PROACTIVE WATER SERVICE CONNECTION REPLACEMENT PILOT PROJECT

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ABSTRACT

Due to the small customer impact and relatively low-cost asset, the risks of water service failure were overlooked. In the past five years, the reactive repair of water service connection (WSC) has become the highest frequency (almost 60%) activity of civil maintenance teams, therefore the business decided to initiate a pilot project to determine the most cost-effective approach for the replacements of WSCs and to have a better understanding of failure modes.

Results indicate more than half of service failures are due to poor condition fittings, especially on the metering side. In addition to the material issues identified, the previous repair strategy has also caused repeated leaks from the same service pipe. The key benefits of the pilot project include financial savings and achieving delivery efficiency by bundling similar useful life assets in one project scope. However, the challenge identified in implementing a large-scale proactive replacement program is the data availability and accuracy. Therefore, effective communication with the maintenance team to continuously collect essential information is critical to success.

1.0 INTRODUCTION

The City of Gold Coast owns and maintains 157,019 (updating) service pipes and 273,536 house connections throughout the water network consisting of approximately 2,063Km pipework. Generally, the service pipe is expected to last more than 60 years and 80% of our service pipes have operated for less than 40 years, which means our service network is relatively young.

Due to the small customer impact and relatively low-cost asset, the risks of water service failures were overlooked. In the past five years, the reactive repair of WSC has become the highest frequency (almost 60%) activity of civil maintenance teams in Water and Waste (W&W). According to the data record system, the average number of repair works associated with WSCs reached 7000 and is expected to be increasing in the future years:

Table 1 The number of repairs on leaking services

FY16/17	FY17/18	FY 18/19	FY19/20	FY20/21
6,735	9,226	7,491	8,543	8,045

Currently, the WSC asset is not a separate asset class and is financially incorporated in the value of drinking water mains. The estimated value for WSCs is approximately $110M, equating to 10% of the total water main asset (netbook) value. In addition, the annual average repair cost for WSCs over the last five FY is $7M which is 6% of the total asset value.

Non-revenue water management is one of W&W's top strategic priorities. The analysis shows that pipe burst / slow leakage from WSC is one of the major contributing factors to the overall non-revenue water loss. Unfortunately, due to invisible leaks, it is difficult to

estimate the total water loss from WSCs. Still, a reasonable estimate of the water loss from the leaks that customers reported and repaired is worth more than $250,000 per annum.

Only 10% of the total WSC repairs triggered renewal works and were delivered on a reactive basis. The cost breakdown of reactive renewal indicates that almost 40% of the cost concerns the following potential cost elements: 1) internal labour; 2) leak detection survey; 3) restoration; 4) water shutdown; 5) traffic control; 6) non-revenue water.

2.0 DISCUSSION

2.1 Selection Criteria

To control the overall risks, W&W analysed WSC failures in the suburbs linked to the water main profile. The selection criteria are based on a combination of the number of failures, equivalent to the percentage of the total suburb WSC network, and the average cost of reactive repair. Table 2 below indicates that the worst performance suburbs are where the water mains still have more than 30 years remaining useful life.

Table 2 Top three poor performance suburbs

Suburb	# of Failures	% of Total Suburb WSC Network	Avg Cost of Reactive Repairs	Water Main Remaining Useful Life
SOUTHPORT	253	4%	$ 1,085	35
SURFERS PARADISE	105	4%	$ 1,627	32
TALLAI	58	5%	$ 1,088	37

A further analysis was carried out to narrow down the targeted areas to streets where there has historically been an above-average number of leaking WSCs that are yet to be renewed. This proactive approach aimed to achieve cost efficiencies, minimise customer impact and ensure that the water mains will not be replaced soon after the services have been renewed.

2.2 Delivery method

An idea of the opportunistic replacement was also considered as part of this pilot project to examine a method of improving our current delivery efficiency. A stakeholder consultation was undertaken to identify the poor condition hydrants and valves within the targeted streets. This delivery method of bundling other water assets with proactive water replacements was expected to have the following benefits:

- save costs on investigation and construction works
- improve water network reliability
- reduce customer impacts
- optimise human and equipment resources
- identify potential site hazards such as rocky ground conditions, thirty-party conflicts, and potential electrical hazards; and create a risk management plan prior to construction works.

