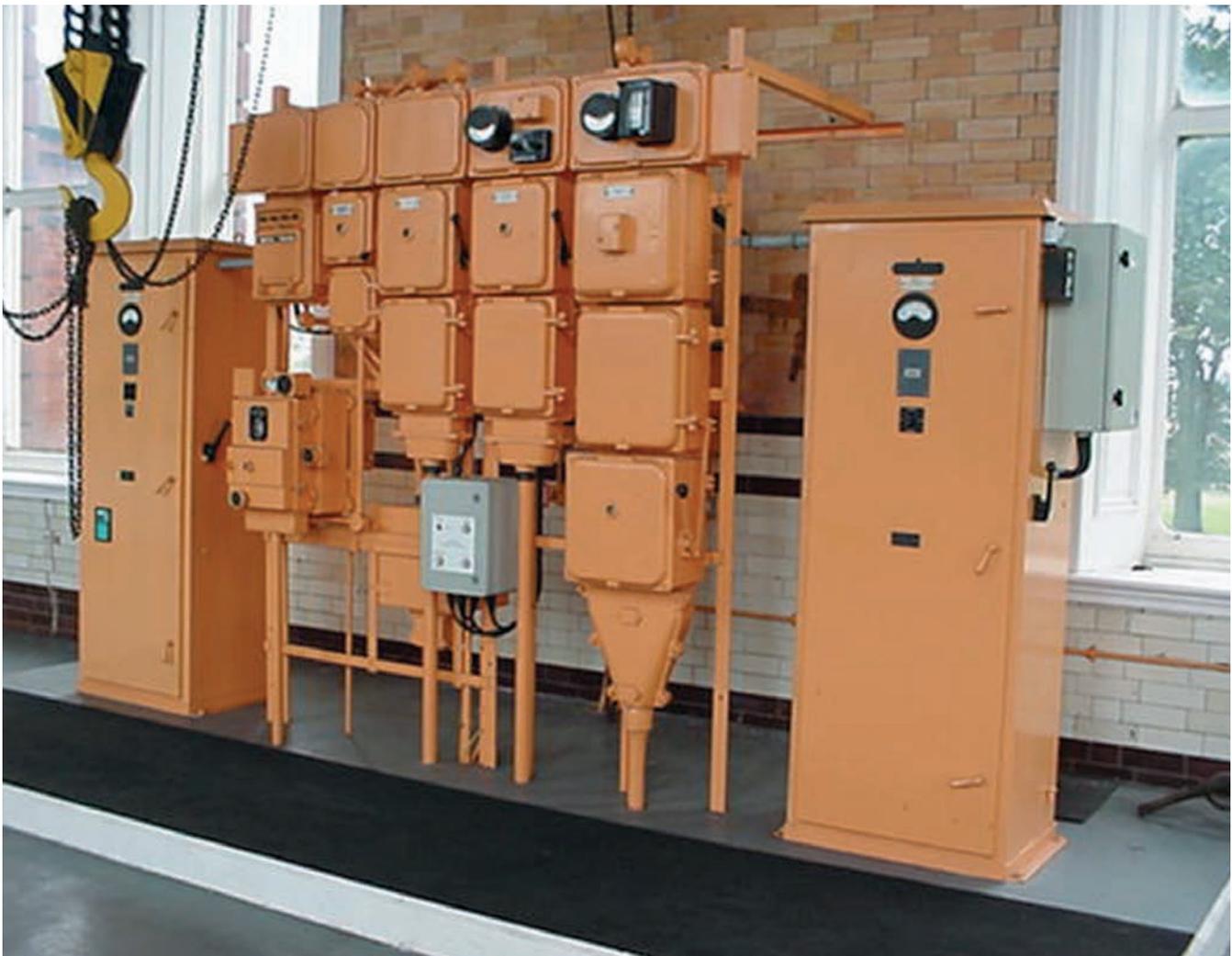


# Sunderland Groundwater Stations

## major refurbishment of late 19th & early 20th century stations

by M I Abbott BSc, MICE, CEng

**N**orthumbrian Water (NWL) currently operates eight ground-water pumping stations in the Sunderland area abstracting potable water from the underlying Magnesian Limestone aquifer into the Sunderland area distribution system. NWL has undertaken a review of its water resources strategy to determine the requirements to meet customer demand and regulatory water quality standards for the next forty years. A conclusion of this review was that the Sunderland GWS should continue to be key assets and provide an average 30 MI/d of potable water. A £3m programme of refurbishment works was required in order to comply with this strategy.



Stoneygate PS Old MCC Panel (courtesy Northumbrian Water).

