




Managed Aquifer Recharge

Providing for Managed Aquifer Recharge
(MAR) in Canterbury

Prepared for Environment Canterbury

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1.0 Purpose of the report

Boffa Miskell Ltd was commissioned by Environment Canterbury (ECan) in August 2018 to address the issue of enabling micro Managed Aquifer Recharge (MAR) in Canterbury. This was later revised to considering the inclusion of region wide provisions to enable the establishment and operation of permanent MAR whilst taking into account concerns expressed by those involved in establishing MAR systems about the provisions of the Land and Water Regional Plan (LWRP) and the consenting process.

The purpose of the report therefore, is to understand:

- what is MAR.
- the operative statutory matters.
- the issues that have arisen with regard to consenting MAR and the lack of region wide provisions.
- potential options to address the issues identified above.

This report has been targeted at an audience who has a reasonable understanding of MAR, the Resource Management Act 1991 (RMA 1991) and the LWRP.

2.0 Who have we engaged with?

As part of preparing this report, we engaged with the following people who assisted us in understanding the science behind MAR, and the consenting process both from the applicant and ECan's viewpoint:

- Tegan Wadworth and Simon Woodlock – ECan Consent Planners.
- Zeb Etheridge – ECan Groundwater Scientist who provided technical advice for the Waimakariri infiltration trial.
- Brett Painter - ECan Project Lead for Hinds MAR Governance Group.
- Peter Lowe – Chairman of Hinds MAR Governance Group.
- Bob Bower – Groundwater Scientist involved in the Hinds, Waimakariri and Gisborne MAR trials.

3.0 What is Managed Aquifer Recharge?

MAR systems are essentially infiltration basins, which act like big leaky ponds, that are filled with high-quality clean water which seeps down and recharges the groundwater. MAR can be used to recharge aquifers subject to declining yields, to control saltwater intrusion or to prevent

land subsidence. MAR may also be applied to sustain or improve the functioning of ecosystems and the quality of groundwater.

Whilst not a new concept, having been used in other countries for a number of years, MAR has only recently been trialed in New Zealand. The examples below highlight the range of reasons that MAR is applied in New Zealand: from improving water quality to augmenting ground water levels to ensuring security of supply. They also assist in understanding the types of activities involved in establishing MAR i.e. discharges to water and land, earthworks and water takes.

It is noted that MAR often relies on using water that is being taken under an existing water permit i.e. the efficient use of water by irrigators creates 'excess' water within existing water takes that can be used for MAR. Furthermore, MAR generally operates during the off-peak/winter season when water is not required for irrigation, but this means it can compete with electricity generators as is their peak season.

3.1 Canterbury

The Hinds/Hekeao MAR trial was consented in 2016¹. The MAR pilot project uses source water from the existing Ashburton District Council (ADC) stockwater consent from the Rangitata River² and operates as follows:

- Unused stock water from ADC's Cracroft diversion (Rangitata River) is diverted at the Rangitata Diversion Race (RDR) Klondyke intake. Real time monitoring of both the ADC and RDR takes is used to ensure that the cumulative takes do not exceed the ADC consented water take. RDR delivers the recharge water to the Valetta intake as is practical (due to other demands for conveyance capacity) throughout the calendar year.
- Valetta Irrigation Ltd (Valetta) delivers the recharge water through their pond and pipe system to Valetta Pond #3, which represents the intake structure for the MAR pilot site.
- Recharge water is delivered via a SCADA controlled gate and flow control system down an 900m abandoned Valetta race to the intake weir at the MAR site. Recharge water is measured (as flow) leaving Valetta Pond #3 (flow control-hydraulic gate) flowing down to the intake of the MAR Site (Weir #2). A water quality bypass gate allows water to be shunted (if required during times of flood, if incoming water quality is poor or there is an issue with the filtration basin) to two adjacent farm storage ponds.
- A water level logger measuring the recharge basin depth communicates directly (via radio link) to the flow control-hydraulic gate releasing water from Valetta Pond #3. This will allow the amount of water being sent to the recharge site to be managed based on the effective infiltration rates at the site. This rate is expected to change marginally

¹ Resource consents: CRC162191 to discharge contaminants to land and groundwater, CRC162192: to excavate land over an unconfined aquifer within 50m of a surface water body, CRC16428 for a water permit to partially transfer water from resource consent CRC012114 to take and use surface water. CRC182576 to discharge water to land.

² The Rangitata River's Water Conservation Order (WCO) allows the use of stockwater for the purposes of either stock or for environmental purposes. The MAR pilot project has been deemed to be environmental enhancement in accordance the Rangitata WCO.

during operations due to changes in temperature, sediment accumulation and other physical changes.

- Recharge water then enters a 'forebay' area designed to collect and settle any sediments and/or debris picked up along the system. The fore bay has a total water holding volume of 2700m³, and a surface area of 1,844m², or 2,010m² when filled to 2.2m depth. An overflow weir then spills the recharge water into the main recharge/infiltration basin, which is specifically designed to direct the recharge water toward the saturated groundwater table. The infiltration basin is where the bulk of the infiltration to land takes place. The total water holding volume is 16,204m³, with a surface area of 8,349m², or 11,271 m² at the operational depth. On the floor of the fore bay and infiltration basin are approximately 12 to 16 "clam shell" holes, 1m diameter and 5-6m deep which have been backfilled with native site materials that have been screened and washed to remove fine silts and sands. These "soak holes" are designed to allow rapid infiltration into the underlying aquifer.
- RDR/Valetta and ECan (contractors) work together to operate the MAR site under a memorandum of understanding using an agreed operational and recharge water delivery plan.
- Water is not recharged during times of significant rainfall to reduce the risk of flooding downstream. Likewise, during dry periods, when there is a high demand for water for irrigation, recharge operations cease. Monitoring of water flow at several points within the scheme including the hydraulic gate controller (at the Valetta Pond) will be automated to allow MAR project staff to track the project operations and turn the project off/on via a smart phone application. A start-up/shut down controller is also located at the Valetta Pond #3 turn out structure, allowing the 'on call' MAR staff to manually manage the project if required.
- Water that has filtrated into the groundwater aquifer forms part of the natural flow that feeds springs, streams and rivers downstream of the recharge site, eventually flowing out to sea. It has benefits to downstream landowners by potentially providing a higher quality, more reliable and consistent flow of water that can be used for potable supply (with treatment) and irrigation. The issue of water use is discussed further in Issue 5.3.
- Ongoing monitoring of both quality and quantity and ecological health in groundwater and downgradient surface waterbodies is conducted to track the results of the MAR site operations, as well as help to specifically manage drainage concerns related to storm flooding in the coastal streams.
- An ECan hosted website provides background information, project update reports, water quality sampling results, and real time MAR site and groundwater information, which helps provide the community with a transparent and interactive source of project information.
- During Phases 1 and 2 of the project, annual analysis reports for the project have been prepared for review by the MAR Pilot Working and Stakeholder groups and subsequently provided to the wider community for further discussion and consultation.

The first official report on the Hinds MAR trial was released in August 2017. The key findings of the report are:

- The total volume of water discharged during the first year was 2.4 million cubic metres.
- Increased groundwater levels have reached approximately 7km downstream from the trial site.
- Nitrate levels in the groundwater beneath the recharge site decreased from 4g/m³ to less than 1g/m³.
- Nitrate levels in down gradient groundwater influenced by the trial reduced from 14g/m³ to 4g/m³.

In 2018, a further 16 trial sites were consented within the Mayfield-Hinds and Valetta catchment, and consent was also granted in 2018 for two infiltration trial sites in the Waimakariri District³. The statutory processes to establish both the Hinds/Hekeao and Waimakariri trial MAR schemes are addressed in Section 4.

3.2 Gisborne

In 2017, the Gisborne District Council successfully injected 75,000m³ of water into the Makauri Aquifer as part of a trial to test the feasibility of increasing water in the aquifer with minimal impact on water quality and the environment. The Makauri aquifer is the largest underneath the Poverty Bay Flats, extending from Kaiteratahi down to Makaraka and spanning both sides of the Waipaoa River. The aim of the project is to increase security of supply for use on 3000 hectares of irrigated horticultural farmland by injecting water from the Waipaoa River into the Makauri aquifer.

