final report

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Prepared by: Jessica Tan
South Australian Research and Development Institute

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Meat and Livestock Australia Limited
Locked Bag 1961
NORTH SYDNEY NSW 2059

ESAM Analysis Reporting Service 2014 - 2015

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Abstract

The *Escherichia coli* and *Salmonella* monitoring program (ESAM) collects data on *E. coli* and *Salmonella* from each export slaughter establishment in Australia and is now included in the submission of the Product Hygiene Indicator data to the Department of Agriculture and Water Resources. Since 2007, SARDI Food Safety and Innovation has been providing regular monthly ESAM reports to each participating red meat establishment as well as national reports to MLA and the Department of Agriculture and Water Resources. Major changes to the ESAM Analysis Reporting Service include the inclusion of carton results and 'Big 6' STEC testing, company species-specific Group ESAM reports, a comparison of shifts report and an updated Explanatory Guide to the ESAM Reports. A feedback survey of users also highlighted the value received by industry from the ESAM reports. SARDI Food Safety and Innovation has also worked with MLA to investigate trends in the data, contributed to MLA presentations and projects and provided additional information and support to QA managers on request.

Executive Summary

The *E. coli* and *Salmonella* monitoring program – ESAM – was established in 1997 to help Australia meet market access requirements for the US. The program requires all export slaughter establishments to collect and analyse carcase samples from all slaughter species for *E. coli* and *Salmonella*. Data is then entered into a national database (formerly the National Microbiological Database, now the Product Hygiene Indicator database) where it provides useful information for benchmarking Australia's performance. These data along with industry baseline data has proven very useful in market access negotiations and ensuring consumer confidence, particularly with *E. coli* O157:H7 and now 'Big 6' *Shiga* toxin-producing *E. coli* (STEC) data.

In 2009, SARDI, through an MLA project, developed a fully functional software system for carrying out regular data analysis of ESAM data, providing regular, monthly reporting to export establishments and training materials to industry on the interpretation of the ESAM reports. The ESAM Analysis Reporting Service has continued to further develop and extend the reports over time and the aim of this project is to continue the provision of *E. coli* and *Salmonella* & *E. coli* O157:H7 and STEC monitoring reports and work with MLA to identify and investigate trends in the ESAM data.

The impact of the ESAM Analysis Reporting Service on the red meat industry is two-fold: at the individual establishment level and for the whole of industry. The whole industry has access to data to support claims for the quality of Australia's systems and their implementation. Investigation of trends can occur on a whole industry basis to ensure that Australia's quality remains at the highest standard. At the level of individual establishments, value is gained from understanding trends and comparisons with the whole industry. From the analysis of the ESAM data, opportunities are gained for learning and further research, and thus further improvements in processing and the ability to monitor process control.

As part of the project, the ESAM reports were modified and extended in response to user feedback and in conjunction with MLA. A number of changes include:

- The merging of the National Microbiological Database and the Product Hygiene Indicator database to form a single, consistent repository of the ESAM data.
- The inclusion of carton testing results in the national and individual establishment reports.
- Company species-specific Group ESAM reports for comparison of plant performance and reporting to management.
- Circulation of an updated 'Explanatory Guide to the ESAM Reports'.
- Extension of the national and individual establishment *E. coli* O157 reports to include STEC results – now titled *E. coli* O157 and STEC Monitoring Reports.

A feedback survey of recipients of the ESAM reports was conducted in December 2014 and the responses reiterated the usefulness and informative nature of the ESAM reports.

- 88.5% of responses read the ESAM reports fully.
- 89% of responses had a pretty good to very good understanding of the reports.

- 89% of responses rated the value they received from the reports as fair to a lot of value (i.e. have made changes based on the reports, use the reports to benchmark performance).

SARDI Food Safety and Innovation has also worked with MLA to investigate trends in the national ESAM levels and provided input and data summaries to a number of MLA projects and presentations, such as:

- "ESAM: Getting the most out of your micro testing program" at the 2014 National MINTRAC MI&QA conference
- "Improving micro quality – where are we going?" at the February-March 2015 MINTRAC MI&QA managers network meetings, with an emphasis on trends from the ESAM data and feedback on the ESAM reports
- Monthly TVC, *E. coli* and *Salmonella* summaries and detections by state and for Cow/Bull and Steer/Heifer were provided to Long Huynh (MLA) and Peter Horchner (Symbio Alliance) for an MLA project on *Salmonella*.

Data summaries and statistical assistance has also been provided to processors upon request.

It can be seen that over the past two years, the ESAM reporting system is continuing to provide value and to be developed according to the needs of red meat export establishments and the meat and livestock industry – it is recommended that the ESAM Analysis Reporting Service be continued.

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1 Background

1.1 History & Motivation

In the wake of the Jack-in-the-Box illnesses involving *E. coli* O157:H7 in 1993, the United States Department of Agriculture Food Safety and Inspection Service required meat establishments implement microbiological testing of meat destined for grinding. In Australia in December 1997, the then-regulator Australian Quarantine and Inspection Service (now known as the Department of Agriculture and Water Resources (DAWR)) developed a program for *E. coli* and *Salmonella* Monitoring (ESAM) of carcases, to help Australia meet market access requirements for the US. Over the past 18 years, the ESAM program has been extended to include multiple species, carton meat testing and microbiological tests for aerobic plate counts, coliforms, generic *E. coli*, *Salmonella*, *E. coli* O157:H7 and the "Big Six" *Shiga* toxin-producing *E. coli* or STECs (O26, O45, O103, O111, O121 and O145).

1.2 ESAM Data

The ESAM program requires all export slaughter establishments to collect and analyse carcase and carton samples and the data are entered into a national database which is maintained by DAWR. The national database was originally known as the National Microbiological Database (NMD), but from 2014, the ESAM data is now reported in the Product Hygiene Indicator (PHI) database. The data, along with industry baseline data, have proven very useful in market access negotiations and in benchmarking the performance of Australian slaughter establishments. The ESAM database continues to be a valuable resource in the wider scope of collection of data on meat hygiene and process control in the red meat industry.

1.3 ESAM Analysis Reporting Service

In 2009, SARDI Food Safety and Innovation began providing regular monthly ESAM reports to each participating red meat export slaughter establishment. The reports have been a valuable resource to establishments, providing access to data through statistical summaries and graphs, benchmarking the performance of individual establishments to national trends and monitoring ESAM results over time.

The breadth of the ESAM Analysis Reporting Service now includes:

- *E. coli* and *Salmonella* monitoring reports for each species slaughtered at each export establishment
- *E. coli* O157:H7 and STEC establishment reports
- Company species-specific Group ESAM reports
- Hot Swabbed Cow/Bull and Sheep reports
- Comparison between shifts report
- National ESAM and *E. coli* O157 and STEC reports.

Establishments have also been able to access additional information and statistical analysis on request through SARDI Food Safety and Innovation as part of the ESAM Analysis Reporting Service.

In addition to the monthly ESAM reports, SARDI has produced an explanatory guide for the ESAM reports, to assist Quality Assurance (QA) staff in reading, understanding and interpreting the reports. SARDI has also run feedback surveys and comments from QA managers and on-site microbiologists are indicative of the value of the ESAM reports to the establishments and how they are actively using the reports for the management and improvement of results.

2 Project Objectives

1. Continue the provision of the monthly report to establishments until December 2015.
2. Provide a monthly report to MLA and DAWR that contains national results.
3. Provide a monthly report to MLA which documents all user feedback (i.e. phone calls or emails) received over the project's duration to MLA.
4. Modify the report as required based on the outcome of previous surveys and other feedback.
5. Modify the reports to include additional information on the Big 6 STEC (O26, O45, O103, O111, O121, O145).
6. Work with MLA to develop a system for identifying trends and obtaining processor feedback that will then be used to develop case studies on processing issues.

