Environmental Site Management Plan

Raw Materials, Water and Waste Residue Efficiency Management Plan: Crossness STW

Using this standard

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This standard works in combination with other corporate documents including the Asset Standards, Site Operating Manuals, site Odour Management Plans, Health and Safety Standards, and regulatory permits.

Document Control & Procedures

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1 Glossary of Terms

TERM	DESCRIPTION
AD	Anaerobic Digestion
CHP	Combined Heat and Power
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EMS	Environmental Management System
EPR	Environmental Permitting Regulations
FFT	Flow to Full Treatment
ICA	Instrumentation Control & Automation
IED	Industrial Emissions Directive
OCU	Odour Control Unit
OMC	Operational Management Centre
OMP	Odour Management Plan
PFT	Picket Fence Thickener
PM	Process Manager
PS	Pumping Station
PST	Primary Settlement Tank
Receptors	Sensitive receptors are any fixed buildings or installations where odour annoyance may occur, such as residential homes, schools, hospital, offices, shops or garden centres. Open areas such as playgrounds and public footpaths should also be listed where these are known to have been affected by odour.
SAP	Thames Water's enterprise resource and planning system
SCADA	Supervisory Control And Data Acquisition
SOM	Site Operating Manual
STW	Sewage Treatment Works
TW	Thames Water
UWWTD	Urban Waste Water Treatment Directive

2 Executive Summary

In accordance with the consolidated IED Environmental Permit for Crossness; Waste BAT, specifically BAT3; and associated written management systems, this is the site management plan covering use of raw materials, water and residues. Thames Water Utilities Ltd is required to review and record at least every 4 years whether there are suitable alternative materials that could reduce environmental impact or opportunities to improve the efficiency of raw material and water use and to carry out a waste minimisation review.

The prime function of the Crossness Sludge Treatment Centre (STC) at Crossness Sewage Treatment Works (STW) is to capture the energy potential from the treatment of sewage sludges. The plant is run 24/7 due to the continuous supply of sewage received at the STW either from the surrounding catchment, or via tanker discharge.

This document forms part of the Thames Water Environmental Management System (EMS) for the permitted STC within Crossness STW.

Thames Water is committed to continual environmental improvements, including materials management, water resources and waste management. This commitment is delivered through efficient control of processes, capital investments, and environmental training.

3 Process Responsibility

The Operational Manager for the site has overall responsibility for reviewing the processes on the site that use raw materials, raw water and create residual wastes. This document is reviewed 4-yearly, but the review process is ongoing as part of the regular performance monitoring for the site.

There are many drivers for reducing use of raw materials, and creation of wastes within our processes, including environmental, financial, and resourcing, so it is in our best interests to undertake these reviews regularly, and to include representatives across the full chain of specialist teams involved in the decisions. For example, from initial procurement processes, and contractor management, through to operations, alarms, and the regular maintenance of the installation. These all work together to ensure that the processes utilise the minimum amount of raw materials/water (such as overdosing of chemicals), and that wastes are minimised (such as worn parts or broken machinery).

4 Raw Materials and Water Management

There are a limited number of raw materials used in the process. All materials used at the installation are subject to storage and handling procedures, as laid out in relevant Asset/ Essential Standard and the Site Operating Manual (SOM). There are no dusty or potentially wind conveyed materials used on the installation.

The use of raw materials is carefully monitored and benchmarked for cost reasons, and in many cases the correct quantity has to be precisely used for proper processing to take place, so there are controls in place through monitoring and optimisation of the process.

Regular maintenance of the installation, is carried out in accordance with the site's preventative maintenance programme, and the SOM. This ensures that there are minimal energy losses from worn parts, thereby maintaining its inherent efficiency.

4.1 Biogas

The principal fuel used in the installation is biogas resulting from the anaerobic digestion of sludge from the STC. There is no alternative fuel used in the Combined Heat and Power (CHP) engines as the biogas utilisation is the primary reason for the installation's existence. Biogas is stored in the Biogas Storage Holders within the installation boundary.

The heat produced by the CHP engines allows the Thermal Hydrolysis Plant (THP) and digestion processes to be optimised in order to maximise biogas production. Overall, this allows a greater efficiency in converting sludge to biogas and power. Key to maximising the energy production of the site is the consistent and predictable production of biogas from the digestion process and the minimisation of the use of electrical power in doing so.

The generation and use of power and heat from a renewable biogas source represents a positive impact with respect to global warming potential.

