Citycare Water

Final Report

Greytown Smart Water Meter Trial

Wellington Water

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

advizzo

Landis+Gyr

Contents

Executive Summary

The Greytown Smart Water Meter Trial was initiated by the Landis+Gyr sponsored Wellington Water Trial Charter document (Appendix A), released 26-February 2021, whereby the project purpose, scope, team, structure, trial parameters, out-of-scope items, success criteria and deliverables were outlined. Soon after, a Discovery Phase occurred in June 2021, facilitating site selection. Initial community relations initiatives were deployed to the Greytown community in September 2021. While installations commenced on 13-December 2021, the official 1-year trial start date started in March 2022, with partial installations expected to be completed by this point. The trial's main goals were to promote Te Mana o te Wai's goals, encourage sustainability through behaviour and leak management, and trial products and processes in preparation for potential future smart meter projects. The project was made possible by Three Waters stimulus funding with the aim of stimulating work and interest in the area of Three Waters.

In March-2021, Citycare Water responded to the Trial Charter document with a multifaceted smart metering solution, as outlined in the Trial Proposal document (Appendix B). This solution not only aligned with the requirements and outcomes aligned in the Charter document but also considered the Discovery Phase findings and recommendations and the project planning and shaping discussions undertaken between all project parties, including accommodating agreed changes to the original Charter document. The core deliverables of the solution included: the installation of Landis+Gyr smart meters in agreed Greytown locations, remote meter data reading, leak detection on both customer and network side, near real-time reporting of critical alarms, engaging trial householders with water usage and sustainability insights and a post-trial report detailing trial findings, insights and recommendations.

As outlined in the Trial Proposal, the solution team had a collective depth of global and local experience. Wellington Water (WW) were the project sponsor and middleware/dataflow owner responsible for integrations and was also in charge of householder communications, while South Wairarapa District Council (SWDC) were the asset owner. Landis+Gyr (L+G) were the provider of the ultrasonic meters with ongoing fleet monitoring services, and Vodafone provided the Narrow Band Internet of Things (NB-IoT) network used for transmitting meter data. Advizzo was the provider of the customer portal and customer engagement expertise. Citycare Water (CCW) carried out field installation activities, provided project management for the trial proposal solution, and, along with all the parties mentioned above, prepared this end-of-trial report. In addition to the proposal, Wellington Water stood up a business intelligence platform, Tableau, which allowed for further network monitoring and analytics to be carried out. Landis+Gyr, through creating their own business intelligence platform, were able to provide additional insights beyond the outlined proposal scope. The solution, or project team, tracked progress and change on a weekly basis through project meetings.

The trial sufficiently met the requirements outlined in both the Trial Charter and Proposal documents while also highlighting opportunities, challenges and areas requiring further analysis prior to a larger-scale rollout. The installed meters will continue to operate in Greytown beyond the decommissioning of this project, providing continued leak detection and potential for analysis and annual remote meter readings. While various risks were highlighted in the Trial Proposal, emphasis was placed on the high risks associated with the uncertain nature of deploying the project during the COVID-19 pandemic. As predicted, indiscriminate global supply chain disruptions were experienced, and installation delays took place as a result of isolation rules and crew unavailabilty. However, with this said, ‘contactless’ installations were able to be continued throughout legislated ‘lockdown’ periods due to water infrastructure works being classed as an essential service. Readers should note that certain appendices for this report are not publicly releasable due to containing third-party commercially sensitive information. In these instances, this is noted with placeholders in the appendices section of this report.

Document History

Date	Name	Organisation	Changes Made
23/11/22	Jonathan Eweg Sourab N Simha	Wellington Water	Requirements provided in advance.
29/03/23	Julien Lancha	Advizzo	Information submitted (including survey results).
06/04/23	Sam Repia Dean Eckersley	Landis+Gyr	Information submitted (including data and leak report).
06/04/2023	Rebecca Holland David Beckwith	Citycare Water	Initial draft submitted.
02/06/2023	Sourab N Simha Jonathan Eweg Sam Repia Dean Eckersley Rebecca Holland	Wellington Water Landis+Gyr Citycare Water	Updates and refinements.
22/06/23	Sourab N Simha	Wellington Water	Project Sponsor updates.
11/07/2023	Rebecca Holland	Citycare Water	Final submitted for review.
10/08/2023	Sourab N Simha Sam Repia Julien Lancha Rebecca Holland	Wellington Water Landis+Gyr Advizzo Citycare Water	Authorised for internal use. Version One/Unredacted: Contains property and related asset data.
16/08/2023	Sourab N Simha Sam Repia Julien Lancha Rebecca Holland	Wellington Water Landis+Gyr Advizzo Citycare Water	Additional version edited and authorised for external use. Version Two/Redacted: Property and identifiable asset data redacted.

Trial Overview

A primary reason for the Greytown Smart Meter Trial project to be carried out was to better understand the opportunities, challenges, and overall level of feasibility around smart water meter procurement, physical installations, data (capture, connectivity and flow) and platform commissioning and community deployment and analysis. A constructive number of learnings have been acknowledged as a result of the trial, which can be utilised by South Wairarapa District Council (SWDC) and Wellington Water for future district planning and rollouts. Key lessons have been noted in each section of this report, and an additional lessons learnt register is located in Appendix C-G.

The trial was initiated by a project charter, which outlined the trial success factors, key parameters and project deliverables. The trial successfully met the following outlined success factors outlined:

- Successfully capturing events in near real-time.
- Successfully delivering daily payload information remotely according to the agreed scope.
- Successfully detecting leaks through various types of service lines and trunk mains.
- Successfully completing a cost-benefit analysis in favour of the technology.
- Demonstrating the ability to push notifications and data to customers at regular intervals, which may influence customer behaviour, resulting in an overall reduction in consumption.

Additionally, the Trial Proposal outlined six areas of project metrics to be analysed as part of the trial. These areas will be addressed throughout this and are:

- Economical
- Meter performance
- Consumer consumption behaviour
- Meter communication performance
- Leak detection
- Customer recruitment and engagement

The trial Charter document is available in Appendix A, and the full trial metric requirements and outcomes are tabled in Appendix H.

Project Team

The project team consisted of a variety of inter-organisational stakeholders, as detailed in the Project Charter (Appendix A) and Solution Proposal (Appendix B). It was deemed important to have 'hands-on' involvement from solution-related industry professionals; thus, the project solution team were scheduled to meet on a weekly basis. Below is a brief overview of the roles and responsibilities owned and carried out during the project.

Organisation	Role and Responsibilities
Wellington Water (WW)	Business Owner acting on behalf of SWDC, final site selection, data flow commissioning and management for middleware and integrations, community engagement and data analytics.
Citycare Water (CCW)	On-site discovery, installations, and overall smart meter solution project management.
Landis+Gyr (L+G)	Smart meter suppliers, network connectivity management (with/for Vodafone) and fleet management (device health and connectivity) for the duration of the trial.
Advizzo	Delivery of the customer portal and responsible for preparing and providing home report PDFs (letters/emails).

Other stakeholders involved in the wider delivery of the project included:

Organisation	Role and Responsibilities
South Wairarapa District Council (SWDC)	Asset Owners.
Householders / Greytown community	Meter and solution recipients.
South Wairarapa District Council Public Library	Community engagement day venue and hosts.
Vodafone New Zealand	NB-IoT network tower providers (wider NB-IoT network communications solution was provided through Landis+Gyr).

Trial Goals and Objectives

The Trial Charter document (Appendix A) spoke of four predominant trial goals and objectives. These were:

- To promote customer engagement in an attempt to drive customer behaviour to align with the goals of Te Mana o te Wai.
- To drive greater cost efficiencies by lessening the on-site work required. For instance: meter readings, leak identification and tracking, limited opportunities for human errors through manual updates and more accurate leak estimates to determine resourcing and infrastructure requirements.
- To gain a better understanding of how consumer behaviour may be impacted through greater visibility of usage and additional water sustainability messaging (the correlation between visibility and behaviour) and an insight into usage trends for properties installed at.
- To identify opportunities, challenges, and risks associated with smart meter rollouts to be considered for future smart meter deployments.

Trial Phases

Three phases were outlined, forming the trial scope in the Trial Charter document (Appendix A). This highlighted the key objectives of the trial, which consisted of the following:

1. To verify W350 meter base functions and understand installation requirements.
2. To verify the functionality of vibration sensors and understand customer behaviour using a customer trial.
3. To complete reporting.

The above phase requirements are explained in detail in the Trial Charter document in Appendix A.

For this report, to provide a clearer representation of the stages and steps carried out during the trial, the phases have been expanded and are discussed in detail below.

1: Discovery Phase

The Discovery Phase took place in July 2021 and focused on surveying and understanding various aspects relating to the Greytown area and community to make informed decisions and plans for the approaching trial. Largely carried out directly in Greytown, this phase set the foundation for site selection (Appendix J), project purchasing (Appendix I), community engagement (Appendix T) and additional planning relating to the solution proposal (Appendix B).

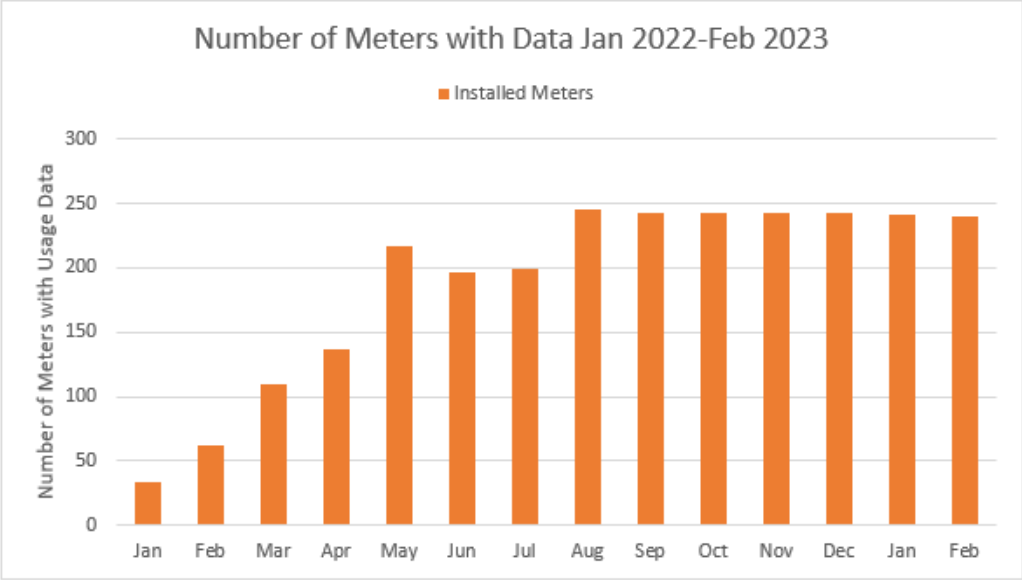
Citycare Water completed on-site data capture for 490 properties, which had previously been identified as being potential trial installation properties by a Wellington Water desktop study. The list was refined to make up 369 properties for which Wellington Water would start the community engagement process. These properties were selected based on the anticipated lower level of effort and disruption required to complete the installations and reinstatements. Meters with added sensors required additional thought into where they would be best placed in Greytown to maximise their potential. Details around the site selection by type of smart meter are available for review in Appendix J. As a result of the Discovery Phase, 250 properties were selected and onboarded for the trial by Wellington Water.

2A: Installation (/Network Connectivity) Phase

The Installation Phase focused on procuring, installing, and commissioning network connectivity for smart water meters across 250 households in the Greytown area. This phase was interesting because it included the commissioning of network connectivity and, subsequently, wider data flow.

Citycare Water began installation work in December 2021 and completed the initial set of installations in April 2022. Additional retrofitting work was completed in May 2022, and troubleshooting continued into June 2022. Important learnings were gained during the installation process, as listed in this report (Appendix C-G). In total (excluding additional retrofitting work), 250 Landis+Gyr smart meters were installed with a mix of three different meter functionalities. The procurement methodology for each type of smart meter – W350 base meters, W350 base meters with vibration sensors and W350 base meters with pressure sensors – is detailed in Appendix I.

Vodafone NB-IoT (Narrow Band Internet of Things) network connectivity was attempted to be commissioned as physical installations took place. Additional refinement based on environmental considerations specific to Greytown was carried out between June to August 2022. Commissioning and refining network connectivity involved a variety of stakeholders, including Wellington Water network professionals, Citycare Water technicians, Landis+Gyr technical specialists and Vodafone telecommunications professionals.



The above graph clearly shows the progress made through installations and environmental-based NB-IoT troubleshooting up until July-August 2022. Environmental NB-IoT troubleshooting carried out included enabling remote tower-related changes to improve connectivity (ECL 1 and 2 parameters were changed). The reduced number of meters with a full month's data available in June and July, as visible in the above graph, was due to the swap out of Base Flow Meters with meters that included Acoustic/Vibration sensors. It was acknowledged upfront that it was likely that not all 250 meters would gain network connection, as the connection is subject to environmental factors unique to a particular area. Environmental factors impacting connectivity in Greytown are summarised in the Network Connectivity section of this report. The level of connectivity gained is consistent with other smart meter projects which have taken place in recent years.

3.1: Leak Analysis

Leak analysis work commenced following the completion of the installations and network connectivity refinement in May-2022. The leak analysis was two-fold, encompassing both domestic and network leaks. It used data from the different types of meters and sensors to detect out-of-ordinary events and interesting insights valuable for network management and overall network health.

While domestic leaks were provisioned to be identified and analysed in the Advizzo portal, further leak analysis, including network leak analysis, was able to be carried out due to additional solution measures. Wellington Water provisioned a Tableau BI (business intelligence) platform, which featured data and graphs for individual and aggregated meters. Analysis using the Tableau platform was carried out on a manual and retrospective basis; however, the opportunity to streamline this process through thresholds and automations was widely noted. Through this, proactive and, perhaps, predictive maintenance could be facilitated. Landis+Gyr further supported this leak analysis phase through the commissioning of their own business intelligence platform. This data has cumulated in a leak report featuring leak identification data and insights, which are referred to in the domestic and network leak portions of this report. The full Landis+Gyr Post-Trial Leak Analysis Report is in Appendix K.

3.2: Customer Behavioural Analysis

The customer behaviour analysis phase included onboarding householders, ensuring they had the resources available to understand the benefits of smart meters, providing customised sustainability messaging, monitoring engagement levels, and analysing changes in consumption and responses to domestic leaks once made aware of them.

An initial call-to-action took place in September 2021 with the deployment of an informational letter and community engagement day and again in June 2022 through a general project update letter. Behaviour relating to the initial uptake of the project was analysed and was sound to be overall encouraging. Monthly usage reports, or 'home reports', commenced in August/September 2022 (August home report sent during September) once most of the data refinement work had been completed. Domestic leak letters were sent on three occasions on a property-by-property basis and generally resulted in leaks being repaired in a timely manner. The last home report was sent in January 2023 with a decommissioning letter which let householders know that the portal was no longer operational. Community feedback was gathered through an Advizzo-Wellington Water post-trial survey (Appendix L). While it has been acknowledged that the trial was not of sufficient size to support a control group methodology for large-scale smart meters and rollouts, the trial provided valuable insight into what is required to launch a customer portal and related community engagement initiatives.

3.3: Reporting

The main reporting phase of the project commenced after trial completion in January 2023 and included community surveys, data analysis, information gathering and the writing of this report. The Trial Proposal document (Appendix B) outlined the below three reporting requirements:

1. To provide a summary of the trial scope, approach, and deliverables.
2. To provide a summary of trial metrics tracked and captured throughout the trial.
3. To mention key trial findings, insights, and any applicable recommendations for future smart metering projects.

Various resources from different stakeholders were used to ensure the integrity of the report. As mentioned above, Landis+Gyr also provided a Post-Trial Leak Analysis Report (Appendix K), which is a key source of leak detection data. As also mentioned above, the Advizzo customer survey (Appendix L) works to ensure householder feedback is heard while also indicating the effectiveness of a customer portal under circumstances similar to the trial. Information from South Wairarapa District Council, Wellington Water, Citycare Water and representatives on behalf of Vodafone has also been included.

Trial Costs

Trial costs are a key area of analysis for the trial project, and findings relating to it are ultimately dependent on the trial size, scope and timing. It was found that the smart meter stand-up costs were higher than they would have been if installing mechanical meters; however, these meters have the potential to be more cost-effective over time. They have the potential to preserve water through the locating of leaks, assist with preventative network maintenance and save on billing team and onsite maintenance team resourcing. Below is a high-level cost analysis for the trial project.

Consideration	Mechanical	Smart
Meter Procurement	Lower procurement cost	Higher procurement cost
Additional Fitting Procurement	Higher procurement cost	Higher procurement cost (Including trials)
Meter Installation	Lower installation cost	Higher installation cost
Meter Replacements	Lower replacement cost	Higher replacement cost
Meter Readings	More resource/cost required (on-site readings)	Less resource/cost required (remote readings)
Meter Maintenance	More resource/cost required	Less resource/cost required
Leak Identification	More resource/cost required (manual leak detection)	Fewer resources/costs required

As alluded to above, the small-scale size and timing of the trial likely impacted the per unit (meter) costs relating to hardware, technology commissioning and licensing, and resource time. Further analysis is recommended in this area to better gauge costs for fuller-scaled roll outs across the region, as related hardware and technology becomes more common in New Zealand. It would also be beneficial to assess the on-going business-as-usual operational costs.

Trial Highlights and Opportunities

Key trial findings, insights and recommendations were a reporting requirement for the trial. By the end of the monitored trial period (March 2022 to December 2022), the below highlights and opportunities were acknowledged.

Key trial highlights included:

- Accuracy in determining private property leakage – 19.8% of the total volume measured by the W350 smart meters, as explained in the Domestic Leak Management section of this report.
- Identification of potential strategies feasible for more accurately determining legitimate night usage.
- Further analysis of pressure sensor data leading to more insight into outage events and the overall network health.
- Information about community preferences and influential ways to promote sustainability measures.
- Insights into Wellington Water technical requirements for third-party integrations and services.
- A more optimised annual billing process, with minimal on-site work and less opportunity for human error when recording billing data.
- Better ability to manage and track private property leak repairs.
- Ability to remotely view and record final usage totals when a property is sold and record starting usage totals when a new owner moves in.
- Greater visibility around customer usage, minimum night flows and network pressure, and an identified added potential in being able to determine legitimate night flow.
- An understanding of compatible locations for different meters and sensors to increase meter and sensor productivity within a specified budget.

Key smart meter opportunities for Greytown and the wider South Wairarapa District include:

- Roll out smart meters to the entire South Wairarapa network.
- Increase billing frequency to quarterly or monthly.
- Develop a home reporting process that will positively influence customers' water use behaviours.
- Develop an automated private leak detection and notification system.
- Develop an automated network leak detection process if vibration meters are installed.
- Proactive water distribution network maintenance – the potential for future proactive maintenance through artificial intelligence (AI) systems which can detect and mitigate potential upcoming issues before they take place.
- Trend analysis – helpful for reporting, configurations, and future roll-out planning. Areas of analysis could be around impacts of temperature changes, property clusters, and vehicle placements.

Key Trial Learnings

- An all-encompassing on-site discovery stage must be carried out to identify possible upcoming risks and to determine what meters should go where. In lieu of an all-encompassing discovery phase, additional time should be added as a contingency for the installation phase.
- Accuracy of installation data impacts the wider project, as additional work can be required to check and update records. Automating the process on-site, such as having barcode scanning functionalities and detailed photo-taking requirements, can increase accuracy and efficiency.
- A training/practice phase for the installers, prior to starting installations is recommended. This should include information about network connectivity and accurate and timely data management.
- Different installation data capture software between organisations creates the need for additional labour through the double handling of data and increases the opportunity for human error. Therefore, data capture software should integrate directly into the Council/Water Utilities systems.
- New Zealand specifications need to be communicated and checked when purchasing items and services internationally. For instance, where threading is customisable, it should be ordered to match the New Zealand standard of 11TPI (threads per inch).
- A customer-centric approach should be taken when carrying out installations in an attempt to decrease impacting residents' daily lies while positively introducing them to smart water technology. A high level of community involvement in the early stage of the trial is beneficial.
- Installation and network connectivity stand-up phases can impact and skew usage data; therefore, it may be beneficial to begin usage analysis following installations and environmental-specific network refinement. Environmental considerations can positively and negatively impact the 'reachability' of the NB-IoT network.
- Existing supply infrastructure, including stainless steel pipes and meter box sizes, can impact the level of additional troubleshooting required during and post installations. Jumbo meter boxes should be installed, if possible, to ensure meters can easily be replaced without requiring excavation. This is especially important for meters installed in concrete or asphalt. Future project managers should plan for around 2.5% of leaks needing to be repaired when dealing with stainless steel service pipes.
- Research and analysis are needed around managing changes in tenancies and property ownership. Developing an automated process to update customer details would be beneficial.
- The process for notifying customers about leaks was partially manual during the trial, as was for locating leaks. Developing an automated process for notifying householders and network managers about leaks would save time and resources.
- The upfront costs for the Greytown Trial project are higher per unit than they would be for a larger-scale rollout. Hardware and installation costs proved to be higher for smart meters in comparison to mechanical meters; however, monitoring and ongoing resourcing costs should be significantly decreased.
- Hardware and software data commissioning, processes, integrations and automations would benefit from being further researched and tested ahead of a larger-scale rollout.

1. Hardware

Hardware Selection

Summary

Landis+Gyr W350 smart meters were chosen for this trial; following a proof-of-concept stage during mid-2021, procurement was carried out, which consisted of obtaining 155 W350 base flow meters, 45 W350 base flow with pressure sensor meters and 50 W350 base flow with acoustic/vibration sensor meters were ordered. Due to unforeseen delays with the acoustic sensor meters, an additional 50 base flow meters were provided by Landis+Gyr to ensure that data flow could be set up for all selected 250 properties faster.

As outlined in the trial Solution Proposal document in Appendix B, financial analysis, more specifically, smart meters compared with mechanical meters, is an important outcome of the trial. Costs relating to hardware, installations, hardware-related resourcing, connectivity and software all contribute to this. A high-level financial analysis of the Greytown trial suggests that, while upfront costs (hardware and installations) were higher, ongoing resourcing costs for device health, resourcing around leak identification, network management and annual customer billing will be significantly lowered over time. Not to forget, the costs saved through preventative leak identification and network management.

During the trial, it was found that the W350 smart meters offered additional benefits over the prior installed mechanical meters. These benefits are summarised below.

- High accuracy throughout the estimated meter life of 12-15 years.
- Remote communications over a reliable NB-IoT network.
- Remote device configuration (firmware) and feature upgrades.
- Backflow prevention.
- Network pressure information.
- Consumption profiles.
- Real-time reporting of critical alarms.
- Inbuilt pressure sensor and vibration sensor options.
- Inbuilt security mechanisms to prevent meter tampering.
- Sending data at 24-hour intervals (up to three data push attempts per 24 hours).
- Horizontal or vertical mounting.
- Customisable threading.
- Accuracy Class 2 T50 Option for R160/R200/R250/R315/R400.
- ISO4064-1:2005, AS3565.1-2010, NMIR49-1:2015 compliant.

Meter performance was another key metric outlined in the Solution Proposal (Appendix B), which related to the percentage of time the smart meters were fully functional during the trial. The trial conclusively found that the smart meters operated consistently and reliably throughout the duration of the trial. It also found that firmware updates were able to be successfully deployed on one occasion and that the meter battery levels remained consistently high by the conclusion of the trial. Information about meter performance is tabled in Appendix H.

Alarms and Thresholds

With the W350 smart meters came opportunities to make use of inbuilt alarms and thresholds and the potential to further maximise the use of the data through business intelligence methods and platforms. The option to configure inbuilt alarms on the W350 smart meters increased project team members (and, in the future, Network Manager's) ability to locate and fix leaks and to identify trends for reporting and future planning.

The following alerts/alarms can be set on the W350 smart meters:

- Leak alarm – 5L per hour consistently over a period of 24 hours.
- Tamper alarm – The tamper alarm is a real-time alarm that is triggered when the meter detects that the cover has been removed or that the meter has been or is in the presence of a strong magnet.
- Temperature alarm – The alarm is triggered when the meter measures a temperature outside the configurable limits. The default limits are 1c and 50c, which are the meter limits.
- Pressure alarm – Alarms are built in to warn of high- and low-pressure events in near real-time. This data can be used to analyse network pressure at different times of the day and seasons of the year.
- Noise alarm (AUC) – The network leak alarm is based on the calculated Area Under the Curve (AUC) score, which is calculated from 9 vibration samples taken between 12am and 2am daily. The AUC score helps to indicate the presence and magnitude of vibrations detected by the vibration sensor.

Remote Firmware Updates

A notable benefit of using the W350 smart meters is the ability to update individual or bulk meters, through firmware updates, over the NB-IoT network. This process is also known as FOTA (firmware over the air). These firmware updates are for both the MUC and the module and were/are developed and deployed by Landis+Gyr technology professionals on a case-by-case basis.

During the trial, the latest firmware updates were applied to the vibration sensor meters during the factory configuration stage of the hardware supply chain. Due to being a later release, this was a different version of firmware than had been applied to the base flow and base flow with pressure sensor meters which had been installed earlier in the year. The installation procedure documentation was altered to reflect the new installation process relating to the newer version of firmware for the vibration sensor meters.

More complex updates can be installed on the smart meter units using a Landis+Gyr optical port and cable, a laptop and specialised Landis+Gyr configuration software. This method is typically only needed for larger system architectural changes, such as moving and connecting a unit to a different application programming interface (API).

Smart Meter Specifications

The W350 smart meter is available in four functional states: base flow meter, base flow meter with pressure sensor, base flow meter with vibration sensor and base flow meter with both pressure and acoustic sensor. As they are ultrasonic, they measure transmit times – from one side of the pipe to the other – of soundwaves/ultrasonic signals, which are recorded by two or more transmitters.

The NB-IoT operating W350 meters contain internal antennas with optional internal pressure and/or acoustic sensors. The pipe diameter size is 20mm inlet and outlet, with customisable unit threading (TPI/thread per inch). The unit size fits within a standard meter box; however, during the trial, jumbo meter boxes were found to be better sized for working with these meters, as they allowed more space for working with tools.

The W350 smart meters are IP68 rated, which, in short, means they are water resistant in fresh water at a depth of up to 1.5 meters for 30 minutes. This rating also indicates that they are built to be protected from the elements, such as dust. Detailed information about the W350 specifications is in Appendix M.

Base flow capabilities

The W350 base flow meter captures water supply totals and, therefore, is a replacement for standard mechanical meters. A main benefit of this meter is the fact that supply data can be sent digitally and intermittently via the NB-IoT network. NB-IoT connectivity is highly scalable, reliable, has low power consumption, high security, and wide coverage.

The W350 meter brings several benefits through digitisation. The meter has the ability to detect customer leakage, determine if the meter metrology is working, detect overflow rate, sense meter removal from the water supply, generate reverse flow alarms, generate meter opening tamper alarms, produce either immediate or flag alarms, as well as incorporating sensors such as pressure and/or acoustic leak detection in the proximity of the meter.

The following default alarms came pre-set up on this meter:

- Water Meter Customer Leakage Alarm
- Water Meter Reverse Flow Alarm
- Water Meter Empty Pipe Alarm
- Water Meter Tamper Alarm
- High-Temperature Alarm
- Low-Temperature Alarm
- Low Battery Alarm
- Daughter Board Failure Alarm
- Device Reboot Event
- Time Synchronisation Event

Pressure sensor capabilities

The W350 base flow meter with an internal pressure sensor has the same base functionalities, external appearance, and battery as the base flow meter with added network pressure detection capabilities. The benefits included reducing operation costs by operating closer to the minimum pressure-demand, prolonging pipe life, reducing leakage, bursts, and energy consumption within the supply network.

All default alarms included with the base variant of the W350 (noted above), plus:

- Water Meter High-Pressure Alarm
- Water Meter Low-Pressure Alarm

Vibration sensor capabilities

The W350 base flow meters with vibration sensors were strategically installed to optimise their capabilities. Visually, the W350 smart meters with sensors appear to be the same as the base flow smart meters, as the sensors are inbuilt and, therefore, do not impact the unit size. The leak sensors are a unique patented technology developed by South East Water (SEW).

SEW extensively tested and implemented the vibration sensors for their Australian-based smart metering projects. Through this, they were proven to be effective in saving non-revenue water losses. SEW expect to achieve at least a 1% reduction in non-revenue water losses.

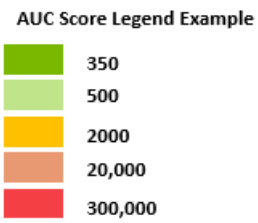
All default alarms included with the base variant of the W350 (noted above), plus:

- Water Network Leak Alarm (AUC / area under curve)

The Water Network Leak Alarm is based on a number of data points that are generated on a daily basis via nine vibration samples taken between 12am and 2am at 15-minute intervals. The sensor is designed to detect vibrations within a set frequency range that reflects optimal detection for water leaks. The 12am to 2am period is chosen as this is typically when minimal water usage or potential noise within the network is at a minimal.

Based on the results of the samples, an Area Under the Curve (AUC) value is detected, which can indicate the presence and magnitude of vibrations. The nine samples taken are calculated into a singular AUC Value, along with providing a singular peak frequency value and additional filtering information, such as whether any flow was detected at the time of each sample. Typically, it would expect no flow to happen at these times, but if flow is detected, this could mean someone who may work a night shift who uses more water in these off-peak times than the typical user. The inclusion of data sets on whether flow is detected can help act as a filtering tool to eliminate high AUC scores, which in normal circumstances would detect a potential network leak when it is due to actual usage by the customer at a site.

Analytic tools can be used by customers to provide heat mapping visualisation of AUC scores to assist in triangulating a leak within a specific area. As observed below, we can see most houses of a built-in vibration sensor, resulting in more data points coming through and greater visualisation of AUC scores.



Additional Hardware

Adaptor tails were ordered and installed for the trial for two reasons. The first reason is that tails allow for a more seamless swap-out of the meters, therefore, somewhat 'future-proofing' the installation and troubleshooting procedures. The second is to match the pipe diameter. This was only required for the initial batch of meters (pressure sensor meters), as they had been ordered with 14TPI. Additional information on fittings, such as valves, can be found in the installation and troubleshooting handover document, located in Appendix N.

Device Health Monitoring

Low battery alarms are built into the meters, and these details are sent in the daily event data log if triggered. Daily readings of battery levels are also recorded and sent in the daily data logs. The default thresholds for battery, during the trial, would typically be a value of 36 in the raw data, denoting 100% battery, with most meters observed to be at a battery level between 34 to 36.

A tamper alarm is built into all variants of the W350 meter, whereby a real-time event alarm is triggered when the meter detects that the cover has been removed or that the meter has been or is in the presence of a strong magnet.

Smart Meter Performance

Capturing metrics around smart meter performance was a key requirement for the trial, as outlined in the Charter (Appendix A) and Proposal (Appendix B) documents. A summary of these metrics is in Appendix H.

Key Learnings

- Washers and thread tape are required to mitigate leaks within meter boxes
- To avoid requiring additional fittings, smart meters should be ordered with New Zealand standard threading (11TPI).
- Additional training should be provided to water technicians around technology and network connectivity.
- The importance of hardware-related data capture – serial numbers and meter readings – should be highlighted to the installation team.
- Simple additional analytics are recommended for domestic leak alarms.
- Additional robust network leak analytics are recommended.
- Analytical requirements are likely to evolve over time and be scalable.

2. Installations

Site Selection

Smart meter installation site selection was based on a variety of set trial requirements, environmental factors and project team and South Wairarapa District Council preferences. The discovery and proof of concept (PoC) phases, which took place prior to the trial beginning, helped to identify areas with appropriate conditions for installation.

District Metered Area (DMA)

The Greytown townships consist of one DMA, making it a great starting point for smart meter rollouts in the South Wairarapa District. The boundary for this DMA is shown below and encompasses the whole of Greytown and several properties in the rural Woodside. The DMA can be supplied from two sources, namely the Greytown Bore-Memorial Park Water Treatment Plant and the Waiohine Water Treatment Plant.

Geospatial and Discovery Data

Differing levels and methods of discovery and analysis were carried out prior to the trial's commencement, which helped to determine appropriate locations for each of the three types of NB-IoT connecting meters/sensors.

Water network infrastructure

Prior to the trial, it was important to gain an understanding of the existing network infrastructure in Greytown so that the pressure and acoustic network monitoring sensors could be placed successfully.

The following was identified:

- Greytown is a single district metered area
- Greytown is one pressure zone
- Supplied by direct pumping from the Greytown Bore-Memorial Park Water Treatment Plant
- Supplied by gravity from the Waiohine Water Treatment Plant via a PRV

Seasonal analysis

Various forms of information and methods were considered and utilised to set the scene for the trial.

Seasonal Usage and Related Policies (water restrictions):

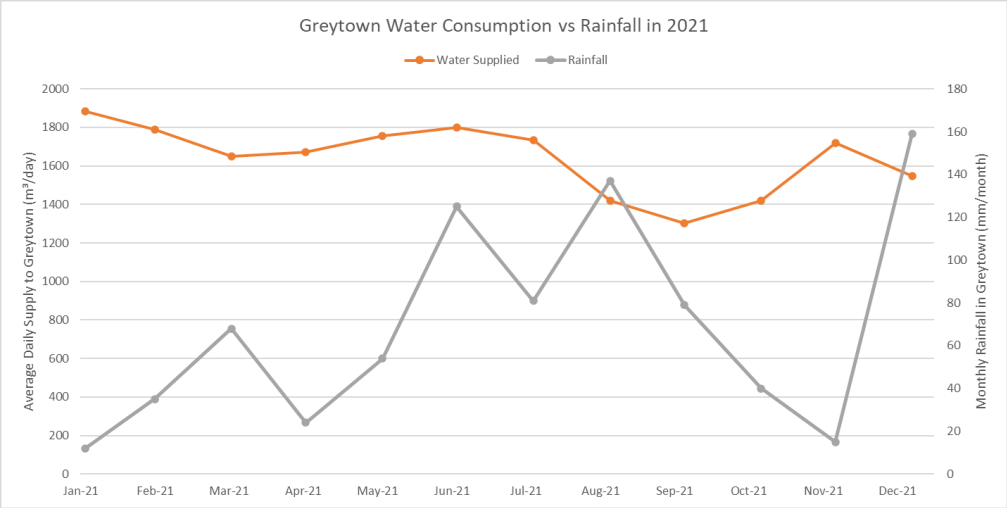
Behavioural patterns were acknowledged in relation to seasonal changes and the policies put in place in response. This included water restrictions in the Greytown area, consisting of:

- Level 1 – Use sprinklers every other day
- Level 2 – Limit residential outdoor water use
- Level 3 – Stop residential outdoor use
- Level 4 – Ban on outdoor water use, reduce indoor water use (drought conditions)

Greytown remained at Level 1 or higher year-round and was at Level 1 throughout the trial except for a period where it was at Level 2 between 21 January 2022 and 4 March 2022.

Usage in relation to rainfall:

An analysis of rainfall and its impacts on water supply consumption was carried out based on rainfall measured at the nearby weather station near Greytown at Renalls Weir on Parkvale Stream over the same time as the water consumption. The below graph shows the water supplied to Greytown between January and December 2021.



As can be noted above, there was a significant reduction in water supplied to Greytown during the months of August and September. However, this was determined more likely to be attributed to the annual water accounts alerting customers to leaks, which were subsequently repaired. Similarly, it could have been attributed to short-term behavioural changes in response to the annual billing.

As far as the analysis of rainfall versus consumption had gone, it was determined that there was no obvious correlation between the amount of rainfall and the amount of water used during the months of February to October 2021. However, in the months of January and November 2021, low rainfall and high consumption were recorded, as would typically be an expected pattern for warmer months.

Current (pre-trial) metering position

As of 2021, prior to the official trial commencement, the 'current' metering position was assessed through desktop research. Through this analysis, the following details were noted:

1. Greytown had mechanical meters installed at all domestic and commercial properties.
2. All mechanical meters are read annually, June-July, for the purpose of yearly water excess usage billing. There were a total of 1,472 meter readings captured during this process over recent years.

For a meter reading to be valid, it was decided that they must have a current meter reading that was taken on or after 1 January 2021; next, it was decided that the record must be at least 300 days was not influenced by a particular season. Finally, any negative readings were removed as these were likely to be either meters that had been recently replaced or reading errors. This reduced the list to 1,212 useful meter readings for the 2020 year.

There was no way to determine which of these connections were domestic and commercial; however, as the bottom 5% consumption readings for these connections (recorded as zero water consumption) they were considered faulty or empty sections and the top 5% consumption readings for these connections (recorded above 840m³ consumption) they were assumed to be commercial connections or to have significant leaks. With these connections removed, the list could be refined down to 1,094 readings/properties, which was consistent with the anticipated 1,100 domestic 'customers' expected to be present in Greytown at the time. Appendix O contains a list summarising the consumption readings for the refined list of 1,094 readings/properties.

Additional geospatial and discovery data

- Existing NB-IoT infrastructure and service levels:
- We checked that there was an existing NB-IoT network in Greytown, which is why it was selected (field signal testing was carried out in May 2021).
- Existing property and customer data:
- Property and customer data (water account data received from SWDC) and GIS maps were used to select compatible sites for the varying smart meters. There were limitations in determining whether or not a property was owner-occupied or leased; assumptions were made based on whether the supply and account addresses for a property matched.
- Pre-trial community feedback:
- During September 2021, a community day was held to inform the Greytown community of the upcoming trial, as well as to provide an opportunity for open dialogue and feedback.

Physical Property Selection

Following the selection of the streets, specific properties could be allocated to the specific types of meters/sensors. Property selection factored in the advice provided by Landis+Gyr around how to best optimise meter and sensor functionalities to gain the most constructive insights relating to usage and leak data.

The property selection process commenced with a desktop discovery phase whereby 490 properties were identified and concluded with a list of 250 applicable meters in the Greytown area. The list was refined by the location of existing infrastructure (TOBYs located under asphalt or concrete were excluded to minimise disruption), community feedback and confirmed project budget. A more detailed summary of the selection process can be found in Appendix J.

Street Selection Criteria and Process

The trial street selection was dependant on several factors set prior to the beginning of the trial and ad-hoc during the trial. The below map shows the streets selected prior to the beginning of the trial.

Purple = Both sides of the street
Green = Only even side
Orange = Only odd side

The initial street selection was made using aerial imagery and street view to locate streets where the TOBY was likely to be in a grassed area. This resulted in properties on both sides of the street being selected for some streets and only one side for others.

Site Selection Considerations

The budget allowed for 250 meters to be installed; beyond this, site selection based on meter type was carried out. Beyond the site selection process carried out in the trial (Appendix J), the below additional site selection criteria could also be considered for future rollouts:

- Meter box depth
- Meter box lid type
- Pipe age
- Pipe materials
- Pipe diameter
- Number of assessable cellular (/NB-IoT enabled) towers in area
- Cellular (/NB-IoT enabled) tower size and location
- Address positioning in relation to a cellular tower
- Address positioning in relation to landscape. For instance, hills and valleys
- Address positioning in relation to built infrastructure. For instance, garages with large metal doors
- Season/weather

Alterations to Property Selection

During and post the installation period of the trial, it was acknowledged that certain meters would not be able to be installed as initially intended. This was for a variety of reasons, which included:

Interim flow meter installations

Hardware delays (acoustic sensor meters) led to an additional 50 base flow meters being delivered and installed as an interim solution until the new meters arrived. This meant base flow meters were (temporarily – for most) installed at addresses assigned for the acoustic sensor meters. The majority of these interim base flow meters were replaced with acoustic sensor meters once they had arrived; however, as addressed directly below, some base flow meters had to remain in these spots.

Meter box size

Delays in receiving the acoustic sensor meters had meant additionally supplied base flow smart meters were installed at the intended vibration sensor smart meter addresses, with the intention of swapping these with the vibration meters once they arrived. However, upon attempting to swap out the base flow meters for the base flow with acoustic sensor meters, it became apparent that this was not possible at several locations due to the size of the meter box in relation to the already installed smart meter. This meant the water technician could not fit their spanner into the meter box to complete the retrofit, meaning excavation would have been required to complete the job. In some cases, in lieu of excavating at the site for a second time (note that excavation was required for the initial installations), it was decided that some sixteen vibration meters were installed at new addresses which had met the trial criteria and or were swapped with others.

Key Learnings

- Adding a reminder for portal sign-up on calling cards worked to increase sign-up numbers.
- Replacement of meters may not be possible without excavation at some locations if standard meter boxes are used.
- The cost of installing meters that are surrounded by concrete or asphalt will be significantly higher. As meter boxes under asphalt or concrete are likely in drivable areas, traffic management may be required, as well as additional care and costs around deconstruction and reconstruction. Ensuring a high level of reconstruction on private driveways will be particularly important.
- Ideally, when installing smart meters, jumbo meter boxes should be installed to ensure it is possible to swap out meters or troubleshoot issues (/to be able to work with tools inside the meter box) without requiring excavation.

Physical Installations

Installation Procedure

Physical installations were carried out by Citycare Water Lower Hutt water technicians and managers, with the support of Wellington Water industry professionals. The scope of work proved to be multi-layered, as it had combined traditional water engineering with new hardware technology and data flow methodologies, with specific data capture requirements crucial for ensuring implementation is successful. The full smart meter installation instructions can be found in the installation handover documentation in Appendix N.

Due to the need to commission network connectivity and the importance of capturing accurate installation data, it was found that additional installation crew training would be beneficial for future projects.

Commissioning Connectivity On-site

While the W350s were preconfigured and factory tested by Landis+Gyr, which had included pre-installing batteries and NB-IoT SIM cards, Citycare Water technicians were required to 'wake' the smart meter while on-site. This involved pressing a light-sensitive button to the number of times and duration specified by instructions specific to the version of firmware installed on the meter at the time.

It was recognised that it could take up to 30 minutes for a meter to transition out of flight mode to be able to connect to the network during the next scheduled daily transit (in locations with sufficient levels of NB-IoT connectivity, in relation to various environmental factors). Therefore, water technicians attempted to 'wake' the meters prior to beginning physical work.

Refer to the on-site smart meter configurations section of the installation handover documentation, in Appendix N, for instructions used by the installation team to 'wake' the meters on site.

Risks

Ahead of installations, the following risks were identified and acknowledged:

- Stainless steel flexible pipes
- Double handling of pipes and fittings
- Meter box size with a smart meter installed
- Installation data capture – double handling of data and human errors
- Installation data capture – environmental factors and human errors
- Weather/seasons
- Industry-wide resourcing constraints at the time
- Traffic management
- Community disruption and feedback
- COVID-19 governmental restrictions and sickness

Installation Data Management

The Fulcrum job management application was used to capture installation data during the installation phase. The decision had been made to use this application due to Citycare Water's previous experience working with it and because of its map and data capture capabilities.

Risks were identified ahead of installations which centred largely around the increased opportunity for human error due to environmental-related risks. Consequently, it was agreed that photographs should be taken to capture numerical data, such as serial numbers and final meter readings.

Five requirements were set ahead of installations relating to installation data capture:

1. Address
2. Old meter serial number (photo)
3. Old meter reading (photo)
4. New meter serial number (photo)
5. Reinstatement of contextual photo

As a result, the below steps were carried out:

1. Wellington Water specifying data capture requirements (for South Wairarapa District Council systems and processes).
2. Citycare Water provisioning Fulcrum workflow with installation data requirements and addresses, providing installation crew data capture logins and training.
3. Citycare Water on-site water technicians complete steps in Fulcrum while capturing data and photographs as specified in Fulcrum.
4. Citycare Water project managers export installation data (CSV files and photographs) on a weekly basis and upload them to a Wellington Water SharePoint folder.
5. South Wairarapa District Council Billing team accessing the SharePoint folder and updating the council Survey123 portal with this data and photographs.

During the installation phase, a barcode scanner feature was tested and added to the Fulcrum workflow, allowing the water technicians to scan the serial numbers in addition to taking photos. This reduced the need for re-typing serial numbers later down the track. However, as the Fulcrum system did not integrate with Wellington Water or SWDC systems, additional data entry was still required. This led to the need for additional time and resources and an increased opportunity for human error when carrying out data entry.

Keeping the data up to date

A process is required to account for meters that are replaced with either a mechanical meter or a smart meter. In addition, it is necessary to have a process to correct any errors in the data. Finally, it is the process that must allow for any updates to the customer account details to be captured. Below is an outline of the process:

- If a meter is replaced and all asset information (old and new meter) is captured in Survey123 by the Wellington Water field crew.
- Any errors in data that are identified are updated in Survey123.
- Wellington Water (DPS) have a process to automatically export data Survey123 to SWDC on a regular basis.
- SWDC have a process to receive that data and update their customer account information.
- SWDC have a process to export an update of their customer account data to Wellington Water (DPS) on a regular basis.
- Wellington Water (DPS) have a process to update customer account details received from SWDC.
- It will be imperative that there is a robust, proven process in place before a wider rollout of meters is undertaken.

