Peach Island Proposed Quarry: Hydrogeology

Prepared for

CJ Industries Ltd

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Executive Summary

CJ Industries Ltd are seeking resource consent to establish an aggregate quarry at Peach Island. This will involve the extraction of aggregate material from excavation pits at the site and backfilling of the pits with uncontaminated, clean fill material sourced from both on and off site.

A shallow, unconfined alluvial aquifer system, that is predominantly recharged by flow losses from the Motueka River provides a source of clean groundwater for irrigation and domestic supply purposes to a number of properties at Peach Island. The shallow aquifer also underlies the proposed location of the Quarry site and therefore the main risk from the proposed quarry on the groundwater resources at Peach Island is potential for adverse effects on groundwater quality.

The key areas of concern that may impact groundwater quality from the proposed quarry activities are:

- Exposure of groundwater within open pit excavations; and,
- Inundation of contaminated fill material in backfilled pits, mobilising contaminants within the aquifer.

Exposed groundwater within an open excavation is susceptible to contamination via faecal contamination (i.e., birds etc) and increased susceptibility to spills from machinery operating in the excavation. To avoid exposure of groundwater, it is recommended that a vertical separation of at least 0.3 m between the pit floor and the highest groundwater level at the time of the excavation will be maintained. This can be achieved by using ongoing real-time groundwater level monitoring to inform excavation depths during the excavation process. This methodology will allow CJ Industries to excavate to deeper depths during times of low groundwater levels without exposing groundwater.

Backfill material will be placed within excavations, some of which will be inundated by groundwater at times of high groundwater levels. Therefore, strict controls on the type and quality of the fill material will be implemented to avoid placement of contaminated material. This will include only using hardfill natural materials (i.e., silt, clay, sand, gravel, rock) from on site and also off site from areas that are uncontaminated.

An overarching groundwater and clean fill management plan provides details for implementing the controls to reduce the risk of adverse groundwater quality changes in the Peach Island aquifer. This document includes the controls described above as well as groundwater level and quality monitoring to continually assess effects of the quarry activities on downgradient water quality.

Provided that the Applicant operates the proposed quarry as outlined in the groundwater and clean fill management plan, the effect of the quarrying activities on the groundwater quality will be less than minor.

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1.0 Introduction

CJ Industries Ltd ("the Applicant") are proposing to establish a quarry to extract gravel aggregate at 134 Peach Island Road on the true left of the Motueka River, near an area called Peach Island (referred to as the "Quarry site"). The location of the site is shown in Figure 1, Appendix A.

The proposed quarry will involve the excavation of gravel from three staged areas with a combined area of around 7.4 ha.

Exposed groundwater within open excavations such as gravel extraction pits is susceptible to contamination from sources at the surface. To manage this risk while maximising the volume of gravel aggregate that can be extracted at the Quarry site, the Applicant is proposing to maintain a vertical separation of material between the base of the excavation pit and groundwater levels at times while excavation pits are open. This means that during periods of low groundwater levels, the excavation pit floor will be at a deeper elevation than during periods of high groundwater levels although vertical separation of material will always be maintained at the base of the pit to avoid exposing groundwater.

The purpose of this report is to supplement the existing groundwater assessments and reports that have been provided with the proposed quarry resource consent application by providing a description of the overall hydrogeological setting of the Peach Island area and an assessment of potential effects that the proposed quarry may have on groundwater resources in the area. This information is provided in the report in the following format:

- A discussion of local geology and hydrogeological conditions at the Quarry site and surrounding area;
- An assessment of potential effects arising from the proposed quarry activities including:
  - Identification of potential groundwater receptors (i.e., groundwater users, receiving waterways etc);
  - Groundwater contamination sources and pathways from quarrying activities; and,
  - Inflows from nearby streams to excavation pits during quarrying activities.
- A proposed management plan to mitigate potential effects from quarrying activities; and,
- Summary and conclusions.

2.0 Hydrogeological Setting

2.1 Topography and Geology

The Quarry site is located on the western edge of the Moutere Depression at the foot of the Arthur Range which is a subsidiary range of the Tasman Mountains. The Moutere Depression is around 30 km wide, up to 2,500 m deep (near the eastern side of the depression) and bounded by the Waimea Flaxmore fault to the east and the Tasman Mountains to the west (Rattenbury et. al, 1998). The depression was formed during the Pliocene – Pliestocene during uplift of the Tasman Mountains and Nelson Ranges (to the southeast) and has been infilled with Plio-Pliestocene alluvial sediments sourced from eroded Torlesse and eroded granitic rocks of the Separation Point Granite Suite closer to the Tasman Mountains (Rattenbury et. al, 1998; Stewart et. al, 2004).

The elevation of the Quarry site generally ranges between around 17 and 20 masl – NZVD2016 and is partly located on an active flood plain of the Motueka River. The Arthur Range to the west of the Quarry site consists of steep, bush covered hills extending up to 1,330 m at Pukeone (Mt Campbell). A number of minor tributaries of the Motueka River drain the Arthur Range, notably a stream known by Tasman District Council (TDC) as “Shaggery Stream” diverts flow from the Arthur Range around the western side of the Peach Island area before discharging into the Motueka River.

The local geology of the Quarry site and the wider Peach Island area is described by Rattenbury et. al (1998) in the 1:250,000 geological map of the wider Nelson area. A generalised version of the geological map specific to the Peach Island area is shown in Figure 2, Appendix A.

The geological map shows that basement geology consists of equigranular biotite granitic rocks of the Separation Point suite and was intruded into surrounding country terrane rocks during the Cretaceous (Rattenbury et. al, 1998).

Unconformably overlying the granite is poorly to moderately well sorted clay bound gravel otherwise known as the “Moutere Gravels”. The Moutere Gravels are Pliocene in age and described as being deeply weathered. These gravels are dominated by quartzofeldspathic sandstone clasts, derived predominantly from erosion of Torlesse terrane sandstone and semi-schist during rapid uplift of the Southern Alps and deposited via fluvial processes (Rattenbury et. al, 1998).

Overlying the Moutere Gravel deposits are alluvial gravel deposits that represent aggregational surfaces within the Motueka River Valley and are Pleistocene in age. These gravel deposits generally consist of clay bound gravel and colluvial fan deposits described as, poorly sorted, angular silt to boulder sized clasts at foot of steep streams draining hills/mountains (Rattenbury et. al, 1998).

The near surface geology at Peach Island consists of well sorted Holocene alluvial gravels, forming the modern flood plains and young fan gravels which. Given the proximity of both the Pleistocene and Holocene gravels to the foot of the Arthur Range, it is expected that alluvial gravels and colluvial deposits are interbedded

at the foot of the range. The source of gravels clasts within the Holocene gravels are expected to be a mixture of reworked alluvial gravels, Torlesse derived sandstone/semi schist and granitic rocks from the Separation Point Suite.

Borelog information is available for 6 bores in the Peach Island area with bore depths ranging up to 9 m deep. Copies of available borelogs are provided in Appendix B and the locations of bores shown in Figure 2, Appendix A. It should be noted one of the borelogs (MW05) provided in Appendix B does not have any coordinate locations and therefore its location is not displayed on Figure 2, although it is understood to be located at Peach Island. The borelogs indicated that the shallow strata beneath the Peach Island area generally consists of interbedded, grey to brown well sorted and poorly sorted sandy gravel with minor silt and some discrete sand layers ranging between 0.5 and 1.2 m in thickness. It is possible that the well sorted gravel material and the poorly sorted gravel material represent alluvium (sorted via fluvial processes) and colluvium (from alluvial fan processes from the adjacent hills) respectively but it is difficult to distinguish this from the borelog information alone. The borelogs for 24546 (MW04) and 22116 indicates that grey granitic rock was encountered at around 5.8 m bgl, which suggests that the depth to basement granite of the Separation Granite Suite is shallow in this area of the Motueka River Valley.

Overall, the borelog information is generally consistent with the available geological map for the area.

2.2 Hydrogeology

The Peach Island area is located approximately 1 km upstream of where the Motueka River Valley opens out to the broader, Motueka – Riwaka Plains which contains the Motueka – Riwaka aquifer system (Weir and Thomas, 2018).
The Motueka – Riwaka Aquifer is the dominant groundwater resource in the area and is a primary source of water for a number of uses in the area, including domestic and community supply, stockwater supply, irrigation, and industrial purposes. The aquifer system consists of relatively permeable sandy gravels, interbedded with less permeable claybound gravels. The Motueka – Riwaka Aquifer system is reported to be up to 20 to 30 m thick near the centre of the plains and underlain by the less permeable, claybound Moutere gravels and granite of the Separation Point suite. The Motueka – Riwaka Aquifer system reportedly pinches out toward any basement outcrops. The Motueka – Riwaka Aquifer system is reported to be highly connected with both the Motueka and Riwaka Rivers with significant proportions of groundwater recharge being sourced from the two rivers (Weir and Thomas, 2018). The shallow aquifer system is interpolated in the report by Weir and Thomas to have a thickness in the order of around 10 m with deeper, permeable strata also having a thickness of around 10 – 20 m thick. The two aquifers are separated by a relatively less permeable aquitard consisting of claybound gravels with a higher clay content than the two aquifers overlying and underlying the aquitard (Weir and Thomas, 2018).

The geological map shown in Figure 2, Appendix A indicates that the general hydrogeology of the Motueka – Riwaka Aquifer is expected to be similar to the shallow aquifer system beneath the Peach Island area, based on the description of the near surface geology of the Motueka – Riwaka Plains, combined with the proximity of the site to the Motueka – Riwaka Plains.

Information from TDC indicates that the Peach Island area is located within the Middle Motueka Water Management Zone, as defined in the Tasman Resource Management Plan. This zone is used for defining water allocation limits for groundwater and surface water abstractions.

The following sections describe groundwater flow directions, aquifer parameter information, groundwater levels and groundwater quality data.

2.2.1 Groundwater Flow Directions

Groundwater flow direction information is available from modelling commissioned by TDC for the wider Motueka – Riwaka Aquifer which includes the northern extent of the Peach Island area. The contours are available for water levels measured on 24 March 2001 and 24 January 2006 and generally indicate that groundwater flows away from the Motueka River particularly to the true left of the river, suggesting the Motueka River loses flow to groundwater along this reach of the river, although it is acknowledged that the extent of the contours for Peach Island are limited. Furthermore, the modelling report indicates that the Motueka River loses on average 970 L/s between the flow recorder at Woodmans Bend (located near Peach Island) and State Highway 60 (SH60) located around 7 km downstream (Weir and Thomas, 2018).

Monitoring undertaken by Envirolink on behalf of CJ Industries for the resource consent application for the Quarry site was used to determine median groundwater level contours across the site (Tiernan, 2021). These contours indicated that groundwater beneath the site generally flows in an approximately north direction, subparallel to the Motueka River. The contours produced by Envirolink only used water level data measured in four bores located at the Quarry site (24543, 24544, 24545 and 24546) owned by CJ Industries and are displayed as median winter groundwater levels (Tiernan, 2021).

PDP measured groundwater levels in the following bores on 7 July 2022:

- 24543 (MW01 – screened between 5 and 8 m bgl);
- 24544 (MW02 – screened between 5 and 8 m bgl);
- 24545 (MW03 – screened between 5 and 8 m bgl);
- 24546 (MW04 – screened between 3.8 and 6.8 m bgl);
- 21948 (4583 – screened between 3 and 6.8 m bgl); and,
- 21033 (3003 – 4.8 m deep).

The groundwater levels measured in these bores were used to generate groundwater level elevation contours across the site.

LiDAR data (2008 – 2015) available from Land Information New Zealand (LINZ) was used to estimate the ground surface elevation in the Nelson 1955 vertical datum at each bore location which was used convert the groundwater level data at each bore to an elevation as metres above sea level (masl). The LiDAR data is reported to have a resolution of 1 m.

Existing reports indicate interactions between the Motueka River and the Motueka – Riwaka Aquifer (Tiernan, 2021) and therefore water level elevations in the Motueka River adjacent to the Quarry site were estimated using available LINZ LiDAR data (2008 – 2015) and included as control water level elevations to produce the groundwater contours. Shaggery Stream was flowing at the time of the 7 July 2022 groundwater measurements. The measurements show a steep hydraulic gradient between the stream bed and shallow groundwater (measured in Piezos 1 and 4) of around 0.07 which is an order of magnitude higher than the hydraulic gradient for the shallow groundwater at Peach Island. As Shaggery Stream was observed to have a continuous flow within the reach adjacent to the Quarry site at the time of the July 2022 water level measurements, the steep hydraulic gradient between the stream and surrounding shallow groundwater indicates that the stream is elevated above shallow groundwater and is therefore likely to have a lower permeability than the shallow groundwater in this area of Peach Island aquifer. As such, control water level elevations in the stream were not included to produce the contours.

Figure 3, Appendix A shows the estimated groundwater level contours from the 7 July 2022 groundwater level data. The contours indicate that groundwater has an overall, north north easterly flow direction and is generally subparallel to the Motueka River. The contours indicate that a major source of groundwater recharge at the southern extent of the Quarry site is likely sourced from the Motueka River, possibly as a result of flow losses at a bend in the Motueka River in the vicinity of Hurley Road. Around the eastern extent of the Quarry site, groundwater appears to flow back toward the Motueka River. Available information indicates that there is an old paleo channel in the vicinity of Shaggery Stream locally known as the Peach Island Channel and is a topographical low area that acts as a flood plain (Martin and Hewitt, 2019). It is possible that the alluvial strata in the vicinity of this old channel is relatively more permeable and may cause some groundwater at the western side of the site to flow in this direction.

The hydraulic gradient of the water table shown in Figure 3 is around 0.004.

Based on the available information, the dominant source of groundwater recharge to the shallow aquifer system at Peach Island is expected to occur from flow losses in the Motueka River. Smaller contributions of groundwater recharge from rainfall infiltration to the shallow aquifer system are also expected but are likely to be proportionally much smaller and occur intermittently compared to the larger, continuous contribution via flow losses from the Motueka River. It is also possible that flow losses from Shaggery Stream and is tributaries may contribute to groundwater recharge although the available information indicates that any flow losses are likely to be small.

2.2.2 Aquifer Parameters

Information provided by TDC indicates that there is no aquifer parameter data for the Peach Island area. However, modelling commissioned by TDC for the wider Motueka – Riwaka Plains Aquifer indicates that some aquifer parameter information is available from pumping tests. The aquifer parameter data collated as part of the modelling report was used to interpolate the expected range of aquifer parameters across the wider Motueka – Riwaka Aquifer which included the northern area of Peach Island.

A summary of the aquifer parameters for the shallow aquifer at the northern extent of the Peach Island area is provided below (Weir and Thomas, 2018):

- Horizontal hydraulic conductivity of shallow aquifer = 0 to 500 m/day;
- Specific storage = 0.03 – 0.04; and,
- Stream bed conductance = 8 m /day (for the reach of the Motueka River adjacent to Peach Island).

The modelling report indicates that the average thickness of the Motueka – Riwaka shallow aquifer is around 10 m thick (Weir and Thomas, 2018). Assuming that the shallow aquifer beneath Peach Island is of a similar thickness, transmissivities of up to 5,000 m^2/day may be possible.