Biogas is also used as the primary fuel for the boiler plant with natural gas back-up. The boilers operate if there is a temperature deficit to provide steam to the THP process most of the time, and to provide supplementary heat to the digestion plant, which happens occasionally in practise.

4.2 Natural Gas

Natural Gas is used in the installation as a back-up fuel for the boilers.

4.3 Lubrication Oil

Lubrication oil used on site in the CHP engines, with the volume dictated by the operational requirements. Thames Water monitors the use of oil to increase its efficiency and reduce quantities required. The monitoring is carried out through a monthly oil analysis programme, which assesses the condition of the oil. The oil is changed if the quality is below pre-defined standards. This minimises consumption of oil as it will only be replaced when necessary. Once determined to be below standard, the oil is changed, and the replaced oil is sent for recycling off-site.

CHP engine oil is monitored for contaminants, which indicate oil performance and general engine condition.

4.4 Water

Water used on the installation is mains water, for three purposes:

- General use;
- Make up of polymer; and the
- Heating loop and boiler system.

Water within the heating loop and boiler systems are treated with dosing chemicals under the management of a specialist subcontractor. It is in closed loop system which only requires minimal top up and inhibitor chemicals addition. This is to decrease water hardness that can cause scale build up within the heat exchangers. The system is inspected for leaks, particularly where excess water has to be added to top up the system.

A review has been undertaken of water use within the site, to see if lower grade water, specifically final effluent from the works can be used to replace any potable water. Savings have been identified and implemented, for example, where water is used for washing down purposes within the site, for example if a spillage of sludge occurs, this water is final effluent from the works.

4.5 Other Raw Materials

The site Odour Management Plan gives details of contractor performance and maintenance checks, so these are not covered further here.

Table 4.1 below lists all the raw materials used on site followed by Table 4.2 that gives their composition and fate.

Table 4.1 - Raw Material List

Description of raw material and composition	Maximum storage amount (tonnes or as stated)	Annual throughput (tonnes per annum or as stated)	Description of the use of the raw material
Sludge polymer: 1. Polymer powder – Primary Sludge Thickening Flopam FO4698XXR 2. Polymer powder – SAS Thickening Flopam FO4698XXR 3. Polymer liquid – sludge thickening EM 640 HIB 4. Polymer powder – Pre THP Dewatering Flopam FO 4650VHM 5. Polymer powder – Digested Sludge Dewatering Flopam FO4698XXR	1. 10 tonnes stored in bunded silo. 2. 10 tonnes stored in bunded silo. 3. 5,000 litres in Intermediate Bulk Containers (IBCs) stored on bunds. 4. 24 tonnes stored in bunded silo. 5. 20 tonnes stored in bunded silo and 4 tonnes of 25 KG bags stored within a building.	1. 40 tonnes. 2. 40 tonnes. 3. 30,000 litres. 4. 200 tonnes. 5. 600 tonnes.	Agent used in sludge thickening and sludge dewatering processes.
Anti foam: Flofoam 681 F	3.5 tonnes stored in IBCs on portable bunds.	275 tonnes.	Agent used to control foaming within Primary Digester Tanks.
Ferric chloride 40% solution ICL 40% solution	25m^3 stored in bunded silo.	650 m^3.	Agent used to reduce odour/ H2S in biogas.
Biogas	As required.	As required.	Primary fuel for CHP engines and boilers.
Diesel: Generators WP White Diesel	724,000 litres stored within a number of double skinned fuel tanks.	48,000 litres* (used during monthly testing for six back-up generators (approx. 8,000 litres per generator per annum) but excludes fuel used from emergency use during periods of grid failure).	Fuel supply to back-up generators Monthly generator testing.
Lubricant / engine oil	7,500 litres stored in bunded oil tanks or bunded IBCs.	10,000 litres.	Equipment lubricant.