Key Learnings

- Existing infrastructure impacts the viability of smart meter rollouts and the level of troubleshooting which will be required.
- A handover should be provided to the maintenance team to ensure they are familiar with the handling of smart meters.
- Data capture software should be strategically selected to streamline processes and the flow of accurate information.
- Installing in the grass berm is relatively unobtrusive; however, extra caution and planning will likely be needed for installations in other areas.
- For instance, installations in busy or drivable areas may require additional traffic management, installations under asphalt and concrete may require extra reestablishment work, and installations inside of property boundaries may require additional community engagement.
- The smart meter installations differed in requirements and process from mechanical meter installations.
- Time should be factored into training installation teams on digital processes while emphasising the importance of accurate and timely installation data capture due to the impact this has on the wider data flow process.
- There is little difference in time and effort required between installing mechanical and W350 smart meters in properties without an existing manifold styled TOBY. It may make sense to install smart meters at new build properties.
- More work is required to swap a mechanical meter with a smart meter than there is to swap a mechanical meter with another mechanical meter. However, when considering time and effort, ongoing maintenance and meter reading requirements should also be considered.
- Barcode scanners should be used to accurately capture numerical data and to avoid double-handling, such as through the typing of serial numbers from photographs and possible data entry human errors.
- Verification photos should still be taken in addition to data entered directly into the chosen central software. This will allow for any discrepancies to be investigated by simply checking the photos.

3. Network Connectivity

NB-IoT Network Connectivity

The W350 smart meters used a communication solution provided by Landis+Gyr utilising the Narrow Band Internet of Things (NB-IoT) network. LP-WAN (NB-IoT) transmitted traffic was encrypted by default via the local Greytown Vodafone New Zealand NB-IoT enabled tower. This tower was commissioned to support NB-IoT prior to the beginning of the trial. Meter communication performance metrics are tabled in Appendix H.

NB-IoT Opportunities

Narrow Band Internet of Things is a preferred communication method for smart metering in a range of utilities in New Zealand. Data can be delivered in a scalable, cost-effective manner with minimal impact on battery life, which is particularly important for stationary battery-operated IoT devices like smart water meters.

NB-IoT bandwidth provides strong coverage that can penetrate through most materials well, making it well-suited for smart metering devices within meter boxes. One big advantage is that these data packets can be transmitted with relatively low battery consumption, helping to support the longer battery life of smart metering devices. NB-IoT also provides strong security protocols, offering all the security measures currently present in LTE Networks. Given NB-IoT is a communication band suited to IoT devices at scale; pricing can be competitive for large-scale rollouts.

Various Greytown-specific opportunities were noted ahead of and/or during the trial, which included:

- Low power, bandwidth
- Carrier-grade security
- Open protocol, backed by 3GPP worldwide
- E-sim capable, minimal service disruption
- Wide coverage, high penetration

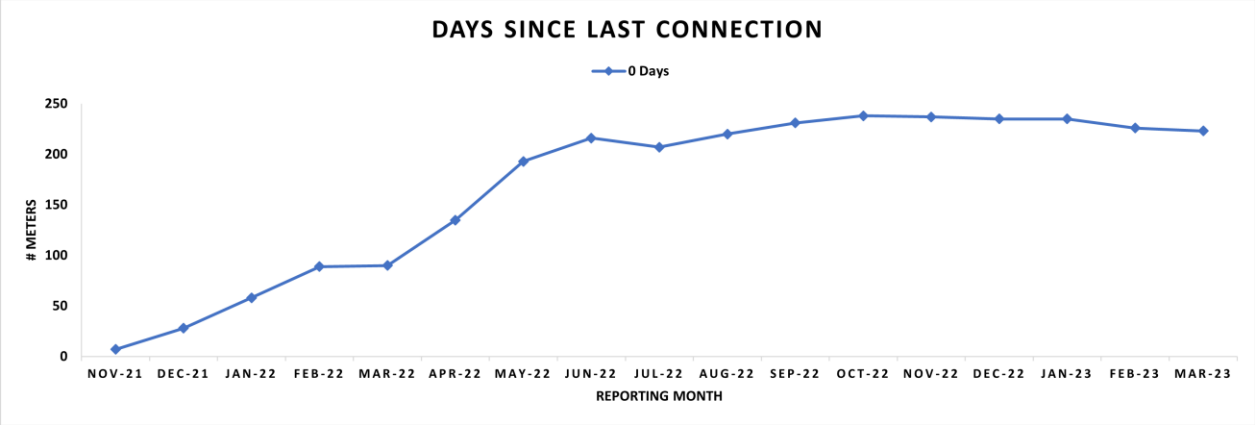
Environmental Network Connectivity Risks

Localised environmental considerations which were noted during the trial included:

- Metal garages, lids and parked vehicles
- Meter box positioning (below ground vs above) and depth
- Topography (i.e., flat vs hills)
- Availability of cellular towers that are NB-IoT enabled (dependent on the cellular provider used to provide connectivity services)

Successful Connections by Month

The number of W350 smart meters connecting to the network steadily increased as the trial went on, as can be seen in the data provided by Landis+Gyr in the below graph and in Appendix P. This increase is reflective of the different phases in the project and additional troubleshooting which took place as more learnings were achieved along the way.



Supplied by Landis+Gyr.

Phases impacting the level of connectivity per month included the installation phase, which commenced in mid-December 2021 and concluded in April 2022. The installation phase was extended largely due to pandemic resourcing restrictions. By May 2022, all applicable 250 meters had connected to the network at least once.

Additional troubleshooting, specific to the Greytown environment, was carried out by the Landis+Gyr and Vodafone, which increased transmission reliability. This was carried out between June and August 2022, leading to a significant increase in the number of meters connecting to the network daily and a decrease in meters connecting intermittently or not connecting at all.

Key Learnings

- Installation and data capture delays result in network connectivity delays, which may impact further data flow and/or community engagement.
- Environmental factors unique to a township being installed can impact meter connectivity and should be assessed on a location-by-location basis.
- Allocating time for installation and connectivity troubleshooting is recommended to ensure further data flow and community engagement is not impacted.
- Meter connectivity impacts community visibility of data, and therefore, it is important to set realistic expectations with homeowners when rolling out smart meters and related technology.
- Cellular towers should be commissioned to support NB-IoT in advance of rollouts.
- Network providers may be able to adjust the 'cell' tower direction, and make other adjustments, to support the environmental requirements of installed meters.
- Most NB-IoT meters will connect reliably and daily.
- Intermittent network connectivity should be expected for a small number of NB-IoT smart meters due to a variety of environmental considerations.
- On two occasions, meter boxes were flooded, which interrupted the network connectivity. Additional research is recommended around ways to prevent this in the future in the event of unforeseen environmental conditions.
- For a likely small number of meters unable to connect over the NB-IoT network, manual reads will be required. Field crews have found that the existing version of smart meters is sometimes more challenging to read than the existing mechanical meters. It was suggested that drive-by RFI could be used in combination with smart meters – for sites unable to achieve connectivity – to eliminate the need for manual meter readings.

4. Data Flow

Digital Solution

Solution Architecture

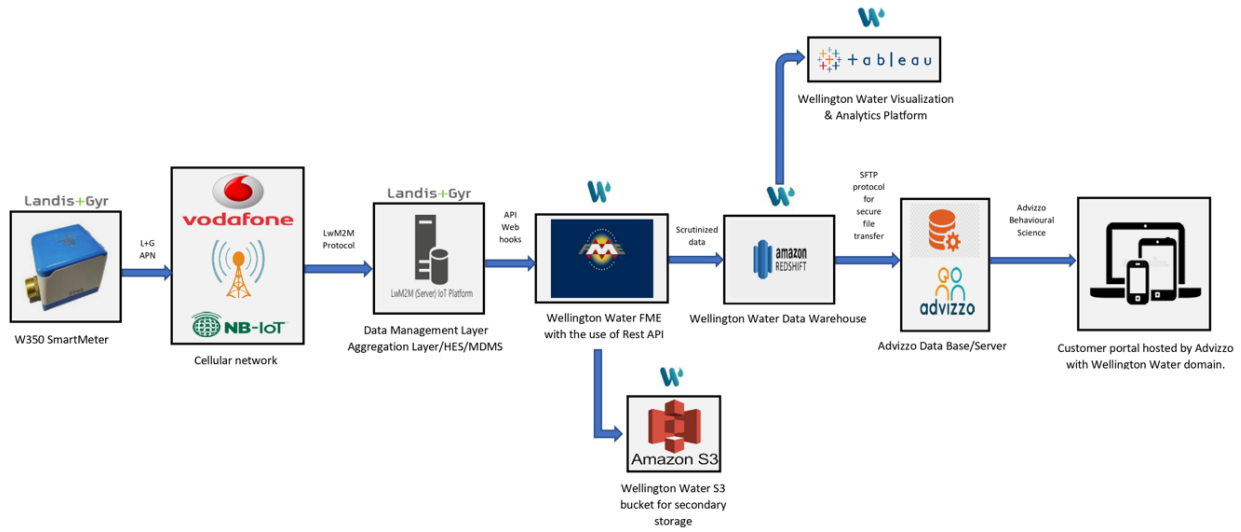
Meter factory configurations aside, the solution data flow was commissioned by the water technician installing the meters and with the smart meters themselves. Incremented/total flow data (half-hourly), incremented pressure data (4-hourly) and incremented acoustic data (15-minutes/9 samples taken in the 2-hour window) were then delivered in raw format, on a once-daily basis, to the Landis+Gyr device management layer (DML). This was facilitated by the NB-IoT network and related backhaul connectivity.

Once reaching the DML, this data is pulled daily into Wellington Water middleware via an application programming interface (API), whereby it is stored and processed to meet the specific data flow requirements of each destination platform. Data was pulled for a second time by API into the Wellington Water commissioned and managed Tableau business intelligence (BI) platform. Various customer, property, and usage data comma-separated value (CSV) files were shared with the Advizzo customer portal via a Secure File Transfer Protocol (SFTP).

Additional planning and development were carried out by Wellington Water and Advizzo developers to customise the existing Advizzo communications delivery process. Instead of having 'clickable' emails delivered automatically via the Advizzo platform, formatting and integration changes were implemented, allowing Wellington Water to send the emails directly to customers.

Landis+Gyr and Citycare Water supported the raw data flow, and Landis+Gyr supported the integration from the DML to the middleware. Solution backend integrations and data flow was managed by Wellington Water Technology professionals, who also worked with Advizzo to refine and implement the customer portal integration process.

On an ad-hoc basis, when requested by Wellington Water, Landis+Gyr carried out remote firmware updates over the air (FOTA) via the NB-IoT network. This allowed for further customisations to the ways the meters captured, stored and/or sent data. Consequently, this process increasingly refined the overall data flow solution and can continue to do so in the future.



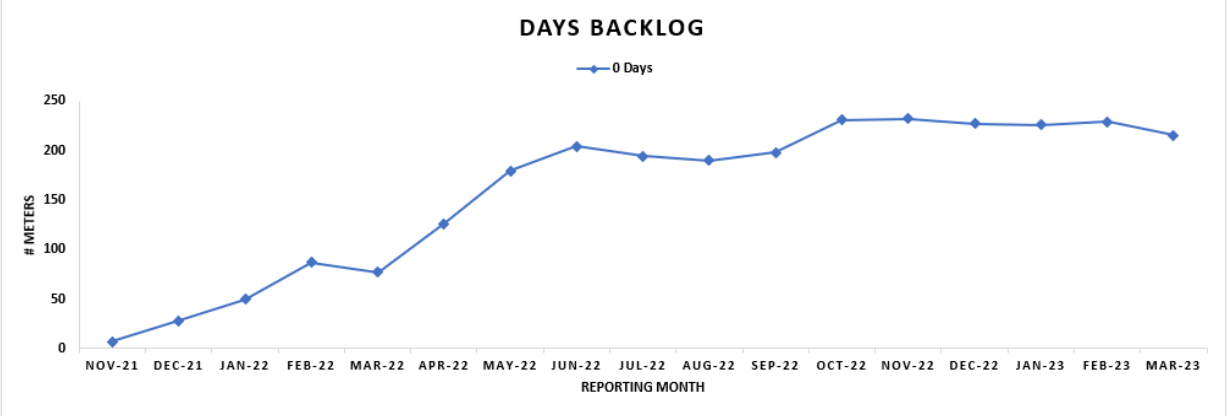
The full-sized version of the above Wellington Water solution architecture diagram is located in Appendix Q.

Data Retention

In direct correlation to the above-discussed NB-IoT connectivity levels by month, the rate of successful network connections directly impacted how and what data was available for each meter and property. The W350 smart meters retained incremented data for up to 21 days while retaining the usage total indefinitely within the meter life cycle.

During the trial, it was noted that many variables could impact a meter's ability to connect and send data on a given day. For each day which resulted in an unsuccessful connection, up to a maximum of 21 days, incremented data was sent for that day during the next successful connection. For each day past 21 days without a successful network connection, incremental data was overridden for that meter.

As can be seen in Appendix P, most meters were able to successfully and regularly connect to the network. This led to comparatively little loss in incriminated data throughout the course of the trial.



Supplied by Landis+Gyr.

The above graph shows that an overwhelming majority of meters were able to achieve regular and consistent NB-IoT connection and, therefore, were able to send daily data to the device management layer (DML).

Key Learnings

- Commissioning and managing data flow is a team effort which requires input from many stakeholders. This includes the meter manufacturers, the suppliers of the SIMs, the on-the-ground installation crew, and various technology professionals.
- Primarily consistent and reliable connections are achieved with smart meters and the NB-IoT network, leading to reliable and up-to-date data flow.
- A small amount of incremented data may be lost with smart meters and NB-IoT solutions, which should be taken into consideration when planning solution architecture and community rollouts.
- Although incremented data is retained for up to 21 days, total usage data is retained indefinitely within a meter's lifecycle. If a meter cannot connect to the network, data can be retrieved through a site visit.
- There is value in completing a comprehensive business analysis phase with the developers completing the integrations. This would help to identify, scope and plan for additional requirements and customisations.

Data Handling

Customer Data Requirements

To enable householder customer portal access and to respect New Zealand privacy legislation, a new onboarding solution was developed for the Advizzo customer portal. This solution included providing residents with a unique ID along with their supply address, two identifiers which automatically link and authenticate a resident's portal account upon initial online registration.

Prior to the commencement of the trial, limitations were identified with the householder data available, and this ultimately led to the need for this new solution. While ratepayer data was stored with SWDC, leaseholder details were not. Implementing Advizzo's typical onboarding process via standard email and password log-in, leaseholder data would have also been required to ensure the leaseholder's privacy was not compromised.

SWDC Data Processes

The way in which annual billing was completed, and domestic leaks were identified and managed changed, meaning different processes and systems needed to be put in place for the South Wairarapa District Council's (SWDC) billing team. During the trial, the project team captured remote readings before providing these to SWDC to be uploaded to the billing system (Magic). Integrating a system would automate this process and is recommended in the future.

Third Parties

In the trial, contracts with third-party partners had to meet legislative standards to ensure data was stored and used securely.

Key Learnings

- There are important privacy considerations when it comes to sharing usage data with householders, as only those using the water should be privy to usage data.
- There is still work to be scoped around changes in property ownership and tenancies.
- Third parties working with householder data should be trusted and verified.
- Smart meter installations transform daily tasks and roles through changes in data collection and management processes.
- Having half smart meters installed and half mechanical meters installed means that two separate systems and processes need to be carried out to capture readings and manage leaks in one township. Installing smart meters would reduce the need for separate processes and site visits.
- Prior to wider rollouts, there needs to be robust processes in place to accommodate the above learnings.

5. Domestic Usage

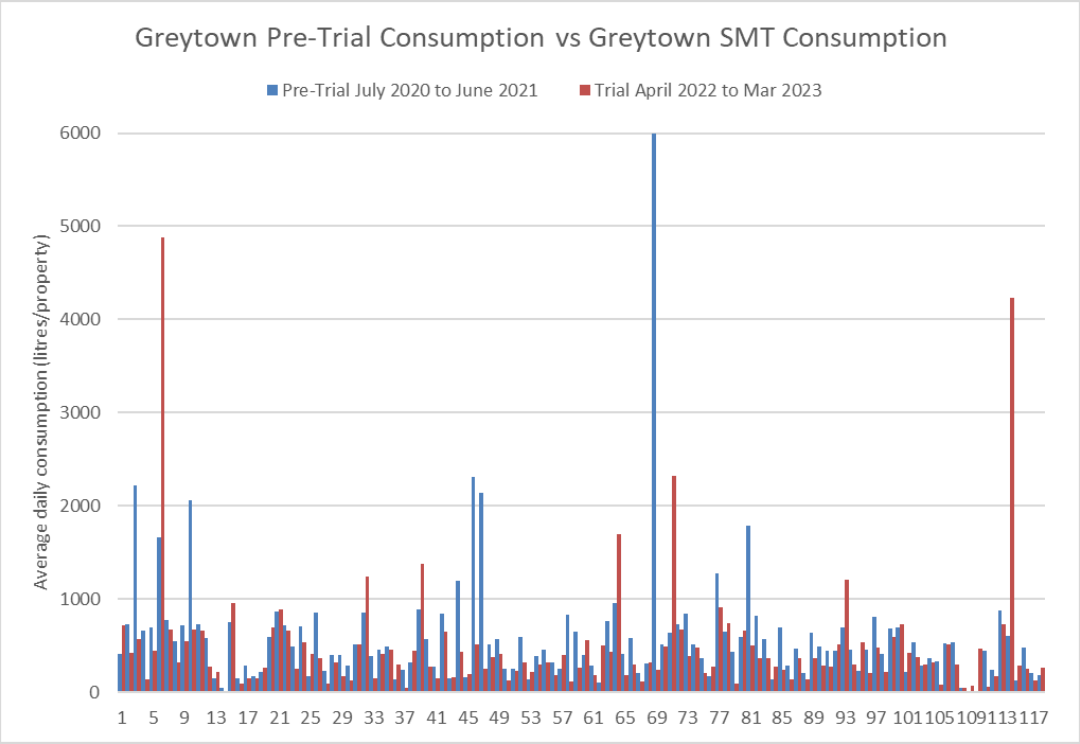
Consumption Analysis

Summary

As outlined in the Trial Metrics section of the Trial Proposal and as tabled in Appendix H, data relating to consumer consumption behaviour was a key area of analysis for the trial. The trial found that consumption within the Greytown region remained consistent (3.5% increase); however, when comparing the consumption of properties pre and during the smart meter trial, specifically for properties with smart meters installed, there was a measurable reduction (20.2% decrease). The trial found that installing smart meters and implementing sustainability campaigns is a beneficial method for influencing positive water-saving behaviours. However, it should be noted that the reduction in consumption may have been influenced by additional factors, such as the weather throughout the trial period.

Pre and Post Trial Consumption on 118 *Households

*Number of households with data before and after the trial.



The median average consumption pre-trial was 485 litres per property (July 2020 to June 2021); during the trial, the median average consumption was 322 litres per property (April 2022 to March 2023). A sample size of 118 properties. Requires further analysis to determine if this reduction is related to the trial or if it could be other external factors, such as the weather during each of these periods. The total water supplied to

Greytown, the rainfall measured near Greytown and the average daily consumption of these 118 properties is compared in the table below.

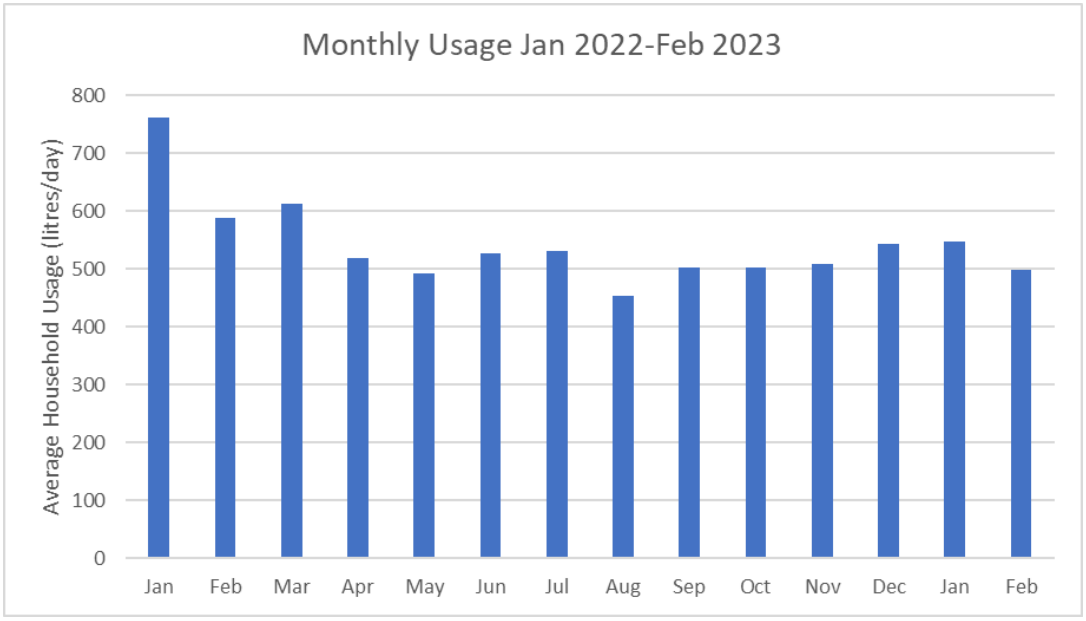
Period	Avg. supply to Greytown (m^3/day)	Avg. monthly rainfall near Greytown (mm/month)	Avg. daily consumption 118 participants (L/prop/day)
Pre-trial Jul-20 to Jun-21	1,716	67.4	598
During trial Apr-22 to Mar-23	1,776	121.7	477
Measurable changes:	Increase of 3.50%	Increase of 80.5%	Decrease of 20.2%

The decrease measured by the 118 trial meters could be attributed to the increased monthly rainfall; however, the total supply to Greytown increased over this same period leaving us unable to be certain if the smart meters drove the decrease or if it was the increased rainfall.

Average Monthly Usage

The average monthly usage was calculated for all meters which had a total volume reading on the 1st of consecutive months. The average total usage for the entire trial was 520 litres/day/property.

The below graph shows the average daily total usage per month and the number of meters that had data available (number connected to the network):



Note: Total usage includes leakage. Further analysis could allow for legitimate usage to be calculated.

Variables Impacting Average Monthly Usage Calculations

Seasonal changes

A typical season usage pattern is evident in the graph above; however, the high usage in January-March 2022 may be influenced by the small number of meters installed in the early stages of the trial.

Total number of smart meters installed and connected to the network

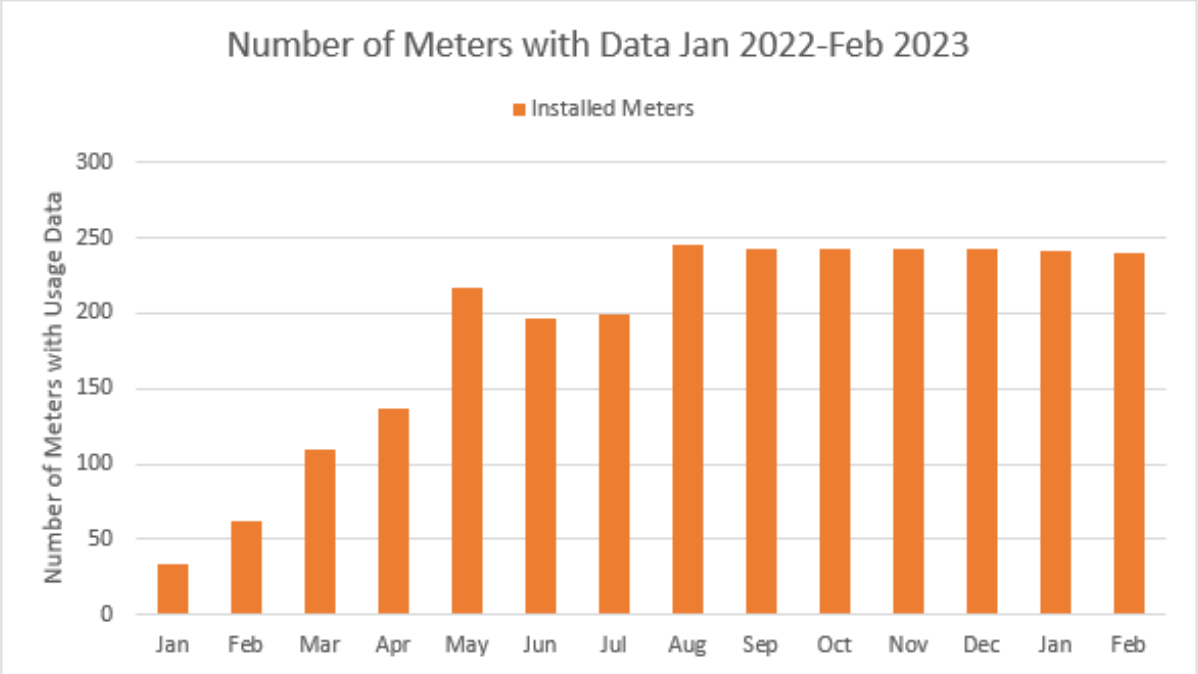
As can be seen in the below graph, the number with usage data initially increased as the meter installations were carried out and also as the network connectivity was improved.

Smart meter swap-outs

A small reduction in June and July can be noticed, and this can be attributed to the swap out of 50 base meters with leak detections (vibration/acoustic sensor) meters. With additional data processing, this could be allowed for in future calculations.

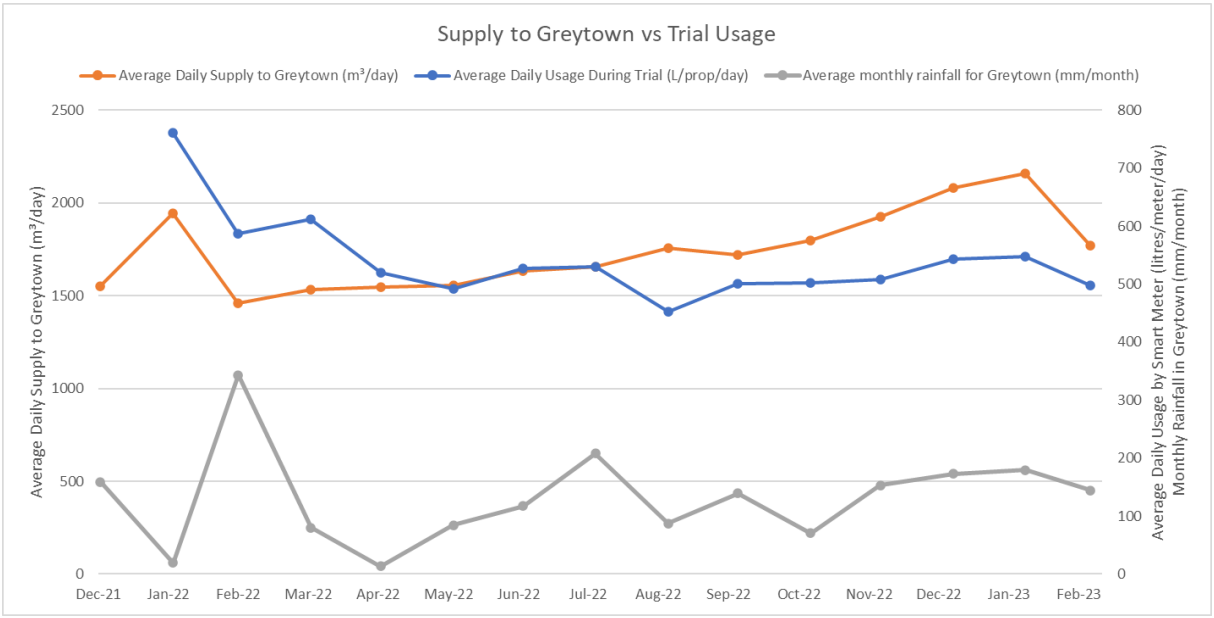
Smart meter removals

In the below graph, a small drop in the number of meters with data from August 2022 can be noted. This is due to a minimal number of meters being removed at the request of the customer. This may also be due to leaks between individual meters and the connecting pipework resulting in the service crew deciding that replacing affected smart meters with manifolds and mechanical meters was the easiest repair option. This reduced the number of smart meters installed, further impacting the usage data.



Supply vs. Usage Observations

Usage during the trial was compared to the total volume of water supplied to Greytown. This is displayed in the below graph.



Supplied by Landis+Gyr.

Since Greytown has very few commercial customers, the shape of the two lines in the graph can be expected to be very similar and mirror seasonal variations. The January to April 2022 smart meter usage may be influenced by the small sample size; however, the smart meters do appear to have had a smaller increase between November 2022 and January 2023 than the rest of Greytown. This smaller increase coincides with the delivery of monthly home reports, which were sent to residents signed up to participate in the trial. More in-depth statistical analysis is required to confirm this apparent trend.

Rainfall vs Usage Observations

As expected, and as can be seen in the above graph, usage has an inverse relationship to rainfall. It would also be expected to have an inverse relationship to soil moisture content and a direct relationship to temperature. These three factors all influence garden watering, which has a significant influence on how much water people use.

Key Findings

- The data indicates that the usage of customers with smart meters installed reduced during the trial.
- The period of the trial saw higher rainfall than the previous billing period and may have contributed to some of the reduction in usage.
- Early detection, notification and repair of domestic leaks may be another factor that contributed to the reduction.
- The supply to Greytown, however, remained consistent, with a very small increase measured during the same period.

6. Domestic Leak Management

Methods and Measurables

Summary

Three main methods were used to detect domestic leaks during the trial. These were through the default leak alarms, minimum night flow calculations (MNF) and vibration/acoustic (noise) sensor AUC (area under curve) identification. On top of this, a BI (business intelligence) platform and the customer portal provided the opportunity for further analysis of the data gained through these three measurables/methods.

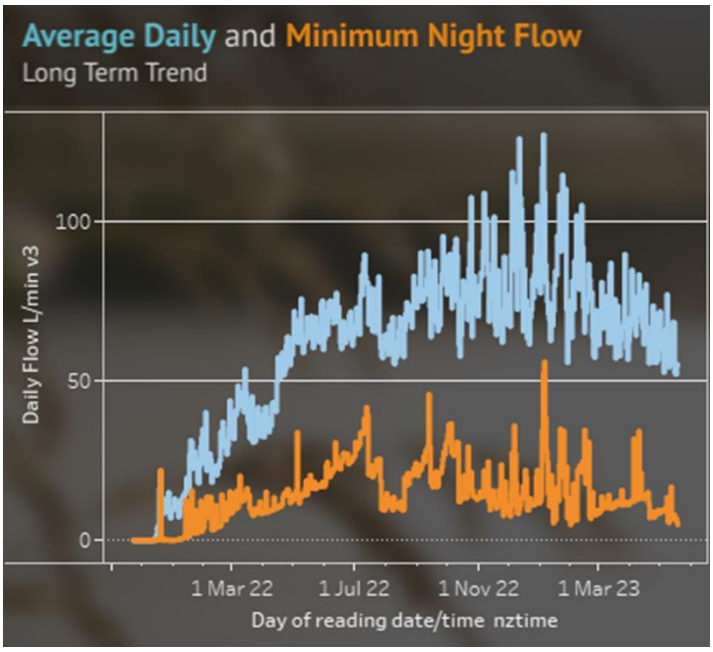
Default leak alarms

Typical parameters indicating householder usage vs leakage are dependent on the usage patterns and behaviours specific to each householder; however, the minimum flow for a meter to start querying a customer leak is five litres per hour. For instance, consistent usage showing at over five litres per hour over a 24-hour period triggers the default customer leak alarm. If there are periods of no usage (or less than 5L of usage) at any stage during the 24-hours, the 24-hour timer resets.

Analytical software and tools can be used to track alarms over more than one day at a time. This may reduce the chances of false positives and, therefore, save network manager and water technician time and costs.

MNF used to calculate leakage

Minimum Night Flow (MNF) is a useful measurement to estimate leakage. At a District Metered Area (DMA) or aggregated data level, it is necessary to subtract the Legitimate Night Usage (LNU) to get an estimate of leakage. However, at an individual domestic property level, typically, there are periods during the night when there is zero flow. While measuring data flow at 30-minute intervals rules out LNU, such as for usage from washing machines or dishwashers set on timers, there may still be other LNU in instances such as the use of automated garden watering systems continued consistently throughout the night. It can be expected that this type of LNU would not be present on consecutive nights, particularly in Greytown, where there is a restriction on only using sprinklers on alternate days.



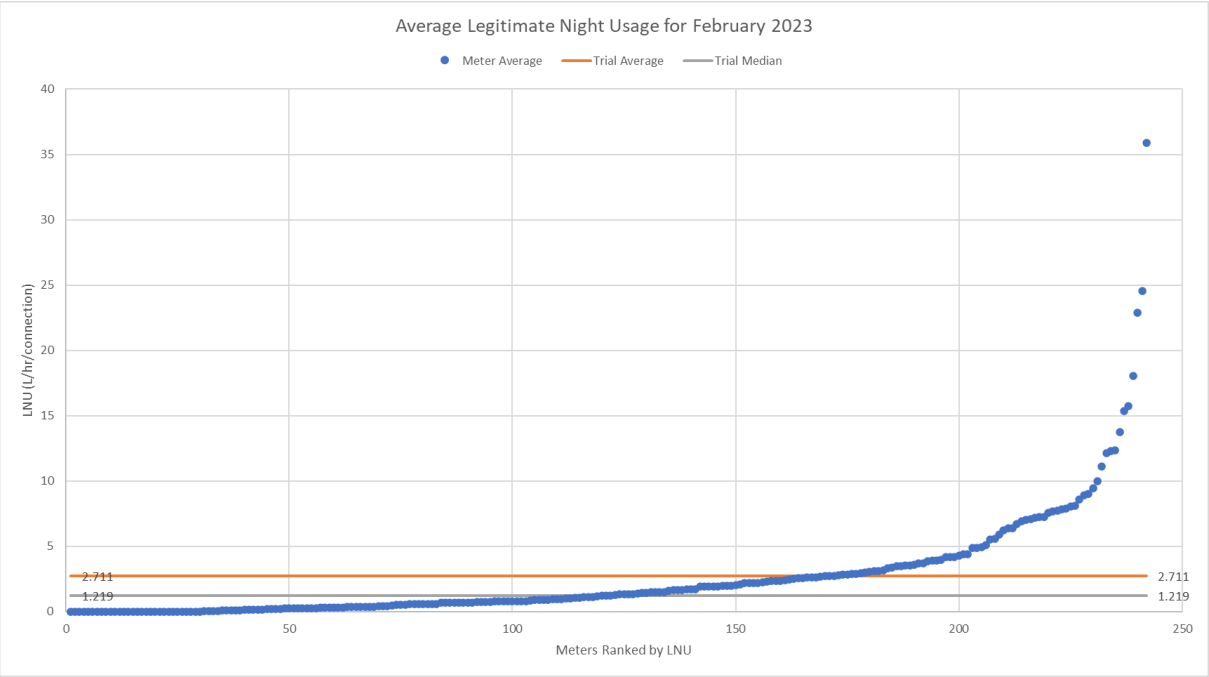
As 30-minute volume data can be analysed to identify likely private side leakage patterns in the trial, it was decided to use the Minimum Night Flow (MNF) calculated between 2am and 5am. Any property that had an MNF of 5 litres/hour for three consecutive days was considered to have a leak. This was spot checked by visual inspection of the 30-minute volume data, and all calculated leaks were found to have a pattern consistent with leakage. A sensitivity analysis was undertaken to check if an MNF of 5 litres/hour for two days or four days would make much difference. It was found that this resulted in a small increase (3.0%) and a small decrease (1.9%), respectively, to the total calculated leakage volume. Since the change is relatively small and an MNF of above 5 litres/hour for two days is likely to include some legitimate short-term high

usage, it was decided three consecutive days of MNF of 5 litres/hour was the correct threshold to confirm leakage.

When looking at the aggregated MNF data for the Greytown SMT, a few trends were noted. Firstly, there is an increase in both MNF and the average daily flows as the number of meters installed and connected increases. Secondly, one can see a drop in MNF when a significant leak has been repaired. Further details on how the MNF has been used in the Greytown SMT have been included in the Domestic Leak Management section below.

Legitimate night usage used to calculate leakage

Legitimate Night Usage (LNU) is a very useful parameter to determine what percentage of MNF in a District Metered Area (DMA) is likely to be leakage. Wellington Water has limited ability to determine LNU, and the smart meter trial, which provides 30-minute volumes, is a valuable tool to do so. The LNU was determined for February 2023 and is shown in the graph below.

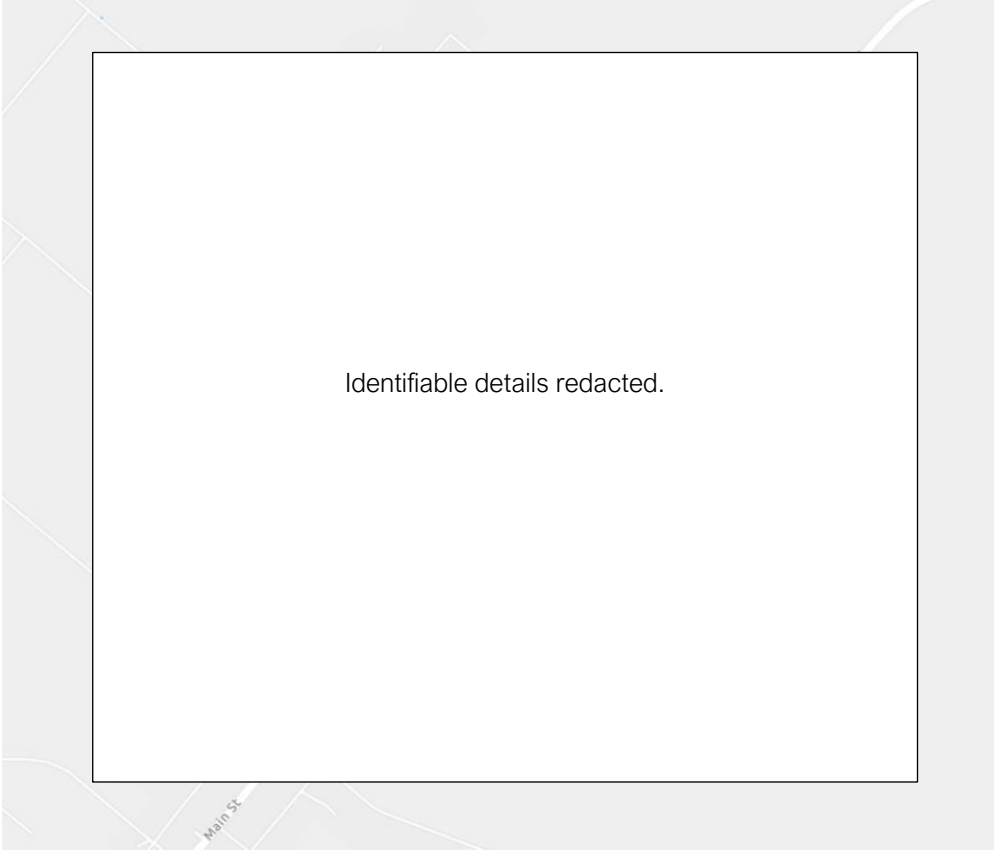


The above-displayed data is skewed by a few high night users (likely to be shift workers), as seen by the large difference between the average and the median. A more in-depth statistical analysis is required to get a representative figure. The data is, however, in the correct range when compared to national averages.

It has been concluded that further analysis will be required to draw any in-depth conclusions. Wellington Water has commissioned The University of Auckland to undertake a more in-depth statistical analysis of the Greytown Smart Meter Trial data.

Domestic Leak Observations

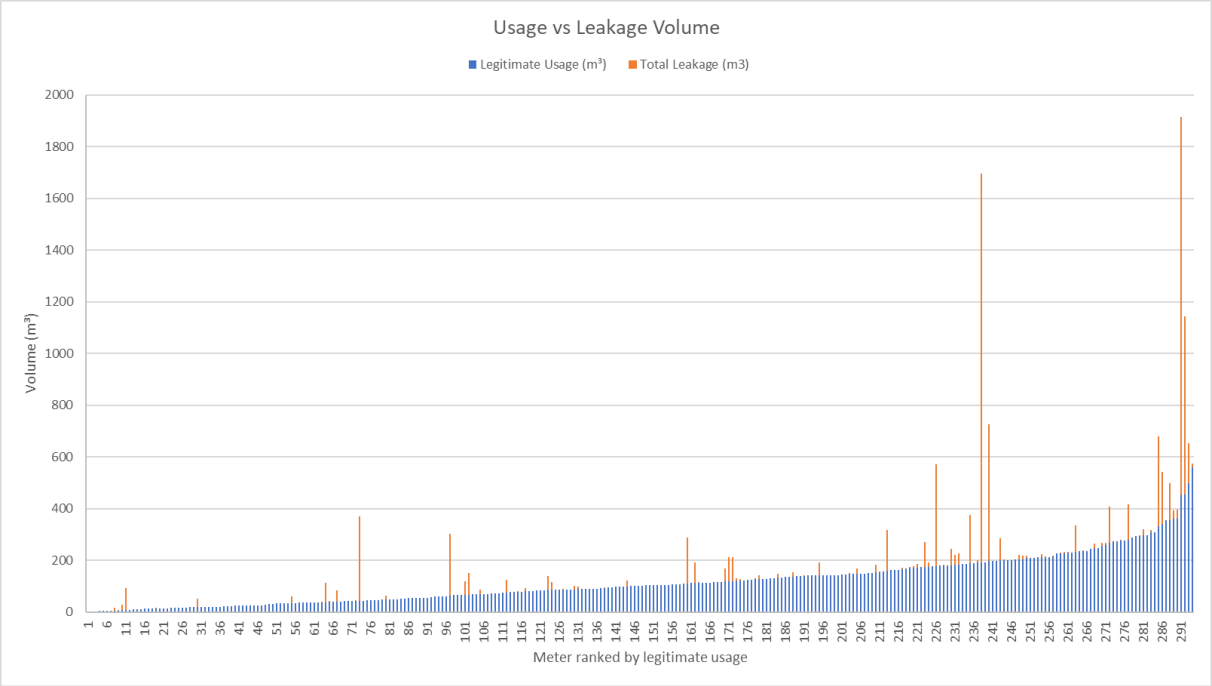
Below are the placements and sizes of customer leaks which were identified during the trial.

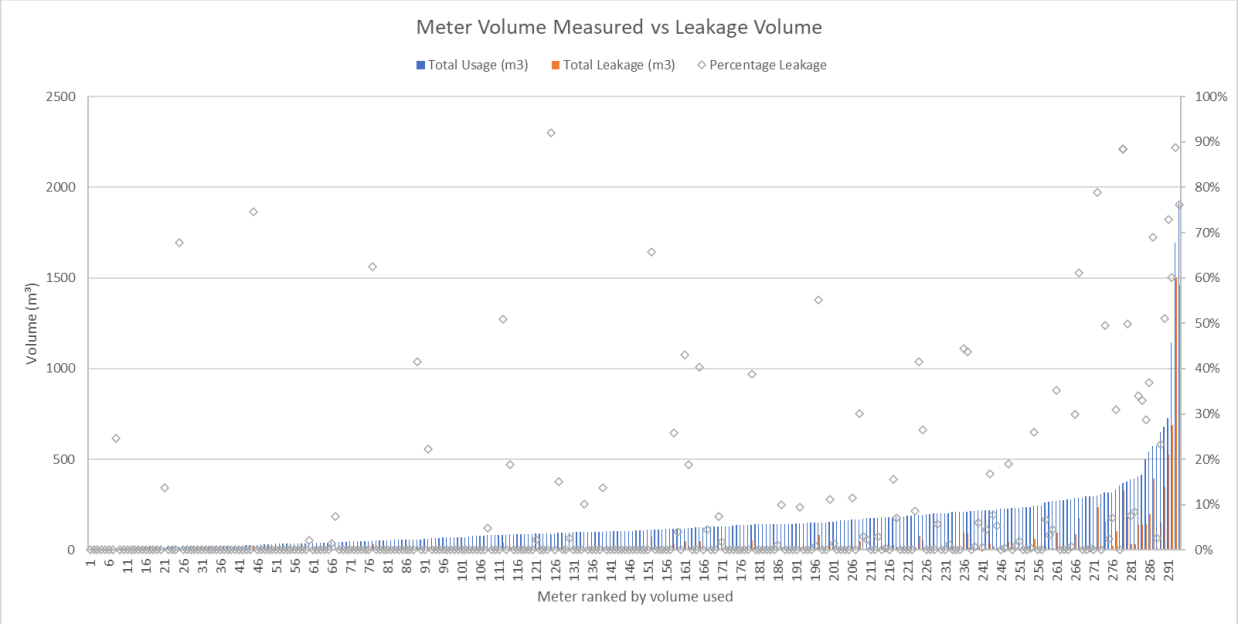


Supplied by Landis+Gyr.

Throughout the trial, 250 domestic meters were installed. Of these, 105 meters generated a minimum of 509 leak alarms, and 93 meters recorded 211 periods of leakage. There were 19 of these meters that did not generate a leak alarm on 39 occasions. The reason for this is being investigated.

The volume of each leak can be approximated by taking the MNF and multiplying it by 24 hours to get a daily volume. This daily volume can then be added for the duration of the leak to give a volume lost to leakage. Up to 15 February 2023, a total of 8,638,000 litres were calculated as leakage. The total volume recorded by all meters up to 15 February 2023 was 43,699,000 litres. This equates to private leakage being 19.8% of total usage. As part of the sensitivity analysis, this would only increase by 0.59% if two days were used as the threshold or decrease by 0.37% if four days were used, giving a high level of confidence that the domestic leakage for all meters up to 15 February 2023 is around 20%.





