Environmental Guidelines for the Australian Egg Industry

A report for the Australian Egg Corporation Limited
As part of the DAFF EMS Pathways to Sustainable Agriculture Program

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GLOSSARY

Aerobic – contains dissolved or free oxygen.

Anaerobic – no dissolved or free oxygen.

Background site – the ideal background site for a by-product utilisation area should be close to the area of interest. It must have a similar soil type and land use to the utilisation area but must not have been used for spreading effluent or solid by-products.

Barn Laid – production system where birds are housed in a shed with nesting boxes and roosts provided.

Bedding – material placed on the floors of sheds to adsorb the manure produced by hens.

Best practice – the best practice at a particular time, following consideration of scientific information and accumulated experience and public opinion, but it must also consider the economic feasibility of various methods that might be available to a specific type of operation. It is generally a higher standard of practice than the minimum standard, except when the minimum standard is best practice. It can be varied as new information is developed and validated.

Biological Oxygen Demand (BOD) – A measure of the amount of oxygen consumed by microorganisms in breaking down organic matter in water over a certain time period. BOD is used as an indirect measure of the concentration of biologically degradable material present in organic wastes. It usually reflects the amount of oxygen consumed in five days by biological processes breaking down organic waste.

Biosecurity – protection from the introduction of potential disease organisms.

Breeding farms – those keeping breeding hens and roosters to produce fertile eggs.

Buffer distances – they are distances used to protect non-amenity resources, such as water resources and bio-security measures. They are measured as the distance between the impact source (sheds, manure stockpiles or by-product utilisation area) and the resources to be protected (e.g. watercourse, bore, other poultry farm).

Bunding – an embankment to exclude run-on and run-off.

By-product – manure (from cage and wire systems), spent litter (from barns and free-range systems), unhatched chicks, membranes, embryonic fluids, off-sex chicks, egg shells and liquid effluent (from hatcheries), liquid waste water and cracked/broken eggs (from grading floors) and egg washing water, egg shells and liquid waste (from egg product manufacturing).

By-product utilisation area – a managed area used for land-spreading of the by-products of egg production.

Cage Production - a production system where birds are kept in cages.

Chicks – newly hatched chickens.

Chemical Oxygen Demand (COD) – A measure of the amount of oxygen required for the total chemical breakdown of organic substances in water.

Community amenity – anything that is agreeable to the community.

Composite sampling – sample comprising a sub-sample of several grab samples collected over minutes, hours or days according to a sampling program.

Contaminant – can be a gas, liquid or solid, an odour, an organism (whether dead or alive), including a virus; energy; including noise and heat, or a combination of these.

Contamination – the release of a contaminant to the environment in the form of a gas, odour, liquid, solid, organism or energy.

Controlled drainage area – an area that collects contaminated stormwater runoff and excludes clean rainfall runoff.

Culls – chickens humanely killed for health or welfare reasons.

Eco-efficiency –a business-oriented approach to environmental management that focuses on reducing resource inputs and avoiding the generation of wastes and pollutants.

Effluent – for the purposes of the guidelines it is a liquid or slurry containing bird manure, spent litter or egg waste.

Egg facilities – egg chicken hatcheries, egg chicken pullet rearing facilities, egg production facilities (cage, free range and barn), grading floors and egg product manufacturing.

Erosion – the wearing away of the land surface by rain or wind, removing soil from one point to another e.g. gully, rill or sheet erosion.

Euthanase/euthanasia – an easy or painless death.

Eutrophication - is the process by which a body of water becomes rich in dissolved nutrients, thereby encouraging the growth and decomposition of oxygen-depleting plant life and resulting in harm to other organisms.

Exchangeable sodium percentage (ESP) **–** the percentage of a soil's cation exchange capacity that is occupied by sodium.

Freeboard – the height of the pond embankment crest above the design full storage level. The freeboard protects the bank against wave action and construction inaccuracies.

Free range – production system where birds have access to outside run area.

General environmental duty – all practical measures are taken to prevent harm to the environment.

Groundwater – all water below the land surface that is free to move under the influence of gravity.

Groundwater recharge – the replenishment of a groundwater body, by gravity movement of surplus soil water that percolates through the soil profile.

Hydraulic load – the input of water via precipitation and irrigation applications into a pond or onto land.

Leaching – process where soluble nutrients e.g. nitrogen are carried by water down through the soil profile.

Limiting nutrient – the element or nutrient that limits the sustainable application rate of by-product to land.

Litter – the composite of poultry manure and adsorbent bedding.

Major water supply storage – any public water supply storage, lake, lagoon, marsh or swamp.

Maximum standard – also referred to as "Best practice". Generally defined as in the text by the use of the words "should" or similar words or phrases, such as "consideration should be given to". (See also definition of "best practice").

Measuring point – for a watercourse this is the maximum level to which the water surface of a watercourse may reach before overtopping of a bank begins (bank-full discharge level). For a public road it is the surveyed boundaries of the road on the same side of the road as the operation. For tunnel ventilated sheds, without impact walls, the measuring point should be taken from a point 25 m out from the exhaust end of the shed. All other operations should measure the distance from the shed perimeter.

Minimum standard – minimum standard required. Generally defined in the text by the use of the word "must" or similar words or phrases.

Nutrient – a food essential for a cell, organism or plant growth. Phosphorus, nitrogen and potassium are essential for plant growth. In excess they are potentially serious pollutants encouraging nuisance growth of algae and aquatic plants in water. Nitrate-nitrogen poses a direct threat to human health. Phosphorus is the major element of concern in relation to algal blooms.

Organic carbon – a chemical compound making up organic matter. Organic carbon multiplied by 1.75 gives an estimate of organic matter.

Organic matter – chemical substances of animal or plant matter.

Pathogens – organisms that can cause infections or disease, such as a bacterium, viruses, fungi or protozoa.

pH – a measure of the acidity or alkalinity of a product. The pH scale ranges from 1 to 14. A pH of 7 is neutral, a pH below 7 is acidic and a pH above 7 is alkaline.

Piezometer – a non-pumping well, generally of small diameter, that is used to measure the elevation of the water table and for collecting samples for water quality analysis. It generally has only a short well screen through which water can enter.

Pollution – direct or indirect alteration of the environment causing contamination or degradation.

Potable water – water that is suitable for drinking by the human population because it contains no harmful elements.

Riparian land – any land that adjoins or directly influences a body of water. It includes the land immediately beside creeks and rivers (including the bank), gullies that sometimes run with water, areas surrounding lakes and wetlands and river floodplains that interact with the river during flood times.

Runoff – all surface water flow, both over the ground surface as overland flow and in streams as channel flow. It may originate from excess precipitation that can't infiltrate the soil or as the outflow of groundwater along lines where the watertable intersects the earth's surface.

Salinity – electrical conductivity (EC) is the generally accepted measure of salinity (that is: of the concentration of salts in solution). The salts that occur in significant amounts are the chlorides, sulphates and bicarbonates of sodium, potassium, calcium and magnesium. In water these salts dissociate into charged ions and the electrical conductivity of the solution is proportional to the concentration of these ions, providing a convenient means of measuring salinity. Usually expressed as deciSiemens per metre (dS/m) or its equivalent, milliSiemens per centimetre (mS/cm)

Sensitive area – public roads and any watercourse including a river, creek, lake, dam or wetland.

Sensitive land use – a sensitive land use includes a dwelling, dependant persons unit, residential building, hospital, school, child care centre, caravan park and other use involving the presence of people for an extended period of time.

Separation distances – Are distance used to protect sensitive land uses from amenity impacts (e.g odour, dust, noise, visual). The separation distance is measured, unless otherwise specified as the shortest distance measured from impact source (sheds, manure stockpiles or by-product utilisation area etc) to the nearest part of a building associated with the sensitive land use. Where there are potential 'as of right' or equivalent dwellings on an adjoining lot, the separation distance is measured to the centre line of the vacant lot.

Sludge – the accumulated solids separated from effluent during treatment and storage.

Sodicity – an excess of exchangeable sodium causing dispersion to occur.

Sodium absorption ratio (SAR) – a measure of the sodicity of water. It is the relative proportion of sodium ions to calcium plus magnesium ions. It is important since excess sodium in irrigation waters may adversely affect soil structure and permeability. A higher SAR value equates to a higher sodium content and higher potential for soil problems.

Soil electrical conductivity – a measure of the conduction of electricity through water, or a water extract of soil. The amount of electricity conducted can reflect the amount of soluble salts in an extract therefore providing an indication of soil salinity.

Soil profile – vertical cross-section of soil from the surface to the parent material or substrate.

Spent litter – litter that has been used as bedding but is no longer used for that purpose.

Surface waters – includes dams, impoundments, rivers, creeks and all waterways where rainfall is likely to collect.

Topography – the shape of the ground surface as depicted by the presence of hills, mountains or plains; that is, a detailed description or representation of the features, both natural and artificial, of an area, such as are required for a topographic map.

Total dissolved solids (TDS) – the inorganic salts (major ions) and organic matter / nutrients that are dissolved in water, used as a measure of salinity.

Total solids (TS) – dry matter content of a compound.

Vegetative filter strip (VFS) – a vegetated area separating an area where organic matter is deposited (e.g. by-product utilisation area or shed surrounds) and a watercourse, drainage line etc.

Volatile solids (VS) – the quantity of TS burnt or driven off when a material is heated to 600^0C for 1 hour. VS is a measure of the biodegradable organic solids content of a material.

Watercourse – a naturally occurring drainage channel that includes rivers, streams and creeks. It has a clearly defined bed and bank, intermittent flows. Refer to relevant state or territory acts for legal definition.

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1. INTRODUCTION

1.1. Purpose of the Document

These guidelines are a proactive approach by the industry to encourage all operators to strive towards Best Management Practice (BMP) to ensure both the economic and environmental sustainability of the Australian egg Industry.

They have been developed to enable participants in the Australian egg industry to assess the potential environmental impacts of their enterprises. They are also designed to enable operators to implement measures to minimise the risk of adverse impacts and continually improve the performance of their enterprise.

1.2. Scope of the Document

These Environmental and Planning Guidelines for the Australian Egg Industry (the guidelines) detail the development, design and management options to assist the egg industry with planning and environmental sustainability issues. The sectors of the industry covered by the guidelines include hatcheries, pullet rearing facilities, egg production facilities (cage, free range and barn), grading floors and egg product manufacturing. The guidelines were developed to allow the information to be incorporated into the National Egg Quality Assurance Program - Egg Corp Assured. It provides information that will enable egg operations to include environmental management issues into their Quality Assurance Program.

1.3. Guideline Contents

This first section of the guidelines provides background information on the egg industry and the purposes of the guidelines.

Section 2 of the guidelines provides an overview of the egg industry in Australia and egg production, egg grading and egg product manufacture (collectively called “egg facilities”). This is included to provide readers unfamiliar with the industry an understanding of the general concepts of the egg industry.

Section 3 provides information on how egg production and manufacturing facilities can affect the environment through impacts to community amenity, water (surface and ground) and land. It is these potential impacts that are addressed in the good practice design and management sections of the guidelines.

Section 4 focuses on best practice planning and location of egg production and manufacturing facilities. It is most relevant for operators intending to develop a new facility or expand an existing operation.

Section 5 provides information on design and construction considerations for egg facilities. It is most relevant to those planning to develop a new facility or refurbish an existing operation, particularly an egg production, pullet rearing or breeder farm.

Section 6 details best practice management for egg facilities.

Industry, regulators and the community can use Sections 4, 5 and 6 of the guidelines to ensure egg production, egg grading and egg product manufacturing facilities are developed, designed and managed to minimise the risk and severity of adverse environmental impacts.

Included at the back of the document are a number of references containing technical information that can be used by the egg industry in managing potential negative environmental impacts.

1.4. Limitations of the Guidelines

The guidelines have been developed to assist in minimising potential negative environmental impacts. ***However, it is important to be aware that each state and local government area may have specific laws and regulations that need to be followed. These regulatory requirements change over time and it is the responsibility of all business operators to ensure they are aware of and comply with all current relevant regulatory requirements.*** It is envisaged that the guidelines will assist the industry to address inconsistencies and omissions in the laws and regulations in relation to environmental management.

1.5. Review of the Guidelines

The information in these guidelines is based on current information, knowledge and practice and can be used as a reference standard. However, research and innovation may establish new accepted standards and redefine best management practices for the egg industry in the future.

Hence, the guidelines will be revised as new information and expertise on facility siting, design or management and to environmental management in the egg industry becomes available. Major reviews are envisaged every five years or more often if justified.

2. THE AUSTRALIAN EGG INDUSTRY

2.1. Industry Location

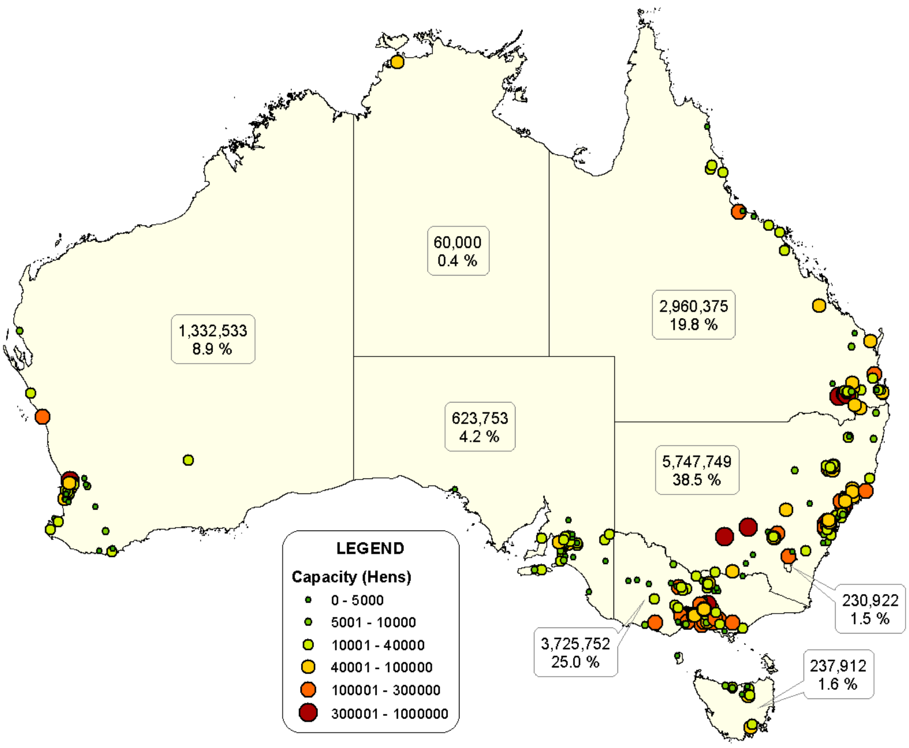
There are 423 egg producers in Australia with an annual production of 203 million dozen eggs (Australian Bureau of Statistics – 2004/05). These eggs are produced mainly in cage housing systems with barn laid and free range systems making up the balance.

Most eggs are sold as fresh shell eggs but a small proportion is processed to make egg products such as pulp ('liquid eggs') or powder.

Figure 1 shows the distribution of approved egg production farms (not necessarily constructed) across Australia. This figure is sourced from information gathered from a number of sources, including the AECL and the Poultry Cooperative Research Centre as of November 2007. This distribution has and will likely further change with the introduction of new cage legislation in each state.

Servicing these egg producers are breeding facilities, hatcheries, poultry rearers, grading facilities and egg product manufacturers.

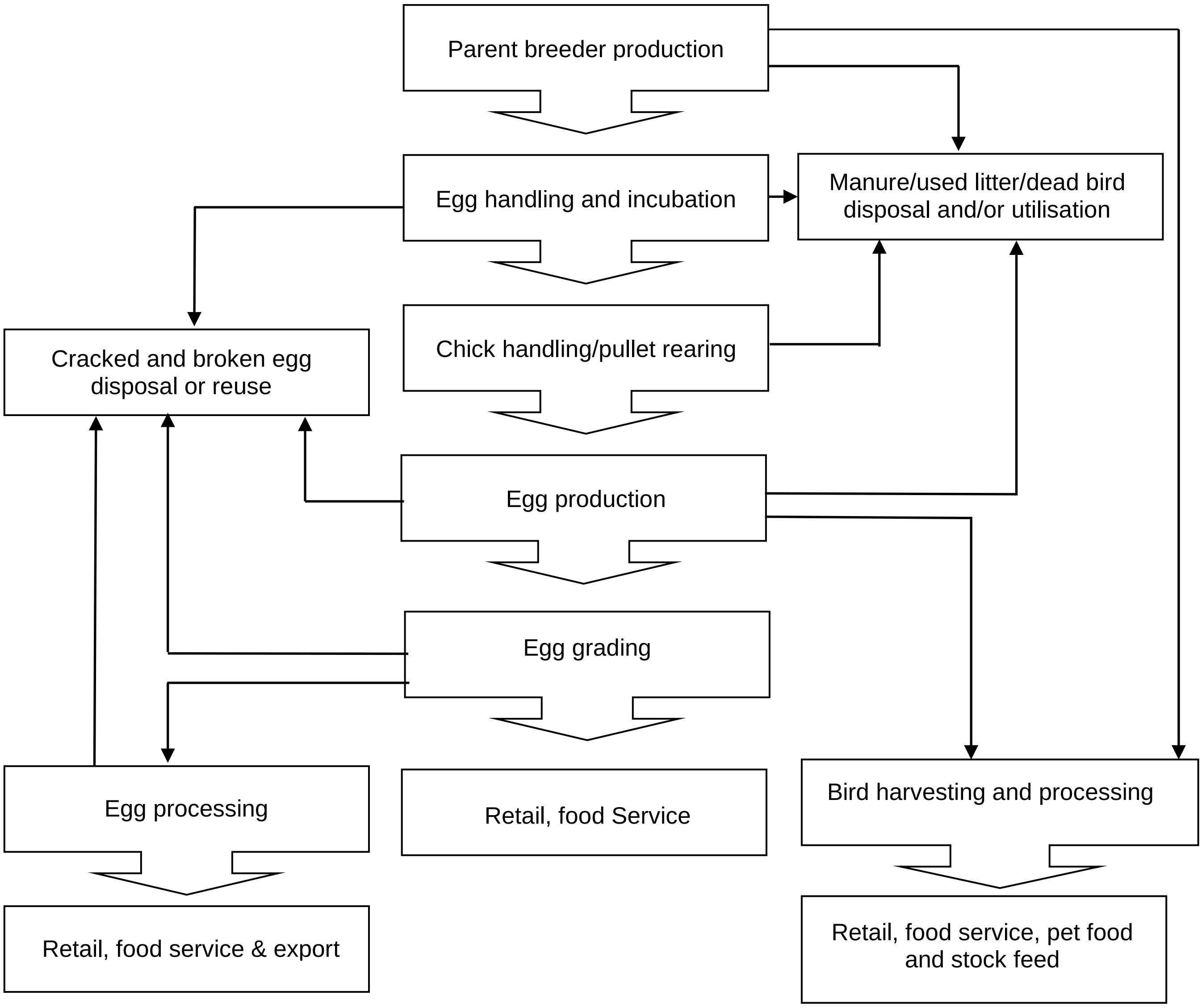
FIGURE 1 – LOCATION OF EGG PRODUCTION FARMS – NOVEMBER 2007



2.2. Egg Production

To understand how egg production may interact with the environment, an appreciation of production systems is needed. This section provides a brief description of these systems. Figure 2 diagrammatically describes the egg production industry.

FIGURE 2 - FLOW DIAGRAM OF EGG PRODUCTION



2.2.1. Breeding Farms

Breeding farms are those keeping breeding hens and roosters to produce fertile eggs. The birds that produce the egg chickens are known as parent or secondary stock. They are housed in sheds with either litter or wire mesh flooring. The fertile eggs produced by the parent stock are collected daily and stored for transport to a hatchery. The parent stock are productive for about 12 months. At the end of their productive life they are removed for meat processing. The used manure or litter is generally cleaned from the sheds at the end of each 12-month cycle and the process repeated.

Because of the different requirements of egg farms and breeder farms, egg producers often purchase day old chicks or pullets, rather than operating their own breeding farm.

The main wastes from breeder farms are spent litter or manure, with some broken/cracked eggs.

2.2.2. Hatcheries

Hatcheries incubate the eggs collected from the parent stock until they hatch. The chicks produced are consigned to either egg production or pullet rearing farms within hours of hatching. Hence, they need to be graded for quality, sexed and vaccinated promptly after hatching. Buildings are washed and disinfected at the end of a batch.

The main wastes from hatcheries are unhatched chicks, membranes, embryonic fluids, off-sex chicks, egg shells and liquid effluent from cleaning and disinfection.

2.2.3. Pullet Rearing

Some farms raise day old chicks to point of lay pullets (approximately 17 weeks of age). These pullets are then transferred to egg production farms or else sold offsite to other egg enterprises.

Pullets are generally reared in cages but may also be reared in barns.

The main waste products from pullet rearing facilities include manure, spent litter, dead birds and sometimes-liquid waste from shed clean-out between batches.

2.2.4. Egg Production Facilities

Cage

Cage systems represent about 80% of egg production in Australia, as this is currently the most cost-effective system and most consumers currently purchase their eggs based on price. The two forms of cages used in egg production are conventional cages and environmental cages.

