SECTION 4

RISK ASSESSMENT FOR PRIVATE WATER SUPPLIES

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Private Water Supplies

SECTION 4

SUMMARY 4.1

4.1 Risk Assessment and Hazard Identification – Background and development of the Approach in the UK

Even in the developed world, infectious diseases caused by pathogenic bacteria, viruses and protozoa or by parasites are the most common and widespread health risk associated with drinking water, and such waterborne infectious diseases can be fatal.

4.2 Integrated Drinking Water Management

To ensure safe drinking water, suppliers have been moving away from the limitations of compliance monitoring in favour of a more integrated approach.

Definitions vary, but here **Multiple Barrier Approach** means overlapping water treatments, so that if one layer fails there are others in place. A **Water Safety Plan** (WSP) is wider in scope, meaning everything that can prevent or reduce water contamination – including legislation, standards, training etc. as well as monitoring and treatments.

The World Health Organisation (WHO), defines a WSP as using:
supply system assessment from source to tap
control measures and effective monitoring
management plans for both normal and incident conditions

The basis of the approach is Risk Assessment, and its the aim is to protect public health.

4.3 Historical Development of Approach in the UK

In 1996-97 an outbreak of *E. coli* O157 poisoning from a private water supply in north-east Scotland prompted a scoping study and research to assess and protect private water supplies. The resulting report from The Robert Gordon University and The Macaulay Institute in 1998 concluded that any *quantitative* risk assessment would be highly complex and cumbersome.

4.4 Development of the Approach in the UK

Initial development of RGU/Macaulay Risk Assessment Protocol - the initial risk assessment was *qualitative*, based on the physical nature of the source and whether certain activities occurred within 50m and 250m catchments. Soil was recognised as a key protective component for groundwaters.

Each of the two sections – source character and catchment activities - was scored as being low, medium or high risk and the overall risk assessment taken as the highest risk scored. A revised **Manual on Treatment for Small Water Supply Systems** incorporated this risk assessment system in March 2001.

After a fatal outbreak of *E. coli* O157 traced to a butcher's shop in Wishaw in 1996, the landmark **Pennington Report** of 2000 concluded that most *other* sporadic cases of contamination were actually due to environmental sources.

In 2001, a Task Force on *E coli* O157 recommended that users and owners of private water supplies be educated on the risks of faecal contamination of supplies, and that their sources should be risk assessed and protected.

Further refinement of the Risk Assessment approach - more research was undertaken to validate the original RGU/Macaulay risk assessment approach. Of 33 sites monitored in 2002, none was free of coliform bacteria contamination. The proximity of agricultural land and the timing of rainfall were important factors.

The study suggested the need for wider sampling, but it was felt that risk assessment could help to keep drinking water safe. However, the current approach scored most supplies as High Risk, and a better system was needed.

Water Safety Plan Approach for Private Water Supplies in the UK - the validation study was used to develop a prototype *semi-quantitative* risk assessment in 2004 that included chemical and other contaminants as well as microbiological ones. This risk assessment required development but was preferable to the existing one and could be recalibrated with future data, using, and would use the WHO guidelines where possible.

The resulting index scoring system uses a hazard assessment matrix to pair take the *likelihood* of a given hazard occurring, and multiply it with against the *severity* of its consequences. Its cut-off score of 16 is not a mathematically derived figure. These numbers (1, 2, 4, 8, 16) are convenient indices though, not mathematical probabilities. The cut-off score of 16 is used to prioritise remedial action for each hazard.

4.5 Risk Assessment Guidance

There are four separate sets of guidance for risk assessing each type of supply, i.e. one set each for assessing wells, springs, bore holes and surface supplies.

For visiting and inspecting sites, the same pattern of working is suggested for all four types of supply. This requires relevant site contact details and the use of Ordnance Survey maps in all cases, as well as soil leaching potential maps and/or water sampling equipment in particular cases.

Risk Assessment Pro Formas
Each Risk Assessment requires the completion of a Pro Forma with different sections of questions relating to the supply and the site it is located in. The answers to the questions ("yes", "no" or "don't know") are combined to give an overall risk grading and a set of hazard scores for prioritising remedial actions if the overall risk is high.

The purpose of the guidance sections is to help the assessor answer these pro forma questions conclusively. Where there is uncertainty ("don't know"), the pro forma will always lead the assessor to err on the side of caution and assign a high risk.

Overlapping sections
Many of the pro forma questions (and therefore the items in the guidance sections) are identical for each type of supply, but there are marked differences too:-

Sections A to C are the same in all four risk assessments (and so Items 1 to 22, which relate to very general questions, are the same in each guidance section).

Section D(i) General Site Survey is the same in all four except for two questions that are not included for surface waters. (Items 23 and 39 of the other three.)

Section D(ii) Supply Survey varies slightly or markedly between all four types.

Only **springs and wells** have section D(iii) on **Soil Leaching**, identical in both cases.

Boreholes have additional sections Site and Supply survey sections E(i) and (ii) for Site and Supply surveys for headworks located above ground. E(i) is identical to D(i), while E(ii) is very similar to D(ii).

Overall Risk Assessment
The final section of each pro forma describes how to assign the overall risk category (low, moderate or high) from the hazard scores in the individual sections.

References for the entire section (4.1 to 4.9) are included at the end.

4.6 Well Risk Assessment guidance sections

SECTION A – Supply Details

Item 1 – Supply category.
Type A provides 10 or more cubic metres of water per day, serves 50 or more persons, or is used for commercial or public activity. Any other is Type B.

Items 2-4 concern contact details of key individuals. The 'responsible person' owns or manages the distribution system; the relevant person provides the supply or occupies the land around it. These role(s) may overlap.

Item 5 – details of premises and purposes supplied are essential for scoping the impact of any safety concerns.

SECTION B

Items 6 & 7 – diagram, description and Ordnance Survey grid reference to enable newly visiting colleagues to navigate the supply. How to give a grid reference is explained here.

Item 8 – daily volume. If not metered, estimate the volume based on 200 litres per person per day using a robust estimate of the maximum number of people supplied.

Item 9 – details of *all* water treatment processes, cross-referenced to the diagram in 6.

SECTION C

Item 10 – summary details of any temporary departures granted.

Item 11 – sample results for the last 12 months, so that, e.g. if lead failed previously, then lead sources can be investigated.

Item 12 – previous two investigations and actions, to help resolve if still ongoing.

Item 13 – enforcement notices.

Item 14 – previous risk assessment.

Items 15 & 16 – location and suitability of public notice on water quality.

Item 17 – remedial action needed if (re-)sampling indicates supply quality failure.

Item 18 – whether exempt (i.e. not drinking water or directly affecting food or drink).

Item 19 – other relevant information collated by the local authority.

Items 20-22 relate to whether there is a WSP, and its fitness for purpose.

SECTION D

This section describes how the risk assessment process assigns qualitative risk ratings (low, moderate, high) and numerical hazard assessment scores for a given risk **indicator**, e.g. animal remains being present near the supply.

Each such indicator has a severity score preassigned to it from the scale 1, 2, 4, 8, 16. Similarly, its likelihood score (how often it is thought to be present) is rated on the same scale, though this is done by the assessor, using the guidance notes.

The hazard score is the product of these two scores - severity times likelihood - and is simply an index that can be used to prioritise remedial action, if needed. It can vary from *Rare* x *Insignificant* (1x1=1) to *Almost certain* x *Catastrophic* (16x16=256).

This process is applied to each of the risk indicators (below) relevant to the supply:-

SECTION D (i) General Site Survey

Item 23 – evidence of poor drainage causing stagnant water, e.g. mud or reeds around the wellhead.

Item 24 – evidence of livestock; likely to be permanent.

Item 25 – evidence of wildlife and whether seasonal or persistent.

Item 26 – surface run-off from agriculture; deals with drains and overland flow on farmland.

Item 27 – wastewater irrigation; differs from 26 in applying materials to, as well as disrupting, the soil.

Item 28 – disposal of organic wastes to land, e.g. abattoir waste.

Item 29 – farm wastes relates to middens, bagged silage and other grounded hazards.

Item 30 – remediation of land will typically involve a higher application than in 27.

Item 31 – forestry activity; planting and harvesting can disrupt water supplies.

Item 32 – awareness by agriculture workers, who might ignore or not know of sources.lack of awareness, or consideration, of the supply by agricultural workers.

Item 33 – waste disposal sites such as scrap yards, landfill and incinerator sites can contaminate supplies.

Item 34 – disposal sites for animal remains, including human burial sites.

Item 35 – unsewered human sanitation; the condition and position of septic tanks etc. are very important in preventing leaching.

Item 36 – sewage pipes that cross the source may need special consideration.

Item 37 – sewage effluent lagoons may leach into groundwater.

Item 38 – sewage effluent discharge to adjacent watercourse; e.g. from treatment works.

Item 39 – old wells or supplies can contaminate a new well.

Item 40 – pesticides, including sheep dip.

Item 41 – industrial activity introduces hazards from chemical or pharmaceutical manufacture, mining, electroplating (solvents) etc.

SECTION D(ii) Supply Survey

Item 42 – no suitable stock proof fence (see diagram in main document).

SUMMARY 4.6

Item 43 – no suitable barrier to prevent ingress of flooding (e.g. impermeable cut-off ditch with downslope discharge).

Item 44 – no concrete apron to prevent soil splashing into well.

Item 45 – well top too close to apron to keep out surface flows.

Item 46 – no pre-cast concrete cover slab; a well-fitting, lockable cover is essential to keep out rain, vermin and unauthorised people.

Item 47 – the well construction must itself be in a good state of repair.

Item 48 – supply network must not be liable to fracture e.g. clay or asbestos concrete.

Item 49 – adequate protection of any intermediate tanks, since the potential for contamination via intermediate points is as high as for the source itself.

Item 50 – junctions present in the supply network must have back-siphoning protection (e.g. on permanent hosepipes to provide water for animal troughs).

Item 51 – no maintenance in previous 12 months suggests inadequate care of the supply.

Item 52 – header tank does not have vermin-proof cover; particularly relevant if it feeds the main potable tap.

Item 53 – header tank not cleaned in last 12 months – slime and scum grow naturally on tank walls.

Item 54 – point of entry/use equipment not serviced correctly suggests inadequate care of the supply.

Item 55 – UV lamps not working; a common fault is for UV bulbs to stop working.

Item 56 – noticeable change in level and flow; constancy of supply relates directly to the quality of the source; consider treating as a surface-derived supply.

Item 57 – noticeable change in turbidity or colour after heavy rain or snow melt; the hazard assessment will depend on whether weather or surface influence is the cause.

SECTION D(ii) Soil Leaching Risk Survey

4.6 Background

Introduction – any groundwater can be contaminated through human activity, and there are many factors affecting groundwater vulnerability, including the overlying soil, drift deposits, solid geological strata in the unsaturated zone, groundwater depth and the contaminant itself.

Use of soil information – full assessment of groundwater vulnerability requires actual field investigation but existing environmental data can prove useful. Some **drift deposits** can hinder pollution (although reliable maps may not be available), as can less permeable **aquifers**. **Soil mapping** can be used to

determine how effectively different soils attenuate pollutants, using characteristics such as permeability, wetness, porosity, clay content and parent geological material.

Soil leaching potential maps classify soils into three different leaching classes with Class 1 having the highest vulnerability or soil leaching potential, and Class 3 the lowest. Class 1 and Class 2 have further subdivisions, including an urban class that is assumed to be a worst case until proved otherwise. These maps must be used cautiously but can be helpful when used with soil inspection pits. For large catchments or uncertain source locations, **interpreted soil maps** can be used where available. Both approaches must take account of land use, as even land offering little protection will not be contaminated if no contaminants were introduced.

Other factors affecting groundwater contamination include physical disturbance of aquifers and groundwater flow (e.g. groundwater extraction, landfill and field drainage); waste disposal to land; contaminated land; discharges to underground strata (including sewage treatment); and diffuse pollution (i.e. spread over time).

In conclusion, soil can protect the shallow groundwaters used by many supplies, while for deeper groundwaters, geological factors will also need to be considered. Assessments will use either site inspection or soil maps, with past and present land use a key component.

Surface waters – soil type affects the risk of contamination for surface waters too, in regard to surface run-off and stream expansion after rainfall. Research suggests this is lower for mineral soils and those without a slowly permeable surface layer. Land use will also be a factor (e.g. forestry may reduce contamination; grazed moorland may increase it).

However, surface waters are inherently at higher risk of contamination.

SECTION D(iii) Soil Leaching Potential Survey

The soil category is read from the OS grid reference of the supply on the appropriate soil leaching potential map, and a look-up table is used to assign the hazard score.

A simplified explanation of soil leaching potential is also given.

SECTION D(iv) Overall Risk Assessment for Wells

This is the highest individual risk category present in any of the three surveys.
Hazard scores of 16 or higher indicate priority for remedial work on the supply.

Throughout the risk assessment, any uncertainty implies a high risk.

Section E applies this principle when the type of supply is not known, and **Section F** allows space for additional notes.

Well Risk Assessment Pro Forma
The sections of questions correspond to those in the guidance sections above, with hazard scores and risk characterisations built in.

4.7 Spring Supply Risk Assessment guidance section

Guidance sections A to D(i) for springs are identical to those for wells, above.

D(ii) Supply Survey is the same too, except for items 44-46 as follows:

Item 44 – overflow/washout pipe must be fitted with vermin-proof cap. Mice can get through a gap the size of a pencil diameter.

Item 45 – inlet pipe must have a filter to prevent ingress of detritus.

Item 46 – if chamber present, a lockable water-tight pre-cast cover slab is essential, which should be vermin-proof if ventilated.

Guidance section **D(iii) Soil Leaching** is also identical to that for wells, but the hazard scores in the springs pro forma (Table D1) are higher for spring water.

Section **D(iv) Overall Risk Assessment** for springs is the same as for wells too, as are sections **E and F**.

The **Springs Pro Forma** is therefore almost identical to that for wells.

4.8 Bore Hole Risk Assessment guidance sections

NB: Assessments differ between bore holes with headworks above and below ground.

Guidance sections A to D refer to *all* Bore Holes and these sections are identical to those for wells and springs (see 4.6 Wells).

D(i) General Site Survey for bore holes with headworks **below** ground is the same as that for wells and springs (see 4.6 Wells).

D(ii) Supply Survey relates to Bore Holes with headworks **below** ground, as follows:

Item 42 – below ground chamber not watertight means contaminated surface water could enter the supply.

Item 43 – casing not 150mm above floor means a risk of water entering the chamber or vermin entering the pipe.

Item 44 – a watertight lining cap is essential to seal out material, water and vermin.

Item 45 – a suitable barrier to keep out flooding is essential, e.g. an impermeable cut-off ditch..

Item 46 – chamber top must be 150mm above ground level to keep out surface flows.

(**Note**: Items 47 to 58 are almost the same as items 46-57 for wells, namely:-)

Item 47 – no pre-cast concrete cover slab; a well-fitting, lockable cover is essential to keep out rain, vermin and unauthorised people.

Item 48 – the bore hole construction must itself be in a good state of repair.

Item 49 – supply network must not be liable to fracture e.g. clay or asbestos concrete.

Item 50 – adequate protection of any intermediate tanks, since the potential for contamination via intermediate points is as high as for the source itself.

as items 42-45 for any intermediate tanks, since the potential for contamination via intermediate points is as high as for the source itself.

Item 51 – junctions present in the supply network must have back-siphoning protection (e.g. on permanent hosepipes to provide water for animal troughs).

Item 52 – no maintenance in previous 12 months suggests inadequate care of the supply.no maintenance in previous 12 months suggests inadequate care of supply.

Item 53 – header tank does not have vermin-proof cover; particularly relevant if it feeds the main potable tap.

Item 54 – header tank not cleaned in last 12 months – slime and scum grow naturally on tank walls.

Item 55 – point of entry/use equipment not serviced correctly suggests inadequate care of the supply.

Item 56 – UV lamps not working; a common fault is for UV bulbs to stop working.

Item 57 – noticeable change in level and flow; constancy of supply relates directly to the quality of the source; consider treating as a surface-derived supply.

Item 58 – noticeable change in turbidity or colour after heavy rain or snow melt; the hazard assessment will depend on whether weather or surface influence is the cause.

D(iii) Overall Risk Assessment for headworks **below** ground:
Soil leaching potential assessment is not applied to boreholes, so the overall risk is taken from the site and source surveys only.

E(i) General Site Survey for bore holes with headworks **above** ground is the same as that for wells, springs and other bore holes (see 4.6 Wells).

E(ii) Supply Survey for bore holes with headworks **above** ground is the same as for those with headworks below ground, except for the 1st and 5th items and the higher numbering:-

Item 78 – housing cover must be watertight to exclude surface water and vermin.

Item 79 – casing not 150mm above floor means a risk of water entering the chamber or vermin entering the pipe.

Item 80 – a watertight lining cap is essential to seal out material, water and vermin.

Item 81 – a suitable barrier to keep out flooding is essential, e.g. an impermeable cut-off ditch...

Item 82 – a sloping concrete apron must be provided to keep water off the casing.

Item 83 – no pre-cast concrete cover slab; a well-fitting, lockable cover is essential to keep out rain, vermin and unauthorised people.

Item 84 – the bore hole construction must itself be in a good state of repair.

Item 85 – supply network must not be liable to fracture e.g. clay or asbestos concrete.

Item 86 – as items 42-45 for adequate protection of any intermediate tanks, since the potential for contamination via intermediate points is as high as for the source itself.

Item 87 – junctions present in the supply network must have back-siphoning protection (e.g. on permanent hosepipes to provide water for animal troughs).

Item 88 – no maintenance in previous 12 months suggests inadequate care of the supply.

Item 89 – header tank does not have vermin-proof cover; particularly relevant if it feeds the main potable tap.

Item 90 – header tank not cleaned in last 12 months – slime and scum grow naturally on tank walls.

Item 91 – point of entry/use equipment not serviced correctly suggests inadequate care of the supply.

Item 92 – UV lamps not working; a common fault is for UV bulbs to stop working.

Item 93 – noticeable change in level and flow; constancy of supply relates directly to the quality of the source; consider treating as a surface-derived supply.

Item 94 – noticeable change in turbidity or colour after heavy rain or snow melt; the hazard assessment will depend on whether weather or surface influence is the cause.

E(iii) Overall Risk Assessment for headworks **above** ground:
Soil leaching potential assessment is not applied to boreholes, so the overall risk is taken from the site and source surveys only.

Throughout the risk assessment, any uncertainty implies a high risk.

Section F applies this principle when the type of supply is not known, and **Section G** allows space for additional notes.

Bore Holes Risk Assessment Pro Forma
The sections correspondThe sections of questions correspond to those in the guidance sections above, with hazard scores and risk characterisations built in.

4.9 Surface Supply Risk Assessment guidance sections

Guidance sections A to D for surface supplies are identical to those for wells, springs and bore holes (see 4.6 Wells).

D(i) General Site Survey for surface supplies is the same as for wells etc., but minus the two items concerning drainage and old wells:-

Item 23 – evidence of livestock; likely to be permanent.

Item 24 – evidence of wildlife and whether seasonal or persistent.

Item 25 – surface run-off from agriculture; deals with drains and overland flow on farmland.

Item 26 – wastewater irrigation; differs from 25 in applying materials to, as well as disrupting, the soil.

Item 27 – disposal of organic wastes to land, e.g. abattoir waste.

Item 28 – farm wastes relates to middens, bagged silage and other grounded hazards.

Item 29 – remediation of land will typically involve a higher application than in 26.

Item 30 – forestry activity; planting and harvesting can disrupt water supplies.

Item 31 – awareness by agriculture workers, who might ignore or not know of sources. Lack of awareness, or consideration, of the supply by agricultural workers.

Item 32 – waste disposal sites such as scrap yards, landfill and incinerator sites can contaminate supplies.

Item 33 – disposal sites for animal remains, including human burial sites.

Item 34 – unsewered human sanitation; the condition and position of septic tanks etc. are very important in preventing leaching to streams.

Item 35 – sewage pipes that cross the source may need special consideration.

Item 36 – sewage effluent lagoons may leach into groundwater.

Item 37 – sewage effluent discharge to adjacent watercourse; e.g. from treatment works.

Item 38 – pesticides, including sheep dip.

Item 39 – industrial activity introduces hazards from chemical or pharmaceutical manufacture, mining, electroplating (solvents) etc.

D(ii) Supply Survey

This has all but the first six items from the wells supply survey in 4.6:-

Item 40 – supply network must not be liable to fracture e.g. clay or asbestos concrete.

Item 41 – intermediate tanks should be as protected as the source, since the potential for contamination via intermediate points is as high as for the source itself.

Item 42 – junctions present in the supply network must have back-siphoning protection (e.g. permanent hosepipese.g. on permanent hosepipes to provide water for animal troughs).

Item 43 – no maintenance in previous 12 months suggests inadequate care of the supply.

Item 44 – header tank does not have vermin-proof cover; particularly relevant if it feeds the main potable tap.

Item 45 – header tank not cleaned in last 12 months – slime and scum grow naturally on tank walls.

Item 46 – point of entry/use equipment not serviced correctly suggests inadequate care of the supply.

Item 47 – UV lamps not working; a common fault is for UV bulbs to stop working.

Item 48 – noticeable change in level and flow; constancy of supply relates directly to the quality of the source; consider treating as a surface-derived supply.

Item 49 – noticeable change in turbidity or colour after heavy rain or snow melt; the hazard assessment will depend on whether weather or surface influence is the cause.

Overall Risk Assessment
Soil leaching potential assessment is not applied to surface supplies, so the overall risk is taken from the site and source surveys only.

Throughout the risk assessment, any uncertainty implies a high risk.

Surface Supply Risk Assessment Pro Forma
The sections of questions correspond to those in the guidance sections above, with hazard scores and risk characterisations built in.

Private Water Supplies

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4. RISK ASSESSMENT FOR PRIVATE WATER SUPPLIES

4.1 Risk assessment and hazard identification – Background and development of the approach in the UK

Nowadays, most Europeans take clean drinking water for granted. However, in the WHO European region – covering Western Europe, central and eastern Europe and the countries of the former Soviet Union – there are 120 million people without a regular supply of safe water. Cleaner water and better sanitation could prevent over 30 million cases of water-related disease each year in this region alone.[1]

Infectious diseases caused by pathogenic bacteria, viruses and protozoa or by parasites are the most common and widespread health risk associated with drinking water. Waterborne infectious diseases can be fatal; globally, two million people die from diarrhoea every year; in the WHO European region alone, over ten thousand children under five die of diarrhoea. Although the problem is not as acute as in the developing world, also in the WHO European region thousands of people suffer from infectious disease caused by poor quality water, or are affected by water-related diseases. For example, a large proportion of gastrointestinal disease comes from water.[1]

4.2 Integrated drinking water management

Traditionally, drinking water suppliers have relied heavily on a process called compliance monitoring to ensure water is safe to drink. Compliance monitoring relies on sampling small amounts of water in a drinking water system and testing those samples for the presence of known and quantifiable organisms or contaminants. If those samples comply with established requirements for drinking water quality, the water is considered safe to drink. However, this approach has major limitations in its sampling and monitoring techniques and in the range of factors that affect drinking water quality that can be considered. For instance, compliance monitoring only deals with microbiological pathogens and/or contaminants for which a prescribed numerical guideline value or established method of analysis has been developed, making it nearly impossible to address the entire range of potential health concerns. Sample analysis also takes time, during which period consumers will be drinking the water. If the water is contaminated, some people may become ill before the problem is identified and resolved. In order to address these limitations, the drinking water industry has been shifting focus in recent years to using more integrated approaches to drinking water management.[3]

The concept of multiple barriers for drinking water sources has applied for over a hundred years but, unfortunately, there is no single, widely accepted definition of precisely what the term encompasses [4]. The term can mean having "defence in depth" through having layers of treatment that "overlap" by removing (or having the potential to remove) similar contaminants so that if one layer should fail the remaining processes will ensure treatment is maintained. However, the term "multiple barrier approach" can also have a wider remit encompassing source protection, treatment, distribution system, monitoring and responses to adverse conditions [4].

The multiple barrier approach has been defined as "an integrated system of procedures, processes and tools that collectively prevent or reduce the contamination of drinking water from source to tap in order to reduce risks to public health"[3]. Under this approach all potential control barriers are identified along with their limitations. The barriers can be physical, such as the installation of a filtration system in a drinking water treatment plant, or they can be processes or tools that improve the overall management of a drinking water programme. Examples of the latter include legislation and policies, guidelines and standards, staff training and education, and communications strategies that programme staff may use to communicate with the media or the public.[3]

The latter definition of multiple barrier (or multi barrier) approach is very close to the concept of "water safety plan" and it is perhaps better to use this term when describing such wide-ranging approaches to drinking water safety, and retaining the term "multiple barrier approach" to define the concept of systems back-up such that should one system fail consumers are still protected by other complementary treatment systems[5]. This leads to the question "What is a water safety plan?"

"The most effective means of consistently ensuring the safety of a drinking water supply is through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer."[2] The WHO Guidelines for Drinking-water Quality 3rd edition (2004) define such an approach as "water safety plans (WSPs)".

The WHO state that a WSP has three key components which are guided by health-based targets and overseen through drinking-water supply surveillance. They are:

(i) system assessment to determine whether the drinking water supply chain (up to the point of consumption) as a whole can deliver water of a quality that meets health-based targets. This also includes the assessment of design criteria of new systems;
(ii) identifying control measures in a drinking water system that will collectively control identified risks and ensure that the health-based targets are met. For each control measure identified, an appropriate means of operational monitoring should be defined that will ensure that any deviation from required performance is rapidly detected in a timely manner; and
(iii) management plans describing actions to be taken during normal operation or incident conditions and documenting the system assessment (including upgrade and improvement), monitoring and communication plans and supporting programmes.[2]

The Guidelines go on to state:

"The primary objectives of a WSP in ensuring good drinking water supply practice are the minimization of contamination of source waters, the reduction or removal of contamination through treatment processes and the prevention of contamination during storage, distribution and handling of drinking water. These objectives are equally applicable to large piped drinking water supplies, small community supplies and household systems and are achieved through:

- development of an understanding of the specific system and its capability to supply water that meets health-based targets;
- identification of potential sources of contamination and how they can be controlled;
- validation of control measures employed to control hazards;
- implementation of a system for monitoring the control measures within the water system;
- timely corrective actions to ensure that safe water is consistently supplied; and
- undertaking verification of drinking water quality to ensure that the WSP is being implemented correctly and is achieving the performance required to meet relevant national, regional and local water quality standards or objectives."[2]

The aim for regulatory authorities and practitioners in the early part of the 21st century is to realise the goals set out by the WHO through incorporation of the water safety plan (WSP) approach into corporate systems as well as national (and international) water quality standards and objectives. This paper describes how the concept of risk assessment for private water supplies arose and has developed to a point where risk assessment will form the basis of the regulatory regime for private water supplies in the UK, and from their current status as embryonic WSPs how they may further develop into a mature WSP, thereby achieving the aim of incorporation of the WSP approach into national legislation to enhance the protection of public health for consumers of drinking water from private water supplies.

4.3 Historical development of approach in the UK

During the autumn of 1996 and early 1997 a spate of outbreaks of *E. coli* O157 infections resulted in the deaths of 20 elderly people in Scotland although not all outbreaks caused deaths to occur[6]. One of these non-fatal outbreaks was attributable to a private water supply at Dunecht in north-east Scotland:

> "The private water supply was provided and maintained by an estate for the use of a number of properties within its boundaries. The original supply was constructed around 1945 using water derived from a surface spring source. Asbestos-lined pipes were used to take the water to a primary tank located 250 metres away. The water was then pumped up to a header tank 500 metres from the primary tank where it was distributed to a number of houses. Over the years the spring had disappeared but the pipes continued to bring water into the supply. The distribution downstream of the header tank had also been recently modified with an additional spur constructed using piping made from modern material. The area around the primary collection tank was pasture on which cattle were frequently grazed. There was a marked gradient on the field dropping toward this tank.
>
> "Eleven properties were supplied by the main header tank and 41 people utilise the water supply. The outbreak consisted of 13 cases of enteritis with diarrhoea of varying severity. Seven of these individuals had positive stool samples for *E coli* O157. A further asymptomatic excretor was also discovered during the screening undertaken as part of the management of the incident. All had consumed water from the estate supply.
>
> "A survey of the system revealed a number of interesting points. The pump house was well maintained and the water within the tank appeared to be clear. There were no obvious areas of disrepair and no signs of water entering the tank other than through the feeder pipe. Few individuals could remember the spring as a surface feature and the exact location of the source remained unclear. Inspection of the header tank revealed it to be in need of some repair. The inspection hatch was broken and the roof area showed signs of rainwater accumulation. The structure was located in a remote spot and there was evidence of animal faecal contamination on the roof of the tank.
>
> "Water samples taken from domestic taps demonstrated the presence of faecal coliforms and a boil water notice was issued to prevent further illness. Although the header tank was a possible source of the contamination, given the results of the inspection, the geography of the system did not rule out the pump house. Indeed, a sample taken from this tank also showed the presence of faecal coliforms. An adjacent field used for grazing sloped down towards the pump house and there was ample evidence to show that cattle had been present in the field for some time.

> "Laboratory studies confirmed the presence of *E. coli* O157 in water taken from the pump house and from faecal material collected from the field. The grazing cattle were also shown to be positive for the organism too. Isolates from the animals, water and environmental samples were indistinguishable from those recovered from the affected individuals. The water from the supply continued to be unsatisfactory for a considerable time in spite of the remedial action undertaken by the estate." [7]

This incident prompted the then Scottish Office to send a circular [8] to local authorities alerting them to the risk of *E. coli* O157 infection from private water supplies and suggesting an approach to managing the risk. The Scottish Office also prepared a leaflet ("Keeping It Safe") for local authorities to send to all owners and users of private water supplies, this was issued in July 1997.

The Scottish Office also commissioned a scoping study to consider the need for further research into the risk posed by *E. coli* O157 to water supplies. The work was awarded to a group from WRc and the main findings of the study were:

(i) A review of the literature revealed that because of the predominance of food associated infections and outbreaks, past and current research had focused on agricultural sources of *E. coli* O157 and how it entered the food chain – there was a marked absence of research specifically directed at studying *E. coli* O157 in water.
(ii) There was no evidence to indicate that *E. coli* O157 was more persistent in the environment or more resistant to water treatment processes than non-pathogenic *E. coli* found in the gastro-intestinal tract.
(iii) Except in the case of humans with a severe infection, the number of *E. coli* O157 in faecal material would be several orders of magnitude lower than the concentration of other *E. coli* serotypes. It was tentatively concluded that existing microbial standards for drinking water quality should be adequate. However, because the infective dose of *E. coli* O157 appeared to be low, drinking water supplies which only just achieved compliance with coliform and *E. coli* standards should be regarded as being at risk.
(iv) Private water supplies may require barriers to prevent contamination by *E. coli* O157 and other enteric pathogens and this should be achieved by better source protection, the use of point of use devices, or a combination of both.
(v) Future research must concentrate on obtaining better information on the fate of *E. coli* O157 in the environment, ensuring that it is removed by normal water treatment processes and identifying the most acceptable and cost-effective means of protecting private water supplies. [9]

The Scottish Office took the findings of the scoping study and acted on them by commissioning research projects to investigate the fate of *E. coli* O157 in the environment and to develop a methodology for improved source protection for private water supplies.

In a separate development the Drinking Water Inspectorate in England and Wales, acting also on behalf of Northern Ireland and Scotland, commissioned and published a Manual on Treatment for Small Water Supply Systems [10].

The Scottish Office commissioned the project “Improved source protection for private water supplies” in January 1998 and the final report was produced in June 1998 [7] from a consortium led by The Robert Gordon University and Macaulay Institute, both located in Aberdeen. The design of the risk assessment protocols required cognisance to be taken of the multifactorial nature of hazards that could impact upon any given source. Much of the scientific evidence regarding microbiological hazards exists without reference to the importance of such hazards in specific physical situations. There was also a lack of evidence regarding synergistic interactions between such microbiological hazards. In addition, in order to provide consistent and reliable assessments the possibility of subjectivity in a quantitative system needed to be reduced to as low a level as possible. Given the complexity of the individual situations concerning private water supplies (for example, location, size, construction and maintenance regime – if any!), any quantitative risk assessment system could have become highly complex and cumbersome and would have ceased to conform to the user-friendly requirement of the system.

4.4 Development of the approach in the UK

4.4.1 Initial development of RGU/Macaulay risk assessment protocol

The initial risk assessment was a qualitative risk assessment that identified all the specific activities that were hazardous to the maintenance of good microbiological water quality at the source. Hazards were placed into two main categories based on their proximity to the source – those within 50 metres' radius of the source and those within 250 metres of the source. Factors associated with the 50 metres radius were primarily concerned with the physical nature and construction of the source and were scored as high, medium or low risk based on a presence/absence system. The different types of sources (e.g. wells, springs, boreholes, rivers/streams) would not necessarily have the same risk factors associated with them requiring source-specific risk assessment protocols to be developed.

The importance and potential influence of soils and substrates, on private water supply systems, particularly those derived from groundwater systems, was recognised as an important component of any risk assessment system from the start of the project. The soil can offer a degree of protection to the contamination of groundwater through its ability to buffer (chemically and biologically) potential contaminants and to act as a physical barrier. These attributes can vary considerably between different soil types and between the different layers, or "horizons", within the soil. Some soils have a greater propensity for preferential flow than others, that is, contaminated water can by-pass the filtering ability of the soil matrix, and fluctuations in soil wetness can enhance transport of pathogens through the soil to shallow groundwaters. Although site inspection of the soil properties is desirable it requires considerable expertise. In recognition of this, a series of maps were produced indicating the ability of the soil to buffer pathogens and other potential contaminants.

A second group of hazards relating to activities undertaken near the source that had the potential to introduce microbiological contamination to the source water were also identified. These activities were divided between those occurring within 50 metres' radius of the source and those occurring within 250 metres' radius of the source – such radii relating to the recommended Arbitrary Fixed Radius Circle values (AFRCs) detailed by NRA at $AFRC_{50}$ and MAFF at $AFRC_{250}$ respectively [11,12].

Upon completion of the risk assessment each of the two sections was scored as being low, medium or high risk and the overall risk assessment for the source was determined by applying the highest level of risk from the individual sections.

Throughout the development of the risk assessment approach each phase of the developing assessment system was tested and evaluated in the field with the researchers and practising experts (environmental health officers). This partnership approach ensured that the final risk assessment system was practicable, user-friendly and robust.

The risk assessment protocol was launched at a series of roadshow events in Scotland in late 1998 held jointly by the Scottish Office and the Royal Environmental Health Institute for Scotland (REHIS) – the professional body representing environmental health officers in Scotland. REHIS, through the Public Health and Housing Working Group's Private Water Supplies Sub-group, were developing a "Manual of Best Practice for Environmental Health Officers and Support Staff" which was published in March 2000[13] and incorporated the elements of the RGU/Macaulay risk assessment system presented in 1998.

4.4.2 Manual on treatment for small water supply systems

During 2000 the Drinking Water Inspectorate recognised the need to update their earlier Manual to take account of developments in the area of private water supplies. The revised second edition of the Manual on Treatment for Small Water Supply Systems was published in March 2001[14] and it too incorporated the elements of the RGU/Macaulay risk assessment system.

4.4.3 Pennington Report and Task Force on *E. coli* O157

In November 1996 21 elderly people died in Wishaw, Scotland, 17 of whom were subsequently found to have been affected by *E. coli* O157. In total 496 persons were thought to have become ill after consuming meat products from a butcher's shop in Wishaw, and which were found to have been distributed widely throughout Central Scotland. The landmark Report of the group led by Prof. Hugh Pennington looked closely at procedures for preparation and sale of raw and cooked meat products, and made 32 recommendations on the management, distribution and handling of such products. The findings of the Fatal Accident Inquiry into the Central Scotland Outbreak gave added weight to the factors identified in the Pennington Report[15].

