

M5X01836

M5X01836: BUILT ENVIRONMENT SERVICES
DESIGN CRITERIA – WATER SUPPLY & WASTE SERVICES



Lecturer: Alan Nantel

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INTRODUCTION

The objective of this paper is to satisfy all criteria specified in the project brief for questions 1 & 2. Through the research which has been obtained through reliable sources.

Main Document

QUESTION 1

Davies (2002) Avers, that the Victorian era was very unsanitary in the disposal of waste.

Also Stating that most waste ended up in the river Thames where Londoners drew their drinking water.

Mayhew (1851) cites, that some households contained a cess pool, normally in a basement that held on average, 5 tons of waste. These homes, would be emptied once every 2 years by “Night men” who were employed to operate at night only to transport it away by hand.

Bazalgette (2014) reasons, that before the construction of the current London sewage system commenced, that diseases were rife. Owing to consuming water from the Thames River. Additionally, Child deaths through Cholera were “as high as 50% for 0 – 5 year olds”.

Hibbert et al (2010) agrees, the smell at the house of commons was so strong, that Lime Chloride soaked the curtains to mask it. Furthermore, Bazalgette’s plans were rushed through parliament for approval after just 3 days debate and reworking the Metropolitan Local Management Bill. “if you want action from politicians, affect them personally” (London Sewers, 2017)

History (2018) states, that the London’s sewer took 12 years to complete, from 1858 to 1870. Although, the South-fall works were opened by the prince of wales in 1865.

Haven (2006) conditions, that it involved upgrading 165m of existing sewers creating 1100m of new intercepting tunnels beneath London’s Infrastructure. Additionally, claiming that the overall project involved hand digging 350 million cubic yards of dirt.

Bazalgette (1856) reports, that gravity from the smaller intercepting sewers flows all sewage east to west towards the release points. However, 2 pumping stations were necessary to pump to higher land (FIG1.2)

1. Abbey Mills (North)
2. Deptford (South)

The waste is pumped to the Northern and Southern Outfall Sewers on the banks of the Thames. Then travels to the final 2 treatment / Pumping stations before being released into the Thames at high tide:

1. Beckton Works (North)
2. Crossness Works (South)

Roberts (2005) Avers, that Bazalgette reclaimed 22 acres (89,000m²) of land from the Thames. Office of National Statistics (2017) state land price in Chelsea and Kensington are £19,439m². Valued at £1,730,071,000 in today's market, "Board of Works sold divisions of land to wealthy customers in 1877, who built stunning terraced properties" (Costello, 2010).

Halliday (2014) avers, that the sewer revolutionised how waste disposal was approached on a worldwide scale.

Owen (1982) Expresses, the design, estimated future population of 1.13m south of the river and 2.3m to the north, allowing for increase of 40% or 1.25m over the estimated 1851 population of 2m. Also, that it was considered future proof.

Jackson (2014), nonetheless, adds that the population rose to 4 million by 1875. Putting it over-capacity for its engineered load.

Dobraszczyk (2014) avows, that increasing population levels (Fig 1.2) combined with Global warming are too much for Bazalgette's sewer.

Crawford (2016) concurs, insisting that the 2004 storm and floods are Evidence of the system's ability to cope with the added surface water during heavy rain. Furthermore, Raw

sewage enters the Thames approximately 50 times per year, with intercepting overflow sewers being at capacity.

Shiply (2016) proffers that 39m Tons of waste which is let out into the Thames each year.

Also, stating, most waste is released on the North Bank at Abbey Mills at the River Lee.

The Thames Project

CH2M (2016) claim, £4.2B Project consists of 3 Main focus points, to be executed over a planned works schedule:

1. Upgrading the existing treatment works

Stride (2018) Says, that 5 sewage treatment locations Bazalgette's system will be upgraded with emphasis on Abbey Mills Pumping Station (AM) and Beckton Treatment works (BTW). Due to AM solely processing 40% of all of London's Waste and leading to BTW.

Moreover, that Both works are grade 2 Listed, this ensues extra challenges and costs when upgrading the existing services. Features of significant historical importance must be retained.

