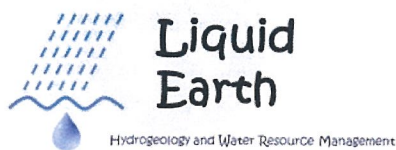


Central Plains Water Limited

Baseline Groundwater Level Assessment

Liquid Earth
January 2014



Central Plains Water Limited

Baseline Groundwater Level Assessment

- January 2014

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Executive Summary

Central Plains Water Limited (CPWL) are currently in the process of developing an irrigation scheme which will encompass a command area of approximately 60,000 Ha extending between the Waimakariri and Rakaia Rivers, inland of SH1. The suite of consents granted to CPWL includes a range of conditions which require extensive monitoring and assessment of environmental effects associated with the project. This report is intended to provide information relating to 'baseline' groundwater levels to assist in the preparation of the Ground and Surface Water Plan and provide context to inform the Ground and Surface Water Expert Review Panel (GSWERP).

Development of the CPWL scheme will result in significant changes to existing water budget of the Central Plains due to a combination of additional land surface recharge from ~30,000 Ha of additional irrigated land and a reduction in cumulative groundwater abstraction as existing takes are replaced by surface water supplied by the CPWL scheme. These changes will result in an increase (or 'mounding') of the water table underlying the CPWL command area. The additional water flowing through the Central Plains aquifer system will also result in an increase in groundwater levels down gradient (east) of the scheme as groundwater flows toward natural discharge areas toward the coastal margin.

Groundwater levels across the Central Plains area vary on a range of spatial and temporal scale. Monitoring wells close to surface water bodies (e.g. alpine rivers, Te Waihora/Lake Ellesmere and the coastal margin) tend to exhibit appreciable short term variability but typically show limited seasonal or long-term variations. In contrast, hydrographs from wells across the central section of the Central Plains generally exhibit appreciable variability in response to seasonal and long-term variations in rainfall and associated land surface recharge. While the effects of abstraction are observed to have resulted in increased seasonal variability in many areas, for a majority of the Central Plains, longer-term trends in groundwater level track corresponding variations in land surface (rainfall and irrigation) recharge.

Analysis of Environment Canterbury groundwater level records shows lowest recorded groundwater levels since monitoring commenced in the early-1950's were observed during a dry period in the early 1970's, with higher groundwater levels observed during the latter half of the same decade following a sequence of 'wet' years. From the early 1980's groundwater levels exhibited a relatively consistent decline through to 2005 (this decline exacerbated by increased seasonal drawdown resulting from groundwater abstraction in later years). However, over recent years groundwater levels have steadily increased in response to a period of above normal winter recharge, with levels in 2013 (particularly in lowland areas) approaching or in some cases exceeding those observed during the late 1970's.

Down gradient of the CPWL scheme groundwater levels are predicted to rise in lowland areas due to the increased throughflow occurring within the groundwater system, although the absolute magnitude and occurrence of such changes is poorly constrained. While the magnitude of resulting increases are likely to be relatively minor, due to the existing shallow water table in lowland areas and the resulting sensitivity to relatively small changes in groundwater levels, particularly in terms of land drainage and the functioning of existing wastewater and stormwater discharges to ground. These effects may be particularly significant during periods of naturally high groundwater levels (such as winter 2013). However, increased groundwater levels in lowland areas resulting from the CPWL scheme will also provide positive environmental benefits due to increased baseflow in lowland streams thereby helping achieve management objectives established by the CWMS Selwyn Waihora limit setting process.

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1. Introduction

1.1. Central Plains Water Limited

Central Plains Water Limited (CPWL) are currently in the process of developing an irrigation scheme which will encompass a command area of approximately 60,000 Ha extending between the Waimakariri and Rakaia Rivers, inland of SH1. **Figure 1** shows the approximate extent of the scheme area.

