

Yorkshire Water's Large FFD Scheme

Introduction to £220m Freshwater Fish Directive Programme

by

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

Yorkshire Water (YW) are investing over £220 million in waste water treatment works as part of their commitment to the Fresh Water Fish Directive (FFD) in the AMP4 period. These works form part of their "Riverlife" promotion with the vision to "create a more natural river environment and help a wider variety of fish and wildlife to thrive in Yorkshire's rivers. Helping cities and towns rediscover their river heritage, benefiting local people and tourists alike." These new works are being constructed between 2005 and 2010 and will improve around 410 km of rivers across Yorkshire. Compliance with FFD will involve upgrading some of Yorkshires largest waste water treatment works, including Esholt, which serves Bradford and Knostrop, which serves Leeds. The principal driver of the FFD is a reduction in ammonia levels discharged into watercourses.



Yorks FFD: Primary tank construction underway upgraded inlet works in background

courtesy Yorkshire Water

FFD Strategic Study

For YW the FFD means an unprecedented programme of upgrades will be required at 23 works across the region. In response to this challenge YW created a strategic FFD Vision that is being carried through the FFD Programme. Key to the vision's success is the selection and adoption of new, efficient and sustainable process technology.

Compliance with the forthcoming EU Water Framework Directive (WFD) is also likely to introduce even stricter controls on discharges to rivers. This means that the works being carried out must have capacity to retrofit additional plant and equipment in future AMP periods. Future proofing is therefore a top priority within the FFD programme.

Prior to commencement of the AMP4 period, YW instigated a Strategic Study to develop a Management and Design Guide to give direction to bring the Vision to reality. Arup as newly appointed Framework Technical Consultants supported specialist YW staff in

developing the detail around the vision and setting out how it would be implemented. A number of working groups were established to develop the Vision in specific areas such as Sludge Strategy, Energy Strategy, Programme Delivery, Process & Technology and Integrated Catchment Management. Representatives from the Large Scheme Contract Partners, who would undertake the scheme detailed design and construction were involved at an early stage to contribute to the groups, to gain an understanding of the new procurement strategy and to ensure early involvement in the feasibility process.

The outcome of the Strategic Study was summarised in the "AMP4 Programme Management & Design Guide" which was published in June 2005 and widely distributed within YW and to the Framework Contractors and Consultants.

Programme Summary

The first scheme in the FFD Programme to commence was Esholt, serving Bradford and parts of Leeds. This scheme was developed in parallel with the Strategic Study with the Phase 1 contract being



Esholt activated sludge tanks under construction. The large crane is installing a pipe bridge across the river connecting the ASP to the new final settlement tanks.

photo courtesy Peter Smith Photography

awarded in August 2005. The Phase 2 contract followed a year later with overall completion due early in 2009. The second scheme to be tendered was the smaller Halifax scheme which commenced early in 2006 with completion in 2007. Further details of the above schemes follow below.

During 2006 contracts were awarded for the following large schemes at:

- * Lundwood (Barnsley) to *ETM*;
- * Neiley (near Huddersfield) to *Morgan Est*;
- * Knostrop (Leeds) to *Laing O'Rourke*;
- * Mitchell Laithes (Dewsbury) to *ETM*;
- * Naburn (York) to *Black & Veatch*;

A rationalisation scheme for the works at Denaby, Mexborough and Burcroft in South Yorkshire is being constructed by Watermark.

The remaining schemes in the FFD programme are at Huddersfield, Spen Valley (two works between Bradford and Dewsbury) and Harrogate South.

Esholt WwTW

The Esholt treatment works serves Bradford and north Leeds and surround areas with a population equivalent of 730,000. The existing trickling filter treatment processes, installed some 100 years ago, need to be replaced to meet the consent standard imposed by the FFD.

Yorkshire Water's scheme will be constructed in two phases at an overall cost of £64 million.

Arup are Project Managers for the scheme with Turner & Townsend as commercial consultants. The Arup role includes site supervision, CDM Coordination and contractual Project Manager.

Esholt Phase 1

The Phase 1 contractor is a joint venture company between the management, engineering and development consultant *Mott MacDonald* and contractor *JN Bentley*. Phase 1 of the project commenced in September 2005 and is focused on the preliminary and primary treatment – the inlet works, a hydroturbine, six 39m diameter primary tanks, pumping stations, sludge storage tanks and several kilometres of pipelines.

