BIOSOLIDS ASSURANCE SCHEME

Assured Biosolids Limited
Biosolids Assurance Scheme

HAZARD ASSESSMENT

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FOREWORD

The Biosolids Assurance Scheme and associated documents have been prepared by Assured Biosolids Limited (ABL) in consultation with industry experts.

This document provides an assessment of potential hazards both in source materials to the sludge treatment process and in end product biosolids and the management control measures adopted in the Scheme Standard to mitigate any associated risks to humans, animals, crops and the environment.

CONTENTS

Assessment and control of potential hazards

1. Introduction

Hazard Analysis and Critical Control Point – HACCP (Codex Alimentarius, 2009) methodology is widely used in farming and food processing industries to identify and control food safety risks. As biosolids is an input to agriculture and indirectly to the food chain, it has become increasingly relevant to align biosolids recycling practices with those adopted in the farming and food industries by applying a similar methodology to the processing of biosolids products for recycling to agricultural land. In 2003, the water industry adopted HACCP methodology for the control of microbiological parameters in its sludge treatment processes, which has helped to increase both process control and product consistency. The Biosolids Assurance Scheme builds on this previous work by using a similar approach for the control of other potential hazards and integrates identified management controls within the Scheme Standard.

2. The application of HACCP methodology

2.1. **Hazard analysis:** potential hazards in end product biosolids and their application to agricultural land were identified and are discussed in more detail in Sections 3 to 6. The principle hazards identified were; microbiological parameters; heavy metals and other elements; nutrients (nitrogen and phosphate); and nuisance odours. The risk to humans, animals, crops and the environment were assessed for each hazard to determine the need for controls.

2.2. **Critical Control Points** (CCPs) and **Critical Limits** (CLs) will be used to control microbiological parameters in sludge treatment where the physical process can be influenced to reduce or eliminate the potential hazard.

2.3. **Management Control Measures** (MCMs) and their corresponding actions required as part of the Standard (Section 7 - Standard Requirements) will be used to control heavy metals and other elements; nutrients (nitrogen and phosphate); and nuisance odours. Note HACCP process terminology has not been used for these potential hazards as they will be controlled by management assessment and decisions, and specifications already identified within the Standard.

2.4. **Monitoring** requirements of Critical Limits and Standard Requirements have been set out in the Standard.

2.5. **Corrective Actions** for deviation from Critical Limits and Standard Requirements have been set out in the Standard.

2.6. **Verification** of the effectiveness of the Standard for the assessment and control of potential hazards will be part of the annual review of objectives of the Scheme.

2.7. **Documentation** and record keeping requirements have been set out in the Standard.

3. Microbiological parameters

Assessment of risk and the need for controls

Hazard type: biological

Risk group	Humans	Animals	Crops	Environment (soil, air, water)
Risk description	Food contamination or disease transmission through contamination of soil and subsequent crops.	Food contamination or disease transmission through contamination of soil and grazed crops.	None	Direct elevation of levels in soil
Controls required	Yes	Yes	No	No

3.1. One of the main objectives of sludge processing is to reduce or eliminate potentially harmful micro-organisms e.g. *E. Coli and Salmonella* spp. in the biosolids end product. *E. Coli* testing is used worldwide as an indicator for faecal contamination and concentrations.

3.2. To consistently achieve end product microbiological parameter limits, for both *Conventionally* and *Enhanced* treated biosolids, sludge processing should be subject to risk assessment, monitoring and control measures.

3.3. By its nature, HACCP does not preclude any form of sludge treatment so as not to prevent the development of innovative or novel methods of treatment, but instead serves to document the key steps that sludge should go through during a treatment process.

3.4. As a general overview, HACCP is used to detail the process of treatment, identify the main hazards to the process and put in place control measures that reduce the risk of those hazards occurring to an acceptable level.

3.5. By managing and monitoring the process to ensure that it remains within defined limits, a consistent quality of biosolids end product can be expected.

3.6. Due to significant differences in technologies used for sludge treatment, a detailed HACCP plan will be created for each Processing Facility (Sludge Treatment Centre), where biosolids are planned to be recycled to agriculture.

