MEAT & LIVESTOCK AUSTRALIA


# Industry environmental performance review

## Integrated meat processing plants

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**PRENV.033**

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# Executive summary

In 1998 the environmental performance of nine medium to large integrated meat processing plants throughout Australia was studied. The findings from this investigation resulted in industry recognised key performance indicators (KPIs) which have since been used by individual facilities to monitor their environmental performance. The current study (conducted five years after the initial study) covers 10 medium to large integrated meat processing plants throughout Australia to assess the level of industry improvements in meeting the original KPIs. Additional KPIs have been introduced in this study to reflect the changing community and industry expectations within the red meat industry.

Where possible, within each category the average or median of the 10 2003 sites has been related to the average of the 1998 survey. The comparison of the averages between the two studies has to be viewed in the context that only four of the original sites are represented in the current study and that some of these sites have changed substantially since 1998. The comparison of the averages is therefore only to be used as a guide. The data within the report is presented in relationship to the tonnes of hot standard carcase weight (HSCW) or to the number of head processed.

The overall industry trends identified in this study include:

- Average energy usage per tonne of HSCW has remained relatively steady since the 1998 study
- Average raw water use per tonne of HSCW has decreased by approximately 11% since the 1998 study
- Average wastewater generation per tonne of HSCW has reduced since the 1998 study
- Average wastewater nutrient loads per tonne of HSCW have increased slightly since the 1998 study
- Average complaints (noise and odour) per kiloton of HSCW has reduced since the 1998 study
- Average overall environmental performance has increased since the 1998 study

Due to the complex nature of the red meat industry processes and the variety of ways plants report their environmental performance, the figures generated as part of this study are a guide only.

# Introduction

In 1998 the environmental performance of nine medium to large integrated meat processing plants throughout Australia was studied. The findings from this investigation resulted in industry recognised key performance indicators (KPIs) which have since been used by individual facilities to monitor their environmental performance. The current study (conducted five years after the initial study) covers 10 medium to large integrated meat processing plants throughout Australia to assess the level of industry improvements in meeting the original KPIs. Additional KPIs have been introduced in this study to reflect the changing community and industry expectations within the red meat industry.

Four of the original nine 1998 study sites are included in the current industry study. In the interest of confidentiality none of the sites are identified in the report.

# Objectives

The objective of the industry environmental performance review was to measure current industry environmental performance and assess the improvement in industry sustainability against the 1998 performance review.

In order to ensure the data collected can be meaningfully compared between the current, past and possibly future studies, the parameters and questions posed have been kept largely the same as those used in the 1998 study. The questionnaire (Appendix B) has been changed to an electronic MS Excel format to allow easy manipulation of data, use of macros and generation of trend tables and graphs.

# Key performance indicators (KPIs)

## 1.1 1998 KPIs

In the 1998 environmental assessment eight KPIs were given a numerical benchmark value which was seen as the desired industry standard. These KPIs included:

- Status of environmental management
- Energy usage
- Water usage
- Wastewater generation
- Wastewater loads (phosphorus, nitrogen, biological oxygen demand [BOD] and sodium absorption ratio [SAR])
- Number of annual odour complaints
- Number of annual noise complaints
- Solid waste to landfill

In addition to these eight, other semi-quantitative benchmarks were established based on management of environmental issues and also given a numerical benchmark value. These included:

- General environmental management
- Energy management
- Water and wastewater management
- Irrigation management (if applicable)
- Solid waste management
- Management of noise emissions
- Management of air emissions
- Overall performance

As one of the main aims of the current study was to be able to compare between the 1998 and 2003 benchmarking findings, the large majority of the 1998 questions have remained unchanged. Some additional KPIs were included as outlined in Section 1.2. Other changes to the 1998 KPIs included the removal of the status of environmental management KPI which was related to the status of any environmental management system (EMS). It was decided that the questions relating to EMS would be more appropriately included in the general environmental management KPI section.

## 1.2 Additional KPIs

The following KPIs were included in the current study to supplement the KPIs listed above:

- Recycled water usage
- Packaging waste
- Greenhouse gas emissions
- Management of community relations

The addition of these KPIs is reflected in the additional fields to be completed in the updated questionnaire.

## 1.3 Site visits

Ten red meat processing sites were visited throughout Australia including sites in Western Australia, South Australia, New South Wales, Victoria and Queensland. The site visits were conducted by qualified project personnel and comprised one to two days on site with the site environmental representative. The site visits were conducted between January and March 2004.

Prior to the site visit, each participating site was sent an electronic copy of the project questionnaire (**Appendix B**). The questionnaire was designed to be easy to use and to automatically calculate the required KPI outputs for the site. Typically, the site visit would commence with a walk over of the facilities to familiarise project personnel with the site's individual product and waste treatment processes. Once the walk over was completed, the project personnel and site representative would work through the questionnaire together and aim to complete all of the required information fields. Some sites did not have access to the latest or most accurate information as discussed in **Section 1.4**.

Follow-up visits were conducted in June 2004 to present the preliminary findings of the study to site management and to obtain feedback that could be incorporated into the study report.

## 1.4 Qualifications

When reviewing the data in **Sections 1.5 and 1.6**, the following factors should be kept in mind. This is not an exhaustive list, however it indicates the complex nature of the red meat industry processes and of reporting their environmental performance.

- The quality of the data varies between sites. This is dependent on how accurately the sites measure factors such as solid waste generation, raw water and waste water flows, the number of complaints and nutrient loads in wastewater.
- The number of complaints is influenced by the location of the plant in relation to sensitive receptors just as it will be affected by the noise and odour levels.
- The regulatory requirements placed on the various sites by state environmental regulators and water boards (trade waste licences) result in varying levels of enforced compliance. Sites across five states (Queensland, Victoria, New South Wales, South Australia and Western Australia) were included in the 2003 study.
- The sites are a mixture of beef only, beef and sheep, sheep only and beef and veal.
- Nearly every site is unique in the way that they choose to treat their waste water, conduct their rendering operation and operate their plant.
- All of the sites in the 2003 study are export plants.
- The KPI questions in Form 9 of the questionnaire on 'overall environmental management' are relatively subjective and there is room for a degree of interpretation in these semi-qualitative outcomes.
- The data from the current study is from a defined period (calendar year 2003); the previous study gathered data from a variety of sources and time periods.

# Findings

## 1.5 Calendar year 2003

The following graphs are a visual illustration of the KPI results for the ten sites participating in the 2003 environmental study. Where appropriate the average or median of the 10 sites has been included as a column on the right hand side of the graph. Where possible it has been related to the average of the 1998 survey. The comparison of the averages between the two studies has to be viewed in the context that only four of the original sites are represented in the current study and that some of these sites have changed substantially since 1998. The comparison of the averages is therefore to be used as a guide only and is not expected to accurately represent the overall industry trend. For a comparison of the four original sites please refer to **Section 1.6**. The data is presented in relationship to the tonnes of hot standard carcase weight (HSCW) or to the number of head processed.
As per head calculations were not included in the 1998 study, only 2003 averages are shown on these graphs.

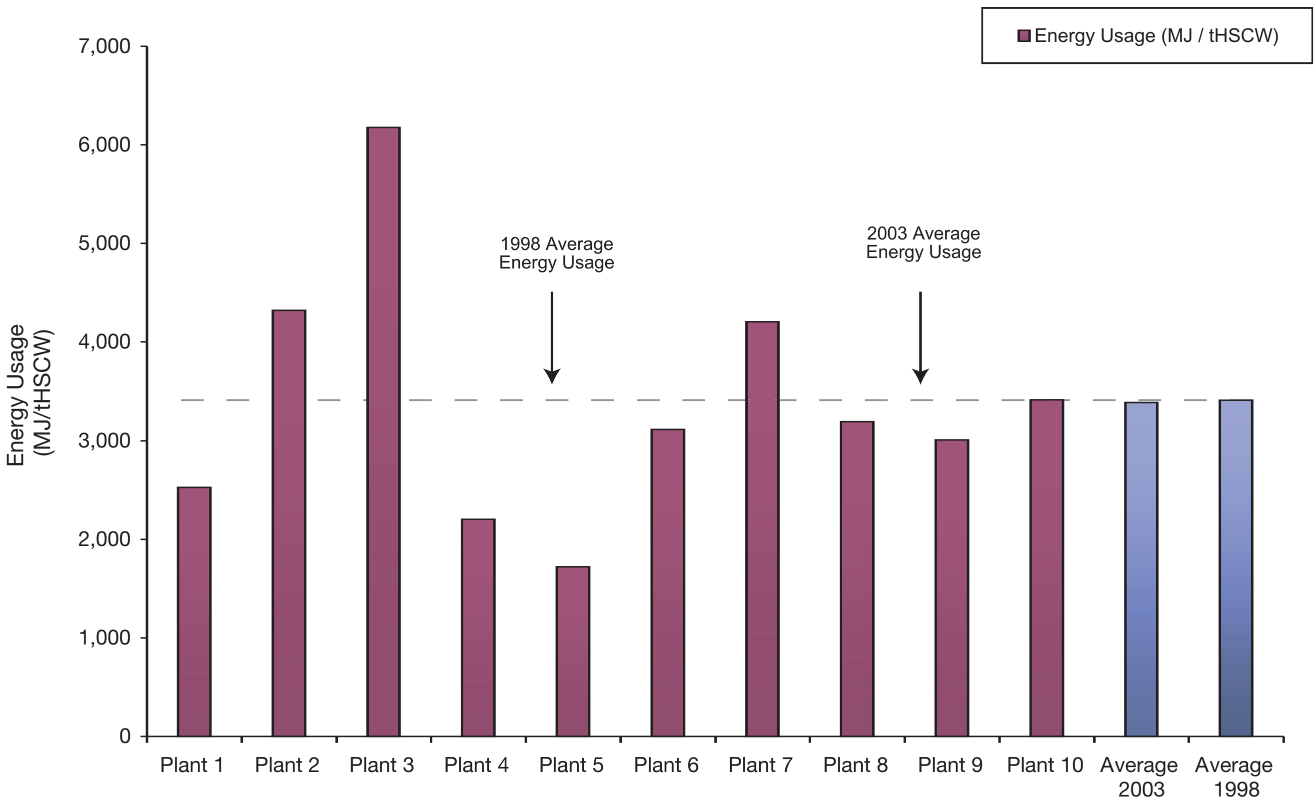
*Table 1 Industry averages 1998 v FY2003*

| KPI | Score 1998 | Score FY2003 | Units |
|---|---|---|---|
| **Greenhouse emissions** | | | |
| Greenhouse gas Emissions | NA | 525 | kg CO2-e/tHSCW |
| | NA | 76 | kg CO2-e/head |
| **Energy** | | | |
| Energy usage | 3411 | 3,389 | MJ/tHSCW |
| | NA | 463 | MJ/head |
| **Water** | | | |
| Raw water usage | 11.8 | 10.6 | kL/tHSCW |
| | NA | 1,481 | L/head |
| Wastewater generation | 10.2 | 10.0 | kL/tHSCW |
| | NA | 1,397 | L/head |
| **Wastewater loads** | | | |
| – phosphorus | 0.3 | 0.34 | kg/tHSCW |
| – nitrogen | 1.7 | 2.05 | kg/tHSCW |
| **Solid waste** | | | |
| Solid waste to landfill | 7 | 15.6 | kg/tHSCW |
| | NA | 1.6 | kg/head |
| **Complaints** | | | |
| Odour complaints | 1 | 0.1 | Complaints/ktHSCW |
| Noise complaints | 1 | 0.2 | Complaints/ktHSCW |
| Overall site performance | 51 | 62 | % |

