Gilston Park Estate

North of Harlow

8 - Sewage Treatment & Drainage Strategy

places for people

May 2014

AECOM Water Places for People December 2013

GILSTON PARK ESTATE

Sewage Treatment and Foul Drainage Strategy

Prepared by ..... Checked by: .....

Approved by:

Foul Drainage and Sewage Treatment Strategy

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Rev A	Updated	BDF	KS	18/02/2014
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Capabilities on project:
Water

Introduction

AECOM has been instructed by Places for People (PfP) to develop a strategy for the drainage of the proposed Gilston Park Estate residential development to the North of Harlow. The primary objectives of the strategy include establishing a viable system of foul water drainage to allow future development as part of the Planning process.

Places for People (PfP) have indicated that they wish to deliver homes that will meet Level 4 of the Code for Sustainable Homes potable water demand of 105 l/hd/day as a minimum, which can be achieved through the use of rainwater harvesting and low flow appliances.

The Rye Meads Water Cycle Strategy highlights the requirement for upgrades to the Water Treatment Works, but these are not planned within the current AMP period. The uncertainty associated with the environmental and capacity constraints of the sewerage network and Rye Meads Sewage Treatment as identified in the above reports, to accommodate the planned growth in the whole region, coupled with the need for a reliable source for non-potable water to reduce potable water consumption to 80-105 l/hd/day, has led to the selection of on-site local sewage treatment as the preferred option for Gilston Park Estate.

The other benefits of a local treatment as opposed to regional treatment at Rye Meads are as follows:

- Local sewage treatment works would avoid the need for the construction of a new sewage pipeline to Rye Meads (as far as the Gilston Park Estate is concerned);
- Local treatment and disposal of treated effluent could assist in replenishing the local aquifer;
- Development of the local infrastructure would be more flexible and able to cope with dispersed phased growth throughout the site over the anticipated 16 year construction period;
- Provision of an additional flow to local water courses would be of particular benefit during dry summer periods;
- Sludge from the treatment works could be digested and become a source of biogas;
- Enhance public understanding of issues related to sustainability and the water cycle.

At a meeting on 15th December 2009, the Environment Agency was supportive in principle of local treatment with the proviso that the effluent will not have a detrimental effect on the local streams, which would be the subject of more detailed design and specification. This strategy was also discussed in the meeting with the EA in 2013.

Foul Drainage Strategy

The proposed foul water regime is shown schematically on Figure 1 below, which illustrates the proposed water network systems for the cycle of water from domestic use.

