DEVELOP AND IMPLEMENT WORK INSTRUCTIONS IN WATER TREATMENT PLANTS OWNED AND OPERATED BY SEQWATER

Paper Presented by:

Dennis Maguire

Author:

Denis Maguire, *Team Leader/Acting Technical Writer*

Seqwater

37th Annual Qld Water Industry Operations Workshop
Parklands, Gold Coast
5 June to 7 June, 2012

DEVELOP AND IMPLEMENT WORK INSTRUCTIONS IN WATER TREATMENT PLANTS OWNED AND OPERATED BY SEQWATER

Denis Maguire, *Team Leader/Acting Technical Writer,* Seqwater

ABSTRACT

As Seqwater was formed from multiple local authorities, who all had different standards of operations and asset management, a need was recognised to implement a set of operational documents so the water treatment plants can be operated to a uniform standard. This task involved the development of site procedures and work instructions. These documents would then be categorised into sub folders to form an online set of documents in a broader management system available to staff at all sites. As I had previous experience developing and writing work instructions I was asked to take on this task.

1.0 INTRODUCTION

Seqwater is the bulk water supplier for South East Queensland. To perform this function we operate and maintain the following assets:

- 24 water storages
- 49 weirs
- 51 water treatment plants (WTPs)
- 85 sewage treatment systems (STPs)
- 3 advanced water treatment plants
- 1 desalination plant
- 14 groundwater bore fields
- 250 km of water supply pipeline (WCRWS)
- 6 protected habitat reserves (nature refuges)
- 25 recreation nodes
- 5 irrigation schemes
- 1,010 rural irrigator customers

At the heart of our production capability is the conventional WTPs. The WTPs vary in size from 30KL/d to 700ML/d. Site specific Drinking Water Quality Management Plans have been written and implemented for all WTPs.

Due to the area of coverage, Seqwater's treatment operations team is divided along geographical lines – Northern and Southern. Each of these districts has zones or regions and each region has a Coordinator and Team Leader. As you can appreciate, each of these zones has their own history and as a result they each had different ways of managing assets and water quality.

2.0 DISCUSSION

All of the larger plants had an existing library of work instructions and procedures developed prior to Seqwater ownership. Templates were available for procedures and work instructions. Procedures are written largely to describe a process which has a large amount of detail. Essentially the procedure tells the operator why we are doing something.

The work instruction then details how we go about the task. Our task was to develop a top ten list of work instructions for each plant to apply the same standard of rigour in their operations. Any high risk activity was also to be identified, and a work instruction developed to better manage and mitigate the risks. Part of the task in developing the procedures was to instil common terms and descriptions and to get the operators to use and understand the terms and follow the work instructions.

Initially City Water Technology was engaged as a consultant to establish a common set of work instructions. These consultants were adept at gaining knowledge from the Water Treatment Operators and together we developed between 80 and 100 work instructions covering a variety of plants in different regions.

To start with, the top ten work instructions were identified by the Managers, Coordinators and Team Leaders. The WTPs already had common fluoride procedures but the next list of priorities included the following work instructions:

- Start Up and Shut Down.
- Backwashing.
- Disinfection Dose Control.
- pH Dose Control.
- Coagulant Dose Control and associated drop test.
- Poly Dosing.
- Potassium Permanganate Dosing.
- Jar Testing Procedure.
- De- sludge Clarifier or similar.
- Receive chemical deliveries.
- Sludge handling.
- Managing Off stream Storage or Raw Water Source.
- Any other high risk activity that could be managed by Work Instructions.

My role was to liaise with the Team Leaders and/or Coordinators and arrange for a day to be onsite to gather knowledge. This would involve having an operator being offline to discuss the process and walk through the plant outlining the steps taken in the normal course of operation.

The operators who were involved in the development of the procedures were enthusiastic and happily shared their knowledge of the WTPs. Once we developed a work instruction it was sent back to the operators to audit and to provide feedback on any improvements needed. Sometimes the work instruction would have five drafts before we were happy with it. The instructions are then trialled and approved by the Team Leader and Coordinator before they are implemented and entered into the document records system (Q-Pulse).

The documents include a purpose, scope and step-by-step breakdown of tasks.

Safety or environmental hazards are included in the scope, and controls or mitigations included in the final document. For example, it is easy to add a task that says “start the lime pump” but the operator needs to be aware of the consequences of each action. Further, each of the WTPs has different raw water quality issues. Some of them have long raw water concrete lined rising mains which can change the quality parameters of the raw water when the plant goes off line. The operator needs to be aware they may have a pipeline full of high pH water. The operator will need to adjust the chemical dosing and monitor the quality as the plant starts.

