PROJECT NEWSLETTER STRENGTHENING THE RESILIENCE OF MARAE AND COMMUNITY WATER AND WASTEWATER INFRASTRUCTURE

Issue 2, September 2014

WATER MONITORING SYSTEM INSTALLATION AT MORIA MARAE, NORTHLAND

AUE TE PIRO

Te Waipara kia kaua e Paatu ki te Wai Māori

"No whea taua whakaaro"
"What is the meaning of this"?

Kei te mohio tonu e maha ngā take me ngā wero mo tēnei take me te roa hoki, o te hapori me te Iwi e whae tonu nei he huarahi hei whakarite ēnei āhua ki waenganui ia rātou. Koinei i whakaaro me mahi ngātahi te Iwi me te hapori, kia kore te waipara e paatu ki te Waimaori.

Kaore noa kua kitea tētahi huarahi hei whai tonū mo tātou engari e kaha tonu te Māori ki te akiaki i o tatou rangatira o te hāpori kia rangahautia he tikanga kia kaua e tuku ngā waipara ki roto i o tātou whanga, awa, rānei.

No reira kōinei e hiahia nei ko ngā tuhinga korero i roto i tēnei pānui kia mahitahi tātou katoa a taea tātou kia kitea he tikanga, huarahi mō te take nei

AUE TE PIRO – WHAT'S IN A NAME?

Where our waste is flushed away *out of sight* through underground pipes it often ends up *out of mind*. However for those with on-site wastewater systems, "flush and forget" is not the wisest option. Overloading the system, lack of maintenance or inappropriate use can result in system failures including bad odours, wastewater overflows and blockages, and negative impacts on our surface and ground waters, all of which can adversely affect the health and wellbeing of our environment, our guests and ourselves. Many of our marae and rural communities manage their own wastewater on-site and need to design, operate and manage their systems appropriately to avoid problems.

We have called our newsletter "Aue te Piro", which can be translated as "Oh the Stink", to provoke your interest and highlight the real world consequences of poor wastewater management. Aue te Piro will keep you up to date with what's happening in the collaborative research project that NIWA and marae and community partners are doing to help improve on-site wastewater management.

Some of the wastewater management challenges faced by marae and rural communities include extreme flow variations, ageing infrastructure and increased development pressures. To safeguard our communities these challenges and issues require attention – sustainable, cost effective and resilient solutions need to be developed.

The second part of our project newsletter title "Te Waipara kia kaua e Paatu ki te Wai Māori" reflects our aspiration to collaborate and work together to find appropriate, sustainable and resilient solutions to the wastewater management issues and challenges facing marae and communities.

We hope to use this newsletter to raise awareness of on-site wastewater management solutions as well as keep our project partners, other stakeholders and interested parties informed about the work we are doing and the outcomes of this research.

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IN THIS ISSUE

Kokiri Centre Greywater System

As an outcome of collaborative partnership between Tainui Awhiro and NIWA, a greywater treatment wetland has been piloted to service the Kokiri Centre in Whāingaroa. In this issue, we present some of the wastewater management improvements made at the Kokiri Centre, the greywater treatment concept and provide an overview of how it is performing.

Pilot Wastewater Wetland Trial

NIWA is seeking a marae partner to collaborate with to construct a marae scale wastewater treatment wetland. In this issue, we outline the main objectives of the project and how you can get involved.

Kokiri Centre, Whāingaroa

USING WETLANDS TO TREAT MARAE GREYWATER

WASTEWATER CHALLENGES

Marae perform a range of important roles for both Māori and the wider community, acting not only as community meeting places, but also variously as homes, offices, early childhood teaching facilities (kohanga reo), health clinics, and sometimes local civil defence centres. They may host small events such as meetings (hui) for a few people, or less frequent gatherings (wānanga), funerals (tangi) or weddings where several hundred people may be present for 2-3 days.

In rural situations, where wastewater treatment is frequently via on-site systems, the range in event size can place considerable strain on the performance of existing facilities which can be exacerbated where this infrastructure is outdated, undersized or in poor condition.

The design and implementation of new marae infrastructure must not only reduce human health risks and risks to the local environment, but also address tikanga (cultural design criteria) which commonly favours treatment of human wastes via the cleansing capacity of soil (Papatūānuku) and the avoidance of water.

Marae wastewater treatment and dispersal systems typically consist of septic tanks draining to soil infiltration fields. However, these systems may be undersized for modern wastewater loads and can struggle when exposed to shock-loads which exceed normal flows by many-fold. Marae communities often feel they have limited options available to help them adapt and cope with such situations, particularly when they arise in the middle of large events.

