

SMALL AND RURAL WATER SUPPLIES RISK AND OPTIONS ASSESSMENT

Rachael Casey/RATA, Emma Good/RATA, Shaun Hodson/AMBI & Roger Brady/Otorohanga District Council

ABSTRACT (500 WORDS MAXIMUM)

Small and Rural Water Supplies are an often-forgotten high risk public health and compliance issue across NZ. They are managed, or not as the case may be, by a plethora of organisations with varying levels of record keeping, understanding and operational competence. The number of unregistered supplies have wide and varied estimations of between 8,000 to 75,000 schemes. This estimation sits additionally alongside the number of registered schemes through councils and larger corporate bodies and are now becoming a focus area for the new regulator: Taumata Arowai.

The Regional Asset Technical Accord (RATA), Asset Management Business Improvement (AMBI) and Otorohanga District Council (ODC), working alongside Taumata Arowai, have completed a pilot study that investigated and made recommendations for reducing public health risk and noncompliance with the NZ Drinking Water Standards (NZDWS 2018) on the Kahorekau Water Supply Scheme in ODC. This investigation took a source to tap approach and produced a Small and Rural Supply Options Assessment Framework for use by Waikato Local Authority Shared Services (WLASS) councils.

This framework provided the tools for councils to quickly assess schemes in a standardised manner. For a complete picture, councils needed to be aware of the extent of small and rural supplies in their geographic areas. To this effect a risk assessment for the Waikato was undertaken to understand this inherent risk across the region.

Multivariate data was gathered from the Drinking Water Register for New Zealand held by Environmental Science and Research (ESR), Waikato Regional Council (WRC) consents database and council data sets to understand the status of drinking water supplies and schemes in the region. GIS data science skills were utilised in the mapping of this data and used to highlight areas of concern and infer the probability of unregistered/unknown schemes existing along with a risk rating for prioritised further investigation.

To ensure the risk profile was well understood a communication plan was developed and delivered to all WLASS councils. This ensured councils were aware of and appropriately advised on the best course of action to take including prioritisation of activities and support services to ensure compliance with regulatory requirements and timeframes.

KEYWORDS

Taumata Arowai, Small and Rural Water Supplies, Risk Assessment

PRESENTER PROFILE

Rachael Casey is the Water Collaborations Lead at Regional Asset Technical Accord (RATA). She has over 10 years' experience in Water Quality and Forensic science with a focus now on collaborative projects for the Waikato region in three waters asset management and regulatory requirements.

Shaun Hodson is a three waters specialist consultant with over 30 years' experience in operations, asset/project management and strategic planning roles (NZ and Internationally). Working extensively in government and private sectors he has focused on blending good asset management and operational practices to generate optimal compliance and investment outcomes.

INTRODUCTION

The Waters sector is facing significant change due to several external and internal influences. Central Government are investigating options for the most appropriate mechanisms for the delivery of water services to our communities. Recent developments have seen the formation of Taumata Arowai (TA) (the new Three Waters Regulator). TA have indicated that one of their principal concerns and areas of highest risk is rural and agricultural water supplies and this has been one of the focus areas for the unit since it was formed.

It has been estimated that there are between 8,000 and 75,000 unregistered schemes across New Zealand as well as those registered rural water supplies through ESR such as councils and larger corporate bodies. A working group has been set up by TA (the Small/Rural Supplies Working Group) for such supplies and covers council as well as private water supply scheme representatives. Roger Brady, formerly of Otorohanga District Council (ODC) was a member of this group and has formed the conduit for direction and information to and from this working group.

RATA and ODC acknowledged that there was an unknown risk to councils in adopting small and rural drinking water supply schemes and set up a pilot study project for the Kahorekau scheme with Shaun Hodson from Asset Management Business Improvement (AMBI) consultants brought on board to assist. The pilot study and report have been completed along with an options assessment framework for use by WLASS councils. Additional works have also been undertaken to assess the number of unregistered small and rural supplies across the Waikato to determine the scale and scope of risks in the region. These outputs form the crux of this paper.

SMALL AND RURAL SUPPLIES

CHARACTERISTICS

The exact number of small and rural supplies across NZ is not known, and still under review in terms of definition within the Water Services Act 2021 (WSA) (New Zealand Parliament, 2020). A registerable supply could be as little as two properties served by a supply i.e., a dairy farmhouse and dairy shed with kitchen

facilities, a place of gathering such as a Marae or Community Hall or a much larger number of properties with a common supply.

Information on such supplies including details of ownership, treatment processes and current compliance levels are still under investigation. The best-known schemes are those currently registered with ESR and of those, the schemes with the most information gleaned from the Waikato study have been those operated or managed via local council entities such as ODC. These small and rural supplies typically have:

- Basic treatment processes such as filtration and chlorine dosing.
- A lack of remote control and monitoring.
- Manually intensive operations and maintenance regimes in remote areas of NZ.
- Experienced significant underfunding and renewals have not kept pace with depreciation and/or regulatory requirements.
- Carry reasonably high levels of debt.
- Non standardised plant and equipment - much of it potentially being installed by the original scheme members/owners.
- Mixed supply systems i.e., a treated water supply topped up by rain tanks and other sources.
- High potential for cross connection to higher risk systems such as dairy sheds and processes which may not have backflow devices installed or maintained correctly.
- Minimal to no as-built information or operations and maintenance documentation.
- Mixed supply purposes i.e., drinking water, stock, dairy sheds etc.
- Mixed or confused ownership.
- Mixed or confused regulatory responsibilities i.e., schools, maraes, community halls and prisons.
- Large data gaps in terms of where they are, who looks after them and how to find them.
- Little to no resilience built into them and have unreliable sources (particularly during a drought).

Little is known by councils about the privately/community owned ESR registered schemes across the Waikato. Typically, an "arm's length" approach is being taken by most scheme owners and councils on the operation of such supplies. Through the RATA research across the Waikato, it has become evident that there are a good number of unregistered schemes serving 25 properties or more and more than 600 schemes in total that could be classed as supplying potable water covered under the current definition in the Water Services Act (supplying more than one household from a supply). Also of note is the number of dairy farms in the Waikato region (>2500) that could push the potential number of schemes up more, with the supply of cowshed and mess facilities with drinking water to staff.

DATA AND INFORMATION SOURCES

INSTITUTE OF ENVIRONMENTAL SCIENCE AND RESEARCH (ESR)

The most logical first source of data for small and rural scheme information is ESR, as the nominated data holder for registered water supply schemes at the time of this assessment. The register relies heavily on scheme owners/operators knowing

about the requirement to register and wanting to register their scheme with ESR. ESR publish registers of schemes on their website (ESR, 2021), and these comprise of three data sets in both Excel and PDF format. These have a varied structure and format, with District Health Boards overlapping both regional and district council boundaries.