Available literature indicates that the shallow strata at Peach Island would have a hydraulic conductivity between approximately 5 and 100 m/day for sand and gravel mixtures (Kruseman and de Ridder, 1991).

Based on the available aquifer parameter information described above, the shallow aquifer system is considered to be relatively permeable, unconfined and hydraulically connected to the Motueka River.

2.2.3 Groundwater Levels

With the exception of discrete water level measurements, TDC do not have any long-term groundwater level monitoring data for the Peach Island area.

Continuous groundwater level data has been measured in six bores at Peach Island by Envirolink Limited on behalf of the Applicant intermittently from October 2019 onwards as part of their resource consent application to understand groundwater fluctuations at the proposed Quarry site. Most recently, additional manual groundwater levels were measured by PDP on 7 July 2022.

Table 1 below provides details of bores at Peach Island which have continuous groundwater level data and Figure 4, Appendix A shows the locations of these bores.

Table 1: Details of bores with continuous groundwater level data

TDC Bore Number	Bore Name	Diameter (mm)	Depth (m bgl)	Screened interval (m bgl)	NZTMX	NZTMY
24543	Piezo 1	80	8	5 – 8	1595764	5447353
24544	Piezo 2	80	8	5 – 8	1595991	5447061
24545	Piezo 3	80	8	5 – 8	1596076	5447242
24546	Piezo 4	80	6.8	3.8 – 6.8	1595677	5447027
21948	4582 (Lucas Bore)	200	6.8	3 – 6.8	1595620	5446664
21033	3003 (Peach Island)	1000	4.8	-	1595875	5447462

Groundwater levels have been monitored in the bores listed above by the Applicant and the groundwater level data presented in the consent application and responses to requests for information from TDC in reports prepared by Envirolink Limited. Additional groundwater data has been measured by the using pressure transducers installed by Envirolink following the lodgement of the resource consent application in three bores (21033, Piezo 2 and Piezo 3). A timeseries plot of that additional water level data is provided in Figure 5, Appendix A.

A summary of the range of water levels previously presented in information to TDC by the Applicant and the additional water level measurements are provided in Table 2.

It was not possible to determine the depths to groundwater or water level elevations from the datasets for bore 21948 (4582) from the available reports, although the water level record for this bore is relatively short and indicates a small range of fluctuations which are not considered to be representative of the full range of groundwater level fluctuations at this bore.

The available groundwater level data for bores located at the Quarry site generally indicate groundwater level fluctuations are in the order of 2 to 3 m with the highest groundwater level being recorded in 24545 (Piezo 3 – 1.2 m bgl) and the lowest groundwater level recorded in 24546 (Piezo 4 – 4.4 m bgl).

Table 2: Summary of measured groundwater levels at Peach Island

TDC Bore Number	Bore Name	Groundwater level			Period of available data
		High (m bgl / masl)	Low (m bgl / masl)	Range (m)	
24543	Piezo 1	1.7[1] / 17.13	4.0[1] / 14.8	2.3	August 2020 – November 2020
24544	Piezo 2	1.6[3] / 17.0	3.8[3] / 14.9	2.2	August 2020 – June 2022
24545	Piezo 3	1.2[3] / 17.5	4.0[1] / 15.6	2.8	August 2020 – June 2022
24546	Piezo 4	2.2[1] / 18.1	4.4[1] / 15.9	2.2	August 2020 – November 2020
21948	4582 (Lucas Bore	-	-	0.45	October 2019 – December 2019
21033	3003 (Peach Island)	1.3[3] / 17.1	3.2[3] / 15.14	1.9	May 2022 – June 2022

Notes:

[1]Summarised data from *"Quarry proposal – 134 Peach Island Road Motueka: Groundwater Quality Assessment"* prepared by Envirolink for CJ Industries Ltd, dated 4 June 2021.

[2]Summarised data from *"Peach Island Groundwater Assessment/Hydrology Report"* prepared by Envirolink Ltd for CJ Industries Ltd, dated 5 December 2019.

[3]Data from continuous groundwater levels measured by Envirolink on behalf of the Applicant after lodgement of resource consent application and response to TDC RFI.

Groundwater elevations provided as elevation above sea level using the Nelson 1955 vertical datum.

The water level data from available report and the timeseries data presented in Figure 5, Appendix A indicate a strong relationship between groundwater levels in all 6 bores and flow variations in the Motueka River based on flow/stage height data available for the river from a TDC recorder site located near the Quarry site (Woodmans Bend). Groundwater levels in all 6 bores appear to respond rapidly to changes in river flow/stage with smaller variations in water associated with flow changes in the river becoming more muted with distance from the river.

There is insufficient data to estimate the full seasonal range of groundwater level fluctuations for bores at Peach Island, although based on the strong relationship with flow variations in the Motueka River, the much longer flow record provides a proxy for assessing when high and low groundwater levels occur at Peach Island over a hydrological year. The daily average flow record for the Motueka River at the Woodmans Bend recorder site (available for the period between March 2001 and May 2022) indicates there is not an obvious pattern of seasonality and that average flows are highest during May/June and also during November/December. Average flows in the river are lowest during February, April and July. Based on this, it could be assumed that groundwater level fluctuations may follow a similar pattern although continued long-term groundwater level monitoring is recommended to confirm seasonality and the full range of groundwater level fluctuations at Peach Island.

2.2.4 Groundwater Quality

Information provided by TDC indicates that there is no groundwater quality data available for bores in the Peach Island area. TDC prepared a groundwater quality report in 2019 for the Motueka – Riwaka Plains area which detailed a groundwater sampling program undertaken by TDC, although the sampling program did not include any bores located at Peach Island. The report found that the wider Motueka – Riwaka Aquifer has water of relatively good quality and that the Motueka River (which is a significant source of recharge to the aquifer) also had generally good water quality. The report noted that one of the main risks of contamination of the shallow, unconfined aquifer was from inappropriate siting of bores, inadequate sealing of boreheads and storage of contaminants close to the borehead (TDC, 2020). It was noted that one of the recommendations of the report was for TDC to consider a reticulated water supply as the Motueka – Riwaka shallow aquifer system does not meet the Drinking-water Standards for New Zealand 2005 (revised 2018) definition for secure groundwater (TDC, 2020).

Due to the limited available data and to determine background groundwater quality at Peach Island, Envirolink Limited has undertaken groundwater quality sampling in two bores at the Quarry site on behalf of the Applicant. Table 3 below provides a summary of the bores that have been sampled for water quality purposes at Peach Island and the locations of these bores are shown in Figure 6, Appendix A.

Table 3: Details of bores/sites with water quality data

TDC Bore/Site Number	Bore/Site Name	Diameter (mm)	Depth (m bgl)	Screened interval (m bgl)	NZTMX	NZTMY	Period of available data
24544	Piezo 2	80	8	5 – 8	1595991	5447061	9/09/2020
24546	Piezo 4	80	6.8	3.8 – 6.8	1595677	5447027	5/10/2020
Woodmans Bend	Motueka River	N/A	N/A	N/A	1596435	5447481	27/12/1995 – 27/11/2019

Both bores 24544 and 24546 have only been sampled once and are both located upgradient of the Quarry site. Water quality data is also available for the Motueka River at one site (Woodmans Bend) and a summary of the water quality data for the Motueka River is provided in Appendix C for comparison.

Table 4, provides a summary of the available groundwater quality data at Peach Island.

The shallow aquifer at Peach Island is used by residents for drinking water supply purposes. Therefore, the available water quality data has been compared against the Drinking-water Standards for New Zealand (DWSNZ) 2005 (revised 2018) (MoH, 2018) maximum acceptable values (MAV) for protection of human health and guideline values (GV) for aesthetic effects. It is worth noting that the DWSNZ 2005 (revised 2018) are to be updated with the Water Services (Drinking Water Standards for New Zealand) Regulations 2022 (Taumata Arowai, 2022) which are proposed to take effect on 14 December 2022.

The available groundwater quality data indicates that there were no exceedances of the relevant MAV and GV for the two samples collected from 24544 (Piezo 2) and 24546 (Piezo 4). The groundwater samples were also tested for a suite of Organochlorine pesticides but no detections of any of these compounds were reported.

Electrical conductivity has been measured using automated loggers by the Applicant in Piezo 4, Piezo1, 21033 and 21948 and indicate that electrical conductivity varied over a small range, between 16 and 176 uS/cm (Piezo 4).

While there is a limited suite of chemical parameters available for the Peach Island groundwater system, the much larger record of water quality for the Motueka River at Woodmans Bend also indicates generally good quality although detections of *E. coli* up to 370 MPN/100 ml have been measured in the river (although this is not unusual for a surface water body).

Table 4: Summary of available groundwater quality data for bores at Peach Island

Parameter	Unit	24544 (Piezo 2) (9/09/2020)	24546 (Piezo 4) (5/10/2020)	NZDWS 2005 (Revised 2018) – MAV	NZDWS 2005 (Revised 2018) – GV
Chloride	(g/m^3)	4.6	4.4	-	250
Carbonaceous Biochemical Oxygen Demand	g O_2/m^3	< 2	< 2	-	-
Chemical Oxygen Demand (COD)	g O_2/m^3	< 6	< 6	-	-
Dissolved Copper	(g/m^3)	0.0008	0.0009	2	1
Dissolved Iron	g/m3	0.02	< 0.02		0.2
Dissolved Lead	g/m^3	< 0.00010	< 0.00010	0.01	-
Dissolved Manganese	(g/m^3)	0.0017	0.0014	0.4	0.04
Dissolved Zinc	(g/m^3)	0.0068	0.0116	-	1.5
Sulphate	(g/m^3)	7.2	10.2	-	250

3.0 Assessment of Potential Effects

The main effect on groundwater resources at Peach Island from the proposed quarry activities is potential for adverse changes to groundwater quality. Therefore, the key areas of concern regarding the effects of the proposed quarry at Peach Island on groundwater quality at Peach Island are:

- Exposure of groundwater within aggregate excavation pits; and,
- Backfill of pits using material that may become inundated at times of high groundwater levels and cause contaminants to become mobilised.

The document "Technical Guidelines for Disposal to Land" (WasteMINZ, 2018) provides guidance for defining different classes of solid waste deposition which WasteMINZ (2018) refer to as landfills. As the Quarry site will involve backfilling of excavation pits with solid waste material that was not originally extracted from the pit, the Quarry site is considered to be a landfill, as defined by WasteMINZ (2018). While WasteMINZ (2018) does not have any official status, it

has been used as a point of reference to consider effects on groundwater from the proposed quarry activities. The key hydrogeological technical constraint for the siting of different Classes of landfill is whether the underlying aquifer system beneath the proposed landfill is used for drinking-water purposes. Only Class 5 landfills are allowed to be sited over aquifers used for drinking-water purposes. As the shallow groundwater aquifer system in the Peach Island area is used for drinking-water supply purposes, the proposed Peach Island Quarry is therefore defined as a Class 5 landfill and means that only clean fill material can be deposited at the Quarry site. Clean fill material is defined by WasteMINZ (2018) as:

"Virgin excavated natural materials (VENM) such as clay, soil and rock that are free from:

- *Combustible, putrescible, degradable or leachable components;*
- *Hazardous substances or materials (such as municipal solid waste) likely to create leachate by means of biological breakdown;*
- *Products or materials derived from hazardous waste treatment, stabilisation or disposal practices;*
- *Materials such as medical and veterinary waste, asbestos, or radioactive substances that may present a risk to human health if excavated;*
- *Contaminated soil and other contaminated materials; and,*
- *Liquid waste."*

Therefore, it is important that any material used to backfill any excavation pits at the Quarry site meet strict acceptance criteria to avoid altering the groundwater chemistry in a way that could adversely affect drinking water supply bores in the Peach Island area. Furthermore, the fill material acceptance criteria should result in the site remaining suitable for unencumbered potential future land use (WasteMINZ, 2018).

Exposure of groundwater within an open excavation pit can allow contamination of shallow groundwater from a number of different sources including faecal contamination from animals (i.e., birds attracted to ponded water etc) and accidental spills from machinery. To reduce this risk, it is important that groundwater is never exposed within an excavation pit.

To ensure that the risks of these two key concerns are managed correctly during the operation of the proposed Quarry, a dedicated groundwater and clean fill management plan has been prepared which provides details of how the Applicant will mitigate and reduce any risk from the operation of the quarry on groundwater resources and a copy of the management plan is provided in Appendix D.

The following sections provide an assessment of potential effect from the proposed quarry activities at Peach Island.

3.1 Potential Groundwater Receptors

Information provided by TDC indicates that there a total of 20 bores located in the Peach Island area, as shown in Figure 7, Appendix A. The available information indicates that 15 bores are currently actively used while the status of 5 bores is unknown. However, for the purposes of this assessment, all bores in the Peach Island area have been considered. The uses of the 20 bores in the area include irrigation (13), monitoring/piezometer (4), unknown (2) and domestic (1). With the exception of the 4 bores located at the Quarry site and one bore located upgradient (21948), the majority of the bores in the area are located downgradient of the proposed Quarry site, and therefore are potential receptors from any changes in groundwater chemistry as a result of the proposed quarry activities.

The closest down gradient monitoring bores used for abstraction purposes (listed as irrigation) are bores 21033 (located around 86 m downgradient of the quarry boundary) and bore 21435 (located around 88 m downgradient). The only listed domestic supply bore based on information provided by TDC is bore 21188, located around 400 m cross-gradient and on the true left of Shaggery Stream.

Information provided by TDC indicates that there are 16 resource consents for the take and use of water in the Peach Island area. Of these, 2 are surface water takes (located in Shaggery Stream) and 14 are underground (groundwater) take and use consents. All of the underground and surface water take and use consents in the Peach Island area are for irrigation or irrigation/frost protection purposes with the largest underground water take being Resource Consent 180024 which allows groundwater to be taken at a rate of up to 4,900 m^3/week (average 7-day instantaneous pumping rate of 8 L/s).

Any adverse changes in groundwater chemistry that could impact downgradient bores are proposed to be managed by the management and operational procedures discussed in the preceding sections of this report.

Groundwater level data and groundwater contour information for the Peach Island area indicate a strong relationship between shallow groundwater and flow variations in the Motueka River. The Motueka River is around 130 m from the proposed Quarry site at the closest point. Although the Motueka River is a primary source of recharge to the shallow aquifer system at Peach Island, it is expected that the groundwater system also discharges back to the river and is therefore a potential receptor of any changes in groundwater chemistry changes as a result of the proposed quarry activities. However, any effects on water quality associated with the proposed Quarry activities are expected to be minimal due to significant dilution effects based on the much higher flow rate in the river compared to the shallow aquifer system.

