

Glencorse WTW

Edinburgh's new £130m WTW is a feat of modern construction methods and sustainable engineering

From the sweeping Tweedsmuir Hills in the Scottish Borders, to the rolling Pentlands on the capital's doorstep, gravity carries up to 175Ml/d of clear, fresh drinking water to 450,000 customers in Edinburgh and parts of Midlothian. Glencorse Water Treatment Works (WTW), Scottish Water's £130m flagship investment, is a 21st century replacement for the existing works at Fairmilehead and Alnwickhill (constructed in 1909 and 1885 respectively), which despite serving the city well for over a century, have now reached the end of their operational life. Carried along the Victorian engineered Talla Aqueduct to the new WTW, like Scotland's famous tartans that it is so well known for, the city's water supply blends a mix of ancient and modern.



Glencorse WTW - Courtesy of Scottish Water

Consultation & planning

In April 2006, a decision was taken to replace the ageing facilities at Fairmilehead and Alnwickhill rather than undertake further capital maintenance work and upgrades. Following Scottish Water's largest ever consultation, in collaboration with the latest civil engineering studies, the site at Glencorse was selected as the most suitable and helps meet Scottish Water's drive to deliver renewable energy from its assets. Gravity will carry raw water supplies some 50km into the inlet building, as well as delivering the treated water directly into the capital, reducing the need for energy sapping pumps.

Working closely with Midlothian Council planning department and local residents, in September 2007 the project received planning permission after just 10 weeks, unheard of for a construction project of this size.

Archaeology

Following initial archaeological studies, a Roman Marching Camp was discovered on the proposed site of the treatment building. Neighbouring residents agreed the repositioned works location

to protect this important local antiquity. Throughout construction close links have remained between the project team and the community surrounding the new facility. Other finds included Cromwellian military artefacts at the site of an old World War Two army camp situated along the pipeline route.

Raw water supplies

Raw water travels over 50km by gravity through the existing aqueducts and pipes to the new Glencorse WTW, and comes from a variety of sources; primarily the Talla, Fruid and Megget Reservoirs, located in the Scottish Borders. Glencorse Reservoir, located approximately 1km from the works, will also be utilised.

Hydro turbine

The raw water entering the site operates a Gilkes twin-jet Turgo Impulse Hydro Turbine housed within the raw water inlet building. With a designed operating regime of between 30 and 50Ml/d at pressures varying between 53m and 73m of head, the turbine has a nominal rating of 230KW, and will generate roughly one third of the entire energy requirements for the WTW.

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Treatment process

Raw water contains impurities which affects the colour, taste and clarity of the water. To ensure that the drinking water meets the Water Supply (Water Quality) (Scotland) Regulations 2001, water treatment processes vary across the country depending on the water supply and the technologies available when each treatment works was built. As Scottish Water's flagship project, Glencorse Water Treatment Works utilises some of the most up-to-date and efficient processes:

- **Coagulation:** Colloids and other impurities in the raw water need to be removed. Coagulants like alum (aluminium sulphate) will be used to help bind the impurities together to form particles. This solid-liquid separation process requires precise dosing and pH control along with good mixing to be effective.
- **Flocculation:** The coagulated water is mixed for around 20 minutes to allow the particles to grow in size for effective removal in the next stage. The water passes over and under baffle weir walls forming a 'floc' on the surface. This form of hydraulic flocculation requires no moving machinery, unlike other systems which use mechanical mixers, meaning there is a reduction in power and maintenance costs. In colder temperatures, a chemical polymer can be added to aid the process. The choice of the polymers used may differ, depending on the quality of the raw water.
- **CoCoDAFF:** Glencorse utilises the innovative CoCoDAFF (counter current dissolved air flotation & filtration) system which combines two forms of impurity removal in one; dissolved air flotation (DAF) and rapid gravity filtration (RGF).
DAF Process: During the DAF process, impurities are floated to the surface, instead of being allowed to settle at the bottom. A mass of fine bubbles is created by saturating the water with air under high pressure, and mixed with the flocculated raw water to help float the impurities to the surface. This sludge blanket is periodically removed by a flushing of water over a weir into an outlet channel.
Filtration: After the DAF Process, the water is passed onto the rapid gravity filters in the lower section of the CoCoDAFF cell. Here any remaining impurities too big to pass through the filter are trapped in a media of sand and anthracite. The filter beds are periodically backwashed to remove the build up of impurities. Phosphate is then added to help prevent lead being absorbed from lead pipes at customers' properties.
Footprint: The CoCoDAFF process reduces the size of the overall footprint of the WTW and has significantly helped in achieving the "low impact" building and aids in visual mitigation of the structure(s).
- **Disinfection:** Disinfection is vital to ensure that water-borne diseases are eliminated, and that the drinking water meets the Water Supply (Water Quality) (Scotland) Regulations 2001. Sodium hypochloride is added as a liquid form and the water passed through a contact tank for around 25 minutes before entering an underground storage tank.
- **Sludge:** The waste water produced from backwashing the filters and sludge from the DAF process passes through lamella settlement tanks and is recycled back to the head of the of the works. Using this process, approximately 99% of the backwash water can be reused. The remaining waste is a sludge form which is transferred away from Glencorse to be treated at a wastewater treatment works.

