# FARM-STAY ACCOMMODATION & RURAL INDUSTRY DEVELOPMENT

## LOT 7 DP228075

## 440 MULHOLLANDS ROAD

## THIRLMERE. NSW. 2572

# STORMWATER QUALITY ASSESSMENT

Prepared by SOWDES
3 July 2019

A: PO BOX 619 GOULBURN. NSW. 2580 | M: 0428 863 401 | E: sowdes@sowdes.com

# Table of Contents.

# STORMWATER QUALITY ASSESSMENT

## Introduction.

SOWDES has been commissioned by the proponents of a farm-stay accommodation and rural industry development established on a portion of land identified as Lot 7 DP228075 – 440 Mulhollands Road at Thirlmere. NSW. 2572 to undertake an assessment of existing farm management practices and arrangements relating to the management and treatment of stormwater quality, and the discharge of stormwater to natural receiving systems.

This report and its recommendations have been compiled with reference to and consideration of the Wollondilly Shire Council Development Control Plan (2016), 'Developments in the Drinking Water Catchment – Water Quality Information Requirements' (WaterNSW, February 2015), relevant Australian and industry standards and guidelines, the development site layout as proposed in the Stormwater Management Site Plan prepared by SOWDES Ref: 0070519-01B, existing stormwater and sewer drainage infrastructure, neighbouring developments and all existing site conditions.

Where practical and appropriate, the recommendations, constraints and conditions from the above listed reports and documents have taken precedence in the design process such that any water quality issues, environmental concerns and matters pertaining to public amenity have been addressed. The proponents through their appointed representatives have been involved throughout the design and recommendation process by contributing to the information source and providing general commentary on the overall system outcomes.

The basis of this report and its recommendations are derived from information obtained by the requesting and/or developing party. Changes pertaining to location, orientation, size and/or design may render the contents of this report inappropriate and hence invalid. Any such occurrence is beyond the control of the author and hence responsibility for accuracy and validity is passed. Further, data and input parameter values associated with any modelling program and are understood to be current and valid at the time of compiling the report, hence any changes to these protocols is beyond the reasonable control of the author and with such, the recommendations contained in this report are construed in good faith.

| 1. DEVELOPMENT DETAILS | | |
|---|---|---|
| **#** | ***DESCRIPTION*** | ***DETAIL*** |
| 1.1 | Property details | Lot 7 DP228075 |
| 1.2 | Address | 440 Mulhollands Road, Thirlmere. NSW. 2572 |
| 1.3 | Land zoning | 'RU1' Primary Production (Wollondilly Council Local Environmental Plan 2011 - Land Zone Map 008 & 008C) |
| 1.5 | Development details | The property owner has undertaken a program of horticultural developments and building improvements on the property to establish a viable primary production enterprise as the principle use of the land, and a tourism facility as an ancillary land use. |
| | | The primary focus of the operations is the large-scale propagation of lavender for the extraction of the essential oils that complements other business interest in the cosmetic and aroma-therapy industries in which the property owner operates. |
| | | Lavender (*Lavandula angustifolia*) is harvested manually from the plot of approximately 5,000 plants and then steam distilled in rooms on the northern end of the machinery shed to extract the oil component, with the current plant numbers anticipated to yield approximately 4 to 5 litres of oil per harvest. |
| | | The harvested oil is then used in the production and value-adding of cosmetic and aroma-therapy products, with some of the product on display in the entertainment and dining building and available for purchase by visitors to the site. |
| | | The outlying areas of the site are set to a range of animal and bird holdings that provide additional attractions and inter-actions for visitors, the majority of whom are from China that don't necessarily get to experience the hands-on activities of a working property in their normal day-to-day lives. |
| | | The location and operation of some of the animal holdings are the subject of this assessment, along with some of the day-to-day and seasonal activities of the horticultural enterprise |
| 1.6 | | The development property is not serviced by a gravity sewer system thereby requiring all sewage and waste streams to be collected, treated and discharged onsite in an approved manner that meets NSW Health Department and local Council guidelines. |
| 1.7 | | An assessment of the onsite management of effluent has been prepared by SOWDES as a separate document titled 'Wastewater Management Assessment' which has also considered the impact on water quality and the protection of environmentally sensitive areas, and therefore wastewater management as a potential source of stormwater quality pollution will not be addressed specifically within the scope of this report. |

| 2. EXISTING SITE CONDITIONS | | |
|---|---|---|
| *#* | *DESCRIPTION* | *DETAIL* |
| 2.1 | Area | The development property covers an area of approximately 10.12 hectares and is essentially rectangular in shape. |
| 2.2 | Access | Access to the development property is from the Mulhollands Road traffic corridor with the front entrance located approximately 110 metre to the east from the intersection with Oaks Road. |
| 2.3 | Slope / topography | The terrain throughout the development property is essentially divided into two regimes – separated by the passage of a defined drainage depression running west → east through the centre of the property. |
| 2.4 | | The southern half of the block which houses the majority of the development activities and horticultural enterprises falls from the south toward the north at an average grade of 7%, whilst the northern half which is set to several grazing paddocks falls from the north-northwest toward the south at slightly lower grades approximating 5%. |
| 2.5 | | The last 50 metres of the terrain between the grazing paddocks on the northern aspect of the drainage line and the banks of a formed dam within the drainage corridor has a significantly steeper grade of 10 to 15%. |
| 2.6 | Site stormwater drainage | The development property is not serviced by an inter-allotment stormwater drainage system and is thereby required to manage all stormwater runoff on the site. |
| 2.7 | | Several of the sheds and roofed areas are connected to a number of rainwater tanks scattered across the site that are primarily used for animal drinking water, external cleaning – particularly around the main machinery shed area, and small amounts of localised irrigation by hand-watering. |
| 2.8 | | The majority of surface water runoff from the southern half of the property is essentially directed to the defined drainage depression located in the centre of the site, however there is a shared dam with the neighbouring property to the west located approximately midway long the length of the western boundary in that half of the block |
| 2.9 | | The main source of water from the development property entering this dam is derived from the overflow pipe off a concrete water tank located at the rear of the machinery shed, and a small amount of surface water runoff from the machinery shed area and an adjoining orchard in the southeast quarter of the block. |