Patel et al (2014) issues, that the Internal modernising works of AM are extensive but meet the grade 2 specification:

- Re-using the pumps motor casing - housing a modern 3.3 kV 450 kW 4-pole motor
- A new Epicyclic Gear Box system within the casing. Lowering the working load from 1480rpm to the 214rpm.
- Reuse of all 8 storm pump valves to 20-year life expectancy.
- New mezzanine floor to support the estimated 50+ tonne weight of new electrical works.

Cuthbert et al (2014) avers, that BTW is the largest in Europe and can currently managing waste for 3.5m people daily. Also, once completed, the capacity will raise to 3.9m.

Laine-Rourke (2012) concurs, siting that the work on site will include:

- Upgrade old and make new activated sludge plant (ASP)
- New final settlement tanks (FST).
- “Boring a 750-metre tunnel to transport final effluent BTW existing outfall-channel.

Tilley (2013) affirms, that the site capacity will increase 60% to process the excrement from the Lee Tunnel.

2. The Lee Tunnel (Fig 1.)

Water Technology (2018) transcribe, that the Lee Tunnel runs below water ways and ground through the east end and was completed in 2016 and is 6.3K (4 Miles) in length. Moreover, that the tunnel is 80m below ground level and measures 7.2m in diameter.

Beckton works and Abbey Mills pumping stations (A & F) are instrumental in the effective use of the Tunnel. One shaft at Abbey Mills and 3 at the Beckton site:

- Overflow Shaft – Connects the out flow to the River Thames if the main shaft is full.
- Pumping Station shaft – houses 6 x 3 megawatt for conveying sewage to the works.
- Connection Shaft from Beckton to Abbey mills via Lee Tunnel.

Sutherland (2015) notes, that construction of the shafts begun the process of connecting Both Stations. Beforehand, soil investigation and archaeological teams assessed the first 6 meters below ground. Located, east and west of the Lee Tunnel, both required test & design works as the external forces from ground water pressure were 8 bar in places. Furthermore, stating, this made design and building teams decided upon a diaphragm wall system.

Bacsol (2013) specify, that both were constructed to EC2 & EC7 European standards and involved firstly inserting the diaphragm walls (Outer Lining) into place.

Schiffler (2015) agrees, expressing that each internal wall segment was made using Bentonite Slurry and Reinforced-steel. Additionally, that, trenches were excavated below the slurry with reinforced steel cages lowered into the void. Concrete with grade 50/60 is then pumped to the cavity through a tremie pipe system which displaces the Bentonite. Each concrete pour contains 70% blast furnace slag waste instead of cement with 6-hour workability to avoid cold joins with concrete pours of upto 1400m².

Jewel et al (2012) States that the concrete is thixotropic, staying in a semi-solid state until manipulated to become more workable. Next, the soil was excavated using traditional techniques or in some instances, using Hydrofraise cutting drums to mill the earth in a backwards direction. To the point where the next Bentonite section is ready to be completed post steel insertion.

Agrawal (2018) Proffers, that once the diaphragm shaft is completed, a reinforced-concrete base is cast in-situe. Moreover, that due to the Eurocode requirements and Building regulations to BS8007 for water tightness, a secondary internal ring was constructed inside the shaft. This used a slip-form system of prefabricated concrete segments, each being independant of external Diaphragm Walls. This allowed for concrete pour between the 2 layers, to allow a slower drying time concrete mix that would be less likely to have defects through high pressure at deep excavation. This system was originally developed by the mining industry and was first employed in 1950.

Wassenaer (2017) avers, that, the Tunnel Boring Machine (TBM) which was designed for this project, was manoeuvred by crane into the bottom of the shaft. The TBM, transported from Germany by road and barge, is a total of 122m Long once fully constructed. The first piece has an 8.8m diameter cutting face which will bore the start of the tunnel. As it progresses deeper, the next attachments were lowered into the shaft and married to the front.

Tideway (2018) declare that the TBM produces 2 types of waste when boring. The first was soil, conveyed through the tunnel for disposal. Secondly, Sludge/Slurry which is removed via pump. Both are transported away on the river by barge once full for a lower site CO₂ Emmisions on paper. However, Harvey (2018) claims, that boats, operate on oils and diesel which have a high pollution. Moreover, claiming that this is not currently regulated therefore will not count to the overall co₂ emissions when factored into projected calculations.

