

Canterbury Water Management Strategy Waimakariri Zone Committee

Agenda

Monday 13 August 2018

3.00pm

***Council Chambers,
Waimakariri District Council,
215 High Street Rangiora***

Members:

David Ashby (Chair)
Grant Edge (Deputy Chair)
Carolyn Latham
Judith Roper-Lindsay
Gary Walton
Cameron Henderson
Michael Blackwell
Arapata Reuben (Te Ngai Tūāhuriri Rūnanga)
Sandra Stewart (WDC Councillor)
Claire McKay (ECan Councillor)

Chairperson and Members

CWMS WAIMAKARIRI ZONE COMMITTEE

Agenda for the meeting of the **CANTERBURY WATER MANAGEMENT STRATEGY WAIMAKARIRI ZONE COMMITTEE** to be held in the **WAIMAKARIRI DISTRICT COUNCIL CHAMBERS, 215 HIGH STREET, RANGIORA** on **MONDAY 13 AUGUST 2018** commencing at **3.00PM.**

Adrienne Smith
Committee Advisor

Recommendations in reports are not to be construed as
Council policy until adopted by the Council

BUSINESS

PAGES

KARAKIA

1 **APOLOGIES**

REGISTER OF INTERESTS

5 - 6

Conflicts of interest (if any) to be reported for minuting.

CONFIRMATION OF MINUTES

1.1 **Minutes of the Canterbury Water Management Strategy Waimakariri Zone Committee meeting – 9 July 2018**

7 - 17

RECOMMENDATION

THAT the CWMS Waimakariri Zone Committee:

- (a) **Confirms** the minutes of the Canterbury Water Management Strategy Waimakariri Zone Committee meeting, held on 9 July 2018, as a true and accurate record.

MATTERS ARISING

- 2 **KAIAPOI RIVER INVESTIGATIONS AND PHOTOGRAPHS BY MICHAEL BATE– Adrian Meredith (Principal Scientist, ECan)**

18 - 53

RECOMMENDATION

THAT the CWMS Waimakariri Zone Committee:

- (a) **Receives** this report for its information

- 3 **DAIRYNZ NUTRIENT MITIGATION REPORT - BRIEFING – presented by Rachael Davidson (Economist DairyNZ) and Katherine McCusker (Regional Sustainability Leader DairyNZ, Canterbury and West Coast) Report written by Charlotte Wright, (Senior Policy Advisor, DairyNZ)**

54 - 59

RECOMMENDATION

THAT the CWMS Waimakariri Zone Committee

- (a) **Receives** this report for its information and with regard to the committee's preparation of the Waimakariri Land and Water Solutions Programme draft recommendations, and 2018 community engagement priorities.

- 4 **WAIMAKARIRI IRRIGATION LIMITED – UPDATE – presented by Brent Walton (CEO Waimakariri Irrigation Ltd) and Paul Reece (Environmental Manager, Waimakariri Irrigation Ltd)**

60

RECOMMENDATION

THAT the CWMS Waimakariri Zone Committee

- (a) **Receives** this report for its information and with regard to the committee's preparation of the Waimakariri Land and Water Solutions Programme draft recommendations, and 2018 community engagement priorities.

- 5 **OPPORTUNITY FOR PUBLIC TO SPEAK**

- 6 **COMMITTEE UPDATES** – Zone Committee Members, Murray Griffin, (CWMS Facilitator, ECan)

61 - 74

- 6.1 **Waimakariri Land and Water Solutions Programme – Update**

- 6.2 **CWMS Regional Committee working group meeting 10 July 2018,**–
Carolyn Latham, (Waimakariri Zone Regional Committee Representative)

- 6.3 **Regional Infrastructure Working Group Briefing Paper, 10 July 2018**

6.4 **CWMS Fit for the Future Project** – Murray Griffin (CWMS Facilitator)

6.5 **CMMS Fit for the Future Project – Key Dates**

6.6 **Media and Communications – August Update** – Gina McKenzie
(Director – Real Communications)

RECOMMENDATION

THAT the CWMS Waimakariri Zone Committee:

- (a) **Receive** these updates for its information and with regard to the committee's 5 Year Outcomes, drafting of the Land and Water Solutions Programme recommendations, and 2018 community engagement priorities.

7 **GENERAL BUSINESS**– Dave Ashby (Committee Chairperson)

8 **KARAKIA**

9 **NEXT MEETING**

The next meeting of the CWMS Waimakariri Water Zone Committee will be held on Monday 10 September 2018 commencing at 3.00pm.

WAIMAKARIRI ZONE COMMITTEE

Register of Interests – at August 2018

Name	Committee Member Interests
David Ashby	<ul style="list-style-type: none"> - Director/shareholder: Pineleigh Farm Limited - Director/shareholder: Dave Ashby Rural Consultants Limited - Shareholder: Waimakariri Irrigation Limited - Member: Cust Main Drain Water User Group
Michael Backwell	<ul style="list-style-type: none"> - Director/ Shareholder Blackwells Limited , Kaiapoi - Treasurer, North Canterbury Clay Target Association - 4ha property, Tuahiwi.
Grant Edge	<ul style="list-style-type: none"> - Director: Edge Landscape Projects Ltd, Edge Plants Ltd, and Edge Products Ltd - Member: NZ Institute of Landscape Architects - Member: Urban Design Forum - Member: QEII National Trust - Member: NZ Forest & Bird - Member: Heritage NZ - 1ha property Fernside (shallow bore user)
Cameron Henderson	<ul style="list-style-type: none"> - Dairy Farmer - Groundwater irrigator - Member - NZ Institute of Primary Industry Management - Member - NZ Dairy Environment Leaders Forum - Chairman - DairyCan - Canterbury Dairy Environment Leaders Forum - Chairman - North Canterbury Federated Farmers
Carolyn Latham	<ul style="list-style-type: none"> - Farmer: Sheep, beef - Director of Latham Ag Ltd Consulting - Shareholder: Silver Fern Farms, Farmlands - Registered Member: New Zealand Institute of Primary Industry Management
Claire McKay	<ul style="list-style-type: none"> - Dairy Farmer - Irrigator and shareholder: Waimakariri Irrigation Ltd - Holder of Groundwater take and use consents in Cust groundwater allocation zone - Holder of Effluent discharge consents - Member: Federated Farmers - Member: DairyNZ Dairy Environmental Leaders forum - Member: P21 Canterbury Industry Advisory Group
Arapata Reuben	<ul style="list-style-type: none"> Trustee – Tuahiwi Marae Trustee – Tuhono Trust Trustee – Mana Waitaha Charitable Trust Member - National Kiwi Recovery Group Rūnanga Rep and Chair – Christchurch – West Melton Water Zone Committee
Judith Roper-Lindsay	<ul style="list-style-type: none"> - Director/ecologist: JR-L Consulting Ltd. - Land-owner/small-scale sheep farmer, Ashley downs - Fellow: Environment Institute of Australia and New Zealand (EIANZ)
Sandra Stewart	<ul style="list-style-type: none"> - Self-employed journalist - Land-owner, 4ha Springbank – sheep & dogs

Gary Walton	<ul style="list-style-type: none">- Director, Walton Farm Consulting Ltd- Director & Shareholder, Loburn Irrigation Co- Trustee, Rugby World Heritage Trust- Ashley Rugby Football Club (Inc.)- Farmer, sheep & cattle, Loburn
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**MINUTES FOR THE MEETING OF THE CANTERBURY WATER MANAGEMENT
STRATEGY WAIMAKARIRI ZONE COMMITTEE HELD IN THE COUNCIL CHAMBERS
215 HIGH STREET, RANGIORA ON MONDAY 9 JULY 2018 AT 3.00PM.**

PRESENT

David Ashby (Chair), Grant Edge (Deputy Chair), Carolyn Latham, Judith Roper-Lindsay, Gary Walton, Michael Blackwell, Arapata Reuben (Te Ngāi Tūāhuriri Rūnanga), Claire McKay (Environment Canterbury Councillor), and Sandra Stewart (Councillor, Waimakariri District Council)

IN ATTENDANCE

Brent Walton (General Manager, WIL), Mike O'Connell (Senior Policy Analyst, WDC), Geoff Meadows (Policy Manager WDC), Gerard Cleary (Manager Utilities and Roothing), Colin Roxburgh (Water Asset Manager), Owen Davies (Drainage Asset Manager WDC), Brett Beer (Team Leader, Three Waters Assets, Hurunui District Council, Team Leader 3 Waters Assets), Michael Bate (Kaiapoi), Gina McKenzie (Real Communications), Victoria Trayner, (Oxford), Jessica Steel (ECan), Dave Winter, (Farmers, W S Winter & Sons Ltd), Jason Holland (ECan), Adrian Meredith (ECan), Leo Fietje (ECan), Maureen Whalen (ECan), Shane Kelly (Ngāi Tahu Farming), Ash-Leigh Campbell (Ngāi Tahu Farming), Treena Davidson (Ngāi Tahu), Sophie Allen (WDC), John Benn (Department of Conservation), Charlotte Wright (Dairy NZ), Nick Ledgard (Ashley Rakahuri Rivercare Group), Wayne Randle, Tom McBrearty (Mandeville Residents Assn and Eyre District Environmental Assn Inc), Noel Fraser (Mandeville Residents Association and Eyre District Environmental Assn Inc), Rosina Rouse (Mandeville Residents Assn and Eyre District Environmental Assn Inc), Michael De Hamill, Dugald McLean, Andrew Arps (Zone Delivery Team Manager, ECan), Murray Griffin (CWMS Facilitator, ECan) and Adrienne Smith (WDC Committee Advisor).

KARAKIA

A Reuben conducted the karakia.

1 **APOLOGIES**

Moved C McKay seconded G Edge

THAT an apology for absence be received and sustained from Cameron Henderson.

CARRIED

REGISTER OF INTERESTS

There were no updates to the Register of Interest as per the circulated Agenda.

CONFIRMATION OF MINUTES

1.1 Minutes of the Canterbury Water Management Strategy Waimakariri Zone Committee meeting – 11 June 2018

Moved A Reuben seconded C McKay

THAT the CWMS Waimakariri Zone Committee:

- (a) **Confirms** the minutes of the Canterbury Water Management Strategy Waimakariri Zone Committee meeting, held on 11 June 2018, as a true and accurate record.

CARRIED

MATTERS ARISING

There was brief discussion regarding the biodiversity funding application dealt with at the previous meeting, and the retaining of the quorum. It was confirmed that though D Ashby had declared a conflict of interest, moved away from the table and not taken part in consideration of the application for Immediate Steps Funding for the Easterbrook Road Community Planting Project, he was still present at the meeting. The committee quorum was therefore still present and the committee's decision to approve the application stands from the meeting.

2 OPPORTUNITY FOR PUBLIC TO SPEAK

Canterbury Landscape Supplies Composting, Diversion Road, Eyreton

Rosina Rouse, Noel Fraser and Tom McBrearty. Representatives from the Mandeville Residents Association, were present to speak in relation to the composting business that has been operating for two years on Diversion Road, Eyreton, by Canterbury Landscape Supplies Ltd. The members have concerns with the impact this operation is having on the surrounding environment and showed some photos of the site, in support of their concerns. The photos showed water ponding on the site following rainfall at different times this year. It is the belief of this group that their matters of concern are not minor and that the application for Consent must be publically notified. R Rouse, T McBrearty are both also members of the Eyre District Environmental Association Incorporated. They were also supported by other members of this group in attendance.

Following the presentation, C McKay reminded members that while this resource consent had been declined by the Commissioners, this decision is currently in the appeal period. Should an appeal be lodged, this would be heard in the Environment Court.

Brent Walton, Waimakariri Irrigation Ltd, WIL

B Walton updated the committee on the proposed water storage project. The Hearing had resumed on 18 June and has been adjourned again. More evidence is to be submitted by ECan and Waimakariri District Council, and also WIL.

B Walton spoke on Regen, a water metering policy to help support the shareholders and demonstrating efficient irrigation use.

WIL would be keen to have discussions with all committee members on the current challenges with nitrate levels and share the Regen demonstration with

the Committee. B Walton noted some WIL shareholders are unsure of how to face the challenges around nitrates and it was noted it is important to keep the momentum up based on the direction of travel signalled on this issue.

WIL are doing a comprehensive biodiversity survey of the catchment noting that there is good evidence of freshwater mussels being present. As a Company it is planning to initiate some monitoring, using technology to aid this.

Michael Bate

M Bate showed some slides of various waterways in the district and the impact of the green slime in the water. M Bate, as he has indicated previously, believes this is a result of farming practices and ECan and this committee need to work with the farmers to turn this situation around. The Chairperson, D Ashby, asked ECan staff member Adrian Meredith if there could be some samples taken of this and have it tested.

There were also several slides showing photos taken at Pines Beach, in the vicinity of the Ocean Outfall, with sea foam visible which M Bate believes can be attributed to the Ocean Outfall. The presence of this foam on the beach is only evident when there is onshore wind. It was suggested to M Bate that sea foam is a natural process.

G Edge asked is there any testing being undertaken on the temperature of the seawater as this could be attributing to the presence of the sea foam.

M Bate was thanked for his presentation.

3 COMMITTEE UPDATES – Zone Committee Members, Lesley Woudberg (CWMS Facilitator, ECan) A Arps (Waimakariri Zone Delivery Manager, ECan)

3.1 CWMS Regional Committee meeting, 12 June 2018 – Carolyn Latham, (Waimakariri Zone Regional Committee Representative)

This report was taken as read and there were no questions.

3.2 Waimakariri Zone Delivery update – Andrew Arps

As a follow up from the last committee meeting, A Arps advised that the geomorphic report for the Ashley-Rakahuri River has been received. There has also been discussed with Mr Robert Johnston, in relation to his concerns with his farm land. He was assured this is in the Zone Delivery work programme and is not something that will fall off the radar.

Update on the Kaiapoi River – ECan River Engineers have an annual and ongoing maintenance programme, where dead and dangerous trees are identified. If any trees are identified as dangerous, these are dealt with immediately. If trees are dead, these are included in the next maintenance programme. It is not planned to replace the willow trees that are being removed, but there may be natives planted in their place to help stabilise the riverbank.

Councillor Stewart suggested that it would be beneficial for the Zone Manager to provide a written report which could be included in the

agenda, to allow time for committee members to read prior to the meeting.

Media and Communications Report

G McKenzie (Real Communications), tabled the Zone Committee Media and Communications Report for March – July at the meeting. This is a comprehensive list of media items in local publications over this time including matters on water quality, rivers, lifestyle blocks, nitrate levels and planting days at Silverstream Reserve and Tuhaitara Coastal Park.

Moved C McKay seconded G Edge

THAT the CWMS Waimakariri Zone Committee:

- (a) **Receive** these updates for its information and with regard to the committee's 5 Year Outcomes, drafting of the Land and Water Solutions Programme recommendations, and 2018 community engagement priorities.

CARRIED

4 Ngāi Tahu Farming

Shane Kelly and Ash-Leigh Campbell were present on behalf of Ngāi Tahu Farming. Shane Kelly spoke to a PowerPoint presentation on the farming operations of Ngāi Tahu, specifically at Eyrewell. Ngāi Tahu farming operate two farming businesses across three locations in Te Waipounamu (the South Island), which includes 7,600 ha comprising eight dairy farms and five dairy support farms in Eyrewell, collectively called Te Whenua Hou.

Ngāi Tahu Farming operates with the belief that the natural environment provides sustainable products but in turn they have a responsibility to nurture the environment through the generations. This is achieved by pursuing financial, environmental and social outcomes with sustainability at the heart of all they do.

Technology will assist farming operations to reach the goals of farming best practice. The dairy farming operation includes installation of Lysimeters, and drainage and nitrate monitoring. Ngāi Tahu farming use Variable Rate Irrigation System, a significant investment in the latest irrigation technology. The Regen programme has been implemented on all eight dairy farms and the dairy support unit. It provides the farms with a daily recommendation for the next ten days on how much irrigation water to apply. Farm Managers use an app to make decisions on when and how much water to use. There is 15 days water storage pond per farm. S Kelly confirmed the Ngāi Tahu farm managers are passionate about the environment.

Ngāi Tahu Farming will also be using electromagnetic surveys to map soil characteristics within the soil profile such as texture, moisture level, temperature, bulk density, salinity and cation exchange capacity. This will improve pasture performance, maintain inputs more sustainably, and reduce environmental impacts by eliminating potential dangers and risk.

There are six wells on the properties which are monitored and tested regularly. The depth of these wells are mostly between 30 and 50 metres, but up to 140m.

S Stewart asked if all the farms are operating at Good Management Practice (GMP) which S Kelly confirmed they are collectively. G Edge asked if GMP being achievable collectively over all the farms means some farms do not meet the GMP requirements. S Kelly said this would be the case, but all are progressing to meet GMP.

S Stewart asked if farms could go 20-25% beyond GMP. S Kelly believes that the zero-nitrate level is not achievable, and time is important in enabling farm operations, and the auditing process, to adjust. He added there are a range of innovations and technology that will assist in the future to further reduce nitrate leaching, but we need time to develop and implement these technologies.

S Kelly also confirmed 150 hectares are planned to be put into native plantings. This will include shelter belts though these will not assist in decreasing nitrate levels. Ngāi Tahu are partnering with Lincoln University with this native planting project, with more than 150,000 native trees to be planted. Over 90,000 of the native trees will be grown through the Ngāi Tahu Farming nursery. There is a target of 80% self-supply of trees and 16 varieties of Manuka trees are being trialed.

Ngāi Tahu are keen to share information with the committee and highlighted a future development – LowN Cows. There is some evidence that nitrogen concentration is genetic and there is the ability to breed cows that produce less nitrogen. Breeding with LowN sires will reduce milk urea nitrogen concentration in their progeny. CRV Ambreed have released a product which they estimate will aid in a 20% reduction in nitrate leaching within 20 years. Breeding intervals means it takes 20 years to get 95% penetration of genetics.

The Chair thanked Shane and Ash-Leigh for the presentation.

Moved A Reuben seconded J Roper-Lindsay

THAT the CWMS Waimakariri Zone Committee

- (a) **Receive** the information and reflect on the steps to reduce nitrate discharges that it is considering as part of the Land and Water Solutions Programme.

CARRIED

5 **Ashley Rakahuri Rivercare Group – Update** – Nick Ledgard

N Ledgard from the Ashley Rakahuri Rivercare Group provided an update on the recent activities of the group, with the aid of a PowerPoint presentation.

The Group will require ongoing funding for weed control in the riverbed where the preferred nesting areas are located. M Griffin asked if the group had mapped those preferred nesting sites which N Ledgard confirmed, adding it amounted to an area of 22ha in the riverbed.

Information on the breeding season was provided. N Ledgard advised that productivity is measured in the numbers of chicks raised per pair.

There are some native birds that nest in farm paddocks, as highlighted in the photos presented. N Ledgard confirmed that there is no doubt that native birds can benefit from carefully managed farmland. He noted the conditions

were similar to the ideal nesting sites in the riverbed, in that they are clear of predator concealing vegetation.

The Waimakariri River has hundreds of Southern Black Backed Gulls which are a significant predator of other native river nesting birds. While Black Backed Gulls are an issue being addressed in a number of braided rivers in the Region they, for reasons unclear at present, are not an issue on the Ashley-Rakahuri River.

N Ledgard concluded his presentation with photos highlighting significant weed encroachment of the riverbed over time and the impact of a flood event in removing large tracts of these invasive weeds.

Moved J Roper-Lindsay seconded G Edge

THAT the CWMS Waimakariri Zone Committee

- (a) **Receive** this update for its information with regard to the committee's 5 Year Outcomes, drafting of the Land and Water Solutions Programme recommendations, and 2018 community engagement priorities.

CARRIED

- 6 **Waimakariri District Council – Update** – Gerard Cleary (Manager Utilities and Roading, WDC), Owen Davies (Drainage Asset Manager, WDC), Colin Roxburgh (Water Asset Manager, WDC) and Brett Beer (Hurunui District Council)

Ashley River Water Takes

Colin Roxburgh (Water Asset Manager, WDC) provided information on water takes by Waimakariri District Council and Hurunui District Council from the Ashley River and what consents are currently held for these. The three consents are for:

- Summerhill water supply emergency supply, maximum take of 7 Litres per second (L/s) which expires in 2032.
- Emergency supply for the Rangiora Scheme from a number of sources, wells beside the River and others in Rangiora, with a maximum rate of 300 L/s and also expires in 2032.
- Hurunui District Council have a water take for the Ashley Rural Water Supply which is within the Waimakariri District, but managed by the Hurunui District Council. This is the primary source at a rate of 70 L/s.

It was noted that all consents are subject to restrictions of water flows.

The Summerhill Emergency supply used to be the primary source for Summerhill, but this is now connected to West Eyreton which has a deep secure source. This is a higher quality water, but relies on approx. 10km pipe to transport water from West Eyreton to the tanks on top of Hunters Glen in Summerhill. Consent is therefore retained in case of any emergency of a significant issue with the pipeline (or multiple simultaneous failures). At present the connection from the source is capped, but could be connected if required.