This makes data handling much harder to undertake and assign to specific council areas/boundaries. This data set yielded approximately 130 registered schemes across the Waikato region. The majority of the registered schemes are council owned/managed, with the rest being roughly split between private supplies, schools and marae.

WAIKATO REGIONAL COUNCIL (WRC)

WRC hold a register of water take consents that includes details on primary industry type (Waikato Regional Council, 2021), i.e., municipal, domestic, and industrial etc. Like the ESR register, the WRC register relies on abstractors applying for a resource consent and has a minimum volumetric 15m³/day take that currently requires consenting. Abstraction volumes below this could supply several properties with potable water and trigger the proposed WSA threshold, but without an easy way of tracking and tracing as the water take is not consented.

Whilst the WRC register is not intended to monitor, or report on potable water takes, the information held in the "database" is particularly useful as a cross reference to the ESR data set and helps identify potential unregistered drinking water supplies. The WRC information was supplied in a GIS and excel convertible format with geocoded references and multiple data fields that enabled data filtering and manipulation to get summary information relatively easily.

WRC have requirements under their legislative drivers to hold records for schools and maraes as well as consented water takes. WRC advised that they monitor water quality on approximately 96 schools every 2 years and are aware of approximately 100 in total across the region. They also advised that a previously developed database had identified approximately 275 supplies serving over 25 people in the region. Unfortunately, this database was no longer in use.

The WRC data sets highlighted a total of 5,247 consented water takes with the vast majority being in the active category. Approximately 217 having an identified primary industry use of being water supply for municipal and / or domestic use and should, in theory be registered on the ESR database. Of these 217 consents, approximately 40 had no reference to drinking water use and had commercial takes and non-drinking water supply entities such as NZTA as the applicants. Both Municipal and Domestic categories had mixes of both supplier types in the separate lists, making a direct assumption on use category difficult to apply in determining consents used for potable water supply.

Cross referencing of these primary industry users showed only 79 supplies to be on both the WRC and ESR list. These differences are concerning as the inconsistency of drinking water supply registers presents a source of confusion and a significant risk element for councils when considering small and rural supplies within their area.

Further analysis of the WRC data using the other primary industry classifications (i.e., Accommodation, Dairy farms and Other) and a use component of drinking water in the consent database generated over 500 matches. The majority of these were for Dairy Farms with around 50 across the other categories.

It is highly likely that more of the 3,954 dairy farm water take consents will have a drinking water component to them. The actual number is currently difficult to determine from the data received and is dependent on the final version of the WSA and subsequent act. Whilst not strictly community water supplies, many of these farms could be covered under the new regulations as requiring treatment and monitoring/reporting regimes implemented on them.

WAIKATO COUNCIL DATA SETS

Council data sets were not readily available in the format, level of detail and timeframe required for the assessment. As a result, a modified approach was taken to this data set that included the use of:

- a) Selecting 3 case study areas to gain an understanding of variability across councils. The three geographical areas used were Thames Coromandel District Council (TCDC), Otorohanga District Council (ODC) and Waitomo District Council (WDC).
- b) WLASS data portal information.
- c) Publicly accessible data from council and government owned webs sites.
- d) In house data sets for Waipa (accessible by RATA).
- e) Exclusion of reticulated supplies (where appropriate to do so) from study areas including a buffer zone around the logged council supply areas to account for growth and development cells.

An added complication for council data sets is the areas of Community Halls and other places of gathering where food and drink may be prepared for a large number of visitors. Such sites may have roof water rather than surface or groundwater supplies and may or may not be registered supplies, have consented water takes or be owned/managed by Councils.

SUMMARY DATA SETS

The results of the regionwide data assessment are included in Table 1 below (Regionwide Data Summary). The table lists the supplies linked to drinking water and the level of confidence in the data contained in information source. The confidence level does not reflect the completeness of such registers, which is largely dependent on the water taker registering as a water supplier with ESR, or noting potable water use for in their consent application.

Table 1: Regionwide Data summary

Supply Status	Range	Confidence Level	Comment
ESR Registered Supplies	80 – 130	High	Geo coding difficult (high end of range includes schools)
WRC & ESR schools and maraes	80 - 100	High	Mismatch across data sets
*WRC consented takes (municipal)	113	High	Some private/community supplies present
*WRC consented takes (domestic)	104	High	Some Council supplies present
WRC Consented Take ("Others")	3861	Medium	Filtered agricultural data set
Community Halls	Unknown	Low	Council data deficiencies
Surface water proximity communities	Unknown	Low	Data difficult to analyse.

**Not all municipal and domestic take consents contain a reference to drinking water and may be used for other purposes, such as recreation, agriculture and industry etc.*

The data summary highlights the number of unregistered schemes that may be in the Waikato and the mismatch of data between ESR registered supplies and WRC water takes consents.