2.3 Identified failure modes:

The previous understanding of the primary factors that cause pipe failure includes the degradation of aging polyethylene (PE) pipe, a quality drop of the new standard blue

stripe polyethylene pipe, contractors' poor workmanship, and bedding issues. Through the project delivery process, more failure modes of the WSCs were found and separated into pipes and associated fittings (tapping, joiner, and meter).

Pipe Failure

Based on our site investigation, the previous repair strategy can also be attributed to causing repeated leakages from the same WSC. For instance, figure 1 is shown a typical example of a leaking water service that contains three different types of PE pipes and has more than one joint or clamp. This evidence indicates that several repairs had been undertaken in the past years without triggering renewal works. With the increased number of joints and clamps, the risk of water leaking is also escalated.

Figure 1 – Identified repeated leaking water service

Although the maintenance teams are responsible for operating the whole WSC asset (including tapings, service pipes and meters), the metering asset is recognised as an individual asset and a different branch and contractor manage its annual meter replacement works. The metering replacements are conducted across the city, driven by its 15 years of useful life. However, the city metering contractor replaces the existing meters with a new meter and a section of new PE pipe and joints (example shown in Figure 2 below), consequently it creates more potential leaking points.

Figure 2 – Metering replacement

Fittings Failure

A commonly known reason causing metallic fittings failure is the corrosion issue. Figure 3 as an example is shown that the previous steel (cast iron) tapping band is experiencing severe corrosion issues. In contrast the brass tapping band remained in excellent condition after 30 years of installation. However, replacing the saddle tapping band is challenging on a reactive basis as the work requires a water main shutdown. The proactive replacements of the poor condition saddle tapping band can reduce the number of emergency water shutdowns and the impact of service interruption.

Figure 3 – Corrosion issue on steel tapping band

Another major failure was found in 'ReadyTap' fitting (an alternative saddle taping product), distributed mainly in the new development areas. This ductile taping failure is due to internal corrosion after service pipe replacements. Since many failures had been identified, W&W had reported quality issues back to the manufacturers and waited for the product re-design to eliminate the corrosion issues.

Figure 4 – Internal corrosion from the ReadyTap fitting

2.4 Challenges for the future project

Although the proactive approach of service replacements has shown many benefits to the business, the challenge of developing future renewal programs remains. The most considerable complexity is the low maturity of the WSC attributes and the maintenance activities data. The city introduced the SAP system to record the maintenance activities and costs in 2014, but due to the lack of training programs, the initial record reports failed to fully capture the critical information such as job description, failure parts, damage, and cause codes.

This risk was recognised at the project imitation stage and effective communication of improving the maintenance records has been widely engaged. As a result, the recent leakage report (figure 5) has been significantly improved. It is shown that more than half of the maintenance activities are related to the 'Not GWC equipment' that are the jobs investigating private internal leaks, groundwater saturation and pressure / odour complaints.

