URS

28 June 2012
Project No. 42071748

Western Bay of Plenty District Council
1484 Cameron Road
Greerton
Tauranga

Attention: Peter Edwards
Operations Manager

Dear Peter

Subject: Katikati Wastewater Treatment Plant - Pipeline Hydraulic Testing

1 Introduction

Review and analysis of the above outfall has been carried out in accordance with the Phase 1 and 3A works outlined in URS New Zealand Limited's (URS's) proposal dated 24 November 2011, and in URS's proposal dated 7 March 2012. The work has involved both review and analysis of historical data and hydraulic testing of the outfall pipeline.

Based on information provided to URS the outfall pipeline is approximately 12,200m long and comprises the following sections from the effluent pump station at the Katikati WWTP through to the final discharge point in the ocean:

a. 192m long DN250 PN12.5 PE100 (203mm ID)

b. 2952m long DN200 PN12 uPVC (203mm ID)

c. 8325m long DN200 PN9 uPVC (208mm ID)

d. 8325m long 161mm ID CLS (ocean outfall section)

Performance of the outfall has been below it's design and consented capacity which presents limitations in terms of capacity, energy efficiency and accommodating longer term peak flows. The objective of this review is to identify the causes of the reduced performance and present recommendations for improvements.

2 Review Methodology

2.1 Site Inspection

A pump station and pipeline inspection was carried out on 2 and 3 May 2012 as part of the hydraulic testing. The pump station receives flow from a fixed weir at the end of the ultraviolet disinfection plant. Inflow to the pump station is therefore dictated by the effluent level in the wetland and cannot be varied. The pump station is understood to normally operate on a flow paced basis

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rather than intermittent operation, however periodic stopping is evident on the SCADA records reviewed.

2.2 Hydraulic Testing

Hydraulic testing was carried out on 3 May 2012 to provide a better understanding of the current pipeline performance in regard to the location and cause of hydraulic losses in the system. The work involved placement of pressure dataloggers in the following locations:

Location	Chainage*	High Speed Datalogging	Low Speed Datalogging
Pump Station Air Valve	0m	Yes	Yes
Air Valve SSVA0068	9,871m	Yes	Yes
Air Valve SSVA0066	10,955m	Yes	Yes
Air Valve SSVA0076	11,403m	Yes	No

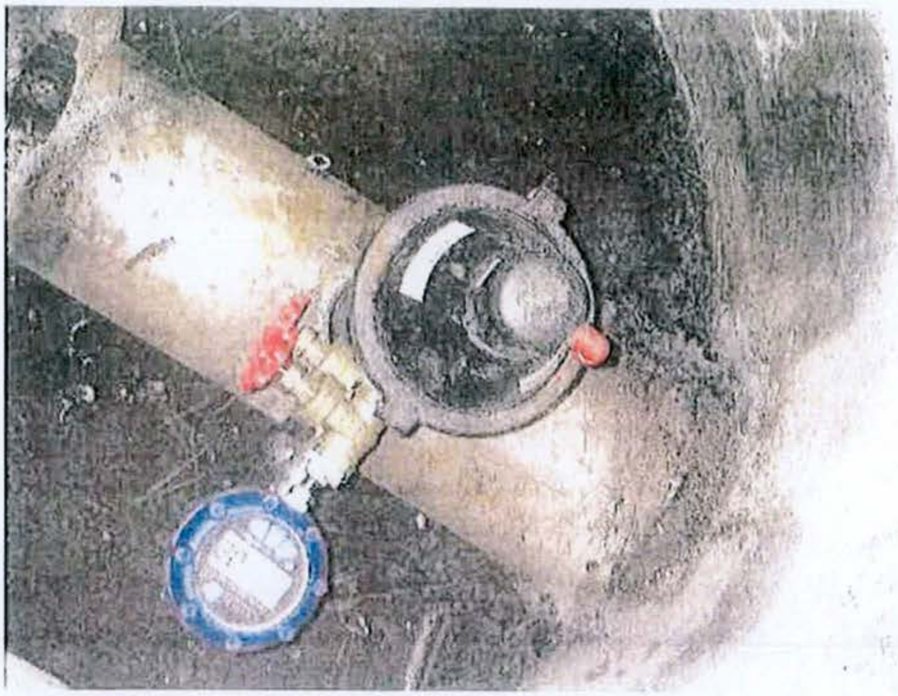
**Chainages have been estimated based on pipe section lengths presented in the Outfall Pump Station Operation and Maintenance Manual.*

The high speed dataloggers used were Madgetech PRTrans1000 type, with a logging frequency set at 0.2 second intervals. Low speed dataloggers were included at three of the air valves for improved steady state measurement accuracy and redundancy. Crystal XP2i models were used for the low speed dataloggers. Plate 2.1 shows the installed dataloggers (high speed model visible beneath low speed model).

Testing was carried out by incrementally raising the flow rate from zero to a peak steady state flow rate of 17.8 L/s, followed by successive flow reductions. Data from the peak flow rate and subsequent reductions were collated for analysis.

Level information for the air valves on Matakana Island were provided by Tiaki Engineering Consultants by accurate survey (see Section 2.3). The level of the pump station air valve was estimated from the pump station construction drawings.

Plate 2.1: Dual dataloggers installed on air valve connection



2.3 Other Background Information

Western Bay of Plenty District Council has provided a range of other information for review, including:

a) Transpacific Industries, 1 March 2012, CCTV survey of outfall pipeline section on Matakana Island

b) Tiaki Engineering Consultants, 17 May 2012, Letter to Western Bay of Plenty District Council regarding air and scour valve levels on Matakana Island.

c) Source unknown, Lontigitudinal Section Alignment – (6) across the inner Tauranga Habour

d) GIS plan outputs of the outfall pipeline across Matakana Island

e) Bruce Wallace Partners, Katakati WWTP Management Plan, pp 11-12

f) Bruce Wallace Partners, various hydraulic design data and pump curves

g) Resource consent (effluent discharge to ocean)

h) Duffill Watts Consulting Group, October 2007, Katikati Wastewater Treatment and Disposal Systenm and Report on Treated Effluent Discharge Alternatives

i) Duffill Watts and King Ltd, August 2007, Katikati Wastewater Outfall Pipeline – Structural Intergrity

j) SCADA outputs for the Katikati Outfall WWTP parameters for various periods.

3 Findings and Discussion

3.1 Air Management

The presence of air pockets in a pipeline can reduce hydraulic performance. For this reason air should be managed as far as practicable to limit entry into the system and provide for venting and/or flushing.

Currently pipeline venting is provided from air valves located at the pump station and at seven locations across Matakana Island. The air valves have recently been replaced with ARI D-021 combination air valves. These air valves are of limited venting/vacuum relief capacity for kinetic air (large orifice area of only 100mm^2) which will limit the rate of drain down during any line maintenance. A further limitation of the air valves is the small diameter tapping to the pipeline, which is likely to be resulting in poor capture of moving air bubbles and pockets.

The small orifice size on the air valves may also present some issues with providing adequate vacuum relief following a pump trip event. Preliminary model runs do however indicate that minimum pressures are unlikely to approach potentially damaging cavitation heads (namely -10m) during such an event, and hence should be acceptable. However, additional more detailed modelling would need to be carried out to confirm whether pressure transient issues exist and to provide more definitive comment.

Unvented high points in a pipeline can promote the formation and trapping of air pockets. It is understood that no asbuilt profile data for the outfall pipeline exists, except for the recent survey of the valve chambers on Matakana Island. The profile across the Tauranga Harbour is however expected to approximately follow the undulating bed topography, and accordingly could include descending gradients of around 2-3 degrees based on reference (c) in section 2.3. Similarly, the profile across Matakana Island clearly contains some undulations without air valves based on the ponding in the CCTV footage in reference (a). The CCTV footage also shows scum lines between ponding sections, which indicates the accumulation of air pockets.

It is likely that some air will be entering the outfall as entrained air via the pumps. Some air may also be coming out of solution over the length of the outfall as a result of reducing pressures and turbulence. An influent dropper has been recently installed in the pump station to reduce air entrainment associated with the 2-3 metre fall to the wetwell level. URS supports this concept, although some air entrainment can still be expected to occur. The base of the drop was not visible and hence it was not clear where the dropper stops relative to the minimum pumping level.

A further means of air entry into the outfall will occur at the times when the pump station is stopped. Inferred pump start data for the period December 2010 to November 2011 shows an average of around several start/stops per day, despite the flow paced pumping philosophy. Following stopping of the pumps, significant lengths of pipeline across Matakana Island are expected to drain as a result of the height above sea level (discharge point). It is questionable whether the current air valves and pipeline profile facilitate efficient or complete removal of this air.

To assess the ability of the current pipeline system to flush air which has entered, calculations have been carried out based on HR Wallingford research[1] for movement of air pockets. For the 200mm nominal diameter pipeline section and assuming a 3 degree worst case decent, the required flow rate to move air pockets is calculated to be between 28 L/s and 38 L/s depending on the size of the air pocket. This is well above the current peak flow rates and hence trapped air pockets can be expected to be currently forming in the pipeline.

Based on the information reviewed and air movement calculations, it is anticipated that a number of air pockets exist in the outfall pipeline and are having an adverse effect on the hydraulic performance. Additional discussion on performance is provided in Section 3.3 of this report. Recommendations to improve air management are provided in Section 4.

3.2 Slime Formation

The CCTV inspection identified what appears to be slime aggregation on the pipe walls which indicates inadequate flushing conditions. In some locations large deposits of this material are present. This material is expected to be causing a significant loss in hydraulic performance, both due to surface roughness and constriction of the pipe bore. Plate 3.1 provides an example view from the CCTV footage.

Plate 3.1: Internal Deposits on the Pipeline Walls

[1] HR Wallingford, 2005, Experimental and numerical studies on movement of air in water pipelines

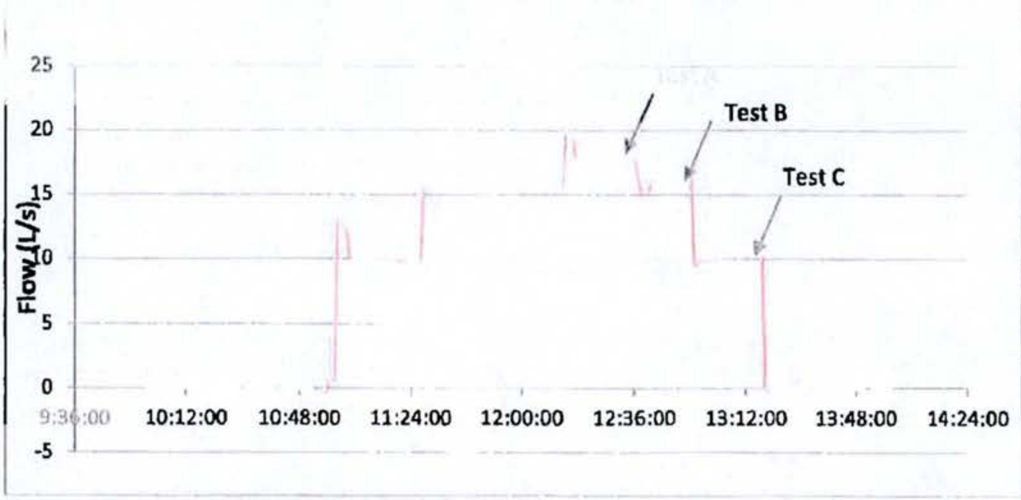
The required velocity to shear slime deposits is dependent in part on the hydraulic roughness of the pipeline. A typical shearing velocity to maintain a relatively clear 208mm ID sewer pressure main is indicated by guidelines[2] to be around 1 m/s (34 L/s).

3.3 Hydraulic Testing

Pressure and flow data from the testing on 3 May 2012 was compiled for assessment of hydraulic performance for the individual pipeline sections between dataloggers. Plots of SCADA and datalogger information are presented in Annex A.

Test data analysed was for the three steady-state periods commencing from the peak flow period as indicated in Figure 3.1.

Figure 3.1: 3 May 2012 Flows and Test Events



Test data was compiled and analysed to give the test outputs as presented in Table 3.1 and Figure 3.2.

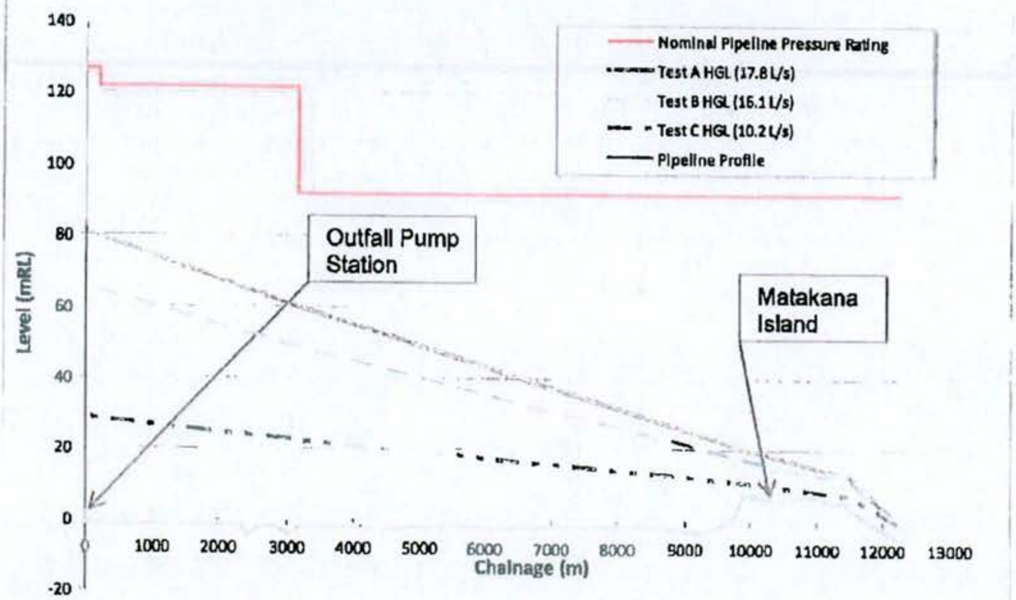
[2] Technological Standing committee on Hydrogen sulphide Corrosion in Sewerage Works, 1989, Hydrogen sulphide Control Manual – Volume 1

Table 3.1: 3 May 2012 Data Analysis

Test	A	B	C
Time	13:10	12:50	12:30
Flow (L/s)	17.8	16.1	10.2
Hydraulic Grade (mRL)			
Pump Station Air Valve	81.3	65.8	28.6
Air Valve AV0068	20.8	17.9	11.1
Air Valve AV0066	15.4	13.4	8.3
Air Valve AV0076	13.5	12.1	7.5
Ocean*	0.2	0.0	-0.1
Inferred Pipeline Roughness, k (mm) - Downstream Section			
Pump Station Air Valve	15.6	14.5	11.9
Air Valve AV0068	11.2	11.5	25.3
Air Valve AV0066	6.9	5.6	12.9
Air Valve AV0076	7.9	9.8	22.9

**Sea level estimated from LINZ tide projection charts and correlated to mRL.*

Figure 3.2: 3 May 2012 Inferred Hydraulic Grade Lines



As is evident from Table 3.1, roughness coefficients (k) are calculated as being very high at between 5.6mm and 25.3mm. By comparison, a well performing effluent pipeline with routine flushing and good air management could be expected to operate with a k value of less than 0.5mm. For each pipe section there is some variability in the k value between flow rates, and this expected to be a result of dynamic changes to air pocket shape, air pocket position, and wall slime profiles.

As a point of note, the initial pump station air valve pressure at zero flow was only 12.8 kPa at the start of testing (SCADA data). This is below the estimated static pressure of around 40 kPa and indicates some drain down had occurred. SCADA data does indicate around 30 minutes of reverse flow up to 4 L/s following the pump station shut down prior to the testing work (10:39am 2 May 2012). This reverse flow may have been manually initiated as it does not feature to any extent of note following other pump stops in the 2 May to 3 May 2012 SCADA data record.

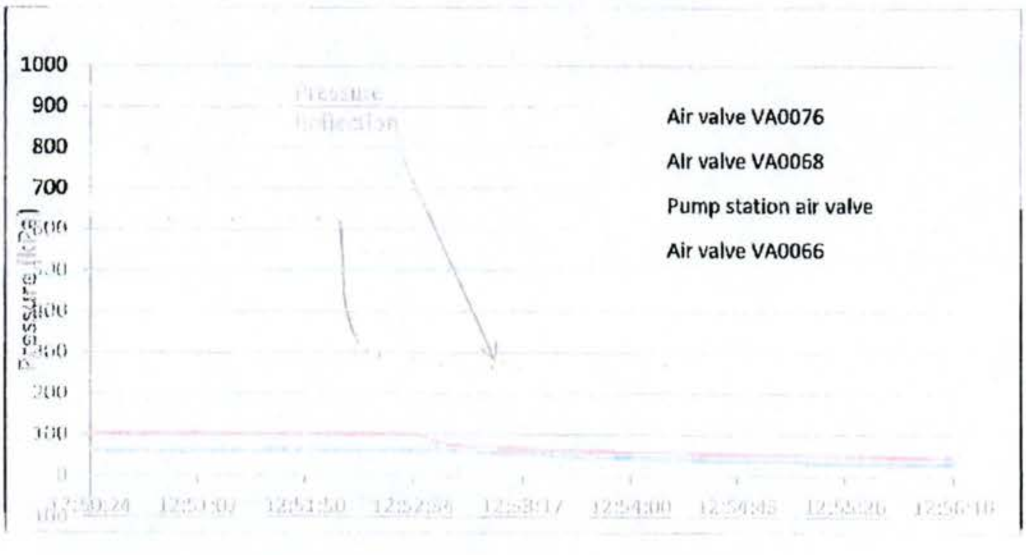
3.4 Analysis of Pressure Transients

The data from the high speed pressure dataloggers was reviewed for evidence of pressure trace characteristics which could indicate accumulated air. The following two aspects were noted:

i. The pump stop following Test C appears to have initiated a pressure oscillation between the pump station air valve and air valve SSVA0068 on Matakana Island (refer Figure A1, Annex A). The period of this wave is approximately 126 seconds, which based on the estimated chainage for air valve SSVA0068 correlates to a wave speed of 313 m/s. This is around 10% to 20% lower than the theoretical wavespeed for the subject pipeline section which is indicative of some air presence. The fraction of air is not expected to be large based on this data, although further calculations could be carried out to provide better definition.

ii. The flow was deliberately reduced quickly from Test B to Test C in order to initiate a pressure translent (refer Figure 3.3). A small pressure reflection can be seen at the pump station air valve around 58 seconds following the pressure/flow reduction, and this is expected to be attributable to a modest air pocket in the pipeline. Assuming the inferred wavespeed of 313 m/s, the air pocket would be estimated to exist around chainage 9,000m to 9,200m. This location approximately correlates with a 500m long slowly descending section of the pipeline as inferred from reference (c) in section 2.3.

Figure 3.3: Test B to C Pressure Data



3.5 Fatigue

In 2011 URS carried out preliminary fatigue calculations for the uPVC pipeline sections based on pressure data for the weeks ending 10/2/11 and 20/8/11. These periods show relatively constant pump operation with less than one pump start per day which corroborates with data for July 2007 in the report by Duffill Watts & King Ltd3. However, inferred pump start data for the period December 2010 to November 2011 shows an average of around 4.4 start per day (refer Table 2) although the data is highly variable. Assuming the more conservative 4.4 starts per day and allowing for one start every <u>two</u> days reaching the pipeline pressure rating (ie during flush flows), the pipeline is not expected to require pressure derating for fatigue for around 100 years. Fatigue calculations are provided in Annex B.

Consideration has also been given to the test results for the exhumed pipe section in 2003, as reported in Duffill Watts & King Ltd's report. Of particular interest are the following test results:

a) Impact testing was carried out on 14 samples under the original manufacturing standard (NZS 7648). All tests passed indicating that the material has retained good mechanical strength and ductility.

b) Short-term hydrostatic pressure testing was carried out at 3.6 times the nominal pressure rating (namely 3.6 x 12 bar) in accordance with the manufacturing standard. The test passed indicating no unacceptable loss in pressure rating.

High temperature stress relief testing was also carried by IPLEX and advised to URS4. Whilst not required under the manufacturing standard at the time of pipe production (NZS 7648), URS are advised that findings from this test met the requirements of AS/NZS 1477. IPLEX comment that the test "passed with no sign of degradation in the sample, indicating a very good standard of gelation in the PVC-U material". Plate 3.1 shows the sample following testing.

Whilst, the available data indicates that the pipe material can be still expected to accommodate it's specified pressure, checking of the capacity of system joints and fittings would also be necessary. From discussions IPLEX Pipelines, it is understood that the backing rings on the flanged pipeline sections (nominally 50m section lengths) are likely to have been steel. It may be prudent to expose and inspect one of these joints for backing ring corrosion and hence possible loss of pressure capacity.

[3] Duffill Watts & King Ltd, 2007, Katikati Wastewater Outfall Pipeline – Structural Integrity Report to Environment Bay of Plenty
[4] Email from IPLEX Pipelines (Frank O'Callaghan) to URS dated 8 March 2012.

Plate 3.1: Pipeline sample subjected to high temperature stress relief testing

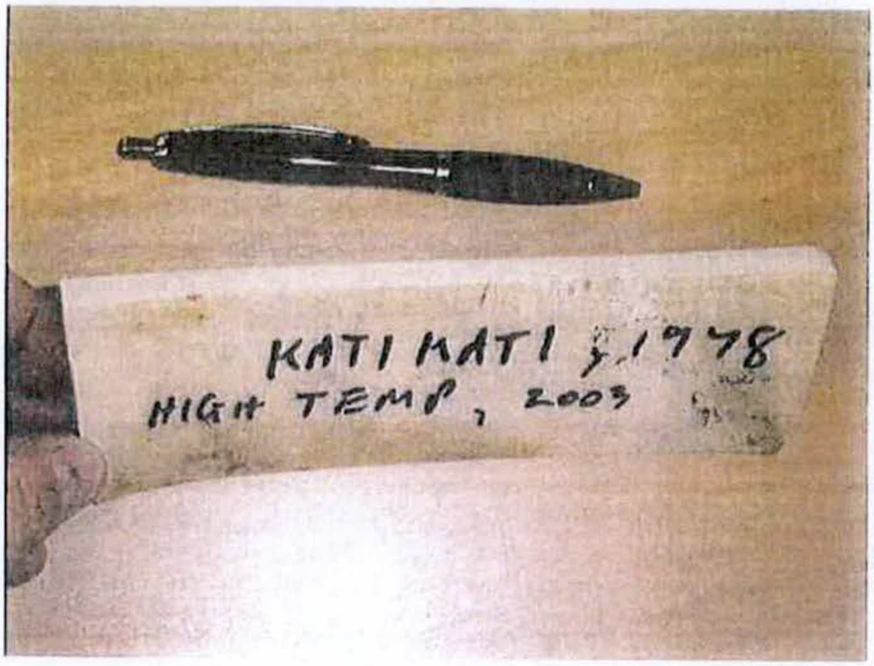


Photo courtesy of IPLEX Pipelines.

4 Recommendations

4.1 Air Management Improvements

There is a clear opportunity to improve management of air in the pipeline in order to increase hydraulic performance. Air management will need to address air entry at the pump station, air entry on Matakana Island during pump stops, air removal via air valves, and air flushing. On this basis the following improvements are recommended:

a) If practicable, raise the operating level in the pump station wetwell.

b) Review the performance of the new pump station inlet dropper in terms of minimising air entrainment. This could be by visual inspection and/or analysis (target entrained air should be less than 0.5% by volume).

c) Install a second air valve on a 200x150mm tee around 20m to 30m downstream of the pump station to intercept separated air. Resource consent for works in the Coastal Marine Area may be required.

d) Replace tappings for air valves at either side of Matakana Island (SSVA0068 and SSVA0076) with 200x150mm tees to improve air capture.

e) Modify pipework to create a high point around 30m upstream of air valve SSVA0076 to maintain full pipe conditions across Matakana Island. The design would remain subject to additional calculation but is envisaged to comprise an 11.25 degree rise and fall to a high point invert level around 9mRL (around 1m above existing ground level).

f) Provide routine flushing as discussed in section 4.4.

4.2 Confirm Fitting Pressure Ratings

Fatigue calculations and test data from an exhumed pipe section indicate that the pipeline should be capable of being operated at the specified pressure ratings. It is however recommended that the capacity and condition of the pipeline joints and fittings be checked. The inspection should include for example, the pressure ratings of air valves, pressure relief valves (and settings), and a physical inspection of at least one uPVC flanged joint in the tidal zone. Some replacement work may be required as an outcome from these inspections.

4.3 Line Pigging

Given the extent of deposits in the pipeline and the pipeline length, the most practicable method of cleaning is expected to be by pigging of the PE100 and uPVC sections. Cleaning and air flushing of the smaller diameter CLS ocean section is expected to be adequately acheived if flow rates can be elevated somewhat above 20 L/s.

A pigging operation would need a number of progressive passes given the mass of wall slimes and deposits which are likely to exist. The initial run is likely to use a soft foam proving pig or brush pig, followed by progressively firmer pig types. To enable pigging, a launcher would need to be installed at the pump station, with receiving of the pig occurring at the existing pig receiving chamber on Matakana Island. A transducer should be installed in each pig to enable tracking and/or location should the need arise.

A key consideration for a pigging operation would be the need to remain compliant with the current discharge consent for effluent quality, or obtain a further specific consent for the pigging exercise. To this end, a possible approach could be to monitor the effluent turbidity at the existing pig receiving chamber and divert the debris slugs from each run into tanker trucks or other temporary storage.

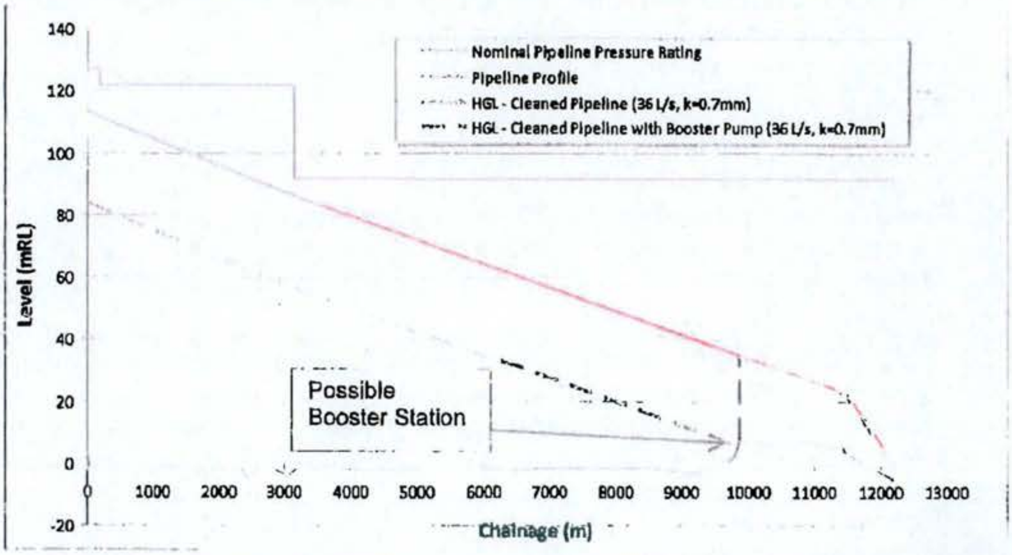
4.4 Routine Flushing

Following pigging of the pipeline, routine flushing flows are recommended to minimise slime formation and provide flushing of accumulated air pockets. Flushing at the peak consented flow rate of 130 m^3/hour (36 L/s) is expected to be generally adequate. Initially, it is recommended that flushing be carried out for two hours every two days. The frequency and duration of flushing would remain subject to ongoing operational experience and review of head/flow data.

Calculations for the pipeline have been carried out using an assumed "improved" roughness coefficient of k=0.7mm, following a pigging operation (namely removal of slimes and large air pockets). By comparison, a well maintained effluent pipeline with good air management could be expected to see k values of less than 0.5mm based on URS's experience. The calculations based on k=0.7mm indicate that it should be possible to flush the pipeline at 36 L/s and remain within the pipeline pressure ratings. This scenario is indicated by the red hydraulic grade line in Figure 4.1.

In the event that high friction persists and/or lower operating pressures are required, a booster pump station with a head break tank could be constructed on Matakana Island. The station would likely be diesel powered with telemetry controls to start and stop the booster pump during flushing flow or peak flow events. The design would also need to take into account matching the booster pump station with the WWTP pump station. A general arrangement for a booster pump station is indicated by the dashed green hydraulic grade line on Figure 4.1.

Figure 4.1: Indicative Scenarios for an Improved Performance Katikati Outfall Pipeline



In order to facilitate a routine flushing cycle it would be necessary to reconfigure the pump station to enable controlled higher flows from the wetland. Currently flows are limited by a fixed weir at the outlet of the UV treatment plant. To increase flows, it may be necessary to operate the wetlands at a slightly higher level and construct a second weir upstream of the UV plant. This second weir would have a bypass to release adequate flow to the pump station (via the UV plant) for the flushing events.

With regular flushing of the pipeline, it is not expected that routine pigging would be necessary.

5 Limitations

URS New Zealand Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Western Bay of Plenty District Council and only those third parties who have been authorised in writing by URS to rely on this 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 URS's proposals dated 24 November 2011 and 7 March 2012.

Where this Report indicates that information has been provided to URS by third parties, URS has made no independent verification of this information except as expressly stated in the Report. URS assumes no liability for any inaccuracies in or omissions to that information.

This Report was prepared between May and June 2012 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.

To the extent permitted by law, URS expressly disclaims and excludes liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this Report. URS does not admit that any action, liability or claim may exist or be available to any third party.

6 Closure

Please contact either of the undersigned if you have any questions regarding this assessment or wish to discuss aspects further.

Yours sincerely
URS New Zealand Limited

Matthew Reed
Senior Associate Engineer

Martin Evans
Senior Principal

ANNEX A
3 MAY 2012 TESTING – DATA PLOTS

Figure A1 - Datalogger Pressures

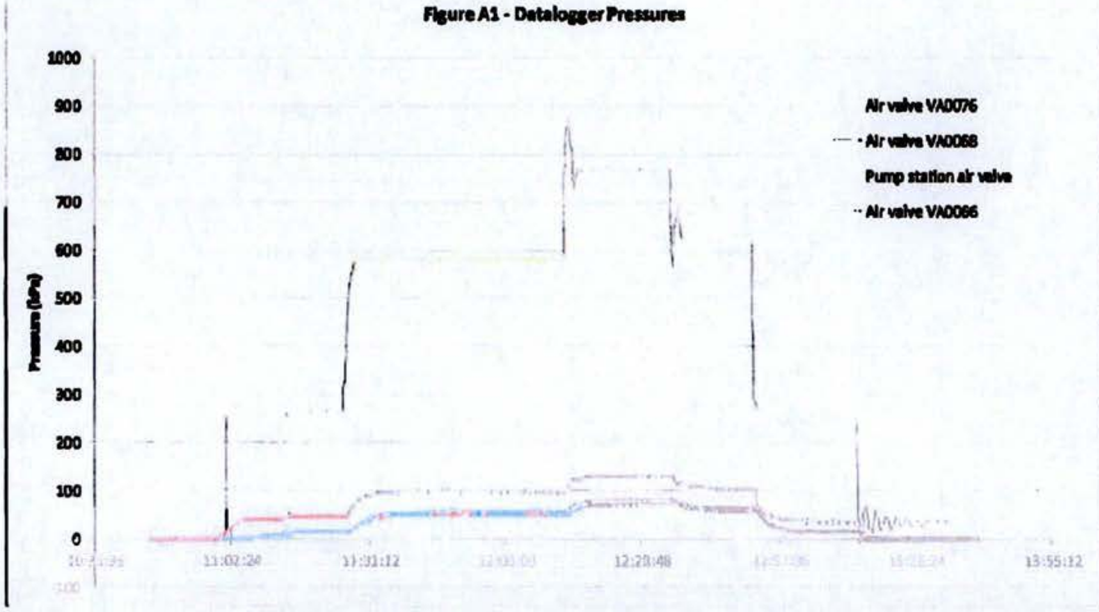


Figure A2 - Pump Station SCADA Pressures

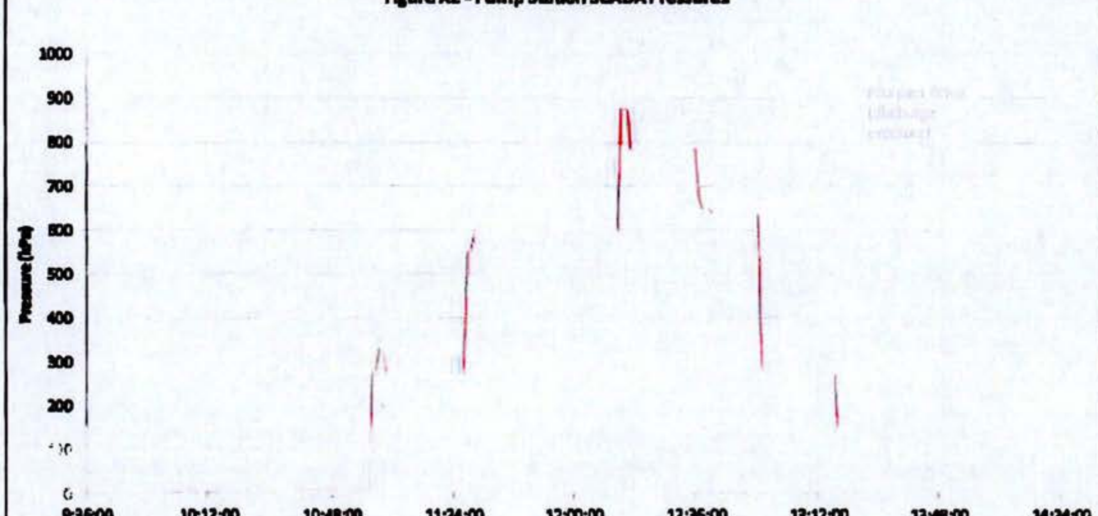


Figure A3 - Pump Station SCADA Flow

Figure A4 - SCADA Pump Speeds

ANNEX B
FATIGUE CALCULATIONS

Pipeline Fatigue Calculations
Katikati Effluent Outfall Pipeline

Prepared: N Holden
Checked: M Reed 26/06/2012

Class D uPVC Section

Description	Units	Primary	Secondary
Maximum Pressure*	kPa	1200.0	900.0
Minimum Pressure*	kPa	0.0	0.0
Pressure range*	kPa	1200.0	900.0
Cumulative effect of 1 cycle in this pressure range	-	1.00	0.40
Percentage cycles in pressure range caused by one pump start/stop*	-	11%	89%
Cumulative effect of 1 start/stop for each pressure range	-	0.11	0.35
Factor the number of starts by this much - this is the weighting factor	-	0.46	
Pressure range from data	kPa	1200.0	
Pipe rating	PN	12.0	
Allowable fatigue cycle factor, f	f	1.00	
Allowable no. of equivalent primary cycles	-	100,000	
Weighting factor from above	-	0.46	
Allowable number of pump starts	starts	215,297	
Projected pump starts per hour	starts/hr	0.182	
Lifetime	yrs	134.9	
Installed	year	1978	
Predicted end of fatigue life	year	2113	

Class C uPVC Section

Description	Units	Primary	Secondary
Maximum Pressure	kPa	900.0	670.0
Minimum Pressure	kPa	0.0	0.0
Pressure range*	kPa	900.0	670.0
Cumulative effect of 1 cycle in this pressure range	-	1.00	0.39
Percentage cycles in pressure range caused by one pump start/stop	-	11%	89%
Cumulative effect of 1 start/stop for each pressure range	-	0.11	0.35
Factor the number of starts by this much - this is the weighting factor	-	0.46	
Pressure range from data	kPa	900.0	
Pipe rating	PN	9.0	
Allowable fatigue cycle factor, f	f	1.00	
Allowable no. of equivalent primary cycles	-	100,000	
Weighting factor from above	-	0.46	
Allowable number of pump starts	starts	219,230	
Projected pump starts per hour	starts/hr	0.182	
Lifetime	yrs	137.4	
Installed	year	1978	
Predicted end of fatigue life	year	2115	

Note:
1) Pressure inputs based on one flush every two days at around max pressure rating.
2) Pump start frequency data based on flow data for period December 2010 through November 2011 although data is highly variable.
3) Shaded cells indicate manually entered values.

Katikati Wastewater Treatment Plant

Consideration of Alternatives

Contents

1 Introduction

1.1 Background

Section 105(1) of the RMA states that for a consent application for an activity that would contravene section 15, a consent authority must have regard to several matters in addition to those outlined in section 104(1), including *"any possible alternative methods of discharge, including discharge into any other receiving environment"*.

The Katikati Wastewater Treatment Plant (WWTP) has been operating since it was built in 1999 and provides tertiary treatment for effluent from the Katikati township, prior to discharge to the Pacific Ocean. The treatment system consists of aerated lagoons, constructed wetlands and ultraviolet disinfection. The ocean outfall is an 11.9 kilometre pipeline from the WWTP, passing across the northern part of Tauranga Harbour, across Matakana Island, terminating in a 650m long 150mm diameter steel ocean outfall section with a diffuser port.

The current resource consent for the existing WWTP required that the Western Bay of Plenty District Council (Council) investigate alternative disposal options with a view to ceasing use of the ocean outfall at expiry of the consent. Best endeavours to meet the commitment were required but there was no guarantee that there will be a practical alternative at the expiry of the consent. It is noted that iwi have for a long time expressed concerns over the existing pipeline.

This report provides an overview of previous investigations and the 2015/16 investigations. An Implementation Plan, by way of proposed consent conditions, is provided that will see the existing pipeline replaced with an alternative disposal method.

1.2 Why consider alternatives?

There are a number of statutory and non-statutory reasons why Council need and should consider alternatives (options) to the present wastewater scheme. These include:

- Statutory requirements of legislation and planning documents including the NZ Coastal Policy Statement RMA (Section 88 and Schedule 4) and Regional Plan policies
- Requirements under the existing resource consent to consider alternatives
- Community, key stakeholder and tangata whenua issues need careful consideration
- Revisit previous alternatives and confirm or otherwise conclusions made then
- New technologies since earlier assessments
- Consideration of beneficial reuse alternatives
- Addressing any changes in environmental standards and environmental understanding relating to the treated wastewater discharge receiving environment of the Bay of Plenty.

1.3 Approach

In summary, the approach undertaken to the consideration of alternatives includes:

- Revisiting previous investigations
- Using knowledge of environmental effects of discharge and monitoring

- Considering representative alternatives – not all alternatives
- Assessing generic groupings of alternatives.

Not all alternatives that are (physically) possible have been identified and evaluated as part of this assessment. Instead, as is common procedure with alternative assessments undertaken in accordance with the RMA, only 'representative alternatives' have been assessed within the various categories or groupings of alternatives available. In the selection of the alternatives considered, those offering the most appropriate or most representative are evaluated.

2 Review of Previous Investigations

Through the 1990s and 2007-2012 investigations and reports were prepared. This section provides a summary of the previous work.

Previous investigations (2007 and 2012 – reports attached as Appendix 1) examined a number of disposal options but considered that the status quo was the most appropriate.

2.1 Consent Application

Between August 1994 and July 1998 a Working Party considered options for Katikati's wastewater. At that time the treatment plant did not exist. The following options were considered:

Option	Description
1A	**Prospect Drive** – aerated lagoons, surface flow wetland, existing ocean outfall
1B	**Wills Road** – compact plan, coarse filter and UV disinfection, existing ocean outfall
4A	**Prospect Drive** – aerated lagoon and retention pond, discharge by forest irrigation on Matakana Island
4B	**Wills Road** – compact plant and retention pond, discharge by forest irrigation on Matakana Island
5	**Busby Road** – inland site, aerated lagoon and retention pond, discharge by forest irrigation near Katikati

Resource consent applications and a Notice of Requirement were lodged for Prospect Drive with discharge to the ocean as the preferred option. Consent was granted in 1999 including condition 12 that required the consent holder to investigate alternatives to the ocean discharge:

12 ALTERNATIVE DISPOSAL OPTIONS

12.1 That during the term of this permit there shall be a positive commitment on the part of Council as consent holder to investigate alternative effluent disposal options with a view to ceasing the discharge from the ocean outfall at the expiry of this consent or at such earlier time as determined by the consent holder in consultation with the Matakana Island community. It is acknowledged that the consent holder will at all times use its best endeavours to meet this commitment but that it cannot guarantee absolutely that it will be able to provide a practicable alternative at the expiry of the consent.

12.2 For the purpose of implementing this commitment, the consent holder shall observe the following:

(i) By 31 October 2007, submit to the Bay of Plenty Regional Council a report on investigations of alternatives to the discharge of effluent from Katikati via the ocean outfall. Such alternatives shall include land based disposal options including the feasibility of forest irrigation on Matakana Island on land owned by Te Kotukutuku Corporation Limited.

(ii) By 31 October 2012 submit to the Bay of Plenty Regional Council a report updating the earlier report dated 31 October 2007, and identifying the preferred option(s).

(iii) The studies to be completed by 31 October 2007 and 31 October 2012 shall have regard to engineering, cultural, environmental, financial and other relevant considerations.

SEE CHANGE

(iv) That by 1 January 1999 there shall be constituted a Matakana Island Liaison Group consisting ~~of four members~~ of up to four members from the Matakana Island community. The Liaison Group shall as its purpose the objective of ensuring the consent holder observes its commitment to investigate alternative disposal options. For this purpose the consent holder shall report and meet at least annually with the Liaison Group but no later than 31 October in each year as to its progress in considering alternative options and shall make available to the Group all available material and data relating to its investigations. The reasonable costs of the Liaison Group shall be met by the consent holder.

2.2 2007 Investigations

A 2007 Duffill Watts report[1] presents the outcomes of the alternative investigations. The report notes that:

- since earlier investigations treatment technology has advanced in that membrane filter technology moved from being unproven to a reliable process available for effluent polishing and to remove suspended solids and pathogens
- there had been no similar technological advancement of alternatives for disposal
- the four alternatives identified and investigated as part of the work in 1994 – 1997 remain the only alternatives that can be considered as a substitute for the ocean outfall.

The report concludes that:

"...at this stage no favourable alternative to the ocean outfall discharge has been identified."

[1] Duffill Watts, October 2007, Katikati Wastewater Treatment and Disposal System and Report on Treated Effluent Discharge Alternatives

Table 1: Options considered as part of the 2007 investigations

Option	Description	Matters considered	Cost estimate based on 2026 flow capacity
Discharge to an Alternative Surface Receiving Environment	Tauranga harbour directly via a short outfall pipe to the harbour or indirect via Uretara Stream	- Simple to implement but environmental less sound option than the ocean outfall	Resource consent and physical works $270,000
Slow Rate Irrigation to forest land on Matakana Island	Piped to Matakana Island and irrigated onto suitable blocks of established pinus radiata by surface drip irrigation or spray irrigation	- Preliminary calculations determined 46ha would be required in 2007 and by 2026 76ha - Concern that irrigation systems present forest management problems that "make the proposal undesirable to commercial operators". - Past experience "has found that generally the trees to not benefit from the effluent irrigation"	Resource consent and physical works $6,200,000
Slow Rate irrigation on farm land converted to forest plantation on the mainland	Piped from the treatment plant and irrigated on suitable blocks of land that had been converted to forestry	- Had been considered in 1994-97 to the extent that a possibly suitable block of land at Busby Rd was identified and purchased by the District Council – 95ha would have been needed including buffers - Irrigated effluent would percolate through the soil, enter groundwater and flow into streams leading to the harbour meaning nitrogen removal would be essential - Prospect Drive treatment plant not specifically designed for nitrogen removal. - Previous studies concluded environmental impact of the residual nitrate flow on stream and the harbour would be unacceptable. - 2007 conclusion the same	Resource consent and physical works $9,200,000
Horticultural Farming	Install pipelines to provide a piped treated effluent supply network that could be used to irrigate horticultural land. Individual landowners could use for seasonal	- Was sufficient water sources for horticulture irrigation but if a water shortage developed in the future could be used as an alternative.	

Option	Description	Matters considered	Cost estimate based on 2026 flow capacity
	irrigation and a charge made to recover the cost	- Not noted at the time – would only be seasonal so potentially not a year round solution	
Pastoral Farming	Subsurface drip irrigation installed in suitable paddocks to allow the paddocks to be irrigated during summer dry weather to improve pasture productivity	- General policy to avoid irrigation with municipal wastewater as perceive stigma that may affect sales of dairy products to overseas markets	
Irrigation of Parks and Reserves	Subsurface drip irrigation during summer to parks and reserves eg. Moore Park	- Determined that 15mm/week would be suitable therefore requiring approx. 56ha but the park is only 7.5ha - Irrigation would only be for 3 months of the year	Resource consent and physical works $5,050,000
Improvement to existing discharge	Use new technology and install a membrane filtration until to polish the effluent removing all residual suspended solids and pathogen indicator organisms and a large part of the residual BOD	- Acknowledged that some sectors of the community see the existing discharge as aesthetically and cultural unacceptable - Monitoring of the discharge to date indicated that the discharge was having no adverse environmental or public health impacts - Upgrade considered "unnecessary but may be seen as aesthetically desirable"	Physical works $1,800,000

2.3 2012 Alternative Investigations

The 2012 investigations were carried out by URS and reported in October 2012[2]. The approach was:

- Desktop review of the 2007 report
- Review of changes in legislation that had occurred since the 2007 report with the focus on changes that could have an impact on the alternative options contained in the 2007 report being:
  - Proposed Regional Policy Statement
  - Regional Coastal Environment Plan 2002
  - Regional Water and Land Plan 2008
  - District Plan
  - National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES)
- Review of treatment plant process changes that have been implement or were being proposed
  - Operational process changes implemented at the treatment plant since 2007
  - Any significant maintenance works undertaken since 2007, for example de-sludging of the oxidation ponds
  - Measures implemented or being proposed, to mitigate the impact of the current treatment plant disposal
  - Records of treatment plant discharge testing and sampling results.

The review concluded that:

> "...the operational and maintenance changes that have been implement, together with the mitigation measures implemented, and being proposed, would have a positive impact on the performance and capacity of the current outfall and further minimise environmental risks."

and

> "...based on the current information the currently consented discharge to the Pacific Ocean remains the preferred option."

[2] URS, October 2012, Katikati Wastewater Treatment Plant Consent – 2012 Disposal Options Report

Table 2: Options considered as part of the 2012 investigations

Option	Description	Matters considered in 2012	Cost estimate – figures adjusted from 2007
Discharge to an Alternative Surface Receiving Environment	Tauranga harbour directly via a short outfall pipe to the harbour or indirect via Uretara Stream	- Issues identified in 2007 report remain and in some cases may have higher public resistance - A Papakuanuku area could possibly be added to suit cultural sensitivities relating to a direct discharge	$293,000
Slow Rate Irrigation to forest land on Matakana Island	Piped to Matakana Island and irrigated onto suitable blocks of established pinus radiata by surface drip irrigation or spray irrigation	- Blakely pacific Ltd (part owner of commercial forest plantation) had appealed Court decision to overturn subdivision consent – if granted would reduce area available for irrigation - Benefit to trees has found to be marginal - Some interest expressed by community in using effluent for emergency fire fighting supply – does not provide long term solution	$6,731,000
Slow Rate irrigation on farm land converted to forest plantation on the mainland	Piped from the treatment plant and irrigated on suitable blocks of land that had been converted to forestry	- Council search of records showed no block of land was purchased in Busby Rd area - Land purchase cost, together with issues associated with transfer pipeline and pump station, holding ponds and irrigating forest plantations make it an undesirable alterative	$9,988,000
Horticultural Farming	Install pipelines to provide a piped treated effluent supply network that could be used to irrigate horticultural land. Individual landowners could use for seasonal irrigation and a charge made to recover the cost	- Subsurface drip irrigation during summer months technically feasible but a number of perceived and actual public health issued that need to be considered - Water use in Katikati area doubles in peak summer months therefore alternative source of irrigation water would ease pressure - Only provide an alternative during summer months	
Pastoral Farming	Subsurface drip irrigation installed in suitable paddocks to allow the paddocks to be irrigated during		

Option	Description	Matters considered in 2012	Cost estimate – figures adjusted from 2007
	summer dry weather to improve pasture productivity		
Irrigation of Parks and Reserves	Subsurface drip irrigation during summer to parks and reserves eg. Moore Park		$5,483,000
Improvement to existing discharge – new technology	Use new technology and install a membrane filtration until to polish the effluent removing all residual suspended solids and pathogen indicator organisms and a large part of the residual BOD Upgrade or replace UV facility to improve efficiency of disinfection process	- Acknowledged that some sectors of the community see the existing discharge as unacceptable - Monitoring of the discharge to date indicated that the discharge was having no adverse environmental or public health impacts - Membrane filtration unit would have provided little benefit - Current UV system performing well but recognised that disinfection process could be improved, particularly management of suspended solids and storm related overflows – programme of works identified to address this - Based on results of discharge testing, no major replacement or upgrade of UV system justified	$1,954,000

3 Current Investigations

In 2015 Council began further investigates on disposal options. The Council is aware that the pipeline has a fixed life and beyond that there needs to be an alternative solution but equally that the pipeline is an existing resource that should be utilised until the end of its life.

In mid-2015 a Steering Group comprising of representatives from Matakana Island hapu was formed and on 17th December 2015 an alternatives workshop was held at the District Council offices. The workshop was run by an independent facilitator. In attendance was representative(s) from:

- Western Bay of Plenty District Council
- The five Hapū of Matakana and Rangiwaea Islands; Ngati Tauaiti, Ngai Tuwhiwhia and Ngai Tamawhariua based at Matakana Island, and Te Whanau a Tauwhao and Te Ngare who are located at Rangiwaea Island, Tauranga
- The Hapū of Te Rereatukahia, Tuapiro and Otawhiwhi
- Katikati Community Board
- Katikati Community

Prior to the workshop Council considered the options that should be presented at the workshop. The following were included:

1. Status quo	existing ocean outfall
2. Land Disposal	to Pasture (cut and carry e.g. Taupo) or forestry
3. Beneficial Reuse	Horticulture / Parks/ Reserves/ Gardens etc.
4. Marine	new Ocean Outfall in different location
5. Surface – Surface water	River/ Stream/ Harbour
6. Reticulate to another system	e.g. Tauranga City Council

Information on the options is in Appendix 2.