Notes:
tHSCW – tonnes hot standard carcase weight
ktHSCW – kilotons hot standard carcase weight
kg $CO_2$-e – kilograms of carbon dioxide equivalent
NA – not available

## Graph 1: Energy usage – MJ/tHSCW

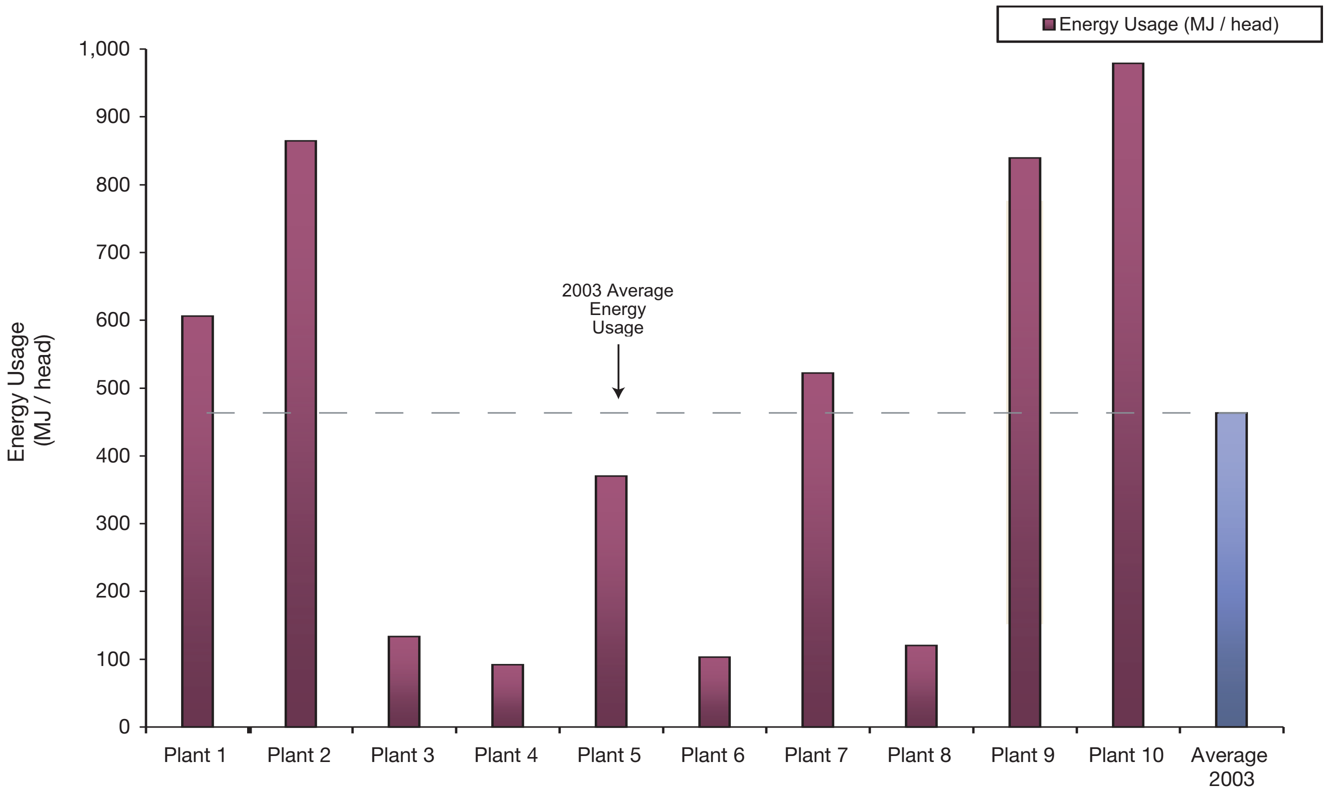
Site energy usage was measured as mega joules (MJ) per tonne of HSCW. Energy sources included electricity, natural gas, liquid petroleum gas (LPG), wood waste, diesel, petrol and coal. The graph below shows that there has been minimal change in the average energy usage since the 1998 study. Reasons for this trend may include the fact that some of the plants in the 2003 survey have more vertical integration and by-product production included in their energy calculations. Other contributing factors may include the age and condition of the plant equipment, the type of freezing conducted on site (blast or plate), the percentage of the product that is frozen, the type of fuel used in the site boiler and whether aerators are used in the wastewater treatment system.




It is possible to see in **Graph 1** that there are large variations between the sites in this KPI. The range of values is from 1,722 (Plant 5) to 6,178 MJ/tHSCW (Plant 3). Even though some plants have a high degree of value adding processes included in their energy totals, it is still possible to say that many plants can improve their energy efficiency performance.

### Graph 2: Energy usage – MJ/Head

The second graph on site energy usage was measured as mega joules (MJ) per head. Due to the variety of animals (cattle and sheep) processed by the sites it is possible to see large variations in a site's position relative to the average between **Graph 1** and **Graph 2**. A site which processes smaller animals (eg sheep) will use less energy per head than a site that processes larger animals (eg cattle).



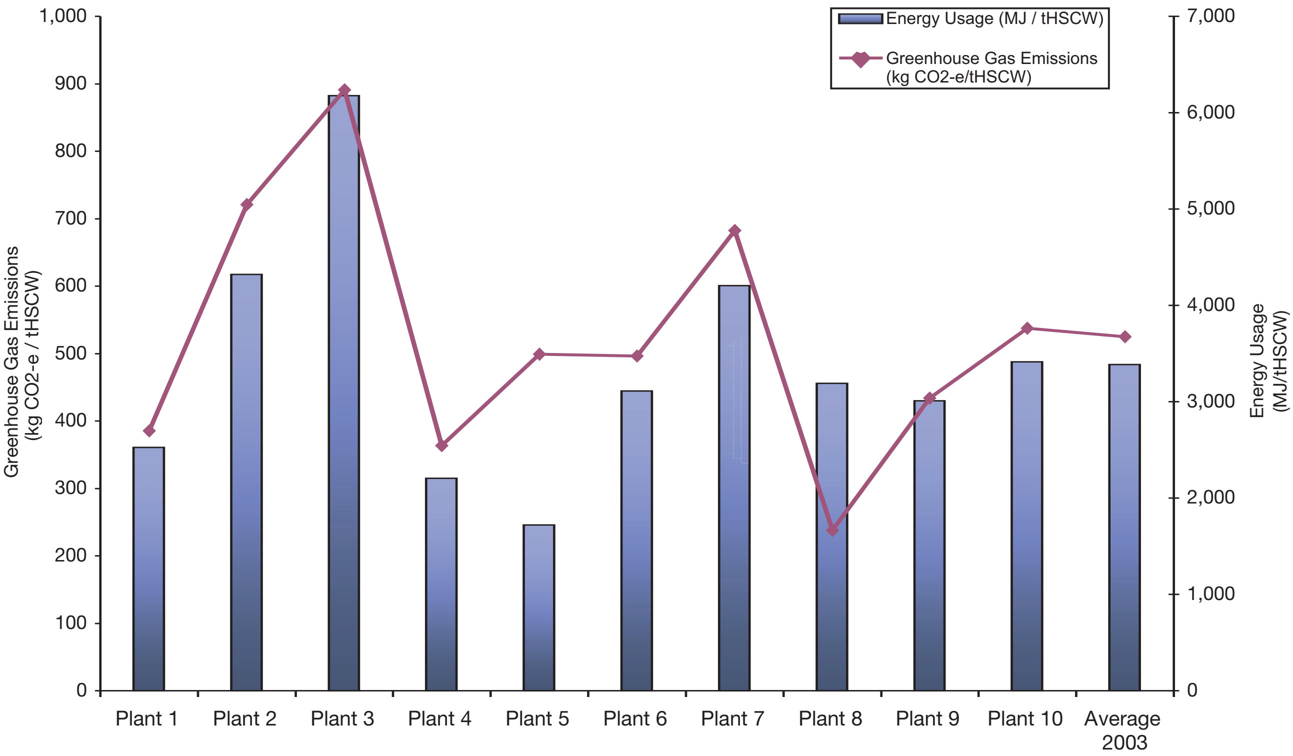

Like in **Graph 1**, the range of values in **Graph 2** are broad. The range of values is from 92 (Plant 4) to 979 MJ/head (Plant 10).

## Graph 3: Greenhouse gas vs energy usage (kgCO2-e/tHSCW)

Greenhouse gas is a new parameter for the 2003 study and was measured as kilograms of carbon dioxide equivalent (kg$CO_2$-e) per tonne of HSCW. The site greenhouse gas outputs were automatically calculated within the questionnaire and were a factor of the type and quantity of fuel usage. Greenhouse gases emitted as part of livestock handling, emissions from anaerobic ponds and the use of carbon dioxide ($CO_2$) in packaging were not included in calculations.

The relationship of greenhouse gas emissions and energy usage is not the same for all of the sites, as it is influenced by the type of fuel used. For example, a site that uses coal to power their boiler will have higher greenhouse gas emissions than a site that uses natural gas for the same energy output.

