Best Available Technique Assessment

Colt Hayes L4 Data Centre

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APPENDICES

1.0 INTRODUCTION

This Best Available Technique (BAT) assessment has been prepared by HDR on behalf of the operator Colt data centre Services Limited (Colt) in support of the application for a new bespoke Environmental Permit for the Colt Hayes L4 data centre located at:

Beaconsfield Road,
Brook Industrial Estate,
Hayes, London
UB4 0SL (TQ 11533 80192)
(Colt L4 Hayes)

Colt, as the legal operator, is required to apply to the Environment Agency (EA) for an Environmental Permit because the total thermal capacity of the site's emergency back-up combustion plant exceeds the 50MW threshold stipulated in the regulations[1].

At the time of writing, the installation is not yet operational, with commissioning planned to commence in 2025 through to 2027, pending receipt of the Environmental Permit or permission to operate from the EA.

For a detailed description of the data centre site and surrounding area, please refer to the Environmental Risk Assessment (ERA) and Non-technical Summary (NTS) submitted as part of the application for a permit.

Colt currently holds an environmental permit for its site in Welwyn Garden City (ref: KP3139DW) and is in the process of obtaining a second permit for the Colt site in Park Royal, north west London (ref: DP3107LF). Colt is fully committed to operating in accordance with the relevant permit conditions and demonstrating best practice within the data centre sector.

1.1 Purpose of this report

It is a requirement that the operator demonstrates how they comply with the indicative BAT requirements, with assessment to be completed as part of the application for an environmental permit. 'Techniques' include both the technology used and the way the installation is designed, built, maintained, operated, and decommissioned.

At the time of writing there are no relevant published BAT reference documents (BREF notes) for Data Centres. The previous guidance document: 'Combustion Activities (EPR 1.01)' was withdrawn in August 2018. To replace this, the EA have produced a working draft BAT guidance document specifically for Data Centres: 'Data Centre FAQ Headline Approach v21' (November 2022). This BAT assessment is structured using this guidance document and seeks to provide evidence of BAT or justification where the requirements have not been met.

Note: Each individual Emergency Standby Generator (ESG) is significantly below the threshold of 15MWth for large combustion plant. Therefore, the BAT requirements for large combustion plant are not relevant for this installation.

[1] The Environmental Permitting (England and Wales) Regulations 2016 (as amended)

2.0 SITE SUMMARY

We have presented a high-level summary below. Please refer to the Non-technical Summary (NTS) document submitted with the application for a non-technical introduction to the installation and the application for a permit.

Colt L4 Hayes (L4) is the development of a data centre, following the demolition of existing buildings and the construction of x2 five-storey buildings. The data centre campus will see the construction of x2 data hall buildings, with associated office spaces, emergency generators, fuel systems and electrical infrastructure. The location of the generators, tanks and installation boundary can be seen in Figure 1 and Figure 2.

The data centre will use Emergency Standby Generators or 'ESGs' to provide emergency power in the event of grid electrical failure. As per Table 1, the current plans are for the installation of 44 no. ESGs over two buildings across two phases as shown in Figure 3.

The generator models Colt has selected are as follows with further details:

- 17no. 2.4MWe Rolls Royce MTU DS3100 (6.4MWth each).
- 27no. 2.6MWe Rolls Royce MTU DS3600 (6.4MWth each).
- Total: 44no ESGs, 282MWth

At present, the generators for Building 2 are still to be confirmed. It is likely that the design will be similar to Building 1, with 2.4MWe generators on the intermediate floors and 2.6MWe on the roof. The number will depend on final IT capacity of Building 2. To be conservative, the application assumes all the Building 2 generators will be 2.6MWe.

All the ESGs due to be commissioned are over 1MWth and are therefore classed as new 'Medium Combustion Plant '(MCP). These ESGs are 'limited hour MCPs', as they are purely standby plant that will operate less than 500 hours per year and there is no capacity agreement in place. More details can be found in the Thermal Schedule and Non-technical Summary submitted with the application.

The operation of the ESGs is likely to be limited to monthly/annual maintenance and testing of approximately 20hrs/year/ESG. The ESGs can operate on diesel or biodiesel (such as 'HVO' or Hydrotreated Vegetable Oil).

The Directly Associated Activities (DAA) include the 160kW life safety generator, fuel storage tanks, Urea storage tanks, associated pipework, and the drainage network.

Table 1 – Summary of MCP details

Location	MCP type	Rating (MWe)	No. of ESGs	Thermal capacity (MWth)	Install date
Building 1	New	2.4MW	17	109.19	Q3 2025 – Q4 2028 (planned)
	New	2.6MW	5	32.16	Q3 2025 – Q4 2028 (planned)
Building 2	New	2.6MW	22	141.52	Q3 2028 – Q1 2030 (planned). This is TBC, as noted above
		Total	**44**	**282.87**	

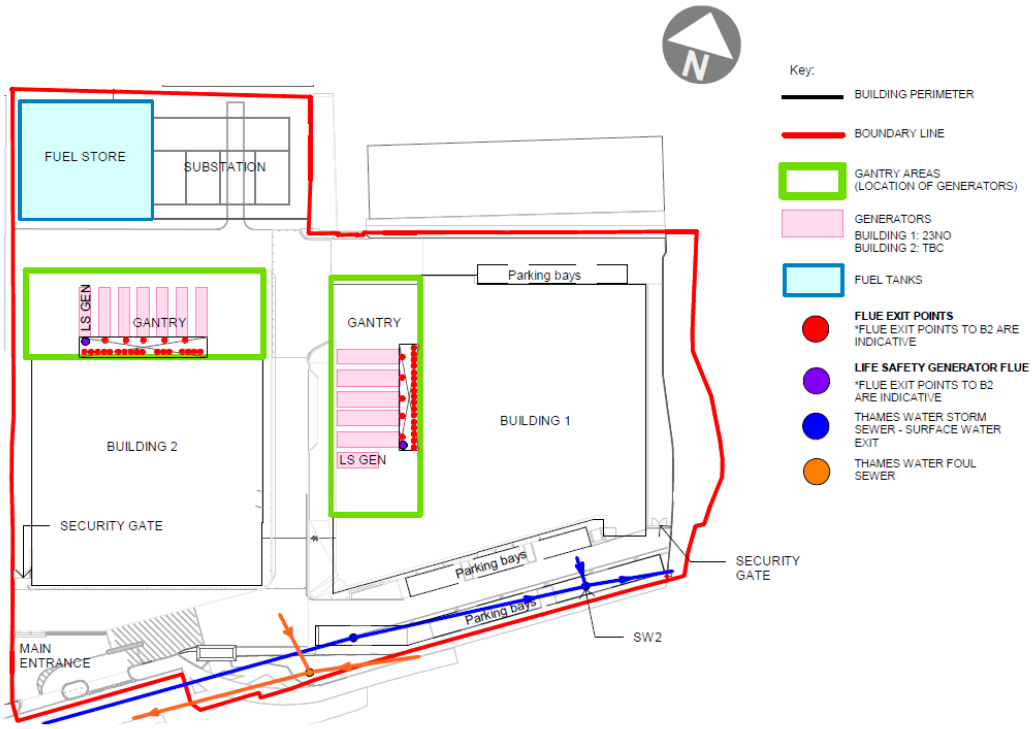


Figure 1 – Installation boundary and emission points

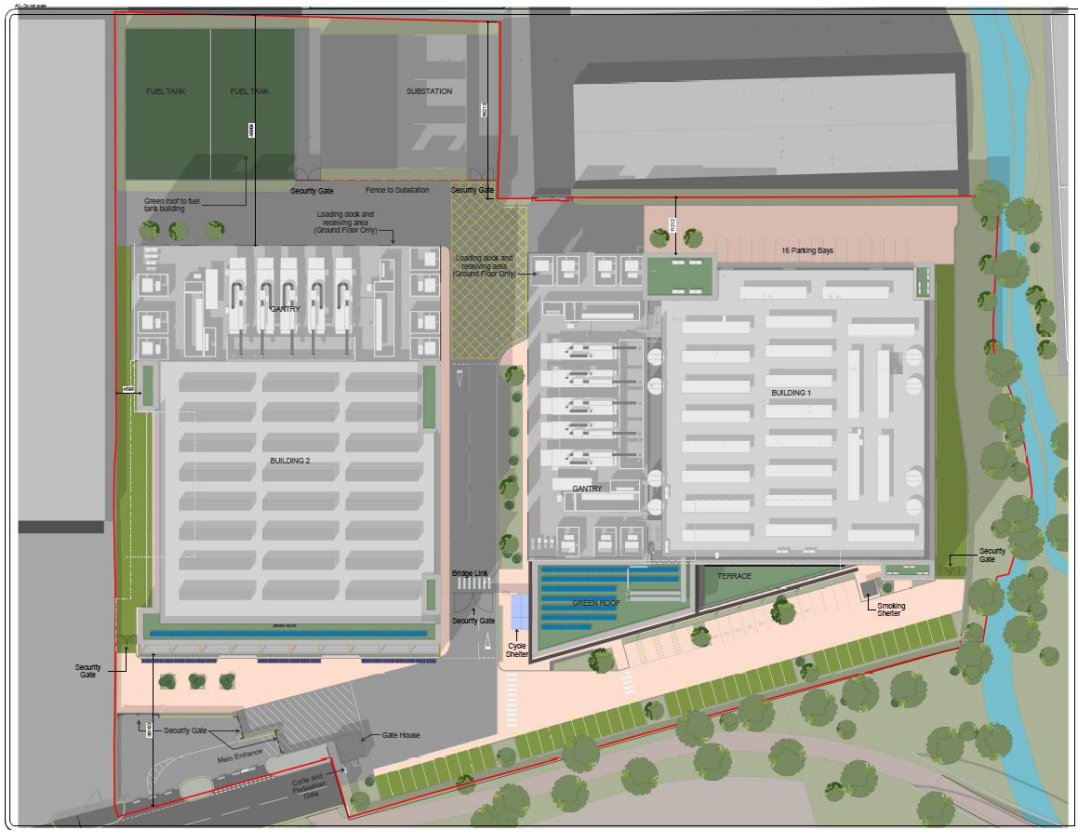


Figure 2 – Site layout plan

Figure 3 – Phasing plan

3.0 DATA CENTRE DESIGN

3.1 Uninterruptible power provision

The data centre functions by renting out data halls to customers, which are subsequently filled with various servers and associated IT equipment. This equipment requires a stable and constant supply of electricity to operate.

'Uptime' or power availability is a term used to explain how reliable a power source is. Data Centres require a high level of uptime or uninterruptible power provision, and being supplied by the national grid brings a risk of a mains failure events (black out) or fluctuations outside of acceptable limits (brown outs).

Downtime, i.e., power failures or voltage drops, even momentarily, may mean loss of service to customers, e.g., banks. This could have significant negative implications to site services, both in terms of direct financial costs and indirectly through reputational damage. Therefore, an uninterruptible power supply is critical to a data centre's ability to operate.

The Uptime Institute's Tier classification and performance standard[2] provides an objective basis for comparing one site's infrastructure versus another. The differing tiers are summarised below.

	Tier I	Tier II	Tier III	Tier IV
Active Capacity Components to Support IT Load	N	N+1	N+1	N after any failure
Distribution Paths	1	1	1 active and 1 alternate	2 simultaneously active
Concurrently Maintainable	No	No	Yes	Yes
Fault Tolerance (single event)	No	No	No	Yes
Compartmentalization	No	No	No	Yes
Continuous Cooling*	load density dependent	load density dependent	load density dependent	Yes (Class A)

Figure 4 – Uptime Institute's Tier classifications

Uptime is calculated based on the amount of downtime a site experiences as a % of the year, i.e., 99% or 'two 9's' corresponds to about 7 hours and 12 minutes of downtime per month. As the "nines" uptime increases – to three (99.9%), four (99.99%) and five (99.999%), the downtime decreases.

In general, five nines are considered a reasonably high reliability. With six nines, or 99.9999%, an average customer would experience about 2.6 seconds of downtime per month, or less than 32 seconds per year.

The National Grid produce an annual report of performance. Below is the performance statement from the National Grid report for 2022/23[3].

> *"The Overall Reliability of Supply for the NGET Transmission System during 2022-23 was: 99.999997%"*

3.2 Onsite electrical infrastructure

For resilience reasons, it is preferable to have numerous power supplies to the site; this provides an alternate route to switch to, should one supply be compromised during an outage. This can be provided in several ways, but the common option is to have separate supply routes within one substation, or to have multiple substations onsite. If one supply route fails, the data centre can switch to the alternate supply that is unaffected. This is a

[2] https://uptimeinstitute.com/tiers
[3] https://www2.nationalgrideso.com/document/289196/download

process known as “bus coupling.” This ability to switch to the unaffected supply route reduces the duration for which the generators operate in the event of an outage.

The electrical supply will be from Iver substation, which is located within the site boundary, and will be operated by Colt/IDNO. The substation receives 132kV supplies from the National Grid Uxbridge Moor substation. Building 1 will derive power from Iver substation from day 1.

Subject to timelines of power being available from the utility, Building 2 may initially be supplied from another nearby campus substation which derives power from North Hyde at 66kV. In this case, Building 2 would later switch over to the Iver substation.

The Colt connection is fully redundant and dedicated.

1. The supply is dedicated and there are no other offtakes on the connection that could interfere or trip the circuit.
2. The circuit from North Hyde is configured as N+N. Each feeder is a 100% rated from two separate connection boards at North Hyde. So, if one circuit failed or one set of cables was dug up by a digger, for example, the full load is maintained from the second feeders.
3. The supply is at 66kV connected directly to the 275kV national grid principal infrastructure. The 275 kV infrastructure is, in turn, connected to the 400kV national infrastructure. This is a very secure infrastructure.
4. The service is a fully buried service so not effected by weather issues.
5. There has not been a recorded failure incident at the current data centre for the last 20 years.

Availability Information from national grid[4]:

- There were 34 service interruptions between 2016 and 2021, 4 per year.
- The overall reliability of the network is assessed at 99.999966% in 2021 and has similar levels of reliability for 2020 and 2019. This equates to an average down time over the entire network of 17.67 seconds per year (average for national grid).
- During 2021 there were 455 system events where circuits were connected. Only 10 resulted in a loss of supply, with the average power outage being less than 90 mins.

[4] National Grid annual report 2021 public report reviewed by OFGEM

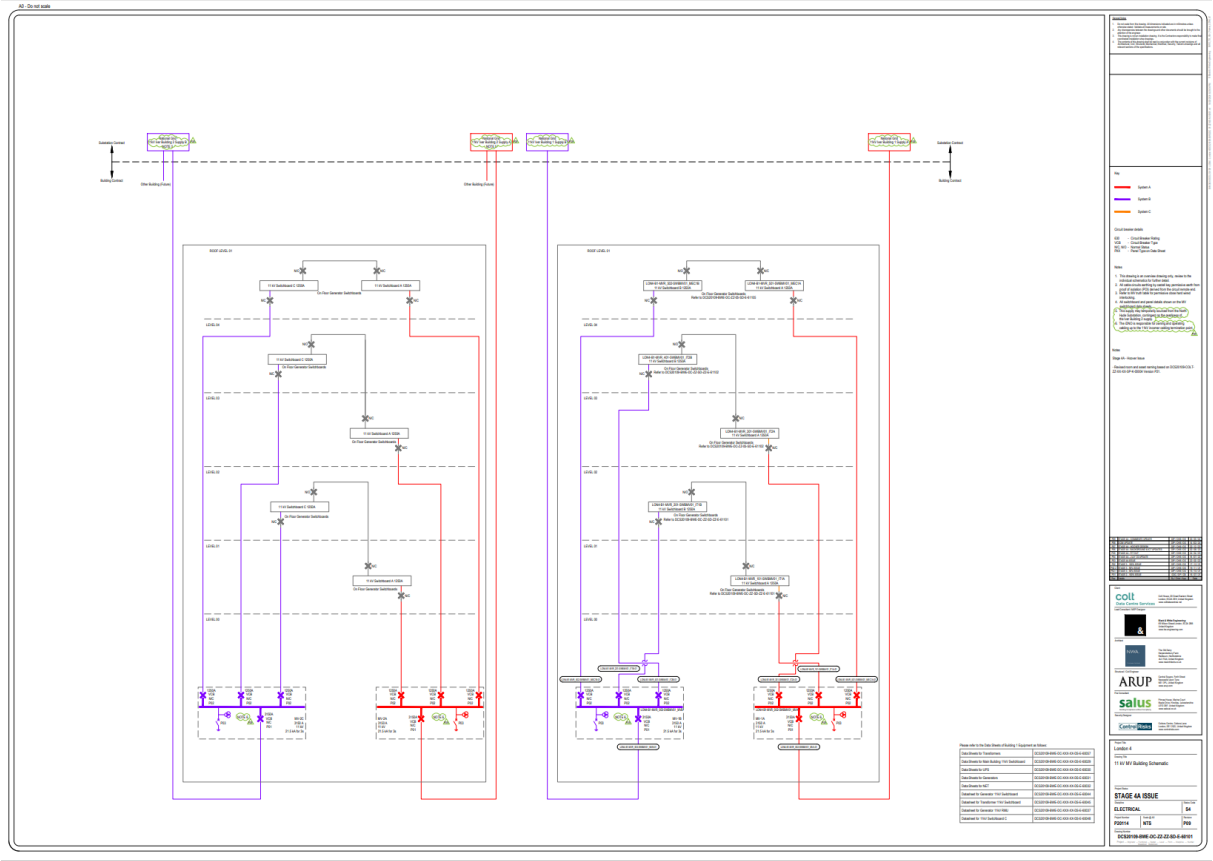


Figure 5 – Site electrical supplies

3.3 Redundancy arrangement

The installation has incorporated redundancy/resilience as a risk measure to help ensure that power provision is not interrupted even in the event of a mains failure. The size and number of generators is based on the site electrical IT load plus supporting equipment load on a design day. Generators are only sized to provide the maximum amount of power.

The redundancy arrangement for the generators is stated below where 'N' is the number of generators required to carry the maximum electrical load.

- System 1 – 8N + 1 redundant
- System 2 – 7N +1 redundant
- System 3 – 4N + 1 redundant

In the event of grid failure, the generators will start up, but they will not be able to take the electrical load immediately. Power is initially provided by the site's Uninterruptible Power Supply (UPS) (arrangement of batteries) until the generators start to take the site's electrical load.

The generators start from 'cold' to take on the load from the UPS (typically within 30-60 seconds). The backup generators then provide ongoing power until a stable mains electrical supply is restored. The redundancy arrangements are to safeguard power to their dedicated data hall, as Diesel generators have up to a 15 % probability of not starting and therefore a +1 or +2 (depending on total building load) is installed.

In a major outage where the installation loses both A & B grid supplies, all generators will start. If generators start, Colt will look to sequence with the mains and come off generators once the supply to site is stable.

3.4 Technology selected to provide emergency power

ESGs capable of operating on diesel or HVO have been selected to provide emergency power to the installation in the event of grid failure. A BAT assessment considering alternative technologies and why ESGs are considered BAT is presented below.

There are currently no BAT reference documents or BREF notes that have been made available by the European Commission for the specific provision of backup power in the data centre industry. We are therefore proposing an alternative which is based on the guidance in the EAs "*Data Centre FAQ v21 – Working Draft*".

The key criteria used in the selection of the BAT to fulfil the backup power requirements are split into two categories:

- Operational requirements
- Environmental risks

The criteria for both categories have been chosen based on the main risks posed and in accordance with the risk assessment guidance for bespoke permits.

3.4.1 Operational requirements

Table 2 – Operational requirements

Criteria	Considerations	Weighting
Cost benefit analysis	The initial capital cost of the technology being considered, and the potential cost of potential mitigation measures need to be considered to ensure they are not disproportionately high compared to the environmental benefits. Otherwise, the operator will cease to be competitive.	High – impacts competitiveness
Proven as a reliable technology	The resilience requirements of data centres are such that the key operational criterion is for the technology used to be a proven and reliable technology. An indication of reliability of a technology can be taken from the number of instances that the technology in question has been successfully utilised in the industry, i.e., whether this is a tried and tested technology or is it new and emerging. The technology also needs to suit the prevailing model of the industry.	High – if technology is not proven it presents a risk to the operator
Cold start capability	The technology will need to have the ability to start operating quickly in the event of a sudden loss of power. A warm start configuration would necessitate 24/7 operation of generators at the site: creating unnecessary fuel costs and environmental impacts. A slow start technology would necessitate additional energy storage UPS capacity (in the form of batteries or flywheels), taking up additional space and creating additional cost.	High – the ability to provide instant power is critical to business functions
Space requirements	Space requirements are relevant as an environmental consideration as a technology that requires excessive use of space (in the form of generator units, energy storage UPS capacity, and fuel storage) will reduce the amount of space available at the data centre for the IT equipment it is designed to host. This will necessitate a larger site area or construction of additional sites to provide the same level of service.	High/Medium – space limitations often dictate the technologies that can be considered
Fuel suitability	The fuel used needs to be capable of being stored/transported to and across the site without excessive risks to operations e.g., low risk of combusting.	Medium – low volatility and low risk is vital
Lifetime of stored fuel	The fuel will need to be stored onsite potentially over a long period of time as mains failure events are rare and as such the generators are not routinely operated, other than for maintenance and testing purposes. The fuel stored onsite may remain unused for a long period of time and should therefore be of a type that will remain useable under these conditions – rather than becoming a waste product in need of disposal.	Medium to low – whilst an added cost it is not top priority

3.4.2 Environmental risks

Table 3 – Operational requirements Environmental risks

Criteria	Considerations	Weighting
Air quality impact	Local air quality impacts from exhaust of combustion gases when operating the technology in combination with the fuel being combusted.	High – internal combustion engines perform poorly but they are run infrequently
Noise/odour	The technology should not incite regular Odour/Noise complaints from nearest sensitive receptors e.g., residences.	Low – complaints are unlikely due to infrequent operation
Global warming impact	The global warming impact of the fuel being combusted should compare favourably against the electrical output of the technology.	Medium – impact is high, but combustion of fuel is infrequent
Release to water (fuel spillage)	The risk of fuel escaping to the environment, e.g., local river course/ground should be low.	Low – fuel use is low due to infrequent operation
Fugitive emissions (leak of gaseous fuel)	The risk of fuel escaping to the air, e.g., gaseous escape should be low.	Low – fuel use is low due to infrequent operation

The following technologies were considered for the provision of emergency power to the Data Centre:

- Diesel Generators (includes operation on HVO/alternative liquid fuels)
- Diesel rotary uninterruptible power supply engines (DRUPS)
- Natural Gas (piped) Fuelled Generator – Spark Ignition Engine
- Natural Gas (piped) Fuelled Generator – Gas Turbine (CCGT or OCGT)
- Liquid Petroleum Gas (LPG) Fuelled Generator – Spark Ignition Engine
- Hydrogen Fuel Cell Technology: Polymer Electrolyte Membrane (PEM) Fuel Cells
- Hydrogen Fuel Cell Technology
- Standby Gas turbine Technology

The conclusion of the assessment is that emissions optimised ESGs (operating on Diesel/HVO) have been selected again as BAT for this installation for the following reasons, which are in line with EA BAT guidance for Data Centres:

- Proven technology for providing reliable power supply
- Start-up time & cold start capability
- Space requirements
- Capital expenditure
- Environmental impact
- Fuel storage

3.5 Generator emissions performance

The generator engine and emissions datasheets can be found in Appendix B. A summary has been provided in Table 4 below.

The EA guidance for new generators is that they, as a minimum achieve the following:

> *"TA-Luft 2g' or Tier II USEPA with guaranteed emissions: this has requirements for 2000mg/m3 NOx; 650 mg/m3 for CO; particulates and dust 130 mg/m3 and 150 mg/m3 for hydrocarbons (all at reference conditions and 5% O2)."*

The new ESGs that have been selected to support the site development are emissions optimised and achieve the Tier II US EPA standard (See Appendix B).

The installation is located within an Air Quality Management Area (AQMA) for NO_2 and as such, the operator has made significant investment in NO_x abatement technology in the form of Selective Catalytic Reduction (SCR). All generators will be fitted with SCR to achieve a NOx concentration of <250 mg/Nm^3 (5% O_2).

Once the SCR is fully operational, the NO_x emissions will be reduced to a level that surpasses what can generally be achieved by a gas generator of equivalent size and output. This SCR system is to be located on top of the generator container and connected to the generator flue system. The system works by dosing the exhaust gases with ammonia to convert NO_x to Nitrogen (N_2) and water (H_2O).

The generator emissions rates used in the Air Quality Assessment (AQA) (See Section 10.3), are presented in Table 4 below.

The life safety generator for Building 1 is 160kW (below 1MWth) and has not been fitted with SCR as it is listed as DAA. Building 2 is expected to house a life safety generator of a similar size.

Table 4 – Generator emissions rates

Generator set make and model	Engine	Pollutant	Emissions concentration* (mg/Nm³)	Mass Emissions** (g/s)
Rolls Royce DS3100 (2.4MWe)	MTU 20V4000G74F	NO_x (unabated)	1,907	5.71
		NO_x (abated)	250	0.52
		CO	203	0.371
		PM	16.3	0.03
		HC	64.7	0.111
Rolls Royce DS3600 (2.6MWe)	MTU 20V4000G94F	NO_x (unabated)	1,865	5.58
		NO_x (abated)	250	0.6
		CO	98	0.172
		PM	8	0.017
		HC	27	0.06

*at 75% load and 5% O2

**at 100% load

3.6 Generator noise attenuation

Each generator shall be fitted with a dedicated exhaust gas flue system. All generators will be housed within containers, and the containers complete with inlet/outlet attenuators, silencers and SCR, that will incorporate acoustic treatment to ensure that a sound pressure level 1m from the container does not exceed 80dbA@1m.

For more information on noise impacts, please refer to the noise impact assessment submitted with the application ('Noise Impact Assessment').

3.7 Generator flue and exhaust design

The flue arrangement for the new ESGs has been summarised below with further information in Table 5.

- Each engine shall also be provided with a dedicated attenuated exhaust gas flue system
- Each flue will exit into a common outlet air plenum that will rise and terminate above roof level
- The grouping and allocation of the flues is a fixed requirement agreed during planning of the permitted development

Table 5 – ESG flue arrangements

MCP type	No. of ESGs	Flue height (m)	Flue orientation	Cowls/caps?
New (building 1)	22	38.6m	Vertical (above ground)	None
New (building 2)	22	38.6m	Vertical (above ground)	None

Flue gas from the new internal ESGs goes through a flue dilution system prior to dispersing vertically above roof height.

Dispersion of pollutants has been considered when designing the flues for the generators. As a result, all flues are unimpeded by flaps/cowls and have been orientated vertically, terminating at 1m above the height of the building. The design of the flues is therefore considered to be BAT for this application.

During the design process, consideration was given to implementing a common windshield to group stacks as this is understood to improve dispersion in certain situations. Common windshields require additional support structure and the space constraints for the new generators could not support this. Additionally, if the common windshield was compromised for any reason, the data centre's requirement for redundancy could also be compromised. During normal operation, generators are tested individually to minimise air quality and noise impacts. Thus, a combined flue arrangement would have little impact on emissions.

3.8 Fuel storage

The ESGs require adequate fuel storage to allow them to operate during a grid failure. The ESGs are capable of operating on diesel or HVO, which is supplied from day tanks local to the generator they serve, which are in turn fed from larger bulk tanks located in a permanent fuel store shown in Figure 6 & Figure 7 below.

The permanent fuel store will be constructed as either part of Phase 1 or Phase 2 works. If the permanent store is delayed until Phase 2, a temporary fuel storage arrangement will be implemented. This will be located within the footprint of Building 2. Once the permanent fuel storage building has been constructed, these temporary tanks will be removed and Building 2 constructed.

The fuel schematic for Building 1 is shown in Appendix C and the phasing in Appendix D. The schematic for Building 2 is still to be produced but is likely to be based on Building 1.

Further details are covered in the following sections.

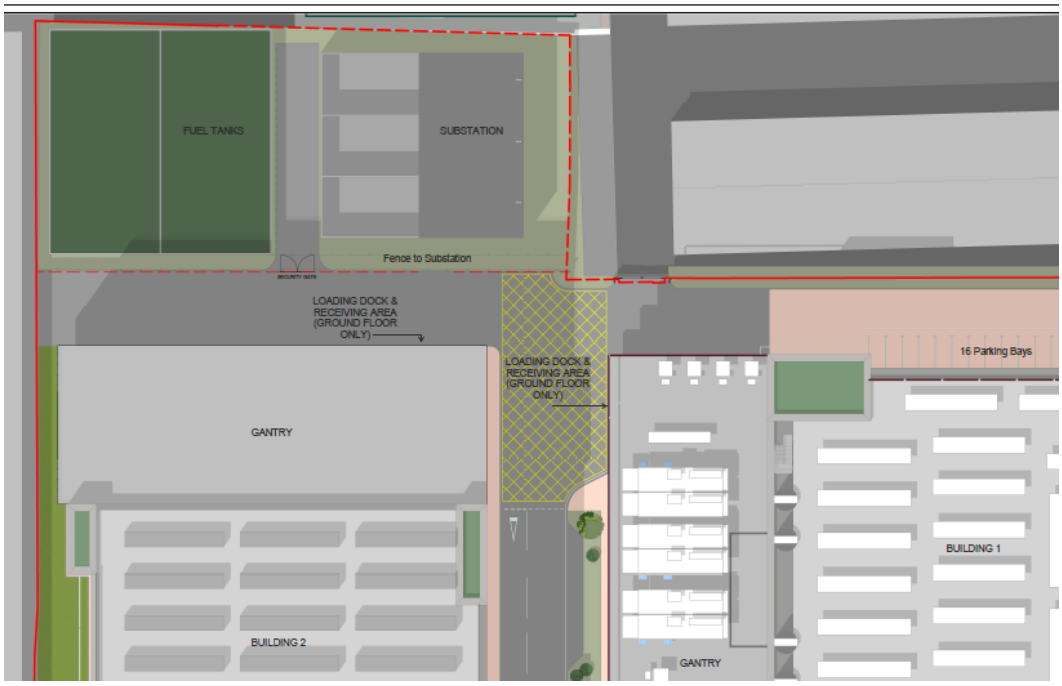


Figure 6 – Location of fuel tanks and fuel store

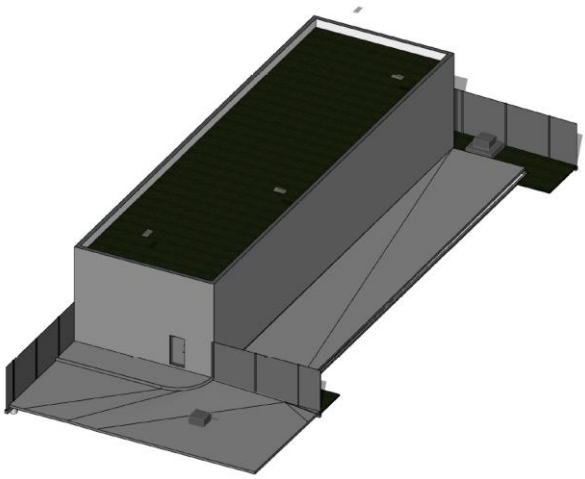


Figure 7 – Permanent fuel store building

3.8.1 Fuel storage capacity

The site stores enough fuel to operate in the event of grid failure. The combination of the generator fuel storage bulk and day tanks will provide 48 hours of autonomy, whilst operating under full load (i.e., 100% load). The local day tanks have capacity to support the generator set at full load for 2 hours. This is based on a worst-case scenario where the data halls are at capacity, requiring the generators to run at 100% load. This is highly unlikely, as Halls are rarely above 50-75% of their design capacity.

As outlined in 3.8 above, both a temporary and a permanent fuel storage arrangement may be required, as there is insufficient space to locate the bulk fuel tanks until land becomes available. Details of both arrangements is summarised in Table 6 below, with further detail in Appendix C and Appendix D.

Table 6 – Temporary fuel storage arrangements

Solution	Building	Description	Capacity per tank (litres)	Serves	Details
Temporary solution	Building 1	X6 Bulk tanks	70,000	Day tanks for Generators for building 1 (Phase 1A and 2A)	Each pair of tanks is breached.
Permanent solution	Building 1	X10 Bulk tanks	70,000	Generator day tanks for Building 1	Located within the permanent fuel storage building.
		X22 Day tanks	2,000	Associated generator	Fed from bulk tanks. Located within the generator room.
		X1 Fuel dump tank	3,000	All tanks	Used to dump fuel to when required.
	Building 2	X10 Bulk tanks	70,000	Generator day tanks for Building 2	Located within the permanent fuel storage building.
		X22 Day tanks	2,000	Associated generator	Fed from bulk tanks. Located within the generator room.
		X1 Fuel dump tank	3,000	All tanks	Used to dump fuel to when required.

3.8.2 Fuel fill points

A single filling cabinet or fill point for all bulk tanks will facilitate filling of each bulk tank. These will, in turn, pump fuel to each day tank as required.

A 50-litre fuel spill kit with drain covers will be located in the vicinity of the fill point, to reduce the risk of spilt fuel entering the drainage network during refuelling or in an emergency.

3.8.3 Fuel storage controls

All tanks

Generator fuel storage shall comprise of bulk and day tanks, where the combination of tanks provides 48 hours of autonomy whilst operating under full load. All tanks are located above ground, there are no underground fuel storage tanks. The fuel tanks are proposed to be located in the northeast corner of the site and situated within a framed structure to prevent rainwater egress and contamination. The fuel tank building will be fitted with a green roof to help in removing any potential contaminants on the site.

Level control of the bulk and day tanks and fuel transfer shall be controlled via a hot-redundant PLC fuel management system with head-end located in the Facility Operations Centre.

Fuel sampling points will be provided at each day tank, each bulk tank, and the fuel polishing unit. Fuelling points will be equipped with source capture and separation to contain potential fuel spills.

Bulk tanks

As discussed in Section 3.8, the permanent fuel store will be constructed as either part of Phase 1 or Phase 2 works.

If the permanent store is constructed in Phase 2, a temporary fuel storage arrangement will be implemented. The temporary fuel compound will be used during Phase 1 and will be located in the footprint of Building 2. The Veetec land will become available before the development of Building 2, and the tanks will be relocated before the development of Building 2 commences.

This strategy may change if the permanent fuel store is built during Phase1.

The temporary tank compound will accommodate three 140m3 single skinned tanks, each comprising of two 70m3 sections, sufficient to accommodate the generators for phase 1A and 2A of the construction program.

The tank compartments shall be fitted with variable speed master and slave submersible turbine type fuel transfer pumps operating on an assist basis, to make-up demand of the day tanks.

The fuel delivery system will incorporate motorised valves to facilitate transfer of fuel from one bulk tank to another bulk tank, and fuel polishing through a fuel polishing unit. One cabinet-mounted 50-litre fuel spill kit with drain covers shall be provided, along with one set of spare pads/socks.

Day tanks

Tanks are to be manufactured with 5m milk steel plate. Each generator shall benefit from a local day tank with capacity sufficient to support two hours at full load. The day tanks shall be fitted on a purpose-built metal frame of sufficient height to facilitate fuel delivery by means of gravity. Day tanks will be contained within a bund and provided with leak detection.

Each day tank shall contain a minimum of four level sensors to indicate LOW, LOW-LOW, HIGH and HIGH-HIGH fuel levels to the fuel management system. Each day tank shall call for fuel from the fuel transfer system, once the fuel level falls below the LOW level, and maintain the call for fuel until the HIGH fuel level is reached.

The PLC-based fuel management system shall monitor the fuel transfer system, notably the bulk fuel tanks, fuel polishing system, fuel transfer pumps and generator day fuel tanks, via hardwired signals and a high-level data communications interface.

Day tanks shall be completed with motorised fuel dump valves, positioned at low level. Dump valves actuators shall be interfaced with fire alarm system via the fuel management system. An overflow connection from the day tank shall by-pass the motorised dump valve to prevent spillage should the make-up valve malfunction resulting in an overflow event.

Each day tank is to have a 15-litre fuel spill kit provided, with one kit to be installed on each level of the gantry.

Fuel dump line

A motorised fuel day tank shall dump its fuel in the event of a confirmed fire within the generator enclosure, or malfunction of the motorised fuel make-up valve. The fuel dump lines discharge via gravity to a 3,000-litre capacity above-ground receiving tank within the loading bay area, with a single submersible pump and level controls.

The dumped fuel receiving tank/pump shall transfer fuel back to the bulk fuel tanks under the control of the fuel management system.

3.8.4 Fuel transfer system and pipework

A fuel transfer system shall be provided to manage the supply of fuel from bulk storage to individual generator day tanks.

Fuel pipework connecting the fuel pumps to the distribution risers shall be buried, all other fuel pipework shall be above ground.

All fuel pipework shall be pipe-in-pipe, with vacuum leak detection provided. Distribution pipework shall be flexible, with a stainless-steel DIN 1.4404 liner and 1.4301 outer casing, steel reinforcing bands and PE-LD corrosion proof sheathing. Pipework shall fall back to bunded areas. No pipework fittings shall be located outside of bunded areas.

3.8.5 Fuel management procedures and security

Fuel consumption is low in this installation due to the plant being used for emergency back-up power generation only. As such, fuel deliveries are, on average, less than once per year. When required, refuelling is conducted by trained fuel tanker drivers, and supervised by a trained member of the site engineering team.

A standard operating procedure (SOP) is to be implemented to facilitate refuelling activities. This SOP is intended to help reduce the risk of spillage during refuelling. These are supplemented by additional supplier procedures for fuel deliveries. In addition to this, additional controls are to be developed to help reduce the risk of an incident including an SOP for spill response and spill kits.

A periodic preventative maintenance (PPM) regime is to be implemented once operational that will include periodic visual checks for leaks/spills and checks for suitably stocked spill kits, and that these are located within close proximity of fuel storage tanks and fill points.

A 50-litre fuel spill kit with drain covers shall be located in the vicinity of the fill point to reduce the risk of spilt fuel entering the drainage network during refuelling or in an emergency.

Colt L4 Hayes will have thorough security provision, ensuring access to all critical areas is restricted without permission. The site will be operated 24-7, with a 24-7 managed security staff, CCTV and an alarm system in place. The site will have security office that allows operations to switch on all external luminaries on intruder detection by an operation switch.

The above controls and operating techniques are these are considered to meet the EA's BAT requirements for this Data Centre.

3.9 Urea storage arrangements

Urea is to be used in the Selective Catalytic Reduction (SCR) equipment to reduce the NOx emissions from the ESGs. This SCR system uses Urea as a raw material to achieve the prescribed NOx reductions.

Generator urea storage shall comprise bulk and day tanks, providing 8 hours of autonomy whilst operating under full load. Level control of the bulk and day tanks will be controlled via a hot-redundant PLC fuel management system with head end located in the Facility Operations Centre.

Urea deliveries shall be from a fill cabinet adjacent to the loading bay, with level control and overfill alarms. Refilling of the urea bulk tanks will be directly from the mobile tanker.

Level control of the bulk and day tanks and urea transfer shall be controlled via a hot-redundant PLC fuel management system, with head-end located in the Facility Operations Centre.

Urea bulk tanks

The urea bulk storage shall be located at level 5 roof within three 35m3 insulated GRP panel tanks. The tanks will be provided with a variable speed submersible turbine type transfer pumps and the system will be configured and have sufficient valves for concurrently maintainable operation.

The Urea storage tanks are made from mild steel. Each tank will be complete with:

- 50mm Fill connection
- 50mm Vent unit
- 25mm socket for level probe
- 25 and 50mm socket spares
- 25mm Draw line c/w valve
- Suitable lifting Lugs and earth Lug to main body
- 2" overfill prevention valve
- Hydrostatic tank contents gauge percentage

Urea day tanks

Each containerised generator set shall benefit have a local day tank, each with a capacity sufficient to support the generator SCR operation at full load for 2 hours.

Day tanks shall be installed on purpose-built metal frame of sufficient height for fuel delivery by gravity and installed within a bund with leak detection provided.

Each day tank shall contain a minimum of four level sensors to indicate LOW, LOW-LOW, HIGH and HIGH-HIGH urea levels to the fuel management system. Each day tank shall call for urea from the urea transfer system, once the urea level falls below the LOW level, and maintain the call for fuel until the HIGH fuel level is reached.

Day tank inlet valves shall be motorised, and valve actuators shall be interfaced with the fuel transfer and management systems.

The PLC based fuel management system shall monitor the urea transfer system, notably the bulk urea tanks, urea transfer pumps and generator day fuel tanks via hardwired signals and via a high-level data communications interface.

Urea dump line

Due to the limited shelf life of urea (expected to be 6 months), provision shall be made to facilitate drain-down of each urea tank for refill with fresh product. A motorised urea dump valve, positioned at the bottom of the nearest urea riser, shall allow for each tank to be independently drained to a mobile tanker via the urea transfer pump associated with the tank being drained. Deliveries are expected onsite every 6 months, accordingly.

Urea Transfer System

A urea transfer system shall be provided to manage the supply of urea from bulk storage to individual generator day tanks.

All urea pipework shall be pipe-in-pipe, with vacuum leak detection provided to the annular space. Distribution pipework shall be stainless steel DIN 1.4404 liner and 1.4301 outer casing, steel reinforcing bands and PE-LD corrosion proof sheathing.

3.10 Fuel & Urea Leak Detection System

A leak detection system shall be provided which will interface with the fuel management system to detect leakage of fuel and urea at the following locations:

- Bulk fuel tanks
- Fuel transfer pump skids
- Drip trays with leak detection beneath any single wall pipework.
- Day tanks
- Bunded area sump pumps
- Twin-walled transfer pipework
- Point leak detection within drip trays beneath components that do not have secondary containment.

3.11 Tertiary containment

Where possible, sustainable drainage systems (SuDS) have been incorporated into the site drainage design. This includes the use of green roofs and permeable paving systems, which will provide water filtration to remove suspended solids, metals & hydrocarbons from runoff.

To provide an additional level of treatment, a Class 1 full retention separator with an overflow alarm has been proposed at the downstream extent of the network, as well as an additional localised interceptor at the refuelling point to the north of building 2.

The proposed location of the downstream interceptor is shown below and in the site-wide drainage plan in Appendix F.

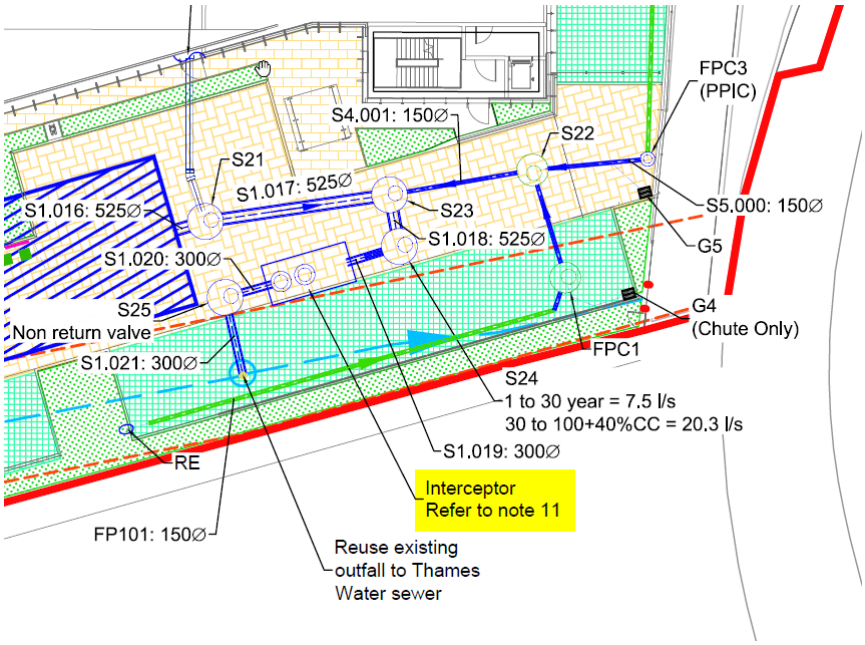


Figure 8 – Proposed interceptor location

4.0 OPERATING TECHNIQUES

4.1 Generator operation

The generators are to be used purely as standby plant to provide emergency standby power in the event of grid failure. There is no capacity agreement in place or elective operation of the plant for generating revenue (e.g., STOR, Triad avoidance, Demand Side Response, Peak Demand, etc.). As such, operation of the generators is likely to be limited to monthly maintenance and testing only.

4.2 Maintenance & Testing

The maintenance schedule for the generators is based on manufacturer guidelines. These guidelines help to prolong the life of the equipment, reduce the use of raw materials (e.g., replacement parts, oil changes) and ensure the engines perform efficiently to prevent increases in pollutant levels or black smoke.

Regimes for monthly and annual testing are detailed below. The AQA in Section 10.3 has not identified significant impacts to short term Air Quality from the proposed test regime. The current test regime is considered to meet the BAT requirements.

Where possible and practicable, the intention will be to avoid testing during peak traffic periods when background NOx has the potential to be elevated and to avoid testing during school hours. There may be instances where operational requirements dictate the time tests are to be undertaken.

Table 7 –Annual operational hours per generator

Generator Test Frequency	Description	Load Profile	Duration	Total hours, per gen
Emission measurements	Each standby generator may be operated individually to carry out emission measurements.	Site load	N/A	**Unknown**
Monthly “Black Building Test”	The simulation of a mains failure (parallel operation)”to test the functionality, performance and protection of the standby generation system. All standby generators on a common bus may be operated for a maximum of 1 hour per month (maximum 12 hours per calendar year) to test its operational readiness in the “black building test”.	Site load	1 hour	**12**
Annual Function test operation 1	To test each standby generators operational readiness.	Site load	2 hours	**2**
3x per year Function test operation 2	To test each standby generators operational readiness.	Site load	2 Hours	**6**
			Total hours of operation per generator	**20**

5.0 F-GAS

Fluorinated gases or ‘F-gases’ will not be used in the permitted activities e.g., generators and associated fuel storage.

There is potential that F-gases will be used in the chiller plant and/or air conditioning units. This plant is to be maintained in accordance with manufacturer specifications and recommendations with relevant documentation retained. During the development of the sites Environmental Management System, an F-gas register is to be maintained onsite, and will include details such as plant make, model and serial number, the type and volume of refrigerant, and maintenance history. Any significant releases or leaks are to be recorded and, notified to the EA as soon as possible.