The Rangiora Emergency supply is similar in that it used to be the primary source for Rangiora. This allows maximum combined take of 300 L/s from the following sources:

Ayers Street - two shallow groundwater bores

Dudley Park – two shallow groundwater bores
Western wells – four taking water directly from the river.

The western wells were previously the primary source until the upgrade to the deep secure source from Smith Street, Kaiapoi source in 2010 and the new source provides much higher quality water but requires 9km of pipeline to transport the water into Rangiora. Consent for this emergency source is therefore retained in case of emergency if there was any significant issue with pipeline, such as an earthquake or some other natural disaster. The connection from the source is capped at Ayers Street, but could be connected if required.

The third take is for the Ashley Rural Water Supply which allows for a maximum take of 70 L/s. This is the primary supply for this scheme and is subject to restrictions during low flow conditions of the Ashley River. There has been some work done by the Hurunui Council to make some parts of the scheme less reliant on this source to reduce the influence of the river restrictions. This includes supplying the northern areas from the Leithfield Beach bore, which has meant 800 connections have been taken off the Ashley Rural Water Supply Scheme.

J Roper-Lindsay asked would the current water takes for the Ashley Rural Water Scheme be able to cope with the projected increase in population over the coming years, which is expected would increase on the north side of the Ashley River as well. B Beer (Hurunui District Council) noted that currently there is less than half of the consent being used, so there is more than enough capacity in this current consent to handle growth. J Roper-Lindsay referred to the restrictions that were put in place last summer and suggested this could be happening much more frequently, especially with the effects of climate change and the low flows in the Ashley River. She also questioned how the Councils were working together with the predicted population growth. C Roxburgh noted that any water restrictions are the result of how much flow is in the river, not how many connections there are – having more connections would mean any restrictions would impact on more people. G Cleary advised that there is a lot of work done on projecting future demands on the scheme and as growth occurs for Rangiora primarily this will be met by more storage in Rangiora. One of the reasons for the change to the Smith Street, Kaiapoi water source for Rangiora was the need for restrictions from the Ashley River supply and the impact this was having. There has been significant work undertaken looking at the best water source for the Ashley Rural Water Scheme and the current source is still considered the preferred option.

Following a question from C Latham, G Cleary responded that there is an Ashley Rural Water Supply Liaison Committee, which has representatives from both the Rangiora-Ashley Community Board and the Waimakariri District Council. Staff from both the Hurunui and Waimakariri District Councils work together for the best outcome for the residents and the cross over into two districts is not seen as an issue.

Wastewater Treatment Plant Operation Matters

G Cleary (Manager Utilities and Roding, WDC) provided an update on WWTP operation matters, some of which have been covered at previous Zone Committee meetings. These relate to effects or perceived effects of the Councils wastewater treatment plants on the wider environment and surrounding neighbours.

Avian Botulism – this is an international issue and has been an issue in New Zealand for many decades. Auckland have had this issue for a long time and has also been in Christchurch for a number of years before it was present in Waimakariri. 2015 was the first year that it was experienced here and there was quite a large number of bird deaths. This is a disease that affects

waterfowl, causing paralysis and eventual death. The toxin is commonly found in lake and pond beds including oxidation ponds. During the last five years there have been outbreaks of avian botulism primarily at Kaiapoi WWTP, but also to a lesser degree at Rangiora and Woodend WWTP and other Council sites, as well as Tutaepatu Lagoon (to a much lesser extent). Management to date is to effectively remove the carcasses and this can be quite difficult at a wastewater treatment pond with getting access. It is important to remove the carcasses to stop the spread of the toxin. Collaboration is undertaken with Christchurch City Council who also experience similar issues at the Bromley wastewater ponds. The Council is seeking further advice on managing the outbreaks, and the removal of carcasses. Council staff are also looking to see if there is any way that the operation of the wetlands can be modified to try to minimise the risks by trying to create an environment that is less prone to the conditions. All options are being looked at to try to get the best outcome.

Sea Foam – Sea foam on the beach along Pegasus Bay has been attributed to the ocean outfall system and concern has been expressed by some members of the community. Advice has been sought from experts from ESR and Lincoln University on this matter. Only one sample has been collected in January. Results of samples taken at different sampling sites were shown, these sites being 500m south of the ocean outfall, 1km north and 1km south of the ocean outfall and in the Waimakariri River 1km west of the Kaiapoi WWTP. These showed slightly elevated E. coli and enterococci in the sea water and very elevated levels in the Waimakariri River water tested. All samples were below the Ministry for the Environment alert level. It is planned to undertake further monitoring during the coming summer. Council will continue to do this monitoring and hope to get more samples when there are any foam conditions in the future. Council has also engaged a consultant to report on options to remove the enterococci as part of the treatment process (potentially using chlorine disinfection if necessary).

Odour Control – Council has set a level of service target of no odour complaints from its treatment plant sites. One complaint was received regarding odour from its Kaiapoi treatment plant site in February 2018. This was during an extended warm dry period. The water level in the wetlands dropped because of this evaporation, causing accumulated sludge around the edge of the wetlands to become exposed to air and become septic, generating offensive odours to the public in the area around the treatment plant. Council has since raised the water level in the wetland to prevent the sludge from becoming septic. Council will be keeping a closer eye on this in the future.

Midges – Council has set a level of service target of no complaints from midges or other nuisance insects related to its wastewater treatment plants. One complaint has been received regarding midges at the Kaiapoi treatment plant. Council has commissioned the development of a plan for managing midges at the Kaiapoi plant – this includes using traps and potentially insecticides to control midge larvae and adults.

G Cleary also spoke on the Ocean Outfall Compliance and referred to the Annual Compliance Monitoring report 2016 – 2017. This is prepared and issued to Environment Canterbury in August each year. There is quite a number of determinants in the suite of testing. The Ocean Outfall fully complied with the consent conditions in 2016-17 apart from a minor non-compliance issue for not properly sampling for metals. This was an unfortunate mix-up between Council and the laboratory but it is believed that there would not have been any exceedances during the time that this incorrect testing was being undertaken. There have been two recordings of elevated enterococci levels but these did not exceed the consent limit. It is important to note that there have been significant upgrades carried out at both the Woodend and Rangiora wastewater treatment plants, including adding additional ponds at these plants to provide increased treatment, a new inlet at

the Rangiora plant and a big desludging programme carried out at the Rangiora wastewater treatment plant. These upgrades were driven primarily by growth, making sure that there is capacity for growth but will also give enhanced performance.

Questions

J Roper-Lindsay sought confirmation on how many complaints there had been regarding midges and this was confirmed as one complaint. There was brief discussion on the possibility of introducing swallows into the area to reduce the midge population.

G Edge asked if the Council has control of the water levels in the wastewater treatment plants impacting on the avian botulism and odour issue. G Cleary confirmed this is the case, but the Council said with wastewater treatment plants relying on natural processes, so any alteration on the water levels can have an impact on the plant operation. This has to be very measured and controlled and need to still operate within the consent requirements.

G Edge asked could the introduction of vegetation have a positive impact, for example, overhanging trees, to provide shade and reduce water temperature. G Cleary noted that there are some great opportunities at the Council's wastewater treatment plants to try to improve biodiversity, as these are already an internationally significant bird flocking and breeding ground. He added that it is extremely difficult to provide shade for a big open wetland.

In relation to the current system of asking farmers to do audits and farm management plans which they get rated on A to D, G Cleary was asked what sort of rating he would give the Council on its current performance. G Cleary responded that he would give the Council an "A" for its wastewater treatment plants, noted that there is quite strict consent conditions applied to the treatment plants. It was noted that the WWTP is a modern system and Council is keeping ahead of growth and development in the district. Council is also making sure there is capacity and complying with the consent conditions and is doing a good job in terms of the discharge. The Council also has the ability to go beyond the consent conditions (e.g. looking at the reasons for elevated levels of some samples, even though these are within the consent conditions, and opportunities to enhance biodiversity).

Pond C Update.

Owen Davies (Drainage Asset Manager, WDC) spoke to a presentation relating to current issues with Pond C – Wet Pond. This was commissioned in 2012 to treat storm water from the West Rangiora industrial area. It is located at the intersection of Flaxton and Fernside Roads. The issues with this pond are

- Suspended sediment is passing through Pond C and into the Number 7 Drain receiving environment.
- High sediment loads generated within the West Rangiora industrial catchment
- Poor maintenance practices in the catchment
- Vegetation die-off in the pond (the cause of this is unsure at this point)

The sediment coming off the industrial area is a problem, and it is believed there needs to be more control over the amount of sediment going into the pond.

Planting was done when the pond was commissioned in 2012 to filter out sediment from north to south. There has been considerable plant die off, which has happened over a number of years.

Poor maintenance practices on the Flaxton Road drain were noted, including spraying the sides of the drain. This was probably done with all good intent, but this can destabilise the sides which then washes into the drain, and in turn adds to the sediment that goes into the pond. This is a Council drain, but this spraying was not undertaken by the Council.

A report has been commissioned by Opus on the vegetation die-off and Council staff are reviewing the findings and recommendations at the moment. Funding has been approved in the LTP for rehabilitation works. The next step is a full report to the Council Utilities and Roading Committee meeting on 21 August. There is a roading project to be started this year on upgrading Flaxton Road and it is intended to incorporate upgrades to the Flaxton Road Drain during this time. It is important that the drain looks nice and serves the function that is intended.

Regarding the plant die off, Opus don't believe the plant die off is caused by industrial pollutants. Council will be looking at other sources of what could be causing this die off.

G Edge noted he is a member of the Keep Rangiora Beautiful group who have funding available through the Council's LTP process to improve the entrance to Rangiora, on Flaxton Road, from Threlkelds Road corner through to Lineside Road.

There was discussion on the problems with the sediment passing through the Pond and O Davies confirmed that it is considered that the main issue is the plant die off and the load from the industrial catchment. There is a small pond at the outlet and Council staff believe that the waterfowl congregating there are stirring the sediment up in dry weather and pushing it out through the outlet. Council are potentially looking at planting that out to exclude the birds. The pond has never been cleaned out but this is not recommended by Opus. There will be plant trials undertaken, as replacing all the current planting would be an expensive exercise.

Members asked what the purpose of the ponds being there. O Davies advised there are two purposes, firstly to treat the water before it goes out into the receiving environment. Secondly this is to provide a catchment for the industrial site of Southbrook, to hold back water and let it out at a moderated rate so it doesn't have an undue effect on the downstream environment. It was pointed out that it is important that members of the public are advised that there are currently issues with this pond system.

Nick Ledgard asked if there had been any counts of bird life on the ponds. O Davies said this hadn't been done in the past and it is possibly something that could be undertaken in the future by the Council.

Moved G Walton seconded C McKay

THAT the CWMS Waimakariri Zone Committee

- (a) **Receives** this update for its information.
- (b) **Notes** that Waimakariri District Council staff will continue to seek solutions to address the issues associated with avian botulism, sea foam, enterococci, odour control and midges at its WWTP.
- (c) **Notes** that Waimakariri District Council staff will continue to investigate options to improve the performance of Pond C.

- (d) **Notes** that WDC water takes CRC160704 & CRC971820 and HDC water take CRC161302 are required for the current and future management of these schemes.

CARRIED

7 **CORRESPONDENCE**

7.1 **Response Letter from B Bayfield, (ECan Chief Executive**

Moved M Blackwell seconded G Walton

THAT the CWMS Waimakariri Zone Committee

- (a) **Receives** this item for its information.

8 **GENERAL BUSINESS**– Dave Ashby (Committee Chairperson)

Deer Farm day on Wednesday 18 July at the farm of Ken Blakemore, Birch Hill Road in Okuku. The Chair sought interest in the numbers of members who can attend. ECan staff will be in attendance.

9 **KARAKIA**

Arapata Reuben provided a karakia.

There being no further business, the meeting closed at 6.10pm.

CONFIRMED

Chairperson

Date



Canterbury Water Management Strategy

Meeting	Waimakariri Water Zone Committee meeting
Date of meeting	Monday 13 August 2018
Agenda item	Kaiapoi Report and photographs by Michael Bate
Author	Adrian Meredith

Kaiapoi River water quality, and value of community monitoring observations.

Purpose

1. Present the ZC with an overview of the Kaiapoi River water quality report, that arose out of regular community observations of the river condition.
2. Provide the Zone Committee with an interpretation and value of river and coastal community monitoring photographs/videos.

Value proposition

3. This presentation identifies how community observations on state of rivers or the natural environment can be a positive resource for identifying river management issues, rather than being received as ongoing criticism of management processes.

Recommendations

That the Committee:

1. **receive this report for its information.**

Background

4. Community observations (photographs, videos etc.) of habitats and water quality, or their perceptions of the state of the environment can be very useful information because they are often more frequent and wide ranging than staff gathered information. If such evidence is put in appropriate management context they can assist the identification of new issues, changes in environmental state, and so can help the understanding and management of the environment.
5. This memo acknowledges and responds to the community photographic evidence provided to the Zone Committee by Mr Michael Bate over the past 5 years for the Kaiapoi River; that allowed the identification of a recent change in salinity status of the river. We also examine evidence from the Waimakariri River; and the coastal beaches to determine their value.

The Kaiapoi River

6. Photographs have been provided of the degraded state of the lower Kaiapoi River and its contributing tributaries. These showed several issues including: sedimentation, loss of submerged macrophyte beds, ill-health of river margin trees, episodes of algal blooms and scums in the river, and algal mats. We responded to these observations by verifying the descriptions and determining plausible explanations for them.
7. Examination of them led us to agree there was a distinct and recent change in the river state, and in evaluating several explanations, we determined that there was a recent increase in salt water penetration up the Kaiapoi River over summer or low flow periods in the Waimakariri River. This has been published as the attached Kaiapoi River Report. This change in saline state explains many of the observed issues.
8. The Kaiapoi River has previously been valued as a freshwater port and freshwater waterway, and the freshwater status contributed to many of its beneficial features. It is suggested this change is a result of both earthquake induced bed level changes and increasing periods of low flow in the lower Waimakariri River. Such a change in coastal rivers is not unusual or unique to the Kaiapoi River but, should be acknowledged for informed future management of the Kaiapoi River.
9. **The Identification and characterisation of this issue has arisen predominantly from responses to the sustained observations of the river provided by community members (Mr Michael Bate).**
10. Other ongoing observations: such as the deposition of fine sediment, development of algal mats on the banks and structures, and discolouration of the river with algal blooms and scums, are not directly related to salt water ingress into the river. They are a result of catchment wide contaminant loads (sediment, nutrients, bacteria) moving down from the upstream tributaries. **Contaminant generation is an issue identified in the current state assessment of the Kaiapoi River tributaries and, consequently, a direct focus for the Zone Committee.**
11. These past, and recent (June/July 2018), photographs illustrate that these sedimentation and eutrophication issues are also just as relevant for improvements needed in the tidal Kaiapoi River environment as well as the tributaries. Under recent flow conditions this sedimentation and mat growth can occur at any time of year.
12. This finding is no different to the focus on both tributaries and Te Aka Aka/Ashley Estuary in the Ashley/Rakahuri River. The lower Kaiapoi River is the valuable estuary receiving water body of the northern Waimakariri tributaries.

The lower Waimakariri River

13. Photographs have also been provided of tidal reaches of the lower Waimakariri River. These show boulder river edges close to the sea with growths of bright green sea-lettuce (*Ulva* sp.), and silt and algal sludge on horizontal rock surfaces. These are clear

illustrations of the eutrophication of the Waimakariri estuary areas. Regular observations such as these would illustrate whether these eutrophic growths were getting worse over time.

14. Photographs and descriptions also show tree and vegetation die-back, and more extensive mudflats. Examination of aerial photographs over the past 10 years illustrate this increasing vegetation loss and mudflat development. It appears to begin around the time of the 2010/11 earthquakes and may be explained by land subsidence.
15. These illustrate three features: increasing salt water penetration into the tidal Waimakariri River; increased biological growths as a result of nutrient enrichment and siltation from increased sediment load, and earthquake land subsidence. Several of these issues are acknowledged and are the focus of Zone Committee catchment management issue recommendations.

The Coastal beaches

16. Photographs have been provided of issues along the Pegasus Bay beach north of the Waimakariri River mouth. These show mortality of mixed species of surf clams; discoloured water indicating algal blooms; beach foams; and algal material scums in the intertidal zone. These observations were also previously forwarded to Council and our Coastal scientists.
17. These issues are generally considered by our coastal scientists as natural episodes, explained by hydraulic (king tides and storm wave action) or regular nutrient responses on surf beaches. They are not considered unusual or of public health significance as surf diatom blooms are not considered toxic or of any other immediate public health risk. They are however, conspicuous and unpleasant.
18. The greatest value of this community monitoring or reporting is in assisting the councils to determine whether these episodes are becoming more frequent or of higher duration, and therefore whether they raise any “flags” for a “change in current state of the coastal environment”.
19. **The greatest value of this community monitoring is in faithfully recording individual incidents so that their frequency and patterns of occurrence are better understood.** Reporting these events in a timely manner can also assist councils to sample these events, should such sampling be required (particularly Waimakariri DC). It is not helpful to “re-issue” the same images.

Summary

20. We are increasingly seeing communities wanting to illustrate their perceptions of issues or environmental state. This has been a reoccurring theme with Mr Michael Bate’s images. The most constructive response is to:
 - a. – identify and acknowledge unusual patterns

- b. Acknowledge common themes or issues
- c. Encourage ongoing reporting to be constructive documentation of the frequency and duration of key issues

Attachments

Meredith, A.S. (2018). Assessment of the State of a Tidal Waterway: the Lower Kaiapoi River. Environment Canterbury Technical Report R18/7. 23pp.

TECHNICAL REPORT Science Group

Assessment of the state of a tidal waterway - the Lower Kaiapoi River

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March 2018



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Executive summary

The lower Kaiapoi River is a large river channel that traverses Kaiapoi township and drains to the large alpine fed braided Waimakariri River less than two kilometres from the sea. It is unique in being a previous channel of the Waimakariri River (the North Branch), receiving drainage from several major plains tributaries, and being strongly tidal over several kilometres of its length. It is a highly valued river, a culturally important waterway, a designated port and navigational waterway, and an important recreational and fishery resource. However, in recent years there have been complaints of degradation of its water quality and ecology.

We identified six 'classes' of recent river degradation complaints, relating to variable features, such as water quality, riverbed and bank vegetation and in-stream fauna. We confirmed that there was some visible evidence of all reported classes of degradation occurring regularly since 2012. However, it was difficult to identify a single cause or driver of all of the classes of degradation. The Kaiapoi River has historically been valued as a freshwater tidal waterway and port that provided for many unique values and activities. We suggest a recent change may have occurred that had allowed saline water to penetrate upstream into the Kaiapoi River on the incoming tides. The effects of this saline water could explain many of the recent degradation observations.

Salinity depth profiling of the Waimakariri River and Kaiapoi River in summer 2016 confirmed that on occasion saline water was penetrating well up the Kaiapoi River, particular during times of low flow in the Waimakariri River. In summer and autumn 2017 and 2018 we demonstrated that salt water frequently intruded up the Kaiapoi River. We considered that the recent saline intrusion up the Kaiapoi River since 2012 could be explained by several changes to the river environment. The saline intrusion episodes, broadly correlate with periods of sustained lower flows in the Waimakariri River. However, they also appeared to commence soon after the 2011 Canterbury earthquakes, which could have depressed river bed levels in one or both rivers. The cumulative flows in the Kaiapoi River tributaries appear to exert little influence on saline intrusion, as saline intrusion occurs both when summer tributary flows were very low (2017) and when summer tributary flows were high (2018).

We therefore concluded that the lower Kaiapoi River now exhibits sustained periods of tidal salinity intrusion, and these can explain many of the complaints and observations of degraded water quality and ecology. These findings should be communicated to community and management agencies to allow more informed river management decisions to be made particularly for times in the summer when the river may be saline. More detailed monitoring and modelling of the river systems is necessary to further explain the complicated interactions of earthquake mediated bed level changes, river flow regimes, and tidal height interactions. Better understanding of these would allow for better prediction and management of the saline episodes in the Waimakariri and Kaiapoi Rivers.

Assessment of the state of a tidal waterway - the Lower Kaiapoi River

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1 Introduction

The Kaiapoi River is a major lowland tributary drainage system of the large braided alpine Waimakariri River in North Canterbury. The Kaiapoi River is a unique example of a lowland tributary to our large braided rivers for a number of reasons. Firstly, it collects flow from at least five major spring fed stream systems (the Silverstream, Ohoka, Cust, Cam and Courtenay streams) draining a large area of extensive plains. Secondly it drains to the Waimakariri River in a lower tidal reach and so it is influenced by the sea and exhibits twice daily tidal cycles. Thirdly, the Kaiapoi River has unique features as a result of historic and current human management, including: being an oversized river channel as it is the historic north branch channel of the Waimakariri River before being cut off from receiving Waimakariri River flows for flood management purposes by construction of stop banks and construction of the Waimakariri River Wrights Cut. Fourthly, is also a historic and current navigational waterway; is still currently a managed port, and is an urban waterway that traverses the township of Kaiapoi that brands itself as "Kaiapoi River Town".