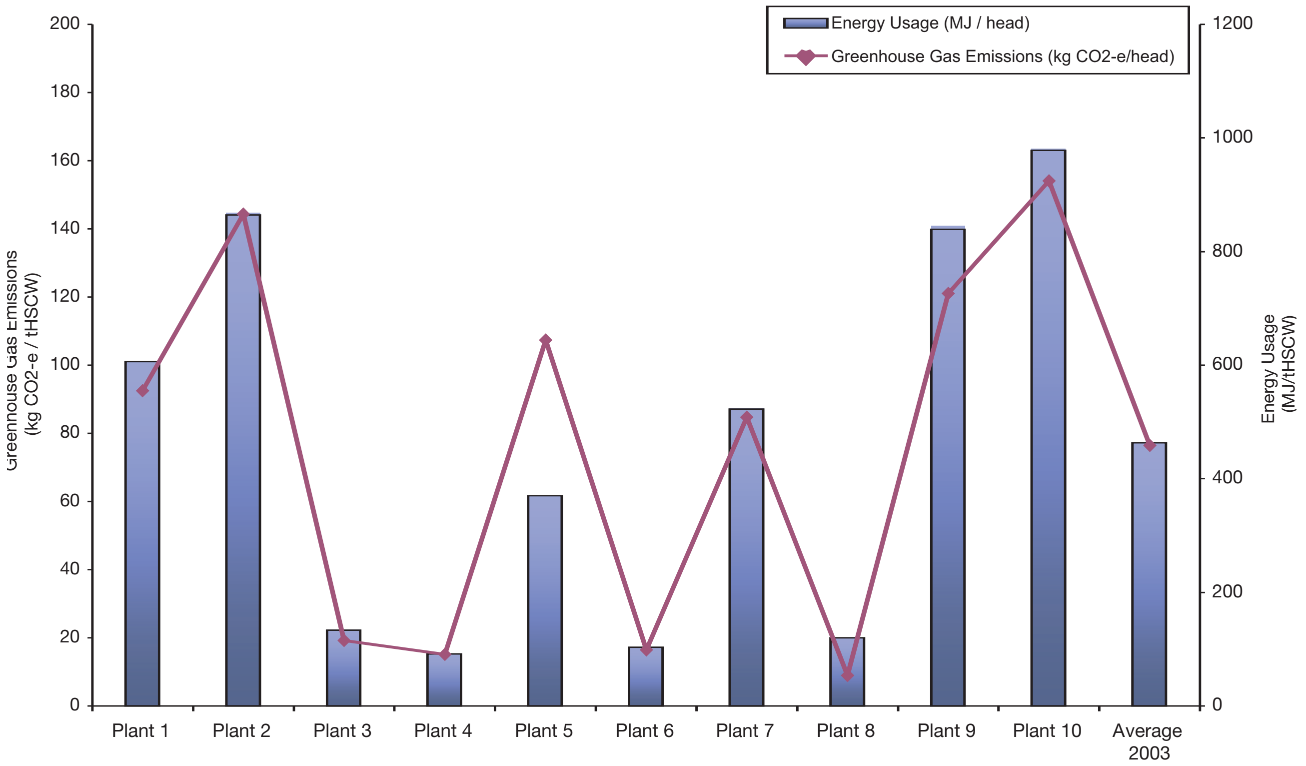
However, sites that are below the average in energy usage (**Graph 1**) are more likely to be below the average for greenhouse gas emissions per tonne of HSCW. Refer to **Appendix C** for the detail of greenhouse gas calculations.




It is possible to see in **Graph 3** that there is large variations between the sites in this KPI. The range of values is from 238 (Plant 8) to 891kg $CO_2$-e/tHSCW (Plant 3).

## Graph 4: Greenhouse gas vs energy usage (kg$CO_2$-e/per head)

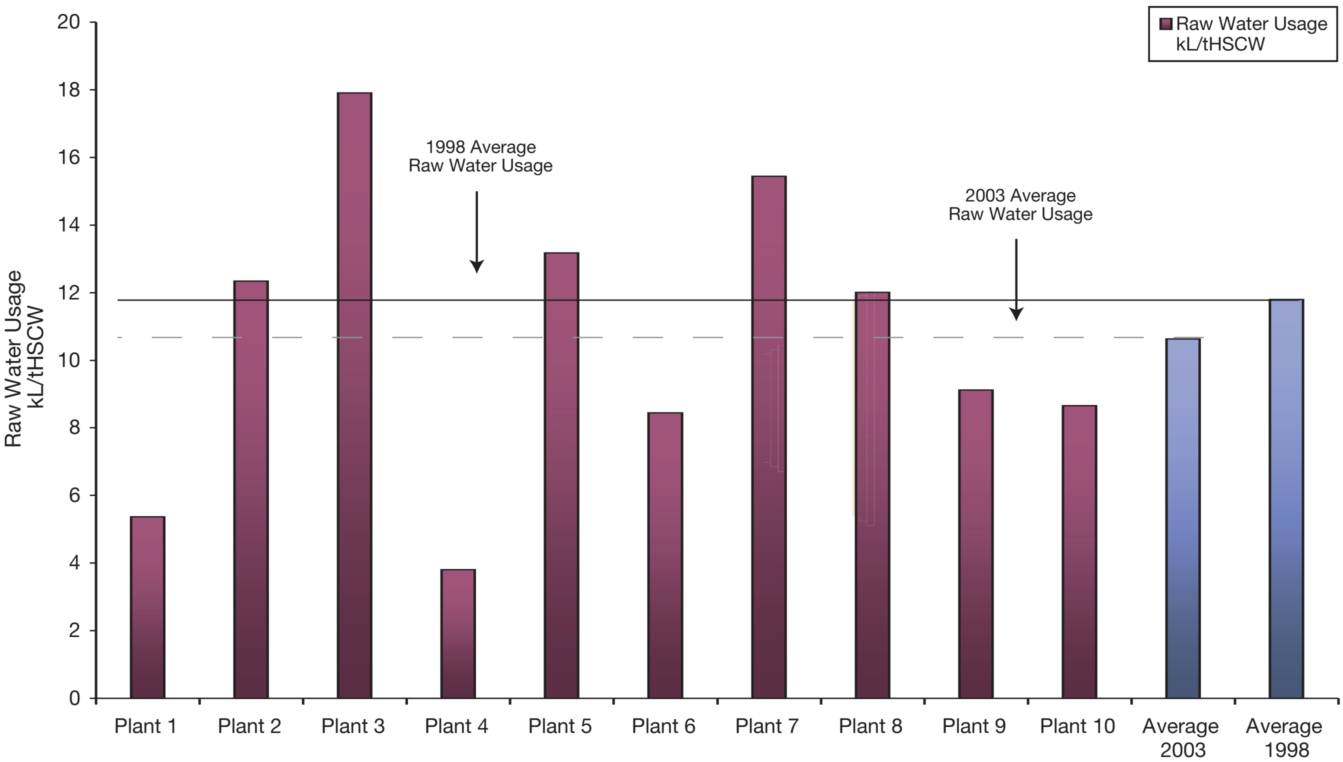
The second greenhouse gas graph presents the site results as kilograms of carbon dioxide equivalent per head. The differences as seen in Graph 2 (Energy usage – MJ/Head) are again represented here, where sites processing small animals show a large reduction in the average greenhouse gas production on a per head basis as opposed to per tonne of HSCW. With the exception of Plant 5, the sites that are above average for energy usage (per head) are also above for greenhouse gas production. Plant 5 while being below average for energy consumption is above average for greenhouse production possibly due to the type of fuel used on site.




The range of values for this KPI are from 8.9 (Plant 8) to 154kg $CO_2$-e/head (Plant 10).

## Graph 5: Raw water usage (kL/tHSCW)

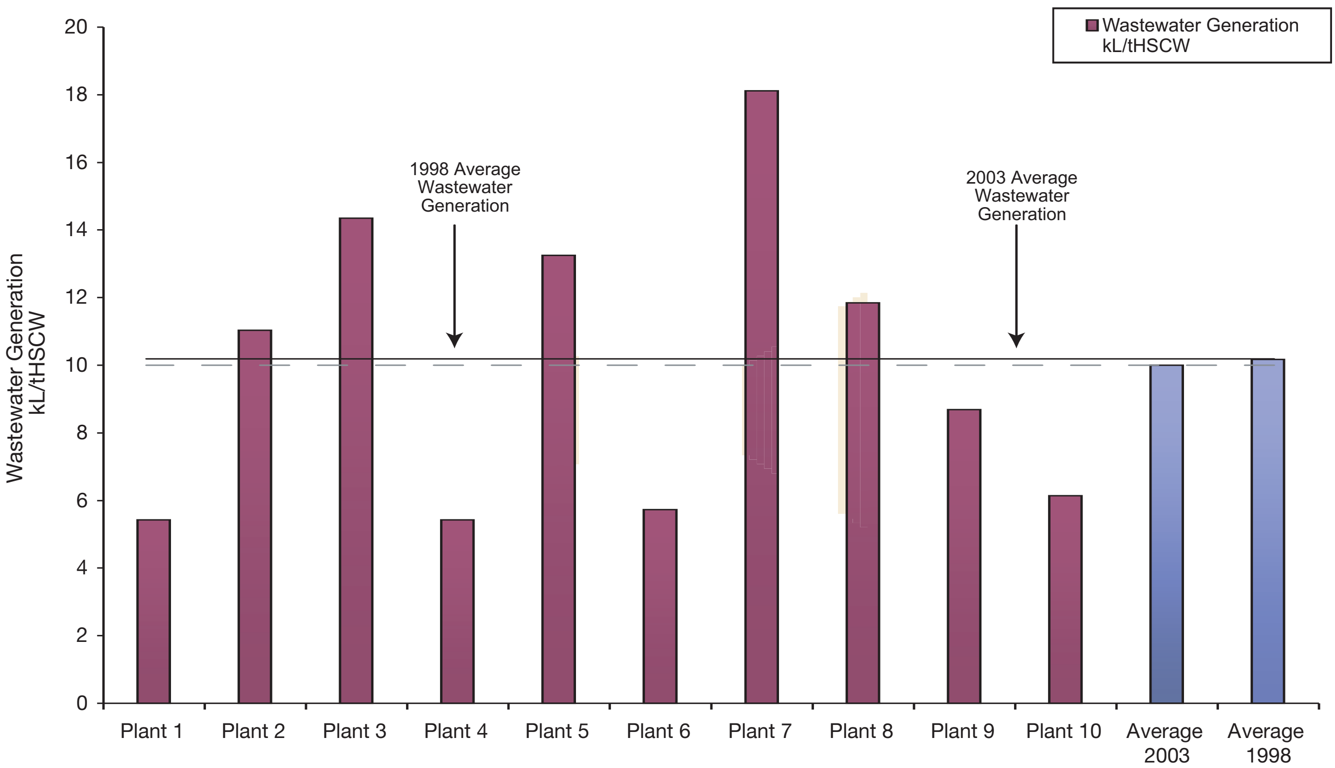
Site raw water consumption including water from town supply, bores, dams or watercourses are included in Graph 5. As it can be seen, the average kilolitres per tonne of HSCW has decreased by approximately 11% since the 1998 study. This increased water efficiency is most probably due to water saving innovations such as motion sensors and employee education. Driving mechanisms for this change would have included the onset of drought conditions across the majority of the country resulting in a decrease in water availability and increases in costs. The ability of plants to defer significant capital expenditure when their existing wastewater treatment plant is near its limit by reducing water consumption per unit throughput is a site water saving mechanism. As well as the increased costs of disposing of the wastewater also being a factor in reducing the quantity of raw water used on sites.




It is possible to see in **Graph 5** that there are large variations between the sites in this KPI. The range of values is from 3.8 (Plant 4) to 17.9 kL/tHSCW (Plant 3). This range of results indicates that while some plants were performing very well there is room for improvement at others.