The purpose of the workshop was to shortlist options for further investigation rather than select the actual option.

The assessment of the options at the workshop adopted a Multi Criteria Analysis (MCA) approach whereby the criteria to assess the options were weighted and the options scored against the criteria.

The criteria used were:

Ref	Analysis Criteria	Criteria Description	Notes
Goal based Analysis Criteria – Independent of Cost			
G1	Social / Public Health	Public Health Risk, Safety, Visual Amenity, Proximity to Neighbours and Effects on Them, Construction Effects, Public Acceptance	Scoring will be influenced by: the degree of public health risk, removal of direct discharges to freshwater/coastal environments, proximity to neighbours and overall likelihood of public acceptance
G2	Cultural	Matauranga Maori, Discharge to Freshwater, Discharge to Land, Discharge to Coastal Water, Transfer of Wastewater from one rohe to another, Iwi Management Plans	Scoring will be influenced by: ability to support a healthy ecosystem appropriate to that locality, ensure resources are able to be used for customary use and customary practices are able to be exercised to the extent desired, kaimoana is safe to harvest and eat
G3	Environmental	Adverse Effects on the Natural Environment	Scoring will be influenced by: the potential for adverse effects on the environment including ecosystems, water quality, recreational use
G4	Planning and Regulatory	Consentability, RMA Freshwater NPS, NZCPS, Catchment Management Plans, Complexity and viability of obtaining future consents and designations	Scoring will be influenced by the need (or not) to obtain new discharge consents and designations, or whether existing consent conditions could be changed via a potentially non-notified process and future resource consent requirements, the avoidance of discharges to freshwater and coastal water generally. Overall marking will be from a complexity and viability of consenting/ planning process
G5	Sustainability	Alignment with WBOPDC Sustainability Strategy, Energy Use/Carbon Footprint, Sustainable Development, , Beneficial Reuse	Scoring will be influenced by: the amount of energy use, beneficial reuse of the treated wastewater
G6	Technical / Functional	Reliability, Flexibility, Constructability, Proven Engineering, Engineering Resilience including to natural hazards and climate change, Use of Existing Infrastructure	Scoring will be influenced by: proven technology, maximises the use of existing infrastructure, the ability to respond to population growth/increase in demand. Complex options to construct will score more poorly
G7	Operational	Complexity, Safety, Reliability	Scoring will be influenced by: the operability of the option i.e. proven technology, can it be supported in NZ, are there other examples in NZ.

The weightings applied to the criteria were on a scale of 1 to 10 where 1 was least important and 10 most important.

Criteria Weighting								
Goal based Analysis Criteria – Independent of Cost								
Attribute Refs	G1	G2	G3	G4	G5	G6	G7	**Most important**
10								
9								
8								
7								
6								
5								
4								**Least important**
3								
2								
1								
Criteria	Social/ Public Health	Cultural	Environmental	Planning and Regulatory	Sustainability	Technical / Functional	Operational	
Weight	10	10	10	4	7	6	7	
Sum of goals 54								

The options shortlisted for further investigation are:

- Land Disposal – to pasture or forestry
- Beneficial Reuse – horticulture / parks / reserves / gardens or another use
- Surface Water – river / stream / harbour

At the workshop it was agreed that should during the process of investigating the shortlisted options other options were deemed to be worth a level of investigation, the working group would not be limited to the shortlist. For example, deep well injection and potable reuse were identified at the workshop as options that require some consideration.

Scoring of Scenarios Against Criteria										
Scenario		**Assessment Criteria – Goal based Analysis Criteria – Independent of Cost**							**Scores and Ranking**	
		Social/ Public Health	Cultural	Environmental	Planning and Regulatory	Sustainability	Technical / Functional	Operational	Overall Score	Rank
Criteria Weighting		0.185	0.185	0.185	0.074	0.130	0.111	0.130		
1	**Status Quo – existing ocean outfall**	1	1	1	1	1	3	3	1.48	6
2	**Land Disposal – to pasture or forestry**	4	3	3	4	4	4	3	3.5	2
3	**Beneficial Reuse – horticulture / parks / reserves / gardens**	4	4	4	3	5	4	2	3.8	1
4	**Marine – new ocean outfall in different location**	1	1	2	2	2	1	4	1.78	4
5	**Surface Water – river / stream / harbour**	1	1	1	3	3	5	4	2.24	3
6	**Reticulate to another system**	1	1	1	5	1	2	2	1.54	5

3.1 Next Steps

Detailed investigations will result in the formation of a wastewater working group with representation similar to the workshop attendees. The task of the working group will be to oversee the technical investigation work and ultimately recommend to Council the best practicable option.

4 Future Directions

The requirement to undertake the alternatives detailed investigations is to be proposed as a condition of consent in the resource consent application. The condition sets out:

- Membership and role of Te Ohu Waiora
- Timeframes for the investigations and preparation of a Future Directions Report
- Reporting of progress.

The condition proposed is:

12 TE OHU WAIORA AND FUTURE DIRECTIONS REPORT

12.1 Within 6 months of the grant of these consents, the Consent Holder shall establish Te Ohu Waiora. The role of Te Ohu Waiora is to complete an Alternatives Investigation in accordance with the Terms of Reference set out in Condition 12.7.

The objective of the Alternatives Investigation is to identify at least one appropriate and practicable alternative to the ocean outfall discharge authorised under these consents to inform the Future Directions Report required under condition 12.10.

12.2 The Consent Holder must invite:

a) at least one representative from Matakana Island Hapū
b) at least one representative from Mainland Hapū
c) at least two residents of the Katikati community that are considered by the Consent Holder to be representative of the Katikati community
d) at least one representative from Western Bay of Plenty District Council (either staff or Councillors)

to be part of Te Ohu Waiora. Te Ohu Waiora will at all times include a representative of the Consent Holder.

12.3 Once Te Ohu Waiora is formed the Consent Holder shall provide details of its membership, and any subsequent changes, to the Regional Council. The Consent Holder may, from time to time, add to or replace members of Te Ohu Waiora in consultation with Te Ohu Waiora. Any additional or replacement members of Te Ohu Waiora shall be notified to the Regional Council.

12.4 The Consent Holder shall fund the administration and operation of Te Ohu Waiora and shall meet all actual and reasonable costs incurred by Te Ohu Waiora.

12.5 The Alternatives Investigation must have regard to engineering, cultural, environmental, financial and any other relevant considerations.

12.6 Te Ohu Waiora may recommend to the Consent Holder that specialists be invited to participate in an advisory or consultative capacity seconded to Te Ohu Waiora or technical studies be commissioned, from time to time, to assist it to fulfil its role. The decision on whether to act on such a recommendation will rest with the Consent Holder after consultation with Te Ohu Waiora.

12.7 The Terms of Reference for Te Ohu Waiora shall include, but not be limited to:

a) To receive and provide information and feedback on the Alternatives Investigation including the scope and methodology of the investigations and progress of the investigations;

b) To act as the channel for broader community input as necessary; and

c) To commit to finding an agreed way forward and seeking agreement with the group on its advice to Council.

12.8 Within 12 months of the grant of these consents the Consent Holder shall submit to the Regional Council a summary of the scope and methodology of the Alternatives Investigation that has been prepared by Te Ohu Waiora.

12.9 Every two years the Consent Holder shall include in the annual report an update on progress with the Alternatives Investigation.

12.10 No later than 31 December 2026 the Consent Holder shall prepare a Future Directions Report confirming the best practicable option for future management of the discharge and the proposed pathway for implementation of the option prior to expiry of these consents. The Future Directions Report shall be informed by and take into account the outcomes of the Alternatives Investigation.

12.11 The Consent Holder shall lodge any resource consent applications and (if necessary) notices of requirement to implement the option identified in the Future Directions Report prior to the expiry of these consents.

Advice note: Te Ohu Waiora is not a decision-making body with respect to funding.

In practice implementation of the alternatives process will involve:

1. Investigations, Reporting, Monitoring, Decisions and Actions
2. Site and options investigations
3. Feasibility study
4. Preferred Option confirmed
5. Confirmation of target land, if any, and initial discussions with landowners (if any)
6. Budgets for future stages to LTP
7. Resource consent and designation process
    - Environmental investigations
    - Prepare consent application
    - Notification
    - Council/s hearing
    - Decision
8. Allowance for any Environment Court process

9. Geotechnical and Survey
10. Preliminary Design
11. Estimates refined
12. Funding confirmed
13. Detailed design
14. Procurement
15. Construction
16. Commissioning

Appendix 1 Previous Reporting

Duffill Watts

Consulting Group

Western Bay Of Plenty Council

Katikati Wastewater Treatment and Disposal System And Report on Treated Effluent Discharge Alternatives

October 2007

Duffill Watts
Consulting Group

WESTERN BAY OF PLENTY COUNCIL

Katikati Wastewater Treatment and Disposal System

Report on Treated Effluent Discharge Alternatives

Revision	2.0
Status	FINAL

Task	**Responsibility**	**Signature**
Prepared by:	Brian Duncan	[signature]
Reviewed by:	D. RICHARDSON	[signature]
Approved by:	Steve Hawkins	[signature] Hawkins.

Prepared by:

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Job No: 212060
Date: October 2007
Ref: Final Report

Duffill Watts

WESTERN BAY OF PLENTY COUNCIL

Katikati Wastewater Treatment and Disposal System

Report on Treated Effluent Discharge Alternatives

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Duffill Watts

1.0 PURPOSE OF THE REPORT

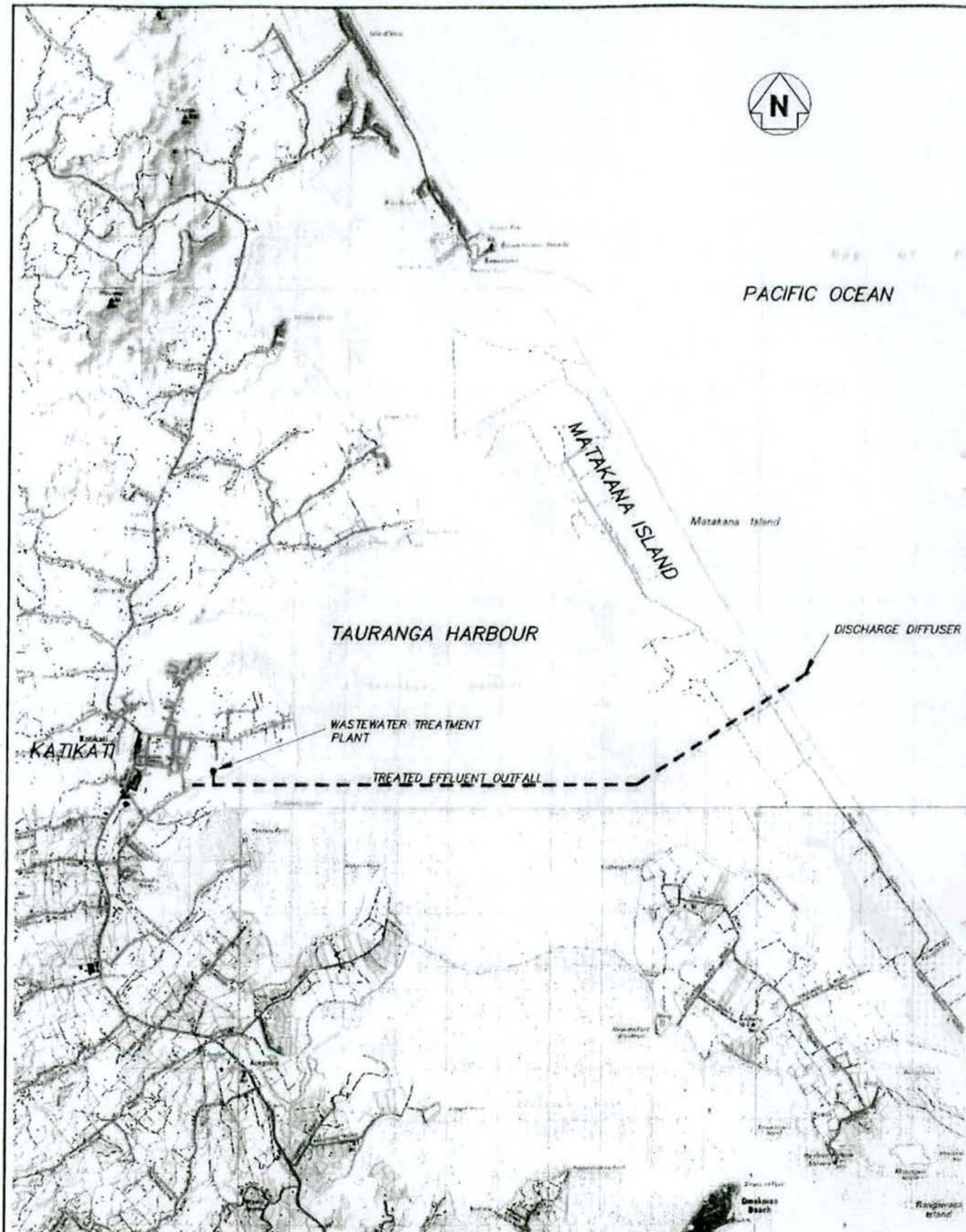
The municipal wastewater from the town of Katikati in the Western Bay of Plenty District is treated at a treatment plant located at Prospect Drive to the east of the town. The treated effluent from the plant is pumped via a pressure pipe laid across the Tauranga Harbour and across Matakana Island to discharge via a submerged diffuser to the Pacific Ocean approximately 650m off the ocean shoreline of the island. The location of the treatment plant and the route of the pipeline is shown in Fig 1.

The Bay of Plenty Regional Council granted the consent for the discharge (No. 24895) in August 1999. The consent was first exercised shortly after that date. The plant continues to be operated satisfactorily meeting all the conditions of the consent. As part of the monitoring programme required by the conditions, samples of the sea water are taken at distances ranging from 50 to 200m from the diffuser, four times per year. These samples are tested for the presence of the pathogen indicator bacteria, enterococci and faecal coliform. The tests continue to indicate that the treated effluent, following initial dilution and mixing with the seawater presents no public health risk to the gathering of kai moana or to the use of the sea for recreation. A copy of the most recent test results (August 2007) are attached as Appendix A.

At the time that the consent application was being considered by the Bay of Plenty Regional Council and the Environment Court there was significant submitter opposition to the proposed discharge of the final treated effluent to the sea. For this reason Condition 12 was included in the consent, requiring the consent holder (WBOPDC) to investigate alternatives to the ocean discharge "with a view to ceasing discharge from the outfall at the expiry of the consent (30 November 2016) or such earlier time as determined by the consent holder in consultation with the Matakana Island community". This report describes the outcome of the alternatives investigation.

2.0 TREATED EFFLUENT QUANTITY

Wastewater flow quantities to a treatment plant such as that serving Katikati are generally in proportion to population. The current population of the town based on the 2006 census is about 3500 people. The WBOPDC projected population by the year 2026 is 5700 people. The consent condition require that the treated effluent flow discharging to the outfall pipe from the treatment plant be continuously measured and recorded.



Duffill Watts & King Ltd
CONSULTING ENGINEERS
Auckland Office

WESTERN BAY OF PLENTY DISTRICT COUNCIL
KATIKATI WASTEWATER SYSTEM
LOCATION PLAN
FIG 1

SCALE: 1:10,000

The currently recorded effluent flows and the present and predicted population figures combine to give the measured and predicted future effluent flow quantities of Table 2.1.

Date	Population	Winter Flow (m^3/d)		Summer Flow (m^3/d)	
		Average	Peak	Average	Peak
2007	3500	920	1720	730	1220
2026	5700	1500	2800	1190	1990

Table 2.1 Present and predicted future daily effluent flows.

The consent permits a maximum daily discharge flow of 3000 m^3/day. Based upon the above proportional projection it would appear that predicted future flows up to 2026 will be within this present consent limit.

3.0 TREATED EFFLUENT QUALITY

The consent conditions require that the treated effluent discharging to the sea be regularly monitored for quality. Recent testing of the effluent has found the following concentrations of significant constituents in the final treated effluent prior to discharge.

Constituent	Units	Concentration		
		Maximum	Median	Average
Total nitrogen	g/m^3	31		20
Zinc	g/m^3	0.03		0.022
Faecal Coliforms	No/100 ml	770	227	
CBOD	g/m^3	8.3		6.1
Suspended solids	g/m^3	33.2		13.7

Table 3.1 Typical monitored treated effluent quality

As is detailed in the discussions below, the only constituent of those tabulated above which is considered significant with respect to disposal alternatives is total nitrogen

4.0 ALTERNATIVES TO TREATED EFFLUENT DISCHARGE TO THE PACIFIC OCEAN

The previous investigation of treatment and effluent disposal options for wastewater from the town of Katikati, which led to the adoption of the currently operating system, commenced in December 1994 and ended about September 1997, nearly three years later. As part of that investigation four alternatives to the ocean outfall proposal were thoroughly investigated and evaluated.

Now, ten years later, there has been a significant advance in treatment technology from that available at the time of the previous investigation. This has been the transition of membrane filter technology from an unproven experimental process to a proven, reliable process now available for effluent polishing to remove suspended solids and pathogens. However there has been no similar technological advancements of alternatives for effluent disposal and it is considered that the four alternatives identified and investigated at the time of the Katikati investigation 1994 to 1997, still remain the only alternatives that can be considered as a substitute for the ocean outfall. These alternatives are described and reviewed below.

4.1 Discharge of the Treated Effluent to an Alternative Surface Receiving Water

In the Katikati situation the alternative surface receiving water to the Pacific Ocean is the Tauranga Harbour with either direct discharge via a short outfall pipe to the harbour or indirect discharge via the Uretara Stream. The Tauranga Harbour is an enclosed waterway and nuisance blooms of algae and sea lettuce have occurred in the past due probably to elevated concentrations of nutrients in the harbour water. It is understood that the limiting nutrient in the harbour water with respect to the potential to trigger such blooms is generally considered to be nitrogen (N).

It is noted that discharge of treated wastewater effluent from Tauranga City to the harbour was terminated about 12 years ago because of concerns with nutrient loading to the harbour waters. The treated effluent from Katikati has a significantly high N content (20g/m^3 av) and for this reason it is considered that direct or indirect discharge of effluent to the harbour although relatively simple to implement because of the close proximity of the existing treatment plant to the harbour is an environmentally less sound option than the currently consented discharge to the open sea.

4.2 Slow Rate Irrigation (SRI) of the Treated Effluent on the Forested Sand Country of Matakana Island

This alternative involves diverting the outfall pipeline where it crosses Matakana Island and piping it to a suitable nearby location where it can be irrigated onto suitable blocks of the established commercial pinus radiata forest by SRI. The method of application could be by surface drip irrigation or by spray irrigation.

The chosen blocks of land would require to have recently planted trees at an age of 3 to 5 years. The blocks would also need to be close to the ocean shoreline. In that location the groundwater level is about 2m below the surface and the subsoil consists of fine to medium sands of good infiltrative capacity. The applied effluent would be naturally filtered by the topsoil/ humus layer at the ground surface removing all significant residual suspended solids, BOD and pathogens from the effluent. The polished effluent would then percolate through the unsaturated sand subsoil to enter the groundwater where it would flow with the groundwater to the sea entering the sea as a groundwater/ effluent mixed seep at the shoreline.

The area of forest required to be irrigated depends on the design land application rate for the effluent. The important application rate criterion would be that the nitrogen in the applied effluent is largely removed by tree uptake so that the concentration of nitrogen is at an acceptably low level when the wastewater effluent mix enters the sea. This is environmentally desirable to avoid the potential for algae blooms along the shoreline.

For preliminary sizing of the required area of forest a conservatively low minimum pinus radiata uptake rate through the tree's life cycle of 130kgN/ha/year could be assumed. Applying this rate to the flows of Table 2.1 and an average total concentration in the effluent of 20g/m^3 gives the following nett forest irrigation areas:

2007 – 46 ha
2026 – 76 ha

The Matakana Island forested land is partly owned by Blakely Pacific Ltd (BPL) and partly by the Te Kotukutuku Corporation Ltd. BPL is the commercial operator of the forest. An approach has been made to BPL for a meeting to discuss the possibility of utilising a block of the forested land for SRI of the effluent but to date no meeting has been arranged. It is understood that the people of the island community, generally do not support the proposal. Also past experience with SRI of municipal wastewater effluent on commercial forested land has found that generally the trees do not benefit from the effluent application.

Also the presence of the solid set irrigation system in the forest has been found to present forest management problems which make the proposal undesirable to commercial operators.

4.3 SRI of the Treated Effluent on Farmland Converted to Forest Plantation on the Mainland

This alternative was thoroughly canvassed at the time of the previous 1994 to 1997 investigation to the extent that a possibly suitably block of land in Busby Road was identified and purchased by the WBOPDC to ensure that the option remained feasible during the comparison of options phase of the investigations. Allowing for buffer zones to neighbours and the probability that some parts of the land block will be unsuitable for irrigation due to localised topographical constraints a block with a total area of about 95 ha would be required.

The particular problem associated with this alternative is that the irrigated effluent will percolate down through the unsaturated subsoil to enter the ground water and will then flow to watercourses and streams leading to the Tauranga Harbour. For this reason it would be essential to operate a combined treatment and disposal system which maximised the removal of N from the wastewater.

The existing wastewater treatment plant at Prospect Drive has not been specifically designed for N removal. The plant could be upgraded by the introduction of a nitrification/ denitrification phase into the process stream and this additional treatment combined with a forest management regime maximising N uptake at the SRI site could probably achieve 90% removal of the N in the incoming raw wastewater from the community. This would result in residual nitrate N levels of about 5g/m^3 entering the groundwater and flowing to the streams and the harbour. At the time of the previous options investigation a study by Bioresearches was made of the environmental impact of the residual nitrate flow on the receiving streams and the harbour and it was concluded that the impact would be unacceptable. It is considered that this situation has not changed.

4.4 Effluent re-use for Horticultural or Pastoral Irrigation or for Irrigation of Parks and Reserves

The treated effluent discharging from the treatment plant is of very high quality and if further treated by on-line filtration to remove residual suspended solids it could be utilised during the three months of summer to provide subsurface drip irrigation to land as discussed below.

4.4.1 Horticultural Farming

There is considerable horticultural farming on land in the vicinity of the treatment plant. It is understood that generally there is sufficient water sources for horticultural irrigation presently available. However if a water shortage developed in the future an alternative could be available to install pipelines and provide a piped treated effluent supply network on the public roads. This supply could then be drawn off by the individual horticulturalists at the farm gate for seasonal irrigation. An appropriate charge could be made for the supply to help cover costs.

4.4.2 Pastoral Farming

There are a number of dairy orchards in reasonable proximity to the treatment plant. It is possible that subsurface drip irrigation line at say 2m centres could be installed in suitable paddocks to allow the paddocks to be irrigated during summer dry weather to improve the productivity of the pasture.

It is not expected that there is any particular interest in this possibility amongst farmers because there is a general policy to avoid irrigation with treated water from a municipal wastewater source because it is suggested that the perceive stigma may adversely affect sales of dairy products into overseas markets. It the proposal was to proceed a new discharge consent would be required. It would be necessary to ensure that the effluent was applied at a rate which achieved virtually full N uptake by the growing grass so that the residual discharge of nitrate via the groundwater to the harbour was minimised. An upper limit for nitrogen loading to the pasture would be about 300kgN/ha/year.

4.4.3 Irrigation of Parks and Reserves

Subsurface drip irrigation of the treated effluent during summer to parks and reserves such as Moore Park is a possibility. The drip lines would be mole ploughed at a shallow depth into the subsoil beneath the grass surface at about 2m centres. A possible acceptable effluent application rate, would be about 15mm/week which would require a total irrigation area at the ultimate design flow of about 56ha. Noting that Moore Park is only about 7.5ha in area it would seem to be unlikely that sufficient parkland within reasonable proximity of the treatment plant is available for this option to be implemented. At this application rate noting that irrigation is only for 3 months of the year, it is considered that the residual N entering the ground water and flowing to the harbour will be reasonably controlled by plant uptake. A new consent would be required for the discharge.

5.0 IMPROVEMENT TO THE EXISTING DISCHARGE

The above discussion indicates that there is no alternative to the ocean discharge in the Katikati situation, which can be clearly identified as being particularly favourable. The existing treatment and disposal system is operating well with no evidence of adverse environmental or public health impacts. However the discharge is understood to be perceived by some groups in the community as being aesthetically and culturally unacceptable. A possible upgrade to the existing system could be considered which may help to meet these concerns. Using the new technology now available as noted in 4.0 above, it would be possible to install a membrane filtration unit at the treatment plant before the effluent was discharged to the outfall. This filter would polish the effluent removing all residual suspended solids and pathogen indicator organisms and also a large part of the residual BOD. The monitoring of the discharge to date indicates that this upgrade is unnecessary however it may be seen as aesthetically desirable.

6.0 COST ESTIMATES

Preliminary indicative budget cost estimates of the alternatives identified above are presented in table 6.1 below. The physical works estimate includes allowances for design and project management and for construction contingencies and are based on capacity to provide for the 2026 year flow. The estimates do not include GST. Alternatives 4.4.1 and 4.4.2 have not included at this stage as it is necessary first to identify a specific land owner(s) who would have an interest in using the effluent.

Report Para	Alternative	Cost	Total Cost
4.1	**Discharge to Tauranga Harbour** Resource Consent Physical Works	 $ 150,000 $ 120,000	 **$ 270,000**
4.2	**SRI Matakana Island** Resource Consent Physical Works	 $ 100,000 $ 6,100,000	 **$6,200,000**
4.3	**SRI Mainland Farm Block** Resource Consent Land Purchase Physical Works	 $ 100,000 $ 3,800,000 $ 5,300,000	 **$9,200,000**
4.4.3	**Summer Subsurface Irrigation of Parks and Reserves** Resource Consent Physical Works	 $ 50,000 $ 5,000,000	 **$5,050,000**
5.0	**Membrane Filtration of Effluent** Physical Works	 $1,800,000	 **$1,800,000**

Table 6.1 Preliminary indicative budget estimate based on 2026 flow capacity

7.0 CONCLUSIONS

The preparation of this report is the first step in a process of considering alternatives to the current ocean outfall to fulfil Condition 12 of the Discharge Consent. It outlines the alternatives that are currently available. It is concluded that at this stage no favourable alternative to the ocean outfall discharge has been identified.

8.0 REFERENCES

- Bruce Wallace Partners Ltd and Alandale Associates Ltd; "WBOPDC Report on options investigated for Katikati Waswater Treatment and Effluent Disposal Investigations" March 1996
- Bioresearches; "WBOPDC, Katikati Sewage – Land Disposal, assessment of the effects of the land disposal of treated sewage effluent on the Boyd and Uretara Streams and Tauranga Harbour" May 1996
- Bruce Wallace Partners Ltd; "Statement of Evidence of CBM Duncan presented before the Joint Hearings Committee on 12 November 1997".
- John Lavery; Pers. Comm. relating to nitrogen uptake of forest plantations.

Duffill Watts

APPENDIX I

Record of Seawater Sampling And testing at the Outfall Diffuser August 2007

Environmental Laboratory Services Ltd.

Western Bay of Plenty D.C.
c/- Duffill Watts & King
P O Box 330
TAURANGA

Attention: Ilze Kruis

Analytical Report

Report Number: 07/15787
Issue: 1
27 August 2007

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-1	KWW - 01		24/08/2007 09:00	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-10	KWW - 10		24/08/2007 09:00	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	8	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-11	KWW - 11		24/08/2007 09:15	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-12	KWW -12		24/08/2007 09:15	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

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Email: mailto:rdeacon@els.co.nz Website: http://www.els.co.nz

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-13	KWW -13		24/08/2007 09:15	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	12	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-14	KWW -14		24/08/2007 09:15	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-15	KWW -15		24/08/2007 09:15	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-16	KWW -16		24/08/2007 09:15	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-17	KWW -17		24/08/2007 09:15	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

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Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-18	KWW -18		24/08/2007 09:15	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-19	KWW -19		24/08/2007 09:15	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	8	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-2	KWW - 02		24/08/2007 09:00	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-20	KWW -20		24/08/2007 09:15	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-21	KWW -21		24/08/2007 09:20	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

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Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-22	KWW -22		24/08/2007 09:20	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-23	KWW -23		24/08/2007 09:20	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-24	KWW -24		24/08/2007 09:20	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-25	KWW -25		24/08/2007 09:20	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-26	KWW -26		24/08/2007 09:20	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

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Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-27	KWW -27		24/08/2007 09:20	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-28	KWW -28		24/08/2007 09:20	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-29	KWW -29		24/08/2007 09:20	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	16	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-3	KWW - 03		24/08/2007 09:00	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	12	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-30	KWW -30		24/08/2007 09:20	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	8	cfu/100mL		Maria Norris KTP/LAS

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Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-31	KWW -31		24/08/2007 09:30	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-32	KWW -32		24/08/2007 09:30	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-33	KWW -33		24/08/2007 09:30	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	8	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-34	KWW -34		24/08/2007 09:30	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-35	KWW -35		24/08/2007 09:30	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-36	KWW -36		24/08/2007 09:30	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-37	KWW -37		24/08/2007 09:30	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-38	KWW -38		24/08/2007 09:30	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-39	KWW -39		24/08/2007 09:30	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-4	KWW - 04		24/08/2007 09:00	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

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Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-40	KWW -40		24/08/2007 09:30	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-5	KWW - 05		24/08/2007 09:00	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-6	KWW - 06		24/08/2007 09:00	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-7	KWW -07		24/08/2007 09:00	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	4	cfu/100mL		Maria Norris KTP/LAS

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-8	KWW - 08		24/08/2007 09:00	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

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Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
07/15787-9	KWW - 09		24/08/2007 09:00	25/08/2007	07/1013

Notes:

	Test	Result	Units	Comments	Signatory
0089	Faecal Coliforms	< 4	cfu/100ml		Maria Norris KTP/LAS
0140	Enterococci	< 4	cfu/100mL		Maria Norris KTP/LAS

Comments:

Sampled by customer using ELS approved containers.

Test Methodology:

Test	Methodology	Detection Limit
Faecal Coliforms	APHA 21st Edition Method 9222 D	1 cfu/100ml
Enterococci	US. Environmental Protection Agency (EPA) Method 1600: Enterococci in Water by Membrane Filtration Using membrane-Enterococcus Indoxyl-ß-D-Glucose Agar (mEI), April 2005	1 cfu/100mL

"<" means that no analyte was found in the sample at the level of detection shown. Detection limits are based on a clean matrix and may vary according to individual sample.

g/m3 is the equivalent to mg/L and ppm.

Samples will be retained for a period of time, in suitable conditions appropriate to the analyses requested.

All test methods and confidence limits are available on request. This report must not be reproduced except in full, without the written consent of the laboratory.

Report Released By

Rob Deacon

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Lower Hutt New Zealand
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Western Bay of Plenty District Council Sample Transfer Document
C/- Duffill Watts & King Ltd, PO Box 330, Tauranga

Phone: +64 7 928 3410
Fax: +64 7 928 3421

Laboratory Request Form	Katikati Wastewater Plant Outfall - Quarterly		
Western Bay of Plenty District Council Sample Transfer Document C/- Duffill Watts & King Ltd, PO Box 330, Tauranga Client			Client's Order Number **Contract No 07/1013**
Address For Report **Duffill Watts & King Ltd, Po Box 330, Tauranga**			Telephone Number **(07) 928-3410**
Copy To: **Ilze Kruis**	Date:	Despatch Time:	Collection Officer (please Print and Sign)

Client ID	Sample Comments	Lab Use Only
KWW-O1 - 200M Up Current		
KWW-O2 - 200M Up Current		
KWW-O3 - 200M Up Current		
KWW-O4 - 200M Up Current		
KWW-O5 - 200M Up Current		
KWW-O6 - 200M Up Current		
KWW-O7 - 200M Up Current		
KWW-O8 - 200M Up Current		
KWW-O9 - 200M Up Current		
KWW-O10 - 200M Up Current		

Type of Samples:
- ▣ Sea Water

Bacteriological Test Required
- ▣ Faecal Coliforms
- ▣ Enterococci

Bottle Type – 120ml Plastic, Yellow Top
Bottle Type – 120ml Plastic, Yellow Top

LTS Revised: 31 July 2007

LABORATORY USE ONLY

Date & Time Received _____/_____/___:___/____ Condition Of Sample Received
Date & Time Tested _____/_____/___:___/____ ....

Western Bay of Plenty District Council Sample Transfer Document
C/- Duffill Watts & King Ltd, PO Box 330, Tauranga

Phone: +64 7 928 3410
Fax: +64 7 928 3421

Laboratory Request Form	Katikati Wastewater Plant Outfall - Quarterly		
Client **Western Bay Of Plenty District Council**			Client's Order Number **Contract No 07/1013**
Address For Report **Duffill Watts & King Ltd, Po Box 330, Tauranga**			Telephone Number **(07) 928-3410**
Copy To: **Ilze kruis**	Date:	Despatch Time:	Collection Officer (please Print and Sign)

Client ID	Sample Comments	Lab Use Only
KWW-O11 - 50M Down Current		
KWW-O12 - 50M Down Current		
KWW-O13 - 50M Down Current		
KWW-O14 - 50M Down Current		
KWW-O15 - 50M Down Current		
KWW-O16 - 50M Down Current		
KWW-O17 - 50M Down Current		
KWW-O18 - 50M Down Current		
KWW-O19 - 50M Down Current		
KWW-O20 - 50M Down Current		

Type of Samples:
- ▣ Sea Water

Bacteriological Test Required
- ▣ Faecal Coliforms
- ▣ Enterococci

Bottle Type – 120ml Plastic, Yellow Top
Bottle Type – 120ml Plastic, Yellow Top

LTS Revised: 31 July 2007

LABORATORY USE ONLY
Date & Time Received _____/_____/____:____/_____ Condition Of Sample Received
Date & Time Tested _____/_____/____:____/_____ ....

Phone: +64 7 928 3410
Fax: +64 7 928 3421

Laboratory Request Form	Katikati Wastewater Plant Outfall - Quarterly		
Client **Western Bay Of Plenty District Council**			Client's Order Number **Contract No 07/1013**
Address For Report **Duffill Watts & King Ltd, Po Box 330, Tauranga**			Telephone Number **(07) 928-3410**
Copy To: **Ilze Kruis**	Date:	Despatch Time:	Collection Officer (please Print and Sign)

Client ID	Sample Comments	Lab Use Only
KWW-O21 - 100M Down Current		
KWW-O22 - 100M Down Current		
KWW-O23 - 100M Down Current		
KWW-O24 - 100M Down Current		
KWW-O25 - 100M Down Current		
KWW-O26 - 100M Down Current		
KWW-O27 - 100M Down Current		
KWW-O28 - 100M Down Current		
KWW-O29 - 100M Down Current		
KWW-O30 - 100M Down Current		

Type of Samples:
- ▣ Sea Water

Bacteriological Test Required
- ▣ Faecal Coliforms
- ▣ Enterococci

Bottle Type – 120ml Plastic, Yellow Top
Bottle Type – 120ml Plastic, Yellow Top

LTS Revised: 31 July 2007

LABORATORY USE ONLY
Date & Time Received ______/______/____:____/_____ Condition Of Sample Received
Date & Time Tested ______/______/____:____/_____ ....

Phone: +64 7 928 3410
Fax: +64 7 928 3421

Laboratory Request Form	Katikati Wastewater Plant Outfall - Quarterly		
Client **Western Bay Of Plenty District Council**			Client's Order Number **Contract No 07/1013**
Address For Report **Duffill Watts & King Ltd, Po Box 330, Tauranga**			Telephone Number **(07) 928-3410**
Copy To: **Ilze Kruis**	Date:	Despatch Time:	Collection Officer (please Print and Sign)

Client ID	Sample Comments	Lab Use Only
KWW-O31 - 200M Down Current		
KWW-O32 - 200M Down Current		
KWW-O33 - 200M Down Current		
KWW-O34 - 200M Down Current		
KWW-O35 - 200M Down Current		
KWW-O36 - 200M Down Current		
KWW-O37 - 200M Down Current		
KWW-O38 - 200M Down Current		
KWW-O39 - 200M Down Current		
KWW-O40 - 200M Down Current		

Type of Samples:
- ▣ Sea Water

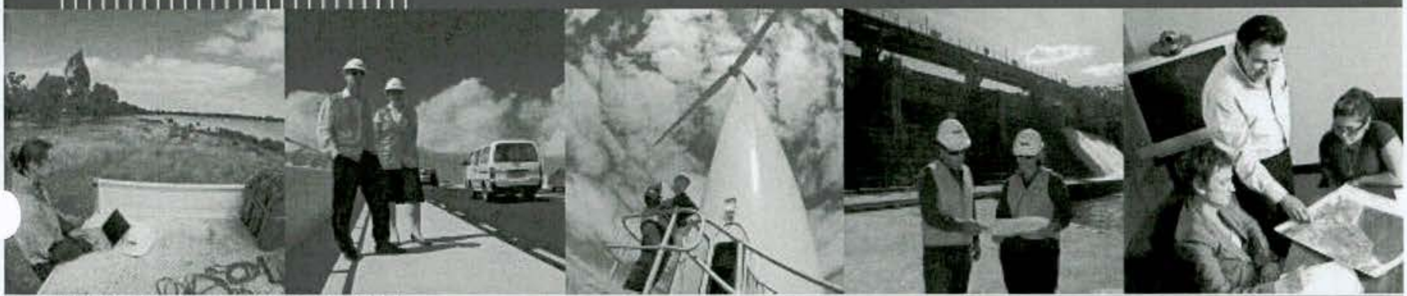
Bacteriological Test Required
- ▣ Faecal Coliforms — **Bottle Type – 120ml Plastic, Yellow Top**
- ▣ Enterococci — Bottle Type – 120ml Plastic, Yellow Top

LTS Revised: 31 July 2007

LABORATORY USE ONLY

Date & Time Received ______/______/____:____/_____ Condition Of Sample Received

Date & Time Tested ______/______/____:____/_____ ....



Report

Katikati Wastewater Treatment Plant Consent - 2012 Disposal Options Report

30 OCTOBER 2012

Prepared for

Western Bay of Plenty District Council

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Date:	**30 October 2012**
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Abbreviations

Abbreviation	Description
WBoPDC	Western Bay of Plenty District Council
SRI	Slow Rate Irrigation
Ha	Hectares
CPI	Consumer Price Index

Executive Summary

In August 1999, Western Bay of Plenty District Council (WBoPDC) were granted a resource consent from the Bay of Plenty Regional Council, Consent Number 24895, for the purpose of discharging wastewater from the Katikati Township and the new pipeline between Sharp Road and the Katikati Township, via a treatment system consisting of aerated lagoons, constructed wetlands and ultraviolet disinfection, with discharge to the Pacific Ocean via an ocean outfall.

The Katikati Ocean Outfall is an 11.9 kilometre long pipeline from the Katikati wastewater treatment plant, passing across the northern part of Tauranga Harbour, across Makatana Island, terminating in a 700m long 150mm diameter steel ocean outfall section with a 'hockey stick " diffuser port.

Condition 12 of the wastewater Consent Number 24895 requires WBoPDC to investigate alternative effluent disposal options and prepare and submit reports to the Regional Council as follows:

- Condition 12.2(i): By 31 October 2007 submit a report on investigations of alternatives to the discharge of effluent from Katikati via the ocean outfall.
- Condition 12.2(ii): By 31 October 2012 submit a report updating the earlier 2007 report, and identifying the preferred options(s).

In October 2007 Duffill Watts Consulting Group issued a report to WBoPDC entitled "Katikati Wastewater Treatment and Disposal System and Report on Treated Effluent Discharge Alternatives", (2007 Report) to fulfil condition 12.2(i) of the consent.

The four alternatives for effluent disposal identified in the 2007 report were as follows:

1. Alternative 1 - Discharge of the Treated Effluent to an Alternative Surface Receiving Water – Tauranga Harbour.
2. Alternative 2 – Slow Irrigation (SRI) of the Treated Effluent on the Forested Sand Country of Matakana Island.
3. Alternative 3 – SRI of the Treated Effluent on Farmland Converted to Forest Plantation on the Mainland.
4. Alternative 4 – Effluent re-use for Horticultural or Pastoral Irrigation or for Irrigation of Parks and Reserves.

In 2012 URS New Zealand Limited (URS) was engaged by WBoPDC to prepare this report to satisfy the requirements of condition 12.2(ii) of the Katikati wastewater treatment plant consent.

The object of this report is to satisfy the requirements of condition 12.2(ii).

A desktop review of the 2007 report was undertaken which included a gap analysis of each of the four effluent disposal alternatives, identification of any improvements to the existing discharge or new technologies, and updated 2007 costs estimates. This process confirmed that none of the alternatives were more favourable to the currently consented discharge to the Pacific Ocean.

A review was also completed of changes in legislation that have occurred since the 2007 report. This focused on changes that could have an impact on the alternative options for the disposal of treated wastewater contained within the 2007 Report. The review considered the impact of:

a) The Proposed Bay of Plenty Regional Policy Statement 2010 (Proposed RPS).
b) The Operative Bay of Plenty Regional Coastal Environment Plan 2002 (Operative CEP).
c) The Operative Bay of Plenty Regional Water and Land Plan 2008 (RWLP).
d) The Operative Western Bay of Plenty District Plan (District Plan).

e) The National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES).

The outcome of the legislation review concluded that the existing disposal method is considered the most favourable. The ocean outfall is existing infrastructure that has provided for the disposal of municipal wastewater in an effective and safe manner. The effects of the outfall have been monitored since the construction and commissioning of the outfall and the results of this monitoring have concluded that the effects to the surrounding environment have been less than minor. It is considered that the planning, consenting and construction of new infrastructure for any of the other disposal alternatives would be significant and relatively expensive compared with the existing option.

A review was also completed of process changes implemented, or being proposed, at the Katikati wastewater treatment plant by WBoPDC since 2007. This included operational process changes, any significant maintenance works that have been undertaken, and mitigation measures that have been or are being considered such as:

a) Partial wetland de-sludging
b) Provision of supplementary pond storage by recommissioning an existing biosolids pond for storage treatment.
c) Future Proposed Operational Changes.
d) Performance of the Outfall Pipeline.
e) Overflow Ultraviolet disinfection.
f) Harbour Overflows.

This review concluded the operational and maintenance changes that have been implemented, together with the mitigation measures implemented, and being proposed, would have a positive impact on the performance and capacity of the current outfall and further minimise environmental risks

It is concluded that based on current information the currently consented discharge to the Pacific Ocean remains the preferred option.

Introduction

1.1 Background

In August 1999, Western Bay of Plenty District Council (WBoPDC) were granted a resource consent from the Bay of Plenty Regional Council, Consent Number 24895, for the purpose of discharging wastewater from the Katikati Township and the new pipeline between Sharp Road and the Katikati Township, via a treatment system consisting of aerated lagoons, constructed wetlands and ultraviolet disinfection, with discharge to the Pacific Ocean via an ocean outfall.

Condition 12 of the consent required WBoPDC to investigate alternative effluent disposal options, and prepare and submit reports to the Regional Council, in particular:

- Condition 12.2(i): By 31 October 2007, submit to the Bay of Plenty Regional Council a report on investigations of alternatives to the discharge of effluent from Katikati via the ocean outfall. Such alternatives shall include land based disposal options including the feasibility of forest irrigation on Matakana Island on land owned by Te Kotukutuku Corporation Limited.
- Condition 12.2(ii): By 31 October 2012 submit to the Bay of Plenty Regional Council a report updating the earlier report dated 31 October 2007, and identifying the preferred options(s).
- Condition 12.2(iii): The studies to be completed by 31 October 2007 and 31 October 2012 shall have regard to engineering, cultural, environmental, financial and other relevant considerations.

In October 2007 Duffill Watts Consulting Group issued a report to WBoPDC entitled "Katikati Wastewater Treatment and Disposal System and Report on Treated Effluent Discharge Alternatives", (referred to in this text as the 2007 Report) to fulfil condition 12.2(i) of the consent.

1.2 Purpose and Scope of the Report

URS New Zealand Limited (URS) was engaged by WBoPDC in 2012 to prepare a report to satisfy the requirements of condition 12.2(ii) of the Katikati wastewater treatment plant consent namely, " By 31 October 2012 submit to the Bay of Plenty Regional Council a report updating the earlier report dated 31 October 2007, and identifying the preferred option(s)."

The scope of this report is seen primarily as a desktop review of the 2007 report and addresses the following:

Complete a review and gap analysis of the 2007 report, in particular:

- Section 4, for each of the four alternatives considered:
  - Identify what is now out of date and update report as required.
  - Identify what technical information is still relevant and change to reflect current practice.
- Section 5, Identify any new technologies or improvements to the existing discharge.
- Section 6, Update cost estimates contained in the 2007 report.

This Report has also reviewed changes in the legislative and compliance regime subsequent to the 2007 report and their impact, if any, on the options considered in the report, specifically:

a) Changes to the Regional Plan.
b) Changes to the District Plan.
c) Changes to Council policy or procedures.
d) Impact of National Environmental Standards.

1 Introduction

Finally for completeness this report has reviewed any process changes implemented, or being proposed, at the Katikati wastewater treatment plant covering:

a) Operational process changes Council have implemented at the treatment plant since 2007.
b) Any significant maintenance works undertaken by Council since 2007, for example de-sludging of the oxidation ponds, etc.
c) Measures implemented, or being proposed, to mitigate the impact of the current treatment plant disposal.
d) Records of treatment plant discharge testing and sampling results.

Review and Update of the 2007 Report

2.1 Review and Gap Analysis of Section 4 – Alternatives to Treated Effluent Disposal to the Pacific Ocean

WBoPDC undertook an investigation of treatment and effluent disposal options for the Katikati wastewater between December 1994 and September 1997 which ultimately led to the adoption of the current operating system. As part of this early investigation work four alternatives to the current Pacific Ocean outfall were evaluated.

The 2007 report reviewed these options, and while acknowledging advances had been made in treatment technology no such advancements had occurred with respect to alternatives for effluent disposal and therefore the four options were still considered the only alternatives to the ocean outfall.

The scope of this section of the report is seen primarily as a desktop review of the four alternatives for effluent disposal identified in the 2007 report as follows:

1. Alternative 1 - Discharge of the Treated Effluent to an Alternative Surface Receiving Water – Tauranga Harbour.
2. Alternative 2 – Slow Irrigation (SRI) of the Treated Effluent on the Forested Sand Country of Matakana Island.
3. Alternative 3 – SRI of the Treated Effluent on Farmland Converted to Forest Plantation on the Mainland.
4. Alternative 4 – Effluent re-use for Horticultural or Pastoral Irrigation or for Irrigation of Parks and reserves.

2.1.1 Alternative 1- Discharge of the Treated Effluent to an Alternative Surface Receiving Water

As identified in the 2007 report the alternative surface receiving water environment for the Katikati treated effluent is the Tauranga Harbour by means of either a direct discharge short outfall pipe to the harbour or indirect discharge via the Uretara Stream. To this option a Papakuanuku area could possibly be added to suit cultural sensitivities relating to a direct discharge

These still remain the only alternative surface receiving water options.

The issues identified in the 2007 report of discharging to the Tauranga Harbour are still relevant today and in some cases have even higher public resistance, namely:

a) An enclosed waterway with high cultural and recreational values.
b) Nuisance blooms of algae and sea lettuce.
c) Elevated concentrations of nutrients and in particular nitrogen.
   To these can be added increased concerns relating to viral presence in the wastewater discharge potentially affecting shellfish gathering, although the final effluent is disinfected using UV radiation which significantly mitigates this risk.

As such, both direct or indirect discharge of the Katikati treated effluent to the Tauranga Harbour are considered environmentally less acceptable alternative options to the currently consented discharge to the Pacific Ocean via an ocean outfall.

The risk of public contact with the treatment wastewater, or any residual contaminants, is significantly lower for the ocean outfall than a coastline discharge.

2.1.2 Alternative 2 - Slow Rate Irrigation (SRI) of the Treated Effluent on the Forested Sand Country of Matakana Island

This alternative involves diverting the outfall pipeline where it crosses Matakana Island and piping it to a nearby location where it could be irrigated onto suitable blocks of commercial pinus radiata forest by either surface drip or spray irrigation SRI.

The 2007 report calculated nett forest irrigation areas, using a conservatively low minimum nitrogen uptake rate of 130kgN/ha/year and an average total concentration of effluent of 20g/m^3, of:

- 46ha in 2007
- 76ha in 2026. This was based on a 2026 population projection of 5700 residents. Current WBoPDC projections show a population of 5400 giving a 2026 area of 72ha.

Blakely Pacific Ltd, part owner of the Matakana Island commercial forest plantation with Te Kotukutuku Corporation Ltd, are currently appealing an Environment Court decision to overturn a subdivision resource consent to subdivide their forestry land on Matakana Island into forty eight 40ha blocks. Development of the forestry land if granted through the appeal process would diminish the amount of area available for SRI.

The benefit to trees in commercial pinus radiata forest land irrigated with municipal effluent has found to be marginal. Pinus radiata generally have low rates of nitrogen uptake, prefer to have dry root systems, (namely perform better in negative saturated conditions), and are very sensitive to the quality of treated effluent used for irrigation. Also the irrigation infrastructure can create operational forest management issues. The effluent can also effect the rate of tree growth and thereby the future uses of the tree and the tree value.

The above issues, and based on URS's understanding from WBoPDC that there is still significant resistance from the Matakana Island community to SRI, make this an undesirable alternative.

However WBoPDC have confirmed some interest has been expressed by the island community to the possibility of utilising the effluent as an emergency fire fighting supply as the island does not currently have a reticulated fire supply system. This option would need to be investigated further if considered feasible by WBoPDC. However this does not provide a long term solution for continuous wastewater disposal.

