Crossness STW

major upgrade to create a cleaner, healthier River Thames, by significantly increasing treatment standards and capacity

by Antony Matheson

Crossness Sewage Treatment Works (STW) in East London is one of the largest treatment works in the UK, serving approximately two million people. The £145m upgrade project forms part of Thames Water's London Tideway Improvements programme, which comprises major engineering schemes to improve water quality in the River Thames. This programme includes upgrading London's five major STWs, so they can treat more sewage and to a higher standard; and creating the Lee Tunnel and proposed Thames Tunnel, designed to prevent pollution entering the Thames from 35 sewer overflow points along the river. Thames Water appointed Tamesis, a joint venture between Laing O'Rourke and Imtech Process, as the contractor for the Crossness STW upgrade.

Aerial view of Crossness STW with new elevated inlet works and new waste water treatment stream - Courtesy of Tamesis for Thames Water

Existing facility and reason for work

Thames Water's upgrade at Crossness STW is designed to meet the improved environment standards required by the Environment Agency (EA). The improvements will enable the site to treat 44% more sewage than it does now, significantly reducing the amount of storm sewage that overflows into the River Thames during heavy rainfall when the site's treatment capacity is exceeded. This scheme will also allow for a 10% population increase until 2021.

The new additional stream at Crossness STW will mirror the existing works to provide optimised wastewater treatment. Being one of the largest treatment works in the UK, Crossness STW along with its sister site at Beckton STW, are the two biggest wastewater improvement projects to be delivered for Thames Water in AMP5.

The scheme

At over 70 hectares, Crossness STW is a large site and many of the scheme's complexities are caused by the sheer size of the site and the requirement to ensure that the existing works are not impacted upon throughout the construction period. Once completed, the Crossness STW upgrade project will provide improved wastewater treatment with improved resource recovery, and will move the plant towards being a more sustainable, and power self-sufficient, wastewater treatment facility.

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New plant under construction - Courtesy of Tamesis for Thames Water

The scheme includes:

- The complete refurbishment of the Crossness STW Inlet Pumping Station.
- Construction of a new elevated preliminary treatment works.
- A new wastewater treatment stream to include primary settlement, aeration basins and final settlement tanks.
- Sludge storage and thickening equipment.
- Extensive refurbishment and upgrading of the existing works.
- Comprehensive power management improvements.
- Additional odour-control for elements of the new and existing plant.
- Environmental enhancements at the Crossness Nature Reserve and the Southern Marshes, including creating a suitable habitat for water voles and birds.

Wind turbine

The project also includes the installation of a wind turbine to be erected in 2013, which will provide 2.3MW of renewable energy to help offset site power requirements. When combined with the renewable energy generated from advanced digestion of sewage sludge it should generate a considerable amount of the total power required.

This wind turbine, capable of powering 1000 homes, will be the first ever installed of this size to help power a major British sewage treatment works.

Technical description of design, process and construction work

Work began in November 2009 and the project is due for completion in December 2013. Industry leading innovations have been incorporated into the project, including the extensive use of Design for Manufacture and Assembly (DfMA), which has ensured a

New primary settlement tanks under construction - Courtesy of Tamesis for Thames Water

Construction of new elevated inlet works - Courtesy of Tamesis for Thames Water

reduction of on-site construction requirements, while maintaining quality and increasing site safety and construction reliability. Overall programme and cost advantages have been realised, with a target to achieve safe, high quality and lean delivery, early and within budget.

Tamesis has brought together the complementary in-house skills and experience of its partners, its proven experience of the global supply chain, and specialist design skills of Hyder Consulting to meet Thames Water's project drivers and quality, programme and financial objectives.

Inlet works pumping station

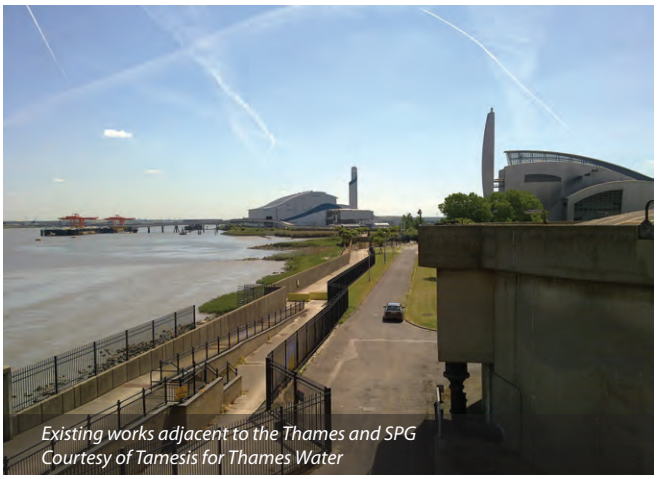
The work on the inlet pumping station consists of 13 (No.) pumps being replaced on line in sequence, while maintaining flow into the existing works. When complete, a third of the existing flow will be split off into the new elevated preliminary treatment works. The upgraded and refurbished inlet works pumping station will be able to pump forward a maximum of 13.68m^3/second.

The coarse screens at the inlet pumping station are also being upgraded. Thames Water reviewed the alternative screens available, but following review has decided that the new screens should be reverse engineered in line with the same basic design as the original 1950s screen, as none of the modern systems were perceived as being as robust as these original screens. The new screens have been designed with modern electronic components while keeping the basic 1950s design.