| | | |
|---|---|---|
| 2.10 | | Overflow from the dam is discharged via a broad weir on the eastern bank that flows overland around the front of the dam and toward the western boundary where it then turns to the north to run parallel with the boundary and eventually drain into the central drainage corridor. |
| 2.11 | | Surface water runoff from the southern half of the site that flows toward the central drainage corridor is largely attenuated and filtered through the horticultural plots which have been formed to run parallel to the contours thereby intercepting and detaining the smaller rain events and the initial first flushes for the larger rain events. |
| 2.12 | | The surface water runoff from the northern half of the property also flows toward the central drainage depression with a moderate sized dam in the southern half intercepting a portion of the runoff and being used by grazing stock for drinking water. |
| 2.13 | | The drainage depression that flows through the centre of the site forms part of the tributary network that discharges into the Stonequarry Creek located further to the east, which in turn drains into the Nepean River system. |
| 2.14 | | Stormwater that flows through the central drainage corridor is collected in a long in-line dam that is formed with a broad wall toward the eastern boundary that is keyed into the banks on either side and houses a narrow-unsealed carriageway for vehicle, animal and machinery movements. |
| 2.15 | | The volume of water within the dam is dependent largely upon upstream runoff and is regulated by a series of piped culverts that pass under through the weir wall on the eastern end. |
| 2.16 | | One of the culverts in particular is directing overflows to a small wading pond on the other side of the weir wall for a mob of ducks that are housed in a fenced enclosure, and this is one source of water quality concern. |
| 2.17 | Vegetation | The vegetation formations throughout the southern half of the property are dominated by managed lands around the main dwelling and curtilage, with a blend of ornamental plants, market and vegetable gardens, fruit orchard, and lavender plots in the outer paddock areas. |
| 2.18 | | The northern half of the property is set to open paddocks of native grasses for grazing by a small number of animals, whilst the central drainage corridor and sections of the front and side boundaries are lined with a scattering of eucalyptus trees and established rows of conifers. |

| | | |
|---|---|---|
| 2.19 | Soils | As part of the wastewater assessment the soils were assessed for effluent loading calculations and disposal suitability, whilst other parts of the site have areas of exposed soils and cuts that allow a visual survey of the soil column |
| 2.20 | | As a general description the soils are comprised of a dry, and slightly non-adherent silty topsoil to 300mm that have an abrupt transition into a light-brown to mid-brown coloured sandy clay loam layer before then transitioning into a slightly darker brown clay loam texture approximately 700mm below the surface. |
| 2.21 | | In the lower elevations of the property nearing the banks of the defined drainage depression the soils become significantly shallower and in many areas there is exposed rocks, gravels, and in a few isolated locations rock shelf. |
| 2.22 | Constraints / other matters | There are several small holding paddocks and animal enclosures located close to the banks of the central drainage depression and dams that do not have an adequate separation distances or buffering measures to mitigate potential nutrient runoff and pollution |
| 2.23 | | At the time of the site survey there was a pig enclosure of 820m² located approximately 40 metres from the banks of the central drainage corridor in the southern half of the property, which was also less than 15 metres from the overflow route from the dam located along the western boundary. |
| 2.24 | | A separate enclosure of 870m² on the eastern side of the weir wall in the southern portion of the property houses a mob of approximately 50 ducks. |
| 2.25 | | The duck enclosure is located approximately 5 metres from the top of the dam wall and 10 metres from the centreline of the drainage depression on the downstream side of the dam and is major source of pollutant runoff from the site. |
| 2.26 | | Some of the vacant land along the banks of the central drainage corridor is being used for the stockpiling of soils and organic materials derived from the farm activities, and whilst some of the soil stockpiles are establishing a grass cover many parts are still exposed and therefore prone to being flushed in to the drainage corridor during large rain events |
| 2.27 | | The following sections will address water quality issues associated with the main areas described in the previous points along with some general advice and recommendations that cover other parts of the development property. |
| 2.28 | | The location of paddocks, enclosures and other matters discussed in this report are reflected in the accompanying Stormwater Management Site Plan – Ref: 0070519-01B. |

Figure 1. View showing one of the existing pig pens close to the central drainage corridor.

Figure 2. View of the duck enclosure on the eastern side of the dam wall in the centre of the property.