6.0 ENERGY EFFICIENCY

6.1 Energy management

As energy prices rise and customers demand more from their data centre providers, there is increasing attention on energy efficiency and better energy management. The most prominent indicator of a Data Centre's energy efficiency is PUE (Power Usage Effectiveness), and this is often reported as a metric to customers.

PUE is the ratio of the total energy delivered to the site compared with the energy used by just the IT equipment. A PUE of 2 means that 50% of the power delivered to the site is used to run the IT equipment. The closer the PUE is to 1, the more efficient the data centre is at delivering power to the IT equipment. Most efficient Data Centres are seeking to achieve a PUE of approximately 1-1.2.

To ensure that the IT load, critical and ancillary loads can be supported by both the generator capacity at N and not exceed the 1.5 PUE at worst-case design condition, the peak PUE will be sufficiently low.

6.2 UK ETS

The site will need to apply for a Greenhouse Gas (GHG) Permit from the EA to participate in the UK Emissions Trading System (UK ETS). This is required for installations with combustion plant in excess of 20MWth.

Participating in UK ETS will require extensive monitoring of generator operational hours and fuel use to determine CO2 emissions per year. This data will likely need to be externally audited or 'verified' prior to submitting to the EA annually.

6.3 ESOS

The UKs Energy Savings Opportunities Scheme (ESOS) is a mandatory energy assessment scheme for organisations in the UK that meet the qualification criteria. At the time of writing these criteria are any company that either:

- employs 250 or more people
- has an annual turnover in excess of £44 million, and an annual balance sheet total in excess of £38 million

There is potential that this site could form part of an ESOS submission which would seek to identify opportunities to improve energy efficiency.

6.4 CCA

Once the site is operational there is potential for the operator to apply for a Climate Change Agreement (CCA) or amend existing agreements to cover this installation. These agreements are voluntary agreements made between UK industry and the EA to reduce energy use and CO_2 emissions.

Energy management techniques will be implemented to monitor, record and track power usage effectiveness (PUE) within the data centre.

6.5 Measures to improve energy efficiency

The electricity efficiency of the generators ranges from 30-40%. Heat recovery on generators is not a viable option since the generators are backup plant that operate infrequently (approx. <30 hours per year). To ensure the generators operate as efficiently as possible, the site follows a periodic preventative maintenance (PPM) regime. This involves regular checks of the generators to help ensure each generator is operating efficiently.

The contractor shall design all energy systems to be efficient, and where possible, select equipment from the Energy Technology List so the Colt can benefit from Enhanced Capital Allowance (ECAs). IT equipment integral to the design and operation of Data Centres, e.g., UPS systems, generators, cooling, BMS/EMS, etc., will be produced in accordance with the “EU Code of Conduct on Data Centres” Best practice supplement version 2.

7.0 EFFICIENT USE OF RAW MATERIALS

The main raw materials that will be used within the permitted installation are as follows.

7.1 Diesel/HVO

Current plans are for the ESGs to operate on Hydrotreated Vegetable Oil (HVO) to EN 15940. Testing and commissioning data and generator performance is provided based on HVO. The initial fuel fill provided by the contractor will be HVO. In the instance that HVO is unavailable for delivery to the site, the ESGs will run on diesel.

The installation will store enough diesel/HVO to provide 48 hours' worth of electricity when running at 100% continuous rated load. Due to the highly reliable grid supply, it is unlikely that large volumes of fuel will be consumed by this installation. Fuel use will mostly be limited to maintenance running of the generators. The PPM regime in place will help seek efficient fuel use by the generators.

As per Section 4.2 (repeated in Table 8), each generator is tested for 20 hours per year. The generator datasheets provide fuel consumption at 50, 75 and 100% load. Using 100% load, the total estimated fuel consumption for each generator can be seen below.

Table 8 - Estimated fuel consumption for testing regime

ESG details	50% l/hr	75% l/hr	100 l/hr	Hours per year	Litres/year
17No. 2.4 MW	345.8	494.6	633.7	20	**215,458**
27No. 2.6 MW	402	578	756	20	**408,240**
				Approx fuel use per year (worst case)	**623,698**

This is a highly conservative estimate, as it has been calculated using fuel consumption at 100% load. Realistically, ESGs may be operated for less time on partial loads or even offload, i.e., 0% load.

Diesel/HVO has been selected due to the ability to store sufficient volumes to ensure security of supply. Other fuels have been considered, but do not currently provide the same level of security. Natural gas could not be stored in sufficient volumes and would be reliant on the National Transmission System. A contract for an uninterruptable supply would be excessively costly given the infrequency of use. Further reasons for fuel selection are present within Section 3.4.2. Due to the limited hours of operation, any potential benefits from the lower impacts associated with emissions from natural gas are reduced.

7.2 Lubrication oils

The engines require lubrication oil to reduce wear and tear through friction. Periodic replacement of this oil is required. Waste oils are to be stored and disposed of responsibly and in accordance with applicable legislation.

7.3 Urea

Urea is to be used in the Selective Catalytic Reduction (SCR) equipment to reduce the NOx emissions. It is expected that there will be urea deliveries every 6 months, as limited amounts will be required during routine site operation. Onsite procedures and controls to reduce the risk of accidents, e.g., spillages occurring, are detailed in Section 3.9.

8.0 AVOIDANCE, RECOVERY AND DISPOSAL OF WASTES

8.1 Waste

Waste streams arise as a result of operation and maintenance of the combustion plant. Maintenance extends the life of the plant and resolves issues in a timely manner, reducing waste associated oils, lubricants & replacement parts. The installation does not produce significant amounts of waste due to the standby nature of the generators.

A licenced third-party maintenance contractor is responsible for removing waste produced as a result of generator maintenance.

Waste streams arising from this installation can include:

- Lubrication oils used in maintenance and servicing (minimal)
- Air and fuel filters (minimal)
- Fuel that has reached end of life (infrequent)
- Used spill kits (emergency only, unlikely)
- Decommissioned plant (end of life only)
- Urea that has reached end of life (infrequent)

Colt aims to minimise waste generation through efficient use of raw materials including diesel, filters, and lubrication oils.

For example, the need to dispose of waste fuel is reduced/minimised by fuel polishing through a fuel polishing unit. This unit filters the diesel in the tank, removing moisture and particulates from the fuel, ensuring the generators run cleanly. The aim is to help maintain the fuel to a usable standard, preventing early degradation and ultimately extending the life of the fuel.

9.0 GENERAL MANAGEMENT

9.1 Management Standards

The potential for adopting the following management standards (or equivalent, including non-certified standards) is to be reviewed once the site is operational:

- ISO 14001:2015 – specifies the requirements for an environmental management system that an organisation can use to enhance its environmental performance.
- ISO 50001:2018 – for organisations committed to addressing their impact, conserving resources, and improving efficient energy management. Designed to support organisations in all sectors, this ISO standard provides a practical way to improve energy use, through the development of an EnMS.
- ISO/IEC 27001:2013 – specifies the requirements for establishing, implementing, maintaining, and continually improving an information security management system within the context of the organisation. It also includes requirements for the assessment and treatment of information security risks tailored to the needs of the organisation. The requirements set out in ISO/IEC 27001:2013 are generic and are intended to be applicable to all organisations, regardless of type, size, or nature.
- ISO9001:2015 – specifies the requirements for establishing, implementing, monitoring, managing, and improving quality throughout the organisation.

9.2 Environmental Management System

Once the site is operational, there are plans to implement an effective EMS. The management system will be developed in accordance ISO 14001:2015, or a suitable equivalent standard.

Once implemented, the EMS will include the policies, management principles, organisational structure, responsibilities, standards/procedures, process controls and resources in place to manage environmental protection across the permitted activities at the installation. Specific focus will be placed on:

- Reducing risks to the environment to a level that is as low as reasonably practicable using best available techniques
- Integrating EMS responsibilities within line management
- A commitment to personnel environmental awareness and competence
- The ongoing monitoring and review of environmental performance
- A commitment to working to achieve continuous improvement in environmental performance

Integral to the EMS will be an overarching environmental policy. This will seek to underpin the EMS and help ensure uptake by all staff with sufficient training provided as required.

The operator will maintain records associated with the management system. These records will be stored on their central system and will be updated in line with the management system's policies. Records kept could include:

- Organisational procedures
- EMS manual
- Aspect register
- Compliance register
- Monitoring documents
- Accident, prevention, and control procedures
- Training records
- Review and audit records
- Environmental risk assessments

10.0 EMISSIONS

There will be no point source emissions to water, air or land, except from the sources and emission points identified in Figure 1 in Section 2.0.

Emissions identified as significant have been further expanded in the following sections.

10.1 Noise Impact assessment

A noise impact assessment (NIA) was completed in support of the application for an environmental permit. This report identifies sensitive receptors and potential sources of noise from the installation. The primary noise sources are the sites generators.

The impact assessment concluded the following:

> *"The results indicate that during the planned testing periods, the calculated site Rating Levels at the closest noise sensitive receptors range between 6dB below and 4dB above the existing background sound level.*
>
> *When considered in context, the risk of an adverse noise impact during the daytime period is low.*
>
> *The criteria adopted for this assessment (based on the Local Planning Authorities noise criteria) of a rating level to be no more than 5 dB above the background sound level is met.*
>
> *Therefore, no further mitigation measures, other than those already incorporated at design stage, are required."*

Given the above, the site's ESGs are unlikely to have a significant impact on surrounding receptors and therefore represent BAT.

10.2 Point source emissions to sewer/surface water

The site's drainage system is split into separate foul and surface water drainage systems, as shown in Appendix F. The site is to be covered in good quality hard standing. As per Section 11.3, contaminated discharges to sewer are not anticipated. The EA are to be notified where incidents occur that have the potential to cause pollution/environmental harm.

The location for where the site's surface water drainage system enters the local Thames Water network is identified in Figure 1 in Section 2.0. As per Section 3.11 on tertiary containment, the surface water drainage system is connected to an interceptor prior to discharging to the local network. Discharges are expected to be limited to surface water run-off, which is not anticipated to contain spilt fuel due to the mitigation measures in place (described below).

The surface water drainage system follows performance requirements that ensure all surfaces are suitably graded, so surface water is conveyed to the drainage system and the drainage systems will adequately convey flows.

The proposed foul drainage for the site proposed to utilising one of the existing foul connections to the Thames Water foul sewer. Prior to the planning application, an enquiry was made to Thames Water to ensure that the foul drainage would be acceptable in principle, with a response of no objections.

The development of the site will include the use of source capture and separation of potential fuel spills surrounding fuelling points, to ensure all high-risk areas appropriately managed and contained.

The fuel tanks will be installed with a framed structure that prevents rainwater contamination. The structure will be bunded with a separator provided locally to ensure containment of potential spillages. Class 1 oil interceptors are to be incorporated at the downstream network and refuelling area. This will help ensure that contaminated runoff does not exit the site by isolating the system.

The site's drainage system and interceptor will be subject to periodic visual inspections and integrity testing as part of the maintenance requirements.

10.3 Air Quality Assessment

Emissions to air will occur from the operation of the generators. Due to the data centre's high levels of resiliency, it is expected that operation will be limited to maintenance and testing only, with no capacity agreement/'elective operation' as detailed in Section 4.1.

An Air Quality Assessment (AQA) was completed in support of the permit application to predict the impacts of operating the generators on short- and long-term air quality. A summary of the findings is as follows.

Scenario 1: 'Testing and Maintenance'

Routine 'Testing and Maintenance' of the SBGs. In this scenario, all generators are expected to run independently for 8 hours per year, and cumulatively for 12 hours per year, at 100% load.

Scenario 2: Emergency operation

72-hour 'Grid Failure'/power outage emergency, inclusive of the testing and maintenance run times above.

The conclusion of the assessment is as follows:

> *"Long term impacts from the proposed SBGs were predicted to be insignificant for both scenarios at all relevant modelled receptor locations when assessed against all relevant long-term UK Air Quality Standards. Short term impacts were also found to be insignificant for scenario 1 which assesses 'business as usual' maintenance and testing operations. An exceedance of the 24-hour critical level for NOX was considered possible if prolonged 72-hour grid failure events occurred consistently for several years, at the nearby Yeading Brook local wildlife site.*
>
> *Prolonged 72-hour grid failure events are considered to be extremely rare events and therefore do not reflect the likely impacts from the installation. To address and mitigate the risks associated with a prolonged grid failure, it is recommended that an Air Quality Management Plan be implemented."*

The conclusion of the AQA indicates that there is a low likelihood of that short- and long-term impacts from operation of the sites ESGs is likely to be insignificant.

Given the above, the sites ESGs are unlikely to have a significant impact on surrounding receptors and therefore represent BAT.

10.4 Air Quality Management Plan

To help reduce the potential impacts during a prolonged outage, BAT is therefore to develop an Air Quality Management Plan (AQMP) once the site is operational. This will include data and general observations of the following:

- Outage occurrence – e.g., date, time, season, meteorologic factors
- Receptors – e.g., AQ model receptors, general public
- Outage situation – e.g., likely duration, how receptors are affected

The AQMP forms a basis for identifying which receptors may be affected and if notification is required. It is to be developed in conjunction with the Local Authority and its Local Air Quality Management (LAQM) process. Once the AQMP is finalised, it shall be submitted to the EA for final approval.

11.0 MONITORING

11.1 Emissions limits & flue gas monitoring

The purpose of the emergency standby plant is to provide power in the event of failure of national grid supplies and is unlikely to exceed operating 50 hours per year. As such, the generators ae classed as 'limited hour MCPs' and are therefore exempt from meeting the BAT emissions limit values (ELVs) for new MCPs/Specified generators.

To facilitate monitoring, the flues are to be fitted with appropriate sampling ports to allow for NOx and CO monitoring.

Monitoring of flue gas monitoring is to be completed in accordance with web guide 'Monitoring stack emissions: low risk MCPs and specified generators' Published 16 February 2021 (formerly known as TGN M5)[5] .

In line with existing permits for data centres, the expectation is that monitoring will be undertaken every 1500 hours of generator operation or once every five years (whichever comes first). The first round of monitoring is to be conducted on the new generators within the first year of operation.

This monitoring will seek to confirm that the generators and their respective SCR systems are achieving the performance specification detailed in Section 3.5.

Monitoring data will be used to report total mass emissions for NOx, SOx, PM, and CO to the EA annually as part of the pollution inventory returns.

11.2 Generator operation

Generator operational hours and fuel consumption for maintenance, testing and for an outage are to be monitored and reported to the EA annually. In addition to the annual report, outages that result in generator operation should be notified to the EA within 72 hours of emergency operation commencing.

11.3 Discharges to sewer

Contaminated discharges to sewer are not anticipated. Any surface water run off which discharges to surface drainage will first pass via the drainage interceptor. This will be subject to periodic visual inspections. The EA is to be notified by the operator where significant pollution incidents occur that have the potential to cause harm.

[5] https://www.gov.uk/government/publications/monitoring-stack-emissions-low-risk-mcps-and-specified-generators/monitoring-stack-emissions-low-risk-mcps-and-specified-generators

12.0 CONCLUSION

We have set out the proposed design and operating techniques for this installation and these are considered to meet the EA's BAT requirements for this Data Centre.

APPENDIX A

Thermal Schedule

Thermal capacity schedule - Colt Hayes

Ref	Emission Source Description	Gen Set Supplier	Genset Manufacturer	Genset model	Engine model	max fuel (litre/hr)	Output rating (kVA)	Output rating (kWe)	Thermal Capacity (MW)
S1	Building 1 - Gen 1	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S2	Building 1 - Gen 2	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S3	Building 1 - Gen 3	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S4	Building 1 - Gen 4	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S5	Building 1 - Gen 5	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S6	Building 1 - Gen 6	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S7	Building 1 - Gen 7	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S8	Building 1 - Gen 8	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S9	Building 1 - Gen 9	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S10	Building 1 - Gen 10	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S11	Building 1 - Gen 11	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S12	Building 1 - Gen 12	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S13	Building 1 - Gen 13	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S14	Building 1 - Gen 14	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S15	Building 1 - Gen 15	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S16	Building 1 - Gen 16	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S17	Building 1 - Gen 17	AVK	MTU	MTU 20V4000 DS3100	20V4000G74F	656	2670	2,400	**6.42**
S18	Building 1 - Gen 18	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S19	Building 1 - Gen 19	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S20	Building 1 - Gen 20	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S21	Building 1 - Gen 21	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S22	Building 1 - Gen 22	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S23	Building 2 - Gen 1	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S24	Building 2 - Gen 2	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S25	Building 2 - Gen 3	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S26	Building 2 - Gen 4	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S27	Building 2 - Gen 5	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S28	Building 2 - Gen 6	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S29	Building 2 - Gen 7	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S30	Building 2 - Gen 8	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S31	Building 2 - Gen 9	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S32	Building 2 - Gen 10	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S33	Building 2 - Gen 11	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S34	Building 2 - Gen 12	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S35	Building 2 - Gen 13	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S36	Building 2 - Gen 14	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S37	Building 2 - Gen 15	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S38	Building 2 - Gen 16	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S39	Building 2 - Gen 17	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S40	Building 2 - Gen 18	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S41	Building 2 - Gen 19	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S42	Building 2 - Gen 20	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S43	Building 2 - Gen 21	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
S44	Building 2 - Gen 22	AVK	MTU	MTU 20V4000 DS3600	20V4000G94F	657	3088	2,600	**6.43**
								Aggregated net thermal input capacity (MW)	**282.87**

Thermal capacity calculation completed in line with Environment Agency guidance:
"AMPS Determination of thermal input power of an engine driven generator" (Equation 4):

	2.4MW	**2.6MW**
Max fuel consumption (litre/hr)	656	657
MK = max fuel x0.828 (fuel density)	543.17	544.00
Hu = calorific value	42.5688	42.5688
Pth = MK x Hu / 3.6	6,422.78	6,432.57
MWth	6.42	6.43

APPENDIX B

Generator Set & Emissions Datasheets

Diesel Generator Set

MTU 20V4000 DS3100

*LON4 Project Specific

380V – 11 kV/50 Hz/standby power/NEA (ORDE) optimized 20V4000G74F/water charge air cooling

Optional equipment and finishing shown. Standard may vary.

Product highlights

Benefits
- Low fuel consumption
- Optimized system integration ability
- High reliability
- High availability of power
- Long maintenance intervals

Support
- Global product support offered

Standards
- Engine-generator set is designed and manufactured in facilities certified to standards ISO 2008:9001 and ISO 2004:14001
- Generator set complies to ISO 8528
- Generator meets NEMA MG1, BS5000, ISO, DIN EN and IEC standards
- NFPA 110

Power rating
- System ratings: 3000 kVA - 3010 kVA
- Accepts rated load in one step per NFPA 110
- Generator set complies to G3 according to ISO 8528-5
- Generator set exceeds load steps according to ISO 8528-5

Performance assurance certification (PAC)
- Engine-generator set tested to ISO 8528-5 for transient response
- 100% load factor with UTI letter
- Verified product design, quality and performance integrity
- All engine systems are prototype and factory tested

Complete range of accessories available
- Control panel
- Power panel
- Circuit breaker/power distribution
- Fuel system
- Fuel connections with shut-off valve mounted to base frame
- Starting/charging system
- Exhaust system
- Mechanical and electrical driven radiators
- Medium and oversized voltage alternators

Emissions
- NEA (ORDE) optimized

Certifications
- CE certification option
- Unit certificate acc. to BDEW (German Grid-Code)

A Rolls-Royce solution

Application data [1)]

Engine

Manufacturer	MTU
Model	20V4000G74F
Type	4-cycle
Arrangement	20V
Displacement: l	95.4
Bore: mm	170
Stroke: mm	210
Compression ratio	16.4
Rated speed: rpm	1500
Engine governor	ECU 9
Max power: kWm	2670
Air cleaner	dry

Fuel system

Maximum fuel lift: m	5
Total fuel flow: l/min	27

Fuel consumption [2)]

	l/hr	g/kwh
At 100% of power rating:	633.7	197
At 75% of power rating:	494.6	205
At 50% of power rating:	345.8	215

Liquid capacity (lubrication)

Total oil system capacity: l	390
Engine jacket water capacity: l	205
Intercooler coolant capacity: l	50

Combustion air requirements

Combustion air volume: m^3/s	2.6
Max. air intake restriction: mbar	50

Cooling/radiator system

Coolant flow rate (HT circuit): m^3/hr	80
Coolant flow rate (LT circuit): m^3/hr	32.5
Heat rejection to coolant: kW	1030
Heat radiated to charge air cooling: kW	490
Heat radiated to ambient: kW	105
Fan power for electr. radiator (40°C): kW	70

Exhaust system

Exhaust gas temp. (after turbocharger): °C	550
Exhaust gas volume: m^3/s	8.6
Maximum allowable back pressure: mbar	85
Minimum allowable back pressure: mbar	30

Standard and optional features

System ratings (kW/kVA)

Generator model	Voltage	NEA (ORDE) optimized					
		without radiator			with mechanical radiator		
		kWel	kVA*	AMPS	kWel	kVA*	AMPS
Leroy Somer LSA53.2 M12 (Low voltage Leroy Somer standard)	380 V	2528	3160	4801	2472	3090	4695
	400 V	2528	3160	4561	2472	3090	4460
	415 V	2528	3160	4396	2472	3090	4299
Marathon 1030FDL7094 (Low voltage Marathon)	380 V	2536	3170	4816	2464	3080	4680
	400 V	2536	3170	4576	2464	3080	4446
	415 V	2536	3170	4410	2464	3080	4285
Marathon 1030FDH7101 (Medium volt. marathon)	11 kV	2536	3170	166	2472	3090	162
Leroy Somer LSA53.2 ZL14 (Medium volt. Leroy Somer)	11 kV	2544	3180	167	2472	3090	162

* cos phi = 0.8

1 All data refers only to the engine and is based on ISO standard conditions (25°C and 100m above sea level).
2 Values referenced are in accordance with ISO 3046-1. Conversion calculated with fuel density of 0.83 g/ml. All fuel consumption values refer to rated engine power.

Standard and optional features

Engine

- ■ 4-cycle
- ■ Standard single stage air filter
- ■ Oil drain extension & shut-off valve
- ■ Closed crankcase ventilation
- ■ Governor-electronic isochronous
- ■ Common rail fuel injection
- ■ NEA (ORDE) optimized engine

Generator

- ■ 4 pole three-phase synchronous generator
- ■ Brushless, self-excited, self-regulating, self-ventilated
- ■ Digital voltage regulator
- ■ Anti condensation heater
- ■ Stator winding Y-connected, accessible neutral (brought out)
- ■ Protection IP23
- ■ Insulation class H, utilization acc. to H
- ■ Radio suppression EN55011, group 1, cl. B
- ■ Short circuit capability 3xIn for 10sec
- ■ Winding and bearing RTDs (without monitoring)
- ■ Excitation by AREP
- ■ Mounting of CT´s: 2 core CT´s
- ■ Winding pitch: 2/3 winding
- ■ Voltage setpoint adjustment ± 10%
- ■ Meets NEMA MG-1, BS 5000, IEC 60034-1, VDE 0530, DIN EN 12601, AS1359 and ISO 8528 requirements
- ■ Leroy Somer low voltage generator
- □ Marathon low voltage generator
- □ Oversized generator
- □ Medium voltage generator

Cooling system

- ■ Jacket water pump
- ■ Thermostat(s)
- ■ Water charge air cooling
- □ Mechanical radiator
- □ Electrical driven front-end cooler
- □ Jacket water heater

Control panel

- ■ Pre-wired control cabinet for easy application of customized controller (V1+)
- □ Island operation (V2)
- □ Automatic mains failure operation with ATS (V3a)
- □ Automatic mains failure operation incl. control of generator and mains breaker (V3b)
- □ Island parallel operation of multiple gensets (V4)
- □ Automatic mains failure operation with short (< 10s) mains parallel overlap synchronization (V5)
- □ Mains parallel operation of a single genset (V6)
- □ Mains parallel operation of multiple gensets (V7)
- □ Basler controller
- □ Deif controller
- ■ Complete system metering
- ■ Digital metering
- ■ Engine parameters
- ■ Generator protection functions
- ■ Engine protection
- ■ SAE J1939 engine ECU communications
- ■ Parametrization software
- ■ Multilingual capability
- ■ Multiple programmable contact inputs
- ■ Multiple contact outputs
- ■ Event recording
- ■ IP 54 front panel rating with integrated gasket
- □ Different expansion modules
- □ Remote annunciator
- □ Daytank control
- □ Generator winding temperature monitoring
- □ Generator bearing temperature monitoring
- □ Modbus TCP-IP

Power panel

- □ Available in 600x600 and 600x1000
- □ Phase monitoring relay 230V/400V
- □ Supply for battery charger
- □ Supply for jacket water heater
- □ Supply for anti condensation heating
- □ Plug socket cabinet for 230V compatible Euro/USA
- □ Supply for electrical driven radiator from 45kW – 75kW (PP 600x1000)

■ Represents standard features

□ Represents optional features

Standard and optional features

Circuit breaker/power distribution

- ☐ 3-pole circuit breaker
- ☐ 4-pole circuit breaker
- ☐ Manual-actuated circuit breaker
- ☐ Electrical-actuated circuit breaker
- ☐ Stand-alone solution in seperate cabinet

Fuel system

- ■ Flexible fuel connectors mounted to base frame
- ☐ Fuel filter with water separator
- ☐ Fuel filter with water separator heavy-duty
- ☐ Switchable fuel filter with water separator
- ☐ Switchable fuel filter with water separator heavy-duty
- ☐ Seperate fuel cooler
- ☐ Fuel cooler integrated into cooling equipment

Starting/charging system

- ■ 24V starter
- ☐ Starter batteries, cables, rack, disconnect switch
- ☐ Battery charger

Mounting system

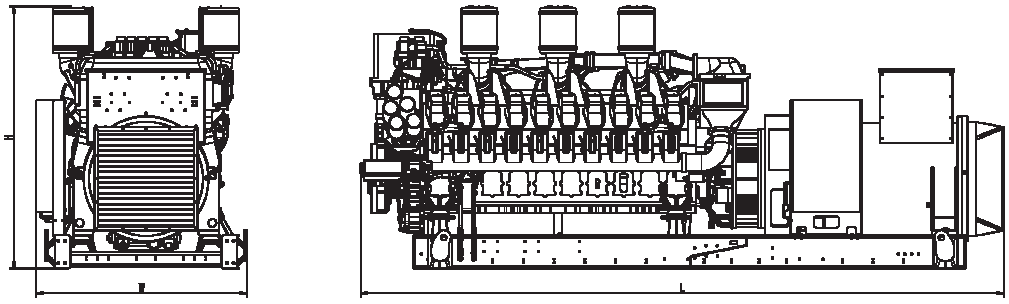
- ■ Welded base frame
- ■ Resilient engine and generator mounting
- ■ Modular base frame design

Exhaust system

- ☐ Exhaust bellows with connection flange
- ☐ Exhaust silencer with 10 dB(A) sound attenuation
- ☐ Exhaust silencer with 30 dB(A) sound attenuation
- ☐ Exhaust silencer with 40 dB(A) sound attenuation
- ☐ Y-connection-pipe

■ Represents standard features
☐ Represents optional features

Weights and dimensions



Drawing above for illustration purposes only, based on a standard open power 400 Volt engine-generator set. Lengths may vary with other voltages. Do not use for installation design. See website for unit specific template drawings.

System	Dimensions (L x W x H)	Weight (dry/less tank)
Open power unit (OPU)	5760 x 1887 x 2332 mm	15819 kg

Weights and dimensions are based on open power units and are estimates only. Consult the factory for accurate weights and dimensions for your specific engine-generator set.

Sound data

- Consult your local MTU distributor for sound data.

Emissions data

- Consult your local MTU distributor for emissions data.

Rating definitions and conditions

- Standby ratings apply to installations served by a reliable utility source. The standby rating is applicable to varying loads for the duration of a power outage. No overload capability for this rating. Ratings are in accordance with ISO 8528-1, ISO-3046-1, BS 5514 and AS 2789.
  Average load factor: ≤ 100%
- Consult your local MTU Distributor for derating information.

Subject to change. | 3237861 | Edition 01/20 | ESM 2020-03.

Diesel Generator Set

mtu 20V4000 DS3600

Project Specific Datasheet

3.3 - 11 kV/50 Hz/standby power/NEA (ORDE) + Tier 2 optimized 20V4000G94F/water charge air cooling

Optional equipment and finishing shown. Standard may vary.

Product highlights

Benefits
- Low fuel consumption
- Optimized system integration ability
- High reliability
- High availability of power
- Long maintenance intervals

Support
- Global product support offered

Standards
- Engine-generator set is designed and manufactured in facilities certified to standards ISO 2008:9001 and ISO 2004:14001
- Generator set complies to ISO 8528
- Generator meets NEMA MG1, BS 5000, ISO, DIN EN and IEC standards
- NFPA 110

Power rating
- System ratings: 3580 kVA - 3730 kVA
- Accepts rated load in one step per NFPA 110*
- Generator set complies to G3 according to ISO 8528-5
- Generator set exceeds load steps according to ISO 8528-5*

Performance assurance certification (PAC)
- Engine-generator set tested to ISO 8528-5 for transient response
- 100% load factor with UTI letter
- Verified product design, quality and performance integrity
- All engine systems are prototype and factory tested

Complete range of accessories available
- Control panel
- Power panel
- Fuel system
- Fuel connections with shut-off valve mounted to base frame
- Starting/charging system
- Exhaust system
- Electrical driven radiators
- Medium and oversized voltage alternators

Emissions
- Tier 2 optimized engine
- NEA (ORDE) optimized

Certifications
- CE certification option
- Unit certificate acc. to VDE-AR-N 4110

* Changes to the standard parameter sets (alternator-regulator and genset-controller) are necessary

A Rolls-Royce solution

Application data [1)]

Engine

Manufacturer	***mtu***
Model	20V4000G94F
Type	4-cycle
Arrangement	20V
Displacement: l	95.4
Bore: mm	170
Stroke: mm	210
Compression ratio	16.4
Rated speed: rpm	1500
Engine governor	ECU 9
Max power: kWm	3088
Air cleaner	dry

Fuel system

Maximum fuel lift: m	5
Total fuel flow: l/min	27

Fuel consumption [2)]

	l/hr	g/kwh
At 100% of power rating:	756	203
At 75% of power rating:	578	207
At 50% of power rating:	402	216

Liquid capacity (lubrication)

Total oil system capacity: l	390
Engine jacket water capacity: l	260
Intercooler coolant capacity: l	50

Combustion air requirements

Combustion air volume: m^3/s	4.5
Max. air intake restriction: mbar	30

Cooling/radiator system

Coolant flow rate (HT circuit): m3/hr	80
Coolant flow rate (LT circuit): m3/hr	44
Heat rejection to coolant: kW	1140
Heat radiated to charge air cooling: kW	890
Heat radiated to ambient: kW	105
Fan power for electr. radiator (40°C): kW	105

Exhaust system

Exhaust gas temp. (after engine, max.): °C	550
Exhaust gas temp. (before turbocharger): °C	642
Exhaust gas volume: m3/s	11.1
Maximum allowable back pressure: mbar	50
Minimum allowable back pressure: mbar	–

Standard and optional features

System ratings (kW/kVA)

Generator model	Voltage	NEA (ORDE) optimized		
		without radiator		
		kWel	kVA*	AMPS
~~Leroy Somer LSA54.2 XL11 (Med. volt. Leroy Somer)~~	~~11 kV~~	~~2864~~	~~3580~~	~~188~~
~~Marathon 1040FDH7103 (Medium volt. marathon)~~	~~11 kV~~	~~2976~~	~~3720~~	~~195~~
~~Leroy Somer LSA54.2 ZL12 (MV Leroy Somer oversized)~~	~~11 kV~~	~~2864~~	~~3580~~	~~188~~
~~Marathon 1040FDH7105 (MV marathon oversized)~~	~~11 kV~~	~~2976~~	~~3720~~	~~195~~
~~Leroy Somer LSA54.2 ZL12 (Engine output optimized)~~	~~11 kV~~	~~2984~~	~~3730~~	~~196~~

* cos phi = 0.8

		with radiator		
Leroy Somer LSA54.2 AL16	11 kV	2645	3306	173

1 All data refers only to the engine and is based on ISO standard conditions (25°C and 100m above sea level).

2 Values referenced are in accordance with ISO 3046-1. Conversion calculated with fuel density of 0.83 g/ml. All fuel consumption values refer to rated engine power.

Standard and optional features

Engine

- ■ 4-cycle
- ■ Standard single stage air filter
- ■ Oil drain extension & shut-off valve
- ■ Closed crankcase ventilation
- ■ Governor-electronic isochronous
- ■ Common rail fuel injection
- ■ Tier 2 optimized engine
- ■ NEA (ORDE) optimized engine

Generator

- ■ 4 pole three-phase synchronous generator
- ■ Brushless, self-excited, self-regulating, self-ventilated
- ■ Digital voltage regulator
- ■ Anti condensation heater
- ■ Stator winding Y-connected, accessible neutral (brought out)
- ■ Protection IP23
- ■ Insulation class H, utilization acc. to H
- ■ Radio suppression EN 55011, group 1, cl. B
- ■ Short circuit capability 3xIn for 10sec
- ■ Winding and bearing RTDs (without monitoring)
- ■ Excitation by AREP + PMI
- ■ Mounting of CT´s: 3x 2 core CT´s
- ■ Winding pitch: 5/6 winding
- ■ Voltage setpoint adjustment ± 5%
- ■ Meets NEMA MG-1, BS 5000, IEC 60034-1, VDE 0530, DIN EN 12601, AS 1359 and ISO 8528-3 requirements
- ■ Leroy Somer medium voltage generator
- □ Marathon medium voltage generator
- □ Oversized generator

Cooling system

- ■ Jacket water pump
- ■ Thermostat(s)
- ■ Water charge air cooling
- □ Electrical driven front-end cooler
- □ Jacket water heater
- □ Pulley for fan drive

Control panel

- ■ Unit cabling with coded plugs for easy connection of customer-specific controls (V0)
- □ Pre-wired control cabinet for easy application of customized controller (V1+)
- □ Island operation (V2)
- □ Automatic mains failure operation with ATS (V3a)
- □ Automatic mains failure operation incl. control of generator and mains breaker (V3b)
- □ Island parallel operation of multiple gensets (V4)
- □ Automatic mains failure operation with short (< 10s) mains parallel overlap synchronization (V5)
- □ Mains parallel operation of a single genset (V6)
- □ Mains parallel operation of multiple gensets (V7)
- □ Basler controller
- □ Deif controller
- □ Complete system metering
- ■ Digital metering
- ■ Engine parameters
- ■ Generator protection functions
- ■ Engine protection
- ■ SAE J1939 engine ECU communications
- ■ Parametrization software
- ■ Multilingual capability
- ■ Multiple programmable contact inputs
- ■ Multiple contact outputs
- ■ Event recording
- □ IP 54 front panel rating with integrated gasket
- □ Remote annunciator
- □ Daytank control
- □ Generator winding- and bearing temperature monitoring
- □ Modbus TCP-IP

Connectivity

The engine system automatically collects and transfers engine data to the manufacturer from time to time. The data is used by the manufacturer for the purposes of product development and improvement as well as service optimization. Users can log in or register via https://mtu-go.com and also gain insight into the data.

■ Represents standard features
□ Represents optional features

Standard and optional features

Power panel

- ☐ Supply electrical driven radiator from 45kW – 75kW

Fuel system

- ■ Flexible fuel connectors mounted to base frame
- ☐ Fuel filter with water separator
- ☐ Fuel filter with water separator heavy-duty
- ☐ Switchable fuel filter with water separator
- ☐ Switchable fuel filter with water separator heavy-duty
- ☐ Seperate fuel cooler
- ☐ Fuel cooler integrated into cooling equipment

Starting/charging system

- ■ 24V starter
- ☐ Redundant starting system
- ☐ Starter batteries, cables, rack, disconnect switch (lockable)
- ☐ Battery charger
- ☐ Alternator

Mounting system

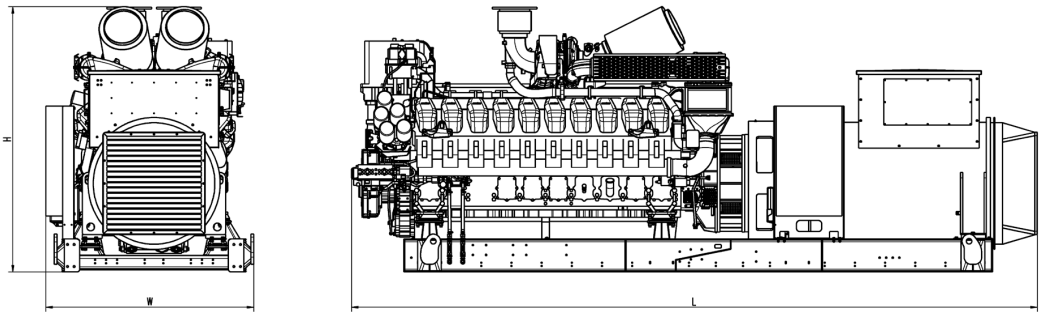
- ■ Welded base frame
- ■ Resilient engine and generator mounting
- ■ Modular base frame design
- ☐ Base frame mounting on foundation/base plate with using clamping brackets

Exhaust system

- ■ Exhaust bellows with connection flange
- ☐ Exhaust silencer with 10 dB(A) sound attenuation
- ☐ Exhaust silencer with 30 dB(A) sound attenuation
- ☐ Exhaust silencer with 40 dB(A) sound attenuation
- ☐ Y-connection-pipe

■ Represents standard features
☐ Represents optional features

Weights and dimensions



Drawing above for illustration purposes only, based on a standard open power 400 Volt engine-generator set. Lengths may vary with other voltages. Do not use for installation design. See website for unit specific template drawings.

System	Dimensions (LxWxH)	Weight (dry/less tank)
Open power unit (OPU)	6249 x 1887 x 2412 mm	18420 kg

Weights and dimensions are based on open power units and are estimates only. Consult the factory for accurate weights and dimensions for your specific engine-generator set.

Sound data

– Consult your local ***mtu*** distributor for sound data.

Emissions data

– Consult your local ***mtu*** distributor for emissions data.

Rating definitions and conditions

– Standby ratings apply to installations served by a reliable utility source. The standby rating is applicable to varying loads for the duration of a power outage. No overload capability for this rating. Ratings are in accordance with ISO 8528-1, ISO-3046-1, BS 5514 and AS 2789. Average load factor: ≤ 85%. Operating hours/year: max. 500.
– Consult your local ***mtu*** distributor for derating information.

Subject to change. | 32310691 | Edition 01/22 | BMC 2021-12.

Inhaltsverzeichnis
Contents

	Genset	Marine	O & G	Rail	C & I
Application	**x**				
Engine model	20V4000G74F				
Rated power [kW]	2670				
Rated speed [rpm]	1500				
Application group	3D				
Emission Stage/Optimisation	NEA-Singapure für ORDE				
Test cycle	D2				
Data Set No.	XZ59654100932				
Data Set Basis	NEA-Singapure für ORDE				
Fuel sulphur content [ppm]	5				

Unterschriftenweg	EDS erstellt	TETC Teamleiter	TET Leiter Org.-Einheit	Baureihen - Teamleiter	Baureihen Leiter Org.-Einheit	Freigabe im Windchill
Datum	29.06.2018	-	-	17.07.2018	17.07.2018	17.07.2018
Org.-Einheit	TETE	-	-	TKFV1	TKF	TKM
Name	Georg Rütz	-	-	Dr. Kneifel	Dr. Baumgarten	Zwisler

MTU
Friedrichshafen GmbH

WORD	Datum/ Date	Name
Erstell. Drawn	13.02.2018 13:53:27	link
Bearb. Change	17.07.2018 14:18:40	zwislerp
Inhalt Content	29.06.2018	Lenhof
Gepr. Checked		

Motortyp / Engine Type
20V4000G74F

Projekt-/Auftrags-Nr.
Project/Order No.
Verwendbar f.Typ
Applicable to Model

Format/Size
A3

Material-Nr./Material No.
EDS 4000 1273

Benennung/ Title
EMISSIONSDATENBLATT
EMISSION DATA SHEET

Zeichnungs-Nr./Drawing No. **ZNG00013330**

Blatt/ Sheet **1** von/of **8**

Aenderungsbeschreibung/Description of Revision Freigabe	Kommt vor/Frequency

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
-.3		In Arbeit

Beschreibung/Description

Revision *Change index*					

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G74F				
Application group	3D				
Emission Stage/Optimisation	NEA-Singapure für ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	5				
mg/mN³ values base on residual oxygen value of [%]	measured				

Motor Rohemissionen*

*Engine raw emissions**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/Pcycle)	[-]	1	0,75	0,50	0,25	0,10			
Power	[kW]	2670	2002	1335	667	267			
Speed (n/nN)	[-]	1	1	1	1	1			
Speed	[rpm]	1500	1500	1500	1500	1500			
Exhaust temperature after turbine	[°C]	528	498	463	366	224			
Exhaust massflow	[kg/h]	12872	11019	8525	5859	4658			
Exhaust back pressure (static)	[mbar]	84	58	30	12	6			
NOx	[g/kWh]	7,7	5,5	4,3	4,9	9,5			
	[mg/mN³]	2232	1390	941	762	735			
CO	[g/kWh]	0,5	0,6	0,8	1,5	4,3			
	[mg/mN³]	136	148	168	240	331			
HC	[g/kWh]	0,15	0,19	0,27	0,58	2,00			
	[mg/mN³]	44	47	60	91	154			
O2	[%]	8,0	9,3	10,5	12,9	16,1			
Particulate measured	[g/kWh]	0,04	0,05	0,10	0,24	0,77			
	[mg/mN³]	12	12	21	38	59			
Particulate calculated	[g/kWh]	-	-	-	-	-			
	[mg/mN³]	-	-	-	-	-			
Dust (only TA-Luft)	[mg/mN³]	-	-	-	-	-			
FSN	[-]	0,2	0,3	0,7	0,8	0,1			
NO/NO2**	[-]	-	-	-	-	-			
CO2	[g/kWh]	618,7	638,3	669,8	717,2	871,2			
	[mg/mN³]	181916	163142	146414	112329	67288			
SO2	[g/kWh]	0,002	0,002	0,002	0,002	0,003			
	[mg/mN³]	0,6	0,5	0,5	0,4	0,2			
CH2O	[g/kWh]	-	-	-	-	-			
	[mg/mN³]	-	-	-	-	-			

* Emission data measurement procedures are consistent with the respective emission evaluation process. Noncertified engines are measured to sales data (TVU/TEN) standard conditions.
These boundary conditions might not be representative for detailed dimensioning of exhaust gas aftertreatment, in this case it is recommended to contact the responsible department for more information.
Measurements are subject to variation. The nominal emission data shown is subject to instrumentation, measurement, facility, and engine-to-engine variations.
All data applies to an engine in new condition and were measured after combined exhaust streams. Over extended operating time deterioration may occur which might have an impact on emission. Exhaust temperature depends on engine ambient conditions.

** No standard test. To be measured on demand.

MTU Friedrichshafen GmbH

WORD	Datum/ Date	Name
Erstell. Drawn	13.02.2018 13:53:27	link
Bearb. Change	17.07.2018 14:18:40	zwislerp
Inhalt Content	29.06.2018	Lenhof
Gepr. Checked		

Motortyp / Engine Type: **20V4000G74F**

Projekt-/Auftrags-Nr. Project/Order No.

Verwendbar f.Typ Applicable to Model

Format/Size **A3**

Material-Nr./Material No.: **EDS 4000 1273**

Benennung/ Title: **EMISSIONSDATENBLATT**

EMISSION DATA SHEET

Zeichnungs-Nr./Drawing No.: **ZNG00013330**

Blatt/ Sheet **2** von/of **8**

Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
Freigabe	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
-.3		In Arbeit

Beschreibung/Description

Revision *Change index*					

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G74F				
Application group	3D				
Emission Stage/Optimisation	NEA-Singapure für ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	5				
mg/mN³ values base on residual oxygen value of [%]	measured				

Not to exceed Werte*

*not to exceed values**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/Pcycle)	[-]	1	0,75	0,50	0,25				
Power	[kW]	2670	2002	1335	667				
Speed (n/nN)	[-]	1	1	1	1				
Speed	[rpm]	1500	1500	1500	1500				
Exhaust back pressure (static)	[mbar]	84	58	30	12				
NOx	[g/kWh]	10,0	7,1	5,6	7,3				
	[mg/mN³]	2902	1807	1223	1143				
CO	[g/kWh]	0,8	1,0	1,5	3,1				
	[mg/mN³]	231	252	319	480				
HC	[g/kWh]	0,26	0,31	0,52	1,16				
	[mg/mN³]	75	80	114	182				
O2	[%]	8,0	9,3	10,5	12,9				
Particulate measured	[g/kWh]	0,06	0,08	0,15	0,36				
	[mg/mN³]	19	19	32	57				
CH2O	[g/kWh]	-	-	-	-				
	[mg/mN³]	-	-	-	-				

* Calculated values are not proven by tests and therefore the accuracy cannot be guaranteed.

Emissions data measurement procedures are consistent with those described in the applicable rules and standards.

The NOx, CO, HC and PM emission data tabulated here were taken from a single new engine under the test conditions shown above and are valid for the following conditions:

- Ambient air pressure 1 bar
- Air intake temperature approx. 25°C
- Rel. Humidity 30%-60%
- New Engine
- New standard- air filter
- Exhaust gas back pressure according the given value in this EDS
- Fuel according to EN 590 or US EPA 40CFR89
- Coolant and Lubricants according MTU Fuels and Lubricants Specification
- measured after combined exhaust streams.

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Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures, and instrumentation. Over time deterioration may occur which may have an impact on emission levels. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may results in elevated emission levels.

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Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
Freigabe	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
-.3		In Arbeit

MTU Friedrichshafen GmbH

WORD	Datum/ Date	Name
Erstell. Drawn	13.02.2018 13:53:27	link
Bearb. Change	17.07.2018 14:18:40	zwislerp
Inhalt Content	29.06.2018	Lenhof
Gepr. Checked		

Motortyp / Engine Type

20V4000G74F

Projekt-/Auftrags-Nr. Project/Order No.