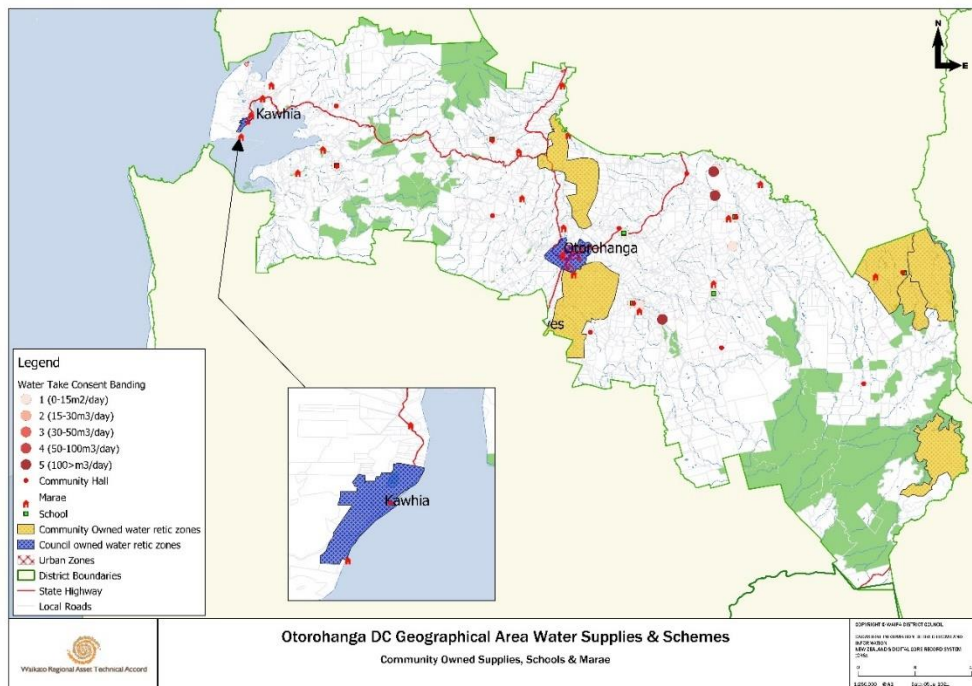
CASE STUDIES

OTOROHANGA DISTRICT COUNCIL (ODC) GEOGRAPHICAL AREA

Otorohanga District Council (ODC) participated in the original discussions with Taumata Arowai on rural and small supply schemes. As an early adopter, the council undertook a review of the Kahorekau supply (part of the Arohena Scheme), that has become a pilot study on which much of the Waikato LASS and RATA framework (discussed later) has been based.

ODC has a mix of standard council community supply areas (Kawhia and Otorohanga) and three rural supply schemes (Arohena, Tihiroa and Waipa), plus two private supply systems; one at Waikeria Prison and a coastal private supply area. These can be seen spatially in Figure 1 – Otorohanga Geographical Area Supplies and in the data set in Table 2 - ODC Summary Data Sets overleaf.

Figure 1: Otorohanga Geographical Area Supplies



The figure above also illustrates the presence of water take consents that have the possibility of drinking water supply distinguished into banding by the water take volume.

Table 2: ODC Geographical Area Summary data sets

Data Type	Number
ESR Registered Supplies	13 includes schools
WRC Schools & Maraes	7
WRC Consented takes (Domestic / Municipal)	6
WRC consented Takes (Potential DW supplies)	416
Surface water proximity communities	Not processed

ODC RURAL SUPPLY SCHEMES

ODC operates rural supply schemes supplying both potable water for human consumption and agricultural purposes (stock water and dairy sheds). The Ranginui scheme has converted to stock water only recently that required auditing by ODC to confirm households were disconnected from the supply. This is a consideration for all councils should schemes try to become stock only supplies and exit drinking water supply agreements.

All 4 rural schemes have treatment plants of varying complexity and capability (all non-compliant for protozoa and occasionally E.coli) feeding into the supply. The Arohena scheme having three treatment plants; Taupaki, Huirimu and Kahorekau, with Kahorekau being part of the original RATA rural supply study.

The Waipa scheme is fed off the main Otorohanga water treatment plant that is compliant with NZDWS and is effectively a trickle feed supply for rural users, akin to many across the Waikato. The scheme also partly transgresses the district

boundary serving some properties in the Waitomo District Council area and raises the issue of cross boundary schemes and supplies. This issue will be addressed on the formation of Entity B.

NON-COUNCIL SUPPLIES

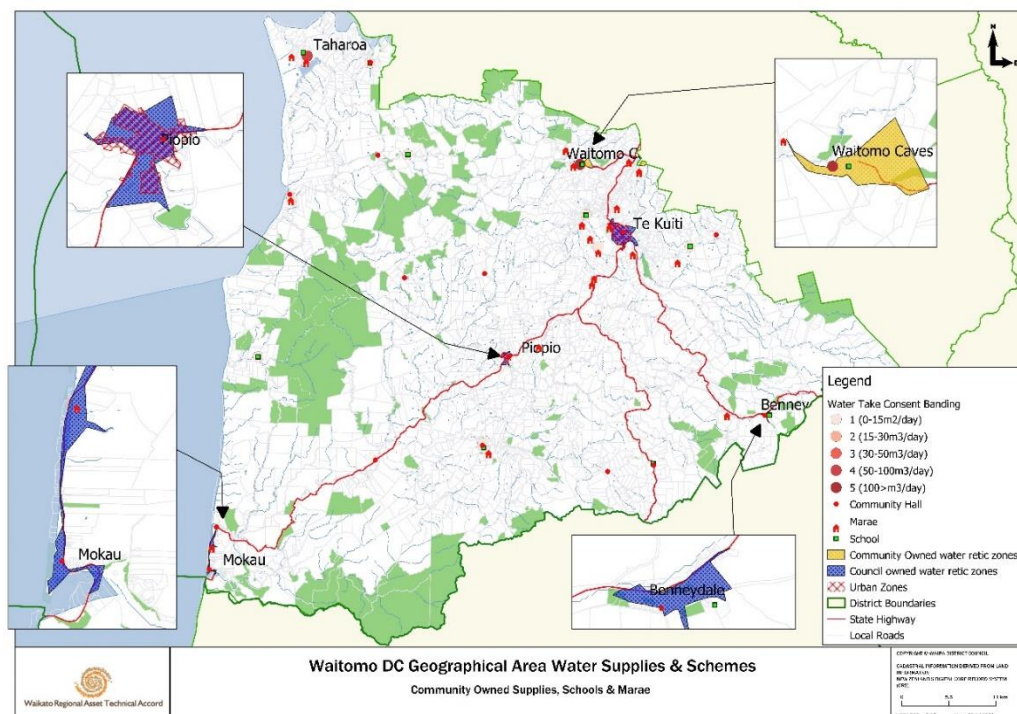
The Waikeria Prison supply is owned by the Department of Corrections (Corrections) and operated on their behalf by private entities. The prison also has a wastewater treatment plant that has been decommissioned and wastewater transferred to Waipa District Council (Te Awamutu Wastewater Treatment Plant) for processing.

One coastal supply area has approximately 120 properties with around 60 being fed by a private supply on a subdivision and would come under the new regulations/Water Services Act as requiring registration and full compliance with NZDWS. This scheme does not appear on the ESR list of registered supplies; however, it is on the WRC list of supplies with drinking water noted on the consent details.

WAITOMO DISTRICT COUNCIL (WDC) GEOGRAPHICAL AREA

WDC has 4 municipal supply schemes that it operates in its larger community areas. WDC has no recorded rural and small supplies that it manages in conjunction with others, though two private supplies are present on the ESR register. These supply areas discussed can be found in Figure 2 - Waitomo Geographical Area Supplies below and summarised as a data set in Table 3 below.

Figure 2: Waitomo Geographical Area Supplies



The figure above also illustrates the presence of water take consents that have the possibility of drinking water supply distinguished into banding by the water take volume.

