

SEPA Technical Guidance Note

***Hydrogeological Risk Assessment for Landfills
and the
Derivation of Control and Trigger Levels,***

Version 2.12



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1.0 INTRODUCTION

1.1 Purpose

This document provides guidance for SEPA officers on the technical requirements for hydrogeological risk assessments and the derivation of control and trigger levels. These requirements arise from the Groundwater Directive and Landfill Directive. This document also refers to and takes account of the requirements of the Water Framework Directive, which has been transposed into Scottish legislation in the Water Environment and Water Services (Scotland) Act 2003. This document will also be of use to landfill operators and designers as guidance to the SEPA's requirements for risk assessment submissions. The procedures described may be applied to both existing and new landfill sites.

1.2 Scope and Applicability of Guidance

The application for a permit to operate a landfill site includes, amongst other things, requirements to submit a hydrogeological risk assessment and propose control and trigger levels for groundwater quality. This document provides guidance on the hydrogeological risk assessment and the derivation of control and trigger levels. This guidance is specific to activities controlled by the Landfill (Scotland) Regulations 2003 and is not applicable to other activities.

2.0 THE RISK ASSESSMENT PROCESS

2.1 Introduction

The SEPA guidance document entitled '*A Framework for Risk Assessment for Landfill Sites, The Geological Barrier, Mineral Layer and the Leachate Sealing and Drainage System*' ([Geological Barrier Guidance](#)) provides an overview of how a hydrogeological risk assessment should be carried out to demonstrate compliance with the Groundwater Directive and Landfill Directive. In particular, that document provides guidance in relation to Annex I of the Landfill Directive. It is vital that readers of this guidance should refer to that document when carrying out hydrogeological risk assessments. The Landfill Regulations and the SEPA document *Guidance on Monitoring of Landfill Leachate, Groundwater and Surface Water* ([Landfill Monitoring Guidance](#)) should be referred to for details and advice on monitoring requirements.

2.2 Structure

The hydrogeological risk assessment must include a conceptual model and a risk assessment. These are dealt with separately below. In many cases it will be necessary to refer to other sections of the application submission for relevant information on leachate management, liner construction and site investigation information.

3.0 THE RISK ASSESSMENT PROCEDURE

The risk assessment process should be structured, transparent and practical. The government document, 'Guidelines for Environmental Risk Assessment and Management – Revised Departmental Guidance, DETR 2000', describes a tiered approach where the level of effort is proportional to the magnitude and complexity of the risks. This framework should be used to guide the risk assessment process. The framework identifies a number of steps that should be followed including:

- The development of a robust conceptual model
- The need to screen and prioritise risks
- The need to consider risks post-closure
- The need to match risks to the potential impact
- The need for appropriate risk management measures (contingency plans)
- The iterative nature of the process

4.0 THE CONCEPTUAL MODEL

The development of a conceptual model involves understanding the design, construction and operation of the landfill, the nature of baseline environmental conditions as well as identifying possible sources, pathways and receptors, and processes that are likely to occur along each pathway.

The importance of a rigorous and realistic conceptual model cannot be overstressed since it underpins the whole risk assessment process. A poor model will almost certainly result in a false estimation of risk.

The model should be evaluated, developed and refined throughout the assessment process, as new information comes to light or as understanding of the system is improved.

Conceptual model development is not a "one off" procedure for the risk assessment. Data gathering continues throughout the lifetime of the site. The model should be periodically examined in the light of the new data with a view to revision if necessary. There are three key stages in the development of a conceptual site model:

- a desk study and site reconnaissance followed by initial model development
- site investigations to test and refine the initial model, and;
- environmental monitoring that validates the model or indicates revision is necessary.

These stages are dealt with in subsequent sections.

4.1 The Desk Study

4.1.1 Waste Type and Leachate Characterisation

The first consideration of the risk assessment should be the landfill and in particular the likely volume and quality of leachate that will be produced on site. This will depend upon the waste type and the landfill design, including any leachate collection and treatment facilities. For sites already in operation, information on the actual leachate quality and waste types deposited should be used. For those sites not yet in operation the source term may be characterised by reference to the proposed waste types and appropriate research documentation. Alternatively, leachate quality from sites accepting similar waste can be considered. Wherever possible, representative samples of leachate from either the landfill or representative waste streams should be tested and the analysis based upon a fully justified and targeted inventory of List I and II groups of substances identified from the types of waste deposited. Previous site investigation works may provide additional information for existing sites.

Where predictions of leachate quality are being made, it should be borne in mind that:

1. The assessment considers the whole life cycle of the landfill site
2. There will be compositional changes in leachate due to long-term degradation of the waste
3. Site specific data is limited to assessment of past and current performance and may not properly reflect future behaviour and leachate quality.

4.1.2 The Environmental Setting and Contaminant Movement

Following definition of the source term, the risk assessment should describe the environmental setting and the potential for movement of substances away from the site. Thought should be given to:

1. Physico-chemical properties of the leachate including:
 - miscibility/solubility of leachate components in water
 - potential for sorption onto strata within the unsaturated and saturated zones
 - potential for degradation given the specific site conditions
2. The underlying geological and hydrogeological conditions including:
 - nature, thickness and depth of the soil and drift units
 - presence or absence of mineral workings
 - presence of preferential flowpaths
 - hydraulic conductivity/effective porosity/storage characteristics of the aquifer
 - predominant flow mechanism
 - location, orientation and density of any fissures

- hydraulic gradient
- groundwater levels, including seasonal and other variations
- rebounding groundwaters and any other predicted future changes in the hydrogeological system
- direction of groundwater flow
- groundwater quality, including possibility of historic contamination
- groundwater dependant receptors, such as abstractions or surface waters hydraulically connected with groundwater, and their sensitivities
- attenuation capability e.g. Half-lives of contaminants, cation exchange capacity and fraction of organic carbon values. If attenuation properties are being taken into account then they must be quantified through site-specific testing of the materials at the site.

4.1.3 Information Sources

The following sources may provide useful information:

- The British Geological Survey, Edinburgh for geological maps and borehole information
- Local Authorities for information relating to private and some public water supplies
- Scottish Water for information relating to public water supplies
- UK Meteorological Office for meteorological data
- Scottish Natural Heritage for information on sites of ecological importance

4.1.4 The Initial Conceptual Model

The information gathered in the desk study, taken together, represents ***the initial conceptual model***. The model should be used to identify uncertainties in defining the system and determine the need for and scope of the subsequent site investigations, as well as containment and engineering measures.

4.2 The Site Investigation

The initial conceptual model developed from the desk study will usually identify the need to obtain additional information through a site investigation. In such cases, the report should describe an appropriate site investigation strategy. The strategy should address data deficiencies, thereby enabling the conceptual model to be validated or refined. The investigation should be based on sound knowledge of the proposed activities to maximise the value of the data generated. The applicants should discuss the outcomes of a desk study and any proposals for further work with SEPA prior to undertaking the site investigation and refer to BS5930 1999 – Code of Practice for Site Investigations for further information.

The report should contain details of the investigation which may include:

- Installation of boreholes to investigate geology and hydrogeology. Boreholes should be logged, with thickness and nature of the geological units, position of water strikes, and include construction details of the borehole, such as the position of the slotted screen. They should be sited to provide the optimum information and designed so that they provide representative samples from each horizon. Good practice will be demonstrated by the choice of single wells for monitoring each horizon, as the use of multiple piezometers can lead to problems due to lack of an effective seal between horizons. Similarly, cross contamination between horizons by inappropriate drilling techniques and well construction should be avoided. Cores may be taken to provide information on porosity and permeability etc.
- Laboratory testing of soils and rocks to determine attenuation properties such as the distribution coefficient, cation exchange capacity and fraction of organic carbon. In addition, some materials may be tested to determine the likely performance of a remoulded mineral liner.
- Hydraulic testing of boreholes to provide estimates of hydraulic conductivity of the aquifer(s).
- Geophysical testing, both down hole and non intrusive to provide further characterisation of geological conditions.
- Groundwater and surface water monitoring to provide information on groundwater level fluctuations, flow direction, hydraulic gradient, and water quality. In general monitoring should be carried out over at least 12 months, on a regular basis, to take account of seasonal fluctuations. In some circumstances, where fluctuations in water levels are critical to the landfill design, continuous water level monitoring devices may be used.
- Leachate monitoring and analysis to determine leachate levels and quality.
- Installation of leachate wells into existing waste deposits. These should have been carefully logged, recording leachate strikes. In addition drilling should be carefully designed and supervised so that it does not result in a puncture of the landfill lining system. Contingency plans should be in place in case this happens.
- In some circumstances tracer tests may be used to gain useful information on groundwater flow rates and directions.

4.3 Monitoring

The Landfill Regulations specify monitoring requirements for landfill sites. These requirements, in relation to groundwater, surface water and leachate, refer to all classes of landfill sites.

Monitoring plays an important role in providing information that will validate the conceptual model. Monitoring also provides information for other aspects of the risk assessment process including:

- Baseline data against which to compare actual or predicted impacts
- As feedback into the iterative process
- To confirm risk management control measures are working
- To determine adverse environmental impacts
- To determine that a landfill meets completion criteria

The SEPA document 'Guidance on Monitoring of Landfill Leachate, Groundwater and Surface Water, v2 July 2003, provides more detailed information.

4.4 The Final Conceptual Model for Risk Assessment

The information gathered during the procedures described above should be used to refine the initial model and decide if further investigative work is required. The end product should be a fully justified **final conceptual model**. This model represents the best interpretation of the information gathered for the purpose of the risk assessment and, as noted above, should be periodically reviewed in the light of new data. The report should represent the model by description and a series of diagrams in plan and cross section that include geology, groundwater level and flow direction information, groundwater monitoring locations, potential pathways and receptors. The detail of the model should reflect the complexity of the site. **One plan and one cross section may suffice for simple sites but more will be required to describe sites that have a number of pathways or receptors.**

5.0 THE RISK ASSESSMENT

5.1 Simple and Complex Risk Assessments

The level of risk assessment should be tailored to the potential environmental impact of the site. A simple risk assessment consists of quantitative calculations solved in a deterministic fashion using conservative parameters. These types of assessment will generally be carried out for sites which pose a low risk to the environment i.e. those where it has been demonstrated by detailed investigation and construction of a rigorous conceptual model, that one or more component of the source-pathway-receptor framework is shown to be absent.

