MWH

BUILDING A BETTER WORLD

Wellington Regional Council
10 JUL 2009

REPORT

Proposed Gravel Extraction and Cleanfill Operation

Effects on Water Resources

Prepared for Wairarapa Aggregates Ltd

JULY 2009

WAIRARAPA AGGREGATES LTD

Proposed Gravel Extraction and Cleanfill Operation Effects on Water Resources

CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 Introduction

In 2008 Wairarapa Aggregates Ltd submitted a Resource Consent Application to Greater Wellington Regional Council (GWRC) for a stormwater discharge permit for proposed gravel extraction and cleanfill operation at a site adjacent to Waingawa Swamp wetlands in the Wairarapa Region. An application was also made to Carterton District Council (CDC) for land use consents.

The exact location and proposed operation details are contained in the resource consent application and AEE documents submitted to GWRC and CDC by MWH in May 2008. The site referred to in this report is the application site, and it does not encompass the whole of the land title.

Figure 3-1 details the proposed site and surrounding hydrological features.

The proposed site is immediately on the up-thrown side of the Masterton fault. At the base of the fault is a set of wetland areas referred to as the Waingawa Wetlands (Boffa Miskell, 2008). The main wetland area, referred to here as the Western Wetland, is largely protected by a QEII covenant.

An existing disused quarry occupies a small portion of the proposed site. This area has been excavated down to approximately 124m RL[1]. This is a similar level to which the proposed quarry operation will reach.

This report provides as overview of the hydrology of the area and any potential adverse effects on the wetlands as a results of the proposed operation.

2 Site Visit

MWH staff carried out two site visits in relation to observing the water resources of the proposed quarry site and surrounds.

The depth of the groundwater at two bores at the proposed quarry site along with a GWRC monitored bore on a neighbouring property were measured on 2 June 2009. A visual inspection of the proposed quarry site was carried out to identify groundwater springs sourced from the proposed quarry area and along the fault scarp. The hydrological interactions of the area were noted.

A second site visit was carried out on 23 June 2009 and groundwater levels were measured again.

3 Hydrological Setting

Figure 3-1 details the hydrological features relevant to the proposed operation site.

The main hydrological feature of the surrounding area is the Waingawa Wetlands (sometimes referred to as the Waingawa Swamp) filling a depression at the base of the Masterton fault to the east and south-east of the proposed site. The wetlands are likely to have formed as part of the uplift of the Masterton fault. Water levels in the wetlands are maintained largely by discharge from a water race stored in an artificial lake. Groundwater spring inflow from the base of the fault escarpment and surface runoff from the existing disused quarry also contribute flow to the wetland system but these are considered to be relatively minor components of inflow.

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[1] *Reduced Level (RL) measured in terms of mean sea level, Wellington Vertical Datum 1953*

Figure 3-1: Proposed Site - Overview and Hydrological Features

Because the wetlands are at a lower elevation to the proposed quarry site it is likely that groundwater contributes to surface water in the wetlands during wetter months.

The wetlands have been modified by previous and current landuse, earthworks (fill and excavation), roading and activities associated with the former Waingawa Freezing Works. A hydrological and ecological assessment of the wetlands by Boffa Miskell (2008) divides the system into three distinct parts (Figure 3-1):

- Eastern Wetland
- Central Wetland
- Western Wetland

The wetland areas are described in further detail below.

No natural surface water features flow through the proposed site. A small area of the site (approximately 10%) is a disused quarry excavation and runoff from this area is currently drained by a man-made water course that ultimately enters the Central Wetland. Evidence suggests shallow groundwater levels can enter and pond in the disused quarry area for periods of time when groundwater levels are high in the winter/spring months. The existing disused quarry has been excavated to a level of 124m RL.

A water race flows along the north-eastern boundary of the proposed site that feeds the wetland system via a man made artificial storage lake (Figure 3-1). The water race has been diverted to flow to the artificial lake and it is at a level that is above the majority of the proposed site.

The artificial lake is raised about 2 metres above the surrounding adjoining Eastern Wetland and is about 4 metres higher than the Western Wetland. Water is discharged from the lake by a series of channels. A small amount of flow goes to the adjoining Eastern Wetland, another small portion of flow goes to the Central Wetland, while the majority of the flow goes to a water race (most likely a continuation of the diverted water race that enters the lake) and initially heads north-east and then travels around the perimeter of the Kiwi Lumber property, under Waingawa Rd, and down alongside Norman Ave towards SH2.

Flow leaves the wetland system via the Waingawa Stream (named as this by Boffa Miskell, 2008). The discharge point is the Western Wetland and the stream is a tributary of the Parkvale Stream.

The in-situ ground material of gravels, sand and silt provides excellent subsurface drainage characteristics and there is little runoff from rainfall events.

Eastern Wetland

The Eastern Wetland is a small area of wetland separated from the Central Wetland by the substantial amounts of fill and the raised artificial lake. The wetland is fed only by a portion of the discharge from the lake so is sensitive to any change to this. It is subject to heavy cattle grazing (Boffa Miskell, 2008).

Central Wetland

The Central Wetland has in the past been infilled with sludge and other material. The man made drainage channel from the existing disused quarry flows into the Central Wetland carrying surface water runoff (untreated) and any groundwater inflow/ponding to the old quarry site. Spring flow from the base of the escarpment also enters the lower parts of this channel. Flow into the Central Wetland is also derived from the small discharge from the artificial lake.

The wetland is not connected to the Eastern Wetland, but is connected to the Western Wetland under the existing roadway.

Western Wetland

The Western Wetland is the most ecologically valuable part of the Waingawa Wetlands (Boffa Miskell, 2008). It is also the largest covering an area of 10.6ha, of which 9.59ha is protected by QEII covenant (across two titles). Cattle graze and congregate in the wetland. Infilling and waste disposal has shrunk the size of the wetland over time with Boffa Miskell (2008) stating "anecdotal evidence suggests it may contain contaminated material associated with the former Waingawa Freezing Works".