Table 3: WDC Geographical Area Summary data sets

Data Type	Number
ESR Registered Supplies	13 (includes Schools)
WRC Schools & Maraes	6
WRC Consented takes (Domestic / Municipal)	3
WRC consented Takes (Potential DW supplies)	109
Surface water proximity communities	Not processed

NON-COUNCIL SUPPLIES

There are two private supplies registered with ESR and outside of WDC input. These are:

- a) Waitomo Holdings Limited have a supply for the Waitomo Caves tourist attraction and surrounding properties.
- b) Taharoa Ironsands Ltd, an ESR registered small supply that does not have a corresponding drinking water designation in the WRC consent data file.

WDC currently does not have any formal management or communications processes with private supply schemes, and they operate completely independently of council.

THAMES COROMANDEL DISTRICT COUNCIL (TCDC) GEOGRAPHICAL AREA

TCDC geographical area has the largest mix of council owned and private/community owned supplies. There are multiple schemes registered with ESR and around 50 consents are noted on WRC asset databases as being consented to take water for domestic/drinking water supply purposes. Table 4 outlines the summary data findings for the TCDC geographic area and Figure 3 - TCDC Geographical Area Supplies (overleaf) details their location.

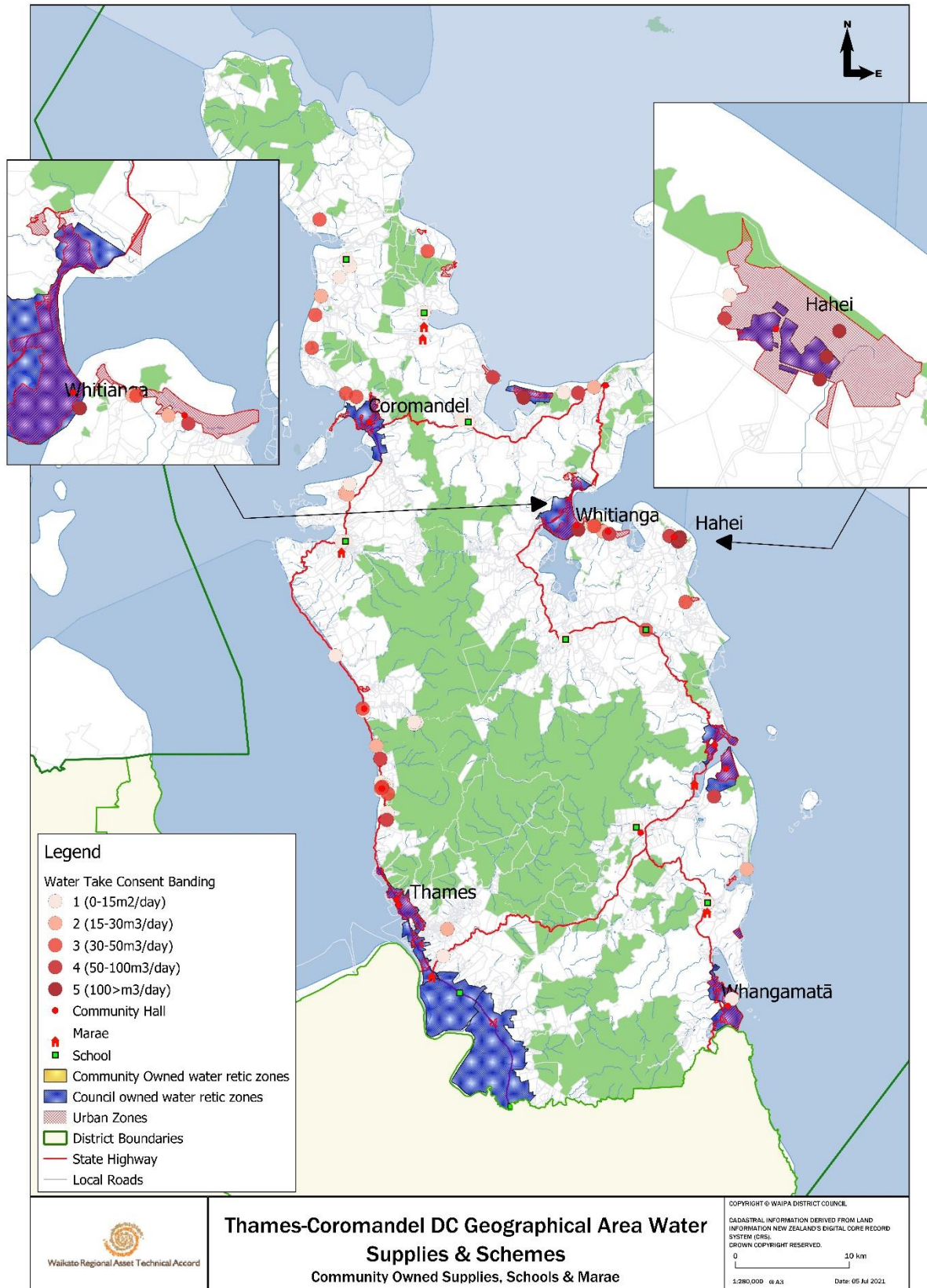
Table 4: TCDC Geographical Area Summary data sets

Data Type	Number
ESR Registered Supplies	28 (includes Schools)
WRC Schools & Maraes	7
WRC Consented takes (Domestic / Municipal)	50
WRC consented Takes (Potential DW supplies)	48
Surface water proximity communities	Not processed

NON-COUNCIL SUPPLIES

There are numerous private supplies registered with ESR and appear on the WRC water takes consent list. Several towns (e.g., Hahei and Whitianga) have areas supplied by both municipal and private supply systems.

Figure 3: TCDC Geographical Area Supplies



The figure above also illustrates the presence of water take consents that have the possibility of drinking water supply distinguished into banding by the water take volume.

SCHEME ASSESSMENT

THE KAHOREKAU SCHEME

To tangibly understand the risks associated with small and rural supplies, a system with good existing data and information is required. This can then be extrapolated across registered supplies and then unregistered supplies with cascading degrees of confidence in the outcomes. As mentioned earlier, ODC was an early adopter of addressing issues on small and rural supplies and undertook a review of the Kahorekau supply (part of the Arohena Scheme), that has become a pilot study on which much of the Waikato LASS and RATA risk and solutions framework has been based.