Sutherden (2017) says, the Lee tunnel was sectionally constructed using pre-cast 350mm fibre strengthened concrete segments. Strategically installed behind the TBM once progressed far enough. Each piece was injected with “ethylene propylene diene monomer (EPDM)” to provide a water-tight seal at every joint. This provided a superior bond in comparison to standard glue and was the first time it had been used in the UK.

Moreover, that, the tunnel was immediately erected behind the TBM, hastening construction times, until it reached the AM Shaft from its starting location at BTW Shaft. Here it was coupled to the shaft to make another water-tight bond.

3. Themes Tideway Super Tunnel

James (2017) states that, the Lee Tunnel was a large-scale trial run of new construction methods and to establish timescales on how the TBM Would perform. Prior to attempting the largest project of its type, the “Thames Super Tunnel” below the river. The tunnel will run for over 25k (16 miles). Starting at Ealing Storm tanks (West London) and ending at AM (East) (FIG1.3).

Tideway (2018) state that 4 TBM Machines will be used at specified points of the river, where Shafts and access points are constructed. These access areas will allow for further reclamation of land from the Thames. Creating public access green areas or gardens for residents to use and enjoy the views of a cleaner river.

The Sewer construction will intercept the current system at the overflow outlets along the Thames (FIG1.4). When the existing Victorian low laying intercepting sewer fills e.g. at times

of heavy rain. The waste which would normally enter the river will be diverted into the localised overflow tunnel shaft and then into the super sewer tunnel.

Problems and Opposition

A plethora of News Broadcaster's have nothing but positive press when reporting on the Project. The BBC is a prime example, any story that focuses on London development is always shown in a positive light, no matter the cost or the effect on the National Deficit. "BBC Commissioning Editor for Specialist Factual says: "The sheer scale, ingenuity and ambition of this project is remarkable, a thrilling insight going on beneath our feet to make the River Thames, one of the UK's best loved landmarks, sewage free". (BBC, 2018)

Meanwhile, there is a clear contrast at ground level, local-residents are not happy. There are numerous reports, especially at the sites where the Shafts and TBM are or have been present. Focussing on the noise pollution from the plant which operates 24 hours a day.

Cllr McCallum said residents were affected by the noise of machinery, light pollution, and the sound of workers "shouting" to each other while working at the site. (South Wark News, 2017). This suggests that certain sites involved in its construction are in breach of the Considerate Constructors Scheme (CCS).

Question 2 - Water Supply

AWWA (2011) States that there are 2 common types of domestic water supply to standard homes in the UK:

Indirect Cold-Water Storage (FIG 2.1)

HSE.Gov (2018) state that a cold-water storage system utilises a Cold-Water rising main. The feed is sometimes on the front of a property, entering the loft-space. On entering the property from the mains branching into 3:

1. leads to a cold-water tank in the loft for distribution to bathroom toilet, taps, shower, bath etc (Non-Potable)
2. leads to one facet, normally a sink in the kitchen. (Used for drinking)
3. leads of the main line directly into a combination boiler which supplies hot water directly to the facets which require it (Non-Potable)

When a non-combination boiler is present, sometimes there is an additional tank in the loft which feeds to a cylinder normally located in a room below. Alternatively, the cylinder may be fed directly from the cold-water storage (FIG 2.2) The system will still only supply one potable water source regardless of boiler type.

These systems are normally found in older properties dating pre-WW2.

A danger related to this system is Legionnaires disease, which is caused by bacteria present in the tank under certain conditions.

Direct-Water Supply (2.3)

Guyer (2018) State that a direct supply is a healthier option in comparison to to an indirect system. A direct system has a low entry mains line which branch to:

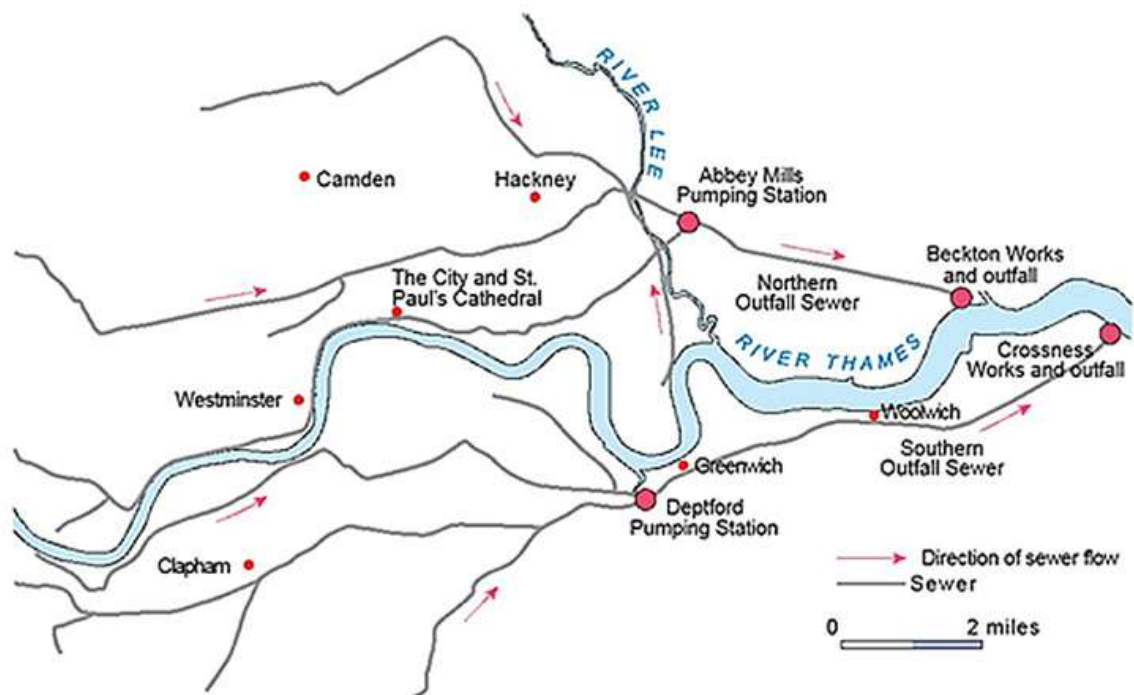
- All Cold-water facets and services including baths, toilets and basins.
- any heating utilized water storage tanks – feed only used for heating.
- a combination boiler.

This system is has a much higher pressure of water as all facets are supplied directly from the mains line and does not rely on gravity feeds.

This system is standard in new build houses and it is very rare to find an indirect system unless a client has directly requested so.

Appendix

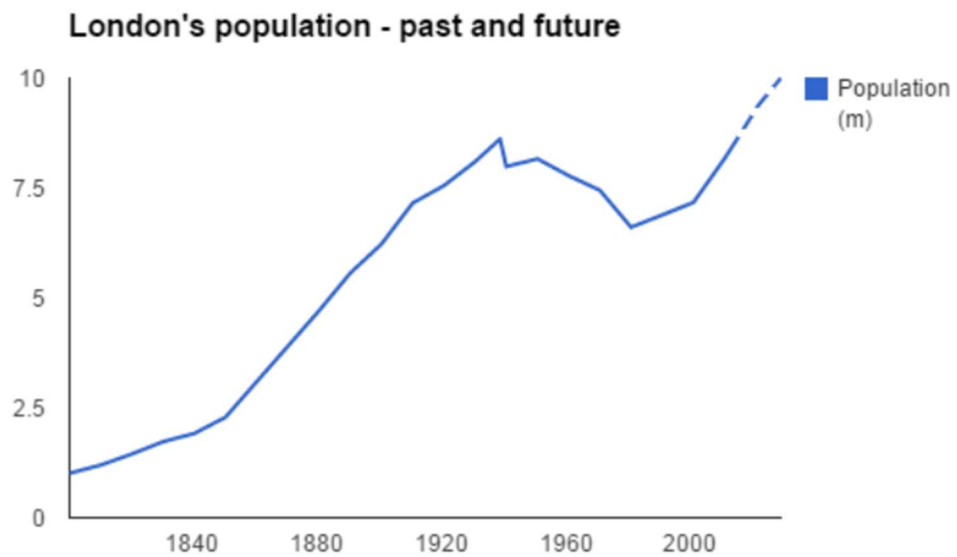
1.1



OedsBoys (2018). *London's post- 1858 sewer system*. [image] Available at:
https://odeboyz.files.wordpress.com/2018/12/bazalgettes_system_of_intercepting_sewers_-_800_1-1.jpg [Accessed 16 Jan. 2019].

