ANNEX E

Water flow meter and mains connection details

The Kent V100 (PSM) and V110 (KSM) are designed for the measurement of cold potable water and offer accuracy, long maintenance-free life and are tamper resistant. These meters operate on the volumetric rotary piston measurement principle and can achieve the highest levels of reading accuracy even at the lowest flow rate. The meter can be installed in any position maintaining optimum performance with no loss of accuracy.

Meter stoppages are substantially reduced, durability enhanced and performance improved as a result of a uniquely-designed grooved piston within the meter measuring chamber, increasing application flexibility.

Valuable management information can be obtained with the aid of a voltmeter pulse unit (available separately). This provides output signals for interrogation by externally powered reading devices and can be attached to previously installed Kent meters at any time without interrupting the water supply.

The V110 (KSM) can also be used with absolute confidence where waters with aggressive or denitrification properties exist.

---

**Fig V100 (PSM) / V110 (KSM)**

<table>
<thead>
<tr>
<th>Size</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D max</th>
<th>E max</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN15</td>
<td>134</td>
<td>86</td>
<td>228</td>
<td>3/4</td>
<td>1/2</td>
</tr>
<tr>
<td>DN20</td>
<td>165</td>
<td>86</td>
<td>267</td>
<td>1</td>
<td>3/4</td>
</tr>
<tr>
<td>DN25</td>
<td>199</td>
<td>104</td>
<td>311</td>
<td>1 1/4</td>
<td>1</td>
</tr>
<tr>
<td>DN32</td>
<td>260</td>
<td>120</td>
<td>327</td>
<td>1 1/2</td>
<td>1 1/4</td>
</tr>
<tr>
<td>DN40</td>
<td>360</td>
<td>158</td>
<td>421</td>
<td>2</td>
<td>1 1/2</td>
</tr>
</tbody>
</table>

* V110 (KSM) Only available up to DN25

**Features and Benefits:**

- **Performance to Class C BS5728 & ISO4064**
- Durable tamper resistant construction.
- Fitted in any orientation.
- Revolutionary grooved piston design.
- Easy to read counter.
- Leak-proof construction.
- Optional pulse output facility.

**Technical Data:**

- Pressure range: Up to 16 bar.
- Temperature range: Up to 50°C.

---

**Options Available:**

<table>
<thead>
<tr>
<th>Options Available</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>V100 (PSM)</td>
<td>Brass Body Without Pulse</td>
</tr>
<tr>
<td>V110 (KSM)</td>
<td>Plastic Body Without Pulse</td>
</tr>
<tr>
<td>V100-T (PSM-T)</td>
<td>Brass Body With Pulse</td>
</tr>
<tr>
<td>V110-T (KSM-T)</td>
<td>Plastic Body With Pulse</td>
</tr>
</tbody>
</table>

**Class C Specifications:**

<table>
<thead>
<tr>
<th>DN</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Continuous Flow Rate (l/min)</td>
<td>15</td>
<td>25</td>
<td>35</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>Min Continuous Flow Rate (l/min)</td>
<td>22.5</td>
<td>37.5</td>
<td>52.5</td>
<td>90</td>
<td>150</td>
</tr>
<tr>
<td>Output Pulse (l/min)</td>
<td>0.2</td>
<td>0.5</td>
<td>1.5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
MAINS SERVICE CONNECTIONS

It was established during the knowledge elicitation exercise that there are a number of options available for connecting a new customer service pipe to an existing water main. It is understood that some types of conventional connectors can have quite restrictive internal passages which could result in significant water pressure drops. Whilst this might not have a significant impact for a conventional plumbing system it might impose an unacceptable pressure loss when implementing the prototype sprinkler system described here.

An example of a conventional strap and ferule type mains connection is shown below. Note the narrow internal bore and sharp right angle entry into mains pipe.

An alternative to this type of connection is illustrated below. The Erhard Valves unit is an ‘under pressure saddle service connection’ type connector. It maintains a large internal bore and is typically used on larger bore service pipes.