SCHEME OVERVIEW

ODC operates several rural water schemes including the Arohena Scheme (commissioned in 1982), which is comprised of 3 separate systems: Kahorekau, Huirimu and Taupaki systems all in close proximity to each other. The largest of the schemes is Kahorekau, serving approximately 45 registered scheme dwellings (points of drinking water supply – houses and dairy sheds etc) and utilising a combination of scheme only water supply (trickle feed), or rainwater and groundwater feeds as supplementary supplies to the property. Additionally, part of the supply scheme feeds dairy sheds generally on separate feed and storage systems, though emanating from a common feed from the scheme. All the supply scheme feeds mentioned are on, or near the houses and within the boundary of the scheme itself.

The water supply source is primarily bush catchment with some open grazing country to the southwest of the intake. Recent ecological assessments of the catchment concluded that the macroinvertebrate community index (MCI) score was indicative of an excellent stream health and unpolluted water source.

TREATMENT PROCESSES

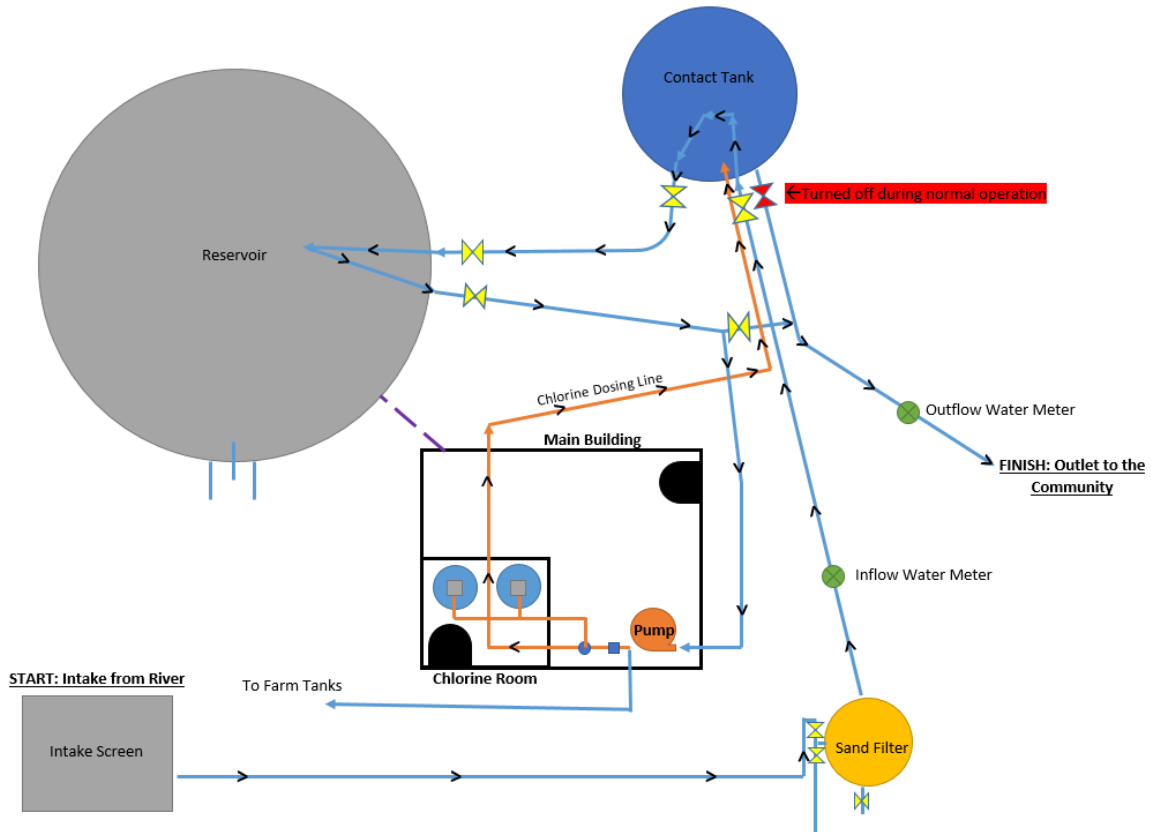
The treatment process is outlined in Figure 4 overleaf: Kahorekau Water Treatment system. The intake consists of a settlement area and rough screening (approximately 20 mm) to catch leaves and twigs. Like most upland sources the raw water is generally of very high quality, but subject to rapid peaks in turbidity and potentially colour (humic and fulvic acids) following rainfall events in the catchment.

The treatment process following intake screening consists of a “roughing” pressure sand filter driven by the head from the intake. Chlorine is dosed into the up-feed line and enters a contact tank (unknown Ct value) and passed on to a main reservoir before entering reticulation. The target Free Available Chlorine (FAC) for the plant is 1.0 mg/l and the raw water pH is around 7.0 or neutral, so overall a reasonable contact time is believed to be achieved across the system. The roughing filter is periodically backwashed with treated water via the up-feed line,

so additional disinfection and cleansing of the filters occurs frequently (backwash occurring every 2 hours when the site was visited in June 2020).

There is limited automated monitoring at the site with only FAC and pH measured via an online analyser. Spot final water samples are periodically taken for turbidity and coliform bacteria.

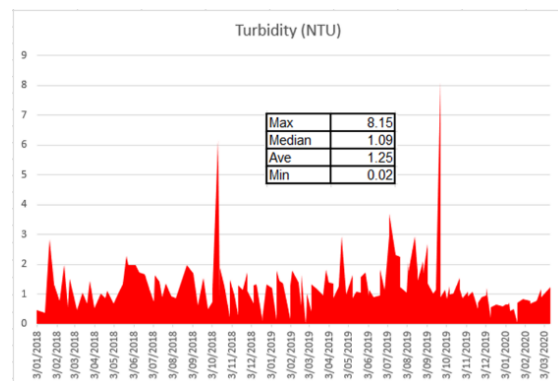
Figure 4: Kahorekau Water Treatment System



As can be seen in Figure 5 - Water Quality Summary Data, the final water and reticulation is generally compliant with NZDWS for Faecal Coliforms, though does have frequent spikes in turbidity, particularly following rainfall.

Figure 5: Final Water Quality Summary Data

Parameter	Category	Kahorekau
Plant		
Attendance / Sampling	Staff Visits Sampling Period	2-3/week
E.coli	No. of Samples	26 Required
	No. of Positive Results	Nil
Total Coliforms	No. of Samples	26 Required
	No. of Positive Results	Nil
FAC, pH, NTU	No. of Samples	52 Required each
	Mean pH	6.79
	Minimum pH	6.25
	Maximum pH	7.4
	Mean FAC	1.18
	Minimum FAC	0.32
	Maximum FAC	2.24



The plant as it stands does not comply with the current NZDWS, which has a log 3 protozoa removal requirement, due to not having effective protozoal barriers in place. Previous studies (CH2M Beca, 2017) indicated that compliance would require investment between \$150,000 and \$2.2M to make the plant compliant with the then New Zealand Drinking Water Standards by installing UV treatment and or membrane treatment processes respectively.