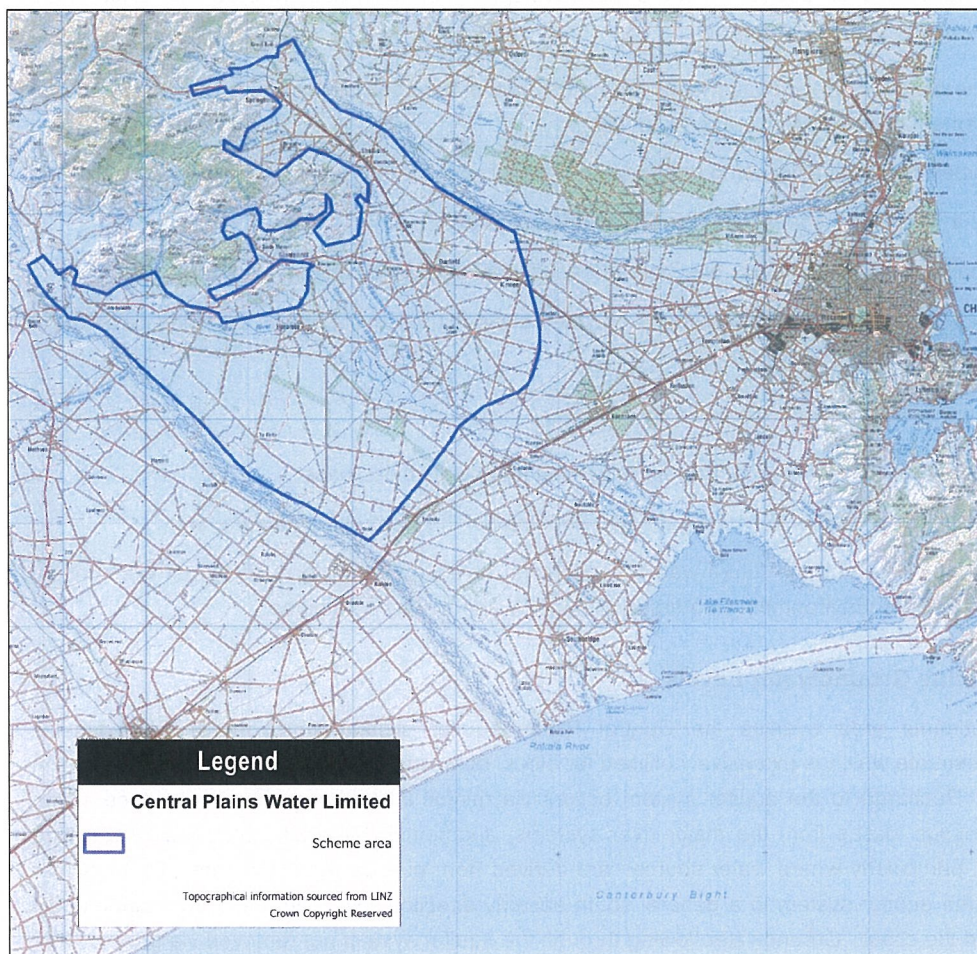


Figure 1. CPWL scheme area

Resource consents for the CPWL scheme were granted by a hearing panel appointed by Environment Canterbury and the Selwyn District Council in May 2010. The suite of consents granted to CPWL includes a range of conditions which require extensive monitoring and assessment of environmental effects associated with the project.

This report is intended to provide information relating to 'baseline' groundwater levels to enable characterisation of the existing environment prior to scheme development and assist in the preparation of the Ground and Surface Water Monitoring Plan required under Condition 21 of the CPWL consents.

1.2. Project Scope

The primary objective of this report is to provide technical background to inform the Ground and Surface Water Expert Review Panel (GSWERP) and assist development of the Ground and Surface Water Plan. The overall objectives of the report are to:

- Analyse historical groundwater level information in the Central Plains area to provide context for assessment of current and future water levels;
- Characterise factors influencing temporal and spatial variability in groundwater levels;
- Define a water level baseline for the Central Plains area
- Summarise projected impacts of scheme development of groundwater levels;
- Describe the relationship between groundwater levels in the Central Plains area and baseflow in lowland streams;

The report draws on information from a variety of sources including:

- The Environment Canterbury groundwater level and hydrological database;
- Published technical reports describing the hydrogeology of the Central Plains area; and
- Assessments of current and future water groundwater levels prepared for both the CPWL consent application and the Environment Canterbury Selwyn Waihora zone committee.

1.3. Baseline Groundwater Levels

The CPWL scheme area overlies the Central Plains aquifer system which hosts an extensive groundwater resource which is extensively utilised for stock, domestic, municipal, industrial and irrigation water supply. Recharge to the aquifer system occurs via rainfall infiltration across the surface of the plains and seepage losses from the major river systems, augmented by additional recharge resulting from irrigation, particularly where water sources are derived from outside the catchment. Groundwater flows through the aquifer system in a general south-easterly direction reflecting the overall topographic gradient toward the coast. Groundwater flowing through the aquifer system not removed via groundwater abstraction is ultimately discharged to lowland streams, direct seepage to Te Waihora/Lake Ellesmere or via discharge to the offshore marine environment.

Groundwater levels across the Central Plains area reflect a balance between aquifer recharge and discharge. Under natural conditions this water balance is primarily influenced by the timing and magnitude of rainfall recharge across the plains (given losses from permanently flowing rivers are relatively constant). As a consequence, long-term variations in rainfall exert a significant influence of groundwater levels across the entire area. However, on a shorter timescale (and often at a more localised scale) the effects of groundwater abstraction and irrigation can also influence groundwater levels.

Within the CPWL scheme area, the permeable nature of the soils and underlying alluvial materials mean that the underlying groundwater resource is the ultimate receiving environment for a majority of nutrients and other contaminants lost from land use activities (including discharges to land). Due to the extensive utilisation of the groundwater resource as a water supply source and its contribution to flows in lowland streams around the margins of Te Waihora/Lake Ellesmere, management of groundwater quality and quantity are critical to ensure that community values associated with water, articulated in the Canterbury Water Management Strategy (including the Selwyn Waihora Zone Implementation Plan), can be achieved.

Development of the CPWL scheme has the potential to exert a significant influence on the water balance across the entire Central Plains area as a result of both increased recharge due to an expanded irrigated area and a decrease in groundwater abstraction as existing groundwater irrigation takes are replaced by water from the CPWL scheme (sourced from the Rakaia and Waimakariri Rivers). This combination of factors has the potential to result in an overall increase in groundwater levels across the Central Plains area which may result in both positive and negative environmental outcomes. Positive outcomes from increased groundwater levels include a reduced depth to groundwater (and associated reductions in drilling and/or pumping costs) in inland areas and increased baseflow in lowland streams. Potential negative effects resulting from higher groundwater levels include increased drainage and/or inundation issues in low-lying coastal areas which may also adversely affect on-site wastewater disposal and other infrastructure.

1.4. Report Structure

The report comprises the following sections:

- Section 2 - *Hydrogeological Setting*: A brief overview of the hydrogeology of the Central Plains area including discussion of primary controls on spatial and temporal groundwater level variations.
- Section 3 - *Baseline Groundwater Levels*: An assessment of historical, current and future groundwater levels in the Central Plains area.
- Section 4 - *Effects Associated with Changes to Baseline Groundwater Levels*: An overview of potential effects associated with changes in groundwater levels resulting from development of the CPWL scheme.