IMPORTANT NOTES – PLEASE READ

This guidance sets out SEPA's expectations on soil and groundwater monitoring at PPC Part A Installations (except landfills). It is intended to assist operators and SEPA staff in determining and complying with soil and groundwater monitoring conditions and to promote a consistency of approach. This guidance may be subject to change in the light of regulatory changes, future government guidance, regulations or experience in its use. It has no legal status other than guidance to staff and operators.

The document will be reviewed in the future in the light of experience gained in using this guidance. Users of the guidance are invited to send any comments on experience of using the guidance to ppc@sepa.org.uk

IED-TG-42 Soil and Groundwater Monitoring Technical Guidance for Part A Installations

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SOIL AND GROUNDWATER MONITORING GUIDANCE FOR PART A INSTALLATIONS

1. PURPOSE AND SCOPE OF THIS GUIDANCE

The Pollution Prevention and Control (Scotland) Regulations 2012 ("PPC 2012") require every Part A installation which involves the use, production or release of a relevant hazardous substance (RHS) to undertake periodic soil and groundwater monitoring, where there is a possibility of soil and/or groundwater contamination, subject to a systematic assessment of risk.

The principal aim of this guidance is to promote a consistent approach to the determination of soil and groundwater monitoring conditions. The guidance also provides advice on the soil and groundwater monitoring plan and assessment of the monitoring results.

This guidance does not apply to circumstances in which there are consented discharges or disposals, such as landfills or indirect releases to land from stack emissions. Monitoring required or facilitated under other regulatory regimes, for example, associated with future cycles of the River Basin Management Planning process, is outwith the scope of this guidance.

The production of Initial Site Condition Reports (see SEPA guidance IED-TG-02), will generate much of the information required to determine monitoring conditions, hence IED-TG-02 is cross-referred to throughout this guidance.

2. REGULATORY REQUIREMENTS

The Industrial Emissions Directive (IED) and PPC 2012 (relevant sections reproduced as Appendix 1) introduce requirements in relation to the protection of soil and groundwater from relevant hazardous substances (RHS). These requirements are triggered by:

- New permit applications;
- Permit variations at substantial change (operator led) where relevant, e.g. substantial changes which require the submission of a baseline report
- Permit review in the circumstances set out in Reg 44(1) e.g after publication of BAT Conclusions report, to comply with PPC 2012:

The requirements include:

- a baseline report (Article 22 IED, Schedule 4(1) PPC 2012)
- upon definitive cessation, where significant pollution has been caused, to return the site to the initial state (Article 22 IED, Regulation 48 PPC 2012)
- periodic monitoring of soil and groundwater for relevant hazardous substances, having regard to the possibility for contamination (Article 14 and 16 IED, Regulation 23 PPC 2012)
- regular maintenance and surveillance of measures in place to prevent emissions. (Article 14 IED, Regulation 23 PPC 2012)
- all appropriate preventive measures taken against pollution (Article 11 IED, Regulation 21 PPC 2012) and to ensure protection of soil and groundwater (Article 14 IED, Regulation 23 PPC 2012)
- that no significant pollution is caused (Article 11 IED, Regulation 21 PPC 2012)

"**Pollution** means the direct or indirect introduction, as a result of human activity, of substances, vibrations, heat or noise into air, water or land which may be harmful to human health or the quality of the environment, result in damage to material property, or impair or interfere with amenities and other legitimate uses of the environment" (Article 3 IED)

Hazardous Substances for the purposes of PPC 2012 means substances or mixtures as defined in Article 3 of the Classification Labelling and Packaging Regulations (REGULATION (EC) No 1272/2008, 16 December 2008, on classification, labelling and packaging of substances and mixtures) ("CLP").

A substance or mixture is classified as hazardous on the basis of it meeting the criteria relating to physical, environmental or health hazards listed in Part 2 to 5 of Annex 1 of the CLP Regulations, a summary of which is provided in appendix 2 together with links to other sources of information which may help to clarify whether substances are hazardous.

Relevant Hazardous Substance is discussed in European Commission Guidance concerning baseline reports 2014/c 136/03[1]. Relevant hazardous substances are those hazardous substances that are capable of contaminating soil and groundwater based upon consideration of the chemical and physical properties of the substance.

3. INTERPRETATION

Purpose of soil and groundwater monitoring

IED (recital paragraph 23) states the purpose of soil and groundwater monitoring is to detect possible soil and groundwater pollution at an early stage and, therefore, to take appropriate corrective measure before the pollution spreads.

Possibility of soil and groundwater contamination

Regulation 23 (2) (f) stipulates *"(ii)appropriate requirements in respect of the periodic monitoring of soil and groundwater in relation to relevant hazardous substances likely to be found on the site, having regard for that purpose to the possibility of soil and groundwater contamination at the site,"*

Interpretation: Where soil and groundwater contamination is not possible monitoring will not be required but the decision and the reasons for it will be recorded. Further guidance on the assessment of whether contamination is possible is provided in Section 4.

Monitoring Frequency and Systematic Appraisal of Risk

Regulation 23 stipulates that SEPA must include in a permit

"(3) For the purposes of paragraph (2)(f)—

(a)emission monitoring requirements must where applicable be based on conclusions on monitoring as described in BAT conclusions, and

(b)periodic monitoring of—

(i)groundwater must be carried out at least every 5 years, and

(ii)soil must be carried out at least every 10 years,

unless such monitoring is based on a systematic appraisal of the risks of contamination of groundwater and soil.

The indicative timescales of 5 years for water and 10 years for soil suggest that this is not relating to catastrophic incidents that are easily detectable during the routine operations, but for more gradual releases that are not readily detected at the site surface or by site monitoring equipment (leak detection systems, alarms). This could include

- leaks from below or partially below ground tanks, sumps, process pipework, drains etc

[1] EC guidance: European Commission Guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions (2014/C 136/03)

- leaks from the base of tanks which are sat directly on the ground,
- slow seepages through joints in concrete or other surfacing as a result of surface activities e.g. uncontained storage of materials or wastes, washing/ hosing down of materials on hard surfacing etc.

Where monitoring is required, the frequency of monitoring will be determined from a systematic appraisal of the risk of contamination occurring (see section 4). The 5 yearly (groundwater) and 10 yearly (soil) monitoring is expected to apply to most low risk circumstances, but PPC 2012 does not preclude both longer and shorter monitoring frequencies. In most circumstances it is not expected that a longer frequency than 5 years for groundwater and 10 years for soil will be determined.

Pollution, contamination and significant pollution. The Directive indicates that these terms are interchangeable.

IED requires that monitoring requirements are to be based on the possibility of soil and groundwater contamination. IED requires that upon cessation of activities at a site any significant pollution is addressed. IED does not define significant pollution but Article 22 IED discusses significant pollution in relation to the baseline report. **From this, and for the purpose of PPC 2012, significant pollution can be taken to mean an appreciable negative change in the condition of soil and groundwater at a site when compared to the Baseline report.** (This is a subtle difference to the conventional interpretation of significant pollution under other regimes where it is typically referred to in terms of potential to cause harm rather than a change.)

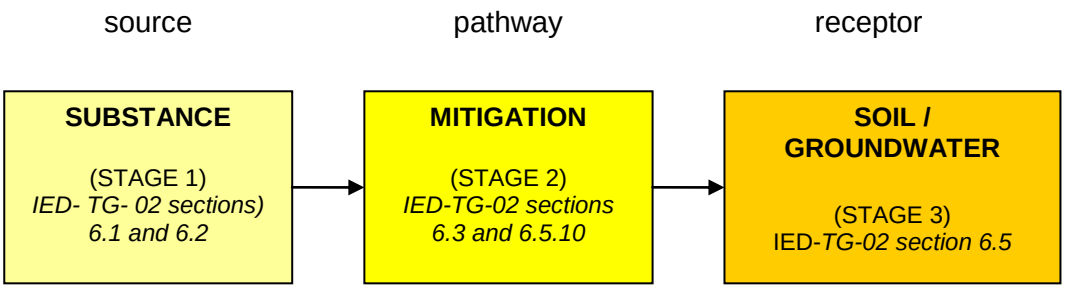
Except where citing regulations or references or where referring to pollution control measures, this document uses the term contamination throughout to refer to significant pollution in terms of PPC, as described in the paragraph above.