These features all illustrate a unique river type in Canterbury, and an important role for the river in the Waimakariri District. However, the Kaiapoi River also provides a wide range of cultural, social, recreational and commercial values including having provided extensive cultural opportunities to Ngāi Tahu and particularly to Ngai Tūāhuriri. These values include:

- cultural, and recreational fishery opportunities particularly for whitebaiting, eeling (tuna), and gathering of other mahinga kai species
- recreational fishing for trout, salmon, and a range of indigenous fish species;
- supporting a commercial salmon hatchery;
- providing widespread additional recreational and amenity opportunities including boating (rowing, dragon boating, waka ama)
- extensive riverside recreational opportunities
- provides infrastructural support for the Kaiapoi township including storm water discharge and land drainage
- providing an abundant abstractive water resource for agricultural and industrial purposes,

Tidal waterways like the Kaiapoi River occur in low elevation and low gradient environments, and can vary along their length from being strongly saline (salt) influenced through to exclusively freshwater environments, despite high (2+m) tidal water level movements. The port of Kaiapoi has been well known as a freshwater tidal environment upstream of the reach that salt water penetrates. This freshwater nature has had benefits in supporting an exclusively freshwater ecology, and in not supporting (or removing) the growths of marine biofouling growths (barnacles, shellfish, seaweeds etc.) from the hulls of vessels and port structures (piles etc.).

These features make the lower Kaiapoi River a very important waterway for social, economic, cultural and environmental purposes. However, the lower Kaiapoi River is not specifically recognised in river management planning objectives, policies and rules to date, because fresh water tidal waterways do not easily fit into current river classification and monitoring/management systems. Tidal waterways in particular, are neither considered a consistently flowing river, nor are considered a lake, estuary or lagoon. As such they are omitted from national management policy approaches for flow management, water allocation, and water quality (National Policy Statement for Fresh Water Management (2017)) and from national environmental monitoring standards; NEMS 2017). These omissions are largely due to the difficulty in establishing effective monitoring systems in tidal waterways, and/or identifying the limiting attributes or features of tidally fluctuating waterways. Current Canterbury regional planning systems (Canterbury Land and Water Regional Plan (LWRP)) similarly omit tidal waterways such as the lower Kaiapoi River from limits, targets and monitoring requirements. The current LWRP management focus therefore considers only the contributing flowing streams, and largely assumes that management of the contributing stream systems will also result in effective management of the quality of the river tidal river environment. There is also no requirement for regular water quality monitoring of the lower Kaiapoi River for state or trends, or plan effectiveness purposes, except for summer contact recreational monitoring (*E. coli*) below the Williams Street Bridge.

The assessment and management of the lower Kaiapoi River water quality and environment has strong local interest through the formation and activities of the Kaiapoi River Rehabilitation Committee. This committee is focusing on the restoration and enhancement of the Kaiapoi River, particularly the reaches

Assessment of the state of a tidal waterway - the Lower Kaiapoi River

through and below the Kaiapoi urban township. Initiatives have particularly focussed on the waterway from the perspectives of identifying favoured river bed profiles and bed and bank vegetation plantings, navigational requirements, and supporting recreational opportunities and infrastructure. Increased focus on the lower Kaiapoi River has also been stimulated by the frequency and intensity of public observations and questions on the health and state of the river through Kaiapoi township. There has also been increased questioning of the absence of structured monitoring (water quality and ecology) of this important tidal waterway.

2 Purpose

During this recent increased attention on the lower Kaiapoi River, there have been a number of questions about the state or health of the lower Kaiapoi River, and specific public observations as to the poor state or degradation of the river environment. These have included complaints of the river becoming periodically discoloured, with scums, algal blooms and odours; descriptions of die-back of previously abundant submerged aquatic macrophyte beds; loss of the abundant shrimp and crustacean communities in the river that support the food sources for native fish and resident trout fisheries; periodic die-back and ill health of river margin willows; degradation of river fisheries; dead or dying freshwater mussel populations; and river banks slumping, eroding and exhibiting pitting and burrow features.

It has been suggested by some community members that these effects may be due to a range of causes ranging from residual herbicide (Glyphosate) poisoning; excessive river engineering works; river nutrient (nitrogen and phosphorus) enrichment; river sedimentation; general “pollution”; and extended duration of low river flows.

With both the increased attention on the state of the lower Kaiapoi River, the increased frequency of complaints, and an absence of structured monitoring of the river, we undertook to:

- Categorise the nature of the public observations of river degradation
- Assess whether the observations of degradation could be verified
- Assess whether the observations could be related to any consistent spatial or temporal patterns
- collate and evaluate the suggested causes of degradation, and determine any additional causes or drivers
- Scope and/or conduct targeted monitoring to refine the likely dominant causes of river degradation observations
- Recommend any further studies necessary to better understand the drivers of water quality and ecology of the Kaiapoi River system.

3 Methods and results

3.1 Overview of methods

This study arose as a response to public observations of visible degradation of the water quality, habitats and ecology of the lower Kaiapoi River through Kaiapoi. These observations were predominantly gained from public statements and feedback at Waimakariri Water Zone Committee meetings, beginning in 2012. We began by reviewing the observations from members of the public, and categorising them into six classes of potential effect. We also identified a range of possible causes of the different categories of degradation, both suggested by the public, and from our independent assessment of these and other possible causes.

We undertook approximately 20 site visits over the period 2012 to 2017 to attempt to verify the public comments and observations. These visits were primarily over the summer period (December to March) and corresponded with the timing of most of the public descriptions of degradation. Site visits were generally to the sites described by complainants, and were timed to maximise the opportunities to verify the described visual observations (generally at low tide during daylight hours).

Assessment of the state of a tidal waterway - the Lower Kaiapoi River

We undertook several specific sampling activities to verify specific complaints (see Figure 3-1 for locations):

1. A survey of the presence and health of freshwater mussel populations adjacent to the confluence with the Cam River.
2. Sampling of any observed algal blooms for microscope identification of dominant phytoplankton taxa. Sampling and microscopic examination of conspicuous scums on the river surface.
3. Salinity profiling in the water column along the length of the river (3 runs conducted during February 2016).
4. installation of continuous salinity loggers on Mandeville Bridge between February 2017 and October 2017, and January 2018 to May 2018.
5. Installation of dissolved oxygen loggers on Mandeville Bridge in February/March 2017.

3.2 Study area

The study area for this investigation was the tidal reaches of the lower Kaiapoi River downstream of the three streams confluence west of Kaiapoi to the confluence of the Kaiapoi River with the Waimakariri River south east of Kaiapoi (Figure 3-1).

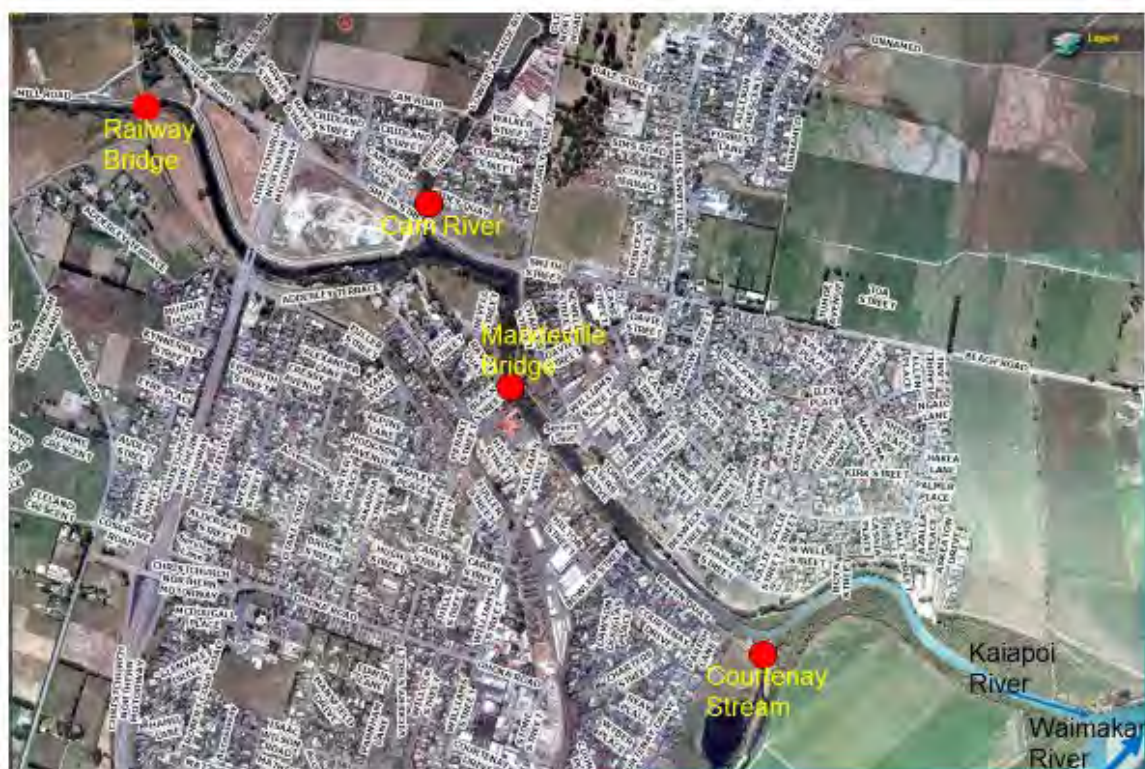


Figure 3-1: Lower Kaiapoi River down to the confluence with the Waimakariri River noting major sites referred to in this study

Assessment of the state of a tidal waterway - the Lower Kaiapoi River

3.3 Assessing observations of degradation

Public observations of the water quality of the lower Kaiapoi River were received primarily as public comments/feedback to regular Waimakariri Water Zone Committee (WWZC) meetings. We separated the complaints into six major subject categories and attempted to validate them with independent observations and an assessment of the seasonality/timing of them.

1. Visible algal blooms, scums, and river discolouration
2. Die-back of submerged macrophyte (plant) beds
3. Die-back of river side willows
4. Death of freshwater mussel populations
5. Loss of trout fisheries and their food sources (shrimps etc.)
6. Degradation of river bank structure

We also collated the causes attributed to them by the public, and determined a range of other possible causes. This allowed us to establish a matrix of effects and possible causes (Table 3-1). This does not validate potential causes, but illustrates the range of effects that could be potentially explained by each cause or driver. This matrix is not judgemental and does not set out to assess or refute public opinions. What this matrix does illustrate is that many causes can only explain a limited range of the effects seen. Salinity intrusion is the only cause that may explain all of the effects described. This matrix indicates a range of possible avenues to explore and assess.

Table 3-1: Potential effects described from the Kaiapoi River and potential causes raised by public and independent assessment

Effect	Herbicide toxicity	River works	Eutrophication	Sedimentation	Low flows	hypoxia	Salinity
Blooms/Scums			?		?	?	?
Macrophyte die-back	?	?		?	?		?
Willow die-back	?						?
FW Mussel death		?		?	?	?	?
reduced trout fishery		?		?	?	?	?
River bank degradation					?		?

3.3.1 Algal blooms, scums and river discolouration

Descriptions of visibly degraded water quality conditions in the Kaiapoi River were generally of visible coloured algal blooms that moved up and down the river on tidal cycles. We noted that these blooms tended to move up and down the Kaiapoi river and into and out of the Cam River rather than up the Kaiapoi River beyond the Cam River confluence. Blooms were described as red, olive green, or brown water discolouration. We managed to sample four of these “algal blooms” for dominant algae identification. On two occasions they were red coloured blooms dominated by algal *Euglena* species, and a third bloom was dominated by unidentified small rhodophytes. There was also one incidence of olive and brown coloured blooms dominated by the diatom *Melosira* sp.. None of these dominant taxa are considered toxin producing or of human health significance, although *Melosira* is often noted as particularly odour producing.

Over the past 6 years (2012 to 2018) observations of river discolouration/algal blooms occurred as early in the calendar year as 1 January (2016). They were most frequent in February, and generally becoming absent after April. This timing matches both with when the river was most frequently being recreationally used/accessed but also coincided with periods of highest algal bloom risk. Visible algal blooms and visible water quality degradation primarily occur in the late summer/early autumn (February and March) when flows are lowest, waterways are hottest and there are high sunshine hours. These are expected to be the times and conditions generating the greatest likelihood of algal blooms in eutrophic water bodies.

Observations of conspicuous scums on the water surface of the Lower Kaiapoi River similarly occurred in the late summer months (January to April). They were observed more consistently and frequently than the coloured algal blooms. We observed scums particularly developing on incoming tides as grey to brown films of textured material on the water surface, and were most conspicuous on incoming tides and immediately following high tide. They were first noted in the early 2000s during resource consent

Assessment of the state of a tidal waterway - the Lower Kaiapoi River

application hearings for the Silver Fern Farms Ltd (SFF) meat works discharge to the Waimakariri River at State Highway 1 bridge. We suggested at that time, that these scums could be associated with congealing of discharged homogenised oil and grease discharges and carried up the Kaiapoi River on incoming tides. However, since these scums have persisted since the SFF discharges ceased in 2011, there must be an alternative explanation of their origin. Microscopic examination of these scums have shown they were not composed of identifiable or dominant algal material, and are primarily composed of an unidentifiable slurry of detritus and organic and inorganic sludges. Recent examination indicates the scums appear to be material lifting off the riverbed and becoming concentrated at the water surface on some incoming tides. The question is therefore, why this material lifts off the bed at times and forms visible scums. It is possible that this effect is a floatation of this material off the bed on denser saline water moving up the river on tides.

3.3.2 Die-back of riverbed submerged macrophyte beds

Public complaints of die-back of submerged river bed macrophyte beds generally related to observations at particular points on the river including the Mafeking footbridge, Cam River confluence and lower reaches of the Cam River (Figure 3-1). On every occasion we visited the river we made observations of the health and extent of submerged macrophyte beds visible at low tide.

Large visible macrophyte beds in the Kaiapoi River were previously noted as being dominated by *Potamogeton* species (*Potamogeton crispus* and/or *P. ochreatus*) although there are also turf species (eg. Starwort - *Callitriche* sp., and *Lilaeopsis* sp.). *Potamogeton crispus* is often colloquially termed "Trout weed" as it often co-exists with or supports popular resident trout fisheries as in-stream habitat for them and their food organisms. The upstream tributaries of the Kaiapoi River (Silverstream, Ohoka Stream etc.) grow a wide range of other exotic and indigenous macrophyte species (*Ranunculus*, *Elodea*, *Lagarosiphon*., *Myriophyllum* sp.), that were regularly seen passing down the Kaiapoi River as plant fragments. All of these macrophyte plant fragments are potentially available to colonise river habitats as root fragments. However, despite this regular and abundant recolonization source, these many aquatic macrophyte species have not recently established, or successfully re-established on the bed through the lower Kaiapoi River over this period.

Macrophyte beds are important habitat features as they are the predominant habitat for many fish and avian food organisms, they provide cover for fish, and have a major influence on ambient water quality. Macrophyte beds trap sediments, reduce or prevent sediment resuspension and nutrient cycling from the sediment, and their photosynthetic activity reaerates the water. Any loss of the macrophyte bed cover can have serious detrimental impacts on water quality and waterway health.

Our observations corroborate the public observations of the reduction of the aerial extent and poor growth/regrowth of submerged macrophyte beds through the lower Kaiapoi River. The areas of visible riverbed at low tide are now dominated by bare sediments and while macrophyte beds show up at low tide as distinct dark patches, their growth is of limited extent and duration, and episodic, so poor macrophyte growth or loss appears to be a consistent riverbed feature. On occasion the macrophyte beds would appear to start to regrow as distinct patches but then regress back to little more than short turf-like growths.

Recently (2017 and 2018) we have noted alternative plant forms beginning to establish in areas of the riverbed. These resemble Sago pondweed (*Stuckenia pectinata* (previously *Potamogeton pectinatus*)). Sago pondweed is not a noxious or problem species, and is better known from brackish and intermittently saline lakes and waterways.

3.3.3 Die back or ill-health of Willows

Willow trees are deciduous and lose their leaves in autumn/winter. Die-back of willows can be very obvious during active growth phases in spring and summer, but can be difficult to detect in winter. Die-back effects are therefore only obvious in spring (illustrating poor leaf burst) and summer (unvegetated branches and/or low densities of leaf growth).

We paid particular attention to any visible willow ill-health on every time the river was visited in spring and summer (2012 to 2018). Willow die-back was more conspicuous in the lower reaches of the Kaiapoi River (below Courtenay Stream confluence), but certainly not consistently obvious, or every year, and not leading to widespread death of willow trees along the Kaiapoi River. Areas below the Kaiapoi River

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confluence in the lower Waimakariri River (eg. Jockey Baker Creek) where willows have all died and not grown back, and in the lower Styx River area all exhibit sustained die-back or loss of willows. However, we cannot establish any areas in the Kaiapoi River where willow death is complete and that they are not re-growing. Most obvious are episodes of willow 'ill-health' particularly below the Courtenay Stream confluence.

3.3.4 Freshwater mussel populations

Public complaints of a high incidence of visible dead mussel shells on the river bed at the Cam River confluence suggested that there was a large freshwater mussel population in the river and that they were undergoing mortality events or decline. We subsequently observed the riverbed at low tide from Mafeking Bridge and confirmed that there were a large number of visible discarded freshwater mussel shells of the freshwater mussel (*Echyridella menziesii*) spread across the riverbed. We could therefore confirm that there was a population of mussels at this site, and that they were indicating a degree of mortality. To further investigate this issue we carried out a field survey of the site (see section 3.4.1).

3.3.5 River bank surfaces

On every occasion the river was visited, observations were made of the surface nature of exposed bare mud and soil substrates on areas of intertidal riverbank. Particular note was made for algal mats covering the firm mud surfaces, whether there were visible burrows (likely to be used by mud crabs), presence of any surface grazing molluscs, and whether the steeper bank surfaces were slumping or otherwise lacking integrity.

On occasions in February of most years odorous slime or mat growths were visible on exposed mud surfaces. These slimes also bound fine sediment and detrital material to the substrate giving the mud surface a smooth and slimy texture. We also responded to public observations that these slime growths included toxic cyanobacteria mats (black mats: *Phormidium spp.*). Presence of *Phormidium* mats was confirmed on one occasion in the Cam River (between the motorway bridge and the mouth) and on two occasions in the Kaiapoi River (upstream of Mandeville Bridge), but was not a consistent or common occurrence from our summer site visits.

On flat mud surfaces we did not observe any evidence of burrowing or large surface grazing macrofaunal (marine crabs or snails). On steeper shaded banks, particularly between the Mandeville bridge and the Cam River confluence, the mud surfaces increasingly exhibited patterns of holes in the intertidal banks consistent with the size and orientation of mud crab burrows. Due to the precarious position of these areas none have been excavated to confirm the presence of mud crabs within them.

3.4 Field surveys

3.4.1 Freshwater mussel population assessment

A one-off survey of the mussel population above the Cam River confluence was undertaken at low tide on 9 February 2016 following the methods of McEwan (2015). A standard effort to identify and collect 50 live mussels (and shells) was undertaken in an area on the left bank of the river below Mafeking bridge. Fifty individual mussels were collected in approximately 25 minutes by a single operator.

There were large numbers of large mussels in this area, but they appeared to be only older adult mussels and represented only two or maybe three size classes of individuals (Figure 3-2 and Figure 3-3). No small or young size classes were present. Freshwater mussels frequently show this skewed population structure, but it appears that this population has not been successfully reproducing and is a relict population of old individuals. This population structure may also help explain the large quantity of dead shell material present (death of old individuals), but could also indicate significant levels of recent mortality of this population.