3 Achievement of Project Objectives

3.1 Reports to establishments

ESAM reports have been sent to participating establishments monthly since June 2009. *E. coli* O157:H7 reports have been sent to establishments monthly since September 2010 and have been extended to include STECs from February 2015. The latest reports sent to establishments were those for the period ending December 2015.

Throughout the year, establishments informed SARDI of staff changes and the ESAM mailing list of contacts was constantly updated to reflect these changes.

3.2 National reports to MLA and DAWR

SARDI Food Safety and Innovation has provided monthly national ESAM reports and national *E. coli* O157:H7 and STEC reports to Ian Jenson (Manager, Market Access Science and Technology) and Long Huynh (Project Manager, Market Access, Science and Technology) at MLA and Glen Edmunds at DAWR. Due to a change in Glen Edmund's role within DAWR, the national ESAM reports will be distributed to Arefin Chowdhury, Paul Vanderlinde, Christine Coulson, Dugald MacLachlan, Mark Salter and Maged Tawadros at DAWR.

3.3 Reports to MLA documenting all feedback

User feedback has been documented in every quarterly milestone report to MLA and the questions and comments received from establishments in relation to the content of the reports are included in the Appendix under 6.1 Feedback from Establishments. In almost all cases, issues were easily resolved through explanation of the reports, correction of data entry errors and suggested improvements to the ESAM Analysis Reporting Service were implemented and rolled out to industry.

3.3.1 Feedback Survey

A feedback survey was distributed by SARDI in mid-December 2014 to users and receivers of the monthly ESAM reports, asking how they use the reports, what value they find from them and any suggested improvements for the reports. A total of 27 people out of 67 (40%) responded and provided feedback via Survey Monkey, an online survey and questionnaire tool. The questions of the feedback survey and the survey results are outlined in Appendix sections 6.2 and 6.3, respectively. From the survey responses, some changes were made to the ESAM Analysis Reporting Service, which are detailed below under 3.4 Report modifications.

3.4 Report modifications

In response to the feedback received from establishments, the ESAM reports have been amended and changed in the following ways:

3.4.1 Merging of NMD & PHI database

The amalgamation of the ESAM or NMD database into the PHI database was identified in the final report of MLA project G.MFS.0295 ESAM Analysis Reporting Service and the transitional period spanned from Nov 2013 to April 2014. Changes were made to the ESAM Analysis Reporting Service system to accommodate the different data format from DAWR. There were data issues during this time, but now a rolling three-month window of ESAM data ensures changes and additions to the data are captured. Post May 2014, no further issues have been raised by establishments.

3.4.2 Carton testing

Carton data from the ESAM database was included in the monthly ESAM reports from January 2015, through statistical summary tables and box plots of counts and prevalence for TVC, coliforms and *E. coli*. Side-by-side box plots enable the visual comparison of carcase and carton microbiological results within an establishment. Both the individual establishment reports and the national reports now report carton data and an example of an establishment report is included in Appendix 6.4.

3.4.3 Group ESAM reports

At the request of a Group QA manager, SARDI added group ESAM reports to the reporting service. Every month, SARDI distributes group ESAM reports per species for companies who own and manage multiple red meat export establishments, so that they can compare between their establishments and with national averages. Currently, Group QA managers and key staff at JBS, Teys, Thomas Foods International, Midfield and Greenhams receive group ESAM reports. The offer was made to NH Foods Australia and Fletcher International, but the absence of a group QA manager made group ESAM reports of limited use to these processors.

Further additions to the group ESAM reports include carton results, a Hot Swabbed Cow/Bull Group report and median summaries, to complement reported means and standard deviations. An exemplar of a group ESAM report is given in Appendix 6.5.

Feedback was also sought from the Group QA managers after sending the group reports for at least three months and is given in Appendix 6.1.1. The collective opinion is that they are useful to QA managers for reporting to management and for ease of comparison.

- "*we do like the group reports especially from a corporate level where we can benchmark our plants performance against the group and across the national data*"
- *"am finding these reports useful as they are a much quicker reference for comparing month to month as well as Plant X to Plant Y*"

3.4.4 Comparison between shifts report

An establishment requested a report to compare the ESAM results from day and night shifts, with the ability to monitor potential differences between shifts over time. A comparison of shifts report was generated and is being sent out with the monthly ESAM reports. Appendix 6.6 contains an example of this report.

3.4.5 Updated Explanatory Guide to the ESAM Reports

The Explanatory Guide for the *E. coli* and *Salmonella* Monitoring (ESAM) reports was first written in 2010 and assists establishment staff with interpreting the reports. Over time, changes in staff receiving the ESAM reports and amendments to the ESAM reports created the need to update and recirculate the guide. An updated guide (Appendix 6.7) was distributed via email to all participating establishments in June 2015. Responses from QA managers and staff were positive and appreciative of the explanatory guide. A copy of the guide is sent to any new contact on the ESAM mailing list.

A request for a copy of the guide was received from Jenny Kroonstuiver, MINTRAC for inclusion in the MINTRAC Training and Assessment materials for AMPCX405 *Conduct statistical analysis of process* – "this Guide will be a very useful addition to the training materials – and you will hopefully also eventually see a much better use and understanding of the ESAM data".

3.4.6 Percentage plot of confirmed positives in national *E. coli* O157 and STEC report

A percentage plot of confirmed positives has been added to the national *E. coli* O157 and STEC report (Fig. 1 – Fig. 5 in the national *E. coli* O157 and STEC report).

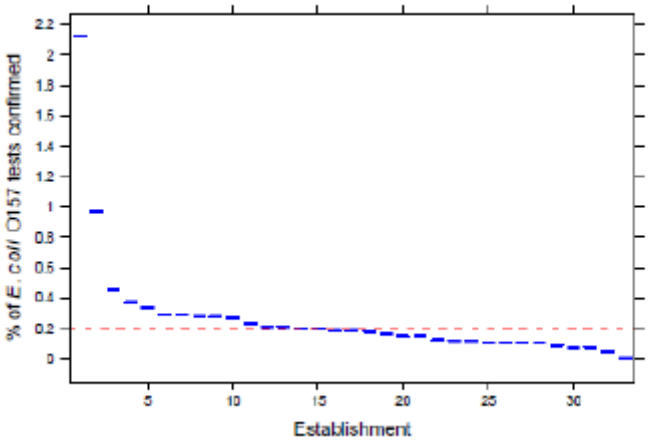


Figure 1: Percentage of confirmed positive *E. coli* O157 counts for each establishment (on-plant and DA verification tests) over the last 3 years. The red dashed line is the national average.

3.5 Modification to include the Big 6 STECs

Testing for the Big 6 STECs began in June 2012 and STEC tests and detections are entered by establishments into the PHI submission spreadsheet (Meat Notice 2013-01). With the transition of ESAM data into the PHI database by April 2014, SARDI gained access to the STEC data, in addition to the O157:H7 results. As a result, the national and establishment *E. coli* O157:H7 reports were extended to include STEC testing results and examples of these reports are included in Appendix 6.8 and 6.9.

3.6 Identifying trends and obtaining processor feedback

SARDI has provided analysis and summaries of the ESAM data to MLA and processors to assist in investigating trends and process control. A comprehensive list of the use of the ESAM data is given below.

- Presentations:
    - Jessica Tan (SARDI Food Safety and Innovation) presented "ESAM: Getting the most out of your micro testing program" at the National Meat Industry Training Advisory Council Conference (17th and 18th September 2014, Sydney), using illustrative examples of how to utilise the ESAM reports and data with all its potential.
    - Plots illustrating high limits of detection which can be improved by changing the dilution factor were provided to Ian Jenson, MLA for the WA MINTRAC MI&QA network meeting.
    - MLA's presentation for the February-March 2015 MINTRAC MI&QA managers network meetings, "Improving micro quality – where are we going?" had an emphasis on trends from the ESAM data, feedback on the ESAM reports and contacting Jessica Tan, SARDI for assistance.
- Process Control:
    - The ESAM database was used by Sam Rogers (SARDI) in the MLA project "Statistical process control – hygiene and hazards" (G.MFS.0294) for:
        - further investigation on identifying seasonal trends
        - providing advice to establishments on improving testing methods
        - looking at the variation of ESAM results within and between different establishments
        - providing plots of trends for a climate study of beef and sheep, and
        - assisting in the selection of plants for plant visits and a survey of red meat establishments' practices and processes.
    - A presentation was delivered on the recent publication of the 2nd edition of the Processors' Guide to Improving Microbiological Quality by MLA and SARDI at the 2015 National MINTRAC Meat Inspection & Quality Assurance conference. The presentation included what is new in the second edition and case studies on in-plant investigations and analysis of establishments' in-house data.

