APPENDIX F

URS Report: Taerutu Gully – Discharge of Water, Contaminants, and Stormwater

Report

Taerutu Gully - Discharge of Water, Contaminants, and Stormwater

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Prepared for

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Executive Summary

This report documents the hydrology and water quality assessment of the outlet that discharges from Taerutu Gully to old Taranaki Stream at Mapleham, Pegasus Town, undertaken by URS New Zealand Limited (URS) on behalf of Pegasus Township Limited. Pegasus Township is located approximately 25 km from Christchurch city and when completed the township will have a design population of approximately 11,000 people. Taerutu Gully has a continuous natural base flow measured at 3-5 Litres per second through to a former channel of Taranaki Stream ("old Taranaki Stream") which guarantees a base flow in old Taranaki Stream throughout the year. Flows increase following periods of rainfall due to natural drainage and stormwater discharge from the Mapleham lakes into Taerutu Gully. The stormwater discharges were intended to occur only a few times a year. However, the continuous discharge from Taerutu Gully to old Taranaki Stream is considered to breach the consent conditions. The discharge of stormwater where it may enter land and water is covered by resource consent CRC061218. Environment Canterbury Compliance Officer – Duncan Harvest assigned a non compliance to Condition three which states that the stormwater system be carried out in accordance with the Stormwater Management Report provided with the application, which states that the discharge will only occur a few times a year. The discharge has been occurring much more frequently than consented hence the non compliance from the Regional Council.

The potential adverse effects on the flood carrying capacity of Taranaki Stream from the continuous low flow discharge is considered to be negligible, while higher flows are expected to operate as consented. Additional monitoring is proposed to provide more accurate information on the frequency and rate of the discharge that occurs from Taerutu Gully to old Taranaki Stream.

URS consider that the existing water quality conditions are inappropriate and do not capture the nature of the discharge water quality. Changes should be made to the conditions of relevant resource consents to better reflect the nature of the discharge and allow for a more intense monitoring regime over the next three years.

1

Introduction

1.1 Background

URS New Zealand Limited (URS) was commissioned by Pegasus Township Limited (PTL) to prepare a report in support of an application to vary the conditions of resource consents CRC061217 and CRC061218, which authorise the discharge of water, contaminants, and stormwater from the Mapleham development to land and to water.

On 16 December 2010 the Regional Council notified PTL of a non-compliance issue with Condition 3 of CRC061218. The details of the condition are provided in Section 1.2.

The purpose of this report is to describe the environment and assess the potential effects associated with varying the consent conditions to authorise a continuous discharge from Taerutu Gully on the water levels and water quality in Taranaki Stream.

1.2 Consent details

PTL holds two consents that authorise the discharge of stormwater (CRC061218) and natural water and contaminants (CRC061217) from Taerutu Gully to old Taranaki Stream.

Consent CRC061218 authorises the discharge of stormwater from the Mapleham lake system where it may enter land and water. A copy of the consent is provided in Appendix A.

On 16 December 2010 Environment Canterbury notified PTL of a non-compliance with Condition 3 of CRC061218.

- Condition 3 states:

> *"Design, construction and management of the stormwater system including grassed swales and artificial waterbodies, shall be carried out in accordance with the design details and procedures provided in the Stormwater Management Report in the application."*

Section 5 of the Stormwater Management Report states:

> *"The overall approach of capturing and reusing stormwater for golf course irrigation means that the discharges to the Taranaki Stream from Mapleham will be reduced from the existing situation. The golf course ponds will capture and slow all additional flows associated with the development (as a result of increased paved surfaces, etc) to less than the existing, even in large storms.*
>
> *When the capacity of the golf course irrigation pond is exceeded, as is expected to occur a few times a year (refer to Section 5.6), then flows will discharge into the new wetland that will be created in the ephemeral stream gully along the eastern boundary.*
>
> *The wetland will effectively be formed through placing a low bund across the ephemeral gully and allowing groundwater and local surface flows to pond. As mentioned above, the wetland will generally not receive flows from the golf course ponds. Flows out of the wetland will be controlled by a box-structure, forming a rock-filter outlet. The normal level of the wetland (set at or just below the inlet level of the rock filter) would mean that no stormwater flows would be passing through the rock filter for most of the year. The wetland will instead operate naturally with the shallow groundwater on the site and water levels within the wetland will vary with the water table. When flows from the golf course ponds enter the wetland system, water will pond up and flow through the filter. Flows will be retained and slowed through filter by the use of an orifice plate on the outlet.*
>
> *The figure on the following page summarises the overall stormwater management system proposed for Mapleham Block"*

1 Introduction

1.3 Site Location

The site is located between State Highway 1 and the coast about 1.5 km north of the existing Woodend Township and approximately 25 km north of Christchurch city. The topography of the site is generally flat towards the coast on the east.

Taerutu Gully is located off Preeces Road. Water from the Mapleham Lake development discharges from Lake 8 via a broad crested weir to Taerutu Gully. Water from Taerutu Gully discharges via an orifice weir to old Taranaki Stream, which then flows along the channel to discharge into Taranaki Stream.

Figure 1-1 Location of level transducers and water quality sampling (Source: Google Earth)

Figure 1-1 above shows the location of Pegasus and the level transducers at the ECMA Interdune Culvert and Waikuku Beach Culvert that are discussed in the hydrology section 2.1.3. Figure 1-1 also shows the sampling locations of the water quality samples which is discussed in Section 3.2.

2 Site Details and Description of the Environment

2.1 Stormwater System

A detailed description of the stormwater and lake system at Mapleham is provided by BECA (2005). The following provides a summary of the main features of the stormwater, lakes, and wetland system that is relevant to the non-compliance issue raised by Environment Canterbury.

The stormwater from roads, footpaths, rights of way and residential hardstand areas discharge to roadside infiltration swales. The swales are designed to capture and infiltrate to ground a first flush volume, equivalent to 18 mm of runoff, in accordance with Waimakariri District Council (WDC) guidelines.

The overflows from the swale system and discharges from the subsurface drain combine in the overflow sumps located at approximately 90 m intervals. The sumps discharge to a central stormwater collector drain running along the centre of the road, which transports flows to the golf course lakes.

The water then discharges during high flow events from the eastern lake at the golf course (Lake 8) via a broad crested weir structure (which utilises rock filters to reduce flow velocity) into Taerutu Gully ("the gully") (Figure 2-1). This structure operates as was described in the application.

The gully has been modified during the construction period (as set out in Section 1.1) to form a wetland environment. Prior to development, the gully was characterised as an ephemeral stream/wetland environment dominated by willow trees (BECA, 2005).

The discharge from Taerutu Gully to old Taranaki Stream is via a modified orifice weir structure. The orifice weir is shown in Plate 2-1 and schematically in Figure 2-2. The invert of the weir is 2.76 m RL. Three smaller PVC pipes of approximately 75 mm diameter are installed through the vertical culvert which forms the orifice weir. The invert of the intake pipes is approximately 2.55 m RL. A rock filter surrounds the weir which reduces the potential for debris to block the discharge.

The invert level of the weir structure is below the level documented in BECA (2005), which suggested that the invert level would be 3.0 m RL. The lower invert level has the potential to increase the frequency of discharges that would have otherwise been retained in the wetland system. The effects of this change are assessed in Section 3.

A more frequent discharge from the orifice weir which discharges from Taerutu Gully to the old Taranaki Stream bed occurs in practice than that described in the original resource consent application. This increase in the frequency of discharge is due to more groundwater through flow than originally identified, not the result of stormwater flows.

2 Site Details and Description of the Environment

Figure 2-1 Location of lake and gully discharge points (Image Source: Google Maps)

2 Site Details and Description of the Environment

Plate 2-1 Orifice weir which discharges from Taerutu Gully to old Taranaki Stream

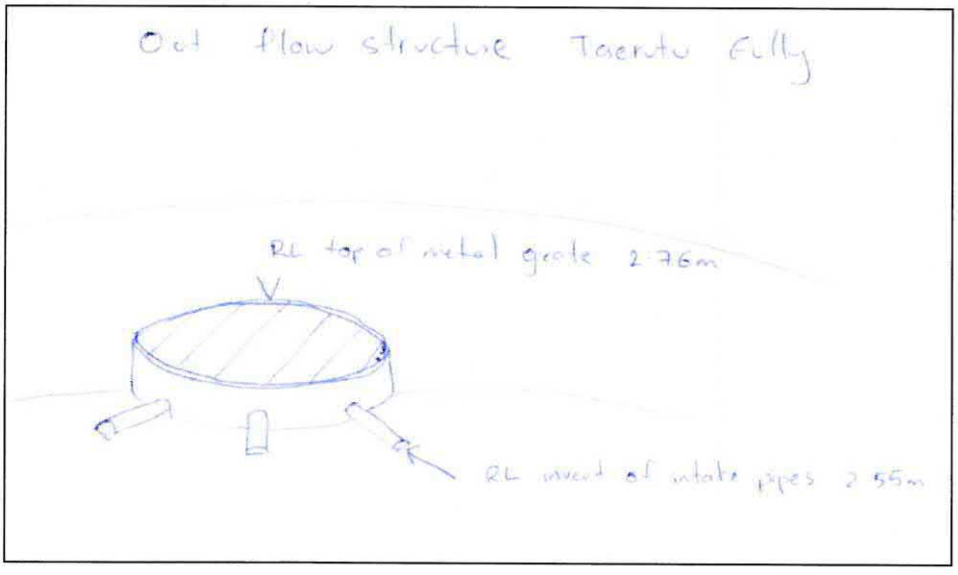

Figure 2-2 Schematic of Orifice Weir construction

The orifice weir is connected to a horizontal culvert of ~300 mm. The culvert runs under the constructed earth bund which has formed Taerutu Gully over a length of approximately 20 m. The culvert conveys water from Taerutu Gully to a receiving basin which has been formed in the old

Taranaki Stream. A rock filter is used to further limit the movement of debris from the discharge to the receiving environment (Plate 2-2). A secondary filter screen is also used to capture any debris contained in the discharge (Plate 2-2).

Plate 2-2 Taerutu Gully to old Taranaki Stream discharge, rock filter, and fabric filter

Once the water is discharged from Taerutu Gully via the orifice weir it flows via the old channel of the Taranaki Stream for a distance of approximately 130 m before it leaves PTL property. The stream then passes under Preeces Road 150 m downstream of the PTL boundary and flows into a wetland system before flowing into Taranaki Stream approximately 550 m downstream of the PTL boundary.

At this location the discharge flows in a northerly direction, by way of the Taranaki Stream, approximately 4.2 km before entering the Ashley River near Waikuku.

2.2 Existing Environment

The following sections provide a brief description of the existing environment which is relevant to the site activities. In particular, the general groundwater, climate, and surface water environments have been presented.