4. DETERMINATION OF MONITORING REQUIREMENTS

4.1 Overall Approach

It is for SEPA to determine the frequency of soil and/or groundwater monitoring based on a systematic appraisal of risk. The information ("relevant information") that will form the basis of this appraisal will ideally be provided in the application (baseline and initial site condition reports) or in the case of Variations and Permit Reviews, responses to Information Notices, along with working files and records of site inspections.

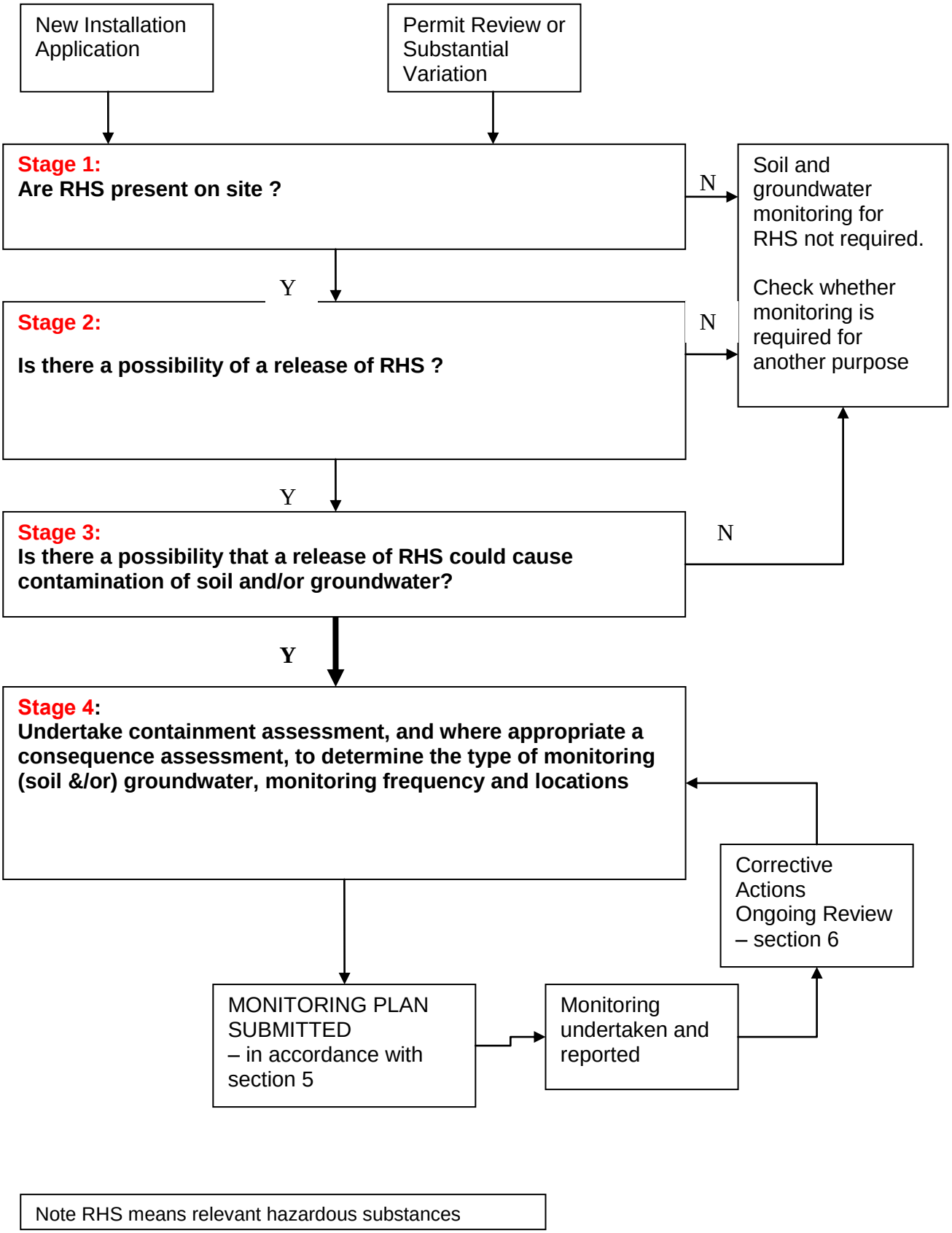
The systematic appraisal of risk uses a generic source-pathway-receptor approach, which in this context can be translated into **substance – mitigation – soil / groundwater** .



This is a staged process, which is summarised in Flowchart 1 below and discussed in more detail in Sections 4.2 and 4.3.

The information requirements and the process follow the same principles as set out in SEPA guidance IED-TG-02, and it will be useful to cross-refer to that guidance. It is expected that the advice of SEPA specialists such as Contaminated Land Specialists or PPC inspectors and specialists trained in soil and groundwater issues, as supported by hydrogeologists and soil scientists, will be required for Stages 3 and 4.

FIGURE 1 FLOWCHART:



4.2 Assessment of Monitoring Requirements

Stage 1 Are RHS used, produced or released?

To answer this question, the inspector should refer to CLP[2], (which defines RHS for the purposes of PPC 2012) to:

- identify the substances present at the installation (the inventory)
- help to establish those which are RHS.

If none of the substances (or their breakdown products) present at the installation fall within the substances listed in parts 2 – 5 of Annex 1 of the CLP then soil and groundwater monitoring (for the purposes of Regulation 23) is not required. If there are RHS proceed to Stage 2.

All decisions should be supported by a full justification which must be documented.

Stage 2 Is there a possibility of a release to soil and groundwater?

To answer this question the inspector should undertake a site specific assessment of whether a release to soil and groundwater is **possible.**

Where possible releases are to the site surface or from above ground structures and these releases will be clearly visible and readily identified, regular inspection, rather than soil and groundwater monitoring, is the best means of detecting releases.

This stage therefore concentrates on emissions that are not readily identifiable (see examples in Appendix 6) e.g.

- bottom leakage from tanks sat directly on the ground,
- corrosion/fracture of below ground tanks/sumps,
- leakage through unsealed joints,
- leakage between manhole ring-joints and through lifting eyes, and
- corrosion, displacement, cracking or joint leakage in drains

Where the assessment cannot be made on the basis of the relevant information a site visit will be required (see IED-TG-02 6.3.1). The site visit should include a detailed physical inspection of the site to determine the observable integrity of containment mechanisms, nature and condition of site surfacing, location and condition of drains, services or other potential conduits for migration, evidence of emissions, taking particular account of any below ground structures or transfers and measures adopted to prevent contamination of soil or groundwater from taking place. Sight of supporting documents (e.g. integrity test results) should be requested.

Examples of circumstances in which a release to soil and groundwater is not possible include:

- Where RHS are present but in a form that cannot result in entry to soil and groundwater (e.g. gaseous emissions to atmosphere)
- Where RHS are delivered, stored and used in a completely enclosed secured environment from which there are no circumstances in which a spill can escape

It is important to note that where RHS are stored or transferred (e.g. pipelines, drains) directly on or below ground, the possibility of a release to soil and/or groundwater cannot be discounted.

If RHS cannot be released to soil or groundwater no further action is required in respect of the soil and groundwater monitoring requirements of Regulation 23, but soil and groundwater monitoring may be required for other purposes.

