

Cromarty & Gairloch Drainage Schemes

Scottish Water brings high-tech to the Highlands

by Stephen Bailey & Glyn Lloyd

Cromarty and Gairloch drainage schemes are both in areas of outstanding natural beauty. Gairloch in the Wester Ross Region of the Highlands, is duly recognised for the quality of its landscape and has been awarded National Scenic Area (NSA) status. Cromarty is an historic coastal village of significant archaeological importance which is also classified as a conservation area. The Cromarty Firth with its links into the Moray Firth is also a popular area for sightings of the Bottlenose Dolphin.



WwTW as a Crofter's cottage (courtesy Scottish Water).

Scottish Water's **Cromarty and Gairloch Drainage schemes** are very similar in terms of the offsite wastewater collection system and associated pumping stations required in transferring flows to treatment for the first time at their respective locations, with final effluent being discharged under gravity via short sea outfalls constructed to mean low water level.

The wastewater treatment process adopted in these particular instances by Scottish Water, utilised membranes for the first time in the Highlands region. This represents a major step forward in embracing new technology for the treatment of associated effluents, which not only enables Scottish Water to comply fully with current directives but even goes well beyond the permitted discharge consents. The ability to achieve this was at no extra cost to the organisation.

Description of works

Cromarty Wastewater Treatment Plant

The new wastewater treatment plant being constructed by Scottish Water is situated on the outskirts of Cromarty on the headland adjacent to the entrance to Cromarty Firth (South Sutors)

Treatment of the wastewater effluent at Cromarty, forms the final stage of a two part, £1.9 million investment programme in the area. Stage one comprised the associated collection and pumping system forwarding flow to treatment. The works has been designed to treat a future population equivalent of 1551.

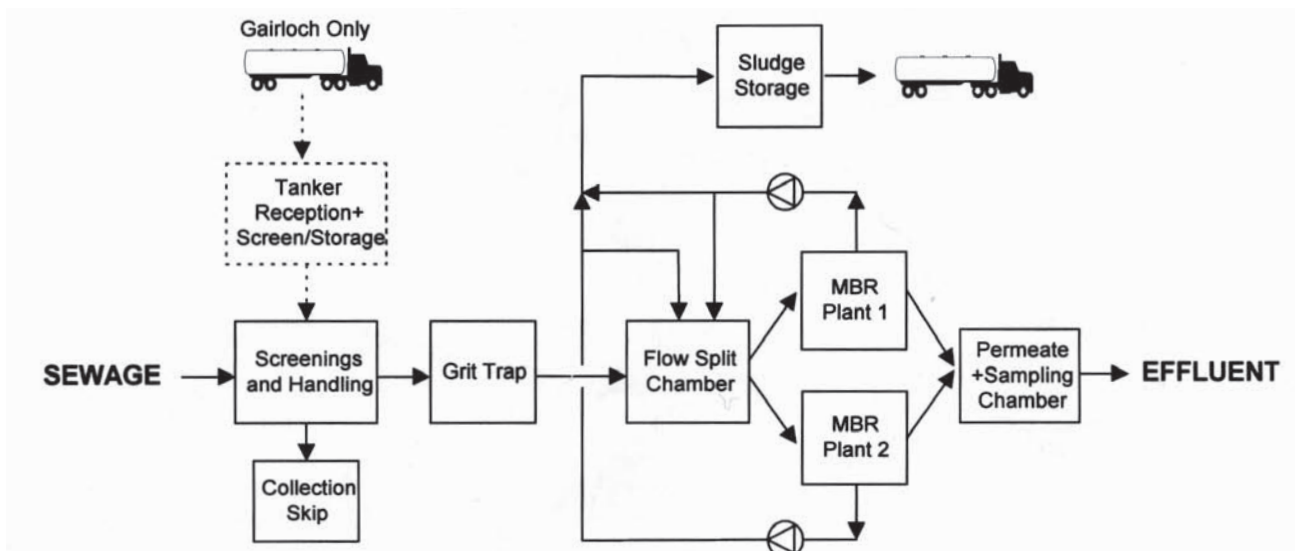
Gairloch Wastewater Treatment Plant

The new wastewater treatment plant is situated on the outskirts of Gairloch on the B8021 between Lonemore and Big Sand and adjacent to Loch Gairloch.

Treatment of wastewater effluent at Gairloch forms the final stage of a four part £2.4 million investment programme in the area. Stages 1, 2 & 3 comprised the associated collection and pumping system forwarding flow to treatment. The works has been designed to treat a future population equivalent of 2122.

Process

The membrane bio reactor combines the principals of conventional activated sludge with those of membrane filtration in order to produce an extremely high level of treated disinfected effluent over traditional systems. The membrane acts as a physical barrier



to separate solids from the treated effluent. Solids retained in the process reactors improve biological efficiency and with the high MLSS, the reduction in sludge production – an inherent advantage.

Sewage is received at both **Cromarty** and **Gairloch** via a network of pumping stations. Flows to each works being measured by an in line Magflo meter located at the forwarding pumping station and linked via telemetry to a master unit located at the new treatment facilities. Optimising control of the pumping stations also eliminated the requirement for flow balancing at each new works.

