

Dunmurry WwTW

£5.5m upgrade to an outdated works in South Belfast to serve an increasing population and meet nitrogen and phosphorous consent conditions

by Derek Crabbe BSc (Hons)

Dunmurry Wastewater Treatment Works (WwTW) is located on the outskirts of Dunmurry Village, on the Lisburn side of Belfast City. It is located on the banks of the River Lagan, approximately 8km south of Belfast City centre. Previous upgrades were carried out in 1984 when modern inlet screening, grit plant, and storm storage were added, and in 1999, when a tertiary filtration plant and sludge dewatering plant were added to help improve the treatment and reduce the operational transport of sludges from the site. This was successfully operated for many years, but in 2009 the works failed to comply with its discharge consents and an upgrade was urgently required to meet the growing population in the area. NI Water invested £5.5 million to upgrade the Dunmurry treatment process capacity to PE 62,500 and meet the required standards. Work commenced at the site in June 2010, and was completed in June 2012.



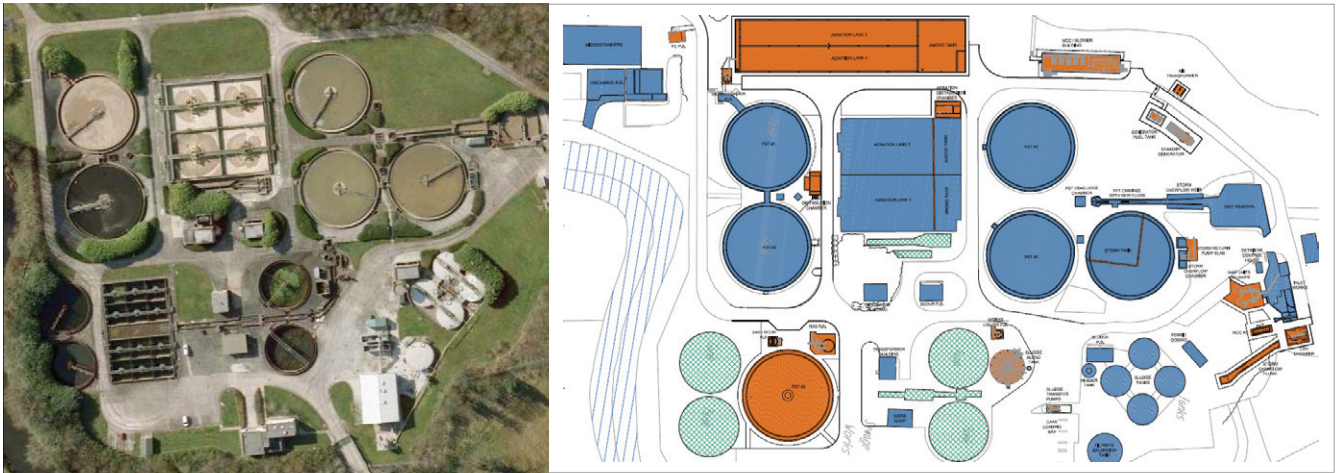
Dunmurry WwTW – Aeration tank fine bubble membrane installation - Courtesy of NI Water

Objectives/need

The old treatment works was in need of modernisation; nearly all elements of the works operation were manual or required manual intervention. The plant demanded two full time operators, with support from M&E and additional reclamation staff in order to maintain compliance. De-sludging, returning storm and general site maintenance operations were manually carried out, which resulted in significant overtime on weekends and very careful sludge management to deal with the lack of capacity. Frequently the sludge export had to be carried out after hours in order to provide sufficient space for holiday periods and planned maintenance.

This upgrade was also designed to meet new total nitrogen and total phosphorous discharge consent conditions. It will also ensure the works can meet its future full flow to treatment capacity and allow for further development in the catchments.

The works required modernisation to automate the treatment process. It required modern control functionality such as historical data recording to ensure it was compliant with the permits and licensing agreements. The new control plant shall utilise SCADA Wiscon and operator controls shall be via one of three touch screen HMIs on the site.



(Left) Aerial of original plant and (right) site layout drawing. Blue: existing plant - Green: redundant plant - Orange: new plant - Both images courtesy of NI Water

This software also allows the site manager to remote dial up to the site, and provides them with full control of any plant connected to the PLC network. This provides invaluable information for the managers when alarms occur out of hours!

Operations required a robust plant that would deliver consistent treatment for the lowest operating cost. The plant chosen was based around an activated sludge process, which was similar to the original plant and is familiar to the operators. It also provides a flexible treatment process which will treat the current flows and respond to the increased capacity demands for the area in the future. The future consent standards to be achieved are:

Parameter	95 Percentile	Upper tier limit
Biochemical Oxygen Demand	10mg/l	50mg/l
Suspended Solids	25mg/l	65mg/l
Ammonia	2.5mg/l	10mg/l
Total Phosphorous as P	n/a	2mg/l (annual average)
Total Nitrogen as N	n/a	15mg/l (annual average)

The aim of the works upgrade is to provide a treatment facility that complies with European Union legislation, and it is designed to meet these needs for South Belfast catchments up to the year 2030. Considering the projected combined population growth in the area, the works has been designed to 62,500 PE.

