

BAY OF PLENTY REGIONAL COUNCIL

UNDER

The Tapuika Treaty Claims Settlement Act 2014
(statutory acknowledgment of the Waiari stream)

Tapuika Environmental Management Plan **(EMP)**

Resource management act

AND

IN THE MATTER OF

Review resource consent applications by the western
bay of plenty district council for a continued operation
of discharge of treated waste water from the Te Puke
Waste Water Treatment Plant

STATEMENT OF TE RANGIPUATA JOSEPH HOHEPA MAXWELL

ON BEHALF OF TAPUIKA IWI AUTHORITY

Process / Water Quality / Tapuika Iwi engagement

30TH MARCH 2019

INTRODUCTION

1. **My name** is Te Rangipuatata Joseph (Hohepa) Maxwell and I am a Senior Environmental Resource Manager (**RMU**) Tapuika iwi Authority, (**TIA**) common law charitable trust based in Te Puke. Prior to joining (**TIA**) in Jan 2006, I was senior partner (International Relations) Tobias Bernstein Assoc Australia Pty Limited (**TBA**). I have a Major in Political Science (Victoria University Wellington VUW), University NSW Sydney postgraduate (LLM) I have over thirtenn years of working experience in environmental resource management within New Zealand (focusing on wastewater characterisation / wastewater constituency/ wastewater treatment, Maturanga Maori assessment of environmental effects, assessment of Iwi Hapu Whanau community health risks and consenting

2. **I prepare assessments of cultural and environmental effects** for a number of resource management unit (RMU) consent applications and renewals, and have served as Iwi Hapu Maori Kaitiaki advisor in WWTP discharge water quality assessment/reporting projects (e.g. Te Puke WWTP and Maketu WWTP I have also served as process Iwi Hapu cultural environment assessor review of fresh water quality fresh water quantity fresh water management and I oppose the continuing discharge of treated waste water and the renewal of the existing permits to discharge treated waste water direct to the Waiari

3. **My experience** academic background Kaupapa Māori Research paradigm research undertaken by Māori, for Māori, with Māori. An important aspect of Kaupapa Māori Research seeks to understand and represent Māori, **as Māori**. Kaupapa Māori within research practice dictates that Māori tikanga and processes are followed throughout the research, from inception to the dissemination of results to the ongoing relationship formed between the researcher(s) and the research participant(s). The ongoing development and/or reclamation of Māori methods. Any research method is first interrogated for its cultural sensitivity, cross-cultural reliability. Research is undertaken in a number of fields (*e.g., health, environmental studies*), and a number of different methods are used (*e.g., quantitative, qualitative*).

CODE OF CONDUCT FOR EXPERT WITNESSES

1. I am familiar with the Code of Conduct for Expert Witnesses in the current (2014) Environment Court Practice Note.
2. I agree to comply with this Code of Conduct in giving evidence to this hearing and have done so in preparing this written brief.
3. The evidence I am giving is within my area of expertise, except where I state I am relying on the opinion or evidence of other experts or third parties.
4. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed
5. I confirm that I have read and am familiar with the submissions, Officer's Report and proposed consent conditions. Tapuika Iwi Authority resource management unit have visited the Te Puke WWTP regularly since January 2015 obtaining an understanding of the current treatment processes and general environmental context of the discharge point and immediate receiving environment.

SCOPE OF THE EVIDENCE

1. **My role** in the Te Puke Waste Water Treatment plant (Te Puke WWTP) application is to support Tapuika Iwi Hapu engagement in seeking mitigation of the Harms Hazards and risks to iwi Hapu community, contaminant discharge waste water trace elements in discharge activity in engagements with consent holders Western Bay of Plenty District Council
 - **Tapuika environmental management plan (EMP)** guidelines and protocols with Territorial and local authorities Tapuika Iwi Hapu interests in Te Puke Waste Water Treatment plant (Te Puke WWTP) application
 - Tapuika Cultural Impact Assessment (CIA) Assessment of the Cultural and Environmental harms hazards and risks to Tapuika iwi Hapu Health discharge of waste water directly into the Waiari Stream
 - Tapuika iwi Authority engagement process as a member of the waste water Te Puke community (OPTIONS) advisory group
 - I have relied upon the Tapuika environmental management plan (EMP) guidelines and protocols and supplementary Tapuika Cultural Impacts Assessment s (CIA)
 - **Tapuika Kaitiakitanga** acknowledged in legislation and is defined as: the exercise of guardianship by the tangata whenua of an area in accordance with tikanga Māori in relation to natural and physical resources, and include the ethic of stewardship (section 2 RMA)
2. **Effects based approach** reforms the current approach of the RMA has been to promote sustainability as a planning tool; reforms are moving to an effects based approach, in this approach the Tapuika statements reflect the real world and existing effects of the activity accordingly a renewal of the existing permits must have regard for the effect of the discharge of treated waste water directly into the Waiari stream
3. **Matauranga Maori biodiversity**; Terrestrial Ecology Assessment Maori biodiversity, monitoring of the primary sector, highlights areas of current uncertainty in mitigation of hazards harms and risks “Manawhakahono a rohe”

4. ***Mana Whakahono a rohe*** - Cultural Indicators ecosystem; there needs to be a corresponding shift in research focus from DNA meta barcoding method development and evaluation toward (Waiari) real-world ecological applications that provide rich information for a range of purposes, including conservation planning and land management decisions. *Key focus:* biodiversity monitoring; bioinformatics; biosecurity; cultural indicators. A Cultural Health Index component capturing *Cultural status* component confirming Mahinga kai component elements widened to “cultural uses” and exclusively narrowed to solely mahinga kai.
5. ***Waiari Cultural stream health*** capturing expanded new indicators added to Cultural stream health components, new indicators added to Cultural stream health component included
 - i. Catchment land use
 - ii. Riparian (river margin) vegetation
 - iii. use of the riparian margin
 - iv. Riverbed condition/sediment
 - v. River channel modification
 - vi. Flow and habitat variety
 - vii. Turbidity Water clarity Water quality
6. ***Tapuika Cultural Environmental Impact Assessment (CIA)*** was undertaken in review of the performance of the Te Puke WWTP and seeking revised effluent quality standards in the future. The comparison of proposed standards and Iwi suggestions are summarised in the AECOM project opinions proposed by WBOPDC
 - i. Tapuika Iwi in mitigation of harms hazards and risks seeking more stringent effluent standards in comparison to those proposed by WBOPDC.
 - ii. Engagement of Tapuika resulted in further suggestions proposed by Tapuika Iwi which involve ongoing monitoring preceding and post the upgrade work review/revision of the effluent standards supported by the monitoring results.
 - iii. Tapuika Iwi suggested levels tabulated in AECOM Table 6 proposed effluent standards do reflect the existing technical capacity and relies on the proposed upgrades at the Te Puke WWTP.

MY EVIDENCE WILL COVER

- (a) ***Kaitiakitanga*** acknowledged in legislation and is defined as follows: the exercise of guardianship by the tangata whenua of an area in accordance with tikanga Māori in relation to natural and physical resources, and include the ethic of stewardship (section 2 RMA)
- (b) ***Mauri*** The existing status of the treatment plant and envisaged upgrades required affecting Mauri of the Waiari
- (c) ***Mana Whakahono a rohe*** - The existing environmental context and status of receiving waters Waiari Stream and Kaituna River with respect to water quality.
- (d) ***Matauranga Maori*** Local Maori Knowledge of the cultural and environmental effects and impact easements of the renewal of the existing consent permits.
- (e) ***Cultural Management Plan - Effects*** based approach; content and quality of the wastewater characteristics effluent from the Te Puke WWTP, and its potential impact on the receiving waters and quality assurances with regard to water quality, Tapuika Iwi Hapu health risks and treatment processes in mitigation of the effects, Waiari catchment Cultural Management Plan Importance of Hapū/Iwi Resource Management Plans planning documents recognised by an iwi authority provide a mechanism in which tāngata whenua interests they can be considered in Council processes.
- (f) ***Legislative requirements Cultural Management Plan*** There are specific legislative requirements which place a duty on Council staff to take these

plans into account. The importance of HIMP planning documents is that they have been recognised by Bay of Plenty Regional Council ¹

EXECUTIVE SUMMARY

(a) ***Renewal existing consent*** Western Bay of Plenty District Council is applying for a 35-year discharge consent for the Te Puke Wastewater Treatment Plant. The current discharge consent for the plant expired in November 2016 so Western Bay District Council lodged an application to the Bay of Plenty Regional Council for consent renewal. . At present the plant discharges into the Waiari Stream. The review of alternatives has been ongoing project and is expected to take several years. In the absence of mitigation and the risks to Tapuika iwi Hapu community Health; a renewal of the existing consent is not supported by Tapuika iwi Hapu. The current discharge consent for the plant expired in November 2016. Renewal of the existing allows; a further thirty five years of potential risks and harms to Tapuika Iwi Community Health

(g) ***Tapuika Iwi Hapu Kaitiakitanga*** Tapuika Iwi Hapu concerns, that the current assets at Te Puke WWTP are not adequate to meet the envisaged future effluent quality limits. In addition to redundancy issues associated with some process units that need to be addressed (e.g. inlet works and solid handling processes), a reasonable upgrade for the secondary treatment system (i.e. increase of both anoxic zone and aerobic zone) with associated recycling streams will be necessary in order to meet the proposed discharge quality limits, is a *basis for opposing the renewal of the existing discharge consent permits*

(h) ***Mauri monitoring*** Te Puke WWTP effluent discharge is contributing to the nutrient elevation, phosphorus in particular, observed at the Waiari Stream downstream to the effluent discharge. This conclusion was

¹ Attachments provided of the Tapuika Environmental Management Plan (EMP)
 Attachments provided of Tapuika Cultural Environmental Assessments (CIA)
 Attachments provided of Tapuika Cultural Management plan (CMP)

derived based on historical monitoring of the nutrient levels both downstream and upstream of the discharge point.

