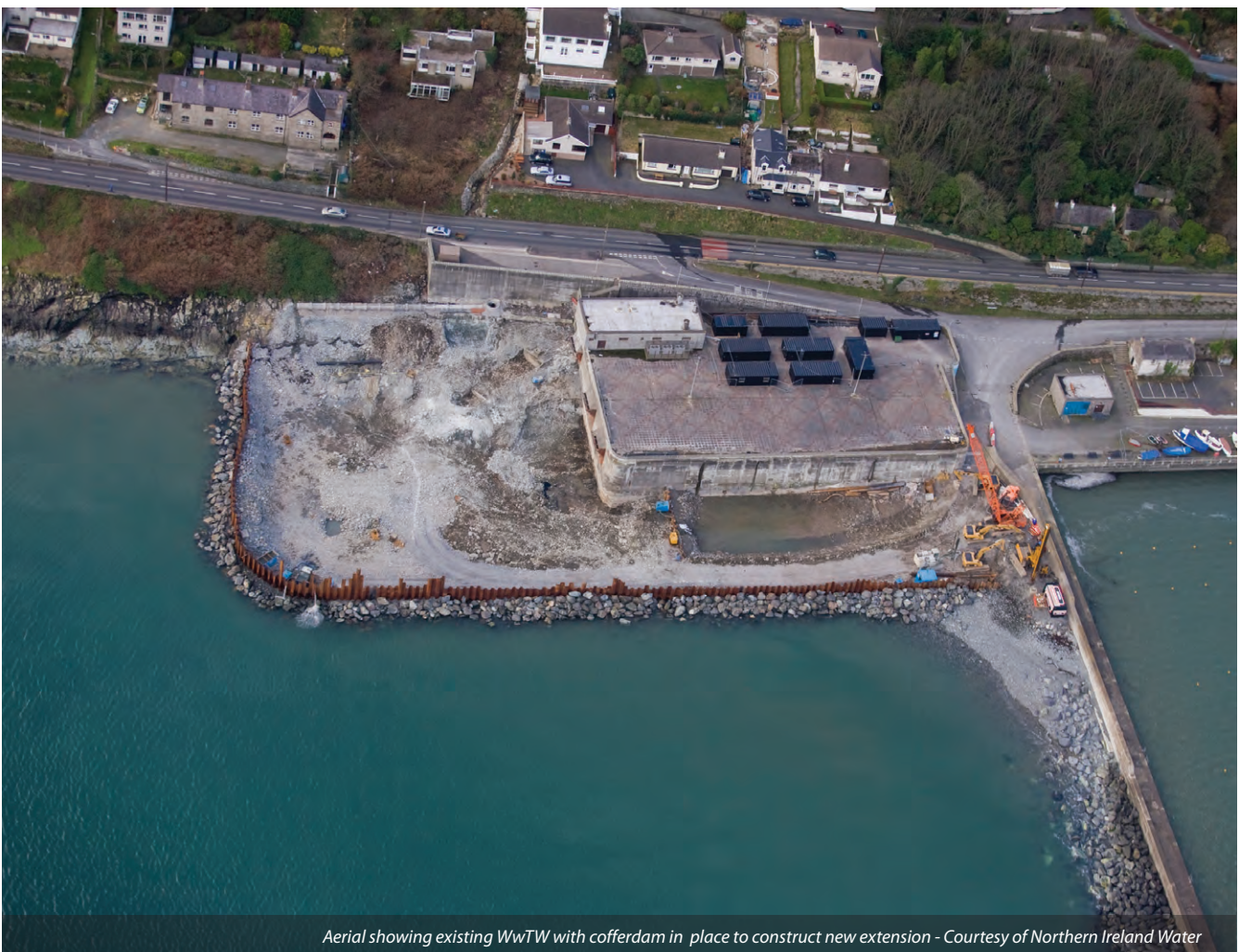


Newcastle WwTW

an £8m NI Water investment to meet future bathing water standards

by Kieran Grant

Situated on the coastline of the Irish Sea and overlooked by the majestic Mourne Mountains, Newcastle has long been one of Northern Ireland's most popular resorts. With its harbour, beach and award-winning promenade the town attracts thousands of day-trippers and holiday visitors alike every year. The upgrade of Newcastle Wastewater Treatment Works represents a major investment by Northern Ireland Water to improve the standard of discharge so that the quality of bathing waters in this popular seaside town meets future EU directives. This extensive project supports the £6m package of infrastructure and network improvements already undertaken in Newcastle in recent years, including the construction of a large scale stormwater storage tank at Castle Park in the town centre. Collectively, these upgrades will ensure that the sewerage infrastructure in Newcastle operates in accordance with EU directives as set down by NIEA.



