Abberton Scheme: Wormingford Pumping Station

new pumping station to extract 120Ml/d of raw water from the River Stour to supply the enlarged Abberton Reservoir

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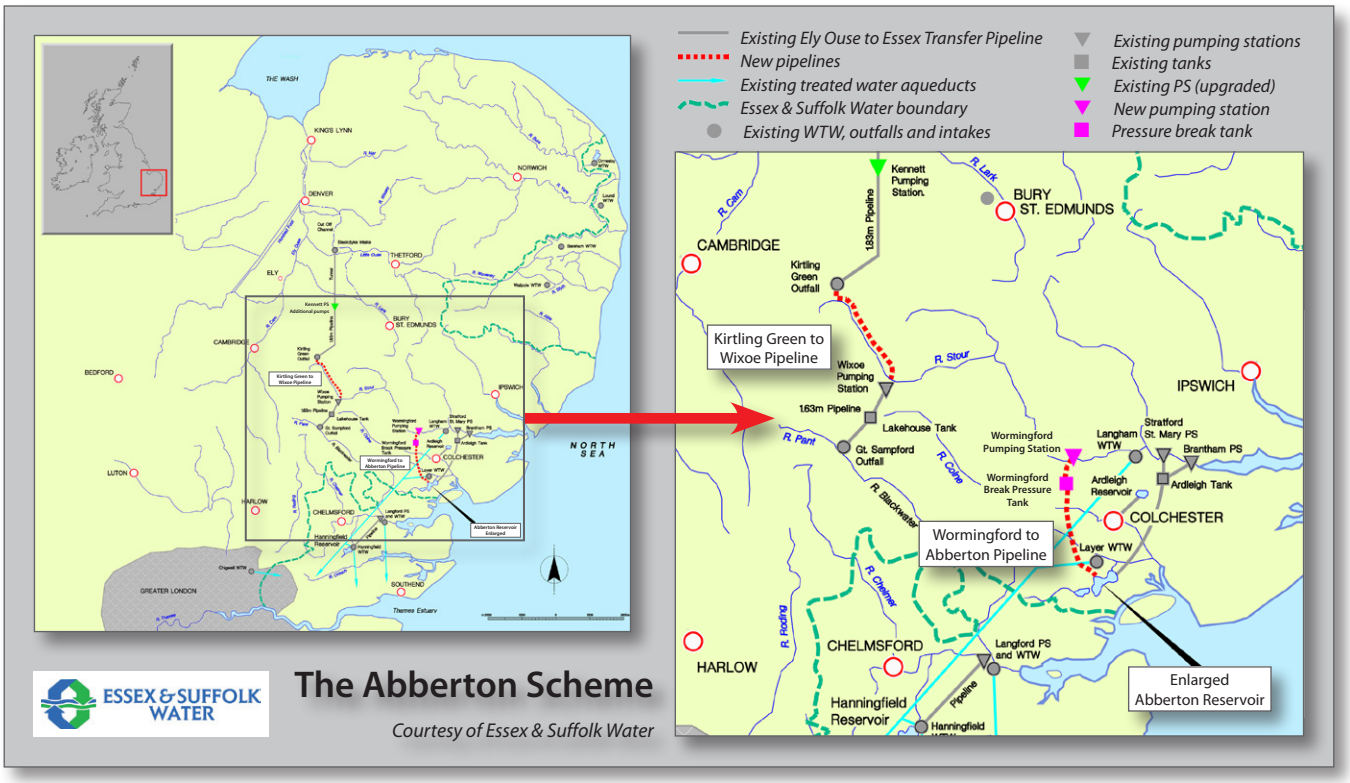
To cover the existing and predicted future shortfall in water supply to its customers in the Essex supply area, Essex & Suffolk Water are constructing the £150m Abberton Scheme. This scheme comprises increasing the capacity of Abberton Reservoir (located to the south of Colchester in Essex) by 58%, increasing the conveyance of water with increased pumping capacity and new pipelines, and increasing abstraction from the River Ely-Ouse near Denver, Norfolk, for transfer to the River Stour from where water is abstracted at a new pumping station and delivered to Abberton Reservoir. This paper focuses on the construction of the new Wormingford Pumping Station.