2.1.3 Alternative 3- SRI of the Treated Effluent on Farmland Converted to Forest Plantation on the Mainland

The 2007 Duffill's report stated *"This alternative was thoroughly canvassed at the time of the previous 1994 to 1997 investigation to the extent that a possibly suitable block of land in Busby Road was identified and purchased by the WBoPDC to ensure that the option remained feasible during the comparison of options phase of the investigations."*

However WBoPDC have confirmed following a search of their records and property files no block of land was, or has subsequently been purchased in Busby Road or the surrounding area.

The 2007 report concluded an area of approximately 95 ha would be required for effluent irrigation including an allowance for buffer zones to neighbouring properties and a provision for some of the land being unsuitable due to topographical constraints. The 2007 report estimated a land purchase cost of $3,800,000, allowing for a 14% increase based on Statistics New Zealand's published CPI figures this would represent a current 2012 cost of approximately $4,332,000. WBoPDC have no provision in their current 2012 – 2022 Long Term Plan for such expenditure.

The land purchase cost associated with this option, together with the issues associated with the transfer pipeline and pump station, wastewater holding ponds (and their associated issues in areas of high rainfall), and irrigation of forest plantations outlined in section 2.1.4, make this an undesirable alternative. Similar options were also considered as part of the Omokoroa scheme and were discounted due to the high rainfall in the area, terrain and high capital and operating costs.

2.1.4 Alternative 4- Effluent re-use for Horticulture or Pastoral Irrigation or for Irrigation of Parks and Reserves

The option of effluent re-use for irrigation on either horticultural, pastoral or parks and reserves land recognises the potential to utilise the very high quality of treated effluent from the Katikati plant (via subsurface drip irrigation to minimise the plant and people contact with the wastewater), as an alternative source of irrigation water during the three summer months.

While subsurface drip irrigation during summer months is technically feasible there are a number of both perceived and actual public health issues that need to be considered. These are listed as follows:

- There is negative cultural and community perception against re-use of treated municipal effluent for irrigation of public open spaces and production of food for human consumption. Whilst this can be minimised using the low rate subsurface drip system issues remain.
- It is difficult and expensive to find sufficient publically owned land within a reasonable distance of the WWTP to irrigate sufficient wastewater to make this option viable. The costs of irrigating multiple land blocks some distance apart is high.
- Most areas of horticultural, pastoral, parks and reserves land considered suitable for effluent re-use already have existing irrigation infrastructure, generally sourcing water from the WBoPDC supply network. In order to protect public health, and eliminate the risk of any cross contamination with the WBoPDC water supply network, any irrigation system re-using treated wastewater effluent would need to ensure separation between the WBoPDC and irrigation networks. This could be achieved either via robust backflow and flushing procedures or construction of completely separate standalone irrigation networks. Both of these options present additional operational issues and costs for the network operator.
- Irrigation of land with treated municipal wastewater effluent would require a new consent application thus potentially requiring the landowner to manage two separate consents.
- Fonterra has a policy driven by its customer base of not accepting any milk from pasture irrigated by treated municipal wastewater effluent unless treated to the very high requirements of the Californian Standard Title 22, which would severely restrict the current and future land use of the irrigated areas.

WBoPDC records indicate water demand in the Katikati area doubles during the peak summer months and therefore alternative sources of irrigation water would help ease pressure on WBoPDC water supply. However the options of effluent re-use for irrigation would only provide an alternative during the summer months to the current ocean outfall and does not address alternatives to the discharge of effluent for the remaining nine months of the year. Thus the actual and perceived risk, and the high implementation costs, of parkland irrigation options make these less favourable alternatives to the currently consented discharge to the Pacific Ocean.

2.2 Review and Update of Section 5 - Improvements to the Existing Discharge or New Technologies

2.2.1 Improvements to the Existing Discharge

A review of WBoPDC's treatment plant discharge testing and sampling records since 2007 supports the 2007 view that the current Katikati treatment and disposal system is continuing to operate effectively with no evidence of any adverse environmental effects or public health impacts.

However it is understood there still exists an issue of perception within the community that continued discharge of treated effluent to the Pacific Ocean is an unacceptable practise. As such WBoPDC, as required by the consent conditions, have continued to monitor the operation of the Katikati wastewater treatment plant and performance of the existing discharge. They have also implemented a number of process changes since 2007 including operational changes, maintenance works programmes and mitigation measures in order to maintain and improve the effluent discharge quality. These are addressed in more detail in section 4 of this report Process Changes.

2.2.2 New Technologies

The 2007 report identified that while the existing treatment and disposal system was operating well with no evidence of adverse environmental or public health impacts there was a perception by some groups in the community that the discharge was aesthetically and culturally unacceptable. As such the option of installing a membrane filtration unit at the treatment plant prior to the discharge of effluent to the outfall was considered.

Whilst this unit would have reduced some of the suspended solids in the effluent a review of discharge testing records at the time indicated that the upgrade was unnecessary as a membrane filtration unit would have provided little benefit for the cost and as such was not progressed by WBoPDC. This is still considered to be the case.

An option, not considered in the 2007 report, is upgrading or replacing the existing ultraviolet facility to improve the efficiency of the disinfection process at the treatment plant. WBoPDC have indicated that, in general, they have not experienced any problems or issues associated with the current ultraviolet system. The current unit is monitored as part of the plants maintenance works programme and results of the seawater sample testing indicate the unit is performing efficiently.

However WBoPDC recognise that disinfection is an area of the treatment process that could be improved, in particular management of suspended solids and storm related overflows. As such they have identified a proposed programme of works to address these issues. These works are discussed in more detail in section 4.3 Mitigation Measures, in particular sections 4.3.1 (a) and 4.3.3. This works programme would address any minor disinfection issues. Based on the results of the discharge testing no major upgrade or replacement of the existing ultraviolet facility is justified.

2.3 Updated Section 6 - Cost Estimates

The preliminary indicative budget cost estimates contained in the 2007 report have been assumed as correct at the time, still relevant and form the basis for this report. No new detailed costing work has been undertaken. The 2007 costs included physical works estimates and allowances for design, project management and construction contingencies based on the capacity to provide for the 2026 year flow. It is not known if any operational costs were considered in the preparation of these

2 Review and Update of the 2007 Report

estimates. For this report the 2007 costs have been adjusted pro-rata for revised population projections and the Consumer Price Index (CPI) to provide a cost estimate in 2012 dollars.

At the time of the 2007 report WBoPDC projected 2026 population for Katikati was 5700 people. The current 2026 population projection is 5400, a decrease of approximately 5%.

Statistics New Zealand's published CPI table "All Groups Index SE9A" has been used as the basis for cost index adjustment. The period applicable for the 2007 report is the quarter September 2007, index base 1025. The most recent published period is June 2012, index 1168, representing a 14% increase.

Table 2- 1 below summaries the updated 2007 cost estimates.

Table 2-1 Updated 2007 Cost Estimates

2007 Disposal Alternative	2007 Cost Estimate	% Population Adjustment	% CPI Adjustment	2012 Adjusted Cost Estimate
Discharge to Tauranga Harbour	$270,000	-5%	+14%	$293,000
SRI Matakana Island Forestry	$6,200,000	-5%	+14%	$6,731,000
SRI Mainland Forest Block	$9,200,000	-5%	+14%	$9,988,000
Summer Subsurface Irrigation of Parks and Reserves	$5,050,000	-5%	+14%	$5,483,000
Membrane Filtration of Effluent	$1,800,000	-5%	+14%	$1,954,000

Note the 2007 report did not include cost estimates for effluent re-use for horticultural or pastoral irrigation due to the need to first identify a specific landowner(s) who would have an interest in using the effluent. The land needs to be identified as it will significantly affect capital and operating costs.

Since the 2007 report it has become common practice for the provision of Papakuanuku areas to suit cultural sensitivities. We estimate this would add an additional $50,000 to $200,000 to the above cost estimates.

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Compliance Review

3.1 Katikati Ocean Outfall Options Review – Applicable Legislation Commentary

This review outlines the changes in legislation that have occurred since the 2007 report was issued to WBoPDC. The review focuses on changes that could have an impact on the alternative options for the disposal of treated wastewater within Katikati contained within the 2007 Report. This review fulfils Condition 12.2(ii) of consent number 24895.

A summary of the compliance review and status of the existing ocean outfall discharge is provided in section 3.1.6.

3.1.1 The Proposed Bay of Plenty Regional Policy Statement 2010 (Proposed RPS)

The Proposed Bay of Plenty Regional Policy Statement 2010 (Proposed RPS) was released on 9 November 2010. Submissions were received by the Bay of Plenty Regional Council and hearings held. The Bay of Plenty Regional Council's (BOPRC) decisions on the Water Quality and Land Use and Coastal Environment provisions were released on 27 March 2012. Decisions on the remaining parts of the Proposed RPS were released on Tuesday 14 August 2012.

Proposed Variation 1 - Coastal Policy to the Proposed RPS was notified for submissions on Thursday 31 May 2012. The proposed variation is to ensure the Proposed RPS meets the requirements of the New Zealand Coastal Policy Statement 2010 (NZCPS). Proposed Variation 1 includes maps identifying the coastal environment and areas with high natural character.

Both the Proposed RPS and Proposed Variation 1 have been considered below.

The Proposed RPS provides a more targeted approach to water quality and management than the Operative Bay of Plenty Regional Policy Statement 1999. The focus is more on identifying and controlling landuse activities and adopting a whole catchment approach rather than a focus on coastal areas only or land based activities separately.

The implementation of policies are also more specific through the use of plan changes, resource consents and notice of requirements, whereas the Operative Regional Policy Statement 1999 (Operative RPS) has a high level approach in terms of education, encouraging and promoting. The Proposed RPS also has a more integrated management emphasis with a combined management approach from Regional Council, District Council and Iwi.

The applicable policies from the Proposed RPS include:

- Policy CE 2A - Avoiding effects on natural character.
- Policy CE 3A - Identifying the key constraints to use and development of the coastal marine area.
- Policy CE 4A - Protecting and restoring natural coastal margins.
- Policy CE 7B - Ensuring use and development avoids adverse effects on the natural character of the coastal environment.
- Policy CE 8B - Safeguarding the life-supporting capacity of coastal eco-systems.
- Policy CE 9B - Managing adverse effects of land-based activities on marine water quality.
- Policy CE 10B - Allocating public space within the coastal marine area.
- Policy WL 2B - Defining catchments at risk – Controlling contaminant discharges in those catchments.
- Policy WL 3B - Establishing contaminant discharge limits for catchments at risk.

- Policy WL 4B - Requiring consent for increased discharges for those catchments at risk.
- Policy WL 8B - Providing for regular reviews of regional council consent conditions.
- Policy IR 1B - Applying a precautionary approach to managing natural and physical resources.
- Policy IR 3B - Adopting an integrated approach to resource management.
- Policy IR 5B - Assessing cumulative and precedent effects.

The Proposed RPS once made fully operative will provide a direction for the Bay of Plenty Regional Plans which will most likely undergo plan changes to be better suited to the directive of the policy statement. The possible effects of the Proposed RPS on the alternatives are outlined below.

Disposal Alternatives 1 (Discharge to Harbour) and 2 (SRI at Matakana Island)

The Proposed RPS identifies that the Tauranga Harbour is adversely affected by surrounding landuse and activities within the harbour. Policies to protect the natural character of the harbour include preservation of undeveloped areas and ensuring that development avoids adverse effects on the natural character of the coastal environment.

Policy CE 3A seeks to identify the key constraints to use and development of the coastal marine area to avoid conflict between incompatible uses and to ensure proactive management of existing and new uses. Policy CE 10B seeks to allocate public space within the coastal marine area (CMA) where proposed activities shall demonstrate a functional or positional need to be located in, or adjacent to the coastal marine area. The activity shall demonstrate efficient use of the natural resources within the CMA with consideration of nett benefit to the public, public access to the CMA, recreational use, sites of significant cultural, landscape, historical and ecological value, and respect for Maori customary practices.

Overall, it is considered that disposal Alternatives 1 and 2 could be inconsistent with some of the objectives and policies of the Proposed RPS. A proposed wastewater discharge within the Tauranga Harbour or a slow rate discharge through land to the harbour could be perceived to assist in the degradation of the natural harbour environment which has been identified as an issue through the Proposed RPS. New outfall infrastructure could face competition and an unfavourable position when BoPRC allocate space within the CMA for proposed uses amongst existing uses as per the above policies. It should be noted the Proposed RPS is a policy statement providing direction to the Regional Plan. Refer to sections 3.1.2 Operative CEP and 3.1.3 RWLP for the rules and their effect on the disposal alternatives.

Disposal Alternatives 3 (SRI on Forest) and 4 (Effluent Reuse on Land)

The focus of the Proposed RPS on a whole catchment approach and identifying landuse activities that could degrade coastal areas would have an effect on Alternatives 3 and 4.

When considering the effects of these two options, a more cumulative and holistic approach would be required than rather traditionally considering the effects of the activity on the land only. Policy IR 3B seeks to adopt an integrated approach that recognises the interconnected nature of natural and physical resources and that encourages developments that provide for the relationship between land use and water quality and quantity.

3.1.2 Operative Bay of Plenty Regional Coastal Environment Plan 2002 (Operative CEP)

A revised New Zealand Coastal Policy Statement was gazetted by the Minister of Conservation on 3 December 2010. This has enabled Council to initiate a full review of the Operative Bay of Plenty Regional Coastal Environment Plan 2002 (Operative CEP).

BOPRC have completed a full review of the Operative CEP and are currently developing a Proposed Regional Coastal Environment Plan which will be notified in early 2013.

The Proposed Regional Coastal Environment Plan (Proposed CEP) will relate to streamlining the plan and will have more focus on objectives and policies. It will also include new legislation that is applicable and which affects the plan such as the Marine and Coastal Area Act 2011.

The Marine and Coastal Area Act 2011 provides a mechanism for customary rights and/or customary marine title to be recognised in the coastal marine area. This means that activities in the CMA in the area over which customary right title is held, cannot commence until permission is received from the holder of that title.

The possible effects of the Operative CEP and Proposed CEP on the alternatives are outlined below.

Disposal Alternative 1 (Discharge to Harbour)

The incorporation of the Marine and Coastal Area Act 2011 into the Proposed CEP could affect any application for an outfall within the Tauranga Harbour if customary rights titles provided by the Act are held at the time of applying for resource consents and development.

Currently, Rule 9.2.4(c) of the Operative CEP states that the discharge of human sewage, other than from vessels, into the coastal marine area of harbours and estuaries, which has not passed through soil or wetland (in addition to other treatment), is a prohibited activity. This means that a resource consent for any outfall within the Tauranga Harbour with direct discharge of treated wastewater could not be granted, unless it passed through land or a wetland in which case it would be deemed a discretionary activity.

Disposal Alternative 2 (SRI on Matakana Island)

Alternative 2 would also face the same issues as Alternative 1 in regard to the introduction of the Marine and Coastal Area Act 2011. Placement of infrastructure and the right to discharge within the CMA could be hindered by any customary title rights.

Rule 9.2.4(b) of the Operative CEP states that any other discharge (through land) is a discretionary activity. BOPRC may grant or refuse such resource consent for a discretionary activity and are not restricted to any matters when making such a decision.

Disposal Alternatives 3 (SRI on Forest) and 4 (Effluent Reuse on Land)

The Proposed CEP would also include influence from the Proposed RPS once operative. As stated within Section 3.1.1 above, this could require a more holistic approach to assessing Alternatives 3 and 4 where new rules could be included that require assessment of effects on the coastal environment/receiving waters in addition to the land or immediate environs.

3.1.3 Operative Bay of Plenty Regional Water and Land Plan 2008 (RWLP)

The Operative Bay of Plenty Regional Water and Land Plan 2008 (RWLP) has not seen significant change since becoming operative in 2008. The most significant change has come from the National Policy Statement for Freshwater Management. The National Policy Statement for Freshwater Management requires alteration to regional plans in regard to any application for a discharge and the management of freshwater. This will give an increased focus to freshwater management issues than would have otherwise been the case, in planning for and managing activities that impact upon fresh water.

New policies 43A and 68A which have been incorporated into the RWLP due to the National Policy Statement or Freshwater Management and state:

When considering any application the consent authority must have regard to:

- The extent to which the change would adversely affect safeguarding the life-supporting capacity of fresh water and of any associated ecosystem.
- The extent to which it is feasible and dependable that any adverse effect on the life-supporting capacity of fresh water and of any associated ecosystem resulting from the change would be avoided.

Disposal Alternative 1 (Discharge to Harbour) and Disposal Alternatives 2 – 4 (SRI on Matakana Island, SRI on Forest, Effluent Reuse on Land)

The RWLP is applicable to Alternative 1 if the treated wastewater were to be discharged into the stream located adjacent to the WWTP. Policies 43A and 68A could have an effect on assessing Alternatives 1 - 4 in that if any discharge ultimately enters an adjacent freshwater body, the effects of such would need to be considered more thoroughly. Additionally, any construction works adjacent to a stream, river or lake would also need to be considered.

Rule 37 of the RWLP states that any discharge to water or land that is not permitted is a Discretionary Activity. Any resource consent for Options 1 – 4 would be a discretionary activity in this case. BOPRC may grant or refuse a discretionary activity and are not restricted by any matters when assessing such an activity.

The RWLP will be subject to change to realign with the direction of the Proposed RPS once it becomes operative.

3.1.4 Operative Western Bay of Plenty District Plan 2012 (District Plan)

The Operative Western Bay of Plenty District Plan (District Plan) came into effect in 2012. All rules associated with Matakana Island are still currently under appeal and are therefore not operative at this stage. The District Plan currently makes most development and some subdivision activities non-complying. WBoPDC intend to undertake a plan change once the Matakana Whole of Island Plan (WOIP) has been implemented.

The WOIP is currently under progress. This is a guidance document but will have some parts incorporated within the District Plan. It is also currently under appeal. The WOIP allows for ongoing use of forestry and management of ecological values, subdivision and other development.

It also identifies that there is increasing interest in intensive development of Matakana Island. For this reason, the District Plan requires that any consideration of intensive or large-scale development must be preceded by a WOIP plan that deals with issues in a holistic manner considering the whole of the island rather than allowing piecemeal development.

Disposal Alternative 1 (Discharge to Harbour)

Alternative 1 is not affected by the District Plan as any outfall would be located within the CMA which is covered by the BOPRC. Any works on land (installation of pipes etc) would be considered under the District Plan, however the installation of wastewater pipes is considered a permitted activity.

Disposal Alternative 2 (SRI on Matakana Island)

Blakely Pacific Ltd (BP Ltd), owner of most of the forestry land on Matakana Island, wish to subdivide the forestry land into forty eight 40ha lots. Consent was granted but successfully appealed by Iwi. BP Ltd are now appealing that decision. Development of the forestry land, if granted through the appeal process would diminish the amount of area available for slow rate irrigation.

Matakana Island has significant cultural values for Maori and most of the island falls within the Acutely Threatened Land Environment NZ category. Proposing to utilise part of the land for slow rate irrigation may be considered contentious and would require consultation with iwi. There are 5 hapu groups that have a connection to Matakana Island.

Disposal Alternative 3 (SRI on Forest)

Busby Road has maintained its rural zoning under the District Plan and production forestry remains a permitted activity within this zone. Sewage treatment plants/schemes/facilities are a Discretionary Activity within the Rural zone. Utilising this site for slow rate irrigation would therefore be considered a Discretionary Activity. WBoPDC may grant or refuse a resource consent application for a discretionary activity and are not restricted by any matters when assessing any such application.

Disposal Alternative 4 (Effluent Reuse on Land)

Moore Park was identified as a possible reserve area to use for irrigation within the 2007 report. Initial assessment had highlighted that the area was 7.5ha and too small for beneficial re-use. The size of the park will change under Plan Change 18 (now operative and incorporated within the District Plan) and has increased in size to approximately 22ha, but is still considered too small to be utilised for beneficial reuse. No other reserve land has been gazetted within the vicinity of the Katikati Wastewater Treatment Plant as part of the District Plan.

3.1.5 National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES)

The National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES) came into effect on 1 January 2012 and is a new piece of legislation that is required to be considered with any works on potentially contaminated land.

Disposal Alternative 1 (Discharge to Harbour)

Alternative 1 is not affected by the NES as any outfall would be located within the CMA which is covered by the BOPRC. Any works on land (installation of pipes etc) would be considered under the NES as stated below.

Disposal Alternatives 2 – 4 (SRI on Matakana Island, SRI on Forest, Effluent Reuse on Land)

Laying pipes from the WWTP to any land to be utilised for disposal of treated wastewater could trigger the requirement for consents under the NES as this would require the disturbance of soil across various sites (mostly pastoral or horticultural land) which could potentially be contaminated.

The NES requires soil investigations and reporting to be completed on land that could potentially be contaminated (due to historic or current landuse activities on the site) to identify if the soil is contaminated. Remediation of the land would be required in the event that it is found to be contaminated. This could be a cumbersome task considering that construction could cross large areas of land.

3.1.6 Summary

Table 3 - 1 summarises the effects of changes in legislation that have occurred since the 2007 report.

Table 3-1 Legislation Summary Table

Alternative	Change of Legislation Effects
1. Discharge to Harbour	Contrary to Proposed RPS in that the effects could have a negative impact on CMA and coastal environment. Would face competition for space within the CMA from other existing and proposed activities and public access to the CMA. Direct outfall into Tauranga Harbour would not be granted resource consent and would be a Prohibited Activity under the Operative CEP. If discharged via ground or Papakuanuku it would be a Discretionary Activity under the Operative CEP Infrastructure within CMA could face issues in regard to customary title rights.
2. (SRI at Matakana Island)	Contrary to Proposed RPS in that the effects could have a negative impact on CMA and coastal environment. Would face competition for space within the CMA from other existing and proposed activities and public access to the CMA. Discretionary activity under the Operative CEP. Infrastructure within CMA could face issues in regard to customary title rights. Any discharge into adjacent freshwater bodies would need to be thoroughly assessed in regard to the effects on the quality of the water. Discharge to land is considered a Discretionary activity under the RWLP. Blakely Pacific Ltd are currently appealing an Environment Court decision to overturn a subdivision resource consent to subdivide their forestry land on Matakana Island into forty eight 40ha blocks. Development of the forestry land, if granted through the appeal process would diminish the amount of area available for slow rate irrigation.

3 Compliance Review

Alternative	Change of Legislation Effects
	Matakana Island has significant ecological and cultural values. Effects to the island could be considered contentious. Disturbance of soil would need to be considered under the NES.
3. (SRI on Forest)	The Proposed RPS has a more integrated approach and whole catchment approach. Discharge effects may need to consider any effects on downstream catchments and the CMA. Any discharge into adjacent freshwater bodies would need to be thoroughly assessed in regard to the effects on the quality of the water. Discharge to land is considered a Discretionary activity under the RWLP. Busby Road site is still zoned rural and any SRI would be considered a Discretionary Activity under the District Plan Disturbance of soil would need to be considered under the NES.
4. (Effluent Reuse on Land)	The Proposed RPS has a more integrated approach and whole catchment approach. Discharge effects may need to consider any effects on downstream catchments and the CMA. Any discharge into adjacent freshwater bodies would need to be thoroughly assessed in regard to the effects on the quality of the water. Discharge to land is considered a Discretionary activity under the RWLP. Moore Park has increased in size to approx 22ha but is still too small for beneficial reuse. No new reserves have been gazetted as part of the District Plan. Disturbance of soil would need to be considered under the NES.

In conclusion, it is considered that the existing disposal method is the most favourable. The ocean outfall is existing infrastructure that has provided for the disposal of municipal wastewater in an effective and safe manner. The effects of the outfall have been monitored since the construction and commissioning of the outfall and the results of this monitoring have concluded that the effects to the surrounding environment have been less than minor.

It is considered that the renewal of the discharge consent in 2016 would have less than minor effect on the environment. The projected population increase from 2006 to 2016 is predicted at 34% (population increase from 3500 to 4700 residents), which is currently expected under the existing resource consent and is therefore considered the current permitted baseline. The predicted population increase from 2016 to 2026 (assuming a 10 year renewal period) is only 15% (population increase 4700 to 5400 residents). This increase in discharge over a 10 year period would be close enough to the permitted baseline established under the existing resource consent. It is therefore considered that a renewal of the discharge consent would have a less than minor effect.

The existing outfall is in keeping with the Proposed Regional Policy Statement in that the infrastructure is an existing occupation of the CMA and does not have conflict with any other activities. It does not restrict public access to the CMA and does not have an adverse effect on the coastal environment.

3 Compliance Review

The existing treated wastewater discharge is also treated through wetland before discharging to the ocean which is in keeping with the Operative CEP. The wastewater is rapidly diluted within the ocean. There are no known adverse effects of the existing disposal method in comparison to utilising any of the alternative options. Obtaining land for irrigation purposes for Alternatives 3 or 4 could be problematic and the cumulative effects of such disposal methods are considered greater when considering a 'whole catchment' approach which is required by the Proposed Regional Policy Statement.

Process Changes

For completeness this report has also reviewed the following process changes implemented, or being proposed, by WBoPDC at the Katikati wastewater treatment plant since the 2007 report.

4.1 Operational Changes

The following assisted with improving the operational efficiency of the treatment plant and quality of the effluent discharge WBoPDC have undertaken the following works at the Katikati wastewater treatment plant:

a) Converted approximately 25% of the lower portion of the wetlands from a planted to floating operation and desludged this area.
b) Constructed an area for dewatering the bio-bags containing the excavated sludge.
c) Constructed an emergency overflow pond.
d) Raised the bund height around the wetland by 500mm in order to increase storage capacity for extreme wet weather events.
e) Constructed a swale at the wetland to intercept any surface sheet stormwater during extreme wet weather events.
f) Reconstructed the rock outlet head works.

4.2 Maintenance Works

WBoPDC have a comprehensive maintenance works programme in place to ensure the Katikati treatment plant and discharge function within optimum operational limits. This programme covers all aspects of the plants operation including:

a) Proactive maintenance and replacement of mechanical and electrical components.
b) Regular inspection and maintenance of flow meters and air valves including those on Matakana Island.
c) Regular cleaning and removal of build up from the inlet screens and grit channels.
d) Monitoring of the ultraviolet units.
e) Wetland pond sludge volume surveys.

4.3 Mitigation Measures

4.3.1 Future Proposed WWTP Operational Changes

Further to the operational changes outlined in Section 4.1, URS understand WBoPDC are proposing the following additional works at the Katikati wastewater treatment plant:

a) Installation of a pre-wetlands filtration unit to improve removal of suspended solids in effluent entering the wetlands,
b) Conversion of the remaining planted wetlands to a fully floating operation and at the same time desludge this remaining area,
c) Construction of a new dewatering area, adjacent to and draining towards the wetlands to store the bio-bags resulting from the desludging operation,
d) Installation of a pre dosing unit at the Wills Road pump station to seed the effluent with bacteria (eco-tabs) to assist with aerobic biological breakdown of the organic sludge and natural fats, oils and grease.

4.3.2 Performance of Outfall Pipeline

WBoPDC had identified issues with progressive poor performance of the outfall pipeline and in early 2012 engaged URS to investigate the potential causes. URS reviewed SCADA data, pump performance records, CCTV footage and pipe pressure test results. The results of this review confirmed the outfall pipeline had an appropriate pressure design rating and residual performance life[1] However it was found the line was significantly blocked with accumulated slime and fats and the pressure test results also strongly suggested that the pipeline capacity was constrained by the accumulation of air within the pipeline.

As a result URS identified a number of possible solutions for improving the performance and capacity of the outfall pipeline, as follows:

a) Air Management – address air entry at the pump station and air entry on Matakana Island during pump stops by forcing air removal from the pipeline via air valves and air flushing. To date, WBoPDC have replaced or upgraded the air valves and modified the pump station wet well at the treatment plant
b) Line Pigging – given the extent of slime and fat deposits and length of the pipeline the most practicable method of cleaning the pipeline is expected to be by a combination of air flushing and pigging. WBoPDC have recently undertaken a trial dosing of the effluent using a proprietary tablet application (eco-tabs[2]) to initiate aerobic biological breakdown of the organic sludge and natural fats, oils and grease. URS understand initial results are favourable, however WBoPDC are still to complete post dosing flow tests to confirm this. If successful the pipeline will be progressively pigged to assist with deposit removal.
c) Routine Flushing – following pigging of the pipeline URS recommended a regime of routine flushing flows (i.e. weekly flushing) be implemented to minimise slime formation and provide flushing-through of accumulated air pockets. WBoPDC are considering implementation of this as part of their routine operations the final programme and sequence is still to be confirmed, subject to the outcome of the "dosing trial" and subsequent pigging programme.
d) Flow Boosting – to be used on a periodic basis to improve flushing velocities in the outfall for the purpose of improving hydraulic performance. WBoPDC are progressing a final design, prepared by URS, for a temporary booster arrangement on the outfall pipeline on Matakana Island.

4.3.3 Overflow Ultraviolet Disinfection

During periods of high stormwater infiltration at the treatment plant overflows can occur from the existing wetlands as the volume capacity is exceeded. These overflows are discharged into the existing wastewater treatment plant outlet pump station and ultimately the Tauranga Harbour without additional treatment. WBoPDC recently engaged URS to design an overflow facility including an ultraviolet unit to provide disinfection of this discharge. The design is currently being finalised and once complete WBoPDC will apply for a resource consent to enable construction of the facility.

4.3.4 Harbour Overflows

The Katikati wastewater treatment plant has experienced instances of effluent overflows into the Tauranga Harbour when the hydraulic capacity of the plant is exceeded. The mitigation measures outlined above together with the process changes implemented or being proposed by WBoPDC will

[1] URS letters reference 42071748 L007 dated 28 June 2012 and L008 dated 20 September 2012
[2] www.eco-tabs.co.nz

assist in minimising the potential for future overflows and, with the additional UV disinfection, reduce the public health and environmental impact should any future overflow occur.

4.4 Discharge Records

A condition of the current consent requires WBoPDC to implement a monitoring programme sampling seawater on a quarterly basis at distances of 50m, 100m and 200m down current of the diffuser and 200m up current. The samples are tested for the presence of pathogen indictor bacteria enterococci and faecal coliform.

A review of WBoPDC seawater sampling and testing records for the Katikati wastewater treatment plant outfall diffusers show no adverse trends since 2007 and indicate the treated effluent, following initial ocean dilution and mixing, presents no risk to public health for kai moana gathering or recreational use.

A copy of the most recent testing results for August 2012 are attached in Appendix A.

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5 Conclusion

Following a desktop review and update of the 2007 report, a review of changes in legislation that has occurred and process changes implemented or being proposed by WBoPDC at the Katikati wastewater treatment plant since 2007, it is considered the alternative wastewater disposal options would result in additional capital costs and in some cases present higher environmental risks therefore no favourable alternative to the currently consented discharge to the Pacific Ocean has been identified.

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References

1. Katikati Wastewater Treatment and Disposal System and Report on Treated Effluent Discharge Alternatives, Duffill Watts Limited, October 2007.
2. Proposed Bay of Plenty Regional Policy Statement 2010, released 9 November 2010.
3. Operative Bay of Plenty Regional Coastal Environment Plan, 2002.
4. Operative Bay of Plenty Regional Water and Land Plan, 2008.
5. Operative Western Bay of Plenty District Plan, 2012.
6. National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health, 2012.
7. URS letters reference 42071748 L007 dated 28 June 2012 and L008 dated 20 September 2012
8. www.eco-tabs.co.nz

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7 Limitations

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A

Appendix A Record of Seawater Sampling and Testing at the Katikati Outfall Diffuser August 2012

Environmental Laboratory Services Ltd.

Western Bay of Plenty D.C.
Private Bag 12 803
TAURANGA
3143

Attention: Ilze Kruis

Analytical Report

Report Number: 12/19119
Issue: 1
23 August 2012

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-1	KWW - 01		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-10	KWW - 10		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-11	KWW - 11		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-12	KWW - 12		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	4	cfu/100mL	Sunita Raju KTP

85 Port Road Seaview
Lower Hutt New Zealand
Phone: (04) 576 5016 Fax: (04) 576 5017
Email: mailto:reports@els.co.nz Website: http://www.els.co.nz

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-13	KWW - 13		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-14	KWW - 14		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-15	KWW - 15		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-16	KWW - 16		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-17	KWW - 17		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	8	cfu/100mL	Sunita Raju KTP

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Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-18	KWW - 18		21/08/2012 00:00	22/08/2012	12/1001

Notes:

Test		Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-19	KWW - 19		21/08/2012 00:00	22/08/2012	12/1001

Notes:

Test		Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-2	KWW - 02		21/08/2012 00:00	22/08/2012	12/1001

Notes:

Test		Result	Units	Signatory
M0102	Faecal Coliforms	8	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-20	KWW - 20		21/08/2012 00:00	22/08/2012	12/1001

Notes:

Test		Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-21	KWW - 21		21/08/2012 00:00	22/08/2012	12/1001

Notes:

Test		Result	Units	Signatory
M0102	Faecal Coliforms	8	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

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Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-22	KWW - 22		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-23	KWW - 23		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-24	KWW - 24		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-25	KWW - 25		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	8	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-26	KWW - 26		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	4	cfu/100mL	Sunita Raju KTP

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Email: mailto:reports@els.co.nz Website: http://www.els.co.nz

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-27	KWW - 27		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-28	KWW - 28		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-29	KWW - 29		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-3	KWW - 03		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-30	KWW - 30		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-31	KWW - 31		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-32	KWW - 32		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-33	KWW - 33		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-34	KWW - 34		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-35	KWW - 35		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-36	KWW - 36		21/08/2012 00:00	22/08/2012	12/1001

Notes:

Test		Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-37	KWW - 37		21/08/2012 00:00	22/08/2012	12/1001

Notes:

Test		Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-38	KWW - 38		21/08/2012 00:00	22/08/2012	12/1001

Notes:

Test		Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-39	KWW - 39		21/08/2012 00:00	22/08/2012	12/1001

Notes:

Test		Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-4	KWW - 04		21/08/2012 00:00	22/08/2012	12/1001

Notes:

Test		Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-40	KWW - 40		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-5	KWW - 05		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-6	KWW - 06		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-7	KWW - 07		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	8	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-8	KWW - 08		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
12/19119-9	KWW - 09		21/08/2012 00:00	22/08/2012	12/1001

Notes:

	Test	Result	Units	Signatory
M0102	Faecal Coliforms	< 4	cfu/100ml	Sunita Raju KTP
M0107	Enterococci	< 4	cfu/100mL	Sunita Raju KTP

Comments:

Sampled by customer using ELS approved containers.

Test Methodology:

Test	Methodology	Detection Limit
Faecal Coliforms	APHA 21st Edition Method 9222D:2005	1 cfu/100ml
Enterococci	USEPA 1600: April 2005	1 cfu/100mL

means that no analyte was found in the sample at the level of detection shown. Detection limits are based on a clean matrix and may vary according to individual sample.

g/m3 is the equivalent to mg/L and ppm.

Samples will be retained for a period of time, in suitable conditions appropriate to the analyses requested.

Report Released By

Rob Deacon

This laboratory is accredited by International Accreditation New Zealand and its reports are recognised in all countries affiliated to the International Laboratory Accreditation Co-operation Mutual Recognition Arrangement (ILAC-MRA). The tests reported have been performed in accordance with our terms of accreditation, with the exception of tests marked "not IANZ", which are outside the scope of this laboratory's accreditation.

85 Port Road Seaview
Lower Hutt New Zealand
Phone: (04) 576 5016 Fax: (04) 576 5017
Email: mailto:reports@els.co.nz Website: http://www.els.co.nz

Western Bay of Plenty District Council Sample Transfer Document
WBOPDC, Private Bag 12803, Tauranga

Phone: +64 7 571 8008
Fax: +64 7 571 8042

Western Bay of Plenty District Council	Katikati Wastewater Plant Outfall - Quarterly		
Western Bay of Plenty District Council Sample Transfer Document Client			Client's Order Number **Contract No 12/1001**
Address For Report **WBOPDC, Private Bag 12803, Tauranga**			Telephone Number **(07) 571 8008**
Copy To: **Ilze Kruis**	Date:	Despatch Time:	Collection Officer (please Print and Sign)

Client ID	Sample Comments	Lab Use Only
KWW-O1 - 200M Up Current		
KWW-O2 - 200M Up Current		
KWW-O3 - 200M Up Current		
KWW-O4 - 200M Up Current		
KWW-O5 - 200M Up Current		
KWW-O6 - 200M Up Current		
KWW-O7 - 200M Up Current		
KWW-O8 - 200M Up Current		
KWW-O9 - 200M Up Current		
KWW-O10 - 200M Up Current		

Type of Samples:
- ☒ Sea Water

Bacteriological Test Required
- ☒ Faecal Coliforms — **Bottle Type – 120ml Plastic, Yellow Top**
- ☒ Enterococci — Bottle Type – 120ml Plastic, Yellow Top

LTS Updated 20/6/2012 Lab contract amended and logo added

LABORATORY USE ONLY
Date & Time Received ______/______/_____:_____/_____ Condition Of Sample Received
Date & Time Tested ______/______/_____:_____/_____ ....

Phone: +64 7 571 8008
Fax: +64 7 571 8042

Laboratory Request Form	Katikati Wastewater Plant Outfall - Quarterly		
Client **Western Bay Of Plenty District Council**			Client's Order Number **Contract No 07/1013**
Address For Report **WBOPDC, Private Bag 12803, Tauranga**			Telephone Number **(07) 571-8008**
Copy To: **Ilze Kruis**	Date:	Despatch Time:	Collection Officer (please Print and Sign)

Client ID	Sample Comments	Lab Use Only
KWW-O11 - 50M Down Current		
KWW-O12 - 50M Down Current		
KWW-O13 - 50M Down Current		
KWW-O14 - 50M Down Current		
KWW-O15 - 50M Down Current		
KWW-O16 - 50M Down Current		
KWW-O17 - 50M Down Current		
KWW-O18 - 50M Down Current		
KWW-O19 - 50M Down Current		
KWW-O20 - 50M Down Current		

Type of Samples:
- ▣ Sea Water

Bacteriological Test Required
- ▣ Faecal Coliforms — **Bottle Type – 120ml Plastic, Yellow Top**
- ▣ Enterococci — Bottle Type – 120ml Plastic, Yellow Top

LTS Updated 20/6/2012 Lab contract amended and logo added

LABORATORY USE ONLY

Date & Time Received ______/______/_____:_____/______ Condition Of Sample Received
Date & Time Tested ______/______/_____:_____/______ ....

Laboratory Request Form	Katikati Wastewater Plant Outfall - Quarterly		
Client **Western Bay Of Plenty District Council**			Client's Order Number **Contract No 07/1013**
Address For Report **WBOPDC, Private Bag 12803, Tauranga**			Telephone Number **(07) 571-8008**
Copy To: **Ilze Kruls**	Date:	Despatch Time:	Collection Officer (please Print and Sign)
Client ID	**Sample Comments**		**Lab Use Only**
KWW-O21 - 100M Down Current			
KWW-O22 - 100M Down Current			
KWW-O23 - 100M Down Current			
KWW-O24 - 100M Down Current			
KWW-O25 - 100M Down Current			
KWW-O26 - 100M Down Current			
KWW-O27 - 100M Down Current			
KWW-O28 - 100M Down Current			
KWW-O29 - 100M Down Current			
KWW-O30 - 100M Down Current			

Type of Samples:
■ Sea Water

Bacteriological Test Required
■ Faecal Coliforms — **Bottle Type – 120ml Plastic, Yellow Top**
■ Enterococci — Bottle Type – 120ml Plastic, Yellow Top

LTS Updated 20/6/2012 Lab contract amended and logo added

LABORATORY USE ONLY
Date & Time Received ______/______/____:____/_____ Condition Of Sample Received
Date & Time Tested ______/______/____:____/_____ ....

Western Bay of Plenty District Council Sample Transfer Document
WBOPDC, Private Bag 12803, Tauranga

Phone: +64 7 571 8008
Fax: +64 7 571 8042

Laboratory Request Form	Katikati Wastewater Plant Outfall - Quarterly			
Client **Western Bay Of Plenty District Council**				Client's Order Number **Contract No 07/1013**
Address For Report **WBOPDC, Private Bag 12803, Tauranga**				Telephone Number **(07) 571-8008**
Copy To: **Ilze Kruis**	Date:	Despatch Time:		Collection Officer (please Print and Sign)
Client ID	**Sample Comments**			**Lab Use Only**
KWW-O31 - 200M Down Current				
KWW-O32 - 200M Down Current				
KWW-O33 - 200M Down Current				
KWW-O34 - 200M Down Current				
KWW-O35 - 200M Down Current				
KWW-O36 - 200M Down Current				
KWW-O37 - 200M Down Current				
KWW-O38 - 200M Down Current				
KWW-O39 - 200M Down Current				
KWW-O40 - 200M Down Current				

Type of Samples:
- ▣ Sea Water

Bacteriological Test Required
- ▣ Faecal Coliforms
- ▣ Enterococci

Bottle Type – 120ml Plastic, Yellow Top
Bottle Type – 120ml Plastic, Yellow Top

LTS Updated 20/6/2012 Lab contract amended and logo added

LABORATORY USE ONLY
Date & Time Received ______/______/____:____/_____ Condition Of Sample Received
Date & Time Tested ______/______/____:____/_____ ....

URS New Zealand Limited
URS Centre, 13-15 College Hill
Auckland 1011
PO Box 821, Auckland 1140New Zealand

T: 64 9 355 1300
F: 64 9 355 1333

www.urscorp.co.nz

Appendix 2 Alternatives Information Sheets

Katikati Wastewater

Options

1. Status quo — existing ocean outfall
2. Land Disposal — to Pasture (cut and carry e.g. Taupo) or forestry
3. Beneficial Reuse — Horticulture / Parks/ Reserves/ Gardens etc.
4. Marine — new Ocean Outfall in different location
5. Surface – Surface water — River/ Stream/ Harbour
6. Reticulate to another system e.g. Tauranga City Council

Terms Used

Bacteria – Microscopic organisms which can cause disease. Present in large numbers in human wastewater.

Beneficial use – where the treated wastewater is used in a beneficial way e.g. watering of golf courses, community gardens, sports fields.

Biosolids – a by-product of wastewater treatment, comprised of heavy solids which enter the wastewater treatment plant, dead bacteria and dead algae. Biosolids accumulate in wastewater treatment ponds.

Land Disposal – the disposal of treated wastewater to land, purely for the purpose of getting rid of it.

Nutrients – essential for growth of plants, nitrogen, phosphorus. Nitrogen in wastewater is from the decomposition of proteins, from unused food or poo. Phosphorus in wastewater is from household soaps and detergents.

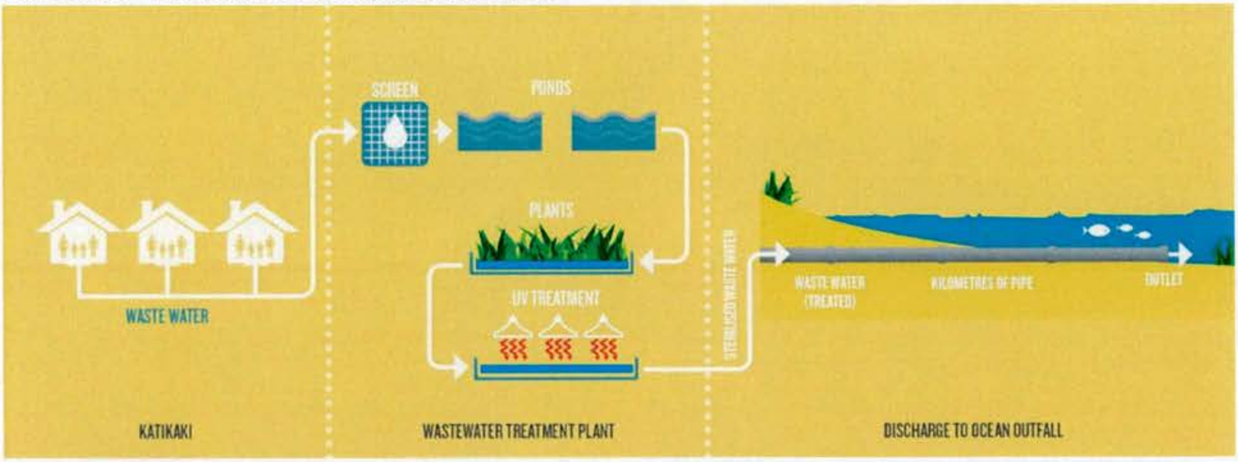
Potable water – water which is of a standard that makes it safe for people to drink.

Wastewater – Water, other liquids and solids which go into the sewer from bathrooms, kitchens and laundries.

Evapotranspiration - is the sum of evaporation and plant transpiration from the Earth's land and ocean surface to the atmosphere. Evaporation accounts for the movement of water to the air from sources such as the soil, canopy interception, and waterbodies.

KATIKATI TREATED WASTEWATER DISPOSAL OPTIONS

Status Quo – Discharge to existing Ocean Outfall



Extra Equipment

What does this option involve (additional to current treatment plant)	
Nil other than plant upgrades to cater for growth as required	

Matters to Consider

What matters should be considered for this?	
Cultural Considerations	Regional council direction currently removing treated wastewater disposal from surface water /ocean outfall where possible
Age of pipeline	

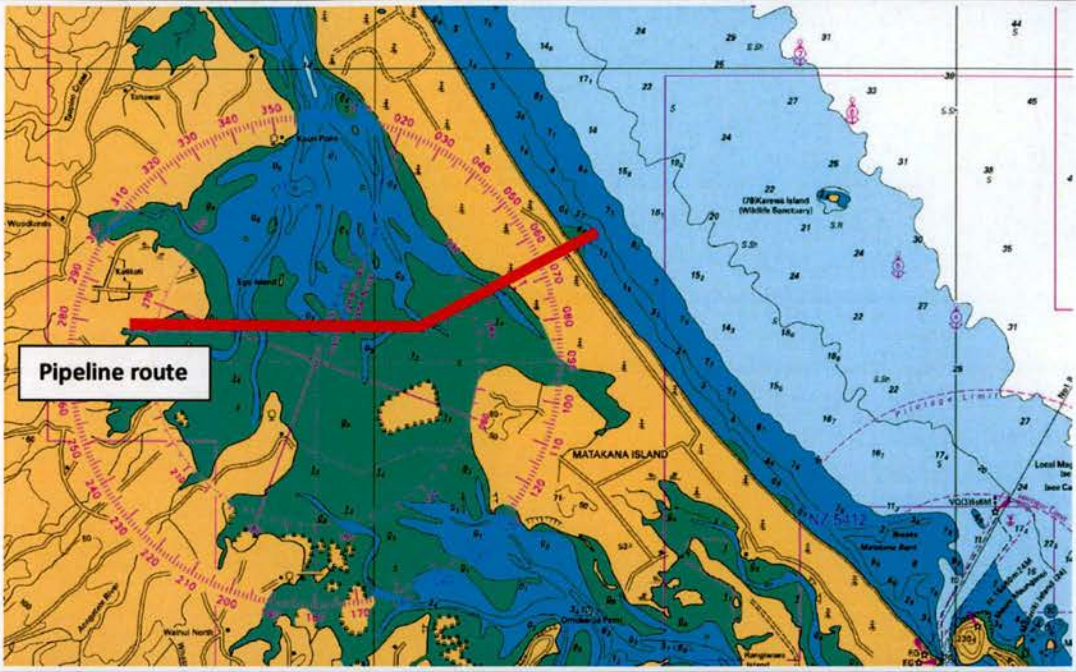
Environmental Effects to consider

What Environmental Effects area associated with this option?	
All year round disposal to receiving environment	Effects on marine environment

My Thoughts

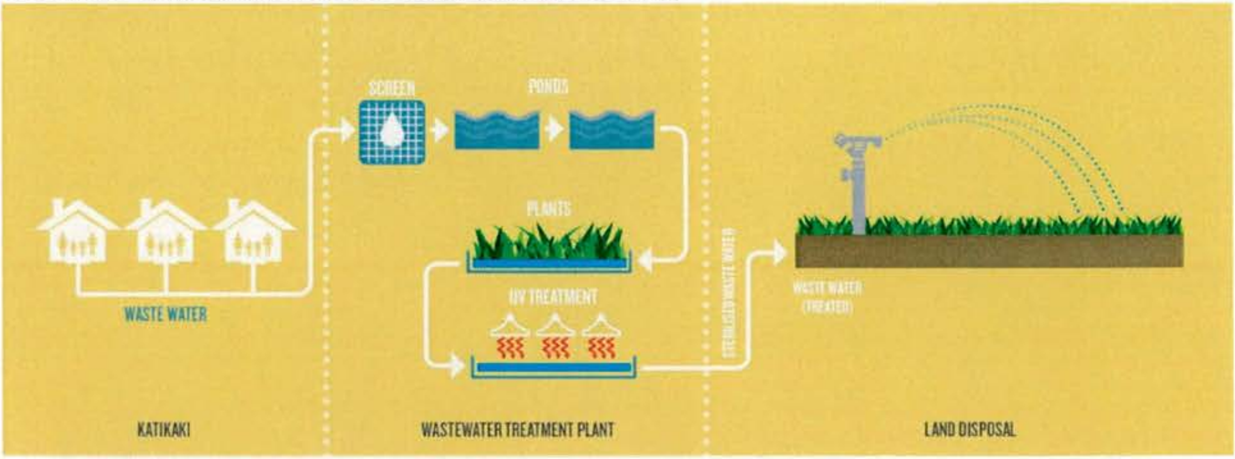
My thoughts?

Photographs of Option

What does the existing situation look like?



