

Ballyronan WwTW

a modern, sustainable wastewater treatment facility designed to meet increasingly stringent consents for discharging into Lough Neagh

by Caoimhe Toner, Paul McElroy & Sean Milligan

Ballyronan is a small village situated in County Londonderry, within the Mid-Ulster District Council area located on the western shore of Lough Neagh. The towns of Magherafelt and Cookstown are both approximately 4 miles to the north-west, and 11 miles to the south-west respectively. The existing Ballyronan Wastewater Treatment Works (WwTW) was constructed to cater for a design population equivalent (PE) of 571, but in 2021, it was calculated that the existing works was dealing with a PE of 1,020 and that a future PE of 1,520 was anticipated.



Existing works

The existing works comprised of an inlet chamber, a rectangular hopper-bottomed primary settlement tank, two percolating filters, a hopper-bottomed humus tank and a sludge holding tank. There was also a brick building which housed the control panel and NIE supply for the WwTW. Interstage pumping was also required to lift the primary settled flows to the biological filters.

The existing works was required to comply with a discharge consent of 40 mg/l BOD, 60 mg/l total suspended solids, and 7.5 mg/l ammonia.

Project drivers

Though the treatment process was generally in compliance with the current standard, the Northern Ireland Environment Agency (NIEA) had indicated that a new, more stringent consent would be imposed for future flows discharging to Lough Neagh. In addition, the existing works was operating beyond its capacity, many of the structures were nearing the end of their design life, and regular operator intervention was required to maintain compliance.

Since the existing works was not capable of fulfilling the requirements of NI Water's long-term strategy to enhance wastewater services, and was expensive to operate and maintain, a new treatment works was deemed essential to ensure compliance with the stricter consents throughout the design horizon.

The provision of a new fully automated rotating biological contactor (RBC) WwTW would provide effective and robust wastewater treatment services for the future catchment area, catering for economic growth (having a design population equivalent of 1,520), and improving the local environment by adhering to a tighter discharge consent of 20 mg/l BOD, 30 mg/l total suspended solids, and 7.5 mg/l ammonia.

Project team

As principal contractor, GEDA Construction had overall responsibility to deliver the project on time and within budget. Water Solutions Ireland were responsible for designing and delivering a full turnkey MEICA, process design and build solution for the new works.

Through provision of **Feasibility, Design, Project Management and Supervision Service** on NI Water's new IF182 Framework, McAdam remain an integral part of NI Water's supply chain supporting delivery of it's largest ever capital plan, protecting our natural environment and sustaining growth in Northern Ireland's economy.



Warrenpoint WwTW



Carmony to Strabane Trunk Main



Avish Water Pumping Station



Integrated Environmental Modelling
River Gauging



Meadowlane WwPS



Existing site on western shores of Lough Neagh - Courtesy of NI Water



Existing percolating filters - Courtesy of NI Water



Existing PSTs - Courtesy of NI Water



Early excavation works with compound set up - Courtesy of NI Water

McAdam provided civil, structural, and geotechnical design services, including the initial enabling and investigatory works carried out at the Early Contractor Involvement (ECI) stage, as well as the detailed design for construction.

The contract delivery team worked in a collaborative manner with NI Water, project managers RPS, and key suppliers and subcontractors to deliver a robust, effective and modern treatment solution which allows for future growth in the catchment area and protects the environment by adhering to a tighter discharge consent.

