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EQUIPMENT AND ADDRESSES

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Bibliography 291
The following definitions are those used within these documents but may not be dictionary definitions.

For definitions of the following words refer to the section *Background to groundwater and aquifers* pp230-5:

aquiclude; aquifer; aquitard; artesian borehole; basement complex confined aquifer; consolidated sediments; desalination; dyke; evaporation; fault; fissure; fracture; fractures; ground water; hydraulic conductivity; igneous; infiltration; joint; laterite; loam; loess; metamorphic; mineral; perched aquifer; percolation; permeability; pores; porosity; precipitation; rock; saturated zone; sedimentary; sill; soil; specific yield; sub-soil; sub-surface water; surface water; transmissivity; transpiration; unconfined aquifer; unconsolidated sediments; unsaturated zone; voids; water table; weathering.

**Accessibility**
How easy something is to access or approach.

**Affected population**
Refugees, internally displaced persons and populations not displaced but still affected by an emergency. Where a displacement has occurred a differentiation has been made between the displaced and non-displaced or 'local population'.

**Aggressivity**
The carbon dioxide level in the water. Aggressive waters tend to be corrosive and hence can damage supply systems.

**Agrochemical pollution**
Pollution resulting from agriculture including chemicals used therein.

**Assessment**
Evaluation. Process of identifying and understanding a situation.

**Assisted sedimentation**
Sedimentation speeded up with the addition of chemicals such as alum, ferric chloride or other. Includes the processes of flocculation, coagulation and sedimentation.

**Biological survey**
A study of the water based biological life in an area e.g. small water animals, plants, algae, invertebrates etc.

**Birka**
An uncovered rainwater catchment pond / tank found in Southern Sudan and Ethiopia. Often lined with vertical concrete walls.

**BOD₅ or BOD**
The five day biochemical oxygen demand is defined as the amount of oxygen required by bacteria while stabilising decomposable organic matter under aerobic conditions (Sawyer and McCarty, 1978).
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borehole</td>
<td>A hole drilled to give access to an underground water source. Other names include tubewell or drilled well.</td>
</tr>
<tr>
<td>Catchment map</td>
<td>A diagrammatic representation of a catchment area i.e. an area of land where the natural slope of the ground leads water to be drained into a river basin or reservoir. Map should include potential sources of pollution.</td>
</tr>
<tr>
<td>Disaster</td>
<td>‘A ‘disaster’ results in serious disruption of society, causing widespread human suffering and physical loss or damage, and stretches the community’s normal coping mechanisms to breaking point’ (Davis and Lambert, 1995).</td>
</tr>
<tr>
<td>E.coli</td>
<td><em>Escherichia coli</em>, thermotolerant coliform organisms used as indicator organisms to identify the likelihood of faecal pollution.</td>
</tr>
<tr>
<td>EBCT</td>
<td>Empty Bed Contact Time. Calculation of time for a volume of water to pass through a filter with media, calculated ignoring the volume of the media i.e. as though the filter bed was empty.</td>
</tr>
<tr>
<td>Emergency</td>
<td>‘A crisis that arises when a community has great difficulty in coping with a disaster. External assistance is needed, sometimes lasting for many months, perhaps years’ (Davis and Lambert, 1995).</td>
</tr>
<tr>
<td>Evaluation</td>
<td>‘An assessment at one point of time of the impact of a piece of work and the extent to which the objectives have been achieved’ (Gosling and Edwards, 1995 p98).</td>
</tr>
<tr>
<td>Geomorphological analysis</td>
<td>The analysis, description and interpretation of landforms.</td>
</tr>
<tr>
<td>Global Positioning System (GPS)</td>
<td>Devise used for locating positions in the world using information from American military satellites.</td>
</tr>
<tr>
<td>Hafir dam</td>
<td>A constructed rainwater catchment pond with a settlement basin at the inlet and a separate outlet for abstraction. Found in Southern Sudan and Ethiopia.</td>
</tr>
<tr>
<td>Hydroclimatic monitoring</td>
<td>Monitoring of climatic changes and the effects on the hydrology of the area.</td>
</tr>
<tr>
<td>Hydrogeology</td>
<td>The study of geology and water in the ground.</td>
</tr>
<tr>
<td>Industrial pollution</td>
<td>Pollution from industrial or agricultural sources.</td>
</tr>
<tr>
<td>Internally displaced person</td>
<td>A person displaced within the boundary of their own country.</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Invertebrates</td>
<td>Any animal lacking a backbone.</td>
</tr>
<tr>
<td>Landsat images</td>
<td>Satellite images showing thermal signatures of the ground.</td>
</tr>
<tr>
<td>Local population</td>
<td>Population living near to the displaced population who were there prior to the emergency or disaster.</td>
</tr>
<tr>
<td>Logistics</td>
<td>Planning and organisation of the provision of resources.</td>
</tr>
<tr>
<td>Morbidity data</td>
<td>Data relating to diseases.</td>
</tr>
<tr>
<td>Mortality data</td>
<td>Data relating to death.</td>
</tr>
<tr>
<td>National and local government</td>
<td>Central, regional and local government and, although not strictly true, authorities concerned with the supply and management of utilities.</td>
</tr>
<tr>
<td>Natural threats</td>
<td>Natural phenomenon which causes danger to people, facilities and the environment. May include earthquakes, volcanic eruptions, hurricanes and others.</td>
</tr>
<tr>
<td>Operation and maintenance</td>
<td>The activities undertaken to ensure the continued running of a process such as chemical dosing and structural repair.</td>
</tr>
<tr>
<td>Organisation</td>
<td>Used in this document to cover NGOs and international agencies.</td>
</tr>
<tr>
<td>Refugee</td>
<td>Person who has crossed an international border in genuine fear of persecution (refer to the Geneva Conventions for complete definitions).</td>
</tr>
<tr>
<td>Sanitary investigation</td>
<td>Survey of the sanitary or hygienic conditions of a water source.</td>
</tr>
<tr>
<td>Schmutzdecke</td>
<td>A layer of sediment and microbiological growth which forms on the top of a slow sand filter and breaks down pathogens by biological and chemical processes.</td>
</tr>
<tr>
<td>Seasonal yield</td>
<td>Volume of water obtainable from a water source during a particular season of the year.</td>
</tr>
<tr>
<td>Sedimentation</td>
<td>The settlement of solid matter to the bottom of a liquid.</td>
</tr>
<tr>
<td>Small water animals</td>
<td>Small invertebrates living in surface water, visible with the naked eye.</td>
</tr>
<tr>
<td>Socio-political consideration</td>
<td>A consideration related to the social or political environment.</td>
</tr>
</tbody>
</table>
Spring  
Natural outflow of groundwater which often forms the starting point of a stream.

Survey  
To look at and take a general view of.

Tankering / trucking  
The transportation of water by vehicular means.

Treatability  
How easy a water is to treat/clean/improve to a required level.

Turbidity  
The murkiness of water caused by suspended materials.

Upgrading approach  
Where systems are designed at a specified level of service and then subsequently improved to higher levels of service.

Water quality analysis  
Evaluation of water quality using laboratory or field water testing equipment.

Water quality assessment  
Evaluation of water quality using one or more of a range of methods (including water quality analysis, catchment mapping and others).

Water quality parameter  
A characteristic of water quality, either chemical, physical or biological.

Water source  
A water body from which water may be abstracted or obtained. Can be groundwater, surface water or rainwater. It could also be a point on an existing supply system.

Water supply  
Where water is provided. It may be from a groundwater source via a borehole, shallow well or spring or from a surface water source via direct abstraction or pumped, or from rainwater collected in tanks, in ponds in the ground or sub-surface dams. Supply may be simple where the user abstracts straight from a source or it may be a complex arrangement of pumps, pipes and taps.

Well  
A hole or shaft bored or dug into the earth to allow abstraction of supply of water, oil, gas etc.
Water quality analysis and surveying equipment

The types of equipment required to assess water sources in an emergency situation can be split into the following groups:

- general (including surveying, flow measurement and other); and
- water quality analysis.

Brand names and suppliers have been noted in the following listings for convenience but this does not imply endorsement by WEDC or DFID. Other brands may be just as suitable.

**General equipment** (surveying, yield measurement etc.)

General items include equipment for surveying, yield measurement, sample collection, storage, and treatability testing.

The most important items of equipment for each activity are as follows:

- **surveying** (compass; clinometer / Abney level; 3m tape; line level; altimeter / aneroid barometer; global positioning system)
- **yield measurement** (stop watch; 3m tape)
- **sample collection and storage** (sample bottles; syringes for dilutions or measurement of small volumes; sampling container and string)
- **treatability testing** (beakers (1-litre if possible); spatula / spoon; chemicals)
- **other** (sampling net for biological survey; workplace mat; tissues; marker pen; Swiss Army Knife or equivalent; torch / flashlight; survey or record book)

See the tables, pp281–2 for a detailed list of equipment.

**Makes and suppliers of general equipment**

**Clinometer or Abney level**

**Makes and Suppliers**

Clinometers and altimeters can both be purchased from surveying equipment suppliers. Their prices range from £85 (including sales tax) to several hundred pounds.

- **Makes (1996; Abney level):** Abney level (5.25 inch; 6.5 inch)
- **Makes (1996; Clinometer):** Suunto Clinometer (aluminium body with or without light illumination); Suunto Compass / Clinometers; Silva Compass / Clinometers
- **Example supplier:** GeoSupplies Ltd.

**Altimeter or aneroid barometer**

**Makes and Suppliers**

Altimeters are supplied by outdoor specialists and possibly surveying equipment suppliers. Their prices can range from around £100 to several hundred pounds.
Makers (1996): Thommen Altitronic Traveller (range -500 to +6000m +/- 10m); Thommen Altitrek Altimeter (range 0 to + 5000m +/- 30m); Avocet Vertech; Silva;
Example suppliers: Field & Trek Ltd.; Cotswolds

Global positioning system (GPS)

Makes and Suppliers
There are many suppliers and makes of GPS receivers and prices range from approximately £130 (including sales tax) to thousands of pounds. Following are a few of the makes at the lower price range and their suppliers:

Makers (1996): Garmin (GPS 38, GPS 40, GPS 45XL); Magellan (GPS 2000, GPS 300, GPS 4000, Meridian XL, Trailblazer XL); Trimble (Scout Master (tm) GPS); Silva (GPS XL1000)
Example suppliers: Business on the Move Ltd.; Field & Trek Ltd.; Cotswolds; Silva (UK)Ltd.

See Catchment mapping: surveying, pp161-8 which discusses each item of equipment and its applicability to the assessment of water sources. Also see Useful addresses, pp286–8 for suppliers’ details.

Water quality analysis equipment

A range of equipment types are available for the measurement of each water quality parameter.

Physical and chemical testing equipment

The following list is a selection of equipment types.

