# On-site wastewater treatment works

Treatment process overview

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ST Connect

SEVERN TRENT

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## Introduction to wastewater treatment

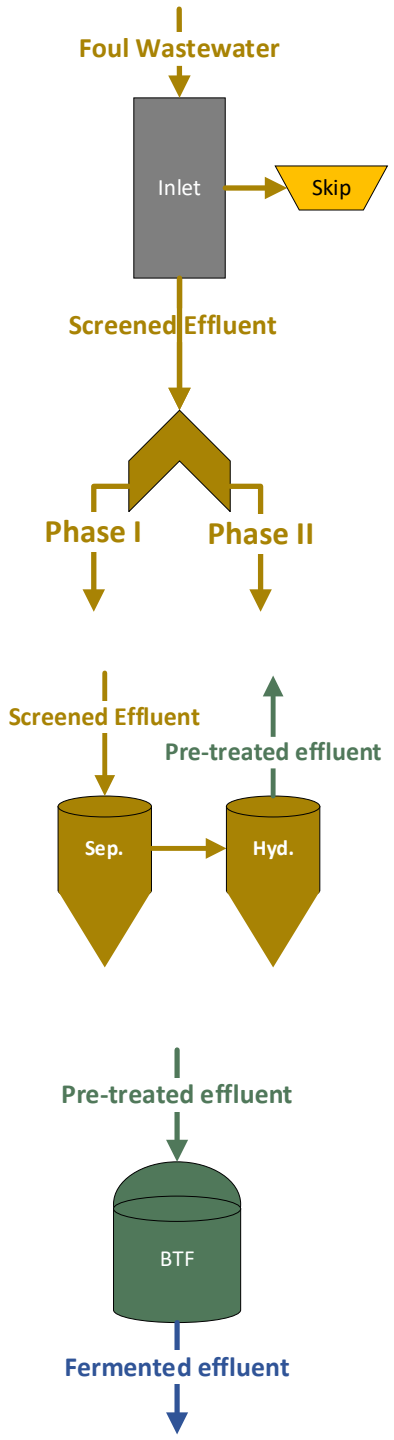
The vast majority of WwTW globally rely on traditional treatment processes which despite continuous investment and innovation often struggle to meet the more stringent quality standards which have been introduced in the last few decades. Nutrient removal in particular poses a challenge to the water sector, which is now increasingly looking for retrofit solutions to ageing treatment assets to meet these higher standards.

Whilst all wastewater treatment processes rely on physical treatment, e.g. screening and settlement, they are fundamentally biological processes utilising bacteria naturally present in wastewater. Traditional WwTW rely on the following stages:

- **Preliminary Treatment** – Wastewater arriving at the WwTW passes through the inlet works, where a series of screens remove wipes, grit, and other matter not suitable for onward treatment. This material is stored in skips and collected as required.
- **Primary Settlement (optional)** – Effluent flow is substantially slowed, allowing solid organic matter to settle out. This primary sludge makes up a large proportion of the total organic content of the wastewater. Some processes elect to skip this stage, instead removing the organic content during biological treatment.
- **Biological or Secondary Treatment** – Biological Treatment is the most crucial step in wastewater treatment, and also that which varies most across the various types of WwTW. Bacteria and other micro-organisms are cultivated within the process, feeding on organic and inorganic pollutants in the effluent. Many older WwTW lack the level of monitoring or process control to facilitate nutrient removal, not having originally been designed to accommodate for this requirement.
- **Final Settlement** – Remaining solids from Biological Treatment are settled out and removed to a storage tank or further treatment. This secondary sludge is typically of lesser volume and mass than primary sludge.
- **Tertiary Treatment (optional)** – Though many small and medium WwTW do not typically have tertiary treatment, it is becoming increasingly commonplace to meet nutrient removal requirements. Often this takes the form of chemical dosing and additional filtration to reduce Total Phosphorus levels, or additional biological treatment to reduce Total Nitrogen levels which remain after biological treatment.

## ST Connect WwTW Overview

The proposed ST Connect WwTW has been specifically designed to sustainably meet the most stringent nutrient removal standards. It utilises a Sequential Batch Reactor (SBR) process which allows for improved process control and more reliable biological treatment than traditional WwTW, whilst also greatly reducing the footprint of the plant and minimising impact on the local community. The key process stages are outlined below:




**1. Inlet flows**

Removal of gross solids and grit is carried out in a compact, covered inlet works to reduce odour and noise compared to traditional inlet works. Skips storing dry waste material typically do not cause odour issues but will be covered to further reduce impact.

**2. Flow-split / Dual-phase set-up**

The WwTW will consist of two phases, to avoid much of the site sitting idle while the development is built. This will also provide long-term resilience allowing flows to be re-routed during routine maintenance

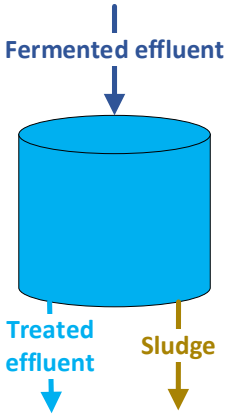
**3. Spiral Separator and Hydrolysing Tank**

This tank and the associated solid separation act as a booster for the biological process. The wastewater receives some pre-treatment to allow the microorganisms to perform at their full potential.