2.3 Hydrogeology

2.3.1 Regional Hydrogeology

Pegasus township is in the catchment of the Waimakariri-Ashley Plains. The geology of the Plains mainly consists of fan debris from the Southern Alps transported by rivers during the Quaternary. The Rangiora sub basin underlies the Plains and deepens towards the coast to a depth of more than 2 km

at the Waimakariri River mouth[1]. During interglacial periods of the Quaternary, the Waimakariri and Ashley Rivers entrenched and redeposited well sorted gravels (Woodlands, Windwhistle, and Burnham Formations) over the Plains. During this time sea level also rose resulting in deposition of marine and estuarine sands, and swamp and lagoonal clay and peat over fluvial deposits at the coast. These fine sediments create low permeability confining layers between the gravels. Overlying the gravels of the Burnham Formation is the Springston Formation which consists of redistributed gravel, sand and silt. At the coast the Springston Formation is interbedded with postglacial beach, estuarine and swamp sediments (Christchurch Formation). Overlying this sequence of sediments at the coast are dune sands, interdune swamps and lagoon sediments[2].

The predominant groundwater flow direction is towards the coast through higher permeability gravels which are separated vertically and laterally by lower permeability silts and sands.

Semi-confined aquifers are the most common aquifers in the Plains with confined aquifers predominantly found in the coastal areas[2]. The confined aquifers are separated by interbedded estuarine and marine sediments and gravels along a narrow strip along the coast. However, semi-confined aquifers are common in the Woodend area where permeable gravels are separated by silty and sandy gravels[2]. The aquifers are typically fluvial and heterogeneous with transmissivities that vary considerably over short distances and with aquifer depth[3]. The aquifers are predominantly recharged by the Ashley River.

2.3.2 Local Hydrogeology

URS have been monitoring 14 wells since 2009 in the vicinity of the lake in Pegasus Township, the monitoring of the groundwater levels provides useful information on the dynamics of the shallow unconfined groundwater system. There is no recent monitoring of shallow groundwater levels in the vicinity of Mapleham.

The groundwater levels over the 2010/2011 period are relatively stable with a variation of between 2.4 – 2.6 m RL in MWI, which is located approximately 180 m east of the Taerutu Gully orifice weir. The elevation of the groundwater head is comparable to the invert level of the Taerutu Gully orifice weir, particularly the invert of the PVC intake pipes. This suggests that the water contained in the wetland is likely to be associated with the groundwater table.

2.4 Hydrology

Taerutu Gully receives flow through the broad crusted weir from the Mapleham golf course ponds. It also receives groundwater inflow as it flows towards Taranaki Stream. The discharge from the orifice weir structure (including the piped intakes) from Taerutu Gully to the old channel of Taranaki Stream has been measured on a monthly basis by PTL (Table 2-1). The field sheets associated with the site inspections is provided in Appendix B.

[1] Hicks, S. R. (1989). Structure of the Canterbury Plains, New Zealand, from gravity modelling. Geophysics Division, Department of Scientific and Industrial Research. Report No. 222.
[2] Sanders, R. (1997). Groundwater of the Waimakariri-Ashley Plains, A resource summary report. Environment Canterbury, Christchurch. Report No. U97(43).
[3] Brown, L. J. (2001). Canterbury. In M. R. Rose, & P. A. White, Groundwaters of New Zealand (pp. 441-460). The New Zealand Hydrological Society, Wellington.

2 Site Details and Description of the Environment

Table 2-1 Measured monthly Taerutu Gully Flow information from July 2010 to April 2011

Date	Taerutu Gully Orifice Weir Discharge (L/s)	Rainfall (mm)	Flow Through Lake 7 to Lake 8* (L/s)	Comments
1/07/2010	3-5	0	0	no significant rainfall in past 72 hours
26/07/2010	10	0	0.6	inspection 48 hours after rainfall
2/08/2010	3-5	0	0	no significant rainfall in past 72 hours
1/09/2010	3-5	0	0	no significant rainfall in past 72 hours
13/09/2010	Submerged drainage flow	22	0	inspection 12 hours after moderate rainfall event
1/10/2010	3-5	0	0	no significant rainfall in past 72 hours
1/11/2010	3-5	0	0	no significant rainfall in past 72 hours
1/12/2010	3-5	0	0	no significant rainfall in past 72 hours
1/02/2011	3-5	0	0	no significant rainfall in past 72 hours
1/03/2011	3-5	0	0	no significant rainfall in past 72 hours
1/04/2011	3-5	0	0	no significant rainfall in past 72 hours

* Flow in the lakes is measured between Lake 7 and Lake 8 (as shown in Figure 2-1).

The measured discharge from the orifice weir structure varies from 3-5 l/s to something significantly greater during times of storm flows. When a significant rainfall event occurs the orifice weir becomes submerged.

The discharge from the old channel of the Taranaki Stream to Taranaki Stream is via a small diameter culvert, upstream of the culvert the tributary is confined in an open drain for approx 30-40 m before opening up into a broad, shallow, willow laden swamp area.

Taranaki Stream river bank is lined with willows. The banks of the creek are affected by stock trampling, with a number of areas upstream and downstream of the confluence showing signs of stock induced bank erosion (Plates 2-3 and 2-4). The bed of Taranaki Stream is characterised by a layer of fine silt/clays which are not consolidated, both upstream and downstream of the confluence of the old channel. Taranaki stream discharges into the Ashley River, which in turn discharges into the ocean.

2 Site Details and Description of the Environment

Plate 2-3 **Taranaki Stream - downstream of confluence with old Taranaki Stream (June 2010)**

Plate 2-4 **Taranaki Stream - upstream of the old channel confluence, (June 2010)**

2 Site Details and Description of the Environment

URS has monitored the water levels in the Waikuku Beach culvert of Taranaki Stream since September 2010 for the purpose of measuring the potential effects of the ECMA discharge on water levels in the Taranaki Stream (location of Waikuku Beach culvert) near Waikuku Beach. The location of the culvert is shown in Figure 1 in Section 1.3. The Waikuku Beach culvert does not display any seasonal trend such as a higher stage height in the winter compared to the summer months. Overall the stage height stays within the average range of 30 to 60 cm and does respond to tidal variations and flows of the Ashley River, a subtle response to large rainfall events is observed, however no apparent response to the discharge from the interdune drain is apparent.

2.5 Climate

The climate data in Table 2-2 shows that the average rainfall from eleven years of data, the lowest rainfall month is March with 36.5 mm and the highest rainfall month is April with 64.1 mm. The rainfall deficit is highest in the month of March with 116.5 mm. The rainfall deficit is lowest in the month of August with 9.4 mm.

Table 2-1 Climate data from Woodend Gladstone Station 11601 showing the rainfall and the rainfall deficit data between 2001-2011

Month	Average Rainfall (mm) 2001-2011	Average Rainfall Deficit (mm) 2001-2011
January	48.8	115.7
February	52.1	113.9
March	36.5	116.5
April	64.1	91.7
May	60.2	66.5
June	59.0	33.6
July	62.5	14.6
August	58.5	9.4
September	41.1	26.9
October	53.3	46.9
November	59.6	89.8
December	49.7	110.2

2.6 Soils

The soils at the site are Temuka deep silt loam on clay loam. Temuka deep silt loam is described as a gley soil, which is slow draining and retaining moisture. The high soil moisture content has favoured the accumulation of plant material, resulting in a high carbon content and have layers of peat within the soils.

2 Site Details and Description of the Environment

2.7 Ecology of Taranaki Stream

Aquatic investigations of Taranaki Stream took place by Boffa Miskell in 2005. The fish survey showed high numbers of inanga (Galaxias maculats), the common bully (Gobiomorphus cotidianus). It was observed there to be numerous small brown trout within the stream (Salmo trutta). The New Zealand Fish database contains several records of fish caught in Taranaki Stream and its tributaries between 1981 and 2001, these include: giant bully (Gobiomorphus gobioides), Canterbury galaxis (Galaxias vulgaris), short fin eel (Anguilla australias), long fin eel (Anguilla dieffenbachia) and black flounder (Rhombosolea retiaria).[4] There is no information about the ecology of Taerutu Gully.

2.8 Water Quality

URS has collected water quality samples from Taranaki Stream, the old Taranaki Stream (which receives discharges from Taerutu Gully), and the discharge from the Eastern Conservation Management Area (ECMA) which is associated with the main Pegasus Town development.

The sampling locations are shown in Figure 1-1 in Section 1.3.

2.8.1 June 2010

In-situ sampling of water quality of Taranaki Stream, upstream and down-stream of the confluence of the old Taranaki channel discharge (located approximately 550 m downstream from the actual discharge (Figure 2-3). Table 2-3 shows the results of the sampling.

Table 2-2 Taranaki Stream Water Quality In-situ sampling (4 June 2010)

Parameter	Site 2a (Upstream)	Site 3 (Downstream)
Easting	2485080	2485095
Northing	5767178	5767205
Temperature (°C)	8.9	8.1
pH	7.7*	8.1*
Conductivity (µS)	190	183
DO (mg/L)	nm	nm
Water Clarity (cm)	>60	>60
Bed Sedimentation Rate	np	np
* = *metre not calibrated*		
nm = not measured (metre not working correctly)		
np = not possible to measure		

Bed sedimentation was not measured. This was due to the state of the bed of Taranaki Stream, which was shown to be heavily affected by stock upstream and downstream of the discharge point (see Plates 2-3 and 2-4). The DO was not measured due to a malfunction with the meter.

The difference in pH between the sites was less than the 0.5 stated in condition 14 of CRC061218. There is also no difference in the water clarity results between upstream and downstream.

[4] Boffa Miskell (2003)Pegasus Town – Assessment of Effects on the Environment - Application to Environment Canterbury for Resource Consent.

2.8.2 May 2011

On 23 May 2011 URS sampled the surface water of Taranaki Stream (upstream and downstream of its confluence with the old Taranaki Stream channel), old Taranaki Stream, and the Mapleham lakes at the main bridge into Pegasus Township. The location of the sampling points is shown on Figure 2-3. It is noted that the sampling location for old Taranaki Stream (Site 2b) is located immediately upstream of the confluence of the stream with Taranaki Stream. Site 2b is approximately 550m downstream of the point of discharge from the wetland.

In-situ sampling of water quality parameters was undertaken at each site. The results are provided in Table 2-3. Samples which were collected at two of the sites (Site 1 and Site 3) were sent to Hill Laboratories for analysis. The results of the analysis are shown in Table 2-5.