SOLUTIONS

At Tainui Awhiro’s Kokiri Centre near the mouth of Whāingaroa Harbour (Raglan), the existing wastewater system (septic tank and infiltration field) was discovered to be undersized, particularly for the larger events held at the site. Tainui Awhiro did not want to connect to the nearby town wastewater treatment plant because, against their wishes, it discharges effluent directly into the harbour adjacent to their ancestral lands. Instead, they chose to reduce the hydraulic loading to their existing wastewater facilities with low/dual flush toilets and by diverting greywater (showers and hand basins only) to a newly constructed separate land-based waste treatment system (Figure 1).

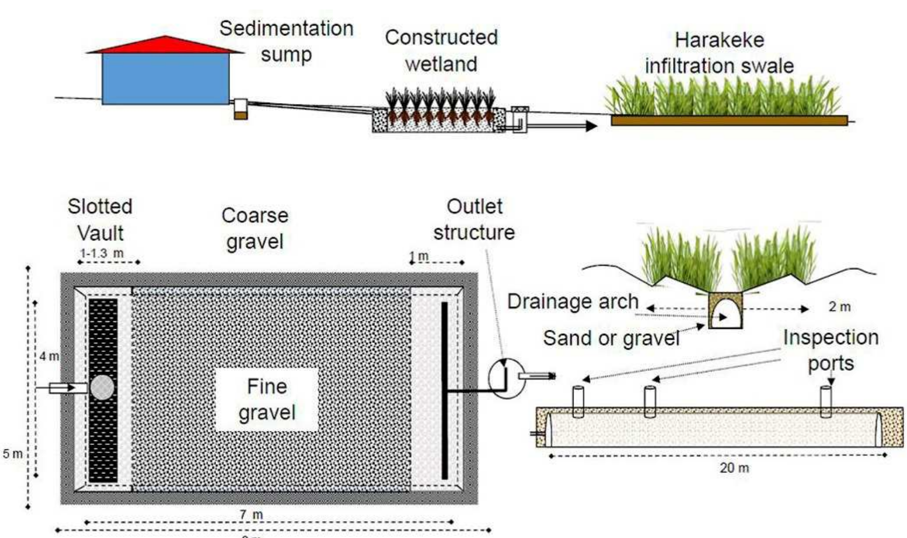

Figure 1: *Conceptual schematic of greywater treatment wetland.*

Figure 2: *Constructing the greywater treatment wetland.*

Low flow shower heads were also retrofitted as part of their commitment to reduce water usage and to reduce the load to the greywater system.

The new secondary greywater waste treatment system, comprises a sub-surface flow gravel-bed wetland followed by an infiltration swale (Figure 1).

In the wetland, plants, microbes and invertebrates (worms and insects) help break-down the waste to purify the water slowly percolating through the gravel media.

The wetland was sized to accommodate the anticipated greywater volumes for events commonly held at this facility which typically extend over 2-3 days.

Incoming wastewater gradually displaces treated wastewater from previous events which may have been present anywhere between several days or weeks previously. Thus hydraulic residence times and associated treatment levels were anticipated to be high.

The marae and local community were involved in and contributed significantly to all stages of the system construction from excavation to planting (Figure 2).

The wetland was planted with a mixture of native vegetation (*Carex secta*, *C. virgata* and *Cyperus ustulatus*) (see Figure 3). Plant species were selected by local kaumātua (James "Tex" Rickard), who chose species that had previously been common in the Whāingaroa area but are now much less so due to urban and rural development. The native harakeke (*Phormium tenax*) which has many cultural uses was also planted along the infiltration swale.

Figure 3: *Established constructed wetland plantings.*

BENEFITS

The reduced loading on the existing septic tank system (now treating mainly blackwater) means that it is now able to cope with wastewater flows and loads even during large events.

Use of a sub-surface flow design throughout reduces the likelihood of direct human contact with wastewaters.

The new greywater wetland is being monitored for removal efficacy of key contaminants including:

- BOD (Biochemical Oxygen Demand, a measure of decomposable organic matter).
- SS (Suspended Solids, a measure of particles in the water).
- Nitrogen and phosphorus (nutrients that can cause excessive growth of algae).
- Faecal microbes (indicators of potential pathogen risk).