## Graph 6: Wastewater generation (kL/tHSCW)

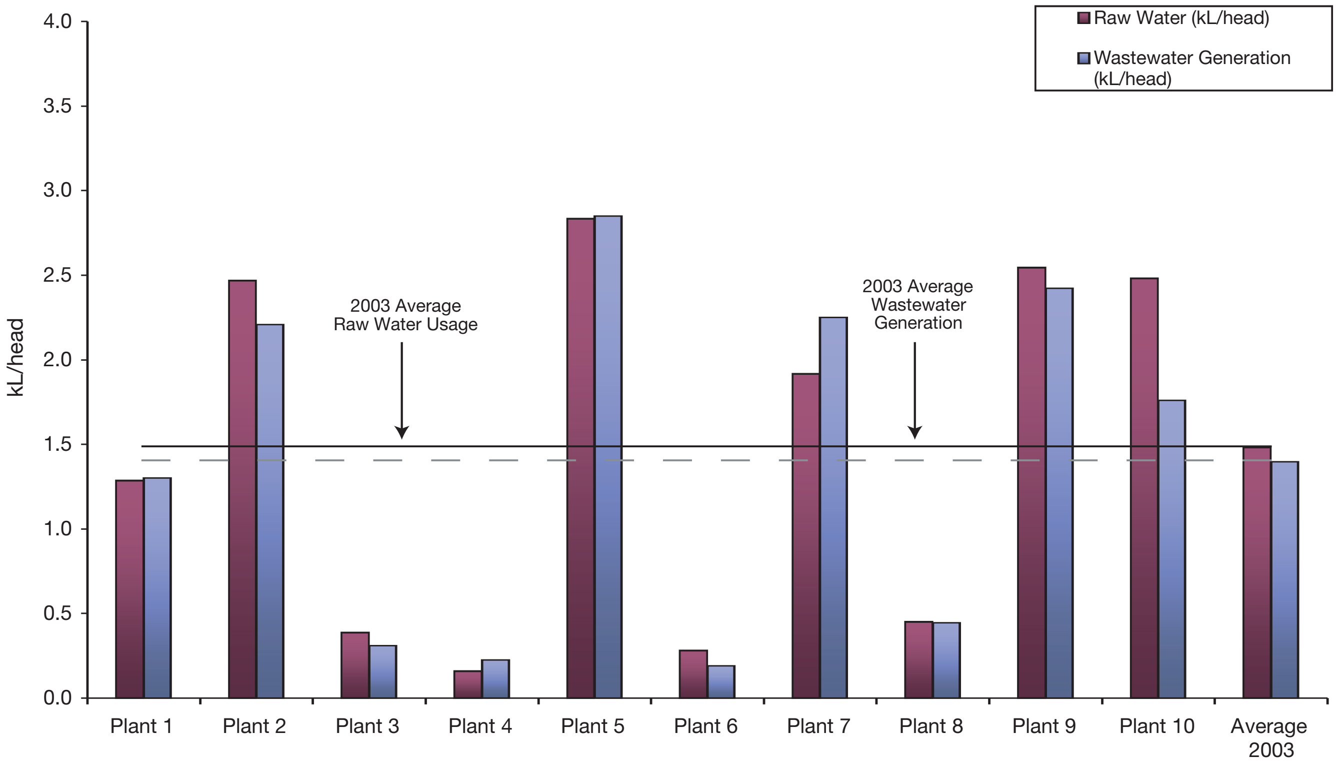
Average site wastewater generation has remained relatively steady across the industry since the 1998 study. This result would be influenced by the accuracy of metering wastewater volumes on the sites. On many of the sites the data on wastewater quantities is incomplete and has a reasonable percentage error. This error is increased by the inclusion of stormwater flows and paunch material into some wastewater systems. Also, not included in the wastewater balance is the evaporation which occurs on sites with large surface area treatment ponds. Factors that contribute to the increased volume of wastewater generated on sites include the use of blow bowls, inefficient sterilizers, no water recycling and wet washing of the plant production areas.




It is possible to see that like **Graph 5** (raw water usage), there are large variations between the sites in this KPI (**Graph 6**). The range of values is from 5.4 (Plants 1 and 4) to 18 kL/tHSCW (Plant 7). This range indicates that while some plants were performing very well there is room for improvement at others.

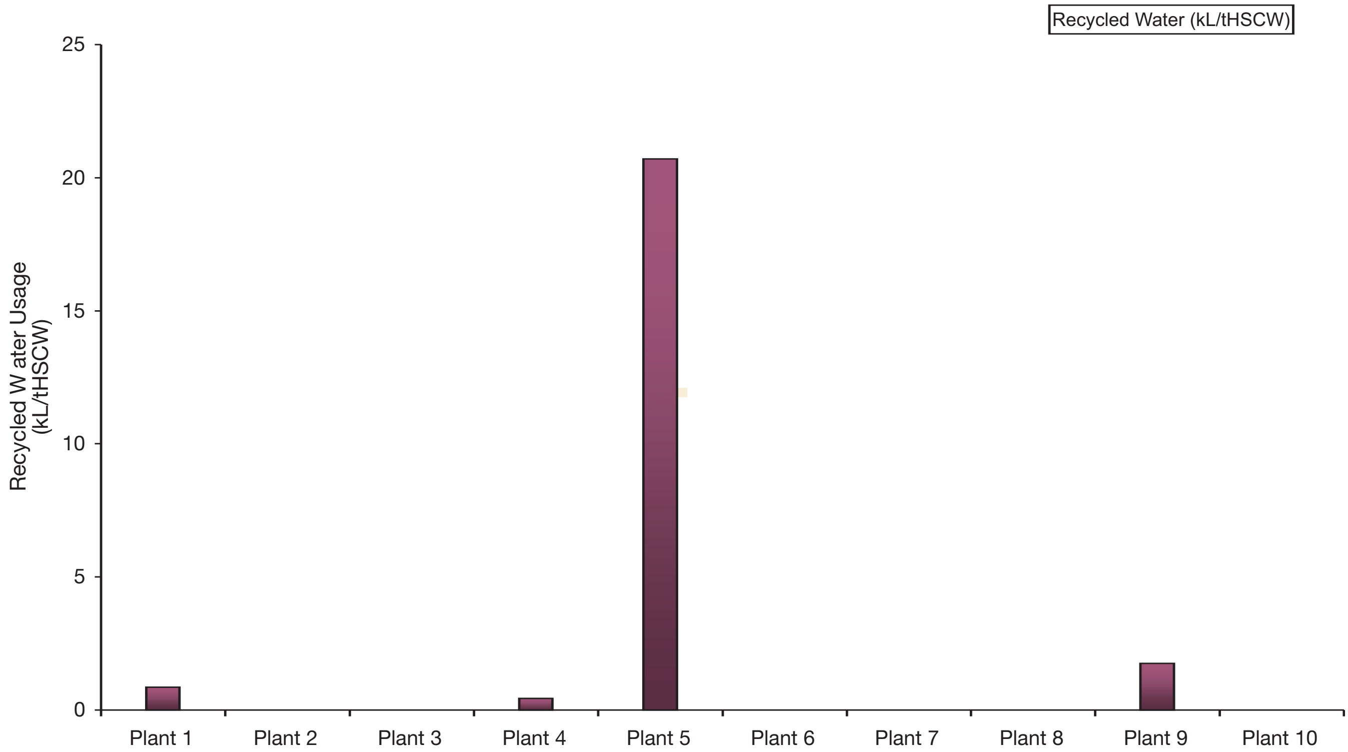
### Graph 7: Raw water vs wastewater (kL/per head)

The graph below shows the relationship between raw water (input) and the wastewater (output) at the ten study sites. As it can be seen, some of the sites are relatively similar in the quantities that enter the site as raw water and leave as wastewater. Others sites have discrepancies with either more raw water used than wastewater generated or more wastewater being generated than raw water being consumed. Reasons for these anomalies are site specific but may include: poor metering of water flows; stormwater entering the wastewater system; paunch material in the wastewater system; recycling of wastewater; evaporation of wastewater and liquid generated from the carcase while being processed and frozen.



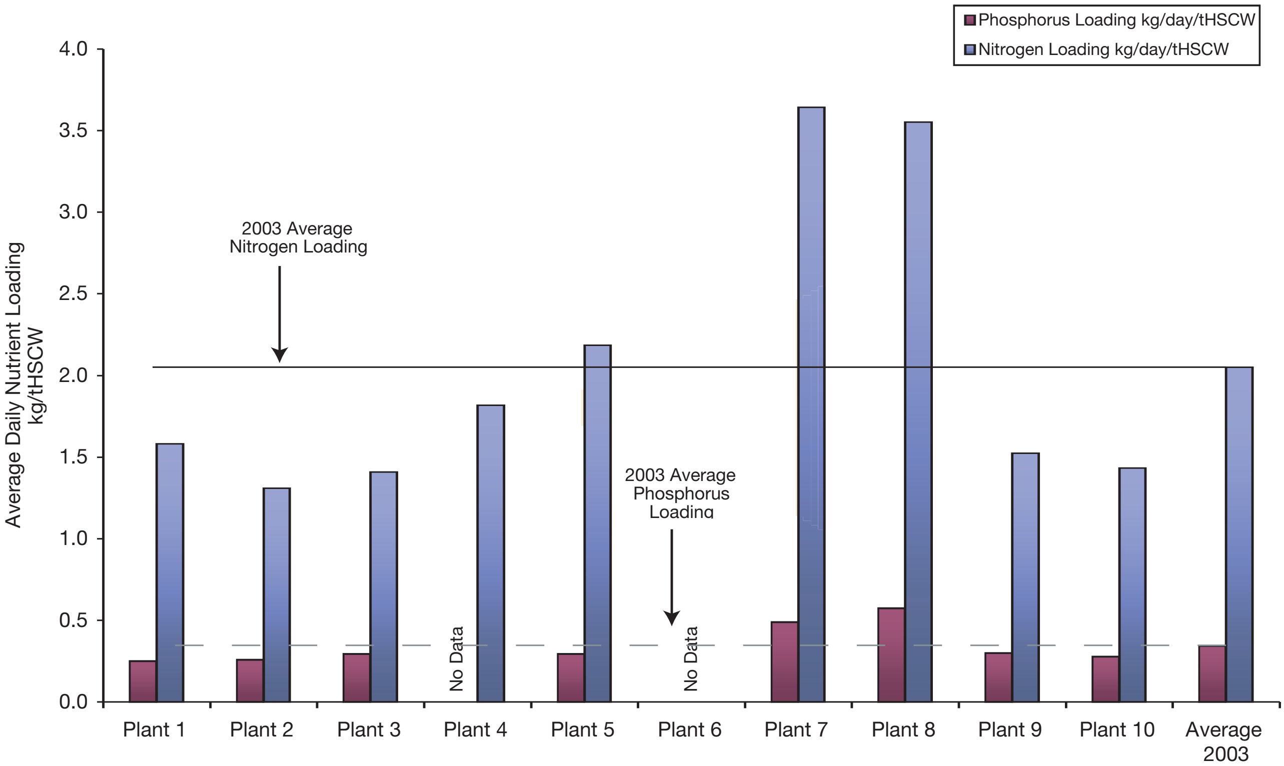
### Graph 8: Recycled water use (kL/tHSCW)

This graph shows that only four of the ten sites recycle water as part of their production cycle. The main restriction to recycling of water in the plants visited was the AQIS requirements imposed on them for export products. You will note that one of the plants appears to recycle more water than they use raw water. The most probable explanation for this is the use on site of a closed loop water recycling unit where a unit of water is counted more than once as it circulates through the system.



## Graph 9: Site wastewater nutrient loads

As many of the plants at the time of the current site visits did not collect data on their raw wastewater nutrient loads, some extrapolation from their available end-of-pipe data was carried out. The data was sourced (where available) from the plant discharge point (normally irrigation) and, where their treatment process was unlikely to affect nutrient concentrations, adopted as their site wastewater nutrient loads. Graph 9 shows the available data on nitrogen and phosphorous loading at the sites. Whereas there is a reasonable range with the nitrogen loadings the phosphorous concentrations are more closely grouped. The average nutrient loadings give a good basis for industry standards.