Table 2-3 Taranaki Stream Water Quality In-situ sampling (23 May 2011)

Parameter	Site 1 (Mapleham Bridge)	Site 2a (Upstream)	Site 3 (downstream)	Site 2b (old Taranaki Stream)
Easting	2483660	2485080	2485095	2485105
Northing	5766320	5767178	5767205	5767201
Temperature (°C)	11.68	11.93	11.58	10.43
pH	7.3	7.32	6.48	5.95
Conductivity (µS)	119	114	103	158
DO (mg/L)	7.03	6.78	6.7	1.12
DO (%)	64.5	62.6	61.4	10.1
Water Clarity (cm)	>60	31.2	30.8	30
ORP	109.3	82.3	114.6	130.9

The water quality characteristics between Site 2 and Site 3 are similar, with the exception of a reduction in pH in the order of 0.84, and an increase in the ORP (Oxidation – Reduction Potential). The difference in water quality between Site 1 (at the Mapleham Bridge) and Site 2 are minor, with water clarity being significantly greater at the lake site.

The water quality measured at Site 2b (old Taranaki Stream) immediately upstream of the confluence with the Taranaki Stream is significantly different from the other samples. The pH is slightly acidic at 5.95, with very low Dissolved Oxygen indicating anoxic conditions. The water quality parameters measured at this location are also very different to the water quality measured at the Taerutu Gully discharge to old Taranaki Stream in June 2011 (Site 4) (see Table 2-4). The change to the water quality is considered to be associated with the influence of a wetland located on the northern side of Preeces Road. It is also noted that the shallow groundwater has a naturally elevated iron concentration, which is consumed by microorganisms in the Preeces Road wetland (where flows are very slow). Evidence of this biological process is shown by a sheen on the water at Site 2b (Plate 2-5). The consumption of the dissolved iron by microorganisms will reduce the dissolved oxygen concentration in the water, which is shown in the in-situ monitoring results.

2 Site Details and Description of the Environment

Plate 2-5 **Old Taranaki Stream immediately upstream of confluence with Taranaki Stream (sheen on water)**

2 Site Details and Description of the Environment

Figure 2-3 Water Quality Sampling Locations

2 Site Details and Description of the Environment

2.8.3 June 2011

URS visited the site of the discharge from Taerutu Gully to old Taranaki Stream (Site 4) on two occasions during June 2011. The first visit was on 1 June, which followed a moderate rainfall event (23 mm) on the 26 May 2011 that lasted for a period of 24 hours. Plate 2-6 and 2-7 show the water level in the wetland at the orifice weir and the discharge that was occurring via the PVC intake pipes. The flow of the discharge during this visit was measured at approximately 10 l/s. The water level in the wetland measured by the staff gauge was 0.54 m.

No in-situ water quality parameters were measured during this site visit. However, a grab sample was taken from the discharge point and sent to Hills Laboratories for analysis. The results of the sample are shown in Table 2-5.

Plate 2-6 Taerutu Gully to old Taranaki Stream Discharge (1 June 2011)

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Plate 2-7 Taerutu Gully to old Taranaki Stream Discharge - flow through PVC Pipes (~10l/s)

A water quality sample was also collected at Site 4 on 29 June 2011. The wetland water level measured on the staff gauge at the orifice weir was 0.46 m (Plate 2-8). The discharge from the weir via the PVC pipes was measured at approximately 1.5 l/s. Table 2-4 shows the results of the in-situ water quality sampling. A water quality sample was also collected at that time and sent to Hills Laboratories for analysis. The results of the sample are shown in Table 2-5.

Table 2-4 Site 4 Taerutu Gully to old Taranaki Stream Discharge - field parameters

Parameter	Taerutu gully discharge (Site 4)
Easting	
Northing	
Temperature (°C)	7.59
pH	7.46
Conductivity (µS)	109
DO (mg/L)	9.35
DO (%)	78.5
Water Clarity (cm)	n/m
ORP	62.4

2 Site Details and Description of the Environment

Plate 2-8 Taerutu Gully to old Taranaki Stream discharge Weir (29 June 2011)

Laboratory Analysis of Taerutu Gully to old Taranaki Stream Discharge

Samples of the water being discharged from the weir that discharges from Taerutu Gully to old Taranaki Stream were taken on 1 June and 29 June 2011 using a grab sampler. The samples were collected from the area immediately downstream of the bubble-up sump and rock filter. Samples collected from Taranaki Stream (Site 3) and the golf course lakes at the Mapleham Bridge (Site 1) on 23 May 2011 were also sent to Hill Laboratories for analysis. The samples were analysed for standard water quality parameters (Table 2-6).

The results have been compared against two different guideline levels; the ANZECC New Zealand trigger level guidelines for Lowland River and the ANZECC recreational guidelines.

For the 1 June sample all of the analytes tested for were below guideline levels, with the exception of Total Nitrogen, Total Phosphorus and Total Kjedahl Nitrogen. These analytes were above the ANZECC New Zealand trigger guideline for Lowland Rivers. The sample result for Total Nitrogen was 1.4 mg/L and the guideline is 0.6 mg/L , the result for Total Phosphorus 0.53 mg/L and the guideline is 0.03 mg/L and the sample result for Total Kjedahl Nitrogen was 1.34 mg/L and the guideline is 0.46 mg/L.

The results from the 29 June sample show the same analyte exceedances of the ANZECC New Zealand trigger guideline for Lowland Rivers. The sample result for Total Nitrogen was 0.86 mg/L and the guideline is 0.6 mg/L , the result for Total Phosphorus 0.2 mg/L and the guideline is 0.03 mg/L and the sample result for Total Kjedahl Nitrogen was 0.84 mg/L and the guideline is 0.46 mg/L.

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Total Kjeldahl Nitrogen is the sum of organic nitrogen, ammonia (NH_3), and ammonium (NH_4^+). Total Nitrogen is the sum organic and inorganic forms of Nitrogen. The Nitrogen form present at Site 4 is most likely to be ammonia.

Total phosphorus is a measurement of all forms of phosphorus both dissolved and particulate. It is a useful indicator for ecosystems with long residence times (e.g. lakes). The measurement of total phosphorus at Site 4 captures the phosphorus suspended in sediment and dissolved phosphorus. Dissolved reactive phosphorus is the measurement of soluble phosphorus within surface water readily able to be taken up by plants and algae, and on both sampling events this was under the guideline level.

Two more samples were taken from two other locations on the Pegasus site on 23 June 2011 and compared against the same set of guidelines. The first site is upstream of Taerutu gully at the Mapleham overbridge at the southern end of the first of the Mapleham lakes. The water quality of the Mapleham overbridge complied with all the guidelines. The second location was taken from Taranaki Stream, downstream of the confluence with old Taranaki Stream. The water quality results for downstream water quality of Taranaki Stream showed exceedances for Total Nitrogen, Nitrite N + Nitrate N and Total Kjedahl Nitrogen. The sample result for Total Nitrogen was 0.92 mg/L and the guideline is 0.6 mg/L; the sample result for Nitrite N + Nitrate N was 0.45 mg/L and the guideline is 0.4 mg/L; and the sample result for Total Kjedahl Nitrogen was 0.47 mg/L and the guideline is 0.46 mg/L.

The Nitrite N + Nitrate N guideline exceedance at Taranaki Stream indicates that it is the predominant form of nitrogen, which shows that the ammonia has nitrified into Nitrite N + Nitrate N.

A sample taken from the ECMA discharge is included for comparative purposes. PTL sample the discharge on a monthly basis as part of their consent requirements for the ECMA.

On 23 May 2011 a sample was taken from the ECMA discharge culvert and compared against the same set of guidelines. The water quality result for the ECMA discharge culvert showed one exceedance for Total Kjedahl Nitrogen.

An inspection of Taranaki Stream and the old Taranaki Stream in June 2010 and May 2011 showed both waterways have high suspended sediment entrained in the water, which is derived from the unconsolidated bed of the stream. It was also noted that there was pugging from stock around the banks of Taranaki Stream. Both of these factors reduce the water quality within Taerutu gully and Taranaki Stream.

URS New Zealand
Engineering and Environmental Management

Table 2-5 : Pegasus Township Limited: Mapleham Analytical Results Compared to Acceptance Criteria

	Sample Details and Analytical Results	Sample Details and Analytical Results	Sample Details and Analytical Results	Sample Details and Analytical Results	Sample Details and Analytical Results	Surface Water Acceptance Criteria	Surface Water Acceptance Criteria	Surface Water Acceptance Criteria
Sample Location	Mapleham bridge	Taranaki Stream	Taerutu Gully	Taerutu Gully	ECMA discharge	ANZECC 2000 guidelines NZ trigger values for lowland rivers	ANZECC 2000 recreational guidelines	NZDWS 2000 guidelines
	Site 1	Site 3	Site 4	Site 4	Pegsus Town			
URS Sample Number			PTG-01	PTG				
Laboratory Sample Reference (Hills)	899215.2	899215.1	902287.1	909955.1	899218.1			
Date Sampled	23-May-11	23-May-11	1-Jun-11	29-Jun-11	23-May-11			
Turbidity	5.8	20	81	30	6			2.5
pH	7.8	7.2	7	7.6	7.9	6.5-7.0	6.5-7.0	7.0-8.5
Total Suspended Solids	5	23	100	32	4			
Dissolved Copper	0.0023	< 0.0005	0.0023	0.0011	< 0.0005		1000	2
Dissolved Zinc	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010		5000	1.5
Total Nitrogen	0.33	0.92	1.4	0.86	0.53	0.6		
Nitrate-N + Nitrite-N	0.054	0.45	0.056	0.013	0.014	0.4	11000	11.3
Total Kjeldahl Nitrogen (TKN)	0.28	0.47	1.34	0.84	0.52	0.46		
Dissolved Reactive Phosphorus	0.047	0.064	0.097	0.028	0.023	0.01		
Total Phosphorus	0.074	0.27	0.53	0.2	0.077	0.03		

Notes:

1.All results and criteria are expressed in units of mg/L.

2. ANZECC, 2000. National Water Quality Management Strategy: Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2000.
Values taken from Table 3.4.1 as trigger values for freshwater, to protect 95% of species in slightly to moderately disturbed ecosystems.

3

Assessment of Effects

3.1 Introduction

The following sections provide the assessment of potential adverse effects that are associated with the changes to the orifice weir and the continuous discharge from Taerutu Gully to old Taranaki Stream.

3.2 Water quantity

The potential adverse effects associated with the continuous low flow discharge of water from Taerutu Gully to old Taranaki Stream are associated with the reduction in flood carrying capacity of Taranaki Stream and the potential for flooding of properties.

3.2.1 Background

A continuous discharge from the orifice weir which discharges from Taerutu Gully to Taranaki Stream has been observed. This discharge is considered to breach conditions of resource consent which require the stormwater system for Mapleham to operate as described in the resource consent application. At the time of preparing the resource consent application for Mapleham it was thought that the discharge from the orifice weir would only occur a few times per year; however, this is not the case in practice.