Funding and resource consent has been approved for Gisborne District Council to proceed with Stage 2 of the trial which will fully investigate potential risks and inject up to 360,000m³ from the Waipaoa River into the aquifer commencing in Autumn 2019 when river flows are greater than 4 m³/s. A Mauri Compass assessment of the trial will be undertaken as part of the cultural framework agreed with Te Aitanga a Mahaki.

³ CRC184025: to take and use water and CRC184026 to discharge water to land.

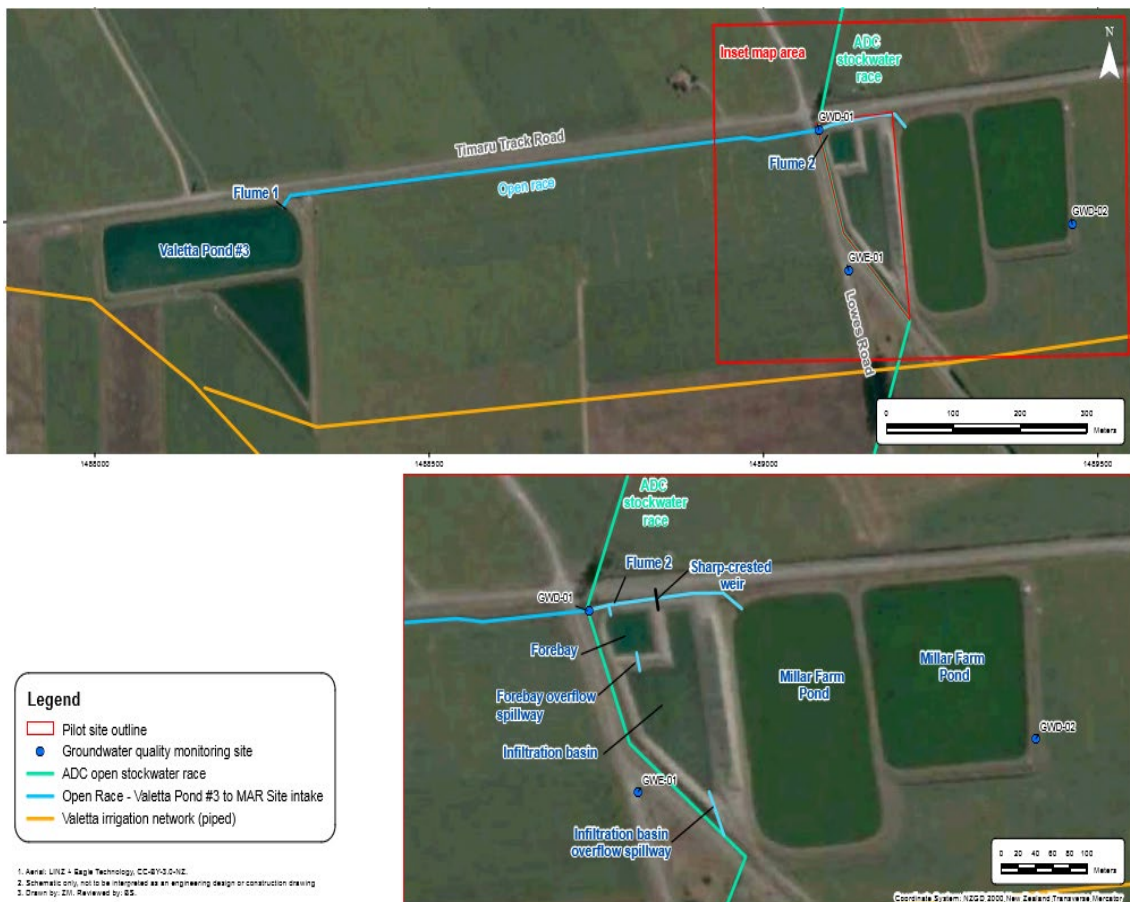


Figure 1: Aerial view of the Hinds/Hekeao managed aquifer recharge trial

4.0 The statutory framework

This section sets out and discusses the statutory framework that applies to establishing MAR under the LWRP. It is noted that when the LWRP was made fully operative in February 2017, it did not specifically provide for any type of MAR scheme. Whilst established overseas, it was the work of the zone committees that introduced the concept of MAR/augmentation trials into the LWRP.

4.1 Background to Plan Change 2 that introduced provisions enabling MAR trials into Section 13: Ashburton

The Ashburton Zone Committee (a joint committee of Environment Canterbury and the Ashburton District Council) prepared the 'Ashburton ZIP Addendum Hinds Plains Area' in March 2014. This document provided recommendations to Environment Canterbury and the Ashburton District Council on actions to improve the management of water in the Hinds Plains area.

For a number of years, the Hinds Plains network of water races and border dyke irrigation has recharged the groundwater of the Hinds Plains area. This recharge has been unmanaged and is largely a by-product of leaky races and irrigation needs above State Highway 1. Closing parts of the water race system and shifting border dyke irrigation systems to more efficient irrigation systems has had the effect of reducing the amount of water entering the groundwater system. This has affected both the flows of spring-fed water bodies and the nitrate concentration in shallow groundwater further down the Plains.

As a consequence, the Ashburton Zone Committee recommended that the Hinds section of the LWRP support the trial of managed aquifer recharge as a first step toward the implementation of a groundwater replenishment programme to include:

- Diluting groundwater concentrations of nitrate;
- Achieving minimum flows in spring-fed water bodies;
- Increasing reliability for existing consent holders; and
- Minimising the amount of on-farm mitigation needed.

These objectives were subject to the availability of a clean source of water, the proposal being culturally acceptable; and the risk of flooding in lowland areas induced by MAR being low. However, it was determined that further technical work and consultation needed to be undertaken including:

- Development and evaluation of MAR options,
- Acceptability of mixing waters, and
- Development of a trial programme.

The Zone Committee recognised that the desired outcomes for the Hinds Plains area would not be met without MAR and recommended a staged trial of MAR to determine feasibility and effectiveness. The Zone Committee also recognised that further work needed to be undertaken to identify a long term sustainable cost sharing solution for MAR if it proves to be effective.

Provisions to provide for trial MAR were introduced into the LWRP: Section 13 Ashburton sub region section through Plan Change 2 in 2014. It is noted that the s32 report considered relying on regional provisions to enable MAR and clearly sets out why this was not deemed to be appropriate. The s32 report states:

“Though none of the policies and rules explicitly reference MAR, it was considered that the following appear most relevant and would need to be complied with.

Policies in the pLWRP essentially seek to control various adverse environmental, social and cultural effects from moving water from one catchment to another (Policy 4.55) and that there is no cross contamination of aquifers or effects on water quality from abstracting groundwater (Policy 4.57).

Where water is introduced from outside a catchment that any increase in flows are not made available for abstraction unless a new environmental flow and allocation regime is

introduced through a plan change or the existing regime has been developed in anticipation of the additional surface water flows (Policy 4.56).

Non-consumptive groundwater takes are generally supported and are not subject to groundwater allocation zone limits where in conjunction with other activities on a site result in a neutral or positive water balance (Policy 4.58). The policy does have potential constraints, for example groundwater is required to be returned to the same groundwater allocation zone within 24 hours. On face value this would appear to prevent the use of groundwater to support stream flows (Targeted Stream Augmentation).

The next issue is to consider if the regional rules support the abstraction and discharge of water for MAR and TSA.

The region-wide rule framework prohibits new abstractions where a surface water catchment or groundwater allocation zone is fully or over-allocated. The source of water for MAR and TSA would therefore need to come from water that is already consented to be taken. It is understood that there are discussions with Ashburton District Council over the use of consented stock water as a potential source for MAR.

Another possibility is to take advantage of the rules on the non-consumptive taking of surface water (Rules 5.126 and 5.127) and groundwater (Rules 5.131 and 5.132). However, it is noted that these rules may not be ideally suited to a MAR or TSA scheme as they require the take and discharge to be to the same water body (surface water to surface water and groundwater to groundwater). To qualify as a permitted activity under Rule 5.126 the discharge must also be within 250m from the take which may be impractical for a MAR or TSA scheme. If the permitted activity conditions are not met the activity status defaults to non-complying under Rule 5.127, which is a high hurdle.