Sheds fitted with the older style conventional cages have limited environmental controls and automation. In accordance with Model Code of Practice for Welfare of Animals – Domestic Poultry (4th edition) all standard cages that do not meet the requirements of the Code as specified in ***state and territory legislation*** need to be decommissioned as of 1 January 2008. All egg farms using cage hens must meet the requirements of the relevant state and territory legislation. With older style cage systems, the manure drops down under cages and is removed at the end of the batch (approximately 12 to 18 months).

Sheds fitted with modern environmental cages have computerised climate control with tunnel ventilation. Most of these sheds also have automated feeding systems and many are also fitted with manure belts under the cages that collect the manure and automatically remove it. These belts are also often fitted with a drying system that removes moisture from the manure to optimise the shed environment and hence improve production.

Cages are designed to allow eggs to roll clear of the hens for daily collection. Collection is done either manually or automatically via conveyor belts. These modern cages produce superior bird performance and reduce overall labour requirements. However, they require a higher capital investment cost per bird.

After approximately 12 months the birds go into a natural moult and are removed for processing. Any waste products are removed from the sheds at this time, before they are cleaned and sanitised. The main wastes from cage egg farms are manure, dead birds, cracked/broken eggs and sometimes liquid waste from shed clean-out in-between batches.

Once removed from the shed the manure is generally immediately transported from the farm for further processing or sold/used in agriculture.

<u>Barn Laid</u>

The barn system has slowly evolved in Australia and represents about 6% of the eggs produced. These systems generally comprise an automated nesting system, with the hens group-housed in sheds with litter and perches. The stocking rates should not exceed 30kg/m^2 to comply with animal welfare regulations.

After approximately 12 months the birds go into a natural moult and are removed for processing. At this time the manure and spent litter are also removed from the sheds before they are cleaned and sanitised. Other waste products from free range egg farms are dead birds, cracked eggs and general refuse.

<u>Free Range</u>

Free-range accommodation represents about 15% of eggs produced in Australia. The average flock size is much smaller than in the other systems; typically being 1,000 – 7,000 birds, with a few of the larger farms having as many as 20,000 to 100,000 birds.

Free-range systems comprise weatherproof buildings where hens can roost, lay, drink and eat. Adjoining the shed is an open-aired outdoor range. The sheds protect the birds from the elements and predators while the free-range area allows them access to open space and vegetation. Increasingly, free range systems have automated nesting, feeding and watering systems.

Free-range egg production is considerably more expensive than the alternatives because of the greater land area needed, increased labour requirements, higher feed consumption and generally smaller economies of scale. The maximum stocking density for free range is 30kg/m^2 in the shed. It is recommended in the Model Code of Practice for Welfare of Animals – Domestic Poultry (4th edition) that the range area should not have a stocking density in excess of 1500 birds/ha

After approximately 12 months the birds go into a natural moult and are removed for processing. At this time the manure and spent litter are also removed from the sheds before they are cleaned and sanitised. The remainder of the manure is spread over the range by the birds. Other waste products from free range egg farms are dead birds, cracked eggs and general refuse.

2.2.5. Grading Floors

After eggs are collected from egg production facilities they are transferred to grading floors. Grading floors are used to candle, clean and sort eggs into batches of different qualities.

Waste products from grading facilities include liquid waste water from the washing and sanitising process, cracked/broken eggs, as well as rejected packaging.

2.2.6. Egg Product Manufacturing

The first step in manufacturing egg products is washing and sanitising the shells. The eggs are then broken and the yolks and whites separated and/or combined in mixtures. Liquid egg products are filtered mixed, and then chilled before further processing, which may include drying.

Waste products include liquid waste from egg washing water, egg shells and liquid waste from equipment cleaning. The egg shell waste may be spun to separate out the shells (that can be used as a fertiliser) from the remaining yolk and white. The remaining yolk and white is transferred to the liquid waste stream.

3. Potential Environmental Impacts of Egg Production

3.1. Community Amenity and Health

Amenity impacts occur when the operation of an enterprise unreasonably interferes with the comfortable enjoyment of life of individuals or the community.

An egg production farm, breeder farm or pullet rearing facility could disrupt amenity through odour generation or noise from farm operations; and traffic, dust, light, flies, feather drift and visual impacts.

A hatchery could disrupt amenity through odour generation or noise from farm operations and traffic, light impacts and visual impacts.

A grading floor could disrupt amenity through odour generation or noise from operational activities; and traffic, light and visual impacts.

An egg manufacturing facility could disrupt amenity through odour generation (effluent treatment), noise from farm operations and traffic, light and visual impacts.

The potential for nuisance depends upon a range of factors, including:

- The location of the enterprise in relation to sensitive sites.
- The adequacy of separation and buffer distances provided.
- Design features of the enterprise.
- The on-going management of the enterprise.
- Communication between those operating the enterprise and neighbours. On-going two-way communication provides a basis to manage impact and to reduce the risk of nuisance odour, dust, noise and light at neighbouring residences.

Lighting associated with security and vehicle movements can cause off-site light impact from enterprises.

Poultry farm neighbours exposed to dust or adverse odours could suffer stress or respiratory reactions such as asthma. It is this exposure that can lead individuals to link poultry farm emissions with other diseases. There is a potential for some diseases to be transmitted through contact with poultry manure. The management of sheds and the application of manure and spent litter to land must be carefully managed to avoid any potential human health impacts.

3.2. Surface Water

Nutrients exported in surface water runoff from waste storage sites and areas where organic by-products are spread may cause eutrophication in water bodies (creeks, rivers, dams, lakes, etc). This may promote the growth of algae, including toxic blue-green algae. High nitrate levels in water are also toxic to fish, birds, wildlife, stock and humans. Elevated organic matter levels in water reduce oxygenation, affecting fish and other aquatic life. Hence, practices that elevate the nutrient content of runoff should be avoided or the runoff contained.

3.3. Groundwater

Nutrients and salts can leach through the soil and contaminate groundwater. Sheds, waste storage and treatment sites, dead bird disposal pits and composting areas need to be adequately sealed to prevent this from occurring. Incorrect by-product management can also promote excess nutrients and salts in the soil profile and increase the risk of leaching. Once groundwater contamination has occurred it can go undetected and when established, remediation is difficult and expensive.

3.4. Land, Flora and Fauna

Most of the by-products from egg facilities (manure, spent litter, composted birds, egg shell waste and treated effluent) can be used as a valuable organic fertiliser/soil amendment and are environmentally safe when applied at sustainable rates. However, the application and storage of these by-products needs to be carefully managed to avoid soil degradation. This degradation can occur via elevated nutrient levels and associated changes in pH; elevated salinity and sodicity levels; soil structural decline; increased soil erosion; and chemical and micro-organism contamination.

Enterprises need to be sited and managed to avoid disruption to remnant vegetation, wildlife habitats and natural wetlands. Information on remnant vegetation and tree clearing restrictions can be obtained from state government agencies that manage vegetation and also from local governments.

Methods for minimising the impacts on community amenity and health; surface water; groundwater; land; and flora and fauna of egg facilities (including by-product utilisation areas) are detailed in the Facility Design Considerations (Section 5) and the Facility Management (Section 6) sections of these guidelines.

4. Facilities Location and Planning

The facilities location and planning section of this guideline primarily deals with separation and buffer distances of operations, but also includes issues to be addressed during the planning and construction phase. It includes:

1. Infrastructure.
2. Planning considerations.
3. Buffer distances to relevant features.
4. Separation distances to sensitive land uses (including property boundaries).
5. Erosion management during construction.

4.1. Infrastructure

4.1.1. Power

Location and planning considerations include:

- Providing access to a reliable, adequate and constant power supply (possibly three phase). Power must be provided to supply water, deliver feed to the birds, operate conveyor belts, run processing equipment, run incubators at hatcheries, provide heating requirements for chicks on rearing farms and to light and ventilate (running fans) sheds.
- Installing standby generators with auto-switch control to manage power supply failures. This is required during hot weather with sealed mechanically ventilated sheds where only minimal interruptions to ventilation and cooling equipment can cause mass bird deaths. Standby generators need to have sufficient power output and be appropriately connected to run all critical equipment for which manual alternatives are not available.
- Considering the requirements for possible future expansions of the facilities.

4.1.2. Water

Egg production farms, breeder farms and pullet rearing facilities must have an adequate and reliable supply of water for drinking, cooling and shed cleaning (disinfection). Hatcheries, grading floors and egg manufacturing facilities require a clean and reliable supply of water for cleaning plant and equipment. Hatcheries also require water for operating humidifiers.

Generally, water used is sourced from groundwater or from town water supplies. If surface water is used it should be treated to minimise the risk of health impacts, including disease transmission from wild birds and contamination of eggs and egg products.

Location and planning considerations include:

- State government guidelines and regulations for drawing water from surface watercourses or bores, or for catching water in dams must be adhered to.
- Providing an adequate and suitable source of water.

Drinking water requirements - The Model Code of Practice for the Welfare of Animals – Domestic Poultry (4th edition) provides a guide to bird water requirements. Drinking water usage should be about 350 mL/adult bird/day, with peak requirements at about 400 mL/bird/day. Thus, about 1.3 ML/yr (1,300,000 litres per year) of drinking water per 10,000 birds. Additional water is also needed for cleaning, shed cooling etc.

4.1.3. Traffic and Parking

All weather road access is required for staff (all types of operations); the delivery of fresh bedding (barn systems, free range systems, breeders and pullets'); day-old chickens (egg production farms, breeder farms and pullet rearing facilities); pullets (breeder farms and egg production farms); and feed. Also required is the removal of eggs (egg production and breeder farms); spent hens for processing (breeder farms and egg production farms); pullets (pullet rearing farms); manure; spent litter; and dead birds (if necessary). Hatcheries require access for the delivery of eggs and the removal of chicks and waste egg products. Egg grading and manufacturing facilities require transport access for the delivery of eggs and the removal of processed egg and waste products.

Location and planning considerations include:

- Provision of access to the site from a road that is constructed to a suitable standard to accommodate the anticipated types and numbers of vehicles. In designing access and roads, the potential impacts on nearby sensitive land uses must be considered.
- Providing adequate parking space for the anticipated number of vehicles.

4.2. Planning Considerations

The acceptability of any development relies upon community perceptions. Community consultation during the planning stage will often provide the information to address relevant community concerns. For this to be effective the consultation process must be structured to suit the individual situation. There is no set formula, approaches or certainties in undertaking effective consultation but good planning from the outset is important. Poorly planned and ineffective consultation can lead to a breakdown in the process, which can be time consuming and expensive.

4.2.1. Land Use and Future Development

When developing a proposal for a new facility it is critical to consider current and future land use zonings and existing and planned developments in the adjacent area, including potential 'as of right' or equivalent dwellings.

For the purpose of considering whether an area affected by a separation distance may contain a sensitive use in the future, consideration must be given to the potential for the development of a dwelling on an adjoining property 'as of right' (that is, without a planning permit). Where a lot is identified as having potential for an 'as of right' dwelling the separation distance is generally calculated to the centre line of the vacant lot.

Location and planning considerations include:

- Locating new developments on land that is appropriately designated under the local planning schemes, with future land use planning considered.
- Avoiding locations near urban or rural residential development where possible.
- Protecting existing operations from incompatible future development by encouraging suitable provisions in planning schemes.
- Providing an adequate area of suitable land on-farm for the sustainable utilisation of by-products (nutrients and water) if practical or other arrangements for the removal of wastes off farm.

4.2.2. Designated Areas

Most states have declared water catchments or groundwater recharge areas in which intensive livestock industries, including poultry farms and associated facilities are not permitted. When selecting a site it should be done through consultation with the relevant authority/agency (local government, water board, state government agency).

4.2.3. Traffic and Parking

The local government and the transport department (or equivalent) should be consulted regarding road usage at an early stage of the planning process. This helps to determine appropriate routes, access and road layout requirements and to identify whether approval with the state transport authority is required.

Location and planning considerations include:

- Planning, siting and designing on-farm roads meet the needs of all vehicle movements associated with all the activities of the farm. The location and proximity to nearby sensitive land uses should also be considered.

- Planning, designing and locating lighting so that it does not interfere with nearby sensitive land uses.
- Designing access points, including acceleration and deceleration lanes (if required), to ensure that sufficient road width is provided for the turning of all anticipated vehicles.
- Planning, siting and designing access points, on-farm roads and on-farm parking areas with consideration for possible noise and vehicle light impacts on nearby sensitive land uses.

4.3. Buffer Distances

Providing buffers assists in minimising potential off-site impacts of poultry facilities on nearby water resources. Buffers from other poultry facilities also minimises the occurrence and impacts of disease outbreaks. However, buffers are not a substitute for using best practices. They need to be used in combination with good design and management.

4.3.1. Surface Water and Groundwater

Good siting, design and management are critical in protecting water resources against the entry of nutrients, organic matter, pathogens and salts from the organic by-products of egg industry facilities. Secondary protection is provided through measures that slow the movement of runoff and eroded soil. Maintaining or rehabilitating vegetative cover, particularly riparian vegetation, reduces the movement of contaminants and eroded soil into surface waters.

The appropriate width of the vegetative cover depends on the slope of the land, the type of vegetative cover within the buffer area and whether there are other stormwater control devices like diversion banks and terminal ponds. A vegetative filter strip planted with runner-developing, non-clump forming grass can very effectively minimise contaminant entry to watercourses by reducing the concentrations in the runoff. This is achieved through particle trapping and absorption of runoff through increased soil infiltration.

Generally, wider vegetative filter strips reduce the soil loss rate from erosion. However, for the same soil loss rate, areas with higher slopes need a wider vegetative filter strip than areas with lower slope. To be most effective a vegetative filter strip needs to be located as close as possible to by-product utilisation areas to minimise additional runoff. It is also critical to locate the vegetative filter strip before any convergence of runoff (i.e. drainage lines).

More information on designing vegetative filter strips can be found in Appendix F.

As a safeguard, an adequate buffer distance should be provided between the operations of the enterprise (including manure and spent litter utilisation areas and effluent irrigation areas) and any nearby groundwater bores and surface waters. The required distances should be determined on a case-by-case basis, with the aim of protecting sensitive waters while not being overly restrictive. For instance, a relatively small buffer would be needed if there is a well developed and maintained vegetative filter strip between a relatively flat utilisation area and a watercourse and best practice application methods are carried out. Some local government's or state agency's may specify set buffer distances.

Major potable water supply storages and watercourses within drinking water catchments generally need the greatest protection. However, it is also important to protect groundwater from the infiltration of nutrients down bores. In most states, a minimum buffer distance applies to water supply storages, watercourses and groundwater bores; these need to be consulted.

Table 1 provides **recommended** buffer distances from an egg production facility to relevant surface waters. Table 2 provides **recommended** buffer distances from by-product utilisation areas to relevant surface waters by utilisation category.

TABLE 1 – RECOMMENDED BUFFER DISTANCES FROM EGG INDUSTRY FACILITIES[%]

Feature	Distance (m)
Major water supply storage	800[*^]
Watercourse	100[#^]

[%]Egg Industry Facilities include sheds, manure storages, litter storages, effluent pond or any other area when organic by-products are located or stored. It does not include by-product utilisation areas (they are covered in Table 2).

* For major storages owned by Water Boards or Local Authorities, restrictions may apply in their catchment areas.

A reduced buffer distance may be allowed if it can be demonstrated via a site specific assessment that the feature will be protected. For highly protected or vulnerable resources, or under some state requirements, the distance may need to be increased.

^ The relevant regulatory authority needs to be consulted where an operation is proposed within a declared catchment area or a declared groundwater area.

Notes:

1. Major Water Supply Storage means any public water supply storage, lake, lagoon, marsh or swamp.
2. A watercourse is a naturally occurring drainage channel that includes rivers, streams and creeks. It has a clearly defined bed and bank, with water flows at any time. Refer to relevant state or territory acts for legal definition.
3. The Measuring Point for a watercourse shall be the maximum level to which the water surface of a watercourse may reach before overtopping of a bank begins (bank-full discharge level).

TABLE 2 – RECOMMENDED BUFFER DISTANCES FROM BY-PRODUCT UTILISATION AREAS

Distances (m)			
Category No.*	1	2	3
Major water supply storage	800	800	800
Watercourse (See Note 2)	100	50	25

* Category Descriptions

Category 1: Effluent is discharged or projected to a height > 2 m above ground level. By-products that remain on the soil surface for more than 24 hours (i.e. are not immediately ploughed in). Manure and spent litter that is spread immediately (i.e. not stockpiled / composted) and remains on the soil surface for more than 24 hours (i.e. not immediately ploughed in). Includes flood irrigation systems. Also includes free range systems.

Category 2: Mechanical spreaders and downward discharge nozzles. The discharged material shall not be projected to a height in excess of 2 m above ground level. Manure and spent litter that has been stockpiled prior to spreading.

Category 3: Discharge by injection directly into the soil (to a depth of not greater than 0.4 m) and at a rate not exceeding either the hydraulic or N, P, K limits determined for the local soil types. Manure and spent litter that has been composted. Application of effluent / spent litter / manure in combination with immediate incorporation of material into the soil.

Notes:

1. Distances shall be measured from the perimeter of the area used for handling or utilising by-products.
2. The buffer distances surrounding by-product utilisation areas are to be used as a guide. Dispensation may be obtained for these distances following site-specific assessment from the relevant authority e.g. appropriate vegetative buffers and terminal pond design will be considered in reducing the required distance to watercourses.

Location and planning considerations include:

- Meeting buffer distances specified in any local government or state government local laws or guidelines.
- Locating any sheds containing birds, grading floors, processing facilities, manure and spent litter stockpiles and effluent ponds above the 1 in 100 year flood line. Information on flood levels should be available from the state agencies responsible for natural resources and water and/or local authorities.
- Allowing sufficient buffers for planned future expansions of the operation.

4.3.2. Biosecurity

The “Code of Practice for Biosecurity in the Egg Industry” is designed to assist in the development of effective biosecurity plans to minimise the occurrence and impacts of disease outbreaks in the egg industry.

Disease outbreaks can significantly affect the egg industry through substantial loss of income and can create significant environmental problems with the disposal of large numbers of birds. Selecting a site that is well separated from other poultry facilities and from wild bird habitats can reduce the risk of disease transmission within the industry.

There are no recommended buffer distances between poultry farms and grading floors or processing facilities. For on-farm grading floors and manufacturing facilities that only service that farm, it is best to locate the grading floor in a position that is central to all egg production sheds for logistical reasons. On-farm facilities that receive eggs from offsite facilities should be situated away from the poultry sheds to protect biosecurity.

Location and planning considerations include:

- Locating poultry farms a reasonable distance from other poultry farms to minimise the risk of disease transfer between farms. This will also reduce the potential for the cumulative environmental effects of closely located enterprises. There is no set distance that will eliminate the risk of disease transfer, but generally the greater the distance the lower the risk. The following recommended buffer distances are suggested:
    - 1000 metres between an existing farm and any proposed alternative form of intensive poultry farming
    - 1000 metres between a new farm and any existing alternative form of intensive poultry farming.
    - 5000 metres between any intensive poultry farming and a breeder farm.
- Considering the locality of poultry farms in relation to waterways and wetlands that are used by waterfowl, as these birds may carry avian diseases.
- Considering transport routes for live birds to and from farms, as feather/dander drift from passing transport trucks can be an important biosecurity issue.
- Providing adequate buffer distances between sheds on the one farm minimise potential disease spread within the farm.

4.4. Separation Distances from Egg Industry Facilities

Separating egg facilities from sensitive land uses provides important protection against amenity impacts. Separation distances alone do not always guarantee an absence of amenity impacts. Good design and management are also important.

State government departments and agencies and individual local governments may specify minimum separation distance requirements between new/expanding developments and neighbouring houses, property boundaries, residential developments and other sensitive land uses. These need to be complied with in the first instance.

In lieu of any specified by state and local government departments and agencies separation distance requirements, the following recommended separation distances are suggested:

- Provide at least 500 metres between the impact source and any land use zone that is not compatible with the development (e.g. residential, rural residential).
- Provide at least 250 metres separation distance between the impact source and any sensitive land use (neighbouring house) that is located on land that is compatible with the development (e.g on land designated rural, farming or similar). Where a lot is identified as having potential for an 'as of right' dwelling the separation distance should be calculated to the centre line of the vacant lot.
- Provide at least 100 metres separation distance between the impact source and the property boundary where the adjoining boundary is land that is compatible with the development (e.g. rural, farming or similar);
- Provide at least 100 metres separation distance between the impact source and a public road that carries more than 50 vehicles per day that are not associated with the development.
- Provide at least 50 metres separation distance between the impact source and a public road that carries less than 50 vehicles per day not associated with the development.

Notes:

1. The measuring point for a public road shall be the surveyed boundaries of the road on the same side of the road as the operation.
2. Traffic volume excludes vehicles associated with the operation.
3. Greater distances should also be considered from transport routes that move live poultry for biosecurity reasons.
4. These distances only apply to new and expanding operations and not to operations that have prior approval.
5. For tunnel ventilated sheds, the measuring point should be taken from a point 25 m out from the exhaust end of the shed. All other operations should measure the distance from the shed perimeter.