Shaggery Stream may also be a potential receptor from changes in groundwater chemistry as a result of the proposed quarry activities. Based on available LiDAR information (LINZ 2008 – 2015) and groundwater level data in bores 24543 (Piezo 1) and 24546 (Piezo 4), the reaches of the stream adjacent to the Quarry

site appear to be elevated above shallow groundwater and therefore the stream would be expected to lose flow to groundwater. This appears to be supported by aerial imagery (Google Earth) which indicates that the channel adjacent to the proposed Quarry site is frequently dry. However, the groundwater contour information indicates that the reach of the stream adjacent to the proposed quarry does not appear to effect groundwater levels in this area of Peach Island. This suggests that the stream bed has a lower permeability than the underlying strata and therefore any flow losses from the stream will have a small impact on shallow groundwater levels. Under certain groundwater level conditions, it is possible that the lower reaches of Shaggery Stream gain flow from groundwater discharges at the surface although, Shaggery Stream ultimately discharges into the Motueka River and therefore any changes in water chemistry would be significantly diluted by the much larger flows in the Motueka River.

3.2 Exposure of Groundwater within Excavation Pits

As previously mentioned, exposure of groundwater within any excavation pits increases the risk of groundwater contamination, in particular faecal contamination from animals (i.e., birds) as well as increased risk from any spills from heavy machinery impacting on groundwater.

The Applicant proposes to mitigate this risk by not excavating below the water table and maintaining a working vertical separation distance of 1 m above the highest groundwater level at the time of that excavation. This will provide a vertical separation distance between the base of the excavation and shallow groundwater which allows for variations in groundwater level fluctuations. However, deeper excavations to depths no less than 0.3 m above groundwater level can be undertaken as long as the deeper excavation is backfilled within the same day as extraction. This means that the excavation depth will vary depending on the time of year and groundwater levels at that time. This will allow the Applicant to extract aggregate to a sufficient depth below ground level to maintain viability of their operation but avoid exposing groundwater and adversely effecting groundwater quality. All excavations to depths between 1 m and 0.3 m above groundwater level will be undertaken during dry weather conditions.

The minimum vertical separation distance of 0.3 m between the excavation pit floor and groundwater level at the time of the excavation is based on the measured range of groundwater level fluctuations at Peach Island (in the order of 2 to 3 m). This will maintain a vertical separation of at least 10% of the measured range of groundwater level fluctuations at the Quarry site.

Groundwater levels will be monitored in dedicated monitoring bores at the Quarry site with groundwater levels measured in real time via a telemetry system. Prior to excavation works being undertaken each day, the telemetered groundwater level data will be used to inform excavation machinery operator(s) of the allowable elevation of the base of the excavation. This will ensure that at least 0.3 m of material above the groundwater level is maintained. If this excavation reduces the vertical separation to less than 0.3 m, a warning system will notify the machinery operators at the Quarry site and the Quarry operator.

All excavations between 1 m and 0.3 m above groundwater level will occur during dry weather conditions. During extreme weather events, or flood events in the Motueka River, it is possible that groundwater levels could rise rapidly, inundating open pit excavations. To mitigate this, the Applicant will maintain an onsite supply of sufficient fill material to back fill any open pit excavations in the event of a rapid increase in groundwater levels.

More in-depth procedures and management practices are provided in Section 5.0 the groundwater and clean fill management plan (Appendix D) for avoiding exposure of groundwater in open excavation pits.

If the Applicant operates as per the proposed requirements discussed in this section and the groundwater and clean fill management plan, then the effects of the proposed quarry activities on groundwater from exposure of groundwater in open pit excavations are expected to be less than minor.

3.3 Inundation of Back Fill Material

The existing strata at the site has been deposited via natural geological processes. Removal of natural strata during excavation and backfilling of excavations with fill material will change the physical structure of the strata that the groundwater occurs in. Some of the clean fill material will be sourced from off site and therefore would be expected to contain material that has a different geology and chemistry compared to the existing strata. This has the potential to result in some level of change in groundwater chemistry, particularly if the fill material becomes inundated by groundwater. As the proposed Quarry will involve excavating above the shallow groundwater level but to depths which will become inundated at later times as a result of fluctuating groundwater levels, it is possible that inundation of any backfill material that contains material that is different from the current strata may result in some changes to groundwater quality.

As the proposed Quarry site is defined as a Class 5 Landfill, the Applicant will avoid backfilling the excavation pits using any material that could result in adverse changes in groundwater chemistry. This will be accomplished by using strict fill material acceptance criteria and procedures to ensure that only natural, uncontaminated hardfill material is placed within any excavation pits at the Quarry site.

Fill material will comprise natural material sourced both on site (i.e., at the Quarry) and off site which will include uncontaminated soil, clay, rock and gravel. The fill material will include some incidental biodegradable organic matter that will not exceed 2% by volume per load of fill and exclude soils with high organic content (i.e., peat, loam, topsoil etc.).

Fill material sourced off site must not be from a site listed on the Tasman District Council Hazardous Activities and Industries List (HAIL) register and will only be accepted to the Quarry site as back fill if the total soil contaminant concentrations in the imported fill are below regional background concentration limits. WasteMINZ (2018) provides contaminant concentration limits for some parameters and regions in New Zealand, although it does not specify any limits for the Tasman region. However, soil background concentration limits specific to the Tasman region are provided in the Landcare Research report "Background concentrations of trace elements and options for the managing of soil quality in the Tasman and Nelson Districts" (Cavanagh, 2015). The Applicant will ensure that total soil contaminant concentrations in any imported fill material sourced off site do not exceed the limits provided in the Landcare Research report.

All imported fill material sourced off site will be graded at another facility by the Quarry operator prior to being delivered to the Quarry site, with the exception of clean fill material that may be delivered to the Quarry site during a civil emergency. In this scenario, the clean fill material may be graded on site prior to placement in any excavation pits to ensure that the material has contaminant concentrations below the regional background concentrations.

All fill material source off site will be delivered to the Quarry site by the Applicant and they will maintain a register of details regarding the fill material (including date of receipt, source of fill, documentation regarding testing of fill, quantity of fill etc.).

The Applicant will also undertake random chemical testing of any imported clean fill from 1 truck in every 50 truckloads to ensure that the imported fill material meets the requirements of clean fill material.

More in-depth procedures and management practices are provided in Sections 2.0 and 3.0 of the groundwater and clean fill management plan (Appendix D) to ensure that the back fill material is considered appropriate clean fill material.

Provided that the Applicant follows the requirements for acceptance of clean fill material at the Quarry site described above, any changes in groundwater chemistry from inundation of fill material would most likely be subtle differences in the concentrations of common cations and anions that would not be noticeable to people who use the aquifer for drinking-water supply purposes. Therefore, the effects of the backfilling of excavation pits with clean fill material that may be become inundated at times of high groundwater levels is expected to be less than minor.

3.4 Spillage of Hydrocarbons

There is potential for groundwater contamination from the use of vehicles and machinery operating within any excavation pits as a result of spillages of hydrocarbons such as hydraulic oil and diesel fuel, particularly where protective strata thicknesses have been reduced during excavation. To reduce the potential impacts of this occurring, it is proposed that the Applicant will undertake management practices that will includes measures such as ensuring refuelling and maintenance of vehicles and machinery does not occur in any quarry pit excavations. The Applicant will always maintain a thickness of at least 0.3 m above groundwater level in any excavation pits to reduce the potential for direct contact of any accidental spills with groundwater.

All quarry staff operating in the excavation pits will be trained in the appropriate way to respond to a spill and spill kits will be always available in the excavation pits. Any spill events will be managed immediately by the Quarry staff and the operator by limiting the extent of the spill removing any contaminated strata and disposed of at an appropriate facility. If any spills greater than 20 L occur, the Applicant will immediately notify Tasman District Council. During any spill event, all operations at the Quarry site will cease until the spill event has been mitigated.

Section 6.0 of the groundwater and clean fill management plan outlines these mitigation measures to reduce the effects of spills at the Quarry site.

Even following best practice measures and the proposed management plan, accidental spills within an excavation pit can still occur (e.g., hydraulic hose breakage etc). However, an accidental spill of this nature is likely to be small in volume and contains a low proportion of chemicals that are readily soluble and mobile in groundwater, which would only occur if the spill was large enough to infiltrate down to the groundwater table. Therefore, it is expected that the proposed management procedures to mitigate spills in any excavation pits at the Quarry site are sufficient to minimise the risk of contamination of groundwater from spills.

Provided that the Applicant follows the requirements for managing and mitigating against spills associated with quarrying activities at the Quarry site, the risk of spills should be minimised to such an extent that effects on the groundwater resources at Peach Island are expected to be less than minor.

3.5 Excavations and Backfill Near Streams

Open excavations near waterways can result in change in groundwater flow direction toward the excavation, particularly if groundwater is exposed within the excavation pit and the nearby waterway loses flow to ground. In this scenario, the open excavation acts as a preferential pathway directing shallow groundwater flows toward the excavation.

A tributary of Shaggery Stream is located around 25 m from the boundary of the proposed Quarry site (excavation area Stage 1). Available LiDAR data (LINZ 2008 – 2015) indicates that areas of ground surface within the Stage 1 excavation area are around 0.25 m below the adjacent Shaggery Stream channel.

Limited flow data measured by TDC in Shaggery Stream at a location around 700 m upstream of the confluence of Shaggery Stream with the Motueka River on 26 occasions between 1972 and 2019. The available data indicates that flows in Shaggery Stream have been measured up to 258 L/s with average and minimum flows of 108 L/s and 45 L/s respectively. As previously noted, aerial imagery indicates that the reach of Shaggery Stream adjacent to the Quarry site goes dry occasionally and therefore may lose flow to the shallow groundwater system. Based on this, it is possible that open excavations associated with the Quarry site could intercept shallow seepage losses from the stream. If this was observed to occur, the quarry excavation would need to be restricted during times of low, or no streamflow, and backfilled before streamflow recommenced. This will ensure that no excavations will occur below groundwater level at the time of excavation. It is expected that the stream will either be dry or have reduced flow at times of low groundwater level and therefore no inflows from Shaggery Stream into the excavation should occur at those times.

Inflows to excavations from the Motueka River are also not expected to occur as no excavations will occur below shallow groundwater. Therefore, the controls to mitigate inflows from Shaggery Stream and the Motueka River are incorporated into the operational procedures to avoid exposure of groundwater within any excavation pits and are detailed in Section 5.0 of the groundwater management and clean fill management plan (Appendix D).

Provided that the Applicant operates the Quarry site in accordance with the proposed requirements discussed in this section and the groundwater and clean fill management plan, the effects of the proposed quarry activities on groundwater from inflow of diverted flow from adjacent water ways are expected to be less than minor.

4.0 Proposed Management Plan

Due to the nature of the proposed quarry activities, the excavation and backfilling of excavations with uncontaminated clean fill material will likely alter the physical structure of that part of the aquifer (i.e., a change in hydraulic conductivity of the aquifer material) and cause a localised change in the chemistry and biological condition of the Peach Island aquifer. However, any change in the aquifer arising from the quarry activities will be at a level that will not adversely affect the downgradient environment or groundwater users, based on the operational provisions of the groundwater and clean fill management plan.

However, in addition to the management operational procedures (including groundwater level monitoring), ongoing monitoring of groundwater quality both upgradient and downgradient of the Quarry site will be undertaken by the Quarry operator to monitor for any adverse changes in groundwater quality as a result of the quarry activities. This will provide additional certainty to ensure any effects are less than minor.

Groundwater quality monitoring will involve collection of groundwater samples from at least one dedicated upgradient monitoring bore at the southern extent of the quarry and from at least two dedicated downgradient monitoring bores at the northern extent of the quarry. In addition to these dedicated monitoring bores, sampling of up to three downgradient water supply bores within 500 m of the quarry will also be undertaken by the Quarry operator. The downgradient water supply bores should be inspected prior to being selected for sampling purposes to ensure that they have a secure bore head.

Groundwater sampling will occur at three monthly intervals. At least two samples will be collected prior to any quarrying activities commencing at the site to establish pre-quarry groundwater quality conditions, and sampling will continue until two years after quarrying and backfilling has ceased.

The groundwater quality data will be used to determine any effects on groundwater quality arising from quarrying activities. This assessment process is provided in Sections 7.1 and 7.2 of the groundwater and clean fill management plan and involves a comparison of upgradient and downgradient concentrations, comparison with trigger levels (Table 2 of the groundwater and clean fill management plan) and a comparison against the relevant DWSNZ 2022 (Taumata Arowai, 2022) MAV and GV. Any issues arising from groundwater quality monitoring will be investigated by the Quarry operator and includes notifying Tasman District Council of any issues, undertaking additional groundwater quality monitoring, undertaking investigations to establish the potential cause of any issues, cessation of any quarrying activities identified as causing the issue, removal of any backfill material and providing an alternative water supply to downgradient groundwater users if deemed necessary.

Further to this monitoring, the Quarry operator will maintain a complaints register and will investigate any complaint of bad taste, odour or illness reported in bores used for drinking water supply purposes and located downgradient of the Quarry site. Any complaints shall be investigated and details of the complaint and actions to address the complaint by the Quarry manager should be documented.

An annual monitoring report will be prepared by the Quarry operator and provided to Tasman District Council and will include all groundwater and excavation elevation data, all groundwater quality data and a discussion of any trends, any exceedances of groundwater quality trigger levels and mitigation actions in response to any groundwater quality issues.

Details of the groundwater quality monitoring and the steps to address any contamination as a result of quarrying activities are provided in Section 7.0 of the groundwater and clean fill management plan (Appendix D).

5.0 Summary and Conclusions

CJ Industries Ltd are seeking resource consent to establish a quarry at Peach Island. The quarry excavation pits will be backfilled with clean fill material sourced both on and off site. A shallow, unconfined alluvial aquifer system, that is predominantly recharged by flow losses from the Motueka River provides a source of clean groundwater for irrigation and domestic supply purposes to a number of properties at Peach Island. The shallow aquifer underlies the proposed location of the Quarry site and therefore the main potential risk from the proposed quarry on the groundwater resources is adverse effects on groundwater quality.

The key areas of concern that may impact groundwater quality from the proposed quarry activities are:

- Exposure of groundwater within open pit excavations; and,
- Inundation of contaminated fill material in backfilled pits, mobilising contaminants within the aquifer.

These concerns will be addressed by implementing a groundwater and clean fill management plan which provides strict controls to avoid excavations within groundwater/exposure of groundwater in excavation pits and ensuring that only clean fill material that is uncontaminated is used to back fill any excavations. Groundwater level and quality monitoring will be implemented as part of the management plan to monitor effects of the quarry activities on downgradient water quality.

Provided that the Applicant operates the proposed quarry as outlined in the groundwater and clean fill management plan, the overall effect of the quarrying activities on the groundwater resources at Peach Island are expected to be less than minor.

