AUTOMATED DREDGING- A SAFER WAY TO CLEAN OUR WASTEWATER BASINS

Charndeep Chahal, *Ops Readiness Technical Advisor (Wastewater),* SA Water

ABSTRACT

A diverless aeration basin clean was undertaken at Finger Point Wastewater Treatment Plant (WWTP) to improve operator safety by reducing ongoing manual handling tasks associated with continual ragging, and to optimise process capacity. This was the first trial of a Phoenix dredge and D:MAX screening equipment at a regional SA Water WWTP. The basin was cleaned while the plant continued to receive flow without any process bypasses. The dredge was run through the whole basin to remove rags. The clean also helped to understand the true capacity of the basin, recognised the efficiency of sludge surveys, identified optimisation opportunities, and will inform future upgrades.

1.0 INTRODUCTION

Finger Point Wastewater Treatment Plant (WWTP) in Port Macdonnell serves both the local township and nearby Mount Gambier. The plant was commissioned in 1989 with a hydraulic design of 6 ML/d average annual flow, (AAF) equating to a service population of 30,000 Equivalent population. Sewage is pumped 8 km from Mount Gambier to a high point and then gravitates to the site via a 22 km main. The received influent is screened through a 3 mm duty only step screen then a girt vortex to remove larger solids and grit respectively. Screened influent is then transferred to the head of a single train Intermittent Decant Extended Aeration (IDEA) basin for secondary treatment. The influent undergoes treatment cycles of aeration, settling and decant, and clarified effluent is then distributed to two polishing lagoons. Polishing lagoon effluent is then chlorinated and discharged to the sea.

The IDEA basin is 5.3 m deep with a total volume of 11.5 ML. It has 6 floating aerators (Figure 1) which are held in position by cables connected to the side of the basin and fixed shackles in the middle of the basin. Each aerator has a dedicated walkway which is not connected to the aerator during normal operation and has automated swing gates to access the aerators when required. The basin has two inlets for screened influent, as well as a bypass from the inlet screen, sludge supernatant return lines and three decanting weirs at the opposite end to the inlets. Waste activated sludge (WAS) is removed periodically from the basin and transferred to one of the four sludge drying lagoons which are fitted with underdrains. Partially dried sludge (8-10% dry solids) is then excavated onto a dedicated hardstand area for further drying and stabilisation. Two mixed liquor return (MLR) pumps recirculate mixed liquor from the basin to the head of the plant to create a plug flow selector by mixing incoming sewage with return activated sludge. They are currently not in use due to ongoing ragging issues.

Figure 1: *The IDEA Basin at Finger Point WWTP*

1.1 PROBLEM STATEMENT

The inlet screen has had multiple failures over the years and been offline for extended periods ranging from days to months at any given time. This had led to bypassing unscreened influent directly to the aeration basin and accumulation of rag material at the bottom. Rag build up and transfer from the inlet bypass to the basin has created downstream issues such as solids carry over to the polishing lagoons, rag carry over to sludge lagoons and multiple blockages within pipes, pumps and valves around the site. This had in turn led to various manual handling and safety issues for ongoing site operations and maintenance. The MLR pumps have been offline for an extended period due to ongoing blockages and manual handling issues with isolation and repairs. It was also difficult to understand the true process capacity of the basin and make informed decisions for any maintenance and future upgrade projects without confirming and removing any deposited rag from the basin.

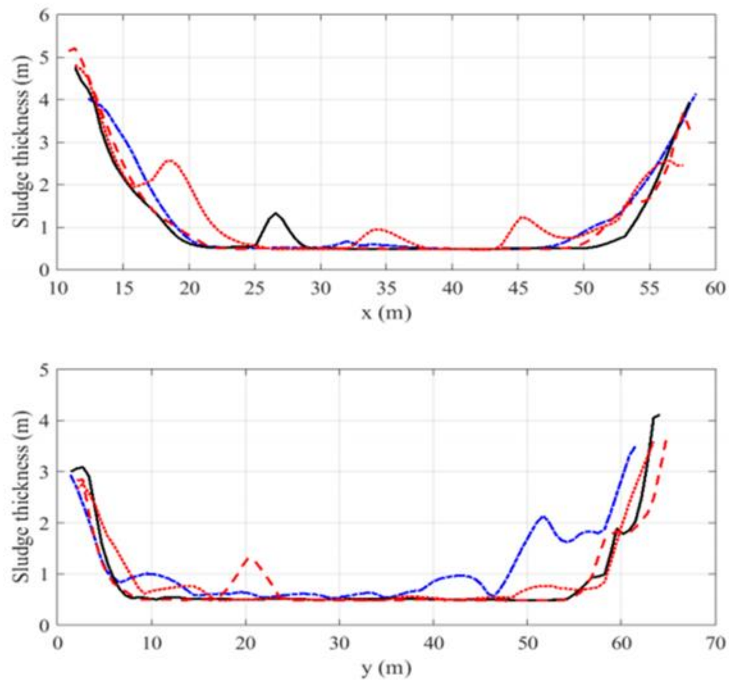
The basin was last cleaned in 2013 using divers and cages where the divers shovelled rag at the bottom of the basin and cages full of rag were lifted out and emptied on tarps on site (Figure 2). The rags were then left to dry and taken to landfill. This approach had safety, operational and environmental risks and so alternative options were investigated. There were numerous constraints to safely conducting another clean, including identifying a suitable approach and managing the treatment process given the IDEA basin could not be taken offline for the cleaning.