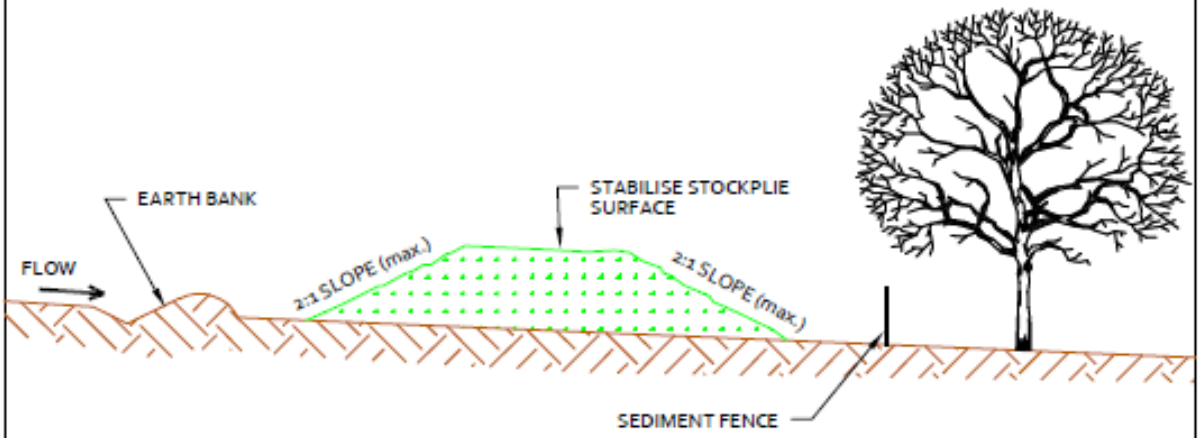
| 3. STORMWATER QUALITY TREATMENT MEASURES - PIGS | | |
|---|---|---|
| *#* | *DESCRIPTION* | *DETAIL* |
| 3.1 | Existing conditions | The existing pig enclosure covers an area of 820m² and is divided into two pens that at the time of the site survey housed approximately 8 beasts. |
| 3.2 | | The site is essentially bare of vegetative cover with loose topsoils and rocks exposed across the entire area, and small wallowing ponds near to the front fence lines |
| 3.3 | | Along the rear of the pens is a set of roofed shelters for the animals to seek shelter from the sun and for sleeping |
| 3.4 | | Access to the pig enclosure is from an internal laneway that separates the animal holdings along the western third of the property from the horticultural plots in the central and eastern portions of the site. |
| 3.5 | | The laneway allows people to walk around the property and therefore visitors can see and inspect the pigs. |
| 3.6 | | The northern aspect of the enclosure is located approximately 40 metres from the banks of the central drainage corridor, and less than 15 metres from the drainage depression for stormwater overflow from the dam to the west, with part of one enclosure actually extending to the margins of the depression. |
| 3.7 | | The surface terrain has a general fall from the southeast toward the northwest within the enclosure which tends to direct surface water runoff toward the overflow corridor from the western dam |
| 3.8 | | The small area separating the pens from the overflow corridor has some vegetative cover, but much of the cover is uncontrolled growth and sparse, therefore not providing any effective interception to the sediment and nutrient laden stormwater that runs across the site. |
| 3.9 | | Separate to the main pig enclosure is a small plot located adjacent to the machinery shed on the site that houses a sow and 6 piglets. |
| 3.10 | | The sow and piglets are separated from the larger adult group mainly for protection purposes; however, the plot is very similar to the main enclosure in that it is completely devoid of any ground covers. |
| 3.11 | Proposed measures | The management of the pigs is to be undertaken in two ways; the first being to reduce the numbers on the property as there is no real requirement to have so many, and the fact that the larger bores and sows are increasingly difficult to handle; and the second is to relocated to enclosure to the grazing paddocks on the northern side of the central drainage line. |

| | | |
|---|---|---|
| 3.12 | | Current best practice standards by Australian Pork (Outdoor Piggery Fact Sheet Series - July 2011) recommend a minimum buffer separation distance of 100 metres between a defined drainage depression or waterway and the enclosure, and the only place where this can be achieved is within the grazing paddocks on the northern half of the site. |
| 3.13 | | The existing dam in the northern paddocks is also considered a constraint for the pig enclosure as it connects directly with the central drainage depression and it supplies drinking water to other stock so the best location of the pigs would be in the extreme northeast quarter of the block where the required separation distance of 100 metres can be readily achieved. |
| 3.14 | | The northeastern quarter paddock should be further subdivided within internal fencing to create four separate paddocks – each approximately 1000m² in area that will allow for rotational grazing of the pigs, in small numbers, and for the separation of a sow and piglets. |
| 3.15 | | To accommodate the rotational grazing of the pigs simple transportable shelters which will provide protection from the sun and weather should be constructed such that they can be moved from paddock to paddock, and within the individual paddocks by towing. |
| 3.16 | | Use of portable shelters and rotational grazing will also help to minimise the concentration of nutrient loading associated with deposits of excretion and defection around feeders and waterers by constantly moving the sources points. |
| 3.17 | | The existing pig enclosure should be decommissioned by removing all fences, shelters and wallowing ponds, and returning the paddock to a ungrazed pasture crop over the next growing season |
| 3.18 | | Once the existing paddock has been spelled and recovered it can be used for small periods of rotational grazing by other animals on the farm. |
| 3.19 | | The farm operators should refer to the series of fact sheets and best practice guidelines prepared by Australian Pork and the Department of Primary Industry for information of pig management and good environmental protection measures. |
| 3.20 | | Three of the fact sheets from Australian Pork that relate to small-scale outdoor free-range pig operations are included in Appendix A of this report for quick reference, however the following website has more information of relevance: http://australianpork.com.au/wp-content/uploads/2016/07/NGforOP_2013_22_lowres.pdf |

| 4. STORMWATER QUALITY TREATMENT MEASURES - DUCKS | | |
|---|---|---|
| **#** | ***DESCRIPTION*** | ***DETAIL*** |
| 4.1 | Existing conditions | The duck enclosure which houses approximately 50 birds and covers an area of approximately 870m² is located on the eastern side of the central dam wall and also forms part of the animal attractions for visitors to see when at the property. |
| 4.2 | | Wading water for the ducks is directed from the main dam into a small pond within the enclosure via a piped culvert through the wall when the levels within the dam are sufficiently high |
| 4.3 | | When the water level within the dam is below the invert level of the culvert pipes a separate water supply line from a pump located adjacent to the dam allows the water level in the wading pond to filled manually. |
| 4.4 | | During periods of high water levels the constant flush of water through the culvert and into the wading pond invariably transfers any droppings and nutrient deposits from the wading pond into the downstream side of the central drainage corridor. |
| 4.5 | | Between the outlet of the wading pond and the margins of the downstream drainage corridor is a narrow 20 metre wide section of vegetation designed in part to filter the overflow from the wading pond before it reaches the drainage depression, however the integrity of the buffer strip is compromised and the vegetation has essentially been killed-off - presumably due to the concentration of nutrients being flushed over the surface and the underlying shallow soils. |
| 4.6 | Proposed measures | The existing duck enclosure is located too close to the central drainage depression, and the flushing of nutrient rich water from the wading pond and runoff from the surface area within the enclosure is deposited directly into the drainage corridor. |
| 4.7 | | It is recommended that the existing enclosure and wading pond be decommissioned, and that the ducks be relocated to a location where the nearest part of their new enclosure is at least 40 metres from the margins of a defined drainage depression. |
| 4.8 | | It is considered that the best location for the ducks would be on the northern side of the central drainage corridor within the southwest corner of the existing grazing paddocks. |
| 4.9 | | The existing dam in the northern paddocks is also considered a constraint for the duck enclosure as it connects directly with the central drainage depression and it supplies drinking water for other grazing animals and therefore requires a minimum separation distance of 40 metres. |
| 4.10 | | The lower elevations around the fence line of the duck enclosure should be formed with a slightly raised berm that has a |