Domestic and associated waste from the control building along with chemical waste and surface water drainage from around the works is collected via an on-site pumping station. This associated waste is forwarded to the head of the inlet works/screening unit where it combines with the main incoming flows prior to screening.

Screening consists of one 6mm screen and one 3mm screen, with associated grit and grease removal at Gairloch. At Cromarty, screening is via two 3mm screenings units in a duty/standby arrangement. At both sites *Huber* were responsible for providing package units to the main Process, Mechanical. & Electrical Contractor, *Naston Limited*.

Screened sewage flows into the distribution chamber, where it combines with recycled activated sludge produced in the membrane bio reactor tanks and then via two low level outlets into the membrane bio reactor tanks.

Process air from three blowers operating in a duty/duty/standby arrangement deliver oxygen for biological growth and for creating a liquid cross-flow over the membranes. This sewage flow helps to keep the membranes free from excessive fouling and is induced via the process air distribution manifold in the base of each membrane unit.

Cromarty contains four membrane units in each of the two process streams, with each unit containing 200 of the flat sheet membranes, whilst at Gairloch there are six membrane units in each of the two process streams with each containing 200 flat sheet membranes.

The filtration process permits continual transfer of effluent from the plant, which operates under a hydrostatic head, flow being controlled through a series of valves and magflo meters. The treated effluent is collected via a manifold arrangement whereby it is then discharged from the works under gravity to the outfall which has been constructed

to mean low water. There is also a SEPA sampling point. The control valves are also used to operate routine automated back flushing of the membrane aeration system. Back flushing is conducted using treated effluent which is also used for screen washwater, local hose down points and for hypochlorite make up water used as part of the membrane cleaning regime.

At a preset time, excess biomass will be removed from the reactors via dedicated sludge pumps that transfer the excess solids into the integral storage chamber. The sludge storage chamber at both works have a 14 day capacity.



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The flat sheet membrane process at each of the new works required the construction of a compartmentalised semi recessed, reinforced, water retaining concrete tank structure and local control building. The design comprises a process pipe gallery, accessed via adjacent control building, two reactor tanks for housing immersed membrane

units, common distribution chamber, treated water storage, required for process and non potable applications such as a hose down point and screen washwater and sludge storage (14 day capacity) (SEE FIG 2)

(Gairloch also acts as a reception centre for imported septic tank wastes and has an additional chamber with fixed coarse screen, over that of Cromarty)

Site access roads have been designed to accommodate parking and facility for FTA Articulated Vehicles/Scottish Water operatives and constructed to a standard suitable for adoption. At Gairloch, the road is in the form of a loop from the existing main road, whilst **Cromarty** is in the form of a hammer head.

Surface water from tankering points, where potential spillage and contamination may occur are collected and treated within the process.

The mean low water sea outfall at Gairloch is constructed from ductile iron, whilst at Cromarty from HPPE. Each have tidal flap at the discharge.

Building works

The control buildings have strip foundations and are of traditional construction in keeping with respective locations. Each building has been designed to accommodate normal welfare facilities, laboratory, chemical storage and stores along with the process plant control equipment, such as motor control centre and blowers. The building also provides access via a set of stairs down to the pipe gallery that runs parallel to the building and process streams.

Constructing the tank and buildings adjacent to one another also eliminated any unnecessary pipe and cable runs adding to the savings achieved as part of the value management exercises.

Advantages of chosen process & site

A feature of the membrane process chosen by Scottish Water includes a reduction in the amount of sludge produced, which directly benefits the organisation in terms of cost of collection, as well as those associated with frequency of vehicle movements.

By adopting membranes based upon the "flat sheet" design, it was possible to reduce the physical footprint of both works, compared with the size traditionally associated with other forms of conventional treatment. Methods of construction have been improved along with operation and maintenance and all due to the inherent features of the process.

Considerable savings were achieved in terms of value management, from a design, engineering and construction perspective, given the similarities between both works. This also meant a significant amount of duplication was avoided. Additional advantages of the process also included, no odour, high biomass concentration, high loading rates and high quality of treated effluent, suitable for discharge into sensitive receiving waters. Disinfection being achieved without the need for UV or chemicals.

Civil and building structures were designed to complement their respective environments. Buildings containing motor control, aeration, process control valves and associated equipment have been designed to look like Crofters Cottages, which are typical of the area.

Scottish Water went through various stages of consultation with both planning, local community councils and other consultative governmental organisations such as Scottish Environmental Protection Agency and Scottish Natural Heritage. The latter, in particular, paid compliment to Scottish Water's endeavours at **Gairloch**, welcoming closer cooperation between respective organisations..

At **Gairloch** it was possible to relocate proposed works from the original site to an adjacent 'borrow pit' thus meeting/achieving governmental objectives towards brown-field site re-development. This also reduced capital expenditure, disruption and inconvenience. Scottish Water was not only able to reduce the environmental impact of construction related activities and minimise levels of reinstatement required by use of the latest technology. The local economy also benefited from contractors ensuring that local trades were involved in all aspects of construction and related activities.

Gairloch was due for completion summer 2003; Cromarty was due for completion winter 2003. ■

Note on the authors: *Stephen Bailey, is Project Manager and Glyn Lloyd, Area Programme Leader (North-West), both with Scottish Water.*



Water and Wastewater Treatment Process Contractors

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Mechanical and Electrical Contractor for the:
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