6.0 References

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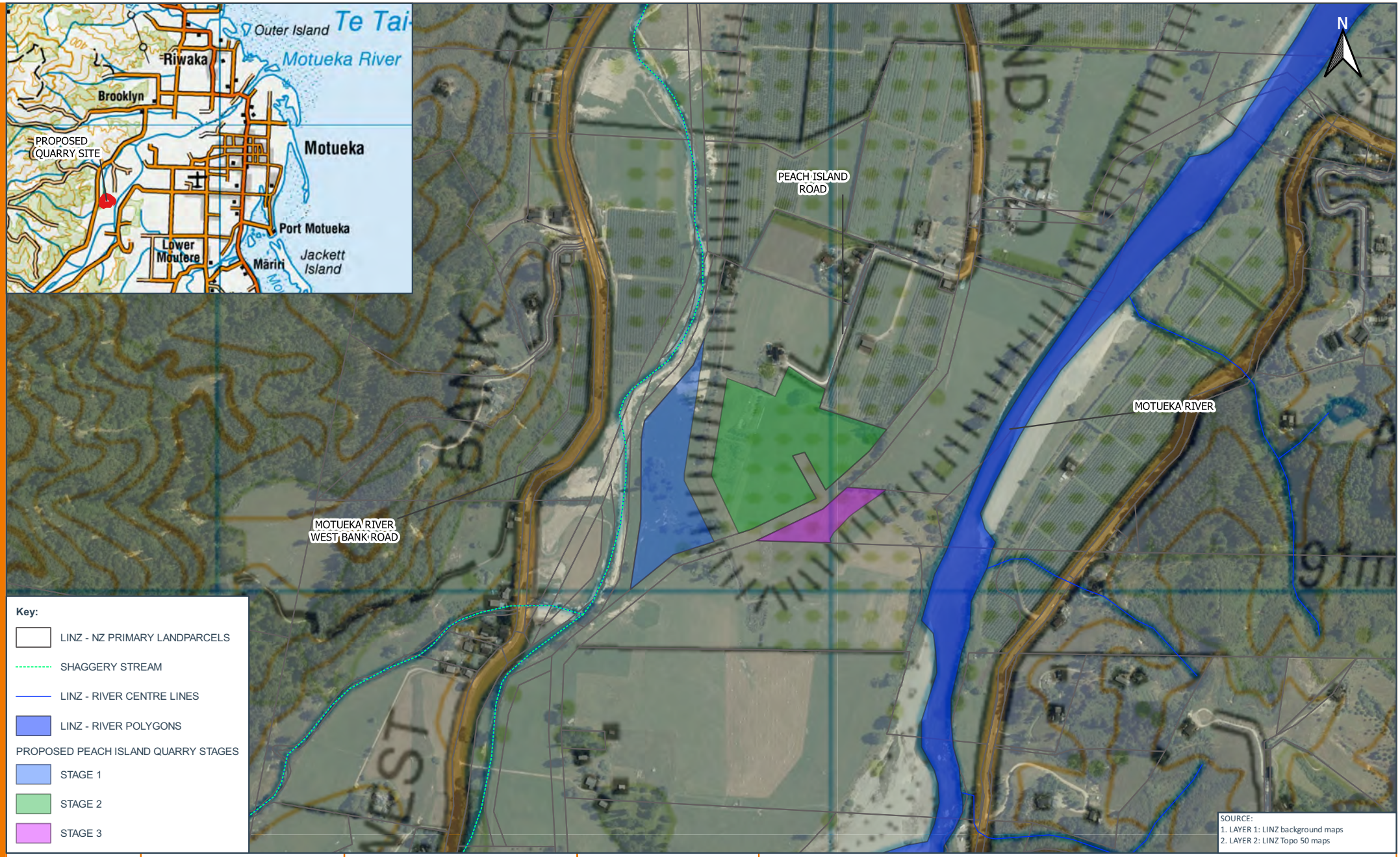
Appendix A: Figures



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NO.	REVISION	DATE	BY
A	FINAL	JUN 22	RN

CLIENT

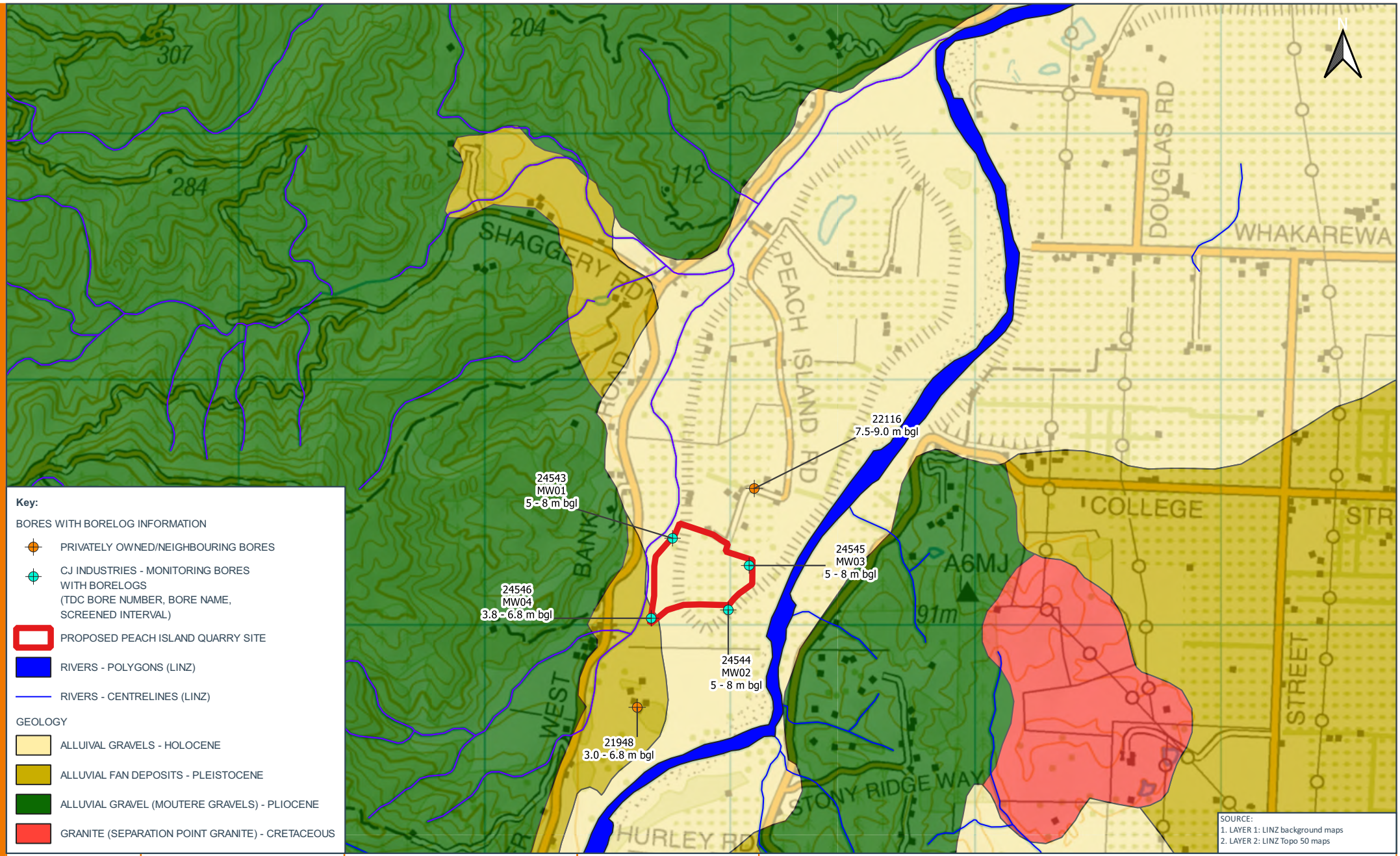
CJ INDUSTRIES LIMITED

FIGURE

FIGURE 1: LOCATION OF PROPOSED PEACH ISLAND QUARRY SITE

PROJECT

PEACH ISLAND PROPOSED QUARRY - HYDROGEOLOGY



Key:

BORES WITH BORELOG INFORMATION

- PRIVATELY OWNED/NEIGHBOURING BORES
- CJ INDUSTRIES - MONITORING BORES WITH BORELOGS (TDC BORE NUMBER, BORE NAME, SCREENED INTERVAL)
- PROPOSED PEACH ISLAND QUARRY SITE
- RIVERS - POLYGONS (LINZ)
- RIVERS - CENTRELINES (LINZ)

GEOLOGY

- ALLUVIAL GRAVELS - HOLOCENE
- ALLUVIAL FAN DEPOSITS - PLEISTOCENE
- ALLUVIAL GRAVEL (MOUTERE GRAVELS) - PLIOCENE
- GRANITE (SEPARATION POINT GRANITE) - CRETACEOUS

0 100 200 300 400

METRES

SCALE : 1:20000(A4)

NO.	REVISION	DATE	BY
A	FINAL	JUN 22	RN

CLIENT

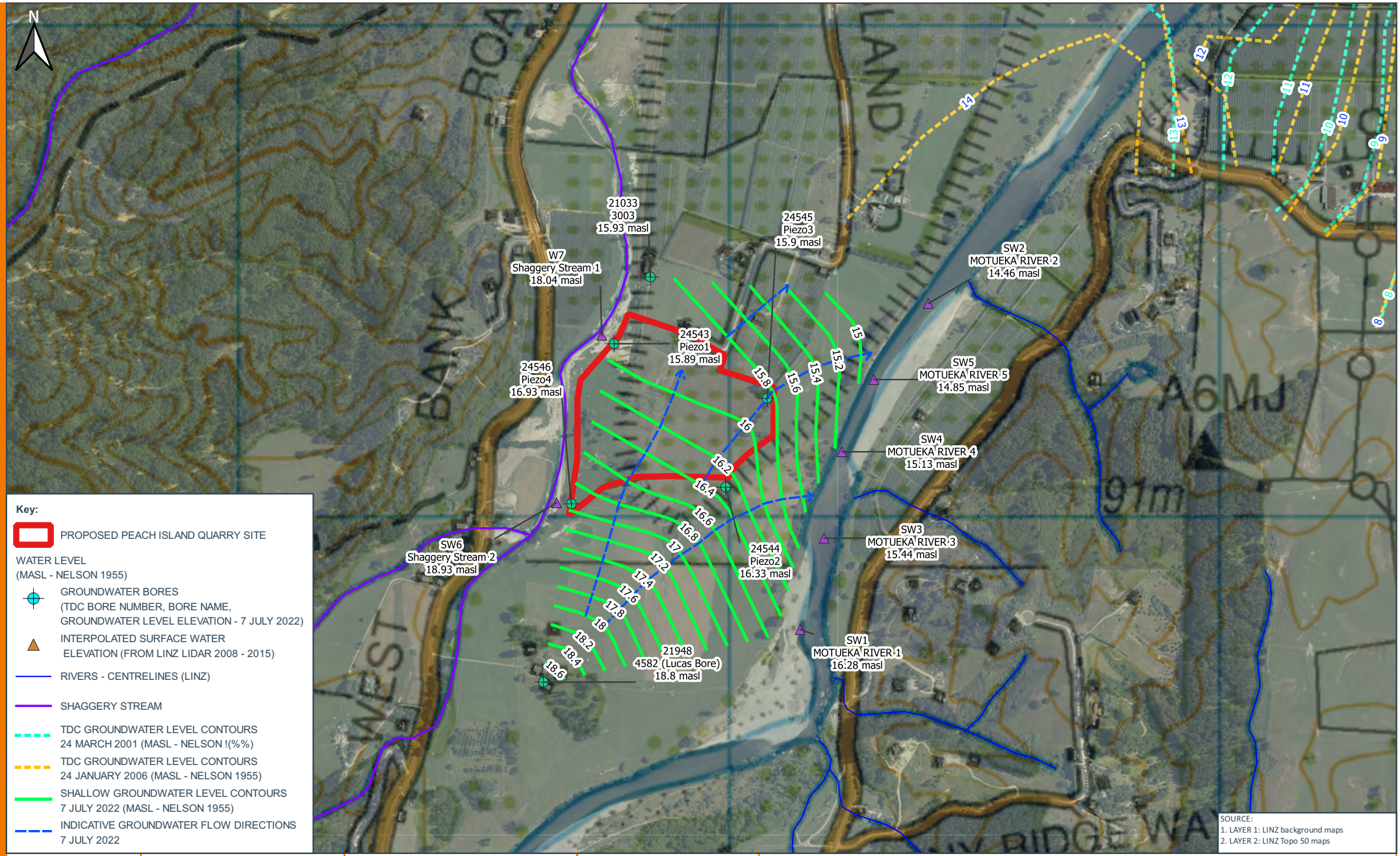
CJ INDUSTRIES LIMITED

FIGURE

FIGURE 2: GENERALISED GEOLOGICAL MAP OF PEACH ISLAND AREA (ADAPTED FROM RATTENBURY ET. AL, 1998)

PROJECT

PEACH ISLAND PROPOSED QUARRY - HYDROGEOLOGY



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A	FINAL	JUL 22	RN

CLIENT

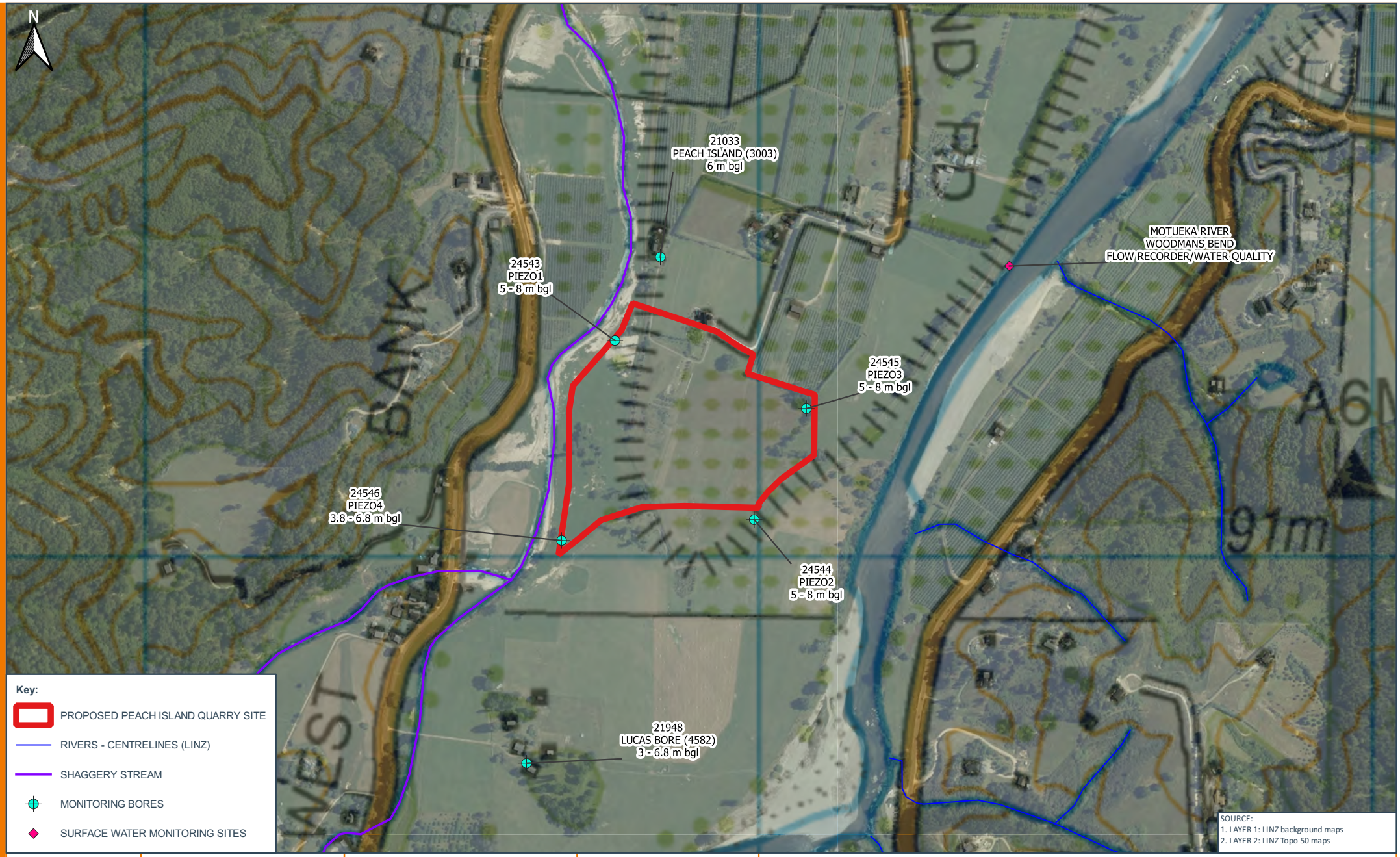
CJ INDUSTRIES LIMITED

FIGURE

FIGURE 3: GROUNDWATER LEVEL CONTOURS AND INDICATIVE SHALLOW GROUNDWATER FLOW DIRECTIONS

PROJECT

PEACH ISLAND PROPOSED QUARRY - HYDROGEOLOGY



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SCALE : 1:8000 (A4)