    - SARDI provided the statistical tools associated with the Processors' Guide to a QA manager.
- Querying of ESAM data by MLA
    - Trends in national *E. coli* (generic and O157) detections.
    - *E. coli* O157 and STEC detections by state, region and establishments around Australia.
    - MLA KPIs updated to include summaries of carton data.
    - Monthly TVC, *E. coli* and *Salmonella* summaries and detections by state and for Cow/Bull and Steer/Heifer were provided to Long Huynh (MLA) and Peter Horchner (Symbio Alliance) for an MLA project on *Salmonella*.
    - Assistance in interpretating the national prevalence of *E. coli* (STEC and non-STEC).
    - Data summaries and graphs of monthly TVC and *E. coli* counts and prevalence (respectively) for a sheep/lamb establishment were provided to Ian Jenson, Andreas Kiermeier and John Sumner.
    - Data on monthly *E. coli* O157 and STEC potentials and confirmed positives for an establishment were provided.
    - The ESAM data was used to answer the question of how often are low counts detected and the frequency distribution of counts in reference to the ESAM moving window for *E. coli* on beef carcases. The conclusion from a brief analysis of the ESAM data was that low counts are not occurring frequently.
- Queries from processors
    - SARDI provided assistance to a QA manager on sample sizes for a Plant Initiated Project (PIP) and background microbiological data to give an indication of the average microbiological load on carcases post slaughter and prior to boning. Based on the recommendations given by SARDI, the QA manager increased the sample size and made other improvements to the experimental design of the trial.
    - Summary prevalence statistics on coliforms and BAX results from June to November 2015 were provided to an establishment's laboratory microbiologist.

SARDI and MLA have also been in discussion about the use of data to investigate hygiene and process control issues, with particular emphasis on investigating the potential for novel data and valuable indicators of meat safety and suitability, beyond ESAM.

4 Discussion

The details of the outcomes and practical implications for each of the project objectives are covered in Section 3: Achievement of Project Objectives, but holistically, the impact on the red meat processing industry is two-fold: at the individual establishment level and for the whole of industry.

The Australian meat industry expends considerable effort complying with the requirements of the ESAM program. One immediate benefit is continued access to particular international markets and MLA has used summaries and graphs of the ESAM data for this purpose. ESAM has also resulted in an accumulation of data that is valuable as a descriptor of hygienic standards of meat processing in Australia. Coupled with statistical tools, analysis

and modelling, the ESAM Analysis Reporting Service has provided easy-to-understand, scientific and longitudinal information and reports to individual establishments so that they can monitor hygiene levels, improve processing practices and ensure the safety of their products. Additionally, the ESAM reports support an evidence-based management of food safety issues and provide a benchmarking reporting service for establishments and the industry.

Another immediate benefit of the ESAM reporting service is it is the mechanism for assessing the validity of the data entered into the national PHI database and errors can be rectified. Consequently, data quality is verified and maintained and will assist processors, the industry and DAWR during market access negotiations.

5 Conclusions and Recommendations

Over the past 18 years, a history of detailed, long-term results from the ESAM database and the ESAM reports provided by SARDI Food Safety and Innovation has provided valuable information and resources to establishments and the red meat industry. Scientific background monitoring information on the industry is supported by over a million data points accumulated by ESAM / PHI. An extensive repertoire of tailored reports are available to QA staff, MLA and DAWR and continue to be developed based on industry needs. Feedback from QA managers is still regularly received and are integral to maximising full value from the ESAM Analysis Reporting Service.

There is discussion on the horizon of a review of the current food safety assessments and framework for the red meat industry and also a revision of the ESAM / PHI system. This may impact on the status of the ESAM program in the future, but this is ongoing research to identify the potential for alternative microbial indicators and monitoring system.

In summary, it is recommended that ongoing provision of the ESAM Analysis Reporting Service to service and benefit the red meat industry continues under the MLA project ‘Process Control Data and Analysis for Market Access’.

6 Appendix

6.1 Feedback from Establishments

- A total of 15 emails were received regarding changes to contact details on the ESAM distribution list.

- In relation to the merging of ESAM data from the NMD and the PHI databases:

> 14/03/2014
>
> We are still receiving no data from the ESAM reports due to the information now being provided within the PHI submission to Dept of Ag, intead of the ESAM national base. This has been ongoing for several months. Is there an end in sight, as this information is valuable to the company, which are not currently benefiting from?

Response: Data from this establishment had been received from the PHI spreadsheet and had been included in the Steer/Heifer report.

> 14/03/2014
>
> I have just opened and seen entries for Steer/Heifer. Est XXX has not sampled for Steer/Heifer for years and not within the last 3 year period. All our entries are Cow/Bull and Hot Boned.
>
> I have checked our entries for Dec 2013, there are no Steer/Heifer entries. How can we get the separate file for these.
>
> I keep a copy of the PHI submitted. I have attached this and you will see there is something wrong at DA and their database that gets to you. A quick check of the Cow/Bull file shows only 5 entries - this should be much more, about 70.
>
> 04/04/2014
>
> Again, I have problems with the information and have attached our record for Jan and Feb 2014.
>
> The hot boning data sent separately is also incorrect – January data is missing.
>
> The Steer/Heifer data that shows 71 tests over the past three years is also incorrect as previously discussed, not a single Steer/Heifer test has been done at Est XXX.
>
> There are no Salmonella tests for Jan 2014. This is incorrect. I believe DA entered much of this year's data as Steer/Heifer which has now been removed but have not replaced with the Cow/Bull data as questioned last month.

Response: The above emails were received from the same establishment in response to the January and February 2014 reports. All issues with data were resolved.

> 04/04/2014
>
> Where do you get your data from? Is it the AQIS PHI sheets? Because a lot of the figures for here aren't quite correct. The most obvious thing that I can tell just looking at it is the number of tests.

Response: It was explained how there had been difficulty merging ESAM data from the NMD and the PHI database during this transitional phase.

> 07/04/2014
>
> There is no data for Est XXX for Jan & Feb. Do you know why this is?

Response: No data had been received for January and February. The establishment was going to investigate the issue with DAWR.

> 27/06/2014
>
> Did the department of ag not provide you with May's results? They definitely have them although there were a couple of minor things that needed correcting that have since been. Hopefully they get them to you in time for

Response: May's data was received and reported in June's report.

- > 3/09/2014
  >
  > The reports need to be divided into the following:
  >
  > Est XXX Plant MMI – hot cow/bull, cold cow/bull, cold steer/heifer, sheep, lambs, calves, *E. coli* O157
  >
  > Est. XXX Plant MMP – cow/bull, steer/heifer, lambs, sheep

Response: The code was amended to generate separate reports for the two chains or plants and sent to the establishment for review and comment. Since then, two separate ESAM reports, one for each chain, have been generated each month.

- Feedback was received on including STEC reporting in the ESAM reports.

4/09/2014

Just a couple of things from reports:

- Table 4 in Hot Boning Report has June column with all NA entries, this is not correct
- In the *E. coli* O157 Monitoring Report
    - Test numbers in Table 1 should be June 111 and July 111
    - Table 2 should have 3 entries for 2014, they are not there
    - Table 3 there is an entry for a potential in June, this is incorrect, this in fact was a non O157 potential

I have attached our records of the June and July 2014 PHI for your info

15/10/2014

Phone conversation about STECs:

Received two spreadsheets, giving more accurate details about the difference between O157 vs non-O157 tests vs both (potentials and confirmed).