KATIKATI TREATED WASTEWATER DISPOSAL OPTIONS

Alternative Option–Irrigation to Pasture/ farmland/ forestry



Extra Equipment

What does this option involve (additional to current treatment plant)	
Storage pond as can't irrigate when soil is saturated	Pumps
Pipe network	Automated monitoring
Irrigation system	

Matters to Consider

What matters should be considered for this alternative?	
End use of crop	Type of irrigation needs to be carefully considered
Pasture only used for cut and carry (Hay or Baleage)	Likely a very large area required
Common as a disposal option for other municipal authorities (Carterton, Greytown (under development), Rakaia, Taupo, Mangawhai, Whangamata, Ashburton, Rolleston, Leeston)	Crop may not be able to be used as feed for dairy cows
Irrigation not possible when soil is saturated – Will effect council's ability to dispose of treated wastewater	Suitability of soil
Ownership of destination land	Type of trees/ forest block or crop
If using forest need to consider what happens if/when block is logged	Use of high value land for disposal of treated wastewater

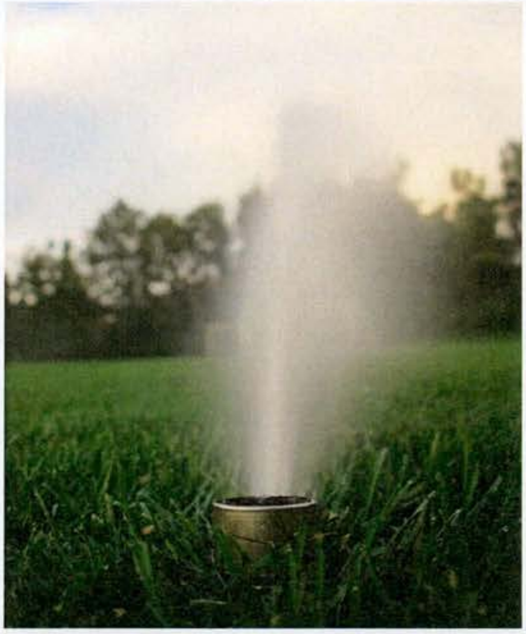
Environmental Effects to consider

What Environmental Effects area associated with this alternative?	
Nutrients used by pasture and removed to other locations	Improper application rate could cause nutrient leaching to groundwater
Water used by pasture	Improper application could cause surface runoff to waterways
Water storage during rainfall events	

My Thoughts

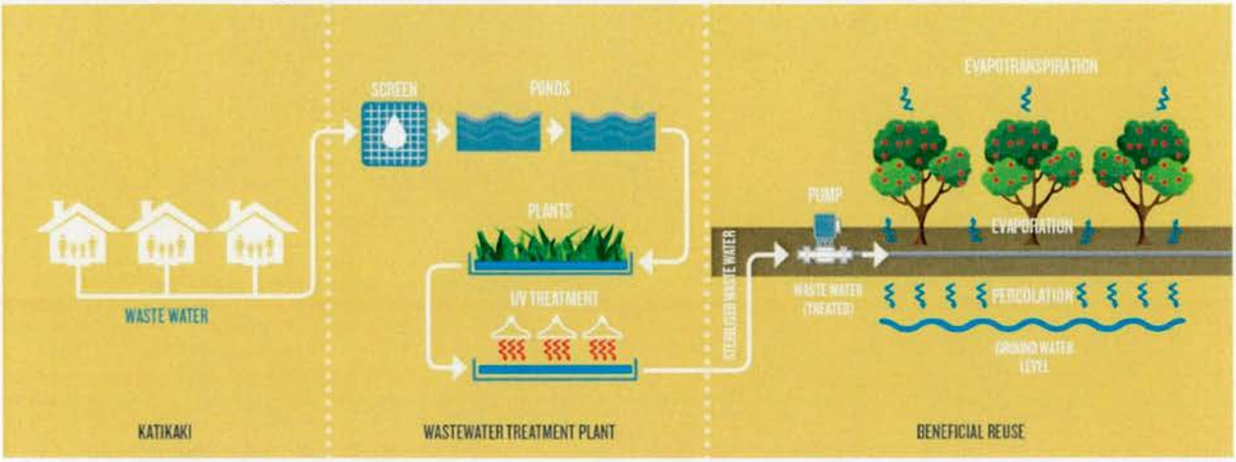
My thoughts?

Photographs of Option

What could this alternative look like?	
	
	

KATIKATI TREATED WASTEWATER DISPOSAL OPTIONS

Alternative Option – Irrigation to Horticulture / recreational areas / parks / Gardens etc.



Extra Equipment

What does this option involve (additional to current treatment plant)	
Pumps	Pipe network
Storage pond (can't irrigate when soil is saturated)	Automated monitoring
Possible requirement or extensive subsurface irrigation	

Matters to Consider

What matters should be considered for this alternative?	
Are the crops still acceptable for animal/human consumption?	Ownership of destination land
Irrigation not possible when soil is saturated – Will effect council's ability to dispose of treated wastewater	Difficulty of managing disposal/use on multiple blocks of land
Suitability of soil	Type of irrigation may be critical
Human health	Timing of irrigation – ideally at night
Plant selection	Public perception
Used at Pauanui (parks), McLaren Vale Vineyards	

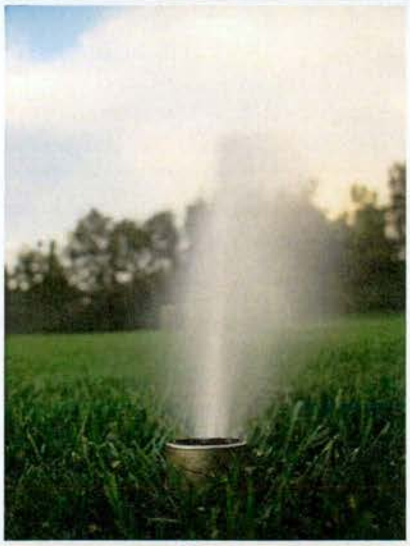
Environmental Effects to consider

What Environmental Effects area associated with this alternative?	
Nutrients used by plants/lawns/gardens	Improper application rate could cause nutrient leaching to groundwater
Water used by plants/lawns/gardens	Improper application could cause surface runoff to waterways
Water storage during rainfall events	

My Thoughts

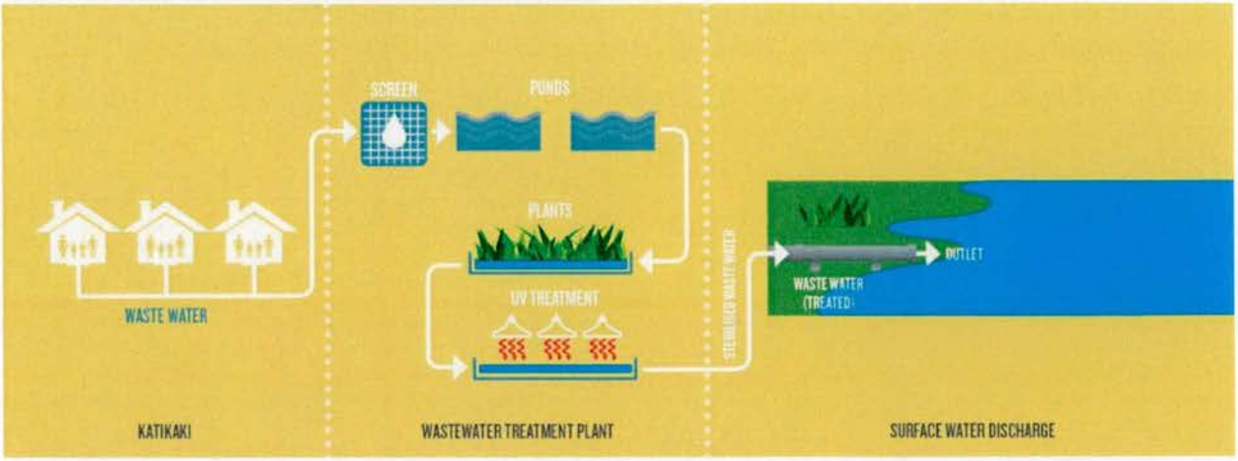
My Thoughts

Photographs of Option

What would this alternative look like?	
	
	
 	

KATIKATI TREATED WASTEWATER DISPOSAL OPTIONS

Alternative Option–discharge to new Ocean Outfall



Extra Equipment

What does this option involve (additional to current treatment plant)	
New pipeline	New diffuser

Matters to Consider

What matters should be considered for this alternative?	
Cultural considerations	Regional council direction currently removing treated wastewater disposal from surface water /ocean outfall where possible
Ownership if pipeline has to cross private land	Ongoing maintenance of buried pipeline
Used at Christchurch, Tauranga, Ōhope, Gisborne, Napier, Hastings, Wellington, Dunedin, Hokitika, New Plymouth, Kaiapoi, Rangiora	

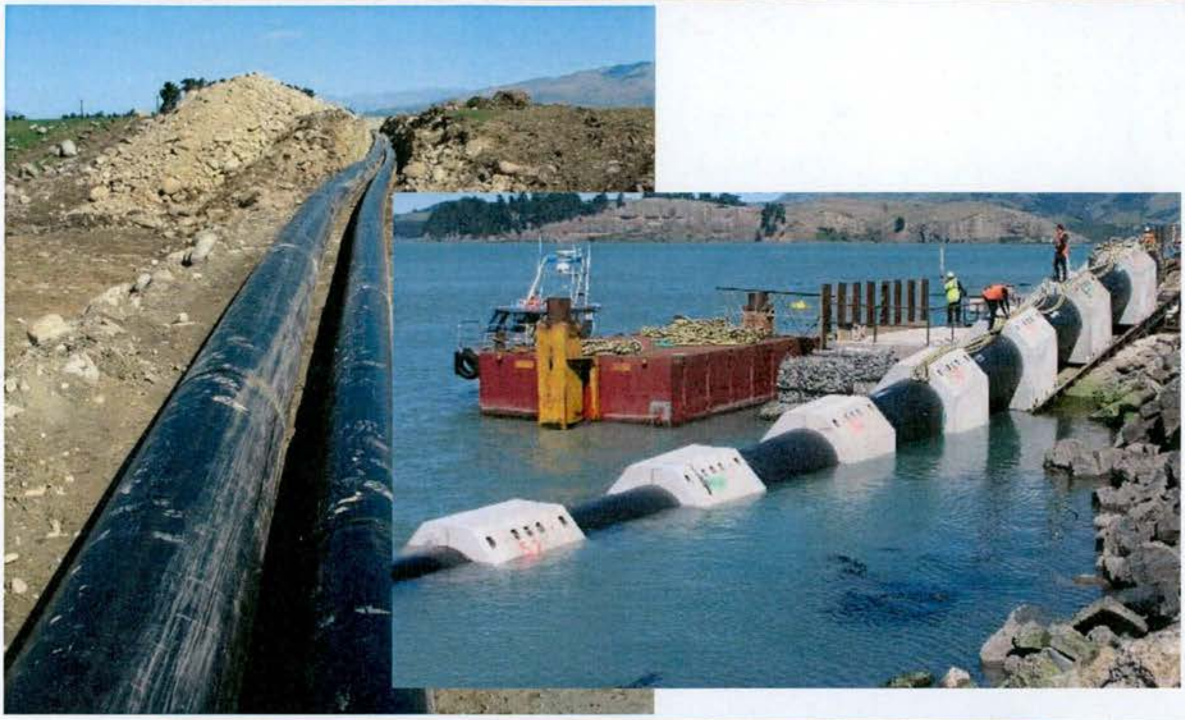
Environmental Effects to consider

What Environmental Effects area associated with this alternative?	
All year round disposal definite	Effects on marine environment – water quality, sediment, fauna, kiamoana

My Thoughts

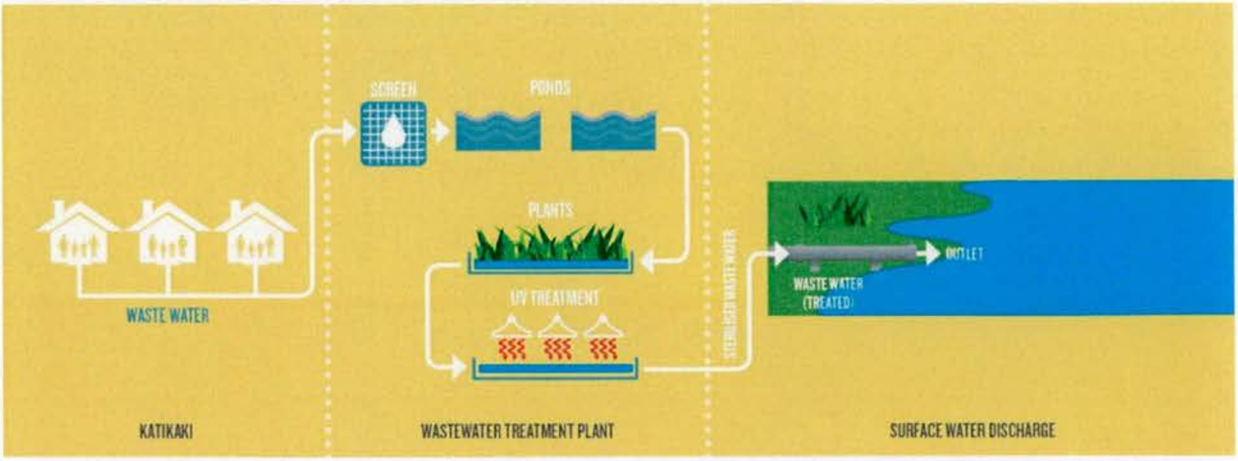
My thoughts?

Photographs of Option

What would this alternative look like?



KATIKATI TREATED WASTEWATER DISPOSAL OPTIONS

Alternative Option – Discharge of high quality to river, stream or harbour



Extra Equipment

What does this option involve (additional to current treatment plant)	
Pipeline	Additional treatment, so treated wastewater is of a high quality – upgrade to the existing plant would be required so to remove nitrogen, phosphorus and bacteria to provide a high level of treatment

Matters to Consider

What matters should be considered for this alternative?	
Cultural considerations	Regional council direction currently removing treated wastewater disposal from surface water /ocean outfall where possible
Regional council rules about discharges to water	
Used at Whitianga (estuary) River/stream - Te Puke, Tirau, Turangi, Te Aroha, Milton, Hamilton, Gore, Putaruru, Tokoroa, Thames	

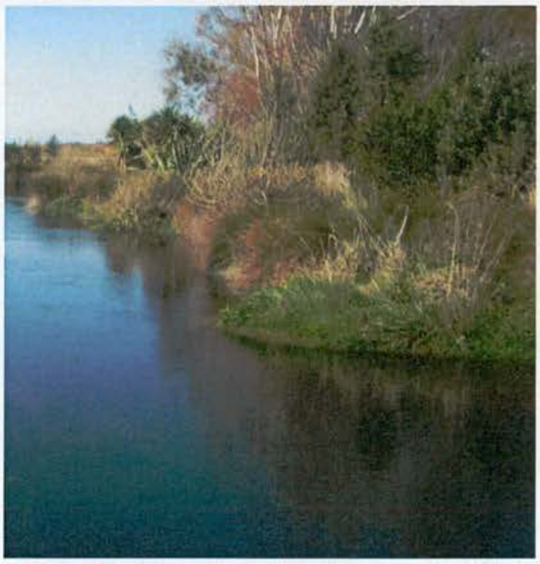
Environmental Effects to consider

What Environmental Effects area associated with this alternative?	
Close to potable quality water discharged to surface water	
All year round disposal possible	

My Thoughts

My thoughts?

Photographs of Option

What would this alternative look like?	
	
	
	

KATIKATI TREATED WASTEWATER DISPOSAL OPTIONS

Alternative Option – pipe to alternative Council wastewater network

Extra Equipment

What does this option involve (additional to current treatment plant)	
Pipeline to other council wastewater system	Supplementary pump stations

Matters to Consider

What matters should be considered for this alternative?	
Security of disposal option controlled by external party – i.e. other council	Sewer (pipeline) corrosion issues
May require an agreement with other Council.	odour

Environmental Effects to consider

What Environmental Effects area associated with this alternative?	
Environmental effects would become the responsibility of the council taking the wastewater	All year round disposal possible
Wastewater disposed of outside of the area it is generated in	

My Thoughts

My thoughts?

Photographs of Option

What would this alternative look like?	
	
	

CULTURAL IMPACT ASSESSMENT FOR MATAKANA ISLAND SEWERAGE OUTFALL TAURANGA 2016

Papaki tu ana nga tai ki Mauao
I whakanukunuku hia, I whakanekenekehia
I whiu a reretia e Hotu
A Wahinerua ki te wai
Ki taiwiwi, ki taiwawa
Ki te whai ao, ki te ao marama
Tihei Mauri Ora!

Where my sacred mountain Mauao stands
The tide slaps and moves at his feet
The power of the ocean is strong
And I desire that connection
I sneeze, therefore I am
The breath of life!

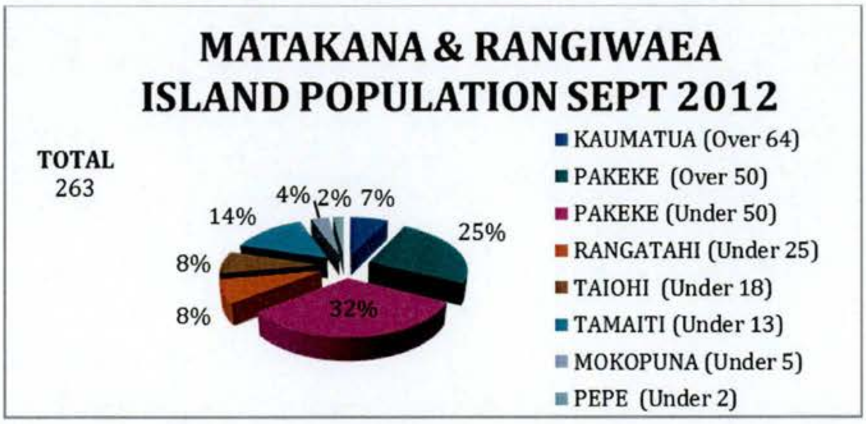
Table of Contents

1.0 Introduction

1.1 Description

This Cultural Impact Assessment (CIA) has been prepared for the Western Bay of Plenty District Council on behalf of the five Hapu of Matakana and Rangiwaea Islands; Ngati Tauaiti, Ngai Tuwhiwhia and Ngai Tamawhariua based at Matakana Island, and Te Whanau a Tauwhao and Te Ngare who are located at Rangiwaea Island, Tauranga. It will be noted that whilst other mainland Hapu have mana whenua in the area of the waste water treatment station located at Katikati, a separate CIA has been prepared, for and on behalf of the five Hapu of Matakana and Rangiwaea to provide their perspectives.

This CIA assesses the potential cultural effects of the Katikati treatment plant discharges at the Matakana Island outlet on the five Hapu of Matakana and Rangiwaea Island. The CIA will record the cultural values of the Hapu of Matakana and Rangiwaea over the area and the related receiving environment located on the ocean side of Matakana Island known as Te Moananui a Toi. Matakana Island is 28 kilometres long, with forestry located on the ocean side of the Island, known as **"the bush", and an area of land located within the inner Tauranga Harbour is known as "the bulge"**. The bulge supports a number of agricultural and horticultural and commercial activities and the majority of the total Islands population of 263 (Census 2012) live there.



The community is predominantly Maori who have a proud seafaring history and occupation of the Islands of Matakana and Rangiwaea for 30+ generations and a whakapapa to the five Hapu (sub-tribes) of the Islands. Matakana Island stretches from Bowentown at the northern entrance to Tauranga Harbour in the south and is described in the Bay of Plenty Regional Council Coastal Plan as a unique Outstanding Natural Feature and Landscape. Matakana Island provides a natural buffer and protection from the sea and elements for the mainland population spread throughout the northern Western Bay of Plenty region. The Western Bay of Plenty mainland area encompasses Bowentown/Waihi Beach to the Kaitiuna River located at Te Puke and provides a temperate climate that is suitable for a variety of agricultural and horticultural activities on a commercial scale and provides employment for an increasing population that is closely linked to the city of Tauranga.

This CIA will identify matters pertaining to the Matakana/Rangiwaea Hapu Management Plan 2012, the values and principles, its vision and aspirations, and identify environmental issues and challenges for both now and in the future.

It also sets out to describe its obligations, responsibilities and protection mechanisms as described in the document - Te Awanui, Tauranga Iwi Harbour Management Plan 2008 that is currently under review. The obligations of the regulatory authorities are also described; BOP Regional Council

(BOPRC), Tauranga City Council (TCC), Western BOP District Council (WBOPDC), Ministry for Primary Industries (MPI), Department of Conservation (DOC), and Maritime NZ.

The CIA refers to the Legislative Provisions –Te Tiriti o Waitangi 1840, Resource Management Act 1991 (RMA), in particular the principles of Protection, Participation and Partnership in its obligations of regulatory authorities.

The CIA describes succinctly the relationship and history of the tangata whenua and Hapu of the Islands who have Mana Whenua and Mana Moana. The relationship between the Hapu and the coastal marine area particularly Te Awanui and Te Moananui a Toi is a challenging and enduring relationship given the raft of environmental issues associated with maintaining our kaitiakitanga, orangatanga and rangatiratanga of the Islands.

The traditional ethic of conservation is described as follows:

- Kaitiakitanga (guardianship)
- Orangatanga (sustainability); and
- Rangatiratanga (autonomy)

The CIA describes an extensive history of the Matakana Island sewerage outfall since the Dairy Factory pipeline establishment and its subsequent challenges and effects over five decades.
The CIA describes its consultation and engagement; Hapu representation and engagement with staff and its representatives of the Western Bay of Plenty District Council. A steering group of Hapu representatives and Council staff will continue to monitor the resource consent and conditions, in particular the alternatives to the current pipeline sewage outfall that is scheduled for implementation and funding in the future.

1.2 Purpose

The purpose of this report is to record the cultural values of the five Hapu of Matakana and Rangiwaea Islands by the provision of a cultural impact assessment. It will identify the impacts of the current pipeline sewage outfall on the cultural heritage, resources and values of significance to the five Hapu.

This report will describe cultural values and traditional relationships within the affected areas of Rangiwaea and Matakana, and provide an assessment of the effects of the pipeline sewage outfall on customary practices and cultural values; and provide recommendations and mitigation for the Western Bay of Plenty District Council.

1.3 Writers

This report has been prepared by Ngaraima Taingahue, Jason Murray and Nessie Kuka who have whakapapa affiliations to the Hapu of Matakana and Rangiwaea. The Writers were mandated and engaged in the provision of this CIA on behalf of the Hapu.

1.4 Literature Review

A review of existing material was conducted and the following sources were reviewed:

- Matakana and Rangiwaea Environmental Management Plan, October 2012
- Te Awanui Tauranga Harbour Iwi Management Plan
- Survey of the Katikati Outfall Environment 2006
- WBOPC Katikati Wastewater Treatment plant Operation and Maintenance Manual
- WBOP Katikati Wastewater Treatment and disposal system, October 2007
- Katikati Wastewater Treatment Plant Consent- 2012 Disposal Options Report

- The Matakana Island Sewerage Outfall, Robert A McClean 1998
- Waitangi Tribunal Reports for Tauranga Moana
- Waitangi Tribunal Report on the Post-Raupatu Claims 1886-2006
- Cultural Values Assessment, A. Coffin, December 2011
- Previous Ngāi Te Rangi Iwi Cultural Impact Assessments reports
- Documented accounts of Tangata Whenua cultural experts
- European/Maori Timelines Tauranga Public Library

A review of current literature provides some detail on Matakana and Rangiwaea cultural values associated with areas of cultural significance.

Historical research has been conducted for some time in Tauranga for the Treaty of Waitangi claims and hearings of the Waitangi Tribunal. A number of reports of relevance relating to the subject area were reviewed for this CIA. The most relevant publications were historical reports to the Waitangi Tribunal Claim (215) relating to the Tauranga claim. The reports detail Ngai Te Rangi history and the effects of land confiscation in the 18th century. Detailed information on the subject area is described generally in the context of wider land and confiscation issues that occurred at the time. Reports describe the relationship of Ngai Te Rangi in the general area, in particular areas occupied by families and the activities associated with the area.

Te Raupatu o Tauranga Moana are reports produced by the Waitangi Tribunal (2004, 2010) and details the Tribunals findings to breaches of the Treaty of Waitangi. The Tribunal noted that Tauranga Māori suffered considerable prejudice as a result of breaches of the principles of the Treaty arising from Crown laws, policies, and actions in the period before 1886; and that substantial redress is due to them.

1.5 Methodology and Assessment Framework

The preparation of this report involved a review of existing literature and information, complimented by discussions and communications with members of the Hapu. Published and unpublished sources were assessed in the review.

The assessment framework below sets out the assessment values that were taken into consideration to formulate a systematic approach to assessing the impact from a cultural point of view. It largely draws on the information collated through consultation with Hapu members to determine what key values might be used to assess the historical, current and future impact of the outfall.

Table 1 below provides the assessment matrix to assist the reader in the methodology used in "Assessment of Cultural Effects". We strongly advocate that this cultural assessment be included when assessing wastewater impact in the future.

Table 1 - Assessment Matrix

Cultural Values	Site Assessment
Putaiao – environmental; air, land, water	
Tikanga maori – cultural; kawa and tikanga	
Kaitiakitanga – guardianship, stewardship	
Manaakitanga – hospitality, respect, safety, security	
Rangātiratanga – autonomy, control, management	
Whānaungatanga – relationships, community connectivity	

Cultural Values	Site Assessment
Wairuatanga – spirituality, embedded emotion	
Mana Whenua/Mana Moana – authority	
Ohanga – economic; quality and quantity of natural and physical resources	
Four well-beings – social, cultural, environment, economic	

2.0 Cultural Values

The following values and principles underpin a Maori perspective to environmental and cultural management. The values have been derived from an assessment of Rangiwaea and Matakana mana whenua, literature review, consultation, and identified sites of cultural significance. The values and principles are used to assess any environmental matters.

Putaiao

Historically all matters pertaining to Putaiao (the living world) were entrusted to specific tohunga who often had the inherent responsibility of ensuring nature was balanced. This involved strict rules that were put in place to ensure resources were being managed sustainably. Breaching of these rules was not tolerated. Nowadays, these roles still exist amongst the "haukainga" (whanau living at home) who have an added responsibility to ensure our resources and taonga are sustainably managed for future generations.

Kaitiakitanga: Stewardship and Guardianship

Traditionally, Maori believe there is a deep kinship between humans and the natural world. All life is connected. People are not superior to the natural order; they are part of it. Like some other indigenous cultures, Maori see humans as part of the web or fabric of life. To understand the world, one must understand the relationships between different parts of the web. Kaitiakitanga is a vehicle for rediscovering and applying these ideas. Kaitiakitanga in a planning regimen involves consideration by tangata whenua of the potential adverse impacts of human activity on the mauri of the natural and physical resources within an environment. Kaitiakitanga is derived from the root word tiaki, which is to nurture, guard, protect and care for.

Whanaungatanga: Relationships, Community Connectivity

Maori are a communal people and value collective participation and membership. Each member of the collective had set roles, responsibilities and functions that contributed to the day-to-day living of the tribe. These notions recognise common interests to encourage and build community pride, identification and ownership.

Relationships and connections reflect the importance of the social interactions between people and the environment. Settlement design should help the community make social and environmental connections. Whanaungatanga refers to notions of membership and participation within communities. The design of spaces must encourage community participation and membership and not isolate or segregate its members.

Wairuatanga: Spirituality, Embedded Emotion

Maori recognised an immortal element in man, which is referred to as the wairua. Wairua refers to the innate spiritual nature of a person and their extended relationships to natural, physical and supernatural characteristics of their environment. Wairuatanga is a condition of spiritual and emotional connection. It is a spiritual and emotional connection between: people and people, people and ancestors; people and deity; and people and the environment.

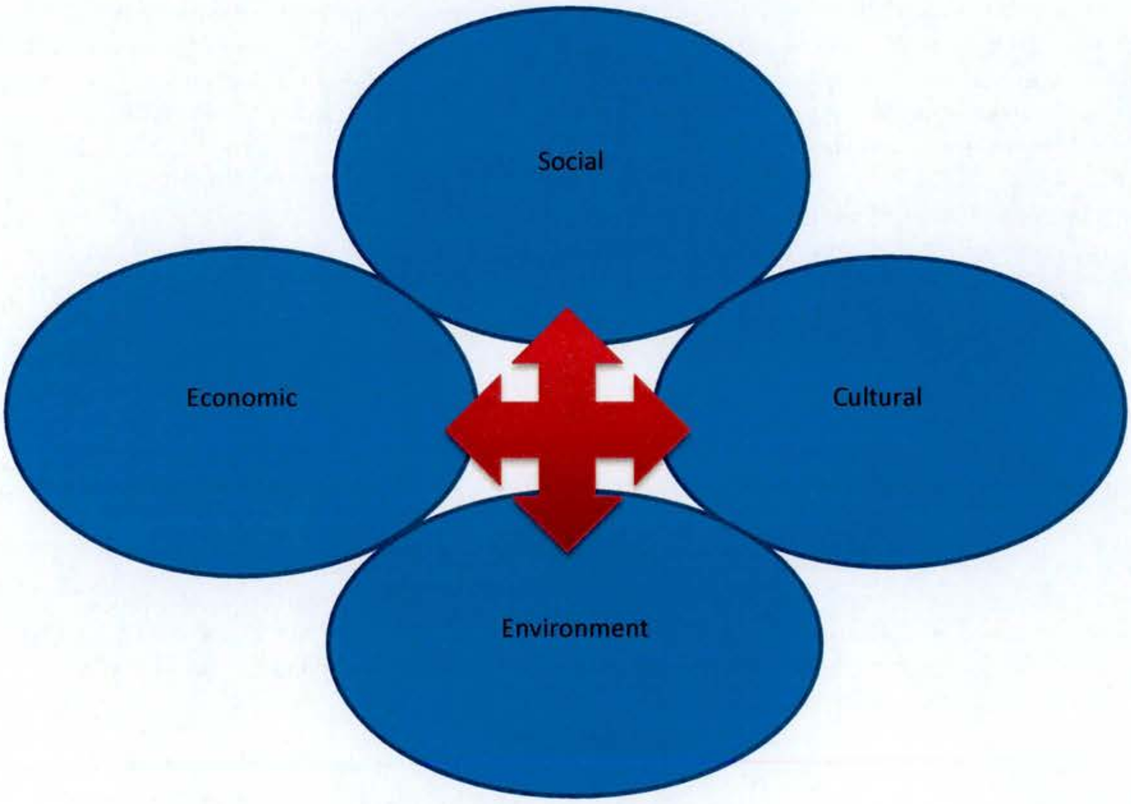
Wairuatanga underpins the ability of Maori to interpret conditions, signs and symbols as observed through the natural environment.

Mana Whenua/Mana Moana

The Hapu of Rangiwaea and Matakana recognise the mana whenua and mana moana as authority associated with the possession of lands; it is also the authority associated with the ability of the land to produce the bounties of nature. Other principles associated with mana whenua/mana moana are still applicable today including; inherited rights, the authority to control and protect, land confiscation and conservation.

The Four Well-Beings

Whilst this CIA is concerned with environmental and cultural impacts, it is influenced by economic and social themes. This approach is a holistic approach to the wellbeing of the Rangiwaea and Matakana community and its environment. The diagram below illustrates the overlap and influence of economic, social and cultural factors in the environment that do not stand in isolation of each other. Rangiwaea and Matakana see themselves as part of the environment and responsible with others for determining and influencing their social, economic, cultural and social wellbeing.



Example Values	Site Assessment
Kaitiakitanga – guardianship, stewardship	Ohinetama is the historical name that is given to the whenua where the pipeline runs through to the ocean outfall. This area has high cultural importance to the Hapu and its resources that sustain the life force of the people. The outer ocean area provides a bountiful supply of fish, shellfish and crustaceans. However, like with many ecosystems, keystone species are the most important living things that require ongoing monitoring to ensure the foodweb remains balanced. In this case, the Tuatua is the keystone species that would require ongoing kaitiakitanga to maintain the values the Hapu have with the moana. Of similar importance is the Tauranga Harbour/Te Awanui and its bounty that provides a variety of sea food and habitat for a diversity of native fish, invertebrates and wading birds. Tauranga Harbour is used for food gathering, recreation, boat transport and aesthetics.
Whānaungatanga – relationships, community connectivity	The sites associated with Mauao, Rangiwaea and Matakana Islands and the Tauranga Harbour are important resources shared with the community and general public. The Hapu of Rangiwaea and Matakana acknowledge protection of community heritage including cultural sites.
Wairuatanga – spirituality, embedded emotion	Rangiwaea and Matakana Islands, Mauao, Panepane-Purakau, the Tauranga Harbour, and Te Paritaha o Te Awanui have spiritual connections for the Hapu of the Islands. These sites connect the Hapu with their past.
Mana whenua/mana moana – authority, prestige, power	Rangiwaea and Matakana Islands, Mauao and the Tauranga Harbour are important areas in which the Hapu live and sustain themselves by harvesting the bounty provided by the sea. The Island Hapu still exercise mana whenua/mana moana to the areas identified.

Name of Site	Location	Heritage Value	Description	Reference
Mauao	Entrance to Tauranga Harbour Also known as Mt Maunganui	Maunga – mountain Source of identity	Legend of Mauao and **Puwhenua, "caught by the light".**	
Matakana Island	Matakana Island	Unique Island that serves as protection for the Western Bay of Plenty region and inner Tauranga Harbour Waahi tapu Tahuna kai – food gathering area Historic occupation Settled area of occupation for agriculture/horticulture and other land based activities	A settled Island with a Maori community of 200+ that provides health, social and education facilities. Two active Marae exist at Opureora Marae and Oruarahi Marae at the northern end of the **"bulge"**. Three Hapu of Matakana with strong whakapapa ties to the two Rangiwaea Island Hapu and mainland Hapu of Ngai Te Rangi Iwi.	
Rangiwaea Island	Island located in the inner Tauranga Harbour facing Matua suburb	Unique Island Tahuna kai – food gathering area Historic occupation Settled area of occupation for agriculture/horticulture and other land based activities	A settled Island with a Maori community of 20 that provides for its own health, employment, social and environment matters. One active Marae; Rangiwaea Marae serves two Hapu with strong whakapapa ties to Matakana Island Hapu and the mainland Hapu of Ngai Te Rangi Iwi.	
Panepane	Matakana Island, located at the southern end that provides boat (via a wharf)	Historic and archaeological importance Land taken under the Public Works Act 1923 for Tauranga Harbour purposes	The legend of Wahinerua of the Tainui Waka Land tenure is currently with the Western BOP District Council	

	and barge access to the Island	Tahuna kai – food gathering area		
Te Paripari	Sulphur Point Reclamation	Tahuna kai – food gathering area	Sand spit that extended from Otamataha out into the harbour. The area was also a well-known fishing and shellfish collection spot. Te Paripari provided Maori with good access to other areas around the harbour. According to Ngai Tamarawaho people the Takitimu canoe made landfall at the base of Otamataha Pa at Te Paripari. The area was later reclaimed to form Sulphur Point. The sandbank stretched almost all the way to Mauao **and was known as a "pataka kai".** The New Zealand Transport Agency Harbour Link project acknowledges the connections and relationship Ngai Tamarawaho has to Te Paripari through the placement of pou and the anchor stone at the base of Otamataha Pa.	Tauranga City Plan – Chapter 7 Heritage, Section 32 Report
Te Awanui	Also known as Tauranga Harbour	Estuarine harbour, food gathering area	The northern entrance is at the Bowentown Heads, opposite Matakana Island. The southern entrance is at Mauao on one side, and Matakana Island. Te Awanui has spiritual and cultural connections to all Iwi and Hapu of Tauranga Moana.	
Te Paritaha o Te Awanui	Extensive pipi bank in front of Mauao	Tahuna kai – food gathering area	The largest and most recognised shellfish collection area in the Tauranga Harbour. This area was known as part of the food basket of Tauranga Moana.	
Mataitai Reserve	Cutters channel extending to below Mauao	Reserve, recognised by Ministry for Primary Industries, BOPRC, TCC, WBOPDC, DOC, Historic Places Trust, Maritime NZ, NIWA Science, Environmental Risk Management Authority	The Mataitai Reserve is supported by the 3 Iwi and Hapu of Tauranga Moana. The Tauranga Moana Kaitiaki Forum exists as the watchdog for Iwi and Hapu interests.	

3.0 Mana Whenua

The five Hapu of Matakana and Rangiwaea Islands descend from the original inhabitants of Tauranga Moana and the pre-waka people who traversed and occupied Te Moana a Toi Te Huatahi (the entire Bay of Plenty). The eponymous ancestor Te Rangihouhiri started his journey in or around the 16th century from Whangara, Gisborne, occupying Torere and Maketu and ended his journey in Tauranga as part of the Ngai Te Rangi conquest. **This journey is known as "Te Hekenga o Te Rangihouhiri".** The arrival of Ngai Te Rangi iwi to Tauranga was through intermarriage with the original inhabitants, pre-Waka people and subsequent conquest of Kinonui at the Battle of Kokowai that entrenched the mana of Ngai Te Rangi Iwi in Tauranga Moana.

The Iwi of Ngai Te Rangi comprises the descendants of the eponymous ancestor, Te Rangihouhiri and his children; Tutengaehe, Taapuiti, Takoro, Tuwhiwhia, Turourou and Tamawhariua. Ngai Te Rangi iwi is one of three iwi, along with Ngati Ranginui and Ngati Pukenga who are tangata whenua for Tauranga Moana. The Hapu of Ngai Te Rangi occupy the islands of Matakana, Rangiwaea, Motuhoa, Tuhua and Motiti Islands and areas of the Tauranga region from Te Tumu - Papamoa out to Nga Kuri a Wharei – Otawhiwhi, the northern most boundary of Tauranga Moana.

There are a number of versions that may differ from the above. What can be said with some certainty is that the Ngai Te Rangi Hapu occupied Matakana and Rangiwaea Islands from this time to now. Reference: Cultural Values Assessment, Coffin A., December 2011

Ngai Tuwhiwhia

Ngai Tuwhiwhia are the descendants of Tuwhiwhia and Te Aoreke. Tuwhiwhia is the fourth child of Te Rangihouhiri. The ancestor Tuwhiwhia lived at Maketu. Tuwhiwhia and his son Tauaiti were part of a Ngai Te Rangi group gathering toitoi from Te Tumu. They were attacked and Tuwhiwhia was killed. Tauaiti was taken to Tauranga near the Tūkorako stream where he was tortured to death. The whakatauki derives from this event, where Tauaiti cried out *"Aue, he aha rawataku he, kiapenei he mate moku. Akuaneitemoananeiihohonu me hangakia papakuitakumokaii a Kotorerua". Oh what have I done to deserve this fate. This ocean though deep will be rendered shallow when my brother Kotorerua hears of this.* This event was the pre-cursor to Kotorerua coming to Tauranga, taking revenge at the Battle of Kokowai and Ngai Te Rangi moving to Tauranga and occupying to this day. The original wharenui of Ngai Tuwhiwhia stood at Motuhoa Island and was moved to Matakana Island.

Ngai Tamawhariua

Ngai Tamawhariua are descendants of the ancestor Tamawhariua, youngest son of Te Rangihouhiri. One of Tamawhariua's sons is Tauaiti, the eponymous ancestor of Ngati Tauaiti. The ancestor Tamawhariua is closely associated with the taking of Matakana Island, in particular a number of Pa in the vicinity of Te Uretureture. A number of places are attributed to his occupation of the area along with his son Tauaiti.

Ngati Tauaiti

Ngati Tauaiti are the descendants of Tauaiti and Hineaorangi, not to be confused with Tauaiti, son of Tuwhiwhia. The Marae Te Kutaroa was prominent in the 1800s and 1900s. During the 1970s access to the Marae site was compromised. In 1981 the hapū decided to bury the Wharenui with aspirations of building a new marae complex in the future. The mauri of Tauaiti and Hineaorangi was taken to Opureora Marae for safe keeping.

Te Ngare

The home of Te Ngare descendants is at Oponui, Rangiwaea Island. Te Ngare is a Ngai Te Rangi Hapu however oral accounts suggest that they were living in this area before Te Heke o Te Rangihouhiri arrived in the early 1700s. Whilst the Te Ngare origins are unclear, the connections with other Hapu are acknowledged through whakapapa. Te Ngare ancestors originate from Nga Marama, Te Papaunahi, Te Urungawera and Te Purukupenga. It is acknowledged that they are the first occupants at Rangiwaea Island.

Te Whanau a Tauwhao

Te Whanau a Tauwhao descend from one of the six children of Te Rangihouhiri; Turourou. His son Tamaoho subsequently married Tauwhao of Ngati Awa, from whom the Hapu of Tauwhao are named for a women ancestress with many descendants. Today, generations of Te Whanau a

Tauwhao are an amalgam from the ancient tangata whenua tribes of Ngati Awa and Ngai Te Rangi. Tauwhao descendants proudly claim the Islands of Motiti, Rangiwaea, Tuhua, Karewa and Ruamaihio, and the mainland areas of Tuapiro at Katikati and Otawhiwhi at Waihi Beach.

3.1 Historic battles of Tauranga Moana

Tauranga Moana was a rich source of food which sustained a substantial population. The region was closely settled and tribes were spread across the Harbour. Relationships evolved through conflict, peace-making and intermarriage. Much of the history of Ngai Te Rangi in Tauranga Moana documents fierce battles with other Hapu from the iwi of Ngati Ranginui and Ngati Pukenga, and times of peace between themselves.

In the early 1860s, tensions between the Crown and iwi supporting the Maori King continued to grow. In July 1863 war broke out after Crown troops invaded the King's territory in the Waikato. Tauranga Moana was on the route taken by some of the King's supporters to reach the Waikato. Ngai Te Rangi Hapu sent men and provisions to support the Kingitanga and the Paimarire movement in the conflict.

Crown troops arrived in Tauranga on board the HMS Miranda on 21 January 1864 and occupied the mission station at Te Papa. Their presence was intended to prevent the flow of men and supplies to Waikato and to draw Maori away from the fighting in Waikato. Over the next few months, tension between Maori and Crown troops increased. Ngai Te Rangi as a whanau, Hapu and iwi committed their men and women folk to the conflict in the ensuing battles of Pukehinahina and Te Ranga. In early April 1864, the Crown redirected troops originally intended for Taranaki, following the defeat of Waikato forces, increasing the garrison at Te Papa to 1700 troops. In mid-April 1864, Maori at Tauranga Moana fortified Pukehinahina, also known as Gate Pa, close to Te Papa. On 29 April 1864 Crown forces attacked Pukehinahina. A sustained artillery bombardment did not destroy the pa's defences and a Crown assault force was overwhelmed with heavy casualties. The Maori defenders withdrew during the night and Crown forces entered the pa unopposed the next morning.

In May 1865, the Crown issued an Order in Council confiscating approximately 214,000 acres of land at Tauranga Moana under the New Zealand Settlements Act 1863. The Order in Council described the land of Tauranga Moana as "all the lands of the tribe Ngaiterangi". At that time this term was used by Crown officials to describe all Maori of Tauranga Moana. The chief Judge of the Native Land Court warned the Crown that the confiscation might not include all of the 29,000 acres because there were other iwi with interests in this land not identified in the Order in Council. However, the Order in Council confiscated all the land described in the schedule, regardless of the iwi to whom it belonged or whether they had fought against the Crown.

The New Zealand Settlements Act 1863 provided the legal framework for the Crown's confiscation of Maori land. The Act was designed to punish any Maori who had taken up arms or supported those involved in armed resistance against the Crown. The Crown's confiscation policy implemented in Tauranga Moana was also driven by a determination to open up large areas of land for settlers, to have a land bank to pay for the war, and its commitment to place military settlers on the land. Ngai Te Rangi and Ngati Ranginui were severely affected by the confiscation of land in the Battles of Pukehinahina and Te Ranga and as a consequence labelled as rebels, and rendered landless by the Tribunal.

The Hapu of Te Whanau a Tauwhao and Te Ngare suffered great loss of life during the colonial wars, coupled with the legal framework of the Crown to confiscate Maori owned land. It is of note that the battle of Pukehinahina and subsequent "gun fire" during the night skirmishes was observed from the shores of Rangiwaea Island. Many fallen warriors were relocated to Rangiwaea Island for rest and recuperation during and after these battles.

The report on the post raupatu claims and Treaty of Waitangi Raupatu Claims for Tauranga Moana details the significant land loss of Tauranga Maori that took place in the last decade of the 19th century following the major confiscation of whenua as a result of the Battle of Pukehinahina. The Waitangi Tribunal highlighted policies that identified idle Maori land that would be suitable for settlement by European and a range of public works takings resulting in the total loss of Maori owned land of around 4960 acres between 1886 and 2006. The Tribunal found that the Crown had breached the Treaty principle of protection allowing alienation of Maori land by failing to ensure that Tauranga Maori retained a sufficient land base for their needs. As a consequence, tangata whenua were subjected to policies that ensured loss of control over land and natural resources.
The confiscation of land and policies prevented Tauranga Maori from being able to manage their land under the Crown's land development schemes between 1929 and 1975. In some cases Tauranga Moana Maori were locked into long term peppercorn leases which provided limited financial return. Inevitably, Maori land development was held up by Council policies that did not understand how Maori value land.

The Public Works takings of Maori owned land that was taken for "public good" was questionable and more land than was needed was taken by the Crown. The example of Panepane/Purakau, an area of 400 hectares situated at the southern end of Matakana Island that was taken under the Public Works Act 1923 for Tauranga Harbour Board purposes. This Crown acquisition is an issue for the five Hapu of Rangiwaea and Matakana who are pursuing the right to regain ownership of this whenua situated on a strategic part of Matakana Island. The land identified as Panepane-Purakau is currently in the ownership of the Western Bay of Plenty District Council. The Hapu of Matakana and Rangiwaea fervently seek the return of the land to the ownership of the five Hapu.

Land loss also stopped Tauranga Maori from accessing other natural resources which they had always had by customary right. Inland farmable land was taken by Europeans for settlement resulting in a loss of coastal and customary rights by Hapu. The farmable areas occupied by Europeans resulted in the draining of wetlands, deforestation (taking out of trees) and significant environmental degradation of ecosystems and species.

Significant land loss has contributed to Tauranga Maori being alienated economically, socially and culturally. Tauranga Maori was prevented from being able to use and develop what little land they were able to hold on to. Many Tauranga Maori who had land confiscated were unable to develop or farm their lands and were limited in their ability to support themselves or their Whanau. Much of the land in Tauranga Moana is confiscated land; now in European title, a situation that has forced tangata whenua from their land where their tupuna were land owners and lived and died. Some Tauranga Maori have become disconnected from their whenua including waahi tapu, urupa, gardens, and papakainga in a situation that leaves tangata whenua aggrieved as "strangers on their own lands".

A well-known maxim describes succinctly the relationship of tangata whenua to land as thus; "Loss of land, loss of culture, loss of language, loss of a place to stand".

Tauranga Moana Maori have been affected from the time of the raupatu in 1886 to the present day and now own less than 10% of the land base in the Western Bay of Plenty. Tauranga is a thriving busy city in which tangata whenua of Tauranga Moana own small pockets of land. It is noted also that Tauranga Maori find it a bigger challenge to assert cultural perspectives in political processes that shows little regard for Maori cultural values.

3.2 Land confiscation at Matakana and Rangiwaea Islands

The following information provides the historical context in which the land confiscation at Matakana and Rangiwaea Islands was instigated:

At the Pacification Hui on the 5-6 August 1864, Governor George Grey declared to the Iwi of Ngai Te Rangi" that inalienable reserves be established at Ohuki, Matapihi, Matakana, Rangiwaea and Motuhoa. Inalienable meaning "that the land is not open to purchase, it is non-negotiable" and yet by 1887 a total of 4488.4 hectares of land was sold to land prospectors. Ref: Matakana Island Claims Committee, 2000.

The claims for Matakana and Rangiwaea Islands were lodged with the Waitangi Tribunal and included:
Inalienable Reserves declared for land blocks on Matakana
Raupatu/confiscation or other acquisition of land blocks
Lack of records proving that original Maori ever signed plans for sale or land transfer
Seeking a legal definition of ownership
Public works takings
Sewage pipeline
Financial and asset compensation from the Crown for grievances as a consequence
Role of Kingitanga
Role of Paramount Chief Hori Tupaea in the war
Return and subsequent alienation of Hapu land
Crown/Maori Trustee role in the purchasing of land

Land loss during the 19th Century including the investigation by the Tauranga Land Commission, concluded that lands returned by way of Crown grant and the purchase of the "barrier arm" of Matakana Island clearly illustrated the role of Crown appointed representatives who were able to influence colonial policy to take advantage of the vulnerable position of the Matakana and Rangiwaea Hapu.

Waitangi Tribunal reports and evidence record that the Crown representative Whitaker stated in Parliament... *"It is absolutely essential not only for the sake of ourselves, but also for the benefit of the natives that the Native Title should be extinguished, the Native Custom got rid of, and the natives as far as possible placed in the same position as ourselves. Maori must be subdued and that Maori lands must, by whatever means, come more freely into European hands".*

Waitangi Tribunal reports conclude that the Crown representatives Russell, Whitaker and Daldy were working in concert by acquiring as much land on Matakana Island as possible.

Rangiwaea Island was a safe and settled island that harboured and healed many wounded during the times of the colonial wars. The Chief Taharangi of Te Ngare was an active participant throughout the many battles losing his life along with his kinsmen of Te Ngare Hapu. Chief Hori Tupaea of Te Whanau a Tauwhao was active prior to the battles and post war through the Native Land Court hearings in which land belonging to his Hapu was confiscated. The role of Henare Taratoa of Te Ngare and Te Whanau a Tauwhao is acknowledged in New Zealand wars history as being the facilitator of "Rules of Engagement for War" – the pre-cursor to the Geneva Bill of Human Rights. The "Rules of Engagement for War" included the following edicts;
If thou enemy shall hunger, feed him
If thou enemy shall thirst, give him water
If thou enemy needs shelter, keep him safe

It is fair to say that Tauranga warriors followed this doctrine in documented evidence of chivalrous conduct, however the same cannot be said for the colonial soldiers and its allies during the many skirmishes and battles that ensued in their treatment of Tauranga Maori.

Today, less than 1/3 of Matakana Island is in Maori owned title and Rangiwaea Island is administered by Tauwhao Te Ngare Trust who represents 1800+ owners of multiple owned Maori lands.

