

Bristol Wastewater Treatment Works

secondary treatment upgrade & storm tank storage

by

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Bristol Waste Water Treatment Works, situated on 46.5 hectares of marshland reclaimed from the Severn Estuary at Avonmouth, is Wessex Water's largest. It serves a domestic population of approximately 660,000 and a further 250,000 population equivalent of industrial waste from the Bristol area. Secondary treatment was provided to meet the Urban Waste Water Treatment Directive (UWWTD) by 31 December 2000 in the form of one of the largest Sequencing Batch Reactor plants in the UK. The current secondary treatment capacity of 213 MI/d is being increased to 300 MI/d together with the provision of 25,000m³ of storm tank storage. Value engineering and alliancing are being used to provide cost effective solutions.



Existing SBR plant commissioned in 2000. Additional basins to be sited beyond existing (courtesy Wessex Water)

Existing operation

Three trunk sewers, the Frome Valley Relief Sewer (FVRS) from north Bristol, the Avonmouth sewer from the village and docks and the Bristol Trunk Sewer convey flows to Bristol WwTW, combining at a point some 200m south-east of the Inlet Works.

Saltmarsh PS, the original feed pumping station to the WwTW, constructed in the early 1960s, is now situated on a spur from the Bristol Trunk Sewer and is only used when flows exceed the capacity of the the Works Inlet PS (currently approximately 470 MI/d in duty/assist operation). Saltmarsh PS is capable of delivering in excess of 320 MI/d into the Inlet Works through two 1.8m diameter concrete rising mains, giving a total flow to the works of around 800 MI/d.

The Works is currently required to deal with a dry weather flow of

up to 160 MI/d, primary treatment up to 300 MI/d (consented FFT) and secondary treatment up to 213 MI/d. Raw sewage arrives at the inlet pumping station where it is lifted by two archimedian type screw pumps to the head of the works. Flows in excess of FFT spill over a storm weir through horizontally raked screens and discharge to the outfall culvert.

Project objectives

Following completion of the SBR plant in the late summer of 2000, further improvements are required as part of Wessex Water's AMP3 quality outputs and to improve compliance with the Bathing Water Directive. These include the provision of 25,000 m³ of storm tank storage and a further increase in secondary treatment capacity. to 300 MI/d by extending the SBR plant, thus eliminating any primary settled effluent discharge. No qualitative changes to the discharge consent are proposed.

A further objective is to achieve sufficient pass-forward flow to substantially reduce the frequency and volume of storm spills through the Black Rock CSO, located in the Avon Gorge just down stream of Clifton Suspension Bridge.

Flow delivery & storm tanks

The fixed volume of storm tank storage has been negotiated and agreed with the Environment Agency.

The maximum pass forward flow to the works was established by modelling the extended plant in conjunction with the trunk sewer model for the Bristol Catchment. Discharge of final effluent from the Works is limited when the existing outfall culvert becomes tide locked under certain high tide conditions in the Severn Estuary. An existing screw pumping station on the culvert operates to maintain the discharge and prevent flooding of the Works. Current output of this station is 718 Ml/d. Discharges from the SBR basins provide instantaneous peak flows in excess of the incoming flow and, taking this into account, the maximum pass forward flow to the Works was agreed with the Environment Agency at 657 Ml/d.

Provision had been made for future storm tanks in the original design of the inlet works. This comprises a partially completed overflow structure at the downstream end of the grit channels together with two additional grit channels. The overflow will be modified to incorporate a Storm Tank Feed PS. The additional grit channels will be commissioned and fitted with grit removal trains and fine screens at their downstream end to match the existing.

Two storm tanks, each 45m in diameter and some 8.5m high will be constructed. Full bridge scrapers will be provided.

Two possible pumping options to deliver flows to the Works are now being developed.

Option 1 proposes a new pumping station at the confluence of the three sewers. This is divided into two sections, one for flows from the FVRS to prevent surcharging of this sewer, the other accepting flows from the Bristol and Avonmouth sewers in excess of the inlet screw pumping station capacity. Pumps from each section will discharge flows into the Inlet Works using short lengths of the existing rising mains from Saltmarsh PS. Saltmarsh PS will be decommissioned.

Option 2 proposes a complete refit of Saltmarsh PS. This will include removal of the existing curved bar screens and the mixed flow pumps will be replaced with submersibles. Significant structural alterations will be necessary. Some challenging engineering works will also be required. At present, a concrete weir exists in the trunk sewer isolating Saltmarsh PS from all but the higher storm flows. This will have to be removed. Additionally, flows in the Bristol Trunk sewer between Saltmarsh PS and the Inlet Works will need to be controlled to ensure the FVRS discharge is not impeded and the capacity of one screw at the Inlet PS at the Treatment Works. This will require the construction of a control penstock chamber on the 2.74m diameter Bristol Trunk Sewer,

Secondary Treatment Extension

The eight basin Sequencing Batch Reactor (SBR) plant commissioned in 2000, which uses *JetTech Omniflo* SBR technology, was designed to be extended by the addition of one basin to each of the two streams. However, increased loads and recycled flows required a further process review on both this and the two existing activated sludge plants.

The split of flows envisages a maximum of 302 Ml/d through the extended SBR plant with 30 Ml/d through the two existing ASPs. Anoxic zones and modifications to existing baffles to improve plug flow will be necessary in the ASPs to maintain treatment to the UWWTD consent. Currently it is intended to construct three additional SBR basins and add a fourth decanter to each of the existing eight basins. The plant will then be configured as one stream of six basins and one stream of five. A review of process control and hydraulic distribution is currently in progress to confirm this solution.

Procurement

Procurement of both the storm tanks and SBR extension is being undertaken through one of four Alliancing Agreements established at the beginning of 2002. The Quadrant Alliance comprises Wessex Water, MWH Wessex (a joint venture established in late 2001 between Wessex Water and *Montgomery Harza* to deliver the remainder of the AMP3 programme) and *MJ Gleeson Group plc* with *Binnie Black & Veatch*. The process contractor and designers for the original SBR plant, OTVB/Vivendi (formerly USF) and *Faber Maunsell Ltd* have been retained by *Gleeson* for the SBR extension. The Alliance uses a modified form of the Engineering and Construction Contract (2nd Edition) - Option C.

The benefits of this procurement route are that the contractor is able to provide valuable construction input at the early design and value engineering stages. Furthermore, a phased approach to construction is possible where key elements of the works can be progressed whilst other issues are resolved. In this instance, construction work has commenced on the three SBR basins and the storm tanks whilst the issues of process control and hydraulics on the SBRs and storm pumping are resolved.

Both aspects of the project are due to be commissioned in 2003. ■

Note: *The author of this article, Richard Thackeray, is Project Manager, MWH Wessex.*