ENSURING A QUALITY OUTCOME – EXPERIENCES IN DELIVERING A THREE CUBICLE TOILET BLOCK IN A SEMI RURAL LOCATION

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ABSTRACT

In October 2008, Andrew.Stewart Ltd commissioned a three cubicle toilet block at Karekare Beach for Waitakere City Council. This paper presents our experiences over the last 8 years from the initial public hearing and Environment Court through to installation and commissioning.

How many consent conditions does it take to build a simple three cubicle toilet block in a semi-remote location?

In the case of the Karekare public toilets constructed in the Waitakere Ranges, the answer was 131, with these being spread over four different types of permits, including a:

- Land Use Consent under the Resource Management Act
- Wastewater Discharge Permit under the Resource Management Act
- License to Occupy park land under the Reserve Act
- Building Consent under the Building Act

From the Engineers Representative and Contractor's perspective, there was also the Traffic Management Plan, Health and Safety Plan and contractual commitments to comply with.

To increase the frustration of this project was the effort and expense the City Council had to go to, to get these consent, the extent of double up and overlap of agencies and departments, and overall lack of focused holistic management. This excludes the power of one public stakeholder to cause countless years of delays and wasted ratepayer money.

The end result of the consenting process was that the wastewater discharge consent tied the Council into brand specific treatment technology, which through the public hearing process ended up trebling in size and being enhanced with ultraviolet disinfection. This increased the cost of the system by approximately 25%.

Consultation for the land use consent and license to occupy the reserve resulted in the attempt to incorporate a portion of the now much larger treatment plant under the toilet block to reduce the loss of car parks on the site. This increased the cost of the toilet block by approximately 30%.

The paper covers planning issues, wastewater treatment and disposal, resource consenting, engineering design, and installation

KEYWORDS

Compliance, on site wastewater, planning, resource consents

1 INTRODUCTION

Karekare is approximately half an hours drive to the west of Waitakere City, and 45 minutes from Auckland City. The catchment is made up of four streams starting in the Waitakere Ranges, and flowing down to the west through steep sided rocky valleys of regenerating native bush. The streams converge near the beach and flow out to sea.

In addition to its approximately 170 residential properties, Karekare is a popular day trip destination for visitors from around the Auckland Region, with the car park area catering for approximately 70 cars, often full to capacity over summer weekends.

In October 2008, Andrew.Stewart Ltd commissioned a three cubicle toilet block at Karekare Beach for Waitakere City Council.

The original (now decommissioned) Karekare public toilet block is located across the road from the public car park (which forms the main accessway to the beach) making access to the toilets difficult. The toilets were difficult to find, old and were in poor condition.

The toilets were serviced by an old septic tank and standard trench disposal field located under the car park across the road and was often susceptible to damage. The old disposal field was also located immediately adjacent to a watercourse, within a flood plain, which represents a significant risk to stream water quality and public health.

Photograph 1: Karekare Public Toilets – Now Decommissioned

In 2001 Waitakere City Council (WCC) planned the replacement of the old toilet block. The new public toilet facilities and wastewater treatment and disposal system have a positive effect on the local community and visitors by providing toilet and changing facilities for public use. Karekare Beach experiences a large fluctuation in visitor numbers, typical of remote, but popular beaches, with huge increases over the summer months.

WWC's vision was to provide a toilet block in the car park that improves accessibility, visibility and security. The works would also ensure that the environmental impacts of visitors to Karekare were minimised and that the safety, hygiene and aesthetics of the toilet facilities were improved.

The new Karekare public toilet block is shown below in Photograph 2.

Photograph 2: The new Karekare Public Toilets

2 PLANNING AND DESIGN OF TOILET BLOCK

2.1 PLANNING ISSUES

Prior to construction of the new toilet block various consents were required. In total four types of consent conditions were issued, with a combined total of 131 consent conditions. The consents included:

- Land Use Consent under the Resource Management Act
- Wastewater Discharge Permit under the Resource Management Act
- License to Occupy park land under the Reserve Act
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2.2 DETERMINATION OF WASTEWATER FLOWS

The proposed design flows prepared by Riley Consultants were based on water meter readings taken over a three week peak summer period (21 December 2001 to 10 January 2002). These readings provided an average flow of $0.7m^3$/day and a peak flow of $1.98m^3$/day.