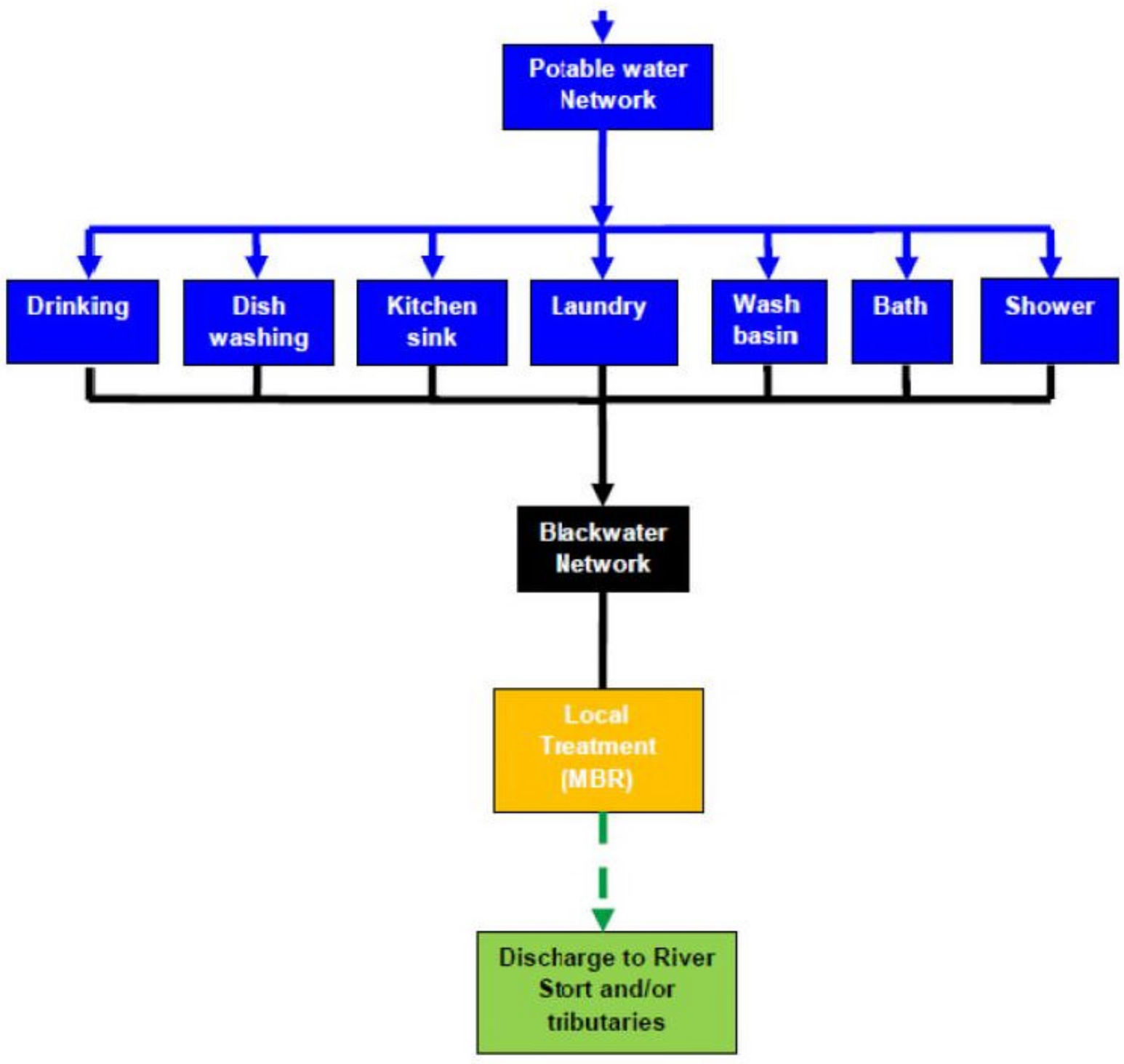


Figure 1 – Foul water Regime Schematic

The proposed sewage treatment and foul drainage strategy will include:

- Collection of sewage using conventional foul drainage system, designed and built to adoptable standards
- Treatment of sewage using strategically positioned local treatment plants using membrane bioreactor (MBR) technology
- The ability to re-charge the system from the sustainable drainage system to dilute foul water flows as required
- Discharge of treated effluent to the local watercourses/ tributaries or direct to the River Stort

The proposed site foul water drainage strategy consists of gravity sewers draining to local sewage treatment plants that serve defined catchments. The local sewage treatment works will be sited at strategic locations to suit

topography. Foul water would be collected from individual properties and drained to the local treatment work for treatment. The treated water is disinfected and pumped back via a non-potable water network to the properties within the catchment for non-potable water use including toilet flushing, irrigation and fire fighting. Surplus treated water would then be discharged to the local watercourses with approval from the Environment Agency.

Approximate locations of the proposed sewage treatment plant are indicated on the Concept plan (No. 60102629/SK/001A), included as Appendix A.

Treated Water Quality

Foul Sewage Treatment

The selection of the most suitable local treatment plart is environmentally governed by the quality of treated discharge. Effluent standards are set based on a number of EU directives including Water Framework Directive, the Urban Wastewater Treatment Directive and Bathing Water Directive. These standards have specific objectives and are aimed at protecting the Environment and human health.

It is the duty of the Environment Agency to safeguard the quality of the Environment and is responsible for issuing consents to discharge to watercourses, which impose restrictions.

Current studies carried out by the Environment Agency indicate that the following treatment parameters are to be imposed for effluent discharge from the local treatment to protect the environment and that the development should aim to achieve these.

(i) BOD: 5 mg/l;

(ii) Ammonia: 1 mg/l;

(iii) Phosphorus: 1 mg/l.

The EU Water Framework Directive requires control of nutrient inputs to rivers in order to improve river water quality and protect biodiversity. High nutrient level can promote excessive plant growth (eutrophication) which could be damaging to the ecosystem. The major sources of nutrient entering rivers are sewage effluents and agricultural runoff. Current studies indicate that sewage effluents with detergents etc, may contribute more than diffuse sources. Gilston Park Estate is predominantly agricultural land and the nutrient rich runoff from this enters the River Stort. Development of the Gilston Park Estate is likely to change the way nutrients enter the river from diffuse agricultural run-off to point sources from local sewage treatment works. This enables easier control and removal of concentration of nutrients to an acceptable level. The Gilston Park Estate development would therefore provide the opportunity to improve the ecology of the river.