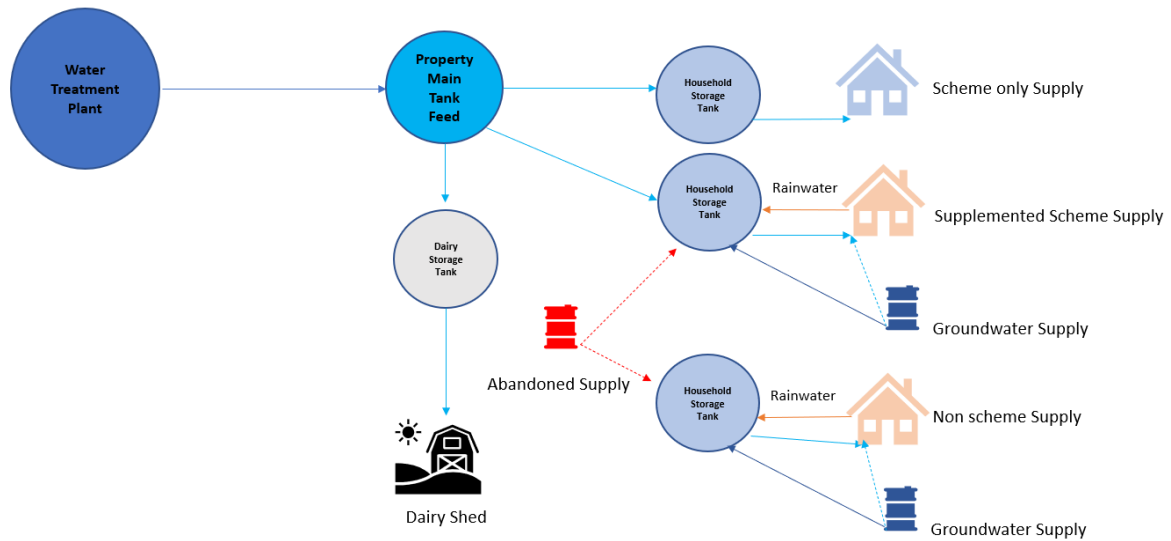
Recent discussions (2020) with Taumata Arowai indicated that achieving a low turbidity (<1 NTU) on final water and maintaining acceptable FAC residuals could mean compliance with future standards for rural schemes with this type and quality of source (to be confirmed pending the acceptable solutions report being approved).

RETICULATION

The reticulation system is quite dispersed and feeds a mix of residential properties, troughs (for stock feed) and an increasing number of dairy farm units. Much of the reticulation has been installed by the scheme property owners and is of mixed age and material types, though anecdotally are believed to be mainly plastics (alkathene and MPDE). The extent and layout of the reticulation after the property boundaries is not fully recorded on ODC systems. That said the layout is generally known by the property owners and typically extends out from a main source tank on the property high point that then feeds other tanks and houses on site via gravity. A small number of residential properties require booster pump systems due to the location of the house in relation to the tank feed. These pumps are typically situated near the house.

Some of the properties have supplementary supplies for dairy sheds and irrigation that include groundwater and surface water supplies. Inspection of several properties identified limited backflow prevention devices, though tanks feeding residential properties were believed to have an air gap system, and one dairy shed inspected had a non-return valve installed on the tanks feeding the wash system. There are also several abandoned sources (ground and surface water) in the scheme area. The degree of abandonment and method of disconnection from properties has not been confirmed as part of this investigation and represents a potential risk to public health and compliance with the NZDWS going forward. An example of the system complexity is depicted in Figure 6 - Property Supply Arrangements below:

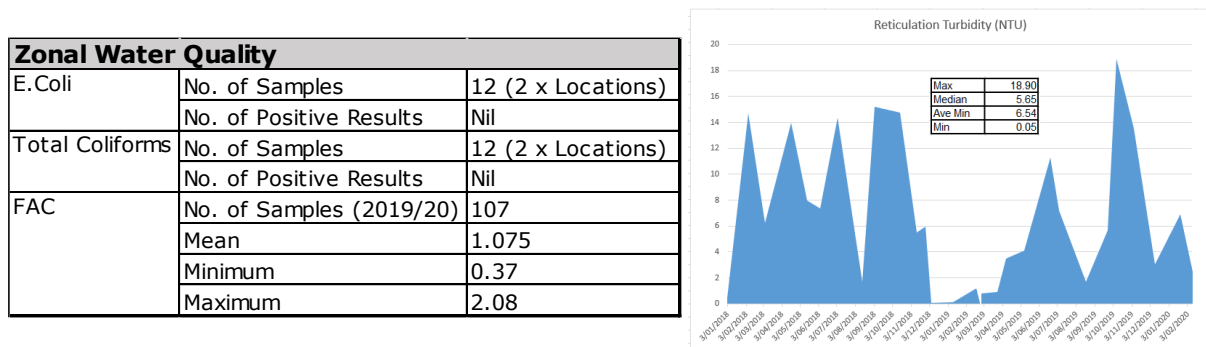
Figure 6: Kahorekau Property Supply Arrangements



Overall, the piped network is complex with a fusion of new and old assets, interconnectivity of various water sources and an inability to confirm pipework layout and status of abandoned sources.

Zonal samples for water quality are presented in Figure 7 and whilst compliant with bacteriological requirements during the period assessed (2018 - 2020), there are extremely high spikes of turbidity. These spikes are much higher than those at the plant and the root cause is currently unknown, but is suspected to be a combination of disturbance of sediments deposited in extended pipework systems and from the onsite storage tanks on the property that did not have regular maintenance regimes and often had lids missing and/or structural issues.

Figure 7: Zonal Water Quality Results



It was quickly concluded that NZDWS compliance at the customers tap could not be guaranteed by compliance at the treatment plant alone and that the biggest risk to public health was from the reticulation system (bacteriological and chemical) and not the treatment plant. This has been borne out recently with both site audits of reticulation assets and boil water notices (BWN) being imposed on the scheme, and still in force for the school in 2021.

