

Yorkshire Water's Large FFD Schemes

an update on progress with YW's £300m Freshwater Fish Directive Programme

by
Noel Feather BSc, CEng, CEnv, MICE, FCIWEM,
Philip Press BSc, CEng, MICE, MCIWEM
and Peter Caldwell BSc, CEng, MICE, MCIWEM

Yorkshire Water (YW) are investing over £300 million in waste water treatment works as part of their commitment to the Fresh Water Fish Directive (FFD) in the AMP4 period. This article provides an update on progress with these schemes since the introduction in UK Water Projects 2007. Also covered in more detail are the large schemes at Spen Valley WwTW, Naburn WwTW and Harrogate South WwTW. The last year has been challenging, however Yorkshire Water and their Contract Partners have delivered the capital programme on time and on budget. Yorkshire Water is in the enviable position of achieving the goals and visions set out at the outset, whilst maintaining good working relationships.



Aerial photograph of Harrogate South WwTW showing construction work

Courtesy of Peter Smith Photography

Programme Update

For Yorkshire Water the FFD programme involves unprecedented upgrades to many of its largest treatment works. In response to this challenge YW created a strategic FFD Vision that is being carried through the FFD Programme. Prior to commencement of the AMP4 period YW undertook a Strategic Study to develop a Management and Design Guide to give direction to bring the Vision to reality.

Having completed the study YW and [Arup](#), as Framework Technical Consultants, have been able to quickly progress feasibility and

tendering to the extent that by early 2008, all Contracts had been awarded for major FFD schemes. As a consequence of this YW should be in a position to complete all their schemes well within the regulatory timescale.

The first schemes to be commenced, at Esholt (serving Bradford) and Halifax were described in UK Water Projects 2007. The Esholt Phase 1 works and the Halifax scheme are complete. The next schemes to follow, at Neiley and Knostrop Sludge which were described in UK Water Projects 2008. These are also now complete.



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The new activated sludge plant at Spen Valley (Phase 1) and Naburn are also complete. These schemes are covered in more detail later. Good progress is being made with the work at Knostrop WwTW (serving Leeds). Works are also completed at Lundwood (Barnsley) with main contractor [Earth Tech Morrison](#) (ETM), and at Denaby, Mexborough and Burcroft (South Yorkshire) with main contractor Watermark.

Of the remaining schemes the contracts for the new treatment plant at Huddersfield with main contractor Morgan Est and at Harrogate South with main contractor Laing O'Rourke are both on programme.

Spen Valley Strategy

Yorkshire Water's Spen Valley Strategy involves improving the discharges from three treatment works, North Bierley, Spenborough and Dewsbury (Mitchell Laithes WwTW) to comply with the Freshwater Fish Directive with a discharge standard of 5 mg/l of Ammonia. A rationalisation solution has been developed under which sewage treatment is concentrated at the Mitchell Laithes site in Dewsbury which is being extensively rebuilt under the scheme. The Project is being delivered in two phases.

- Phase 1: additional secondary treatment and sludge treatment at Mitchell Laithes
- Phase 2: flow transfer from North Bierley and Spenborough to Mitchell Laithes plus treatment of storm flows.

[Arup](#) are Project Managers for the strategy with Turner & Townsend as cost consultants. The Arup role includes feasibility, tender preparation and appraisal, site supervision, Project Management under the NEC and CDM coordinator.

Spen Valley Phase 1 Works

This article concentrates on the Phase 1 Contract which was completed in mid 2009. The Phase 2 contract is following on with completion scheduled for early 2010. The contract for Phase 1 was awarded to [Earth Tech Morrison](#) (ETM) in December 2006 with a value of about £26m.

Mitchell Laithes Wastewater Treatment Works currently serves Dewsbury and surrounding districts with a population equivalent of 320,000. On completion of the strategy with flows from Spenborough and North Bierley transferred the population equivalent will have increased to 500,000 with a flow to full treatment of 200,000m³/day, the equivalent of 80 Olympic swimming pools per day.



Mitchell Laithes – Activated sludge plant and final settlement tanks nearing completion

Courtesy of Peter Smith
Photography

In summary the Phase 1 works involve the construction of:

- Activated Sludge Plant (ASP)
- Final Settlement Tanks (FST)
- Sludge processing
- Gravity Belt Thickeners
- Drum Thickeners
- Centrifuges
- Sludge Phyto Conditioning process areas (SPC).

One innovative aspect of the construction works was the fact that the new ASP and FSTs are located within sludge lagoons. At the start of the project these lagoons were operational and contained approximately 140,000 cubic meters of sludge. By working closely with Yorkshire Water's operational staff these lagoons were emptied and processed through the conditioning process to produce a product which was used as top soil on various reclamation projects throughout Yorkshire as well as on site on completion of the project.