In the wake of the Pennington Report numerous research projects were commissioned and by mid-2000 much of this work on animal sources and case control studies came to a conclusion. In June 2000 the results of this research were made public at an Open Forum in Edinburgh. The significant finding overall was that the majority of sporadic cases[a] lay in environmental sources rather than in the food chain; however, the food chain retained potential to cause large numbers of cases from particular events. The Scottish Executive (the successor to the Scottish Office following devolution in 1999) together with the newly-created Food Standards Agency in Scotland (FSAS) identified a requirement to place this research output into a practical plan for action highlighting the range of sources of infection. The result was the creation of a Task Force on *E. coli* O157 which commenced its work in September 2000 and presented its final report in June 2001. The Task Force was set up with the deliberate brief to be open and consultative, to gather information widely from scientific and professional sources and from practitioners and patients. Membership of the Task Force was from throughout the UK and while it was convened under the auspices of the Scottish Executive, the recommendations were to apply to the UK through the appropriate devolved or national agencies or Government departments. The desired output from the Task Force was to be a practical action plan to improve the protection of the public from infection by *E. coli* O157.

[a] Single cases of disease apparently unrelated to other cases

As part of the work of the Task Force water supplies were considered – both public and private water supplies. Part of the evidence provided by the drinking water regulatory team in Scotland to the Task Force related to the RGU/Macaulay risk assessment approach and the Scottish Executive's desire to incorporate the approach within the revision of the Regulations covering private water supplies in Scotland. This approach was also endorsed by the drinking water regulators in the rest of the UK (England, Wales and Northern Ireland). The Task Force recommended, in relation to private water supplies, that users and owners should be educated on the risks associated with faecal contamination of private water supplies; that appropriate works should be undertaken to protect and stock proof the sources of private water supplies and that a microbiological risk assessment protocol should be applied to all private water supplies.

The Scottish Executive accepted the recommendations of the Task Force and has been adopting the recommendations. The Scottish Agricultural Pollution Group was asked to take appropriate account of the relevant recommendations as part of the planned process of reviewing and updating the Code of Good Practice – Prevention of Environmental Pollution from Agricultural Activity (PEPFAA)[16]. The leaflet "Keeping It Safe" was updated and distributed to all local authorities in Scotland in December 2001[17]. The question of risk assessment and other issues were identified in "Private Water Supply Regulation: A Consultation" which was published in November 2001[18].

4.4.4 Further refinement of the Risk Assessment approach

In 2001, prior to the publication of the consultation paper on private water supply regulation in Scotland, the Scottish Executive commissioned research from a consortium led by The Macaulay Land Use Research Institute, Aberdeen and included the Centre for Research into Environment and Health and University of Aberdeen. The research was undertaken to validate the original RGU/Macaulay risk assessment approach in order to provide additional evidence to support the incorporation of the approach into the proposed new regulatory regime. The final report was delivered in March 2003 [19].

A total of 33 sites in North-east Scotland were monitored throughout 2002. The proportion of source types in the study reflected the proportion of supplies in each of the Private Water Supply Regulations (1992) [20] categories that occur nationally and included sources on a range of land uses such as arable agriculture, grazed pastures, woodland and moorland. The type of supplies within the sampling network included wells tapping shallow groundwater; springs; surface flow to reservoirs or holding tanks; and field drainage collection systems.

No source sampled was free of coliform bacteria contamination over the 12 consecutive months of sampling. The results showed that there was a greater degree of contamination in sources surrounded by agricultural land compared with moorland or woodland despite the weak statistical relationship between the presence of domestic stock and levels of contamination, and may simply be reflecting a greater population of bacteria associated with the more fertile land.

In the study rainfall appeared to be an important driver of contamination either by inducing overland flow (which was observed in a number of instances) or by enabling the transport of bacteria to the groundwater. However, it was found that the amount of rainfall was less important than the timing of heavy or prolonged rainfall events. The heavy rainfall would be more likely to induce by-pass flow during infiltration and overland flow when the soils became saturated. The water sources associated with soils that were naturally wet were found to be at greater risk of contamination. In these soils near-saturated conditions would be reached in less time than in freely drained soils and they often occur in topographic hollows where excess overland flow could gather.

The results agreed well with other studies but concluded that the complex nature of private water supplies may mean that any validation of such an approach would not be possible without a considerable increase in the number of sources sampled. However, the authors also stated that, intuitively, the individual components of the risk assessment would seem to encompass the main factors likely to affect the quality of water supplies and so the risk assessment could be viewed as a tool to aid risk identification which would allow the integrity of supplies to be strengthened. The main concern over the approach was an apparent lack of differentiation within the resulting scores with most supplies being scored as High Risk. A greater degree of resolution was felt to be desirable in any system such that appropriate action plans could be devised and implemented in an achievable manner.

4.4.5 A Water Safety Plan approach for private water supplies in the UK

The conclusions from the validation study were carried forward and widened to encompass the other constituent parts of the UK. The data collected were used to verify other approaches to risk assessment following a workshop convened at Peebles, Scotland in early April 2003, hosted by the Scottish Executive. Key stakeholders were able to present and discuss their approaches to risk assessment as applied to private water supplies and a prototype quantitative risk assessment was developed and applied to several data sets in Wales and Scotland. The workshop delegates agreed the assessment should not limit itself to only microbiological parameters and potential sources of chemical and other contaminants should be considered also. The goal of the revised risk assessment was to achieve the greater resolution within the assessed risk for each private water supply – a weakness in the original system. It was felt that the introduction of a semi-quantitative approach would provide this desired output.

Several key data sets relating to private water supplies, their source and distribution system details and water quality details were identified and reanalysed using the semi-quantitative risk assessment system that emerged from the workshop. This work was undertaken by The Macaulay Institute and the Centre for Research into Environment and Health and the final report (Analysis of Risk Protocol Options for Private Water Supplies) was presented in March 2004[21]. The conclusions from the work were:

(i) there were doubts as to whether the data sets utilised were sufficiently comparable to justify combination into a unified data matrix. This appeared to be an artefact of the sampling strategies employed in the studies that generated the original data sets.

(ii) Although weak in many cases, the correlation with rainfall made it difficult to validate the quantified risk assessment scoring systems. The most likely reason suggested by the researchers for this was that the 'noise' in the data, which was produced by rainfall (a non-risk-related factor), was so great that it was masking the 'signal' derived from the risks indexed in the data sets.

(iii) To effect better calibration of a quantitative risk index, it is likely that additional, and greater, resolution sampling would be required, which was specifically designed to discriminate between the 'rainfall effect' and catchment risk factors. With such enhanced data it would be possible that more sophisticated statistical analyses would be able to identify other contributing factors.

(iv) The present regulatory regime, particularly for Category 1F supplies[b] is clearly unsatisfactory and a risk scoring system would certainly be preferable to the *status quo* even without firm empirical data to fully calibrate a set of score weights and derive a fully quantitative risk assessment.

(v) Movement towards a scoring system which could be subject to subsequent re-calibration if suitable data are acquired would be prudent. In the interim, such a system would be a valuable tool for indicating weaknesses in the supply system that can be improved.

The results of the study were circulated to the original participants of the April 2003 workshop, and another meeting of the group was convened in Edinburgh in July 2004. The results of the March 2004 report and associated developments with water safety plans and the Bonn Charter were discussed. The meeting agreed with the conclusions of the March 2004 report and that a pragmatic decision should be taken to refine the original risk assessment system with a view to reviewing the opportunity for developing a more quantitative approach once sufficient data had been acquired through the use of the risk assessment within the new Regulations governing private water supplies. It was also agreed that, wherever possible, the WHO Guidelines for Drinking Water Quality (3rd Edition)[2] guidance on water safety plans should be incorporated into the revised risk assessment protocol.

The final version of the risk assessment protocol intended for incorporation into the revised Regulations governing private water supplies was developed during autumn 2004 and circulated for final approval/organisational affiliation in December 2004. The final risk assessment form retains the original structure with a series of questions relating to different parts of the private water supply system. The original risk assessment is now termed "Risk Characterisation" and is still based on a presence/absence scoring system. In conjunction with each risk characterisation question there is also an associated "Hazard Assessment" score which has been derived from the WHO Guidelines. The risk index (Figure 1) is intended to provide the much sought-after differentiation for undertaking remedial/intervention works. The risk cut-off is proposed as being 16 – but it should be stressed that this is an index and has no implied mathematical relationship to risk, it is merely a convenient way of prioritising actions where there may be resource conflicts.

[b] Category 1F supplies are single dwellings with no commercial activity associated with them. Private Water Supplies (Scotland) Regulations 1992 (1992 No. 575 (S.64)). http://www.opsi.gov.uk/si/si1992/Uksi_19920575_en_1.htm

Figure 1 – Hazard assessment matrix

	Severity of consequences				
Likelihood	**Insignificant**	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	16	32	64	128	256
Likely	8	16	32	64	128
Moderately likely	4	8	16	32	64
Unlikely	2	4	8	16	32
Rare	1	2	4	8	16

4.5 Risk assessment guidance

The following sections provide detailed instructions and guidance for the completion of each of the items contained in the risk assessment forms. A separate set of guidance is presented for each of the four risk assessment forms – well, borehole, spring and surface derived supplies. While each form has some common sections, guidance for each complete form is given for ease of reference.

It is important to understand that under most circumstances it will be appropriate to combine the risk assessment investigation with some sampling in order that the quality of the water can be assessed in conjunction with the risk investigation. Such sampling will be undertaken at a domestic (potable) tap from premises served by the supply. Additional sampling may be required as part of investigative work, e.g. at source or intermediate tanks.

The following list provides a suggested pattern to follow when undertaking a risk assessment investigation.

(1) Identify the private water supply on which to undertake the risk assessment investigation.
(2) Confirm with the relevant person or persons who will be an appropriate contact person.
(3) Arrange with contact person identified from (2) a mutually agreeable date/time/location to meet and undertake the investigation. **Note that the risk assessment is principally based around the source of the supply.**
(4) Ensure that an appropriate premise will also be available for sampling and make necessary arrangements to take a sample of the drinking water.
(5) Prepare risk assessment forms prior to site investigation completing all sections that require historic or archived data.
(6) Ensure that appropriate maps (soil leaching potential and Ordnance Survey 1:50,000) for the likely area of the source are available and take to site investigation meeting.
(7) Ensure that appropriate sampling equipment and containers are available and take to site investigation meeting.
(8) Undertake site risk assessment investigation.
(9) Undertake appropriate sampling activities at location(s) identified in (4).
(10) Collate results of sampling activity into risk assessment form
(11) Complete risk assessment form including any additional information requested at time of site investigation.
(12) Record and file complete risk assessment form.
(13) Send a copy of the completed risk assessment to the relevant person(s) for their records.

4.6 Well risk assessment (see 4.6 Annex 1 for full form)

Overall Risk – this is taken from the overall risk assessment in section D(iv)(a) of the risk assessment form.

SECTION A – Supply Details

Item 1 – Supply Category

The supply category that is required to be identified is taken from The Private Water Supplies (Scotland) Regulations 2006 Part 1(2). These state:

"Type A supply" means a private water supply for human consumption purposes which

(a) on average, provides 10 or more cubic metres of water per day or serves 50 or more persons, or
(b) regardless of the volume of water provided or the number of persons served, is supplied or used as part of a commercial or public activity,

and references in this definition –

(i) to the average volume of water provided by such a supply, are references to such volume (calculated as a daily average) as may be reasonably estimated to have been distributed or, if not distributed, used or consumed from the supply during the year prior to the year in which these Regulations come into force; and that estimate may be on the assumption that five persons use one cubic metre of water per day; and
(ii) to the average number of persons served by such a supply, are references to such number of persons as may be reasonably estimated to be the maximum number served by the supply on any one day during the year prior to the year in which these Regulations come into force;

"Type B supply" means a private water supply other than a Type A supply; and "year" means a calendar year.

Item 2 – Address and telephone number of responsible person

"Responsible person" is a term used in the Regulations referring to the person who owns or otherwise is responsible for the domestic distribution system which includes the pipework, fitting and appliances which are installed between the taps that are normally used for human consumption purposes and the distribution network which is not the responsibility of a relevant person (see Item 3). Full contact details of the responsible person should be recorded here.

Item 3 – Name of person (or persons) who is relevant person in relation to the supply

The term “relevant person” refers to the person considered by the local authority to be the person providing the supply, or occupying the land from, or on, which the supply is obtained or located, and any person who exercises powers of management or control in relation to the supply.

The relevant and responsible person may be one and the same person in some instances.

In some instances there may be more than 3 relevant persons in which case additional sheets should be used to record the information and details of these additional sheets should be included in section (d) and the sheets appended to the form when completed.

Item 4 – Address of relevant person (or persons) (if different from above)

Where the responsible person and the relevant person are different then the contact details for the relevant person or persons should be recorded in this section.

In some instances there may be more than 3 relevant persons in which case additional sheets should be used to record the information and details of these additional sheets should be included in section (d) and the sheets appended to the form when completed.

Item 5 – Details of premise(s) served by the supply and purpose for which water is supplied

This item seeks to capture details of any premise that may be served by the supply and the purpose for which the water is being supplied. It is necessary to have as complete a list of properties served by a private water supply as possible in order that the true interconnectivity of the supply may be assessed and the potential population affected by any breach of the Regulations or incidence of waterborne disease outbreak can be assessed rapidly and efficiently. For larger supplies this exercise will be challenging but attention to detail will ensure that the most comprehensive and accurate records are compiled which will assist in future investigations relating to the supply.

Additional sheets (as required) should be appended to the form and a note of these made at section (d).

SECTION B

Item 6 – Diagram of the supply

This is intended to enable the investigating officer to provide a schematic sketch showing the interrelationships between the various components of the supply such as source, intermediate tanks and properties being supplied. While there is undoubtedly a balance to be struck between too much detail and insufficient detail, a guiding principle should be to provide sufficient information to enable colleagues who have not visited the site to quickly navigate around the supply.

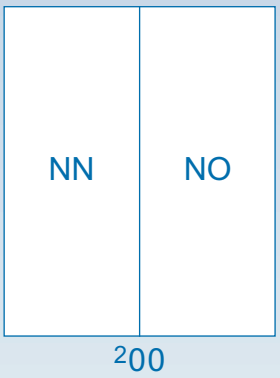
Item 7 – Description of the source of the supply

The description provided should complement the schematic sketch provided at Item 6. The purpose of having a written description is to provide a record of the condition of the infrastructure at the time of the risk assessment. This will enable a baseline to be established against which any future developments made to the supply can be benchmarked. If the facility exists it would be appropriate to also include relevant photographic evidence of the various components so long as they are uniquely identified and cross-referenced within the risk assessment report.

A full National Grid Reference for the source (or the closest point to the source identified) should also be provided.

How to give a grid reference to nearest 100 metres

The example below is taken from Ordnance Survey Braemar to Blair Atholl Sheet 43 1:50000 Landranger Series.

100 000 metre Grid Square Identification	Example - Altaltan			
	1. Read letters identifying 100 000 metre square in which the point lies.	NO		
	2. FIRST QUOTE EASTINGS Locate first VERTICAL grid line to LEFT of point and read LARGE figures labelling the line either in the top or bottom margin or on the line itself. Estimate tenths from grid line to point.		18 4	
	3. AND THEN QUOTE NORTHINGS Locate first HORIZONTAL grid line BELOW line either in the left or right margin or on the line itself. Estimate tenths from grid line to point.			63 5
	EXAMPLE REFERENCE	NO	184	635
Ignore the smaller figures of any grid number: these are for finding the full coordinates. Use ONLY the LARGER figure of the grid number. Example: 280 000m				

Extract from 1:50 000 sheet 43 showing location of Altaltan

Item 8 – Estimated daily volume of water provided by the supply

If the volume of water is not being measured, e.g. via a water meter, then the investigating officer can make an estimate of the volume based on 200 litres of water per day per person served by the supply. While the figure will only be an estimate every effort should be made to identify the maximum number of people who are being supplied with water from the supply. It is not sufficient just to base the estimate on historical records, e.g. the classification of the supply made under previous regulatory frameworks. It is important to have a robust and defensible maximum occupancy for the supply as this may well have an impact on the sampling frequency to which the supply is subjected.

Item 9 – Details of any water treatment processes associated with the supply

While it is important to document any treatment that occurs on the supply it is not practicable to list all possible treatment types or systems that may be encountered. The risk assessment form concentrates on the provision of standard disinfection equipment/processes but all other treatment systems should be included in the description including items such as sediment traps of pH correction systems. Each of the treatment processes should be cross-referenced to those identified on the schematic provided at Item 6.

For larger systems it will not be practicable to complete Item 9 (c) and so a table should be drawn up listing the properties and the treatments associated with each property differentiating between point of entry and point of use devices, e.g.:

Responsible Person	Property address (including post code)	Point of entry device (specify)	Point of use device (specify)	Notes
Mr D Able	1 Wellside Cottage, Nethermuir, ZZ1 1AA	UV lamp	None	located in lean-to on north side of house, pre-filter bypassed
Mrs C Brown	3 Wellside Cottage, Nethermuir, ZZ1 1AA	UV lamp	None	On maintenance contact with Bloggs Plumbing, Nethermuir
Ms B Charlie	Springside House, By Nethermuir, ZZ1 2BA	None	UV lamp	Under sink in kitchen – poor access for changing bulb
Rev. A Davis	Riverbank Cottage, Nethermuir, ZZ1 1AB	None	None	

These details should be recorded as additional sheets on the form at Item 9 (d)

SECTION C

Item 10 – Details of departures authorised

Provide details of any temporary departures granted under Part IV of the Private Water Supplies (Scotland) Regulations 2006. These details should summarise the details provided in the original temporary departure and should cross-reference to the complete application. If applicable the temporary departure authorisation (Regulation 6(7) of the above Regulations) can be appended to the risk assessment. Details of this should be recorded in Section F.

Item 11 – Details of sample results for previous 12 months or last available (reference location of information, e.g. paper or electronic files, reference number, sample numbers, etc.)

The inclusion of this information is to assist the investigation officer in their investigations. Details of the previous sampling results will enable areas of concern to be highlighted and assist in focusing on areas where actual breaches of the drinking water quality standards have occurred. For example, if lead is highlighted as failing in the sample results, while lead is not specifically being looked for in the risk assessment, the investigation officer may take the opportunity of the investigation to attempt to determine whether there are any known lead pipes or tanks associated with the supply or through examination of the appropriate geological map whether lead is naturally occurring in the vicinity of the source. If lead pipes or tanks are present then appropriate advice can be provided on the need for their removal; if lead is naturally occurring at the source then discussions around locating a more acceptable alternative source for the supply can be entered into.

Item 12 – Details of previous (last two) investigations and actions taken

If there have been investigations into previous failures then the last two such investigations should be summarised here along with the actions that were taken or were understood to have been agreed to have been taken. This information will provide the investigation officer with a background to the problems that have been encountered previously along with an understanding of what actions have been attempted to improve the situation and whether these actions have proved to be successful. If they have proved to be unsuccessful then this information will allow the investigation officer to consider alternative solutions that have not been previously implemented.

Item 13 – Details of enforcement notices served

If any enforcement notices have been served that affect the supply under investigation, details of these should be provided here. If necessary additional information may be appended to the risk assessment and details of these should be provided in Section F.

Item 14 – Results of previous risk assessment (if applicable)

If the source or supply has previously been risk assessed then the details of the previous risk assessment(s) should be included with the current risk assessment. The previous risk assessments should be appended to the current form and details of these additional sheets should be recorded against this item.

Item 15 – Details of location of Notice for Type A supplies (location)

Regulation 31 of the Private Water Supplies (Scotland) Regulations 2006 requires that up-to-date information about the quality of the water provided in commercial or public premises shall be displayed in a prominent location. This notice forms part of the communication of risk to members of the public and so the location of the notice should be recorded to ensure that appropriate risk communication is being undertaken.

Item 16 – Is Notice appropriate (conforms to requirements of the Regulations)

Regulation 31 (2) details the form that the information notice must take. This item confirms that the appropriate form of the notice is being displayed as the form of the notice interlinks with additional information available to both owners/users and visitors to private water supplies making it vital that the appropriate form of the notice is utilised.

Item 17 – Details of action taken (or to be taken) by relevant persons to comply with (a) results of sampling (b) results of follow-up to sampling

If sampling results indicate that the supply fails to comply with the requirements of the Regulations, this section should be completed to identify what suggested/agreed remedial steps should be taken to prevent future failures.

Item 18 – Whether supply exempt under Regulation 2 (4)

If the supply is used solely for washing a crop after it has been harvested or during the distillation of spirits (solely in the mashing process or for washing plant but for no other purpose) and which does not affect, either directly or indirectly, the fitness for human consumption of any food or drink or, as the case may be, spirits in their finished form, then the provisions of the Private Water Supply (Scotland) Regulations 2006 do not apply to that supply with the exception of the provisions of regulation 29. If the supply is exempted under the provisions of regulation 2(4) then a full risk assessment is not required to be completed but good practice would require a partially completed form to be retained by the local authority containing the information required by regulation 29.

Item 19 – Details of other information relating to the supply collated by the local authority

If the local authority has other relevant information relating to the supply then these details should be included here or appended to the form and details of the additional sheets recorded under this item.

Item 20 – Is there a Water Safety Plan/Emergency Action Plan available for the supply

Some supplies may have a water safety plan or emergency action plan that details steps to be taken to ensure the quality of water at the source and steps to be taken in the event of a loss of constancy or quality from that supply.

Item 21 – If "Yes" to Item 20, is it fit for purpose

This item requires an assessment by the investigation officer as to whether or not the water safety plan or emergency action plan is suitable for the premises it relates to.

Item 22 – If "No" to Item 20, what deficiencies are required to be addressed (provide details)

If the assessment undertaken in Item 21 suggests there are inadequacies in the water safety plan or emergency action plan then the deficiencies should be noted against this item with suggestions, where appropriate, as to what improvements may be considered to the plan(s).

SECTION D

General introduction

In this part of the form each of the indicators being looked for, e.g. disposal sites for animal remains, will have two separate scores associated with them.

The first score will be the Risk Characterisation score.

The Risk Characterisation score has three values – High, Moderate or Low – and is based on the presence or absence of the indicator based on the evidence available to the person undertaking the risk assessment. The form is preloaded with the risk characterisation value based on the individual indicator being present or absent. If the assessor cannot determine if the indicator is present then the "Don't know" option should be used.

The assessor should tick the appropriate response box for each indicator. If any response is identified as High Risk (H) then the Risk Characterisation Score will be **HIGH**. If no response is High Risk but there are Moderate Risks (M) identified then the Risk Characterisation Score will be **Moderate**. If no response is High Risk or Moderate Risk then the Risk Characterisation Score is **Low**.

The second score is the Hazard Assessment score.

The Hazard Assessment Score is also based on the indicator being present but this scoring allows the extent of the potential influence of the indicator to be taken into account. Thus the likelihood score is dependent on a knowledge or estimate of the time period during which the indicator may be present at the source under investigation. The table in the form provides guidance on the values to be assigned based on how frequently the indicator is known, or thought, to be present. If the indicator is present continuously, i.e. once per day or a permanent feature, then the likelihood value assigned will be 16 as the indicator is almost certainly there continuously; if the indicator is present once a week then the likelihood value assigned will be 8; if the indicator is present once a month then the value will be 4; if the indicator is present once a year then the likelihood value assigned will be 2; and if the indicator is known, or thought, to occur rarely such as once every five or more years, then the value assigned will be 1. Once the likelihood value has been assigned on the form the Hazard Assessment Score is determined by multiplying the Likelihood Value by the Severity (which is pre-loaded on the form) to give the overall Hazard Assessment Score.

The Hazard Assessment Score is an index and there is no implied mathematical relationship to risk. The Hazard Assessment Score is a convenient way of prioritising actions or interventions so that resources are effectively targeted to those areas that pose the greatest potential risk of contamination to the source under investigation.

If the Hazard Assessment Score is **16** or greater for an individual component then the issues associated with that component should be considered as a priority for remedial works to reduce the hazard experienced by the supply.

The value of 16 is considered to be appropriate when only a rare event may produce a catastrophic outcome, e.g. sewage effluent discharge to adjacent watercourse (item 38). However, the presence of sewage effluent discharge to an adjacent watercourse were to occur more frequently than once every 5 years or more then the Hazard Assessment Score would reflect this change by increasing the score, and hence flag the requirement to take appropriate action to reduce the likelihood of the occurrence.

Hazard assessment matrix

	Severity of consequences				
Likelihood	**Insignificant**	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	16	32	64	128	256
Likely	8	16	32	64	128
Moderately likely	4	8	16	32	64
Unlikely	2	4	8	16	32
Rare	1	2	4	8	16

Each of the indicators in Section D will now be considered in turn.

Section D(i) General site survey

Item 23 – Evidence or history of poor drainage causing stagnant/standing water

If standing water can be seen present around the well head area or if there is evidence of standing water having been present, e.g. mud or vegetation consistent with marshy ground such as reeds, then the hazard should be scored as being present and the risk characterisation assigned as "Yes". If there is a suggestion that the likelihood of the standing water being present (or evidence of having been present) is a long-standing occurrence then the likelihood score for the hazard assessment should reflect this.

Item 24 – History of livestock production (rearing, housing, grazing) – including poultry

Any evidence of domestic livestock production being present (either directly by the presence of animals in the vicinity of the supply) or indirectly (through presence of broken ground around the supply or the presence of animal droppings around the supply) should result in the risk characterisation being scored as "Yes". Further investigations will be required to decide on the persistence of such presence in order to allow the hazard assessment likelihood score to be accurately assigned.

Item 25 – Evidence of wildlife

Any evidence of wildlife, mammals (rabbits, deer, etc.), birds (gulls, geese, migratory birds, etc.), reptiles (newts, frogs including spawn) etc. at the source could indicate the potential for contamination of the supply either from faecal material or from carcasses falling into the supply. If evidence of wildlife is found then the risk characterisation should be scored as "Yes". Account should be taken of the likely frequency of the presence of wildlife, e.g. a rabbit warren nearby will suggest permanent presence; migratory birds will suggest a seasonal presence which will require the suggested likelihood values to be moderated to reflect this seasonal presence by raising the once per year score of 2 to 4.

Item 26 – Surface run-off from agricultural activity diverted to flow into source/supply

This indicator is intended to deal with field drains and other drainage systems employed on agricultural land which may be connected to the source or supply. The indicator also deals with instances where there is overland flow from agricultural land that ends up in a watercourse or entering the source and potentially contaminating the supply, e.g. applied slurry where there is potential for it to be washed into field drains or watercourse or similar drainage systems. If there are drainage systems or similar present in areas of agricultural activity then the risk characterisation response will be "Yes". The likelihood value will be based on the probable time the land is being subjected to agricultural applications.

Item 27 – Soil cultivation with wastewater irrigation or sludge/slurry/manure application

This indicator differs from Item 26 in that there will be active application of the materials in conjunction with the disruption of the soil itself, e.g. via ploughing or sub-soil injection. If such activities are considered to be undertaken then the risk characterisation will be "Yes". The likelihood value will be based on the probable time/duration that such activities occur at.

Item 28 – Disposal of organic wastes to land

This indicator deals with any other organic waste, e.g. abattoir wastes or "blood and guts". The scoring for this indicator will be irrespective of whether there has been disruption of the soil. If such activities are considered to be undertaken then the risk characterisation will be "Yes". The likelihood value will be based on the probable time/duration that such activities occur at.

Item 29 – Farm wastes and/or silage stored on the ground (not in tanks or containers)

If there are middens or areas where silage are being stored in polyethylene bags (or equivalent) or other farm-derived wastes where there is no bunded storage and there is the potential for spillage entering drainage systems, then this item should be scored such that the risk exists. If the storage appears to be a permanent or long-term feature then the hazard assessment should be scored as almost certain (value 16) or likely (value 8).

Item 30 – Remediation of land using sludge or slurry

In some areas brownfield sites or derelict land will be remediated using sewage-derived sludge or slurry or similar materials. The rate of application will typically be higher than those used in Item 27 and this should be borne in mind when assessing both the risk characterisation and hazard assessment parts of the risk assessment form.

Item 31 – Forestry activity

Forestry activities have the potential to cause significant disruption to water supplies to the area in which they are being undertaken. The disruption may occur when forests are being planted, when thinning activities are being carried out or when the timber is being harvested. Account should be taken of the maturity of the forest and the likelihood of activity starting or changing during the period of the risk assessment. If the risk assessment is not scheduled to be time-limited then the potential for disruption should be highlighted.

Item 32 – Awareness of the presence of drinking water supply/source by agricultural workers

If the awareness of the presence of a drinking water source is absent from those agricultural or forestry workers who may be available to be interviewed or if there is evidence of disregard for the presence of such sources, e.g. ploughing to the margins of a well or spring, then the risk characterisation will be “No” or “Don’t Know” to reflect the high level of risk such a lack of knowledge may be introducing to the supply. Lack of awareness on the hazard assessment should be scored as almost certain (16) again to reflect the potential for introduction of harmful materials or disturbance of the supply.

Item 33 – Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)

The presence of disposal sites may influence the quality of water at the source by allowing the introduction of microbiological or chemical contaminants into the supply, depending on the nature of the materials being disposed. Incineration is also included in this section as the question of both airborne material and disposal sites for ash residues need to be considered when making the overall assessment of the likely impact of this item on the water quality at the source. If any waste disposal sites are present then the risk characterisation will be "Yes" and the associated hazard assessment should reflect the permanent nature (or longevity) of such sites in terms of their potential to continue to release polluting materials for many years after their immediate use has ceased.

Item 34 – Disposal sites for animal remains

This definition includes on-farm carcass disposal, burial pits, e.g. arising from foot-and-mouth disease, and vicinity to human burial sites such as graveyards or family plots away from traditional burial sites. If any disposal sites are present then the risk characterisation will be "Yes" and the associated hazard assessment should reflect the permanent nature (or longevity) of such sites in terms of their potential to continue to release polluting materials for many years after their immediate use has ceased.

Item 35 – Unsewered human sanitation including septic tanks, pit latrines, soakaways

If unsewered human sanitation is present near the source then there is considerable potential for raw human sewage to contaminate the source of the drinking water supply. Great care must be taken when assessing the positioning of septic tanks as well as their condition (maintenance), the areas where the soakaway is positioned, the condition of any pipes leading from the septic tank to the soakaway (is there evidence of different vegetation which may indicate a leaking pipe) and the discharge point of the soakaway if this is directed towards a surface receiving water. Similarly if there are pit latrines in use, e.g. at a campsite or areas where chemical toilets are discharged, the area surround the disposal point or latrine should be considered carefully in terms of allowing contact with the source. The contact may not be visible as there may be some connectivity underground and so some thought must be given to the soil leaching potential of the site.

Item 36 – Sewage pipes, mains or domestic (e.g. leading to/from septic tank)

In addition to Item 35 consideration must be given to the path that sewers may take. If the line of the pipe intersects with the area from which the drinking water source is being recharged (the area from where the water is being drawn) then there is the potential that any failure (leak) from the sewer or similar pipe will introduce raw sewage directly into the water source. It is unlikely that the path of such pipes will be clearly visible and so some care in interpreting the area will need to be taken, e.g. areas where the vegetation/ground appears to be drier indicating that there is a pipe buried below the surface or if there is a fracture in the pipe areas that would not naturally be damp or areas where there is vegetation indicative of wet or nutrient enriched conditions such as reeds or nettles.

Item 37 – Sewage effluent lagoons

Sewage effluent lagoons bring the potential that leaking material from the lagoon may enter the soil and pass into the groundwater providing a direct route for the contamination of the source with raw sewage. Farm effluent lagoons may be viewed as being the same in terms of the risks posed to the source when assessing the scoring values to be assigned.

Item 38 – Sewage effluent discharge to adjacent watercourse (where present)

While some aspects of this item may be identified when reviewing Item 35, Item 38 draws attention to the potential for sewage effluent discharges from a variety of sources such as municipal wastewater treatment works, septic tanks, privately owned/operated sewage treatment systems or reed beds. If there is evidence of discharge to a watercourse that is adjacent to the source of the supply under investigation then the risk characterisation should reflect the circumstances and “Yes” should be recorded. Similarly, for the hazard assessment the permanent, or semi-permanent, nature of the hazard should be reflected in the likelihood value assigned which should be almost certain (value 16).

Item 39 – Supplies or wells not in current use

If there are supplies or wells not in use that are associated with the supply under investigation then the potential for material to be introduced directly into the source water exists. For example, if an older, out of use well is located adjacent to the currently operational well and the out of use well is not properly sealed then the opportunity exists for faeces or animals to enter the older well and contaminate the same source of water that the new well is drawing from.

Item 40 – Evidence of use of pesticides (including sheep dip) near source

If disposal sites for pesticides (including sheep dip) are known to be close to the source under investigation then the risk characterisation should reflect this as should the hazard assessment. If there is evidence of the area having been used for dipping sheep (with dip tanks, fanks, etc.) then this evidence should be taken into account when assessing the site.

Item 41 – Evidence of industrial activity likely to present a contamination threat

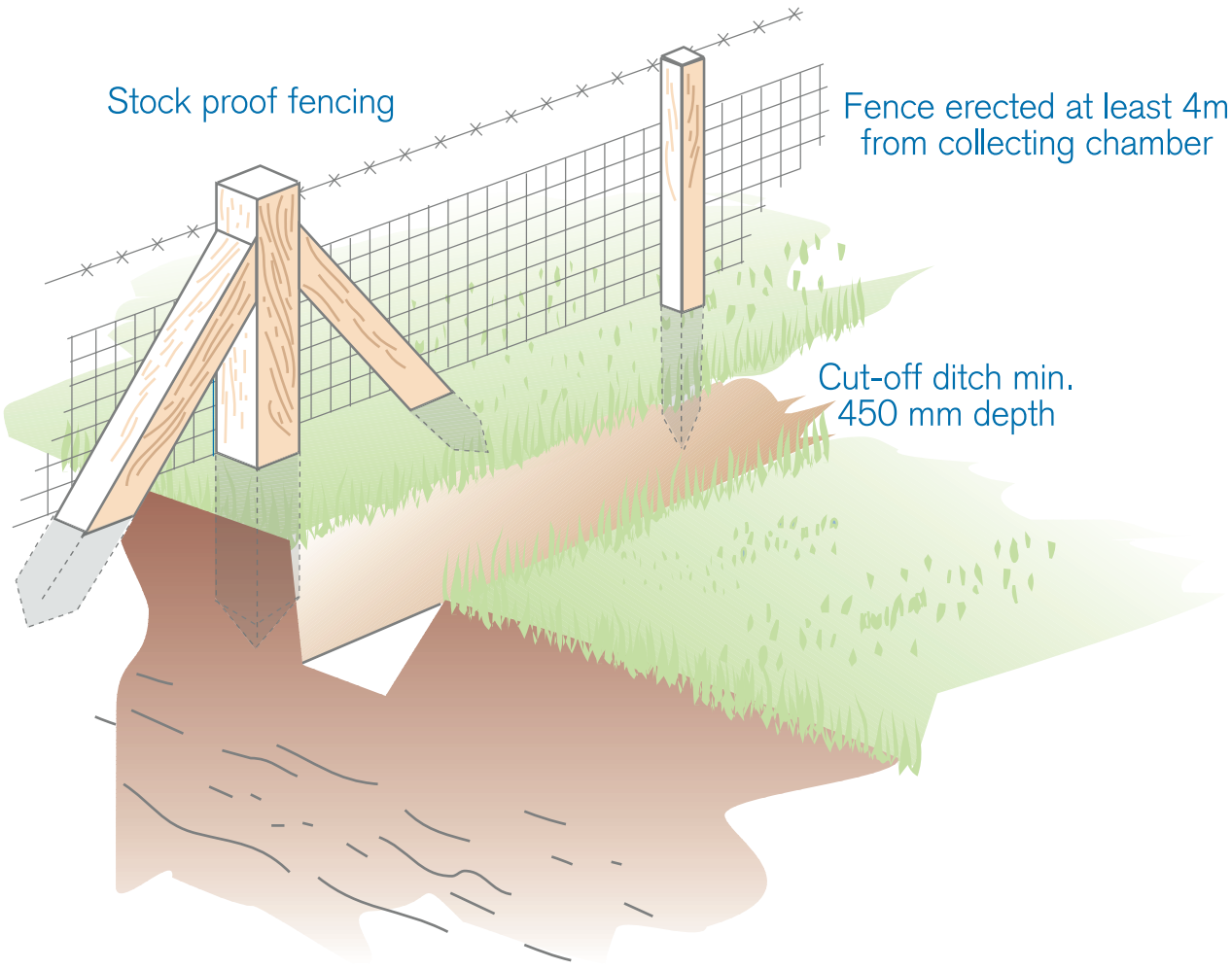
If there is evidence of the area adjacent to the source having been used for industrial activity which may pose a contamination threat then this should be recorded on the risk assessment. Such activities may include chemical or pharmaceutical production, mineral or other extraction such as coal mining, areas where old fuel tanks may have been located or may still be in place either below or above ground, or industries where solvents would have been in use and may have been disposed of on to the ground, e.g. electroplating, metal working or electronics. This list is not exhaustive and so appropriate interpretation of the previous use to which the site may have been put will be required by the investigation officer.