(i) **Monitoring exceedances** With the proposed more stringent nutrient concentration and mass load limits within the treated effluent, water quality within the receiving water body be maintained and monitored by Tapuika iwi for the whole term of the consent, as *a basis for opposing the renewal of the existing discharge consent permits*

(j) **Mana Whakahono a rohe** Waiari stream Water quality assessment has focused primarily on the Waiari Stream as it is the direct receiving environment of the Te Puke WWTP discharge. The localised water quality monitoring within the Waiari Stream has been undertaken over 10 years. Tapuika iwi Hapu review of the historical monitoring results and understanding of the Waiari Stream, the discharge associated with this consent renewal as a continuation of existing state

- Te Puke WWTP a contributor of water quality degradation within the Kaituna River or the Maketu Estuary. In anticipation of the additional trade waste connection that will require additional treatment or pre-treatment the existing consent conditions, do not make provision for those potential additions.
- Te Puke WWTP is likely to receive wastewater generated from Rangiuru Business Park (RBP) holds a consent to lay a pipeline to the Te Puke WWTP which is to be developed in the future.
- Planned upgrades timeframe and details of the development are unknown, Tapuika seeks an assurance that exceedance limits do not continue to be exceeded and further to ensure water quality is maintained. These factors taken as consideration of the environmental hazards and harms risks is the *basis for opposing the renewal of the existing discharge consent permits*

- (k) ***Tapuika Cultural Environmental - Effects*** based approach Tapuika Iwi Hapu community remaining health risk associated with recreational use of the Waiari Stream and the Kaituna River as a result of the Te Puke WWTP discharge, against an assumption that the Te Puke WWTP operates *normally* and that no outbreaks of *water borne viruses including enteric viruses*.
- (l) ***Tapuika Community Health risks*** The public health risk assessment is normally required to be updated periodically (e.g. in 5-10 year intervals) to reflect changes in processes and Tapuika Hapu community exposure routes, of Enteric viruses may be present naturally in aquatic environments or, more commonly, are introduced through human activities such as leaking sewage and septic systems, urban runoff, agricultural runoff.
- (m) ***Mauri Monitoring*** Waiari stream Waterborne Viruses Over 100 types of pathogenic viruses are excreted in human and animal wastes these viruses can be transported in the environment through groundwater, estuarine water, seawater, rivers, aerosols emitted from sewage treatment plants, insufficiently treated water, drinking water, and private wells that receive treated or untreated wastewater either directly or indirectly



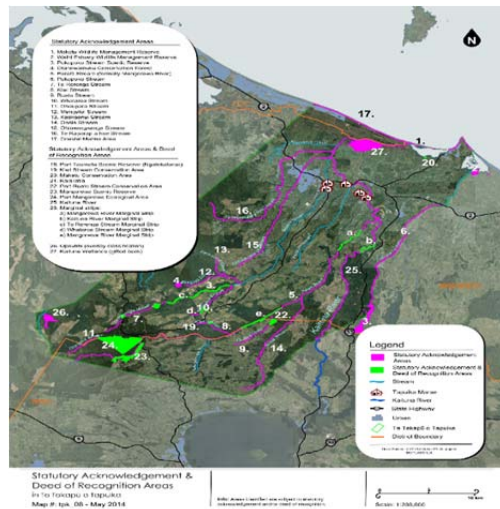
TAPUIKA IWI ENGAGEMENT

A. Treaty Settlement - Tapuika Claims Settlement Act 2014

The origins of Tapuika in Aotearoa date back to the arrival of Tia and his son Tapuika on Te Arawa waka. According to Tapuika tradition, Te Takapu o Tapuika, the tribal estate of Tapuika the iwi was formed on the lands within the claim or taumau of Tia in the Bay of Plenty between Papamoa and Maketu in settlement and statutory Acknowledgment areas of 'Rohe o Tapuika' **Crown acknowledgements and apology** The Crown acknowledges that it breached the Treaty of Waitangi and its principles in its dealings with Tapuika. These breaches include:

- the compulsory extinguishment of Tapuika customary interests and Land Water Taonga through the Tauranga raupatu of the 1860s,
- the destruction of Tapuika settlements in 1867 using scorched earth tactics,
- the erosion of the traditional tribal structures of Tapuika as a result of native land laws, and
- the unlawful taking of a Tapuika wahi tapu sacred sites urupa (cemetery) in 1971.

The Tapuika Claims Settlement Act 2014 deed also includes an apology from the Crown to Tapuika for these breaches of the Treaty of Waitangi.



Treaty Settlement Legislation

Resource Management Act 1991 Sec 5,6,7,8

National Policy Statement NPS

Regional Policy Statement RPS
Territorial Local Authorities TLA

Tapuika Claims Settlement Act 2014

Resource Management Act 2017 Te Manawhakahono a Rohe Tapuika

Validation of Manawhenua
Identification Manawhenua

RMA Unique relationship Manawhenua

Case Studies Common Law

Tohu (proof) Te Taioa a Tapuika - Ngatahu King Salmon case

Air, Water, Earth Cultural Environmental Impacts

In Mitigation Avoidance of Risks Harms Hazard with Adaptation

B. Tapuika Environmental Management Plan (EMP)



ENVIRONMENTALLY FOCUSED IWI MANAGEMENT PLAN

DEFINES TRIBAL ASPIRATIONS AND EXPECTATIONS IN RELATION TO THE NATURAL ENVIRONMENT WITHIN TE TAKAPŪ O TAPUIKA (TAPUIKA TRIBAL ESTATE)

The Tapuika Environmental Management Plan (EMP)

- ▶ WHAT TAPUIKA VALUE
- ▶ WHAT CONCERNS TAPUIKA
- ▶ WHAT OUTCOMES TAPUIKA WOULD LIKE



Resource Management Act (RMA). The Tapuika EMP incorporates and replaces the existing Iwi Management Plan “Ngā Aukati Taonga o Tapuika me Waitaha 1993”. It is recognised by the Tapuika Iwi Authority and therefore has weight under the Resource Management Act (RMA).

Tapuika Environment Management Plan (EMP) has been developed to:

- ▶ Articulate Tapuika environmental issues, aspirations and priority actions
- ▶ guide Tapuika-led environmental projects
- ▶ Resource management Act enabling participation Territorial local authorities
- ▶ ensure Tapuika are proactive, instead of reactive to environmental issues
- ▶ clarify Tapuika expectations with regards to consultation

The priority issues and actions within this Plan were identified during consultation with Tapuika Whānau in early 2014. This Plan focuses on priority issues and actions for the next ten years.