Panepane-Waikoura

Panepane is an area located at the southern end of Matakana Island at the Tauranga Harbour entrance, opposite Mauao, a cultural icon for Tauranga Maori. Waikoura, located at the northern end of the island at the Bowen town entrance also has great cultural and historic significance for the five Hapu of Matakana and Rangiwaea (see map below) who are the kaitiaki for the barrier arm.

Names given to certain areas on the island were often descriptions of historical events, food source areas, anchorage places or areas specific to certain tupuna. Today our kaitiaki responsibilities for the barrier arm includes the recent Rena clean-up of 28km of debris ridden, flotsam/jetsam, oil and beads, putting out fires from recreational boaties, cleaning up rubbish, fire fighting in the bush, monitoring fish and shellfish stocks, monitoring pest plants and animals, restoration of biodiversity values and general caretaking roles.

The forested barrier arm from Panepane to Waikoura has a long history of pre-European occupation and is an area considered waahi tapu/sacred area. Land tenure of the barrier arm of Matakana Island is refuted by tangata whenua, and evidenced in Waitangi Tribunal reports. Recent Environment Court findings associated with land developers seeking to provide large scale housing development on the Matakana barrier arm is that whilst Hapu and whanau do not have land tenure, we still maintain a kaitiaki role/caretaker-guardian role of the barrier arm which has been the case since time immoral. Judge Smith noted that whilst land tenure is not with the Hapu, the onus of responsibility for Hapu who recognise and care for this area as if it was still their own is an attitude unique to the Islands. It is the Hapu view that whilst we do not have land tenure, we still maintain and care for the area as if it is still in our ownership as many of our tupuna who whakapapa to the 5 Hapu lived and are buried throughout the barrier arm.

In 1877, the Tauranga Lands Commission under the Tauranga District Lands Act 1867/68 determined the title to the Panepane and Purakau blocks. The Panepane block consisted of approximately 1,342 acres known as Lot 13 Katikati Parish. The block remained in Maori ownership until the 1920s. In December 1922, the Crown compulsorily acquired the block under the Public Works Act 1908 for "harbour improvement purposes" and vested in the Tauranga Harbour Board in 1923. Two lots were acquired, Lots 11B and 13. Lot 13 is the closer of the two to the harbour entrance and were subsequently planted in trees. Today, the access from other parts of the island to a boat ramp and to the wharf for the ferry which connects the island to the mainland passes over Lot 11B.

Historically, a tall growing tree was established on Lot 11B as a navigation marker, and it has been retained there since. Sometime before 1976, the Harbour Board placed navigational lights and beacons on Lot 13 to assist ships making passage through the nearby Tauranga Harbour entrance. No navigational structures were built on Lot 11B. At the time, Panepane and Purakau were covered in Manuka and bush. The intent of Tauranga Harbour Board was to plant marram grasses or lupins to control drifting sands. Soon after acquisition the Board planted the blocks in pine with the dual aims of stopping sand drift and creating a cash crop.

In 1989, Panepane and Part Purakau 11B were transferred from the Tauranga Harbour Board to the Western Bay of Plenty District Council. At the time, the Minister of Transport did not consent to the

blocks being acquired by the newly established Port of Tauranga Limited who wished to utilise the Island for its own use.

The Western Bay of Plenty District council now retains ownership of Panepane and Part Purakau 11B and assert that the land is still required for "harbour improvements".

An enduring aspiration of the Matakana and Rangiwaea Hapu is for the land at Panepane-Purakau to be returned to the ownership of the Hapu of the Islands.

Map showing the cultural names of sites of significance

Ngai Te Rangi Iwi

Today, Tauranga Moana (as it is known) is the traditional home of three Iwi. They are Ngai Te Rangi, Ngati Ranginui and Ngati Pukenga. The registered office of Ngai Te Rangi Iwi is listed as Taiaho Place, Mt Maunganui. Ngai Te Rangi Iwi provide health, education and social services and resource management advice to its affiliated Hapu and wider community.

Today, the relationships of Ngai Te Rangi Iwi provides the following Hapu and marae affiliations:

Ngati Kuku	Matapihi/Whareroa/Mount Maunganui
(Marae)	Whareroa Marae
Ngai Tukairangi	Matapihi/Whareroa/Mount Maunganui
(Marae)	Hungahungatoroa Marae
Ngati Tapu	Matapihi/Te Papa in central downtown Tauranga
(Marae)	Waikari Marae
Nga Potiki	Matapihi/Mt Maunganui/Tamapahore, inner Rangataua Harbour
(Marae)	Tamapahore Marae
Ngati He	Maungatapu, inner Rangataua Harbour
(Marae)	Maungatapu Marae
Ngai Tamawhariua ki Katikati	Katikati
(Marae)	Te Rereatukahia Marae
Ngai Tamawhariua Ki Matakana	Matakana Island
(Marae)	Te Rangihouhiri Marae
Ngati Tauaiti	Matakana Island
(Marae)	Opureora Marae
Ngai Tuwhiwhia	Matakana Island
(Marae)	Opureora Marae
Te Ngare	Rangiwaea Island
(Marae)	Rangiwaea Marae
Te Whanau a Tauwhao Ki Otawhiwhi	Bowentown, Waihi Beach
(Marae)	Otawhiwhi Marae
Te Whanau a Tauwhao Ki Rangiwaea	Rangiwaea Island
(Marae)	Rangiwaea Marae

3.3 Sites of Cultural Significance

Section 6(e) and (f) of the RMA recognises the relationship Māori have with their ancestral lands, waters, sites, waahi tapu, and other taonga; and the protection of historic heritage.

From the Rangiwaea and Matakana perspective, it is difficult to separate the relationship and importance of one site over another. In their cultural traditions all sites including settlements, gardening areas, food gathering practices, cemeteries, springs, and tracks are interrelated. In this instance a landscape approach is taken to the impacted area of Matakana Island and the waters surrounding the outer Islands including Mauao.

4.0 Consultation / Engagement

Rangiwaea and Matakana representatives have discussed in detail the impacts associated with the outfall discharge on a number of occasions dating back to the 1950's. However the Hapu have only recently in 2015 progressed discussions with Western Bay of Plenty District Council representatives to facilitate and progress a monitoring project and the production of a CIA to document the impacts of the oil spill.

Until recently, the Hapu of the Rangiwaea and Matakana were excluded from any involvement in planning of resource management. For the past five years however Rangiwaea and Matakana have gained membership representation with a sitting member on committees associated with Local Body Councils; Western Bay of Plenty District Council.

5.0 Cultural Impacts of the Sewerage Outfall

5.1 History of Matakana Island Sewerage Outfall

The Harbour and seas of Tauranga Moana have provided kaimoana for Hapu and iwi since time immemorial, we regard our kaimoana as our sustenance "we liken the sea to a garden: the supplier of our kaimoana, a playground for our children and the belief that healing comes from the serenity of the waters in its purest form". The adverse effects on the harbour after European settlement began to seriously impact the inner harbour with sewerage pollution being a major contributor. As the Harbour became more polluted, the oceanbeach foreshore of Matakana Island remained in a pristine condition. Our oceanbeach and the kaimoana that is found within it is very highly valued by the tangata whenua as a taonga and comes under protection through Article 2 of the Treaty of Waitangi. The tangata whenua of Matakana Island has always vehemently opposed the Katikati Sewerage Pipeline and feel that the whole process from its inception has been fundamentally flawed and has seriously undermined and breached the principles of 'Partnership' and 'Protection' of the Treaty of Waitangi.

The following information was gathered from a Waitangi Tribunal Research Report by Robert A McClean: The Matakana Island Sewerage Outfall.

1974 Bay of Plenty Co-operative Dairy Association report into its Dairy Effluent discharge into the Tauranga Harbour from the Katikati Dairy Factory showed that "considerable adverse ecological changes have occurred" and that the "Dairy Company's discharge is contributing to 'serious pollution' of the Harbour.

1975 Katikati Ratepayers rejected a plan for a 'land-based' sewerage disposal system due to 'cost' factors.

May 1977 The Dairy Association was granted a permit to discharge its dairy waste via an ocean outfall pipe at Matakana Island. NO consultation with Matakana Island community was undertaken.

August 1977 Tauranga County Council apply for a water right permit to discharge **raw sewerage** through the pipeline of Matakana Island using the Dairy Pipeline. NO consultation with Matakana Island community was undertaken.

1 Dec 1977 The Regional Water Board granted the Tauranga County Council the permit to discharge raw sewerage from the township of Katikati via the Dairy Pipeline.

2 Dec 1977 Dr Larcombe submitted an amended expert evidence detailing that much more contamination would occur in the outfall area than he had previously estimated, and that the contamination would exceed SB standards at times. The amended contamination zone was 700-1100m from the outfall site. **This evidence was disregarded**.

Feb 1978 Chief Engineer (for the Tauranga County Council) Mr Revington stated that because "the seaward side of Matakana Island was of little public use, the discharge was considered acceptable".

March 1978 The Minister of Health, Mr Gill, in response to letters of concern about the sewerage plans, supported the granting of the permit and restated that the disposal of raw sewerage was approved as the Matakana Beach was inaccessible.

July 1979 The Ocean outfall pipeline was completed and dairy waste was being pumped out.

Dec 1980 Tauranga County Council announce plan to buy 2/7th share in the dairy pipeline to use for Katikati sewerage. When asked at a public meeting if there had been an ecological study of the effect of discharging the effluent into the Sea of Matakana Island, the reply was that "according to Mr Larcombe ... the water should be reasonably pure 200m from the outfall". **This statement was false.**

Dec 1980 After the public meeting the Tauranga County Council made an application to the Local Authorities Loans Board for a loan to purchase the 2/7ths of the pipeline and build a treatment plant. Mr Sherring provided an Environmental Impact Assessment statement for this application where he stated that "adverse ecological effects were thought to be negligible". He did not report that the shellfish in the outfall area were being gathered by the residents of Matakana Island.

Late Dec 1980 Untreated sewerage from Katikati township started being pumped out via the Dairy Factory Pipeline.

May 1982 Bay of Plenty Dairy Association announced the closure of the Katikati Dairy Factory.

June 1982 Approval was given for the loan to purchase 2/7ths of the dairy pipeline and build a treatment plant.

June 1983 Wills Rd Treatment plant was completed.

September 1984 Tauranga County Council resolved to purchase the entire pipeline to provide for the future expected population of Katikati.

February 1987 Regional Water Board wrote to the County Council stating that they had not been fulfilling the conditions (effluent testing and annual ecological surveys) imposed on the Water Right for the ocean outfall.

August 1988 Bacteriological testing of the marine water and shellfish was carried out. These tests found faecal coliforms to the strength of 160,000 p/100g of flesh present in green-lipped mussels living on the pipeline. The Health Department limit for edible shellfish is 230 faecal coliforms p/100g flesh. These results were not sent to the Senior Water Treatment Officer until October 1990 – over 2yrs after the test had been carried out.

September 1988 Hauata Palmer (resident & tangata whenua of Matakana) wrote to the Tauranga County Council asking the following questions – 1. Is the pipeline now being used for the discharge of human wastes? 2. Is the waste treated or untreated? 3. Was any special approval sought and given to the change? 4. Was the change advertised and objections invited? 5. Is there any risk of contamination of shellfish beds? 6. Is there any risk to human health?
This letter is the first evidence of Matakana Island residents receiving information about the Katikati discharge.

1 December 1988 Tauranga County Council finally replied to Hauata Palmers letter – 1. Yes, the pipeline is being used for human waste discharge. 2. The waste is subject to milliscreening (it did not say whether it was treated or untreated). 3. Water Right was granted on 1 Dec 1977. 4. The application was advertised and one objection was received. 5. "... no contamination of shellfish beds has been found". 6. Risk to human health is extremely slight... the council is required to monitor the situation.
This information did not say that the sewerage was <u>untreated</u> and did not state that high faecal coliform levels had been found 800m from the outfall.

April 1989 Following complaints from the Tauranga Moana District Maori Council, who had registered their opposition to the Matakana Island discharge to members of parliament and other government organisations, water and shellfish samples were taken. These tests found little evidence of faecal coliforms, but more importantly these results should have been declared **invalid** as they took too long to get to the testing lab.

June 1989 Despite the invalid status of the sampling tests, a letter was sent to the Tauranga Moana District Council saying that no pathogenic organisms were present in the water near the discharge, and shellfish were free from contamination.

November 1989 The new Western Bay of Plenty District Council (replacing the Tauranga County Council) and the Bay of Plenty Regional Council (replacing the Regional Water Board and Catchment Commission) came into existence.

1990 Serious problems were occurring with the effluent rate at the Katikati Sewerage Scheme. As the Dairy waste was not being pumped anymore, sedimentation was occurring in the pipeline due to lack of velocity, causing the effluent to be in an "advanced stage of decay" having much worse effects at the point of discharge.

Monitoring of the effluent to date had been sporadic and uncoordinated with most samples being taken from a tap near the treatment plant – with the absence of any major ecological surveys, the water and shellfish quality of the receiving environment off Matakana Island is unclear. Regional Council have stated that this absence of annual ecological reports has been "disappointing".

August 1990 The development of the WBOP District Wastewater Collection & Disposal Concept Plan. This concept plan shockingly proposes four seperate ocean outfalls through Matakana Island. The effect of these pipelines on Maori interests was not considered in this concept plan.

April 1991 Article appeared in BOP Times which commented on the problems of Katikati Sewerage and stated that Katikati's **untreated sewerage** was being discharged into the sea off Matakana Island.

11 April 1991 Following the BOP Times article a letter to the editor from tangata whenua of Matakana Island explaining *"For many years Matakana Island people have shown a great deal of concern over the dumping of sewerage via a pipeline from Katikati... We have in our possession all relevant information concerning the pipeline which we acquired from the Tauranga County Council in 1989. Nowhere in this conglomeration of material does it show that the engineers **ever consulted the tangata whenua**. I cannot remember our people being **given the right to object**. One can argue that notices appeared in the local newspaper. I can argue back and state Matakana Island residents do not get a newspaper... Our people were told that the sewerage had been treated before passing through the pipeline, but we still questioned this, because of the stench and residue sometimes appearing at the outlet area. Now **at last someone has told the truth**, shocking as it may be – but not expected... **The Matakana Island people are not going to sit back and allow their Moana to be desecrated**. When will they ever learn.*

June 1991 Two major ecological survey reports were completed with conflicting results. The report by Biological Researchers concluded that the discharge was having no serious impact on the marine environment and that "**there were no areas of high intrinsic value near the outfall, and no uses of subtidal resources that are incompatible with effluent discharge**". Obviously, this report did not include the values that tangata whenua and the community of Matakana Island placed on the marine environment and the kaimoana resources.

The survey report by Beca-Steven concluded that 1. The sewerage effluent causes shellfish near the outfall structure to be unfit for human consumption **at all times**. 2. At night time and during periods of heavy onshore swell, the extent of **serious contamination** increases to at least 1000m from the outfall structure.

1992 WBOPDC plan to upgrade the Katikati Treatment Plant to provide primary and secondary treatment of wastewater using oxidation ponds.

18 Sept 1992 Letter sent by Matakana Island Trust to WBOPDC outlining that that "the discharge of raw sewerage is <u>absolutely not acceptable</u> and the community at large <u>demand</u> some remedial measures to address this issue." It also asked if the Matakana Island Trust can be made a party to any submissions. On receiving this letter, the Matakana Island Trust was invited to join the Katikati Wastewater Treatment Working Party.

Feb 1993 Study completed by Bruce Henderson Consultants into three different disposal sites for Katikati Sewerage – mainland disposal, Matakana Island land-based disposal, and using the existing Matakana Island ocean outfall. This study recommended that Katikati should continue to use the existing ocean outfall after primary and secondary treatment. **The report did not take into account or comment on the Matakana Island iwi opposition against the continued use of the pipeline**.

March 1993 The expiry date of the discharge permit was fast approaching but decisions on the proposed treatment options had still not been made. Katikati Wastewater Working Party reported its recommendations for the forthcoming new resource consent application. This included – "That the Resource Consent Application be for the discharge of Katikati secondary treated wastewater ... be discharged through the existing pipeline to the ocean outfall off Matakana Island."

May 1993 Matakana Island Community made a four page submission to the Working Party, the following objection was recorded – *"We strongly object to any proposed wastewater discharge into any waterway, harbour or ocean, or on to any land that makes up Matakana, Rangiwaea or Motuhoa Islands or on to any beach or foreshore surrounding these islands."* This objection was based on the consultation process and cultural values. In summary the submission says –

- In regard to consultation, the Matakana Island Community say that they were never consulted in 1977 when the water right was obtained by the County Council.

- Later the Matakana Island Community were led to believe that the sewerage was treated as the term milliscreened was thought to be a form of treatment. From 1982 the County Council has been discharging raw sewerage into the ocean off Matakana Island.

- In terms of international standards, it was thought that the existing pipeline was not long enough and that the discharge point should be at least one kilometre from the mean low water mark (this point was made to illustrate the inefficiencies of the existing system, not to be construed as an agreement to ocean discharge).

- Shellfish have been regularly collected from ocean beach by the Matakana and Rangiwaea community.

- The Katikati Wastewater Working Party did meet with the Matakana Community on the 6 March 1993. However this amount of consultation is inadequate and that proper consultation has not occurred in the first place.

- In truth, the Tauranga County Council would have gone ahead with the pipeline plan even if the Matakana Island community had objected to it.

- In regard to the cultural values of the tangata whenua, waste and food do not occupy the same receptacle. These values are undermined by ocean outfalls.

- Maori cultural values are being ignored as problems are attempted to be solved from only a Pakeha perspective.

In conclusion, the submission stated that finance should not be the only consideration and that **the right decisions may require "high financial input today but the benefits to coming generations would be enormous." As equal partners to the Treaty of Waitangi, Maori people should not have to continually defend their values, and the "Maori view should not only be heard but it should be taken heed of".**

29 June 1993 Despite this objection, the District Council went ahead and applied for resource consent.

23 May 1994 Matakana Island claimants sent their claim to the Waitangi Tribunal concerning the prejudicial effects of the discharge of sewerage into the waters of Matakana Island. The claim was registered by the Tribunal as Wai 228 on 6 April 1995. In its report to the Minister of Conservation (as the discharge permit was treated as a restricted coastal activity), the Joint Hearings Committee observed that the "disposal of sewage cannot cease immediately" and the proposal was not for a long term period. It was also accepted that the "discharge of human effluent through a pipeline into the ocean is **culturally unacceptable to the tangata whenua of Matakana Island**." In its decision, the committee considered that the resource consent be granted for only a short term and conditional on the preparation of a long term plan.'"

10 June 1994 A prehearing meeting was held to discuss the Matakana Island outfall issue. During the meeting, Mr Hauata Palmer made a number of points regarding the outfall. These points included:

- The previous ten years of discharge had been too long and a number of mistakes had been made in the past regarding the pipeline and sewage discharge;
- Aquaculture development is proposed in the Matakana Island coastal marine area;
- Large numbers of shellfish had been found dying on the beach near the outfall;
- Alternative discharge locations should be considered and ultimately the pipeline should be closed;
- There is still some opposition to the discharge of effluent that has been treated by wetlands; and
- Land-disposal is the most accepted option.

These issues were included in a formal objection by Hauata Palmer on behalf of Matakana Island iwi. This objection included the following statements:

a) The reputation of the iwi is related to quality of food offered to visitors on special occasions. Tauranga Moana area contains finest mataitai and sea foods.
b) The existing pipeline across the harbour is an environmental threat;
c) The discharge has breached articles two and three of the Treaty of Waitangi as customary fishing rights are now restricted due to the presence of the outfall. However, the extent of contamination over the beach area is unknown. Regulatory organisations of the Crown should be actively protecting the natural resources of the area;
d) In terms of future development, the Matakana community is seeking to develop aquaculture. This development right is undermined by the discharge;
e) Between January 1994 and June 1995 "a staggering 772,800 cubic metres will have been discharged - to say nothing of the 5,000,000 cubic metres of the past ten years during which time nothing was done to remedy the situation;" and
f) Treatment will still not guarantee the presence of unaffected mataitai.

In conclusion the Matakana Island community sympathised with the costs of the problem, but reiterated they wanted "the ocean outfall on Matakana Island removed and the discharge right be cancelled forthwith."'

11 Oct 1994 The coastal permit was granted, providing that after Nov 1996, all effluent would be treated by sequential batch reactor, all wastewater would meet a high standard, shellfish monitoring would be extensive. This consent meant that secondary treatment of the effluent was required by 30 November 1996 and a long term plan was to be provided to Environment BOP for further upgrading.

1996 Debate about different options for the location and different treatment options and costs was extensive. Tangata whenua are angered that their views are still being ignored. The 1996 Alandale Report states -
"It became apparent at an early stage that the iwi of Matakana Island were deeply opposed to the existing pipeline to the ocean under any circumstances. This attitude came about by a feeling of betrayal by the island people of the way the Council had not kept them informed about the change in status from the dairy factory effluent to human waste. Notwithstanding that the correct legal procedures were followed, the island Maori believe they weren't properly informed. Definite action was taken after November 1994 that a procedure be developed for consultation with this iwi group that was meaningful and fully met the requirements of the Resource Management Act... It is clear

that past and present discharge of sewerage off Matakana has undermined the mauri of the waters and polluted the kaimoana".

November 1997 WBOPDC had failed to meet the obligations of coastal permit no. 02 3604 which required discharge of screened sewage to cease by 30 November 1996. On the 12th and 13th of November 1997, a special joint hearing was held by the Regional Council. This hearing considered the application of the WBOPDC to build a sewerage treatment plant near Katikati and discharge 1,010 cubic metres per day (dry weather) and 3000 cubic metres per day (wet weather) of treated sewerage via the existing Matakana Island outfall. Seven submissions were received, all opposing the application. **Despite opposition this consent was granted for a term of 10years.**

A temporary consent was also sought for which would allow for the discharge of 2000 cubic metres per day of untreated sewerage via the existing Matakana Island outfall. Five submissions were received for this consent all opposing the temporary consent. **Despite opposition this consent was granted.**

5.2 Monitoring and Testing

Since the discharge facility was opened in the 1980s, tangata whenua still maintain its stance against the continued discharge of the treated effluent until cultural and environmental concerns can be satisfied. Outfall monitoring has been ongoing since 1985. During that time (1985-1989) a number of water quality tests were carried out with no involvement with tangata whenua in the monitoring and testing up until this point today. We have great concerns around the reporting information that has been passed on to the Hapu which is often confusing and complicated particularly around the threshold limits for contamination. This information is being relayed onto tangata whenua in a format that requires some high level scientific interpretation to understand which limits the Hapu members in making informed decisions around the impacts of the outfall discharge onto the receiving environment. In the view of tangata whenua the effects of the discharge onto the receiving environment is not up to the standard that tangata whenua feel would satisfy their ongoing concerns. For tangata whenua, solutions need to be long term focussed, of a high quality standard and with the ability to change methodologies as technology advances.

Map showing the location of the discharge point (orange circle)

Tangata whenua have great concerns about the distance and location of the outfall area that sits 650m off shore within a water depth of 4-5m. A report carried out by Robert McClean (1998) outlined the drift of the plume would likely spread over a 1000m radius which would likely impact onto the shoreline particularly given onshore currents and winds (see photo below). During these events there are often brown sludge deposits that is washed up particularly within 3km either side of the pipeline outfall itself.

Map showing the estimated plume area


Map showing the locations of photo points (below) for brown discharge south of the Pipeline.

Photo showing brown material washed up during onshore currents and winds

Tuatua

Tuatua are regarded as a taonga to tangata whenua and one that has an important role to play along this coastal stretch which is often referred to as a keystone species. The life cycle of the Tuatua supports many other taonga within the moana that ultimately rely on these beds as an important food source for their own sustenance. Tuatua often migrate to the deep (1-2m) during the winter season and migrate inshore during the end summer months to spawn. It is during this time that the many fish and shellfish species can be found in great numbers eating off the bountiful beds. These species include Snapper, Kahawai, Trevally, Grey-mullet, Yellowed-eye Mullet, white belly Flounder, yellow belly Flounder and paddle crabs which all rely on the tuatua beds as an integral part of their own individual life cycles.


Tuatua spawning during Feb - April

To our knowledge there has been no extensive tests or monitoring carried out on the impact of the outfall discharge to firstly, test whether or not there is any impact on the Tuatua populations particularly during the spawning phase and secondly whether or not the number of tests carried out in any given year is sufficient evidence to indicate Tuatua are safe to eat all year round for tangata whenua particularly within 2-3km either side of the discharge point.

The Hapu of Matakana and Rangiwaea islands wish to be involved in **ALL** discussions, monitoring and decisions for the remaining lifetime of the Pipeline discharge.

6.0 Connections to the Whenua/Land

It is our "Island perspective" that the waters around Rangiwaea and Matakana are an extension of our gardens that exist on land, and safeguarding and protecting the resources of the "sea garden" is no different.

The connection of the land and the people is most apparent in the practices of whakatauki (proverbs) which are timeless and wise sayings that serve to image the relationships of people and their attitude to land.

"Te toto o te tangata he kai; te orange o te tangata, he whenua"
Food supplies the blood of man; his welfare depends on the land

Another example highlights the importance of land and its enduring nature, for unlike humanity, land lives on forever.

"Toitu te whenua, whatungarongaro te tangata"
The land remains, while the people have disappeared

Indeed, security of existence was never based on being human. Rather, it was sourced to the land because of its unfailing nature. The fact that land plays a fundamental role in people's very existence conveys also that land was the source of social unity, and gives physical expression to systems and structures that served to govern and administrate the affairs of the people. More importantly, whenua provided a sense of permanency from which good life could be measured and sustained.
Ref: Matenga-Kohu, J. (2003). Nga Korero o Nga Tupuna. Cambridge, New Zealand: Kina Film Productions Ltd.
The following excerpt clearly portrays the Island perspective in relation to our environment:

Our relationship with the land on our Islands is more than a physical relationship... It is also a spiritual relationship because our tupuna lived, died and are buried there. As a people, we have an emotional, spiritual, social and cultural relationship with the land.

We are the Islands and the land and sea there, and the Islands and the land and sea are who we are. Our Island and our lifestyle are deeply entrenched in our identity. Na, Peter Rolleston

7.0 Matakana and Rangiwaea Islands Hapu Management Plan 2012

The Matakana and Rangiwaea Islands Hapu Management Plan (referred to as the HMP) was presented to the Bay of Plenty Regional Council and Western Bay of Plenty District Council in 2013, and is a formally recognised resource management tool to advocate for the Hapu of Matakana and Rangiwaea in issues regarding their resources. The HMP is an "indigenous tool" for the Hapu of the Islands to practice their Kaitiakitanga (guardianship) and Tino Rangatiratanga (self-determination) of their natural resources and taonga including the Tauranga Harbour – referred to as Te Awanui.
Under Section 2, Environment, the topics - issues and concerns are headed;

- Protecting our taonga
- Protecting our flora and fauna
- Protecting our fresh water
- Protecting our salt water
- Protecting our coastal regions
- Protection of harbour
- Protecting our land
- Protecting archaeological sites
- Waste management
- Bio security
- Bio diversity
- Protection of air space

The environmental, social, economic and cultural aspirations for the five Hapu are listed as follows:

A. Environment

We want our heritage areas, wahi tapu and taonga treasures protected. Our aspirations involve keeping the human environment in harmony with the natural environment. We want all those engaged in developmental activities on the islands to follow environmentally friendly and sustainable practices that align with our cultural perspective.

Cultural Perspective:

We recognise the interconnectedness of life cycles and the role of tangata whenua to enhance and protect the balance of all indigenous species and their habitats. We are Rangatira of our whenua and moana.

B. Economic

We want sustainable economic development that safeguards the wellbeing of the Hapu. Our aspirations are for a vibrant, self-sustaining economy with full employment, sound infrastructure and support services. To achieve these goals, each Hapu asserts its own vision and plan for economic development. We respect the vision of each Hapu and recognise that each has the opportunity to progress its own economic aspirations. The long term land leases over Maori freehold blocks are coming to an end. The Hapu view this as an ideal opportunity to progress future economic aspirations.

Cultural Perspective:

The economic well-being of our Hapu cannot be measured in monetary terms alone. Our economic health is inextricably linked to our cultural, social and environmental well-being.

C. Social Aspirations:

Our enduring aspiration is for our people to lead healthy and culturally fulfilling lives. We envisage:
Fully functioning marae
Accessible Hauora services
Quality education and training
Sustainable employment
Recreation and sporting activities
Durable housing and papakainga initiatives

Cultural Perspective:

We whakapapa to these Islands and this continues to shape our view of the world and our place in it. Our marae are an important part of our culture and are used extensively. We lead self-sufficient lifestyles that sustainably draw on the resources of our environment.

The Islands of Matakana and Rangiwaea are the jewels in the crown of the Western Bay of Plenty region. Rangiwaea Island comprises 267 hectares and is used primarily for:

- Forestry
- Pastoral grazing
- Horticulture
- Agriculture
- Residency

Matakana Island spans approximately 28 kilometres and comprises 6,000 hectares. Matakana is the largest sand barrier island in New Zealand. The barrier arm is predominantly a plantation pine forest with isolated pockets of native vegetation. The harbour side of Matakana Island is primarily used for:

- Agriculture
- Horticulture
- Dairy farming
- Native nursery operations
- Residence
- Pastoral grazing

The Vision and desire for the Hapu and its people is to:

- Enhance and preserve the natural environment and resources
- Maintain and strengthen Hapu identity
- Raise the profile of the Hapu of Matakana and Rangiwaea and associated organisations
- Adhere and acknowledge Tikanga principles and values of the Hapu of Matakana and Rangiwaea
- Promote and enhance the well-being of healthy and thriving communities connected to the Hapu
- Strengthen partnerships and strategic alliances
- Create an environment that strengthens continuous learning
- Establish and sustain economic independence that provides dividends to its beneficiaries

Kia tu pakari a nga Whanau me nga Hapu a nga Moutere o Matakana me Rangiwaea I roto I te ao whanui

The families and Hapu of the Islands of Matakana and Rangiwaea will stand tall and proud in the wider world

The following statements from the HMP as it relates directly to Te Awanui/Tauranga Harbour, and provides direction and guidance for Councils and large consumers like the Port of Tauranga and its associates to ensure the Hapu values of the Islands are considered in any planning regimen.

Fisheries

Traditionally, the bountiful resources of the moana have always provided sustenance to the Hapu of the Islands and are referred to as the "pataka kai" – the food cupboard. Kaimoana features in the diets of all Islanders as a fundamental food source, and underpins our cultural identity and obligation to provide these taonga when hosting visitors. Our fishing areas include large areas of Tauranga Harbour and the open coast identified in maps.

The depletion of kaimoana and fisheries stocks, degradation of coastal environments and associated negative impacts are major concerns for our people. Some coastal ecosystems have been continuously modified and have become so degraded in recent years that the local Hapu have effectively become "disconnected" from them.

It is imperative that research is undertaken for the above issues, and the current coastal restoration projects continue. We want recognition of our mana motuhake over a 2km radius commercial free exclusive zone from the Islands.

Environmental Threats and Challenges

We identify four sources of threats to our environment:

1. General threats to indigenous biodiversity
2. Threats from human activity

3. Threats from poor planning and policies
4. Threats from natural events

Threats from Human Activity
Pollution from the Mainland
Run-off from agricultural and horticultural activities
Industrial pollution
Effluent disposal
Storm-water run-off
Sewage from the mainland
Excessive chemical use (pesticides)
Siltation and sedimentation
Excessively bright lights from the Mainland
Horse rider's unfettered access to the Islands

The Hapu of the Islands highlight the requirement and outcome to be actively involved in a monitoring and co-management role of our waterways and estuaries in the event of a breach of the threats posed to clean up and protect our environment.

Summary of our Environmental Goals
Below is a summary of the goals embodies in the charters and constitutions of the environmental organisations on the Islands;

1. Protect and enhance areas of natural, cultural and historical significance
2. Promote and provide opportunity to re-introduce native fauna and flora
3. To ensure discharges into the water and land meet environmental and cultural standards
4. To decrease sedimentation
5. To work with landowners to develop riparian margins
6. To maintain the Islands role as the Guardian of Te Awanui
7. To enhance and protect the significance of Te Awanui for Aotearoa
8. To retain the traditional character and values of the Islands
9. To effectively plan and monitor the resources and activities on the Islands
10. To provide educational, training and employment opportunities for Hapu members
11. To encourage landowners to preserve and enhance the biodiversity on the Islands

8.0 Te Awanui, Tauranga Iwi Harbour Management Plan 2008

The Te Awanui Tauranga Iwi Harbour Management Plan 2008 is operational and has been in effect since February 2008. The following excerpts from the Plan are highlighted as relevant matters for consideration in relation to the Port of Tauranga Consent.

The Plan is recognised by Local Body Councils and Government Agencies and is a statement of the three Iwi of Ngai Te Rangi, Ngati Ranginui and Ngati Pukenga values and policies with regard to the management of the Tauranga Harbour. The document is prescribed as an indigenous tool created by Tangata Whenua to carry out their function as kaitiaki and rangatira over their ancestral waters, Te Awanui. The plan was produced by members of the three Iwi in conjunction with the whanau, Hapu and iwi of Tauranga Moana as an Iwi Harbour Management Plan.

Te Runanga o Ngaiterangi Iwi Trust is the tribal iwi authority for the Hapu of Ngai Te Rangi. Te Runanga o Ngati Ranginui is the tribal iwi authority for the Hapu of Ngati Ranginui. Ngati Pukenga ki Tauranga Trust is the tribal authority for the Hapu of Ngati Pukenga.

The Plan refers to the Port of Tauranga in particular and the associated businesses that utilise the Port for import/export activities and inevitably enhance the economic growth of the region. However this has come at a cost for the cultural and environmental values of Hapu and Iwi that are extensive. Iwi and Hapu have lost significant cultural blocks of land through the Public Works Act in the development of the Port of Tauranga.

A series of harbour works, including dredging, embankments, new wharves and reclamations, took place to enable the development of the port. The creation of the Port has caused destruction to the marine environment, kaimoana beds and the loss of significant cultural sites and cultural identity. There has been a dramatic reduction in the fish and shellfish that were abundant within the life times of elders still alive today. The result of the economic development of the Port has destroyed whanau, Hapu and iwi relationships with Te Awanui. This development has been at the expense of tangata whenua traditional food gathering and traditional cleansing sites.

The need to balance economic growth with cultural and environmental sustainability is increasingly apparent. Those Port activities that have caused and continue to cause detrimental effects to the relationship tangata whenua have with Te Awanui, need to be taken into account and provided for. Currently, management of Te Awanui currently falls under the obligation of the following group of regulatory authorities.

Crown Agency	**Obligations**
Bay of Plenty Regional Council (BOPRC)	Resource Management Act, Local Government Act, National Coastal Policy Statement, Regional Coastal Policy Statement, Regional Plans, Long Term Council Community Plan, Iwi Management Plans, Hapu Management Plans
Tauranga City Council (TCC)	Resource Management Act, Local Government Act, District Plan, Long Term Council Community Plan, Iwi Management Plans, Hapu Management Plans
Crown Agency	**Obligations**
Western Bay of Plenty District Council (WBOPDC)	Resource Management Act, Local Government Act, District Plan, Long Term Council Community Plan, Iwi Management Plans, Hapu Management Plans
Ministry for Primary Industries (MPI)	Fisheries Regulations, sustainable fisheries
Department of Conservation (DOC)	Crown Reserves, wildlife protection
Maritime New Zealand	Maritime safety. Most functions at regional level carried out by BOPRC.

Matters in relation to water quality and wastewater/sewage are referred to in the Plan, and prescribes the following:

To protect the mauri of Te Awanui is an important obligation that tangata whenua aspire to uphold. Tangata whenua regard Te Awanui as a sacred entity in that it has its own mauri or life essence that plays an important role in its purity and life supporting qualities. Degradation of this taonga through drainage and pollution is a major resource management issue in Tauranga and is culturally unacceptable.

Traditionally, all waste is returned to Papatuanuku and passed through the land, as an act of purification. The water is the resource that provides us with food and spiritual resources. Therefore, ensuring that the mauri of the harbour and its tributaries are intact is paramount to the health of our physical and cultural well-being.

The dilution of pollution, before discharge to waterways, continues to be an inappropriate solution from the perspective of tangata whenua. The mixing of the life giving properties of water with that of waste "waikino ki waimaori" is offensive by the standards of tangata whenua.

Tauranga Maori identified that the following issues degrade the health and wellbeing, and adversely impact upon the mauri of the receiving environment or water quality of Te Awanui.

a. *The mixing of geothermal water with waste/storm water and then discharged*
b. *Discharge activities such as; stormwater, agricultural, horticultural, industrial, and sewerage.*
c. *Leachate from development and ponds resulting in soil and groundwater contamination.*

Tauranga Maori are consistent in advocating discharge to land, allowing Papatuanuku (through wetlands and riparian areas) the opportunity to filter and clean any impurities. However, the use of discharge to land must be accordingly managed with regard to the carrying capacity of the land to ensure that land and water are not at risk to contamination.

Waikino (dirty water) to waiora (healthy water) is considered detrimental to the health and wellbeing of all people and alters the mauri of the entire ecosystem. Tauranga Maori have and always will be consistent in their stance to object to waste to water.

9.0 Legislative Provisions

Te Tiriti o Waitangi 1840

There is a requirement of local and regional councils to give effect to the cultural, spiritual and historical association of the three Tauranga Moana Iwi by seeking guidance and direction for management and planning decisions for the harbour.

The principles of Protection, Participation and Partnership in particular are relevant in applying legislative provisions to this consent.

The principle of protection under the Treaty of Waitangi must clearly outline ways in which Mobil NZ Ltd may restore, improve and/or protect Maori interests and impacts by mitigating or remedying the receiving environment of Te Awanui.
For environmental and resource management planning, the Treaty is critical to the relationship and responsibility of Crown agencies with Iwi, Hapu and Whanau. The Treaty recognises the right of iwi, Hapu and whanau to the management of their environment generally, including land, fisheries, forests and estates and other properties, and taonga.

To take account of the principles of the Treaty of Waitangi, local and regional councils must recognise the role of Tangata Whenua as kaitiaki and provide for tangata whenua involvement in management of the coastal environment.

Those exercising functions and powers under the Resource Management Act shall take into account the principles of the Treaty of Waitangi and include these considerations and clearly outline ways they may restore, improve and/or protect Maori interests and the impact on their Tino Rangatiratanga and Kaitiakitanga.

Resource Management Act 1991 (RMA)
The purpose of the RMA is to promote the sustainable management of natural and physical resources. Sections 5, 6, 7 and 8 of the RMA 1991 are considered important to the implementation of the Matakana/Rangiwaea Hapu Management Plan in giving effect to matters of Kaitiakitanga and Tino Rangatiratanga.

10.0 Conclusion

Since confiscation, Matakana Island has served as a haven, as a space defined as Maori, for Maori. The Matakana Island community today wish to uphold their rangatiratanga and mana over the Island. The pipeline, as a structure that connects the mainland with the island is an unwanted connection. The Mauri of the ocean waters surrounding the outfall has been seriously compromised since the pipeline was built. Since consent was granted in 1997 WBOP District Council has not been forthcoming, and tangata whenua have not been privy to, any Ecological Reports, Annual Monitoring Reports and Shellfish Monitoring Reports on the effects of the ocean outfall of the Katikati Sewerage Pipeline.

Throughout the entire process from the first water right consent of 1977 the cultural values and opinions of tangata whenua have been totally ignored and we want to reiterate that as equal partners to the Treaty of Waitangi, Maori people should not have to continually defend their values, and the **"Maori view should not only be heard but it should be <u>taken heed of</u>".** Tangata whenua have always maintained their stance in their objection to the continued discharge of treated sewerage. The history and timeline of events has shown that the council has continuously and deliberately ignored the opinions and rights of tangata whenua in all aspects - complete lack of consultation, total disregard of cultural values, lack of regular and appropriate scientific and ecological tests surveys and reports, and lack of methodologies that balance the worldly view of Hapu who utilize these kai resources as part of their extended pataka kai (Food cupboard).

The tangata whenua of Matakana and Rangiwaea Islands are adamant that the Western Bay of Plenty District Council has had ample opportunity and warning (since 1996, and before that) to plan and budget for an alternative sewerage treatment scheme for Katikati. Our Hapu place cultural value as the essence for identity therefore the awareness by council and others for tangata whenua to have the ability to firstly be recognised and secondly to have input into all facets of discussions that relate to the continued discharge off Matakana Island.

We are appalled and extremely dismayed and frustrated that the Council has continued to delay and excuse itself of its responsibility to the community and tangata whenua of Matakana and Rangiwaea Islands.

11.0 Recommendations

The Matakana and Rangiwaea Islands – Hapu Management Plan 2012 explains clearly the process for communication in any environmental matter be they lands or waters, as we have regard that our unimpeded access from our land to our waters is tribal taonga. Our position as tangata whenua for Matakana and Rangiwaea recognises the ongoing implications of this discharge upon our pristine environment all the whanau who gather kai from the moana.

The recommendations sought by tangata whenua of Matakana and Rangiwaea include;

1. **All monitoring involve tangata whenua in the data collection.**
2. **That the council sought an alternative discharge point/sewerage scheme before 2035.**
3. **Acknowledgement by council to the communication framework within the Matakana and Rangiwaea Islands Hapu Management Plan.**
4. **To allow for more compliance testing and monitoring of Tuatua beds for the duration of the consent sought.**
5. **Resource Consents with regard to the continued discharge need to be more robust to align with international water quality standards.**
6. **That the council deliver a summary of the annual and quarterly monitoring in lamens terms for the general public and community to understand.**

12.0 Acknowledgements

We the tangata whenua of Matakana and Rangiwaea Islands have always considered ourselves as extremely fortunate to live on these islands. The relationship that tangata whenua and their environment have is synonymous to whakapapa which ultimately represents the inherent responsibility for exercising the fundamental principles of kaitiakitanga. It is with this in mind that we acknowledge our whanau who have contributed to the many discussions throughout the 36 years the pipeline has been in operation. We would particularly like to acknowledge those individual whanau for their effort into the creation of this document: Nessie Kuka, Jason Murray and Ngaraima Taingahue.

He mihi aroha ki a koutou mo nga korero me nga mahi hohonu o nga Tupuna o nga Hapu. No reira, tena koutou, tena koutou tena koutou katoa.

13.0 Glossary of Maori Words and Abbreviations

(Use as a guide only)

Maori	English
Hapu	Sub-tribe
Hau kainga	People of the area who reside there
Hoha	Wearied with expectation, anxious
Hui	Meeting
Hui a whanau	Family meeting
Hui kura	School meeting
Iwi	Main tribe
Kai	Food
Kaitiakitanga	Defined in the Resource Management Act 1991 as the exercise of guardianship by the Tangata whenua of an area in accordance with tikanga maori in relation to natural and physical resources; and includes the ethic of stewardship

Kia ora	Greetings, good health
Kapata kai	Food cupboard
Kaumatua	Elder male/female
Koha	Gift
Mahinga kai	Traditional food sources
Manaaki	Hospitality
Mana whenua	Defined in the Resource Management Act 1991 as customary authority exercised by an iwi or Hapu in an identified area
Manuhiri	Visitors
Marae	Community facility
Rahui	Protection/conservation/restriction
Rohe	Area
Taiao	District
Takutai moana	Sea coast
Tapu	Sacred
Tangihanga	Funeral
Tangata whenua	People of the land
Taonga	Treasure
Tauranga Waka	Landing place
Te Moana a Toi	Area identifying the eastern coastline
Te Runanga o Ngai Te Rangi Iwi	Council of the Tribe of Ngai Te Rangi
Tino rangatiratanga	Sovereignty
Tikanga	Maori customary values and practices
Tupuna	Ancestor
Turangawaewae	Place to stand
Waahi tapu	A place sacred to Maori in the traditional Spiritual, religious, ritual or mythological sense
Wahine	Women
Waiata	Song
Whakapapa	Family tree/lineage
Whaikorero	Oratory
Whakatauki	Proverb
Whanau	Family

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Environmental Effects of the Katikati Wastewater Outfall on the Receiving Environment

PREPARED BY CHRISTOPHER GIBBONS

For Opus International Consultants

Table of Contents

1. Introduction

1.1 Background

As part of re-consenting Western Bay of Plenty District Council's (Council) Katikati Wastewater Treatment Plant (WWTP) a marine ecological assessment of the receiving environment surrounding the outfall site has been undertaken.

The Katikati Wastewater Treatment Plant is a tertiary treatment facility consisting of aerated lagoons, constructed wetlands and ultraviolet disinfection. Treated wastewater discharges from the plant, through a pipeline extending approximately 650m offshore on the ocean side of Matakana Island into the Pacific Ocean at a water depth of approximately 24m.

Council hold a resource consent permit for the purpose of discharging treated wastewater from the plant into the Pacific Ocean. The current resource consent expires on 30 November 2016 and another consent is sought. The consent does not include any limits on the receiving environment other than for bacteria.

The effects of the discharge has been previously characterised by Kingett Mitchell (2006) for ecology, sediments and water quality.

This report has been prepared in two parts:

(i) Methods: field design to investigate the effects of the Katikati sewage outfall on the receiving environment

(ii) the field results and an assessment of the effects on the marine environment.

1.2 Environmental Characteristics

1.2.1 Bathymetry

The Katikati sewage outfall extends approximately 650 m out from the oceanside of Matakana Island (Fig 1.). It is located south of the Katikati entrance to Tauranga Harbour at a depth of 5 m below chart datum. The seabed surrounding the outfall is regarded as a shallow wave exposed shore that maintains a slight seawards slope consisting of fine sand (Bioresearches, 1996).

Figure 1. Map of New Zealand indicating the Katikati sewage outfall exit point.

1.2.2 Currents

Studies using dyes and drogues have found no tidal reversing, tide-related current or regular coastal current. Under calm conditions, currents have been observed to run parallel to the shore and have displayed minimal onshore and offshore movement except when influenced by wind (Bio-Researches Ltd 1977; Beca 1991). However, dye studies have documented a high degree of dispersal dilution as wastewater is transported away from the outfall (Bio-Researches Ltd 1977; Beca 1991).

2. Methods

The sampling survey was conducted over two and a half days on 24th – 26th November 2015 using Greenfield Diving Services vessel 'Lulu'. The shellfish samples were collected on 10th December 2015. Tides (at Tauranga) on the sampling days were:

Date	High tide	Low tide
24 /11/15	0603 (1.8m)	1206 (0.2m)
25/11/15	0702 (1.9m)	1305 (0.2m)
26/11/15	0758 (1.9m)	1401 (0.2m)
10/12/15	0717 (1.7m)	1313 (0.5m)

2.1 Study Protocol

The survey was designed with regard to the current resource consent conditions, the Waste Water Monitoring Guidelines (2002) and ANZECC Guidelines (2000). Additionally, sections of the survey have been replicated from Kingett Mitchell (2006) to compare and contrast temporal changes.

2.2 Study Area

Field sampling was undertaken around the vicinity of the outfall and on Matakana Island. This included sampling of the water column, benthic sediment and ecology (epifauna and infauna) and tuatua.

2.3 Benthic Study

2.3.1 Sample Sites

Sites sampled within the vicinity of the Katikati outfall are shown in Table 1 and were replicated from Kingett Mitchell (2006).

Table 1. Latitude and longitude of sites.

Point	South	East
NW130	37°32.237	176°03.784
NE140	37°32.440	176°04.200
SW130	37°32.328	176°03.748
SE140	37°32.433	176°03.892
W250	37°32.234	176°03.723
W100	37°32.290	176°03.847
W50	37°32.312	176°03.867
E50	37°32.356	176°03.908
E100	37°32.386	176°03.909
E250	37°32.478	176°03.945
Outfall	37°32.389	176°03.949
E1000	37°32.776	176°04.326
E4000	37°33.875	176°05.800

*Two additional sites were added at the request of Matakana Island hapu at W10 and E10.

2.3.2 Pre-Survey Procedure

2.3.2.1 Site Inspection

An inspection of each site was undertaken by SCUBA divers prior to sampling. This was to determine any obvious visible/identifiable effect on the benthic habitat (e.g. sediment blankets, discoloration, organic debris, bacterial mats etc) from the discharge. Photographic documentation and recording of any significant impact was required.

2.3.2.2 Randomisation within sites

At each site (e.g. E50) a 5 x 5 m^2 area was plotted. Each area was divided into 50 x 50 cm quadrates to form a 10 x 10 grid and a randomised sampling pattern was used. Epifauna and Infauna were sampled from the same quadrat for each replicate.

2.3.3 Physical Properties

Water samples and the measurement of physical properties were taken at sea. Water samples were collected from a depth of 1 m using a Van Dorn water sampler and stored on ice and in the dark whilst at sea. Samples were analysed for the following:

Biological:

- Enterococci
- Faecal coliform bacteria

Nutrients:

- Total Nitrogen
- Total Phosphorus

Electrical:

- Electrical conductivity

The following properties were measured from surface waters using a YSI 6050 Professional Plus Multiparameter.

- Temperature (^oC)
- Salinity (PPT)
- pH

Surface waters were assessed for floatables by the application of Table 2 (MfE, 2002).

Table 2. Scales used for assessment of the conspicuousness of visual effects (MfE 2002).

Rank	Description
0	Visual effect absent
1	Effect visible only when observed closely from a stationary position.
2	Effect visible to a passer-by or casual observer but effect not grossly visible.
3	Effect grossly visible or 'eye-catching' to a passer-by or casual observer

2.3.4 Seabed Characteristics

2.3.4.1 Sediment Sampling

Sediment samples were collected by SCUBA divers using plastic corers. Each core had a depth of 90 mm and a surface area of 600 mm^2. A series of five cores were taken from each quadrat to form one composite sample. A total of 15 cores were taken from each site to form 3 composite samples.

2.3.4.2 Sediment texture

Each composite sample was wet sieved through a gradation process (>2 mm; <2 mm - >0.063 mm; <0.63 mm) separating sediment size and texture and remain separate.

