NORTHERN PIPELINE INTERCONNECTOR "NPI" IMPLEMENTATION: THE EFFECT ON OPERATION OF THE NORTH PINE WTP

Paper Presented by:

Denis Maguire

Author:

Denis Maguire, *Team Leader,*

Seqwater North Pine

35th Annual Qld Water Industry Operations Workshop
Community Sports Centre, CQ University, Rockhampton
22 to 24 June, 2010

NORTHERN PIPELINE INTERCONNECTOR "NPI" IMPLEMENTATION: THE EFFECT ON OPERATION OF THE NORTH PINE WTP

Denis Maguire, *Team Leader,* Seqwater North Pine.

BACKGROUND

The North Pine WTP is a conventional alum coagulation, sedimentation and filtration plant that treats water that supplies many Northern Brisbane suburbs as well as the regions of Moreton Regional Council including Pine Rivers, Caboolture as well as Redcliffe City. The treatment plant is located downstream and adjacent to the North Pine Dam. This treatment plant began in 1970 with operation commencing in 1974. The plant can treat 250 mega litres of water per day.

A multi billion dollar Water Grid has been established in SEQ which is an integrated system that secures and efficiently manages SEQ water supplies and comprises an infrastructure network of treatment facilities and two way pipes that move water from new and existing sources across the region. One particular network interface that has been established as part of this Grid initiative is the Northern Pipeline Interconnector (NPI) that links the North Pine WTP with the Lander Shute WTP some 60 klms to the North.

1.0 INTRODUCTION

Planning for the Northern Pipeline Interconnector began some years ago. The first version of this project had the pipeline running from the then planned "Traveston Crossing Dam" to North Pine Dam discharging into the head waters of North Pine. This concept did not go ahead and a subsequent pipeline was established - planned from Landers Shute WTP to discharge into North Pine WTP Reservoirs. These plans were fine-tuned because North Pine WTP chloraminates treated water as it is pumped from the plant. In conjunction with these changes, the establishment of a Grid fluoride was required to be added to the water supplies in SEQ. This, in conjunction with the different disinfection methods utilised between Landers Shute and North Pine WTP, has been an interesting challenge for the operators of this plant.

2.0 DISCUSSION

2.1 Overview of North Pine

North Pine Water Treatment Plant is a 250ML/d plant situated adjacent to the dam wall at North Pine Dam (which is the third largest dam in south east Queensland) holding 213000 ML when full.

A Honeywell SCADA system controls all aspects of operation at North Pine. All chemical dosing is flow paced with operator input for the initial set points. The filter control is flow paced with basin level control and flow meters comprising components of the algorithm. The plant is manned for 8.5 hours daily and then remotely monitored by Mt. Crosby operators who work a 24 hour roster. A North Pine operator is on call at all times the plant is remotely monitored.