Figure 3-2: Sample of freshwater mussels collected from the lower Kaiapoi River in February 2016

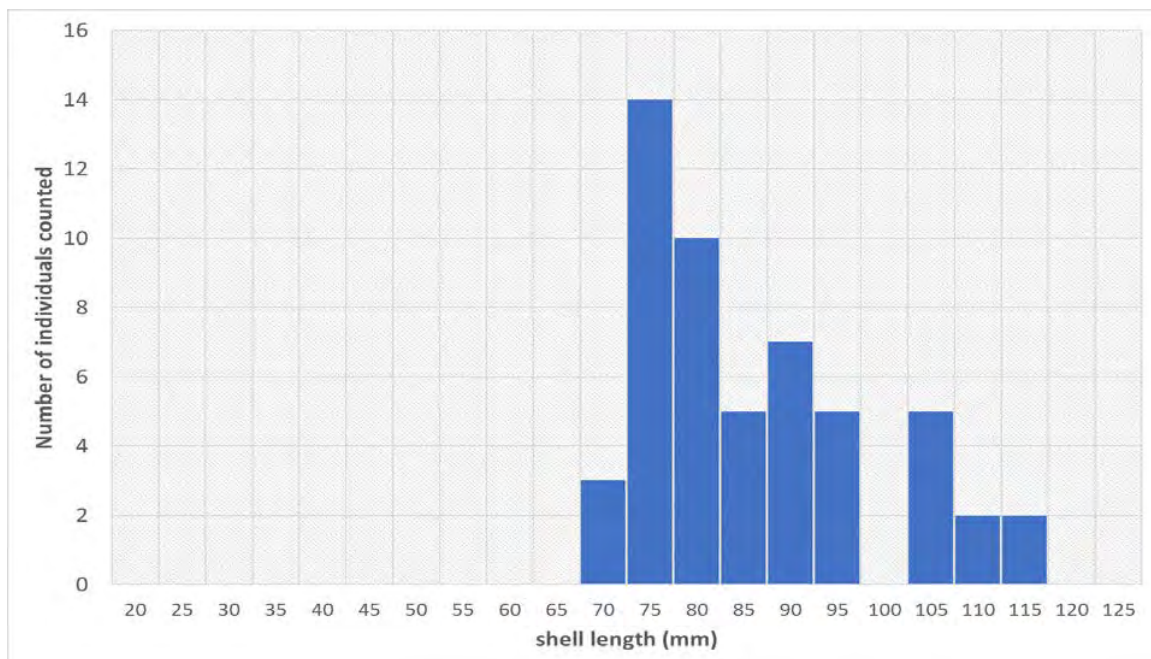


Figure 3-3: Length frequency of 50 fresh water mussel individuals collected from the lower Kaiapoi River in February 2016

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3.4.2 Dissolved oxygen monitoring

The odorous nature of the water scums and water discoloration indicated a potential for the Kaiapoi River to undergo dissolved oxygen sags or oxygen depression and production of odorous reduction chemistry. This would only occur if water moving back and forth in tidal cycles was not being adequately exchanged and there were no significant reaeration occurring. In summer 2017 a dissolved oxygen logger (ZebraTech) was deployed attached to the piles of the Mandeville Foot Bridge 30 cm off the river bed. Dissolved oxygen concentrations were recorded at 15 minute intervals.

Dissolved oxygen concentrations fluctuated diurnally and tidally, but were generally between 80% and 100% saturation, and minimum recorded dissolved oxygen concentrations were 60% of saturation (or approximately 6 mg/l). While there were discernible dissolved oxygen sags in the lower Kaiapoi River, there was no indication that they were generating significant hypoxic or anoxic conditions that could influence water quality degradation through reduction chemistry processes. Reduction processes include reduction of nitrate to ammonia, sulphate to sulphides, and carbon to methane etc., and nutrient mobilisation from the sediments.

3.4.3 Salinity monitoring

We considered the possibility that a recent establishment of frequent tidal salinity intrusion up the Kaiapoi River could be a significant factor causing many of the recent observations (Table 3-1). A literature survey to identify previous salinity investigations and data for the Waimakariri River and Kaiapoi River yielded little if any hard evidence of confirmed saline limits or salt wedge positions in either the Kaiapoi or Waimakariri Rivers. We expected that extensive investigations of meat works discharge plume studies in the lower Waimakariri River in the 1980s and 1990s would have yielded considerable information on Waimakariri tidal salinity measurements, however salinity dynamics were seldom mentioned. The setting of the 'Coastal Marine Area' boundary in the Canterbury Regional Coastal Environment Plan (CRC, 2005) between the sea and the mouth of the Kaiapoi River similarly appeared not to be based on any significant empirical salinity data. Finally, consideration from the position of whitebait spawning habitats on salt wedges had previously set the likely extent of salt penetration into the Kaiapoi River as the confluence with Courtenay Stream, but again this did not appear to be based on consistent empirical salinity data.

Our first objective was therefore to determine the spatial extent of salt penetration into the Waimakariri and Kaiapoi Rivers. We used a YSI Castaway CTD (Conductivity Temperature and Depth) profiler to 'prospect' for salinity presence on high tide periods off accessible bridges across the Kaiapoi River. Brackish to moderately saline (>25% seawater) was detected a number of times from the Williams Street, Mandeville, and Mafeking footbridges in January 2016. This indicated the prevailing understanding of little salt penetration beyond the Courtenay Stream confluence was either incorrect or had changed in recent years.

Three longitudinal surveys of salinity profiles were then conducted by boat with the YSI Castaway CTD along the length of the lower (tidal) Waimakariri River and/or Kaiapoi River in February 2016. Salinity depth profiles were conducted over a one hour period (half an hour either side of high tide) starting in the Waimakariri River and progressing upstream to and/or into the Kaiapoi River. The first survey was at a Waimakariri River mean daily flow of 80 cumecs (2nd February 2016), and showed the high tide upstream salinity limit ended just downstream of McIntosh's hole in the Waimakariri River (200 metres downstream of the confluence with the Kaiapoi River). A second survey (4 February 2016) at a daily mean flow of 62 cumecs in the Waimakariri River showed the upstream high tide salinity limit was only just reaching upstream to the mouth of the Kaiapoi River but not penetrating significantly into the Kaiapoi River. At a lower Waimakariri River flow (42 cumecs: 9 February 2016) the salinity influence penetrated at least 0.5 km upstream of the Kaiapoi River in the Waimakariri River, and penetrated strongly into and up the Kaiapoi River to west of Kaiapoi township. On this last occasion salinity intrusion patterns were demonstrated from over 50 individual salinity depth profiles conducted longitudinally along the Kaiapoi River (Figure 3-4).

Profiles in the Waimakariri River showed strong salinity stratification, with saline water dominating most of the depth of the water column (Figure 3-5). There was between 0.5 to 0.8 metres of freshwater at the river surface, a mixing zone between 1 to 2 metres deep below the fresh water, and then a full strength seawater layer between 2 to 5 metres deep to the river bottom. At McIntosh's hole there was a layer of

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over 5 metres of full strength seawater on the bottom of the river at the hole (the deepest part of the lower river that can be over 10 metres deep).



Figure 3-4: Schematic of the 53 depth profiles conducted on the Waimakariri and Kaiapoi Rivers on 9 February 2016. Numbers denote number of profiles conducted in each river reach, red lines indicate the approximate position of bridges, and arrows indicate water flow direction and significant tributary inflows

In the Kaiapoi River there was similar strong salinity stratification in the lower river, with approximately one metre of freshwater at the water surface, a further metre of mixed salt and fresh water below this, and up to two metres of seawater on the river bottom (Figure 3-6). Saline water penetrated continuously upstream to just east of the South Island Main Trunk Railway line bridge west of Kaiapoi. Strong stratification patterns were maintained throughout the Kaiapoi River, with 0.5 to 0.8 metres of freshwater at the surface, but the deeper saline water steadily decreased in salinity up river to less than 25% seawater at the upper sites. At the South Island Main Trunk Railway bridge there was no stratification and the water column was all fresh water. This indicated this was the upstream limit of the salt wedge, although regular tidal water level changes of over one vertical metre continued for a further 500 metres upstream to beyond the three streams confluence.

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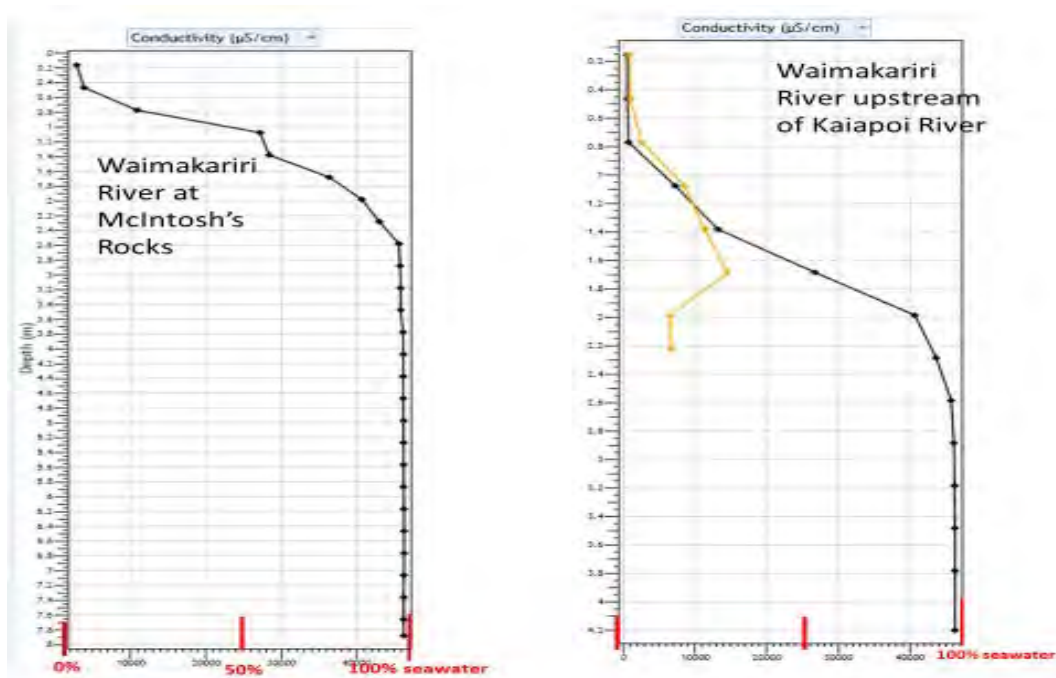


Figure 3-5: Representative CTD profiles from the Waimakariri River on 9 February 2016. Conductivity is a measure of salinity (At the time of sampling 5000 $\mu\text{S}/\text{cm}$ = 100% seawater)

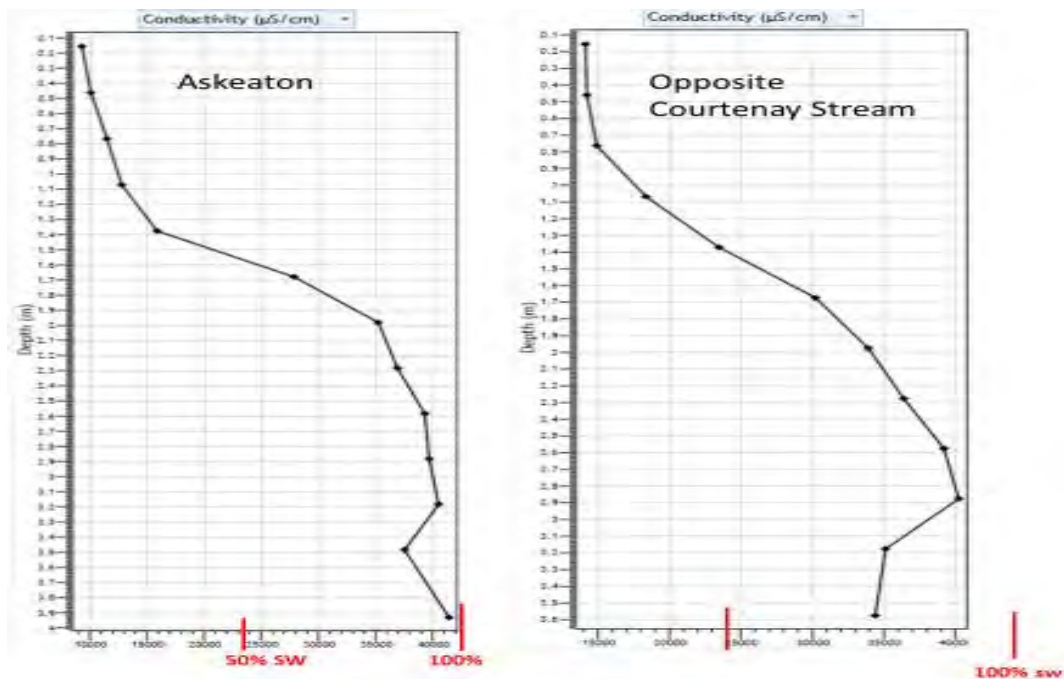


Figure 3-6: Representative CTD profiles from the lower end of the Kaiapoi River on 9 February 2016. Conductivity is a measure of salinity (At the time of sampling 5000 $\mu\text{S}/\text{cm}$ = 100% seawater)

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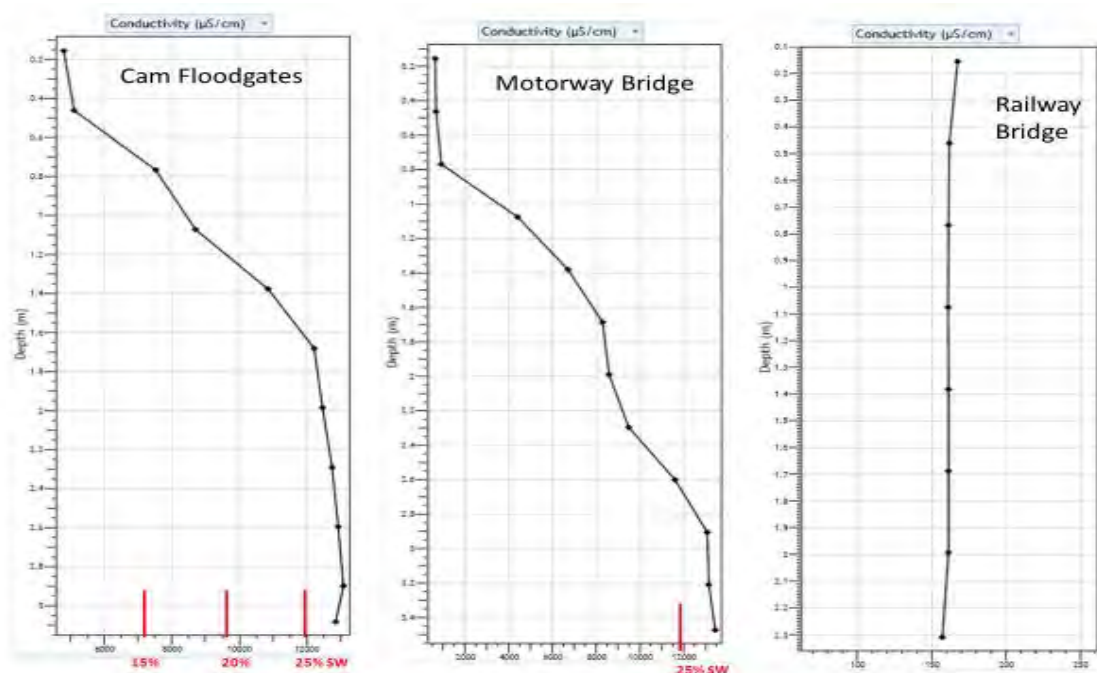


Figure 3-7: Representative CTD profiles from the middle and upper end of the Kaiapoi River on 9 February 2016. Conductivity is a measure of salinity (At the time of sampling 5000 uS/cm = 100% seawater)

Once we established that salinity penetrated west of Kaiapoi township, it became important to understand the frequency or duration of these saline incursions.

AquaTROLL 100 salinity loggers were deployed on a steel frame and strapped to a bridge pile in the deepest channel position on the Mandeville Footbridge 200 metres upstream of the Williams Street bridge in Kaiapoi. This sampling position was chosen as it was easily accessible to the public boat ramp, and was central to public interest and activities on the river in Kaiapoi. Loggers were initially deployed only at one position 30 cm off the riverbed (in approximately 2 m water depth at low tide and 4 m water depth at high tide: (Figures 3-8 and 3-9). Loggers were set to collect data at 15 minute intervals. The sensors were protected with copper coil covers to minimise biofouling of the sensor probes, a particular concern in marine or saline environments. They were recovered and cleaned at monthly intervals.

The first salinity logger was deployed on 21 February 2017 and data first downloaded on 17 March 2017. These data are presented in Figure 3-10. Saline intrusion events were detected two days after deployment, firstly on only a single tide, and then on sporadic occasions on only a single tide each day, and then continuously on both daily tides every day from the beginning of March to mid-March. Initial saline intrusion events were strongly brackish but less than 50% seawater, however, once a continuous salinity pattern established on every tide, the peak saline concentration ranged from 70-80% seawater.

A second datalogger was deployed on 21 March at a position 30 cm below the low tide level and approximately 2 metres off the river bottom (Figure 3-9). Both salinity loggers were then next downloaded on 18 October 2017. There were regular extended periods of salinity intrusion on the riverbed through Kaiapoi between March and July 2017 (Figure 3-11). These largely replicated the March 2017 pattern of twice daily tidal salinity intrusions and with up to 80–90% seawater concentrations at high tide at the Mandeville Bridge. These saline tidal periods became more sporadic or of shorter duration in July and were totally absent from mid-July to the end of October 2017.

Both dataloggers were re-deployed on 3 January 2018 and then data downloaded on 14 May 2018. These largely replicated the summer 2017 pattern of periods of twice daily tidal salinity intrusions and with up to 80–90% seawater concentrations at high tide at the Mandeville Bridge (Figure 3-12). These

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saline tidal periods were strongest in early January, and late January/early February, but with shorter periods of saline intrusion through February, March and early April, and were totally absent from mid-April and May.

Fine detail of individual tidal salinity incursions from early March 2017 are shown in Figure 3-13. Initially all salt water had left the river at low tide but over successive tides a residue of salinity remained present at low tide. This residue may be slower outwash of salt from salt penetrating into bed sediments, or ongoing loss of salt from poorly flushed areas along the margins of the river. On each tidal cycle the period of salt intrusion was similar to the period dominated by freshwater conditions. As the saline water arrived at Mandeville Bridge it appeared as a two-step process with an initial rise in brackish water that briefly plateaued, and then a rapid rise to a sustained highly saline period over high tide of approximately 4-6 hours.

During each tidal cycle the river was exposed to high salinity for 4-6 hours, exposed to brackish water for a further 2 to 4 hours, and freshwater for 2 to 6 hours. During these times the Kaiapoi River is therefore behaving like a long narrow estuary illustrating complete exchange of saline and fresh water at (and above) the Mandeville Bridge.

The salinity data at the mid water column level (low tide level) was generally lower salinity than on the river bottom (Figures 3-14, 3-15, 3.16). When salinity was detected on the riverbed, the water at mid water column was also always of elevated salinity but the variable salinity indicated this logger was in the mixing zone between fresh and saline water (see Figures 3-5, 3-6 and 3-7). For the period shown in Figure 3-14, only one tide showed both loggers recording high strength seawater. However, in later events Figure 3-15; 3-16) the salinity at the two water column heights was often similar. This shows that the depth of the salt wedge may vary greatly at different flows and tide heights, but can routinely exceed at least two metres of water depth (50% of the high tide water column). During periods where both loggers are recording high salinities, saline water will be in contact with the entire width of the river and covering all submerged bed sediments.

The initial CTD profile results indicated that river flow in the Waimakariri River (40–80 m³/s) appeared to have a significant influence on whether tidal salt water penetrated up the Waimakariri River to the Kaiapoi River mouth, and subsequently into the Kaiapoi River. We plotted Waimakariri River mean daily flows alongside the salinity incursion data from 2017 to identify whether the logger data also illustrated this relationship. A mean daily flow hydrograph was plotted below the salinity data in Figure 3-17 for the February-March sampling period. This shows that the salinity incursions only became continuous on every tide when Waimakariri River flow dropped below 40 m³/s. These data appeared to corroborate the earlier CTD data for the onset and cessation of salinity intrusion at Waimakariri River flows between 60 and 40 m³/s. There was a pattern with river flows for the full 2017 sampling period February to October 2017 (Figure 3-18), although the relationship is not perfect, as there are lower flow periods in May 2017 that did not result in full salinity intrusion. Beyond July 2017, a total absence of salinity intrusion incidents matches with continuous flows in the Waimakariri River above 70 m³/s. However further investigation into all possible factors affecting salinity intrusion will be required, including the hydrology of the Kaiapoi tributaries, and variation in tidal heights (particularly spring to neap tides).