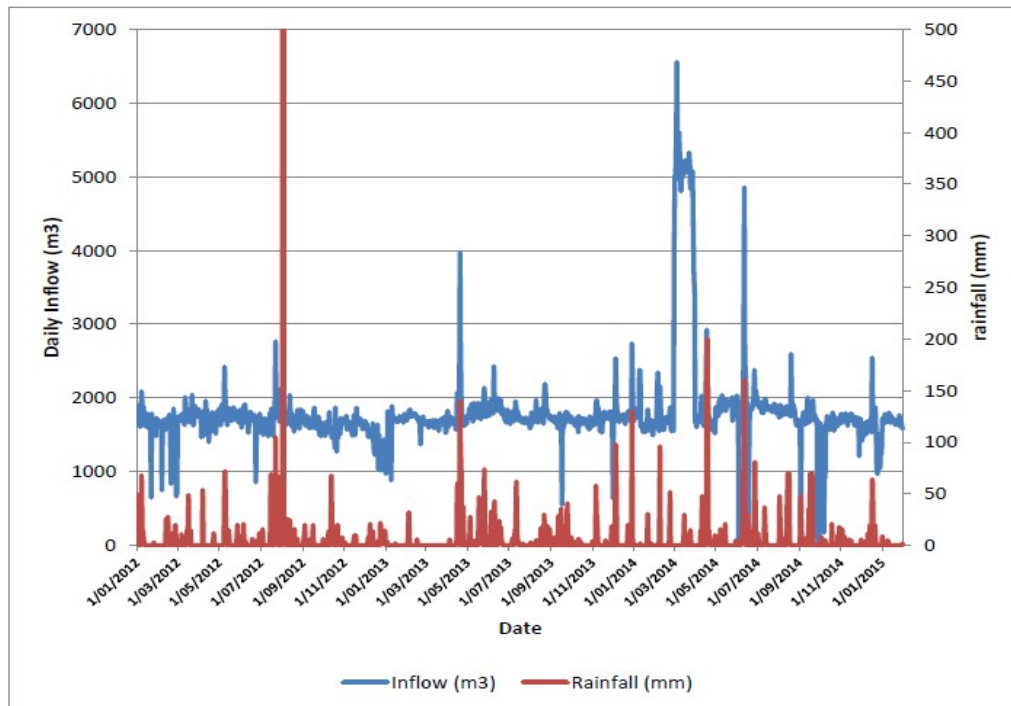
THE TAPUIKA ENVIRONMENTAL MANAGEMENT PLAN
IN NO WAY SUBSTITUTES OR ALLEVIATES
THE NEED FOR COUNCILS, CONSULTANTS AND CONSENT APPLICANTS



PROCESS OF REVIEW EXISTING CONSENT

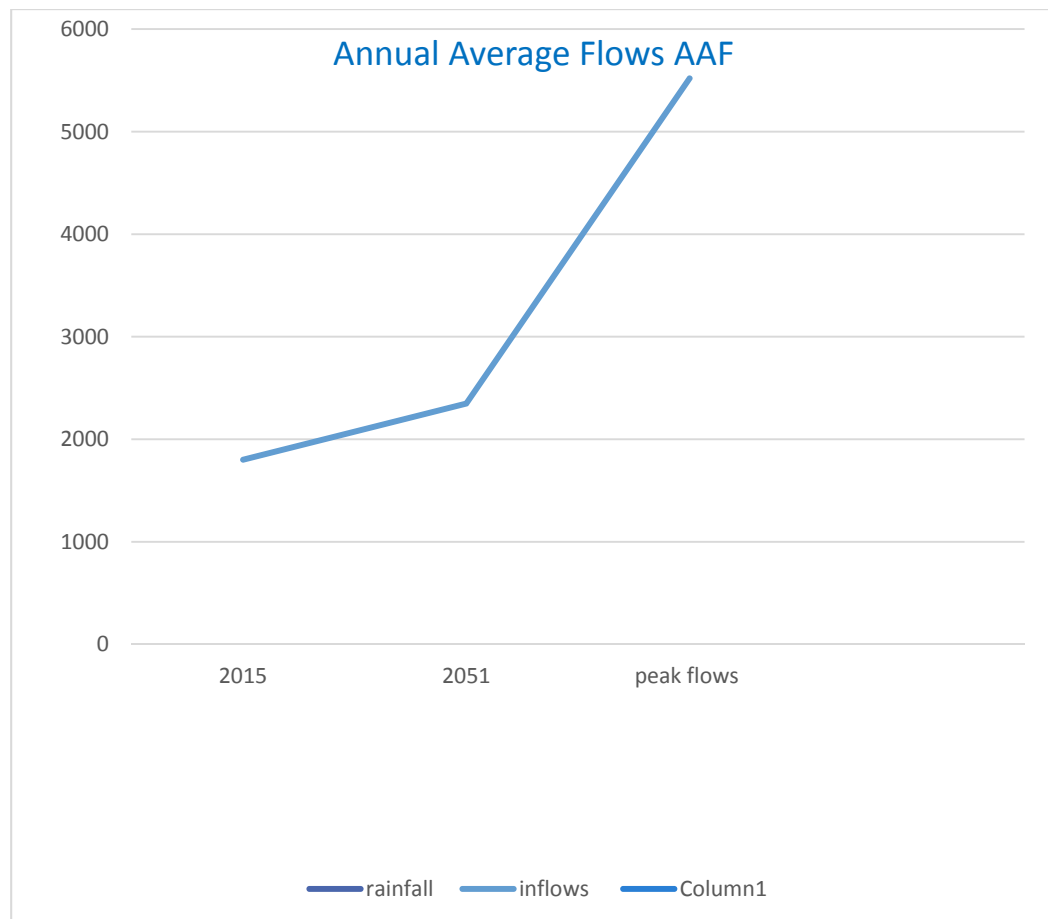
Waste Water Te Puke (WWTP)

- (a) *Wastewater Inflow Volume* into the Te Puke WWTP and Rainfall records (2012-2015) show current annual daily average wastewater flow into the Te Puke WWTP has been relatively stable at around 1800 m³/day in recent years. The flow pattern shows a relatively weak correlation with rainfall records, indicating a very low observed peaking factor (ratio of maximum flow to the average daily flow).
- (b) *The original design* applied a peaking factor of 2.35, has been applied in an assessment. The figure is taken from a Review analysis shows the daily wastewater inflow volume into the Te Puke WWTP alongside rainfall records: However with recently re-occurring rainfall events these records may not be conclusive Re-occurring rainfall events flooding I regard as consideration of the cultural and environmental hazards harms risks is the basis for opposing the renewal of the existing discharge consent permits



Daily Inflow Volume into the Te Puke WWTP and Rainfall Records (2012-2015)

- b) *Modelling scenario's* a review, the annual average flow (AAF) for the Te Puke WWTP is calculated based on existing observed per capita flow of 223 L/day. By 2051, based on the Smart Growth Western Bay of Plenty District Council (**WBOPDC**) population projection (modelling evidence of Ms Coral-Lee Ertel), the projected AAF is expected to reach approximately 2348 m³/day, with a peak wet weather flow at 5519 m³/day modelling untested statistical information I regard as consideration of the potential of cultural and environmental hazards harms risks is the basis *for opposing the renewal of the existing discharge consent permits*



In an upward trend review, of the annual average flow (AAF) for the Te Puke WWTP is calculated based on existing observed per capita flow of 223 L/day. By 2051, based on the Smart Growth Western Bay of Plenty District Council (WBOPDC) population projection (modelling evidence of Ms Coral-Lee Ertel).

The projected AAF is expected to reach approximately 2348 m³/day, with a peak wet weather flow at 5519 m³/day a renewal of the existing permits allows the consent holder to continue the current state and condition of the WWTP plant till 2049 These factors are taken as consideration of the environmental hazards harms risks and is the basis *for opposing the renewal of the existing discharge consent permits*

Urgent upgrade during the Iwi engagement of the existing plant operational and treatment constraints as such the existing plant may not be fit for purpose the key identified upgrade works have a direct impact on improving effluent quality:

- (a) Upgrade of the brush clarifier: this will improve solids removal prior to the UV treatment, ensure that the UV system operates effectively and the effluent pathogen level is adequately reduced before being discharged into the Waiari Stream.
- (b) Grit removal system: this will help to remove grits at the inlet works and improve aeration tank operation.
- (c) Inlet screen upgrade: this will provide additional screening capacity to cater for future flow increase.
- (d) A sludge thickener: this will improve sludge handling constraints currently observed and improve the sludge dewatering capacity.
- (e) ***Reactor upgrade priority upgrade*** in order to improve effluent quality that will involve increasing the sludge retention time and/or improve the internal recycling streams of the bioreactors. This will improve ammonia removal and facilitate biological nitrogen removal so that effluent total nitrogen level can be further reduced in the effluent.
- (f) Fixed generator: along with a switchboard upgrade to ensure that the Te Puke WWTP operates normally during power failure (e.g. UV operation is never compromised).
- (g) Upgrade Review sets out performance and operational issues at the Te Puke WWTP, including ***inadequate aeration, short sludge retention time and a lack of redundancy for certain units***

Urgent upgrades of the existing plant operational and treatment constraints may not be fit for purpose the ***immediate upgrade of works*** that has a direct impact on improving effluent quality the current discharge consent for the plant expired in November 2016. Renewal of the existing allows; a further thirty five years of potential risks and harms to Tapuika Iwi Community Health

Effects based approach reforms from the existing approach of the RMA has been to promote sustainability as a planning tool; reforms are moving to an effects based approach, in this approach the Tapuika statements reflect the (Waiari catchment) real world of the existing effects of the discharge activity;

accordingly a renewal of the existing permits must have regard for the effect of the discharge of treated waste water directly into the Waiari stream

Tapuika Mauri Monitoring Waiari stream Waterborne Viruses over 100 types of pathogenic viruses are excreted in human and animal wastes these viruses can be transported in the environment through groundwater, estuarine water, seawater, rivers, aerosols emitted from sewage treatment plants, insufficiently treated water, drinking water, and private wells that receive treated or untreated wastewater either directly or indirectly

Tapuika Cultural Environmental - Effects based approach Tapuika Iwi Hapu community with remaining health risks associated with recreational use of the Waiari Stream and the Kaituna River as a result of the Te Puke WWTP discharge, against an assumption that the Te Puke WWTP operates *normally* and that no outbreaks of *water borne viruses including enteric viruses*.

