Auchneel Water Treatment Works

new plant on a sloping site

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The existing Auchneel Water Treatment Works, owned and operated by West of Scotland Water, is situated just to the north west of the ferry town of Stranraer in Dumfries and Galloway. The existing works treats soft upland waters from three reservoirs, Upper and Lower Dindinnie and Knockquhassan Reservoirs and blending of these supplies is done by hand control using the best quality water available. The existing plant is sited in two separate buildings some 150 metres apart, on an east sloping hillside above Stranraer, overlooking Loch Ryan, and is highly visible. It also has an outfall which discharges into the Loch that was known to be of suspect quality. The brief for a new works was, to utilise the existing clarifiers, as they performed very well, and replace the pressure filters with a new treatment works, treating sufficient water to supply 4.3ml/d of treated water (allowing for waste and recycling) to Stranraer and environs.

Auchneel: Rapid gravity filters *(courtesy Scottish Water)*

The existing treatment process is by hopper bottomed clarifiers as primary treatment and pressure filters for final quality. Raw water is chemically conditioned with lime for pH correction and aluminium sulphate and polyelectrolyte for flocculation and coagulation prior to the clarification stage. Filtered water is disinfected by the addition of sodium hypochlorite and the addition of lime for pH correction. Storage on site is currently two reinforced concrete reservoirs of 2.2Ml's. Sludges generated from the clarifiers and pressure filters are drained into settling lagoons and removed by road tanker.

The treatment works was designed to be located between two existing buildings on a green field site, together with two new 1.1ml RC reservoirs to, in effect, double the storage capacity for final treated water on site. The building had to be kept as low profile as possible so as not to be too obtrusive in the landscape. Colours for cladding and roofing were selected to assist this.

The existing clarifiers were to be modified by the installation of actuated de-sludging valves controlled by blanket detectors, a new inlet flow splitting device to overcome slight difference in operating levels which the two clarifiers habitually adopted and a new inlet main and flowmeter to control flow. Relocated aluminium sulphate, lime and poly dosing points were also introduced.

Main treatment building
This is divided into several areas:

* chemical handling and storage;
* main water treatment area;
* sludge treatment area;
* MCC area and office;
* laboratory and amenity area.

To facilitate chemical deliveries via a cattle gridded entrance, the chemical area is sited at the west end of the building adjacent to the entrance. The treatment area is in the centre, again taking advantage of the site's slope from west to east, with first stage filters to the west end and 2nd stage filters to the east end, followed by the sludge area

at the east end. The amenity area is located on a mezzanine floor above the workshops, storage and standby generator room.

The treatment building accommodates the preferred process of four GAC first stage filters and three second stage sand filters, followed by disinfection in the contact tank and then gravity flow to the twin compartment service reservoir. Flow from this service reservoir is controlled by actuated valves on the inlets to the two existing reservoirs via signals from ultrasonic level detectors sited in both the new and existing reservoirs. These also control the raw water inlet flows to the site.

The first and second stage filters are pre-fabricated m.s. tanks, coated to give a minimum of 25 years life between maintenance. The contact tank, together with the clean washwater tanks and dirty washwater tanks are located below the general building slab level in order to reduce the footprint size and take advantage of the sloping site. To simplify construction, flexible curtains were used in the contact tank in lieu of RC walls.

GAC was chosen as the first stage filter media to primarily remove THM precursors and colour. The second stage is primarily a polishing filter for fine particulates, colour and manganese removal. Minimum 24hr run times between washes are required on the first stage filters.

Dosing
Storage tanks have been supplied for aluminium sulphate, sodium hypochlorite. orthophosphoric acid and a silo for hydrated lime. There is also a dedicated area for polydosing which provides duty/standby for the clarification stage and duty only for sludge thickening. Three units have been provided for these duties. It is anticipated that the same polymer may be used on both the clarifiers and sludge thickening. This will then give duty/joint standby for both systems, thus ensuring more reliability.

Motive water and flushing water (the latter for lime dosing lines), together with domestic water, are supplied via dedicated booster sets sited in the combined valve/outlet chamber of the new reservoirs.

Aluminium sulphate is used as the coagulant prior to the clarifiers to floccculate suspended particles, which are then settled out in the clarifiers. Sodium hypochlorite and lime are added upstream of the second stage filters to oxidise manganese present in the water. Manganese is the main source of colour in the raw water. Lime is added to raise the pH to the required level and the resultant manganese dioxide is precipitated out of the solution for removal in the second stage filters.

Flow from the second stage filters is further dosed with sodium hypochlorite for disinfection. The chlorine residual out of the second stage filters and the dose rate is adjusted automatically to a pre-determined set point via SCADA.

Orthophosphoric acid is dosed at the end of the process to prevent plumbosolvency.

Sludge treatment
Sludge from the washwater is decanted into the dirty washwater tanks, whilst the supernatant is decanted via floating arms to the recovered water pumping station and returned to the head of the works.

The decanted sludge is pumped to a buffer tank where it is combined with the clarifier sludges via an in-tank mixer and then to a gravity thickener where it is thickened to approximately 5%. The sludge is then stored before being moved to a plate press via sludge transfer pumps, where the cake produced will be to 17% dry solids minimum. Cake removal will be via conventional covered 8 cu.yd skip.

Novel features
To assist in the efficient running of the plant, high level walkways and stairs allow direct access from the control room to clean areas of the plant i.e. first and second stage filter, at high level for manual observation of backwashing etc., MCC and chemical dosing area.

The sludge area is kept separate by dividing walls and access is either at ground level, or to the control room via a changing room and shower room. Messing facilities are located between the laboratory, control room and the changing room/shower room.

To assist in efficient mechanical installation, thin walled stainless steel pipe has been used throughout (except in chemical areas) for all above ground installation. All pipework outside the building is buried to preclude trace heating and lagging.

If there should be a breakdown in automatic control of the plant, the facility to run the plant in manual has been provided. Control for the treatment works is split between a chemical area PLC and the main process PLC. All dosing loops include their own dedicated PID controller. The local islands of control reduce the impact of a single failure within the control system. Individual PID controllers allow the operator to run each dosing loop without PLC input. The whole treatment works is monitored and can be controlled from the site SCADA system. There are four workstations allowing convenient access to setpoints, trends, alarms and control facilities.

The use of granular activated carbon (GAC) in first stage filters primarily removes trihalomethane (THM) precursor. THMs are the by-products of chlorine disinfection. Removal of this organic matter at the primarily filtration stage serves to reduce chlorine consumption as well as THM concentrations in the final water.

To avoid contamination in the underground tanks i.e contact, clean washwater etc., all access openings have ventilated upstands integral with the access cover. All processes have manually lockable bypasses to enable problem areas to be isolated.

SUDS
The principle of SUDS (Sustainable Urban Drainage System) have been incorporated into the site/roof drainage schemes at the request of West of Scotland Water, to ensure more even run-off and dissipation of rainfall by natural means.

General
Gaining planning permission was the responsibility of the Consortium and this was achieved by close liaison with the Local Planning authority and attention to detail. To help break the outline of the new plant, extensive planting of indigenous trees and plant species has been required.

During the design and early construction phase it became evident from detailed discussions with the client that the existing outfall from the works would not be of sufficient capacity to take the flows necessary from the works. As a result, surveys were taken for proposed routes and location of outfall and currently (March 2002) work is proceeding to install a new outfall and diffuser below high water level alongside the existing outfall so as not to inhibit commissioning of the plant.

Take-over tests were due in March 2002, some 18 months after contract award. ■

Note on the authors: *David Eastwood is Project Manager and Camilla Needham, Process Engineer, both with PURAC.*