4.5. Property Size

Ideally, a property should be large enough to contain the facility itself and any required by-product utilisation areas. However, third party by-products utilisation is an option. Owning sufficient land around the operation to cater for the recommended separation distances prevents encroachment by other developments on nearby land.

State government departments and agencies, and individual local governments may have requirements for minimum land areas for various types of operations.

Location and planning considerations include:

- Meeting state and local government department requirements for minimum property areas.

5. FACILITY DESIGN AND CONSTRUCTION CONSIDERATIONS

5.1. Landscaping and Vegetation

Landscaping improves the visual amenity of an operation and assists in reducing noise, light and dust impacts. The primary focus is vegetative landscaping, although earthen structures may also be used for screening.

There are many practical benefits in establishing trees on poultry farms, including:

1. Neighbour relations:
   a. By filtering dust, odour, noise emitted from sheds and surrounds.
   b. Providing a visual screen.
   c. Improving public perception.
2. Environmental - reduction in ammonia, dust, odour, surface and groundwater nutrients leaving the farm.
3. Production:
   a. Providing windbreaks.
   b. Providing shade (natural cooling).
   c. Filtering out airborne pathogens.
   d. Conserving energy.
   e. Improving farm biosecurity.

Design and construction considerations include:

- Adhering to state vegetation management and tree clearing acts. This is a mandatory requirement.
- Existing trees should be retained and incorporated into the landscaping where practical.
- Consider developing a landscaping plan for a new or expanding farm to ensure the long-term effectiveness of screening.
- Using the natural vegetation and terrain of the site to the best advantage to maximise visual screening and improve biodiversity.
- Plant species should be selected that require little maintenance and are suited to the location.
- Preferentially selecting species indigenous to the region.
- Using a variety of different-sized trees and shrubs and / or earthen mounds to achieve effective upper and lower canopy screening.
- Appropriately maintaining landscaping features is recommended, including removal and replacement of dead and diseased plants.
- Considering the installation of a vegetative screen or other suitable emission reduction control measure at the exhaust end of tunnel ventilated sheds at a distance that does not affect the performance of the ventilation system. If a vegetative screen is used, the trees should

be a suitable species for the area, consist of a low and high canopy and have slender leaves to trap dust. If a vegetative screen is used it should be at least 8 m wide.

5.2. Erosion Management During Construction

Soil erosion is a major concern where soil is disturbed and left uncovered, a situation that arises during the construction phase of a development.

Design and construction considerations include:

- Developing a farm plan during the planning stages of the development so that excavations can be used for multiple purpose, such as constructing sediment traps and using soil to build up sheds, roads or earthen banks.
- Promptly revegetating all disturbed areas on completion of construction. It is important to select species of grass, trees and shrubs that will rapidly establish to produce good ground cover.
- Diverting upslope runoff from around the construction site.
- Reduce runoff velocities by constructing contour banks at regular intervals around the site and by increasing the surface roughness in areas of the site that are not being prepared for shed pad bases.
- Install silt traps and barriers, similar to those used during road construction to induce particle settlement. These should be retained until sufficient ground cover is established to minimise erosion.

5.3. Shed Design and Orientation

Good shed design and layout can reduce potential environmental impacts and operating costs.

Most of the newly constructed cage sheds are tunnel ventilated. They generally have curtains or solid sides and are fitted with large fans at one end that draw air through the length of the building for discharge. Careful positioning of the discharge end of these buildings is necessary to prevent odour, dust, feather and noise impacts.

Sheds for free range and barn laid systems are generally steel framed, clear span, gable roofed structures or they may be hooped metal frames covered in a weatherproof fabric, similar to plastic greenhouses used in horticulture. Sidewalls are generally solid from ground level to 300 – 400 mm. The balance of the wall is usually netted and fitted with woven plastic curtains, hinged metal shutters or solid sides. These are raised or lowered either manually or automatically to control ventilation and temperature, and to provide protection from adverse weather conditions. The flooring of sheds may comprise litter, slatted flooring or wire flooring. Hens housed in free range and barn laid systems generally lay in specially made nests and roost on installed perches. They need to be designed to enable the effective and easy removal of manure and spent litter.

Free-range consist of a weatherproof barn or building in which birds can roost, lay, drink and eat, with an adjoining open-aired outdoor range.

Design and construction considerations include:

- Providing a parallel distance of at least 15 m between sheds to improve ventilation and lower the temperature and humidity in the sheds. This distance is less critical with tunnel-ventilated sheds.
- Orienting the long axis of sheds east-west to minimise solar heat absorption during hot weather. With tunnel ventilated sheds varying the shed orientation may help to minimise odour, dust and noise impacts on the surrounding community.
- Designing sheds and using materials that seek to avoid light nuisance from reflection that may affect neighbouring residences and traffic on local roads.
- Considering the separation and buffer distances needed between the discharge end of tunnel ventilated sheds to sensitive land uses and other features to prevent odour, dust and noise nuisance.
- Providing sufficient roof overhang and sidewall height to prevent rainwater from entering the shed.
- Building and maintaining poultry sheds to exclude feral animals and other birds.

5.4. Ventilation System

Adequate ventilation is required for maintaining bird health and welfare. It also aids in controlling shed temperatures. It also is critical in maintaining acceptable moisture content in the manure and litter to help prevent excessive odour generation and control the accumulation of water vapour, heat, gases and dust particles.

Design and construction considerations include:

- Providing adequate shed ventilation to control shed temperature and minimise gas build up and to allow manure and litter to dry.

5.5. Feeding Systems

Feeding systems need to be designed and located to allow all birds equal access to feed. This helps to ensure the welfare and performance of the birds.

Design and construction considerations include:

- Designing feeding systems to ensure adequate access to feeding space.
- Installing feeding systems that can be adjusted to meet the requirements of the birds.

- Designing feeders to minimise retention of old feed.
- Installing and properly maintaining feeders to minimise feed wastage. This reduces both production costs and the nutrient content of the manure produced.
- Properly designing and maintaining silos and feed-lines to minimise feed spillage and the ingress of water. Wet and spoiled feed can produce offensive odours.
- Designing feed storages to prevent access by rodents.

5.6. Watering Systems

Egg industry facilities need an adequate and reliable supply of water for various reasons (see section 4.1.2).

Design and construction considerations include:

- Designing watering systems to ensure adequate access to watering space.
- Installing watering systems that can be adjusted to meet the requirements of the birds.
- Installing waterers that can be easily cleaned.
- Designing watering systems to minimise spills and leakages.

5.7. Monitoring and Control Systems

Most new environmental sheds are fitted with automatic controllers for feed, water, fans and blinds (temperature and ventilation).

Design and construction considerations include:

- Installing automated systems to continuously monitor relative humidity and temperature levels should be installed in tunnel ventilated sheds. This allows the shed environment to be optimised.
- Fitting alarm systems (visual or telemetry if noise impacts can occur) to alert farm management to malfunctions or extended abnormal shed conditions. Audible alarms are only suitable if they do not impact on neighbouring sensitive land uses.

5.8. Effluent Treatment and Storage System Design

Egg facilities can generate effluent from the following sources:

- Shed wash out of pullet rearing and egg production sheds at the end of a batch of birds.
- Cleaning of equipment and shed wash-out at grading floors.

- Washing eggs at grading floors and egg manufacturing plants.
- Washing out hatchery facilities.
- Washing out of egg manufacturing plants.

There is little readily available data on the effluent quality from these sources. However, there is a need to capture and treat or store effluent that exceeds development approval/licence conditions or exceeds the ANZECC (2000) - Australian and New Zealand Guidelines for Fresh and Marine Water Quality - Volume 1 or more recent recommended standards. The strength and frequency of the effluent produced will depend on whether the effluent needs to be treated before utilisation or disposal or simply captured for irrigation.

Treatment aims mainly to reduce organic matter content (volatile solids, BOD & COD) in effluent. It may also reduce the nitrogen content of liquid effluent, mainly through ammonia volatilisation losses. Effective treatment of effluent containing significant solids content will also produce a stabilised sludge.

This section of the guidelines deals mainly with effluent ponds, however alternative systems are available. The most appropriate treatment and by-product utilisation practices for each site and type of effluent should be assessed and used.

Factors to consider before designing a treatment pond or pond system include:

- Effluent characteristics.
- Volume of effluent.
- Size of the operation.
- Proposed end use of by-products.
- Availability and properties of land for by-product utilisation.
- Sensitivity of neighbouring environment (including proximity to potential receptors).
- Climatic factors.
- Topography.
- Soil characteristics.
- Groundwater vulnerability.
- Nutrient mass balance.
- Water balance.
- Future expansion plans.
- State regulatory requirements.
- Cost.
- Reliability.
- Maintenance requirements.
- Ease of use.

Design and construction considerations include:

- The effect of topography, soil type, gravity drainage, proximity to by-products source, potential future expansion of the operation and ponds, cleaning of ponds, proximity to neighbours and public areas, prevailing winds and local and state government requirements on pond location.
- Constructing ponds to ensure effective mixing and treatment.
  - Round, square and rectangular ponds are all effective.
  - The length to width ratio should not exceed two.
  - Ponds with narrow side channels or with sections isolated from the main volume reduce the effective treatment volume.
  - Positioning inlets and outlets to prevent effluent short-circuiting, thus maximising retention time and treatment efficiency.
  - Inlet pipes or channels should discharge into the pond beyond the toe (intersection of the base of the pond and the internal pond bank).
- Provision of access for desludging and maintenance. Suitable access must be provided if desludging will be required. Bank tops 2.5 to 4 metres wide allow vehicular access for maintenance.
- Design and construction of internal and external pond banks (batters). These must maintain the pond integrity based on a soil stability assessment. Below the water level, side slopes should not exceed 1:2 (vertical:horizontal). For slopes that are to be mown, a grade of at least 1:3 (vertical:horizontal) is required. Ideally, there should be no vegetation on the inner pond embankments.
- Using adequate soil compaction and correct moisture content to ensure a maximum design permeability of less than 1×10^{-9} m/s for a depth of 300 mm for ponds up to 2 m deep or 450 mm for deeper ponds is achieved (compacted layers must not exceed 150 mm depth). Ponds constructed using soils containing less than 20% clay will require sealing with clay, PVC (polyvinyl chloride) or HDPE (high density polyethylene) liners.
- Ensuring the base ground level (base of works) is always at least 2 m above the water table.
- Providing at least 500 mm freeboard. This must be provided to allow the pond banks to contain wave action and prevent overtopping due to imperfections in the crest level. (Freeboard is not wet weather storage).
- Providing a spillway on the effluent treatment pond or on the final pond in a series of ponds. This must be provided to avoid pond banks being eroded and breached during extreme rainfall events. However, run-off from the spillway should be directed to an area that will not cause a negative environmental impact or leave the farm.
- Providing sufficient storage capacity to contain the inflow of effluent, plus rainfall and runoff during extended periods of wet weather. It is recommended that they be designed to ensure that they do not overtop more than once every ten years on average.
- Minimising the entry of clean stormwater runoff.

- Grading bank tops away from the pond to reduce the amount of rainfall runoff to be handled by the system.
- Observing responsibilities under ***workplace health and safety legislation*** for enclosures and signs around ponds. These must be observed.

When designing effluent treatment and storage ponds there are five main aims:

1. To keep odour emissions low by avoiding excessive organic loads that may produce offensive odours through incomplete organic matter stabilisation (although this may not be an issue where the operation is isolated).
2. To ensure efficient and effective biodegradation of organic load to minimise odour generation and sludge accumulation.
3. To provide sufficient sludge storage volume if the effluent contains a significant amount of solids.
4. To provide sufficient liquid storage volume that restricts overtopping to an acceptable frequency until a suitable time of reuse.
5. To enable ready removal of the liquid from the system for reuse purposes.

Volume is the most important design criterion. The larger the volume per unit of added organic matter, the greater the amount of liquid and bacteria for effective degradation of incoming effluent. Where the organic matter loading rate is too high, either because the liquid volume of the pond is too low or because large amounts of organic matter are added infrequently, incomplete anaerobic digestion may produce strong odours. Treatment ponds are typically 2 to 5 m deep. A deeper pond generally has a smaller surface area for a given volume, which reduces the odour-emitting surface.

Wet weather ponds provide emergency wet weather effluent storage. In the southern states of Australia, they also provide winter effluent storage for the months when rainfall exceeds evaporation and irrigation cannot occur.

Evaporation ponds provide storage prior to effluent “disposal” by evaporation. Solids deposited in the base of evaporation ponds may need periodic removal.

Wet weather ponds and evaporation ponds need to be sized to prevent overtopping more than once every ten years on average. More stringent overtopping frequencies may be warranted in environmentally sensitive locations. Wet weather ponds may need to be designed to store up to several months of effluent.

Effluent treatment ponds should be managed to minimise any impacts on community amenity (particularly odour), groundwater and surface water.

More detailed information on the design of effluent treatment and storage systems can be found in the National Environmental Guidelines for Piggeries (Australian Pork Limited, 2004) or Kruger et. al. (1995) – Effluent at Work.

5.9. Manure and Spent Litter Treatment and Storage Systems

Most manure and spent litter is generally removed from the farm at shed clean-out for biosecurity reasons. The storage and composting of spent litter needs to comply with ***relevant acts and legislation***.

Design and construction considerations include:

- Appropriately designing manure and spent litter stockpiles or composting facilities to ensure they can freely drain and not pond water. Use bunding to prevent entry and contamination of stormwater runoff. Alternatively, manure and spent litter can be stored in covered sheds to overcome weather impacts.
- Installing an impermeable base on any manure and spent litter stockpiling or composting areas. This avoids leaching and possible groundwater contamination. This can be achieved with compacted clay, gravel and clay, lime or cement stabilised soils. They should be designed to achieve a design permeability of $1x10^{-9}$m/s over a depth of 300 mm
- Installing a dam to catch runoff from outdoor manure and spent litter compost or stockpile sites. Design the dam to hold a 1 in 10 year, 24 hour storm event. Runoff collected in the dam can be applied to land at sustainable nutrient loading rates or reapplied to compost piles to maintain optimal moisture content (50-55% wet basis).
- In some states, a separate licence or works approval is needed for compost production. Stable fly breeding in Western Australia is a particular issue and local regulations need to be adhered to.

6. Facility Management

6.1. Traffic

Any egg facility needs to manage its own, staff and contractors/service provider vehicles. Farm managers should liaise with truck drivers to ensure they understand the possible effects of traffic nuisance on nearby sensitive land uses.

Management practices include:

- Vehicles need be driven at moderate speeds on-site, especially with regards to unsealed roads and trucks. This includes displaying speed limit signs to reduce dust generation and damage to road/lane surfaces.
- Informing workers, visitors, drivers and contractors of the potential noise conflicts caused by vehicle use.
- Avoiding the use of truck air/exhaust brakes near sensitive land uses.
- Using flashing lights or other suitable warning devices (night) with reverse warning beepers (day) on trucks and machinery. However, safety warning devices should only be modified and used if a site-specific risk assessment has been conducted. All people on-farm (owners, operators, contractors, visitors) will also need to be informed of any modifications. State workplace health and safety regulations must be checked and adhered to.
- Watering unsealed on-farm roads as needed during dry and dusty climatic conditions.
- Developing and implementing a plan to ensure off-farm vehicle movements have minimal detrimental amenity impacts.
- Scheduling truck movements (feed delivery etc) for daylight hours wherever practical. Local government and EPA requirements may limit traffic movements to certain hours to avoid noise conflicts.

6.2. Visual Appearance

The overall appearance of the entire facility may influence community attitudes to the facility. Clearly visible buildings with unsightly surrounds can promote complaints from nearby sensitive receptors. A well-planned and maintained operation is more aesthetically pleasing and will generally have lower rates of disease, rodent infestation, odour emission and dust generation.

Management practices include:

- Planting tree buffers around buildings. If an operation is less visible to the public, complaints are less likely. The tree buffers can also lower the amount of odour and dust leaving the property.
- Maintaining poultry sheds, buildings and surrounds to ensure they are clean and tidy. This will improve the visual amenity of the operation.

6.3. Stocking Density

The type of accommodation used and the age and size of the birds determines the required stock density. Signs of over-crowding include variable bird performance and increased disease outbreaks.

In accordance with the Egg Corp Assured Program and the Model Code of Practice for the Welfare of Animals – Domestic Poultry 4th Edition, the egg industry has agreed maximum stocking densities for birds.

Management practices include:

- Not stocking birds at densities exceeding those prescribed in the Welfare of Animals – Domestic Poultry 4th Edition.
- Not stocking birds at densities exceeding those prescribed in any relevant state regulations. This is a mandatory requirement.
- Consider reducing stocking densities below the mandatory requirements if the specific conditions on the farm don't allow the prescribed densities to be used without unacceptable impacts on bird health and welfare or the environment.

6.4. Biosecurity

Contact between the flock and other poultry or wild birds may spread avian diseases. Rodents, dogs, cats and foxes can kill poultry and spread diseases. The risk of disease transmission within the industry can be reduced through good management. Management practices include:

- Cleaning up spilt feed, as it attracts birds and other rodents.
- Treating any surface water used to a potable standard (if used for poultry drinking water).
- Requiring the strict adherence of persons entering a poultry farm to the biosecurity protocols of the farm to avoid cross contamination. (Industry biosecurity protocols are available in the Code of Practice for Biosecurity in the Egg Industry).
- Requiring that drivers of trucks collecting dead birds, delivering or picking-up chicks and birds, picking up and delivering eggs or delivering feed strictly follow farm biosecurity protocols to avoid disease transfer.
- Proper disposal of dead birds (refer to section 6.14 – Dead Bird Management).
- Properly controlling rodents and feral animals (refer to section 6.20 – Control of Pest and Disease Vectors).
- Preventing contact between animals and wild birds with the poultry.
- Adhering to the biosecurity buffers in 4.3.2.

6.5. Sheds and Surrounds

Sheds and their surrounds need to be managed to prevent environmental impacts. Management practices include:

- Properly maintaining silos and feed-lines to avoid feed spillage and the ingress of water. Wet and spoiled feed can produce excessive odours.
- Filling water holding depressions around sheds.
- Gradually opening naturally ventilated sheds first thing in the morning to avoid a large and sudden release of odorous gases.
- Maintaining ventilation and evaporative cooling systems in good working order to ensure optimum efficiency (e.g. evenly distributed water flow over the evaporating surface).
- Ammonia levels in sheds should be controlled for both bird and human health. Ammonia levels should not be consistently above where they can be detected by smell (10 – 15 ppm). When ammonia levels cause irritation (> 25 ppm) immediate action must be taken to reduce levels by reducing manure and litter moisture content and/or increasing ventilation. By maintaining an optimum environment for the birds, risks associated with high ammonia exposure to workers will be minimised.
- Maintaining watering systems to avoid leaks and maintaining sheds to avoid extraneous water entering the sheds.

6.6. Energy Savings and Eco-efficiency

Eco-efficiency is a business-oriented approach to environmental management. It focuses on reducing resource inputs and avoiding the generation of wastes and pollutants. Eco-efficiency not only provides improved environmental performance, but provides financial savings and improved competitiveness in a market where consumers are more environmentally aware.

Electricity is the primary energy source used on poultry farms, grading floors and egg manufacturers. It is used for running lights, fans, pumps, conveyor belts and machinery. Liquid petroleum gas is generally used for heating poultry sheds and buildings. Outlined here are some of the eco-efficiency assessment findings for reducing these costs.

6.6.1. Lighting

While lighting costs vary across farms depending on the number of lights and type of lighting systems used, lighting can account for a significant component of electricity usage. Farms that use high wattage incandescent lights as their main light source have significantly higher lighting costs than those using energy efficient lighting.

Management practices include:

- Installing triphosphour fluorescent lighting to improve lighting efficiencies. These types of lights can reduce electricity consumption significantly and last up to eight times longer than incandescent lights.
- Switching off lighting when not required.

6.6.2. Ventilation (for mechanically ventilated environmental sheds)

Management practices include:

- Using automatic control systems to improve efficiency by continuously monitoring parameters such as light, temperature, humidity and static pressure and by continually adjusting ventilation to suit the conditions.
- Minimising air leaks in sheds to reduce the loads on fans. For controlled ventilation systems, sheds with air leaks use more power, have poorer temperature control and have higher heating and cooling costs. Heated air can leak out of the shed in winter, while warm air drawn into the sheds in summer increases the load on the cooling system. Eco-efficient maintenance also requires tight sealing of sidewall curtains, filling of cracks around doors and shutters and patching holes in ceiling insulation.
- Selecting energy efficient fans.
- Regularly maintaining fans to ensure optimum efficiency.
- Keeping fan shutters clean. Dirty shutters can reduce the air-moving capacity of a fan by up to 30 percent with a similar increase in electricity usage and/or reduced performance in production.
- Regularly checking fan belts for wear.

6.7. Manure Production

6.7.1. Introduction

Manure and spent litter from poultry farms varies in composition and quantity. The primary factors affecting this are:

- Types of sheds used.
- Age of birds housed.
- Diet of the birds.
- Feed wastage.
- Stocking density of birds.
- Amount and type of bedding used (barn and free range).
- The amount of nitrogen loss (via volatilisation) in the shed from the manure or litter.