If there is a possibility of release to soil and groundwater proceed to Stage 3.

[2] REGULATION (EC) No 1272/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006

All decisions should be supported by a full justification, which must be documented.

Stage 3 - Is there a possibility that a release could cause contamination of soil and/or groundwater?

Based on the findings of Stage 2 and the relevant information, consider the extent to which circumstances exist which may result in the release of the substance in sufficient quantities to result in contamination of soil and groundwater either as a result of a single emission or as a result of accumulation from multiple emissions.

Where the assessment cannot be made on the basis of the relevant information a site visit will be required.

The key factors in determining whether a release could cause contamination are the form, quantity and concentration of RHS that could be released. For example, the following circumstances are unlikely to result in contamination:

- Releases of non leachable solids
- Where the RHS is used in very small quantities
- Where either a one off or cumulative releases would be of insufficient scale to result in contamination.

If there is a possibility of a release causing contamination of soil and/or groundwater then soil and/or groundwater monitoring will be required. Proceed to Stage 4.

All decisions should be supported by a full justification which must be documented.

Stage 4 - Determining Monitoring Requirements

Having determined in Stages 1-3 that there is a possibility of releases of RHS that could cause contamination of soil and groundwater, i.e. monitoring is required, the main aim of Stage 4 is to consider in detail the likelihood of releases and the nature, extent and location of releases that could occur and how such releases could migrate through soil and groundwater. Whilst PPC 2012 is primarily concerned with preventing releases to soil or groundwater, other receptors are considered in the determination of monitoring frequency to ensure that any risk is not exacerbated by reaching another receptor.

The stage 4 assessment provides the information required to determine

- the monitoring frequency,
- the monitoring locations, and
- media (soil and/or groundwater).

To carry out the appraisal, the inspector will need to refer to the documents reviewed in Stages 2 and 3 (relevant information).

How frequently is monitoring required?

The monitoring frequency will be determined on the basis of SEPAs appraisal of the **likelihood of releases** and the possible adverse **consequences** of a release. The greater the risk of release, the more frequent the monitoring. The approach should be precautionary and proportionate.

The aide memoirs in Appendix 3 should be used to aid the assessment of the likelihood of releases (Aide Memoir 1) and consequences of a release (Aide Memoir 2), as follows.

Step 1) Using Aide Memoir 1, review the relevant information, taking a precautionary approach, to assess the likelihood of release, paying particular attention to:

- the nature of containment – e.g. whether storage, infrastructure, pipework, drains, sumps etc are above or below ground, and whether there is secondary containment, including for below ground infrastructure e.g. drains, process pipework etc

- hardstanding e.g. is good quality hardstand in place in all operational and transfer areas, how is it constructed and drained, is it at risk of deterioration

- the extent to which surveillance measures or alarms will ensure that leaks are readily detected

- Standard of containment infrastructure, testing and repair (ageing plant issue) – whether construction is largely compliant with CIRIA 736 and the frequency and adequacy of maintenance and inspection programmes

- Whether any emission could be identified and rectified immediately

Step 2) If Category 3 is ticked in any row, the installation's pollution prevention and control measures are likely to be subject to BAT improvement/upgrade conditions. A monitoring frequency of 3-6 monthly for groundwater and 5 yearly or more frequent for soil (subject to Stages 5 and 6) is appropriate until the upgrade has been completed and signed off, at which time a review of monitoring frequency will be required.

Step 3) For Category 1 sites, the installation's pollution prevention and control measures ensure that there is a low risk to soil and groundwater and a monitoring frequency of 5 yearly (groundwater) and 10 yearly frequency (subject to Stages 5 and 6) is appropriate.

Step 4) For Category 2 sites (and sites which straddle Categories 1 and 2) further assessment of the consequences of a release is required to establish an appropriate monitoring frequency. This involves consideration of

- The ease and speed with which pollutants could move; and
- The volume, concentration, toxicity, mobility and persistence of RHS and known breakdown products of RHS.

In addition, consideration is given to the presence of vulnerable receptors, neighbouring land use and environmental designations relevant to the nature of the possible emissions.

Aide Memoir 2 is used to assist this Consequence Assessment and allocate monitoring frequency (subject to Stages 5 and 6).

Step 5) Site specific Soil Assessment – consider whether a shorter frequency of soil monitoring is required, for example, where there is a high likelihood of spills migrating via soils or groundwater to off-site receptors such as protected habitats, terrestrial ecosystems, residential areas, built areas, land under cultivation etc

Step 6) Determining an appropriate monitoring frequency will always involve an element of subjectivity. A final sense check and, in cases which are not clear cut, peer review (by SEPA contaminated land specialists (CLS)) will help to ensure that requirements are appropriate and consistent.

Where is monitoring required?

The purpose of this stage is to establish monitoring locations and depths where soil and groundwater are coincident with potential emission sources.

Once it is established that monitoring is required consideration must be given to where monitoring is to be undertaken. The number of monitoring locations will depend on the size of the site, the locations and extent of a possible release and the nature of sub-surface transport.

At Stage 2 the locations (pinch points) at which a polluting release is possible will have been established. The monitoring locations selected should be capable of detecting polluting releases from these areas of the site.

To consider where to monitor, check how a polluting release would migrate in the site's specific environmental setting, taking into account the location of releases, site topography, solid and drift geology, the vulnerability of any groundwater, proximity of any vulnerable off-site receptors and the direction of groundwater flow.

The focus should be on capturing releases at the identified "pinch points", where potential sub-surface corrosion of infrastructure and leakage from sources coincide with pathways to soil and groundwater, taking particular account of how and where hazardous substances are stored, used and to be transported around the installation. Zoning the site on the basis of where different emissions to soil and groundwater are likely will assist in selecting suitable monitoring locations.

In deciding where to locate monitoring points it will be important to understand the depth and point at which releases may occur. This is particularly important where containment and transfer structures are sub-surface. In the case of potential releases of free product (non-aqueous phase liquids, NAPL) consideration should also be given to the depth at which monitoring is required taking into account whether the product is floating (LNAPL) or denser than water (DNAPL).

Depending on the site, the monitoring locations may be a combination of high risk areas and sentinel monitoring points. Sentinel monitoring points may be located at the periphery of a potential emission point, periphery of the site or off-site, down gradient of groundwater flow. Sentinel monitoring points are likely to be appropriate where there are operational site constraints, to preserve site integrity and where the use of sentinel monitoring points would improve the overall "capture" rate of releases. However, where sentinel monitoring is employed this may result in some delay in detecting (and therefore delaying the opportunity to remedy) contamination, and more frequent monitoring may therefore be required.

Which media required to be monitored - Soil and/or Groundwater

There may be circumstances in which whilst there is a risk of contamination, monitoring of **both** soil and groundwater is not appropriate. This is likely to be based on which media (soil or groundwater) is at risk, the nature of sub-surface fate and transport and practical restrictions on site, and, where the risk of emission is above ground whether a good quality hard stand is in place.

For example, groundwater monitoring may not be considered necessary:

- where contaminants would be adsorbed onto soils and prevented from entering groundwater
- where groundwater is present at depth and groundwater vulnerability is sufficiently low to indicate that there is no viable pathway to groundwater e.g. low permeability soils or where an aquiclude prevents migration to groundwater

Soil monitoring may not be necessary

- where releases (even recurring releases) would be of highly leachable substances that would not result in soil contamination
- where there is no soil present at the site (ie the installation is constructed on bedrock) or where the release would take place below soil level (e,g from the base of a tank sited on bedrock). Coring of the bedrock is not required

- where it is impractical to test soils (especially if plant and equipment restricts access or high integrity hardstanding would be compromised).