Verwendbar f.Typ Applicable to Model

Format/Size **A3**

Material-Nr./Material No.

EDS 4000 1273

Benennung/ Title

EMISSIONSDATENBLATT

EMISSION DATA SHEET

Zeichnungs-Nr./Drawing No. **ZNG00013330**

Beschreibung/Description

Blatt/ Sheet **3** von/of **8**

Revision *Change index*					

Typzulassung für NEA Singapur

Type approval for NEA Singapore

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G74F				
Application group	3D				
Emission Stage/Optimisation	NEA-Singapure für ORDE				
Test cycle	D2				
Data Set	XZ59654100932				
Serial-Number	528102893				
Test-Report-Number	EDS40001273				
Test Location	210				
Date of test	01.07.2013				
Tester	MTU Friedrichshafen GmbH				
Date of EDS	29.06.2018				

Emissions Zykluswerte*

*Engine cycle emissions**

Emission	Cycle Value [g/kWh]	U.S. T2-Limit [g/kWh]
NOX	5,34	-
HC	0,31	-
NOX+NMHC	5,65	6,4
CO	0,86	3,5
PM	0,108	0,20

* Cycle values based on not rounded values, differences between single values and added values, e.g. NOX/HC/NOX+HC.
NMHC = 0,98*HC (40 CFR Part 1065.650 (c)(5))

Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
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Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
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Erstell. Drawn	13.02.2018 13:53:27	link
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Inhalt Content	29.06.2018	Lenhof
Gepr. Checked		

Motortyp / Engine Type
20V4000G74F

Projekt-/Auftrags-Nr.
Project/Order No.
Verwendbar f.Typ
Applicable to Model

Format/Size
A3

Material-Nr./Material No.
EDS 4000 1273

Benennung/ Title
EMISSIONSDATENBLATT
EMISSION DATA SHEET

Zeichnungs-Nr./Drawing No. **ZNG00013330**

Beschreibung/Description

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Revision *Change index*					

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G74F				
Application group	3D				
Emission Stage/Optimisation	NEA-Singapure für ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	5				
mg/mN³ values base on residual oxygen value of [%]	5				

Motor Rohemissionen*

*Engine raw emissions**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/Pcycle)	[-]	1	0,75	0,50	0,25	0,10			
Power	[kW]	2670	2002	1335	667	267			
Speed (n/nN)	[-]	1	1	1	1	1			
Speed	[rpm]	1500	1500	1500	1500	1500			
Exhaust temperature after turbine	[°C]	528	498	463	366	224			
Exhaust massflow	[kg/h]	12872	11019	8525	5859	4658			
Exhaust back pressure (static)	[mbar]	84	58	30	12	6			
NOx	[g/kWh]	7,7	5,5	4,3	4,9	9,5			
	[mg/mN³]	2751	1907	1435	1507	2390			
CO	[g/kWh]	0,5	0,6	0,8	1,5	4,3			
	[mg/mN³]	168	203	256	475	1077			
HC	[g/kWh]	0,15	0,19	0,27	0,58	2,00			
	[mg/mN³]	54	65	91	180	500			
O2	[%]	8,0	9,3	10,5	12,9	16,1			
Particulate measured	[g/kWh]	0,04	0,05	0,10	0,24	0,77			
	[mg/mN³]	15	16	32	75	193			
Particulate calculated	[g/kWh]	-	-	-	-	-			
	[mg/mN³]	-	-	-	-	-			
Dust (only TA-Luft)	[mg/mN³]	-	-	-	-	-			
FSN	[-]	0,2	0,3	0,7	0,8	0,1			
NO/NO2**	[-]	-	-	-	-	-			
CO2	[g/kWh]	618,7	638,3	669,8	717,2	871,2			
	[mg/mN³]	224170	223769	223274	222139	218787			
SO2	[g/kWh]	0,002	0,002	0,002	0,002	0,003			
	[mg/mN³]	0,7	0,7	0,7	0,7	0,7			
CH2O	[g/kWh]	-	-	-	-	-			
	[mg/mN³]	-	-	-	-	-			

* Emission data measurement procedures are consistent with the respective emission evaluation process. Noncertified engines are measured to sales data (TVU/TEN) standard conditions.
These boundary conditions might not be representative for detailed dimensioning of exhaust gas aftertreatment, in this case it is recommended to contact the responsible department for more information.
Measurements are subject to variation. The nominal emission data shown is subject to instrumentation, measurement, facility, and engine-to-engine variations.
All data applies to an engine in new condition and were measured after combined exhaust streams. Over extended operating time deterioration may occur which might have an impact on emission. Exhaust temperature depends on engine ambient conditions.

** No standard test. To be measured on demand.

WORD	Datum/ Date	Name
Erstell. Drawn	13.02.2018 13:53:27	link
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Motortyp / Engine Type: **20V4000G74F**

Projekt-/Auftrags-Nr. Project/Order No.

Verwendbar f.Typ Applicable to Model

Format/Size **A3**

Material-Nr./Material No.: **EDS 4000 1273**

Benennung/ Title: **EMISSIONSDATENBLATT**

EMISSION DATA SHEET

Zeichnungs-Nr./Drawing No.: **ZNG00013330**

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Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
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-.3		In Arbeit

Beschreibung/Description

Revision *Change index*					

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G74F				
Application group	3D				
Emission Stage/Optimisation	NEA-Singapure für ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	5				
mg/mN³ values base on residual oxygen value of [%]	5				

Not to exceed Werte*

*not to exceed values**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/Pcycle)	[-]	1	0,75	0,50	0,25				
Power	[kW]	2670	2002	1335	667				
Speed (n/nN)	[-]	1	1	1	1				
Speed	[rpm]	1500	1500	1500	1500				
Exhaust back pressure (static)	[mbar]	84	58	30	12				
NOx	[g/kWh]	10,0	7,1	5,6	7,3				
	[mg/mN³]	3576	2479	1866	2261				
CO	[g/kWh]	0,8	1,0	1,5	3,1				
	[mg/mN³]	286	345	486	950				
HC	[g/kWh]	0,26	0,31	0,52	1,16				
	[mg/mN³]	92	111	173	360				
O2	[%]	8,0	9,3	10,5	12,9				
Particulate measured	[g/kWh]	0,06	0,08	0,15	0,36				
	[mg/mN³]	23	26	48	112				
CH2O	[g/kWh]	-	-	-	-				
	[mg/mN³]	-	-	-	-				

* Calculated values are not proven by tests and therefore the accuracy cannot be guaranteed.

Emissions data measurement procedures are consistent with those described in the applicable rules and standards.

The NOx, CO, HC and PM emission data tabulated here were taken from a single new engine under the test conditions shown above and are valid for the following conditions:

- Ambient air pressure 1 bar
- Air intake temperature approx. 25°C
- Rel. Humidity 30%-60%
- New Engine
- New standard- air filter
- Exhaust gas back pressure according the given value in this EDS
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Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
Freigabe	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
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MTU Friedrichshafen GmbH

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Bearb. Change	17.07.2018 14:18:40	zwislerp
Inhalt Content	29.06.2018	Lenhof
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Motortyp / Engine Type: **20V4000G74F**

Projekt-/Auftrags-Nr. Project/Order No.

Verwendbar f.Typ Applicable to Model

Format/Size **A3**

Material-Nr./Material No.: **EDS 4000 1273**

Benennung/ Title: **EMISSIONSDATENBLATT**

EMISSION DATA SHEET

Zeichnungs-Nr./Drawing No.: **ZNG00013330**

Beschreibung/Description

Revision *Change index*					

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G74F				
Application group	3D				
Emission Stage/Optimisation	NEA-Singapure für ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	5				
mg/mN³ values base on residual oxygen value of [%]	15				

Motor Rohemissionen*

*Engine raw emissions**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/Pcycle)	[-]	1	0,75	0,50	0,25	0,10			
Power	[kW]	2670	2002	1335	667	267			
Speed (n/nN)	[-]	1	1	1	1	1			
Speed	[rpm]	1500	1500	1500	1500	1500			
Exhaust temperature after turbine	[°C]	528	498	463	366	224			
Exhaust massflow	[kg/h]	12872	11019	8525	5859	4658			
Exhaust back pressure (static)	[mbar]	84	58	30	12	6			
NOx	[g/kWh]	7,7	5,5	4,3	4,9	9,5			
	[mg/mN³]	1032	715	538	565	896			
CO	[g/kWh]	0,5	0,6	0,8	1,5	4,3			
	[mg/mN³]	63	76	96	178	404			
HC	[g/kWh]	0,15	0,19	0,27	0,58	2,00			
	[mg/mN³]	20	24	34	67	188			
O2	[%]	8,0	9,3	10,5	12,9	16,1			
Particulate measured	[g/kWh]	0,04	0,05	0,10	0,24	0,77			
	[mg/mN³]	6	6	12	28	72			
Particulate calculated	[g/kWh]	-	-	-	-	-			
	[mg/mN³]	-	-	-	-	-			
Dust (only TA-Luft)	[mg/mN³]	-	-	-	-	-			
FSN	[-]	0,2	0,3	0,7	0,8	0,1			
NO/NO2**	[-]	-	-	-	-	-			
CO2	[g/kWh]	618,7	638,3	669,8	717,2	871,2			
	[mg/mN³]	84064	83913	83728	83302	82045			
SO2	[g/kWh]	0,002	0,002	0,002	0,002	0,003			
	[mg/mN³]	0,3	0,3	0,3	0,3	0,3			
CH2O	[g/kWh]	-	-	-	-	-			
	[mg/mN³]	-	-	-	-	-			

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Erstell. Drawn	13.02.2018 13:53:27	link
Bearb. Change	17.07.2018 14:18:40	zwislerp
Inhalt Content	29.06.2018	Lenhof
Gepr. Checked		

Motortyp / Engine Type: **20V4000G74F**

Projekt-/Auftrags-Nr. Project/Order No.

Verwendbar f.Typ Applicable to Model

Format/Size: **A3**

Material-Nr./Material No.: **EDS 4000 1273**

Benennung/ Title: **EMISSIONSDATENBLATT**

EMISSION DATA SHEET

Zeichnungs-Nr./Drawing No.: **ZNG00013330**

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Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
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Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
-.3		In Arbeit

Beschreibung/Description

Revision *Change index*					

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G74F				
Application group	3D				
Emission Stage/Optimisation	NEA-Singapure für ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	5				
mg/mN³ values base on residual oxygen value of [%]	15				

Not to exceed Werte*

*not to exceed values**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/Pcycle)	[-]	1	0,75	0,50	0,25				
Power	[kW]	2670	2002	1335	667				
Speed (n/nN)	[-]	1	1	1	1				
Speed	[rpm]	1500	1500	1500	1500				
Exhaust back pressure (static)	[mbar]	84	58	30	12				
NOx	[g/kWh]	10,0	7,1	5,6	7,3				
	[mg/mN³]	1342	930	699	848				
CO	[g/kWh]	0,8	1,0	1,5	3,1				
	[mg/mN³]	107	129	182	356				
HC	[g/kWh]	0,26	0,31	0,52	1,16				
	[mg/mN³]	34	41	65	134				
O2	[%]	8,0	9,3	10,5	12,9				
Particulate measured	[g/kWh]	0,06	0,08	0,15	0,36				
	[mg/mN³]	9	10	18	42				
CH2O	[g/kWh]	-	-	-	-				
	[mg/mN³]	-	-	-	-				

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Emissions data measurement procedures are consistent with those described in the applicable rules and standards.

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- New standard- air filter
- Exhaust gas back pressure according the given value in this EDS
- Fuel according to EN 590 or US EPA 40CFR89
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The nominal emissions data shown is subject to instrumentation, measurement, facility and engine to engine variations. Emissions data is based on single operating points and thus cannot be used to compare to EPA regulations which use values based on a weighted cycle. Emissions data may vary depending on the type of exhaust gas aftertreatment that may be installed on the engine, therefore it is suggested that the engine manufacturer be contacted directly for further information.

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Inhalt Content	29.06.2018	Lenhof
Gepr. Checked		

Motortyp / Engine Type

20V4000G74F

Projekt-/Auftrags-Nr. Project/Order No.

Verwendbar f.Typ Applicable to Model

Format/Size **A3**

Material-Nr./Material No.

EDS 4000 1273

Benennung/ Title

EMISSIONSDATENBLATT

EMISSION DATA SHEET

Zeichnungs-Nr./Drawing No. **ZNG00013330**

Beschreibung/Description

Blatt/ Sheet **8** von/of **8**

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	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G94F				
Rated power [kW]	3088				
Rated speed [rpm]	1500				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
Data Set No.	XZ54954100066				
Data Set Basis	NEA Singapore for ORDE				
Fuel sulphur content [ppm]	15 (max. value of DIN EN 590)				

Unterschriftenweg	EDS erstellt	~~TETC Teamleiter~~	~~TET Leiter Org.-Einheit~~	Baureihen - Teamleiter	Baureihen Leiter Org.-Einheit	Freigabe im Windchill
Datum	18.02.2019	-	-	18.02.2019	18.02.2019	20.02.2019
Org.-Einheit	TKEE	-	-	TKFV	TKF	TKM
Name	T. Lenhof	-	-	Dr. Kneifel	Breuer	Link

Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
NO/NO2 Verhältnis mit aufgenommen sowie die Fußzeile ausgetauscht	

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MTU
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Erstell. Drawn	17.01.2019 13:19:28	link
Bearb. Change	20.02.2019 13:47:31	link
Inhalt Content	17.01.2019	Lenhof
Gepr. Checked		

Motortyp / Engine Type
20V4000G94F

Projekt-/Auftrags-Nr.
Project/Order No.

Verwendbar f.Typ
Applicable to Model

Format/Size
A3

Material-Nr./Material No.
EDS 4000 1186

Benennung/ Title
Emissionsdatenblatt
Emission Data Sheet

Zeichnungs-Nr./Drawing No. **ZNG00005098**

Beschreibung/Description NEA Singapore for ORDE

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Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G94F				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	15 (max. value of DIN EN 590)				
mg/mN³ values base on residual oxygen value of [%]	measured				

Motor Rohemissionen*

*Engine raw emissions**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/Pcycle)	[-]	1	0,75	0,50	0,25	0,10			
Power	[kW]	3090	2317	1545	772	309			
Speed (n/nN)	[-]	1	1	1	1	1			
Speed	[rpm]	1501	1501	1501	1501	1500			
Exhaust temperature after turbine	[°C]	460	427	436	394	262			
Exhaust massflow	[kg/h]	18500	15819	11326	7150	5284			
Exhaust back pressure (total)	[mbar]	52	35	16	5	0			
NOx	[g/kWh]	6,5	5,3	4,8	4,6	9,2			
	[mg/mN³]	1541	1108	918	686	735			
CO	[g/kWh]	0,2	0,3	1,1	1,4	3,2			
	[mg/mN³]	54	58	206	201	251			
HC	[g/kWh]	0,07	0,08	0,10	0,18	0,84			
	[mg/mN³]	16	16	18	27	66			
O2	[%]	10,3	11,5	12,0	13,3	16,0			
Particulate measured	[g/kWh]	0,02	0,02	0,09	0,14	0,06			
	[mg/mN³]	4	5	17	21	5			
Particulate calculated	[g/kWh]	-	-	-	-	-			
	[mg/mN³]	-	-	-	-	-			
Dust (only TA-Luft)	[mg/mN³]	-	-	-	-	-			
FSN	[-]	0,2	0,2	0,7	0,9	0,0			
NO/NO2**	[-]	24,5	20,7	16,0	9,3	6,7			
CO2	[g/kWh]	642,1	655,7	668,8	721,9	867,8			
	[mg/mN³]	149443	132804	125858	106693	68168			
SO2	[g/kWh]	0,006	0,006	0,006	0,007	0,008			
	[mg/mN³]	1,4	1,3	1,2	1,0	0,7			

* Please note that these data are physical and/or technical values only referring to and representing a normative defined operating condition. Any change in operating time and conditions will have impact on these values mentioned above and as well on engine behavior, which have to be reflected and assessed within the complete propulsion system especially in regard to emission compliance and product safety.
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and the customer will indemnify MTU on first demand for any third party claim out or in connection with this.

** No standard test. To be measured on demand.

Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
NO/NO2 Verhältnis mit aufgenommen sowie die Fußzeile ausgetauscht	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
g.1		In Arbeit

MTU
Friedrichshafen GmbH

WORD	Datum/ Date	Name
Erstell. Drawn	17.01.2019 13:19:28	link
Bearb. Change	20.02.2019 13:47:31	link
Inhalt Content	17.01.2019	Lenhof
Gepr. Checked		

Motortyp / Engine Type
20V4000G94F

Projekt-/Auftrags-Nr. Project/Order No.
Verwendbar f.Typ Applicable to Model
Format/Size **A3**

Material-Nr./Material No.
EDS 4000 1186

Benennung/ Title
Emissionsdatenblatt
Emission Data Sheet

Zeichnungs-Nr./Drawing No. **ZNG00005098**

Beschreibung/Description NEA Singapore for ORDE

Blatt/ Sheet **2** von/of **8**

Revision *Change index*	a	b	d	g	

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G94F				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	15 (max. value of DIN EN 590)				
mg/mN³ values base on residual oxygen value of [%]	measured				

Not to exceed Werte*

*not to exceed values**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/Pcycle)	[-]	1	0,75	0,50	0,25				
Power	[kW]	3090	2317	1545	772				
Speed (n/nN)	[-]	1	1	1	1				
Speed	[rpm]	1501	1501	1501	1501				
Exhaust back pressure (total)	[mbar]	52	35	16	5				
NOx	[g/kWh]	8,4	6,9	6,2	6,8				
	[mg/mN³]	2003	1440	1193	1029				
CO	[g/kWh]	0,4	0,5	2,1	2,7				
	[mg/mN³]	92	99	391	402				
HC	[g/kWh]	0,12	0,13	0,18	0,36				
	[mg/mN³]	27	27	34	54				
O2	[%]	10,3	11,5	12,0	13,3				
Particulate measured	[g/kWh]	0,03	0,04	0,13	0,21				
	[mg/mN³]	6	7	25	31				
SO2	[g/kWh]	0,009	0,009	0,010	0,010				
	[mg/mN³]	2,2	1,9	1,8	1,5				

* Please note that these data are physical and/or technical values only referring to and representing a normative defined operating condition. Any change in operating time and conditions will have impact on physical values and engine behavior, which have to be reflected and assessed within the complete propulsion system especially in regard to emission compliance and product safety.
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and the customer will indemnify MTU on first demand for any third party claim out or in connection with this.
Calculated values are not proven by tests and therefore the accuracy cannot be guaranteed.
Emissions data measurement procedures are consistent with those described in the applicable rules and standards.
The NOx, CO, HC and PM emission data tabulated here were taken from a single new engine under the test conditions shown above and are valid for the following conditions:
• Ambient air pressure 1 bar
• Air intake temperature approx. 25°C
• Rel. Humidity 30%-60%
• New Engine
• New standard- air filter
• Exhaust gas back pressure according the given value in this EDS
• Fuel according to EN 590 or US EPA 40CFR89
• Coolant and Lubricants according MTU Fuels and Lubricants Specification
Emissions data is based on single operating points and thus cannot be used to compare to EPA regulations which use values based on a weighted cycle.
Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures, and instrumentation. Over time deterioration may occur which may have an impact on emission levels.
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Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
NO/NO2 Verhältnis mit aufgenommen sowie die Fußzeile ausgetauscht	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
g.1		In Arbeit

MTU Friedrichshafen GmbH

WORD	Datum/ Date	Name
Erstell. Drawn	17.01.2019 13:19:28	link
Bearb. Change	20.02.2019 13:47:31	link
Inhalt Content	17.01.2019	Lenhof
Gepr. Checked		

Motortyp / Engine Type: **20V4000G94F**

Projekt-/Auftrags-Nr. Project/Order No.

Verwendbar f.Typ Applicable to Model

Format/Size: **A3**

Material-Nr./Material No.: **EDS 4000 1186**

Benennung/ Title: **Emissionsdatenblatt**

Emission Data Sheet

Zeichnungs-Nr./Drawing No.: **ZNG00005098**

Beschreibung/Description: NEA Singapore for ORDE

Blatt/ Sheet **3** von/of **8**

Revision *Change index*					

Typzulassung für NEA Singapur

Type approval for NEA Singapore

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G94F				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
Data Set	XZ54954100066				
Serial-Number	V122				
Test-Report-Number	EDS40001186				
Test Location	P126				
Date of test	29.03.2017				
Tester	MTU Friedrichshafen GmbH				
Date of EDS	04.04.2017				

Emissions Zykluswerte*

*Engine cycle emissions**

Emission	Cycle Value [g/kWh]	U.S. T2-Limit [g/kWh]
NOX	5,23	-
HC	0,12	-
NOX+NMHC	5,35	6,4
CO	0,77	3,5
PM	0,063	0,20

* Cycle values based on not rounded values, differences between single values and added values, e.g. NOX/HC/NOX+HC.
NMHC = 0,98*HC (40 CFR Part 1065.650 (c)(5))

Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
NO/NO2 Verhältnis mit aufgenommen sowie die Fußzeile ausgetauscht	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
g.1		In Arbeit

MTU
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Inhalt Content	17.01.2019	Lenhof
Gepr. Checked		

Motortyp / Engine Type
20V4000G94F

Projekt-/Auftrags-Nr. Project/Order No.
Verwendbar f.Typ Applicable to Model

Format/Size **A3**

Material-Nr./Material No.
EDS 4000 1186

Benennung/ Title
Emissionsdatenblatt
Emission Data Sheet

Zeichnungs-Nr./Drawing No. **ZNG00005098**

Beschreibung/Description NEA Singapore for ORDE

Blatt/ Sheet **4** von/of **8**

Revision *Change index*	d	e	f	g	

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G94F				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	15 (max. value of DIN EN 590)				
mg/mN³ values base on residual oxygen value of [%]	5				

Motor Rohemissionen*

*Engine raw emissions**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/Pcycle)	[-]	1	0,75	0,50	0,25	0,10			
Power	[kW]	3090	2317	1545	772	309			
Speed (n/nN)	[-]	1	1	1	1	1			
Speed	[rpm]	1501	1501	1501	1501	1500			
Exhaust temperature after turbine	[°C]	460	427	436	394	262			
Exhaust massflow	[kg/h]	18500	15819	11326	7150	5284			
Exhaust Volumetric Flowrate	[m³/s]	10,6	8,7	6,3	3,8	2,3			
Exhaust back pressure (total)	[mbar]	52	35	16	5	0			
NOx	[g/kWh]	6,5	5,3	4,8	4,6	9,2			
	[g/s]	5,5	3,4	2,1	1,0	0,8			
	[mg/mN³]	2306	1865	1624	1429	2350			
CO	[g/kWh]	0,2	0,3	1,1	1,4	3,2			
	[g/s]	0,2	0,2	0,5	0,3	0,3			
	[mg/mN³]	81	98	365	418	803			
HC	[g/kWh]	0,07	0,08	0,10	0,18	0,84			
	[g/s]	0,06	0,05	0,04	0,04	0,07			
	[mg/mN³]	24	27	32	56	210			
O2	[%]	10,3	11,5	12,0	13,3	16,0			
Particulate measured	[g/kWh]	0,02	0,02	0,09	0,14	0,06			
	[g/s]	0,02	0,01	0,04	0,03	0,01			
	[mg/mN³]	6	8	30	43	15			
Particulate calculated	[g/kWh]	-	-	-	-	-			
	[mg/mN³]	-	-	-	-	-			
Dust (only TA-Luft)	[mg/mN³]	-	-	-	-	-			
FSN	[-]	0,2	0,2	0,7	0,9	0,0			
NO/NO2**	[-]	24,5	20,7	16,0	9,3	6,7			
CO2	[g/kWh]	642,1	655,7	668,8	721,9	867,8			
	[g/s]	551,1	422,0	287,0	154,9	74,4			
	[mg/mN³]	223679	223481	222717	222190	217875			
SO2	[g/kWh]	0,006	0,006	0,006	0,007	0,008			
	[g/s]	0,002	0,002	0,001	0,001	0,000			
	[mg/mN³]	2,2	2,1	2,1	2,1	2,1			

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** No standard test. To be measured on demand.

Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
NO/NO2 Verhältnis mit aufgenommen sowie die Fußzeile ausgetauscht	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
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MTU
Friedrichshafen GmbH

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Erstell. Drawn	17.01.2019 13:19:28	link
Bearb. Change	20.02.2019 13:47:31	link
Inhalt Content	17.01.2019	Lenhof
Gepr. Checked		

Motortyp / Engine Type
20V4000G94F

Projekt-/Auftrags-Nr.
Project/Order No.
Verwendbar f.Typ
Applicable to Model

Format/Size
A3

Material-Nr./Material No.
EDS 4000 1186

Benennung/ Title
Emissionsdatenblatt
Emission Data Sheet

Zeichnungs-Nr./Drawing No. **ZNG00005098**

Beschreibung/Description NEA Singapore for ORDE

Blatt/ Sheet **5** von/of **8**

Revision *Change index*	d	e	f	g	

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G94F				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	15 (max. value of DIN EN 590)				
mg/mN³ values base on residual oxygen value of [%]	5				

Not to exceed Werte*

*not to exceed values**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/Pcycle)	[-]	1	0,75	0,50	0,25				
Power	[kW]	3090	2317	1545	772				
Speed (n/nN)	[-]	1	1	1	1				
Speed	[rpm]	1501	1501	1501	1501				
Exhaust back pressure (total)	[mbar]	52	35	16	5				
NOx	[g/kWh]	8,4	6,9	6,2	6,8				
	[g/s]	7,2	4,5	2,7	1,5				
	[mg/mN³]	2998	2425	2111	2144				
CO	[g/kWh]	0,4	0,5	2,1	2,7				
	[g/s]	0,3	0,3	0,9	0,6				
	[mg/mN³]	138	167	694	836				
HC	[g/kWh]	0,12	0,13	0,18	0,36				
	[g/s]	0,10	0,09	0,08	0,08				
	[mg/mN³]	41	46	61	112				
O2	[%]	10,3	11,5	12,0	13,3				
Particulate measured	[g/kWh]	0,03	0,04	0,13	0,21				
	[g/s]	0,02	0,02	0,06	0,05				
	[mg/mN³]	10	13	44	64				
SO2	[g/kWh]	0,009	0,009	0,010	0,010				
	[g/s]	0,004	0,003	0,002	0,001				
	[mg/mN³]	3,2	3,2	3,2	3,2				

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The NOx, CO, HC and PM emission data tabulated here were taken from a single new engine under the test conditions shown above and are valid for the following conditions:
• Ambient air pressure 1 bar
• Air intake temperature approx. 25°C
• Rel. Humidity 30%-60%
• New Engine
• New standard- air filter
• Exhaust gas back pressure according the given value in this EDS
• Fuel according to EN 590 or US EPA 40CFR89
• Coolant and Lubricants according MTU Fuels and Lubricants Specification
Emissions data is based on single operating points and thus cannot be used to compare to EPA regulations which use values based on a weighted cycle.
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Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
NO/NO2 Verhältnis mit aufgenommen sowie die Fußzeile ausgetauscht	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
g.1		In Arbeit

MTU Friedrichshafen GmbH

WORD	Datum/ Date	Name
Erstell. Drawn	17.01.2019 13:19:28	link
Bearb. Change	20.02.2019 13:47:31	link
Inhalt Content	17.01.2019	Lenhof
Gepr. Checked		

Motortyp / Engine Type: **20V4000G94F**

Projekt-/Auftrags-Nr. Project/Order No.

Verwendbar f.Typ Applicable to Model

Format/Size: **A3**

Material-Nr./Material No.: **EDS 4000 1186**

Benennung/ Title: **Emissionsdatenblatt**

Emission Data Sheet

Zeichnungs-Nr./Drawing No.: **ZNG00005098**

Beschreibung/Description: NEA Singapore for ORDE

Blatt/ Sheet **6** von/of **8**

Revision *Change index*	g				

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G94F				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	15 (max. value of DIN EN 590)				
mg/mN³ values base on residual oxygen value of [%]	15				

Motor Rohemissionen*

*Engine raw emissions**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/Pcycle)	[-]	1	0,75	0,50	0,25	0,10			
Power	[kW]	3090	2317	1545	772	309			
Speed (n/nN)	[-]	1	1	1	1	1			
Speed	[rpm]	1501	1501	1501	1501	1500			
Exhaust temperature after turbine	[°C]	460	427	436	394	262			
Exhaust massflow	[kg/h]	18500	15819	11326	7150	5284			
Exhaust Volumetric Flowrate	[m³/s]	10,6	8,7	6,3	3,8	2,3			
Exhaust back pressure (total)	[mbar]	52	35	16	5	0			
NOx	[g/kWh]	6,5	5,3	4,8	4,6	9,2			
	[g/s]	5,5	3,4	2,1	1,0	0,8			
	[mg/mN³]	865	699	609	536	881			
CO	[g/kWh]	0,2	0,3	1,1	1,4	3,2			
	[g/s]	0,2	0,2	0,5	0,3	0,3			
	[mg/mN³]	30	37	137	157	301			
HC	[g/kWh]	0,07	0,08	0,10	0,18	0,84			
	[g/s]	0,06	0,05	0,04	0,04	0,07			
	[mg/mN³]	9	10	12	21	79			
O2	[%]	10,3	11,5	12,0	13,3	16,0			
Particulate measured	[g/kWh]	0,02	0,02	0,09	0,14	0,06			
	[g/s]	0,02	0,01	0,04	0,03	0,01			
	[mg/mN³]	2	3	11	16	6			
Particulate calculated	[g/kWh]	-	-	-	-	-			
	[mg/mN³]	-	-	-	-	-			
Dust (only TA-Luft)	[mg/mN³]	-	-	-	-	-			
FSN	[-]	0,2	0,2	0,7	0,9	0,0			
NO/NO2**	[-]	24,5	20,7	16,0	9,3	6,7			
CO2	[g/kWh]	642,1	655,7	668,8	721,9	867,8			
	[g/s]	551,1	422,0	287,0	154,9	74,4			
	[mg/mN³]	83879	83805	83519	83321	81703			
SO2	[g/kWh]	0,006	0,006	0,006	0,007	0,008			
	[g/s]	0,002	0,002	0,001	0,001	0,000			
	[mg/mN³]	2,2	2,1	2,1	2,1	2,1			

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** No standard test. To be measured on demand.

Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
NO/NO2 Verhältnis mit aufgenommen sowie die Fußzeile ausgetauscht	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
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MTU
Friedrichshafen GmbH

WORD	Datum/ Date	Name
Erstell. Drawn	17.01.2019 13:19:28	link
Bearb. Change	20.02.2019 13:47:31	link
Inhalt Content	17.01.2019	Lenhof
Gepr. Checked		

Motortyp / Engine Type
20V4000G94F

Projekt-/Auftrags-Nr.
Project/Order No.

Verwendbar f.Typ
Applicable to Model

Format/Size
A3

Material-Nr./Material No.
EDS 4000 1186

Benennung/ Title
Emissionsdatenblatt
Emission Data Sheet

Zeichnungs-Nr./Drawing No. **ZNG00005098**

Blatt/ Sheet **7** von/of **8**

Beschreibung/Description NEA Singapore for ORDE

Revision *Change index*	g				

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G94F				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	15 (max. value of DIN EN 590)				
mg/mN³ values base on residual oxygen value of [%]	15				

Not to exceed Werte*

*not to exceed values**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/Pcycle)	[-]	1	0,75	0,50	0,25				
Power	[kW]	3090	2317	1545	772				
Speed (n/nN)	[-]	1	1	1	1				
Speed	[rpm]	1501	1501	1501	1501				
Exhaust back pressure (total)	[mbar]	52	35	16	5				
NOx	[g/kWh]	8,4	6,9	6,2	6,8				
	[g/s]	7,2	4,5	2,7	1,5				
	[mg/mN³]	1125	909	792	804				
CO	[g/kWh]	0,4	0,5	2,1	2,7				
	[g/s]	0,3	0,3	0,9	0,6				
	[mg/mN³]	51	63	260	314				
HC	[g/kWh]	0,12	0,13	0,18	0,36				
	[g/s]	0,10	0,09	0,08	0,08				
	[mg/mN³]	15	17	23	42				
O2	[%]	10,3	11,5	12,0	13,3				
Particulate measured	[g/kWh]	0,03	0,04	0,13	0,21				
	[g/s]	0,02	0,02	0,06	0,05				
	[mg/mN³]	4	5	17	24				
SO2	[g/kWh]	0,009	0,009	0,010	0,010				
	[g/s]	0,004	0,003	0,002	0,001				
	[mg/mN³]	3,2	3,2	3,2	3,2				

* Please note that these data are physical and/or technical values only referring to and representing a normative defined operating condition. Any change in operating time and conditions will have impact on physical values and engine behavior, which have to be reflected and assessed within the complete propulsion system especially in regard to emission compliance and product safety.
These data are representing the contractual agreed scope of the MTU engine at the time of delivery.
MTU doesn´t take any responsibility or liability neither out or in connection with the contract nor on any other basis
• beyond these specified operating conditions of the engine
• and for any installation/modification of the entire propulsion system by the customer itself or any third party
and the customer will indemnify MTU on first demand for any third party claim out or in connection with this.
Calculated values are not proven by tests and therefore the accuracy cannot be guaranteed.
Emissions data measurement procedures are consistent with those described in the applicable rules and standards.
The NOx, CO, HC and PM emission data tabulated here were taken from a single new engine under the test conditions shown above and are valid for the following conditions:
• Ambient air pressure 1 bar
• Air intake temperature approx. 25°C
• Rel. Humidity 30%-60%
• New Engine
• New standard- air filter
• Exhaust gas back pressure according the given value in this EDS
• Fuel according to EN 590 or US EPA 40CFR89
• Coolant and Lubricants according MTU Fuels and Lubricants Specification
Emissions data is based on single operating points and thus cannot be used to compare to EPA regulations which use values based on a weighted cycle.
Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures, and instrumentation. Over time deterioration may occur which may have an impact on emission levels.
MTU Friedrichshafen GmbH has made efforts to ensure that the information in this data sheet is accurate, but reserves the right to amend specifications and information without notice and without obligation or liability. No liability for any errors, facts or opinions is accepted. Customers must satisfy themselves as to the suitability of this product for their application. No responsibility for any loss as a result of any person placing reliance on any material contained in this data sheet will be accepted.

Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
NO/NO2 Verhältnis mit aufgenommen sowie die Fußzeile ausgetauscht	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
g.1		In Arbeit

MTU Friedrichshafen GmbH

WORD	Datum/ Date	Name
Erstell. Drawn	17.01.2019 13:19:28	link
Bearb. Change	20.02.2019 13:47:31	link
Inhalt Content	17.01.2019	Lenhof
Gepr. Checked		

Motortyp / Engine Type: **20V4000G94F**

Projekt-/Auftrags-Nr. Project/Order No.

Verwendbar f.Typ Applicable to Model

Format/Size: **A3**

Material-Nr./Material No.: **EDS 4000 1186**

Benennung/ Title: **Emissionsdatenblatt**

Emission Data Sheet

Zeichnungs-Nr./Drawing No.: **ZNG00005098**

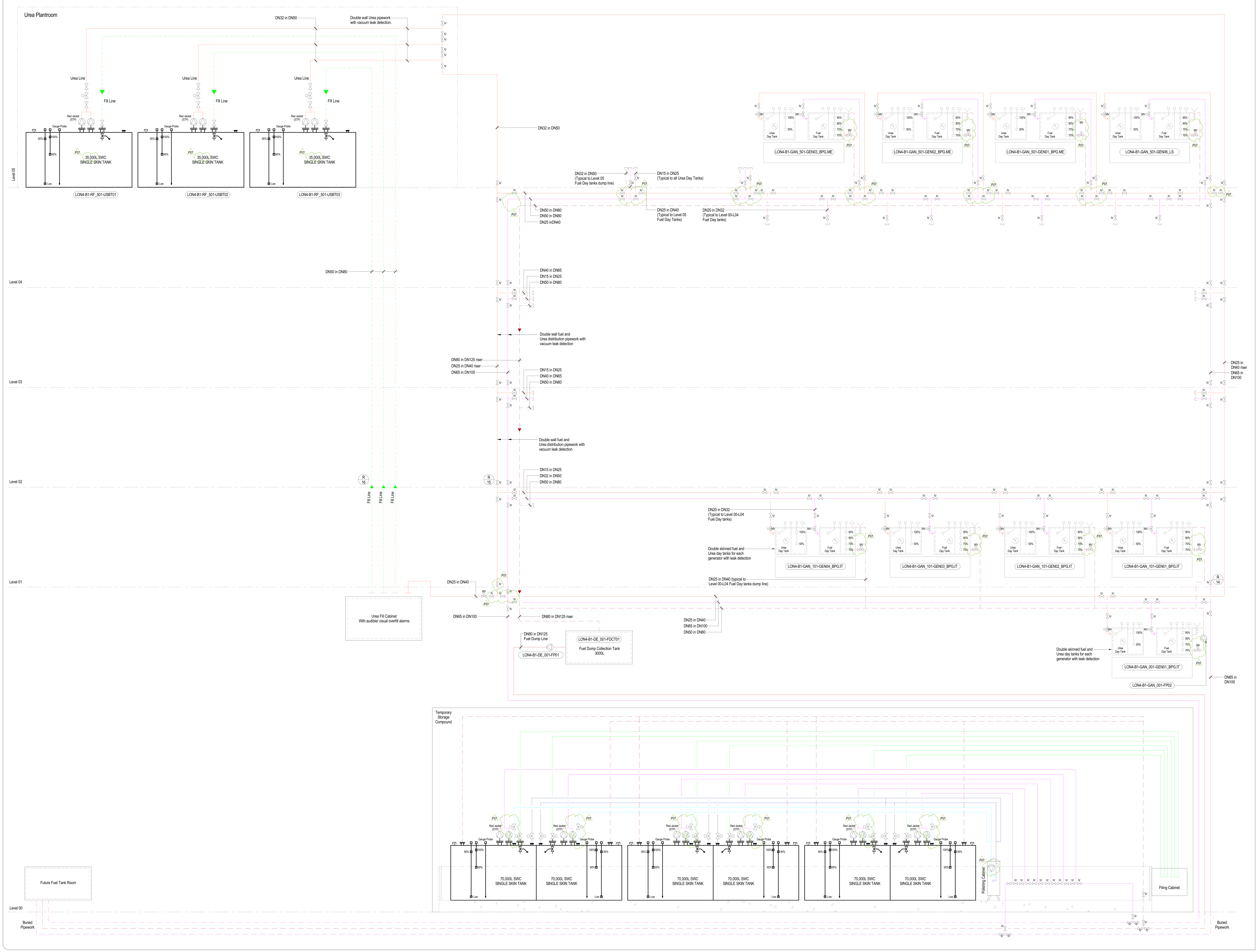
Beschreibung/Description: NEA Singapore for ORDE

Blatt/ Sheet **8** von/of **8**

APPENDIX C

Fuel Schematic

A0 - Do not scale



General Notes

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2. Any discrepancies between the drawings and other documents should be brought to the attention of the engineer.
3. This drawing is not an installation drawing. It is the Contractors responsibility to make final coordinated installation shop drawings.
4. The contents of this drawing shall be read in conjunction with the current revisions of Architectural, Civil, Structural, Mechanical, Electrical, Security, Telcoms drawings and all relevant sections of the specifications.

Legend

- IV Isolation Valve
- NRV Non-Return Valve
- MV Motorised Valve
- Pressure Gauge
- Strainer
- Fuel Pump
- Urea Pump
- Fuel Fill Line
- Urea Pipe
- Fuel Pipe
- Fuel Polishing Pipe (Flow)
- Fuel Polishing Pipe (Return and Transfer)
- Double Skinned Fuel Dump Line

Notes

Stage 4A - Hoover Issue

- Revised room and asset naming based on DCS20109-COLT-ZZ-XX-XX-SP-K-00004 Version P21.

This drawing shows the phase 1 installation

Rev	Details	By / Chkd / App	Date
P07	STAGE 4A - COMMENT & DCIM UPDATE	JM / PA / OO	07 / 02 / 24
P06	STAGE 4A - HOOVER DESIGN	JM / PA / OO	22 / 12 / 23
P05	STAGE 4A - FIT OUT	JM / PA / OO	24 / 04 / 23
P04	STAGE 4A - JULY '22 UPDATE	JM / PA / OO	20 / 07 / 22
P03	STAGE 4A - JULY '22 UPDATE	JM / PA / OO	18 / 07 / 22
P02	STAGE 4A ISSUE	JM / PA / OO	22 / 02 / 22
P01	STAGE 3 - 100% ISSUE	JM / PA / OO	17 / 12 / 21
P01.2	STAGE 3 - 90% ISSUE	JM / PA / OO	19 / 11 / 21
P01.1	STAGE 3 - 50% ISSUE	JM / PA / OO	15 / 10 / 21

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Newcastle Upon Tyne
NE1 3PL, United Kingdom
www.arup.com

Fire Consultant
salus Building Compliance without Complexity
Primea House, Marina Court
Maple Drive, Hinckley, Leicestershire
LE10 3BF, United Kingdom
www.salusai.co.uk

Security Designer
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Project Title
London 4

Drawing Title
Fuel Schematic
Building 01

Project Status
STAGE 4A ISSUE

Discipline	Status Code
PLUMBING	**S4**

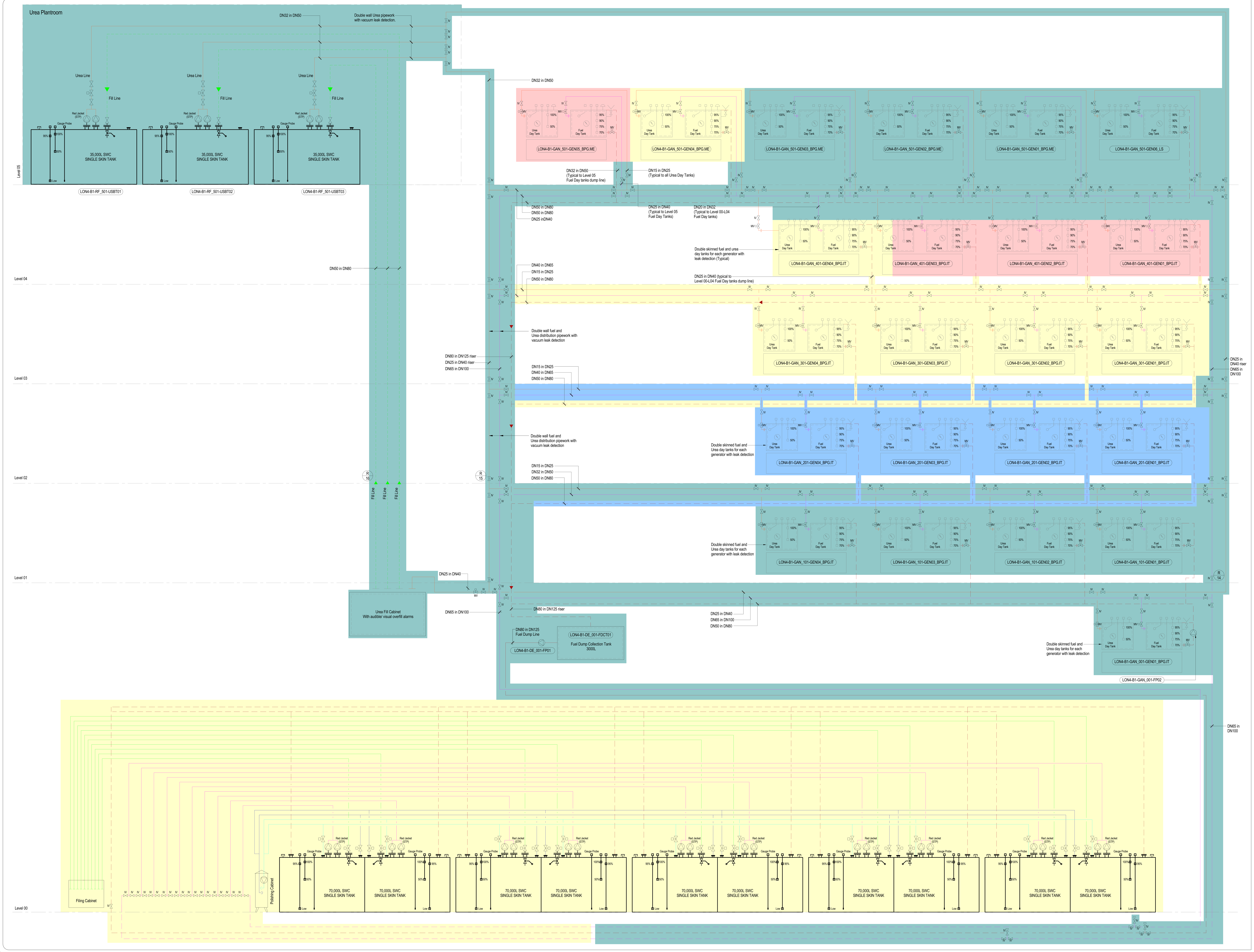
Project Number	Scale @ A0	Revision
P20114	**NTS**	**P07**

Drawing Number
DCS20109-BWE-DC-B1-ZZ-SD-P-54102
Project — Originator — Functional Breakdown — Spatial Breakdown — Level — Form — Discipline — Number

APPENDIX D

Fuel Phasing Schematic

A0 - Do not scale



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Legend

- Isolation Valve
- Non-Return Valve
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- Pressure Gauge
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- Urea Pump
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- Urea Pipe
- Fuel Pipe
- Fuel Polishing Pipe (Flow)
- Fuel Polishing Pipe (Return and Transfer)
- Double Skinned Fuel Dump Line
- PHASE 1
- PHASE 2
- PHASE 3
- PHASE 4

Notes

Stage 4A - Hoover Issue

- Revised room and asset naming based on DCS20109-COLT-ZZ-XX-XX-SP-K-00004 Version P21.