Due to these factors it is difficult to provide standard values for manure or litter production and composition. The following sections outline methods for estimating the amount and composition of manure or litter produced by individual egg farms.

With recent advancements in bird genetics and feed formulation, feed use efficiencies have improved. This in turn affects the amount of manure produced. Hence, many of the older references of poultry manure production do not accurately represent the current scenario.

6.7.2. Estimating Manure Production

Mass Balance

The general principle of mass balance for estimating the amount of any particular nutrient excreted in the manure takes the following form:

Amount excreted = Amount fed – Amount taken up as liveweight

– Amount removed in eggs.

Additional losses, such as the volatilisation of nitrogen in the shed, can also be considered. For barn and free-range systems the amount of any particular nutrient added in the bedding also needs to be added to the feed to determine the amount of nutrients remaining in the by-product.

Typical Measured Manure and Spent Litter

Appendix B provides chemical and physical properties of layer poultry manure and spent bedding taken from the Environmental Code of Practice for Poultry Farms in Western Australia.

Appendix B also details measured chemical and physical properties of layer poultry as reported by the American Society of Agricultural and Biological Engineers (2004) and also some measured Australian data.

6.8. Bedding Materials and Litter Management - Shed

Bedding is placed on the floors of barn, free-range and some breeder farm sheds to adsorb the manure produced by hens.

The bedding materials for egg production sheds should have the following characteristics:

- Dry.
- Light.
- Highly absorbent.
- Low dust generation.
- Dry rapidly.

- Remain friable.
- Free of contaminants such as heavy metals.
- Suitable for use as a soil conditioner, compost or fertiliser.
- Cost effective.

The type of bedding selected depends on local availability and price. Examples of suitable bedding material include hardwood sawdust, softwood sawdust, timber shavings, shredded paper, rice hulls and chopped straw. Alternate materials may be used but their suitability should be determined against the above characteristics.

Good litter management is integral to a well-operated poultry farm that houses birds on bedding. It has implications for both the health of the flock and for dust and odour levels.

The moisture content of shed litter has the greatest influence on odour and dust nuisance potential. Litter that is too dry (less than 15% moisture – wet basis) may cause dust nuisance, poor bird condition and health problems for farm workers. When the litter is too wet (greater than 40% moisture – wet basis) it becomes anaerobic and odour and ammonia emissions increase. This may lead to odour nuisance, poor bird health and possibly to health problems for farm workers. Table 3 provides a guide to litter moisture content and properties and management procedures to maintain optimum litter moisture contents.

Management practices include:

- Evenly distributing enough clean bedding at the beginning of a cycle of birds to ensure it remains dry and friable. Consider adding additional bedding throughout the length of the cycle if required to maintain dry friable litter.
- Maintaining litter moisture content between 15% and 40% (wet basis). At this moisture content the litter should be relatively dry and friable.
- Not allowing litter to become too dusty (below 15 % wet basis). Dust particles may contain moulds, bacteria and endotoxins that may be harmful to humans. Dust may also cause health problems with susceptible members of the population (e.g. asthma sufferers);
- Not allowing litter to become too wet (above 40% wet basis). Wet litter can generate and emit significantly more odour as it breaks down. Immediate action should be taken to reduce the litter moisture content or to remove the litter from the shed.
- Topping up areas of wet litter within the shed or removing and replacing the litter.
- Minimising interruptions in diet due to feed formulation. The use of medication and poor bird health are important in preventing wetter manure. Wet manure increases litter moisture content and subsequently increases ammonia generation and odour emissions.
- Observing and recording details of litter moisture content daily. This should be done throughout each shed, with particular emphasis on likely high moisture areas (e.g. near drinkers).

TABLE 3 - DESCRIPTION OF LITTER AT CORRESPONDING MOISTURE CONTENTS AND MANAGEMENT RESPONSES

Litter Description	Moisture Content (% w.b)	Management Response
Dusty	<15	Increase shed humidity
Dry to friable	15 – 20	No response
Friable to moist	20 – 30	No response
Sticky – beginning to cake	30 – 40	Increase ventilation rates and/or manually turn litter.
Wet and sticky – heavy caking	40 – 50	Increase ventilation rates. Add additional bedding and/or manually turn litter.
Very wet and sticky	>50	Remove wet litter and replace with fresh bedding.

6.9. Manure Management - Shed

Depending on the type of production system used, manure from birds is managed either as manure, litter (manure plus bedding) or is naturally spread by the birds in free range systems. Poultry manure is generally relatively dry and manageable. Older style sheds and breeder farms store manure within the shed until clean-out. This typically occurs after a cycle is completed or before new poultry are brought into the shed. In newer sheds manure is typically removed more frequently (once to twice weekly) than in older sheds.

For modern cage systems manure is most commonly removed using conveyor belts. Cages with wire mesh floors are fixed above conveyor belts that are rotated to carry the manure out of the shed for storage or removal. Older sheds collect the manure for a varying period (generally longer in the cooler months) before clean-out for stockpiling and/or utilisation. Breeder farms where birds are on wire mesh flooring or slats undertake clean-out between batches.

For systems with less permanent fixtures, such as barns and free range, all of the fittings inside the shed are generally removed or raised and bobcats or other machinery are used to transport manure from the shed

Controlling manure moisture is critical in minimising odour generation and fly breeding. This is less critical in systems where manure is only stored in the sheds for short periods. Nevertheless, drier manure is easier to handle and in-situ drying equipment can assist in this process. Drier manure also provides a better environment for the birds.

Management practices include:

- Controlling manure moisture by providing sufficient ventilation (and drying on belts in modern environmental sheds) around the manure and by minimising water additions to the manure.

6.10. Managing Manure/Litter Beetles

These beetles breed in manure and litter within sheds or in stockpiles on-farm. Litter and manure beetles (darkling beetles) need to be controlled to avoid damage to insulation and wood structures and to reduce the risk of diseases such as salmonella spreading.

Management practices include:

- Controlling beetle populations using an integrated pest management approach. This should include:
    - using pesticides,
    - pasteurising (partial composting),
    - total shed clean-out or
    - a combination of these.

The management strategy adopted will be dependent on a number of factors, including:

- the degree of infestation,
- shed floor types,
- chemical resistance of the beetles and
- how long the manure and litter remains in the shed.

Additional information on the managing manure/litter beetles can be found in Appendix D.

6.11. Managing Cracked/Broken Eggs and Embryonic Matter

Egg waste products are generated at egg production farms, hatcheries, grading floors and egg manufacturing plants. The material may not only contain egg material, but also embryonic matter. Effective disposal or utilisation of this material is needed to avoid disease transfer, amenity impacts (odour) and contamination of surface water and groundwater.

Management practices include:

- Effectively containing all waste products by either securing them in a sealed container for disposal to an approved land site or treating them on-farm.
- Disposing or refrigerating these of these products daily.

- Minimising the amount of solid waste entering an effluent treatment or holding pond through the use of grates and sieves.

If allowed by the development approval/licence, consider composting these by-products with an appropriate co-composting agent (sawdust, wood shavings, paper, cardboard, etc). This will allow the nutrient and organic matter value of these products to be utilised.

Additional information on the treatment, options for manure, spent litter and other by-products can be found in Appendix C.

6.12. Effluent Treatment and Storage Systems Management

The sources of effluent from egg facilities were identified in Section 5.8 - Effluent Treatment and Storage System Design. The following management strategies deal particularly with treatment ponds. However, alternate treatment systems can be effectively implemented and used.

Management practices include:

- Managing effluent treatment ponds to minimise any impacts to community amenity (particularly odour), groundwater and surface water.
- Preventing foreign material (veterinary equipment, plastic bags etc), toxic chemicals, oxidising agents and other substances that may inhibit microbial activity from entering effluent ponds.
- Grassing the outer banks of ponds prevent weed infestation, cracking and erosion.
- Keeping grass cover short to facilitate regular inspections for signs of deterioration.
- Preventing the establishment of trees, shrubs and woody weeds on pond banks.
- Removing some effluent from the ponds (e.g. by irrigation or diversion to an evaporation basin) to remove excessive salts, helping to maintain salinity at an acceptable level.
- Maintaining pond pH between 6.8 and 8.0. When ponds are overloaded pH levels may fall resulting in septic conditions, generating excessive odours. This can be corrected by added slaked lime or caustic soda daily, at a rate of 1.6 kg per 1000 m^3 of pond volume, until a neutral pH is reached.
- Monitoring total dissolved solids (TDS) to enable the maintenance of a suitable pond bacterial population. Reduce TDS levels via dilution or increasing pond treatment volumes' particularly when they exceed 4,000 mg/L.
- Diluting pond effluent with fresh water as needed to keep the salinity at an acceptable level (below 6 dS/m). The land utilisation of high salinity effluent can cause salt accumulation in the soil with detrimental effects on plant growth.

- Possibly using commercially-available additives if a pond is not functioning efficiently. However, this is not a substitute for correct design and management.
- Possibly using permeable or impermeable pond covers if odour is an issue with the operation.
- Managing pond volumes to avoid overtopping more than once every 10 years on average or meet ***similar criteria as specified by state or local government regulatory authorities***. This may include regular reuse of the effluent via a land based irrigation system.

6.13. Managing and Disposing of Packaging and Other Waste

There are a number of wastes besides manure, spent litter and effluent that can be produced at egg facilities. These include:

- Plastic packaging used during the transportation of eggs (particularly grading floors).
- Cardboard packaging used during the transport of eggs.
- Used chemical drums.
- Used vaccination bottles and containers.
- Sharps and syringes.
- General rubbish (including disused and obsolete plant and equipment).

The waste management hierarchy should be used when dealing with packaging and other waste. This hierarchy moves from the most preferred to least preferred method, that is:

- Waste avoidance.
- Waste re-use.
- Waste recycling.
- Energy recovery from waste.
- Waste treatment and containment.
- Waste disposal.

Good management practices include:

- Recycling wastes such as cardboard and empty chemical containers in accordance with manufacturers specifications.
- Placing all unwanted waste products in sealed refuse containers for removal to approved landfill.
- Placing all sharps in specific sharps containers for collection. In some states it is illegal for sharps to be buried at landfill sites. ***Relevant state and territory legislation must be checked***.
- Minimising waste generation through good practice design and management.

- Using cardboard waste as an alternative carbon source in any composting operations that are used in the farm (e.g. composting dead birds, egg wastes and manure).

6.14. Dead Bird and Cull Management

Management of dead birds is a daily operation on egg production, pullet rearing and breeder farms. Culls from hatcheries may also need to be dealt with. Poor practices may contaminate ground and surface water, cause odour nuisance, spread infectious diseases and attract vermin. Current dead bird treatment methods in order of minimising environmental impacts include:

- Rendering.
- Composting.
- Burial.
- Incineration.

Contractors may also collect birds and culls for disposal at waste refuse sites. However, dumping birds on-site is not an acceptable disposal method as the carcasses become odorous and attract scavenging animals which increases the risk of disease spread. Planning permit requirements may specify or restrict disposal options on your farm.

6.14.1. Rendering

Rendering is the best method for dead bird and cull disposal if a rendering plant is located nearby. If the dead birds are correctly stored before pick-up there is little risk of adverse environmental impacts. The end product is a protein meal that is used as a feed ingredient in livestock production (excluding ruminants) or as a fertiliser.

Management practices include:

- Managing dead bird collection to avoid the spread of pathogenic microorganisms. Although daily pick-up and short-term freezing on-farm reduces the chance of pathogen spread, they do not completely eliminate the risk.
- Developing a contingency plan (e.g. short-term refrigeration, composting or burial) for use in the event of a failure to dispatch carcasses.
- Treating dead birds with chemicals to preserve/disinfect the carcasses if birds are not collected daily (e.g. over week-ends) or provide short-term refrigeration.

The disadvantage of rendering is that it is only economically viable if a rendering plant is located nearby.

6.14.2. Composting in Open Bays and Piles

If performed correctly, composting dead birds in open bays and piles is an environmentally and biologically safe alternative. A major advantage is the production of a nutrient rich humus-like material that can be used as a replacement for inorganic fertiliser and/or a soil amendment. When managed correctly the bird composting process can be completed in a few weeks.

The optimum moisture content for carcass composting is around 50%. Adding a co-composting material to the carcasses provides additional carbon, which helps to maintain a high level of microbial activity. On poultry farms, the most readily available co-composting materials are manure, spent litter and grain milling residues, provided they do not contain excessive moisture. Sawdust is an excellent material for composting mortalities because of its absorbent qualities and ability to shed water when piled. The co-composting product must have a sufficiently dry moisture content (< 30% wet basis) to avoid the compost having excessive moisture when the carcasses are added.

Carbon (C), nitrogen (N) and oxygen are key elements in the composting process. Without an appropriate balance of C:N ratio (15:1 to 30:1), limited microbial growth will inhibit the decay rate. Adequate oxygen must be available to keep the pile aerobic and relatively odourless. This is achieved by ensuring the co-composting material has a high porosity. Also, turning the pile after 2 to 3 weeks of adding the last carcass will also increase oxygen levels. A test for inadequate oxygen is if the compost is still active (not yet finished), the compost material still has an optimal moisture content (50–60 % wet basis) and the temperature reduces to below 40 ^{o}C.

The temperature inside properly sized and maintained compost piles should reach 50-65 ^{o}C. This temperature stimulates the growth of the thermophilic bacteria that promote break-down, which helps to destroy disease-causing micro-organisms. This improves on-farm biosecurity and creates a product that is safe for land application. Compost piles are likely to be cooler close to the edge, so dead birds should be kept at least 300 mm from the edge of the pile.

Compost bins can be as simple as large round or square hay bales configured into an open-fronted bay.

Management practices include:

- Designing and managing these facilities to avoid any biosecurity hazards.
- Locating compost bays on an impermeable pad (compacted clay or preferably concrete).
- Bunding compost sites if any leachate is produced from the piles and capturing the leachate so it is either reused back in the compost or applied to land.
- Locating carcass compost facilities within a shed if the operation is located in a higher rainfall area. This design allows for improved environmental control by excluding rainfall. It can also

reduce amenity impacts and control vermin. The sidewalls of these sheds can be timber, concrete or plywood with timber supports. Bins are generally about 2 m deep and 2.5 m wide. The width needed depends on the implements available for turning the compost (front-end loader, bobcat etc).

- Excluding feral animals from carcass composting facilities with appropriate fencing (e.g. chain wire, electric).

If large quantities of compost are produced and sold off-site it may trigger the requirement for a separate development application/permit or similar.

6.14.3. Composting in Sealed Bins

Current dead birds composting practices mainly use purpose built rotary composters. The size and number of units needed depends on the size of the operation and normal levels of bird mortality. Some facilities are using rotary composters and bins as the first step in the composting process to get some initial breakdown before completing the process in piles or windrows.

Management practices include:

- Operating these units to ensure an aerobic environment is maintained. This reduces the possibility of excessive odour generation.
- Adding sufficient carbon material to avoid excessive moisture (anaerobic conditions) and ensure effective breakdown.

6.14.4. Burial On-site

Burial pits and trenches are sometimes used for dead bird disposal. Some major problems with burial pits and trenches include:

- The dead birds decompose slowly and the daily mortalities need to be covered to avoid scavenging and odour problems, thus disposal pits fill quickly and regularly need to be replaced.
- There is potential for groundwater contamination through nutrient and bacteria leaching, particularly if there is shallow groundwater and inappropriate sealing of the pit base.
- Surface water contamination can also occur through stormwater runoff exiting poorly managed disposal pits.
- Some state agencies and local governments discourage the use of burial as a disposal option.

Management practices include:

- Ensuring the base of trenches is at least 2 m above the water table at all times. Individual states also may have minimum requirements for the depth of trenches above the groundwater level.

- Sealing or lining the base of the pits to minimise nutrient leaching. This includes ensuring they have a maximum design permeability of $1x10^{-9}$ m/s over a depth of 300 mm.
- Preventing surface or sub-surface seepage from the pit or trench that may cause the spread of disease or release of contaminants.
- Covering each batch of dead birds with soil or other suitable material.
- Covering full pits with at least 0.5 m of compacted clay soil.

6.14.5. Burning or Incineration

While correct incineration is biologically the safest dead bird disposal method, it may not be ideal for the following reasons:

- It needs to be performed efficiently and effectively to ensure complete incineration and to avoid odour and particulate problems.
- Appropriate incineration is expensive.
- Some state regulations and local government's do not permit incineration as a disposal method.
- The process eliminates some of the nutrients that can be a valuable by-product.
- Burning needs to be conducted in an incinerator at sufficient temperatures to ensure the entire carcass is destroyed. An appropriate fuel source should be used (not sump oil or tyres). Acceptable disposal or utilisation of the ash is necessary. Burning of dead birds in open fires is unacceptable, as it creates smoke and odour and is unlikely to maintain a sufficiently high temperature consistently. It is also a biosecurity hazard due to thermal updraughts dispersing feathers and other matter.

Management practices include:

- Burning mortalities in an incinerator operated at sufficient temperatures to ensure the entire carcass is destroyed.
- Using an appropriate fuel source (not sump oil or tyres).
- Acceptable disposal or use of the ash produced. For example, application to crops or pastures at sustainable loading rates.

6.15. Manure and Spent Litter Clean-out

Manure and spent litter removal methods for cage, barn and free range egg production systems are described in Section 6.9 - Manure Management.

Management practices include:

- Implementing a well managed shed clean-out program.

- Cleaning out sheds during daylight hours to minimise noise impacts. This also reduces dust and odour impacts because of the increased dispersion potential of atmospheric conditions during daylight hours.
- Carefully managing shed clean-outs to minimise the increased risk of odour, dust and noise emissions from the farm during this activity.
- Cleaning up any manure and spent litter that is spilt outside the shed during clean out.
- Covering vehicles that transport manure and spent litter off farm to minimise potential dust and odour impacts.
- Opening the side shutters or curtains of sheds during manure or spent litter removal to prevent the build-up of gases in the shed that may threaten the health and safety of workers.
- Considering wind direction and strength during shed clean out. If possible shed clean out should occur when the wind is blowing away from sensitive receptors/areas.
- Considering contacting neighbours if the clean out of manure and spent litter may affect them, so they are aware of possible timeframes. .i.e smell for a few hours.
- Consider neighbour movements when cleaning out manure and spent litter. Try to avoid clean out when neighbours are at home. i.e. weekends.

6.16. Manure and Spent Litter Storage and Compost Management

If manure and spent litter is stored or composted on farm it needs to be managed to avoid contamination of surface water and groundwater, not cause a nuisance (odour, dust and noise) to neighbouring residents and to avoid excessive fly breeding.

Management practices include:

- Minimising the amount of manure and spent litter stored or composted on-farm as this may contribute to odour generation, possible contamination of watercourses and groundwater, as well as additional biosecurity risks.
- Appropriately designing and constructing suitable storage areas that keep stockpiled manure and spent litter dry until it can be removed or utilised as per Section 5.9.
- Covering manure and spent litter that has to be stored on-site for a short period of time after shed clean-out (less than one week) to avoid nutrient leaching from rainfall and to minimise dust and odour emissions.
- Minimising fly breeding during storage and composting. Stored heaps may need to be turned and/or sprayed to control fly breeding. In Western Australia, stable fly breeding is of particular concern and local regulations need to be checked with regard to storage and land application.

Additional information on the treatment options for manure, spent litter and other by-products can be found in Appendix C.

6.17. Manure and Spent Litter Utilisation

Manure and spent litter by-products are not generally utilised near poultry sheds, except for free range systems. This is because:

- There may be insufficient land on smaller poultry farms to sustainably use all of the by-products.
- Application of by-products in close proximity to poultry sheds poses a bird health risk.

The primary focus of most egg industry farms is either egg production or the production of chicks and pullets, with the application of by-products on agricultural land mostly a secondary interest. The resources, skills and time required to sustainably use the nutrients in by-products are generally not considered worthwhile, except for operations with other broadacre farming enterprises. Thus, manure and spent litter is generally sold or removed from the site for further treatment and/or utilisation.

Land application to crops (horticulture and broadacre) and pasture is the most widely adopted and cost effective way of utilising the nutrients in manure and spent litter from egg production. It reduces the need for commercial fertilisers, potentially lowering the cost of crop production. Another advantage of applying these by-products is that generally not all the nutrients are available to the plant immediately. Hence they act as a slow release fertiliser allowing the plant to access nutrients when they are required.

Organic by-products such as those sourced from poultry sheds are not balanced fertilisers so additional nutrients may need to be added via inorganic fertilisers to meet crop requirements. The application of manure and spent litter also needs to be carefully managed. Inappropriate use and over application can cause nutrients and organic matter leaching through the soil profile or lost via runoff and eroded soil.

In calculating the required utilisation area for by-products, nutrient applications (particularly nitrogen and phosphorus) should not exceed the sum of the following:

- The rate at which an element can be taken up by plants or animals and removed from the site.
- The amount that can be safely stored in the soil, where permitted.
- The amount released to the atmosphere in an acceptable form (primarily the gaseous loss of nitrogen via ammonia volatilisation).

This can be expressed for each element/nutrient as:

Amount applied = Amount removed by plant/grazing
+ Amount safely stored in the soil
+ Safe losses (primarily ammonia loss).