- 15/10/2014

There should be no XXX cow/bull HOT report as we don't do hot beef at our XXX plant?

Response: There were two 'Hot swabbed' results in May 2013 which were identified as data entry errors. These incorrect entries were corrected in the ESAM database.

- 13/10/2014

I have been looking at the ESAM reports for August and found there has been an issue with the data entry as every *E. coli*/Coliform results have been positive. The results have been entered incorrectly i.e. 0.08 or 0.33 where they should have been mostly 0.

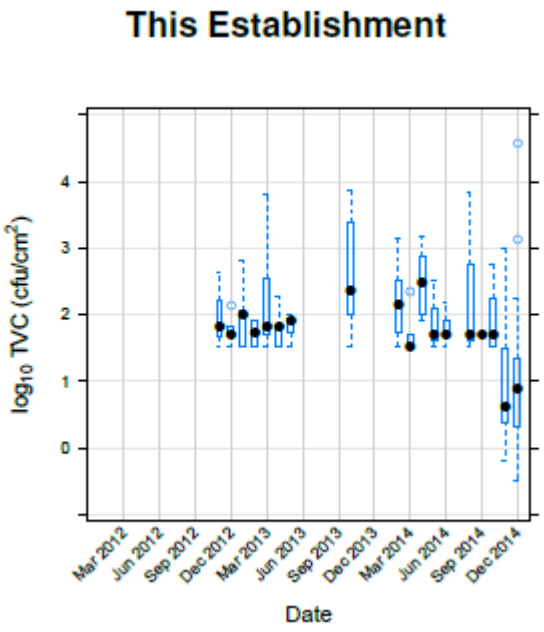
Response: The correct results were emailed to SARDI and the establishment's reports regenerated. The updated PHI spreadsheets were then forwarded to the DAWR so that the changes could also be reflected in the central PHI database.

- 22/10/2014

Phone call from the QA manager of a WA establishment after the WA MI&QA MINTRAC network meeting in September. He asked for advice on how to make changes to their current lab testing practices in order to lower the limit of detection and what information and terminology to send to the laboratory responsible for testing their samples.

Response: Emails were exchanged with the QA manager, to clarify the current laboratory methods and information was provided to go back to the laboratory so that they can achieve a lower limit of detection.

From the information provided by SARDI, this establishment's subsequent ESAM reports reflected a change in the laboratory testing practices, a lowered limit of detection and an increase in the count data collected from sample testing.



- 10/11/2014

  Received a phone call from an establishment after the September reports, asking about the absence of results in their Calf reports from November 2013.

Response: DAWR were contacted about the lack of Calf results and the response was that the results had been entered as "Veal" instead of "Calf". This message was communicated back to the establishment.

A misunderstanding was also clarified, explaining that the standard ESAM reports include both Cold and Hot Swabbed results, not just Cold Swabbed results.

- 11/11/2014

  I was just looking through the data for September for our establishment and I see we have a report for *E. coli* O157, however we are a sheep plant and do not test for this. I have looked at our September PHI file that we sent to our On Plant Vet who submits the PHI data and I can't seem to see anywhere that shows we have tested for this. Can you shed any light on why it is reporting that we have carried out a test in September 2014?

Response: An obviously incorrect data entry was found in the database, so deleted that entry and emailed the establishment back.

- The request for a category of only cold swabbed beef was received from an establishment

> 11/11/2014
>
> Jess, for XXX can we have the following categories for beef:
> Cow/Bull HOT
> Cow/Bull COLD
> Steer/Heifer COLD. There is no hot category for this one.

Response: “Cold only” reports is not standard practice currently and may be investigated at a later date.

-

> 20/01/2015
>
> We are just reviewing our ESAM graph data and it appears there is an error for the November 2014 data as it reads 0 TVC samples were registered in November. I have checked our PHI submission form and the data is included in the excel document. Can you shed any light as to why the report is showing no TVC tests or results for November 2014?

Response: The establishment responded saying that their OPV had found that a relieving OPV sent the Excel spreadsheet off with only the DAWR OPV data included and not the ESAM results. The data was sent to the DAWR and was reported in the next month’s ESAM report.

-

> 28/01/2015
>
> At a quick look, the STEC table for potential positives is incorrect Nov 14 had 3 potential STEC which were confirmed one was O157 the others O26 In the heading it states all potentials although these are then confirmed, to have 1 potential and then 1 confirmed (for O157) see Aug 14 figure 4 potential for 1 confirmed. The anomaly appears that when an STEC potential is confirmed it is then not regarded as a potential which is inaccurate in regard potentials.
>
> I have attached PHI for Oct and Nov 14.

Response: The issue was identified, fixed and this establishment’s November 2014 O157 report was reissued.

- Assistance was provided to a QA manager at a beef export establishment to understand and interpret the ESAM reports
    - How to interpret lower/upper bounds and time plots
    - Why is the TVC prevalence (percent +ve) so high (100%) – the thinking was as for *E. coli* detections and the QA manager was concerned by the 100% prevalence

- Why there was a lack of data for carton testing and also lack of data on carcase testing for some months

In addition to explaining and answering questions, SARDI Food Safety and Innovation sent the 'Explanatory Guide for the ESAM Reports' to assist in understanding the reports. Data issues were also resolved through conversations and as of March 2015, changes in data entry have been noticed.

- 04/03/2015

  I was hoping you could help with a copy of the 2014 annual analysis from SARDI ESAM/O157:H7 for Est. XXX?

Response: The establishment's latest ESAM and *E. coli* O157 reports were sent – the reply confirmed that this was the information required.

- A QA manager contacted SARDI to ask about sample sizes for a Plant Initiated Project (PIP) – she provided a brief description of the proposed PIP, requesting advice on sample sizes and background microbiological data to give an indication of the average microbiological load on carcases post slaughter and prior to boning. Based on the recommendations given by SARDI, the QA manager increased the sample size and made other improvements to the experimental design of the trial.

- An email was received from Symbio Alliance (via Long Huynh, MLA)

  06/03/2015

  Hi Jessica,

  I've had a couple of clients query me re PHI data recently in regards to if their results are typical or not and they're looking for limits as well. I've explained the best guide is the report ranking them against other establishments. It's kind of sinking in for them but I'm wondering what else I can do to explain things for them.

  So the reason for contacting you was to ask if it's ok for them to contact you directly? Also, is there a de-identified report of recent results which I can use to talk them through it?

  Thanks for your help.

  Thanks for your email. Please pass on my contact details (below in my email signature) to your clients and I can help them in understanding and interpreting their PHI data. I am always available and keen to work together with processors to help them understand their data, especially as I send out the monthly ESAM reports to all establishments – so very keen to talk to the clients who have approached you with questions.

  If there is anything else which I can help with, please do not hesitate to contact me.

- Feedback was received on the inclusion of carton reporting in monthly ESAM reports

> 18/03/2015
>
> Thanks for the reports.
>
> Finding it strange that your national median logs for the CARTON TESTS are the same for all species. There should be different log values between the species?
>
> We do carton testing on both HOT & COLD beef.
>
> Also, cartons don't require E. coli testing – only TVC and coliform testing, so

Response: The code was fixed to correct the national median logs for all species and carton testing results were added to the Hot Swabbed ESAM reports. An email reply was sent which said that although *E. coli* testing for cartons is not compulsory, some plants are testing *E. coli* on cartons and these are the results which are reported in the ESAM reports.

- Four establishments cannot receive ESAM reports in ZIP files, so they now receive individual PDF reports.

- > 13/05/2015
  >
  > I have been looking at the box plot chart and in Steer Heifer Figure 8 there is a grey background where our results and I am not sure what our result are, Can you let me know what our results are on this chart.