Tapuika Cultural Management Plan (CMP) - The demands and pressures on freshwater resources and increasing degradation of fresh water ecosystems the Waiari Catchment is a catchment at risk. The Waiari stream heavily over allocated, the proposed extraction of water from the Waiari combined with discharge of wastewater into the Waiari Tapuika Iwi engagement extends to include Tapuika Cultural Management Plan (CMP) enables tangata whenua values and interests and the Fresh water management of the Waiari catchment

(TAPUIKA (RMU) review Waste water Te Puke Waiari stream Waste Water characterisationⁱ

The production of waste from human activities is unavoidable. A significant part of this waste will end up as wastewater. The quantity and quality of wastewater is determined by many factors. The amount and type of waste produced in households is influenced by the behaviour, lifestyle and standard of living of the inhabitants as well as the technical and juridical framework by which people are surrounded.

- a. The design of the sewer system affects the wastewater composition significantly. Storm water is transported in trenches, canals or pipes. Old

urban areas might have combined sewer systems where different types of wastewater are mixed the total wastewater is discharged to local water bodies, often stormwater discharge is without any pre discharge treatment.

- b. Waste water constituents; the constituents in wastewater can be divided into main categories according to Table as below. The contribution of constituents can vary strongly. Waiari Influent characterisation analysis, the lack of regular and consistent adequate influent data monitoring in review analysis Tapuika Iwi Authority RMU applied typical wastewater strengths as part of the initial assessment of the Waiari influent characterisation.
- c. Whenever good quality water is scarce, water of marginal quality will have to be considered for use in agriculture. Although there is no universal definition of 'marginal quality' water, for all practical purposes it can be defined as water that possesses certain characteristics which have the potential to cause problems when it is used for an intended purpose.
- d. The rapid expansion of urban populations and increased coverage of domestic water supply and sewerage give rise to greater quantities of municipal wastewater. With the current emphasis on environmental health and water pollution issues, there is an increasing awareness of the need to dispose of these wastewaters safely and beneficially.
- e. However it should be realized that the quantity of wastewater available in most countries including NZ will account for only a small fraction of the total irrigation water requirements. Nevertheless, wastewater use will result in the conservation of higher quality water and its use for purposes other than irrigation, as the marginal cost of alternative supplies of good quality water will usually be higher in water-shortage periods
- f. Most components in wastewater are not the direct target for treatment, but they contribute to the toxicity of the wastewater, either in relation to the biological processes in the treatment plant or to the receiving waters. The substances which are found in the effluent might end up in a drinking water

supply system in which case it is dependent on surface water extraction with urban expansion industrial farming and Horticulture expansion with ‘New Kiwi Gold’ cultivars demand for quality fresh water increased

Wastewater Characteristics for Te Puke WWTP

Parameters	Previous Assumption	Influent Analytical Results (2016/2017) mg/L		
		Average	10%ile (low load)	90%ile (peak load)
BOD	375	310	207	439
COD	660	685	435	955
TSS	320	377	181	557
Ammonia	60	41	29	51
TKN	75	60	43	78
Total Phosphorous	10	8.4	6.3	11.4
Alkalinity (CaCO ₃ equivalent)	302	-	-	-
pH	7.3	7.5	7.2	7.9

Sampling data shown above, the average *chemical oxygen demand (COD)* to 5-day **biochemical oxygen demand (BOD₅)** ratio is found to be approximately 2.2, which the applicant has *stated as within the normal range for typical municipal wastewater*. Further wastewater fractionation parameters determined as *part of the process simulation work*.

Simulation modelling included determination of key fractions such as

- readily biodegradable COD,
- phosphate component,
- ammonia fraction and soluble
- ***Un-biodegradable COD that are not provided.***

- Most of the fractionation parameters adopted indicated typical municipal wastewater modelling characteristics.
- Upgrade Review sets out performance and operational issues at the Te Puke WWTP, which include *inadequate aeration, short sludge retention time and a lack of redundancy for certain units*

BOD AND COD Organic matter is the major pollutant in wastewater. Traditionally organic matter has been measured as BOD and COD.

COD Organic matter

- COD analysis is ‘quick and dirty’ (if mercury is used).
- COD analysis measures through chemical oxidation by dichromate the majority of the organic matter present in the sample. COD measurements are needed for mass balances in wastewater treatment.

BOD is slow and cumbersome due to the need for dilution series. The

Chemical Oxygen Demand (COD) can be subdivided in fractions useful for consideration in relation to the design of treatment processes. Suspended and soluble COD measurement is very useful. Beware of the false COD measurement with permanganate, since this method only measures part of the organic matter, and should only be used in relation to planning of the BOD analysis.

The theoretical COD of a given substance can be calculated from an oxidation equation. For example, theoretical COD of ethanol is calculated based on the following equation: $C_2H_6O + 3O_2 \rightarrow 2CO_2 + 3H_2O$ (3.1) or, 46 g of ethanol requires 96 g of oxygen for full oxidation to carbon dioxide and water. The theoretical COD of ethanol is thus $96/46 = 2.09$.

Biological Oxygen Demand (BOD) measures the oxygen used for oxidation of part of the organic matter. BOD analysis has its origin in effluent control, and this is what it is most useful for. The standard BOD analysis takes 5 days (BOD₅), but alternatives are sometime used, The presence of a sufficient concentration of dissolved oxygen is critical to maintaining the aquatic life and aesthetic quality of streams and lakes.

Determining how organic matter affects the concentration of dissolved oxygen (DO) in a stream or lake is integral to water-quality management. The decay of organic matter in water is measured as biochemical or chemical oxygen demand. Oxygen demand is a measure of the amount of oxidizable substances in a water sample that can lower (DO) concentrations (Nemerow, 1974; Tchobanoglous and Schroeder, 1985).

TABLE Wastewater Types

Wastewater from society	Wastewater generated internally in treatment plants
Domestic wastewater	Thickener supernatant
Wastewater from institutions	Digester supernatant
Industrial wastewater	Reject water from sludge dewatering
Infiltrated waste	Drainage water from sludge drying beds
Stormwater waste	Filter wash water
Leachates	Equipment cleaning water
Septic tank	

TABLE Wastewater Constituents

Wastewater Constituents	Effects
Microorganisms Pathogenic bacteria, virus and worms eggs	Risk when bathing and eating shellfish
Biodegradable Organic materials	Oxygen depletion in rivers, lakes and fjords Fish death, odours
Other Inorganic materials	Acids, for example hydrogen sulphide, bases Corrosion, toxic effect

Nutrients	Nitrogen, phosphorus, ammonium Eutrophication, oxygen depletion, toxic effect
Metals. Hg, Pb, Cd, Cr, Cu, Ni	Toxic effect, bioaccumulation
Radioactivity	Toxic effect, accumulation
Microorganisms Pathogenic bacteria, virus and worms eggs	Risk when bathing and eating shellfish
Biodegradable Organic materials Wastewater constituents	Oxygen depletion in rivers, lakes and fjords Fish death, odours
Other organic materials	Detergents, pesticides, fat, oil, and grease,
Odour (and taste)	Hydrogen sulphide Aesthetic inconveniences, toxic effect
Thermal effects	Hot water Changing living conditions for flora and fauna

WASTEWATER COMPONENTS Most components in wastewater are not the direct target for treatment, but they contribute to the toxicity of the wastewater, either in relation to the biological processes in the treatment plant or to the receiving waters. The substances which are found in the effluent might end up in a drinking water supply system in which case it is dependent on surface water extraction. The metals in wastewater can influence the possibilities for reuse of the wastewater treatment sludge to farmland. Typical values for metals in municipal wastewater

