Guideline

Open windrow composting

Open windrow composting under environmentally relevant activity 53(a) Organic material processing by composting

The guideline provides advice to assist Department of Environment and Science staff for consistent state-wide development assessment and regulation of Environmentally Relevant Activity 53(a) Organic material processing by composting operations for open windrow composting. The guideline will also assist operators to manage risk of environmental harm in design and operation of open windrow composting facilities and to achieve required environmental outcomes in accordance with the Environmental Protection Act 1994.

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Version history

Version	Date	Version details
1	04 JUN 2013	Document first published.
1a	26 MAY 2014	Minor rewording of section 1.2.
1.02	15 AUG 2016	Added publication number and updated to current corporate style.
1.03	15 JUN 2018	Document rebranded to align with machinery of government changes
2.00	23 NOV 2018	Updated for the Environmental Protection (Waste ERA Framework) Amendment Regulation 2018
2.01	08 OCT 2019	Updated to reflect the Environmental Protection Regulation 2019 remake

1. ERA 53(a) compost operations for open windrow composting

1.1 Introduction

This guideline for open windrow composting under Environmentally Relevant Activity (ERA) 53(a) Organic material processing by composting has been developed to provide clear and contemporary advice to the Department of Environment and Science's (DES's) development assessment staff to ensure consistency in approval conditions for open windrow composting, the most common type of composting in Queensland.

The guideline has also been developed to create clear expectations for operators, communities and local governments. The guideline provides advice to assist facility operators in assessing the risks of environmental harm in the design and operation of their facilities as well as complying with the general environmental duty (GED) per section 319 of the *Environmental Protection Act 1994*. It is intended that the use of outcome focused instead of prescriptive conditions will result in shorter development assessment timeframes and more consistent conditions of approval.

The guideline is also intended to reduce the amount of operator monitoring and reporting to DES by requiring it only for activities and aspects with the greatest potential for environmental harm while allowing other activities and aspects to be managed through operator GED.

1.2 Guideline scope

This guideline applies to open windrow composting operations that are regulated under ERA 53(a) that processes 200 tonnes (t) or more a year of organic material (which includes organic waste) by composting. (The Aggregate Environmental Score (AES) for ERA 53(a) is 18 under the Environmental Protection Regulation 2019 (EP Reg)).

1.3 About composting

Under the EP Reg, a development approval and environmental authority is required to carry out the environmentally relevant activity of organic material processing by composting (ERA 53(a)).

ERA 53(a) Organic material processing by composting

The activity does not include:

a) manufacturing mushroom growing substrate; or

b) the composting of organic material from agriculture or livestock production if:

   i) the organic material is either—

      A) composted at the site where it was produced; or

      B) transported to another site, where agriculture or livestock production is carried out, and composted at that site; and

   ii) the composted organic material is supplied, free of charge, for use at a site where agriculture or livestock production is carried out

Organic material means—

a) animal matter, including, for example, dead animals, animal remains and animal excreta; or

b) plant matter, including, for example, bark, lawn clippings, leaves, mulch, pruning waste, sawdust, shavings, woodchip and other waste from forest products; or

c) organic waste.

Organic wastes includes:

i) a substance used for manufacturing fertiliser for agricultural, horticultural or garden use;

ii) animal manure;

iii) bio-solids;

iv) cardboard and paper waste;

v) fish processing waste;

vi) food and food processing waste;

vii) grease trap waste;

viii) green waste;

ix) poultry processing waste;

x) waste generated from an abattoir; but

does not include:

i) clinical or related waste;

ii) contaminated soil;

iii) quarantine waste; or

iv) synthetic substances, other than synthetic substances used for manufacturing fertiliser for agricultural, horticultural or garden use .