### Background

The eight operational Sunderland Groundwater Stations are a mixture of deep shafts, boreholes or combinations of both, pumping water from the underlying magnesian limestone aquifer. Requiring only chlorination before pumping into supply, the water is of good quality although very hard with average values of 140 to 190 total hardness as Ca. The aquifer extends from South Shields to Teesside and varies in thickness between 100 to 200 metres. The majority of the Groundwater Stations were built in the latter half of the 19th century and early part of the 20th century and were aged assets requiring extensive refurbishments. Each Groundwater Station has service buildings housing plant and equipment, a number of which have listed building status subject to stringent planning procedures.

### Feasibility

Northumbrian Water's framework Consultant, *Entec*, was initially appointed to undertake a feasibility study to investigate the hydrogeology of the aquifer and the condition of the associated assets to determine whether or not they would provide a sustainable source of water. The feasibility study included data collection, hydrogeological assessment of the aquifer and comprehensive surveys of the condition and performance of all existing electrical, mechanical and civil assets including CCTV surveys of the shafts and boreholes.

The study also included the examination of the current operation of the stations and recommendations for future operational strategy.



Fulwell PS - a Grade 11 Listed Building (courtesy Northumbrian Water).



Fulwell PS Well-Head (courtesy Northumbrian Water).

Capex and Opex cost estimates for refurbishment works to retain the assets in operation for the next forty years were prepared together with a programme for capital investment and a review of health and safety aspects.

After the successful completion of the feasibility study, the project was extended to include conceptual design, detailed design, preparation of contract documentation, evaluation of tenders and construction management. This work included conservation and planning matters.

#### Hydrogeological studies

Entec was also appointed to undertake further extensive hydrogeological investigations, which had the following three main objectives:

- \* quantification of available resource. This included recharge modelling and stream baseflow assessments;
- \* better understanding of pumping station performance. A series of pumping tests were carried out to establish the performance of stations and aquifer and also degree of well interference, which will assist NWL in formulating its medium term pumping strategy;
- \* improved aquifer management. A MODFLOW regional ground water model was developed to assess the behaviour of the aquifer and its response to NWL pumping operations. The model will enable resource and impact assessment runs thereby enabling NWL to formulate its long term pumping strategy.

#### Refurbishment work

Prior to the main refurbishment works, a contract was awarded to *Lloyds British Group* for the replacement/refurbishment of winches, headgear and lifting equipment at each station. These are used to remove pipework and pumps from the deep shafts and to enable man-access for general maintenance. Man-riding winches were replaced with a single portable *Tirak* winch and the existing ancillary winches were stripped down and completely overhauled. In addition, two overhead cranes were electrified. The work brought all of the lifting equipment at the groundwater stations in line with current legislation.

The chosen procurement strategy was to award a single refurbishment contract for all of the remaining work. The main contract included detailed design together with all associated civil, electrical and mechanical refurbishment works for the eight stations. There were a number of operational constraints which limited the time individual stations could be shut down for refurbishment and consequently the construction programme was critical.

A £2 million refurbishment contract was awarded to NWL's frame work contractor *Black & Veatch*, commencing January 2002. The chosen conditions of contract were the WSA General Conditions of Contract for Water Industry Plant Contracts form G90 with amendments and additions in accordance with NWL Engineering Standard E1203. Included in the main contract works were pump refurbishments, replacement of MCC panels, new chlorination equipment, shaft repairs, building repairs and general access works for Health and Safety.

The original submersible pumps had been in service for up to 30 years and with regular maintenance, had proved very reliable. The original pump manufacturer *Hayward Tyler* provided a full refurbishment service, completely rebuilding each pump. The majority of pump motors were replaced with new units.

The stations could only be taken out of service one at a time and, at North Dalton, which is the major ground station, a single pump was kept running whilst the other three pumps and associated control equipment were replaced and commissioned. Two adjacent major water booster stations within the distribution system were also replaced as part of the project.

Civil sub-contractor *Border Construction Ltd* strictly controlled work within the shafts. A permit to work system was adopted together with entry/exit procedures, which were developed following consultation with Mines Rescue and the local Fire Brigade who provided emergency back-up. Inherently safe short wave radio sets were used for communications between the surface and shafts.

#### Summary

**Following a review of its supply/demand strategy, NWL has invested £3m in refurbishment works and associated studies of the Sunderland Groundwater Stations. Comprehensive hydrogeological studies, including modelling of the aquifer will enable NWL to develop future abstraction strategy and aid aquifer management. The refurbishment works have brought the stations in line with current health and safety legislation and have replaced aged assets at the end of their design life. The stations will now be able to sustain an average 30MI/d into the Sunderland distribution system for the foreseeable future. ■**

*Note: The author of this article, Mick Abbott, is Project Manager, Northumbrian Water.*