Aerial showing existing WwTW with cofferdam in place to construct new extension - Courtesy of Northern Ireland Water

Location

Newcastle WwTW is located on the coastline, adjacent to the harbour on South Promenade, an area that lies within or adjacent to the following environmental designations: Murlough SAC, Murlough ASSI, Mourne Coast ASI and Mournes ANOB.

Need for improvement

The existing treatment works was commissioned in 1990 to treat the sewage produced by a Population Equivalent (PE) of 20,000 to a standard of 30:50 (BOD:SS). The existing PE is 16,365 and the projected PE (2035) is 18,845.

The works consists of screens, a contact stabilisation activated sludge process, mechanical sludge thickening and sludge storage. The final effluent is discharged into the Irish Sea via the existing 280m long sea outfall.

Although the works has consistently produced a compliant effluent, bathing water at Newcastle has failed to comply with the mandatory standard in 2001, 2005 and 2007 due to other external influences. As a result NIEA designated the bathing water 'sensitive' under the UWWTD, and required further treatment in the form of bacterial reduction, be provided at Newcastle WwTW by May 2013.

NEWCASTLE WwTW EXTENSION





Existing Newcastle WwTW located on the Irish Sea coastline at the foot of the Mourne Mountains - Courtesy of Northern Ireland Water



Newcastle: View from existing WwTW towards Blackrock PS and South Promenade - Courtesy of Northern Ireland Water



Blackrock Pumping Station
Courtesy of Northern Ireland Water



(Top) Artist's impression of proposed planting being considered for eco-friendly 'green' roof on extension (bottom) view of the roof of the existing Newcastle WwTW - Courtesy of Northern Ireland Water

Project drivers

The Newcastle Drainage Area Plan report and Bathing Water Compliance Assessment Study concluded that, in addition to the required network improvements (now completed), the final effluent quality and frequency of storm discharges from the works would need to be improved. Recommendations of the Bathing Water Compliance Assessment Study were made to NIEA and the following were put forward and accepted as key project drivers to ensure compliance with the new Bathing Water Directive:

- **Compliance with the new Bathing Water Directive (2006/7/EC):** Requirement for additional treatment to reduce bacterial concentrations in the final effluent and 500m³ of storage to reduce storm spills.
- **Compliance with Urban Waste Water Treatment Regulations (NI) 2007:** Requirement for further treatment, in the form of bacterial reduction, by May 2013.
- **Compliance with NI Water odour standards:** Requirement to rationalise the current sludge storage arrangements.

An NIEA pre-application Water Order Consent (WOC) for the treatment works indicated a revised discharge standard of 30 BOD, 50 SS, 20,000 cfu/100ml, during the bathing water season.

Scope of work

The scope of work included improvements to the existing WwTW as well as a large extension to the existing structure to house new equipment and treatment processes as follows:

- Replacement of the inlet works screens and screening compactors.
- New grit removal system.
- New storm screen and transfer pipework.
- New storm tanks, mixers and return pumps.
- New inter-stage pumping station.
- New washwater filters and pumps.
- Space for future tertiary filters.
- New UV channels and lamps.
- Rationalised thin sludge storage.
- Upgraded odour control.
- Upgraded ventilation and building services.
- New standby generator.
- Extended administration building.
- Replacement mechanical sludge thickener.
- Replacement aeration blowers, manifold pipework and aeration diffusers.
- Refurbishment of final settlement tanks.
- Replacement main control centre (MCC).
- Cleaning and refurbishment of the long sea outfall.
- Concrete repairs to existing WwTW structure.
- Full refurbishment of Harbour and Blackrock Pumping Stations.
- 'Green' roof to new extension.

Designing for the future

Due to the complex build of the new extension (the works extends from the coastline into the Irish Sea) and significant temporary works that were required to construct the extension, it was decided to build in additional capacity into the treatment process to ensure compliance, protect against greater-than-anticipated population growth and provide redundancy to ensure security of treatment.

It was also recognised that a further extension to the works would most likely not be possible due to its location and lack of NI Water land ownership and therefore future-proofing the process now was paramount for the design team.

The additional capacity provided was in the form of an additional (5th) treatment stream, additional storm storage (increased to a total of 1,000m³), and additional inter-stage pumping station

emergency storage (increased to a total of 1,250m³). Additional floor space and hydraulic head was also incorporated into the design to accommodate future tertiary discfilters. These additional measures have increased the potential capacity of Newcastle WwTW to a population equivalent of 25,000.