Section D (ii) Supply survey

Item 42 – No stock proof fence (to BS1722 or equivalent) at a minimum of four metres around the source

Figure 9.1 identifies a fence to BS1722. The fence must be erected at a minimum of four metres around the source to ensure that any animals who may frequent the area around the fence, e.g. for scratching, do not have an opportunity to contaminate the area of the source with faecal material which may be deposited. If there is no fence or the fence is deficient in terms of the distance or specification of construction (i.e. not fit for purpose) then the risk characterisation will be “Yes” and the hazard assessment will reflect the permanent nature of the deficiency.

Figure 9.1 Fence and ditch



Item 43 – No suitable barrier present to prevent ingress of surface flows into the well (e.g. cut-off ditch lined with impermeable material, steep incline/decline such as embankments, appropriate walls, etc.)

The well head areas need to be protected from the ingress of surface flows (such as flooding). This can be accomplished in a variety of ways such as having a cut-off ditch surrounding the well with an impermeable lining and a suitable discharge downslope from the well head area or conveying the water away from the immediate vicinity of the well head. Another method would be to have the well head area built up such that it protrudes above the ground level and the slopes convey surface flows away from the well head. It should be borne in mind that surface flows, while including flooding, are not restricted to flooding. In certain ground conditions the impermeable nature of the soil during periods of dry weather will produce a surface akin to concrete which will result in rainfall, such as a heavy summer downpour, running over the surface rather than percolating into the soil. Such conditions need to be protected against by use of appropriately engineered well head arrangements. If suitable arrangements are absent from the site under investigation then the risk characterisation will be scored as "Yes" with the hazard assessment reflecting the permanent nature of the deficiency by scoring the likelihood as almost certain (value 16).

Item 44 – No concrete apron, a minimum of 1200 mm, sloping away from the well and in good condition

The presence of a concrete apron is necessary to prevent soil (or faecal material present) from splashing to top of the well. If there is an unsuitable cover on the well such splashing may allow the direct entry of contaminating material into the well and hence into the drinking water supply. If suitable arrangements are absent from the site under investigation then the risk characterisation will be scored as "Yes" with the hazard assessment reflecting the permanent nature of the deficiency by scoring the likelihood as almost certain (value 16).

Item 45 – The top of the well not 150 mm above the apron described in [44]

This requirement is to ensure that in all but extreme weather conditions there will be very little opportunity for the well head to be inundated with surface flows. If suitable arrangements are absent from the site under investigation then the risk characterisation will be scored as "Yes" with the hazard assessment reflecting the permanent nature of the deficiency by scoring the likelihood as almost certain (value 16).

Item 46 – No reinforced pre-cast concrete cover slab, or equivalent, in satisfactory condition with a watertight, vermin-proof inspection cover present to BS497 (lockable steel type or equivalent) with or without ventilation

A properly constructed and well-fitting well cover is essential to maintaining the integrity of the source. The cover should be watertight to prevent ingress of rainwater; vermin-proof to prevent animals from entering the well (vermin-proof means having no holes, remember a field mouse can easily enter a space where a pencil will fit); and lockable to prevent malicious (or just curious) persons gaining access to the supply. If ventilation is present ensure that it is also vermin-proof with appropriate wire mesh in place. If suitable arrangements are absent from the site under investigation then the risk characterisation will be scored as "Yes" with the hazard assessment reflecting the permanent nature of the deficiency by scoring the likelihood as almost certain (value 16).

Item 47 – The well construction in an unsatisfactory state-of-repair

The fabric of the well itself (i.e. below ground) should be in good repair to prevent any short-circuiting with water entering from or near the soil surface. If suitable arrangements are absent from the site under investigation then the risk characterisation will be scored as "Yes" with the hazard assessment reflecting the permanent nature of the deficiency by scoring the likelihood as almost certain (value 16).

Item 48 – Supply network constructed from material liable to fracture (e.g. asbestos concrete, clay, etc.)

If the network of pipes that lead from the well are constructed of materials that are liable to deterioration or fracture, e.g. if heavy farm machinery is driven over the top of the pipeline, then the integrity of the system will be lost and potentially polluting material may enter the pipes through the fractures or the whole supply will be lost through pipe blockages. If it is considered likely that such materials have been used for all or part of the pipework being used to convey water from the source then the risk characterisation must reflect this with a "Yes" score and the hazard assessment must similarly reflect the permanent nature of the hazard by scoring as almost certain (value 16).

Item 49 – Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected (i.e. do not have protection described in [42] to [45])

The level of protection for all intermediate tanks or similar structures should be equivalent to that recommended for the source itself as the potential for contamination to enter the system via such intermediate points is just as high as for the source itself. If any of the intermediate tanks or similar structures are deficient in respect of the requirements provided in Items 42 to 45 then this should be reflected in the risk characterisation and hazard assessment. If there is more than one intermediate tank or similar structure, the deficient ones should be noted in section F and cross-referenced with the diagram provided in Section B (Item 6).

Item 50 – Junctions present in the supply network, particularly supplying animal water systems, have no back-siphon protection

If there are provisions made to provide water to animal watering troughs or other connections where back-siphonage may occur, e.g. from a hosepipe permanently connected, there is potential for the contents of the trough or container to be back-siphoned into the distribution pipe and for the contents of the trough or container to enter the supply. Clearly the contents of a cattle watering trough or a barrel into which the end of a hose has been dangled for some weeks will do little to improve the quality of the drinking water being provided. It is essential that where connections are made on the system prior to the first taps to be used for domestic (potable) consumption appropriate back-siphonage prevention devices are fitted. If they are not or there is no evidence to support claims that they have been fitted then the risk characterisation must reflect this with a “Yes” response. Similarly the hazard assessment should highlight the permanent nature of the situation with an almost certain (value 16) rating.

Item 51 – No maintenance (including chlorination) has been undertaken in the previous 12 months

If the system has had no maintenance undertaken in the 12 months preceding the investigation then this suggests that the level of care and attention required to ensure the system is operating as effectively as possible is lacking. If this is the case then the risk characterisation score should reflect the situation encountered and a “Yes” response entered. The hazard assessment likelihood score should also reflect the situation with an unlikely score (value = 2).

Item 52 – If present, header tank within the property(s) does not have a vermin-proof cover

Many properties served by a private supply, particularly those on smaller supplies, will have a header tank within the property to provide sufficient water pressure for the household and also to act as a balancing tank to equalise the pressure differences experienced in the system when pumps are operating to bring water into the property. However, if the header tank is not properly constructed and protected then any material that may be present in the roof space, whether that be dust or mice or bat droppings, will have the potential to enter the tank and so contaminate the supply. If the property has a header tank which feeds the main domestic (potable) tap, usually the kitchen cold water tap, and that tank is not properly protected then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an almost certain score (value = 16). If the header tank is present and unprotected but does not feed the main domestic (potable) tap then the risk assessment can be moderated but the risk to other taps in the property should be highlighted in Section F and noted on the diagram at Section B.

Item 53 – Header tank has not been cleaned in the last 12 months

If the header tank has an appropriate vermin-proof cover (Item 52) it will still require to be maintained by cleaning at least every 12 months to prevent the build-up of slime and scum which will naturally grow on the tank walls. If the tank has not been cleaned in the 12 months prior to the investigation then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an unlikely score (value = 2).

Item 54 – Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months

If any point of entry/point of use devices have had no maintenance undertaken in the 12 months preceding the investigation then this suggests that the level of care and attention required to ensure the system is operating as effectively as possible is lacking. If this is the case then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an unlikely score (value = 2).

Item 55 – If present ultraviolet (UV) lamps are not operating

While ultraviolet disinfection systems if properly installed and maintained are an effective treatment option to prevent potentially harmful micro-organisms from causing disease they can provide a false sense of security if they are not looked after. A particularly common fault is for the UV bulb to stop operating. The UV bulb is at the heart of the installation and is responsible for the disinfection process. If there is not an automatic warning system on the installation then the loss of the bulb could go undetected. Similarly if the bulb has not been changed in accordance with the manufacturer's recommended replacement period then the efficiency or operation of the bulb could be impaired or have ceased to function at all. It is important, therefore, to assess if the UV bulbs (lamps) are operating on a UV system at the time of the inspection. If they are not operating then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation based on an assessment of when the UV bulb (lamp) ceased to function.

Item 56 – Is there a noticeable change in the level and flow of water throughout the year

This question deals with the issue of constancy of supply as it relates to the quality of the source. If the source is highly dependable and provides adequate levels of water throughout the year then it is likely that the source is not under direct influence from either the surface or from prevailing climatic conditions. On the other hand, if the supply is "flashy" and changes with the weather then it is likely that it is under the influence of surface flow and prevailing weather conditions which increases its vulnerability to contamination from the surface. If there are noticeable changes in level and flow the risk characterisation response will be "Yes". The hazard assessment likelihood in these circumstances will be almost certain (value = 16). This circumstance may also cause the investigating officer to reconsider if the supply is in fact a well or if it would be better treated as a surface-derived supply.

Item 57 – Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt

If the supply is under the influence from either the surface or the weather then the quality experienced cannot be guaranteed if there are conditions prevailing which make surface flow (e.g. flooding) or adverse weather conditions likely. If there are noticeable changes in the appearance of the water then the risk characterisation response will be "Yes". The hazard assessment likelihood in these circumstances will be dependent on whether weather or surface influence is considered the most likely cause.

Section D(iii) Soil leaching risk survey

4.6 Background to soil and land use factors underpinning the assessment of groundwater vulnerability

4.6.1 Introduction to concepts of vulnerability and risk associated with soils and groundwaters

Wherever groundwater is present there is potential for contamination through human activity. No soil or geological strata is completely impermeable and likewise no pollutant is completely immobile. The concept of groundwater vulnerability, or the susceptibility of groundwater to microbiological contamination from surface or near-surface derived pollutants, recognises that the potential risk of contamination is greater under certain hydrological, geological, land use and soil conditions than others. In site-specific terms, groundwater contamination depends on the natural or man-made characteristics of the site in that the ease with which the potential pollutant can migrate to the underlying water table or spring source is dependent upon the physical, chemical and biological properties of the soil and rocks pertaining to the site. The factors which define the vulnerability of groundwater resources to a given pollutant or activity, acting singly or in combination, are as follows:

- presence and nature of the overlying soil
- presence and nature of the drift deposits
- nature of the solid geological strata within the unsaturated zone
- depth to groundwater
- nature of contaminant.

It must also be recognised that contamination can only occur if a potential pollutant is present, therefore land use is a critical factor. Similarly, the intrinsic factors listed above can be modified by man-made structures or excavations.

The key to groundwater vulnerability classification lies in the unsaturated zone, namely that volume of soil and unsaturated material situated above the water table. In the absence of major fissures or cracks within that zone, water movement is essentially slow, being confined to interconnected soil pores within an aerobic environment. However, the rate of this movement depends on the moisture content of the soil and therefore varies throughout the year. The overlying soil provides the potential for interception, adsorption and elimination of bacteria and viruses. Where vertical fissures occur or shattered rock is close to the surface, there is the potential for rapid flow of micro-organisms to groundwater and therefore a reduction in the ability of the soil and substrate to act as a barrier or filter.

4.6.2 Use of soil information for both general protection of groundwater resource and specific protection of individual water supply sources

4.6.2.1 Introduction

It should be stressed that a full assessment of the risks posed to groundwater by potentially polluting activities on the land surface can only be achieved by actual field investigation, which, in many instances, will involve detailed soil and hydrogeological investigations both close to the water supply source and often within a wider field of interest in relation to the zone of influence and capture zones (see section 3.3). Such investigation would, for example, be relevant to determine the suitability of a site for a new water supply. Where this is deemed necessary expert assistance should always be sought. It is also possible to assess groundwater vulnerability without field studies from close examination of existing environmental data, although this approach is not without limitations.

4.6.2.2 Presence and nature of overlying soil

Soil is the thin upper layer of the earth's crust and is the product of complex interactions between five recognised soil forming factors: namely the action of **climate, living organisms** and **topography** on the **parent material** over a period of time. Development of soil arises primarily from the accumulation of mineral grains from either the physical or chemical weathering of rocks and the addition of organic material (humus) from decaying vegetation. As plants become established, topsoils develop as organic matter is incorporated into the soil and nutrients are released from minerals to the soil solution where they can be taken up by plant roots. Gradually, the soil matures at a rate which is dependent upon the local climate.

A vertical section through soil, as seen in the face of a pit or excavation, is referred to as a soil profile which exhibits a number of distinct layers or horizons. These are the product of soil forming processes taking place within the soil matrix. Where soils are uncultivated, there is usually a complex assemblage of horizons but, for convenience, it is often appropriate to talk of a three-fold division into:

a) topsoil - this is usually a dark brown to dark greyish brown colour due to the incorporation of decomposed organic material. This layer has a high biological activity resulting in an intimate mixing of mineral and organic material to give uniform colours.
b) subsoil - this is essentially pedogenically altered parent material where soil forming processes have been active to break down minerals and reorganise the soil material into aggregates of bound soil particles. Organic material is much less abundant than in the topsoil.
c) parent material - the relatively unaltered material at the base of the soil profile where the soil forming processes have had least influence. The depth to parent material within the soil depends not only on the resistance to weathering but also on the length of time the weathering processes have been active.

4.6.2.3 Presence and nature of the drift deposits

In many areas drift deposits are present overlying the solid geology and are characterised, in many instances, by vertical and horizontal variation both in thickness and lithology. Therefore, where the drift is of substantial thickness and of low permeability it can provide an effective barrier to downward percolation of any pollutant which has passed through the soil zone. However, detailed and reliable maps of drift deposits are unavailable on a national scale and where there is uncertainty about drift composition and thickness, they are treated as a special case in any groundwater vulnerability assessment. In instances where the low permeability drift deposits are sufficiently thick (up to 5 metres) to afford complete protection to underlying major or minor aquifers from surface downward pollutants, such aquifers are not depicted on the map.

4.6.2.4 Nature of solid geology within the unsaturated zone

Geological strata with a groundwater content in exploitable quantities are referred to as aquifers, in contrast to rocks without the ability to transmit substantial quantities of water which are classed as non-aquifers. All aquifers vary in their general and hydraulic characteristics and in the unsaturated zone such variation determines the vulnerability of the groundwater to pollution. Permeable strata are classified, for convenience, into highly permeable aquifers and moderately permeable aquifers, the former having generally less capacity for attenuating contaminated recharge entering at the surface. A third category of weakly or non-permeable aquifers has also been recognised. Within the Scottish context the principal aquifers are shown in Table 3.1.

4.6.2.5 Soil classification

The systematic mapping for soils in Scotland began in 1947 with the aim of understanding their distribution and characteristics. By 1987 most of the arable soils in Scotland had been mapped at 1:25 000 scale and for publication at 1:63 360 scale, and the entire country had also been mapped at the reconnaissance scale of 1:250 000. The system of soil classification used in these series of maps is based principally on morphological features recognisable by surveyors in the field and takes only limited cognisance of chemical characteristics. It relies, therefore, on the recognition of central concepts of soil classes and the comparison of soil profiles within them. The lowest commonly used category in the classification system, and the unit shown on the most detailed maps, is the Soil Series, of which there are over 800 identified. Each Soil Series has a limited and defined range of diagnostic properties that distinguish it and allow it consistent national recognition in accordance with a definition as follows: a group of soils similar in character and arrangement of horizons within the profile and developed on the same soil parent material. Soil Series are named after the place where they were first described or are extensive. For example, Countesswells Series is developed entirely on glacial till derived from granite, has the morphological characters of a humus-iron podzol and was first mapped at Countesswells, within the grounds of the then Macaulay Institute for Soil Research, Aberdeen.

A Soil Association is a grouping of Soil Series in which the soils are developed on similar parent materials but differ in characteristics related to local variations in texture, relief and hydrologic conditions. They are generally characterised and named after the most frequently occurring component Soil Series.

Allied to the soil mapping is an extensive database of measured and observed soil physical and chemical properties which allow identification of several important diagnostic properties which influence the movement of pollutants in soil. These factors can be considered as follows:

a) slowly permeable layer - the presence of a dense, compact layer within the soil impedes the downward percolation of water with resultant intermittent waterlogging within the soil material. If present, slowly permeable layers can prevent contaminants within the soil solution moving vertically but careful consideration should be given to possible lateral movement downslope into receiving basins where problems may arise. Waterlogging is often associated with these layers, either within the layer itself or in the layers immediately above. Where waterlogging occurs the strong brown colours normally found within the subsoil of free draining soils are replaced by drab colours, greys and generally intense mottling. Horizons with these morphological characteristics are referred to as gleyed horizons. In some cases these slowly permeable layers can exist without clear evidence of waterlogging, for example, on slopes or mounds, or where the soils are very red in colour or in drier parts of the country. Either this layer is ineffective in intercepting downward percolating water, or other soil, site and climatic factors are operating to reduce waterlogging above it. As it can be difficult to interpret the degree of protection afforded by these situations precisely within the field or from existing soil maps, such soils are generally considered to give only medium protection to groundwater supplies.

b) gley characteristics without the slowly permeable layer - where gley characteristics are present and compact, dense subsoil horizons compatible with a slowly permeable layer are absent, it is likely that the soil is affected by groundwater. Given that this groundwater table is evident within the soil profile then even relatively short-lived potential contaminants entering the soil are likely to reach the groundwater. Such soils should be considered as affording a poor level of protection and should be placed in the high risk category.

c) soil porosity - under normal conditions soils develop a structure where the porosity allows gradual percolation of the soil solution through the soil matrix. In some cases the cracks and pores can be of sufficient width that they form pathways for rapid downward movement of water when the soil is unsaturated, termed by-pass flow. Liquid discharges entering at or near the surface of such soils have the potential to rapidly by-pass the upper, most attenuating soil layers. Similarly, a proportion of any diffuse-source contaminants dissolved in the soil water fraction are likely to move rapidly out of the upper soil layers as soon as there is a significant rainfall event. In such situations, if there are no slowly permeable layers present and the subsoil is shallow over shattered rock or gravel, or is seasonally affected by groundwater (as described in b above), then a significant proportion of any potential contaminants entering the soil are likely to move rapidly to underlying strata or to groundwater. These soils are of high risk.

d) soil adsorption capacity - in simple terms, the ability of a soil to adsorb contaminants or bacteria depends on several factors with clay content and organic matter content being of particular significance. These soil particles carry a net negative surface charge which allows the chemical bonding of positively charged ionic pollutants and certain microorganisms. Once bound, these contaminants can be chemically degraded through the normal processes of weathering within the soil. Thus the lower the clay and soil organic matter content, the lower the ability to attenuate potential contaminants.

e) soil parent material - the presence of rock, shattered rock or gravel within the soil profile indicates the presence of geological material. Where such material occurs within the soil profile, any potential contaminant entering the soil is likely to reach groundwater relatively quickly and, because the ability of geological material to attenuate potential pollutants is far less than that of weathered soil material, the potential for groundwater contamination is greater.

4.6.3 Use of groundwater vulnerability maps

4.6.3.1 Introduction

A methodology for classifying soils into three leaching potential classes has been developed for use in groundwater vulnerability maps[22] as identified for use in Scotland[23]. This classification also embraces all Soil Series which have been mapped to date within Scotland, with each soil series being assigned a value corresponding to the ease with which a representative pollutant could move through the soil. This representative pollutant is assumed not only to be soluble in water so that it moves through the soil column in solution but also able to adsorb or stick onto clay particles and organic matter. Whilst it is recognised that not all pollutants have these characteristics, the classification does provide a generalised picture and many of the central concepts are valid in the assessment of the risks of microbiological contamination.

4.6.3.2 Soil leaching potential categories

Palmer *et al.*[22] published a classification which defines three main categories of leaching potential ranging from high to low. These classes were derived primarily for assessing the vulnerability of major aquifers to contamination from a wide range of pollutants and are as follows:

Class 1 High vulnerability or soil leaching potential

Soils in which water has the potential to move relatively rapidly from the surface to underlying strata or to shallow groundwater. This may be because there is fissured rock or gravel near to the soil surface, or because the soil has a low volumetric water content, or because, at certain times of the year, there is either groundwater near to the soil surface or there is by-pass flow through the upper soil layers. In such soils there is a high risk that, at certain times of the year, contaminants will move rapidly through the soil with little time for attenuation. The high category has been subdivided into four classes with soils in the H1 subclass having a greater soil leaching potential than H2, etc.

H1 Soils with groundwater at shallow depth. Soils with rock, rock-rubble or gravel at shallow depth. Undrained lowland peat soils with permanently wet topsoils.
H2 Sandy soils with low topsoil organic matter content.
H3 Sandy soils with a moderate topsoil organic matter content. Soils with rock, rock-rubble or gravel at relatively shallow depth within the soil profile.
HU Soils in urban areas and areas of restored mineral workings for sand/gravel.

Class 2 Intermediate vulnerability or soil leaching potential

Soils in which it is possible that significant amounts of water will penetrate to below two metres in depth. In such soils contaminants may move vertically through the soil, but are likely to be substantially attenuated by the processes of biological and chemical degradation, adsorption and dilution. The intermediate category has been divided into two subclasses; mineral soils are placed in I1 and peat soils in I2.

I1 Deep loamy and clayey soils unaffected by marked seasonal waterlogging, with a topsoil of low or moderate organic matter content.

I2 Lowland peat soils which have been drained for agricultural use.

Class 3 Low vulnerability or soil leaching potential

Soils in which excess water movement is predominantly horizontal, with little likelihood of any contaminants penetrating below two metres in depth. Where such soils fringe those in classes 1 and 2 however, lateral drainage may contribute to groundwater recharge and hence potential pollution. There is no subdivision of the low category of soil leaching potential.

L Soils with a dense subsoil which restricts downward water movement. Upland soils with a permanently wet peaty topsoil.

4.6.3.3 Benefits derived from groundwater vulnerability maps

In England and Wales a series of such maps have been published by the Environmental Agency at the scale of 1:100 000. Similar maps within Scotland are being produced by the Scottish Environmental Protection Agency. In simple terms, the maps contain three layers of information which from the surface downwards include:

- soil leaching potential classes and subclasses;
- presence, where applicable, of low permeability drift deposits at the surface above aquifers by stipple ornament;
- permeability of the geological deposits (major/minor/non-aquifer; see Table 3.1).

Together these layers of information produced 27 different vulnerability combinations, some of which must be interpreted with caution because of limitations within the following:

- soil data, in particular differences in map scale and variability within mapping units;
- drift data, in particular possible mismatches with soil information;
- geological data, in particular lack of data on the variability of mapped units, inadequate description of drift deposits and difficulties of portraying multi-aquifers as a single unit.

However these vulnerability combinations provide critical information for assessing the level of protection afforded to shallow groundwater by the soil and drift deposits, in particular the soil leaching potential. This information has been systematised allowing the rapid assessment of the protection afforded by the soil to private water supplies in terms of microbiological contamination. This information can be used to give assistance to site specific assessments in the area immediately surrounding a water supply when used in conjunction with soil inspection pits. Alternatively, and where the exact location of the source is not known, or where there is a substantial catchment area associated with the supply, interpreted soil maps (as exemplified in Appendix C) can be used. This approach has the benefit that the interpretation of the soils

information is made by experts and it has a spatial component which takes account of the fact that the supply should be protected within a 50 metre radius. Either soil interpretation or interpretative soil maps must be used in conjunction with information on land use. Even water supplies which are classified as having a soil which offers poor protection may not become contaminated if the land use in the surrounding area precludes the introduction of a contaminant.

4.6.3.3 Other factors which influence groundwater vulnerability

There are a series of site-specific factors which can contribute towards possible groundwater contamination but, in most instances, it is not possible to quantify the degree of risk. Examples of these are listed below:

- Physical disturbance of aquifers and groundwater flow. These activities lead to the disturbance of the physical barrier offered by the soil and may provide preferential pathways of water (and contaminant) movement to shallow groundwaters. These include: most forms of groundwater extraction; landfill operations; nearby borehole construction; any activity which interconnects naturally separate aquifers; existing or modified field drainage schemes that intercept recharge water; quarrying and gravel extraction both above and below the water table.

- Waste disposal to land. Many waste disposal practices have the potential to cause groundwater contamination. In this respect, the environment protection agencies have laid down certain regulations, many of them statutory, to ensure specific objectives. For example, there will normally be objections at the planning stage to waste disposal activities which extend to or below the water table within prescribed limits of a source. However, the disposal of slurries and other wastes on agricultural land in the vicinity of a private water supply is not subject to the same regulation, although codes of good agricultural practice do exist.

- Contaminated land, being land currently or previously used in connection with the following activities: sewage treatment works; landfill sites and other waste disposal and recycling activities; waste lagoons. The environmental agencies will seek to protect water supplies where any of the above activities are to be found in close proximity to a water source.

- The application of liquid effluents, sludges and slurries to land. Three categories of waste are recognised, being controlled wastes (industrial effluent sludges, both organic and inorganic in nature), sewage sludges and agriculture waste. Where the environment agencies consider that any of these deposits will give rise to a significant risk of polluting groundwater or surface water, there will be a presumption against spreading or compliance with existing environmental legislation. Wherever possible, farmers should have a waste management plan for their farm with information relevant to suitable land available for spreading liquid effluents, sludges and slurries.

- Discharges to underground strata. Three areas of concern have been identified:

  – sewage effluent discharges including septic tank and sewage treatment plant;
  – effluents from individual properties or small housing estates;
  – trade effluent discharges;
  – surface water discharges which include contaminated run-off from roofs; and
  – impermeable areas such as roads, car parks, storage areas, etc.

- Diffuse pollution of groundwater. Diffuse pollution refers to pollution spread over time and space and caused by mechanisms other than local and specific discharges or events. Such pollutants are usually at much lower levels than other sources and are therefore at lower concentrations in the soil water. However, the build-up over a long period can generate potential problems. Diffuse pollution varies in character between urban and rural areas. Within the former, the two most notable examples of pollution arise from industrial sites and discharges from sewage systems. In contrast, within rural areas, the pollutant is not from an individual point discharge but arises from activities connected with intensive arable and livestock farming.

- Additional activities or developments which pose a threat to groundwater quality include miscellaneous activities such as: storage of farm wastes and intensive livestock housing; graveyards and animal burial sites; sewage works; storm overflows.

4.6.3.4 Conclusion

Soil can offer protection to the shallow groundwaters associated with many private water supplies while a combination of soil and geological factors need to be considered when assessing deep groundwaters. The necessary soil information needed to make such assessments is obtained either by simple site inspection or from interpretations of soil maps; however, both the current and past land use practices will have a bearing on the ability of the soil to function as a filter and buffer to potential contaminants and on the presence of these contaminants. Therefore, land use remains a key component in any site appraisal.

4.6.4 Soil and land use factors underpinning the assessment of surface water vulnerability

4.6.4.1 Introduction

In some instances, private water supplies are fed by surface waters. The role of soils in offering protection to these sources is much more limited than that described above for groundwaters but nonetheless, differences in soil type will have an influence on the risk of microbiological contamination of these waters. Clearly, the soil has no role where the contaminant is deposited directly into the water body, but where a potential contaminant is deposited near to a water body, then there are a number of factors which affect the risk of contamination. The main factors are surface run-off which washes the contaminant into the water body and stream extension (both laterally and upslope) which entrains the contaminant.

The degree of surface flow is dependent on the intensity and duration of rainfall, the soil type, slope and land use. In general terms, high intensity rainfall, like that associated with thunder storms, is likely to initiate overland flow in most soils as the infiltration rate of the soil is exceeded by the rainfall intensity. More recently, it has been recognised that low intensity rainfall over a prolonged period of time can also lead to overland flow. In both cases the soil type can have a major influence on the amount of rainfall that can be absorbed before the initiation of run-off. Soils with open, porous structures and with no slowly permeable layer will be able to absorb more than shallow soils or those with slowly permeable layers near to the soil surface. The land use can act as an interceptor for rainfall (for example, a forest), reducing the actual amount that reaches the soil surface as well as providing the opportunity for the presence of potential contaminants (for example, open moorland which is grazed by domestic and wild animals).

Stream extension is the process whereby the apparent stream network as seen under dry conditions extends during rainfall, with the development of ephemeral streams and rivulets which occupy topographic hollows and are interconnected with the normal stream network. In many Scottish catchments, these streams and rivulets become dry soon after the rain has stopped. However, during rainfall the water flowing along these pathways will often be sufficiently fast and deep to entrain contaminants such as animal faeces. The occurrence of these pathways is difficult to predict from soil maps but some soil types will be more likely to behave in this way than others.

During periods of rainfall, the levels of streams and rivers generally rise and may extend out beyond their normal channel to occupy their floodplain. In many small catchments, these floodplains may only be a few metres wide, but any faecal material or other potential contaminants on the surface may be entrained in the stream.

4.6.4.2 Soil assessment

The risk assessment of the vulnerability of surface waters is not as well developed as that of groundwaters, however, the concepts of surface and immediate sub-surface flow have been developed in other sub-disciplines within soil science and can be used to derive a provisional

vulnerability classification. The general concepts are derived from the Hydrology of Soil Types (HOST) technical report (Boorman *et al.*, 1995). This work derived a classification of UK soils which both describes the dominant pathways of water movement through the soil and assigns proportions of the rainfall likely to lead to a fast response in streams and rivers. These proportions are termed standard percentage run-off and can be used to indicate the soils likely to have a high incidence of overland flow as well as those likely to cause a rapid rise in river levels or to initiate stream extension. This work indicates that soils with peaty surface layers tend to initiate surface run-off quicker than soils with a mineral surface layer and that soils with a slowly permeable layer close to the soil surface will initiate surface run-off more quickly than deep, porous soils.

4.6.4.3 Conclusion

Although still an underdeveloped area of microbiological risk assessment, the results and concepts derived from soil hydrological research can be used to rank the role of soil in assessing the vulnerability of these waters to contamination. However, the very fact that there is no protection from the direct entry of contaminants into surface waters means that these sources must remain at a high risk of contamination.

SECTION D (iii) Soil leaching risk survey

Using the National Grid Reference derived in Section C (7(iii)) the appropriate soil leaching risk map is examined and the category of the soil associated with the source is determined using the table below.

If the source cannot be identified then the risk characterisation for the soil leaching risk classification will be assigned a “High” value.

If there appear to be several soil leaching potentials at or near the point where the source has been determined then the soil leaching potential with the highest risk characterisation score will be used to complete the risk assessment.

The appropriate hazard assessment score will be assigned according to the table.

Soil Leaching Risk Classification	Risk Characterisation	Hazard Assessment
Low	Low	4
Intermediate 1	Moderate	8
Intermediate 2	Moderate	8
High 1	High	16
High 2	High	16
High 3	High	16
Built up	High	16

The following (simplified) explanation of soil leaching potential is taken from the soil leaching risk map legend.

Principles

The purpose of the soil leaching potential maps for microbiological risk assessment is to show, in broad terms, the potential of soils to attenuate possible pollutants by adsorption and degradation. Where the soil has a limited ability to attenuate, there is an increased possibility that potential pollutants will leach from the soil and penetrate underlying groundwater. In areas where the geological drift is thick and of low permeability, the soils are of less significance and groundwater may be less vulnerable to contamination than shown by the map.

The scale of the underlying soil mapping means that the map units may not comprise single soil types, thus only the Soil Leaching Potential that constitutes the greatest proportion of a map unit can be shown. The map is a compromise between the representation of natural complexity and simplicity of interpretation at the scale of representation. This places limitations on the resolution and precision of the map information. The variety of soil, potential pollutants and the generalised nature of Soil Leaching Potential classification means that individual sites and circumstances should be subject to more detailed assessment.

Soil leaching potential classification

The ability of a soil to protect underlying groundwaters from contamination depends on the physical properties that affect the downward passage of water and the chemical properties that affect the attenuation of contaminants. These include: texture (clay and organic matter contents), structure, soil water regime and the presence of distinctive layers such as raw peaty topsoil and rock or gravel at shallow depth. In areas where the geological drift is thick and of low permeability, the soils are of less significance and groundwater may be less vulnerable to contamination than shown by the map. All soils in Scotland can be grouped into one of six classes. Where the soil cover has been considerably altered, for example, in urban areas, they are designated as being at high risk of leaching and form a separate class.

For the purpose of the Microbiological Risk Assessment procedure, it is recommended that three classes will be sufficient: High, Medium and Low risk corresponding to the three main soil leaching potential classes of High, Intermediate and Low.

Soils of high leaching potential (H)

Soils with little ability to attenuate diffuse source contaminants and in which non-adsorbed diffuse contaminants and liquid discharges have the potential to move rapidly to underlying strata or to shallow groundwater. Three subclasses are recognised:

H1 Soils that readily transmit liquid discharges because they are either shallow or susceptible to by-pass flow directly to rock, gravel or groundwater.

H2 Deep, permeable, coarse textured soils that readily transmit a wide range of contaminants because of their rapid drainage and low attenuation potential.

H3 Coarse textured or moderately shallow soils which readily transmit non-adsorbed contaminants and liquid discharges but which have some ability to attenuate adsorbed contaminants because of their organic matter content.

HU Soils over current and restored mineral workings and in urban areas that are often disturbed or absent. A worst case vulnerability classification (equivalent to H1) is therefore assumed for these areas, until proved otherwise.

Soils of intermediate leaching potential (I)

Soils with a moderate ability to attenuate diffuse source contaminants or in which it is possible that some non-adsorbed diffuse source contaminants and liquid discharges could penetrate the soil layer. Two subclasses are recognised:

I1 Deep, permeable, medium textured soils that can possibly transmit a wide range of pollutants.

I2 Deep, permeable, medium textured soils with high topsoil organic matter contents that can possibly transmit non- or weakly-adsorbed diffuse contaminants and liquid discharges, but are unlikely to transmit adsorbed contaminants.

Soils of low leaching potential (L)

Soils in which contaminants are unlikely to penetrate the soil layer due to the presence of a low permeability horizon. Water and contaminant movement is, therefore, largely horizontal but the soils may also have the ability to attenuate contaminants. Lateral flow from these soils may contribute to groundwater recharge elsewhere in the catchment. These soils may have a high clay or organic matter content.

Notes

(i) Where no subclasses are indicated for the Intermediate and High soil leaching potentials, the underpinning map units comprise a number of distinctive soil types. Only the soil leaching potential of the dominant soil type is given.

(ii) The map is a compromise between the representation of natural complexity and simplicity of interpretation at the chosen scale. This places limitations on the resolution and precision of map information. In this case, the variety of soils that has to be covered is wide, and the classification used is generalised. Individual sites and circumstances will always require further and more detailed assessment.

(iii) The map only represents conditions at the surface and, therefore, where the soil and/or underlying formations have been disturbed or removed, for example, during mineral extraction, the leaching potential may have been changed. Hence, where there is evidence of disturbance, site specific data will need to be used.