Figure 3-8: Mandeville Bridge at low tide looking upstream from Williams Street Bridge, showing salinity logger placement (red dot), and indicative depth profile (red line)

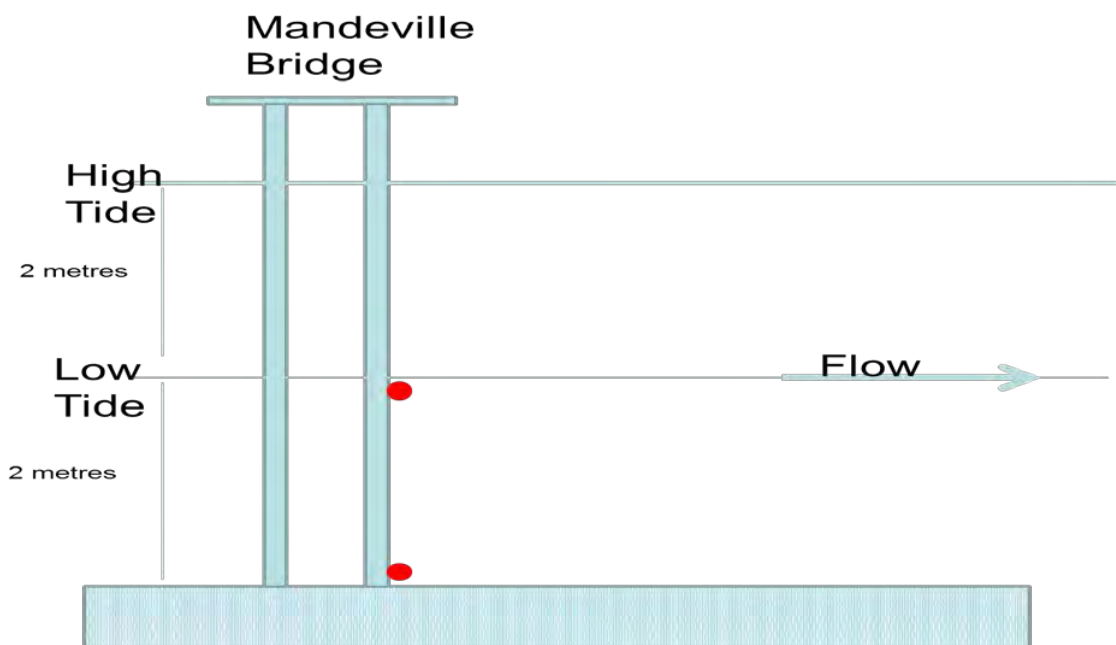


Figure 3-9: Structure and placement of salinity loggers on the Mandeville Bridge

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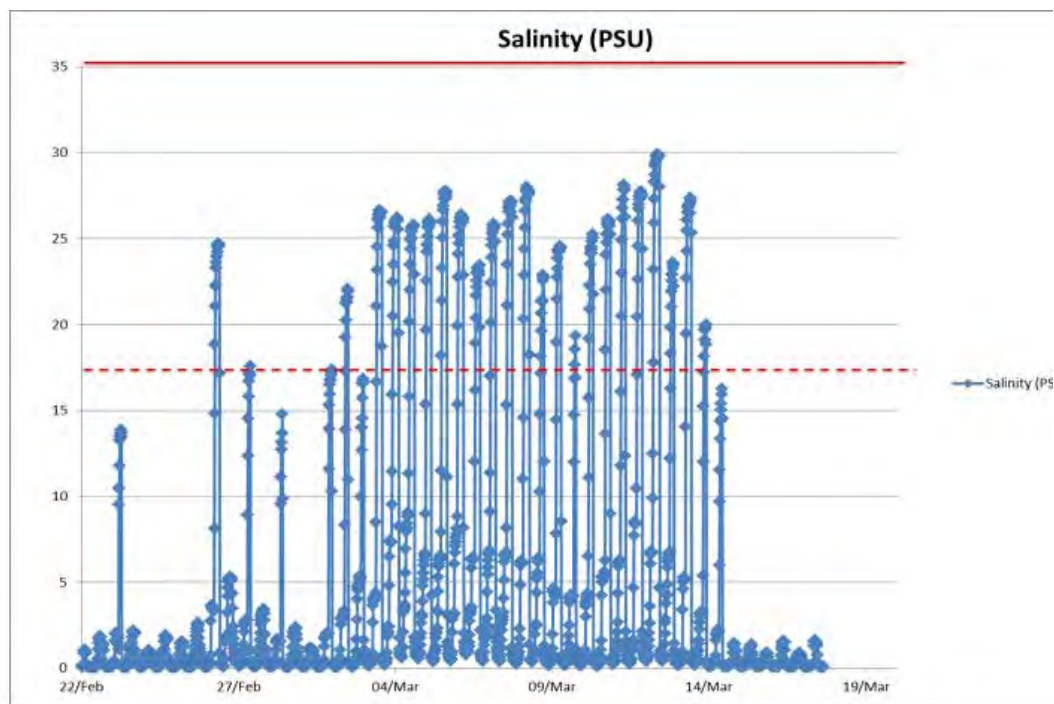


Figure 3-10: Salinity in the Kaiapoi River near the river bed (February/March 2017). Red line indicates 100% seawater, dashed line indicates 50% seawater

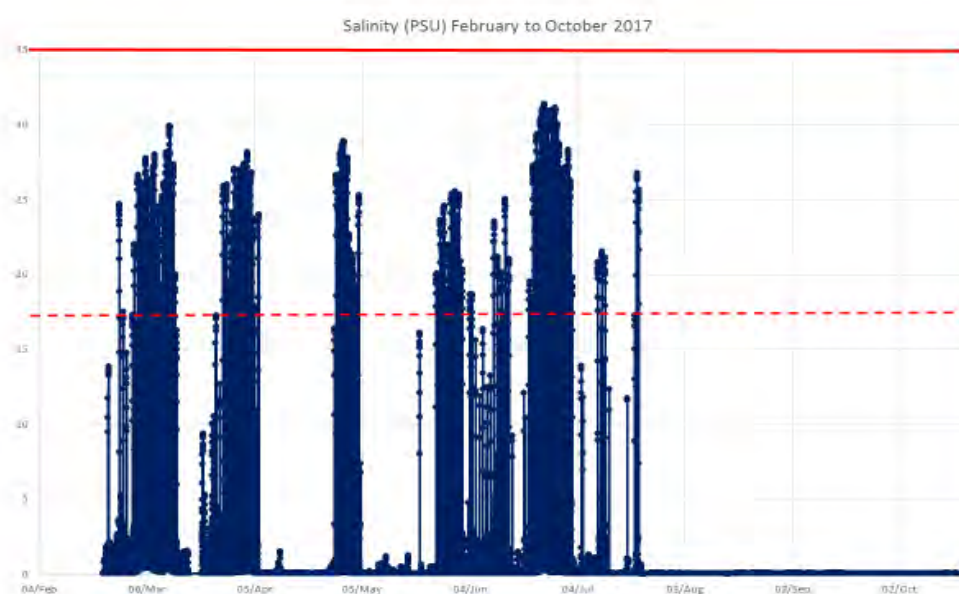


Figure 3-11: Salinity in the Kaiapoi River near the river bed (February/October 2017). Red line indicates 100% seawater, dashed line indicates 50% seawater

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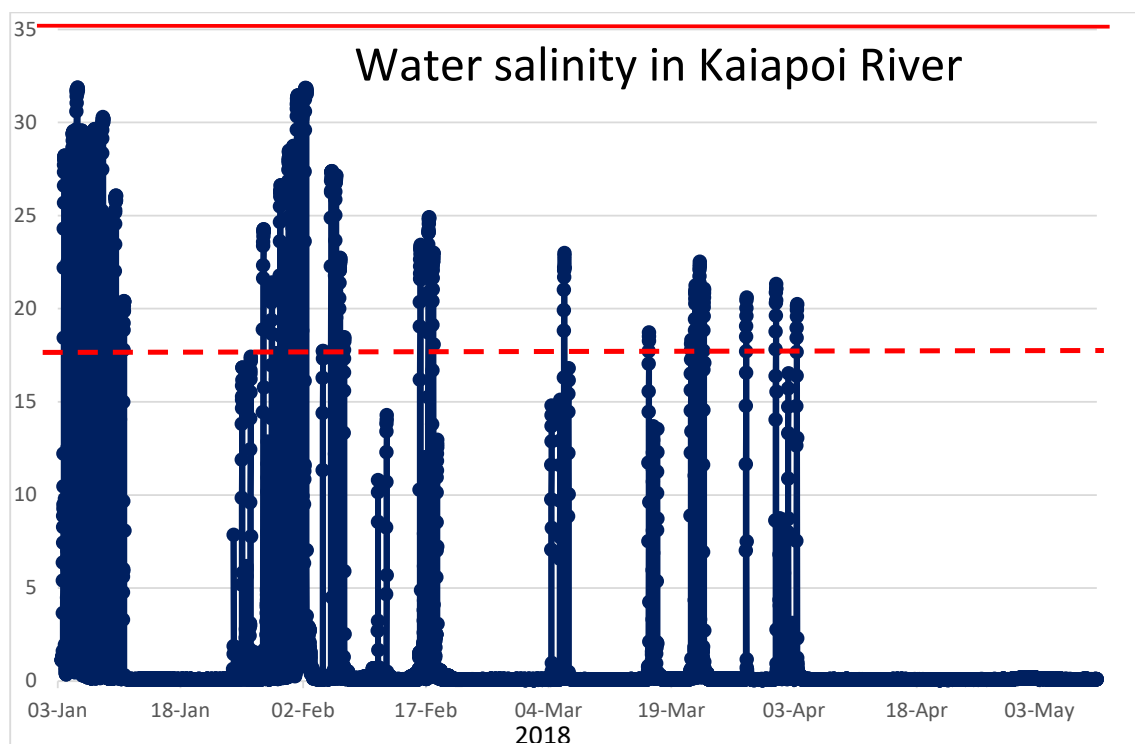


Figure 3-12: Salinity in the Kaiapoi River near the river bed (January to May 2018). Red line indicates 100% seawater, dashed line indicates 50% seawater

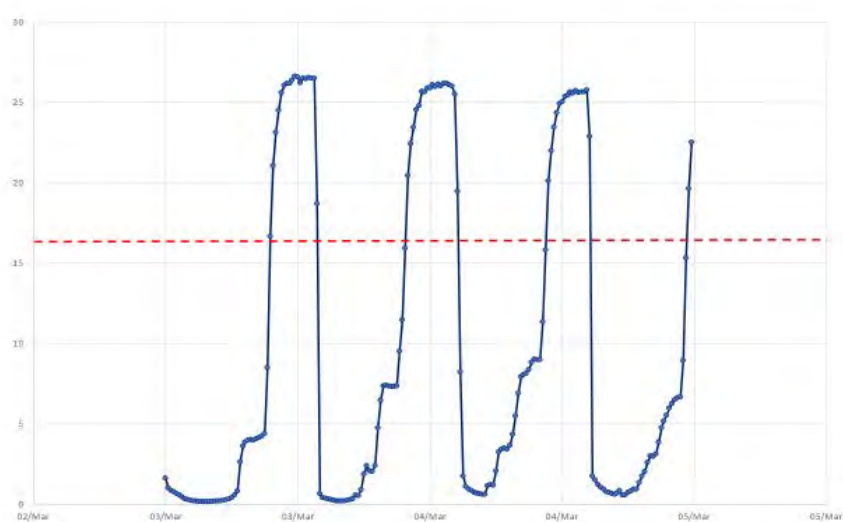


Figure 3-13: Fine detail of tidal salinity results from four tides in March 2017. Dashed line indicates 50% seawater

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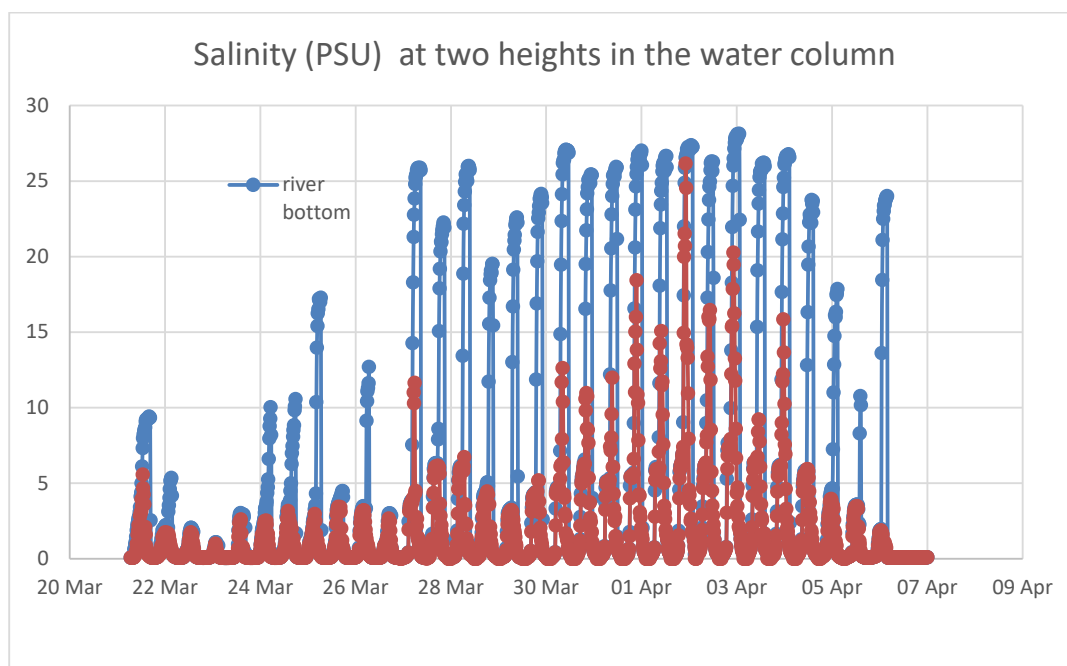


Figure 3-14: Salinity at two heights in the water column (near the bed (blue) and 2 m above the bed (red)) in the Kaiapoi River, March-April 2017

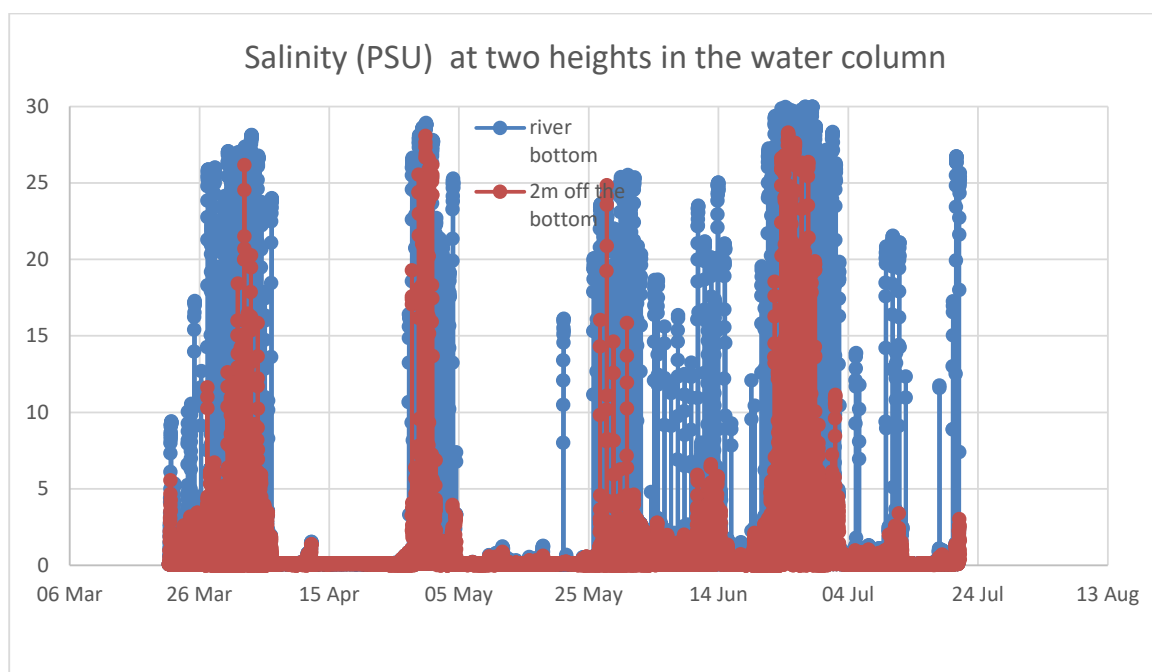


Figure 3-15: Salinity at two heights in the water column (near the bed and 2m above the bed) in the Kaiapoi River, March-October 2017

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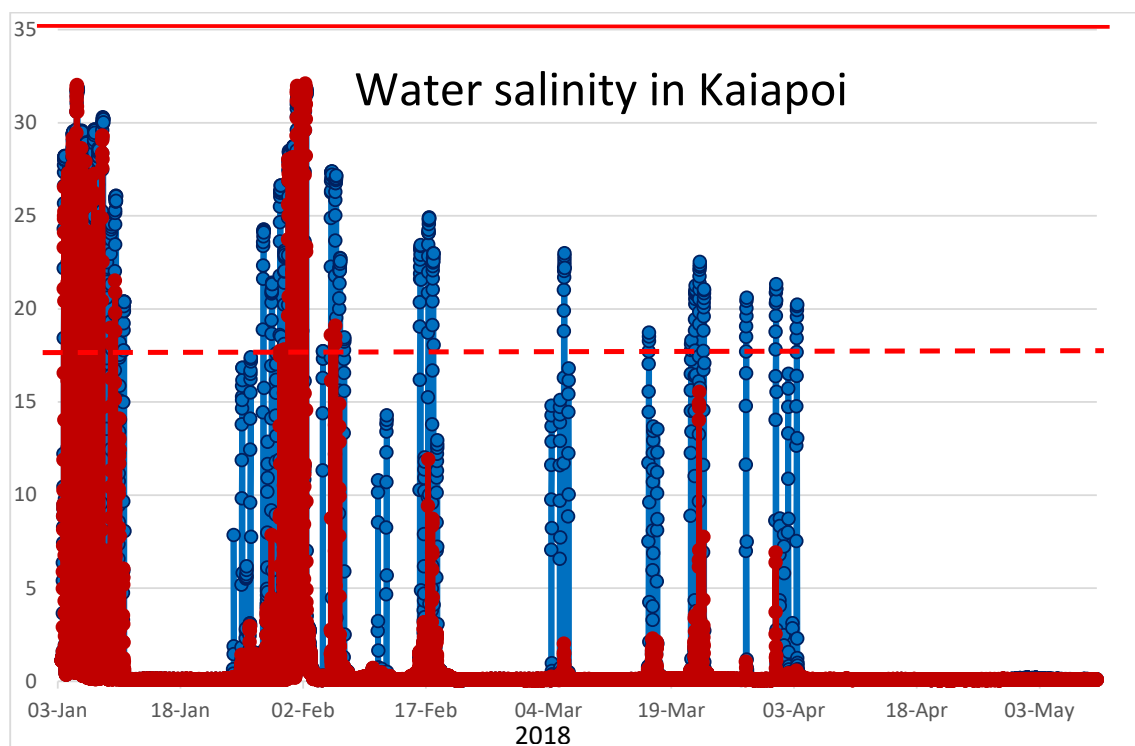


Figure 3-16: Salinity at two heights in the water column (near the bed (blue) and 2m above the bed (red)) in the Kaiapoi River, January to May 2018

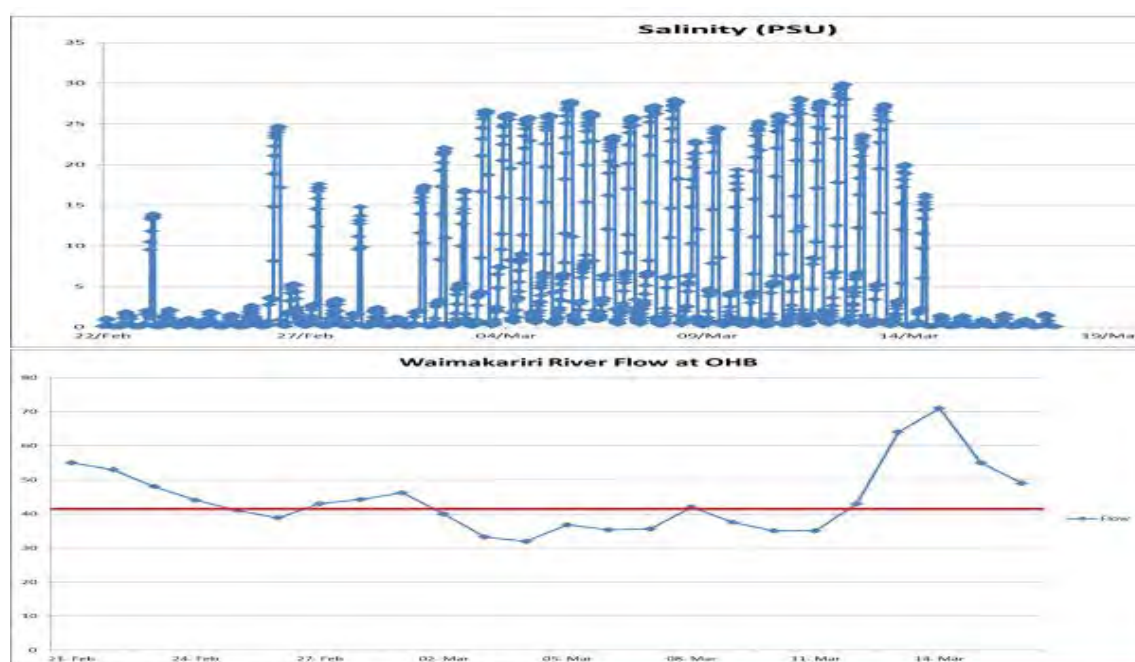


Figure 3-17: Salinity in the Kaiapoi River aligned with daily river flows (m^3/s) in the Waimakariri River (at SH1) for the period February/March 2017

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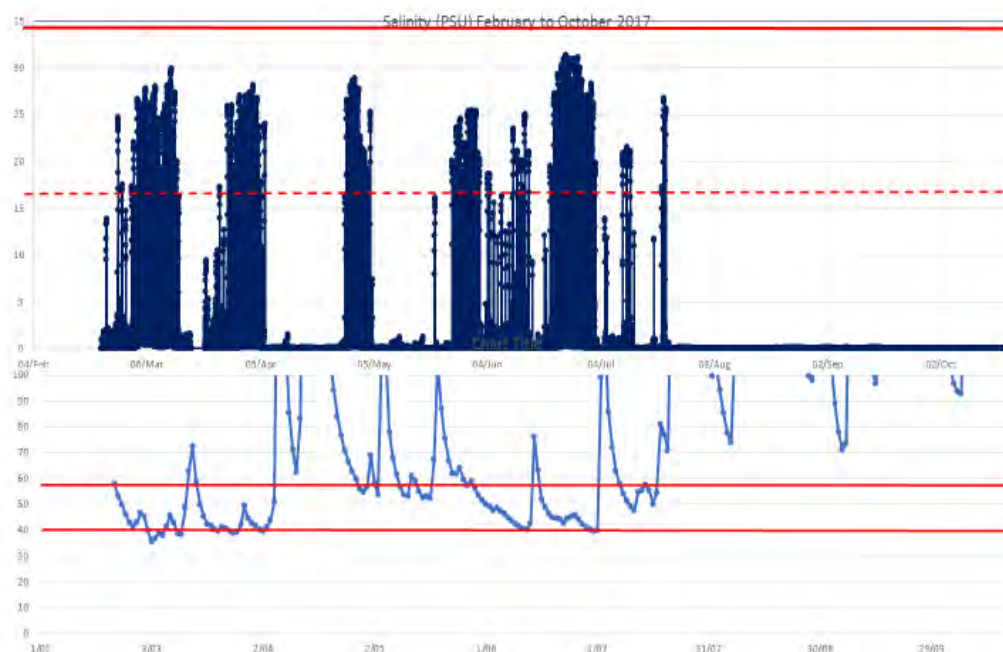


Figure 3-18: Salinity in the Kaiapoi River aligned with daily river flows (m^3/s) in the Waimakariri River (at SH1) for the period February/March 2017

4 Discussion

There were a range of public complaints about visible adverse water quality and aquatic habitat conditions in the lower Kaiapoi River. Most of these visual observations were able to be substantiated from independent observations. The lower Kaiapoi River does exhibit periods of algal blooms, river scums, and slime or mat growths on the beds and banks. There is evidence of extensive riverbed macrophyte bed collapse and places where river edge willows exhibit poor health or die back. However biological responses of the aquatic fauna are less clear cut. We documented an abundant population of freshwater mussels near the mouth of the Cam River, but they appear to be a relict population of old age individuals that may not be successfully breeding, and therefore abundant visible shell material may indicate ongoing rather than recent increases in mortality of this population. Large individuals of freshwater mussels may be decades old.