For almost a century Esholt's inlet works has received flow from the Bradford catchment via a tunnel which is almost 2 miles in length. Screenings are transported from various locations en route to the inlet works. During storm conditions the increased velocity in the tunnel (over that occurring at average flows) means that a backlog of debris is washed down and can potentially overload the inlet works. UID improvements under AMP3 have also raised a number of issues, with substantially more screenings being passed down to the inlet works following rectification of unsatisfactory CSO's.

The inlet works is being reconfigured to provide two-stage screening – coarse screens and fine screens. This will provide a robust and effective preliminary treatment solution.

The inlet works will also incorporate a two-stage grit removal process. After the coarse screens the existing grit removal facility will be upgraded, with new secondary grit detritors installed after the fine screens.

The inlet works is key to the operation of the whole of the Esholt WwTW scheme. Its correct functioning will facilitate the optimum operation of the biological treatment process. One of the major challenges at the inlet works is to satisfy all the design criteria – including hydraulic constraints, screen design and grit removal requirements within the footprint of the existing inlet works.



Map showing locations of Yorkshire Water's Freshwater Fish Directive Schemes

courtesy of Yorkshire Water



New odour control equipment installed at Halifax WwTW comprising bio-filters and carbon filters for sludge dewatering and storage facility.

courtesy of Ove Arup



Halifax WwTW at 5am, July 2006 awaiting first delivery of concrete for the second pour for the new activated sludge plant

courtesy Ove Arup

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Web: www.ayrisward.com

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Due to the topography of the Esholt site, the inlet works is approximately 12 meters higher than the primary settlement tanks. This has allowed the incorporation of a power generating hydroturbine. This comprises two 'archimedial' screws that operate 'backwards' – instead of lifting flow (as a conventional screw pump) with wastewater passing through the screws to generate power. This feature, unique to the UK, will generate around 180kW of power and realise a cost saving of £110,000 per year.

Six new circular primary settlement tanks are being constructed at Esholt. The design criteria for the tanks has been refined through a thorough piloting process to determine the appropriate design parameters such as the upward flow rate and surface loading. The final process design is robust without being oversized.

The primary sludge and sludge thickening facilities on site allow the primary, indigenous and imported sludge to be thickened and incinerated. For the Esholt redevelopment, tried and tested technology is being incorporated into the design of this process.

Esholt Phase 2

The Phase 2 contractor is a partnership between the multidisciplinary consultant *Grontmij* (formerly *Carl Bro*) and contractor *Morgan Est* who are the infrastructure services division of *Morgan Sindall*. Phase 2 of the project commenced in May 2006 and is focused on the biological treatment with the construction of a new activated sludge plant, final settlement tanks, sludge digestion tanks and the 6.4ha sludge phyto-conditioning area.

With respect to secondary treatment, a new nitrifying activated sludge plant will have the capacity for 75% of the load. Some of the filters will be retained for 25% of the load. The industry recognised activated sludge plant will incorporate 12 'U' shaped lanes. Esholt's

activated sludge plant is extremely large, with a total volume of 91,000m³.

The surplus activated sludge will be thickened and transferred through a digestion process to produce a cake. The cake will then be mixed with green waste to form a compost type material. This will then be laid down, approximately one metre deep and seeded, and left for a full growing season. When the grass is cut the product is screened and sold as high quality material for use in landscaping and land reclamation such as golf courses.

Some of the existing humus tanks at Esholt are being converted into final settlement tanks. CFD (Computational Fluid Dynamic) modelling has been utilised to determine the scope of the conversion.

As with Phase 1 energy is being generated from waste in a new digestion plant. The surplus secondary sludge will be used to generate power from biogas in a combined heat and power plant.

Yorkshire Water's ultimate vision is for the site to be completely automated. The design of the new works incorporates CCTV cameras, plant condition monitoring, intelligent control panels and SCADA. This makes the site partly automated, but operatives are still necessary for unpredicted challenges. Provision is being made for the future requirement of a completely automated system, but the technology to enable this is still under development.

Esholt Phase 1 was completed in mid 2007 but flows will not pass through the new activated sludge plant until completion of Phase 2 programmed for early 2009.