Rule 5.131 provides for the non-consumptive taking of groundwater limits. However, the conditions limit its application to MAR and TSA and it provides only to the use of water for domestic purposes.

The discharge is required to be within 50m of the abstraction point and to the same aquifer or groundwater source. If the conditions of Rule 5.131 are not met the activity status becomes a discretionary activity under Rule 5.132 which may provide an opportunity for TSA schemes where deep groundwater is discharged to the shallow groundwater system up-gradient of spring-fed streams to improve low summer flows.

The discharge to surface water or onto or into land from any MAR or TSA scheme would also need to comply with the regional Rules 5.98, 5.99 and 5.100 which control "Other Minor Discharges of Contaminants".

Whilst the regional policies and rules noted above may not preclude MAR or TSA they do not explicitly provide for it either. The regional rules appear to have a number of barriers, particularly in connection with the taking of water for MAR or TSA where allocation limits are exceeded, and where water is taken from one resource and discharges to another".

The preferred option was to provide additional policy direction and statutory basis for facilitating trial MAR in the Hinds/Hekeao Plains Area. This option was used to encourage trials of MAR

rather than permanent MAR because of the need for further technical work and consultation including the development and evaluation of MAR options and the acceptability of mixing waters. That said, MAR was seen as fundamental to achieving the Ashburton Zone Committee’s outcomes and implementation of its solution for water management in the catchment.

4.2 Definition

The region-wide definitions in the LWRP do not include a definition of ‘MAR’ or ‘augmentation’ or ‘augmenting’. Section 13: Ashburton includes a definition of ‘Augmenting’ and Section 11: Selwyn-Te Waihora sub-region section includes a definition of ‘Augmentation’ as follows:

Selwyn Waihora	Ashburton	Region wide
Augmentation: means the addition of water to surface water or groundwater to increase flows in Hill fed-lower and Spring fed-plains rivers.	Augmenting: means the addition of water to surface water or groundwater specifically for the purpose of reducing the concentration of nitrate nitrogen in groundwater or increasing flows in lowland streams.	No definition

4.3 Objectives and Policies

The objectives and policies of the LWRP seek to achieve freshwater outcomes to protect the life supporting capacity of ecosystems and drinking water supplies and ensure that groundwater is a sustainable source of high quality water. This includes avoiding and managing adverse effects on water quality to meet nutrient limits and minimise the risk of accumulation of contaminants.

The policies emphasise the need for the efficient use of water especially in over allocated aquifers. Efficiency is defined as “that for any given levels of output, inputs are minimised and includes technical, dynamic and allocative efficiency”. In over allocated surface water zones, the taking of more water is prohibited including for environmentally beneficial proposals and therefore additional uses can only be provided for if the existing water take is used efficiently⁴. Policy 4.58 provides for non-consumptive groundwater takes that are not subject to any groundwater allocation zone limits, and will generally be supported, provided the water either remains in the aquifer, or is returned to the same groundwater allocation zone within 24 hours and is protected from contamination. However, Policy 4.50 provides for the allocation of water (where the rate of take or volume of water consented for abstraction from a catchment exceeds the environmental flow and water allocation limit for surface water or stream depleting groundwater, or the groundwater allocation limit for that catchment) provided that, amongst

⁴ Policy 4.2

other matters, there are significant and enduring improvements in the efficiency of water use and reductions in any adverse effects; or it is demonstrated that the existing use of water is efficient and that the efficiency is enduring.

The sharing of water between uses during times of restriction is provided for by Policy 4.72. The transfer of water between users is provided for but within over-allocated zones, unused water cannot be further allocated through the granting of a water permit⁵. In addition, systems designed to carry or apply water must be designed to maximise its efficient use⁶.

In terms of the sub regions, only Selwyn -Te Waihora and Ashburton specifically provide for aquifer recharge. The provisions in the Selwyn-Te Waihora section are intended to improve lowland stream flows and their ecological and cultural health. The policies⁷ in the Ashburton section are quite directive and apply to the Upper and Lower Hinds/Hekeao Plains Areas, using MAR to augment groundwater and/or surface water to improve overall water quality and improve flows and water levels.

The Waitaki and South Coastal Canterbury sub-region section specifically provides for the augmentation of Wainono Lagoon to improve water quality.

Overall, the policies that specifically relate to MAR/augmentation apply to identifiable areas because there are no region wide provisions.

4.4 Activities

The following table compares the rules that would be applicable when establishing and operating a MAR scheme under the current region-wide rules in Section 5 of the LWRP, Section 11: Selwyn-Te Waihora and Section 13: Ashburton.

Activities	Selwyn-Te Waihora	Ashburton: Hinds	Region wide
Water take	Rule 11.5.35: Discretionary - take and use of surface water or groundwater for the sole purpose of augmenting groundwater or surface water to increase stream flows in the Selwyn Te Waihora sub-region and including	Rule 13.5.35: Discretionary - take and use of surface water or groundwater in the Lower Hinds/Hekeao Plains Area for the sole purpose of augmenting surface water or groundwater.	Permitted - use of water already being taken for irrigation. Rule 5.125 – prohibited – new take from over allocated surface water body. Rule 5.126 - Restricted Discretionary – non-consumptive take.

⁵ Policy 4.71

⁶ Policy 4.69.

⁷ Policy 13.4.14 specifically applies to the Lower Hinds/Hekeao Plains Area, where by 2035 it is intended to achieve the target nitrate toxicity limits set out in Table 13(g) for 'Hill-fed Lower' and 'Spring-fed Plains' surface waterbodies, and an annual average groundwater nitrate-nitrogen concentration of 6.9 mg/L4 by, amongst other matters, implementing Managed Aquifer Recharge and Targeted Stream Augmentation.

	all areas within the Little Rakaia Combined Surface and Groundwater Allocation Zone.		Rule 5.133: Restricted Discretionary - transfer of water.
Discharge of water/contaminants	<p>Rules 11.5.42 and 13.5.36</p> <p>Restricted Discretionary Activity if the discharge is part of a trial for investigative purposes and for a duration of no more than 5 years.</p> <p>Rules 11.5.43 and 13.5.37</p> <p>If the discharge is not associated with a trial, it is a Discretionary Activity.</p>		Rule 5.100: Discretionary Activity.
Earthworks (excavation and deposition) – only region-wide rules.	Rules 5.176 and 5.177 - Restricted discretionary activity.		

4.5 Water Takes

The region-wide rule framework **prohibits** new abstractions where a surface water catchment or groundwater allocation zone is fully or over-allocated.

Alternatively, water can be transferred from existing irrigation schemes provided the take remains within the maximum volume of take consented under each scheme. This is provided for as a **Restricted Discretionary Activity**. However, if the written agreement of the owner or manager of the irrigation or hydroelectric canal or water storage facility to take water from the artificial watercourse or water storage facility (Rule 5.122) is not provided, it becomes a **Discretionary Activity**. Furthermore, a change of conditions may be required to enable the water to be used for MAR, as discussed in Section 5.3 below.

The Selwyn-Te Waihora sub region section provides for the taking and use of surface water or groundwater for the sole purpose of augmenting groundwater or surface water to increase stream flows in the Selwyn Te Waihora sub-region and including all areas within the Little Rakaia Combined Surface and Groundwater Allocation Zone as a **Discretionary Activity** (Rule 11.5.35).

The Ashburton sub region section provides for the taking and use of surface water or groundwater in the Lower Hinds/Hekeao Plains Area for the sole purpose of augmenting surface water or groundwater to reduce concentrations of nitrate nitrogen in surface water or groundwater and/or increase flows in lowland streams as a **Discretionary Activity** (Rule 13.5.35).

Another possibility is to take water under the 'non-consumptive' rules (taking of surface water: Rules 5.126 and 5.127 and groundwater: Rules 5.131 and 5.132) as a **Restricted Discretionary Activity**. However, these rules require water to be discharged to the same water body. If this requirement is not met in surface water bodies and the discharge is more than 250m from the take, the take is a **Non-Complying Activity** (Rule 5.127). If the discharge of the groundwater is not to the same aquifer or groundwater source, is not for domestic purposes; or contains contaminants, other than water of the same or different temperature, the take and associated discharge is a **Discretionary Activity** (Rule 5.131).