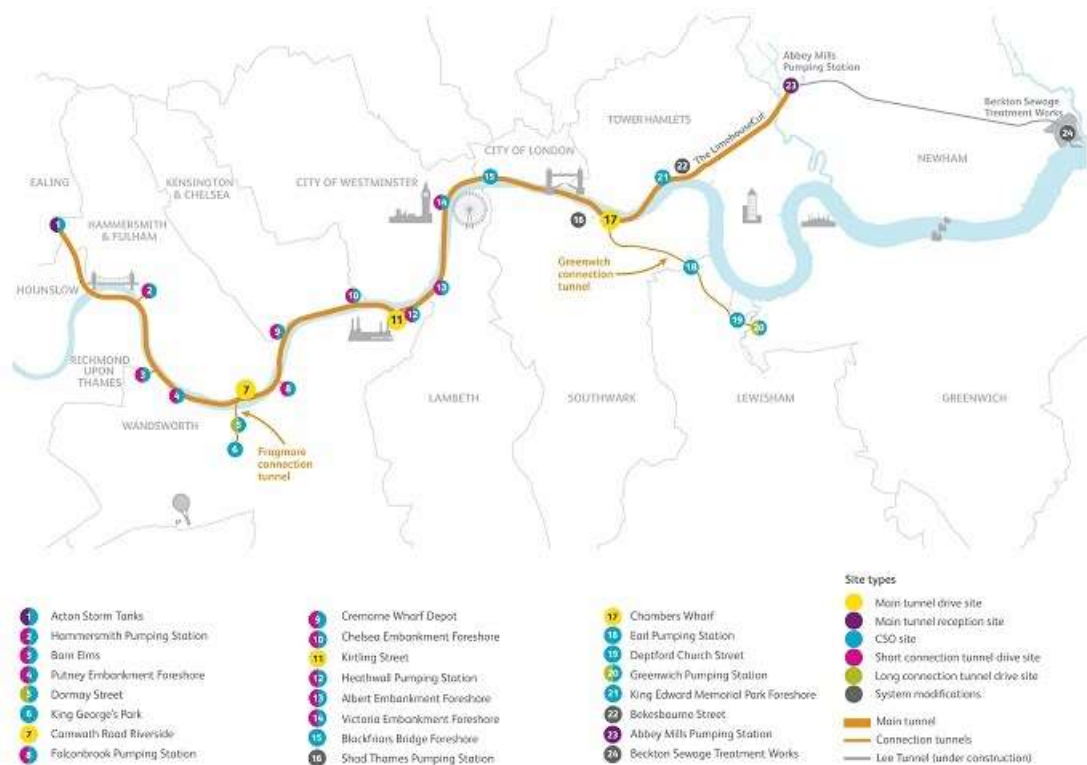
Fig 1.2

starting in 1801 and projected into the future:



Elledge, J, (2015), *10 Ways of visualising Londons Growth* [ONLINE]. Available at: <https://www.citymetric.com/sites/default/files/images/2%20London%20historic%20and%20future%20pop.png> [Accessed 2 January 2019] Fig 1.2