Rev	Details	By / Chkd / App	Date
P06	STAGE 4A - COMMENT & DCIM UPDATE	JM / PA / OO	07 / 02 / 24
P05	STAGE 4A - HOOVER DESIGN	JM / PA / OO	22 / 12 / 23
P04	STAGE 4A - FIT OUT	JM / PA / OO	24 / 04 / 23
P03	STAGE 4A - JULY '22 UPDATE	JM / PA / OO	18 / 07 / 22
P02	STAGE 4A ISSUE	JM / PA / OO	22 / 02 / 22
P01	STAGE 3 - 100% ISSUE	JM / PA / OO	17 / 12 / 21
P01.1	STAGE 3 - 90% ISSUE	JM / PA / OO	19 / 11 / 21

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Security Designer

Control Risks
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London, SE1 2QG, United Kingdom
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Project Title

London 4

Drawing Title

Fuel Phasing Schematic
Building 01

Project Status

STAGE 4A ISSUE

Discipline	Status Code
PLUMBING	**S4**

Project Number	Scale @ A0	Revision
P20114	**NTS**	**P06**

Drawing Number

DCS20109-BWE-DC-B1-ZZ-SD-P-54103

Project — Originator — Functional Breakdown — Spatial Breakdown — Level — Form — Discipline — Number

APPENDIX E

NOx Warranty Letter

The Power People. Power Systems House, Malvern Road, Maidenhead, Berkshire SL6 7RE Tel: 01628 503900

Date: June 10th 2022

ISG Group,
Aldgate House,
33 Aldgate High Street,
London
EC3N 1AG

Our Ref COLT LON 4 Hayes

For the attention of Mr Randip Grewal

Dear Sirs

Re: COLT, LON 4 Hayes

We are fully compliant with the requirements of the EA as to this statement from the EA.

The EA would expect that the combustion plant for the new Data Centre Generators would be to the latest emission standards for standby plant unless otherwise justified under BAT. The minimum appropriate is the "TA-Luft 2g" or Tier II USEPA with guaranteed emission: The has requirements for 2000mg/m3 NOx; 650mg/m3 for CO; particulates and dust 130 mg/m3 and 150 mg/m3 for hydrocarbons (all at reference conditions and 5% O)

The above statement is to be the base level requirement before any after treatment is introduced. More specifically the reference to Tier II USEPA as at the engine size specified the 2g requirement is not achievable however the US EPA Tier II is.

The Generators have a factory spec sheet detailing at least one of the standards and this would be meet BAT requirements in this case.

Consequently, we believe we have compliance with the requirements from the London Borough of Hilingdon

Caveat: meeting EA BAT is no guarantee of gaining an EPR permit; a full AQ impact assessment (like the local authority of Hillingdon) is still needed.

Yours Faithfully

John Farrow

John Farrow
Regional Sales Manager
AVK Ltd
Mobile 07710 850143

APPENDIX F

Drainage Plan

Colt Data Centre Services

London 4, Hayes

Sustainable Urban Drainage Strategy

DCS20109-ARUP-DC-XX-XX-RP-C-52001

P05 | 22 August 2022

Job number 281528

Ove Arup & Partners Ltd
Central Square
Forth Street
Newcastle upon Tyne NE1 3PL
United Kingdom
www.arup.com

ARUP

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Water Cycle Strategy

1 Introduction

Ove Arup & Partners Limited (Arup) has been commissioned by Colt Data Centre Services (COLT DCS) to provide Civil and Structural Engineering (CSE) design services for the proposed London 4, Hayes Data Centre. Arup's scope includes the production of a Drainage Strategy in support of the planning application.

This report should be read in conjunction with the Arup Flood Risk Assessment (FRA) DCS20109-ARUP-DC-XX-XX-RP-C-00012.

The drainage design has been developed following the principles set out in the Hillingdon SuDS Design and Evaluation Guide[1]. A copy of The London Sustainable Drainage Proforma has been completed to accompany this application. Refer to Appendix A.

Following the planning submission, London Borough of Hillingdon provided a pre-commencement condition (No. 14) related to sustainable water management. This condition is outlined below, along with an associated table which directs the reader to the appropriate section of this report that demonstrates compliance with the condition.

Condition 14 - Sustainable Water Management
Prior to the commencement of development (excluding demolition and site clearance), a scheme for the provision of sustainable water management in line with the approved document reference 'DCS20109-ARUP-DC-XX-XX-RP-C-52001 Rev. P02 Sustainable Urban Drainage Strategy (Dated 24th March 2022)' shall be submitted to, and approved in writing by the Local Planning Authority. The scheme shall clearly demonstrate how it manages water and demonstrate ways of controlling the surface water on site by providing information on:

[1] London Borough of Hillingdon SuDS Design and Evaluation Guide, 2018

Condition	Section confirming compliance
a) Sustainable Drainage features:	
i. Surface water discharge - the submitted drainage strategy must identify the proposed method and location of discharging collected surface water from the site in accordance with the hierarchy set out in Policy SI 13 of the London Plan (2021). Where the proposal does not utilise the most sustainable solution, justification must be provided. Any proposal that includes a connection to a private sewer network should provide details of the condition and ownership of the entire drainage route to a public sewer or ordinary watercourse.	Refer to Section 3.1. The point of discharge has not been changed. The subsequent findings of the soakaway tests confirmed infiltration not to be viable. The drainage will connect into the Thames Water sewer.
ii. SuDS - the submitted drainage strategy should incorporate Sustainable Drainage System (SuDS) elements that are embedded, where practicable, within the landscaping plan for the development. Preference should be given to above-ground SuDS elements that control water at source and provide wider biodiversity, water quality and amenity benefits.	Refer to Section 3.3. A full SUDS suitability review has been carried out detailing the reasoning behind each SUDS system being or not being incorporated.
iii. Runoff rates - surface water discharge from the site must be no greater than greenfield runoff rates at a variety of return periods including 1 in 1 year, 1 in 30, 1 in 100, and 1 in 100 plus 40% climate change.	Refer to Section 3.4.1. A table of greenfield rates and proposed flow rates has been included.
iv. Drainage calculations - include calculations to demonstrate that the volume of storage and size of drainage features provided is adequate to control surface water for a range of storm duration and rainfall intensities for events up to and including the critical 1 in 100 plus 40% climate change rainfall event.	Refer to Section 3.4.1 and Appendix H.
v. Exceedance routes - provide a plan showing the route surface water will take through the development for rainfall events exceeding the 1 in 100 year event. Where it is intended to store water on the ground surface, the maximum extent of overland flooding should be mapped and include details on flow paths, depths and velocities. Safe access and egress for the site must be demonstrated.	Refer to Appendix G for the flood route drawing. Exceedance drainage has been added in strategic places to provide additional flood resilience in failure of permeable surfaces or in exceedance of the below ground drainage system.

b) Long-term management and maintenance of the drainage system.	
i. Provide a Management and Maintenance Plan for the drainage system that includes clear plans showing all the drainage network above and below ground, and identifies the responsibility of different parties for each component of the drainage network.	Refer to Appendix F for SuDS Management and Maintenance plan and Appendix G for drainage drawings. All drainage within the site boundary except for the Thames Water Sewer is to be maintained by Colt.
ii. Include details of the necessary inspection regimes and maintenance frequencies.	Refer to Appendix F.
c) Minimise water use.	
i. incorporate water saving measures and equipment.	Refer to Section 5 and the Water Cycle Strategy produced by the M&E Engineer in Appendix I. Confirmation that the design of water saving measures and equipment (designed by the M&E engineer) is included within the scheme.
ii. provide details of how rain and/or grey water will be recycled and reused in the development.	Refer to Section 5. Confirmation that a 35m3 rainwater harvesting tank (internal to the building and designed by the M&E engineer) has been designed to be dedicated to meet 100% of the WC flushing requirements of the building 1 under normal seasonal conditions.

Note: Revision P03 has been updated with further information as the design has progressed. Minor amendments have been made to the text in the body of the report to reflect consultation responses, GI findings and minor strategy updates. Design drawings in Appendix G have been updated to reflect further design development of the scheme and the drainage strategy, which has also been reflected in the drainage hydraulic modelling.

2 Project and Site Details

2.1 Location

The site is located off Beaconsfield Road, Hayes, UB4 0SL in the London Borough of Hillingdon (LBH). It is situated in the Brook Industrial Estate. The site is currently occupied by the Optimum Data Centre, Tudor Works and Veetec Motor Group Facility shown in Figure 1 below.

The site is approximately 2.12 hectares (ha) and is bounded by Yeading Brook to the east, Beaconsfield Road and Hayes and Yeading Football Club to the south, Express Reinforcements and other commercial buildings to the west and industrial warehouses/structures to the north.

The approximate National Grid reference of the site is TQ116 801.

Figure 1 Existing Site Plan

2.2 Existing Topography

A topographical survey was undertaken by Catsurveys between May and July 2021.

The ground levels within the site are generally flat.8 The highest elevations are on the western boundary at circa 30m falling to circa 29m AOD at the south-eastern boundary.

2.3 Existing Drainage

A Ground Penetrating Radar (GPR) survey was undertaken by Catsurveys between May and July 2021. Figure 3 illustrates the drainage shown on the GPR survey.

Arup have also obtained historic drainage records for the Optimum Data Centre site and Thames Water (TW) asset records for the area. Refer to Appendix B for existing drainage information.

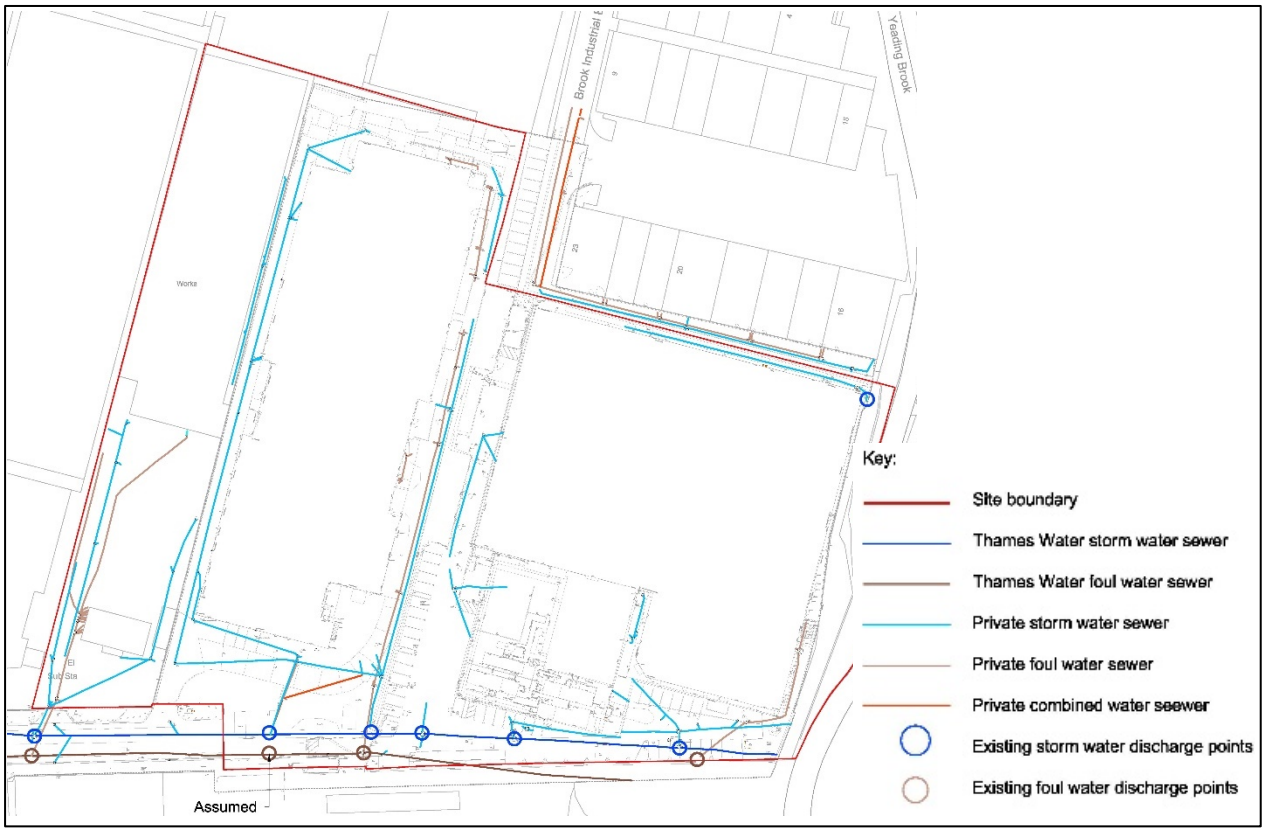


Figure 2 Existing Discharge Points Based on GPR Survey

2.3.1 Public System

The drainage records and GPR survey illustrate that a 525mm diameter TW storm water sewer crosses the site to the south, running from Beaconsfield Road to an outfall into Yeading Brook.

The records also show a 225mm diameter TW foul water sewer running east to west through the southern corner of the Optimum Data Centre plot.

As part of the legal searches for the site, TW have confirmed there are no current wayleave/easement agreements for these sewers.

2.3.2 Private System

2.3.2.1 Surface Water

The GPR and drainage records illustrate the site to be fully drained.

The Optimum Data Centre, Tudor Work and Veetec Motor Group Facility predominantly discharge to the TW storm water sewer in the south of the site. The following connections to the TW site are shown on the GPR survey:

- Optimum Data Centre
  - Two 300mm diameter connections within the site
  - Two 150mm diameter connections within the site (assumed only to pick up singular gullies)
- Tudor Work
  - 150mm diameter connection within the site
  - 100mm diameter connection within the site

The survey information has not picked up manholes in these areas, it is possible the chambers are buried, or the connection has been formed using “T” junctions.

- Veetec Motor Group Facility 225mm diameter connection to a manhole in Beaconsfield Road

A small area to the northeast of the Optimum Data Centre is shown to discharge directly to the Yeading Brook via a 225mm diameter outfall.

Oil interceptors are only known to be present upstream of the two connections from the Optimum Data Centre to the TW sewer and there are no known flow controls.

2.3.2.2 Foul Water

Foul water from the Tudor works, Optimum Data Centre and Veetec Motor Group Facility are shown on the GPR to each discharge to the TW foul sewer to the south of the site via three separate 150mm diameter connections.

The GPR survey of the Tudor work also highlighted the presence of a 100mm diameter foul sewer which followed the alignment of the 100mm storm water connection. It is assumed that the foul drain continues to connect to the TW foul water sewer and is not connected into the surface water system however this has not been proven by the survey.

2.4 Proposed Development

2.4.1 Masterplan

Colt DCS propose to redevelop the existing brownfield site to deliver a new data centre campus including: two data centre buildings; associated energy and electricity infrastructure, buildings, and plant; security gatehouse, systems and enclosures; works to the highway, car parking and cycle parking; hard and soft landscaping; as well as associated infrastructure, ancillary office use, and associated external works.

The masterplan is shown in Figure 3. Refer to Appendix C for Detailed Development Layout and Landscaping Plans.

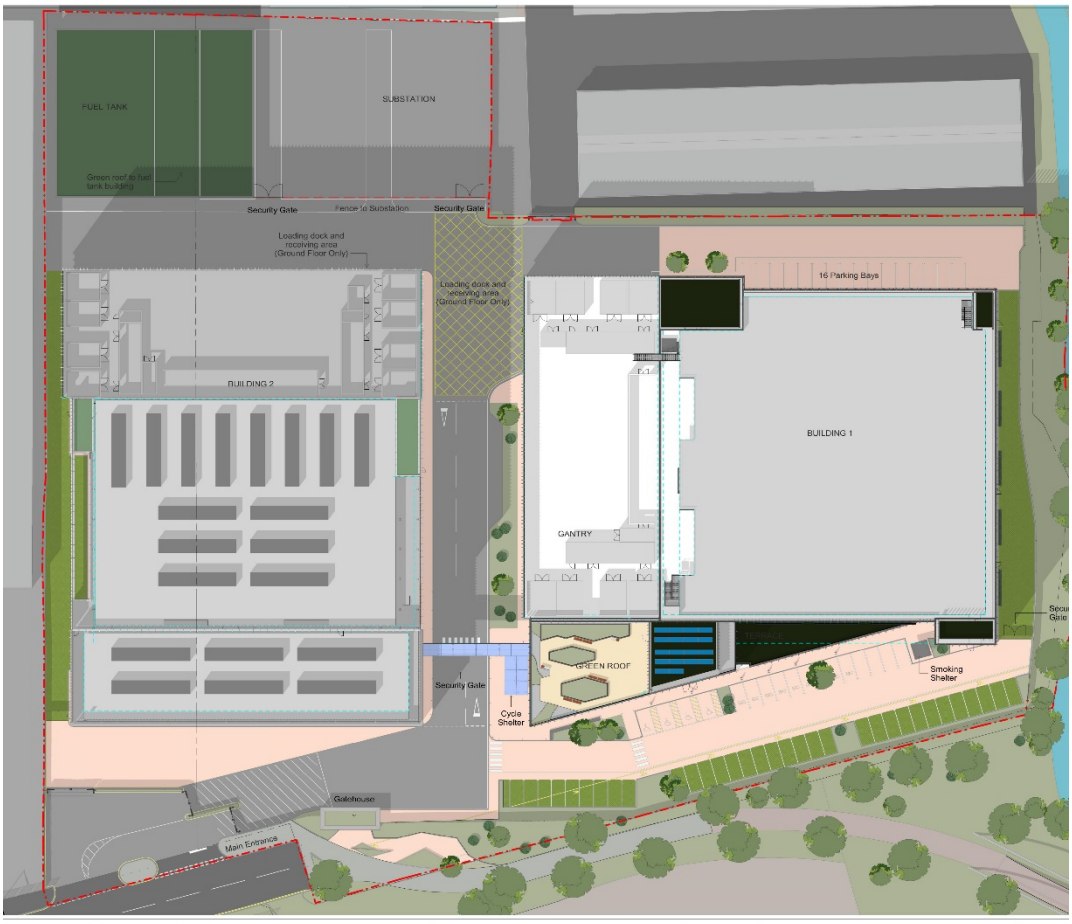


Figure 3 Proposed Development

A pre-planning application was issued to LBH in June 2021 and subsequent discussions have been held with the planning officers around the masterplan and design strategies.

2.4.2 Site Selection and Design

The site meets the wider technical and logistical requirements for the construction and operation of a data centre (access to infrastructure and services).

The footprint of the data centre buildings and external areas shown in the development plan have been reviewed during the design stages to ensure space planning has been carried out efficiently and the minimum footprints are shown for a viable data centre on this site. Whilst there is significant plant and associated logistical space required to support this type of development (i.e., offices, logistics, parking, maintenance etc.), the areas shown for the inclusion Sustainable Drainage Systems have been maximised in line with the required constraints this type of development presents.

3 Proposed Storm Water Drainage

The principles of the drainage strategy have been set out in accordance with national and local planning guidance.

In advance of the full planning application consultation has been undertaken with Victoria Boorman, the Lead Local Flood Authority (LLFA) officer for LBH to review the suitability of the drainage principles.

3.1 Drainage Hierarchy

In accordance with the CIRIA SuDS Manual (C753)[2] and National Planning Practice Guidance[3] stormwater disposal should follow the hierarchy of discharge.

1st. Discharge to the ground

2nd. Discharge to a watercourse

3rd. Discharge to a surface water sewer/drain

4th. Discharge to a combined sewer

Geotechnical investigations (GI) were carried out during late 2021.

The site sits above London Clay which is present at varying depths of circa 2-12m Below Ground Level (BGL). The site investigation suggests variable geology on site, with the presence of a possible drift filled hollow identified due to an increased presence of superficial deposits identified in the northwest corner of the site. In addition to this, water seepage has also been identified throughout the London Clay. This poses the risk of hydraulic continuity between the upper and lower aquifer which is to be confirmed by the outstanding groundwater monitoring.

It is considered that due to variable water levels, infiltration rates and potential contamination, it is not deemed appropriate to discharge storm water via infiltration.

The existing storm water outfall to the Yeading Brook at the north of the site is insufficiently sized and too shallow to serve the proposed development.

It is thus proposed that the site discharge indirectly to the Yeading Brook via one of the existing 300mm diameter TW sewer connections. This will limit disruption to the river and adjacent planting, while utilising existing infrastructure and creating a single controlled point of discharge for the whole development.

[2] The SuDS Manual (C753), CIRIA, December 2015
[3] National Planning Policy Framework, Ministry of Housing, Communities & Local Government, July 2021

3.2 Discharge Restrictions

3.2.1 Planning Policy

LBH Local Plan Part 2[4] Policy DMEI 10 states that:

"All major new build developments, as well as minor developments in Critical Drainage Areas or an area identified at risk from surface water flooding must be designed to reduce surface water run-off rates to no higher than the pre-development greenfield run-off rate in a 1:100-year storm scenario, plus an appropriate allowance for climate change for the worst storm duration. The assessment is required regardless of the changes in impermeable areas and the fact that a site has an existing high run-off rate will not constitute justification"

As a development with a site boundary exceeding 1 hectare London 4 is considered a Major Development in line with NPPF[5] and must be restricted to Greenfield discharge in line with DMEI 10.

3.2.2 Predevelopment Flow Rates

The greenfield equivalent runoff rates for the site are summarised in Table 1. The greenfield rates have been calculated using the IH124 method tool on the HR Wallingford's UK SuDS website[6]. The tool is based on the Institute of Hydrology Report 124[7], flood estimation for small catchments.

Restricting the site to greenfield equivalent provides a significant betterment on existing brownfield discharge rates which have also been summarised in Table 1. The existing brownfield rates for the site have been estimated using a simple MicroDrainage model based on the available Ground Penetrating Radar Survey of the existing site. Where required conservative assumptions have been made.

Of the existing 2.2 ha site boundary, 2.1 ha is currently fully drained hardstanding with no known flow control devices. The remaining area forms the densely vegetated embankment falling into the Yielding Brook, which will remain undeveloped. This area has been discounted from the calculations.

[4] London Borough of Hillingdon A Vision For 2026 Local Plan: Part 1 Strategic Policies, November 2012
[5] National Planning Policy Framework, Ministry of Housing, Communities & Local Government, July 2021
[6] https://www.uksuds.com/drainage-calculation-tools/greenfield-runoff-rate-estimation accessed July 2021
[7] Report No.124 Flood Estimation for Small Catchments, Institute of Hydrology, June 1994

Return Period	Brownfield (l/s)	Greenfield Flow (l/s)	Betterment
Area (ha)	2.122		
Qbar		8.8	
1 in 1 year	165.5	7.5	95%
1 in 30 year	326.6	20.3	94%
1 in 100 year	367.4	28.2	92%

Table 1 Brownfield and Greenfield Flow Rates

Copies of these calculations are included within in Appendix D

In line with Approach 1 set out in the Hillingdon SuDS Design and Evaluation Guide. Arup propose to utilise a complex flow control. This will allow the discharge from the site to vary between the allowable 1-year and 30-year greenfield flow rates set out in Table 1. This allows the site to better mimic the greenfield equivalent rates for each respective storm and minimise storage requirements. This is covered in further detail in Section 3.4.1.

3.2.3 Thames Water Capacity

A Pre-Planning Enquiry has been made to TW to ensure that the drainage strategy is acceptable in principle prior to the planning application.

TW's response (DS6085964) is included in Appendix E confirming there are no objections to discharging the site to the TW sewer at the greenfield rates set out in Table 1. This was also confirmed as part of the planning consultation process.

3.3 SuDS Measures

In line with the National Planning Policy Framework[8]:

"major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate".

The drainage strategy has been developed in conjunction with the masterplan and a comprehensive multidisciplinary review has been undertaken to identify where sustainable drainage features have the potential to be implemented. Table 2 below provides a summary of this review.

3.3.1 SuDS Suitability

SuDS Feature	Suitability	Pollution Reduction	Storage Provided	Comment
Building features				
Rainwater harvesting	✓	x	x	A rainwater harvesting (RWH) strategy is being developed by the M&E Engineer. Rainwater harvesting from the entire roof area of Building 1(excluding the gantry) is collected in a 35m³ RWH tank at ground floor with associated distribution pump. The rainwater harvesting tank for building 1 is dedicated to meet 100% WC flushing requirements under normal seasonal conditions.
Green roof or blue roof	✓ (Limited)	✓	✓	Intensive/ extensive green roof area has been proposed above the stair/lift cores of both buildings, the office space of building one, above the lowered portion of building 2, in addition to the fuel tank building (area of which is still under development). Additional planted areas will also be provided on the office roof terrace Application of green roof space in other areas of the buildings is limited due to the high quantity of mechanical plant required at roof level which will be spread over two levels. The location of the plant on the roof has been determined based on the plant replacement strategy and Computational Fluid Dynamics (CFD) calculations. This results in the mechanical plant being spread across the whole of the gantry and data hall roof area. Green or blue roofs are thus unsuitable above these areas.

[8] National Planning Policy Framework, Ministry of Housing, Communities & Local Government, July 2021

SuDS Feature	Suitability	Pollution Reduction	Storage Provided	Comment
Green wall	✓	x	x	Green walls are proposed to the southern and eastern elevations of Building 1. They will be incorporated into the building drainage system designed by the M&E engineer.
Soft or permeable landscaping features				
Filter drain	✓	✓	Low	Filter drains have been included to capture runoff from permeable paving areas.
Filter strip	x	✓	✓	Due to the size of the vehicles and cranes which will need to access the site and the extent of their vehicular movements, the site will need to be predominantly hard surfaced leaving limited room for filter strips or swales.
Swale	x	✓	✓	
Rainwater Garden/ Bioretention	x	✓	✓	The limited areas to the north of the site which are free from vehicular movements and may be soft landscaped are constrained by the number of existing and proposed utilities in these areas and their depth requirements. This includes Thames's Water assets which they have communicated should not be located close to trees/bushes/shrubs etc. Rain Gardens are thus not considered to be suitable in these areas.
Permeable Paving	✓	✓	✓	Permeable paving has been considered for areas other than those areas frequently used by HGVs. The pavement design has been considered in line with vehicular loading and the design levels of utilities.
Detention basin	x	✓	✓	There is insufficient space for basins, ponds, or wetlands within the site. The only amenable space is to the north western corner which is at the furthest point from the site outfall and will be adjacent to the proposed substation and potential fuel storage This area is therefore unsuitable.
Pond	x	✓	✓	
Wetland	x	✓	✓	
Hard landscaping features				
Kerb Drains, Rills and Channels	✓	x	x	The design incorporates channel drains as the primary capture for areas not drained by permeable paving. They will also be included in areas of permeable paving to provide resilience in the event of exceedance events or drainage failures.
Below-ground features				
Storage Tank	✓	x	✓	To meet the greenfield flow restrictions set out in Table 1 storm water storage has been utilised. Due to spatial availability within the site the only means of achieving this will be through storage tanks.

SuDS Feature	Suitability	Pollution Reduction	Storage Provided	Comment
Hydrocarbon Separators	✓	✓	x	A full retention Class 1 oil interceptor will be incorporated at the downstream extent of the network and in the area of refuelling to the north of Building 2.

Table 2 Suitability of SuDS Features

3.3.2 Contamination Risks

The following contamination risks are present within the site:

- Glycol

  The chilled water system will have 20% glycol. Handling units will be located on the main roof area. The M&E engineer has confirmed under normal use and operation glycol will not enter the surface water system. The rainwater harvesting system used for the main roof will however include a glycol alarm. As this would only occur under failure of the plant this event is considered unlikely and has not been considered further within the design.

- Fuel

  Fuel storage will be required within the site to power backup generators serving the data centre. These Tanks are being designed by the M&E engineer in consultation with the Environment Agency. The fuel tanks are proposed to be in the northeast corner of the site. The tanks will be within a framed structure preventing rainwater egress and risk of rainwater contamination. The structure will be bunded and a separator will be provided locally to provide containment of any potential spillages.

3.3.3 Site Improvements Through SUDS

3.3.3.1 Water quality

The previous industrial usages within the site present many possible sources of water contamination. This includes the following:

- Multiple large above and below ground fuel tanks. Some are not bunded and show evidence of spillages.
- Potential Asbestos containing materials (ACMs) within the Tudor Works and Veetec Motor roofs, drainpipes, and guttering.
- Fly tipped materials of unknown origin in addition to bins and waste materials included wooden pallets, tyres, paint cans, empty oil drums and possible ACMs.
- The site housed multiple industrial units including vehicle servicing and maintenance shops, housing degreasers, paint booths and compressors.

The only known level of water treatment within the three sites is hydrocarbon separators located within the existing data centre. The classification for the separators is unknown.

The development of the London 4 data centre will ensure that all high-risk areas will be appropriately contained and managed. This will include the use of at source capture and separation of potential fuel spills around the fuelling points.

Most of the site area will be at low risk of contamination. Water capture will predominantly occur on the commercial roofs or within the low trafficked areas.

Permeable paving is proposed across low trafficked areas which is effective at removing suspended solids, metals, and hydrocarbons.

The use of green roof spaces above the areas described in section 3.3 will also be effective at removing any potential contaminants in this area.

To provide an additional level of treatment a Class 1 full retention separator with an overflow alarm has been proposed at the downstream extent of the network, as well as an additional localised interceptor at the refuelling point to the north of building 2.

It is considered that the development will have a significant benefit to water quality against the existing scenario.

3.3.3.2 Biodiversity

Due to the nature of the site and the required vehicular and crane movements, there is limited opportunity to implement large areas of ground level greening. London 4 will however include green walls to the southern elevations of buildings and a number of green roofs.

Along the eastern and western boundaries of the site cellular grassed paving is proposed to provide some greening. Although these areas will not be used often, they must remain accessible for fire tenders.

Small, grassed areas and above ground / movable planters are also proposed in the areas surrounding the carparking to the south of the site and between the two buildings. Movable planters are also proposed to the north. These areas have been constrained by the proposed utilities, existing Thames Water sewer and HGV/crane requirements.

Through these measures it is considered the development will have a benefit to biodiversity against the existing scenario.

3.3.3.3 Amenity

The green walls and green roofs will be dominant aspects on the frontage of the buildings and recreational area of the office. These large SuDS will have a significant impact on the wellbeing of staff, visitors, and neighbours, softening the appearance of the building and connecting people to water and biodiversity.

The use of permeable paving where possible throughout the site and appropriate design of the below ground storage will also ensure a pleasant and safe environment for users preventing existing surface water flooding.

It is considered that the development will have a benefit to amenity.

3.3.4 SuDS Maintenance

To sustain functionality of the drainage systems and suitably safeguard water quality, biodiversity, and amenity all drainage systems must be appropriately maintained.

The maintenance and management of all surface water drainage will be the responsibility of the appointed Contractor during the construction phase and maintenance period and the responsibility of Colt Data Centre Services thereafter.

Maintenance responsibilities have been set out in Appendix F for both parties.

3.4 Proposed Drainage Design and Evaluation

The surface water drainage system has been designed in accordance with the recommendations set out in:

- BS EN 752:2017 - *Drain and sewer systems outside buildings - Sewer system management*, and
- The Building Regulations 2010, Approved Document H – *Drainage and waste disposal*.

Proposed drainage layouts and details showing the proposed surface water strategy for the development are included in Appendix G.

Drainage within the substation area is to be developed by a specialist contractor. Performance requirements will be placed on the contractor to ensure that all surfaces are suitably graded to ensure that surface water is conveyed to the drainage system, the drainage systems are designed to adequately convey the flows entering the system and features shall be designed to meet self-cleansing velocities.

The contractor will also be required to install a full retention oil interceptor for the substation area, in line with Environment Agency policy document PPG 3 and ensure that the substation drainage is designed and constructed to ensure that contaminates are intercepted, both during construction and operations, and prevented from entering surrounding watercourses and ground water systems.

3.4.1 Drainage Network Modelling

The drainage has been modelled using MicroDrainage. Refer to Appendix H for summary of results.

The following constraints /conservative assumptions have been applied:

- Paved external surfaces and the building roofs have been modelled as 100% impermeable.
- Cellular grassed paving areas have also been modelled as 100% impermeable to develop conservative storage requirements.
- The summer and winter volumetric runoff coefficients have been modelled as 1.
- Storage within the permeable paving, green roof and rainwater harvesting have not been included within the model.
- An additional 40% rainfall intensity has been incorporated in line with climate change allowances set out in the National Planning Policy Framework [9].

[9] National Planning Policy Framework, Ministry of Housing, Communities & Local Government, July 2021

- The drainage has been modelled and designed to the following storm events:
    - 1 in 30-year storm. – Designed for no flooding
    - 1 in 100-year storm – Designed for no flooding to property
- The model has been analysed for storm events ranging between 15 mins to 7 days duration.

A Hydro Brake flow control device has been proposed to limit flows from the site to 7.5l/s up to the 1 in 30-year storm event. This is the equivalent of the 1 in 1-year greenfield runoff rate.

Above the maximum water level for the 1 in 30-year storm event an additional orifice is proposed. This will allow events above the 1 in 30-year storm to discharge up to an additional 12.8l/s. This will equate to a combined discharge of 20.3l/s which is the equivalent of the 1 in 30-year greenfield runoff rate.

Based on the MicroDrainage modelling approximately 1,658m^3 of storage is required through the network. This has been accommodated within the proposals using approximately 1,563m^3 storage volume within the attenuation tanks, with the remaining volume provided throughout the network of manholes and pipes.

The site is highly spatial constrained by the number of utilities required to service the development. The tanks have therefore had to be distributed around the network.

The total volume of the tanks shown in the design have accounted for a 95% void capacity within typical geocellular systems. An additional 5% increase in volume above that simulated and described above has also been allowed for the possible need to locally remove geocellular units around utility crossings / other external constraints as the design progresses. This additional 5% volume will be reviewed once the utility designs have been completed and the geocellular manufacturer designs have been concluded.

Therefore, based on the Microdrainage modelling and the system design, the following discharge rates are proposed for the development:

	Greenfield Rate (l/s)	**Proposed Discharge (l/s)**	**Predicated Flood Risk based on Modelling**
1 year	7.5	7.5	
30 years	20.3	7.5	No flood predicted in model
100years + 40% CC	28.2	20.3	3m3 of flooding predicted in model on FPC01 which is in the most southeaster corner of the site. Any exceedance in this area would overtop the kerb line and run directly into the adjacent watercourse. However, due to the conservative approach demonstrated to modelling, this is deemed negligible and will be accommodated within the permeable surfacing of which the volume has not been modelled.

Table 3 Proposed Discharge Rates

4 Foul Drainage

The foul water drainage system has also been designed in accordance with the recommendations set out in BS EN 752:2017 and The Building Regulations 2010, Approved Document H in addition to BS 12056 – *Gravity drainage systems inside buildings.*

Proposed drainage layouts and details showing the proposed foul water strategy for the development are included in Appendix G.

The proposals for the site are based on the foul water from London 4 utilising one of the existing foul connections to the Thames Water foul sewer.

4.1 Thames Water Capacity

A Pre-Planning Enquiry has been made to TW to ensure that the foul drainage would be acceptable in principle prior to the planning application.

TWs response (DS6085964) is included in Appendix E confirming there are no objections to discharging to their sewer. This was also confirmed as part of the planning consultation process.

TW have made their own assessment of the foul flow rates for the site based on the Stage 2 development schedule.

5 Minimising Water Use

The development has been designed to ensure that water use is kept to a minimum through both efficient specification and incorporation of water recycling features.

All sanitaryware meets the requirements for the first credit of BREEAM Wat.1, namely:

- WC effective flushing volume shall be 4.5 litres or less.
- All taps (except kitchen taps, cleaners sink, external taps) shall have a maximum flowrate not exceeding 6 litres/min at a pressure of 0.3MPa.

In addition to this, each wet room has PIR sensing and solenoid valves to inhibit flow to the room when there is no occupancy.

Water recycling has also been incorporated into the design through the collection of rainwater from the entire building 1 roof area (excluding gantry) which is directed to a 35m3 rainwater harvesting tank and associated distribution pump within a plant room located in the south of building 1.

The rainwater harvesting tank has been designed to be dedicated to meeting 100% of the WC flushing requirements of the building 1 under normal seasonal conditions.

Due to the main welfare facilities being located within Building 1 and only limited lavatory facilities located within Building 2, no rainwater harvesting is proposed within Building 2.

6 Conclusion

It is assumed that ground conditions are unsuitable for infiltration due to variable groundwater levels and inconclusive infiltration tests.

It is proposed that the London 4 development discharges via one of the sites' existing connections to TW storm water sewer, which outfalls to the Yeading Brook within the south of the site.

A pre-planning enquiry has been submitted to TW. TW confirmed there is sufficient capacity within the network for the site to discharge in line with local planning policy at the equivalent greenfield rates.

SuDS features have been incorporated into the development where possible. External surfaces will drain by a combination of permeable paving and green roofs. Traditional systems, such as gullies and linear channels are however required in some locations due the operational requirements of the site and for exceedance/resilience. A full retention class one interceptor is proposed at the downstream extent of the site, with localised interceptor(s) at the fuel area to the north.

Storm water storage will need to be provided in the form of geocellular tanks which will be distributed around the site to suit utility coordination.

An allowance of 40% increased rainfall intensity has been incorporated into the design to account for potential climate change.

It is proposed that foul water from the site discharges to one of the existing connections to the TW foul water sewer. TW have confirmed that this is acceptable based on their own assessment of potential flows from the site.

Appendix A

The London Sustainable Drainage Proforma

HILLINGDON LONDON

GREATER**LONDON**AUTHORITY

LoDEG

1. Project & Site Details

Project / Site Name (including sub-catchment / stage / phase where appropriate)	London 4
Address & post code	Beaconsfield Road Hayes London Greater London UB4 0SL
OS Grid ref. (Easting, Northing)	E 511528 N 180175
LPA reference (if applicable)	38421/PRC/2021/132
Brief description of proposed work	Redevelopment of existing data centre, Tudor works and Veetec sites into two new data centres buildings with parking and energy centre.
Total site Area	22000 m^2
Total existing impervious area	21220 m^2
Total proposed impervious area	21220 m^2
Is the site in a surface water flood risk catchment (ref. local Surface Water Management Plan)?	A small area of Surface water flooding is shown on the flood maps to the west of the existing data centre. The site levels and drainage have been developed to reduce risk.
Existing drainage connection type and location	Storm Data centre : 2no 300mm dia to TW Sewer 225mm dia outfall to Yeading Brook Tudor Works : 150mm & 100mm dia to to TW SW Veetec : 225mm dia to to TW SW Foul 150mm dia to TW sewer for each building (x3)
Designer Name	Jamie Temple
Designer Position	Engineer
Designer Company	Arup

2. Proposed Discharge Arrangements

2a. Infiltration Feasibility

Superficial geology classification	Langley Silt or Lynch Hill Gravels
Bedrock geology classification	London Clay
Site infiltration rate	- m/s
Depth to groundwater level	Approx 3 m below ground level
Is infiltration feasible?	No

Test terminated due to low infiltration rate during time limit

2b. Drainage Hierarchy

	Feasible (Y/N)	*Proposed (Y/N)*
1 store rainwater for later use	Y	Y
2 use infiltration techniques, such as porous surfaces in non-clay areas	N	N
3 attenuate rainwater in ponds or open water features for gradual release	N	N
4 attenuate rainwater by storing in tanks or sealed water features for gradual release	Y	Y
5 discharge rainwater direct to a watercourse	Y	N
6 discharge rainwater to a surface water sewer/drain	Y	Y
7 discharge rainwater to the combined sewer.	N	N

2c. Proposed Discharge Details

Proposed discharge location	To TW Sewer via existing eastern data centre connection
Has the owner/regulator of the discharge location been consulted?	Yes - Pre-planing enquiry to Thames Water confirmed capacity to discharge at greenfield rates.

3. Drainage Strategy

3a. Discharge Rates & Required Storage

	Greenfield (GF) runoff rate (l/s)	*Existing discharge rate (l/s)*	*Required storage for GF rate (m^3)*	*Proposed discharge rate (l/s)*
Qbar	8.84			
1 in 1	7.51	165.5		7.5
1 in 30	20.33	326.6		7.5
1 in 100	28.19	367.4		20.3
1 in 100 + CC			1657	20.3
Climate change allowance used		40%		
3b. Principal Method of Flow Control		Hydro-Brake @ outfall level restricted to 1yr greenfield rate (7.5l/s) Orifice @ 30yr water level restricted to combined 30yr greenfield rate (12.8l/s)		

3c. Proposed SuDS Measures

	Catchment area (m^2)	*Plan area (m^3)*	*Storage vol. (m^3)*
Rainwater harvesting	3400		35 (Discounted from Hydraulic Modelling)
Infiltration systems	N/A 0		0
Green roofs	1617 +Fuel Tank Building	1617 +Fuel Tank Building	Discounted from Hydraulic Modelling
Blue roofs	N/A 0	0	0
Filter strips	N/A 0	0	0
Filter drains	N/A 0	0	0
Bioretention / tree pits	N/A 0	0	0
Pervious pavements	3404	3404	Discounted from Hydraulic Modelling
Swales	N/A 0	0	0
Basins/ponds	N/A 0	0	0
Attenuation tanks	N/A 0		1657 0
Total	**0**	**0**	**0**

4. Supporting Information

4a. Discharge & Drainage Strategy	*Page/section of drainage report*
Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results	Refer to Section No. 3.1 Page No. 7
Drainage hierarchy (2b)	Refer to Section No. 3.1 Page No. 7
Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location	Refer to Appendix E.
Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations	Refer to Section 3.4.1 P16 and Appendix H .
Proposed SuDS measures & specifications (3b)	Refer to Section No. 3.3.1 P10 And Appendix G
4b. Other Supporting Details	*Page/section of drainage report*
Detailed Development Layout	Refer to Appendix C / Appendix G
Detailed drainage design drawings, including exceedance flow routes	Refer to Appendix G
Detailed landscaping plans	Refer to Appendix C
Maintenance strategy	Refer to Appendix F
Demonstration of how the proposed SuDS measures improve:	Refer to Section No. 3.3.3 Page No. 13
a) water quality of the runoff?	
b) biodiversity?	
c) amenity?	

Appendix B

Existing Drainage

CommercialDW
Drainage & Water Enquiry

Thames Water Property Searches

SearchFlow Limited
42
Kings Hill Avenue
Kings Hill
West Malling
ME19 4AJKent

Search address supplied	Optimum Data Centre, Tudor Works, Beaconsfield Road, HAYES, UB4 0SL
Your reference	1107077.00014
Our reference	CDWS/CDWS Standard/2020_4272783
Received date	8 October 2020
Search date	11 November 2020

Keeping you up-to-date

Commercial Drainage and Water Enquiry

The Commercial Drainage and Water Enquiry is specifically designed for those purchasing or leasing land or commercial property.

With comprehensive information regarding water and sewerage services and infrastructure assets, combined with appropriate guarantees for commercial property and land transactions, the Commercial Drainage and Water Enquiry mitigates risk and provides peace of mind for commercial property professionals and their advisers.

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0845 070 9148

COMMERCIALDW
DRAINAGE AND WATER ENQUIRY

CommercialDW
Drainage & Water Enquiry

Thames Water Property Searches

Question		Summary Answer
Maps, Wayleaves, Easements, Manhole Cover and Invert levels		
1.1	Where relevant, please include a copy of an extract from the public sewer map.	Map Provided
1.2	Where relevant, please include a copy of an extract from the map of waterworks.	Map Provided
1.3	Is there a wayleave/easement agreement giving Thames Water the right to lay or maintain assets or right of access to pass through private land in order to reach the Company's assets?	No
1.4	On the copy extract from the public sewer map, please show manhole cover, depth and invert levels where the information is available.	See Details
Drainage		
2.1	Does foul water from the property drain to a public sewer?	See Details
2.2	Does surface water from the property drain to a public sewer?	See Details
2.3	Is a surface water drainage charge payable?	See Details
2.4	Does the public sewer map indicate any public sewer, disposal main or lateral drain within the boundaries of the property?	Yes
2.4.1	Does the public sewer map indicate any public pumping station or any other ancillary apparatus within the boundaries of the property?	No
2.5	Does the public sewer map indicate any public sewer within 30.48 metres (100 feet) of any buildings within the property?	See Details
2.5.1	Does the public sewer map indicate any public pumping station or any other ancillary apparatus within the 50metres of any buildings within the property?	No
2.6	Are any sewers or lateral drains serving, or which are proposed to serve the property, the subject of an existing adoption agreement or an application for such an agreement?	No
2.7	Has a sewerage undertaker approved or been consulted about any plans to erect a building or extension on the property over or in the vicinity of a public sewer, disposal main or drain?	No
2.8	Is the building which is or forms part of the property, at risk of internal flooding due to overloaded public sewers?	Not At Risk
2.9	Please state the distance from the property to the nearest boundary of the nearest sewage treatment works.	6.193 Kilometres
Water		
3.1	Is the property connected to mains water supply?	See Details
3.2	Are there any water mains, resource mains or discharge pipes within the boundaries of the property?	Yes
3.3	Is any water main or service pipe serving or which is proposed to serve the property, the subject of an existing adoption agreement or an application for such an agreement?	No
3.4	Is the property at risk of receiving low water pressure or flow?	See Details
3.5	What is the classification of the water supply for the property?	See Details
3.6	Please include details of the location of any water meter serving the property.	See Details

Question		Summary Answer
Charging		
4.1.1	Who are the sewerage undertakers for the area?	Thames Water
4.1.2	Who are the water undertakers for the area?	Affinity Water
4.2	Who bills the property for sewerage services?	See Details
4.3	Who bills the property for water services?	See Details
4.4	Is there a meter installed at this property?	No
4.5	Are there any trade effluent consents relating to this site/property for disposal of chemically enhanced waste?	No

Search address supplied: Optimum Data Centre, Tudor Works, Beaconsfield Road, HAYES, UB4 0SL

Any new owner or occupier will need to contact Thames Water on 0800 316 9800 or log onto our website www.thameswater.co.uk and complete our online form to change the water and drainage services bills to their name.

The following records were searched in compiling this report: - the map of public sewers, the map of waterworks, water and sewer billing records, adoption of public sewer records, building over public sewer records, the register of properties subject to internal foul flooding, the register of properties subject to poor water pressure and the drinking water register.
Thames Water Utilities Ltd (TWUL) holds all of these.