The discharge consents set by the EA are tight and there might be a need to add some precipitating chemical to ensure that the phosphorus limit is consistently met, although current MBR processes are capable of meeting these levels. An MBR activated sludge process could be configured for nitrification and biological phosphorus removal to be able to meet the standard suggested.

The current Water Bathing Directive (76/160/EEC) is in the process being replaced by a new directive (2006/7/EC). The new directive is implemented in stages until 2015, by which time it will become mandatory. In the UK, compliance is currently based on the following two parameters:

- A maximum of 10,000 total coliforms per 100ml of water
- A maximum 2,000 faecal coliforms per 100ml of water

The new directive sets higher standards. The two parameters that will apply from 2015 and their limits are:

	Excellent	Good	Sufficient

1. Intestinal enterococci (cfu/100 ml	200	400	330
2. Escherichia coli (cfu/100 ml)	500	1 000	900

The UK has aimed to change the monitoring standard by 2012 with the aim of achieving the higher standards by 2015.

Treatment Plant Selection

Proven technology, installation and efficiency suggests that membrane bioreactor (MBR) plants be adopted for Gilston Park Estate rather than a conventional activatec sludge plant. The MBR plant provides smaller footprint than a conventional activated sludge plant and MBR technology is also modular so that the overall plant can be sized to meet the required treatment capacity as the development is built out over time, with units provided in phases. The technology can treat to a very high level quality effluent and can meet the future statutory requirements. MBR plant can be designed with long sludge age to achieve low sludge production. However, an MBR plant is more energy intensive and requires highly trained personnel to run the plant.

An MBR plant system provides for the biological oxidation of the organic material dissolved in sewage and the separation from the resultant slurry of a relatively clean liquid (with or without tertiary liquid/solid treatment). The excess solids created by the oxidation process can then be easily removed for subsequent treatment. It is a continuous process, and one that is quite easily controlled, and is rapidly becoming the best available technology (BAT) for waste water treatment.

The sludge settlement stage of the conventional secondary process is a fairly slow one, so the removal of the clear liquid from the slurry is a better option, and results in a cleaner liquid, because of the membrane filtration, at least to microfiltration standards, and quite commonly to those of ultra filtration.

A major advantage of the MBR system is that it can operate at a much higher solids concentration in the bioreactor than that of a conventional activated sludge plant. The MBR plant can work effectively at MLSS (mixed liquor suspended solids) concentrations typically in the range 8000 to 12,000 mg/l (or 0.8 to 1.2%), and has been demonstrated successfully at up to 3%, whereas conventional activated sludge plants work at about 2000 to 3000 mg/l, because of the limitations on settling. This higher slurry concentration permits effective removal, not only of dissolved organic material but also of residual particulate solids.

This high sludge concentration capability enables an MBR system to deal effectively with strong industrial wastes, especially in places where water is short, and factories are seeking to close their water cycles.

The cost of an MBR plant for secondary processing is still higher than that for a conventional plant, but as the numbers of MBR plants increase, and as membrane costs fall, the life cycle cost differential will soon disappear, and the process advantages should lead to rapid uptake of the MBR system by the waste water treatment industry. The smaller footprint of an MBR plant will make it much more attractive for construction in developing urban areas.

The construction of the MBR works will be to agreed adoptable standards, and will be so designed to ensure that connection to a future public trunk sewer can be made in the future.

MBR Layout and Locations

A typical layout of an MBR works plan to treat wastewater flows from residential units (60102629/SK/202) and a process flow schematic for an MBR facility (60102629/SK/203) are included in the appendices.

At this stage, it is estimated that four MBR Works will be required for the development of circa 10,000 residential units and associated local retail, community, educational and commercial uses. It is estimated that each MBR would be designed to accommodate peak design flows in the range 56 – 130 l/s, which do not include any

allowance for water saving consumption reduction measures or the potential for implementation of re-use options.