The issue of mains connection method and selection of materials and equipment will need to be addressed in detail in a future work programme.

24 Information provided by Erhard Valves Ltd
ANNEX F

Details provided for purpose of obtaining system installation costs

In requesting installation costs of the prototype system the following details were provided in addition to a full verbal description of the system design and method of operation.
Sprinklers are connected to main supply loops by a short vertical drop pipe – no reduction from 22mm should be used prior to connection direct to the sprinkler head (which is ½ inch male NPT). An example connection could be:
Drop pipes shown are from experimental test rig.

Actual drop pipes used in a house may be much shorter (possibly with the sprinkler head screwed directly into an appropriate T-piece fitting) to fit in the floor void.

### Domestic plumbing utilities installed

<table>
<thead>
<tr>
<th>Floor</th>
<th>Room</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground floor</td>
<td>Toilet near front door</td>
<td>Toilet cistern</td>
</tr>
<tr>
<td></td>
<td>&quot; &quot; &quot; &quot; &quot; &quot;</td>
<td>Cold water washbasin tap</td>
</tr>
<tr>
<td></td>
<td>Kitchen</td>
<td>Kitchen sink cold water tap</td>
</tr>
<tr>
<td></td>
<td>&quot; &quot;</td>
<td>Outside tap with integral backflow protection</td>
</tr>
<tr>
<td></td>
<td>&quot; &quot;</td>
<td>Valved flexible hose outlet for dishwasher</td>
</tr>
<tr>
<td></td>
<td>&quot; &quot;</td>
<td>Valved flexible hose outlet for washing machine</td>
</tr>
<tr>
<td></td>
<td>&quot; &quot;</td>
<td>Valved flexible hose outlet for hot water boiler</td>
</tr>
<tr>
<td>First floor</td>
<td>Bathroom</td>
<td>Cold water connection to shower head</td>
</tr>
<tr>
<td></td>
<td>&quot; &quot;</td>
<td>Cold water bath tap</td>
</tr>
<tr>
<td></td>
<td>&quot; &quot;</td>
<td>Cold water washbasin tap</td>
</tr>
<tr>
<td></td>
<td>&quot; &quot;</td>
<td>Toilet cistern</td>
</tr>
</tbody>
</table>

### Schematic of domestic plumbing arrangements

- **Kitchen domestic plumbing arrangement**
  - Outside tap
  - Sink tap
  - Dish washer connection
  - Washing machine connection
  - Hot water boiler connection

- **Bathroom domestic plumbing arrangement**
  - Shower head
  - Bath tap
  - Sink tap
  - Toilet cistern

- **Downstairs toilet plumbing arrangement**
  - Toilet cistern
  - Sink tap
  - Connection to combined sprinkler plumbing – either incoming supply or first floor loop

![Diagram of domestic plumbing arrangements](image-url)
COSTS REQUIRED

<table>
<thead>
<tr>
<th>Item</th>
<th>Labour Cost</th>
<th>Materials Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New build</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation of internal cold water plumbing for domestic items detailed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation of internal combined cold water system (domestic plumbing items and sprinkler pipework)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Net additional cost of combined plumbing system</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation of standard (25mm MDPE) house supply pipe to water mains (including cost of water meter, valves, boundary box, mains saddle connector etc if appropriate – please state what items are included in the costing)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation of 32mm MDPE house supply pipe to water mains (including cost of water meter, valves, boundary box, mains saddle connector etc if appropriate – please state what items are included in the costing)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Net additional cost of enlarged mains connection pipe</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Retro Fit – house already emptied &amp; ready for renovations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal of existing cold water plumbing system and replacement with combined cold water system (domestic plumbing items and sprinkler pipework) – excluding ‘making good’.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If possible, distinguish between cost of extracting old plumbing and installation of new plumbing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replacement of existing mains water connection pipework with a 32mm plastic pipe connection to water mains supply pipe (with all fittings and water meter compatible with 32mm plastic pipe). Include all costs for trench digging (plus subsequent back filling), removal of old pipe and installation of new pipe &amp; fittings.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Retro Fit – Fully furnished house</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated additional costs for removal and replacement of carpets/furniture/etc if installing in a fully furnished house</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
- Please detail any assumptions made in providing this costing.
- Where possible, cost for all components (joints, compression fittings, reducers etc).
- Assume ‘normal’ type of house construction (i.e. brick built, brick or stud walls internal, direction of floor boards is optional.)
- All bends to be machined – no 90° elbow.
- All parts to conform with WRAS requirements for drinking water.
- Domestic plumbing items to be connected to 15mm copper pipe – linked at one end to the main 22m loop supply.
- Do not include cost of actual domestic fittings (taps, sinks, shower, toilet cisterns etc) or sprinkler heads.
• Main internal house pipework is in 22mm copper.