Complex risk assessments should be undertaken for all sites where the source-pathway-receptor framework is complete. Sites controlled by the Landfill (Scotland) Regulations 2003 will typically require a complex risk assessment. The assessments should be quantitative and use stochastic (probabilistic) techniques such as the computer model LandSim. The level of assessment and the type of model used should be agreed in prior consultation with SEPA, with due consideration of the geological setting of the site. Many landfill sites where probabilistic assessments will be made include cells constructed under a regime where less rigorous construction practices were required. In such cases, cells constructed to comply with the Landfill Regulations should be assessed probabilistically. For other parts of the site, where a standard

probabilistic model cannot easily be adapted to the specific conditions, a greater emphasis will need to be placed on conceptual modelling and site characterisation through targeted ground investigation, sampling and testing schedules and well planned monitoring arrays.

5.2 Risk Assessment Requirements

The probabilistic risk assessment must be closely linked to the conceptual model. It should take account of degradation of engineering and management systems e.g. liner and cap lifetimes and leachate collection and extraction system. It should predict effects for the whole of the life of the landfill i.e. from the start of the operational phase until the landfill no longer has the potential to pose an unacceptable risk to the environment. One of the biggest variables and key areas of uncertainty is the leachate quality which will vary considerably over the life of the site. Assessment of the long term behaviour will rely heavily on predictive quality changes to the leachate source term, with measured historic and current data sets of use for the short term analysis.

Sensitivity analysis should be used to identify the parameters that have the greatest effect upon the model and site specific data should be used for those parameters where possible. For stochastic models the 95th percentile is the normal level of acceptable confidence. Priority should be given to modelling substances identified within the leachate that are included in:

- Lists I and II of the Groundwater Directive
- The List of Main pollutants given in Annex VIII of the Water Framework Directive

A copy of these may be found in Appendix I

The choice of Listed substances may be limited to a range of indicator species that will act as surrogates, as demonstrated in Table 1.

Table 1 Potential List I and List II Surrogate Substances

Category	Typical Example
Inorganic Cation	Ammonium, Potassium
Inorganic Anions	Chloride, Cyanide
Hydrophilic Organic Chemicals	Phenol
Hydrophobic Organic Chemicals	Polyaromatic Hydrocarbons
Herbicides	Mecoprop
Mobile Metallic Ions	Nickel
Less Mobile Metallic Ions	Mercury
Organo-metallic Substances	Organo-tin Compounds

This list is not definitive and the ultimate choice of modelling parameters should be based upon site specific information, i.e. waste stream and/or leachate analysis, and justified.

6.0 COMPLIANCE POINTS

The Groundwater Regulations 1998, which implemented the EC Directive 80/68/EEC (the Groundwater Directive) into UK legislation, require that there is no entry of List I substances to groundwater and that there is no pollution of groundwater by List II substances. Compliance points are needed to measure impacts, ensure performance and are of importance in gathering data to validate the risk assessment. The Water Framework Directive characterisation process has placed almost all groundwater in Scotland into groundwater bodies, which are subject to WFD status objectives. The resource potential of groundwater bodies, both present and future, and any impacts upon groundwater dependant surface waters and terrestrial ecosystems must be considered when assessing the location of compliance points.

Note: when the Groundwater Regulations are withdrawn as a result of legislative changes the principles of the Groundwater Directive will be incorporated into the replacement legislation

6.1 List I Substances

For List I substances the compliance point should be at the point of entry into groundwater i.e. the base of the unsaturated zone beneath the site. As protection of liner integrity is imperative, the monitoring location for compliance cannot be beneath the site, except in rare circumstances (e.g. if appropriate under-drainage/leak detection systems are present). The compliance point(s) for List I substances will therefore typically be a down hydraulic gradient borehole(s) directly adjacent to edge of the landfill, i.e. as close to the point of discharge as possible.

6.2 List II Substances

The compliance point(s) for List II substances will be a down hydraulic gradient monitoring borehole (s) near to the edge of the landfill. It is acceptable practice to use List I monitoring points for List II substance monitoring.

7.0 DETERMINING THE APPROPRIATE STANDARD

7.1 Standards for List I Substances

The European Directive on Groundwater (80/68/EEC) forbids:

- the introduction of certain listed substances (List I substances) into groundwater and,
- the pollution of groundwater by certain other listed substances (List II substances)

Minimum Reporting Values (MRVs) represent the smallest quantity of a substance that can be accurately determined at a given laboratory. MRVs therefore represent the maximum allowable concentration of a List I substance in groundwater that would not contravene the Groundwater Directive and hence the Landfill Regulations. Minimum Reporting Values of a number of List I substances commonly found in leachate and determined in SEPA laboratories are given in Appendix III. SEPA chemists should be consulted for substances not included in this list.

7.2 Standards for List II Substances

Environmental Assessment Limits (EAL's) can be used to define the most appropriate water quality standards for List II substances that apply to all receptors identified in the risk assessment process. Control and Trigger levels for List II substances (see below) are based upon the most stringent EAL for each substance.

7.3 Receptor Type

A receptor is that which may be affected by a change in groundwater quality (including groundwater itself). There are two main classes of receptor, those for which standards exist and those without directly applicable standards.

7.3.1 Receptors without Standards or where Standards are not Applicable

Unless it can be unequivocally demonstrated that the potentially impacted groundwater is not being or will not be used for the supply of drinking water, EAL's should be based upon the Drinking Water Quality Standards as defined in the Water Supply (Water Quality) (Scotland) Regulations 2003.

The EAL should be defined using baseline groundwater chemistry where:

- no Drinking Water Standard exists for a particular substance or,
- where groundwater is not, and is not likely to be, used for supply of drinking water or,
- baseline groundwater quality of a substance is inferior to the most stringent water quality standards, a) naturally or b) because of up hydraulic gradient anthropogenic activity not connected with the Landfill Installation being assessed, as shown in Figure 1.

Because baseline groundwater quality may fluctuate, definition of the EAL should make use of statistical analysis of monitoring data. For example, where the data set is suitable the EAL could be set at the mean value plus three standard deviations (the 99.9th percentile).

Where baseline groundwater quality data is inconclusive, the EALs should not be increased above the DWS (where available). In such cases, the sampling methodology

and frequency should be reviewed with a view to reducing fluctuations due to sampling inconsistency and establishing the true range of baseline groundwater quality.

Where groundwater baseline quality is poor due to anthropogenic activity, monitoring data should be regularly reviewed with a view to reduction as the source term of the historic contamination declines. Where justified, some consideration of attenuation of substances during flow beneath the site can be accorded.

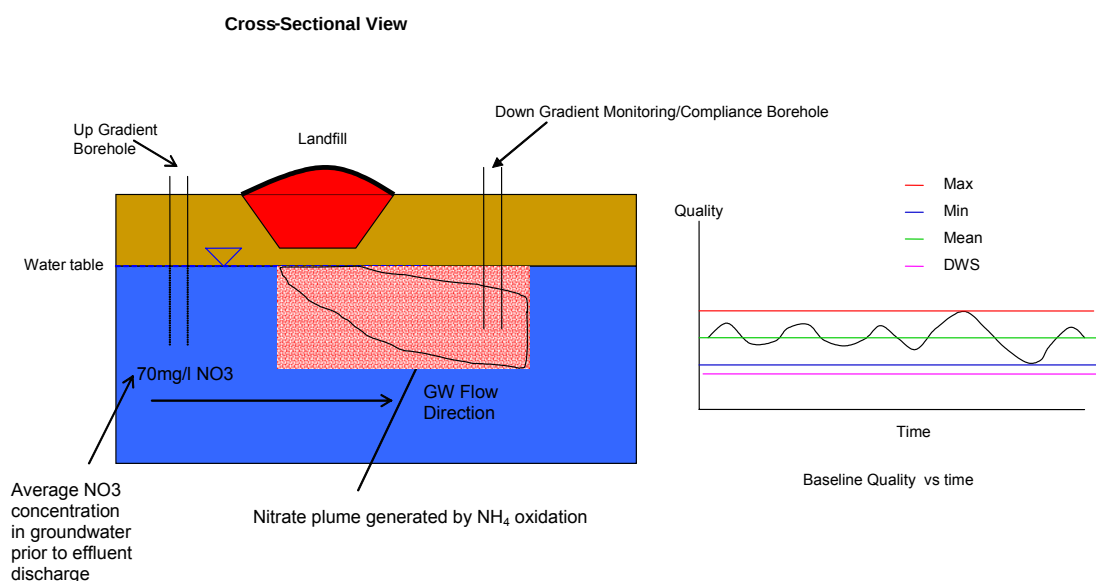
7.3.2 Other Receptors where Standards can be Applied

Where there are other receptors the appropriate environmental standards should be chosen based on compliance at the receptor. Typically the receptor will have an Environmental Quality Standard (EQS) if it is surface water, and Drinking Water Standards (DWS) will apply if it is an abstraction used for public or private supply. EQS and DWS are based on rigorous scientific assessment and are therefore very useful in assessing pollution. Useful Environmental Quality Standards are included in Appendix II

7.3.3 Multiple Receptors

Where a number of receptors have been identified and several EAL's recognised, the most stringent should be applied. The chosen EAL should take full account of WFD objectives of maintenance or improvement in status and protection of surface waters and groundwater dependant ecosystems and prevent overall deterioration in status. This will apply particularly to conservative substances or those producing conservative breakdown products, e.g. chloride, ammonium (into nitrate).

Figure 1 High Baseline Groundwater Quality



7.4 Baseline Concentration Of The Substance In Groundwater Is Substantially Lower Than The Applicable Water Quality Standard.

Whilst some decrease in water quality might be acceptable, deterioration to the appropriate water quality standard is not, because of potential impacts upon other receptors. The selected EAL should be set at a point between the baseline concentration and the water quality standard, e.g. Chloride – background 30mg/l, DWS 250mg/l, EAL could be set at 60mg/l.

8.0 TRIGGER LEVELS

The Landfill (Scotland) Regulations 2003 (Schedule 4, para 5(1)) states that::

‘significant adverse environmental effects, as referred to in regulations 16(3) and 17(5)(b), should be considered to have occurred in the case of groundwater, when an analysis of a groundwater sample shows a significant change in water quality’.

Trigger Levels are used to indicate the concentration that represents ‘significant change in water quality’. The Regulations require that they must be determined taking account of the specific hydrogeological formations in the location of the landfill and groundwater quality. Whenever possible, Trigger Levels must be set out in the conditions of a landfill permit.

As many current landfill sites in Scotland have operated under a different regulatory regime in the past, particularly with regard to design philosophy (i.e. dilute and disperse) and engineering control, some exhibit signs of leachate breakout and migration within underlying groundwater systems. As many of these older sites will continue to co-exist in combination with future landfill phases designed under much stricter engineering controls, it is inevitable that the effects of migratory leachate will require careful monitoring for many years. In such cases, if Trigger Levels are set in line with appropriate Minimum Reporting Values (for List I substances), and Environmental Assessment Limits (for List II substances), they may fall below the contaminant concentrations that are actually present.