The current invert level of the orifice weir (including the PVC intake pipes) is below the initial planned invert level of 3.0 m RL and therefore has the potential to increase the natural discharge from the groundwater system to the surface water environment. It is considered that if the invert level of 3.0 m RL was used for the orifice weir there would be no natural groundwater through flow and it would be unlikely that open water would be present in the wetland. It is considered that this was not the intention of the development of the wetland when it was presented to the Regional Council.

3.2.2 Low Flow Discharge

It is considered that the continuous low flow discharge events that have been measured from Taerutu Gully are typically associated with groundwater baseflow discharge. The measured flows at the orifice weir in the range of 3-5 l/s correspond with no/minimal discharge occurring from the lake to the wetland, and no significant rainfall occurring in the 72 hours prior to the measurement being taken.

This discharge has very limited impact on the downstream receiving environment. In early December 2010 where the flow from the orifice weir was measured in the 3-5 l/s range, the water levels in Taranaki Stream measured at Waikuku Beach culvert were very stable, with a time averaged water level range in the order of +/- 0.05 m (Figure 3-1).

3 Assessment of Effects

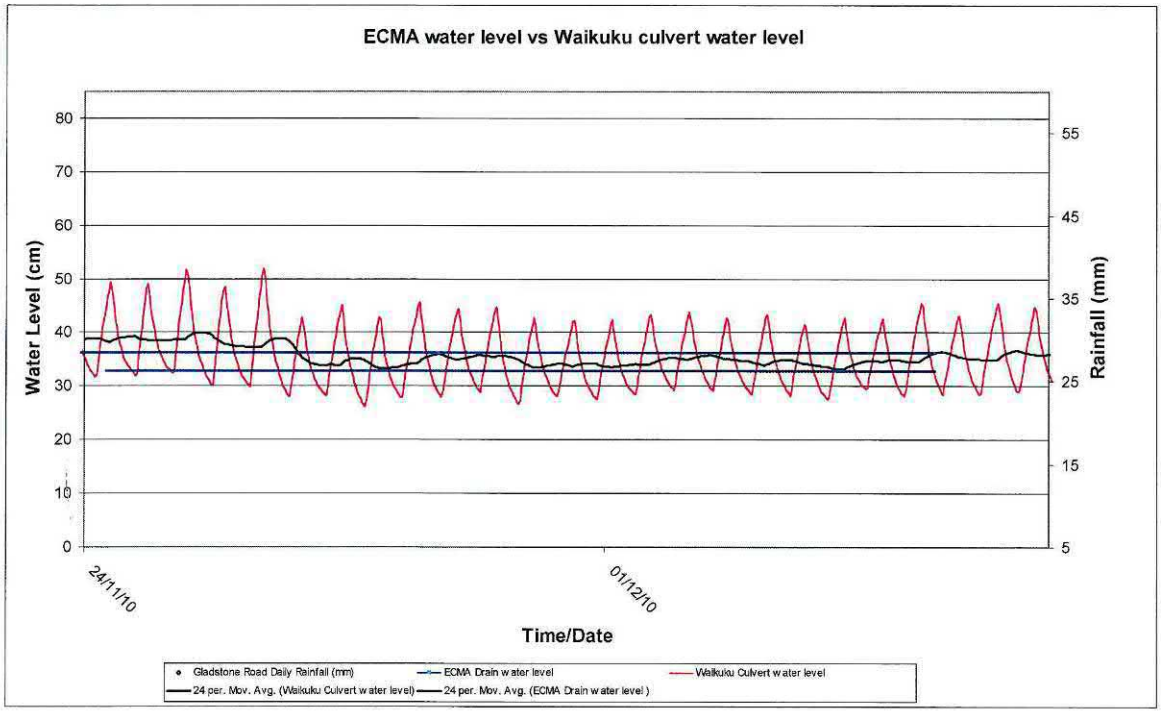


Figure 3-1 Water Levels at Waikuku Beach and Rainfall (Nov-Dec 2010)

During other periods where the discharge was measured in the range of 3-5 l/s from Taerutu Gully there was minimal change in the water levels recorded in Taranaki Stream at the Waikuku Beach culvert that could be interpreted as a direct result of the low flow discharge.

It is also noted that the mean flow at Waikuku Beach culvert is in the order of 230 l/s (BECA, 2005), which indicates that a continuous discharge in the order of 3-5 l/s is approximately 1 % of the flow.

Based on the data collected to date, the low flow discharge of groundwater and pond water via the orifice weir installed which discharges from Taerutu Gully to old Taranaki Stream is likely to have a very minor effect on water levels in Taranaki Stream, and is expected to have a negligible effect on flooding risk. It is also considered that a small amount of baseflow through the wetland provides benefits to the health of the wetland system by reducing the potential for stagnation.

3.2.3 High flow discharge

During the periods where rainfall preceded the spot measurement of flow at the orifice weir it appears that the rainfall increased the natural discharge as well as the stormwater discharge from the lake system.

For the September 2010 event, the rainfall over the preceding 24 hour period resulted in the water levels in the wetland increasing to above the invert level of the orifice weir plate. Corresponding water levels at the Waikuku Beach culvert increased over the same period by approximately 0.2 m (accounting for tidal influences) (Figure 3-2). It is difficult to determine the relative contribution from Taerutu Gully to the increase in water levels at Waikuku Beach without an accurate measure of flow

3 Assessment of Effects

from Taerutu Gully, or an accurate measure of water level at the orifice weir. The lack of information around these high flow events means that the changes to the design of the orifice weir system are difficult to quantify.

The July 2010 event, which was recorded approximately 48 hours after the peak rainfall event on 26 July (which had a rainfall of 35 mm over a 24 hour period), showed a significant increase in water levels at the Waikuku Beach culvert. The water levels at the culvert increased by more than 0.5 m over a period of three days (over which time a total of approximately 60 mm of rainfall fell) (Figure 3-3). The measured discharge from the orifice weir was approximately 10 l/s on 26 July. This is likely to represent a small proportion of the overall flow at the Waikuku Beach culvert. However, there is no information available on the peak discharge that occurred at Waikuku Beach or from Taerutu Gully at that time.

It is noted that at the time the inspection of Taerutu Gully was made, there was no significant discharge from the golf course lakes to Taerutu Gully recorded. This suggests that the lake system was operating as designed and limiting the discharge of stormwater to the wetland. However, as the inspection did not occur during peak rainfall it cannot be confirmed if there was an associated discharge from the lake.

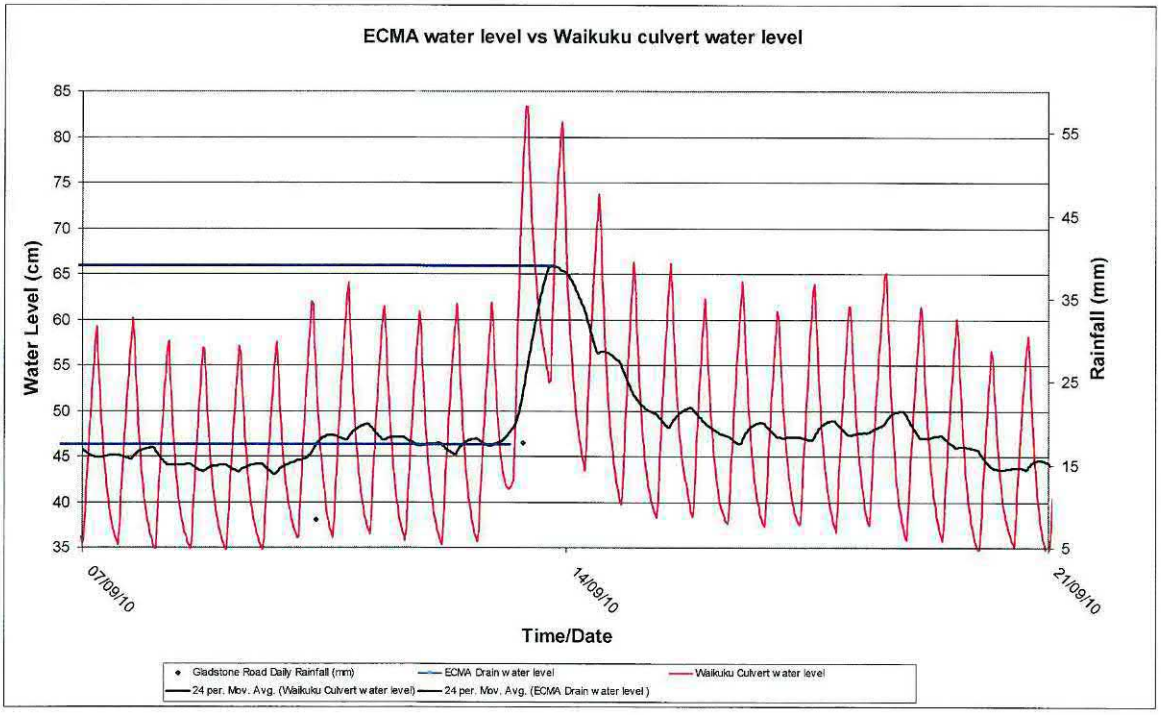


Figure 3-2 Water levels at Waikuku Beach and Rainfall (Sept 2010)

3 Assessment of Effects

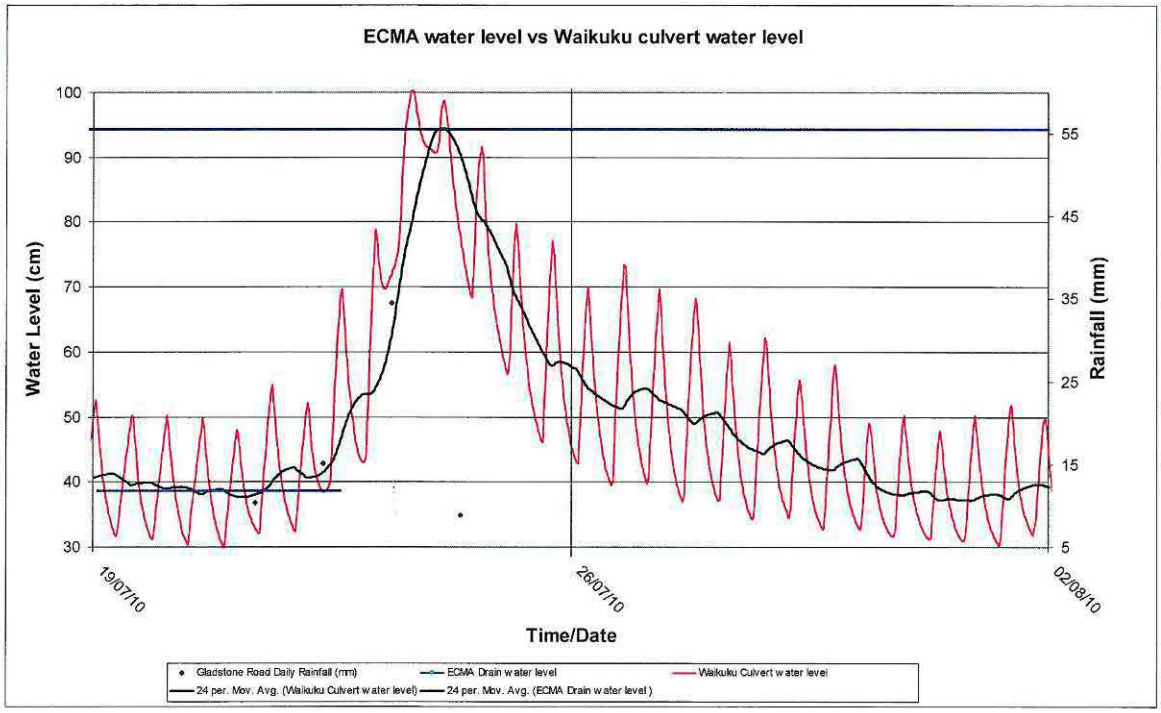


Figure 3-3 Water Levels at Waikuku Beach and Rainfall (July 2010)