Response: An explanation of how to interpret Figure 8 (along with tables 5 and 6) in the Steer/Heifer report and the QA manager came back saying that she now understood.

- > 14/07/2015
  > Hi Jess
  > Two things:
  > 1) When will you start with a XXX Group CARTON report, and
  > 2) Can you please include hot beef in the XXX Group ESAM reports?

Response: Changes have been made (see Report Modifications).

- > 16/07/2015
  >
  > Just finished comparing out calculations of means (+ve) against yours and every single one of our calculations is different to yours.

Response: A copy of the plant's data / spreadsheet was requested to compare with the national ESAM data from DAWR and in the end, it was established that the discrepancy

was caused by the plant's calculation of means – a phone call conversation helped to explain and address the issue.

- Calculation of Means and Medians:

> 01/09/2015
>
> Morning Jessica, Hope you're well.
>
> Received the reports you sent through to us yesterday and they've left us a little puzzled again. As I'm sure you're aware from previous enquires we've made, we generate our own monthly reports here and since you've started to send out the group reports that are calculated using the Mean (+ve) we have also. My question to you is how are you calculating the mean? Do you take the zero readings into account or is it just from positives? Do you still take the zero tests into account when calculating the mean? I'm just not sure why our results are so different and inconsistently so. Some are the same, some, you say we're above the national average whilst we say we're below and vice versa (see table below). Its left us scratching our heads.. Any light you can shed would be much appreciated.
>
> 02/09/2015
>
> Thanks for that Jessica. That is how we are working out our means as well and after going through our figures and the ones you've sent below our values do match which makes me think there may be an error in the automatic report being generated through our online system. I'll have to talk to the man who set that all up for us.
>
> Just a quick question though, when you calculate the means why do you not take the zero tests into account? I understand not adding zero to the total because it doesn't change the total value but say for example you had a month where you tested 50 carcasses, 49 came back with 0 as a result and 1 test had 50, Log10(50)/1(total +ve test) would give us a mean monthly value of 1.699 which isn't really representative? Shouldn't it be Log10(50)/50 (total tests) which would be a mean value of 0.034. Does that make sense?

Response: The inquiries were responded to and how to calculate means was explained.

> 16/10/2015
>
> Hi Jess
>
> Our IT person got a different result to you for TVC, E. coli & coliforms for calves in June. You had 0.771, -0.302, -0.158 and he had 0.637, -0.481 and -0.305, respectively. Any idea why? See his calculations below.
>
> The values he has in the median columns are the TVC results/cm2, or E. coli or Coliforms/cm2. He has labelled the columns wrong.

Response: It was identified that the establishment had been comparing their calculated median results with the mean results reported in the ESAM reports. The median values did match correctly.

> 20/10/2015
> Hi Jess
> Sebastian has changed his calf TVC calculation to mean (not median) but it is still giving a different result to yours??? Yours is 0.771?
> I can't figure out why, can you…

Response: The plant resolved the problem and now their summary statistics agree with the ESAM reports.

- > 07/12/2015
  >
  > Hi Jessica
  >
  > I am the OPV and have received today an MLA pulication titled: "Processor's Guide to Improving Microbiological Quality 2nd Edition". The paper provides your contact details in relation to the statistical calculator tools. Unfortunately, these were not provide with the publication, and I was wondering whether you will be kind to e-mail me the tools. Your assistance will be much appreciated.

Response: SARDI provided the statistical tools to the OPV as well as availability to help with any further questions.

- An email was received from Jenny Kroonstuiver, MINTRAC (07/12/2015) with a request for a Word copy of the 'Explanatory Guide for the ESAM Reports' for inclusion in the Training and Assessment materials for AMPX405 *Conduct statistical analysis of process*. A copy of the guide was provided in Word format – "this Guide will be a very useful addition to the training materials – you will hopefully also eventually see a much better use and understanding of the ESAM data".

6.1.1 Feedback in response to the Group ESAM reports

- "We do like the group reports especially from a corporate level where we can benchmark our plants performance across the group and across the national data."
- "Am finding these reports useful as they are a much quicker reference for comparing month to month as well as Plant X to Plant Y. Don't think TVC prevalence is relevant as it should always be 100%! Also need to be able to have hot & cold data for our Plant X beef."
- "Given that the DA website is not that user friendly to navigate around + we currently aren't able to access the DA KPI analysis (which only provides plant by plant data not a data set for the whole group etc), so from a Group QA perspective, I am finding the data very useful specifically for

  1) Indication as to performance against national averages; (really important for me to see this)

  2) Performance across the group plant vs plant; (again this has provided the wider QA and Plant Management teams with a more determined focus in terms of continuous improvement - a bit of friendly competition);

  3) The Group QA Business plan/continuous improvement strategy is developed and underpinned by a number of KPI's of which includes these reports;

  4) All key staff receive the data and it is a quick guide of performance;

  5) Reports are very professional in presentation;

  6) Has certainly cut down on the amount of manual data analysis that I had to perform prior to getting these reports;

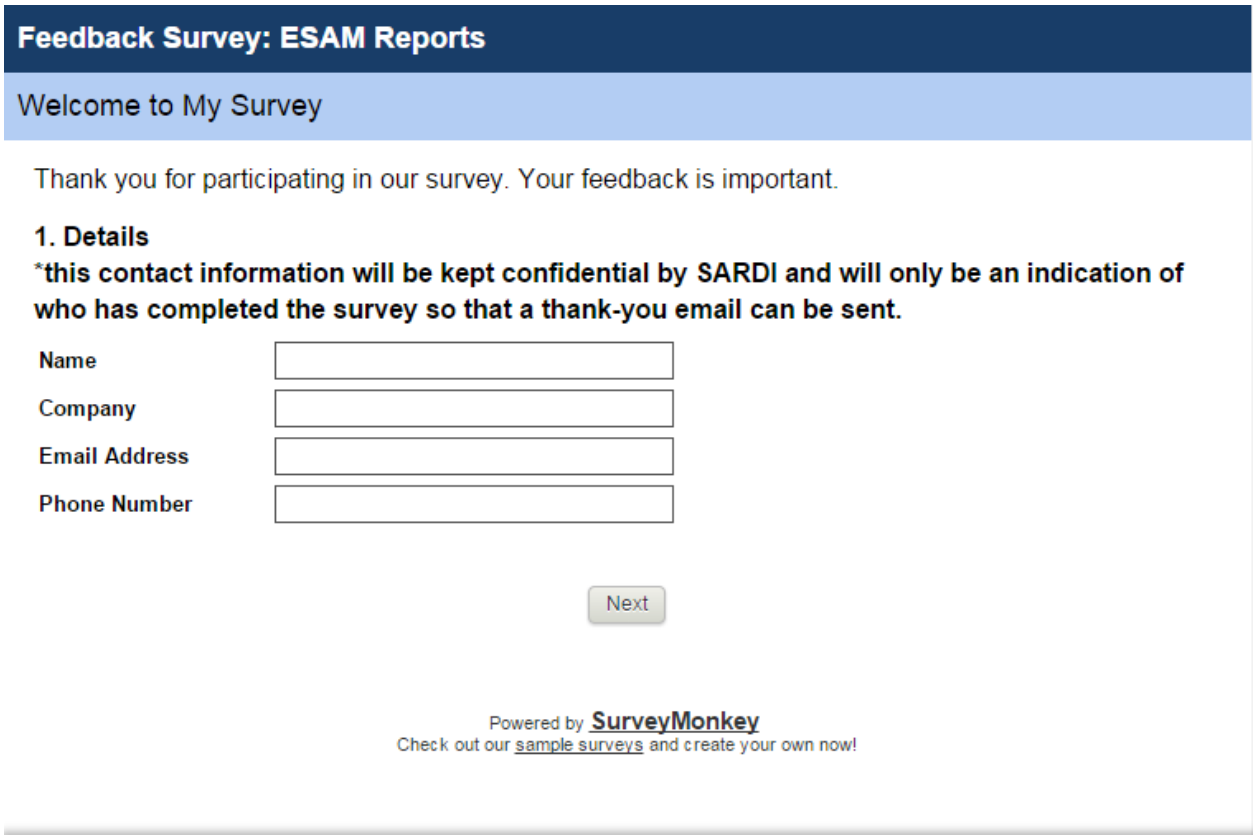
  7) Staff X is not a fan of the box plots but personally I am.