The potentially contaminated fill is over 150m away from the closest point of the proposed quarry site.

Inflow to the Western Wetland is via connectivity with the Central Wetland. Therefore, the discharge from the artificial lake is the major source, with minor contributions from any spring flow or surface runoff from the existing disused quarry site.

3.1 Groundwater

GWRC (2008b) describe the area of the proposed site as poorly sorted sands and gravels with a high percentage of silts and clays. An unconfined aquifer exists to a depth of 25m but due to the presence of silts and clays the hydraulic conductivity is low. Rainfall is the main source of recharge.

Three on-site groundwater monitoring wells were constructed during 2008. Bore logs for these three bores are contained in Appendix A.

Water level measurements were conducted by MWH staff on the 2nd and 23rd June 2009. The groundwater levels measured at the two bores are given in Table 3-1. Static water levels taken during drilling of the bores are also included.

GWRC have made available groundwater level data for a neighbouring bore S26/0299 (See Appendix A). Quarterly groundwater levels have been measured since 1997/1998. Because of the good groundwater record, similar elevation and proximity to the site, bore S26/0299 was also measured during the 2 June 2009 site visit. The measured groundwater level is also presented in Table 3-1. The locations of the three bores are shown on Figure 3-1 and Figure 3-2.

Table 3-1: Depth to Groundwater (metres below ground level – m bgl)

	Borehole			
	BH1	**BH2**	**BH3**	**S26/0299**
2 June 2009	NA	3.72	2.55	3.33
23 June 2009	2.9	3.68	NA	NA
24-27 November 2008	4.0	4.2	4.7	NA

The groundwater levels are measured in metres below ground level (m bgl)

Readings at BH2 were very similar for the two days measured.

The difference between the groundwater level observed at Bore S26/0299 and the level obtained from BH2 on 2 June 2009 is used to estimate the winter/spring groundwater levels at the proposed quarry site using two methods. BH3 lies on a lower elevation part of the proposed site so BH2 is preferred for applicability to the overall site.

A difference of 0.4m was observed between groundwater levels at BH2 and S26/0299.

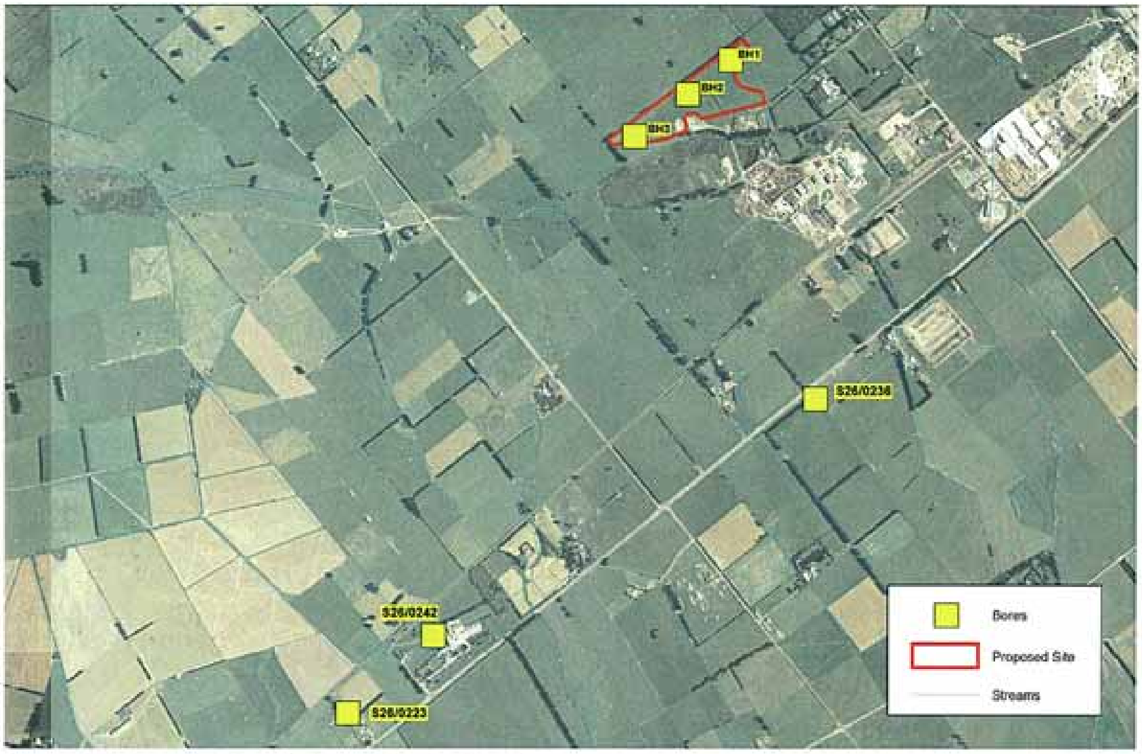


Figure 3-2: Nearby Groundwater Monitoring Sites

3.1.1 Method 1 to Derive At-site Groundwater Levels

The measured difference of 0.4m is applied to the measured winter/spring groundwater levels at bore S26/0299 to derive corresponding groundwater levels at BH2. The groundwater data supplied by GWRC for S26/0299 are measured from the top of the bore casing, so to be consistent with measurements presented here for the proposed site a margin of 0.25m (as measured by MWH) is subtracted to convert them to 'below ground level'.

The resulting winter/spring groundwater levels at BH2 are shown in Figure 3-3.

Based on this analysis, groundwater levels at BH2 can be expected to range between 3.18m bgl and 4.71m bgl, with a winter/spring mean level of 4.01m bgl.

Applying these results, the groundwater levels measured by MWH staff on 2nd and 23rd June 2009 were higher than the winter/spring mean by 0.29m and 0.33m respectively.