SCHEME RISKS

The risks associated with noncompliance with NZDWS are obvious and required significant investment to make compliant. This was brought sharply into focus with the formation of Taumata Arowai (TA) and their attention on small and rural supplies that they saw as being a significant risk to public health. At the time of the system assessment, TA was formulating its acceptable solutions approach for such supplies. There was a risk that any solution for Kahorekau could fall outside of this requirement and involve abortive costs. Engagement with the new regulator, and the scheme committee was initiated to guide and inform the solutions process.

During this process, additional risks were identified including the financial viability of the scheme going forward with a potential to exit the management agreement with council, go stock only or look to a permanent boil water notice (BWN) on the scheme (not an acceptable solution for TA). Further discussions with the scheme committee raised other issues including that of scheme ownership (legal opinion sought and inconclusive), changes to consent and security of supply, unit costs of water, community viability, liabilities on scheme committees and owners and what would happen under reform if the scheme stayed with council.

Other risks identified outside of the scheme included an increasing interest from other small and rural schemes to transfer ownership and or operation to the councils. This was happening across several councils in the Waikato region particularly from "industry" and larger private supply schemes. Added to this was the "confused" regulatory responsibilities surrounding schools, maraes and community facilities and potentially conflicting requirements under the Local Government and Resource Management Acts (currently under review) and associated key regulators, not to mention the WSA and formation of Taumata Arowai.

FINDING ACCEPTABLE SOLUTIONS

THE LONG LIST

It is standard industry practice to look at a wide range of options when considering significant investment on infrastructure. This typically starts with a brainstorm of potential solutions to develop a long list of options as outlined in Figure 8. The long list was developed in conjunction with ODC and aimed to cover off all logical potential options regardless of their fit to the current scheme requirements or compliance with NZDWS. This was more of a "no-fatal flaw" approach so that a comprehensive list of considerations could be put forward to council and the scheme committee in lieu of the then unknown regulatory requirements for such schemes. The formation of Taumata Arowai and any potential new regulations coming into force during 2021 was later utilised in reducing the number of options considered.

The long list focussed on options at the treatment plant, in reticulation, alternate supplies and additional considerations including do nothing, abandoning the scheme, permanent boil water and maintenance agreements with suppliers.

An example of the acceptable solutions criteria options is contained in Figure 9, with additional considerations being made in respect to what standards to comply

with (for UV etc), operational costs, online vs manual sampling and analysis, write off costs, and disposal of waste products including UV lamps. For each option, rough order costs ranges including land purchase as well as infrastructure and consenting was collated, along with potential risks and benefits.

Figure 8: Assessment Process

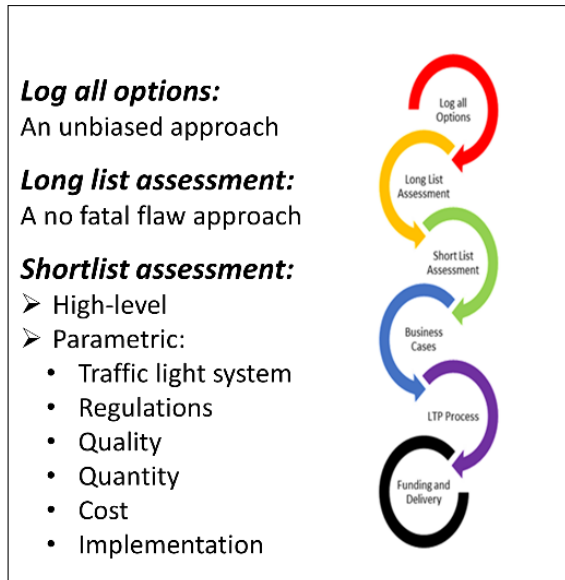


Figure 9: Solution Criteria

- 1) Upgrade Treatment Plant**
- Filter upgrades to meet a 1 NTU
 - Automatic shutdown on high turbidity
 - Automated backwash on head-loss
 - Remote monitoring and control
- 2) Point of Use Devices**
- UV systems with absolute filter cartridges
 - Potential for:
 - ✓ Automatic alarming
 - ✓ Backwash
 - ✓ Shutdown on high turbidity

SHORTLISTING

The shortlisting process involved capturing rough order costs of solutions and then applying a set of criteria to the option. Two sets of criteria were considered:

- 1) PESTEL: Political, Environmental, Social, Technical, Economic and Legal. Each category having multiple sub-components to them. PESTEL analysis is a recognised industry standard approach for larger and more complex projects, options and solution selection.
- 2) High level Parametric approach, considering: Regulations, Quality, Quantity and Cost (QQC) and Implementation.

Option 2 was chosen as it adequately reflected the scale of the problem and the level of investigation/detail required given the information captured and the likely outcome of some of the more significant investment options. The key components of the assessment criteria are outlined in Table 5 below and included a temperature gauge approach to the selection process. This being a traffic light system of minimal concerns, some concerns, and major concerns.

Table 5: Parametric Considerations

Regulations	Quality-Quantity-Cost	Implementation
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NZDWS	Total volume - take	Ops and Maintenance
Public Health Act	Useable volume – production	Technical Complexity
RMA (Take Volumes and Waste Streams)	% +ve/-ve impact of supply/demand	Waste Streams
Potential MALF achieved (RMA/Regional Plan)	Resilience	Land Purchase/Easements
LGA	Capex	Competing demand for water
Major Legal Challenge	Opex	Ease of Implementation (1-10)
Building Act	Pressure Systems	Timeframe to achieve
		Acceptability to the community

PREFERRED SOLUTIONS

AT THE PLANT: On the assumption that point of use devices are required on the residential properties, upgrade options at the plant could be limited to minor upgrades to current systems and include a potential new filter system complete with head-loss measurement, online raw and treated water turbidity analysis and more remote control and operation such as auto shutdown on high turbidity. The rough order costs for these range between \$100,000 and \$500,000 dependent on the systems chosen as part of the upgrade as well as the degree of automation employed.

There is also an option being considered to integrate the other two supplies (Taupaki and Huirimiu) into one treated supply in the scheme area. This could use the assets at the other plants as part of the upgrade, for example the UV system at Taupaki and the Filter units at Huirimiu and Taupaki.

IN RETICULATION: A number of point of use UV devices have been costed as part of this project including absolute cartridge filters, backflow devices, and the potential for auto backwash systems and remote alarming of issues such as low flow and UV lamp outage at each site. The rough order costs (ROC) range for the UV systems is between \$2,000 and \$15,000 per unit dependent on degree of automation and alarms incorporated into the design. It is noted that these prices are exclusive of install and do not reflect economies of scale that can be gained from multiple unit purchases. Maintenance of the units has also been investigated and range between \$1,000 and \$2,000 per property per year, and again is dependent on the unit chosen for install and whether internal ODC or external contracted services are utilised for the activity.

