1. Introduction

1.1 This document provides guidance on the protection of the water environment from cemetery developments. It is for developers and local authorities intending to expand or construct human cemeteries. This guidance applies to both traditional and green burial grounds.

1.2 The burial of humans and subsequent degradation can pose a risk of pollution to groundwater. This risk can be mitigated if either a) the natural ground conditions allow attenuation of pollutants, and/or b) the design of the cemetery is amended to minimise pollutant loading. This guidance describes how the planning applicant can demonstrate these types of mitigation are sufficient.

1.3 SEPA recommends pre-application discussions on any cemetery developments and can provide a scoping opinion to assist with the identification of issues which should be addressed as part of the application.

2. Assessing the potential risk to Groundwater

2.1 Stage 1 Screening Assessment

2.1.1 This is a simple assessment to check if the location of the site is feasible. It is a test to see if the site is too close to sensitive receptors.

2.1.2 The criteria are described in Box 1.

- If the development is for <100 burials/year and it meets the criteria in Box 1 then proceed to undertake a stage 2 assessment.
- If the development is for ≥100 burials/year and it meets the criteria in Box 1 then proceed to undertake a stage 3 assessment.
- If the development does not meet the criteria in Box 1 then it is unlikely to be suitable unless the design of the cemetery is altered to reduce or eliminate the pollutant loading (see Annex 2) AND a stage 3 assessment is undertaken.

BOX 1
Stage 1 site screening criteria

a) >250 metres from any groundwater abstraction (spring, well or borehole) used as a source of drinking water[1];

b) >50 metres from any spring, well or borehole for non-potable use ;

c) >50 metres from any watercourse[2];

d) >10 metres from a field drain[3];

e) Not above known or probable shallow mine workings if it can be reasonably judged that the workings form a preferential pathway to surface waters[4];

f) Not on designated Contaminated Land under Part IIA of the Environmental Protection Act (1990);

g) Has a slope with a gentle gradient (slope <10^{o}, which is equivalent to a slope of 17%;

h) Is not on land prone to flooding[5].

Notes:
1 – The local authority is the lead regulator for private water supplies. SEPA holds records of other abstractions >10m^3/day.
2 – Note that the term "watercourse" here includes lochs but does not include the sea, unless there is potential for contaminants to emerge at the shoreline via exposed cliffs or springs.
3 – Field drains here includes both buried pipe drains and ditches; note this restriction does not apply if the base of the field drain is <0.5m depth or if the field drainage will be diverted as part of the cemetery development.
4 – The Coal Authority holds records of known and probable shallow coal mine workings. The British Geological Survey holds information regarding other types of mining. Note that in relation to historic mining, SEPA will focus on the risks to the water environment. It is expected that, where shallow mining is known or likely to be present, the developer will also undertake a mining risk assessment that will consider ground stability and gas risks for the consideration of the relevant statutory consultees.
5 – SEPA flood maps will help with this. http://map.sepa.org.uk/floodmap/map.htm.

2.2 Stage 2: Initial Site Investigation

2.2.1 This stage relates to developments of <100 burials/year that meet the criteria in Box 1. It involves obtaining site specific information on groundwater levels, soil depth and soil permeability at the base of the burial lairs. This should be done by digging trial pits and then examining the soil type and groundwater levels exposed within the pits.

2.2.2 For sites where there are <30 burials /year then at least 3 pits are required in the development area. For larger scale burials (>30 burials/yr), a minimum of 6 trial pits or site investigation boreholes per hectare is required; SEPA may accept a lesser frequency at large sites (>5 hectares) provided this is agreed in advance through pre-application consultation.

2.2.3 The key assessment criteria are as follows:

- Investigations should occur to a depth of at least 1m below the planned base of the burial lairs.
- The soil strata exposed by the investigations should be described in accordance with British Standards[1]. The key is to describe the "principal soil type", backed up with particle size analysis from the coarsest material within each hole.
- The presence of groundwater inflows or a water table should be noted. Exploratory holes should be surveyed to Ordnance Datum to enable groundwater levels across the site to be compared. Investigations should be sufficient to demonstrate that the annual maximum water table should be at least 1m below the planned bottom of the burial lairs. Thus, it is recommended that the initial site investigation is undertaken in winter or early spring (November to March). Where it is not possible to conduct investigations during this period, then information from the pits should be supplemented by estimates regarding the likely maximum water table based on information gathered by desk study, which could include measurements or records from adjacent developments.

A summary is provided in Box 2.

2.2.4 If the development is for <100 burials per year, and it meets the criteria in Box 2, then the site is suitable and can proceed.

