

A JOURNEY OF IMPLEMENTATION OF PREVENTIVE MAINTENANCE PROGRAM

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ABSTRACT

Prior to the implementation of the prevailing preventive maintenance program, the Water and Wastewater Operations and Maintenance Team in Isaac Regional Council (IRC) were primarily engaged in reactive maintenance, responding to repairs resulting from frequent breakdowns and a lack of preventive maintenance plans. The Operations and Maintenance Team routinely logged approximately 40 repair work orders per month through the internal system, supplemented by countless requests received via calls, emails and face-to-face interactions 24/7. The absence of a structured preventive maintenance program, coupled with inadequate condition assessments for aging infrastructure, compelled the prioritisation of rectifying only emergent operational issues. The initiation of a preventive maintenance program for assets in eight (8) Water Treatment Plants, six (6) Wastewater Treatment Plants and three (3) Recycled Water Treatment Plants occurred predominantly since 2022. Subsequently, a comprehensive review, development, and acknowledgment of a dozen contracts ensued, with plans for further tender release in 2024. The integration of project ownership, collaboration and commitment within the Operations and Maintenance Team underpins this implementation journey. This paper outlines the developmental trajectory of the preventive maintenance program, detailing its status and outcomes.

1.0 INTRODUCTION

IRC Water and Wastewater Department (W&WW) has eight (8) Water Treatment Plants, six (6) Wastewater Treatment Plants and three (3) Recycled Water Treatment Plants in 8 different townships, covering an area of 58,000m² for approximately 22,550 permanent residents and 13,400 non-permanent residents (Council, 2021). Most of treatment plants have been running for over four decades, and their aging infrastructure has led to unplanned equipment failures. IRC W&WW records approximately 40 repair work order requests every month through the authorised internal system; however, it receives countless extra emergency breakdown repair requests. To stabilise the water and wastewater treatment plant process, the W&WW Operations and Maintenance team predominantly allocates resources, time and budget to respond to equipment repairs every day. Reactive maintenance, despite being successful in repairing failed equipment in a timely manner, carries potential risks. These include unexpected downtime, which can lead to financial losses and legislative breaches if the sudden equipment failure causes compliance issues. This maintenance approach can result in inefficient plant operation and budget overspending due to emergency repairs and replacement. (Wu, 2020) To address current operational risks and manage the aging infrastructure, the concept of preventive maintenance was unreservedly accepted in July 2022 and has been implemented across Water, Wastewater and Recycled Water schemes in IRC for the last two (2) years.

1.1 RUN-TO-FAILURE (RTF) VS PREVENTIVE MAINTENANCE

Reactive maintenance adopts an idea: Run-To-Failure (RTF), which refers to using equipment until it breaks down. This approach generally has a more negative impact on production and processes compared to preventive maintenance (Hupje, 2022). Preventive maintenance offers various benefits, including improved process stability, financial

savings and advanced asset management. Preventive maintenance ensures the consistent operation of these systems, allowing for better planning and fostering a proactive approach to asset management.

1.2 ASSET EVALUATION AND CONDITION ASSESSMENT

IRC W&WW is currently collecting asset condition data through the preventive maintenance program, updating this information in the IRC Computerised Maintenance Management System (CMMS): TechnologyOne. Each asset component is periodically reevaluated by service providers as a part of the preventive maintenance program for observable assets and assessed equipment condition in line with Institute of Public Works Engineering Australasia (IPWEA) guidelines (IPWEA, 2006). Condition assessments are conducted with condition gradings from 1 (Very Good) to 5 (Unserviceable). This data is updated and utilised for capital project planning, the Finance Asset Registry (FAR) and Operational Asset Registry (OAR). This long-term condition assessment data will help generate a draft list of renewal works for the forecast period and estimate when an asset will reach the end of its useful life.

2.0 DISCUSSION

The preventive maintenance program at IRC adheres to the essential preventive maintenance process pathway.

2.1 Identification

A maintenance planner oversees the designing and organising the preventive maintenance program to encompass all relevant plants in the Isaac Region. With assistance from the personnel of the Water and Waste (W&W) Directorate, a total of thirty-one (31) preventive maintenance programs have been identified as a starting point and designated as separate programs.

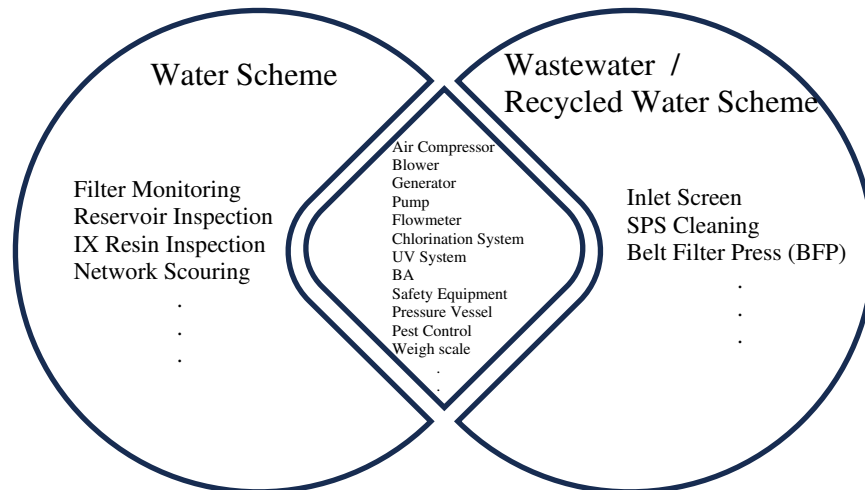


Figure 1: *Preventive maintenance program identified*

2.2 Priority Setting and Job Planning

The identified and categorised programs are prioritised based on two key criteria: Value and Criticality. Value refers to the significance of the equipment in operating a treatment

plant, monitoring the treatment process and whether the plant has redundancy equipment to ensure continuous service. Criticality refers to the impact on the treatment process in the event of a breakdown, affecting the community and end-users. Each maintenance program is designated for a minimum of two (2) years, with two (2) additional one-year extension options.