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A	FINAL	JUN 22	RN

CLIENT

CJ INDUSTRIES LIMITED

FIGURE

FIGURE 4: BORES WITH AVAILABLE LONG-TERM GROUNDWATER LEVEL RECORDS AND SURFACE WATER MONITORING SITES AT PEACH ISLAND

PROJECT

PEACH ISLAND PROPOSED QUARRY - HYDROGEOLOGY

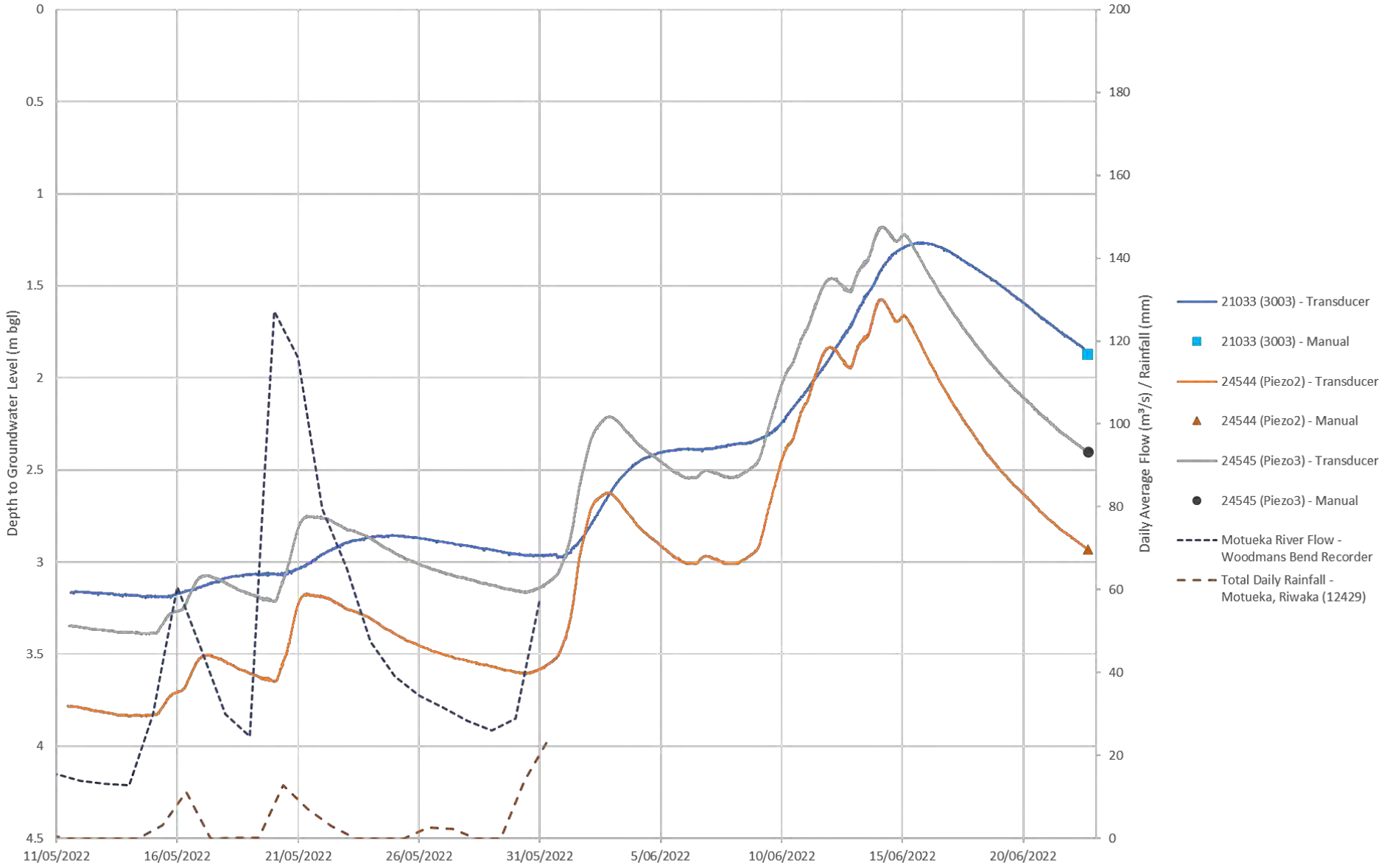
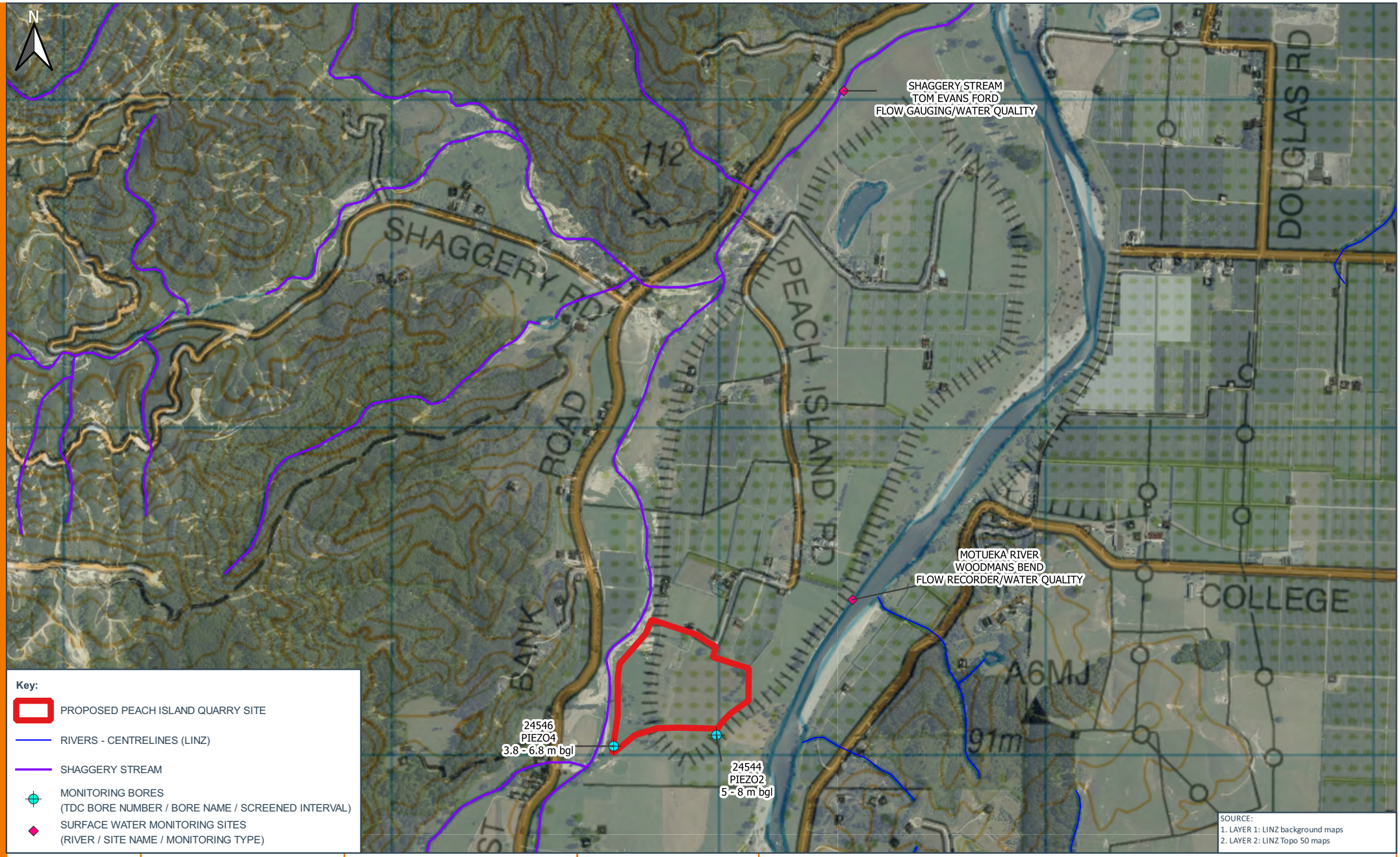


FIGURE 5: CONTINUOUS GROUNDWATER LEVEL DATA FOR BORES AT PEACH ISLAND



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A	FINAL	JUN 22	RN

CLIENT

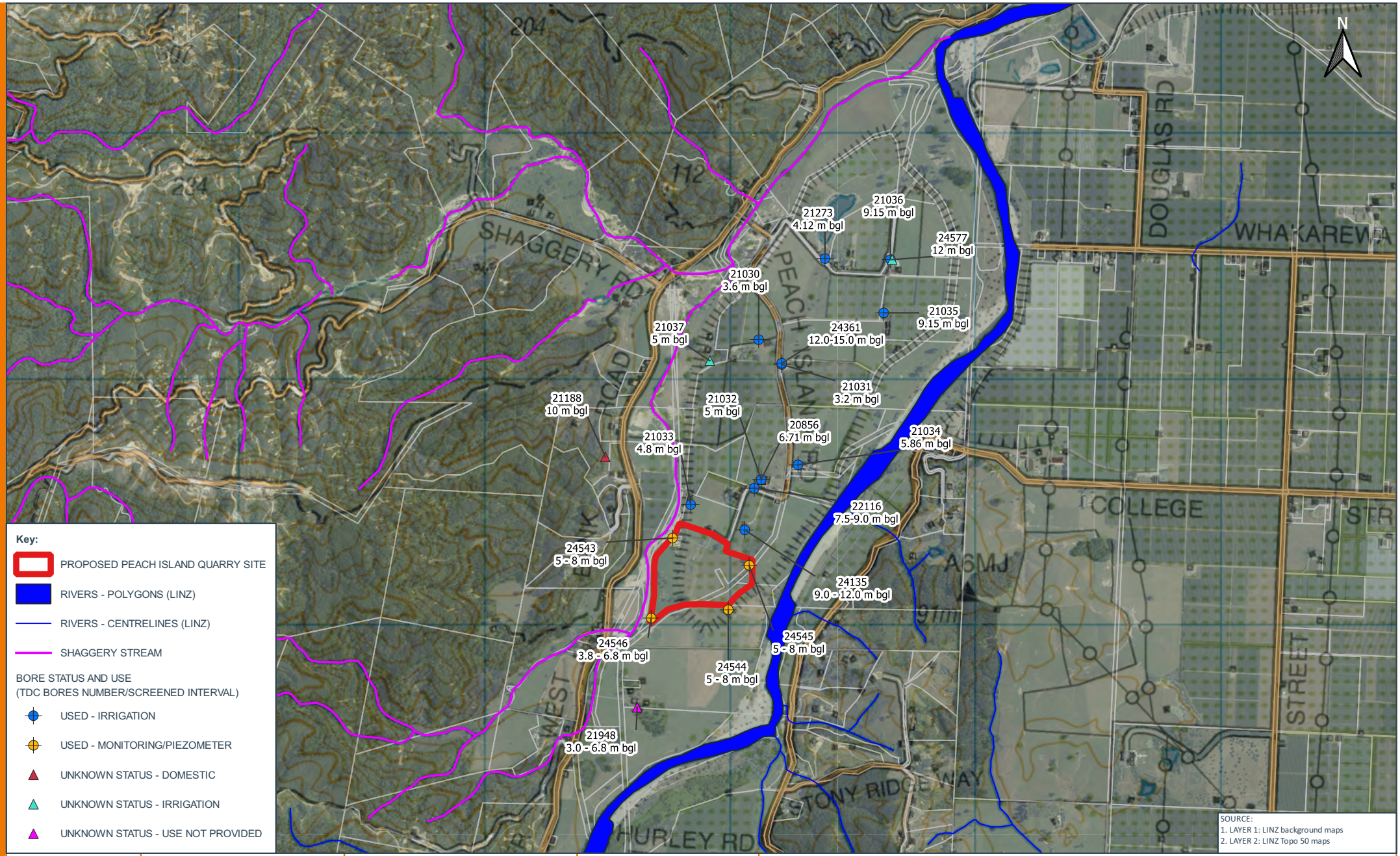
CJ INDUSTRIES LIMITED

FIGURE

FIGURE 6: WATER QUALITY AND SURFACE FLOW MONITORING SITES AT PEACH ISLAND

PROJECT

PEACH ISLAND PROPOSED QUARRY - HYDROGEOLOGY



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METRES

SCALE : 1:20000(A4)

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A	FINAL	JUN 22	RN

CLIENT

CJ INDUSTRIES LIMITED

FIGURE

FIGURE 7: STATUS AND USES OF BORES AT PEACH ISLAND BASED ON INFORMATION FROM TDC

PROJECT

PEACH ISLAND PROPOSED QUARRY - HYDROGEOLOGY

Appendix B: Borelogs

Piezo 4 1595680 E 5447055 N (NZTM)

CWDRILL

WELL NUMBER MW04

PAGE 1 OF 1

CLIENT CJ Industries
PROJECT NAME Monitoring Well
PROJECT NUMBER MW04
PROJECT LOCATION Peach Island

DATE STARTED 4/8/20 **COMPLETED** 4/8/20
GROUND ELEVATION _____ **HOLE SIZE** 80
DRILLING CONTRACTOR CW Drilling
GROUND WATER LEVELS:
DRILLING METHOD Concentrics
AT TIME OF DRILLING ---
LOGGED BY Darryl Keown **CHECKED BY** James Chapman
AT END OF DRILLING 4.00 m
NOTES Monitoring Well Installation
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0		Steel Monument cover installed above ground		Brown sandy silt	
0.50				Light brown well sorted sandy Gravels	Natural pack backfill
1					
2					80mm UPVC blank pipe to surface
					Bentonite seal
3					
3.00				Grey, poorly sorted sandy Gravels	
4					
5					Washed Gravel pack 80mm Machine slotted upvc wellscreen
5.80				Grey/White Granite Roack	
6					
6.60				Bottom of hole at 6.60 m.	