  I will discuss further with the team and give some thought as to what proposed changes or additions may be beneficial.

  I don't know who else is providing feedback but I would like to keep receiving these. Will be back in touch soon.

  The other aspect of receiving these reports from you – is the independence aspect, so from that perspective more credible."

6.2 Feedback Survey: ESAM Reports



Feedback Survey: ESAM Reports

This questionnaire is part of an evalution process we are running for the *E. coli* and *Salmonella* monitoring (ESAM) reports which you currently receive. The aim of the evaluation is to gain and respond to your feedback in order to improve the reporting service for your benefit.

Please answer the following questions as best you can and remember, the more information the better, so please provide as many comments as you'd like!

2. How often do you read the ESAM reports?

- ◯ I don't read the reports.
- ◯ I have a quick look, but only when I have time.
- ◯ If I have time, I read them fully.
- ◯ I read them fully every time I receive one.

Any other comments:

3. How well do you feel you understand the content of the reports?

- ◯ I don't really understand the reports that well.
- ◯ I have a fairly limited understanding of the reports.
- ◯ I have a pretty good understanding of the reports.
- ◯ I understand the reports really well.

Any other comments:

4. How would you rate the value you get out of the reports?

- ◯ I don't get any value from the reports.
- ◯ I don't get a lot of value from the reports.
- ◯ I get a fair bit of value from the reports.
- ◯ I get a lot of value from the reports (i.e. have made changes based on reports; use to benchmark performance).

Any other comments:

Prev Next

Feedback Survey: ESAM Reports

5. How, or in what way do you use the reports?

For example, is it just you who reads the reports each month, or do you read them and pass them on to your staff to read them too? Have you made any changes to your hygiene practices because of what the reports show? Do you keep them for future reference? ...etc

6. Do you find the reports easy to interpret?

- ○ Yes
- ○ No

If 'No', please give a brief explanation of why they aren't that easy to interpret, or indicate which tables and graphs you find difficult to interpret.

Prev Next

Feedback Survey: ESAM Reports

7. What other requirements for microbiological reporting do you have?
E.g. what other information would you like to see reported or what would you like to see changed in the current reports?

8. How regularly would you like to receive the reports?

- ○ Once a month, as we do now
- ○ Less often (please specify frequency)

Frequency:

9. How could the reports be improved or extended, to give maximum value to you?

Prev Done

6.3 Feedback Survey Results

On the 16th December 2014, QA managers and staff from the 55 establishments currently receiving the ESAM reports were invited to provide feedback on the reports and the service provided. Of these, a total of 27 responses were returned by 31st January 2015. Comments are reproduced verbatim (except for spelling corrections).

The previous feedback survey was carried out in April-May 2010 and a total of 11 responses were received. Some questions were used as the starting point for the current feedback survey.

Question 2.How often do you read the ESAM reports?

Answer Option	Number of Responses	%
I don't read the reports.	1	3.8
I have a quick look, but only when I have time.	2	7.7
If I have time, I read them fully.	8	30.8
I read them fully every time I receive one.	15	57.7
Total	26	100

- Not necessarily every time I receive them but I eventually get to them.
- I have a quick look when they come in and then read them in detail later.

Question 3.How well do you feel you understand the content of the reports?

Answer Option	Number of Responses	%
I don't really understand the reports that well.	0	0
I have a fairly limited understanding of the reports.	3	11.1
I have a pretty good understanding of the reports.	20	74.1
I understand the reports really well.	4	14.8
Total	27	100

- I understand them better after Jessica Tan explained them to me.
- More information on how to interpret reports would be beneficial.

Question 4.How would you rate the value you get out of the reports?

Answer Option	Number of Responses	%
I don't get any value from the reports.	1	3.7
I don't get a lot of value from the reports.	2	7.4
I get a fair bit of value from the reports.	17	63
I get a lot of value from the reports (i.e. have made changes based on reports; use to benchmark performance).	7	25.9
Total	27	100

- For my role, the new Group ESAM reports are invaluable particularly for benchmarking across the group & these are a good tool for establishing quality improvement projects.
- I work in a support role to QA (in the laboratory). I tend to look through our own spreadsheets for trends etc.
- Used to bench mark our performance

Question 5.How, or in what way do you use the reports? For example, is it just you who reads the reports each month, or do you read them and pass them on to your staff to read them too? Have you made any changes to your hygiene practices because of what the reports show? Do you keep them for future reference? …etc (26 responses)

- After reading them, I go over the process monitoring sheets and micro findings to see if we need to change or look at the procedures. Then see where we rank over all.
- There are other staff that are required to read and are kept for reference.
- I just read them, sometimes James and I talk about them.
- The reports are read by myself, passed on to the management team. Use them to monitor hygiene practises. Used as reference material at management meeting to evaluate and monitor hygiene practises within our establishment.
- To trend our micro performance against national standards.
- Pass the reports onto the QA Team and the supervisors.
- I read them and use them to drive the company's continuous improvement program. I distribute to all key staff. I review them with key staff across the Group. I use them to benchmark the plants against each other and the national average. The reports support the QIP's and we have used these to refocus our efforts.
- I file them away without reading them.
- The reports are distributed to everyone that reports to the QA team. I am included in the email list, so just skim through out of interest as they don't impact directly on my role.
- I review and discuss with the OIC on how we can proceed.
- We use them for board data and to keep supervisors informed.
- Reports are passed on to staff and more focus on dressing if evidence of higher readings. All records are kept for future reference.
- Forward to both Lab Staff and DA OPV Discuss with QA Staff Our Est undertakes much more Micro testing than what is mandated in ESAM I tend to just use ESAM as a comparison to our in house testing ESAM is the only Salmonella testing we do because of the nature of the sampling and incidence of positive Salmonella ESAM it is not particularly useful as a measure of process performance.
- Hold on file for future reference, if significant differences present discuss the outcomes with other management representatives.
- The reports are used and tabled as part of the management review process and therefore are provided to QA and Frontline Managers as well as myself. They are used as part of trend analysis, benchmarking and customer information.
- I read them and pass them onto other staff members. I use the data to enter into a feedback system for the Department of Agriculture. If the results are above our maximum limits, corrective action is put in place after investigating why the results are out of specification. The report is saved and is used when corresponding with customers on the hygiene of our product.
- I read the report, inform other management or supervisors of any noticeable trends or higher than average findings. The results are discussed at management meetings.

- I pass the info on to floor supervisors and management if we are below the national average. Have made changes to floor processes because of this. Keep all reports for future reference. Create graphs comparing seasonal changes and year-to-year changes.
- I send them to the plant and operations managers and the slaughter floor supervisors. We discuss the results and work on improving carcase hygiene and we also do this with daily ESAM results as well.
- ESAM reports are utilised quarterly during QA management review meetings. It is an analysis of how we are trending against the national average and clearly defines outliers for when improvement is required.
- The reports are discussed during Management meetings and QAs are advised.
- We use them to compare ourselves to other establishments around the country and also as ammunition to use against senior management to support our case to implement changes that we are confident will improve micro results but are costly.
- Pass onto all staff
- Customer values the Food Safety of the tested products
- Myself and my team review the reports for continuous improvement/trend analysis etc.
- Read and distribute. No changes have been made.

Question 6. Do you find the reports easy to interpret?