• Pipework in loft should be insulated for frost protection.

• Valves on supply pipe and house inlet should be full bore type to avoid pressure losses.

• Mains connection is 32mm HDPE plastic – assume 10m from property to mains supply. Water meter should be at least 25mm/1” type (not the standard 15mm type).

• If additional costs would be incurred in the hot water plumbing as a result of installing the combined cold water system – please add details of these costs with notes to indicate why they have been incurred.

• If possible, detail any cost savings if implemented in multiple new build houses?

• Please state any assumptions that you make.
The following details regarding the various costs involved in obtaining a new water supply connection were downloaded from the Severn Trent company website.

**ANNEX G**

**Illustrative costs of water company connection charges**

The table below details the cost of new water service connections up to 32mm external diameter MDPE (Medium Density Polyethylene pipe) or equivalent. Large diameter connections are individually costed and the charging arrangements for these are available on request. With standard services additional charges are made for meter fitting, infrastructure charges and water supplied for construction. Further details are provided overleaf.

The standard connection charge includes the connection to the water main, laying up to 12m of service pipe, providing a controlling tap, a meter and connecting, usually at the property boundary, to the customers pipe. The actual charge depends on the surface we have to excavate. An additional charge, per metre of pipe applies for services over 12m in length.

<table>
<thead>
<tr>
<th>Surface type</th>
<th>Surface definition</th>
<th>Standard Charges including up to 12m of pipe (£)</th>
<th>Additional per metre charge for pipes over 12m long (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No excavation</td>
<td>Where no excavation or backfill needs to be done by Severn Trent (Specific conditions apply to this category)</td>
<td>278.20</td>
<td>3.60</td>
</tr>
<tr>
<td>Unmade</td>
<td>Grass verges, soil or virgin ground are included in this category</td>
<td>362.40</td>
<td>24.30</td>
</tr>
<tr>
<td>Painted</td>
<td>Where tarmac or stone are present and/or imported backfill is required</td>
<td>495.30</td>
<td>46.50</td>
</tr>
<tr>
<td>Complete</td>
<td>Where a highway surface is fully constructed and we have to either excavate it or bore under it and reinstate. - Work entirely in footpaths - Where work extends into/under a roadway</td>
<td>525.70</td>
<td>59.40</td>
</tr>
<tr>
<td>Self connected</td>
<td>Connection administration fee (This facility is only available to pre-registered installers working on development sites)</td>
<td>132.60</td>
<td>79.50</td>
</tr>
</tbody>
</table>

Notes:
- The charge due will be based on the surface found when the work is done.
- The charges are for work done between 1 April 2005 and 31 March 2006.
- Where ducts are provided and the ends marked, the charge for the surface at the ends of the ducts applies.
- We must agree in advance to the provision of ducts and to any excavation work. We will then provide details of the work you must do.
- For mixed surface types the higher rate applies.
- Where up to 3 services can be laid in the same trench the rate for the surface to be excavated applies to the first service and the others will be at the ‘no excavation’ rate.