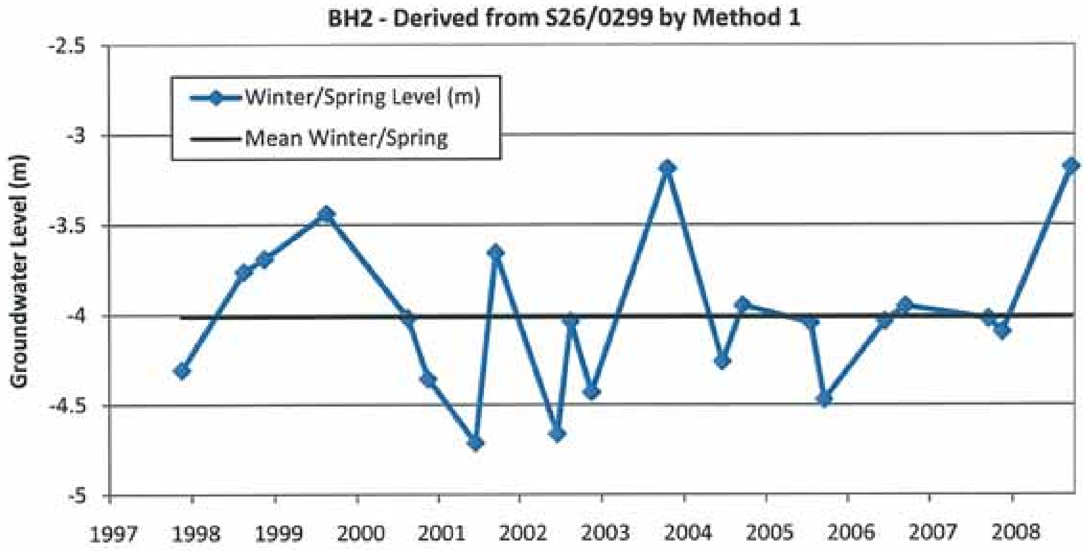


Figure 3-3: Method 1 Derived Winter/Spring Groundwater Levels (m bgl) at BH2

3.1.2 Method 2 to Derive At-site Groundwater Levels

As the data record for S26/0299 is relatively sparse, a long term record for this site has been derived by correlating its measured groundwater levels with the corresponding levels at the nearby long term monitoring bore S26/0242. Figure 3-2 shows the location of S26/0242. It is in the same groundwater zone as both S26/0299 and the proposed site so can be expected to behave similarly.

Groundwater level data is available at S26/0242 between 1983 and 2009 at approximately four weekly intervals. This data is processed through the TIDEDA software (hydrological analysis and database tool) to interpolate between the actual measured data.

Measured water levels at S26/0299 have been correlated with the corresponding water level at S26/0242 as shown on Figure 3-4. The resulting linear regression equation to transform S26/0242 data to S26/0299 (in metres) is:

$$S26/0299 = (0.2092 \times S26/0242) - 25.844$$

The S26/0242 dataset is transformed through this equation to produce a long term dataset for S26/0299.

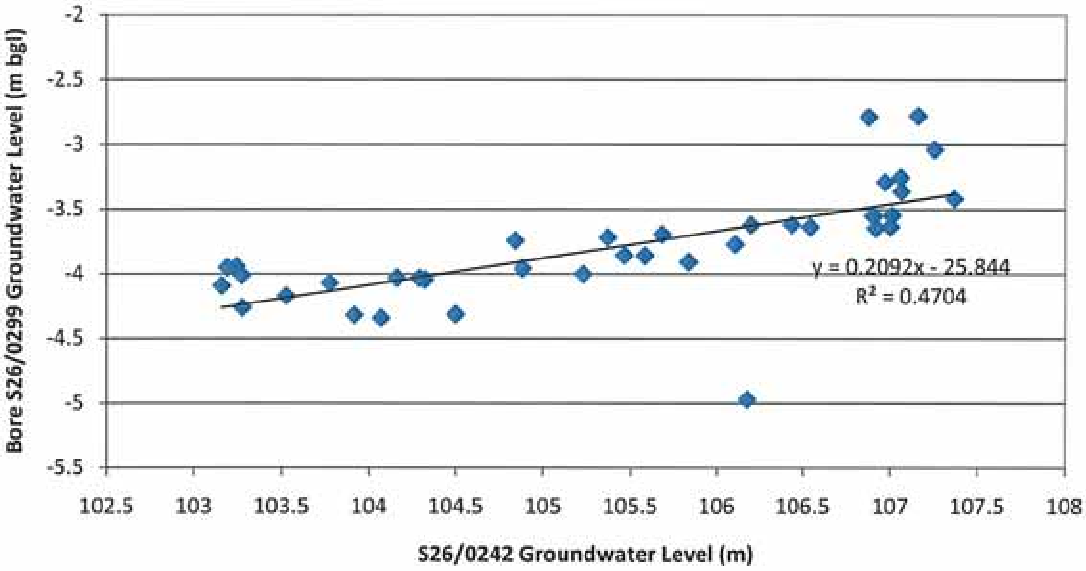


Figure 3-4: Correlation between S26/0299 and S26/0242 Groundwater Levels

As previously, a difference of 0.4m is applied to the derived S26/0299 data to estimate groundwater levels at BH2 at the proposed quarry site. Figure 3-5 shows the derived long term winter/spring groundwater levels at BH2 in the proposed quarry site.