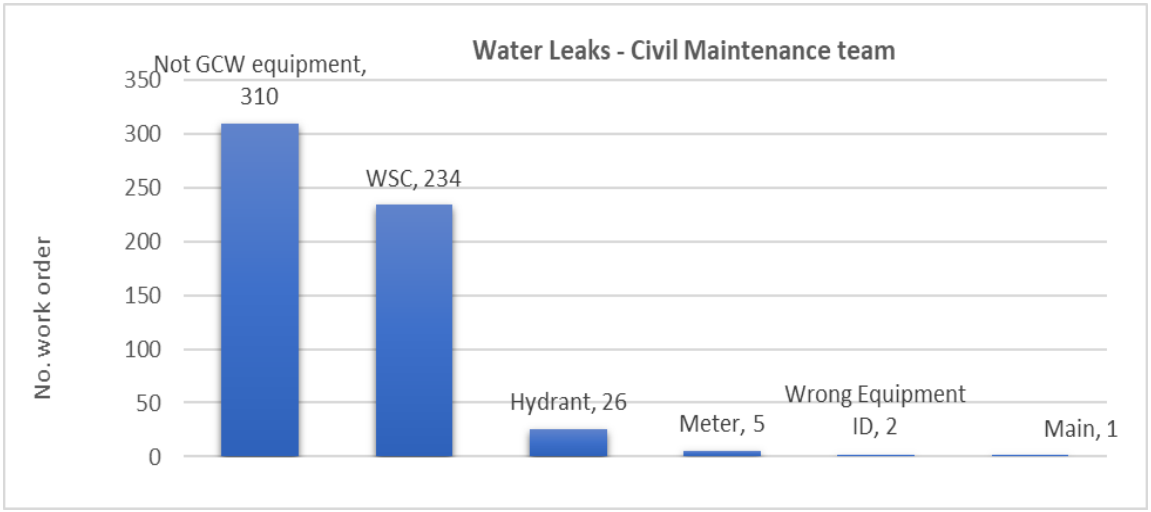

Figure 5 – Water leaks report on WSCs

A further analysis (shown in figure 6) for the failed WSC parts is indicated that almost half of the leaks are due to the poor condition fittings (joints & couplings, end connectors, and stop cocks), particularly on the meter side.

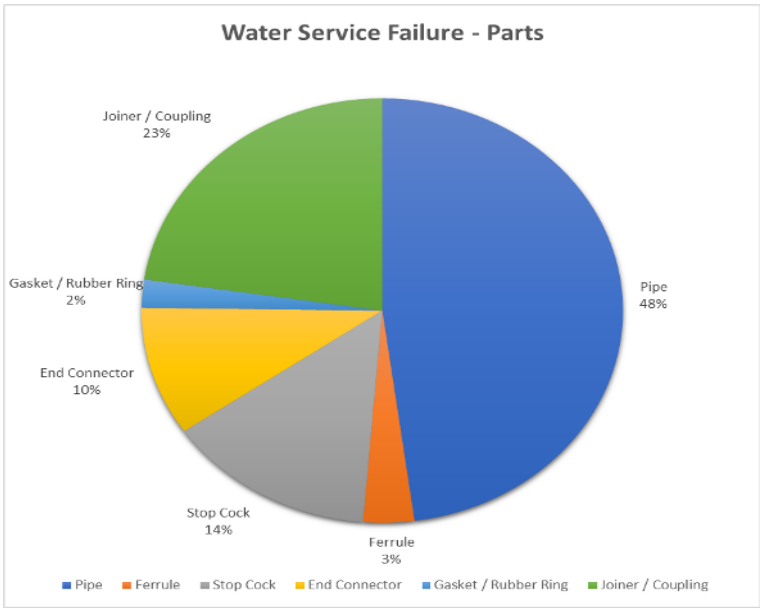

Figure 6 – Water service failure - parts analysis

With the continuous improvement of the data availability and accuracy, W&W will be able to develop a more targeted replacement program for leaking service pipes and tapings. At the same time, it is also recommended to initiate a customer engagement / education program and enhance the regular communication with the metering team to address the issues apart from the WSC asset failures.

3.0 CONCLUSION

The pilot project was initiated in 2021 and competed in June 2022. Based on the financial comparison of the reactive and the proactive replacements, the planned work is approved as the cost-effective and safe approach. In addition, the opportunistic replacement of other poor condition water assets within targeted areas can significantly improve delivery efficiency and optimise resources. Therefore, it will be the recommended approach for the future delivery mechanism of bundling the other water assets with the service

replacements.

Furthermore, successfully implementing the proactive replacement program in the future will not only achieve economic efficiency but also will reduce the workload for the reactive maintenance activities and costs as well as the non-revenue water from the leaking services.

The material issues, especially for newly developed products, from both pipes and associated fittings should be addressed through the following process: 1) collect data or samples from the repair works; 2) report to standards engineer; 3) review design issues; 4) suspended the poor-quality products; 5) engage lab testing and design improvement; 6) review and approve the new design.

The most appropriate way forward for improving our performance with the maintenance or renewal is by continuing to repair service on a reactive basis and were identified by the first responder, any services that have had significant repairs carried out already and can be easily renewed then these serviced can be replaced immediately. However, those services that are more difficult and complex to renew can be repaired and tabulated for planned renewal.

The possibility of the future proactive service renewal program for high activities in suburbs or streets will be based on the data maturity, which allows us to provide a more accurate targeted scope. Therefore, effective communication with the maintenance team to continuously collect the essential information to enhance our data availability and accuracy is critical to success. Meanwhile a customer engagement program will assist in reducing the total number of civil maintenance activities.

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