Key Findings

- The W350 are an effective way to locate pre-existing and new domestic leaks.
- 20% of flow measured by the Smart Meters during the Greytown SMT was determined to be domestic leakage.
- An automated process can be set up to automatically notify any customers who have supplied an email address about suspected leakage.
- This timely notification will lead to several leaks being repaired sooner than they may have been, leading to significant water savings.

7. Network Leaks Management

Network Leak Testing and Analysis

Summary

The Landis+Gyr W350 smart meters were partially used for their network monitoring capabilities. During the trial, network leak detection methodologies were established through the implementation and analysis of measurables in an attempt to gain insights and conserve water.

As discussed in more detail below, network leaks were identified during the trial through the analysis of W350 base smart meter flow data and W350 base smart meter with acoustic sensor noise (or vibration) data. Additional tools and methodologies can be used to manage the wider network, such as pressure and minimum night flow (MNF) monitoring. As a leak has to be significant before it registers as a pressure event, pressure data was not primarily used to detect leaks during the trial; however, it was acknowledged to be a useful tool for overall network management.

Performance outcomes relating to network leak detection are tabled in Appendix H, and information relating to MNF for network leak detection can be found in Appendix S.

Simulating a Leak

For testing purposes, the project team had planned to stage a leak but decided to hold off on it due to the spring-summer water restrictions in Greytown at that time. A leak simulation could be carried out in the future by following the below strategy, which would allow for the testing of the efficiency of flow, pressure and acoustic meter and sensor capabilities. The following steps can be completed to achieve this:

1. Install a hydrant cap, with a ¼" tapping, on a fire hydrant in a convenient location (not in the road and that can be drained to nearby stormwater) with W350 smart meters that have vibration sensors nearby.
2. Install ¼" copper pipe from the fire hydrant to above the ground level.
3. Crimp the end of the copper pipe such that a flow of about 1 litre per minute can escape out the end of the copper pipe.
4. Install a length of PVC drainpipe from the end of the copper pipe to the stormwater network.
5. Open the fire hydrant in the afternoon and leave it to run overnight.
6. In the morning, close the fire hydrant and remove the copper pipe, the drainpipe and the hydrant cap.
7. Check the AUC (Area Under Curve) score of the nearby W350 smart meters with vibration sensors.
8. If no increase in AUC score is detected, repeat with a higher and a lower flow rate to determine what effect that might have.

In contrast, a domestic leak could be simulated by turning on the outdoor tap at a property and letting the water flow for a set duration. In lieu of carrying out any leak simulations, Landis+Gyr provided a leak data observation report, which can be found in Appendix K of this report.

Desktop Data Analysis

The Wellington Water Tableau and Landis+Gyr business intelligence (BI) platforms were used to process and analyse network leak data. Automations, such as setting thresholds and alerts, helped to initially refine the data. Beyond this, discussions took place and are unfinished around how to further filter leak detection data in an attempt to reduce instances of false positives, which may lead to misplaced resource management. Leaks were manually reviewed on a case-by-case basis during the trial. However, it was acknowledged that there is potential to refine and, perhaps, automate this as an entirely analytical process.

Leak Observations

During the trial, often network leaks were identified through pre-existing leak detection measures. Smart meter data was then analysed for the purpose of generating deeper insights into the leaks. This analysis provided useful insight for overall network management. It was determined that, in the future, smart meters will be useful for proactive network maintenance once appropriate systems (/integrations) and processes have been put in place to do so.

Vibration sensor data registering high AUC scores – Street details redacted.

Several network leak alarms and spikes in AUC scores were observed on four meters located on East Street. This prompted Wellington Water to send a crew out to validate whether a leak was present on the street. The crew attended the site on 15/1/2023 but could not see any sign of a leak due to wet weather. A 2nd visit was completed on 31/1/2023, where a wet patch was noticed close to a stormwater sump. Excavation work was ordered, and a leak was found coming from the 100mm asbestos cement water main, which was also encased in the cement wall of the stormwater sump. Repair work was completed to repair the leak. Since this repair, we have still observed periods of high AUC scores and network leak alarms, with a recommendation for SWDC water technicians to complete a follow-up check on the street in case there are more network leaks present.

Vibration sensor data registering high AUC scores

In the cases of network side leaks we have focused on in our analysis, the primary trigger for action/investigation has been repeated network alarms observed on several meters within the specific area. While we have observed instances of high AUC scores, we have not seen sustained periods of AUC scores being observed in periods where a leak has been confirmed on-site and repaired. The recommendation is to set up the right analytic processes to observe high AUC scores over a 5-7 day period. This will assist in filtering out external environmental factors, such as periods of heavy rain or construction work happening near vibration sensors which could pick up noise not directly related to a leak. This is an approach adopted by many other water utilities in order to filter data that could indicate a leak being present. By utilising these insights, water utilities can better manage field crews to attend sites with the highest likelihood of a leak being present which helps to drive greater efficiencies when deploying field crews and providing reactive actions to leaks before these are reported by customers.

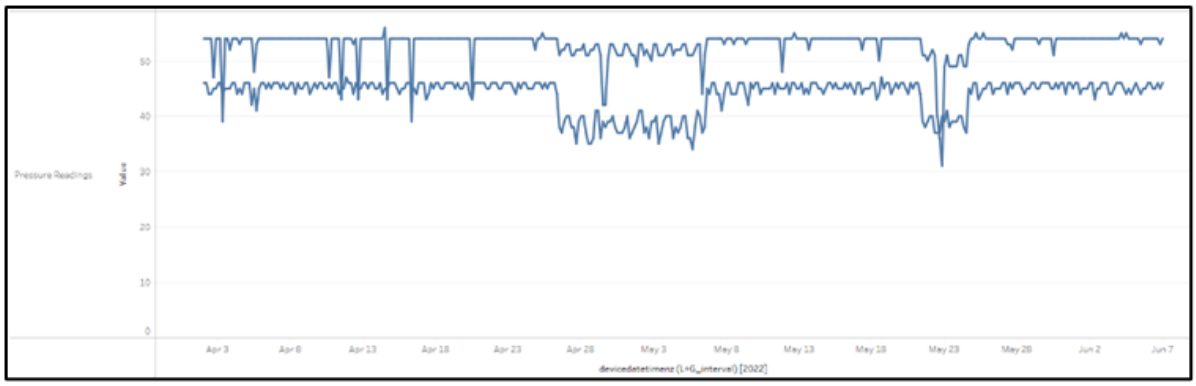
Pressure sensor abnormality due to whole town outage

The W350 meter has the option for an integrated pressure sensor. By installing a pressure sensor at strategic places in the network, the utility company or asset owner will have much better control of network pressure. With pressure under constant surveillance, Wellington Water can operate closer to the minimum pressure-demand, thereby reducing operation costs, prolonging pipe life, reducing leakage, bursts, and energy consumption within the supply network. Alarms are built in to warn of high- and low-pressure events in near real-time. This data can be used to analyse network pressure at different times of the day and seasons of the year.

The pressure sensor does not require an additional battery. This makes for a very cost-effective means of monitoring pressure in the network.

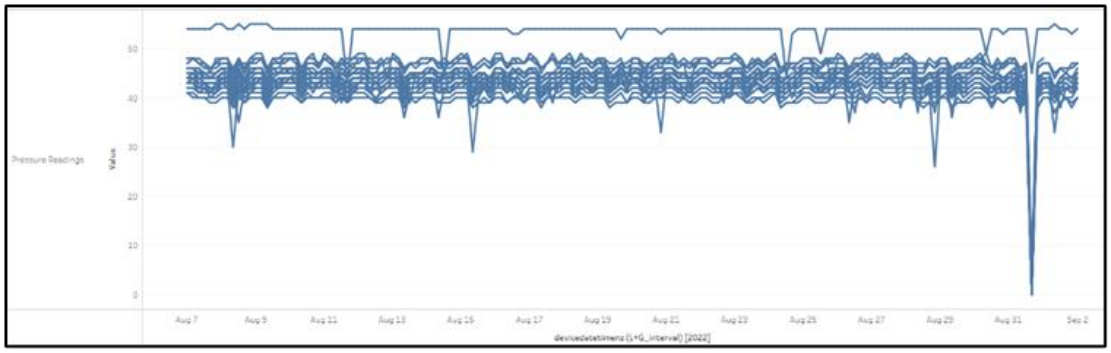
For example, it was possible to easily identify the two periods where the Memorial Park Bore and Water Treatment Plant were isolated, and the town was being supplied by the Waiohine Water Treatment Plant through the PRV. An approximate 5m reduction in pressure was recorded between 25 April 2022 and 6 May 2022 and 21 May 2022 to 24 May 2022. In addition, it is possible to see the difference between the pressure on Humphries Street upstream of the PRV, which is receiving water from the Waiohine Water Treatment Plant and the pressure on Humphries Street downstream of the PRV, which is receiving water from the Memorial Park Bore and Water Treatment Plant.

Pressure readings from two locations showing network changes:



Another example of the value of having meters that can record pressure in the network is the ability to identify outages, such as the one that occurred between 12pm and 4pm on 31 August 2022, seen on all meters except the one upstream of the PRV on Humphries Street. This confirms that the interruption to the supply affected the entire network and was not just a localised issue.

Pressure readings from several locations showing a system outage:



Key Learnings

- Acoustic sensors are a valuable tool for locating and gauging the intensity of network leaks.
- Analysis should be completed once the raw data is received to ensure the meters are not alerting false positives.
- Different pipe materials can impact the noise (AUC) levels and, therefore, should be taken into account when investigating potential leaks.
- Learnings relating to pressure sensor meters specifically include:
    - Ability to identify closed valves on the network.
    - Provides additional network health monitoring and insights.
    - Consistency in pressure across the network – provide data to serve a function.
    - Future potential for hydraulic modelling and proactive maintenance.
    - Data provided by pressure sensors can significantly improve utilities' ability to use data-driven insights to maximise the health and performance of water pressure across their network, allowing for greater proactive and reactive actions to occur while providing a wealth of information that utilities can use to inform future decisions on future Capex requirements to meet demand growth via more accurate models driven by data from smart devices.

8. Community Engagement

Community Engagement Strategy

Summary

The trial implemented a variety of methods and additional technologies to deploy and introduce the smart meters to the Greytown community. This included pre-trial, mid-trial and post-trial interactive communication through letters, emails, portal access, telephone calls, in-person conversations, social media and surveys. As the overall deployment of key milestones was delayed throughout the trial, it was important to establish open two-way communication between Wellington Water and the community. A list of communications initiatives, as detailed by the Wellington Water Communications team, is detailed in Appendix T. A high-level community engagement timeline can be found in Appendix U.

The communications and engagement strategy were built around six central objectives. These were:

- Introducing smart meters and their mutual benefits to the community.
- Community engagement and trial transparency.
- Introducing a customer portal to the community.
- Growing community understanding of and confidence in new water technology.
- Starting conversations around the mutual benefits of conscious water usage and leak management and analysing the impact on behaviour in response to this.
- Highlighting how valuable water is as a resource to the community.

Themes were communicated in an attempt to increase the effectiveness of the trial while building trust and providing new information. Key communication themes included: personal data privacy, usage data privacy, leak management, community member costs, community/council costs, sustainability, technology accessibility and knowledge accessibility. The messages communicated along with these themes are outlined in Appendix U. The Trial Solution Proposal document (Appendix B) listed customer recruitment and engagement as the sixth and last key area for trial metrics, as tabled in Appendix H.

Engagement Risks and Opportunities

From a community engagement perspective, there were various risks acknowledged upfront which could impact the effectiveness of the launch and implementation of the W350 smart meters and, subsequently, platforms and technologies. These included:

- Community concerns about usage and personal data.
- Community perceptions around spending.
- Technology and accessibility.
- Launch timing around political announcements.

On the alternate side, various opportunities were also noted, including:

- Setting the scene (first smart meter project in the region).
- Behavioural analytics insights for future projects.
- Feedback for future projects.
- Strategic knowledge in time for further governmental policy changes.

Key Engagement Methods

To achieve the community engagement objectives, the following methods and activities were carried out by the project team:

- Establishing overarching and consistent key messages.
- Having one main and central location for information with links to other relevant web locations (https://www.wellingtonwater.co.nz/projects/greytown-smart-meter-trial/).
- Updating the website.
- Providing a factsheet and frequently asked questions (FAQ) section.
- Inviting residents to a drop-in session (Greytown Town Centre, November 2021).
- Hand delivering pre-installation letters.
- Door knocking prior to installations.
- Providing a telephone number and email address for feedback and ad-hoc queries.
- Posting progress updates on social media.
- Equipping South Wairarapa District Council representatives (support officers and councillors) with trial-related knowledge and updates.
- Supporting South Wairarapa District Council with proactive press releases and other updates.
- Inviting the community to pre-register for the Advizzo customer portal and later inviting them to log in to the portal.
- Offering a customised portal experience through the completion of a survey on initial sign-in.
- Sending monthly letters and/or emails with usage information and personalised tips (Advizzo monthly home reports).
- Sending separate apology letters for properties with intermittent or no network connectivity.
- Accepting community members not wanting to participate – proving multiple options for 'opt-outs'.
- Sending a trial decommissioning letter to thank community members for their participation and let them know they will no longer have access to the portal and/or will no longer be receiving home reports.
- Facilitating a post-pilot Advizzo customer survey to provide an opportunity for community feedback and gain engagement insights.

Communications Materials

Installation Communications

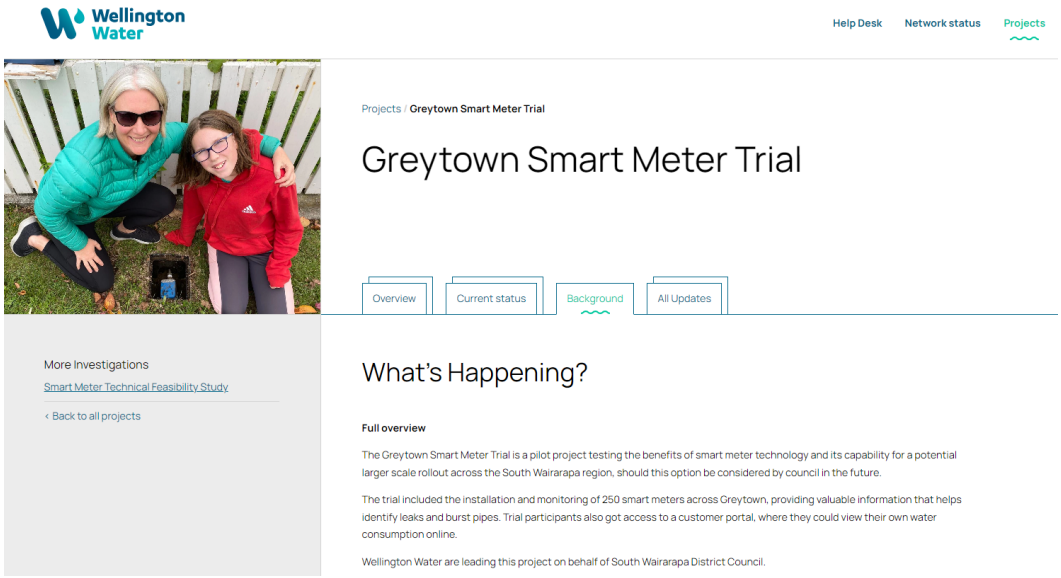
It was important to keep the community in the loop during installations so that they were aware of the works about to be completed on or around their property and the impact this may have on their day. This also gave the residents the opportunity to reschedule the installation if it was going to be an inconvenience.

The objectives of the installation communications are straightforward and include:

- Keeping the householder up to date / letting them know someone may be within their property boundary (if applicable).
- Giving the householder the opportunity to reschedule to a more convenient time.
- Ensuring that turning the water off at a particular time will not be harmful to anyone at a given time.

As per standard protocols, community members were notified of upcoming on-site work a few days prior to beginning installations. This was primarily prepared by Wellington Water and hand-delivered in letter form by the Citycare Water technicians responsible for completing the on-site work. The letter included information about water turn procedures and implications, contact details for questions or feedback and general trial information.

Wellington Water Website



The Wellington Water website provided a central location for trial information and links, making it easy for the Greytown community to stay up to date. The website objectives were three-fold in nature:

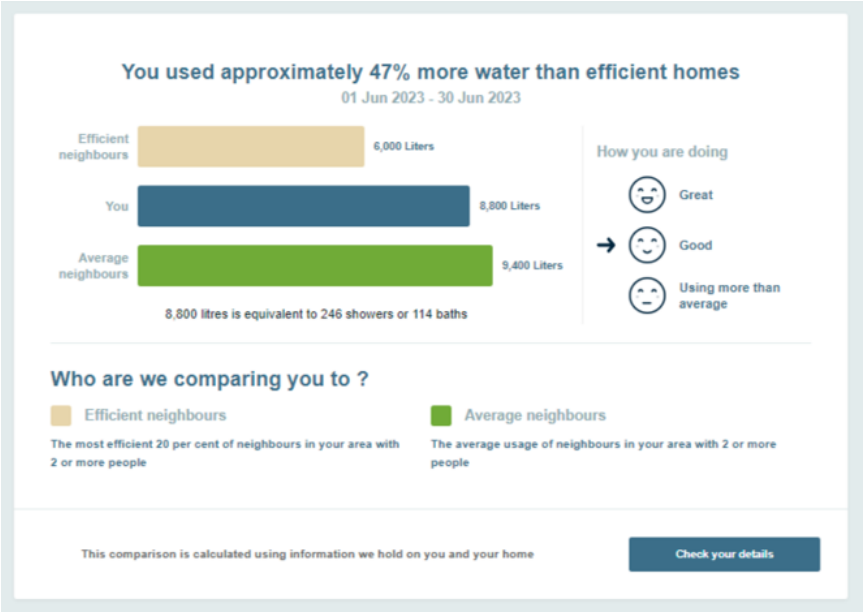
- To have a central location for details and updates.
- To have a central location for external links.
- To provide contact details for feedback.

Refer to Appendix W for screenshots of the Wellington Water website, which was still visible to the community in early-2023.

Advizzo Customer Portal and Communications

A critical aspect of the trial included commissioning and providing a customer portal to Greytown residents. This included sending a letter to invite the community to sign up for the portal in advance, an introductory letter to start viewing usage in the portal, an optional survey to customise the users' experience, anonymous neighbourly comparisons, personalised tips, monthly usage letters and emails and a final trial/portal decommissioning letter.

Above is a consumption graph from the Greytown portal. Further portal images and a full analysis of the Advizzo customer portal implementation process, including overarching portal objectives and methods of localisation, can be found in Appendix X. Results from Advizzo and Wellington Water's post-trial customer survey are in Appendix L.



Example of anonymous neighbourly comparisons in the Greytown trial customer portal/letters.

Privacy

Due to the sensitive nature of the data being captured and displayed, various privacy considerations were considered when launching the trial to the community. These primarily included:

- Householder data sharing:
  It was noted that only owner-occupant data was known and stored, which proved to be an important consideration when dealing with leaseholders or non-owner tenancies. Workarounds, such as the customised Advizzo log-in development and process, were enabled to ensure that landlords – and the likes – were not privy to non-owner-occupants 'real-time' data.
- Property buy-sell data processes:
  A process for automatically decommissioning old owners' or tenants' data was not established, as further analysis is required. Likewise, a process for automatically onboarding new owners was not enabled. During the trial, it was made known to the householders that they were to get in touch if they were moving out of a property to ensure that their data was not shared with additional parties.
- Sharing Advizzo customer portal neighbourly comparison data:
  As neighbourly comparisons were based on similar households and similar living conditions, it was ensured that they were anonymous and taken from a substantial enough pool of properties.
- Suppressed personal details:
  Coming into the trial, it was acknowledged that some Greytown householders had pre-standing requests to have their personal data suppressed. These householders were excluded from communications activities or were contacted directly to confirm at what level they could participate.
- Optional opting out:
  Prior to the trial officially beginning and throughout the full duration of the trial, householders were given the option to opt out of the trial.
- Third-party contracts:
  Third-party suppliers and sub-contractors were only made privy to data once contractual obligations were made clear and agreements – to the legislative standard – were signed.

Decommissioning Trial

Decommissioning the portal was threefold in nature, which involved having a clear timeline set out and shared with the community, sending a final letter to community members, and facilitating a post-pilot survey. These three functions are detailed below.

- Upfront Timeline:
  From the point of the initial trial communications, the timeline was made clear; the trial would commence on 1 January 2022 and conclude on 31 December 2023. As a result, the community were made aware in advance of the conclusion date.
- Final Letter:
  A final letter was sent with the last of the monthly home report, the December home report. The purpose of this letter was to thank community members for their patience and participation and to let them know that they will no longer have access to the portal and will no longer receive the monthly reports.
- Post-Trial Survey:
  On Tuesday, 15 March, Advizzo deployed a survey to 58 trial participants in an attempt to understand how the portal was received by the Greytown community. The criteria for sending the survey were based on those who signed up for the portal/trial and provided an email address as the preferred method of communication. Appendix L contains the full survey, along with additional Advizzo analysis.

Key Learnings

- As with any new technology and changes to infrastructure and/or related processes, the level of understanding a community may impact how it is accepted. Letting the community know the 'why' so that they 'buy' into the solution and make conscious or unconscious changes to their behaviour. Having advocates, or 'champions', in the community would be an advantage for future rollouts.
- Initial trial communications took place at around the same time as wider council communications around increased rates were released. As a result, some members of the community opted out. A takeaway from this is that time is important. It would be beneficial to plan the release of similar future projects amongst other council communications, milestones and projects.
- Due to installation delays, there was a long period between initial communications being sent pre-trial, in September 2021, and following the end of the installations in June 2022 (with scheduled installations concluding April 2022). For future related projects, it is recommended that the 'call to action' to sign up to the portal is started nearer to the end of installations to allow for any unforeseen delays and to ensure momentum is not lost.
- Approximately 13% of metered homes had already signed up for the portal prior to monthly home reports (letters and/or emails) being sent. Typically speaking, for Advizzo, portal activity at such a high rate does not occur until after home reports have been sent.
- Sophisticated behavioural analytics were able to be achieved due to the high completion rate of the pre-trial Advizzo online questionnaire (approximately 80% of those who signed up completed the questionnaire based on consumption habits and property information).
- As meter data flow was validated and technical infrastructure was refined, more Greytown residents were able to view their usage in the portal and communications material (monthly home reports).
- The platform and communications material allows utility organisations to better understand and engage with their customers to attempt to reach core objectives, such as sustainable water usage.
- Regular home reports were not provided over an extended period, so the project team was unlikely to see a further reduction in consumption due to positive customer behavioural changes. However, at a high level, the Greytown community appeared to be receptive to smart meter technologies and information.

9. Closing Summary

As made evident in this report, the trial has helped the project team and stakeholders to better understand opportunities, challenges and the level of feasibility around smart meter procurement, installations, data flow, community deployment and leak analysis. The project success factors outlined in the charter document were met, and the trial provided constructive learnings while also highlighting areas requiring additional planning and analysis. Considerations for future project teams who may be using the trial as a planning resource were noted. The various learnings acknowledged during and following the trial, which have provided a deep depth of knowledge likely useful for future smart meter implementation projects, have been listed below under their individual categories.

Key Hardware Learnings:

- Washers and thread tape are required to mitigate leaks within meter boxes
- To avoid requiring additional fittings, smart meters should be ordered with New Zealand standard threading (11TPI).
- Additional training should be provided to water technicians around technology and network connectivity.
- The importance of hardware-related data capture – serial numbers and meter readings – should be highlighted to the installation team.
- Simple additional analytics are recommended for domestic leak alarms.
- Additional robust network leak analytics are recommended.
- Analytical requirements are likely to evolve over time and be scalable.

Key Site Selection Learnings:

- Adding a reminder for portal sign-up on calling cards worked to increase sign-up numbers.
- Replacement of meters may not be possible without excavation at some locations if standard meter boxes are used.
- The cost of installing meters that are surrounded by concrete or asphalt will be significantly higher. As meter boxes under asphalt or concrete are likely in drivable areas, traffic management may be required, as well as additional care and costs around deconstruction and reconstruction. Ensuring a high level of reconstruction on private driveways will be particularly important.
- Ideally, when installing smart meters, jumbo meter boxes should be installed to ensure it is possible to swap out meters or troubleshoot issues (/to be able to work with tools inside the meter box) without requiring excavation.

Key Physical Installation Learnings:

- Existing infrastructure impacts the viability of smart meter rollouts and the level of troubleshooting which will be required.
- A handover should be provided to the maintenance team to ensure they are familiar with the handling of smart meters.
- Data capture software should be strategically selected to streamline processes and the flow of accurate information.
- Installing in the grass berm is relatively unobtrusive; however, extra caution and planning will likely be needed for installations in other areas.
- For instance, installations in busy or drivable areas may require additional traffic management, installations under asphalt and concrete may require extra reestablishment work, and installations inside of property boundaries may require additional community engagement.
- The smart meter installations differed in requirements and process from mechanical meter installations.

- Time should be factored into training installation teams on digital processes while emphasising the importance of accurate and timely installation data capture due to the impact this has on the wider data flow process.
- There is little difference in time and effort required between installing mechanical and W350 smart meters in properties without an existing manifold styled TOBY. It may make sense to install smart meters at new build properties.
- More work is required to swap a mechanical meter with a smart meter than there is to swap a mechanical meter with another mechanical meter. However, when considering time and effort, ongoing maintenance and meter reading requirements should also be considered.
- Barcode scanners should be used to accurately capture numerical data and to avoid double-handling, such as through the typing of serial numbers from photographs and possible data entry human errors.
- Verification photos should still be taken in addition to data entered directly into the chosen central software. This will allow for any discrepancies to be investigated by simply checking the photos.

Key Network Connectivity Learnings:

- Installation and data capture delays result in network connectivity delays, which may impact further data flow and/or community engagement.
- Environmental factors unique to a township being installed at can impact meter connectivity and should be assessed on a location-by-location basis.
- Allocating time for installation and connectivity troubleshooting is recommended to ensure further data flow and community engagement is not impacted.
- Meter connectivity impacts community visibility of data, and therefore, it is important to set realistic expectations with homeowners when rolling out smart meters and related technology.
- Cellular towers should be commissioned to support NB-IoT in advance of rollouts.
- Network providers may be able to adjust the 'cell' tower direction, and make other adjustments, to support the environmental requirements of installed meters.
- Most NB-IoT meters will connect reliably and daily.
- Intermittent network connectivity should be expected for a small number of NB-IoT smart meters due to a variety of environmental considerations.
- On two occasions, meter boxes were flooded, which interrupted the network connectivity. Additional research is recommended around ways to prevent this in the future in the event of unforeseen environmental conditions.
- For a likely small number of meters unable to connect over the NB-IoT network, manual reads will be required. Field crews have found that the existing version of smart meters is sometimes more challenging to read than the existing mechanical meters. It was suggested that drive-by RFI could be used in combination with smart meters – for sites unable to achieve connectivity – to eliminate the need for manual meter readings.

Key Data Flow Learnings:

- There are important privacy considerations when it comes to sharing usage data with householders, as only those using the water should be privy to usage data.
- There is still work to be scoped around changes in property ownership and tenancies.
- Third parties working with householder data should be trusted and verified.
- Smart meter installations transform daily tasks and roles through changes in data collection and management processes.
- Having half smart meters installed and half mechanical meters installed means that two separate systems and processes need to be carried out to capture readings and manage leaks in one township. Installing smart meters would reduce the need for separate processes and site visits.
- Prior to wider rollouts, there needs to be robust processes in place to accommodate the above learnings.

Key Data Handling Learnings:

- There are important privacy considerations when it comes to sharing usage data with householders, as only those using the water should be privy to usage data.
- There is still work to be scoped around changes in property ownership and tenancies.
- Third parties working with householder data should be trusted and verified.
- Smart meter installations transform daily tasks and roles through changes in data collection and management processes.
- Having half smart meters installed and half mechanical meters installed means that two separate systems and processes need to be carried out to capture readings and manage leaks in one township. Installing smart meters would reduce the need for separate processes and site visits.
- Prior to wider rollouts, there needs to be robust processes in place to accommodate the above learnings.

Key Domestic Usage Learnings:

- The data indicates that the usage of customers with smart meters installed reduced during the trial.
- The trial period saw higher rainfall than the previous billing period and may have contributed to some of the reduction in usage.
- Early detection, notification and repair of domestic leaks may be another factor that contributed to the reduction.
- The supply to Greytown, however, remained consistent, with a very small increase measured during the same period.

Key Domestic Leak Management Learnings:

- The W350 are an effective way to locate pre-existing and new domestic leaks.
- 20% of flow measured by the Smart Meters during the Greytown SMT was determined to be domestic leakage.
- An automated process can be set up to automatically notify any customers who have supplied an email address about suspected leakage.
- This timely notification will lead to several leaks being repaired sooner than they may have been, leading to significant water savings.

Key Community Engagement Learnings:

- As with any new technology and changes to infrastructure and/or related processes, the level of understanding a community may impact how it is accepted. Letting the community know the 'why' so that they 'buy' into the solution and make conscious or unconscious changes to their behaviour. Having advocates, or 'champions', in the community would be an advantage for future rollouts.
- Initial trial communications took place at around the same time as wider council communications around increased rates were released. As a result, some members of the community opted out. A takeaway from this is that time is important. It would be beneficial to plan the release of similar future projects amongst other council communications, milestones and projects.
- Due to installation delays, there was a long period between initial communications being sent pre-trial, in September 2021, and following the end of the installations in June 2022 (with scheduled installations concluding April 2022). For future related projects, it is recommended that the 'call to action' to sign up to the portal is started nearer to the end of installations to allow for any unforeseen delays and to ensure momentum is not lost.
- Approximately 13% of metered homes had already signed up for the portal prior to monthly home reports (letters and/or emails) being sent. Typically speaking, for Advizzo, portal activity at such a high rate does not occur until after home reports have been sent.
- Sophisticated behavioural analytics were able to be achieved due to the high completion rate of the pre-trial Advizzo online questionnaire (approximately 80% of those who signed up completed the questionnaire based on consumption habits and property information).
- As meter data flow was validated and technical infrastructure was refined, more Greytown residents were able to view their usage in the portal and communications material (monthly home reports).
- The platform and communications material allows utility organisations to better understand and engage with their customers to attempt to reach core objectives, such as sustainable water usage.
- Regular home reports were not provided over an extended period, so the project team was unlikely to see a further reduction in consumption due to positive customer behavioural changes. However, at a high level, the Greytown community appeared to be receptive to smart meter technologies and information.

In addition to the above learnings, various smart meter benefits were noted during the trial, including the potential for long-term resourcing cost benefits, timely identification of domestic leaks and more optimised leak management and billing processes. Additional benefits included improved knowledge of network management and leak analytics – including customer usage, minimum night flow and legitimate night usage – a better understanding of pressure and vibration (acoustic) sensor capabilities and an opportunity for reduced human errors through data capture. Smart meters were also found to increase the opportunity for positive two-way communication, enabling effective and transparent information sharing with a community. Ultimately, the trial has provided insight into what a large-scale rollout could entail and has highlighted the benefits of installing smart meters over traditional mechanical meters, while also highlighting areas requiring further research and analysis.

Considering the above learnings and acknowledgements, the project team agreed that it would be beneficial to have a longer trial period to capture additional insights. Continued analysis of the already installed Greytown meters may serve this purpose to an extent. However, a larger scale trial, encompassing an entire DMA, would allow for the ability to measure changes in consumption of customers who have regular access to their data against a control group who don't. A larger scale trial may also provide additional context around how quantity may impact per unit pricing, how timing and pre-explore to similar technology may impact levels of uptake and how different environmental considerations may impact connectivity, among other areas of analysis. Therefore, the project team recommends additional analysis of the existing installed smart meters be carried out, as well as further desktop research into data flow and deployment strategies prior to a larger scale smart meter roll out.

10. Appendices

A: Project Charter

Redacted – contains commercially sensitive information relating to third parties.

B: Solution Proposal

Redacted – contains commercially sensitive information relating to third parties.

C: Mid-Trial Lessons Learnt – Global Pandemic

Internal supply chain / freight disruptions	
Summary of impact:	As a result of the manufacturing and configuring process taking place in China, Australia, and New Zealand, the installation start date was pushed back. This impacted the entire trial, as dataflow and community onboarding rely on the meters being installed.
Actions taken in the trial:	Airfreight was arranged to speed up the delivery process. A technician was on standby to commence installations as soon as the meters arrived.
Future recommendations:	To avoid similar delays in the future, hardware can be ordered prior to confirming project dates.

Team resourcing	
Summary of impact:	COVID-19 restrictions meant that installation resources could not be guaranteed due to the unpredictable nature of the pandemic and isolation rules. This resulted in having just one technician available for most of the installation period.
Actions taken in the trial:	The project became agile in nature to allow for the unpredictability of the installation timeline. As soon as a second technician was available, they were assigned to the project.
Future recommendations:	In the future, it would be beneficial to allow more time for installations.

Community notification / water shut-off notifications	
Summary of impact:	The standard public notification procedure to advise the resident of water shut-off was not possible due to COVID-19 restrictions. An alternative was put in place; however, there was a risk that some residents could still be unaware of their water being shut off.
Actions taken in the trial:	To avoid face-to-face interaction between the technician and residents, the project team prepared a letter to be left on the resident's doorstep just prior to the installation. The technician was asked to knock on the door at the time of leaving the letter but to walk away immediately after knocking.
Future recommendations:	If budget and time allow, additional communications could be deployed in advance.

D: Mid-Trial Lessons Learnt – Data Integration and Management

Aggregated data / duplicates	
Summary of impact:	Delays were experienced in getting the required data through to Advizzo and, as a result, setting up the customer portal for onboarding.
Actions taken in the trial:	Any partial downloads of data were cross-referenced and deleted, leaving only the full downloads of data available to be provided to Advizzo.
Future recommendations:	Replicate the solution.

Data variances / incremented vs aggregated data	
Summary of impact:	Landis+Gyr explained that the 30-minute meter data is set to round down to the nearest litre. This replicated over multiple reads adds up to a noticeable amount. The aggregated data total is, however, accurate. This impacted how the data is being treated and processed.
Actions taken in the trial:	It was agreed that this would not materially affect customer usage data or patterns and that billing would be based on the aggregated data.
Future recommendations:	No change to what has been done. Landis+Gyr have mentioned a future firmware upgrade will round the data up instead of data, which should remove the error.

Software for installation data capture	
Summary of impact:	There were delays in matching the serial numbers and address/customer codes (for Advizzo) because of the installation platform used. This was due to not using a barcode scanner initially (photos of serial number only) and the double handling of data between Fulcrum and Survey123.
Actions taken in the trial:	A barcode scanner was used at the end of the installations to save doublehanding and help avoid human error through the doublehanding of data.
Future recommendations:	Data can be entered directly into Survey123.

Network coverage / unsuccessful transmissions	
Summary of impact:	Coverage was checked on-site (during the Discovery Phase) and indicated that all meters should be able to communicate through the Vodafone NB-IoT network, yet connection issues are evident after installations. A number of residents are unable to view all or any meter data, impacting their ability to participate in the trial.
Actions taken in the trial:	Network changes were made at a cell tower level by Landis+Gyr/Vodafone. Continued network issues persisted. Landis+Gyr/Vodafone are preparing to create a service map of the entire township.
Future recommendations:	Include testing from inside the meter boxes. Map townships for coverage, by the network providers, prior to choosing a provider.

Customer data access	
Summary of impact:	With only ratepayer data stored, the standard Advizzo onboarding process would only allow for the reach of homeowners and not tenants leasing the property in the area.
Actions taken in the trial:	A new onboarding solution was developed with Advizzo, where a resident can sign in using the address and associated unique ID.
Future recommendations:	Continue with the new solution.

E: Mid-Trial Lessons Learnt – Hardware Specifications

Meter threading capability	
Summary of impact:	It was discovered that standard European threading specifications vary from New Zealand's. This resulted in meters with 14TPI threading being sent instead of meters with 11TPI threading (New Zealand standard).
Actions taken in the trial:	Tails were ordered to work as an adapter between the meter and the existing pipe network. The remainder of the project meters were customised (during the manufacturing process) to have 11TPI thread.
Future recommendations:	It is recommended to do site-specific research related to threading. For future orders, ensure you opt to have the threading customised. 11 TPI (threads per inch) is the NZ standard.

Valves	
Summary of impact:	To install the inline meters, the existing mechanical meters and manifold needed to be removed due to meter box sizing constraints. This meant new valves needed to be purchased, increasing both installation costs and time.
Actions taken in the trial:	Valves were purchased for all 250 meters, and replacing the valve was a standard part of the installation procedure.
Future recommendations:	Landis+Gyr meters now come with the option for integrated valves. This option should be ordered in the future to save on costs and time.

Meter box dimensions	
Summary of impact	Tails were installed at all 50 of the interim base/vibration sensor sites, yet when it came to the time of retrofitting (from within the box, i.e., without excavation), it proved difficult to remove some of the meters due to the tight space within the box differences in meter box sizes.
Actions taken in the trial:	The technician was advised that if too difficult to remove an interim base meter, they could retrofit another of the base meters in this place. An error occurred in removing six pressure meters instead of six base meters.
Future recommendations:	Including detailed meter box sizing for each of the meter boxes would help with future scoping.

F: Mid-Trial Lessons Learnt – Stakeholder Management and Deliverables

Council billing data	
Summary of impact:	A main deliverable of this project was to provide the council with all meter reading data to incorporate in time for end-of-financial-year billing. All reading data was not collected at the time of meter removal. As of July 2022, not all meter data has been located and recorded.
Actions taken in the trial:	As many removed meters as possible were relocated, and the readings were recorded.
Future recommendations:	Ensure processes are followed so that visible meter readings are recorded at the time of removal.

International project team	
Summary of impact:	Time zones influenced when we could hold meetings and schedule deliverables. Additional 'localising' of products and services was also required.
Actions taken in the trial:	Meetings were scheduled outside of normal business hours, and email was used as the preferred mode of communication in some instances.
Future recommendations:	Project teams should be aware of and agree to the time-related implications of an international project team. Additional time for business analysis should be added to the beginning of a project plan to adapt and localise processes and products to best fit a New Zealand 'market'.

G: Mid-Trial Lessons Learnt – Community Engagement

Installation updates	
Summary of impact:	Installation dates initially communicated to residents did not account for supply chain delays, meaning residents were less informed.
Actions taken in the trial:	Residents were kept updated by the Wellington Water Communications Team.
Future recommendations:	Prepare regular updates in case of delays.

Customer portal usage data	
Summary of impact:	Due to network connectivity, several meters did not transmit data, resulting in residents being unable to see their usage data in the customer portal. Residents with meters not connecting to the network will have to be excluded from the trail.
Actions taken in the trial:	The communications team are preparing apology letters for residents with partial or no data.
Future recommendations:	A more comprehensive network-related discovery, particularly in townships not currently using an NB-IoT network. This may impact the choice of network provider. Preparation of communications material for all possible scenarios.

Customer portal / neighbourly comparison restrictions	
Summary of impact:	Neighbourly comparisons are only visible after at least one month of data flow from a particular meter. When initially signing up, not all trial participants will have access to the neighbourly comparisons feature.
Actions taken in the trial:	A 'holding' message has been arranged to display where the Neighbourly Comparisons will sit in the portal until enough data has been collected for the meter/resident.
Future recommendations:	An additional phase for post-installation/data flow would allow for more time to troubleshoot hardware and monitor real-time network capabilities. This additional time will allow be beneficial for gathering data.

H: Trial Metrics

The below trial metrics were outlined as a requirement in the Trial Proposal documentation.

Project Metrics	Responsible Party	Frequency of Data Capture	Trial Outcome
Economic Metrics			
Cost of installation, including different types and locations	Citycare Water	Once	Suppressed in the report – commercially sensitive
Average time required to install meters	Citycare Water	Once	30-minutes
Cost components: Meter (including software and freight), manifold, labour and material costs	Citycare Water	Once	Suppressed in the report – commercially sensitive
% of complex installations found in the trial and the installation cost	Citycare Water	Once	Percentage TBD. Installation costs largely remained the same, as additional works (i.e., leak fixes) were charged via a separate maintenance contract.
Project management cost	Citycare Water	Once	Suppressed in the report – commercially sensitive
1. Meter Performance Metrics			
% of time meters fully functional			
• Flow	Landis+Gyr – Dean	Monthly during trial	94% Average
• Pressure	Landis+Gyr – Dean	Monthly during trial	95% Average
• Vibration	Landis+Gyr – Dean	Monthly during trial	95% Average
• Temperature	Landis+Gyr	Monthly during trial	94% Average
• Telemetry	Landis+Gyr	Monthly during trial	94% Average
Meter Failures (counts) – terminal failure and intermittent failure			
• Electronic	Landis+Gyr	Monthly during trial	2
• Ultrasonic flow sensor	Landis+Gyr	Monthly during trial	0
• Pressure sensor	Landis+Gyr	Monthly during trial	0
• Vibration sensor	Landis+Gyr	Monthly during trial	0
• Battery	Landis+Gyr	Monthly during trial	0
• Communications	Landis+Gyr	Monthly during trial	0

Instances or % measurement error			
• Flow	Not applicable	Monthly during trial	Not applicable for trial
• Pressure	Wellington Water	Monthly during trial	Not applicable
• Vibration	Wellington Water	Monthly during trial	Not applicable
2. Consumer consumption behaviour metrics			
• Average residential consumption (L/hh/d) during different stages			
• Before trial (July 2020 – June 2021)	Wellington Water	Weekly (data only available as average during the billing period, not weekly)	598 L/hh/day
• During the trial (April 2022 – March 2023)	Wellington Water	Weekly or as required	477 L/hh/day (reduction may be the result of 80.5% higher average monthly rainfall over this period)
• After trial	Wellington Water	Weekly	Not applicable
Average residential consumption for different types of properties (bedroom number, kitchen units, gardens etc.)	Advizzo	--	The sample size was too small
• Average residential consumption for participants of the trial who are provided with the Advizzo platform in comparison with a control group (no platform, one-way communication only)	Wellington Water	Once	The sample size was too small to have a control group
3. Meter communication performance			
Signal			
• % time adequate signal for data transmission	Landis+Gyr	Per month during the trial	99.9%
• Frequency of dropouts (average per meter per month)	Landis+Gyr	Per month during the trial	3.4 Failed Connections
• Average drop-out duration per meter	Landis+Gyr	Per month during the trial	0.9
Network outages during trial			
• Frequency	Landis+Gyr	Per month during the trial	
• Duration	Landis+Gyr	Per month during the trial	
Data capture rate (data points received by server compared with theoretical data production)			
• Average per meter	Landis+Gyr	Once	51
• Overall	Landis+Gyr	Once	

Data transmission			
• % first attempt success	Landis+Gyr	Once	85%
• Average delays per meter per month	Landis+Gyr	Once	3.4 Delays
• Average duration of delays	Landis+Gyr	Once	3.8 Days of Backlog
4. Leakage detection metrics			
Private leakage identified during the trial			
• Private leaks identified (count) per meter	Wellington Water	Per month during the trial	Further analysis is required to be able to report this as per meter per month; however, up to 15/02/2023, 211 separate leaks were identified on 93 out of 295 meters at an average of 0.72 leaks/meter and 18.8 days of leakage per meter for all meters or an average of 59.6 days of leakage per meter for the 93 meters that recorded leakage.
• Total leakage across installations (kL)	Wellington Water	Per month during the trial	8,638kL (calculated as total to 15/02/2023, further analysis required to calculate this as a per month figure)
• Average leakage per customer (with confidence intervals) (L/hh/d)	Wellington Water	Per month during the trial	Further analysis was required to get confidence intervals; preliminary analysis indicated about 20% of measured flow was domestic leakage. The average leakage per meter per day was calculated as 1,559L/hh/day when the meter was leaking, with the maximum recorded leak reaching 40,368L/hh/day.
• Private leaks notified to the customer	Wellington Water	June & Nov	10 & 13
• Private leaks verified by a customer	Wellington Water	Per month during the trial	N/A
• Private leaks repaired by the customer	Wellington Water	Per month during the trial	N/A
• Total water saved from private leak identification and repair (kL)	Wellington Water	Once at the end of the trial	N/A
• Average savings from private leakage repair (with confidence intervals) (L/hh/d)	Wellington Water	Once at the end of the trial	N/A
• Average legitimate night use (2-4am) (L/hh) *this is the actual period used for MNF	Wellington Water	Once at the end of the trial	2.711

Network leakage (using *vibration sensors, only a limited area) *Retrospective analysis of leak sensor data due to the sample size installed being small (most effective way)			
• Network leaks identified (count)	Wellington Water	Per month during the trial	There are example cases mentioned in the Network Leakage Management section.
• Network leaks notified to WWL	Wellington Water	Per month during the trial	Not applicable – no way to measure within the scope of the trial
• Network leaks verified by WWL	Wellington Water	Per month during the trial	Not applicable
• Network leaks repaired by WWL	Wellington Water	Per month during the trial	Not applicable
• Reduction time in identifying leaks	Wellington Water	Once	Not applicable
• Total water saved from network identification and repair (kL) (WWL)	Wellington Water	Once	Not applicable
• Reduction in network flows (WWL)	Wellington Water	Once	Not applicable
• Change in CARL (WWL) and ILI	Wellington Water	Once	Not applicable
• Estimated reduction in water consumption over the course of the trial (with confidence intervals) (L/hh/d)	Wellington Water	Once	Not applicable
5. Customer Recruitment and Engagement			
• Number of customers approached by letters	Wellington Water	Once	369 initial letters deployed
• Number of customers who requested additional information	Wellington Water	Once	Approximately 30-40 for the duration of the trial
• Number of offers not accepted (number of opt-out) and reasons for opt-out	Wellington Water	Once	59 pre-trial; of this, 16 letters were returned to the sender. Two during trial
• Number of completed pre-trial survey questionnaires	Wellington Water	Once	69 (95%)
• Portal engagement	Advizzo	Once	346 customers set up on the platform 242 customers engaged proactively (70%) 73 customers set up an online account (30%)
• Total participants	Advizzo	Once	250 trial householders
• Options selected	Advizzo	Once	Not applicable
• Tips provided/acknowledged	Advizzo	Once	1 (0%)
• Number of post-trial surveys completed	Advizzo	Once	18 of the 58 customers the survey was sent to (30%)

I: Procurement Methodology – Meter Types

Make	Model	Quantity	Procurement Methodology
Landis+Gyr	W350 Base Flow	205	Included the maximum number of base flow meters able to be purchased within the project budget.
Landis+Gyr	W350 Base Flow with Pressure Sensor	45	Initially assessed to be the preferred number of pressure sensors, budget permitting, to be strategically installed throughout Greytown.
Landis+Gyr	W350 Base Flow with Acoustic/ Vibration Sensor	50	Initially assessed to be the preferred number of acoustic sensors, budget permitting, to be strategically installed throughout Greytown.