**Comparator with discs**
Colorimetric method. Tablets are dissolved in the sample in a small tube. The sample in the tube is viewed in the comparator versus a graded colour on an interchangeable disc. The colour intensity / shade indicates the concentration of the parameter being tested.

**Checkits / pool-testers or pocket kits**
Colorimetric method. Tablets are dissolved in the sample and the resulting colour compared to a scale which is either on the sample container (checkit or pool-tester) or on a separate card (pocket kits).

**Papers**
Colorimetric method. Test paper strips have reactive test zones which produce colours relative to the concentration of the parameter under test. The strip is dipped into the sample and after the colour change has occurred it is compared to a scale.

**Photometer**
Colorimetric method. The photometer is an electronic instrument which has built in filters and a digital display. Tablets are dissolved in the sample and then the concentration of colour is measured electronically. Calibration has to be undertaken against a blank of the sample.
**Electronic stick meters**
Small electronic stick meters which read digitally when the enclosed electrode is submerged. They require calibrating against a standard solution periodically.

**Tablet count**
Titrimetric method. Tablets are dissolved one by one into a sample of known volume until a prescribed colour change takes place. The concentration of the parameter is determined from the number of tablets and the size of the sample.

**Shelf-life and storage conditions for consumables:**

- The **foil-wrapped tablets** (for photometer, comparator with discs and checkits) should be stored in a cool, dry place out of direct sunlight to maintain their maximum shelf-life of five years. If stored in other conditions the shelf-life reduces to two years maximum. They should always be stored out of direct sunlight.
- The **bottled tablets** (tablet count method) have a shelf-life of nine months when the seal is broken if stored in cool, dry conditions. If the seal has not been broken then they last much longer. If the seal is broken and they are stored in hot, humid conditions then the shelf-life will be six months at a maximum. They should be stored out of direct sunlight.
- The **paper strips** (as in the Merckoquant strips) will last for five years if unopened and stored in a cool, dry place (room temperature is acceptable). If opened or stored in hot and humid conditions then the manufacturer would not state time scales. They should be stored out of direct sunlight.

**Microbiological testing equipment:**

Several methods for the quantitative determination of indicator bacteria in a water sample are noted below with their major advantages and disadvantages.

**Multiple tube (or Most probable number (MPN))**
This method involves the addition of measured volumes of the sample to sets of sterile tubes or bottles each holding a suitable liquid medium (containing lactose). Thermotolerant coliform organisms (*E. coli*) produce acid and gas when incubated at 44°C for 48 hours. They then need to be incubated for a longer period for confirmative tests. This method is often used in laboratories in developing countries but is not suitable for field analysis.

**Advantages:**
- can be used for turbid water
- good for the detection of a small number of organisms

**Disadvantages:**
- result take a long time
- large volume of consumables
- training is required to carry out the test

**Membrane filtration**
This method involves filtering a measured volume of the sample through a membrane filter with a pore size of 45µm. Micro-organisms are retained on the surface of the filter. The filter is then placed on an absorbent pad which has been soaking in a suitable selective growth medium (containing lactose) in a petri dish and then incubated at 44°C for 24 hours. Bacteria grow into colonies on the filter paper and can be counted visually.
Advantages:
• results are quicker than from multiple tube method
• uses less consumables than the multiple tube method

Disadvantages:
• it is unsuitable for use with turbid waters or waters containing small numbers of desired organisms, as they and the undesirable bacteria grow on the same medium
• training is required to carry out the test
• there are many opportunities for contamination

Colilert / MUG
A known volume of the sample is added to pre-prepared test tubes which have then been sealed. In each tube is a mixture containing salts, nitrogen and carbon sources and a specific indicator for \textit{E.coli} and total coliform (MUG and ONPG). Non-coliform bacteria are chemically suppressed. The tubes are incubated at 37°C. In less than 24 hours positive tubes containing total coliform turn yellow and positive tubes containing \textit{E.coli} fluoresce in the dark. The test is confirmatory.

Advantages:
• the short time required to produce confirmed results (less than 24 hours)
• it is a simple test to undertake and does not require lengthy training
• sterilization is not necessary
• additional pieces of equipment are not needed except for an incubator, a fluorescent light (and sterile, bacteria free water and syringes if required)
• the tubes can be stored at room temperature
• the tubes can be incubated against the body in an emergency

Disadvantages:
• a large number of consumables are required
• a five tube test will only indicate up to >16 per 100ml. To determine higher levels dilution is required with bacteria-free water

Dipslides
A pre-prepared sampler, consisting of a plastic handle with a 0.45µm filter and an absorbent pad containing dehydrated nutrient medium, is immersed in the sample. 1 ml of the sample is drawn through the filter and the resulting sampler is incubated at 44°C for 24 hours. Each colony represents 1 organism per 1ml (100 per 100ml).

Advantages:
• simple to use and no training needed
• sterilization is not required
• additional equipment is not required except an incubator

Disadvantages:
• the method is not recommended for counts of less than 10 colonies per 1ml (manufacturer’s literature)
• the dipslides need to be stored at 0-2°C

Other methods:
Studies have been undertaken into alternative, non-traditional, procedures for estimating water quality. Four simple tests were studied (IDRC / CRDI / CIID, 1990) to try and overcome the problems of the present bacteriological tests. Problems with current tests are that:
• the tests are not easily portable;  
• they use expensive supplies;
• they require trained personnel; and  
• a long time is required to obtain the results.
Water quality analysis:  
General equipment

Survey equipment
Left to right: line level, global positioning system receiver, compass / clinometer, altimeter and stopwatch

Other equipment
Left to right: 1 litre beaker, autoclavable sample containers, marker pen, spatula / spoon, tissues, 10 ml and 1 ml syringes

De-ionisation pack
Water quality analysis:
Physical / chemical test equipment

Comparator with disks

Checklists / pool testers and pocket kits

Paper strips

Photometer
Water quality analysis:
Physical / chemical test equipment

Electric stick meters

Turbidity tube

Test kits

Tablet count
Water quality analysis:
General equipment

Sampling net

Membrane filtration apparatus (minus incubator)

Left to right: filter pads and dispenser, membrane lauryl sulphate broth and MFC broth, filter papers, sampling cup and line, spares for filtration unit, filter suction pump, grease, filter unit and petri dishes

Water quality analysis:
Microbiological test equipment

Colilert test, H₂S strip and dipslides

Left to right: Colilert test tubes, fluorescent light, H₂S strip tube and dipslides
The four tests studied were:
- Bacteriophages
- A-1 broth
- H₂S paper strip
- Presence / absence tests

The tests are not all quantitative. Further research needs to be undertaken but the tests look promising and may overcome some of the problems mentioned above. Some of the above tests are available commercially: the H₂S paper strip test is supplied as part of the All India Institute of Hygiene & Public Health and UNICEF Water Quality Field Test supplied in India. It is also supplied by the Fundación Zumaque in Venezuela and Premier Health Care Products in India.

### Makes and suppliers of water quality testing equipment

See table p270 for a selection of ‘ready-made’ test kits as provided by suppliers which include a microbiological component. Also see the tables pp271–276 which identify alternative items of field equipment for a range of chemical, physical and microbiological parameters and *Useful addresses*, pp286–288 for suppliers’ addresses.