4.6 Discharge of water and contaminants

In the Ashburton (Hinds/Hekeao Plains Area) and the Selwyn-Te Waihora sub-region, the discharge of water is a **Restricted Discretionary Activity** (Rules 13.5.36 and 11.5.42 respectively) if the discharge is part of a trial for investigative purposes and for a duration of no more than 5 years. Otherwise the discharge of water is a **Discretionary Activity** (Rules 11.5.37 and 13.5.43).

The discharge of water for a MAR scheme under the region-wide rules is a **Discretionary Activity** under Rule 5.100, which states 'The discharge of water in land where it will enter groundwater is not classified by any other rule in the LWRP.'

4.7 Earthworks

Any earthworks would be subject to the region-wide rules (Rules 5.176 to 5.178). The excavation of material would be a **Permitted Activity** if the volume of material excavated is less than 100 m³; or where the volume exceeds 100m³, there is more than 1m of undisturbed material between the deepest part of the excavation and the seasonal high-water table level; and the excavation does not occur within 50 m of any surface waterbody. If any excavation does not meet this standard, it would be a **Restricted Discretionary Activity**.

The deposition of more than 50m³ of material in any consecutive 12-month period onto land which is excavated to a depth in excess of 5m below the natural land surface and is located over an unconfined or semi-confined aquifer, where the seasonal high-water table is less than 5m below the deepest point in the excavation is a **Controlled Activity**, provided certain conditions⁸ are met. Where the conditions are not met, any deposition is a **Restricted Discretionary Activity**.

Overall, an activity to establish MAR (where water can be utilised from an existing take) is likely to be a **Discretionary Activity** because of the discharge rules. This means that the Council can

⁸ 1. The material is only cleanfill; and

2. The volume of vegetative matter in any cubic metre of material deposited does not exceed 3%; and

3. The material is not deposited into groundwater; and

4. Any cured asphalt deposited is placed in the land at least 1 m above the highest groundwater level expected at the site; and

5. The material is not deposited onto or into land that is listed as an archaeological site; and

6. A management plan has been prepared in accordance with Section 8.1 and Appendix B of "A Guide to the Management of Cleanfills", Ministry for the Environment, January 2002.

consider any matter it considers appropriate, and applications can be declined or approved, and the scheme will be subject to conditions of consent. However, where water cannot be taken from an existing take, the scheme is likely to be a **Non-Complying Activity** because of the water take rules.

4.8 How the rules applied to the Hinds/Hekeao and Waimakariri trial schemes.

The following section demonstrates how the rules applied to the Hinds/Hekeao and Waimakariri trial schemes.

4.8.1 Original Hinds/Hekeao trial site, 2016.

Description

Canterbury Regional Council (the applicant) applied for a discharge consent, a land use consent, and a water permit to construct and operate the pilot study for the managed aquifer recharge (MAR) project in the Hinds Plains Catchment.

Applicable rules⁹

Land and Water Regional Plan (made partly operative on 1 September 2015)			
Activity	Rules	Activity Status	Compliance and Activity Status
Discharge of water or contaminants.	Rule 5.98: the discharge of water or contaminants onto or into land in circumstances where a contaminant may enter groundwater provided the conditions are met.	Permitted	The volume and application rate of the proposed discharge exceeds the values stated in condition (1) of Rule 5.98. The discharge does not comply with condition (6) of Rule 5.98 as the sole purpose is for the augmentation of the groundwater resource. Therefore, the activity falls to be a discretionary activity under Rule 5.100 of the LWRP.
Excavation of land	Rule 5.175: the use of land to excavate material	Permitted	The volume of material proposed to be excavated at

⁹ Consideration of the water take was also required under the Water Conservation (Rangitata River) Order 2006 and consent was required under the Ashburton District Plan for earthworks.

	over an unconfined or semi-confined aquifer provided the conditions of the rule are met		the site is more than 100 m ³ and the excavation is to occur within 50 m of an existing ADC water race therefore the activity does not comply with conditions (2)(a) and (b). Therefore, the excavation falls to be a restricted discretionary activity under Rule 5.176 of the LWRP.
Water take	Rule 5.133: the transfer of a water permit provided the conditions of the rule are met.	Restricted Discretionary	The proposed partial site to site transfer of CRC012114 for a limited duration complies with all conditions of Rule 5.133, therefore the activity falls as a restricted discretionary activity .
Proposed Plan Change 2 to the LWRP – Section 13 Ashburton (PPC2) was publicly notified by ECan on 18 September 2014. Hearings had been completed at the time of application, and the provisions of PPC2 had legal effect but were not operative.			
Discharge of water	Rule 13.5.36 provides for the discharge of water into water or onto land in circumstances where it may enter water and the water may contain contaminants, for the purpose of augmenting groundwater or surface water within the Hinds/Hekeao Plains Area provided the all conditions of the rule are met.	Restricted Discretionary	The application had been designed to meet all conditions of this rule and was therefore a restricted discretionary activity under Rule 13.5.36 of Plan change 2 to the LWRP.

Consent was granted to:

- discharge water to land (CRC162191). This is how the activity is referred to on the decision documents but the s42a report refers to 'a discharge consent to discharge contaminants to land and groundwater.
- excavate land over an unconfined aquifer within 50m of a surface water body (CRC162192), and

- to partially transfer water from resource consent CRC012114 to take and use surface water (CRC164281).

4.8.2 Additional Hinds/Hekeao trial sites, 2017.

Description

Canterbury Regional Council (the applicant) holds discharge permit CRC162191 to discharge a maximum of 500 litres of water onto land at Lagmhor, Ashburton to facilitate the original MAR pilot trial. The MAR pilot trial completed its first year of aquifer augmentation and analysis of the trial data showed that the maximum average recharge rate of the discharge equated to 113 litres per second. The application made in 2017 sought consent to authorise the remaining 387 litres per second to be discharged to 16 other MAR sites within the Mayfield-Hinds and Valetta catchments. The discharge was only water sourced from the Rangitata Diversion Race Klondyke intake in accordance with resource consent CRC164281 and sodium chloride for use as a tracer.

Applicable rules

Land and Water Regional Plan including Plan Change 4			
Activity	Rules	Activity Status	Compliance and Activity Status
Discharge of tracers	Rule 5.101: the discharge of tracers provided conditions are met.	Controlled.	The discharge meets the conditions of Rule 5.101 and is therefore a controlled activity .
Excavation of land	Rule 5.175: the use of land to excavate material over an unconfined or semi-confined aquifer provided the conditions of the rule are met	Permitted	The excavation meets the conditions of Rule 5.175 and is therefore a permitted activity .
Water take	Rule 5.121: taking or use of water from irrigation or hydroelectric canals or water storage facilities provided certain conditions are met.	Permitted	The take will occur from irrigation canals. The applicant supplied written approval from the managers of the Mayfield-Hinds, Valetta, Barhill-Chertsey and RDR regarding the take of water from their respective irrigation

			distribution races, and therefore the take is a permitted activity .
Proposed Plan Change 2 to the LWRP – Section 13 Ashburton (PPC2) was publicly notified by ECan on 18 September 2014. Hearings had been completed at the time of application, and the provisions of PPC2 had legal effect but were not operative.			
Discharge of water	Rule 13.5.36 provides for the discharge of water into water or onto land in circumstances where it may enter water and the water may contain contaminants, for the purpose of augmenting groundwater or surface water within the Hinds/Hekeao Plains Area provided the all conditions of the rule are met.	Restricted Discretionary	The application had been designed to meet all conditions of this rule and was therefore a restricted discretionary activity under Rule 13.5.36 of Plan Change 2 to the LWRP.

Consent was granted to discharge water to land (CRC182576). This included the discharge of tracers, although this is not clear from the title of the consent decision.