MICRO ORGANISMS – Waste Water Discharge

Wastewater is infectious. Most historic wastewater handling was driven by the wish to remove the infectious elements outside the reach of the population in

the cities. In the 19th century microorganisms were identified as the cause of diseases. The microorganisms in wastewater come mainly from human's excreta, as well as from the food industry. Table 3.13 gives an idea of the concentration of microorganisms in domestic wastewater. For more information on pathogenic microorganisms and their removal from wastewater the Concentrations of microorganisms in wastewater (number of microorganisms per 100 ml) (based on Henze *et al.*,2001)

WAIARI - Micro-organisms Highs and Lows

E. coli 5·10⁸ 10⁶ Coliforms 10¹³ 10¹¹ *Cl. perfringens* 5·10⁴ 10³ Faecal *Streptococcae* 10⁸ 10⁶ *Salmonella* 300 50 *Campylobacter* 10⁵ 5·10³ *Listeria* 10⁴ 5·10² *Staphylococcus aureus* 10⁵ 5·10³ Coliphages 5·10⁵ 10⁴ *Giardia* 10³ 10² Roundworms 20 5 *Enterovirus* 10⁴ 10³ *Rotavirus* 100 20

The high concentration of above microorganisms may create a severe health risk when

Waiari existence of *E.coli* Out breaks of diarrhea and the hemolytic–uremic syndrome caused by an unusual serotype of Shiga-toxin–producing *Escherichia coli* (O104:H4) began in Germany in May 2011 a large number of cases of diarrhea caused by Shiga-toxin–producing *E. coli* have been reported producing *E. coli* strains. Preliminary genetic characterization of the outbreak strain suggested that, unlike most of these strains, it should be classified within the entero aggregative patho type of *E. coli*

Waiari existence of Coliforms potential sources of bacteria in water the presence of fecal coliform in aquatic environments may indicate that the water has been contaminated with the fecal material of humans or other animals. Fecal coliform bacteria can enter rivers through direct discharge of waste from mammals and birds, from agricultural and storm water runoff and from human animal sewage..

Human sewage Failing home septic systems can allow coliforms in the effluent to flow into the water table, aquifers, drainage ditches and nearby surface waters. Sewage connections that are connected to storm drain pipes can also allow human sewage into surface waters. Some older rural settlement in NZ use a combined sewer system to handle waste. A combined sewer

carries both domestic sewage and stormwater. During high rainfall periods, a combined sewer can become overloaded and overflow to a nearby stream or river, bypassing treatment.

Animals Pets, especially dogs, can contribute to fecal contamination of surface waters. Runoff from roads, parking lots, and yards can carry animal wastes to streams through storm sewers.

Birds can be a significant source of fecal coliform bacteria. Swans, geese, seagulls, and other waterfowl can all elevate bacterial counts, especially in wetlands, lakes, ponds, and rivers.

Agriculture practices such as allowing livestock to graze near water bodies, spreading manure as fertilizer on fields during wet periods, using sewage sludge bio solids and allowing livestock watering in streams can all contribute to fecal coliform contamination

APPENDIX 1 Te Mana o Te Wai

Iwi Hapu Freshwater acknowledged as taonga, Māori are the kaitiaki (guardians) and acknowledgement of the Mana and Māuri O Te Wai



Treaty principle of Active protection

The Crown's duty to protect Māori rights and interests arises from the plain meaning of the Treaty, the promises that were made at the time (and since) to secure the Treaty's acceptance, and the principles of partnership and reciprocity. The duty is, in the view of the Court of Appeal, 'not merely passive but extends to active protection of Māori people in the use of their lands and waters to the fullest extent practicable', and the Crown's responsibilities are 'analogous to fiduciary duties'. Active protection requires honourable conduct by, and fair processes from, the Crown, and full consultation with – and, where appropriate, decision-making by – those whose interests are to be protected

Matauranga Māori knowledge are a set of common values which denote the way Tapuika Iwi Māori connect with the world. Values include

- whakapapa (genealogy),
- mana (authority, right, power),
- tapu (sacred or controlled),
- noa (common, open),
- tikanga (practice) and
- māuri (life force).

Freshwater is a taonga, and Māori are the kaitiaki these values inform how Māori place themselves in the world, and through this awareness are able to recognise the connection they have with other animate and inanimate things.

- Tāne separated Papatūānuku (Earth Mother) and Ranginui (Sky Father),
- Ranginui shed tears of grief. The tears of Ranginui eventually filled the deep caverns, the valleys, and the great basins which are now seas.
- Freshwater whakapapa can be traced to creation and the attributes it contains have been spiritually woven through the course of human activity.

- For this reason freshwater is a taonga, and Māori are the kaitiaki (guardians).

Māuri O Te Wai - Māuri, or life force, can be described as the flow of energy. All things have a particular flow of energy which influences their nature and characteristics. Freshwater has an energy flow which influences the nature and characteristic of a waterbody. Sometimes the differences are tangible: from a swift flowing river to a wide expansive lake, you can perceive and physically appreciate the māuri contained within those water bodies. Māori recognised that the māuri in a water-body (or the absence of māuri) influenced its characteristics, and for this reason gave names to types of water:

- Wai-ora (pure water).
- Wai-māori (fresh water).
- Wai-kino (polluted).
- Wai-mate (dead water).
- Wai-tai (saltwater or water from ocean).
- Wai-ariki (hot springs or curative waters).

Understanding the nature, shape, form and quality of the water will give you sense of the māuri present within that water body. Undertaking certain types of activities will affect mauri, or in some cases, dissipate it. Recognising that the energy flows in a water body are dependent upon how we behave and use the water resource is a fundamental part of the way Māori view the world.

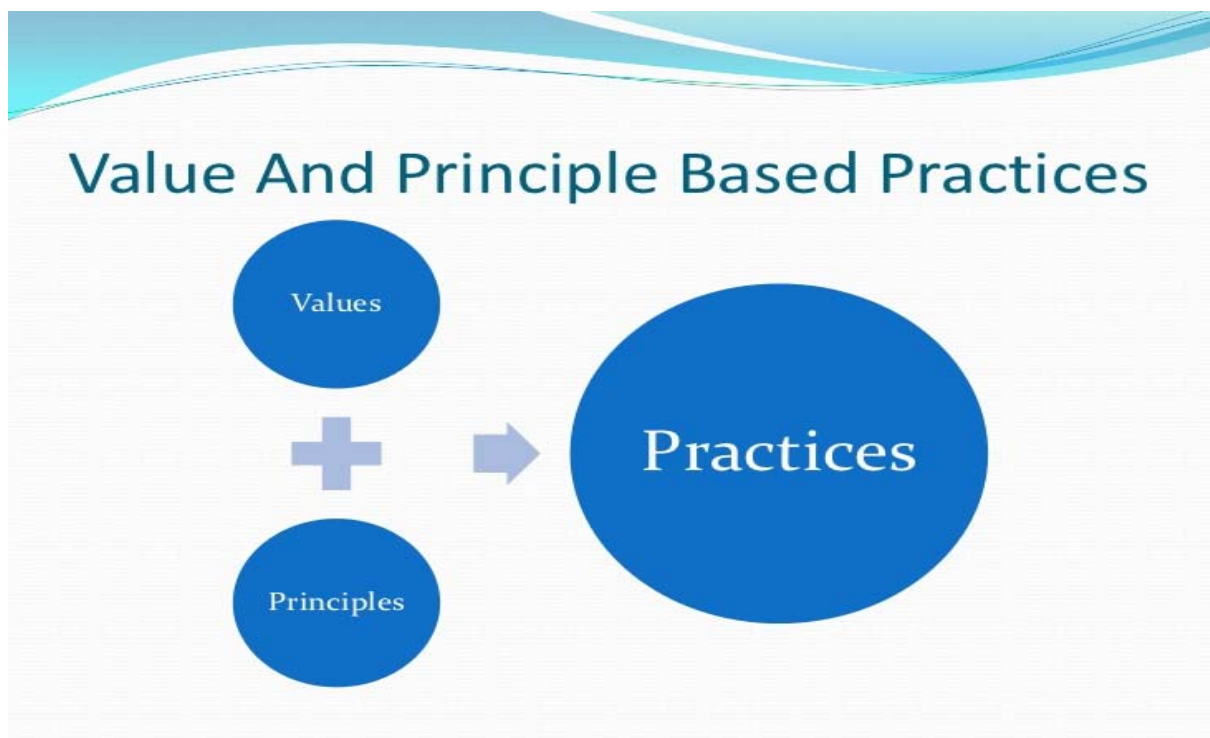
Regional Council's commitment Te Mana o te Wai Central government has recognised the national significance of freshwater and Te Mana o te Wai through the

National Policy Statement for Freshwater Management 2014. The Policy Statement requires Council to consult and engage with our communities, to set objectives for the state of fresh water bodies in its region and to set limits to meet these objectives. That includes requirements to:

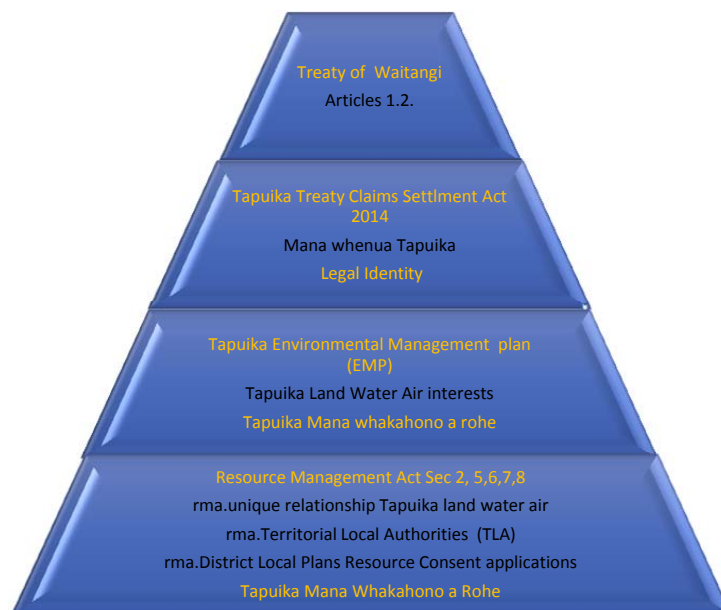
- Engage with Tāngata Whenua to identify the values they have for freshwater.

- Involve Iwi & Hapū in decision-making and management of freshwater.
- Determine the appropriate set of methods for the objectives and limits.

Te Mana o te Wai commitments and wider obligations to Māori into the strategic framework and Long Term Plan that guide our work. We're using a range of tools to deliver on those including; consultation, co-governance arrangements, relationship agreements, joint projects, iwi and hapū management plans, plan and policy changes, māuri monitoring and a matauranga Māori framework.



APPENDIX 2 Manawhakahono a Rohe – Tapuika



Treaty of Waitangi settlement

- **Art.1** Kawanatanga Governance legislate make and un make laws
- **Art.2** Self determination Taonga over lands water and culture



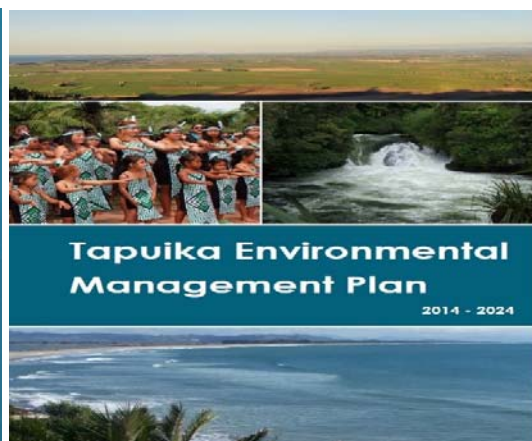
Tapuika Legal Identity

- Tapuika Treaty Claims Settlement Act 2014
- Legal identity and Manawhenua Tapuika Iwi
- Tapuika Taonga over lands water and culture
- RMA Sec 2,5,6,7,8 Tapuika Manawhakahono a rohe



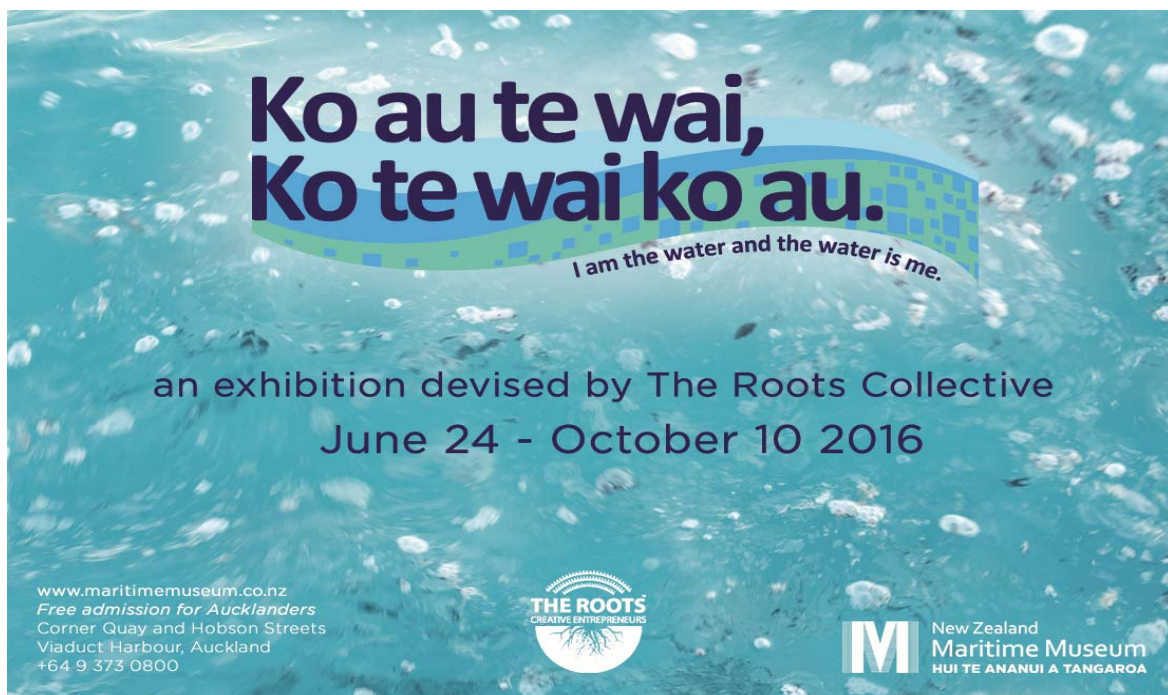
Tapuika Environmental Management Plan

- Tapuika Environmental Management Plan (EMP)
- EMP v RMA (TLA) Territorial Local Authorities District local Plans
- EMP v RMA (TLA) Resource Consent Applications



APPENDIX 3 KO au te wai Ko te wai ko au

- ❖ Water is an integral, defining part of Iwi Māori self-identity. And here in the Bay of Plenty, Tapuika iwi, has promote as a more proactive voice in fresh water sustainability and protection of our Fresh Water Taonga
- ❖ Like all Marae Our Tapuika marae were always situated strategically near waterways which provided mahinga kai (e.g. tuna/eels, pātiki/flounder, mullet, kakahi/mussels, watercress) and were also the ‘highways’ of the past, linking interior and coastal Bay of Plenty rohe settlements together
- ❖ Tapuika rohe is a virtual fresh water tribal territory , rivers, streams, estuaries, foreshore and sea have always been an integral part of our Tapuika existence, supporting and providing sustenance for our Taha Hinengaro (psychological), Taha Tinana (physical), Taha Wairua (spiritual) and Taha Whānau (family) well-being and health



Fresh water in New Zealand vision for fresh water

- Our lakes, rivers, wetlands and aquifers are suitable for the local and national values and aspirations of all New Zealanders, including tāngata whenua
- Fresh water is used efficiently and productively
- Freshwater quality is maintained or improved
- Te Mana o te Wai is respected and provided for with healthy freshwater resources supporting our long-term well-being and prosperity
- Our freshwater bodies are healthy places for aquatic plants and animals
- Our use of fresh water respects iwi/hapū values and honours the Treaty of Waitangi (Te Tiriti o Waitangi)
- Outstanding lakes, rivers and wetlands are protected