### Notes accompanying tables pp271–276:

(i) Prices quoted are as of June 1997 and do not include sales tax or postage and packaging.
(ii) PT= Palintest; WT= Wagtech; CAM = Camlab; ELE= ELE; DEL= Delagua; MER= Merck; TINT= Tintometer
(iii) Items marked with a ❖ have chemicals which are restricted for transport by IATA regulations.
    Note that other items in tables pp271–276 may also be restricted in the same way. Confirmation should be sought prior to purchase.
(iv) Tables pp272–276 do not include capital costs or details for the photometer or the Lovibond or Palintest disc comparators. The basic costs for these items can be found in table p271 and should be added where necessary.
## 'Ready-made' test kits (including microbiological components)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Delagua/ Oxfam</th>
<th>ELE '50'</th>
<th>ELE '25'</th>
<th>ELE '25l'</th>
<th>Wagtech 'potalab'</th>
<th>Wagtech 'potakit'</th>
<th>CAMLAB HACH, MEL presence/ absence safe drinking water lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.coli (includes lighter, tweezers, silicone grease, etc.)</td>
<td>membrane filtration - 16 test 44°C aluminum dishes (lauryl sulphate broth (lso)) (incubator in kit box)</td>
<td>membrane filtration - 50 test 37 or 44°C aluminium dishes (50) or plastic dishes (16) (lso) (incubator in kit box)</td>
<td>membrane filtration - 25 test 37 or 44°C aluminium dishes (25) or plastic dishes (8) (lso) (incubator in kit box)</td>
<td>membrane filtration - 25 test 37 or 44°C aluminium dishes (25) or plastic dishes (8) (lso) (incubator in kit box)</td>
<td>membrane filtration - 50 / 16 test 37 or 44°C aluminium dishes (50) or plastic dishes (16) (lso) (incubator in kit box)</td>
<td>membrane filtration - adjustable 25 to 50°C plastic dishes (lso) (incubator not in kit box)</td>
<td>MUG reagents in disposable test tubes and fluorescent lamp (incubator included which fits in kit box)</td>
</tr>
<tr>
<td>sampling cup</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>-</td>
</tr>
<tr>
<td>turbidity</td>
<td>tube 5-2000 TU</td>
<td>meter 0-50 NTU</td>
<td>meter 0-50 NTU</td>
<td>tube 5-500 JTU</td>
<td>tube 5-500 JTU</td>
<td>tube 5-500 JTU</td>
<td>-</td>
</tr>
<tr>
<td>pH</td>
<td>comparator (phenol red 6.8-8.2)</td>
<td>meter 0-14</td>
<td>meter 0-14</td>
<td>photometer (phenol red 6.8-8.4)</td>
<td>meter 0-14</td>
<td>comparator 4-11 (universal)</td>
<td>pH stick probe</td>
</tr>
<tr>
<td>conductivity</td>
<td>meter</td>
<td>meter 0-2000 µS/cm (temperature compensation)</td>
<td>meter 0-200 µS/cm (temp. comp.)</td>
<td>meter 0-2000 µS/cm (temp. comp.)</td>
<td>meter 0-1999 µS/cm</td>
<td>meter 0-1999 µS/cm</td>
<td>pocket meter 0-199 µS/cm</td>
</tr>
<tr>
<td>temperature</td>
<td>meter</td>
<td>meter -30 to +150°C</td>
<td>meter -30 to +150°C</td>
<td>meter -30 to +150°C</td>
<td>meter -30 to +150°C</td>
<td>meter -30 to +150°C</td>
<td>thermometer</td>
</tr>
<tr>
<td>redox</td>
<td>-</td>
<td>meter 0-1999 mV</td>
<td>meter 0-1999 mV</td>
<td>meter 0-1999 mV</td>
<td>meter 0-1999 mV</td>
<td>meter 0-1999 mV</td>
<td>-</td>
</tr>
<tr>
<td>nitrates</td>
<td>photometer 0-1.0 mg/l (as NO₃⁻)</td>
<td>photometer 0-1.0 mg/l (as NO₃⁻)</td>
<td>* photometer 0-1.0 mg/l (as NO₃⁻)</td>
<td>* photometer 0-1.0 mg/l (as NO₃⁻)</td>
<td>photometer 0-1.0 mg/l (as NO₃⁻)</td>
<td>* comparator 0-15 (as N) mg/l</td>
<td>comparator 0-50 mg/l as ?</td>
</tr>
<tr>
<td>nitrites</td>
<td>photometer 0-0.5 mg/l (as N)</td>
<td>photometer 0-0.5 mg/l (as N)</td>
<td>* photometer 0-0.5 mg/l (as N)</td>
<td>* photometer 0-0.5 mg/l (as N)</td>
<td>photometer 0-0.5 mg/l (as N)</td>
<td>* comparator 0-0.4 (as N) mg/l</td>
<td>-</td>
</tr>
<tr>
<td>ammonia</td>
<td>photometer 0-1.0 mg/l</td>
<td>photometer 0-1.0 mg/l</td>
<td>* photometer 0-1.0 mg/l</td>
<td>* photometer 0-1.0 mg/l</td>
<td>photometer 0-1.0 mg/l</td>
<td>* comparator 0-1.0 mg/l</td>
<td>-</td>
</tr>
<tr>
<td>aluminium</td>
<td>* photometer 0-0.5 mg/l</td>
<td>* photometer 0-0.5 mg/l</td>
<td>* photometer 0-0.5 mg/l</td>
<td>* photometer 0-0.5 mg/l</td>
<td>* photometer 0-0.5 mg/l</td>
<td>* comparator 0-0.5 mg/l</td>
<td>-</td>
</tr>
<tr>
<td>fluoride</td>
<td>* photometer 0-1.5 mg/l</td>
<td>* photometer 0-1.5 mg/l</td>
<td>* photometer 0-1.5 mg/l</td>
<td>* photometer 0-1.5 mg/l</td>
<td>* photometer 0-1.5 mg/l</td>
<td>* comparator 0-1.5 mg/l</td>
<td>-</td>
</tr>
<tr>
<td>iron</td>
<td>* photometer 0-10 mg/l</td>
<td>* photometer 0-10 mg/l</td>
<td>* photometer 0-10 mg/l</td>
<td>* photometer 0-10 mg/l</td>
<td>* photometer 0-1.0 to 10 mg/l</td>
<td>* comparator 0-1.0 to 10 mg/l</td>
<td>-</td>
</tr>
<tr>
<td>manganese</td>
<td>* photometer 0-0.03 mg/l</td>
<td>* photometer 0-0.03 mg/l</td>
<td>* photometer 0-0.03 mg/l</td>
<td>* photometer 0-0.03 mg/l</td>
<td>* photometer 0-0.03 mg/l</td>
<td>* comparator 0-0.03 mg/l</td>
<td>-</td>
</tr>
<tr>
<td>chlorine</td>
<td>comparator (DPD1 &amp; DPD3)</td>
<td>photometer 0-5.0 mg/l</td>
<td>photometer 0-5.0 mg/l</td>
<td>photometer 0-5.0 mg/l</td>
<td>photometer (DPD) 0-5.0 mg/l</td>
<td>comparator (DPD) 0 to 1, 2, or 5 mg/l</td>
<td>comparator 0-3.5 mg/l</td>
</tr>
<tr>
<td>case supplied</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no (carring bag can be bought)</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>weight</td>
<td>6 kg</td>
<td>20 kg</td>
<td>16 kg</td>
<td>9 kg</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes:
- 28 parameters can be tested with the photometer as ELE 50
- 36 parameters can be tested with the photometer
- Also stopwatch and deionised water pack
- 19 parameters can be tested with the comparator
- Also stopwatch and deionised water pack
- Only indicates presence/ absence of E.coli. It is not quantitative
## Microbiological tests — field equipment alternative

<table>
<thead>
<tr>
<th>Equipment / consumable</th>
<th>Supplier</th>
<th>Code</th>
<th>Capital cost (£)</th>
<th>Consumables cost (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dipslides</td>
<td>Incubator</td>
<td>WAG</td>
<td>WAG8000</td>
<td>603.98</td>
</tr>
<tr>
<td></td>
<td>Dipslides</td>
<td>PT (or Millipore)</td>
<td>PT 710</td>
<td>-</td>
</tr>
</tbody>
</table>

Consumable cost per test = £1.648 (for 100 when purchasing more than 100)

<table>
<thead>
<tr>
<th>Colierts for dilutions:</th>
<th>Incubator</th>
<th>WAG</th>
<th>WAG8000</th>
<th>603.98</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic syringes (1ml and 10ml)</td>
<td>BDH / Merck</td>
<td>-</td>
<td>-</td>
<td>19.86 &amp; 16.19 per 100</td>
<td></td>
</tr>
<tr>
<td>UV lamp</td>
<td>PT</td>
<td>CT102</td>
<td>25.25</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Consumable cost per test = £13.95 (for 15 tubes and count to >1600 / 100ml)

## Membrane filtration

<table>
<thead>
<tr>
<th>Equipment / consumable</th>
<th>Supplier</th>
<th>Code</th>
<th>Capital cost (£)</th>
<th>Consumables cost (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEL</td>
<td>DEL</td>
<td>-</td>
<td>1050</td>
<td>-</td>
</tr>
<tr>
<td>MLS broth</td>
<td>DEL</td>
<td>-</td>
<td>-</td>
<td>3.00 for 38.1g tub (200 tests)</td>
</tr>
<tr>
<td>Pads and filter papers</td>
<td>DEL</td>
<td>-</td>
<td>-</td>
<td>20.00 for 200</td>
</tr>
<tr>
<td>Pad dispenser</td>
<td>DEL</td>
<td>-</td>
<td>-</td>
<td>6.11</td>
</tr>
</tbody>
</table>

Consumable cost per test = £0.15 for one filtration without wastage (for 6 filtrations using syringes for dilutions then cost = £1.23 without wastage)

### Photometer and Comparator costs

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Code</th>
<th>Supplier (also supplied by ELE and WT)</th>
<th>Capital cost (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photometer (as Palintest but also supplied by others)</td>
<td>PT250</td>
<td>PT</td>
<td>480.00</td>
</tr>
<tr>
<td>Disc comparator (as Lovibond but also supplied by others)</td>
<td>142000</td>
<td>TINT</td>
<td>31.50</td>
</tr>
<tr>
<td>Set of five No. 13.5mm cells (10ml) cells for Lovibond disc comparator</td>
<td>354243</td>
<td>TINT (also supplied by ELE and PT)</td>
<td>16.00</td>
</tr>
<tr>
<td>Disc comparator ‘standard kit’ includes comparator, cells, dilution tube, case (Palintest)</td>
<td>PT220</td>
<td>PT</td>
<td>54.60</td>
</tr>
</tbody>
</table>
### Core water quality parameters — field equipment alternatives

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Range and accuracy required</th>
<th>Field equipment available</th>
<th>Range and accuracy of equipment</th>
<th>Supplier</th>
<th>Code capital equip.</th>
<th>Capital cost (£)</th>
<th>Code consumables</th>
<th>Consumables cost (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbidity</td>
<td>&lt; 5, 5, 10, 20, 50, 100, 200 NTU</td>
<td>Turbidity tube</td>
<td>5-500 TU</td>
<td>DEL</td>
<td>-</td>
<td>36.28</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Photometer</td>
<td>5-400TU</td>
<td>PT (or ELE, WT)</td>
<td>*</td>
<td>*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>pH</td>
<td>4-10 +/- 0.5</td>
<td>pH sensor</td>
<td>-2 to 16 +/- 0.1</td>
<td>PT</td>
<td>PT151</td>
<td>39.30</td>
<td>PT105/5</td>
<td>16.20 Buffer pack for pH 4.7,10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pH sensor (self-calibrating)</td>
<td>-2 to 16 +/- 0.1</td>
<td>PT</td>
<td>PT151</td>
<td>39.30</td>
<td>PT105/5</td>
<td>16.20 Buffer pack for pH 4.7,10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Papers</td>
<td>1-12 +/- 1 Pehanon indicator papers</td>
<td>CAM</td>
<td>-</td>
<td>-</td>
<td>mn90401</td>
<td>10.80 for 200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Papers</td>
<td>4-9 +/- 0.5 Pehanon indicator papers</td>
<td>CAM</td>
<td>-</td>
<td>-</td>
<td>mn90424</td>
<td>9.30 for 200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Papers</td>
<td>4-7 +/- 0.2 non-bleeding strips</td>
<td>MER</td>
<td>-</td>
<td>-</td>
<td>315022D</td>
<td>10.40 for 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Papers</td>
<td>6.5-10 +/- 0.2 non-bleeding strips</td>
<td>MER</td>
<td>-</td>
<td>-</td>
<td>315062L</td>
<td>10.40 for 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Papers</td>
<td>0-14 non-bleeding strips</td>
<td>MER</td>
<td>-</td>
<td>-</td>
<td>315082P</td>
<td>10.40 for 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Checkit</td>
<td>6.0-9.2 +/- 0.4</td>
<td>TINT</td>
<td>155280</td>
<td>19.95</td>
<td>-</td>
<td>6.30 for 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Checkit</td>
<td>6.0-8.2</td>
<td>DEL</td>
<td>-</td>
<td>10.50</td>
<td>-</td>
<td>9.00 for 250 phenol red</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sample containers with lids</td>
<td>-</td>
<td>see general equipment</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Odour</td>
<td>not objectionable to consumers</td>
<td>Sample containers with lids</td>
<td>-</td>
<td>see general equipment</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Conductivity</td>
<td>Conductivity &lt; 450, 450 to &gt; 1300 µS/cm +/- 100 µS/cm</td>
<td>Conductivity meter / TDS sensor</td>
<td>PT</td>
<td>PT159 cond PT152 TDS</td>
<td>46.55</td>
<td>PT156 cond PT155 TDS</td>
<td>7.85 standard conductivity solution 7.85 standard TDS solution</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conductivity &lt; 450, 450 to &gt; 1300 µS/cm +/- 100 µS/cm</td>
<td>Conductivity meter / TDS sensor</td>
<td>0-1990 µS/cm +/- 10 0-1990 mg/l +/- 10</td>
<td>MER</td>
<td>309/0782/01 or 03</td>
<td>40.00</td>
<td>309/0741/14 cond</td>
<td>10.50 standard conductivity solution</td>
</tr>
<tr>
<td></td>
<td>TDS &lt; 300, 300 up to 1000 mg/l +/- 100 mg/l</td>
<td>Portable conductivity meter</td>
<td>0-1990 µS/cm +/- 10 0-1990 mg/l +/- 10</td>
<td>DEL</td>
<td>-</td>
<td>220.50</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
### Secondary water quality parameters — field equipment alternatives