D (iv) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the three surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	
Source Survey	
Soil Leaching Risk Survey	
Overall Risk	

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 16 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

SECTION E

If the type of the supply has not been determined then the risk assessment will not have been completed. In this case the overall risk assessment for the supply will default to High Risk to ensure that appropriate control measures are put in place to maintain public health.

SECTION F

Additional Notes – this section can be used to include additional information or observations made during the investigation.

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Section 4.6 – Annex 1

Well Risk Assessment pro forma

Private water supply risk assessment form

WELL SUPPLY

OVERALL RISK .....

Section A – Supply Details

1. Supply category

Type A1 / A2 / A3 Type B (circle appropriate category)

2. Address and telephone number of responsible person

.....

.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

3. Name of person (or persons) who is relevant person in relation to the supply

(a) .....

(b) .....

(c) .....

(d) details of additional sheets .....

4. Address of relevant person (or persons) (if different from above)

(a) .....

.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

(b) .....

.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

(c) .....

.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

(d) details of additional sheets .....

5. Details of premise(s) served by the supply and purpose for which water is supplied

(a) .....

.....

.....

Post Code .....

Supply purpose .....

(b) .....

.....

.....

Post Code .....

Supply Purpose .....

(c) .....

.....

.....

Post Code .....

Supply Purpose .....

(d) details of additional sheets .....

Section B

6. Provide a diagram of the supply showing source(s), intermediate storage and/or collection tanks and properties on the supply. The diagram is indicative only and is intended to aid completion of the rest of this section.

Notes: Items should be labelled from source (A) through intermediate tanks (B) to properties (C) with individual components numbered, e.g. for a supply with one source this would be A1; two intermediate tanks (B1 and B2 respectively) and two properties (C1 and C2) respectively.

7. Description of the source of the supply including (i) details of supply source(s), (ii) location of the source(s) and (iii) National Grid Reference of location(s) of source(s). Cross reference from Item 6 above.

(i) .....

.....

.....

(ii) .....

.....

.....

(iii) National Grid Reference N / J / 0 / 0 / 0 / 0 / 0 / 0

8. (a) Estimated daily volume of water provided by the supply ..... m^3 per day

(b) Number of persons served by supply (at maximum occupancy) .....

9. Details of any water treatment processes associated with the supply

(a) At source – identify which of the following systems are present: (cross reference to Item 6)

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

(b) Intermediate Water Storage Tank/Chamber (cross reference to Item 6)

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

(c) At property (cross reference to Item 6)

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

(d) details of additional sheets .....

Section C

10. Details of departures authorised

.....

.....

.....

11. Details of sample results for previous 12 months or last available (reference location of information, e.g. paper or electronic files, reference number, sample numbers, etc.)

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12. Details of previous (last 2) investigations and actions taken

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13. Details of enforcement notices served

.....

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.....

14. Result of previous risk assessment (if applicable)

.....

.....

.....

15. Details of location of Notice for Type A supplies (location)

.....

.....

.....

16. Is Notice appropriate (conforms to requirements of the Regulations)? Yes ☐ No ☐

17. Details of action taken (or to be taken) by relevant persons to comply with

(a) results of sampling

.....

.....

.....

.....

(b) results of follow-up to sampling

.....

.....

.....

.....

18. Whether supply exempt under Regulation 2(4)

.....

.....

.....

19. Details of other information relating to the supply collated by the local authority

.....

.....

.....

20. Is there a Water Safety Plan/ Emergency Action Plan available for the supply?

Yes ☐ No ☐

21. If "Yes" to Item 20, is it fit for purpose? Yes ☐ No ☐

22. If "No" to Item 21, what deficiencies are required to be addressed (provide details)?

.....

.....

.....

Section D

D(i) General site survey

Are any of the following known to be present and likely to influence water quality at the source?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
23	Evidence or history of poor drainage causing stagnant / standing water	H	L	H		8	
24	History of livestock production (rearing, housing, grazing) – including poultry	H	L	H		16	
25	Evidence of wildlife	M	L	M		4	
26	Surface run-off from agricultural activity diverted to flow into the source/supply	H	L	H		8	
27	Soil cultivation with wastewater irrigation or sludge / slurry/ manure application	H	L	H		16	
28	Disposal of organic wastes to land	H	L	H		8	
29	Farm wastes and/or silage stored on the ground (not in tanks or containers)	M	L	M		8	
30	Remediation of land using sludge or slurry	H	L	H		16	
31	Forestry activity	M	L	M		4	
32	Awareness of the presence of drinking water supply/source by agricultural workers	L	H	H		4	
33	Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)	H	L	H		8	
34	Disposal sites for animal remains	H	L	H		8	
35	unsewered human sanitation including septic tanks, pit latrines, soakaways	H	L	H		16	
36	Sewage pipes, mains or domestic (e.g. leading to / from septic tank)	H	L	H		8	
37	Sewage effluent lagoons	H	L	H		16	
38	Sewage effluent discharge to adjacent watercourse (where present)	H	L	H		16	
39	Supplies or wells not in current use	H	L	H		8	
40	Evidence of use of pesticides (including sheep dip) near source	H	L	H		8	
41	Evidence of industrial activity likely to present a contamination threat	H	L	H		8	

[1] The Hazard Assessment Score is derived from Likelihood value multiplied by the Severity value. The values are :

Likelihood	Definition	Value
Almost certain	Once per day (or permanent feature)	16
Likely	Once per week	8
Moderate likely	Once per month	4
Unlikely	Once per year	2
Rare	Once every 5 years	1

Risk Characterisation

Tick the appropriate box for each question.

If any question is High Risk (H) then the Risk Characterisation Score is **High**. ☐

If no question is High Risk but there are Moderate Risks (M) identified then the Risk Characterisation Score is **Moderate**. ☐

If no question is High Risk (H) or Moderate Risk (M) then the Risk Characterisation Score is **Low**. ☐

Hazard Assessment

If the Hazard Assessment Score is 16 or greater for any individual component then the issues associated with that component should be considered as a priority for remedial works to reduce the hazard experienced by the supply.

D (ii) Supply survey

Are any of the following known to occur in relation to the supply (source, pipework and properties served)?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
42	No stock proof fence (to BS1722 or equivalent) at a minimum of 4 metres around the source?	H	L	H		8	
43	No suitable barrier present to prevent ingress of surface flows into the well (e.g. cut-off ditch lined with impermeable material, steep incline/decline such as embankments, appropriate walls, etc.)	H	L	H		16	
44	No concrete apron, a minimum of 1200mm, sloping away from the well and in good repair?	H	L	H		8	
45	The top of the well not 150mm above the apron described in [44]?	H	L	H		16	
46	No reinforced pre-cast concrete cover slab, or equivalent, in satisfactory condition with a watertight, vermin-proof inspection cover present to BS497 (lockable steel type or equivalent) with or without ventilation?	H	L	H		16	
47	The well construction in an unsatisfactory state-of-repair?	H	L	H		8	
48	Supply network constructed from material liable to fracture, e.g. asbestos-concrete, clay, etc.	M	L	M		8	
49	Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected (i.e. do not have protection described in [42] to [45] above)?	H	L	H		8	
50	Junctions present in the supply network, particularly supplying animal watering systems, have no back-siphon protection?	H	L	H		4	
51	No maintenance (including chlorination) has been undertaken in the previous 12 months?	H	L	H		8	
52	If present, header tank within the property(s) does not have a vermin-proof cover?	H	L	H		4	
53	Header tank has not been cleaned in the last 12 months?	H	L	H		8	
54	Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months?	H	L	H		8	
55	If present ultraviolet (UV) lamps are not operating?	H	L	H		16	
56	Is there a noticeable change in the level and flow of water throughout the year?	H	L	H		4	
57	Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt?	H	L	H		8	

[1] The Hazard Assessment Score is derived from Likelihood value multiplied by the Severity value. For details see Section D (i).

Risk Characterisation

Tick the appropriate box for each question.

If any question is High Risk (H) then the Risk Characterisation Score is **High**. ☐

If no question is High Risk but there are Moderate Risks (M) identified then the Risk Characterisation Score is **Moderate**. ☐

If no question is High Risk (H) or Moderate Risk (M) then the Risk Characterisation Score is **Low**. ☐

Hazard Assessment

If the Hazard Assessment Score is 16 or greater for any individual component then the issues associated with that component should be considered as a priority for remedial works to reduce the hazard experienced by the supply.

D (iii) Soil leaching risk survey

Using the NGR identified in 7 determine and record below the soil leaching potential from the appropriate soil leaching potential map covering the geographic area of interest for location of the source.

National Grid Reference N / J / 0 / 0 / 0 / 0 / 0 / 0

Soil Leaching Risk Classification Assigned .....

Risk Characterisation Score .....

Hazard Assessment Score .....

Table D1 - Soil leaching risk characterisation and hazard assessment scores

Soil Leaching Risk Classification	Risk Characterisation	Hazard Assessment
Low	Low	4
Intermediate 1	Moderate	8
Intermediate 2	Moderate	8
High 1	High	16
High 2	High	16
High 3	High	16
Built up	High	16

D (iv) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the three surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	
Source Survey	
Soil Leaching Risk Survey	
Overall Risk	

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 32 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

Section E

You have been unable to discern the type of supply and so the overall risk assessment for this source must be given as **High Risk**.

Section F – Additional Notes

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4.7 Spring risk assessment (see 4.7 Annex 1 for full form)

Overall Risk – this is taken from the overall risk assessment in section D(iv)(a) of the risk assessment form.

SECTION A – Supply details

Item 1 – Supply category

The supply category that is required to be identified is taken from The Private Water Supplies (Scotland) Regulations 2006 Part 1(2). These state:

"Type A supply" means a private water supply for human consumption purposes which

(a) on average, provides 10 or more cubic metres of water per day or serves 50 or more persons, or
(b) regardless of the volume of water provided or the number of persons served, is supplied or used as part of a commercial or public activity,

and references in this definition –

(i) to the average volume of water provided by such a supply, are references to such volume (calculated as a daily average) as may be reasonably estimated to have been distributed or, if not distributed, used or consumed from the supply during the year prior to the year in which these Regulations come into force; and that estimate may be on the assumption that five persons use one cubic metre of water per day; and
(ii) to the average number of persons served by such a supply, are references to such number of persons as may be reasonably estimated to be the maximum number served by the supply on any one day during the year prior to the year in which these Regulations come into force.

"Type B supply" means a private water supply other than a Type A supply; and "year" means a calendar year.

Item 2 – Address and telephone number of responsible person

"Responsible person" is a term used in the Regulations referring to the person who owns or otherwise is responsible for the domestic distribution system which included the pipework, fitting and appliances which are installed between the taps that are normally used for human consumption purposes and the distribution network which is not the responsibility of a relevant person (see Item 3). Full contact details of the responsible person should be recorded here.

Item 3 – Name of person (or persons) who is relevant person in relation to the supply

The term “relevant person” refers to the person considered by the local authority to be the person providing the supply, or occupying the land from, or on, which the supply is obtained or located, and any person who exercises powers of management or control in relation to the supply.

The relevant and responsible person may be one and the same person in some instances.

In some instances there may be more than 3 relevant persons in which case additional sheets should be used to record the information and details of these additional sheets should be included in section (d) and the sheets appended to the form when completed.

Item 4 – Address of relevant person (or persons) (if different from above)

Where the responsible person and the relevant person are different then the contact details for the relevant person or persons should be recorded in this section.

In some instances there may be more than 3 relevant persons in which case additional sheets should be used to record the information and details of these additional sheets should be included in section (d) and the sheets appended to the form when completed.

Item 5 – Details of premise(s) served by the supply and purpose for which water is supplied

This item seeks to capture details of any premise that may be served by the supply and the purpose for which the water is being supplied. It is necessary to have as complete a list of properties served by a private water supply as possible in order that the true interconnectivity of the supply may be assessed and the potential population affected by any breach of the Regulations or incidence of waterborne disease outbreak can be assessed rapidly and efficiently. For larger supplies this exercise will be challenging but attention to detail will ensure that the most comprehensive and accurate records are compiled which will assist in future investigations relating to the supply.

Additional sheets (as required) should be appended to the form and a note of these made at section (d).

SECTION B

Item 6 – Diagram of the supply

This is intended to enable the investigating officer to provide a schematic sketch showing the interrelationships between the various components of the supply such as source, intermediate tanks and properties being supplied. While there is undoubtedly a balance to be struck between too much detail and insufficient detail, a guiding principle should be to provide sufficient information to enable colleagues who have not visited the site to quickly navigate around the supply.

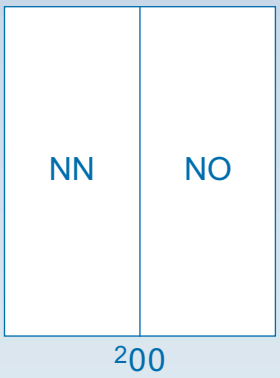
Item 7 – Description of the source of the supply

The description provided should complement the schematic sketch provided at Item 6. The purpose of having a written description is to provide a record of the condition of the infrastructure at the time of the risk assessment. This will enable a baseline to be established against which any future developments made to the supply can be benchmarked. If the facility exists it would be appropriate to also include relevant photographic evidence of the various components so long as they are uniquely identified and cross-referenced within the risk assessment report.

A full National Grid Reference for the source (or the closest point to the source identified) should also be provided.

How to give a grid reference to nearest 100 metres

The example below is taken from Ordnance Survey Braemar to Blair Atholl Sheet 43 1:50000 Landranger Series.

100 000 metre Grid Square Identification	Example - Altaltan			
	1. Read letters identifying 100 000 metre square in which the point lies.	NO		
	2. FIRST QUOTE EASTINGS Locate first VERTICAL grid line to LEFT of point and read LARGE figures labelling the line either in the top or bottom margin or on the line itself. Estimate tenths from grid line to point.		18 4	
	3. AND THEN QUOTE NORTHINGS Locate first HORIZONTAL grid line BELOW line either in the left or right margin or on the line itself. Estimate tenths from grid line to point.			63 5
	EXAMPLE REFERENCE	NO	184	635
Ignore the smaller figures of any grid number: these are for finding the full coordinates. Use ONLY the LARGER figure of the grid number. Example: 280 000m				

Extract from 1:50 000 sheet 43 showing location of Altaltan

Item 8 – Estimated daily volume of water provided by the supply

If the volume of water is not being measured, e.g. via a water meter, then the investigating officer can make an estimate of the volume based on 200 litres of water per day per person served by the supply. While the figure will only be an estimate every effort should be made to identify the maximum number of people who are being supplied with water from the supply. It is not sufficient just to base the estimate on historical records, e.g. the classification of the supply made under previous regulatory frameworks. It is important to have a robust and defensible maximum occupancy for the supply as this may well have an impact on the sampling frequency to which the supply is subjected.

Item 9 – Details of any water treatment processes associated with the supply

While it is important to document any treatment that occurs on the supply it is not practicable to list all possible treatment types or systems that may be encountered. The risk assessment form concentrates on the provision of standard disinfection equipment/processes but all other treatment systems should be included in the description including items such as sediment traps of pH correction systems. Each of the treatment processes should be cross-referenced to those identified on the schematic provided at Item 6.

For larger systems it will not be practicable to complete Item 9 (c) and so a table should be drawn up listing the properties and the treatments associated with each property differentiating between point of entry and point of use devices, e.g.:

Responsible Person	Property address (including post code)	Point of entry device (specify)	Point of use device (specify)	Notes
Mr D Able	1 Wellside Cottage, Nethermuir, ZZ1 1AA	UV lamp	None	located in lean-to on north side of house, pre-filter bypassed
Mrs C Brown	3 Wellside Cottage, Nethermuir, ZZ1 1AA	UV lamp	None	On maintenance contact with Bloggs Plumbing, Nethermuir
Ms B Charlie	Springside House, By Nethermuir, ZZ1 2BA	None	UV lamp	Under sink in kitchen – poor access for changing bulb
Rev. A Davis	Riverbank Cottage, Nethermuir, ZZ1 1AB	None	None	

These details should be recorded as additional sheets on the form at Item 9 (d)

SECTION C

Item 10 – Details of departures authorised

Provide details of any temporary departures granted under Part IV of the Private Water Supplies (Scotland) Regulations 2006. These details should summarise the details provided in the original temporary departure and should cross-reference to the complete application. If applicable the temporary departure authorisation (Regulation 6(7) of the above Regulations) can be appended to the risk assessment. Details of this should be recorded in Section F.

Item 11 – Details of sample results for previous 12 months or last available (reference location of information, e.g. paper or electronic files, reference number, sample numbers, etc.)

The inclusion of this information is to assist the investigation officer in their investigations. Details of the previous sampling results will enable areas of concern to be highlighted and assist in focusing on areas where actual breaches of the drinking water quality standards have occurred. For example, if lead is highlighted as failing in the sample results, while lead is not specifically being looked for in the risk assessment, the investigation officer may take the opportunity of the investigation to attempt to determine whether there are any known lead pipes or tanks associated with the supply or through examination of the appropriate geological map whether lead is naturally occurring in the vicinity of the source. If lead pipes or tanks are present then appropriate advice can be provided on the need for their removal; if lead is naturally occurring at the source then discussions around locating a more acceptable alternative source for the supply can be entered into.

Item 12 – Details of previous (last two) investigations and actions taken

If there have been investigations into previous failures then the last two such investigations should be summarised here along with the actions that were taken or were understood to have been agreed to have been taken. This information will provide the investigation officer with a background to the problems that have been encountered previously along with an understanding of what actions have been attempted to improve the situation and whether these actions have proved to be successful. If they have proved to be unsuccessful then this information will allow the investigation officer to consider alternative solutions that have not been previously implemented.

Item 13 – Details of enforcement notices served

If any enforcement notices have been served that affect the supply under investigation, details of these should be provided here. If necessary additional information may be appended to the risk assessment and details of these should be provided in Section F.

Item 14 – Results of previous risk assessment (if applicable)

If the source or supply has previously been risk assessed then the details of the previous risk assessment(s) should be included with the current risk assessment. The previous risk assessments should be appended to the current form and details of these additional sheets should be recorded against this item.

Item 15 – Details of location of Notice for Type A supplies (location)

Regulation 31 of the Private Water Supplies (Scotland) Regulations 2006 requires that up-to-date information about the quality of the water provided in commercial or public premises shall be displayed in a prominent location. This notice forms part of the communication of risk to members of the public and so the location of the notice should be recorded to ensure that appropriate risk communication is being undertaken.

Item 16 – Is Notice appropriate (conforms to requirements of the Regulations)

Regulation 31 (2) details the form that the information notice must take. This item confirms that the appropriate form of the notice is being displayed as the form of the notice interlinks with additional information available to both owners/users and visitors to private water supplies making it vital that the appropriate form of the notice is utilised.

Item 17 – Details of action taken (or to be taken) by relevant persons to comply with (a) results of sampling (b) results of follow-up to sampling

If sampling results indicate that the supply fails to comply with the requirements of the Regulations, this section should be completed to identify what suggested/agreed remedial steps should be taken to prevent future failures.

Item 18 – Whether supply exempt under Regulation 2 (4)

If the supply is used solely for washing a crop after it has been harvested or during the distillation of spirits (solely in the mashing process or for washing plant but for no other purpose) and which does not affect, either directly or indirectly, the fitness for human consumption of any food or drink or, as the case may be, spirits in their finished form, then the provisions of the Private Water Supply (Scotland) Regulations 2006 do not apply to that supply with the exception of the provisions of regulation 29. If the supply is exempted under the provisions of regulation 2(4) then a full risk assessment is not required to be completed but good practice would require a partially completed form to be retained by the local authority containing the information required by regulation 29.

Item 19 – Details of other information relating to the supply collated by the local authority

If the local authority has other relevant information relating to the supply then these details should be included here or appended to the form and details of the additional sheets recorded under this item.

Item 20 – Is there a Water Safety Plan/Emergency Action Plan available for the supply

Some supplies may have a water safety plan or emergency action plan that details steps to be taken to ensure the quality of water at the source and steps to be taken in the event of a loss of constancy or quality from that supply.

Item 21 – If "Yes" to Item 20, is it fit for purpose

This item requires an assessment by the investigation officer as to whether or not the water safety plan or emergency action plan is suitable for the premises it relates to.

Item 22 – If "No" to Item 20, what deficiencies are required to be addressed (provide details)

If the assessment undertaken in Item 21 suggests there are inadequacies in the water safety plan or emergency action plan then the deficiencies should be noted against this item with suggestions, where appropriate, as to what improvements may be considered to the plan(s).

SECTION D

General introduction

In this part of the form each of the indicators being looked for, e.g. disposal sites for animal remains, will have two separate scores associated with them.

The first score will be the Risk Characterisation score.

The Risk Characterisation score has three values – High, Moderate or Low – and is based on the presence or absence of the indicator based on the evidence available to the person undertaking the risk assessment. The form is preloaded with the risk characterisation value based on the individual indicator being present or absent. If the assessor cannot determine if the indicator is present then the "Don't know" option should be used.

The assessor should tick the appropriate response box for each indicator. If any response is identified as High Risk (H) then the Risk Characterisation Score will be **HIGH**. If no response is High Risk but there are Moderate Risks (M) identified then the Risk Characterisation Score will be **Moderate**. If no response is High Risk or Moderate Risk then the Risk Characterisation Score is **Low**.

The second score is the Hazard Assessment score.

The Hazard Assessment Score is also based on the indicator being present but this scoring allows the extent of the potential influence of the indicator to be taken into account. Thus the likelihood score is dependent on a knowledge or estimate of the time period during which the indicator may be present at the source under investigation. The table in the form provides guidance on the values to be assigned based on how frequently the indicator is known, or thought, to be present. If the indicator is present continuously, i.e. once per day or a permanent feature, then the likelihood value assigned will be 16 as the indicator is almost certainly there continuously; if the indicator is present once a week then the likelihood value assigned will be 8; if the indicator is present once a month then the value will be 4; if the indicator is present once a year then the likelihood value assigned will be 2; and if the indicator is known, or thought, to occur rarely such as once every five or more years, then the value assigned will be 1. Once the likelihood value has been assigned on the form the Hazard Assessment Score is determined by multiplying the Likelihood Value by the Severity (which is pre-loaded on the form) to give the overall Hazard Assessment Score.

The Hazard Assessment Score is an index and there is no implied mathematical relationship to risk. The Hazard Assessment Score is a convenient way of prioritising actions or interventions so that resources are effectively targeted to those areas that pose the greatest potential risk of contamination to the source under investigation.

If the Hazard Assessment Score is **16** or greater for an individual component then the issues associated with that component should be considered as a priority for remedial works to reduce the hazard experienced by the supply.

The value of 16 is considered to be appropriate when only a rare event may produce a catastrophic outcome, e.g. sewage effluent discharge to adjacent watercourse (item 38). However, if the presence of sewage effluent discharge to an adjacent watercourse were to occur more frequently than once every 5 years or more then the Hazard Assessment Score would reflect this change by increasing the score, and hence flag the requirement to take appropriate action to reduce the likelihood of the occurrence.

Hazard assessment matrix

	Severity of consequences				
Likelihood	**Insignificant**	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	16	32	64	128	256
Likely	8	16	32	64	128
Moderately likely	4	8	16	32	64
Unlikely	2	4	8	16	32
Rare	1	2	4	8	16

Each of the indicators in Section D will now be considered in turn.

SECTION D(i) General site survey

Item 23 – Evidence or history of poor drainage causing stagnant/standing water

If standing water can be seen present around the well head area or if there is evidence of standing water having been present, e.g. mud or vegetation consistent with marshy ground such as reeds, then the hazard should be scored as being present and the risk characterisation assigned as "Yes". If there is a suggestion that the likelihood of the standing water being present (or evidence of having been present) is a long-standing occurrence then the likelihood score for the hazard assessment should reflect this.

Item 24 – History of livestock production (rearing, housing, grazing) – including poultry

Any evidence of domestic livestock production being present (either directly by the presence of animals in the vicinity of the supply) or indirectly (through presence of broken ground around the supply or the presence of animal droppings around the supply) should result in the risk characterisation being scored as "Yes". Further investigations will be required to decide on the persistence of such presence in order to allow the hazard assessment likelihood score to be accurately assigned.

Item 25 – Evidence of wildlife

Any evidence of wildlife, mammals (rabbits, deer, etc.), birds (gulls, geese, migratory birds, etc.), reptiles (newts, frogs including spawn) etc. at the source could indicate the potential for contamination of the supply either from faecal material or from carcasses falling into the supply. If evidence of wildlife is found then the risk characterisation should be scored as "Yes". Account should be taken of the likely frequency of the presence of wildlife, e.g. a rabbit warren nearby will suggest permanent presence; migratory birds will suggest a seasonal presence which will require the suggested likelihood values to be moderated to reflect this seasonal presence by raising the once per year score of 2 to 4.

Item 26 – Surface run-off from agricultural activity diverted to flow into source/supply

This indicator is intended to deal with field drains and other drainage systems employed on agricultural land which may be connected to the source or supply. The indicator also deals with instances where there is overland flow from agricultural land that ends up in a watercourse or entering the source and potentially contaminating the supply, e.g. applied slurry, where there is potential for it to be washed into field drains or watercourse or similar drainage systems. If there are drainage systems or similar present in areas of agricultural activity then the risk characterisation response will be "Yes". The likelihood value will be based on the probable time the land is being subjected to agricultural applications.

Item 27 – Soil cultivation with wastewater irrigation or sludge/slurry/manure application

This indicator differs from Item 26 in that there will be active application of the materials in conjunction with the disruption of the soil itself, e.g. via ploughing or sub-soil injection. If such activities are considered to be undertaken then the risk characterisation will be "Yes". The likelihood value will be based on the probable time/duration that such activities occur at.

Item 28 – Disposal of organic wastes to land

This indicator deals with any other organic waste, e.g. abattoir wastes or "blood and guts". The scoring for this indicator will be irrespective of whether there has been disruption of the soil. If such activities are considered to be undertaken then the risk characterisation will be "Yes". The likelihood value will be based on the probable time/duration that such activities occur at.

Item 29 – Farm wastes and/or silage stored on the ground (not in tanks or containers)

If there are middens or areas where silage are being stored in polyethylene bags (or equivalent) or other farm-derived wastes where there is no bunded storage and there is the potential for spillage entering drainage systems, then this item should be scored such that the risk exists. If the storage appears to be a permanent or long-term feature then the hazard assessment should be scored as almost certain (value 16) or likely (value 8).

Item 30 – Remediation of land using sludge or slurry

In some areas brownfield sites or derelict land will be remediated using sewage-derived sludge or slurry or similar materials. The rate of application will typically be higher than those used in Item 27 and this should be borne in mind when assessing both the risk characterisation and hazard assessment parts of the risk assessment form.

Item 31 – Forestry activity

Forestry activities have the potential to cause significant disruption to water supplies to the area in which they are being undertaken. The disruption may occur when forests are being planted, when thinning activities are being carried out or when the timber is being harvested. Account should be taken of the maturity of the forest and the likelihood of activity starting or changing during the period of the risk assessment. If the risk assessment is not scheduled to be time-limited then the potential for disruption should be highlighted.

Item 32 – Awareness of the presence of drinking water supply/source by agricultural workers

If the awareness of the presence of a drinking water source is absent from those agricultural or forestry workers who may be available to be interviewed or if there is evidence of disregard for the presence of such sources, e.g. ploughing to the margins of a well or spring, then the risk characterisation will be “No” or “Don’t Know” to reflect the high level of risk such a lack of knowledge may be introducing to the supply. Lack of awareness on the hazard assessment should be scored as almost certain (16) again to reflect the potential for introduction of harmful materials or disturbance of the supply.

Item 33 – Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)

The presence of disposal sites may influence the quality of water at the source by allowing the introduction of microbiological or chemical contaminants into the supply, depending on the nature of the materials being disposed. Incineration is also included in this section as the question of both airborne material and disposal sites for ash residues need to be considered when making the overall assessment of the likely impact of this item on the water quality at the source. If any waste disposal sites are present then the risk characterisation will be "Yes" and the associated hazard assessment should reflect the permanent nature (or longevity) of such sites in terms of their potential to continue to release polluting materials for many years after their immediate use has ceased.

Item 34 – Disposal sites for animal remains

This definition includes on-farm carcass disposal, burial pits, e.g. arising from foot-and-mouth disease, and vicinity to human burial sites such as graveyards or family plots away from traditional burial sites. If any disposal sites are present then the risk characterisation will be "Yes" and the associated hazard assessment should reflect the permanent nature (or longevity) of such sites in terms of their potential to continue to release polluting materials for many years after their immediate use has ceased.

Item 35 – Unsewered human sanitation including septic tanks, pit latrines, soakaways

If unsewered human sanitation is present near the source then there is considerable potential for raw human sewage to contaminate the source of the drinking water supply. Great care must be taken when assessing the positioning of septic tanks as well as their condition (maintenance), the areas where the soakaway is positioned, the condition of any pipes leading from the septic tank to the soakaway (is there evidence of different vegetation which may indicate a leaking pipe) and the discharge point of the soakaway if this is directed towards a surface receiving water. Similarly if there are pit latrines in use, e.g. at a campsite or areas where chemical toilets are discharged, the area surround the disposal point or latrine should be considered carefully in terms of allowing contact with the source. The contact may not be visible as there may be some connectivity underground and so some thought must be given to the soil leaching potential of the site.

Item 36 – Sewage pipes, mains or domestic (e.g. leading to/from septic tank)

In addition to Item 35 consideration must be given to the path that sewers may take. If the line of the pipe intersects with the area from which the drinking water source is being recharged (the area from where the water is being drawn) then there is the potential that any failure (leak) from the sewer or similar pipe will introduce raw sewage directly into the water source. It is unlikely that the path of such pipes will be clearly visible and so some care in interpreting the area will need to be taken, e.g. areas where the vegetation/ground appears to be drier indicating that there is a pipe buried below the surface or if there is a fracture in the pipe areas that would not naturally be damp or areas where there is vegetation indicative of wet or nutrient enriched conditions such as reeds or nettles.

Item 37 – Sewage effluent lagoons

Sewage effluent lagoons bring the potential that leaking material from the lagoon may enter the soil and pass into the groundwater providing a direct route for the contamination of the source with raw sewage. Farm effluent lagoons may be viewed as being the same in terms of the risks posed to the source when assessing the scoring values to be assigned.

Item 38 – Sewage effluent discharge to adjacent watercourse (where present)

While some aspects of this item may be identified when reviewing Item 35, Item 38 draws attention to the potential for sewage effluent discharges from a variety of sources such as municipal wastewater treatment works, septic tanks, privately owned/operated sewage treatment systems or reed beds. If there is evidence of discharge to a watercourse that is adjacent to the source of the supply under investigation then the risk characterisation should reflect the circumstances and “Yes” should be recorded. Similarly, for the hazard assessment the permanent, or semi-permanent, nature of the hazard should be reflected in the likelihood value assigned which should be almost certain (value 16).

Item 39 – Supplies or wells not in current use

If there are supplies or wells not in use that are associated with the supply under investigation then the potential for material to be introduced directly into the source water exists. For example, if an older, out of use well is located adjacent to the currently operational well and the out of use well is not properly sealed then the opportunity exists for faeces or animals to enter the older well and contaminate the same source of water that the new well is drawing from.

Item 40 – Evidence of use of pesticides (including sheep dip) near source

If disposal sites for pesticides (including sheep dip) are known to be close to the source under investigation then the risk characterisation should reflect this as should the hazard assessment. If there is evidence of the area having been used for dipping sheep (with dip tanks, fanks, etc.) then this evidence should be taken into account when assessing the site.

Item 41 – Evidence of industrial activity likely to present a contamination threat

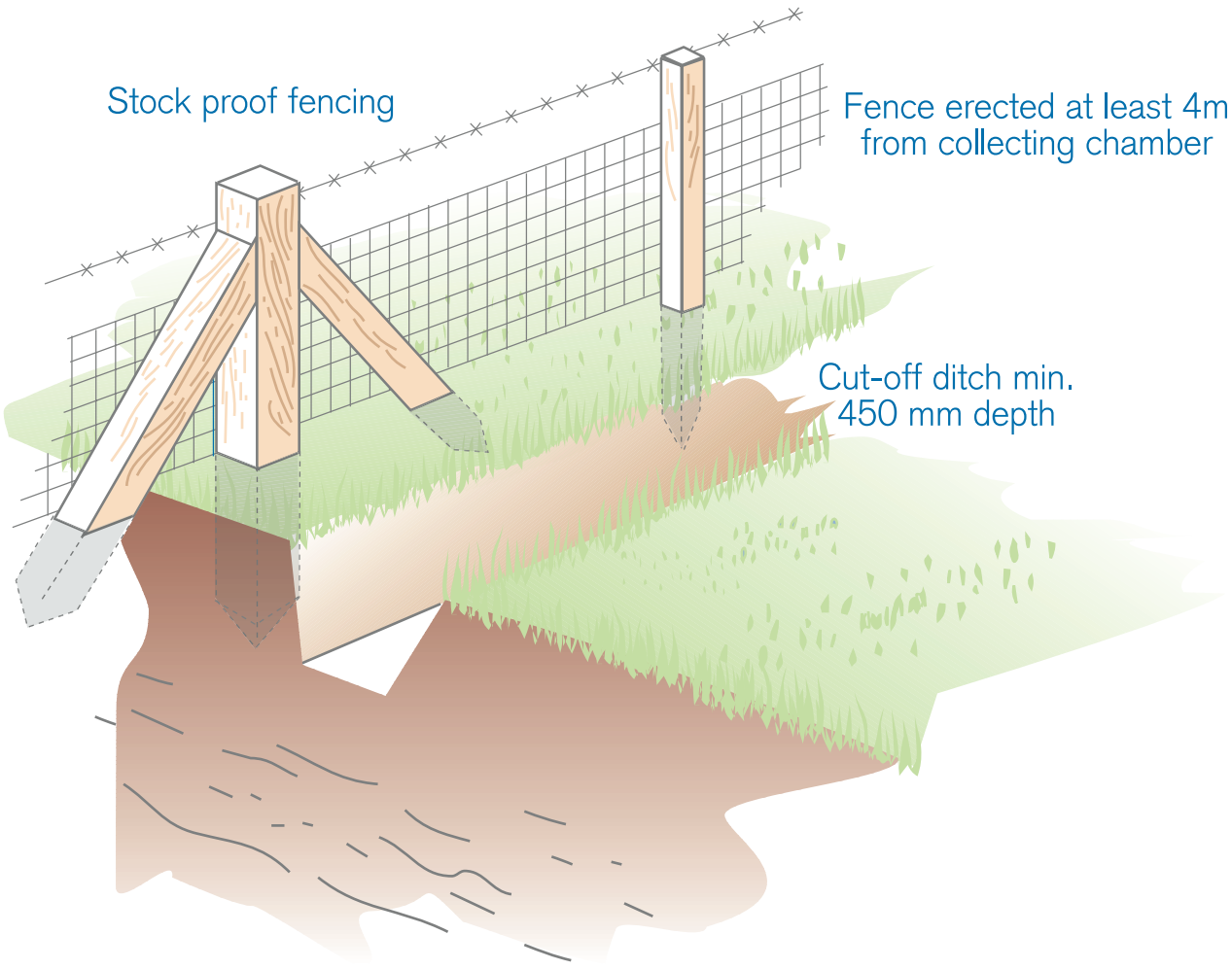
If there is evidence of the area adjacent to the source having been used for industrial activity which may pose a contamination threat then this should be recorded on the risk assessment. Such activities may include chemical or pharmaceutical production, mineral or other extraction such as coal mining, areas where old fuel tanks may have been located or may still be in place either below or above ground, or industries where solvents would have been in use and may have been disposed of on to the ground, e.g. electroplating, metal working or electronics. This list is not exhaustive and so appropriate interpretation of the previous use to which the site may have been put will be required by the investigation officer.