J: Site Selection

Below are the wider trial site selection criteria and process:

Step	Stage	Process and Justification
1.	Desktop discovery	All Greytown properties with existing tobys identified through desktop research carried out by Wellington Water in 2021. The main road was excluded due to the complexities (traffic management etc.) of being a state highway. This came to a list of a total of 490 properties which was provided to Citycare Water.
2.	On-site discovery	Citycare Water received the list of 490 properties and began an on-site discovery in July 2021, whereby any meters which were installed in concrete or asphalt driveways or which had another restriction were removed. Sections of streets which had TOBYs under asphalt or concrete were ruled out due to the large costs associated with reinstatement and the disruption smart meter works may cause. This process brought the total number of applicable properties down to 354 properties. Citycare Water passed the updated list on to Wellington Water.
3.	Community engagement day	A community engagement day was organised by Wellington Water and held at the Greytown Public Library in September 2021. During the event, the community were given the opportunity to not be included in the installation process and wider trial. Through this, the list of applicable trial properties was reduced to 311 properties.
4.	Community letters	Letters were sent to the applicable 311 properties by Wellington Water in September 2021. In response, some recipients responded, requesting not to be included in the installations/trial.

		This brought the total of applicable properties down to 294 properties.
5.	Project budget refinement	Wellington Water reviewed the project budget and was able to confirm that 250 smart meter installations/properties, and their subsequent data flow, could be supported. With this in mind, preferred streets were identified, and 250 properties were selected. Refer to the below sections sub-sections for more information on street selection criteria and site selection by meter type (base flow, base flow with pressure sensor and based flow with acoustic sensor).

Selection by meter type:

Consideration	Quantity	Selection Methodology
Base Flow Meter	205	Base flow meters replaced mechanical meters to capture usage data totals and, therefore, could be installed at any properties which met the trial site selection criteria.
Base Flow Meter with Pressure Sensor	50	Landis+Gyr recommended the pressure sensor meters be installed at the end of the network/pipes and/or around intersections. To be completed. Pressure sensor locations were selected in a way to ensure that there was at least one meter that could measure pressure between each isolating valve. Therefore, a level of network management analysis was required.
Base Flow Meter with Acoustic/Vibration Sensor	45	Landis+Gyr recommended the acoustic sensor meters be installed at properties along one street, with gaps no greater than 50-80ms between each sensor. To be completed Two streets were selected for the acoustic (/vibration) sensor installations to ensure suitable spacings were achieved. Therefore, a level of geospatial analysis was required.

K: Landis+Gyr Post-Trial Leak Analysis Report

Table of Contents

Serial numbers redacted.

Executive Summary

Overview

The Greytown Smart Meter Trial was a pilot project to test the potential of digital smart meters over and above the basic mechanical meters by measuring and recording private leaks, network leaks, network pressures, and water usage trends. The other aspect of the trial was to understand consumer behavior and promote customer engagement by providing meter consumption and event information in real time over the internet. Wellington Water Limited is the business owner acting on behalf of the South Wairarapa District Council.

The trial involved the installation of Landis+Gyr W350 smart meters in about 250 households across Greytown in the South Wairarapa region. About 155 base meters, 45 pressure meters, and 50 vibration meters were installed across Greytown by City Care Water starting mid-December 2021 and completed in mid-June 2022.

Greytown Trial Key Stats

- Trial Period: 1st June 2022 to 31st December 2022.
- 250 Landis+Gyr W350 meters installed across Greytown, split between the following meter variants:
  - 155 Base Meters
  - 45 Pressure Meters
  - 50 Vibration Meters
- 44 private leaks identified up to August 2022, with an estimated volume of 4,234m³ for this group; this equates to 24% of likely water savings potential for Wellington Water.
- 1 network leak identified/repaired in September 2022
- Insights derived from the pressure sensor data provides greater ability to identify outages within the network, for example an outage event occurred in August 2022, seen on all meters except the one upstream of the PRV on Humphries Street. This confirmed that the interruption to the supply affected the entire network and was not just a localized issue.

Leak Data Report Purpose

This leak data observation report provides analysis of a selected list of leaks identified and repaired by Wellington Water. The report covers nine customer leaks and two network leaks, which was on a service pipe. The report also notes that leaks were identified either via daily monitoring of smart meter data or through customer reports. The report aims to identify any data trends in the historical data that could have resulted in earlier leak identification and resolution. Ultimately, the analysis will assist in informing future strategies and processes of Wellington Water.

Leak Report Learning Outcomes

Gaining insights on customer and network leaks requires the effective utilization of data analytics to maximize insights from smart water meter data. Abnormal data values, such as high AUC scores, are essential to make an informed determination on whether a leak exists in the network.

Key Customer Leak Learnings: Focus on observed increases in water flow usage over several days and customer leak event alarms.

Key Network Leak Learnings: Focus on consistently high AUC's scores over several days, and network leak alarms and sample heard scores.

These insights inform site visits to verify the presence of a leak and then fix it. It is crucial to remember that leak sensors are listening for "Noise" in the network, which could be affected by environmental factors such as roadworks or other activities that produce vibrations/sounds. Therefore, analyzing data from smart water meters correctly can significantly reduce water loss and lead to efficient management of the water network system. In addition, the continued roll out of smart water meters across the network will continue to improve the ability to observe and respond to customer and network leaks.

Customer Leaks

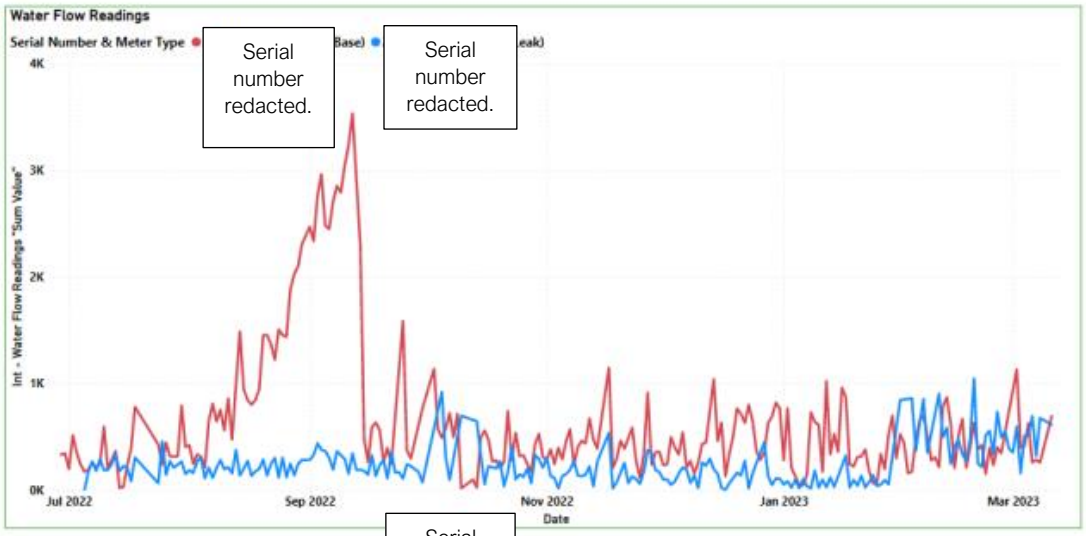
Meter Serial Number: Serial number redacted.

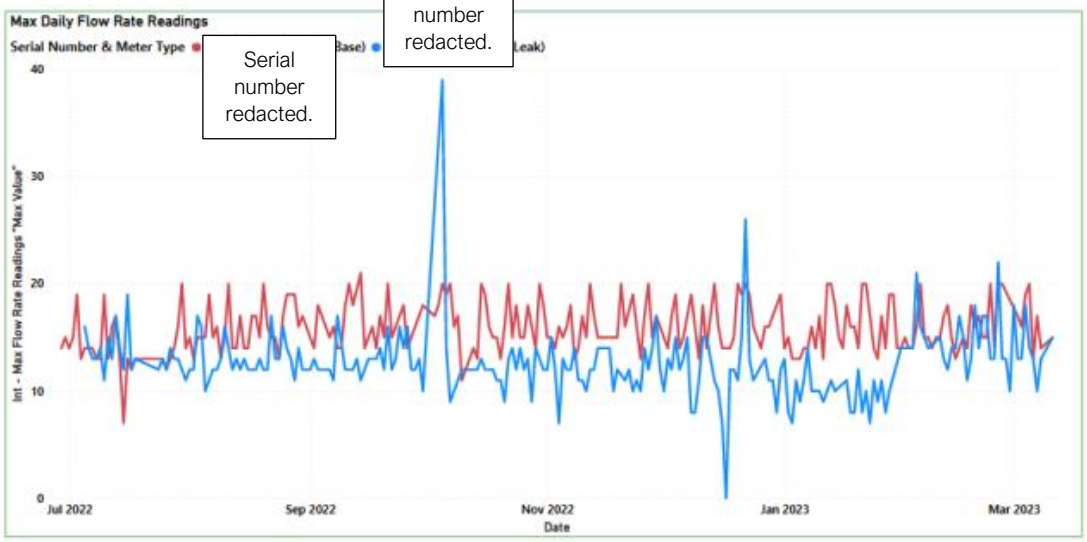
Key Observations for Meter Serial Number: Serial number redacted.

- Steady increase in water flow readings from Aug-22 to 13/9/2022 when the leak was repaired.
- The customer alarm on 4/8/22 occurred prior to the steady increase noted above, possible indication of when the leak started.

Key Findings for Meter Serial Number: Serial number redacted.

No real insights are available for this particular customer leak, aside from the increase in daily water usage observed on the water flow readings graph.



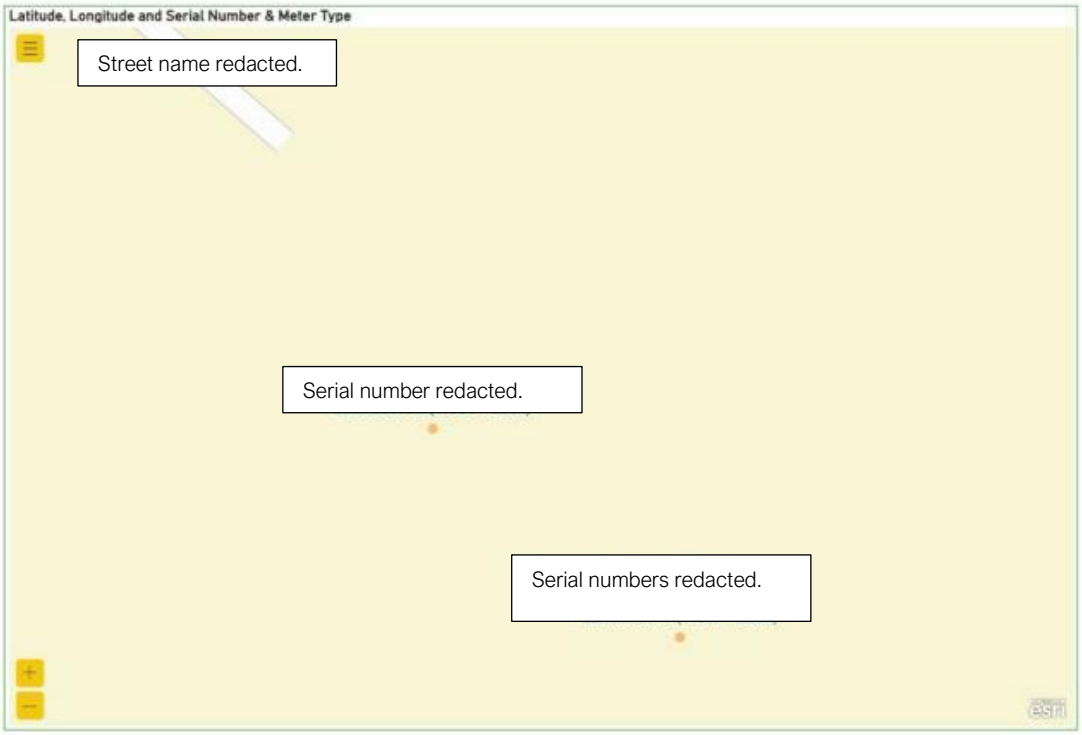


Water Meter Customer Leakage Alarm

Date	Customer Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Thursday, 4 August 2022	1	50 - Base)
Thursday, 1 September 2022	1	50 - Base)

Serial numbers redacted.

Meter Serial Number: Serial number redacted.



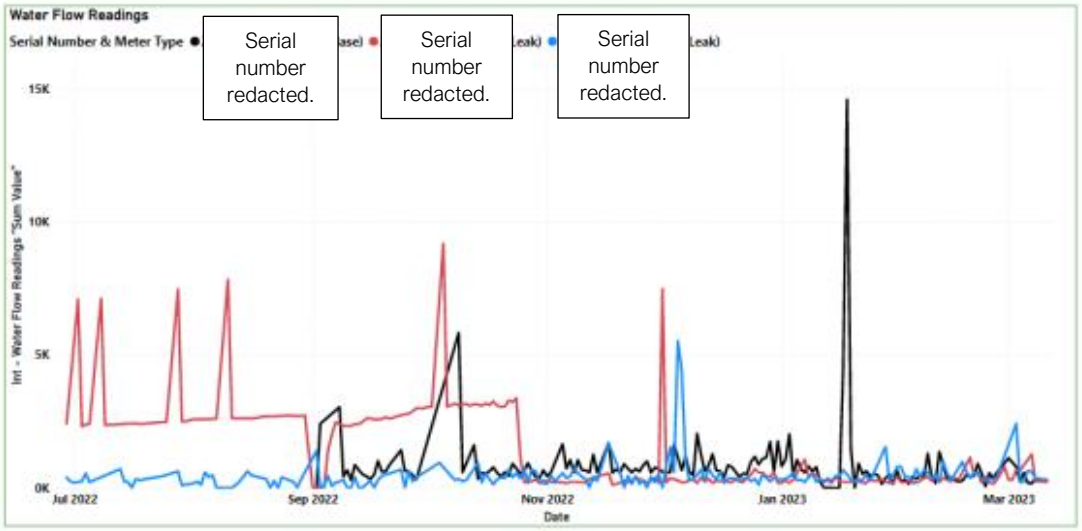
Key Observations for Meter Serial Number: Serial number redacted.

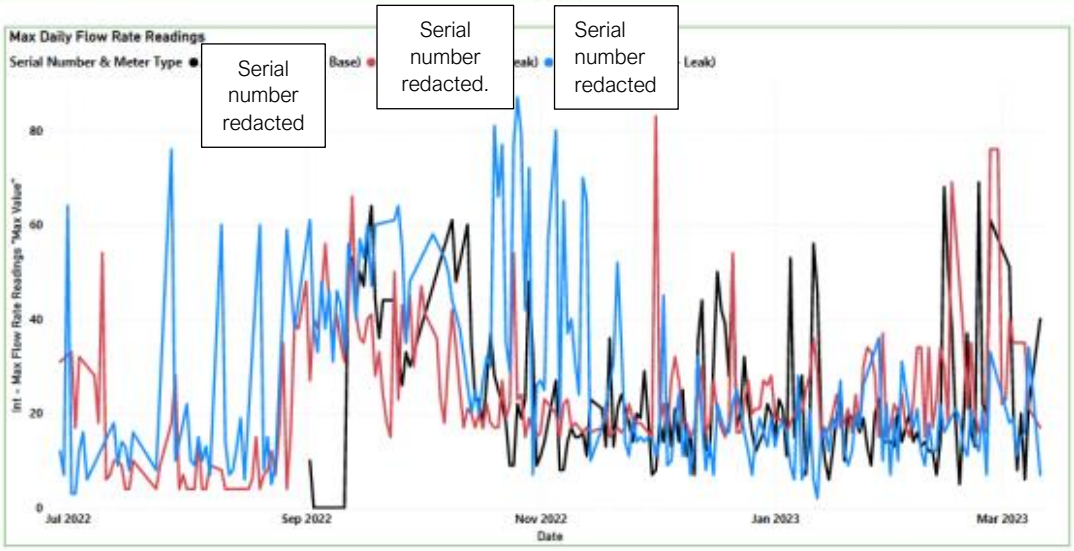
- Leak was existing when meter was installed in April 2022 and is currently around 12L/hr
- Minimal observations available given the leak existed prior to when the meter was installed, and we don't have visibility on prior usage patterns/behaviors.

Key Findings for Meter Serial Number: Serial number redacted.

No real insights are available for this particular customer leak, aside from the increase in daily water usage observed on the water flow readings graph.

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report





Water Meter Customer Leakage Alarm

Date	Customer Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Friday, 2 September 2022	1	Base)
Tuesday, 6 September 2022	1	Leak)
Thursday, 8 September 2022	1	Base)
Friday, 2 December 2022	1	Base)
Tuesday, 6 December 2022	1	Base)
Friday, 6 January 2023	1	Base)
Wednesday, 18 January 2023	1	Base)

Serial numbers redacted.

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report

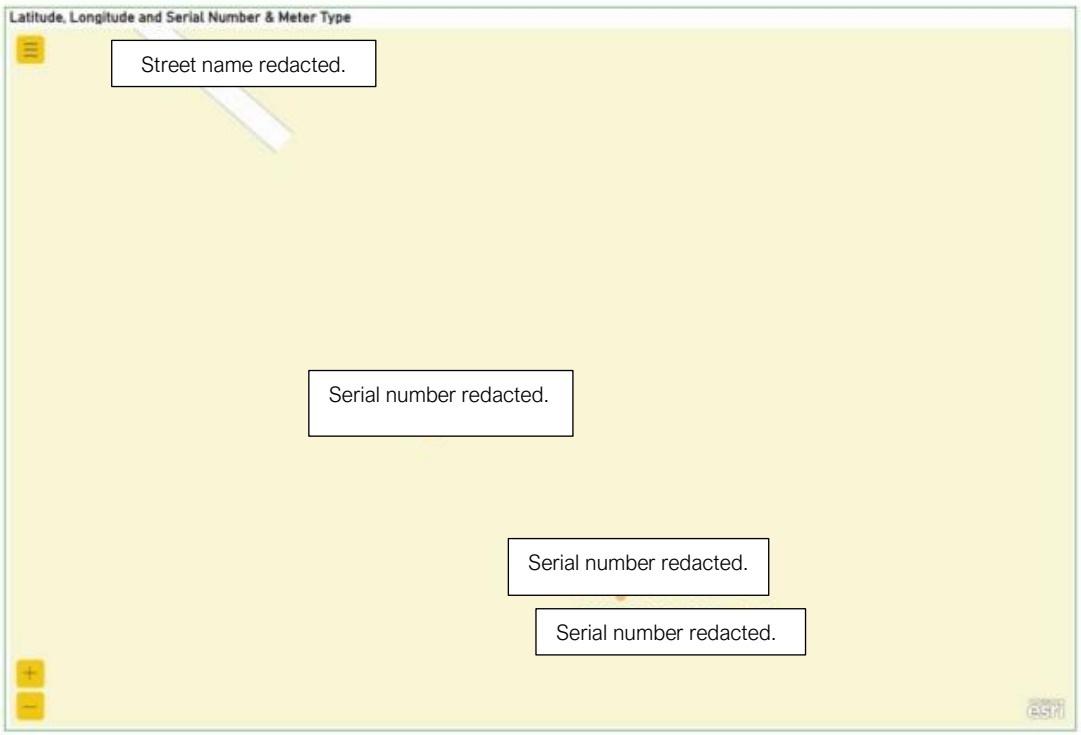
Sample Heard Scores

Date	Sample Heard Score	Serial Number & Meter Type
Saturday, 11 March 2023	8	- Leak)
Friday, 9 December 2022	7	- Leak)
Tuesday, 6 December 2022	9	- Leak)
Wednesday, 2 November 2022	6	- Leak)
Monday, 24 October 2022	9	- Leak)
Sunday, 23 October 2022	9	- Leak)
Saturday, 22 October 2022	9	- Leak)
Friday, 21 October 2022	9	- Leak)
Thursday, 20 October 2022	9	- Leak)
Wednesday, 19 October 2022	9	- Leak)
Monday, 17 October 2022	9	- Leak)
Sunday, 16 October 2022	9	- Leak)
Saturday, 15 October 2022	9	- Leak)
Friday, 14 October 2022	9	- Leak)
Thursday, 13 October 2022	9	- Leak)
Tuesday, 11 October 2022	9	- Leak)
Monday, 10 October 2022	9	- Leak)
Saturday, 8 October 2022	9	- Leak)
Friday, 7 October 2022	9	- Leak)
Wednesday, 5 October 2022	9	- Leak)
Sunday, 2 October 2022	9	- Leak)
Saturday, 1 October 2022	9	- Leak)
Thursday, 29 September 2022	9	- Leak)
Wednesday, 28 September 2022	9	- Leak)
Tuesday, 27 September 2022	9	- Leak)
Sunday, 25 September 2022	9	- Leak)
Saturday, 24 September 2022	9	- Leak)
Friday, 23 September 2022	9	- Leak)
Thursday, 22 September 2022	9	- Leak)
Wednesday, 21 September 2022	9	- Leak)
Monday, 19 September 2022	9	- Leak)
Sunday, 18 September 2022	9	- Leak)
Friday, 16 September 2022	9	- Leak)
Thursday, 15 September 2022	9	- Leak)
Tuesday, 13 September 2022	9	- Leak)
Sunday, 11 September 2022	9	- Leak)
Saturday, 10 September 2022	9	- Leak)
Friday, 9 September 2022	9	- Leak)
Wednesday, 7 September 2022	9	- Leak)
Monday, 5 September 2022	9	- Leak)
Tuesday, 30 August 2022	9	- Leak)
Monday, 29 August 2022	9	- Leak)
Sunday, 28 August 2022	9	- Leak)
Saturday, 27 August 2022	9	- Leak)
Friday, 26 August 2022	9	- Leak)
Wednesday, 24 August 2022	9	- Leak)
Monday, 22 August 2022	9	- Leak)
Sunday, 21 August 2022	9	- Leak)
Saturday, 20 August 2022	9	- Leak)

Serial numbers redacted.

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report

Meter Serial Number: Serial number redacted.

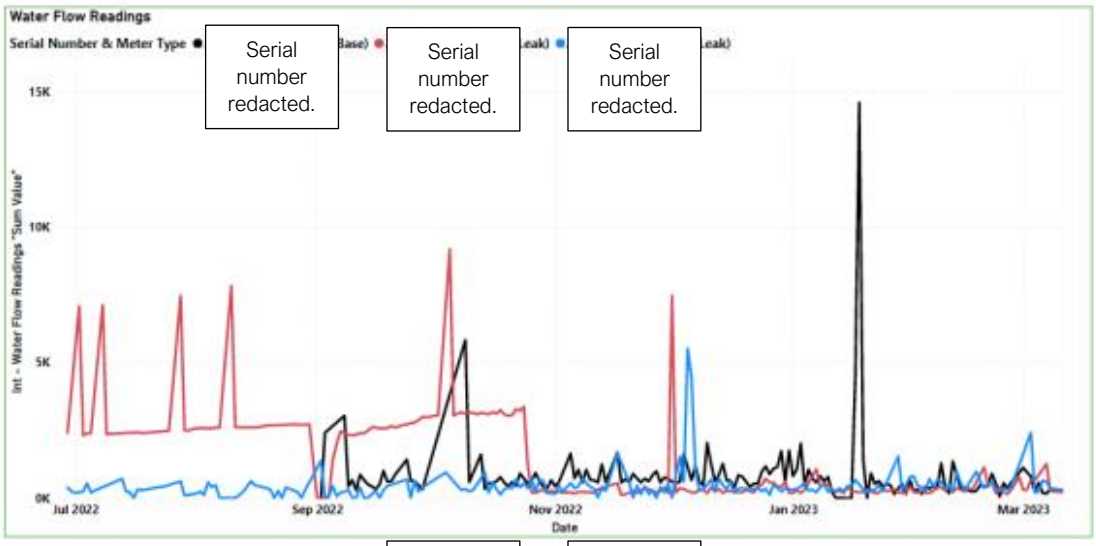


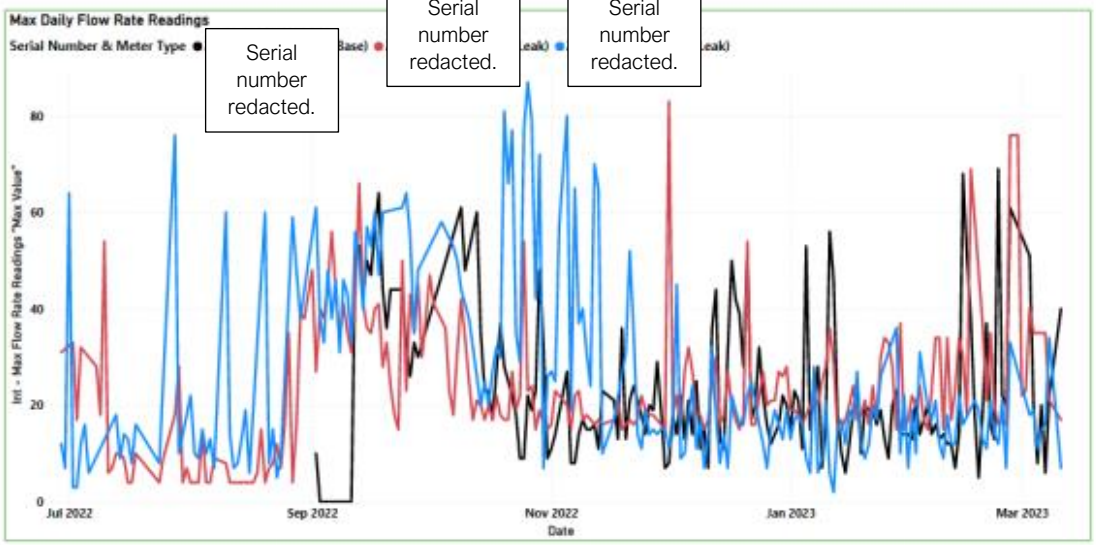
Key Observations for Meter Serial Number: Serial number redacted.

- Leak was existing when meter was installed in mid-June 2022 and was repaired 25/10/2022, was about 120L/hr
- Minimal observations available given the leak existed prior to the meter was installed and we don't have visibility on prior usage patterns/behaviors.

Key Findings for Meter Serial Number: Serial number redacted.

No real insights are available for this particular customer leak, aside from the increase in daily water usage observed on the water flow readings graph.





Water Meter Customer Leakage Alarm

Date	Customer Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Friday, 2 September 2022	1	- Base)
Tuesday, 6 September 2022	1	- Leak)
Thursday, 8 September 2022	1	- Base)
Friday, 2 December 2022	1	- Base)
Tuesday, 6 December 2022	1	- Base)
Friday, 6 January 2023	1	- Base)
Wednesday, 18 January 2023	1	- Base)

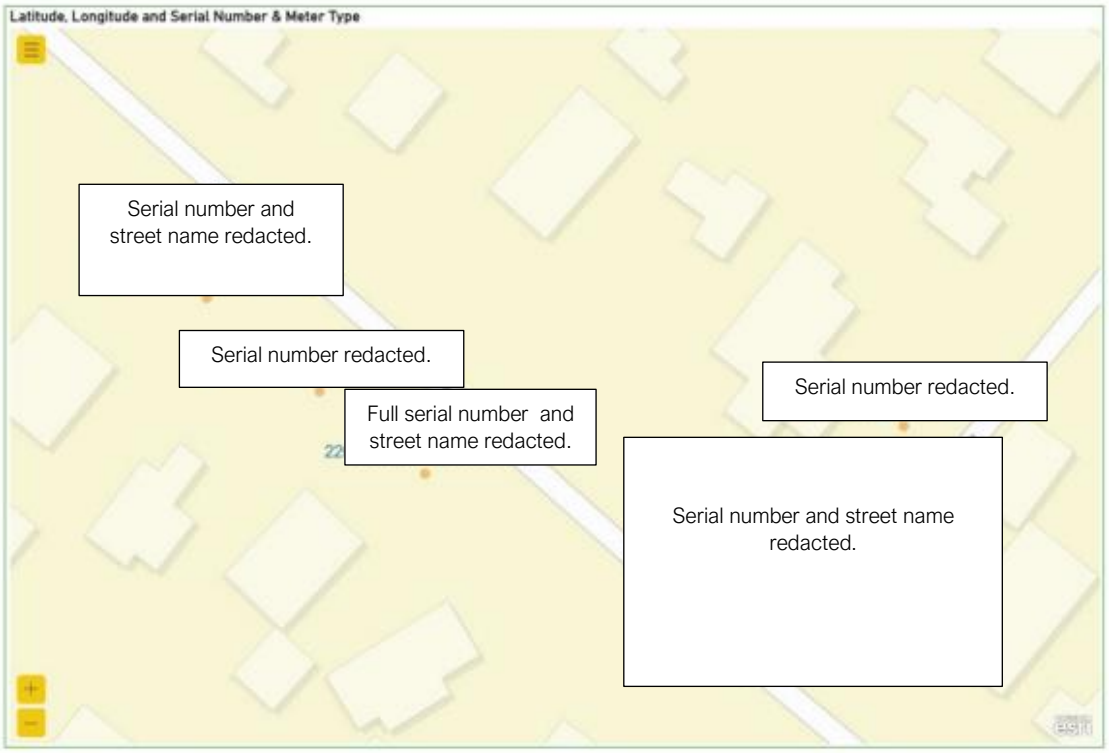
Serial numbers redacted.

Sample Heard Scores

Date	Sample Heard Score	Serial Number & Meter Type
Saturday, 11 March 2023	8	- Leak)
Friday, 9 December 2022	7	- Leak)
Tuesday, 6 December 2022	9	- Leak)
Wednesday, 2 November 2022	6	- Leak)
Monday, 24 October 2022	9	- Leak)
Sunday, 23 October 2022	9	- Leak)
Saturday, 22 October 2022	9	- Leak)
Friday, 21 October 2022	9	- Leak)
Thursday, 20 October 2022	9	- Leak)
Wednesday, 19 October 2022	9	- Leak)
Monday, 17 October 2022	9	- Leak)
Sunday, 16 October 2022	9	- Leak)
Saturday, 15 October 2022	9	- Leak)
Friday, 14 October 2022	9	- Leak)
Thursday, 13 October 2022	9	- Leak)
Tuesday, 11 October 2022	9	- Leak)
Monday, 10 October 2022	9	- Leak)
Saturday, 8 October 2022	9	- Leak)
Friday, 7 October 2022	9	- Leak)
Wednesday, 5 October 2022	9	- Leak)
Sunday, 2 October 2022	9	- Leak)
Saturday, 1 October 2022	9	- Leak)
Thursday, 29 September 2022	9	- Leak)
Wednesday, 28 September 2022	9	- Leak)
Tuesday, 27 September 2022	9	- Leak)
Sunday, 25 September 2022	9	- Leak)
Saturday, 24 September 2022	9	- Leak)
Friday, 23 September 2022	9	- Leak)
Thursday, 22 September 2022	9	- Leak)
Wednesday, 21 September 2022	9	- Leak)
Monday, 19 September 2022	9	- Leak)
Sunday, 18 September 2022	9	- Leak)
Friday, 16 September 2022	9	- Leak)
Thursday, 15 September 2022	9	- Leak)
Tuesday, 13 September 2022	9	- Leak)
Sunday, 11 September 2022	9	- Leak)
Saturday, 10 September 2022	9	- Leak)
Friday, 9 September 2022	9	- Leak)
Wednesday, 7 September 2022	9	- Leak)
Monday, 5 September 2022	9	- Leak)
Tuesday, 30 August 2022	9	- Leak)
Monday, 29 August 2022	9	- Leak)
Sunday, 28 August 2022	9	- Leak)
Saturday, 27 August 2022	9	- Leak)
Friday, 26 August 2022	9	- Leak)
Wednesday, 24 August 2022	9	- Leak)
Monday, 22 August 2022	9	- Leak)
Sunday, 21 August 2022	9	- Leak)
Saturday, 20 August 2022	9	- Leak)

Serial numbers redacted.

Meter Serial Number: Serial number redacted.



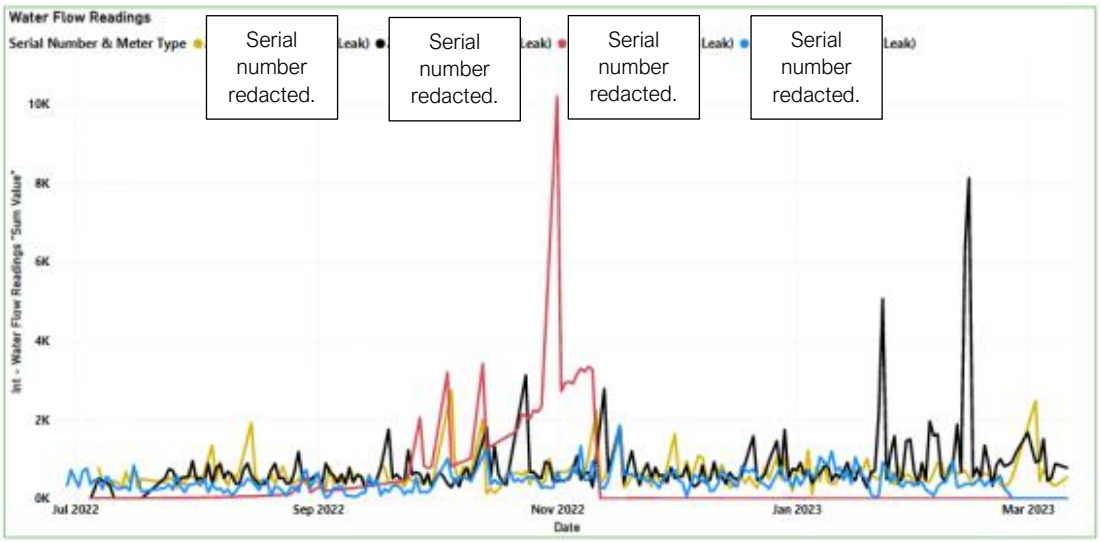
Key Observations for Meter Serial Number: Serial number redacted.

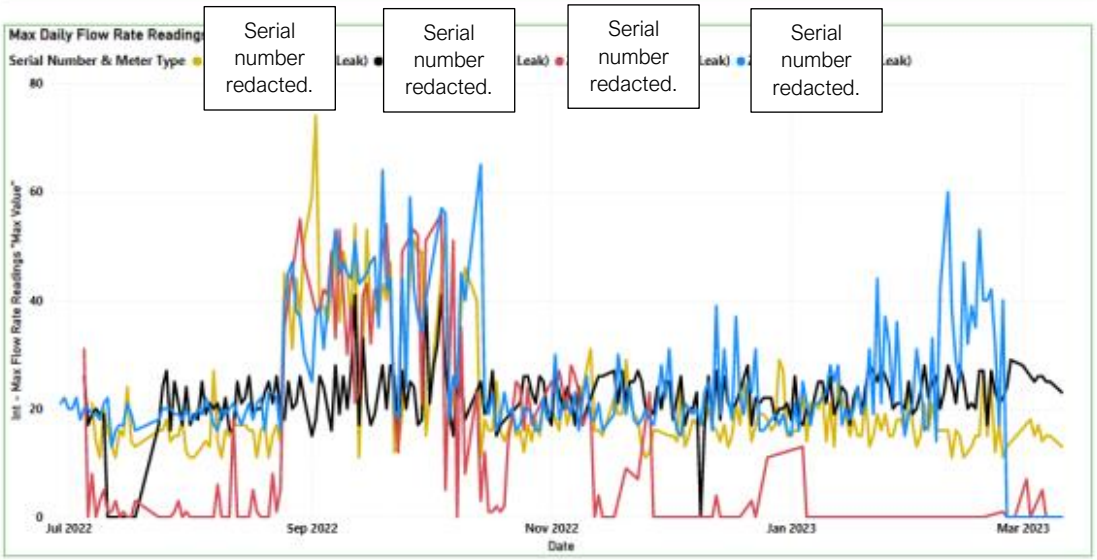
- Leak started mid-August very small but has increased to around 100L/hr
- Several network alarm events throughout Aug & Sep 22
- Repeated sample heard scores of 9 throughout early Sep-22

Key Findings for Meter Serial Number: Serial number redacted.

Primary findings for this meter include the steady increase in both daily water usage through to when the customer leak was repaired in Oct-22. What is of note in the case of this meter are the network leak alarms and high sample heard scores observed on these meters. The high sample heard scores being recorded in Oct & Nov 22 on multiple meters indicate there is potentially a network leak present in the area, likely closer to [redacted] St. It is interesting that we are getting high sample heard scores after the time these customer leaks should have been repaired, further supporting the idea of a network leak being present in this area. This also supports the case to deploy more smart water meters with leak detection capabilities to get greater visibility in the area, particularly on Horton Street.

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report





Water Meter Customer Leakage Alarm

Date	Customer Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Thursday, 22 September 2022	1	- Leak)
Wednesday, 28 September 2022	1	- Leak)
Thursday, 13 October 2022	1	- Leak)

Serial numbers redacted.

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report

Wellington Water

Sample Heard Scores

Date	Sample Heard Score	Serial Number & Meter Type
Tuesday, 21 February 2023	8	eak)
Saturday, 18 February 2023	9	eak)
Thursday, 16 February 2023	9	eak)
Thursday, 16 February 2023	9	eak)
Wednesday, 15 February 2023	9	eak)
Wednesday, 15 February 2023	6	eak)
Tuesday, 14 February 2023	9	eak)
Tuesday, 14 February 2023	9	eak)
Monday, 13 February 2023	7	eak)
Saturday, 11 February 2023	9	eak)
Thursday, 9 February 2023	9	eak)
Wednesday, 8 February 2023	9	eak)
Tuesday, 7 February 2023	9	eak)
Monday, 6 February 2023	9	eak)
Saturday, 4 February 2023	7	eak)
Thursday, 26 January 2023	6	eak)
Tuesday, 24 January 2023	9	eak)
Sunday, 22 January 2023	9	eak)
Saturday, 21 January 2023	9	eak)
Friday, 20 January 2023	9	eak)
Thursday, 19 January 2023	9	eak)
Tuesday, 17 January 2023	9	eak)
Sunday, 15 January 2023	9	eak)
Thursday, 5 January 2023	9	eak)
Tuesday, 3 January 2023	9	eak)
Sunday, 1 January 2023	9	eak)
Saturday, 31 December 2022	9	eak)
Thursday, 29 December 2022	9	eak)
Wednesday, 28 December 2022	9	eak)
Monday, 26 December 2022	9	eak)
Friday, 16 December 2022	8	eak)
Thursday, 15 December 2022	9	eak)
Tuesday, 13 December 2022	9	eak)
Sunday, 11 December 2022	9	eak)
Saturday, 10 December 2022	9	eak)
Thursday, 8 December 2022	9	eak)
Wednesday, 7 December 2022	9	eak)
Monday, 5 December 2022	9	eak)
Sunday, 4 December 2022	9	eak)
Saturday, 3 December 2022	9	eak)
Friday, 2 December 2022	6	eak)
Friday, 2 December 2022	9	eak)
Wednesday, 30 November 2022	9	eak)
Sunday, 27 November 2022	9	eak)
Saturday, 26 November 2022	9	eak)
Sunday, 20 November 2022	9	eak)
Saturday, 19 November 2022	9	eak)
Friday, 18 November 2022	8	eak)
Thursday, 17 November 2022	9	eak)

Serial numbers redacted.

Sample Heard Scores

Date	Sample Heard Score	Serial Number & Meter Type
Friday, 11 November 2022	9	eak)
Thursday, 10 November 2022	9	eak)
Thursday, 10 November 2022	9	eak)
Wednesday, 9 November 2022	9	eak)
Wednesday, 9 November 2022	9	eak)
Tuesday, 8 November 2022	9	eak)
Tuesday, 8 November 2022	9	eak)
Tuesday, 8 November 2022	9	eak)
Monday, 7 November 2022	9	eak)
Monday, 7 November 2022	9	eak)
Monday, 7 November 2022	9	eak)
Sunday, 6 November 2022	9	eak)
Sunday, 6 November 2022	9	eak)
Sunday, 6 November 2022	9	eak)
Saturday, 5 November 2022	9	eak)
Friday, 4 November 2022	9	eak)
Friday, 4 November 2022	9	eak)
Thursday, 3 November 2022	9	eak)
Thursday, 3 November 2022	9	eak)
Wednesday, 2 November 2022	9	eak)
Tuesday, 1 November 2022	9	eak)
Tuesday, 1 November 2022	9	eak)
Friday, 28 October 2022	8	eak)
Friday, 28 October 2022	9	eak)
Thursday, 27 October 2022	9	eak)
Wednesday, 26 October 2022	9	eak)
Wednesday, 26 October 2022	9	eak)
Tuesday, 25 October 2022	9	eak)
Monday, 24 October 2022	9	eak)
Sunday, 23 October 2022	9	eak)
Saturday, 22 October 2022	9	eak)
Friday, 21 October 2022	9	eak)
Friday, 21 October 2022	9	eak)
Thursday, 20 October 2022	9	eak)
Wednesday, 19 October 2022	9	eak)
Tuesday, 18 October 2022	8	eak)
Monday, 17 October 2022	9	eak)
Sunday, 16 October 2022	9	eak)
Friday, 14 October 2022	9	eak)
Thursday, 13 October 2022	7	eak)
Thursday, 13 October 2022	9	eak)
Monday, 10 October 2022	9	eak)
Sunday, 9 October 2022	9	eak)
Saturday, 8 October 2022	9	eak)
Friday, 7 October 2022	9	eak)
Thursday, 6 October 2022	9	eak)
Wednesday, 5 October 2022	9	eak)
Tuesday, 4 October 2022	9	eak)
Thursday, 29 September 2022	9	eak)

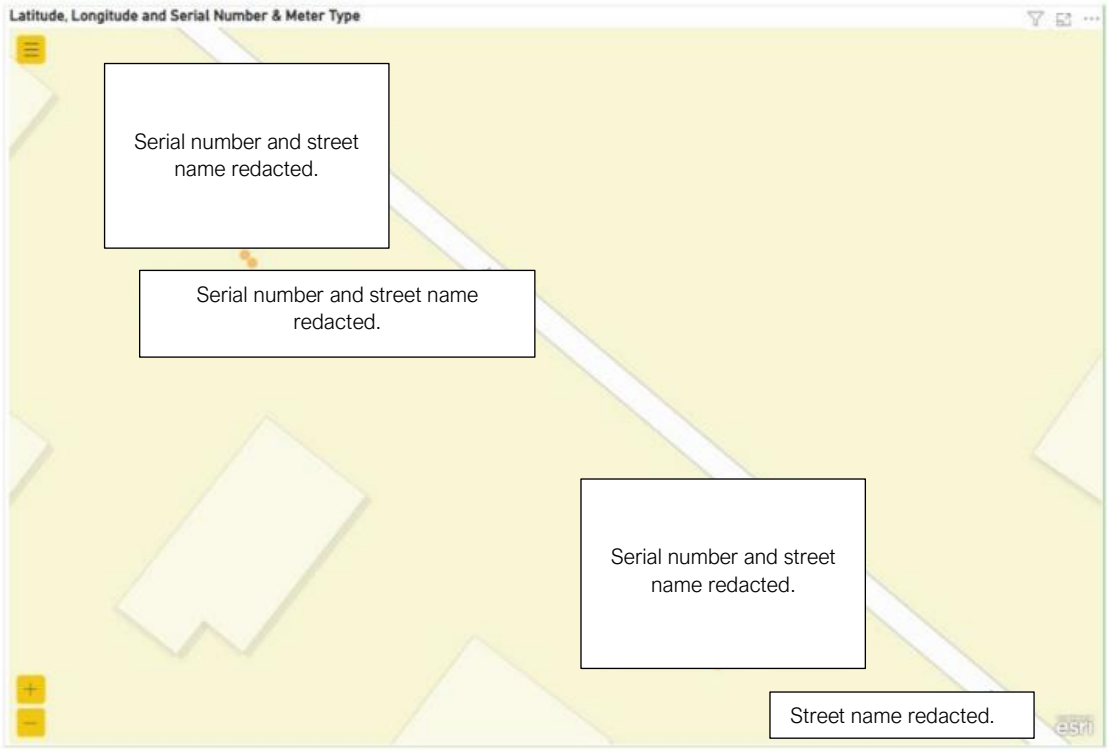
Serial numbers redacted.