| | | |
|---|---|---|
| | | vegetated cover to intercept and prevent the migration of nutrient rich droppings and waste from being washed in to the central drainage depression, and where the collected solids can be removed in a controlled manner over the course of time. |
| 4.11 | | As the ducks are generally susceptible to excessive sun they should be provided with adequate shelter and nesting facilities |
| 4.12 | | The existing duck enclosure will need to be fully decommissioned and rehabilitated to return ground covers over the entire area and remove the nutrient sinks that have accumulated in the wading pond and other surface depressions |
| 4.13 | | The wading pond and other depressions should be allowed to dry out naturally, all weeds should be removed manually, and the diversion of water from the main dam via the piped culvert will need to be ceased so that all overflows from the dam are in future directed into the downstream depressions |
| 4.14 | | Once the wading pond has dried out the settled materials at the bottom of the pond should be collected manually and moved to a higher elevation within the site for further drying. |
| 4.15 | | Once the waste material has dried for the second time it can be spread over the grazing paddocks in the northern half for incorporation |
| 4.16 | | Whilst the existing duck enclosure is rehabilitating the external fence should be retained to prevent unnecessary entry to the area, and all upslope surface water runoff should be directed around the site by way of temporary earthen berms and/or shallow trenches. |
| 4.17 | | With the wading pond emptied the finished surface area between the pond and the lower drainage line should be slightly regraded, the pond filled with clean earth materials, and the surface covered with a layer of topsoil source from within the site that has the seedbank for the native grasses incorporated. |
| 4.18 | | Until the vegetative cover has re-established a temporary sediment control fence equal to the Standard Drawing SD6-8 from the publication titled '*Managing Urban Stormwater – Soils & Construction'*, Volume 1 (the 'Blue Book', Landcom 2004) should be erected along the lower contour of the site. |
| 4.19 | | The sediment control fence and temporary surface water diversions will need to be removed once the ground cover has an effective strike of at least 80% |
| 4.20 | | Appendix B of this report has some general information from the Department of Primary Industry related to the establishment of duck housing design, layout and equipment for reference |

| 5. STORMWATER QUALITY TREATMENT MEASURES - STOCKPILES | | |
|---|---|---|
| **#** | ***DESCRIPTION*** | ***DETAIL*** |
| 5.1 | Existing conditions | The stockpiles of soils and decaying organic materials that are located on the banks of the central drainage corridor are prone to erosion and sediment runoff during large rain events, despite some sections of the stockpiles having a partial grass cover. |
| 5.2 | | Effective grass cover over the stockpiles is reliant upon the runners from existing kikuyu and other native grasses and ground covers to establish |
| 5.3 | | It is noted in particular at the time of the site survey that a stockpile of organic material that was located on the lower eastern side of the dam wall, immediately above the downstream drainage depression. |
| 5.4 | | This material can be washed into the drainage system during large rain events and contribute to blockages and possible weed growth within the corridor if allowed to remain |
| 5.5 | Proposed measures | If still in-situ, the stockpile of organic material referenced in the previous point should be completely removed and placed in a higher location within the site, no closer than 40 metres to any drainage depression or dam. |
| 5.6 | | Ideally the stockpiles of soils and mixed materials along the banks of the dam should be located outside a 40 metre buffer zone either side of the dam within the central drainage corridor, and/or any other drainage depression or dam within the site. |
| 5.7 | | As a minimum the stockpiles should be treated in accordance with the provisions of the publication titled '*Managing Urban Stormwater – Soils & Construction'*, Volume 1 (the 'Blue Book', Landcom 2004), and should be prevented from flushing sediments, soils and other contaminants into the waterways by erecting appropriate barrier control fencing and stockpile management – refer to the following images of Standard Drawings SD4-1 and SD6-8 in the following pages for details. |
| 5.8 | | All future stockpiles, irrespective of the nature of the materials should be at least 40 metres from the margins of the high-water level in the central dam, and all dams and waterways. |
| 5.9 | | Suitable areas at least 40 metres away from drainage depressions and dams need to be identified for the future composting of organic material which will need to include an impermeable base to prevent migration of concentrated nutrients into the groundwater sources |
| 5.10 | | The impermeable base would ideally be concrete; however a compacted earth-clay base with a permeability of 0.1mm/day can be used if suitable compaction can be achieved. |




**CONSTRUCTION NOTES:**

1. PLACE STOCKPILES MORE THAN 2 (PREFERABLY 5) METRES FROM EXISTING VEGETATION, CONCENTRATED WATER FLOW, ROADS AND HAZARD AREAS.