Open windrow compost operations are based on thermophilic composting, a microbial process involving the degradation of organic compounds containing proteins and carbohydrates. This process releases heat, carbon dioxide and water as the primary by-products. To achieve sufficiently high thermophilic temperature conditions, raw materials must be prepared and/or combined to produce a suitable feedstock with adequate moisture, structure and porosity for the process and equipment employed. The metabolic activity of aerobic microorganisms (including a diverse range of bacteria and fungi) releases energy and generates heat as they consume materials in the presence of sufficient moisture and oxygen. A mechanism for maintaining adequate moisture and oxygen levels is required to avoid the formation of anaerobic conditions that are associated with the generation of obnoxious odours.

Commonly for open windrow composting the primary mechanism for introducing air into the windrow involves turning with a tractor, wheel loader, excavator or purpose built windrow turner to loosen and mix the materials. Appropriate turning of (adequately moistened) outer material to the inside of the windrow can ensure the entire mass is subjected to sufficiently high temperatures for a sufficient duration that all materials can be pasteurised, and decomposition can be more consistent throughout the windrow.

Oxygen can be introduced into windrows under pressure from blower fan piles. Where such forced aeration provides adequate distribution of air to maintain adequate oxygen levels throughout the decomposing mass, and where the cover or container provides sufficient insulation it is possible for the entire mass to be maintained at sufficiently high temperatures for a sufficient duration that all materials can be pasteurised without requiring turning. The material must be sufficiently moist throughout, and the absence of turning and mixing throughout the process requires that greater attention be given to preparing a homogeneous initial mixture for composting.

The highest biological oxygen demand, the greatest odour generation and vector (pests, including insects and birds) attraction potential, and the most rapid rate of decomposition of biodegradable organic materials and

organic waste materials all occur at the point of receipt, preparation, mixing and initial stages of decomposition. Once the more putrescible and higher nutrient materials are metabolised by microorganisms the rate of decomposition decreases and the level of biological stability increases.

General environmental duty (GED)

An operator is responsible for complying with the general environmental duty which includes understanding and managing the potential for environmental risk and taking all reasonable and practical measures to prevent environmental harm.

In deciding the measures to be taken to prevent environmental harm the operator should consider a number of factors. These include:

- physical, chemical and biological risks associated with the raw materials being received for processing
- the potential risks of environmental and community amenity impact from different processing activities (for example potential odour, noise, dust, and water discharge impacts beyond the property boundary and below ground)
- the likelihood of harm occurring upon application of products to land, taking into account the sensitivity of the receiving environment.

The operator should be aware of industry best management practices for open windrow composting and have the necessary technical knowledge of the activity and procedures and training so that measures can be implemented as needed in different weather conditions and phases of the operation to prevent environmental harm.

It is the responsibility of the operator to work out how to achieve the outcomes set by the department, and if the operator fails to achieve those outcomes they will be subject to enforcement action.

1.4 Agency interests

1.4.1 Odour

Odour, if not managed appropriately, has the potential to have an impact on the amenity and well-being of the surrounding community. Odour is generally the main source of public complaints in open windrow composting. Potential causes of odour from open windrow composting operations are:

- inadequate planning of the site selection and modelling of expected air emissions from the site resulting in insufficient distance and terrain buffers to existing or zoned residential and other sensitive development areas
- inappropriate management methods and infrastructure for the type of materials being processed
- poorly managed or poorly implemented operating procedures
- inappropriate materials accepted into the composting process
- inappropriate proportions of materials mixed into windrows
- inadequate handling of raw materials particularly for putrescible and/or high moisture content materials
- Inadequate aeration of windrows allowing establishment of anaerobic conditions within the decomposing biomass
- windrows at heights too high to be effectively managed with available plant and equipment (above four metres generally not recommended)

- inadequate odour mitigation measures.

Odour modelling and/or monitoring should consider meteorological aspects such as rainfall, relative humidity, wind direction and speed as this will help in determining the most likely source(s) of complaints. Field odour inspections to assess and identify the source of odour should follow a defined and standardised procedure to support consistent implementation.

1.4.2 Water

Contamination of surface and ground water from inadequate environmental management has the potential to occur from open windrow composting operations, and can result in significant environmental harm and remediation costs.