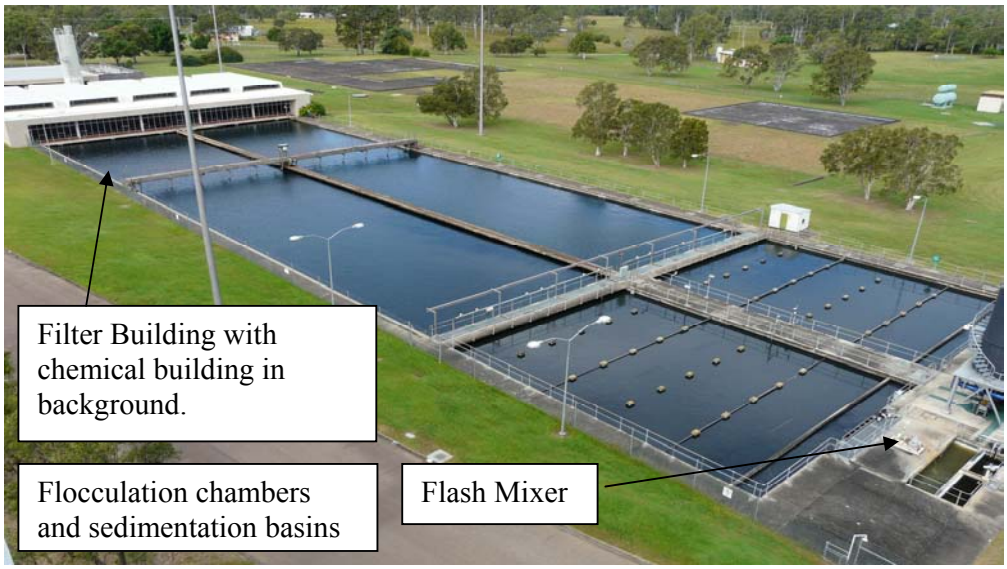

Figure 1: ***North Pine Water Treatment Plant***

The plant is supplied by a 1.5m main delivering raw water to the suction manifold of six raw water pumps. The pumps are two speeds and can run in stand alone or a combined mode when dam levels are low and both pumps are required to pump to the flash mixers. The raw water is pumped through a 1500mm main which bifurcates about 40 metres west of the flash mixers. Even flows are delivered to both basins with penstock valves in place to allow for the disabling of either basin for maintenance purposes.

There are two separate flash mixers, flocculation basins and two sedimentation basins. The basins have a capacity of 8ML each. The plant has a minimum turn down of 3ML/h and a maximum rate of 11.5 ML/h with five raw pumps operating. The large basins give a long detention time resulting in excellent colour removal and low Settled Water NTU onto the filters. Alum is used as a primary coagulant and powdered activated carbon is added at the beginning of the flocculation process as the raw water has had a history of taste and odour compounds. A filter aid polyelectorite is added at the outlet of the basins along with a 2mg/L dose of sodium hypochlorite to aid manganese and iron removal.

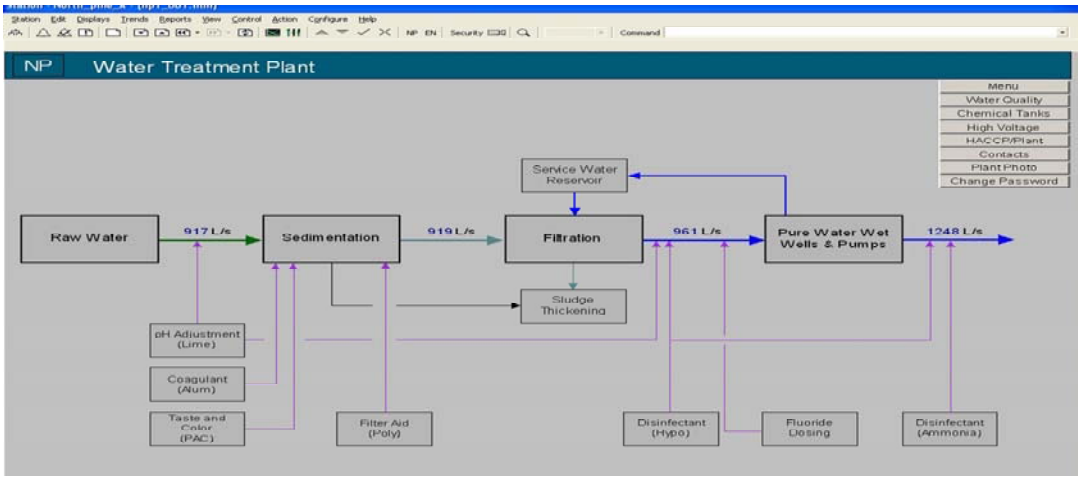

Figure 2: ***Honeywell SCADA system. This overview of the plant control system shows the flows trough the plant. Notice the final flow which is partly comprised with flows from the NPI.***

Each sedimentation basin has two outlet pipes. The four pipes combine to feed the five sand filters. Each of the five filters is comprised of 300mm of Anthracite and 300 mm of sand sitting on a gravel base. The filters then discharge to the reservoir via the filter to storage main. In this transit phase lime is added for pH correction; primary disinfection is by addition of sodium hypochlorite.

This main discharges into two separate reservoir cells, jointly holding 89Ml of treated water, and the outlets of the cells discharge to a common 60 inch main. The cell outlet main discharges into the suction manifold of eight treated water pumps. These eight pumps consist of four pump sets with a maximum flow from the treated water pumps of 3600L/s. The pumps are single speed and can run in single or combined mode. One pump will deliver 1200L/s or 105ML/d and pump to Aspley reservoir which is 89 metres higher than North Pine and a distance of 12 Kilometres away from the plant.

