t/yr)	(kg/yr)	(kg/yr)	(t/yr)	(kg/yr)	(kg/yr)	
Addington	289	75	572	94	47	431	54	Addington biofilter
Avondale	106	28	85	11	19	39	6	Avondale basin
Cranford	798	186	894	90	84	540	53	Cranford basins & wetlands, east and west. This table has assumed a conservative load reduction midway between 10 & 25 year cases. (The 2018 Cranford subcatchment includes present day Upper and Middle Dudley Creek.)
Knights	183	46	267	43	13	120	17	"Knights" subcatchment. To be treated in Knights Pond + Waitaki Basin + Wainoni biofilter
Riccarton	321	76	552	60	33	273	27	Riccarton biolfilter
5 subcatchments totals		411	2370	298	196	1403	157	
Load Reduction after treatment					411-196 = 215	2370-1403 = 967	298-157 = 141	
Avon load totals		1924	10362	1335				Avon load totals for the 2018 Base Case are copied from the table above.
%age reduction					$\frac{215}{1924}$ x100% = 11.2%	$\frac{967}{10362}$ x100% = 9.3%	$\frac{141}{1335}$ x100% = 10.6%	Reduction as a percentage of the Base Case loads.

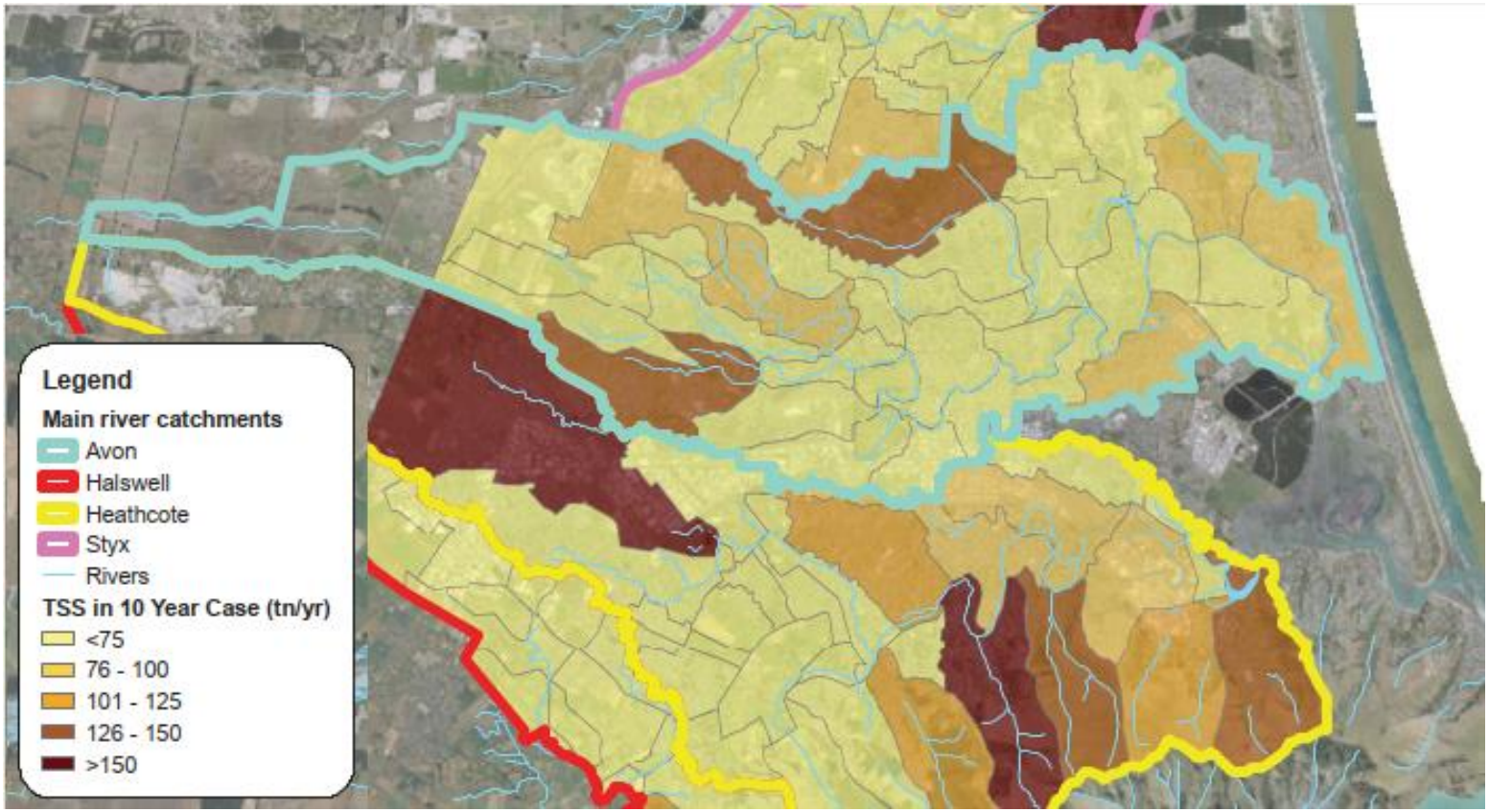


Figure 16: Annual TSS load, tonnes/year, for Ōtākaro-Avon sub-catchments, as estimated by the Christchurch Contaminant Load Model for year 2028, after mitigation with proposed facilities.

(Note that colours represent total annual load not unit load. Some larger sub-catchments are coloured darker for this reason)