SECTION D (ii) Supply survey

Item 42 – No stock proof fence (to BS1722 or equivalent) at a minimum of four metres around the source

Figure 9.1 identifies a fence to BS1722. The fence must be erected at a minimum of four metres around the source to ensure that any animals who may frequent the area around the fence, e.g. for scratching, do not have an opportunity to contaminate the area of the source with faecal material which may be deposited. If there is no fence or the fence is deficient in terms of the distance or specification of construction (i.e. not fit for purpose) then the risk characterisation will be "Yes" and the hazard assessment will reflect the permanent nature of the deficiency.

Figure 9.1 Fence and ditch



Item 43 – No suitable barrier present to prevent ingress of surface flows into the well (e.g. cut-off ditch lined with impermeable material, steep incline/decline such as embankments, appropriate walls, etc.)

The well head areas need to be protected from the ingress of surface flows (such as flooding). This can be accomplished in a variety of ways such as having a cut-off ditch surrounding the well with an impermeable lining and a suitable discharge downslope from the well head area or conveying the water away from the immediate vicinity of the well head. Another method would be to have the well head area built up such that it protrudes above the ground level and the slopes convey surface flows away from the well head. It should be borne in mind that surface flows, while including flooding, are not restricted to flooding. In certain ground conditions the impermeable nature of the soil during periods of dry weather will produce a surface akin to concrete which will result in rainfall, such as a heavy summer downpour, running over the surface rather than percolating into the soil. Such conditions need to be protected against by use of appropriately engineered well head arrangements. If suitable arrangements are absent from the site under investigation then the risk characterisation will be scored as "Yes" with the hazard assessment reflecting the permanent nature of the deficiency by scoring the likelihood as almost certain (value 16).

Item 44 – Overflow/washout pipe not fitted with vermin-proof cap

The overflow pipe or washout pipe should be fitted with an appropriately-sized metal mesh or similar material to prevent the entry of vermin into the collection chamber. It should be borne in mind when assessing the covers that small rodents such as field mice can easily negotiate holes the diameter of a standard pencil. If an appropriate cover is not in place then the risk characterisation should be scored as "Yes" and the hazard assessment likelihood should also reflect the permanent nature of the deficiency by scoring as almost certain (value = 16).

Item 45 – Inlet pipe not fitted with course filter or screen

The inlet pipe should have some facility to prevent ingress of detritus. If suitable arrangements are absent from the site under investigation then the risk characterisation will be scored as "Yes" with the hazard assessment reflecting the permanent nature of the deficiency by scoring the likelihood as almost certain (value 16).

Item 46 – If chamber present no reinforced pre-cast concrete cover slab, or equivalent, in satisfactory condition with a watertight, vermin-proof inspection cover present to BS497 (lockable steel type or equivalent) with or without ventilation

A properly constructed and well-fitting well cover is essential to maintaining the integrity of the source. The cover should be watertight to prevent ingress of rainwater; vermin-proof to prevent animals from entering the well (vermin-proof means having no holes, remember a field mouse can easily enter a space where a pencil will fit); and lockable to prevent malicious (or just curious) persons gaining access to the supply. If ventilation is present ensure that it is also vermin-proof with appropriate wire mesh in place. If suitable arrangements are absent from the site under investigation then the risk characterisation will be scored as "Yes" with the hazard assessment reflecting the permanent nature of the deficiency by scoring the likelihood as almost certain (value 16).

Item 47 – Construction in an unsatisfactory state-of-repair

The fabric of the well itself (i.e. below ground) should be in good repair to prevent any short-circuiting with water entering from or near the soil surface. If suitable arrangements are absent from the site under investigation then the risk characterisation will be scored as "Yes" with the hazard assessment reflecting the permanent nature of the deficiency by scoring the likelihood as almost certain (value 16).

Item 48 – Supply network constructed from material liable to fracture (e.g. asbestos concrete, clay, etc.)

If the network of pipes that lead from the well are constructed of materials that are liable to deterioration or fracture, e.g. if heavy farm machinery is driven over the top of the pipeline, then the integrity of the system will be lost and potentially polluting material may enter the pipes through the fractures or the whole supply will be lost through pipe blockages. If it is considered likely that such materials have been used for all or part of the pipework being used to convey water from the source then the risk characterisation must reflect this with a "Yes" score and the hazard assessment must similarly reflect the permanent nature of the hazard by scoring as almost certain (value 16).

Item 49 – Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected (i.e. do not have protection described in [42] to [46])

The level of protection for all intermediate tanks or similar structures should be equivalent to that recommended for the source itself as the potential for contamination to enter the system via such intermediate points is just as high as for the source itself. If any of the intermediate tanks or similar structures are deficient in respect of the requirements provided in Items 42 to 46 then this should be reflected in the risk characterisation and hazard assessment. If there is more than one intermediate tank or similar structure, the deficient ones should be noted in section F and cross-referenced with the diagram provided in Section B (Item 6).

Item 50 – Junctions present in the supply network, particularly supplying animal water systems, have no back-siphon protection

If there are provisions made to provide water to animal watering troughs or other connections where back-siphonage may occur, e.g. from a hosepipe permanently connected, there is potential for the contents of the trough or container to be back-siphoned into the distribution pipe and for the contents of the trough or container to enter the supply. Clearly the contents of a cattle watering trough or a barrel into which the end of a hose has been dangled for some weeks will do little to improve the quality of the drinking water being provided. It is essential that where connections are made on the system prior to the first taps to be used for domestic (potable) consumption appropriate back-siphonage prevention devices are fitted. If they are not or there is no evidence to support claims that they have been fitted then the risk characterisation must reflect this with a “Yes” response. Similarly the hazard assessment should highlight the permanent nature of the situation with an almost certain (value 16) rating.

Item 51 – No maintenance (including chlorination) has been undertaken in the previous 12 months

If the system has had no maintenance undertaken in the 12 months preceding the investigation then this suggests that the level of care and attention required to ensure the system is operating as effectively as possible is lacking. If this is the case then the risk characterisation score should reflect the situation encountered and a “Yes” response entered. The hazard assessment likelihood score should also reflect the situation with an unlikely score (value = 2).

Item 52 – If present, header tank within the property(s) does not have a vermin-proof cover

Many properties served by a private supply, particularly those on smaller supplies, will have a header tank within the property to provide sufficient water pressure for the household and also to act as a balancing tank to equalise the pressure differences experienced in the system when pumps are operating to bring water into the property. However, if the header tank is not properly constructed and protected then any material that may be present in the roof space, whether that be dust or mice or bat droppings, will have the potential to enter the tank and so contaminate the supply. If the property has a header tank which feeds the main domestic (potable) tap, usually the kitchen cold water tap, and that tank is not properly protected then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an almost certain score (value = 16). If the header tank is present and unprotected but does not feed the main domestic (potable) tap then the risk assessment can be moderated but the risk to other taps in the property should be highlighted in Section F and noted on the diagram at Section B.

Item 53 – Header tank has not been cleaned in the last 12 months

If the header tank has an appropriate vermin-proof cover (Item 52) it will still require to be maintained by cleaning at least every 12 months to prevent the build-up of slime and scum which will naturally grow on the tank walls. If the tank has not been cleaned in the 12 months prior to the investigation then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an unlikely score (value = 2).

Item 54 – Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months

If any point of entry/point of use devices have had no maintenance undertaken in the 12 months preceding the investigation then this suggests that the level of care and attention required to ensure the system is operating as effectively as possible is lacking. If this is the case then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an unlikely score (value = 2).

Item 55 – If present ultraviolet (UV) lamps are not operating

While ultraviolet disinfection systems if properly installed and maintained are an effective treatment option to prevent potentially harmful micro-organisms from causing disease they can provide a false sense of security if they are not looked after. A particularly common fault is for the UV bulb to stop operating. The UV bulb is at the heart of the installation and is responsible for the disinfection process. If there is not an automatic warning system on the installation then the loss of the bulb could go undetected. Similarly if the bulb has not been changed in accordance with the manufacturer's recommended replacement period then the efficiency or operation of the bulb could be impaired or have ceased to function at all. It is important, therefore, to assess if the UV bulbs (lamps) are operating on a UV system at the time of the inspection. If they are not operating then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation based on an assessment of when the UV bulb (lamp) ceased to function.

Item 56 – Is there a noticeable change in the level and flow of water throughout the year

This question deals with the issue of constancy of supply as it relates to the quality of the source. If the source is highly dependable and provides adequate levels of water throughout the year then it is likely that the source is not under direct influence from either the surface or from prevailing climatic conditions. On the other hand, if the supply is "flashy" and changes with the weather then it is likely that it is under the influence of surface flow and prevailing weather conditions which increases its vulnerability to contamination from the surface. If there are noticeable changes in level and flow the risk characterisation response will be "Yes". The hazard assessment likelihood in these circumstances will be almost certain (value = 16). This circumstance may also cause the investigating officer to reconsider if the supply is in fact a well or if it would be better treated as a surface-derived supply.

Item 57 – Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt

If the supply is under the influence from either the surface or the weather then the quality experienced cannot be guaranteed if there are conditions prevailing which make surface flow (e.g. flooding) or adverse weather conditions likely. If there are noticeable changes in the appearance of the water then the risk characterisation response will be "Yes". The hazard assessment likelihood in these circumstances will be dependent on whether weather or surface influence is considered the most likely cause.

Section D (iii) Soil leaching risk survey

4.7 Background to soil and land use factors underpinning the assessment of groundwater vulnerability

4.7.1 Introduction to concepts of vulnerability and risk associated with soils and groundwaters

Wherever groundwater is present there is potential for contamination through human activity. No soil or geological strata is completely impermeable and likewise no pollutant is immobile. The concept of groundwater vulnerability, or the susceptibility of groundwater to microbiological contamination from surface or near-surface derived pollutants, recognises that the potential risk of contamination is greater under certain hydrological, geological, land use and soil conditions than others. In site-specific terms, groundwater contamination depends on the natural or man-made characteristics of the site in that the ease with which the potential pollutant can migrate to the underlying water table or spring source is dependent upon the physical, chemical and biological properties of the soil and rocks pertaining to the site. The factors which define the vulnerability of groundwater resources to a given pollutant or activity, acting singly or in combination, are as follows:

- presence and nature of the overlying soil
- presence and nature of the drift deposits
- nature of the solid geological strata within the unsaturated zone
- depth to groundwater
- nature of contaminant.

It must also be recognised that contamination can only occur if a potential pollutant is present, therefore land use is a critical factor. Similarly, the intrinsic factors listed above can be modified by man-made structures or excavations.

The key to groundwater vulnerability classification lies in the unsaturated zone, namely that volume of soil and unsaturated material situated above the water table. In the absence of major fissures or cracks within that zone, water movement is essentially slow, being confined to interconnected soil pores within an aerobic environment. However, the rate of this movement depends on the moisture content of the soil and therefore varies throughout the year. The overlying soil provides the potential for interception, adsorption and elimination of bacteria and viruses. Where vertical fissures occur or shattered rock comes close to the earth's surface, there is the potential for rapid flow of micro-organisms to groundwater and therefore a reduction in the ability of the soil and substrate to act as a barrier or filter.

4.7.2 Use of soil information for both general protection of groundwater resource and specific protection of individual water supply sources

4.7.2.1 Introduction

It should be stressed that a full assessment of the risks posed to groundwater by potentially polluting activities on the land surface can only be achieved by actual field investigation, which, in many instances, will involve detailed soil and hydrogeological investigations both close to the water supply source and often within a wider field of interest in relation to the zone of influence and capture zones (see section 3.3). Such investigation would, for example, be relevant to determine the suitability of a site for a new water supply. Where this is deemed necessary expert assistance should always be sought. It is also possible to assess groundwater vulnerability without field studies from close examination of existing environmental data, although this approach is not without limitations.

4.7.2.2 Presence and nature of overlying soil

Soil is the thin upper layer of the earth's crust and is the product of complex interactions between five recognised soil forming factors: namely the action of **climate, living organisms** and **topography** on the **parent material** over a period of time. Development of soil arises primarily from the accumulation of mineral grains from either the physical or chemical weathering of rocks and the addition of organic material (humus) from decaying vegetation. As plants become established, topsoils develop as organic matter is incorporated into the soil and nutrients are released from minerals to the soil solution where they can be taken up by plant roots. Gradually, the soil matures at a rate which is dependent upon the local climate.

A vertical section through soil, as seen in the face of a pit or excavation, is referred to as a soil profile which exhibits a number of distinct layers or horizons. These are the product of soil forming processes taking place within the soil matrix. Where soils are uncultivated, there is usually a complex assemblage of horizons but, for convenience, it is often appropriate to talk of a three-fold division into:

a) topsoil - this is usually a dark brown to dark greyish brown colour due to the incorporation of decomposed organic material. This layer has a high biological activity resulting in an intimate mixing of mineral and organic material to give uniform colours.
b) subsoil - this is essentially pedogenically altered parent material where soil forming processes have been active to break down minerals and reorganise the soil material into aggregates of bound soil particles. Organic material is much less abundant than in the topsoil parent material - the relatively unaltered material at the base of the soil profile where the soil forming processes have had least influence. The depth to parent
c) material within the soil depends not only on the resistance to weathering but also on the length of time the weathering processes have been active.

4.7.2.3 Presence and nature of the drift deposits

In many areas drift deposits are present overlying the solid geology and are characterised, in many instances, by vertical and horizontal variation both in thickness and lithology. Therefore, where the drift is of substantial thickness and of low permeability it can provide an effective barrier to downward percolation of any pollutant which has passed through the soil zone. However, detailed and reliable maps of drift deposits are unavailable on a national scale and where there is uncertainty about drift composition and thickness, they are treated as a special case in any groundwater vulnerability assessment. In instances where the low permeability drift deposits are sufficiently thick (up to 5 metres) to afford complete protection to underlying major or minor aquifers from surface downward pollutants, such aquifers are not depicted on the map.

4.7.2.4 Nature of solid geology within the unsaturated zone

Geological strata with a groundwater content in exploitable quantities are referred to as aquifers, in contrast to rocks without the ability to transmit substantial quantities of water which are classed as non-aquifers. All aquifers vary in their general and hydraulic characteristics and in the unsaturated zone such variation determines the vulnerability of the groundwater to pollution. Permeable strata are classified, for convenience, into highly permeable aquifers and moderately permeable aquifers, the former having generally less capacity for attenuating contaminated recharge entering at the surface. A third category of weakly or non-permeable aquifers has also been recognised.

4.7.2.5 Soil classification

The systematic mapping for soils in Scotland began in 1947 with the aim of understanding their distribution and characteristics. By 1987 most of the arable soils in Scotland had been mapped at 1:25 000 scale and for publication at 1:63 360 scale, and the entire country had also been mapped at the reconnaissance scale of 1:250 000. The system of soil classification used in these series of maps is based principally on morphological features recognisable by surveyors in the field and takes only limited cognisance of chemical characteristics. It relies, therefore, on the recognition of central concepts of soil classes and the comparison of soil profiles within them. The lowest commonly used category in the classification system, and the unit shown on the most detailed maps, is the Soil Series, of which there are over 800 identified. Each Soil Series has a limited and defined range of diagnostic properties that distinguish it and allow it consistent national recognition in accordance with a definition as follows: a group of soils similar in character and arrangement of horizons within the profile and developed on the same soil parent material. Soil Series are named after the place where they were first described or are extensive. For example, Countesswells Series is developed entirely on glacial till derived from granite, has the morphological characters of a humus-iron podzol and was first mapped at Countesswells, within the grounds of the then Macaulay Institute for Soil Research, Aberdeen.

A Soil Association is a grouping of Soil Series in which the soils are developed on similar parent materials but differ in characteristics related to local variations in texture, relief and hydrologic conditions. They are generally characterised and named after the most frequently occurring component Soil Series.

Allied to the soil mapping is an extensive database of measured and observed soil physical and chemical properties which allow identification of several important diagnostic properties which influence the movement of pollutants in soil. These factors can be considered as follows:

a) slowly permeable layer - the presence of a dense, compact layer within the soil impedes the downward percolation of water with resultant intermittent waterlogging within the soil material. If present, slowly permeable layers can prevent contaminants within the soil solution moving vertically but careful consideration should be given to possible lateral movement downslope into receiving basins where problems may arise. Waterlogging is often associated with these layers, either within the layer itself or in the layers immediately above. Where waterlogging occurs the strong brown colours normally found within the subsoil of free draining soils are replaced by drab colours, greys and generally intense mottling. Horizons with these morphological characteristics are referred to as gleyed horizons. In some cases these slowly permeable layers can exist without clear evidence of waterlogging, for example, on slopes or mounds, or where the soils are very red in colour or in drier parts of the country. Either this layer is ineffective in intercepting downward percolating water, or other soil, site and climatic factors are operating to reduce waterlogging above it. As it can be difficult to interpret the degree of protection afforded by these situations precisely within the field or from existing soil maps, such soils are generally considered to give only medium protection to groundwater supplies.

b) gley characteristics without the slowly permeable layer - where gley characteristics are present and compact, dense subsoil horizons compatible with a slowly permeable layer are absent, it is likely that the soil is affected by groundwater. Given that this groundwater table is evident within the soil profile then even relatively short-lived potential contaminants entering the soil are likely to reach the groundwater. Such soils should be considered as affording a poor level of protection and should be placed in the high risk category.

c) soil porosity - under normal conditions soils develop a structure where the porosity allows gradual percolation of the soil solution through the soil matrix. In some cases the cracks and pores can be of sufficient width that they form pathways for rapid downward movement of water when the soil is unsaturated, termed by-pass flow. Liquid discharges entering at or near the surface of such soils have the potential to rapidly by-pass the upper, most attenuating soil layers. Similarly, a proportion of any diffuse-source contaminants dissolved in the soil water fraction are likely to move rapidly out of the upper soil layers as soon as there is a significant rainfall event. In such situations, if there are no slowly permeable layers present and the subsoil is shallow over shattered rock or gravel, or is seasonally affected by groundwater (as described in b above), then a significant proportion of any potential contaminants entering the soil are likely to move rapidly to underlying strata or to groundwater. These soils are of high risk.

d) soil adsorption capacity - in simple terms, the ability of a soil to adsorb contaminants or bacteria depends on several factors with clay content and organic matter content being of particular significance. These soil particles carry a net negative surface charge which allows the chemical bonding of positively charged ionic pollutants and certain microorganisms. Once bound, these contaminants can be chemically degraded through the normal processes of weathering within the soil. Thus the lower the clay and soil organic matter content, the lower the ability to attenuate potential contaminants.

e) soil parent material - the presence of rock, shattered rock or gravel within the soil profile indicates the presence of geological material. Where such material occurs within the soil profile, any potential contaminant entering the soil is likely to reach groundwater relatively quickly and, because the ability of geological material to attenuate potential pollutants is far less than that of weathered soil material, the potential for groundwater contamination is greater.

4.7.3 Use of groundwater vulnerability maps

4.7.3.1 Introduction

A methodology for classifying soils into three leaching potential classes has been developed by the Soil Survey and Land Research Centre for use in groundwater vulnerability maps[22] as identified for use in Scotland. This classification also embraces all Soil Series which have been mapped to date within Scotland, with each soil series being assigned a value corresponding to the ease with which a representative pollutant could move through the soil. This representative pollutant is assumed not only to be soluble in water so that it moves through the soil column in solution but also able to adsorb or stick onto clay particles and organic matter. Whilst it is recognised that not all pollutants have these characteristics, the classification does provide a generalised picture and many of the central concepts are valid in the assessment of the risks of microbiological contamination.

4.7.3.2 Soil leaching potential categories

Palmer *et al.*[22] published a classification which defines three main categories of leaching potential ranging from high to low. These classes were derived primarily for assessing the vulnerability of major aquifers to contamination from a wide range of pollutants and are as follows:

Class 1 High vulnerability or soil leaching potential

Soils in which water has the potential to move relatively rapidly from the surface to underlying strata or to shallow groundwater. This may be because there is fissured rock or gravel near to the soil surface, or because the soil has a low volumetric water content, or because, at certain times of the year, there is either groundwater near to the soil surface or there is by-pass flow through the upper soil layers. In such soils there is a high risk that, at certain times of the year, contaminants will move rapidly through the soil with little time for attenuation. The high category has been subdivided into four classes with soils in the H1 subclass having a greater soil leaching potential than H2, etc.

H1 Soils with groundwater at shallow depth. Soils with rock, rock-rubble or gravel at shallow depth. Undrained lowland peat soils with permanently wet topsoils.
H2 Sandy soils with low topsoil organic matter content.
H3 Sandy soils with a moderate topsoil organic matter content. Soils with rock, rock-rubble or gravel at relatively shallow depth within the soil profile.
HU Soils in urban areas and areas of restored mineral workings for sand/gravel.

Class 2 Intermediate vulnerability or soil leaching potential

Soils in which it is possible that significant amounts of water will penetrate to below two metres in depth. In such soils contaminants may move vertically through the soil, but are likely to be substantially attenuated by the processes of biological and chemical degradation, adsorption and dilution. The intermediate category has been divided into two subclasses; mineral soils are placed in I1 and peat soils in I2.

I1 Deep loamy and clayey soils unaffected by marked seasonal waterlogging, with a topsoil of low or moderate organic matter content.
I2 Lowland peat soils which have been drained for agricultural use.

Class 3 Low vulnerability or soil leaching potential

Soils in which excess water movement is predominantly horizontal, with little likelihood of any contaminants penetrating below two metres in depth. Where such soils fringe those in classes 1 and 2 however, lateral drainage may contribute to groundwater recharge and hence potential pollution. There is no subdivision of the low category of soil leaching potential.

L Soils with a dense subsoil which restricts downward water movement. Upland soils with a permanently wet peaty topsoil.

4.7.3.3 Benefits derived from groundwater vulnerability maps

In England and Wales a series of such maps have been published by the Environmental Agency at the scale of 1:100 000. Similar maps within Scotland are being produced by the Scottish Environmental Protection Agency. In simple terms, the maps contain three layers of information which from the surface downwards include:

- soil leaching potential classes and subclasses;
- presence, where applicable, of low permeability drift deposits at the surface above aquifers by stipple ornament;
- permeability of the geological deposits (major/minor/non-aquifer; see Table 3.1).

Together these layers of information produced 27 different vulnerability combinations, some of which must be interpreted with caution because of limitations within the following:

- soil data, in particular differences in map scale and variability within mapping units;
- drift data, in particular possible mismatches with soil information;
- geological data, in particular lack of data on the variability of mapped units, inadequate description of drift deposits and difficulties of portraying multi-aquifers as a single unit.

However these vulnerability combinations provide critical information for assessing the level of protection afforded to shallow groundwater by the soil and drift deposits, in particular the soil leaching potential. This information has been systematised allowing the rapid assessment of the protection afforded by the soil to private water supplies in terms of microbiological contamination. This information can be used to give assistance to site specific assessments in the area immediately surrounding a water supply when used in conjunction with soil inspection pits. Alternatively, and where the exact location of the source is not known, or where there is a substantial catchment area associated with the supply, interpreted soil maps (as exemplified in Appendix C) can be used. This approach has the benefit that the interpretation of the soils

information is made by experts and it has a spatial component which takes account of the fact that the supply should be protected within a 50 metre radius. However, maps of this kind are not yet widely available for Scotland, there is a cost associated with their production, the scale of the available soil information may not always be suitable and there is an inherent variability in soils which can not always be shown on maps. Either soil interpretation or interpretative soil maps must be used in conjunction with information on land use. Even water supplies which are classified as having a soil which offers poor protection may not become contaminated if the land use in the surrounding area precludes the introduction of a contaminant.

4.7.3.3 Other factors which influence groundwater vulnerability

There are a series of site-specific factors which can contribute towards possible groundwater contamination but, in most instances, it is not possible to quantify the degree of risk. Examples of these are listed below:

- Physical disturbance of aquifers and groundwater flow. These activities lead to the disturbance of the physical barrier offered by the soil and may provide preferential pathways of water (and contaminant) movement to shallow groundwaters. These include: most forms of groundwater extraction; landfill operations; nearby borehole construction; any activity which interconnects naturally separate aquifers; existing or modified field drainage schemes that intercept recharge water; quarrying and gravel extraction both above and below the water table.

- Waste disposal to land. Many waste disposal practices have the potential to cause groundwater contamination. In this respect, the environment protection agencies have laid down certain regulations, many of them statutory, to ensure specific objectives. For example, there will normally be objections at the planning stage to waste disposal activities which extend to or below the water table within prescribed limits of a source. However, the disposal of slurries and other wastes on agricultural land in the vicinity of a private water supply is not subject to the same regulation, although codes of good agricultural practice do exist.

- Contaminated land, being land currently or previously used in connection with the following activities: sewage treatment works; landfill sites and other waste disposal and recycling activities; waste lagoons. The environmental agencies will seek to protect water supplies where any of the above activities are to be found in close proximity to a water source.

- The application of liquid effluents, sludges and slurries to land. Three categories of waste are recognised, being controlled wastes (industrial effluent sludges, both organic and inorganic in nature), sewage sludges and agriculture waste. Where the environment agencies consider that any of these deposits will give rise to a significant risk of polluting groundwater or surface water, there will be a presumption against spreading or compliance with existing environmental legislation. Wherever possible, farmers should have a waste management plan for their farm with information relevant to suitable land available for spreading liquid effluents, sludges and slurries.

- Discharges to underground strata. Three areas of concern have been identified:

  – sewage effluent discharges including septic tank and sewage treatment plant;
  – effluents from individual properties or small housing estates;
  – trade effluent discharges;
  – surface water discharges which include contaminated run-off from roofs; and
  – impermeable areas such as roads, car parks, storage areas, etc.

Diffuse pollution of groundwater. Diffuse pollution refers to pollution spread over time and space and caused by mechanisms other than local and specific discharges or events. Such pollutants are usually at much lower levels than other sources and are therefore at lower concentrations in the soil water. However, the build-up over a long period can generate potential problems. Diffuse pollution varies in character between urban and rural areas. Within the former, the two most notable examples of pollution arise from industrial sites and discharges from sewage systems. In contrast, within rural areas, the pollutant is not from an individual point discharge but arises from activities connected with intensive arable and livestock farming.

Additional activities or developments which pose a threat to groundwater quality include miscellaneous activities such as: storage of farm wastes and intensive livestock housing; graveyards and animal burial sites; sewage works; storm overflows.

4.7.3.4 Conclusion

Soil can offer protection to the shallow groundwaters associated with many private water supplies while a combination of soil and geological factors need to be considered when assessing deep groundwaters. The necessary soil information needed to make such assessments is obtained either by simple site inspection or from interpretations of soil maps; however, both the current and past land use practises will have a bearing on the ability of the soil to function as a filter and buffer to potential contaminants and on the presence of these contaminants. Therefore, land use remains a key component in any site appraisal.

4.7.4 Soil and land use factors underpinning the assessment of surface water vulnerability

4.7.4.1 Introduction

In some instances, private water supplies are fed by surface waters. The role of soils in offering protection to these sources is much more limited than that described above for groundwaters but nonetheless, differences in soil type will have an influence on the risk of microbiological contamination of these waters. Clearly, the soil has no role where the contaminant is deposited directly into the water body, but where a potential contaminant is deposited near to a water body, then there are a number of factors which affect the risk of contamination. The main factors are surface run-off which washes the contaminant into the water body and stream extension (both laterally and upslope) which entrains the contaminant.

The degree of surface flow is dependent on the intensity and duration of rainfall, the soil type, slope and land use. In general terms, high intensity rainfall, like that associated with thunder storms, is likely to initiate overland flow in most soils as the infiltration rate of the soil is exceeded by the rainfall intensity. More recently, it has been recognised that low intensity rainfall over a prolonged period of time can also lead to overland flow. In both cases the soil type can have a major influence on the amount of rainfall that can be absorbed before the initiation of run-off. Soils with open, porous structures and with no slowly permeable layer will be able to absorb more than shallow soils or those with slowly permeable layers near to the soil surface. The land use can act as an interceptor for rainfall (for example, a forest), reducing the actual amount that reaches the soil surface as well as providing the opportunity for the presence of potential contaminants (for example, open moorland which is grazed by domestic and wild animals).

Stream extension is the process whereby the apparent stream network as seen under dry conditions extends during rainfall, with the development of ephemeral streams and rivulets which occupy topographic hollows and are interconnected with the normal stream network. In many Scottish catchments, these streams and rivulets become dry soon after the rain has stopped. However, during rainfall the water flowing along these pathways will often be sufficiently fast and deep to entrain contaminants such as animal faeces. The occurrence of these pathways is difficult to predict from soil maps but some soil types will be more likely to behave in this way than others.

During periods of rainfall, the levels of streams and rivers generally rise and may extend out beyond their normal channel to occupy their floodplain. In many small catchments, these floodplains may only be a few metres wide, but any faecal material or other potential contaminants on the surface may be entrained in the stream.

4.7.4.2 Soil assessment

The risk assessment of the vulnerability of surface waters is not as well developed as that of groundwaters, however, the concepts of surface and immediate sub-surface flow have been developed in other sub-disciplines within soil science and can be used to derive a provisional

vulnerability classification. The general concepts are derived from the Hydrology of Soil Types (HOST) technical report[24]. This work derived a classification of UK soils which both describes the dominant pathways of water movement through the soil and assigns proportions of the rainfall likely to lead to a fast response in streams and rivers. These proportions are termed standard percentage run-off and can be used to indicate the soils likely to have a high incidence of overland flow as well as those likely to cause a rapid rise in river levels or to initiate stream extension. This work indicates that soils with peaty surface layers tend to initiate surface run-off quicker than soils with a mineral surface layer and that soils with a slowly permeable layer close to the soil surface will initiate surface run-off more quickly than deep, porous soils.

4.7.4.3 Conclusion

Although still an underdeveloped area of microbiological risk assessment, the results and concepts derived from soil hydrological research can be used to rank the role of soil in assessing the vulnerability of these waters to contamination. However, the very fact that there is no protection from the direct entry of contaminants into surface waters means that these sources must remain at a high risk of contamination.

SECTION D (iii) Soil leaching risk survey

Using the National Grid Reference derived in Section C (7(iii)) the appropriate soil leaching risk map is examined and the category of the soil associated with the source is determined using the table below.

If the source cannot be identified then the risk characterisation for the soil leaching risk classification will be assigned a “High” value.

If there appear to be several soil leaching potentials at or near the point where the source has been determined then the soil leaching potential with the highest risk characterisation score will be used to complete the risk assessment.

The appropriate hazard assessment score will be assigned according to the table.

Soil Leaching Risk Classification	Risk Characterisation	Hazard Assessment
Low	Low	4
Intermediate 1	Moderate	8
Intermediate 2	Moderate	8
High 1	High	16
High 2	High	16
High 3	High	16
Built up	High	16

The following (simplified) explanation of soil leaching potential is taken from the soil leaching risk map legend.

Principles

The purpose of the soil leaching potential maps for microbiological risk assessment is to show, in broad terms, the potential of soils to attenuate possible pollutants by adsorption and degradation. Where the soil has a limited ability to attenuate, there is an increased possibility that potential pollutants will leach from the soil and penetrate underlying groundwater. In areas where the geological drift is thick and of low permeability, the soils are of less significance and groundwater may be less vulnerable to contamination than shown by the map.

The scale of the underlying soil mapping means that the map units may not comprise single soil types, thus only the Soil Leaching Potential that constitutes the greatest proportion of a map unit can be shown. The map is a compromise between the representation of natural complexity and simplicity of interpretation at the scale of representation. This places limitations on the resolution and precision of the map information. The variety of soil, potential pollutants and the generalised nature of Soil Leaching Potential classification means that individual sites and circumstances should be subject to more detailed assessment.

Soil leaching potential classification

The ability of a soil to protect underlying groundwaters from contamination depends on the physical properties that affect the downward passage of water and the chemical properties that affect the attenuation of contaminants. These include: texture (clay and organic matter contents), structure, soil water regime and the presence of distinctive layers such as raw peaty topsoil and rock or gravel at shallow depth. In areas where the geological drift is thick and of low permeability, the soils are of less significance and groundwater may be less vulnerable to contamination than shown by the map. All soils in Scotland can be grouped into one of six classes. Where the soil cover has been considerably altered, for example, in urban areas, they are designated as being at high risk of leaching and form a separate class.

For the purpose of the Microbiological Risk Assessment procedure, it is recommended that three classes will be sufficient: High, Medium and Low risk corresponding to the three main soil leaching potential classes of High, Intermediate and Low.

Soils of high leaching potential (H)

Soils with little ability to attenuate diffuse source contaminants and in which non-adsorbed diffuse contaminants and liquid discharges have the potential to move rapidly to underlying strata or to shallow groundwater. Three subclasses are recognised:

H1 Soils that readily transmit liquid discharges because they are either shallow or susceptible to by-pass flow directly to rock, gravel or groundwater.

H2 Deep, permeable, coarse textured soils that readily transmit a wide range of contaminants because of their rapid drainage and low attenuation potential.

H3 Coarse textured or moderately shallow soils which readily transmit non-adsorbed contaminants and liquid discharges but which have some ability to attenuate adsorbed contaminants because of their organic matter content.

HU Soils over current and restored mineral workings and in urban areas that are often disturbed or absent. A worst case vulnerability classification (equivalent to H1) is therefore assumed for these areas, until proved otherwise.

Soils of intermediate leaching potential (I)

Soils with a moderate ability to attenuate diffuse source contaminants or in which it is possible that some non-adsorbed diffuse source contaminants and liquid discharges could penetrate the soil layer. Two subclasses are recognised:

I1 Deep, permeable, medium textured soils that can possibly transmit a wide range of pollutants.

I2 Deep, permeable, medium textured soils with high topsoil organic matter contents that can possibly transmit non- or weakly-adsorbed diffuse contaminants and liquid discharges, but are unlikely to transmit adsorbed contaminants.

Soils of low leaching potential (L)

Soils in which contaminants are unlikely to penetrate the soil layer due to the presence of a low permeability horizon. Water and contaminant movement is, therefore, largely horizontal but the soils may also have the ability to attenuate contaminants. Lateral flow from these soils may contribute to groundwater recharge elsewhere in the catchment. These soils may have a high clay or organic matter content.

Notes

(i) Where no subclasses are indicated for the Intermediate and High soil leaching potentials, the underpinning map units comprise a number of distinctive soil types. Only the soil leaching potential of the dominant soil type is given.

(ii) The map is a compromise between the representation of natural complexity and simplicity of interpretation at the chosen scale. This places limitations on the resolution and precision of map information. In this case, the variety of soils that has to be covered is wide, and the classification used is generalised. Individual sites and circumstances will always require further and more detailed assessment.

(iii) The map only represents conditions at the surface and, therefore, where the soil and/or underlying formations have been disturbed or removed, for example, during mineral extraction, the leaching potential may have been changed. Hence, where there is evidence of disturbance, site specific data will need to be used.

D (iv) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the three surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	
Source Survey	
Soil Leaching Risk Survey	
Overall Risk	

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 16 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

Section E

If the type of the supply has not been determined then the risk assessment will not have been completed. In this case the overall risk assessment for the supply will default to High Risk to ensure that appropriate control measures are put in place to maintain public health.

Section F

Additional Notes – this section can be used to include additional information or observations made during the investigation.

Section 4.7 – Annex 1

Spring Risk Assessment pro forma

Private water supply risk assessment form

SPRING SUPPLY

OVERALL RISK .....

Section A – Supply Details

1. Supply category

Type A1 / A2 / A3 Type B (circle appropriate category)

2. Address and telephone number of responsible person

.....

.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

3. Name of person (or persons) who is relevant person in relation to the supply

(a) .....

(b) .....

(c) .....

(d) details of additional sheets .....

4. Address of relevant person (or persons) (if different from above)

(a) .....

.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

(b) .....

.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

(c) .....

.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

(d) details of additional sheets .....

5. Details of premise(s) served by the supply and purpose for which water is supplied

(a) .....

.....

.....

Post Code .....

Supply purpose .....

(b) .....

.....

.....

Post Code .....

Supply Purpose .....

(c) .....

.....

.....

Post Code .....

Supply Purpose .....

(d) details of additional sheets .....

Section B

6. Provide a diagram of the supply showing source(s), intermediate storage and/or collection tanks and properties on the supply. The diagram is indicative only and is intended to aid completion of the rest of this section.