The MBR works will be located in the following locations, dependent upon final development land use designation:

- North of the A414 at Gilston
- North of A414 at Eastwick near Eastwick Brook
- North of the A414 to the west of Eastwick
- North of Gilston Park adjacent to Fiddlers/Golden Brook

These locations are shown on the Concept plan (No. 60102629/SK/201), included in Appendix A

Design Objectives

Foul Drainage System

The design objectives for the strategic foul drainage system will be:

- Protection of public health
- Protection of receiving water and treatment works from hydraulic overloading and adverse environmental effects
- Protection of groundwater
- Provision for the local recharge of aquifers, if significant
- Provision of necessary capacity, durability and satisfactory operation and maintenance
- Prevention of nuisance through odour emission

Design Principles

The foul drainage strategy utilises the topography and the layout to minimise the depth of sewers and numbers of pumping stations to reduce capital and long-term operating and maintenance costs. It is proposed that at each MBR works there will be one pumping station that distributes treated water to the main development areas for re-use.

The foul water drainage system will be designed as a separate gravity and rising main network to adoptable standards in accordance with the latest edition of Sewers for Adoption and Thames Water requirements and will integrate with the surface water systems to provide an in:egrated surface and foul water management strategy for the Gilston Park Estate.

The foul catchments will be designed to limit the maximum depth of inlet pipes to local treatment works and pumping stations to approximately 6.0m.

The minimum gradients adopted will be 1 in 500 for the main strategic foul sewers, subject to achieving minimum self-cleansing velocities at ⅓ design flows in accordance with the requirements of Sewers for Adoption (7th Edition).

The minimum depths to pipe soffit will be set generally at 1.2m, although at the head of public foul sewers a depth of between 1.5 – 2.0m has been assumed to allow for incoming drains from individual development plots.

Other factors affecting final layouts may be protection of water abstraction zones; layout and use of buildings; planning and coordination of utility services; construction and construction cost implications; existing, planned or future development within or outside the site; provision for phased construction and occupation and levels of receiving waters and groundwater levels.

Design Flows

In preliminary design flow estimation and final design the following flow rate multipliers for respective land uses have and will be used:

- Residential Units: Sewers for Adoption, design flow of 4000 litres/dwelling/day which is based on a peaking factor of 6 x dry weather flow (DWF) +10% infiltration. It may be possible to negotiate a reduction with Thames Water in the design flow to 4 x DWF as the Gislton Park Estate is a major development where dampening of flows is more marked within the typical diurnal pattern.
- Land Use B1 (Employment Areas/Offices): DWF = 750 l/day per 100 sq.m over a 24 hour period.
- Land Use B2 and B8 (Manufacturing Units): DWF = 550 l/day per 100 sq.m
- Mixed Use/Local Centre: DWF = 400 l/day per 100 sq.m
- Schools: DWF = 80 l/hd/day
- Design flow rates for other uses, i.e. hospitals, will be based on specific numbers of employees and visitors, special activities and special needs.

Based upon the current masterplan, it is proposed that the sewage arising from development will be treated as follows:

TW1 serves Villages 1&5 – total combined units = 2599;
TW2 serves Villages 2 & 3 – total combined units = 2829;
TW3 serves Village 4 – total units = 1940;
TW4 serves Village 6 – total units = 1213.

From this, the anticipated flows will be:

- TW1 - 18l/s – discharging to pond 30;
- TW2 - 19.6l/s – discharging to pond 20;
- TW3 - 13.5l/s – discharging to pond 7;
- TW4 - 8.4l/s – discharging to pond 38

Currently, Sewers for Adoption standards do not take into account the high density development with relatively low occupancy. Hence, the impact of these scenarios can be explored in future design stages with the potential to reduce design flows, sewer sizes and construction costs.

Regulatory Requirements and Drivers

The following documents form the regulatory requirements and drivers for the Gilston Park Estate with respect to adoption, pollution, water quality, drainage planning and drainage specification

Sewers for Adoption (Edition 7 – August 2012):

Sewers for Adoption 7th Edition was updated in August 2012. Defra published the Protocol, Design, Construction and Adoption of Sewers in England and Wales. The aim of this was to ensure that sewers would be built to a standard which would not preclude future adoption by a Water Company.

Pollution Prevention Guidelines (PPG4): - Treatment and disposal of sewage where no foul sewer is found (July 2006 Environmental Agency (EVNA))

Environmental Protection – Treatment and disposal of sewage where no foul sewer is found (EVNA) was published in July 2006.This document is a guide to help choose the right option of treatment and disposal of sewage where no foul sewer is found by explaining what treatment and disposal methods are available, maintenance requirements of the chosen system and basic legal requirements.