4.8.3 Waimakariri MAR trail investigation site, 2018.

Description

Canterbury Regional Council (CRC) applied for consents to take and use of water from the WIL irrigation canals and discharge water into a trench for the purpose of an infiltration testing trial for MAR. This was the first stage of a feasibility assessment whether farm-based MAR is a viable means to mitigate the impacts of groundwater abstraction and nitrate nitrogen discharges within the application area.

Applicable rules

Land and Water Regional Plan including Plan Change 4			
Activity	Rules	Activity Status	Compliance and Activity Status

Discharge of tracers	Rule 5.100: any discharge that is not permitted by either Rule 5.98 or 5.99 and is not classified by any other rule in this Plan.	Discretionary	The discharge is not provided for by any other rule in the Plan and is therefore a discretionary activity .
Excavation of land	Rule 5.175: the use of land to excavate material over an unconfined or semi-confined aquifer provided the conditions of the rule are met	Permitted	The excavation meets the conditions of Rule 5.175 and is therefore a permitted activity .
Water take	Rule 5.121: taking or use of water from irrigation or hydroelectric canals or water storage facilities provided certain conditions are met.	Permitted	The take will occur from irrigation canals, but the applicant has not supplied the written approval of the owner/manager of the canal and therefore the take is a discretionary activity .

Consent was granted for a:

- water permit to take and use water (CRC184025), and
- discharge permit to discharge water to land (CRC184026). This included contaminants, although this is not clear from the title of the consent decision.

It is noted that both the Hinds/Hekeao MAR trial and the Waimakariri trial schemes required consent as discretionary activities: the Hinds/Hekeao MAR trial for the discharge of water to land and the Waimakariri MAR trial for the taking and use of water and the discharge of water to land. The additional 16 sites at Hinds/ Hekeao MAR trial required consent as a restricted discretionary activity for the discharge of water to land.

The tables above identify the key activities that required consent being: water take, earthworks and discharge of water to land. However, there appears to be a range of rules that apply, in particular as the Hinds/Hekeao MAR trial was consented prior to Plan Change 2 becoming operative and the 16 additional sites triggered a region wide rule to discharge a tracer in the discharge water. It may be this complexity that has led to concern being expressed by applicants about the consenting process.

5.0 The Issues

The issues have been derived from consultation with the parties identified under Section 2 above, our understanding of MAR and the current statutory and consenting requirements. The purpose of this section is to inform the requirements and appropriateness of new region-wide provisions in the LWRP to provide for MAR.

5.1 No consistent definition of augmentation

There is no definition of MAR in the LWRP. However, there is a definition of ‘augmentation’ and in the Selwyn Te Waihora sub region section and ‘augmenting’ in the Ashburton sub-region section which apply to the MAR provisions.

The definitions have been specifically tailored to each sub-region and are not consistent as the Selwyn-Te Waihora definition refers to the addition of water to Hill-fed lower and Spring fed-plains rivers, and the Ashburton definition refers to ‘lowland streams’. In addition, only the Ashburton definition specifically refers to ‘reducing the concentration of nitrogen’. In terms of the sub-region sections, this is not considered to be an issue as each definition is applied within a defined area.

However, if it is intended to enable augmentation (MAR is a form of augmentation) across Canterbury, it would assist plan users if there was a consistent definition of this term. It can be costly and time consuming to figure out how each section of the plan works, generating high investment risks and compliance cost. It is a more efficient system to apply the same definition across the LWRP.

5.2 Science and understanding

Our discussions with the ECan science team, as well as Bob Bower and Peter Lowe of the Hinds MAR scheme, suggest that there is a significant amount of science and credible trial results from the Hinds MAR trail and internationally to support MAR including its environmental benefits as suggested above under Section 3.1, which could inform decision making on resource consent applications.

It is acknowledged that work is on-going, and knowledge is improving all the time as more trials are installed and operated for longer. As pointed out by the science team, the process of establishing MAR involves working with complex natural systems that differ across Canterbury. It is essential these are understood to be able to determine the adverse effects and potential benefits of establishing and operating MAR. It would therefore be pertinent for the consenting teams to be provided with the latest reports on the Hinds MAR scheme, and the Waimakariri infiltration trail (when this is available). However, this does not release the applicant from their obligation to provide information in such detail as required to undertake an assessment of the environmental effects of a proposal (this was discussed in section 4 above).

5.3 The statutory framework

From our analysis under section 4, it would appear that the taking of water is likely to be the most difficult matter to address under the region wide rules. The Selwyn Te Waihora sub region section has a rule that enables the taking of water solely for augmentation as a discretionary activity. To date, the Hinds and Waimakariri trial MAR schemes have relied on using water being taken by irrigation schemes but surplus to irrigation requirements. In addition, a water take for an irrigation scheme could apply to use water for MAR at the time of application. This would be subject to a consideration of 'reasonable use' under Schedule 10.

If such irrigation water is not available, a MAR scheme would need to rely on being able to take water as a new take and, in a ground or surface water allocation zone that is not over allocated that may not be an issue. But of course, MAR is often required to address issues relating to water quality and quantity that have arisen in over allocated zones. In these cases, water could be transferred from another site, with a restricted discretionary activity being required where this is for a limited duration (Rule 5.133), but more stringent conditions applying to permanent transfers. This can result in the loss of 50% of the transferred volume and make a MAR scheme unviable.

The policies in the LWRP enable the transfer of water provided that:

- the transfer occurs within the same surface water catchment or sub-catchment, or the same groundwater zone;
- the same or a lesser amount of water is being taken or used;
- the transferee's water take is reasonable for their proposed use as determined under the provisions of the Plan including Schedule 10 for irrigation uses;
- the adverse effects of the take and use of water are not more than minor; and
- that in an over-allocated surface water catchment or groundwater zone, a proportion of the allocated water is surrendered and is not re-allocated, unless there is a method and defined timeframe to phase out over-allocation set out in an applicable sub-region Section.

However, the conditions on the transferred water permit remain as per the original consent and a change of consent conditions under s127 of the RMA may be required to use the water for augmentation. This may trigger an assessment of 'reasonable need'¹⁰, if the consent does not

¹⁰ Policies 4.64, 4.65 and 4.71.

4.64 Where existing abstractors do not have a maximum seasonal or annual allocation, to impose these conditions, determined in accordance with Schedule 10, when any of the following occur:

- (a) resource consent conditions are changed in accordance with Section 127 of the RMA;
- (b) water permits are transferred;
- (c) existing resource consents to abstract water expire and are replaced; or
- (d) the consent authority determines that a review of consent conditions is required to impose seasonal or annual volumes in a catchment.

4.65 The rate, volume and seasonal duration for which water may be taken will be reasonable for the intended use.

have a maximum annual water take volume. The reason for the assessment of reasonable need is to manage existing water takes, lower over allocation in the ground and surface water zones and endorse the efficient use of water by imposing maximum water takes. A review of 20 water take consents granted between 2016 and 2018 across Canterbury (refer to Appendix 1), would suggest that very few consents would enable water to be used for MAR. It is acknowledged that the sample of consents is small, but we consider it to be representative as ECan generally consents the taking of water for particular purposes. As such, to use 'transferred' water for MAR is likely to require a change of consent conditions, if not a new consent.

However, there are also region-wide rules that enable the taking of surface water for non-consumptive uses (Rules 5.126 and 5.127) and groundwater (Rules 5.131 and 5.132) as a Restricted Discretionary Activity. However, these rules require water to be discharged to the same water body and the discharge to be no more than 250m from the take. If these conditions cannot be met, the take is a Non-Complying Activity (Rule 5.127). If the discharge of the groundwater is not to the same aquifer or groundwater source, is not for domestic purposes; or contains contaminants, other than water of the same or different temperature, the take and associated discharge is a Discretionary Activity (Rule 5.131).

Given that water is likely to be taken from a surface water body and discharged to a groundwater aquifer, it is likely that the taking of water under these rules would be a non-complying activity and would need to not be contrary to the objectives and policies of the LWRP.