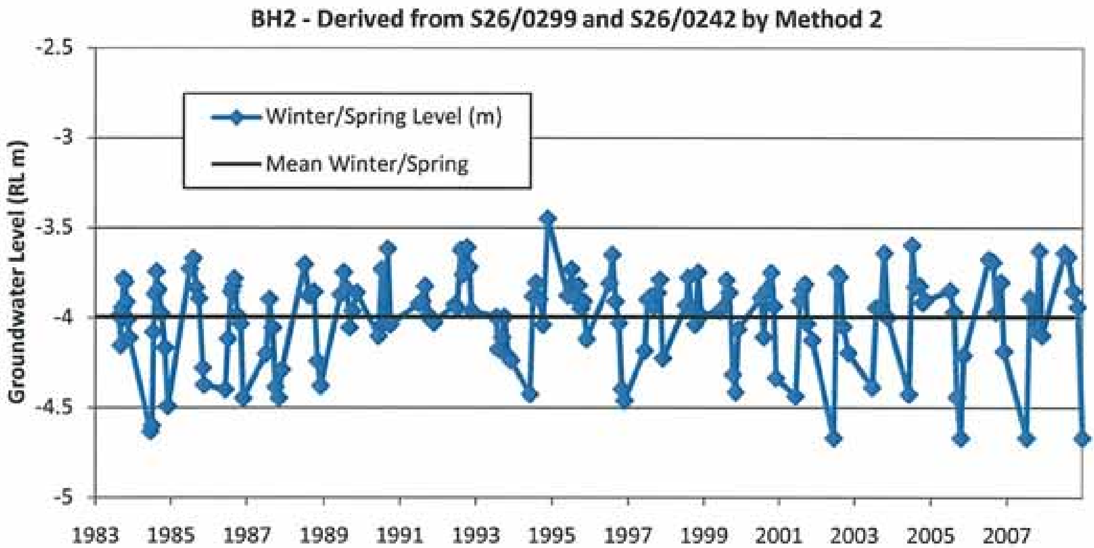


Figure 3-5: Method 2 Derived Winter/Spring Groundwater Levels (m bgl) at BH2

The resulting data for the winter/spring months gives the maximum groundwater level as 3.45m bgl and the minimum as 4.67m bgl. The mean winter/spring groundwater level is estimated at 4.03m bgl.

3.1.3 Groundwater Summary

Table 3-2 summarise the winter/spring groundwater levels derived for BH2 at the proposed site.

Table 3-2: Estimated Winter/Spring Groundwater Levels at BH2

	Method 1	Method 2	Average
Minimum	3.40	3.45	3.43
Maximum	4.79	4.67	4.73
Mean	4.09	4.03	4.06

The three monitoring bores have not been levelled in by survey. The contour plan (contained in the Resource Consent Application) shows BH2 to be at an elevation of approximately 128.2m RL. Applying the mean winter/spring groundwater level of 4.06m bgl gives an estimated level of 124.22m RL for the mean winter/spring groundwater level at the site.

The existing disused quarry has been excavated to approximately 124m RL and groundwater inflow is observed there during the winter and spring months when groundwater levels are high, particularly after substantial rainfall. Ponding of groundwater inflow was observed on both site visits (2^{nd} and 23^{rd} June 2009) when the measured level at BH2 was 3.72m bgl and 3.68m bgl, above the estimated mean by 0.34m 0.38m respectively.

It has to be noted that the analyses presented here are based on only one corresponding measurement of groundwater levels between BH2 and the nearby bore S26/0299. Further concurrent groundwater level measurement of at least one bore at the proposed site with nearby monitoring bores is required to provide greater confidence in the results.

The proposed excavation is to be no closer than 0.5m to the mean winter/spring groundwater level. This equates to an elevation of 124.7m at the BH2 monitoring bore location.

3.2 Visual Inspection

During the visual inspection it appeared that the majority of water feeding the wetlands was from surface water sources. A small water race runs along the eastern verge of the proposed quarry site feeding an artificial lake situated between the Eastern and Central wetlands. The water race source is the Waingawa River. It is noted that the race is beyond the eastern boundary of the proposed quarry excavations.

As detailed by Boffa Miskell (2008) the site visit confirmed that the artificial lake has small outlets which feed the Eastern and Central wetlands and a main outlet that discharges to the continuation of the water race which subsequently circumvents the edge of the Kiwi Lumber site and flows towards SH2.

The waterway that drains from the existing disused quarry to the Central Wetland comes from two sources; surface water collected in the part of the site that has been excavated, and a spring coming from beneath an area of the excavation outside the site that has been filled. It is likely the spring is a result of groundwater and surface water that has percolated to the base of the less permeable fill and is draining westwards following the slope at the base of the fill. No other groundwater springs were observed.

The topography of the area with the exception of the fault scarp is reasonably flat indicating a low groundwater velocity. A slow groundwater velocity along with the distance of the proposed quarry excavations from the wetlands would significantly reduce movement of suspended solids within the groundwater system to the wetlands. Therefore excavations at the site above the groundwater level should not cause any adverse effects to the wetlands via a groundwater pathway.

3.3 Hydrological Summary

Figure 3-1 details the hydrological components of the area around the proposed site. The Waingawa Wetlands are the significant hydrological (and ecological) feature, with the Western Wetland being protected under QEII covenant.

The major source of inflow to the wetland system is from a water race to the north that runs along the boundary of the proposed site and enters an artificial storage lake. This lake is raised above the wetland and contributes flow directly to the Eastern and Central wetlands, and indirectly to the Western Wetland (through connectivity with the Central Wetland). The majority of the flow discharges from the lake to a water race that flows towards SH2.

Surface runoff and spring flow contribute relatively minor inflow components to the Central and Western wetlands.

The contribution of the water race and artificial lake to the Waingawa Wetlands is essential to its hydrological and ecological health.

4 Potential Adverse Effects

A number of potential effects of the proposed operation on the Waingawa Wetlands are:

- The potential of sediment laden surface water runoff from the site entering the wetland system and compromising water quality and introducing sediment
- The potential for the proposed quarry operation to impact on groundwater flow and adversely impact the spring water fed inflow component of the wetland system.
- Movement of suspended solids in groundwater from the proposed site to the wetland system

Runoff from the proposed site is to be collected and diverted to a number of constructed sediment control pond (refer to Quarry Management Plan). The existing man-made watercourse draining the existing disused quarry area will be diverted from its current course where it discharges directly to the Central Wetland to be channelled into the sediment control pond.

The proposed operation will contain runoff of sediment from the site as per the GWRC *Erosion and Sediment Control Guidelines for the Wellington Region* (2002). Up to three sediment control ponds will treat runoff from the quarry area which will ultimately discharge under the existing access road and into the Central Wetland.