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range and accuracy required</th>
<th>Field equipment available</th>
<th>Range and accuracy of equipment</th>
<th>Supplier</th>
<th>Code capital equipment</th>
<th>Capital cost (£)</th>
<th>Code consumables</th>
<th>Consumables cost (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chloride</strong></td>
<td>100, 250, 500 ±/− 50</td>
<td>Tablet count</td>
<td>0-1000</td>
<td>PT</td>
<td>-</td>
<td>-</td>
<td>AS079</td>
<td>7.55 for 50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tablet count</td>
<td>0-5000</td>
<td>TINT</td>
<td>-</td>
<td>-</td>
<td>414180</td>
<td>17.50 for av 40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pocket kit</td>
<td>0-1000</td>
<td>PT</td>
<td>-</td>
<td>-</td>
<td>PK079</td>
<td>14 for 50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drop count titration</td>
<td>20-400</td>
<td>CAM</td>
<td>-</td>
<td>-</td>
<td>HH01440-01</td>
<td>39.30 for 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disc comp (LB)</td>
<td>0-200</td>
<td>TINT</td>
<td>** ** 3 ** 371</td>
<td>** ** 60.00</td>
<td>464801</td>
<td>5.75 for 100 ml reagent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Photometer</td>
<td>0-50 to 0-50,000</td>
<td>PT</td>
<td>*</td>
<td>*</td>
<td>PM268</td>
<td>13.50 for 50</td>
</tr>
<tr>
<td><strong>Flouride</strong></td>
<td>0.5, 1.5, 3.0 ±/− 0.5</td>
<td>Disc comp. (LB) + Nessler attachment</td>
<td>0-1.6</td>
<td>TINT</td>
<td>too bulky and fragile</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Photometer</td>
<td>0-1.5</td>
<td>PT</td>
<td>*</td>
<td>*</td>
<td>PM179</td>
<td>14.05 for 50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disc comp (PT) + Nessler attachment</td>
<td>0-1.5</td>
<td>PT</td>
<td>too bulky and fragile</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Colorimeter</td>
<td>0-2</td>
<td>CAM</td>
<td>HH46700-05</td>
<td>350.00 (includes 50 tests)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Iron</strong></td>
<td>0.1, 0.3, 1.0 ±/− 0.1</td>
<td>Aquacquant, simple</td>
<td>0-1.0</td>
<td>MER</td>
<td>-</td>
<td>-</td>
<td>166052D</td>
<td>25.00 for 50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Checkit</td>
<td>0-10.0 ±/− 0.2 up to 1.0 ±/− 0.2 up to 10</td>
<td>TINT</td>
<td>155340</td>
<td>19.95</td>
<td>515370</td>
<td>16.80 for 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cube comparator</td>
<td>0-5.0 ±/− 1</td>
<td>CAM</td>
<td>HH414008-00</td>
<td>18.60 (inc 150 tests)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pocket kit</td>
<td>0-1.0</td>
<td>PT</td>
<td>-</td>
<td>-</td>
<td>PK155</td>
<td>14 for 50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disc comp (LB)</td>
<td>0.1-1.0 ±/− 0.1</td>
<td>TINT</td>
<td>** ** 3 ** 3116</td>
<td>** ** 36.65</td>
<td>NOL515370</td>
<td>16.80 for 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disc comp (PT)</td>
<td>0-1.0</td>
<td>PT</td>
<td>** ** ** CD155</td>
<td>** ** 28.25</td>
<td>AK155</td>
<td>32.40 for 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Photometer</td>
<td>0-1.0</td>
<td>PT</td>
<td>*</td>
<td>*</td>
<td>PM155</td>
<td>11.90 for 50</td>
</tr>
<tr>
<td><strong>Manganese</strong></td>
<td>0.05, 0.1, 0.3 ±/− 0.05</td>
<td>Disc comp (LB) + Nessler attachment</td>
<td>0.0025-0.5</td>
<td>TINT</td>
<td>too bulky and fragile</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Photometer</td>
<td>0-0.03</td>
<td>PT</td>
<td>*</td>
<td>*</td>
<td>PM173</td>
<td>11.90 for 50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disc comp (HACH)</td>
<td>0-0.7 ±/− 0.05</td>
<td>CAM</td>
<td>HH423508-00</td>
<td>160 (includes 50 tests)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disc comp (PT)</td>
<td>0-0.03</td>
<td>PT</td>
<td>** ** CD173</td>
<td>** ** 28.50</td>
<td>AK173</td>
<td>26.90 for 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aquacquant</td>
<td>0-0.5</td>
<td>MER</td>
<td>-</td>
<td>-</td>
<td>155442J</td>
<td>88.26 for 110</td>
</tr>
<tr>
<td>Parameter</td>
<td>Range and accuracy required</td>
<td>Field equipment available</td>
<td>Supplier</td>
<td>Code capital equipment</td>
<td>Capital cost (£)</td>
<td>Code consumables</td>
<td>Consumables cost (£)</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------------</td>
<td>---------------------------</td>
<td>----------</td>
<td>------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>---------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Nitrites</strong>&lt;br&gt;1, 2, 3, 5 as NO$_3^-$ +/- (0.3, 0.7, 0.9, 1.5 as N)&lt;br&gt;Disc comp (LB) 0-0.5 as N</td>
<td>TINT</td>
<td>☑</td>
<td>☑</td>
<td>3/103</td>
<td>3.50</td>
<td>512310</td>
<td>7.75 for 100</td>
<td></td>
</tr>
<tr>
<td>Pocket kit 0-2.0 as NO$_2^-$</td>
<td>PT</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>PK109</td>
<td>14 for 50</td>
<td></td>
</tr>
<tr>
<td>Photometer 0-0.5 as N</td>
<td>PT</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>36.50</td>
<td>PM109</td>
<td>6.25 for 50</td>
<td></td>
</tr>
<tr>
<td>Disc comp (HACH) 0-0.5 as N</td>
<td>CAM</td>
<td>HH/21280-00</td>
<td>63.20 (includes 100 tests)</td>
<td>-</td>
<td>-</td>
<td></td>
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</tr>
<tr>
<td>Cube comp 0-1.0 +/- 0.2 as N</td>
<td>CAM</td>
<td>HH/20596-00</td>
<td>18.60 (includes 50 tests)</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Merckoquant strips 0-1-5-10-40-80 as NO$_2^-$</td>
<td>MER</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>315202F</td>
<td>23.40 for 100</td>
<td></td>
</tr>
<tr>
<td>Checkit 0-1.6 as NO$_2^-$</td>
<td>TINT</td>
<td>155260</td>
<td>19.95</td>
<td>512310</td>
<td>7.75 for 100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disc comp (PT) 0-15 as N</td>
<td>PT</td>
<td>* * C2109</td>
<td>28.25</td>
<td>AL109</td>
<td>15.05 for 200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sulphates</strong>&lt;br&gt;100, 400, 600 as SO$_4^{2-}$ +/- 50&lt;br&gt;Photometer 0-200</td>
<td>PT</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>414320</td>
<td>PM154</td>
<td>5.15 for 50</td>
<td></td>
</tr>
<tr>
<td>Tablet count 0-200</td>
<td>TINT</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20.50 for av. 40</td>
<td></td>
</tr>
<tr>
<td>Turbidimetric 50-200 +/-60</td>
<td>CAM</td>
<td>HH/02251.00</td>
<td>53.90 (includes 100 tests)</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Merckoquant strips 200-300, 400-500, 800-900, 1400-1600</td>
<td>MER</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>315212H</td>
<td>23.40 for 100</td>
<td></td>
</tr>
<tr>
<td><strong>Taste</strong>&lt;br&gt;local reports&lt;br&gt;local reports&lt;br&gt;-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Temp</strong>&lt;br&gt;e.g. -10 to 100°C&lt;br&gt;Thermometer in brass case -10 to 50°C</td>
<td>PT</td>
<td>PT684</td>
<td>17.10</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Pocket thermometer in aluminium case -10 to 250°C</td>
<td>PT</td>
<td>PT689</td>
<td>11.55</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Parameter</td>
<td>Range and accuracy required</td>
<td>Field equipment available</td>
<td>Range and accuracy of equipment</td>
<td>Supplier</td>
<td>Code capital equipment</td>
<td>Capital cost (£)</td>
<td>Code consumables</td>
<td>Consumables cost (£)</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------------</td>
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<td>----------</td>
<td>------------------------</td>
<td>------------------</td>
<td>------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Chlorine residual</td>
<td>0, 1, 2 +/- 0.2</td>
<td>Checkit</td>
<td>0.2-8.0 +/- 0.2 to 1.0 then various to 8.0</td>
<td>TINT</td>
<td>155300</td>
<td>19.95</td>
<td>511310 &amp; 511290</td>
<td>5.10 for 100 (x2) rapid dissolving</td>
</tr>
<tr>
<td>Disc comp (LB)</td>
<td>0.1-2.0</td>
<td>TINT</td>
<td>3/40J</td>
<td></td>
<td></td>
<td>30.30</td>
<td>511310 &amp; 511290</td>
<td>5.10 for 100 (x2) rapid dissolving</td>
</tr>
<tr>
<td>Disc comp (PT)</td>
<td>0-2.0 free combined and total</td>
<td>PT</td>
<td>CD011/5</td>
<td></td>
<td></td>
<td>28.25</td>
<td>A0031</td>
<td>17.60 for 200</td>
</tr>
<tr>
<td>Photometer</td>
<td>0-5.0 free combined and total</td>
<td>PT</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td>A0031</td>
<td>20.30 for 200</td>
</tr>
<tr>
<td>Pocket kit</td>
<td>0-2.0</td>
<td>PT</td>
<td>-</td>
<td></td>
<td></td>
<td>-</td>
<td>PK011</td>
<td>14 for 50</td>
</tr>
<tr>
<td>Disc comp (HACH)</td>
<td>0-3.5 +/- 0.1 (free and total)</td>
<td>CAM</td>
<td>HH/02231-01</td>
<td></td>
<td></td>
<td>48.30 (includes 50 tests)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Parameter</td>
<td>Range and accuracy required</td>
<td>Field equipment available</td>
<td>Range and accuracy of equipment</td>
<td>Supplier</td>
<td>Code capital equipment</td>
<td>Capital cost (£)</td>
<td>Code consumables</td>
<td>Consumables cost (£)</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------------------</td>
<td>---------------------------</td>
<td>-------------------------------</td>
<td>----------</td>
<td>------------------------</td>
<td>-----------------</td>
<td>----------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Aluminium</td>
<td>0.1, 0.2, 0.5</td>
<td>Disc comp (LB)</td>
<td>0.0-0.5 +/-0.5</td>
<td>TINT</td>
<td>✲ ✲ 3/127</td>
<td>✲ ✲ 36.50</td>
<td>515461 &amp; 515471</td>
<td>13.40 for 250 (x2)</td>
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<td></td>
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<tr>
<td>Photometer</td>
<td>0.0-0.5</td>
<td>PT</td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td>PM166</td>
<td>10.55 for 50</td>
</tr>
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<td>0.0-0.5</td>
<td>PT</td>
<td>-</td>
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<td>-</td>
<td></td>
<td>PK166</td>
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<td>Aquaquant</td>
<td>0.0-0.8</td>
<td>MER</td>
<td>-</td>
<td></td>
<td>-</td>
<td></td>
<td>165562Q</td>
<td>94.70 for 185</td>
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<tr>
<td>Checkit</td>
<td>0.0-0.5</td>
<td>TINT</td>
<td>155200</td>
<td></td>
<td>19.95</td>
<td>515461 &amp; 515471</td>
<td>13.40 for 100</td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.005, 0.01, 0.03</td>
<td>Merckoquant strips</td>
<td>0.0-1-0.5-1.0-1.7-3.0</td>
<td>MER</td>
<td>-</td>
<td></td>
<td>315292A</td>
<td>76.20 for 100</td>
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<tr>
<td>Cadmium</td>
<td>0.001, 0.003, 0.005</td>
<td>none</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>Chromium</td>
<td>0.01, 0.05, 0.1</td>
<td>Disc comp kit (LB)</td>
<td>0.01-0.1</td>
<td>TINT</td>
<td>413630</td>
<td>260.00</td>
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<td></td>
</tr>
<tr>
<td>Photometer</td>
<td>0-1.0 (vi &amp; iii)</td>
<td>PT</td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td>PM281 (v) &amp; PM281S (iii)</td>
<td>17.05 for 50 &amp; 47.35 for 50</td>
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<td>HH25050-25</td>
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<td>HH12527-00</td>
<td>18.60 (includes 50 tests)</td>
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<tr>
<td>Copper</td>
<td>1, 2, 5 +/- 1</td>
<td>Disc comp</td>
<td>0.5-5.0 +/-0.5</td>
<td>TINT</td>
<td>✲ ✲ 3/149</td>
<td>✲ ✲ 30.80</td>
<td>513550 &amp; 513560</td>
<td>21.90 &amp; 10.00 for 100</td>
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<tr>
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</tr>
<tr>
<td>Photometer</td>
<td>0-5.0</td>
<td>PT</td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td>PM186</td>
<td>16.25 for 50</td>
</tr>
<tr>
<td>Aquaquant</td>
<td>0-5.0</td>
<td>MER</td>
<td>-</td>
<td></td>
<td>-</td>
<td></td>
<td>165281K</td>
<td>88.26 for 100</td>
</tr>
<tr>
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<tr>
<td>Disc comp (HACH)</td>
<td>0.5-0.0 (free &amp; total)</td>
<td>CAM</td>
<td>HH21941.00</td>
<td></td>
<td>66.80 (includes 50 tests)</td>
<td>-</td>
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<td>Disc comp (PT)</td>
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<td>PT</td>
<td>✲ ✲ ✲ CD186</td>
<td></td>
<td>28.25</td>
<td>AK186</td>
<td>39.75 for 50</td>
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<td>Pocket kit</td>
<td>0-5.0</td>
<td>PT</td>
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<td></td>
<td>-</td>
<td></td>
<td>PK186</td>
<td>14 for 50</td>
</tr>
<tr>
<td>Checkit</td>
<td>0-5.0 (free &amp; total)</td>
<td>TINT</td>
<td>155420</td>
<td></td>
<td>19.95</td>
<td>513550 &amp; 513560</td>
<td>21.90 &amp; 10.00 for 100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Detergents</td>
<td>visual, odour</td>
<td>visual, odour</td>
<td>-</td>
<td></td>
<td>-</td>
<td></td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>0.005, 0.01, 0.03</td>
<td>✲ Chlorimetric</td>
<td>0.0-15</td>
<td>CAM</td>
<td>HH41100-48</td>
<td>570 (includes 20 tests)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td>0.005, 0.01, 0.03</td>
<td>none</td>
<td>-</td>
<td></td>
<td>-</td>
<td></td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Pesticides</td>
<td>varies</td>
<td>none</td>
<td>-</td>
<td></td>
<td>-</td>
<td></td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Petroleum products</td>
<td>visual and odour</td>
<td>none</td>
<td>-</td>
<td></td>
<td>-</td>
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<td></td>
</tr>
</tbody>
</table>
Equipment selection