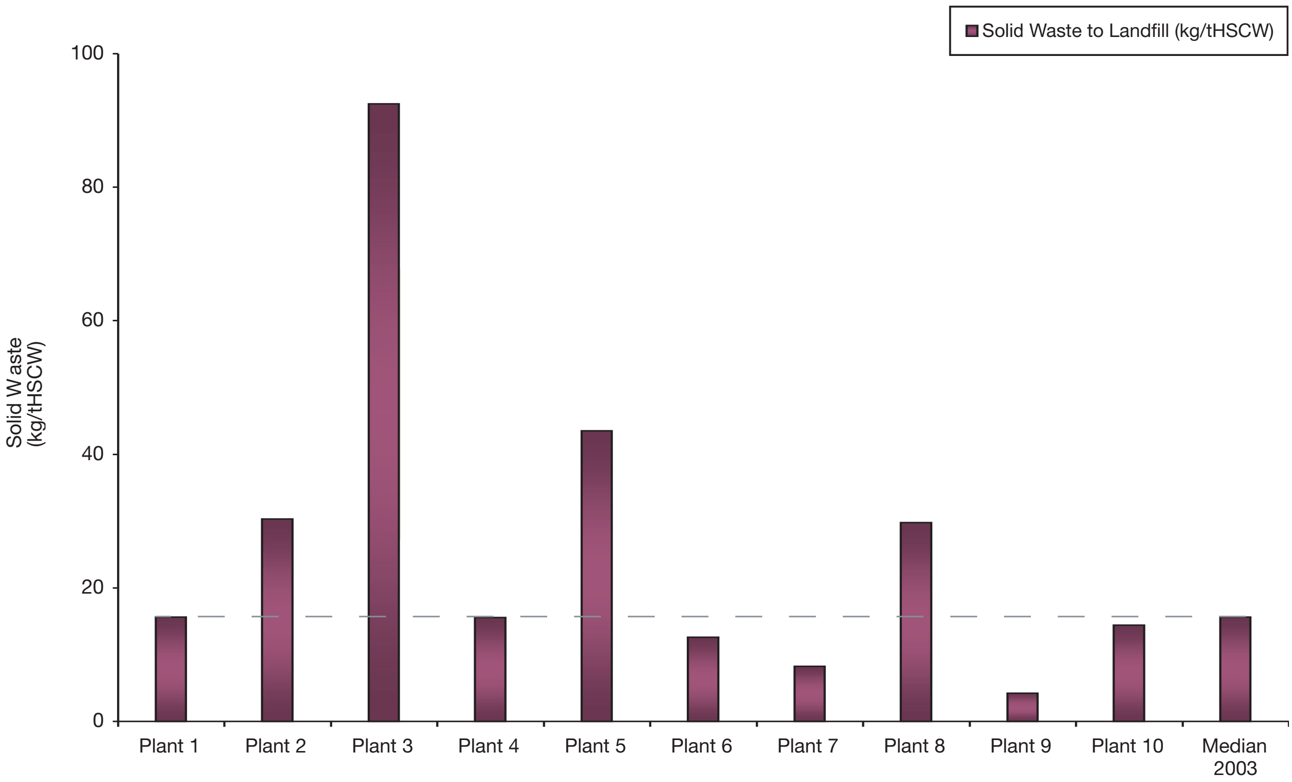



It is possible to see in **Graph 9** that there are large variations between the sites for the nitrogen and phosphorous KPIs. The range of values for nitrogen is from 0.25 (Plant 1) to 0.57kg/tHSCW (Plant 8) and the range of values for phosphorous is from 1.3 (Plant 2) to 3.6kg/tHSCW (Plants 7 and 8). This range of results indicates that while some plants were performing very well there is room for improvement at others.

### Graph 10: Solid waste to landfill (kg/tHSCW)

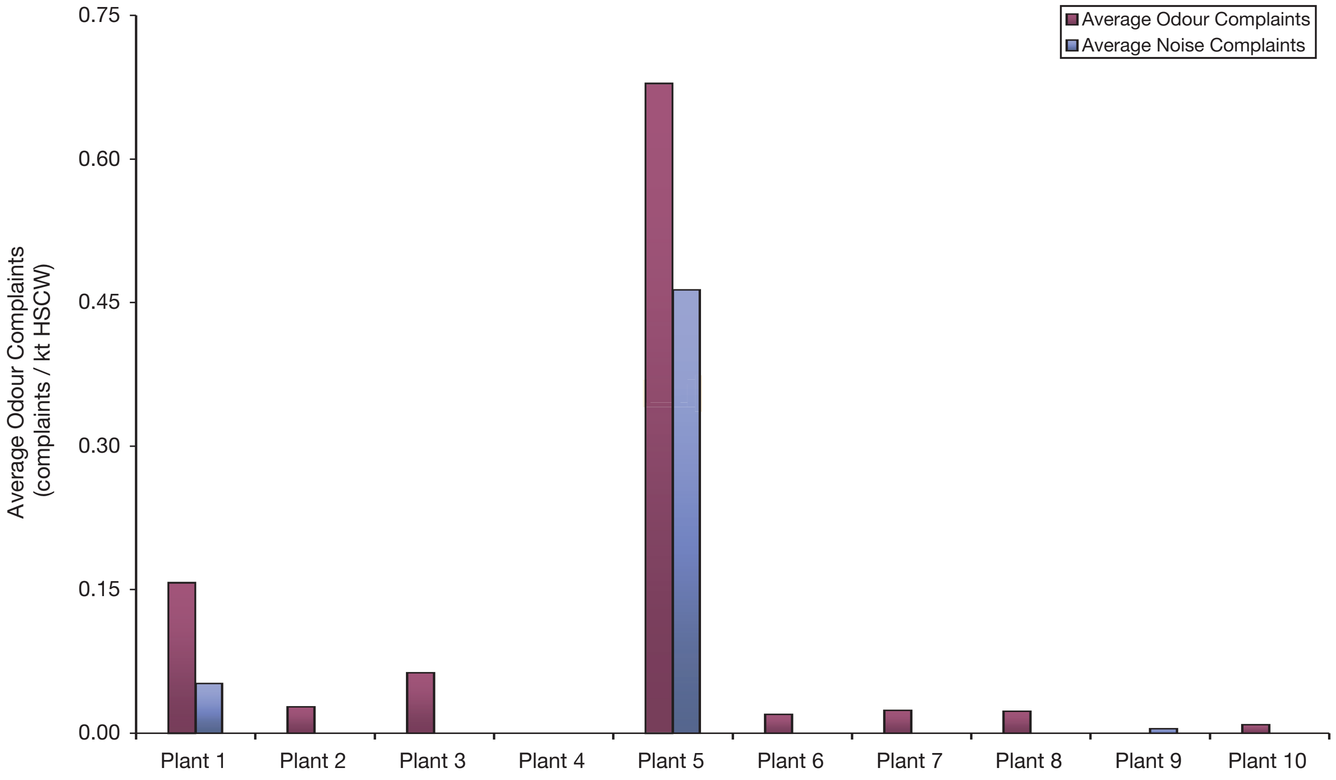
Solid waste was split into two sections in the site questionnaire: organic (including animal parts, cardboard, pond sludge and crust, paunch solids and manure); and non-organic (including coal ash, plastic, rubber, metal and general waste). Waste that was not sent to a landfill (ie recycled or composted) was not included in the calculations.

Many of the sites do not maintain accurate records of the amount of waste sent to landfill. To estimate the waste volumes at these sites the number of bins removed off-site per week was multiplied by the volume of the bins and by a generic density. (Refer to the calculations section in **Appendix C**). Due to the bins not always being 100% full when emptied, there is a high probability that the waste tonnages are over estimated.



## Graph 11: Site noise and odour complaints

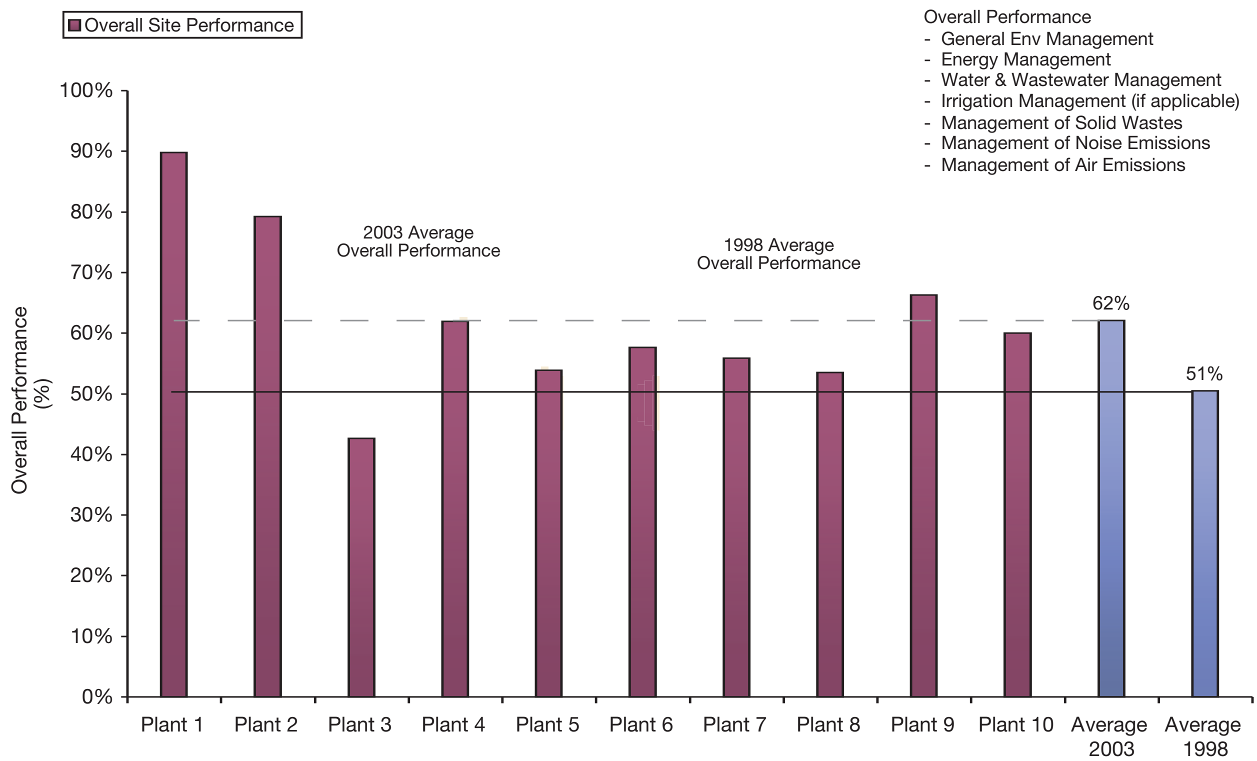
As mentioned in Section 1.4 there are factors such as plant locations and distance to the nearest sensitive receptor (residences, hospitals, schools etc) which influence the number of complaints received. Graph 11 shows the number of noise and odour complaints per site on the basis of complaints per kiloton of HSCW averaged over the last three years. The graph shows that only three of the sites have had noise complaints over this period. All but one of the sites have received at least one odour complaint in that time. This suggests that encroachment of buffer distances between the industry and neighbours remains an ongoing concern and/or there are changing community expectations.