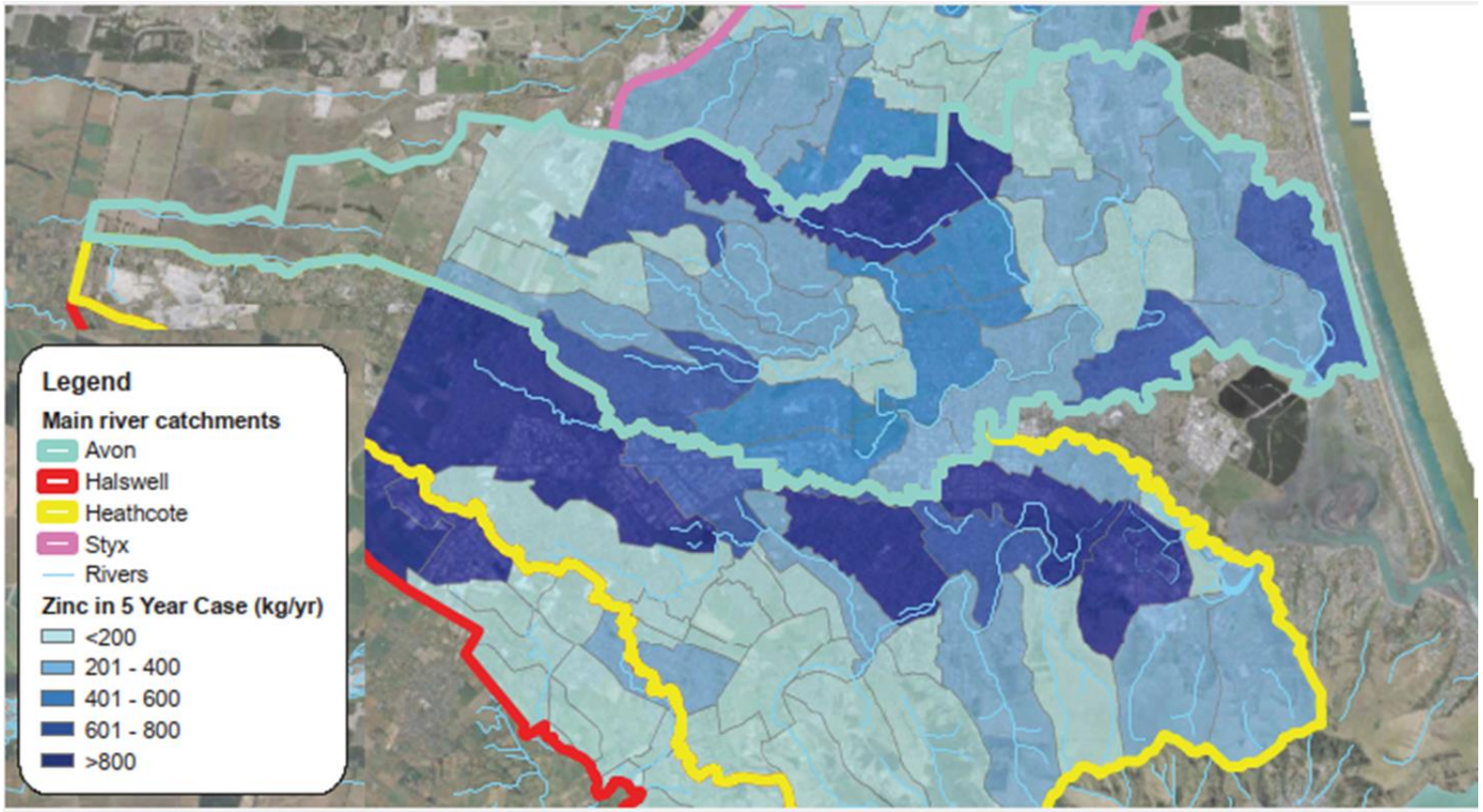


Figure 17: Annual zinc load, kilograms/year, for Ōtākaro-Avon sub-catchments, as estimated by the Christchurch Contaminant Load Model for year 2028, after mitigation with proposed facilities.

(Note that colours represent total annual load not unit load. Some larger sub-catchments are coloured darker for this reason)