Preliminary performance monitoring data from one summer and one winter event showed that on its own the wetland significantly improves water quality, notably faecal microbes (almost 99.9% removal), nitrogen (98% removal), phosphorus (>90% removal) and SS (90% removal) (Table 1).

The infiltration swale has been able to readily accommodate the discharge from the wetland, with minimal measureable effect on groundwater concentrations.

On-going performance monitoring of the constructed wetland and infiltration swale will continue to improve our understanding of the ability of such technologies to help fulfil the wastewater management needs of marae communities.

Constructed wetlands appeal to marae communities due to their utilisation of natural processes, low maintenance requirements, capacity to cope with fluctuating loads and ability to be built and maintained by communities themselves.

The collaborative process facilitated the incorporation of design features to improve the cultural acceptability of the technology.

This project continues to provide an important opportunity to physically demonstrate these technologies "in action" and it is hoped that this will promote greater engagement and support of such approaches in other marae communities around New Zealand.

Table 1: *Constructed wetland performance monitoring results measured over one summer and one winter event.*

	NH4 - N (g/m³)	NO3 - N mg/m³	TN (g/m³)	DRP (g/m³)	TP (g/m³)
Inflow	117 ± 113	17 ± 36	136 ± 103	5.8 ± 4.0	7.0 ± 4.5
Outflow	0.08 ± 0.15	1 ± 2	0.75 ± 0.22	0.3 ± 0.3	0.4 ± 0.3
% Removal	99.90%	94%	99.40%	95%	94%

	EC µS/cm	Turbidity (NTU)	SS (g/m³)	E. Coli (MPN/100ml)
Inflow	1,227 ± 702	19 ± 17	54 ± 38	530,000 ± 7,070,000
Outflow	479 ± 32	8 ± 7	6 ± 3	1,260 ± 5680
% Removal	61%	58%	89%	99.80%

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Kokiri Centre, Whāingaroa

USING WETLANDS TO TREAT MARAE GREYWATER (CONTINUED)

The building of the Kokiri Centre greywater treatment wetland, community involvement, and the ethos behind treatment of wastes in a land-based system were the subject of Episode 11 of the first Project Mātauranga Series on Māori TV. The episode can be viewed online – follow link below.

Figure 4: *Raglan Harbour.*

Related articles have been published in the Land Treatment Collective Newsletter Issue No. 43, Nov. 2013 and more recently in the "Wet & Wild" – The National Wetland Trust Newsletter.

Links to articles are listed below:

http://www.maoritelevision.com/tv/shows/project-matauranga/S01E011/project-matauranga-series-1-episode-11

http://www.scionresearch.com/general/new-zealand-land-treatment-collective/publications-and-resources/recent-LTC-newsletters

http://www.wetlandtrust.org.nz/Cache/Pictures/2435240/Winter_2014.pdf?ts=635409361736435804

Figure 5: *Discharge from the outlet of the greywater treatment wetland before it goes through the harakeke infiltration trench.*

Seeking a Marae Partner for a Wastewater Treatment Wetland Trial

BUILDING UPON THE KNOWLEDGE GAINED FROM THE GREYWATER TREATMENT WETLAND INSTALLED AT THE KOKIRI CENTRE, AND AFTER SEVERAL YEARS OF TRIALLING AND TESTING NEW WASTEWATER TREATMENT APPROACHES AT A SMALL SCALE, WE ARE KEEN TO PARTNER WITH A MARAE TO DESIGN AND INSTALL A COMBINED WASTEWATER OR BLACKWATER TREATMENT WETLAND.

We have experience in the design and implementation of improved wastewater management systems and are looking to design and apply the ecotechnologies and ideas developed at a marae-scale to:

- Demonstrate that engineered wetlands can provide reliable and cost-effective treatment, i.e., resilient to highly fluctuating flows and load conditions that are typical of marae.
- Provide real-world information and data to develop practical guidelines for other marae and communities to follow and assist others in considering options available to improve onsite wastewater management.
- Monitor and prove the performance and effectiveness of appropriately designed and constructed wetland-based systems at addressing common challenges with onsite wastewater management.

Participation in the project will provide the marae with an opportunity to collaborate with experienced scientists and engineers to:

- Identify and address existing onsite (site specific) marae wastewater management challenges and consider alternative water and wastewater management scenarios and options to address those challenges.
- Provide leadership in onsite wastewater management to others and greatly contribute to resolving significant onsite wastewater management challenges through the installation of a trial wastewater treatment wetland.
- Deliver improved onsite water and wastewater management with reduced environmental impact and capital and operating costs.