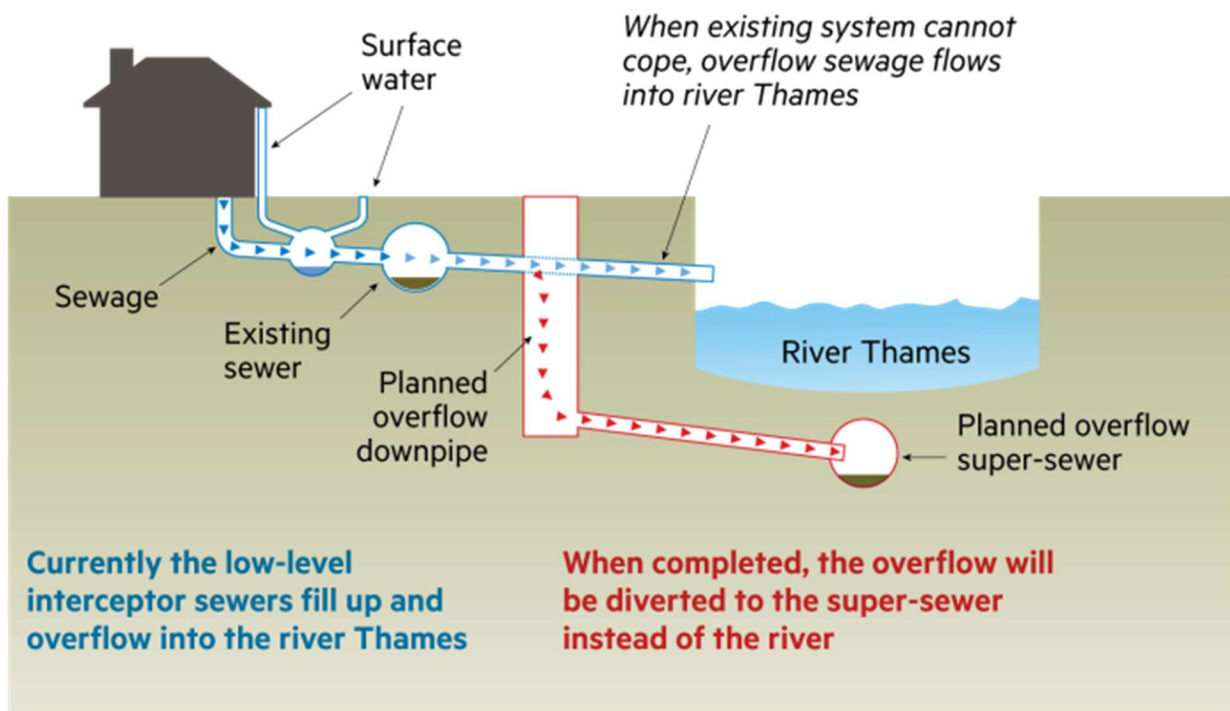
Fig 1.3



Londonist (2017). *What Is The Thames Tideway Tunnel?*. [image] Available at: <https://assets.londonist.com/uploads/2015/07/i875/proposed-tunnel-route-and-key.jpg> [Accessed 24 Jan. 2019].