Some of the smaller plants have elevated steel clarifiers. In the colder months, the clarifiers will have temperature related boil up issues. These issues, whilst known to the Plant Operator, are not readily available to other operators relieving at these sites and therefore documentation of these issues and the steps required to manage them has been a huge leap forward in operations management at Seqwater. These issues can be recognised and included into the SCOPE of the document as noted in Figure 2.

Variable raw water quality in the dam
The raw water quality in the dam is influenced by inflow from storm events and also can change as a result of little or no inflow into the dams. Little or no flow can result in low dissolved oxygen with associated metals and taste compound problems. Inflow can result in low alkalinity, metals, high colour and turbidity.

Variable dam water entering the plant
This variance is caused by the cement lining in the rising main. The lime component in the cement forces pH up as the water is stored in the pipeline overnight or when the plant is offline. If the plant is online for a significant period, the pH will drop off as the cement lining hasn't had the contact required to elevate the pH. As raw water conditions change, optimal coagulation dose rates also change and careful control is required to prevent overdosing and underdosing. The operator must carefully monitor raw water pH and ensure optimal CO_2 dose is applied at all times. Overdosing can lead to excessive concentrations of coagulant entering the distribution system. This can occur if the pH and alkalinity are not controlled at optimum levels too. Underdosing can cause poor removal of colour, turbidity and micro-organisms. Continual monitoring of raw water quality determinants, such as pH, alkalinity and turbidity will aid WTP performance and assist in selecting optimum coagulation dose rates.

The differing temperatures of raw and settled water held overnight in the clarifier
The operator needs to have a good understanding of the issues caused by temperature change. At Esk WTP, a common operational problem is for short circuiting currents to occur, resulting in boil up or billowing of the floc blanket and carry over of floc onto the filters. This is attributed to the temperature differential between existing water in the tank and incoming fresh water. Esk WTP has an elevated clarifier open to overnight low temperature and is supplied by an underground main which supplies much warmer water. If the operator is encountering problems with boil-up/billowing of the floc blanket he may need to stop the plant and backwash the filters. On start up, the operator should closely monitor the clarifier outlet's turbidity and also the filter's turbidity. In response to rising filter turbidity, the operator must stop the plant and back wash the filter to ensure compliance with water quality parameters.

Figure 2: ***ESK WTP excerpts from Scope of Plant Start Up Shut Down document***

In the case of three WTPs supplied by a catchment prone to raw water quality easily compromised by rainfall, offstream storages have been constructed. A procedure containing limits in a table and the actions required has been developed referring to the Cyanobacterial Management Plan. This plan has been developed in-house by a water quality scientist.

Algae, taste and odour compound levels are communicated by email to Coordinators, Team Leaders and Process Staff to inform of any water quality issues in the catchment. An alert level framework is in place and refers back to a Cyanobacterial Management Plan, which covers all aspects of the catchment quality issues.

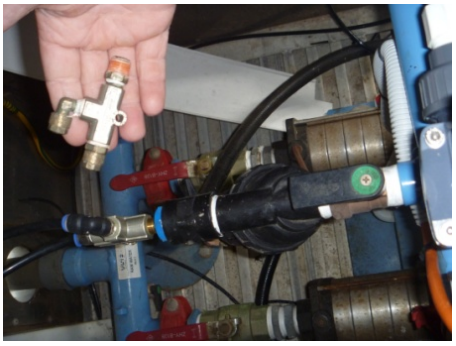
Table 1: ***Excerpt from Kilcoy WTP Offstream Storage Management Procedure***

Water Source	Parameter	Limits	Tasks
OSS or Weir	Algal Count	<2000c/mL	Sample weekly for monitoring by external laboratory. Monitor pH daily. If increasing, initiate sampling for algal count twice weekly.
		>2000c/mL	Sample twice weekly for monitoring by external laboratory. If high and increasing, initiate toxin testing. Check water quality of alternative source and discuss changeover with Team Leader/Area Coordinator.
	Toxin Analysis	>1µg/L	Change to alternate raw water unless agreed otherwise with Team Leader/Area Coordinator. Consider pre-filter chlorination or potassium permanganate dosing and discuss with Team Leader/Area Coordinator.
	Soluble Mn	<0.15mg/L	Monitor daily
		>0.15mg/L	Check water quality of alternative source and discuss changeover with Team Leader/Area Coordinator. Change source if possible. If source change not possible, initiate $KMnO_4$ dosing at an appropriate dose rate. Monitor frequently.
Weir	Turbidity	<10 NTU	Make every attempt to keep OSS as full as possible
		10-20 NTU	Pump to maintain OSS level unless otherwise agreed with Team Leader/Area Coordinator.
		>20 NTU	Discontinue transfer to OSS unless OSS level is very low.
	True Colour	<30 PCU	Make every attempt to keep OSS as full as possible
		30-50 PCU	Pump to maintain OSS level unless otherwise agreed with Team Leader/Area Coordinator.
		>50 PCU	Discontinue transfer to OSS unless OSS level is 1.5 m on level indicator. Notify Team Leader/Area Coordinator.
	Algal Count	Low	Make every attempt to keep OSS as full as possible
	Soluble Manganese	<0.15mg/L	Make every attempt to keep OSS as full as possible

The work instructions are developed by interviewing the operators. The photos below were taken during the operator discussions, actions and screen shots from the SCADA which are pertinent to the document.