When determining the required size of a utilisation area, each element (nitrogen, phosphorus, potassium, salt, metals etc) needs to be considered individually. Manure and spent litter is not a balanced fertiliser so the sustainable application rate will be determined by the most limiting nutrient (the nutrient that limits the amount that can be applied). State agricultural departments or agronomists can provide details of crop removal and soil requirements.

When applying by-products, the aim should be to make the maximum use of the fertiliser while avoiding any potential negative effects, such as soil degradation and contamination of ground and surface water.

Manure and spent litter may contain traces of pesticides used for insect and rodent control in the shed. They also contain pathogens but the level of these is unlikely to pose a risk to human health. The level of risk depends on the period between applying the by-product and crop harvest (particularly crops for direct human consumption without post harvest treatment/processing). Pathogens will die-off when applied and exposed to the sun (dried). However, care should be taken when handling and applying manure by-products.

Refer to the "Freshcare Code of Practice - On-farm Food Safety Program for Fresh Produce" and the Agriculture Fisheries and Forestry - Australia guidelines for "On-farm Food Safety for Fresh Produce" for information regarding the application of organic manures to vegetable crops.

In some states environmental legislation dictates that industries that produce organic by-products have a duty of care to ensure their by-products sold or taken off-site are used sustainably. Although the egg industry may not control the reuse of manure or spent litter, their environmental responsibility for the sustainable utilisation of the by-products still exists. A contract between producers of manure and end users can define the quantity of by-product involved and the application method. It is helpful for the producer to inform the purchaser of their environmental responsibilities and give the purchaser some idea of the composition of the material (nutrient analysis). The composition of the by-products can either be estimated using mass balance principles or determined by chemical analysis. The composition of any compost sold will also need to be in accordance with any State and territory legislation.

Information Specific to Free Range Farms

The same nutrient mass balance principles apply to free range systems in that nutrient applications (particularly nitrogen and phosphorus) should not exceed the following:

- The rate at which an element can be taken up by the plant and removed from the site, plus
- The amount that can be safely stored in the soil, where permitted, plus
- The amount released to the atmosphere in an acceptable form (primarily the gaseous loss of nitrogen via ammonia volatilisation).

Brown (2001) estimates that, for free range birds, 40% of the manure produced is excreted in the range. Thus, based on the figures provided by Brown (2001) the nutrient excretion for every 1000 birds in the range is 712 kg N/yr, 280 kg P/yr, 140 kg K/yr and 72 kg S/yr. If a free-range system is stocked at 250 birds/ha the amount of nutrients applied would be 178 kg N/ha/yr, 70 kg P/ha/yr, 35 kg K/ha/yr and 18 kg S/ha/yr (although some of this nitrogen will be lost via volatilisation processes). This demonstrates that even relatively low stocking densities may still result in reasonably high nutrient application rates. These run areas may need regular rotation to allow for cropping and subsequent nutrient removal to avoid excessive nutrient accumulation and potential loss.

Crop Uptake

The type of crops grown on the by-product utilisation area determines the nutrient removal via the amount of harvested material and its nutrient content. Appendix A (Table 5) shows typical dry matter nutrient contents and expected yield ranges for a variety of pasture, silage, hay and grain crops. The yields presented are for typical cropping soils.

Grazed pasture is rarely an effective method of removing nutrients from by-product utilisation areas since most of the nutrients are recycled through the grazing animal and returned to the utilisation area. Grazing systems typically require at least five to ten times more area than a system using a crop removal process (e.g. cut and cart).

Management practices include:

- Only spreading manure and spent litter on areas that are approved under a development approval/licence. ***In Western Australia, stable fly breeding is of particular concern and local regulations need to be checked with regard to storage, transport and land application of manure and spent litter***. Additionally, approval/permit conditions may specify or restrict methods of manure and spent litter utilisation.
- Matching application rates to crop uptake, plus safe storage, plus allowable losses (nitrogen volatilisation).
- Not grazing pastures spread with manure and spent litter until it is well broken down (allow three weeks minimum).
- Not applying manure and spent litter to the foliage of crops that are to be consumed by humans.
- Not spreading on land subject to frequent flooding (i.e. the 1 in 100 year flooding frequency).
- Not spreading manure and spent litter near watercourses and drainage lines (refer to Section 4.3.1). The planting of appropriate buffer strips (grass and trees) can also be useful in intercepting nutrients, dusts and other particles.
- Protecting riparian zones around watercourses with appropriate buffers zones, and vegetative filter strips. These assist in reducing the risk of surface water contamination from runoff. The greater the vegetative cover and distance the greater the possibility of filtering out nutrients, particularly phosphorus.
- ***Not feeding spent manure and litter to livestock. This is mandatory as it is illegal to do so in all states due to the high risk of botulism***.

- Covering manure and spent litter during transportation to prevent spillage and minimise odour emissions.
- Not spreading material that is too dry (less than 15% moisture wet basis).
- Considering the wind speed and direction at the time of spreading.
- Only applying manure and spent litter when the soil is not saturated and heavy rain is not expected.
- Only applying manure and spent litter just before planting or when crops are actively growing to ensure maximum nutrient uptake and to minimise nutrient losses by leaching.
- Incorporating manure and spent litter spread on bare soil as soon as possible after application. This minimises the chance of contamination from wind drift or rainfall runoff and will also maximise the nutrient value of the material by reducing potential losses.
- Spreading manure and spent litter thinly to help kill fly larvae/eggs through rapid drying and ultraviolet light.
- Regularly monitoring utilisation areas (at least annually) for the parameters listed in Table 4 (Section 6.25.2) and comparing the results with background monitoring sites to determine if application rates need to be adjusted.
- Monitoring long-term trends in soil pH should be monitored. A neutral (7) to slightly acidic (6) pH soil is optimal for plant growth. Spreading of manure and spent litter may alter soil pH.
- Not spreading on steep slopes with inadequate groundcover. Slopes of greater than 10% should be avoided.
- Not spreading on rocky or highly erodible land.
- Not spreading on highly impermeable soils.
- Adopting appropriate soil conservation measures, such as contour banks and strip cropping.
- Maintaining adequate groundcover at times of probable high rainfall intensity to reduce erosion potential.
- Considering the chemical residues in manure and spent litter and long-term soil concentration trends.
- Maximising the time between application and crop harvest. Do not apply untreated animal manure where direct or indirect contact may occur with the edible part of the crop.
- Composting or aging the manure and spent litter to reduce the microbe populations. Composting is more effective than aging. Longer treatment periods are required for aging (usually 6 months) than composting (about 6 weeks).
- Applying only properly composted manure or treated proprietary organic products that contain less that 100 *E. coli* per gram as side dressing. Refer to the “Freshcare Code of Practice (On-farm Food Safety Program for Fresh Produce)” and the Agriculture Fisheries and Forestry - Australia guidelines for “On-farm Food Safety and Fresh Produce” for information regarding the application of organic manures to vegetable crops.

- Retaining a record of where manure and spent litter went off farm and the quantities involved.
- Informing end users of manure or spent litter of the composition of the product. This may include fact sheets on typical or actual composition.
- Providing end users of manure or spent litter with information on nutrient uptakes of crops or pastures on which the material may be applied.

More detailed information on by-product utilisation can be found in Appendix E, including individual state requirements that are current at the time of the publication of these guidelines.

6.18. Effluent Utilisation

The same general principles and management practices should apply to the utilisation of effluent generated from hatcheries, grading floors and egg plant manufacturing as the utilisation of manure and spent litter by-products covered in Section 6.17. This effluent may contain additional chemicals used for cleaning (e.g. sodium) and as such may require additional management.

Additional management practices include:

- Not irrigating at rates that cause waterlogging or excessive drainage (runoff).
- Only using surface irrigation methods on areas with an even grade.
- Regularly monitoring the salt (electrical content) and sodium concentration of the effluent (at least annually) to determine the suitability for irrigation.
- Adding additional clean water during effluent irrigation to lower the salt and sodium content of the effluent.
- Using additional clean irrigation water to flush salts through the soil profile after effluent irrigation.
- Monitoring the long-term trends in soil salinity to detect soil salinity problems.
- Monitoring soil conditions in case of soil structural decline.
- Restricting cultivation practices if effluent is irrigated onto dispersive soils.
- If the effluent is likely to contain heavy metals or other contaminants (chemicals) it should be analysed before application to enable the adjustment of application rates to safe levels.

More detailed information on by-product utilisation can be found in Appendix E, including individual state requirements that are current at the time of the publication of these guidelines.

6.19. Control of Flies

Flies can be a significant issue for egg production facilities and can generate complaints from nearby residences. James *et al.* (2004) state that flies can disperse in large numbers from poultry sheds and are known reservoirs and vectors for a range of both poultry diseases, such as Newcastle and pathogens, such as *Salmonella*, *Campylobacter*, and *E coli*.

Migrating flies can be difficult to control, but they are best managed though an integrated program. James *et al*. (2004) describes methods for controlling flies.

Management practices include:

- Monitoring fly numbers:
  - at least weekly and records kept of population counts; and
  - using white spot cards, sticky tapes of fly traps or a visual scoring system.
- Monitoring water leaks both in sheds and shed surrounds to control manure and litter moisture by:
  - regularly checking for and repairing broken waterers and leaking pipes;
  - providing maximum ventilation over manure and litter to aid rapid drying; and
  - diverting surface water around sheds and providing sufficient gradient to allow good drainage from storage areas.
- Carefully managing manure and litter by:
  - cleaning out manure in low fly periods, if possible; and
  - preventing flies breeding in manure and litter after cleanout – both in temporary storage areas and when manure and litter is applied to soil as a fertiliser.
- Enhancing populations of natural biocontrol agents by:
  - keeping manure and litter dry;
  - avoiding killing predators and parasites through inappropriate spraying; and
  - leaving a pad of manure at cleanout as a reservoir for predators and parasites if biosecurity and other practical considerations allow.
- Using good sanitation practices, such as:
  - cleaning up spilt feed;
  - removing dead birds from sheds daily and storing them in a sealed container; and
  - mowing grass and clearing bushes from around sheds to facilitate airflow and remove fly resting sites.
- Selectively using adulticides to treat flies, including:
  - using surface sprays when monitoring indicates fly numbers are increasing or at times of the year when flies regularly become a problem;

        - treating surfaces where large numbers of flies rest;
        - rotating insecticide groups;
        - using an ongoing baiting program; and
        - use fogging or misting (if fitted) for rapid knock down of high fly populations.
    - Consider selectively using larvicides to treat manure and litter, including:
        - using only products containing chemicals safe for natural predators and parasites;
        - using a spot treatment if problem sites with high maggot numbers can be identified;
        - strategically timing manure and litter treatments for problem periods;
        - using feed additives for periods of 4-6 weeks and then discontinue use for a similar period, or until maggots are again seen in manure and litter; and
        - avoiding spraying or contaminating manure and litter with other chemicals.

6.20. Control of Rats and Mice

Rodents can migrate to neighbouring properties and generate health and nuisance complaints. They pose a risk of disease transfer between farms. Rodents can transmit pathogens to humans via contaminated poultry carcasses. Rodents also damage insulation, curtains, hoses, electrical wiring and can kill young chicks. The occasional siting of a mouse or rat (particularly during the day) may indicate a large infestation. A combination of chemical and non-chemical methods is usually the best method of controlling rats and mice.

Management practices include:

- Designing and maintaining sheds to minimise rodents. This includes installing rat walls on sheds and blocking entry points with durable materials (iron grills, heavy gauge sheet metal and concrete mixers), while avoiding the use of plastics, wood and soft metals.
- Minimising feed spillage and promptly cleaning up any spillage.
- Storing all potential feed sources and nesting materials in rodent-proof containers.
- Removing all rubbish (e.g. timber piles).
- Keeping all grass around complexes short.
- Minimising rodent breeding sites (e.g. holes, burrows).
- Maintaining a baiting program of anticoagulant rodenticides, tracking powders (e.g. poisonous dust) or gels and fumigants. If there is resistance to some baiting chemicals use an alternative chemical.
- Keeping baits in a dark safe place out of the reach of other animals and children.

6.21. Chemical Storage and Use

Factors to consider in minimising possible environmental problems from the storage and use of chemicals include:

- Keeping only small quantities of chemicals on-site.
- Correctly storing and using chemicals to avoid spills that may contaminate groundwater and surface waters.
- ***Storing chemicals in accordance with workplace health and safety codes of practice***. This includes locking chemical storage sheds or containers.
- **Adhering strictly to any requirements of the dangerous goods safety and management acts or similar**.
- Bunding the bases of fuel storage areas or constructing these of an impermeable material such as concrete and bunding these areas. ***Compliance with the Australian Standard AS1940:2004 is required***.
- Adhering to any requirements in relation to chemical and fuel storage and use stipulated by the local government.
- ***Strictly adhering to manufacturers instructions for chemical storage and use.*** Volatile components of shed disinfectants may affect neighbours if not used in accordance with manufacturer and workplace health and safety requirements.
- Maintaining a register of all dangerous goods and combustible liquids stored or handled. ***If required, Material Safety Data Sheets (MSDS) must be available for all chemicals stored and used.*** The website: www.msds.com.au contains a comprehensive list of MSDS.
- Supplying appropriate signage (e.g. HAZCHEM).
- Storing incompatible chemicals in a manner that allows for adequate separation from each other.
- Training all staff in the safe use and handling of chemicals. This could include attending a chemical handlers course to gain knowledge on legislative requirements, handling procedures, storage and signage.
- Implementing procedures and making equipment available to contain and clean up a spill or leak. These procedures must be documented in an emergency response plan.
- Selecting only chemicals with low toxicity and water contamination potential.
- Not spraying chemicals near waterways or drainage lines and avoiding run-off.
- Using chemicals in a manner that minimises spray drift by using well maintained equipment and avoiding application during windy weather. This equipment should be regularly calibrated to ensure correct application rates.
- Washing up chemical containers and mixing chemicals in a bunded and sealed area to contain any spills.

- Disposing of empty drums in accordance with manufacturer's instructions. Take advantage of chemical container collections and drum recycling programs such as DrumMuster that operate in some states. Contact your local government for details on recycling programs in your area.

6.22. Contingencies and Management of Emergencies

Contingency plans should be developed to enable egg industry operations to deal with emergency situations. A contingency plan should have contacts and phone numbers of suppliers, veterinarians, state government departments, emergency contacts etc and be placed in a location that is known to and accessible by all staff.

6.22.1. Mass Bird Deaths

A contingency plan is required to cope with high mortality events. The contingency plan will depend on whether the mortalities were due to disease or environmental conditions. The cause of death (disease or environmental conditions) will dictate the outcome of the contingency plan).

Disease outbreaks

For emergency animal disease outbreaks, the industry and the poultry farm operator have to follow the AusVetPlan under the direction of the relevant state or territory chief veterinary officer. Operations should also refer to AusVetPlan in their Quality Assurance program or farm plan

Environmental conditions

For mass bird deaths caused by environmental conditions, disposal options in order of minimising environmental impacts include:

- Rendering.
- Composting.
- Disposal in a land-fill site.
- Burial on-farm.
- Incineration.

Follow management options in Section 6.14 for these disposal options.

Carcass composting of mass deaths can be undertaken in long windrows instead of bins and piles. These windrows can be constructed in a shed. Windrows should only be one bird depth per layer with a maximum of two layers. The windrows need to capped and are generally 1-2 m wide at the base and can run the length of the shed. When the temperature in the pile drops it needs to be turned into a second row and re-capped. Before commencing composting, consult veterinarians and relevant state government departments e.g.: primary industries or environmental protection authorities.

6.22.2. Power and Water Supply Failure

Standby generators are required for managing power supply failures and maintaining a constant supply of water, feed delivery, lighting and ventilation (particularly running fans), as well as operating necessary equipment at hatcheries and grading floors.

Poultry farms require an adequate and continuous supply of water for drinking and cooling. Hatcheries, grading floors and egg processing plants require an adequate and continuous supply of water for cleaning and operating humidifiers (hatcheries).

Management practices include:

- Addressing potential noise impacts of standby generators by installing mufflers and considering acoustic screening.
- Regularly running standby generators (at least fortnightly) to ensure they are working effectively.
- Providing a back-up supply (tanks) or contingency for at least two days water in case of breakdown or loss of supply.

6.22.3. Interruptions to Feed Supply

A prolonged feed interruption can restrict young bird growth, reduce egg production and in severe circumstances cause starvation. Failure of the automated feed delivery system and interruption to feed supply need to be catered for.

Management practices include:

- Having a back-up manual feed delivery protocol to cater for failure to automated feed delivery systems.

6.22.4. Equipment Malfunction

Automatic machinery is the primary equipment subject to malfunction at poultry farms, hatcheries, grading floors and egg manufacturing plants. At egg production, pullet rearing and breeder farms this includes feed, water and ventilation. Egg farms may also require equipment for egg collection. The main items of equipment required at hatcheries are incubators, facilities for the euthanasia of culls and equipment for sorting, vaccinating and beak tipping of chicks. Grading floors and egg manufacturing plants require a range of equipment to run the plants. In the case of equipment failure, manual operation systems need to be supplied.

6.22.5. Interruption to By-product Disposal or Utilisation

Unsuitable storage of manure, spent litter and effluent can cause impacts to amenity, surface water and groundwater. In situations where by-products cannot be utilised, sold off-site or disposed of in the usual manner, alternate arrangements need to be made to store or handle the material safely. In the short term, the manure and spent litter could be covered to avoid nutrient leaching from rainfall and to minimise both dust and odour emissions. Alternatively it could be composted in an area where it will not cause any adverse environmental or bird health impacts. A back-up plan will be required to dispose of any effluent stored in open ponds to avoid overtopping.

6.23. Dealing with Neighbours and Regulators

6.23.1. Community Liaison

Providing an increased understanding of the operations of egg facilities assists in the breakdown of misperceptions. This can be achieved by having a good relationship with neighbours. This can often assist in avoiding conflicts via the understanding and tolerance developed. Liaison between the operator and surrounding residents can also be helpful in communicating complaint resolution procedures. Open lines of communication are useful in identifying problems, confirming complaints and successfully applying appropriate remedies to minimise the impact of the farm operations on neighbours. Establishing and maintaining lines of communication from the beginning is always better than dealing with complaints as they occur.

It is important to maintain communications with the relevant regulatory bodies including both state and local government. Communication with regulators can provide clarification regarding any questions relating to regulatory requirements, legislative amendments, and emerging issues, which may affect the poultry industry. An effective relationship between all sectors of the egg production industry and regulatory bodies is beneficial to both parties when dealing with issues of community concern and during the resolution of issues.

Management practices include:

- Informing neighbours in advance of any unusual events or problems that may cause an unavoidable odour, dust or noise problem. Neighbours should also be informed of any proposed practices to mitigate the problem and the expected duration of the potential problem.
- Attempting to resolve disputes by participating and cooperating in any dispute resolution mechanism.
- Gathering relevant evidence and identifying and implementing strategies to remedy the problem.
- Complainants should be informed of the outcome of any investigations and any actions taken to avoid future associated problems.

More information on community consultation can be found in Appendix G.

6.23.2. Handling Complaints

This is one of the most contentious and difficult areas for all parties. It is important to note that various sides in any conflict situation can quickly make assumptions on views and positions that may be difficult to change. Litigation rarely provides a satisfactory outcome for anyone and the damage to community relations and industry image can be very substantial. For this reason, the development of very good relations between the operator and the local community is extremely important.

The main method for measuring the community amenity impact is the number of complaints received. While this is an imperfect measure, because some people will not complain when there is a problem and others will complain when there is no problem, it does aid in identifying when neighbours perceive that the farm is having an unreasonable impact on their enjoyment of life.

Management practices include:

- Monitoring weather conditions daily if complaints are ongoing, because many community amenity impacts are closely related to weather conditions. This can also help in assessing the validity of complaints.
- Recording full details of any complaints received along with results of investigations and corrective actions taken in a “Complaints Register”. Also consider correlating complaint data to identify trends in complaints received. Neighbours should be encouraged to phone the operator directly with complaints.
- Installing and maintaining an automatic weather station for operations where separation distances are constrained or where regular complaints begin to arise. This will aid in complaint investigation and hot weather management.

6.23.3. Complaints Register

Full details of complaints received, results of investigations into complaints and corrective actions should be recorded in a “Complaints Register”. An example of a Complaints Register form is shown in Figure 3.

Complaint Register

Complaint Details

Date of complaint	
Time of complaint	
Nature of complaint (e.g. odour, dust, noise etc)	
Distance to complainant	
Name of person advising of complaint	
Method of complaint	
Name of complainant	
Complainant contact details	

Investigation Details

Temperature at time of complaint	Cold Cool Mild Warm Hot Very hot
Wind strength at time of complaint	Calm Light Moderate Fresh Strong Gale
Wind direction at time of complaint	
Person responsible for investigating complaint	
Investigating method	
Findings of investigation	

Action Taken

Corrective actions	
Communications with complainant	

FIGURE 3 - EXAMPLE COMPLAINTS REGISTER

6.24. Environmental Management Systems (EMS)

6.24.1. Need for an Environmental Management System

Operators of egg industry facilities are encouraged to either develop an EMS or complete the environmental components of the Egg Corp Assured Program (or other quality assurance programs) to demonstrate that the farm is effectively managing potential environmental impacts. This may also assist in improving farm management and productivity. It is important to continually operate in accordance with the EMS or Environmental Assurance Program and aim to achieve accreditation via an external auditing system. A training program to assist in the development of site-specific EMS has been developed by the Australian Egg Corporation Limited with funding from the Department of Agriculture, Fisheries and Forestry (DAFF) - EMS Pathways to Industry Program. Information on this training program can be obtained from the Australian Egg Corporation Limited (AECL).