The clear water tank

With an impressive 490 internal columns, and 90ML capacity, the new 208m by 90m clear water tank is one of the largest in Europe, storing the treated water before it commences the journey to Edinburgh. This storage tank is covered with a grass roof, providing hill-walkers with an unspoiled view from the top of the Pentlands.



Construction is underway - Courtesy of Scottish Water



Pipe gallery - Courtesy of Scottish Water



Glencorse hydro turbine - Courtesy of Scottish Water



Inside the clear water tank - Courtesy of Scottish Water

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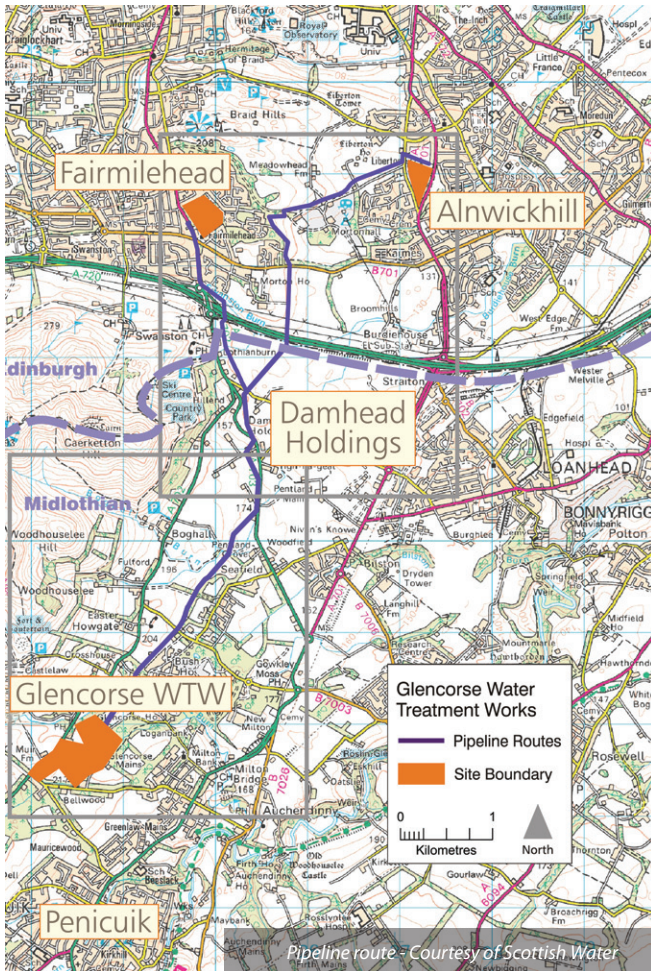


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Pipeline route - Courtesy of Scottish Water

Pipelines

Over 7km of twin 1,200mm dia pipes were required to deliver the treated water from the new works into Edinburgh's existing distribution network. The route of these pipelines required careful consideration from engineering, environmental and social perspectives such as:

- Avoiding the need for expensive pumping by choosing a route that allows the water to flow by gravity.
- Minimising disruption to road users and pedestrians by using agricultural land where possible.
- Avoiding sites of archaeological interest.
- Minimise damage to trees and hedgerows in areas that are important for nature conservation by crossing at existing gaps or areas of sparse vegetation where possible.