**Meter fitting arrangements**

Supplies to new properties are metered inside the building. In accordance with Water Regulation 4 (3) Schedule 2 – 11 and BS6700, you are required to provide: (i) a stop tap either side of where the water meter is to be fitted, (ii) a drain valve downstream of the meter, (iii) where you fit the meter, an approved electrical cross bond between the incoming and outgoing pipework either side of the stop taps.

Where you elect to fit the meter yourself we provide the water meter, cable and the touch pad. The cost of these items, and our audit checks, are included in our connection charges. For replacement supplies, not requiring a meter, an allowance of £51.50 is given on each connection. Where we fit the meter ourselves an additional charge of £35.00 is payable.

Where we allow a single supply to multiple properties (typically flats/apartments) further charges apply to cover our costs in working with developers to ensure that each unit is metered in accordance with our specification and the additional work in commissioning meters installed by developers in such developments.
New supply connection charges – 2005/06

Abortive visits
If we cannot gain access on the arranged date to make a connection or to complete a meter installation we will charge for the cost we incur in aborting and re-scheduling the work. Our charge will be based on our actual costs.

Infrastructure charges
As well as water connection charges, infrastructure charges are normally due when a premises is connected for the first time to a water main or public sewer. The charges shown below are for a standard water connection (25mm diameter MDPE or equivalent). Charges for larger connections are calculated from the number of fittings to be installed. Our office will advise you of this calculation.

<table>
<thead>
<tr>
<th>Connection for</th>
<th>Standard Charge (£) per property connected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>260.15</td>
</tr>
<tr>
<td>Sewerage</td>
<td>260.15</td>
</tr>
<tr>
<td>Total water and sewerage</td>
<td>520.30</td>
</tr>
</tbody>
</table>

If a property is in the Severn Trent water supply area but will receive sewerage services from another company that company’s sewerage charge will apply.

Value added tax
Where the connection is made to a qualifying residential property during the course of its construction, the charge for the work will be zero rated for VAT purposes.

Water for construction
Charges are made for mains water used during construction. For household and other premises with a standard sized supply (25mm dia. MDPE or equivalent) the charge is per unit being constructed. For non-household premises with supplies larger than 25mm diameter MDPE a measured supply will be required.

<table>
<thead>
<tr>
<th>Premises supplied</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic property</td>
<td>£45.50/Unit</td>
</tr>
<tr>
<td>or non-domestic property with a 25mm diameter MDPE supply</td>
<td></td>
</tr>
<tr>
<td>Non domestic premises with a larger than 25mm diameter supply</td>
<td>Standard metered charges</td>
</tr>
</tbody>
</table>

Charges for building water are subject to VAT, unless raised by DIY housebuilders in which case they are zero rated.

Disputes
We have a procedure for handling disputes so please let us know of any issues you have with our service. If we cannot resolve any dispute about the reasonableness of a new supply connection charge, or any undertaking or security required in association with a water connection, you can ask the Director General of OFWAT to investigate. His decision will be final and binding on both parties.

The Director General of OFWAT can be contacted at the Offices of Water Services, Centre City Tower, 7 Hill Street, Birmingham, B5 4UA. Telephone 0121 628 1300

Issued by:
Severn Trent Water Ltd, New Connections, Anstey Lane, Leicester LE7 7GU
Tel: 0870 2410269 Fax: 0870 6081848 email: new.connections@severntrent.co.uk
website: www.stwater.co.uk/newconnections

299
Development of a lower-cost sprinkler system for domestic premises in the UK

The following details regarding the various costs involved in obtaining a new water supply connection were downloaded from the Thames Water company website.

---

Please note, any customer-led variations in cost associated with the connection will be payable.

**Our prices do not include**

**Infrastructure charges**
- Infrastructure charges (domestic usage), or network charges (non-domestic usage) must be paid in addition to the cost of new service connections. These charges are regulated by the Director General of Water Services. For more information please refer to our Infrastructure Charges and Network Charges leaflet.

**Mainlaying**
- Where developments require mainlaying in order to provide an adequate supply, the developer will have to contribute towards the cost. This will be quoted for separately where required.