Serial number redacted

Two photos of the leak at meter were provided by Wellington Water. Feedback received that the meter was removed and replaced with a mechanical meter as the service crew didn't have the correct fittings (washer/o-ring) to repair the leak. (Received via email from Wellington Water 11/11/2022).

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report

Meter Serial Number: Serial number redacted.



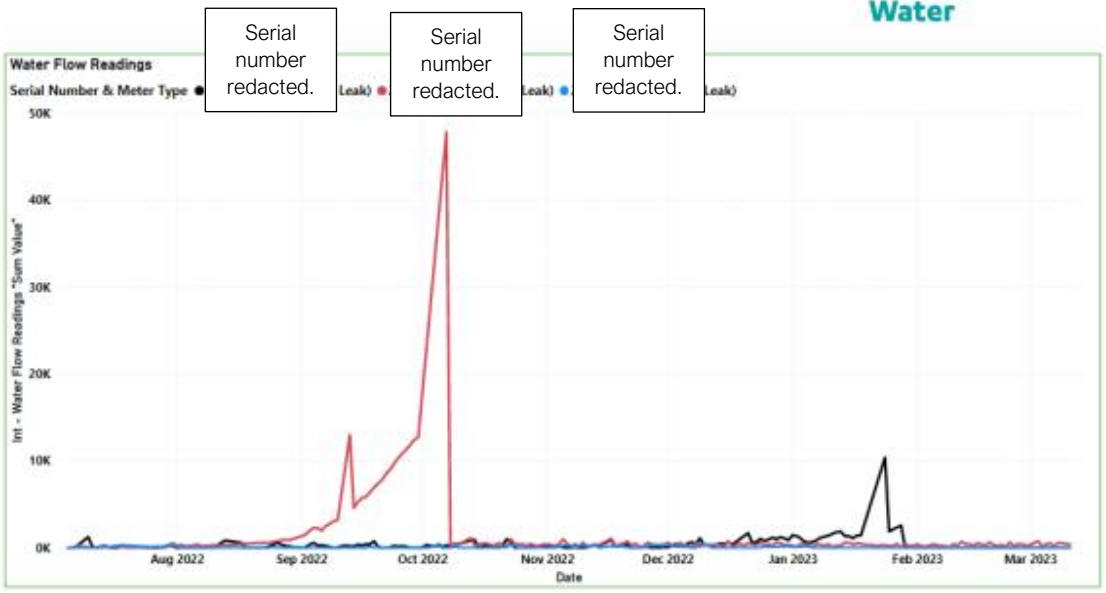
Key Observations for Meter Serial Number: Serial number redacted.

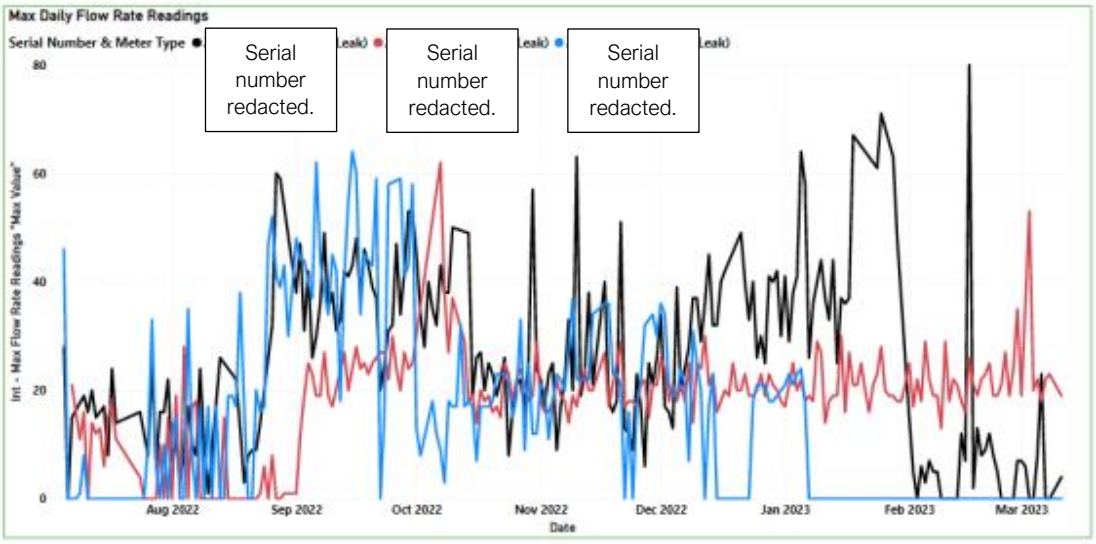
- Leak started at the end of July and was repaired 4/10/2022 when it was about 580L/hr
- Several network alarm events throughout Jul & Aug 22

Key Findings for Meter Serial Number: Serial number redacted.

No real insights are available for this particular customer leak, aside from the increase in daily water usage observed on the water flow readings graph.

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report





Water Meter Customer Leakage Alarm

Date	Customer Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Sunday, 17 July 2022	1	Leak)
Sunday, 31 July 2022	1	Leak)
Wednesday, 10 August 2022	1	Leak)
Friday, 16 September 2022	1	Leak)
Monday, 12 December 2022	1	Leak)
Saturday, 17 December 2022	1	Leak)
Wednesday, 21 December 2022	1	Leak)
Thursday, 12 January 2023	1	Leak)

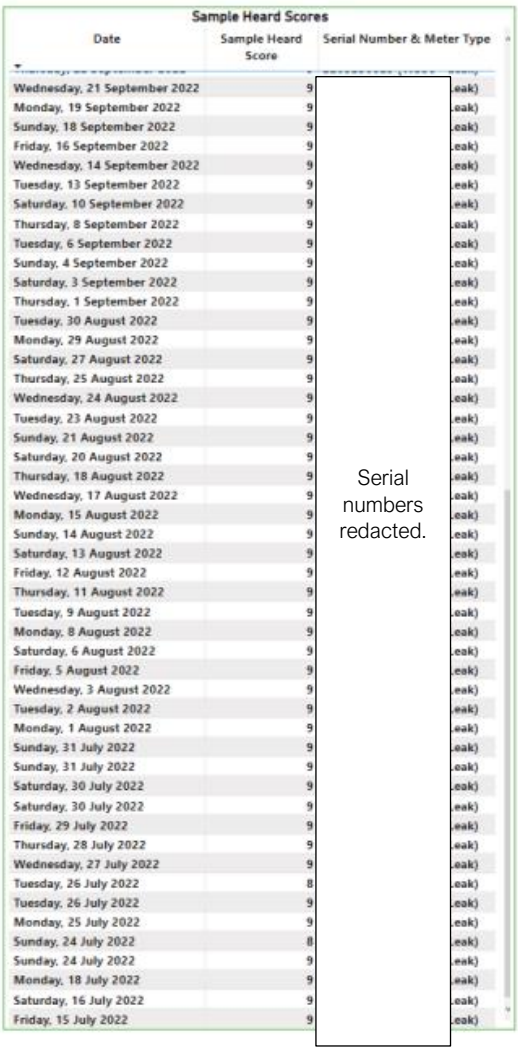
Serial numbers redacted.

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report

Sample Heard Scores

Date	Sample Heard Score	Serial Number & Meter Type
Saturday, 28 January 2023	9	eak)
Tuesday, 24 January 2023	9	eak)
Wednesday, 18 January 2023	9	eak)
Tuesday, 17 January 2023	9	eak)
Sunday, 15 January 2023	9	eak)
Friday, 13 January 2023	9	eak)
Thursday, 12 January 2023	9	eak)
Wednesday, 11 January 2023	9	eak)
Tuesday, 10 January 2023	9	eak)
Sunday, 8 January 2023	9	eak)
Saturday, 7 January 2023	9	eak)
Thursday, 5 January 2023	9	eak)
Wednesday, 4 January 2023	9	eak)
Tuesday, 3 January 2023	9	eak)
Monday, 2 January 2023	9	eak)
Saturday, 31 December 2022	9	eak)
Friday, 30 December 2022	9	eak)
Thursday, 29 December 2022	9	eak)
Tuesday, 27 December 2022	9	eak)
Sunday, 25 December 2022	9	eak)
Saturday, 24 December 2022	9	eak)
Friday, 23 December 2022	9	eak)
Wednesday, 21 December 2022	9	eak)
Saturday, 17 December 2022	9	eak)
Friday, 16 December 2022	9	eak)
Thursday, 15 December 2022	9	eak)
Tuesday, 13 December 2022	9	eak)
Monday, 12 December 2022	9	eak)
Sunday, 11 December 2022	9	eak)
Saturday, 10 December 2022	9	eak)
Friday, 9 December 2022	9	eak)
Thursday, 8 December 2022	9	eak)
Wednesday, 7 December 2022	9	eak)
Tuesday, 6 December 2022	9	eak)
Sunday, 4 December 2022	9	eak)
Friday, 7 October 2022	9	eak)
Friday, 30 September 2022	9	eak)
Thursday, 29 September 2022	9	eak)
Wednesday, 28 September 2022	9	eak)
Monday, 26 September 2022	9	eak)
Sunday, 25 September 2022	9	eak)
Friday, 23 September 2022	9	eak)
Thursday, 22 September 2022	9	eak)
Wednesday, 21 September 2022	9	eak)
Monday, 19 September 2022	9	eak)
Sunday, 18 September 2022	9	eak)
Friday, 16 September 2022	9	eak)
Wednesday, 14 September 2022	9	eak)
Tuesday, 13 September 2022	9	eak)

Serial numbers redacted.



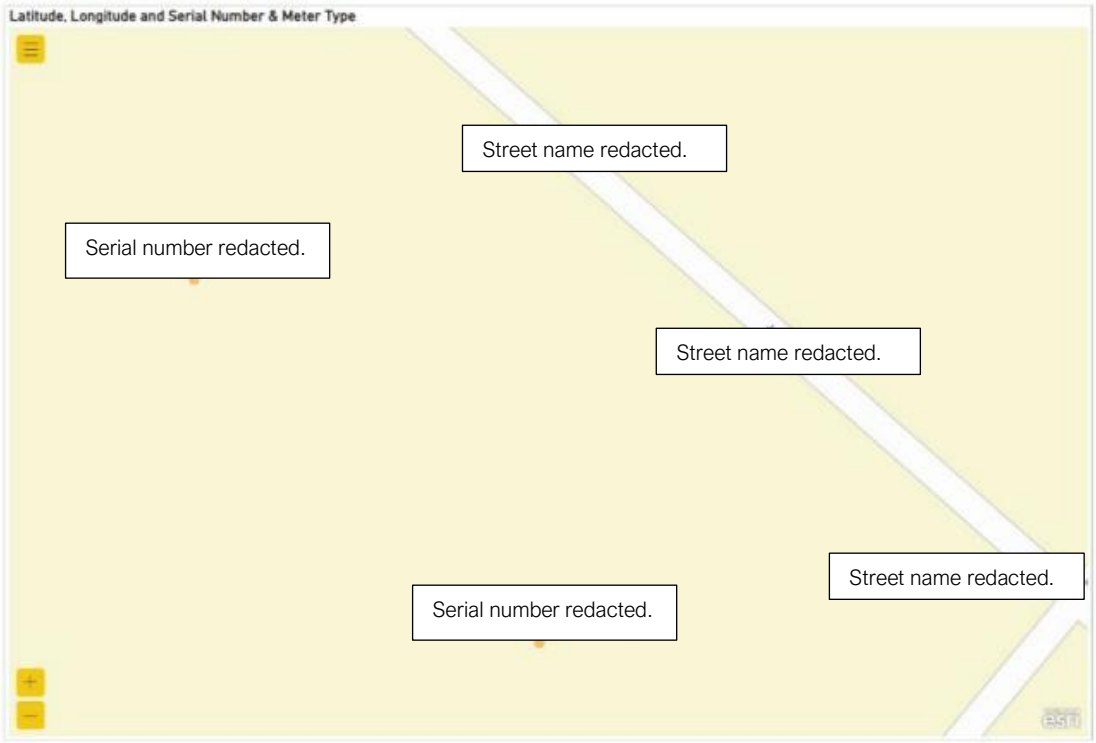
Sample Heard Scores

Date	Sample Heard Score	Serial Number & Meter Type
Wednesday, 21 September 2022	9	eak)
Monday, 19 September 2022	9	eak)
Sunday, 18 September 2022	9	eak)
Friday, 16 September 2022	9	eak)
Wednesday, 14 September 2022	9	eak)
Tuesday, 13 September 2022	9	eak)
Saturday, 10 September 2022	9	eak)
Thursday, 8 September 2022	9	eak)
Tuesday, 6 September 2022	9	eak)
Sunday, 4 September 2022	9	eak)
Saturday, 3 September 2022	9	eak)
Thursday, 1 September 2022	9	eak)
Tuesday, 30 August 2022	9	eak)
Monday, 29 August 2022	9	eak)
Saturday, 27 August 2022	9	eak)
Thursday, 25 August 2022	9	eak)
Wednesday, 24 August 2022	9	eak)
Tuesday, 23 August 2022	9	eak)
Sunday, 21 August 2022	9	eak)
Saturday, 20 August 2022	9	eak)
Thursday, 18 August 2022	9	eak)
Wednesday, 17 August 2022	9	eak)
Monday, 15 August 2022	9	eak)
Sunday, 14 August 2022	9	eak)
Saturday, 13 August 2022	9	eak)
Friday, 12 August 2022	9	eak)
Thursday, 11 August 2022	9	eak)
Tuesday, 9 August 2022	9	eak)
Monday, 8 August 2022	9	eak)
Saturday, 6 August 2022	9	eak)
Friday, 5 August 2022	9	eak)
Wednesday, 3 August 2022	9	eak)
Tuesday, 2 August 2022	9	eak)
Monday, 1 August 2022	9	eak)
Sunday, 31 July 2022	9	eak)
Sunday, 31 July 2022	9	eak)
Saturday, 30 July 2022	9	eak)
Saturday, 30 July 2022	9	eak)
Friday, 29 July 2022	9	eak)
Thursday, 28 July 2022	9	eak)
Wednesday, 27 July 2022	9	eak)
Tuesday, 26 July 2022	8	eak)
Tuesday, 26 July 2022	9	eak)
Monday, 25 July 2022	9	eak)
Sunday, 24 July 2022	8	eak)
Sunday, 24 July 2022	9	eak)
Monday, 18 July 2022	9	eak)
Saturday, 16 July 2022	9	eak)
Friday, 15 July 2022	9	eak)

Serial numbers redacted.

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report

Meter Serial Number: Serial number redacted.

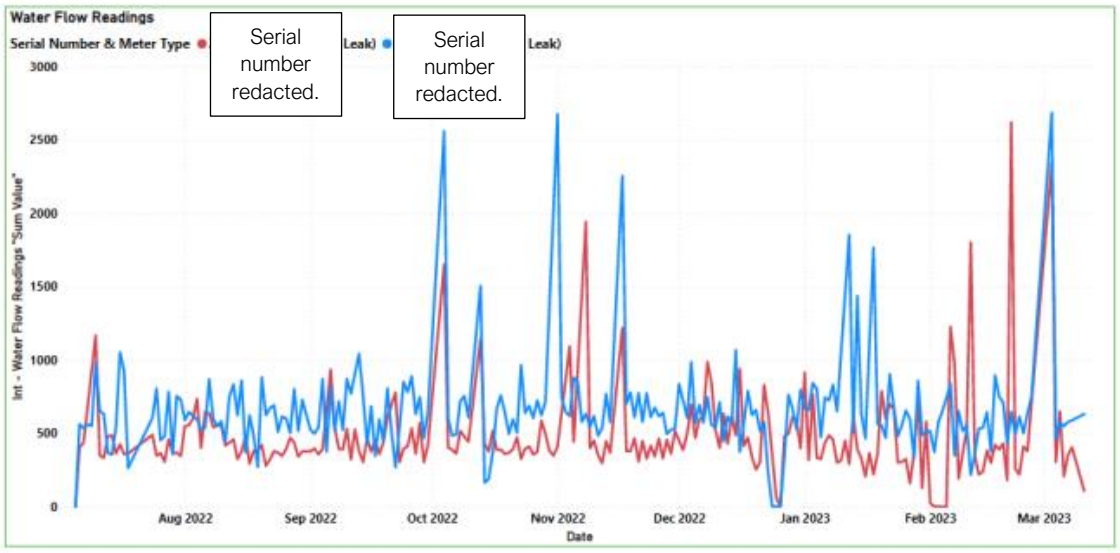


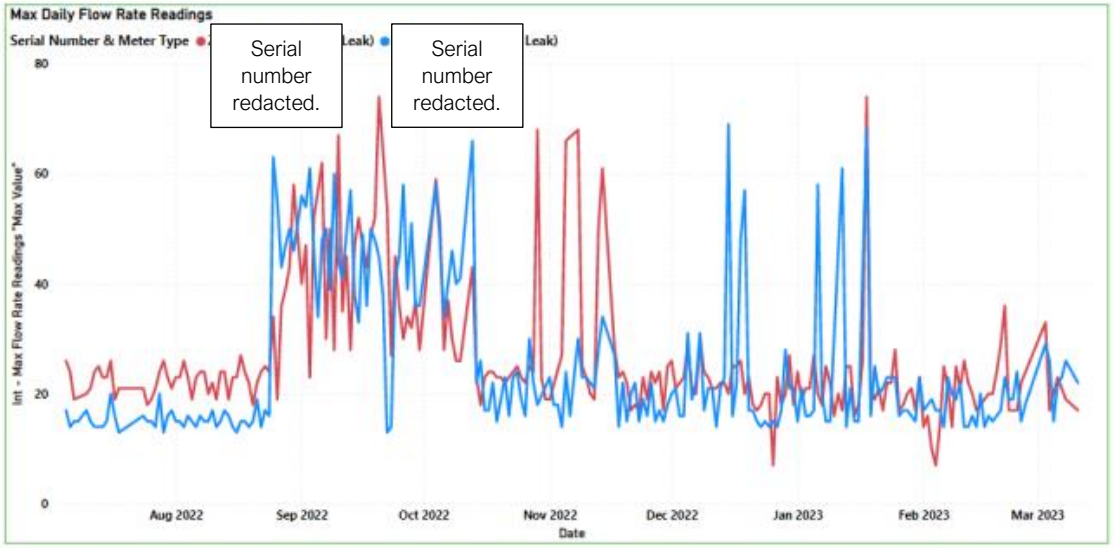
Key Observations for Meter Serial Number: Serial number redacted.

- Very small leak started 24/10/2022 and is around 6L/hr
- Unusual increase in max flow rates in,Sep/Oct 22.
- Several network alarm events throughout Aug & Sep 22

Key Findings for Meter Serial Number: Serial number redacted.

No real insights are available for this particular customer leak, aside from the increase in daily water observed on the below graphs.





Water Meter Customer Leakage Alarm

Date	Customer Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Saturday, 29 October 2022	1	- Leak)
Thursday, 17 November 2022	1	- Leak)

Serial numbers redacted.

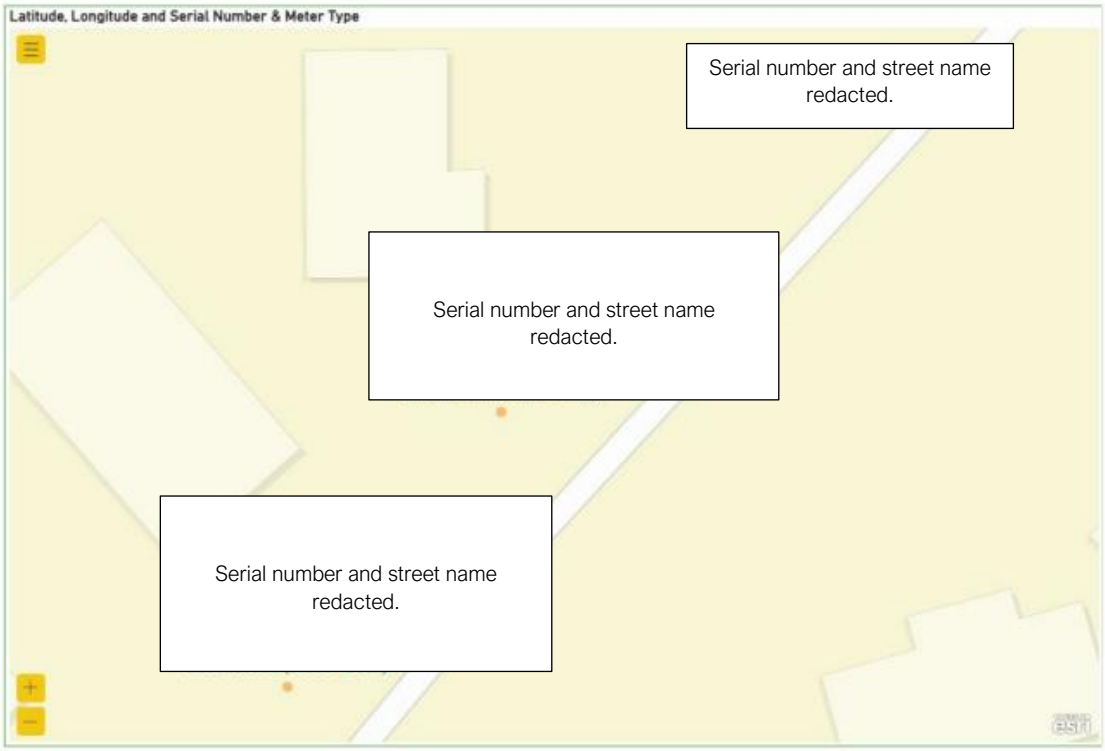
Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report

Sample Heard Scores

Date	Sample Heard Score	Serial Number & Meter Type
Thursday, 8 December 2022	9	- Leak)
Friday, 18 November 2022	9	- Leak)
Thursday, 17 November 2022	9	- Leak)
Thursday, 3 November 2022	9	- Leak)
Tuesday, 1 November 2022	9	- Leak)
Saturday, 29 October 2022	9	- Leak)
Friday, 28 October 2022	6	- Leak)
Monday, 24 October 2022	7	- Leak)

Serial numbers redacted.

Meter Serial Number: Serial number redacted.

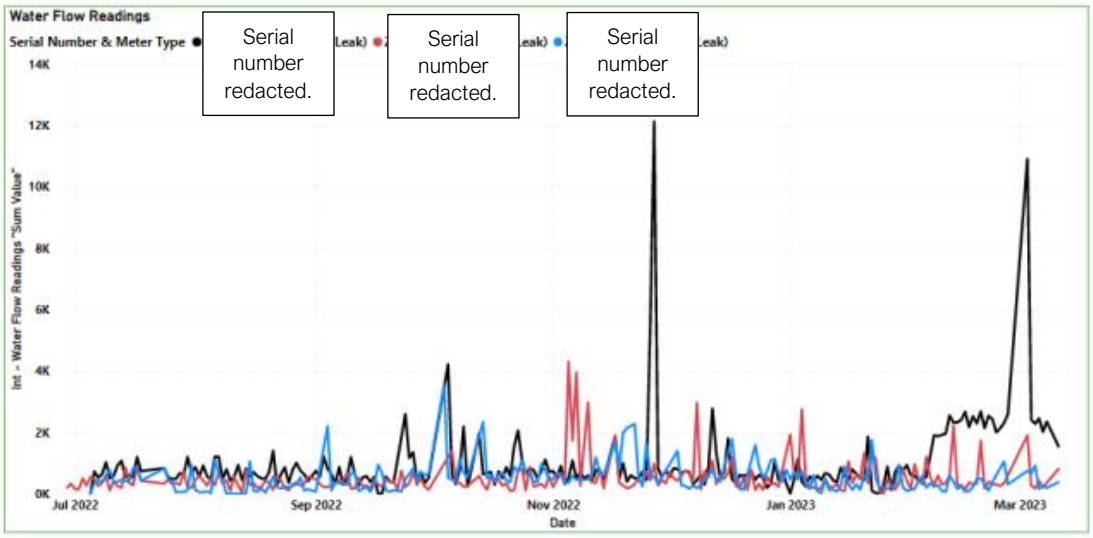


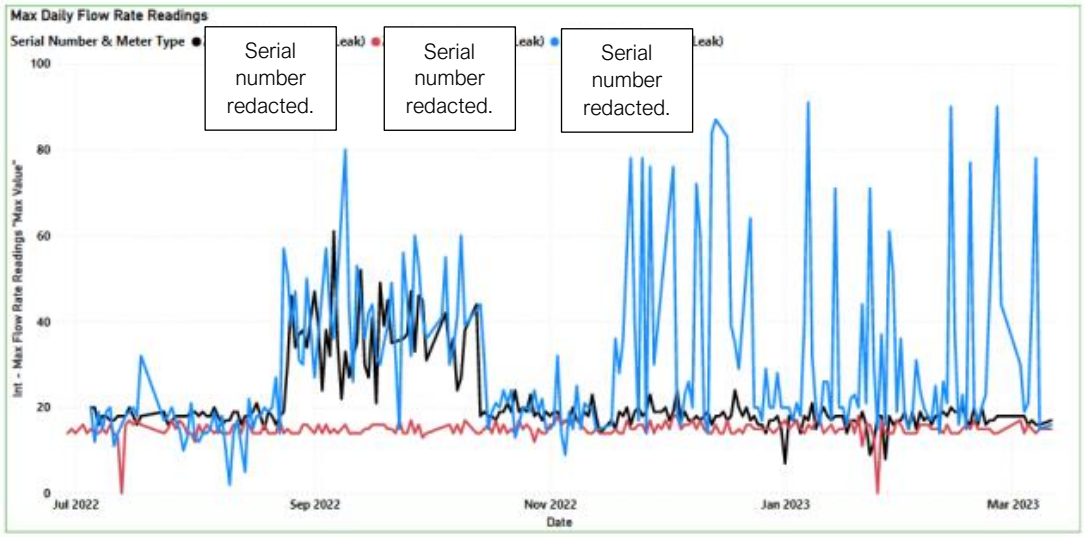
Key Observations for Meter Serial Number: Serial number redacted.

- Very small leak started 24/09/2022 and is around 12L/hr
- Highly irregular usage patterns observed on both the water flow readings and max flow rates.
- Another network leak alarm on 28/9/22, with a spike in AUC value on 29/9/22.

Key Findings for Meter Serial Number: Serial number redacted.

High sample heard scores of 9 on the 2 meters located near this customer leak indicate they are either picking up on the customer leak occurring up the road or potentially a network leak exists in the area. Roll out of additional smart water meters with leak detection capabilities to get greater visibility in the area.


Water Flow Readings
Serial Number & Meter Type
Serial number redacted.
Serial number redacted.
Serial number redacted.
Int - Water Flow Readings "Sum Value"
14K
12K
10K
8K
6K
4K
2K
0K
Jul 2022
Sep 2022
Nov 2022
Jan 2023
Mar 2023
Date


Max Daily Flow Rate Readings
Serial Number & Meter Type
Serial number redacted.
Serial number redacted.
Serial number redacted.
Int - Max Flow Rate Readings "Max Value"
100
80
60
40
20
0
Jul 2022
Sep 2022
Nov 2022
Jan 2023
Mar 2023
Date

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report

Water Meter Customer Leakage Alarm

Date	Customer Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Tuesday, 5 July 2022	1	Leak)
Wednesday, 13 July 2022	1	Leak)
Monday, 26 September 2022	1	Leak)
Thursday, 20 October 2022	1	Leak)
Sunday, 30 October 2022	1	Leak)
Monday, 7 November 2022	1	Leak)
Monday, 6 February 2023	1	Leak)
Wednesday, 22 February 2023	1	Leak)
Friday, 3 March 2023	1	Leak)
Sunday, 5 March 2023	1	Leak)

Serial numbers redacted.

Sample Heard Scores

Date	Sample Heard Score	Serial Number & Meter Type
Wednesday, 8 February 2023	9	eak)
Monday, 6 February 2023	9	eak)
Sunday, 5 February 2023	9	eak)
Saturday, 4 February 2023	9	eak)
Saturday, 4 February 2023	9	eak)
Friday, 3 February 2023	8	eak)
Wednesday, 1 February 2023	9	eak)
Tuesday, 31 January 2023	9	eak)
Monday, 30 January 2023	9	eak)
Saturday, 28 January 2023	9	eak)
Friday, 27 January 2023	9	eak)
Tuesday, 24 January 2023	8	eak)
Sunday, 22 January 2023	9	eak)
Saturday, 21 January 2023	9	eak)
Friday, 20 January 2023	9	eak)
Thursday, 19 January 2023	9	eak)
Wednesday, 18 January 2023	9	eak)
Wednesday, 4 January 2023	9	eak)
Monday, 2 January 2023	9	eak)
Wednesday, 28 December 2022	9	eak)
Friday, 23 December 2022	9	eak)
Sunday, 18 December 2022	8	eak)
Sunday, 18 December 2022	9	eak)
Saturday, 17 December 2022	9	eak)
Friday, 16 December 2022	9	eak)
Friday, 16 December 2022	9	eak)
Thursday, 15 December 2022	9	eak)
Wednesday, 14 December 2022	9	eak)
Sunday, 11 December 2022	9	eak)
Saturday, 3 December 2022	9	eak)
Tuesday, 22 November 2022	9	eak)
Saturday, 19 November 2022	9	eak)
Friday, 18 November 2022	9	eak)
Thursday, 17 November 2022	6	eak)
Thursday, 17 November 2022	9	eak)
Sunday, 13 November 2022	9	eak)
Saturday, 12 November 2022	9	eak)
Friday, 11 November 2022	9	eak)
Thursday, 10 November 2022	9	eak)
Wednesday, 9 November 2022	9	eak)
Monday, 7 November 2022	9	eak)
Sunday, 6 November 2022	9	eak)
Saturday, 5 November 2022	9	eak)
Saturday, 5 November 2022	9	eak)
Friday, 4 November 2022	9	eak)
Wednesday, 2 November 2022	9	eak)
Tuesday, 1 November 2022	9	eak)
Monday, 31 October 2022	9	eak)
Sunday, 30 October 2022	9	eak)

Serial numbers redacted.

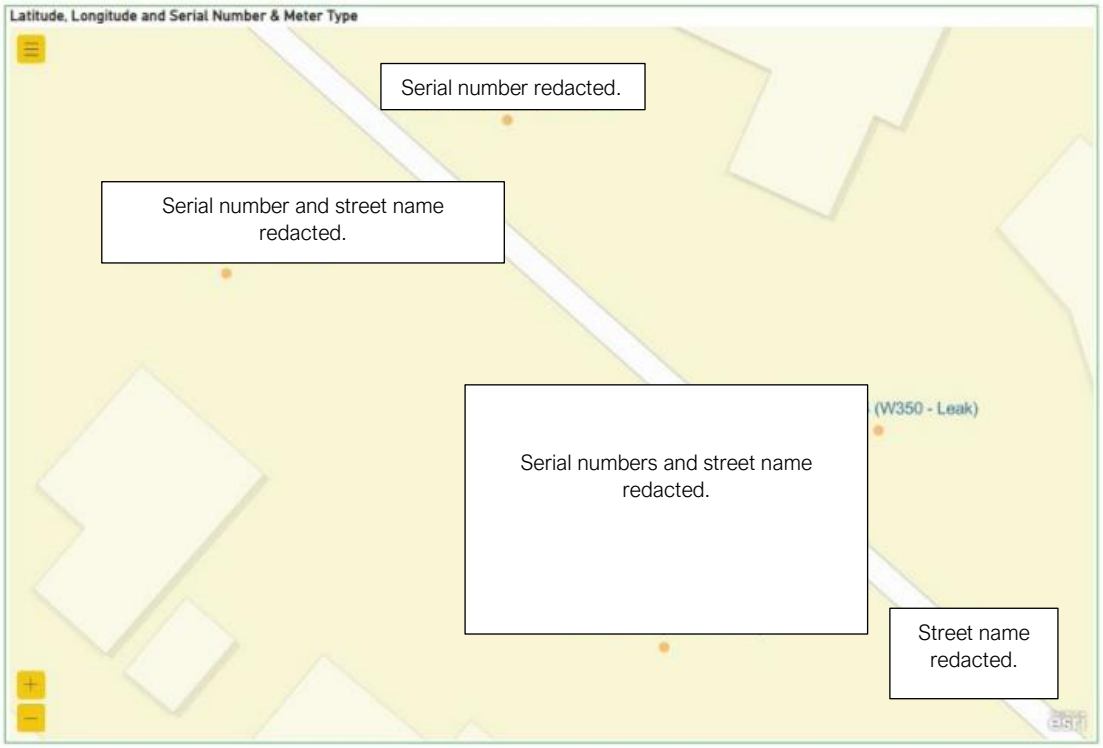
Sample Heard Scores

Date	Sample Heard Score	Serial Number & Meter Type
Thursday, 20 October 2022	9	eak)
Tuesday, 18 October 2022	9	eak)
Monday, 17 October 2022	9	eak)
Sunday, 16 October 2022	9	eak)
Saturday, 15 October 2022	9	eak)
Friday, 14 October 2022	9	eak)
Monday, 10 October 2022	9	eak)
Sunday, 9 October 2022	9	eak)
Saturday, 8 October 2022	9	eak)
Friday, 7 October 2022	9	eak)
Wednesday, 5 October 2022	9	eak)
Tuesday, 4 October 2022	9	eak)
Friday, 30 September 2022	9	eak)
Wednesday, 28 September 2022	9	eak)
Tuesday, 27 September 2022	9	eak)
Tuesday, 27 September 2022	9	eak)
Monday, 26 September 2022	9	eak)
Sunday, 25 September 2022	9	eak)
Saturday, 24 September 2022	9	eak)
Saturday, 24 September 2022	9	eak)
Monday, 19 September 2022	9	eak)
Friday, 9 September 2022	9	eak)
Wednesday, 7 September 2022	9	eak)
Sunday, 4 September 2022	9	eak)
Friday, 2 September 2022	9	eak)
Saturday, 27 August 2022	9	eak)
Friday, 26 August 2022	9	eak)
Tuesday, 26 July 2022	9	eak)
Monday, 25 July 2022	9	eak)
Sunday, 24 July 2022	9	eak)
Sunday, 24 July 2022	9	eak)
Monday, 18 July 2022	9	eak)
Sunday, 17 July 2022	9	eak)
Friday, 15 July 2022	9	eak)
Thursday, 14 July 2022	9	eak)
Wednesday, 13 July 2022	9	eak)
Wednesday, 13 July 2022	9	eak)
Tuesday, 12 July 2022	9	eak)
Tuesday, 12 July 2022	9	eak)
Monday, 11 July 2022	9	eak)
Sunday, 10 July 2022	9	eak)
Saturday, 9 July 2022	9	eak)
Friday, 8 July 2022	9	eak)
Friday, 8 July 2022	9	eak)
Thursday, 7 July 2022	9	eak)
Wednesday, 6 July 2022	9	eak)
Tuesday, 5 July 2022	9	eak)
Tuesday, 5 July 2022	9	eak)

Serial numbers redacted.

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report

Meter Serial Number: Serial number redacted.

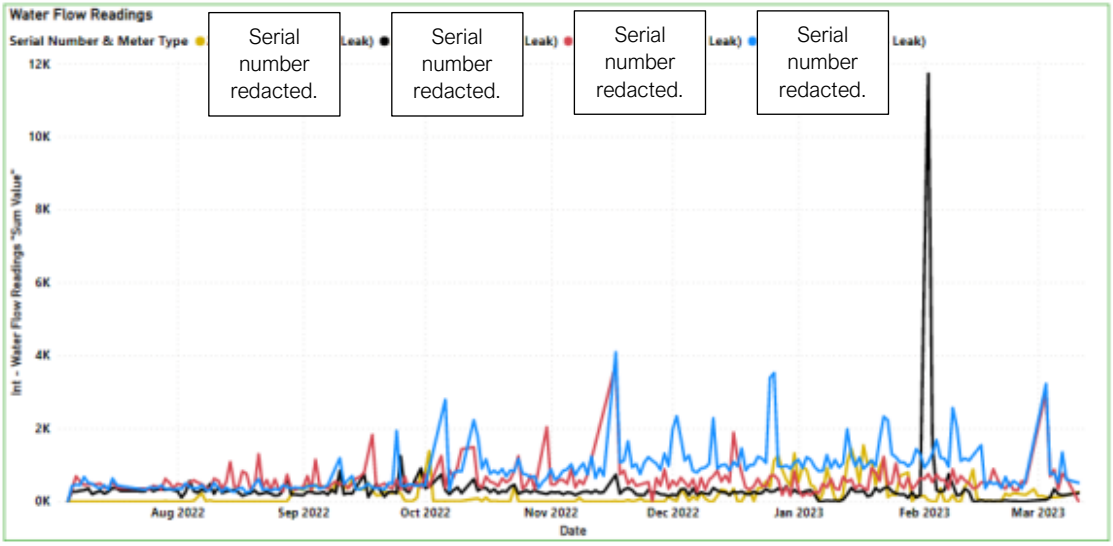


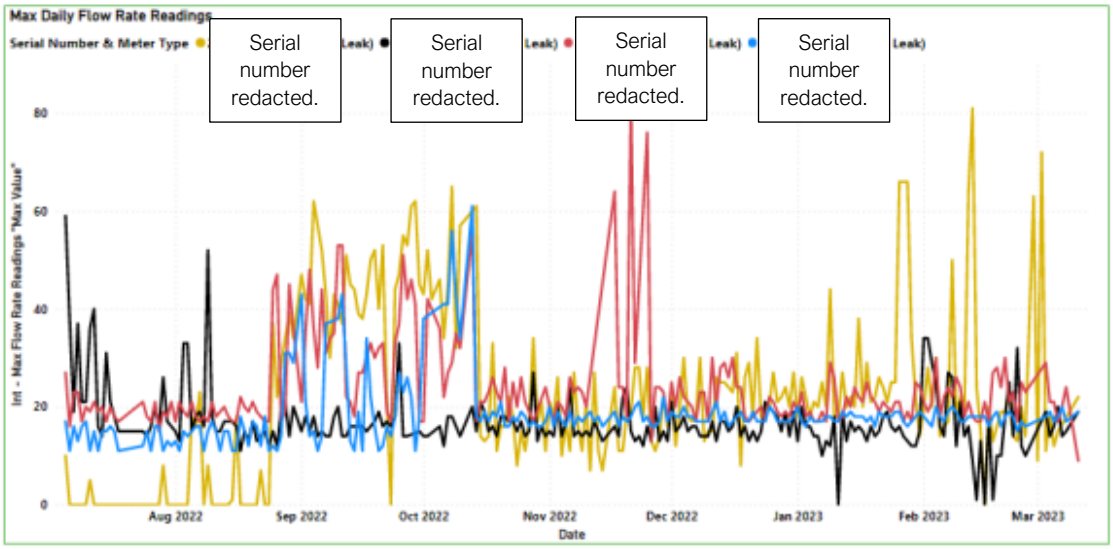
Key Observations for Meter Serial Number: Serial number redacted.

- Leak was existing when meter was installed in early July and is currently around 12L/hr
- Minimal observations available given the leak existed prior to the meter was installed and we don't have visibility on prior usage patterns/behaviors.
- Unusual peaks in max flow rates in Sep/Oct-22

Key Findings for Meter Serial Number: Serial number redacted.

High sample heard of 9 on meters located near this customer leak indicate they are either picking up on the customer leak occurring on meter [ ] or potentially a network leak exists in the area. Roll out of additional smart water meters with leak detection capabilities would provide greater visibility in the area.





Water Meter Customer Leakage Alarm

Date	Customer Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Friday, 7 October 2022	1	Serial numbers redacted. - Leak)
Thursday, 23 February 2023	1	- Leak)

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report

Wellington Water

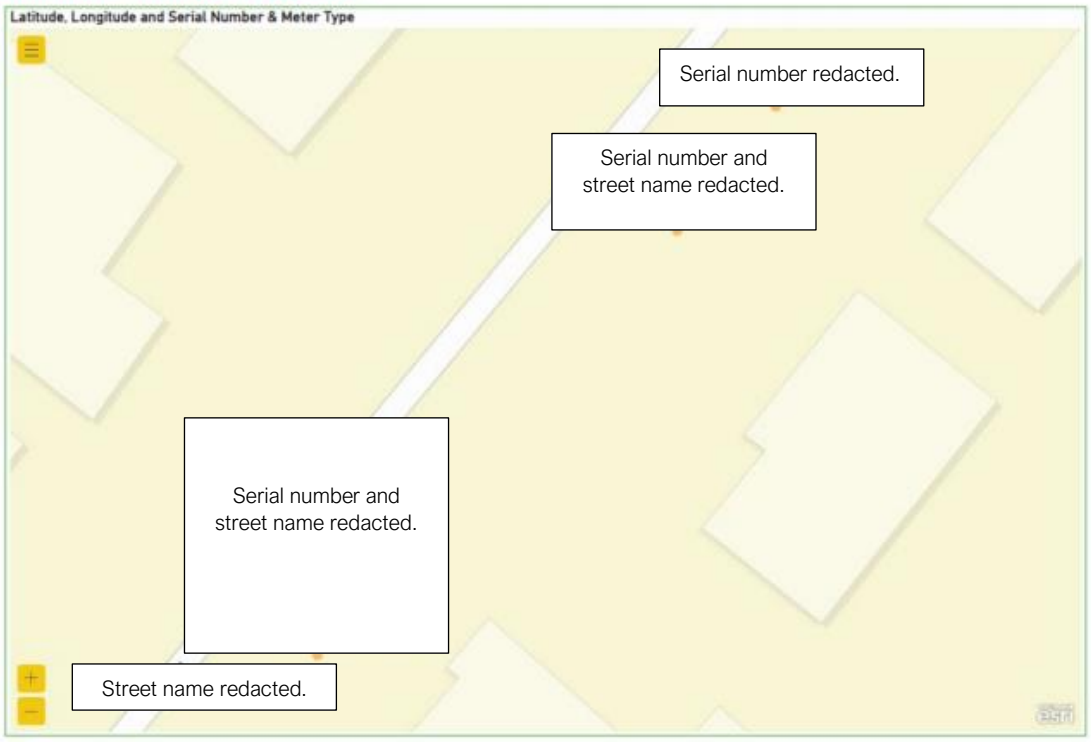
Sample Heard Scores

Date	Sample Heard Score	Serial Number & Meter Type
Sunday, 20 November 2022	9	Serial numbers redacted.
Saturday, 19 November 2022	9	
Friday, 18 November 2022	9	
Thursday, 17 November 2022	9	
Sunday, 13 November 2022	9	
Saturday, 12 November 2022	9	
Thursday, 10 November 2022	9	
Tuesday, 8 November 2022	9	
Sunday, 6 November 2022	9	
Saturday, 5 November 2022	9	
Thursday, 3 November 2022	9	
Tuesday, 1 November 2022	9	
Monday, 31 October 2022	9	
Sunday, 30 October 2022	9	
Saturday, 29 October 2022	9	
Friday, 28 October 2022	9	
Thursday, 27 October 2022	9	
Wednesday, 26 October 2022	8	
Tuesday, 25 October 2022	9	
Sunday, 23 October 2022	9	
Saturday, 22 October 2022	9	
Thursday, 20 October 2022	9	
Tuesday, 18 October 2022	8	
Monday, 17 October 2022	9	
Sunday, 16 October 2022	9	
Saturday, 15 October 2022	9	
Friday, 14 October 2022	9	
Thursday, 13 October 2022	9	
Sunday, 9 October 2022	9	
Saturday, 8 October 2022	9	
Friday, 7 October 2022	9	
Thursday, 6 October 2022	9	
Saturday, 1 October 2022	9	
Saturday, 1 October 2022	9	
Friday, 30 September 2022	8	
Friday, 30 September 2022	9	
Thursday, 29 September 2022	9	
Tuesday, 27 September 2022	9	
Monday, 26 September 2022	9	
Saturday, 24 September 2022	9	
Saturday, 24 September 2022	9	
Friday, 23 September 2022	9	
Friday, 23 September 2022	9	
Thursday, 22 September 2022	9	

Sample Heard Scores

Date	Sample Heard Score	Serial Number & Meter Type
Wednesday, 14 September 2022	9	Serial numbers redacted.
Tuesday, 13 September 2022	9	
Saturday, 10 September 2022	9	
Monday, 5 September 2022	9	
Sunday, 4 September 2022	9	
Saturday, 3 September 2022	9	
Friday, 2 September 2022	9	
Tuesday, 30 August 2022	9	
Monday, 29 August 2022	9	
Saturday, 27 August 2022	9	
Thursday, 25 August 2022	9	
Wednesday, 24 August 2022	9	
Tuesday, 23 August 2022	9	
Monday, 22 August 2022	9	
Saturday, 20 August 2022	9	
Thursday, 18 August 2022	9	
Tuesday, 16 August 2022	9	
Monday, 15 August 2022	9	
Sunday, 14 August 2022	9	
Friday, 12 August 2022	9	
Thursday, 11 August 2022	9	
Wednesday, 10 August 2022	9	
Monday, 8 August 2022	9	
Sunday, 7 August 2022	9	
Friday, 5 August 2022	9	
Thursday, 4 August 2022	9	
Wednesday, 3 August 2022	9	
Tuesday, 2 August 2022	9	
Monday, 1 August 2022	9	
Saturday, 30 July 2022	9	
Friday, 29 July 2022	9	
Thursday, 28 July 2022	9	
Tuesday, 26 July 2022	9	
Sunday, 24 July 2022	9	
Monday, 18 July 2022	9	
Sunday, 17 July 2022	9	
Friday, 15 July 2022	9	
Thursday, 14 July 2022	9	
Wednesday, 13 July 2022	9	
Tuesday, 12 July 2022	9	
Monday, 11 July 2022	9	
Sunday, 10 July 2022	9	
Saturday, 9 July 2022	9	
Friday, 8 July 2022	9	
Thursday, 7 July 2022	9	
Wednesday, 6 July 2022	9	
Tuesday, 5 July 2022	9	
Tuesday, 5 July 2022	9	

Meter Serial Number: Serial number redacted.