In addition, the baseline groundwater quality may, on account of natural or up-gradient anthropogenic influences, be inferior to Environmental Assessment Limits (EAL) based on the most stringent water quality standard. In these cases the EAL and subsequent List II Trigger Levels, should be developed having regard to the baseline groundwater condition, where that condition can be demonstrated (by sampling and analysis) to have arisen from a source unrelated to present or past landfilling operations at the installation under consideration.

8.1 Setting Trigger Levels

It is important to select an appropriate number of substances that are representative of the contaminants that are either predicted or known to be present in the leachate source term. These will normally be drawn from the key contaminants identified through leachate characterisation studies and taken forward in the risk assessment. These will often be contaminants present at high concentrations in the leachate and/or the most mobile in the subsurface environment. This should not exclude the use of substances that are less mobile or in lower concentrations where these may have significant impact if release to the wider environment occurred.

8.1.1 List I Trigger Levels

The Trigger Levels for List I substances either predicted or known to be present in the leachate source should be set at:

- the Minimum Reporting Value (MRV) if these substances are **not present** in the up-gradient baseline groundwater chemistry;
- the maximum concentration of the up-gradient baseline groundwater quality determined on an agreed statistical basis.

It should be noted that the up-gradient baseline groundwater condition should be determined at a locality which has not been influenced by the contaminant footprint, arising from any phase of the landfill. Where baseline data is inconclusive with regard to this then, until further investigation conclusively demonstrates an external source, List I Trigger Levels should not be increased above the MRV.

The presence of List I substances in up-gradient groundwater does not mean that the landfill can discharge List I substances up to the elevated trigger level. Measures must be taken to ensure that the disposal operations do not lead to entry of List I substances into the groundwater regardless of up-gradient groundwater quality. This may be demonstrated by undertaking an appropriate risk assessment or may require other measures such as putting in place control rules set for leachate monitoring. In such situations Trigger Values alone may not give an appropriate evaluation of landfill performance and the use of control rules and charts to monitor performance by other means would also be required. This can only be determined on a case by case basis considering the site specific conditions.

Minimum Reporting Values for a number of List I substances commonly found within leachate can be found in Appendix III. SEPA should be consulted for substances not included in this list.

8.1.2 List II Trigger Levels

The Trigger Levels for List II substances either predicted or known to be present in the leachate source should be set at the Environmental Assessment Limit selected in accordance with the criteria described in Section 7 above.

8.1.3 Existing Impacts

Circumstances will arise where the Trigger Levels, set in line with the above guidance, are exceeded because of a contaminant footprint resulting from 'older' landfill phases. It follows that in these cases pollution is occurring and SEPA will seek to oblige the operator to predict, manage and control a downturn in contaminant concentrations to ensure that the contaminant concentrations will fall to a level consistent with, and ultimately below, the Trigger Levels set for the site within an agreed timeframe. The setting of targeted Control Levels for the site is the primary mechanism by which this key objective is achieved.

9.0 CONTROL CHARTS, RULES AND LEVELS

Schedule 4, para 5(4) of the Landfill Regulations requires that the observations made of the groundwater monitoring data against the Trigger Values '*must be evaluated by means of control charts with established control rules and levels for each down gradient well*'. Control levels are a component of this requirement and along with observed trends from control charts provide a warning to operators that there may be a problem occurring that, if not rectified, may result in Trigger Levels being breached. Consistent breach of control rules and levels will mean that further investigation and a review of operating procedures should be undertaken. The situation may be one that is easily rectified, e.g. by a reduction in leachate levels, but any consistent breach of a control rule or level should be considered serious. It is important to note that control rules and levels may constitute either contaminant concentrations or site specific operational controls, or indeed a combination of both.

9.1 Control Rules and Levels for New Sites and others where no Evidence of Pollution of Groundwater has been Identified

Control rules and levels will provide early warning of a potential problem. They should therefore be set at a concentration that will not be constantly exceeded unless, for example, average baseline groundwater quality is already close to the EAL. The values must be derived on a site specific and borehole specific basis established from an understanding of monitoring data variability. However in general the control level should be set at a point between the mean value for that specific parameter and the Trigger Level. In most cases the mean of the background concentration plus one standard deviation will be suitable although this will require to be established on a case by case basis. A fixed control value should not be relied upon in isolation and changes to any trends identified by the use of control charts should also be assessed.

9.2 Control Rules and Levels for Sites where Evidence of Groundwater Pollution Exists

Where pollution from an existing site has previously been identified, control levels represent short term targets for improvement aimed at decreasing, with time, contaminant concentrations to a level at or below Trigger Levels set for the site. In such cases, control rules and levels represent intermediate short term targets, namely; a series of decreasing concentrations to be achieved within a time limited framework in conjunction with a targeted programme of operational controls e.g. leachate head restrictions and phasing of site capping. The operator should seek to achieve a gradual improvement in groundwater quality with the objective of improvement to below the Trigger Level within a timescale agreed with SEPA. This will mean that, in such cases, the control levels set will, in terms of contaminant concentrations, exceed the Trigger Level. This should be viewed as a short term measure. Control charts should be used to identify any trends in concentration with a view to achieving a reversal of any upward trends of pollution and a long term gradual improvement of groundwater quality. The timescales will vary widely between site setting, geological and hydrogeological conditions and the reasons for the monitoring data exceeding the Trigger level. In a simple situation where exceedance was due to a small event this may be weeks or months. However in more complex settings for example where dilute and disperse phases have operated in the past this could be much longer.

In order to prescribe a representative set of Control Levels the operator will need to predict the time based downturn in contaminant concentrations resulting from the future development and operational control of previous, current and future landfill phases. Where applicable the use of a probabilistic modelling package such as LandSim can be used to determine a program of measures that reduces pollution significantly faster than would be achieved by natural attenuation. In some cases, for example when there is insufficient data for a probabilistic model, it may be more appropriate to use a deterministic modelling tool to assist in this type of decision making.

A timetable of Control Levels to be achieved at the site may be made a condition of the permit if considered appropriate by SEPA

In cases where groundwater quality is clearly and demonstrably shown to be affected by up-gradient anthropogenic impacts or natural causes, Control levels should be set at a value derived from a statistical analysis of the background quality data. In most cases a value representing the mean plus two standard deviations will represent a suitable value although this will require to be established on a case by case basis. A fixed control level should not be relied upon in isolation and changes to any trends, identified by the use of control charts, should also be assessed.

Specific control values must be derived on a site specific and borehole specific basis. Due to normal statistical variation a control value may be exceeded from time to time.

For example if the control value is set as described above (the mean baseline groundwater quality plus 2 standard deviations) this would include approximately 90% of the sample population and hence, one in five monitoring samples are likely to exceed the Control Level (and one in five will be below the mean at the lower end of the range). At a three monthly sampling frequency. This represents one sample every 5 years. For this reason control charts should be used in conjunction with control levels when making an assessment of any changes to trends revealed by monitoring data.

If exceedance is due to changes in site conditions, appropriate measures will be needed to reverse the trend and a more frequent sampling regime required to monitor the effects. Where insufficient numbers of monitoring results are available for reliable statistical analysis, a programme of frequent sampling should be introduced that will collect sufficient data. The baseline data should be regularly reviewed with the aim of redefining the Control and Trigger Levels to allow for any improvement in baseline quality, or change in statistics.

10.0 PERIODIC REVIEWS

As noted above the conceptual model and risk assessment should be periodically reviewed in the light of new information e.g. monitoring data. For example, groundwater level fluctuations may indicate periodic changes in flow direction or hydraulic gradient, groundwater quality and may indicate unforeseen deteriorating or improving conditions.

In a similar way control rules, charts and levels and Trigger levels should be reviewed on an annual basis although a shorter frequency may be incorporated into the PPC permit if required. In practice Trigger levels should be informally reviewed each time compliance is measured, i.e. each time a sample is taken and analysed. More frequent assessment should be carried out if consistent breaches of a Control level have indicated that a potential breach of a Trigger level is imminent.

11.0 CONTINGENCY PLANS

The operator should assess the risks of the site not performing as predicted and describe corrective measures in the application that will be adopted for each identified potential risk of impact upon groundwater. For example, one potential risk is a Trigger level breach, the operator might suggest a contingency measure that reduces the volume of discharges by decreasing the levels of leachate head or, alternatively, improving the capping system. The magnitude of the measures should be used to inform decisions on the financial provision required for the site.

If a site is properly managed and close attention is paid to compliance monitoring, repeated breaches in Control levels will provide the operator with early warning that things are not as they should be. In such cases action may need to be taken by the operator to rectify the situation. However, where a significant adverse environmental

effect is detected, i.e. a breach of the Trigger level, the operator must notify SEPA and carry out corrective measures.

APPENDIX 1

Lists I and II of the Groundwater Regulations Water Framework Directive Annex VIII List of Pollutants

THE GROUNDWATER REGULATIONS

LIST 1 Substances

1. - (1) Subject to sub-paragraph (2) below, a substance is in list I if it belongs to one of the following families or groups of substances-

- (a) organohalogen compounds and substances which may form such compounds in the aquatic environment;
- (b) organophosphorus compounds;
- (c) organotin compounds;
- (d) substances which possess carcinogenic, mutagenic or teratogenic properties in or via the aquatic environment (including substances which have those properties which would otherwise be in list II);
- (e) mercury and its compounds;
- (f) cadmium and its compounds;
- (g) mineral oils and hydrocarbons;
- (h) cyanides.

(2) A substance is not in list I if it has been determined by SEPA to be inappropriate to list I on the basis of a low risk of toxicity, persistence and bioaccumulation.

LIST II Substances

2. - (1) A substance is in list II if it could have a harmful effect on groundwater and it belongs to one of the following families or groups of substances-

- (a) the following metalloids and metals and their compounds:

Zinc	Tin
Copper	Barium
Nickel	Beryllium
Chromium	Boron
Lead	Uranium
Selenium	Vanadium

Arsenic	Cobalt
Antimony	Thallium
Molybdenum	Tellurium
Titanium	Silver.

(b) biocides and their derivatives not appearing in list I;

(c) substances which have a deleterious effect on the taste or odour of groundwater, and compounds liable to cause the formation of such substances in such water and to render it unfit for human consumption;

(d) toxic or persistent organic compounds of silicon, and substances which may cause the formation of such compounds in water, excluding those which are biologically harmless or are rapidly converted in water into harmless substances;

(e) inorganic compounds of phosphorus and elemental phosphorus;

(f) fluorides;

(g) ammonia and nitrites.