---

**Getting in touch**

Enquiries about new water supplies

0845 8502 777
Monday - Friday 8.00am - 5.00pm

You can contact Thames Water 24 hours a day, 365 days a year.
We record all our calls to ensure that we always give you a quality service.

0845 9200 800

- For emergencies
- Other non-billing enquiries
- Literature
- Minicom service if you are deaf or hard of hearing

0845 7200 898

If you prefer you can write to us at:
Thames Water, Developer Services, PO Box 84,
Brentford, Middlesex, TW8 8EE

Visit the Thames Water website on
www.thameswateruk.co.uk

Have you any comments about this leaflet?
We will be happy to hear from you regarding this or any other matter where our service to you could be improved.

This leaflet can be supplied in large print, braille or audio-tape upon request.
Our prices

This leaflet lists our standard charges for installing new water service connections for pipes up to 32mm in diameter. These prices apply to quotes issued on or after 1st April 2005. All quotations are valid for three months and are payable in advance.

Please note, any customer-led variations to the costs associated with the connection will be payable by the applicant.

Connection charge

The connection charges shown are for 25mm and 32mm Medium Density Polyethylene (MDPE) supplies. This charge includes the work we will carry out to excavate, lay and reinstate (if required) the first metre of pipework from our water main in the street up to the site boundary of your property. It also includes the installation of a stop valve, boundary box and water meter.

You will need to excavate the pipework on your property so it is visible in order for the connection to be made. You may need to employ a private plumber to do this work. Alternatively please call Developer Services’ Helpdesk on 0845 850 2777, to obtain a list of Thames Water approved contractors.

Please note if your pipework is not visible when we come to carry out the connection, any additional work carried out by Thames Water will be charged back to you. There will be a charge for metering an existing supply, should you require a temporary water supply for construction purposes. Please ask for a copy of our Building Water Charges leaflet for further details.

Pipelaying charge per metre

This charge covers the materials, excavation, backfill and reinstatement required per linear metre of pipe laid. Lengths of less than a whole metre will be rounded to the nearest metre.

Manifolds (25 mm supply only)

Manifold connections can be installed to reduce the need for multiple connections. They are only suitable where there is enough space for the larger chamber and where all customer-side service pipes are laid out to the same point.

Barrier pipework

Where land is deemed as contaminated, it will be necessary to provide the service connection in barrier pipe. In this instance the following additional charges will apply:

Pipelaying charge per connection
- 25mm barrier pipe connection: add £7
- 32mm barrier pipe connection: add £15
- 63mm barrier pipe connection (6 port manifolds): add £18

Pipelaying charge per linear metre
- 25mm barrier pipe: add £5
- 32mm barrier pipe: add £6
- 63mm barrier pipe (6 port manifolds): add £12
ANNEX H

Illustrative cost benefit analysis

The following three cost benefit analysis (CBA) calculations were produced by BRE based on information detailed in the draft FPA report. (Note: the figures relating to numbers of fires, injuries and deaths in this section are the average of the years 2002 and 2003.)

