

Construction Earthworks Spring and Groundwater Monitoring Plan – 531 and 535 Mill Road, Ōhoka

✦ Prepared for

Carter Group Ltd

✦ August 2026



PATTLE DELAMORE PARTNERS LTD
Level 2, 134 Oxford Terrace
Christchurch Central, Christchurch 8011
PO Box 389, Christchurch 8140, New Zealand

Tel +64 3 345 7100
Web www.pdp.co.nz



solutions for your environment

Quality Control Sheet

TITLE Construction Earthworks Spring and Groundwater Monitoring Plan – 531 and
535 Mill Road, Ōhoka

CLIENT Carter Group Ltd

ISSUE DATE 31 August 2026

JOB REFERENCE C045180002

Revision History					
REV	Date	Status/Purpose	Prepared By	Reviewed by	Approved
0 1	28 August 2026	Draft	Caitlin Frazer Emma Rhodes	Bas Veendrick	Bas Veendrick
0 2	31 August 2026	Final	Caitlin Frazer Emma Rhodes	Bas Veendrick	Bas Veendrick

DOCUMENT CONTRIBUTORS

Prepared by

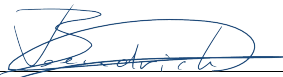
SIGNATURE



Caitlin Frazer and Emma Rhodes

Reviewed and Approved by

SIGNATURE



Bas Veendrick

Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Carter Group Limited and others (not directly contracted by PDP for the work), including Inovo and Environment Canterbury. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Carter Group Limited for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

© 2026 Pattle Delamore Partners Limited

Table of Contents

SECTION	PAGE
1.0 Introduction	1
2.0 Baseline Monitoring Summary	1
2.1 Surface Water Baseline Monitoring Summary	1
2.2 Groundwater Baseline Monitoring Summary	2
3.0 Monitoring Plan	2
3.1 Surface Water Monitoring	3
3.2 Groundwater Monitoring	4
3.3 Monitoring Summary	6
3.4 Data Review and Reporting Requirements	7
4.0 Reference List	7

Table of Figures

Figure 1: Locations of Monitoring Sites	8
---	---

Table of Tables

Table 1: Proposed Surface Water Monitoring Locations	4
Table 2: Proposed Groundwater Level Monitoring Locations	5
Table 3: Proposed Monitoring Programme	6

1.0 Introduction

Carter Group Ltd (Carter Group) has engaged Pattle Delamore Partners (PDP) to prepare a draft groundwater and spring flow monitoring plan for construction earthworks for the proposed Ōhoka Development to support its Fast-track application. The proposed Ōhoka Development involves the subdivision and development of 531 and 535 Mill Road, Ōhoka, for residential and commercial use.

Condition 9 of the proposed Excavations/Earthworks consent conditions (S9 land use consent) requires the consent holder to prepare and implement a Groundwater and Spring Flow Monitoring Plan.

This report outlines the recommended groundwater level and surface water/spring flow monitoring during and after construction. This report also summarises the baseline monitoring undertaken to date.

This groundwater and spring flow monitoring plan is a draft plan outlining the proposed monitoring based on the information available at this point in time. The proposed monitoring is subject to change.

2.0 Baseline Monitoring Summary

Baseline monitoring undertaken at the site is summarised in the following sections. For full results, refer to PDP (2026).

2.1 Surface Water Baseline Monitoring Summary

Baseline surface water monitoring has been undertaken at the site in the streams and drains in February 2025, July 2025, August 2025 and November 2025 to characterise seasonal flow conditions and groundwater-surface water interactions within the site waterways.

Monitoring locations were established at the upstream and downstream extents of the primary waterways, including the Ōhoka Stream South Branch, Northern Spring Channel, Groundwater Seep Channel, Southern Spring Channel, and Ōhoka Stream Tributary. Additional monitoring locations were established on the Ōhoka Stream South Branch and the Northern Spring Channel during the August and November 2025 rounds to better define locations where groundwater inflows occur.