Solution

The existing site was selected as the obvious location to construct the upgrade, as the site benefited from all the planning requirements

to provide a WwTW. Space on the site was at a premium, and the optimum location was chosen with the requirement to carry out a substantial excavation. While this location for the main tank was on an embankment, the location still allowed for a relatively easy connection as a parallel process and negated the need for pumping or affecting the existing plant hydraulics.

The existing tanks, which were previously surface aerated, now presented the opportunity to fit fine bubble aeration, a more efficient process and more economical to operate. Additional controls were also possible and now the plant operates much more efficiently where the aeration capacity is increased to match the demand. The new aeration lane was designed in accordance with the latest research into aeration lane design. The split structure is approximately 80m long x 18m wide and 4.5m water depth. The whole structure has a capacity of approximately 5,500m³.

During the design phase, anti-floatation was identified as a particular requirement given this size of the structure and its location close to the River Lagan. Initial excavation identified a natural water table level which was 3m above the proposed finished floor. Rock tests were then carried out and rock anchoring was the proposed solution.

To anchor the tank sufficiently it required 24 (No.) anchors each 14.5m in length into the rock beneath.

The additional final tank construction was a 31m diameter tank, with a capacity of approximately 2,800m³. Tank design was a traditional conical shape, but due to the existing hydraulics and requirement to maintain gravity feed and discharge as per the existing tanks, it therefore required construction with a top water level approximately 2m below the surrounding ground level. The



Tank excavation and rock anchors - Courtesy of NI Water



Dunmurry WwTW – New aeration tank construction - Courtesy of NI Water

centre floor level was 8.3m below the surrounding ground level. The tank was also located only 80m from the River Lagan and the floor level was well below the normal river dry water level. As was the case with the aeration structure, the natural water table was only 3-4 m below the finished ground level, with a high water table and risk of floatation, the tank also required rock anchoring. This tank required 72 (No.) rock anchors, which were all 9m deep.

Other new plant additions include:

- Increased sludge blending capacity, 600m³ glass lined tank.
- Refurbishment of the existing final tank sludge scrapers and structures.
- Storm tank separation and river abatement measures.
- Return activated sludge pumping station.
- New power standby generator.
- Inlet screening conditioning and new inlet flow control and measurement.
- Final effluent recycling system, replace the potable water supply.

Final effluent recycling system

Final effluent shall be reused on the site in a plan to reduce the potable water consumption. Within the design the contractor has included a separate final effluent ring main on the site to feed plant requiring backwashing. This was specifically the inlet screenings, conditioning units and sludge plant.

Inlet works screening is the largest consumer of water on a treatment works. Backwashing demands a high pressure of clean water to be delivered to the spray bars and allows the screen to operate efficiently. At this site, similar to many NI Water sites, the objective was to eliminate potable water consumption for the process plant, so a final effluent recirculation pumping station with

automatic filtration was added to recycle final effluent and boost to approximately 6 Bar pressure to backwash the inlet screens and sludge screens as demanded.

River protection and improvements

NI Water in partnership with the Graham MWH JV has developed robust Environmental Management Plans to meet Northern Ireland Environmental Agency (NIEA) requirements. Deep excavations within this proximity of a main river can incur obstacles, but with assistance and agreement with NIEA, abstracting the water locally and discharging within their guidelines allowed the work to be progressed without significant delay. The area and depth of the two main excavations resulted in construction works well below the natural water table level, particularly at a wet time of the year. This therefore required 24-hour water drainage and was controlled using up to 4 (No.) diesel drainage pumps during the main elements of the deep work. This had to be carefully monitored and tested throughout and was under licence and discharge consent from NIEA.

Conclusion

Dunmurry WwTW is just one example of the scale of investment required by NI Water to provide cleaner rivers and in doing so, meet European standards and deliver a modern water and wastewater infrastructure. The investment is also essential to protect public health and provide Northern Ireland with a modern service comparable with that of water companies in the UK.

This design and build project has been undertaken by NI Water working in partnership with Jacobs consultant services, and the joint venture contractors Graham Construction and MWH Treatment.

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DESIGN, MANUFACTURE, INSTALLATION AND COMMISSIONING OF MATERIALS HANDLING EQUIPMENT.

CTM Systems Ltd are proud to have designed, manufactured and installed various shaftless screw conveyors for the new sludge dewatering equipment at Northern Ireland Water's Dunmurry WwTW. CTM supplied the 6 (No.) transfer conveyors which transfer the sludge cake to one of three trailer/skip filling points within the new sludge treatment building. The conveyors are due to be commissioned in Q3/Q4 of 2013.