We could not independently substantiate the poor state of the resident trout fishery and their food sources, but loss of the macrophyte beds can affect both habitat and production of river resident trout populations. Further comments from other members of the public indicated that salmon and migratory [sea-run] trout fisheries in the Kaiapoi River were improving in contrast to the reports on the loss of the river resident trout populations. These contrasting opinions may reflect changing river conditions promoting improvements in alternative fisheries utilising different habitats and water quality rather than these observations being conflicting.

The greatest challenge is identifying and attributing causes to these described adverse effects. There was a vigorous argument that these effects predominantly result from excessive herbicide [Glyphosate] use for aquatic and bankside weed control in upstream catchments. This issue has been addressed elsewhere by Waimakariri District Council (WDC) investigations. The results of these WDC studies, and the large amount of available dilution in the tidally flushed lower Kaiapoi River suggest a sole cause of river degradation being due to residual glyphosate toxicity to be highly unlikely.

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The visible algal blooms in the river, and algal mats on the river banks are likely to be predominantly a result of the high degree of nutrient enrichment of contributory catchment streams (Wilks and Meredith 2009; Greer and Meredith 2017) and the increased residence time of catchment water and nutrient loads in these tidal waterways. This catchment nutrient issue is acknowledged and is a particular focus of the WWZC solutions programme. Nutrient dynamics and responses in tidal waterways are a complex interaction of flow directions, different water sources, water residence time, and internal recycling of nutrients from the bed sediments. For this reason nutrient dynamics in such tidal waterways are seldom studied in-situ. The current observations of several episodes of algal blooms occurring in these tidal reaches suggest this may be a significant issue for water quality through Kaiapoi. More scrutiny of this issue and scoping of a more intensive study could be considered if this issue was to be more effectively understood and managed.

The ecological responses (die-back) of the plant and animal communities remained largely unexplained by conventional physico-chemical river water quality data (nutrients, colour and clarity, dissolved oxygen, pH etc.). However, the finding of strong saline intrusions up the Kaiapoi River provides a plausible alternative cause for all of the observations and effects (Table 3-1). Previous understanding was that the lower Kaiapoi River was predominantly a strongly tidal environment but without significant saline influence, or with only rare episodes of saline intrusion. The river was understood to be a freshwater environment that benefitted many port and recreation activities. This is a common occurrence in many lowland rivers where the saline intrusion reach is relatively short, but the tidal freshwater reach extends long distances inland (i.e. Avon River, Heathcote River, and Styx River in Christchurch; Otupua Creek, Washdyke Creek in Timaru). We have now demonstrated from sampling in 2016, 2017 and 2018 that tidal saline intrusion up the Kaiapoi River can extend over most of the tidal reach, and this can now be a frequent occurrence in summer and autumn, or any time the Waimakariri River flows remain particularly low.

Many aquatic macrophyte communities are not tolerant to exposure to salt water. The public observations of the macrophyte die-off commencing around 2012 suggest a change in saline intrusion up the river occurred at or about this time. The challenge is to determine whether there were changes to any of the attributes that affect saline intrusion, that occurred in the 2011/2012 period and that could directly generate the subsequent saline intrusion patterns. These could include changes in river bed levels, sea levels/ tide heights, and river flow levels.

The 2011 Canterbury earthquakes caused considerable damage to land and waterways in Canterbury, and particularly to Christchurch and Kaiapoi, with extensive areas of land subsidence. In particular, areas of land either side of the Kaiapoi River subsided and are now “red zoned” as high earthquake damage/earthquake risk. The Ihutai/Avon Heathcote Estuary in Christchurch tilted on its axis and bed levels changed affecting tidal and outflow drainage patterns. It is therefore conceivable that the Kaiapoi River bed levels may have similarly subsided allowing easier access of saline waters into the Kaiapoi River. Preliminary surveys of the bed of the Kaiapoi River since the earthquakes indicate that river bed levels have not changed appreciably (A. Boyle, Environment Canterbury, pers. com.). However, bed levels may have subsequently infilled through bank slumping and lateral spread of sediments back into the river channel. There continues to be ongoing community pressure to initiate dredging of parts of the lower Kaiapoi River, particularly identified high points along the lower channel, to maintain effective navigation. This ongoing dredging requirement (pre- and post-earthquakes) adds further to an understanding that river bed levels may not have appreciably dropped since the earthquakes. Our understanding of river bed levels therefore remains somewhat uncertain, particularly as pre-earthquake bed levels/profiles were not consistently characterised.

It is also possible that the bed levels of both the Kaiapoi and Waimakariri River beds may have simultaneously dropped during the earthquakes, allowing increasing tidal salinity incursions upstream in both the Waimakariri and Kaiapoi rivers. This could further confuse our interpretations.

The river CTD profiling in 2016 indicated that Waimakariri River daily mean flows had a strong influence on inland penetration of saline water up the Waimakariri River. Waimakariri River flows may therefore have a direct effect on whether salt water penetrates upstream on high tides to the mouth of the Kaiapoi River. Subsequent saline intrusion patterns up the Kaiapoi River will then firstly be determined by any difference in bed levels between the bed of the Waimakariri River and Kaiapoi River (the Kaiapoi River bed likely being perched above the bed level of the Waimakariri River). Thereafter, saline penetration

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will be determined by whether Kaiapoi River catchment flows (the combined flows of the Cam, Cust, Ohoka, Silverstream, and Courtenay streams/ rivers) exert any limitation to upstream saline intrusion inflows. We have not determined any relationship with Kaiapoi River catchment flows as such data are sporadic and need to be determined from summing of correlations or estimates of the flows of the five contributing spring-fed catchments. Current understanding is that flows in the five contributing catchments have not changed appreciably in recent years (Megaughin and Hayward 2016). It appears unlikely that Kaiapoi River catchment flows have changed, or are exerting much control over saline intrusion up the Kaiapoi River, as once saltwater enters the Kaiapoi River, it appears to regularly penetrate to well west of Kaiapoi. This may also be because the Kaiapoi River catchment summer flows are low ($<5 \text{ m}^3/\text{s}$) compared to the large channel size of the lower Kaiapoi River.

Subsequent saline intrusion data in 2018 were obtained at a time when district groundwater levels were very high, and the five spring fed river systems supplying the Kaiapoi River had seasonally high base flows. Despite these higher contributing catchment flows, there were still many summer saline intrusion events up the Kaiapoi River. This further suggests contributing tributary flow rates may exert little effect on saline intrusion up the main channel of the Kaiapoi River.

A preliminary analysis of the frequency of low flow ($<45 \text{ m}^3/\text{s}$) days in the Waimakariri River over the 50 years of record at SH1 show that the frequency of low flow days has been highly variable over 1967 to 2005 (Figure 4-1). There was an early sustained dry weather period (1969 – 1973) with a high incidence of low flow events, but from 1973 to 2004, years with large numbers of low flow days were intermittent and occurred on average once every 5 to 10 years. Since 2005 periods of extended low flows have become more regular or consistent (except for 2011) with over 7 weeks of cumulative low flow days each year. This possible change in flow pattern may be influenced by lower rainfall weather patterns and/or increased water use/allocation as extensive irrigation scheme development and abstraction and land irrigation has increased over this time.

From this preliminary Waimakariri River flow data, it could be expected that saline intrusion events could have become more common since 2005. However, this does not fit with the public observations of plant die-off commencing in 2012.

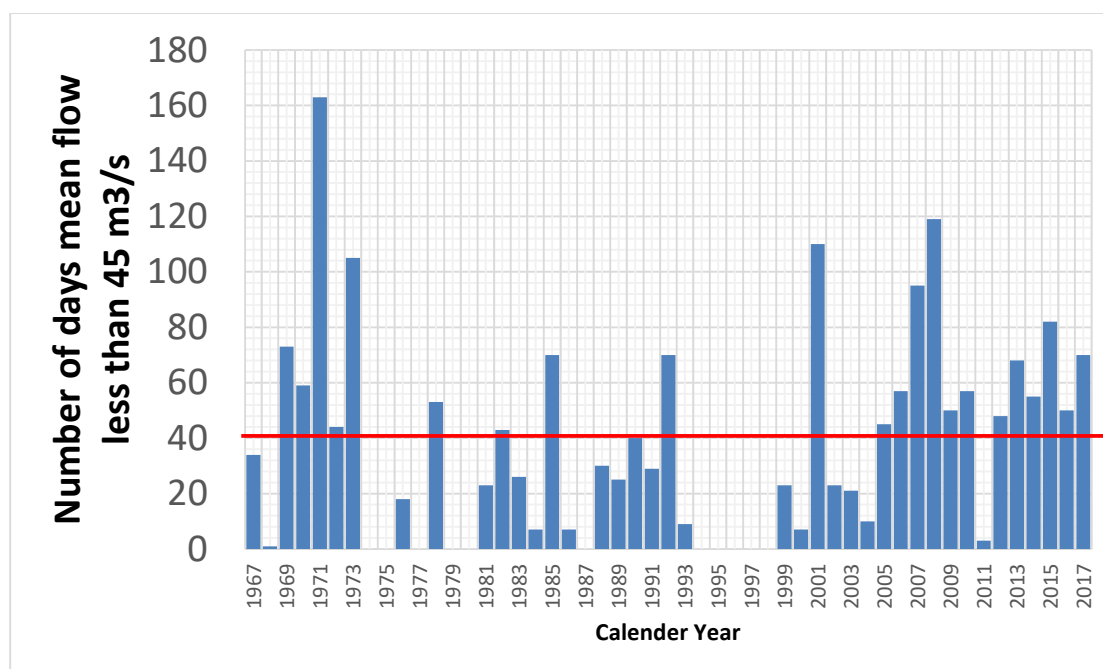


Figure 4-1: Number of days per calendar year that the Waimakariri River daily flows are at or less than 45 cumecs at SH1 recorder for the period 1967 to 2017. Red line indicates 42 days (7 weeks) of low flow duration

Assessment of the state of a tidal waterway - the Lower Kaiapoi River

Overall, these initial results illustrate that saline water is currently penetrating a long way up the Kaiapoi River. There is no evidence to demonstrate that this has not previously occurred, but the biological communities (extensive weed beds and accompanying resident trout fisheries) previously existing in the river suggest this is unlikely. The recent observations of macrophyte bed die-back and willow ill health are consistent with this saline intrusion pattern being a recent feature since 2011/12. The definitive causes of this pattern are not clear, but may relate to a number of influences including possible earthquake induced changes in river bed levels and reduction in Waimakariri River flows particularly over summer/autumn. These are deserved of further study.

There appears to be little to impede tidal saline intrusion from penetrating a long distance up the Kaiapoi River when salt water in the Waimakariri River penetrates up to or beyond the Kaiapoi River mouth. There are no obvious structures, changes in gradient, or high points present in the riverbed that would be expected to impede tidal and salinity movement up the Kaiapoi River until the reach near the SI Main Trunk Railway bridge. Increased gradient changes would be indicated by riffle-like structures or visible increases in low tide outflowing water velocity or turbulent water. Recent maintenance dredging adjacent to the Lineside Road floodgates (downstream of the Railway Bridge) transferred a large quantity of gravel into the Kaiapoi River channel immediately downstream of the Lineside Road floodgates, forming a significant visible riffle structure. This new riffle structure may now represent a new upstream limit or control for salinity penetration up the Kaiapoi River.

This study indicates that saline intrusion up the Kaiapoi River to the west of Kaiapoi is now a routine or normal feature of the river environment particularly over summer/autumn periods. This finding should be acknowledged and become a consideration for river management and river edge development actions into the future. Presence of saline water in the river will influence the viability and choice of river planting plans, consideration of materials used in structures proposed for the river bed or banks, and activities that may be sensitive to saline water in the river water and bed. The navigable and port areas of Kaiapoi should now consider infrastructure and activities to be located in a tidally saline environment for much of the summer and autumn period.

This change in salinization of tidal river reaches is not unusual in river systems and has occurred elsewhere. The Heathcote River in Christchurch is an appropriate case study to compare the Kaiapoi River. In 1986 a response to flooding issues in the Heathcote River led to the development and opening of the 'Woolston Cut' – a canal that cut off a loop in the river to allow less restrictive flood outflows. Within a short time of the cut being commissioned it was noted that willow trees were dying, and banks became unstable with blocks falling into the river. It became apparent that salt water was penetrating almost 2 kilometres further upstream as a result of the "cut" than it had done previously and led to a series of adverse ecological responses (Roper-Lindsay, 1994). The solution chosen to address these effects was construction of a tidal barrage structure to restrict the upstream tidal movements and therefore prevent salt intrusion beyond the barrage.

Similarly, the Styx River, a south bank tributary of the Waimakariri River, had floodgates installed to both reduce tidal flooding issues and to limit salt intrusion up the Styx River. Interestingly, the willow trees have all died in recent years below the Styx River floodgates and remain healthy above the floodgates. Both of these local river cases involved responses to increased upstream penetration of saline water and accompanying adverse environmental effects on the bed, banks and plant communities, similar to those being seen since 2012 in the Kaiapoi River.

Elsewhere in New Zealand, there have been other studies to document and manage the increased upstream movement of saline water in tidal reaches of rivers. The Whakatane River is a significant drinking water source for Whakatane township in the Bay of Plenty, but the intake site is increasingly being compromised by saline inundation during low flow periods (Tukey *et al.*, 2013). There is also penetration of saline water increasing distances up the Manawatu River as river flows have decreased (Gee *et al.*, 2017). This issue of varying saline penetration up tidal rivers, particularly as flow regimes are altered, is therefore not an unusual issue, and can develop under changing river management.

Under most climate change scenarios, increased sea level rise from global warming will similarly push salt water further upstream in many low gradient coastal rivers exacerbating many of these issues.

Assessment of the state of a tidal waterway - the Lower Kaiapoi River

The recent patterns seen in the Kaiapoi River may therefore only be an early onset of issues that might well have occurred in decades to come under climate change scenarios.

Responses or options to manage this increased salinization of the Kaiapoi River may need to be considered, as occurred with the Heathcote and Styx River examples. Alternatively, future management of the Kaiapoi River could simply adapt to the changing state, and acknowledge that the Kaiapoi River will at times now be a long narrow saline estuary rather than the previous freshwater tidal river.

5 Conclusions and recommendations

5.1 Conclusions

Public observations of visible features of river degradation were corroborated via our site visits. The main indicators of degradation are:

- Episodes of algal blooms, scums, and bankside algal mats
- Submerged macrophyte bed die-off
- Willow die-off or ill-health

While there were a range of potential causes of the described river degradation, nutrient enrichment and salinity intrusion were the most plausible and consistent causes.

Nutrient enrichment issues in zone waterways and groundwater are already under scrutiny by the Waimakariri Water Zone Committee. Assessment and solutions for the contributing upstream catchments are being considered.

Regular saline intrusion up the Kaiapoi River changes our understanding of the nature of the lower Kaiapoi River, in that it has recently become a long narrow saline estuarine environment, rather than a freshwater tidal environment.

The direct cause of this change in saline tidal influence are not simple, but may relate to possible change in both river bed levels and lower flows in the summer in the Waimakariri River.

Knowledge can also be gained from other nearby rivers that have undergone similar salination issues. These can assist in assessing responses or solutions to these changes.

5.2 Recommendations

We recommend that further work is undertaken to understand environmental quality drivers in the Kaiapoi River. This includes:

1. Investigation into 2011 earthquake effects on river bed and bank levels of both the Kaiapoi and Waimakariri Rivers.
2. A study of the interactions between the Waimakariri River flows and tidal heights, to explain the distance upstream and duration of saline intrusion from the sea.
3. A wider study into the interactions between the Waimakariri River and the Kaiapoi River and its tributaries, particularly the influence of the hydrology of both rivers.
4. Continue ongoing continuous salinity monitoring in the Kaiapoi River to increase the breadth of the database for subsequent study and modelling. This should include monitoring over extreme periods such as "king tides" and when high flow periods in the Kaiapoi River correspond with low flow periods in the Waimakariri River.

Assessment of the state of a tidal waterway - the Lower Kaiapoi River

5. Investigate nutrient dynamics (nutrient retention, nutrient cycling, and retention time) in the tidal reaches of the lower Kaiapoi River to allow increased understanding of the drivers and solutions to the currently observed detrimental algal blooms
6. Collation of common solutions to salinization of rivers to assist the community to assess the benefits and detriments of different river management options.
7. Proactively Inform interested parties (with zone delivery support) of the key findings of this investigation, to assist in their wider decision making and river management planning.

6 Acknowledgements

We thank members of the Waimakariri community for taking an interest in the Kaiapoi River, communicating their concerns, and freely entering into conversations on these issues.

7 References

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AGENDA ITEM NO: 3	SUBJECT: DairyNZ Nutrient Mitigation Report – Briefing	
REPORT TO: Waimakariri Water Zone Committee		MEETING DATE: 13 August 2018
REPORT BY: Charlotte Wright, Senior Policy Advisor – DairyNZ		

PURPOSE

This agenda item provides the committee with an opportunity for Dairy NZ to present the findings and implications from its recently completed nutrient mitigation modelling report.

This update will focus on:

1. Mitigation Modelling of case study farms (Rachael Davidson)
2. Farm implications of N loss reductions (Katherine McCusker)

The purpose of this briefing is to assist the Zone Committee in understanding the findings and implications and give the Zone Committee an opportunity to ask any questions of DairyNZ

RECOMMENDATIONS

- The Zone Committee are asked to receive this update for its information, and with regard to the committee's preparation of the Waimakariri Land and Water Solutions Programme draft recommendations, and 2018 community engagement priorities.

BY WHO

- This briefing will by:
 - Rachael Davidson, Economist, DairyNZ
 - Katherine McCusker, Regional Sustainability Leader at DairyNZ (Canterbury & West Coast)

BACKGROUND

Waimakariri Nutrient Reduction Options towards Limit-setting: Economic impacts and on-farm Implications

Overall summary

In our view, Good Management Practice (GMP) is a minimum requirement in the Waimakariri Zone. What is less clear, is the extent of nutrient reductions required to achieve ecological, socio-cultural and economic goals for the zone, as set out under the Waimakariri Zone Implementation Programme.

Mitigation Modelling for the Waimakariri Zone

Recent mitigation modelling of five case study farms in the Waimakariri zone has been undertaken by DairyNZ.¹ This modelling compared reductions in nitrogen loss to meet GMP and beyond, with predicted impacts on farm profitability (or ability to remain viable), and found varying impacts from N loss reductions on farm profitability. Reductions to meet GMP

¹ Mitigation Modelling for Dairy Farms in the Waimakariri Zone: The impact of implementing farm-system mitigations to reach nitrogen Good Management Practice (and beyond) on farm profitability. DairyNZ 2018

are predicted to reduce profitability by up to 16 percent. Further reductions (beyond GMP) of up to 22 percent resulted in reductions in operating profit of up to 48 percent from the base, not considering interest and tax expenses. When interest and tax expenses are included, these impacts on farm viability could be severe.

