

# Ashton Avenue Sewage Pumping Station

## refurbishment & upgrade of a critical pumping station in southern Bristol to cope with a growing population

by Shaun Hobbs BA (Hons)

Commissioned during July 1970, Ashton Avenue Sewage Pumping Station is one of Wessex Water's critical pumping stations. It is contained within a steel palisade fence with its own access road off Clift House Road, Cumberland Basin, with the highway to the south of the station, and to the west, Bristol City central park. The east side is bounded by a warehouse and garden centre, and on the north side is the River Avon. The incoming gravity sewer to the pumping station is a 3.6m x 3.6m box culvert and takes the majority of the flow from southern Bristol (the Malago DAP catchment).



Screenings Chamber Base Steel

Courtesy of WECS Civils

### Existing works/system

- The original 3 (No.) comminutors upstream of the DWF pumps were abandoned in 1994.
- The 3 (No.) DWF pumps, which lift the foul sewage up into the Southern Foul Water Interceptor (SFWI), were replaced in 1994 (having replaced the original pumps in 1980) and the fourth pump was refurbished. These are 3 (No.) dry well submersible pumps (pumps #2, 3, 4), and 1 (No.) centrifugal-flow pump (pump #5) with the motor located at ground level. The fifth pump (central pump #1) was abandoned.
- The theoretical pumped FFT, delivered by the DWF pumps, is currently 2,150l/s (2 (No.) 65kW pumps at 650l/s plus 1 (No.) 70kW pump at 850l/s; duty/assist/assist, with another 85l/s pump on standby). This flow is pumped up in to the SFWI box culvert (2.51m wide x 2.13m high) for onward flow to Bristol Sewage Treatment Works in Avonmouth for treatment.
- There are 3 (No.) storm pumps (# 6, 7, 8), wet-well axial flow pumps, shaft-driven with the 200kW motors located at ground level. These pumps are each rated at 1,700l/s and normally operate duty/assist/standby. One of the storm pumps also acts as standby to the DWF pumps at peak pumping times. The storm pumps can either deliver into the SFWI culvert or into the storm discharge box culvert (2.44m wide x 3.65m high) to the River Avon. These pumps are the originals from 1970.
- Total output from the station is theoretically 5.55m<sup>3</sup>/s, with a standby DWF pump and a standby storm pump. With all pumps manually selected to run, a peak of 8.1m<sup>3</sup>/s is theoretically possible, but rarely practicable.
- There are 2 (No.) emergency pneumatically-operated penstocks on the inlet to the pumping station. Closure of these diverts all flows to the storm discharge culvert into the River Avon. This culvert has 2 (No.) tide flaps installed as the "New Cut". The River Avon is still tidal at this point.
- Each pump discharge has an electric actuator on the isolating valve; manually selected.
- The SFWI culvert, and the storm discharge culvert connection, each has an actuated penstock (manually selected) to enable the SFWI to be diverted directly into



the storm discharge culvert in an emergency (this is rarely, if ever, used).

- The SPS has a standby 515kVA generator, which is only sufficient for the DWF pumps, but it does have 2 (No.) main 11kV electrical supplies, although only one is live at any given time. In the event of a power failure on one of the supplies there is no automatic switchover. An engineer from the power company (WPD) has to visit site to switch it over. Each supply has a 1,000kVA transformer, which is currently run at its limit.

**Consent**

A revised (preliminary) EA Consent to Discharge from the sewage pumping station was issued in March 2005. Conditions included:

- Storm sewage, and sewage discharged in an emergency, for all flows up to a 1 in 5 year return period shall pass through 6mm, 2D, auto-cleaning screens. Screenings are to be removed from this storm discharge.
- The following numeric conditions; DWF is 28,392m<sup>3</sup>/d ((329l/s), and flow to full treatment (FFT) is 2,050l/s.
- A standby pump and a permanent standby generator are to be installed (both automatically activated) for the pass forward flow.
- A 24-hour response telemetry alarm system revision to the consent is anticipated with respect to the standby generator.
- An alternative mains power supply is proposed.

The 1 in 5 year storm return period flow entering the sewage pumping station from the Malago catchment has recently been modelled at 9,500l/s. With 2,050l/s of FFT, then 7,450l/s of storm water may be discharged in a 1 in 5 year event.

**Design criteria**

Sewage pumping station flows:

Dry weather flow	28,392m <sup>3</sup> /d	329l/s
Flow to full treatment <i>DWF pump combined output.</i>	177,120m <sup>3</sup> /d	2,050l/s
1 in 5 year inflow	820,800m <sup>3</sup> /d	9,500l/s
Storm pumping <i>'Storm' pump combined output</i>	643,680m <sup>3</sup> /d	7,450l/s
Storm pump rating (each)	2,500l/s x 3 (No.)	
Population equivalent	100,000	

**Screening**

Fine screens to all storm overflow and emergency overflow spills to the River Avon up to a 1 in 5 year return period shall be 6mm, 2-D, automatic mechanically cleaned screens; 4 (No.) each rated at 2,000l/s.