Currently, runoff from the existing disused quarry enters the wetlands untreated. The proposed operation will provide improved runoff quality to the wetlands by eliminating the existing untreated direct discharge to the wetlands and replacing it with treated discharge. The input of the water race and artificial lake to the wetland system remains unchanged. The existing spring fed source will also remain unchanged and will still enter the wetland system as it does now.

Currently untreated sediment laden runoff from the existing disused quarry can reach the wetland system. The proposed quarry operation, although larger than the existing quarry, will treat all runoff through sediment control structures and an improvement in the quality of water passed to the wetland system can be expected from the site.

Given the occurrence of groundwater inflow and ponding to the existing disused quarry excavation during times of high rainfall, it is expected this will occur for the proposed operation as well. The proposal states that quarry operation will not excavate to within 0.5m of the mean winter groundwater level.

Guidance on groundwater levels at the site has been presented here (Section 3.1). The estimated mean winter/spring groundwater level is 124.2m RL. A margin of 0.5m on top of this gives a maximum quarry depth down to 124.7m RL in the vicinity of the BH2 borehole. Further monitoring of groundwater levels at site will provide greater confidence in this estimate.

The topography of the area with the exception of the fault scarp is reasonably flat indicating a low groundwater velocity which would significantly reduce movement of suspended solids within the groundwater system towards the wetlands. The hydraulic conductivity of the area is expected to be low (GWRC, 2008b). Excavations at the proposed site above the groundwater level should not cause any adverse effects to the wetlands via a groundwater pathway.

5 Conclusions and Recommendations

No surface water bodies flow through the proposed site. A man-made channel currently drains runoff from the existing disused quarry site and runoff from a spring originating from an area of fill in the previous excavation outside the current application site.

The proposed site is immediately on the up-thrown side of the Masterton fault. At the base of the fault is a set of wetland areas referred to as the Waingawa Wetlands. The main wetland area (the Western Wetland) is largely protected by a QEII covenant.

The major source of inflow to the wetland system is from a water race to the north that runs along the north-eastern boundary of the proposed site and enters an artificial storage lake. This lake is raised above the wetland system and contributes flow directly to the Eastern and Central wetlands and subsequently the Western Wetland.

The surface runoff and spring flow sourced from the proposed site contribute relatively minor inflow components to the Central and Western wetlands, and make no contribution to the Eastern Wetland.

The proposed quarry and cleanfill operation will intercept all runoff from the site (most of which currently drains directly to the Central and Western wetlands) and divert it into sediment control ponds designed to GWRC (2002) guidelines. Treated discharge will then continue to the Central and Western wetlands.

The collection and treatment of surface runoff, coupled with the likely low groundwater velocity and hydraulic conductivity, ensures no contaminants are expected to reach the Waingawa Wetland system. This of course relies on good management of the sediment control devices as detailed in the Quarry Management Plan.

The contribution of the water race and artificial lake to the Waingawa Wetlands is essential to its hydrological and ecological health and will be maintained in its current state.

Mean winter/spring groundwater levels at the BH2 monitoring bore within the proposed site are estimated at 124.2m RL. The existing disused quarry is excavated to approximately 124m RL and experiences groundwater inflow for periods during the winter and spring months.

Basic analysis and interpretation of groundwater levels at the proposed site has been presented here, but frequent monitoring of the groundwater level at the proposed long term monitoring bore (BH1) is required so that excavation can be managed as proposed. A weekly or fortnightly groundwater level measuring programme over the winter and spring will provide more certainty in the winter/spring mean groundwater level at the site. Advice from GWRC (*pers. comm.* Doug McAlister, 1/7/2009) indicates that this winter is currently conforming to 'average' groundwater trends so implementing a monitoring programme now is recommended.

6 References

Boffa Miskell, 2008. *Waingawa Structure Plan.* Report to the Carterton District Council December 2008.

Boffa Miskell, 2008. *Ecological Report on Waingawa Wetland.* Appendix 1 of Waingawa Structure Plan prepared for Carterton District Council.

GWRC, 2002. *Erosion and Sediment Control Guidelines for the Wellington Region.* Prepared by Paul Denton and Rob Robson, GWRC

GWRC, 2008a. *Wairarapa Groundwater Model Update.* Report to Regulatory Committee by Douglas McAlister 14 October 2008.

GWRC, 2008b. *Targeted Groundwater Quality Investigations in the Wairarapa.* Prepared by Sheree Tidswell for the Environmental Monitoring and Investigations Department, August 2008, GW/EMI-T-08/81

Appendix A

Borelog Information for Monitoring Bores at Proposed Quarry Site.

GRIFFITHS DRILLING

10 December, 2008

Wairarapa Aggregates Ltd
PO Box 70
Greytown

Attn: Paul Strange
Re: Report on Monitoring Bores

Griffiths Drilling was engaged by Wairarapa Aggregates Ltd to carry out the construction of three monitoring bores. Two temporary and one permanent bore to monitor the ground water levels at the site address of 10 Norman Ave, Waingawa, Masterton.
The permanent bore was Bore 1 this was drilled on 27/11/08 and it was situated in the Northern corner of the site.
Bore 1 was drilled to 5.25 metres and lined with a 125mm steel casing and a pvc screen placed from 5.25metres up to 3.25 metres. The Static Water Level was at 4.0 metre when drilling.

Bore 2 was a temporary monitoring bore and was drilled on the 24/11/08 this was situated in the middle next to the North West Boundary.
Bore 2 was drilled to 5.5 metres and a pvc casing installed with a pvc screen placed from 5.4 metres up to 2.4 metres. The Static Water Level was at 4.2 metre when drilling.

Bore 3 was a temporary monitoring bore and was drilled on the 25/11/08 this was situated in the southern end of the site.
Bore 3 was drilled to 5.5 metres and a pvc casing installed with a pvc screen placed from 5.2 metres up to 2.2 metres. The Static Water Level was at 4.7 metre when drilling.

Attached to this report are the bore logs and as-built drawings.

Please let me know if you need any further information.