Description of raw material and composition	Maximum storage amount (tonnes or as stated)	Annual throughput (tonnes per annum or as stated)	Description of the use of the raw material
Texaco HDAX 6500 LFG Gas Engine Oil SAE 40			
Glycol coolant Texaco Delo XLC Antifreeze/Coolant - Premixed 40/60	3,000 litres stored in bunded IBCs.	8,000 litres.	CHP engine coolant.
Boiler house – sodium bisulphite Nalco 77211	300 litres in bunded tanks.	1,500 litres.	Agent used as oxygen scavenger in boiler water to achieve water quality objectives.
Boiler house – phosphate polymer Nalco Nexguard 22310	300 litres in bunded tanks	400 litres.	Agent used to reduce foaming in boiler water to achieve water quality objectives.
Boiler house – sodium hydroxide (20% solution) Nalco 77224	300 litres in bunded tanks.	1,500 litres.	Agent used to control pH in boiler water to achieve water quality objectives.
Boiler house – Salt Zoutman Softsel pluss	1 tonne in bags stored within a building.	60 tonnes.	Agent used to soften boiler water to achieve water quality objectives.
Digested sludge press – sodium hydroxide 25% Brenntag 25% solution	1,500 litres bunded tanks.	4,500 litres.	Cleaning chemical as per manufacturer recommendation.
Digested sludge press – hydrogen peroxide 35% Brenntag Product name: Hydrogen Peroxide 35-<50%	1,500 litres bunded tanks.	4,500 litres.	Cleaning chemical as per manufacturer recommendation.
Digested sludge press – phosphoric acid 75%	1,500 litres bunded tanks.	4,500 litres.	Cleaning chemical as per manufacturer recommendation.

Description of raw material and composition	Maximum storage amount (tonnes or as stated)	Annual throughput (tonnes per annum or as stated)	Description of the use of the raw material
Brenntag Product name: Phosphoric acid >=25% - <=100%			
Sludge coolers – sodium hydroxide Brenntag Product name: Sodium hydroxide solution 5-50%	10 x 25 litre drums stored on a portable bund	250 litres	Cleaning chemical as per manufacturer recommendation
Spraid Blue	10 x 25 litre drums stored on a portable bund.	250 litres.	Cleaning chemical.

Raw material use is subject to change as a result of internal procurement requirements in order to identify opportunities for change (for economic, environmental, operational resiliency and market forces). The current list reflects raw materials used at the STC at the time of writing the application.

Table 4.2 - Composition and Fate of Raw Materials

Raw Material	Composition	Fate	Viable Alternative
Polymer – dependent upon the polymer used	Polyacrylamide copolymer. Distillates (petroleum) (20-50%). Hydrocarbons, C12-C15, n-alkanes, isoalkanes, cyclics, <2% aromatics (20-30%) Isotridecanol, ethoxylated (<5%). Adipic acid (<=2.5%). Sulphamidic acid (<=2.5%).	Absorption into sludge or digested sludge cake. Leftover polymer returned to head of works via return liquors.	No viable alternative.
Anti-Foam	Polydimethylsiloxane.	Absorption into sludge. Waste product to be recycled.	No viable alternative.
Ferric chloride	Hydrochloric acid (1-5%) Iron (II) chloride (0.1 – 1%) Iron (III) chloride (40-60%). Nickel Dichloride (<1%)	Absorption into sludge. Waste product to be recycled.	No viable alternative.
Biogas	Methane (58-71% by volume). Carbon dioxide (29-44% by volume). Trace Hydrogen sulphide (50-3500 ppm concentration). Trace Nitrogen (0.05-3% by volume). Hydrogen (40-120ppm concentration).	Electrical and heat energy. Air emissions of carbon monoxide, carbon dioxide, sulphur dioxide and nitrogen oxides.	No Alternatives: CHP engines require biogas fuel.
Diesel	White diesel (100%).	Electrical and heat energy. Air emissions of carbon monoxide, carbon dioxide, sulphur dioxide and nitrogen oxides	No Alternatives: Back-up fuel for the boilers used rarely in practise.
Lubrication oil	Highly refined mineral oil (70-99% weight). Phenol, paraalkylation products (1-5% weight).	Waste – Recycled.	None known.

Raw Material	Composition	Fate	Viable Alternative
	Benzenesulfonic acid, methyl-, mono-C20-24- branched alkyl derivs., calcium salts (0.1 - <1% weight). A mixture of: calcium bis(C10-14 branched alkylsalicylate); calcium bis(C18-30 alkyl salicylate); calcium bis(C18-30 alkyl phenolate); calcium bis(C10-14 branched alkyl phenolate); lubrificating oil (C15-30) (0.1 - <1% weight).		
Glycol coolant	Ethylene Glycol (34-<80% weight). Sodium 2- ethylhexanoate (1-<3% weight).	Waste – recovery or recycling	No viable alternative.
Sodium bisulphite	Sodium bisulfite (30-<50%). Cobalt sulphate (0.01 - ,0.025%).	Recirculation through boiler which is drained occasionally to onsite effluent.	No viable alternative recommended by boiler manufacturer
Phosphate polymer	Sodium sulphate.	Recirculation through boiler which is drained occasionally to onsite effluent.	No viable alternative recommended by boiler manufacturer
Sodium Hydroxide Solution	Sodium hydroxide (20 - <25%).	Recirculation through boiler which is drained occasionally to onsite effluent.	No viable alternative recommended by boiler manufacturer
Salt	Sodium Chloride (99.9% purity).	Recirculation through boiler which is drained occasionally to onsite effluent.	No viable alternative.
Caustic soda solution	Sodium hydroxide (>=5 - <=50%)	Generally handled in a totally enclosed system and is used for cleaning chemical as per manufacturer recommendation. Diluted waste may enter site drainage and be treated.	No viable alternative.
Hydrogen peroxide	Hydrogen peroxide (>=35-<50%).	Generally handled in a totally enclosed system and is used for cleaning chemical as per manufacturer	No viable alternative.