3.2.4 Summary

The potential effects associated with the continuous low flow discharge from the orifice weir which discharges from Taerutu Gully to old Taranaki Stream on the water levels in Taranaki Stream are considered to be minor. The data recorded during the monthly inspections indicates that typical discharges are in the order of <10 l/s, which comprise approximately 3 % of the mean flow of Taranaki Stream at Waikuku Beach. This rate of discharge is considered to have a very minor effect on water levels in Taranaki Stream, and may provide some benefits to the wetland and downstream environment during periods of low flow.

The change to the orifice weir design and invert level to that which was presented by BECA (2005) is understood to be in response to the natural groundwater conditions that were encountered at the site during development. In order to create a sustainable open wetland environment the invert level of the wetland needed to be lowered and the associated invert level of the orifice weir also needed to be adjusted. If this was not done, the wetland would have exhibited no natural through flow and the water quality would promptly deteriorate. The installation of the PVC intake pipes enable the continual low flow drainage of the wetland which promotes the groundwater through flow and maintains the health of the wetland system. These adjustments are considered to be necessary in the overall design of the system, while having minimal impact on the control of stormwater events.

The reduction in the invert of the orifice weir has the potential to reduce the storage capacity of the wetland, and hence reduce the residence time that was intended when the wetland system was initially proposed. However, it is considered that this is not the case. The reduction in the invert level corresponds to the overall adjustment required to intercept groundwater and enable the development of the wetlands. There remains a differential between the top of the PVC intake pipes and the invert of

the orifice plate in the order of 0.15 m. This 0.15 m provides additional storage in the wetland system before overflow occurs. While it is accepted that a discharge will continue via the PVC pipes, the rate of the discharge will be limited by the diameter of the pipes and the head above the pipe. Therefore, the discharge that could occur via the pipes that would otherwise be stored is considered to be small and unlikely to result in any adverse effects on the flood carrying capacity of Taranaki Stream.

It is considered that the current regime of monthly inspections of flow at the orifice weir is too coarse for the purposes of capturing the short duration peak storm events. Therefore, it is proposed that a water level transducer is installed in the wetland at the orifice weir. The water levels are proposed to be recorded on an hourly basis using the water level transducer. The water levels are proposed to be collected over a period of 36 months. The water level data can be used to assist with the interpretation of the water quality data collected from Site 4 over the same monitoring period. The results of the monitoring will be presented to the Regional Council in the annual monitoring report (or when requested). The water levels will be corrected to the relative level (m amsl) to enable a comparison to be made to the invert level of the orifice weir.

By implementing this revised regime it is considered that the effects of the changes to the lake and wetland system can be better monitored.

3.3 Water quality

Water quality effects associated with a discharge of stormwater to surface water are typically associated with a change in the chemical and biological characteristics of the receiving environment and the potential for the discharge to carry suspended sediment that can be deposited on the stream bed, reducing/suffocating the available biomass.

3.3.1 Background

Consent CRC061218 and CRC061217 contain conditions that require the sampling of water up-stream and down stream of Mapleham (i.e. upstream and downstream of the discharge point from old Taranaki Stream to Taranaki Stream). The condition requires annual sample during a discharge event. The sample is to be tested for water clarity, dissolved oxygen, pH, and temperature. There is also a requirement to sample the sediment depth at the bed of Taranaki Stream.

Samples were collected at the upstream and downstream monitoring sites in 2010 and 2011 (Section 2.8). The data shows that old Taranaki Stream which discharges into Taranaki Stream approximately 550 m downstream of the wetland exhibits very different water quality characteristics. It is considered that the water quality of old Taranaki Stream prior to flowing into Taranaki Stream is significantly altered by the wetland swamp which is located immediately up-stream (and down-stream of the discharge from Taerutu Gully). Therefore, it is considered that the sampling locations that have been selected for the purpose of monitoring the potential effects associated with the discharge from Taerutu Gully to old Taranaki Stream are inappropriate.

Furthermore, the conditions require the sampling of sediment depth upstream and downstream of the confluence to determine if the discharge is having an adverse effect on the substrate of Taranaki Stream. The existing condition of the bed and banks of the Taranaki Stream up stream and down stream of the confluence with old Taranaki Stream are heavily affected by stock. It is considered that a more appropriate measure of water quality would be to monitor water clarity at the discharge point (both for visual clarity and turbidity). The measurement for embeddedness by attempting to measure sediment depth is considered very coarse, and unlikely to provide any clarity on the potential effects from the Taerutu Gully discharge.

3.3.2 Water Quality Effects

The water quality sample taken from Site 4 during a low flow event (29 June 2011) shows slightly elevated turbidity levels (30 NTU) and suspended solids (32 mg/l). The nutrient concentrations recorded are also slightly elevated in comparison to the samples taken from the Mapleham bridge and the ECMA (on different dates), but within the range that has been typically observed at the ECMA over the past 12 months (Appendix C).

The effects on water quality as a result of the discharge from Taerutu Gully on Taranaki Stream are considered to be minor. The continuous low flow discharge will have a negligible effect on water quality and sedimentation depth in the Taranaki Stream. Previous monitoring of water quality from the Taerutu Gully discharge (at Site 4) and the stream flows into Taranaki Stream (Site 2b) has shown that the water quality is considerable altered between the PTL boundary and the confluence of old Taranaki Stream with Taranaki Stream. It is considered that the water quality changes are due to the biological processes that occur in a wetland located on the northern side of Preeces Road. The water that passes through the wetland undergoes a significant change in its chemical and biological properties, with pH and DO decreasing. It also reduces the suspended sediment load and decreases nutrient concentrations.

The water quality sample taken from Site 4 on 1 June 2011 represents an event where the orifice weir was near to over topping. It was sampled approximately five days after a rainfall event. The Turbidity level measured was 81 NTU, with total suspended solids 100 mg/l. The nutrient concentrations were also elevated. By comparison, the nutrient concentrations were below the maximum concentrations of Total N and DRP that were recorded at the ECMA over the past 12 months. While the turbidity levels are moderate, and above those levels that have been recorded in the ECMA over the past 12 months, the levels are below those observed at the ECMA during the later part of 2009 and early 2010.

It is expected that during periods where the discharge from the orifice weir increases in response to rainfall events there will be a corresponding increase in turbidity, suspended solids and potentially nutrient concentrations. This is due to the shallow profile of the Taerutu Gully wetland and the unconsolidated bed sediments. As water levels increase in the gully, it is expected that bed material will be entrained in the surface water and discharged. However, PTL have installed a number of measures to help reduce the potential effects of the discharge on water quality downstream. Those measures include; the creation of a stilling basin at the discharge point which lowers flows and allows suspended sediment to settle. The use of a rock filter around the orifice weir which acts to reduce the potential for larger material to be filtered and the use of a fabric filter downstream of the discharge will assist in the removal of fine particles. While this will not remove all of the suspended sediment from the water column prior to leaving the PTL site, it will provide some benefits to water quality. Given

3 Assessment of Effects

these design features, it is considered that the potential adverse effects on the water quality of Taranaki Stream from the high flow discharge are minor.

It is also noted that the impacts on the water quality of Taranaki Stream from stormwater discharge events were considered and consented as part of CRC061218. However, it is the conditions that were attached to CRC061218 (and CRC061217) that are considered largely inappropriate for the purpose of monitoring the water quality effects on Taranaki Stream. Therefore, it is proposed that the conditions attached to CRC061218 and CRC061217 be altered to reflect the continuous flow discharge and the impacts that the natural wetland on Preeces Road has on water quality. Furthermore, it is considered that the measurement of sediment depth is unwarranted given the existing conditions of Taranaki Stream, which is clearly affected by stock pugging the bed and banks of the stream.

Condition 13 of CRC061218 states:

> *"The consent holder shall sample annually during a discharge from the wetland to the Taranaki Stream, the sediment depth, water clarity, dissolved oxygen, pH, and temperature in the Taranaki Stream. Sampling shall include sampling points both up and downstream of Mapleham. These sampling points shall be easily identified and accessible. A map showing the location of these sampling points shall be submitted to Canterbury Regional council at least 10 working days prior to the first sampling round."*

Condition 14 of CRC061218 states:

> *"The results of the sampling in condition 13 shall meet the following criteria: The increase in the depth of sediment at the downstream site shall not be more than 10 percent higher than that which has occurred in the upstream site. Water clarity shall not be reduced by more than 20 percent in the downstream sample. The dissolved oxygen concentration in the downstream sample shall not be lower than that in the upstream sample. There shall not be more than a 0.5 unit difference in the pH in the downstream sample compared with the upstream sample. The water temperature in the downstream sample shall not be more than three degrees Celsius higher than n the upstream sample."*

It is proposed that condition 13 and 14 are deleted and replaced with an alterative condition.

In-situ sampling is still required but the sampling regime also includes sampling for turbidity, dissolved metals, and nutrients. These parameters are important water quality parameters that should be captured from any continuous discharge from Taerutu Gully. It is proposed that the same time frame for sampling is applied while the locations of sampling are made specific to the point immediately downstream of the last treatment device (Site A, Figure 3-4). It is noted that the samples collected to date have been from the area immediately adjacent to the culvert discharge.

Given the nature of the downstream environment it is considered that condition 14, which contains triggers, is not required. If the sampling indicates a significant reduction in water quality it is considered that the Regional Council can review the discharge consent to address the issue.

3 Assessment of Effects

If condition 13 of CRC061218 is to be retained, then it is considered that the location of the sampling is changed to reflect the true nature of the discharge. The location of the proposed sampling sites is shown below (Site A and Site B). Site A would provide details on the quality of the water associated with the discharge from Taerutu Gully while Site B would provide information on the water quality associated with Taranaki Stream.