The ideal equipment requirements for assessing emergency water sources are:

**Individual items:**
- easy to use with simple instructions
- small and easily transportable
- no restrictions on air transport
- fast and easy to produce results
- covers range and is accurate enough
- limited requirement for distilled / deionized water
- dilutions not necessary
- does not require calibration (or then calibration to itself, or then calibration to deionized water)
- robust — limited effects from: U.V.light; shock; humidity; temperature
- can test several parameters
- easy to repair or replace
- limited consumables or consumables easy to obtain
- reasonable cost of equipment and consumables
- microbiological test equipment - limited need for sterilization

**Whole kit:**
- can be packed into a durable case; and
- possible to carry the kit over long distances by hand or using a shoulder strap.

There are very few items of equipment which are perfect for the task as most items have both positive and negative features. Examples of negative features of the equipment include:
- the ranges measured by the equipment are not appropriate and hence dilutions are required to measure the parameter to the World Health Organisation guideline value;
- the equipment is bulky, heavy, expensive or fragile; or
- some of the test reagents are restricted for air transportation by IATA regulations.

**Example total kit list**

The following kit has been identified as suitable for assessing emergency water sources and treatment processes in the field. Modifications to this kit list would be required for a monitoring programme.

The kit has been divided into three sections:
- Core tests
- Secondary tests
- General and treatability tests

When packaging the kit it can be divided into the following parts:
1. The Delagua kit has all of the equipment to undertake the core tests (including microbiological analysis) if the conductivity stick / sensor, standard solution for calibration and the pH non-bleeding sticks (to widen the pH measurement range of the pool-tester included in the kit) are added.
2. The secondary tests would need to be packed separately to the core tests if the Delagua kit is used. They include paper strips, a photometer, and tablet count methods. A deionized
A water pack would be required to provide dilution water for the manganese test as the photometer measures a range below the WHO guideline level. It can also be used to provide dilution water when one of the parameters is found to be unusually high. The general items for survey and yield measurement, sample collection and storage, and treatability can be packed with the secondary test equipment.

Alternatively, if the Delagua kit is not selected and an alternative incubator is used then the whole kit could be packed into a single case.

**Reasons for choice**

When identifying suitable physical / chemical test equipment the aim was to identify a single, simple, small but robust item of equipment covering the required range for measurement without the need for dilution. The ideal requirements for equipment have been noted earlier on p227. Laboratory trials, field trials and personnel preferences were also used to assess the alternative options.

The final choice of equipment was partially directed by the difficulty of measuring fluoride in the field. The photometer has been included in this kit list to measure several of the parameters simply due to its ability to measure fluoride to WHO guideline levels. The only other simple item of equipment identified as potentially suitable for field analysis of fluoride was the disc comparator. However, Nessler attachments are required for the measurement of fluoride, and this consists of long glass tubes which are not suitable for a portable field kit. Although the photometer can measure several parameters and, therefore, is favorable in this way, it is electronic and hence not always trusted by fieldworkers. Some of the reagents required to measure the secondary parameters (e.g. nitrates and nitrites) are also restricted by IATA transport regulations. Some of the parameters require dilution to measure at WHO guideline levels (e.g. manganese).

Should fluoride measurement not be required the following items of equipment can be interchanged with the photometer:

- **Iron:** - Lovibond checkit
- **Manganese:** - Aquaquant manganese kit (easy to use and samples do not require dilution but it has liquid reagents and is bulky)
- **Aluminum:** - Lovibond checkit
- **Chlorine:** - Checkit

The photometer would not be suitable for daily monitoring of chlorine or aluminium residual on site. The checkits are much more suitable for this purpose.

Simple field equipment for the measurement of arsenic to WHO guideline levels was not identified.

The next best alternative to the membrane filtration test (for a quantitative measurement of *E. coli*) was found to be the Colilert test. The main problem with this test is the volume of consumables it requires, its cost, and the need for sterile dilution water. However, the test is simpler to undertake and incubates at 37°C which is advantageous in the field. The main disadvantage of the Delagua kit is its weight.
### Core tests — example field kit list

<table>
<thead>
<tr>
<th>Parameter / Purpose</th>
<th>Equipment Type / Method</th>
<th>Supplier</th>
<th>Order Number</th>
<th>Capital Cost (£)</th>
<th>Order Number Consumables</th>
<th>Consumables Cost (£)</th>
<th>Total Kit</th>
<th>Total Cost (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Turbidity</strong></td>
<td>Turbidity tube (5-500 TU)</td>
<td>DEL</td>
<td>-</td>
<td>36.28</td>
<td>-</td>
<td>-</td>
<td>In Delagua kit</td>
<td>-</td>
</tr>
<tr>
<td><strong>pH</strong></td>
<td>BDH non-bleeding strips</td>
<td>MER</td>
<td>-</td>
<td>-</td>
<td>315022D (4-7 pH) &amp; 315062L (6.5-10 pH)</td>
<td>10.40 for 100 (x2)</td>
<td>2 con</td>
<td>20.80</td>
</tr>
<tr>
<td><strong>Conductivity</strong></td>
<td>Conductivity / TDSensor</td>
<td>PT</td>
<td>PT159</td>
<td>46.55</td>
<td>PT156</td>
<td>7.85 standard solution</td>
<td>1 cap</td>
<td>46.55</td>
</tr>
<tr>
<td></td>
<td>✷ Methanol / ethanol / alcohol</td>
<td>buy in field</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>E. coli</strong> (Sterilisation)</td>
<td>Sodium thiosulphate (hydrated)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>E. coli</strong> (Stabilisation of chlorinated samples)</td>
<td>Delagua kit (includes items below)</td>
<td>Del</td>
<td>-</td>
<td>-</td>
<td>1 cap &amp; cons</td>
<td>1050.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Charging unit, leads, battery</td>
<td>Del</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.00</td>
<td>4 con</td>
<td>12.00</td>
</tr>
<tr>
<td></td>
<td>Filter unit including funnel and collar, vacuum cup, vacuum pump, sample cup, cable for sample cup, bronze disc, sealing gasket and rubber o-ring</td>
<td>Del</td>
<td>-</td>
<td>6.11</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>6.11</td>
</tr>
<tr>
<td></td>
<td>Petri dishes x 16</td>
<td>Del</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20.00</td>
<td>1 con</td>
<td>20.00</td>
</tr>
<tr>
<td><strong>E. coli</strong> (Incubator)</td>
<td>MLS broth (38.1g)</td>
<td>Del</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.00</td>
<td>4 con</td>
<td>12.00</td>
</tr>
<tr>
<td></td>
<td>Pad dispenser</td>
<td>Del</td>
<td>-</td>
<td>6.11</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>6.11</td>
</tr>
<tr>
<td></td>
<td>Pads and filter papers (200)</td>
<td>Del</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20.00</td>
<td>1 con</td>
<td>20.00</td>
</tr>
<tr>
<td>Tweezers</td>
<td>Del</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.00</td>
<td>4 con</td>
<td>12.00</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>3.00</td>
<td>4 con</td>
<td>12.00</td>
</tr>
<tr>
<td>Lighter</td>
<td>Del</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20.00</td>
<td>1 con</td>
<td>20.00</td>
</tr>
<tr>
<td>Lubricating grease</td>
<td>Del</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.00</td>
<td>4 con</td>
<td>12.00</td>
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### Primary equipment for secondary tests — example field kit list