Hundreds of photos were taken. It was a large task just to download the photos and label them so we could include the photos in the plant or process they pertained to SCADA screen shots relevant to the work instructions were gathered and form an integral part of the work instruction.

Instruments and sample points Somerset Township WTP



This an inline valve which often fails at Maroon Dam WTP

Work instructions are in progress for Sewerage Treatment Plants (STPs) as well. I have produced trouble shooting guides for the operators with parameters and actions required. We have several small STPs servicing recreational parks. They are very hard to operate as they have extremely variable loading. They are either underfed or overwhelmed by inflow, especially on public or school holidays. Process staff have designed and implemented mitigations to improve the process and prevent discharge out of spec effluent to the environment. We are developing processes and procedures to feed the activated sludge in lean times and prepare the sites for busy times such as Easter when the park numbers can go from 10 occupants to 3500 within 2 days. STPs do not like this rapid change!

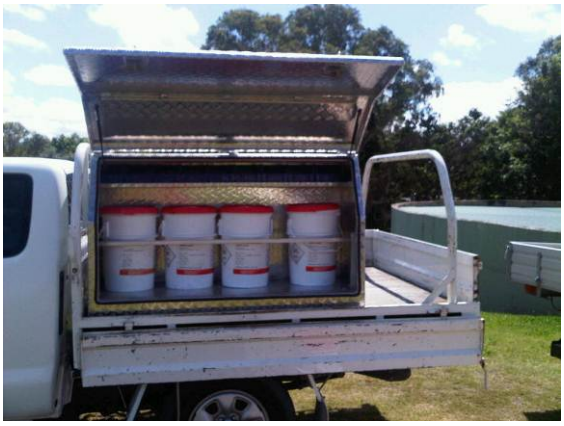
Together with site based documents I also produce corporate work instructions, some process and some administration procedures. The administration procedures usually relate to a change in process and help the management team to get the change message to all members of the organisation. The organisation is changing the Work Request Process in relation to how an Operator communicates a breakdown and the priority related to the breakdown.

Recently, the organisation switched the delivery method of Sodium Fluoride to 25kg pails instead of the previous 25kg paper bags.
I was asked to complete a risk assessment on the handling of the pails and together with Workplace Health and Safety Advisor Kris McCulloch, we decided to upgrade the trolleys available to the Operators, vacuum lifting system and also designed and manufactured a transport box for the pails.

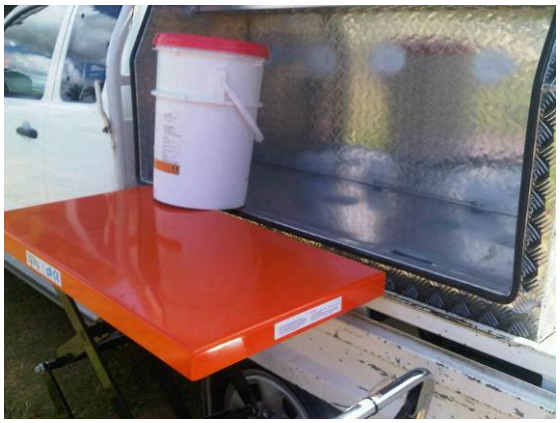
Previously, a vacuum lifting system was used to lift the bags but this was unsuccessful as the delivery storage boxes were not suited to the vacuum lifter. The bag lifting head has been replaced with a head that is suited to the 25kg pails. Kris made the point the existing trolleys were too low to suit the vehicles currently used by our Operators. After some searching, replacements were sourced at a good price from Trade Tools.

Seqwater covers a broad region and the pallets of Sodium Fluoride are stored at four bulk storage facilities. Each of these sites has a bulk storeroom, a fork lift to handle the pallets and a vacuum lifting device to handle individual pails, and a storeroom. After a delivery of Sodium Fluoride I invited operators from the different regions to one of these sites and conducted training on the new handling techniques required.

Pictures were taken and the existing work instruction upgraded to reflect the change.



Transport box



Scissor lift trolley

Trusten in PPE required when loading the pails.

Vacuum lifting system

3.0 CONCLUSION

In conclusion, I have enjoyed working on this project. The organisation now has ~300 work instructions for most of our WTPs. I have implemented checklists across all of the plants I have visited and received positive feedback from both the Operators and management.

We are now working on what we would describe as 'WorkFlow' procedures that link the instructions into a standard process that must be followed by the Operators every day. Lots to go but we are on our way!