The flow gauging baseline programme generally identified year-round gains from groundwater to the surface waterways across the site, which are larger in magnitude in winter. These results are consistent with the interpretation of the wider area as a groundwater discharge zone as per Sanders and Lovell (1999). The largest volumetric gains were observed within the Ōhoka Stream South Branch and Northern Spring Channel, with monitoring indicating that

groundwater gains predominantly occur within the western part of the development area. Monitoring also demonstrated clear seasonal variations in flow, with generally higher flows recorded during winter compared to summer conditions.

2.2 Groundwater Baseline Monitoring Summary

Baseline groundwater monitoring has been undertaken at the site via the following methods:

- ✧ 1 x existing Environment Canterbury (ECan) long-term monitoring bore (M35/0596) located within the site boundary. Historic groundwater level records were available with periodic measurements extending from 1977 to 2026. The long-term record for this bore indicates a generally shallow groundwater level, with a range of 0.22 – 1.50 m below ground level (bgl).
- ✧ A network of 37 shallow standpipes installed across the site by Tetra Tech Coffey in 2023 and monitored between August 2023 and February 2025. The monitoring indicated groundwater depths generally ranged from approximately 0.05 to 1.0 m bgl, with the shallowest groundwater levels occurring around springs and surface waterways.
- ✧ 23 permanent bores (P1 to P23) installed across the site by PDP monitored regularly since March 2025, with seven of these containing pressure transducers to measure groundwater levels at 15-minute intervals (and additionally in ECan bore M35/0596). Monitoring results in these bores show a groundwater level range from approximately 0.01 to 2.28 m bgl across the site.

3.0 Monitoring Plan

Condition 9 of the proposed Excavations/Earthworks consent conditions (S9 land use consent) requires the consent holder to prepare and implement a Groundwater and Spring Flow Monitoring Plan. This condition states:

“The consent holder shall prepare and implement a Groundwater and Spring Flow Monitoring Plan for the duration of construction activities that may interact with groundwater, and for a period of up to two years following completion of those works.

The Monitoring Plan shall:

- a. *Confirm the monitoring locations (including piezometers and identified springs/seepage areas), parameters, methods, and frequency for groundwater level and spring flow monitoring.*
- b. *Require that accurate records of groundwater levels and spring flows are maintained and made available to the Consent Authority upon request.*

- c. *Include procedures for the ongoing review and interpretation of monitoring results to inform construction methodology, including any dewatering requirements or mitigation measures for working in shallow groundwater conditions, and to confirm that post-construction conditions are consistent with anticipated effects.*
- d. *Identify any trigger levels or indicators of adverse effects on groundwater levels or spring flows and set out the response actions to be implemented in the event these are exceeded.*
- e. *Require that monitoring results are periodically summarised and, where necessary, used to update the Construction Site Management Plan and inform any adaptive management measures required following completion of works to ensure that adverse effects on groundwater and spring flows are avoided or mitigated."*

To satisfy the monitoring requirements outlined above, it is proposed that groundwater level monitoring at a number of bores established at stormwater management areas and adjacent to key waterways, as well as flow gauging along the waterways is conducted. It is proposed that the same (or analogous) surface water and groundwater monitoring sites utilised for baseline monitoring are utilised during and following the excavations/earthworks period. Monitoring sites, frequency of monitoring, review of data, and reporting requirements are outlined in the following sections.

3.1 Surface Water Monitoring

It is proposed to monitor surface water flow at 13 different locations in the surface waterways at the site, as presented in Table 1 and Figure 1. The flows at each site should be undertaken according to the National Environmental Monitoring Standards for Open Channel Flow Measurement (NEMS, 2026). The flow gaugings should be conducted three times a year, with the objective to capture a range of different flows. A winter baseflow, summer baseflow, and an autumn or spring baseflow should be captured. The flow gaugings should occur after a period of stable weather (i.e. not immediately after a significant rain event). In any instance that a reach is dry, it is proposed that a visual observation will be undertaken along the length of the reach to identify the extent of the dry reach.