Notes: Items should be labelled from source (A) through intermediate tanks (B) to properties (C) with individual components numbered, e.g. for a supply with one source this would be A1; two intermediate tanks (B1 and B2 respectively) and two properties (C1 and C2) respectively.

7. Description of the source of the supply including (i) details of supply source(s), (ii) location of the source(s) and (iii) National Grid Reference of location(s) of source(s). Cross reference from Item 6 above.

(i) .....

.....

.....

(ii) .....

.....

.....

(iii) National Grid Reference N / J / 0 / 0 / 0 / 0 / 0 / 0

8. (a) Estimated daily volume of water provided by the supply ..... m^3 per day

(b) Number of persons served by supply (at maximum occupancy) .....

9. Details of any water treatment processes associated with the supply

(a) At source – identify which of the following systems are present: (cross reference to Item 6)

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

(b) Intermediate Water Storage Tank/Chamber (cross reference to Item 6)

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

(c) At property (cross reference to Item 6)

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

(d) details of additional sheets .....

Section C

10. Details of departures authorised

.....

.....

.....

11. Details of sample results for previous 12 months or last available (reference location of information, e.g. paper or electronic files, reference number, sample numbers, etc.)

.....

.....

.....

12. Details of previous (last 2) investigations and actions taken

.....

.....

.....

13. Details of enforcement notices served

.....

.....

.....

14. Result of previous risk assessment (if applicable)

.....

.....

.....

15. Details of location of Notice for Type A supplies (location)

.....

.....

.....

16. Is Notice appropriate (conforms to requirements of the Regulations)? Yes ☐ No ☐

17. Details of action taken (or to be taken) by relevant persons to comply with

(a) results of sampling

.....

.....

.....

.....

(b) results of follow-up to sampling

.....

.....

.....

.....

18. Whether supply exempt under Regulation 2(4)

.....

.....

.....

19. Details of other information relating to the supply collated by the local authority

.....

.....

.....

20. Is there a Water Safety Plan/ Emergency Action Plan available for the supply?

Yes ☐ No ☐

21. If "Yes" to Item 20, is it fit for purpose? Yes ☐ No ☐

22. If "No" to Item 21, what deficiencies are required to be addressed (provide details)?

.....

.....

.....

Section D – Springs

D (i) General site survey

Are any of the following known to be present and likely to influence water quality at the source?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
23	Evidence or history of poor drainage causing stagnant / standing water	H	L	H		8	
24	History of livestock production (rearing, housing, grazing) – including poultry	H	L	H		16	
25	Evidence of wildlife	M	L	M		4	
26	Surface run-off from agricultural activity diverted to flow into the source/supply	H	L	H		8	
27	Soil cultivation with wastewater irrigation or sludge / slurry/ manure application	H	L	H		16	
28	Disposal of organic wastes to land	H	L	H		8	
29	Farm wastes and/or silage stored on the ground (not in tanks or containers)	M	L	M		8	
30	Remediation of land using sludge or slurry	H	L	H		16	
31	Forestry activity	M	L	M		4	
32	Awareness of the presence of drinking water supply/source by agricultural workers	L	H	H		4	
33	Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)	H	L	H		8	
34	Disposal sites for animal remains	H	L	H		8	
35	Unsewered human sanitation including septic tanks, pit latrines, soakaways	H	L	H		16	
36	Sewage pipes, mains or domestic (e.g. leading to / from septic tank)	H	L	H		8	
37	Sewage effluent lagoons	H	L	H		16	
38	Sewage effluent discharge to adjacent watercourse (where present)	H	L	H		16	
39	Supplies or wells not in current use	H	L	H		8	
40	Evidence of use of pesticides (including sheep dip) near source	H	L	H		8	
41	Evidence of industrial activity likely to present a contamination threat	H	L	H		8	

[1] The Hazard Assessment Score is the product of the Likelihood and Severity values. The values are :

Likelihood	Definition	Value
Almost certain	Once per day (or permanent feature)	16
Likely	Once per week	8
Moderate likely	Once per month	4
Unlikely	Once per year	2
Rare	Once every 5 years	1

Risk Characterisation

Tick the appropriate box for each question.

If any question is High Risk (H) then the Risk Characterisation Score is **High**. ☐

If no question is High Risk but there are Moderate Risks (M) identified then the Risk Characterisation Score is **Moderate**. ☐

If no question is High Risk (H) or Moderate Risk (M) then the Risk Characterisation Score is **Low**. ☐

Hazard Assessment

If the Hazard Assessment Score is 16 or greater for any individual component then the issues associated with that component should be considered as a priority for remedial works to reduce the hazard experienced by the supply.

D (ii) Supply survey

Are any of the following known to occur at the head works site or in relation to the supply?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
42	No stock proof fence (to BS1722 or equivalent) at a minimum of 4 metres around the source?	H	L	H		8	
43	No suitable barrier present to prevent ingress of surface flows into the well (e.g. cut-off ditch lined with impermeable material, steep incline/decline such as embankments, appropriate walls, etc.)	H	L	H		16	
44	Overflow/washout pipe not fitted with vermin proof cap	H	L	H		8	
45	Inlet pipe not fitted with course filter or screen	H	L	H		16	
46	If chamber present no reinforced pre-cast concrete cover slab, or equivalent, in satisfactory condition with a watertight, vermin-proof inspection cover present to BS497 (lockable steel type or equivalent) with or without ventilation?	H	L	H		16	
47	Construction in an unsatisfactory state-of-repair?	H	L	H		8	
48	Supply network constructed from material liable to fracture, e.g. asbestos-concrete, clay, etc.?	H	L	H		8	
49	Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected (i.e. do not have protection described in [42] to [46] above)?	H	L	H		8	
50	Junctions present in the supply network, particularly supplying animal watering systems, have no back-siphon protection?	H	L	H		4	
51	No maintenance (including chlorination) has been undertaken in the previous 12 months?	H	L	H		8	
52	If present, header tank within the property(s) does not have a vermin-proof cover?	H	L	H		4	
53	Header tank has not been cleaned in the last 12 months?	H	L	H		8	
54	Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months?	H	L	H		8	
55	If present ultraviolet (UV) lamps are not operating?	H	L	H		16	
56	Is there a noticeable change in the level and flow of water throughout the year?	H	L	H		4	
57	Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt?	H	L	H		8	

[1] The Hazard Assessment Score is the product of the Likelihood and Severity values. For details see Section D.

Risk Characterisation

Tick the appropriate box for each question.

If any question is High Risk (H) then the Risk Characterisation Score is **High**. ☐

If no question is High Risk but there are Moderate Risks (M) identified then the Risk Characterisation Score is **Moderate**. ☐

If no question is High Risk (H) or Moderate Risk (M) then the Risk Characterisation Score is **Low**. ☐

Hazard Assessment

If the Hazard Assessment Score is 16 or greater for any individual component then the issues associated with that component should be considered as a priority for remedial works to reduce the hazard experienced by the supply.

D (iii) Soil leaching risk survey

Using the NGR identified in Section B (7)(iii) determine and record below the soil leaching potential from the appropriate soil leaching potential map covering the geographic area of interest for location of the source.

National Grid Reference N / J / 0 / 0 / 0 / 0 / 0 / 0

Soil Leaching Risk Classification Assigned .....

Risk Characterisation Score .....

Hazard Assessment Score .....

Table D1 - Soil leaching risk characterisation and hazard assessment scores

Soil Leaching Risk Classification	Risk Characterisation	Hazard Assessment
Low	Low	8
Intermediate 1	Moderate	16
Intermediate 2	Moderate	32
High 1	High	64
High 2	High	128
Built up	High	16

D (iv) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the three surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	
Source Survey	
Soil Leaching Risk Survey	
Overall Risk	

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 32 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

Section E

You have been unable to discern the type of supply and so the overall risk assessment for this source must be given as **High Risk**.

Section F – Additional Notes

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4.8 Borehole risk assessment (see 4.8 Annex 1 for full form)

Overall Risk – this is taken from the overall risk assessment in section D(iv)(a) of the risk assessment form.

SECTION A – Supply details

Item 1 – Supply category

The supply category that is required to be identified is taken from The Private Water Supplies (Scotland) Regulations 2006 Part 1(2). These state:

"Type A supply" means a private water supply for human consumption purposes which

(a) on average, provides 10 or more cubic metres of water per day or serves 50 or more persons, or
(b) regardless of the volume of water provided or the number of persons served, is supplied or used as part of a commercial or public activity,

and references in this definition –

(i) to the average volume of water provided by such a supply, are references to such volume (calculated as a daily average) as may be reasonably estimated to have been distributed or, if not distributed, used or consumed from the supply during the year prior to the year in which these Regulations come into force; and that estimate may be on the assumption that five persons use one cubic metre of water per day; and
(ii) to the average number of persons served by such a supply, are references to such number of persons as may be reasonably estimated to be the maximum number served by the supply on any one day during the year prior to the year in which these Regulations come into force;

"Type B supply" means a private water supply other than a Type A supply; and "year" means a calendar year.

Item 2 – Address and telephone number of responsible person

"Responsible person" is a term used in the Regulations referring to the person who owns or otherwise is responsible for the domestic distribution system which included the pipework, fitting and appliances which are installed between the taps that are normally used for human consumption purposes and the distribution network which is not the responsibility of a relevant person (see Item 3). Full contact details of the responsible person should be recorded here.

Item 3 – Name of person (or persons) who is relevant person in relation to the supply

The term “relevant person” refers to the person considered by the local authority to be the person providing the supply, or occupying the land from, or on, which the supply is obtained or located, and any person who exercises powers of management or control in relation to the supply.

The relevant and responsible person may be one and the same person in some instances.

In some instances there may be more than 3 relevant persons in which case additional sheets should be used to record the information and details of these additional sheets should be included in section (d) and the sheets appended to the form when completed.

Item 4 – Address of relevant person (or persons) (if different from above)

Where the responsible person and the relevant person are different then the contact details for the relevant person or persons should be recorded in this section.

In some instances there may be more than 3 relevant persons in which case additional sheets should be used to record the information and details of these additional sheets should be included in section (d) and the sheets appended to the form when completed.

Item 5 – Details of premise(s) served by the supply and purpose for which water is supplied

This item seeks to capture details of any premise that may be served by the supply and the purpose for which the water is being supplied. It is necessary to have as complete a list of properties served by a private water supply as possible in order that the true interconnectivity of the supply may be assessed and the potential population affected by any breach of the Regulations or incidence of waterborne disease outbreak can be assessed rapidly and efficiently. For larger supplies this exercise will be challenging but attention to detail will ensure that the most comprehensive and accurate records are compiled which will assist in future investigations relating to the supply.

Additional sheets (as required) should be appended to the form and a note of these made at section (d).

SECTION B

Item 6 – Diagram of the supply

This is intended to enable the investigating officer to provide a schematic sketch showing the interrelationships between the various components of the supply such as source, intermediate tanks and properties being supplied. While there is undoubtedly a balance to be struck between too much detail and insufficient detail, a guiding principle should be to provide sufficient information to enable colleagues who have not visited the site to quickly navigate around the supply.

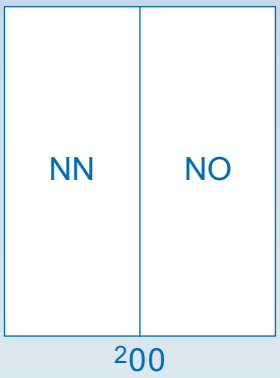
Item 7 – Description of the source of the supply

The description provided should complement the schematic sketch provided at Item 6.
The purpose of having a written description is to provide a record of the condition of the infrastructure at the time of the risk assessment. This will enable a baseline to be established against which any future developments made to the supply can be benchmarked. If the facility exists it would be appropriate to also include relevant photographic evidence of the various components so long as they are uniquely identified and cross-referenced within the risk assessment report.

A full National Grid Reference for the source (or the closest point to the source identified) should also be provided.

How to give a grid reference to nearest 100 metres

The example below is taken from Ordnance Survey Braemar to Blair Atholl Sheet 43 1:50000 Landranger Series.

<table>
<tr><th>100 000 metre Grid Square Identification</th><th colspan="4">Example - Altaltan</th></tr>
<tr><td rowspan="4"> 
</td><td>1. Read letters identifying 100 000 metre square in which the point lies.</td><td>NO</td><td></td><td></td></tr>
<tr><td>2. FIRST QUOTE EASTINGS
Locate first VERTICAL grid line to LEFT of point and read LARGE figures labelling the line either in the top or bottom margin or on the line itself.
Estimate tenths from grid line to point.</td><td></td><td>18
4</td><td></td></tr>
<tr><td>3. AND THEN QUOTE NORTHINGS
Locate first HORIZONTAL grid line BELOW line either in the left or right margin or on the line itself.
Estimate tenths from grid line to point.</td><td></td><td></td><td>63
5</td></tr>
<tr><td>EXAMPLE REFERENCE</td><td colspan="3">NO 184 635</td></tr>
<tr><td>Ignore the smaller figures of any grid number: these are for finding the full coordinates. Use ONLY the LARGER figure of the grid number.

Example: 280 000m</td><td></td><td></td><td></td><td></td></tr>
</table>

Extract from 1:50 000 sheet 43 showing location of Altaltan

Item 8 – Estimated daily volume of water provided by the supply

If the volume of water is not being measured, e.g. via a water meter, then the investigating officer can make an estimate of the volume based on 200 litres of water per day per person served by the supply. While the figure will only be an estimate every effort should be made to identify the maximum number of people who are being supplied with water from the supply. It is not sufficient just to base the estimate on historical records, e.g. the classification of the supply made under previous regulatory frameworks. It is important to have a robust and defensible maximum occupancy for the supply as this may well have an impact on the sampling frequency to which the supply is subjected.

Item 9 – Details of any water treatment processes associated with the supply

While it is important to document any treatment that occurs on the supply it is not practicable to list all possible treatment types or systems that may be encountered. The risk assessment form concentrates on the provision of standard disinfection equipment/processes but all other treatment systems should be included in the description including items such as sediment traps of pH correction systems. Each of the treatment processes should be cross-referenced to those identified on the schematic provided at Item 6.

For larger systems it will not be practicable to complete Item 9 (c) and so a table should be drawn up listing the properties and the treatments associated with each property differentiating between point of entry and point of use devices, e.g.

Responsible Person	Property address (including post code)	Point of entry device (specify)	Point of use device (specify)	Notes
Mr D Able	1 Wellside Cottage, Nethermuir, ZZ1 1AA	UV lamp	None	located in lean-to on north side of house, pre-filter bypassed
Mrs C Brown	3 Wellside Cottage, Nethermuir, ZZ1 1AA	UV lamp	None	On maintenance contact with Bloggs Plumbing, Nethermuir
Ms B Charlie	Springside House, By Nethermuir, ZZ1 2BA	None	UV lamp	Under sink in kitchen – poor access for changing bulb
Rev. A Davis	Riverbank Cottage, Nethermuir, ZZ1 1AB	None	None	

These details should be recorded as additional sheets on the form at Item 9 (d)

SECTION C

Item 10 – Details of departures authorised

Provide details of any temporary departures granted under Part IV of the Private Water Supplies (Scotland) Regulations 2006. These details should summarise the details provided in the original temporary departure and should cross-reference to the complete application. If applicable the temporary departure authorisation (Regulation 6(7) of the above Regulations) can be appended to the risk assessment. Details of this should be recorded in Section G.

Item 11 – Details of sample results for previous 12 months or last available (reference location of information, e.g. paper or electronic files, reference number, sample numbers, etc.)

The inclusion of this information is to assist the investigation officer in their investigations. Details of the previous sampling results will enable areas of concern to be highlighted and assist in focusing on areas where actual breaches of the drinking water quality standards have occurred. For example, if lead is highlighted as failing in the sample results, while lead is not specifically being looked for in the risk assessment, the investigation officer may take the opportunity of the investigation to attempt to determine whether there are any known lead pipes or tanks associated with the supply or through examination of the appropriate geological map whether lead is naturally occurring in the vicinity of the source. If lead pipes or tanks are present then appropriate advice can be provided on the need for their removal; if lead is naturally occurring at the source then discussions around locating a more acceptable alternative source for the supply can be entered into.

Item 12 – Details of previous (last two) investigations and actions taken

If there have been investigations into previous failures then the last two such investigations should be summarised here along with the actions that were taken or were understood to have been agreed to have been taken. This information will provide the investigation officer with a background to the problems that have been encountered previously along with an understanding of what actions have been attempted to improve the situation and whether these actions have proved to be successful. If they have proved to be unsuccessful then this information will allow the investigation officer to consider alternative solutions that have not been previously implemented.

Item 13 – Details of enforcement notices served

If any enforcement notices have been served that affect the supply under investigation, details of these should be provided here. If necessary additional information may be appended to the risk assessment and details of these should be provided in Section G.

Item 14 – Results of previous risk assessment (if applicable)

If the source or supply has previously been risk assessed then the details of the previous risk assessment(s) should be included with the current risk assessment. The previous risk assessments should be appended to the current form and details of these additional sheets should be recorded against this item.

Item 15 – Details of location of Notice for Type A supplies (location)

Regulation 31 of the Private Water Supplies (Scotland) Regulations 2006 requires that up-to-date information about the quality of the water provided in commercial or public premises shall be displayed in a prominent location. This notice forms part of the communication of risk to members of the public and so the location of the notice should be recorded to ensure that appropriate risk communication is being undertaken.

Item 16 – Is Notice appropriate (conforms to requirements of the Regulations)

Regulation 31 (2) details the form that the information notice must take. This item confirms that the appropriate form of the notice is being displayed as the form of the notice interlinks with additional information available to both owners/users and visitors to private water supplies making it vital that the appropriate form of the notice is utilised.

Item 17 – Details of action taken (or to be taken) by relevant persons to comply with (a) results of sampling (b) results of follow-up to sampling

If sampling results indicate that the supply fails to comply with the requirements of the Regulations, this section should be completed to identify what suggested/agreed remedial steps should be taken to prevent future failures.

Item 18 – Whether supply exempt under Regulation 2 (4)

If the supply is used solely for washing a crop after it has been harvested or during the distillation of spirits (solely in the mashing process or for washing plant but for no other purpose) and which does not affect, either directly or indirectly, the fitness for human consumption of any food or drink or, as the case may be, spirits in their finished form, then the provisions of the Private Water Supply (Scotland) Regulations 2006 do not apply to that supply with the exception of the provisions of regulation 29. If the supply is exempted under the provisions of regulation 2(4) then a full risk assessment is not required to be completed but good practice would require a partially completed form to be retained by the local authority containing the information required by regulation 29.

Item 19 – Details of other information relating to the supply collated by the local authority

If the local authority has other relevant information relating to the supply then these details should be included here or appended to the form and details of the additional sheets recorded under this item.

Item 20 – Is there a Water Safety Plan/Emergency Action Plan available for the supply

Some supplies may have a water safety plan or emergency action plan that details steps to be taken to ensure the quality of water at the source and steps to be taken in the event of a loss of constancy or quality from that supply.

Item 21 – If "Yes" to Item 20, is it fit for purpose

This item requires an assessment by the investigation officer as to whether or not the water safety plan or emergency action plan is suitable for the premises it relates to.

Item 22 – If "No" to Item 20, what deficiencies are required to be addressed (provide details)

If the assessment undertaken in Item 21 suggests there are inadequacies in the water safety plan or emergency action plan then the deficiencies should be noted against this item with suggestions, where appropriate, as to what improvements may be considered to the plan(s).

SECTION D

General introduction

In this part of the form each of the indicators being looked for, e.g. disposal sites for animal remains, will have two separate scores associated with them.

The first score will be the Risk Characterisation score

The Risk Characterisation score has three values – High, Moderate or Low – and is based on the presence or absence of the indicator based on the evidence available to the person undertaking the risk assessment. The form is preloaded with the risk characterisation value based on the individual indicator being present or absent. If the assessor cannot determine if the indicator is present then the "Don't know" option should be used.

The assessor should tick the appropriate response box for each indicator. If any response is identified as High Risk (H) then the Risk Characterisation Score will be **HIGH**. If no response is High Risk but there are Moderate Risks (M) identified then the Risk Characterisation Score will be **Moderate**. If no response is High Risk or Moderate Risk then the Risk Characterisation Score is **Low**.

The second score is the Hazard Assessment score.

The Hazard Assessment Score is also based on the indicator being present but this scoring allows the extent of the potential influence of the indicator to be taken into account. Thus the likelihood score is dependent on a knowledge or estimate of the time period during which the indicator may be present at the source under investigation. The table in the form provides guidance on the values to be assigned based on how frequently the indicator is known, or thought, to be present. If the indicator is present continuously, i.e. once per day or a permanent feature, then the likelihood value assigned will be 16 as the indicator is almost certainly there continuously; if the indicator is present once a week then the likelihood value assigned will be 8; if the indicator is present once a month then the value will be 4; if the indicator is present once a year then the likelihood value assigned will be 2; and if the indicator is known, or thought, to occur rarely such as once every five or more years, then the value assigned will be 1. Once the likelihood value has been assigned on the form the Hazard Assessment Score is determined by multiplying the Likelihood Value by the Severity (which is pre-loaded on the form) to give the overall Hazard Assessment Score.

The Hazard Assessment Score is an index and there is no implied mathematical relationship to risk. The Hazard Assessment Score is a convenient way of prioritising actions or interventions so that resources are effectively targeted to those areas that pose the greatest potential risk of contamination to the source under investigation.

If the Hazard Assessment Score is **16** or greater for an individual component then the issues associated with that component should be considered as a priority for remedial works to reduce the hazard experienced by the supply.

The value of 16 is considered to be appropriate when only a rare event may produce a catastrophic outcome, e.g. sewage effluent discharge to adjacent watercourse. However, if the presence of sewage effluent discharge to an adjacent watercourse were to occur more frequently than once every 5 years or more then the Hazard Assessment Score would reflect this change by increasing the score, and hence flag the requirement to take appropriate action to reduce the likelihood of the occurrence.

Hazard assessment matrix

	Severity of consequences				
Likelihood	**Insignificant**	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	16	32	64	128	256
Likely	8	16	32	64	128
Moderately likely	4	8	16	32	64
Unlikely	2	4	8	16	32
Rare	1	2	4	8	16

Each of the indicators in Section D will now be considered in turn.

Section D(i) Boreholes with headworks located below ground

General site survey

Item 23 – Evidence or history of poor drainage causing stagnant/standing water

If standing water can be seen present around the well head area or if there is evidence of standing water having been present, e.g. mud or vegetation consistent with marshy ground such as reeds, then the hazard should be scored as being present and the risk characterisation assigned as "Yes". If there is a suggestion that the likelihood of the standing water being present (or evidence of having been present) is a long-standing occurrence then the likelihood score for the hazard assessment should reflect this.

Item 24 – History of livestock production (rearing, housing, grazing) – including poultry

Any evidence of domestic livestock production being present (either directly by the presence of animals in the vicinity of the supply) or indirectly (through presence of broken ground around the supply or the presence of animal droppings around the supply) should result in the risk characterisation being scored as "Yes". Further investigations will be required to decide on the persistence of such presence in order to allow the hazard assessment likelihood score to be accurately assigned.

Item 25 – Evidence of wildlife

Any evidence of wildlife, mammals (rabbits, deer, etc.), birds (gulls, geese, migratory birds, etc.), reptiles (newts, frogs including spawn) etc. at the source could indicate the potential for contamination of the supply either from faecal material or from carcasses falling into the supply. If evidence of wildlife is found then the risk characterisation should be scored as "Yes". Account should be taken of the likely frequency of the presence of wildlife, e.g. a rabbit warren nearby will suggest permanent presence; migratory birds will suggest a seasonal presence which will require the suggested likelihood values to be moderated to reflect this seasonal presence by raising the once per year score of 2 to 4.

Item 26 – Surface run-off from agricultural activity diverted to flow into source/supply

This indicator is intended to deal with field drains and other drainage systems employed on agricultural land which may be connected to the source or supply. The indicator also deals with instances where there is overland flow from agricultural land that ends up in a watercourse or entering the source and potentially contaminating the supply, e.g. applied slurry, where there is potential for it to be washed into field drains or watercourse or similar drainage systems. If there are drainage systems or similar present in areas of agricultural activity then the risk characterisation response will be "Yes". The likelihood value will be based on the probable time the land is being subjected to agricultural applications.

Item 27 – Soil cultivation with wastewater irrigation or sludge/slurry/manure application

This indicator differs from Item 26 in that there will be active application of the materials in conjunction with the disruption of the soil itself, e.g. via ploughing or sub-soil injection. If such activities are considered to be undertaken then the risk characterisation will be "Yes". The likelihood value will be based on the probable time/duration that such activities occur at.

Item 28 – Disposal of organic wastes to land

This indicator deals with any other organic waste, e.g. abattoir wastes or "blood and guts". The scoring for this indicator will be irrespective of whether there has been disruption of the soil. If such activities are considered to be undertaken then the risk characterisation will be "Yes". The likelihood value will be based on the probable time/duration that such activities occur at.

Item 29 – Farm wastes and/or silage stored on the ground (not in tanks or containers)

If there are middens or areas where silage are being stored in polyethylene bags (or equivalent) or other farm-derived wastes where there is no bunded storage and there is the potential for spillage entering drainage systems, then this item should be scored such that the risk exists. If the storage appears to be a permanent or long-term feature then the hazard assessment should be scored as almost certain (value 16) or likely (value 8).

Item 30 – Remediation of land using sludge or slurry

In some areas brownfield sites or derelict land will be remediated using sewage-derived sludge or slurry or similar materials. The rate of application will typically be higher than those used in Item 27 and this should be borne in mind when assessing both the risk characterisation and hazard assessment parts of the risk assessment form.

Item 31 – Forestry activity

Forestry activities have the potential to cause significant disruption to water supplies to the area in which they are being undertaken. The disruption may occur when forests are being planted, when thinning activities are being carried out or when the timber is being harvested. Account should be taken of the maturity of the forest and the likelihood of activity starting or changing during the period of the risk assessment. If the risk assessment is not scheduled to be time-limited then the potential for disruption should be highlighted.

Item 32 – Awareness of the presence of drinking water supply/source by agricultural workers

If the awareness of the presence of a drinking water source is absent from those agricultural or forestry workers who may be available to be interviewed or if there is evidence of disregard for the presence of such sources, e.g. ploughing to the margins of a well or spring, then the risk characterisation will be “No” or “Don’t Know” to reflect the high level of risk such a lack of knowledge may be introducing to the supply. Lack of awareness on the hazard assessment should be scored as almost certain (16) again to reflect the potential for introduction of harmful materials or disturbance of the supply.

Item 33 – Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)

The presence of disposal sites may influence the quality of water at the source by allowing the introduction of microbiological or chemical contaminants into the supply, depending on the nature of the materials being disposed. Incineration is also included in this section as the question of both airborne material and disposal sites for ash residues need to be considered when making the overall assessment of the likely impact of this item on the water quality at the source. If any waste disposal sites are present then the risk characterisation will be "Yes" and the associated hazard assessment should reflect the permanent nature (or longevity) of such sites in terms of their potential to continue to release polluting materials for many years after their immediate use has ceased.

Item 34 – Disposal sites for animal remains

This definition includes on-farm carcass disposal, burial pits, e.g. arising from foot-and-mouth disease, and vicinity to human burial sites such as graveyards or family plots away from traditional burial sites. If any disposal sites are present then the risk characterisation will be "Yes" and the associated hazard assessment should reflect the permanent nature (or longevity) of such sites in terms of their potential to continue to release polluting materials for many years after their immediate use has ceased.

Item 35 – Unsewered human sanitation including septic tanks, pit latrines, soakaways

If unsewered human sanitation is present near the source then there is considerable potential for raw human sewage to contaminate the source of the drinking water supply. Great care must be taken when assessing the positioning of septic tanks as well as their condition (maintenance), the areas where the soakaway is positioned, the condition of any pipes leading from the septic tank to the soakaway (is there evidence of different vegetation which may indicate a leaking pipe) and the discharge point of the soakaway if this is directed towards a surface receiving water. Similarly if there are pit latrines in use, e.g. at a campsite or areas where chemical toilets are discharged, the area surround the disposal point or latrine should be considered carefully in terms of allowing contact with the source. The contact may not be visible as there may be some connectivity underground and so some thought must be given to the soil leaching potential of the site.

Item 36 – Sewage pipes, mains or domestic (e.g. leading to/from septic tank)

In addition to Item 35 consideration must be given to the path that sewers may take. If the line of the pipe intersects with the area from which the drinking water source is being recharged (the area from where the water is being drawn) then there is the potential that any failure (leak) from the sewer or similar pipe will introduce raw sewage directly into the water source. It is unlikely that the path of such pipes will be clearly visible and so some care in interpreting the area will need to be taken, e.g. areas where the vegetation/ground appears to be drier indicating that there is a pipe buried below the surface or if there is a fracture in the pipe areas that would not naturally be damp or areas where there is vegetation indicative of wet or nutrient enriched conditions such as reeds or nettles.

Item 37 – Sewage effluent lagoons

Sewage effluent lagoons bring the potential that leaking material from the lagoon may enter the soil and pass into the groundwater providing a direct route for the contamination of the source with raw sewage. Farm effluent lagoons may be viewed as being the same in terms of the risks posed to the source when assessing the scoring values to be assigned.

Item 38 – Sewage effluent discharge to adjacent watercourse (where present)

While some aspects of this item may be identified when reviewing Item 35, Item 38 draws attention to the potential for sewage effluent discharges from a variety of sources such as municipal wastewater treatment works, septic tanks, privately owned/operated sewage treatment systems or reed beds. If there is evidence of discharge to a watercourse that is adjacent to the source of the supply under investigation then the risk characterisation should reflect the circumstances and “Yes” should be recorded. Similarly, for the hazard assessment the permanent, or semi-permanent, nature of the hazard should be reflected in the likelihood value assigned which should be almost certain (value 16).

Item 39 – Supplies or wells not in current use

If there are supplies or wells not in use that are associated with the supply under investigation then the potential for material to be introduced directly into the source water exists. For example, if an older, out of use well is located adjacent to the currently operational well and the out of use well is not properly sealed then the opportunity exists for faeces or animals to enter the older well and contaminate the same source of water that the new well is drawing from.

Item 40 – Evidence of use of pesticides (including sheep dip) near source

If disposal sites for pesticides (including sheep dip) are known to be close to the source under investigation then the risk characterisation should reflect this as should the hazard assessment. If there is evidence of the area having been used for dipping sheep (with dip tanks, fanks, etc.) then this evidence should be taken into account when assessing the site.

Item 41 – Evidence of industrial activity likely to present a contamination threat

If there is evidence of the area adjacent to the source having been used for industrial activity which may pose a contamination threat then this should be recorded on the risk assessment. Such activities may include chemical or pharmaceutical production, mineral or other extraction such as coal mining, areas where old fuel tanks may have been located or may still be in place either below or above ground, or industries where solvents would have been in use and may have been disposed of on to the ground, e.g. electroplating, metal working or electronics. This list is not exhaustive and so appropriate interpretation of the previous use to which the site may have been put will be required by the investigation officer.

SECTION D (ii) Supply survey

Item 42 – Below ground chamber not watertight

If the chamber is not watertight then there is a risk that a continued influx of water will inundate the top of the borehole causing potentially contaminated surface water to enter the supply. The entry could either be via an uncapped pipe or casing (forming the top of the borehole) or down the side of the pipe through inappropriate or absent grouting material. There should be no standing water in the bottom of the chamber. If there is evidence that the chamber is not watertight then the risk characterisation score should be "Yes" and the hazard assessment likelihood score should reflect the almost certain nature of the hazard (value = 16).

Item 43 – Borehole lining (casing) does not extend at least 150mm above level of floor

If the borehole lining (casing) does not extend above the level of the floor then there is an increased risk or the top of the borehole either being inundated with water (should water enter the chamber) or of vermin entering the pipe and introducing contamination into the borehole either through faecal material or decomposition of their remains should they become lodged in the borehole. If there is evidence that the casing does not extend at least 150 mm above the floor level then the risk characterisation score should be "Yes" and the hazard assessment likelihood score should reflect the almost certain nature of the hazard (value = 16).

Item 44 – Watertight lining cap not fitted

The top of the borehole (casing) should be capped off to prevent material falling into the borehole when the chamber is opened or if water or vermin should enter the chamber. If any cables or similar materials penetrate the cap (e.g. the power cable for the borehole pump) then the cables should also be sealed as they pass through the cap. Investigating officers may wish to enquire if materials used to seal either the cap itself or cables passing through the cap are suitable for use in drinking water installations for although there should be no direct contact with the water surface there is a potential for some of the material to enter the borehole particularly during construction or maintenance. If there is evidence that a watertight lining cap has not been fitted or is not in place then the risk characterisation score should be "Yes" and the hazard assessment likelihood score should reflect the almost certain nature of the hazard (value = 16).

Item 45 – No suitable barrier present to prevent ingress of surface flows into the well (e.g. cut-off ditch lined with impermeable material, steep incline/decline such as embankments, appropriate walls, etc.)

The borehole needs to be protected from the ingress of surface flows (such as flooding). This can be accomplished in a variety of ways such as having a cut-off ditch surrounding the borehole with an impermeable lining and a suitable discharge downslope from the borehole or conveying the water away from the immediate vicinity of the borehole. It should be borne in mind that surface flows, while including flooding, are not restricted to flooding. In certain ground conditions the impermeable nature of the soil during periods of dry weather will produce a surface akin to concrete which will result in rainfall, e.g. a heavy summer downpour, running over the surface rather than percolating into the soil. Such conditions need to be protected against by use of appropriately engineered borehole arrangements. If suitable arrangements are absent from the site under investigation then the risk characterisation will be scored as "Yes" with the hazard assessment reflecting the permanent nature of the deficiency by scoring the likelihood as almost certain (value 16).

Item 46 – The top of the chamber not 150 mm above ground level

This requirement is to ensure that in all but extreme weather conditions there will be very little opportunity for the borehole to be inundated with surface flows. If suitable arrangements are absent from the site under investigation then the risk characterisation will be scored as "Yes" with the hazard assessment reflecting the permanent nature of the deficiency by scoring the likelihood as almost certain (value 16).

Item 47 – No reinforced pre-cast concrete cover slab, or equivalent, in satisfactory condition with a watertight, vermin-proof inspection cover present to BS497 (lockable steel type or equivalent) with or without ventilation

A properly constructed and well-fitting well cover is essential to maintaining the integrity of the source. The cover should be watertight to prevent ingress of rainwater; vermin-proof to prevent animals from entering the well (vermin-proof means having no holes, remember a field mouse can easily enter a space where a pencil will fit); and lockable to prevent malicious (or just curious) persons gaining access to the supply. If ventilation is present ensure that it is also vermin-proof with appropriate wire mesh in place. If suitable arrangements are absent from the site under investigation then the risk characterisation will be scored as "Yes" with the hazard assessment reflecting the permanent nature of the deficiency by scoring the likelihood as almost certain (value 16).

Item 48 – The chamber construction in an unsatisfactory state-of-repair

If the chamber is in an unsatisfactory state-of-repair then there is an increased risk of vermin entering or of surface flows inundating the structure. If there is evidence that the chamber is in an unsatisfactory state-of-repair then the risk characterisation score should be "Yes" and the hazard assessment likelihood score should reflect the almost certain nature of the hazard (value = 16).

Item 49 – Supply network constructed from material liable to fracture (e.g. asbestos concrete, clay, etc.)

If the network of pipes that lead from the well are constructed of materials that are liable to deterioration or fracture, e.g. if heavy farm machinery is driven over the top of the pipeline, then the integrity of the system will be lost and potentially polluting material may enter the pipes through the fractures or the whole supply will be lost through pipe blockages. If it is considered likely that such materials have been used for all or part of the pipework being used to convey water from the source then the risk characterisation must reflect this with a "Yes" score and the hazard assessment must similarly reflect the permanent nature of the hazard by scoring as almost certain (value 16).