Yours Sincerely,

Melvyn Griffiths
Managing Director

WELLINGTON REGIONAL COUNCIL

Drillers' Water Well Log Form

Page 1

WELL - OWNER [illegible]

ADDRESS [illegible]

DRILLING FIRM [illegible]

DRILLER A Walker

DRILLING DATE 27/11/0[illegible]

LOCALITY [illegible]

GRID REFERENCE [illegible]

VALUATION NO. 18[illegible] 11[illegible]0

WELLS NO. & Wal ID S2[illegible]/10[illegible]

BORE PERMIT: WAR [illegible]

GW ZONE [illegible] AQ ZONE 1

REDUCED LEVEL OF WELL SITE (m.a.m.s.l.)

Depth from Surface (m) Top	Depth from Surface (m) Bottom	Colour	Description	Details of Aquifers: Depth from Surface (m) Top	Details of Aquifers: Depth from Surface (m) Bottom	Static Water level (m)
0.0	1.5	Grey	Gravels			
1.5	3.0	Grey	Gravels, small Some sand Damp			
3.0	3.5	Grey	Boulders Some sand			
3.5	4.0	Grey	Sand, fine to coarse Trace of silt			
4.0	5.2	Grey	Boulders Gravels Some silt	4.0	5.25	4.0

CASING DIAMETER (cm) 125mm

LENGTH (m) 3.25m

SCREEN TYPE PVC

SET AT 5.25m to 3.25m

SCREEN LENGTH (m)* 2m

SLOT SIZE 1mm

STATIC WATER (m) 4.0 metres below case

Water Level (m) 4.0 after 1 min

Water Level (m) 4.0 after 15 mins

PUMPING AT ____ (litres / sec)

Water Level (m) ____ after 5 mins

Water Level (m) ____ after ____

BORE USE Monitoring

DISCHARGE REQUIRED n/a

REMARKS Permanent monitoring bore

* If more than one, list depth of all screens

WELLINGTON REGIONAL COUNCIL

Wairarapa Aggregates — Drillers' Water Well Log Form

Page 2

WELL OWNER [redacted]

ADDRESS [redacted]

DRILLING FIRM	[illegible] Drilling (NZ) Ltd	LOCALITY	[illegible]
DRILLER	A. [illegible]	GRID REFERENCE	[illegible]
DRILLING DATE	25/10/02	VALUATION NO.	[illegible]
		WELLS NO. & Wel ID	S26/1063
		BORE PERMIT:	WAR 020265
		G/W ZONE [illegible]	AQ ZONE 1

REDUCED LEVEL OF WELL SITE (m.a.m.s.l.) ____________

Depth from Surface (m)		Colour	Description	Details of Aquifers: Depth from Surface (m)		Static Water level (m)
Top	Bottom			Top	Bottom	
0.0	1.2	Grey	Gravels, medium Sand			
1.2	2.2	Grey	Boulders, Sand			
2.2	2.5	Grey	Gravels, small [illegible] sand Damp			
2.5	3.0	Grey	Gravels small rounded S.H. Damp			
3.0	3.5	Grey	Gravels and boulders (Dry)			
3.5	4.2	Grey	S.H. Gravels, moist			
4.2	5.5	Grey	Gravel small Boulders W water	4.2	5.5	4.2

CASING DIAMETER (cm) 5 (50mm) LENGTH (m) 2.4

SCREEN TYPE PVC SET AT 5.4m to 2.4m

SCREEN LENGTH (m)* 3 SLOT SIZE 0.5mm

STATIC WATER (m) 4.2 metres below case

Water Level (m) 4.2 after 1 min

Water Level (m) 4.2 after 15 mins

PUMPING AT ____________ (litres / sec)

Water Level (m) ____________ after 5 mins

Water Level (m) ____________ after ______

BORE USE Monitor

DISCHARGE REQUIRED No

REMARKS Temporary monitoring bore.

* If more than one, list depth of all screens

Bore 3

WELLINGTON REGIONAL COUNCIL

Waiohine Aggregates

Drillers' Water Well Log Form

WELL OWNER	[illegible]	LOCALITY	[illegible]
ADDRESS	[illegible]	GRID REFERENCE	[illegible]
DRILLING FIRM	[illegible] Drilling (NZ) Ltd	VALUATION NO.	[illegible]
DRILLER	A Walker	WELLS NO. & Wal ID	S26/1064
DRILLINGDATE	25/11/08	BORE PERMIT:	WAR 090064
		G/W ZONE	[illegible]
		AQ ZONE	1

REDUCED LEVEL OF WELL SITE (m.a.m.s.l.) ______

Depth from Surface (m)		Colour	Description	Details of Aquifers		
				Depth from Surface (m)		Static Water level (m)
Top	Bottom			Top	Bottom	
0.0	0.5	Grey	Gravels, silty			
0.5	1.2	Brown	Gravels			
1.2	3.0	Grey	Cobbles			
3.0	4.0	Grey	Cobbles, traces of silt			
4.0	4.2	Brown	Cobbles, trace of sand and silt			
4.2	5.2	Grey	Cobbles, gravels and sand	4.2	5.2	4.7

CASING DIAMETER (cm) 5 (50mm) LENGTH (m) 2.2

SCREEN TYPE PVC SET AT 5.2m to 2.2m

SCREEN LENGTH (m)* 3 SLOT SIZE .05 mm

STATIC WATER (m) 4.7 metres below case PUMPING AT ______ (litres / sec)