Some surface waterway reaches are proposed to be realigned (i.e., Groundwater seep Channel will be realigned, and Northern and Southern Spring Channels are to be merged). Where a flow gauging site (i.e. FG-7, FG-8) is removed as part of the realignment works, a replacement site should be established along the new alignment, unless an existing monitoring site can adequately meet the monitoring objectives. For example, FG-4 would not require replacement, as existing monitoring sites FG-5 and FG-6 are considered fit for purpose.

Monitoring of surface waterways should be conducted during, and one year following the construction phase (earthworks and excavations) of any of the proposed stages of the development. Only the waterways that intersect or are adjacent to the development stage(s) under construction will be monitored at any one time. Waterways that do not intersect or are not adjacent to any of the proposed stages that are under construction will not be monitored.

Table 1: Proposed Surface Water Monitoring Locations			
Flow Gauging Site	Waterway	NZTMX	NZTMY
FG-1	Ōhoka Stream South Branch	1563966	5198131
FG-13		1564346	5198146
FG-12		1564729	5198039
FG-2		1565241	5197921
FG-3	Northern and Southern Spring Channels <i>(proposed to be merged)</i>	1564485	5198441
FG-11		1564744	5198377
FG-4 ¹		1565359	5198165
FG-5		1565023	5198234
FG-6		1565309	5198060
FG-7 ²	Groundwater Seep Channel	1565233	5198328
FG-8 ²		1565453	5198302
FG-9	Ōhoka Stream Tributary	1564771	5198639
FG-10		1565559	5198451
Notes:			
1. Can be disestablished following stream realignment			
2. May need to be relocated following stream realignment			

3.2 Groundwater Monitoring

It is proposed that shallow groundwater monitoring at the site shall be undertaken in the 11 bores presented in Table 2 and displayed on Figure 1. Pressure transducers should be installed in each of these bores to record water pressure at a minimum of one-hour intervals. The pressure transducers should be downloaded at least three times a year. A manual water level measurement should additionally be obtained at the time of data download.

Groundwater levels bores should be monitored during, and for one year following the construction (excavation/earthworks) of the stage they are located within. Additionally, any bores adjacent to surface waterways that are monitored in accordance with Section 3.1 above should be monitored. These include:

- ✧ P4 associated with the Ōhoka Stream Tributary
- ✧ P10 and P12 associated with spring BW24/1013 and associated groundwater seep channel
- ✧ P23, P21 and P14 associated with the Southern Spring Channel

Groundwater levels in long-term ECan monitoring bore M35/0596 should also be monitored throughout the construction phase of the development independent of which stage is being constructed.

Bores which do not intersect or are adjacent to stages that are under construction (or are required to be monitored alongside the surface waterways as listed) above do not need to be monitored.

If a bore requires disestablishment for any reason, an analogous bore should be installed in order comply with the monitoring requirements.

Table 2: Proposed Groundwater Level Monitoring Locations		
Bore Number	NZTMX	NZTMY
P02	1565542	5198720
P04	1565252	5198560
P10	1565228	5198335
P12	1565487	5198328
P14	1565235	5197966
P18	1564991	5197539
P20	1564590	5197998
P21	1564943	5198267
P22	1564746	5198335
P23	1564441	5198460
M35/0596	1564458	5198386

3.3 Monitoring Summary

A summary of the groundwater and surface water monitoring required is provided in Table 3 below, with locations on Figure 1.

Table 3: Proposed Monitoring Programme	
SURFACE WATER MONITORING	
Flow Gauging Site	Frequency and Schedule
FG-1	Flow gauging rounds to be completed three times a year (winter baseflow, summer baseflow, and either spring or autumn baseflow). Monitoring of surface waterways should be conducted during, and one year following completion of the construction phase (earthworks and excavations) of any of the proposed stages of the development. Only the waterways that intersect or are adjacent to the development stage under construction will be monitored at any one time. Waterways that do not intersect or are not adjacent to any of the proposed stages that are under construction will not be monitored.
FG-2	
FG-3	
FG-4	
FG-5	
FG-6	
FG-7	
FG-8	
FG-9	
FG-10	
FG-11	
FG-12	
FG-13	
GROUNDWATER MONITORING	
Bore Number	Frequency and Schedule
P02	Pressure transducers in each bore to record water pressure at a minimum of one-hour intervals, to be downloaded at least three times a year. A manual water level measurement should additionally be obtained at the time of data download.
P04	
P10	
P12	Groundwater level bores should be monitored during, and for one year following the completion of the construction of the stage they are located within. Additionally, any bores adjacent to surface waterways that are monitored in accordance with Section 3.1 should be monitored. These include P4 associated with the Ōhoka Stream Tributary; P10 and P12 associated with spring BW24/1013 and associated groundwater seep channel; and P23, P21 and P14 associated with the Southern Spring Channel.
P14	
P18	
P20	
P21	
P22	
P23	