Ballyronan WwTW: Supply chain - key participants

- **Project managers:** RPS
- **Civil contractor:** GEDA Construction
- **MEICA & process designer/contractor:** Water Solutions Ireland
- **Civil, structural & geotechnical design:** McAdam
- **Electrical design:** SBE Design
- **PLC software & commissioning:** Ashdale Engineering
- **MCC:** R&R Engineering
- **Mechanical storm screen:** Jacopa Ltd
- **Static storm screen:** Eliquo Hydrok
- **6mm inlet screening:** M&N Electrical & Mechanical (Hydro International UK Wastewater Services)
- **Rotating biological contactors & primary/final settlement tanks:** KEE Process Ltd
- **Pumps & mixers:** Xylem Water Solutions
- **Instrumentation:** Park Electrical Systems
- **Flow measurement:** Siris Environmental Ltd
- **Flow measurement:** AMPM Flow & Energy Services Ltd
- **Penstocks, valves & actuators:** Flow Technology Services
- **Storm tank cleaning tipping bucket:** CSO Group Ltd
- **GRP kiosks & site-wide metalwork:** Victoria Engineering
- **10mm bar screen, skip rails & trolleys:** Graham Steelwork Engineering
- **Potable & FE service water boosters:** Dutypoint Ltd
- **Lifting equipment:** Columbus McKinnon Co Ltd
- **Access covers:** JP Corry
- **Site security fencing & gates:** NK Fencing
- **Concrete & precast products:** FP McCann
- **Pipes & fittings:** APP
- **Welfare unit:** Sean Jordan Engineering

Project description & scope

The RBC treatment process at Ballyronan WwTW was to be constructed within the same footprint of the existing site. The new treatment works was designed and built to include the following individual process stages for robust and effective treatment of incoming flows:

- A preliminary treatment process stage comprising of 6mm mechanical inlet screening and forward flow control equivalent to Formula 'A'. Any flows greater than Formula 'A' are treated via a mechanical storm screen.
- A new interstage pumping station for passing forward flows equivalent to FFT to the downstream treatment processes.
- A new storm storage and management facility, providing a total storage capacity of 81m³ for both storm and emergency flows. The storm tank is also equipped with a tipping bucket system for efficient cleaning of the storm tank floor from CSO Group Ltd.
- The interstage pumps transfer FFT to two primary settlement tanks each of 6m diameter. The primary sludge from the primary settlement tanks is drawn off by the primary sludge pumping station for transferring to the new concrete sludge holding tank.
- Primary settled flows then gravitate to the biological treatment process; three RBCs from KEE Process Ltd.

- Following treatment in the three RBCs, the treated effluent gravitates to the two final settlement tanks each of 6m diameter. The sludge from the final settlement tanks is drawn off by the humus sludge pumping station, which can either be transferred directly to the new concrete sludge holding tank or to the primary tanks for co-settling with the primary sludge, before being stored in the new concrete sludge holding tank prior to transporting off-site.
- Following final settlement, the treated effluent gravitates through a final effluent washwater transfer pumping station, prior to discharge at the final effluent outfall location.

The new Ballyronan WwTW includes a new concrete sludge storage tank sufficiently sized for 10 days' storage prior to being tankered off site.

The site-wide drainage system is segregated between storm and dirty drainage, with any dirty drainage directed to the new return liquors pumping station which transfers additional flows back to the head of the works for treatment.

The old brick building was demolished, and the new works was provided with a new GRP kiosk housing a dedicated main works MCC which controls all mechanical and electrical plant equipment and instrumentation.

As the new works had to be built within the confines of the existing site boundary, a complex construction phasing plan was developed to bring the new treatment works online in four separate stages. GEDA Construction, Water Solutions Ireland and McAdam worked closely with NI Water Operations to ensure effluent compliance was maintained throughout the individual construction phases.

Early contractor involvement

GEDA Construction was awarded an NEC 4 (Option A) Early Contractor Involvement (ECI) contract in February 2021 for a replacement treatment works at Ballyronan WwTW. To assist with the development of a turnkey design and build solution for a replacement treatment works, GEDA appointed Water Solutions Ireland as the MEICA & Process Contractor and McAdam Design as the Civil Designer to deliver both the ECI contract and construction contract.

An extensive ECI process was undertaken for the replacement treatment works at Ballyronan WwTW, which included ongoing collaboration with NI Water for design outputs and workshops such as HAZOP and Value Management. The ECI phase allowed GEDA, Water Solutions Ireland and McAdam to gain an early understanding of the key drivers for the project and achieve buy-in from all stakeholders within NI Water and their project management team from RPS to benefit delivery.