Procurement route

A Prequalification Questionnaire was issued in February 2011 to the OJEU restricted list prequalification competition and five economic operators were subsequently shortlisted. The contract was tendered to all five economic operators using NEC3 ECC Option A: Priced Contract with Activity Schedule condition of contract.

Five tender submissions were returned to NI Water on the revised return date of 26 August 2011 and following appropriate quality and cost assessment the contract was awarded to the Dawson-Wam/Ovivo JV. Belfast-based McAdam Design was appointed by NI Water to provide project management support.

Planning permission

A FEPA licence application was submitted in February 2011 and no statutory objections were received. Full planning permission was granted in May 2011 following the completion of an Environmental Impact Assessment which included:

- Archaeological impact assessment.
- Ecological impact assessment.
- Contaminated land assessment.
- Odour assessment report.
- Visual impact assessment.
- Article 6 assessment.

Work on site got underway in January 2012 to meet the key project target of having the discharge from the treatment works fully compliant with the new directives by the end of May 2013.

Process description

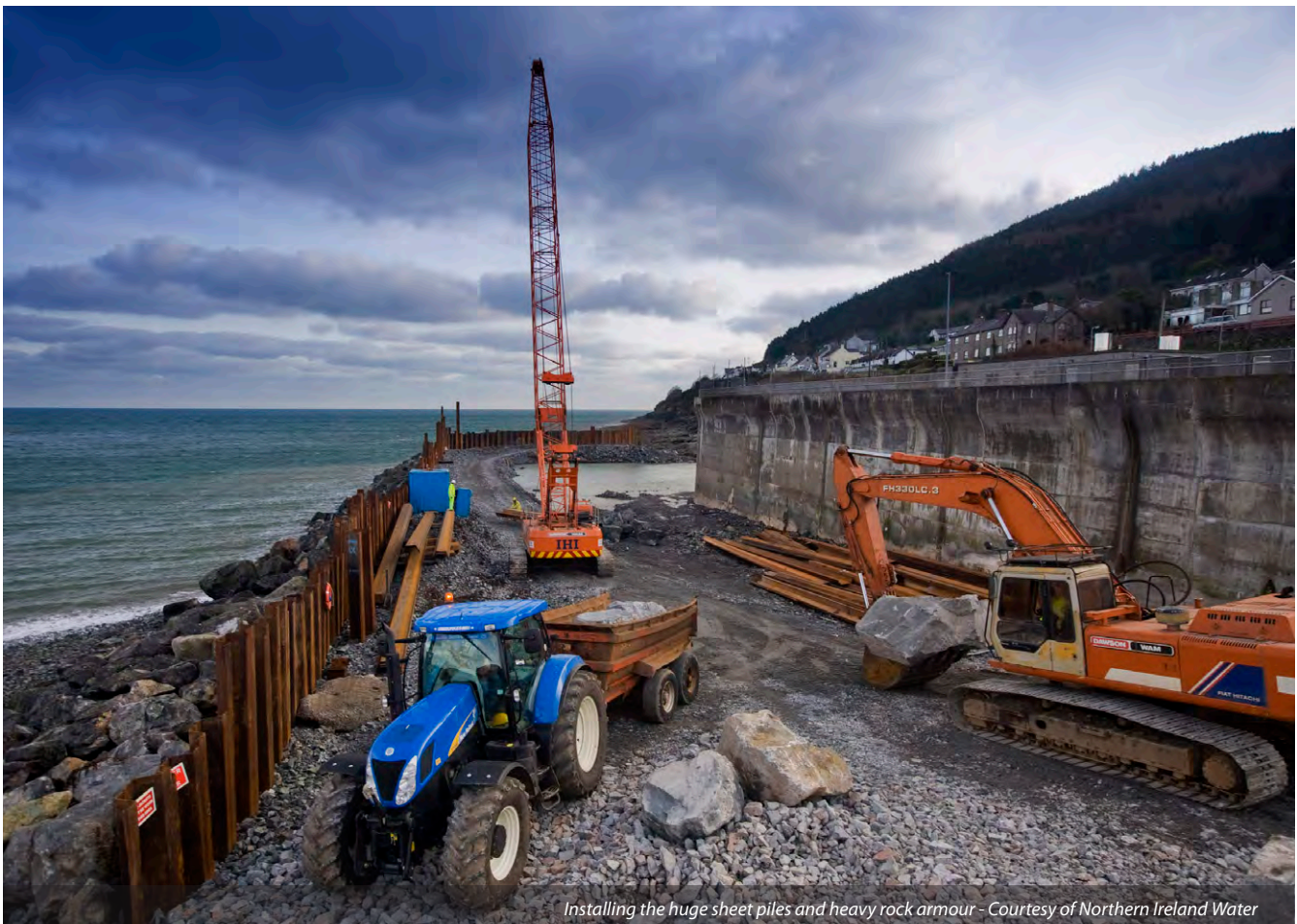
The extended works process system has been designed to make best use of the existing assets, whilst upgrading the treatment capacity of the plant to meet the requirements of the Bathing Water Directive.