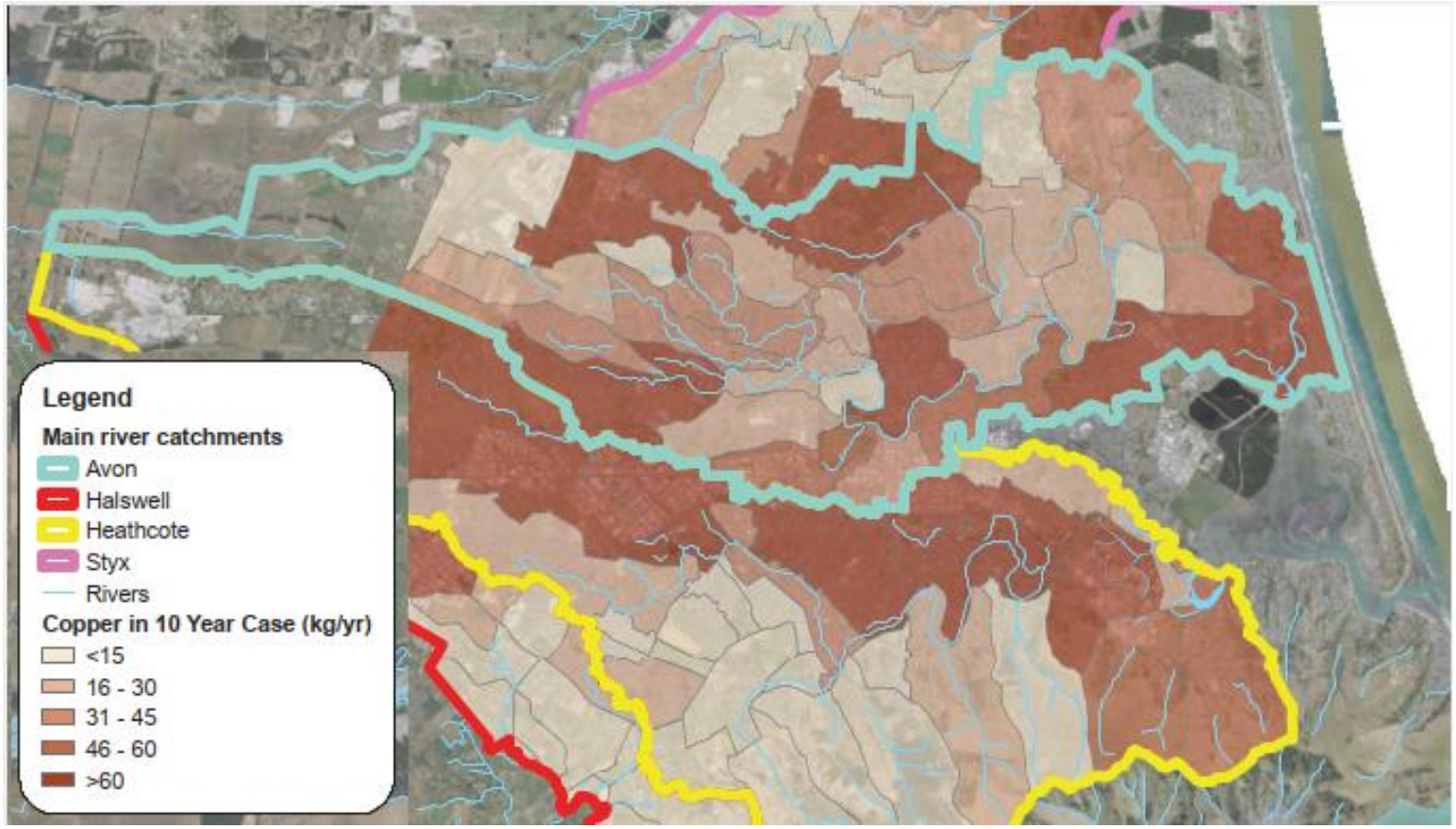


Figure 18: Annual copper load, kilograms/year, for Ōtākaro-Avon sub-catchments, as estimated by the Christchurch Contaminant Load Model for year 2028, after mitigation with proposed facilities.

(Note that colours represent total annual load not unit load. Some larger sub-catchments are coloured darker for this reason)

Appendix E Basins and Land Contamination

Table 14: Recorded land contamination in the vicinity of proposed treatment basins

Basin ID	Address	Investigation report	Report Date	Findings	Justification for siting basin
Addington biofilter No ID	25 Deans Avenue PT RSs 9, 9, 9 Cant. Dist.	INV256985SW pond sampling INV89103 Asbestos Audit Report	2020 2014	LLUR: Potential agrichemicals, asbestos products, livestock dip/spray.	Siting likely very constrained by land availability. Land will be tested and remediated if necessary.
Riccarton biofilter No ID	South Hagley Park, west side RS 41182 Canterbury Dist.		n/a	LLUR comment: persistent pesticide bulk storage or use, storage tanks fuel, chemicals or waste within the park	Siting likely very constrained by consenting processes. Contamination less likely in western area. Land will be tested and remediated if necessary.
Dudley Creek Diversion FF Basin 1063 (west) Dudley Creek Diversion FF Basin 1119 (north) Cranford Basin 1064 (east)	45 McFaddens Road Pt Lot 1 DP 24638, Lot 1 DP 29952 69 Grassmere Street Lot 2 DP 427759	INV69801 Northern Arterial extn & Cranford Stormwater Basin Detailed Site Investigation INV113352, INV117294 detailed site investigations	2014 2015, 2016	Previous market gardening. Metals, hydrocarbons, pesticides not exceeding NES Recreational use. Metals & DDT exceed environmental	Siting reflects an existing situation and is essential for both flood protection and contaminant removal. Land will be tested and remediated as necessary. Fish may be excluded from wetlands if