2.2.5 If the site does not meet the criteria in Box 2 the site is unlikely to be suitable unless:

- the design of the cemetery is altered to minimise the pollutant loading;
- and, if necessary, a detailed Stage 3 assessment, taking account of the revised design, meets the criteria outlined in Section 2.3.

[1] *BS 5930:2015 Code of practice for ground investigations*

BOX 2
Stage 2 site suitability criteria
A suitable site is one that meets the criteria in Box 1 AND:

a) If the burial rate is less than 10 burials per year:

   i. There is >1m between the planned base of the lairs and the annual maximum water table.

b) If the burial rate is 11 to 100 burials per year:

   a) There is no rock outcropping at surface and no rock exposed in investigations to at least 1m below the planned base of the lairs;
   b) AND there is no “coarse SAND” or “GRAVEL” exposed by the investigations;
   c) AND there is >1m between the planned base of the lairs and the annual maximum water table.

Note that in making these calculations the thickness of soil cover above the coffin or shroud should not be less than 1m.

Burials below the water table are not acceptable at any site.

2.3 Stage 3: Detailed Quantitative Risk Assessment

2.3.1 Developments >100 burials per year or those failing the criteria in Boxes 1 or 2 may still be acceptable. This is if it can be demonstrated via Stage 3 that the pollutants from the cemetery will not cause significant adverse impacts on the water environment by considering a) the catchment of a receptor such as an abstraction b) information on the particular ground conditions at the site, and c) additional measures to reduce pollutant loading. Position Statement (WAT-PS-10-01) Assigning Groundwater Assessment Criteria for Pollutant Inputs provides details of the standards that can be used to assess this impact.

2.3.2 The exact requirements of a Stage 3 assessment are complex and site-specific, and thus cannot be prescribed in this guidance. It should only be undertaken by professionals with demonstrable qualifications and experience in groundwater risk assessment.

2.3.3 In most cases this stage requires a detailed quantitative risk assessment based on numerical pollutant fate and transport modelling. The type of numerical model to be used depends on site specific circumstances but examples include ConSim, P20, and/or Modflow. The assessment also needs to take account of any changes to graveyard design implemented to minimise pollutant loading (Annex 2).

2.3.4 Where proposed sites are extensions to existing burial grounds, the existing site may provide an analogue to aid the risk assessment process if the ground conditions and proximity to sensitive receptors on both sites are similar.

2.3.5 The detailed quantitative risk assessment should include ammoniacal nitrogen, which is the principal contaminant of concern to the water environment from burials. Risks from other contaminants such as metals, formaldehyde, and microbial pathogens should also be taken into consideration if a sensitive receptor is very close (within the standoff distances presented in Box 1).

2.3.6 The risk assessment should be undertaken using a Source-Pathway-Receptor approach. The main risk factors are a) the number of people buried per year, b) proximity to receptors such as rivers and drinking water sources, c) the depth to water table and the permeability of soil above the water table, and d) the nature of groundwater flow below the water table. Factors (a) to (c) form the basis of the criteria set out in Box 1 and Box 2 of this guidance.

2.3.7 The detailed quantitative risk assessment will require to be supported by a more detailed intrusive site investigation and an extended period of prior monitoring of both groundwater levels and quality. The scope of the additional investigation and monitoring should be designed taking into account the environmental setting of the site. As a minimum, SEPA will expect:

- At least three monitoring boreholes extending at least 3m below the maximum lair depth. The boreholes must be surveyed in to Ordnance Datum to permit interpretation of the groundwater flow regime.
- At least one year of monthly monitoring of groundwater levels.
- At least three baseline water quality rounds (analytical suite to include: pH, electrical conductivity, chloride, ammoniacal nitrogen, nitrate) for groundwater, and if applicable, surface water.

At sites with complex hydrogeology or in close proximity to sensitive receptors, the investigation and monitoring requirements may be greater than the minimum described above. It is suggested that the proposed scope of additional investigation be submitted to SEPA for comment prior to commencing the works on site.

2.3.8 It is in the best interest of the applicant to provide sufficient information in their planning application to enable us to make an informed and timely response. Submissions should include the form in Annex 1, along with the results of the stage 3 assessment and all supporting evidence.

2.4 Burial of Cremated Remains

2.4.1 Cremation burials usually pose a lesser risk to the water environment than conventional burials. Cremated remains should not be interred below the water table. It is preferable, but not essential, to maintain >1m between the planned depth of the buried cremated remains and the annual maximum water table. Standoff requirements from water features (see Box 1) should be maintained.