In these circumstances, it may be more appropriate to use groundwater monitoring as a surrogate for soil contamination.

5. THE MONITORING PLAN

The monitoring plan should be determined on a site specific basis and reflect the outcomes on type extent and frequency of monitoring as determined by the approach described in Section 4. The minimum requirement shall be that authoritative guidance has been followed, that the monitoring plan is fit for purpose and that the monitoring plan has been submitted to and approved by SEPA.

SEPA considers that current authoritative guidance is that provided within:

- current British Standards and Codes of Practice (e.g. current versions of BS 10175, BS 5930),
- current guidance published by SEPA including Section 6 of IED-TG-02 and related guidance available on the contaminated land pages of the SEPA website, and
- where supported by suitable justifications (to account for any cross-border policy differences concerning protection of the water environment), guidance published by the Environment Agency.

IED-TG-02 (6.7.2) provides advice on the requirements for a site investigation. A checklist - "Site Characterisation and Environmental Risk Assessment of Land Contamination: A List of the Types of Raw Data to be Included in Submissions to SEPA" is also available on the SEPA website.

Other guidance may be used where its relevance is fully justified.

With reference to SEPA's checklist and published guidance, the monitoring plan should, as a minimum, contain:

- details of the relevant hazardous substances or other substances to be monitored and their locations;
- the locations of the points to be monitored shown on a plan; surveyed to ordnance datum mAOD
- plans showing any zoning of the site
- borehole fitness for purpose assessment (where groundwater monitoring is to be undertaken)
- other measurements to be taken, where relevant e.g. DO, K, pH, hardness, groundwater level etc (where groundwater monitoring is to be undertaken).
- frequency of these measurements
- sampling strategy (sample type, method for obtaining representative samples, storage and transport etc)
- frequency and timing of sampling
- analytical parameters for the samples taken;
- analytical methods, including adequately stringent limits of detection,
- tabular presentation of raw analytical results to enable review
- plans for assessment, interpretation and reporting of analytical results,
- and plans for identifying and implementing any required remedial actions for problems identified by the monitoring.

An example of a suggested monitoring plan contents page is provided in Appendix 4.

The monitoring plan should be regularly reviewed in the light of the monitoring results, any changes in activities, locations or substances at the Installation and to ensure that it is up to date with best practice. The monitoring frequency will need to be reviewed following any upgrades to or deterioration of containment infrastructure.

Note that over time boreholes may become silted up, damaged or otherwise unusable – a fitness for purpose assessment will be required prior to each monitoring survey. Where a borehole becomes unusable a suitable replacement shall be provided and the abandoned borehole backfilled in accordance with best practice such as Scottish Government/SEPA guidance on decommissioning redundant wells which is available at the following link, http://www.sepa.org.uk/water/water_regulation/guidance/idoc.ashx?docid=cb4fd936-0f91-46f0-8b42-9e17d306592d&version=-1

6. REVIEW OF THE PERIODIC MONITORING REPORTS

Any unauthorised emissions to soil and groundwater must be reported to SEPA in compliance with the incident reporting conditions of the permit.

The periodic monitoring report is a factual report, supported by a detailed interpretation of the results to determine whether releases to ground or groundwater have occurred or are occurring. This may include graphs of trends and for groundwater, contour plots. It will not be sufficient just to forward on the raw data.

The interpretation should be made in the context of previous monitoring results and the initial site condition report, and should identify any change in soil or groundwater quality. Where a negative change (other than that within the margins of analytical error or attributable to background variability) in soil or groundwater quality is identified the report should include an assessment of where the release has come from, details of any further investigations necessary, timescales, proposals for corrective action and the frequency of monitoring should be reviewed. The permit may require to be reviewed as a result of a release to determine any required upgrade conditions.

Corrective actions such as:

- Maintenance and repairs
- Review of management systems
- Leak identification and rectification
- Further soil and groundwater investigation

should be undertaken as soon as possible.

It is expected that any contamination as a result of the activities of the installation will be remedied back to the initial site condition unless site specific circumstances dictate that it is more appropriate to undertake remediation at the time of surrender of the permit. The nature and timing of the remediation should be appropriate to the significance of the change and the practicability of taking the corrective action.

The type of factors to take into consideration when assessing the significance of the change (and the urgency of corrective actions) include: magnitude of the change, spatial extent, potential for further migration, degradation and the potential impact of the change on the environment or human health. Comparison of the results with relevant soil and groundwater standards may in some circumstances help in the assessment of the seriousness of the contamination and the urgency with which soil and/or groundwater remediation should be taken.

Records shall be kept of actions taken.

7 SURVEILLANCE OF MEASURES

PPC permits place a responsibility on the operator to periodically risk assess all measures on site to prevent emissions to soil and groundwater. This should include both management measures and physical measures.

Operators must have a management system, including inspection and maintenance of all measures on site to prevent emissions e.g. tanks, bunds, procedures etc, that provides adequate records of how the soil and groundwater have been protected throughout the life of the permit, until the end of operations under the permit.

Section 6.3.1 of IED-TG-02 provides further guidance on the physical factors to be considered. Guidance on the management factors related to surveillance and maintenance of measures has been developed for inspectors under the COMAH regulatory regime, notably post-Buncefield incident. Of particular use to both inspectors and operators is the CIRIA Guidance C736*.Containment systems for the prevention of pollution 2014, (formerly CIRIA 164)

APPENDIX 1

Relevant Articles of Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (IED)

Article 3

(2) 'pollution' means the direct or indirect introduction, as a result of human activity, of substances, vibrations, heat or noise into air, water or land which may be harmful to human health or the quality of the environment, result in damage to material property, or impair or interfere with amenities and other legitimate uses of the environment;

Article 11

Member States shall take the necessary measures to provide that installations are operated in accordance with the following principles:

(a) All the appropriate preventive measures are taken against pollution;

(b) the best available techniques are applied;

(c) no significant pollution is caused;

(h) The necessary measures are taken upon definitive cessation of activities to avoid any risk of pollution and return the site of operation to the satisfactory state defined in accordance with Article 22.

Article 22. 2. Where the activity involves the use, production or release of relevant hazardous substances and having regard to the possibility of soil and groundwater contamination at the site of the installation, the operator shall prepare and submit to the competent authority a baseline report before starting operation of an installation or before a permit for an installation is updated for the first time after 7 January 2013.

3. Upon definitive cessation of the activities, the operator shall assess the state of soil and groundwater contamination by relevant hazardous substances used, produced or released by the installation. Where the installation has caused significant pollution of soil or groundwater by relevant hazardous substances compared to the state established in the baseline report referred to in paragraph 2, the operator shall take the necessary measures to address that pollution so as to return the site to that state. For that purpose, the technical feasibility of such measures may be taken into account.

Article 14

1. Member States shall ensure that the permit includes all measures necessary for compliance with the requirements of Articles 11 and 18.

Those measures shall include at least the following:

(a) emission limit values for polluting substances listed in Annex II, and for other polluting substances, which are likely to be emitted from the installation concerned in significant quantities, having regard to their nature and their potential to transfer pollution from one medium to another;

(b) appropriate requirements ensuring protection of the soil and groundwater and measures concerning the monitoring and management of waste generated by the installation;

(e) appropriate requirements for the regular maintenance and surveillance of measures taken to prevent emissions to soil and groundwater pursuant to point (b) and appropriate requirements concerning the periodic monitoring of soil and groundwater in relation to relevant hazardous substances likely to be found on site and having regard to the possibility of soil and groundwater contamination at the site of the installation;

Article 16

2. The frequency of the periodic monitoring referred to in Article 14(1)(e) shall be determined by the competent authority in a permit for each individual installation or in general binding rules.