A site-specific EMS should:

- Identify and evaluate potential environmental risks.
- Include the implementation and maintenance of an environmental management plan (EMP).
- Include auditing to verify that the system is working.

The development of the EMP for an enterprise is a formal commitment that all reasonable and practical efforts will be made to operate the farm in an environmentally sustainable manner. It provides a system for documenting:

- The environmental risks of the enterprise.
- How these risks will be minimised by design and management.
- Measurement of the effectiveness of these strategies by monitoring.
- Reporting of monitoring results.

The development of an EMS (or similar) is also a requirement for the licensing or approval of egg production farms in some states.

6.24.2. Components of an Environmental Management System

The key components of an EMS are shown diagrammatically in Figure 4 and include:

- Identification and contact details, with a brief description of the operation and a commitment that it will be operated in an environmentally sustainable manner.
- Legal requirements of the enterprise, including applicable consents, approvals and/or licences to operate the enterprise and use water etc.

- Information on the natural resources and amenity issues of the property and surrounding area.
- Description of all the design and management facets of the operation.
- Identification of any environmentally vulnerable areas by examining how the location, design and management of the operation interact with the environment. Identification of a risk may mean regular monitoring or a change in design and management is required to minimise the risk.
- Monitoring to measure any environmental impacts. This may be soil sampling if by-products are utilised on-farm or chemical analysis of manure and spent litter sold off-farm.
- Contingency plans for emergency situations.
- Environmental training undertaken by staff.
- The periodic review of the system to update changes in regulatory requirements, operation, environment, design or management.

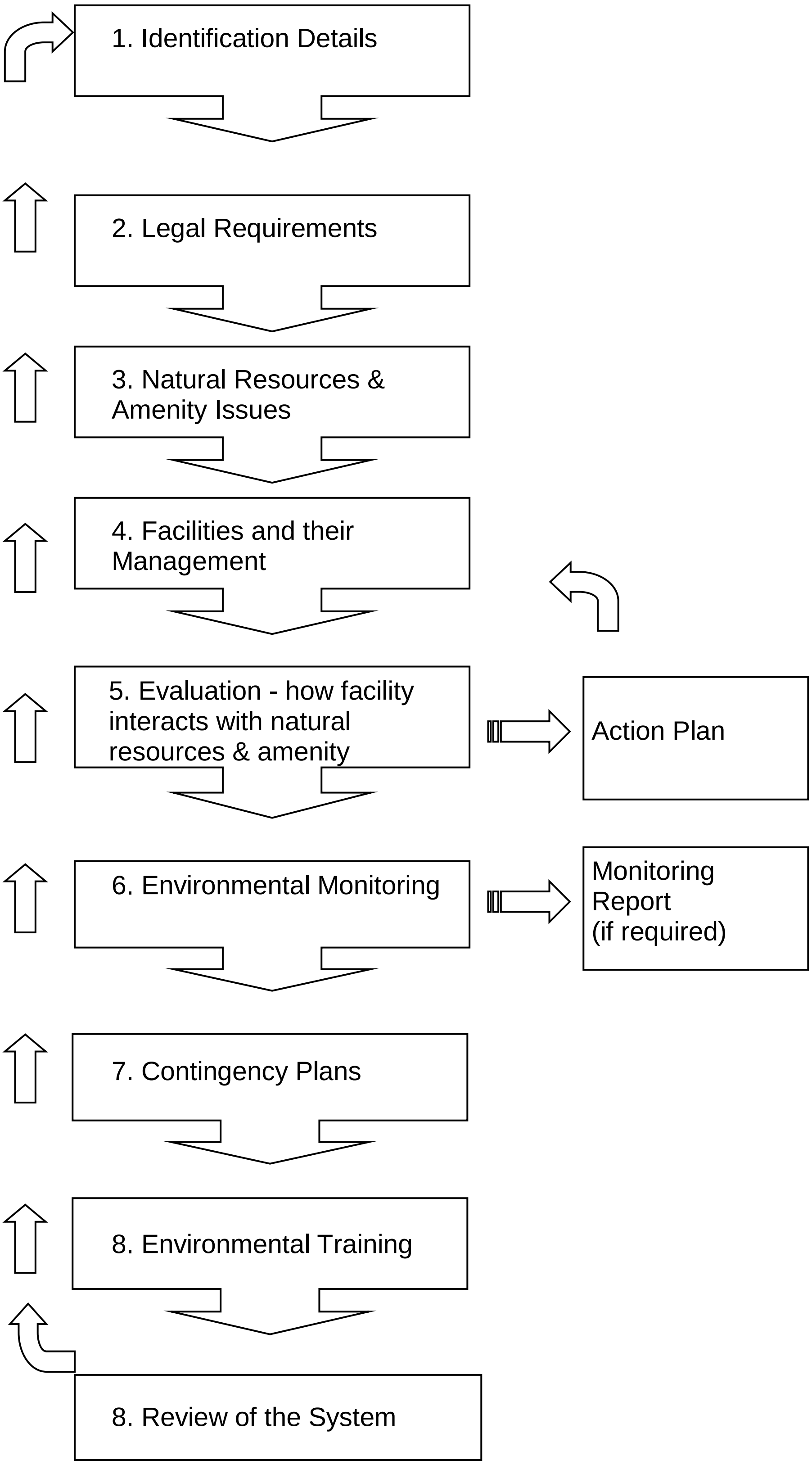


FIGURE 4 - FLOW DIAGRAM OF AN EMS FOR AN EGG INDUSTRY FACILITY

6.25. Environmental Monitoring

6.25.1. By-products

Monitoring of by-products is required to determine levels of beneficial nutrients and potential contaminants. From the monitoring, potential reuse options and by-product application rates can be determined.

Suggested parameters to monitor in manure, spent litter, compost and effluent include:

- Total nitrogen (TN) or total Kjeldahl nitrogen (TKN), ammonium nitrogen (NH_4N). and nitrate-nitrogen (NO_3N);
- Total phosphorus
- Potassium;
- Copper;
- Zinc;
- Carbon;
- pH;
- Electrical conductivity; and
- Sodium adsorption ratio (for effluent only).

Additionally, all facilities should ensure that their by-products are used sustainably.

Management practices include:

- Provision of fact sheets or analysis sheets to end users including typical or actual composition.
- Provision of fact sheets on typical nutrient uptakes of crops or pastures on which manure, spent litter, compost or effluent may be used as an organic fertiliser.
- Recording of off-site sales records (destination and amount).

Information on collecting, storing and handling samples can be found in Appendix H.

6.25.2. Soil Analysis – By-product Utilisation Areas

Regular monitoring of soils of by-product utilisation areas assists in determining appropriate application rates. If soil monitoring is required as part of a licence or approval condition, analysis parameters will usually be specified. Monitoring should identify changes in soil properties caused by by-product utilisation. The frequency of monitoring for each parameter should depend on the likely rate of change for each parameter. Mobile or soluble parameters (e.g. Nitrate-nitrogen - NO_3N) change more quickly and should therefore be monitored more frequently than parameters that change more slowly. Typical monitoring parameters for soils are given in Table 4.

TABLE 4 - TYPICAL SOIL ANALYSIS PARAMETERS

Soil Test	Depth	Frequency
pH	0-0.1 m 0.2–0.3 m 0.5-0.6 m	Annually 3 yearly 3 yearly
Electical Conductivity (EC) - (1:5 soil/water)	0-0.1 m 0.2–0.3 m 0.5-0.6 m	Annually 3 yearly 3 yearly
Total Kjeldahl N	0-0.1 m	3 yearly
Nitrate-N	0-0.1 m 0.2–0.3 m 0.5-0.6 m	Annually Annually Annually
Avail. Phosphorus (Colwell, Olsen or Bray)	0-0.1 m 0.2–0.3 m 0.5-0.6 m	Annually 3 yearly 3 yearly
Organic Carbon	0-0.1 m	3 yearly
Exchangeable Sodium	0-0.1 m 0.2–0.3 m 0.5-0.6 m	Annually 3 yearly 3 yearly
Exchangeable cations & CEC (Calcium, Sodium, Potassium, Magnesium)	0-0.1 m 0.2–0.3 m 0.5-0.6 m	Annually 3 yearly 3 yearly

Information on collecting, storing and handling samples can be found in Appendix H.

6.25.3. Groundwater and Surface Water

Management practices include:

- Strictly following the requirements of any development approval/licence (or equivalent) in regards to any ground or surface water monitoring, recording and reporting.

Refer to the Appendix H for information on protocols and equipment required for ground and surface water monitoring. Local government or state agencies may also provide information in regard to water quality sampling.

6.25.4. Release of Effluent

Before any effluent can be released it needs to be treated to a suitable standard. ***State legislation (e.g. Victoria) may also prohibit the release of treated and/or untreated effluent from agricultural activities to surface and groundwaters***.

Management practices include:

- Analysing effluent before releasing it into the environment.
- Ensuring that the quality of any effluent for release meets the requirements of any Development Approval or Licence (or equivalent). In lieu of this, ANZECC (2000) - Australian and New Zealand Guidelines for Fresh and Marine Water Quality - Volume 1 or subsequent editions should be used. Details on water quality trigger values are provided on pages 3.3-10 to 3.3-16 of the ANZECC (2000) guideline.

Information on collecting, storing and handling samples can be found in Appendix H.

6.25.5. Community Amenity

Management practices include:

- Assessing background noise levels before commissioning a new enterprise or converting of an existing enterprise (e.g. adding a mechanical ventilation system).
- Regularly undertaking subjective checks to monitor potential sources of noise, odour and dust. These should be performed at potential high impact times (manure and spent litter clean-out, shed cleaning or manure, spent litter and effluent application) at the most sensitive land uses (i.e. near neighbours).
- Recording details and proposed solutions to any problems encountered.
- Documenting any changes made to the design and management of the operation and assessing the effectiveness of these changes in reducing the problem.
- For larger enterprises, consider utilising equipment for monitoring air quality and noise levels, as it is becoming more economically feasible. Operators with nearby sensitive receptors should keep themselves informed about technological advances in these areas so that their viability can be assessed.

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Appendix A. NUTRIENT CONTENT AND ANTICIPATED DRY MATTER YIELD OF VARIOUS CROPS

TABLE 5 – NUTRIENT CONTENT AND ANTICIPATED DRY MATTER YIELD OF VARIOUS CROPS

Crop	DM Nutrient Content (kg/t)			Normal Yield Range* (DM t/ha)	Normal Nutrient Removal Range (kg/ha)		
	N	P	K		N	P	K
Dry Land Pasture (cut)	20	3	15	1 - 4	20 - 80	3 - 12	15 - 60
Irrigated Pasture (cut)	20	3	15	8 - 20	160 - 400	24 - 60	120 - 300
Lucerne Hay (cut)	31	3	25	5 - 15	155 - 465	15 - 45	125 - 375
Maize Silage	22	3	20	10 - 25	220 - 550	30 - 75	200 - 500
Forage Sorghum	22	3	24	10 - 20	220 - 440	30 - 60	240 - 480
Winter Cereal Hay	20	3	16	10 - 20	200 - 400	30 - 60	160 - 320
Seed Barley	19	3	4	2 - 5	38 - 95	6 – 15	8 - 20
Seed Wheat	19	4	5	2 - 5	38 - 95	8 - 20	10 - 25
Triticale	19	4	6	1.5 - 3	29 - 57	6 - 12	9 - 18
Rice	14	3	4	4 - 8	56 - 112	12 - 24	16 - 32
Seed Oats	15	3	4	1 - 5	15 - 75	3 - 15	4 - 20
Grain Sorghum	20	3	3	2 - 8	40 - 160	6 - 24	6 - 24
Grain Maize	20	3	4	2 - 8	40 - 160	6 - 24	8 - 32
Chickpea	40	4	4	0.5 - 2	20 - 80	2 - 8	2 - 8
Cowpea	30	4	20	0.5 - 2	15 - 60	2 - 8	10 - 40
Faba Bean	40	4	12	1 - 3	40 - 120	4 - 12	12 - 36
Lupins	45	3	8	0.5 - 2	22.5 - 90	1.5 - 6	4 - 16
Navy Bean	40	6	12	0.5 - 2	20 - 80	3 - 12	6 - 24
Pigeon Peas	26	3	9	0.5 - 2	13 - 52	1.5 - 6	4.5 - 18
Cotton	20	4	8	2 - 5	40 - 100	8 - 20	16 - 40

Sources: Reuter, D.J., Robinson, J.B. (eds) (1997) and National Research Council (1984).
*Yields may vary from these ranges (Refer to historical data for the region for more accurate estimates).

Appendix B. TYPICAL MANURE AND SPENT LITTER COMPOSITION

Parameter	Layer shed-cage (manure only)		Layer shed – barn/free to range litter		Comments
	Range	Average	Range	Average	
Production rate/ bird /week (unless noted) (70- 80% moisture when fresh	0.6 - 1.1kg	1kg	0.95 - 1.5kg	1.3 kg	
Moisture content (% of solids)	7 - 46	30	22 - 29	25	At shed cleanout
Dry solids production (grams/bird/week)	ID	300	ID	400	
Dry density (kg/m^3)	ID	550	320 - 600	550	At ~25% Moisture content
pH	ID	8.0	ID	8.0	Mildly alkaline
Concentrations expressed as a % of dry solids (residue after moisture removed)					
Calcium (Ca) - %	3.6 - 6.0	3.9	0.1 - 1.7	1.4	
Carbon (as organic) - %	ID	29	ID	38	
Chloride (Cl) - %	ID	2.4	ID	1.3	
Iron (Fe) - %	0.1 - 0.6	0.3	0.53 - 1%	0.8	
Magnesium (Mg) - %	0.2 - 0.7	0.5%	0.1 - 0.4	0.3	
Nitrogen (total N) - %	1.3 - 7.2	4.6	1.7 - 6.8	4.1	
Nitrogen as ammonia (NNH4) - %	0.2 - 3.0	1.4	0.01 - 2.0	0.3	
Phosphorus (P) - %	0.5 - 3.4	2	0.8 - 2.6	1.4	
Potassium (K) - %	1.2 - 3.2	2.1	1.3 - 4.6	2.1	
Trace elements (expressed as parts per thousand or kg/tonne in dry solids)					
Arsenic (As) – kg/t	ID	0.03	ID	ID	
Boron (B) – kg/t	ID	0.02	ID	ID	
Copper (Cu) – kg/t	ID	0.02	ID	ID	
Manganese (Mn) – kg/t	0.26 - 0.38	0.3	0.17 - 0.32	0.27	
Sodium (Na) – kg/t	2 - 7.4	4.2	0.7 - 5.3	3.3	
Sulphur (S) – kg/t	ID	4.0	ID	ID	
Zinc (Zn) – kg/t	ID	0.35	ID	ID	

Source: Environmental Code of Practice for Poultry Farms in Western Australia.

Notes:

1. The composition of poultry manure varies with the type of bird, the feed ration, the proportion of litter to droppings, the manure handling system and the type of litter. All manures should be sampled and analysed for specific content before being applied to the land.
2. Nitrogen figures assume approximately 25% loss of N as ammonia gas to atmosphere.
3. Absorbent material e.g. sawdust, wood shavings or absorbent soil granules used as bedding is often incorporated with manure to create poultry litter. The blended material changes the characteristics of the manure. Poultry litter often contains 25-50% sawdust (mainly as organic carbon).
4. Data sources (desktop search only): DPI Qld, Griffiths (2003), Edwards and Daniel (1992), Hawson (AgWA), O'Malley (AgWA), L Turner & J. Stevens.
5. ID denotes insufficient data.

Table 6 lists measured manure production of layer poultry as reported by the American Society of Agricultural and Biological Engineers (2003). Values are reported in kg/day for every 1,000 kg of animal mass.

Assuming the average live mass of a bird is 2 kg, the amount of manure per bird and its composition can be calculated. Table 7 shows the annual manure production (as excreted) of 1,000 birds and its composition (dry basis).

TABLE 6 - MANURE PRODUCTION (KG/D/1000 KG OF ANIMALS) – ASABE STANDARDS (2003).

Component	Mean (kg/d)	Standard Deviation
pH	6.9	0.56
Dry matter	16	4.3
Volatile solids (VS)	12	0.84
Nitrogen (N)	0.84	0.22
Phosphorus (P)	0.3	0.081
Potassium (K)	0.3	0.072
Calcium (Ca)	1.3	0.57
Magnesium (Mg)	0.14	0.042
Sodium (Na)	0.1	0.051
Sulphur (S)	0.14	0.066
Chloride (Cl)	0.56	0.44

Australian data is presented in Table 8. It shows the predicted nutrient production per 1,000 birds per annum adapted from Brown (2001) for Australian production systems. Brown (2001) also estimates the amount excreted in a free-range run is 40% of these values.

Table 7 and Table 8 highlight the large variation in nutrient output from different references. Thus, the most accurate way to determine the amount of nutrients available for utilisation is to analyse the by-product for nutrient composition and measure the total mass.

TABLE 7 - MANURE PRODUCTION (T/YR/1000 BIRDS) AND COMPOSITION – ASABE STANDARDS (2004).

Component	Average (t/yr/1000 birds)	Composition (% dry basis)
PH	6.9	-
Dry matter	11.68	100.0
Volatile solids (VS)	8.76	75.0
Nitrogen (N)	0.61	5.3
Phosphorus (P)	0.22	1.9
Potassium (K)	0.22	1.9
Calcium (Ca)	0.95	8.1
Magnesium (Mg)	0.10	0.9
Sodium (Na)	0.07	0.6
Sulphur (S)	0.10	0.9
Chloride (Cl)	0.16	1.4

TABLE 8 - MANURE PRODUCTION (T/YR/1000 BIRDS) AND COMPOSITION – BROWN (2001).

	Excreted Manure (t/yr/1000 birds)	Composition (% dry basis)
Nitrogen (N)	1.78	5.0
Phosphorus (P)	0.70	2.0
Potassium (K)	0.35	1.0
Sulphur (S)	0.18	0.5

Appendix C. TREATMENT OPTIONS FOR MANURE, SPENT LITTER AND OTHER BY-PRODUCTS

A report was commissioned by the Australian Egg Corporation Limited (AECL) in 2007 to investigate disposal options for by-products from the egg industry. The report is titled “A scoping study of egg and litter disposal options”, and was written by the University of New South Wales. The report explores options such as; land application, composting, production of feedstock, anaerobic digestion and thermochemical processes. A copy of the report is available from AECL.

Composting

Composting can turn manure and spent litter into a more marketable, value added and environmentally acceptable product. Composting is defined as the process whereby organic materials are microbiologically transformed under aerobic conditions for a period not less than 6 weeks, which includes a pasteurisation phase (Australian Standard AS 4454 – 2003).

A range of factors influence the speed and completeness of composting. These factors can be controlled through appropriate selection of raw materials and management methods. The main factors influencing the compost process include:

- Carbon:Nitrogen ratio (ideally 30:1 to avoid excessive loss of nitrogen).
- Surface area and particle size (rows approximately 1.2 m high and 2.4 m wide).
- Aeration.
- Porosity.
- Moisture Content (ideally 40-50%).
- Temperature.
- pH of materials.
- Nutrients.
- Toxic Substances.

Stabilised compost is easier to handle than untreated manure and spent litter (due to a decrease in volume and particle size), does not emit odours or attract flies, is free of pathogens, does not contain viable weed seeds, is a more reliable source of nutrients for plants and an excellent soil conditioner.

A significant disadvantage of composting is that the process requires equipment, labour and management. Producers also need sufficient land, a suitable site and storage when composting. Other considerations include odour management, marketing (if producers wish to sell the product), potential loss of nitrogen and possible emissions of greenhouse gases.

Practical and detailed technical information is readily available for people seeking advice on how to compost. In addition to this information, the Council of Standards Australia in 2003 approved an Australian Standard on Composts, Soil Conditioners and Mulches. This document is the benchmark for compost quality in Australia and applies to organic products and mixtures of organic products that are used to amend the physical and chemical properties of soils and other growing media

The Australian Standard provides manufacturers, suppliers and government agencies with the minimum processing requirements for the elimination of pathogens and weeds. It also details reporting requirements for physical, chemical and biological properties of products that have been treated by pasteurisation or composting procedures. Table 9 lists the limits for contaminants in composts, soil conditioners and mulches.

