

FOUL SEWER DESIGN: HISTORIC CONVENTIONS ARE THEY STILL APPROPRIATE?

Potable Water Usage (The basis for foul sewer design)

During the inter-war years and for some time thereafter it had been British engineering practice to allow up to 68 litres/person/day for small villages, 113 litres for medium sized provincial towns and upwards of 142 litres for large conurbations when designing public foul sewer networks.

Records from 1936 – 38 also show that the largest groups of water authorities were supplying about 125 litres/person/day, including both domestic and trade demands, while at the same time, the largest groups of sewage treatment works were receiving average dry-weather flows of about 147 litres/person/day in dry weather. (Further research has been unable to determine the precise basis for this difference but surface water 'infiltration' will no doubt have played a contributing part).

Moving forward in time figures published by the Water Council in 1980, put average household consumption of water still at only 120 litres/person/day, albeit these figures were at variance with those produced by the Department of the Environment – these were somewhat higher at 322 litres/person/day for the period 1976 - 1980. (Importantly, this latter figure also included trade effluents and therefore distorted actual domestic use).

The latest figures published by Defra c2008, put daily consumption at an average of 150 litres/person/day with acknowledged municipal engineering texts identifying that only 95% of all potable water supplied actually finds its way into the public foul/combined sewer network.

Infiltration & Inflow (A WaSC matter for WaSCs to deal with through AMP submissions)

It is important to distinguish between these two phenomena - there is a subtle distinction but they are rarely differentiated and/or quantified, using robust data, whenever WaSCs undertake any capacity/hydraulic assessment of their foul/combined sewer networks. In short, infiltration is extraneous groundwater or water from other leaking pipes ⁽¹⁾ that enters the sewer system through defective drains and sewers (cracks & fissures), pipe joints, couplings and manholes. Inflow is storm-water that enters separate foul sewers from illegal or misconnected surface water drainage and/or manholes ⁽²⁾, i.e. cross-connections.

In terms of quantity, it is possible that infiltration into old sewerage systems may well, (on average) add 40% to the dry-weather flow. (Ref: L B Escritt: Sewerage & Sewerage Treatment - 1984). Moreover, to account for such and to ensure foul sewer capacity was not compromised, earlier design conventions relied on an increase in dry-weather flow (DWF) from 3 to 6 to counter the perceived effects of infiltration especially in those circumstances when the integrity of the system was either suspect or compromised. This approach has continued to be applied in Sewers for Adoption 6th Edition which in turn relies on a conservative foul discharge rate of 4000litres/dwelling/day (peak flow rate of 0.046 litres/sec) when designing new foul (adoptable) foul sewers for residential developments. This needs to be contrasted with the current requirements of the Building Regulations for potable water usage – see later section of this note.

Current engineering conventions also suggest that leakage (infiltration) of more than 15 litres/day/m² of interior surface of a sewer is considered excessive.

(1) Latest WaSC returns to Ofwat and/or the Environment Agency have confirmed that 23% all potable water that is supplied is lost through uncontrolled leakage.

(2) The changes introduced through the FWMA 2010 should have made a major contribution in the reduction of such connections.

Put into context, this equates to 2.1m of 150 mm diameter pipe with a combined rate of infiltration of 15 litres/24 hour day from say two pipe joints. In numerical terms an infiltration rate of 0.01 litres/min.

Looking at the foul drainage for a single dwelling with a floor area of approximately 1000 sq. ft. (93m²) we would normally expect to see around 15.0 linear metres of underground foul drainage. Using the previous figure(s) this would equate to an infiltration rate 0.071 litres/min/dwelling (0.001 litres/sec. As a percentage of the peak discharge/dwelling (0.04 litres/sec - as set down in Sewers for Adoption and based upon a discharge rate of 4000 litres/dwelling/day), this would be in the order of 2.6%. This begs the question why WaSCs are factoring into their foul/combined sewer capacity analyses, a further allowance for infiltration in the range of 10 – 40% of the peak discharge? This is a pertinent question in its own right as the peak discharge of 4000 litres/dwelling already includes a 10% (400 litres/dwelling) factor of safety for infiltration. That said this is an analysis at the 'micro' level – but one can reasonably conclude that WaSCs are relying on the concept of misaligned and inappropriate infiltration criteria to justify foul sewer network reinforcement, and paid for at the developer's expense. Given the WaSCs statutory obligations pursuant to S94 of the Water Industry Act 1991 this is neither appropriate, nor equitably justified. See relevant abstract from Water Industry Act below:-

Section 94 WIA 1991- General duty to provide sewerage system

S94(1) - It shall be the duty of every sewerage undertaker - (a) to provide, improve and extend such a system of public sewers (whether inside its area or elsewhere) and so to cleanse and maintain those sewers and any lateral drains which belong to or vest in the undertaker as to ensure that that area is and continues to be effectually drained; and (b) to make provision for the emptying of those sewers and such further provision (whether inside its area or elsewhere) as is necessary from time to time for effectually dealing, by means of sewage disposal works or otherwise, with the contents of those sewers. . . . (Underlining – HBF emphasis).

Future Direction of Potable Water Use

At a time when the UK Government, irrespective of its political persuasion, is seeking to reduce potable water usage through Planning Control and the Building Regulations, this is still not being taken on board by the WaSCs. The current Building Regulations set down two important limitations for water use, namely 125/litres/person/day as a maximum and a reduced water usage rate of 110 litres/person/day in defined water-stressed areas. The trend in reduction is likely to continue. Importantly, these mandated requirements are also not being factored into foul/combined sewer network analyses.

Summary

Based on the body of evidence that is now readily available it is becoming increasingly evident that WaSCs are relying on excessive and disproportionate rates of infiltration to justify foul and/or combined sewer network reinforcement at the developer's expense. Moreover, it is of increasing concern that WaSCs are also seeking to lend credence to their demands for network reinforcement through the planning process but without disclosing any evidence in support thereof. In addition, serious questions need to be asked not just about the assessment criteria that is being used but also the very basis for determining foul discharges from new residential development.