We are looking for a marae partner who has sufficient land and resources to construct a trial wetland within the next 12–18 months and who, over the next two months, is in a position to start the initial planning for the project.

If you are interested in partnering with NIWA on this project or for more info please contact by 31 October 2014

Chris Tanner
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Māori Development Manager

See Page 6 for more contact details

Tech Corner – Conventional Septic Tank Systems

TECH CORNER WILL BE A REGULAR FEATURE OF THE PROJECT NEWSLETTER AIMED AT PROVIDING BASIC 101 INFORMATION ON ASPECTS OF ONSITE WASTEWATER SYSTEMS. FOR THE INAUGURAL TECH CORNER WE THOUGHT WE'D START WITH AN OVERVIEW OF THE COMPONENTS OF CONVENTIONAL SEPTIC TANK SYSTEMS.

A conventional septic tank system comprises three major components: a septic tank, a distribution device and an absorption/infiltration field or trench, as shown in Figure 1 below.

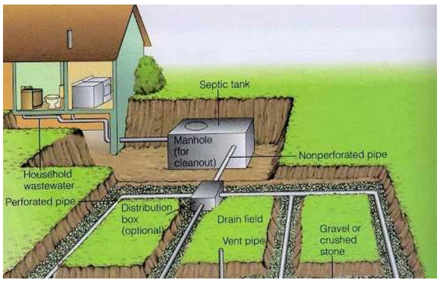

Figure 1*: Conventional septic tank system* (Source: www.osawaterworks.com).

The septic tank is a watertight single or multi-chambered tank that wastewater flows through (Figure 2). The tank is primarily a settling tank where the organic matter contained in the wastewater settles and is decomposed (digested) by anaerobic bacteria (Crites & Tchobanoglous 1998).

Solids that are not digested either settle to the bottom as sludge or float to the top and form a scum layer, both of which must be periodically removed to ensure correct system operation.

Wastewater from within the clear zone of the septic tank (i.e., between the scum and sludge layers (Figure 2)) flows to a distribution device and then into the adsorption field where it is discharged to ground. The distribution device aims to split the flow equally to each pipe in the absorption field.

The absorption field or trench is a sub-surface system within the soil (typically a network of perforated pipes buried in free-draining material) which allows effluent to seep into the surrounding soil (both through the base and side walls of the trenches). Effluent from the septic tank typically flows via gravity through to the absorption field or trench. The effluent receives further treatment in the soil through filtering, and further bacterial action. The absorption field must be designed

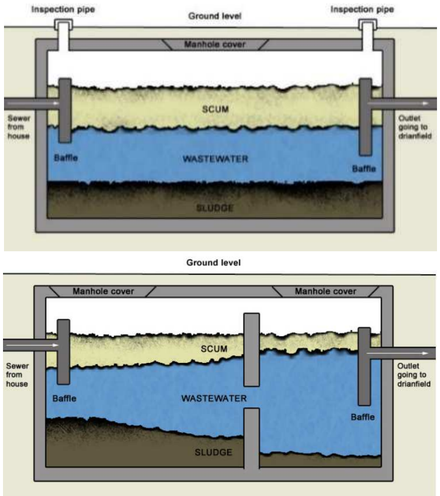

Figure 2: *Single and dual chambered septic tank* (Source: www.usaplumbing.info).

based on the properties of the soil at the site otherwise the system will not function properly.

An appropriately designed and installed septic tank system is capable of adequately managing wastewater, however inappropriately designed, sited and/or managed systems can fail.

Reasons for failure can include excessive water entering the system, lack of maintenance or improper system design (sizing and siting). Septic tank failure may be obvious (e.g., effluent emerging on the ground surface, drainage system backing up and overflows) or less conspicuous (e.g., inadequate treatment resulting in ground/surface water contamination). The cause of failure may be obvious, you may require a professional to help determine the cause.

One of the most common causes of failure of septic tank systems is the carryover of solids and oils/grease from the septic tank to the absorption field. These can be a result of overloading the system or from lack of maintenance. Use of appropriate grease traps and effluent filters help to protect the disposal field from solids and oils carry over from the septic tank. While grease traps and filters require periodic cleaning, this is far more cost effective than having to replace or refurbish the infiltration field or trench. Filters can also be retrofitted to existing septic tank outlets with relative ease.

