

# Stressholme STW Upgrade

## increased process capacity

by  
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**S**tressholme STW is situated on the outskirts of Darlington, Co Durham, on the banks of the River Skerne and serves a population of approximately 100,000. Sewage treatment has been undertaken at the site since 1939 and to accommodate evolving legislation and catchment growth in the intervening years, the works has been extended and modified several times to now include preliminary treatment (inlet screens, screenings handling and de-gritting), primary settlement and secondary biological filtration / settlement together with storm flow retention in tanks and sludge digestion / storage.



*Filters under construction*

*photo courtesy of Northumbrian Water*

### PROJECT AIMS

Significant investment was required at the works by Northumbrian Water as a shortfall in biological filter capacity and the deterioration of ageing filter media was necessitating prolonged and extensive recirculation of filtered effluent, operation of formally abandoned filter beds and chemically assisted primary and secondary settlement to maintain consent compliance.

Additionally performance issues relating to the inlet screens and screenings handling equipment was resulting in significant volumes of material passing to the down stream process units as well as frequent operator intervention. Similarly, manual cleansing of the on-site storm tanks involved unacceptable levels of operator attendance. Other issues included inadequate screening of imported sludge, shock

loading the main treatment process by high rates of sludge liquor returns, and unsatisfactory access to the site via a hazardous junction onto public highway and single shared access track through a municipal golf course.

These principal drivers led to the following main objectives of the works upgrade project:

- Replacement of the biological filters;
- Upgrade of the inlet works;
- Installation of an automatic storm tank cleansing system;
- Provision of new imported sludge reception and sludge liquor management facilities;
- Improved site access through construction of new road;

The £16m project also aimed to deliver significant environmental and sustainability benefits with a desire to generate a rationalised site layout through appropriate demolition, materials re-use where possible, ground improvement, site restoration and landscaping.

### DELIVERY STRATEGY

#### Choosing the Right Solution

Entec UK Ltd was appointed by Northumbrian Water as consulting engineers for the project and feasibility work commenced in 2006. It was quickly determined to make best use of existing assets where possible. Furthermore, in alignment with operational preferences, the replacement process selected was biological filtration rather than a change of treatment philosophy to an activated sludge plant or sequencing batch reactor. The existing filter media was analysed and proven to be unsuitable for use in re-constructed or deepened filters, therefore new build options only were considered.

Estimates were prepared, and the relative process, operability and environmental merits (including carbon footprint analysis) were considered for the major project elements including four trickling filter options.

The provision of 8 no. structured plastic media filters (20,000m<sup>3</sup> volume) was selected as the preferred treatment method as it offered significant savings in media and associated construction materials volumes, together with capital and whole life cost compared to stone filters. It also offered the advantage of a much reduced footprint, allowing construction of the new assets in space alongside the existing filters whilst retaining the existing filters in service. This

allowed adherence to the essential operational constraint of retaining the existing filters in service until the replacement units were constructed, commissioned and fully seeded.

The recommended options were approved and developed through conceptual and detail design.

#### Access to the Works

As the existing access road was unsuitable for the large volume of construction traffic that would be required for the works upgrade and was identified for replacement, the new road was constructed under a separate contract in advance of the main contract.

The road was constructed (by Byzak Limited) in early 2007 across land owned by Northumbrian Water and used for the spreading of digested sewage sludge from the on site sludge centre. During construction of the 1km long bitumen macadam road, approximately 6000m<sup>3</sup> of surplus excavated topsoil and subsoil was retained on site for use in the main works upgrade.

#### Main Works Upgrade

Design and construction of the asset improvements were challenging in that the upgrade had to be achieved on a space constrained operational site with a multitude of existing below ground services, whilst managing very large flows and ensuring continued satisfactory operation and consent compliance at the STW. These issues were a major consideration when developing the design and determining construction methods, programming constraints and operational interfaces.



Screenings Handling Units

photo courtesy of Northumbrian Water

The £13m construction contract (ECC Option A Priced Contract with Activity Schedule) was awarded to Carillion in March 2008 following competitive tender.

### **Enabling Works**

Initially about 16,000m<sup>3</sup> of dried sewage sludge retained in redundant sludge lagoons was removed and stockpiled for later use as a soil medium in the final site restoration. The empty sludge lagoons were then used throughout the contract as on site landfill sites for crushed demolition and surplus excavated materials. The site for the new filters was then prepared by demolishing eight redundant humus tanks and four redundant percolating filters and suitable demolition material were crushed and graded to produce structural fill material to support the new filters. Approximately 30,000m<sup>3</sup> of unsuitable ground was then excavated and placed in the on site landfill. The engineered fill foundations to the filters were then formed with both recycled and imported material.

