

# Scottish Water – Forth Valley Area

## remote rural WTWs using membrane plants

by Derek Young

**E**ast of Scotland Water, now Scottish Water, is currently upgrading the water supplies to a number of rural communities in the West Stirlingshire area under a phased programme of works. The latest works to be upgraded will supply drinking water meeting the Water Supply (Water Quality) (Scotland) Regulations 2001 to the communities of Ardeonaig, Lochearnhead and Strathyre. The works will supply summer populations of approximately 50, 400 and 500 to the three communities respectively. The resultant design throughput of each plant was determined as 100m<sup>3</sup>/d, 300m<sup>3</sup>/d and 150m<sup>3</sup>/d.



Tubular membrane plant building with stone fascia to blend with the environment (courtesy Scottish Water)

Contract for these works was awarded to *PCI Water* of Hampshire under the performance based IChemE ‘Red Book’ Conditions of Contract. Phase 2 included the installation of plants at Ardeonaig and Lochearnhead at an approximate outturn cost of £1.8m, with Phase 3 covering Strathyre at approximately £840k.

Each plant is remotely located and winter conditions can be severe with access cut off for extended periods. These plants must, therefore, be of robust design with no fragile treatment or control; options, and be capable of unmanned operation for extended periods.

Each plant is fed from a burn source which can be flashy and highly coloured in nature with raw water colour ranging to 60mg/l Pt/Co and turbidity to 6 FTU.

Raw water is abstracted from the burn through a 2mm clear opening double stainless steel screen arrangement before being fed by gravity to the treatment plant inlet. Pressure at the inlet varies between 0.5 bar to 4 bar depending on the plant location. Flow is then fed through a duty/standby stainless steel coarse screen basket arrangement of 2mm perforation to prevent the ingress of gross solids to the main process.

**Process**

Main element of the process is a tubular membrane filtration process based on a tubular nano-filtration design known as the *Fyne* process. The filtration system works by removing colour, solids and reduces mineral concentration, in effect by passing the flow through a semi permeable membrane at high pressure.

Within the process unit, the tubular membranes are grouped together in bundles and housed in a cylindrical shroud, termed a module. Each module is equipped with end cap arrangements so that the raw water passes through all the tubes in series under high pressure. Permeate filters through the membrane and is collected within the shroud whilst the raw water is recycled through the process unit. A proportion of this raw water is discharged from the recycling system and this is termed the reject water.

Modules are mounted in rows on a framework to form stacks. Pipework is provided to distribute raw water to the modules and collect reject and permeate from the modules. In order to ensure the correct fluid velocities are achieved over the surface of the membranes and to make the process work, raw water is pumped through the modules on the stacks by a recycle pump.

Reject water leaving the modules is discharged to the adjacent stream. As this water has received no chemical treatment, it can be discharged back to the watercourse with no further treatment.

Following filtration, the final water is dosed, via duty/standby dosing pumps, with sodium hypochlorite to provide a chlorine residual within the distribution system and it is rehardened by passing the flow through a limestone contact tank. In the limestone contact tank the permeate passes through a bed of limestone chips. As the permeate passes through it dissolves some of the



Tubular membrane filtration plant (courtesy Scottish Water)

limestone modifying the pH and hence improving the taste of the treated water and affording some protection to the distribution system pipework.

The treated water flows by gravity from the limestone contact tank to the service reservoir tank. Turbidity, pH and chlorine residual are all measured at discharge from the treatment plant and prior to supply into the distribution system.

**Civil works**

There is also a significant element of civil works associated with each of the plants, with each being housed within a portal frame building, clad to suit the environment in which it is located. This can range from standard steel clad structure to a stone clad facade chosen to match the character of the existing community.

At Ardeonaig, the existing service reservoir had reached the end of its working life and a new 100m<sup>3</sup> steel tank was constructed to replace the existing tank.

At Lochearnhead an aesthetic finish to the building housing the process plant was required in order for the building to blend into the area. The process building was designed to reflect the appearance of a shepherd's cottage and was clad in stone with a slate roof and window and chimney features added.

The site for the new works at Strathyre is on a very steep slope and required a retaining structure for containment of the infill material to form the level area for the plant building. Due to the prominent location of the works, on a popular hill walking route, it was important that the final finish to the works was aesthetic, fitting to the surrounding environment.

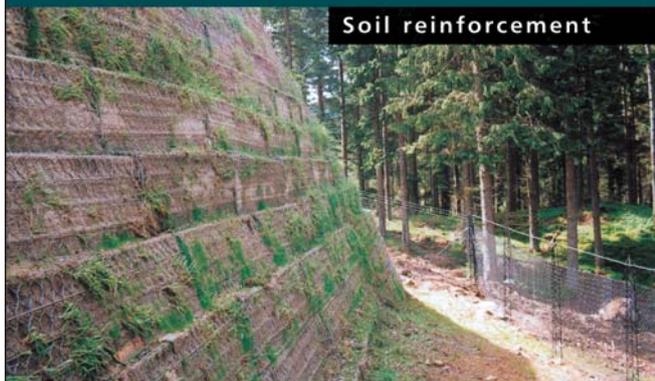
A cost effective solution was to use an innovative reinforced soil system called Terramesh as developed by *Maccaferri*. This system uses coated woven wire mesh with a geofabric external face reinforced with second welded wire mesh panel and horizontal reinforcing rods and two triangular steel brackets to increase the unit strength.

Once construction is completed the area will be landscaped and the exposed face of the soil embankment hydroseeded to form a grassed face to the slope which will blend in with the surrounding landscape. ■

**Note:** *Derek Young, author of this article, is Engineering Manager, Waterway Consultancy*

# Unrivalled

**Soil reinforcement**



Green Terramesh embankment at Strathyre WTW two months after completion

**TERRAMESH**<sup>®</sup>, developed by Maccaferri, builds on our worldwide success with gabions and other double twist wire products. The galvanised wire units, with PVC coating for even greater durability, form the front face and horizontal reinforcement for vertical, battered or green faced slopes. Installation requires minimum skill levels and time.

Terramesh<sup>®</sup> has BBA certification and is approved for Highway Works. Our company is ISO 9002 registered with specialist designers and Chartered Engineers who will work with you on your project, offering support and know-how from concept to completion.

**MACCAFERRI** - experts in soil reinforcement.



Retaining structures



Soil reinforcement



Erosion protection



Pavements



Basal platforms

**MACCAFERRI** www.maccaferri.co.uk