

# Lopwell Pumping Station

## £2.1m refurbishment scheme safeguard's critical raw water supply for Plymouth

by

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**L**opwell raw water pump station is situated on the banks of the River Tavy, just north of Plymouth, Devon, in an Area of Outstanding Natural Beauty. The station is considered by South West Water as a critical asset in maintaining clean, potable, drinking water to Plymouth and the surrounding South Hams district. In September 2009 South West Water engaged local process engineering contractor Tecker Ltd to undertake the modernisation of Lopwell Raw Water Pump Station as a design and construct contract, working closely with their engineering team, led by SWW's Project Manager Phil Thomas.



*View across the River Tavy to the well-concealed entrance of Lopwell Pumping Station*

*Courtesy of South West Water*

### History

The first Pump Station and Tidal Dam were built at Lopwell in 1953. This pump station remained in operation up until 1981, when due to greater demand for water and security of supply, the present pump station was constructed.

The station was originally equipped with 4 No. low lift - high lift tandem pumping sets, which were able to deliver flows ranging from 22Mld to 90Mld to Crownhill WTW, the main water treatment works for the city of Plymouth serving a population of 250,000.

During the 1990's the original pumps were further complimented by the addition of 2 No. split case high lift pumps, offering improved efficiency at the lower end of the station's flow range down to 10Mld.

In 2009, after nearly 30 years of reliable operation, the pump sets had reached the end of their working life.



*Lopwell RWPS under construction circa 1981*

*Courtesy of South West Water*

## Key Objectives

The key objectives for the scheme were:

- To ensure security of supply from this critical pump station was maintained for the foreseeable future;
- To modernise the station with the latest technologies with the aim of reducing the station's environmental impact and operational cost.

## 21st Century Technology used to Optimise Savings

At the heart of the new design are 6 No. Flowserve 315KW 5-stage vertical turbine pumps each capable of delivering 632m<sup>3</sup>/hr @ 131.2m head, resulting in a maximum cumulative flow of 91 million litres per day being available for delivery directly to Crownhill Water Treatment Works, from the river intake at Lopwell.

The new pumps are designed to operate on a duty/assist basis, with 4 No. pumps operated at fixed speed via soft starts and the two remaining pumps operated from variable speed drives. Each pump will provide a 15Mld increment at full speed and the VSD controlled pumps enable a smooth transition throughout the full range of flow.

A new intelligent MCC was designed, manufactured and installed by Tecker, allowing the new plant to be operated remotely. In addition to soft starts and VSD's, the panel also incorporated a dual supply design with each half of the 4000 Amp rated MCC fed by a separate 2.5MVA transformer. In the event either supply was to fail, redundancy was provided via a bus-coupler which allowed either transformer to feed the whole MCC.

The MCC also provided a central-hub for the numerous process instruments, condition monitoring devices and surveillance equipment installed throughout the station. A Profi-Bus enabled device network was installed on-site, allowing the station's process instruments to provide far more information than using traditional digital & analogue communications. Instruments could not only provide process readings, but could also be interrogated for fault finding and remotely programmed to avoid unplanned and routine site visits.

Further reduction in operational costs have been achieved through the provision of the latest predictive maintenance systems. The installation of new monitoring instrumentation such as pump vibration and power monitoring devices, provides real-time plant condition performance data enabling the user to optimise plant performance and detect early warnings of component failure or performance deterioration.

High resolution surveillance equipment and remotely operated building management systems were provided to assist South West Water personnel in the operation of the station, removing the need to visit site on a daily basis hence reducing operational costs and

consequential carbon emissions, both key targets of South West Water.

Remote operation of the site meant that robust automation of the new equipment was vital in achieving the predicted operational savings.

Bespoke control software provides assistance to the operators, monitoring & controlling various plant criteria such as automatically rotating and selecting duty pumps based on performance & wear factors, or advising the operator of preferred flow setpoints to optimise the efficiency of the pumps.

## HV Upgrade

A significant driver for the scheme was the potential OPEX savings achieved by removing the requirement for maintenance of HV control equipment on-site.

Improvements in pump efficiency have made it possible to utilise LV pumps and switchgear to achieve the desired output from the pump station. The existing HV switchgear was decommissioned and removed to make way for an LV equivalent control system, which included an upgrade to the existing HV mains supply, installing 2 No. 2.5MVA 11kV/433V transformers and upgrading over 300 metres of buried HV supply cables.