Table 3: Proposed Monitoring Programme

M35/0596	Groundwater levels in long-term ECan monitoring bore M35/0596 should also be monitored throughout the construction phase of the development independent of which stage is being constructed.
----------	--

3.4 Data Review and Reporting Requirements

The following data review and reporting requirements are proposed to meet Condition 9 of the proposed Excavations/Earthworks consent conditions.

During monitoring associated with excavations/earthworks:

- ∴ Accurate records on groundwater levels and the flow gaugings should be maintained and made available to the Consent Authority upon request.
- ∴ The data should be reviewed three times yearly in alignment with the flow gauging monitoring/groundwater level downloads to identify if there are any indicators of adverse effects of the construction (excavations/earthworks) on groundwater levels or spring flows. The results can be compared with the baseline monitoring established in PDP (2026) as well as any other relevant records.
- ∴ In the case that any adverse effects are identified, a short report detailing the identified effects and proposed response actions to be implemented should be provided to the Consent Authority, and the construction Site Management Plan should be updated as necessary.

Following the final one-year post-construction monitoring period for each development stage, a monitoring report shall be completed and provided to ECan within three months. The monitoring report shall summarise the monitoring data collected and compare the results with any available baseline data to confirm that the effects of the completed earthworks/excavations on groundwater levels and surface water flows/spring flows are no more than minor. Where monitoring has been undertaken consistently across multiple stages, the results may be reported together.

4.0 References

National Environmental Monitoring Standards (NEMS). (2026). Open Channel Flow Measurement, Version 2.0.0 Final Draft for Comment, March 2026.

Pattle Delamore Partners Ltd (PDP). (2026). Fast-track Application – 535 Mill Road, Ōhoka – Groundwater Assessment of Environmental Effects Report. Report No. C045180002R002.

Sanders, R., & Lovell, M. (1999). Observations of the Ōhoka Stream System in a Drought. Report No. U99/32.



- ▬ SITE OUTLINE
- PROPOSED STORMWATER MANAGEMENT AREAS
- FLOW GAUGING MONITORING SITES
- GROUNDWATER LEVEL MONITORING BORES
- SPRING SITES
- SURFACE WATERWAYS**
- ▬ EXISTING REACHES TO REMAIN
- ▬ REALIGNED REACHES
- ▬ REACHES TO BE REMOVED

NOTES

- AERIAL IMAGERY SOURCED FROM THE LINZ DATA SERVICE [<https://data.linz.govt.nz>] AND LICENCED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.
- SURFACE WATERWAYS AND REALIGNMENTS PROVIDED TO PDP VIA INOVO AUGUST 2026.

CLIENT

CARTER GROUP LTD

FIGURE 01: PROPOSED SURFACE WATER AND GROUNDWATER MONITORING SITES FOR CONSTRUCTION EARTHWORKS

OHOKA FAST TRACK



0 100 200 m
METRES (A3)
SCALE : 1:7,000

THIS DRAWING REMAINS THE PROPERTY OF PATTLE DELAMORE PARTNERS LTD AND MAY NOT BE REPRODUCED OR ALTERED WITHOUT WRITTEN PERMISSION. NO LIABILITY SHALL BE ACCEPTED FOR UNAUTHORISED USE OF THE DRAWING

01	DRAFT	AUG 26	ER
NO.	REVISION	DATE	BY