Overview of Wormingford Pumping Station

The location for Wormingford PS and Intake on the River Stour is on a flood plain to the north-west of Wormingford village in Essex, adjacent to an area of outstanding natural beauty.

A Flood Risk Assessment was carried out to determine the effect of the proposals and this was submitted to the Environment Agency. The assessment included proposals for 136m^3 of compensatory storage in the form of a detention basin adjacent to the pumping station.

The equipment housed in the pumping station building is vulnerable to damage by flooding and the floor level is at 600mm above the predicted flood level for a 1 in 100 year flood flow plus 20%. This will prevent water ingress to the pumping station for all except the most severe flood events. The required floor level is approximately 800mm above the general ground level.

Out-of-bank flow on the River Stour floodplain will be a more frequent event than a 1 in 100 year flood and the pumping station will cease to operate in these conditions. Access to the pumping station across the floodplain during flood events is therefore not provided for, i.e. the access road is at the surrounding ground level and not raised on an embankment.

Intake structure

Two intake chambers are provided at the river, each with coarse screening, and each followed by a 1,200mm diameter pipeline between the intake and the fine screen units at the pumping station. The velocity of flow approaching the screens is 0.35m/s at the maximum station output, with both intake pipes operational.

Each chamber is equipped with stoplogs and penstocks at the pipeline inlet to allow independent isolation and each pipeline can take the full design flow of 120Ml/d. This will allow operation to continue if either pipeline has to be shut down for cleaning or maintenance.

The coarse screens will be manually raked; experience on the other intakes on the River Stour has shown that amounts of debris are not likely to be great. The screen is inclined to facilitate manual raking, with a platform behind the screen where the operator can stand with a removable guard rail. Screenings will be manually transferred to a small man-handleable wheeled skip for disposal to landfill.

The intake structure has been designed such that the future fitting of a trash raking machine (Brackett Green Bosker type or similar) will be possible, if it is found that amounts of weed are much greater than anticipated and manual raking becomes too onerous.

Wormingford Pumping Station

Design Capacity: The pumping station is required to deliver a maximum of 120Ml/d of raw water from the River Stour at Wormingford to Abberton Reservoir, which is the maximum additional transfer from Denver via Kirtling Green and Wixoe enabled by the Abberton Scheme.

Fine Screens: 2 (No.) fine screen chambers are provided at the pumping station, each equipped with a powered band screen with 5mm screen aperture. The screens are automatically washed and screenings collected in a trough for manual transfer to a skip. The 2 (No.) screens (duty and standby) each have a capacity of 120Ml/d so that operation of the pumping station can continue in the event of breakdown of one of the screens. The screens employ a dual wash system with fish capture and return to river.

The screens are mounted in a room attached to the main pumping station building to prevent unauthorised interference by the public, which could be dangerous due to the moving parts of the screen. To minimise the size of the screen room and to avoid the need for fixed lifting equipment, the screens are installed via openings in the building roof covered by removable, lockable access hatches.

Pumps: To provide for flexible operation and to limit the power requirements for pump starting, 4 (No.) split casing single stage pumps have been provided, each with a capacity of 30Ml/d (350l/s at 61m pumping head). The pumps are installed in a dry well to allow safe and easy access for maintenance. The pump motors are installed on the motor floor above the pumps, connected via carbon shafts, which reduce weight and the need for universal joints.

Variable speed drives are provided, primarily to limit the starting current restrictions imposed by EDF Energy. However, the variable speed facility will be utilised in the control of the output of the pumping station.

The pumping station building

A key factor in gaining planning approval was that the building was designed to have the appearance of traditional local farm buildings, with timber cladding and pitched roof with clay tiles. A tee shaped plan, with different roof ridge heights creates visual interest and variety in the elevations. The maximum plan dimensions of the building are 29.95m by 21.22m, and the height to the highest roof ridge is 10m from pump room floor level. This design was adopted to satisfy planning requirements.