Basin ID	Address	Investigation report	Report Date	Findings	Justification for siting basin
				guidelines at many locations.	sediment is contaminated.
Avondale basin 1171	Ardrossan Street (multiple Red Zone addresses)			LLUR entry: Potential asbestos products, potential storage tanks for fuel, chemicals, waste in the wider area.	No known contamination. Some flexibility in siting basin(s) but constrained by topography. Likely no significant contamination. Site will be investigated and remediated if necessary during basin construction.
Knights 878	537-589 Pages Rd Multiple legal descriptions	INV187948 Detailed site investing report Knights Drain Ponds INV371495 Remedial Action Plan Knights Drain SW Developmt	2017 2023	Minor contamination remediated according to Remedial Action Plan	The basin is constructed. Minor contamination, remediated before construction.
Wainoni biofilter 5859	35 Hulverstone Drive Lot 130 DP 569084	Site not investigated (from SIT10369)		Potential HAIL activities metal treatment or coating.	Siting constrained by land availability. Land will be tested and remediated as necessary.
Wainoni Park FA Basin	31 Hampshire Street Multiple parcels	INV171045 Wainoni Land Drainage	2017	Asbestos, localised DDT, metals above background	Jacobs Soil Validation Report 252937-018. Contaminated soils

Basin ID	Address	Investigation report	Report Date	Findings	Justification for siting basin
824		Recovery Programme Contaminated Land DSI			removed off site before start of construction.
Waitaki basin & wetland 5761	106 Bexley Road Multiple legal descriptions	INV263275 Waitaki St Stopbank & SW Basin detailed site investigation INV317701 Waitaki St Stopbank & SW Basin – additional sampling INV 322131 Waitaki St S/B environmental site investigations supplementary report	2020 2022 2021	INV263275 & INV322131 Some exceedances of GVs for metals and PAHs	No alternative site for a storage/treatment facility. Details of contamination mitigation are to be dealt with via a resource consent application and remediated before construction.

Appendix F Treatment Efficiencies

Table 15: Treatment efficiencies used in the C-CLM[3]

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

[3] The Christchurch Contaminated Load Model is the model presented to the consent hearing and used in this SMP

Appendix G Consent Targets: Schedules 7 to 10

Waterways, Coastal and Groundwater Receiving Environment Attribute Target Levels in Schedules 7 to 10 from Condition 23, Consent CRC231955.

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 52.

TBC-B = To Be Confirmed following engagement with Papatipu Rūnanga, through an update to the EMP, in accordance with Condition 54.

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.

Objective	Attribute	Attribute Target Level	Basis for Target
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 SMP 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 Huritīni-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	These metals can be toxic to aquatic organisms, negatively affecting such things as fecundity, maturation, respiration, physical structure and behavior. The Council 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' (ANZG, 2018) 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
		Banks Peninsula catchments: TBC	
		Upper limit concentration of dissolved copper: Ōtākaro-Avon River catchment: 0.00356 mg/L Ōpāwaho/ Heathcote River catchment: 0.00543 mg/L Cashmere Stream: 0.00302 mg/L Huritīni-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	

Objective	Attribute	Attribute Target Level	Basis for Target
		Upper limit concentration of dissolved lead: Ōtākaro-Avon River catchment: 0.01554 mg/L Ōpāwaho-Heathcote River catchment: 0.02916 mg/L Cashmere Stream: 0.00521 mg/L Huritīni-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 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%	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.

		Upper limit filamentous algae cover of the stream bed: 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	Metals can bind to sediment and remain in waterways, potentially negatively affecting biota. These trigger values are based on the ANZG guidelines (ANZG, 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.

Objective	Attribute	Attribute Target Level	Basis for Target
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 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 *Escherichia coli* 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 Escherichia coli 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 *E. coli* 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 Council 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

MODELLED CATCHMENTS				
Objective for the management of stormwater quantity: 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.				
Attribute Target Level: 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**	**AEP**	**Maximum Increase (mm)**
Ōtākaro-Avon River	Gloucester Street Bridge	2014	2%	50
Pūharakekenui-Styx	Harbour Road Bridge	2012	2%	100
Ōpāwaho-Heathcote	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
	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 Ōtukaikino at Dickeys Road Bridge. Council does not currently model flooding in the Ōtukaikino 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 a Maximum Increase can be set during review of the SMP.