2.4.2 An average spacing of at least 0.5m between individual cremated remains is recommended. At the discretion of the Local Authority the burial depth may be less than a metre.

2.4.3 If urns are used, SEPA recommended the urns are composed of either inert (e.g. ceramic) or biodegradable (e.g. wood) materials.

2.5 SEPA Objections

2.5.1 We will object to proposals which:

- do not meet the site suitability requirements outlined in Stage 1, 2, or 3 (as appropriate).
- do not provide the summary table provided in Annex 1 along with necessary supporting information.

2.5.2 For the duration of cemetery use it is considered good practice to maintain a groundwater level and groundwater quality monitoring programme, to confirm that the site is not having a detrimental impact on the water environment. Such a monitoring programme is however not a compulsory planning requirement and will not be requested by SEPA.

ANNEX 1: SITE SUITABILITY CHECKLIST

Site Name:	
NGR of centre of site:	
PCS No: **[to be completed by SEPA]**	
Area of site (hectares)	
Burial rate (per year)	
Maximum depth of burial and method of body containment (m)	
Author:	
Date:	

Criteria **Stage 1 Assessment**	**Y/N**	**Details**	**Location in report where more details can be found**
1. Will burials be within 250m of potable groundwater abstractions; namely any spring, well or boreholes used as a source of drinking water?			
2. Will burials be within 50m of any other springs, wells or boreholes?			
3. Will burials be within 50m of any watercourse (loch, wetland, burns etc)?			
4. Will burials be within 10m of any field drain?			

5. Will any burials be within an area of known or probable shallow mine workings?			
6. Is the development located within an area designated as Contaminated Land?			
7. Is the development located on land prone to flooding?			
Stage 2 Assessment			
8. Is there any rock outcropping at surface or exposed in investigations to at least 1m below the planned base of the lairs?			
9. Is the soil exposed by the investigations "coarse SAND", "GRAVEL" or coarser?			
10. Is there >1m between the planned base of the lairs and the annual maximum water table?			
Stage 3 Assessment (if required): Please provide a summary of the results of the more detailed assessment of ground conditions and/or of changes to the design of the cemetery to minimise pollutant loading			**Location in report where more details can be found**

ANNEX 2: OPTIONS FOR CEMETERY DESIGN TO MINIMISE POLLUTANT LOADING

Where the cemetery does not meet the requirements specified above the developer could consider modifying the design to meet these requirements. This section provides some guidance on possible modifications that could be undertaken to address some of these issues.

Option 1: Only use the parts of the site which meet the suitability criteria

Many sites suffer from constraints related to topography or groundwater levels. These constraints in effect define a restricted envelope of ground suitable for burial use and therefore the suitability of various areas of the site for multiple, single or no burial.

If a portion of the site is not suitable for burials the entire site need not necessarily be rejected. Internal zoning of the site according to site conditions may be appropriate as shown in Figures A1 and A2.

Option 2: Increase the depth to groundwater by land raise

Land raise is the most obvious of the solutions where available sites exhibit groundwater levels that are only marginally too high or where soil thickness is a limitation. This should not be confused with burial mounds which will not routinely be considered (a mound erected over the dead on an individual basis).

If a land raise option is under consideration, the implications for local flood risks must be assessed.

Materials used must be inert and should meet the permeability criteria specified in Box 2.