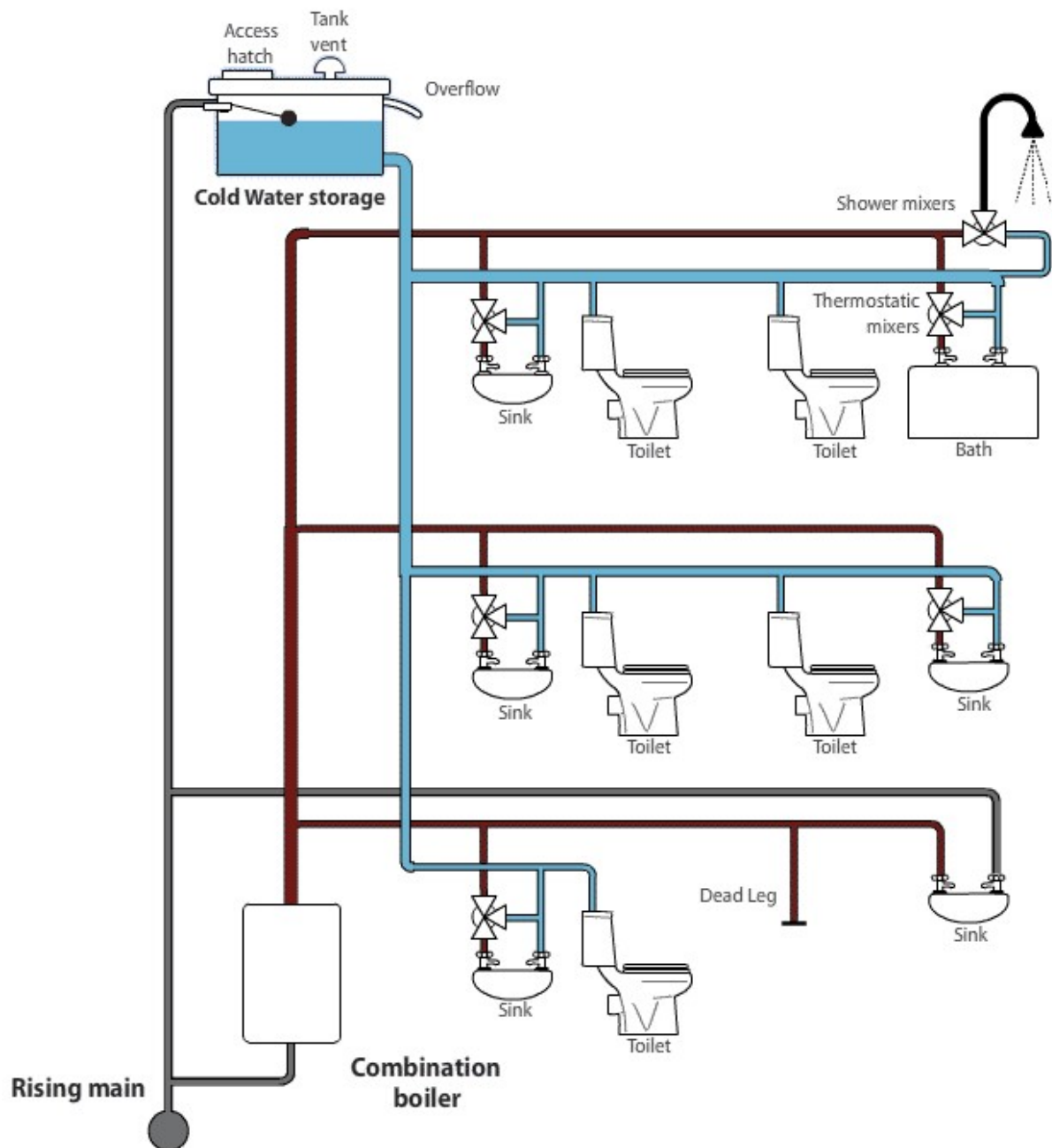
Fig 1.4

How it works



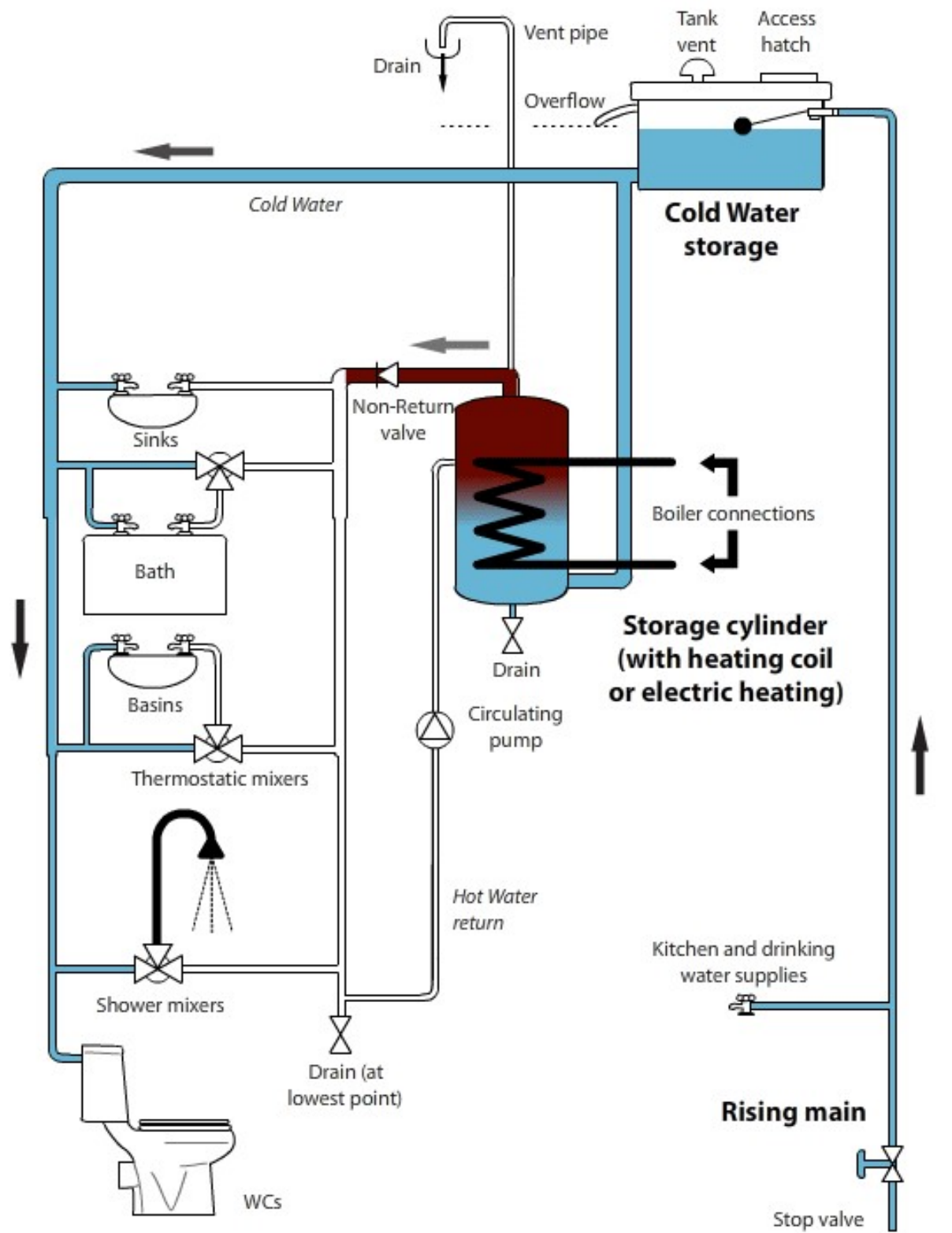
FT (2019). *London super sewer causes stink over opaque funding structure*. [image] Available at: https://www.ft.com/__origami/service/image/v2/images/raw/http%3A%2F%2Fcom.ft.imagepublish.prod.s3.amazonaws.com%2F02e71522-7b8e-11e7-9108-edda0bcb928?source=next&fit=scale-down&quality=highest&width=700 [Accessed 24 Jan. 2019].