Without prejudice to the first subparagraph, periodic monitoring shall be carried out at least once every 5 years for groundwater and 10 years for soil, unless such monitoring is based on a systematic appraisal of the risk of contamination.

PPC 2012 Schedule 1 conditions: general provisions

23. (1) SEPA must include in a permit for—

(a)a Part A installation the conditions SEPA considers appropriate—

(i)to comply with paragraph (2), and

(ii)to ensure, when taken with regulation 22, a high level of protection for the environment as a whole taking particular account for that purpose of the general principles in regulation 21, and

(b)a Part B installation or any mobile plant, the conditions SEPA considers appropriate, when taken with regulation 22, for the purpose of preventing or, where that is not practicable, reducing emissions into the air, taking particular account for that purpose of the general principles set out in regulation 21(2).

(2) A permit for a Part A installation must include conditions—

(a)aimed at minimising long distance or trans-boundary pollution,

(b)ensuring, where necessary, appropriate protection of the soil and groundwater including requirements for the regular maintenance and surveillance of measures taken to prevent emissions to soil and groundwater,

(c)ensuring, where necessary, appropriate monitoring and management of waste produced by the installation,

(d)setting out the steps to be taken prior to the operation of the installation and after the definitive cessation of operations,

(e)relating to any period when the installation will not operate normally, including as required conditions relating to start up and shut down operations, leaks, malfunctions, momentary stoppages and definitive cessation of operations,

(f)setting out suitable emission monitoring requirements specifying measurement methodology, frequency, and evaluation procedure, including in particular—

(i)appropriate requirements in respect of the surveillance of measures taken to prevent emissions to soil and groundwater,

(ii)appropriate requirements in respect of the periodic monitoring of soil and groundwater in relation to relevant hazardous substances likely to be found on the site, having regard for that purpose to the possibility of soil and groundwater contamination at the site,

(iii)ensuring, where regulation 25(7) applies, that results of emission monitoring are available for the same periods of time and for the same reference conditions as for the emission levels associated with the best available techniques,

(g)requiring the operator to supply SEPA regularly, and at least annually, with—

(i)the results of the monitoring of emissions, and

(ii)the other required data that enables SEPA to verify compliance with the permit conditions, and

(iii)where regulation 25(7) applies, a summary of the results of emission monitoring which allows a comparison with the emission levels associated with the best available techniques,

(h)requiring the operator to inform SEPA, without delay, of any incident or accident significantly affecting the environment, and

(i)in respect of assessment of compliance with the emission limit values.

(3) For the purposes of paragraph (2)(f)—

(a)emission monitoring requirements must where applicable be based on conclusions on monitoring as described in BAT conclusions, and

(b)periodic monitoring of—

(i)groundwater must be carried out at least every 5 years, and

(ii)soil must be carried out at least every 10 years,

unless such monitoring is based on a systematic appraisal of the risks of contamination of groundwater and soil.

APPENDIX 2 – Sources of information to help clarify whether substances are hazardous

Sources of information to help clarify whether substances are hazardous include: the classification and labelling inventory (http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database), information on substances registered under the REACH regulation

(http://echa.europa.eu/web/guest/information-on-chemicals/registered-substances) and the OECD chemical database (http://www.echemportal.org/echemportal/index?pageID=0&request_locale=en).

PPC 2012 refers to "Relevant Hazardous Substances" and defines Hazardous Substances as substances or mixtures as defined in Article 3 of the Hazardous Substances Regulation. REGULATION (EC) No 1272/2008, 16 December 2008, on classification, labelling and packaging of substances and mixtures)

Article 3 refers the reader to Annex 1 Parts 2 to 5. The following provides a summary of the main classes of substances and mixtures which are referred to in Parts 2 to 5 of Annex 1. The reader is directed to the full text of the EC Regulations for a full explanation of the classes.

Part 2 – Physical Hazards

2.1 Explosives
2.2 Flammable gases
2.3 Flammable aerosols
2.4 Oxidising gases
2.5 Gases under pressure
2.6 Flammable liquids
2.7 Flammable solids
2.8 Self-reactive substances and mixtures
2.9 Pyrophoric liquids
2.10 Self-heating substances and mixtures
2.11 Substances and mixtures which in contact with water emit flammable gases
2.12 Oxidising liquids
2.13 Oxidising solids
2.14 Organic peroxides
2.15 Corrosive to metals

Part 3 – Health Hazards

3.1 Acute toxicity
3.2 Skin corrosion/irritation
3.3 Serious eye damage/eye irritation
3.4 Respiratory or skin sensitisation
3.5 Germ cell mutagenicity
3.6 Carcinogenicity
3.7 Reproductive toxicity
3.8 Specific target organ toxicity – single exposure
3.9 Specific target organ toxicity – repeated exposure
3.10 Aspriation hazard

Part 4 – Environmental Hazards

4.1 Hazardous to the aquatic environment

Part 5 – Additional EU Hazard Class

5.1 Hazardous to the ozone layer

APPENDIX 3 – Aide Memoirs Determining Monitoring Frequency

AIDE MEMOIR 1 FOR DETERMINING SOIL AND GROUNDWATER MONITORING FREQUENCY – LIKELIHOOD OF RELEASE

	CATEGORY 1 : 5 Yearly – Groundwater 10 Yearly – Soil		**CATEGORY 2**		**CATEGORY: 3-6 Monthly – Groundwater 5 Yearly - Soil**	
Containment						
Above or below ground storage, transfers, infrastructure, tanks, pipework, drains, sumps	All infrastructure above ground or in secondary containment. Bund floor extends laterally beneath storage/effluent tanks and sumps and all joints in the bund floor are sealed and contain waterstops. IBC's, drums etc are located in a bund or on concrete hardstandings and the bund floor / hardstandings are sealed and contain waterstops. All pipework and drains containing potential pollutants are either above ground and capable of being inspected, or located in secondary containment channels (or are sleeved) such that releases do not go to ground. Sumps and drains are installed with secondary containment		Infrastructure below ground or no secondary containment Some repairs or improvements are required to the existing bunding/hardstands Drains and process pipework are in the ground and do not have secondary containment. No secondary containment of below ground tanks and sumps.		Bunding does not extend beneath storage tanks or in poor state of repair requiring significant upgrade. Tanks, IBC's, drums etc on located on a permeable surface (e.g. soil, gravel, tarmac etc) Leaking drains/process pipework in need of repair	
Hardstanding in all operational and transfer areas	Good integrity of hardstanding in areas of possible release. Concreted areas have been set to slope down to a drain or sump which is adequately sealed and has secondary containment. Hardstanding is kerbed and the kerbs are sealed to contain spills and to deflect any such spills to sealed, secondary contained sumps or drainage.		Mostly hardstanding in key areas; some small areas of repair may be needed to make them leak tight. Joints may need to be re-sealed if only of moderate quality,. No kerbing or kerbs not sealed so spills can go off hardstanding to permeable ground – NOTE: this would require an upgrade to ensure adequate containment.		No hardstanding or hardstanding in very poor condition – e.g. cracked, open joints etc. Tarmac, compacted ground, block pavement, gravel. Upgrade to site surface required.	
Surveillance measures and alarms	All secondary subsurface containment, sumps, drains etc alarmed (or equivalent) to indicate release		No alarms in secondary containment, drains, sumps etc		None	
Standard of containment infrastructure, testing and repair	Construction largely compliant with CIRIA 736 e.g. Regular inspection and testing of containment, including tanks, sumps and drains. Planned preventative maintenance. Demonstrable adherence to operational procedures. Operational procedures are up to date. Regular (daily) inspections of bunds, sumps, etc… to confirm no releases.		Construction NOT largely compliant with CIRIA 736 . Infrequent or reactive inspection/maintenance - insufficient to catch leak timeously. Poor/incomplete operational procedures. Insufficient demonstration of adherence to existing operational procedures. Inadequate bund/sump inspection frequency to confirm no releases.		Poorly maintained/constructed bunds Breezeblock or block work bund – especially single skin No or ad-hoc inspection and/or maintenance regime.	
Whether any emission could be identified and rectified immediately.	Any release would be readily identifiable by visual inspection and contained in the event of a leak e.g. horizontal / bullet tank on tank cradle and in bund e.g • Storage tank on concrete plinth which extends laterally beneath the full tank base (not just a ring beam) with tell tale drains into the bund. • Clear windows on the pipe sleeve to allow inspection at low points. • Alarms on secondary contained below ground sumps and drains and mechanism for inspection		Any release from the base and undersides of such a structure would NOT be readily identifiable by visual inspection as it is hidden from view. E.g • Tank seated directly on the ground, or on a ring beam (i.e around edge only) or there are no details of the tank foundation or whether the bund extends laterally beneath the tank base or below ground. • Joints to the bund floor and/or walls require repair. • Sumps, pipelines and drains are below ground, and not secondary contained. Slow leaks would not be readily detected.		Even if identified quickly it is likely that emissions would enter the ground.	

