SEVENTY SEVEN NOT OUT OR HOW TO PROLONG THE LIFE OF A VERY OLD WATER TREATMENT PLANT

Paper Presented by:

Doug Moorby

Author:

Doug Moorby, *Manager Engineering Operations,*

Narromine Shire Council

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Doug Moorby, *Manager Engineering Operations*, Narromine Shire Council (formerly at Lachlan Shire Council)

ABSTRACT

Aged infrastructure and a lack of substantial income is one of the biggest single problems faced by most western NSW Councils. A decade long drought and constant reduction in available income has meant that Engineers and Operators all over the state have had to find innovative ways to extend the life of water and sewage plants while increasing the quality of product produced to comply with higher standards.

A total lack of any documentation, limited capital budgets and difficult to treat source water, plus the need to continue production, meant that the team involved in this project were faced with some very interesting challenges. Innovative thinking with a high level of operator input and the willingness to try new concepts proved that a good result could be achieved in this case.

1.0 INTRODUCTION

Condobolin Water Treatment Plant was commissioned in 1937 and has provided treated water to the community since that time. The plant has undergone very few modifications in its lifetime and the only real changes in the process have been:

- Addition of Fluoride around 1965,
- Conversion from Powdered Alum dosing to Liquid Polymer Flocculant
- Renewal – reconstruction of clarifier structure

In general, the plant was in an extremely poor state of repair with only the most basic and essential repairs and upgrades being carried out over the last thirty years.

Council's long term planning called for the construction of a new plant to be commenced around 2010. A decade long drought and shrinking rate base, along with serious drought related problems in other townships, meant the issues surrounding this plant were easy to ignore, it just kept on working. In late 2012, the advent of increased Drinking Water Standards and the completion of the more pressing projects associated with other Council Water Systems, meant that it was possible to focus upon this plant and its problems.

Immediate replacement of the plant was not feasible as reserves would struggle to cover the cost without grants and loan funding, which would take some time to obtain. A decision to carry out major renewals/upgrades was made as an interim measure, with the goal of another 8 to 10 years of service. Issues identified during creation of a Drinking Water Quality Management Plan, along with known EPA compliance issues, formed the basis of a report that prompted this decision. A general budget allocation over a 2 year period of $1.5 million was approved to move forward with the project.

The biggest single problem faced by the Project team was the complete lack of any documentation in relation to the plant and its systems. No plans, specifications or written information about the plant existed. This meant that major investigations and the creation of drawings of the existing systems would be required before planning of any upgrade or renewal works could occur.

2.0 DISCUSSION

The key problems identified with the plant included:

- Major Work Health and Safety issues including damaged bonded asbestos.
- Substandard chemical dosing and no mixing systems leading to poor clarification.
- Gravity sand filters with poor water quality results and extended backwash times.
- No air scour system, which is essential in dealing with polymer created mud balls.
- Aged and depreciated backwash water pumping system.
- No information available on filter flume and underdrain system.
- Deprecated electrical and SCADA Diagram Control Systems.

<u>Figure 1:</u> ***External and internal images of the Raw Water Mixing Well***

2.1 Major Problem Identified

The project plan called for an exploration dig within one of the four gravity sand filters to determine the structure of the underdrains and assist in the redesign of the backwash pumps and design of an air scour system. This dig lead to a discovery and incident that meant that the redevelopment of the filters had to be accelerated and quick decisions needed to be made in relation to the systems to be used. The dig was conducted in the first week of March 2013, and revealed that the underdrain filter flume was constructed from asbestos super six sheeting on a hardwood support structure.

This discovery occurred when the operator who was carrying out the dig, had his foot disappear though the then unknown surface. This somewhat dramatic discovery meant the immediate and permanent shutdown of filter number 2 and a reduction of treatment capacity by 25%.

Figure 2: ***Example of AC Super Six*** **Figure 3:** ***View of damaged filter***

2.2 Solution Sought and Plans Devised

As Council's Water and Sewer Engineer, I had undertaken some initial research into underdrain systems suggested by Mr Kamal Fernando of the NSW PWD and had reviewed projects carried out in both Australia and overseas. This research lead to quotations and proposals being sought from two companies. The final selection saw orders placed with Xylem Leopold for their SL® Underdrain System and I.M.S® 200 Media Retainer and Underdrain Accessories including Air Header Tanks.

The underdrain system would take some months to arrive and we needed to have the filter back on line by the end of October. The project team, led by me with the help of a graduate engineer and the plant operator, got very busy with planning the design of the associated works. This included drawing up plans, writing specifications, sourcing materials and services, along with carrying out the works these activities generated as outlined below. The input of the Plant Operator, Mr Rod Harland, cannot be underestimated in this process; his experience and ideas were invaluable in getting the project planned.