GENERAL BH / TP / WELL CJ INDUSTRIES PEACH ISLAND MW04.GPJ CW DRILLING.GDT 5/8/21

CWDRILL

WELL NUMBER MW05

CLIENT CJ Industries
PROJECT NAME Monitoring Well
PROJECT NUMBER MW05
PROJECT LOCATION Peach Island

DATE STARTED 5/8/20 **COMPLETED** 5/8/20 **GROUND ELEVATION** _____ **HOLE SIZE** 80
DRILLING CONTRACTOR CW Drilling **GROUND WATER LEVELS:**
DRILLING METHOD Concentrics **AT TIME OF DRILLING** ---
LOGGED BY Darryl Keown **CHECKED BY** James Chapman **AT END OF DRILLING** 3.77 m
NOTES Monitoring Well Installation **AFTER DRILLING** ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0		Steel monument cover installed above ground		Light brown silty sand	
1.20				Grey, well sorted sandy Gravels	Natural pack backfill
2					80mm Blank upvc to surface
3					
4					Bentonite seal
4.60				Light brown well sorted sandy Gravels	
5					
6					
7					Washed Gravel pack 80mm machine slotted upvc wellscreen
8					
8.00				Bottom of hole at 8.00 m.	

GENERAL BH / TP / WELL CJ INDUSTRIES PEACH ISLAND MW05.GPJ CW DRILLING.GDT 5/8/21

Piezo 3 1596079 E 5447242 N (NZTM)

CWDRILL

WELL NUMBER MW03

PAGE 1 OF 1

CLIENT CJ Industries Ltd
PROJECT NAME Monitoring Well
PROJECT NUMBER MW03
PROJECT LOCATION Peach Island

DATE STARTED 4/8/20 **COMPLETED** 4/8/20 **GROUND ELEVATION** _____ **HOLE SIZE** 80
DRILLING CONTRACTOR CW Drilling **GROUND WATER LEVELS:**
DRILLING METHOD Concentrics **AT TIME OF DRILLING** ---
LOGGED BY Darryl Keown **CHECKED BY** James Chapman **AT END OF DRILLING** 3.22 m
NOTES Monitoring Well Installation **AFTER DRILLING** ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0		Steel Monument cover installed above ground		Brown Sand	Natural pack backfill
0.60				Grey, poorly sorted sandy Gravels	80mm Blank upvc pipe to surface
3.40				Grey, well sorted sandy Gravels	Bentonite seal
8.00				Bottom of hole at 8.00 m.	Washed Gravel pack 80mm machine slotted upvc wellscreen

GENERAL BH / TP / WELL CJ INDUSTRIES PEACH ISLAND MW03.GPJ CW DRILLING.GDT 5/8/21

Piezo 2 1595972 5447052 N (NZTM)

CWDRILL

WELL NUMBER MW02

PAGE 1 OF 1

CLIENT CJ Industries
PROJECT NAME Monitoring Well
PROJECT NUMBER MW02
PROJECT LOCATION Peach Island

DATE STARTED 5/8/20 **COMPLETED** 5/8/20 **GROUND ELEVATION** _____ **HOLE SIZE** 80
DRILLING CONTRACTOR CW Drilling **GROUND WATER LEVELS:**
DRILLING METHOD Concentrics **AT TIME OF DRILLING** ---
LOGGED BY Darryl Keown **CHECKED BY** James Chapman **AT END OF DRILLING** 0.25 m
NOTES Monitoring Well Installation **AFTER DRILLING** ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0		Steel monument cover installed above ground		Light brown sandy Silt	Natural pack backfill
2.00				Light brown well sorted sandy Gravels	80mm Blank upvc to surface; Bentonite seal; Washed Gravel pack 80mm Machine slotted wellscreen
8.00				Bottom of hole at 8.00 m.	

GENERAL BH / TP / WELL CJ INDUSTRIES PEACH ISLAND MW02.GPJ CW DRILLING.GDT 5/8/21

Piezo 1 1595755 E 5447345 N (NZTM)

CWDRILL

WELL NUMBER MW01

PAGE 1 OF 1

CLIENT CJ Industries Ltd
PROJECT NAME Monitoring Well
PROJECT NUMBER MW01
PROJECT LOCATION Peach Island

DATE STARTED 4/8/20 **COMPLETED** 4/8/20 **GROUND ELEVATION** _____ **HOLE SIZE** 80
DRILLING CONTRACTOR CW Drilling **GROUND WATER LEVELS:**
DRILLING METHOD Concentrics **AT TIME OF DRILLING** ---
LOGGED BY Darryl Keown **CHECKED BY** James Chapman **AT END OF DRILLING** 0.20 m
NOTES Monitoring Well Installation **AFTER DRILLING** ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0		Steel monumnet cover installed above ground		Light brown sandy silt	Natural pack backfill
0.90				Grey, well sorted sandy silty gravels	
2.40				Brown sand	80mm upvc blank pipe to surface
2.80				Grey, poorly sorted Gravels, sandy	Bentonite seal
7.10				Light brown, well sorted sandy Gravels	Washed Gravel pack 80mm machine slotted wellscreen
8.00				Bottom of hole at 8.00 m.	

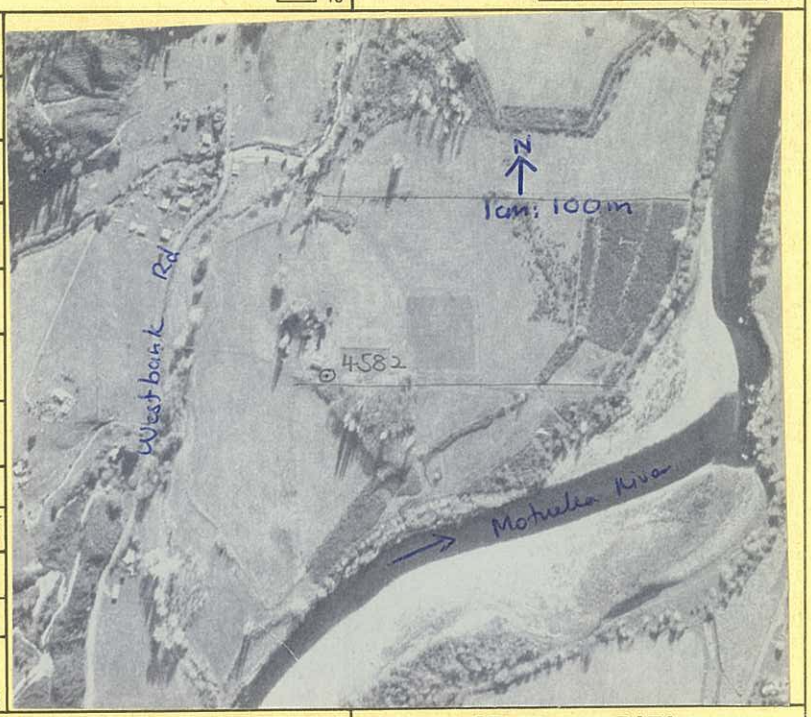
GENERAL BH / TP / WELL CJ INDUSTRIES PEACH ISLAND MW01.GPJ CW DRILLING.GDT 5/8/21

NEW ZEALAND WATER WELL DATA FORM

21948

SHEET No. N27 3	GRID REF 0561083 7 11	G.S. WELL No. W 4582 15	AREA Upper Motueka
CATCHMENT Motueka. 16	WATER AUTHORITY TDC 17	WATER USE I 18	PERMIT No. 925326 24

Well depth (m) 6.83 28	Measured Reported	Well diameter (mm) 200 29	Wellhead altitude (m) a.m.s.l. 33
Yield l/min 1200 / m³/day 39	Drawdown (m) 0.3 (½ hr pumping) 42	Specific l/min/metre capacity m²/day	
Driller Waimea Drilling Co	Drilling date 48	Well status 49	
Owner ~~C.S. LJ~~ Lucas	Address West Bank Road, RD1, Motueka		
Pump Type Surface 50	Well Type 51	Type of development	
Screen Type Slotted 175 mm	Slot sizes 10	Set at 3-6.83 52	
Source of information on well location, log, etc WDC log	Date 23/2/95		



STATIC WATER LEVELS (m below surface)

HIGHEST	LOWEST	MEAN	RANGE	FREQUENCY OF MEASUREMENT 53
		57		PERIOD OF MEASUREMENT 61

AQUIFER CHARACTERISTICS

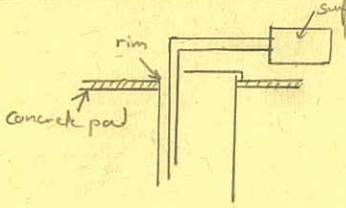
Transmissivity (m²/day) 66 Storage coefficient 72 Water Temperature (°C) 73

Permeability (m/day) Specific yield

TEST PUMPING		RECOVERY	
Drawdown (metres)	After time (min)	Residual Drawdown (m)	After Time (min)

REMARKS

Bore is in a shed.
M. Ward, 4/12/00 at 1320 hrs.
R.T.S: 3.3m
Depth: 6.1m



OTHER DATA

Pump Test	74
Chemical Analysis	75
Geophysical Data	76
Lithological Log	77
Isotope Data	78
	79
Card Type	80

Compiled by Date Checked by Date

EFA.

REDUCED LEVEL IN METRES above+ below− m.s.l.	GRAPHIC LOG	DEPTH IN METRES Below ground surface	LITHOLOGY <=drillwater gain >= drill water loss Reduced level of surface	COLOUR	STATIC WATER LEVEL (a) Related to ground surface	STATIC WATER LEVEL (b) Related to m.s.l	CASING	SCREEN	Approximate yield (litres/min) (m^3/day)	Specific capacity (litres/min/metre) (m^2/day)

E.T.A.

ATTN: JOSEPH THOMAS.

W.D.C LOG NO.: 1160

MEMBER OF N.Z.D.F.

WAIMEA DRILLING CO. LTD

DRILLERS WATER WELL LOG FORM

Drilled for

First name: R **Last name/Company:** Drummond

Well owner: R Drummond **N.M.R.C. No:**

Address: Belmont Downs, Dehra Doon **Suburb:** MOTUEKA **City:**

Driller: G Butler **Map sheet No:** **Depth(m):**

Drilling date: 21/1/78 **Grid Ref East:** **North:**

Locality: Shaggery Lane, Motueka.

STRATA

Depth from surface(m)	Colour	Description
1: 0.0	C1:	D1:
2: 4.5	C2:	D2: OPEN 0.9M WELL
3: 6.0	C3:	D3: MS,C SL 2.0 WB
4: 6.835	C4: GREY CB	D4: C
5:	C5:	D5:
6:	C6:	D6:
7:	C7:	D7:
8:	C8:	D8:
9:	C9:	D9:
10:	C10:	D10:
11:	C11:	D11:
12:	C12:	D12:
13:	C13:	D13:
14:	C14:	D14:
15:	C15:	D15:
16:	C16:	D16:
17:	C17:	D17:
18:	C18:	D18:
19:	C19:	D19:
20:	C20:	D20:

Aqufia details 1: 1.FIN: **Static Level 1:**
Aqufia details 2: 2.FIN: **Static level 2:**
Aqufia details 3: 3.FIN: **Static level 3:**

Casing Diameter (mm): 200 **Casing length (m):** 6.835
Screen Type: SLOTTED 175MM CASING **Screen set (m):** 3 **to:** 6.835
Screen length (m): 4 **Slot size (mm):** 10 **Leader (m):** **Sump (m):**
Draw down (m): 0.3 **Hours pumping:** 1/2 **Flow rate (lpm):** 1200

Remarks including notes on cores and samples taken:
200MM CASING WAS LEFT IN AND 0.9M WAS FILLED IN BACK TO GROUND LEVEL.

EMS # 13

NEW ZEALAND WATER WELL DATA FORM

2216

SHEET No. N27 3	GRID REF 0609265 11	G.S. WELL No. W 4816 15	AREA Mot
CATCHMENT Mot 16	WATER AUTHORITY TDC 17	WATER USE I 18	PERMIT No. WP 040363 24

Well depth (m) 10.10 28	Measured Reported	Well diameter (mm) 200 29	Wellhead altitude (m) a.m.s.l. 33
Yield l/min m^3/day 39	Drawdown (m) 42	Specific l/min/metre capacity m^2/day	
Driller C&W Drilling	Drilling date 6-01-03 48	Well status 49	
Owner JW & VA Walker	Address 130 Peach island rd		
Pump Type 50	Well Type 51	Type of development	
Screen Type SS wedgewire	Slot sizes 5.0	Set at 7.5-9.0m 52	
Source of information on well location, log, etc		Date	

STATIC WATER LEVELS (m below surface)

HIGHEST	LOWEST	MEAN	RANGE	FREQUENCY OF MEASUREMENT 53
		57		PERIOD OF MEASUREMENT 61

AQUIFER CHARACTERISTICS

Transmissivity (m^2/day) 66 Storage coefficient 72 Water

Permeability (m/day) Specific yield Temperature(°c) 73

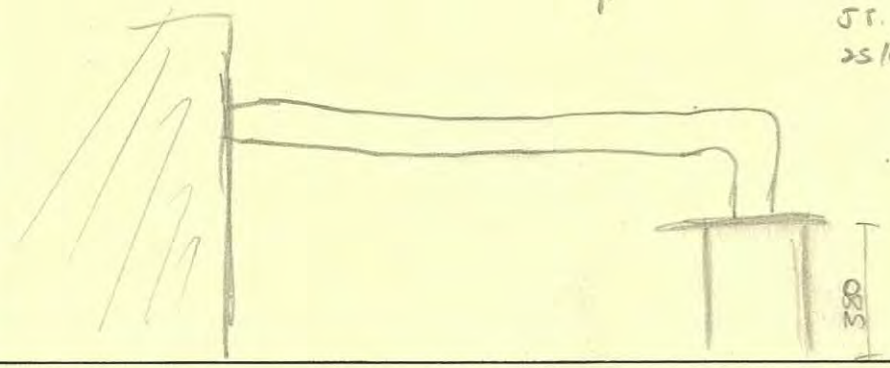
TEST PUMPING		RECOVERY	
Drawdown (metres)	After time (min)	Residual Drawdown (m)	After Time (min)

REMARKS

E 2506082 N6009265

#7

? replaced wwo 3002 JT. 25/11/07



OTHER DATA

Pump Test	74
Chemical Analysis	75
Geophysical Data	76
Lithological Log	77
Isotope Data	78
	79
Card Type	80

Compiled by Date Checked by Date

EEA.

MN000609

REDUCED LEVEL IN METRES above+ below− m.s.l.	GRAPHIC LOG	DEPTH IN METRES Below ground surface	LITHOLOGY <=drillwater gain >= drill water loss Reduced level of surface	COLOUR	STATIC WATER LEVEL (a) Related to ground surface	STATIC WATER LEVEL (b) Related to m.s.l	CASING	SCREEN	Approximate yield (litres/min) (m^3/day)	Specific capacity (litres/min/metre) (m^2/day)

ETA

DRILLING & INVESTIGATION LTD

MEMBER OF NZDF

Log No. **9055**

Member of N.Z.D.F.

