Alva WwTW

final cost achieved £1.836m opposed to Capital provision £3.2m

Alva Waste Water Treatment Works is located to the south of Cobblebrook Burn which flows into the River Devon from the north. The plant treats domestic wastewater from the village of Alva and flows from Glenochils Young Offenders Institution. The majority of the town is on a combined system, with separate systems installed to new developments in recent years. Industrial wastewaters generated by Dye works were also accommodated. The original works was constructed in the 1970s, providing primary treatment, with oxidation ditches added in 1987. The works was designed to meet the SEPA consent for a population of 9,000 with a design DWF of 2,800m³/d. The purpose of the Alva project - and challenge - was to regain compliance with the current consent requirements.

Alva WwTW

courtesy Scottish Water Solutions

The Alva WwTW comprised four stages of treatment: incoming wastewater received preliminary treatment in the form of a 25mm inlet screen and de-gritting, with a manually set storm overflow between the screen and grit trap, primary sedimentation in Imhoff primary settlement tanks with a fixed weir storm overflow after primary treatment. The flow of wastewater was divided into two streams, each of which passed on to secondary treatment in oxidation ditches with conventional secondary clarification units. Settled activated sludge is returned from secondary settlement to the mechanically aerated ditch to maintain biomass concentration and surplus sludge is returned to the inlet PS wet well to be co-settled in the Primary Settlement Tanks. Sludge is stored in two sludge tanks for removal off site for further treatment. The final effluent passes from the works via a measuring flume to an outfall on Cobblebrook Burn near its confluence with the River Devon.

The Capital Expenditure project Initiation Report listed inefficient flow control to primary and secondary treatment stages, low nutrient levels due to high network infiltration, combined with high Dissolved Oxygen and filamentous bacteria, poor contact and mixing zones in ditches, failure to maintain sufficient biomass, rising floating sludge as contributory factors to the erratic performance of the plant.

Trials and Scope Development

From the initial project stakeholder meetings in April 2004, initial site investigations and data evaluation of existing flow and load data, it was found that the site received predominantly domestic wastewater, but there was a small industrial contribution from a brewery and the prison. The design basis for the Alva plant was a dry weather flow of 2,800 m³/d and a population equivalent of 9,000, thus assuming a contribution of 311 litres/capita. The SEPA consent of 20 mg/l BOD and 15 mg/l ammonia at a 95 %ile was easily within the capabilities of a well designed and operated

oxidation ditch. Indeed, 15mg/l BOD at a 95%ile are usually quoted for a typical UK sewage. However, large quantities of suspended solids in the final effluent will make the BOD consent hard to meet, thus it was identified that improving the suspended solids removal would also make a big difference to the BOD removal efficiency and give an extra window of safety in consent compliance.

A number of possible permutation were considered for optimising the Alva oxidation ditches. Four possible future operating scenarios were considered with and without primary sedimentation. The plant operation was optimised for carbonaceous removal as the ammonia standard was achieved by a combination of influent dilution (as a result of high infiltration) and nitrogen assimilation by new biomass. However, due to a combination of planned improvements to the network infrastructure and additional load from new housing developments, the plant was required to achieve complete nitrification. This would, therefore, necessitate the ditches to operate with increased operational sludge ages. There was also the possibility that the existing primary tanks would be removed and retrofitted as storm tanks, in which case the ditch would operate on screened raw sewage.

With long term historic SSVl levels being in excess of 140 ml/g, optimisation of the SSVl was, therefore, key.For carbonaceous only removal the maximum SSVl at average flow could be >120ml/g but at peak flow would need to be 90 ml/g in order to prevent final effluent compliance problems. If nitrification was required at the lowest F:M ratio quoted above, the SSVl at average flow would need to be approximately 70ml/g and at peak flow significantly <<70 ml/g and so unlikely to be achieved in this case.

At this stage, high level costing of the four options was undertaken and, to achieve a 100% confidence level of regaining compliance with the current consent, a capital provision of £3.2m was required. A staged approach to the design was promoted by the project team to achieve the most efficient capital expenditure. This approach meant the construction of a selector tank, monitoring the performance and then reviewing the requirement for further capital work at the site.