It should be noted that these flows, were recorded over the busiest time of the year, and therefore would be unlikely to be reached on a regular basis throughout the year.

It is also interesting to note that the maximum recorded flow of $1.98m^3$/day is marginally less than the maximum design flow of $2m^3$/day allowed as a permitted activity under Rule 5.5.20 of the Proposed Auckland Regional Plan: Air, Land and Water (permitted activity criteria being subject to other conditions also).

To allow for potential increased patronage, Riley Consultants designed the treatment system to cater for flow peaks of up to $4m^3$/day, with a daily peak treatment and discharge volume of $2m^3$/day. The $4m^3$ peaks are dealt with via a flow buffering tank with a pump delivering no more than $2m^3$ to the treatment plant.

The peak design flow of $4m^3$/day is equivalent to approximately 27 people per hour or 405 people per day (Based on 10 litres per person between 6:00am and 9:00pm). The peak discharge of $2m^3$/day is equivalent to 13 people per hour or 195 people per day. It was considered unlikely that the toilets would experience such patronage on a regular daily basis.

In order to minimise the volume of wastewater generated, the new toilet block was deigned to have typical wastewater reducing fixtures, such as:

- low flush / dual flush toilets
- push button taps.

The existing facilities, from which the water meter readings were taken, did not have wastewater reducing fixtures. Therefore, it increased the conservative nature of the flow estimates.

The design flow and peak discharge volume were therefore considered to be very conservative and unlikely to be reached regularly. Actual flow data is presented in Section 2.5.

2.3 ON SITE WASTEWATER TREATMENT SYSTEMS

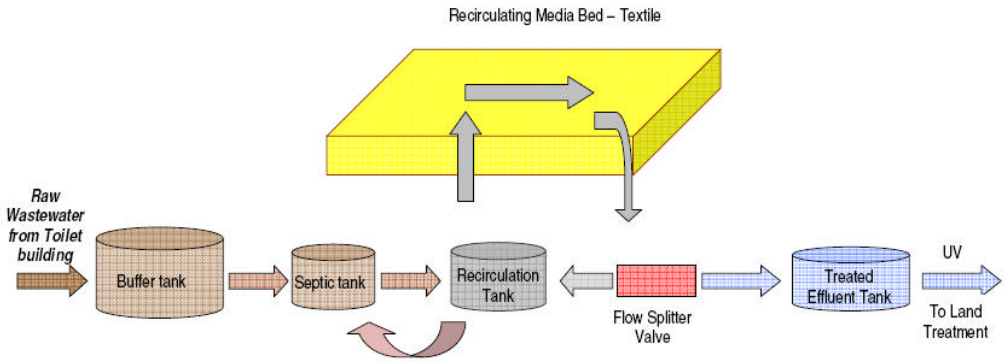
Karekare is unreticulated for wastewater so on site wastewater treatment and disposal had to be provided. Four on-site secondary wastewater treatment systems were considered:

- aerated package plant
- bottomless packed bed reactor
- recirculating sandfilter (RSF)
- recirculating packed bed reactor (rPBR)

A recirculating packed bed reactor was selected, as it was determined to be the most stable treatment system capable of handling fluctuating loads while having the smallest footprint.

This type of system is based on the well known recirculating sand filter system. However, rather than using sand it uses a textile medium which has a much greater surface area than sand, and therefore can accept a higher loading rate while achieving the same discharge standard. This results in a smaller treatment plant footprint.