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<tr>
<th>Parameter / purpose</th>
<th>Equipment type / method</th>
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<th>Order number capital item</th>
<th>Capital cost (£)</th>
<th>Order number consumables</th>
<th>Consumables cost (£)</th>
<th>Total kit</th>
<th>Total cost (£)</th>
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<tr>
<td>Chloride</td>
<td>Tablet count</td>
<td>PT</td>
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<td></td>
<td>PK079</td>
<td>7.55 for 50</td>
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<td>7.55</td>
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<td>Fluoride</td>
<td>Photometer</td>
<td>PT</td>
<td>PT250</td>
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<td>pm179</td>
<td>14.05 for 50</td>
<td>1 cap</td>
<td>480.00</td>
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<td>Photometer</td>
<td>PT</td>
<td>PT250</td>
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<td>-</td>
</tr>
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<td>Photometer</td>
<td>PT</td>
<td>PT250</td>
<td></td>
<td>pm173</td>
<td>11.90 for 50</td>
<td>1 cap</td>
<td>-</td>
</tr>
<tr>
<td>Nitrates</td>
<td>Merckoquant strips</td>
<td>MER</td>
<td></td>
<td></td>
<td>315244P</td>
<td>16.60 for 100</td>
<td>1 con</td>
<td>16.60</td>
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<td>Sulphates</td>
<td>Merckoquant strips</td>
<td>MER</td>
<td></td>
<td></td>
<td>315212H</td>
<td>23.40 for 100</td>
<td>1 con</td>
<td>23.40</td>
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<td>Permanganate value</td>
<td>Tablet count</td>
<td>PT</td>
<td></td>
<td></td>
<td>CP113</td>
<td>33.55 (incl. 50 tests)</td>
<td>1 con</td>
<td>33.55</td>
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<td>Deionized water packs</td>
<td>water pack</td>
<td>PT</td>
<td>PT500</td>
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<td></td>
<td>8.15</td>
<td>2 con</td>
<td>16.30</td>
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### General and treatability tests — example field kit list

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<th>Parameter / purpose</th>
<th>Equipment type / method</th>
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<th>Order number</th>
<th>Capital cost (£)</th>
<th>Order number</th>
<th>Consumables cost (£)</th>
<th>Total kit</th>
<th>Total cost (£)</th>
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</thead>
<tbody>
<tr>
<td><strong>Yield measurement and survey</strong></td>
<td>stop watch</td>
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<td>126.80</td>
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<td>1 cap</td>
<td>126.80</td>
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<tr>
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<td>GPS (Garmin 36)</td>
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<td>126.80</td>
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<tr>
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<td>Geo Supplies</td>
<td>SV15TDCL</td>
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<td>1 cap</td>
<td>44.95</td>
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<tr>
<td></td>
<td>altimeter</td>
<td>Field &amp; Trek</td>
<td>25075</td>
<td>119.11</td>
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<td>-</td>
<td>1 cap</td>
<td>129.00</td>
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<td>float and weight</td>
<td>Use 110 ml bottles + sand</td>
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<td>19.92</td>
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<td>1 cap</td>
<td>19.92</td>
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<td>24.25</td>
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<td>Swiss Army-type pen knife</td>
<td>1-09-01</td>
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<td>-</td>
<td>1 cap</td>
<td>19.92</td>
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<tr>
<td></td>
<td>pencil, pen and ruler</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>2.99</td>
<td></td>
</tr>
<tr>
<td></td>
<td>paper</td>
<td>-</td>
<td>2.99</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>2.99</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3m tape</td>
<td>PT</td>
<td>CTT02</td>
<td>25.25</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>25.25</td>
</tr>
<tr>
<td></td>
<td>torch</td>
<td>Geo Supplies</td>
<td>GLx10</td>
<td>2.50</td>
<td>-</td>
<td>-</td>
<td>2 caps</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td>geo lens</td>
<td>Geo Supplies</td>
<td>-</td>
<td>1.39</td>
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<td>2 caps</td>
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<td></td>
<td>line level</td>
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<td>CW2256</td>
<td>7.36</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>7.36</td>
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<tr>
<td></td>
<td>survey book</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>4.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>electrical tape</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>4.00</td>
<td></td>
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<tr>
<td><strong>Other</strong></td>
<td>sample bottles 60ml x 12</td>
<td>MER</td>
<td>215/0399/02</td>
<td>5.88</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>5.88</td>
</tr>
<tr>
<td></td>
<td>sample bottles 110ml x 12</td>
<td>MER</td>
<td>215/0399/04</td>
<td>9.12</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>9.12</td>
</tr>
<tr>
<td></td>
<td>bottles 500ml x 12</td>
<td>MER</td>
<td>215/0399/16</td>
<td>20.37</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>20.37</td>
</tr>
<tr>
<td></td>
<td>syringes 1ml</td>
<td>MER</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>1 cap</td>
</tr>
<tr>
<td></td>
<td>syringes 10ml</td>
<td>MER</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>1 cap</td>
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<tr>
<td></td>
<td>sampling cup</td>
<td>included with filtration kit</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>1 cap</td>
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<tr>
<td></td>
<td>sampling line</td>
<td>included with filtration kit</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>1 cap</td>
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<tr>
<td></td>
<td>biological sampling net (1 mm mesh bag for 200mm frame)</td>
<td>GB nets</td>
<td>-</td>
<td>6.85</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>6.85</td>
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<tr>
<td></td>
<td>glassware wipes (or tissues)</td>
<td>PT</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>2.00</td>
</tr>
<tr>
<td>Parameter / purpose</td>
<td>Equipment type / method</td>
<td>Supplier</td>
<td>Order number capital item</td>
<td>Capital cost (£)</td>
<td>Order number consumables</td>
<td>Consumables cost (£)</td>
<td>Total kit</td>
<td>Total cost (£)</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------</td>
<td>----------</td>
<td>---------------------------</td>
<td>-----------------</td>
<td>--------------------------</td>
<td>---------------------</td>
<td>----------</td>
<td>---------------</td>
</tr>
<tr>
<td>Working surface</td>
<td>workplace mat</td>
<td>PT</td>
<td>PT525</td>
<td>5.25</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>5.25</td>
</tr>
<tr>
<td>Marker</td>
<td>marker pen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 cap</td>
<td></td>
</tr>
<tr>
<td>Treatability</td>
<td>spatula/spoon (120ml)</td>
<td>MER</td>
<td>2000140.01</td>
<td>5.76</td>
<td>-</td>
<td>-</td>
<td>2 cap</td>
<td>11.52</td>
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<tr>
<td></td>
<td>breakers 1l x 5</td>
<td>MER</td>
<td>2090730.39</td>
<td>10.97</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>12.48</td>
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<tr>
<td>(Alkalinity)</td>
<td>Tablet count</td>
<td>TINT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 cap</td>
<td>29.50</td>
</tr>
<tr>
<td></td>
<td>(Total, M or T)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 cap</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Caustic, P)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 cap</td>
<td></td>
</tr>
<tr>
<td>(Temperature)</td>
<td>Thermometer in case</td>
<td>PT</td>
<td>PT684</td>
<td>17.10</td>
<td>-</td>
<td>-</td>
<td>1 cap</td>
<td>17.10</td>
</tr>
<tr>
<td>(Aluminium)</td>
<td>Photometer in case</td>
<td>PT</td>
<td>PT250</td>
<td>included in fluoride price</td>
<td>PM 166</td>
<td>10.55 for 50</td>
<td>1 cap</td>
<td>-</td>
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<tr>
<td>(Residual chlorine)</td>
<td>Photometer in case</td>
<td>PT</td>
<td>PT250</td>
<td>included in fluoride price</td>
<td>PM 031</td>
<td>20.30 for 200</td>
<td>1 con</td>
<td>10.55</td>
</tr>
<tr>
<td>Aluminium sulphate</td>
<td>PT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 cap</td>
<td>-</td>
</tr>
<tr>
<td>(18 hydrate)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 con</td>
<td>20.30</td>
</tr>
<tr>
<td>HTH 65%</td>
<td>buy in-country</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35% chlorine</td>
<td>buy in-country</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Ferric chloride</td>
<td>buy in-country</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Kit box
Mobile treatment units are self-contained and portable. Modular kits come in pieces and are fitted together on location. The following table identifies a selection of mobile units and two modular treatment kits. Most of the larger relief organizations have their own selection of modular kits which are ordered through their logistics departments. Items such as water storage tanks have not been included in this table. For information on Oxfam tanks, bladder tanks, fast tanks, modular distribution kits, pumping units, etc. contact the relief organizations directly.

Nothomb (1995, p8), referring to mobile treatment units states that ‘The uses are still not clearly defined, nor are the specifications. No unit seems to live up to the high expectations. The performances have not been properly and independently evaluated, as neither the indicators of performance nor test protocols are defined.’