In July 2004, Scottish Water Solutions (SWS) Engineering commissioned *Aqua Enviro* to carry out a process study at Alva WwTW. The process study encompassed a review of the plant operation, analysing all available historical data, undertaking microscopic examination to confirm the identity and abundance of filamentous bacteria, evaluating potential engineering solutions and confirming recommendations, with a 6-month evaluation on the effect of the engineered solution.

The recommendation was that two selectors be installed, each of 28.5m$^{3.}$ The installed selectors were baffled into three zones, using under/over baffles. The first zone of the selector receives all of the incoming settled sewage; in addition, it also receives RAS at a rate of 1050 m^3/d. Note that the use of these design criteria required Scottish Water Solutions to obtain a specification waiver from Scottish Water. This waiver was granted, demonstrating Scottish Water's receptive approach to innovation. Installation of the selector tanks commenced in November 20004, and was completed in January 2005.

The trials were also to establish if the secondary treatment stage could be made to work more efficiently with a weak pre-settled sewage, or whether there was a requirement to by pass the existing upstream primary settlement tanks to increase the BOD loading to the works. Should a bypass be required, then the additional scope of works would potentially involve conversion of the PSTs to sludge storage and storm tanks; construction of an SAS pumping station and installation of an additional inlet screen at an estimated cost of £1.2m. In addition there was also a contingency plan in place to provide additional chemical dosing facilities in order to aid final settlement at an estimated cost of £0.2m.

The installation of the selector tanks resulted in a progressive improvement to the settlability of the sludge in the final settlement tanks was observed. Analysis showed that the activated sludge SSVl has reduced from an average of over 140ml/g before the trial to an average of 70 ml/g in the final month. As one of the main aims of the selector trial was to reduce the SSV1 value to below a target value of 95ml/g, The selector tanks can be seen as very successful. The selector tanks have improved the performance of the activated sludge plant to the extent that a PST bypass or chemical dosing was not required.

Microscopic evidence collected from Alva indicates that, whilst the selectors to date have not changed the overall abundance levels of filamentous bacteria, the dominant species present has changed from *Microthris parvicella* to Type 0041 and Type 1851, resulting in the reduction in the length of filamentous bacteria present and significantly improving the morphology of the flocs within the activated sludge mixed liquor.

Construction

The Delivery Partner for the project was *Purac Leslie* consortium, who commenced work in November '04. initially installing the Selector Tanks and bifurcation chamber, which were completed in January '05. Work recommenced in April '05 with the installation of 1km of temporary access track and associated landscaping works required by Clackmannanshire planning approval, so that the site traffic was removed from the normal access route through a local housing estate.

Planning proved to be a drawn out process. third party negotiations were required with two landowners, in order to progress installation of the temporary access track. Community liaison was undertaken with presentations to the local community council, and the local councillor. Letter drops were carried out with the local councillor to the houses in the vicinity of the plant, allied with the neighbour notifications carried out as part of the planning protest.

The final scope of works delivered included an inlet works conversion, installation of a new 6mm Huber Screen, relocation of existing grit classifier, installation of a washwater booster set, 4 new 2DWF pumps with VSDs and sump pump, new variable speed RAS pumps. Weir plate installation to PSTs, RAS, and SAS flow meters and auto desludge controls, structural repair works to Primary Settlement Tanks, inlet well and distribution chamber, new selector tanks and splitter chamber, new MCC with associated electrical works, temporary access road and additional landscaping screening to the plant.

Results

Due to the staged approach of the design and construction, the final out-turn Capital Cost for the project was £1.836 million as opposed to the £3.2 million Capital provision estimated in the early stages of the project. Maintaining a close working relationship with Scottish Water Operations and the community allowed the project to be delivered into service 20 days ahead of the approved programme on the 10th March 2006. ■

Acknowledgements

The authors wish to thank Scottish Water and Scottish Water Solutions for permission to publish this paper. They would also like to thank Scottish Water Strategy & Planning and Operations teams for assistance during the trial work.