- Prepare drawings of existing plant, including P&ID design for upgrade works.
- Formulate a Site Safety Plan for high level demolition and asbestos removal and submit to Work Cover NSW.
- Prepare specification for demolition of old structure over raw water mixing well and removal of broken AC sheet ceiling above filter gallery.
- Prepare drawings plans and specifications for new structure and platform over raw water mixing well, including weir structure. New raw water delivery lines, chemical dosing, injection systems and flocculation mixers.
- Write specifications for new backwash pumping system, air scour blower, air scour pipe work and new high lift pumps.
- Prepare specifications for new electrical switchboards including control boards and VFD drives for all pumps and the blower.
- Prepare specification for replacement telemetry system and installation of PLC and HMI control devices.
- Prepare drawings for all the above works including 3D design for Air Scour Pipework.

This process involved many late nights by all due to the tight time constraints to be ready for the installation of the underdrains by September 2013.

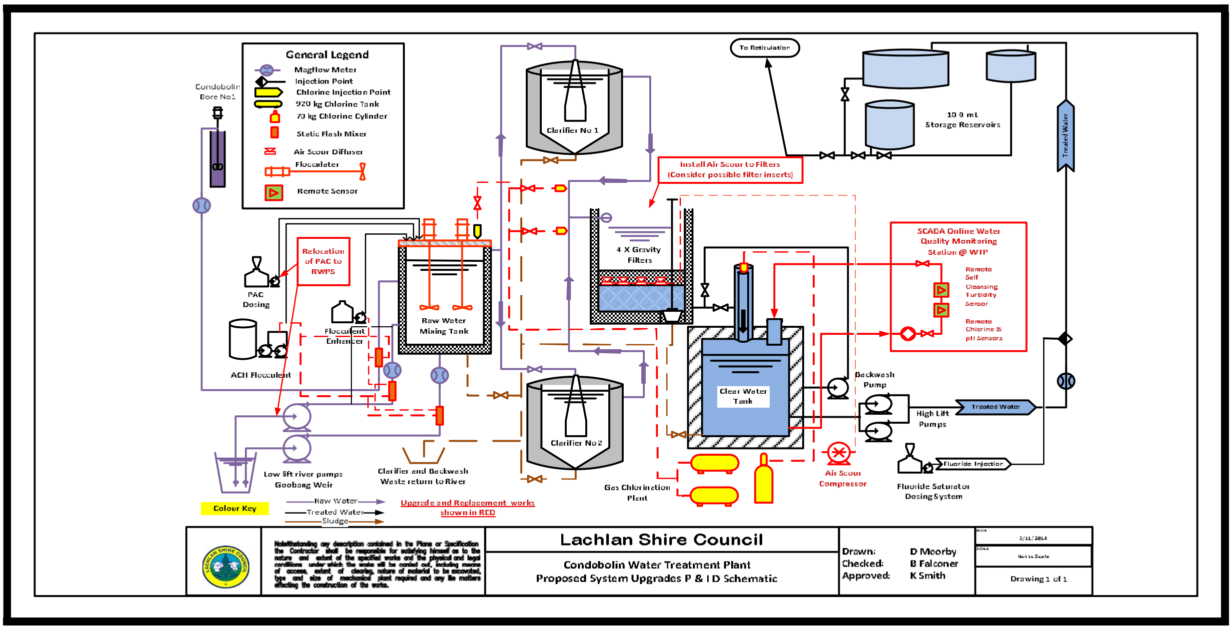

Figure 4: *P&ID Diagram of existing plant plus enhancements*

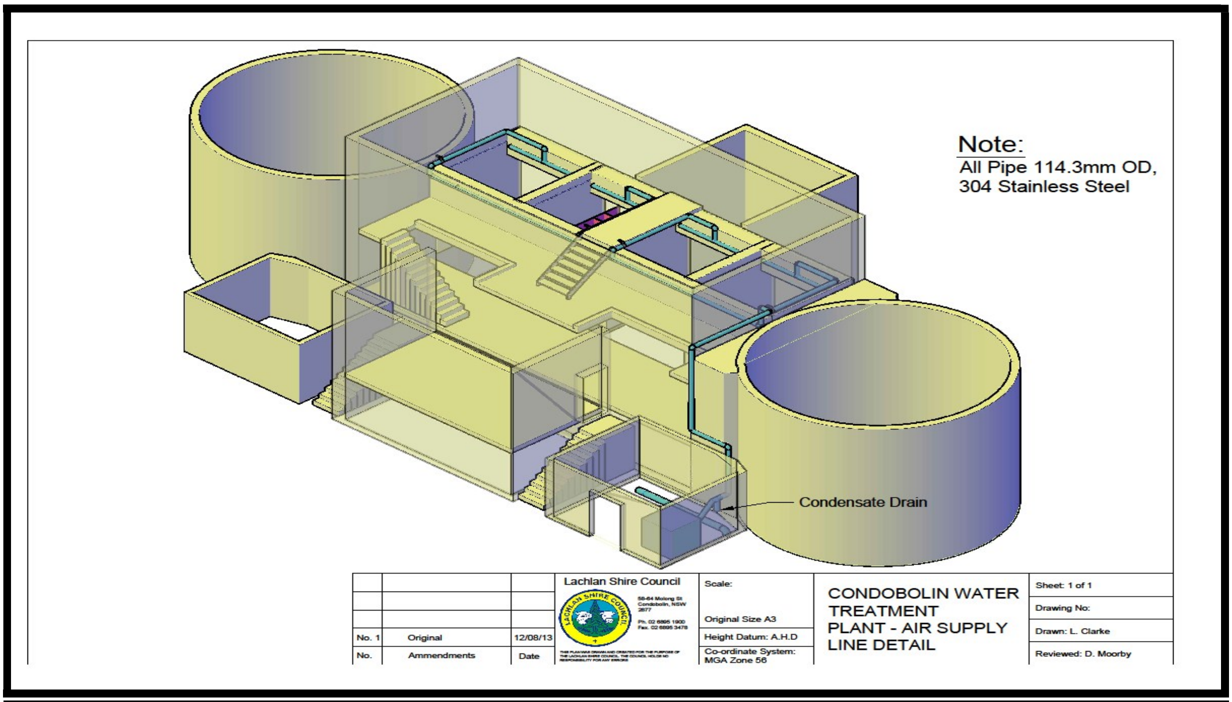

Figure 5: *3D General arrangement of Air Scour System*

Most of the general arrangements drawings, of which Figure 4 is just one example, were prepared using Microsoft Visio Design. The 3D diagram in Figure 5 was prepared from plans and elevations developed using GPS positioning and mapping programs in conjunction with Auto Cad.

2.3 Solutions Developed Project Delivered

Large amounts of planning and preparation work were commenced in late 2012. Project Grant Charts and budget submissions had already been prepared and presented to Council. Major works did not commence until the end of summer 2013 and followed approximately the sequence as outlined below. During this time, quotation assessments and engineering reviews took place to determine materials to be utilised and which specialty contractors would be engaged. Large amounts of the works, especially hydraulic construction and the actual filter block installation, was carried out by Council Staff including the Plant Operator, the Water and Sewer Gang and especially our two Trainee Operators.

2.4 Works Carried Out

- Removal of filter media and asbestos filter flume from the damaged No 2 Filter.
- Off-site construction of the new mixing well structure by contractors.
- Demolition of existing mixing well structure, disused dosing system and flocculator removal of asbestos including filter deck ceiling.
- Installation of new raw water feed line relocation of raw water flow meters and flash mixer including dosing quills and systems.
- Installation of new filter gallery ceiling and painting.
- Installation of mixing well weir followed by installation of platform and well structure.