Item 50 – Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected (i.e. do not have protection described in [45] to [47])

The level of protection for all intermediate tanks or similar structures should be equivalent to that recommended for the source itself as the potential for contamination to enter the system via such intermediate points is just as high as for the source itself. If any of the intermediate tanks or similar structures are deficient in respect of the requirements provided in Items 45 to 47 then this should be reflected in the risk characterisation and hazard assessment. If there is more than one intermediate tank or similar structure, the deficient ones should be noted in section G and cross-referenced with the diagram provided in Section B (Item 6).

Item 51 – Junctions present in the supply network, particularly supplying animal water systems, have no back-siphon protection

If there are provisions made to provide water to animal watering troughs or other connections where back-siphonage may occur, e.g. from a hosepipe permanently connected, there is potential for the contents of the trough or container to be back-siphoned into the distribution pipe and for the contents of the trough or container to enter the supply. Clearly the contents of a cattle watering trough or a barrel into which the end of a hose has been dangled for some weeks will do little to improve the quality of the drinking water being provided. It is essential that where connections are made on the system prior to the first taps to be used for domestic (potable) consumption appropriate back-siphonage prevention devices are fitted. If they are not or there is no evidence to support claims that they have been fitted then the risk characterisation must reflect this with a "Yes" response. Similarly the hazard assessment should highlight the permanent nature of the situation with an almost certain (value 16) rating.

Item 52 – No maintenance (including chlorination) has been undertaken in the previous 12 months

If the system has had no maintenance undertaken in the 12 months preceding the investigation then this suggests that the level of care and attention required to ensure the system is operating as effectively as possible is lacking. If this is the case then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an unlikely score (value = 2).

Item 53 – If present, header tank within the property(s) does not have a vermin-proof cover

Many properties served by a private supply, particularly those on smaller supplies, will have a header tank within the property to provide sufficient water pressure for the household and also to act as a balancing tank to equalise the pressure differences experience in the system when pumps are operating to bring water into the property. However, if the header tank is not properly constructed and protected then any material that may be present in the roof space, whether that be dust or mice or bat droppings, will have the potential to enter the tank and so contaminate the supply. If the property has a header tank which feeds the main domestic (potable) tap, usually the kitchen cold water tap, and that tank is not properly protected then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an almost certain score (value = 16). If the header tank is present and unprotected but does not feed the main domestic (potable) tap then the risk assessment can be moderated but the risk to other taps in the property should be highlighted in Section G and noted on the diagram at Section B.

Item 54 – Header tank has not been cleaned in the last 12 months

If the header tank has an appropriate vermin-proof cover (Item 53) it will still require to be maintained by cleaning at least every 12 months to prevent the build-up of slime and scum which will naturally grow on the tank walls. If the tank has not been cleaned in the 12 months prior to the investigation then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an unlikely score (value = 2).

Item 55 – Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months

If any point of entry/point of use devices have had no maintenance undertaken in the 12 months preceding the investigation then this suggests that the level of care and attention required to ensure the system is operating as effectively as possible is lacking. If this is the case then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an unlikely score (value = 2).

Item 56 – If present ultraviolet (UV) lamps are not operating

While ultraviolet disinfection systems if properly installed and maintained are an effective treatment option to prevent potentially harmful micro-organisms from causing disease they can provide a false sense of security if they are not looked after. A particularly common fault is for the UV bulb to stop operating. The UV bulb is at the heart of the installation and is responsible for the disinfection process. If there is not an automatic warning system on the installation then the loss of the bulb could go undetected. Similarly if the bulb has not been changed in accordance with the manufacturer's recommended replacement period then the efficiency or operation of the bulb could be impaired or have ceased to function at all. It is important, therefore, to assess if the UV bulbs (lamps) are operating on a UV system at the time of the inspection. If they are not operating then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation based on an assessment of when the UV bulb (lamp) ceased to function.

Item 57 – Is there a noticeable change in the level and flow of water throughout the year

This question deals with the issue of constancy of supply as it relates to the quality of the source. If the source is highly dependable and provides adequate levels of water throughout the year then it is likely that the source is not under direct influence from either the surface or from prevailing climatic conditions. On the other hand, if the supply is "flashy" and changes with the weather then it is likely that it is under the influence of surface flow and prevailing weather conditions which increases its vulnerability to contamination from the surface. If there are noticeable changes in level and flow the risk characterisation response will be "Yes". The hazard assessment likelihood in these circumstances will be almost certain (value = 16). This circumstance may also cause the investigating officer to reconsider if the supply is in fact a well or if it would be better treated as a surface-derived supply.

Item 58 – Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt

If the supply is under the influence from either the surface or the weather then the quality experienced cannot be guaranteed if there are conditions prevailing which make surface flow (e.g. flooding) or adverse weather conditions likely. If there are noticeable changes in the appearance of the water then the risk characterisation response will be "Yes". The hazard assessment likelihood in these circumstances will be dependent on whether weather or surface influence is considered the most likely cause.

D (iii) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the two surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	
Source Survey	
Overall Risk	

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 16 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

SECTION E (i) Boreholes with headworks located below ground

General site survey

Item 59 – Evidence or history of poor drainage causing stagnant/standing water

If standing water can be seen present around the well head area or if there is evidence of standing water having been present, e.g. mud or vegetation consistent with marshy ground such as reeds, then the hazard should be scored as being present and the risk characterisation assigned as "Yes". If there is a suggestion that the likelihood of the standing water being present (or evidence of having been present) is a long-standing occurrence then the likelihood score for the hazard assessment should reflect this.

Item 60 – History of livestock production (rearing, housing, grazing) – including poultry

Any evidence of domestic livestock production being present either directly (by the presence of animals in the vicinity of the supply) or indirectly (through presence of broken ground around the supply or the presence of animal droppings around the supply) should result in the risk characterisation being scored as "Yes". Further investigations will be required to decide on the persistence of such presence in order to allow the hazard assessment likelihood score to be accurately assigned.

Item 61 – Evidence of wildlife

Any evidence of wildlife, mammals (rabbits, deer, etc.), birds (gulls, geese, migratory birds, etc.), reptiles (newts, frogs including spawn), etc. at the source could indicate the potential for contamination of the supply either from faecal material or from carcasses falling into the supply. If evidence of wildlife is found then the risk characterisation should be scored as "Yes". Account should be taken of the likely frequency of the presence of wildlife, e.g. a rabbit warren nearby will suggest permanent presence; migratory birds will suggest a seasonal presence which will require the suggested likelihood values to be moderated to reflect this seasonal presence by raising the once per year score of 2 to 4.

Item 62 – Surface run-off from agricultural activity diverted to flow into source/supply

This indicator is intended to deal with field drains and other drainage systems employed on agricultural land which may be connected to the source or supply. The indicator also deals with instances where there is overland flow from agricultural land that ends up in a watercourse or entering the source and potentially contaminating the supply, e.g. applied slurry where there is potential for it to be washed into field drains or watercourse or similar drainage systems. If there are drainage systems or similar present in areas of agricultural activity then the risk characterisation response will be "Yes". The likelihood value will be based on the probable time the land is being subjected to agricultural applications.

Item 63 – Soil cultivation with wastewater irrigation or sludge/slurry/manure application

This indicator differs from Item 62 in that there will be active application of the materials in conjunction with the disruption of the soil itself, e.g. via ploughing or sub-soil injection. If such activities are considered to be undertaken then the risk characterisation will be "Yes". The likelihood value will be based on the probable time/duration that such activities occur at.

Item 64 – Disposal of organic wastes to land

This indicator deals with any other organic waste e.g. abattoir wastes or "blood and guts". The scoring for this indicator will be irrespective of whether there has been disruption of the soil. If such activities are considered to be undertaken then the risk characterisation will be "Yes". The likelihood value will be based on the probable time/duration that such activities occur at.

Item 65 – Farm wastes and/or silage stored on the ground (not in tanks or containers)

If there are middens or areas where silage are being stored in polyethylene bags (or equivalent) or other farm-derived wastes where there is no bunded storage and there is the potential for spillage entering drainage systems then this item should be scored such that the risk exists. If the storage appears to be a permanent or long-term feature then the hazard assessment should be scored as almost certain (value 16) or likely (value 8).

Item 66 – Remediation of land using sludge or slurry

In some areas brownfield sites or derelict land will be remediated using sewage-derived sludge or slurry or similar materials. The rate of application will typically be higher than those used in Item 63 and this should be borne in mind when assessing both the risk characterisation and hazard assessment parts of the risk assessment form.

Item 67 – Forestry activity

Forestry activities have the potential to cause significant disruption to water supplies to the area in which they are being undertaken. The disruption may occur when forests are being planted, when thinning activities are being carried out or when the timber is being harvested. Account should be taken of the maturity of the forest and the likelihood of activity starting or changing during the period of the risk assessment. If the risk assessment is not scheduled to be time-limited then the potential for disruption should be highlighted.

Item 68 – Awareness of the presence of drinking water supply/source by agricultural workers

If the awareness of the presence of a drinking water source is absent from those agricultural or forestry workers who may be available to be interviewed or if there is evidence of disregard for the presence of such sources, e.g. ploughing to the margins of a well or spring, then the risk characterisation will be “No” or “Don’t Know” to reflect the high level of risk such a lack of knowledge may be introducing to the supply. Lack of awareness on the hazard assessment should be scored as almost certain (16) again to reflect the potential for introduction of harmful materials or disturbance of the supply.

Item 69 – Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)

The presence of disposal sites may influence the quality of water at the source by allowing the introduction of microbiological or chemical contaminants into the supply, depending on the nature of the materials being disposed. Incineration is also included in this section as the question of both airborne material and disposal sites for ash residues need to be considered when making the overall assessment of the likely impact of this item on the water quality at the source. If any waste disposal sites are present then the risk characterisation will be "Yes" and the associated hazard assessment should reflect the permanent nature (or longevity) of such sites in terms of their potential to continue to release polluting materials for many years after their immediate use has ceased.

Item 70 – Disposal sites for animal remains

This definition includes on-farm carcass disposal, burial pits, e.g. arising from foot-and-mouth disease, and vicinity to human burial sites such as graveyards or family plots away from traditional burial sites. If any disposal sites are present then the risk characterisation will be "Yes" and the associated hazard assessment should reflect the permanent nature (or longevity) of such sites in terms of their potential to continue to release polluting materials for many years after their immediate use has ceased.

Item 71 – Unsewered human sanitation including septic tanks, pit latrines, soakaways

If unsewered human sanitation is present near the source then there is considerable potential for raw human sewage to contaminate the source of the drinking water supply. Great care must be taken when assessing the positioning of septic tanks as well as their condition (maintenance), the areas where the soakaway is positioned, the condition of any pipes leading from the septic tank to the soakaway (is there evidence of different vegetation which may indicate a leaking pipe) and the discharge point of the soakaway if this is directed towards a surface receiving water. Similarly if there are pit latrines in use, e.g. at a campsite or areas where chemical toilets are discharged, the area surround the disposal point or latrine should be considered carefully in terms of allowing contact with the source. The contact may not be visible as there may be some connectivity underground and so some thought must be given to the soil leaching potential of the site.

Item 72 – Sewage pipes, mains or domestic (e.g. leading to/from septic tank)

In addition to Item 71 consideration must be given to the path that sewers may take. If the line of the pipe intersects with the area from which the drinking water source is being recharged (the area from where the water is being drawn) then there is the potential that any failure (leak) from the sewer or similar pipe will introduce raw sewage directly into the water source. It is unlikely that the path of such pipes will be clearly visible and so some care in interpreting the area will need to be taken, e.g. areas where the vegetation/ground appears to be drier indicating that there is a pipe buried below the surface or if there is a fracture in the pipe areas that would not naturally be damp or areas where there is vegetation indicative of wet or nutrient enriched conditions such as reeds or nettles.

Item 73 – Sewage effluent lagoons

Sewage effluent lagoons bring the potential that leaking material from the lagoon may enter the soil and pass into the groundwater providing a direct route for the contamination of the source with raw sewage. Farm effluent lagoons may be viewed as being the same in terms of the risks posed to the source when assessing the scoring values to be assigned.

Item 74 – Sewage effluent discharge to adjacent watercourse (where present)

While some aspects of this item may be identified when reviewing Item 35, Item 38 draws attention to the potential for sewage effluent discharges from a variety of sources such as municipal wastewater treatment works, septic tanks, privately owned/operated sewage treatment systems or reed beds. If there is evidence of discharge to a watercourse that is adjacent to the source of the supply under investigation then the risk characterisation should reflect the circumstances and “Yes” should be recorded. Similarly, for the hazard assessment the permanent, or semi-permanent, nature of the hazard should be reflected in the likelihood value assigned which should be almost certain (value 16).

Item 75 – Supplies or wells not in current use

If there are supplies or wells not in use that are associated with the supply under investigation then the potential for material to be introduced directly into the source water exists. For example, if an older, out of use well is located adjacent to the currently operational well and the out of use well is not properly sealed then the opportunity exists for faeces or animals to enter the older well and contaminate the same source of water that the new well is drawing from.

Item 76 – Evidence of use of pesticides (including sheep dip) near source

If disposal sites for pesticides (including sheep dip) are known to be close to the source under investigation then the risk characterisation should reflect this as should the hazard assessment. If there is evidence of the area having been used for dipping sheep (with dip tanks, fanks, etc.) then this evidence should be taken into account when assessing the site.

Item 77 – Evidence of industrial activity likely to present a contamination threat

If there is evidence of the area adjacent to the source having been used for industrial activity which may pose a contamination threat then this should be recorded on the risk assessment. Such activities may include chemical or pharmaceutical production, mineral or other extraction such as coal mining, areas where old fuel tanks may have been located or may still be in place either below or above ground, or industries where solvents would have been in use and may have been disposed of on to the ground, e.g. electroplating, metal working or electronics. This list is not exhaustive and so appropriate interpretation of the previous use to which the site may have been put will be required by the investigation officer.

SECTION E (ii) Supply survey

Item 78 – Housing covering headworks not watertight and/or vermin proof and/or secure

If the housing covering the headworks is not watertight then there is a risk that the top of the borehole could be inundated with surface water and contamination enter the borehole. If the housing is not vermin proof then vermin such as small rodents or amphibians may enter the structure and either contaminate the borehole directly with faecal material or if they enter the borehole itself the supply will become contaminated with their decomposing remains. If the housing is not secure then there is a risk that the curious or malicious may enter the structure and introduce contamination into the supply either accidentally or deliberately. If there is evidence that the housing is not secure against these hazards then the risk characterisation score should be "Yes" and the hazard assessment likelihood score should reflect the almost certain nature of the hazard (value = 16).

Item 79 – Borehole lining (casing) does not extend at least 150 mm above level of floor

If the borehole lining (casing) does not extend above the level of the floor then there is an increased risk of the top of the borehole either being inundated with water (should water enter the chamber) or of vermin entering the pipe and introducing contamination into the borehole either through faecal material or decomposition of their remains should they become lodged in the borehole. If there is evidence that the casing does not extend at least 150 mm above the floor level then the risk characterisation score should be "Yes" and the hazard assessment likelihood score should reflect the almost certain nature of the hazard (value = 16).

Item 80 – Watertight cap not fitted

The top of the borehole (casing) should be capped off to prevent material falling into the borehole when the chamber is opened or if water or vermin should enter the chamber. If any cables or similar materials penetrate the cap (e.g. the power cable for the borehole pump) then the cables should also be sealed as they pass through the cap. Investigating officers may wish to enquire if materials used to seal either the cap itself or cables passing through the cap are suitable for use in drinking water installations for although there should be no direct contact with the water surface there is a potential for some of the material to enter the borehole particularly during construction or maintenance. If there is evidence that a watertight lining cap has not been fitted or is not in place then the risk characterisation score should be "Yes" and the hazard assessment likelihood score should reflect the almost certain nature of the hazard (value = 16).

Item 81 – No suitable barrier present to prevent ingress of surface flows into the well (e.g. cut-off ditch lined with impermeable material, steep incline/decline such as embankments, appropriate walls, etc.)

The borehole needs to be protected from the ingress of surface flows (such as flooding). This can be accomplished in a variety of ways such as having a cut-off ditch surrounding the borehole with an impermeable lining and a suitable discharge downslope from the borehole or conveying the water away from the immediate vicinity of the borehole. It should be borne in mind that surface flows, while including flooding, are not restricted to flooding. In certain ground conditions the impermeable nature of the soil during periods of dry weather will produce a surface akin to concrete which will result in rainfall, e.g. a heavy summer downpour, running over the surface rather than percolating into the soil. Such conditions need to be protected against by use of appropriately engineered borehole arrangements. If suitable arrangements are absent from the site under investigation then the risk characterisation will be scored as "Yes" with the hazard assessment reflecting the permanent nature of the deficiency by scoring the likelihood as almost certain (value 16).

Item 82 – No concrete apron sloping away from borehole lining

A concrete apron sloping away from the top of the borehole (casing) should be provided to ensure any water that may ingress the structure is flowing away from the top of the borehole. If this is not present then the risk characterisation will be scored as "Yes" with the hazard assessment likelihood score reflecting the permanent nature of the hazard by scoring as almost certain (value = 16).

Item 83 – No reinforced pre-cast concrete cover slab, or equivalent, in satisfactory condition with a watertight, vermin-proof inspection cover present to BS497 (lockable steel type or equivalent) with or without ventilation

A properly constructed and well-fitting well cover is essential to maintaining the integrity of the source. The cover should be watertight to prevent ingress of rainwater; vermin-proof to prevent animals from entering the well (vermin-proof means having no holes, remember a field mouse can easily enter a space where a pencil will fit); and lockable to prevent malicious (or just curious) persons gaining access to the supply. If ventilation is present ensure that it is also vermin-proof with appropriate wire mesh in place. If suitable arrangements are absent from the site under investigation then the risk characterisation will be scored as "Yes" with the hazard assessment reflecting the permanent nature of the deficiency by scoring the likelihood as almost certain (value 16).

Item 84 – The housing construction in an unsatisfactory state-of-repair

If the housing is in an unsatisfactory state-of-repair then there is an increased risk of vermin entering or of surface flows inundating the structure. If there is evidence that the housing is in an unsatisfactory state-of-repair then the risk characterisation score should be "Yes" and the hazard assessment likelihood score should reflect the almost certain nature of the hazard (value = 16).

Item 85 – Supply network constructed from material liable to fracture (e.g. asbestos concrete, clay, etc.)

If the network of pipes that lead from the well are constructed of materials that are liable to deterioration or fracture, e.g. if heavy farm machinery is driven over the top of the pipeline, then the integrity of the system will be lost and potentially polluting material may enter the pipes through the fractures or the whole supply will be lost through pipe blockages. If it is considered likely that such materials have been used for all or part of the pipework being used to convey water from the source then the risk characterisation must reflect this with a "Yes" score and the hazard assessment must similarly reflect the permanent nature of the hazard by scoring as almost certain (value 16).

Item 86 – Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected (i.e. do not have protection described in 78 to 85)

The level of protection for all intermediate tanks or similar structures should be equivalent to that recommended for the source itself as the potential for contamination to enter the system via such intermediate points is just as high as for the source itself. If any of the intermediate tanks or similar structures are deficient in respect of the requirements provided in Items 42 to 45 then this should be reflected in the risk characterisation and hazard assessment. If there is more than one intermediate tank or similar structure, the deficient ones should be noted in section F and cross-referenced with the diagram provided in Section B (Item 6).

Item 87 – Junctions present in the supply network, particularly supplying animal water systems, have no back-siphon protection

If there are provisions made to provide water to animal watering troughs or other connections where back-siphonage may occur, e.g. from a hosepipe permanently connected, there is potential for the contents of the trough or container to be back-siphoned into the distribution pipe and for the contents of the trough or container to enter the supply. Clearly the contents of a cattle watering trough or a barrel into which the end of a hose has been dangled for some weeks will do little to improve the quality of the drinking water being provided. It is essential that where connections are made on the system prior to the first taps to be used for domestic (potable) consumption that appropriate back-siphonage prevention devices are fitted. If they are not or there is no evidence to support claims that they have been fitted then the risk characterisation must reflect this with a "Yes" response. Similarly the hazard assessment should highlight the permanent nature of the situation with an almost certain (value 16) rating.

Item 88 – No maintenance (including chlorination) has been undertaken in the previous 12 months

If the system has had no maintenance undertaken in the 12 months preceding the investigation then this suggests that the level of care and attention required to ensure the system is operating as effectively as possible is lacking. If this is the case then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an unlikely score (value = 2).

Item 89 – If present, header tank within the property(s) does not have a vermin-proof cover

Many properties served by a private supply, particularly those on smaller supplies, will have a header tank within the property to provide sufficient water pressure for the household and also to act as a balancing tank to equalise the pressure differences experienced in the system when pumps are operating to bring water into the property. However, if the header tank is not properly constructed and protected then any material that may be present in the roof space, whether that be dust or mice or bat droppings, will have the potential to enter the tank and so contaminate the supply. If the property has a header tank which feeds the main domestic (potable) tap, usually the kitchen cold water tap, and that tank is not properly protected then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an almost certain score (value = 16). If the header tank is present and unprotected but does not feed the main domestic (potable) tap then the risk assessment can be moderated but the risk to other taps in the property should be highlighted in Section G and noted on the diagram at Section B.

Item 90 – Header tank has not been cleaned in the last 12 months

If the header tank has an appropriate vermin-proof cover (Item 52) it will still require to be maintained by cleaning at least every 12 months to prevent the build-up of slime and scum which will naturally grow on the tank walls. If the tank has not been cleaned in the 12 months prior to the investigation then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an unlikely score (value = 2).

Item 91 – Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months

If any point of entry/point of use devices have had no maintenance undertaken in the 12 months preceding the investigation then this suggests that the level of care and attention required to ensure the system is operating as effectively as possible is lacking. If this is the case then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an unlikely score (value = 2).

Item 92 – If present ultraviolet (UV) lamps are not operating

While ultraviolet disinfection systems if properly installed and maintained are an effective treatment option to prevent potentially harmful micro-organisms from causing disease they can provide a false sense of security if they are not looked after. A particularly common fault is for the UV bulb to stop operating. The UV bulb is at the heart of the installation and is responsible for the disinfection process. If there is not an automatic warning system on the installation then the loss of the bulb could go undetected. Similarly if the bulb has not been changed in accordance with the manufacturer's recommended replacement period then the efficiency or operation of the bulb could be impaired or have ceased to function at all. It is important, therefore, to assess if the UV bulbs (lamps) are operating on a UV system at the time of the inspection. If they are not operating then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation based on an assessment of when the UV bulb (lamp) ceased to function.

Item 93 – Is there a noticeable change in the level and flow of water throughout the year

This question deals with the issue of constancy of supply as it relates to the quality of the source. If the source is highly dependable and provides adequate levels of water throughout the year then it is likely that the source is not under direct influence from either the surface or from prevailing climatic conditions. On the other hand, if the supply is "flashy" and changes with the weather then it is likely that it is under the influence of surface flow and prevailing weather conditions which increases its vulnerability to contamination from the surface. If there are noticeable changes in level and flow the risk characterisation response will be "Yes". The hazard assessment likelihood in these circumstances will be almost certain (value = 16). This circumstance may also cause the investigating officer to reconsider if the supply is in fact a well or if it would be better treated as a surface-derived supply.

Item 94 – Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt

If the supply is under the influence from either the surface or the weather then the quality experienced cannot be guaranteed if there are conditions prevailing which make surface flow (e.g. flooding) or adverse weather conditions likely. If there are noticeable changes in the appearance of the water then the risk characterisation response will be "Yes". The hazard assessment likelihood in these circumstances will be dependent on whether weather of surface influence is considered the most likely cause.

E (iii) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the two surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	
Source Survey	
Overall Risk	

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 16 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

Section F

If the type of the supply has not been determined then the risk assessment will not have been completed. In this case the overall risk assessment for the supply will default to High Risk to ensure that appropriate control measures are put in place to maintain public health.

Section G

Additional Notes – this section can be used to include additional information or observations made during the investigation.

Section 4.8 – Annex 1

Borehole Risk Assessment pro forma

Private water supply risk assessment form

BOREHOLE SUPPLY

OVERALL RISK .....

Section A – Supply Details

1. Supply category

Type A1 / A2 / A3 Type B (circle appropriate category)

2. Address and telephone number of responsible person

.....

.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

3. Name of person (or persons) who is relevant person in relation to the supply

(a) .....

(b) .....

(c) .....

(d) details of additional sheets .....

4. Address of relevant person (or persons) (if different from above)

(a) .....

.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

(b) .....

.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

(c) .....

.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

(d) details of additional sheets .....

5. Details of premise(s) served by the supply and purpose for which water is supplied

(a) .....

.....

.....

Post Code .....

Supply purpose .....

(b) .....

.....

.....

Post Code .....

Supply Purpose .....

(c) .....

.....

.....

Post Code .....

Supply Purpose .....

(d) details of additional sheets .....

Section B

6. Provide a diagram of the supply showing source(s), intermediate storage and/or collection tanks and properties on the supply. The diagram is indicative only and is intended to aid completion of the rest of this section.

Notes: Items should be labelled from source (A) through intermediate tanks (B) to properties (C) with individual components numbered, e.g. for a supply with one source this would be A1; two intermediate tanks (B1 and B2 respectively) and two properties (C1 and C2) respectively.

7. Description of the source of the supply including (i) details of supply source(s), (ii) location of the source(s) and (iii) National Grid Reference of location(s) of source(s). Cross reference from Item 6 above.

(i) .....

.....

.....

(ii) .....

.....

.....

(iii) National Grid Reference N / J / 0 / 0 / 0 / 0 / 0 / 0

8. (a) Estimated daily volume of water provided by the supply ..... m^3 per day

(b) Number of persons served by supply (at maximum occupancy) .....

9. Details of any water treatment processes associated with the supply

(a) At source – identify which of the following systems are present: (cross reference to Item 6)

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

(b) Intermediate Water Storage Tank/Chamber (cross reference to Item 6)

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

(c) At property (cross reference to Item 6)

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

(d) details of additional sheets .....

Section C

10. Details of departures authorised

.....

.....

.....

11. Details of sample results for previous 12 months or last available (reference location of information, e.g. paper or electronic files, reference number, sample numbers, etc.)

.....

.....

.....

12. Details of previous (last 2) investigations and actions taken

.....

.....

.....

13. Details of enforcement notices served

.....

.....

.....

14. Result of previous risk assessment (if applicable)

.....

.....

.....

15. Details of location of Notice for Type A supplies (location)

.....

.....

.....

16. Is Notice appropriate (conforms to requirements of the Regulations)? Yes ☐ No ☐

17. Details of action taken (or to be taken) by relevant persons to comply with

(a) results of sampling

.....

.....

.....

.....

(b) results of follow-up to sampling

.....

.....

.....

.....

18. Whether supply exempt under Regulation 2(4)

.....

.....

.....

19. Details of other information relating to the supply collated by the local authority

.....

.....

.....

20. Is there a Water Safety Plan/ Emergency Action Plan available for the supply?

Yes ☐ No ☐

21. If "Yes" to Item 20, is it fit for purpose? Yes ☐ No ☐

22. If "No" to Item 21, what deficiencies are required to be addressed (provide details)?

.....

.....

.....

Section D – Boreholes with headworks located below ground

D (i) General site survey

Are any of the following known to be present and likely to influence water quality at the source?e?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
23	Evidence or history of poor drainage causing stagnant / standing water	H	L	H		8	
24	History of livestock production (rearing, housing, grazing) – including poultry	H	L	H		16	
25	Evidence of wildlife	M	L	M		4	
26	Surface run-off from agricultural activity diverted to flow into the source/supply	H	L	H		8	
27	Soil cultivation with wastewater irrigation or sludge / slurry/ manure application	H	L	H		16	
28	Disposal of organic wastes to land	H	L	H		8	
29	Farm wastes and/or silage stored on the ground (not in tanks or containers)	M	L	M		8	
30	Remediation of land using sludge or slurry	H	L	H		16	
31	Forestry activity	M	L	M		4	
32	Awareness of the presence of drinking water supply/source by agricultural workers	L	H	H		4	
33	Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)	H	L	H		8	
34	Disposal sites for animal remains	H	L	H		8	
35	Unsewered human sanitation including septic tanks, pit latrines, soakaways	H	L	H		16	
36	Sewage pipes, mains or domestic (e.g. leading to / from septic tank)	H	L	H		8	
37	Sewage effluent lagoons	H	L	H		16	
38	Sewage effluent discharge to adjacent watercourse (where present)	H	L	H		16	
39	Supplies or wells not in current use	H	L	H		8	
40	Evidence of use of pesticides (including sheep dip) near source	H	L	H		8	
41	Evidence of industrial activity likely to present a contamination threat	H	L	H		8	

[1] The Hazard Assessment Score is the product of the Likelihood and Severity values. The values are :

Likelihood	Definition	Value
Almost certain	Once per day (or permanent feature)	16
Likely	Once per week	8
Moderate likely	Once per month	4
Unlikely	Once per year	2
Rare	Once every 5 years	1

Risk Characterisation

Tick the appropriate box for each question.

If any question is High Risk (H) then the Risk Characterisation Score is **High**.

If no question is High Risk but there are Moderate Risks (M) identified then the Risk Characterisation Score is **Moderate**.

If no question is High Risk (H) or Moderate Risk (M) then the Risk Characterisation Score is **Low**.

Hazard Assessment

If the Hazard Assessment Score is 16 or greater for any individual component then the issues associated with that component should be considered as a priority for remedial works to reduce the hazard experienced by the supply.

D (ii) Supply survey

Are any of the following known to occur at the head works site or in relation to the supply?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
42	Below ground chamber not watertight	H	L	H		8	
43	Borehole lining (casing) does not extend at least 150mm above level of floor	H	L	H		8	
44	Watertight lining cap not fitted	H	L	H		8	
45	No suitable barrier present to prevent ingress of surface flows into the chamber (e.g. cut-off ditch lined with impermeable material, steep incline/decline such as embankments, appropriate walls, etc.)	H	L	H		16	
46	The top of the chamber not 150mm above ground level?	H	L	H		16	
47	No reinforced pre-cast concrete cover slab, or equivalent, in satisfactory condition with a watertight, vermin-proof inspection cover present to BS497 (lockable steel type or equivalent) with or without ventilation?	H	L	H		16	
48	The chamber construction in an unsatisfactory state-of-repair?	H	L	H		8	
49	Supply network constructed from material liable to fracture, e.g. asbestos-concrete, clay, etc.?	H	L	H		8	
50	Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected (i.e. have protection described in [1] to [5] above)?	H	L	H		8	
51	Junctions present in the supply network, particularly supply animal watering systems, have no back-siphon protection?	H	L	H		4	
52	No maintenance (including chlorination) has been undertaken in the previous 12 months?	H	L	H		8	
53	If present, header tank within the property (s) does not have a vermin-proof cover?	H	L	H		4	
54	Header tank has not been cleaned in the last 12 months?	H	L	H		8	
55	Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months?	H	L	H		8	
56	If present ultraviolet (UV) lamps are not operating?	H	L	H		16	
57	Is there a noticeable change in the level and flow of water throughout the year?	H	L	H		4	
58	Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt?	H	L	H		8	

[1] The Hazard Assessment Score is the product of the Likelihood and Severity values. For details see Section D.

Risk Characterisation

Tick the appropriate box for each question.

If any question is High Risk (H) then the Risk Characterisation Score is **High**. ☐

If no question is High Risk but there are Moderate Risks (M) identified then the Risk Characterisation Score is **Moderate**. ☐

If no question is High Risk (H) or Moderate Risk (M) then the Risk Characterisation Score is **Low**. ☐

Hazard Assessment

If the Hazard Assessment Score is 16 or greater for any individual component then the issues associated with that component should be considered as a priority for remedial works to reduce the hazard experienced by the supply.

D (iv) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the two surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	
Source Survey	
Overall Risk	

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 32 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

Section E – Boreholes with headworks located above ground

E (i) General site survey

Are any of the following known to be present and likely to influence water quality at the source?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
59	Evidence or history of poor drainage causing stagnant / standing water	H	L	H		8	
60	History of livestock production (rearing, housing, grazing) – including poultry	H	L	H		16	
61	Evidence of wildlife	M	L	M		4	
62	Surface run-off from agricultural activity diverted to flow into the source/supply	H	L	H		8	
63	Soil cultivation with wastewater irrigation or sludge / slurry/ manure application	H	L	H		16	
64	Disposal of organic wastes to land	H	L	H		8	
65	Farm wastes and/or silage stored on the ground (not in tanks or containers)	M	L	M		8	
66	Remediation of land using sludge or slurry	H	L	H		16	
67	Forestry activity	M	L	M		4	
68	Awareness of the presence of drinking water supply/source by agricultural workers	L	H	H		4	
69	Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)	H	L	H		8	
70	Disposal sites for animal remains	H	L	H		8	
71	Unsewered human sanitation including septic tanks, pit latrines, soakaways	H	L	H		16	
72	Sewage pipes, mains or domestic (e.g. leading to / from septic tank)	H	L	H		8	
73	Sewage effluent lagoons	H	L	H		16	
74	Sewage effluent discharge to adjacent watercourse (where present)	H	L	H		16	
75	Supplies or wells not in current use	H	L	H		8	
76	Evidence of use of pesticides (including sheep dip) near source	H	L	H		8	
77	Evidence of industrial activity likely to present a contamination threat	H	L	H		8	

[1] The Hazard Assessment Score is the product of the Likelihood and Severity values. The values are :

Likelihood	Definition	Value
Almost certain	Once per day (or permanent feature)	16
Likely	Once per week	8
Moderate likely	Once per month	4
Unlikely	Once per year	2
Rare	Once every 5 years	1

Risk Characterisation

Tick the appropriate box for each question.

If any question is High Risk (H) then the Risk Characterisation Score is **High**. ☐

If no question is High Risk but there are Moderate Risks (M) identified then the Risk Characterisation Score is **Moderate**. ☐

If no question is High Risk (H) or Moderate Risk (M) then the Risk Characterisation Score is **Low**. ☐

Hazard Assessment

If the Hazard Assessment Score is 16 or greater for any individual component then the issues associated with that component should be considered as a priority for remedial works to reduce the hazard experienced by the supply.

E (ii) Supply survey

Are any of the following known to occur at the head works site or in relation to the supply?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
78	Housing covering headworks not watertight and/or vermin proof and/or secure	H	L	H		8	
79	Borehole lining (casing) does not extend at least 150mm above level of floor	H	L	H		8	
80	Watertight lining cap not fitted	H	L	H		8	
81	No suitable barrier present to prevent ingress of surface flows into the chamber (e.g. cut-off ditch lined with impermeable material, steep incline/decline such as embankments, appropriate walls, etc.)	H	L	H		16	
82	No concrete apron sloping away from borehole lining	H	L	H		16	
83	No reinforced pre-cast concrete cover slab, or equivalent, in satisfactory condition with a watertight, vermin-proof inspection cover present to BS497 (lockable steel type or equivalent) with or without ventilation?	H	L	H		16	
84	The housing construction in an unsatisfactory state-of-repair?	H	L	H		8	
85	Supply network constructed from material liable to fracture, e.g. asbestos-concrete, clay, etc.?	H	L	H		8	
86	Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected (i.e. have protection described in [1] to [5] above)?	H	L	H		8	
87	Junctions present in the supply network, particularly supply animal watering systems, have no back-siphon protection?	H	L	H		4	
88	No maintenance (including chlorination) has been undertaken in the previous 12 months?	H	L	H		8	
89	If present, header tank within the property (s) does not have a vermin-proof cover?	H	L	H		4	
90	Header tank has not been cleaned in the last 12 months?	H	L	H		8	
91	Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months?	H	L	H		8	
92	If present ultraviolet (UV) lamps are not operating?	H	L	H		16	
93	Is there a noticeable change in the level and flow of water throughout the year?	H	L	H		4	
94	Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt?	H	L	H		8	

[1] The Hazard Assessment Score is the product of the Likelihood and Severity values. For details see Section E.

Risk Characterisation

Tick the appropriate box for each question.