Figure 3-4 Proposed Sampling Locations

Given the proposed monitoring conditions, it is considered that the potential for there to be unforeseen adverse effects arising as a consequence of the discharge from Taerutu gully is relatively minor.

3.4 Summary

The changes to the discharge frequency and nature from Taerutu gully have been assessed as having no more than minor effects on the environment and people. Increased monitoring has been proposed which seeks to address some of the uncertainty around the timing and magnitude of discharge events, and the water quality associated with the discharge. It has also been shown that the existing monitoring conditions are inappropriate for the purpose of determining the effects of the discharge on water quality in Taranaki Stream.

Overall, it is considered that the continuous low flow discharge from Taerutu Gully will have negligible effects on flood risk and water quality in Taranaki Stream. Stormwater discharge effects will continue to operate as intended. However, increased monitoring will enable PTL and Environment Canterbury to measure the effectiveness of Taerutu gully in retaining stormwater events from the Mapleham lakes.

4

Conclusions

The hydrology of Taerutu Gully has a continuous natural flow through to Taranaki Stream which guarantees a base flow in the stream throughout the year. The orifice weir was installed during construction to allow a constant natural flow of water through Taerutu gully to old Taranaki Stream, which has been measured to be approximately to be 3-5 litres per second. During natural overflow the pipes of the orifice weir are visually above the water level.

The Waikuku Beach culvert on Taranaki Stream does not display a distinct seasonal trend of a higher stage height in the winter when compared to the summer months. Overall the stage height stays within an average range of 30 to 60 cm. The Taerutu gully discharge will have a negligible effect on the level of Taranaki Stream given that the measured flow is 3-5 Litres per second.

The existing water quality monitoring conditions are considered inappropriate, and it is recommended that they are changed.

Given the conditions proposed it is considered that the potential adverse effects are less than minor.

5

Limitations

5.1 Geotechnical & Hydro Geological Report

URS New Zealand Limited (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Pegasus Township Limited and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 12th of May 2011.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between 25th of June and the 23rd of August 2011 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

This report contains information obtained by inspection, sampling, testing or other means of investigation. This information is directly relevant only to the points in the ground where they were obtained at the time of the assessment. The borehole logs indicate the inferred ground conditions only at the specific locations tested. The precision with which conditions are indicated depends largely on the frequency and method of sampling, and the uniformity of conditions as constrained by the project budget limitations. The behaviour of groundwater and some aspects of contaminants in soil and groundwater are complex. Our conclusions are based upon the analytical data presented in this report and our experience. Future advances in regard to the understanding of chemicals and their behaviour, and changes in regulations affecting their management, could impact on our conclusions and recommendations regarding their potential presence on this site.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, URS must be notified of any such findings and be provided with an opportunity to review the recommendations of this report.

Whilst to the best of our knowledge information contained in this report is accurate at the date of issue, subsurface conditions, including groundwater levels can change in a limited time. Therefore this document and the information contained herein should only be regarded as valid at the time of the investigation unless otherwise explicitly stated in this report.

Appendix A Resource Consents – CRC061218 and CRC061217

RecordNo CRC061217

Consent Summary

Type Consent
Souce Applic /New

PermitType Discharge Permit

FileNo CO6C/25000-04

ClientID 45917 **ClientName** Pegasus Town Limited

To To discharge water and contaminants from new lakes associated with the golf course to an ephemeral watercourse, being Taerutu Gully, to Taranaki Stream

Location Mapleham Development, Main North Road, WOODEND

Status Current

Events

15/Feb/2006	Consent Commenced
15/Feb/2016	Lapse Date if not Given Effect To
31/Jan/2041	Consent Expires

Subject to the following conditions:

1) Discharge to Taranaki Stream from the lakes within the Mapleham golf course and residential complex, shall occur, via Taerutu Gully at or about:NZMS 260 M35 Grid 5766620 North, 2484740 East.

2) The maximum rate of discharge to the Taranaki Stream from the lakes shall not be more than the rate of discharge from the land, in its state before the development commences, for all events up to the 1 in 50 year return period storm for the critical duration of the land before development.

3) A certificate signed by the person responsible for designing the stormwater system, or a competent person, shall be submitted to Canterbury Regional Council within one month of construction, to certify that the system has been constructed and installed in accordance with the plans, design details and procedures submitted with the application as required by conditions 1-2 of this consent.

4) The consent holder shall take all practicable measures to avoid spillages of contaminants into the lakes. In the event of any accidental spillage, the consent holder shall inform Canterbury Regional Council within 24 hours of the event, and shall provide the following information:The date, time, location, and estimated volume of the spillage.The cause of the spillage, details of the steps taken to control and remediate the effects of the spill on the receiving environment, and measures taken to prevent a reoccurrence.

5) The consent holder shall ensure that an on-going record is kept of the number of times per year that water from the lakes is discharged into Taerutu Gully, including a record of the level that the wetland in Taerutu Gully rises to in situations of discharge. Copies of these records shall be provided to Canterbury Regional Council on request.

6) The consent holder shall ensure that the receiving environment immediately downstream of the wetland rock filters at Taerutu Gully is inspected monthly on an ongoing basis to identify if there is evidence of settled material or scour. Copies of these records shall be provided to Canterbury Regional Council on request.

7) The consent holder shall sample annually during a discharge from the wetland to the Taranaki Stream, the sediment depth, water clarity, dissolved oxygen, pH, and temperature in the Taranaki Stream. Sampling shall include sampling points both up and downstream of Mapleham. These sampling points shall be easily identified and accessible, and the upstream sampling point shall be located no more than 200 metres upstream of Mapleham. A map showing the location of these sampling points shall be submitted to Canterbury Regional Council at least 10 working days prior to the first sampling period.

8) The results of the sampling in condition 7 shall meet the following criteria:The increase in the depth of sediment at the downstream site shall not be more than 10 percent higher than that which has occurred in the upstream site.Water clarity shall not be reduced by more than 20 percent in the downstream sample from the upstream sample.The dissolved oxygen concentration in the downstream sample shall not be lower than that in the upstream sample.There shall not be more than a 0.5 unit difference in the pH in the downstream sample compared with the upstream sample.The water temperature in the downstream sample shall not be more than three degrees Celsius higher than that in the upstream sample.

9) The results of the samples taken in Condition 7 shall be submitted to Canterbury Regional Council within 30 working days of the date of sampling. Where results exceed the requirements of Condition 8 the report shall provide an explanation for these and where necessary provide details of how the stormwater system will be changed to ensure compliance with Condition 8 in future sampling.

10) Records of the operation and maintenance of the stormwater system shall be kept. The records shall include, but not be limited to information that demonstrates compliance with the management plan referred to in condition 11 of this consent. Copies of these records shall be provided to Canterbury Regional Council on request.

11) A Stormwater Management Plan detailing the operation and maintenance of the stormwater system, including measures undertaken to ensure compliance with conditions 4 to 10, shall be developed for the site and submitted to Canterbury Regional Council at least 10 working days prior to the operation of the system. A copy shall also be held by the consent holder along with a copy of the consent. The consent holder shall comply with the provisions of this plan at all times. Where necessary, this Plan may be reviewed and updated and resubmitted to Canterbury Regional Council.

12) Operation and maintenance of the stormwater system shall at all times be in accordance with the Stormwater Management Plan required by condition 11 of this consent.

13) Discharge of treated stormwater from Taerutu Gully to Taranaki Stream shall only be as described in the application and shall be located at or about NZMS 260 M35: 5766620 North-2484740 East.

14) Stormwater secondary flow paths shall be designed such that when flows exceed the capacity of the proposed system due to an extreme rainfall event, the overland flows from Mapleham will not have an adverse effect off-site.

15) Pursuant to Section 128 of the Act or the Resource Management Act, the Canterbury Regional Council may review the conditions of the consent by serving notice on any of the last five working days of January each year, for any of the following purposes:To deal with any adverse effect on the environment which may arise from the exercise of the consent and which it is appropriate to deal with at a later stage, orTo require the consent holder to adopt the best practicable option to remove or reduce any adverse effect on the environment.

16) The lapsing provisions of Section 125 of the Act or the Resource Management Act will apply on expiry of ten years from the date of commencement of this consent.

RecordNo CRC061218

Consent Summary

Type Consent
Souce Applic /New

PermitType Discharge Permit

FileNo CO6C/25000-04

ClientID 45917 **ClientName** Pegasus Town Limited

To To discharge stormwater to land and water, and to land in circumstances where it may enter water.

Location Mapleham Development, Main North Road, WOODEND

Status Current

Events

15/Feb/2006	Consent Commenced
15/Feb/2016	Lapse Date if not Given Effect To
31/Jan/2041	Consent Expires

Subject to the following conditions:

1) Stormwater discharge to Taranaki Stream via swales and artificial waterbodies from roads, roofs, hardstand areas, tees and greens within the Mapleham golf course and residential complex, shall occur, as shown in the Figure CRC061218, at or about:NZMS 260 M35 Grid 5766620 North, 2484740 East,NZMS 260 M35 Grid 5766500 North, 2484000 East; andNZMS 260 M35 Grid 5766770 North, 2484500 East

2) There shall be no untreated discharge from roads, roofs, hardstand areas, tees and greens to Taerutu Gully or Taranaki Stream.

3) Design, construction and management of the stormwater system including grassed swales and artificial waterbodies, shall be carried out in accordance with the design details and procedures provided in the Stormwater Management Report in the application.

4) The maximum rate of discharge to the Taranaki Stream from the stormwater treatment system shall not be more than the rate of discharge from the land, in its state before the development commences, for all events up to the 50 year return period storm for the critical duration of the land before development.

5) A certificate signed by the person responsible for designing the stormwater system, or a competent person, shall be submitted to the Canterbury Regional Council within one month of construction, to certify that the system has been constructed and installed in accordance with the plans, design details and procedures submitted with the application as required by conditions 1-4 of this consent.

6) At least one month prior to the construction of each stage of the development the consent holder shall submit to the Canterbury Regional Council:design plans for the stormwater treatment and disposal system, including the sumps; andany additional assessments and calculations not included in the application that are necessary and have been undertaken to ensure compliance with Conditions 1-4 of this consent.

7) The consent holder shall take all practicable measures to avoid spillages of contaminants to the stormwater system. In the event of any accidental spillage, the consent holder shall inform Canterbury Regional Council within 24 hours of the event, and shall provide the following information:The date, time, location, and estimated volume of the spillage.The cause of the spillage, details of the steps taken to control and remediate the effects of the spill on the receiving environment, and measures taken to prevent a reoccurrence.