At North Pine, Link Water the "State owned Bulk Transport Authority" own and maintain the treated water pumps; however at this stage the pumps are operated by Seqwater operators. Each day the North Pine duty operator contacts Link Water operators centre to check on pumping requirements for North Pine to confirm expected flow from the NPI and the required pumping from the North Pine WTP.

2.2 Overview of the NPI in relation to North Pine.

The Northern Pipeline Interconnector joins the North Pine plant with a pipe discharging into the suction manifold of the treated water pumps. The pipeline enters North Pine Pump station thru the wall. It then runs trough a flow control valve and into Treated water suction main. There is PLC protection to make sure this valve is closed unless a treated water pump is running. This prevents the chloraminated water from entering North Pine's clear water reservoirs.

The NPI can deliver 52ML/d into North Pine. This is achieved with a flow of 600L/s relying only on gravity to deliver. The Landers Shute Plant is 165 Metres above the North Pine plant. The NPI is fed from a reservoir at the plant and its water is not pumped until it reaches North Pine. Typical flows from Landers Shute are at around 300L/s or 25ML/d. These flows are governed by the Grid Instruction.

3.0 NPI "INTEGRATION" WITH NORTH PINE AND THE CHALLENGES ENCOUNTERED BY OPERATORS

The SEQ Water Grid Manager (SEQWGM) sets the monthly supply demand targets for all plants in the Water Grid. Plants are expected to comply within a 20% plus or minus of this monthly volume. Historically this supply volume is associated with local demand but, with the establishment of a Water Grid, it is now linked to a broader system demand and may not bear any resemblance to what was traditionally the local demand in this area. This also introduced the need to ensure the NPI pipeline has a minimum flow of 15ML/d to ensure Water Quality objectives are maintained.

3.1 Lime dosing

The lime dosing system at North Pine had been constructed to allow for a minimum flow of 105 ML/d or the flow from two raw water pumps. With the inception of Water Grid the operators were asked to run the plant at a lower rate utilising one raw water pump.

In order to compensate for these lower flows a gear box was changed on the lime feeder. This plan worked but the flow paced dosing for the pH correction has been more difficult to manage, resulting in higher operator input and M&E input to change gearboxes on the lime system to accommodate the new variability of flow rates required.

The plant had never been run at such low rates throughout its thirty year history. The low flows and turnover caused poor water quality in the reservoirs at North Pine resulting in a loss of chlorine residual. We fine-tuned our operation, running higher set points in the initial disinfection, and ran our reservoir at lower levels to ensure increased turnover. This then led to further problems with the lower cell levels picking up lime turbidity.

North Pine uses hydrated lime to adjust the pH in the water entering the reservoir cells. This lime will always settle, leaving deposits on the reservoir floor at low velocities. With the extra turbulence encountered at these low levels, the lime was stirred up and led to elevated NTU leaving the reservoir. In response cell levels and initial disinfection set points were raised and this helped alleviate this problem. Careful consideration should always be taken when raising plant flows at low cell levels in the reservoir. Link Water network operators have become aware of this problem and now base their demand on cell levels at North Pine to assist with our WQ management objectives and to assist them they have alarms for our operating cell levels on their SCADA system

3.2 Construction and Commissioning

During the construction phase of the NPI there were large groups of contractors onsite. This placed time constraints on North Pine operators. Inductions for all visitors and construction staff were regularly conducted. Requests for information on infrastructure were a drain on operational staff as well.

The final stages of construction included a flush of the pipeline from Morayfield to North Pine. This was a total of around 38 ML of water. Because the pipeline was built in the midst of one of the worst droughts we had encountered it was decided to recycle all flush water trough the North Pine Water Treatment Plant.

Work Instructions and job safety assessments were developed to go ahead with this operation. One cell or half of the North Pine WTP reservoir was emptied and made available to the SRWP Alliance. A temporary pipe line was constructed from the NPI through the fence and to the entrance of cell #1. This was a 450mm mild steel line laid on top of the ground with welded joints. A screen was constructed to stop any debris from entering the reservoir during the flush.