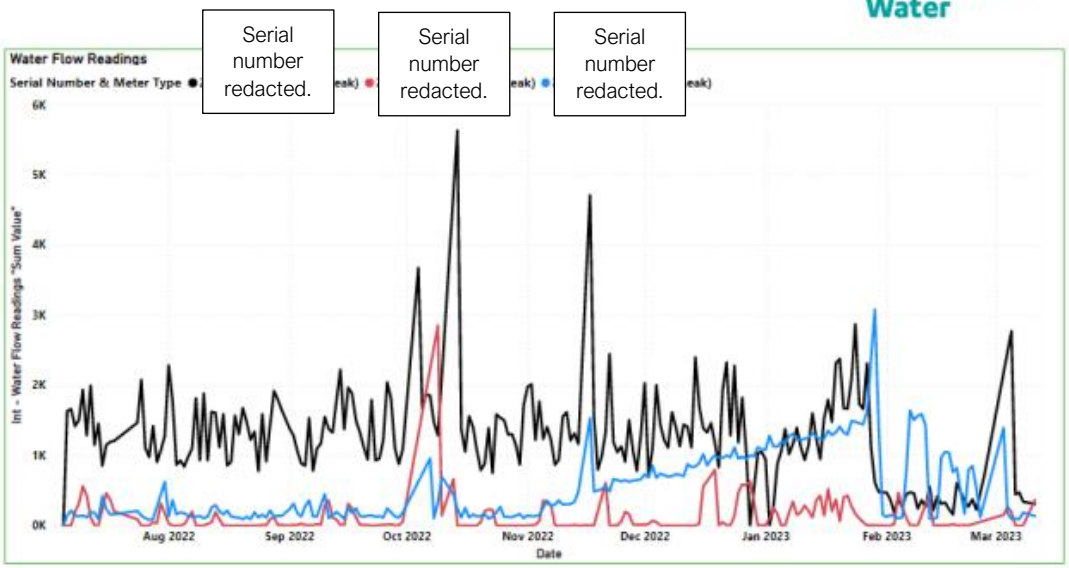
Key Observations for Meter Serial Number: Serial number redacted.

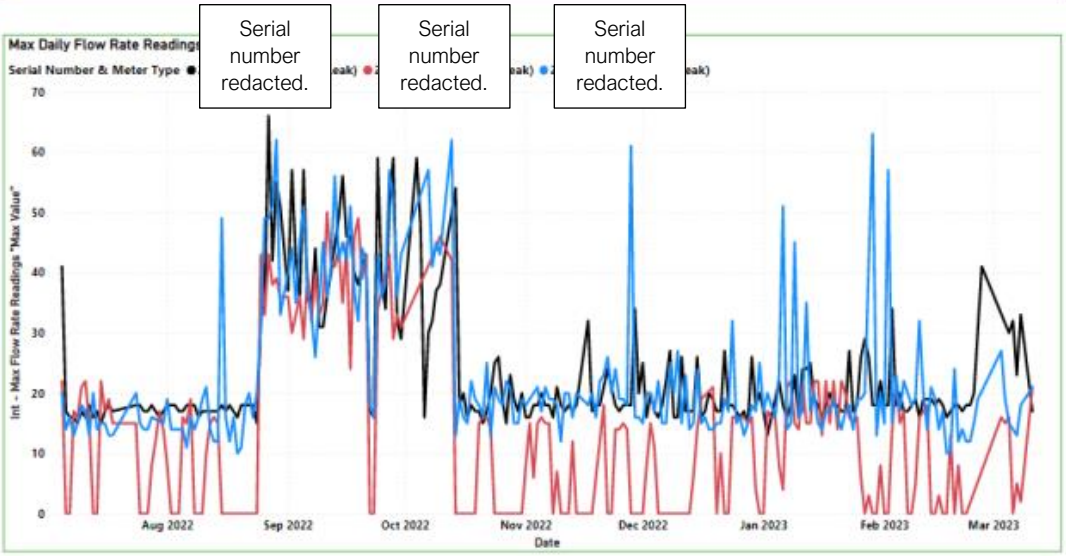
- High variability in max flow rates and overall water usage.
- Leak was existing when meter was installed at the end of April 2022 and is currently around 10L/hr
- Multiple network leak alarms throughout Jul-Sep 22.
- Interesting to note the massive increase in max flow rates in late Aug-22.

Key Findings for Meter Serial Number: Serial number redacted.

The high sample heard of 9 on meters located near this customer leak indicate they are either picking up on the customer leak occurring on meter [redacted] or potentially a network leak exists in the area. Roll out of additional smart water meters with leak detection capabilities would provide greater visibility in the area.

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report





Water Meter Customer Leakage Alarm

Date	Customer Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Friday, 8 July 2022	1	Leak)
Monday, 25 July 2022	1	Leak)
Wednesday, 2 November 2022	1	Leak)
Saturday, 12 November 2022	1	Leak)
Sunday, 20 November 2022	1	Leak)
Friday, 23 December 2022	1	Leak)
Tuesday, 7 February 2023	1	Leak)

Serial numbers redacted.

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report

Sample Heard Scores

Date	Sample Heard Score	Serial Number & Meter Type
Thursday, 8 September 2022	8	
Wednesday, 7 September 2022	9	
Tuesday, 6 September 2022	9	
Monday, 5 September 2022	9	
Sunday, 4 September 2022	9	
Saturday, 3 September 2022	9	
Thursday, 1 September 2022	9	
Tuesday, 30 August 2022	9	
Monday, 29 August 2022	9	
Saturday, 27 August 2022	9	
Friday, 26 August 2022	9	
Thursday, 25 August 2022	9	
Wednesday, 24 August 2022	9	
Monday, 22 August 2022	9	
Sunday, 21 August 2022	9	
Saturday, 20 August 2022	9	
Friday, 19 August 2022	9	
Thursday, 18 August 2022	9	
Wednesday, 17 August 2022	9	
Tuesday, 16 August 2022	9	
Sunday, 14 August 2022	9	
Friday, 12 August 2022	9	
Thursday, 11 August 2022	9	
Tuesday, 9 August 2022	9	
Monday, 8 August 2022	9	
Sunday, 7 August 2022	9	
Friday, 5 August 2022	9	
Thursday, 4 August 2022	9	
Tuesday, 2 August 2022	9	
Sunday, 31 July 2022	9	
Sunday, 31 July 2022	9	
Friday, 29 July 2022	9	
Thursday, 28 July 2022	9	
Tuesday, 26 July 2022	9	
Sunday, 24 July 2022	9	
Monday, 18 July 2022	9	
Sunday, 17 July 2022	9	
Saturday, 16 July 2022	9	
Friday, 15 July 2022	9	
Thursday, 14 July 2022	9	
Wednesday, 13 July 2022	9	
Tuesday, 12 July 2022	9	
Monday, 11 July 2022	9	
Sunday, 10 July 2022	9	
Saturday, 9 July 2022	9	
Friday, 8 July 2022	9	
Thursday, 7 July 2022	9	
Wednesday, 6 July 2022	9	
Tuesday, 5 July 2022	9	

Serial numbers redacted.

Sample Heard Scores

Date	Sample Heard Score	Serial Number & Meter Type
Sunday, 6 November 2022	9	
Saturday, 5 November 2022	9	
Friday, 4 November 2022	9	
Wednesday, 2 November 2022	9	
Tuesday, 1 November 2022	9	
Sunday, 30 October 2022	9	
Saturday, 29 October 2022	9	
Thursday, 27 October 2022	9	
Wednesday, 26 October 2022	9	
Monday, 24 October 2022	9	
Saturday, 22 October 2022	9	
Friday, 21 October 2022	9	
Thursday, 20 October 2022	9	
Wednesday, 19 October 2022	9	
Tuesday, 18 October 2022	9	
Monday, 17 October 2022	9	
Sunday, 16 October 2022	9	
Saturday, 15 October 2022	9	
Friday, 14 October 2022	9	
Monday, 10 October 2022	9	
Sunday, 9 October 2022	9	
Friday, 7 October 2022	9	
Wednesday, 5 October 2022	9	
Tuesday, 4 October 2022	9	
Friday, 30 September 2022	9	
Thursday, 29 September 2022	9	
Wednesday, 28 September 2022	9	
Tuesday, 27 September 2022	9	
Monday, 26 September 2022	9	
Sunday, 25 September 2022	9	
Saturday, 24 September 2022	9	
Friday, 23 September 2022	9	
Thursday, 22 September 2022	9	
Wednesday, 21 September 2022	9	
Monday, 19 September 2022	9	
Sunday, 18 September 2022	9	
Saturday, 17 September 2022	9	
Friday, 16 September 2022	9	
Thursday, 15 September 2022	9	
Wednesday, 14 September 2022	9	
Saturday, 10 September 2022	9	
Friday, 9 September 2022	9	
Thursday, 8 September 2022	8	
Wednesday, 7 September 2022	9	
Tuesday, 6 September 2022	9	
Monday, 5 September 2022	9	
Sunday, 4 September 2022	9	

Serial numbers redacted.

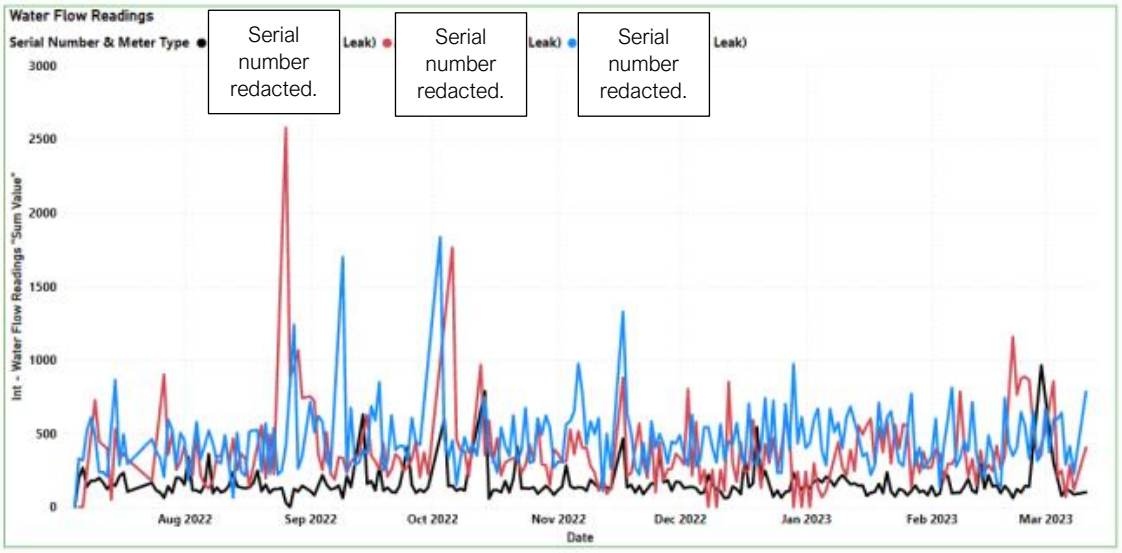
Meter Serial Number: Serial number redacted.

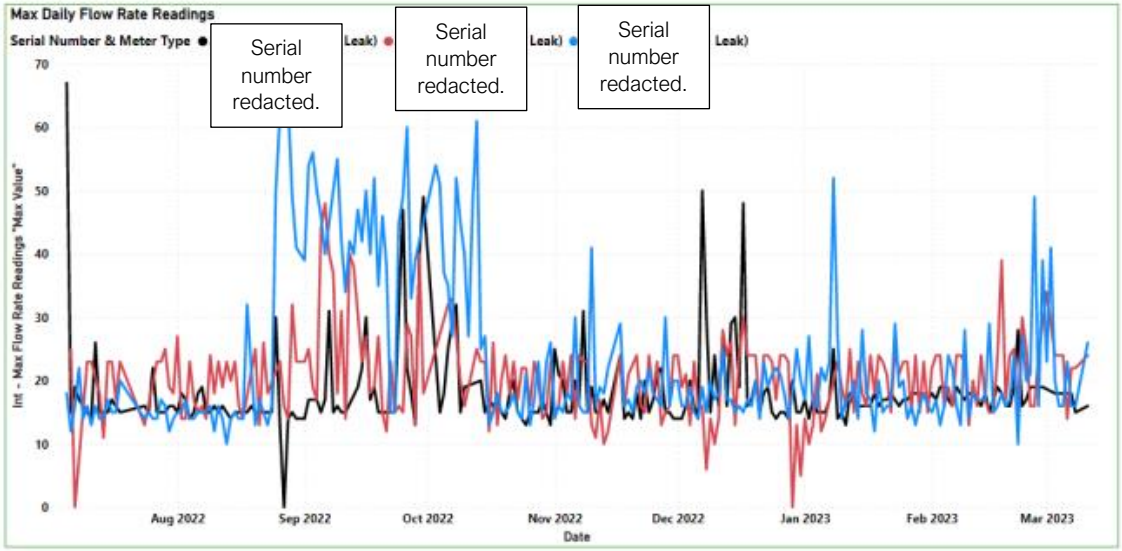
Key Observations for Meter Serial Number: Serial number redacted.

- Leak started at end of September and was repaired on 25/10/2022 it was about 24L/hr
- Note the drop in water flow readings near the end of Oct-22 due to the leak repair

Key Findings for Meter Serial Number: Serial number redacted.

Primary findings for this meter are the sample heard scores of 9 and network leak alarms detected by meters located around meter [redacted]. This data indicates they are either picking up on the customer leak occurring on meter [redacted] or potentially a network leak exists in the area. Roll out of additional smart water meters with leak detection capabilities would provide greater visibility in the area.

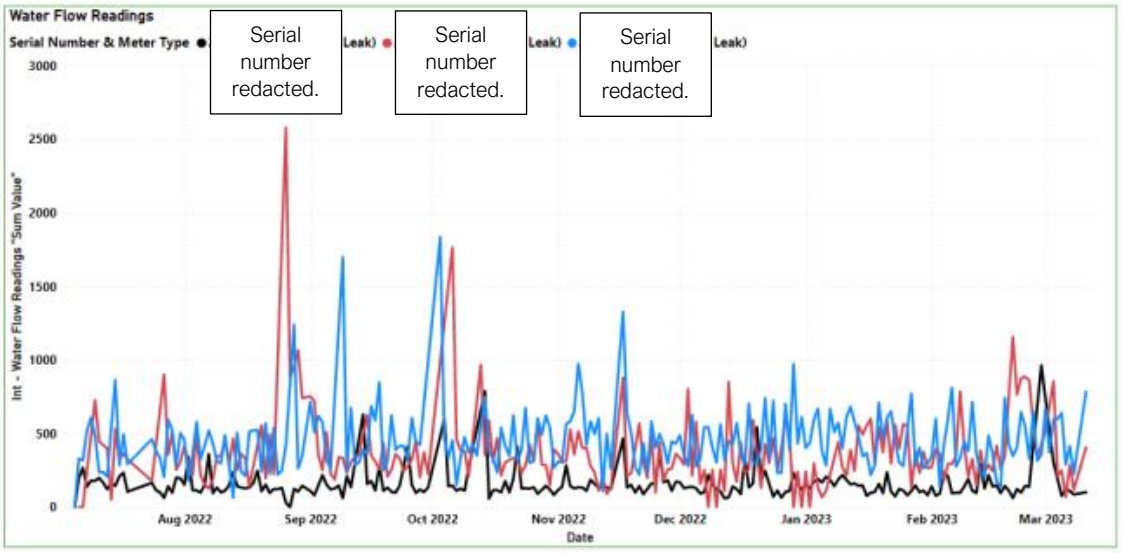


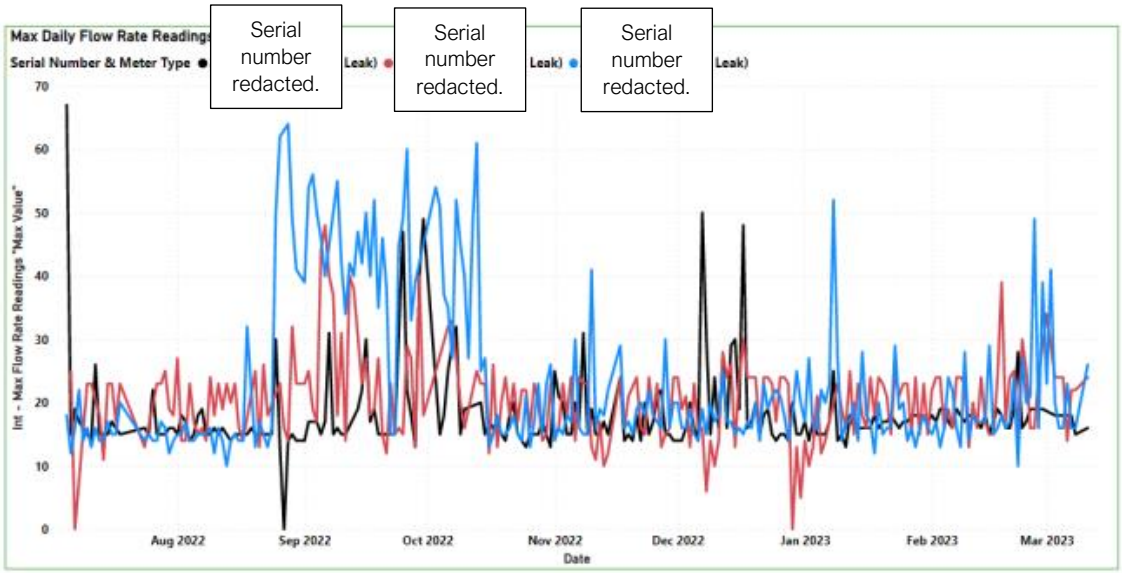


Water Meter Customer Leakage Alarm

Date	Customer Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Friday, 26 August 2022	1	- Leak)
Wednesday, 28 September 2022	1	- Pressure)
Thursday, 20 October 2022	1	- Pressure)

Serial numbers redacted.

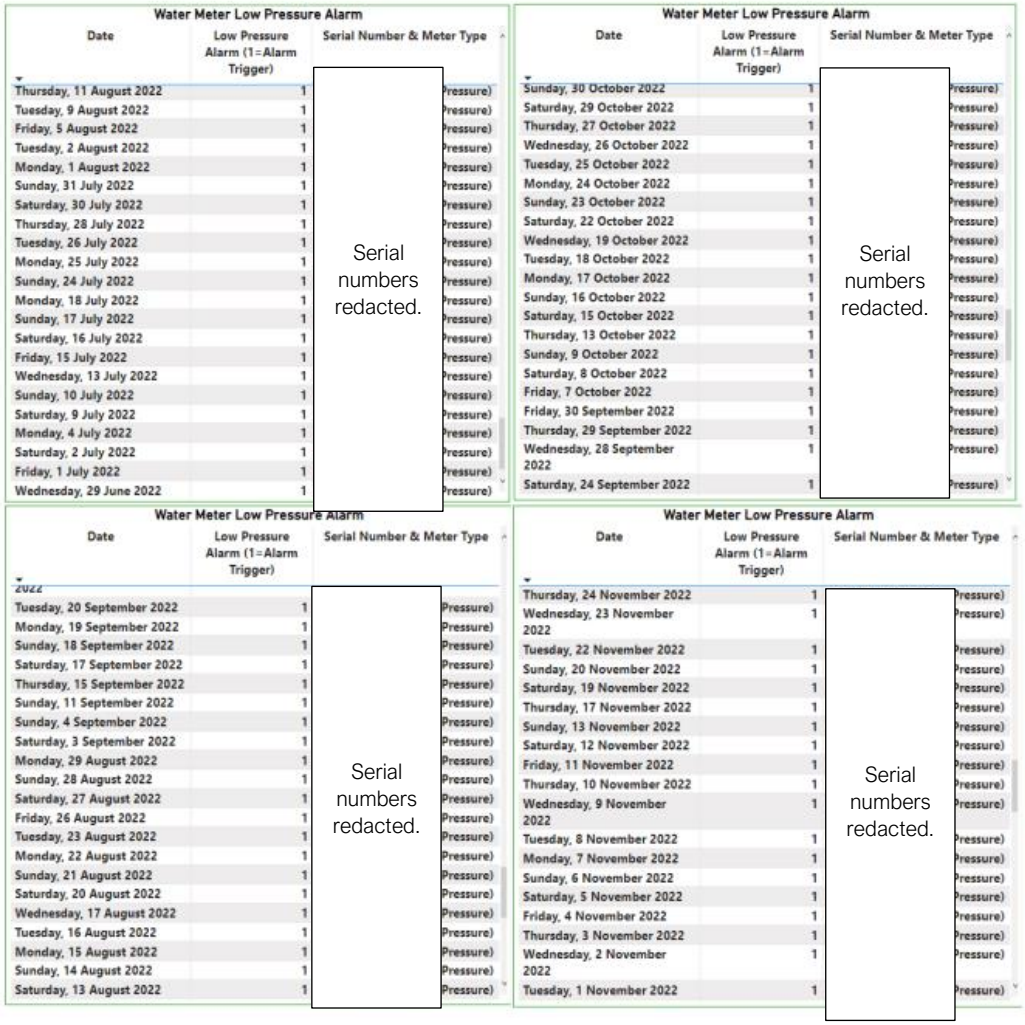




Water Meter Customer Leakage Alarm

Date	Customer Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Friday, 26 August 2022	1	Serial numbers redacted. - Leak)
Wednesday, 28 September 2022	1	- Pressure)
Thursday, 20 October 2022	1	- Pressure)

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report



Water Meter Low Pressure Alarm

Date	Low Pressure Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Thursday, 11 August 2022	1	Pressure)
Tuesday, 9 August 2022	1	Pressure)
Friday, 5 August 2022	1	Pressure)
Tuesday, 2 August 2022	1	Pressure)
Monday, 1 August 2022	1	Pressure)
Sunday, 31 July 2022	1	Pressure)
Saturday, 30 July 2022	1	Pressure)
Thursday, 28 July 2022	1	Pressure)
Tuesday, 26 July 2022	1	Pressure)
Monday, 25 July 2022	1	Pressure)
Sunday, 24 July 2022	1	Pressure)
Monday, 18 July 2022	1	Pressure)
Sunday, 17 July 2022	1	Pressure)
Saturday, 16 July 2022	1	Pressure)
Friday, 15 July 2022	1	Pressure)
Wednesday, 13 July 2022	1	Pressure)
Sunday, 10 July 2022	1	Pressure)
Saturday, 9 July 2022	1	Pressure)
Monday, 4 July 2022	1	Pressure)
Saturday, 2 July 2022	1	Pressure)
Friday, 1 July 2022	1	Pressure)
Wednesday, 29 June 2022	1	Pressure)

Serial numbers redacted.

Water Meter Low Pressure Alarm

Date	Low Pressure Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Sunday, 30 October 2022	1	Pressure)
Saturday, 29 October 2022	1	Pressure)
Thursday, 27 October 2022	1	Pressure)
Wednesday, 26 October 2022	1	Pressure)
Tuesday, 25 October 2022	1	Pressure)
Monday, 24 October 2022	1	Pressure)
Sunday, 23 October 2022	1	Pressure)
Saturday, 22 October 2022	1	Pressure)
Wednesday, 19 October 2022	1	Pressure)
Tuesday, 18 October 2022	1	Pressure)
Monday, 17 October 2022	1	Pressure)
Sunday, 16 October 2022	1	Pressure)
Saturday, 15 October 2022	1	Pressure)
Thursday, 13 October 2022	1	Pressure)
Sunday, 9 October 2022	1	Pressure)
Saturday, 8 October 2022	1	Pressure)
Friday, 7 October 2022	1	Pressure)
Friday, 30 September 2022	1	Pressure)
Thursday, 29 September 2022	1	Pressure)
Wednesday, 28 September 2022	1	Pressure)
Saturday, 24 September 2022	1	Pressure)

Serial numbers redacted.

Water Meter Low Pressure Alarm

Date	Low Pressure Alarm (1=Alarm Trigger)	Serial Number & Meter Type
2022		
Tuesday, 20 September 2022	1	Pressure)
Monday, 19 September 2022	1	Pressure)
Sunday, 18 September 2022	1	Pressure)
Saturday, 17 September 2022	1	Pressure)
Thursday, 15 September 2022	1	Pressure)
Sunday, 11 September 2022	1	Pressure)
Sunday, 4 September 2022	1	Pressure)
Saturday, 3 September 2022	1	Pressure)
Monday, 29 August 2022	1	Pressure)
Sunday, 28 August 2022	1	Pressure)
Saturday, 27 August 2022	1	Pressure)
Friday, 26 August 2022	1	Pressure)
Tuesday, 23 August 2022	1	Pressure)
Monday, 22 August 2022	1	Pressure)
Sunday, 21 August 2022	1	Pressure)
Saturday, 20 August 2022	1	Pressure)
Wednesday, 17 August 2022	1	Pressure)
Tuesday, 16 August 2022	1	Pressure)
Monday, 15 August 2022	1	Pressure)
Sunday, 14 August 2022	1	Pressure)
Saturday, 13 August 2022	1	Pressure)

Serial numbers redacted.

Water Meter Low Pressure Alarm

Date	Low Pressure Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Thursday, 24 November 2022	1	Pressure)
Wednesday, 23 November 2022	1	Pressure)
Tuesday, 22 November 2022	1	Pressure)
Sunday, 20 November 2022	1	Pressure)
Saturday, 19 November 2022	1	Pressure)
Thursday, 17 November 2022	1	Pressure)
Sunday, 13 November 2022	1	Pressure)
Saturday, 12 November 2022	1	Pressure)
Friday, 11 November 2022	1	Pressure)
Thursday, 10 November 2022	1	Pressure)
Wednesday, 9 November 2022	1	Pressure)
Tuesday, 8 November 2022	1	Pressure)
Monday, 7 November 2022	1	Pressure)
Sunday, 6 November 2022	1	Pressure)
Saturday, 5 November 2022	1	Pressure)
Friday, 4 November 2022	1	Pressure)
Thursday, 3 November 2022	1	Pressure)
Wednesday, 2 November 2022	1	Pressure)
Tuesday, 1 November 2022	1	Pressure)

Serial numbers redacted.

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report

Sample Heard Scores

Date	Sample Heard Score	Serial Number & Meter Type
Sunday, 26 February 2023	9	- Leak)
Friday, 24 February 2023	9	- Leak)
Thursday, 23 February 2023	9	- Leak)
Tuesday, 21 February 2023	9	- Leak)
Monday, 20 February 2023	9	- Leak)
Friday, 27 January 2023	9	- Leak)
Tuesday, 17 January 2023	9	- Leak)
Sunday, 15 January 2023	9	- Leak)
Saturday, 14 January 2023	9	- Leak)
Friday, 13 January 2023	9	- Leak)
Wednesday, 11 January 2023	9	- Leak)
Tuesday, 10 January 2023	9	- Leak)
Monday, 9 January 2023	9	- Leak)
Sunday, 16 October 2022	9	- Leak)
Saturday, 17 September 2022	9	- Leak)
Friday, 2 September 2022	9	- Leak)
Monday, 29 August 2022	9	- Leak)
Sunday, 28 August 2022	9	- Leak)
Saturday, 27 August 2022	9	- Leak)
Friday, 26 August 2022	9	- Leak)

Serial numbers redacted.

Network Leaks

Service Pipe Leak on Jellicoe Street

Key Observations

The leak on this service pipe was first flagged on 2/09/2022 and repaired on 15/09/2022. Wellington Water suspect the leak could have been running prior to 2/9/2022. The service connection that was leaking does not have a meter installed on it. The leak was on a DN20 HDPE service connection and the main is DN100 PVC. Wellington Water estimate the leak was around a litre per minute.

The leak was at Latitude -41.0828099 and Longitude 175.4692594

Wellington Water identified the below list of Landis+Gyr Smart Meters that were installed/active in the proximity of this service leak.

Final Meter ID	Straight line distance from leak (m)	Main pipe length from leak (m)	Combined service pipe length from leak (m)
Serial numbers redacted.	10.5	8.1	17.5
	16	12.9	18.2
	44	46.5	10.4
	60	62.3	10.1
	71	68.7	18.4
	71	68.7	18.4
	71	68.7	18.4
	71	68.7	18.4
	109	109.2	18.1
	109	109.2	18.1
	125	128.4	8.7

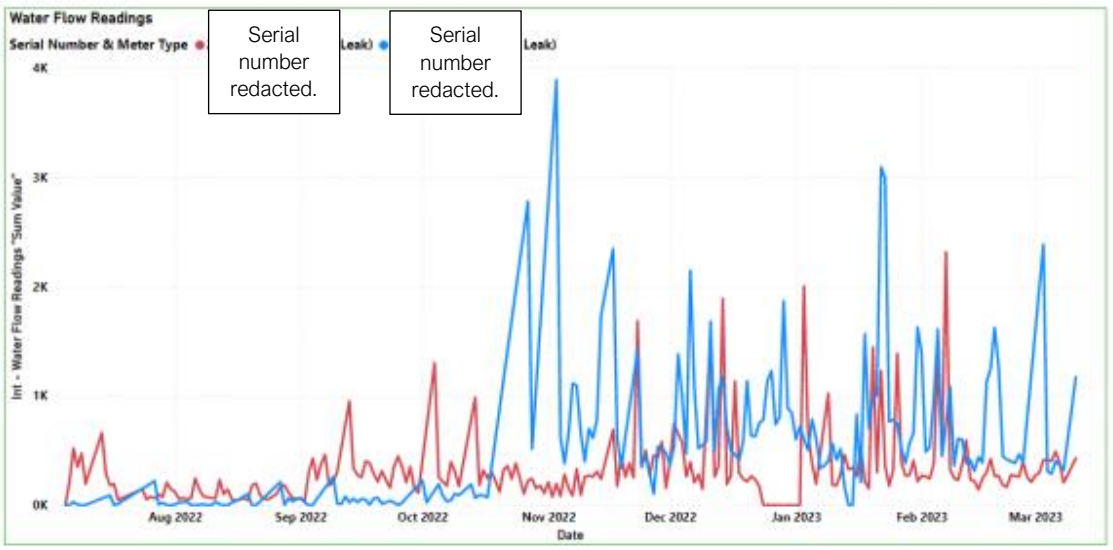
Important to note that Meter [redacted] is one of the identified customer leaks included in this observational report.

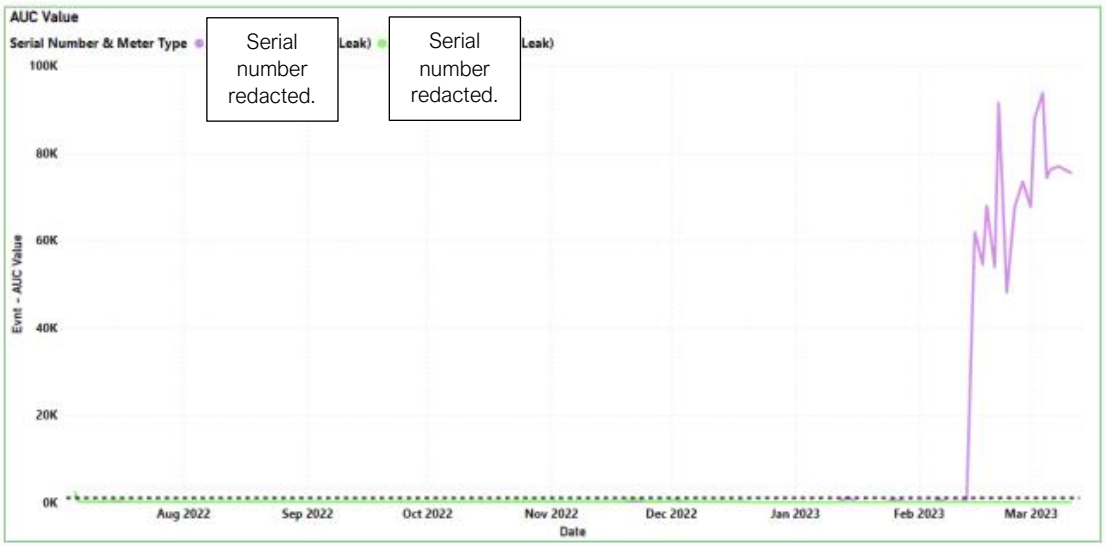
Photo of service leak taken by repair team on 15/9/2022

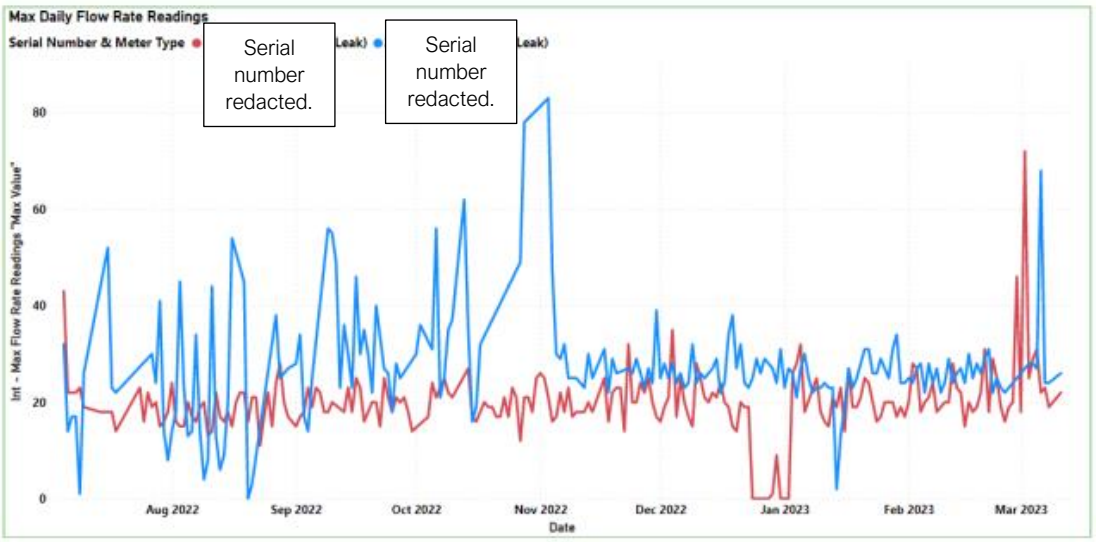
Key Findings for Service Pipe Leak on Jellicoe Street

Key findings we observe from the data for identified meters located near the service pipe leak on Jellicoe Street included the network leak alarms detected on meter [redacted], along with the high sample heard scores of 9 for this same meter between 22/8/2022 – 27/8/2022. While this could be due to the customer leak on [redacted] it could also be due to this service leak given the spike in the AUC score for meter [redacted] in late August before it drops to normal levels in early September. Given the customer leak on [redacted] wasn't fixed until 4/10/2022 we would expect to see an increased AUC score for this meter if it was related to the customer leak.


Latitude, Longitude and Serial Number & Meter Type
Serial number redacted.
Serial number redacted.
Service leak (N/A)


Water Flow Readings
Serial Number & Meter Type
Serial number redacted.
Leak)
Serial number redacted.
Leak)
4K
3K
2K
1K
0K
Int - Water Flow Readings "Sum Value"
Aug 2022
Sep 2022
Oct 2022
Nov 2022
Dec 2022
Jan 2023
Feb 2023
Mar 2023
Date


AUC Value
Serial Number & Meter Type
Serial number redacted.
Leak)
Serial number redacted.
Leak)
100K
80K
60K
40K
20K
0K
Evnt - AUC Value
Aug 2022
Sep 2022
Oct 2022
Nov 2022
Dec 2022
Jan 2023
Feb 2023
Mar 2023
Date


Max Daily Flow Rate Readings
Serial Number & Meter Type
Serial number redacted.
Leak)
Serial number redacted.
Leak)
80
60
40
20
0
Int - Max Flow Rate Readings "Max Value"
Aug 2022
Sep 2022
Oct 2022
Nov 2022
Dec 2022
Jan 2023
Feb 2023
Mar 2023
Date

Water Meter Network Leak Alarm

Date	Network Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Saturday, 11 March 2023	1	
Wednesday, 8 March 2023	1	
Monday, 6 March 2023	1	
Sunday, 5 March 2023	1	
Saturday, 4 March 2023	1	
Thursday, 2 March 2023	1	
Wednesday, 1 March 2023	1	
Monday, 27 February 2023	1	
Saturday, 25 February 2023	1	
Thursday, 23 February 2023	1	
Tuesday, 21 February 2023	1	
Monday, 20 February 2023	1	
Saturday, 18 February 2023	1	
Friday, 17 February 2023	1	
Wednesday, 15 February 2023	1	
Monday, 13 February 2023	1	
Monday, 19 December 2022	1	
Sunday, 18 December 2022	1	

Serial numbers redacted.

Water Meter Network Leak Alarm

Date	Network Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Sunday, 18 December 2022	1	
Wednesday, 14 December 2022	1	
Sunday, 11 December 2022	1	
Thursday, 8 December 2022	1	
Tuesday, 29 November 2022	1	
Thursday, 17 November 2022	1	
Thursday, 10 November 2022	1	
Wednesday, 26 October 2022	1	
Thursday, 20 October 2022	1	
Tuesday, 18 October 2022	1	
Sunday, 16 October 2022	1	
Monday, 10 October 2022	1	
Tuesday, 4 October 2022	1	
Wednesday, 28 September 2022	1	
Tuesday, 5 July 2022	1	
Tuesday, 5 July 2022	1	

Serial numbers redacted.

Water Meter Customer Leakage Alarm

Date	Customer Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Friday, 2 December 2022	1	Leak)

Serial numbers redacted.

Sample Heard Sco

Date	Sample Heard Score	Serial Number & Meter Type
Wednesday, 1 February 2023	9	Leak)
Monday, 23 January 2023	9	Leak)
Tuesday, 17 January 2023	8	Leak)
Friday, 2 December 2022	9	Leak)
Thursday, 1 December 2022	9	Leak)

Serial numbers redacted.

Potential Network Leak – East St

Key Observations/Findings for potential network leak on East St

Key findings we observe from the data for identified meters located near the service pipe leak on East Street included the consistent network leak alarm events observed across several meters located on the map. We also observe several high AUC scores across the period of Jan-Mar 2023.

A strong indicator of network leaks are consistently high AUC scores observed across a 7–15 day period. This is to account for other potential variables that may be impacting AUC scores such as weather events, road works and other factors which could produce vibrations around leak meters. This observational period of 7-15 days helps to provide greater filtering of data as we would expect a network leak to be consistent over time.

Additional data analytics can assist in providing greater insights from meter data to inform corrective action decisions by Wellington Water.

From: Jonathan Eweg <Jonathan.Eweg@wellingtonwater.co.nz>
Sent: Tuesday, February 21, 2023 4:48 PM
To: Repia, Sam <Sam.Repia@landisgyr.com>
Cc: Sourab Simha <Sourab.Simha@wellingtonwater.co.nz>; Eckersley, Dean <Dean.Eckersley@landisgyr.com>
Subject: Greytown SMT - Leask near vibration meters

This Message Is From an External Sender
This message came from outside your organization.

Hi Sam

The field team have confirmed that they have a leak in one of the streets we have vibration meters in. I don't know much about the leak at this stage but you might want to check out the following "nearby meters":

Meter ID	Lat	Long

Serial numbers and coordinates redacted.

Unfortunately, there are a few meters that are either base or mechanical near this leak so we might not see too much.

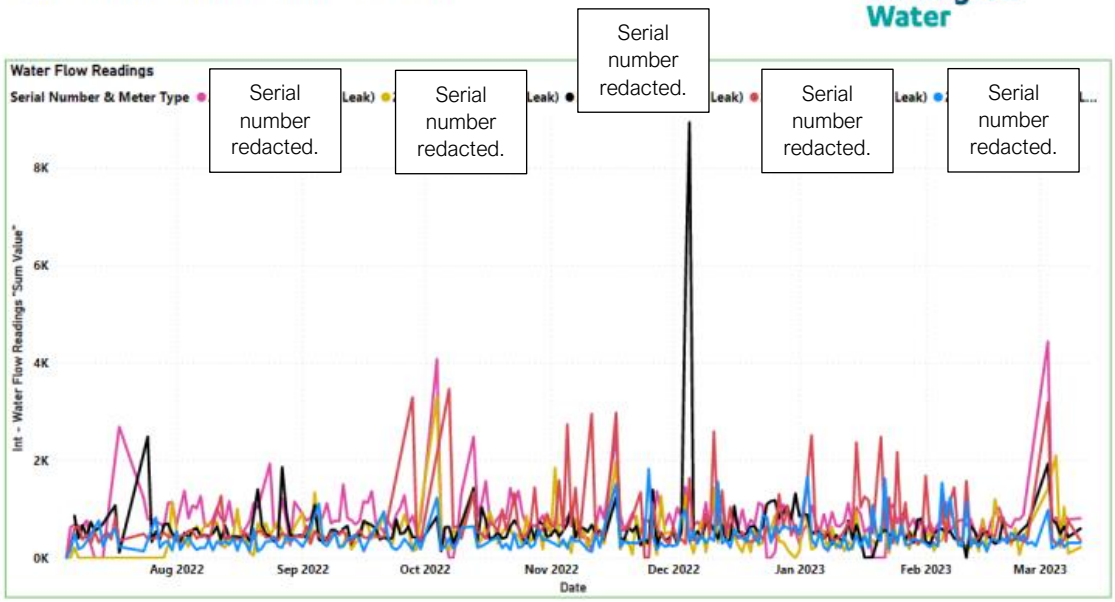
Kind regards
Jonathan Eweg Design Lead, CPEng, CMEngNZ

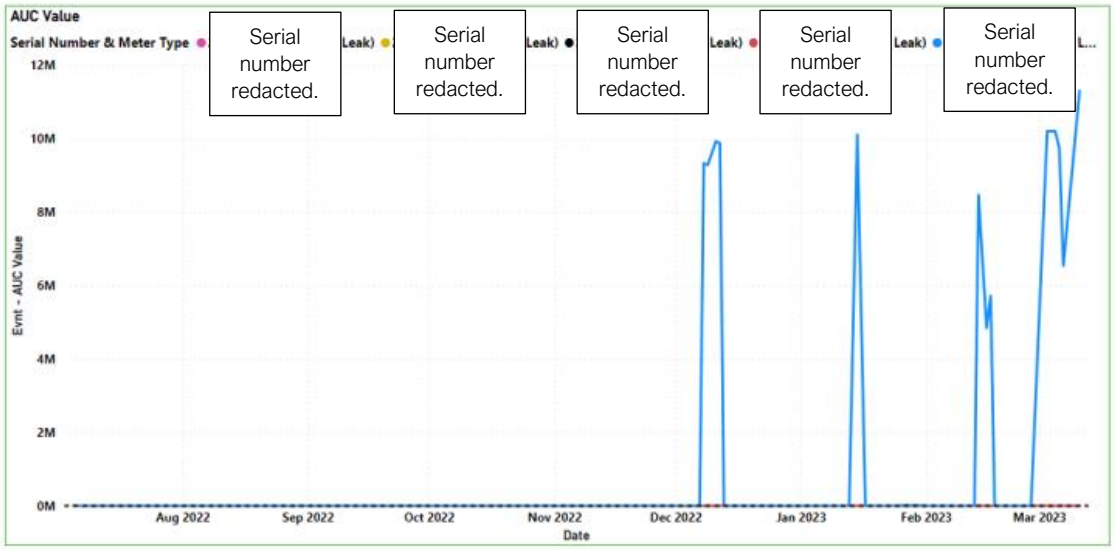
Wellington Water

DDI 04 912 4421 Mob 027 688 1917 Tel 04 912 4400
Private Bag 39804, Wellington Mail Centre 5045
Level 4, 25 Victoria Street, Petone, Lower Hutt
www.wellingtonwater.co.nz

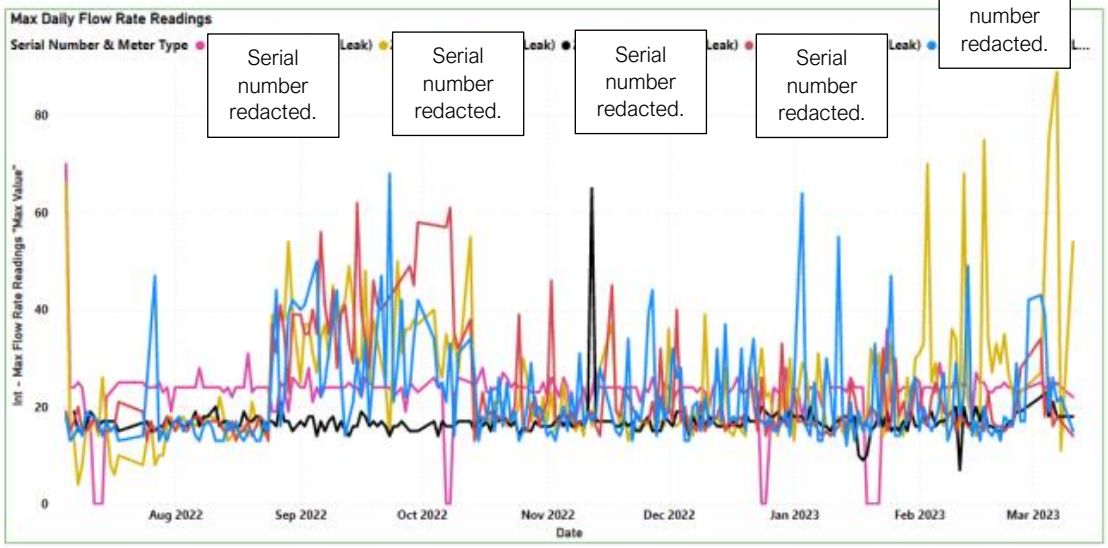

Latitude, Longitude and Serial Number & Meter Type
Serial number redacted.
Serial number redacted.
Approximate leak
Serial number redacted.
Serial number redacted.
Serial number redacted.
Main St
East St
Reading St
esri

Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report





Wellington Water
Greytown Smart Meter Trial - Leak Data Observations Report



Water Meter Network Leak Alarm

Date	Network Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Saturday, 11 March 2023	1	
Tuesday, 7 March 2023	1	
Sunday, 5 March 2023	1	
Tuesday, 21 February 2023	1	
Thursday, 2 February 2023	1	
Wednesday, 1 February 2023	1	
Tuesday, 31 January 2023	1	
Tuesday, 31 January 2023	1	
Monday, 30 January 2023	1	
Sunday, 29 January 2023	1	
Sunday, 29 January 2023	1	
Saturday, 28 January 2023	1	
Thursday, 26 January 2023	1	
Thursday, 26 January 2023	1	
Wednesday, 25 January 2023	1	
Monday, 23 January 2023	1	
Friday, 20 January 2023	1	
Thursday, 19 January 2023	1	
Wednesday, 18 January 2023	1	
Tuesday, 17 January 2023	1	
Sunday, 8 January 2023	1	
Wednesday, 4 January 2023	1	

Serial numbers redacted.