TABLE 9 - LIMITS FOR CONTAMINANTS IN COMPOST, SOIL CONDITIONERS AND MULCHES FOR UNRESTRICTED USE (MG/KG)

Contaminant	ARMCANZ	NSW EPA	VIC EPA
Arsenic	20	20	20
Cadmium	3	3	3
Chromium (total)	400	100	50
Copper	200	100	60
Lead	200	150	150
Mercury	1	1	1
Molybdenum	4	-	-
Nickel	60	60	60
Selenium	3	5	5
Zinc	250	200	200

ARMCANZ: Australian Guidelines for Sewerage Systems-Biosolids Management (1995)
NSW EPA: Environmental Guidelines for Use and Disposal of Biosolids
VIC EPA: Environmental Guidelines for Composting and Other Organic Facilities

Cawthon (1998) describes options for the treatment of hatchery waste (unhatched chicks, membranes, embryonic fluids and egg shell). One disposal option involves the loading and transport of the material to a facility that separates the liquids from the solids using centrifugal force. The liquid is refrigerated and transported by tanker truck to pet food manufacturing plants, with the solids sent to landfill. They used an in-vessel composting operation to deal with these solids instead of land-filling them. The co-composting agent was either wood products or poultry litter.

Combustion and Electricity Production

Electricity can be generated from a number of biomass sources and being a form of renewable energy can be marketed as 'Green Energy'. The production of electricity from renewable biomass sources does not contribute to the greenhouse effect as the carbon dioxide released by the biomass when it is combusted, (either directly or after a biofuel is produced) is equal to the carbon dioxide absorbed by the biomass material during its growth.

There are a wide range of animal by-products that can be used as sources of biomass energy. The most common sources are manures from intensive pigs, chickens and cattle (in feedlots) because these animals are reared in confined areas generating large quantities of by-products in a small area.

Direct combustion is the main process adopted for utilising biomass energy. The energy produced can be used to provide heat and/or steam for cooking, space heating and industrial processes, or for electricity generation. Other systems operating throughout the world incorporate an anaerobic digestion process to generate methane as an energy source.

A plant has been proposed for Western Australia that will burn all animal manures. This proposal is seen as the most viable and environmentally responsible way to utilise poultry manure in that area. It provides a significant step towards a long term solution for the local stable fly problem, the production of green energy, reduced greenhouse emissions and the potential for the reuse of the ash as a high value fertiliser. A co-generation plant that will burn meat chicken spent litter is also proposed for southeast Queensland.

Air emissions are the major issue associated with the combustion of by-products although the combustion of biomass such as manure and spent litter is considered to have less potential to produce toxic air pollutants than the combustion of municipal solid waste or medical waste. The emissions are lower in sulphur, chlorine and metals compared with coal.

Illegal Uses of Manure and Spent Litter

In Australia, poultry manure and spent litter is considered a risk to botulism in ruminants. Botulism is a serious form of food poisoning caused by the bacteria *Clostridium botulinum,* which may be present in poultry litter. Due to this risk, it is now illegal in Australia to feed material containing poultry manure to stock and to allow stock access to animal matter or animal contaminated matter (Department of Primary Industries (2004), Cook (2004) and Nee (2004)). These restrictions are also reflected in the Stock Regulation 1988, which governs Queensland (Stock Regulation).

The two primary sources for cattle to access manure and spent litter are on paddocks that have been spread with the material and via feed supplements.

The prevention of livestock consuming manure and spent litter also supports Australia's bovine spongiform encephalopathy (BSE) freedom program (Biosecurity Business Group, Department of Primary Industries, 2004). Poultry feeds may include a significant proportion of meat meal (Cook, 2004). Ingestion of animal meals contaminated with the BSE disease agent is recognised as the major cause of BSE spread in outbreaks overseas. The ruminant feed ban is designed to prevent the potential spread of the BSE disease agent.

Reasonable measures put forward by the Queensland Government (Douglas (2001), Department of Primary Industries (2004) and Nee (2004)) to deny livestock access to manure spent litter includes:

- Ensure livestock do not graze or roam pasture during the spreading of manure and spent litter and are not allowed access for 3 weeks after.
- Plough in manure and spent litter rather than spread it on the surface.
- Ensure cattle that graze pastures where manure and spent litter has previously been used have received full vaccination for botulism well in advance.

These are precautionary measures to:

- Minimise the survival of disease agents on the pasture.

- Allow for pasture regrowth to further reduce potential for direct ingestion of manure and spent litter.
- Reduce palatability issues of the pasture.

Appendix D. MANAGING MANURE/LITTER BEETLES

Darkling beetles, *Alphitobius diaperinus* breed in manure and litter within sheds or stockpiles on-farm. They damage insulation and wood structures and increase the risk of disease spread, including salmonella. Lambkin (2001) investigated management strategies for controlling the pest. This work found from a literature review and field studies that the beetle has an ability to avoid contact with insecticides, which contributes to control strategies failing. This behaviour, together with the predominant use of clay floors also contributes to control problems, as many of the insects stay concealed in the floor and do not receive a lethal dose of insecticide. This work advocates an integrated pest management approach where the application of insecticides is varied to suit the geographical location.

McGoldrick (2004) suggests a number of control strategies, including:

- Improved facility design.
- New insecticides
- Biological control.
- Improved insecticide application techniques.
- Improved farmer awareness.
- Employing effective husbandry and hygiene techniques.

Appendix E. BY-PRODUCT UTILISATION

Nitrogen Losses and Availability

Chastain *et al.* (2000) collated data on nitrogen volatilisation losses from land applying poultry manure products (Table 10). Ten to 15% of ammonium is lost from surface applied poultry litter each day unless a significant rain event occurs. Rain will carry most of the ammonium nitrogen into the soil. Soil incorporation significantly reduces this loss to between 5 and 30%.

TABLE 10 - ESTIMATES OF AMMONIA NITROGEN LOSS BASED ON LAND APPLICATION METHOD.

	Loss of Ammonia Nitrogen (%)	
Application Method	**Range**	**Recommended Value**
Surface application without incorporation	10 – 100%	50 %
Surface application with incorporation the same day	5 – 30%	20 %

Chastain *et al.* 2000

The organic-nitrogen fraction gradually becomes available for crop uptake. Soil microbes convert organic nitrogen to the plant available form ammonium-nitrogen by a process called mineralisation. Mineralisation rates can range from 40 – 90% depending on environmental conditions including soil temperature, soil moisture, soil pH, type of manure and the extent of incorporation.

Chastain *et al.* (2000) reports the amount of organic nitrogen available during the first growing season can range from 30–80%. Organic nitrogen does not leach from the soil and can only be lost via erosion.

Under anaerobic conditions manure and spent litter contains minimal nitrate-nitrogen. Aerobic conditions, such as composting systems, will result in significant levels of nitrate-nitrogen present in the manure. In the soil, nitrate is mobile and is readily taken up by plants. Rainfall or irrigation that results in the movement of water beyond the root zone may result in nitrate leaching and potential groundwater pollution. Nitrate can also be converted to nitrogen gas and be lost to the air.

Specific requirements as to the use of poultry manure and spent litter for each state are listed below:

Western Australia Requirements

In Western Australia the document ‘Environmental Code of Practice for poultry farms in Western Australia’ outlines clear and precise guidelines for planning, biosecurity and good management practices. Recommendations include:

- Manure and spent litter should be contained in a weather proof compound (preferably on hard-stand areas within a shed) until removal from the farm for disposal.
- There are no restrictions on the quantity of manure and spent litter that can be stored.
- The land application of manure and spent litter in Western Australia is governed by the *Health (Poultry Manure) Regulations 2001*. The regulation applies to 13 local government districts only. This imposes restrictions over the sale, supply and use of manure and spent litter. Regulation was introduced to control the breeding of nuisance flies associated with the utilisation of manure and spent litter.
- Market gardeners (Perth district) are no longer permitted to obtain or use untreated manure and spent litter for crop production during the months of September to April.
- Application of manure and spent litter should not occur on the following situations:
  - In Priority 1 or 2 Public Drinking Water Source Areas or Wellhead Protection Zones.
  - Within 50 metres of any private water supply bore or in-ground reservoir.
  - Within at least 50 meters of the outside edge of a wetland/waterways fringing vegetation (depending on adequacy of vegetation).
  - Within 200 meters of a Conservation Category Wetland or wetland/waterway listed on any Environmental Protection Policy.
  - Land susceptible to flooding or where the water table may rise to within two metres of the surface.
  - Where the topography or soil factors may cause stormwater run-off to flush contaminants into surface waters.
  - Spread onto land between poultry sheds or on land within the recommended buffer to another owner's poultry sheds.

New South Wales Requirements

Commercial poultry farming is usually considered 'intensive agriculture' or 'intensive livestock' and may require council approval before construction can commence. Specific activities that require council approval are defined within Local Environmental Plans (LEPs) and can vary between different local council areas.

When a proposed poultry development requires consent, a Development Application with accompanying documentation must be submitted. Information required to support the Development Application does not have to follow a standard format however, NSW Agriculture provide a checklist of suggested topics to address (Briggs, 2004). Notes pertaining to manure and spent litter have been summarised below.

- If manure and spent litter will be spread on the property, identify the estimated volume generated in each cycle and how much may be kept on farm. Identify on a map where manure and spent litter will be stockpiled and applied.

- Confirm suitability by assessing and identifying:
  - Total volume of manure and spent litter used on site.
  - Proposed rate and frequency of application and area over which it will be spread.
  - How soil nutrients and fertilisers will be monitored.
  - Runoff control measures.
  - Fertiliser history, pasture status and necessary buffer areas of each target paddock.

South Australia Requirements

The ‘Guidelines for the establishment and operation of poultry farms in South Australia’ (South Australian Farmers Federation, 1998) are not a legal or statutory document but has been prepared to promote orderly development and economic operation of poultry farms while minimising their environmental impact and protecting the welfare of the birds. They complement State legislative requirements and enhance the administrative arrangements between Local Government and State Government authorities responsible for administering the establishment and effective operation of the poultry industries.

Information contained within these guidelines, specifically relating to manure spent litter is summarised below:

- For the manure and spent litter to be disposed of on site, buffer distances must be preserved between utilisation areas and sensitive features. They are in addition to the buffer distances for the chicken sheds which are calculated from a formula based approach.
- If manure and spent litter is incorporated into the soil, while these buffer zones need not be adhered to, care must be taken to ensure that nearby residents are not inconvenienced.
- Manure and spent litter storage on site should be on an impervious base with all clean rainfall runoff excluded from the site.
- When manure and spent litter is to be spread, account should be taken of actual and forecast weather conditions so as to prevent any manure and spent litter being carried by the wind into the buffer zone, or the creation of an odour nuisance to neighbouring properties.
- In addition, nutrient loads in the soil should be taken into account.

Queensland Requirements

In Queensland, poultry farming is overseen by both local government and the Department of Primary Industries & Fisheries. Notes specifically relating to the utilisation of manure and spent litter include:

- Limit the use of insecticides in fly control programs to application of baits and contact types in areas where flies rest.
- Where some or all the manure and spent litter is disposed of off-site then proportionately less on-site disposal area will be required.

- Recommended minimum separation distances applying to manure and spent litter disposal areas are identical to those listed for poultry buildings except that these may be reduced when manure and spent litter is immediately incorporated in the soil.
    - 300 meters from settlements of more than 10 houses.
    - 100 meters from well trafficked public roads.
    - 20 meters from other boundaries, dry gullies and channels.
    - 100 meters from watercourses, wells and bores.
    - 150 meters from neighbouring houses.
    - 100 meters from dwellings on the same farm.
    - Buildings are to be above the 100 year flood level.
- Material should be transported in a covered vehicle if moved on a public road.
- Spreading should be discontinued if wind is carrying dust and odour into neighbouring properties.
- Spreading should be avoided in wet, overcast conditions when quick drying is prevented.
- Material not being incorporated in the soil should be applied as a thin layer to assist rapid drying.

Victoria Requirements

In Victoria, there is no specific guideline for the egg industry in regards to by product utilisation. By products must be managed in accordance with the general provisions of the *Environment Protection Act 1970* and associated policies. Generally by products should be managed to avoid nutrient overloading, leaching and run-off leaving the property. Odours and dust must also be managed to avoid offsite impacts.

Environmental Guidelines for Composting and other Organic Recycling Facilities (EPA 1996) provides suggested best practise environmental measures for a range of issues associated with composting.

Tasmania Requirements

In Tasmania, the egg industry is controlled under the Local Government Act (1962), which is administered by municipal authorities and local health surveyors. Environmental Guidelines for Poultry Producers (Brennan *et al.* 1990) contains information on planning and housekeeping and maintenance.

At the time of publication, land spreading was considered the most acceptable method for the utilisation of manure and spent litter. Where producers are unable to utilise all manure and spent litter to their own land it is advised to sell material to the public and/or neighbouring farms.

Brennan *et al.* (1990) provides the following information with regards to the application of manure and spent litter to land:

- Consider soil type porosity, depth to groundwater, rainfall, topography of proposed area, drainage, manure production and the land base available for proper utilisation.
- When applying to crops, applications should be on a rotational basis.
- Allow two weeks between application to pasture and grazing.
- Spreading should not be carried out adjacent to streams and watercourses.
- Apply so as not to cause runoff, channelling or ponding.
- Apply on the contour to reduce runoff.
- Do not apply r to areas that are subject to waterlogging or flooding.
- In areas where run off may occur, construct appropriate diversion drains and catch dams.
- Discontinue spreading if wind is carrying solids onto neighbouring properties.
- Wet product should be utilised promptly to reduce odours.

Appendix F. VEGETATIVE FILTER STRIPS

McGahan and Tucker (2003) advocate that the appropriate buffer width depends on the slope of the land, vegetative cover of the buffer area and the presence of other stormwater control devices such as diversion banks and terminal ponds. Vegetative filter strips (VFS's) planted with runner developing, non-clump forming grass can very effectively reduce nutrient entry to watercourses by reducing the nutrient concentration of runoff through particle trapping and restricting runoff volumes by promoting increased infiltration.

Generally, wider VFS's reduce the soil loss rate. However, for the same soil loss rate, areas with higher slopes need a wider VFS than areas with lower slope. To be most effective a VFS needs to be located as close as possible to by-product utilisation areas to minimise additional runoff. It is also critical to locate the VFS before any convergence of runoff (i.e. drainage lines). The table below (Table 11) gives appropriate VFS widths based on soil loss rates.

TABLE 11 – GRASS FILTER STRIP WIDTHS (m) FOR TYPICAL VALUES OF SOIL LOSS AND FILTER GRADIENTS

Soil Loss	Filter Strip Slope								
(t/ha/yr)	1	2	3	4	5	6	7	8	9
10	5	5	8	8	9	9	10	10	10
20	6	12	15	15	15	16	17	16	16
30	12	18	21	21	22	22	22	23	23
40	18	24	27	27	28	28	29	29	29
50	25	>30	>30	>30	>30	>30	>30	>30	>30

Adapted from Karssies and Prosser (1999) by Redding and Phillips (2002).

Appendix G. COMMUNITY CONSULTATION

Henderson and Epps (2001) summarised the benefits of community and regulator consultation for new and existing poultry farms. Implications for new farms include:

- It is recommended that industry participate in forums where state government departments are consulted at and early stage of a proposal, such as a planning focus meeting.
- Although state government may not be the decision-maker, having negotiated most key issues may discourage local government from forcing a developer of a farm to appeal against rejection of the development proposal.
- If and environmental impact statement is required it needs to be carefully considered and prepared. The document can represent a small cost to the overall development. It can save time and hence money, and overcome the problem of local government continually asking for additional information.

Implications for existing farms include:

- Farmers need to be seen to be doing something to resolve environmental problems. Simple actions may prevent neighbours from complaining, may favour local government attitudes and prevent State governments from introducing tougher forms of environmental regulation. Actions might include planting vegetative barriers, putting up light or dust screens, making sure dead birds and manure are properly and quickly disposed of, and watching for fly breeding activity and responding quickly with control measures. The reality is that farmers may become lax about management practices over time if they are not under continual pressure to control their externalities.
- When approached by neighbours, farmers need to listen carefully and take their concerns seriously.
- Dealing openly with neighbours, perhaps by conducting a farm tour to explain how the farm operates and to show what is being done to minimise externalities, may prevent conflict from developing and local government may not become involved.
- Keep open lines of communication with local residents, especially in relation to notifying them of significant events, such as the removal of birds and by-products.

The acceptability of a proposed new or expanding development can rely on community acceptance. Community consultation during the planning stage will often provide the information to address relevant community concerns. For community consultation to be effective it is important to structure the consultation process to suit the individual situation. There is no set formula, approaches or certainties in undertaking effective consultation, but it is important to get the process right from the beginning. Poorly planned and ineffective consultation can lead to a breakdown in the process, which can be time consuming and expensive.

Appendix H. Collection, Storage, Handling & Treatment of Samples

Surface Water - Quality

Before undertaking any water sampling, plan how this will be undertaken.

1. Decide on the sampling locations and the sampling frequency or triggers.
2. Select a suitable accredited laboratory.
3. Identify couriers that can transport the samples to the laboratory (if needed).
4. Assemble the sampling equipment.
5. Clearly understand the sampling procedures.
6. Know the monitoring parameters.

Many regulatory agencies and or laboratories have their own water quality monitoring guidelines. Advice should be sought from the relevant agency before planning sampling and monitoring procedures. In the absence of specific advice from the applicable agency, the following guidelines may be used.

<u>Sampling Location</u>

If monitoring is a licence condition, the licence may specify sampling locations. If sampling locations are not detailed on your licence conditions, identify suitable sites that you can locate and access each time monitoring is required. Discuss selected sampling locations with the licensing authorities before sampling to ensure that the results will be acceptable.

For stream monitoring, take samples upstream and downstream of the area of interest. A sample should be taken immediately upstream and approximately 100 m downstream of an area of interest. The downstream sample should be taken some distance downstream of the area of interest. However, if the distance between sampling points is too great, inflows from other sources may affect the analysis results. If another watercourse enters the relevant stream between the two sampling points, you should also sample water from the secondary watercourse close to it's junction with the watercourse of interest.

Contaminants within a terminal pond may disperse slowly. It is therefore appropriate to sample close to the entry point of runoff into the pond.

<u>Water Quality Monitoring Interval</u>

Water quality monitoring may be undertaken at a set interval (e.g. quarterly, six monthly or annually) or may be triggered by specific events (e.g. an overtopping effluent pond). Water quality varies with time of day, flow rate and recent weather conditions. Note these factors at the time of sampling.

If a spill to a watercourse is the trigger for sampling, you should sample during the spill. You should also sample the spilling effluent at this time.

Select a Laboratory

National Association of Testing Authorities, Australia (NATA) accredited laboratories are preferred for sample analysis. Check that the laboratory is NATA-accredited (or equivalent) for the analyses needed. Analysis methods vary between laboratories, which may affect results.

Select a Courier (if needed)

If you cannot take samples directly to the laboratory yourself, identify a courier that can transport the samples to the laboratory within the required time frame between collection and analysis.

Samples should arrive at the laboratory within two days of sampling and must be kept on ice over this whole time period. If this is not possible, you may need to freeze your samples (consult the laboratory). You should schedule sampling to coincide with courier dispatch to minimise the amount of time between sampling and analysis. *Ideally, sampling should occur on a Monday or Tuesday so that samples arrive at the laboratory and are promptly analysed rather than having to sit over a weekend.*

Assemble Sampling Equipment

The sampling equipment may include:

1. Appropriate sample containers and preservatives. Most laboratories will supply suitable sample containers, as well as any necessary preservatives. Water quality sampling manuals can also be consulted to determine sample container sizes and required preservatives. Obtaining sample containers from the laboratory reduces the chance of sample contamination and ensures that the sample size is adequate.
2. A sampling rod. A rod with a large clamp for holding the sampling container allows greater reach when sampling.
3. A bucket that has been washed several times with clean water and then rinsed several times with the water to be sampled.
4. Cheap, styrofoam eskies.
5. Plenty of crushed ice to pack around the samples in the eskies.
6. Waterproof pen to mark sample bottles.
7. Waterproof tape to seal eskies.
8. Personal protective clothing.
9. Analysis request forms. Most laboratories have their own analysis request forms and prefer these to accompany samples. Some of the details on the forms can be completed prior to sampling. (e.g. name, sampling location and analysis parameters). However, some details can only be completed at sampling (e.g. time of sampling). If analysis request forms are not provided, you will need to make up your own.
10. Envelope that analysis request forms will fit in.
11. Pen to complete analysis request form.

Collect and Dispatch Samples

The following are suggested sampling procedures:

1. Assemble the sample containers and the sample preservatives.

2. With a waterproof pen, label the sample containers with the enterprise name, your telephone number, a unique sample number (new numbers should be used at each sampling), the sampling location (e.g. Deep Creek upstream of effluent irrigation area) and the date of sampling. Label the container instead of the lid, as lids can get mixed up in the laboratory.

3. Complete as many details of the analysis request forms as possible. This should include: contact details, sample numbers (matching those recorded on the sample bottles), sampling location, sampling date and analysis parameters.

4. Fill eskies with ice.

5. If you need to wade into a watercourse, first satisfy yourself that it is safe to enter. Hidden obstacles and rapid flowing water pose significant risks, particularly if alone.

6. Collect samples directly into sample containers. Either take a grab sample or a composite sample. A grab sample is one taken by quickly filling sample containers. A composite sample comprises several grab samples collected over several minutes and mixed together. Composite samples comprising five grab samples should be collected if there is little movement in the watercourse or for dam samples. Stream samples should be collected midstream, clear of bank edges and other potential contaminant sources. If sampling from a terminal pond, take the sample away from the edge of the pond. Sample containers need to be rinsed with the sample water prior to collection. Do not take samples in the same area as the rinsing as silt etc may have been disturbed.