The plant is configured with a future design capacity population equivalent of 25,000. This figure includes the peaks in biological and hydraulic loads which arise from the influx of tourists to the town during the holiday seasons and bank holidays. It is configured in a modular arrangement enabling the operational personnel to vary the capacity of the works on a seasonal basis to address the peaks in load whilst maximising the efficiency of the process systems at other times of the year.

The existing plant secondary treatment contact stabilisation process has been retained, extended with a 5th stream added and upgraded to provide additional hydraulic capacity. This system is well suited for this application due to the fact that it is a very compact suspended growth type treatment process. Contact stabilisation operates at lower retention times than an equivalent activated sludge process and can rapidly achieve the required level of carbonaceous treatment to provide clarified secondary treated effluent to the downstream process of UV disinfection.

The works receives all of its influent via a pumped main from the Harbour Pumping Station which discharges into the main reception chamber fitted with a high level emergency overflow weir. Flows in excess of flow to full treatment (FFT) are screened and piped to the storm storage system. Blind and online storm tanks are provided to attenuate storm flows prior to return to the main process.

In the event that the storm tanks are full and incoming flows are in excess of Formula A, these discharge directly to the long sea outfall via a Formula A overflow weir.



Installing the huge sheet piles and heavy rock armour - Courtesy of Northern Ireland Water



One of the new screw pumps ready for transportation to Blackrock Pumping Station - Courtesy of Northern Ireland Water

Flows up to FFT are subject to preliminary treatment by means of fine screens in and grit removal. Screened flows are fed to a distribution chamber to be equally split between the five online contact tanks, where returned mixed liquor from the aerated stabilisation zone is contacted with the influent for a short time period. The returned sludge adsorbs BOD in the aerated contact tanks and is fed to the online final settlement tanks, where it is separated from the secondary clarified effluent.

The underflow of consolidated sludge is fed to the online stabilisation tanks where it is aerated for a longer period allowing biodegradation of the accumulated BOD. A proportion of the now stabilised sludge is fed back to the contact tanks in a continuous process to repeat the treatment and a small proportion fed for sludge storage and thickening prior to removal off site by tanker.

Aeration, sludge and scum returns are enabled by a common multiple blower system with the additional functionality to act as an air lift system on a common piped main with actuated valve connections for each of the relevant operational systems. As the majority of liquid returns within the plant are thin sludge or liquid this system works effectively and is an efficient use of the available assets to achieve multiple objectives.



Inside new extension: Final effluent pumping station Courtesy of Northern Ireland Water

Clarified secondary effluent discharges into a dedicated interstage pumping station/interstage pump storage tank with a capacity of 1,250m³. This pumping station and interstage storage tank will perform a number of functions provided that the effluent turbidity is within standard. The final effluent can be directly fed to the multiple module channel mounted UV disinfection plant, which is operational in bathing season for maximum process efficiency, or discharged directly to the outfall outside of bathing season should tidal conditions dictate. In the event of interstage pump failure, this pumping station is also configured for connection to a future set of tertiary filtration units and can redirect effluent with a high turbidity content to a storm tank for storage.

Design and construction challenges

The upgrade to Newcastle WwTW presented many challenges right from the outset in terms of both process and civil design. Not only did the treatment process require complete flexibility to cater for the extreme variations in biological and hydraulic loadings brought about by the summer/winter PE fluctuations, but it also had to be robust enough to adapt immediately to extreme run-off from rainfall events given the mountainous catchment it serves.

The actual building of the Newcastle WwTW extension was out of the ordinary in that the extension was constructed in the Irish Sea, and both the fitting out of the new works and the refurbishment of the existing works were carried out entirely within large reinforced concrete boxes.

Initially the biggest challenge for the JV was to design and create a completely watertight area to facilitate construction and furthermore, workable systems that would protect the site given its exposed location.

The footprint of the treatment works extension and the required working area was created within a cofferdam. Initially a stone bund was formed within a geotextile envelope, being immediately protected by rock armour to protect the works from the Irish Sea's winter gales, flash floods and high tides. A sheet piled wall was then driven through the bund to cut off water flow. A battery of pumps ensured that the tidal groundwater was forwarded to silt traps for filtering before it returned to the sea.