For some farms, reductions are required to achieve their GMP Loss Rate when starting from their base/current state (Nitrogen Loss Calculation). Figure 1 shows the abatement curves for the five case study farms from the base/current state. It compares the required reduction in nitrogen leaching to the predicted change in operating profit. Operating profit can be defined as a profit from business operations (total farm revenue minus operating expenses) before deduction of interest and tax (EBIT measure). Nitrogen loss reductions needed to achieve the GMP Loss Rate ranged from 0 to 48 percent with associated profit reductions ranging from 0 to 16 percent. For some farms reaching GMP meant adjusting the farm system and consequently, reducing profitability. However, for others, the target GMP Loss Rate was achieved with few financial costs through improving irrigation efficiency, assuming pasture production was not reduced. Improvements in irrigation efficiency and farm management practices (effluent, fertiliser and supplements) seem to be sufficient if farms are to achieve GMP nitrogen loss targets, but at reduced profitability.

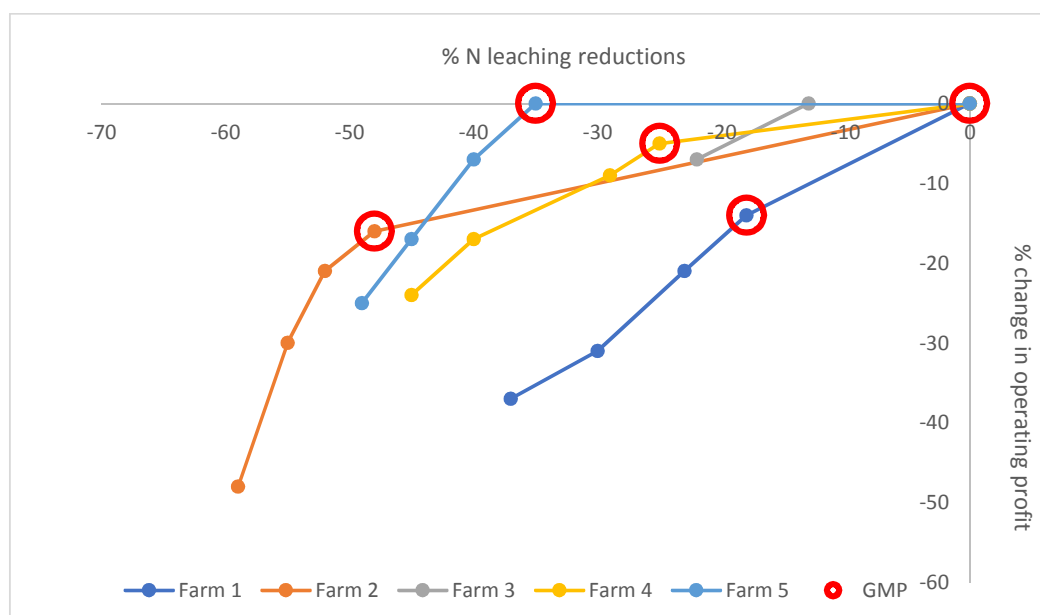


Figure 1: Abatement curve for case study farms from current state to achieve GMP (red circle) and 10, 20 and 30 percent reductions beyond GMP.

Mitigations beyond GMP (10, 20 and 30 percent reductions beyond GMP) for most farms involved de-intensification requiring nitrogen fertiliser and stocking rate reductions which had significant impacts on profitability. Figure 3 below shows the abatement curves for the five case study farms assuming all farms were starting from the GMP Loss Rate. Assuming GMP was achieved by the farms, mitigations targeting 30 percent reductions beyond the GMP Loss Rate were too difficult to achieve. Nitrogen leaching reductions of up to 22 percent beyond GMP resulted in reductions in operating profit of up to 48 percent from the base, not considering interest and tax expenses.

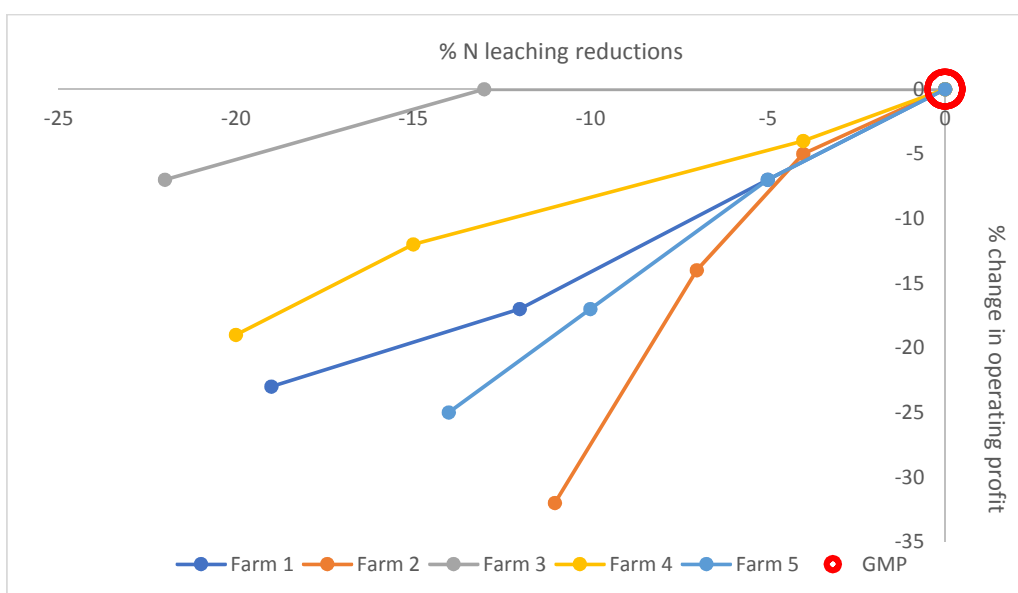


Figure 2: Abatement curve for case study farms starting at GMP (red circle) and 10, 20 and 30 percent reductions beyond GMP.

Weightings were applied to the five case study farms to provide an average that is representative of the Waimakariri zone. Weighted average operating profit and nitrogen leaching reductions are shown in Table 1. To achieve GMP, the weighted average farm is required to reduce nitrogen leaching by 31 percent which would be accompanied by a reduction in operating profit of 7 percent. For reductions beyond GMP, the impacts on profitability become more severe as nitrogen leaching targets become increasingly difficult to achieve.

Table 1: Weighted average of the five case study farms for operating profit and nitrogen leaching per hectare

	Base	GMP	GMP - 10%	GMP - 20%	GMP - 30%
Weighted average N loss (kg N/ha)	49	34	31	28	26
N loss % reduction from Base	0%	-31%	-36%	-42%	-47%
Operating Profit (\$/ha)	\$1,485	\$1,378	\$1,289	\$1,177	\$1,046
% change in Operating Profit from Base	0%	-7%	-13%	-21%	-30%

It is important to realise that each farm is unique, and will require different levels of effort to achieve targets through different mitigations. These mitigations will have different effects on profitability. The economic impact on individual farms depends on the current nitrogen leaching and nitrogen leaching target, farm system, existing infrastructure including effluent system and irrigation, production levels, soils, climate, debt levels and interest repayments, among other factors that may impact on farm viability. While it is possible to indicate likely impacts through modelling, achieving some of the targets through farm system and infrastructure changes may be challenging on some farms where significant changes are necessary.

Debt servicing obligations (principal + interest) are an important consideration when assessing the viability of a farm business. Table 2 shows the breakeven milk price required for an average Marlborough-Canterbury Owner-operator from the DairyNZ Economic Survey over the last five years. Breakeven milk price accounts for interest, rent, tax and drawings which are not included in the calculation of operating profit. Table 2 shows that a milk price of about \$5.30 has been required over the last five years if Marlborough-Canterbury Owner-

operators are to breakeven, this is only just below the average long-term milk price of \$6.00. Variability in milk price has a significant impact on the ability of farm businesses meeting debt servicing obligations, with interest payments for the average Marlborough-Canterbury Owner-operator around \$380,000 or about \$1.20 per kilogram milksolids over the last 5 years. Significant reductions in milk income and increased farm working expenses as a result of mitigation to achieve nitrogen leaching targets are likely to compromise farm businesses and farm businesses would require a higher milk price to break even.

Table 2: Breakeven milk price for an average Marlborough-Canterbury Owner-operator from the DairyNZ Economic Survey over the last five years

	2012-13	2013-14	2014-15	2015-16	2016-17
Net milk income	6.36	7.76	5.61	3.94	5.74
Stock/Other Dairy Cash	0.40	0.34	0.56	0.61	0.50
Net dairy cash income	6.76	8.10	6.17	4.56	6.24
Farm working expenses	4.19	4.38	4.23	3.79	3.74
less interest and rent	1.29	1.21	1.27	1.26	1.20
less tax	0.24	0.47	0.12	0.01	0.11
less net drawings	0.25	0.58	0.51	0.21	0.26
*Cash surplus available for debt or investment in growth areas	0.80	1.46	0.04	-0.71	0.92
Break-even milk price	5.56	6.30	5.57	4.65	4.82

Achieving nitrogen leaching targets beyond GMP would reduce operating profit significantly for some farms and limit the ability to meet interest payments let alone repaying debt. This would severely impact the viability of farm businesses and would have flow-on impact for the regional economy through reduced milk production, employment and expenditure.

Impacts on district/regional economy

The Zone Committee is working towards identifying a solutions package to achieve sustainable water management and water quality outcomes as well as improved contribution to the regional economy from the zone. The Waimakariri zone's largest sectors for employment are construction and retail trade, with only half of workers living in the zone also employed in the Waimakariri District as many commute to Christchurch city due to the close proximity. Agriculture is in the top five sectors for employment, but for other parts of the zone outside of close-commuting areas, agriculture is an important part of the economy. Of the agricultural land uses (arable, dairy, dairy support, sheep and beef, horticulture and other), dairy is the largest contributor to regional gross domestic product (GDP) and household income.

The case study farm modelling has shown that it is possible to achieve nitrogen loss reductions, but there will be financial implications for most farms. These impacts are likely to have flow-on impacts for the local economy, through reduced milk production, employment and less expenditure. There may also be impacts on land values, however this was not included in this study. To assess the district level impact of mitigation and achieving nitrogen leaching targets, a regional Computable general equilibrium (CGE) model or the use of multipliers could be used to estimate how the local economy would react to the proposed nitrogen targets placed on farmers.

Waimakariri farmer reference group work

Recent farmer reference group work has modelled various mitigations to assess what N reductions might be possible under less costly scenarios. So far, it has not been able to identify any 'magic bullet' options to achieve significant N reductions. Mitigations are specific to each farm system and the farmer's aspirations but the principles are the same:

- Improved efficiency of water, effluent, fertiliser

- Reduced N inputs: less fertiliser, low-N feed, reduced N surplus,
- Less urine patches in autumn by reducing stocking rate or time grazing pasture

As well as this, the farmer reference group has been presented with mitigation options coming out of ongoing scientific trials; and their likely range of benefits and costs. Some of these can be implemented by most farms. Others require more consideration before implementation due to significant capital cost, uncertainty in terms of extent of effectiveness and potential flow-on issues for the rest of the farm system, for example impacts of alternative feed on animal welfare.

What should dairy farmers have to do and by when?

The dairying community accepts that GMP is a minimum requirement, and that reductions beyond GMP may be necessary, particularly considering recent groundwater modelling showing a hydraulic connection between the Waimakariri recharge zone and Christchurch's drinking water aquifers. For the majority of farms, meeting Plan Change 5 GMP and the Farm Portal baseline N loss rate will be a challenge and will require a change to farm practices and for a number of farms upgrading of farm infrastructure particularly irrigation systems and in some cases effluent. DairyNZ modelling of some case study farms in the Waimakariri, referred to above, showed N loss reductions from meeting GMP ranged from no reductions to up to 48% reduction from the baseline N loss.

With this view in mind, a requirement to meet Good Management Practice in the 2020 to 2025 period is sufficiently immediate, whilst allowing farmers in the district sufficient time to gain clarity on GMP actions required and then to implement them.

N reductions beyond GMP are problematic. Whilst reductions of up to 10% beyond GMP by 2030 could be described as resulting in acceptable costs. Reductions beyond this would require a longer timeframe to allow new mitigation technologies to be developed and trialled and farmers to transition to new farm systems. If higher N loss reductions are required by 2030, farmers could be forced to go out of business. This outcome would be out of alignment with the Waimakariri target, 'increase zone contribution to regional economy'. A very high degree of certainty in terms of nitrate modelling is thus required to justify reductions beyond 10%, given the significant potential economic impact of the dairying community and potential flow-on impacts to the district/regional economy. A suitably staged transition time would allow farmer adoption of N reductions such that:

- Farmers can more easily absorb economic costs and be given time to understand, select and implement mitigation options; starting with options to achieve GMP
- Learnings from other zones and catchments already working towards significant reductions can be captured and applied

Other practical considerations

A suitably staged transition time would also reduce the risk of farmers becoming disengaged and not making any reductions resulting in poorer environmental outcomes than the lower level of N loss targets.

Part of the Waimakariri zone has deep poorly drained soils with moderate to high profile available water (PAW) of greater than 120mm that require less irrigation. These soils have very low N leaching vulnerability but a moderate risk of P runoff to surface water. Overseer modelling of farms on these soils show the N loss is about half of that of similar farm systems on the free draining soils. This makes achieving the N loss reduction targets beyond GMP far more challenging and the contribution to the catchment load reduction from farms on these soils significantly less.

Most of these farms on poorly drained soils have natural waterways and drains that connect to these natural waterways. Rather than focusing on reducing N loss beyond GMP to

groundwater, a better environmental outcome would be to encourage these farmers to change land management practices particularly for wintering and riparian planting along waterways including drains. Grass buffers and riparian planting will reduce waterway contamination of phosphorus, sediment, bacteria and some nitrogen. Riparian planting also has the benefit of improving Mahinga kai, biodiversity, provides spawning habitat for fish, provides shade to keep water cooler helping aquatic life and reducing the risk of algal blooms, and provides shade and shelter to livestock. Riparian planting is costly as it not only involves establishment but also weed and pest control for number of years. Farmers doing significant areas of riparian planting are unlikely to be able to invest in other N loss mitigations to achieve reductions beyond GMP.

For farms on these poorly drained soils, having a lower limit for N reductions of between 25 and 30 kg N/ha/year, whilst encouraging farmers with waterways to reduce phosphate and sediment loss to surface water, would have better environmental outcomes than focusing only on N loss reductions beyond GMP.

AGENDA ITEM NO: 4	SUBJECT: Waimakariri Irrigation Ltd – Update	
REPORT TO: Waimakariri Water Zone Committee		MEETING DATE: 13 August 2018
REPORT BY: Murray Griffin, CWMS Facilitator – Waimakariri, ECan		

PURPOSE

This agenda item provides the committee with an update from Waimakariri Irrigation Limited. This update will focus on

- **An update on the measures that WIL are implementing scheme wide to improve practices and generate good management**
- **the spectrum of individual situations out there and the challenges of getting to GMP and beyond as proposed.**
- **With some context of what WIL and the irrigation industry means to the district.**

RECOMMENDATIONS

- The Zone Committee are asked to receive this update for its information, and with regard to the committee's preparation of the Waimakariri Land and Water Solutions Programme draft recommendations, and 2018 community engagement priorities.

BY WHO

- This briefing will be by Brent Walton CEO and Paul Reese environmental manager for Waimakariri Irrigation Ltd

BACKGROUND

As an integral and dominant cog in the environmental, business and community aspects of the rural district the WIL organisation represents an opportunity to help achieve environmental, business and social outcomes for the district.

AGENDA ITEM NO: 6	SUBJECT: Committee Updates
REPORT TO: Waimakariri Water Zone Committee	MEETING DATE: 13 August 2018
REPORT BY: Murray Griffin, CWMS Facilitator – Waimakariri, ECan	

PROPOSAL

This agenda item provides the committee with an overview of updates for review.

RECOMMENDATIONS

- The Zone Committee are asked to receive these updates for its information and with regard to the committee's 5 Year Outcomes, drafting of the Land and Water Solutions Programme draft recommendations, and 2018 community engagement priorities.

COMMITTEE UPDATES

The following updates are tabled for the committee:

1. Waimakariri Land and Water Solutions Programme – update

An update on the Waimakariri Land and Water Solutions programme is provided as **agenda item 6-1**.

2. CWMS Regional Committee – update

The last Regional Committee Working Groups meeting was held on Tuesday 10 July. The next Regional Committee meeting will be held on Tuesday 14 August.

- Carolynne Latham, the Zone Committee's CWMS Regional Committee representative, has provided notes on the 10 July Working Group meeting which is provided as **agenda item 6-2**.
- Also provided for the committee is the Regional Infrastructure Working Group briefing paper, 10 July, as **agenda item 6-3**.
- The link to the CWMS Regional Committee papers is provided below:
<https://ecan.govt.nz/data/document-library/?Search=regional+water+management+committee%2C+agenda&documentTypes=-1&pageSize=12&start=1&sortDir=desc>

3. CWMS Fit for the Future Project

The memo provided as **agenda item 6-4** is to update the Zone Committee on the Canterbury Mayoral Forum project to ensure the Canterbury Water Management Strategy (CWMS) is fit for the future needs of the region.

Key points in this memo are:

- i) The Canterbury Mayoral Forum has agreed to sponsor a project to ensure the CWMS is fit for the future needs of the region. Environment Canterbury is managing the project, working closely with territorial authorities and Ngāi Tahu. The CWMS Regional Committee has been asked to take a lead role in developing advice on intermediary goals (targets) for 2025 and 2030 for the ten CWMS target areas.
- ii) The process of developing goals for 2025 and 2030 will involve wide engagement with stakeholders. Environment Canterbury will keep Zone Committees informed and engage at two key points:
 - o Engagement on draft goals (mid-September to early October 2018 meetings)
 - o Engagement on refined goals and measures, and on implementation issues (mid-November to early December 2018 meetings).

Accompanying this memo is an A3 graphic for the CWMS Fit for Future project, which is provided as **agenda item 6-5**.

4. Waimakariri Zone Delivery – Update

North Canterbury Zone Delivery Manager, Andrew Arps, has confirmed Zone Delivery is moving to a bi-monthly reporting schedule across all Zones in the Region. Consequently, the next full Zone Delivery report to the committee will be in September 2018.

5. Media & Communications – update

Gina McKenzie has provided a media and communications report for August, which is provided as **agenda item 6-6**.

RECOMMENDATIONS

- The Zone Committee are asked to receive these updates for its information and with regard to the committee's 5 Year Outcomes, drafting of the Land and Water Solutions Programme draft recommendations, and 2018 community engagement priorities.

AGENDA ITEM NO: 6-1	SUBJECT: Waimakariri Land & Water Solutions Programme – Update
REPORT TO: Waimakariri Water Zone Committee	MEETING DATE: 13 August 2018
REPORT BY: Murray Griffin, CWMS Facilitator – Waimakariri, ECan	

PROPOSAL

This agenda item provides the committee with an update of the Waimakariri Land and Water Solutions Programme schedule for review at 13 August 2018.

RECOMMENDATIONS

The Zone Committee are asked to receive this update on the schedule for drafting of the Land and Water Solutions Programme recommendations, and 2018 community engagement priorities.

WAIMAKARIRI LAND & WATER SOLUTIONS PROGRAMME – UPDATE

At the last Zone Committee meeting on 9 July the committee confirmed a two-month extension to this programme had been granted by Environment Canterbury. This was based on the complexity of some of the issues and options being considered, particularly reducing nitrates and the need for further consultation with the community. It was agreed this additional time was an important step in enabling the zone committee to gather initial feedback on options from Ngāi Tūāhuriri, water users, consent holders and the wider community.

Since the last Zone Committee meeting in July three community meetings have been hosted – in Kaiapoi, Oxford, and Rangiora – to present and get feedback on the issues involved in reducing nitrates. These were well attended, with over 200 people attending all three meetings. The feedback from these meetings is being collated and will inform the committee's preparation of the draft recommendations to be taken out for the next round of community consultation in September and October 2018.

Consequently, the Waimakariri Land and Water Solutions Programme schedule for the period until mid-2019 looks like:

- Review of options for the Waimakariri Land & Water Solutions Programme – Mar to July 2018
- Engagement on options and issues – April to August 2018
- Draft recommendations for the Waimakariri Land & Water Solutions Programme – September 2018
- Draft ZIP Addendum consultation – September/October 2018
- Zone Committee sign-off final recommendations for Solutions Programme – November 2018
- Final Solutions programme recommendations to ECan and WDC councils – December 2018

- Informing the community on the final Land and Water Solutions Programme – January/March 2019
- Notify a sub-region plan change to the Land and Water Regional Plan in response to the ZC's recommendations – mid 2019.