**Graph 11** shows that there are large variations between the sites for the odour and noise complaints. The range of values for odour complaints is from 0 to 0.68 complaints/ktHSCW (Plant 5) and the range of values for noise complaints is from 0 to 0.46 complaints/ktHSCW (Plant 5).

### Graph 12: Overall site performance

This overall performance graph was designed reflect each site's evaluation of their environmental management practices. The components included in the ranking are outlined in **Section 1.1**. Each of the components is given an equal weighting in the final performance outcome. Within each component there are a number of questions which the site's had to score itself between zero and four. These scores are then averaged to give a percentage score for that section (Form 9 in **Appendix B**). The graph below shows that there has been a marked improvement in the environmental management performance across the industry since the 1998 study. There is only one site in the current study which is below the 1998 average. Reasons for this improvement include the use of environmental management systems, greater environmental awareness of both management and employees, improved irrigation management and control of noise and air emissions. This good result is encouraging as it points to the industry actively working to improve its environmental standards.




It should be noted that in contrast to the 1998 study, the higher the percentage score illustrated in the graph above, the more superior the overall site performance.

## 1.6 1998 study versus 2003 study

A weakness of the current study is that a different set of processing facilities were used in the performance review compared to 1998. There are a number of reasons for this, including plant closure and unavailability of some plants. Nevertheless, the current sites are considered representative of the industry in 2003.

The following graphs show the relationships between the four sites that were included in both the 1998 and 2003 studies. As previously mentioned, some of these four sites have changed dramatically in the five years between the two studies, changing their product lines, the animals processed and the number of head killed. A comparison of the plant averages of some KPIs between 1998 and FY 2003 are presented in **Table 2**.

*Table 2 Plant averages comparison 1998 v FY2003*

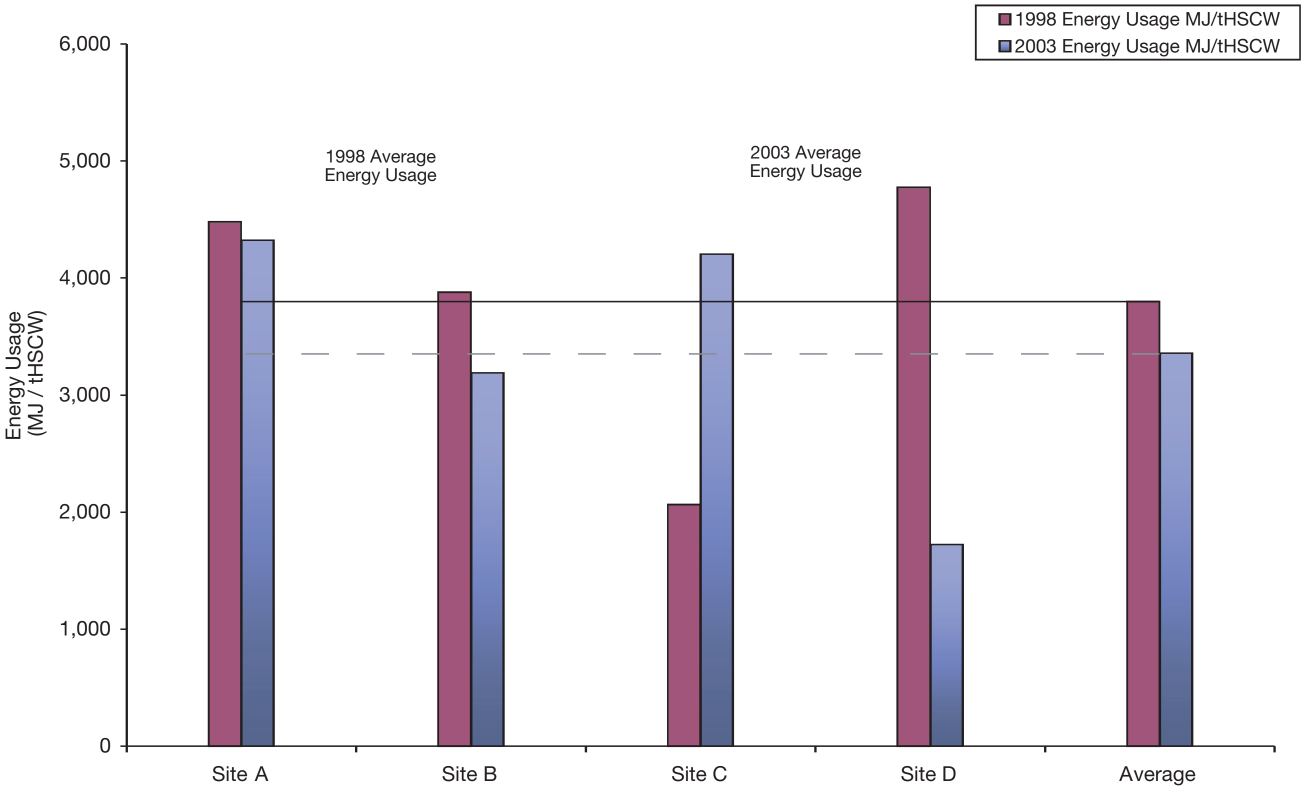
| KPI | Score 1998 | Score FY2003 | Units |
|---|---|---|---|
| **Energy** | | | |
| Energy usage | 3799 | 3360 | MJ/tHSCW |
| **Water** | | | |
| Raw water usage | 14.2 | 13.2 | kL/tHSCW |
| Wastewater generation | 10.8 | 13.6 | kL/tHSCW |
| **Solid waste** | | | |
| Solid waste to landfill | 10.1 | 28 | kg/tHSCW |
| **Overall site performance** | 56 | 63 | % |

Notes:

tHSCW – tonnes hot standard carcase weight
kLHSCW – kilolitres hot standard carcase weight
MJ – mega joule

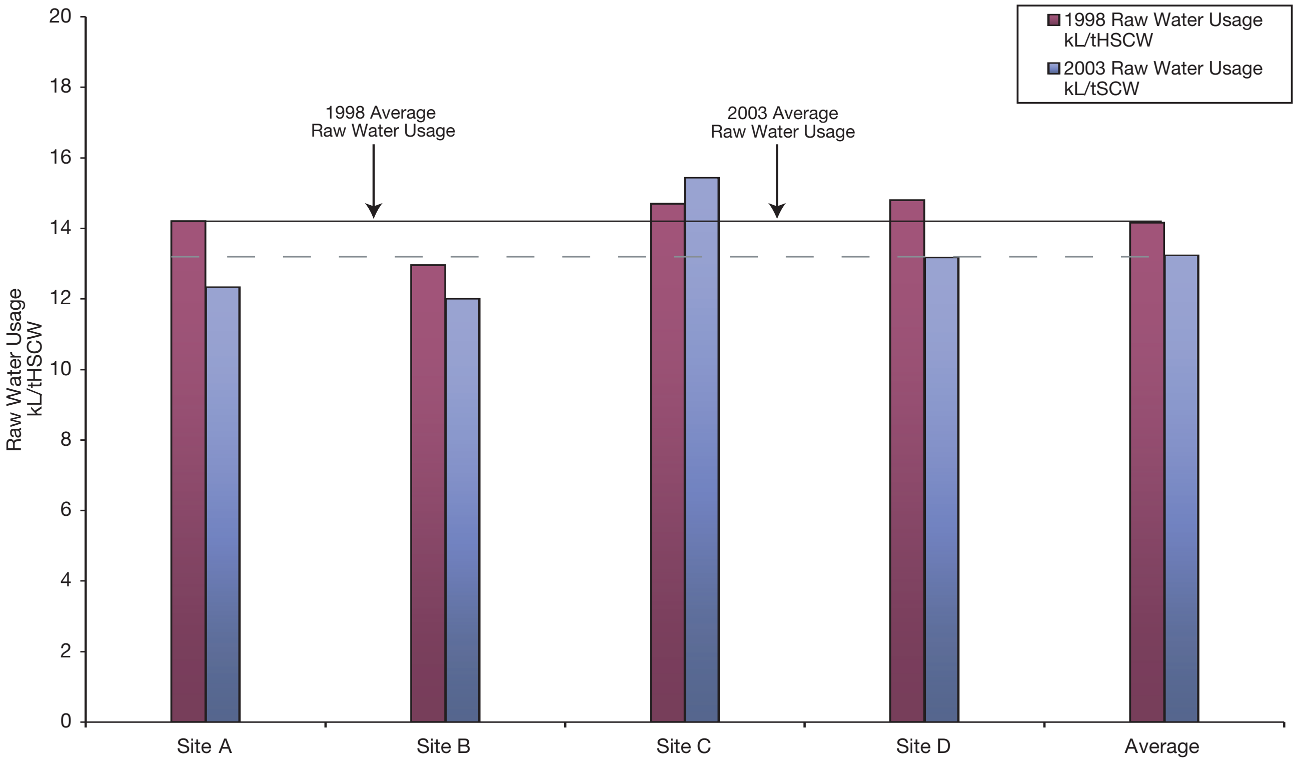
### Graph 13: Energy usage study comparison (MJ/tHSCW)

This graph shows that all but one of the sites has reduced its energy usage per tonne of HSCW since the 1998 study. The average energy use across the four sites has come down by 11% in those five years. This reduction is greater than the industry-wide comparison as presented in **Graph 1**.