An area of particular difficulty and risk was the sealing of the cofferdam around the existing outfall that bisected the footprint of the works extension; the outfall had been laid in bedrock considerably below low water. Due to the profile of indigenous



Construction of cofferdam Courtesy of Northern Ireland Water



The roof of the new extension is sown out with a mix of indigenous coastal seeds - Courtesy of Northern Ireland Water

rock, a very hard greywacke, a large volume was broken out from the shore side using a variety of methods, and recycled. Farther from shore, cased concrete piles were required to support the treatment works. All piling and rock breaking was carried out using in-house Dawson-Wam plant.

Civil and MEICA works being carried out within the existing structure had their own difficulties due to the confined space and subsequently unique solutions were developed. Walls and floors were cut and cored. Where large diameter pipework passed through walls, concrete thicknesses of up to 2.4m were wire-sawed and removed in sections of up to 9 tons in weight. Excavation was carried out using excavators with their cabs removed due to restricted working space, whilst pipes up to 800mm diameter were manhandled and installed using rollers and tirsors.

An added challenge to the construction and process installation was the requirement to keep the existing works live at all times and facilitate the day-to-day work carried out by NI Water operations staff. To ensure a smooth contract period the NI Water project team met weekly with NI Water staff to brief them on the planned working week and take on board any critical operational activities.

Minimising impact

The location of Newcastle WwTW, being in a coastal and mountainous catchment, presented challenges in terms of dealing with run-off and potential flash floods. Additionally, the fact that the WwTW is located next to a harbour and overlooked by many residential properties, also presented the project team with difficulties during the 18-month construction period.

As such, special arrangements were made to facilitate the construction traffic so that there was no parking in residential/tourist areas. Noise was reduced through the use of silencers fitted to machinery and the visual impact of the extension was minimised through an eco-friendly design for the roof. Public meetings were organised to provide information to the local community and various meetings held throughout the construction period to update key stakeholders on the project. An information board, regularly updated with photographs and news, kept the many passers-by abreast of developments.

'Green' roof

From the outset of the project, NI Water appreciated the high amenity value and scenic importance of the area surrounding the Newcastle WwTW and worked closely with architects, engineers and local landscape experts to develop a visually-pleasing design for the roof of the new extension.

Using a special process known as hydroseeding, the top of the new 50m-long concrete structure has been sown out with a special mix of indigenous coastal seeds to provide a soft green area, which not

only offers a more attractive view for the overlooking properties, but which also provides a natural habitat for local birds and insects.

Working with local landscape experts from the County Down area and members of the Mourne Heritage Trust, NI Water devised a low-maintenance landscape plan that would be rich in biodiversity.

The make-up of the green roof comprises a drainage layer of natural gravel topped with a thin layer of lightweight soil laid on a separation/filter membrane. Drifts of natural gravel and boulders from local gravel pits provide additional visual and ecological interest.

Increasing biodiversity

As a further measure towards improving habitats for seabirds, NI Water and Dawson-Wam/Ovivo erected nesting ledges for Kittiwakes on the seaward side of the new building and developed a resourceful system for nesting boxes out of drainage pipes and small manhole systems. These have been placed high up on the rock armour which surrounds the entire building and it is hoped that many of the Guillemots who flock to the area will make use of them as secure nesting places.

Congratulating everyone involved in the Newcastle project, Danny Kennedy, Minister for Regional Development said during a recent visit to the site:

"The Mournes area is one of the most spectacular landscapes in Northern Ireland and all efforts to maintain its beauty and eco-friendliness are to be commended. It is important to protect our valuable scenic coastline and Newcastle WwTW now blends in more with the natural surroundings."

Current situation

The project team has delivered on its key target of having the newly-extended WwTW compliant with the new directives by the end of May 2013. All civil construction work has been completed on the new extension, with remedial work continuing on repairing the concrete façade on the original, older part of the building.

Inside the new extension, testing and commissioning work is ongoing by the M&E contractor, Ovivo while the extensive improvements to Harbour and Blackrock Pumping Stations should be completed by the end of September.

At this stage Newcastle WwTW will be fully commissioned with handover to NI Water as planned in early 2014.

The Editor & Publishers would like to thank Kieran Grant, Senior Project Manager with NI Water, for providing the above article for publication.



Completed extension to Newcastle WwTW - concrete repair work ongoing to existing structure - Courtesy of Northern Ireland Water