CBA CALCULATION 1: MOST EXPENSIVE RETROFIT OPTION

<table>
<thead>
<tr>
<th></th>
<th>average</th>
<th>uncertainty</th>
<th>net effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Cost of System (per unit)</td>
<td>£1,085</td>
<td>£100</td>
<td>0.03</td>
</tr>
<tr>
<td>Water connection charge (per unit)</td>
<td>£995</td>
<td>£175</td>
<td>0.04</td>
</tr>
<tr>
<td>Capital Recovery Factor</td>
<td>0.043</td>
<td>0.025</td>
<td>0.31</td>
</tr>
<tr>
<td>Annual Cost of Loan</td>
<td>£88.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Inspection Cost</td>
<td>£0</td>
<td>£0</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Total Annual Cost</strong></td>
<td><strong>£88.68</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Deaths</strong> per Million Units</td>
<td>17.8</td>
<td>1.2</td>
<td>0.01</td>
</tr>
<tr>
<td>Sprinkler Effectiveness Factor</td>
<td>0.83</td>
<td>0.15</td>
<td>0.04</td>
</tr>
<tr>
<td>Deaths saved per Million Units</td>
<td>14.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monetary Value per Death Saved</td>
<td>£1,243,000</td>
<td>£62,150</td>
<td>0.01</td>
</tr>
<tr>
<td>Monetary Benefit per Single Unit</td>
<td>£18.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Injuries</strong> per Million Units</td>
<td>482</td>
<td>6.2</td>
<td>0.00</td>
</tr>
<tr>
<td>Sprinkler Effectiveness Factor</td>
<td>0.65</td>
<td>0.15</td>
<td>0.05</td>
</tr>
<tr>
<td>Injuries saved per Million Units</td>
<td>313.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monetary Value per Injury Saved</td>
<td>£58,300</td>
<td>£2,915</td>
<td>0.01</td>
</tr>
<tr>
<td>Monetary Benefit per Single Unit</td>
<td>£18.27</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fires</strong> per Million Units</td>
<td>2609</td>
<td>25.1</td>
<td>0.00</td>
</tr>
<tr>
<td>Sprinkler Effectiveness Factor</td>
<td>0.50</td>
<td>0.15</td>
<td>0.03</td>
</tr>
<tr>
<td>Unsprinklered property damage</td>
<td>£7,540</td>
<td>£377</td>
<td>0.01</td>
</tr>
<tr>
<td>Reduced property damage per fire</td>
<td>£3,770</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monetary Benefit per Single Unit</td>
<td>£9.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Monetary Benefit per unit</strong></td>
<td><strong>£46.47</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Benefit : Cost ratio** 0.52 +/- 0.32
**Confidence Level (ratio > 1)** 0%
### CBA CALCULATION 2: LEAST EXPENSIVE RETROFIT OPTION

<table>
<thead>
<tr>
<th>Description</th>
<th>average</th>
<th>uncertainty</th>
<th>net effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Cost of System (per unit)</td>
<td>£390</td>
<td>£40</td>
<td>0.04</td>
</tr>
<tr>
<td>Water connection charge (per unit)</td>
<td>£660</td>
<td>£175</td>
<td>0.17</td>
</tr>
<tr>
<td>Capital Recovery Factor</td>
<td>0.043</td>
<td>0.025</td>
<td>0.61</td>
</tr>
<tr>
<td>Annual Cost of Loan</td>
<td>£44.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Inspection Cost</td>
<td>£0</td>
<td>£0</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Total Annual Cost</strong></td>
<td><strong>£44.77</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Deaths per Million Units
- Sprinkler Effectiveness Factor: 0.83
- Deaths saved per Million Units: 14.8
- Monetary Value per Death Saved: £1,243,000
- Monetary Benefit per Single Unit: £18.36
- Deaths per Million Units: 17.8
- Sprinkler Effectiveness Factor: 0.83
- Deaths saved per Million Units: 14.8
- Monetary Value per Death Saved: £1,243,000
- Monetary Benefit per Single Unit: £18.36

#### Injuries per Million Units
- Sprinkler Effectiveness Factor: 0.65
- Injuries saved per Million Units: 313.3
- Monetary Value per Injury Saved: £58,300
- Monetary Benefit per Single Unit: £18.27
- Injuries per Million Units: 482
- Sprinkler Effectiveness Factor: 0.65
- Injuries saved per Million Units: 313.3
- Monetary Value per Injury Saved: £58,300
- Monetary Benefit per Single Unit: £18.27

#### Fires per Million Units
- Sprinkler Effectiveness Factor: 0.50
- Unsprinklered property damage: £7,540
- Reduced property damage per fire: £3,770
- Monetary Benefit per Single Unit: £9.84
- Fires per Million Units: 2,609
- Sprinkler Effectiveness Factor: 0.50
- Unsprinklered property damage: £7,540
- Reduced property damage per fire: £3,770
- Monetary Benefit per Single Unit: £9.84