Raw Material	Composition	Fate	Viable Alternative
		recommendation. Diluted waste may enter site drainage and be treated.	
Phosphoric acid	Phosphoric acid (>=25 - <=100%)	Diluted waste may enter site drainage and be treated.	No viable alternative.
Sodium Hydroxide solution	Sodium hydroxide (5 50%)	Generally handled in a totally enclosed system and is used for cleaning chemical as per manufacturer recommendation. Diluted waste may enter site drainage and be treated.	
Spraid Blue	Potassium hydroxide (4-6%). Primary alcohol ethoxylate (<1%).	Used product may end up in site drainage for treatment with spillages or adsorbed onto spillage media for off-site disposal.	No viable alternative.

5 Waste Gas and Water

5.1 Waste Gas Streams

Waste gases are generated in a limited number of locations within the site, primarily the air emission points associated with the biogas handling, storage and utilisation system.

Biogas comprises a mixture of approximately 40% carbon dioxide and 60% methane; with low levels of other volatile organic compounds and Hydrogen Sulphide and entrained moisture. Moisture is removed using moisture traps within the biogas handling system, so both the exact composition and volume of biogas handled at the site vary dependent upon the precise location where sampling occurs. This contains four main potential sources:

- Pressure relief valves;
- Boiler emissions;
- CHP engine stacks; and
- Flare stacks.

Pressure relief valves, if operated, will release raw biogas.

CHP engine stacks, boilers and flare stacks combust biogas, so will release primarily CO_2, and NOx with low volumes of SO_2, volatile organic compounds (VOCs) and CO.

The CHP engines and stacks are subject to routine maintenance and emission testing as per permit requirements. The emergency flare stacks are not monitored unless its operational hours exceed 10% of the year.

There are also low volume emissions from the odour control units on site, although the full composition of these is not analysed.

5.2 Waste Water Streams

Waste water is returned to the STW Works Inlet from operational areas of the site via the site’s drainage system. Waste water is then treated through the UWWTD stream. Where such transfers leave the permitted area for the digestion process, these are marked on the site plan.

Waste water arises from a number of sources within the STC. These include:

- SAS Thickening Plant Liquors;
- Picket Fence Thickener Liquors;
- Primary Sludge Thickening Plant Liquors
- Pre THP Dewatering Plant Liquors;
- Digested Sludge Dewatering Plant Liquor;
- Biogas Condensate
- OCU Waste Waters
- Boiler Blowdown;
- Site surface rain run-off; and
- Washdown for maintenance and cleaning.

The majority of surface water drainage is rainfall related, however most rainwater which falls on site is absorbed by soakaways and does not enter the drainage system.

At present, waste water returns to the works inlet are not metered or measured directly. Waste water liquor monitoring proposals will be developed in-line with the requirements of the applicable IC in the permit, draft proposals have been provided in a separate document which has been submitted to the Environment Agency. Refer to this proposal for full details.

5.3 Waste Water Drainage

Note that the drainage system at the works includes both process waters and surface water drainage within the same system. This reduces the risk of any spillages being released into a separate surface water drainage system and diverted directly to the adjacent water body. Instead, all water in the drainage system is captured and returned to the STW inlet for processing within the UWWTD stream at the site. Where drainage leaves the permit boundary, it may include waste waters from within areas of the site which sit outside of the installation permit boundary, due to the design and configuration of the drainage system within the STW.

At present, no direct monitoring of site drainage is carried out where it leaves the permit boundary, with regards to chemical composition; loading; volume or variability.. All process returns within the drainage system originate within the incoming sludge derived from the main STW flow. Sampling and analysis of waste water drainage will be developed inline with the requirements of the applicable IC in the permit. Draft proposals have been provided in a separate document which has been submitted to the Environment Agency. Refer to this proposal for full details.