2.3.4.3 Sediment Chemical Analysis

Sediment samples collected for chemical analysis were analysed for the following:

Nutrients:

- Total Organic Carbon
- Nitrogen
- Phosphorous

Heavy Metals:

- Arsenic
- Cadmium
- Chromium
- Cooper
- Mercury
- Nickel
- Lead
- Zinc
- Aluminium

2.3.5 Benthic Ecology

2.3.5.1 Sampling of Epifauna

Epifauna were collected by SCUBA divers by hand. A total of 3 quadrats were sampled at each site, with all epifauna within the quadrat collected and retained in 100% isopropanol. Organisms collected were identified to the lowest possible taxonomic level and counted.

2.3.5.2 Sampling of Infauna

Infauna samples were collected by SCUBA divers using 13 cm diameter cores to a depth of 13 cm. Three quadrats were sampled within each area. Sample cores collected for biological assessment were sieved through a gradation process under running seawater onboard the vessel, preserved in 100% isopropanol and identified to the lowest possible taxonomic level, and counted.

2.4. Shellfish Study

2.4.1 Sampling of Tuatua

Tuatua were sampled below the sub-tidal at a depth of 1 m. Sample sites were located at 100, 200, 400, 800 and 1600 m east and west of the outfall with tuatua collected by hand from each site. They were then stored on ice and sent to the laboratory to be analysed for the following:

Biological:

- Entercocci
- Faecal coliform bacteria

Heavy Metals:

- Arsenic
- Cadmium
- Chromium
- Cooper
- Mercury
- Nickel
- Lead
- Zinc
- Aluminium

2.5 Statistical Analysis

Univariate analysis of variance (ANOVA) was used to test for differences between impact and control sites for sediment texture, size, chemistry, species richness, total abundance and the Shannon Weiner diversity and evenness Index (1/d). Post hoc Tukey tests were performed for further investigation into differences.

3. Wastewater Characteristics

Table 3. Summary of wastewater effluent results from the Katikati wastewater treatment plant from January 2014 – June 2015.

Limit	3000	36	500	1000	300	55
Date	**Max. Flow m^3/day**	**Instant l/s**	**Faecal Coliforms Median / 100ml**	**Faecal Coliforms Max / 100ml**	**Enercocci Max / 100ml**	**Total Nitrogen median of 4 or 5 samples kg/d**
Jan-14	1108	17.6	1560	3800	270	36.95
Feb-14	2397	16.8	185	390	76	43.07
Mar-14	2637	20.8	208	330	330	47.97
Apr-14	1411	29.7	168	680	670	34.62
May-14	806	31.6	259	510	180	22.18
Jun-14	2194	48.2	646	12400	770	47.35
Jul-14	1484	18.2	4	4800	1100	35.17
Aug-14	1257	21.8	1139	3400	750	31.16
Sep-14	1663	16.7	140	170	76	25.97
Oct-14	1034	21.7	252	500	320	28.75
Nov-14	968	18.7	4	4	4	44.90
Dec-14	1779	19.9	270	2300	3700	61.92
Jan-15			26	48	24	52.6
Feb-15			4	52	4	42
Mar-15			4	4	4	41.8
Apr-15			16	16	20	40.4
May-15			4	4	48	18.900
Jun-15			93	360	24	35.300

Heavy metals (2010 to 2015). All units are shown in g/m^3:

Arsenic: <0.005 to 0.023

Chromium <0.001 to 0.002

Mercury: <0.001

Lead: <0.001 to <0.002

Cadmium: <0.001 to <0.002

Copper: <0.001 to 0.007

Nickel: <0.001 to 0.006

Zinc: <0.005 to 0.023

4. Results and Discussion

4.1 Physical Characteristics and Visual Rank

Measurements of temperature, salinity and pH and a visual rank of each site are shown in Table 4. Water temperature varied between sites from a low of 16.7°C at NW130 to a high of 18°C at E1000. Salinity fluctuated from a low of 34.45ppt at E4000 to a maximum of 34.99ppt at W50. pH was recorded to be lowest at E1000 (7.6) and highest at both W10 and the outfall site (8.1).

A visual assessment of conspicuous effects documented a rank of 0 across all sites rendering any visual effect to be absent. The visual rank is based on Table 2 were the absence of a visual effect is given a 0 and something grossly visible a 3.

Table 4. Physical characteristics and visual assessment of conspicuous effects from all sites (n=1).

Site	Temp (°C)	Salinity (ppt)	pH	Rank
NW130	16.7	34.64	7.64	0
NE140	17.2	34.97	7.8	0
SW140	17	34.75	7.92	0
SE140	17.3	34.88	7.91	0
W250	16.8	34.79	7.9	0
W100	16.9	34.85	7.85	0
W50	16.9	34.99	7.76	0
W10	17.2	34.88	8.1	0
E10	17.3	34.71	7.95	0
E50	17	34.62	7.8	0
E100	17.2	34.76	7.89	0
E250	17.5	34.81	8.06	0
Outfall	17	34.89	8.1	0
E1000	18	34.82	7.6	0
E4000	17.7	34.45	7.75	0

4.2 Water Quality Parameters

Measurements of water quality parameters for each site are shown in Table 5. Electrical conductivity (EC) varied between sites from a low of 5300 mS/m at sites SW140, W250, W100, W50, and E50 compared to a high of 5400 mS/m at E10. Total Nitrogen including Nitrate, Nitrite and TKN was reported to be <0.3 g/m^3 across all sites. Additionally, Phosphorus levels were no higher than 0.048 g/m^3 from E50. Faecal coliforms were recorded to be < 1 cfu per 100ml across all sites whilst a maximum Enterococci measurement of 134 MPN / 100 ml was reported from W10.

Table 5. Water quality parameters from sites located near the sewage outfall (TN = Total Nitrogen, TKN = Total Kjeldahl Nitrogen, TP = Total Phosphorus) (n = 1).

Site	Electrical Conductivity (mS/m)	TN (g/m^3)	Nitrate-N + Nitrite-N (g/m^3)	TKN (g/m^3)	TP (g/m^3)	Faecal Coliforms (cfu / 100 ml)	Enterococci (MPN / 100 ml)
NW130	5,390[1]	< 0.3[1]	0.0177[1]	< 0.2[1]	0.012[1]	< 1[1]	10[1]
NE140	5,370[2]	< 0.3[2]	0.0067[2]	< 0.2[2]	0.01[2]	< 1[2]	< 10[2]
SW140	5,300	< 0.3	0.02	< 0.2	0.015	< 1	< 10
SE140	5,360[2]	< 0.3[2]	0.0062[2]	< 0.2[2]	0.011[2]	< 1[2]	< 10[2]
W250	5,300	< 0.3	0.027	< 0.2	0.017	< 1	< 10
W100	5,300	< 0.3	0.025	< 0.2	0.014	< 1	< 10
W50	5,300	< 0.3	0.029	< 0.2	0.014	< 1	< 10
W10	5,390[1]	0.2[1]	0.0149[1]	0.2[1]	0.012[1]	< 1[1]	134[1]
E10	5,400[1]	0.3[1]	0.0144[1]	0.2[1]	0.012[1]	< 1[1]	31[1]
E50	5,300	0.3	0.026	0.2	0.048	< 1	< 10
E100	5,390[2]	< 0.3[2]	0.0068[2]	< 0.2[2]	0.01[2]	< 1[2]	< 10[2]
E250	5,380[2]	< 0.3[2]	0.0028[2]	< 0.2[2]	0.008[2]	< 1[2]	< 10[2]
Outfall	5,390[1]	0.2[1]	0.02[1]	< 0.2[1]	0.023[1]	< 1[1]	10[1]
E1000	5,380[1]	< 0.3[1]	0.0033[1]	< 0.2[1]	0.012[1]	< 1[1]	10[1]
E4000	5,340[2]	< 0.3[2]	0.0196[2]	< 0.2[2]	0.013[2]	< 1[2]	< 10[2]

[1]Samples analysed at 48 hours not 24
[2]Samples analysed after 24 hours

Treated wastewater is estimated to vary in temperature from 10 – 21°C (NZWERF, 2002). The temperature of seawater in the Bay of Plenty region has been reported to vary from 13°C - 23°C between summer and winter (Paul, 1968). The temperature of seawater reported in this study (16.7°C - 18°C) is well within both ranges stipulated. A variation of 1.3°C is likely due to sampling occurring between the hours of 0830 - 1530 and reflects a natural temperature variation.

Seawater salinity varied from 34.45 – 34.99ppt and is within an expected range of 34 – 35 ppt reported in ANZECC (2002). Additionally, EC measurements were reported to vary from 5300 – 5400 mS/m across all sites compared with freshwater systems typically retaining less than 10 mS/m (ANZECC, 2002).

Marion *et al.* (2012) report the pH of seawater to be between 8.08 – 8.3 and ANZECC (2002) suggest the pH of marine water should not be lower than 8.2 based on Australian data. The pH of all sites in this study varied from 7.6 – 8.1, however there are no clear recommendations for the pH of seawater in New Zealand conditions. The lower levels of pH reported in this study are suggested to be due to the respiration of animals within the sediment (Chris Cornwall 2016; pers. comm. Feb 27)

A visual assessment of surface waters at each site documented no effect of the discharge on surface level waters.

The current resource consent sets compliance limits for bacteria as follows:

Condition 8.3: Samples taken at 100m and 200m from the outfall structure off Matakana Island shall meet the shellfish gathering water quality standard as specific in the 'Provisional Microbiological water quality guidelines for Recreational and Shellfish-gathering water in New Zealand' (January 1992, Public Health Services Department of Health Wellington).

Condition 8.4: Samples taken at 50m shall meet the contact recreation standard as specified 'Provisional Microbiological water quality guidelines for Recreational and Shellfish-gathering water in New Zealand' (January 1992, Public Health Services Department of Health Wellington).

Indirectly, the two conditions have set a mixing zone of 100m and 50m.

Monitoring of bacteria levels in the water has been undertaken quarterly since 2007.

Enterococci counts were highest at W10 (134 MPN) and E10 (31 MPN) whilst all remaining sites were < 10. Consequently, W10 exceeded the primary contact (swimming, bathing) rate of 35 MPN/ 100 ml (maximum number in any one sample: 60-100 MPN/100 ml) (ANZEEC, 2002). It is possible that the higher count at W10 came from the outfall. However, as water samples were analysed after 24 and 48 hours from when they were collected, this reading should be treated with caution. Consequently, it should be treat as being worst case, as the levels would have been lower. Faecal coliform samples were all < 1 cfu per 100 ml and less than the primary contact rate (< 150 FC /100 ml) (ANZECC, 2002).

Over the period February 2007 to November 2015 the results show:

	Faecal coliforms	Enterococci
Total number of samples (down current)	990	990
Median	<4	<4
Total <4	854	811
>43	29	26
>140	1	6

When comparing the results with the Proposed Regional Coastal Environment Plan microbiological standard, only 4 samples have exceeded 280 cfu/100ml. Those samples were:

Location	Sample No.	Date	Sample result
200m up current of the outfall structure	10	Feb-11	340
50m down current of the outfall structure	20	Feb-11	340
100m down current of the outfall structure	28	Feb-13	450

Concentrations of Nitrogen were < 0.3 g/m^3 (300 μg N L^{-1}) whilst Phosphorus < 0.048 g/m^3 (48 μg P L^{-1}) across all sites and are of respectable levels. Currently, there are no trigger values for Nitrogen or Phosphorus in New Zealand marine conditions.

3.3 Sediment Characteristics

3.3.1 Grain Size

The mud, sand and gravel textural data obtained from the sediment samples for all sites are shown in Table 6. Statistical analysis of the site data (each site had 3 composite samples) was undertaken to see whether any sites differed in their physical characteristics from other sites.

Matakana Island is formed from sandy coastal sediments that are both Pleistocene and Holocene based with tephra deposits (Shepherd *et al.* 1996). Consequently sand (< 2 mm - > 0.063 mm) dominated the composition of samples across all sites. The composition of sand varied from 94% at the control site E4000 to 98% at E250. Therefore on average over 95% of the material was sand. This is the same result as the 2006 survey. Mud (< 0.063 mm) comprised 1.9% - 2.4% of all samples. There are some differences between sites and E4000 in relation to sand and gravel. Gravel (> 2 mm) contained a minimum of < 0.1% to a maximum of 3.87% across all sites.

Table 6. Sediment grain size fractions for all sites (n=3). Values are means ± 1 SE.

Site	**Gravel** =/> 2 mm (g/100g dry wt)	**Sand** < 2 mm, =/> 63 µm (g/100g dry wt)	**Mud** < 63 µm (g/100g dry wt)
NW130	< 0.1 ± NA	97.57 ± 0.09	2.27 ± 0.03
NE140	1.27 ± 0.57	96.43 ± 0.62	2.3 ± 0.06
SW130	< 0.1 ± NA	97.87 ± 0.09	2.1 ± 0.12
SE140	< 0.1 ± NA	97.8 ± 0.1	2.17 ± 0.12
W250	< 0.1 ± NA	97.87 ± 0.07	2.03 ± 0.07
W100	< 0.1 ± NA	97.57 ± 0.03	2.37 ± 0.07
W50	0.35 ± 0.04	97.53 ± 0.07	2.3 ± 0.15
W10	0.5 ± 0.25	97.5 ± 0.26	2.17 ± 0.09
E10	0.87 ± 0.07	96.83 ± 0.22	2.3 ± 0.15
E50	0.23 ± 0.13	97.47 ± 0.17	2.4 ± 0.15
E100	< 0.1 ± NA	97.9 ± 0.01	2.07 ± 0.03
E250	0.27 ± 0.17	97.97 ± 0.19	1.73 ± 0.03
Outfall	< 0.1 ± NA	97.73 ± 0.09	2.17 ± 0.09
E1000	< 0.1 ± NA	97.60 ± 0.06	2.37 ± 0.03
E4000	3.87 ± 1.39	94.23 ± 1.07	1.9 ± 0.42

3.3.1 Organic materials

Sediment samples collected were examined for nutrients (organic material) and trace elements. This section considers Total Organic Carbon (TOC), Total Nitrogen (TN) and Total Phosphorus (TP) within the sediments. Organic sediment contents for all sites are shown in Table 7.

TOC concentrations in the sediment were low with all samples < 0.13 g/100g. This is typical of sandy coastal sediments. Concentrations of TN in sediments around the outfall were low with < 0.05 g/100g recorded in all samples including the control sites (E1000 and E4000). Identical results were reported in 2006.

Total Phosphorus measured in all samples ranged from 132 to 181 mg/kg. A range of 139-183 mg/kg was reported in 2006. These are low levels when compared to some coastal sediments. TP was lowest from the primary control site of E4000 (139.67 mg/kg) and highest at site E250 (171.67 mg/kg). An analysis of variance (ANOVA) yielded significant variation among sites for phosphorus ($F = 2.369$, $P = 0.023$). A further post hoc Tukey test revealed significant differences between the primary control of E4000 and NW130, Outfall, SE140, SW130, W10, W50, W100, W250, E10, E50, E100, E1000. Lower levels of phosphorus between E4000 and outfall sites are thought to be geochemical in origin rather than originating from the discharge (Kingett Mitchell 2006). Additionally, there are no nutrient guidelines developed by ANZECC (2002) for low and high trigger values of TOC, TN and Phosphorus in New Zealand conditions.

Table 7. Sediment organic material characteristics from all sites (TP = Total Phosphorus, TN = Total Nitrogen, TOC = Total Organic Carbon) (n = 3); Values are means ± 1 SE.

Site	TP (mg/kg dry wt)	TN (g/100g dry wt)	TOC (g/100g dry wt)
NW130	158 ± 6.43	<0.05	< 0.13
NE140	154.33 ± 4.91	<0.05	< 0.13
SW130	161.33 ± 5.78	<0.05	< 0.13
SE140	157.67 ± 1.86	<0.05	0.12
W250	159 ± 1.73	<0.05	< 0.13
W100	164 ± 6.56	<0.05	< 0.13
W50	157 ± 4.73	<0.05	< 0.13
W10	158 ± 0.58	<0.05	< 0.13
E10	158 ± 6.03	<0.05	< 0.13
E50	161.33 ± 5.24	<0.05	0.13
E100	169.67 ± 2.4	<0.05	< 0.13
E250	171.67 ± 5.49	<0.05	< 0.13
Outfall	150.33 ± 9.28	<0.05	0.13
E1000	154.67 ± 2.03	<0.05	< 0.13
E4000	139.67 ± 1.2	<0.05	< 0.13

3.3.2 Inorganic Materials

Heavy metal contaminants in soils at concentrations below 100 mg/kg are typically referred to as trace metals (BOP Regional Council, 2011). Trace metals accumulate in soils either naturally through the weathering of minerals contained in their parent materials or become introduced into the natural environment through anthropogenic means. Anthropogenic metals are bound to sediments by particle surface absorption, ion exchange, co precipitation and complexion with organic matter. Cu, Zn, Pb, and Cd are the most environmentally concerning elements that have been reported to cause contamination of soil, water and food chains. All trace elements tested for in this study were similar in levels to that as reported in Kingett Mitchell (2006) and were also below the interim sediment quality guidelines (ISQG) (ANZECC, 2006). The ISQG-Low value is the level below which adverse effects are very unlikely (low likelihood of toxic effects). As such, it is not a level that is cause for concern but simply the trigger point indicating the need for further investigation. The ISQG-High value is a level at which adverse effects are expected in half of the exposed organisms. Concentrations above the ISQG-High value are interpreted as being reasonably likely to cause significant adverse effects on aquatic organisms (high likelihood of toxic effects). Between the ISQG-Low and ISQG-High values the effects of trace elements and organic compounds are unknown. Therefore they are thought to pose a moderate level of risk to sediment-dwelling organisms (moderate likelihood of toxic effects).

Concentrations of arsenic, chromium, nickel and lead were lower at E4000 than a number of outfall sites. Kingett Mitchell (2006) report lower levels of arsenic, copper, chromium, nickel and zinc at their control site compared with outfall sites. They suggest differences are largely as a result of natural variation in the geology of the area rather than accumulation of trace metals due to the WWTP. Differences in levels of trace metals between E4000 and outfall sites in this study may also be due to a similar effect. However, It is difficult to determine the natural baseline levels of trace metals in sediments and the additional enrichment caused by anthropogenic effects. This is, as baseline levels will depend on the concentration of trace metals in the soil and rocks within the surrounding area. Currently, there is a lack of data on the baseline concentrations of many trace metals within New Zealand sediments. Therefore differences between the levels of trace metals in sediments may not be as a result of human activity but rather a result of natural processes. The levels of trace elements in the sediments show little evidence of accumulation as a result of any discharge from the outfall. Analysis of the treated wastewater shows that it has a low concentration of most metal contaminants. Although there is a limited number of sediment surveys, mean concentrations are below the ISQG low trigger values.

Table 8. Sediment inorganic material characteristics from all sites. (As) Arsenic, (Cd), Cadmium, (Cr) Chromium, (Cu) Copper, (Pb) Lead, (Hg) Mercury, (Ni) Nickel, (Zn) Zinc, (Al) Aluminium (n=3). Values are means ± 1 SE.

Site	As (mg/kg dry wt)	Cd (mg/kg dry wt)	Cr (mg/kg dry wt)	Cu (mg/kg dry wt)	Pb (mg/kg dry wt)	Hg (mg/kg dry wt)	Ni (mg/kg dry wt)	Zn (mg/kg dry wt)	Al (mg/kg dry wt)
NW130	4.77 ± 0.09	< 0.01	6.37 ± 0.12	0.6 ± 0	2.6 ± 0.06	0.01	1.67 ± 0.03	12.33 ± 0.38	4400.00 ± 152.75
NE140	4.47 ± 0.03	< 0.01	6.10 ± 0.06	0.7 ± 0	2.57 ± 0.03	< 0.01	1.67 ± 0.03	13.70 ± 0.15	4233.33 ± 145.3
SW130	4.83 ± 0.12	< 0.01	6.60 ± 0.06	0.53 ± 0.03	2.57 ± 0.03	< 0.01	1.53 ± 0.03	11.40 ± 0.1	4366.67 ± 33.3
SE140	4.80 ± 0.06	< 0.01	6.70 ± 0	0.6 ± 0	2.83 ± 0.03	0.01	1.73 ± 0.03	12.97 ± 0.09	4533.33 ± 33.3
W250	4.53 ± 0.13	< 0.01	6.57 ± 0.12	0.57 ± 0.03	2.43 ± 0.03	< 0.01	1.67 ± 0.03	11.93 ± 0.19	4566.67 ± 88.19
W100	4.97 ± 0.12	< 0.01	6.53 ± 0.03	0.73 ± 0.07	2.7 ± 0	< 0.01	1.7 ± 0	12.80 ± 0.06	4666.67 ± 88.19
W50	4.77 ± 0.12	< 0.01	6.50 ± 0.15	0.63 ± 0.03	2.67 ± 0.03	0.01	1.77 ± 0.03	13.27 ± 0.35	4800.00 ± 173.21
W10	4.37 ± 0.12	< 0.01	6.47 ± 0.12	0.67 ± 0.03	2.67 ± 0.07	< 0.01	1.77 ± 0.03	13.27 ± 0.24	4600.00 ± 208.17
E10	4.43 ± 0.03	< 0.01	6.43 ± 0.07	0.6 ± 0	2.53 ± 0.09	0.02	1.73 ± 0.03	12.90 ± 0.23	4466.67 ± 120.19
E50	4.90 ± 0	< 0.01	6.63 ± 0.03	0.6 ± 0	2.70 ± 0	0.02	1.7 ± 0	12.63 ± 0.09	4700.00 ± 208.17
E100	4.80 ± 0.06	< 0.01	6.70 ± 0.06	0.6 ± 0	2.77 ± 0.03	< 0.01	1.7 ± 0	13.07 ± 0.07	4733.33 ± 88.19
E250	5.33 ± 0.03	< 0.01	6.50 ± 0.06	0.6 ± 0	2.7 ± 0.06	< 0.01	1.6 ± 0	12.13 ± 0.17	4466.67 ± 145.3
Outfall	4.57 ± 0.07	< 0.01	6.70 ± 0.15	0.57 ± 0.03	2.53 ± 0.03	< 0.01	1.7 ± 0.06	12.43 ± 0.38	4500.00 ± 230.94
E1000	4.50 ± 0	< 0.01	6.47 ± 0.09	0.63 ± 0.03	2.63 ± 0.07	< 0.01	1.77 ± 0.07	13.33 ± 0.22	4500.00 ± 57.74
E4000	4.57 ± 0.27	< 0.01	5.43 ± 0.47	0.57 ± 0.12	2.50 ± 0.17	< 0.01	1.47 ± 0.12	14.13 ± 1.73	3033.33 ± 352.77
ISQG-Low	20	1.5	80	65	50	0.15	21	200	
ISQG-High	70	10	370	270	220	1	52	410	

3.4 Benthic Ecology

The first investigation of benthic biota around the outfall was undertaken in 2006. There are however a number of biological surveys undertaken around New Zealand at other ocean outfalls and a number in Tauranga Harbour. The 2006 study showed that there were no significant effects on benthic fauna in relation to the discharge and that the detected changes were generally along a west to east gradient rather than in the vicinity of the outfall discharge.

A summary of species richness, abundance and diversity at the sites is presented below. The count data for the samples is in Appendix 2.

Total species richness and species richness for each phylum of Annelids, Crustaceans, Mollusca, Echinoderms and other phyla are show in Figure 2. Mean total species richness was greatest at the secondary control site of E1000 (10.6) and lowest at SE140 and NW130 (5). An ANOVA revealed no significant differences between sites for mean total species richness (F = 1.434, P = 0.2). Annelids varied in mean species richness from 2 – 4.3 per site but there was no significant difference between sites (F = 1.411, P = 0.21). Crustaceans varied from 2 – 5 in mean species richness across all sites. An ANOVA revealed no significant difference between sites for mean crustacean species (F = 1.729, P = 0.104). Mollusca varied from a mean of 0 – 1.6 species richness across all sites with no significant difference between sites for mean Mollusca species richness (F = 1.348, P = 0.24). Echinoderms averaged 0 – 0.33 mean species richness across sites. An ANOVA revealed no significant difference across sites (F = 0.942, P = 0.53). Other species recorded 0 – 0.33 mean species richness across sites. An ANOVA revealed no significant differences between sites (F = 0.834, P = 0.63).

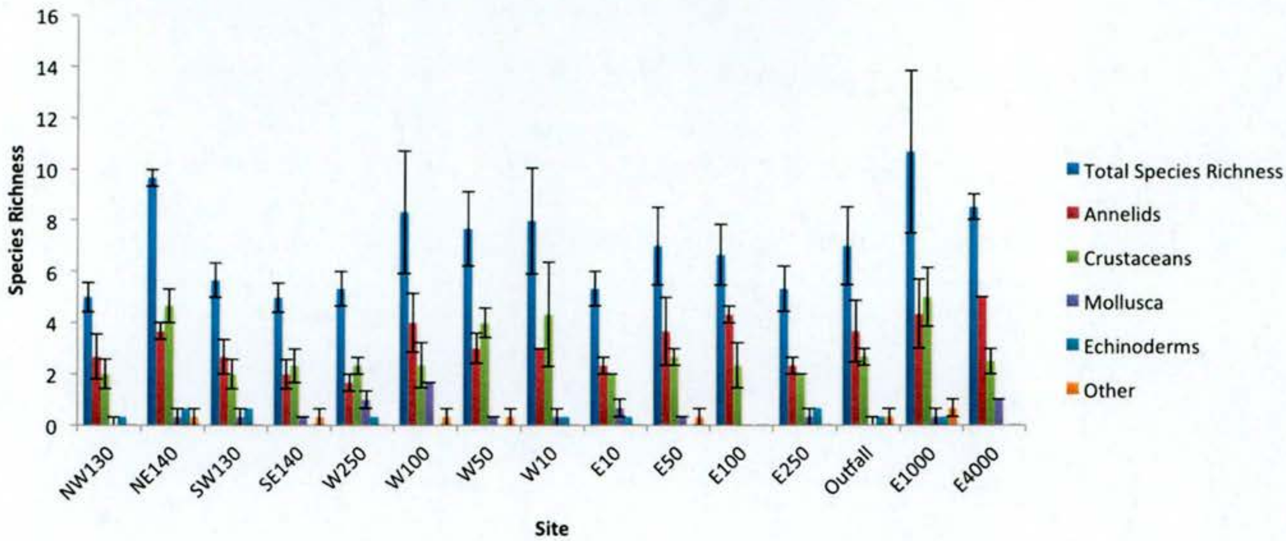

Figure 2. Mean total Species richness and mean species richness for the phyla of Annelids, Crustaceans, Mollusca, Echinoderms and other phyla (n = 3 for all sites except E4000 (n = 2)); Values are means ± 1 SE.

Species Abundance

Mean total abundance (Figure 3) varied from a low of 8 individuals at W250 to a high of 47.7 at NE140. There was no significant difference between sites (F = 1.97, P = 0.06). Mean abundance of Annelids was lowest at E250 (5) and highest at the outfall (22.7). An ANOVA revealed a significant difference among sites (F = 2.211, P = 0.035) however a post hoc Tukey test revealed no significant difference between the controls and test sites.

Crustaceans varied in mean abundance from 2 at W250 to 13 at NE140 with a significant difference between sites (F = 4.641, P < 0.001). A post hoc Tukey test revealed a significant difference between E4000 and NE140 (P = 0.002).

Mean Mollusca abundance varied from 0 at a number of sites to a high of 5.5 at E4000 but there was no significant difference between sites (F = 1.673, P = 0.118). Mean Echinoderm abundance varied from 0 – 6.66 and an ANOVA revealed no significant differences among sites (F = 1.213, P = 0.318). The mean abundance of other phyla varied from 0 – 0.7 with no significant difference between sites (F = 0.834, P = 0.63).

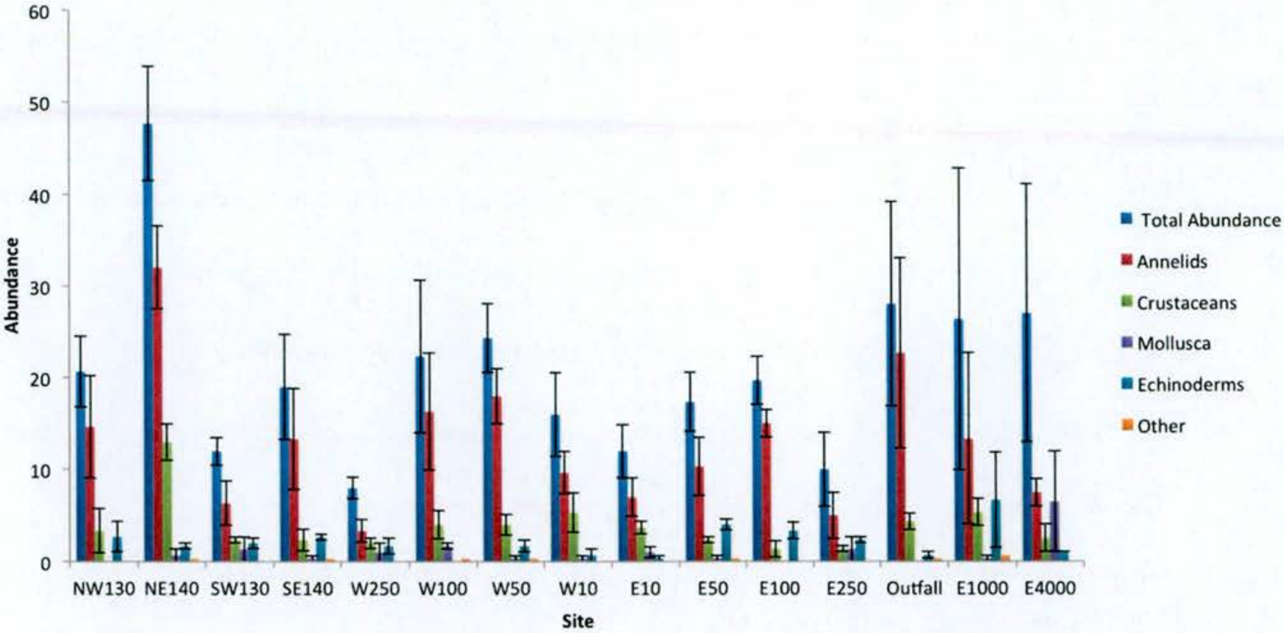

Figure 3. Mean abundance of all individuals and mean abundance for the phyla of Annelids, Crustaceans, Mollusca, Echinoderms and other phyla; n = 3 for all sites except E4000 (n = 2)); Values are means ± 1 SE.

Diversity

The Shannon Wiener Diversity index varied from 1.2 at NW130 to a high of 2 at E1000. An ANOVA revealed significant differences among sites (F = 2.303, P = 0.028). A post hoc Tukey test revealed a significant difference between the secondary control site of E1000 and SE140 (P = 0.023) and NW130 (P = 0.03).

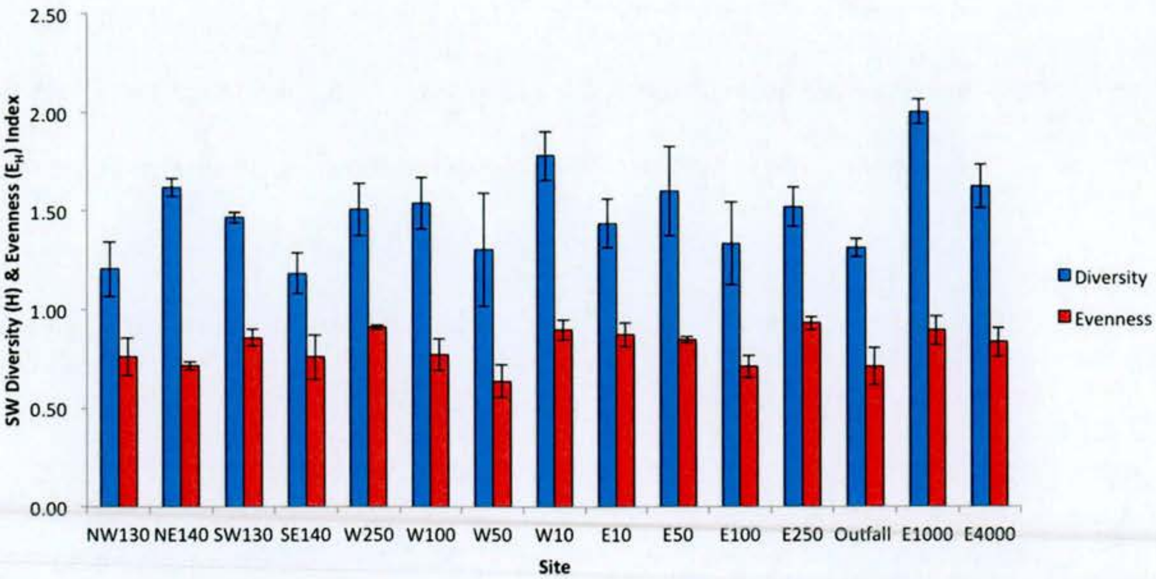

Figure 4. Mean Shannon Wiener Diversity and Evenness index for all sites (n = 3 for all sites except E4000 (n = 2)); Values are means ± 1 SE.

Species Evenness varied from 0.64 at W50 to 0.93 at E250 with no significant difference between sites (F = 1.757, P = 0.0973).

The composition of species across all sites was largely similar as no significant differences were observed. Additionally, there were no differences between the control and test sites.

Mean species richness varied from 5 - 10.7 species per site compared with the 2006 study (Kingett Mitchell) that reported species richness from 11 – 19 species per site. Species richness per phyla was also less in this study when compared to 2006.

Table 10. Comparison of species richness between the 2006 and 2015 surveys. Note the 2015 survey had 3 additional sites.

Phyla	**2006**	**2015**
Annelids	1.6 – 5	6 -8.5
Crustaceans	2 – 4.6	5 – 10
Mollusca	0 – 1.6	2 – 4
Echinoderms	0 – 0.33	0 - 1

Abundance was also lower in this study as it varied from 8 – 47.7. This compared with 70 – 207 individual organisms from 2006. Additionally, the abundance of individuals per phyla was also lower in this study. It is possible that differences in the numbers of species and abundance between this study and Kingett Mitchell (2006) are due to physical disturbance of the benthic environment. The area sampled off Matakana Island is shallow (< 6 m) and exposed to large predictable and unpredicatable fluctuations in environmental variables such as high energy swells and rough wind swells. Processes such as these are regarded to prevent communities from developing to persistant stable states. Turner *et al.* (1995) reveals the community structure of 2 from 6 sites to be influenced by wind generated wave activity. For example, small surface living fauna are likely to be buried or washed away by the action of the turbulent water. Dernie *et al.* (2003) investigated the recovery rate of a faunal community to different intensities. When sediment was removed to a depth of 10 cm recovery of the faunal component occurred within 64 days of the disturbance. However, when sediment was removed to 20 cm depth, recovery was not complete until after 107 days but had occurred within 208 days of the disturbance. Consequently, a physical disturbance to the area offshore of Matakana Island prior to sampling taking place may explain low numbers of species richness and abundance in this study. Additionally, depending on the date of the disturbance and the time sampling took place, the community may not have fully recovered to the levels reported by Kingett Mitchell (2006).

The SW diversity index showed significant differences between E1000 and SE140 and NW130 however there were no differences between evenness. Despite the differences between the 2006 and 2015 surveys, a low diversity is expected from open coastal environments as exposure to high energy environments results in higher rates of disturbance and turn over (Morton Miller 1968) and also as sediment grain size characteristics can greatly influence the ecological community present (NZWRF, 2002).

The top ten most abundant species from the control and outfall sites are shown in Table 11. The polychaete *Prionospio* sp. dominated the composition across outfall sites, contributing 49.42% and 381 individual specimens. However, the same species contributes only 3.7% and 2 individuals towards total abundance of E4000. *Fellaster zelandiae* (38.89%) and *Austrofusus glans* (22.22%) dominated the composition of E4000 respectively. However, of these two species, only *Fellaster zealandiae* (7.78%) was reported within the top ten of species most abundant from outfall sites. *Prionospio* sp. are the dominant species amongst outfall (57.86%) and control (62.55%) sites from the 2006 survey.

Table 11. Abundance and percentage of total abundance of the ten most abundant species for the control and outfall sites (n = 3 for outfall sites; n = 2 for control sites).

Location	Species	Abundance	% Total Abundance
Outfall	Polychaeta - *Prionospio* sp.	381	49.42
	Polychaeta - *Magelona dakini*	85	11.02
	Asteroidea - *Fellaster zelandiae*	60	7.78
	Amphipoda - *Haustoridae*	38	4.93
	Ostracoda - *Diasterope grisea*	34	4.41
	Amphipoda - *Phoxocephalidae*	29	3.76
	Polychaeta - *Sigalionidae*	18	2.33
	Bivalvia - *Myllitella vivens vivens*	14	1.82
	Crustacea - *Nebalia* sp.	10	1.30
	Polychaeta - *Cirratulidae*	8	1.04
E4000 (Control)	Asteroidea - *Fellaster zelandiae*	21	38.89
	Gastropoda - *Austrofusus glans*	12	22.22
	Polychaeta - *Magelona dakini*	7	12.96
	Decapoda - *Pagurus sp.*	3	5.56
	Polychaeta - *Sigalionidae*	2	3.70
	Polychaeta - *Glyceridae*	2	3.70
	Polychaeta - *Prionospio* sp.	2	3.70
	Polychaeta - *Cirratulidae*	2	3.70
	Ostracoda - *Diasterope grisea*	1	1.80
	Cumacea - *Cumacea* sp.	1	1.80

3.5 SHELLFISH

Shellfish bacteria and trace element analysis for all sites is shown in Table 13. Levels of faecal coliform were all < 18 MPN/100 g and Enterococci were all less then < 10 g across all sample sites. The standard used for shellfish quality for consumption is based on the 'Ministry of Health Microbiological Reference Criteria for Food' (1995). This standard is listed in the 13th schedule of the Operative Regional Coastal Environment Plan. To comply with the standard faecal coliform levels in flesh should be less than 330 MPN/100 g, and levels from 230 to 330 MPN/100 g are marginally acceptable. All samples were well below detection levels for faecal coliform.

There are no formal bacteria limits for shellfish gathered for non-commercial purposes in New Zealand or Australia. Historically the Ministry of Health (1995) criteria for faecal coliform bacteria in shellfish have been applied. These state that concentrations of up to 230 MNP/100 g are acceptable with up to two samples from the same site allowed to exceed this level and no sample to exceed 330 MPN/100 g. The criteria are based on five samples so some caution should be applied in comparing the results of the current limited investigation as there has not been the sample replication. For this, and other reasons, Council have proposed continuing the shellfish monitoring.

Shellfish feed by filtering particles out of the water and can accumulate contaminants which can have a direct impact on our health if we eat shellfish that have high heavy metal concentrations.

Table 12. Shellfish metal levels and maximum allowable levels of metal contaminants in food (Food Standards Australia and New Zealand FSANZ, 2012)

	Range mg/kg	**FSANZ**
Aluminium	23-220	-
Arsenic	1.55-2.7	1[a]
Cadmium	0.05-0.36	2
Chromium	0.11-0.36	-
Copper	0.77-3	30[b]
Lead	0.024-0.1	2
Mercury	<0.01-0.025	0.5
Nickel	0.13-0.23	-
Zinc	8.3-18.6	290[b]

a) This is for inorganic arsenic. Organic arsenic is estimated to be 10% of total arsenic. Most studies measure total arsenic levels as it is difficult and expensive to measure inorganic arsenic accurately. The US Food and Drug Administration has set maximum allowable levels for total arsenic in shellfish at 86 mg/kg
b) Generally expected levels (GEL) 90th percentile. The value for zinc level applies to oysters

Concentrations are well below the FSANZ criteria. There are no New Zealand guidelines for acceptable levels of chromium, copper, nickel or zinc in shellfish tissue. The risk to human health from copper and zinc is regarded as too low for a criteria however, FSANZ provides a generally expected level (GELs) for shellfish as a benchmark. The results are below these levels. The sampling results show that the discharge is not having an adverse effect on tuatua.

Table 13. Shellfish bacteria and trace metal contamination levels from all sites. (As) Arsenic, (Cd), Cadmium, (Cr) Chromium, (Cu) Copper, (Pb) Lead, (Hg) Mercury, (Ni) Nickel, (Zn) Zinc, (Al) Aluminium (n=3). Values are means ± 1 SE.

Site	Faecal Coliforms MPN / 100g	Enterococci cfu/g	As (mg/kg)	Cd (mg/kg)	Cr (mg/kg)	Cu (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	Ni (mg/kg)	Zn (mg/kg)	Al (mg/kg)
E1600	<18	<10	2.7	0.053	0.15	1.43	0.053	<0.01	0.14	13.4	113
E800	<18	<10	1.8	0.36	0.12	0.98	0.033	0.017	0.13	10.3	53
E400	<18	<10	2.3	0.123	0.16	1.42	0.063	<0.01	0.16	13.8	136
E200	<18	<10	2.7	0.195	0.29	1.71	0.101	0.013	0.19	17.3	220
E100	<18	<10	2.5	0.23	0.2	1.25	0.086	0.01	0.21	11.3	182
Outfall	<18	<10	1.92	0.29	0.17	1.86	0.092	0.023	0.21	12.7	187
W100	<18	<10	1.55	0.078	0.12	0.77	0.047	<0.01	0.1	8.3	96
W200	<18	<10	2.2	0.3	0.17	3	0.074	0.021	0.23	16.2	137
W400	<18	<10	2.4	0.192	0.36	1.54	0.03	0.015	0.17	12.4	41
W800	<18	<10	1.94	0.25	0.13	1.49	0.047	0.016	0.17	12.5	99
W1600	<18	<10	1.94	0.11	0.17	1.87	0.046	0.01	0.17	11.2	103
Control 4000m	<18	<10	2	0.33	0.11	2.2	0.024	0.025	0.2	18.6	23

4 Summary and Conclusions

This report summarises the results of a survey of the Katikati outfall environment. A similar survey was undertaken in early 2006 as part of the conditions of the resource consent. The survey looked at the quality of the water, sediment, benthic communities and tidal shellfish. Samples were collected from 15 sites along increasing distances from the outfall. Analysis of sediment samples indicated a homogeneous substrate of sand with very little mud or gravel. This is consistent with the previous studies and there does not appear to be any pattern relating to the outfall.

While water quality sampling is of limited efficacy unless there is significant replication over time, there is a long-term record of bacteria sampling with 1320 samples having been collected over eight years. Council proposes to repeat the survey quarterly for 3 years and then at appropriate intervals.

The measurements of trace metals in the sediments show little evidence of accumulation of contaminants due to the discharge and supports the 2006 study that outlined a similar finding.

Overall 44 benthic taxa were identified from all samples with the low abundance and diversity typical of a sandy coastal environment. In comparison, the 2006 survey had a higher species richness and abundance across all sites compared with this current survey. Lower rates in this study are possibly related to a disturbance event such as a storm that resulted in a physical disturbance to the area potentially reducing species richness and abundance. Outfall sites were dominated by *Prionispio* sp. while the control site was dominated by *Fellaster zelandiae.* The 2006 study was dominated by *Prionospio* sp across both the control and outfall sites.

This survey was the first time that shellfish had been investigated for levels of contamination. Bacteria and heavy metals levels were below detection and low respectively.

Continuation of the discharge is unlikely to have an adverse impact on the receiving environment and pose a threat to human health.

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Appendix 1 - Laboratory Results

Appendix 2 – Benthic Data

General Group	Taxa	Common Name	E1000-A7	E1000-D10	E1000-F7	E4000-E4	E4000-G4	E100-D4	E100-H10	E100-H4	E10-C10	E10-C5	E10-D2
Anthozoa	Edwardsia sp.	Burrowing anemone											
Nemertea	Nemertea	Proboscis worms	1		1								
Gastropoda	Amalda australis	Olive shell											
Gastropoda	Austrofusus glans	Knobbed whelk					12						
Gastropoda	Turbonilla sp.	Small spiral shell											
Bivalvia	Dosinia anus	Coarse biscuit shell				1							
Bivalvia	Dosinia subrosea	Fine biscuit shell											
Bivalvia	Mactra discors	Large trough shell											
Bivalvia	Myadora boltoni	Box shell											
Bivalvia	Myllitella vivens vivens	Small bivalve			1							1	2
Bivalvia	Paphies subtriangulata (juvenile)	Tuatua											
Polychaeta: Paraonidae	Aricidea sp.	Polychaete worm			1								
Polychaeta: Spionidae	Prionospio sp.	Polychaete worm	2	2	15	1	1	14	9	10	3	9	4
Polychaeta: Spionidae	Spiophanes modestus	Polychaete worm	1					1				1	
Polychaeta: Magelonidae	Magelona dakini	Polychaete worm	1		12	5	2	1	1	3		1	2
Polychaeta: Capitellidae	Heteromastus filiformis	Polychaete worm		1	1								
Polychaeta: Maldanidae	Maldanidae	Bamboo Worms							1				
Polychaeta: Opheliidae	Armandia maculata	Polychaete worm							1				
Polychaeta: Phyllodocidae	Phyllodocidae	Paddle worms						1					
Polychaeta: Sigalionidae	Sigalionidae	Polychaete worm		1	1	1	1			1			
Polychaeta: Syllidae	Syllidae	Polychaete worm			1								
Polychaeta: Glyceridae	Glyceridae	Polychaete worm			1	1	1			1			
Polychaeta: Nephtyidae	Aglaophamus sp.	Polychaete worm								1			
Polychaeta: Lumbrineridae	Lumbrineridae	Polychaete worm											
Polychaeta: Cirratulidae	Cirratulidae	Polychaete worm				1	1				1		
Crustacea	Nebalia sp.	Small crustacean		2	1					1	2	1	1
Cumacea	Cumacea	Cumaceans			1	1							
Tanaidacea	Tanaid sp.	Tanaid Shrimp											
Isopoda	Munna neozelanica	Isopod											
Amphipoda	Haustoridae	Amphipod (family)	1	1				1		1			
Amphipoda	Lysianassidae	Amphipod (family)			3								2
Amphipoda	Phoxocephalidae	Amphipod (family)	1	1									
Amphipoda	Amphipoda Unid.	Amphipod											
Decapoda	Ogyrides sp	Shrimp (long eyes)											
Decapoda	Pagurus sp.	Hermit Crab			1		3						
Decapoda	Pariliacantha georgeorum	Mantis Shrimp											
Ostracoda	Copytus novaezealandiae	Ostracod	1										
Ostracoda	Diasterope grisea	Ostracod		1	1		1			1	1	4	
Ostracoda	Leuroleberis zealandica	Ostracod (Large)											
Ostracoda	Parasterope quadrata	Ostracod			1								
Cirripedia	Austrominius modestus	Estuarine Barnacle											
Asteroidea	Fellaster zelandiae	Sand Dollar		3	15	2	19	2	3	5			
Ophiuroidea	Ophiuroidea	Brittle stars			2								1
Holothuroidea	Trochodota dendyi	Sea cucumber											
	Count: No of Individuals		**8**	**12**	**59**	**13**	**41**	**20**	**15**	**24**	**7**	**17**	**12**
	Count: No of Taxa		**7**	**8**	**17**	**8**	**9**	**6**	**5**	**9**	**4**	**6**	**6**
	SW_Diversity		**1.9062**	**1.9792**	**2.1158**	**1.8393**	**1.5076**	**1.0791**	**1.1700**	**1.7460**	**1.2770**	**1.3438**	**1.6762**
	SW_Evenness		**0.9796**	**0.9518**	**0.7468**	**0.8845**	**0.6861**	**0.6022**	**0.7270**	**0.7946**	**0.9212**	**0.7500**	**0.9355**

Common Name	E250-E5	E250-F8	E250-F9	E50-E7	E50-F3	E50-G2	NE140-E2	NE140-F3	NE140-H2	NW130-D2	NW130-D8	NW130-F8
Burrowing anemone				1								
Proboscis worms								1				
Olive shell												
Knobbed whelk												
Small spiral shell												
Coarse biscuit shell					1							
Fine biscuit shell												
Large trough shell												
Box shell												
Small bivalve		4					2					
Tuatua												
Polychaete worm				1								
Polychaete worm	1	7	2	6	9	5	16	18	32	17		12
Polychaete worm					1				1			
Polychaete worm	1	2		1	3		10	8	7	4	4	3
Polychaete worm												
Bamboo Worms				1			1			1		
Polychaete worm												
Paddle worms												
Polychaete worm		1	1						1	1		2
Polychaete worm												
Polychaete worm					2		1					
Polychaete worm												
Polychaete worm					1							
Polychaete worm				1				1				
Small crustacean												
Cumaceans												1
Tanaid Shrimp								1	1			
Isopod												
Amphipod (family)	1				1	1	9	7	9			1
Amphipod (family)												
Amphipod (family)				3	1	1	1	2	2		3	
Amphipod												
Shrimp (long eyes)								1				
Hermit Crab												
Mantis Shrimp												
Ostracod									1		5	
Ostracod		2	1				1		4			
Ostracod (Large)												
Ostracod												
Estuarine Barnacle												
Sand Dollar	2	1	2	3	4	5	1		2	1		6
Brittle stars		1	1				1	1			1	
Sea cucumber												
Count: No of Individuals	**5**	**18**	**7**	**17**	**23**	**12**	**43**	**40**	**60**	**24**	**13**	**25**
Count: No of Taxa	**4**	**7**	**5**	**8**	**9**	**4**	**10**	**9**	**10**	**5**	**4**	**6**
SW_Diversity	**1.3322**	**1.6715**	**1.5498**	**1.8131**	**1.8310**	**1.1437**	**1.7019**	**1.5971**	**1.5507**	**0.9401**	**1.2659**	**1.4088**
SW_Evenness	**0.9610**	**0.8590**	**0.9630**	**0.8719**	**0.8333**	**0.8250**	**0.7391**	**0.7269**	**0.6735**	**0.5841**	**0.9131**	**0.7863**

Common Name	O/F REP1-J5	O/F REP2-C1	O/F REP3-A9	SE140-B6	SE140-B8	SE140-G3	SW130-D9	SW130-G4	SW130-J9	W100-D10	W100-E10	W100-I8
Burrowing anemone		1										
Proboscis worms				1								1
Olive shell					1							
Knobbed whelk												
Small spiral shell											1	
Coarse biscuit shell												
Fine biscuit shell											1	1
Large trough shell												
Box shell												1
Small bivalve									4	1		
Tuatua												
Polychaete worm												
Polychaete worm	12	34	6	22	9	4	4	8	1	8	5	24
Polychaete worm											1	1
Polychaete worm	3	5	3	1	2		1		2	3	2	1
Polychaete worm												
Bamboo Worms		1										
Polychaete worm												
Paddle worms								1				
Polychaete worm	1	1			2			1				1
Polychaete worm												
Polychaete worm												
Polychaete worm												
Polychaete worm		1									1	1
Polychaete worm		1						1				1
Small crustacean		2		2								
Cumaceans												
Tanaid Shrimp												
Isopod												
Amphipod (family)	1						1		3			
Amphipod (family)		1	3									
Amphipod (family)				1		3	1	2				2
Amphipod												1
Shrimp (long eyes)										1		
Hermit Crab												
Mantis Shrimp												
Ostracod												
Ostracod	2	3				1					2	1
Ostracod (Large)												3
Ostracod										2		
Estuarine Barnacle			1									
Sand Dollar	1			3	2	3	3	1				
Brittle stars			1									
Sea cucumber								1	1			
Count: No of Individuals	**20**	**50**	**14**	**30**	**16**	**11**	**10**	**15**	**11**	**15**	**13**	**39**
Count: No of Taxa	**6**	**10**	**5**	**6**	**5**	**4**	**5**	**7**	**5**	**5**	**7**	**13**
SW_Diversity	**1.2707**	**1.2595**	**1.4003**	**0.9784**	**1.2767**	**1.2945**	**1.4185**	**1.5066**	**1.4681**	**1.2869**	**1.7327**	**1.5878**
SW_Evenness	**0.7092**	**0.5470**	**0.8701**	**0.5460**	**0.7933**	**0.9338**	**0.8814**	**0.7742**	**0.9122**	**0.7996**	**0.8904**	**0.6190**

Common Name	W10-E5	W10-E6	W10-H4	W250-C10	W250-H1	W250-I10	W50-B7	W50-F8	W50-I5
Burrowing anemone									
Proboscis worms									1
Olive shell					1				
Knobbed whelk									
Small spiral shell									
Coarse biscuit shell									1
Fine biscuit shell									
Large trough shell		1			1				
Box shell									
Small bivalve									
Tuatua					1				
Polychaete worm									
Polychaete worm	10	2	4	4	1	3	14	21	11
Polychaete worm						1			1
Polychaete worm		2	6				1		2
Polychaete worm		1							
Bamboo Worms									
Polychaete worm									
Paddle worms									
Polychaete worm	1		2					1	1
Polychaete worm									
Polychaete worm	1								
Polychaete worm									
Polychaete worm				1					
Polychaete worm								2	
Small crustacean	1								
Cumaceans									
Tanaid Shrimp									
Isopod								1	
Amphipod (family)			1			1			
Amphipod (family)	1		2						
Amphipod (family)	1			1		1	1	2	1
Amphipod									
Shrimp (long eyes)	1								1
Hermit Crab	1								
Mantis Shrimp					1				
Ostracod		1							
Ostracod	2		2	2			1	2	2
Ostracod (Large)								1	
Ostracod	1		2						
Estuarine Barnacle									
Sand Dollar	1			1	3		1	1	3
Brittle stars	1								
Sea cucumber				1					
Count: No of Individuals	**22**	**7**	**19**	**10**	**8**	**6**	**18**	**31**	**24**
Count: No of Taxa	**12**	**5**	**7**	**6**	**6**	**4**	**5**	**8**	**10**
SW_Diversity	**1.9814**	**1.5498**	**1.7949**	**1.6094**	**1.6675**	**1.2425**	**0.8378**	**1.2374**	**1.8262**
SW_Evenness	**0.7974**	**0.9630**	**0.9224**	**0.8982**	**0.9306**	**0.8962**	**0.5205**	**0.5951**	**0.7931**

Appendix 3: Analysis

Sediment Characteristics

Grain size - sand

ANOVA revealed significant variation among sites (F = 7.721, P < 0.001).