Stormwater

Potential causes of stormwater contamination:

- inadequate diversion of stormwater flow around contamination sources
- insufficient testing and treatment of stormwater prior to discharge into the environment
- inadequate erosion and sediment control measures
- site slopes that are too steep and/or non-uniform slopes that prevent proper direction of stormwater towards holding ponds
- inadequate design and/or maintenance of holding ponds
- inadequate irrigation and stormwater re-use systems.

Hierarchy of methods of dealing with stormwater

The order of preference for dealing with stormwater is indicated in the diagram below. The preference in the first instance is to avoid stormwater contamination.

Most preferred  **Least preferred**	1) Avoid the contamination of stormwater in the first instance. Measures may include: roofing areas where contaminants and or wastes are stored or handled, diverting uncontaminated stormwater runoff away from areas where contaminants or wastes are stored or handled, and preventing incident rainfall on contaminants or wastes and using alternate materials and or processes.
	2) Minimise the quantity and or hazardous nature of the contaminated stormwater generated, for example by minimising the size of areas where contaminants or wastes are stored or handled and by using materials and or processes.
	3) Recycling of contaminated stormwater produced, for example by incorporating reuse, reprocessing, and use of the stormwater.
	4) Treatment of any contaminated stormwater to render it less or non-hazardous.

Monitoring of stormwater and leachate run-off

The operator should monitor and record the quality of any stormwater or leachate which leaves the site that has been in contact with raw materials, wastes, or contaminants used for, and/or resulting from, carrying out the activity on the licensed place. The water quality monitoring regime should reflect the risk of potential environmental impacts associated with run-off from the site.

Where an operator needs to undertake monitoring, the following water quality parameters may be considered relevant depending on the level of environmental risk posed by the activities on site:

Aluminium; Nitrogen as Ammonia and Nitrate; Arsenic; Barium; Borate (boron); Cadmium; Calcium; Chromium (total); Copper; E Coli; Electrical conductivity; Fluoride; Iron; pH (field measured); Lead; Manganese; Mercury; Nickel; Phosphorus (total); Selenium; Silver; Sodium; Strontium; Sulphate; Tin; Total Organic Carbon (TOC); Total Petroleum Hydrocarbons (TPH); Zinc; and BTEX (i.e. benzene, toluene, ethyl benzene, xylene).

Groundwater

Potential causes of groundwater contamination from nitrates, pesticides, bacteria, pathogens and other contaminants include:

- inadequate hard stand area
- inappropriate site selection including aspects such as:
  - shallow water table
  - highly permeable or cracked soils
  - surface rock with fractures or bedding planes
  - vulnerability to subsidence and structural instability
  - existing contamination or acid sulfate soils
  - low groundwater recharge
  - high impact of the unsaturated zone of the aquifer on permeability
  - high hydraulic conductivity of the aquifer.
- inadequate erosion and sedimentation management
- inadequate direction of stormwater management around contamination sources and around where contaminants are stored.

Groundwater monitoring should be undertaken unless it can be proven:

a) the groundwater is at such a depth as not to be impacted

b) the geotechnical composition of the composting pad surface and/or subsurface is sufficiently impermeable so that groundwater is not impacted.

1.4.3 Feedstock (waste stream)

Inappropriate processing procedures and/or technologies for higher risk materials in open windrow composting have the potential to generate significant odour impacts, to attract vermin and other vectors (birds and insects), and to generate harmful leachate that could, unless contained, be released to contaminate surface water, groundwater and soil.

Various organic materials and some inorganic materials may be suitable for use in open windrow composting. The appropriateness of a waste stream for a composting facility is dependent on the capacity of a facility to manage risk factors embodied in the raw materials and to achieve acceptable environmental performance outcomes.

It is the responsibility of the operator to ensure that waste materials received onsite for feedstock are suitable for use in composting. It is not suitable to impose conditions on an environmental authority for an open windrow compost operation to indicate acceptable waste inputs.