7. Remove the sample bottle lid, taking care not to touch the inside of the lid or bottle. Face the mouth of the bottle downwards and plunge into the water. Turn the bottle to a horizontal position facing the current preferably 0.2 m below the water surface (this avoids sampling surface scum). If necessary, create a current by dragging the bottle away from yourself. Remove the bottle as soon as it completely fills. If you are taking a composite sample, you should collect five samples over a period of a few minutes and thoroughly mix these in a clean plastic bucket before pouring the mixed water into a sample bottle. Add any required preservative and replace the lid.

8. Immediately place the sample in an esky, pack crushed ice completely around it and replace the esky lid. *Do not put effluent samples in the same esky as surface water samples.* Store the esky in the shade.

9. If samples will take longer than 48 hours to get to the laboratory, they should be frozen. Do not completely fill the sample bottle if you intend to freeze the sample.

10. When all other surface water or groundwater samples have been added to the esky, seal it with the waterproof tape.

11. Thoroughly wash your hands.

12. Complete the analysis request forms and photocopy for your own records (if you have access to a photocopier or fax machine). Place the original forms in an envelope. Clearly address the envelope to the laboratory and add their phone number. In smaller writing, put your own address and phone number on the envelope as "sender". Firmly tape the envelope to the top of the esky. Store the esky in the shade.

13. Deliver the samples or arrange for courier delivery.

14. Contact the laboratory to confirm that the samples were received within 48 hours of sampling.

Recording

At each water quality sampling, record:

1. Location and name of sampling site. The sampling location must be clearly identified so that you can return to the same site for future sampling

2. Date and time of day that each sampling occurs. Water quality varies over time.

3. Flow rate (in watercourses) or approximate depth of water in terminal ponds and weather conditions at the time of sampling. Water quality varies with flow rate.

4. Weather conditions at the time of each sampling. This may influence water quality.

5. Method of sampling. For instance, grab sample or composite sample.

6. Name of sampler.

7. Time between sampling and dispatch of sample to laboratory.

8. Method of preserving samples (e.g. sample immediately put on ice in esky).

9. Time samples dispatched to laboratory.

10. Analysis parameters requested. (Preferably keep a copy of the original analysis request forms).

Remember to keep the original copy of any laboratory analysis reports.

Groundwater Quality

Refer to surface water quality section.

Sampling Location

If monitoring is a licence condition, the licence may specify sampling bore or piezometer locations. A piezometer is a non-pumping well generally of small diameter with a short screen through which groundwater can enter. If sampling locations are not detailed on your licence conditions, or if you are undertaking voluntary monitoring, you will need to identify or install suitable monitoring bores or piezometers. These must be installed correctly. Depth and casing are particularly important. Monitoring bores or piezometers may also need to be registered prior to construction. Consult the regulatory agency in your area (generally Local Government).

As groundwater may move extremely slowly, bores or piezometers should be located in close proximity, and downstream, of the area for monitoring. It is also advisable to locate a bore or piezometer above the area of interest for comparison purposes. Ensure that both bores are tapping into the same aquifer. A network of bores will provide better information than a single monitoring bore plus background bore. However, budgetary constraints will often preclude the installation of several bores. Bores should be located with the assistance of expert advice.

Groundwater Quality Monitoring Interval

Groundwater quality monitoring is usually undertaken at a set interval (e.g. quarterly, six monthly or annually).

Select a Laboratory

Refer to surface water quality section.

Select a Courier (if needed)

Refer to surface water quality section.

Assemble Sampling Equipment

Refer to surface water quality section.

Also:

- A sampling bailer or pump. You will need to use a bailer or pump to draw water from the monitoring bores. If you are using a bailer, wash it thoroughly with water before use. A bailer is a time consuming method for sampling groundwater. It is also impractical for deep bores. A pump is convenient to use and allows for samples to be quickly collected.

- A tape measure to determine depth to groundwater.

Collect and Dispatch Samples

1-4. See steps 1-4 of "Collect and Dispatch Samples" of surface water quality section.

5. Measure the depth to groundwater. Pump several bore volumes from the casing to ensure that you are not sampling stagnant water. Sometimes this will take quite a while.

   Bore volume (L) = ((3.14/1000) * (radius m)^2) * water depth (m)

   Collecting grab samples of standing water may provide misleading results since the groundwater quality may be stratified and interactions between the bore casing and atmosphere of the water may influence water quality properties. If it is not possible to purge the bore prior to sampling, the sampling process should disturb the water within the bore as little as possible. For shallow piezometers, it may be appropriate to empty the piezometer one to two days prior to sampling and then to allow it to refill.

6. Allow bore to recharge with groundwater. Measure the depth to groundwater. Collect a grab sample using a bailer or pump.

7. Remove the sample bottle lid, taking care not to touch the inside of the lid or bottle. Fill the bottle directly from the bailer or pump. Remove the bottle from the flow as soon as it completely fills. Add any required preservative and replace the lid.

8.-14. See steps 8-14 of "Collect and Dispatch Samples" of surface water quality section.

Recording

Refer to surface water quality section.

Also:

- Name and location of bore or piezometer.

- Depth to groundwater.

Effluent, Solid By-Products and Soils Quality Monitoring

Refer to steps 1-6 in the surface water quality section.

Sampling Location

Effluent

Effluent should be sampled from the sampling stopcock, priming plug or main outlet of the effluent irrigation pump. If this is not possible, collect the sample from the pond from which irrigation water will be drawn.

Solid By-Products

For each type of solid by-product a separate sample is needed (e.g. manure, spent litter and each type of compost). If manure is spread fresh, then a fresh sample should be collected. If manure is composted before spreading, then a composted sample should be collected.

Soils

For soils each sampling location should represent a particular type of soil and general land use (including land use and effluent or solids spreading rates).

The following steps will help you decide how many sampling locations are needed:

- Divide each area used for effluent irrigation or solids spreading according to soil types. Dig some holes and compare the soils of each hole. (Recording information as you go is important!).

- Divide each area on the basis of land use as sustainable spreading rates vary widely depending on whether the land is grazed or used to grow a crop. Areas with different land uses should be monitored separately. However, it is not necessary to provide a monitoring plot in each separate paddock if there are similar land uses between paddocks with the same soil type.

- Divide each area on the basis of by-product type (e.g. effluent, manure, spent litter or compost) and application rate. For instance, there might be two major soil types on your farm. If both soil types are used for growing cereal crops and for manure application, but at two different rates, you have four different soil type/land use combinations (soil 1 low rate, soil 1 high rate, soil 2 low rate, soil 2 high rate). Similarly, if there is one soil type, but two different land uses (e.g. cereal crops V grazing), you will have two soil type/land use combinations (soil 1 land use 1, soil 1 land use 2).

- Identify a 20 m diameter sampling plot for each soil type, by-product and land use combination. This area should be representative of the area most at risk. For instance, if you have two areas of land with similar soils and land uses but different manure application rates, you may monitor only the area with the highest manure application rate. This area should also be free from stumps, atypical rockiness, tracks, animal camps and other unusual features.

- For each soil type to be monitored, you should also locate a 20 m diameter background monitoring plot on an area that has not been used for effluent irrigation, solids spreading or conventional fertiliser spreading. This will be used to compare with monitoring plot data from the effluent and solids spreading areas. It is recognised that it is not always easy to find a suitable background plot.

- Mark the location of the plots on your Property Map so that you can come back to same area in subsequent years. (Keep using these sites from year to year).

Assemble Sampling Equipment

Effluent

See "Assemble Sampling Equipment" in surface water quality section.

Solid By-Products

See "Assemble Sampling Equipment" in surface water quality section.

Sampling containers will either be wide-mouthed sampling bottles or plastic bags. Bottles may better suit high moisture solids. It is recommended that you obtain these from the chosen laboratory. Bags will suit drier products.

Also:

- A shovel.
- A small garden trowel.

Soils

See "Assemble Sampling Equipment" in surface water quality section.

Also:

- Soil auger or hydraulic soil sampling rig (these can be hired).
- Plastic sample bags. Most laboratories will supply suitable sample bags.
- Ruler or tape measure.
- Hand trowel.
- Plastic sheet.
- A bucket that has been washed several times with clean water.

Collect and Dispatch Samples

Effluent

1-4 See steps 1-4 of the Collect and Dispatch Samples section of surface water quality section.

5. Put on disposable gloves if sampling effluent. Avoid splashing eyes with effluent or sample preservatives. Do not inhale aerosols from the effluent being sampled or the preservatives. Do not eat, drink or smoke and carry out standard hygiene practices.

6. If sampling from a pump: Start the pump and allow it to run for at least 10 minutes prior to collecting samples. While you are waiting, rinse the bucket several times with the effluent from the pump. Remove the sample bottle lid taking care not to touch the

inside of the lid or bottle. Sample the effluent by collecting a cup of effluent in the sampling bottle every three to four minutes and adding each of these to the bucket until it is half full (10-15 samples). Thoroughly mix the effluent by swirling the bucket. Fill the sample bottle from the composite sample. Add any required preservative and replace the lid.

7. If sampling from the pond: Rinse the bucket several times with effluent. Remove the sample bottle lid taking care not to touch the inside of the lid or bottle. Sample effluent by facing the mouth of the bottle downwards and plunging it into the water. Turn the bottle to a horizontal position 0.2 m below the water surface (this avoids sampling surface scum). Create a current by dragging the bottle away from yourself. Remove the bottle as soon as you have filled the container and pour the effluent into the bucket. Repeat this procedure four times sampling from a different spot in the pond each time. When you have collected five samples, thoroughly mix these before pouring the composite sample into a sample bottle. Add any required preservative and replace the lid.

8-14 See steps 8-14 of the Collect and Dispatch Samples section of surface water quality section.

Solid By-Products Quality

1-4 See steps 1-4 of the Collect and Dispatch Samples section of surface water quality section.

5. Put on disposable gloves and dust mask (if sampling dusty products). When sampling, do not eat, drink or smoke and carry out standard hygiene practices.

6. If sampling from a pump e.g. sludge: Start the pump and allow it to run for at least 10 minutes prior to collecting samples. Remove the sample bottle lid taking care not to touch the inside of the lid or bottle. Sample the sludge by collecting a cup in the sampling bottle every three to four minutes and adding each of these to the bucket until it is half full (10-15 samples). Thoroughly mix the sludge by swirling the bucket. Fill the sample bottle from the composite sample. Add any required preservative and replace the lid.

7. If sampling from a stockpile (manure, spent litter, compost): Use a clean shovel to collect 25 samples of solids (sample size should be about a cup). As you collect each sample, place in the bucket and thoroughly mix with the garden trowel. Place about four cups of the mixed sample into a bottle or bag and seal. Put the bag or bottle inside another bag and seal well.

8-14 See steps 8-14 of the Collect and Dispatch Samples section of surface water quality section.

Soils

1-4 See steps 1-4 of the Collect and Dispatch Samples section of surface water quality section.

When labelling the sample bags, remember to include the sampling depth (e.g. 0-0.1 m).

5. From random locations within each 20 m diameter sampling plot, collect 25 equal-sized samples of soil to a depth of 0.1 m (10 cm). As you go, record a description of the soil sampled. Combine all of the samples in the bucket and thoroughly mix using a hand trowel. Remove rock fragments exceeding 2 cm diameter and large roots. Break up large clods.

6. Pour the mixed composite sample into a cone on the plastic sheet. Divide the cone into four quarters. Discard three and thoroughly mix the remaining quarter. Repeat the procedure with the remaining quarter until the sample size is small enough to fill the sample bag (generally about 0.4-0.5 kg or 1 lb). Fill the sample bag and immediately place it in an esky.

7. From random locations within each 20 m diameter sampling plot, drill at least five holes to collect subsoil samples. (Drilling more holes provides a more reliable sample. Eight holes are preferred). As you go, record a description of the soil encountered.

   Samples should be collected from the 0.2-0.3 m (20-30 cm) and 0.5-0.6 m (50-60 cm) depths. If the base of the root zone is below 0.6 m, it is also useful to collect a deeper sample (1.5 – 2.0 m). Combine all of the samples from the same depth in the bucket and thoroughly mix using a hand trowel. Remove rock fragments exceeding 2 cm diameter and large roots. Break up large clods. Use the same mixing and sub-sampling procedure as for the 0-0.1 m sample to obtain a 0.4-0.5 kg sample. Place the sample in the esky.

   Either a bulked sample representative of the entire crop or pasture root depth, or alternatively, a number of samples at different intervals, could be sampled and analysed to determine the phosphorus sorption isotherm.
   Never bulk (mix) soils of two different types.

   Never mix soil layers (profiles) that are clearly different from each other.

   Never bulk in depths greater than 0.3 m.

8-14 See steps 8-14 of the Collect and Dispatch Samples section of surface water quality section.

It is useful to take note of any unusual changes in the soils and plants of the effluent irrigation areas. These include:

- Free water on the soil surface may indicate waterlogging. Other signs include reduced plant growth, growth of weeds (dock, nutgrass) and drooping foliage with pale leaves.

- A surplus of nitrogen may be indicated by invasion of an area with nettles or fat hen.

- Yellow or browned off vegetation is indicative of toxic nutrient levels or nutrient deficiencies.

- Bare patches in paddocks. These may indicate poor germination due to excess salinity. White crusting on soil surface in dry times may indicate evaporation from a shallow saline water table.

- Areas in effluent-irrigated paddocks that are consistently bare of vegetation may indicate too much salinity, poor fertility, elevated SAR levels, soil structure decline or waterlogging.

Quantity of Effluent Irrigated

Methods for measuring the quantity of effluent irrigated vary depending on the enterprise. A flow meter can accurately measure the effluent flow rate. In-line flow meters should be a non-corrosive type. Alternatively, non-contact ultra-sonic, Doppler, and non-contact magnetic flow meters that clamp to the outside of the pipe are available although they may be too expensive.

A depth gauge in the pond, used with a storage capacity curve, can provide an estimate of the irrigation rate when large volumes are irrigated at a time. The curve shows the volume of effluent in the pond when filled to any depth. The change in depth from the start to the finish of the irrigation should be measured.

For a single hand-shift type sprinkler, the pumping rate can be estimated from the time taken to fill a container of known volume. The flow rate must be measured from the irrigation nozzle. It can be very difficult to measure effluent volumes this way. A plastic hose fitted over the nozzle and a 10 L bucket will help. For a sprayline, the outflow from at least three nozzles should be measured. Both sides of double-sided nozzles should be measured. As long as there are not too many pipe-join leaks, this method will give a good estimation.

If effluent is pumped from a tank or sump of known capacity, daily or weekly irrigation volumes may be estimated from the sump or tank volume and the emptying frequency.

If bulk tankers are used to spread effluent, tanker volume and emptying frequency provide a good estimate of the irrigation rate.

The quantity of effluent irrigated, and the paddock involved, should be recorded each time irrigation occurs.

Quantity of Solid By-Products Spread

If a manure or fertiliser spreader is used to spread solids, the spreading rate may be calculated from the volume of the storage hopper, the area of land for spreading and the bulk density of the solids (as per tanker method). Alternatively, you can determine the mass of the solids by weighing the truck or spreader filled with solids then subtracting the net weight of the truck or spreader.

The quantity of solids spread, and the paddock involved, should be recorded each time spreading occurs.

Yield of Plants or Liveweight Gain

It is generally adequate to estimate the nutrients removed from an area by yields and textbook nutrient concentrations of plants.

Measure yield of plants harvested by weighing or by estimating weight from the number of truck-loads removed. For a crop, the yield from an area should be recorded and a yield per hectare calculated (divide the total yield for the paddock (t) by the area of the paddock (ha)). The yield should then be converted to a dry matter yield. As a guide, grain crops have a dry matter content of about 88% and hay has a dry matter content of about 90%. Fresh harvested forage crops vary more.

If you harvest 4 t/ha of barley, the dry matter yield is about 3.5 t/ha (4 t/ha X 88/100). From Table 5, a 4 t/ha winter cereal crop removes about 80 kg N/ha and 12 kg P/ha. Hence, the 3.5 t/ha crop will remove about 70 kg N/ha and 10.5 kg P/ha (i.e. 80 kg N/ha X (3.5t/4t); 12 kg P/ha X (3.5 t/4t)).

Laboratory determination of the dry matter and plant tissue analysis can more accurately determine the nitrogen and phosphorus concentration of the harvested material. *This should only be required in border-line cases, for example where removing sufficient nutrients relies on nutrient uptake greater than would be typically seen for a particular plant species (luxury uptake).*

Monitoring Interval

Effluent and Solid By-Products

This should be based on the level of environmental risk. If monitoring results for the quality of the effluent or solid by-products over several years indicates similar results, the level of monitoring should be reduced from every year to say every three years, unless unusual circumstances that could result in an adverse environmental impact occur in the meantime.

Soils

This should be based on the level of environmental risk.

Sampling should occur at the end of a cropping cycle or at a time when nutrients are most vulnerable to leaching (before the onset of the wet season).

Plants

For most enterprises, analysis of plant composition should not be required. At a maximum, this should be once per crop (at harvest).

Recording

Quantity of Effluent Irrigated and Solid By-Products Spread

Each time effluent is irrigated or solids are spread on-farm, record the date, the paddock involved and the quantity of effluent (m^3 or ML) or solids (m^3, ML or t) involved. Also calculate the application rate (m^3/ha, ML/ha or t/ha).

If effluent or solids are removed off-site, record the date, the volume of material involved, the type of material involved, the recipients name and the proposed use (e.g. where the material will be irrigated or spread, the land use of the area involved and the application rate).

Effluent and Solid By-Products Quality

It is suggested that original copies of effluent and solid by-product analyses be kept for at least five years or as required by your licensing conditions. Use the analysis results to calculate appropriate irrigation or spreading rates depending on possible land uses.

If effluent or solid by-products are reused off-site, provide recipients with a copy of the analyses each time these products are analysed. Use the analyses to calculate appropriate irrigation or spreading rates depending on preferred land uses. Advise by-product recipients of the appropriate irrigation or spreading rates.

Soil Properties

Original copies of soil analyses should be kept indefinitely along with records of sampling locations and land use. This assists with long-term farm management.

Production from Land Area

Each time crops are harvested from effluent irrigation or solid by-products spreading areas record the yield harvested. Calculate the dry matter yield and the approximate nitrogen and phosphorus removal rates.

Appendix I. USEFUL CONVERSIONS

METRIC CONVERSIONS

Length

1 inch (in)	25.4 millimetres (mm) 1 mm = 0.04 in
1 foot (ft)	0.3 metres (m) 1 m = 3.3 ft

Weight

1 pound (lb)	0.45 kilograms (kg) 1 kg = 2.2 lb
1 t	1000 kg

Area

1 acre (ac)	0.405 hectares (ha) 1 ha = 2.5 ac
1 hectare (ha)	10,000 square metres (m^2) 1 m^2 = 0.0001 ha

Volume

	1 cubic foot (ft^3) = 28.3 litres (L) 1 L = 0.035 ft^3
1 gallon (gal)	4.5 L 1 L = 0.22 gal
1 gallon/hour (gph)	0.00125 litres per second (L/s) 1 L/s = 800 gph

OTHER CONVERSIONS

1 ML	1,000,000 L = 1,000 m^3
1 m^3	1000 L = 0.001 ML
1 ML/ha	100 mm depth over 1 ha
ppm	mL/L, mg/kg, mg/L
1 mg/kg	1 g/t
1 mg/L	1 kg/ML

WATER QUALITY CONVERSIONS

TDS to EC	multiply TDS in mg/L by 640 to convert EC to dS/m

Nitrate-N	multiply nitrate-N (mg/L) by 4.427 to convert to nitrate
Nitrite-N	multiply nitrite-N (mg/L) by 3.284 to convert to nitrite
Phosphate-P	multiply phosphate-P (mg/L) by 3.066 to convert to phosphate
Sulfate-S	multiply sulfate-S (mg/L) by 2.996 to convert to sulfate

SALINITY CONVERSIONS

From ↓ To →	S/m	dS/m	mS/m	uS/m	mS/cm	uS/cm	TDS (mg/L)	meq/L
S/m	X 1	X 10	X 10^3	X 10^6	X 10	X 1 0^4		X 100
dS/m	X 0.1	X 1	X 100	X 10^5	X 1			X 10
mS/m	X 10^{-3}	X 0.01	X 1	X 10^3	X 0.01			X 0.1
uS/m	X 10^{-6}	X 10^{-5}	X 10^{-3}	X 1	X 10^{-5}			X 10^{-4}
MS/cm	X 10^{-3}	X 1	X 100	X 10^5	X 1			X 10
uS/cm	X 10^{-4}	X 10^{-3}	X 0.1	X 100	X 10^{-3}			X 0.01
TDS (mg/L)	X $1.56\text{X}10^{-4}$	X $1.56\text{X}10^{-3}$	X 0.156	X $1.56\text{X}10^{-2}$	X $1.56\text{X}10^{-3}$	X 1.56	X 1	X $1.56\text{X}10^{-2}$
Meq/L	X 0.01	X 0.1	X 10	X 10^4	X 0.1			X 1