TWUL, trading as Property Searches, are responsible in respect of the following:-

(i) any negligent or incorrect entry in the records searched

(ii) any negligent or incorrect interpretation of the records searched

(iii) any negligent or incorrect recording of that interpretation in the search report

(iv) and compensation payments

Please refer to the attached Terms & Conditions. Customers and clients are asked to note these terms, which govern the basis on which this Commercial Drainage and Water search is supplied.

Maps, Wayleaves, Easements, Manhole Cover and Invert levels

1.1 Where relevant, please include a copy of an extract from the public sewer map.

A copy of an extract of the public sewer map is included, showing the public sewers, disposal mains and lateral drains in the vicinity of the property.

1.2 Where relevant, please include a copy of an extract from the map of waterworks.

A copy of an extract from the map of waterworks is included in which the location of the property is identified.

1.3 Wayleaves & Easements

Is there a wayleave/easement agreement giving Thames Water the right to lay or maintain assets or right of access to pass through private land in order to reach the Company's assets?

No.

1.4 Manhole

On the copy extract from the public sewer map, please show manhole cover, depth and invert levels where the information is available.

Details of any manhole cover and invert levels applicable to this site are enclosed.

Drainage

2.1 Does foul water from the property drain to a public sewer?

The enquiry appears to relate to a plot of land or a recently built property. It is recommended that drainage proposals are checked with the developer.

2.2 Does surface water from the property drain to a public sewer?

Records indicate that this enquiry relates to a plot of land or a recently built property. It is recommended that the drainage proposals are checked with the developer. If the property was constructed after 6th April 2015 the Surface Water drainage may be served by a Sustainable Drainage System (SuDS). Further information may be available from the Developer.

2.3 Is a surface water drainage charge payable?

This enquiry appears to relate to a plot of land or a recently built property. It is recommended that charging proposals are checked with the developer. If the property was constructed after 6th April 2015 the Surface Water drainage may be served by a Sustainable Drainage System (SuDS). Further information may be available from the Developer.

2.4 Does the public sewer map indicate any public sewer, disposal main or lateral drain within the boundary of the property?

The public sewer map included indicates that there is a public sewer, disposal main or lateral drain within the boundaries of the property. However, from the 1st October 2011 there may be additional public sewers, disposal mains or lateral drains which are not recorded on the public sewer map but which may further prevent or restrict development of the property.

2.4.1 Does the public sewer map indicate any public pumping station or any other ancillary apparatus within the boundaries of the property?

The public sewer map included indicates that there is no public pumping station within the boundaries of the property.

2.5 Does the public sewer map indicate any public sewer within 30.48 metres (100 feet) of any buildings within the property?

The public sewer map indicates that there are no public sewers within 30.48 metres (100 feet) of any buildings within the property.
However, from the 1st October 2011 many private sewers were transferred into public ownership and may not be recorded on the public sewer map and it is our professional opinion that if the property is connected to a foul sewer it is likely that there will be a public sewer within 30.48 metres (100 feet) of any buildings within the property.

2.5.1 Does the public sewer map indicate any public pumping station or any other ancillary apparatus within 50 metres of any buildings within the property?

The public sewer map included indicates that there is no public pumping station within 50 metres of any buildings within the property.

2.6 Are any sewers or lateral drains serving, or which are proposed to serve, the property the subject of an existing adoption agreement or an application for such an agreement?

Records confirm that Foul sewers serving the development, of which the property forms part are not the subject of an existing adoption agreement or an application for such an agreement.

The Surface Water sewer(s) and/or Surface Water lateral drain(s) are not the subject of an adoption agreement.

2.7 Has a sewerage undertaker approved or been consulted about any plans to erect a building or extension on the property over or in the vicinity of a public sewer, disposal main or drain?

There are no records in relation to any approval or consultation about plans to erect a building or extension on the property over or in the vicinity of a public sewer, disposal main or drain. However, the sewerage undertaker might not be aware of a building or extension on the property over or in the vicinity of a public sewer, disposal main or drain.

2.8 Is the building which is or forms part of the property, at risk of internal flooding due to overloaded public sewers?

The property is not recorded as being at risk of internal flooding due to overloaded public sewers.

From the 1st October 2011 most private sewers, disposal mains and lateral drains were transferred into public ownership It is therefore possible that a property may be at risk of internal flooding due to an overloaded public sewer which the sewerage undertaker is not aware of. For further information it is recommended that enquiries are made of the vendor.

2.9 Please state the distance from the property to the nearest boundary of the nearest sewage treatment works.

The nearest sewage treatment works is Mogden STW which is 6.193 kilometres to the south east of the property.

Water

3.1 Is the property connected to mains water supply?

The enquiry appears to relate to a plot of land or a recently built property. It is recommended that the water proposals are checked with the developer.

3.2 Are there any water mains, resource mains or discharge pipes within the boundary of the property?

The map of waterworks indicates that there are water mains, resource mains or discharge pipes within the boundaries of the property.

3.3 Is any water main or service pipe serving, or which is proposed to serve, the property the subject of an existing adoption agreement or an application for such an agreement?

Records confirm that water mains or service pipes serving the property are not the subject of an existing adoption agreement or an application for such an agreement.

3.4 Is the property at risk of receiving low water pressure or flow?

Records confirm that the property is not recorded on a register kept by the water undertaker as being at risk of receiving low water pressure or flow.

3.5 What is the classification of the water supply for the property?

The water supplied to the property has an average water hardness of 112mg/l calcium which is defined as Hard by Affinity Water.

3.6 Please include details of the location of any water meter serving the property.

This enquiry appears to relate to a plot of land or a recently built property. It is recommended that drainage proposals are checked with the developer.

Charging

4.1.1 – Who is responsible for providing the sewerage services for the property?

Thames Water Utilities Limited, Clearwater Court, Reading, RG1 8DB is the sewerage undertaker for the area.

4.1.2 – Who is responsible for providing the water services for the property?

Affinity Water Ltd, Tamblin Way, Hatfield, AL10 9EZ, is the water undertaker for the area.

4.2 Who bills the property for sewerage services?

If you wish to know who bills the sewerage services for this property then you will need to contact the current owner. For a list of all potential retailers of sewerage services for the property please visit www.open-water.org.uk

4.3 Who bills the property for water services?

If you wish to know who bills the water services for this property then you will need to contact the current owner. For a list of all potential retailers of water services for the property please visit www.open-water.org.uk

4.4 Is there a meter installed at this property?

Records indicate that there is no meter installed at this property.

4.5 Trade Effluent Consent

Are there any trade effluent consents relating to this site/property for disposal of chemically enhanced waste?

No.

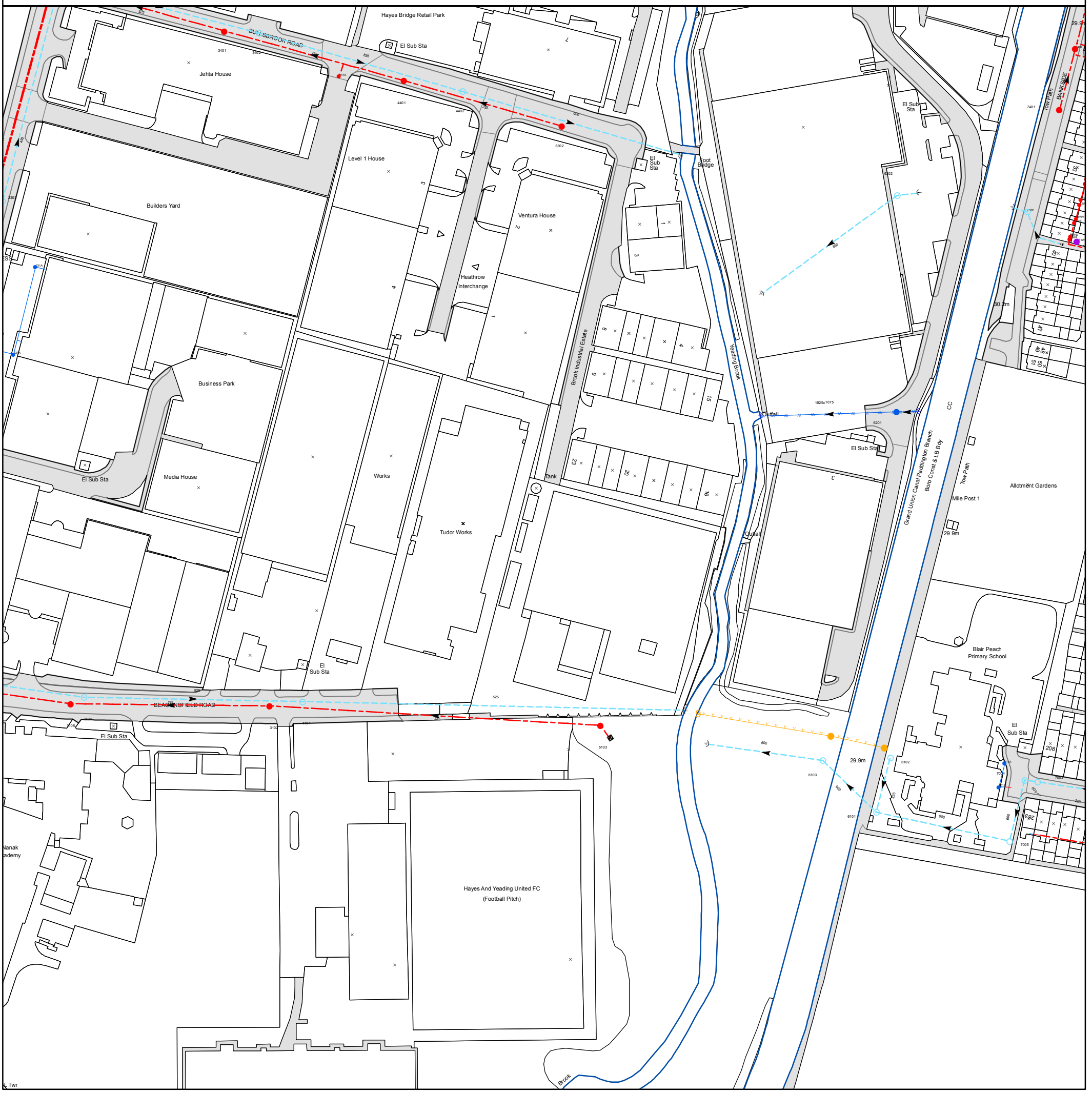
Payment for this Search

The charge will be added to the NLIS Account. This search was ordered through National Land Information Services, Russell Square House, 10-12 Russell Square, London WC1B 5LF.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information.

Based on the Ordnance Survey Map with the sanction of the Controller of H.M Stationary Office License Number 10019345

CDWS/CDWS Standard/2020_4272783



The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified before any works are undertaken. Crown copyright Reserved

Scale:	1:1792
Width:	500m
Printed By:	G1KANAGA
Print Date:	13/11/2020
Map Centre:	511519,180202
Grid Reference:	TQ1180SE

Comments:

CDWS/CDWS Standard/2020_4272783

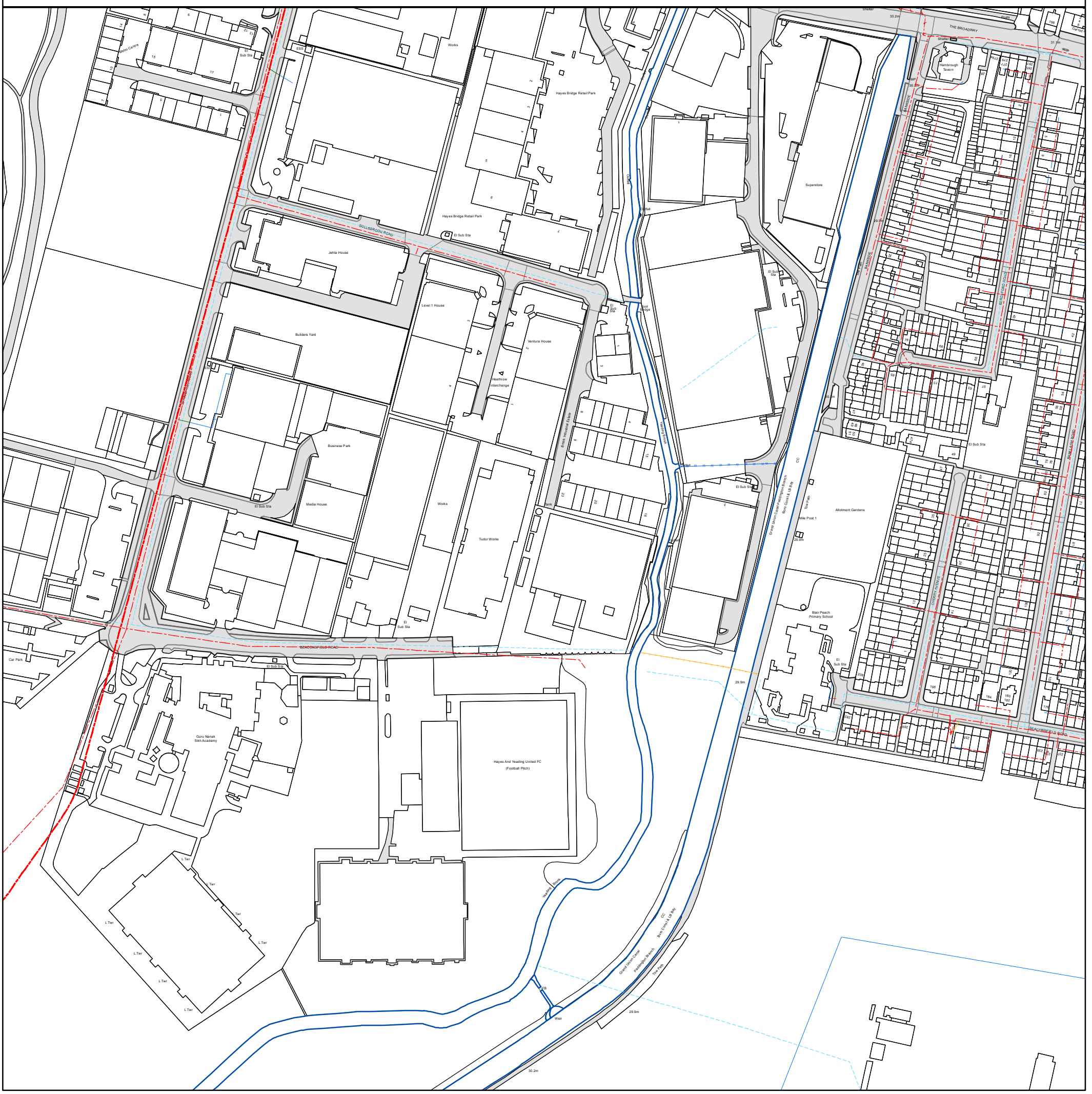
NB: Level quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates no Survey information is available.

REFERENCE	COVER LEVEL	INVERT LEVEL
3401	30.5	26.5
5103		
3101	30.71	28.08
4401	39.78	36.81
6102	29.16	27.64
7004	29.51	27.46
7003	29.62	27.62
6201	29.52	27.67
4402	29.31	27.51
7401	29.88	28.44
73WH		
73WF		
73WB		
73WA		
731W		
701C		
221A		

REFERENCE	COVER LEVEL	INVERT LEVEL
5302		
4101	30.11	27.45
3105	30.69	25.77
6101	29.04	19.15
6302		
7005	29.66	27.34
6103	30.33	19.95
3402	30.48	28.07
3102	30.17	26.14
7402	29.87	28.29
73WG		
73WV		
73WD		
7302	30.15	
711A		
231A		
441A	30.4	29.42

Based on the Ordnance Survey Map with the sanction of the Controller of H.M Stationary Office License Number 10019345

CDWS/CDWS Standard/2020_4272783



0 15 30 60 90 120 Meters

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Scale:	1:2865
Width:	800m
Printed By:	G1KANAGA
Print Date:	13/11/2020
Map Centre:	511519,180202
Grid Reference:	TQ1180SE

Comments:

Sewer Key - Commercial Drainage and Water Enquiry

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.

2) All measurements on the plans are metric.

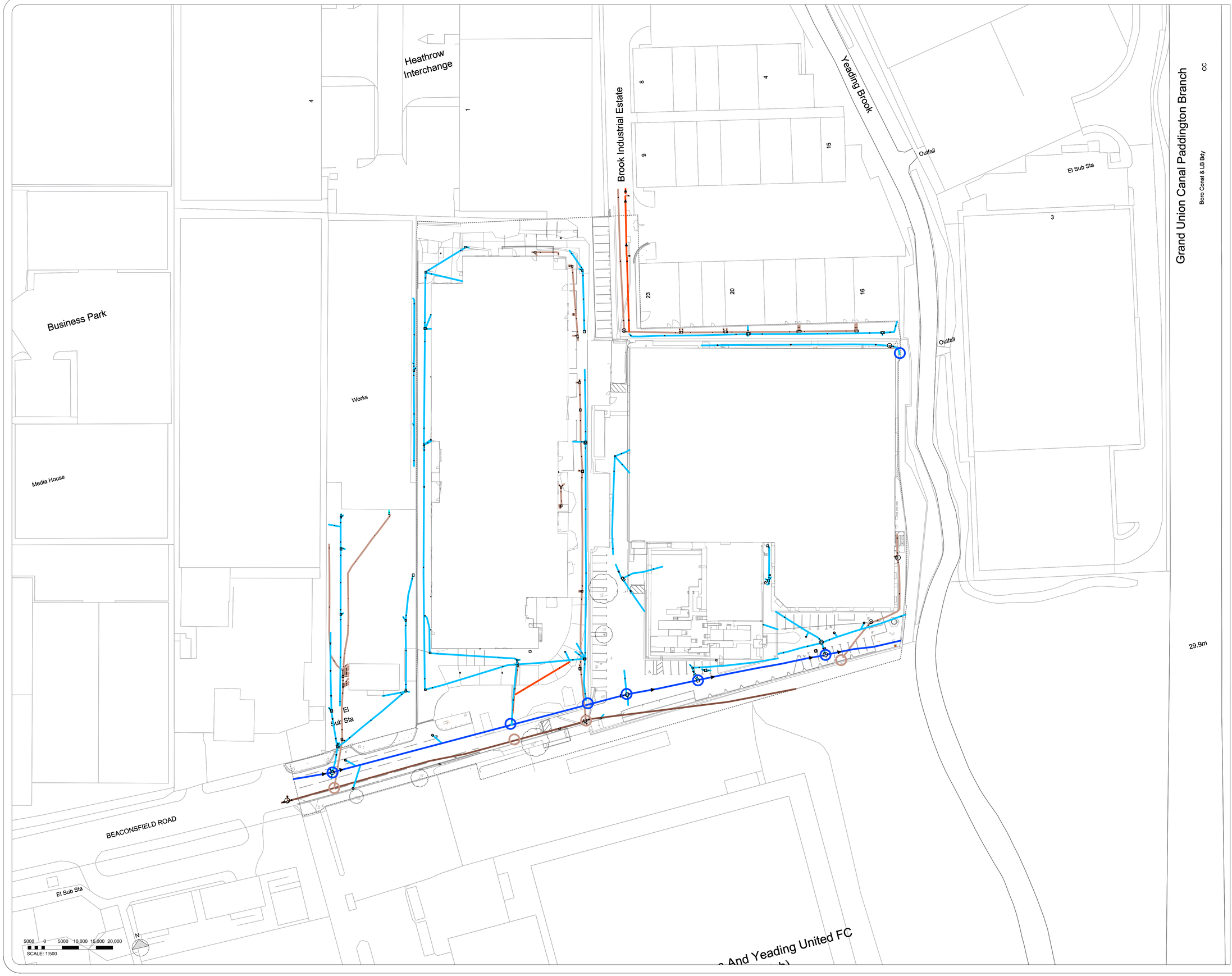
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.

4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

5) 'na' or '0' on a manhole level indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Searches on 0118 925 1504.

A1 - Do not scale



General Notes

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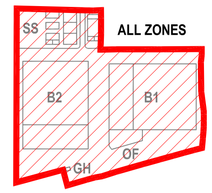
3. This drawing is not an installation drawing. It is the Contractors responsibility to make final coordinated installation shop drawings.
4. The contents of this drawing shall be read in conjunction with the current revisions of Architectural, Civil, Structural, Mechanical, Electrical, Security, Telcoms drawings and all relevant sections of the specifications.

Key Plan



Key:

- Site boundary
- Thames Water storm water sewer
- Thames Water foul water sewer
- Private storm water sewer
- Private foul water sewer
- Private combined water seewer
- Existing storm water discharge points
- Existing foul water discharge points

Rev	Details	By / Chkd / App	Date
P01.01	For Information	JT / LD / SFB	xx / xx / 21

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Structural / Civil Engineer

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Fire Consultant

salus
Building Compliance without Complexity
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Security Designer

Control Risks
Cottons Centre, Cottons Lane
London, SE1 2QG, United Kingdom
www.controlrisks.com

Project Title

Colt LON4 Hayes

Drawing Title

GPR Existing Below Ground Drainage

Project Status

Planning

Discipline	Status Code
Civil - Drainage	**S4**

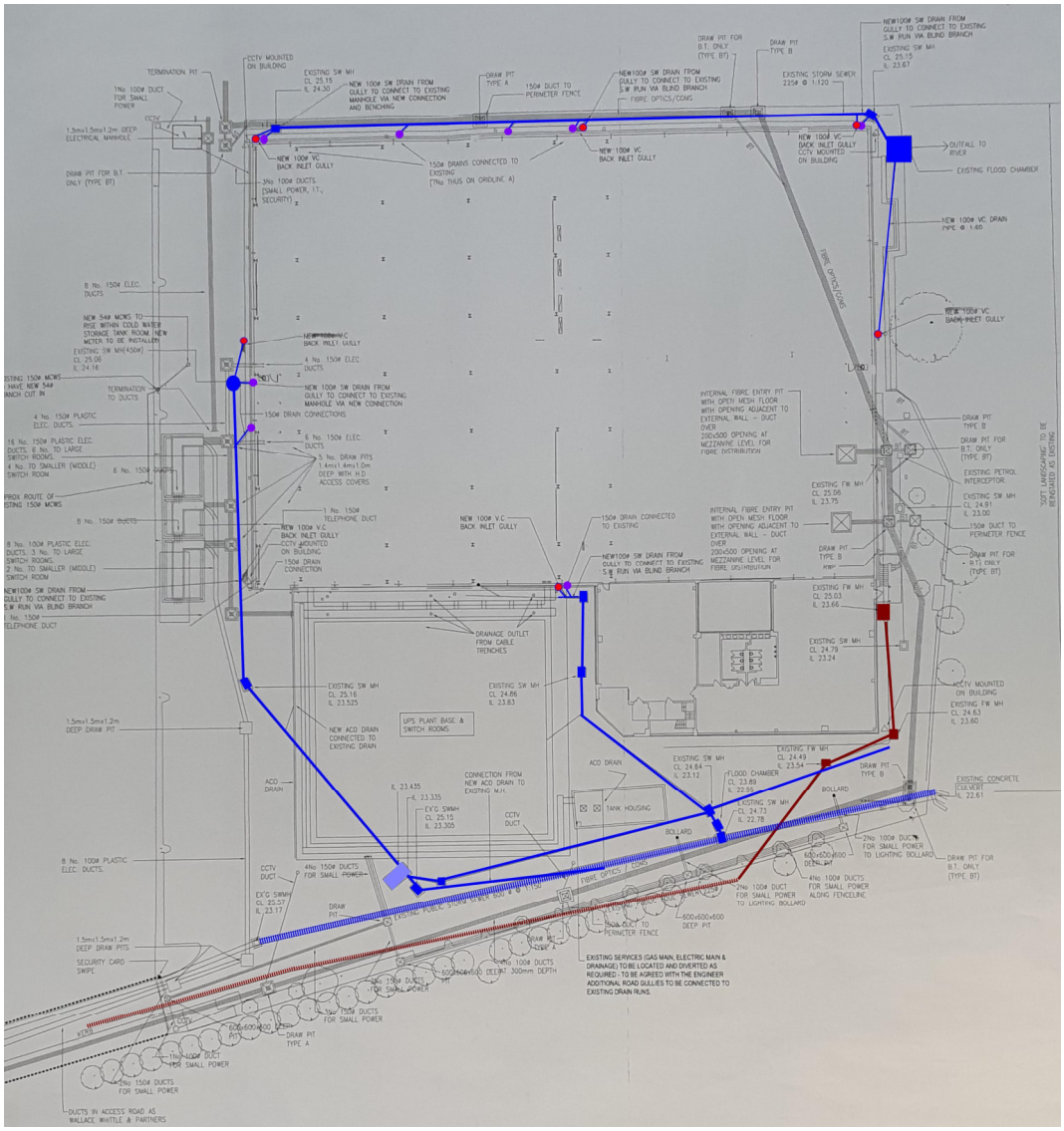
Project Number	Scale @ A1	Revision
P20114	**1:500**	**P01.00**

Drawing Number

DCS20109-ARUP-PL-EX-LP-DR-C-52200

Project — Originator — Functional — Spatial — Level — Form — Discipline — Number Breakdown Breakdown

As Built Services Record - Optimum Data Centre



Appendix C

Proposed Site Plans

PROPOSED SOFT LANDSCAPE - URBAN GREEN FACTOR CALCULATION

	LANDSCAPE TYPE	AREA	FACTOR	VALUE
	Existing retained vegetation	512m2	1	512
	Mixed ornamental Planting	1319	0.5	659.5
	Mixed Native Thicket	565	1	565
	Intensive/Extensive Green Roof	1617	0.8	1293.6
	Trees (closed pits) Trees (open pits)	8 0	0.6 0.8	4.8 0
	Native hedges	202	0.6	121.1
	Green Wall / Living Wall	1059	0.6	635.4
	Grasscerete	1055	0.4	633

TOTAL LANDSCAPE VALUE 4424.4

OVERALL SITE AREA 21,907m2
LANDSCAPE VALUE 4424.4m2
UGF SCORE 0.202
4424.4/21907 = 0.202

SCALE 1:500 0 12.5 25 37.5 50m

SCALE 1:1 0 10 20 30 40 50 60 70 80 90 100mm

NOTES

NORTH

REV	NOTE	DATE AUTH
B:	Updated to suit latest architecural layout.	18-02-22 HC
A:	Landscape areas amended & calculation updated to suit.	12-10-21 HC

BARRY CHINN associates Landscape Architects

CLIENT
COLT DATA CENTRE SERVICES

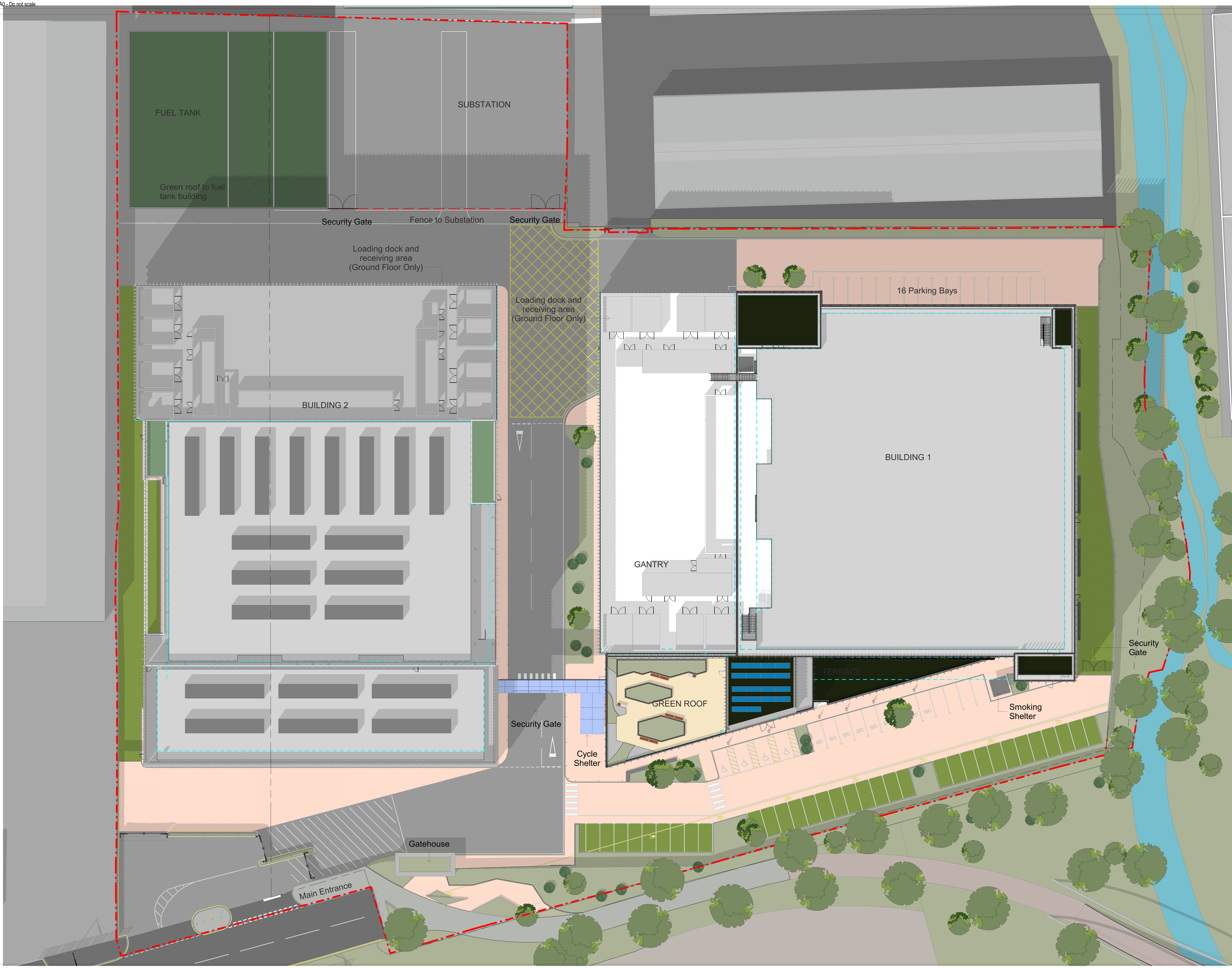
PROJECT
COLT L4

DRAWING
URBAN GREENING FACTOR PLAN

CONTRACT	2179-21		DRG NO. 02
DATE	12-10-2021	DRAWN HC	
ISSUE	Preliminary	CHECKED MB	
SCALE	1:500	ORIG SHEET A2	REV B
CAD FILE	2179-21-02 - Urban Greening Factor.dwg		

Barry Chinn Associates Ltd. Harbury Road, Deppers Bridge, Southam, Warwickshire, CV47 2SZ
Tel: +44 (0)1926 614031 Email: gen@bca-landscape.com Website: www.bca-landscape.com

A0 - Do not scale



General Notes

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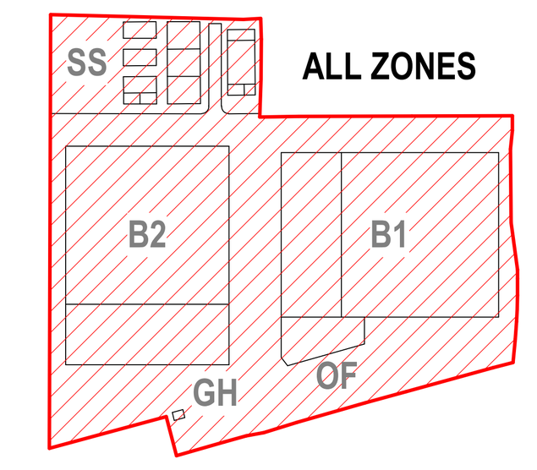
2000 0 2000 4000 6000 8000
SCALE: 1:200
N

Key Plan



Key:

Boundary Line

Rev	Details	By / Chkd / App	Date
A	PLANNING REVISION	DL	18/02/2022
P02.03	STAGE 3 - 100% ISSUE	DL/EB	17/12/2021
P02.01	STAGE 3 - 90% ISSUE	DL\EB	19/11/2021
P01	PLANNING ISSUE	DL\EB	19/10/2021

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Redbourn, Hertfordshire
AL3 7QA, United Kingdom
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Structural / Civil Engineer
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Newcastle Upon Tyne
NE1 3PL, United Kingdom
www.arup.com

Fire Consultant
salus Building Compliance without Complexity
Primea House, Marina Court
Maple Drive, Hinckley, Leicestershire
LE10 3BF, United Kingdom
www.salusai.co.uk

Security Designer
Control Risks
Cottons Centre, Cottons Lane
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www.controlrisks.com

Project Title
London 4

Drawing Title
Buildings 1
Site Plan

Project Status
PLANNING REVISION

Discipline: ARCHITECTURE
Status Code: S3
Project Number: 0493
Scale @ A0: 1:200
Revision: A

Drawing Number
DCS20109-NWA-DC-01-LP-DR-A-10201
Project — Originator — Functional Breakdown — Spatial Breakdown — Level — Form — Discipline — Number

Appendix D

Greenfield and Brownfield Calculations

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Jamie Temple
Site name:	London L4
Site location:	Hayes

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.50967° N
Longitude:	0.39426° W
Reference:	270696452
Date:	Jun 01 2021 15:03

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 2.122

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	617	617
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	8.84	8.84
1 in 1 year (l/s):	7.51	7.51
1 in 30 years (l/s):	20.33	20.33
1 in 100 year (l/s):	28.19	28.19
1 in 200 years (l/s):	33.06	33.06

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Veetec

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E1.000	E3	15 Winter	1	+0%	1/15 Summer	30/15 Summer			29.871
E1.001	E4	15 Winter	1	+0%	1/15 Summer	30/15 Summer			29.759
E2.000	E6	15 Winter	1	+0%	1/15 Summer	30/15 Summer			29.881
E2.001	E7	15 Winter	1	+0%	1/15 Summer	30/15 Summer			29.860
E2.002	E8	15 Winter	1	+0%	1/15 Summer	30/15 Summer			29.811
E1.002	E5	15 Winter	1	+0%	1/15 Summer				29.610

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E3	0.131	0.000	0.91			20.1	SURCHARGED	17
E1.001	E4	0.379	0.000	0.50			18.3	SURCHARGED	9
E2.000	E6	0.251	0.000	1.50			13.2	FLOOD RISK	18
E2.001	E7	0.260	0.000	1.04			14.1	FLOOD RISK	18
E2.002	E8	0.341	0.000	0.74			15.5	SURCHARGED	11
E1.002	E5	1.570	0.000	5.22			25.3	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Veetec

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E1.000	E3	30 Winter	30	+0%	1/15 Summer	30/15 Summer			30.203
E1.001	E4	15 Winter	30	+0%	1/15 Summer	30/15 Summer			30.100
E2.000	E6	30 Winter	30	+0%	1/15 Summer	30/15 Summer			30.169
E2.001	E7	30 Winter	30	+0%	1/15 Summer	30/15 Summer			30.137
E2.002	E8	15 Winter	30	+0%	1/15 Summer	30/15 Summer			30.121
E1.002	E5	15 Summer	30	+0%	1/15 Summer				29.933

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E3	0.463	12.643	0.82			18.2	FLOOD	17
E1.001	E4	0.720	0.161	0.50			18.2	FLOOD	9
E2.000	E6	0.539	8.674	1.33			11.7	FLOOD	18
E2.001	E7	0.537	7.029	1.15			15.6	FLOOD	18
E2.002	E8	0.651	1.369	0.79			16.6	FLOOD	11
E1.002	E5	1.893	0.000	5.69			27.6	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Veetec

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E1.000	E3	30 Winter	100	+0%	1/15 Summer	30/15 Summer			30.213
E1.001	E4	15 Winter	100	+0%	1/15 Summer	30/15 Summer			30.101
E2.000	E6	30 Winter	100	+0%	1/15 Summer	30/15 Summer			30.175
E2.001	E7	30 Winter	100	+0%	1/15 Summer	30/15 Summer			30.142
E2.002	E8	15 Winter	100	+0%	1/15 Summer	30/15 Summer			30.123
E1.002	E5	15 Winter	100	+0%	1/15 Summer				29.935

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E3	0.473	22.857	0.78			17.1	FLOOD	17
E1.001	E4	0.721	0.537	0.51			18.8	FLOOD	9
E2.000	E6	0.545	15.204	1.26			11.1	FLOOD	18
E2.001	E7	0.542	12.285	0.98			13.4	FLOOD	18
E2.002	E8	0.653	3.115	0.82			17.4	FLOOD	11
E1.002	E5	1.895	0.000	5.69			27.6	SURCHARGED	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Tudor Works

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	30 Winter	1	+0%	1/15 Summer	30/15 Summer			29.586
S1.001	S2	30 Winter	1	+0%	1/15 Summer	30/15 Summer			29.573
S1.002	S2	15 Winter	1	+0%	1/15 Summer	30/15 Summer			29.532
S1.003	S3	15 Winter	1	+0%	1/15 Summer	30/15 Summer			29.014
S2.000	S5	15 Winter	1	+0%	1/15 Summer	30/15 Summer			29.325
S1.004	S5	15 Winter	1	+0%	1/15 Summer				28.354

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.416	0.000	0.59			8.3	FLOOD RISK	15
S1.001	S2	0.523	0.000	0.77			10.7	FLOOD RISK	23
S1.002	S2	0.712	0.000	0.95			16.1	FLOOD RISK	20
S1.003	S3	0.874	0.000	1.31			21.1	SURCHARGED	7
S2.000	S5	0.385	0.000	0.94			22.8	SURCHARGED	17
S1.004	S5	0.634	0.000	1.94			40.9	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Tudor Works

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	30	+0%	1/15 Summer	30/15 Summer			29.724
S1.001	S2	60 Winter	30	+0%	1/15 Summer	30/15 Summer			29.658
S1.002	S2	30 Winter	30	+0%	1/15 Summer	30/15 Summer			29.649
S1.003	S3	15 Winter	30	+0%	1/15 Summer	30/15 Summer			29.810
S2.000	S5	30 Winter	30	+0%	1/15 Summer	30/15 Summer			29.738
S1.004	S5	15 Winter	30	+0%	1/15 Summer				28.713

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.554	4.387	0.85			12.0	FLOOD	15
S1.001	S2	0.608	27.576	1.37			19.2	FLOOD	23
S1.002	S2	0.829	19.424	1.14			19.2	FLOOD	20
S1.003	S3	1.670	0.463	1.66			26.8	FLOOD	7
S2.000	S5	0.798	18.167	1.03			25.0	FLOOD	17
S1.004	S5	0.993	0.000	2.31			48.6	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Tudor Works

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	30 Winter	100	+0%	1/15 Summer	30/15 Summer			29.728
S1.001	S2	60 Winter	100	+0%	1/15 Summer	30/15 Summer			29.672
S1.002	S2	30 Winter	100	+0%	1/15 Summer	30/15 Summer			29.663
S1.003	S3	15 Winter	100	+0%	1/15 Summer	30/15 Summer			29.812
S2.000	S5	30 Winter	100	+0%	1/15 Summer	30/15 Summer			29.753
S1.004	S5	15 Winter	100	+0%	1/15 Summer				28.716

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.558	8.369	0.85			12.0	FLOOD	15
S1.001	S2	0.622	42.518	1.38			19.2	FLOOD	23
S1.002	S2	0.843	33.068	1.10			18.6	FLOOD	20
S1.003	S3	1.672	2.224	1.67			26.9	FLOOD	7
S2.000	S5	0.813	32.926	1.04			25.1	FLOOD	17
S1.004	S5	0.996	0.000	2.31			48.7	SURCHARGED	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for EX Data Centre Western Conection

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E1.000	E1	15 Winter	1	+0%	100/15 Summer				28.359
E1.001	E2	15 Winter	1	+0%	30/15 Summer				27.664
E1.002	E3	15 Winter	1	+0%	30/15 Summer				27.455

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E1	-0.211	0.000	0.19			27.8	OK	
E1.001	E2	-0.146	0.000	0.51			52.8	OK	
E1.002	E3	-0.015	0.000	1.00			49.4	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for EX Data Centre Western Conection

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E1.000	E1	15 Winter	30	+0%	100/15 Summer				28.419
E1.001	E2	15 Winter	30	+0%	30/15 Summer				28.271
E1.002	E3	15 Winter	30	+0%	30/15 Summer				27.720

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E1	-0.151	0.000	0.46			68.5	OK	
E1.001	E2	0.461	0.000	1.26			130.5	SURCHARGED	
E1.002	E3	0.250	0.000	2.63			130.1	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for EX Data Centre Western Conection

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E1.000	E1	15 Winter	100	+0%	100/15 Summer				28.823
E1.001	E2	15 Winter	100	+0%	30/15 Summer				28.620
E1.002	E3	15 Winter	100	+0%	30/15 Summer				27.830

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E1	0.253	0.000	0.55			81.3	FLOOD RISK	
E1.001	E2	0.810	0.000	1.49			153.9	SURCHARGED	
E1.002	E3	0.360	0.000	3.12			154.4	SURCHARGED	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for EX Data Centre Eastern Conection

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E1.000	E1	15 Winter	1	+0%	100/15 Summer				28.042
E1.001	E2	15 Winter	1	+0%	100/15 Summer				27.204
E2.000	E3	1440 Winter	1	+0%	1/15 Summer				27.632
E1.002	E3	15 Winter	1	+0%					27.060

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E1	-0.088	0.000	0.35			16.8	OK	
E1.001	E2	-0.176	0.000	0.35			23.0	OK	
E2.000	E3	27.482	0.000	0.04			0.2	SURCHARGED	
E1.002	E3	-0.200	0.000	0.25			23.1	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for EX Data Centre Eastern Conection

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E1.000	E1	15 Winter	30	+0%	100/15 Summer				28.089
E1.001	E2	15 Winter	30	+0%	100/15 Summer				27.309
E2.000	E3	240 Winter	30	+0%	1/15 Summer				27.767
E1.002	E3	15 Winter	30	+0%					27.135

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E1	-0.041	0.000	0.87			41.3	OK	
E1.001	E2	-0.071	0.000	0.90			59.2	OK	
E2.000	E3	27.617	0.000	1.40			6.2	SURCHARGED	
E1.002	E3	-0.125	0.000	0.64			60.1	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for EX Data Centre Eastern Conection

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E1.000	E1	15 Winter	100	+0%	100/15 Summer				28.351
E1.001	E2	15 Winter	100	+0%	100/15 Summer				27.392
E2.000	E3	60 Winter	100	+0%	1/15 Summer				28.017
E1.002	E3	15 Winter	100	+0%					27.155

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E1	0.221	0.000	1.03			48.7	SURCHARGED	
E1.001	E2	0.012	0.000	1.08			70.9	SURCHARGED	
E2.000	E3	27.867	0.000	3.88			17.1	SURCHARGED	
E1.002	E3	-0.105	0.000	0.76			70.8	OK	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for EX Data Centre Northern Outfall

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E1.000	E1	15 Winter	1	+0%	1/15 Winter	100/15 Summer			28.223
E1.001	E2	15 Winter	1	+0%					27.919

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E1	0.008	0.000	1.01			26.9	SURCHARGED	4
E1.001	E2	-0.136	0.000	0.33			26.8	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for EX Data Centre Northern Outfall

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E1.000	E1	15 Winter	30	+0%	1/15 Winter	100/15 Summer			28.937
E1.001	E2	15 Winter	30	+0%					27.975

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E1	0.722	0.000	2.26			60.2	FLOOD RISK	4
E1.001	E2	-0.080	0.000	0.74			60.2	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for EX Data Centre Northern Outfall

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E1.000	E1	15 Winter	100	+0%	1/15 Winter	100/15 Summer			29.024
E1.001	E2	15 Winter	100	+0%					27.985

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E1	0.809	3.868	2.47			65.9	FLOOD	4
E1.001	E2	-0.070	0.000	0.81			65.9	OK	

Appendix E

Thames Water PPE Response

Jamie Temple

ARUP
4 Central Square
Forth Street
Newcastle Upon Tyne
NE1 3PL

Wastewater pre-planning
Our ref DS6085964

26th Augst 2021

Pre-planning enquiry: Confirmation of sufficient capacity

Site Address: London 4, Beaconsfield Road, Hayes, London, UB4 0SL

Dear Mr Temple,

Thank you for providing information on your development for a 34,540m^2 data hall, 3290m^2 of office space and a 12,585m^2 gantry replacing the existing 8940m^2 data hall, 3345m^2 of office space and 5735m^2 of industrial space at the above site.

We have completed the assessment of the foul water flows and surface water run-off based on the information submitted in your application with the purpose of assessing sewer capacity within the existing Thames Water sewer network.

Foul Water

If your proposals progress in line with the details you've provided, we're pleased to confirm that there will be sufficient sewerage capacity in the adjacent foul water sewer network to serve your development.

This is based on the foul water flows gravitating from the site and discharging to the 225mm dia. foul water sewer to the South of the site

This confirmation is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of three years.

Please note that you must keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient sewerage capacity.

Surface Water

Please note that discharging surface water to the public sewer network should only be considered after all other methods of disposal have been investigated and proven to not be viable. In accordance with the Building Act 2000 Clause H3.3, positive connection to a public sewer will only be consented when it can be demonstrated that the hierarchy of disposal methods have been examined and proven to be impracticable. The disposal hierarchy being: 1st Soakaways; 2nd Watercourses; 3rd Sewers.

Only when it can be proven that soakage into the ground or a connection into an adjacent watercourse is not possible would we consider a restricted discharge into the public surface water sewer network.

If the peak surface water run-off discharge is then restricted to a maximum of 7.5 l/s under the 1 in 1 year, 20.33 l/s for the 1 in 30 year and 28.19 l/s for the 1 in 100 year storm condition and is discharged to the 525mm dia. surface water sewer to the South of the site, as your drainage strategy indicates, then we would have no objections to the proposals.

We would encourage techniques such as green roofs and/or permeable paving that restricts surface water discharge from your site.

Please note that the Local Planning authority may comment on surface water discharge under the planning process.

Please Note

All connection requests are subject to a full Section 106 (Water Industry Act 1991) application before the Company can confirm approval to the connection itself. Please also note that capacity in the public sewerage system cannot be reserved. Please make sure you submit your connection application giving us at least 21 days' notice of the date you wish to make your new connection/s.

The discharge of non-domestic effluent is not permitted until a valid trade effluent consent has been issued by Thames Water. If anything other than domestic sewage is discharged into the public sewers without the above agreement an offence is committed and the applicant will be liable to the penalties contained in Section 109(1) (WIA 1991).