Drilled For :

Name / Company : **Walker**

Well Owner : **Justin Walker**

Address : **RD 3 Brooklyn**

Driller : **J Chapman**

Drilling Date : **06-Jan-03**

Locality : **Peach Island**

N.M.R.C. No :

Map Sheet No :

Grid Ref East :

Depth (m) : **10.1**

North :

STRATA

	Depth from surface (m)	Colour	Description
1:	0.00	Light Brown	Silty Sand
2:	1.80	Light Brown / Grey	Medium coarse gravels, Sandy
3:	5.60	Grey	Medium coarse gravels, sandy (good water)
4:	9.00	Brown	Silty clay bound, medium gravels
5:	10.10	EOB	
6:			
7:			
8:			
9:			
10:			
11:			
12:			
13:			
14:			
15:			
16:			
17:			
18:			
19:			
20:			

Aquifer details 1: **5.6** 1. FIN: **9** Static Level 1: **4**

Aquifer details 2: 2. FIN: Static Level 2:

Aquifer details 3: 3. FIN: Static Level 3:

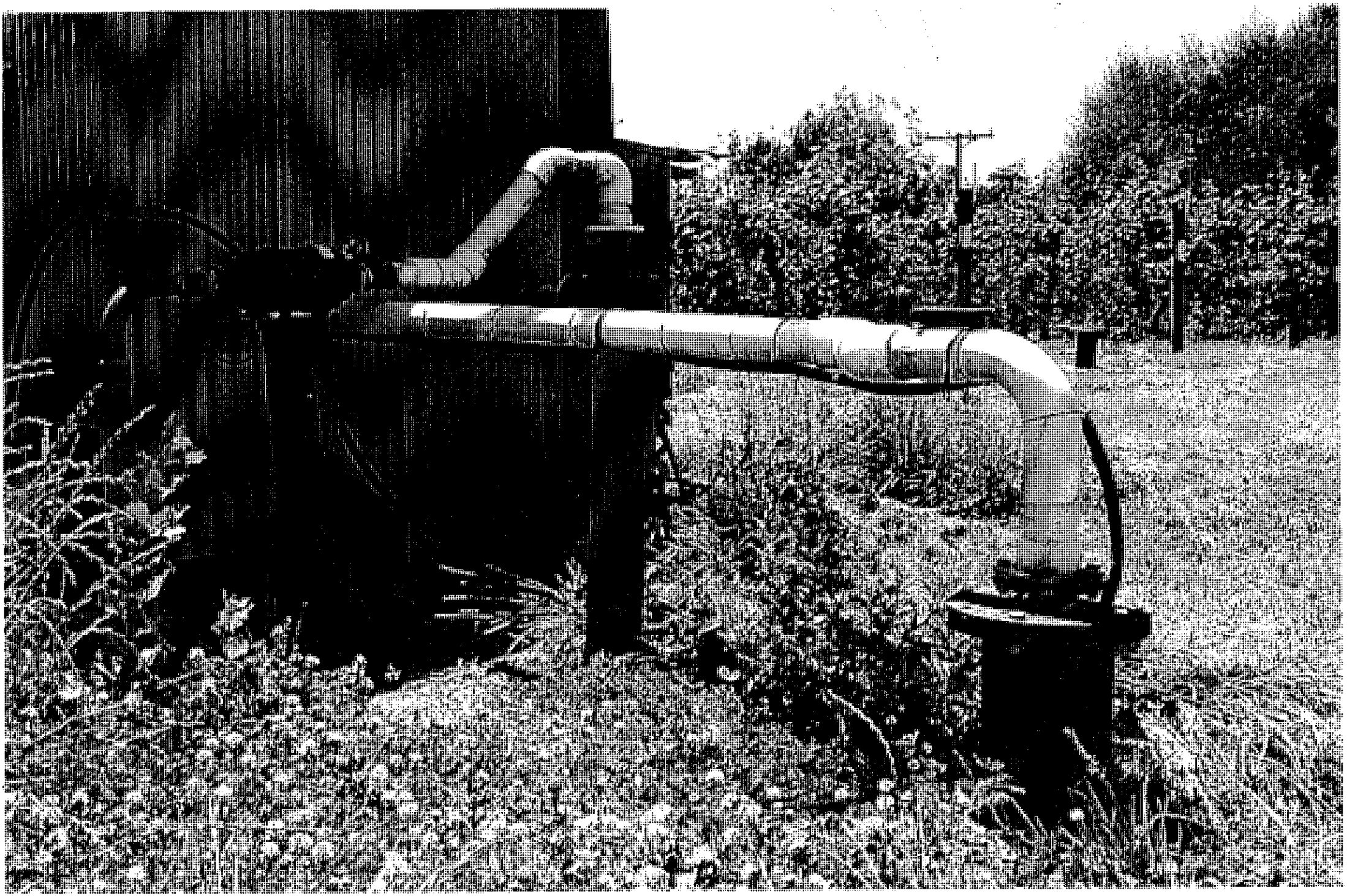
Casing Diameter (mm): **200** Casing Length (m): **7.5**

Screen Type: **Stainless steel Wedgewire** Screen set (m): **7.5** to **9.0**

Screen length (m): **1.5** Slot size (mm) : **5.0** Leader (m) : **0.5** Sump (m) **0.5**

Draw down (m): Hours pumping : Flow rate (1pm)

Remarks including notes on cores and sample taken:



Appendix C: Motueka River Water Quality Data

Table C1: Summary of water quality data for the Motueka River at Woodmans Bend Monitoring site						
Parameter	**Unit**	**Maximum**	**Mean**	**Median**	**Minimum**	**Number of Samples**
Acidity	(g/m3 as CaCO3)	4.9	2.3	1	1	3
Alkalinity (CaCO3)	(g/m3 as CaCO3)	63	61	61	59	2
Alkalinity (HCO3)	(g/m3)	76	60.5	60.5	45	2
Bicarbonate	(g/m3 as HCO3)	76	76	76	76	1
Biochemical Oxygen Demand	(g/m3)	<1	<1	<1	<1	1
Bromide	(g/m3)	<0.05	<0.05	<0.05	<0.05	1
Carbonate	(g/m3)	<1	<1	<1	<1	1
Chloride	(g/m3)	7.1	5.7	5.75	4.2	4
Carbonaceous Biochemical Oxygen Demand	g O2/m3	-	-	-	-	-
Chemical Oxygen Demand (COD)	g O2/m3	-	-	-	-	-
Electrical Conductivity	(uS/cm)	15	12.3	12	10	5
Dissolved Boron	(g/m3)	0.008	0.008	0.008	0.008	1
Dissolved Calcium	(g/m3)	19	16.6	18.2	11	4
Dissolved Copper	(g/m3)	-	-	-	-	-
Dissolved Inorganic Nitrogen	(g/m3)	0.13	0.13	0.13	0.13	1
Dissolved Iron	g/m3	0.12	0.062	0.045	0.02	3
Dissolved Lead	g/m3	-	-	-	-	-
Dissolved Magnesium	(g/m3)	4.2	3.8	3.9	3.3	4

Table C1: Summary of water quality data for the Motueka River at Woodmans Bend Monitoring site						
Parameter	**Unit**	**Maximum**	**Mean**	**Median**	**Minimum**	**Number of Samples**
Dissolved Manganese	(g/m3)	0.006	0.003	0.003	0.0013	3
Dissolved Organic Carbon	(g/m3)	2.3	2.3	2.3	2.3	1
Dissolved Oxygen Saturation	(%)	136.3	109.6	107.5	91.6	26
Dissolved Potassium	(g/m3)	1	0.7	0.6	0.6	3
Dissolved Reactive Phosphorus	(g/m3)	0.025	0.0053	0.005	<0.001	52
Dissolved Sodium	(g/m3)	5.2	4.6	4.6	4	3
Dissolved Zinc	(g/m3)	-	-	-	-	-
E. coli	(MPN / 100mL)	370	25	10	2	65
Enterococci	(MPN/100mL)	190	44	23.5	5	16
Faecal coliforms	(cfu/100ml)	560	28.2	10	2	65
Fixed Suspended Solids	(g/m3)	9	1	0.5	0.3	31
Fluoride	(g/m3)	0.05	0.05	0.05	0.05	1
Hardness	(g/m3 as CaCO3)	64	57	61.5	41	4
Nitrate-N	(g/m3)	0.45	0.15	0.11	0.005	27
Nitrate-N + Nitrite-N	(g/m3)	0.59	0.20	0.12	0.011	24
Nitrite-N	(g/m3)	0.002	0.002	0.002	0.002	1
Silica	(g/m3)	9.6	8.39	8.25	6.7	10
Sulphate	(g/m3)	5	4.575	4.55	4.2	4

Table C1: Summary of water quality data for the Motueka River at Woodmans Bend Monitoring site						
Parameter	**Unit**	**Maximum**	**Mean**	**Median**	**Minimum**	**Number of Samples**
Total Ammonia	(g/m3)	0.028	0.0065	0.005	0.001	50
Total Manganese	(g/m3)	0.0033	0.0033	0.0033	0.0033	1
Total Nitrogen	(g/m3)	0.944	0.29	0.2	0.06	49
Total Phosphorus	(g/m3)	0.149	0.02	0.009	0.003	49
Total Potassium	(g/m3)	0.75	0.75	0.75	0.75	1
Total Sodium	(g/m3)	5.6	5.6	5.6	5.6	1
Total Suspended Solids	(g/m3)	10	1.56	1	0.3	36
Turbidity	NTU	8.7	1.1	0.7	0.2	65
pH		8.4	8.1	8	8	4

Appendix D: Proposed Peach Island Quarry Groundwater and Clean Fill Management Plan

Peach Island Proposed Quarry: Groundwater and Clean Fill Management Plan

D
R
A
F
T

Prepared for

CJ Industries

14 July 2022

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

Office +64 3 **345 7100**
Website **http://www.pdp.co.nz**
Auckland Tauranga **Hamilton** Wellington
Christchurch Invercargill

Quality Control Sheet

TITLE	Peach Island Proposed Quarry: Groundwater and Clean Fill Management Plan
CLIENT	CJ Industries
VERSION	Draft
ISSUE DATE	14 July 2022
JOB REFERENCE	
SOURCE FILE(S)	C04627800R002_GW_Management_Plan-Final_Draft.docx Click here to enter File Reference.

DOCUMENT CONTRIBUTORS

Prepared by

SIGNATURE

Ryan Nicol

Reviewed and approved by

SIGNATURE

Peter Callander

Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by CJ Industries and others (not directly contracted by PDP for the work), including Tasman District Council. 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 CJ Industries 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.

Table of Contents

Table of Tables

1.0 Introduction and purpose

This report sets out the measures and procedures to manage the excavation of gravel aggregate by CJ industries (the "quarry operator") at their proposed Peach Island quarry site (the "Quarry site") and backfilling of the excavations with clean fill material, as authorised by consent RMXXXXXX.

Exposed groundwater within open excavations is susceptible to contamination. To reduce the risk of contamination, it is important that the gravel extraction pit does not become inundated with groundwater. This will be managed by maintaining at least 1 m of material between base of the working gravel extraction pit and the highest measured groundwater level at the time of the excavation. However, deeper excavations to no less than 0.3 m above groundwater level can occur as long as these deeper excavations are backfilled on the same day as extraction. This means that during periods of low groundwater levels, the pit floor will be at a deeper elevation than during periods of high groundwater levels although a separation of 1 m will always be maintained to avoid exposing groundwater within the pit. All excavations to depths between 1 m and 0.3 m above groundwater level will only occur during dry weather conditions.

Given that the excavation depths will vary depending on groundwater level conditions at the quarry site, it is expected that material used to back fill areas of the quarry excavated during periods of low groundwater levels will become inundated by groundwater during periods of high groundwater levels. Therefore, it is important that suitable controls are placed on the material being used to back fill the excavation pits to avoid contamination of shallow groundwater. Furthermore, procedures and mitigation measures are also required to reduce the risk of accidental discharges within the excavation pit (i.e., spills, etc.) as well as mitigation measures that will be implemented should any changes in groundwater quality occur as a result of the quarrying activities.

2.0 Consent compliance and key performance indicators

The overall purpose of the groundwater and clean fill management plan is to ensure that the Quarry site will be managed to comply with consent conditions related to the quarrying activities and discharge of contaminants to land, specifically in respect achieving groundwater quality outcomes. The relevant performance indicators to ensure that the site activities are managed are:

- Ensuring that excavations do not expose groundwater in excavations.
- Ensuring that all backfill material is strictly managed to ensure it meets the definition of 'clean fill' under WasteMINZ guidelines.

- Minimise any change to the physical and chemical properties of groundwater as result of the land use and discharge activities associated with quarry activities (as defined by the trigger levels in Table 2).
- Ensuring that under no circumstances that the land use and discharge activities associated with quarry activities result in groundwater quality exceeding the acceptable values in the Drinking Water Standards for New Zealand.

The following sections of this report detail the procedures and mitigation measures to achieve these outcomes.

3.0 Clean fill materials

The WasteMINZ document Technical Guidelines for Disposal to Land (2018) (WasteMINZ) define differing Classes of landfill and the technical constraints (i.e., hydrogeology, hydrology, ecology, etc.) on the Class of landfill considered acceptable for a particular location. The key hydrogeological technical constraint for the siting of different Classes of landfill is whether the underlying aquifer system beneath the proposed landfill is used for drinking-water purposes. Only Class 5 landfills are allowed to be sited over aquifers used for drinking-water purposes. Therefore, since the shallow groundwater aquifer system in the Peach Island area is used for drinking-water supply purposes, the proposed Peach Island Quarry is therefore defined as a Class 5 landfill.

WasteMINZ provides guidance on material that should be used to backfill a Class 5 landfill. To meet the requirements of the WasteMINZ guidelines and to provide protection of shallow groundwater resources in the area, only the following classes of material will be acceptable for placement at the Quarry site (Table 1).

Table 1: Summary of acceptable clean fill material

Material	Discussion
Natural materials sourced onsite.	• Uncontaminated soil, clay, rock and gravel. • Quarry overburden comprising sand, clay and other soils (but specifically excluding peats, loams, topsoils and other soils with high organic content). • Other inert natural materials arising from quarry operations provided that the volume of biodegradable matter (i.e., vegetative matter)

Table 1: Summary of acceptable clean fill material

Material	Discussion
	in any material buried shall not exceed 2% by volume per load and is limited to incidental organic matter associated with the excavation of the inert natural materials.
Natural materials sourced offsite	Uncontaminated, natural materials arising from construction/excavation operations at uncontaminated sites and other quarry operations but specifically excluding any material sourced from any site listed on the Tasman District Council Hazardous Activities and Industries List (HAIL) register (as defined by the Ministry for the Environment) that is known to have been occurring before the date the clean fill material is received. This includes the following materials: ⁘ Rock, stone, gravels, soils, and other inorganic inert natural. ⁘ Overburden/construction/excavation material comprising sand, clay and other soils (but specifically excluding peats, loams, topsoils and other soils with high organic content). ⁘ Other inert natural materials provided that the volume of biodegradable matter (i.e., vegetative matter) in any material buried shall not exceed 2% by volume per load and is limited to incidental organic matter associated with the excavation of the inert natural materials. Imported fill material will only be accepted if total soil contaminant concentrations are below regional soil background concentration limits.