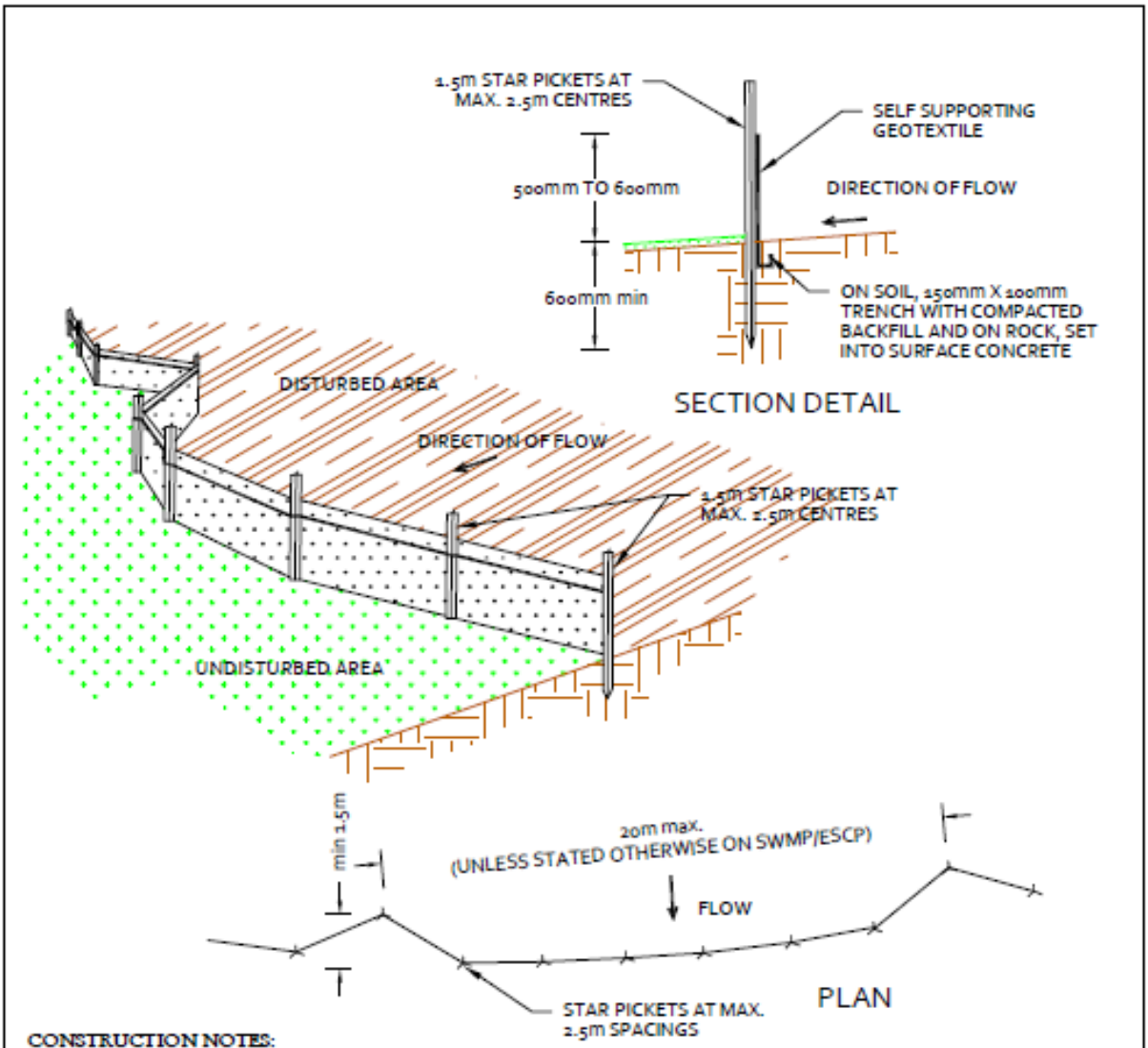
2. CONSTRUCT ON THE CONTOUR AS LOW, FLAT, ELONGATED MOUNDS.

3. WHERE THERE IS SUFFICIENT AREA, TOPSOIL STOCKPILES SHALL BE LESS THAN 2 METRES IN HEIGHT

4. WHERE THEY ARE TO BE IN PLACE FOR MORE THAN 10 DAYS, STABILISE FOLLOWING THE APPROVED ESCP OR SWMP TO REDUCE THE C-FACTOR TO LEE THAN 0.10

5. CONSTRUCT EARTH BANKS (STANDARD DRAWING 5-5) ON THE UPSLOPE SIDE TO DIVERT WATER AROUND STOCKPILES AND SEDIMENT FENCES (STANDARD DRAWING 6-8) TO 1 TO 2 METRES DOWNSLOPE

**STOCKPILES** **SD 4-1**




**CONSTRUCTION NOTES:**

1. CONSTRUCT SEDIMENT FENCES AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DRAWING TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION. THE CATCHMENT AREA SHOULD BE SMALL ENOUGH TO LIMIT WATER FLOW IF CONCENTRATED AT ONE POINT TO 50 LITRES PER SECOND IN THE DESIGN STORM EVENT, USUALLY THE 10 YEAR EVENT.

2. CUT A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.

3. DRIVE 1.5 METER LONG STAR PICKETSINTO GROUND AT 2.5 METER INTERVALS (max) AT THE DOWNSLOPE EDGE OF THE TRENCH. ENSURE ANY STAR PICKETS ARE FITTED WITH SAFETY CAPS.

4. FIX SELF SUPPORTING GEOTEXTILE TO THE UPSLOPE SIDE OF THE POSTS ENSURING IT GOES TO THE BASE OF THE TRENCH. FIX THE GEOTEXTILE WITH WIRE TIES OR AS RECOMMENDED BY THE MANUFACTURER. ONLY USE GEOTEXTILE SPECIFICALLY PRODUCED FOR SEDIMENT FENCING. THE USE OF SHADE CLOTH FOR THIS PURPOSE IS NOT SATISFACTORY.

5. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP.

6. BACKFILL THE TRENCH OVER THE BASE OF THE FABRIC AND COMPACT IT THOROUGHLY OVER THE GEOTECTILE.

# SEDIMENT FENCE SD 6-8

| 6. STORMWATER QUALITY TREATMENT MEASURES - OTHERS | | |
|---|---|---|
| **#** | ***DESCRIPTION*** | ***DETAIL*** |
| 6.1 | Existing conditions | The machinery shed on the western aspect of the main development precinct has historically been used for processing lavender oils and general washing and cleaning activities |
| 6.2 | | There is two sinks located within the shed that are presently discharging onto the ground immediately outside the northern aspect of the shed, approximately 40 metres from the dam along the western boundary |
| 6.3 | | The wastewater management assessment has recommended that a low-pressure sewer pump station equal to the the '*Aquatec Sewertec 1 – Tank Model A – 620 Litres'* to be located on the northern aspect of the building that will discharge the contents under pump level controls to the existing wastewater treatment system via a 32Ø PN12.5 polyethylene pipe with lilac stripes |
| 6.4 | | This measure will remove the need to install a standalone wastewater system just for the small and intermittent amount of wastewater generated within the shed. |
| 6.5 | | Further details including technical specifications of the proposed low-pressure sewer pump system are included within the 'Wastewater Management Assessment' report document and accompanying site plan. |
| 6.6 | General comments | Once the existing pig enclosure has been decommissioned and allowed to rehabilitate it can be used for low-intensity grazing on a rotational basis by a small number of animals, such as donkeys and alpacas that are currently on the site |
| 6.7 | | The paddock can also be used for brief periods to bring the pigs across to the main side of the drainage corridor for viewing purposes if visitors are expected to avoid the need for them to walk to the other side of the farm |
| 6.8 | | The proponents should seek assistance from a qualified agronomist to help prepare a rotation program for the grazing paddocks, including grass and crop types to best suit the site. |
| 6.9 | | All rainwater tanks should have overflow pipes of 90Ø installed away from any building or structural elements that run down the side of the tank wall, turn at 90° and then discharge on to the surface via a stabilised outlet apron |
| 6.10 | | The stabilised outlet apron should be formed with rocks of 100 to 150Ø and extend for a distance of at least 500mm to prevent concentrated flows scouring the surrounding soils. |
| 6.11 | | Where the overflow pipe can be extended further away from the footprint of the rainwater tank the it is encouraged to do so. |