Applicants should contact Trade Effluent prior to seeking a connection approval, to discuss trade effluent consent and conditions of discharge. For Trade Effluent queries and to apply for Discharge Consents please call 0203 577 9200 or email trade.effluent@thameswater.co.uk.

The views expressed by Thames Water in this letter are in response to this pre-planning enquiry at this time and do not represent our final views on any future planning applications made in relation to this site.

Yours sincerely,

Jonathan Shildrick BSc
Development Engineer
Developer Services

Appendix F

SuDS Management and Maintenance

SuDS maintenance requirements

Maintenance of the drainage system should be planned in accordance with CIRIA C609. Maintenance can be split by frequency into the following categories.

a) Regular day to day care - litter collection, grass cutting and checking the inlets and outlets where water enters or leaves the network.

b) Occasional tasks - removing any silt that builds up in the system.

c) Remedial work - repairing damage where necessary.

A typical maintenance task and schedule list has been provided below. The frequency of the maintenance requirements will be dependent on the site, its usage, seasonal weather etc. The frequency noted below is indicative only. Where found to be required, more frequent visits may be necessary.

	Maintenance	Action	Frequency
Regular maintenance & inspections	Litter management	Collect and remove from site all extraneous rubbish that is detrimental to the operation of the SUDS and the appearance of the site, including paper, packaging materials, bottles, cans, and similar debris.	12 visits / monthly and during any other maintenance action
	Grass cutting	Mow grass and remove cuttings.	As required or monthly
	Weeds	Hand-pull, or spot treat with an approved herbicide, perennial weeds such as nettles, docks, thistle and ragwort that have become established. Avoid blanket spraying of weed killer, which may inhibit bioremediation of organic pollutants and contribute to pollution load.	As required or monthly
	Brushing and Vacuuming	Pervious pavements need to be regularly cleared of silts and sediments	Annually after autumn leaf fall of as required.
	Inspection chambers, storage tanks, inlets, outlets and control chambers.	Remove cover and inspect ensuring water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt. Undertake inspection after leaf fall in autumn	Annually and following poor performance
	Rainwater harvesting	Clean the tank inlets, outlets, gutters, withdrawal device and rood drain filters of silts and debris.	Annually and following poor performance
	Filter trenches	Inspections to identify any areas not operating correctly, infiltration surfaces that	As required or monthly

		have become compacted, silt-laden or ineffective for any reason. Record any areas that are ponding and where water is lying for more than 48 hours.	
	Green roof	Inspect underside of roof for evidence of leakage	Annually and after severe storms
		Inspect drain inlets to ensure unrestricted runoff from the drainage layers	
		Inspect the soil substructure for evidence of erosion channels and identify and sediment source	
		Inspect all components including soil substructure, vegetation, drain, irrigation systems (if applicable) membranes and roof structure for proper operation, integrity and waterproofing.	
		Replace dead plants as required	Annually in Autumn
		Mow grass/manage planting. Clippings to be removed	Six monthly or as required.
Occasional tasks	Inspection and control of all elements	Annual inspection, remove silt and check free flow	1 visit / yearly
	Rainwater harvesting tank	Clean and/or replace any filters	Three monthly or as required
	Attenuation Tank	Inspection and maintenance to be to the manufacturer's specification. Contractor to add the manufactures maintenance specification and installation requirements to the health and safety file.	
	Oil Interceptor Tank		
	Hydro brake		
Remedial work	Repair	Inspect drainage system regularly to check for damage or failure. Undertake remedial work as required.	As required
	Siltation at surface of filter trenches	Remove all stone and perforated pipe replacing as original spec.	As required
	Green roof	If erosion is evident the area should be stabilised with extra soil similar to the original material. Cause of erosion should be identified and controlled.	As required
		If the inlets have settled, cracked or moved investigate and repair.	
	Permeable paving	Remedial work to any depressions rutting and cracked or broken blocks consider detrimental to	As required

		performance of hazard to users.	
		Rehabilitation of surface and upped substructure by remedial sweeping	Every 10 to 15 years or as required

Maintenance and Management Responsibilities During the Construction Phase

In addition to the carrying out the maintenance requirements set out in the section above the contractor will also be responsible for the following elements during the construction phase:

- For ensuring the drainage is constructed to the Arup design and specification. All assets are to be installed in line with the manufacturer's details.
- Liaising with the client and Thames Water to inform them of defects to their assets and facilitating any remedial works.
- Providing the client with an inventory of all materials used for the permanent works, for inclusion in the Health and Safety File. This shall include details of the manufacturer, make/model, sizes etc and their maintenance requirements.
- The Contractor will be responsible for procuring designs for the attenuation tanks. The Contractor shall ensure that the access and maintenance of the systems is considered within the designs and that the tanks are constructed in accordance with CIRIA Report C737.
- All pipes shall be flushed and tested in accordance with the requirements of Appendix 90/1 and Clause 509 of the Specification for Highway Works. Any material flushed through to the existing sewer network shall, where practicable, be removed on completion of the drainage works.
- The Contractor shall be responsible for all temporary drainage required to manage surface water flows during the construction phase. The Contractor will be responsible for obtaining any discharge agreements and management of surface water quality.
- The Contractor shall provide detailed As-Built Records for the Works.

Appendix G

Proposed Drainage Layout and Details

A1 - Do not scale

Key :

- Site Boundary
- Thames Water Storm Sewer
- Thames Water Foul Sewer
- 3m offset from Thames Water Assets
- Storm Water Carrier Pipe
- Storm Water Perforated Collector Pipe Permeable & Cellular Pavement
- Foul Water Carrier Pipe
- Storm Water Manhole
- Catchpit
- Foul Water Manhole
- Rodding Eye
- Storm Water Linear Channel
- Storm Water Gully
- Storm Water Storage Tank
- Storm Water Storage Tank Access
- Storm Water Infiltration trench to Tank
- Permeable Pavement
- Cellular Grassed Paving (Lined unless otherwise noted)
- Soft Landscaping (As per Landscape Architect's design)

Connections from fuel store roof and area
Connections from substation.
Substation drainage by specialist drainage contractor.
Interceptor
Refer to note 11
SBCFS01: 150Ø
SBCFS02: 150Ø
SBCFS03: 150Ø
SBCSS01: 225Ø
SBCSS02: 225Ø
C1
C2
C3 (Outfall 1)
C3 (Outfall 2)
C4
C5
C6
C7
C8
C8A
C10
C11
C12
C13
C14
Tank 2
Tank 4
Tank 3
Tank 5
Tank 6
Tank 7
Tank 8
Tank 8A
Tank 9
Tank 10
Tank 11
Tank 12
PS Access Tank 1 (1)
PS Access Tank 1 (2)
PS Access Tank 2
PS Access Tank 3
PS Access Tank 4
PS Access Tank 5 (1)
PS Access Tank 5 (2)
PS Access Tank 6 (1)
PS Access Tank 6 (2)
PS Access Tank 7 (1)
PS Access Tank 7 (2)
PS Access Tank 8 (1)
PS Access Tank 9
PS Access Tank 10 (1)
PS Access Tank 10 (2)
PS Access Tank 10 (3)
PS Access Tank 11 (1)
PS Access Tank 12
S1
S1.000: 225Ø
S1.001: 225Ø
S1.003: 225Ø
S1.004: 225Ø
S1.005: 300Ø
S1.006: 300Ø
S1.007: 300Ø
S1.008: 375Ø
S1.009: 375Ø
S1.010: 375Ø
S1.011: 375Ø
S1.012: 375Ø
S1.013: 375Ø
S1.014: 500Ø
S1.015: 525Ø
S1.016: 525Ø
S1.017: 525Ø
S1.018: 525Ø
S1.019: 300Ø
S1.020: 300Ø
S1.021: 300Ø
S2
S2.000: 225Ø
S2.001: 300Ø
S2.002: 300Ø
S2.003: 300Ø
S2.004: 300Ø
S3
S3.000: 150Ø
S3.001: 225Ø
S3.001A: 225Ø
S3.002: 225Ø
S3.003: 225Ø
S3.004: 300Ø
S3.005: 300Ø
S3.006: 300Ø
S3.007: 300Ø
S3.008: 375Ø
S4
S4.001: 150Ø
S5
S5.000: 150Ø
S6
S7
S8
S10
S11
S12
S13
S14
S14A
S15
S16
S17
S18
S19
S20
S21
S22
S23
S24
S25
SBCB101: 200Ø
SBCB102: 250Ø
SBCB103: 250Ø
SBCB104: 375Ø
SBCB201: 150Ø
SBCB202: 150Ø
SBCB203: 150Ø
SBCB204: 150Ø
SBCB205: 150Ø
SBCB206: 150Ø
SBCB207: 150Ø
SBCB208: 150Ø
SBCB209: 150Ø
SBCB210: 150Ø
SBCB211: 150Ø
SBCB212: 150Ø
SBCB213: 150Ø
SBCB214: 150Ø
SBC201: 150Ø
SBCGHB1: 150Ø
FBCB101: 150Ø
F1
F1.000: 150Ø
F1.001: 150Ø
F2
F2.000: 100Ø
F2.001: 150Ø
F3
F4
F5
FP101: 150Ø
FP102: 150Ø
FP103: 150Ø
FP104: 150Ø
FP205: 150Ø
FP206: 150Ø
FPC1
FPC2 (PPIC)
FPC3 (PPIC)
G1
G2
G3
G4 (Chute Only)
G5
RE
Permeable Paving Subbase formation to locally fall towards tank 4
Permeable Paving Subbase formation to locally fall towards tank 3
Permeable Paving Subbase formation to locally fall towards FP102
Permeable Paving Subbase formation to locally fall towards filter drains to north and south
Permeable Paving Subbase to step under landscaping and drain into carriageway subbase.
Permeable Paving Subbase to step under landscaping and drain into carriageway subbase.
Living / green wall to east facade
Living / green wall to south facade
SBCB104: 375Ø
Connection from rainwater harvesting tank overflow in Building 1.
Tank to be 35m3 dedicated to meet 100% WC flushing requirements under normal seasonal conditions.
Non return valve
Interceptor
Refer to note 11
Reuse existing outfall to Thames Water sewer
Reuse existing outfall to Thames Water sewer
Entrance area to match existing with line from back of footway falling towards bullsbrook road and area to north to fall into the site.
Footway to drain to localised landscaping / planters
1 to 30 year = 7.5 l/s
30 to 100+40%CC = 20.3 l/s

Notes:

1. Existing drainage information taken from Cat Surveys Survey GPR drawing Rev P04 11/10/21.
2. All filter drains to be Ø150mm unless noted otherwise.
3. All gully leads to be Ø150mm unless noted otherwise.
4. For size of geocellular storage, refer to drainage schedules.
5. A Pre-Planning Enquiry response has been received from Thames Water Ltd confirming acceptance in principle to the site discharge to their sewers. Contractor to apply for consent to discharge.
6. All covers within trafficked areas to be Grade D400.
7. This drawing is to be read in conjunction with:
   - 7.1. Drainage Schedules DCS20109-ARUP-PL-ZZ-XX-DR-C-52700
   - 7.2. Drainage Details DCS20109-ARUP-PL-ZZ-XX-DR-C-52500 to 52503.
8. Drainage layout and tank sizes subject to further coordination as detail design of other utilities is progressed.
9. Tanks to be procured by the contractor and designed by manufacturer including access and venting arrangements. Polystorm Xtra or similar approved.
10. Interceptor to be Class 1 Full Retention with high level alarm. SPEL Puraceptor or similar approved.
11. Signage and public realm furniture foundations to be positioned out with the line of the drainage infrastructure. Where foundations require locating in proximity to the line of the Thames Water drainage infrastructure the contractor is to coordinate with Thames Water.
12. Contractor to coordinate with Thames Water to gain relevant approvals and agree any asset protection requirements.
13. Refer to the drainage strategy report (DCS20109-ARUP-DC-XX-XX-RP-C-52001) and the Architects / Landscape Architect's plans and details for green roof locations and information.

Rev	Details	By / Chkd / App	Date
P02	Planning Submission Update	LD / CH / GM	06 / 06 / 22
P01	Planning Submission	JT / CH / GM	15 / 10 / 21

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Fire Consultant
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Project Title
London 4

Drawing Title
Site Plan
Underground Drainage

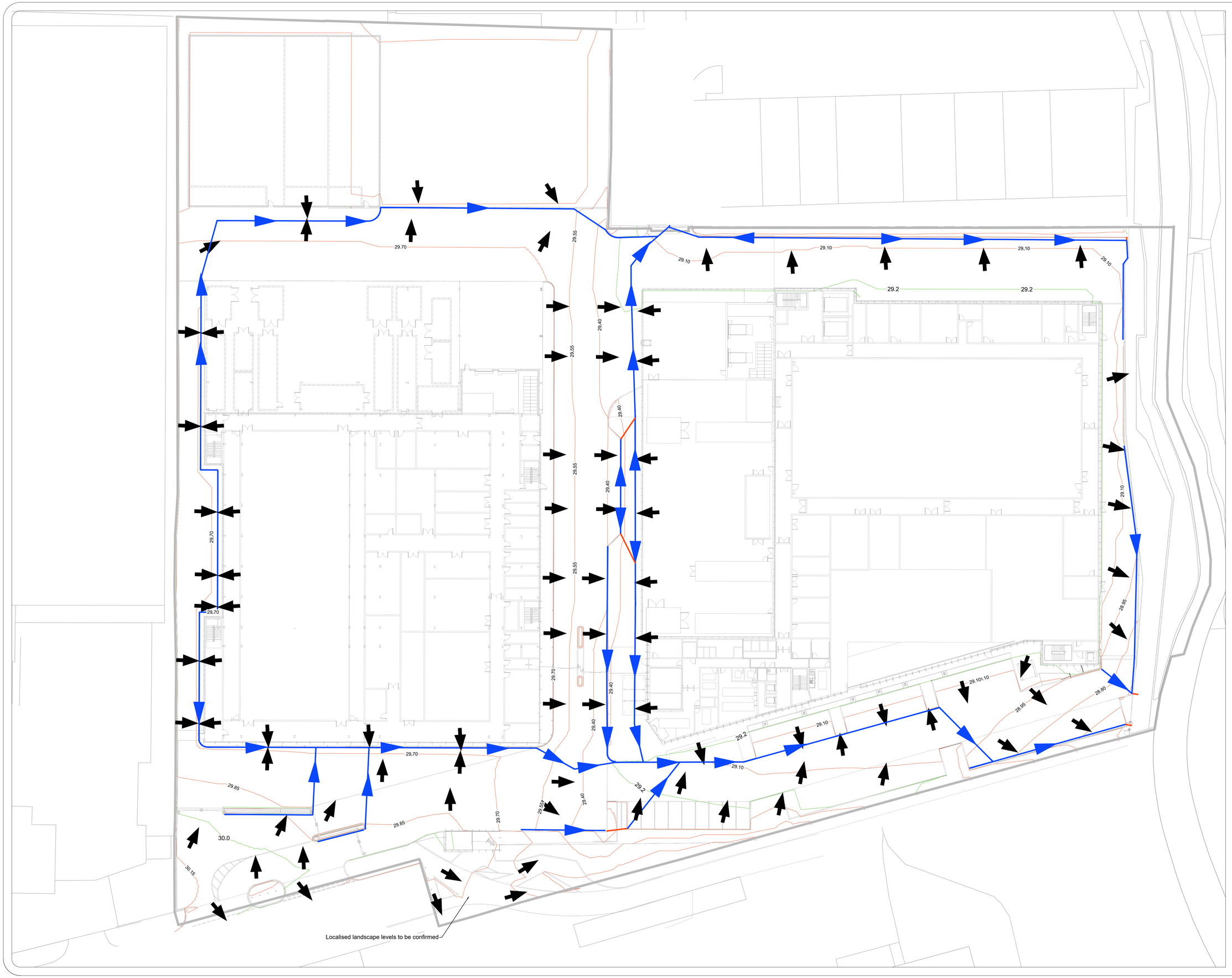
Project Status
PLANNING

Discipline	Status Code
Civil - Drainage	S4

Project Number	Scale @ A1	Revision
281528	1:300	P02

Drawing Number
DCS20109-ARUP-PL-ZZ-LP-DR-C-52200
Project — Originator — Functional Breakdown — Spatial Breakdown — Level — Form — Discipline — Number

A1 - Do not scale



Notes:

1. Flow routes based upon Architect layout from February 2022.
2. Existing levels have been taken from CatSurveys Topographical survey Information provided 11/10/21.
3. This drawing is to be read in conjunction with Drainage Layout DCS20109-ARUP-PL-ZZ-XX-DR-C-52200

Key :

- Site Boundary
- Proposed direction of ground fall
- Proposed watershed route
- Proposed watershed route of water overtopping a kerb or low point
- 29.1 Proposed Contours (m AOD)

Rev	Details	By / Chkd / App	Date
P02	Planning Submission Update	LD / CH / GM	06 / 06 / 22
P01	Planning Submission	JT / CH / GM	15 / 10 / 21

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Project Title

London 4

Drawing Title

Exceedance Flow Routes

Project Status

PLANNING

Discipline	Status Code
Civil - Drainage	S4

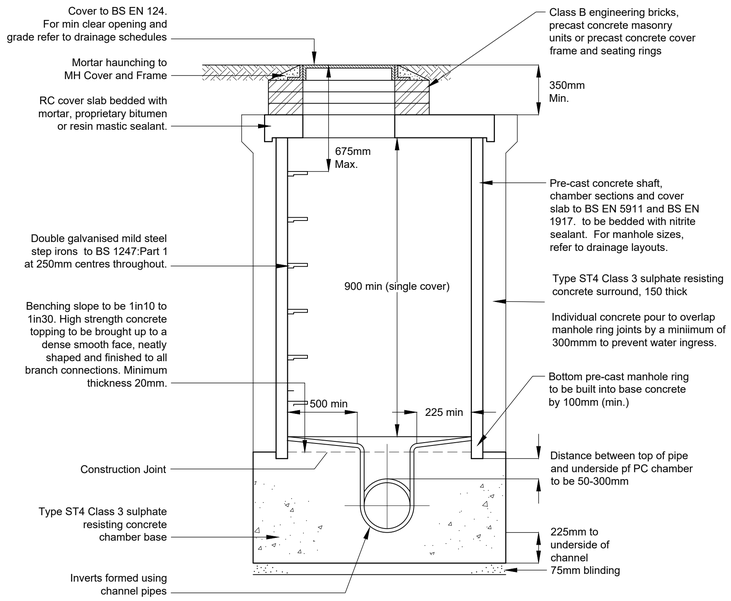
Project Number	Scale @ A1	Revision
281528	1:300	P02

Drawing Number

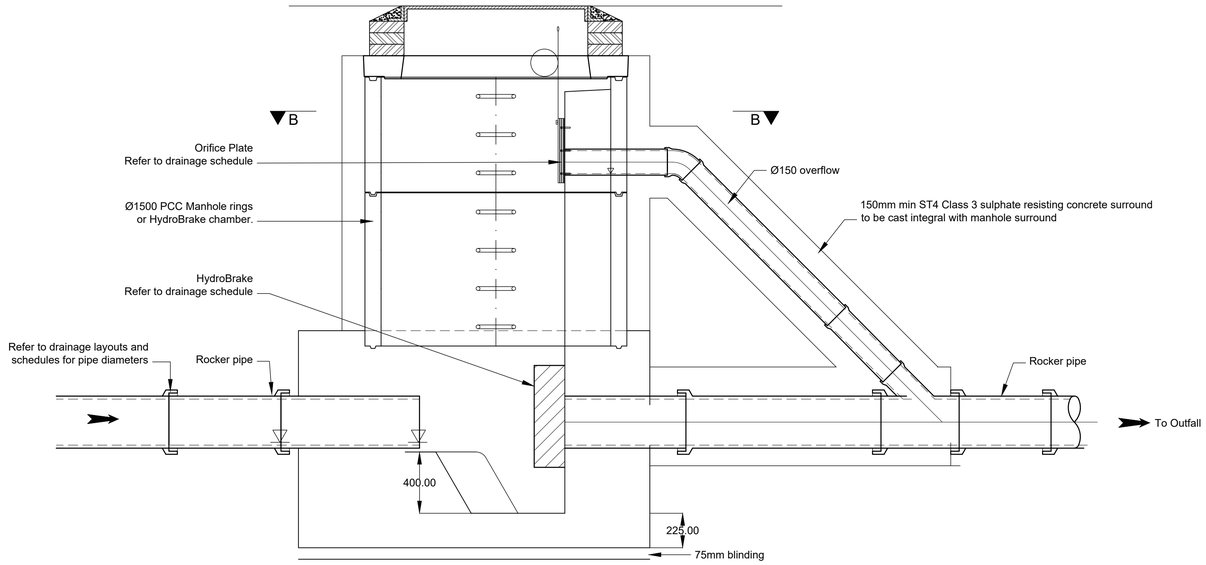
DCS20109-ARUP-PL-ZZ-LP-DR-C-52201

Project — Originator — Functional Breakdown — Spatial Breakdown — Level — Form — Discipline — Number

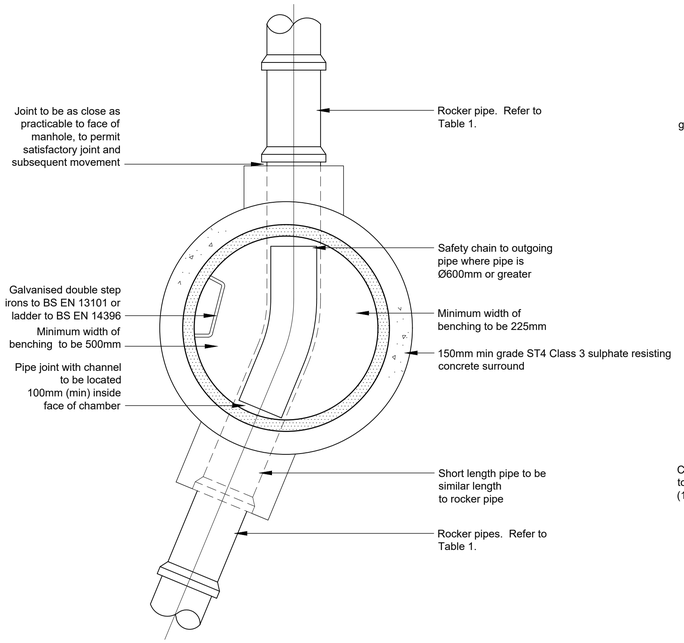
BWE_TB_A1v_Frame_LON4



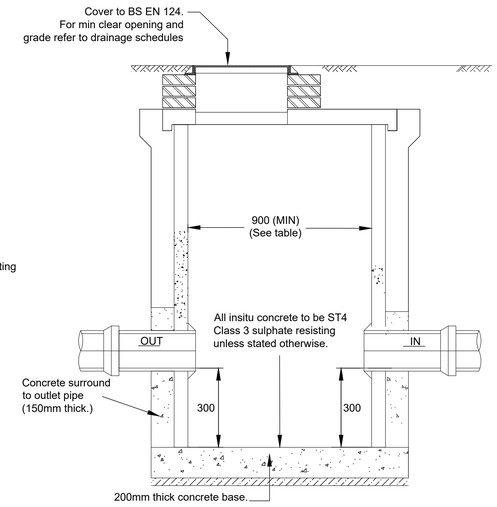
Type B PCC Manhole - Maximum depth from to soffit from cover 3m
Typical Detail - Section



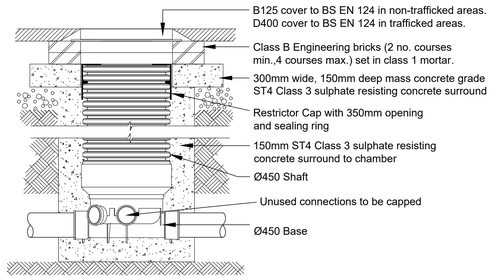
Control Chamber - Section



Type B PCC Manhole - Maximum depth from to soffit from cover 3m
Typical Detail - Plan



Typical Catchpit Detail



Reduced Access PPIC
Typical Detail

Diameter of pipe (mm)	Length of rocker pipe (mm)
150 - 600 600 - 750 > 750	600 1000 1250

TABLE 1 Rocker Pipe Lengths

Depth to pipe soffit (mm)	Diameter of largest pipe DN (mm)	Min internal diameter of manhole (mm)	Min clear opening size (mm)
< 1500	150 225 300 > 300	1200 1200 1200 Larger of 1800 or DN+450	750 x 675 1200 x 675
> 1500	225 300 375-450 > 450	1200 1200 1200 Larger of 1800 or DN+775	600 x 600
Manhole Shaft > 3000	Steps Ladder Winch	1050 1200 900	600 x 600

TABLE 2 Minimum chamber dimensions

Notes

1. All dimensions are in millimeters (mm) and all levels are in meters (m) Above Ordnance Datum (AOD) unless otherwise stated.
2. Cover and invert levels of existing manholes and pipes to be confirmed prior to commencement of construction.
3. All drainage <300mm to be HDPE. All drainage ≥300mm to be concrete.
4. All pipes and manholes to have Nitrile Seals
5. All covers within trafficked areas to be Grade D400. All other covers to be Grade B125.
6. Minimum clear openings to BS EN 752 as shown on Table 2 on DCS20109-ARUP-PL-ZZ-XX-DR-C-52500
7. Drainage to be laid, bedded and backfilled in accordance with manufacturer's recommendations.
8. Pipes with less than 900mm cover in areas not subjected to vehicular loading to be concrete protected. Pipes with less than 1200mm cover in areas subjected to vehicular loading to be concrete protected.
9. Interceptors to be Class 1 Full Retention separators with high level alarm, SPEL Puraceptor or similar approved. For standard details refer to spelproducts.co.uk.
10. Surface Water Tanks to be procured by the contractor and designed by manufacturer including access and venting arrangements. Polystorm Xtra or similar approved. For standard details refer to PSM series available on Polystorm.com
11. This drawing is to be read in conjunction with:
    - Drainage Layout DCS20109-ARUP-PL-ZZ-LP-DR-C-52200
    - Drainage Schedule DCS20109-ARUP-PL-ZZ-LP-DR-C-52700
    - Drainage Details DCS20109-ARUP-PL-ZZ-XX-DR-C-52500 to 52503

Rev	Details	By / Chkd / App	Date
P02	Planning Submission Update	LD / CH / GM	06 / 06 / 22
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Project Title
London 4, Hayes

Drawing Title
Underground Drainage Details
Sheet 1 of 3

Project Status
Planning

Discipline
Civil - Drainage

Status Code
S4

Project Number
281528

Scale @ A1
NTS

Revision
P02

Drawing Number
DCS20109-ARUP-PL-ZZ-XX-DR-C-52500
Project — Originator — Functional Breakdown — Spatial Breakdown — Level — Form — Discipline — Number

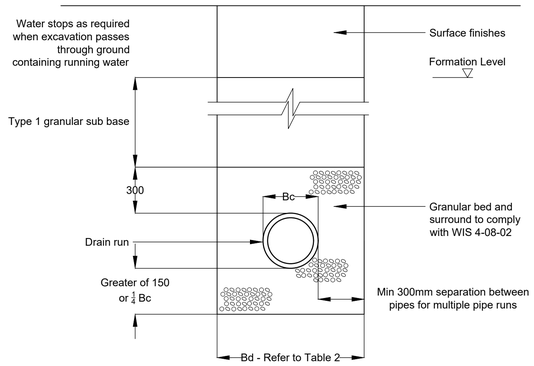
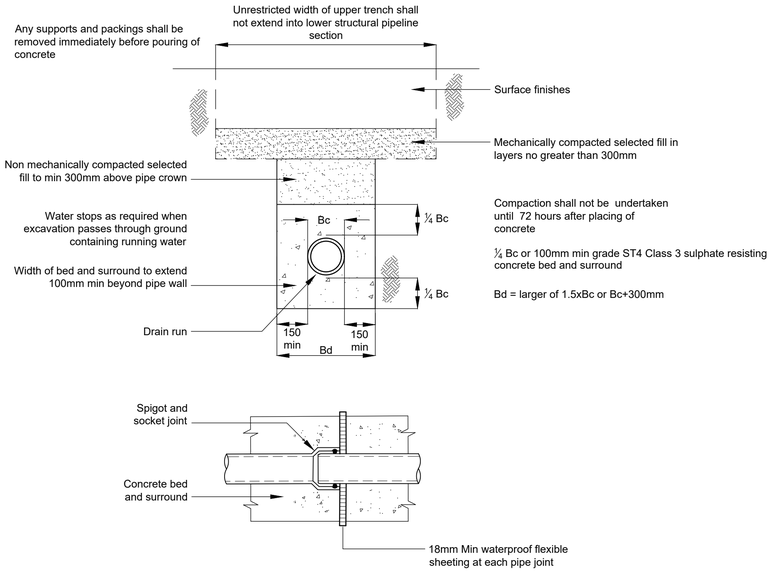


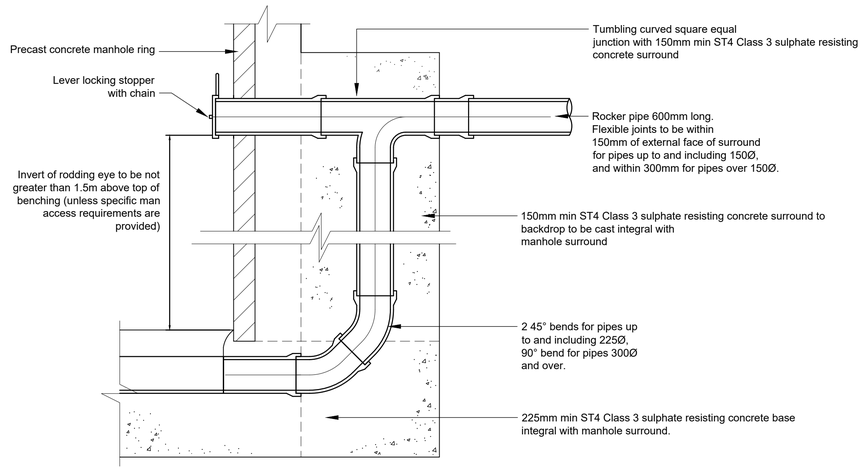
Table 1 - Granular Bed and Surround	
Pipe Diameter (mm)	Aggregate
150	10mm or 14mm single size or 14mm to 5mm graded
225-525	14mm or 20mm single size or 20mm to 5mm graded or 14mm to 5mm graded
1200	10,14,2mm or 40mm single size or 40mm to 5mm graded or 20mm to 5mm graded or 14mm to 5mm graded.

Table 2 - Trench Width (Bd)	
Pipe Diameter (mm)	Recommended Trench Width (mm)
150	600
225	700
300	750
375	1050
450	1150
500	1200
525	1200

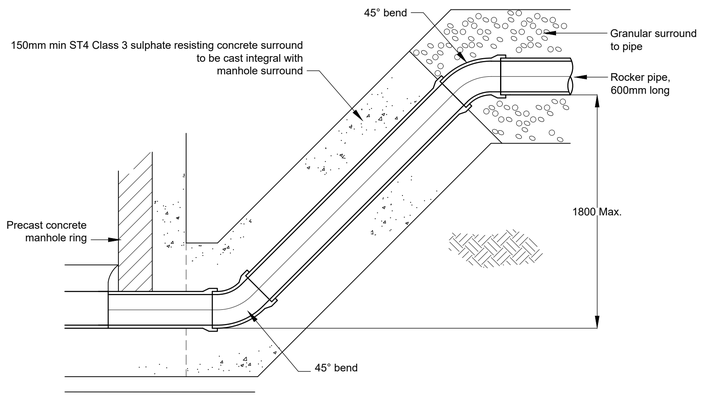
Class S Pipe Bed and Surround



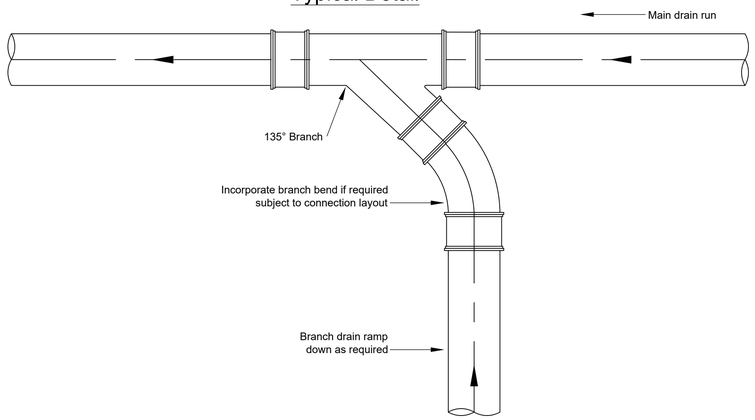
Unreinforced Concrete Bed and Surround



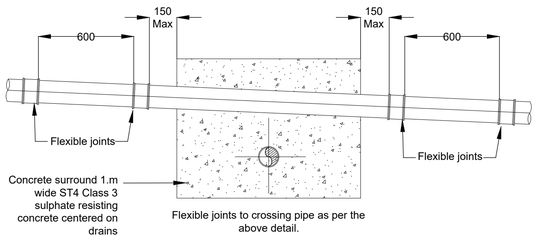
External Backdrop Typical Detail



Drainage Ramp Typical Detail



Typical External Drainage Branch Connection



Drain Crossing with less than 300mm clearance

Notes

1. All dimensions are in millimeters (mm) and all levels are in meters (m) Above Ordnance Datum (AOD) unless otherwise stated.
2. Cover and invert levels of existing manholes and pipes to be confirmed prior to commencement of construction.
3. All drainage <300mm to be HDPE. All drainage ≥300mm to be concrete.
4. All pipes and manholes to have Nitrile Seals
5. All covers within trafficked areas to be Grade D400. All other covers to be Grade B125.
6. Minimum clear openings to BS EN 752 as shown on Table 2 on DCS20109-ARUP-PL-ZZ-XX-DR-C-52500
7. Drainage to be laid, bedded and backfilled in accordance with manufacturer's recommendations.
8. Pipes with less than 900mm cover in areas not subjected to vehicular loading to be concrete protected. Pipes with less than 1200mm cover in areas subjected to vehicular loading to be concrete protected.
9. Interceptors to be Class 1 Full Retention separators with high level alarm, SPEL Puraceptor or similar approved. For standard details refer to spelproducts.co.uk.
10. Surface Water Tanks to be procured by the contractor and designed by manufacturer including access and venting arrangements. Polystorm Xtra or similar approved. For standard details refer to PSM series available on Polystorm.com
11. This drawing is to be read in conjunction with:
    - 11.1. Drainage Layout DCS20109-ARUP-PL-ZZ-LP-DR-C-52200
    - 11.2. Drainage Schedule DCS20109-ARUP-PL-ZZ-LP-DR-C-52700
      Drainage Details DCS20109-ARUP-PL-ZZ-XX-DR-C-52500 to 52503

Rev	Details	By / Chkd / App	Date
P02	Planning Submission Update	LD / CH / GM	06 / 06 / 22
P01	Planning Submission	JT / CH / GM	15 / 10 / 21

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Project Title
London 4, Hayes

Drawing Title
Underground Drainage Details
Sheet 2 of 3

Project Status
Planning

Discipline	Status Code
Civil - Drainage	S4

Project Number	Scale @ A1	Revision
281528	NTS	P02

Drawing Number
DCS20109-ARUP-PL-ZZ-XX-DR-C-52501
Project — Originator — Functional Breakdown — Spatial Breakdown — Level — Form — Discipline — Number

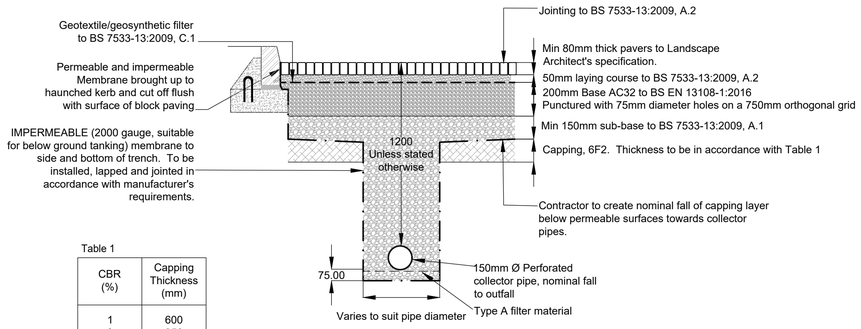
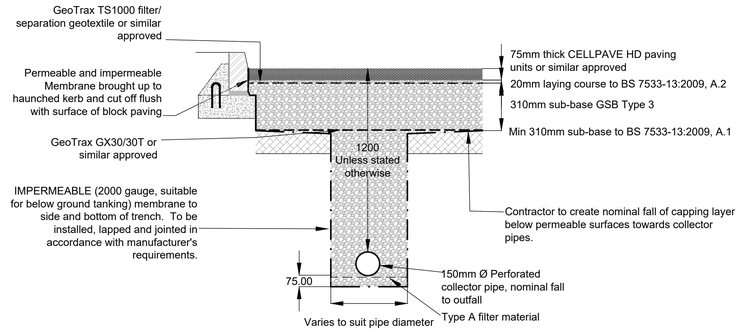


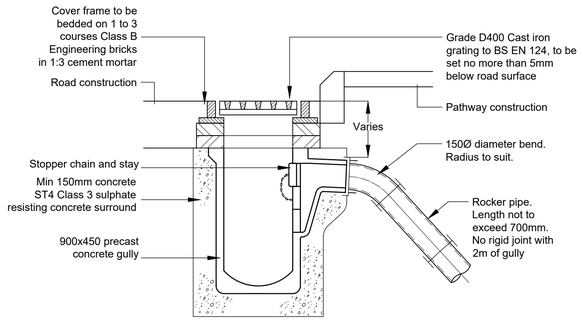
Table 1

CBR (%)	Capping Thickness (mm)
1	600
2	350
3	250
4	200
5+	150

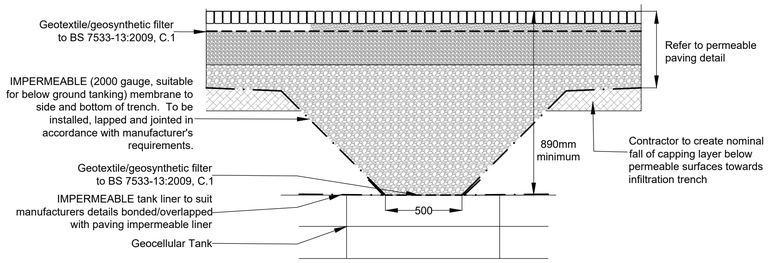
Typical Detail
Permeable Paving & Collector Pipe



Typical Detail
Cellular Grass Paving - Impermeable wilth Collector Pipe



Precast Concrete Highway Gully
Typical Detail

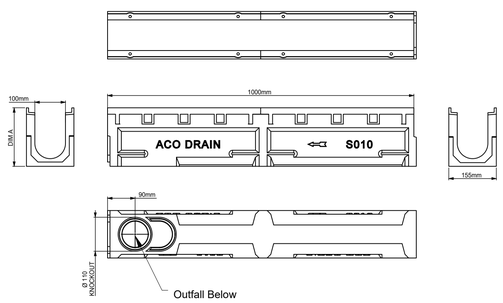


Indicative Detail Permeable Paving
Infiltration Directly To Tank

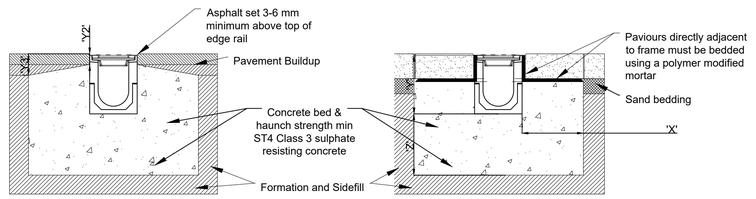
Table 2

CHANNEL	DIM A
S01	137
S010	191
S020	251
S030	311

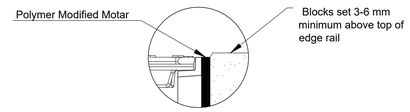
Linear channel details based on ACO S Range, S Range or similar approved



Linear Drainage



Load Class		F 900*
Minimum Dimensions (mm)	X	200
	Y	Full Channel Height (Less Y2 where applicable)
	Z	200
Maximum Dimensions (mm)	Y2	35
	Y3	70



Linear Drainage Surround

Notes

1. All dimensions are in millimeters (mm) and all levels are in meters (m) Above Ordnance Datum (AOD) unless otherwise stated.
2. Cover and invert levels of existing manholes and pipes to be confirmed prior to commencement of construction.
3. All drainage <300mm to be HDPE. All drainage ≥300mm to be concrete.
4. All pipes and manholes to have Nitrile Seals
5. All covers within trafficked areas to be Grade D400. All other covers to be Grade B125.
6. Minimum clear openings to BS EN 752 as shown on Table 2 on DCS20109-ARUP-PL-ZZ-XX-DR-C-52500
7. Drainage to be laid, bedded and backfilled in accordance with manufacturer's recommendations.
8. Pipes with less than 900mm cover in areas not subjected to vehicular loading to be concrete protected. Pipes with less than 1200mm cover in areas subjected to vehicular loading to be concrete protected.
9. Interceptors to be Class 1 Full Retention separators with high level alarm, SPEL Puraceptor or similar approved. For standard details refer to spelproducts.co.uk.
10. Surface Water Tanks to be procured by the contractor and designed by manufacturer including access and venting arrangements. Polystorm Xtra or similar approved. For standard details refer to PSM series available on Polystorm.com
11. This drawing is to be read in conjunction with:
    - Drainage Layout - DCS20109-ARUP-PL-ZZ-LP-DR-C-52200
    - Drainage Schedule DCS20109-ARUP-PL-ZZ-LP-DR-C-52700
    - Drainage Details DCS20109-ARUP-PL-ZZ-XX-DR-C-52500 to 52503

Rev	Details	By / Chkd / App	Date
P02	Planning Submission Update	LD / CH / GM	06 / 06 / 22
P01	Planning Submission	JT / CH / GM	15 / 10 / 21

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www.controlrisks.com

Project Title
London 4, Hayes

Drawing Title
Underground Drainage Details
Sheet 3 of 3

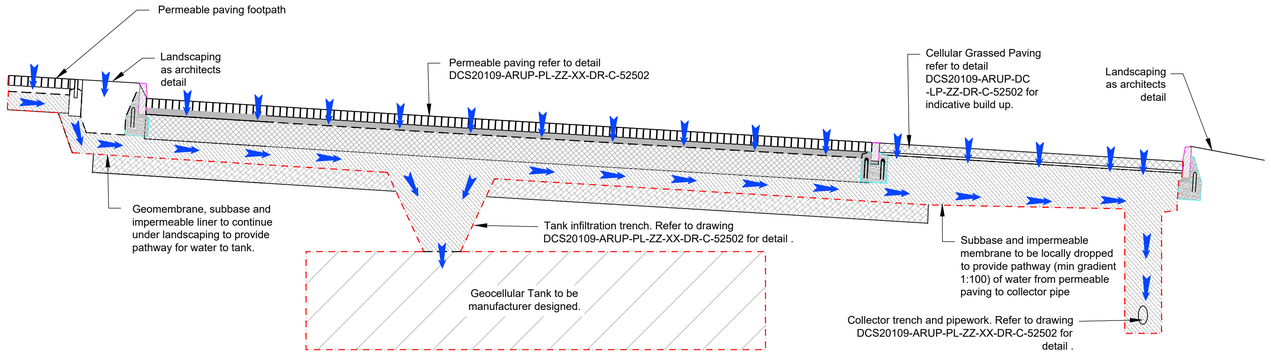
Project Status
Planning

Discipline	Status Code
Civil - Drainage	**S4**

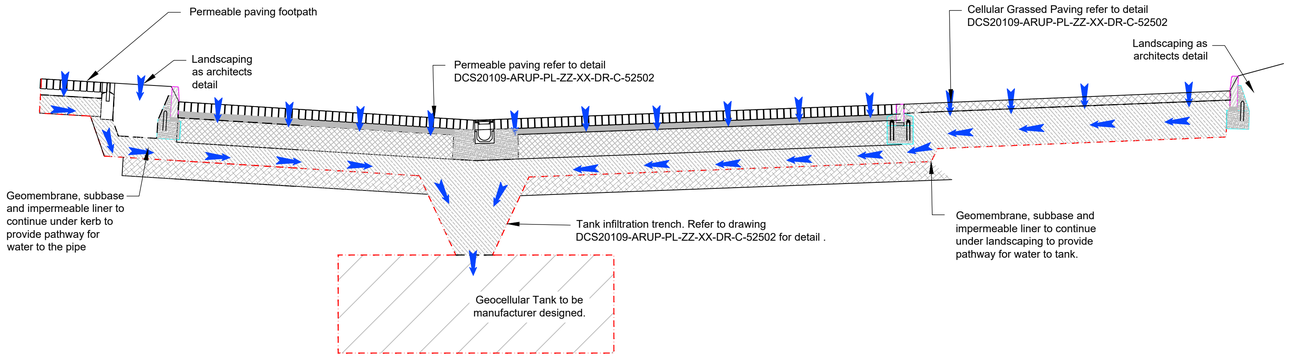
Project Number	Scale @ A1	Revision
281528	**NTS**	**P02**

Drawing Number
DCS20109-ARUP-PL-ZZ-XX-DR-C-52502
Project — Originator — Functional Breakdown — Spatial Breakdown — Level — Form — Discipline — Number

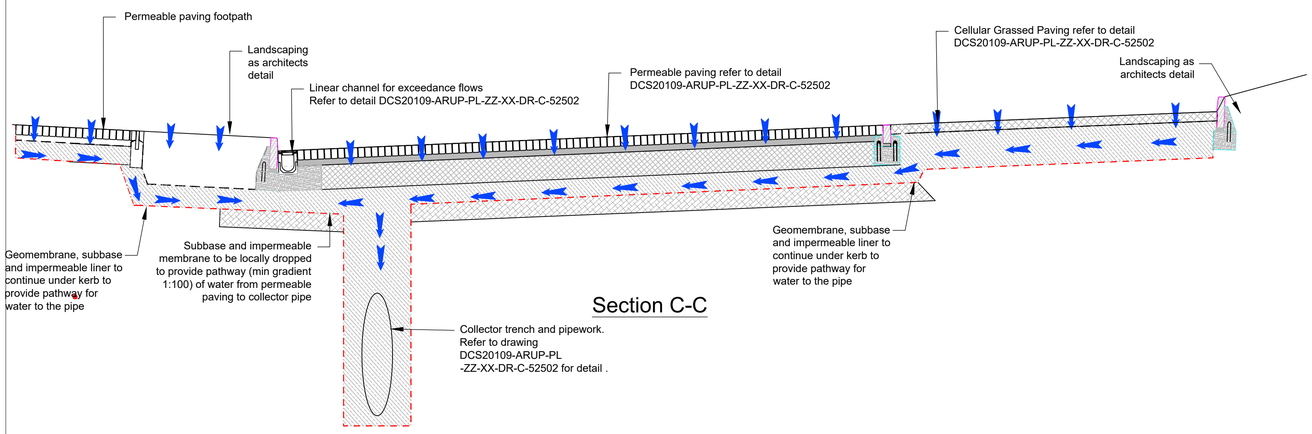
A1 - Do not scale



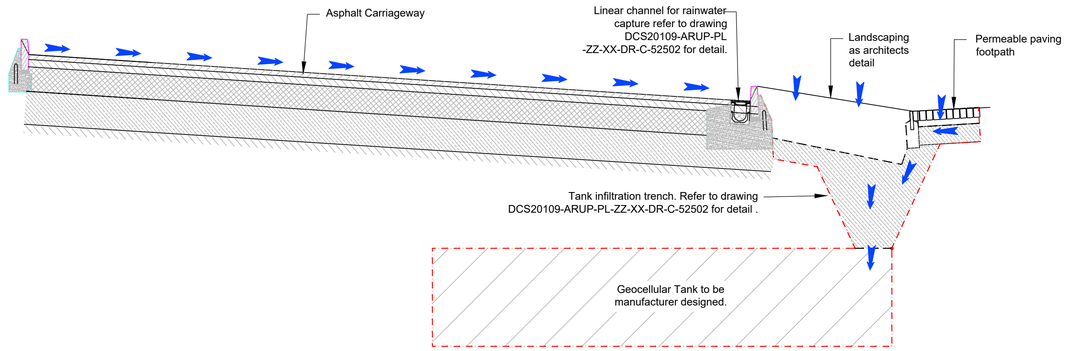
Section A-A



Section B-B

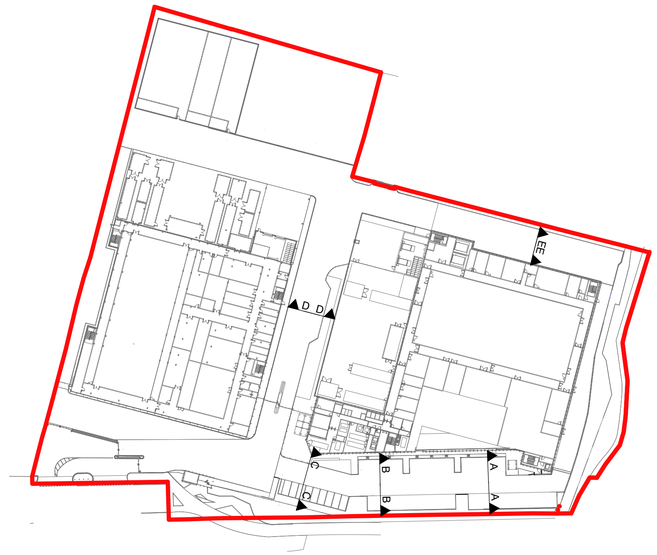


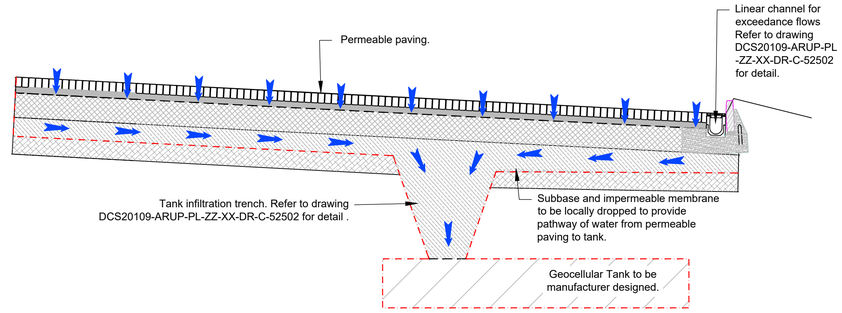
Section C-C



Section D-D

Section Plan





Section E-E

Notes

1. The following drawing provides an indicative cross section and water flow routes through the proposed permeable paving.
2. Refer to the following drawings and specifications for details of individual elements:
   - Drainage Layout DCS20109-ARUP-PL-ZZ-LP-DR-C-52200
   - Drainage Schedules DCS20109-ARUP-DC-ZZ-XX-DR-C-52700
   - Drainage Collector Details DCS20109-ARUP-PL-ZZ-XX-DR-C-52502
3. Drainage to be laid, bedded and backfilled in accordance with manufacturer's recommendations.
4. Surface water storage tanks to be procured by the contractor and designed by manufacturer including access and venting arrangements. Polystorm Xtra or similar approved. For standard details refer to the PSM series available on the Polystorm.com.