The flush was delivered in three parts. The first flush involved a flow of 12ML with low to nil chlorine levels. This flush was conducted until turbidity was at an acceptable level. Initial turbidity was as high as 30NTU. Rocks, sticks some broken concrete and an old welding glove were collected by the intake screen. Water was flushed until turbidity reached below 1.0 NTU.

The second part of the flush involved filling the pipe with super chlorinated water. This included an initial flush of 9ML with chlorine at 20/25mg/L. This water was left in the pipe for 24 hours.

The third part of the flush involved the flushing of the super chlorinated water. This was an anticipated flush of 9ML but continued for some time longer than expected. I calculated the total flush volume at around 38ML.

The water was then left to settle and for chlorine levels to decrease before the water was recycled through the treatment plant. A Sykes pump was set up to deliver flows of 100L/s or around 10% of expected flows through the plant.

Once chlorine levels were below 2.0 mg/L the water was pumped to the head of the basins around 350 metres from the pump. A temporary manifold was constructed to deliver the flow to both flash mixers. Alum doses were not changed and the extra flow had little or no impact on the treated water results. Basin outlet turbidity of 1.0 NTU and colours of 1.2 PCU were the norm during this exercise. Filter outlet turbidity's of less 0.1NTU are the norm at this plant.

When the cell was empty Transpacific contactors were used to clean the empty cell. They utilised a vacuum truck with a jet rodder to clean the walls and floor of the reservoir cell. The reservoir holds a total of around 45ML and the floor area is huge. The sludge from the clean up was transferred to drying lagoons onsite. The effluent was pumped through a series of settling lagoons and then released after ensuring it met all environmental discharge limits.

During this period the NPI was commissioned with the North Pine operators developing and working a roster to cover 16 hours of operation of the pipeline. The treatment plant was run at different rates to ensure all operating rates of the NPI were covered during the commissioning phase. This commissioning was managed by Link Water who is the owner and maintainer of the NPI. Link Water is responsible for all bulk water mains and transport of the bulk water within the water grid.

Some water quality issues were encountered during this phase with high turbidity being the main problem. This was put down to the flow stripping sand and grout from the concrete lining of the pipeline.

3.3 Integration into North Pine Operation

Modifications were made to the existing SCADA to allow for the NPI integration. A water quality station is sited on the pump room floor providing data both to Link Water and also Seqwater SCADA systems. This data is displayed along with the MODE selected and current flows through the NPI.

There are three different MODES of operation. The most common mode is the combined mode which allows the NPI water to enter the suction main only after a treated water pump is started.

The next mode of operation would be North Pine in a stand alone mode. This can occur when the pipeline is off line for maintenance purposes. The other mode of operation is NPI only. In this mode the reservoirs are emptied and cleaned. The MODE changes are selected on the SCADA. This will create an interlock alarm on the fluoride plant and lock it out of operation. The NPI is then allowed to fill the reservoir through the suction manifold and reservoir outlet main.

4.0 CONCLUSION.

Does the NPI have a good or bad effect on North Pine WTP?

As a result of this drought, the NPI was designed and commissioned to have ongoing effect on operation at North Pine. North Pine Dam was at an historic low level of 15%. The dam was built and almost complete in 1974 when heavy rain flooded the dam site. The dam was completed and commissioned and low levels such as this were never before encountered. At the present the NPI is usually supplying 25ML/d to the Grid. This makes our operation easier as the operator can match intake and discharge flows. This results in a consistent flow thru the plant with minimum impacts on pH corrections and disinfection changes. North Pine current grid instruction calls for 105ML/d and this equals the production one treated water pump. One raw pumps delivers around 80 ML/d and the NPI is delivering the further 25ML/d required. When we are issued with a higher grid instruction the NPI has a positive impact on both the dam and the treatment plant. Lake Baroon supplies Landers Shute WTP and the rainfall received by this dam is much more regular than flows to North Pine. By suppling the grid with the NPI we conserve water in North Pine and avoid overflow in Lake Baroon improving Water Supply Security which is one of the primary reasons for the establishment of the SEQ Water Supply Grid.