**Total Monetary Benefit per unit**: £46.47

**Benefit : Cost ratio**: 1.04 +/- 0.65

**Confidence Level (ratio > 1)**: 55%
### CBA Calculation 3: New Build House Option

<table>
<thead>
<tr>
<th>Description</th>
<th>Average</th>
<th>Uncertainty</th>
<th>Net Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Cost of System (per unit)</td>
<td>£390</td>
<td>£40</td>
<td>0.19</td>
</tr>
<tr>
<td>Water connection charge (per unit)</td>
<td>£90</td>
<td>£45</td>
<td>0.21</td>
</tr>
<tr>
<td>Capital Recovery Factor</td>
<td>0.043</td>
<td>0.025</td>
<td>1.33</td>
</tr>
<tr>
<td>Annual Cost of Loan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Inspection Cost</td>
<td>£0</td>
<td>£0</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Total Annual Cost</strong></td>
<td><strong>£20.46</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Deaths per Million Units
- Average: 17.8
- Uncertainty: 1.2
- Net Effect: 0.06

#### Injuries per Million Units
- Average: 482
- Uncertainty: 6.2
- Net Effect: 0.01

#### Fires per Million Units
- Average: 2609
- Uncertainty: 25.1
- Net Effect: 0.00

#### Deaths saved per Million Units
- Average: 14.8

#### Monetary Value per Death Saved
- Average: £1,243,000
- Uncertainty: £62,150
- Net Effect: 0.04

#### Monetary Benefit per Single Unit
- Average: £18.36

#### Injuries saved per Million Units
- Average: 313.3

#### Monetary Value per Injury Saved
- Average: £58,300
- Uncertainty: £2,915
- Net Effect: 0.04

#### Monetary Benefit per Single Unit
- Average: £18.27

#### Total Monetary Benefit per Unit
- Average: £46.47

#### Benefit: Cost ratio
- Average: 2.27
- Uncertainty: +/- 1.40
- Confidence Level (ratio > 1): 97%
The table below details revised CBA cost ratios, for each of the installation options detailed above, using updated values for the sprinkler effectiveness factors. These values have been obtained by partially re-creating the BRE cost benefit model and so do not include details of uncertainty and confidence levels.

<table>
<thead>
<tr>
<th></th>
<th>Most expensive retro-fit</th>
<th>Least expensive retro-fit</th>
<th>New build</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millions of units considered</td>
<td>24.63</td>
<td>24.63</td>
<td>24.63</td>
</tr>
<tr>
<td>Total number of deaths</td>
<td>439</td>
<td>439</td>
<td>439</td>
</tr>
<tr>
<td>Total number of injuries</td>
<td>11900</td>
<td>11900</td>
<td>11900</td>
</tr>
<tr>
<td>Capital cost of system (per unit)</td>
<td>£1,085</td>
<td>£390</td>
<td>390</td>
</tr>
<tr>
<td>Water connection charge (per unit)</td>
<td>£995</td>
<td>£660</td>
<td>90</td>
</tr>
<tr>
<td>Capital recovery factor</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Annual cost of loan</td>
<td>£88.68</td>
<td>£44.77</td>
<td>£20.46</td>
</tr>
<tr>
<td>Annual inspection cost</td>
<td>£0.00</td>
<td>£0.00</td>
<td>£0.00</td>
</tr>
<tr>
<td>Total annual costs</td>
<td>£88.68</td>
<td>£44.77</td>
<td>£20.46</td>
</tr>
</tbody>
</table>