The LWRP contains policies that seek to ensure water is used efficiently. So, is using water for MAR an efficient use of this resource? This is a somewhat philosophical consideration. In simple terms, the output of water to a MAR system should roughly be the same as the input as the water is filtrated through the soil into a groundwater aquifer. Furthermore, the objectives and policies¹¹ clearly direct that allocated but unused water is relinquished to the aquifer and that water should be used efficiently. It could be argued that this is achieved by way of infiltration basins. However, where water for MAR is taken from a surface water body, it could result in water being taken from an over allocated water body to supplement water levels and improve water quality in another i.e. taking water from the Rangitata River to discharge into the Hinds groundwater aquifer. Is this an efficient use of water or should any 'excess' water, in this example, be relinquished only to the Rangitata River? This matter is likely to be the cause of lengthy discussions and the use of water for MAR will need to be supported by strong evidence of its benefits and directive polices. As previously noted, there are likely to be downstream benefits, but it is noted that water discharged via a MAR scheme could not be extracted from an overallocated aquifer unless a new flow regime is proposed. Overall, it could be argued that MAR is an efficient use of water especially if it is considered in a broader sense than one water body or even allocation zone.

The discharge of water is a Restricted Discretionary for trials up to 5 years in duration. This was intended to encourage MAR trials. A Discretionary Activity was applied to discharges associated with permanent MAR schemes to enable all relevant matters to be assessed. This is considered

¹¹ Objectives 3.9 and 3.10, Policies 4.69 and 4.71

to be appropriate given that the matters that may need to be addressed could differ from site to site or change over the lifetime of the LWRP.

Likewise, a restricted discretionary activity status for earthworks is considered to be appropriate given the matters that are likely to be addressed.

5.4 Requirements of resource consent applications

The operative resource consent application requirements can be summarised as:

- the location, method and timing of the discharge to groundwater or surface water; and
- the adequacy of the scheme design, construction, operation, monitoring, reporting; and
- the appropriateness of integration with existing or planned infrastructure and water conveyance systems; and
- any adverse effects on people and property from raised groundwater levels and reduced drainage capacity in the drainage system; and
- any adverse effects on water quality in the receiving aquifer or river or significant habitats of indigenous flora and fauna; and
- any adverse effects on sites or values of importance to Ngāi Tahu from moving water from one catchment or water body to another; and
- any adverse effects on sites or areas of wāhi tapu, wāhi taonga or mahinga kai; and

The Consents Planners are finding that applicants are not consulting with iwi prior to lodging applications for MAR under the sub-region MAR discharge rules when it is proposed to take water from one water body and discharge it to another. Whilst this is not a requirement under the RMA and cannot be legally required by ECan, it is considered best practice given that the region-wide policies and sub-region MAR discharge rules¹² include effects on Ngai Tahu as a matter of restricted discretion.

E. coli is seen as a key risk by ECan, especially where water is delivered by open waterways such as the Rangitata Diversion Race, ponds or channels. However, it has been suggested by the Hinds scheme that ECan places too much focus on this matter. The applications and s42a reports for the Waimakariri MAR trial and the Hinds/Hekeao MAR trial addressed the discharge of E.coli, to some extent. However, it was concluded in the s42a report on the Waimakariri MAR trial and the Hinds/Hekeao MAR trial, that effects on groundwater quality would be less than minor. For the Hinds/Hekeao MAR trial, initial sampling of the source water indicated low levels of E.coli and nitrate-nitrogen, and for the Waimakariri MAR trial:

- a. The race water had low nitrate concentrations and relatively low contaminant microbiology concentrations (e.g. E.coli); and

¹² Policy 4.14B, 4.55, 4.71A, Rule 5.126, Rule 11.5.42, Rule 13.5.36, Rule 15A.5.31, Rule 15A.5.41 and Rule 15A.5.44

- b. Microbial discharges from neighbouring winter grazing were likely to be several orders of magnitude higher than any microbial discharges from the infiltration test.

Whilst it is recognised that the applications and s42a reports do not necessarily reflect the discussions that occurred between ECan and the applicants, it does not appear E.coli was a particularly contentious issue. However, E.coli will always be a matter of concern to ECan given its requirement to manage effects on water quality, ecological and human health. Likewise, on-going monitoring would also include records of E.coli levels given the Region Wide Water Quality Limits in Schedule 8 and the need to manage effects on human health especially the provision of drinking water under the NZ Drinking Water Standard.

Flooding downstream of a MAR site is a significant concern that needs to be addressed at the time of consent application. It is a matter of discretion under the sub region rules and was seen as so important by the science team, the Consent Planners and past applicants that there should not be rules to reduce consenting requirements or provide for MAR as a permitted activity.

In addition, there are different types of systems used to deliver water to MAR sites and at present these require a site by site assessment, and this can be complex if a number of sites are being established under one application. As an alternative, it has been cautiously suggested by the science team that there could be an assessment of the general risk i.e. risk assessment of the delivery system rather than each site. That said, we understand that there is still some trial and error with delivery systems and some have worked whilst others have not.

5.5 Individual schemes

There has been concern expressed that MAR should only be established by community schemes rather than individuals as a plethora of MAR sites across the region was not considered appropriate given the potential for adverse effects such as flooding. Whilst this could be managed through the consent process, the risk of cumulative effects was seen as highly significant and could potentially prevent the establishment of a larger community scheme in the future, which is likely to be easier to manage and may have greater environmental benefits.

6.0 Options to address the issues.

We have set out below a number of options to address the issues identified above. It is considered that one or multiple options could be adopted to enable the LWRP to provide for MAR in an efficient and effective manner. It is also noted that these options may require additional work to be undertaken to fully understand the implications of each option or provide supporting scientific evidence sufficient for a s32 report that would be required to accompany a future plan change.

In summary the options are:

1. Retain the status quo.
2. Include a region-wide definition of Augmentation.
3. Sub-regional provisions.
4. Region-wide provisions.
5. Include a schedule of standards.
6. Providing for community MAR schemes only.

6.1 Option 1: Status Quo

Option 1 would retain the status quo with all the issues that have been identified above in Section 5.

6.2 Option 2: Include a region-wide definition of Augmentation

This option would involve including a definition of Augmentation in the region-wide definitions of the LWRP to assist plan users and enable specific rules related to MAR/augmentation to be drafted and included in the LWRP. The science team has suggested that there should be reference to environmental benefits or gains within such a definition.

We suggest that the definition of 'augmenting' used in the Ashburton sub-region is the most appropriate as it refers to reducing concentrations of nitrate nitrogen and it could easily be amended to specifically refer to 'augmentation' and Managed Aquifer Recharge as follows:

~~Augmenting~~ Augmentation: means the addition of water to surface water or groundwater specifically for the purpose of reducing the concentration of nitrate nitrogen in groundwater or increasing flows in lowland streams and any other resultant environmental benefits and gains. This includes Managed Aquifer Recharge.

The definitions in the sub-region sections could then be deleted. This would ensure consistency in terms of its application and reduce the potential for debate about its purpose. It would also enable the term to be used in policies and rules as its meaning would be clear, although it is acknowledged that this may require consequential changes to other provisions in the LWRP.

6.3 Option 3: Sub Region Provisions

This option would require rules to provide for MAR to be included in each sub-regional section of the LWRP or at least in those where MAR is likely to establish. The rules would need to be

supported by enabling policies. Overall, the approach could follow that taken in the Ashburton sub-region section, which specifically provides for the take and use of water to augment surface or ground water 'to reduce concentrations of nitrate nitrogen in surface water or groundwater and/or increase flows in lowland streams'. This option would enable provisions to be tailored to each sub-region, if required.

It could also enable the reference to 'a trial for investigative purposes' to be removed as trials are indicating that MAR is a successful method of recharging aquifers whilst also reducing the concentration of contaminants. Whilst further trials are proposed, and the science is constantly being informed, it is considered appropriate to enable permanent MAR to establish and operate especially in areas where aquifers are over allocated (in terms of both water quantity and quality) and/or the concentration of nutrients in groundwater is known to be elevated.