The collaborative approach between the Contractor and NI Water in the ECI contract was an exemplary reflection of NI Water values, purpose and vision. As a result, the ECI led to enhanced value, robustness and operational efficiency for the overall construction project.

MEICA & process design

GEDA Construction, in conjunction with Water Solutions Ireland and McAdam, undertook an optioneering exercise to investigate the ideal treatment solution for Ballyronan WwTW under a back-to-back NEC 4 (Option A) ECI contract. This optioneering exercise included the process design requirements of a new treatment works and the potential option of employing temporary treatment facilities to replace the existing works during construction. A full turnkey MEICA design was provided, including steelwork structural drawings and ICA documentation such as PLC architecture and Functional Design Specification for the new process.



Excavation of FSTs to depth of 5m - Courtesy of NI Water



Aerial view of construction November 2023 - Courtesy of NI Water



Construction of inlet works, sludge tank & storm tank - Courtesy of NI Water



Project team marks delivery of first RBC - Courtesy of NI Water

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Civil design

McAdam was appointed under a bespoke Professional Services Contract to GEDA Construction for all civil engineering design requirements for the ECI and was also engaged by GEDA for the construction contract. The ECI contract allowed McAdam to develop a turnkey civil design including a detailed construction sequencing plan which included the use of both temporary pipework and permanent pipework for the new structures to enable phasing.

An offline build solution was presented to NI Water as an option during the ECI phase for ease of construction and ongoing process management during construction. However, in agreement with all stakeholders, the preferred design for the replacement WwTW was constructing the new treatment works in a phased manner within the existing site footprint whilst the existing works remained operational. This approach satisfied the long-term operation and maintenance requirements for the new works and negated the need for NI Water to purchase additional land.

Main challenges for design/construction

Existing site: The key challenge around the design and construction of the new Ballyronan WwTW was building a new treatment works in its entirety within the same site boundary as the existing WwTW.

Interface between new and old works during construction: The construction of the new treatment works at Ballyronan required a continuous interface between the new and old works during construction. The new WwTW was constructed and commissioned in four individual phases.

Phase 1: Relocation of existing MCC and temporary diversion of NIE connection. The existing brick building housing the MCC was then demolished which provided the required footprint to construct two new final settlement tanks and humus sludge pumping station.

Once the new final settlement process was constructed and commissioned, a temporary diversion of flows from the outlet of the existing percolating filter beds was put in place via a temporary pumping station. This made the existing humus tank redundant and available for demolition.

Phase 2: The new interstage PS and storm tank was constructed. The existing humus tank was demolished which created space on site for constructing the three RBCs. Following construction and commissioning of the new interstage PS, storm tank and RBC process, primary settled flows were diverted to the new RBC flow splitting chamber for seeding.

At the initial stages of turning flows between the two biological treatment processes, any effluent from the RBCs was re-diverted for re-treatment through the existing filter beds to ensure effluent compliance. The effluent from the filter beds was then pumped via a temporary pumping station to the new final settlement tanks before gravitating to the effluent discharge location.

Both the effluent from the new RBCs and the existing filter beds was rigorously tested, and once the RBCs were fully seeded and proved to be treating incoming flows to the required standard, NI Water granted approval to demolish the two existing filter beds. The construction of a section of the site-wide dirty drainage and the new return liquors pumping station also took place in this phase.

Phase 3: The existing two filter beds were demolished in Phase 3 which then created sufficient space on site for constructing the two PSTs. The new inlet works comprising Formula 'A' flow control was constructed in the final phase, as was the new concrete sludge holding tank.

Phase 4: The final phase involved the construction of the two new primary settlement tanks (PSTs) and completing a successful



Bottom section of FSTs installed - Courtesy of GEDA Construction



Make up of the FSTs from KEE Process - Courtesy of GEDA Construction



RBC reinforced concrete base - Courtesy of GEDA Construction



Installation of RBCs - Courtesy of GEDA Construction

turn of flows from the interstage PS to the new PSTs. Once this was completed, Water Solutions Ireland and GEDA were granted approval to respectively decommission and demolish the existing primary settlement tanks.