The twin pipeline runs from Glencorse WTW through agricultural land to Damhead, where it splits. One leg of the pipeline connects into existing pipework and takes water to the Fairmilehead area. The other connects into the network at Alnwickhill. Directional tunnelling under the Edinburgh City Bypass was required to cross one of Scotland's busiest roads without disrupting the thousands of commuters who use this vital artery every day.

Two smaller pipes were also necessary to connect with the sewerage network and take this minimal amount of sludge away from the Glencorse site for treatment.

Mobile pipeline production plant - this aspect was featured in detail in *UK Water Projects 2009* and on www.WaterProjectsOnline.com

In a world's first, Scottish water and Black & Veatch 'dropped' a mobile pipeline production plant onto the route of the trunk main connecting the new treatment works with the existing network serving the capital.

Rather than being restricted to using long trailers for the transportation of pipes, it was possible to go beyond the 15m restriction and mould extra long pipes of 22m. This ensured the overall dual trunk main was more robust, requiring fewer welds, and helping to reduce the duration of the pipeline project. Additionally the mobile pipeline project saved around a million lorry miles – enough to reach the moon and back twice.

Minimising the visual impact

The site of the new WTW neighbours the Pentland Hills Regional Park, and so as not to detract from the natural beauty of the area, measures were taken to minimise the visual impact of the project.

Instead of using corrugated metal, a living grass roof covers the treatment building and the clear water storage tank, an area totalling around 43,000m², making the works almost invisible from the Pentland Hills, the A702, and surrounding properties.

The wildflower meadow seed mixture provides excellent biodiversity, and the variety of native grasses and flowers fits in well with the surrounding landscape. The grass roof will also harvest rainwater, which will be stored in bio-diverse wetlands, providing rich habitats for a number of insect, animal and plant species. The turf was grown on the banks of Loch Leven near Kinross, at a farm of turf experts Stewartsturf.

To further minimise the visual impact, the treatment building is sunken into the ground and shielded from view by landscaped bunds of earth.

Locally sourced materials

Where possible, the project has used locally sourced materials to ensure a natural fit, reduce the transportation footprint and reduce maintenance. Perimeter walls have been constructed from wire baskets filled with locally quarried stone, which allows



Mobile pipeline production plant - Courtesy of Scottish Water



Glencorse WTW - July 2011 - Courtesy of Scottish Water



Directional tunnelling - Courtesy of Scottish Water

the construction spoil to be reused in landscaping the facility. This practice has helped to reduce construction traffic by 75%, significantly improving the projects overall carbon footprint.

Legacy

As well as providing an engineering legacy, the Glencorse project will also provide a living legacy for up to 500 young people who passed through its doors during the 3½ year construction programme, inspiring future generations of young engineers. The project 'adopted' three local primary schools from Year 4, through the evolution of the project, holding classes on an annual basis.

Young people grew up with the project, learning lessons in environmental engineering, health & safety, and civil engineering practice. Lessons were practical, with numerous site visits and tours of the neighbouring Pentlands Park to learn about the plants and animals that call this area home.

Working with the project's education programme 60 oak trees were donated by Green MSP Robin Harper, who also helped the children to plant this living legacy for the young people who took part in this community education programme. The oaks will provide additional landscaping to screen the works from motorists on the A702.



First of the pipes being laid - Courtesy of Scottish Water

Project delivery team

The delivery team consisted of a partnership of specialists. Scottish Water engaged Black & Veatch (B&V) as Design & Build Contractor for the project, coordinating and managing all phases of delivery. B&V in turn engaged ERM as Environmental Consultants and BDP as Building and Landscape Architects. Scottish Water also engaged EC Harris as Cost Consultants.

The project was delivered on time and under budget. It has won a number of prestigious awards including the CIWEM World of Difference Award; the International Green Apple Environment Award and a trio of Considerate Constructor Gold Awards.

Glencorse is an exemplar project, not only delivering a state-of-the-art water treatment works and providing a 21st century water supply for Scotland's capital, but it is a cutting edge example of how sustainable engineering is possible in a project of such a mammoth scale. Glencorse will now serve Scotland's modern capital for a further century, with additional capacity and room to modernise yet further built into the existing project.

The editor & publishers would like to thank Scottish Water for providing the above article for publication.



The green roof - Wildflower grass mix - Courtesy of Scottish Water