

Budds Farm

nitrogen removal scheme

by
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Southern Water is undertaking £1.8 billion of capital schemes between 2005 and 2010. The company's contractor, 4Delivery, is carrying out a portfolio of work, including six schemes that have the common objective of nitrogen removal. The largest of these schemes is at Budd's Farm, a wastewater treatment works (WwTW) located in Hampshire on the south coast near Portsmouth which treats wastewater from both Portsmouth and Havant catchments with a total population equivalent of approximately 400,000 and an incoming flow of approximately 2,400l/s. It also includes a Sludge Treatment Centre treating both indigenous sludge and imported sludges and has a very tight programme of process conversion to achieve 10mg/l total nitrogen (TN) standard by the end of March 2008.



Budds Farm Nitrogen removal scheme

courtesy of Nick Day, Blowfish Photography

Nutrient consents

Nutrient removal in wastewater treatment normally means the removal of phosphorous and or nitrogen to levels at which eutrophication is limited in the receiving waters. Eutrophication is defined as a process whereby water bodies receive excess nutrients that stimulate excessive plant growth. This enhanced plant growth, often called an algal bloom, reduces dissolved oxygen in the water when dead plant material decomposes and can cause other organisms to die.

Where waters are defined as sensitive under the Urban Wastewater Treatment Directive (UWWTD) with respect to particular nutrients, the final effluent discharge needs to achieve 2mg/l total P and/or 15mg/l TN as annual averages for works between 10,000 and 100,000 pe, and 1mg/l total P and/or 10mg/l TN as annual averages for works between over 100,000 PE as defined by the UWWTD. Alternatively, percentage removal of 80% total phosphorus and 70-80% total nitrogen can also be applied.

The Solent, which is the area of sea between the UK mainland and the Isle of Wight, as well as harbours around the area has been designated as sensitive in regard to eutrophication. Budds Farm serves a pe in excess of 100,000 and so due to the sensitive waters designation and the UWWTD, is required to achieve a 10mg/l TN standard.

Existing process

The two flow streams from the Havant and Portsmouth catchments both undergo preliminary and primary treatment before they combine prior to the secondary treatment stage. The previous consent required carbonaceous treatment to achieve the Water Resources Act consent of 60mg/l SS and 40mg/l BOD together with UWWTR requirements of 25mg/l BOD and 125 mg/l COD. The secondary treatment was achieved using the activated sludge process (ASP). This consisted of 8 No. lanes each with an anoxic and aeration zone, with a total capacity of 32,000 m³. The flow from the lanes was combined before distribution to 8 No. 35m dia final settlement tanks (FST) as indicated in figure 1.1

Process modifications

To achieve TN reduction the existing activated sludge process was modified and expanded such that nitrification could be achieved in the aerobic zones and denitrification in the anoxic zones.

Southern Water carried out a full flow and load wastewater characterisation survey over a 12 month period that identified that the incoming flow contained quantities of nitrogen higher than the typical industry design parameter, and low levels of readily biodegradable COD (rbCOD). The rbCOD is necessary to achieve

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Gee is fully familiar with the special storage and handling requirements demanded by methanol, as it is a very flammable liquid with an unusually wide range between maximum and minimum explosive limits. To create a safe storage environment, the methanol is stored in special double-skinned tanks. Within the storage tanks, content levels are monitored by radar. At the heart of the dosing process, Gee utilises highly sophisticated chemical metering pumps. These are Signal series 300 hydraulically actuated units, fitted with pneumatic servos for automatic control of stroke length.

