Royal Oak PS, Waltham Abbey

refurbishment & upgrade to cure capacity problems

by James Smith BEng (Hons)

Royal Oak Pumping Station is a foul water pumping station (PS) located in the Waltham Abbey catchment of North London and serves a population of approximately 2000 people. The original station is thought to originate from the 1940s, however, its current configuration has two submersible pumps running on a duty and assist basis within a small wet well beneath a brick building housing the control equipment. Flows are pumped via a 900 metre long, 225 mm diameter asbestos cement rising main which discharges by way of another PS into Deephams STW.

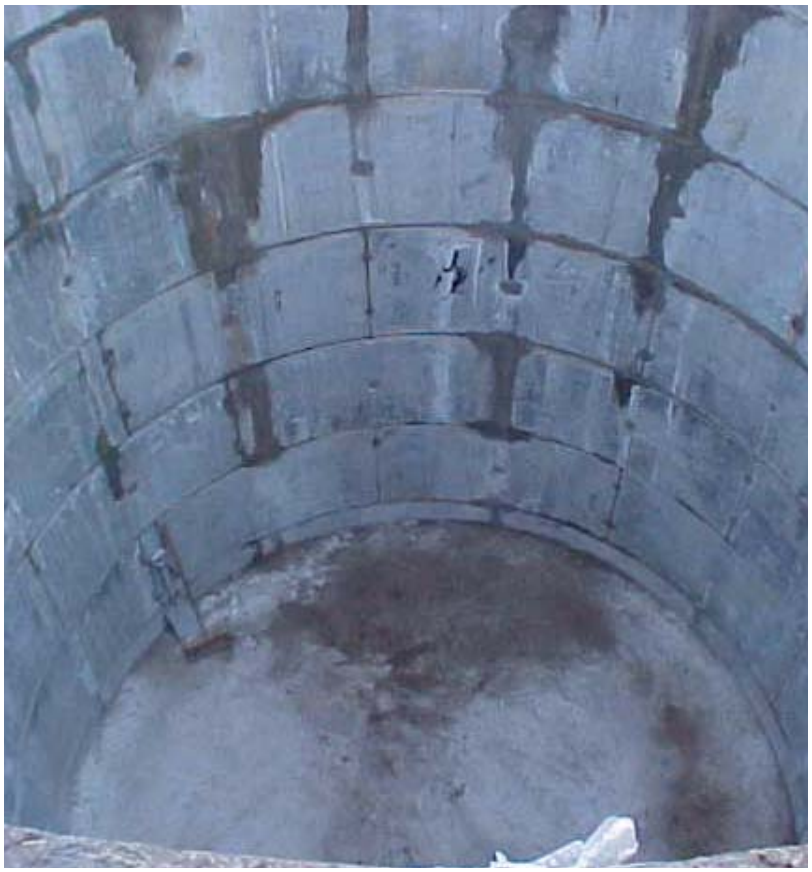
Segment being raised into position using Charcon's underbuilding frame ideal for use in very stiff weathered London Clay *(courtesy Thames Water)*

The station has suffered from chronic capacity problems due to the very small and shallow wet well. This has been exacerbated by growth and infiltration in the catchment. It has also experienced operational problems due to the age and integrity of the existing mechanical and electrical equipment. Consequently a £330,000 project was approved to address these issues.

Procurement

The project is being delivered by the *Network Noerg Alliance ,* one of the AMP3 Network Alliances set up by Thames Water in the summer of 2000. Following a modified IChemE Green Book conditions of contract, the contractor, in this case a partnership between *Barhale and Subterra*, becomes responsible for delivery of the project for an agreed target cost. This target cost includes ALL the project costs such as design resources and compensation, which may have traditionally sat outside the contractor's construction costs. Incidentally, in the Thames Water Network model the design is still undertaken by in-house resources, which are supplemented by external resources when required.