Post hoc Tukey test revealed significant differences between E4000:

W250 (P < 0.001)	W100 (P < 0.001)	W50 (P < 0.001)
W10 (P < 0.001)	SW130 (P < 0.001)	SE140 (P < 0.001)
Outfall (P < 0.001)	NW130 (P < 0.001)	NE140 (P = 0.006)
E250 (P < 0.001)	E100 (P < 0.001)	E50 (P < 0.001)
E10 (P < 0.001)	E1000 (P < 0.001).	

Organic materials

Total Phosphorus

An analysis of variance (ANOVA) yielded significant variation among sites for phosphorus (F = 2.369, P = 0.023). A further post hoc Tukey test revealed significant differences between the primary control of E4000 and:

NW130 (P = 0.005)	Outfall (P < 0.001)	SE140 (P = 0.005)
SW130 (P < 0.001)	W10 (P = 0.005)	W50 (P = 0.005)
W100 (P = 0.005)	W250 (P < 0.001)	E10 (P < 0.001)
E50 (P = 0.001)	E100 (P = 0.016)	E1000 (P = 0.005).

Inorganic materials

Levels of chromium (Cr) were lowest at E4000 (5.43 mg/kg) and highest at SE140, E100 and the outfall (6.7 mg/kg). An ANOVA documented significant variation among sites (F = 4.575, P <0.001) whilst a post hoc Tukey test revealed significant differences between the primary control of E4000 and:

W250 (P < 0.001) W100 (P = 0.001) W50 (P = 0.002)

W10 (P = 0.002) SW130 (P < 0.001) SE140 (P < 0.001)

Outfall (O/F) (P < 0.001) NW130 (P = 0.008) E250 (P = 0.002)

E100 (P < 0.001) E50 (P < 0.001) E10 (P = 0.004)

E1000 (P = 0.002).

Levels of nickel (Ni) were lowest at E4000 (1.47 mg/kg) and highest at W10, W50 and W1000 (1.77 mg/kg). An ANOVA revealed significant variation among sites (F = 3.571, P = 0.002) whilst a post hic Tukey test revealed significant variation between E4000 and W50 (P = 0.004), W10 (P = 0.004), SE140 (P = 0.017), E10 (P = 0.017), E1000 (P = 0.004).

Levels of aluminium (Al) were lowest at E4000 (3033 mg/kg) compared to a high from W50 of 4800 mg/kg. An ANOVA revealed significant variation among sites (F = 6.434, P < 0.001). Further investigation by a post hoc Tukey test revealed significant differences between E4000 and W250 (P < 0.001), W100 (P < 0.001), W50 (P < 0.001), W10 (P < 0.001), SW130 (P < 0.001), SE140 (P < 0.001), O/F (P < 0.001), NW130 (P < 0.001), NE140 (P < 0.001), E250 (P < 0.001), E100 (P < 0.001), E50 (P < 0.001), E10 (P < 0.001), E1000 (P < 0.001).

Appendix 4: Proposed Regional Coastal Environment Plan

Schedule 10 – Water Quality Classifications

Explanation

This schedule provides receiving water quality standards for coastal waters.
The standards apply after reasonable mixing of any contaminant or water with the receiving water and disregarding the effect of any natural perturbations that may affect the water body.
The effect of more than one discharge may be assessed cumulatively and the standards apply whether or not the point of discharge is in the coastal marine area.
This schedule is not an exclusive list of quantitative standards. When necessary, additional standards may be referred to in accordance with the approach set out in Policy CD 2A to prevent degradation of existing water quality.

Coastal Water Quality Classifications: Equivalent Qualitative and Quantitative Standards

Qualitative Standard	Quantitative Standard	Mātauranga Māori	Coastal Water Classification
There shall be no conspicuous change in the colour or visual clarity.	The decrease in secchi disc vertical depth or black disc horizontal range shall not be greater than 20%.	Te Hauora o te Wai / the health and mauri of water Coastal waters support a healthy ecosystem appropriate to that locality (open coastal water, lagoon, estuary, coastal wetland, saltmarsh, intertidal areas, rocky reef system etc. Coastal water quality enables ecological processes to be maintained, supports an appropriate range and diversity of indigenous flora and fauna, and there is resilience to change.	All coastal waters. Water managed for aquatic ecosystem purposes.
There shall be no significant adverse effects on aquatic life.	Refer to: Australian and New Zealand Guidelines for Fresh and Marine Water Quality Australian and New Zealand Environment and Conservation Council, 2000.		
There shall be no production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials.	None		
There shall be no emission of objectionable odour	Refer to the Bay of Plenty Regional Air Plan		

The visual clarity of the water shall be suitable for bathing.	The horizontal sighting distance of a 200 mm black disc should exceed 1.6 metres (in the active surf zone it is not possible to use this method). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Environment and Conservation Council, 2000.	Kei te ora te mauri (the mauri of the place is intact). Coastal resources are able to be used for customary use and customary practices are able to be exercised to the extent desired. Tikanga and preferred methods are able to be practised.	Within all harbours and estuaries, and into the open coast out to a distance of 400 metres from the line of mean high water springs, and within 500 metres of any consented aquaculture farm. Water managed for contact recreation purposes and for the gathering or cultivating of shellfish for human consumption.
The water shall not be rendered unsuitable for bathing by the presence of contaminants.	Microbiological: The concentration of enterococci must not exceed 280 cfu/100ml. See Microbiological Water Quality Guidelines for methodology (MfE & MoH, 2003).		
Aquatic organisms shall not be rendered unsuitable for human consumption by the presence of contaminants.	Microbiological The median faecal coliform content of samples taken over a shellfish-gathering season shall not exceed a Most Probable Number (MPN) of 14/100 mL, and not more than 10% of samples should exceed an MPN of 43/100 mL (using a five-tube decimal dilution test). See Microbiological Water Quality Guidelines for methodology (MfE & MoH, 2003).	Kaimoana is safe to harvest and eat.	
There shall be no undesirable biological growths as a result of any discharge of a contaminant into the water	None		
The natural temperature of the water shall not be changed by more than 3 degrees C			

The concentration of dissolved oxygen shall exceed 80% of saturation concentration			

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Duffill Watts & King Ltd

CONSULTING ENGINEERS

43111

15 May 2006

The Principal Compliance Officer
Environment Bay of Plenty
P O Box 364
Whakatane

Attention: Steve Pickles

Dear Sir

Survey of the Katikati Outfall Environment 2006
DWK Reference 55027/5/3/8

Please find attached the report of the survey done on the Katikati Outfall Environment to satisfy condition 11.4 of consent nr 24895, Katikati Wastewater Treatment Plant, discharge to the ocean.

Yours faithfully
DUFFILL WATTS & KING LTD
per:

D Richardson
Engineer

Enclosure:
» Survey of the Katikati Outfall Environment 2006

Copy to:
Dave Karrol
WBOPDC

Kingett Mitchell Ltd
RESOURCE & ENVIRONMENTAL CONSULTANTS

SURVEY OF THE KATIKATI OUTFALL ENVIRONMENT 2006

APRIL 2006

on behalf of

Western Bay of Plenty District Council

prepared by

Kingett Mitchell Limited

Kingett Mitchell Limited

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Document Quality Assurance

This report has been prepared in accordance with Kingett Mitchell quality assurance procedures. All relevant quality control information in relation to biological and/or environmental data is identified within the document. The report has been reviewed and is approved for release as set out below.

	Name	**Signature**
Project Manager	**Paul Kennedy**	Paul Kennedy
Project Reviewer	**Scott Speed**	S Speed
Director approval for release	**Adrian Goldstone**	A Goldstone

1. Introduction

1.1 Background

Treated wastewater generated from the Katikati Wastewater Treatment Plant is discharged through an outfall approximately 650 m offshore on the ocean side of Matakana Island at a water depth of approximately 24 m.

Kingett Mitchell conducted a survey of the environment around the Katikati outfall at Matakana Island for Western Bays District Council (WBDC) (through Duffill Watts and King Ltd.) to satisfy condition 11.4 of Resource Consent 24895 granted on 9 November 1998 (Environment Court Decision).

1.2 Coastal Permit and Survey Scope

The survey design was based on condition 11.4 of the resource consent granted to WBPDC (Resource Consent 24895). The condition states:

> *"The consent holder shall, seven years of after the granting of this consent, submit to the Bay of Plenty Regional Council, an investigation and report on the effect of this discharge on the marine habitat surrounding the Matakana Island outfall."*

A survey design was developed and provided to Environment Bay of Plenty (EBOP) for comment. The design had two levels of sampling dependent upon confirmation of the nature of the environment around the outfall.

1. Undertake site visit and assess the immediate area around the outfall visually.
2. If the area around the outfall displays no evidence of visible effects/change arising from the presence of the outfall, then implement a 'reduced scale' survey.
3. If the area around the outfall shows any evidence of build-up of material or possible effects/change arising from the presence of the outfall, then implement the 'full' survey.

These survey options are described below.

The key components of both the reduced scale and full work programme would include the following:

1. Collation and review of discharge information to overview potential effects on benthic environment.
2. Collection of qualitative epibenthic information using underwater photography to describe the surface environment (should visibility allow).

3. Collection of benthic samples to assess the infaunal community structure of the sediments surrounding the discharge.
4. Collection of benthic sediments for physical and chemical composition.
5. Visual examination of the outfall structure and immediate receiving environment surrounding the discharge.

The full survey design would include the following stations:

A transect parallel to the shore at approximately the same depth contour as the outfall location, with sampling stations located at distances of 50, 100, 250 and 1,000 m along the shore both eastwards and westwards from the discharge.

A second transect perpendicular to the coast with stations sampled at distances of 50, 100 and 250 m both inshore and offshore from the outfall location (this assumes that the discharge plume travels alongshore).

The immediate receiving environment surrounding the outfall will be visually inspected and photographed.

The 'reduced scale' survey would include the following sites:

1. Collect samples from one alongshore transect at 50, 100, 250 and 1,000 m.
2. Collect samples from the second alongshore transect at 50 and 100 m.

The station located 1,000 m from the outfall for the purpose of this survey were considered adequate for control purposes.

1.3 Report Contents

This report contains five key sections following this introduction.

Section two describes the characteristics of the Katikati outfall.

Section three describes the results of physical examination of the sediments collected during the 2006 survey. This includes examination for man-made objects in the coarser fractions of the sediments and the textures of the sediments.

Section four describes the chemistry of sediments sampled including total organic carbon, nitrogen and phosphorous concentrations, trace elements (as specified by the resource consent conditions) and organic compounds including polyaromatic hydrocarbons and organochlorine pesticides.

Section five describes the benthic ecology of the environment around the location of the outfall. The information presented includes a description of the epibenthos (the fauna present on the seabed) and the infauna (the fauna inhabiting the sediment) present.

Section six provides a summary of the survey findings.

2. Outfall Characteristics

The existing wastewater outfall pipeline was constructed in 1978 and up to 1999 discharged effluent with just the solids screened out to the discharge point. The new wastewater treatment plant at Prospect Drive was built and commissioned in September 1999. Current treatment comprises aerated lagoons, constructed wetlands and ultraviolet disinfection. WBDC undertake monitoring of the final discharge of treated wastewater from the Katikati wastewater treatment plant. The resource consent identifies what monitoring is carried out and provides for limits on the load of key constituents ($cBOD_5$, suspended solids, total nitrogen) in the discharge.

Table 2.1 provides a summary of treated wastewater quality from the Katikati Wastewater Treatment Plant (WTP) outfall for the period July 2004 – June 2005.

Table 2.1: Summary of treated wastewater quality from the Katikati Wastewater Treatment Plant (units g/m^3, n=11, unless otherwise stated).

Parameter	Minimum	Maximum	Median	95th percentile
Suspended solids	1	38	8	25.6
BOD_5	1	11	3	9
Faecal coliforms (cfu/100mL)	<4	76	<4	30.4
Enterococci (cfu/100mL)	<4	3300	<4	124
Total nitrogen	5.63	38.68	21.8	30.9
TKN	3.3	25	8.45	21.59
Total oxidised nitrogen	0.14	19.88	6.81	16.42
Nitrate - N	0.06	18.8	5.19	16.05
Nitrite - N	0.06	10.5	0.26	5.95

The data summarised in Table 2.1 indicates that the median suspended solids and BOD_5 concentration in the discharge was low at 8 g/m^3 and 3 g/m^3 respectively. Based upon a median maximum daily discharge of 1,216 m^3 then the respective loadings would be 9.7 and 3.6 kg/day.

Median concentrations of total nitrogen in the wastewater were 21.8 g/m^3. Nitrogen concentrations in Table 2.1 show that oxidised nitrogen is only a small to moderate proportion of the total nitrogen. It is presumed that the difference is ammoniacal-nitrogen.

Metal concentrations measured in treated wastewater from the Katikati WTP were generally low. Detection limits used in the analysis over time have changed making the accurate calculation of medians and loads difficult. As the long-term data set is inconsistent, data for two periods (which has better detection limits) is summarised in Table 2.2. The data from the two years is generally consistent and shows a pattern of generally low metal concentrations. Nickel copper and zinc are the dominant elements in terms of concentration and loads present. The highest load of any metal is that of zinc at about 27 g/day.

Table 2.2: Summary of trace element concentrations in treated wastewater quality from the Katikati Wastewater Treatment Plant (all units g/m^3).

Parameter	1999/2000 (n=3)	2004/2005 (n=4)
Arsenic	0.003 (0.002-0.004)*	<0.002 (<0.002 (<0.002-0.002)
Chromium	0.0006 (<0.0005-0.0007)	<0.001 (<0.001-0.002)
Mercury	0.001 (<0.00008-0.00104)	<0.001
Lead	0.0012 (0.0002-0.0012)	<0.001 (<0.001-0.003)
Cadmium	<0.00005 (<0.00005-0.00007)	<0.001
Copper	0.0046 (0.0027-0.0084)	0.006 (0.004-0.007)
Nickel	0.0019 (0.0017-0.0022)	0.0025 (0.002-0.012)
Zinc	0.01 (0.006-0.011)	0.022 (0.011-0.045)

Notes: * - median (range).

3. Environment and Seabed Characteristics

3.1 Outfall Location

The outfall is located on the Oceanside of Matakana Island, to the south of the Katikati entrance of Tauranga Harbour. The Katikati coast is a relatively shallow wave exposed shore, with predominately sandy substrates (Hesp et al. 1999). There have been a number of studies of the Tauranga Harbour and harbour entrance environments (refer McIntosh 1994).

3.2 Sampling

Following initial dives and inspection on at sites close to the diffuser (at the edge of the mixing zone) it was decided that the discharge was not having any obvious visible/identifiable effects on benthic habitat (e.g., sediment blankets, discoloration, organic debris, bacterial mats etc.). In this case the investigation was reduced to observation and limited quantitative benthic sampling to support those observations. As such a 'reduced scale' sampling programme was implemented (Refer Section 1.2)

Sample locations are shown on Fig. 3.1. Following an initial sampling run on 11.01.06, it was identified that a number of sample locations were not positioned in the locations required by the survey design. A second sample run was undertaken on 10.02.06 to re-sample locations W50, W100 and E100.

Overall, sediment and faunal sampling was undertaken at eight sites within the vicinity of the outfall at 50, 100, 140, and 250 m east and 50, 100, 130 and 250 m west of the diffuser. The locations of all samples and the outfall diffuser are presented in Table 3.1. The station, located 1000 m west from the outfall, was identified as the control site.

Table 3.1: Summary of locations sampled near the Katikati outfall, 2006.

Site	Distance from outfall (m)	Easting	Northing
W250	250	2780835	6402608
W130	130	2780844	6402445
W100	100	2780992	6402511
W50	50	2781020	6402469
Outfall	-	2781049	6402429
E50	50	2781077	6402385
E100	100	2781076	6402330
E140	140	2781048	6402244
E250	250	2781124	6402158
E1000	1000	2781665	6401588

Note: Coordinates refer to New Zealand Geodetic Datum 1949.

In the following sections the samples are considered in three groups. Sites E50, E100, E250, W50 and W100 are considered to be sites potentially impacted by the outfall as they are immediately up and down coast from the diffuser. Site E1,000 m is considered to be sufficiently far away from the outfall to be away from any primary influence of the outfall. Sites E140 and W130 although close to the diffuser are located inshore of diffuser. Information on these samples is presented and discussed as they provide information in addition to the E1,000 m site on the nature of the environment around the outfall.

3.3 Sediment Sampling

Sediment samples were collected by SCUBA divers using plastic sediment corers with a depth of 50 mm and a surface area of 600 mm^2, producing a volume of 300 cm^3 (small box cores). A series of five cores were collected and combined to form a composite sample of about 1-2 L in volume. The location of all of the sample sites is shown in Fig. 3.1.

Fig. 3.1: Location of sampling points around the Katikati outfall.

At each site, 3 sediment samples were collected resulting in a total of 3 individual samples being collected from the control site and 15 samples from sites around the diffuser location.

Samples were examined for simple sediment texture (gravel, sand, mud) using sieving and weighing of dried samples.

3.4 Katikati Sediments

A summary of the mud (<36 µm), sand (<36 µm to 2 mm) and gravel (>2 mm) textural data obtained for the sediment samples in the vicinity of the Katikati outfall and the E1000 control site is provided in Table 3.2. Simple statistical analysis of site data was undertaken to see whether any sites differed in their physical characteristics from other sites. In undertaking this analysis, the single sample data from the sites located around the outfall were combined to form an artificial replicate.

The general nature of the seabed can be seen in the photographs in Fig. 5.1.

Coarse material

The samples collected contained little coarse material > 2mm in size. Six of 21 samples examined for texture contained more than 1% coarse material with the largest proportion of 'gravel' sized material in the samples being 3.23% (Table 3.2). The identifiable species comprising the shell gravel material included gastropods *Maoricrypta costata*, *Sigapatella novaezelandiae* and *Umbonium zelandicum*, and bivalves *Nucula* sp., *Tawera spissa*, *Paphies* spp., *Myadora striata* and *Mactra* sp.

Man-made objects

Man-made objects were assessed by visually examining all of the material contained in the gravel fraction of each sample (i.e., the material >2 mm in size). There were no man-made objects contained within the gravel fraction of the sediment samples from around Katikati outfall or the control site.

Sand and mud

Table 3.2 summarises the sand and mud data for the samples collected in the survey. On average more than 95% of the material in all samples was sand. Mud was only a minor component of the sediment with the mud content ranging from 0.28 to 4.6%. For the site replicates and grouped samples, although the group around the outfall have on average very slightly higher mud content than other sets of samples, there was no difference in the mud content between the sites (one way anova, $F=0.895$, $p=0.502$).

Hesp et al. (1999) has previously described well-sorted fine sands present along the Katikati coastline.

Table 3.2: Summary of sediment textures for sample groups in the 2006 survey (median, (range), all data % dry weight).

Sample set	Gravel (>2 mm)	Sand (<2 > 0.063 mm)	Mud (<0.063 mm)	No. of samples
W50	0.1	95.3	4.6	1
W-100	0.4	96.8	2.8	1
W-130	0.62 (0.36-0.86)	96.37 (95.45-96.77)	2.77 (2.62-4.18)	3
W250	0 (0-1.10)	96.05 (95.56-96.14)	3.86 (2.84-4.34)	3
E-50	0.1	96.3	3.6	1
E-100	0.88 (0.57-1.39)	97.20 (96.58-97.21)	2.03 (1.91-2.22)	3
E-140	1.42 (0-2.56)	96.48 (96.42-97.16)	2.16 (0.28-3.52)	3
E-250	1.68 (0.29-3.23)	95.34 (95.13-97.03)	1.64 (1.29-4.36)	3
E-1,000	0.53 (0.47-0.76)	97.11 (95.54-97.55)	2.36 (1.69-4.00)	3

3.5 Summary

Overall, the sediments around the outfall are sandy in nature with little difference in physical characteristics between the sites that were sampled.

4. Sediment Quality

4.1 Introduction

In the following sections, the sediment quality data from the samples collected around the Katikati outfall is discussed. The information is discussed in the context of what the composition of the sediments would be expected to be in the absence of the outfall. It should be noted that when making comparisons of this kind, factors such as field sampling methods and laboratory methods need to be taken into account.

Sediments collected in the 2006 survey were examined for two key chemical groupings.

1. Nutrients, including total organic carbon, nitrogen and phosphorus.
2. Trace elements (arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc).

The 2006 Katikati survey data was then compared with data presented by McIntosh (1994). In the McIntosh (1994) survey which encompassed the whole of the Tauranga Harbour, the depth of sediment sampling was 50 mm (as in this survey) and the analytical methods were generally similar. For comparative purposes, a subset of the data was used comprising the sites sampled in the northern basin of the Harbour (site numbers 1-27). This area corresponded to the Harbour north of the Katikati outfall alignment. The second set of data included was for a set of sediment samples collected from the sandy inshore environment of Pegasus Bay (work undertaken for Waimakariri District Council, Kingett Mitchell 2005). Although this location is well removed from the Katikati outfall, the site is located in a geological environment that reflects the rock types that make up the main axial ranges of New Zealand. The analytical methods were identical to those used in this survey.

4.2 Sediment Chemical Analysis

All methods of sediment chemical analysis are presented in the laboratory reports presented in Appendix 1.

4.3 Nutrients in Sediments

4.3.1 Organic carbon

Total organic carbon (TOC) concentrations in sediment were low (Table 4.1) with concentrations ranging from 0.05-0.18%. These concentrations can be considered typical of sandy coastal sediments in energetic environments.

The broad relationship between mud content of the coastal sediments and TOC concentration is shown in Fig. 4.1. Examination of the data collected did not identify any statistical differences in TOC concentrations for the sites where replicate sediment samples were collected (one way anova, $F=2.631$, $p=0.097$). The concentration in the sediments near the outfall were similar to the concentrations measured in sediments collected in the northern basin of Tauranga Harbour. They also fell within the range expected in sandy coastal sediments (e.g., refer Waimakariri data on Fig. 4.1).

4.3.2 Nitrogen

Concentration of total nitrogen (TN) in sediments from around the outfall were low, with concentrations of <0.1 % total nitrogen recorded in all samples. As with TOC, TN tends to increase with increasing mud content in coastal sediments with TN content only reaching 0.1% where a significant mud content is present (Kingett Mitchell 2005).

Table 4.1: Summary of TOC, TN and TP concentrations in Katikati outfall sediments (all data median, range, mg/kg dry weight unless stated).

Sample set	TOC %	Total nitrogen (%)	Total phosphorous (mg/kg)	No. of samples
W50	0.15	0.05	153	1
W-100	0.14	0.05	156	1
E-50	0.15	0.05	153	1
E-100	0.05 (0.05-0.13)	0.05	173 (172-177)	3
E-140	0.15 (0.15-0.18)	0.05	165 (154-170)	3
E-250	0.13 (0.05-0.13)	0.05	167 (139-183)	3
E-1,000	0.13 (0.05-0.13)	0.05	171 (165-180)	3

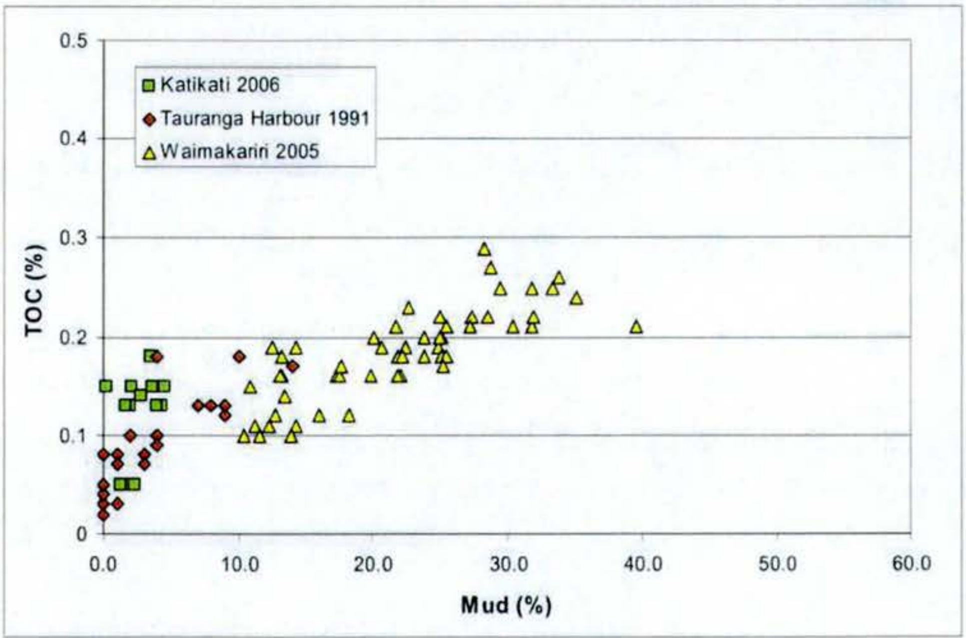

Fig. 4.1: Total organic carbon in Katikati outfall sediments.

4.3.3 Phosphorous

Concentrations of total phosphorous (TP) were generally similar between all sites (Table 4.1) with no statistically significant differences between sites (F=1.540, p=0.263).

Concentrations measured in all samples (139-183 mg/kg) appear low when compared to some sandy coastal sediments around New Zealand but high compared to some such as those collected from Tauranga Harbour (McIntosh 1994) (Fig. 4.2). In the case of the Katikati sediments, this difference is likely to be geochemical in origin, rather than originating from the WTP discharge.

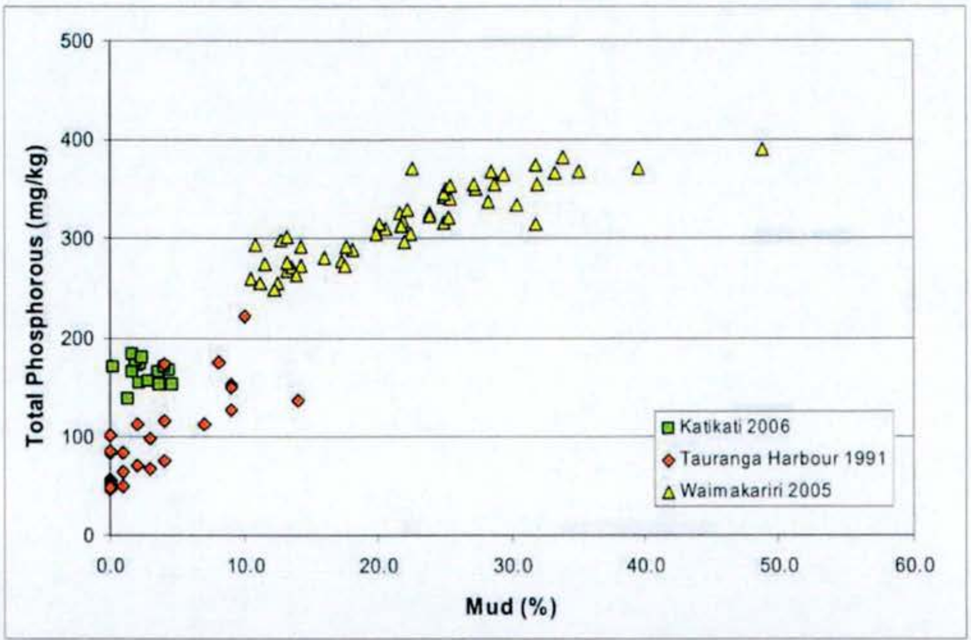

Fig. 4.2: Total phosphorous in Katikati outfall sediments.

4.4 Trace Elements

4.4.1 Arsenic

The arsenic concentrations in sediments collected from around the Katikati outfall are summarised in Table 4.2. Although site concentrations are relatively similar, Fig. 4.3 shows the general relationship between arsenic concentration in sediment and the mud content of the sediment. Typically, as the mud content increases, arsenic concentrations increase. This is reflected generally in the overall trend seen in Fig. 4.3. There was no statistical difference in concentrations between the sites, however, ($F=2.135$, $p=0.263$).

Arsenic concentration in coastal sediments are influenced by the geochemistry of arsenic and its geochemical similarity to phosphorous. As such, arsenic mobility is linked to that of phosphorous. Fig. 4.4 illustrates the relationship between phosphorous and arsenic for samples collected in this study and the other two areas being used for comparative information in this assessment. The arsenic concentration appears to follow that of phosphorous relatively independent of location. The presence of shell carbonates also influences the concentration of arsenic however.

Table 4.2: Summary of arsenic, copper and chromium concentrations in Katikati outfall sediments (all data median, range, mg/kg dry weight).

Sample set	Arsenic	Copper	Chromium	No. of samples
W50	5.3	0.5	6.1	1
W-100	4.9	0.5	6.6	1
E-50	4.7	0.5	6.4	1
E-100	4.7 (4.5-4.7)	0.4 (0.4-0.4)	5.5 (5.4-5.6)	3
E-140	4.0 (3.8-4.6)	0.5 (0.5-0.5)	5.8 (5.2-5.8)	3
E-250	4.7 (4.1-4.9)	0.5 (0.4-0.5)	5.1 (5.1-5.3)	3
E-1,000	4.6 (4.4-5.2)	0.5 0 (0.5-0.5)	5.6 (5.5-6.0)	3

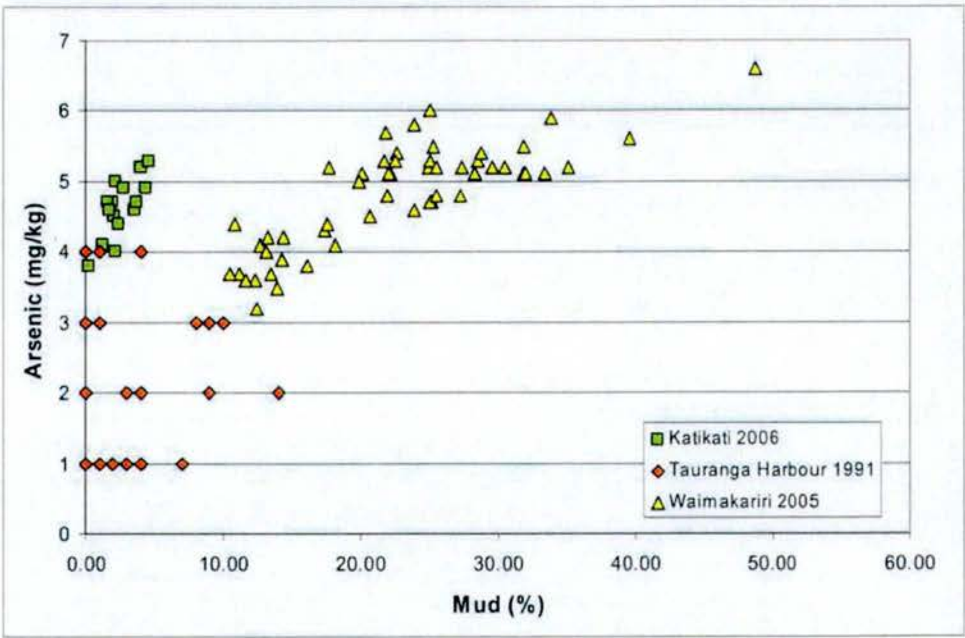

Fig. 4.3: Arsenic in Katikati outfall sediments.

Carbonate content of the sediment samples was not assessed and variation in shell content might influence the concentration somewhat.

Arsenic concentrations measured in the discharge appear to be consistently low. The data for the two discharge periods shown in Table 2.2 suggest a concentration at or below 0.002 g/m^3. Overall, there is no evidence to indicate that arsenic concentrations in sediments around the Katikati outfall are affected by the discharge from the outfall.

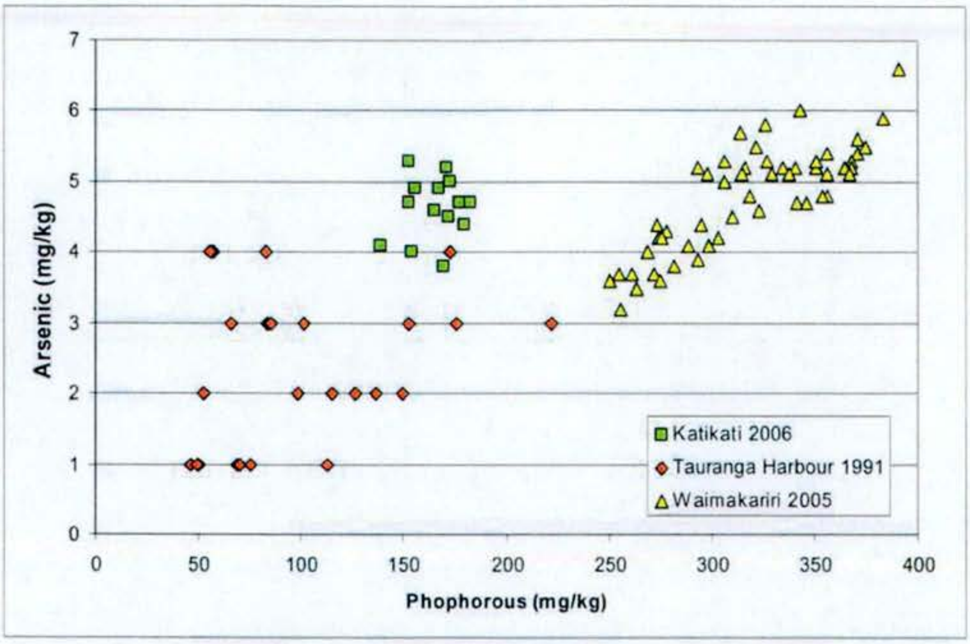

Fig. 4.4: Arsenic and phosphorous in Katikati outfall sediments.

4.4.2 Cadmium

Cadmium concentrations measured in all samples collected around the Katikati outfall were less than 0.01 mg/kg. Concentrations measured in the discharge are low, but accurate concentration data is lacking because detection limits were higher than the concentration for a number of years. In the 1999-2000 monitoring years, analysis indicated that concentrations were likely to be <0.05 mg/m^3.

Overall, although the identification of cadmium concentrations is limited by the low concentrations present, there is no evidence to indicate that cadmium concentrations around the Katikati outfall are affected by the WTP discharge.

4.4.3 Copper

Copper concentrations were present in low and consistent concentrations between samples with all data lying between 0.4 and 0.5 mg/kg (Table 4.2). Statistical analyses indicated that there was a difference between sites, with site E100 having a lower concentration than all of the other sites including E1,000 (F=4.999, p=0.003). This difference arose as all three sites at E100 had concentrations of 0.4 mg/kg, while at several other sites all three replicates had concentrations of 0.5 mg/kg. This difference is not environmentally significant.

Fig. 4.5 illustrates the copper data from the Katikati outfall survey along with some data from Tauranga Harbour reported in McIntosh (1991). The data from these sites plus that from a recent coastal sediment survey off the Canterbury coast indicates that copper concentrations are low in sandy sediments and vary slightly with increasing mud content (double from 5 to 20% mud.

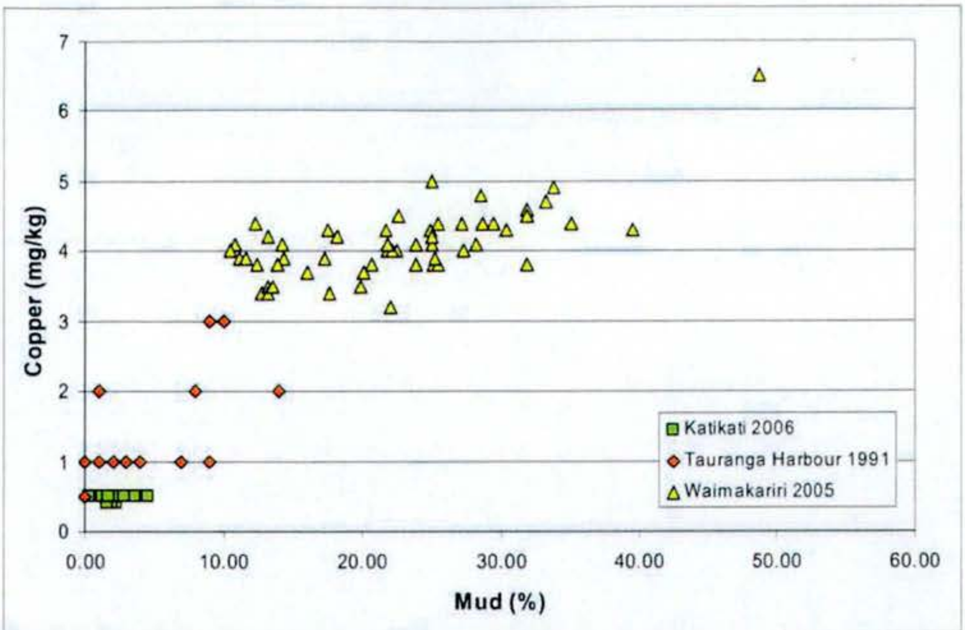

Fig. 4.5: Copper in Katikati outfall sediments.

Copper is present in the discharge at low concentrations (of the order of 0.006 g/m^3). Overall, there is no evidence to indicate that copper concentrations around the Katikati outfall are affected by the discharge from the outfall.

4.4.4 Chromium

Chromium concentrations in sediments around the Katikati outfall were similar between sites, showing low concentrations between 5.1 and 6.6 mg/kg (Table 4.2). Examination of the chromium data indicates that there is a statistical difference between the replicate samples (F=10.481, p=0.001) with the combined single samples from adjacent to the outfall (E50, W50 and W250 m) having a higher concentration than any of the other sites. The chromium concentrations in samples from the first round of sampling had concentrations ranging from 5.1-6.0 mg/kg and the second set of three samples 6.1-6.6 mg/kg. Although the statistical analysis indicates that the three individual samples from around the outfall contain higher concentrations of chromium, the difference is +0.66 mg/kg (about 10% relative).

Fig. 4.6 illustrates the relationship between chromium and mud content. The data from the three data sources shown in Fig. 4.6 suggests that in coastal sediments of generally similar provenance, the chromium concentration is related to the mud content of the sediments.

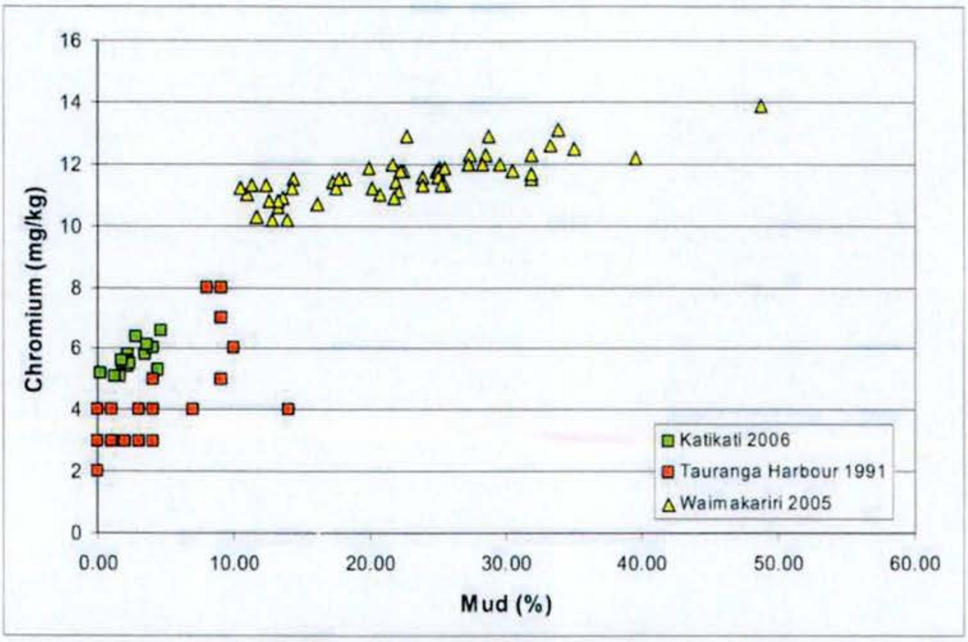

Fig. 4.6: Chromium in Katikati outfall sediments.

Chromium concentrations in the Katikati wastewater discharge appear to be very low. In both years of data summarised in Table 2.2, the average concentration was <1 mg/m^3. In the 1999/2000 year of wastewater characterisation, the concentrations were below 1 mg/m^3.

Overall, although a small positive difference was detected in the concentration of chromium in some samples of sediment collected around the Katikati outfall, the difference is small. It is not possible to confirm whether the small difference is the result of chromium present in the discharge, the slight textural difference observed at this site or by inter-run variation in the analysis of the sediment samples. However, the low concentration of chromium in the discharge would indicate that the detected increase may be the result of small iter-run laboratory variation rather than an actual change.

4.4.5 Mercury

Mercury concentrations in the discharge have been reported as low (<0.001 g/m^3), but reported concentrations are limited by elevated detection limits with actual concentrations likely to be much lower. Table 4.3 summarises mercury concentrations measured in Katikati outfall sediments. Concentrations in sediment ranged up to 0.02 mg/kg with most being in the range <0.01-0.01 (all but the 0.02 mg/kg recorded in a sample from E250). Examination of the data indicated no significant differences in concentrations between sites (F=0.682, p=0.620).

Table 4.3: Summary of mercury, nickel, lead and zinc concentrations in Katikati outfall sediments (all data median, range, mg/kg dry weight).

Sample site	Mercury	Nickel	Lead	Zinc	No. of samples
W50	0.01	1.6	2.52	12.6	1
W-100	0.01	1.6	2.42	12.5	1
E-50	0.01	1.6	2.31	12.8	1
E-100	0.01 (<0.01-0.01)	1.3 (1.13-1.13)	2.35 (2.15-2.39)	9.6 (9.3-9.8)	3
E-140	0.01 (<0.01-0.01)	1.4 (1.3-1.6)	2.35 (2.13-2.42)	10.2 (9.4-10.8)	3
E-250	<0.01 (<0.01-0.02)	1.4 (1.3-1.4)	2.24 (2.13-2.24)	9.5 (9.4-9.8)	3
E-1,000	<0.01	1.4 (1.4-1.5)	2.37 (2.2-2.43)	10.0 (9.9-10.7)	3

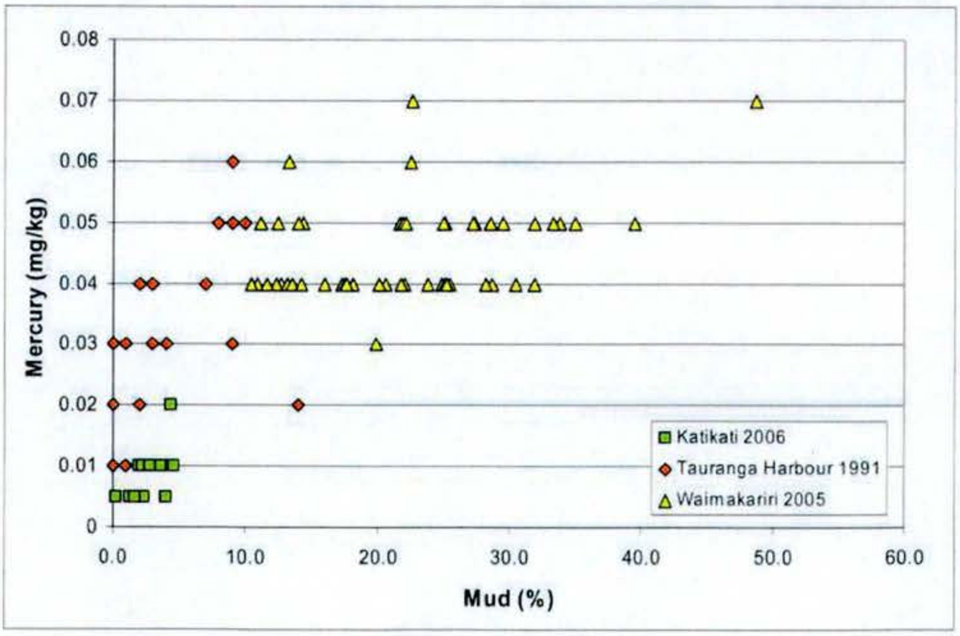

Fig. 4.7: Mercury in Katikati outfall sediments.

Fig. 4.7 illustrates the typical range in mercury concentration found in sandy coastal sediments. The figure suggests a broad but general relationship between % mud and mercury concentration.

Overall, there is no evidence to indicate that mercury concentrations in sediments around the Katikati outfall are affected by the discharge from the outfall.

4.4.6 Nickel

Nickel concentrations in Katikati outfall sediments ranged in concentration from 1.3 to 1.6 mg/kg (Table 4.3). Statistical analysis identified that the 3 individual samples collected around the outfall in the second sampling run contained a higher concentration of nickel than the other samples ($F=10.482$, $p=0.001$). The difference arises because all three samples collected in the second set of samples contained the same concentration of 1.6 mg/kg. The difference may reflect the slightly higher mud content in these samples (not statistically significant) and the fact that the analysis were undertaken in a separate analytical run.

There is very little comparable data (same processing and analytical methods) for nickel in coastal sediments. Fig. 4.8 shows that the concentrations are low and clustered due to their low mud content. There was no nickel data reported for sediments in Tauranga Harbour by McIntosh (1994).