Figure 2: Schematic Drawing of the Karekare Wastewater Treatment System



The installed system is diagrammatically shown in Figure 2, and comprises the following components:

- $9m^3$ buffer tank – receives untreated wastewater from the toilets and is designed to deal with peak flows in excess of $2m^3$ per day. The buffer tank is fitted with a pump that delivers no more than $2m^3$ per day to the septic tank.
- $5.2m^3$ septic tank fitted with effluent filter – this tank allows for more than 48 hours detention, sufficient for primary treatment. The effluent filter screens solid particles greater than 3mm in diameter reducing solids carryover to the secondary treatment system.
- $2.6m^3$ recirculation tank – provides timer controlled dose loading to the packed bed reactor.
- $3m^2$ packed bed reactor (1 x AX 100 pods) – the primary treated effluent percolates through the packed bed textile and collects at the bottom of the reactor where it gravity feeds back into the recirculation tank. Depending on the flows, 100% of the secondary treated effluent is returned to the reactor for dilution and further treatment. Under constant flow conditions, 20% (4:1 ratio) is split off and directed to the treated effluent tank. The textile media is provides a large surface area for biological attachment and growth. It is the biological activity that treats the wastewater.
- $2.6m^3$ treated effluent tank – a timer controlled pump delivers high quality secondary treated effluent in controlled doses to the UV disinfection system prior to final land disposal.

All of these components (excluding the AX100 pod) are sealed units located below the ground surface. Access risers extend approximately 0.5 metres above the ground to ensure lids and vents are above the 100-year flood plain and the area is contoured to improve the aesthetics of the toilet block. The lids are also watertight, further protecting against stormwater infiltration.

As is stated by TP58[1], recirculating packed bed reactors are suitable for sites having intermittent or variable wastewater production and strength, capable of achieving a high quality effluent. To meet the discharge consent standards and facilitate Nitrogen removal, the system has been design with the ability to reduce Nitrogen further by the addition of supplementary Carbon and alkalinity (these are not currently being added).

For comparative purposes, Table 1 provides typical effluent from a septic tank versus that achievable by a recirculating packed bed reactor.

Table 1: Typical Treatment Quality - Primary vs Recirculating Packed Bed Reactor

CONSTITUENT	SEPTIC TANK WITH EFFLUENT FILTER	RECIRCULATING PACKED BED REACTOR	DISCHARGE CONSENT
BOD_5	70 –120mg/l	15mg/l	15mg/l
TSS	25 – 30mg/l	15mg/l	15mg/l
Total Nitrogen	40 – 100mg/l	5-30mg/l[2]	5mg/l
Faecal coliforms	100,000 MPN/100mls	1,000 – 10,000 MPN/100mls	
		200 MPN/100mls[3]	200 MPN/100mls

A remote monitoring alarm is installed and is connected to a WCC central control centre via an Irrinet platform. This type of system immediately alerts the operating company when an alarm is triggered (i.e. if a pump fails within one of the tanks). If necessary, emergency on-site storage can be utilised while the problem is rectified. The overall system has in excess of 24 hours emergency on-site storage.

2.4 CONSIDERATION OF DISPOSAL FIELD OPTIONS

Waitakere City Council considered a number of locations for disposal of the treated wastewater:

- Slopes above the toilet block
- Memorial Garden
- Cave Track area
- Watchman Road Wetland
- Union Bay (up Watchman Road)
- Pine Tree Plantation
- Southern Sand Dunes.

The slopes above the toilet block were considered unsuitable from an engineering perspective due to steep slopes, lack of an adequate soil horizon overlaying the rock and a high water table in winter. Preliminary discussions with the Auckland Regional Council indicated that they also believed that this would not be a suitable option.

Memorial Garden was considered unsuitable due to steep slopes, available area, and the local importance of the gardens.

The Cave Track area was also found to be unsuitable due to similar environmental constraints as the slopes above the toilet block. The site is also of cultural significance to local iwi.

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[1] Auckland Regional Council (August 2004). "On-Site Wastewater Disposal from Households and Institutions." *The New Zealand Manual of Alternative Wastewater Treatment and Disposal Systems, Volume 2, Part A*. ARC Technical Publication No.58, Third Edition. Published by Auckland Regional Council.

[2] Nitrogen reduction to 5mg/L was an optional extra, which is achieved by diverting a portion of the recirculated flow back to the septic tank and carbon/alkalinity dosing.

[3] Via Disinfection, limit required by Condition of Consent

Consultation on the Pine Tree Plantation area resulted in significant opposition from downstream property owners. They were concerned that the nearby watercourse, which runs through their properties, would become polluted.

