Code of Practice

Flows and Loads – 4
Sizing Criteria, Treatment Capacity for Sewage Treatment Systems
Flow and Loads – Sizing Criteria, Treatment Capacity for Sewage Treatment Systems

This code of practice was prepared by the British Water Package Sewage Treatment Plant Focus Group comprising manufacturers, suppliers and service companies of all types of small wastewater treatment systems. The Environment Agency, the Northern Ireland Environment Agency and the Scottish Environmental Protection Agency support the use of this code of practice, but the Agencies do not specifically endorse any particular manufacturer’s product.

This code of practice provides a table of loadings which allows the total daily sewage load from properties to be calculated and it is recommended that all designers should use this table when sizing and designing non-mains sewage treatment systems. The flows and loads values given represent current best knowledge within the UK but may change with time in line with per capita water use.

Where proposed alternative usage rates or methods of sizing might be more appropriate for a particular application this should be supported by the collection of data or additional site specific evidence to validate the proposal. Professional judgment is required and may be used to compare alternatives especially when assessing sewage strengths and treatability.

Guidance is provided to assist the user to identify the various sources of sewage, to consider the nature of the sewage to be treated and to make users aware of issues which may affect treatability and system performance. Each manufacturer is aware of the capabilities of their own systems with respect to different situations.

The table of loadings may be used to design all sizes of sewage treatment systems serving up to 1000 population.

Use of this code of practice by all UK manufacturers and system designers will:

• help to clearly define site activity and sewage sources
• promote a consistent approach to collecting accurate and complete loading information
• provide consistent information about problem effluents and treatability, and
• promote the design and installation of appropriate treatment systems and so reduce the problem of undersized systems causing environmental contamination.

The loadings in this code of practice are more comprehensive than in previously published guidance, they are generally higher and include values for ammonia.

1 Scope
The purpose of this code of practice is to provide an appropriate table of loadings (volumes and loads) to allow the total daily load entering a treatment system to be calculated.

2 Regulations
Early contact with the Regulator to discuss the proposed discharge of sewage effluent is advisable.

• Planning requirements, eg DETR Circular 3/99, site survey, etc.
• Building regulations, eg part H DTLR England & Wales, part M Scotland, Water (Northern Ireland) Order 1999 and Northern Ireland building regulations.
• A Permit, Authorisation or Consent to discharge will be required from the environmental regulators (the Agencies).
• Planning permission (Local Authority Planning Guidance).

3 Definitions of terms

• Population (P) – number of people the system will serve.
• Biochemical oxygen demand (BOD<sub>5</sub>) – Mass concentration of dissolved oxygen consumed under specified conditions (5 days at 20° C with nitrification inhibition) by the biological oxidation of organic and/or inorganic matter in water.
• Ammonia expressed as mglL N – Ammonia is NH₃. Ammonium is NH₄OH. In wastewater we frequently refer to and use the word symbol, ammonia/NH₃. The term ammonia usually includes ammonium as well.

4 Selection considerations – all applications

• Values and conditions required by any regulatory permit or consent.
• Loading figures for each specified load are given for Flow, BOD and NH₃.
• The user/purchaser of the system must declare ALL ACTIVITIES to enable all loads entering the treatment system to be identified and evaluated. The user/purchaser should be made aware that there is a risk of poor performance from the equipment if loads are understated. The accuracy of the declared loads is of paramount importance.
• Guidance points given under each category suggest questions to enable the specifier to recognise variable or unusual loads.

The owner of the treatment system holds the permit, consent or authorisation to discharge and should be aware that he is responsible for the effluent quality discharged. Thus all sources of discharge into the system must be declared. It is an offence if the effluent fails to comply with the regulators requirements.
# Table of Loadings for Sewage Treatment Systems