### **Inlet works**

Flows to the STW can exceed 2,100l/s in storm conditions, with FFT currently consented at 750l/s. The inlet works receiving these flows is located immediately adjacent to the River Skerne. The concrete structures of the existing inlet works were carefully modified and extended to allow the installation of three new Adams escalator fine screens each of 1,110l/s capacity. These were installed in a duty / assist / standby arrangement with the standby screen capable of operating as a second assist unit should the other screens become overloaded.

Two Washpactor units from Ovivo (formerly Eimco Water Technologies) were installed each capable of handling 18m<sup>3</sup> of wet screenings per hour which discharge clean dewatered screenings into four skips housed in a new portal framed skip building.

The construction contract included early sectional completion targets for the refurbishment of the inlet works and the sludge related improvements described below to reduce the risk of screenings carry over to the new filters and of strong sludge liquors impacting on the performance of the new process.

### **Sludge Treatment Assets**

A new sludge reception centre was constructed incorporating a Huber R03 sludge screen which discharges screenings into a single skip again housed in a small portal frame skip building. A new sludge liquor pumping station, transfer main and 100m<sup>3</sup> capacity glass coated steel balancing tank were constructed which now control the rate at which sludge liquors are returned to the head of the works.

### **Storm Tanks**

Substantial structural modifications were made to the existing six reinforced concrete structures which now enable the tanks to be filled sequentially rather than concurrently, thus reducing the number of tanks to be cleaned after smaller storm events. Twelve tipping buckets each of 5m<sup>3</sup> capacity were supplied and installed by CSO Technik which now enables automatic cleaning of the tanks. The old storm return pumps were also replaced with new Flygt N pumps.

### **Electrical Works**

Extensive electrical works were carried out including the provision of 4 new MCCs, a new 700KVA LV switch room, a new site standby generator and associated enhancements to SCADA and telemetry systems.

### **Biological Filters**

Each of the eight 30m diameter, 5m high filters were constructed in-situ with reinforced concrete. A total of 20,000m<sup>3</sup> of structured plastic media was supplied, assembled into blocks on site in a temporary on-site factory before being installed by crane into the completed tanks by GEA 2H Water Technologies Ltd. The assembly process involved thermally bonding together separate preformed polypropylene sheets

that had been delivered to site by HGV. This saved approximately 300 vehicle movements compared to normal off-site factory manufacture, an enormous advantage on one of the largest water industry plastic media installations in the UK. Furthermore, the use of polypropylene will prove to be a sustainable solution as it can ultimately be recycled when the filters are decommissioned.

A new filter feed / recirculation pumping station with a capacity of 850l/s was constructed inside a 7m diameter 10m deep caisson shaft. A 3 tonne, plc controlled recirculation valve was installed on the works outfall which allows flows up to FFT to be re-circulated to the pumping station and hence the filters during low flow conditions to ensure that operator selectable seasonal minimum wetting rates for the plastic media are maintained (even if incoming flows to the works are interrupted). This alleviated concerns regarding the drying out of the filter media during protracted warm dry summer spells.

Risks associated with the process commissioning of the new filters were reduced by two means. Firstly, Bioamp Technology from Chem-Aqua was employed to automatically generate and dose large quantities of live bacteria (from pellets stored within the dosing units) into the filter distribution chambers. Secondly, the proportion of influent flow being diverted onto the new filters was carefully controlled and biological activity was maintained in the old filters by recirculation with temporary pumps. As seeding progressed flows to the new filters was increased and the existing process units were taken out of service. Together, these measures produced compliant effluent within 4 weeks.



*Filters Distribution Chamber*

*photo courtesy of Northumbrian Water*



Filters in operation

photo courtesy of Northumbrian Water

#### Site Remediation and Contract Completion

Successful commissioning of the new filters allowed demolition of redundant process units together with other now disused assets. Arisings were crushed and used for final site restoration together with previously stockpiled soils.

The construction contract was successfully completed ahead of programme in February 2010.

#### Key Project Participants

**Client:** Northumbrian Water, **Designer:** Entec UK Ltd

**Principal Contractors:** Byzak Ltd (Access Road), Carillion plc (Works Upgrade)

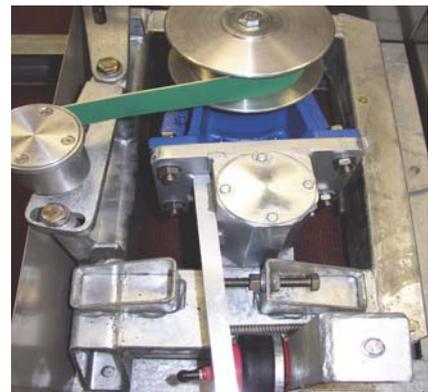
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