Feedstock categories

Organic materials associated with a low potential environmental impact:

- plant material (including vegetation from garden and landscape management)
- untreated timber products and shavings
- natural organic fibrous organics such as peat, seed hulls/husks, and straw
- processed fibrous organic materials such as cardboard and paper waste, paper-processing sludge and non-synthetic textiles.

Organic materials associated with a low to medium potential environmental impact risk:

- other natural processed vegetable organics such as fruit and seeds, pomace and grapemarc, processing sludges and wastes
- winery, brewery and distillery wastes
- biosolids and manures such as sewage biosolids, septic wastes (unprocessed), animal manures
- mixtures of manure and biodegradable animal bedding organics.

Organic materials associated with the greatest potential environmental impact risk:

- meat, fish and fatty food wastes and animal by products such as carcasses and parts of carcasses, including blood, bone, fish, and fatty animal processing wastes
- fatty and oily sludges and organics of animal and vegetable origin including dewatered grease trap waste
- mixed residual waste containing putrescible organics (such as food and animal by-products) from household domestic waste sources or wastes from commercial and industrial waste sources.

Some inorganic materials may embody known and manageable risks to manufacturing and resulting product quality, and with appropriate risk assessment and analysis of the materials may be safely incorporated into some composting processes without adversely affect the composting process, whilst still enabling the manufacture of products that are safe and beneficial for land application. Such inorganic materials may be acceptable for inclusion under tightly managed procedures:

- crushed concrete
- excavated natural materials such as sand, clay and calcium bentonite
- some industrial by-products such as foundry sand
- some coal combustion products such as fly ash
- biodegradable plastics
- some drill wastes in the form of liquids and earthen materials from activities such as water boring, infrastructure drilling and coal seam gas drilling.

Inorganic wastes which may be suitable for use in compost and may also be categorised as regulated wastes under the EP Reg include foundry sand, coal combustion products, and coal seam gas drill wastes. An end-of-waste approval, ERA 55 Regulated waste recycling or reprocessing, or ERA 58 Regulated waste treatment approval may also be required from the department for operations which propose to use any inorganic waste that is a regulated waste in the composting process. Operators which propose to use inorganic regulated waste in the composting process should contact the department prior to using this material in the composting process.

Feedstock risk analysis and management

Determining waste acceptance criteria is the responsibility of the operator. Where there is a greater than low potential of environmental risk from adding the waste streams received onsite to the compost, the operator should assess the risk and characteristics of the waste materials and source before inclusion. This assessment should include the relevant material characteristics, contaminant levels and the potential for human or ecotoxicity (noting that contaminants can combine to form a substance(s) of greater environmental risk than the original waste stream).

To complete a risk assessment of waste received the operator may consider requesting a certified report or other adequate information from the waste provider about the waste received. Where relevant, information obtained should include representative sampling and analysis to characterise the chemical, physical and biological nature of the waste material as well as the potential for human or ecotoxicity. A risk assessment is particularly important in identifying process parameters and controls, including contaminants that might inhibit the composting process, and thereby determining the appropriateness of the proposed treatment method.

Any risk assessment should consider the general principles of the likelihood and consequences of an event occurring i.e. the likelihood of a release to the environment and the consequence if the waste material was released to the environment. A risk assessment of waste received should consider at a minimum: sampling frequency, chemical/physical/biological parameters to be analysed and the risk of environmental impact (i.e. ecotoxicology assessment) if the material were to be released to land, waters or atmosphere.

Industrial waste streams can be highly heterogeneous in composition and can be variable between loads due to factors such as time, location, season and the specific activity that generates the waste. Industrial waste streams, both solid and liquid, are often complex mixtures of compounds and contaminants, both organic and inorganic. In such situations, the risk assessment requires an initial characterisation of the primary compounds/contaminants of concern in the waste material in order to determine the highest ecological risk during the management of the waste material.