Emptying sludge lagoons. Sludge was mixed with saw dust and green waste prior to conditioning and ultimately use for landscaping applications around the region

Courtesy of Arup

To store product generated by the lagoon emptying works it was necessary to utilise some additional land on the edge of the treatment works site. Crop marking had been observed in this area and archaeological excavations were undertaken as part of the scheme. The excavations revealed an early Bronze Age barrow. A small pottery vessel, "pygmy cup", found adjacent to the barrow was likely to date from the period 2000-1500 BC.

Evidence of late Neolithic, Iron Age and Romano-British settlements were also found in the excavations. The barrow was re-constructed as a landscape feature and to protect the site from operational traffic.



"Pygmy cup" found during preconstruction excavations adjacent to the Bronze Age Barrow

Courtesy of Northern
Archaeological Associates

The ASP and FST construction programme was phased to facilitate the lagoon emptying works. The new ASP has six “U” shaped lanes which are 6m deep and have a combined volume of over 60,000m³. Flows from the ASP enter one of 5 final settlement tanks prior to discharge to the River Calder. The majority of flows will be treated by the new process with the remainder passing through the existing treatment process.

Sludge treatment forms a significant element of the works at Mitchell Laithes. The scheme is expanding and enhancing the Sludge Phyto Conditioning process (SPC). The process has been developed collaboratively at Mitchell Laithes by Yorkshire Water and Green-tech Ltd. This is an award winning environmentally friendly process utilising green waste from local council recycling centres in addition to the sludge produced by the sewage treatment process. Concrete slabs have been constructed for the SPC process. These slabs contain the green waste reception area and chipping facility, mixing areas, windrowing and conditioning area.



Mitchell Laithes – Sludge storage tanks and associated pumps and pipework

Courtesy of Arup

Seven sludge storage tanks with a combined capacity of 12,000m³ have been constructed. Primary sludge is being thickened using Gravity Belt Thickeners which have been installed in an existing building. Drum Thickeners are being used to thicken surplus activated sludge from the ASP. The combined thickened sludge is then transferred to the existing digester prior to dewatering in a new centrifuge building.

As well as the flow transfer works a new inlet works with coarse and fine screening plus grit removal is being constructed at Mitchell Laithes as part of the Phase 2 works by [Mott Macdonald Bentley \(MMB\)](#). On completion of both schemes Mitchell Laithes will become one of Yorkshire Water’s largest works with a population equivalent of over 500,000.

Naburn Process Scheme

Yorkshire Water’s AMP4 scheme at Naburn involved the installation of a new treatment process to improve the performance of the works and to provide additional capacity. The site is the eighth largest treatment works operated by Yorkshire Water. It is the main treatment works for the city of York serving a population of 237,000 people.

Arup were initially appointed the Project Manager for the scheme with Turner & Townsend as cost consultants. The Brief was then extended to include tender preparation and appraisal, site supervision, Project Management under the NEC and CDM coordination.

The existing Sequence Batch Reactor treatment system had developed significant performance issues. Its reliability from mechanical, electrical and capacity perspectives was causing compliance concerns. As a short term measure YW re-commissioned a previously mothballed filter works on site to reduce the load on the SBR. Due to the age of the filter works this was not a sustainable situation.

Initially it was necessary to identify the most appropriate cost effective solution to address the issues on site. Consideration was



Naburn WwTW - Aerial photograph of the working area

Courtesy of Peter Smith Photography



Installation of aeration diffusers and pipework at Naburn WwTW

Courtesy of Peter Smith Photography

given to the construction of a new side stream treatment system to supplement the SBR plant. It was however identified that the optimum solution was to convert the treatment process to an extended aeration activated sludge plant. The re-use of the reactor basins with an alternative aeration system provided adequate capacity for the planned growth within the catchment. The extended aeration process was adopted as the solution due to there being no primary tanks on site. The size of the reactor basins (110m x 24m x 6.5m) was such that they would when modified conform with all of Yorkshire Water's design parameters. The standard AMP4 design includes the use of U shaped lanes (in plan) to provide maximum flexibility for modification to suit future consent requirements.

The other key structures required by the scheme were a new selector tank, distribution chambers and associated pipelines and 6 No 40m Dia. Final Settlement Tanks. The original outfall was to be retained. Following a competitive tender MJ Gleeson (subsequently **Black & Veatch** Ltd) were appointed as the Principal Contractor under the terms of the Engineering & Construction Contract Option C. Contract award was in October 2006 with a contract period of 102 weeks and a Target Cost of approximately £13.5m.

Programming and sequencing of the works was the most important aspect of the scheme. The conversion of the process had to be undertaken while maintaining the treatment capacity of the plant. Considering that the reliability of the existing installation was one of the drivers for the scheme this was not without its risks. An extensive contingency plan was developed by the project team to mitigate these risks and reviewing it on a regular basis was essential.