- The building houses the pumps in a dry well below ground level, with pump motors in the motor room above. An overhead crane is provided in the main pump room to enable pumps, motors and other equipment to be removed for maintenance.
- A loading area adjacent to the main door, allows flat-bed lorries to reverse into the building for loading of equipment that requires replacement or maintenance off site.
- The electrical switchgear and control equipment is located in the adjacent Motor Control Centre (MCC) room.
- To reduce the visual impact of the station, the transformer is housed inside the building in a separate room.
- A forced air ventilation system for the building is necessary to maintain the temperature within limits required by the plant.
- A chemical room is provided inside the pumping station for chemical storage tanks and dosing equipment, for occasional dosing with sodium hypochlorite solution for zebra mussel control of the pipeline.
- 2 (No.) compressors (duty/standby) for the surge protection equipment are located in a room off the main pump motor room. The compressors will normally operate only occasionally, to keep the surge vessels topped up with the required amount of air.

Pressure vessels designed to look like grain silos
Courtesy of Essex & Suffolk Water

Chlorine dosing room - Courtesy of Essex & Suffolk Water

Pumps showing carbon shafts - Courtesy of Essex & Suffolk Water

External appearance designed to resemble an Essex barn
Courtesy of Essex & Suffolk Water

External works

Access to the pumping station is from the B1508, utilising the existing access road to Staunch Farm which has been extended to the pumping station site. The surrounding area will be landscaped to assist with blending the pumping station into the environment. Additionally, some river bank protection works have had to be carried out to prevent erosion around the intake structure.

Surge protection

Surge analysis for the Wormingford Pumping Station and pumping main has been undertaken, which showed that surge protection measures would be required to protect the pipeline from unacceptable cavitation pressures in the event of emergency shutdown or pump failure under peak design flow, such as may be caused by power failure.

The conclusions of the surge analysis were that for adequate protection of the system, the provision of a total surge vessel volume of at least 47m^3 was required, together with the provision of 3 (No.) air valves specifically designed for surge protection at critical points along the pumping main.

To reduce the visual impact, the total surge vessel capacity will be provided as two vessels, each sized at approximately 25m^3 in volume. Located outside the building , the vessels will be positioned vertically on the east side of the pumping station, and will look like grain silos typical for the area.

Facilities for chlorine dosing for zebra mussel control

Permanent facilities are provided for periodic chlorination aimed at preventing the growth of zebra mussels in the pipeline. The facilities are designed for a mussel kill dose of 1.5 to 2.0mg/l of chlorine to be applied to the raw water for a period of at least 10 days, 3 to 4 times a year, typically in March, May, July and September.

Sodium hypochlorite solution will be used as the source of chlorine. In order to reduce the quantities of chemicals used, the dosing will be carried out with a flow in the pipeline of 30Ml/d rather than at the full design flow of 120Ml/d. A storage tank of capacity 5,000 litres is provided, which will store sufficient sodium hypochlorite for 10 days of dosing at 2mg/l at a station output of 30Ml/d.

NOTE: *The Abberton Pipelines Project was featured in UK Water Projects 2013 and the Abberton Reservoir Enhancement Project was featured in UK Water Projects 2012. All three Abberton case studies are available at: www.waterprojectsonline.com/water_companies/Essex_&_Suffolk.htm*

Electrical requirements

Wormingford Pumping Station is built on a site which had no power supply available. A new 1,250KVA power supply was requested from the regional electricity supplier EDF Energy. Because there was no available electrical power in the area of the pumping station, a new power supply had to be run from a substation at Marks Tey some 10km from the site. The cable ducts were laid alongside the water delivery main during the pipe laying contract, into which EDF installed their new cables.

EDF imposed a major restriction of a maximum motor starting current of 630A at 400V. To comply with this restriction, variable speed pumps with inverter drives have been selected, with a pump configuration of 4 (No.) units each with a motor rated at 315kW.

Pumping station control

Operation of the pumping plant will be monitored remotely at the ESW control room at Layer WTW, and any faults or malfunction will be indicated by an alarm relayed to Layer. The triggering of an alarm may require a visit to site by operations staff to investigate and correct the problem. Routine operation and maintenance activities for the pumping station will normally be limited to weekly visits by operations staff to check the security of the building and site, the general operation of the plant, the level of sodium hypochlorite in the storage tank, and to transfer debris collected in the baskets of the band screens into the skip.

Undertakings

The project commenced in June 2011 and was completed on time and within budget in February 2013. The engineering consultants were MWH and the contractor was Farrans Construction Ltd.

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