### Water treatment: Mobile treatment and modular kits

<table>
<thead>
<tr>
<th>Description</th>
<th>Performance (details taken from manufacturers’ literature or from Nothomb, 1995)</th>
<th>Supplier</th>
<th>Approximate cost (1995)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modular kits</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment unit for water for emergency situations</td>
<td>Includes: Four containers mounted on ‘euro-palettes’ weighing a total of 500kg. Contains all material for approx. 1.5 months of treatment (except fuel). Includes pumps, feed controls, piping, etc.</td>
<td>30 m³/h max. Used at 5 to 8m³/h at a pressure of approx. 1 bar produces an effluent of 5 NTU from water of 50 - 200 NTU. Uses coagulation with ferric chloride (or alternatively aluminium sulphate with pH adjustment), and rapid sand filtration with chlorination to complete. Storage tanks are not part of the kit.</td>
<td>MSF Belgium</td>
</tr>
<tr>
<td>Oxfam slow sand filter kit</td>
<td>Includes 2 x 95,000 litre and 2 x 75,000 litre tanks and fittings including undraining, but does not include treated water tanks</td>
<td>Will supply 3.2m³/hour</td>
<td>Oxfam (UK &amp; Ireland)</td>
</tr>
<tr>
<td><strong>Mobile units</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-contained water purification kit</td>
<td>Includes: 1 trailer-mounted water purification unit, 1 steel tank 40m³, six water distribution kits with six taps each, piping, tools, necessary accessories such as monitoring tools and consumables for min six months (excluding gasoil)</td>
<td>Can fulfil daily water requirement of 10,000 people. Slotted well PVC pipe is provided with 6m-long perforated water collection pipe to construct an infiltration gallery to reduce turbidity. Sand and gravel required locally. Main treatment process of unit is rapid sand filtration.</td>
<td>UNICEF</td>
</tr>
<tr>
<td>Portable water purifier</td>
<td>Includes: purification unit only with cartridge for 25 to 5000 litres depending on size of unit</td>
<td>Small-scale use only. Up to a maximum of 1500 litres / day. Uses coarse filtration, absorption filtration with activated charcoal cloth, primary disinfection and secondary disinfection with an iodine-resin complex. Can also have post filtration to remove iodine residual. Tests have indicated &gt; 99.9% of virus removal.</td>
<td>Pre-Mac, Kent, UK</td>
</tr>
<tr>
<td>Aquarius 150 ° water purification unit</td>
<td>Uses pre-chlorination, coagulation and flocculation, horizontal sand filters and an activated carbon filter. Flow rate of 0.6m³/hr at 75 NTU. (Sizes vary from 0.18 - 6m³/hr ), 90kg. US$200 consumables for 90 days. Disinfection capacity not consistent.</td>
<td></td>
<td>Water International Ltd. UK</td>
</tr>
<tr>
<td>Description</td>
<td>Performance (details taken from manufacturers’ literature or from Nothomb, 1995)</td>
<td>Supplier</td>
<td>Approximate cost (1995)</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>GB13000D* water purification unit</td>
<td>Uses diatomaceous earth coated filter. Chlorination. Flow rate of 4.3 m³/hr at 75 NTU. (5-7 m³/hr) 350 kg. US$20,900 consumables for 90 days. Can reduce max. turbidity of 200 NTU to 5 NTU. Disinfection capacity not consistent.</td>
<td>Goodmann Ball Inc. USA</td>
<td>US$37,000</td>
</tr>
<tr>
<td>LMS* water purification unit</td>
<td>Uses course straining. Sand and activated carbon filtration and optional microstrainer. Venturi chlorine doser. Flow rate of 8.0 m³/hr at 75 NTU. 1600 kg. US$270 consumables for 90 days. Can reduce max. turbidity of 50 NTU to 5 NTU. Disinfection capacity not consistent.</td>
<td>LMS Industries, France</td>
<td>US$18,000</td>
</tr>
<tr>
<td>Berkefeld* water purification unit</td>
<td>Uses pre-chlorination, coagulation with ferric chloride, adsorption with powdered activated carbon, flocculation with lime, filtration (using candle filters pre-treated with diatomite and activated carbon). Flow rate of 5.4 m³/hr at 75 NTU. 3000 kg (includes weight of vehicle). US$33,500-93,000 consumables for 90 days. Can reduce max. turbidity of 500 NTU to 5 NTU. Good disinfection to WHO recommended levels.</td>
<td>Berkefeld Anlagebau GmbH, Germany</td>
<td>US$87,000</td>
</tr>
<tr>
<td>CLM5000” water purification unit</td>
<td>Pre-chlorination, pH correction, coagulation and flocculation with polychlorate aluminium sulphate and then filtration on a foam medium. Activated carbon filtration. UV disinfection and/or chlorination. Flow rate of 4.0 m³/hr at 75 NTU. 2500 kg. US$200 consumables for 90 days. US$24,300 consumables for 90 days. Can reduce max. turbidity of 200 NTU to 5 NTU. Disinfection capacity not consistent.</td>
<td>Sulzer Chemtech Ltd., Switzerland</td>
<td>US$56,000</td>
</tr>
<tr>
<td>Conniston* water purification unit</td>
<td>Filtration in filter coated with diatomaceous earth and chlorination via a venturi chlorine doser. Flow rate of 4.0 m³/hr at 75 NTU. 250 kg. US$200 consumables for 90 days. US$24,300 consumables for 90 days. Can reduce max. turbidity of 200 NTU to 5 NTU. Disinfection capacity not consistent.</td>
<td>Stella-Meta, UK</td>
<td>US$21,000</td>
</tr>
<tr>
<td>Lightweight water purification unit</td>
<td>Average 1.36 m³/h. Unit will filter 95% of all particles greater than 0.005 mm. Raw water is passed through a floating suction strainer and pumped into a Vokes filter unit (diamotaceous earth) and then it is chlorinated using a venturi feed system. Uses liquid chlorine. Flexible water tanks.</td>
<td>Refer to British army</td>
<td></td>
</tr>
<tr>
<td>Standard Water purification unit</td>
<td>Average 6.8 m³/h. Unit will filter 95% of all particles greater than 0.005 mm. Raw water is passed through a floating suction strainer and pumped into a Vokes filter unit (diamotaceous earth) and then it is chlorinated using a venturi feed system. Uses liquid chlorine. Flexible water tanks. Total weight 540 kg.</td>
<td>Refer to British army</td>
<td></td>
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<tr>
<td>Reverse Osmosis Plant (Weir Westgarth) containerised**</td>
<td>Average 4.15 m³/h.</td>
<td>Refer to British army</td>
<td></td>
</tr>
<tr>
<td>Water purification unit (NBC)</td>
<td>Average 6.8 m³/h in non-NBC mode or 2.28 m³/hr in NBC mode. Can supply water from brackish sources, or water contaminated by sewage, nuclear, biological or chemical substances but not sea water. Process involves filtration, reverse osmosis, activated carbon absorption and chlorination. There are four eight inch diameter reverse osmosis modules and four stellacarb carbon absorption columns. Total weight for towing is 3300 kg.</td>
<td>Refer to British army</td>
<td></td>
</tr>
<tr>
<td>Water purification unit (NBC) Desalination version: Trailer mounted **</td>
<td>Average 1.9 m³/h.</td>
<td>Refer to British army</td>
<td></td>
</tr>
</tbody>
</table>

* Information on these units was taken directly from Nothomb (1995) and the results of an interagency collaborative testing meeting in Geneva, Switzerland on June 12-20, 1995. For further direct comparisons refer to Nothomb (1995).
** Units used by the British Army
Useful addresses

Organizations which may be able to interpret industrial pollution data

Should you not be able to interpret industrial pollution laboratory data yourself, or you are not able to find an organization in the vicinity to do it then the following organizations may be able to assist. They should either have the capacity to interpret the data or will be able to provide alternative contacts. There is likely to be a charge for any interpretation work and this should be discussed with the organization when you first contact them.

This study does not have the capacity to confirm the skill of the organizations or the personnel responding to requests and so further investigations should be undertaken where necessary.

Details of organizations and contacts

<table>
<thead>
<tr>
<th>Organization</th>
<th>Address</th>
<th>Contact</th>
<th>Telephone</th>
<th>Fax</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>The National Centre for Environmental Toxicology</td>
<td>Water Research Centre (WRc plc)</td>
<td>Mr Jim Taft of the Office of the Ground Water and Drinking Water (OGWDW)</td>
<td>+202 260 5519</td>
<td></td>
<td><a href="mailto:cet@wrcplc.co.uk">cet@wrcplc.co.uk</a></td>
</tr>
<tr>
<td>Henley Road</td>
<td>Medmenham, Bucks, SL7 2HD, UK</td>
<td>Mr Krishan Khanna of the Health and Ecological Criteria Division (HECD)</td>
<td>+202 260 7588</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office of Science and Technology</td>
<td>United States Environmental Protection Agency</td>
<td>Mr Jim Taft of the Office of the Ground Water and Drinking Water (OGWDW)</td>
<td>+202 260 5519</td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States Environmental Protection Agency</td>
<td>Washington DC 20460, USA</td>
<td>Mr Krishan Khanna of the Health and Ecological Criteria Division (HECD)</td>
<td>+202 260 7588</td>
<td></td>
<td></td>
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<tr>
<td>Office of Science and Technology</td>
<td>Washington DC 20460, USA</td>
<td>Mr Krishan Khanna of the Health and Ecological Criteria Division (HECD)</td>
<td>+202 260 7588</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Umweltbundesamt Institute for Water, Soil and Air Hygiene</td>
<td>PO Box 33 00 22, 14191 Berlin, Germany</td>
<td>Mr Krishan Khanna of the Health and Ecological Criteria Division (HECD)</td>
<td>+49 30 8903 1400</td>
<td>+49 30 8903 1830</td>
<td></td>
</tr>
<tr>
<td>WELL</td>
<td>Water and Environmental Health at London and Loughborough</td>
<td>World Health Organisation, CH-211, Geneva 27, Switzerland</td>
<td>+41 22 791 2111</td>
<td>+41 22 791 0746</td>
<td>UNISANTE-GENEVA Telex 415416OMS</td>
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</table>
## Equipment manufacturers and suppliers