<table>
<thead>
<tr>
<th>Per person / activity / day (unless otherwise specified)</th>
<th>FLOW (Litres)</th>
<th>BOD (Grams)</th>
<th>Ammonia as N</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DOMESTIC DWELLINGS</strong> (Grams)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard residential</td>
<td>150</td>
<td>60</td>
<td>8</td>
</tr>
<tr>
<td>Mobile home type caravans with full services</td>
<td>150</td>
<td>60</td>
<td>8</td>
</tr>
<tr>
<td><strong>INDUSTRIAL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office / Factory without canteen</td>
<td>50</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>Office / Factory with canteen</td>
<td>100</td>
<td>38</td>
<td>5</td>
</tr>
<tr>
<td>Open industrial site, e.g. construction, quarry, without canteen</td>
<td>60</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>*Full-time Day Staff</td>
<td>90</td>
<td>38</td>
<td>5</td>
</tr>
<tr>
<td>*Part-time Staff (4 hr shift)</td>
<td>45</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td><strong>SCHOOLS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-residential with canteen cooking on site</td>
<td>90</td>
<td>38</td>
<td>5</td>
</tr>
<tr>
<td>Non-residential without a canteen</td>
<td>50</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>Boarding school (i) residents</td>
<td>175</td>
<td>60</td>
<td>8</td>
</tr>
<tr>
<td>(ii) day staff (inc. mid-day meal)</td>
<td>90</td>
<td>38</td>
<td>5</td>
</tr>
<tr>
<td><strong>HOTELS, PUBS &amp; CLUBS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hotel Guests (Prestige hotels)</td>
<td>300</td>
<td>105</td>
<td>12</td>
</tr>
<tr>
<td>Hotel Guests (3rd &amp; 4th hotels)</td>
<td>250</td>
<td>94</td>
<td>10</td>
</tr>
<tr>
<td>Guests (Bedroom only – no meals)</td>
<td>80</td>
<td>50</td>
<td>6</td>
</tr>
<tr>
<td>Residential Training/Conference Guest (inclusive all meals)</td>
<td>350</td>
<td>150</td>
<td>15</td>
</tr>
<tr>
<td>Non residential Conference Guest</td>
<td>60</td>
<td>25</td>
<td>2.5</td>
</tr>
<tr>
<td>Drinkers</td>
<td>12</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>Holiday camp chalet resident</td>
<td>227</td>
<td>94</td>
<td>10</td>
</tr>
<tr>
<td>Resident Staff</td>
<td>180</td>
<td>75</td>
<td>10</td>
</tr>
<tr>
<td>Restaurants - Full Meals - luxury catering</td>
<td>30</td>
<td>38</td>
<td>4</td>
</tr>
<tr>
<td>- pre-prepared catering</td>
<td>25</td>
<td>30</td>
<td>2.5</td>
</tr>
<tr>
<td>- Snack Bars &amp; bar meals</td>
<td>15</td>
<td>19</td>
<td>2.5</td>
</tr>
<tr>
<td>- Function Rooms including buffets</td>
<td>15</td>
<td>19</td>
<td>2.5</td>
</tr>
<tr>
<td>- Fast Food i.e. (roadside restaurants)</td>
<td>12</td>
<td>12</td>
<td>2.5</td>
</tr>
<tr>
<td>- Fast Food Meal (burger chain and similar)</td>
<td>12</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>Students (Accommodation only)</td>
<td>100</td>
<td>60</td>
<td>8</td>
</tr>
<tr>
<td><strong>AMENITY SITES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toilet Blocks (per use)</td>
<td>10</td>
<td>12</td>
<td>2.5</td>
</tr>
<tr>
<td>Toilet (WC) (per use)</td>
<td>10</td>
<td>12</td>
<td>2.5</td>
</tr>
<tr>
<td>Toilet (Urinal) (per use)</td>
<td>5</td>
<td>12</td>
<td>2.5</td>
</tr>
<tr>
<td>Toilet Blocks in long stay car parks/lorry parks (per use)</td>
<td>10</td>
<td>19</td>
<td>4</td>
</tr>
<tr>
<td>Shower (per use)</td>
<td>40</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>Golf Club</td>
<td>20</td>
<td>19</td>
<td>5</td>
</tr>
<tr>
<td>Local community sports club, e.g. squash, rugby &amp; football</td>
<td>40</td>
<td>25</td>
<td>6</td>
</tr>
<tr>
<td>Swimming (where a separate pool exists without an associated sports centre)</td>
<td>10</td>
<td>12</td>
<td>2.5</td>
</tr>
<tr>
<td>Health Club/Sports Centre</td>
<td>50</td>
<td>19</td>
<td>4</td>
</tr>
<tr>
<td>Tent sites</td>
<td>75</td>
<td>44</td>
<td>8</td>
</tr>
<tr>
<td>Caravan Sites - (i) Touring not serviced</td>
<td>100</td>
<td>44</td>
<td>8</td>
</tr>
<tr>
<td>(ii) Static not serviced</td>
<td>100</td>
<td>44</td>
<td>8</td>
</tr>
<tr>
<td>(iii) Static fully serviced</td>
<td>150</td>
<td>60</td>
<td>8</td>
</tr>
<tr>
<td><strong>HOSPITALS &amp; RESIDENTIAL CARE HOMES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential old people / nursing</td>
<td>350</td>
<td>110</td>
<td>13</td>
</tr>
<tr>
<td>Small hospitals</td>
<td>450</td>
<td>140</td>
<td>Assess</td>
</tr>
<tr>
<td>Large hospitals</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Staff figures also apply to other applications*
1. A treatment system for a single house with up to and including 3 bedrooms shall be designed for a minimum population (P) of 5 people.