Figure A1: Restricted development due to groundwater level constraint

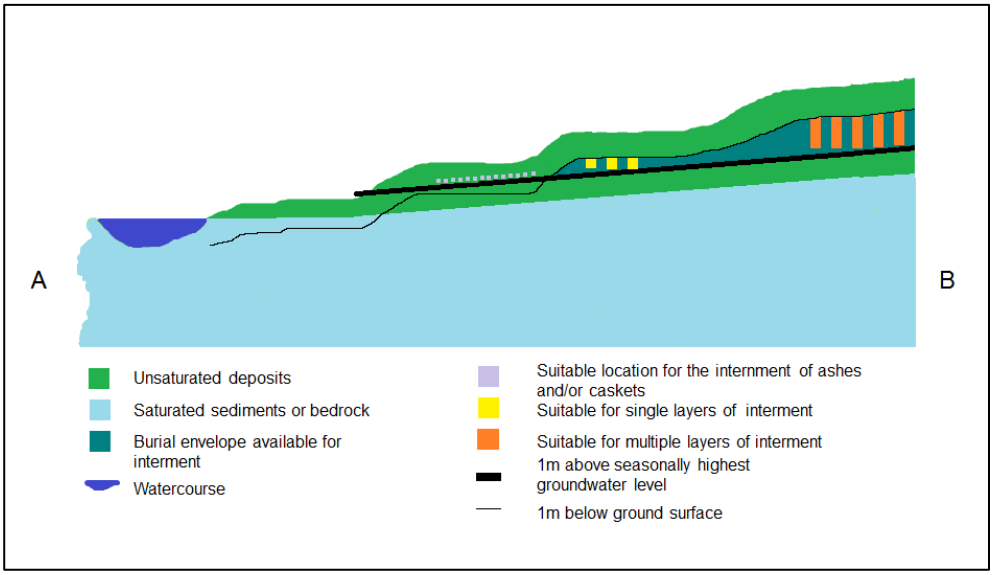
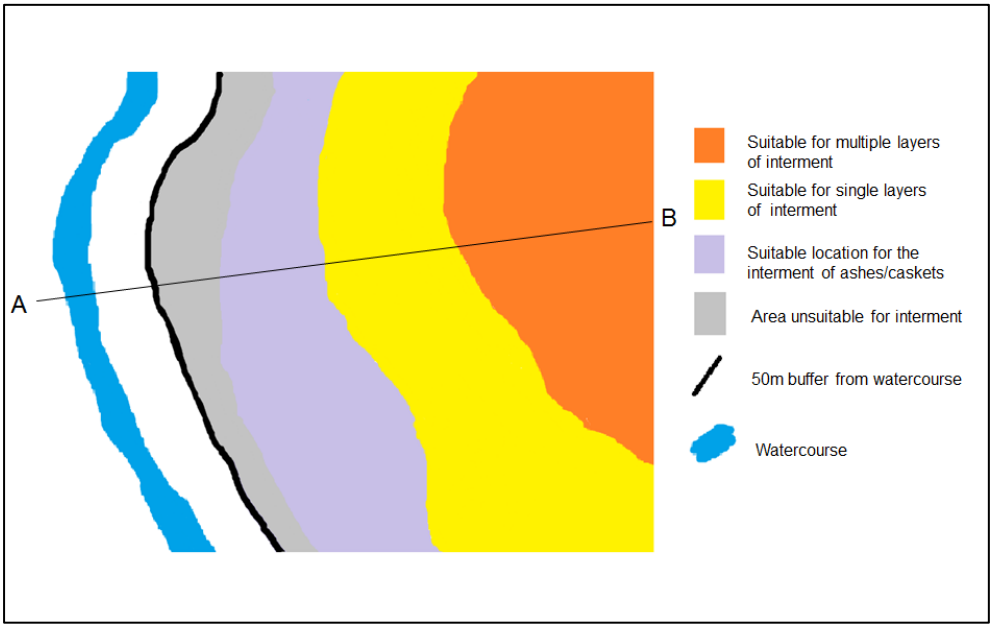


Figure A2: Zoned development appropriate to Figure A1



Option 3: Increase the depth to groundwater through passive drainage

Developers should note that passive drainage options may only rarely provide a viable development option. The cost of getting the assessment wrong may be high.

This methodology can however be applied where groundwater levels are marginally too high, rendering the site unsuitable. Where present this methodology utilises underlying permeable strata and artificial drains to lower the groundwater level to a point where the site meets the criteria outlined in Box 2.

Only sustainable passive drainage should be considered an appropriate drainage design. Soils within the footprint area may need to be engineered and homogenised to remove preferential flow pathways and the permeability requirements outlined in Box 2 should be applied. It is recommended that a numerical model be used to demonstrate the viability of the design. This should fully consider the local three-dimensional flow regime, including any vertical component of groundwater flow from the underlying soils or bedrock aquifer.

For the duration of cemetery use it is considered good practice for cemetery managers to maintain a discharge quality monitoring programme, to ensure that no consequential pollution of the environment occurs.

It is suggested that drainage maintenance, and financial provision for treatment, should be agreed by prior arrangement with the planning authority.

Option 4: Reduce pollutant loading

In many areas where conventional cemetery developments and burials are not possible or portions of a cemetery development site are unsuitable for normal development, alternative burial methodologies may prove appropriate for use either on their own or in conjunction with other measures.

Burial chambers: Where soils are thin, groundwater levels shallow or the permeability of the strata too high, the use of burial chambers built of durable and impermeable materials may be considered (Suitable concrete may be C35A as defined in BS EN 1992-3:2006 or better). In these instances there is no need to demonstrate the potential for natural attenuation within the materials below the burial chamber.

Where the type of burial chamber proposed comprises fully sealed units, the potential for groundwater contamination would no longer be a consideration. This means the requirements in Box 2 can be disregarded.