(2) A substance is also in list II if-

(a) it belongs to one of the families or groups of substances set out in paragraph 1(1) above;

(b) it has been determined by SEPA to be inappropriate to list I under paragraph 1(2); and

(c) it has been determined by SEPA to be appropriate to list II having regard to toxicity, persistence and bioaccumulation.

WATER FRAMEWORK DIRECTIVE ANNEX VIII

INDICATIVE LIST OF THE MAIN POLLUTANTS

1. Organohalogen compounds and substances which may form such compounds in the aquatic environment.
2. Organophosphorous compounds.
3. Organotin compounds.
4. Substances and preparations, or the breakdown products of such, which have been proved to possess carcinogenic or mutagenic properties or properties which may affect steroidogenic, thyroid, reproduction or other endocrine-related functions in or via the aquatic environment.
5. Persistent hydrocarbons and persistent and bioaccumulable organic toxic substances.
6. Cyanides.
7. Metals and their compounds.
8. Arsenic and its compounds.
9. Biocides and plant protection products.
10. Materials in suspension.
11. Substances which contribute to eutrophication (in particular, nitrates and phosphates).
12. Substances which have an unfavourable influence on the oxygen balance (and can be measured using parameters such as BOD, COD, etc.).

Appendix II

Drinking Water Standards

Environmental Quality Standards

TABLE A

MICROBIOLOGICAL PARAMETERS

Part I: Directive requirements

<i>Item</i>	<i>Parameters</i>	<i>Concentration or Value (maximum)</i>	<i>Units of Measurement</i>	<i>Point of compliance</i>
1.	Enterococci	0	number/100ml	Consumers' taps
2.	<i>Escherichia coli</i> (<i>E. coli</i>)	0	number/100ml	Consumers' taps

Part II: National requirements

<i>Item</i>	<i>Parameters</i>	<i>Concentration or Value (maximum)</i>	<i>Units of Measurement</i>	<i>Point of compliance</i>
1.	Coliform bacteria	0	number/100ml	Service reservoirs* and water treatment works
2.	<i>Escherichia coli</i> (<i>E. coli</i>)	0	number/100ml	Service reservoirs and water treatment works

Note: *Compliance required as to 95% of samples from each service reservoir (regulation 4(6)).

CHEMICAL PARAMETERS

Part I: Directive requirements

<i>Item</i>	<i>Parameters</i>	<i>Concentration or Value (maximum)</i>	<i>Units of Measurement</i>	<i>Point of compliance</i>
1.	Acrylamide	0.10	µg/l	(i)
2.	Antimony	5.0	µgSb/l	Consumers' taps
3.	Arsenic	10	µgAs/l	Consumers' taps
4.	Benzene	1.0	µg/l	Consumers' taps
5.	Benzo(a)pyrene	0.010	µg/l	Consumers' taps
6.	Boron	1.0	mgB/l	Consumers' taps
7.	Bromate	10	µgBrO ₃ /l	Consumers' taps
8.	Cadmium	5.0	µgCd/l	Consumers' taps
9.	Chromium	50	µgCr/l	Consumers' taps
10.	Copper (i)	2.0	mgCu/l	Consumers' taps
11.	Cyanide	50	µgCN/l	Consumers' taps
12.	1, 2 dichloroethane	3.0	µg/l	Consumers' taps
13.	Epichlorohydrin	0.10	µg/l	(i)
14.	Fluoride	1.5	mgF/l	Consumers' taps
15.	Lead (ii)	(a) 25, from 25th December 2003 until immediately before 25th December 2013	µgPb/l	Consumers' taps
		(b) 10, on and after 25th December 2013	µgPb/l	Consumers' taps

16.	Mercury	1.0	µgHg/l	Consumers' taps
17.	Nickel (ii)	20	µgNi/l	Consumers' taps
18.	Nitrate (iii)	50	mgNO ₃ /l	Consumers' taps
19.	Nitrite (iii)	0.50	mgNO ₂ /l	Consumers' taps
		0.10		Treatment Works
20.	Pesticides (iv)(v) Aldrin) Dieldrin) Heptachlor) Heptachlor) epoxide)	0.030	µg/l	Consumers' taps
	other pesticides	0.10	µg/l	Consumers' taps
21.	Pesticides: Total (vi)	0.50	µg/l	Consumers' taps
22.	Polycyclic aromatic hydrocarbons (vii)	0.10	µg/l	Consumers' taps
23.	Selenium	10	µgSe/l	Consumers' taps
24.	Tetrachloroethene and Trichloroethene (viii)	10	µg/l	Consumers' taps
25.	Trihalomethanes: Total (ix)	100	µg/l	Consumers' taps
26.	Vinyl chloride	0.50	µg/l	(i)

Notes:

(i) The parametric value refers to the residual monomer concentration in the water as calculated according to specifications of the maximum release from the corresponding polymer in contact with the water. This is controlled by

product specification.

(ii) See also regulation 6(6).

(iii) See also regulation 4(2)(d).

(iv) See the definition of "pesticides and related products" in regulation 2.

(v) The parametric value applies to each individual pesticide.

(vi) "Pesticides: Total" means the sum of the concentrations of the individual pesticides detected and quantified in the monitoring procedure.

(vii) The specified compounds are:

- benzo(b)fluoranthene
- benzo(k)fluoranthene
- benzo(ghi)perylene
- indeno(1,2,3-cd)pyrene.

The parametric value applies to the sum of the concentrations of the individual compounds detected and quantified in the monitoring process.

(viii) The parametric value applies to the sum of the concentrations of the individual compounds detected and quantified in the monitoring process.

(xi) The specified compounds are:

- chloroform
- bromoform
- dibromochloromethane
- bromodichloromethane.

The parametric value applies to the sum of the concentrations of the individual compounds detected and quantified in the monitoring process.

SCHEDULE 2

regulations 2 and 4

INDICATOR PARAMETERS

<i>Item</i>	<i>Parameters</i>	<i>Specification Concentration or Value (maximum) or State</i>	<i>Units of Measurement</i>	<i>Point of monitoring</i>
1.	Ammonium	0.50	mgNH ₄ /l	Consumers' taps
2.	Chloride (i)	250	mgCl/l	Supply point*
3.	Clostridium perfringens (including spores)	0	Number/100ml	Supply point*
4.	Coliform bacteria	0	Number/100ml	Consumers' taps
5.	Colony counts	No abnormal change	Number/1ml at 22°C	Consumers' taps, service
			Number/1ml at 37°C	Reservoirs and treatment works
6.	Conductivity (i)	2500	µS/cm at 20°C	Supply point*
7.	Hydrogen ion	9.5	pHvalue	Consumers' taps
8.	Sulphate (i)	250	mgSO ₄ /l	Supply point*
9.	Total indicative dose (for radioactivity) (ii)	0.10	mSv/year	Supply point*
10.	Total organic carbon (TOC)	No abnormal change	mgC/l	Supply point*
11.	Tritium (for radioactivity)	100	Bq/l	Supply point*
12.	Turbidity	1	NTU	Treatment works

Notes:

(i) The water should not be aggressive.

(ii) Excluding tritium, potassium-40, radon and radon decay products.

*May be monitored from samples of water leaving treatment works or other supply point,
as no significant change during distribution

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EQS List (Updated January 2004)

Table 1: EQS values

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
Abamectin	0.01µg/l (AA) (Tentative) 0.03µg/l (MAC) (Tentative)	0.003µg/l (AA) (Tentative) 0.01µg/l (MAC) (Tentative)	DETR (1998)
Aldrin (total)	0.01µg/l (AA) (Statutory)	0.01µg/l (AA) (Statutory)	EC, HMSO 1998c ^(1a)
Aluminium (for reactive aluminium)	pH <=6.5 10µg/l (MAC); > 6.5 25 µg/l as (MAC) (Tentative) > pH 6.5 15 µg/l as (AA) (Tentative)	25 µg/l (MAC) (Tentative) 15 µg/l (AA) (Tentative)	EA/ SNIFFER (1998)
Ammonia	15 µg (NH ₃ -N/l) unionised (AA)	21 µg (NH ₃ -N/l) unionised (AA)	DoE (1998)
Arsenic (In Statutory Instruments HMSO 1997 and 1998b form, i.e. total or dissolved not stated presumed dissolved as in HMSO 1989)	50µg/l (AA) (Statutory)	25µg/l (AA) (Statutory)	HMSO (1989)/HMSO (1997)/SDD 1985/ HMSO (1998b)
Atrazine (a) (in Statutory Instrument not stated if as dissolved or total)	2µg/l (AA) (Statutory)	2µg/l (AA) (Statutory)	HMSO (1997) and HMSO (1998b)
Atrazine (dissolved)(a) (original EQS report)	2µg/l (AA) 10µg/l (MAC)	2µg/l (AA) 10µg/l (MAC)	DoE (1991)
Azamethiphos	0.02 µg/l (AA) (Tentative) 0.05 µg/l (MAC) (Tentative)	0.02 µg/l (AA) (Tentative) 0.05 µg/l (MAC) (Tentative)	DETR 1998
Azinphos-methyl (in Statutory Instrument not stated if as dissolved or total)	0.01µg/l (AA) (Statutory)	0.01µg/l (AA) (Statutory)	HMSO (1997) and HMSO (1998b)

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
Azinphos-methyl (dissolved) (original EQS report)	0.01µg/l (AA) 0.04µg/l (MAC)	0.01µg/l (AA) 0.04µg/l (MAC)	DoE (1991)
Bentazone (in Statutory Instrument not stated if as dissolved or total)	500µg/l (AA) (Statutory)	500µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
Bentazone (total) (original EQS report)	500µg/l (AA) (Tentative) 5000µg/l (MAC) (Tentative)	500µg/l (AA) (Interim guideline) 5000µg/l (MAC) (Interim guideline)	DETR (1996)
Benzene	30µg/l (AA) (Statutory)	30µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
Benzene	30µg/l (AA) 300µg/l (MAC)	30µg/l (AA) 300µg/l (MAC)	DETR (1997)
Biphenyl	25µg/l (AA) (Statutory)	25µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
Biphenyl (original EQS report)	25µg/l (AA)	25µg/l (AA) (Interim guideline)	DoE (1994)
Boron (Total)	2000µg/l (AA) (EQS 1 and 2) (Statutory)	7000µg/l (AA) (Statutory)	HMSO (1989)
Bromine	2µg/l (Total Residual Oxidant) (AA) (Tentative) 5µg/l (Total Residual Oxidant) (MAC) (Tentative)	10µg/l (Total Residual Oxidant) (MAC) (Tentative)	EA (1997)
Bromoxynil (Total)	100µg/l (AA) 1000µg/l (MAC)	100µg/l (Interim guideline) 1000µg/l (Interim guideline)	DoE (1995)
Cadmium	5µg/l (AA) (Total) (Statutory)	2.5µg/l (AA) (Dissolved) (Statutory)	EC, HMSO 1989, HMSO 1990
Carbendazim	0.1 µg/l (AA) (Tentative) 1 µg/l (MAC) (Tentative)	0.1 µg/l (AA) (Tentative) 1 µg/l (MAC) (Tentative)	DETR (1998)