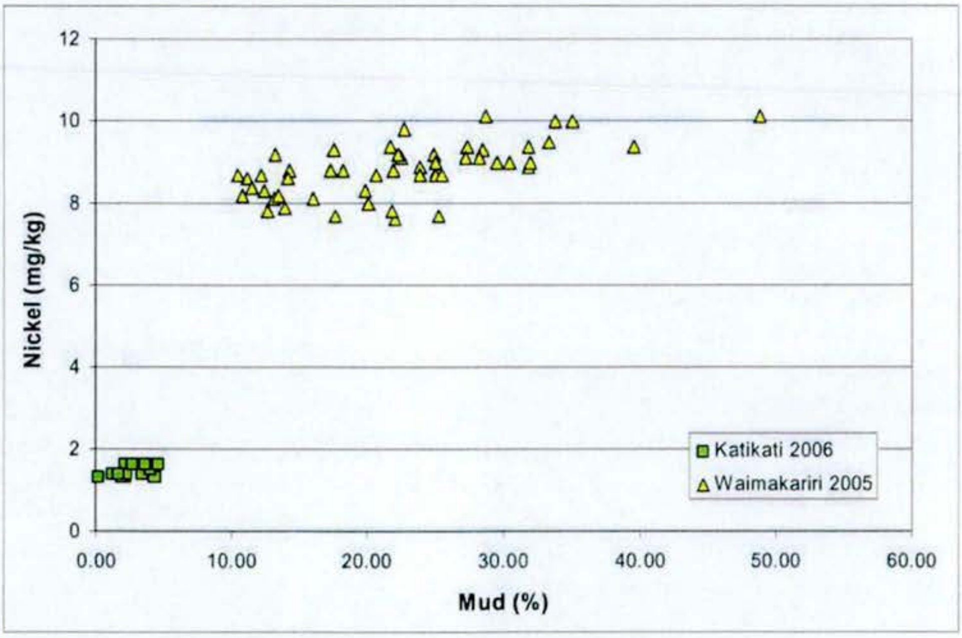

Fig. 4.8: Nickel in Katikati outfall sediments.

Nickel was measured at consistently low concentrations in the Katikati treated wastewater. Mean concentrations in the 1999/2000 and 2004/2005 years were about 0.002 g/m^3 (Table 2.2). Of that dataset, six of seven measurements were under 0.003 g/m^3 with a single elevated concentration of 0.012 g/m^3.

Overall, given the low concentration of nickel in the wastewater discharge and the low solids loading, it is unlikely that the discharge is having any significant effect on nickel concentrations in sediments around the Katikati outfall.

4.4.7 Lead

There was little variation in the lead concentration in Katikati sediments with a range of 2.13 to 2.52 mg/kg (Table 4.3, Fig. 4.9). There were no statistical differences in lead concentration between samples from different locations around the outfall ($F=1.286$, $p=0.338$).

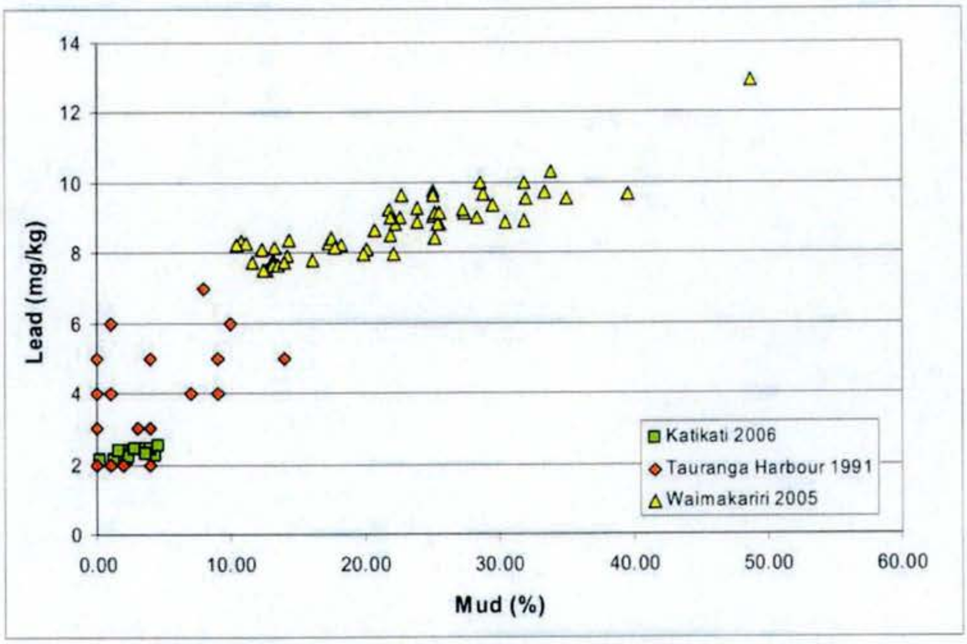

Fig. 4.9: Lead in Katikati outfall sediments.

Earlier concentrations measured in Tauranga Harbour are higher than measured in the Katikati sediments. This difference is likely to reflect the proximity of the Tauranga Harbour sediments to sources of lead (at that time).

Concentrations of lead in Katikati treated wastewater are low. In 1999/2000 the median concentration was 0.001 g/m^3 and in 2004/2005, <0.001 g/m^3) (Table 2.1).

Overall, given the low concentration of lead in the Katikati wastewater discharge and the low solids loading, it is unlikely that the discharge is having any significant affect on lead concentrations in sediments around the outfall.

4.4.8 Zinc

Zinc concentration in sediments collected in the 2006 survey ranged from 9.3 to 12.8 mg/kg (Table 4.3 and Fig. 4.10). The data in Fig. 4.10 indicates that as in most coastal sediments, zinc concentrations increase with increasing mud content. It appears from the clusters of data from the early Tauranga Harbour samples and the current survey samples that they have very similar concentrations.

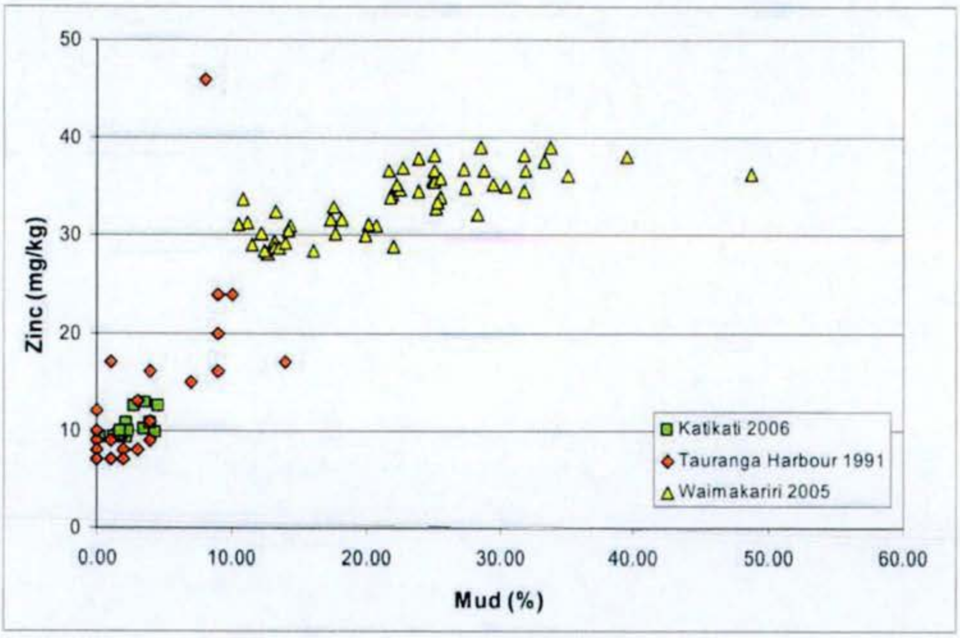

Fig. 4.10: Zinc in Katikati outfall sediments.

Examination of the zinc data showed that there was a statistical difference in the zinc concentration between sites ($F=29.20$, $p<0.001$). The sole difference was a higher concentration in the set comprising the three individual samples from the second sampling run. These samples had a zinc concentration ranging from 12.5 to 12.8 mg/kg in contrast to the remainder of the samples which ranged in concentration from 9.4 to 10.8 mg/kg. The difference may reflect the slightly higher mud content in the three samples compared to the others (not statistically significant) and the fact that the analysis were undertaken in a separate analytical run. It should be noted that the within sediment zinc variation (at a given mud content) is typically about 10%. This is evident in the Waimakariri offshore sediments shown in Fig. 4.10. Fig. 4.11 shows the detail present in Fig. 4.10 for the sediments containing <20% mud.

Zinc is a very common trace element and a common contaminant in wastewater and in urban stormwater. The outfall discharge has been monitored since 1999. The data in Table 2.2 indicates that the concentration measured in 2004/2005 ranged from 0.011 to 0.045 g/m^3 with a median of 0.022 g/m^3.

Overall, given that the outfall discharges a moderate amount of zinc (about 10 kg/year) some accumulation might be expected if the environment around the outfall was depositional in nature. However, the environment is turbulent and the seabed disturbed on a regular basis. As such, accumulation is not likely.

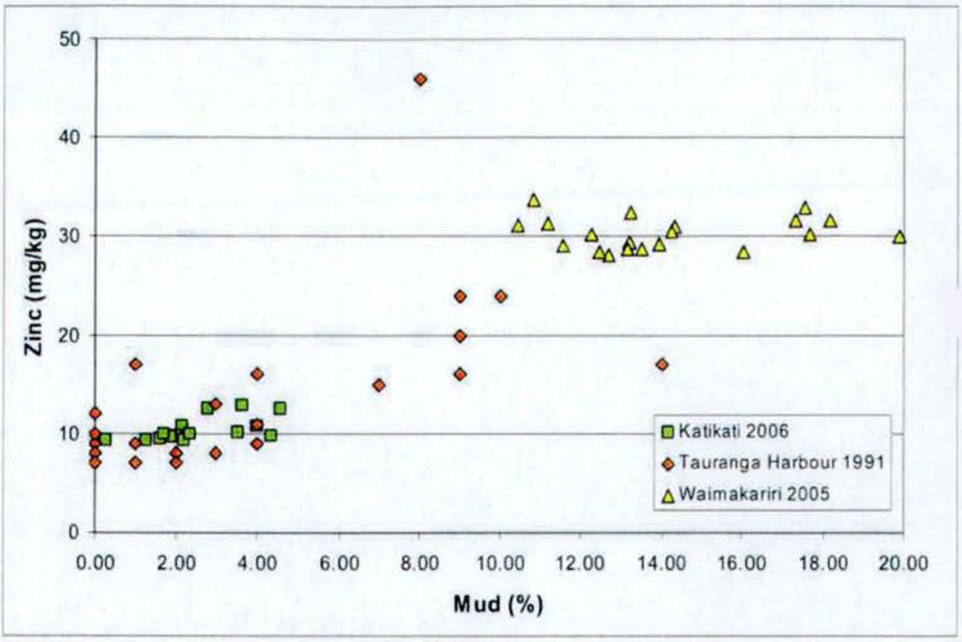

Fig. 4.11: Zinc in sandy sediments.

4.5 Discussion and Summary

The collection of sediments around the Katikati outfall in the 2006 survey has shown that the sediments show little evidence of any accumulation of contaminants as a result of any discharge from the outfall.

Analysis of Katikati wastewater shows that the wastewater has a low suspended solids concentration (median 8 g/m^3) and low concentrations of most key metal contaminants. Although discharge concentration data is limited over a number of years since commissioning by poor detection limits used in the analysis, the most recent year of monitoring provides good data. Median concentrations of arsenic, chromium, mercury, lead and cadmium were all less than 0.001 g/m^3. Copper, nickel and zinc were present in detectable concentrations with copper and zinc being the more common elements present (median concentrations of 0.006 and 0.022 g/m^3 respectively).

5. Benthic Ecology

5.1 Previous Surveys

There have been no previous investigations of the benthic biota present in the region of the Katikati outfall. There have been a number of biological surveys conducted in the Tauranga Harbour, however, (EBOP 1994) and at other ocean outfall locations along the east coast, including Hastings and Gisbourne ocean outfalls (Roper et al. 1989). These surveys show a number of trends in community composition that can be used for comparative purposes with the information gained from around the Katikati WTP outfall.

The macrofaunal communities of the Tauranga Harbour were sampled using 130 mm diameter cores similar to those used in the current survey of the Katikati coastline (EBOP. 1994). The dominant taxonomic group throughout the subtidal harbour areas were polychaete worms, while bivalve molluscs, crustaceans and echinoderms were also common.

Polychaetes were also reported to be the dominant group of macrofaunal taxa at both the Hastings and Gisbourne ocean outfalls (Roper et al. 1989). The most abundant polychaete species in the vicinity of the Hastings outfall included *Heteromastus filiformis*, *Paraprionospio* aff. *pinnata* and *Pectinaria australis*. These species were also present at the Gisbourne outfall, although the cumacean *Diastylopsis crassior* contributed the largest number of individuals at this outfall site. Large numbers of the bivalve *Mactra ordinaria* were also recorded from the Hastings and Gisbourne locations. The substrate conditions of these ocean outfalls varied from that of the Katikati outfall, with Hastings and Gisbourne outfalls occuring in a predominant muddy environment, while the sediments around the Katikati outfall are predominantly sandy reflecting differences in the energetic nature of the environments.

5.2 Sampling Methods

Infaunal biology around the Katikati WTP outfall was examined by collecting 3 x 13 cm diameter cores (15 cm deep) at each of the identified locations shown in Fig. 5.1. Samples were collected at each site by divers using SCUBA, according to a randomised search pattern. Although sites W250, W130 and E140 were sampled and sorted, the organisms present were not formally identified. These sites were replaced in the second sampling run of W100, W50 and E50 by sites located at the designated locations.

On board the vessel, the sample cores collected for biological assessment were sieved (using 0.5 mm sieves) under running seawater and the retained materials preserved using 70% isopropanol. Organisms were then sorted from the remaining debris, post-fixed in 70% isopropanol (for longer term storage), identified to the lowest practicable taxonomic level, and counted.

The immediate receiving environment surrounding the outfall was photographed (Fig. 5.1) and representative epibenthic organisms were hand collected by the divers at each site. Epifaunal samples were retained in 70% isopropanol. Organisms were then identified to the lowest possible practicable taxonomic level and counted.

5.3 Epibenthos

The seabed around the Katikati WTP outfall was examined during the survey and photographs taken (Fig. 5.1). The examination showed that the seabed had a rippled sand substrate, with no indication of and fine silt sediment accumulation. Drift algae was visible in some instances but the typical conspicuous epifauna at both outfall and control sites included sea dollars, and bivalve and gastropod molluscs. Mussels were the predominant encrusting taxa of the outfall structure (Fig. 5.1).

Information on the epifaunal species present at each of the sites is summarised in Table 5.1. The sand dollar, *Fellaster zelandiae* was the most commonly occurring conspicuous epifaunal species and was found at all sampling sites. Other epifaunal taxa included hermit crabs, three species of bivalves and three species of gastropod molluscs.

Table 5.1: Summary of epifaunal taxa present around the Katikati outfall in February, 2006.

Taxa		W250	W130	E100	E140	E250	E1000
Echinodermata							
	Fellaster zelandiiae	√	√	√	√	√	√
Crustacea							
	Pagurus sp.		√	√			√
Mollusca							
	Dosinia anus			√	√	√	
	Myadora striata			√	√	√	√
	Spisula aequilateralis				√	√	
	Amalda australis						√
	Charonia lampas capax						√
	Umbonium zelandicum					√	√

Overall, there appeared to be an increase in the number of epifaunal species from west to east along the transect. There was a general lack of epibenthic taxa at the western sampling sites, with faunal composition extending to include bivalve species at the eastern sampling sites. The E1,000 control site had the greatest number of epifaunal species of all sites, including gastropod and bivalve molluscs, sand dollars and hermit crabs. All species listed in Table 5.1 are typically present in coastal sandy environments and the gastropods *Charonia lampas capax* and *Amalda australis* are reported to be common in harbours in the Bay of Plenty region (Powell 1993).

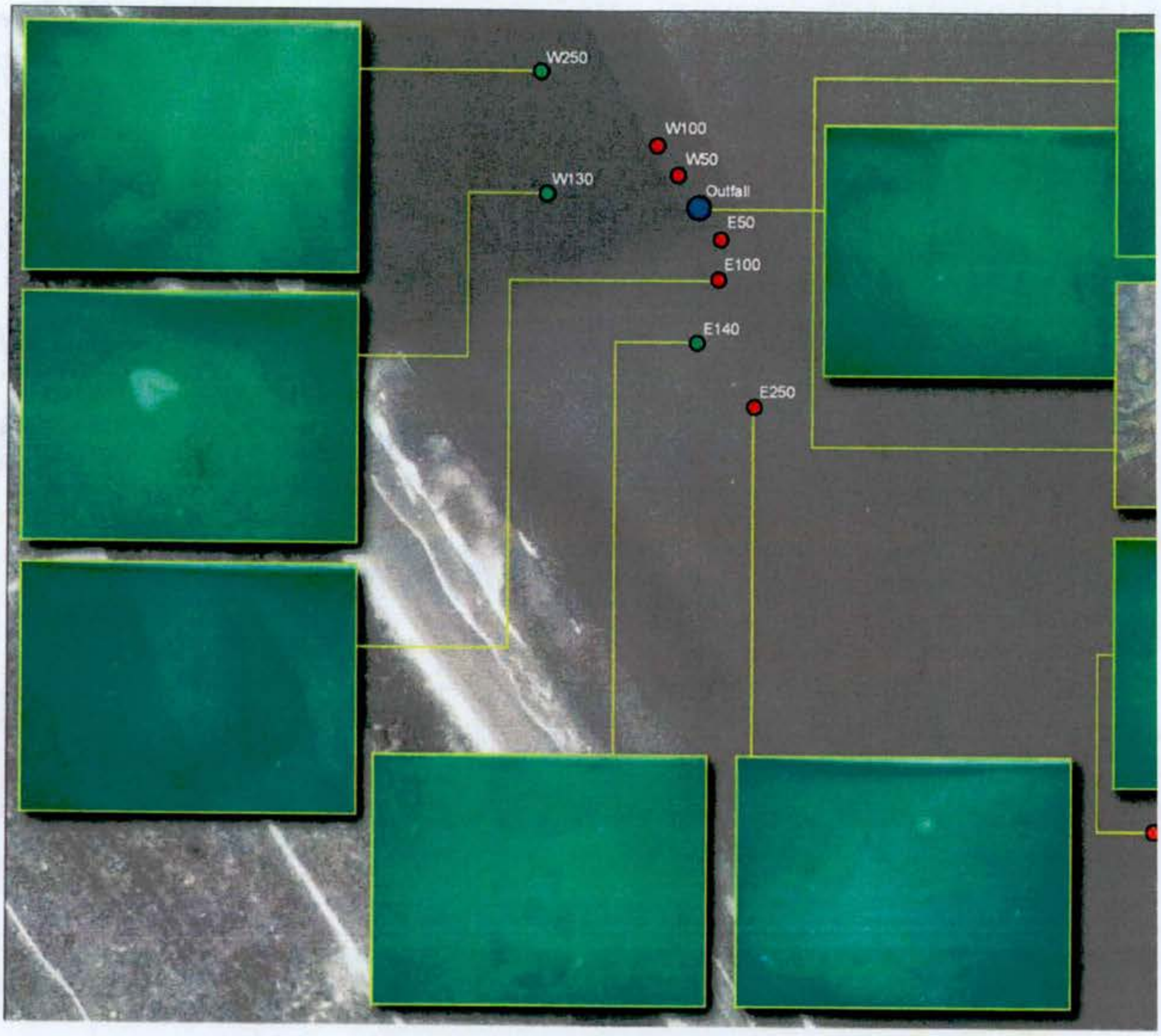

Fig. 5.1: Location of sampling points around the Katikati outfall.

5.4 Benthic Infaunal Assemblages in the Outfall Vicinity

5.4.1 Overall abundance, species richness and diversity

A summary of data for species richness and overall abundance of infaunal species at the Katikati WTP outfall sites and eastern control site is presented in Table 5.2. Species richness from the sites sampled is illstrated in Figs. 5.2 and 5.3, while abundance is illustrated in Figs. 5.4 and 5.5.

Table 5.2: Summary of richness and abundance (± standard error) at outfall and control sites.

Location	Site	Richness	Abundance
Control	E1000	14.0 ± 1.7*	83.7 ± 20.6
Outfall	W50	16.3 ± 0.7	143.0 ± 27.5
	W100	19.3 ± 1.8	160.3 ± 29.9
	E50	19.0 ± 2.1	116.7 ± 14.5
	E100	14.3 ± 2.2	69.7 ± 10.5
	E250	17.7 ± 0.9	121.0 ± 22.2
	Average	16.8 ± 0.8	115.7 ± 10.7

Note: * n=3.

Species richness fluctuated marginally between sites, ranging from 11 to 19 species per site. Generally, species richness was higher at the sites in the vicinity of the outfall in comparison to the control site (Fig. 5.2). The westernmost station (W100) had the highest average species richness of all sampling sites (Fig. 5.2). There were no statistical differences in richness between the sites (F=2.132, p=0.114).

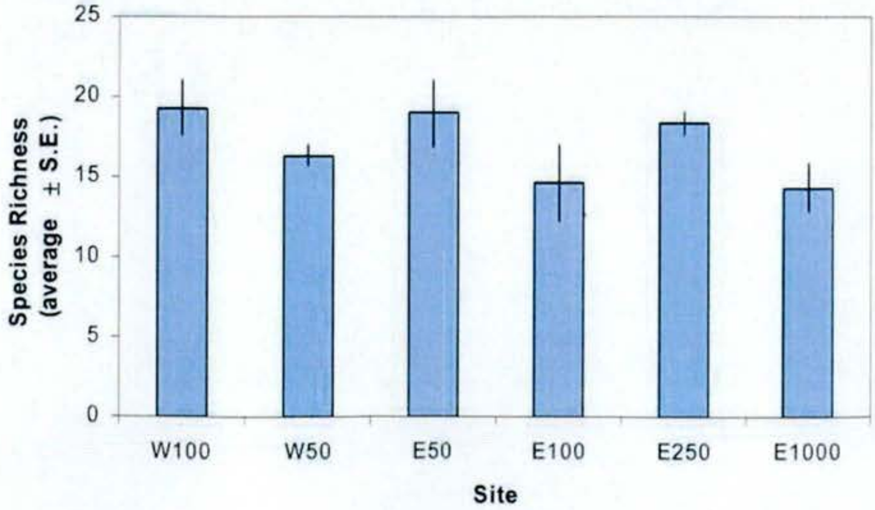

Fig. 5.2: Species richness at control and outfall sites for 2006.

Species richness for taxonomic groups, including annelids, mollusca, crustaceans and echinoderms, are illustrated in Figs. 5.3. The annelids were the most diverse of the taxonomic groups at the sites located to the east of the outfall. Conversely, the crustacean group was the most species rich for the western sites. Typically, from east to west, crustacean species richness increased, while polychaete and mollusc species richness decreased, indicating some broad scale change in faunal composition occurring along the coastline.

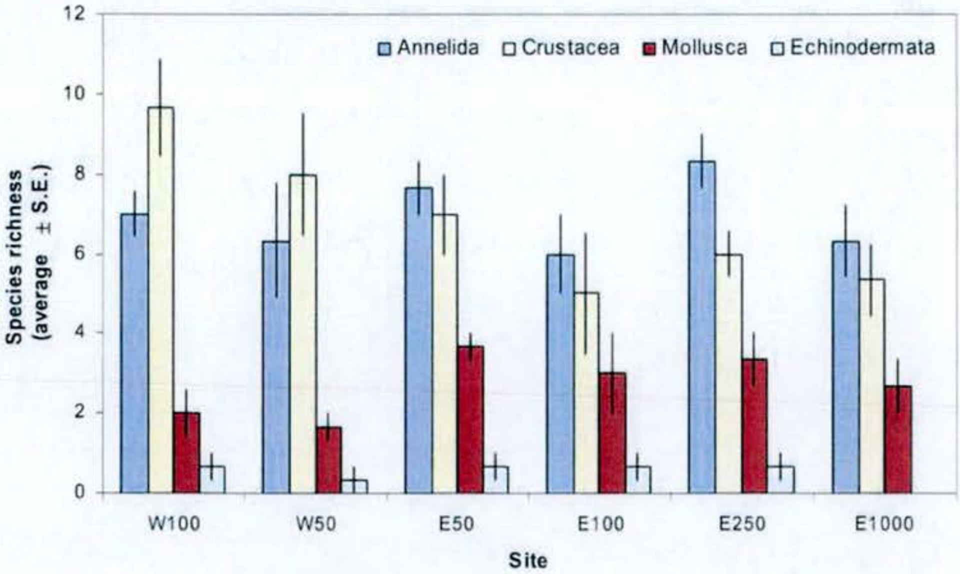

Fig. 5.3: Species richness of common taxa groups at outfall and control sites for 2006.

Average abundance for all sites ranged from 70 to 207 individual organisms (Table 5.2). The greatest average abundance occurred at the westernmost site (W250), while site E100 contained the least number of organisms. Generally, the control site had a lower average abundance than the sites closer to the outfall. Overall, there was general increase in average abundance from east to west along the transect (Fig. 5.4). Statistical analysis of abundance data showed that site W250 had the highest abundance and site E100 the lowest with the sites being statistically different from each other but not from any other site ($F=3.967$, $p=0.016$).

A summary of the total abundance of taxonomic groups for all sites is illustrated in Fig. 5.5. At all locations, annelids were the most abundant taxon, followed by the crustaceans. The western-most site contained the greatest abundance of annelid and crustacean organisms, while the eastern site E100 contained the least number of animals from these two groups.

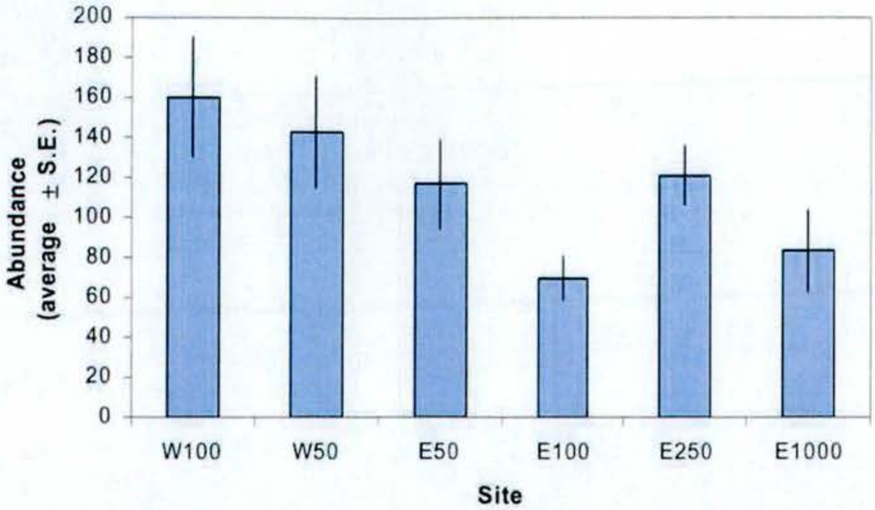

Fig. 5.4: Total abundance of infaunal organisms at control and outfall sites for 2006.

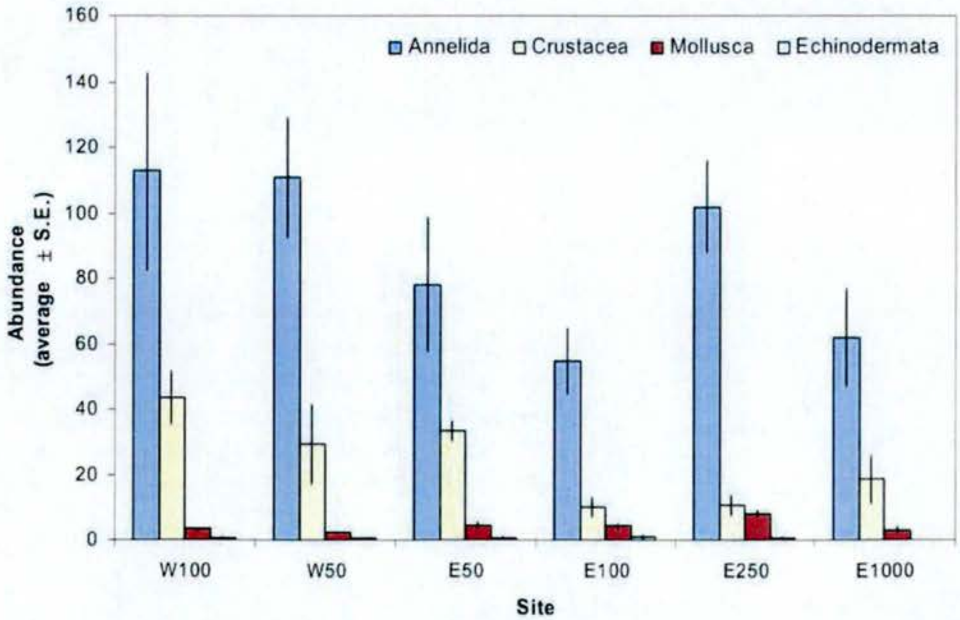

Fig. 5.5: Total abundance of infaunal organisms from common taxa groups at outfall and control sites for 2006.

5.4.2 Community assemblages

A summary of data for species diversity is presented in Table 5.3 and Fig. 5.6. Species diversity was higher at the outfall sites W100 and E50 in comparison to the other sites in the vicinity of the diffuser and to the control site.

Table 5.3: Summary of diversity (± standard error) for outfall and control sites.

Location	Site	Berger-Parker Dominance Index (1/d)
Control	E1000	1.6 ± 0.2
Outfall	W50	1.6 ± 0.1
	W100	2.3 ± 0.4
	E50	2.6 ± 0.7
	E100	1.6 ± 0.1
	E250	1.4 ± 0.1
	Average	1.8 ± 0.2

Overall, average species diversity varied only slightly, with no considerable differences evident between the outfall sites and the control location. There was no statistical difference between the sites examined (F=2.441, p=0.079). Species diversity was lowest at the westernmost site W250, a site that had a very high abundance of polychaete worms, *Prionospio* sp. in particular (Appendix 2).

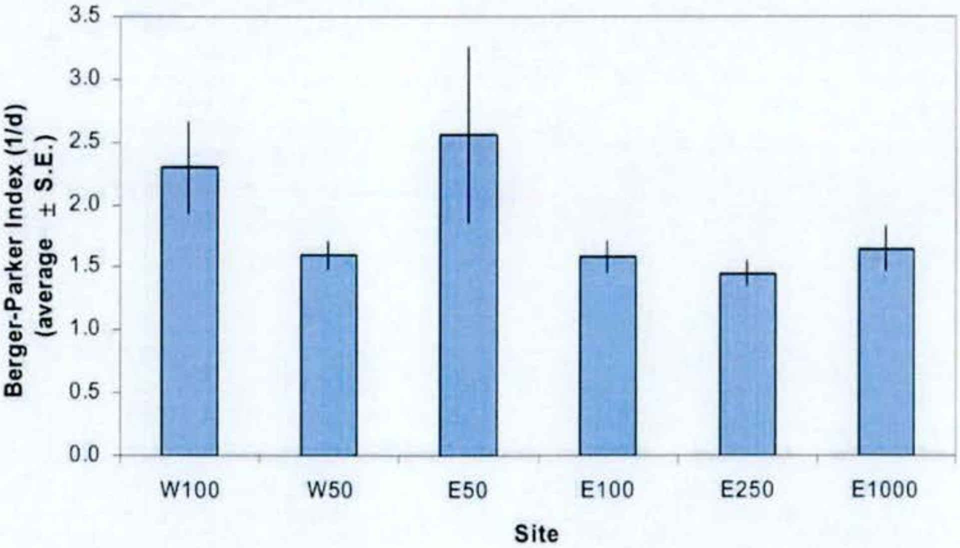

Fig. 5.6: Berger Parker Dominance index (1/d) for outfall and control sites for 2006.

Table 5.4 includes the ten most abundant species for the outfall sites and the control location. The polychaete *Prionospio* sp. was the most abundant species for all sites in close vicinity to the diffuser and at the control site, with this species contributing 57-62% of the overall abundance. There was a statistical difference in the abundance of *Prionospio* with site W250 having higher numbers compared to all other sites (F=6.168, p=0.002). The data for another polychete *Megelona* also had higher abundance at the W250 site, with W250 and W50 sites having higher numbers than sites E100 and E1000 (F=7.523, p=0.001).

Other species present in high abundance at both the outfall and control sites included the ostracod *Diasterope* sp. and an annelid Nematode sp. Overall, the outfall sites had a slightly greater abundance of annelid worms, compared to the control site.

Table 5.4: Composition and abundance of the ten most abundant species for the control and outfall assemblages.

Location	Species composition	Total abundance	Percent of total abundance
Control site	Polychaeta-*Prionospio* sp.	157	62.55
	Ostracoda-*Diasterope* sp.	24	9.56
	Amphipoda-Amphipod sp. 4	15	5.98
	Nematoda-Nematoda sp.	12	4.78
	Polychaeta-*Aglaophamus* sp.	5	1.99
	Copepoda-Copepod sp. 2	5	1.99
	Polychaeta-*Magelona* sp.	4	1.59
	Amphipoda-Amphipod sp. 2	4	1.59
	Bivalvia-*Myllitella vivens vivens*	3	1.20
	Cumacea-*Diastylopsis thilensiusi*	3	1.20
Outfall sites	Polychaeta-*Prionospio* sp.	1060	57.86
	Amphipoda-Amphipod sp. 4	136	7.42
	Polychaeta-*Magelona* sp.	112	6.11
	Nematoda-Nematoda sp.	111	6.06
	Amphipoda-*Haustorius* sp.	63	3.44
	Ostracoda-*Diasterope* sp.	28	1.53
	Ostracoda-Ostracod sp.	25	1.36
	Bivalvia-*Myllitella vivens vivens*	23	1.26
	Isopoda-Paramunnid sp.	22	1.20
	Amphipoda-*Microphoxus* sp.	21	1.15

5.5 Discussion and Summary

The composition of species present at all sites around the Katikati WTP outfall was largely similar, with no consistent relationship observed between the distance from the location of the diffuser community type and organism abundance. There was an increase in epifaunal species richness from west to east with the greatest number of conspicuous epifaunal species collected from site E1000. There was, conversely, a general decrease in infaunal organism abundance, species richness and diversity west to east across the sites with a peak at W100 to site E100 that contained fewer benthic organisms. In comparison with the sites located in the vicinity of the diffuser, the benthic infaunal composition of the control site was typically less abundant and had a smaller number of species. Polychaete worms and crustaceans comprised the majority of the infaunal benthos.

The faunal composition of open coastal environments tends to be less diverse than that of protected beaches (Morton & Miller 1968), as exposed coastal environments have more energetic water flows resulting in highly mobile coarse sediments that can be abrasive for delicate infaunal organisms. Many of the species present in the region of the Katikati outfall are frequently found in coastal, sandy environments such as that present along the Tauranga coast. For example, *Aglaophamus macroura*, *Magelona* sp. and *Pectinaria* sp. are typical sand burrowing polychaete species (Morton & Miller 1968). Other species commonly reported as inhabitants of sandy flats include the bivalves *Dosinia anus*, *Soletellina nitida*, the crustacean *Diastyliopsis thilensinsi*.

A number of these species have also been recorded from sites within the Tauranga Harbour (EBOP 1994). Species present both within the harbour and from the Katikati outfall region include the polychaetes *Aglaophamus* spp., *Magelona* sp, *Glycera* sp., *Pectinaria* sp. and *Notomastus* sp. Crustaceans common to both the harbour and coastal areas of Tauranga include the burrowing shrimp *Upogebia* sp and phoxochepalid amphipods. The cake urchin *Fellaster zelandiae* was a commonly occurring member of the epifauna in both the Tauranga Harbour investigation and the current survey of the Katikati outfall.

Overall, there were no significant effects on the benthic fauna detected in relation to the discharge of the Katikati WTP outfall. There was no indication of fine silt accumulation on the sediment surface around the outfall and the detected changes in benthic fauna were generally along a west to east gradient rather than in the region of the Katikati WTP discharge.

6. Discussion and Summary

This report summarises the results of a survey of the Katikati outfall environment required as a condition of the resource consent granted to WBPDC for the discharge of treated wastewater from the Katikati outfall. The survey focused on the quality of sediments near the outfall and the health of benthic invertebrate communities.

The volume of wastewater discharged from the Katikati outfall is small (~1,216 m^3/day) by comparison with many large urban wastewater treatment system discharges. Analysis of Katikati wastewater shows that the wastewater contains a low suspended solids concentrations (median 8 g/m^3) and low concentrations of most key metal contaminants. Median concentrations of arsenic, chromium, mercury, lead and cadmium were all less than 0.001 g/m^3. Copper, nickel and zinc were present in detectable concentrations with copper and zinc being the more common elements present (median concentrations of 0.006 and 0.022 g/m^3 respectively).

To provide some comparison, Table 6.1 compares the load discharged from the Katikati outfall along with that from a significant outfall such as the NSCC Rosedale outfall. The comparison shows that for some elements (e.g., mercury), assessment of load is limited by the detection limits used in the analysis to date. For some elements (e.g., chromium, lead) the loads are low compared to those from the Rosedale outfall when adjusted for the relative flows. For copper, nickel and zinc the loads are similar to Rosedale when flow is taken into account.

Table 6.1: Summary of trace element loads in treated wastewater quality from the Katikati wastewater treatment Plant (all units g/day).

Parameter	Katikati	Rosedale**
Daily flow m^3	Average maximum daily flow 1,216	Average daily flow 72,000
Arsenic	<2.4	NA
Cadmium	<1.2	<3.6
Chromium	<1.2	216
Copper	7.3	792
Mercury	<1.2	0.5
Lead	<1.2	273
Nickel	3.0	2,088
Zinc	26.7	2,520

Notes: * - median (range). ** from NIWA (1999)

The examination of sediments in the vicinity of the Katikati outfall diffuser has shown a dominance of sands, with very little mud or gravel material. This was consistent with the previous description of well-sorted fine sands present to 24 m depths along the Katikati coastline (Hesp et al. 1999). There does not appear to be any pattern of sedimentary characteristics relating to the presence of the Katikati outfall.

The measurement of strong acid extractable metal concentrations in sediments around the outfall, has shown that the sediments show little evidence of any accumulation of contaminants as a result of any discharge from the outfall.

The low abundance and diversity of benthic fauna is typical of sandy, coastal environments and several of the benthic species found in this region are common in these conditions. The infaunal community at both outfall and control sites was dominated by polychaete worms, with several crustacean and molluscan species also present in the area. The variation in total abundance, species richness and diversity throughout the sampling area was not significantly different. Overall, there was no indication that the discharge from the outfall was having any adverse effects on benthic infaunal communities.

7. References

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Appendices

Appendix 1

Sediments - laboratory reports and data

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Client: *Kingett Mitchell & Assoc*
Address: *P O Box 33 849, Takapuna AUCKLAND*
Contact: *Paul Kennedy*

Laboratory No: *406509*
Date Registered: *14/02/2006*
Date Completed: *27/02/2006*

Client's Reference: DUFWGKTK001

The results for the analyses you requested are as follows:

Sample Type: Environmental Solids, Sediment

Sample Name	E50 10/02/06	W50 10/02/06	W100 10/02/06
Lab No	406509/1	406509/2	406509/3
Total Organic Carbon (g/100g dry wt)	0.15	0.15	0.14
Total Nitrogen (g/100g dry wt)	< 0.1	< 0.1	< 0.1
Total Recoverable Phosphorus (mg/kg dry wt)	153	153	156
Total Recoverable Arsenic (mg/kg dry wt)	4.7	5.3	4.9
Total Recoverable Cadmium (mg/kg dry wt)	< 0.01	< 0.01	< 0.01
Total Recoverable Chromium (mg/kg dry wt)	6.1	6.6	6.4
Total Recoverable Copper (mg/kg dry wt)	0.5	0.5	0.5
Total Recoverable Mercury (mg/kg dry wt)	0.01	0.01	0.01
Total Recoverable Nickel (mg/kg dry wt)	1.6	1.6	1.6
Total Recoverable Lead (mg/kg dry wt)	2.31	2.52	2.42
Total Recoverable Zinc (mg/kg dry wt)	12.8	12.6	12.5

Sample Containers

The following table shows the sample containers that were associated with this job.

Container Description	Container Size (mL)	Number of Containers
Plastic Jar (Soils)	400	3

Details of sample bottle preparation procedures are available upon request.

Summary of Methods Used and Detection Limits

The following table(s) gives a brief description of the methods used to conduct the analyses for this job.
The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Substance Type: Environmental Solids

Parameter	Method Used	Detection Limit
Dry and sieve sample	Air dry (35 °C), sieved to pass 2mm.	N/A
Total Recoverable digest	Nitric / hydrochloric acid digestion. US EPA 200.2	N/A
Total Organic Carbon	10% HCl, hotplate 2hrs, acid pretreatment to remove carbonates if present, Elementar Combustion Analyser.	0.05 g/100g dry wt
Total Nitrogen	Catalytic Combustion (900°C, O_2), separation, Thermal Conductivity Detector [Elementar Analyser]	0.05 g/100g dry wt
Total Recoverable Phosphorus	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	40 mg/kg dry wt
Total Recoverable Arsenic	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.2 mg/kg dry wt
Total Recoverable Cadmium	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.01 mg/kg dry wt
Total Recoverable Chromium	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.2 mg/kg dry wt
Total Recoverable Copper	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.2 mg/kg dry wt
Total Recoverable Mercury	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.01 mg/kg dry wt
Total Recoverable Nickel	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.2 mg/kg dry wt
Total Recoverable Lead	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.04 mg/kg dry wt
Total Recoverable Zinc	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.4 mg/kg dry wt

Analyst's Comments:

These samples were collected by yourselves and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the submitter.

This report must not be reproduced, except in full, without the written consent of the signatory.

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Contact: Paul Kennedy

Laboratory No: 402894
Date Registered: 11/01/2006
Date Completed: 19/01/2006

Client's Reference: DUFWGKTK001

The results for the analyses you requested are as follows:

Sample Type: Environmental Solids, Sediment

Sample Name	Lab No	Total Organic Carbon (g/100g dry wt)	Total Nitrogen (g/100g dry wt)	Total Recoverable Phosphorus (mg/kg dry wt)	Total Recoverable Arsenic (mg/kg dry wt)	Total Recoverable Cadmium (mg/kg dry wt)
WBDC - E50 - S-A 10/1/06	402894/1	0.18	< 0.1	165	4.6	< 0.01
WBDC - E50 - S-B 10/1/06	402894/2	0.15	< 0.1	170	3.8	< 0.01
WBDC - E50 - S-C 10/1/06	402894/3	0.15	< 0.1	154	4.0	< 0.01
WBDC - E100 - S-A 10/1/06	402894/4	0.13	< 0.1	172	4.5	< 0.01
WBDC - E100 - S-B 10/1/06	402894/5	< 0.1	< 0.1	173	5.0	< 0.01
WBDC - E100 - S-C 10/1/06	402894/6	< 0.1	< 0.1	177	4.7	< 0.01
WBDC - E250 - S-A 10/1/06	402894/7	0.13	< 0.1	183	4.7	< 0.01
WBDC - E250 - S-B 10/1/06	402894/8	0.13	< 0.1	167	4.9	< 0.01
WBDC - E250 - S-C 10/1/06	402894/9	< 0.1	< 0.1	139	4.1	< 0.01
WBDC - E1000 - S-A 10/1/06	402894/10	0.13	< 0.1	171	5.2	< 0.01
WBDC - E1000 - S-B 10/1/06	402894/11	< 0.1	< 0.1	180	4.4	< 0.01
WBDC - E1000 - S-C 10/1/06	402894/12	0.13	< 0.1	165	4.6	< 0.01

Sample Name	Lab No	Total Recoverable Chromium (mg/kg dry wt)	Total Recoverable Copper (mg/kg dry wt)	Total Recoverable Mercury (mg/kg dry wt)	Total Recoverable Nickel (mg/kg dry wt)	Total Recoverable Lead (mg/kg dry wt)
WBDC - E50 - S-A 10/1/06	402894/1	5.8	0.5	0.01	1.4	2.42
WBDC - E50 - S-B 10/1/06	402894/2	5.2	0.5	< 0.01	1.3	2.13
WBDC - E50 - S-C 10/1/06	402894/3	5.8	0.5	0.01	1.6	2.35
WBDC - E100 - S-A 10/1/06	402894/4	5.6	0.4	0.01	1.3	2.35
WBDC - E100 - S-B 10/1/06	402894/5	5.4	0.4	0.01	1.3	2.15
WBDC - E100 - S-C 10/1/06	402894/6	5.5	0.4	< 0.01	1.3	2.39
WBDC - E250 - S-A 10/1/06	402894/7	5.1	0.4	< 0.01	1.4	2.24
WBDC - E250 - S-B 10/1/06	402894/8	5.3	0.5	0.02	1.3	2.24
WBDC - E250 - S-C 10/1/06	402894/9	5.1	0.5	< 0.01	1.4	2.13
WBDC - E1000 - S-A 10/1/06	402894/10	6.0	0.5	< 0.01	1.5	2.43
WBDC - E1000 - S-B 10/1/06	402894/11	5.5	0.5	< 0.01	1.4	2.20
WBDC - E1000 - S-C 10/1/06	402894/12	5.6	0.5	< 0.01	1.4	2.37

Sample Name	Lab No	Total Recoverable Zinc (mg/kg dry wt)
WBDC - E50 - S-A 10/1/06	402894/1	10.2
WBDC - E50 - S-B 10/1/06	402894/2	9.4
WBDC - E50 - S-C 10/1/06	402894/3	10.8
WBDC - E100 - S-A 10/1/06	402894/4	9.8
WBDC - E100 - S-B 10/1/06	402894/5	9.3
WBDC - E100 - S-C 10/1/06	402894/6	9.6
WBDC - E250 - S-A 10/1/06	402894/7	9.5
WBDC - E250 - S-B 10/1/06	402894/8	9.8
WBDC - E250 - S-C 10/1/06	402894/9	9.4
WBDC - E1000 - S-A 10/1/06	402894/10	10.7
WBDC - E1000 - S-B 10/1/06	402894/11	10.0
WBDC - E1000 - S-C 10/1/06	402894/12	9.9

Summary of Methods Used and Detection Limits

The following table(s) gives a brief description of the methods used to conduct the analyses for this job.
The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Substance Type: Environmental Solids

Parameter	Method Used	Detection Limit
Dry and sieve sample	Air dry (35 °C), sieved to pass 2mm.	N/A
Total Recoverable digest	Nitric / hydrochloric acid digestion. US EPA 200.2	N/A
Total Organic Carbon	10% HCl. hotplate 2hrs. acid pretreatment to remove carbonates if present, Elementar Combustion Analyser.	0.05 g/100g dry wt
Total Nitrogen	Catalytic Combustion (900°C, O_2), separation, Thermal Conductivity Detector [Elementar Analyser]	0.05 g/100g dry wt
Total Recoverable Phosphorus	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	40 mg/kg dry wt
Total Recoverable Arsenic	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.2 mg/kg dry wt
Total Recoverable Cadmium	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.01 mg/kg dry wt
Total Recoverable Chromium	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.2 mg/kg dry wt
Total Recoverable Copper	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.2 mg/kg dry wt
Total Recoverable Mercury	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.01 mg/kg dry wt
Total Recoverable Nickel	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.2 mg/kg dry wt
Total Recoverable Lead	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.04 mg/kg dry wt
Total Recoverable Zinc	Nitric / hydrochloric acid digestion, ICP-MS (Low level). US EPA 200.2	0.4 mg/kg dry wt

Analyst's Comments:

These samples were collected by yourselves and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the submitter.

Peter Robinson

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Environmental Division Manager

Terry Cooney, MSc(Hons), PhD MNZIC
General Manager

Appendix 2

Benthic Infauna Data

Appendix 2: Benthic Infauna Data

Taxa			Site										
			W250			W100			W50			E5	
			A	B	C	A	B	C	A	B	C	A	B
Annelida	Chaetognatha	Chaetognath sp.											
	Echiura	Euchiurid sp.			1		1				1	1	2
	Nematoda	Nematoda sp.	4	4		6	43	22	1	5	4	8	5
	Nemertea	Nemertea sp.											
	Polychaeta	*Aglaophamus macroura*						1					
		Aglaophamus sp.		1		3	1	1		1	1	2	1
		Aphelochaete sp.							1				
		Glycera sp.				1	1						2
		Goniada sp.		1		1							
		Hesionella sp.											2
		Genetyllis sp.					5	1			1		
		Magelona sp.	17	17	11	13	6	3	17	14	11	[illegible]	8
		Nereid sp.											
		Notomastus sp.											
		Paraonid sp.								1	1		
		Pectinaria sp.											
		Podarkeopsis sp.	1	1	1						1	3	
		Prionospio sp.	190	212	130	66	115	44	121	94	56	62	19
		Scoloplos sp.											
		Spionid sp.	1			3					1		
		Sthenelais sp.			1	1				1		1	2
		Syllid sp. 1											1
		Syllid sp. 2											
		Syllid sp. 3											
		Terebellid sp.											
Crustacea	Amphipoda	Amphipod sp. 1											
		Amphipod sp. 2		1		1			1	3	1	2	1
		Amphipod sp. 3						1				1	
		Amphipod sp. 4	3	3	2	5	9	40	6	31		19	10
		Amphipod sp. 5											
		Haustorius sp.		6		2	25	6	6	5	2	6	3
		Microphoxus sp.				2			4	1			3
		Paraphoxus sp.				1	1	1		2		2	1
	Copepoda	Copepod sp. 1											
		Copepod sp. 2				1	1						
	Cumacea	*Colourstylis* sp.											1
		Cyclaspsis sp.					2						
		Diastylopsis crassior			1								
		Diastylopsis thilensiusi		1		1	1	3	3	2	1		
	Decapoda	Juvenile crab		1									
		Pagurus sp.		1						2			
		Ogyrides dettlli											
		Upogebia sp.				2	2		1	1			
	Isopoda	Microcerbid sp.									1		1
		Natolana sp.				1		1					
		Paramunnid sp.		1		8	1	5	1	1			
	Nebaliacea	*Nebalia* sp.		1			1	1					
	Ostracoda	*Diasterope* sp.		1		4			4	2	3		3
		Ostracod sp.				2			4			9	5
	Peracarida	Mysid sp.											
	Unknown	Unknown crustacean		2									
Echinodermata	Asteroidea	*Amphiura* sp.											
	Echnoidea	*Fellaster zelandiae*				1	1				1		1
Mollusca	Bivalvia	Bivalve sp.								3		2	
		Dosinia anus	1										