The pre-treated effluent is fed back into the flow split and onto the Balance Tanks / Fermenters.

**4. Balance Tank / Fermenter**

The covered Balance Tank / Fermenter (BTF) receives the pre-treated flows and stores them before passing flow to the biological reactors. During this balancing period, the BTF ferments organic material in the effluent, which creates the necessary conditions for specific microorganisms (phosphorus-accumulating organisms or PAOs) to remove phosphate during biological treatment.

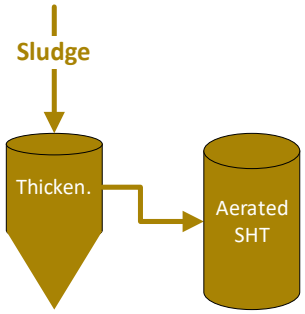



**5. Reactors**

The Reactors are the most critical assets in the process, combining settlement and biological treatment into a single tank. As they are batch reactors, they receive effluent from the BTF and fill completely before going through multiple cycles of aeration, mixing and settlement.

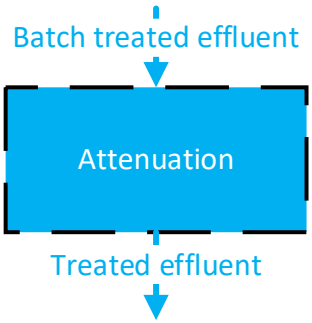
The duration and intensity of these cycles is flexible, and process optimisation with the aid of sensors, continuous on-site testing and remote telemetry is critical to ensure effluent meets the highest quality requirements at all times.

The reactors are the sole source of sludge in the SBR process, some of which is recycled to aid process performance, with the remainder being stored in the Sludge Holding Tank.



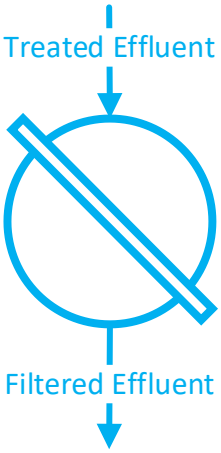

**6. Sludge Thickening and Storage**

The sludge generated by the process is thickened to reduce its volume and transferred to an aerated sludge tank. Aeration of the tank prevents excessive compaction and odour issues from septicity. The supernatant removed during thickening is returned to the inlet works for treatment. Sludge is regularly collected by a small LGV.




**7. Attenuation Tank**

To balance flows of treated effluent from the batch process, an attenuation tank receives the treated batches from the reactor before slowly releasing a steady flow to onward treatment.




**8. Tertiary Solids Removal**

To achieve the very highest level of nutrient removal, biologically inactive forms of Phosphorus, as well as any other remaining suspended solids, must be mechanically removed using fine filters, typically of a cloth-media. The filters are regularly backwashed to return the filtered solids to the inlet works.


**9. Final Effluent Disinfection**

Where appropriate, disinfection of the filtered effluent is included to meet bathing water standards. Disinfection may be chemical (Performic Acid, Ozonation) or physical (UV irradiation, ultrafiltration).


**10. Final Effluent discharge**

The final effluent flows through a sample chamber prior to discharging to the receiving water body. Volume and quality parameters are logged and continuously monitored to ensure compliance with all relevant requirements.

## Other considerations

**Odour** – Perhaps counterintuitively, the majority of the wastewater treatment process does not emit an unpleasant odour. The odour associated with sewage is in large part due to sulfur-containing compounds, the presence of which varies between wastewater catchments. These compounds are largely removed during initial settlement in the form of sludge; hence odour is usually confined to the inlet works and sludge-handling assets.
At the ST Connect WwTW, inlet works, fermenter, and sludge storage tanks are covered to minimise odour where it is most likely to occur.

**Noise** – Under normal conditions noise levels generated by the plant are low. Moving machinery such as mixers, pumps, and blowers, generate noise levels far below the threshold for operators to be able to work nearby and converse. The minimum distance between the WwTW and the nearest property, in combination with appropriate landscaping, eliminate noise pollution to the community at all times under normal operation. Frequent and regular visits from operational staff ensure that unusual noise from the machinery is rectified as quickly as possible.

**Visual** – The SBR process uses overground steel tanks, as opposed to the traditional in-ground concrete tanks. This reduces embedded carbon from construction activities and allows for more effective operation and maintenance. The height of the tanks is kept to an appropriate level, in-line with the landscaping considerations agreed with the client, to ensure that the WwTW is shielded from view of nearby residents.

**Vehicle movements** – Vehicle movements to and from the site will be restricted to:

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| • Operational visits | Small van | 1 – 2 visits per week |
| • Sludge collection | Tanker | 1 – 2 visits per week |
| • Inlet skip collection | Skip lorry | 1 visit per month |

**Further Sludge Processing** – The sludge removed from site will be disposed at a nearby sludge treatment facility to generate sustainable energy from biogas. The remaining by-product, sludge cake, is sold as organic fertiliser.