3.7. *Critical Control Points* (CCPs) will be identified in each Processing Facility Sludge HACCP plan. These may include for example; measurement of potentially harmful microbiological parameters in untreated sludge (before processing); processing temperature, time, pH; and measurement of potentially harmful microbiological parameters in the end product (including calculated reductions in *E. coli* concentrations across the treatment process).

3.8. *Critical Limits* (CLs) for each CCP will be identified in each Processing Facility HACCP plan and will be specific to each plant.

3.9. The requirement for a Processing Facility HACCP plan is included in Section 2 of the Standard.

3.10. The following table identifies the HACCP and Management Control Measures that are required to manage the risks associated with potentially harmful microbiological parameters.

Process stage	**Management Control Measures**	**Reference in the Standard**
Inputs to sludge treatment	Complete Source Material Risk Assessments	Section 1
Sludge treatment	Each Processing Facility will have a site specific HACCP plan to control microbiological parameters. This will include site specific *Critical Control Points* and *Critical Limits.* Microbiological parameter levels should be reduced by treatment processes. Log reduction capability testing (Process Validation Procedures) and process monitoring should be used to confirm that the process will continually achieve the required end product standard.	Section 2 Section 2
Biosolids	Microbiological parameter limits (i.e. maximum allowable concentrations - MACs) in the biosolids end product.	Section 2
Field storage	Controls on amount, location, frequency and duration.	Sections 3/4
Application to agricultural land	Restrictions on biosolids applications to agricultural land used for specific crops (Safe Sludge Matrix). Selection of suitable land (and the subsequent crops) will require assessment.	Sections 5 & 6/7

4. Heavy metals and other elements

Assessment of risk and the need for controls

Hazard type: chemical

Risk group	Humans	Animals	Crops	Environment (soil, air, water)
Risk description	Through contamination of soil and subsequent crops	Through contamination of soil and grazed crops	Through contamination of soil and detriment to plant growth	Direct elevation of levels in soil
Controls required	Yes	Yes	Yes	Yes

4.1. Potentially Toxic Elements (PTEs) include the heavy metals; Zinc, Copper, Nickel, Cadmium, Lead, Chromium and Mercury that are present in biosolids (and naturally occurring in soil). These metals, sourced from domestic and industrial effluents, can be measured before and after sewage sludge treatment. There has been a marked reduction in metal concentrations in untreated sludge over many years, due to reduced industrial activity and tighter trade effluent consents. However, the increased use of advanced digestion technologies (resulting in dry solids loss) has the potential to increase metal concentrations in biosolids, as well as some concentration of nitrogen and phosphate.

4.2. The application rate of biosolids to land is principally restricted by nutrient additions, which in turn limit the rate of addition for metals. The addition rates of nutrients and metals in biosolids are controlled by both legislation and Codes of Practice, which are included in the Scheme Standard.

4.3. Other elements include Arsenic, Fluoride, Molybdenum and Selenium that are monitored in sewage sludge and soils. Maximum concentrations and addition rates to soils are controlled by the Code of Practice, which is included in the Scheme Standard.

4.4. Therefore the risk to human and animal health, crops and the environment should be minimised.

4.5. The following table identifies the Management Control Measures required to manage the risks associated with heavy metals and other elements.

Process stage	Management Control Measures	Reference point in the Standard
Inputs to sludge treatment	Complete Source Material Risk Assessments.	Section 1
Biosolids	Sampling and analysis of heavy metals and other elements in end product biosolids.	Section 2
Field storage	Controls on biosolids amount, location, frequency (on the same site) and duration.	Sections 3/4
Application to agricultural land	Biosolids end product limits for use on grassland (lead and fluoride)**.** A farm assessment will be required. Biosolids should not be applied to agricultural land where soil sampling indicates maximum permissible heavy metal levels have been or will be exceeded. A farm assessment will be required. Biosolids application rates should not cause the rate of addition of metals and other elements to exceed maximum annual average rates of addition. A farm assessment will be required.	Section 5 Section 5 Section 5

5. Nutrients (nitrogen and phosphate)

Assessment of risk and the need for controls

Hazard type: chemical

Risk group	Humans	Animals	Crops	Environment (soil, air, water)
Risk description	None	None	Through excess application to soil leading to elevated nutrient levels.	Through excess or untimely field storage or application to soil leading to soil contamination and/or diffuse water pollution.
Controls required	No	No	Yes	Yes

5.1. Biosolids contain valuable quantities of nitrogen (*c.*4.0%) and phosphate (*c.*4.8%), which are important agronomic resources. However, excess application of these nutrients can lead to diffuse pollution. Legislation and Codes of Practice control the rate and frequency of application of nutrients in biosolids to agricultural land, which are also included in the Scheme Standard.