It was necessary to construct the FSTs and selector as soon as possible and then isolate the first basin for conversion such that they were all ready for commissioning at the same time. Only one basin could be out of service at any one time until two ASP lanes were operational. It was not possible to isolate the old filter works until three ASP lanes were operational.

The Naburn site has changed significantly over the last 100 years that it has been a treatment works site. The layout of the existing plant and environmental restrictions on the site resulted in a small working area being available. Extensive piling was required for the new

structures. Each FST required 130 driven piles approximately 20m long to allow them to be constructed adjacent to the River Ouse. A large platform was required to allow these piles to be installed. The material used was recovered from an abandoned filter works on the site. This significantly reduced the amount of vehicle movements to and from the site and it removed old redundant structures from site.



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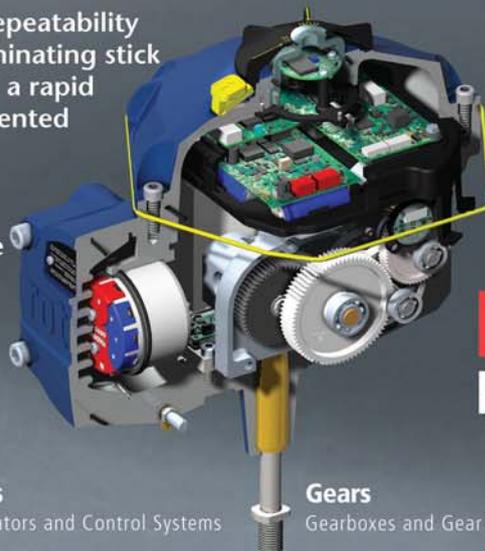
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During the course of the scheme the power supply arrangements had to be reconfigured. The site originally had two separate LV supplies. It was necessary to change the supply to a single HV feed. The ownership of the transformers passed to YWS so it was possible to create a full HV ring main on the site with minimal re-wiring. As such the power supply to the site is deemed to be more reliable. The scheme achieved Takeover on programme. YWS are now operating the plant which is meeting the required consent conditions on a very reliable basis.

Harrogate South WwTW

The feasibility study for Harrogate South WwTW scheme commenced in December 2006. The population equivalent at the 2020 design horizon is 54,000. The population equivalent doubles over the Great Yorkshire Show three day annual event in July.

As a consequence of the Fresh Water Fish Directive the existing works consent standard of 5 Ammonia mg/l needs to be improved to 3 Ammonia mg/l. Flows currently discharge to Crimble Beck. The four options considered were



Harrogate WwTW - Upgrading of the pipework at the inlet work

Courtesy of Arup

- 1) 100% Activated Sludge Plant
- 2) 40% ASP and continue to use existing Biological Filters and Humus Tanks
- 3) 50% ASP with alternating double filtration
- 4) Transfer flows to New WwTW adjacent to River Nidd.

The preferred solution was Option 1 – 100% ASP with an estimated cost of £10m. The scope of the works comprises refurbishment of



Harrogate WwTW - Internal view of the RAS/SAS pumping station

Courtesy of Arup

the inlet works, abandonment of High Rate Filters and Mineral Media Filters, Construction of a New Primary Settlement Tank, Activated Sludge Plant, New Final Settlement Tanks and New Sludge treatment Facilities (dewatering).



Harrogate WwTW - Electricity substation and welfare building

Courtesy of Arup

The procurement strategy was to invite competitive tenders from 3 Large Scheme Framework Contractors. The approach used was to involve Contractors at an early stage and reimburse them for attending 6 ECI meetings, freeze the process design at an early stage, maintain continuity of key personnel during the tendering process, early involvement of Supply Chain (Key Framework Suppliers) and confirm a list of mandatory requirements. The Contractors team are considered to be critical to the success of the scheme.

The tender period commenced on 18 July 2007 with an early tender review in week 3, a mid tender review in week 6, a tender technical presentation in week 9 and a full tender submission (technical and commercial) in week 12. Laing O'Rourke were awarded the contract in February 2008.

The risks on the scheme are perceived as relatively low as the ASP is being constructed offline from the existing works and in sandstone. Challenges were experienced in introducing a new 11KV/760KV High Voltage power supply to the site and reconfiguring BT lines. The scheme is due to be completed during September 2009.

Note: The Editor & Publishers wish to thank Noel Feather, Philip Press and Peter Caldwell, Associates with Arup for producing the above article. ■

A kingfisher bird is captured in mid-flight, splashing water. The bird's wings are spread, showing a mix of brown and blue feathers. Its beak is open, holding a small, orange-colored fish. The background is a soft, out-of-focus blue and white, suggesting a natural aquatic environment. The overall scene is dynamic and energetic, with many water droplets visible around the bird.

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