2. The size of a treatment system for a single house with more than 3 bedrooms shall be designed by adding 1 P for each additional bedroom to the minimum single house value of 5 P, e.g:

   - house with 3 bedrooms = minimum 5 P system
   - house with 4 bedrooms = minimum 6 P system (5+1)
   - house with 6 bedrooms = minimum 8 P system (5+3).

3. For groups of small 1 and 2 bedroom houses or flats
   - flat with 1 bedroom = allow 3 P
   - flat with 2 bedrooms = allow 4 P

4. A treatment system serving a group of houses shall be designed by adding together the P values for each house calculated independently, e.g:

   - for a group of two houses (3 and 4 bedrooms, respectively) the system shall be for a minimum of 11 P (5+6)

5. If the calculated total P for a group of houses exceeds 12 P then some reduction may be made to allow for the balancing effects on daily flow of a group of houses (round UP not down)

   - Where the total is 13-25 P multiply the total by 0.9 to give an adjusted P value, e.g. if there are four four-bedroom houses the total P will be 24 P (4 x 6) and the adjusted P will be 22 P (24 x 0.9 = 21.6)
   - Where the total is 26-50 P multiply the total by 0.8 to give an adjusted P value, e.g. if there are four three-bedroom houses and three four-bedroom houses the total P will be 38 P (4 x 5 and 3 x 6) and the adjusted P will be 31 P (38 x 0.8 = 30.4)

6. Where there are larger groups of houses, the P should be estimated using both the expected total load and the flow, considering both peak and total flow

7. These are minimum recommended population (P) loads, they should not be modified downwards, upward modification may be necessary because of particular characteristics of each property or groups of properties.

8. The above assessments of population (P) should be used for both existing and new properties

### 5 Domestic housing

- A treatment system for a single house with up to and including 3 bedrooms shall be designed for a minimum population (P) of 5 people.
- The size of a treatment system for a single house with more than 3 bedrooms shall be designed by adding 1 P for each additional bedroom to the minimum single house value of 5 P, e.g:
  - house with 3 bedrooms = minimum 5 P system
  - house with 4 bedrooms = minimum 6 P system (5+1)
  - house with 6 bedrooms = minimum 8 P system (5+3).
- For groups of small 1 and 2 bedroom houses or flats
  - flat with 1 bedroom = allow 3 P
  - flat with 2 bedrooms = allow 4 P
- A treatment system serving a group of houses shall be designed by adding together the P values for each house calculated independently, e.g:
  - for a group of two houses (3 and 4 bedrooms, respectively) the system shall be for a minimum of 11 P (5+6)
- If the calculated total P for a group of houses exceeds 12 P then some reduction may be made to allow for the balancing effects on daily flow of a group of houses (round UP not down)
  - Where the total is 13-25 P multiply the total by 0.9 to give an adjusted P value, e.g. if there are four four-bedroom houses the total P will be 24 P (4 x 6) and the adjusted P will be 22 P (24 x 0.9 = 21.6)
  - Where the total is 26-50 P multiply the total by 0.8 to give an adjusted P value, e.g. if there are four three-bedroom houses and three four-bedroom houses the total P will be 38 P (4 x 5 and 3 x 6) and the adjusted P will be 31 P (38 x 0.8 = 30.4)
- Where there are larger groups of houses, the P should be estimated using both the expected total load and the flow, considering both peak and total flow
- These are minimum recommended population (P) loads, they should not be modified downwards, upward modification may be necessary because of particular characteristics of each property or groups of properties.
- The above assessments of population (P) should be used for both existing and new properties

### 6 Commercial Premises

- Identify ALL the sources of waste.
- Identify final maximum site usage/business expectations.
- The individual values provided for each function within the table assume that 100% of every application and load is quantified. DO NOT reduce values based on reduced expectations.
- All catering applications require the installation of adequately sized grease separators, removal or retention systems up-stream of the biological treatment equipment.