Urban Waste Water Treatment Directive (91/271/EEC) May 1991

The objective of this directive is to protect the water quality of watercourses from the adverse effect of sewage discharges. It was adopted by European Union member states in May 1991. The directive sets the required levels of treatment depending on the volume of discharges and sensitivity of receiving watercourses.

Drain and Sewer Systems Outside Buildings

BS EN 752: 2008 (incorporating corrigenda October 2009 and November 2013)

This European Standard sets out the requirements for gravity drain and sewer systems from the point where wastewater leaves a building, roof drainage system, or paved area, to the point where it is discharged into a wastewater treatment plant or receiving water. This standard will be used during the detail design stage. This standard replaces BS 8301.

Water Quality: Sewage treatment in UK: Sensitive Areas (DEFRA) was published in Sept 2007. This document describes what is classed as a sensitive area in the UK with regard to sewage treatment. It explains that additional treatment is needed before urban waste water can enter into identified sensitive water bodies.

Sewage Load

B.S.EN 752 (Drain and Sewers Systems outside Buildings, Building Regulation Part H together with 'Sewers for Adoption' set out requirements for design and specification of sewer and drainage systems in the UK.

Operation and Maintenance

The effective operation and maintenance of a local sewage treatment works and as much of the foul drainage system by others is essential. The design and construction of strategic sewers, pumping stations, rising mains and associated drainage structures for development parcels will be adopted by Thames Water under agreement, as long as the works are in accordance with Sewers for Adoption and connect to a public sewer.

It is therefore anticipated that an agreement can be reached with Thames Water to build, finance and maintain the sewage infrastructure and therefore would adopt and be responsible for operating and maintaining all major water infrastructures for the Gilston Park Estate.

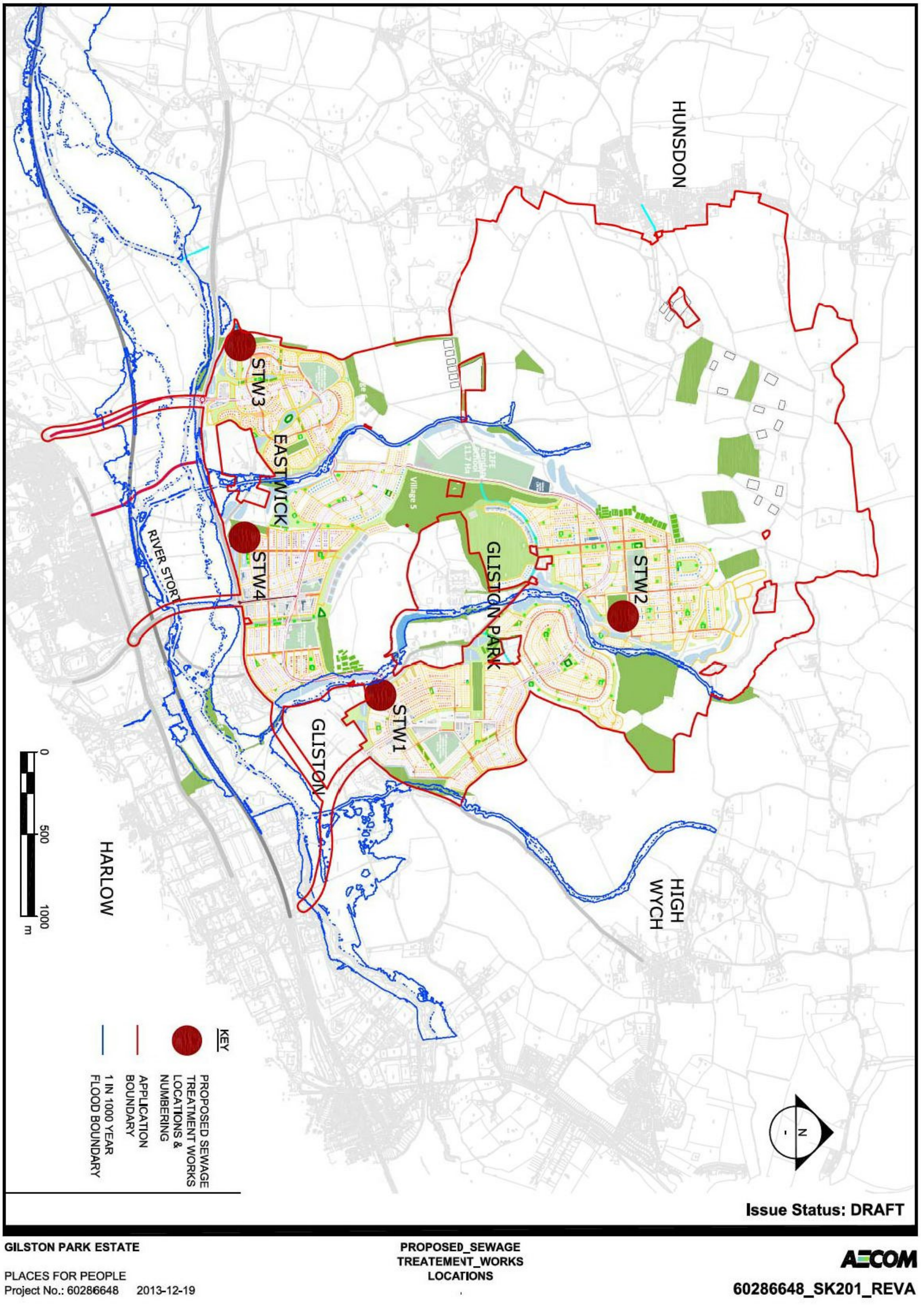
If an agreement is not met, it will be the intention that Places for People will engaged with a management company to operate and maintain the infrastructure.