FOR MORE INFORMATION:

If you would like to get more information on the Waimakariri Land and Water Solutions Programme or the recent community meetings held in July, please go to:

www.ecan.govt.nz/waimakariri-water

Regional Water Management Committee

Working Group notes

10th July 2018

1. Fit for Future Project

An update was received on progress with the project which is being set up to establish 2025/2030 targets for the CWMS, and ensure the CWMS is fit for purpose. The framework for the project is now set up and information is being fleshed out for the task groups. Realistic and measurable targets are sought, and while the 2020 and 2040 targets are considered bookends there may be other issues that could come in such as climate change or measuring social change. It is planned to use the 2025/30 targets to re-engage with stakeholders and keep the CWMS front of mind. Once a draft package of goals for each target area has been identified by the task groups, the package will be discussed with the ZC in Aug/Sept 2018, and again in Oct/Nov 2018 following engagement with community and a wide range of organisations and interested parties.

2. Infrastructure WG

Refer also to the attached infrastructure update.

- (a) Selwyn/Waikirikiriri near river re-charge project is still a work in progress – A linked project to install NZ's first electric fish screen to keep trout out of a tributary, to protect a mudfish population. The stream is too flat for a physical barrier therefore a series of electrodes will be installed across the bed of the stream using electric fishing technology. Different pulses can affect different species and size of fish.
- (b) RDRML – Have been granted consents and any appeals are due before 27 July.
- (c) Lagmhor MAR site – the plume of lower N water is now extending into the high nitrate areas near Tinwald. It is planned to deepen the original MAR site to allow water to get through a clay pan at a depth of about 6m.
- (d) Ashburton ZC – New modelling has meant that Ashburton River flow regimes included in their sub-regional plan will have a much more significant effect on irrigator reliability than anticipated, so a proposed consent review to bring consents in line with the new minimum flows has been put on hold. They are now in a difficult situation in that the flows are enshrined in the plan, but were based on information available at the time that now may not be accurate. The modelling is being re-checked. It was noted that a Rakaia River project which is underway is to get a better understanding of the river so that this sort of situation doesn't arise.
- (e) South Canterbury Hunter Downs – Progressing despite the loss of Crown funding. Farmers in water short areas of OTOP zone that will be affected by stream depletion and increased minimum flow restrictions proposed in the ZIPA, may move to more on-farm storage utilizing larger amounts of floodwater which will have a negative effect on the river. The OTOP infrastructure study concluded with the identification of technically feasible supply and piped options – albeit very expensive.
- (f) Fish Screen Working Group - Progress is slow as the group gets up and running. It may expand out of Canterbury to other provinces with irrigation, and broaden to include eg DOC. Ecan are constrained on resources to regulate fish screens and this may have led to less than best practice to date, but they are building capability. A rationalization of extraction points may be needed to reduce the number of fish screens required if that is more cost effective. RDR recently got consent to change to a rotary screen system, as it seeks to improve effectiveness from the current system.

3. Recreation & Amenity WG

The recreation and amenity values report is due to be presented to the Regional Committee at its meeting in August. Discussion was around the use of this report and how the WG can add value to recreation and amenity across Canterbury. It was noted that the Zone Committees were key to providing information and making progress, and a start had been made with most of the ZC's providing information about their top sites for restoration. However it was uncertain where this was heading and what part the WG had to play. It was concluded that the RC could have a role in identifying information missing in the report and expanding it via the ZC's, and overseeing a database of information across Canterbury with the possibility of it eventually being available to public in a similar format to that of LAWA.

3. Biodiversity WG

Since 2016 Ecan have been working on creating a step-change in efforts for improving freshwater, marine and terrestrial biodiversity. Priorities have been set and provided for in the LTP 2018-2028. There are 4 work programmes:

Regional biodiversity \$3.86 million

Biosecurity \$4.8 million

Braided rivers \$620,000

Wetlands \$260,000

Braided rivers and wetlands are new programmes. There is also additional funding for monitoring and reporting, and partnerships are seen as one of the biggest changes required to leverage additional funding and make a step-change difference. Ecan are looking to re-brand biodiversity and develop ways of incentivizing its protection. Suggestions were made about how to engage with farmers.

Immediate Steps funding will continue in the same format as it has to date, and it will be reviewed at some point to ensure it is the best use of the funds.

Carolyn Latham
Waimakariri Water Zone Committee RC Rep

Infrastructure Working Group briefing paper – 10 July 2018

Portfolio Portfolio Director	Canterbury Water Management Strategy Stefanie Rixecker
Programme	CWMS Infrastructure
Authors	Brett Painter (Project Leader CWMS Assessments), Dennis Jamieson (Project Leader CWMS Infrastructure)
Endorsed by	Caroline Hart (Programme Manager – Strategy and Planning)
Peer-reviewed by	Dennis Jamieson

Purpose

To provide updates regarding CWMS infrastructure activities and opportunities.

- **HURUNUI-WAIAU/KAIKOURA**
 - Amuri Irrigation Corporation (AIC) have completed their new pipeline project. Considering HWRR Plan Change application for Glenrae (Zone B to Zone C).
 - Emu Plains Irrigation consent applications to divert, take & discharge are in process.
 - [Hurunui Water Project considering alternative funding options following withdrawal of Crown Irrigation Investments Fund from scheme. Storage consent application in process. Waipara discharge consent application suspended until September to allow for more consultation with Ngāi Tahu/Ngāi Tūāhuriri.](#)
- **WAIMAKARIRI**
 - Waimakariri Irrigation Ltd: [Wrights Road storage – Environment Court hearing ran on 18 and 19 June 2018.](#)
- **SELWYN-WAIHORA**
 - CPW: Sheffield Scheme up and running. Stage 2+ on-going to September 2018.
 - The Broadacres TSA project: Final habitat enhancements awaiting spring to dry naturally. Mudfish ready for transfer once habitat enhancements are complete.
 - Selwyn/Waikirikiriri Near River Recharge project: [Stage 1 Off-take construction complete. DOC Easement, detailed design and consent documentation processes underway. Stage 2 design and land purchase options to be discussed with Council on 19 July. Linked project to install NZ's first electric fish barrier.](#)
- **ASHBURTON ZONE**
 - Ashburton-Hinds Managed Aquifer Recharge (MAR) project:
 - [Year 2 catchment scoping project well advanced. Construction underway or complete at 14 new small-scale infiltration sites \(plus 2 more on hold\), with testing complete on first 6.](#)
 - [South Hinds Near River Recharge \(now called Hekeao/Hinds River Project\) site has received construction authorisation and construction is well advanced. Discharge consent has been lodged and a planting/blessing day is being planned for Spring.](#)
 - [The clean water plume from the Lagmhor Pilot site has continued to advance and can be identified close to the southern Tinwald springs. A new Tinwald Water Quality Assessment Study is underway to explore potential contaminant sources.](#)

- Pilot site enhancement consent (deep soakage system) and improved operational conditions are confirmed. Pilot site enhancement construction is delayed until 1 August due to unavailability of specialist drilling equipment.
 - ADC Council unanimously approved on-going use (to February 2021) of up to 500 l/s ADC stockwater at their 28 June meeting.
- RDRML consent hearing (Klondyke storage, high flow take, fish screen) ran from 23 April to 4 May.
- Interagency issue to be clarified are ADC/ECan responsibilities for “flooding” and “amenity” management where urban areas (and urban expectations) overlap a “Drainage District” with a rural Level of Service.
- **SOUTH CANTERBURY**
 - OTOP Conceptual Infrastructure Design and Costing study: Project concluded with identification of technically feasible supply options and piped distribution. Follow up discussions underway (14 May with local/regional and national level interests, 11 June with OTOP Zone Committee and 3 July with Geraldine Water Solutions shareholders) to discuss findings and their implications.
 - Hunter Downs Irrigation scheme progressing despite withdrawal of Crown Irrigation Investments Fund from scheme.
- **REGION WIDE**
 - INZ-ECan joint work programme will be updated to reflect new INZ strategic plan.
 - “Future Food Group” (operating as “Left Field Innovation”) active in Canterbury and other regions has been cleared to submit an application to the Provincial Growth Fund. ECan/INZ will both have interests in this proceeding further.

AGENDA ITEM NO: 6-4	SUBJECT: CWMS Fit for Future project
REPORT TO: Waimakariri Water Zone Committee	MEETING DATE: 13 August 2018
REPORT BY: Murray Griffin, CWMS Facilitator – Waimakariri, ECan	

Purpose

1. This paper updates the Zone Committee on the Canterbury Mayoral Forum project to ensure the Canterbury Water Management Strategy (CWMS) is fit for the future needs of the region.

Recommendations

That the Waimakariri Water Zone Committee:

1. **receive the report on the Canterbury Water Management Strategy (CWMS) Fit for the Future project.**

Report

Key points

2. The Canterbury Mayoral Forum has agreed to sponsor a project to ensure the CWMS is fit for the future needs of the region. Environment Canterbury is managing the project, working closely with territorial authorities and Ngāi Tahu. The CWMS Regional Committee has been asked to take a lead role in developing advice on intermediary goals (targets) for 2025 and 2030 for the ten CWMS target areas.
3. The process of developing goals for 2025 and 2030 will involve wide engagement with stakeholders. Environment Canterbury will keep Zone Committees informed and engage at two key points:
 - Engagement on draft goals (mid-September to early October 2018 meetings)
 - Engagement on refined goals and measures, and on implementation issues (mid-November to early December 2018 meetings).

Background

4. On 25 May 2018, the Canterbury Mayoral Forum agreed to sponsor a project to ensure the CWMS is fit for the future needs of the region. The Forum noted that the CWMS strategic framework continues to provide a good foundation for freshwater management in Canterbury and agreed that the focus of the project be on:
 - developing intermediary goals for 2025 and 2030 to ensure that the CWMS continues to provide meaningful guidance for action

- identifying what is required to maintain and build momentum for implementation of the strategy and ensure that it can and will be delivered.
5. The Forum also agreed that Environment Canterbury will manage the project, working closely with territorial authorities, and that the CWMS Regional Committee be responsible for developing advice on intermediary goals.
 6. Environment Canterbury has established a Steering Group with senior staff from each Canterbury territorial authority to provide oversight of the project.

Overview of project

7. The attached A3 provides an overview of the project – as **agenda item 6-5**.
8. Points to note are that:
 - A key objective of the project is to build momentum and ownership for implementation of the CWMS. We anticipate that the process of developing intermediary goals to guide the next ten years will also be a vehicle for discussion on what is needed to deliver the strategy.
 - The intent is to reflect the collaborative ethos of the CWMS in way the project is managed and delivered. This will involve:
 - Environment Canterbury working collaboratively with the territorial authorities, and with Ngāi Tahu
 - bringing together a mix of interests and perspectives to develop draft goals
 - regular engagement with the Zone Committees and other stakeholders.
 - Environment Canterbury is due to report back to the Canterbury Mayoral Forum with final project recommendations by April 2019. Timeframes are tight, and work to develop advice on draft goals for 2025 and 2030 will be undertaken over the next six to eight months.

Process for developing intermediary goals

9. The process of developing advice on intermediary goals will involve:
 - bringing together people from a mix of council, Ngāi Tahu, industry and NGO perspectives to be directly involved in developing draft goals for 2025 and 2030 (through task groups)
 - seeking input Zone Committees on the draft goals
 - engaging with other stakeholders including community groups, young people, iwi and sector interests.
10. There will be two ‘rounds’ of task group workshops: the first to develop draft goals; the second to refine the goals and measures, and identify what actions and resources are needed to achieve the goals. Each round of workshops will include the development of integrated advice for the Regional Committee by a Goals Working Group, and engagement with key stakeholders. A final working group meeting will be held in early

2019, focused what is needed to enable implementation of the strategy and delivery of the recommended goals.

11. The six task groups will cover the following target areas:

- Environmental limits
- Ecosystem health and biodiversity; Natural character of braided rivers
- Kaitiakitanga
- Drinking water; Recreational and amenity opportunities
- Water-use efficiency; Irrigated land area; Energy security and efficiency
- Regional and national economies.

Zone Committee involvement in the process

12. As noted, the process will involve wide engagement with stakeholders. We propose to engage with Zone Committees at two key points:

- *Engagement on draft goals* – to seek feedback on the draft goals from a zone perspective, including any feedback on measures and views on what would be required to achieve them locally (mid-September to early October 2018 meetings)
- *Engagement on refined goals and measures, and on implementation issues* – to provide an update on how feedback has been incorporated into refined goals and to seek feedback on revised goals and measures, what is required to give effect to the goals at the zone level and the support required by Zone Committees (mid-November to early December 2018 meetings).

13. In addition, Environment Canterbury will provide an update on project progress to Zone Committee meetings as required, and on the final outcomes of the project in May 2019. We anticipate that some Zone Committee members will also participate in the task groups being established to support the Regional Committee.

Next steps

14. Key steps for this project over the next few months are:

- establishing task groups and a Goals Working Group (underway)
- holding the first meeting of the Goals Working Group (late July)
- holding the first task group meetings to develop draft goals (August 2018)

15. We will be seeking to engage with the Waimakariri Water Zone Committee again at the following meetings:

- 10 September 2018 – to seek feedback on draft goals
- 12 November 2018 – to seek feedback on refined goals, measures, and implementation issues.

Attachment

- A3 overview of the project

Canterbury Water Management Strategy (CWMS) Fit for the Future Project

DRAFT – 20 June 2018

Purpose of project:

Ensure the CWMS is fit for the future needs of the region, and can deliver the outcomes desired by the community for freshwater

Project objectives:

- recognise and build on the vision, principles and priorities of the CWMS and other fundamental aspects of the strategic approach
- build momentum and ownership for implementation of the strategy by a wide range of partners
- ensure that the CWMS provides clear guidance for action through the development of intermediary goals for 2025 and 2030

Deliverables:

By May 2018:

- Advice to the Mayoral Forum confirming the CWMS strategic framework and seeking renewed commitment to the strategy

By April 2019:

- Intermediary goals for 2025 and 2030
- Advice to the Mayoral Forum on key enablers and barriers to strategy implementation, with recommendations for addressing these
- A summary communication document that sets out the fundamental aspects of the CWMS, including the vision and principles, new goals and key actions

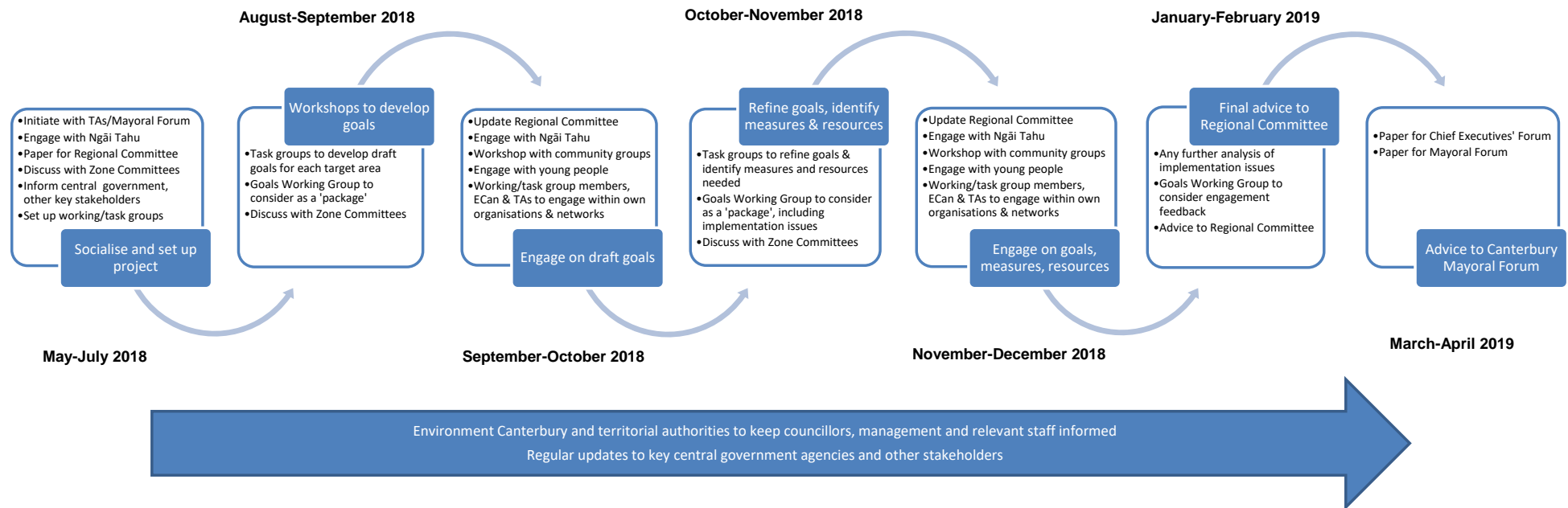
Project approach:

- Reflect the CWMS collaborative ethos in the project:
 - o joint project with territorial authorities (TAs)
 - o seek to partner with Ngāi Tahu through the Tuia relationship
 - o bring together a mix of interests and perspectives to develop draft goals
 - o wide engagement with other stakeholders
- Confirm the ongoing relevance of the CWMS strategic framework from the outset
- Focus on developing goals for 2025 and 2030:
 - o to provide guidance for the next 10 years; and
 - o as a means of engaging with agencies on what is needed to ensure the CWMS is delivered.

Project roles and responsibilities:

- Mayoral Forum: project owner
- Environment Canterbury: project manager
- Regional Committee: develop advice on goals and associated implementation issues, supported by:
 - o Goals Working Group (to include ECan, TAs, Ngāi Tahu, industry and NGOs)
 - o Task groups focused on developing goals for each of the ten CWMS target areas
- Project Team (ECan staff): manage project, provide information, analysis & support for Regional Committee; manage stakeholder engagement
- Project Steering Group (senior ECan & TA staff): provide project oversight and guidance

Project process & timetable:



Key dates:

- | | | | | |
|--|--|--|---|--|
| <ul style="list-style-type: none"> • Mayoral Forum – 25 May • Regional Committee – 12 June • Zone Committees – 18 June to 9 July • Goals Working Group – late July (TBC) | <ul style="list-style-type: none"> • Regional Committee – 14 August • Task group meetings – mid-August (TBC) • Goals Working Group – early September (TBC) • Zone Committees – 10 September to 3 October | <ul style="list-style-type: none"> • Regional Committee – 9 October • Task group meetings – mid-October (TBC) • Goals Working Group – late October (TBC) • Zone Committees – 12 November to 5 December | <ul style="list-style-type: none"> • Regional Committee – 11 December • Goals Working Group – late January 2019 (TBC) • Regional Committee – February 2019 (TBC) | <ul style="list-style-type: none"> • CEs Forum – March 2019 (TBC) • Mayoral Forum – April 2019 (TBC) |
|--|--|--|---|--|

AGENDA ITEM NO: 6-6	SUBJECT: Media and Communications – August Update
REPORT TO: Waimakariri Water Zone Committee	MEETING DATE: 13 August 2018
REPORT BY: Gina McKenzie, Director – Real Communications	

Waimakariri Zone Committee Media and Communications Report -July 5th – August 5th

Newsletters sent

- July – 23rd July – sent out in new template

Articles published

- Thursday 5th July - North Canterbury News - article on Townsend Fields subdivision - cultural and ecological priorities - features Joe Jagusch
- Thursday 12th July - North Canterbury News - "Arps given oversight of water zones" - article on Andrew Arps' new role
- Thursday 12th July - North Canterbury News - "Nitrate solutions crucial" - article on WZC presentation to WDC meeting - quotes Andrew Arps and Dave Ashby
- Friday 13th July - Northern Outlook - Easterbrook Road IMS project - half-page feature article on landowners working together to restore the stream
- Friday 13th July - Kaiapoi Advocate - "Compost consents turned down" - article on ECan turning down Canterbury Landscapes consents
- Friday 13th July - Kaiapoi Advocate - "Meetings to discuss nitrates in groundwater" - article on upcoming public meetings
- Friday 13th July - Kaiapoi Advocate - "Ngai Tahu works on nitrates" - article on Ngai Tahu Farming's presentation at zone committee meeting
- Wednesday 18th July - Northern Outlook - Waimakariri Corridor IMS project - half-page feature on the corridor concept and recent funding from WZC
- Thursday 19th July - North Canterbury News -Waimakariri Corridor IMS project – 1/4-page feature on corridor concept and recent IMS funding from WZC
- Thursday 26th July – North Canterbury News – Easterbrook Road IMS project – ¼ page feature on landowners working together to restore the stream.
- Thursday 2nd August – North Canterbury News – “Water Challenges” – column by David Ayers on public meetings and working together to improve water quality.
- Thursday 2nd August – North Canterbury News – news article on the public meetings and consultation regarding nitrate levels in Waimakariri’s waterways.

Upcoming articles

- WIL biodiversity survey – initial findings along waterways in the scheme
- WIL/ECan infiltration trial at Silverstream – taking action to tackle nitrates
- Education campaign around illegal structures in the Cam River – articles/opinion pieces/advertising/stakeholder engagement
- ESR's monitoring wells along Silverstream
- Denitrification wall trial at Silverstream with ESR

Current cinema advertisement

- "Everything's Connected" - we all need to think about how we use water and work together to improve water quality in Waimakariri

Upcoming cinema advertisement

- Winner of Environmental Step Change Award - North Canterbury Business Awards (September)