The consistency (i.e. homogeneity) or variability (i.e. heterogeneity) of the waste stream will determine the frequency and parameters requiring on-going analysis. The higher the variability in the composition of the waste stream, the more frequent the requirement to characterise the material to ensure that management practices are appropriate.

Each operator in the end-to-end waste management process (generating, providing, transporting, receiving, storing, recycling or disposing of a waste material) is required under general environmental duty to understand and manage potential risk impacts. Operators must make all reasonable efforts to provide an accurate description of waste materials delivered to another operator.

1.4.4 Noise

Noise, if not properly managed, has the potential to cause nuisance for surrounding sensitive places. Causes of noise nuisance can include:

- trucks loading and unloading and accessing the site
- equipment and machinery such as loaders, windrow turners, screeners and crushers inadequately sited on the property
- operating trucks, equipment and machinery without adequate noise mitigation devices and outside restricted hours
- inadequate planning in site selection resulting in insufficient distance and terrain buffers to existing sensitive places
- inadequate noise modelling for new operations and monitoring for existing operations of higher noise risk.

1.4.5 Dust

Dust, if not managed properly, also has the potential to cause nuisance beyond the boundary. Organic dusts and bio-aerosols may present an occupational health and safety risk. Causes of dust nuisance include:

- dry weather, hot dry weather
- insufficient moisture content in stockpiles and windrows
- screening materials that are excessively dry
- dry, unsealed roadways and inadequate ground spraying during heavy vehicle and equipment operation
- inadequate spray down of vehicles leaving the site to remove dirt and compost materials.

If dust modelling is conducted it should consider meteorological aspects such as rainfall, relative humidity, wind direction and speed as this will help in responding to dust complaints.

1.5 Process description, facility planning and design requirements

The design of a composting facility is complex because of the large number of variables that impact the process, facility size, equipment needs and operating cost. The environmental impacts of each of the variables (including the cumulative effects of these variables) should be considered in the design phase of the activity to assess risk and ensure the efficient and effective control of environmental impacts.

1.5.1 Environmental management system

An environmental management system is required as part of an application for an environmental authority for a composting facility to assess site capability and suitability for the activity, plan ways to manage risks and minimise any potential environmental harm, and meet performance outcomes. If there are multiple activities on site or if the multiple operations are involved an integrated environmental management system (IEMS) may be required. If an IEMS is required, the operator must implement a documented IEMS prior to the commencement of operation. The detail of the environmental management system or IEMS should reflect the complexity and risk of the activity.

1.5.2 Feedstock receipt and storage

The raw material received at a composting activity should be received in dedicated unloading areas that are suitable for the type of material being received. Materials should be prepared and mixed (as required) to form a feedstock that is suitable for windrows and managed to minimise the risk of environmental impacts.

The controls adopted will be dependent on the nature of organic materials and waste received and the risk of potential for odour and harm if released to the environment.

Waste providers and compost operations should be aware of best practice industry standards for receiving, handling and mixing raw material inputs to form a suitable feedstock mixture.

Mud and sludge wastes received, if not immediately mixed into the composting process should be adequately stored and dried (to a level of moisture content beneficial to the composting process) to prevent odour nuisance, surface and groundwater pollution, as well as accumulation of contaminants on site.

1.5.3 Feedstock preparation

Feedstock preparation is a key factor for odour control and is the process that initially establishes suitable particle size, nutrient balance and moisture content of the feedstock mixture to facilitate microbial growth. Particle size reduction, addition of carbon or nitrogen amendments and addition of water are performed during this step.

Depending on the quality and physical size of feedstock received, shredding and mechanical material handling is commonly required. Dust, odour and noise impacts of shredding and feedstock handling should be considered in the facility layout and design in order to achieve suitable buffers from nuisance sensitive receptors.

The decision to stockpile incoming raw materials or immediately incorporate with other materials will be dependent on the putrescibility, odour, leachate generation potential and the vector attraction potential of the particular material.