2.3 Budget Estimation

Using previous finance records and market prices, the estimated cost for each preventive maintenance program has been determined. To implement all thirty-one (31) preventive maintenance programs, \$1.25 million was estimated for FY23-24. Sixty percent of the proposed budget was approved for FY23-24, which is equivalent to running nineteen (19) re-prioritised programs.

2.4 Scope of Work (SOW) and Maintenance Schedule

Each preventive maintenance program requires a detailed SOW and specific requirements that the Council aims to achieve. The maintenance planner collects holistic data and information from similar maintenance activities in the industry, consults Australian Standards, manufacturer manuals and staff to determine the appropriate SOW and requirements. Additionally, deep learning software such as ChatGPT is employed to define SOW. Maintenance intervals are established based on available resources and the significance of the program. To date, six (6) preventive maintenance programs are scheduled for six-month intervals, while the remaining twenty-five (25) programs are designated for annual service.

2.5 Service Report Review and Equipment Improvement

Following each periodic service, service reports are submitted for review. The service reports are thoroughly examined and taken into account to address potential risks. According to the SOW, service reports include mechanical/electrical specifications, calibration results, test results and condition assessment results based on IPWEA guidelines. The maintenance planner updates the OAR with this information, aiding in the development of long-term capital planning for up to thirty (30) years. Additionally, condition assessment results also help create a time series dataset to record equipment condition over time.

2.6 Communication and Reporting

The maintenance planner takes strong ownership of the preventive maintenance program, maintaining continuous communication within the team. This includes fortnightly meetings with the manager, coordinator and process engineer to stay updated on water and wastewater issues, monthly meetings with operators to review the previous month's outcomes and discuss plans for the upcoming month. Additionally, biannual reports are presented to the Councillors and Mayor to update them on key milestones achieved through the preventive maintenance program. This process ensures engagement with stakeholders and facilitates the sharing of outcomes.

3.0 Key Milestones Achieved and Future Goals

The following outlines the key milestones achieved over the past two (2) years as well as

the medium- and long-term milestones moving forward.

3.1 Short Term (Within 2 years)

- ✓ Carry out the planned preventive maintenance programs and develop new programs based on priority.
- ✓ Record service reports, certificates and recommendations to identify the issue.
- ✓ Identify the discovered issues and likelihood of breakdowns to reduce the risk of emergency repairs.
- ✓ Implement the recommendations and carry out repairs.
- ✓ Assess the equipment condition to identify the reliability of asset equipment.
- ✓ Evaluate equipment lifespan to make decisions on where to allocate resources.
- ✓ Share the relevant information with other Directorate/Department to help the decision-making process.
- ✓ Develop any new preventive maintenance programs.

3.2 Medium Term (Within 3 years)

- ✓ Track the equipment conditions based on the service reports to monitor variations.
- ✓ Evaluate the awarded tenderers to sustain the ability of the service and optimise the service cost.
- ✓ Re-tender the expired preventive maintenance programs.
- ✓ Manage the allocated and future budgets for the preventive maintenance programs.
- ✓ Register the asset equipment information into the asset management platform.
- ✓ Assist detailed design of capital projects to correlate with current equipment types and makers.
- ✓ Update details of newly installed equipment into the existing contract.

3.3 Long Term (Within 4 years)

- ✓ Monitor variation of the equipment conditions and develop equipment condition improvement plans to sustain functions and capabilities.
- ✓ Register and update asset information based on an asset management plan.

4.0 CONCLUSION

The preventive maintenance program represents a transformative shift from reactive maintenance, driven by equipment breakdowns, to proactive condition assessment and preventive repairs. Since its implementation in the IRC W&WW Department, nineteen (19) out of thirty-one (31) maintenance programs have been successfully executed.

- i. Weigh Scale and Benchtop Lab Scale Annual Service
- ii. Pressure Vessel Annual Service and Certification
- iii. Water and Wastewater Treatment Plant Online Analyser Annual Service
- iv. WTP and WWTP Flow Meter Annual Verification Testing
- v. WTP and WWTP Pest Control Bi-Annual Service
- vi. Moranbah WWTP Belt Filter Press Annual Service
- vii. WTP and WWTP Electric Gate and Roller Door Annual Service
- viii. Air Compressor and Blower Bi-Annual Service
- ix. Generator Bi-annual Service
- x. Sewage Pump Station and Treatment Plant Well Cleaning Annual Service

- xi. Sewage Pump Station and Raw Water Pump Station Pump Annual Service
- xii. Benchtop Lab Analyser Annual Service
- xiii. Wastewater Treatment Plant Inlet Screen Annual Service
- xiv. UV Disinfection System Bi-annual Service
- xv. Chlorination System Bi-Annual Service
- xvi. Nebo WTP Ion Exchange Resin Inspection and Testing
- xvii. Overhead Crane and Lifting Beam Annual Service
- xviii. Safety Equipment Bi-Annual Service
- xix. WTP and WWTP Lift, Dosing and Pressure Pump Annual Service

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