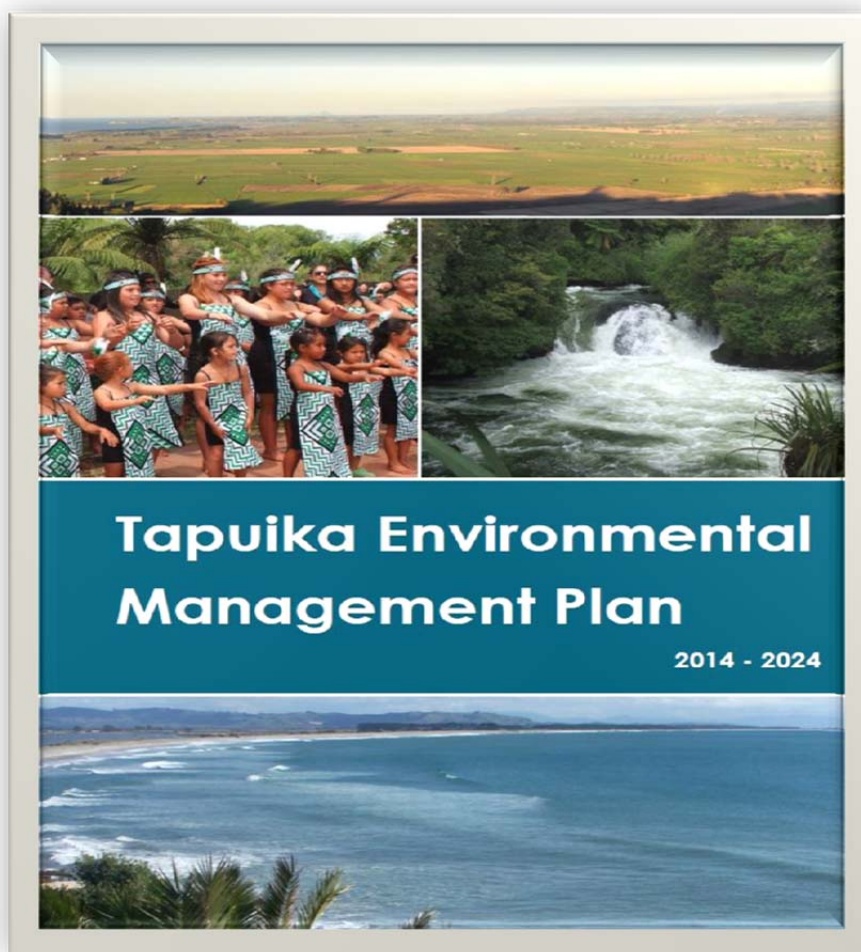


National Policy Statement on Freshwater Management 2011 puts an added imperative on councils to set objectives and limits for freshwater management based on national and community values, which has increased the need for ways to articulate and focuses the debate on how to accommodate competing values rather than whether to use an incomplete schedule of values – that could ultimately lead to more durable decision-making.



National Policy Statement on Freshwater Management 2014 NPS-FM 2014 NPS-FM 2014 expresses the national significance of fresh water and Te Mana o te Wai (the mana of water) thus recognising there are a range of community and tangata whenua values associated with fresh water. Provides additional direction to regional councils on how to safeguard the life-supporting capacity of fresh water, and to maintain and improve overall water quality.

Two compulsory national values for freshwater (ecosystem health and human health for recreation) must be managed at or above national bottom lines. The requirement to maintain or improve the overall water quality of the region is unchanged. NPS-FM 2014 expresses the national significance of fresh water and Te Mana o te Wai (the mana of water) thus recognising there are a range of community and tangata whenua values associated with fresh water.

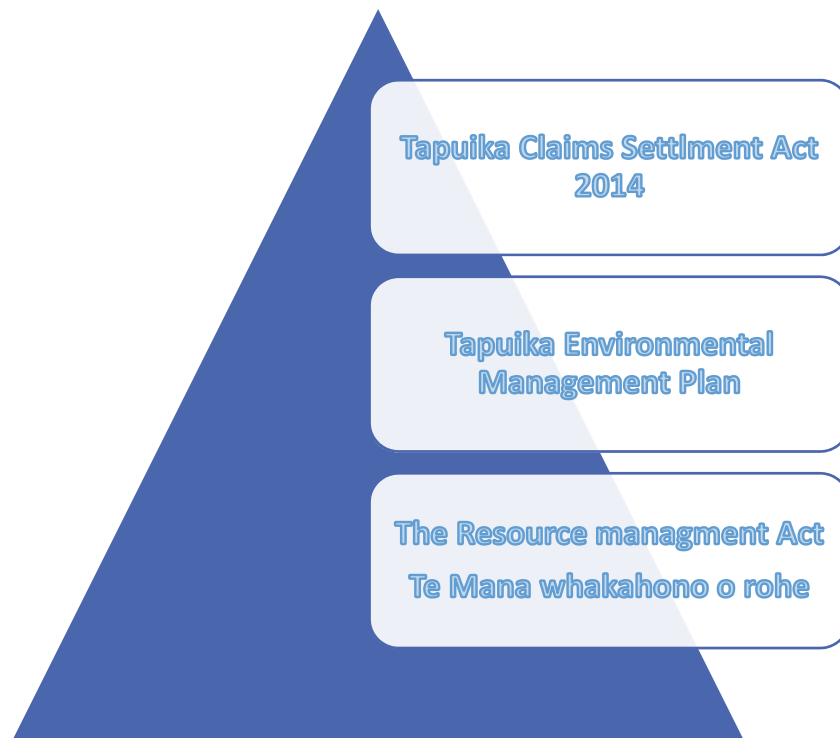


Tapuika Claims Settlement Act 2014

Resource Management Act 1991

Tapuika Environmental Management Plan EMP

Full notification – Permitted Activities adversely impacting Tapuika Cultural and Environmental interests



The Resource Management Act 1991 (RMA) sets out how decisions are made about activities that might affect the environment. Applications from people wanting to undertake such activities are considered by councils or, in some cases, by a board of inquiry or the Environment Court. If successful, a resource consent is issued allowing the proposed activity to go ahead. Common practice of TLA's is to grant activity permits as OF RIGHT Iwi Maori and Hapu are forced to provide evidence in a hearing of a Commissions or the Environment Court

The first step in the council's decision-making process is to determine whether the application should be processed on a non-notified, limited notified or fully notified basis.

For limited notified applications, notice is served to people who will be or are likely to be adversely affected by the proposed activity to a degree that is minor or more than minor (but not less than minor). Only those people can make a submission on the application.

Tapuika Iwi Authority Applications are fully notified if the adverse effects on the environment are assessed as being more than minor. Tapuika holding greater than the public interests identified as being adversely affected by a proposed activity, described in the RMA as ‘affected persons’. It explains:

- ❖ Who an affected person is, and what being an affected person means
- ❖ What ‘giving written approval’ means
- ❖ What you need to do when you’re asked for written approval
- ❖ What happens if you do give written approval
- ❖ What happens if you don’t give written approval?

Resource consent process, ‘conditional approval’ and ‘side agreements’. Tapuika become involved in an application as an affected party / RMA guides in this series. They will help to explain the different types of consents and functions of councils and other agencies involved in the *planning process* affected persons involved in local council resource consents. For more information about resource consent applications decided by boards of inquiry or the Environment Court (which may be directly referred to the Court by the applicant, or may be proposals of national significance), see ‘An Everyday Guide to the RMA’ booklet *1.4 National Level*



Tapuika iwi Authority guidance affected parties/ person? In the absence of mitigation of cultural harms hazards and risk avoidance Tapuika Iwi Authority has no other option other than litigation

Every day, people ask their local council for resource consents to do things putting up a garage, subdividing their property, building a multi-storey apartment block, taking water from a stream.

A **resource consent** is permission from the local council for an activity that might affect the environment, and that isn't allowed 'as of right' in the district or regional plan. An application for resource consent will be **publicly notified** if the proposed activity will have or is likely to have adverse effects on the wider environment that are more than minor.

An application may also be publicly notified if requested by the applicant, if special circumstances exist, or if the district/regional plan or a national environmental standard says it must. Being publicly notified means that the application is advertised in the newspaper and people can make submissions.

Tapuika iwi Authority Mitigation of risks and Harms Submitters can be *for or against an activity*, or be neutral but wanting to provide additional information. They can ask to be heard in support of their submission. Publicly notified applications usually involve a Public hearing. If a council does not publicly notify an application, it must still decide if there are people who will be adversely affected by the activity. The council must notify these people of the application (**limited notification**) unless a rule in a district/regional plan or national environmental standard precludes it. Where an application is limited notified, only those affected are served notice and can make a submission on the application. The RMA test for whether someone is an affected person is whether the proposal has adverse effects on them that are 'minor or more than minor (but are not less than minor)'. Some examples of affected persons are shown proposals of national significance), see 'An Everyday Guide to the RMA' booklet *1.4 National Level*

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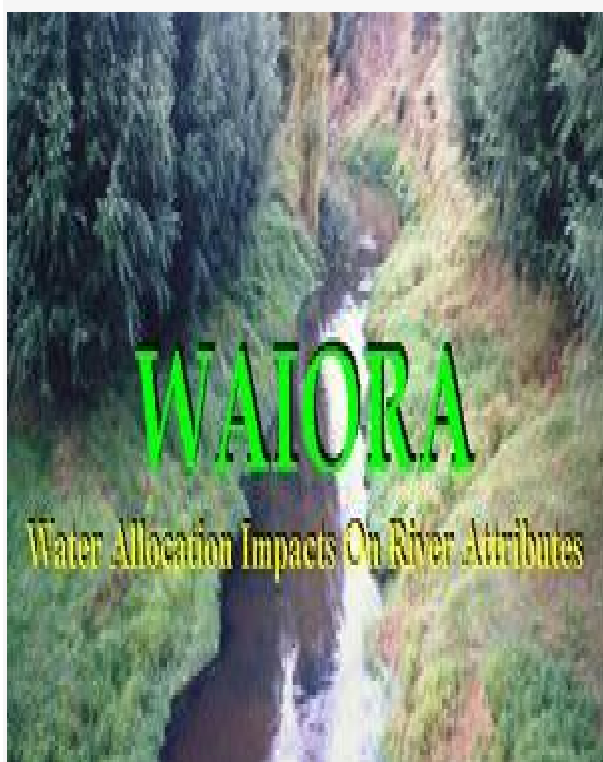
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APPENDIX 5