1.5.4 The composting process

The proper management of the composting process requires monitoring and management to control key process parameters (feedstock preparation and mixture, moisture, air, temperature) in order to manage risk of environmental impacts from dust, odour, leachate, vector attraction and access and contaminant levels. Through this process appropriate conditions are maintained to ensure (aerobic) microbial decomposition and to achieve stabilisation of the decomposing biomass. Open windrow composting involves the feedstock being stacked in long rows for efficient use of available area and for efficient management in discrete batches. The process involves turning the piles to aerate the mass, improve oxygen levels, alleviate compaction and (hence) avoid odour formation. Water may also be added to maintain suitable moisture content for microbial decomposition and to reduce dust generation when turning piles.

The Australian Standard AS4454 for composts, mulches and soil conditioners provides relevant information on requirements for pasteurization, internal composting temperatures, temperature profile monitoring and methodologies for sampling compost piles (amongst other things).

1.5.5 Odour control

Odour control throughout the composting process is a crucial aspect of environmental management for composting operations. Suitable methods and procedures required for odour control will be dependent on the proposed composting method, composition of material received and the potential impact of the activity on surrounding land users and sensitive receptors.

1.5.6 Liners and leachate management systems

Adequate liners (if appropriate) and leachate management systems are critical to prevent the contamination of groundwater systems. The leaching of nutrients to groundwater resources is a high risk where there is a significant degree of permeability of underlying soil/rock and also depends on the nature of feedstock and whether materials generate leachate. Liners and leachate management systems may be required where open windrow composting operations are not conducted undercover or within an enclosed structure or where soil permeability creates a risk of ground water contamination.

1.5.7 Surface water management controls

Well designed and maintained surface water management controls are necessary to prevent pollution and flooding to surrounding land uses and water features. Runoff containing organic constituents from organic materials and organic waste materials is a potential source of environmental impacts due to high nutrient loads in this material. Contaminated stormwater must be settled and/or treated prior to discharge to the environment. Avoiding flood prone areas is also critically important in site selection so as to prevent the release of site water or waste to land and surface and groundwater.

1.5.8 Screening and refining

The main environmental impacts from screening and refining activities are noise and dust which should be considered when selecting the site and designing the site layout. Refining and storing raw compost materials are optional steps that will vary from operation to operation due to differences in market needs. Screening and refining processes are addressed under sections 1.4.4, 1.4.5, 1.5.3 and Table 1 in more detail.

1.5.9 End product must not cause environmental harm

The department does not regulate product characteristics such as nutrient levels but GED requires that the end product does not contain pathogens or contaminant levels that when applied could cause harm to the environment and human health. Producers that sell or distribute a composting product should consider the level of product pathogen or contaminant levels that are appropriate for product end use. For example, certain products may be more appropriate for food production or residential use while other products are more suitable for development or rehabilitation of industrial sites. The sale or distribution of a product that could be found to have caused or contributed to environmental harm may result in enforcement action.

1.5.10 Final storage, bagging and bulk loading

The final stage of the composting activity is the storage and dispatch of material from site. This will vary from operation to operation and is dependent on market requirements. The potential environmental impacts at this stage of the process are dust and noise (for mature products) and odour (for immature products). The risks of impacts to surface and ground water quality continue to apply, particularly to immature products.

1.5.11 Guideline separation distances for odour and dust abatement and water quality

The site should be sited in a location so that the risk of impact from odour, dust and water quality beyond the property boundary can be adequately managed. Site selection and the design process should include the proposed separation distances to communities, residences, public roads, water supply storage, watercourses and groundwater bores.

Separation distances should be adequately supported by a plan of management and/or other relevant material such as an environmental management system that demonstrates that environmental risks will be managed and adequate measures are taken to protect the values of receptors. This may include odour, surface and ground water studies and specific operational measures depending on the geology, topography, ground works, and buffer provisions, on-site composting methods and the nature of raw feedstock.

Best practice is typically not to place an operation between the prevailing wind direction and any local residential or commercial development or other sensitive odour receptors. In assessing separation distances development assessment staff should also consider relevant local knowledge and consult with local government.