**Deaths** per million units
- 17.8
- 17.8
- 17.8

Sprinkler effectiveness factor
- 0.76
- 0.76
- 0.76

Deaths saved per million units
- 13.5
- 13.5
- 13.5

Monetary value per life saved
- £1,243,000
- £1,243,000
- £1,243,000

Monetary benefit per single unit
- £16.84
- £16.84
- £16.84

**Injuries** per million units
- 483
- 483
- 483

Sprinkler effectiveness
- 0.57
- 0.57
- 0.57

Injuries saved per million
- 275.4
- 275.4
- 275.4

Monetary value per injury saved
- £58,300
- £58,300
- £58,300

Monetary benefit per single unit
- £16.06
- £16.06
- £16.06

**Fires** per million units
- 2615
- 2615
- 2615

Sprinkler effectiveness factor
- 0.5
- 0.5
- 0.5

Unsprinklered property damage
- £7,540
- £7,540
- £7,540

Reduced property damage per fire
- £3,770
- £3,770
- £3,770

Monetary benefit per single unit
- £9.86
- £9.86
- £9.86

Total benefit per unit
- £42.75
- £42.75
- £42.75

**Cost benefit ratio**
- 0.48
- 0.95
- 2.09
The table below illustrates the improvement in cost benefit ratios that might be realised by targeting higher risk dwellings. In this example it is assumed that dwellings currently without smoke alarms (approximately 25% of all dwellings) are fitted with smoke alarms and detectors that do not currently have smoke detectors.

<table>
<thead>
<tr>
<th></th>
<th>Most expensive retro-fit option</th>
<th>Least expensive retro-fit option</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All properties</td>
<td>Properties currently with no detector</td>
</tr>
<tr>
<td>Millions of units considered</td>
<td>24.63</td>
<td>6.2</td>
</tr>
<tr>
<td>Total number of deaths</td>
<td>439</td>
<td>261</td>
</tr>
<tr>
<td>Total number of injuries</td>
<td>11900</td>
<td>6100</td>
</tr>
<tr>
<td>Total number of fires</td>
<td>64400</td>
<td>35800</td>
</tr>
<tr>
<td>Capital cost of system (per unit)</td>
<td>£1,085</td>
<td>£1,085</td>
</tr>
<tr>
<td>Water connection charge (per unit)</td>
<td>£995</td>
<td>£995</td>
</tr>
<tr>
<td>Capital recovery factor</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Annual cost of loan</td>
<td>£88.68</td>
<td>£88.68</td>
</tr>
<tr>
<td>Annual inspection cost</td>
<td>£0.00</td>
<td>£0.00</td>
</tr>
<tr>
<td>Total annual costs</td>
<td>£88.68</td>
<td>£88.68</td>
</tr>
</tbody>
</table>

**Deaths per million units**
- 17.8
- 40.7
- 17.8
- 40.7

**Sprinkler effectiveness factor**
- 0.76
- 0.83
- 0.76
- 0.83

**Deaths saved per million units**
- 13.5
- 33.8
- 13.5
- 33.8

**Monetary value per life saved**
- £1,243,000
- £1,243,000
- £1,243,000
- £1,243,000

**Monetary benefit per single unit**
- £16.84
- £41.97
- £16.84
- £41.97

**Injuries per million units**
- 483
- 1056
- 483
- 1056

**Sprinkler effectiveness**
- 0.57
- 0.65
- 0.57
- 0.65

**Injuries saved per million**
- 275.4
- 686.2
- 275.4
- 686.2

**Monetary value per injury saved**
- £58,300
- £58,300
- £58,300
- £58,300

**Monetary benefit per single unit**
- £16.06
- £40.00
- £16.06
- £40.00

**Fires per million units**
- 2615
- 5814
- 2615
- 5814

**Sprinkler effectiveness factor**
- 0.5
- 0.5
- 0.5
- 0.5

**Unsprinkled property damage**
- £7,540
- £7,540
- £7,540
- £7,540

**Reduced property damage per fire**
- £3,770
- £3,770
- £3,770
- £3,770

**Monetary benefit per single unit**
- £9.86
- £21.92
- £9.86
- £21.92

**Total benefit per unit**
- £42.75
- £103.89
- £42.75
- £103.89

**Cost benefit ratio**
- 0.48
- 1.17
- 0.95
- 2.32