**Screenings handling pumps**

Pump capacity shall match the screen discharge rates, at a minimum of 0.03m<sup>3</sup>/d per 1,000 population with a peak loading factor of 40 (design standard DS422); equivalent to a solids handling capacity of 120m<sup>3</sup>/d.

**Construction**

It was recognised that a successful project delivery would depend on the quality of liaison with the operational team due to the sewage pumping station being one of Wessex Waters critical pumping stations. This was achieved with the assistance of Wessex Engineering and Construction Services (WECS) in house civil team as principal contractor.

Due to the significant liaison necessary while working on the live sewage pumping station, including planning and phasing of



the works, the use of WECS lent itself perfectly to the project and enabled rapid and cost effective decision making when foreseen and unforeseen risk events occurred.

The screening chamber was constructed from a RC concrete structure 13.2m x 13.2m with wall thicknesses of 500mm. Interlocking PU20 Larsson piles were used as part of the temporary works and then part of the permanent works, during the construction phase using interlocking piles mitigated any issue with ingress of ground water. The interlocking piles were driven to a depth of 18m to give a toe into the mud rock strata of 2m. CFA piles 350mm dia were bored into the ground up to a depth of 20m to allow the new screening chamber to be supported.

The new screenings chamber comes into action during a storm event, all flows are pushed through 4 (No.) 6mm, 2-D, automatic mechanically cleaned screens; each rated at 2,000l/s. The flows then pass down the newly constructed pre cast box culverts (2,250mm x 1,500mm x 2,000mm) which discharge into the River Avon.

The pumping station refurbishment required each of the existing (1994) DWF pumps to be removed, cleaned and motors checked and re-wound if necessary and new impellers installed.

This work was phased, with one pump being removed at a time; all works completed prior to the storm pump replacement which would ultimately remove the storm pump back up as with the additional DWF pump it would no longer be required. The phase element of this works was delivered via the WECS in house civil team whom in turn liaised with operational control to achieve constant smooth running of the SPS.

The existing storm pumps were isolated and removed, these were 3 (No.) shaft-driven, axial-flow storm pumps complete with 200kW motors at ground level. The removal of these pumps had to be done

sequentially, one at a time, while providing 2 (No.) storm pumps available to run at any given time.

The 3 (No.) new storm pumps are axial-flow 'canister' pumps with submerged motors, which are installed into the existing storm PS sump to replace the existing pumps (sequential installation). Each pump is rated at 2,500l/s at 8m static head (approx 10.6m total design head), 395kW motor rating, complete with variable speed drives.

#### Power/control

It was deemed at early design stage to provide and install new automatic changeover switchgear between the 2 (No.) existing power supply feeds on the HV (11kV) feed side of the station. This included a crossover feeding of supplies to opposite feeds on the LV (400V) side of the transformers. Part of the electrical works was to provide the following: 1 (No.) up-rated HV power supply feed cable to the site, rated at 2,500kVA. Replace 2 (No.) ring main units and 2 (No.) transformers 11kV/400V, rated at 2,500kVA, and associated circuit breakers and isolation/ protection switchgear.

It was necessary to construct reinforced concrete foundations to support the 2 (No.) transformers due to the extra weight of the power up-grade required to the new pumps and screenings chamber.

Control for the new works followed standard Wessex Water practice, with safe start and stop systems.

Control of the storm pumping rate is from signals from the new level sensors in the wet sump. These pumps will be sequenced to operate as duty/assist/assist with variable speed drives to correspond with increasing or decreasing inflow rates. Control of the storm overflow fine screens is from a signal from the level sensor in the screen distribution chamber. All screens will run simultaneously.

The screenings handling plant will operate in association with the running of the screens (including run-on time). The pumps are duty/standby with automatic changeover.

The actuators on the storm pump discharge pipes will be electrically operated, but will only run under manual control for isolation of the individual pump for maintenance.

All electrical works and control philosophy were undertaken by our M&E partners Trant Construction.

#### Environmental

A large majority of the sub-soil that was excavated during the construction of the new screenings chamber was reused to profile the existing ground to give a good contour to the surrounding area. Waste steaming has also been undertaken by WECS civils to eliminate where ever possible cross contamination. This in turn helps the environment and saves money.

#### Health and safety

WECS employs a rigorous attitude to driving health and safety standards ever higher. A dedicated health and safety team undertook regular audits and four weekly look ahead reviews in conjunction with the contract program and site team. Adopting this method has led to an accident frequency ration significantly better than the industry norm. There were no incidents throughout this project.

Business AFR: 0.2

Industry standard AFR: 0.4

Total man-hours worked with no accidents or incidents: 33,598

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