Union Bay was found to be of cultural significance to local iwi. The area is also subject to high groundwater levels in winter and is subject to flooding. Therefore, it was deemed to be unsuitable for wastewater disposal

The Watchman Road wetland was considered inappropriate as it is a natural wetland area, and land disposal is the generally preferred method of disposal.

The southern sand dunes were considered the most suitable, due to:

- suitable soils for disposal of a secondary treated effluent
- sufficient area exists
- the dunes are located well above the winter ground water level
- the dunes are separated from nearby surface waters
- the dunes are well vegetated and stabilized.

Subsequent to a public consultation process, the Waitakere Community Board selected the southern sand dunes as the preferred disposal location.

The disposal field is at least 120m away from the permanent watercourse that drains to the beach. It is also more than 10 metres away from the base of the dune, which is in excess of the 10m separation distance required for secondary treated wastewater and category 2 -3 soils. This reduces to 5m for advanced tertiary treated wastewater.

Therefore based on the required separation distances, which have been set to ensure environmental protection, there will be no adverse effect on either permanent or seasonal water systems. The location of the disposal field in the sand dune depression also provides a degree of shelter from the wind and its erosive effects.

A long, thin rectangular shaped disposal field was decided upon (i.e. 40m long by 10m wide) rather than a wider square shape. This not only provides the same surface area but moves the disposal field away from the edge of the dune system.

Disposal of disinfected effluent is via approximately 400m^2 of UniRAAM pressure compensating dripper irrigation lines, which ensures even dosing of treated effluent. The dosing lines are pinned to the surface and threaded under the existing vegetation. The drippers have a mechanical seal to prevent root intrusion (which can result in disposal fields failing).

A 50% reserve area is also allowed for. It is important to note that this standby emergency disposal area is a standard design requirement.

Due to the free draining nature of the soils a loading rate of 5 litres per square metre per day was proposed. This is significantly lower than the 15 to 25 litres per square metre per day recommended by TP58 for these types of soils. This was done to address concerns of local residents and was a matter of much debate and concern during the public hearing and Environment Court process.

To highlight the conservative nature of the proposed disposal, a comparison between the proposed loading rate, required disposal area, and two New Zealand Standards is provided in

Table 2.

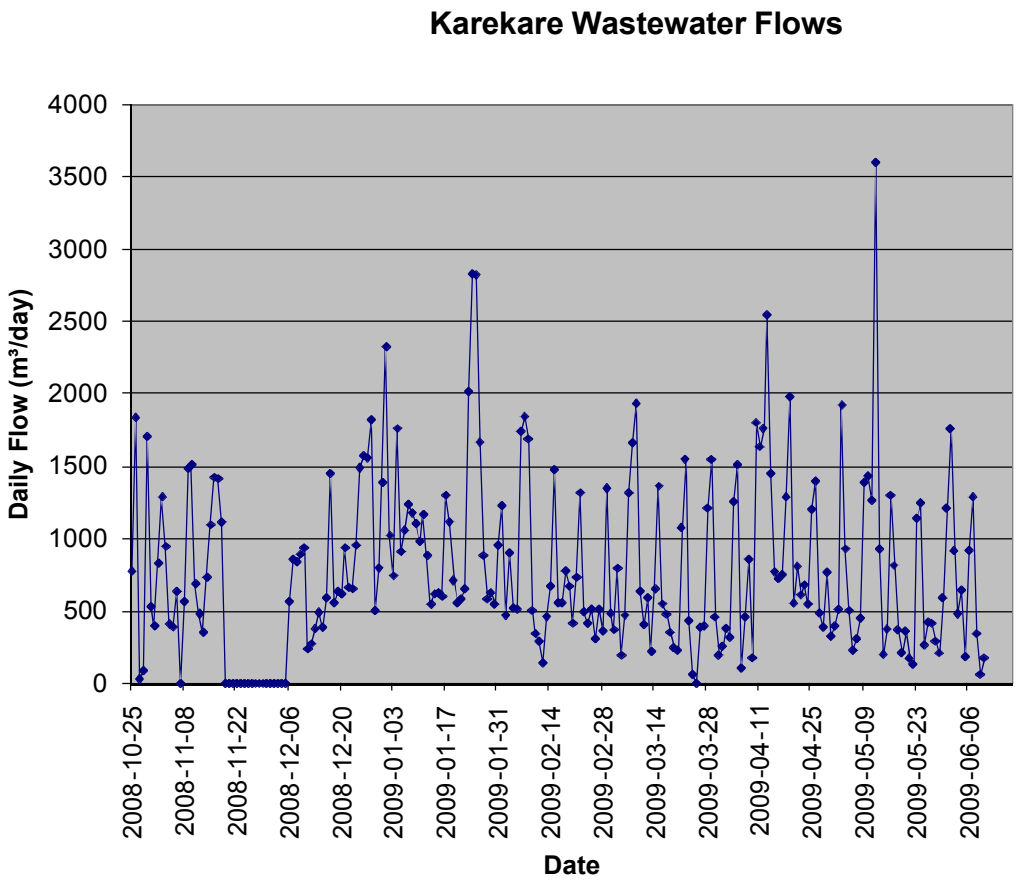
Table 2: Disposal Rates and Areas Required