Answer Option	Number of Responses	%
Yes	22	84.6
No	4	15.4
Total	26	100

- Still learning, I ask the lab manager to help me interpret the findings, no real reason just getting the time to sit down and study them.
- Mostly
- Fairly
- Box plot graphs can be a little difficult to understand
- I have a problem understanding where we are in comparison with other plants by marks on the graphs where everyone's results are shown. I understand the percentages in figures clearer.
- I wouldn't say they are easy to interpret as you do need someone to explain it to you. But once you know what everything in the report means, then it is much easier to interpret.
- Some confusion. Cluttered information

Question 7. What other requirements for microbiological reporting do you have? E.g. what other information would you like to see reported or what would you like to see changed in the current reports? (15 responses)

- The reports are found acceptable and no changes are required.
- All ok.
- Trend data for the non-O15 STEC (confirmed positive) results.
- Shelf life, chemical lean testing.

- I am currently awaiting feedback from key persons across the group as to whether there is any other data they want measured, so I will let SARDI know early in the new year.
- NA
- None
- STEC Data split into O157 and other STECs by O group with both national testing comparisons (Industry) and DA Verification testing also split into I157 and STEC O groups. This would provide a better picture to compare and access risk factors.
- Show graphs of just the last year and the last 6 months comparison as well as the current 3 year comparison.
- Coliform and TVC reporting on ovine and beef trim results.
- Carton meat micro is something that has been submitted to the PHI for some time now, although no statistical reporting is generated and fed back to the industry. I could see this information being adopted and useful.
- Points on the graphs showing the acceptable, marginal and unacceptable limits. Averages for our establishment. Trend analysis.
- No change
- Report tissue testing results
- N/A

Question 8. How regularly would you like to receive the results?

Answer Option	Number of Responses	%
Once a month, as we do now	24	100
Less often	0	0
Total	24	100

- It is important the Data is received monthly, but the only comment I would make is that it would be good to receive the data right up to date. Instead, the report run one or two months behind due to SARDI not receiving the data from the Department of Agriculture.

Question 9. How could the reports be improved or extended, to give maximum value to you? (18 responses)

- No need for improvement
- All right the way they are
- With our plant, a separate table for hot swabbed beef (this is being currently entered in the cow/bull category).
- Report to become more regular ie. fortnightly
- Again, as per Question 8 comments
- NA
- It would be helpful if DA put their reports in more often.
- Could have a 6 or 12 monthly graph to show trend over a longer period.
- See above. Also it is fine to have the shaded potential positive frequencies for STECs but this can be improved by comparison with number of tests performed and split O 157 and STEC O groups. To have 4 potentials when an Est may contribute 20% of tests may be entirely different to having 1 potential and only contribute 0.2% of tests. From a risk management viewpoint, Est need to realistically determine this

risk point to make valid Management decisions. The data provided can be a key to determine this and is not being either made available or captured.

- Not sure
- Am happy with current format
- Show graphs of just the last year and the last 6 months comparison as well as the current 3 year comparison.
- All our species categories (hot and cold) need to be extended
- I don’t know
- These reports show all results, even for data entries that an establishment has entered incorrectly. I think there should be more error checking before these reports are submitted to industry or to simply remove illegitimate results (e.g. minus logs).
- As per question 7
- N/A
- Show STECs

6.4 Example – Inclusion of Carton results in Establishment Report

E. coli and *Salmonella* Monitoring Report

Establishment XXX

SHEEP

Reporting Period:

01 Jan 2013 to 31 Dec 2015

Generated

February 16, 2016 at 22:11

Prepared by
SARDI Food Safety Research
GPO Box 397
ADELAIDE, SA 5001, Australia
Ph: +61 8 8303 9771
Fax: +61 8 8303 9424

Government of South Australia

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

1 Total Viable Count Summary

Table 1: Total Viable Count prevalence summary for this establishment and nationally.

	This Establishment			National
	Nov 2015	Dec 2015	Last 3 Years	Last 3 Years
Tests	**90**	**75**	**2979**	**24540**
Positives	**90**	**75**	**2974**	**22296**
Percent +ve	**100.00**	**100.00**	**99.83**	**90.86**
Lower Bound	95.98	95.20	99.61	90.49
Upper Bound	100.00	100.00	99.94	91.21

Table 2: Total Viable Count summary for this establishment and nationally ($\log_{10}$ cfu/cm^2) for samples where TVC was greater than the limit of detection.

	This Establishment			National
	Nov 2015	Dec 2015	Last 3 Years	Last 3 Years
Minimum	-0.180	0.560	-0.482	-1.222
Q1	**1.131**	**1.115**	**1.098**	**0.880**
Median	**1.424**	**1.338**	**1.438**	**1.375**
Mean (+ve)	1.510	1.540	1.426	1.395
Q3	**1.929**	**2.024**	**1.723**	**1.833**
90th Percentile	2.317	2.352	2.142	2.386
95th Percentile	2.453	2.492	2.519	2.699
99th Percentile	2.975	3.006	2.966	3.447
Maximum	3.181	3.037	5.325	7.176
SD	0.586	0.584	0.599	0.775

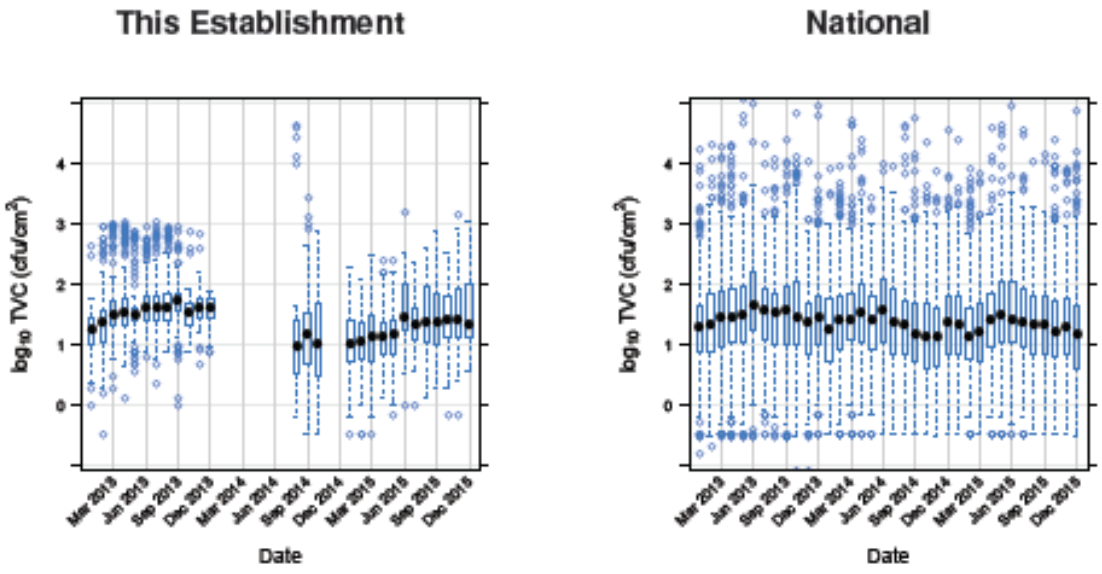


Figure 1: Box plot of monthly Total Viable Counts for Establishment XXX and all establishments **over the last 3 years**.