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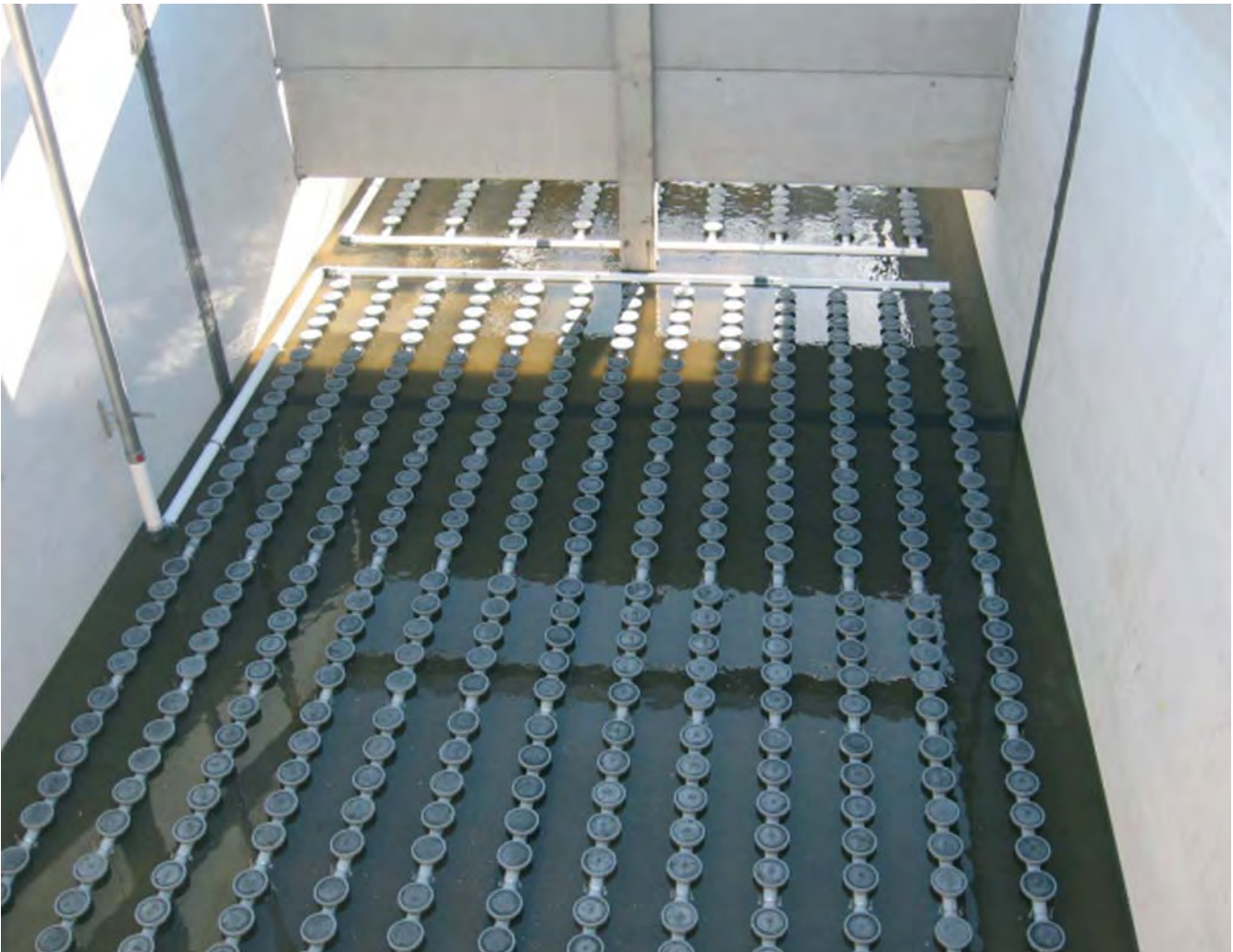


One of eight Signal S300 ATEX pumps at Budd's Farm



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Diffuser in ASP No 1, lane 1 before pattern tests

courtesy of 4Delivery Ltd

denitrification and without sufficient quantities an external carbon source is required. **For Budds Farm it was determined that methanol provided the the most cost effective solution.**

Process design

The process design approach was streamlined in order to meet programme dates and for Budds Farm a minimum sludge age of 20d was selected for nitrogen removal. This resulted in an additional ASP tank with an additional volume of 48,000m³ and an additional 2No. FSTs of the same diameter as the existing tanks.

A number of different denitrifying configurations were considered before selecting a four stage Bardenpho configuration. This process configuration is proven at full scale to work successfully and has an efficient methanol utilisation.

Application of the design

The incoming flow to the secondary process was split so that 60% flowed to the new ASP and 40% flowed into the modified existing ASPs. The existing ASP consisted of two tanks each containing four lanes. To reconfigure each existing ASP to the four stage Bardenpho process the lanes needed modification. Flow distribution was modified to feed three of the four lanes. Each of the three lanes was then refurbished with larger primary anoxic zone and aeration zones. The flow from the three lanes was then combined and diverted to flow through the fourth lane, which was configured to contain the secondary anoxic volume, mixed liquor return pumps and re-aeration zone. These modifications were also designed to enable the lanes to be refitted, put back in service in the carbonaceous mode and to then switch over to operate in the denitrification mode when the whole plant modification was completed.

A new ASP was configured to pass all of the incoming flow through the primary anoxic zones before splitting the flow into four aeration lanes, each the equivalent volume of two of the existing aeration lanes. The flow from the aeration lanes is then collected and passes past the incoming feed point. A lift pumping station recycles mixed liquor by taking a proportion of the flow and returning it to be mixed with the incoming flow. The remaining flow passes through the secondary anoxic zone and the re-aeration zone before passing on to the final settlement tanks.

To achieve these modifications to an existing works while maintaining compliance has provided lots of challenges. The site is compact with little available land for new structures and border environmentally sensitive sites. This has required the team to innovate and apply techniques in new ways and to re-use and reconfigure existing structures. Under pressure coring to construct connections onto live process units has enabled process units to operate unaffected without the traditional need to take them offline. The teamwork approach has enabled ideas to be quickly evaluated and enabled opportunities to be realised.

The project is the first time that this configuration has been applied to a site at this scale within the UK. The team has liaised closely with MWH's nutrient removal experts across the globe to gain from their extensive design and commissioning experience. BIOWIN modelling was used to further optimise the configuration and this resulted in both capital and operational cost savings.

A number of design features were incorporated within the design to ensure commissioning could be achieved and the current consent could be met. These features included the use of standby diffusers in



ASP No 1 & No 2 connecting pipe

courtesy of 4Delivery Ltd

future anoxic zones to provide aeration, configuration of new structures to act as temporary works and installations of pipeline connections to aid flow diversion.

Despite being a highly complex project with large inherent risks and tight deadlines, Budds Farm is on target to finish on schedule. Budds Farm is currently nearing the end of the construction phase and is anticipated being substantially complete this summer when the project will move into commissioning phase.

4Delivery Ltd is a consortium comprising industry leaders United Utilities, Costain and MWH, which is carrying out £750 million worth of environmental improvement schemes on behalf of Southern Water across Kent, Sussex, Hampshire and the Isle of Wight from 2005 and 2010.

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