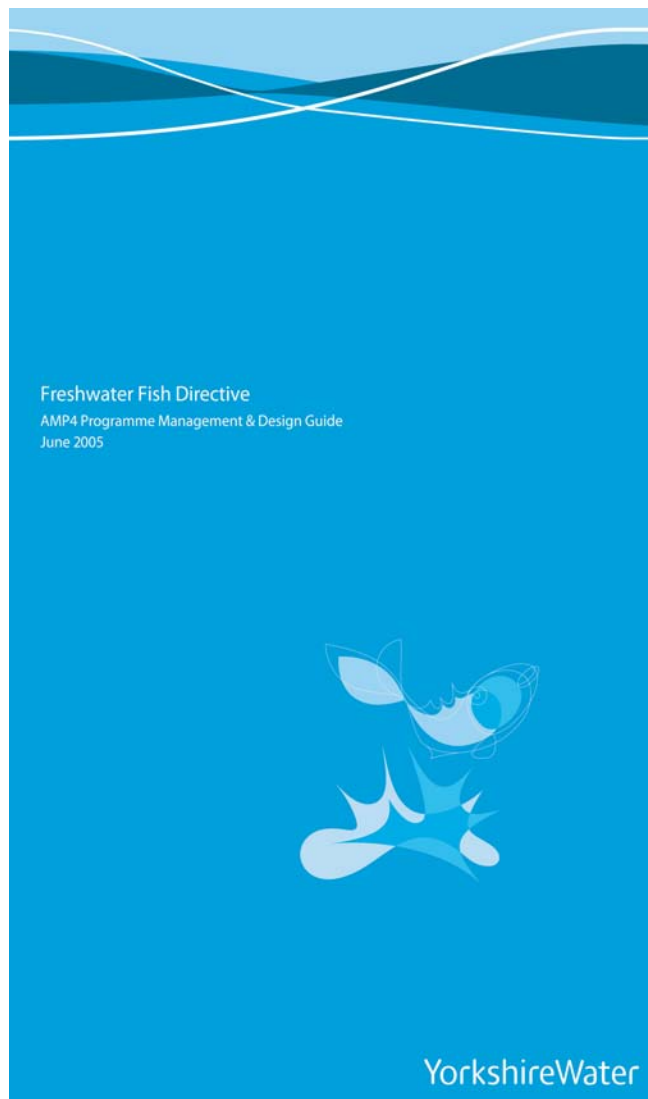
Halifax WwTW

Halifax Waste Water Treatment Works has a consented flow to full treatment of approximately 120,000 m³/d and the requirement of FFD is to improve the ammonia consent from 8mg/l to 5mg/l. As well as Halifax the works also served the Sowerby Bridge sewerage catchment.

There are currently three sites grouped together adjacent to River Colne to the south of Halifax. Salterhebble provides screening and storm water storage, Copley is the main waste water treatment works and the sludge treatment centre is located at North Dean.

Arup carried out the feasibility work and developed a scheme in accordance with Yorkshire Water's FFD vision comprising:

- * Improving the inlet works to provide storm water, coarse and fine sewage screening.
- * Construction of a new activated sludge plant rated to treat up to 33% of the total works flow.
- * Upgrading an existing activated sludge plant from carbonaceous to fully nitrifying operation.
- * Construction of a new sludge treatment facility to dewater indigenous and imported sludge.
- * Construction of a bunker to provide storage for 4,800m³ (21 days production) of sludge cake.
- * A new odour control plant to treat off gases from the sludge storage and dewatering facility.
- * Instrumentation and SCADA to comply with Yorkshire Water's vision to provide state of the art control and automation with remote access.
- * De-commissioning of the North Dean sludge treatment site.



Freshwater Fish Directive Schemes Strategy Design Guide Cover
courtesy of Yorkshire Water

A fast track tender process led to the award of contract to the "North Midland Black and Veatch" joint venture in January 2006.

As always, environmental concerns were considered but were of increased complexity at Halifax. The treatment works has to comply with strict discharge consents at all times and the lack of any spare capacity meant that careful consideration had to be given to the removal of existing assets from service during modification or tie-in. **The sludge treatment facility is the first of its type to be built in the UK in compliance with IPPC regulations.** Particular attention had to be given to secondary containment of tanks and pipe work and to drainage of contaminated surface run off.

The Arup scope of work includes technical advice, feasibility, tender document preparation, tender appraisal and contract administration. Arup provided staff to perform the duties of NEC Project Manager, Site Supervisor and Planning Supervisor/CDM Coordinator. ■

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