Operations and maintenance including the cleaning of the piped network and scheme storage tanks has been considered to reduce the turbidity spikes being experienced in the network. Further consideration has been taken on the potential liabilities arising from currently installed assets and compliance with various legislative requirements including the building act, electrical installation standards and condition of the assets (i.e., old concrete tanks at the end of their useful life).

REFORM FUNDING

The work at Kahorekau has been useful in helping ODC gain Three Waters Reform funding monies to undertake the necessary works on the scheme. This will help to reduce the various compliance risks on the system as well as financial burden on the community. The processes developed and upgrades proposed will also be

used as a case study for other councils in the region and potentially nationally on this emerging area of compliance focus.

REGIONAL IMPLICATIONS

Extrapolating the findings from the assessment of small and rural water supplies and the potential for upgrade to comply with NZDWS and other regulatory requirements has been difficult due to the lack of tangible data and information on both registered and unregistered supplies across the region. This is further exacerbated by the embryonic developments happening on the Water Service Act, Taumata Arowai (and acceptable solutions), NPS and NES for Freshwater and working towards the concepts of Te Mano O Te Wai.

As it stands in the WSA, any supplies servicing more than one household will be subject to regulation and council inputs in terms of ensuring the provision of a water supply for their communities under the LGA. Added to this the complex regulatory arrangements around schools, maraes, campgrounds, and other community gathering points (private, community and council owned) that complicate matters further.

COMMUNITY CONCERNS

Recent discussions with Scheme Committees and general feedback from those involved in small and rural supplies has been:

- Long term security of supply with no water meaning no business and no community.
- The cost of water in the future (will increase and could make schemes unaffordable).
- Asset ownership particularly for council managed schemes with Committees/local communities specifically funding the water supply.
- Will debt be written off on rural schemes on transfer to reform entities?
- Who makes decisions under the reform entity?
- What will happen to the water take consents should the scheme go stock only or exit council supply agreements?
- Who owns risks under the private supply arrangements including the school and marae supplied by the Kahorekau system via an individual farm supply?

COUNCIL CONCERNS

The Waikato study has shown that there is limited understanding around small and rural schemes. The case studies have shown that there are large data and information gaps with the key risks being:

- Most councils have no visibility of the risks they or their communities are facing and no means of funding/resourcing investigations to avoid present and future issues arising from small and rural supplies in their area.
- The lack of visibility will lead to missed opportunities to take a standardised and district/regional approach to understanding and resolving small and rural supply issues, including the potential for future reform funded works.

- Legislation and responsibility areas for potable water supply are complicated with a mix of council owned/operated assets, private supplies in the region and differing approaches, for example schools and maraes involving Ministry of Education, and Regional Council. It is highly likely that some, if not all will fall on the councils or the new reform entities at some point in time.
- Rural schemes currently managed or operated by councils but involving a supply committee are likely to go through the same conversations and questions as ODC had with their schemes with the current/future ownership and cost of water likely to become litigious.
- It is not known whether more private suppliers will seek to transfer ownership/operation of their schemes to councils in the light of changing legislation. Given the current scale and scope of the schemes identified, this is likely to happen, or schemes abandoned leaving councils with major public health and/or rural community viability issues to deal with.

In aggregate, these aspects generate two key risks for council:

- Financial (capital, operational and legal costs).
- Compliance with regulations such as the New Zealand Drinking Water Standards (NZDWS), the Resource Management Act, Local Government Act and Health and Safety at Work Act, most of which have had significant overhauls in the last few years and can have conflicting requirements for councils.

CONCLUSIONS

There are significant unknowns around small and rural supplies in New Zealand. These range from the number of schemes, levels of treatment, asset condition, water quality performance and compliance with regulations such as NZDWS, RMA, Building Act and Electrical Standards etc. A recent report from BECA has estimated that there are up to 75,000 unregistered schemes in NZ covering around 800,000 people.

There is no single source of information that can readily be used by councils, or a regulatory entity to identify unregistered schemes and those that are available require significant amounts of data handling and interpretation. There are regulatory requirements on potable water suppliers with legislation applying to all suppliers except domestic self-suppliers (single households with an individual water supply). The level of visibility and understanding of regulatory requirements on both registered and unregistered water suppliers and the requirement on local authorities is low. The Waikato Councils water supply teams were initially totally unaware of the requirements under the WSA and did not know the number of registered non-council schemes (let alone unregistered supplies) in their area.

Costs of compliance falling on the communities across the Waikato are significant, as are the reporting requirements and potential liabilities for non-compliance with a range of regulations. Even small schemes that are managed by councils such as the Kahorekau supply have significant investment requirements ranging from the hundreds of thousands to the millions of capital costs with corresponding

operations, maintenance and reporting requirements well above those in place at the represent time.

Some private water suppliers are approaching councils to take ownership of their schemes already. This is believed to be related to changing legislation and an acknowledgement by these entities that providing safe drinking water is not their core business or skill set. Others are waiting for reform and believe that this will be sorted then, not understanding that compliance with regulations is required prior to the set-up of the new entities and what will happen with small and rural supplies. Even more are blissfully unaware of what is happening with regulatory changes and or the reform of the water industry in NZ.

To this effect a coordinated regional/national standardised approach is proposed. The findings from the Waikato RATA councils will not be unique and therefore some learnings can be applied to other regions for assessment of small and rural water supplies.

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REFERENCES

CH2M Beca Limited (2017) '*Arohena and Tihiroa Schemes Water Treatment Plants Protozoa Assessment*'. Prepared for Otorohanga District Council.

ESR (2021) '*Drinking-Water Register for New Zealand*'. [Online]. Available: <https://www.esr.cri.nz/our-services/consultancy/water-quality-and-sanitation/register-of-suppliers/>

Ministry of Health (2018) '*New Zealand Drinking Water Standards*'. [Online]. Available: <https://www.health.govt.nz/publication/drinking-water-standards-new-zealand-2005-revised-2018>

New Zealand Parliament (2021) '*Water Services Act 2021*'. [Online]. Available: <https://www.legislation.govt.nz/act/public/2021/0036/latest/LMS374564.html>

Taumata Arowai (2021) '*An acceptable Solution for Rural and Agricultural Water Supplies*'. [Online]. Available: <https://www.taumataarowai.govt.nz/for-water-suppliers/>

Waikato Regional Council (2021) '*State of Environment*'. [Online]. Available: <http://waterallocation.waikatoregion.govt.nz/StateOfEnvironment>