Water Meter Network Leak Alarm

Date	Network Leak Alarm (1=Alarm Trigger)	Serial Number & Meter Type
Saturday, 31 December 2022	1	
Tuesday, 20 December 2022	1	
Wednesday, 14 December 2022	1	
Monday, 12 December 2022	1	
Saturday, 10 December 2022	1	
Friday, 9 December 2022	1	
Saturday, 3 December 2022	1	
Wednesday, 23 November 2022	1	
Tuesday, 22 November 2022	1	
Monday, 14 November 2022	1	
Monday, 14 November 2022	1	
Saturday, 12 November 2022	1	
Friday, 11 November 2022	1	
Saturday, 5 November 2022	1	
Tuesday, 4 October 2022	1	
Tuesday, 4 October 2022	1	
Friday, 30 September 2022	1	
Thursday, 29 September 2022	1	
Tuesday, 20 September 2022	1	
Friday, 9 September 2022	1	
Friday, 2 September 2022	1	
Friday, 19 August 2022	1	

Serial numbers redacted.

Sample Heard Scores

Date	Sample Heard Score	Serial Number & Meter Type
Saturday, 24 September 2022	9	- Leak)

Serial number redacted.

Appendix

Table 1. below provided by Wellington Water, outlining meters with identified faults, along with distance information on each leak.

Table 1.

Final Meter ID		Straight line distance from leak (m)	Main pipe length from leak (m)	Combined service pipe length from leak (m)
	Serial numbers redacted.	10.5	8.1	17.5
		16	12.9	18.2
		44	46.5	10.4
		60	62.3	10.1
		71	68.7	18.4
		71	68.7	18.4
		71	68.7	18.4
		71	68.7	18.4
		109	109.2	18.1
		109	109.2	18.1
		125	128.4	8.7

Table 2. provided by Wellington Water provides the lat/long of each meter with an identified leak, providing commentary on the leak and whether the leak has been repaired or not. Also provides meter serial numbers and lat/longs for meters around the area of identified meters with leaks.

- Meters with identified leaks are highlighted in orange with commentary provided by Wellington Water.
- The blank blue lines separate the groups of meters around the leaks.

Table 2.

Meter Description	Meter serial number	Latitude	Longitude	Comment
Serial numbers and location coordinates redacted.				Leak started mid-August very small but has increased to around 100L/hr
				Leak was existing when meter was installed in early July and is currently around 12L/hr

Serial numbers and location coordinates redacted.				Leak was existing when meter was installed in April 2022 and is currently around 12L/hr
				Leak was existing when meter was installed in mid-June 2022 and was repaired 25/10/2022, was about 120L/hr
				Very small leak started 24/10/2022 and is around 6L/hr
				Very small leak started 24/09/2022 and is around 12L/hr
				Leak was existing when meter was installed at the end of April 2022 and is currently around 10L/hr
				Repaired 13/09/2022
				Leak started at the end of July and was repaired 4/10/2022 when it was about 580L/hr
				Leak reported on 02/09/2022 and repaired on 15/09/2022
				Leak started at end of September and was repaired on 25/10/2022 it was about 24L/hr

Serial numbers and location coordinates redacted.	

L: Advizzo Post-Trial Survey

Summary of results:

*Customer Action	**Benchmark %	Actual No.	Actual %
Customers (for installed addresses) are set up in the portal. Reformat.	--	250/250	100%
Customers (for installed addresses) engaged proactively.	--	242/250	97%
Customers (for installed addresses) who signed up for an online account.	5-7%	73/250	29.2%
Customers who completed the optional initial survey.	50-90%	69/250	29.2%
Customers who did not unsubscribe from portal/communications material.	--	250/250	100%
Customers who provided post-trial feedback out of those who signed up for an online account.	--	18/58	30%


advizzo
Wellington Water
Efficiency coaching pilot
Mar 2023

Project Summary: Encouraging learnings & results to leverage

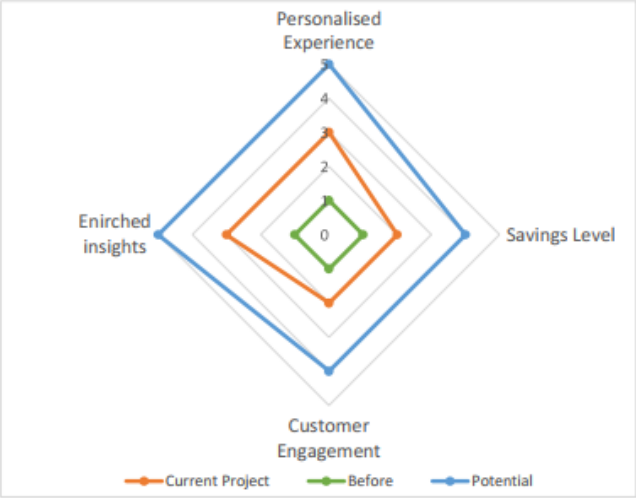
Initial scope & Results to date:

- Programme Type: Standalone online portal with proactive Personalised Home reports by Email
- Proactive campaigns with welcome report on 21 Oct 2022 followed by updates on 24 Nov22, 21 Dec22, 27 Jan23
- Customers reached: 346 customers setup on platform, 242 engaged proactively (70%)
- Customers with an online account: 73 (30% vs. 5-7% benchmark)
- Customers who provided survey answers: 69 (95% vs. 50-90% benchmark)
- Customers unsubscribed: 0
- Customers who provided feedback: 18 / 58 (30%)
- Risks & biases identified at the start, including and not limited to: selection bias with low volume and the absence of statistically relevant sample available meant that no meaningful savings can be measured unless we conduct a randomized control trial over min. 12months. Unknown context factors such as the meter installation experience, other campaigns run in parallel to this pilot and prior customer perception may have also impacted customer sentiment negatively or positively

Impact between Oct 2022 and Feb 2023:

- Customer engagement reports very high levels of engagement with 95% of customers completing their profile to understand better their usage. Perseverance and scaling up volumes required for customers start to get used to new UX and start taking action

Analysis: project needs to continue to deliver benefits at scale



Project Assessment summary

1. **Increase in Customer Digitalization & Customer intelligence**: 70% customers engaged online and 95% customers engaged online completed the home survey
    1. **Data Growth**: > 20 new insights for each customer engaged online. + thousands of data collected for WW so far.
    2. **Data Value:** Data growth per customer generates c$100 extra value for WW (i.e. cost of survey at the door, assuming similar conversion rate which is unlikely as customers may only see immediate benefit for survey completed online). Value = c$ 7k to date and counting...
2. **Macro-Trend – savings and usage reduction:** portfolio overall usage show an expected seasonal increase as well as meter data irregularities. Reminder: program must run for minimum 12month with a representative sample to allow for meaningful savings to be measured.
3. **Micro-Trend -** sample analysis shows
    1. Engaged customers save more water,
    2. Some users have decreased usage.
4. **Positive Customer Feedback** customer survey results:
    1. most customer remember the Portal and the reports
    2. most customers want the programme to continue

Scaling up personalised engagement may deliver insights & savings

Engagement	Benchmark (for Australia/NZ Market)	Actual (Feb23)	Extrapolation - Behavioural Program at Scale
Open	<20.6 %	?	Up to 75,000 people would open their report every month (assuming 50% email penetration on 15,000 portfolio for Wellington Water)
Click-Through	<5 %	?	
Unsubscribe	<0.2 %	0.007 %	n/a
User visits	n/a	242 (70%)	Up to 105,000 customers would visit the website
Web Active	Conversation Rate from Direct Mail to Digital – 0.12 %	73 (21%)	could create up to 16,000 online Accounts over 12m
Repeated visits	59-78%	? %	Up to 10,000 could come back on a regular basis
Survey completed	50-95%	69 (95%)	Up to 15,200 could fill their Virtual Home Audit/Survey
Tips selected	46%	1 (0%)	Up to 7,500 could engage regularly with Saving Tips
Users total		346	

Recommended Next steps

- WW to iron-out metering and data collection issues to enable better data processing
- Ramp-up personalised engagement programme (only 2 data reads required over 12months to make the portal work at scale)
- Run water efficiency programme on an ongoing basis to increase customer adoption & trust in Wellington Water
- Perform a Randomised Control Trial to confirm the % savings level that WW can deliver on a ongoing basis in the WW portfolio/context. Annualised savings expected to be 1-3% on average
- Pilot implementation of other value-add solutions e.g. Leak monitoring, Virtual home audits, personalisation at scale, vulnerability support options, predictive upsells, etc…

Initial Customer survey results

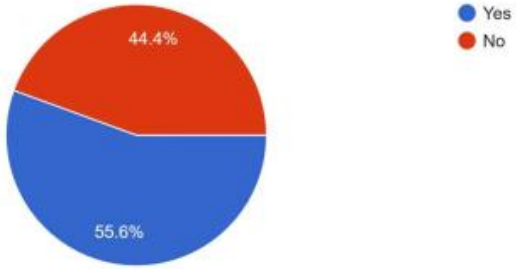
March 2023

Customers provided constructive feedback

- 18 responses out of 58 customers (30%) invite to feedback from email survey in Mar2023
- 56% customers claimed to have taken steps to reduce use but most customers still unclear about efficiency
- Most customers are unsure about the impact of their actions and require more insights about their efficiency

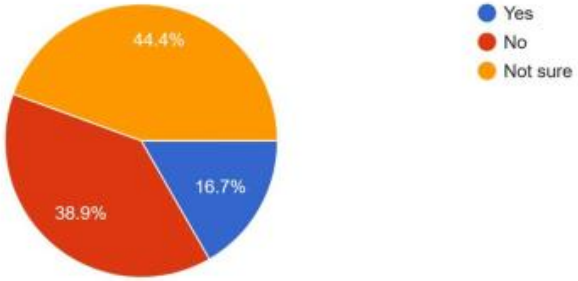
In the past 6 months, have you taken any steps to reduce your home water consumption?

18 responses



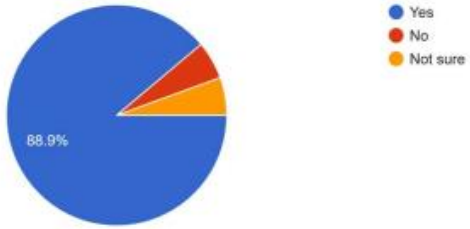
Have those steps led to a decrease in your water use in the last 6 months?

18 responses

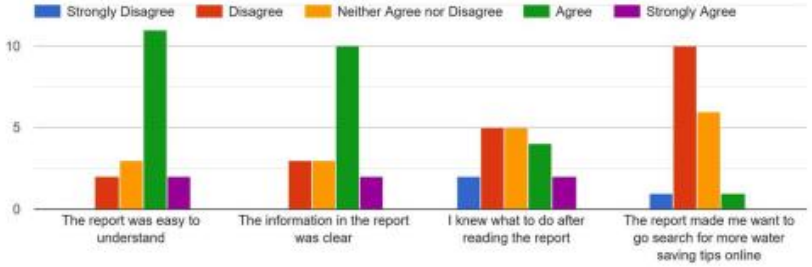


Most customers recalled, read and enjoyed the efficiency reports

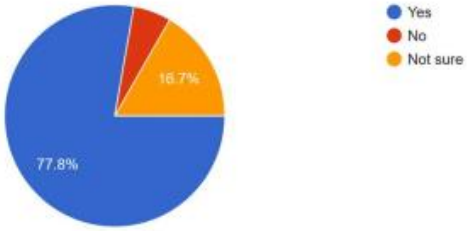
Do you remember receiving a water consumption report from your water supplier?
18 responses



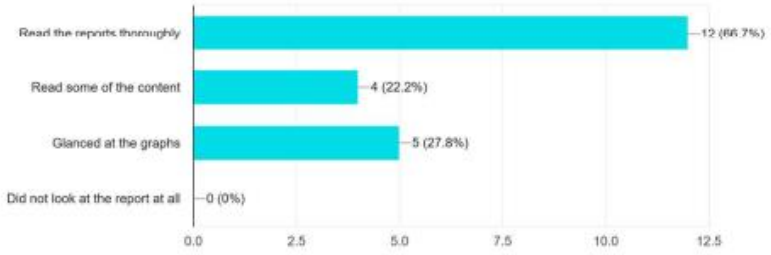
When thinking about all the reports you received, please indicate your level of agreement or disagreement with the following statements:



Your monthly one-page report included a comparison of your water consumption with that of your neighbours, as well as water saving tips. Does this accurately describe the report that you received?
18 responses



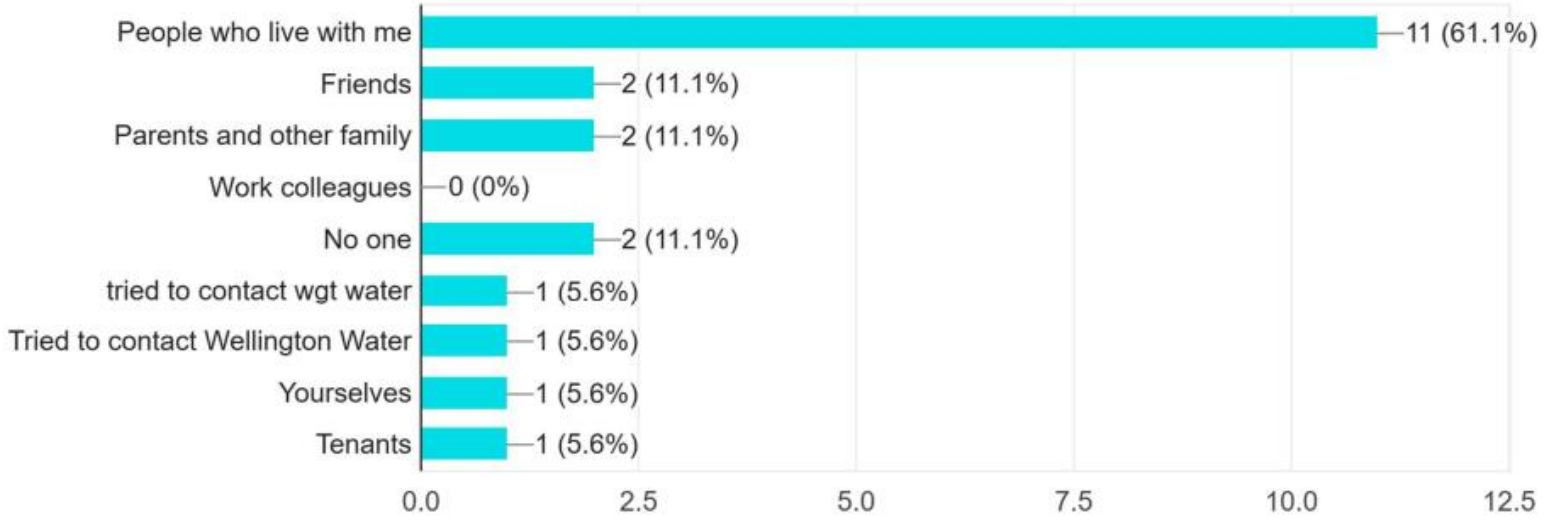
What have you done with the reports you have received?
18 responses



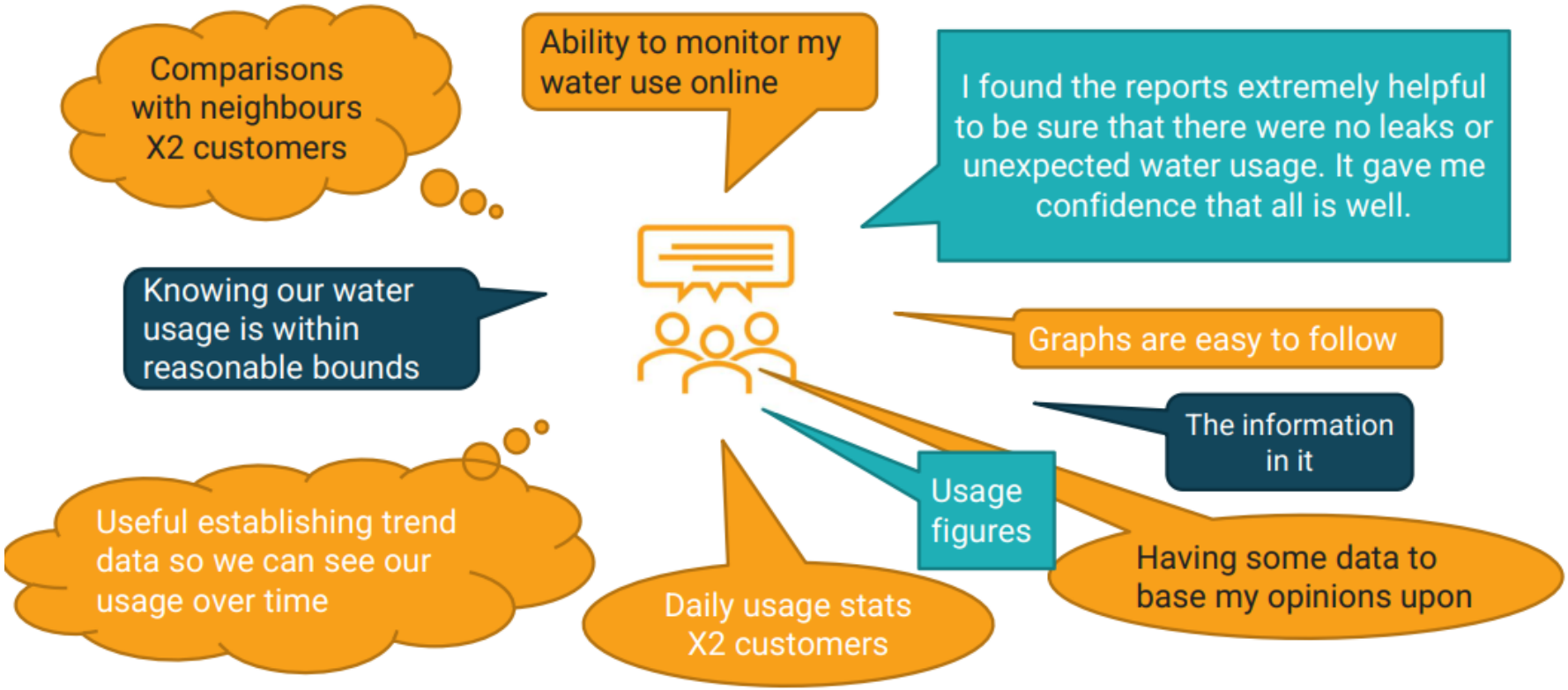
Most customers shared water efficiency insights with others. How did Wellington Water supported customer queries?

Did you share the report or discuss its contents with anyone? If so, what category best describes who you shared this with?

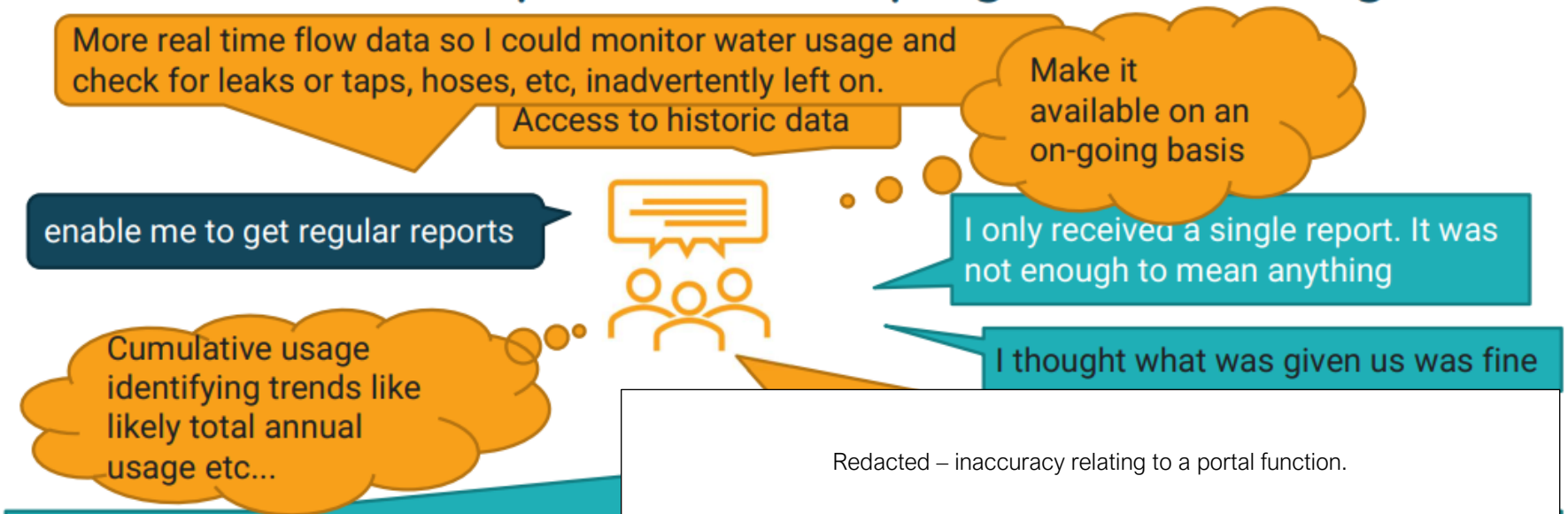
18 responses



What do you/customers liked the most:

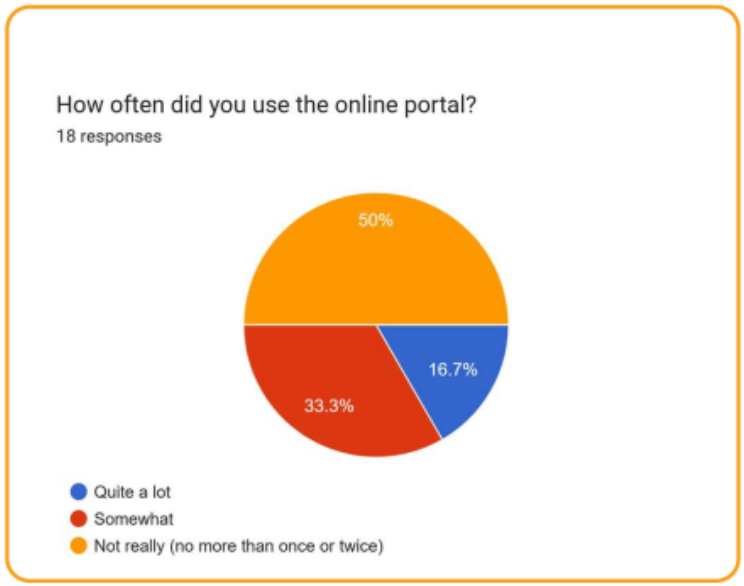


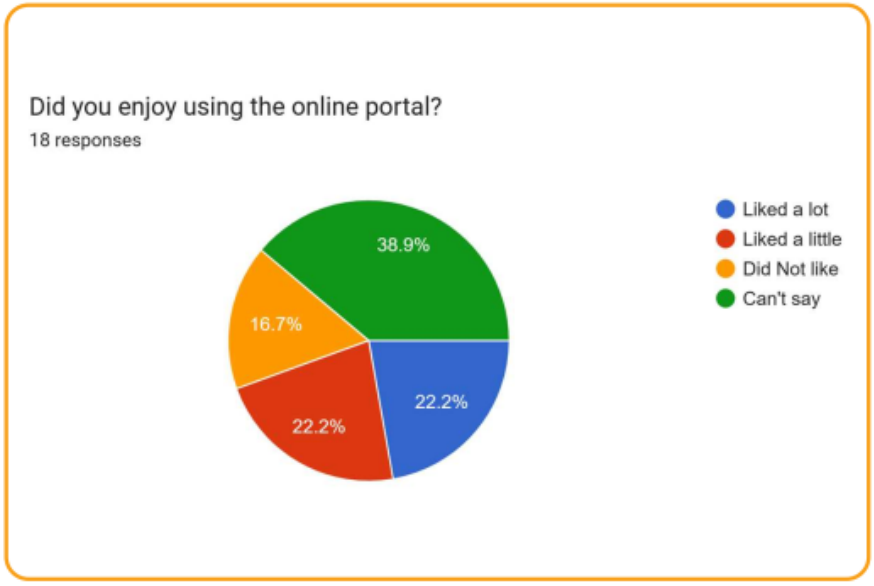
What should be improved i.e. Run programme for longer



TBH, a single monthly paper report about historical usage is pretty useless in changing behaviour. You MUST move to an online reporting and notification system with the real time usage data, and provide facilities to move bridge from "raw data" to "data, analysed and with insights". Consider proactively notifying the end user using tunable monitoring and notification systems to help the user become more conscious of consumption. I want a notification on my phone (via app or otherwise) "Have you left a tap on? Between midnight and 6 am this morning you've used 100 litres of water". Select "I know about it, no worries", "Thanks, I've fixed a problem" or "Yes there's a problem, I'll get someone to fix it". Provide alerts when thresholds are breached on comparatives. Eg. "You have used 500 litres in the last hour, at this time of day you average 150. Is everything ok?" Then provide consumption data that gives the user the ability to analyse and attache a comment to hourly consumption volumes to help quantify drivers of usage. Eg. a peak monthly usage of 5000 litres in one day from 9am to 12pm. Would be useful for user to note that was due to "annual top up of swimming pool". I have no idea how much water my washing machine and dishwasher uses. Suggest how we can trap that info. Provide a sparkline that shows consumption against other benchmarks. Eg. my consumption v the "the 20% most efficient homes with similar occupancy profile". Also, many councils include an annual quota volume within the householder rates. Show how the household is tracking against that. With some predictive extrapolation you could suggest when that quota will be exceeded. "You have consumed 82% of your council allotted volume. At present consumption rates, you will exhaust your allocation in 54 days and your estimated Excess Water Charge from your council will be $755." Gamify consumption comparisons - leaderboard style...congratulations, YTD you are the 5th most efficient 4-pax house in the street, region, island country etc

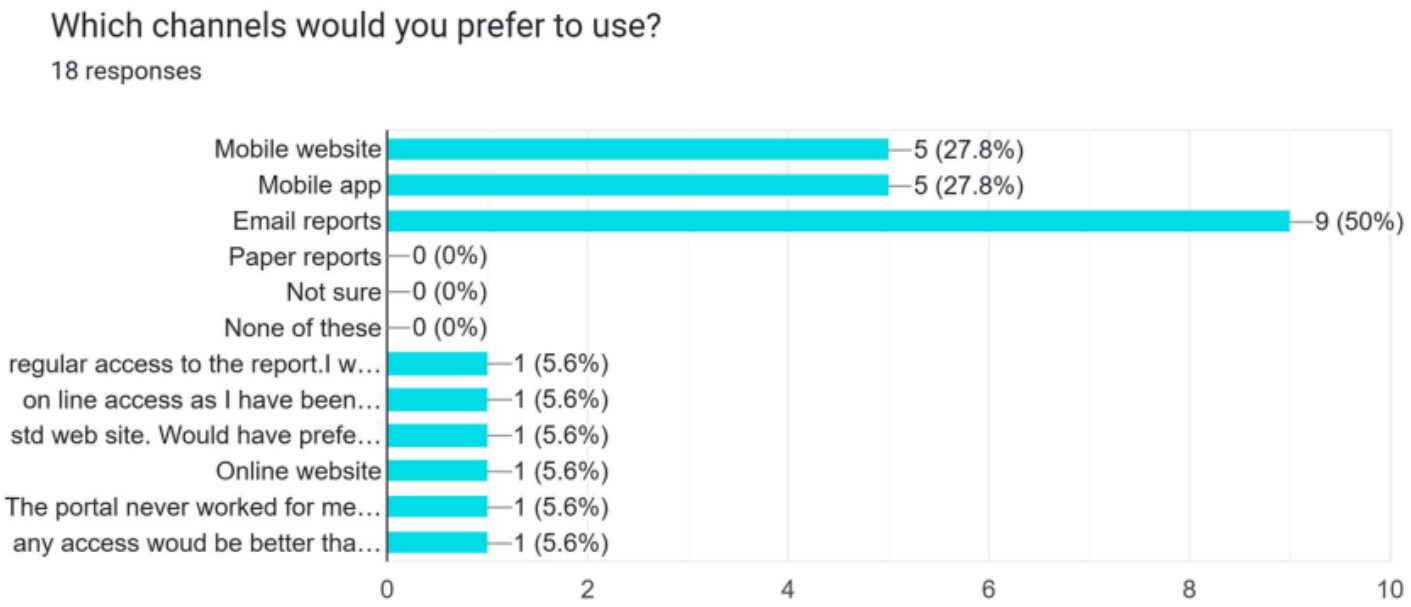
Customers both used and enjoyed the portal but 39% can't say just yet





Reminder: It is proven that customers not engaging online but receiving paper/email reports do save water too

Customers prefer a combination of online and email but paper/post reports are proven to drive most water savings



M: W350 Smart Meter Specifications

Category	Details
Type	Ultrasonic smart meter with optional pressure and/or acoustic sensors
Sensor location	Optional sensor/s are internal
Antenna	Internal antenna External antenna currently being prototyped
Unit pipe diameter	20mm inlet and outlet
Unit Threading	Customisable (Trial: 50x 14TP and 250x 11TPI)
Unit size	Approximate: L: 70mm W: 50mm H: 80mm
Network	Narrow Band Internet of Things (NB-IoT)
Internal Features	Non-return valve, antenna
Detection Capabilities and Alarms	Flow data and leak alarm Overflow rate data Tamper alarm Reverse flow alarm
Display	Electronic liquid crystal display with light-sensitive button
Material	Casting: Polymer Flow tube: DZR brass (dezincification-resistant brass)
IP Rating	IP68
Minimum Flow Rate	0.01m3/h
Transition Flow Rate	0.016m3/h
Max. Cont. Flow Rate	4.0m3/h
Overload Flow Rate	5.0m3/h
Flow Rate Ratio	R160 / R200 / R250
Max. Admissible Temp.	50ºC (T50)
Max. Admissible Pressure	1,600 kPa
Pressure Loss Class	∆p63 or 40
Accuracy Class	2
Environmental Class	B & O (indoor and outdoor)

Orientation	All positions (154mm long)
Flow Direction	Forward (duel non-return valve)
Power Supply	Non-replaceable battery (3.0 – 3.6 V)
Electromagnetic Class	E1 (residential, commercial and light industrial)
Connections	Threaded end connections, type standard R ¾ G1
Flow Profile Sensitivity Class	U0 / D0 – No flow straightener or flow conditioner is required. An optional strainer may be fitted
Firmware updates	FOTA (firmware over the air/NB-IoT) *Updates are also possible via optical cable, laptop and configuration software*

N: Installation Troubleshooting Instructions (Handover Document)

Citycare Water

Installation Handover Documentation

Greytown Smart Water Meter Trial

Trial Scope:

Period:	January to December 2022
Installed:	105x Landis+Gyr W350 base flow meters, 11TPI
	45x Landis+Gyr base flow with pressure sensor meters, 14TPI
	50x Landis+Gyr base flow with acoustic/vibration sensor meters, 11TPI
	25-to-20mm brass reducers (installed until adaptor tails arrived)
	250x Kitz gate valves with T bar handle – Wellington Water approved
	45x pairs of Strongcast adapter tails, 14TPI-to-11TPI – Wellington Water approved
	50x pairs of Strongcast adapter tails, 11TPI-to-11TPI – Wellington Water approved
	10mtr roll of Plumbers teflon professional threadseal tape (used with washers between brass fittings)
	500x fibre washers – Wellington Water approved
Removed:	Mechanical meters (returned to Wellington Water for testing)
	Existing Manifolds
Note:	Due to delivery delays for the acoustic sensor meters, additional base flow meters were installed at the acoustic meter intended sites until they had arrived. For these 50 sites, 11TPI-to-11TPI adapter tails were installed to assist with the future base flow to base with acoustic sensor meter swap outs.

Standard Installation Procedure: Existing manifold style TOBY

1. Take the smart meter out of flight mode by pressing the light sensitive button

   Quantity/frequency of pressing required is dependent on firmware version loaded to the meter at the time – firmware version can be confirmed by Landis+Gyr.

   Refer to the below instructions around network connectivity.

2. Excavate around the meter box to expose the stainless steel 'flexi' pipes
3. Check the flexi pipe fittings are not leaking. If there is a leak, repair or remove flexi pipe and replace with a PE pipe
4. Remove the meter box
5. In leu of gaining approval to turn off the water supply by shutting down the main, clamping or freezing the supply, begin 'live' installation
6. Remove existing manifold and meter, and carefully manipulate the flexi pipe to create enough room to install the new gate valve and Landis+Gyr meter
   Note: You cannot cut the flexi pipes, as there is no fitting to connect it to
7. Replace existing meter base (without the manifold locating fitting)
8. Install the new inline smart meter and gate valve

   Ensure the arrow on the meter is pointing in the direction of the water flow
9. Flush the customers service through the outside hose tap, and check the meter is operating (I.E., measure the flow of water through the meter)
10. Reinstate the meter box. If damaged, replace with new
11. Check fittings are not leaking
12. Backfill around the meter box
13. Reinstate the surface around the meter box

Installation Procedure: No existing manifold style TOBY

If a water service is located where there is no shut off valve already installed: A gate valve will need to be installed and the above installation procedure followed.

On-site smart meter configurations

1. Confirm the meter is turned on by opening the lid and viewing the LCD screen
2. Take the meter out of flightmode by consistently holding finger over light sensitive optical button for 10 seconds

Optical button:

3. Swipe your finger over the light sensitive button for a specified number of times (based on firmware version on meters at the point in time)

   The following number of swipes were undertaken to initiate meters in the trial:

   - Base flow W350 smart meters: 3 swipes
   - Base flow with pressure sensor W350 smart meters: 3 swipes
   - Base flow with acoustic sensor W350 smart meters: *5 swipes

   Acoustic sensor meters installed at later date and had a later version of firmware

4. Wait 5-seconds until the meter displays 'SUCC' to indicate the initiation was successful
5. Wait for up to 30-minutes (physical work can be carried out in the meantime)
6. A WIFI/network signal symbol should now be on display on the top left corner of the screen
7. Press finger to light sensitive optical button again, tapping to cycle through displays until the m3 value display screen is reached

Risks and Troubleshooting

Acknowledged installation related risks:

- Delicate nature and doublehanding of stainless-steel flexi pipes
- Possibility of leakage at fittings (note that additional washes were supplied in case of this)
- Meter box size impact on ability to complete retrofits without excavations at certain sites (difficulty using tools inside meter box once W350s have been installed)
- Flat batteries quicker than intended (7+ years) at sites with lower network service levels
- Minimal possibility of faulty meters for misc. reasons
- Intermittent or no NB-IoT network connectivity achieved (intermittent smart meter data overridden daily past 21-days with no connection, however, total flow is retained regardless)
- Changes to smart meter configuration process based on current firmware version

Troubleshooting suggestions:

Leak at fittings: spanner	Remove and replace fibre washes, before tightening the fittings with
Damage to flexi pipes:	Repair or remove flexi pipe and replace with a PE pipe
Flat battery:	Remove meter and replace with spare via above installation process
Faulty meter:	Remove meter and replace with spare via above installation process
No network connection:	Follow the above instructions to attempt to 're-wake' the meter
Meter remaining in flightmode:	As firmware versions vary, check with Wellington Water/Landis+Gyr to confirm if the meter initiation process is different for the version of firmware on the individual meter.

O: Pre-Trial Usage Per Household

Measure	*Census Data L per day, per person	**FY2020-21 Data L Per day. per household
Average Usage	215	500
Median Usage	183	427
Minimum Usage	0.01	0.02
Maximum Usage	979	2,279
25Th Percentile Usage	105	245
75th Percentile Usage	279	649

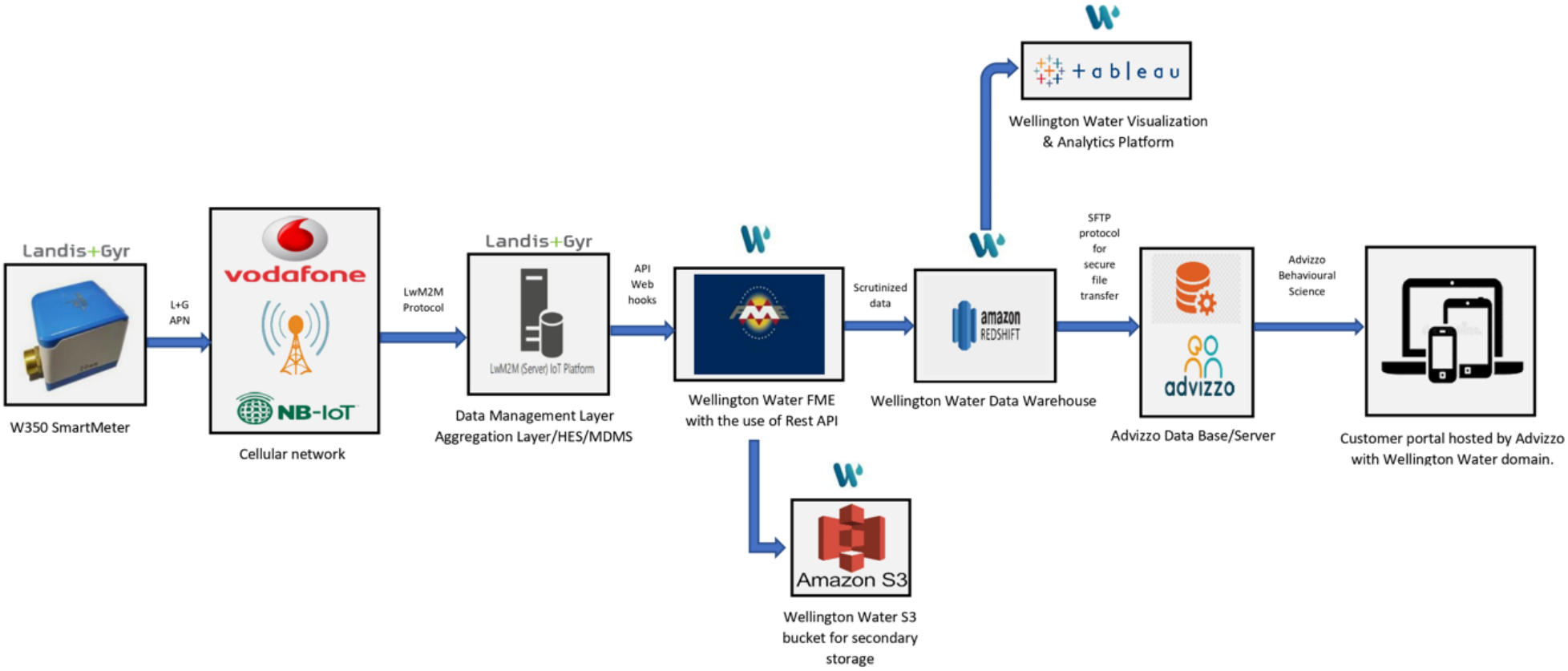
*Based on 2018 New Zealand census data of 2466 people, 1059 occupied dwellings at 2.33 people per household.

**Based on Greytown consumption data and assessed via the parameters discussed above in the table.

P: Connectivity and Backlog Data by Trial Month

Redacted – contains commercially sensitive information relating to third parties.

Q: Smart Water Meter Solution Architecture Diagram



R: Survey123 As-built Data Capture

Is an existing asset being replaced, upgraded or repaired?*

Replaced = there was an operational meter in place but will be replaced as part of a area trial/upgrade
Repaired = the meter was faulty and has been removed, replaced and reinstated
Upgraded = the meter was faulty and has been replaced with a new one
New installation = The property had never been fitted with a meter or any type

- (●) Replaced
- ( ) Upgraded
- ( ) Repaired
- ( ) New Installation
- ( ) No installation possible

Service address:

This is the address of the house that is serviced by this asset - not the physical address of the meter

Address of install:*

The address where the meter is installed. In most cases this will be the same as the service address, but may vary if the service address is at the end of a R.O.W or on the corner of two streets.

Fulcrum ID

Meter Location

Property type:*

- ( ) Commercial property
- (●) Domestic house with garden
- ( ) Town house
- ( ) Appartment
- ( ) Bare land
- ( ) Market garden
- ( ) Public land

Water distribution type:

For household connection select Potable Water Distribution

- ( ) Potable Water Transmission
- ( ) Potable Water Treatment
- ( ) Potable Water Storage
- (●) Potable Water Distribution

Primary function of the meter:*

- ( ) Commercial
- (●) Water usage
- ( ) Leak Detection

Is there a secondary function of the meter? If so, what:

- ( ) Commercial
- ( ) Water usage
- (●) Leak Detection

Existing Meter

Serial number of existing meter*

Format: letters need to be upper case please

How clear is the existing meters desplay?*

- ( ) Clear and legable - reading is accurate
- ( ) Partially readable - estimate reading
- ( ) Unreadable - no final meter reading

Location photo of the meter

Show enough of the surounding area to gave some context of the meters location in relation to buildings, kerbs and other structures

Photo of display panel of the meter

New/Replacement Meter

Installation date*

3/09/2022 02:03 PM

X coordinate of meters location

Please enter in this format: 1,760,979.59

Y coordinate of meters location

Please enter in this format: 5,435,541.08

Latitude of new meters location

Please enter in this format: -41.215509

Longitude of new meters location

Please enter in this format: 175.920330

Installer of the asset?*

- Wellington Water
- Ives Plumbing Limited
- Pope and Grey Limited
- Action Civil Limited
- SAP Contractors
- Construction Contracts Limited (CCL)
- McLatchie & Sharp Ltd
- (•) City Care

What ground surface is the meter to be installed in?

- (•) Grass
- Concrete
- Gravel
- Asphalt

Nominal Diameter (mm)

20

Pipe Material (in to meter)

- HDPE
- MDPE

- ○ Stainless Steet
- ○ Copper
- ○ Other (please specify)

Pipe Material (out to meter)

- ○ HDPE
- ○ MDPE
- ○ Stainless Steet
- ○ Copper
- ○ Other (please specify)

How is the meter read?

- ○ Manual (Dial / Pulse)
- ○ Digital proximity (Smart meter)
- ◉ Digital telemetry (Smart meter)

Make:*

Landis + Gyr

Model:*

- ◉ W350 Smart Meters
- ○ W350 Pressure Smart Meters
- ○ W350 Vibration Smart Meters

Serial number of the new meter*

Format: letters need to be upper case please

Is there a secondary meter?*

- ○ Yes
- ◉ No
- ○ Unknown
- ○ Not Applicable

What is the application of the meter?*

- ○ District metered area (DMA)
- ○ Small area meter / Monitor
- ◉ Customer - domestic use
- ○ Customer - non-domestic use
- ○ Bulk meter

What is the alignment of the meter?*

- ◉ Inline
- ○ Manifold
- ○ Bypass
- ○ Inline combination
- ○ Flume

Is there a strainer installed with this meter?*

- ○ Yes
- ◉ No
- ○ Unknown
- ○ Not Applicable

Type of mechanism used:*

- ○ Electromagnetic
- ○ Mechanical
- ○ Turbine
- ○ Insertion probe
- ○ Oriface Plate
- ◉ Ultrasonic
- ○ Dall Tube
- ○ Unknown

What is the power supply of the meter?*

- ○ Mains power
- ◉ Battery
- ○ Solar
- ○ Wind
- ○ Non-powered

What is the meter reading in cubic meters (m3)?*

Provide these details if the meters initial reading is greater than zero on installation. Three decimal places only please.