Note 1: See ciria 736 ch 2.3 for assistance with assessing source – pathway – receptor Note 2: See ciria 736 ch 5 for assistance with assessing containment measures
Note 3: IBC = intermediate bulk container – typically refers to 1000 litre plastic cube in a metal cage, but also includes metal and plastic drums, containers etc

Instructions for using the LIKELIHOOD OF RELEASE TABLE

Step 1) Review the site information, taking a precautionary approach, and tick the appropriate box(es) and annotate the pro-forma table.
Step 2) If Category 3 is ticked in any row, upgrading is required and a monitoring frequency of 3-6 monthly for groundwater is to be applied. Verify the soil assessment to check whether a shorter frequency than 5 years is required for soil monitoring.
Step 3) For Category 1 sites, sense check, then allocate 5 yearly groundwater and 10 yearly soil monitoring frequency.
Step 4) For Category 2 sites (and sites which straddle Categories 1 and 2) undertake the Consequence assessment, annotating the pro-forma table.
Step 5) Site specific Soil Assessment – consider whether a shorter frequency of soil monitoring is required, for example, where there is a high likelihood of spills migrating via soils or groundwater to off-site receptors such as protected habitats, terrestrial ecosystems, residential areas, built areas, land under cultivation etc
Step 6) Sense check, then allocate monitoring frequency

AIDE MEMOIR 2 FOR DETERMINING SOIL AND GROUNDWATER MONITORING FREQUENCY – CONSEQUENCE ASSESSMENT

	CATEGORY 2(a) : 3- 5 Yearly – Groundwater, 5-10 Yearly - Soil		**CATEGORY 2 (b): 1 – 3 Yearly Groundwater, 5- 10 yearly soil**	
RHS				
Volume (inventory held, total annual usage and container size)	Moderate volume – Single or small number of bulk storage tanks, appreciable quantity IBC's, drums etc		Large volume (multiple bulk storage tanks), large number of IBC's or drums	
Concentration	Typical industrial strength for the chemical		Concentrated. Neat form or concentration above typical industrial strength.	
Toxicity	Low toxicity i.e. need to release large quantity to cause a significant impact.		Toxic/very toxic: release of small quantity can result in significant impact.	
Persistence	Rapid degradation and so is not persistent (long lived) in the environment. No harmful or persistent breakdown products. Doesn't bio-accumulate, or bio-magnify in food chain		Slow degradation and thus more likely to persist in the environment. May degrade to harmful/persistent breakdown products.Bio accumulates and/or biomagnifies in food chain	
Mobility	Limited mobility – eg. thick viscous liquids, substances in heated tanks which solidify readily on release Limited solubility in water		Liquid at ambient temperature - flows easily Solids that are readily leachable/soluble in water	
Environmental Setting				
The ease and speed with which pollutants could move in ground	Low permeability soils e.g. clays, silty clays. Soil structure should not be prone to cracking or fracturing Services located away from areas of potential release, or located above ground so a release would be identifiable by visual inspection.		Permeable soils – sands, gravels, silty sands etc. Presence of buried services, drains, etc in areas of potential release, which could allow or accelerate migration via the pipe bedding material. Such migration may not be readily identifiable by visual inspection.	
Travel times to and in groundwater,	Deep ground water typically below low permeability soil Slow groundwater flow. No subsurface preferential pathways e.g. backfill pipe beds, services, foundations etc.… No soakaways.		Near surface groundwater (within 2-3m of surface)? Fast flowing groundwater Presence of below ground preferential pathways e.g. pipe bedding, drains, below ground structures, services, etc… which could act as a conduit. Presence of soakaways.	
The likelihood and duration of severe consequences	Effect of release is short lived with no significant impact. Environment readily recovers.		Long term impact, slow environmental recovery.	
Presence and proximity of vulnerable receptors, e.g environmental designations, sensitive neighbouring land use	No designated ecosystems, designated water bodies or abstractions which could be adversely affected by a polluting release within close proximity. For more distant designations, an unfeasibly large release would have to take place to have an effect on the receptor at such a distance.		One or more designated ecosystems, designated water bodies or abstractions etc are located within close proximity and could be adversely affected by a polluting release. For more distant designations, groundwater modelling shows that impacts from a significant undetected release are likely.	

PROFORMA 1 – LIKELIHOOD OF RELEASE

Containment		**1**	**2**	**3**
Above or below ground Secondary Containment	Tanks Pipework Drains Sumps			
Hardstanding	Integrity Extent Joints/Seals Kerbing			
Surveillance measures and alarms	Secondary subsurface containment Sumps Drains			
Standard of containment infrastructure, testing and repair	Construction Inspection and Testing frequency Maintenance			
Whether any emission could be identified and rectified immediately.	Extent to which release would be readily identifiable and contained Tank/bund layout Pipe sleeve windows Alarms			

PRO FORMA 2 - CONSEQUENCE ASSESSMENT

RHS		**2(a)**	**2(b)**
Volume (inventory held, total annual usage and container size)	Volume No of tanks/IBCs/drums etc		
Concentration			
Toxicity			
Persistence	Degradation rate Breakdown products. Bio-accumulation/magnification		
Mobility	State Mobility Solubility Leachability		
Environmental Setting			
The ease and speed with which pollutants could move in ground	Soil permeability Below ground services etc		
Travel times to and in groundwater,	Depth to groundwater Rate of groundwater flow. Subsurface preferential pathways Soakaways.		
The likelihood and duration of severe consequences	Duration of impact		
Presence and proximity of vulnerable receptors, e.g environmental designations, sensitive	Designated ecosystems		

neighbouring land use	Designated water bodies Abstractions Neighbouring Land Use		

APPENDIX 4 MONITORING FREQUENCY – WORKED EXAMPLES

Example 1.
Scenario: A waste processing site constructed to provide services to the oil industry from the early years of the "oil boom" (1970's) to the present day. Historically, there have been a number of spills, typically overfilling of above ground brick-bunded tanks when receiving deliveries via flexible hoses. There is visible hydrocarbon staining of the site hardstand in process areas. The hardstanding and drainage infrastructure is ageing and cracked. Delivery hoses and site vehicle fill points are not within bunded areas. The site is partially surfaced with compacted soils and gravel. This is underlain by sandy soils.

Risk Rating Rationale:

1. Relevant hazardous substances (RHS) are used on site in quantity (eg. Diesel, TPH, PAH).
2. Releases are likely due to handling practices, poor pollution control measures, filling taking place outwith bunded areas, hardstand insufficient to prevent release to soil, poor bund construction etc. and apparent soil vulnerability, based on identified historical and recent contamination
3. Releases are likely to cause contamination given the nature of the sub-surface
4. Major infrastructure improvements and an upgrade condition are required.