STANDARD	CATEGORY 2 –3 SOILS	DISPOSAL AREA REQUIRED
TP58	15 – 25 l/m^2/day	133 – 80 m^2
AS/NZ 1547:2000[4]	28 – 35 l/m^2/day	71 – 57 m^2
Installed	5 l/m^2/day	400 m^2

2.5 CURRENT PERFORMANCE

The toilet block has been installed for approximately 9 months and during that time the wastewater treatment system has been operating effectively. For the period from the end of October 2008 to mid June 2009 the average flow rate through the treatment system is 840 litres per day which is close to the average design flow. During the peak periods, which correlate to public holidays, the flows through the treatment increased to greater than 2m^3/d. The flows during this period are shown in Figure 3.

Figure 3: Karekare Wastewater Flows



[4] Australian/New Zealand Standard 1547:2000 On-site Domestic-wastewater management. Standards Australia

The effluent quality is analysed on a quarterly basis. Table 3 below, shows the current performance of the treatment system from a single grab sample.

Table 3: Karekare Effluent Quality

CONSTITUENT	21st MAY 2009 EFFLUENT	DISCHARGE CONSENT
BOD_5	3mg/l	15mg/l
TSS	4mg/l	15mg/l
Total Nitrogen	64.5mg/l	5mg/l
Faecal coliforms	<2	200 MPN/100mls

It can be seen that for BOD, TSS and Faecal coliforms, the treatment plant is meeting its discharge consent requirements. The high Total Nitrogen in the effluent is likely to be due to the influent being carbon and possibly alkalinity limited. Waitakere City Council will undertake a full influent characterization during the peak months to determine the Nitrogen, alkalinity and available carbon concentrations.

3 CONCLUSIONS

It has taken nearly 8 years for Waitakere City Council to replace an old toilet block with one that fits in with the natural beauty of Karekare and a treatment system that protects the sensitive environment. The extensive planning requirements/consultation and attendance at the Environment Court not only delayed the installation but also significantly increased the cost of the toilet block and complexity of the on site wastewater treatment and disposal system.

Waitakere City Council considered a number of wastewater management options, and via the local community board selected on-site treatment and disposal to ground in the southern sand dune as the preferred approach.

The quality of the disinfected effluent produced by the treatment plant is of a high standard and meets discharge consent requirements for BOD, TSS and Faecal coliforms. However, due to the influent TN strength and carbon/alkalinity limitations further influent characterization is required. This will enable Waitakere City Council to determine whether carbon dosing and/or alkalinity dosing is required.

REFERENCES

Auckland Regional Council (August 2004). "On-Site Wastewater Disposal from Households and Institutions." *The New Zealand Manual of Alternative Wastewater Treatment and Disposal Systems, Volume 2, Part A.* ARC Technical Publication No.58, Third Edition. Published by Auckland Regional Council.

Australian/New Zealand Standard 1547:2000 On-site Domestic-wastewater management. Standards Australia