The major elements of mechanical and electrical equipment, such as pumps, panel, valves and pipework, were procured through the relevant Thames Water Framework Agreements, These have been set up to provide a consistent level of service and to provide some degree of standardisation across the company and region. In this case the pumps were supplied by *ITT Flygt Ltd;* the panel by *Saftronics Ltd* and valves and pipework by *Aqua Gas Ltd* and *Saint Gobain Pipelines Plc* respectively.



Wet well base cast

Project elements
Thames Water Engineering Network Design undertook all civil design elements of the project, with the exception of structural design. This was supplemented by external support from *Faber Maunsell Ltd* who undertook the mechanical and reinforced concrete design. Main elements of the project are outlined below:

* construction of an 8m deep, 5m diameter wet well;
* construction of a new valve chamber;
* supply & installation of a new control panel and telemetry;
* installation of two new wet submersible pumps with a duty/assist pumping regime but with the same pump rate as the existing pumps so that the downstream rising main and catchment will not be overloaded;
* demolition of the existing brick building;
* diversion/modification of associated sewers and turn flows.

Wet well
The wet well has been designed to be as large as possible for the available space in the existing compound. The resultant 5m diameter, 8m deep shaft has given a 500% increase in the time to spillage for dry weather flow as a result of complete failure of the pumping station.

The new wet well was constructed by *Joseph Gallagher Ltd* on behalf of *Subterra*, shaft rings used were *Charcon One Pass Rings,* as specified with *Hydrotite hydrophyllic sealing strip* applied to all joints. The shaft was excavated in weathered London clay to a depth of 9.2m using underbuild techniques. The geology was ideal for this type of shaft sinking and no groundwater was encountered during the excavation process.

The mass concrete base slab was placed by crane and skip. The shaft was grouted with ordinary Portland cement and the joints caulked with pointing mortar. The cover slab was cast in place by *Subterra* operatives using a system to suspend the falsework deck from the surface, as opposed to erecting staging from the base of the shaft.

Pump design & installation
The wet well at Royal Oak was oversized to provide storage within the system, consequently the differential levels within the well (6m from top water level to bottom water level) meant that the pump delivery would vary considerably as the water level changed. In addition, the new station was utilising the existing rising main, which if over pressurised by new pumps could potentially fail.

Taking these two points into consideration in the design, a pump was selected that would deliver the required flow rate of 18 l/s at a maximum operating pressure equal to that of the existing station. (The existing pressure was determined by site pumps tests).The flow rate of the pump dropped off to 9 l/s at bottom water level due to the large difference in top and bottom water levels.

Due to the low flows involved, the pump was small in physical size, this meant that the pump through let on most pump designs was less than required and may have resulted in frequent blocking. In order to avoid this a *Flygt N* impeller was selected as Thames' preferred choice for raw sewage applications.

Procurement and installation of the pumps and associated non return and isolation valves and electrical aspects of the project were covered by *Engenica,* a part of the *Subterra alliance team*, who purchased and installed a framework panel based on the pump selection.

Risks
Apart from the usual construction risks associated with the construction of deep structures and the installation of M & E equipment, the major risk associated with this project is the integrity of the existing 225mm diameter asbestos cement rising main. Its condition was unknown, although trial holes indicated it was in a reasonable state close to the pumping station. However, there has been a history of bursts with the last one over five years ago. Although the pumps have been sized such that the discharge flows will not change from those of the existing configuration, the fact that new, more efficient pumps are being installed may exert additional pressures on the main. This risk is to be managed, as there may be an opportunity to lay a new larger rising main to take flows to a different less overloaded catchment in the future. The pumping station has been sized with this in mind.

Completion
The project was successfully delivered, giving the client TW Water and Waste Operations, a robust solution which resolves current problems but also has the capability of being upgraded or modified with the minimum of work in the future. The Alliance way of working allowed the team to overcome any issues without confrontation and culture blame associated with some traditional contracts.■

Note: *The author of this article, James Smith, is Project Manager with Thames Water.*