The new MCC panel and kiosk were also installed in this final stage, with the entire site transferred across and commissioned as a whole. Other works included:

- The construction of the new final effluent outfall configuration which included a new outfall pipe and headwall.
- FE washwater transfer PS
- FCOM flow measurement chamber
- FE washwater booster and potable washwater booster.

At the end of Phase 4, the incoming flows were fully treated by the new RBC works at Ballyronan WwTW.

Turn of flows

As the new works was brought online in four individual phases, a complex turn of flows plan was carefully developed to ensure effluent compliance for NI Water.

GEDA and Water Solutions Ireland managed the individual turn of flow processes between the existing works and new treatment works. A rigorous on-site and external sampling regime was undertaken to regularly monitor the performance of the existing and new works. This sampling regime proved critical in allowing the site team to advise NI Water when the new RBC treatment process was fully functional and treating effluent to the required standard.

As a result, NI Water granted approval for the decommissioning of the existing filter beds. From this, the existing biological filter beds could be demolished to allow further construction to progress.

The turn of flows process, particularly from the old filter beds to the new RBCs, had to be carefully managed both hydraulically and biologically to ensure the treatment process was optimised and effluent compliance was maintained at all times.

The various turn of flow processes required both temporary gravity-fed lines and temporary over pumping lines to demolish existing structures. For example, GEDA had to lay a temporary sewer to divert flows from the existing primary tanks to the new interstage pumping station in Phase 2.

Both GEDA Construction and Water Solutions Ireland had to construct and fit-out a temporary pumping station to direct flows from the outlet of the existing percolating filter beds to the new final settlement tanks.

Commissioning

Construction work on the new Ballyronan WwTW was completed early September 2024 with site-wide testing and commissioning of the plant successfully undertaken for handover to NI Water in October 2024.

Speaking about the economic and environmental benefits of the project, Senior Project Manager, Sean Milligan commented:

“NI Water’s substantial investment of around £5m has provided a robust wastewater treatment solution for the Ballyronan area that will support local development and help improve water quality in Lough Neagh.”

The editor and publishers would like to thank Caoimhe Toner, Director with Water Solutions Ireland, Paul McElroy, Contracts Manager with GEDA Construction, and Sean Milligan, Senior Project Manager with NI Water, for providing the above article for publication.



Completed Ballyronan WwTW - Courtesy of GEDA

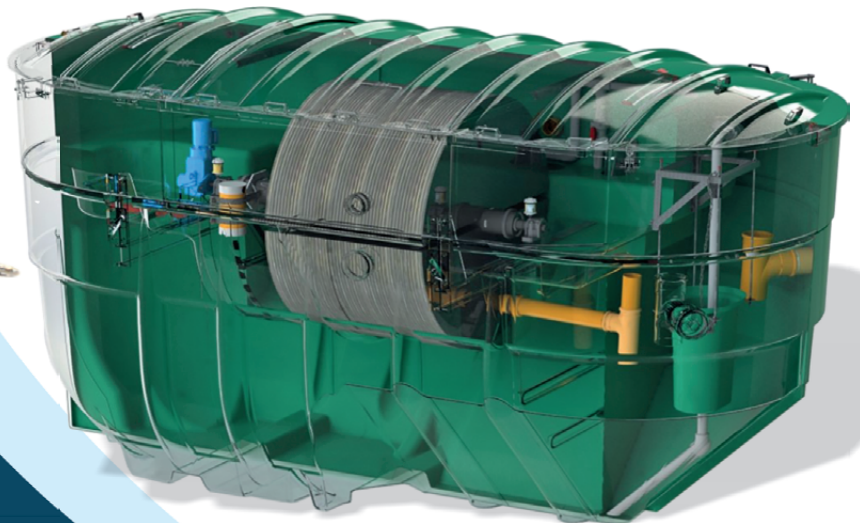
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