# APPENDIX A

AUSTRALIAN Pork

Fact Sheet

# FACT SHEET

Outdoor Piggery Fact Sheet Series
July 2011

## DESIGN AND MANAGEMENT OF OUTDOOR FREE RANGE AREAS FOR PIGS

Free Range (FR) pig production is often promoted on the basis of improved animal welfare and environmental performance compared to conventional pork production. However, if not managed well, outdoor production systems pose different and sometimes higher risks than indoor (conventional / deep litter) piggeries such as nutrient overloading and subsequent losses, soil structure issues (e.g. compaction), vegetation degradation and soil erosion.

Site selection factors important in applying good agricultural practices outdoor free range areas include:

- Finding a site with an annual rainfall of less than 750 mm, a mean maximum January temperature of less than 28°C and a mean minimum July temperature exceeding 3°C;
- Providing sufficient land for a sustainable system to operate;
- Protecting surface waters by providing a buffer at least:
  i. 800 m wide between the piggery and a major water supply storage, and
  ii. 100 m wide between the piggery and a defined watercourse;
- Protecting sensitive land uses such as by providing separation distances between the FR piggery and sensitive land use of at least:
  i. 200 m to a public road carrying >50 vehicles per day, and
  ii. 100 m to a public road carrying <50 vehicles per day, and
  iii. 750 m to a town, and
  iv. 500 m to a rural residential area, and
  v. 250 m to a rural dwelling, and
  vi. 20 m to a property boundary;
- Selecting a site with soils that are well drained but which contain sufficient clay to retain nutrients in the root zone. Sites with light soils are subject to wind erosion (and nutrient removal) when groundcover is denuded. Sites with heavy soils may be difficult to traffic during wet weather; and
- Selecting a site with gently sloping land to minimise the likelihood of local flooding.

Design and management factors important in applying good agricultural practices within outdoor free range areas include:

- Nutrient budgeting. While N, P and K accumulate in soils of FR piggeries, the nutrient accumulation rate is generally not high unless an area has been stocked continuously for more than two years. Consequently, rotations should be planned such that pigs are not continuously stocked on an area for longer than two years. Following the pig stocking phase, crops should be grown to utilise accumulated N, P and K.
- Encouraging even spreading of manure nutrients. A major challenge of FR systems is that manure, and consequently nutrients, is not spread evenly across the paddock. This increases the risk of nutrient overloading, leaching and/or runoff. Moving pig housing and feeding facilities regularly during the stocked phase will help spread nutrients more evenly.
- Adopting strategies to minimise uncontrolled movement of nutrients from FR piggery paddocks. These including regular spelling from pig production, with a plant growth and harvest phase to remove the nutrients added through the stocked phase and provision of a physical barrier and / or a good hardy vegetative cover around the piggery perimeter.
- Providing wallows on soils that allow for minimal nutrient leaching (alternatively clay can be added to the wallows to reduce the leaching rate through the base). Wallows need to be frequently emptied and cleaned to avoid heavy contamination. Wallows should be remediated by ripping; applying gypsum as needed; and proper refilling and levelling.
- Undertaking routine environmental monitoring, particularly soil monitoring during the cropping phase of the rotation.

AUSTRALIAN Pork

Fact Sheet

# FACT SHEET

Outdoor Piggery Fact Sheet Series
May 2012

## LAND AND WATER PROTECTION MEASURES FOR ROTATIONAL OUTDOOR PIGGERIES

Adopting good land protection measures helps to preserve or enhance the productive qualities of the soil and prevent off-site impacts. Rotational outdoor piggeries can sometimes pose a risk to the environment through unsustainable soil nutrient levels, soil structural decline and poor land protection measures. Suitable siting, planning and design; dynamic management; and a commitment to site remediation reduce the risk of land degradation and related surface water contamination.

### Soil Erosion

It is important to prevent soil erosion throughout both the pig and the crop, forage or pasture phases of the rotation. Erosion reduces land productivity by removing the nutrient-rich topsoil. It may also cause increased turbidity and nutrient levels in nearby surface water resources. Erosion is difficult to remedy and prevention is imperative.

Good site selection is important in minimising erosion from rotational outdoor piggeries. Erosion risk increases with higher slope; soil erosivity; and rainfall or wind intensity. Sites with a steep slope are generally unsuitable for rotational outdoor piggeries. Land with a flat to gentle slope is preferable. Sites with dispersible or light soils are also erosion-prone. Locations with higher rainfall intensities also have higher water erosion rates.

Maintaining groundcover over the land is the critical management strategy for minimising erosion. Groundcover is any material on or near the soil surface that provides protection for the soil against the erosive action of rainfall runoff or wind. It may include plant material (alive or dead), spent bedding and other cover materials providing these will not be carried away in rainfall runoff or blown away by the wind. Since attached plant material is more effective than dead plant material or other light matter lying on the soil surface it is recommended that it make up the majority of the groundcover. Groundcover prevents erosion by leaving soil less exposed to wind and rainfall runoff, promoting soil properties that increase rainfall absorption, and intercepting runoff preventing it from becoming erosive. Maintaining groundcover in pig paddocks year-round is challenging and dependent on selecting a suitable stocking density for the locality and soil type.

### Secondary Erosion Control Measures

On sloping sites, contour banks can be constructed to slow the flow of water across the paddock, thereby reducing erosion.