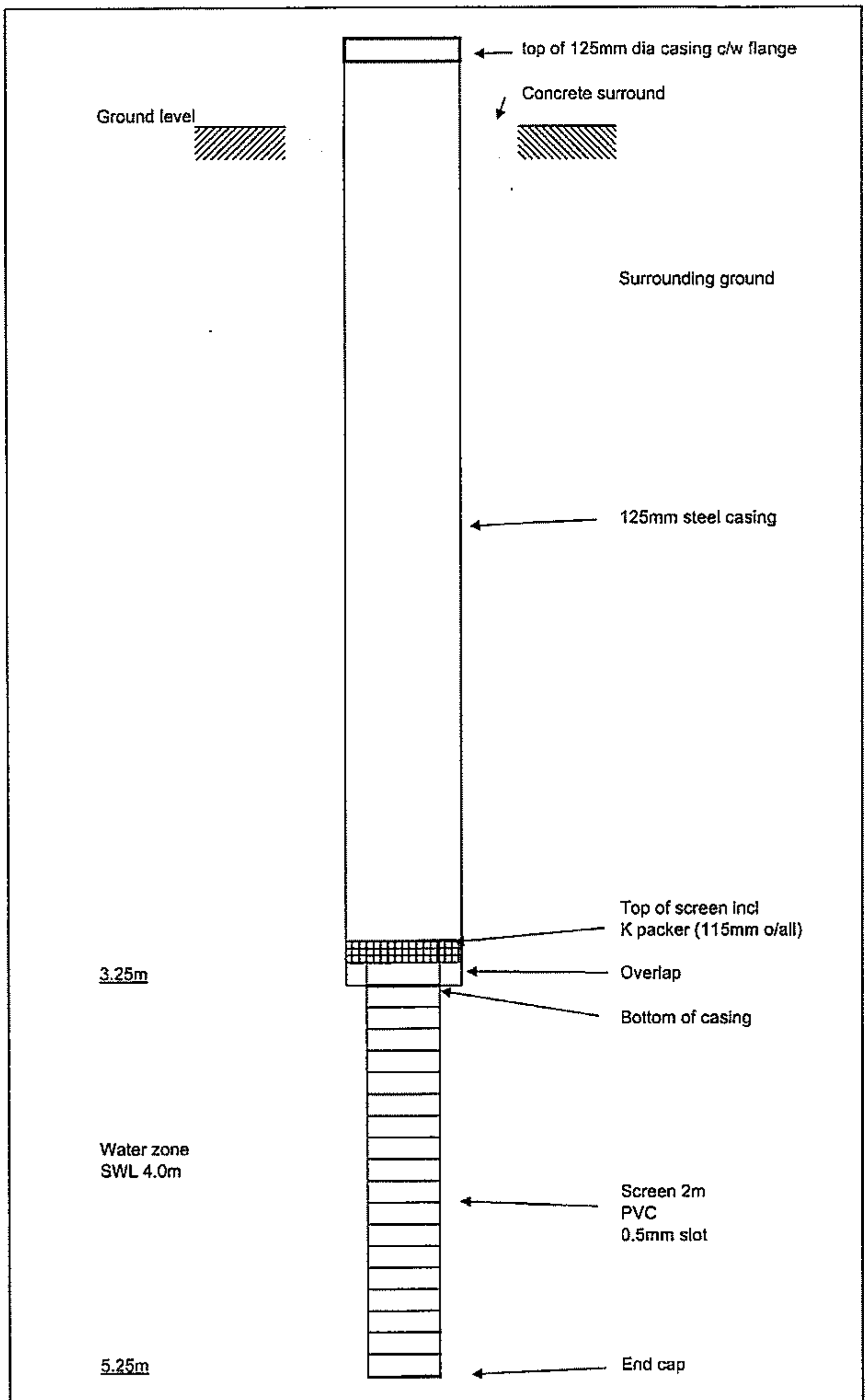
Water Level (m) 4.7 after 1 min Water Level (m) ______ after 5 mins

