# East London Resource Development

## providing 22.5 million litres of water a day to meet demand

by

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**To enable construction of a tunnelled section of the Channel Tunnel Rail Link (CTRL) through East London, groundwater needed to be removed from boreholes along the tunnel route. This dewatering operation between Hackney and Barking provided Thames Water and its East London Resource Development ELReD programme with an ideal opportunity to carry out tests on the groundwater to establish whether it was viable to develop as a new water resource for the area. Quality tests were successful and Thames Water entered into an agreement with current landowners to lease the new boreholes after CTRL's dewatering activity had been completed. It was also agreed "to adopt" the majority of the current dewatering pipeline, which was owned and operated by CTRL. Water from the boreholes can then be transferred to the existing Thames Water well pumping station at East Ham - out of use for public supply but currently used for CTRL dewatering - where it will be added to the borehole raw water and the whole volume treated in a new water treatment works constructed on the site. This new East Ham WTW will provide 22.5 million litres a day to help meet the future requirements of Thames Water's customers in this part of London.**

East Ham Well Pumping Station - a listed building courtesy: Thames Water

**Network**

The ELReD pipeline will run east from Windmill Lane in Stratford to Essex Road in Barking. It connects into the treatment plant at East Ham.

In total there are 6.3 miles of pipeline, 3.2 miles of which were taken over from CTRL after completion of their dewatering activities.

A combination of micro-tunnelling and open cut was used to minimise disruption to road users and to smooth the progress of crossings of both Railtrack and London Underground facilities, as well as the River Roding.

Backfilling shafts have saved operational maintenance and construction costs, using selected excavated material from the open cut sections of the work. This has alleviated the need to carry out the cosmetic finishing, shaft fit-out and the cost of expensive roof slabs.

**East Ham WTW - Process**

The transfer pipelines and tunnels convey up to about 20Ml/d of raw water from nine boreholes to the East Ham site. At the site the output from the East Ham Well is added into the incoming raw water, making a total of up to 23.7Ml/d, before entering the new treatment plant.

The water treatment plant is being constructed on the site of the old well pumping station at East Ham. The site contained the pumping station building, which is locally listed, a cottage, an old cooling pond, five protected trees, a number of other semi mature trees and a range of temporary offices. Designers were requested to preserve as many of these features as possible.

It was also necessary to accommodate a shaft for the new tunnel carrying the raw water and treated water pipelines across the adjoining River Roding.

The available space was further limited by the presence of a flood wall along the River Roding on the East side of the site; this consists of sheet piling tied back to anchor blocks approx 10m into the site.

Construction other than for roads was not permitted in this strip.
Treatment sequence required construction of the following large elements:

* flocculators & rapid gravity filters;
* gravity GAC reactors;
* chlorine contact tanks;
* high-lift pumping station to transfer treated water to the distribution system;
* chemical plant and storage tanks.

The selected layout has minimised the overall footprint with two main features:

* rectangular concrete contact tanks built as a single unit in place of the more usual cyclindrical steel tanks;
* placing the RGFs over the contact tanks (which provide the foundation for the RGF support slab).

**Process**
Water analysed from each borehole identified the contaminants requiring treatment and, based on these projections, the WTW at East Ham includes the following unit treatment processes.

* **borehole blending to maintain fluorides and magnesium concentration within acceptable statutory limits.**

A key element of the process at East Ham WTW is the control of nine different sources of water. The contaminants change in concentration and type from east to west and automated control of borehole blending will be implemented to ensure that all contaminants remain within limits.

The automated blending control will alarm and ultimately shut the system down if a source becomes unavailable and as a consequence threatens water quality. It is only at this point that the operator intervention will be required.

The control system will allow the operator to select a set of water sources and flows that ensure that an acceptable water quality is achieved by the plant. Key controlling parameters are Fluoride, Magnesium and Hardness ($CaCO_3$).

Different wells have different associated running costs. At outputs less than the maximum the control system allows for selection of boreholes and flows to minimise the total running cost.

All borehole and well pumps are controlled by variable speed pumps.

* **Aeration to precipitate iron and raise dissolved oxygen concentration.**

Aeration is required to precipitate iron and raise the dissolved oxygen levels in the raw water. Air compressors inject air directly into the raw water main where it passes through a static mixer.

The flow of air from the air compressors is flow paced and controlled by a Dissolved Oxygen measurement at the end aeration mixer. Undissolved air is released in an air disengagement zone at the inlet to the flocculation tank.

* **Chemical dosing & flocculation.**

Coagulant is mixed into the raw water after aeration using an in-line static mixer. The raw water is then discharged into the flocculation system where a three-stage micro-flocculation tank allows the growth of flocs in the raw water. A polyelectrolyte will be used as a flocculation aid and will be added to the third stage of the flocculator. Perforated baffles have been used to separate each flocculation stage.

* **Dual media filtration for turbidity and iron removal.**

Six dual media (sand/anthracite) rapid gravity filters are provided to remove iron and turbidity, giving a total filtration area of 180m$^2$. Dual media filtration was chosen as it provides more flexibility downstream of a coagulation/flocculation system and has a higher solids loading capacity than mono media.

The collapse pulse wash (or dual air water wash) method is utilised for cleaning the filtration bed.

* **GAC adsorption**

Four GAC adsorbers are provided with a total GAC volume of 192m$^3$ designed to give a nominal 10 minute empty bed contact time.

These are required to remove small quantities of phenols that may cause taste and odour problems in the final water.

It is estimated that the carbon life will be approximately 50,000 bed volumes, which is equivalent to a one year operation. Each adsorber is provided with permanently installed carbon fill/removal pipework to facilitate this annual change.

* **Disinfection**

Super-chlorination is carried out using 10% sodium hypochlorite solution. Chlorination is intended to remove ammonia and to provide super chlorination for disinfection. Sodium hypochlorite is dosed upstream of a suitable inline mixer along with the orthophosphoric acid solution.

Reinforced concrete disinfection contact tanks are provided to allow contact time for sodium hypochlorite to disinfect the treated water comprising of two tanks, each providing 50% of the required contact time. After leaving the contact tank, de-chlorination is required to reduce the free chlorine residual in the product water.

De-chlorination is achieved by dosing a 20% sodium bisulphite solution. Ammoniation, using 10% ammonium sulphate, will then be applied to produce a monochloramine residual from the free chlorine.

It is required to prevent taste and odour complaints, as the water will be mixing in the supply network with ammoniated water.

**Integrated project team**
An integrated team was assembled to design, construct and commission the project.

This included staff from Thames Water, *Costain, Black & Veatch, Murphy's* with *Purac* being the main process alliance contractor and *Aston Dane* as the systems integrator.

The teams are working under two existing partnership arrangements managed by *Costain and Murphy* for process and network respectively.

**Progress**
Construction work started in June 2003. All network and process plant construction is on schedule and will be ready for plant commissioning to commence in September 2004.

Water will be entered into supply in March 2005. ■

**Note:** *Mark Morrison is Senior Project Manager, Thames Water Utilities, Engineering and Mark Pugh is Project Engineer, Purac Ltd.*