Appendix H Guidelines for Bird Strike Management

Bird Strike Management In Stormwater Basin/Water Body Design

Purpose of Design Guidelines

Bird strike is defined in the Christchurch District Plan as when a bird or flock of birds collide with an aircraft and is a key threat to the safe operation of Christchurch International Airport. It is of concern throughout the Ōtākaro-Avon catchment, which lies east of the main Christchurch Airport runway. Bird strike is a significant safety risk which requires diligent management and collaboration between Christchurch International Airport Ltd (CIAL/ the airport), local government and surrounding landowners.

References in the following paragraph are to sections of the Christchurch District Plan.

Strategies for reducing the risk of strikes at the airport focus on managing wildlife populations on and surrounding the airport. There are provisions in the District Plan addressing issues arising out of incompatible land uses relating to the avoidance of bird strike risk introduced in Chapter 6, Section 6.7 Aircraft Protection, supported by Policy 6.7.2.1.2. Section 6.7.4.3 Activity status tables – Bird strike Management Areas outlines activities and specific standards aimed at managing the establishment of new land uses such as water bodies and stormwater basins that might provide new and additional habitat that is attractive to birds, such that it may increase the movement of birds across flight paths. Appendix 6.11.7.5 outlines controls related to water bodies and stormwater basins within the 3km radius, however considerations for bird strike must also be taken into account up to 13km from the airport runway thresholds, in collaboration with CIAL.

Parameters

Bird strike risk can be avoided or minimised appropriately using best practice guidance provided below, in the District Plan, in collaboration with CIAL[4]

Bird use of stormwater management basins are similar to those of natural water bodies. Parameters to minimise bird strike are similar for both basins and water bodies, and include minimising facility surface area as much as practicable, and design considerations such as:

- maximisation of drainage to avoid standing water,
- increased bank gradients to deter bird nesting,
- avoidance of permanent island features which can provide perching sites for birds,
- appropriate landscape design considering perimeter plant species selection and densities (diagrammed in Figure 19 below).

Ongoing bird strike risk management also extends beyond design and implementation to water body or basin operations, maintenance and/or monitoring.

[4] Rules in the District Plan specifically control the creation of new stormwater basins or water bodies within identified Birdstrike Management Areas (i.e., Rule 6.7.4.3.1 Activity P3). Other plan provisions also deal with bird strike and are generally referenced in Section 12 of this management plan.

The risk of bird strike will vary from site to site and may be influenced by factors such as proximity to the airport, the flight patterns of specific bird species, surrounding land uses and natural factors such as season, species ecology, and landscape features.

Some general guidelines for design of stormwater basins / water bodies to minimise the risk of bird strike are shown in

Specific implementation of these guidelines will vary on a site-by-site basis and should be undertaken in consultation with CIAL and on receipt of ornithologist advice.

Additional guidelines are:

1. Minimising open water and vegetative cover that provides food, shelter or roosting for birds are the primary habitat features of focus for bird risk management near the airport.