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
Carbon tetrachloride (total)	12µg/l (AA) (Statutory)	12µg/l (AA) (Statutory)	EC, HMSO 1989, HMSO 1990
Chloride ^(d)	250000µg/l (AA) (updated but standards remains the same)	None proposed	EA (1992) and 1999
Chlorine	2µg/l (Total Available Chlorine) (AA) 5µg/l (Total Available Chlorine) (MAC)	10µg/l (Total Residual Oxidant) (MAC)	EA (1994)
Chlorine dioxide	Decided it was inappropriate to set standards	Decided it was inappropriate to set standards	EA/SNIFFER (1998)
Chlorfenvinphos ^(e)	0.03µg/l (AA) 0.1µg/l (MAC)	0.03µg/l (AA) (Tentative) 0.1µg/l (MAC) (Tentative)	EA/SNIFFER (2000)
Chloroform (total)	12µg/l (AA) (Statutory)	12µg/l (AA) (Statutory)	EC, HMSO 1989, HMSO 1990
4-chloro-3-methyl phenol	40µg/l (AA) (Statutory)	40µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
4-chloro-3-methyl phenol (Original EQS report)	40µg/l (AA) 200µg/l (MAC)	40µg/l (AA) (Tentative) 200µg/l (MAC) (Tentative)	DETR (1997)
Chloronitrotoluenes (In Statutory Instrument unclear as to whether standard refers to 'total - all isomers')	10µg/l (AA) (Statutory)	10µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
Chloronitrotoluenes (Total - all isomers) (Original EQS Report)	10µg/l (AA) 100µg/l (MAC)	10µg/l (AA) 100µg/l (MAC)	DoE (1992)
2-chlorophenol	50µg/l (AA) (Statutory)	50µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
2-chlorophenol 3-chlorophenol 4-chlorophenol	50µg/l (AA) 250µg/l (MAC)	50µg/l (AA) 250µg/l (MAC)	EA/SNIFFER 1997

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
(Total and individual monochlorophenols) (original EQS Report)			
Chlorpropham (total)	10µg/l (AA) (Tentative) 40µg/l (MAC)	10µg/l (AA) (Interim Guideline) 40µg/l (MAC) (Interim Guideline)	DoE (1995)
Chlorothalonil	0.1µg/l (AA) (Tentative) 1.0µg/l (MAC) (Tentative)	0.1µg/l (AA) (Interim Guideline) 1.0µg/l (MAC) (Interim Guideline)	DoE (1995)
Chlorotoluron ^(c)	2µg/l (AA) (Interim Guideline) 20µg/l (MAC) (Interim Guideline)	2µg/l (AA) (Interim Guideline)	EA (1996)
Chromium (Dissolved) (see Note 2)	EQS 1 EQS 2 0-50mg CaCO₃/l 5µg/l 150µg/l 50-100mg CaCO₃/l 10µg/l 175µg/l 100-150mg CaCO₃/l 20µg/l 200µg/l 150-200mg CaCO₃/l 20µg/l 200µg/l 200-250mg CaCO₃/l 50µg/l 250µg/l >250mg/l CaCO₃/l 50µg/l 250µg/l (all as AA) (Statutory)	15µg/l (AA) (Statutory)	HMSO 1989 SDD (1985)
Chromium (Dissolved) (revision - see Note 2)	0-50mg CaCO₃/l 2µg/l 50-100mg CaCO₃/l 10µg/l 100-150mg CaCO₃/l 10µg/l 150-200mg CaCO₃/l 20µg/l 200-250mg CaCO₃/l 20µg/l >250mg CaCO₃/l 20µg/l (all as AA)	5µg/l (AA)	DoE 1994

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
Copper (Dissolved) (see Note 2)	EQS 1 EQS 2 0-50mg CaCO₃/l 1µg/l 1µg/l 1-10mg CaCO₃/l 1µg/l 10-50mg CaCO₃/l 6µg/l 50-100mg CaCO₃/l 10µg/l 100-300mg CaCO₃/l 28µg/l 50-100mg CaCO₃/l 6µg/l 6µg/l 100-150mg CaCO₃/l 10µg/l 10µg/l 150-200mg CaCO₃/l 10µg/l 10µg/l 200-250mg CaCO₃/l 10µg/l 10µg/l >250mg CaCO₃/l 28µg/l 28µg/l (all as AA) (Statutory)	5µg/l (AA) (Statutory)	HMSO 1989 SDD (1985)
Copper (Dissolved) (revision - see Note 2)	0-50mg CaCO₃/l 0.5 µg/l 50-100mg CaCO₃/l 3 µg/l 100-150mg CaCO₃/l 3 µg/l 150-200mg CaCO₃/l 3 µg/l 200-250mg CaCO₃/l 8 µg/l >250mg CaCO₃/l 12µg/l (all as AA)	5µg/l (AA)	DoE (1993)
Cobalt (dissolved)	3 µg/l (AA) 100µg/l (MAC)	3 µg/l (AA) (Tentative) 100µg/l (MAC) (Tentative)	DETR 1998
Coumaphos ^(e)	0.03µg/l (AA) (Tentative) 0.1µg/l (MAC) (Tentative)	0.03µg/l (AA) (Tentative) 0.1µg/l (MAC) (Tentative)	EA /SNIFFER (2000)
Cyanide (Free cyanide (HCN and CN ⁻))	1µg/l (AA) 5µg/l (MAC)	1µg/l (AA) (Tentative) 5µg/l (MAC) (Tentative)	EA (1998)
Cyfluthrin (total)	0.001µg/l (95%ile) (EQS 1 and 2) (Statutory)	0.001µg/l (95%ile) (Statutory)	HMSO 1989

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
Cypermethrin	0.0002 µg/l (AA) (tentative) 0.002 µg/l (MAC)	0.0002 µg/l (AA) (tentative) 0.002 µg/l (MAC) (tentative)	EA/SNIFFER
2,4-D (ester) (In Statutory Instrument not stated that as 'total')	1µg/l (AA) (Statutory)	1µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
2,4-D (ester) (total) (Original EQS Report)	1µg/l (AA) 10µg/l (MAC)	1µg/l (AA) (Interim guideline) 10µg/l (MAC) (Interim guideline)	EA/SNIFFER (1996)
2,4-D (non-ester) (total) (In Statutory Instrument not stated that as 'total')	40µg/l (AA) (Statutory)	40µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
2,4-D (non-ester) (total) (Original EQS Report)	40µg/l (AA) 200µg/l (MAC)	40µg/l (AA) (Interim guideline) 200µg/l (MAC) (Interim guideline)	EA/SNIFFER (1996)
DDT (Total- all 4 isomers)	0.025µg/l (AA) (Statutory)	0.025µg/l (AA) (Statutory)	EC, HMSO 1989, HMSO 1990
ppDDT (total)	0.01µg/l (AA) (Statutory)	0.01µg/l (AA) (Statutory)	EC, HMSO 1989, HMSO 1990
Demetons	0.5µg/l (AA) (Statutory)	0.5µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
Demetons (Approved) (original EQS report)	0.5µg/l (AA) 5µg/l (MAC) (Tentative)	0.5µg/l (AA) (Interim guideline) 5µg/l (MAC) (Interim guideline)	DoE (1995)
Demetons (Total) (Original EQS report)	0.05µg/l (AA) 0.5µg/l (MAC) (Tentative)	0.05µg/l (AA) (Interim guideline) 0.5µg/l (MAC) (Interim guideline)	DoE (1995)
Diazinon ^(e)	0.03µg/l (AA) 0.1µg/l (MAC)	0.03µg/l (AA) (Tentative) 0.1µg/l (MAC) (Tentative)	EA/SNIFFER (2000)
Dichlorobenzene (Dissolved- sum of all isomers)	20µg/l (AA) 200 µg/l (MAC)	20µg/l (AA) 200 µg/l (MAC)	DETR 1998

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
1,2-dichloroethane (total)	10µg/l (AA) (Statutory)	10µg/l (AA) (Statutory)	EC, HMSO 1992 a,b
Dichloromethane	2000µg/l (AA) 20000µg/l (MAC)	2000µg/l (AA) 20000µg/l (MAC)	EA/SNIFFER
Dichlorophen	Insufficient data to proposed EQS's	Insufficient data to proposed EQS's	DETR (1998)
2,4-dichlorophenol	20µg/l (AA) (Statutory)	20µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
2,4-dichlorophenol (Original EQS Report)	20µg/l (AA) 140µg/l (MAC)	20µg/l (AA) 140µg/l (MAC)	EA/SNIFFER (1997)
Dichlorvos	0.001µg/l (AA) (Statutory)	0.04µg/l (AA) (Statutory) 0.6µg/l (MAC) (24 hours after treatment of sea- lice) (Statutory)	HMSO (1997) and HMSO (1998b)
Dieldrin (total)	0.01µg/l (AA) (Statutory)	0.01µg/l (AA) (Statutory)	EC, HMSO 1998c ^(1a)
Diiflubenzuron	0.001µg/l (AA) 0.015µg/l (MAC)	0.005µg/l (AA) 0.1µg/l (MAC)	DETR (1997)
Dimethoate	1µg/l (AA) (Statutory)	1µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
Dimethoate	1µg/l (AA) (no MAC)	1µg/l (AA)	DoE (1994)
Dioxins	No EQS's proposed guidelines for sediments and water considered	No EQS's proposed guidelines for sediments and water considered	EA/SNIFFER (1999)
Diuron ^(c)	2µg/l (AA) 20µg/l (MAC)	2µg/l (AA) (Interim Guideline)	EA (1996)
Doramectin	0.001µg/l (AA)	0.001µg/l (AA)	DETR (1998)