All other materials of any description will be considered as unacceptable for placement unless written permission is obtained from the Regulatory and Compliance Manager at the Tasman District Council. Any permission shall not create a precedent, shall be made on a case-by-case basis and shall be restricted to the site of origin.

Furthermore, any material, that is understood to comply with the Table 1 definition, but displays visual or olfactory evidence of contamination, will either be set aside for chemical testing or rejected.

4.0 Proposed clean fill management system

Any excavation below the depth of the highest groundwater level shall occur when there is sufficient backfill material that is available to rapidly backfill the excavation up to the highest groundwater level prior to a rise in groundwater levels occurring. This is an important requirement to ensure that groundwater is not exposed in the quarry floor.

4.1 Receipt

All imported material received that is to be used for clean fill at the Quarry site shall be documented. This record keeping shall include:

- The date of receipt of the clean fill.
- The name of the CJ Industries staff member that delivered the clean fill to the site.
- The source of the clean fill.
- A description of the clean fill.
- The approximate quantity of the clean fill.
- Any documentation supplied to support the definitions of 'clean fill' (laboratory reports or similar).
- The name, signature, and staff designation of the person that accepted the fill on behalf of the quarry site.

CJ Industries will be the only organisation that delivers and places backfill into the Peach Island Quarry and that clean fill will meet the acceptance criteria specified in Section 3.0. This imported fill will be inspected and graded off site before delivered to the Peach Island Quarry solely by CJ Industries, except during civil emergencies when grading and inspection may occur on site.

Fill material provided by an external contractor will not be accepted by CJ Industries unless the acceptance criteria provided in Section 3.0 is met, the information listed above is provided and the contractor has signed a formal agreement confirming that the deposited clean fill will meet the acceptance criteria specified above. In these circumstances, the material will still be placed in the pit by CJ Industries.

4.2 Inspection and testing of imported clean fill

The following procedures will be followed when material arrives at the quarry site:

1) Any imported clean fill requiring independent environmental investigation undertaken or supervised by a suitably qualified and experienced practitioner and laboratory test, as specified in Section 3.0, will require the documentation from that independent investigation be provided to the quarry operator and will only be allowed on site if the information confirms it is acceptable.

2) All imported clean fill that is visibly wet, has the appearance of mud, or that does not readily break apart due to the presence of moisture will be laid aside and not inspected until dry.

3) Any clean fill material displaying any visual or olfactory evidence of contamination (i.e. manmade hardfill, visible staining, odours, etc) will either be set aside for chemical testing or rejected.

4) Imported clean fill that has previously been subjected to chemical analysis prior to transport to the site and found to comply with the relevant criteria in Section 3.0 will be released for placement.

5) Random chemical testing will be carried out on imported clean fill from 1 truck in every 50 truckloads of fill as per the test requirements for material as specified in Section 3.0.

4.3 Placement of imported clean fill

6) A working excavation pit depth of no less than 1 m above groundwater level will be maintained.

7) Deeper excavations to no less than 0.3 m above groundwater level at the time of the excavation during dry conditions can be undertaken but must be backfilled with clean fill material on the same day as extraction.

8) All excavations to depths between 1 m and 0.3 m above groundwater level shall occur during dry weather conditions.

5.0 Groundwater level monitoring and excavation controls

In addition to ensuring all fill placed in the excavation pits is clean and uncontaminated, a key concern of the quarry operations at the Quarry site is exposure of groundwater within the excavation pit prior to being backfilled with clean fill material. To reduce the risk of groundwater contamination, excavation of gravel aggregate at the Quarry site will not occur within groundwater or result in the exposure of groundwater at the surface (i.e., groundwater exposed in the bottom of the gravel extraction pit). Therefore, groundwater level monitoring

combined with surveying of pit excavations will be continuously monitored to avoid exposure of groundwater in any excavation(s). To achieve this, the following controls will be implemented:

Groundwater Level Monitoring

9) Groundwater levels shall be monitored in two dedicated upgradient monitoring bores located at the southern extent of the site and two dedicated downgradient monitoring bores located at the northern extent of the site.

10) All groundwater level measurements:

    a. Shall be measured to a local common relative level to the nearest 3 mm accuracy (i.e., Nelson vertical datum 1955 or similar).

    b. Shall be recorded via a temper-proof electronic recording device such as a data logger(s) that shall record groundwater levels taken every 15 minutes.

11) The groundwater level recording device:

    c. Shall be connected to a telemetry system that collects and stores all of the data continuously with an independent network provider. No data shall be deliberately changed or deleted.

    d. Shall be accessible to Tasman District Council at all times for inspection and/or data retrieval.

12) All groundwater level measurement data will be used to inform daily excavation depths (outlined in item 14)).

Excavation Controls

13) Commencement of quarrying shall occur at locations at the greatest upgradient distance from any water supply bores, as far as can practicably be achieved.

14) All onsite machinery used for excavation of pit(s) shall be equipped with onboard GPS and elevation systems capable of determining the elevation of the digging implement (i.e., excavator bucket).

15) The onboard GPS and elevation systems shall record elevation measurements to a local common relative level (as per item 10)a).

16) Excavations shall be maintained at a working depth of 1 m above the highest groundwater level measured in the onsite monitoring bores as described in items 10) and 11) on the same day as the active excavation of pit(s).

17) Deeper excavations to no less than 0.3 m above groundwater level at the time of the excavation can occur but must be backfilled with clean fill material on the same day as extraction.

18) During pit excavation, should the difference between the highest groundwater level at the quarry and the depth the excavation be less than 0.3 m, a warning system will notify the machinery operator and the Quarry operator.

19) Should groundwater levels be observed to increase while excavation is ongoing at the quarry and/or significant weather changes are forecast that could result in rapid increases in groundwater levels, suitable clean fill material should be placed as soon as practicably to back fill the excavated pit to ensure at least 1 m of material between the highest groundwater level and the base of the excavated pit is retained.

20) If any groundwater emerges into the excavation pit(s) all excavation activities will cease. All machinery will be moved away from the area of exposed water and no machinery will operate in exposed groundwater. Placement of natural strata (i.e., uncontaminated gravels, sands or silts) can occur to fill in the exposed water if required.

21) The Quarry operator will notify their consent compliance monitoring officer at Tasman District Council if groundwater enters the excavation pit area.

22) The following activities will not occur in any excavation pits at the quarry:

    a. no storage of fuel or hazardous substances.
    b. no refuelling activities.
    c. no parking of unattended vehicles or machinery.

23) No excavations shall occur within 20 m of flowing, open waterways.

6.0 Response and mitigation to a spill

24) Staff operating in the excavation pit area(s) will be trained in the appropriate way to respond to a spill. A spill kit will be available in the excavation pit area(s).

25) In the event of a spill of machinery oil or fuel from excavation machinery, all works shall cease and measures will be taken to limit the extent of the spill and any contaminated strata or spill response material will be excavated and removed from the site to be disposed of at an appropriate disposal facility (subject to approval of the disposal facility).

26) If any spill greater than 20 litres occurs, the site operator will immediately notify the Tasman District Council Pollution Incident contact number.

7.0 Groundwater quality monitoring

The following monitoring of groundwater will be undertaken in relation to the excavation of pits:

27) Collection of groundwater samples from at least one dedicated monitoring bore located upgradient at the southern extent of the quarry areas (representative of background water quality) and at least two dedicated bores located downgradient of the quarry site near the northern extent of the quarry.

28) The monitoring bores shall allow groundwater samples to be collected across the full the range of groundwater level fluctuations.

29) The monitoring bores shall be made accessible to the Tasman District Council at all times for the purpose of groundwater sampling.

30) Groundwater samples from the dedicated monitoring bores listed in 27) will be collected at three monthly intervals. At least two samples will be collected prior to the commencement of quarrying activities and sampling will continue until two years after quarrying and backfilling activities cease.

31) All samples shall be taken by a suitably qualified and experienced person using methods described in the NEMS document "Water Quality – Part 1 of 4: Sampling. Measuring, Processing and Archiving of discrete Groundwater Quality Data" (2019). All samples for dissolved metal analysis must be filtered through a 0.45-micron filter onsite before being placed into an acid preserved sampling bottle.

    All samples must analysed for the contaminants listed in Table 2 by an accredited laboratory.

    The water quality monitoring results shall be provided to the Tasman District Council: Attention – Monitoring and Compliance within one month of them being received.

Table 2: Water quality parameters and trigger concentrations

Parameter	Trigger concentration	Note
Depth to water level	-	Measured prior to purging (where possible)
pH	<7.0 or >8.5	field and laboratory measurement
Electrical Conductivity	-	field and laboratory measurement
Water temperature	-	field measurement
Calcium	-	
Magnesium	-	
Hardness	200 g/m³	Calcium + magnesium
Alkalinity	100 g/m³	As CaCO3
E. coli	1 MPN/100ml	NZDWS MAV
Ammoniacal-N	1.2 g/m³	
Nitrate-N	5.65 g/m³ (annual average) 11.3 g/m³ (maximum)	
Dissolved Aluminium	0.1 g/m³	
Dissolved Arsenic	0.005 g/m³	
Dissolved Cadmium	0.002 g/m³	
Dissolved Chromium	0.025 g/m³	
Dissolved Copper	1 g/m³	
Dissolved Lead	0.005 g/m³	
Dissolved Nickel	0.04 g/m³	
Dissolved Manganese	0.04 g/m³	
Dissolved Iron	0.3 g/m³	
Sodium	200 g/m³	
Sulphate	250 g/m³	
Chloride	250 g/m³	
BTEX compounds	Any detectable presence	

Table 2: Water quality parameters and trigger concentrations		
Parameter	**Trigger concentration**	**Note**
Total Petroleum Hydrocarbons	Any detection >0.1 g/m³	
NOTE: Trigger values are the guideline values for aesthetic determinands or 50% of maximum acceptable values in the Water Services (Drinking Water Standards for New Zealand) Regulations 2022 which take effect on 14 November 2022.		

The trigger levels provided in Table 2 can be amended subject to written approval from Tasman District Council.

7.1 Response to issues arising from groundwater quality monitoring

32) An exceedance of the trigger levels will be deemed to have occurred if:

a. The concentration of a contaminant in at least one of the downgradient bores exceeds the trigger levels in Table 2 and the concentration of the same contaminant in the upgradient bore is below the Table 2 trigger levels; or

b. The concentration of a contaminant in the upgradient bore exceeds the trigger levels in Table 2 and the concentration of the same contaminant in at least one of the downgradient bores is greater than concentration in the upgradient bore and is greater than 20% of the Table 2 trigger levels.

33) If there is an exceedance in a downgradient bore as determined by 32), the consent holder shall as soon as practicable and within 72 hours of receiving that result:

a. Obtain a second sample of groundwater from the bore(s) in which the exceedance was identified in accordance with 27).

b. (b) Obtain a sample of groundwater from the upgradient bore specified in 27).

c. (c) Analyse these samples in accordance with 31).

34) If the results of analysis of the second groundwater samples carried out in accordance with 33) show that none of the concentrations of contaminants analysed exceed the trigger concentrations in Table 2 determined by 32), the consent holder shall continue to sample groundwater in accordance with 30).

35) If the results of analysis of the second groundwater samples carried out in accordance with Condition 33) show an exceedance of the trigger concentrations in Table 2 as determined by 32), the Consent Holder shall:

a. Notify the Tasman District Council – Monitoring and Compliance.

b. Undertake an investigation into the potential cause(s) of the exceedance, which may include undertaking additional monitoring beyond the routine sampling.

c. Implement necessary measures to reduce the concentration of the contaminant in groundwater. Such measures may include:

   i. cessation of activities that may have caused the exceedance.

   ii. removal of the contaminant source(s).

   iii. stabilisation or capping of the contaminant source(s).

   iv. revision of groundwater and clean fill management procedures and updating it accordingly.

36) Any material removed in accordance with 35)c)(ii) shall be disposed of at a facility authorised to receive such material, and the Consent Holder shall provide the Council, Attention: Regional Leader – Monitoring and Compliance, with written confirmation of such disposal within 10 working days.

7.2 Downgradient water supply bores

37) Groundwater samples shall also be collected from up to three downgradient water supply bores within 500 m of the quarry, subject to approval of the bore owner and the land owner.

38) Prior to the use of any of the water supply bores for groundwater monitoring, a bore condition survey should be carried out to identify any existing potential sources of contamination related to the condition of the bore head or its proximity to localised sources of contamination.

39) The Consent Holder shall monitor the drinking water quality of the water supply bores in 37) at the same time as the dedicated monitoring bores in 27). If the monitoring shows that the drinking water quality in the water supply bores in 37) does not comply with the New Zealand Drinking Water Standards (NZDWS) and the non-compliance is proven to be associated with quarrying activities, then the consent holder shall, with agreement of the bore owner and the land owner, provide an alternative drinking water supply to a similar standard as existed prior to commencement of this consent.

7.3 Water quality complaints

40) The quarry operator shall also maintain a complaints register and investigate any complaint of bad taste, odour or illness reported in downgradient bores used for water supply purposes within 500 m of the quarry. These complaints shall be investigated and recorded, including:

a. The location where the complaint was experienced.

b. The date and time when the complaint was experienced.

c. A description of the excavating and filling activities that were being undertaken prior to the complaint being experienced.

d. The most likely cause of the complaint.

e. Any corrective actions undertaken by the consent holder to avoid, remedy, or mitigate any contribution the quarrying activities are likely to have made to the situation that caused the complaint.

A complaint to a quarry shall be investigated jointly depending on the quarry area affected. This record shall be provided to the Manager, RMA Compliance and Enforcement, Tasman District Council following any investigation into a complaint.

8.0 Reporting

41) An annual monitoring report will be prepared for the period of 1 July to 30 June to the Tasman District Council: Attention – Monitoring and Compliance, by 30 September each year. The annual monitoring report shall include but not be limited to:

a. Results of groundwater quality monitoring as required by 27) to 39) and include:

i. A discussion of any groundwater quality trends.

ii. Any exceedances of the Table 2 contaminant trigger concentrations.

iii. Any mitigation actions taken in response to the exceedances.

iv. A description of how effective any mitigation actions were in addressing the exceedances.

v. A description of the drinking water quality results from bores used for domestic supply/irrigation purposes located downgradient of the quarry.

b. Groundwater level data including:

i. A copy of the telemetered groundwater level data measured at the site.

ii. A copy of the excavation elevation data.

9.0 References

Ministry of Health (MoH). 2018. Drinking-water Standards for New Zealand 2005 (Revised 2018). Wellington: Ministry of Health.

National Environmental Monitoring Standards (NEMS). 2019. Water Quality – Part 1 of 4: Sampling, Measuring, Processing and Archiving of Discrete Groundwater Data. Version 1.0.0. March 2019

Taumata Arowai. 2022. Water Services (Drinking Water Standards for New Zealand) Regulations 2022. June 2022. Taking effect on 14 November 2022.

Waste Management Institute New Zealand (WasteMINZ). 2018. Technical Guidelines for Disposal to Land. April 2018.