8) All catchpits, swales, filter strips, rain gardens and artificial waterbodies shall be inspected at least once every six months. Any visible sediment and litter on the swales shall be removed immediately. All other necessary measures shall be undertaken to ensure that the catchpits, swales, filter strips, rain gardens and artificial waterbodies are operating in accordance with the design details and procedures specified in condition 3.

9) As a means of providing for their appropriate disposal all sediments removed from the stormwater system shall be tested to determine the concentration of copper, lead, zinc and total petroleum hydrocarbons. The tests shall be carried out by a laboratory accredited for the above tests. Should the concentrations found exceed the sediments shall be disposed of at an appropriate facility. A certificate shall be retained by the applicant showing the volume and location of disposal. This certificate shall be made available to Canterbury Regional Council on request.

10) All swales, filter strips, rain gardens and artificial waterbodies shall be regularly maintained to ensure that vegetation is in a healthy and uniform state.

11) The consent holder shall ensure that an on-going record is kept of the number of times per year that water from the artificial waterbodies is discharged into Taerutu Gully, including a record of the level that the wetland in Taerutu Gully rises to in situations of discharge. Copies of these records shall be provided to Canterbury Regional Council on request.

12) The consent holder shall ensure that the receiving environment immediately downstream of the wetland rock filters at Taerutu Gully is inspected monthly on an ongoing basis to identify if there is evidence of settled material or scour. Copies of these records shall be provided to the Canterbury Regional Council on request.

13) The consent holder shall sample annually during a discharge from the wetland to the Taranaki Stream, the sediment depth, water clarity, dissolved oxygen, pH, and temperature in the Taranaki Stream. Sampling shall include sampling points both up and downstream of Mapleham. These sampling points shall be easily identified and accessible. A map showing the location of these sampling points shall be submitted to Canterbury Regional Council at least 10 working days prior to the first sampling period.

14) The results of the sampling in condition 13 shall meet the following criteria:The increase in the depth of sediment at the downstream site shall not be more than 10 percent higher than that which has occurred in the upstream site.Water clarity shall not be reduced by more than 20 percent in the downstream sample from the upstream sample.The dissolved oxygen concentration in the downstream sample shall not be lower than that in the upstream sample.There shall not be more than a 0.5 unit difference in the pH in the downstream sample compared with the upstream sample.The water temperature in the downstream sample shall not be more than three degrees Celsius higher than that in the upstream sample.

15) The results of the samples taken in Condition 13 shall be submitted to Environment Canterbury within 30 working days of the date of sampling. Where results exceed the requirements of Condition 13 the report shall provide an explanation for these and where necessary provide details of how the stormwater system will be changed to ensure compliance with Condition 13 in future sampling.

16) Records of the operation and maintenance of the stormwater system shall be kept. The records shall include, but not be limited to information that demonstrates compliance with the management plan referred to in condition 11 of this consent. Copies of these records shall be provided to the Environment Canterbury on request.

17) A Stormwater Management Plan detailing the operation and maintenance of the stormwater system, including measures undertaken to ensure compliance with conditions 6 to 15, shall be developed for the site and submitted to Canterbury Regional Council at least 10 working days prior to the operation of the system. A copy shall also be held by the consent holder along with a copy of the consent. The consent holder shall comply with the provisions of this plan at all times. Where necessary, this Plan may be reviewed and updated and resubmitted to Canterbury Regional Council.

18) Operation and maintenance of the stormwater system shall at all times be in accordance with the Stormwater Management Plan required by condition 16 of this consent.

19) Discharge of treated stormwater from Taerutu Gully to Taranaki Stream shall only be as described in the application and shall be located at or about NZMS 260 M35: 5766620 North -2484740 East

20) Stormwater secondary flowpaths shall be designed such that when flows exceed the capacity of the proposed system for all events up to the 1 in 100 year return period storm, the overland flows from Mapleham will not have an adverse effect off-site.

21) Pursuant to Section 128 of the Act or the Resource Management Act, the Canterbury Regional Council may review the conditions of the consent by serving notice on any of the last five working days of January each year, for any of the following purposes:To deal with any adverse effect on the environment which may arise from the exercise of the consent and which it is appropriate to deal with at a later stage, orTo require the consent holder to adopt the best practicable option to remove or reduce any adverse effect on the environment

22) The lapsing provisions of Section 125 of the Act or the Resource Management Act will apply on expiry of ten years from the date of commencement of this consent.

A

Appendix B Field Sheets of Site Inspections

Pegasus 22/02/11 Raining/overcast

Tavanaki Stream Gauge BM 0.65 @ 10.35am
M35/18059 1.245 (mbTOC - PVC) Dry? 10.50am

WMCA	South	3.195	11.05am
	North	2.44	11:07am

Logger removed from WMCA @ 11.15am

Site	WL (mbTOC)	Time
MWI	2.25	11.10 am
H	Dry	11.11
G	Dry	11.13
F	2.75	11.25
L	2.52	11.28
A	2.25	11.30
B	2.77	11.34
C	1.78	11.40
J	3.05	11.45
K	2.56	11.50
E	2.78	11.56
D_1	Dry	11.59
D_2	3.25	11.59
M	2.58	12.02

* next month:
- take cap for MWM with drilled hole to hang logger
- install logger (MWM)
- take permanent marker to name piezo
- make location map for Joel
- take GPS to record track and download to GIS

Water Quality

	ECMA	Downstream
pH	8.74 (9.09)	9.12
Temp	19.83	19.76
EC	268 µS	249 µS
Sal	0.14	0.13
ORP	186.0	200.9
DO%	81.8 (69.2)	84.1
DO	7.21 mg/L (6.36)	7.53
Clarity	2.2	2.3 (Kelly)

* EC at 12.50pm stream heaved up and down while sampling downstream site

PTL 14/05/11 (Sunny)

Taranaki Stream ~ 0.6 m @ 11.15 am (level logger download)
M35/18059 1.145 b TOC @ 11.30 am

WMCA South 3.21 @ 11.40am
WMCA North 2.435 11.46am

MWE	2.215	11.48	
H	Dry	11.49	
9		11.50	
F	2.73	11.56	
MWM	2.495	12.05	(Depth 7.6, hung logger at 6.60 mb TOC (PVC) started 12.30pm 14/05/11
L	2.53	12.20	
A	2.245	12.22	
B	2.635	12.25	(Baro logger)
C	1.68	12.32	
J	3.07	12.37	
K	2.38	12.41	
E	2.845	12.48	
O_1	3.75	12.54	
O_2	Dry	12.54	

CMA (& Duplicate)	Downstream
t 7.70	7.93
np 21.91 °C	22.4
nd. 0.365 mS/cm	0.32
343 µS/cm	288
l 0.17	0.14
? 117.59	58.0
y. 75.0 %.	86.5
6.45 mg/L	7.19
ity 31 cm	29.2 cm

Rookery

Pegasus - 23-05-2011 - J. Bensing / K. Cooksey

1005 Arrive Waikuku - Taranaki Creek
download data
~~Staff~~: 0.68

Well	dtw
M35/1809	0.96
~~M~~WCMA-S	3.275
WCMA-N	2.53
MWI	2.265
MWH	Dry
MWG	Dry
MWF	2.765
MWK	2.45
MWC	1.68
MWB	2.68
MWA	2.28
MWL	2.535
MWJ	3.11
MWE	2.87
MWD2 ~~MWD1~~	dry
MWD1 ~~MWD2~~	3.795 (effluent smell)
MWM	2.465

Taerutu Gully
Pegasus - 23-05-2011 J. Bensing / K

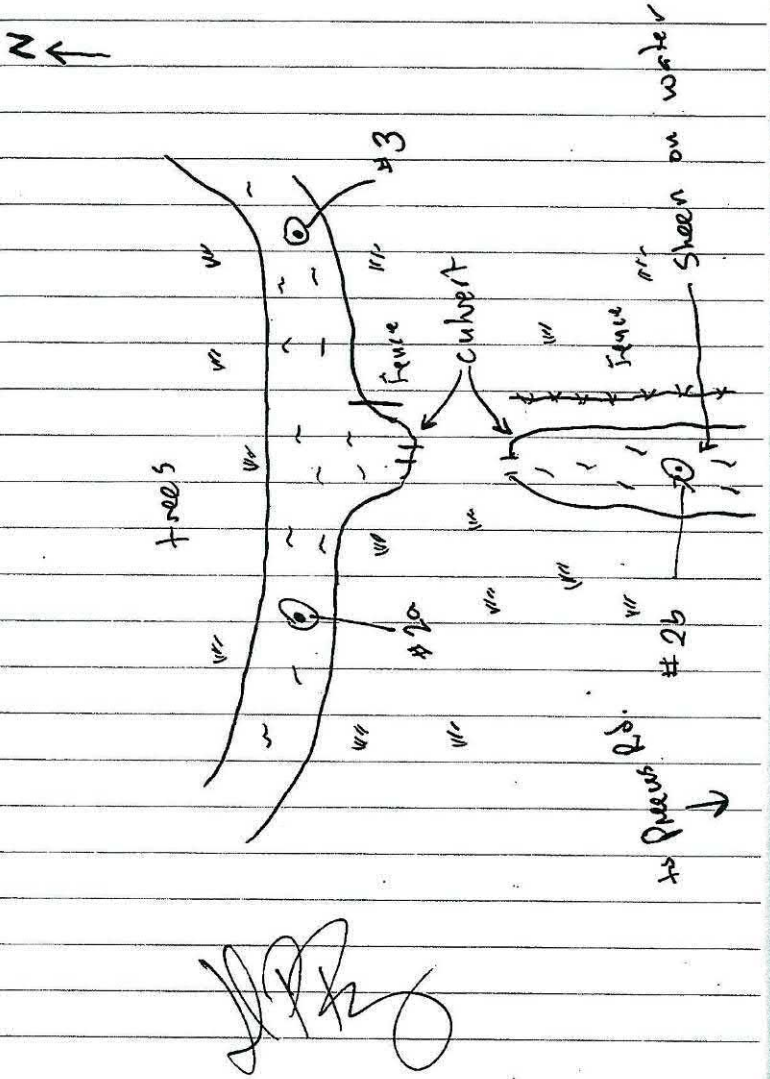
ECMA 1200

Clarity = >60
pH = 6.5
T° = 11.35
Cond = 0.5 ~~m~~mS 296 µS
Salinit = 0.19
ORP = ~~1.68~~ 168
DO = 73.4%
Do = 8 mg

Taerutu Gully Sampling

Upstream sampling Pt (~2a)
pH = 7.32
T = 11.93
Con = 0.152 mS ; 114 µs
Sal = 0.07
ORP = 82.3
DO% = 62.6
DO mg = 6.78
Clarity = 31.2

Taeruta Gully 23-05-2011 J. Bensing / K Coolsen



Taeruta Gully 23-05-2011 J. Bensing /

Downstream (#3)

pH = 6.48
T = 11.58
Con = 0.138 mS 103 µS
Sal = 0.07
ORP = 114.6
DO% = 61.4
DO mg = 6.7
Clarity = 30.8