Suggested follow up Actions

- Continue to liaise with Thames Water (Veolia) to obtain agreement in principal to the future adoption and maintenance of the strategic foul drainage infrastructure.
- Continue to liaise with the Environment Agency on all relevant water-related issues.

Appendix A: Plan 60102629/SK/201 – SEWAGE TREATMENT WORKS LOCATIONS

Project Management Initials: Designer: BDF Checked: KS Approved: KS ISO A3 297mm x 420mm



Issue Status: DRAFT

GILSTON PARK ESTATE

PLACES FOR PEOPLE
Project No.: 60286648 2013-12-19

PROPOSED_SEWAGE TREATEMENT_WORKS LOCATIONS

AECOM

60286648_SK201_REVA

Appendix B: Plans 60102629/SK/202 – STW TYPICAL LAYOUT FOR PROPOSED TREATMENT WORKS & 60102629/SK/203 – WASTEWATER TREATMENT WORKS PROCESS FLOW SCHEMATIC

Last saved by: FYFEB(2014-01-23) Last Plotted: 2014-01-23 Project Management Initials: Designer: BDF Checked: NW Approved: KS ISO A4 297mm x 210mm
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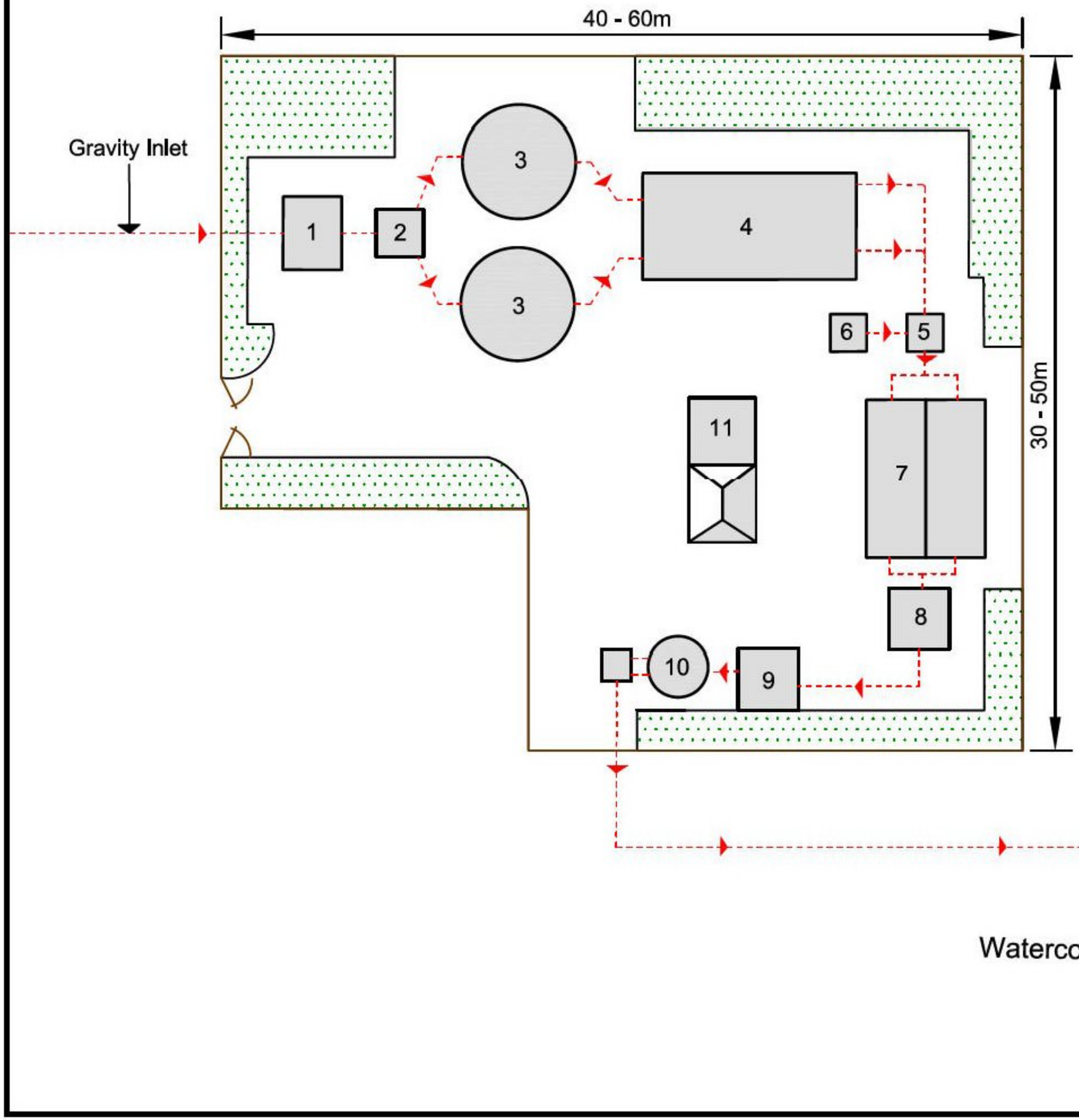

MBR TREATMENT WORKS TYPICAL LAYOUT

LEGEND:

1. SCREENING CHAMBER
2. PRIMARY FLOW SPLITTER
3. PRIMARY CLARIFIERS
4. AERATION BASINS
5. SECONDARY FLOW SPLITTERS
6. ODOUR CONTROL DOSIN CHAMBER
7. MBR TANK
8. SAND FILTER (OPTIONAL)
9. DISENFECTION CHAMBER
10. PUMPING STATION
11. CONTROL ROOM / STORE