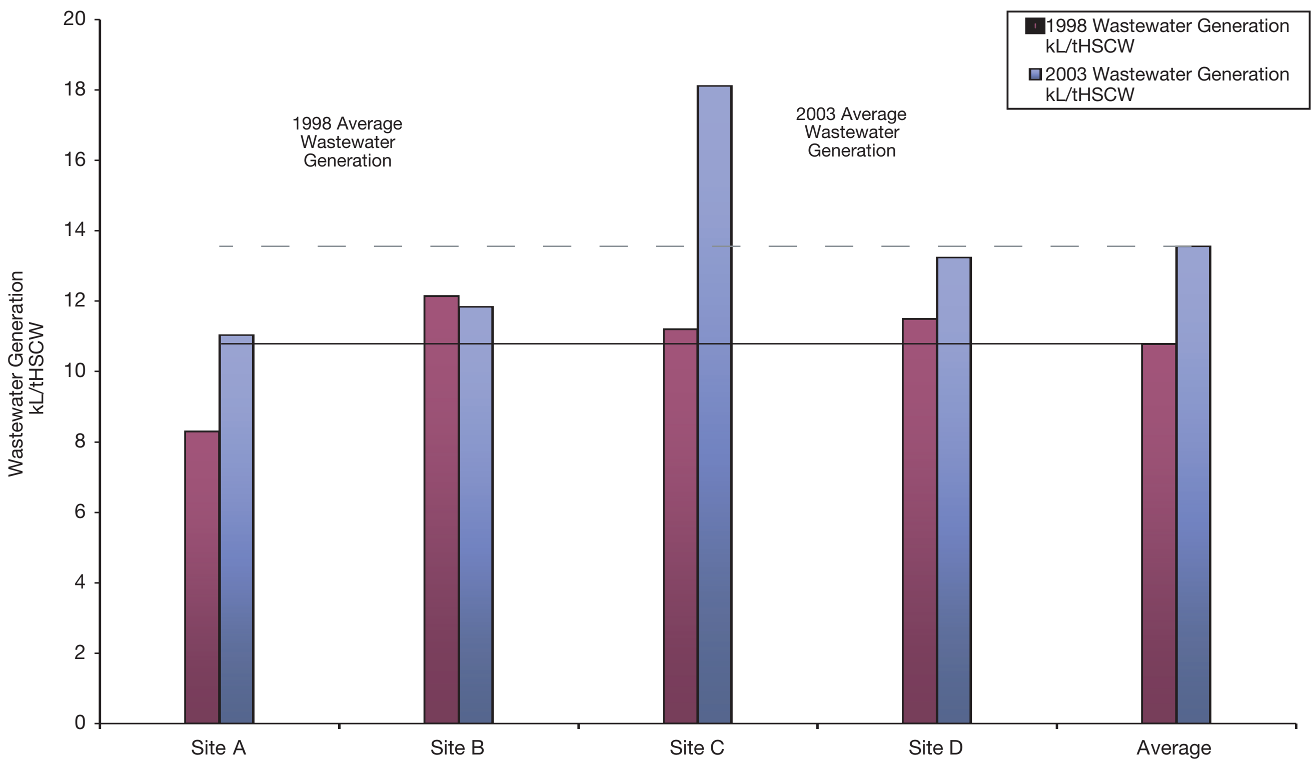
### Graph 14: Raw water usage study comparison (kL/tHSCW)

This graph shows that all but one of the sites have reduced their raw water usage per tonne of HSCW since the 1998 study. The average raw water use across the four sites has come down by 7% in those five years. This reduction is greater than the industry-wide comparison as presented in **Graph 5**.



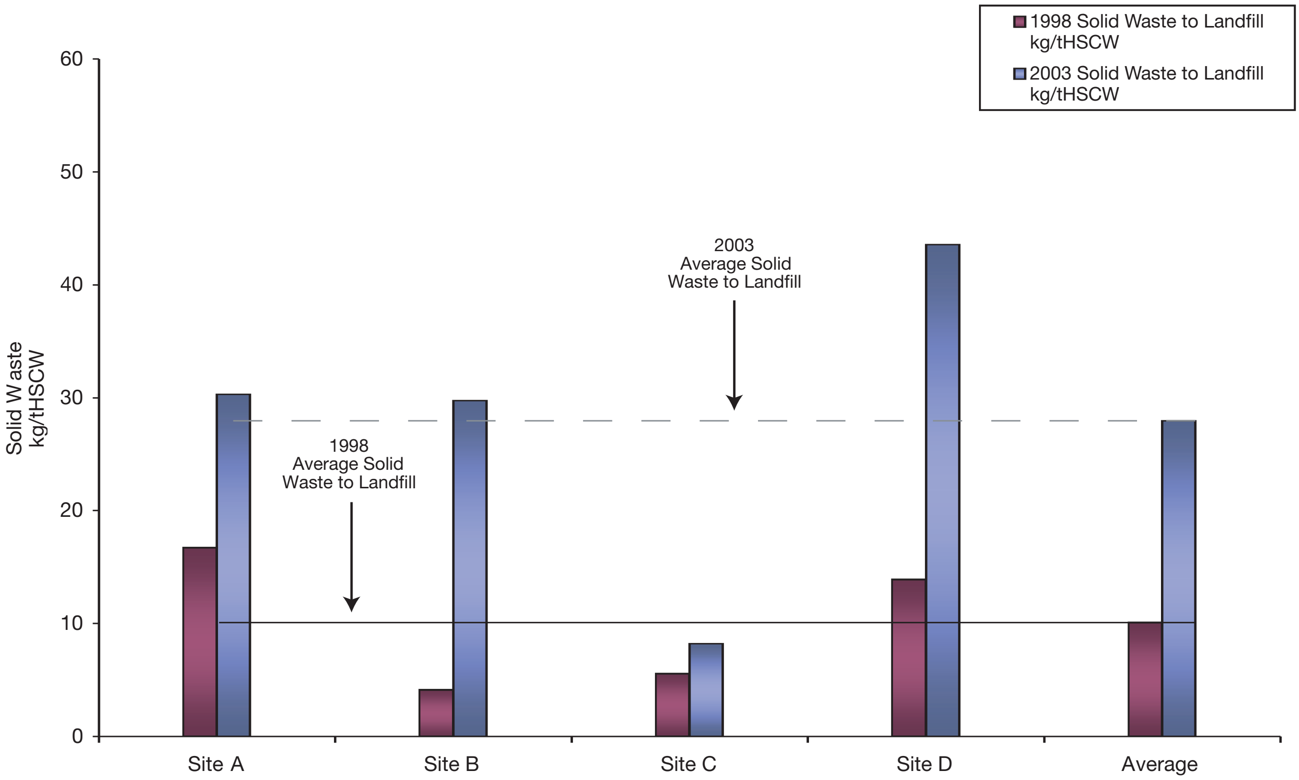
## Graph 15: Wastewater generation study comparison (kL/tHSCW)

This graph shows that all but one of the sites have increased their wastewater generation per tonne of HSCW since the 1998 study. The average wastewater generation across the four sites has risen by 26% in those 5 years. This increase is greater than the industry-wide comparison as presented in **Graph 6**. The possible reasons for this increase (like the explanation given below in **Graph 6**) include the increase in paunch material entering the wastewater systems, increased stormwater entering the system and more realistic and accurate numbers being generated by plants having more wastewater flow gauges on site.



### Graph 16: Solid waste to landfill study comparison (kg/tHSCW)

This graph shows that all four of the sites have increased their solid waste to landfill generation per tonne of HSCW since the 1998 study. The average solid waste to landfill generation across the four sites has risen by 295% in those five years. This increase is greater than the industry-wide comparison as presented in **Graph 9**. The possible reasons for this increase (like the explanation given below in Graph 9) include the inaccuracy of the data available from the sites in both the 1998 and 2003 studies. A more accurate site-by-site survey of solid waste generation would be required to give more meaningful results.



## Conclusions

The general industry trends over the last five years include:

- Energy usage per tonne of HSCW has remained relatively steady
- Raw water usage per tonne of HSCW has dropped by approximately 11%
- Waste water generation per tonne of HSCW has remained relatively steady
- Overall environmental management performance has improved by approximately 11%

It is not possible to draw accurate conclusions on the level of industry improvement relating to the remaining KPIs due to inaccuracies in the original data or lack of data for the current study. On the whole the data gathered as part of the current study (FY2003) will create a good base for future comparisons.

This study has highlighted that all sites are different in the way that they operate and work towards the goal of red meat production with minimal environmental impact. The mechanisms for achieving this level of environmental protection are determined by three main "drivers". These drivers are pressure from the regulator(s), expectations of customers and proactive company management. The regulator, be it the state Environmental Protection Authority or Agency (EPA) or the local water board (for those releasing waste to the sewer), forces a site to meet certain environmental standards. These standards sometimes vary greatly between sites and between states. For example, one site may have only a volume restriction on what it can discharge to the sewer whereas a similar site in a different state may have to also treat their waste before it is accepted by the water authority to a set of concentration criteria.

The second driver is the customer. All of the sites in the 2003 survey supply the export market. The particular market a business supplies its product to will have a bearing on whether it can use recycled water or not in its production process. For instance, at the time of compiling this report, sites that supplied product to the European Union (EU) were not allowed to use recycled water in the production process.

The final driver on a site's environmental management is the senior management strategy or approach. Senior management has significant influence over site environmental performance and should be encouraged to implement environmental programs that are both environmentally and economically acceptable.

The feedback from all of the sites was positive in terms of the usefulness of the electronic questionnaire and the data produced. Many sites were enthused with the idea of using the questionnaire as an internal reporting tool and as a support for tracking their environmental performance.

## Implications for industry

The findings from this study indicate that the red meat industry in Australia has made good progress in reducing its overall raw water usage. It has, however, appeared to make limited progress in reducing the amount of energy used in the production process. In time, it can be expected that more emphasis is going to be placed by government and regulatory authorities on energy usage and greenhouse gas emissions. As a result, to remain competitive and reduce greenhouse emissions, sites should consider (where appropriate) the use of co-generation and more environmentally friendly fuel sources.

## Recommendations

The following are recommendations relating to this industry study.

- MLA member companies should consider adopting the questionnaire for internal reporting purposes. This would enable periodic trends to be monitored for the respective sites.
- For any future environmental KPI study the quantity of solid waste (including packaging waste) disposed to landfill per site should be more accurately determined.
- Prior to any future environmental KPI study, water quality data (nitrogen, phosphorus and BOD), in addition to flow rates, should be gathered for all participating sites from a point after the primary screens but prior to any further treatment system. This one-off monitoring should become part of the project to ensure higher quality outcomes.
- Prior to any future environmental KPI study, sodium load data should be gathered for all participating sites from a point prior to irrigation to land.
- For any future environmental KPI study, consideration should be given to the divulging of general subject site information such as boiler fuel, pond type, type of freezing, whether rendering occurs etc, to enable sites to determine how the peak performing sites are achieving their environmental standards.
- To provide meaningful results on improvement trends from future studies the same pool of participating sites should be used in the study.

## Abbreviations

| | |
|---|---|
| AQIS | Australian Quarantine and Inspection Service |
| BOD | Biochemical oxygen demand |
| COD | Chemical oxygen demand |
| EMP | Environmental management plan |
| EMS | Environmental management system |
| HSCW | Hot standard carcase weight |
| ISO | International Organisation of Standardisation |
| LTR | Low temperature rendering |
| LWK | Live weight killed |
| SAR | Sodium absorption ratio |
| SOP | Standard operating procedure |
| WI | Work instruction |
| WWTP | Waste water treatment plant |

# Glossary

**Composite sample**
Sample taken over a period of time or combination of locations.

**$CO_2$-equivalent**
A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as 'million metric tonnes of carbon dioxide equivalents (MMTCDE)'. The carbon dioxide equivalent for a gas is derived by multiplying the tonnes of the gas by the associated GWP. MMTCDE = (million metric tonnes of a gas) * (GWP of the gas). For example, the GWP for methane is 21 and for nitrous oxide 310. This means that emissions of 1 million metric tonnes of methane and nitrous oxide respectively is equivalent to emissions of 21 and 310 million metric tonnes of carbon dioxide.

**Grab sample**
Sample taken at a specific time or location.

**Hot standard carcase weight (HSCW)**
animal (head+feet+hide+blood+viscera)

**Raw water**
Water originating from either the mains water, river, dam etc. Not recycled or treated.

**Recycled water**
Water which as been treated or previously used on site and is being reused in the process.

**Wastewater**
Water used in the process that is disposed of to the sites discharge point (eg sewer, irrigation, river etc).