2. Table 1: Guidance on regulatory requirements for assessment of open window compost applications

Performance outcomes	Acceptable solutions
PO1 – Odour The activity will be operated in a way that odour nuisance is prevented.	Adequate planning and consultation with local authorities for appropriate site selection has been undertaken including the consideration of prevailing wind direction, local structures and landform, appropriate buffer distances and terrain barriers to existing or zoned residential areas, and any other sensitive receptors. The proposal includes adequate buffers between the operation and odour sensitive places and modelling has shown that odour will not be an issue. Feedstock for the windrows is prepared through mixing and/or shredding to establish suitable particle size distribution, nutrient balance and moisture content to facilitate microbial growth and reduce odour. Putrescible feedstock materials, if not pre-treated or dried to reduce putrescence and odour, are mixed immediately into the compost process. Where appropriate to waste streams being composted, windrows are managed by allowing an initial undisturbed phase for temperature build-up followed by appropriate blending and aeration, control of moisture and other measures to ensure microbial decomposition and stabilisation. Adequate odour control equipment is installed. Management plan and procedures for control of odour are established. Leachate and stormwater is prevented from pooling in the work areas and is directed towards suitable holding ponds. Windrow heights generally do not exceed four metres. Waste from the composting process is appropriately stored and managed until it is removed. Odour impact management includes use of weather forecasts and monitoring weather conditions, including the consideration of rainfall, temperature, wind direction and speed and the results are used to assist in reducing risk of odour complaints and responding to complaints (in relation to identifying if the facility was a likely source of the odours, and if so what activities were being conducted at the time). An environmental management system is implemented per International Organisation for Standards (ISO) 14000.

PO2 – Water quality The operation is managed so that the site does not adversely impact on the environmental values of surface water and groundwater quality.	**A) Storm and surface water quality** Adequate buffers exist between the operation and the receiving environment. Modelling has shown that stormwater quality can be managed. The implementation of an effective collection and recycling system for the reuse of stormwater on-site. Also, implementation of practical opportunities for off-site reuse by other persons of appropriately treated stormwater where reuse of the total expected volume on-site is not practicable. Stormwater is reused where possible and stormwater run-off is prevented from entering locations where contaminated water is stored. Water to be caught in drains and stored in adequately designed and maintained stormwater holding ponds. Contaminated water is directed to appropriate storage locations and to be kept separate from uncontaminated stormwater. Stormwater that is to be released into the environment is tested and appropriately treated taking into account the receiving environment before discharge and meets Environmental Protection Policy Schedule 1 Environmental values and water quality objectives for waters. Adequate erosion and sediment control measures are maintained. Site topography is limited and uniform (i.e. relatively flat to gently sloped) to minimise sediment movement and for the proper direction of stormwater towards holding ponds. Irrigation and stormwater re-use systems are adequately designed and maintained. Where a buffer between a facility and surface waters is potentially necessary, the applicant has considered Table 1 in the CSIRO Guidelines for Riparian Strips for Queensland Irrigators for agricultural operations in the six bio-geographical regions of Queensland. Site selection and design should sufficiently address the flood risk so that storm and flood waters do not enter the site. Where required, the applicant will conduct a qualified investigation and/or modelling report to assess the flood risk to the proposed site. The water quality sampling regime, including appropriate monitoring and reporting that reflects the types and levels of risk associated with the operation. An environmental management system is implemented per ISO 14000. **B) Groundwater quality** The submitted application information and/or modelling have shown that groundwater quality can be managed. Site selection and design have considered water table depth, soil characteristics and geology, slopes, any existing contamination or acid sulfate soils, groundwater recharge rate, impact of the