For more detailed information on onsite wastewater management systems refer to Auckland Regional Council's Technical Publication 58 "On-site Wastewater Systems: Design and Management Manual," Third Edition ARC Technical Publication 2004, prepared by A. W. Ormiston (ARC Consultant) and R. E. Floyd.

References and links

Auckland Regional Council Technical Publication 58 (2004) On-site Wastewater Systems: Design and Management Manual, Third Edition ARC Tech. Publication 2004.

Crites, R. & Tchobanoglous, G. (1998) Small and decentralised wastewater management systems. Boston, WCB/McGraw-Hill.

Schultheis, R. A. (2010) Septic Tank/ Absorption Field Systems: A Homeowners Guide to Installation and Maintenance. University of Missouri-Columbia MU Extension, EQ401. MU Extension, University of Missouri- Columbia.

http://www.epa.gov/
http://www.usaplumbing.info
http://www.gdc.govt.nz/septic-systems/
http://www.gw.govt.nz/assets/council-publications/Environment%20Management_20010223_154203.pdf
http://www.osawaterworks.com
http://www.waternz.org.nz/documents/sigs/swans/120215%20_onsite_wastewater_maint%20_booklet.pdf

Cleaning/desludging a septic tank…

is normally recommended every 3–5 years, but this can vary depending on the size of the septic tank relative to the wastewater load. Ideally sludge levels should be measured at least once a year and desludging done when the depth between the sludge and scum reduces to half or less of the water depth. If your septic tank requires very frequent desludging to stop back-ups (e.g., more than once per year), then it may be undersized and/or there are problems in the infiltration trenches.

NEWS IN BRIEF

Morkel Zaayman: NIWA/ESR funded PhD

THE FATE AND BEHAVIOUR OF WASTEWATER EMERGING ORGANIC CONTAMINANTS IN CONSTRUCTED WETLANDS AND ON-SITE LAND APPLICATION SYSTEMS

Our wastewaters now include a cocktail of organic chemicals from the pharmaceutical and personal care products we commonly use. Some of these so called Emerging Organic Contaminants (EOCs) are washed off our bodies when we shower or are discharged in laundry and dish-washing, while others are excreted from our bodies via the toilet. The increasing occurrence of EOCs in the environment, and their potential health and environmental effects are of serious concern.

A potential issue is that in rural communities, septic tank systems often function poorly due to overloading or poor maintenance. This reduces treatment time in the tanks and microbial breakdown of EOCs. Two potential low-cost treatment options to reduce the environmental risk of EOCs in wastewater include the use of constructed wetlands and separation of waste water streams into blackwater (i.e., toilet) and greywater components. Greywater diversion can reduce the pressure on poorly functioning septic tank systems, and irrigation of greywater to soil or treatment in wetlands offers further potential to remove or degrade EOCs.

Working with NIWA, ESR, University of Canterbury and Northcott Research Associates, the objective of this project is to improve our understanding of the fate and effects of EOCs within pilot-scale constructed wetland system and greywater irrigated soils.

The NZ Land Treatment Collective (NZLTC)

The NZLTC supports research into the treatment of wastes and waste products by land application and provides information on the most recent land treatment technology and research. The 2015 conference is on "*Seasonality impacts of wastewater management*" to be held in Wanaka 25–27 March 2015. For more info on NZLTC including quarterly newsletters visit: www.nzltc.wordpress.com

INTRODUCING MORKEL ZAAYMAN

I graduated with a bachelor's degree in Chemistry in 2004 from the University of Pretoria and I have just completed my Masters in Soil science through Massey University in Palmerston North where I investigated the environmental and health risks of greywater use in New Zealand.

Currently, I am doing a PhD through University of Canterbury where in conjunction with CIBR (Centre for Integrated Biowaste Research) and NIWA we will be investigating the fate and behaviour of emerging organic contaminants (EOCs) from wastewater in constructed wetlands and on-site land application systems. The research aims to identify which types of EOCs are removed by wetlands, the removal and deactivation mechanisms involved, removal and deactivation mechanisms of EOCs in greywater applied to soil, and the potential effects EOCs could have on soil health parameters after greywater application.

For more Information on CIBR visit: http://www.cibr.esr.cri.nz

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FEEDBACK

If you have any feedback on our newsletter, suggestions on content you would like to see included in future issues, or would like to share your wastewater experiences with us, please get in touch.

ACKNOWLEDGEMENTS

NIWA wish to acknowledge our project partners, in particular **Tainui Awhiro** Trust and **Moria Marae** for allowing the use of photographs and references to their marae in this publication.