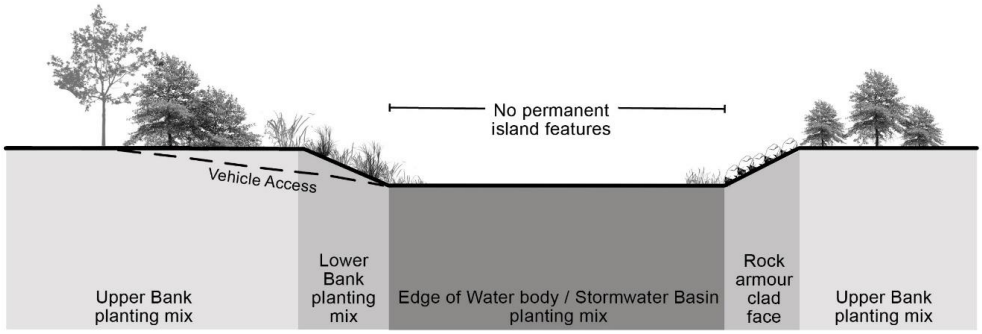


Figure 19: Typical Basin Section

2. Landscape planting plans must limit the attractiveness of basins to birds using suitable non-attracting plant species. Vegetation with berries, nuts, desirable forage, attractive flowers, edible tubers or roots, or large, abundant or high-nutrient seeds should be avoided as a potential wildlife attractant. In general, using low diversity planting strategies and avoiding high-nutrient organic soil amendment (which can attract invertebrates that attract certain birds) is important. Plant species should be limited to those listed in Table 16 (and Appendix 6.11.9 of the District Plan).

Table 16: Plant Species for Water Bodies /Stormwater Basins in the Ōtākaro-Avon Catchment

Edge of Water body / Stormwater basin	
Botanical name	**Common name**
Schoenoplectus validus / tabernaemontani	lake club rush / kapungawha
Eleocharis acuta	spike sedge
Carex germinata	makura
Schoenus pauciflorus	bog rush
Polystichum vestitum	prickly shield fern
Juncus pallidus	tussock rush / wiwi
Cyperus ustulatus	umbrella sedge

Lower Bank	
Botanical name	**Common name**
Anemanthele lessoniana	wind grass
Astelia fragrans	bush lily / kakaha
Coprosma propinqua	mikimiki
Dianella nigra	ink berry / turutu
Plagianthus divaricatus	swamp ribbonwood
Upper Bank	
Botanical name	**Common name**
Aristotelia serrata	makomako / wineberry
Carpodetus serratus	marbleleaf / putaputaweta
Coprosma rotundifolia	roundleaved coprosma
Dodonea viscosa (frost tender)	akeake
Eleocarpus hookerianus	pokaka
Griselinia littoralis	kapuka / broadleaf
Hebe salicifolia	koromiko
Hoheria angustifolia	narrow leaved lacebark
Kunzea ericoides	kanuka
Leptospermum scoparium	manuka
Lophomyrtus obcordata	rohutu / NZ myrtle
Myrsine australis	mapou
Myrsine divaricata	weeping mapou
Pittosporum eugenioides	lemonwood
Pittosporum tenuifolium	matipo
Plagianthus regius	lowland ribbonwood
Podocarpus totara	totara
Prumnopitys taxifolia	matai
Pseudowintera colorata	peppertree
Sophora microphylla	kowhai

3. High risk bird species of particular concern to aircraft bird strike are summarised in Table 17: Bird Species Causing Particular Risk of Bird Strike (Dr. Leigh Bull, 2021). Flexibility or adaptability is needed as birds may modify their behaviour in response to installation of new stormwater facilities in ways

that were not anticipated during design, resulting in an aviation safety problem. Continued collaboration between stormwater facility designers and CIAL is recommended.

Table 17: **Bird Species Causing Particular Risk of Bird Strike (Dr. Leigh Bull, 2021)**

Bird Species	Habitat Characteristics
Southern black-backed gull *(Larus dominicanus)*	Found in most habitats. Colonies can occur on islands, steep headlands, sand, or shingle spits or on islands in shingle riverbeds.
Canada goose (*Branta canadensis*)	Graze on pasture, young crops, and aquatic plants. Prefer pastoral land adjacent to a lake or large pond.
Feral pigeon/ Rock pigeon (*Columba livia*)	Variety of habitats. Roost and nest in buildings, under bridges/wharves, and on ledges of cliffs and caves. Occupy open habitats, usually near water (e.g. river-beds, sea and lake shores, agricultural pasture, and urban parklands).
Spur-winged plover (*Vanellus miles*)	Move in response to availability of wetlands. Use temporary and recently constructed artificial wetlands, and leave a drying wetland or diminished food supply.

Stormwater basin designers should make early contact with CIAL for referral to an ornithologist familiar with aviation operations.