If any question is High Risk (H) then the Risk Characterisation Score is **High**. ☐

If no question is High Risk but there are Moderate Risks (M) identified then the Risk Characterisation Score is **Moderate**. ☐

If no question is High Risk (H) or Moderate Risk (M) then the Risk Characterisation Score is **Low**. ☐

Hazard Assessment

If the Hazard Assessment Score is 16 or greater for any individual component then the issues associated with that component should be considered as a priority for remedial works to reduce the hazard experienced by the supply.

E (iv) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the two surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	
Source Survey	
Overall Risk	

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 32 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

Section F

You have been unable to discern the type of supply and so the overall risk assessment for this source must be given as **High Risk**.

Section G – Additional Notes

4.9 Surface Supply Risk Assessment (see 4.9 Annex 1 for full form)

Overall Risk – this is taken from the overall risk assessment in section D(iv)(a) of the risk assessment form.

SECTION A – Supply details

Item 1 – Supply category

The supply category that is required to be identified is taken from The Private Water Supplies (Scotland) Regulations 2006 Part 1(2). These state:

"Type A supply" means a private water supply for human consumption purposes which

(a) on average, provides 10 or more cubic metres of water per day or serves 50 or more persons, or
(b) regardless of the volume of water provided or the number of persons served, is supplied or used as part of a commercial or public activity,

and references in this definition –

(i) to the average volume of water provided by such a supply, are references to such volume (calculated as a daily average) as may be reasonably estimated to have been distributed or, if not distributed, used or consumed from the supply during the year prior to the year in which these Regulations come into force; and that estimate may be on the assumption that five persons use one cubic metre of water per day; and
(ii) to the average number of persons served by such a supply, are references to such number of persons as may be reasonably estimated to be the maximum number served by the supply on any one day during the year prior to the year in which these Regulations come into force.

"Type B supply" means a private water supply other than a Type A supply; and "year" means a calendar year.

Item 2 – Address and telephone number of responsible person

"Responsible person" is a term used in the Regulations referring to the person who owns or otherwise is responsible for the domestic distribution system which included the pipework, fitting and appliances which are installed between the taps that are normally used for human consumption purposes and the distribution network which is not the responsibility of a relevant person (see Item 3). Full contact details of the responsible person should be recorded here.

Item 3 – Name of person (or persons) who is relevant person in relation to the supply

The term “relevant person” refers to the person considered by the local authority to be the person providing the supply, or occupying the land from, or on, which the supply is obtained or located, and any person who exercises powers of management or control in relation to the supply.

The relevant and responsible person may be one and the same person in some instances.

In some instances there may be more than three relevant persons in which case additional sheets should be used to record the information and details of these additional sheets should be included in section (d) and the sheets appended to the form when completed.

Item 4 – Address of relevant person (or persons) (if different from above)

Where the responsible person and the relevant person are different then the contact details for the relevant person or persons should be recorded in this section.

In some instances there may be more than three relevant persons in which case additional sheets should be used to record the information and details of these additional sheets should be included in section (d) and the sheets appended to the form when completed.

Item 5 – Details of premise(s) served by the supply and purpose for which water is supplied

This item seeks to capture details of any premise that may be served by the supply and the purpose for which the water is being supplied. It is necessary to have as complete a list of properties served by a private water supply as possible in order that the true interconnectivity of the supply may be assessed and the potential population affected by any breach of the Regulations or incidence of waterborne disease outbreak can be assessed rapidly and efficiently. For larger supplies this exercise will be challenging but attention to detail will ensure that the most comprehensive and accurate records are compiled which will assist in future investigations relating to the supply.

Additional sheets (as required) should be appended to the form and a note of these made at section (d).

SECTION B

Item 6 – Diagram of the supply

This is intended to enable the investigating officer to provide a schematic sketch showing the interrelationships between the various components of the supply such as source, intermediate tanks and properties being supplied. While there is undoubtedly a balance to be struck between too much detail and insufficient detail, a guiding principle should be to provide sufficient information to enable colleagues who have not visited the site to quickly navigate around the supply.

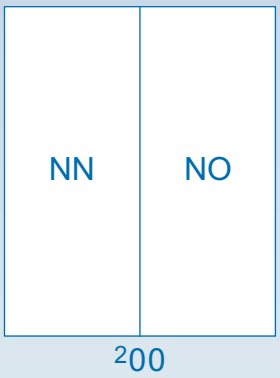
Item 7 – Description of the source of the supply

The description provided should complement the schematic sketch provided at Item 6. The purpose of having a written description is to provide a record of the condition of the infrastructure at the time of the risk assessment. This will enable a baseline to be established against which any future developments made to the supply can be benchmarked. If the facility exists it would be appropriate to also include relevant photographic evidence of the various components so long as they are uniquely identified and cross-referenced within the risk assessment report.

A full National Grid Reference for the source (or the closest point to the source identified) should also be provided.

How to give a grid reference to nearest 100 metres

The example below is taken from Ordnance Survey Braemar to Blair Atholl Sheet 43 1:50000 Landranger Series.

100 000 metre Grid Square Identification	Example - Altaltan			
	1. Read letters identifying 100 000 metre square in which the point lies.	NO		
	2. FIRST QUOTE EASTINGS Locate first VERTICAL grid line to LEFT of point and read LARGE figures labelling the line either in the top or bottom margin or on the line itself. Estimate tenths from grid line to point.		18 4	
	3. AND THEN QUOTE NORTHINGS Locate first HORIZONTAL grid line BELOW line either in the left or right margin or on the line itself. Estimate tenths from grid line to point.			63 5
	EXAMPLE REFERENCE	NO	184	635
Ignore the smaller figures of any grid number: these are for finding the full coordinates. Use ONLY the LARGER figure of the grid number. Example: 280 000m				

Extract from 1:50 000 sheet 43 showing location of Altaltan

Item 8 – Estimated daily volume of water provided by the supply

If the volume of water is not being measured, e.g. via a water meter, then the investigating officer can make an estimate of the volume based on 200 litres of water per day per person served by the supply. While the figure will only be an estimate every effort should be made to identify the maximum number of people who are being supplied with water from the supply. It is not sufficient just to base the estimate on historical records, e.g. the classification of the supply made under previous regulatory frameworks. It is important to have a robust and defensible maximum occupancy for the supply as this may well have an impact on the sampling frequency to which the supply is subjected.

Item 9 – Details of any water treatment processes associated with the supply

While it is important to document any treatment that occurs on the supply it is not practicable to list all possible treatment types or systems that may be encountered. The risk assessment form concentrates on the provision of standard disinfection equipment/processes but all other treatment systems should be included in the description including items such as sediment traps of pH correction systems. Each of the treatment processes should be cross-referenced to those identified on the schematic provided at Item 6.

For larger systems it will not be practicable to complete Item 9 (c) and so a table should be drawn up listing the properties and the treatments associated with each property differentiating between point of entry and point of use devices, e.g.

Responsible Person	Property Address (including post code)	Point of entry device (specify)	Point of use device (specify)	Notes
Mr D Able	1 Wellside Cottage, Nethermuir, ZZ1 1AA	UV lamp	None	located in lean-to on north side of house, pre-filter bypassed
Mrs C Brown	3 Wellside Cottage, Nethermuir, ZZ1 1AA	UV lamp	None	On maintenance contact with Bloggs Plumbing, Nethermuir
Ms B Charlie	Springside House, By Nethermuir, ZZ1 2BA	None	UV lamp	Under sink in kitchen – poor access for changing bulb
Rev. A Davis	Riverbank Cottage, Nethermuir, ZZ1 1AB	None	None	

These details should be recorded as additional sheets on the form at Item 9 (d)

SECTION C

Item 10 – Details of departures authorised

Provide details of any temporary departures granted under Part IV of the Private Water Supplies (Scotland) Regulations 2006. These details should summarise the details provided in the original temporary departure and should cross-reference to the complete application. If applicable the temporary departure authorisation (Regulation 6(7) of the above Regulations) can be appended to the risk assessment. Details of this should be recorded in Section F.

Item 11 – Details of sample results for previous 12 months or last available (reference location of information, e.g. paper or electronic files, reference number, sample numbers, etc.)

The inclusion of this information is to assist the investigation officer in their investigations. Details of the previous sampling results will enable areas of concern to be highlighted and assist in focusing on areas where actual breaches of the drinking water quality standards have occurred. For example, if lead is highlighted as failing in the sample results, while lead is not specifically being looked for in the risk assessment, the investigation officer may take the opportunity of the investigation to attempt to determine whether there are any known lead pipes or tanks associated with the supply or through examination of the appropriate geological map whether lead is naturally occurring in the vicinity of the source. If lead pipes or tanks are present then appropriate advice can be provided on the need for their removal; if lead is naturally occurring at the source then discussions around locating a more acceptable alternative source for the supply can be entered into.

Item 12 – Details of previous (last two) investigations and actions taken

If there have been investigations into previous failures then the last two such investigations should be summarised here along with the actions that were taken or were understood to have been agreed to have been taken. This information will provide the investigation officer with a background to the problems that have been encountered previously along with an understanding of what actions have been attempted to improve the situation and whether these actions have proved to be successful. If they have proved to be unsuccessful then this information will allow the investigation officer to consider alternative solutions that have not been previously implemented.

Item 13 – Details of enforcement notices served

If any enforcement notices have been served that affect the supply under investigation, details of these should be provided here. If necessary additional information may be appended to the risk assessment and details of these should be provided in Section F.

Item 14 – Results of previous risk assessment (if applicable)

If the source or supply has previously been risk assessed then the details of the previous risk assessment(s) should be included with the current risk assessment. The previous risk assessments should be appended to the current form and details of these additional sheets should be recorded against this item.

Item 15 – Details of location of Notice for Type A supplies (location)

Regulation 31 of the Private Water Supplies (Scotland) Regulations 2006 requires that up-to-date information about the quality of the water provided in commercial or public premises shall be displayed in a prominent location. This notice forms part of the communication of risk to members of the public and so the location of the notice should be recorded to ensure that appropriate risk communication is being undertaken.

Item 16 – Is Notice appropriate (conforms to requirements of the Regulations)

Regulation 31 (2) details the form that the information notice must take. This item confirms that the appropriate form of the notice is being displayed as the form of the notice interlinks with additional information available to both owners/users and visitors to private water supplies making it vital that the appropriate form of the notice is utilised.

Item 17 – Details of action taken (or to be taken) by relevant persons to comply with (a) results of sampling (b) results of follow-up to sampling

If sampling results indicate that the supply fails to comply with the requirements of the Regulations, this section should be completed to identify what suggested/agreed remedial steps should be taken to prevent future failures.

Item 18 – Whether supply exempt under Regulation 2 (4)

If the supply is used solely for washing a crop after it has been harvested or during the distillation of spirits (solely in the mashing process or for washing plant but for no other purpose) and which does not affect, either directly or indirectly, the fitness for human consumption of any food or drink or, as the case may be, spirits in their finished form, then the provisions of the Private Water Supply (Scotland) Regulations 2006 do not apply to that supply with the exception of the provisions of regulation 29. If the supply is exempted under the provisions of regulation 2(4) then a full risk assessment is not required to be completed but good practice would require a partially completed form to be retained by the local authority containing the information required by regulation 29.

Item 19 – Details of other information relating to the supply collated by the local authority

If the local authority has other relevant information relating to the supply then these details should be included here or appended to the form and details of the additional sheets recorded under this item.

Item 20 – Is there a Water Safety Plan/Emergency Action Plan available for the supply

Some supplies may have a water safety plan or emergency action plan that details steps to be taken to ensure the quality of water at the source and steps to be taken in the event of a loss of constancy or quality from that supply.

Item 21 – If "Yes" to Item 20, is it fit for purpose

This item requires an assessment by the investigation officer as to whether or not the water safety plan or emergency action plan is suitable for the premises it relates to.

Item 22 – If "No" to Item 20, what deficiencies are required to be addressed (provide details)

If the assessment undertaken in Item 21 suggests there are inadequacies in the water safety plan or emergency action plan then the deficiencies should be noted against this item with suggestions, where appropriate, as to what improvements may be considered to the plan(s).

SECTION D

General Introduction

In this part of the form each of the indicators being looked for, e.g. disposal sites for animal remains, will have two separate scores associated with them.

The first score will be the Risk Characterisation score

The Risk Characterisation score has three values – High, Moderate or Low – and is based on the presence or absence of the indicator based on the evidence available to the person undertaking the risk assessment. The form is preloaded with the risk characterisation value based on the individual indicator being present or absent. If the assessor cannot determine if the indicator is present then the "Don't know" option should be used.

The assessor should tick the appropriate response box for each indicator. If any response is identified as High Risk (H) then the Risk Characterisation Score will be **HIGH**. If no response is High Risk but there are Moderate Risks (M) identified then the Risk Characterisation Score will be **Moderate**. If no response is High Risk or Moderate Risk then the Risk Characterisation Score is **Low**.

The second score is the Hazard Assessment score

The Hazard Assessment Score is also based on the indicator being present but this scoring allows the extent of the potential influence of the indicator to be taken into account. Thus the likelihood score is dependent on a knowledge or estimate of the time period during which the indicator may be present at the source under investigation. The table in the form provides guidance on the values to be assigned based on how frequently the indicator is known, or thought, to be present. If the indicator is present continuously, i.e. once per day or a permanent feature, then the likelihood value assigned will be 16 as the indicator is almost certainly there continuously; if the indicator is present once a week then the likelihood value assigned will be 8; if the indicator is present once a month then the value will be 4; if the indicator is present once a year then the likelihood value assigned will be 2; and if the indicator is known, or thought, to occur rarely such as once every five or more years, then the value assigned will be 1. Once the likelihood value has been assigned on the form the Hazard Assessment Score is determined by multiplying the Likelihood Value by the Severity (which is pre-loaded on the form) to give the overall Hazard Assessment Score.

The Hazard Assessment Score is an index and there is no implied mathematical relationship to risk. The Hazard Assessment Score is a convenient way of prioritising actions or interventions so that resources are effectively targeted to those areas that pose the greatest potential risk of contamination to the source under investigation.

If the Hazard Assessment Score is **16** or greater for an individual component then the issues associated with that component should be considered as a priority for remedial works to reduce the hazard experienced by the supply.

The value of 16 is considered to be appropriate when only a rare event may produce a catastrophic outcome, e.g. sewage effluent discharge to adjacent watercourse (Item 38). However, if the presence of sewage effluent discharge to an adjacent watercourse were to occur more frequently than once every 5 years or more then the Hazard Assessment Score would reflect this change by increasing the score, and hence flag the requirement to take appropriate action to reduce the likelihood of the occurrence.

Hazard assessment matrix

	Severity of consequences				
Likelihood	**Insignificant**	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	16	32	64	128	256
Likely	8	16	32	64	128
Moderately likely	4	8	16	32	64
Unlikely	2	4	8	16	32
Rare	1	2	4	8	16

Each of the indicators in Section D will now be considered in turn.

Section D (i) General site survey

Item 23 – History of livestock production (rearing, housing, grazing) – including poultry

Any evidence of domestic livestock production being present (either directly by the presence of animals in the vicinity of the supply) or indirectly (through presence of broken ground around the supply or the presence of animal droppings around the supply) should result in the risk characterisation being scored as "Yes". Further investigations will be required to decide on the persistence of such presence in order to allow the hazard assessment likelihood score to be accurately assigned.

Item 24 – Evidence of wildlife

Any evidence of wildlife, mammals (rabbits, deer, etc.), birds (gulls, geese, migratory birds, etc.), reptiles (newts, frogs including spawn) etc. at the source could indicate the potential for contamination of the supply either from faecal material or from carcasses falling into the supply. If evidence of wildlife is found then the risk characterisation should be scored as "Yes". Account should be taken of the likely frequency of the presence of wildlife, e.g. a rabbit warren nearby will suggest permanent presence; migratory birds will suggest a seasonal presence which will require the suggested likelihood values to be moderated to reflect this seasonal presence by raising the once per year score of 2 to 4.

Item 25 – Surface run-off from agricultural activity diverted to flow into source/supply

This indicator is intended to deal with field drains and other drainage systems employed on agricultural land which may be connected to the source or supply. The indicator also deals with instances where there is overland flow from agricultural land that ends up in a watercourse or entering the source and potentially contaminating the supply, e.g. applied slurry where there is potential for it to be washed into field drains or watercourse or similar drainage systems. If there are drainage systems or similar present in areas of agricultural activity then the risk characterisation response will be "Yes". The likelihood value will be based on the probable time the land is being subjected to agricultural applications.

Item 26 – Soil cultivation with wastewater irrigation or sludge/slurry/manure application

This indicator differs from Item 25 in that there will be active application of the materials in conjunction with the disruption of the soil itself, e.g. via ploughing or sub-soil injection. If such activities are considered to be undertaken then the risk characterisation will be "Yes". The likelihood value will be based on the probable time/duration that such activities occur at.

Item 27 – Disposal of organic wastes to land

This indicator deals with any other organic waste, e.g. abattoir wastes or "blood and guts". The scoring for this indicator will be irrespective of whether there has been disruption of the soil. If such activities are considered to be undertaken then the risk characterisation will be "Yes". The likelihood value will be based on the probable time/duration that such activities occur at.

Item 28 – Farm wastes and/or silage stored on the ground (not in tanks or containers)

If there are middens or areas where silage are being stored in polyethylene bags (or equivalent) or other farm-derived wastes where there is no bunded storage and there is the potential for spillage entering drainage systems, then this item should be scored such that the risk exists. If the storage appears to be a permanent or long-term feature then the hazard assessment should be scored as almost certain (value 16) or likely (value 8).

Item 29 – Remediation of land using sludge or slurry

In some areas brownfield sites or derelict land will be remediated using sewage-derived sludge or slurry or similar materials. The rate of application will typically be higher than those used in Item 26 and this should be borne in mind when assessing both the risk characterisation and hazard assessment parts of the risk assessment form.

Item 30 – Forestry activity

Forestry activities have the potential to cause significant disruption to water supplies to the area in which they are being undertaken. The disruption may occur when forests are being planted, when thinning activities are being carried out or when the timber is being harvested. Account should be taken of the maturity of the forest and the likelihood of activity starting or changing during the period of the risk assessment. If the risk assessment is not scheduled to be time-limited then the potential for disruption should be highlighted.

Item 31 – Awareness of the presence of drinking water supply/source by agricultural workers

If the awareness of the presence of a drinking water source is absent from those agricultural or forestry workers who may be available to be interviewed or if there is evidence of disregard for the presence of such sources, e.g. ploughing to the margins of a well or spring, then the risk characterisation will be “No” or “Don’t Know” to reflect the high level of risk such a lack of knowledge may be introducing to the supply. Lack of awareness on the hazard assessment should be scored as almost certain (16) again to reflect the potential for introduction of harmful materials or disturbance of the supply.

Item 32 – Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)

The presence of disposal sites may influence the quality of water at the source by allowing the introduction of microbiological or chemical contaminants into the supply, depending on the nature of the materials being disposed. Incineration is also included in this section as the question of both airborne material and disposal sites for ash residues need to be considered when making the overall assessment of the likely impact of this item on the water quality at the source. If any waste disposal sites are present then the risk characterisation will be “Yes” and the associated hazard assessment should reflect the permanent nature (or longevity) of such sites in terms of their potential to continue to release polluting materials for many years after their immediate use has ceased.

Item 33 – Disposal sites for animal remains

This definition includes on-farm carcass disposal, burial pits, e.g. arising from foot-and-mouth disease, and vicinity to human burial sites such as graveyards or family plots away from traditional burial sites. If any disposal sites are present then the risk characterisation will be "Yes" and the associated hazard assessment should reflect the permanent nature (or longevity) of such sites in terms of their potential to continue to release polluting materials for many years after their immediate use has ceased.

Item 34 – Unsewered human sanitation including septic tanks, pit latrines, soakaways

If unsewered human sanitation is present near the source then there is considerable potential for raw human sewage to contaminate the source of the drinking water supply. Great care must be taken when assessing the positioning of septic tanks as well as their condition (maintenance), the areas where the soakaway is positioned, the condition of any pipes leading from the septic tank to the soakaway (is there evidence of different vegetation which may indicate a leaking pipe) and the discharge point of the soakaway if this is directed towards a surface receiving water. Similarly if there are pit latrines in use, e.g. at a campsite or areas where chemical toilets are discharged, the area surround the disposal point or latrine should be considered carefully in terms of allowing contact with the source. The contact may not be visible as there may be some connectivity underground and so some thought must be given to the soil leaching potential of the site.

Item 35 – Sewage pipes, mains or domestic (e.g. leading to/from septic tank)

In addition to Item 34 consideration must be given to the path that sewers may take. If the line of the pipe intersects with the area from which the drinking water source is being recharged (the area from where the water is being drawn) then there is the potential that any failure (leak) from the sewer or similar pipe will introduce raw sewage directly into the water source. It is unlikely that the path of such pipes will be clearly visible and so some care in interpreting the area will need to be taken, e.g. areas where the vegetation/ground appears to be drier indicating that there is a pipe buried below the surface or if there is a fracture in the pipe areas that would not naturally be damp or areas where there is vegetation indicative of wet or nutrient enriched conditions such as reeds or nettles.

Item 36 – Sewage effluent lagoons

Sewage effluent lagoons bring the potential that leaking material from the lagoon may enter the soil and pass into the groundwater providing a direct route for the contamination of the source with raw sewage. Farm effluent lagoons may be viewed as being the same in terms of the risks posed to the source when assessing the scoring values to be assigned.

Item 37 – Sewage effluent discharge to adjacent watercourse (where present)

While some aspects of this item may be identified when reviewing Item 34, Item 37 draws attention to the potential for sewage effluent discharges from a variety of sources such as municipal wastewater treatment works, septic tanks, privately owned/operated sewage treatment systems or reed beds. If there is evidence of discharge to a watercourse that is adjacent to the source of the supply under investigation then the risk characterisation should reflect the circumstances and "Yes" should be recorded. Similarly, for the hazard assessment the permanent, or semi-permanent, nature of the hazard should be reflected in the likelihood value assigned which should be almost certain (value 16).

Item 38 – Evidence of use of pesticides (including sheep dip) near source

If disposal sites for pesticides (including sheep dip) are known to be close to the source under investigation then the risk characterisation should reflect this as should the hazard assessment. If there is evidence of the area having been used for dipping sheep (with dip tanks, fanks, etc.) then this evidence should be taken into account when assessing the site.

Item 39 – Evidence of industrial activity likely to present a contamination threat

If there is evidence of the area adjacent to the source having been used for industrial activity which may pose a contamination threat then this should be recorded on the risk assessment. Such activities may include chemical or pharmaceutical production, mineral or other extraction such as coal mining, areas where old fuel tanks may have been located or may still be in place either below or above ground, or industries where solvents would have been in use and may have been disposed of on to the ground, e.g. electroplating, metal working or electronics. This list is not exhaustive and so appropriate interpretation of the previous use to which the site may have been put will be required by the investigation officer.

SECTION D (ii) Supply survey

Item 40 – Supply network constructed from material liable to fracture (e.g. asbestos concrete, clay, etc.)

If the network of pipes that lead from the well are constructed of materials that are liable to deterioration or fracture, e.g. if heavy farm machinery is driven over the top of the pipeline, then the integrity of the system will be lost and potentially polluting material may enter the pipes through the fractures or the whole supply will be lost through pipe blockages. If it is considered likely that such materials have been used for all or part of the pipework being used to convey water from the source then the risk characterisation must reflect this with a "Yes" score and the hazard assessment must similarly reflect the permanent nature of the hazard by scoring as almost certain (value 16).

Item 41 – Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected

The level of protection for all intermediate tanks or similar structures should be equivalent to that recommended for the source itself as the potential for contamination to enter the system via such intermediate points is just as high as for the source itself. If any of the intermediate tanks or similar structures are deficient then this should be reflected in the risk characterisation and hazard assessment. If there is more than one intermediate tank or similar structure, the deficient ones should be noted in section F and cross-referenced with the diagram provided in Section B (item 6).

Item 42 – Junctions present in the supply network, particularly supplying animal water systems, have no back-siphon protection

If there are provisions made to provide water to animal watering troughs or other connections where back-siphonage may occur, e.g. from a hosepipe permanently connected, there is potential for the contents of the trough or container to be back-siphoned into the distribution pipe and for the contents of the trough or container to enter the supply. Clearly the contents of a cattle watering trough or a barrel into which the end of a hose has been dangled for some weeks will do little to improve the quality of the drinking water being provided. It is essential that where connections are made on the system prior to the first taps to be used for domestic (potable) consumption appropriate back-siphonage prevention devices are fitted. If they are not or there is no evidence to support claims that they have been fitted then the risk characterisation must reflect this with a "Yes" response. Similarly the hazard assessment should highlight the permanent nature of the situation with an almost certain (value 16) rating.

Item 43 – No maintenance (including chlorination) has been undertaken in the previous 12 months

If the system has had no maintenance undertaken in the 12 months preceding the investigation then this suggests that the level of care and attention required to ensure the system is operating as effectively as possible is lacking. If this is the case then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an unlikely score (value = 2).

Item 44 – If present, header tank within the property(s) does not have a vermin-proof cover

Many properties served by a private supply, particularly those on smaller supplies, will have a header tank within the property to provide sufficient water pressure for the household and also to act as a balancing tank to equalise the pressure differences experience in the system when pumps are operating to bring water into the property. However, if the header tank is not properly constructed and protected then any material that may be present in the roof space, whether that be dust or mice or bat droppings, will have the potential to enter the tank and so contaminate the supply. If the property has a header tank which feeds the main domestic (potable) tap, usually the kitchen cold water tap, and that tank is not properly protected then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an almost certain score (value = 16). If the header tank is present and unprotected but does not feed the main domestic (potable) tap then the risk assessment can be moderated but the risk to other taps in the property should be highlighted in Section F and noted on the diagram at Section B.

Item 45 – Header tank has not been cleaned in the last 12 months

If the header tank has an appropriate vermin-proof cover (Item 44) it will still require to be maintained by cleaning at least every 12 months to prevent the build-up of slime and scum which will naturally grow on the tank walls. If the tank has not been cleaned in the 12 months prior to the investigation then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an unlikely score (value = 2).

Item 46 – Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months

If any point of entry/point of use devices have had no maintenance undertaken in the 12 months preceding the investigation then this suggests that the level of care and attention required to ensure the system is operating as effectively as possible is lacking. If this is the case then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation with an unlikely score (value = 2).

Item 47 – If present ultraviolet (UV) lamps are not operating

While ultraviolet disinfection systems if properly installed and maintained are an effective treatment option to prevent potentially harmful micro-organisms from causing disease they can provide a false sense of security if they are not looked after. A particularly common fault is for the UV bulb to stop operating. The UV bulb is at the heart of the installation and is responsible for the disinfection process. If there is not an automatic warning system on the installation then the loss of the bulb could go undetected. Similarly if the bulb has not been changed in accordance with the manufacturer's recommended replacement period then the efficiency or operation of the bulb could be impaired or have ceased to function at all. It is important, therefore, to assess if the UV bulbs (lamps) are operating on a UV system at the time of the inspection. If they are not operating then the risk characterisation score should reflect the situation encountered and a "Yes" response entered. The hazard assessment likelihood score should also reflect the situation based on an assessment of when the UV bulb (lamp) ceased to function.

Item 48 – Is there a noticeable change in the level and flow of water throughout the year

This question deals with the issue of constancy of supply as it relates to the quality of the source. If the source is highly dependable and provides adequate levels of water throughout the year then it is likely that the source is not under direct influence from either the surface or from prevailing climatic conditions. On the other hand, if the supply is "flashy" and changes with the weather then it is likely that it is under the influence of surface flow and prevailing weather conditions which increases its vulnerability to contamination from the surface. If there are noticeable changes in level and flow the risk characterisation response will be "Yes". The hazard assessment likelihood in these circumstances will be almost certain (value = 16). This circumstance may also cause the investigating officer to reconsider if the supply is in fact a well or if it would be better treated as a surface-derived supply.

Item 49 – Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt

If the supply is under the influence from either the surface or the weather then the quality experienced cannot be guaranteed if there are conditions prevailing which make surface flow (e.g. flooding) or adverse weather conditions likely. If there are noticeable changes in the appearance of the water then the risk characterisation response will be "Yes". The hazard assessment likelihood in these circumstances will be dependent on whether weather or surface influence is considered the most likely cause.

D (iii) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the three surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	
Source Survey	
Soil Leaching Risk Survey	
Overall Risk	

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 16 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

Section E

If the type of the supply has not been determined then the risk assessment will not have been completed. In this case the overall risk assessment for the supply will default to High Risk to ensure that appropriate control measures are put in place to maintain public health.

Section F

Additional Notes – this section can be used to include additional information or observations made during the investigation.

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Section 4.9 – Annex 1

Surface Supply Risk Assessment pro forma

Private Water Supply Risk Assessment Form

SURFACE DERIVED SUPPLY

OVERALL RISK .....

Section A – Supply Details

1. Supply category

Type A1 / A2 / A3 Type B (circle appropriate category)

2. Address and telephone number of responsible person

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.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

3. Name of person (or persons) who is relevant person in relation to the supply

(a) .....

(b) .....

(c) .....

(d) details of additional sheets .....

4. Address of relevant person (or persons) (if different from above)

(a) .....

.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

(b) .....

.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

(c) .....

.....

.....

Post Code .....

Telephone Number (including full STD Code) .....

Email Address .....

(d) details of additional sheets .....

5. Details of premise(s) served by the supply and purpose for which water is supplied

(a) .....

.....

.....

Post Code .....

Supply purpose .....

(b) .....

.....

.....

Post Code .....

Supply Purpose .....

(c) .....

.....

.....

Post Code .....

Supply Purpose .....

(d) details of additional sheets .....

Section B

6. Provide a diagram of the supply showing source(s), intermediate storage and/or collection tanks and properties on the supply. The diagram is indicative only and is intended to aid completion of the rest of this section.

Notes: Items should be labelled from source (A) through intermediate tanks (B) to properties (C) with individual components numbered, e.g. for a supply with one source this would be A1; two intermediate tanks (B1 and B2 respectively) and two properties (C1 and C2) respectively.

7. Description of the source of the supply including (i) details of supply source(s), (ii) location of the source(s) and (iii) eight-figure National Grid Reference of location(s) of source(s). Cross reference from Item 6 above.

(i) .....

.....

.....

(ii) .....

.....

.....

(iii) National Grid Reference N / J / 0 / 0 / 0 / 0 / 0 / 0

8. (a) Estimated daily volume of water provided by the supply ..... m^3 per day

(b) Number of persons served by supply (at maximum occupancy) .....

9. Details of any water treatment processes associated with the supply

(a) At source – identify which of the following systems are present: (cross reference to Item 6)

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

(b) Intermediate Water Storage Tank/Chamber (cross reference to Item 6)

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

(c) At property (cross reference to Item 6)

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

Identifier (from Item 6) .....

[tick which of the following treatments are present]

	Chlorination
	Filter
	UV
	Ozone
	UV without pre-filter
	Untreated
	Unknown
	Other (details) .....

(d) details of additional sheets .....

Section C

10. Details of departures authorised

.....

.....

.....

11. Details of sample results for previous 12 months or last available (reference location of information, e.g. paper or electronic files, reference number, sample numbers, etc.)

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12. Details of previous (last 2) investigations and actions taken

.....

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13. Details of enforcement notices served

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.....

14. Result of previous risk assessment (if applicable)

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.....

.....

15. Details of location of Notice for Type A supplies (location)

.....

.....

.....

16. Is Notice appropriate (conforms to requirements of the Regulations)? Yes ☐ No ☐

17. Details of action taken (or to be taken) by relevant persons to comply with

(a) results of sampling

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.....

.....

(b) results of follow-up to sampling

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18. Whether supply exempt under Regulation 2(4)

.....

.....

.....

19. Details of other information relating to the supply collated by the local authority

.....

.....

.....

20. Is there a Water Safety Plan/ Emergency Action Plan available for the supply?

Yes ☐ No ☐

21. If "Yes" to Item 20, is it fit for purpose? Yes ☐ No ☐

22. If "No" to Item 21, what deficiencies are required to be addressed (provide details)?

.....

.....

.....

Section D – Surface derived sources

D (i) General site survey

Are any of the following known to be present and likely to influence water quality at the source?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
23	History of livestock production (rearing, housing, grazing) – including poultry	H	L	H		16	
24	Evidence of wildlife	M	L	M		4	
25	Surface run-off from agricultural activity diverted to flow into the source/supply	H	L	H		8	
26	Soil cultivation with wastewater irrigation or sludge / slurry/ manure application	H	L	H		8	
27	Disposal of organic wastes to land	H	L	H		8	
28	Farm wastes and/or silage stored on the ground (not in tanks or containers)	M	L	M		8	
29	Remediation of land using sludge or slurry	H	L	H		16	
30	Forestry activity	M	L	M		4	
31	Awareness of the presence of drinking water supply/source by agricultural workers	L	H	H		4	
32	Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)	H	L	H		8	
33	Disposal sites for animal remains	H	L	H		8	
34	Unsewered human sanitation including septic tanks, pit latrines, soakaways	H	L	H		16	
35	Sewage pipes, mains or domestic (e.g. leading to / from septic tank)	H	L	H		8	
36	Sewage effluent lagoons	H	L	H		16	
37	Sewage effluent discharge to adjacent watercourse (where present)	H	L	H		16	
38	Evidence of use of pesticides (including sheep dip) near source	H	L	H		8	
39	Evidence of industrial activity likely to present a contamination threat	H	L	H		8	

[1] The Hazard Assessment Score is the product of the Likelihood and Severity values. The values are :

Likelihood	Definition	Value
Almost certain	Once per day (or permanent feature)	16
Likely	Once per week	8
Moderate likely	Once per month	4
Unlikely	Once per year	2
Rare	Once every 5 years	1

Risk Characterisation

Tick the appropriate box for each question.

If any question is High Risk (H) then the Risk Characterisation Score is **High**. ☐

If no question is High Risk but there are Moderate Risks (M) identified then the Risk Characterisation Score is **Moderate**. ☐

If no question is High Risk (H) or Moderate Risk (M) then the Risk Characterisation Score is **Low**. ☐

Hazard Assessment

If the Hazard Assessment Score is 16 or greater for any individual component then the issues associated with that component should be considered as a priority for remedial works to reduce the hazard experienced by the supply.

D (ii) Supply survey

Are any of the following known to occur at the head works site or in relation to the supply?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
40	Supply network constructed from material liable to fracture e.g. asbestos-concrete, clay etc.?	H	L	H		8	
41	Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected	H	L	H		8	
42	Junctions present in the supply network, particularly supplying animal watering systems, have no back-siphon protection?	H	L	H		4	
43	No maintenance (including chlorination) has been undertaken in the previous 12 months?	H	L	H		8	
44	If present, header tank within the property (s) does not have a vermin-proof cover?	H	L	H		4	
45	Header tank has not been cleaned in the last 12 months?	H	L	H		8	
46	Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months?	H	L	H		8	
47	If present ultraviolet (UV) lamps are not operating?	H	L	H		16	
48	Is there a noticeable change in the level and flow of water throughout the year?	H	L	H		4	
49	Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt?	H	L	H		8	

[1] The Hazard Assessment Score is the product of the Likelihood and Severity values. For details see Section D.

Risk Characterisation

Tick the appropriate box for each question.

If any question is High Risk (H) then the Risk Characterisation Score is **High**. ☐

If no question is High Risk but there are Moderate Risks (M) identified then the Risk Characterisation Score is **Moderate**. ☐

If no question is High Risk (H) or Moderate Risk (M) then the Risk Characterisation Score is **Low**. ☐

Hazard Assessment

If the Hazard Assessment Score is 16 or greater for any individual component then the issues associated with that component should be considered as a priority for remedial works to reduce the hazard experienced by the supply.

D (iv) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the two surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	
Source Survey	
Soil Leaching Risk Survey	
Overall Risk	

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 32 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

Section E

You have been unable to discern the type of supply and so the overall risk assessment for this source must be given as **High Risk**.

Section F – Additional Notes

4.10 References

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