   Quarterly (3-monthly) groundwater monitoring will be justified, given the high likelihood of release of RHS to ground and the difficulty of detecting such a release due to the drains and presence of hardstand.

   The inspector judges that 3-5 yearly soil monitoring is justified.

   The monitoring frequency will be reviewed once the upgrades are complete

Example 2.

Scenario: A new oil and gas installation is being constructed at a remote greenfield location. Very large quantities of relevant hazardous substances are being handled. There is a high standard of construction, with primary, secondary and tertiary containment designed-in from the ground up. Most containment, sumps, drains, process pipework is above ground and alarmed. There is one unlined interceptor that receives large volumes of run-off that may be lightly contaminated. There is a high standard of operational site management, daily inspections etc. The likelihood of a release that would not be immediately detected is very low.

However there are several statutory water environment and protected ecosystem designations adjacent to the site. Groundwater travel times are relatively slow and it is concluded that a 5 year monitoring frequency would be adequate to detect any releases prior to any significant migration.

The operator has submitted a detailed monitoring plan positioning the boreholes where unmitigated risk is highest.

For soils, the inspector considers the baseline report findings (non-detects), no historic polluting uses of the site as it was a green field location, and the high standard of construction, site management and pollution control systems etc., indicates that a 10 yearly sampling frequency is reasonable.

Example 3.

Scenario: A waste processing site servicing the oil industry has been operational since 2005. It is broadly the same process as Example 1. The site was constructed on greenfield land and sampling has confirmed it has not been polluted. No reported incidents of spills or overfilling of tanks at delivery (all fixed delivery pipework, within bunds, no flexible hoses). There are no visible or olfactory observations of hydrocarbons in process areas or outdoors. The impermeable surfaces are of a high standard throughout the site. Containment is sub-surface. All installed containment, including site interceptors and drains undergo routine integrity testing and are alarmed. There is a vehicle diesel fill point which is contained within a bunded area.

Rationale:

1. RHS are used on site (eg. diesel).
2. There is a possibility of RHS being released, in particular because much of the containment is sub-surface
3. Due to the quantities involved a release could cause contamination.
4. The inspector judges that 5-yearly groundwater monitoring will be justified, given the environmental setting, history of no pollution incidents and the high standard of management etc. A “sentinel” monitoring strategy will be employed at the downstream boundary of the operational area of the site to provide a watching brief for any fugitive release to groundwater from areas of greatest risk. The sentinel strategy is considered appropriate because operational areas of the site are completely hard-surfaced to a high standard, because the risk of emission is low and because a sentinel approach is considered the best way of detecting fugitive releases from a large area.

Example 4.

Scenario: The process involves food & drink production (vegetable matter processing - soup) and has been operating since 2005. The site was constructed on greenfield land. There is one small heating oil (diesel) tank on site, tank and fill points contained within an above ground bunded area. The inspector has had no reported incidents of spills or overfilling of the tank at delivery (flexible hose). A high standard of impermeable surfaces throughout the site, in operational areas as well as outdoor areas. The site interceptor and drains are double skinned and undergo routine integrity testing. Groundwater is deep and is protected by a substantial thickness of clay which has a high organic matter content and is likely to be able to adsorb limited amounts of hydrocarbon. The environmental setting is of low vulnerability.

Rationale:

1. RHS are used on site (diesel).
2. This physical and management controls are excellent; a release is unlikely.
3. Should there be a release the volumes would be low and would not migrate to groundwater.
4. Groundwater monitoring is not required. 10 yearly soil monitoring is appropriate.

Example 5 – Intensive Agriculture

Chemicals such as disinfectants and herbicides have been stored in a bunded, fire proof and locked chemical store adjacent to the farm office. There have been no incidences involving spillage of chemicals and there is no evidence of spillage or contamination around the chemical store.

There is a large above ground slurry store (metal, double skinned, on cast concrete pad, leak detection system meets SSAFO standards. Yard and roof run-off water (lightly contaminated with ammonia) is diverted for treatment in an unlined swale. The area is underlain by sands and gravels, groundwater is shallow and this is a nitrate vulnerable zone.

1. RHS are present on site (diesel, disinfectants, herbicides, ammonia).
2. Due to the nature of containment (integrity tested, above ground location) it is unlikely that there will be a release of slurry or chemicals. There is a possibility of RHS (ammonia) being released through the base of the swale.
3. Monitoring of the swale is required to confirm that the swale is effective in treating the run-off and is not releasing ammonia to ground/groundwater.
4. Annual groundwater monitoring for ammonia will be undertaken in the vicinity of the swale
5. Soil monitoring is not required because groundwater monitoring should be effective in detecting any releases from the base of the swale and the practical constraints associated with sampling beneath the swale.

Example 6 – Timber Treatment

The timber treatment chemicals are stored in a secure bunded area which is located inside on a good quality concrete floor. The timbers are treated with biocides then left to dry on an external kerbed concrete slab so biocides will run-off onto the slab. The slab is in good condition and well maintained but there is no secondary containment. The hardstanding will be susceptible to damage from heavy machinery placing the logs and its integrity may also deteriorate over time due to pooling of run-off on the slab. Inspection will be constrained by the presence of the slab and the logs. In general, biocides can be persistent in soils. There is a surface water body adjacent to the site. Records available for the last 50 years indicate that the river has not flooded in this time.

1. RHS are present on site (biocides).
2. Due to the nature of containment (integrity, above ground location, no secondary containment, potential for damage) it is possible that there will be a release of RHS and this may be difficult to detect.
3. 5 yearly groundwater monitoring and 10 yearly soil monitoring is required.

Example 7 Dairy

<u>Internal</u>

In the dairy itself all infrastructure sits above a suspended concrete floor slab over a basal concrete slab
Basal slab is constructed with waterbars in the joints and is coated with chemi-resistant finish which is replaced annually
Spills will not be released to ground and can be readily identified and cleaned up.

No soil/groundwater testing is required for internal areas.

<u>External</u>

Tankers discharge milk to large silos
Post-delivery (and daily) area is hosed down with caustic spray
Poorly maintained, some evidence of corrosion of concrete around drains and gullies, some sealant missing between floor slabs (minor)
Therefore large, frequent volumes of weak chemicals present risk of penetrating ground via unsealed joints and corroded drains.
Such emissions would not be readily identifiable

Drains

Below ground in the tanker discharge area
Drains to open channel carrying all site effluent to Treatment plant
Operational all day all year therefore no opportunity for inspection and any emissions would go undetected

External area/ drains area require annual groundwater monitoring, 10 yearly soil monitoring.
Permit needs to include annual inspection of drainage network.

Site Environmental Setting

River downgradient
Overlies drinking water supply (aquifer)
Abstraction within 50m downstream

Example 8 Plant Maintenance Area

Mercury vacuum pumps are used and maintained (annually) on site
Maintenance involves removal and replacement of mercury and cleaning with solvents.
Historically, maintenance involved decanting mercury into a jug and flushing the pump with solvent and water. This was done over a sink with the small amount of effluent going to drain. Condition of drains is not known.
Three yearly groundwater and 5 yearly soil monitoring required as there is a possibility of an infrequent and small quantity, but undetected, below ground release.

The maintenance process has been upgraded.
Maintenance takes place indoors in a room with a sealed concrete floor which has a liner installed above the concrete which lips up the wall providing some bunding.
The sinks have been disconnected from the drains and now discharge directly to sealed waste containers in the room.

All materials are contained. There is no possibility of a release. Monitoring is not required.