# Appendix A

## Literature review

Recently available Australian and international literature from 1998 onwards, deemed appropriate to the benchmarking criteria, was reviewed and used to build on the criteria developed in the 1998 MLA Benchmarking Report. Sources of information included the internet and library holdings.

The literature review found that there is little additional information available on benchmarking within the red meat industry in Australia and overseas. Below is a summary of the available information.

The following documents and information sources were reviewed:

- UNEP and Danish Environmental Protection Agency (2002) *Cleaner Production Assessment in Meat Processing*

This document is one of a series produced by the United Nations Environmental Programme (UNEP) and the Danish EPA on cleaner production. The authors address the full life cycle from the livestock arriving at the abattoir to the consumption of the product and disposal of the packaging by the consumer. In the process of investigating cleaner production within an abattoir, the document clearly outlines the processes involved and the various inputs as well as the waste and product outputs. The report identifies the key environmental issues associated with abattoir operations as the high consumption of water, the generation of high strength effluent streams, the consumption of energy and the generation of by-products. It also identifies that for some sites noise and odour may also be of concern.

This report generally uses as its benchmark value 'per tonne of live carcase weight' which is not standard to the adopted hot standard carcase weight (HSCW) used in this study. It occasionally uses HSCW, such as with typical ranges of energy consumption which it rates as between 1200–4800MJ per tonne of HSCW. It should be noted that one of the main reference documents for this publication was the 1998 MLA benchmarking study. As a result many of the findings as a unit of HSCW are from this report.

In one table the report outlines the average concentrations of pollutants in abattoir effluent; it does not indicate where in the process these readings are recorded and it would be assumed that it is after primary filtering. The parameters include BOD5, COD, suspended solids, total nitrogen, total phosphorous, oil and grease and pH. These pollution loads are broken down to kg per tonne HSCW and the values are referenced from the 1998 MLA and 1995 MRC surveys. The document provides examples of Danish benchmarks relating to the level of technology used and the expected utilisation of water, energy and BOD output per animal.

- Scottish EPA, Environment and Heritage Service and Environment Agency (2003) *Guidance for the Red Meat Processing (Cattle, Sheep and Pigs) Sector*

This document is a guidance produced by the Environmental Agency for England and Wales with the Scottish Environmental Protection Agency (SEPA) and the Northern Ireland Environmental and Heritage Service (EHS). It is a system where operators within the jurisdiction of the member organisations have to present proposals which apply 'best available techniques' (BAT) to gain a permit to operate. These BATs are addressed as part of this document and include water use, effluent management and waste handling.

The document outlines the methods, BATs and standards acceptable to the regulator in relation to such things as emission controls, energy usage, noise etc. It does give per animal benchmarks for water use and heat and electricity kWh. The remaining emissions are to be benchmarked by the individual permit applicant and are not detailed in this publication.

- Australian Food and Grocery Council (2001) *Environment Report 2001*

This report is based on data gathered from a survey of 43 member companies in 2001 and references similar studies undertaken in 1993 and 1999. It does not specifically target the red meat industry but broadly gathers data for, amongst others, the meat processing sector. This report identifies packaging and water issues as the most important environmental concern for food and manufacturing companies in Australia, with greenhouse gas emerging as an increasingly significant issue.

Within this document four key performance indicators are developed for the industry. They are:

– Water consumption (measured in litres per kilo of product)

– Energy use (measured in megajoules per kilo of product)

– Waste generation (as a proportion of the product)

– Post industrial recycling rates (as a proportion of all waste generated)

- NSW EPA (2003) *Compliance Performance Report. Industry Sector: Livestock Processing Industries (Animal Slaughter and Rendering)* September 2003

As part of an industry sector compliance program the NSW EPA audited 19 livestock processing facilities across NSW between September 2001 and August 2002. As the title suggests the main aim of the study was to assess each of the sites compliance against the relevant statutory requirements and to identify other areas of concern in the industry. Based on the audits, the key areas identified as requiring improvement in compliance and environmental performance were:

– Air pollution – by improving odour controls

– Water pollution – by improving effluent management and storage of materials

– Monitoring – by improving effluent, soil, surface water and groundwater monitoring

– Accountability – by notifying the public of the company's complaints line

This document outlines where the industry has appeared to be failing to adequately manage the above issues and where good practices have been observed. The report contains an informative section on the cattle slaughter facility process and the key methods of pollution control. No benchmarks or KPIs are addressed in this report other than statutory compliance.

- UNEP (2003) The UNEP Working Group for Cleaner Production in the Food Industry, Fact Sheet 7: Food manufacturing series

This fact sheet http://www.geosp.uq.edu.au/emc/cp/Res/facts/FACT7.HTM is listed on the University of Queensland webpage and outlines the process steps involved in meat processing and suggests some applicable KPIs. The article references the 1995 MRC and 1998 MLA studies and as a result has similar KPIs to these studies. Included within this document are water consumption rates ranging from 6–15 kL/tonne HSCW with the benchmark of 8 kL/tonne HSCW adopted from the MLA 1998 survey. In terms of waste water, red meat abattoir sites with rendering generate approximately 48.5 kg COD/tonne HSCW and operations without rendering generate approximately 13 kg COD/tonne HSCW as recorded in the 1998 MLA survey. Other MLA 1998 benchmarks referenced in this document include water and energy use, wastewater generation and waste water loads.

- INEM (1999) *Cleaner Production in a Czech Slaughterhouse*

This article is a case study of cleaner production implementation in a slaughterhouse in the Czech Republic. The main focus of the study is reducing the blood content in waste water and the reduction in water consumption. The study outlines where improvements were made to the production line and the costs involved. No benchmark values or KPIs are presented in this study.

- Peter Beswick (1992), *Abattoirs – An Overview of the Current Situation*. Abattoirs, Feedlots and Tanneries R&D Priorities in Waste Management (1992) Workshop Proceedings

This workshop paper gives an overview of the status of the Australian abattoir industry in 1993. The author identifies environmental pollution in the form of air, water and noise as areas of concern and observes that community pressure and complaints are going to increase unless the industry can lift its game. The main focus of the paper is on waste water management and the most appropriate treatment methods in rural and urban settings. Estimated figures are given as to the volumes and percentages used in the various stages of production.

- Michael Johns (1992), *Current Research & Development on Abattoir Waste Management in Australia and Future Needs*. Abattoirs, Feedlots and Tanneries R&D Priorities in Waste Management (1992) Workshop Proceedings

This paper emphasises the growing importance of environmental considerations in the meat industry, just as the quality system previously had. The paper identifies liquid, solid and gaseous waste as the main forms of environmental impact and gives typical volumes of waste outputs. The paper then goes on to describe the research and development advances at that time within the liquids, gases and solid waste fields.

- US EPA (2002), Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Industry Point Source Category (40 CFR 432)

The US EPA in conjunction with the existing Clean Water Act proposes effluent limitations guidelines and standards (ELGs) for the Meat and Poultry Products (MPP) point source category. The US EPA proposes regulations for the MPP direct dischargers based on the ‘best practicable control technology currently available’ (BPT), the ‘best conventional pollutant control technology’ (BCT), the ‘best available technology economically achievable’ (BAT), and the ‘best available demonstrated control technology for new source performance standards’ (NSPS).

The study gives an overview of the process involved in the handling of red meat products. It mentions the typical process wastes produced by an abattoir; unfortunately the units used are imperial and related to live weight.

The report has a good summary of the different aquatic pollutants which could be present in a site’s wastewater and the effect that they may have on a receiving water body. It also describes the current processes employed in the treatment of process wastewater. The regulations are written for sites that directly discharge wastewater to surface waters of the US (eg lake, river, ocean).

- European Commission (2003), Integrated pollution prevention control, draft reference document on best available techniques in the slaughterhouses and animal by-products industries

This draft document details the identified best available techniques (BAT) in European slaughterhouses. There has been a trend to enlarge facilities with an increased economy of scale, however due to diseases such as BSE and foot and mouth there has been an increase in the quantity of solid waste as certain portions of the cattle previously utilised are now disposed of. Similar to other studies, the most significant environmental issues associated with slaughter houses are water consumption, emissions of high organic strength liquids to water and energy consumption.

The document provides BAT associated levels for waste water treatment. These levels are not currently being met by the majority of industry in the EU, however they are the levels which should be achievable with the implementation of BAT. Emission levels are given for COD (25$^{1}/_{n}$ 125mg/L), BOD$_5$ (10$^{1}/_{n}$ 40mg/L), suspended solids (5$^{1}/_{n}$ 60mg/L), total nitrogen (15$^{1}/_{n}$ 40mg/L) and total phosphorus (2$^{1}/_{n}$ 5mg/L). These levels are for release to a water environment.

# Appendix B

## Questionnaire

An excel spreadsheet was used for the survey data collection. The survey can be obtained from the MLA Processor Information Services Co-ordinator on 02 9463 9166 or email cis@mla.com.au

# Appendix C

## Calculations

1 Form 6 **Solid waste**

Organic/non-organic waste $\left(\frac{tonne}{yr}\right) = solid\ waste\left(\frac{m^3}{L}\right) x\ specific\ weight\left(\frac{kg}{m^3}\right) x\ \frac{1tonne}{1000kg}$

2 Form 5b **Nutrients**

Nutrient loading $\left(\frac{kg}{day}\right) = consentration\left(\frac{mg}{L}\right) x\ flow\left(\frac{kL}{d}\right)$

3 Greenhouse calculator
**Greenhouse gas emissions**

Carbon dioxide emissions $(kgCO_2-e) = \left(\frac{kgCO_2-e}{GJ}\right) x\ energy\ (MJ)\ x\left(\frac{GJ}{10^3\ MJ}\right)$

4 Form F2 **Energy**

Energy usage
(for all fuels except wood) $(MJ) = consumption\left(\frac{L}{yr}\right) x\ gross\ energy\left(\frac{MJ}{L}\right)$

Energy usage
(wood) $(MJ) = consumption\left(\frac{tonne}{yr}\right) x\ gross\ energy\left(\frac{MJ}{kg}\right) x\ \frac{10^3\ kg}{1tonne}$

## Solid waste densities:

Organic waste – specific weight: 350 kg/$m^3$

Non-organic waste – specific weight: 300 kg/$m^3$

Tchobanoglous G, Theisen H, Vigil S (1993) *Integrated Solid Waste Management*, McGraw Hill.

Energy conversion values – refer to the questionnaire ‘energy values’ sheet.

Greenhouse conversion values – refer to the questionnaire ‘greenhouse values’ sheet.

# Appendix D

## References

Australian Greenhouse Office (2003) *AGO Factors and Methods Workbook. Version 3*

*Australian Institute of Petroleum Ltd Technical Data Sheet TDS 5 (1990)*

Tchobanoglous G, Theisen H, Vigil S (1993) *Integrated Solid Waste Management*, McGraw Hill

Gutheridge, Hastings and Davey Pty Ltd (1998) *Benchmarking of Environmental Performance*, Meat & Livestock Australia

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