This option could also enable permanent MAR to be established as a restricted discretionary activity. This would mean that applicants would have certainty over the matters that the Council could consider and prepare their applications accordingly. Applications could be declined but the matters to which Council restricts its discretion need to be sufficient to enable all potential adverse effects to be addressed. It may be that the matters of discretion are so lengthy, that it is more appropriate to retain a discretionary activity status. In this regard, it is noted that the s32 report on Plan Change 2 deliberately provided for trials for investigative purposes as a restricted discretionary activity as an 'encouragement': it is assumed that this was provided for by an easier consenting pathway and was confined to the Hinds area. Likewise, the Selwyn Te Waihora sub region rules that provided for trials for investigative purposes as a restricted discretionary activity are contained in one sub region. It is also of note that the Ashburton Zone Committee identified the need to undertake a trial programme as part of 'further technical work and consultation'. It is unclear whether the other matters that were identified have been addressed, being: the development and evaluation of MAR options and the acceptability of mixing waters. Given this, and the on-going trial of delivery systems and the need to address a broad range of matters, it is suggested that if region-wide provisions are included in the LWRP to provide for MAR/augmentation, the discharge of water and contaminants should be subject to careful consideration and analyses under s32 of the Resource Management Act 1991 (RMA).

The taking of water will also need to be addressed and any consideration needs to be in the context of the LWRP's drive for the efficient use of water. If new takes for MAR are provided for, whether permitted or by way of consent, they would need to be within existing allocation limits and this would be an issue in over allocated groundwater zones, unless it could be argued that there is no 'loss' of water. However, where water is taken from one water body or allocation zone and discharged into another, there would be a negative impact on the allocation zone from which the water was taken. As such, any additional abstraction would undermine the environmental benefits of MAR. This matter needs to be considered in greater detail and it may be that there are only two options:

- provide for MAR/augmentation as part of an irrigation scheme, and consider water use for MAR at the time of application, and/or

- enable the use of 'excess' water within existing takes for irrigation schemes to be used for MAR thus promoting the efficient use of an existing take.

6.4 Option 4: Provisions in the main body of the LWRP

As above but policies and rules to enable the establishment of MAR would be included in sections 4 and 5 of the LWRP. It is suggested that the same approach is applied as in the sub-regions with a clear definition, directive policies and rules. However, to provide for sub-regional differences (if required) would rely on exceptions and additions to the policies and rules but this option would avoid the repetition of provisions throughout the LWRP.

6.5 Option 5: Include a schedule of standards

Most likely implemented in conjunction with Option 3 or 4, the LWRP could also include a schedule of minimum standards, required information for consent applications, and operating and monitoring requirements for consented activities. This could be a new schedule in the LWRP and act as a guide to both applicants and Consent Planners when processing applications for MAR. It could also form the matters of discretion or at least provide a guide to the matters that the Council would consider if it is decided to impose a more stringent activity status. It is recommended that the schedule is compiled in conjunction with the science team.

6.6 Option 6: Providing for community MAR schemes only

This option would require the inclusion of new rules in either sections 4 and 5 of the LWRP or sections 6 to 15 of the LWRP to only allow community groups or irrigation schemes to establish MAR. Alternatively, a more stringent activity status could apply to private schemes.

The costs and benefits of each option are considered below.

Option	Costs	Benefits
1: Status quo	<p>The LWRP would not provide for MAR across the Region leading to the activity being subject to rules that were not necessarily intended to manage this type of activity.</p> <p>No definition of MAR to aide understanding of the activities</p>	Enables robust assessment of any application.

	<p>involved in establishing and operating it.</p> <p>May lead to inconsistent approach to processing MAR applications.</p> <p>Lack of policy direction in the LWRP.</p> <p>On-going cost to ECan and applicants due to unnecessarily stringent consenting requirements.</p> <p>More stringent activity status continues to apply to permanent MAR schemes.</p>	
2: Definition	<p>Less flexibility in terms of defining MAR.</p>	<p>Assists understanding of MAR and applies a consistent approach to the nature of the activity.</p> <p>Removes confusion as the sub-regional sections contain different definitions of 'augmentation' but not MAR. The LWRP contains no definition of either.</p> <p>Enables the inclusion of rules that specifically apply to MAR schemes.</p>
3: Sub-regional rules	<p>Repetition of rules throughout the LWRP.</p> <p>Potentially inconsistent approach to establishing MAR.</p>	<p>Plan framework can be tailored to sub-regional requirements.</p> <p>Remove reference to trials and include provisions that support the establishment of permanent MAR.</p> <p>Opportunity to address the benefits of consulting with iwi especially if water is being transferred from one waterbody to another, prior to lodging an application.</p>
4: Policies and Rules in LWRP	<p>Less flexibility to address sub-regional issues/matters.</p> <p>Potential for competing policies on water takes and use.</p>	<p>One set of rules that apply across the region enables a consistent approach.</p> <p>Ease of understanding.</p>

		<p>Remove reference to trials and include provisions that support the establishment of permanent MAR.</p> <p>Provides opportunity to address issue of water take through clear policies and rules.</p> <p>Opportunity to address the benefits of consulting with iwi especially if water is being transferred from one waterbody to another, prior to lodging an application.</p>
5: Schedule of standards	The schedule cannot be changed without a change to the LWRP with subsequent costs.	<p>Enables more consistent approach to be applied even if there are sub-regional rules.</p> <p>Opportunity to address concerns around lack of understanding of science and potential effects through information provided in the schemes.</p> <p>Enables applications to focus on key matters such as E. coli and flood risk.</p> <p>Sets a baseline of minimum requirements for MAR systems.</p>
6: Community schemes	Would disadvantage individuals from applying to establish MAR.	<p>Greater ability to manage cumulative effects because applications are likely to cover a number of sites.</p> <p>Reduces risk of flooding downstream of MAR as effects of large schemes may be easier to manage and monitor than several individual schemes.</p>

7.0 Conclusions

We were commissioned by ECan to consider the inclusion of region wide provisions to enable the establishment and operation of permanent MAR whilst taking into account concerns expressed by those involved in establishing MAR systems about the provisions of the Land and Water Regional Plan (LWRP) and the consenting process.

We have identified several issues, which we have grouped as:

1. No consistent definition of augmentation.
2. The science and understanding of MAR
3. The statutory framework including water take and use.
4. Requirement of Resource Consent applications.
5. Individual schemes.

This report identifies a range of options to address the issues and has very broadly considered the costs and benefits of each. Our conclusion is that the greatest benefit would arise from having a framework including a definition of Augmentation that specifically refers to MAR (Option 2) to provide for MAR/augmentation in the region-wide provisions of the LWRP (Option 4). It would also assist if there was a schedule of standards to consider when developing and consenting a MAR scheme (Option 5).

8.0 Recommendations

If it is decided to proceed with Options 2, 4 and 5, we recommend that:

- the matters identified in the s32 report for Plan Change 2 and identified by the Ashburton Zone Committee as needing to be dealt with prior to enabling permanent MAR, have been, or are addressed, prior to proceeding with a proposed plan change, being the development and evaluation of MAR options and the acceptability of mixing waters.
- a definition to define augmentation, which could include a reference to scale as that would address concerns relating to the development of small-scale MAR across the region, given the concerns expressed under Issue 5.5. Alternatively, ECan may wish to consider imposing a more stringent consenting requirement on private schemes (Option 6) given the potential risk of cumulative effects on flooding and water quality
- at least two new policies are introduced into section 4 of the LWRP to specifically identify the environmental outcomes sought by MAR and the environmental effects that need to be considered. This would assist in overcoming any potential tension between existing policies that seek to achieve the efficient use of water and the use of water for MAR.
- rules to provide for all activities associated with establishing and operating MAR including earthworks, temporary water takes, and discharges associated with activities such as the washing of gravels, permanent water transfers and/or takes, and discharges of water and contaminants to land (including tracers).
- include a Schedule to the LWRP that sets out minimum standards, required information for consent applications, and operating and monitoring requirements for consented

activities. The schedule could also include some reasoning for the requirements, so the effect of any non-compliance can be understood.

By way of example, the schedule could include:

Minimum standards

- Minimum depth from the bottom of the filtration basin to groundwater.
- Minimum water quality standards applied to discharged water and receiving groundwater.
- Infiltration rates.

Information required to accompany resource consents

- The type of delivery system proposed and the associated risks.
- Proposed minimum depth from the bottom of the filtration basin to groundwater.
- Proposed minimum water quality standards applied to discharged water and receiving groundwater.
- Methods of managing effects on water resources – other aquifers and bores, and water quality in the aquifer.
- Infiltration rates.
- Methods of managing potential E.coli contamination.
- Management of flood risk downstream of the scheme.
- Stability of ground layers.
- Measures to manage emergency shut-down and when these would be applied.
- Proposed on-going monitoring and recording of water quality of the discharged and ground water.