123 0

How many digits on the display?*

default to be provided by Jonathan

1 Reset 10

123

Photo of display panel (replacement meter)

Photo of installed meter

A photo of the meter in the ground after it has been connected

Location photo of the meter

Show enough of the surrounding area to gave some context of the meters location in relation to buildings, kerbs and other structures

Address confirmation

Confirmation that the meter was installed in the correct property - include the letter box or other identifying feature

Plants and structures that were impacted by the installation

Installation status*

Status provided by City Care

- ○ Fully Installed
- ○ Pressure Meter Installed
- ○ Vibration Meter Installed

Quality assurance status*

Status provided by Wellington Water

- ○ Not reviewed
- ○ Review in progress
- ○ QA Complete - corrections required
- ○ QA Complete - without corrections

S: MNF and network management

Minimum night flow (MNF) is a method used to estimate water loss in a water network by measuring the flow into a controlled area during the period with minimum demand. It is a common technique worldwide that allows subtracting the expected legitimate water consumption from the recorded system inflow.

Based on prior experience, Landis+Gyr provided information about the general process of applying MNF with the W350 smart meters:

- Dividing the water network into District Metered Areas (DMAs) that can be isolated and monitored
- Installing flow meters and pressure sensors at the inlet and outlet points of each DMA
- Collecting and analysing data on flow and pressure during night hours (usually between 1:00 am and 4:00 am) for several days or weeks
- Calculating the average MNF volume per day and per connection for each DMA
- Comparing the MNF indicators across different DMAs and identifying areas with high leakage or wastage
- Implementing leakage detection and reduction measures in the problematic DMA's

Landis+Gyr recommended the MNF methodology to also be used to identify domestic leakage, as well as network leaks. The addition of acoustic/vibration/sotto leak detection sensor meters increased the potential to detect leaks, via this method, with greater granularity.

T: Engagement and Communication Activity List

The below mid-trial reporting was provided by Wellington Water communications representatives during the trial.

September 2021: Pre-installation

- Wellington Water issued a media release about the trial, its objectives and the beginning of the property selection process – resulting in media coverage in The Wairarapa Times-Age (daily paper) and Wairarapa News (weekly paper).
- An article about the trial was printed in the monthly Greytown community newsletter 'Greytown Grapevine'.
- Social media posts about the trial were posted on the Wellington Water and South Wairarapa District Council Facebook pages.
- Letters were sent to approximately 350 households and absent owners of Greytown properties with water meters in suitable locations sent notification of their property selected to be included in the trial and information about the trial (including FAQs). Following this letter being sent, approximately 30 – 40 households opted out of the trial.

November 2021: Pre-installation

- Update letters sent to approximately 300 households – outlining meter installation process and timeframe and providing details of an online customer portal and smart water meter ID to use to view water consumption data. The letter also invited householders to attend a community open day to learn more about the trial. Approximately 10-15 households opted out of the trial.
- Community Day held at Greytown Town Centre to share information about the trial. Members of the project team were in attendance to answer questions; for example, smart meters were available to view, computers demonstrated how the online customer portal worked, and several attendees were assisted in signing up to the customer portal.

December 2021 – March 2022: Installation

- Wellington Water worked with contractor Citycare Water to draft and agree on a pre-install letter that would be delivered to each household the week of installation to inform them of the installation process and that water would be turned off briefly. The letter noted they would receive a door knock on the day of the installation as well to verbally inform them that work was being undertaken.
- Approximately 50 properties that were to have vibration meters installed received a tailored version of the pre-install letter. The letter noted Citycare Water would need to return in 3 months' time to complete additional upgrades.
- Due to the Covid Omicron outbreak in January 2022, the door knock verbal notification step was replaced with a door knock and letter drop at the doorstep. The letter contained all the points the contract team previously conveyed verbally to minimise contact with residents.
- Once the installation was completed, a 'completion card' was dropped in the letter box. The card had a sticker added to it in early January 2022, reminding people about the information trial and to contact the engagement lead to get their property code for their meter. This led to an increase in requests for property codes.
- It was discovered during the installation phase that 2 meters were installed at the wrong properties due to TOBY boxes being side-by-side. Letters were sent to both properties to explain the mistake and apologise. The letter also noted there would be no change to the water supply or any requirement to participate in the information trial.

April 2022 – August 2022: Post-installation

- Following the installation of the meters, Wellington Water worked with the South Wairarapa District Council to develop a 'leak detection' letter to be sent to trial participants where the smart meter installed at their property had detected higher than usual water use indicating an undiscovered leak.
- In early August 2022, 30 properties received notification from Wellington Water that due to a cellular network coverage issue, their property smart meter had been unable to connect to the online system. This meant real-time water use information was not able to be sent to Wellington Water or viewed on the customer portal, and meters would continue to be manually read on an annual basis.

The below post-trial reporting was added by Citycare Water following the completion of the trial.

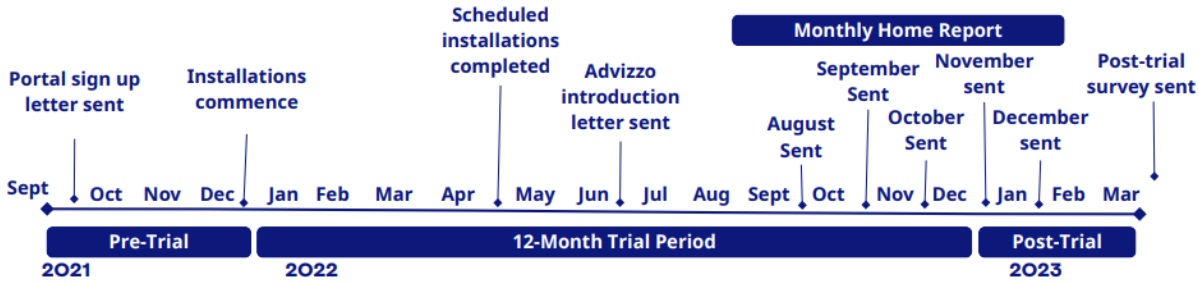
September 2022 – December 2022

- In mid-September 2022, the first home report emails and letters were sent out to applicable householders (householders who had smart meters installed and had sufficient meter data for the month of August).
- Home report letters were prepared and sent by Wellington Water for the subsequent months of September – December 2022
- Leak letters were sent by Wellington Water project team members to householders with unusual leakage data during these months

January 2023 – May 2023

- In January 2023, the last home report letters and emails for the month of December 2022.
- A final letter was sent out at the same time as the final (December) home reports were sent, letting householders know that portal access was no longer available and that no more home reports would be sent for the time being.
- Wellington Water, Citycare Water and Advizzo worked together to prepare a post-trial survey in April 2023. This was sent to householders in mid-April 2022.

U: Community Engagement Timeline



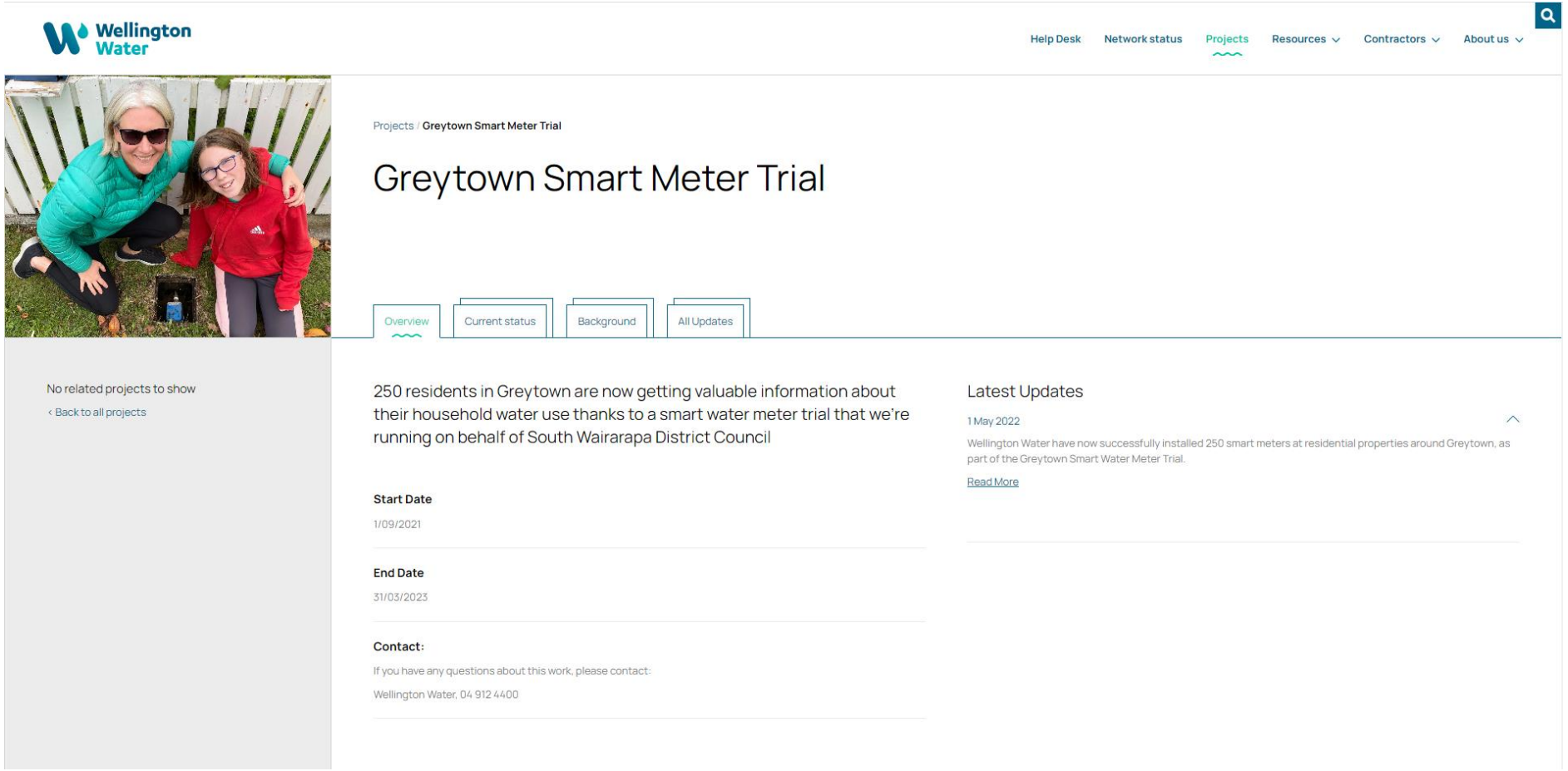
Deploying the monthly home reports was delayed due to the following reasons:

- Installation schedule delays (as highlighted in the Hardware and Installations section of this report).
- Hardware delays (as highlighted in the Hardware and Installations section of this report).
- Additional installations/retrofits.
- Incorrect and/or incomplete on-site installation/data capture, resulting in the need for additional troubleshooting.
- Double-handling of data due to multiple data capture systems being used by various parties.
- Environmental-related NB-IoT network connectivity refinement.
- Customisations to the Advizzo email feature, where added development and resource was carried out (as highlighted in the Connectivity and Data Flow section of this report).

V: Key Engagement Themes

Themes	Communicated Messages
Personal data privacy	It was important to ensure community members felt confident that their personal data was protected throughout the trial and that they were provided with the option to opt out of the trial at any given time.
Usage data privacy	It was important to communicate that the purpose of the trial was not to monitor, share or constrain individual water usage but instead to find leaks and acknowledge aggregated behavioural patterns in relation to the delivery of communications methods.
Leak Management	It was important to highlight the significant number of leaks in the region and throughout New Zealand and the role smart meters can play in helping to mitigate this issue.
Community Member Costs	It was important to emphasise the fact that this was a trial focusing on leak management and sustainability rather than water charging.
Community/Council Costs	It was important to highlight the significant increase in leak detection capabilities through smart meters to highlight the investment in the new hardware (vs what can be detected with standard mechanical meters and related software).
Sustainability	It was important to highlight water as a valuable resource for communities, along with providing realistic, approachable and non-judgemental ways to preserve it (i.e., through personalised tips).
Technology Accessibility	It was important to ensure the community had the knowledge and resources needed to access the information online and that they knew where to contact if assistance was required.
Knowledge Accessibility	It was important to ensure that the community had the knowledge and resources needed to view and understand the water usage and leak information and that they knew where to contact if assistance was required.

W: Wellington Water Website Screenshots



Projects / **Greytown Smart Meter Trial**

Greytown Smart Meter Trial

Overview | Current status | Background | All Updates

250 residents in Greytown are now getting valuable information about their household water use thanks to a smart water meter trial that we're running on behalf of South Wairarapa District Council

Start Date

1/09/2021

End Date

31/03/2023

Contact:

If you have any questions about this work, please contact:

Wellington Water, 04 912 4400

Projects / **Greytown Smart Meter Trial**

Greytown Smart Meter Trial

Overview | Current status | Background | All Updates

Current Status

Wellington Water have successfully installed 250 smart meters into residential properties in Greytown, as part of a trial project. Home reports have been sent to trial participants, which give residents an understanding of their water usage habits compared to similar properties in their area.

Smart meters are a key tool for detecting leaks and burst pipes, helping conserve water on the public and private water network. Wellington Water will provide a report on the project findings, once the data has been analysed and validated.

Projects / **Greytown Smart Meter Trial**

Greytown Smart Meter Trial

Overview | Current status | Background | All Updates

What's Happening?

Wellington Water and South Wairarapa District Council are undertaking a residential smart water meter trial at 250 properties in Greytown to look at how smart meters can help us better manage our water.

A smart meter is a water meter connected to a digital device that records real-time water use. This allows households to monitor how much water they are using and can indicate leaks faster than the current annual water meter reading process.

Approximately 40 percent of South Wairarapa water is lost due to leaks in water pipes. Smart meters can provide real-time information on household water consumption and detect greater than normal water use that indicates pipe damage and leaks. This has the potential to help us identify and fix leaks as quickly as possible, which in turn helps us save water for our region.

There is no cost to participate in the trial, and there will be no changes in the cost of water to property owners, or tenants, during this trial.

The trial will look at how effective the smart meters are at helping us detect leaks, and any changes in the way households consume water during the trial. The trial will also look at how to best communicate with customers about their water use. Participants will be offered real-time water information and water use insights, as well as tips to save water.

Projects / **Greytown Smart Meter Trial**

Greytown Smart Meter Trial

Overview | Current status | Background | All Updates

All Updates

1 May 2022

Update May 2022

Wellington Water have now successfully installed 250 smart meters at residential properties around Greytown, as part of the Greytown Smart Water Meter Trial.

Trial participants can access the trial customer portal to view their household water consumption data by signing up using their unique property code. Household water information is expected to begin transmitting from the smart meters by the end of May.

The trial will run until the end of 2022 at which point at which point Wellington Water will provide a report to the South Wairarapa District Council detailing key findings and learnings.

X: Advizzo Portal Implementation

Summary

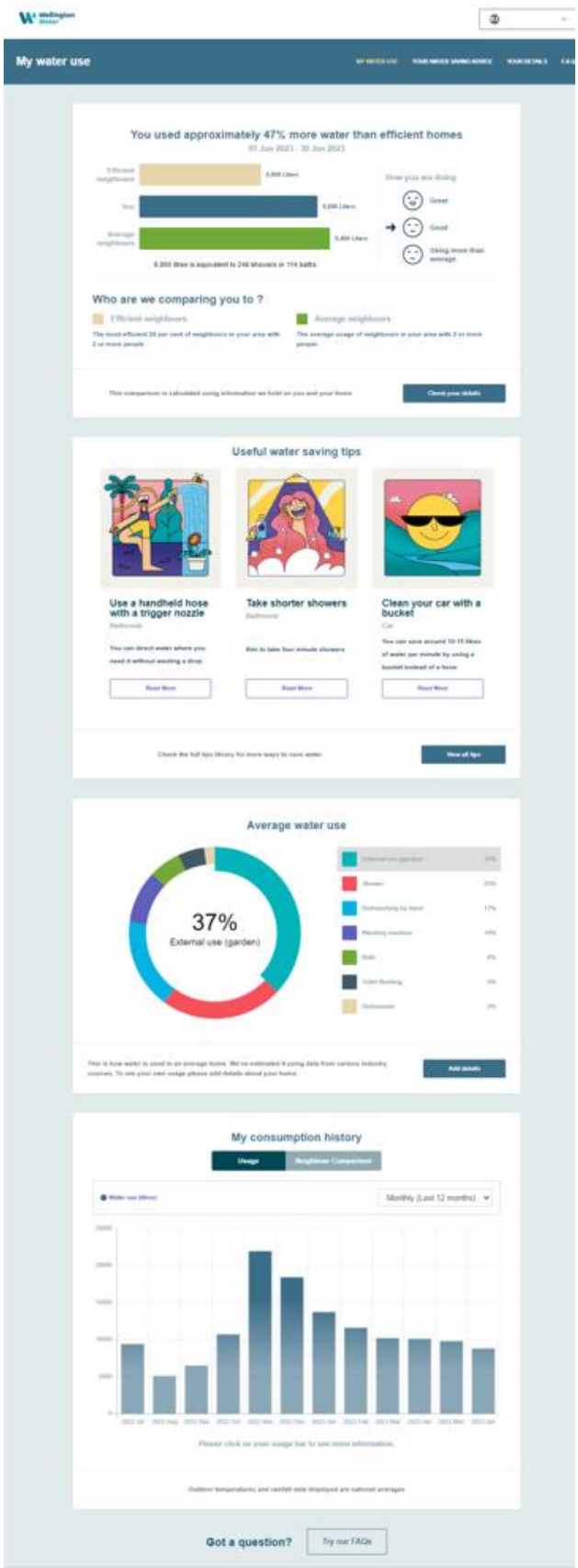
The portal implementation process commenced following the initial May 2021 desktop discovery phase, whereby 311 user profiles were set up in Advizzo ahead of the September 2021 community engagement day, and an introductory letter was also sent in September 2021. The letter prompted community members who lived at the selected applicable properties to register their interest in the Advizzo portal online (in Advizzo).

Customer profiles featuring water usage data and additional features were made available to those who pre-registered for the portal from August 2022 onwards. Monthly usage letters and emails, also known as home reports, were sent for the months of August – December 2022, with the first of which being sent in September 2022. The number of portal users and recipients of home reports increased monthly. Apology letters were required as an additional measure for properties which were unable to gain network connectivity and for properties which could only achieve very intermittent communications. Householders could choose to opt out of receiving monthly usage letters/emails directly in the portal or by contacting Wellington Water via the contact details listed communications material.

Objectives

- To onboard and engage Greytown community members in the trial.
- To ensure the trial more interactive in nature.
- To customise communications for each community member (optional survey, personalised tips, neighbourly comparisons).
- To provide trial participants with their intermittent daily usage data.
- To provide education about ways to consume water sustainably.
- To monitor behavioural changes in response to communications.
- To gain region-wide insights through the admin/analytics portal.
- To alert community members and the project team to potential domestic leaks.

The portal was designed to be visually appealing, approachable and interactive, as displayed below.



Portal and Communications Benefits

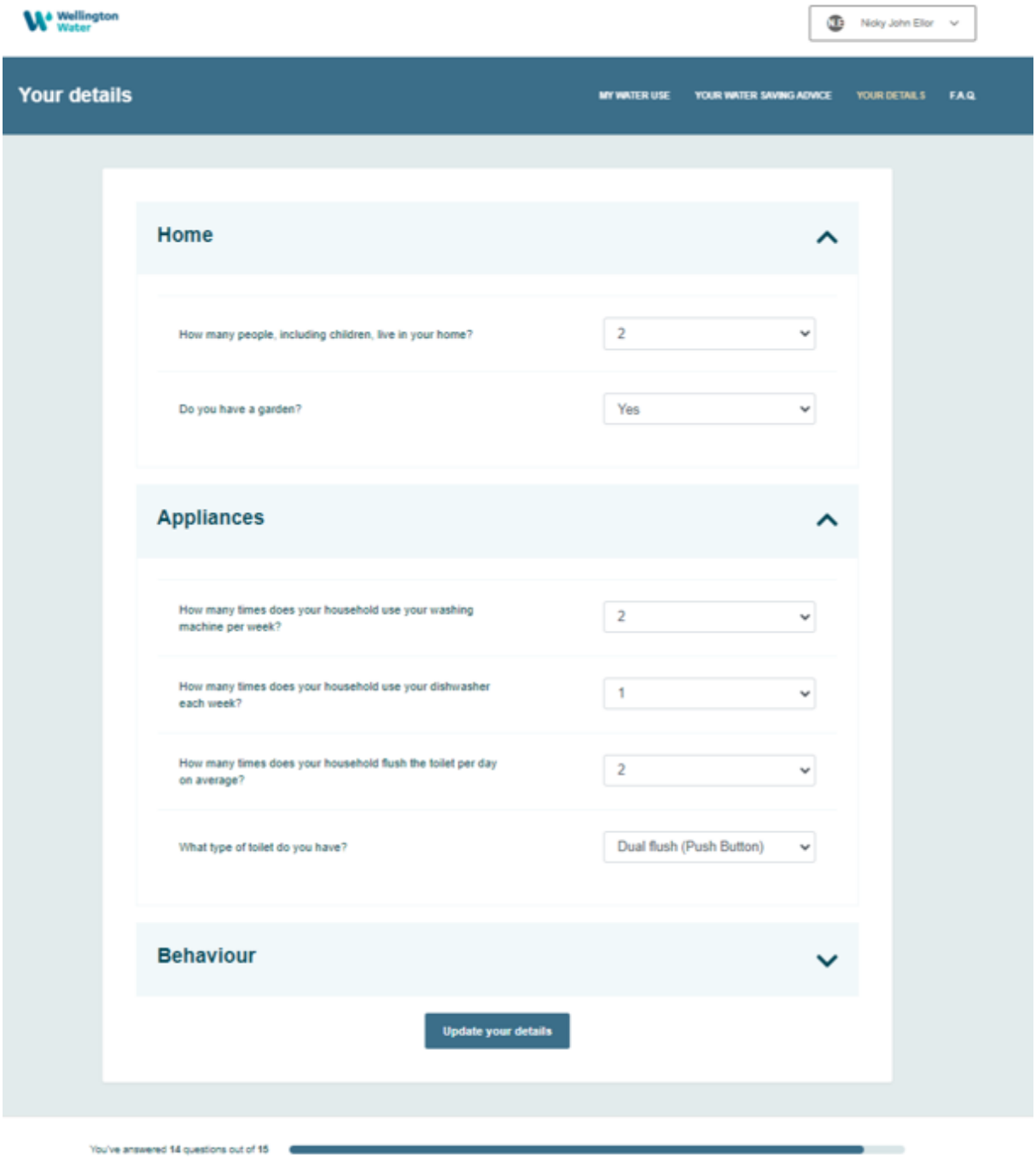
- Understanding customer behaviour when providing smart water metering data through a customer trial.
- Providing householders with consumption data and insights using a customer portal and/or via email communications.
- Delivering key messages and advice.
- Meeting the objectives outlined in the Charter document
    - Providing core comms via preferred channel(s) to householders throughout the trial
    - Providing Wellington Water with administrative access to the Advizzo portal to access householder engagement and water usage data
    - Providing householders with personalised monthly consumption and education-focused reports, including neighbour comparison and customised tips
    - Providing leakage alerts to householders at the agreed cadence via preferred comms channel(s)
    - Providing Wellington Water with Advizzo behavioural science and user experience expertise in shaping a comms plan; up to 10 days of remotely delivered input time from Advizzo's London-based team is included in our proposal pricing
    - Ensuring data protection and privacy throughout the trial.

Communication Methods

Method	Reasoning
Email	Community members who signed up to participate in the trial (/to have access to the portal) and provided email addresses.
Letters by mail	Community members who did not sign up to participate (/to have access to the portal) but who had smart meters installed at their property during the trial.
Nothing	Community members who did not sign up to participate (/to have access to the portal) and who have their personal details suppressed with South Wairarapa District Council.
Not applicable	Community members who did not have smart meters installed at their properties.

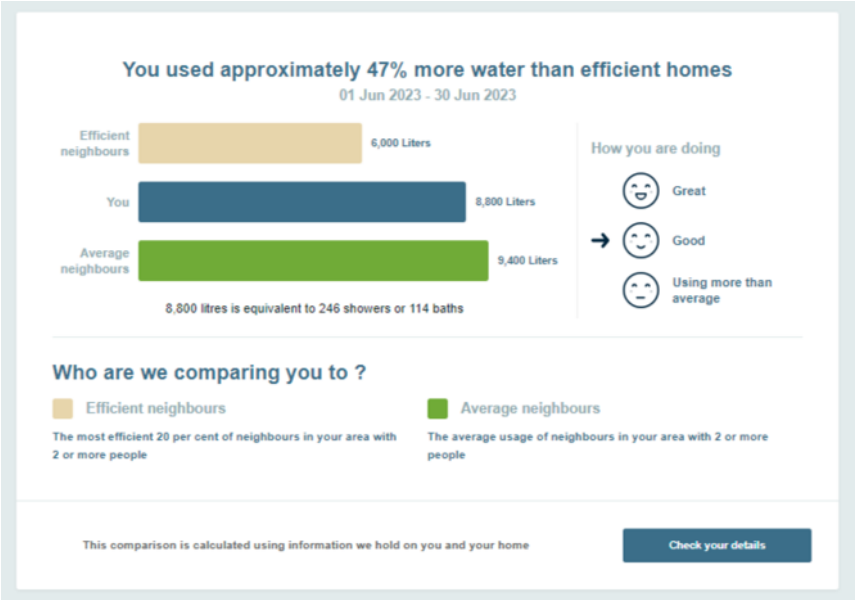
Localisation Methods Included in Trial

Introductory survey
Upon first logging into the customer portal, users were greeted with the option to complete a survey. The optional online survey, made up of 16 questions, was an impactful tool which allowed trial participants to update their household information and, subsequently, personalise their experience.

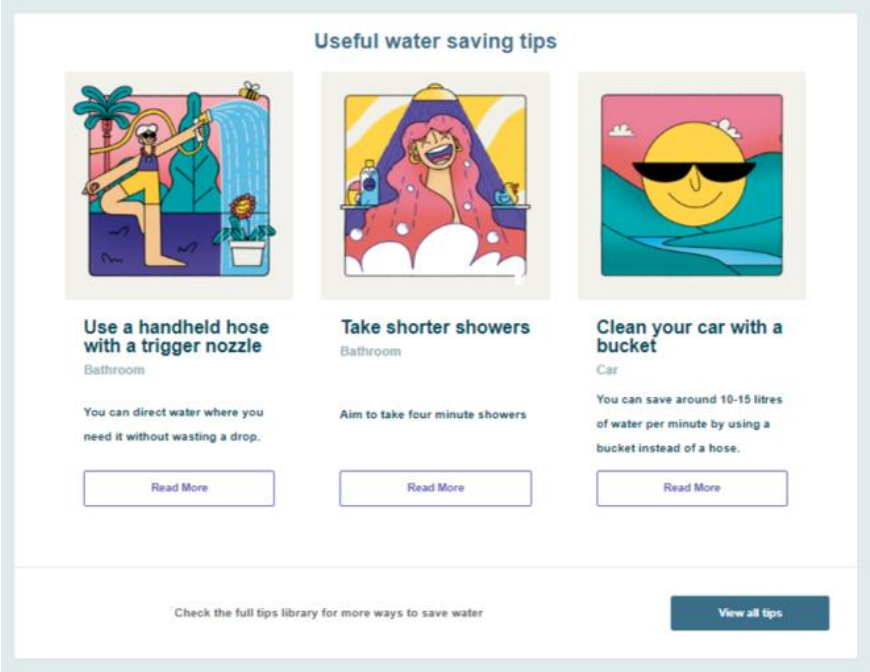


The survey was directly linked to several other functionalities, including the neighbourly comparisons, the tips engine and library and the disaggregation. By updating their occupancy and home details, customers gained a more accurate comparison with neighbours and were suggested increasingly accurate and refined tips and analytics.

Similar home comparison (neighbourly comparison)
The neighbourly comparison feature was considered a crucial part of the engagement strategy. It is believed that one of the most effective strategies to drive persistent behaviour change is through using social norms to compare usage patterns of similar households. Often, when presented with insight into what is a “normal” level of consumption for similar homes, users become motivated to be more efficient and adjust their consumption behaviours. Furthermore, identifying the desire to be in the “most efficient” home category is believed to encourage customers to become part of the group with favourable behavioural.



Personalised tips engine and library
Wellington Water made use of the customisable water-saving tips library/engine. Through the creation and addition of unique tip ideas, the portal and related communications were able to be further localised for the Greytown environment and norms. An additional layer of personalisation was added by different water-saving tips being provided to different consumption levels and profile information.



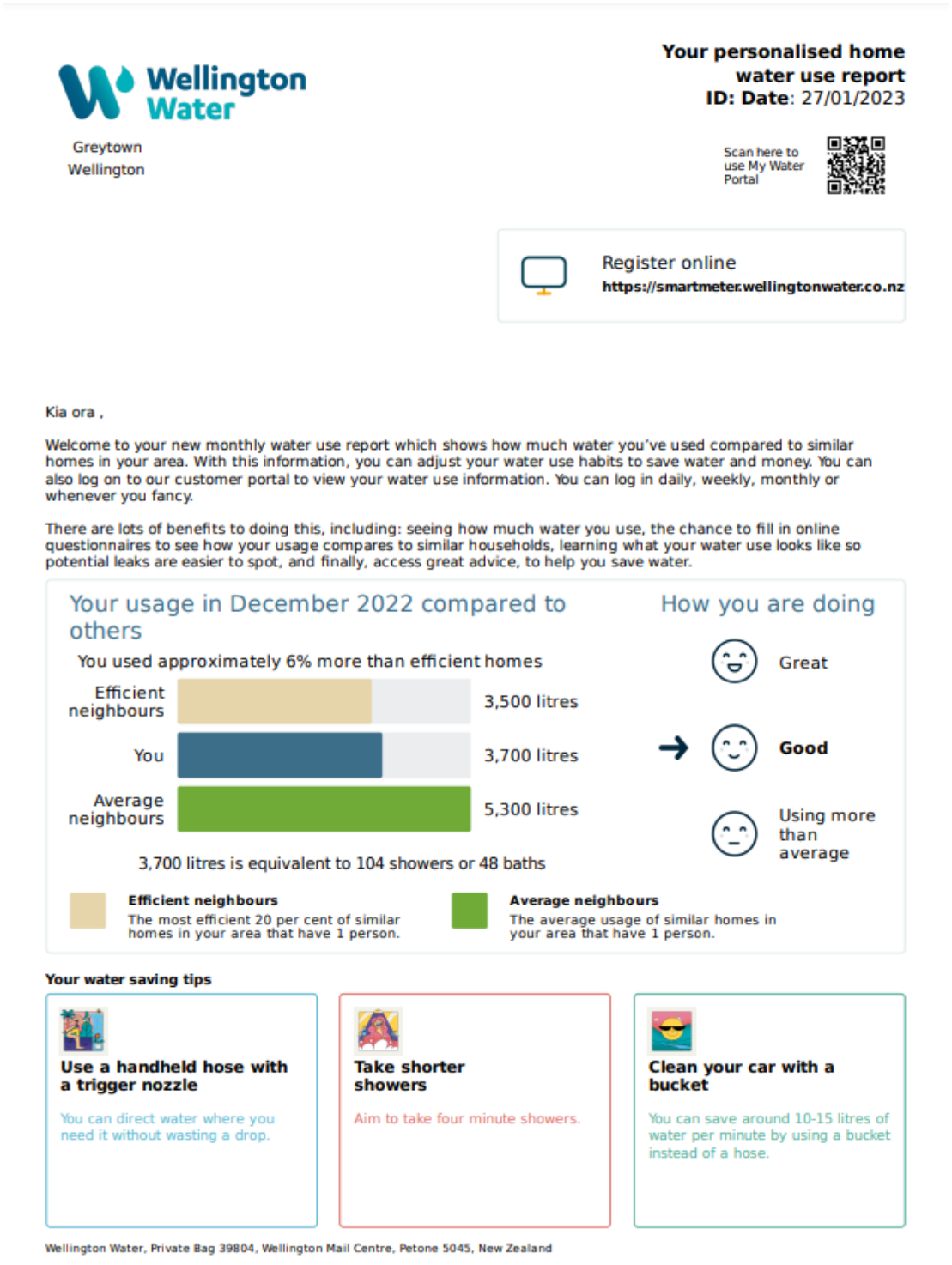
Branding
Wellington Water logos, colours, fonts, communication style, images and other branding elements were used for the portal. This ensured a seamless and familiar experience for trial participants when interacting with the portal, presumptively leading to an increased feeling of trust and assurance for users. This was important to establish when considering the nature of the data.

Language
Letters and emails were addressed broadly, with “Kia ora” being used for every letter.

Deployed Advizzo Features

PDF Letters

As part of standard practice, Advizzo generated letters in PDF format for the participants specified to be applicable for receiving letters from the project team. Mid-way through the trial, it was also arranged for PDFs to be provided to Wellington Water for participants applicable for emails. More information on this can be found in the Connectivity and Data Flow section of this report.



Wellington Water

Greytown
Wellington

Your personalised home water use report
ID: Date: 27/01/2023

Scan here to use My Water Portal

Register online
https://smartmeter.wellingtonwater.co.nz

Kia ora ,

Welcome to your new monthly water use report which shows how much water you've used compared to similar homes in your area. With this information, you can adjust your water use habits to save water and money. You can also log on to our customer portal to view your water use information. You can log in daily, weekly, monthly or whenever you fancy.

There are lots of benefits to doing this, including: seeing how much water you use, the chance to fill in online questionnaires to see how your usage compares to similar households, learning what your water use looks like so potential leaks are easier to spot, and finally, access great advice, to help you save water.

Your usage in December 2022 compared to others

You used approximately 6% more than efficient homes

Efficient neighbours — 3,500 litres
You — 3,700 litres
Average neighbours — 5,300 litres

3,700 litres is equivalent to 104 showers or 48 baths

How you are doing

Great
Good
Using more than average

Efficient neighbours
The most efficient 20 per cent of similar homes in your area that have 1 person.

Average neighbours
The average usage of similar homes in your area that have 1 person.

Your water saving tips

Use a handheld hose with a trigger nozzle
You can direct water where you need it without wasting a drop.

Take shorter showers
Aim to take four minute showers.

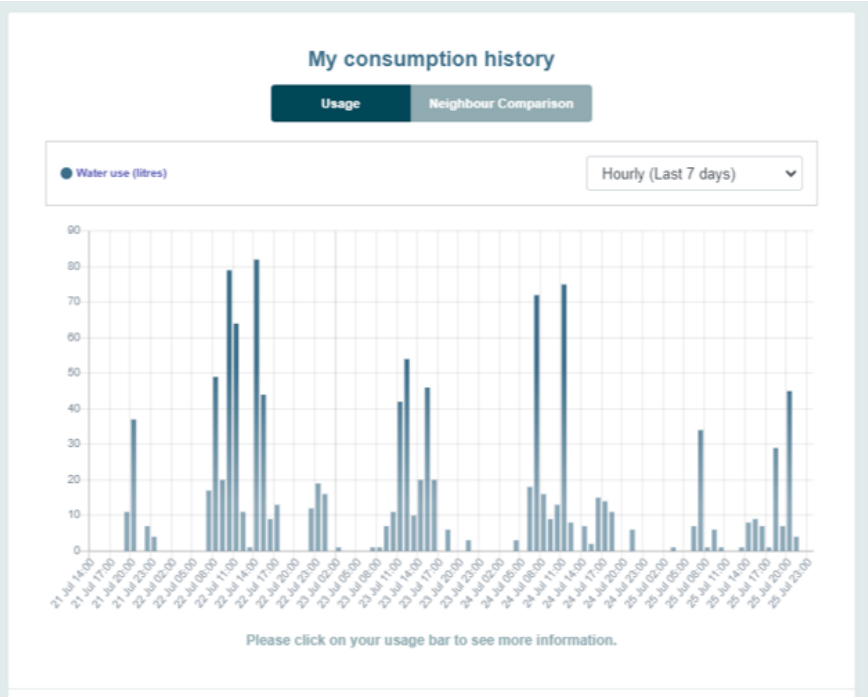
Clean your car with a bucket
You can save around 10-15 litres of water per minute by using a bucket instead of a hose.

Wellington Water, Private Bag 39804, Wellington Mail Centre, Petone 5045, New Zealand

Usage Totals and leak alarms
Trial participants, who logged in to the portal, were able to see their usage data at the rate of the configured meter reads (per hour) for the day prior.

Admin views
The admin view of the customer portal provided authorised Wellington Water members to view portals as a customer would. This allowed Wellington Water the potential for better troubleshooting of issues, such as continuous flow/suspected leaks.

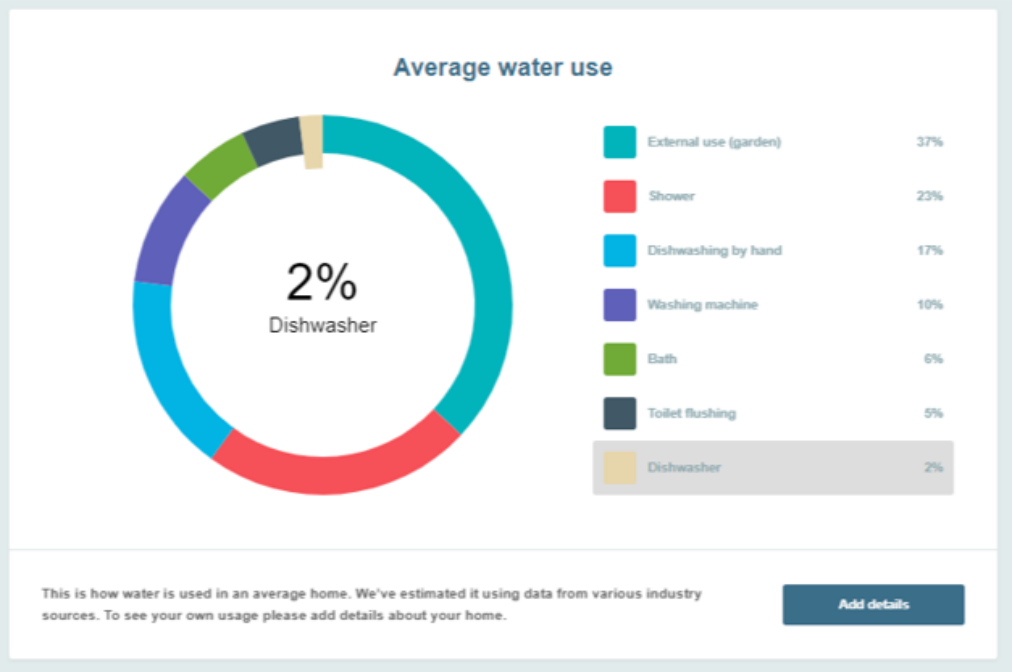
Historical Consumption Graphs
The consumption history graph provided the trial participant with an overview of their usage data since the time of installation.



This was a valuable engagement tool for most, considering the delays in providing community access to the portal. Although participants gained user access to the portal later in the trial, many could still view historical data and patterns, which had the potential to impact perceptions and behaviour.

Usage analytics and disaggregation

The admin portal also features analytics. Consumption and survey data provided trial participants with insights into usage patterns and disaggregation.

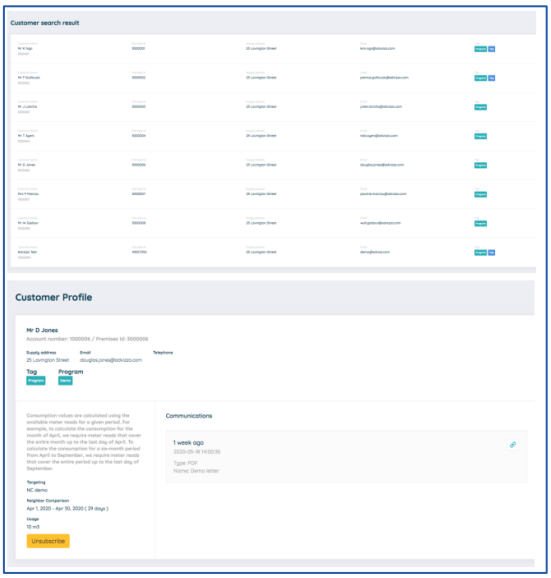


Excluded Advizzo Features

The below features were included in the project contract but were decided against implementation during the trial. Note that Advizzo also has other unused features outside of this trial's contracted scope.

Agent Portal

The Advizzo Agent Portal, which is part of the Advizzo product suite, was not utilised during the trial. This feature, when used, allows for customers to provide feedback and ask questions directly in the portal.



Clickable emails

The project team decided not to have emails sent directly from the Advizzo portal and instead to have PDF versions sent directly from Wellington Water.

Kia ora Nicola ,

Welcome to your new monthly water use report which shows how much water you've used compared to other similar homes in your area.

With this information, you can adjust your water use habits to save water and money.

You can also log on to our customer portal to view your water use information. You can log in daily, weekly, monthly or whenever you fancy.

There are lots of benefits to doing this, including: seeing how much water you use, the chance to fill in online questionnaires to see how your usage compares to similar households, learning what your water use looks like so potential leaks are easier to spot access to lots of great advice, to help you save water.

FIND OUT MORE

Your usage in December 2022 compared to others

You used approximately 82% more than similar homes

18,400 litres is equivalent to 515 showers or 239 baths

Efficient neighbours

The most efficient 20 per cent of similar homes in your area that have 2 people.

Average neighbours

The average usage of similar homes in your area that have 2 people.

How you're doing

Your water saving tips

Use a handheld hose with a trigger nozzle

You can direct water where you need it without wasting a drop.

Take shorter showers

Aim to take four minute showers.

Clean your car with a bucket

You can save around 10-15 litres of water per minute by using a bucket instead of a hose.

Wellington Water

Private Bag 39804
Wellington Mail Centre
Petone 5045
New Zealand

Unsubscribe from information emails
If you'd like to, you can unsubscribe from information emails.

You'll still receive emails about your account and the services you receive from us.

Data Protection
Your data is processed and stored in line with the General Data Protection Regulation.

For more information on how we process your personal data and the rights you have in relation

Engagement Levels

Level	Approach	*Value	**Data
Level One: Did not pre-register for portal/trial and did not interact later in the portal/trial.	Householders are notified before and after installation. Monthly usage reports are delivered to their mailbox.	An unobtrusive introduction to smart meters, sustainability considerations and related technologies. An indication of where their water usage sits amongst their neighbours. The opportunity to identify leaks through usual totals.	Smart meter flow and potential leak alert data.
Level Two: Pre-registered for the portal/trial but did not log-in when they were able to.	Householders are notified before and after installation. The portal introduction letter was delivered to their mailbox. Monthly home reports sent via email (if they provided an email during pre-registration) or letter (if they did not provide an email).	As above.	As above.
Level Three: Pre-registered for the portal/trial, logs in when available, but does not complete a survey or engage with tips engine.	As above.	As above.	As above.
Level Four: Pre-registered for the portal/trial and, once available, was an engaged user of the Advizzo portal (completed survey and engaged with tips library).	As above.	As above, as well as a customised user experience, with more personalised tips and more accurate neighbourly comparisons.	As above, as well as more granular platform usage analytics (specific to property types, householder numbers and preferences).

*Value to community member / **Trial data generated.

Y: Meter Box Leaks

Order	Location	Issue	SWDC Notified	Repaired	Repair Method
194124	Reading Street	Leaking connection, pipe to meter	7-Jun-2022	7-Jun-2022	Replaced smart meter with manifold
228969	Reading Street	Leaking connection, pipe to meter	13-Sept-2022	13-Sept-2022	Replaced smart meter with manifold
246988	Jellicoe Street	Leaking connection, pipe to meter	2-Nov-2022	11-Nov-2022	Replaced smart meter with manifold
252540	East Street	Leaking connection, pipe to meter	14-Nov-2022	15-Nov-2022	Replaced smart meter with manifold
275521	Jellicoe Street	Leaking connection, pipe to meter	13-Jan-2022	27-Jan-2023	Replaced smart meter with manifold
290380	Jellicoe Street	Leaking connection, pipe to meter	21-Feb-2023	24-Feb-2023	Replaced smart meter with manifold

Work order 194124

Work order 228969

Work order 246988

Work order 252540

Work order 275521

Work order 290380

Z: Mains Leak – East Street

Notification and response:

1. Leak was called through to SWDC on January 11th, 2023
2. The reticulation team attended on January 15th and could not see any sign of a leak due to the wet weather
3. The team revisited the site on 31/01/2023 and noticed a wet patch close to a stormwater sump
4. They started excavations after service mark outs and plans were ordered
5. They found that the leak was coming from the 100mm asbestos cement water main, which also was encased in the cement wall of the stormwater sump