### 7 Catering premises

- Establish maximum (and minimum) daily load based on a 24 hour cycle.
- Check period of operation.
- Identify dates of maximum loads, e.g. Mothering Sunday, Easter, Bank holidays, Fridays etc.
- Identify load peaks, usually at lunch or evening.

- Flow balancing may provide an appropriate solution.
- Where WDU and potato peelers are to be used calculate/document the load.
- Identify the nature(s) of the catering in order to select the correct loading, eg
  - Bar snacks - ploughmans, sandwiches, basket meals, etc.
  - Pre-prepared catering - frozen and chilled meals (not prepared on site).
  - Home cooked meals - fresh soups, fresh vegetables, casseroles, etc.
  - Luxury catering - fully prepared on site with cream sauces, home made desserts.
  - Takeaways - Indian, Chinese, fish and chips, etc.
  - Fast food - roadside restaurants, burger chains, etc.
  - Function room catering - Establish “normal” style, may be sandwiches, or full buffet, home cooked meals, conference, wedding banquets, etc.

- The biological unit must be protected from grease and fats. Modern cooking uses light oils, which may not separate. The collection and containment of all forms of grease prior to the biological equipment is vital. Operate any grease system in full accordance with the manufacturer’s instructions.
- Individual kitchen practices affect loads, i.e. leftovers on plates may be scraped into bins, or wet rinsed into system, the former to be encouraged, the latter should be discouraged or factored into the treatment plant design.
- Premises serving beers may produce toxic caustic effluents due to the hygiene and cleaning regimes.
- The proportion of wastes from some sources can produce an effluent, which is difficult to treat, e.g. some Drive Through Fast Food establishments can have an effluent with a low organic content.

### 8 Hotels & Residential Centres

- Establish “style and type” of hotel e.g. Prestige (5*), Bedroom only accommodation, Conference Centres, Resort Hotels with Sports and Spas, Treatment Centres, etc.
- Calculate total loading based on occupancy of at least 2 people per room.

- Some hotels regularly have 4 occupants per room.
9 Laundries
- Excepting domestic premises, it is assumed that all laundry functions are additional.
- For each premises, identify which laundry items are done in house or sent off site.
- Calculate the laundry load on the basis of the number of machines and the period of use.
- Sites with laundries must fit and maintain lint filters.

- The volume/BOD figures are based on an expectation that guests have an evening meal, drink and breakfast and that good kitchen practices are in place.
- Add all other loads, considering non-resident uses, i.e. Lunches, Functions, Visiting Drinkers, Diners, etc.
- Consider periodicity of loads.
- Ensure residential and training centre loadings reflect the complete meal plan, i.e. allow for lunch and afternoon tea, sports, etc.
- Special Events. Check provision of temporary facilities, e.g. summer marquees and allow for appropriate loading.
- Consider any loads from outside catering.

10 Toilet Blocks
- Figures can also be assessed according to the sanitary equipment and control system installed.

- Automatically flushed urinals use 10 litres per hour; a single flush should not use more than 1.5 litres.
- Consider ladies and gents toilet facilities separately.

11 Sports Clubs
- Calculate loadings on 100% usage for the sporting facility. The figure provided includes showering and toilet use by the sports person.
- Consider also the non-sporting uses, i.e. spectators’ toilet use.
- Add drinkers, social members and staff.
- Add values for catering facilities.
- Check normal and exceptional catering provisions.

- A swimming pool with no associated sports centre may be calculated using the number of swimmers, assume a toilet use per person, and by adding values for showers and spectators. Check duration of visits and modify for extended use.
- Consider separate treatment or disposal of backwash waters from ancillary equipment, such as types of filtration and disinfectant removal in swimming pools.