Collect lab sample
Taeruta Downstream #3 @ 1250

Upstream (2b)

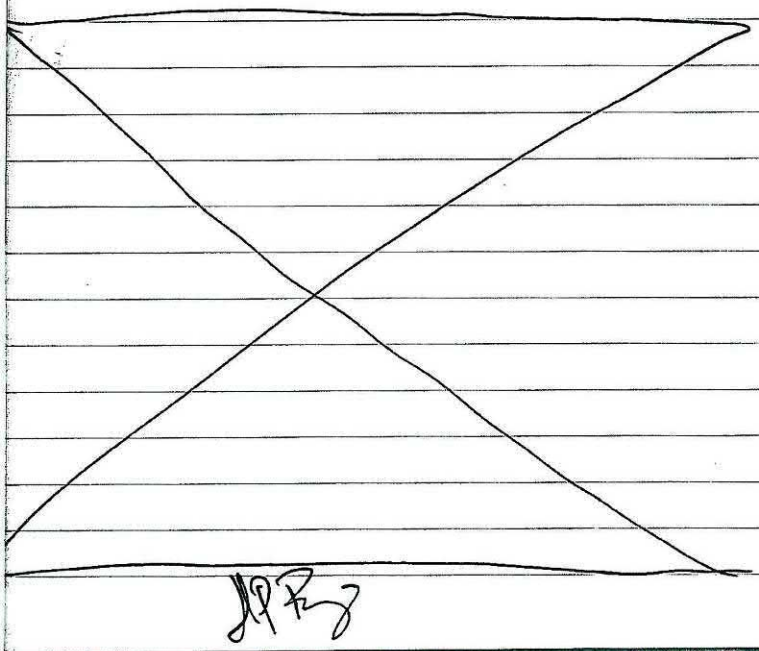
pH - 5.95
T 10.43
Cond 0.218 mS 158 µS
Sa 0.1
ORP 130.9
DO% 10.1
DO mg 1.12
Clarity = 30.0

Collect lab Sample #2b @ 1305

Mapleham Overbridge (#1)

Clarity = >60
pH = 7.3
T 11.68
Cond 0.159mS; 119µS
Sal 0.08
ORP 109.3
DO% 64.5
DOmg 7.03

Mapleham Overbridge #1 1325
Lab sample



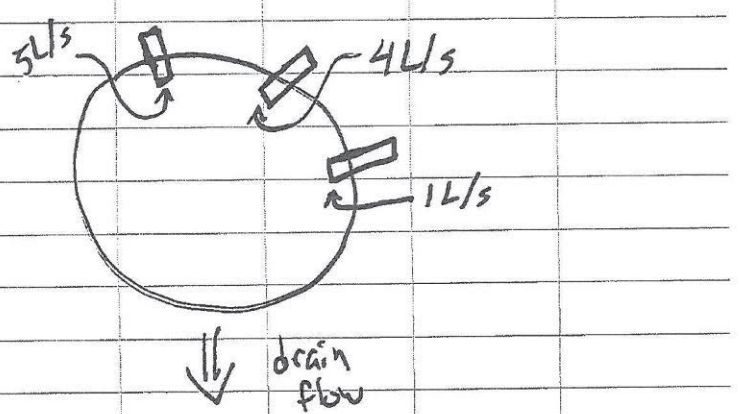
Pegasus J. Bensing N. Wells 01/06/2011

Taecutu gully sample.
down-stream side of culvert

sample name: PTG-01 @ 1155

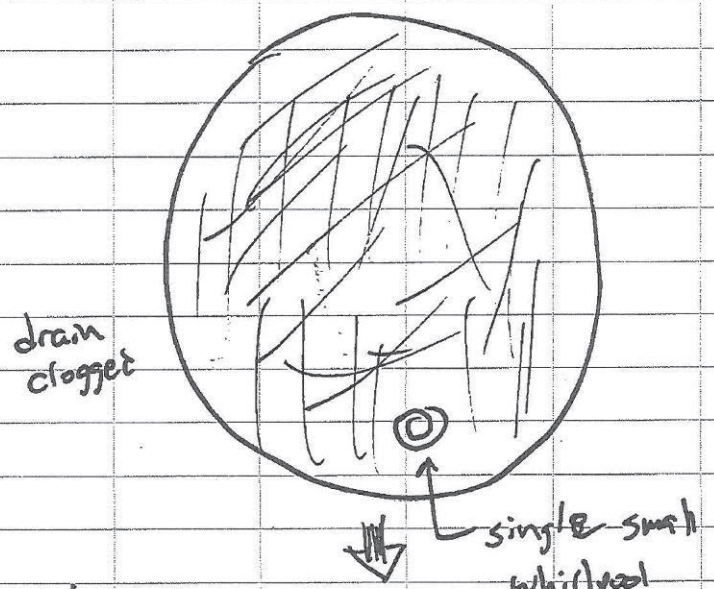
- water discharging at drain.
water on downstream side higher than rock ring at bubble-up.

Staff gauge @ 0.54



Pegasus J. Bensing N. Wells 01/06/2011

ECMA



Water discharging downstream

Pegasus 29/06/2011 Bensing | Wells

1030 Depart office. Go to Mike S. to pick up "Mighty Gripper"

Light rain following day of heavy rain.

1110 Waikuku overbridge
Staff gauge = 0.68 m.

well id	DTW
M35/18059	0.785
WCMA-S	3.337
WCMA-N	2.57
MWI	2.28
MWH	dry (?)
MWG	dry
MWF	2.755
MWK	2.483
MWC	1.690
MWB	2.703
MWL	2.535
MWM	2.465
MWA	2.255
MWJ	3.09

MWD 1	3.835
MWD 2	Dry
MWE	2.875

1300 Finish dip round head to ECMA for sampling

1320 ECMA : pH = 6.15
T = 8.03
0.404 mS/cm
272 µS/cm
0.19 SAL
144.6 ORP
72.1 Do %
8.41 Do mg/L
Collect Sample

1335 Move to Taeruta Gully sampling loc.

Staff gauge @ Taeruta Gully = 0.416m
Flow into drain est. 1.5 L/s

1350 Collect Sample PTG
↳

29/06/2011 Pegasus N. Wells J. Bensing

PTG: pH: 7.46
T: 7.59
0.163 mS/cm
109 µS/cm
0.08 SAL
624 ORP
78.5 DO%
9.35 DOmg/L

1410 Depart site to return to office

1450 Return to office

1530 Drive samples to Hills Lab - Hornby

1600 Return to office

Appendix C ECMA Water Quality Samples 2010 - 2011

Table 2-6 Monthly discharge water quality monitoring

Sample Name	ECMA Drain												Downstream											
Date	7-Apr-10	4-May-10	9-Jun-10	7-Jul-10	11-Aug-10	21-Sep-10	15-Oct-10	10-Nov-10	15-Dec-10	14-Jan-11	22-Feb-11	14-Mar-11	7-Apr-10	4-May-10	9-Jun-10	7-Jul-10	11-Aug-10	21-Sep-10	15-Oct-10	10-Nov-10	15-Dec-10	14-Jan-11	22-Feb-11	14-Mar-11
Laboratory Reference	781472.1	789442.1	799242.1	806983.1	816475.1	829084.1	837225.1	844555.1	854540.1	859814.1	876591.1	877076.1	781472.4	-	799242.3	806983.3	816475.3	829084.3	837225.3	844555.3	854540.3	859814.3	876591.2	877076.3
Laboratory Water Quality Parameters*																								
Turbidity (NTU)	6.3	13.7	6.2	7.9	7.8	5.3	10.1	10.3	17.7	16.7	9.1	13.8	7.0	nm	5.4	7.1	6.4	6.3	7.2	9.2	7.4	13.6	8.6	14
pH (pH units)	8.2	7.8	7.3	7.6	7.7	7.9	7.6	8.5	9.2	7.7	7.4	7.8	-	-	-	-	-	-	-	-	-	-	-	-
Total Suspended Solids	4.9	14.4	4.0	6.0	7.0	5.0	15	8	28	38	17	25	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Copper	0.0029	0.00138	0.0023	0.0018	0.0026	0.0015	0.0022	0.0014	0.0012	< 0.0005	< 0.0005	< 0.0005	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Zinc	0.0061	< 0.0010	0.0011	0.0012	0.0012	0.0062	<0.0010	<0.0010	<0.0010	< 0.0010	< 0.0010	< 0.0010	-	-	-	-	-	-	-	-	-	-	-	-
Total Nitrogen	0.50	0.59	0.75	0.70	0.83	0.56	0.82	0.69	0.73	1.11	2.5	1.31	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate-N + Nitrite-N	0.0082	0.0061	0.149	0.149	0.191	0.091	0.07	0.018	0.005	< 0.002	0.003	0.009	-	-	-	-	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen (TKN)	0.49	0.59	0.60	0.55	0.64	0.47	0.75	0.67	0.73	1.11	2.5	1.31	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Reactive Phosphorus	0.064	0.043	0.060	0.026	0.029	0.019	0.016	0.064	0.118	0.011	0.070	0.014	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphorus	0.117	0.150	0.102	0.087	0.075	0.101	0.112	0.116	0.25	0.23	0.24	0.22	-	-	-	-	-	-	-	-	-	-	-	-
Escherichia coli (cfu / 100mL)	80	220	61	9	1	<1	3	4	24	240	nm	100	-	-	-	-	-	-	-	-	-	-	-	-
Field Measurements																								
pH	6.3	7.6	7.9	6.9	8.4	7.9	7.8	7.7	8.9	7.8	8.7	7.7	7.4	nm	8.8	7.0	8.2	8.2	7.17	7.5	8.9	7.8	9.12	7.93
Temperature (°C)	13.5	11.3	7.6	8.7	7.0	10.9	15.8	19.8	20.6	20.04	19.8	21.9	13.5	nm	7.6	7.9	7.6	11.07	15.77	20.07	20.92	21.2	19.76	22.4
Dissolved Oxygen (mg/L)	6.5	6.1	8.0	11.0	9.0	10.1	6.5	6.9	8.1	9.44	7.2	6.5	7.8	nm	8.6	11.2	10.4	10.02	6.58	7.23	8.59	6.8	7.53	7.19
Dissolved Oxygen Saturation (%)	67	60	72	102	80	98	70	81	96	110	84	78	80	nm	78	102	94	98	71	85	102	81	88	88
Water Clarity (cm)	>60	40	>60	>60	>60	>60	>60	54	40	33	22	31	>60	nm	>60	>60	>60	>60	>60	55	46	25	23	29.2

**all values in g/m³ unless otherwise stated*

nm - not measured

Results indicative only due to 22/02/11 earthquake