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
	0.01µg/l (MAC)	0.01µg/l (MAC)	
EDTA	400µg/l (AA) 4000µg/l (MAC)	400µg/l (AA) (Tentative) 4000µg/l (MAC) (Tentative)	DETR (1997)
Endosulphan	0.003µg/l (AA) (Statutory)	0.003µg/l (AA) (Statutory)	HMSO (1997) and HMSO (1998b)
Endosulphan (Total dissolved) (original EQS report)	0.003µg/l (AA) 0.3µg/l (MAC)	0.003µg/l (AA)	DoE (1991)
Endrin (total)	0.005µg/l (AA) (Statutory)	0.005µg/l (AA) (Statutory)	EC, HMSO 1998c ^(1a)
Ethofumesate	Limited data. No EQS proposed	Limited data. No EQS proposed	DETR (1997)
Ethylbenzene	20 µg/l (AA) 200µg/l (MAC)	20µg/l (AA) 200µg/l (MAC)	EA/SNIFFER (2001)
Fenchlorphos ^(e)	0.03µg/l (AA) (Tentative) 0.1µg/l (MAC) (Tentative)	0.03µg/l (AA) (Tentative) 0.1µg/l (MAC) (Tentative)	EA/SNIFFER (2000)
Fenitrothion	0.01µg/l (AA) (Statutory)	0.01µg/l (AA) (Statutory)	HMSO (1997) and HMSO (1998b)
Fenitrothion	0.01µg/l (AA) 0.25µg/l (MAC)	0.01µg/l (AA) 0.25µg/l (MAC)	DoE (1991)
Flucifuron (total)	1.0µg/l (95%ile) (Statutory) (EQS1 & EQS 2)	1.0µg/l (95%ile) (Statutory)	HMSO (1989)
Flumethrin	Too few data were available for an EQS to be proposed	Too few data were available for an EQS to be proposed	EA/SNIFFER
Fluoride	<50 mg CaCO ₃ /l 1000 µg/l (AA) 3000 µg/l (MAC) dissolved >50 mg CaCO ₃ /l 5000 µg/l (AA) 15000 µg/l (MAC) dissolved (standards may be raised in	5000 µg/l (AA) 15000 µg/l (MAC) dissolved (Tentative)	EA/SNIFFER (1998)

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
	waters of high fluoride content)		
Flusilazole	Inadequate data to propose EQS's	No data	DETR 1998
Formaldehyde	5µg/l (AA) 50µg/l (MAC)	Insufficient data to propose EQS's	DoE (1993)
Hexachlorobenzene (total)	0.03µg/l (AA) (Statutory)	0.03µg/l (AA) (Statutory)	EC, HMSO 1989, HMSO 1990
Hexachlorobutadiene (total)	0.1µg/l (AA) (Statutory)	0.1µg/l (AA) (Statutory)	EC, HMSO 1989, HMSO 1990
Hexachlorocyclohexane (total)	0.1µg/l (AA) (Statutory)	0.02µg/l (AA) (Statutory)	EC, HMSO 1989, HMSO 1990
Hydrogen sulphide (Undissociated)	0.25µg/l (AA) 1.0µg/l (MAC)	10µg/l (MAC) (No AA)	DoE 1993
Imazethapyr	Inadequate data to propose EQS's	no data	DETR 1998
Ioxynil (total)	10µg/l (AA) 100µg/l (MAC)	10µg/l (AA) (Interim Guideline) 100µg/l (MAC) (Interim Guideline)	DoE (1995)
Iron (Dissolved)	1000µg/l (AA) (Statutory)	1000µg/l (AA) (Statutory)	HMSO 1989
Iron (Dissolved) (updated EQS report)	1000µg/l (AA) (updated but no change proposed) (However recommended survey of biological quality if AA consistently exceeds 0.3 mg/l filterable iron or if deposits occur)	1000µg/l (AA) (updated but no change proposed)	DETR 1998
Isodrin (total)	0.005µg/l (AA) (Statutory)	0.005µg/l (AA) (Statutory)	EC, HMSO 1998c ^(1a)
Isoproturon ^(c)	2µg/l (AA) 20µg/l (MAC)	2µg/l (AA) (Interim Guideline)	EA (1996)

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
Ivermectin	0.0001µg/l (AA) (Tentative) 0.001µg/l (MAC) (Tentative)	0.001µg/l (AA) (Tentative) 0.01µg/l (MAC) (Tentative)	DETR (1998)
Lead (Dissolved) (see Note 2)	EQS1 EQS2 0-50mg CaCO₃/l 4µg/l 50µg/l 50-100mg CaCO₃/l 10µg/l 125µg/l 100-150mg CaCO₃/l 10µg/l 125µg/l 150-200mg CaCO₃/l 20µg/l 250µg/l 200-250mg CaCO₃/l 20µg/l 250µg/l >250mg CaCO₃/l 20µg/l 250µg/l (all as AA) (Statutory)	25 µg/l (AA) (Statutory)	HMSO 1989 SDD (1985)
Lead (Dissolved) (revision see Note 2)	0-50mg CaCO₃/l 4µg/l 50-100mg CaCO₃/l 10µg/l 100-150mg CaCO₃/l 10µg/l 150-200mg CaCO₃/l 20µg/l 200-250mg CaCO₃/l 20µg/l >250mg CaCO₃/l 20µg/l (all as AA)	10 µg/l (AA)	DoE 1992
Linuron	2µg/l (AA) (Statutory)	2µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
Linuron ^(c) (Original EQS Report)	2µg/l (AA) 20µg/l (MAC)	2µg/l (AA) (Interim Guideline)	EA (1996)
Malachite Green	0.5µg/l (AA) 100µg/l (MAC)	0.5µg/l (AA) (Interim Guideline) 100µg/l (MAC) (Interim Guideline)	DoE 1993
Malathion	0.01µg/l (AA) (Statutory)	0.02µg/l (AA) (Statutory)	HMSO (1997) and HMSO (1998b)
Malathion (Original EQS Report)	0.01µg/l (AA)	0.02µg/l (AA)	DoE (1991)

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
	0.5µg/l (MAC)	0.5µg/l (MAC)	
Mancozeb	2µg/l (AA) (Tentative) 20µg/l (MAC) (Tentative)	2µg/l (AA) (Tentative) 20µg/l (MAC) (Tentative)	DETR (1997)
Manganese (Dissolved)	30 µg/l as AA 300 µg/l as MAC	none required	DETR (1998)
Maneb	3µg/l (AA) (Tentative) 30µg/l (MAC) (Tentative)	3µg/l (AA) (Tentative) 30µg/l (MAC) (Tentative)	DETR (1997)
MCPA	pH<7 12µg/l (AA) 120µg/l (MAC) pH>7 80µg/l (AA) 800µg/l (MAC)	80µg/l (AA) (Tentative) 800µg/l (MAC) (Tentative)	DETR
Mecoprop (Statutory Instrument does not state if should be as total)	20µg/l (AA) (Statutory)	20µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
Mecoprop (Total) (Original EQS Report)	20µg/l (AA) (Tentative) 200µg/l (MAC) (Tentative)	20µg/l (AA) (Interim Guideline) 200µg/l (MAC) (Interim Guideline)	EA/SNIFFER (1996)
Mercury	1µg/l (AA) (Total) (Statutory)	0.3µg/l (AA) (Dissolved) (Statutory)	EC, HMSO 1989, HMSO 1990
Methiocarb	0.01µg/l (AA) 0.16µg/l (MAC)	0.01µg/l (AA) (Tentative) 0.16µg/l (MAC) (Tentative)	DETR (1997)
Methylphenols (as 0.3 2-MP + 0.2 3-MP +1 4-MP)	100 µg/l (AA) 300 µg/l (MAC)	100 µg/l (AA) 300 µg/l (MAC)	EA
Mevinphos	0.02µg/l (MAC) (Statutory)	No standards proposed	HMSO (1998a) and HMSO (1998c)

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
Mevinphos (Original EQS Report)	0.02µg/l (MAC)	No standards proposed	EA (1997)
Monochlorobenzene	Draft	Draft	DoE (1989)
Naphthalene	10µg/l (AA) (Statutory)	5µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
Naphthalene(Original EQS Report)	10µg/l (AA) (Tentative) 100µg/l (MAC) (Tentative)	5µg/l (AA) (Tentative) 80µg/l (MAC) (Tentative)	EA/SNIFFER (1997)
Nickel (Dissolved) (see Note 2)	EQS 1 EQS 2 0-50mg CaCO ₃ /l 50µg/l 50µg/l 50-100mg CaCO ₃ /l 100µg/l 100µg/l 100-150mg CaCO ₃ /l 150µg/l 150µg/l 150-200mg CaCO ₃ /l 150µg/l 150 µg/l 200-250mg CaCO ₃ /l 200µg/l 200µg/l >250mg CaCO ₃ /l 200µg/l 200µg/l (all as AA) (Statutory)	30µg/l (AA) (Statutory)	HMSO 1989 SDD (1985)
Nickel (Dissolved) (revision – see Note 2)	0-50mg CaCO ₃ /l 8 µg/l 50-100mg CaCO ₃ /l 20 µg/l 100-150mg CaCO ₃ /l 20 µg/l 150-200mg CaCO ₃ /l 40µg/l 200-250mg CaCO ₃ /l 40µg/l >250mg CaCO ₃ /l 40µg/l (all as AA)	15 µg/l (AA)	HMSO 1989
Nonyl phenol	1 µg/l (AA) 2.5 µg/l (MAC)	1 µg/l (AA) 2.5 µg/l (MAC)	EA/SNIFFER (1998)
NTA	1000µg/l (AA) 10000µg/l (MAC)	3000µg/l (AA) (Tentative) 30000µg/l (MAC) (Tentative)	DETR (1997)

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
Octyl phenol	1 µg/l (AA) (Tentative) 2.5 µg/l (MAC) (Tentative)	1 µg/l (AA) (Tentative) 2.5 µg/l (MAC) (Tentative)	EA/SNIFFER (1998)
Omethoate	0.01µg/l (AA) (Statutory)	No standard proposed	HMSO (1998a) and HMSO (1998c)
Omethoate (Original EQS Report)	0.01µg/l (AA) (No MAC)	No standard proposed	DoE (1994)
Oxolinic acid	Limited data. No EQS proposed	Limited data. No EQS proposed	DoE (1994)
Oxytetracycline	Limited data. No EQS proposed	Limited data. No EQS proposed	DoE (1994)
PCSDs (total)	0.05µg/l (95%ile) (EQS's 1 and 2) (Statutory)	0.05µg/l (95%ile) (Statutory)	HMSO (1989)
Pendimethalin	1.5µg/l (AA) (Tentative) 6µg/l (MAC) (Tentative)	1.5µg/l (AA) (Tentative) 6µg/l (MAC) (Tentative)	DETR (1997)
Pentachlorophenol (total)	2µg/l (AA) (Statutory)	2µg/l (AA) (Statutory)	EC, HMSO 1989, HMSO 1990
Permethrin (total)	0.01µg/l (95%ile) (EQS's 1 and 2) (Statutory)	0.01µg/l (95%ile) (Statutory)	HMSO (1989)
PH	6-9 (95%ile) (EQS's 1 and 2) (Statutory)	6 - 8.5 (95%ile) (Statutory) (a more restricted range of 7.0-8.5 should be applied for the protection of shellfish)	HMSO (1989)
Phenol	30µg/l (AA) 300µg/l (MAC)	30µg/l (AA) 300µg/l (MAC)	EA (1995)
Dimethyl phthalate (DMP)	800 µg/l (AA) (Tentative) 4000 µg/l (MAC) (Tentative)	800 µg/l (AA) (Tentative) 4000 µg/l (MAC) (Tentative)	DETR (1998)
Diethyl phthalate (DEP)	200µg/l (AA) (Tentative) 1000 µg/l (MAC) (Tentative)	200µg/l (AA) (Tentative) 1000 µg/l (MAC) (Tentative)	DETR (1998)