<u>Figure 2:</u> ***Material lifted out of the basin in 2013***

2.0 DISCUSSION

The issue was clearly identified and documented via multiple process reviews and during options assessment for other upgrades. The first step was to estimate the amount of rag present within the basin. A sludge profiling survey was undertaken using a sonar equipped sludge profiling boat (Figure 3). The survey was unable to identify differences between organic and inorganic material but provided a settled sludge profile (Figure 4) and identified potential areas of piles within the basin. The survey measured 0.5 to 0.7 m of sludge at the bottom of the basin which equated to 2.7 ML of solids, based on the dimensions of the basin. The survey also identified that the western top corner of the basin (near the bypass inlet) had a significantly higher amount of sludge compared with the rest of the basin. This also corelated with the flow pattern observed within the basin during an earlier study to identify detention times, flow patterns and any short circuiting within the basin. This was done by mixing a fluorescent dye in the influent to determine the transit time from inlet through to the basin at different flow rates.

<u>Figure 3:</u> ***Sludge profiling boat***



<u>Figure 4:</u> ***Sludge thickness cross-section***

To quantify the amount of rag that had entered the basin since 2013, a few assumptions were made: incoming influent was assumed to contain 0.09 m3 of wet screenings per megalitre (based on a previous study on another regional wastewater system) and a 10-20% of the total time of screen bypass was assumed during the last 9 years (given that the screen could be offline for 5-10 weeks a year on average). Based on 5.2 ML/d of flow, the basin was estimated to contain 600-800m3 of wet screenings.

2.1 The clean

A contractor was engaged in early 2022, following a tender evaluation process. The clean involved multiple steps including flow management, equipment isolation and movement, pumping, screening and waste management. With no holding capacity in the sewerage network, the plant continued to receive flow throughout the process. The cleaning equipment consisted of a remotely operated Phoenix dredge with a submersible macerator pump (Figure 5), mobile screening unit (Figure 6) and required pipework and tanks. A flow management plan was prepared, and equipment isolations were planned.

The clean started at the decanter end of the basin with aerator #5 being lifted out and placed on a cradle. All the aerators were electrically isolated, and the operating cycles of the basin were adjusted to provide sufficient run time for the dredge. The remaining the aerators were not lifted out, rather they were moved within the basin to enable dredge movement. As aerator #5 was lifted out of the way, the remote-controlled, robotic dredge was launched into the basin. The dredge, equipped with a macerator pump, lifted out the rags as it moved backwards and forwards on a transverse line controlled by a variable speed winch. The lifted material was fed to the screening unit which separated all the organic material from large inorganic rag and grit. The separated rag and grit were collected in hook lift bins and the liquid biomass was returned to the basin.

Figure 5: ***The robotic dredge being launched into the basin***

Figure 6: ***D:MAX screening unit***

2.2 Outcomes

As the dredge started moving through the basin, only minimal material was being lifted. The dredge was repositioned to further scan the basin, but it did not collect any more rag. The pump was lifted out of the basin and checked for any blockages, and the pipework was also checked. Work was paused to understand why less rag was being collected than anticipated, and a dip test undertaken to confirm the efficacy of the dredge. The contractor and operators then went out in a boat to identify any areas of rag. The dip test verified that the basin did have not have the expected volume of rag and only a small portion was identified in the western top corner of the basin which correlated with the sludge survey.

The dredge then continued to run through the basin to pick up all identified material (Figure 7).

Figure 7: ***Lifted rag from the basin***

3.0 CONCLUSION

The clean concluded that the process capacity of the basin is not solely compromised by rag accumulation identified in previous investigations. It is now clear that rag moves through to downstream processes and is continuously removed during regular wasting or carry over, rather than accumulating on the basin floor. This has also been verified by the presence of rags identified during polishing lagoon desludging works and continuous sludge excavation from the sludge lagoons. The dredge was not able to get underneath the walkways and rags seem to entangle with walkways and other structures/instruments in the basin. Therefore, some proportion of rag remains in the basin and needs to be removed by other means, such as lifting the walkways out. The clean also emphasised the importance of safely conducting a sludge dip test in similar cases to confirm the sludge volumes.

Projects which were on hold due to insufficient information about rag in the basin can now resume with more informed justification. This project has also helped understand design requirements for future upgrades such as inlet works optimisation and sludge handling. Various process improvements and investigations are now underway to improve plant performance, such as reinstating MLR pump functionality. We are looking at further future applications of this approach to support digester cleans, channel and tank cleaning

4.0 ACKNOWLEDGEMENTS

I thank the entire South East Wastewater Treatment Operations team for their immense effort on the ground; the Maintenance Execution team for their on-ground planning and delivery support; the Integrated Planning team for sponsoring the works; and our contractors for undertaking this task.