Other structures can reduce the risk of eroded soil reaching waterways. Vegetated filter strips (VFS) or buffers below piggery paddocks can effectively prevent eroded soil and nutrients from reaching waterways. VFS's are continuous vegetated buffer strips at least 10 m wide that are located immediately downslope of the entire paddock area. Ideally these consist of a runner-developing, non-clump forming grass species. VFSs reduce the nutrient concentration of runoff by trapping soil particles and by slowing the water flow rate which increases infiltration. Generally, wider VFS's can trap greater quantities of eroded soil. For sites with greater slope, higher rainfall intensities or erosive soils wider VFS's are recommended.

As an additional control, or where there is high risk of waterway contamination, terminal ponds sized and located to catch the first 12 mm of runoff from the piggery paddocks and other land within the same catchment area can effectively minimise nutrient contamination of surface water resources. These work primarily by capturing the runoff containing the most nutrients. However, they also slow the flow velocity, promoting settling of suspended soil from the runoff. Runoff caught in terminal ponds needs to be irrigated on land not in use as pig paddocks.

### Monitoring

Regularly monitoring paddocks for signs of soil erosion or structural decline allows corrective action to be taken as needed. Depending on the location, soil properties and facility management, soil compaction can be an issue. This can have serious implications for the growth of future crops and also contributes to erosion.

### Site Remediation

On completion of the pig phase, site remediation helps to prepare the land for the crop, forage or pasture phase. This generally involves removal of fencing, shelters, feeders and other paddock installations; remediation of compacted or eroded land; and wallows remediation.

AUSTRALIAN Pork

# Fact Sheet

If the soil is compacted or eroded, growing an ungrazed ley pasture crop on the area is recommended. The soil should only be cultivated when the moisture content is between wilting point and field capacity. Other soil compaction remedies will depend on the soil type and may include deep ripping and spreading gypsum. Badly eroded areas may need to be fenced off and excluded from agricultural uses.

Wallows tend to be fairly nutrient-rich areas of the pig paddocks. Locating them on areas with loam to clay soils or lining them with compacted clay reduces the risk of groundwater contamination. Wallows remediation typically occurs when they are decommissioned (e.g. for relocation) and on completion of the pig phase to allow for crop or forage production. This may involve discing or deep ripping the base and possibly applying gypsum; filling in the wallow with soil; and levelling to match the slope of the immediately surrounding land.

A forage crop or pasture should be given time to establish before commencement of the next pig phase.

## References and Further Reading

Australian Pork Ltd, 2010. National Environmental Guidelines for Piggeries, 2nd Edition (revised), Australian Pork Ltd, Deakin.

Redding M and Phillips I, 2005. Land Application of Effluent Phosphorus, Australian Pork Ltd Project 1354, Australian Pork Ltd, Deakin.

## Other Fact Sheets in this Series

- Developing a Nutrient Management Plan for a Rotational Outdoor Piggery
- Promoting More Even Distribution of Manure Nutrients in Rotational Outdoor Piggeries
- Soil Monitoring for Rotational Outdoor Piggeries

FSA Consulting has taken all reasonable steps to ensure that the information contained in this fact sheet is accurate at the time of production. FSA Consulting and APL maintain no responsibility for the accuracy or reliability of information supplied in this fact sheet and accept no responsibility due to the incorrect use of this information.



**Maintaining good groundcover levels effectively prevents erosion**

**Vegetated Filter Strips (VFS) protect watercourses**

**Wallows need to be remediated after the pig phase to prepare the land for the crop / pasture / forage phase**

AUSTRALIAN Pork

Fact Sheet

# FACT SHEET

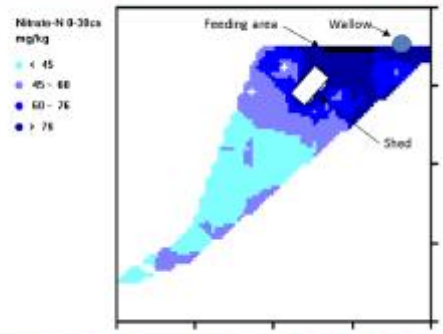
Outdoor Piggery Fact Sheet Series
May 2012

## PROMOTING MORE EVEN DISTRIBUTION OF MANURE NUTRIENTS IN ROTATIONAL OUTDOOR PIGGERIES

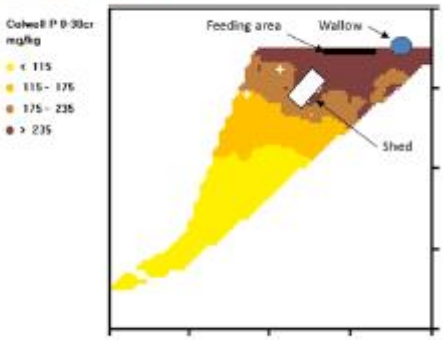
Australian and international research shows that manure nutrients are not distributed evenly across the paddocks of rotational outdoor piggeries. Rather, the nutrients are concentrated around the shelter; and in the area bounded by the shelter, the feeding facilities, the waterers and the wallow.

APL research has used electromagnetic (EM) induction survey technology, coupled with soil sampling and testing, to map the distribution of nutrients in rotational outdoor piggery paddocks. Figure 1 and Figure 2 below show the distribution of nitrate-nitrogen and Colwell phosphorus respectively across one of the surveyed paddocks in relation to the shed, wallow and feeding area.

### Figure 1. Predicted Nitrate-N Distribution Map




### Figure 2. Predicted Colwell Phosphorus Distribution Map




Rotational outdoor piggeries will always accumulate nutrients in the soil because of the quantities of nutrients brought in as feed. If these nutrients are not evenly spread, soil nutrient concentrations in parts of the paddock may quickly reach levels that pose a risk to the environment. The potential for nitrate-nitrogen leaching from these hot-spots is of particular concern. There are also implications for crops grown on the land after the pig phase, in particular uneven crop growth and reduced nitrogen use efficiency.