APPENDIX 5 – Sample Monitoring Plan

Suggested Contents of a Soil and Groundwater Monitoring Plan

1. Introduction
1.1. Purpose
1.2 Objectives

2. Environmental Setting
2.1. Geology
2.2. Hydrogeology
2.3. Hydrology
2.4. Soil type
2.5. Habitat and land use

3. Summary of Operational Installation Design
3.1. Operations
3.2. Control Measures

4. Conceptual Site Model (CSM)
4.1. Sources
4.2. Pathways
4.3. Receptors

5. Rationale for the Monitoring Borehole Network
5.1. Objectives
5.2. Borehole siting
5.3. Monitoring Frequency - *See section 4 of IED-TG-42*

6. Proposed Boreholes
6.1. Borehole Design *~ to correctly specify depths, positions around tanks & bunds, genuinely upgradient locations etc, it is essential to refer to CSM and BS 10175:2011, BS 5930.*

7. Rationale for the Soil Monitoring
7.1. Objectives
7.2. Sampling siting
7.3. Monitoring intensity and frequency

8. Soil Monitoring specifications
8.1. Sampling depth
8.2. Time of sampling
8.3. Materials and tools used for sampling
8.4. Sample quantity
8.5. Cross-contamination
8.6 Barriers to sampling
8.7. Transport and Storage of samples

9. Reporting

Appendices
1. Table of relevant hazardous substances (RHS) to be analysed
2. Table of proposed soil and groundwater monitoring suites and frequency
3. Plan of locations of proposed groundwater monitoring boreholes and soil sampling

Suggested Contents of a Soil and Groundwater Monitoring Plan
With reference to: [**Systematic Appraisal document Y**] and/or [**Baseline Report X**]

1. Introduction
1.1. Purpose
~ To present the rationale for the plan and implementation details for periodic monitoring of soil and groundwater at the installation.

1.2 Objectives
~ To locate boreholes in appropriate locations to provide early warning of any relevant hazardous substances within the groundwater to enable timeous action to be taken;
~ To explain how the installation operator will comply with the soil & groundwater monitoring requirements of the IED as implemented by PPC 2012.

2. Environmental Setting
2.1. Geology *~ superficials and solid bedrock*
2.2. Hydrogeology *~ aquifer productivity & vulnerability; groundwater flow direction & speed, groundwater protected designations*
2.3. Hydrology *~ surface water and surface water protected areas designations*
2.4. Soil type *– Series and association from soil maps*
2.5. Habitat and land use *– Description of land use. Protected area designations. Description of habitat if semi-natural vegetation is present*

3. Summary of Operational Installation Design
3.1. Operations *~ description of main process areas; RHS used in those areas; site drainage and surface water management, utility and service ducts (preferential pathways)*
3.2. Control Measures *~ use of Best Available Techniques (BAT) to prevent releases to soil and groundwater.*

4. Conceptual Site Model (CSM)
4.1. Sources *~ on-site, off-site*
4.2. Pathways *~ pre-development and post-development including preferential pathways*
4.3. Receptors *~ focus on soil and groundwater; note any others*

5. Rationale for the Monitoring Borehole Network
5.1. Objectives ~
- *Demonstrate the site's compliance with the requirements of PPC 2012*
- *Confirm the effectiveness of the pollution control measures in place*
- *Provide early warning of the presence of RHS within the groundwater for prompt corrective action*

5.2. Borehole siting
Borehole locations should take account of any available BREF, BATC reports etc, and:
- *Potential sources of contamination by RHS in each process area;*
- *The location of sensitive receptors;*
- *Groundwater flow direction & speed to specify location of "early warning" points;*
- *The availability of upgradient control boreholes to monitor background quality;*
- *Access and health & safety considerations; avoid creation of new pathways.*

5.3. Monitoring Frequency
See section 4 of IED-TG-42

6. Proposed Boreholes
6.1. Borehole Design *to correctly specify depths, positions around tanks & bunds, genuinely upgradient locations etc, it is essential to refer to CSM and BS 10175:2011, BS 5930.*

7. Rationale for the Soil Monitoring

The soil monitoring shall take into account the nature, concentration, distribution, and variation of the contaminants (and additional parameters) to be analysed at the sampling location. In addition, potential changes of contaminants over time (e.g. caused by migration of contaminant, atmospheric deposition, land/soil use (including turbation caused by soil organisms) caused by the operation itself or from outside factors) has to be taken into consideration.

7.1. Objectives

- *Provide information on background concentrations of pollutants*
- *Demonstrate the site's compliance with the requirements of PPC 2012*
- *Confirm the effectiveness of the pollution control measures in place*
- *Provide early warning of the presence of RHS within the soil environment for prompt corrective action*

7.2. Sampling siting

- *Define sample area(s) based on transfer path to identify likely impacted areas*
- *Detailed information on how sites were selected should be provided*

7.3. Monitoring intensity and frequency

- *Boundary of the area(s) where samples will be taken (map with NGRs) (this area might be smaller than the area identified under 7.2)*
- *Specify and explain which type of sample (single or composite sample, disturbed or undisturbed sample) shall be taken*
- *Specify and explain the sampling pattern (e.g. random, systematic, hot spot)*
- *Specify and explain the total number of samples that will be analysed from each sampling area*
- *Specify and explain the required frequency of taking soil samples*

8. Soil Sampling Specifications

8.1. Sampling depth

Sampling depth will depend on where the contaminant(s) is expected to be and how it/they move through the soil.

- *Specify and explain if and why a given soil depth (e.g. 0-15 cm and 15-30cm) or identifiable soil horizon (e.g. A horizon) shall be sampled.*
- *Specify whether or not humus and/or litter layers shall be included in the sampling and explain why they have been included/excluded. List measures that are to be taken if humus litter layers are to be excluded.*

8.2. Time of sampling

- *Specify if timing for taking soil samples has to be restricted to certain periods of the year or certain weather/soil moisture conditions.*

8.3. Materials and tools used for sampling

- *Specify the sampling tool to be used; it has to be suitable for the task (sample type, soil depth, contamination type/parameters to be analysed for, minimising cross-contamination)*
- *Specify the type of container used for transporting the sample; it must be suitable for the task (volume, material, leak tightness)*
- *Samples should be uniquely labelled, clearly identifiable and have accompanying paperwork*

8.4. Sample quantity

- *Specify the amount of soil material to be taken (minimum determined by need for all analysis, maximum to reduce transport cost)*
- *Specify methods applied if soil amount taken shall be reduced on site to reduce transport costs (might be necessary when composite samples are taken)*

8.5. Cross-contamination

- *Provide detailed information on measures to be taken to prevent cross-contaminations between samples*

8.6. Barriers to sampling

- *Define predetermined rules if sampling is not possible at the given spot*

8.7. Transport and Storage of samples

- *Specify the conditions to be kept during transport and before analysis (e.g. temperature range, need of preservations) and how they will be achieved*
- *Specify the maximum space of time between sampling and analysis*

9. Reporting

Describe how the monitoring and results will be reported. The report shall contain

- *Analytical Results*
- *Date,*
- *Relevant observations (e.g. soil horizons, weather, groundwater level, pH, T, K*
- *Changes from the sampling/monitoring strategy*
- *Interpretation*
- *Actions)*

Appendices

1. Table of relevant hazardous substances (RHS) to be analysed
2. Table of proposed soil and groundwater monitoring suites and frequency
3. Plan of locations of proposed groundwater monitoring boreholes and soil sampling

APPENDIX 6 - EXAMPLES OF CONTAINMENT SYSTEM INTEGRITY FAILURES

Seepage from previously repaired joint and wall/slab joint where bund wall is not sealed to slab

Poor bund construction (blockwork, not tied into base, no tie wires between blocks, blocks hollow – weak)

Unsealed or poorly sealed joints, penetration of bund wall