5.2. The following table identifies the Management Control Measures required to manage the risks associated with nutrients (nitrogen and phosphate).

Process stage	**Management Control Measures**	**Reference point in the Standard**
Inputs to sludge treatment	Complete Source Material Risk Assessments	Section 1
Biosolids	Sampling and analysis of nutrient levels in end product biosolids.	Section 2
Field storage	Controls on biosolids amount, location, frequency (on the same site) and duration.	Sections 3/4
Application to agricultural land	Biosolids applications should not exceed the nutrient requirements of the soils and crops.	Sections 6/7

6. Nuisance odours

Assessment of risk and the need for controls

Hazard type: physiochemical

Risk group	Humans	Animals	Crops	Environment (soil, air, water)
Risk description	Field storage and land application of odorous biosolids products can lead to odour complaints.	None	None	Field storage and land application of odorous biosolids products can impair air quality.
Controls required	Yes	No	No	Yes

6.1. The treatment of sewage sludge can reduce the level of nuisance odours by reducing fermentability. End products include liquids (*c.*4% dry solids), cake (*c.*25% dry solids) and thermally dried granules (*c.*94% dry solids). Odour management from biosolids field storage and following application to land is covered in *The Code of Practice for Agricultural Use of Sewage Sludge* (DoE, 1996). In addition, the Scheme Standard requires a risk assessment to be undertaken to demonstrate the management actions considered necessary to minimise odour (and other potential nuisance) in the selection of all field storage sites and during/following spreading activities.

6.2. The following table identifies the Management Control Measures required to manage risk associated with nuisance odours.

Process stage	**Management Control Measures**	**Reference point in the Standard**
Sludge treatment	Sludge treatment processes can reduce the fermentability and potential for nuisance odours in the end product.	Section 2
Biosolids	The biosolids end product should be a stable product fit for purpose. For example a *cake* for field storage should be sufficiently dewatered to enable it to be stored on a field without breaking down and releasing nuisance odours.	Section 3
Field storage	Controls on biosolids amount, location, frequency (on the same site) and duration.	Sections 3/4
Application to agricultural land	Application to land and subsequent incorporation into the soil should be done in a way that minimises the potential for nuisance odours.	Sections 6/7

7. Management Control Measures and Standard Requirements

Management Control Measures	Process Stage	Standard Requirements
MCM1 Assess risk to treatment process and end products within sludge inputs	INPUTS	Complete source material risk assessments
MCM2 HACCP plans and microbiological parameter log reductions in treatment	SLUDGE TREATMENT	HACCP plans, process validation procedures and process critical limits
MCM3 Microbiological parameter end product Maximum Allowable Concentrations (MACs)		Microbiological parameter checks on the end product (MAC)
MCM4 Prevention of diffuse pollution	FIELD STORAGE	Haulage and storage requirements specified
MCM5 Minimise nuisance odours		Storage requirements specified
MCM6 Application of biosolids types (microbiological parameters) restricted in advance of specific crops	LAND APPLICATION 	Land application requirements specified (Safe Sludge Matrix)
MCM7 Application of biosolids with high metal levels restricted in advance of specific crops		Land application requirements specified (Code of Practice)
MCM8 Application of biosolids prevented where soil pH is low and soil metals are too high or would become too high		Land application requirements specified (Regulations and Code of Practice)
MCM9 Application of biosolids restricted to maximum average annual addition rates of metals		Land application requirements specified (Regulations and Code of Practice)
MCM10 Application of biosolids restricted by nutrient additions to soil		Land application requirements specified (Regulations and water industry controls)
MCM11 Prevention of diffuse pollution		Land application requirements (CoGAP/PEPFAA and NVZ legislation)
MCM12 Minimise nuisance odours		Land application requirements specified

Note the numbered MCMs can be located in the Standard

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