## Design Innovations

Tecker's design team utilised 3D Parametric modelling software to visualise the entire pump station to ensure that all new and existing equipment was installed with due regard for operation & maintenance of the plant.

All stakeholders, including South West Water Operations and Engineering personnel, were able to actively participate in the design process. All were able to benefit from the effective animations of the 3D model, allowing them to easily visualise the pump station and simulate many of the operational and maintenance tasks, prior to commencing construction. Utilising this new technology saved design time and reduced the risks associated with the complex installation of the new equipment in the existing building.

Operational staff could clearly see how they would operate valve hand-wheels, gain access around the pumps, the river intake channel and access all equipment for maintenance purposes. Based on their feed back, designers were able to fine-tune the design, to ensure the scheme was delivered to the client's exact requirements.

Special pump sump baffles were designed to optimise performance and increase efficiency of the new pumps. Hydrotec Consultants Ltd. determined that surface and submerged vortices could develop around the pump suction. In order to prevent this potential problem which could cause damage to the pumps over time, a baffle design was developed which would eliminate the vortices completely. To ensure the same results were achieved in the station, tight tolerances were applied to the baffles to ensure they replicated the modelled results.

Challenged with achieving very accurate benching and baffle dimensions using concrete benching and steel plates, a one piece baffle concept manufactured from stainless steel was researched and considered to be a viable option, carrying the least amount of risk in achieving the brief. This approach eliminated uncertainty regarding dimensional accuracy that would have occurred using concrete and each baffle could be inspected prior to installation. The baffle shape was complex as the sloping side walls continually changed in angle to fit the existing structure.

Tecker's 3D design capability made the task of producing accurate traditional 2-D orthographic fabrication drawings much faster and simpler than using traditional design methods, as much of the process is done automatically by the software.



*New MCC No.2 for the Scheme pictured in Tecker's Workshop*

*Courtesy of South West Water*

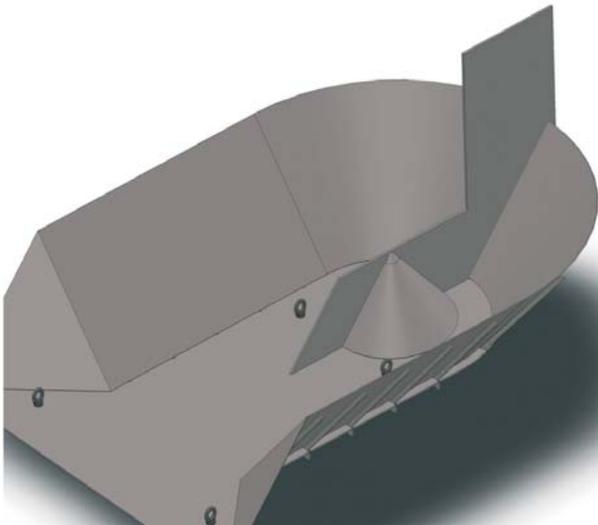


Illustration shows the Pump Baffles being designed Courtesy of South West Water using parametric 3D design software



...and the completed stainless steel baffle Courtesy of South West Water

**Considerate Construction**

Environmental considerations were also at the forefront of the team’s management strategy, particular as Lopwell is sited within a Local Nature Reserve, AONB & SSSI designated areas. Environmental control measures ranged from reducing the number of vehicles travelling to and from site, to using local suppliers and materials when ever feasible to do so.

The Environment Agency was regularly consulted, and river silt samples analysed, to ensure any water discharges from the works into river Tavy did not pose any environmental risk. Recycling waste

materials generated by the scheme resulted in over 250 tonnes of waste material being processed and reducing waste-to-landfill to under 2%.

Tecker have been awarded the Pure Vision Award 2010 by South West Water, for their innovation and continuous improvement on the project at Lopwell Raw Water Pumping Station.

**Note: The Editor and Publishers thank Darren Hobbs, Principle Design Engineer with Tecker Ltd and Andy Lawrance, Contracts Manager Tecker Ltd for producing the above article.■**

## Surge Control Equipment Refurbishment

**Quantum Engineering Developments Ltd**

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