12 Golf Clubs
- The values within the data table allow for light snacks and toilet use.
- Calculate additional allowances for showers.
- Add values for other catering facilities (if other than light snacks).

13 Hospitals
- The nature of the facility affects the design values. Some nursing homes have very high hydraulic loads as a result of the use of bedpans and their sanitation. Consider any disinfection equipment installed.
- With drugs and hygiene requirements of hospitals adjust the equipment size to compensate for treatability factors.

- Disposal of unused/waste medicines is not permitted via the treatment facility.

14 Caravan Sites
- Establish nature of communal blocks, i.e. toilet, shower usage, laundry, etc.
- Where laundry equipment is installed, count the number of machines on site and period of use. Where possible, identify specific commercial machine details for volume and wash cycle duration.

- Hydraulic loads of 100 litres per hour for 12 hours are not unusual.

- Loading figures quoted assume that wastes from chemical toilets do not enter the system as they must not be allowed to enter into the treatment plant.

A cesspool may be installed to receive chemical toilet waste for separate disposal.

15 Installation

The following may affect which equipment is offered.
- The site.
- Location of treatment plant within the site.
- Invert depth of installation (where possible, locate to permit gravity flow into and out of the system).
- Pumping equipment.
- Installation requirements.

Refer to manufacturer’s specifications and installation manual.
- Access for maintenance and servicing.

Refer to manufacturer’s specifications and maintenance instructions.

- The need for a sample chamber.
- Discharge point.
- Soil percolation area or other tertiary treatment.
### 16 Documentation

Records of the loads used to select and recommend the type and size of treatment systems should be maintained by the specifier and the customer. A typical example follows.

#### Treatment system enquiry sizing sheet

**Our Ref.** 123456  **Date** 10th August 2003  **Site** ABC Hotel  **Client** New Architects & Consultants

<table>
<thead>
<tr>
<th>SOURCE OF WASTE</th>
<th>Description</th>
<th>No of rooms</th>
<th>Occupancy</th>
<th>No</th>
<th>Flow LITRE / DAY</th>
<th>BOD GRAMS / DAY</th>
<th>NH₃</th>
<th>TOTAL Per Head</th>
<th>TOTAL</th>
<th>TOTAL Per Head</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rooms</td>
<td></td>
<td>80</td>
<td>2</td>
<td></td>
<td>160</td>
<td>250</td>
<td>94</td>
<td>40000</td>
<td>15040</td>
<td>10</td>
</tr>
<tr>
<td>Bar drinkers</td>
<td></td>
<td>120</td>
<td>12</td>
<td></td>
<td>12</td>
<td>1440</td>
<td>15</td>
<td>1800</td>
<td>5</td>
<td>600</td>
</tr>
<tr>
<td>Non resident luxury meals</td>
<td></td>
<td>150</td>
<td>30</td>
<td></td>
<td>90</td>
<td>4500</td>
<td>38</td>
<td>35700</td>
<td>4</td>
<td>600</td>
</tr>
<tr>
<td>Staff, full-time day staff</td>
<td></td>
<td>30</td>
<td>90</td>
<td>12</td>
<td>2700</td>
<td>38</td>
<td>38</td>
<td>1440</td>
<td>5</td>
<td>150</td>
</tr>
<tr>
<td>Staff, part-time</td>
<td></td>
<td>20</td>
<td>45</td>
<td></td>
<td>900</td>
<td>25</td>
<td>25</td>
<td>500</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>Laundry – all sent off site</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic washing machine for tea towels only</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total load(s)</td>
<td></td>
<td></td>
<td></td>
<td>80</td>
<td>50340</td>
<td>24180</td>
<td>3010</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effluent quality requested</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20 mg/l BOD</td>
<td>30 mg/l SS</td>
<td>20 mg/l NH₃</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suggested type of plant:</td>
<td>XYZ. Invert: 1.0m. Power: 3-phase. Surface water: all to be excluded from foul sewer. Consent to discharge: to be obtained from the Regulator. Waste Disposal Units: assumed that none are fitted.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notes</td>
<td>Swimming pool – present, used for guests only, all backwash wastes to be excluded. No function rooms or catering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Further information and guidance can be obtained from the British Water website – www.britishwater.co.uk

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