Preliminary treatment works

The new inlet works will process 6.5m^3/second and include 5 (No.) band screens, screenings handling and washer

Aerial view of new elevated inlet works under construction - Courtesy of Tamesis for Thames Water



Existing works adjacent to the Thames and SPG
Courtesy of Tamesis for Thames Water

Existing sewage pump transfer system
Courtesy of Tamesis for Thames Water

Existing sewage screening plant
Courtesy of Tamesis for Thames Water

The new waste water treatment stream under construction including primary sedimentation, aeration basins, and final settlement tanks
Courtesy of Tamesis for Thames Water

compactors with the maximum capacity of 43m³/hour. The inlet works has been designed 12m above the existing ground level so that it is high enough for the flows to gravitate through the downstream treatment process.

Activated sludge

The screened sewage flow will gravitate to 2 (No.) new sets of primary settlement tanks via twin 1.2km long 2m diameter culverts, then through a pair of new aeration lanes to 12 (No.) final settlement tanks, each 40m in diameter.

The new activated sludge plant will have a capacity of 564Ml/day. It will include 6 (No.) 69m aeration lanes, with a combined volume of 86,000m³, with anoxic zone mixers, FBDA and 5 (No.) centrifugal blowers giving an air flow of up to 21,000m³/hour.

Sludge storage and thickening facilities

The new works will create additional sludge via the two-process streams. This will be treated with additional sludge storage and thickening facilities. There are 5 (No.) raw sludge gravity belt thickeners, each with a capacity of 6,055m³/day at 2% DS.

Associated works

The scheme also includes screening, degritting, with 4 (No.) new constant velocity grit channels, and a desludging of the 8 (No.) new primary tanks using simple reciprocating Zikkert scrapers which are reliable and efficient.

Each primary settlement tank will be 67m long x 21m wide, to collectively process 6.5m³/second.

Refurbishment and upgrade

In addition to the new works there will be refurbishment and upgrading carried out to the existing works, including the existing aeration lanes and final settlement tanks.

Power management

The scheme also includes a general upgrade to the incoming power supply and power management system.

As one of five key sites, Crossness requires reliable power supply and there was a recognised need to build in substantial resilience, because if power is restricted then the site is liable to flood.

In the event of power shortage, intelligent software SCADA has been utilised to redirect power to the most important parts of the site, such as the pumping station, which must be protected to minimise flooding risk. 2 (No.) standby generators on site can each provide 2MW of power.

The challenges and innovations

With a scheme of this scale the team was faced with a number of on-site challenges. One of the most important was maintaining the performance of the existing process while constructing the new plant.

To ensure that this is achieved Tamesis has worked closely with the Thames Water Operations team to ensure that each stage of the work is fully integrated and all of the extensive interfaces are managed effectively. A co-located Joint Integration Team (JIT) has been formed to facilitate effective working together.

The construction team has more than 120 site operatives and 60 site management and engineering staff based on-site. These in-house resources enabled the multiple complex interactions with existing operational assets and systems to be safely and effectively planned and managed.

Other challenges have included mitigating the environmental impact of the construction work. To offset for habitat lost by construction, the project team has created a new reed bed, and wader scrape, and dug two new ditches to encourage local wildlife species.

During the design development the team optimised the process solution, improving the new works operational efficiency and reliability, including the installation of a 2.3MW wind turbine to generate up to 20% of the site's energy demand.

Other challenges have included taking on board the local planning issues and minimising the traffic logistics, mitigating against odour nuisance and ensuring that the environmental enhancements of the project were promoted to the local community.

Design for Manufacture and Assembly (DfMA)

One of the most important innovations of the scheme at Crossness STW has been the introduction of Design for Manufacture and Assembly (DfMA).

Tamesis is committed to the DfMA principle and it has been adopted for the factory-produced elevated inlet works sections, final settlement tank walls, primary treatment and aeration basins. This has reduced the number of site workers required on site, while maintaining quality and increasing site safety and construction reliability. This has contributed to achieving a zero AFR to date on the project.

DfMA enables precasting of many elements off site. This in turn minimises construction activity on site. This improves safety by reducing working from height requirements and general construction interfaces because the construction activity is carried out in a controlled, purpose-built factory environment.

This also reduces the environmental impact of the construction work, including minimising construction traffic.

DfMA has also been used for the inlet pumping station MCC building, which includes brick cladding assembled off site. DfMA also has beneficial cost implications as the precasting work is done on a repetitive basis.

Key suppliers

In order to deliver the Crossness STW upgrade, Tamesis is working closely with many suppliers, including:

Xylem Water Solutions (Flygt), Kirk Environmental, Ovivo, ETech, Imtech G&H, JK Fabrications, Gallagher & McKinney, Hydro International, Ashbrook Simon-Hartley, Bord na Móna, OSIL, Production Glass Fibre, Hibernia, Bedford Pumps, AJ Fabtech, Elsym, Vulcan, BASF, The Longwood Engineering Company, AVK, Regulators Europa, Broadcrown, Lintott Control Systems, Brush, Schnieder Electric, Thetford International, Bramley Engineering and DH Stainless.

Programme

The scheme is due for completion in 2013 and is currently on target to meet this programme. The major civils work is now substantially complete and all the M&E procurement has been completed.

Phased replacement of the inlet pumping station pumps is now under way. The mechanical installation has commenced on the new inlet works and the refurbishment and upgrade of the existing works is under way.

The Editor & Publishers would like to thank Antony Matheson, Tamesis Project Director at Crossness STW, for providing the above article for publication.

Aerial view of new waste water treatment stream including primary settlement, aeration basins and final settlement tanks
Courtesy of Tamesis for Thames Water