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
Di-butyl phthalates (DBPs)	8µg/l (AA) (Tentative) 40 µg/l (MAC) (Tentative)	8µg/l (AA) (Tentative) 40 µg/l (MAC) (Tentative)	DETR (1998)
Butylbenzyl phthalate (BBP)	20µg/l (AA) (Tentative) 100 µg/l (MAC) (Tentative)	20µg/l (AA) (Tentative) 100 µg/l (MAC) (Tentative)	DETR (1998)
Di-octyl phthalates (Dopes)	20µg/l (AA) (Tentative) 40 µg/l (MAC) (Tentative)	20µg/l (AA) (Tentative) 40 µg/l (MAC) (Tentative)	DETR (1998)
Dicyclohexyl phthalate (DCHP)	-	-	DETR (1998)
Phthalates (see above)			
Pirimicarb (Total)	1.0µg/l (AA) 5.0µg/l (MAC)	1.0µg/l (AA) (Interim Guideline) 5.0µg/l (MAC) (Interim Guideline)	DoE (1996)
Pirimiphos-methyl	0.015µg/l (AA) 0.05µg/l (MAC)	0.015µg/l (AA) (Tentative) 0.05µg/l (MAC) (Tentative)	DETR (1997)
Prochloraz	4µg/l (AA) (Tentative) 40µg/l (MAC) (Tentative)	4µg/l (AA) (Tentative) 40µg/l (MAC) (Tentative)	DETR (1998)
Propetamphos ^(e)	0.03µg/l (AA) (Tentative) 0.1µg/l (MAC) (Tentative)	0.03µg/l (AA) (Tentative) 0.1µg/l (MAC) (Tentative)	EA/SNIFFER (2000)
Propyzamide	100µg/l (AA) (Tentative) 1000µg/l (MAC) (Tentative)	100µg/l (AA) (Tentative) 1000µg/l (MAC) (Tentative)	DETR (1998)
Silver (Total dissolved)	0.05µg/l (AA) 0.1µg/l (MAC)	0.5µg/l (AA) (Interim Guideline) 1.0µg/l (MAC) (Interim Guideline)	DoE (1996)
Simazine (a) (Statutory Instrument does	2µg/l (AA) (Statutory)	2µg/l (AA) (Statutory)	HMSO (1997) and

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
not state if this should be dissolved)			HMSO (1998b)
Simazine (dissolved) (a) (Original EQS Report)	2µg/l (AA) 10µg/l (MAC)	2µg/l (AA) 10µg/l (MAC)	DoE (1991)
Sodium ^(d)	Original 170000µg/l (AA) proposed, however an update was carried out and it was proposed that no EQS was necessary	None proposed	EA (1992)/(1999)
Sulcofuron (total)	25µg/l (95%ile) (EQS1 & EQS2) (Statutory)	25µg/l (95%ile) (Statutory)	HMSO (1989)
Sulphate ^(d)	400000µg/l (AA)	None proposed	EA (1992)/(1999)
Styrene	50µg/l (AA) (Tentative) 500µg/l (MAC) (Tentative)	50µg/l (AA) (Interim Guideline) 500µg/l (MAC) (Interim Guideline)	EA (1995)
Tecnazene (b) (Total)	1.0µg/l (AA) 10µg/l (MAC)	1.0µg/l (AA) (Interim Guideline) 10µg/l (MAC) (Interim Guideline)	DoE (1995)
Tetrachloroethylene	10µg/l (AA) (Statutory)	10µg/l (AA) (Statutory)	EC, HMSO 1992 a,b
Thiabendazole	5µg/l (AA) (Tentative) 50µg/l (MAC) (Tentative)	5µg/l (AA) (Interim Guideline) 50µg/l (MAC) (Interim Guideline)	DoE (1995)
Tin	25µg/l (AA) (Total)	10µg/l (AA) (Dissolved)	DoE (1989)
Toluene	50µg/l (AA) (Statutory)	40µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
Toluene (Original EQS Report)	50µg/l (AA) 500µg/l (MAC)	40µg/l (AA) 400µg/l (MAC)	DoE (1992)
Triallate	0.25µg/l (AA) (Tentative) 5µg/l (MAC) (Tentative)	0.25µg/l (AA) (Tentative) 5µg/l (MAC) (Tentative)	DETR (1998)
Triazophos	0.005µg/l (AA) (Statutory)	0.005µg/l (AA) (Statutory)	HMSO (1998a) and

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
			HMSO (1998c)
Triazophos (Original EQS Report)	0.005µg/l (AA) 0.05µg/l (MAC) (Tentative)	0.005µg/l (AA) 0.05µg/l (MAC) (Interim Guideline)	DoE (1994)
Tributyltin cmpds (Total)	0.02µg/l (MAC) (EQS's 1 and 2) (Statutory)	0.002µg/l (MAC) (Statutory)	HMSO (1989)
Tributyltin)	0.02µg/l (MAC) (Statutory)	0.002µg/l (MAC) (Statutory)	HMSO (1997) and HMSO (1998b)
Tributyl phosphate	50µg/l (AA) (Tentative) 500µg/l (MAC) (Tentative)	50µg/l (AA) (Tentative) 500µg/l (MAC) (Tentative)	DETR (1998)
Trichlorobenzene (all isomers) (Total)	0.4µg/l (AA) (Statutory)	0.4µg/l (AA) (Statutory)	EC, HMSO 1992 a,b
1,1,1-trichloroethane	100µg/l (AA) (Statutory)	100µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
1,1,1-trichloroethane (Original EQS Report)	100µg/l (AA) 1000µg/l (MAC)	100µg/l (AA) 1000µg/l (MAC) (Interim Guideline)	DoE (1992)
1,1,2-trichloroethane	400µg/l (AA) (Statutory)	300µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
1,1,2-trichloroethane (Original EQS Report)	400µg/l (AA) 4000µg/l (MAC)	300µg/l (AA) 3000µg/l (MAC)	DoE (1992)
Trichloroethene (trichloroethylene) (total)	10ug/l (AA) (Statutory)	10ug/l (AA) (Statutory)	EC, HMSO 1992 a,b
Trifluralin	0.1µg/l (AA) (Statutory)	0.1µg/l (AA) (Statutory)	HMSO (1997) and HMSO (1998b)
Trifluralin (Original EQS Report)	0.1µg/l (AA) (dissolved) 1µg/l (MAC) (dissolved)	0.1µg/l (AA) (dissolved) 20µg/l (MAC) (total)	DoE (1990)

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
	20µg/l (MAC) total		
Triphenyltin cmpds (Total)	0.02µg/l (Statutory) (MAC) (EQS1 & EQS2)	0.008µg/l (Statutory) (MAC)	HMSO (1989)
Triphenyltin and its derivatives	0.02µg/l (Statutory) (MAC)	0.008µg/l (Statutory) (MAC)	HMSO (1997) and HMSO (1998c)
Vanadium (Total)	EQS1 EQS2 0 - 50mg CaCO ₃ /l 20µg/l 20µg/l 50-100mg CaCO ₃ /l 20µg/l 20µg/l 100-150mg CaCO ₃ /l 20µg/l 20µg/l 150-200mg CaCO ₃ /l 20µg/l 20µg/l 200-250mg CaCO ₃ /l 60µg/l 60µg/l >250mg CaCO ₃ /l 60µg/l 60µg/l (all as AA) (Statutory)	100µg/l (AA) (Statutory)	HMSO (1989)
Xylenes	30µg/l (AA) (Statutory)	30µg/l (AA) (Statutory)	HMSO (1998a) and HMSO (1998c)
Xylenes (3 isomers total) (Original EQS Report)	30µg/l (AA) 300µg/l (MAC)	30µg/l (AA) 300µg/l (MAC)	DETR (1997)
Zinc (see note 2)	EQS1 EQS2 0-50mg CaCO ₃ /l 8µg/l 75µg/l 50-100mg CaCO ₃ /l 50µg/l 175µg/l 100-150mg CaCO ₃ /l 75µg/l 250µg/l 150-200mg CaCO ₃ /l 75µg/l 250µg/l 200-250mg/l CaCO ₃ /l 75µg/l 250µg/l >250mg CaCO ₃ /l 125µg/l 500µg/l (all as total AA) (Statutory)	40µg/l (AA) (dissolved) (Statutory)	DoE SDD (1985)
Zinc (revision – see Note 2)	0-50mg CaCO ₃ /l 8µg/l	10µg/l (AA) (dissolved)	DoE

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
	50-100mgCaCO ₃ /l 15 µg/l 100-150mg CaCO ₃ /l 15µg/l 150-200mg CaCO ₃ /l 50µg/l 200-250mg/l CaCO ₃ /l 50µg/l >250mg CaCO ₃ /l 50µg/l (all as dissolved AA)		

Notes:

- (a) Sum of atrazine and simazine
 (b) Total tecnazene = sum of tecnazene, 2,3,5,6-tetrachloroaniline (TCA) and 2,3,5,6-tetrachlorothioanisole (TCTA)
 (c) These values are also proposed for total 'urons' i.e. diuron, linuron, isoproturon, chlorotoluron
 (d) Total anions of 250000 µg/l (AA) also proposed. Total anions concentration 'normalised' to Cl⁻ by Cl⁻ = SO₄⁻/1.5 = NO₃⁻/1.8
 (e) The total concentration of diazinon, chlorfenvinphos, propetamphos, coumaphos and fenchlorphos should not exceed an AA of 0.03µg/l or a MAC of 0.1 µg/l
 EQS 1 - derived to protect the most sensitive aquatic life
 EQS 2 - derived to protect less sensitive aquatic life

Additional Notes

1: 'Organisation' denotes the organisation for which the EQS and resultant report was originally derived/produced along with the date the final standard/report was published.
 e.g.: EA = Environment Agency (formerly National Rivers Authority)
 SNIFFER = Scottish and Northern Ireland Forum for Environmental Research
 DoE = Department of the Environment
 DETR = Department of the Environment, Transport and the Regions
 DEFRA = Department for Environment, Food and Rural Affairs

HMSO - where the 'Organisation' is listed as 'HMSO' this refers to the following:

HMSO 1989 refers to the circular in which the first batch of statutory EQS's were proposed.