It is acknowledged that the above recommendations may result in consequential changes being required to the existing provisions in the LWRP including those in Section 11: Selwyn Te-Waihora and Section 13: Ashburton.

Appendix 1: Review of Water Take Consents

1	A	B	C	D	E	F	G	H	I	J
2										
3										
4										
5										
6										
7										
8										
9	Blank	Year	Area	Consent Number	Applicant	Water take consented (volume)	Purpose?	Any other restrictions	Irrigation only	
10	1	May-18	On hill closest to Ashburton River Groundwater Allo	CRC183850	Mtriv Water Ltd & Ashburton Lyndhurst Irrigation Ltd	none stated	Irrigation, Stockwater, Hydro electric power generation	Max irrigation over 94,486ha of crop and pasture	No	
11	2	Mar-18	Sheffield - Semi-confined or unconfined aquifers	CRC184109	Central Plains Water Limited (CPWL)	not exceeding 187 litres per second, with a volume not exceeding 16,157m ³ per day, and 1,506,250 cubic metres between 1st September and the following 31st May.	Only to be used for irrigation of crops and pastures for grazing stock, excluding milking dairy cows	Lower water take limits where river at low levels, time period 1 Sept - 31 May following year		
12	3	Oct-17	Semi-confined or unconfined aquifers	CRC181898	Opuha Water Limited	max 42l/sec max flow rate - not exceeding 24,343m ³ low flow rates apply max 32l/sec max flow rate - not exceeding 603,331m ³ in calendar year from 1 July to following 30 June	to take and use groundwater - use not specified	Water shall only be taken from the following bores: a. J38/0135, 600 millimetres diameter and 10 metres deep, at or about map reference NZMS 260 138-6930-5160, at a maximum rate of 42 litres per second, with a volume not exceeding 24,343 cubic metres over any seven day consecutive period; and b. J38/0641, 300 millimetres diameter and 10 metres deep, at or about map reference NZMS 260 138-6977-5301, at a maximum rate of 3.4 litres per second, with a volume not exceeding 2,250 cubic metres over any seven day consecutive period; and c. J38/0642, 300 millimetres diameter and 10 metres deep, at or about map reference NZMS 260 138-6630-5491, at a maximum rate of 2.2 litres per second, with a volume not exceeding 1,250 cubic metres over any seven day consecutive period;	N/A	
13	4	Jun-17	Leeston - semi confined or unconfined aquifers	CRC176668	Groundwater Holdings Limited	max 12l/sec flow rate - limit 350m ³ /day	to take and use groundwater - use not specified	N/A	N/A	
14	5	Mar-17	Burnham - semi confined or unconfined aquifers	CRC174638	Groundwater Holdings Limited	max 178,224m ³ from 1 July to following 30 June	to take and use groundwater - use not specified	N/A	N/A	
15	6	Jun-18	Methven - semi confined or unconfined aquifers	CRC186125	Ashburton Lyndhurst Irrigation Ltd	only drainage water associated with construction and maintenance of a dam	only for use associated with dam	N/A	N/A	
16	7	Feb-18	Hinds - semi confined or unconfined aquifers	CRC184057	Hindsbank Farming Limited	max 4.9l/sec max flow rate - volume not exceeding 57,465m ³ 1 July and following 30 June	water take from Taylors Drain for irrigation	N/A	N/A	
17	8	Jan-18	Rakaia - semi confined or unconfined aquifer	CRC180819	Rakaia Dairy Limited	max 49l/sec max flow rate - daily volume not exceeding 40m ³ and total 16,000m ³ 1 July - 30 June following year	Dairy and stockwater supply only	N/A	N/A	
18	9	Nov-15	Rakaia - Rakaia Nutrient Allocation Zone - semi confined or unconfined aquifer	CRC162416	South Rakaia Bah Owners Association Incorporated	max 35l/sec max flow rate - volume not exceeding 20,286m ³ over consecutive 7 day period	Community supply and firefighting purposes only	Avoid leakage from pipes and avoid use of water onto non-productive land e.g. impermeable surfaces, river, or stream riparian strips.	N/A	
19	10	Feb-18	Rakaia - Blackbridge - semi confined or unconfined aquifer	CRC183988	Hindsbank Farming Limited	max 25l/sec max flow rate - volume not exceeding 720m ³ per day	Spray irrigation across 108ha	water take must be reduced where flow in Taylors Drain is below 50l/sec	Yes	
20	11	Feb-18	Rakaia - Eiffelton - semi confined or unconfined aquifer	CRC184059	Hindsbank Farming Limited	max 30l/sec max flow rate - volume not exceeding 5,140m ³ over consecutive 7 day period, and 4,651.5m ³ over 1st July - 30th June following	Irrigation of up to 18ha	water take must be reduced where flow in O'Shaughnessys Drain at Poplar Road is less than 25l/sec	Yes	
21	12	Nov-17	Hinds/Willowby - semi confined or unconfined aquifer	CRC181742	Carrfields Limited	max 30l/sec max flow rate - volume not exceeding 5,140m ³ over consecutive 7 day period, and 4,651.5m ³ over 1st July - 30th June following	Irrigation of crops and pasture for grazing stock, stockwater and domestic use.	No	No	
22	13	Oct-17	Springston - semi confined or unconfined aquifer	CRC181609	White Gold Limited	64l/sec max flow rate - max volume 5,250m ³ per day, max 576,450m ³ from 1 July - 30 June	Irrigation of up to 105ha of crops and pasture	Bores to be drilled to following depths only: - 80m below natural ground surface in coastal confined aquifer area - Annexure 3; 4m below natural ground surface in mid-plains area outside of area overlain by A1 - Annexure 3; and 45m below natural ground level in upper plains area as shown on Annexure 3	Yes	
23	14	Oct-17	Christchurch/Riccarton	CRC181993	Sandford Limited	45l/sec max flow rate - max volume 2,592m ³ /day and 943,488 m ³ between 1 July and 30 June.	Only used for industrial and commercial purposes	No		
24	15	Oct-17	St Andrews -	CRC181995	Cherrybank Farm Limited	30l/sec max flow rate - max volume up to 10,000m ³ per week	Spray irrigation across 81ha of crop and pasture	No	Yes	
25	16	Oct-17	Huntingdon - semi confined or unconfined aquifer	CRC181962	Parkfields Farm Limited	63l/sec max flow rate - max volume up to 465,160m ³ in any 150 consecutive days period, and 651,773m ³ between 1 July and following 30 June	Irrigation over 111ha of land	No	Yes	
26	17	Jul-18	Rakaia	CRC1910133	Mr S J & T M Booker & Taha Trustees Limited	75l/sec max flow rate - max volume 6,480m ³ per day and 832,164m ³ between 1 July and following 30 June	Water shall only be used for storage, domestic, stockwater, dairy shed wash down, and irrigation of land shown on Plan CRC181954	No	No	
27	18	Oct-17	Ophi - Washdyke Nutrient Allocation Zone and semi confined or unconfined aquifer	CRC181899	Alpine Fresh Limited	max 40l/sec max flow rate - max volume 24,192m ³ over any consecutive 7 day period	N/A	N/A	N/A	
28	19	Oct-17	Ashburton Forks - semi confined or unconfined aquifer	CRC181906	Mr M W & Mrs SM Thomas & BK Thomas Trustees Limited	max 36l/sec max flow rate - max volume 9,331m ³ in any period of 3 consecutive days, and 442,828m ³ between 1 July and 30 June.	Only to be used for irrigation of crops and pastures for grazing of stock, including milking dairy cows; and dairy shed supply; and stockwater	No	No	
29	20	Oct-17	Ophi - Washdyke Nutrient Allocation Zone and semi confined or unconfined aquifer	CRC181901	Mattsfield Farming Company Limited	max 22.7l/sec max flow rate - max volume 12,157m ³ over any 7 day consecutive period.	N/A	No	No	