Tapuika Wai Mauri (framework)

Wai (water) is the most abundant compound and life force covering some 70% of the Earth's surface. Although essentially tasteless, odorless, and colorless, water is the central source of our being. Because of the unique properties of water it is the great connector to all living things. The water within our body has literally passed through thousands of organisms over millions of years



Kaitiakitanga Stewardship Waterways	Manaakitanga care clean waters
<p>Mana Water is essential to life and central to identity. Ko wai koe? From whose waters do you descend? Where are you from? What is your lake, river, or spring? You and I, we are water.</p> <p>Tapuika source of identity, ko wai koe water is also important. All Māori have a river or a lake that we belong to. When we say ‘ko wai koe?’ we are asking from whose birthing water do you belong “ We are water and water is us” Iwi Māori are the guardians of water in Aotearoa and our vitality is linked to the wellbeing and vitality of water</p>	<p>Caring The health of the environmental Land and water is a critical part of the health and wellbeing of our Iwi Hapu community.</p> <p>Tapuika iwi Hapu want to create a healthy sustainable community so that we are able to support whanau to live healthy happy lives and enjoy the land and waterways they are connected ‘whakapapa to’” Manaakitanga and the idea of caring about others, uplift them, support them, make them feel at home and loved is one of my dearest values</p>

WAIARI – AWA TUPUA



KAITUNA RIVER – AWA TUPUA

River Ecology

AS Geography



APPENDIX 6: TE MATA PONO KI TEWAI

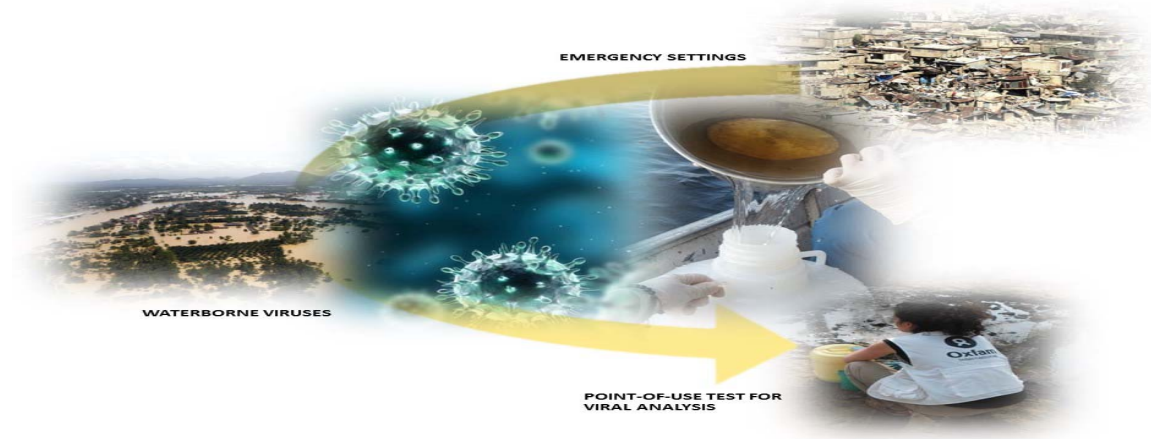


TE MATA PONO KI TEWAI - OBJECTIVES

- ❖ Improving and maintaining water quality – te mana o te wai – first order objective for kiwi and iwi
- ❖ Water is a valuable resource and has the potential to deliver significant benefits including economic benefits for iwi and the community, maximising the value of water (including social, economic, cultural and environmental benefits) for the community, including government, iwi, and all users, will require better definition of the bundle of rights attached to water
- ❖ Recognising Tapuika iwi hapu interests through:
 - (a) providing for iwi in governance and decision making roles
 - (b) recognising iwi values in the decision making framework and
 - (c) Providing iwi with an equitable allocation of water quantity and quality.
 - (d) Iwi want to re-establish and maintain an enduring relationship with their ancestral/ traditional water-bodies – mana whakahaere – recognising both their inherent mana and associated kaitiaki responsibilities over these water bodies. This includes being able to share equitably in any development capacity associated with a water body (allocable quantum)

APPENDIX 7

Enteric viruses – Point of use detection waterborne viruses



Enteric viruses may be present naturally in aquatic environments or, more commonly, are introduced through human activities such as leaking sewage and septic systems, urban runoff, agricultural runoff, and, in the case of estuarine and marine waters, sewage outfall and vessel wastewater discharge.

Over 100 types of pathogenic viruses are excreted in human and animal wastes these viruses can be transported in the environment through groundwater, estuarine water, seawater, rivers, aerosols emitted from sewage treatment plants, insufficiently treated water, drinking water, and private wells that receive treated or untreated wastewater either directly or indirectly

These viruses, collectively known as enteric viruses, usually are transmitted via the fecal-oral route and primarily infect and replicate in the gastrointestinal tract of the host. Enteric viruses are shed in extremely high numbers in the feces of infected individuals, typically between 10^5 and 10^{11} virus particles per gram of stool

Enteric virus groups that are considered to be emerging waterborne pathogens, based on their cellular and molecular structures that make them resistant to current water treatment processes, include circoviruses (consisting of torque tenovirus and torque tenovirus-like virus; these are nonenveloped viruses with single-stranded circular DNA and are resistant to heat inactivation),

- Picobirnaviridae (small nonenveloped viruses with bisegmented double-stranded RNA that are extremely resistant to UV light inactivation), parvoviruses (the smallest known enteric viruses, with single-stranded RNA and high heat resistance), and
- Polyomaviruses (including JC virus, BK virus, and simian virus these are nonenveloped double-stranded DNA viruses that have been found to be very heat stable but are less resistant to chlorination than enteroviruses)

Although enteric virus infections are associated primarily with diarrhea and self-limiting gastroenteritis in humans, they may also cause

- respiratory infections,
- conjunctivitis,
- hepatitis, and diseases that have high mortality rates,
- such as aseptic meningitis,
- encephalitis, and paralysis in immunocompromised individuals

Some enteric viruses have been linked to chronic diseases such as

- myocarditis and insulin-dependent diabetes
- Enteric virus infections in animals such as cattle and swine are normally asymptomatic
- can lead to abortion, neurological disorders, and mortality

Enteric viruses can be transmitted by food, water, fomites, and human contact. In addition to causing acute diseases, they are of public health concern due to their low infectious dose

Because of the potential for contamination from a variety of sources, enteric viruses in water are of particular concern. Since the 1980s, with significant advancements in the area of environmental virology, enteric viruses have been recognized as the causative agents in many nonbacterial gastroenteritis cases and outbreaks

Enteric viruses have been isolated from and linked to outbreaks originating from contaminated drinking water sources, recreational waters (e.g., waters for swimming, canoeing, surfing, etc.), urban rivers, and shellfish harvested from contaminated waters.

Between 1975 and 1979, water, followed by shellfish, was reported to be the main vehicle in outbreaks of vehicle-associated viral disease. Several reports indicate that only a fraction of waterborne disease incidences are ever reported;

In many countries, including New Zealand, regulators are still relying solely on bacterial indicators such as enterococci and fecal coliform and total coliform bacteria to assess the microbiological quality of water; however, bacterial indicators do not always reflect the risk from many important pathogens, such as viruses, stressed pathogenic bacteria (viable but non culturable), and protozoa. Infectious enteric viruses have been isolated from aquatic environments that are in compliance with bacterial indicator standards, and there have been several virus-related outbreaks linked to ingestion of waters that met fecal coliform standards.

fecal coliform bacteria One of the major drawbacks in using fecal coliform bacteria and other traditional indicators (e.g., enterococci) is that these indicators may be found in both human and animal feces and naturally in soils. Furthermore, they may regrow in the environment after being excreted from their host. The ability to identify the dominant sources of fecal pollutants in aquatic environments has become increasingly important in water quality management and remediation;

Bacterial indicators in environmental waters is impossible without laborious and extensive assays such as multiple antibiotic resistance profiling and ribo typing. Complicating matters, studies have shown that in coastal and marine waters traditional bacterial indicators generally die off quickly compared to viruses and protozoa.