### International suppliers

<table>
<thead>
<tr>
<th>Company</th>
<th>International head office</th>
<th>Africa, Asia, Middle East</th>
<th>European Office</th>
<th>The Americas &amp; Australasia</th>
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</thead>
<tbody>
<tr>
<td>Berkefeld Anagebau GmbH</td>
<td>Luckenweg, 5 Postfach 3202 29227 CELLE Germany</td>
<td>as international</td>
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<tr>
<td>Business on the Move Ltd.</td>
<td>2, Woodhill, Kentish Lane, Hatfield, Herts. AL9 6JY, UK Tel: +44 1707 663533 Fax: +44 1707 645976 internet location: <a href="http://www.21store.com/botm/botm.htm">www.21store.com/botm/botm.htm</a></td>
<td>as international</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Camlab Limited (Hach products)</td>
<td>HACH Company International Marketing Department, PO Box 389 Loveland, Colorado 80539 USA Tel: +1 303 669 3050 Fax: +1 303 669 2932 Telex: 160840</td>
<td>as international</td>
<td>Camlab Limited, Nuffield Road, Cambridge CB4 1TH, UK Tel: +44 1223 424222 Fax: +44 1223 420856</td>
<td>as international</td>
</tr>
<tr>
<td>Cotswold</td>
<td>Contract Department tel: +44 1277 224647 fax: +44 1277 260 789</td>
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<tr>
<td>ELE International Limited</td>
<td>Eastman Way Hemel Hempstead Hertfordshire HP2 7HB, UK Tel: +44 1442 218355 Fax: +44 1442 252474 / 218045 Telex: 825239 ELELTD G</td>
<td>as international</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field &amp; Trek Plc.</td>
<td>Contracts Department Unit 3 Wales Way Brentwood, Essex CM159TB, UK Tel: +44 1277 263 554</td>
<td>as international</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GB Nets</td>
<td>Linden Mill Hebdon Bridge West Yorkshire, HX7 7DP, UK Tel: +44 422 845365</td>
<td>as international</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geosupplies Ltd.</td>
<td>16, Station Road Chapeltown Sheffield, S30 4XH, UK Tel: +44 114 245 5746 Fax: +44 114 240 3405</td>
<td>as international</td>
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<td></td>
</tr>
<tr>
<td>Goodman Ball Inc.</td>
<td>3639, Haven Avenue Menlo Park CA 94025, USA</td>
<td>as international</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LMS Industries</td>
<td>73100 Aix-les-Bains, France</td>
<td>as international</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Merck Ltd (BDH Products)</td>
<td>PROMOCHEM GMBH POB 101340 Mercatorstrasse 51 D46569 Wesel Germany Tel: +49 281 98 87 0 Fax: +49 281 9887199 Telex: 812741 Promo D</td>
<td>as international</td>
<td>Merck House Poole, Dorset BH15 1TD, UK Tel: +44 1202 684 778 Sales tel (freephone): +0800 223 344 Fax: +44 1202 666536 Telex: 411 186 TETRA G</td>
<td>as international</td>
</tr>
<tr>
<td>Merck House</td>
<td>Howse &amp; McGeorge Ltd. Laboratory Division PO Box 72030 Nairobi, Kenya Tel: +254 2553064 / 2553154 Fax: +254 2601345 Telex: 21554 Arabco JO</td>
<td>as international</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There are many other distributors in Africa, Asia, the Middle East, Europe, USA and Australasia other than those noted here.
<table>
<thead>
<tr>
<th>Company</th>
<th>International head office</th>
<th>Africa, Asia, Middle East</th>
<th>European Office</th>
<th>The Americas &amp; Australasia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merck Ltd. (BDH Products) (cont.)</td>
<td>E MERCK (INDIA) Limited Shiv Sagar Estate 'A' Dr Annie Besant Road PO Box No. 16554 Worli, Bombay 400 018 Tel: +91 22 4922855 Fax: +91 22 4950307 Telex: 1173756</td>
<td></td>
<td></td>
<td>Gallard Schlesinger Industries Inc. 584, Mineola Avenue Carle Place New York, 11514-1731 USA Tel: +1 516 333 5600 Fax: +1 516 333 5628 Quimibras Industrias Quimicas SA Praca de Bandeira 141, GR 201, Rio de Janeiro RJ 20220, Brazil Tel: +55 21 273 2022 Fax: +55 21 293 3291 Telex: 30083 REDY</td>
</tr>
<tr>
<td>Millipore Corporation</td>
<td>80, Ashby Road, Bedford, MA 01730, Massachusetts, USA Tel: +1 800 645 5476 Fax: +1 617 275 5550</td>
<td>For Austria, Central Europe, Africa, Middle East and the Gulf: Millipore Ges.m.b.H. A-1130 Wein, Austria, Tel: +43 1 877 8926 Fax: +43 1 877 1654 Telex: +43 1 877 1654 Millipore also has subsidiaries in many other countries including: China, India, Japan, Malaysia, Taiwan etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSF Belgium</td>
<td>Logistics Department Duprestr 94 B-1090 Jette Brussels Belgium Tel: +32 2 474 7474 Fax: +32 2 474 7575</td>
<td>As international</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OXFAM (UK and Ireland)</td>
<td>Public Health Team OXFAM (UK and Ireland) 274, Banbury Road Oxford OX2 7DZ, UK Tel: +44 1865 312 135 Fax: +44 1865 312 600 Telex: 83610 OXFAM G</td>
<td>As international</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palintest Ltd.</td>
<td>Palintest House Kingsway Team Valley Gateshead Tyne &amp; Wear NE11 ONS, UK Tel: +44 191 491 0808 Fax: +44 191 482 5372</td>
<td>As international</td>
<td></td>
<td>21, Kenton Lands Road PO Box 18733 Erlanger, Kentucky 41018 USA Tel: +1 606 341 7423 Fax: +1 606 341 2302 4/84-88 Riverside Road, Chipping Norton, PO Box 318, Padstow, NSW 2211, Australia Tel: +61 2 795 3486 Fax: +61 2 795 3491</td>
</tr>
<tr>
<td>Pre-Mac (Kent) Ltd.</td>
<td>40, Holden Park Road Southborough, Tunbridge Wells, Kent TN4 OER, UK Tel: +44 1892 534 361 Fax: +44 1892 515 770</td>
<td>As international</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Robens Institute (Delagua)</td>
<td>Robens Institute University of Surrey Guildford, Surrey GU2 5XH, UK Tel: +44 1483 509 203 Fax: +44 1483 503517 Telex: 859331</td>
<td>As international</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Equipment manufacturers and suppliers — Local

<table>
<thead>
<tr>
<th>Company</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundacion Zumaque</td>
<td>Oficina: Edificio Maraven, Piso 6o, Chuao-Apartado 829 - Caracas 1010A, Venezuela Teléfono: +58 2 908.22.06</td>
</tr>
<tr>
<td>Premier Health Care Products</td>
<td>41 &amp; 42, S.V. Co-op, Ind. Estate, Balanagar, Hyderabad 500 037, A.P. India Tel: +91 40 273515 / 273525, Fax: +91 40 271879</td>
</tr>
<tr>
<td>All India Institute of Hygiene &amp; Public Health and UNICEF, Calcutta</td>
<td>Contact either of the organizations noted on the left</td>
</tr>
</tbody>
</table>
The addresses which follow are only a few of the many which could be useful for obtaining information on water sources around the world. The **embassy of the country of concern** or your **home country government survey department** may be able to provide relevant addresses for the country under consideration.

### General addresses

<table>
<thead>
<tr>
<th>Address</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ordnance Survey</strong>&lt;br&gt;Romsey Road&lt;br&gt;Maybush&lt;br&gt;Southampton&lt;br&gt;SO9 4DH&lt;br&gt;UK</td>
<td>Topographic maps, geological maps</td>
</tr>
<tr>
<td><strong>British Geological Survey</strong>&lt;br&gt;Keyworth&lt;br&gt;Nottingham&lt;br&gt;NG12 5GG, UK&lt;br&gt;or&lt;br&gt;Hydrogeology unit&lt;br&gt;Macclean Building&lt;br&gt;Crowmarsh&lt;br&gt;Gifford&lt;br&gt;Wallingford&lt;br&gt;Oxfordshire&lt;br&gt;OX10 0RA&lt;br&gt;UK</td>
<td>Geological maps, hydrogeological maps, reports, satellite imagery and general data for Great Britain and Overseas.&lt;br&gt;BGS also have a system under trial where they answer any request made for hydrological information for any area to be used in an emergency response, and they are attempting to respond using interpretations of satellite imagery and other data within two to five weeks.</td>
</tr>
<tr>
<td><strong>Spot image</strong>&lt;br&gt;16, Bis Avenue&lt;br&gt;Edourd Belin BP 4359&lt;br&gt;31030 Toulouse, Cedex&lt;br&gt;France</td>
<td>Satellite imagery</td>
</tr>
<tr>
<td><strong>National Cartographic Information Center (NCIC)</strong>&lt;br&gt;US Geological Survey, 507&lt;br&gt;National Center, Reston&lt;br&gt;Virginia 22092, USA</td>
<td>Free information on national state topographic maps and information and remote sensing.</td>
</tr>
<tr>
<td><strong>Operations section WRD</strong>&lt;br&gt;US Geological Survey&lt;br&gt;405, National Center, Reston&lt;br&gt;Virginia, 22092, USA</td>
<td>Data on surface water, groundwater and water quality collected by the US Geological Survey</td>
</tr>
<tr>
<td><strong>United States Geological Survey</strong>&lt;br&gt;Box 25425&lt;br&gt;Federal Center&lt;br&gt;Denver, Colorado&lt;br&gt;80225, USA</td>
<td>USGS maps, books, professional papers and other publications on the geology of the USA and overseas</td>
</tr>
</tbody>
</table>
### United Nations addresses

<table>
<thead>
<tr>
<th>Address</th>
<th>Information</th>
</tr>
</thead>
</table>
| United Nations Environment Programme (UNEP)  
PO Box 30552, Nairobi, Kenya  
Tel: +254 2 230 800  
Fax: + 254 2 226 886  
IPAU@ige.apc.org | Responsible for the Global Environmental Monitoring System (GEMS) |
| World Meteorological Organisation  
World Weather Watch Department  
WMO/OMM, Case Postale No.2300  
CH-1211 Geneva 2  
Switzerland  
Tel: +41 22 730 8333  
email: nkootval@www.wmo.ch | In case of emergency, natural disaster or other crises for which UN assistance has been requested and in which meteorology or hydrology may affect the process of providing humanitarian relief, 24-hour operational contacts through DHA's emergency number +41 22 917 2010 |
| Department of Humanitarian Affairs (DHA)  
Vienna International Centre  
PO Box 500  
1400 Vienna  
Austria  
Tel: +43 1 21131  
Fax: +43 1 232156  
Telex 135 612  
and  
Palais des Nations  
CH–1211 Geneva 10  
Switzerland  
Tel: +4122 9171234  
Fax: +4122 9170023  
e-mail: DHA@DHA.UNICC.ORG | Assists the UN system in co-ordinating humanitarian assistance |
| United Nations High Commissioner for Refugees (UNHCR)  
Centre William Rappard  
154, rue de Lausanne  
1202 Geneva 21  
Switzerland  
Tel: +41 22 739 8111  
Fax: +41 22 731 9546  
Telex: 415 740 | Concerned with the international protection of refugees and the promotion of durable solutions for their problems. Often acts as the co-ordinating organization in the field. |
| Food and Agriculture Organisation (FAO)  
via delle Terme di Caracalla  
00100 Rome, Italy  
Tel: +39 6 579 73152  
Fax: +39 6 579 75155 | Soils, vegetation cover and other aspects of land use around the world. |
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Premier Deepwell Handpumps (P) Ltd., Domestic De-fluoridation Unit, India.

Premier Health Care Products (no date) Water Testing Kit. A Simple Field Test for the Detection of Faecal Pollution in Drinking Water, India.


Semat Technical (UK) Ltd., Everything You Want to Know About Coagulation and Flocculation, Semat Technical (UK) Ltd.


Sigma Chemicals Co. (1997) Material Data Sheets, Sigma Chemical Co., UK.


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UNICEF and All India Institute of Hygiene and Public Health (1996a) *A Manual on Water Quality Field Test Kit*. UNICEF, Calcutta Field Office and the All India Institute of Hygiene and Public Health.

UNICEF and All India Institute of Hygiene and Public Health (1996b) *Specification for Water Quality Field Test Kit for Testing 100 Samples*. UNICEF, Calcutta Field Office and the All India Institute of Hygiene and Public Health.