Fig 2.1



HSE Health & Safety Executiv. (2018). *Cold water storage*. Available:
<http://www.hse.gov.uk/legionnaires/cold-water-storage.htm>.

Fig 2.2



HSE Health & Safety Executiv. (2018). *Hot & Cold water storage*. Available:
<http://www.hse.gov.uk/Legionnaires/hot-and-cold-water-storage.htm>.

FIG 2.3

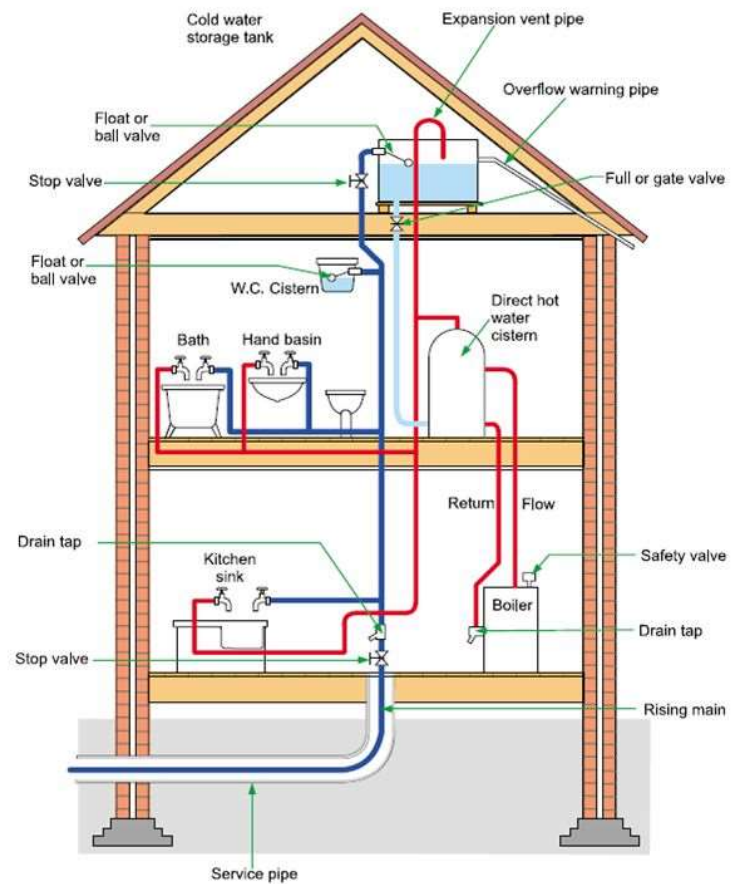
SmartScreen.co.uk
Dedicated online support

Direct system

The only stored water is for the hot water system via the cylinder.

Only one DOV is required to drain the system down.

All pipework can be 15mm due to the system being high pressure.



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