Trent Vale Pumping Station

part of uID Amp3 solutions in Stoke-on-Trent

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Severn Trent's AMP3 investment programme included 54 Unsatisfactory Intermittent Discharges in Stoke-on-Trent, which had been identified by the Environment Agency (EA) as contributing to quality problems in the River Trent. Trent Vale Pumping Station is the largest of the uID schemes included within this uID improvement programme. The pumping station is situated adjacent to the A34/A500 road interchange, to the south west of Stoke-on-Trent and was originally constructed as a stand alone sewage treatment works in 1928, but has been redeveloped over the years resulting in its current function. The works now acts as a terminal pumping station for Strongford STW (which lies a further 4 miles down the River Trent) but also has on site stormwater storage capacity for a population of some 110,000 within the Lyme Valley catchment.

Trent Vale PS: Water starting to weir over the cut out sections *courtesy Haswell Consulting Engineers Ltd & Severn Trent Water*

Flows arriving at Trent Vale (3810 l/s max) combine into a single open channel which includes a storm overflow weir, controlled by a modulating penstock/flume combination. This limits the flows that are passed forward to Strongford to a maximum of 837 l/s.The balance discharged into four running storm tanks (total capacity = 7415m^3) prior to this project, which in turn discharged into the River Trent.

Although the tanks were provided with an automatic emptying system, this was becoming increasingly unreliable and as there was no cleaning system fitted to the tanks, there was heavy reliance on manual intervention for both emptying and cleaning processes.

Although the pass forward pumps were relatively old, they were in themselves operationally reliable. However, the associated control system was outdated and had given rise to reliability issues in the past. Therefore, in addition to addressing the EA imposed water quality issues the proposed solution needed to incorporate some asset renewal to provide updated, automatic control.

Solution

The solution was divided into two parts, firstly the provision of an additional 5200m^3 of storm storage capacity in the form of two new 'blind' rectangular tanks. These tanks have been designed to fill first so that any solids or ragging are kept within the system rather than being allowed to pass to the watercourse. A new 6mm screen has been installed on to the existing storm weir to prevent debris from entering the storm system in the first instance.

The remainder of the solution included installing an automated storm tank cleaning system within the new and existing storm tanks, a new automated storm return pumping station serving all of the stormwater tankage on site and the provision of a new control panel to service new and existing plant and equipment.

A number of design challenges had to be overcome before the final solution was identified, satisfying Severn Trent Water's technical and financial constraints. Many of these were overcome at an early stage within the programme by early collaboration between the client *(Severn Trent Water Ltd),* the *Designer (Haswell Consulting Engineers) and Contractor (DCT Civil Engineering Ltd).* The proposed scheme included considerable work on operational assets and early input and approval from the Client's operational team was also vital to ensuring that the project could progress without affecting the work's operation.

Major difficulties addressed included:

*** Flood Plain/high ground water levels**

Information supplied by the Environment Agency demonstrated that the flood level was above existing ground level in the only practical location for the new storm tanks. As the new structures impinged upon the flood plain of the River Trent, flood compensation works were consequently required. Following specialist advice it was agreed that the compensation works (amounting to a volume of approximately 1000m$^{3)}$ would be carried out in adjacent Severn Trent owned land. Furthermore, the flood compensation works had to be completed in advance of the main construction works, meaning the contractor was required to liase with the specialist environmental team to ensure this element of work ran smoothly.

Given its riverside location, high groundwater levels were anticipated on site and this was confirmed by ground investigation. Site ground levels and hydraulics further dictated that the new storm storage capacity would have to be constructed largely below ground level, presenting the inherent difficulty of flotation. The geology precluded the use of ground anchors so the storm tanks had to be designed as gravity structures incorporating sufficient self weight to resist flotation.

Several options involving detailed structural analyses were considered before it was concluded that a design incorporating mass fill within the base of the tank presented the best solution. Initial designs utilised imported structural fill/sand as the fill material. However, during construction it was found that there was sufficient as-dug material, of adequate quality, to be utilised. This helped to reduce costs and was extremely desirable from an environmental perspective, eliminating the need to take the as-dug material for off site disposal.

*** Hydraulic design**

The hydraulics of the existing site were extremely tight, with only a 150mm level difference between the storm overflow weir and the outlet weirs of the existing tanks. In order to avoid surcharging within the catchment, the upstream top water levels had to be maintained at current levels. Additionally, a storm screen which could only operate within defined hydraulic parameters had to be incorporated at a set point within the existing hydraulic profile. The design also had to cater for failure or total blinding of the storm screen.

In order to deal with the increased flows, and to eliminate the need for interstage pumping, several modifications had to be introduced to the storm water route to reduce hydraulic losses; including abandonment of existing narrow storm tank feeder channels, alteration of the storm tank outlet weir and lengthening of the storm screen bypass.

*** Storm tank cleaning**

Having considered a 'tipping bucket' system, the selected option involved the installation of jet mixer pumps to keep the storm tank contents in suspension during the emptying sequernce, This had the advantage of being most cost effective, having reduced civil works, and being a simple system that could be used under a variety storm conditions. However, it presented the disadvantage of potential increased power demands on the site, the effects of which were mitigated through equipment optimisation with the supplier. A further consideration was an EA requirement which prevented storm tanks being taken out of operation during modification. The viability of this solution was proved during the construction period when there were long periods of inclement weather which would have adversely affected the programme had the other option been progressed.

The £2.4 million contract was awarded in June 2004, with a tight construction programme. Construction progressed well, delivering the scheme benefits by the end of March 2005, in line with the Client's requirements. The achievement of this date would not have been possible without the close collaboration between all members of the Delivery team; Client, Designer, Civil and M & E contractors and Operational staff. ■

The Delivery Team:
Client: Severn Trent Water Ltd;
Designer: Haswell Consulting Engineers;
Main Contractor (Civils): DCT Civil Engineering Ltd;
M & E Sub-Contractor: A C Chesters.

Note on the authors: *Steven Jones, is Group Engineer, Haswell Consulting Engineers; Sarah Greenhalgh, Engineer, Haswell Consulting Engineers; Mike Smith, Senior Engineer, Severn Trent Water Engineering & Purchasing Services.*