	unsaturated zone of the aquifer on permeability, and hydraulic conductivity of the aquifer. An adequate hard stand area is provided to prevent the leaching of contaminants to groundwater. Where soil permeability creates a risk of groundwater contamination the applicant has considered liners and leachate management systems. An adequate erosion and sedimentation management system is provided to minimise contact of surface water with ground water. Adequate direction of stormwater management around contamination sources is achieved. An environmental management system is implemented per ISO 14000.
PO3 – Feedstock (waste stream) management The waste inputs selected are beneficial to the composting process and can be managed to avoid adverse environmental impacts.	Feedstocks are selected that are beneficial to the composting process of an individual facility and will not have adverse environmental impacts such as odour nuisance, contamination of surface and ground water, and environmental harm in the end use of the product. The operator can effectively assess the potential environmental risk of different feedstock and is familiar with industry standards and best practices for processing feedstock and can determine a maturation period of sufficient length to produce stable and mature products that are safe and beneficial for use without risk of adverse impact on environment or health. For any individual waste streams that typically pose a greater than low environmental risk (see waste section categories) in open windrow composting, it has been demonstrated that waste(s) can be effectively composted by the facility whilst managing risk of adverse environmental impacts. The operator may request adequate information from the waste provider to complete this risk assessment, including representative sampling and analysis to characterise the chemical, physical and biological nature of the waste material. For any inorganic wastes suitable for composting but which are categorised as regulated wastes under the EP Reg, the applicant has investigated whether there is an end-of-waste code for the waste and has consulted department officers to determine whether an application for an end-of-waste approval, ERA 55 Regulated waste recycling or reprocessing, or ERA 58 Regulated waste treatment is also required. For drying of mud and sludge on site the operator has demonstrated that suitable on site facilities are provided to prevent environmental harm including but not limited to odour nuisance, surface and ground water contamination, and contamination of soil due to accumulation of contaminants on site. An environmental management system is implemented per ISO 14000.
PO4 – Noise The activity will be operated in a way that	Adequate planning and consultation with local authorities for appropriate site selection has been undertaken including sufficient buffer distance and terrain barriers to existing or zoned residential areas and any other sensitive receptors.

noise nuisance is prevented.	Application information and / or noise modelling references the local planning scheme and indicates that noise impacts from the site can be mitigated to meet Environmental Protection (Noise) Policy 2019 acoustic quality objectives for sensitive receptors. Noise nuisance to other properties is prevented in the on-going operation of the site. Measures are implemented to mitigate the impact of activities associated with high noise levels such as siting vehicles, equipment and machinery away from sensitive receptors, outfitting them with noise mitigation devices, and limiting their operation to specified hours. An environmental management system is implemented per ISO 14000.
PO5 – Dust The activity will be operated in a way that dust nuisance is prevented.	Site design, equipment, and operational procedures manage risk of dust impact to other properties. Dust impacts are sufficiently mitigated to meet Environmental Protection (Air) Policy 2019 Schedule 1 Air quality objectives. Measures are implemented to mitigate the impact of activities that cause dust, such as: • windrows are designed and managed (and moisture content maintained) to reduce the release of dust and windblown material • vehicles, equipment and machinery are sited away from sensitive receptors and their operation limited to specified hours • dust suppression spraying during heavy vehicle and equipment operation • spray down of vehicles leaving the site to remove dirt and compost materials • covered conveyor lines for intensive screening and mulching. Dust monitoring includes the consideration of rainfall, relative humidity, wind direction and speed and the results are used to assist in responding to odour complaints. An environmental management system is implemented per ISO 14000.
PO6 – Separation distances The activity will be operated in a way that adequate separation distances are maintained from sensitive receptors.	Site separation distances are sufficient to prevent adverse odour, water quality, noise and dust impacts to receptors. Separation distances should consider: locational factors, relevant local information, the integrated environmental management system and proposed environmental impact mitigation measures, and any other relevant information such as modelling. An environmental management system is implemented per ISO 14000.

These are not specific solutions and have been provided for guidance only. All ERA 53(a) open windrow compost applications for development approval and an environmental authority should be assessed on a case-by-case basis as the most appropriate management measures will vary depending on a number of factors including receiving environment values, intended waste stream inputs, land availability, composting technologies used, and management practices employed.