Key

Water flow route

Impermeable Membrane

Rev	Details	By / Chkd / App	Date
P01	Planning Submission Update	LD / CH / GM	06 / 06 / 22

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Project Title

London 4

Drawing Title

Underground Drainage
Permeable Paving Cross Section

Project Status

Planning

Discipline	Status Code
Civil - Drainage	**S4**

Project Number	Scale @ A1	Revision
281528	**NTS**	**P01**

Drawing Number

DCS20109-ARUP-PL-ZZ-XX-DR-C-52503

Project — Originator — Functional Breakdown — Spatial Breakdown — Level — Form — Discipline — Number

A1 - Do not scale

Storm Water Manhole Schedule

Manhole Name	Cover Level (m)	MH Depth to outgoing pipe invert (m)	Manhole Diam (mm)	Clear Opening (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Pipes In Backdrop (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Comments
S1	29.720	2.107	1200	600 x 600	SBCFS01	27.688	150		S1.000	27.613	225	Catchpit - additional 300mm sump
Tank 1	29.721	2.128			S1.000	27.593	225		S1.002	27.593	225	
					SBCB201	27.593	150					
					SBCB202	27.593	150					
					SBCFS02	27.593	150					
					Interceptor	28.215	150					
S2	29.707	2.122	1200	600 x 600	S1.001	27.585	225		S1.003	27.585	225	
					SBCFS03	27.585	150					
S3	29.695	2.157	1200	600 x 600	S1.003	27.538	225		S1.004	27.538	225	
					SBCSS01	27.538	225					
S4	29.690	2.205	1200	600 x 600	S1.004	27.485	225		S1.005	27.485	300	Catchpit - additional 300mm sump
					SBCB203	27.485	150					
Tank 2	29.669	2.209			S1.005	27.461	300		S1.006	27.460	300	
					SBCB204	27.461	150					
S5	29.625	2.192	1200	600 x 600	S1.006	27.433	300		S1.007	27.433	300	
					SBCSS02	27.433	150					
S6	29.072	1.485	1350	1200 x 675	FP102	27.587	150		S2.000	27.587	225	Catchpit - additional 300mm sump
Tank 3	29.132	1.615			S2.000	27.518	225		S2.001	27.517	300	
S7	29.123	1.615	1350	1200 x 675	S2.001	27.508	300		S2.002	27.508	300	Catchpit - additional 300mm sump
Tank 4	29.091	1.593			S2.002	27.499	300		S2.003	27.498	300	
S8	29.078	1.590	1350	1200 x 675	S2.003	27.488	300		S2.004	27.488	300	
S10	29.436	2.063	1200		S1.007	27.373	300		S1.008	27.373	375	Catchpit - additional 300mm sump
				600 x 600	S2.004	27.373	300					
Tank 5	29.485	2.156			S1.008	27.330	375		S1.009	27.330	375	
S11	29.353	2.033	1350	600 x 600	S1.009	27.320	375		S1.010	27.320	375	Catchpit - additional 300mm sump
					SBCB101	27.320	200					
					SBCB205	27.320	150					
Tank 6	29.332	2.029			S1.010	27.304	375		S1.011	27.303	375	
					SBCB102	27.423	250					
					SBCB206	27.304	150					
S12	29.318	2.060	1350	600 x 600	S1.011	27.258	375		S1.012	27.258	375	Catchpit - additional 300mm sump
					SBCB207	27.258	150					
Tank 7	29.308	2.066			S1.012	27.243	375		S1.013	27.242	375	
					SBCB103	27.418	250					
					SBCB208	27.243	150					
S13	29.736	1.425	1200	750 x 675					S3.000	28.311	150	Catchpit - additional 300mm sump
S14	29.699	2.195	1200	600 x 600	S3.000	27.579	150		S3.001	27.504	225	Catchpit - additional 300mm sump
					SBCB209	27.579	150					
Tank 8	29.699	2.220			S3.001	27.479	225		S3.001A	27.479	225	
					SBCB210	27.479	150					
S14A	29.723	2.258	1200	600 x 600	S3.001A	27.465	225		S3.002	27.465	225	Catchpit - additional 300mm sump
					SBCB211	27.465	150					
S15	29.726	2.338	1200	600 x 600	S3.002	27.388	225		S3.003	27.388	225	Catchpit - additional 300mm sump
					SBCB212	27.388	150					
S16	29.880	2.565	1200	600 x 600	S3.003	27.315	225		S3.004	27.315	300	Catchpit - additional 300mm sump
					FP206	27.315	150					
Tank 9	29.762	2.455			S3.004	27.308	300		S3.005	27.307	300	
					SBCB213	27.308	150					
S17	29.761	2.461	1200	600 x 600	S3.005	27.300	300		S3.005	27.300	300	Catchpit - additional 300mm sump
Tank 11	29.576	2.284			S3.006	27.293	300		S3.007	27.292	300	
					SBCB214	27.293	150					
					SBCGH1	27.293	150					
S18	29.457	2.181	1200	600 x 600	S3.007	27.263	300		S3.008	27.263	375	
S19	29.217	2.015	1500		S1.013	27.202	375		S1.014	27.202	500	Catchpit - additional 300mm sump
				600 x 600	S3.008	27.202	375					
S20	29.132	1.987	1500	1200 x 675	S1.014	27.145	500		S1.015	27.145	525	Catchpit - additional 300mm sump
Tank 12	29.075	1.971			S1.015	27.105	525		S1.016	27.104	525	
S21	29.006	1.912	1500	1200 x 675	S1.016	27.094	525		S1.017	27.094	525	
					SBCB104	27.094	375					
FPC1	28.645	1.420	1200	1200 x 675	FP101	27.225	150		S4.000	27.225	150	Catchpit - additional 300mm sump
FPC2	28.941	1.420	450	450 Dia	FP103	27.552	150		FP104	27.552	150	Inspection Chamber with Access Reducer
FPC3	28.671	1.364	450	450 Dia	FP104	27.307	150		S5.000	27.307	150	Inspection Chamber with Access Reducer
S22	28.842	1.697	1200	600 x 600	S5.000	27.145	150		S4.001	27.145	150	Catchpit - additional 300mm sump
					S4.000	27.145	150					
S23	28.927	1.887	1500	1200 x 675	S1.017	27.040	525		S1.018	27.040	525	
					S4.001	27.040	150					
S24	28.853	1.843	1500	1200 x 675	S1.018	27.010	525		S1.019	27.010	300	Hydrobrake and Overflow
Interceptor	28.906	1.963			S1.019	26.983	300		S1.020	26.943	300	
S25	28.944	2.061	1500	600 x 600	S1.020	26.883	300		S1.021	26.883	300	
Outfall	28.660				S1.021	26.860	300			OUTFALL		

Storm Water Manhole Schedule

Pipe Number	US/MH Name	Pipe Length (m)	Fall (m)	Slope (1:X)	US/IL (m)	DS/IL (m)	US/CL (m)	Pipe DIA (mm)	US D.Depth (m)
S1.000	S1	3.912	0.020	195.6	27.613	27.593	29.720	150	1.957
S1.001	Tank 1	1.762	0.008	220.3	27.593	27.585	29.721	225	1.903
S1.003	S2	8.778	0.047	186.8	27.585	27.538	29.707	225	1.897
S1.004	S3	10.374	0.053	195.7	27.538	27.485	29.695	225	1.932
S1.005	S4	4.812	0.024	200.5	27.485	27.461	29.690	300	1.905
S1.006	Tank 2	5.283	0.027	195.7	27.460	27.433	29.669	300	1.909
S1.007	S5	5.094	0.060	84.9	27.433	27.373	29.625	300	1.892
FP102	Rodding Eye	21.322	0.106	201.2	27.693	27.587	29.059	150	1.216
S2.000	S6	13.793	0.069	200	27.587	27.518	29.072	225	1.260
S2.001	Tank 3	1.750	0.009	194.4	27.517	27.508	29.132	300	1.315
S2.002	S7	1.746	0.009	194.0	27.508	27.499	29.123	300	1.315
S2.003	Tank 4	1.981	0.010	198.1	27.498	27.488	29.091	300	1.293
S2.004	S8	20.026	0.115	174.1	27.488	27.373	29.078	300	1.290
S1.008	S10	11.003	0.043	255.9	27.373	27.330	29.436	375	1.688
S1.009	Tank 5	2.450	0.010	245.0	27.330	27.320	29.485	375	1.780
S1.010	S11	3.142	0.016	196.4	27.320	27.304	29.353	375	1.658
S1.011	Tank 6	9.041	0.045	200.9	27.303	27.258	29.332	375	1.654
S1.012	S12	2.936	0.015	195.7	27.258	27.243	29.318	375	1.685
S1.013	Tank 7	5.413	0.040	135.3	27.242	27.202	29.308	375	1.691
S3.000	S13	29.097	0.732	39.8	28.311	27.579	29.736	150	1.275
S3.001	S14	4.892	0.025	195.7	27.504	27.479	29.699	225	1.970
S3.001A	Tank 8	2.640	0.014	188.6	27.479	27.465	29.699	225	1.995
S3.002	S14A	15.256	0.077	198.1	27.465	27.388	29.723	225	2.033
S3.003	S15	14.605	0.073	200.1	27.388	27.315	29.726	225	2.113
FP205	Rodding Eye	19.529	0.195	100.1	28.427	28.232	29.777	150	1.2
FP206	Junction	10.102	0.917	11.0	28.232	27.315	29.777	150	1.395
S3.004	S16	1.379	0.007	197.0	27.315	27.308	29.880	300	2.265
S3.005	Tank 9	1.464	0.007	209.2	27.307	27.300	29.762	300	2.155
S3.006	S17	1.506	0.007	215.2	27.300	27.293	29.761	300	2.161
S3.007	Tank 11	5.576	0.029	198.4	27.292	27.263	29.576	300	1.984
S3.008	S18	11.222	0.061	183.8	27.263	27.202	29.457	300	1.881
S1.014	S19	10.805	0.057	188.5	27.202	27.145	29.217	500	1.515
S1.015	S20	8.001	0.040	200.0	27.145	27.105	29.132	525	1.462
S1.016	Tank 12	1.738	0.010	173.8	27.104	27.094	29.075	525	1.446
S1.017	S21	10.287	0.054	190.5	27.094	27.040	29.006	525	1.387
FP101	Rodding Eye	27.063	0.310	87.3	27.535	27.225	28.899	150	1.214
S4.000	FCP1	6.209	0.080	77.6	27.225	27.145	28.645	150	1.270
FP103	Rodding Eye	17.392	0.166	104.8	27.718	27.552	29.082	150	1.214
FP104	FPC2	24.510	0.245	100.0	27.552	27.307	28.941	150	1.239
S5.000	FPC3	6.390	0.162	39.4	27.307	27.145	28.671	150	1.214
S4.001	S22	8.028	0.105	76.5	27.145	27.040	28.842	150	1.547
S1.018	S23	2.937	0.030	97.9	27.040	27.010	28.927	525	1.362
S1.019	S24	5.045	0.027	186.8	27.010	26.983	28.853	300	1.543
S1.020	Interceptor	5.061	0.060	84.3	26.943	26.883	28.906	300	1.663
S1.021	S25	4.397	0.023	191.2	26.883	26.860	28.944	300	1.761

Storm Water Control Schedule

Manhole	Type		Diameter (mm)	Depth Above Pipe (m)	Control Invert (m AOD)
S24	Hydro-Brake	MD-SHE-0120-7500-1500-7500	128	0.000	27.010
S24	Orifice		90	0.905	27.915

Interceptor Schedule

DS Manhole	Interceptor	Inlet Invert Level (m OAD)	Inlet Outfall Level (m OAD)	Pipe Diameter (mm)
Tank 1	SPEL Puraceptor P010 1C/SC	28.335	28.295	150
S25	SPEL Puraceptor P030 2C/SC	26.983	26.943	300

Storm Water Tanks

Tank	Height (m)	Area (m2)	Tank Volume (m3)	Tank Storage Volume (m3) Assume 95% Voids	Upstream Invert Level (m AOD)	Min Cover Level (m AOD)	Min Cover Depth (m)
Tank 1	0.84	123.5	103.7	98.6	27.593	29.658	1.23
Tank 2	1.05	66	69.3	65.8	27.461	29.632	1.12
Tank 3	0.42	115	48.3	45.9	27.518	29.076	1.14
Tank 4	0.42	110	46.2	43.9	27.499	29.053	1.13
Tank 5	0.84	200	168.0	159.6	27.33	29.263	1.09
Tank 6	0.84	165	138.6	131.7	27.304	29.340	1.20
Tank 7	1.05	157.5	165.4	157.1	27.243	29.270	0.98
Tank 8	1.05	73.5	77.2	73.3	27.479	29.684	1.16
Tank 9	1.26	115.5	145.5	138.3	27.308	29.739	1.17
Tank 10	1.26	244.5	308.1	292.7	27.313	29.815	1.24
Tank 11	1.26	176	221.8	210.7	27.293	29.589	1.04
Tank 12	0.84	286.5	240.7	228.6	27.104	28.960	1.02

Foul Water Manhole Schedule

Manhole Name	Cover Level (m)	MH Depth (m)	Manhole Diam (mm)	Clear Opening (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Pipes In Backdrop (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Comments
F1	29.526	2.095	1200	600 x 600	FBCB201	27.431	150		F1.000	27.431	150	
F2	29.509	2.554	1200	600 x 600	F1.000	27.005	150		F1.001	26.955	150	
					FBCB101	26.955	150					
F3	29.769	1.915	1200	600 x 600	FBCB202	27.854	100		F2.000	27.854	100	
F4	29.730	2.430	1200	600 x 600	F2.000	27.350	100		F2.001	27.300	150	
					FBCB203	27.300	150					
F5	29.403	2.628	1200	600 x 600	F1.001	26.775	150		F1.002	26.775	150	
					F2.001	26.775	150					
Outfall	29.374				F1.002	26.667	150					

Foul Water Pipe Schedule

Pipe Number	US/MH Name	Pipe Length (m)	Fall (m)	Slope (1:X)	US/IL (m)	DS/IL (m)	US/CL (m)	Pipe DIA (mm)	US D.Depth (m)
F1.000	F1	18.946	0.476	39.8	27.431	26.955	29.526	100	1.995
F1.001	F2	26.987	0.180	149.9	26.955	26.775	29.509	150	2.404
F2.000	F3	18.553	0.504	36.8	27.854	27.350	29.769	150	1.765
F2.001	F4	41.634	0.525	79.3	27.300	26.775	29.730	150	2.28
F1.002	F5	16.019	0.108	148.3	26.775	26.667	29.403	150	2.478

Notes

1. All dimensions are in millimeters (mm) and all levels are in meters (m) Above Ordnance Datum (AOD) unless otherwise stated.
2. Cover and invert levels of existing manholes and pipes to be confirmed prior to commencement of construction.
3. All drainage <300mm to be HDPE. All drainage ≥300mm to be concrete.
4. All pipes and manholes to have Nitrile Seals
5. All covers within trafficked areas to be Grade D400. All other covers to be Grade B125.
6. Drainage to be laid, bedded and backfilled in accordance with manufacturer's recommendations.
7. Pipes with less than 900mm cover in areas not subjected to vehicular loading to be concrete protected. Pipes with less than 1200mm cover in areas subjected to vehicular loading to be concrete protected.
8. Tanks to be procured by the contractor and designed by manufacturer including access and venting arrangements. Polystorm Xtra or similar approved. For standard details refer to PSM series available on Polystorm.com.
9. Interceptors to be Class 1 Full Retention separators with high level alarm, SPEL Puraceptor or similar approved. For standard details refer to spelproducts.co.uk.
10. This drawing is to be read in conjunction with:
    - 10.1. Drainage Layout DCS20109-ARUP-PL-ZZ-LP-DR-C-52200
    - 10.2. Drainage Details DCS20109-ARUP-PL-ZZ-XX-DR-C-52500 to 52503

Rev	Details	By / Chkd / App	Date
P02	Planning Submission Update	LD / CH / GM	06 / 06 / 22
P01	Planning Submission	JT / CH / GM	15 / 10 / 21

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Project Title
London 4, Hayes

Drawing Title
Underground Drainage Schedule

Project Status
Planning

Discipline: **Civil - Drainage** | Status Code: **S4**

Project Number: 281528 | Scale @ A1: **1:500** | Revision: **P02**

Drawing Number
DCS20109-ARUP-PL-ZZ-XX-DR-C-52700
Project — Originator — Functional Breakdown — Spatial Breakdown — Level — Form — Discipline — Number

Appendix H

MicroDrainage

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm 26-05-22 Planning

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	200

Designed with Level Inverts

Network Design Table for Storm 26-05-22 Planning

- Indicates pipe length does not match coordinates
« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	3.912	0.020	195.6	0.086	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	19.000	0.000	0.0	0.064	0.00	0.0	0.600	T1	-1	Pipe/Conduit	
S1.002	1.762#	0.008	220.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	8.778	0.047	186.8	0.054	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	10.374	0.053	195.7	0.076	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.005	4.812	0.024	200.5	0.068	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	12.000	0.001	12000.4	0.000	0.00	0.0	0.600	T2	-2	Pipe/Conduit	
S1.007	5.283	0.027	195.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.008	5.094	0.060	84.9	0.120	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.07	27.613	0.086	0.0	0.0	0.0	0.93	37.0	11.7
S1.001	50.00	5.83	27.593	0.151	0.0	0.0	0.0	0.42	2047.5	20.4
S1.002	50.00	5.87	27.593	0.151	0.0	0.0	0.0	0.88	34.9	20.4
S1.003	50.00	6.02	27.585	0.205	0.0	0.0	0.0	0.95	37.9	27.7
S1.004	49.57	6.21	27.538	0.281	0.0	0.0	0.0	0.93	37.0«	37.7
S1.005	49.29	6.28	27.485	0.349	0.0	0.0	0.0	1.11	78.2	46.7
S1.006	47.56	6.76	27.461	0.349	0.0	0.0	0.0	0.42	2171.9	46.7
S1.007	47.29	6.84	27.460	0.349	0.0	0.0	0.0	1.12	79.2	46.7
S1.008	47.12	6.89	27.433	0.469	0.0	0.0	0.0	1.71	120.7	59.9

Network Design Table for Storm 26-05-22 Planning

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.000	13.620	0.069	197.4	0.082	5.00	0.0	0.600	o	225	Pipe/Conduit	
S2.001	23.045	0.000	0.0	0.000	0.00	0.0	0.600	T3	-3	Pipe/Conduit	
S2.002	1.750	0.009	194.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.003	1.746	0.009	194.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.004	14.975	0.001	14974.8	0.000	0.00	0.0	0.600	T4	-4	Pipe/Conduit	
S2.005	17.025	0.000	0.0	0.000	0.00	0.0	0.600	T4D	-5	Pipe/Conduit	
S2.006	1.981	0.010	198.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.007	20.026	0.115	174.1	0.050	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.009	11.003	0.043	255.9	0.036	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.010	20.009	0.001	20009.3	0.000	0.00	0.0	0.600	T5	-6	Pipe/Conduit	
S1.011	2.450#	0.010	245.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.012	3.142	0.016	196.4	0.267	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.013	22.000	0.001	22000.0	0.000	0.00	0.0	0.600	T6	-7	Pipe/Conduit	
S1.014	9.041	0.045	200.9	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.015	2.936	0.015	195.7	0.169	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.016	15.000	0.001	15000.0	0.000	0.00	0.0	0.600	T7	-8	Pipe/Conduit	
S1.017	5.429	0.040	135.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S3.000	29.097	0.732	39.8	0.016	5.00	0.0	0.600	o	150	Pipe/Conduit	
S3.001	4.892	0.025	195.7	0.122	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.002	14.002	0.000	0.0	0.000	0.00	0.0	0.600	T8	-9	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.000	50.00	5.24	27.587	0.082	0.0	0.0	0.0	0.93	36.9	11.1
S2.001	47.98	6.64	27.518	0.082	0.0	0.0	0.0	0.28	521.8	11.1
S2.002	47.89	6.66	27.517	0.082	0.0	0.0	0.0	1.12	79.5	11.1
S2.003	47.79	6.69	27.508	0.082	0.0	0.0	0.0	1.13	79.5	11.1
S2.004	44.17	7.82	27.499	0.082	0.0	0.0	0.0	0.22	376.7	11.1
S2.005	41.24	8.91	27.498	0.082	0.0	0.0	0.0	0.26	244.0	11.1
S2.006	41.17	8.94	27.498	0.082	0.0	0.0	0.0	1.11	78.7	11.1
S2.007	40.53	9.22	27.488	0.132	0.0	0.0	0.0	1.19	84.0	14.5
S1.009	40.16	9.38	27.373	0.637	0.0	0.0	0.0	1.13	124.6	69.3
S1.010	37.84	10.50	27.330	0.637	0.0	0.0	0.0	0.30	2256.0	69.3
S1.011	37.78	10.54	27.330	0.637	0.0	0.0	0.0	1.15	127.4	69.3
S1.012	37.70	10.58	27.320	0.904	0.0	0.0	0.0	1.29	142.4	92.3
S1.013	35.36	11.89	27.304	0.904	0.0	0.0	0.0	0.28	1578.4	92.3
S1.014	35.17	12.01	27.303	0.904	0.0	0.0	0.0	1.27	140.8	92.3
S1.015	35.11	12.05	27.258	1.073	0.0	0.0	0.0	1.29	142.7	102.0
S1.016	34.11	12.69	27.243	1.073	0.0	0.0	0.0	0.39	3909.0	102.0
S1.017	34.03	12.75	27.242	1.073	0.0	0.0	0.0	1.56	171.8	102.0
S3.000	50.00	5.30	28.311	0.016	0.0	0.0	0.0	1.60	28.3	2.2
S3.001	50.00	5.39	27.504	0.138	0.0	0.0	0.0	0.93	37.0	18.6
S3.002	50.00	5.94	27.479	0.138	0.0	0.0	0.0	0.42	1203.2	18.6

Network Design Table for Storm 26-05-22 Planning

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S3.003	6.977	0.000	0.0	0.000	0.00	0.0	0.600	T8D	-10	Pipe/Conduit	
S3.004	2.640#	0.014	188.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.005	15.256	0.077	198.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.006	14.605	0.073	200.1	0.054	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.007	1.379	0.007	197.0	0.140	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.008	21.020	0.001	21020.0	0.000	0.00	0.0	0.600	T9	-12	Pipe/Conduit	
S3.009	1.464	0.007	209.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.010	1.506	0.007	215.2	0.047	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.011	32.006	0.001	32006.3	0.026	0.00	0.0	0.600	T11	-13	Pipe/Conduit	
S3.012	5.576#	0.029	192.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.013	11.222	0.061	184.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.018	10.805	0.057	189.6	0.072	0.00	0.0	0.600	o	500	Pipe/Conduit	
S1.019	8.001	0.040	200.0	0.076	0.00	0.0	0.600	o	525	Pipe/Conduit	
S1.020	23.998	0.001	23997.9	0.000	0.00	0.0	0.600	12U	-14	Pipe/Conduit	
S1.021	21.000	0.000	0.0	0.000	0.00	0.0	0.600	12D	-15	Pipe/Conduit	
S1.022	1.738#	0.010	173.8	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
S1.023	10.287	0.054	190.5	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
S4.000	6.209	0.080	77.6	0.049	5.00	0.0	0.600	o	150	Pipe/Conduit	
S4.001	8.028	0.105	76.5	0.028	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S3.003	49.59	6.20	27.479	0.138	0.0	0.0	0.0	0.45	1915.9	18.6
S3.004	49.41	6.25	27.479	0.138	0.0	0.0	0.0	0.95	37.7	18.6
S3.005	48.39	6.52	27.465	0.138	0.0	0.0	0.0	0.93	36.8	18.6
S3.006	47.46	6.79	27.388	0.192	0.0	0.0	0.0	0.92	36.6	24.7
S3.007	47.39	6.81	27.315	0.331	0.0	0.0	0.0	1.12	78.9	42.5
S3.008	44.15	7.83	27.308	0.331	0.0	0.0	0.0	0.34	2143.4	42.5
S3.009	44.09	7.85	27.307	0.331	0.0	0.0	0.0	1.08	76.6	42.5
S3.010	44.02	7.87	27.300	0.378	0.0	0.0	0.0	1.07	75.5	45.1
S3.011	39.24	9.81	27.293	0.405	0.0	0.0	0.0	0.28	1725.6	45.1
S3.012	39.07	9.89	27.292	0.405	0.0	0.0	0.0	1.13	79.9	45.1
S3.013	38.78	10.03	27.263	0.405	0.0	0.0	0.0	1.33	147.2	45.1
S1.018	33.85	12.86	27.202	1.549	0.0	0.0	0.0	1.57	309.1	142.1
S1.019	33.73	12.94	27.145	1.625	0.0	0.0	0.0	1.58	342.1	148.4
S1.020	31.59	14.52	27.105	1.625	0.0	0.0	0.0	0.25	867.2	148.4
S1.021	30.58	15.34	27.104	1.625	0.0	0.0	0.0	0.42	2725.2	148.4
S1.022	30.56	15.36	27.104	1.625	0.0	0.0	0.0	1.70	367.2	148.4
S1.023	30.44	15.47	27.094	1.625	0.0	0.0	0.0	1.62	350.6	148.4
S4.000	50.00	5.09	27.225	0.049	0.0	0.0	0.0	1.14	20.2	6.7
S4.001	50.00	5.21	27.145	0.078	0.0	0.0	0.0	1.15	20.3	10.5

Network Design Table for Storm 26-05-22 Planning

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.024	2.937	0.030	97.9	0.348	0.00	0.0	0.600	o	525	Pipe/Conduit	
S1.025	5.045	0.027	186.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.026	5.061	0.060	84.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.027	4.397	0.023	191.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.024	30.41	15.49	27.040	2.051	0.0	0.0	0.0	2.26	490.1	168.9
S1.025	30.33	15.56	27.010	2.051	0.0	0.0	0.0	1.15	81.1«	168.9
S1.026	30.27	15.61	26.943	2.051	0.0	0.0	0.0	1.71	121.1«	168.9
S1.027	30.20	15.68	26.883	2.051	0.0	0.0	0.0	1.13	80.1«	168.9

Manhole Schedules for Storm 26-05-22 Planning

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Back (m
S1	29.720	2.107	Open Manhole	1200	S1.000	27.613	225				
STANK 1 US	29.721	2.128	Junction		S1.001	27.593	-1	S1.000	27.593	225	
STANK 1 DS	29.721	2.128	Junction		S1.002	27.593	225	S1.001	27.593	-1	
S2	29.707	2.122	Open Manhole	1200	S1.003	27.585	225	S1.002	27.585	225	
S3	29.695	2.157	Open Manhole	1200	S1.004	27.538	225	S1.003	27.538	225	
S4	29.690	2.205	Open Manhole	1200	S1.005	27.485	300	S1.004	27.485	225	
STANK 2 US	29.687	2.226	Junction		S1.006	27.461	-2	S1.005	27.461	300	
STANK 2 DS	29.669	2.209	Junction		S1.007	27.460	300	S1.006	27.460	-2	
S5	29.625	2.192	Open Manhole	1200	S1.008	27.433	300	S1.007	27.433	300	
S6	29.072	1.485	Open Manhole	1200	S2.000	27.587	225				
STANK 3 US	29.132	1.614	Junction		S2.001	27.518	-3	S2.000	27.518	225	
STANK 3 DS	29.132	1.615	Junction		S2.002	27.517	300	S2.001	27.518	-3	
S7	29.123	1.615	Open Manhole	1200	S2.003	27.508	300	S2.002	27.508	300	
STANK 4 US	29.123	1.624	Junction		S2.004	27.499	-4	S2.003	27.499	300	
STANK 4 ND	29.117	1.619	Junction		S2.005	27.498	-5	S2.004	27.498	-4	
STANK 4 DS	29.091	1.593	Junction		S2.006	27.498	300	S2.005	27.498	-5	
S8	29.078	1.590	Open Manhole	1350	S2.007	27.488	300	S2.006	27.488	300	
S10	29.436	2.063	Open Manhole	1350	S1.009	27.373	375	S1.008	27.373	300	
								S2.007	27.373	300	
STANk 5 US	29.445	2.115	Junction		S1.010	27.330	-6	S1.009	27.330	375	
STANk 5 DS	29.485	2.156	Junction		S1.011	27.330	375	S1.010	27.329	-6	
S11	29.353	2.033	Open Manhole	1350	S1.012	27.320	375	S1.011	27.320	375	
STANK 6 US	29.354	2.050	Junction		S1.013	27.304	-7	S1.012	27.304	375	
STANK 6 DS	29.332	2.029	Junction		S1.014	27.303	375	S1.013	27.303	-7	
S12	29.318	2.060	Open Manhole	1350	S1.015	27.258	375	S1.014	27.258	375	
STANK 7 US	29.306	2.063	Junction		S1.016	27.243	-8	S1.015	27.243	375	
STANK 7 DS	29.308	2.066	Junction		S1.017	27.242	375	S1.016	27.242	-8	
S13	29.736	1.425	Open Manhole	1350	S3.000	28.311	150				
S14	29.699	2.195	Open Manhole	1200	S3.001	27.504	225	S3.000	27.579	150	
STANK 8 US	29.740	2.261	Junction		S3.002	27.479	-9	S3.001	27.479	225	
STANK 8 ND1	29.738	2.259	Junction		S3.003	27.479	-10	S3.002	27.479	-9	
STANK 8 DS	29.699	2.220	Junction		S3.004	27.479	225	S3.003	27.479	-10	
S14A	29.723	2.258	Open Manhole	1200	S3.005	27.465	225	S3.004	27.465	225	
S15	29.726	2.338	Open Manhole	1200	S3.006	27.388	225	S3.005	27.388	225	
S16	29.880	2.565	Open Manhole	1200	S3.007	27.315	300	S3.006	27.315	225	
STANK 9 US	29.875	2.567	Junction		S3.008	27.308	-12	S3.007	27.308	300	
STANK 9 DS	29.762	2.455	Junction		S3.009	27.307	300	S3.008	27.307	-12	
S17	29.761	2.461	Open Manhole	1200	S3.010	27.300	300	S3.009	27.300	300	

Manhole Schedules for Storm 26-05-22 Planning

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Ba
STANK 11 US	29.762	2.469	Junction		S3.011	27.293	-13	S3.010	27.293	300	
STANK 11 DS	29.576	2.284	Junction		S3.012	27.292	300	S3.011	27.292	-13	
S18	29.457	2.194	Open Manhole	1350	S3.013	27.263	375	S3.012	27.263	300	
S19	29.217	2.015	Open Manhole	1500	S1.018	27.202	500	S1.017	27.202	375	
								S3.013	27.202	375	
S20	29.132	1.987	Open Manhole	1500	S1.019	27.145	525	S1.018	27.145	500	
STANK 12 US	29.200	2.095	Junction		S1.020	27.105	-14	S1.019	27.105	525	
STANK 12 ND 1	29.070	1.966	Junction		S1.021	27.104	-15	S1.020	27.104	-14	
STANK 12 DS	29.075	1.971	Junction		S1.022	27.104	525	S1.021	27.104	-15	
S21	29.006	1.912	Open Manhole	1500	S1.023	27.094	525	S1.022	27.094	525	
SPPCP01	28.645	1.420	Open Manhole	1200	S4.000	27.225	150				
S22	28.842	1.697	Open Manhole	1200	S4.001	27.145	150	S4.000	27.145	150	
S23	28.927	1.887	Open Manhole	1500	S1.024	27.040	525	S1.023	27.040	525	
								S4.001	27.040	150	
S24	28.853	1.843	Open Manhole	1500	S1.025	27.010	300	S1.024	27.010	525	
SInt	28.906	1.963	Junction		S1.026	26.943	300	S1.025	26.983	300	
S25	28.944	2.061	Open Manhole	1500	S1.027	26.883	300	S1.026	26.883	300	
S	28.660	1.800	Open Manhole	0		OUTFALL		S1.027	26.860	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	511438.913	180249.190	511438.913	180249.190	Required	
STANK 1 US	511442.697	180248.199			No Entry	
STANK 1 DS	511461.088	180243.426	511461.088	180243.426	Required	
S2	511463.044	180243.945	511463.044	180243.945	Required	
S3	511471.527	180241.685	511471.527	180241.685	Required	
S4	511481.605	180239.228	511481.605	180239.228	Required	

Manhole Schedules for Storm 26-05-22 Planning

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
STANK 2 US	511486.291	180238.133			No Entry	
STANK 2 DS	511497.903	180235.105			No Entry	
S5	511503.012	180233.757	511503.012	180233.757	Required	
S6	511598.190	180206.601	511598.190	180206.601	Required	
STANK 3 US	511584.988	180209.952			No Entry	
STANK 3 DS	511562.709	180215.845			No Entry	
S7	511561.120	180216.708	511561.120	180216.708	Required	
STANK 4 US	511559.436	180217.172			No Entry	
STANK 4 ND	511544.947	180220.953			No Entry	
STANK 4 DS	511528.472	180225.246			No Entry	
S8	511526.555	180225.748	511526.555	180225.748	Required	
S10	511507.186	180230.839	511507.186	180230.839	Required	
STANk 5 US	511504.424	180220.188			No Entry	
STANk 5 DS	511499.363	180200.830			No Entry	
S11	511505.544	180196.701	511505.544	180196.701	Required	

Manhole Schedules for Storm 26-05-22 Planning

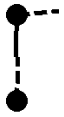
MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
STANK 6 US	511504.739	180193.664			No Entry	
STANK 6 DS	511499.197	180172.373			No Entry	
S12	511496.917	180163.625	511496.917	180163.625	Required	
STANK 7 US	511496.181	180160.783			No Entry	
STANK 7 DS	511492.403	180146.267			No Entry	
S13	511438.215	180240.603	511438.215	180240.603	Required	
S14	511430.870	180212.448	511430.870	180212.448	Required	
STANK 8 US	511429.642	180207.713			No Entry	
STANK 8 ND1	511426.114	180194.163			No Entry	
STANK 8 DS	511424.356	180187.411			No Entry	
S14A	511422.652	180185.088	511422.652	180185.088	Required	
S15	511418.809	180170.324	511418.809	180170.324	Required	
S16	511418.769	180155.719	511418.769	180155.719	Required	
STANK 9 US	511420.100	180155.356			No Entry	
STANK 9 DS	511440.562	180150.544			No Entry	

Manhole Schedules for Storm 26-05-22 Planning

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S17	511441.979	180150.175	511441.979	180150.175	Required	
STANK 11 US	511443.437	180149.797			No Entry	
STANK 11 DS	511474.445	180141.866			No Entry	
S18	511479.834	180139.712	511479.834	180139.712	Required	
S19	511490.979	180141.028	511490.979	180141.028	Required	
S20	511501.442	180138.330	511501.442	180138.330	Required	
STANK 12 US	511509.443	180138.263			No Entry	
STANK 12 ND 1	511533.431	180138.958			No Entry	
STANK 12 DS	511554.422	180139.563			No Entry	
S21	511556.259	180136.145	511556.259	180136.145	Required	
SPPCP01	511574.756	180128.174	511574.756	180128.174	Required	
S22	511574.487	180134.378	511574.487	180134.378	Required	
S23	511566.484	180135.017	511566.484	180135.017	Required	
S24	511566.353	180132.083	511566.353	180132.083	Required	
SInt	511561.311	180132.246			No Entry	

Manhole Schedules for Storm 26-05-22 Planning

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S25	511556.269	180131.808	511556.269	180131.808	Required	
S	511556.157	180127.413			No Entry	



PIPELINE SCHEDULES for Storm 26-05-22 Planning

Upstream Manhole

- Indicates pipe length does not match coordinates

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	225	S1	29.720	27.613	1.882	Open Manhole	1200
S1.001	T1	-1	STANK 1 US	29.721	27.593	1.288	Junction	
S1.002	o	225	STANK 1 DS	29.721	27.593	1.903	Junction	
S1.003	o	225	S2	29.707	27.585	1.897	Open Manhole	1200
S1.004	o	225	S3	29.695	27.538	1.932	Open Manhole	1200
S1.005	o	300	S4	29.690	27.485	1.905	Open Manhole	1200
S1.006	T2	-2	STANK 2 US	29.687	27.461	1.176	Junction	
S1.007	o	300	STANK 2 DS	29.669	27.460	1.909	Junction	
S1.008	o	300	S5	29.625	27.433	1.892	Open Manhole	1200
S2.000	o	225	S6	29.072	27.587	1.260	Open Manhole	1200
S2.001	T3	-3	STANK 3 US	29.132	27.518	1.194	Junction	
S2.002	o	300	STANK 3 DS	29.132	27.517	1.315	Junction	
S2.003	o	300	S7	29.123	27.508	1.315	Open Manhole	1200
S2.004	T4	-4	STANK 4 US	29.123	27.499	1.204	Junction	
S2.005	T4D	-5	STANK 4 ND	29.117	27.498	1.199	Junction	
S2.006	o	300	STANK 4 DS	29.091	27.498	1.293	Junction	
S2.007	o	300	S8	29.078	27.488	1.290	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	3.912	195.6	STANK 1 US	29.721	27.593	1.903	Junction	
S1.001	19.000	0.0	STANK 1 DS	29.721	27.593	1.288	Junction	
S1.002	1.762#	220.3	S2	29.707	27.585	1.897	Open Manhole	1200
S1.003	8.778	186.8	S3	29.695	27.538	1.932	Open Manhole	1200
S1.004	10.374	195.7	S4	29.690	27.485	1.980	Open Manhole	1200
S1.005	4.812	200.5	STANK 2 US	29.687	27.461	1.926	Junction	
S1.006	12.000	12000.4	STANK 2 DS	29.669	27.460	1.159	Junction	
S1.007	5.283	195.7	S5	29.625	27.433	1.892	Open Manhole	1200
S1.008	5.094	84.9	S10	29.436	27.373	1.763	Open Manhole	1350
S2.000	13.620	197.4	STANK 3 US	29.132	27.518	1.389	Junction	
S2.001	23.045	0.0	STANK 3 DS	29.132	27.518	1.194	Junction	
S2.002	1.750	194.4	S7	29.123	27.508	1.315	Open Manhole	1200
S2.003	1.746	194.0	STANK 4 US	29.123	27.499	1.324	Junction	
S2.004	14.975	14974.8	STANK 4 ND	29.117	27.498	1.199	Junction	
S2.005	17.025	0.0	STANK 4 DS	29.091	27.498	1.173	Junction	
S2.006	1.981	198.1	S8	29.078	27.488	1.290	Open Manhole	1350
S2.007	20.026	174.1	S10	29.436	27.373	1.763	Open Manhole	1350

PIPELINE SCHEDULES for Storm 26-05-22 Planning

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.009	o	375	S10	29.436	27.373	1.688	Open Manhole	1350
S1.010	T5	-6	STANk 5 US	29.445	27.330	1.275	Junction	
S1.011	o	375	STANk 5 DS	29.485	27.330	1.780	Junction	
S1.012	o	375	S11	29.353	27.320	1.658	Open Manhole	1350
S1.013	T6	-7	STANK 6 US	29.354	27.304	1.210	Junction	
S1.014	o	375	STANK 6 DS	29.332	27.303	1.654	Junction	
S1.015	o	375	S12	29.318	27.258	1.685	Open Manhole	1350
S1.016	T7	-8	STANK 7 US	29.306	27.243	1.013	Junction	
S1.017	o	375	STANK 7 DS	29.308	27.242	1.691	Junction	
S3.000	o	150	S13	29.736	28.311	1.275	Open Manhole	1350
S3.001	o	225	S14	29.699	27.504	1.970	Open Manhole	1200
S3.002	T8	-9	STANK 8 US	29.740	27.479	1.211	Junction	
S3.003	T8D	-10	STANK 8 ND1	29.738	27.479	1.209	Junction	
S3.004	o	225	STANK 8 DS	29.699	27.479	1.995	Junction	
S3.005	o	225	S14A	29.723	27.465	2.033	Open Manhole	1200
S3.006	o	225	S15	29.726	27.388	2.113	Open Manhole	1200
S3.007	o	300	S16	29.880	27.315	2.265	Open Manhole	1200
S3.008	T9	-12	STANK 9 US	29.875	27.308	1.307	Junction	
S3.009	o	300	STANK 9 DS	29.762	27.307	2.155	Junction	
S3.010	o	300	S17	29.761	27.300	2.161	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.009	11.003	255.9	STANk 5 US	29.445	27.330	1.740	Junction	
S1.010	20.009	20009.3	STANk 5 DS	29.485	27.329	1.316	Junction	
S1.011	2.450#	245.0	S11	29.353	27.320	1.658	Open Manhole	1350
S1.012	3.142	196.4	STANK 6 US	29.354	27.304	1.675	Junction	
S1.013	22.000	22000.0	STANK 6 DS	29.332	27.303	1.189	Junction	
S1.014	9.041	200.9	S12	29.318	27.258	1.685	Open Manhole	1350
S1.015	2.936	195.7	STANK 7 US	29.306	27.243	1.688	Junction	
S1.016	15.000	15000.0	STANK 7 DS	29.308	27.242	1.016	Junction	
S1.017	5.429	135.7	S19	29.217	27.202	1.640	Open Manhole	1500
S3.000	29.097	39.8	S14	29.699	27.579	1.970	Open Manhole	1200
S3.001	4.892	195.7	STANK 8 US	29.740	27.479	2.036	Junction	
S3.002	14.002	0.0	STANK 8 ND1	29.738	27.479	1.209	Junction	
S3.003	6.977	0.0	STANK 8 DS	29.699	27.479	1.170	Junction	
S3.004	2.640#	188.6	S14A	29.723	27.465	2.033	Open Manhole	1200
S3.005	15.256	198.1	S15	29.726	27.388	2.113	Open Manhole	1200
S3.006	14.605	200.1	S16	29.880	27.315	2.340	Open Manhole	1200
S3.007	1.379	197.0	STANK 9 US	29.875	27.308	2.267	Junction	
S3.008	21.020	21020.0	STANK 9 DS	29.762	27.307	1.195	Junction	
S3.009	1.464	209.2	S17	29.761	27.300	2.161	Open Manhole	1200
S3.010	1.506	215.2	STANK 11 US	29.762	27.293	2.169	Junction	

