

Invercannie and Mannofield WTWs

£41m scheme to improve water treatment for Aberdeen

by
Brian Mitchell

The Invercannie and Mannofield water treatment works together serve a population of around 300,000 in Aberdeen, Scotland's third-largest city. The water treatment works at Mannofield, in Aberdeen City, and Invercannie, 28 miles west of Aberdeen, treat raw water extracted from the River Dee and provide the sole source of potable water to the city and surrounding areas. Ongoing water quality analysis identified that both works suffer from failures to meet various permitted concentration values in colour, coliforms, turbidity, manganese and pesticides. The Drinking Water Quality Regulator has also determined that the level of disinfection control at both works is inadequate to ensure consistent bacteriological compliance and taste. Two aqueducts – one laid in 1866 and the other in 1924 – which are currently used to take treated water from Invercannie to Aberdeen also required upgrading work.



Invercannie WTW Memcor Membrane plant – Membranes were upgraded for a type compatible with colour removal

Courtesy Scottish Water Solutions

Single Solution

Although the projects are separate, a single solution tying them together was agreed with Scottish Water. The solution involves reversing the outputs of 70MLD at Invercannie WTW and 49MLD at Mannofield WTW. This has the direct effect of reducing the scope of work on both Invercannie WTW and the aqueducts but increases the scope of work and output at Mannofield WTW. However, taken as an integrated solution, the solution produces not only the lowest capital cost but also the lowest whole life cost.

Scope of work

Mannofield WTW

The works was constructed in 1983, to treat a raw water flow of 37.5

MI/day. Water is pumped from the River Dee, through a raw water balancing tank, to the works inlet for treatment. The treatment plant consists of chemical coagulation, clarification, rapid gravity filtration, for the removal of colour and turbidity. Chlorine gas is used as the disinfectant and is added upstream of a retention chamber (contact tank). Water flows from the contact tank to a clear water tank. Lime is added downstream of the clear water tank. Backwash water is pumped from the outlet of the clear water tank, upstream of the lime injection point, to a wash water storage tank, which provides a gravity supply of wash water for the filters. Filter backwash water passes to a washwater recovery tank and is discharged directly, without settlement to a sewer. Clarifier sludge also passes directly to the sewer.



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Extension to Mannofield WTW (right) and Internal view with the 2 (No.) new clarifiers in the foreground and the 2 (No.) new RGSFs in the background (left)



Courtesy Scottish Water Solutions

Work to expand output at Mannofield has seen extension of the existing clarification and rapid gravity sand filters process and capacity has been raised from 50MLD to 70MLD. The current six clarifiers have been increased to eight and the three sand filters taken up to five. An upgrade of the existing polyelectrolyte make up and dosing plant was also completed. The project was carried out by Morrison/ Enpure.

Invercannie WTW

The water treatment works at Invercannie has been supplying water for Aberdeen for well over a hundred years. Initially treatment comprised raw water storage and slow sand filter filtration. As demand for water grew over the decades, the plant capacity was increased by the construction of additional slow sand filters. Chemical treatment was added in the early 1990s, with chlorine dosed for final disinfection and lime for pH adjustment. Ozone treatment was introduced shortly afterwards to remove organic colour which often existed to levels greater than the current limit of 20⁰ Hazen. Most recently, following a Cryptosporidium incident in

Aberdeen, a membrane plant was constructed, providing an effective barrier to the oocysts.

The ozone plant is a high energy consumer and has been unreliable in operation. It is reported that over a 9 year period the full ozone dosing capacity has only been available for 2 years. The slow sand filters are difficult to maintain during the winter, when increased biological activity increase the frequency of cleaning required. This increased frequency results in a filter requiring to be scraped at 30 day intervals. The low temperatures experienced causes freezing on the filter surface, when it is drained. This freezing prevents or delays cleaning. It is the combination of the increased biological activity and the low winter temperatures that makes it difficult to maintain the process and often leads to a filter being brought back into service before it has ripened, increasing the risk to the supply. The sand washer is 25 years old and has reached the end of its life.

The work at Invercannie, carried out by Biwater Leslie, has seen an upgrade to the existing membrane plant, by replacing primary



Invercannie WTW - New inlet works which includes a screening chamber, chemical dosing, flocculation tank and a new chemical building. These were all contained within an existing slow sand filter which was taken out of service early to accommodate the new inlet works

Courtesy Scottish Water Solutions

membranes with hydrophilic membranes to remove colour and turbidity from the raw water. A flocculation chamber has also been constructed upstream of the membrane plant.

The two existing secondary membranes have been replaced with one new Primary Hydrophilic PVdF membrane cell to improve security of membrane plant operation.

The existing disinfection system has been upgraded and a sludge

treatment facility incorporates sludge thickeners, Lamella and sludge presses. Invercannie's capacity has been maintained at 49MLD and an additional facility for washwater neutralisation and recovery has been provided. The project team worked closely with Siemens Memcor who designed the existing membrane infrastructure.

Note: The Editor & Publishers thank Brian Mitchell, Project Manager with Scottish Water Solutions, for producing the above article. ■



Invercannie WTW - New Chemical building - The planning constraints on the site were very strict and required that all new buildings should match exactly the existing buildings Courtesy Scottish Water Solutions

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