ISSUE_STATUS:DRAFT

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6026648_SK202

MBR_WASTE_TREATMENT_WORKS
TYPICAL_LAYOUT_FOR_PROPOSED
TREATMENT_WORKS_COMPOUND

GILSTON-PARK-ESTATE

PLACES_FOR_PEOPLE
PROJECT:60286648 2013-12-19

Last saved by: FYFEB(2014-01-10) Last Plotted: 2014-01-13
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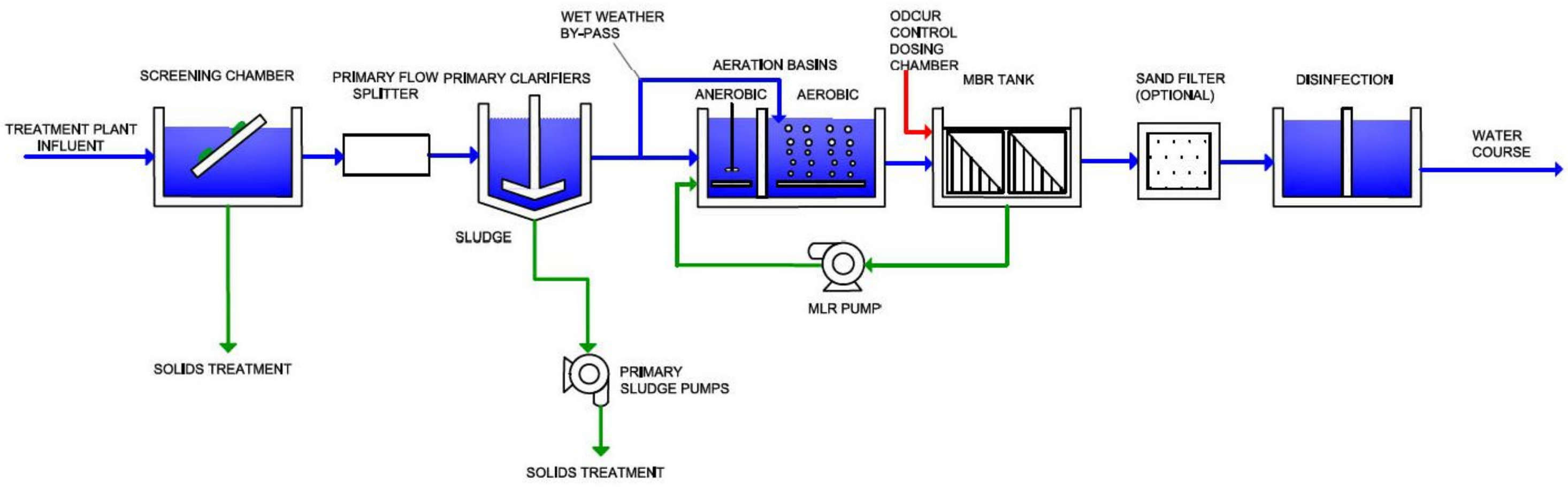
Project Management Initials: Designer: BDF Checked: NW Approved: KS ISO A4 297mm x 210mm

LEGEND

- SOLIDS HANDLING
- LIQUID STREAM
- CHEMICAL STREAM
- MLR MIXED LIQUOR RETURN



ISSUE_STATUS:DRAFT

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60286648_SK203

MBR_WASTEWATER_TREATMENT
WORKS_PROCESS_FLOW
SCHEMATIC_USING_MEBRANE
BIOREACTOR_FACILITY

GILSTON-PARK-ESTATE
.
PLACES_FOR_PEOPLE
PROJECT:60286648 2013-12-19

Appendix C: Correspondence

From: Keen, Rachel [mailto:rachel.keen@environment-agency.gov.uk]
Sent: 16 December 2008 17:05
To: Sweetnam, John C
Subject: FW: Harlow North - Sewage Treatment Works
Importance: High

Dear John

Hopefully you have now had a chat with Dan Bicknell about the Water Cycle Strategy and this will have confirmed point 1.

Point 2.
Modelling on this particular scheme has not been carried out on a Regional Level to date. A proper modelling study can take some time to complete and cannot always be turned around in just a matter of days. We would need to be given adequate information and evidence in order for us to be able to carry out this for any new development and be given fair warning to complete the work to a standard we are satisfied with.

We have carried out a very basic model to give an indication of the discharge consent limits that would be required directly in the Stort. These are not set in stone and could be subject to change if a consent is applied for and by any new direction from the Water Framework Directive (see comments below re SSSI's).

The discharge consent limits that the developer should be aiming to meet are as follows:

5mg/l BOD, 1mg/l Ammonia and 1mg/l Phosphorus.

These represent the current Best Available Technology fgures for Sewage Treatment works.

The Stort is a BAP Chalk Stream. Early indications from a sampling point near Burnt Mill would indicate that the current Phosphate levels are well above the current suggested levels under the Water Framework Directive limits set by UKTAG. We do not yet know what our policy will be on allowing further discharges into waterbodies that are not meeting "good" status is. It may be that we could object to them. Ideally we would recommend that some sort of catchment Phosphorus analysis should be completed.

We would like to stress that we are currently trying to reduce Phosphate in the Stort and will be carrying out ongoing investigations into how best we can achieve this.

An in-depth study into the impact of any proposed works on Hunsden Mead and Royden Mead SSSIs would be needed. Ideally these sites require inundation to bring them into favourable condition.

The Stort is partly a navigation. These sections of the river system are managed for level rather than flow. This will have implications for any discharge because of the lcwer velocity of flow. Discharge really needs to be into the river Stort within a stretch that is less affected by the navigation.

I hope you find these comments of use. Please contact me if you have any queries with this. I have received the next set of information from Simon and I shall send these round for comment. I am highly unlikely to return a response before Christmas, however it may be useful to have a meeting in the New Year to discuss all of the issues to date, and a likely timetable for future input,

Regards

Rachel

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Planning Liaison
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