PIPELINE SCHEDULES for Storm 26-05-22 Planning

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S3.011	T11	-13	STANK 11 US	29.762	27.293	1.209	Junction	
S3.012	o	300	STANK 11 DS	29.576	27.292	1.984	Junction	
S3.013	o	375	S18	29.457	27.263	1.819	Open Manhole	1350
S1.018	o	500	S19	29.217	27.202	1.515	Open Manhole	1500
S1.019	o	525	S20	29.132	27.145	1.462	Open Manhole	1500
S1.020	12U	-14	STANK 12 US	29.200	27.105	1.255	Junction	
S1.021	12D	-15	STANK 12 ND 1	29.070	27.104	1.126	Junction	
S1.022	o	525	STANK 12 DS	29.075	27.104	1.446	Junction	
S1.023	o	525	S21	29.006	27.094	1.387	Open Manhole	1500
S4.000	o	150	SPPCP01	28.645	27.225	1.270	Open Manhole	1200
S4.001	o	150	S22	28.842	27.145	1.547	Open Manhole	1200
S1.024	o	525	S23	28.927	27.040	1.362	Open Manhole	1500
S1.025	o	300	S24	28.853	27.010	1.543	Open Manhole	1500
S1.026	o	300	SInt	28.906	26.943	1.663	Junction	
S1.027	o	300	S25	28.944	26.883	1.761	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S3.011	32.006	32006.3	STANK 11 DS	29.576	27.292	1.024	Junction	
S3.012	5.576#	192.3	S18	29.457	27.263	1.894	Open Manhole	1350
S3.013	11.222	184.0	S19	29.217	27.202	1.640	Open Manhole	1500
S1.018	10.805	189.6	S20	29.132	27.145	1.487	Open Manhole	1500
S1.019	8.001	200.0	STANK 12 US	29.200	27.105	1.570	Junction	
S1.020	23.998	23997.9	STANK 12 ND 1	29.070	27.104	1.126	Junction	
S1.021	21.000	0.0	STANK 12 DS	29.075	27.104	1.131	Junction	
S1.022	1.738#	173.8	S21	29.006	27.094	1.387	Open Manhole	1500
S1.023	10.287	190.5	S23	28.927	27.040	1.362	Open Manhole	1500
S4.000	6.209	77.6	S22	28.842	27.145	1.547	Open Manhole	1200
S4.001	8.028	76.5	S23	28.927	27.040	1.737	Open Manhole	1500
S1.024	2.937	97.9	S24	28.853	27.010	1.318	Open Manhole	1500
S1.025	5.045	186.8	SInt	28.906	26.983	1.623	Junction	
S1.026	5.061	84.3	S25	28.944	26.883	1.761	Open Manhole	1500
S1.027	4.397	191.2	S	28.660	26.860	1.500	Open Manhole	0

Area Summary for Storm 26-05-22 Planning

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	Classification	ROAD	100	0.024	0.024	0.024
	Classification	Roof	100	0.063	0.063	0.086
1.001	Classification	Roof	100	0.064	0.064	0.064
1.002	-	-	100	0.000	0.000	0.000
1.003	Classification	Roof	100	0.038	0.038	0.038
	Classification	ROAD	100	0.016	0.016	0.054
1.004	Classification	ROAD	100	0.076	0.076	0.076
1.005	Classification	Roof	100	0.038	0.038	0.038
	Classification	ROAD	100	0.030	0.030	0.068
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
1.008	Classification	Roof	100	0.036	0.036	0.036
	Classification	ROAD	100	0.013	0.013	0.049
	Classification	ROAD	100	0.071	0.071	0.120
2.000	Classification	ROAD	100	0.073	0.073	0.073
	Classification	ROAD	100	0.009	0.009	0.082
2.001	-	-	100	0.000	0.000	0.000
2.002	-	-	100	0.000	0.000	0.000
2.003	-	-	100	0.000	0.000	0.000
2.004	-	-	100	0.000	0.000	0.000
2.005	-	-	100	0.000	0.000	0.000
2.006	-	-	100	0.000	0.000	0.000
2.007	Classification	ROAD	100	0.050	0.050	0.050
1.009	Classification	ROAD	100	0.036	0.036	0.036
1.010	-	-	100	0.000	0.000	0.000
1.011	-	-	100	0.000	0.000	0.000
1.012	Classification	ROAD	100	0.069	0.069	0.069
	Classification	Roof	100	0.135	0.135	0.203
	Classification	Roof	100	0.063	0.063	0.267
1.013	-	-	100	0.000	0.000	0.000
1.014	-	-	100	0.000	0.000	0.000
1.015	Classification	ROAD	100	0.042	0.042	0.042
	Classification	Roof	100	0.063	0.063	0.105
	Classification	Roof	100	0.065	0.065	0.169
1.016	-	-	100	0.000	0.000	0.000
1.017	-	-	100	0.000	0.000	0.000
3.000	Classification	ROAD	100	0.016	0.016	0.016
3.001	Classification	ROAD	100	0.021	0.021	0.021
	Classification	Roof	100	0.100	0.100	0.122
3.002	-	-	100	0.000	0.000	0.000
3.003	-	-	100	0.000	0.000	0.000
3.004	-	-	100	0.000	0.000	0.000
3.005	-	-	100	0.000	0.000	0.000
3.006	Classification	ROAD	100	0.011	0.011	0.011
	Classification	Roof	100	0.043	0.043	0.054
3.007	Classification	ROAD	100	0.071	0.071	0.071
	Classification	Roof	100	0.069	0.069	0.140
3.008	-	-	100	0.000	0.000	0.000
3.009	-	-	100	0.000	0.000	0.000
3.010	Classification	ROAD	100	0.047	0.047	0.047
3.011	Classification	ROAD	100	0.026	0.026	0.026

Area Summary for Storm 26-05-22 Planning

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
3.012	-	-	100	0.000	0.000	0.000
3.013	-	-	100	0.000	0.000	0.000
1.018	Classification	ROAD	100	0.032	0.032	0.032
	Classification	ROAD	100	0.039	0.039	0.072
1.019	Classification	ROAD	100	0.076	0.076	0.076
1.020	-	-	100	0.000	0.000	0.000
1.021	-	-	100	0.000	0.000	0.000
1.022	-	-	100	0.000	0.000	0.000
1.023	-	-	100	0.000	0.000	0.000
4.000	User	-	100	0.049	0.049	0.049
4.001	Classification	ROAD	100	0.028	0.028	0.028
1.024	Classification	Roof	100	0.348	0.348	0.348
1.025	-	-	100	0.000	0.000	0.000
1.026	-	-	100	0.000	0.000	0.000
1.027	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				2.051	2.051	2.051

Free Flowing Outfall Details for Storm 26-05-22 Planning

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.027	S	28.660	26.860	26.860	0	0

Simulation Criteria for Storm 26-05-22 Planning

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

Online Controls for Storm 26-05-22 Planning

Complex Manhole: S24, DS/PN: S1.025, Volume (m³): 3.6

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0120-7500-1500-7500
Design Head (m)	1.500
Design Flow (l/s)	7.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	120
Invert Level (m)	27.010
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	7.5
Flush-Flo™	0.445	7.5
Kick-Flo®	0.926	6.0
Mean Flow over Head Range	-	6.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.3	1.200	6.8	3.000	10.4	7.000	15.6
0.200	6.7	1.400	7.3	3.500	11.2	7.500	16.1
0.300	7.3	1.600	7.7	4.000	11.9	8.000	16.6
0.400	7.5	1.800	8.2	4.500	12.6	8.500	17.1
0.500	7.5	2.000	8.6	5.000	13.2	9.000	17.5
0.600	7.4	2.200	9.0	5.500	13.9	9.500	18.0
0.800	6.8	2.400	9.3	6.000	14.4		
1.000	6.2	2.600	9.7	6.500	15.0		

Orifice

Diameter (m) 0.090 Discharge Coefficient 0.600 Invert Level (m) 27.915

Storage Structures for Storm 26-05-22 Planning

Tank or Pond Manhole: S16, DS/PN: S3.007

Invert Level (m) 27.317

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	221.1	1.280	221.1	1.281	0.0

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm 26-05-22 Planning

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	1.000
M5-60 (mm)	20.000	Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000		S1 15 Summer	1	+0%	30/15 Summer			
S1.001	STANK 1 US	30 Summer	1	+0%				
S1.002	STANK 1 DS	30 Summer	1	+0%	30/15 Summer			
S1.003		S2 30 Summer	1	+0%	30/15 Summer			
S1.004		S3 30 Summer	1	+0%	30/15 Summer			
S1.005		S4 30 Summer	1	+0%	30/15 Summer			
S1.006	STANK 2 US	30 Summer	1	+0%				
S1.007	STANK 2 DS	30 Summer	1	+0%	30/15 Summer			
S1.008		S5 30 Summer	1	+0%	30/15 Summer			
S2.000		S6 15 Summer	1	+0%	30/15 Summer			
S2.001	STANK 3 US	30 Summer	1	+0%				
S2.002	STANK 3 DS	30 Summer	1	+0%	30/120 Summer			
S2.003		S7 60 Summer	1	+0%	30/120 Summer			
S2.004	STANK 4 US	60 Summer	1	+0%				
S2.005	STANK 4 ND	60 Summer	1	+0%				
S2.006	STANK 4 DS	60 Summer	1	+0%	30/120 Summer			
S2.007		S8 60 Summer	1	+0%	30/120 Summer			

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm 26-05-22 Planning

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	27.740	-0.098	0.000	0.60			15.2	OK
S1.001	STANK 1 US	27.733	-0.700	0.000	0.01			22.4	OK*
S1.002	STANK 1 DS	27.732	-0.086	0.000	0.56			16.9	OK*
S1.003	S2	27.730	-0.080	0.000	0.67			20.6	OK
S1.004	S3	27.708	-0.055	0.000	0.88			27.2	OK
S1.005	S4	27.666	-0.119	0.000	0.67			34.4	OK
S1.006	STANK 2 US	27.639	-0.872	0.000	0.00			34.2	OK*
S1.007	STANK 2 DS	27.637	-0.123	0.000	0.57			35.0	OK*
S1.008	S5	27.625	-0.108	0.000	0.73			44.7	OK
S2.000	S6	27.694	-0.118	0.000	0.45			14.3	OK
S2.001	STANK 3 US	27.587	-0.351	0.000	0.01			12.7	OK*
S2.002	STANK 3 DS	27.586	-0.231	0.000	0.12			7.4	OK*
S2.003	S7	27.583	-0.225	0.000	0.12			6.8	OK
S2.004	STANK 4 US	27.582	-0.337	0.000	0.01			6.6	OK*
S2.005	STANK 4 ND	27.582	-0.336	0.000	0.01			4.6	OK*
S2.006	STANK 4 DS	27.582	-0.216	0.000	0.09			5.3	OK*
S2.007	S8	27.582	-0.206	0.000	0.09			6.6	OK

PN	US/MH Name	Level Exceeded
S1.000	S1	
S1.001	STANK 1 US	
S1.002	STANK 1 DS	
S1.003	S2	
S1.004	S3	
S1.005	S4	
S1.006	STANK 2 US	
S1.007	STANK 2 DS	
S1.008	S5	
S2.000	S6	
S2.001	STANK 3 US	
S2.002	STANK 3 DS	
S2.003	S7	
S2.004	STANK 4 US	
S2.005	STANK 4 ND	
S2.006	STANK 4 DS	
S2.007	S8	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm 26-05-22 Planning

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.009	S10	30 Summer	1	+0%	30/30 Summer		
S1.010	STANk 5 US	360 Winter	1	+0%			
S1.011	STANk 5 DS	360 Winter	1	+0%	30/30 Summer		
S1.012	S11	360 Winter	1	+0%	30/30 Summer		
S1.013	STANK 6 US	360 Winter	1	+0%			
S1.014	STANK 6 DS	360 Winter	1	+0%	30/30 Summer		
S1.015	S12	360 Winter	1	+0%	30/30 Summer		
S1.016	STANK 7 US	360 Winter	1	+0%			
S1.017	STANK 7 DS	360 Winter	1	+0%	30/30 Summer		
S3.000	S13	15 Summer	1	+0%	100/15 Summer		
S3.001	S14	15 Summer	1	+0%	30/15 Summer		
S3.002	STANK 8 US	15 Summer	1	+0%			
S3.003	STANK 8 ND1	15 Summer	1	+0%			
S3.004	STANK 8 DS	15 Summer	1	+0%	30/15 Summer		
S3.005	S14A	15 Summer	1	+0%	30/15 Summer		
S3.006	S15	360 Winter	1	+0%	30/15 Summer		
S3.007	S16	360 Winter	1	+0%	30/30 Summer		
S3.008	STANK 9 US	360 Winter	1	+0%			
S3.009	STANK 9 DS	360 Winter	1	+0%	30/30 Summer		
S3.010	S17	360 Winter	1	+0%	30/30 Summer		
S3.011	STANK 11 US	360 Winter	1	+0%			
S3.012	STANK 11 DS	360 Winter	1	+0%	30/30 Summer		
S3.013	S18	360 Winter	1	+0%	30/30 Summer		
S1.018	S19	360 Winter	1	+0%	30/60 Summer		
S1.019	S20	360 Winter	1	+0%	30/60 Summer		
S1.020	STANK 12 US	360 Winter	1	+0%			
S1.021	STANK 12 ND 1	360 Winter	1	+0%			
S1.022	STANK 12 DS	360 Winter	1	+0%	30/30 Summer		
S1.023	S21	240 Winter	1	+0%	30/30 Summer		
S4.000	SPPCP01	15 Summer	1	+0%	1/15 Summer	100/15 Summer	
S4.001	S22	360 Winter	1	+0%	1/15 Summer		
S1.024	S23	360 Winter	1	+0%	30/15 Summer		
S1.025	S24	240 Winter	1	+0%	1/15 Summer		
S1.026	SInt	30 Summer	1	+0%			
S1.027	S25	15 Winter	1	+0%			

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.009	S10		27.578	-0.170	0.000	0.55			51.3
S1.010	STANk 5 US		27.569	-0.601	0.000	0.00			15.4
S1.011	STANk 5 DS		27.569	-0.136	0.000	0.11			12.0
S1.012	S11		27.569	-0.126	0.000	0.22			18.3
S1.013	STANK 6 US		27.568	-0.576	0.000	0.00			18.2
S1.014	STANK 6 DS		27.568	-0.110	0.000	0.14			14.7
S1.015	S12		27.567	-0.066	0.000	0.22			18.1

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm 26-05-22 Planning

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.016	STANK 7 US		27.566	-0.727	0.000	0.00			18.0
S1.017	STANK 7 DS		27.566	-0.051	0.000	0.12			13.4
S3.000	S13		28.343	-0.118	0.000	0.10			2.8
S3.001	S14		27.656	-0.073	0.000	0.78			20.9
S3.002	STANK 8 US		27.600	-0.929	0.000	0.01			20.5
S3.003	STANK 8 ND1		27.600	-0.929	0.000	0.00			17.5
S3.004	STANK 8 DS		27.600	-0.104	0.000	0.56			16.7
S3.005	S14A		27.580	-0.110	0.000	0.51			16.7
S3.006	S15		27.568	-0.045	0.000	0.15			4.8
S3.007	S16		27.567	-0.048	0.000	0.06			3.6
S3.008	STANK 9 US		27.567	-1.001	0.000	0.00			3.5
S3.009	STANK 9 DS		27.567	-0.040	0.000	0.05			3.0
S3.010	S17		27.567	-0.033	0.000	0.07			3.8
S3.011	STANK 11 US		27.566	-0.987	0.000	0.00			4.3
S3.012	STANK 11 DS		27.566	-0.026	0.000	0.05			3.1
S3.013	S18		27.566	-0.072	0.000	0.03			3.1
S1.018	S19		27.565	-0.137	0.000	0.08			17.3
S1.019	S20		27.564	-0.106	0.000	0.09			18.2
S1.020	STANK 12 US		27.563	-0.382	0.000	0.01			17.8
S1.021	STANK 12 ND 1		27.562	-0.382	0.000	0.00			11.4
S1.022	STANK 12 DS		27.561	-0.068	0.000	0.06			16.1
S1.023	S21		27.568	-0.051	0.000	0.05			11.1
S4.000	SPPCP01		27.561	0.186	0.000	0.47			8.0
S4.001	S22		27.559	0.264	0.000	0.11			1.9
S1.024	S23		27.558	-0.007	0.000	0.06			11.8
S1.025	S24		27.554	0.244	0.000	0.14			7.5
S1.026	SInt		27.012	-0.231	0.000	0.12			7.5
S1.027	S25		26.959	-0.224	0.000	0.15			7.5

PN	US/MH Name	Status	Level Exceeded
S1.009	S10	OK	
S1.010	STANk 5 US	OK*	
S1.011	STANk 5 DS	OK*	
S1.012	S11	OK	
S1.013	STANK 6 US	OK*	
S1.014	STANK 6 DS	OK*	
S1.015	S12	OK	
S1.016	STANK 7 US	OK*	
S1.017	STANK 7 DS	OK*	
S3.000	S13	OK	
S3.001	S14	OK	
S3.002	STANK 8 US	OK*	
S3.003	STANK 8 ND1	OK*	
S3.004	STANK 8 DS	OK*	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm 26-05-22 Planning

PN	US/MH Name	Status	Level Exceeded
S3.005	S14A	OK	
S3.006	S15	OK	
S3.007	S16	OK	
S3.008	STANK 9 US	OK*	
S3.009	STANK 9 DS	OK*	
S3.010	S17	OK	
S3.011	STANK 11 US	OK*	
S3.012	STANK 11 DS	OK*	
S3.013	S18	OK	
S1.018	S19	OK	
S1.019	S20	OK	
S1.020	STANK 12 US	OK*	
S1.021	STANK 12 ND 1	OK*	
S1.022	STANK 12 DS	OK*	
S1.023	S21	OK	
S4.000	SPPCP01	SURCHARGED	3
S4.001	S22	SURCHARGED	
S1.024	S23	OK	
S1.025	S24	SURCHARGED	
S1.026	SInt	OK*	
S1.027	S25	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm 26-05-22 Planning

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.400
Region	England and Wales	Cv (Summer)	1.000
M5-60 (mm)	20.000	Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	30 Summer	30	+0%	30/15 Summer			
S1.001	STANK 1 US	30 Summer	30	+0%				
S1.002	STANK 1 DS	30 Summer	30	+0%	30/15 Summer			
S1.003	S2	30 Summer	30	+0%	30/15 Summer			
S1.004	S3	30 Summer	30	+0%	30/15 Summer			
S1.005	S4	60 Summer	30	+0%	30/15 Summer			
S1.006	STANK 2 US	720 Winter	30	+0%				
S1.007	STANK 2 DS	720 Winter	30	+0%	30/15 Summer			
S1.008	S5	720 Winter	30	+0%	30/15 Summer			
S2.000	S6	720 Winter	30	+0%	30/15 Summer			
S2.001	STANK 3 US	720 Winter	30	+0%				
S2.002	STANK 3 DS	720 Winter	30	+0%	30/120 Summer			
S2.003	S7	720 Winter	30	+0%	30/120 Summer			
S2.004	STANK 4 US	720 Winter	30	+0%				
S2.005	STANK 4 ND	720 Winter	30	+0%				
S2.006	STANK 4 DS	720 Winter	30	+0%	30/120 Summer			
S2.007	S8	720 Winter	30	+0%	30/120 Summer			

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm 26-05-22 Planning

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	28.015	0.177	0.000	1.28			32.4	SURCHARGED
S1.001	STANK 1 US	27.996	-0.437	0.000	0.01			56.8	OK*
S1.002	STANK 1 DS	27.993	0.175	0.000	0.60			18.0	SURCHARGED*
S1.003	S2	27.991	0.181	0.000	0.60			18.4	SURCHARGED
S1.004	S3	27.980	0.217	0.000	0.92			28.4	SURCHARGED
S1.005	S4	27.938	0.153	0.000	0.98			50.0	SURCHARGED
S1.006	STANK 2 US	27.907	-0.604	0.000	0.00			10.0	OK*
S1.007	STANK 2 DS	27.907	0.147	0.000	0.14			8.7	SURCHARGED*
S1.008	S5	27.906	0.173	0.000	0.19			11.8	SURCHARGED
S2.000	S6	27.906	0.094	0.000	0.08			2.6	SURCHARGED
S2.001	STANK 3 US	27.906	-0.032	0.000	0.00			2.5	OK*
S2.002	STANK 3 DS	27.906	0.089	0.000	0.03			1.9	SURCHARGED*
S2.003	S7	27.906	0.098	0.000	0.03			1.9	SURCHARGED
S2.004	STANK 4 US	27.906	-0.013	0.000	0.00			1.9	OK*
S2.005	STANK 4 ND	27.906	-0.012	0.000	0.00			1.5	OK*
S2.006	STANK 4 DS	27.906	0.108	0.000	0.02			1.3	SURCHARGED*
S2.007	S8	27.906	0.118	0.000	0.03			2.4	SURCHARGED

PN	US/MH Name	Level Exceeded
S1.000	S1	
S1.001	STANK 1 US	
S1.002	STANK 1 DS	
S1.003	S2	
S1.004	S3	
S1.005	S4	
S1.006	STANK 2 US	
S1.007	STANK 2 DS	
S1.008	S5	
S2.000	S6	
S2.001	STANK 3 US	
S2.002	STANK 3 DS	
S2.003	S7	
S2.004	STANK 4 US	
S2.005	STANK 4 ND	
S2.006	STANK 4 DS	
S2.007	S8	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm 26-05-22 Planning

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.009	S10	720 Winter	30	+0%	30/30 Summer		
S1.010	STANk 5 US	720 Winter	30	+0%			
S1.011	STANk 5 DS	720 Winter	30	+0%	30/30 Summer		
S1.012	S11	720 Winter	30	+0%	30/30 Summer		
S1.013	STANK 6 US	720 Winter	30	+0%			
S1.014	STANK 6 DS	720 Winter	30	+0%	30/30 Summer		
S1.015	S12	720 Winter	30	+0%	30/30 Summer		
S1.016	STANK 7 US	720 Winter	30	+0%			
S1.017	STANK 7 DS	720 Winter	30	+0%	30/30 Summer		
S3.000	S13	15 Summer	30	+0%	100/15 Summer		
S3.001	S14	15 Summer	30	+0%	30/15 Summer		
S3.002	STANK 8 US	720 Winter	30	+0%			
S3.003	STANK 8 ND1	720 Winter	30	+0%			
S3.004	STANK 8 DS	720 Winter	30	+0%	30/15 Summer		
S3.005	S14A	720 Winter	30	+0%	30/15 Summer		
S3.006	S15	720 Winter	30	+0%	30/15 Summer		
S3.007	S16	720 Winter	30	+0%	30/30 Summer		
S3.008	STANK 9 US	720 Winter	30	+0%			
S3.009	STANK 9 DS	720 Winter	30	+0%	30/30 Summer		
S3.010	S17	720 Winter	30	+0%	30/30 Summer		
S3.011	STANK 11 US	720 Winter	30	+0%			
S3.012	STANK 11 DS	720 Winter	30	+0%	30/30 Summer		
S3.013	S18	720 Winter	30	+0%	30/30 Summer		
S1.018	S19	720 Winter	30	+0%	30/60 Summer		
S1.019	S20	720 Winter	30	+0%	30/60 Summer		
S1.020	STANK 12 US	720 Winter	30	+0%			
S1.021	STANK 12 ND 1	720 Winter	30	+0%			
S1.022	STANK 12 DS	720 Winter	30	+0%	30/30 Summer		
S1.023	S21	720 Winter	30	+0%	30/30 Summer		
S4.000	SPPCP01	15 Summer	30	+0%	1/15 Summer	100/15 Summer	
S4.001	S22	15 Summer	30	+0%	1/15 Summer		
S1.024	S23	720 Winter	30	+0%	30/15 Summer		
S1.025	S24	720 Winter	30	+0%	1/15 Summer		
S1.026	SInt	2880 Summer	30	+0%			
S1.027	S25	1440 Winter	30	+0%			

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.009	S10		27.906	0.158	0.000	0.15			14.0
S1.010	STANk 5 US		27.905	-0.265	0.000	0.00			13.8
S1.011	STANk 5 DS		27.905	0.200	0.000	0.07			8.0
S1.012	S11		27.904	0.209	0.000	0.17			14.5
S1.013	STANK 6 US		27.904	-0.240	0.000	0.00			14.4
S1.014	STANK 6 DS		27.904	0.226	0.000	0.09			9.7
S1.015	S12		27.903	0.270	0.000	0.17			14.6

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm 26-05-22 Planning

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.016	STANK 7 US		27.902	-0.391	0.000	0.00			14.6
S1.017	STANK 7 DS		27.902	0.285	0.000	0.10			10.2
S3.000	S13		28.363	-0.098	0.000	0.25			6.9
S3.001	S14		27.931	0.202	0.000	2.44			65.5
S3.002	STANK 8 US		27.905	-0.624	0.000	0.00			4.4
S3.003	STANK 8 ND1		27.905	-0.624	0.000	0.00			3.8
S3.004	STANK 8 DS		27.905	0.201	0.000	0.12			3.5
S3.005	S14A		27.905	0.215	0.000	0.11			3.5
S3.006	S15		27.904	0.291	0.000	0.15			5.0
S3.007	S16		27.903	0.288	0.000	0.04			2.5
S3.008	STANK 9 US		27.903	-0.665	0.000	0.00			2.4
S3.009	STANK 9 DS		27.903	0.296	0.000	0.04			2.2
S3.010	S17		27.903	0.303	0.000	0.05			2.6
S3.011	STANK 11 US		27.902	-0.651	0.000	0.00			2.9
S3.012	STANK 11 DS		27.902	0.310	0.000	0.04			2.5
S3.013	S18		27.902	0.264	0.000	0.02			2.5
S1.018	S19		27.902	0.200	0.000	0.05			10.6
S1.019	S20		27.901	0.231	0.000	0.05			11.1
S1.020	STANK 12 US		27.900	-0.045	0.000	0.00			11.0
S1.021	STANK 12 ND 1		27.896	-0.048	0.000	0.00			8.5
S1.022	STANK 12 DS		27.894	0.265	0.000	0.04			9.2
S1.023	S21		27.900	0.281	0.000	0.04			8.8
S4.000	SPPCP01		28.145	0.770	0.000	1.27			21.5
S4.001	S22		28.039	0.744	0.000	1.85			32.7
S1.024	S23		27.908	0.343	0.000	0.05			10.0
S1.025	S24		27.908	0.598	0.000	0.14			7.5
S1.026	SInt		27.012	-0.231	0.000	0.12			7.5
S1.027	S25		26.959	-0.224	0.000	0.15			7.5

PN	US/MH Name	Status	Level Exceeded
S1.009	S10	SURCHARGED	
S1.010	STANk 5 US	OK*	
S1.011	STANk 5 DS	SURCHARGED*	
S1.012	S11	SURCHARGED	
S1.013	STANK 6 US	OK*	
S1.014	STANK 6 DS	SURCHARGED*	
S1.015	S12	SURCHARGED	
S1.016	STANK 7 US	OK*	
S1.017	STANK 7 DS	SURCHARGED*	
S3.000	S13	OK	
S3.001	S14	SURCHARGED	
S3.002	STANK 8 US	OK*	
S3.003	STANK 8 ND1	OK*	
S3.004	STANK 8 DS	SURCHARGED*	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm 26-05-22 Planning

PN	US/MH Name	Status	Level Exceeded	
S3.005	S14A	SURCHARGED		
S3.006	S15	SURCHARGED		
S3.007	S16	SURCHARGED		
S3.008	STANK 9 US	OK*		
S3.009	STANK 9 DS	SURCHARGED*		
S3.010	S17	SURCHARGED		
S3.011	STANK 11 US	OK*		
S3.012	STANK 11 DS	SURCHARGED*		
S3.013	S18	SURCHARGED		
S1.018	S19	SURCHARGED		
S1.019	S20	SURCHARGED		
S1.020	STANK 12 US	OK*		
S1.021	STANK 12 ND 1	OK*		
S1.022	STANK 12 DS	SURCHARGED*		
S1.023	S21	SURCHARGED		
S4.000	SPPCP01	SURCHARGED	3	
S4.001	S22	SURCHARGED		
S1.024	S23	SURCHARGED		
S1.025	S24	SURCHARGED		
S1.026	SInt	OK*		
S1.027	S25	OK		

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm 26-05-22 Planning

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.400
Region	England and Wales	Cv (Summer)	1.000
M5-60 (mm)	20.000	Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	600 Winter	100	+40%	30/15 Summer			
S1.001	STANK 1 US	1440 Winter	100	+40%				
S1.002	STANK 1 DS	1440 Winter	100	+40%	30/15 Summer			
S1.003	S2	600 Winter	100	+40%	30/15 Summer			
S1.004	S3	600 Winter	100	+40%	30/15 Summer			
S1.005	S4	600 Winter	100	+40%	30/15 Summer			
S1.006	STANK 2 US	600 Winter	100	+40%				
S1.007	STANK 2 DS	600 Winter	100	+40%	30/15 Summer			
S1.008	S5	600 Winter	100	+40%	30/15 Summer			
S2.000	S6	600 Winter	100	+40%	30/15 Summer			
S2.001	STANK 3 US	10080 Summer	100	+40%				
S2.002	STANK 3 DS	10080 Summer	100	+40%	30/120 Summer			
S2.003	S7	600 Winter	100	+40%	30/120 Summer			
S2.004	STANK 4 US	10080 Summer	100	+40%				
S2.005	STANK 4 ND	10080 Summer	100	+40%				
S2.006	STANK 4 DS	10080 Summer	100	+40%	30/120 Summer			
S2.007	S8	600 Winter	100	+40%	30/120 Summer			

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm 26-05-22 Planning

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	28.527	0.689	0.000	0.23			5.7	SURCHARGED
S1.001	STANK 1 US	28.433	0.000	0.000	0.00			5.0	SURCHARGED*
S1.002	STANK 1 DS	28.433	0.615	0.000	0.10			3.0	SURCHARGED*
S1.003	S2	28.527	0.717	0.000	0.25			7.6	SURCHARGED
S1.004	S3	28.526	0.763	0.000	0.39			12.0	SURCHARGED
S1.005	S4	28.525	0.740	0.000	0.31			15.8	SURCHARGED
S1.006	STANK 2 US	28.511	0.000	0.000	0.00			15.7	SURCHARGED*
S1.007	STANK 2 DS	28.510	0.750	0.000	0.22			13.7	SURCHARGED*
S1.008	S5	28.524	0.791	0.000	0.32			19.5	SURCHARGED
S2.000	S6	28.528	0.716	0.000	0.17			5.6	SURCHARGED
S2.001	STANK 3 US	27.938	0.000	0.000	0.00			0.9	SURCHARGED*
S2.002	STANK 3 DS	27.938	0.121	0.000	0.01			0.8	SURCHARGED*
S2.003	S7	28.526	0.718	0.000	0.08			4.6	SURCHARGED
S2.004	STANK 4 US	27.919	0.000	0.000	0.00			0.7	SURCHARGED*
S2.005	STANK 4 ND	27.918	0.000	0.000	0.00			0.9	SURCHARGED*
S2.006	STANK 4 DS	27.918	0.120	0.000	0.02			1.0	SURCHARGED*
S2.007	S8	28.526	0.738	0.000	0.10			7.4	SURCHARGED

PN	US/MH Name	Level Exceeded
S1.000	S1	
S1.001	STANK 1 US	
S1.002	STANK 1 DS	
S1.003	S2	
S1.004	S3	
S1.005	S4	
S1.006	STANK 2 US	
S1.007	STANK 2 DS	
S1.008	S5	
S2.000	S6	
S2.001	STANK 3 US	
S2.002	STANK 3 DS	
S2.003	S7	
S2.004	STANK 4 US	
S2.005	STANK 4 ND	
S2.006	STANK 4 DS	
S2.007	S8	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm 26-05-22 Planning

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.009	S10	600 Winter	100	+40%	30/30 Summer		
S1.010	STANk 5 US	4320 Summer	100	+40%			
S1.011	STANk 5 DS	4320 Summer	100	+40%	30/30 Summer		
S1.012	S11	600 Winter	100	+40%	30/30 Summer		
S1.013	STANK 6 US	4320 Summer	100	+40%			
S1.014	STANK 6 DS	4320 Summer	100	+40%	30/30 Summer		
S1.015	S12	600 Winter	100	+40%	30/30 Summer		
S1.016	STANK 7 US	720 Winter	100	+40%			
S1.017	STANK 7 DS	720 Winter	100	+40%	30/30 Summer		
S3.000	S13	15 Summer	100	+40%	100/15 Summer		
S3.001	S14	15 Summer	100	+40%	30/15 Summer		
S3.002	STANK 8 US	600 Winter	100	+40%			
S3.003	STANK 8 ND1	600 Winter	100	+40%			
S3.004	STANK 8 DS	600 Winter	100	+40%	30/15 Summer		
S3.005	S14A	600 Winter	100	+40%	30/15 Summer		
S3.006	S15	600 Winter	100	+40%	30/15 Summer		
S3.007	S16	600 Winter	100	+40%	30/30 Summer		
S3.008	STANK 9 US	600 Winter	100	+40%			
S3.009	STANK 9 DS	600 Winter	100	+40%	30/30 Summer		
S3.010	S17	600 Winter	100	+40%	30/30 Summer		
S3.011	STANK 11 US	600 Winter	100	+40%			
S3.012	STANK 11 DS	600 Winter	100	+40%	30/30 Summer		
S3.013	S18	600 Winter	100	+40%	30/30 Summer		
S1.018	S19	600 Winter	100	+40%	30/60 Summer		
S1.019	S20	600 Winter	100	+40%	30/60 Summer		
S1.020	STANK 12 US	10080 Summer	100	+40%			
S1.021	STANK 12 ND 1	10080 Summer	100	+40%			
S1.022	STANK 12 DS	10080 Summer	100	+40%	30/30 Summer		
S1.023	S21	600 Winter	100	+40%	30/30 Summer		
S4.000	SPPCP01	15 Summer	100	+40%	1/15 Summer	100/15 Summer	
S4.001	S22	15 Summer	100	+40%	1/15 Summer		
S1.024	S23	600 Winter	100	+40%	30/15 Summer		
S1.025	S24	600 Winter	100	+40%	1/15 Summer		
S1.026	SInt	600 Winter	100	+40%			
S1.027	S25	600 Winter	100	+40%			

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.009	S10		28.526	0.778	0.000	0.27			25.6
S1.010	STANk 5 US		28.170	0.000	0.000	0.00			6.8
S1.011	STANk 5 DS		28.169	0.464	0.000	0.11			12.2
S1.012	S11		28.529	0.834	0.000	0.43			35.7
S1.013	STANK 6 US		28.144	0.000	0.000	0.00			14.1
S1.014	STANK 6 DS		28.143	0.465	0.000	0.13			14.3
S1.015	S12		28.528	0.895	0.000	0.34			28.5

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm 26-05-22 Planning

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.016	STANK 7 US		28.293	0.000	0.000	0.00			26.1
S1.017	STANK 7 DS		28.292	0.675	0.000	0.22			23.4
S3.000	S13		28.613	0.152	0.000	0.54			14.7
S3.001	S14		28.517	0.788	0.000	4.17			112.0
S3.002	STANK 8 US		28.509	-0.020	0.000	0.00			9.1
S3.003	STANK 8 ND1		28.509	-0.020	0.000	0.00			6.2
S3.004	STANK 8 DS		28.509	0.805	0.000	0.15			4.5
S3.005	S14A		28.508	0.818	0.000	0.14			4.4
S3.006	S15		28.507	0.894	0.000	0.23			7.5
S3.007	S16		28.504	0.889	0.000	0.14			7.7
S3.008	STANK 9 US		28.504	-0.064	0.000	0.00			7.6
S3.009	STANK 9 DS		28.504	0.897	0.000	0.17			10.4
S3.010	S17		28.504	0.904	0.000	0.19			10.5
S3.011	STANK 11 US		28.505	-0.048	0.000	0.00			10.4
S3.012	STANK 11 DS		28.505	0.913	0.000	0.32			19.4
S3.013	S18		28.512	0.874	0.000	0.18			19.3
S1.018	S19		28.526	0.824	0.000	0.14			29.0
S1.019	S20		28.529	0.859	0.000	0.14			28.7
S1.020	STANK 12 US		27.945	0.000	0.000	0.00			8.0
S1.021	STANK 12 ND 1		27.944	0.000	0.000	0.00			8.0
S1.022	STANK 12 DS		27.944	0.315	0.000	0.05			12.1
S1.023	S21		28.531	0.912	0.000	0.11			24.7
S4.000	SPPCP01		28.648	1.273	3.163	1.98			33.5
S4.001	S22		28.620	1.325	0.000	2.45			43.3
S1.024	S23		28.529	0.964	0.000	0.10			20.4
S1.025	S24		28.528	1.218	0.000	0.36			19.5
S1.026	SInt		27.059	-0.184	0.000	0.32			19.5
S1.027	S25		27.011	-0.172	0.000	0.38			19.5

PN	US/MH Name	Status	Level Exceeded
S1.009	S10	SURCHARGED	
S1.010	STANk 5 US	SURCHARGED*	
S1.011	STANk 5 DS	SURCHARGED*	
S1.012	S11	SURCHARGED	
S1.013	STANK 6 US	SURCHARGED*	
S1.014	STANK 6 DS	SURCHARGED*	
S1.015	S12	SURCHARGED	
S1.016	STANK 7 US	SURCHARGED*	
S1.017	STANK 7 DS	SURCHARGED*	
S3.000	S13	SURCHARGED	
S3.001	S14	SURCHARGED	
S3.002	STANK 8 US	OK*	
S3.003	STANK 8 ND1	OK*	
S3.004	STANK 8 DS	SURCHARGED*	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm 26-05-22 Planning

PN	US/MH Name	Status	Level Exceeded
S3.005	S14A	SURCHARGED	
S3.006	S15	SURCHARGED	
S3.007	S16	SURCHARGED	
S3.008	STANK 9 US	OK*	
S3.009	STANK 9 DS	SURCHARGED*	
S3.010	S17	SURCHARGED	
S3.011	STANK 11 US	OK*	
S3.012	STANK 11 DS	SURCHARGED*	
S3.013	S18	SURCHARGED	
S1.018	S19	SURCHARGED	
S1.019	S20	SURCHARGED	
S1.020	STANK 12 US	SURCHARGED*	
S1.021	STANK 12 ND 1	SURCHARGED*	
S1.022	STANK 12 DS	SURCHARGED*	
S1.023	S21	SURCHARGED	
S4.000	SPPCP01	FLOOD	3
S4.001	S22	FLOOD RISK	
S1.024	S23	SURCHARGED	
S1.025	S24	SURCHARGED	
S1.026	SInt	OK*	
S1.027	S25	OK	

Appendix I

Water Cycle Strategy

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Client	Colt DCS
Project No.	P20114
Date	08/102021
Revision	00
Reference	BW-E-P200114-U-REP-700006-0

London 4, Hayes

Water Cycle Strategy

08/10/2021

REVISIONS

Document prepared by:	
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Date	29/09/2021

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Name	Scott Wilson
Signature	SW
Date	08/10/2021

Revision:

Revision No.	Date	Revision Details	Approved by
0	08/10/2021	First Issue	SW

CONTENTS

1.0 INTRODUCTION

This report has been produced to detailed the water reduction strategy at the proposed London 4, Hayes Date Centre development in the London Borough of Hillingdon.

1.1 Site Context

The eastern part of the site is occupied by a Data Centre, a co-location facility operated by Optimum Data Centres. The data centre itself was constructed in the 1980s as a warehouse with an element of office space constructed subsequently, before planning permission was granted in 2001 for the change of use to a data centre. It comprises a two storey traditional steel framed warehouse unit with connected two story brick built office extension to the south and plant equipment located across and adjacent to the two buildings.

To the west of the Data Centre (and forming the central element of the site) are the Tudor Works, a terrace of 16 industrial units with two storey office extensions on both the northern and southern ends. The units are of a steel framed construction with profiled. The units are occupied for a range of storage and manufacturing operations.

To the west of the Tudor Works (and forming the very western part of the site) is the Veetec Motor Group facility which comprises a three storey office building at the front of the site, an open yard used for car storage to its rear, and an industrial unit to the rear. The site is used for the receipt, repair, storage, and maintenance of vehicles.

1.2 Site Description

London 4, Hayes is the redevelopment of the site to deliver data centre campus including: two data centre buildings; associated energy and electricity infrastructure, buildings, and plant; security gatehouse, systems and enclosures; works to the highway, car parking and cycle parking; hard and soft landscaping; as well as associated infrastructure, ancillary office use, and associated external works

1.3 Assessment methodology

As the building will be assessed under BREEAM Data Centres, the BREEAM WAT 01 calculator tool will be used to assess the improvements made from water consumption reduction strategies.

2.0 Strategy

2.1 Domestic Water Consumption

As the data centre is using air cooled chillers rather than evaporative cooling, it will have a low water demand compared to other building types. The water demand will come from the occupants of the building, in particular from the occupants of the office areas.

The development will target all BREEAM Credits under Issue WAT01 Water consumption. To achieve this, sanitary ware will be specified with the following minimum performance values:

Fixture Type	Proposed Performance	BREEAM Baseline
WCs	Dual Flush ≤ 6/4 l/flush	Single Flush 6 l/flush
Showers	≤ 9 l/minute	12 l/minute
Wash-hand basin taps	≤ 4 l/minute	10 l/minute
Kitchen Taps	≤ 6 l/minute	10 l/minute
Urinals	1.5 l/bowl/hour	7.5 l/bowl/hour

As the development is a data centre, it will be assessed under BREEAM Data Centres 2010. However, the performance values listed above would enable achievement of BREEAM excellent under BREEAM New Construction 2018.

2.2 Water Recycling

Rain water harvesting will be incorporated to provide water for flushing of toilets to provide at least 50% of toilet flushing demand. The rainwater will be collected from the roof of building one, to then be stored and used as required. This will also provide a degree of attenuation, reducing the strain on the drainage system.

2.3 Minimisation of water loss

A leak detection system will be installed capable of detecting major leaks on the water supply.

Solenoid valves will be fitted to the cold water supply to each toilet area in the building. The valves will be linked to occupancy sensors to automatically turn off the water supply to the area when there are no occupants present.

2.4 Metering and Monitoring

A meter will be specified on the mains water supply to each building, the water meters will be connected to the BMS system for the monitoring of water consumption.

2.5 Irrigation

While the landscaping strategy is still to be fully developed the development is targeting BREEAM credit – WAT 6 – Irrigation Systems. As a result, the irrigation strategy will incorporate at least one of the following strategies:

- Drip feed subsurface irrigation that incorporates soil moisture sensors. The irrigation control should be zoned to permit variable irrigation to different planting assemblages.
- Reclaimed water from a rainwater or greywater system.
- External landscaping and planting that relies solely on precipitation, during all seasons of the year.
- The only planting specified is restricted to species that thrive in hot and dry conditions.
- Where no dedicated, mains-supplied irrigation systems (including pop-up sprinklers and hoses) are specified, and planting will rely solely on manual watering by building occupier or landlord.

2.6 Calculations

Water consumption has been calculated using the BREEAM New Construction WAT 01 calculator. The results are as follows:

	Proposed Performance (l/person/day)	BREEAM Baseline (l/person/day)	Improvement (%)
Predicted Consumption (excludes fixed uses)	21.61	32.60	33.7%
Water Demand met by Rainwater	13.64	0.00	N/A
Net Water Consumption (excludes fixed uses)	7.97	32.60	75.5%
Net Water Consumption (includes fixed uses)	9.55	34.18	72.1%

Fixed water uses includes water uses not included in sanitaryware- this includes items such as drinking water fountains and cleaning in kitchens. Due to the nature of the building and the cooling strategy employed, this number is predicted to be very low.

Significant reductions in water consumption are expected when compared to the BREEAM baseline. This largely due to the rainwater harvesting. Having a large roof for a catchment area for a relatively low occupancy building means that large proportion of the water demand (63%) can be met by the rainwater.

2.7 Drainage

Full detail of the drainage strategy can be found in the Drainage Strategy report produced by ARUP. The summary, extracted from the Arup report, is shown below:

It is proposed that the London 4 development discharges via one of the sites' existing connections to Thames Water (TW) storm water sewer, which outfalls to the Yeading Brook within the south of the site.

SuDS features have been incorporated into the development where possible. External surfaces will drain by a combination of permeable paving and green roofs. Traditional systems will however be required in some locations due the operational requirements of the site. A full retention class one interceptor is proposed at the downstream extent of the site.

Storm water storage will need to be provided in the form of geocellular tanks which will be distributed around the site to suit utility coordination.

An allowance of 40% increased rainfall intensity has been incorporated into the design to account for potential climate change.

It is proposed that foul water from the site discharges to one of the existing connections to the TW foul water sewer. TW have confirmed that this is acceptable based on their own assessment of potential flows from the site

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