Water Level (m) 3.13 after 15 mins Water Level (m) ______ after ______

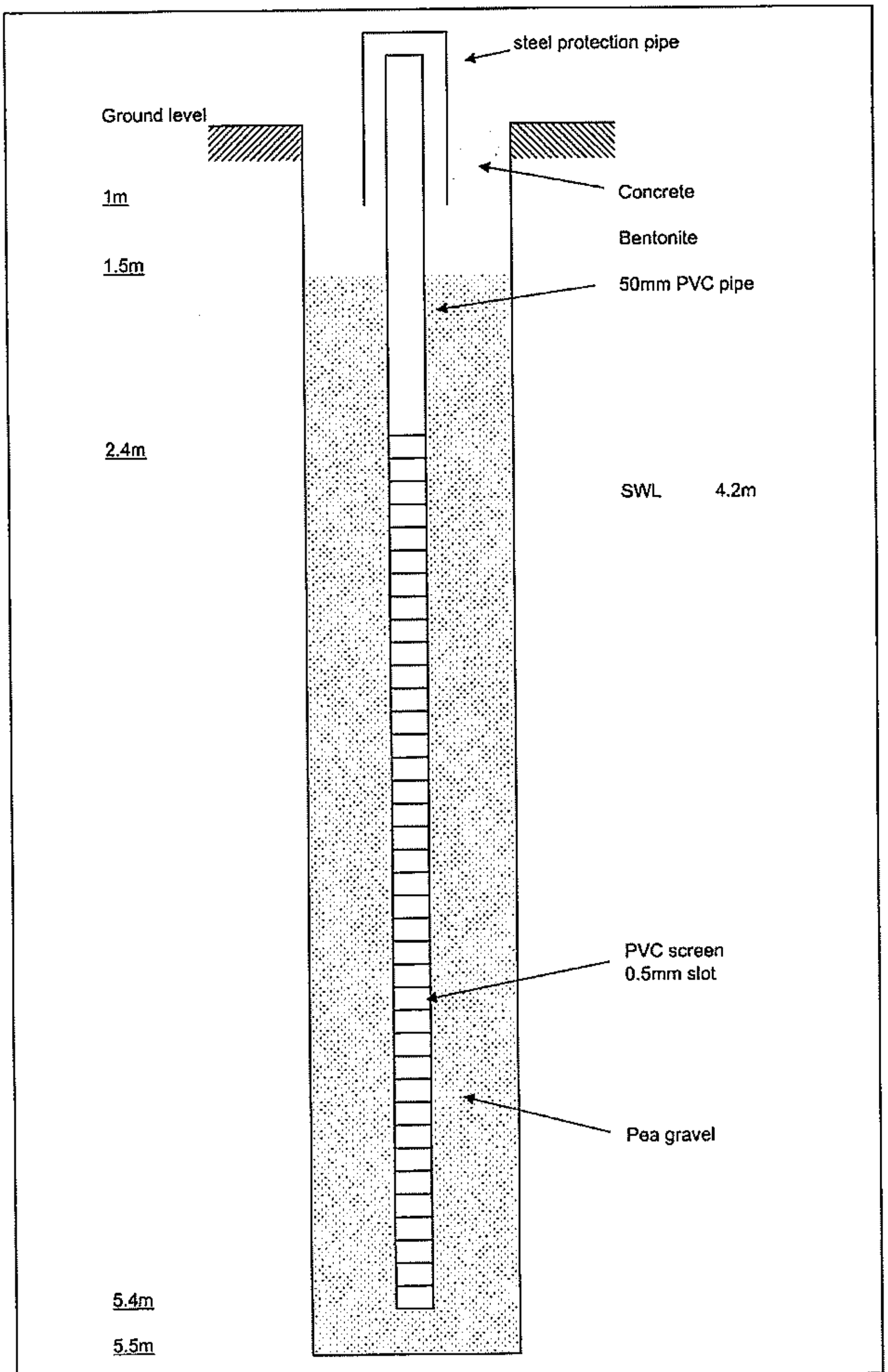
BORE USE ______ DISCHARGE REQUIRED n/a

REMARKS Temporary monitoring bore

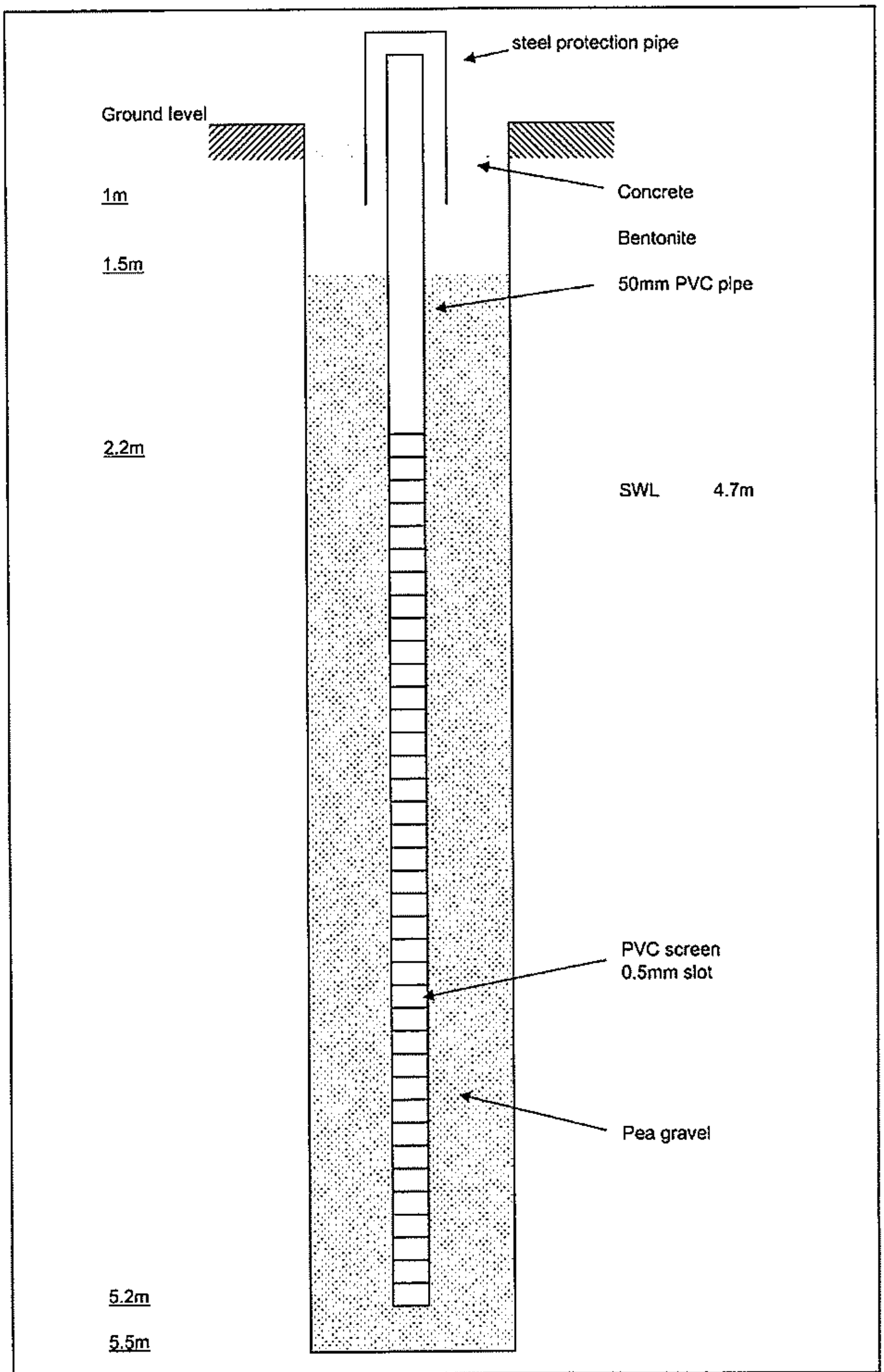
* If more than one, list depth of all screens



Griffiths Drilling (NZ) Ltd	Project: Wairarapa Aggregates Monitor Bore 1, Waingawa			Not to scale
	BH: BH1	Date: 11/24/2008		As-built



Griffiths Drilling (NZ) Ltd	Project:	Wairarapa Aggregates Monitoring Bore 2 Waingawa				Not to scale
	BH:	BH2		Date:	11/24/2008	As-built



Griffiths Drilling (NZ) Ltd	Project:	Wairarapa Aggregates Monitoring Bore 3 Waingawa			Not to scale
	BH:	BH3	Date:	11/24/2008	As-built

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REVISION SCHEDULE

Rev No	Date	Description	Prepared By	Reviewed By	Approved By