Since then the following Statutory Instruments providing lists of statutory EQS's have come into effect in England and Wales and separately in Scotland:

For England and Wales:

HMSO (1989) Statutory Instrument 1989 No. 2286. Water, England and Wales. The Surface Waters (Dangerous Substances) (Classification) Regulations 1989

HMSO (1992a) Statutory Instrument 1992 No. 337. Water, England and Wales. The Surface Waters (Dangerous Substances) (Classification) Regulations 1992

HMSO (1997) Statutory Instrument 1997 No. 2560. Water Resources, England and Wales. The Surface Waters (Dangerous Substances) (Classification) Regulations 1997

HMSO (1998a) Statutory Instrument 1998 No. 389. Water Resources, England and Wales. The Surface Waters (Dangerous Substances) (Classification) Regulations 1998

For Scotland:

HMSO (1990) Statutory Instrument 1990 No. 126 (S.15). Public Health, Scotland. The Surface Waters (Dangerous Substances) (Classification) (Scotland) Regulations 1990

HMSO (1992b) Statutory Instrument 1992 No. 574 (S.63). Public Health, Scotland. The Surface Waters (Dangerous Substances) (Classification) (Scotland) Regulations 1992

HMSO (1998b) Statutory Instrument 1998 No. 250 (S.9). Water, Scotland. The Surface Waters (Dangerous Substances) (Classification) (Scotland) Regulations 1998

HMSO (1998c) Statutory Instrument 1998 No. 1344 (S.68). Water Supply, Scotland. The Surface Waters (Dangerous Substances) (Classification) (Scotland) (No.2) Regulations 1998

SDD (1985) Scottish Development Department, 1985 (November). SDD Circular No 34/1985 Guidance on Implementation of the Directive 76/464/EEC on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community.

For comparison's sake (and because MACs have tended not to be made statutory) the EQS's proposed in the original EQS report are also presented.

- EC - Where the Organisation is listed as 'EC', the standard refers to one for a List 1 chemical. For these chemicals the standards were derived and published by the EC in Daughter Directives of the Dangerous Substances Directive. No original reports providing the derivation are available. The references for the Statutory Instruments in which the values were implemented are also provided
- 1a) Based on the EC Directive the value stated came into force in January 1994. While the Scottish Statutory Instrument implementing these values have been located (and is referenced) none could be located for England and Wales and so a reference cannot be provided.

2: Updates for some metals were undertaken in the early 1990s. Some of these updates proposed standards slightly different to the statutory one however, while these revised values may be used operationally by Regulatory Authorities, they have not been made directly statutory.

Table 2: PNEC values proposed for Steroid Oestrogens

DETERMINAND	PREDICTED NO EFFECT CONCENTRATION (PNEC)		ORGANISATION ¹
	FRESHWATER	MARINE	
17 α -Ethinylestradiol	0.0001 μ g/l (AA)	0.0001 μ g/l (AA) (Tentative)	EA (2002)
Oestrone	None determined, inadequate data	None determined, inadequate data	EA (2002)
17 β -Oestradiol	0.001 μ g/l (AA) (Tentative)	0.001 μ g/l (AA) (Tentative)	EA (2002)
Oestriol	None determined, inadequate data	None determined, inadequate data	EA (2002)

Notes:

1: 'Organisation' denotes the organisation for which the PNEC and report was originally derived/produced along with the date the final standard/report was published.

EA = Environment Agency

Table 3: Additional EQS's derived for DEFRA in 2003

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
Antracene	0.02µg/l (AA) 0.1µg/l (MAC)	0.02µg/l (AA) 0.1µg/l (MAC)	DEFRA (2003)
Pentabromodiphenylether	0.5µg/l (AA) (No MAC proposed due to an absence of sufficient reliable data)	0.5µg/l (AA) (No MAC proposed due to an absence of sufficient reliable data)	DEFRA (2003)
Octabromodiphenylether	None proposed due to an absence of sufficient reliable data	None proposed due to an absence of sufficient reliable data	DEFRA (2003)
Decabromodiphenylether	None proposed due to an absence of sufficient reliable data	None proposed due to an absence of sufficient reliable data	DEFRA (2003)
C ₁₀ -C ₁₃ chloroalkanes	0.5µg/l (AA) 1.4µg/l (MAC)	0.5µg/l (AA) 1.4µg/l (MAC)	DEFRA (2003)
Chlorpyrifos	0.002µg/l (AA) 0.01µg/l (MAC)	0.001µg/l (AA) 0.01µg/l (MAC)	DEFRA (2003)
Benzo-a-pyrene	0.03µg/l (AA) 0.5µg/l (MAC)	0.03µg/l (AA) 0.5µg/l (MAC)	DEFRA (2003)
Benzo-b-fluoranthene	None proposed due to an absence of sufficient reliable data	None proposed due to an absence of sufficient reliable data	DEFRA (2003)
Benzo-g,h,i-perylene	None proposed due to an absence of sufficient reliable data	None proposed due to an absence of sufficient reliable data	DEFRA (2003)
Benzo-k-fluoranthene	None proposed due to an absence of sufficient reliable data	None proposed due to an absence of sufficient reliable data	DEFRA (2003)
Indeno (1,2,3-cd) pyrene	None proposed due to an absence of sufficient reliable data	None proposed due to an absence of sufficient reliable data	DEFRA (2003)

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD		ORGANISATION ¹
	FRESHWATER	MARINE	
Fluoranthene	0.02µg/l (AA)	0.002µg/l (AA)	DEFRA (2003)
	0.1µg/l (MAC)	0.01µg/l (MAC)	

Notes:

1: 'Organisation' denotes the organisation for which the EQS and report was originally derived/produced along with the date the final standard/report was published.

DEFRA = Department for Environment, Food and Rural Affairs

Table 4: EQS values used by SEPA in regulating use of chemicals in aquaculture

(a) Marine Environment

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD (EQS)		REFERENCE
	WATER	SEDIMENT	
Azamethiphos (Salmosan)	MAC after 3 hrs – 250 ng/l MAC after 24 hrs – 150 ng/l MAC after 72 hrs – 40 ng/l		SEPA Policy 17 – November 1998
Cypermethrin (Excis)	3hrs – 16 ng/l – predictive modelling 24 hrs – 0.5 ng/l – max concentration in the system Annual Average – 0.05 ng/l anywhere in the system		SEPA Policy 30 – September 1998
Dichlorvos (Aquagard)	25,000 ng/l – 1 hr post release (outwith mixing zone) 6,000 ng/l – before next release 600 ng/l – 24 hr post release 40 ng/l – annual average		DoE 1991
Emamectin Benzoate (Slice)	MAC - 0.22 ng/l	0.763 µg/kg dry wt/5 cm core depth – as a MAC – outside the allowable zone of effects area (100m from edge of cages – increased up to 150m where strong directional currents exist) 7.63 µg/kg dry wt/5 cm core depth – as an average value – applied within the immediate under cage impact zone, up to 25m from cage edges.	SEPA Recommendation 1999
Ivermectin	Use not permitted.		
Teflubenzuron (Calicide)	Annual average – 6 ng/l MAC – 30 ng/l	2.0 µg/kg dry wt/5cm core depth – as a MAC – outside the allowable zone of effects area (100m from edge of cages – increased up to 150m where strong directional currents exist) 10 mg/kg dry wt/5 cm core depth – as an average value – applied within the immediate under cage	SEPA Policy 29 (version 1.1) – July 1999

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD (EQS)		REFERENCE
	WATER	SEDIMENT	
		impact zone, up to 25m from cage edges.	

Table 4: EQS values used by SEPA in regulating use of chemicals in aquaculture (ctd)

(b) Freshwater Environment

DETERMINAND	ENVIRONMENTAL QUALITY STANDARD (EQS)		REFERENCE
	WATER	SEDIMENT	
Bronopol (Pyceze)	MAC – 70 µg/l		SEPA Guidance – 10 June 2002
Malachite Green	Use not permitted		SEPA Guidance – 10 June 2002

Also see – SEPA’s “Marine Fish Farm Manual” which is available under Guidance on SEPA’s website - use link below:

<http://www.sepa.org.uk/guidance/fishfarmmanual/pdf/A.pdf>.

Appendix III

Minimum Reporting Values (MRV's) For Selected Substances

Substance	MRV (µg/l)	Comment
1, 1, 1 trichloroethane	1 µg /1	0.65 µg /1
1, 1, 2 trichloroethane	n/a	Likely to be similar to the above
1, 2 dichloroethane	1 µg /1	0.97 µg /1
2, 4 D ester	n/a	Methyl, ethyl, isopropyl, isobutyl and butyl each to 0.1
2, 4 dichlorophenol	n/a	
2 – chlorophenol	n/a	
4-chloro-3-methylphenol	n/a	
Aldrin	0.0001 µg /1	0.00002 µg /1
Atrazine	n/a	Info not readily available HIG area
Azinphos-ethyl	n/a	No information
Azinphos-methyl	n/a	0.5 µg /1 HIG method
Benzene	1 µg /1	0.6 µg /1
Cadmium	n/a	0.01 µg/11
Carbon tetrachloride	1 µg /1	0.6 µg /1
Chlorfenvinphos	n/a	0.023 µg /1 HIG method
Chloroform	1 µg /1	0.9 µg /1
Chloronitrotoluenes	n/a	2,6-CNT, 4,2-CNT, 4,3CNT, 2,4-CNT, 2,5-CNT each to 1 µg/l
PCB (individual congeners)	n/a	0.0005-0.010 µg /1 SW Area Method Performance not clear
Dementon	n/a	Dementon-s-methyl only
Diazinon	n/a	0.001 µg /1 HIG Area
Dieldrin	0.0001 µg /1	0.00002 µg /1
Dimethoate	n/a	0.29 µg /1 HIG Area
Endosulfan	n/a	Endosulphan a and endosulphan b, each to 0.005 µg/l
Endrin	0.0001 µg /1	0.00003 µg /1
Fenitrothion	n/a	0.020 µg /1 HIG Area
Fenthion	n/a	Information not readily available HIG Area
Hexachlorobenzene	0.0001 µg /1	0.0003 µg /1 gcms, 0.00003 µg /1 gc-ecd
Hexachlorobutadiene	n/a	0.003 µg /1 gcms
Hexachlorocyclohexanes	0.00003 µg /1	α - HCH, γ-HCH and δ-HCH each to 0.001 µg/l β-HCH to 0.005 µg/l 0.00003 µg /1
Isodrin	0.0001 µg /1	0.00005 µg /1
Malathion	n/a/	0.026 µg /1 HIG Area