6 Inventory

6.1 Water usage

At present, water usage is not metered at the site.

6.2 Biogas

Biogas production is not subject to direct measurement, due to the difficulty of measuring volumes with or without moisture content. Instead, biogas production is monitored by CHP engine output over time. Use of the emergency flares is monitored and recorded, and an allowance made for biogas based on flare capacity. Thames Water operate an ISO50001 Energy Management System, with the aim of continuous improvement. Energy reviews occur frequently, with energy performance reports being produced weekly and monthly.

As the production is dependent upon sewage inputs and flows, the volume produced in any month varies.

7 Residue Management

This section outlines the measures Thames Water take to:

- Minimise the generation of residues arising from the treatment of waste;
- Optimise handling of wastes in accordance with the waste hierarchy; and
- Ensure the proper treatment, recycling, or disposal of residues.

A residue is defined as the solid waste generated by the permitted waste treatment activity. With that definition, this document does not focus on the general wastes created from activities outside the scope of the permit, for example office buildings even if they are collocated on the same site, or on gaseous emissions from the processes. Nor does it include the solid sewage cake produced by dewatering digested sewage sludge, which is removed from site, following checks to determine its quality and adherence to appropriate requirements, and spread to land in accordance with the Sludge Use in Agriculture Regulations (SUiAR) 1989 and the Biosolids Assurance Scheme (BAS).

There are only a limited number of residue streams that require off-site disposal, treatment or recycling because this STC is co-located with Thames Water's STW.

The residues are stored within designated areas.

Oil filters and some contaminated maintenance wastes are hazardous and are, therefore, segregated from non-hazardous wastes for disposal in line with appropriate legislation.

Where waste is required to be sent offsite, it is sent to a suitably permitted facility for disposal / treatment by approved third party waste management contractors.

A Waste Management Framework Contract ensures that approved contractors have been pre-vetted and helps ensure they have the relevant expertise, competency and access to appropriately permitted facilities appropriate to each transferred waste stream. Our waste contractors will supply us with a Waste Transfer Note (WTN) and/or Waste Consignment Note (WCN) - dependant on what type of waste is being removed from site. All waste documentation for the installation is retained for the appropriate length of time at the site (two years for WTN and three years for WCN).

The residues produced by the permitted processes including management in line with the waste hierarchy and areas for potential improvement and future review are detailed in Table 7.1 below:

Table 7.1 - Residue List

Residue Type	Current Measures	In line with Waste Hierarchy	Potential Improvements
Waste lubricant oil	The quality of the oil is monitored so as to minimise its replacement. Any waste oil is recycled. Waste oil is stored in a tank within a bunded area inside the installation boundary. Off-site recovery at appropriately permitted facility.	Recycled	No improvement opportunities foreseen. Current route considered to be BAT.
Biogas condensate	Condensate is removed from the biogas lines using moisture traps. Released to site drainage and returned to works inlet for processing within the UWWTD stream.	Disposal following treatment	No improvement opportunities foreseen. Current route considered to be BAT
Oily rags, oil filters, air filters	Stored within appropriate segregated containers in the waste storage area. Disposed of (as hazardous waste) by specialist contractor.	Disposal	No improvement opportunities foreseen. Current route considered to be BAT.
Filter media from OCU	Removed from OCU during servicing for regeneration.	Recovery	No improvement opportunities foreseen, as returned to manufacturer for

Residue Type	Current Measures	In line with Waste Hierarchy	Potential Improvements
	Off-site recovery at appropriately permitted facility		refreshing. Current route considered to be BAT.
Siloxane filters	Siloxane media is regenerative, reducing disposal requirements. At end of life, media is removed from siloxane filter unit during servicing. Off-site recovery at appropriately permitted facility.	Recovery	No improvement opportunities foreseen, as returned to manufacturer for refreshing. Current route considered to be BAT.
Grit and screenings from digester cleansing	As much grit and screenings as possible are screened out during earlier processes (outside the scope of this permit) to minimise that entering anaerobic digestion process.	Grit: Landfill Screenings: Landfill	No improvement opportunities foreseen. Current route considered to be BAT. Grit / screenings fate reviewed on a periodic basis to identify alternative routes for this waste stream.

8 Summary and Recommendations

Currently, there are no additional techniques or raw material alternatives known, which could be implemented on site to reduce environmental impact or improve the efficiency of raw materials or water usage.

Where raw, potable, water can be replaced with lower grade water on site, for example for washing down small spillages, this has already been implemented.

Due to the small number and type of residue streams, there was very little scope for further reduction of those generated on site.