- Construction of new filter box floor in accordance with specification and drawings supplied by Xylem Leopold.
- Installation of new high lift pumps and associated switch board.
- Installation of air scour blower and associated switch board.
- Installation of Xylem Leopold underdrains by Council Staff and Xylem Staff from the Los Angeles Office.
- Replacement of filter trough extensions with Food Grade HDPE boards and stainless steel support brackets.
- Removal of old backwash pump and installation of new pumps associated pipe work mag flow meter and HMI Control system.
- Installation of new RTU/ PLC and associated SCADA equipment and modification of Clear SCADA programing.
- Commissioning of new backwash system and testing and adjustment to enable backwash of existing filters.
- Connection of air scour system to new underdrains and conduct commissioning clean water test.
- Load filter media consisting of 450mm of Quartz Filter Sand topped by 450mm of Filter Coal (Anthracite).
- Commissioning of new No 2 Filter and HMI backwash control system.

3.0 CONCLUSIONS

The Xylem Leopold underdrain system provides a means by which a very old but sound filter structure can be rehabilitated and upgraded to provide increased flow, better backwash capability and improved compliance with current drinking water guidelines. This conclusion is supported by nearly six months of summer operations data. Turbidity levels through the rehabilitated filter average < 0.05 NTU by comparison with levels of > 2.0 NTU in the un-rehabilitated filters.

The other key results are the reduction in backwash run time and water loss which is as high as 10% of volume treated in the un-rehabilitated filters. This issue is critical and remains a problem in that disposal of the backwash supernatant is yet to be resolved.
Projects such as this will become more common place in Australia as our infrastructure ages. The whole project shows that by looking outside the square, applying the common

sense test to what you propose to do and encouraging input from your operators, a good result can be achieved.

Figure 6: ***Raw water delivery line mixing well structure and flocculation mixers***

Figure 7: ***Completed block installation air induction manifold and water air scour test***

4.0 ACKNOWLEDGEMENTS

I would like to thank the Managers, Directors and staff of Lachlan Shire Council, and, in particular, the Infrastructure Services Department. Special acknowledgement must go to Mr Lachlan Clarke (graduate engineer) master of Auto Cad, with extra special thanks to Mr Rod Harland, Plant Operator in Charge, whose input and support was invaluable in carrying out this project.

Other thanks must go to all the contractors and suppliers involved, with special acknowledgement going to Mr Samik Mukherjee, Mr Alan Aitken from Xylem Australia and Mr Danny Brownlee of Xylem Leopold. USA.

5.0 REFERENCES

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