To promote more even nutrient distribution across the paddock area it is necessary to change the excretory behaviour of the pigs. European researchers have identified that pigs mainly defecate and urinate as they move between the shelter and the feeding area, although they also excrete as they move between other installations. The researchers also demonstrated that regularly moving facilities around the paddock (e.g. every 3-4 weeks) was effective in modifying excretory patterns and in achieving more homogeneous nutrient distribution across the paddock (Quintern & Sundrum (2006) and Eriksen et al. (2006)). Using appropriate nutrient inputs will also help to reduce the ecological risks of nutrient accumulation and leaching.

Regularly relocating movable structures that could include shelters, shade, feeding points, waterers, wallows and spray or drip cooling facilities within the paddocks promotes more even manure deposition. It is recommended that this occur at least every six months for the breeding herd paddocks and at least every three months for grower paddocks. Position the shelters so that they are well separated from the feeding facilities. For piggeries that ground-feed, delivering the feed either right along the length of a paddock perimeter fence or dispersing it over a significant part of the paddock area encourage more heterogeneous spread of manure.

### Other Fact Sheets in this Series

- Developing a Nutrient Management Plan for a Rotational Outdoor Piggery
- Land and Water Protection Measures for Rotational Outdoor Piggeries
- Soil Monitoring for Rotational Outdoor Piggeries.

AUSTRALIAN Pork

# Fact Sheet

## Example of movable farrowing hut

## Example of movable dry sow or grower shelters

## Example of movable self-feeder

## Example of wallow water supply that is readily movable

## References and Further Reading

Australian Pork Ltd 2011, The use of EM technology to determine nutrient distribution in free range pig areas, Australian Pork Ltd Fact Sheet, Australian Pork Ltd, Deakin.

Benfalk, C, Lindgren, C and Rundgren, M 2005. Mobile and Stationary Systems for Organic Pigs – Animal Behaviours in Outdoor Pens, accessed from http://orgprints.org/4313/

Eriksen, J, Hermansen, JE, Strudsholm, K and Kristensen, K 2006. 'Potential loss of nutrients from different rearing strategies for fattening pigs on pasture', *Soil Use and Management*, vol. 22, pp. 256-266.

Quintern, M and Sundrum, A 2006, 'Ecological Risks of Outdoor Pig Fattening in Organic Farming and Strategies for Their Reduction—Results of a Field Experiment in the Centre of Germany', *Agriculture, Ecosystems and Environment*, vol. 117, pp. 238–250

**APPENDIX B**

# Duck Housing Design, Layout and Equipment

## Duck housing design

Elaborate sheds are not necessary, but you should observe the general principles of poultry house design. Breeders may be housed either intensively or semi-intensively:

- **intensive housing** — the birds are housed indoors for the duration of the season;
- **semi-intensive housing** — the birds have access to outside runs during the day, but are locked indoors at night and during adverse weather conditions.

For each type of housing:

- The housing must be clean, dry, adequately ventilated and able to keep out beating rain.
- Allow each breeder an area of at least 0.2 $m^2$ of floor space inside the shed (i.e. 5 birds/$m^2$).
- Cover the shed floor with litter for the comfort of the birds, to absorb moisture and to prevent egg breakage — wood shavings are probably the most suitable, but any soft absorbent material to a depth of about 7–8 cm is satisfactory.

## Siting

The area selected for sheds should be gently sloping. If the site is too hilly, sheds will be difficult to build; if the site is too flat, drainage will be impeded. For siting and layout contact your local council for development advice.

The shed should face north to north-east and should be at least 2 m high at the back, to give enough head room. Since ducks are very susceptible to excessive sun, provide adequate shade.

## Layout

For a systematic farm layout, first draw up a ground plan and spend some time thinking about the plan and shed design. This will enable you to make modifications. When planning the farm, **allow for housing growers and adults separately**, and make sure there is no drainage from the adult housing area to growers. Whatever housing is chosen, a cheap and effective type of shed is one with a skillion roof.

The ideal method of **housing breeding stock** is in a building which has both litter and slatted or wire floor areas. This greatly reduces the amount of wet litter and improves overall production. Feeders and waterers are placed on the slats. The litter area is used by the ducks for mating and for laying eggs. A combination of litter and slats prevents possible leg damage to heavy breeding ducks, which may occur if they are housed on slats only.

## Nests

Encourage ducks to use nests because cleaner eggs result and fewer breakages occur. Furthermore, eggs laid in nests are not exposed to sun or damp. This may be difficult with breeds other than Muscovies.

Nests should be clean, dry, comfortable and only large enough to be used by one duck at a time. Build them from timber and place them in rows along the walls. A suitable size is 30 cm by 30 cm by about 40 cm deep. Nesting material should be placed in the nest to a depth of about 7 cm. Use shavings, sawdust, sand or shell grit. Broody ducks will further line their nests with their own body feathers.

If you wish to follow a system of progeny testing, use trap nests to facilitate identification of eggs laid by individual ducks. Identify and discard ducks that continually lay almond-shaped eggs or other misshapen eggs. Individual duck production can also be recorded. In intensive buildings, encourage Pekin ducks to lay in nests by providing open-framed nest boxes on the side of the walls. The nest boxes must be at floor level, as ducks will not use elevated nests.

## Feeders

No special feeding equipment for ducks is manufactured in this country, so equipment made for other poultry has to be used. This gives satisfactory results. As a general rule, ducks need twice as much feeding space as hens. Flock feeders are the most satisfactory types of feeders for ducks. Provide each duck with a feeding space of at least 12 cm (the equivalent of four 2 m flock feeders per 100 adults).

## Waterers

Swimming facilities are not essential. However, pools can be made available where outside runs are provided. Concrete ponds 1 m wide by 0.25 m deep are satisfactory. To keep litter in the shed dry, place the ponds away from the house. Alternatively, saucer-shaped pools 0.25 m deep and 2 m wide may be used. In both cases, good drainage is essential. To limit wastage of eggs, it is advisable to prevent outside swimming until about 10.00 am, when most eggs will have been laid (most ducks lay their eggs in the evening and early morning).

Although swimming water is not necessary, ducks do need plenty of clean drinking water. Birds should be able to immerse their heads completely and hence clean and prevent blockage of their nasal passages caused by food and dirt. Keep drinking containers shaded at all times. To prevent damp litter, place drinking vessels outside the shed or on a wire grid. Provide about 3 cm of drinking space for each adult bird.