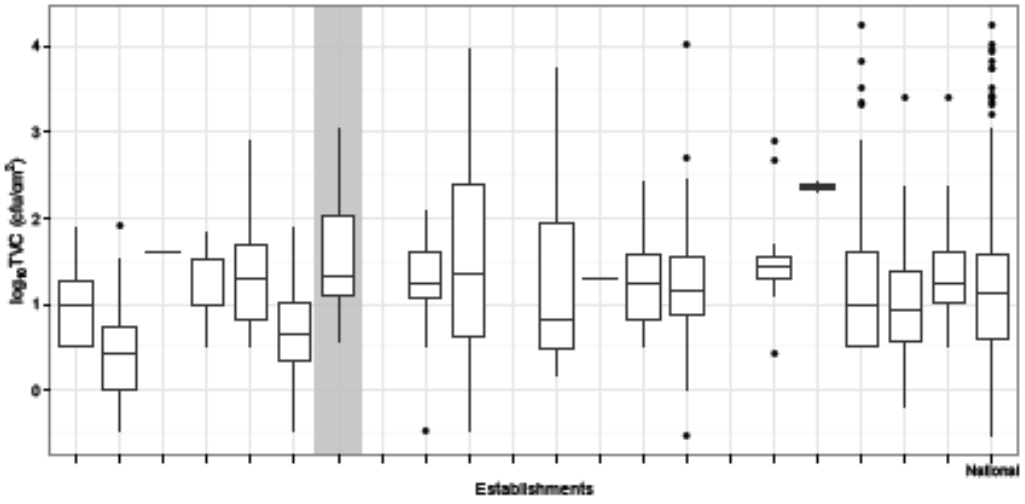


Figure 2: Box plots of this month's Total Viable Counts for all establishments individually and combined into a National box plot. The results for Establishment XXX are identified by the grey background.

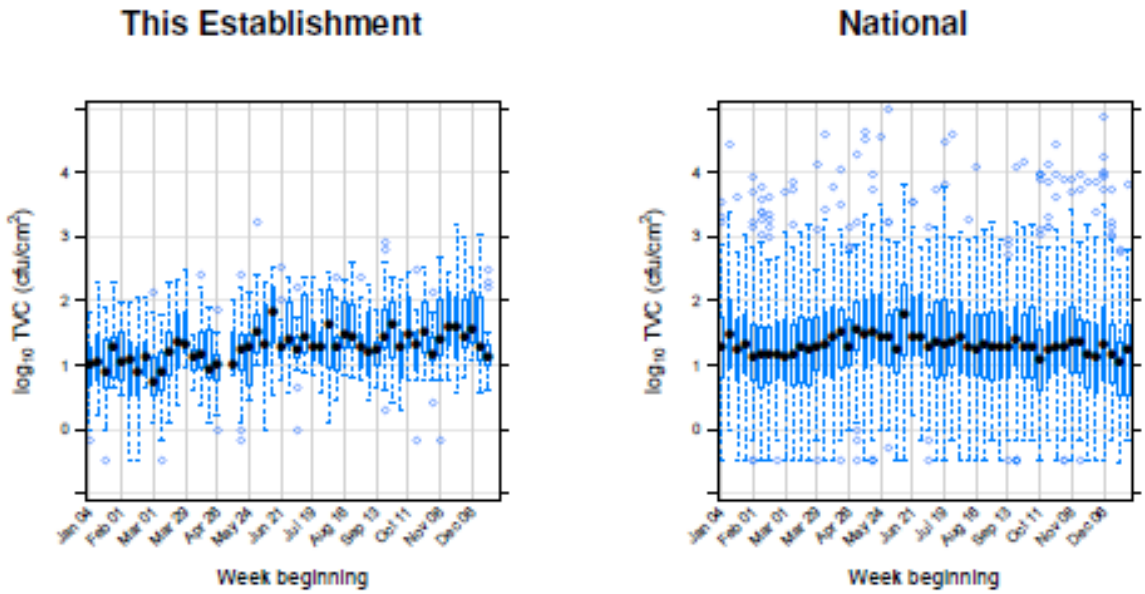


Figure 3: Box plot of weekly Total Viable Counts for Establishment XXX and all establishments **over the last year**.

1.1 Total Viable Count Summary: Carton Testing

Table 3: Total Viable Count prevalence summary of carton testing results for this establishment and nationally.

	This Establishment			National
	Nov 2015	Dec 2015	Last 3 Years	Last 3 Years
Tests	**177**	**159**	**1444**	**12483**
Positives	**177**	**159**	**1425**	**11416**
Percent +ve	**100.00**	**100.00**	**98.68**	**91.45**
Lower Bound	97.94	97.71	97.95	90.95
Upper Bound	100.00	100.00	99.21	91.94

Table 4: Total Viable Count summary of carton testing results for this establishment and nationally ($\log_{10}$ cfu/cm^2) for samples where TVC was greater than the limit of detection.

	This Establishment			National
	Nov 2015	Dec 2015	Last 3 Years	Last 3 Years
Minimum	0.954	0.954	0.000	-1.222
Q1	**1.255**	**1.255**	**1.431**	**1.903**
Median	**1.732**	**1.799**	**1.857**	**2.398**
Mean (+ve)	1.724	1.736	1.807	2.405
Q3	**1.996**	**2.033**	**2.158**	**2.875**
90th Percentile	2.398	2.260	2.471	3.342
95th Percentile	2.663	2.487	2.709	3.763
99th Percentile	3.480	3.068	3.463	4.653
Maximum	3.687	3.297	4.797	7.881
SD	0.578	0.496	0.572	0.792

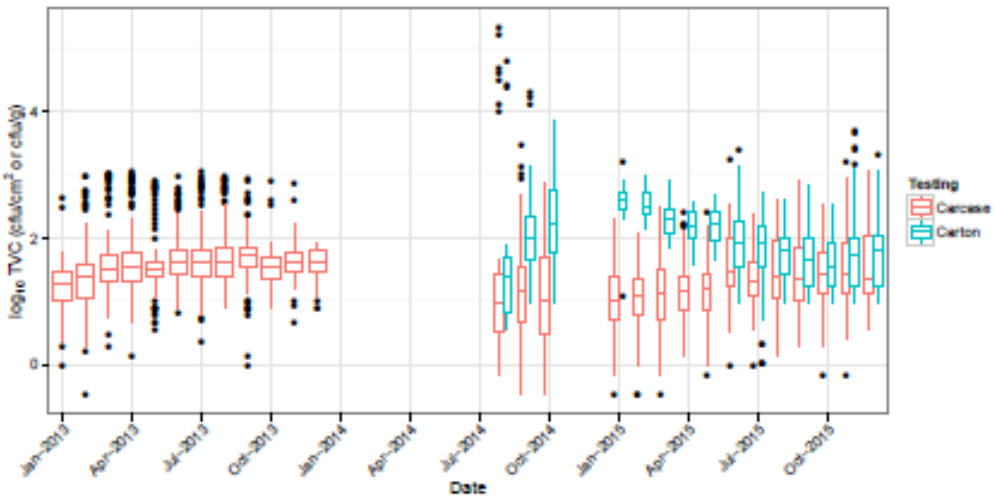


Figure 4: Box plots of Total Viable Counts for this establishment's carcase and carton results.

2 *E. coli* Summary

Table 5: *E. coli* prevalence summary for this establishment and nationally.

	This Establishment			National
	Nov 2015	Dec 2015	Last 3 Years	Last 3 Years
Tests	**90**	**75**	**2977**	**23623**
Positives	**35**	**34**	**1100**	**5403**
Percent +ve	**38.89**	**45.33**	**36.95**	**22.87**
Lower Bound	28.79	33.79	35.21	22.34
Upper Bound	49.74	57.25	38.71	23.41

Table 6: *E. coli* summary for this establishment and nationally ($\log_{10}$ cfu/cm^2) for samples where *E. coli* was detected.

	This Establishment			National
	Nov 2015	Dec 2015	Last 3 Years	Last 3 Years
Minimum	-0.482	-0.482	-0.509	-1.523
Q1	**-0.482**	**-0.482**	**-0.482**	**-0.482**
Median	**-0.180**	**-0.180**	**-0.180**	**-0.174**
Mean (+ve)	-0.091	-0.098	-0.120	-0.007
Q3	**0.218**	**0.089**	**0.121**	**0.297**
90th Percentile	0.500	0.404	0.364	0.778
95th Percentile	0.602	0.529	0.518	1.155
99th Percentile	0.826	0.994	0.820	1.723
Maximum	0.841	1.172	1.422	3.079
SD	0.419	0.398	0.349	0.554

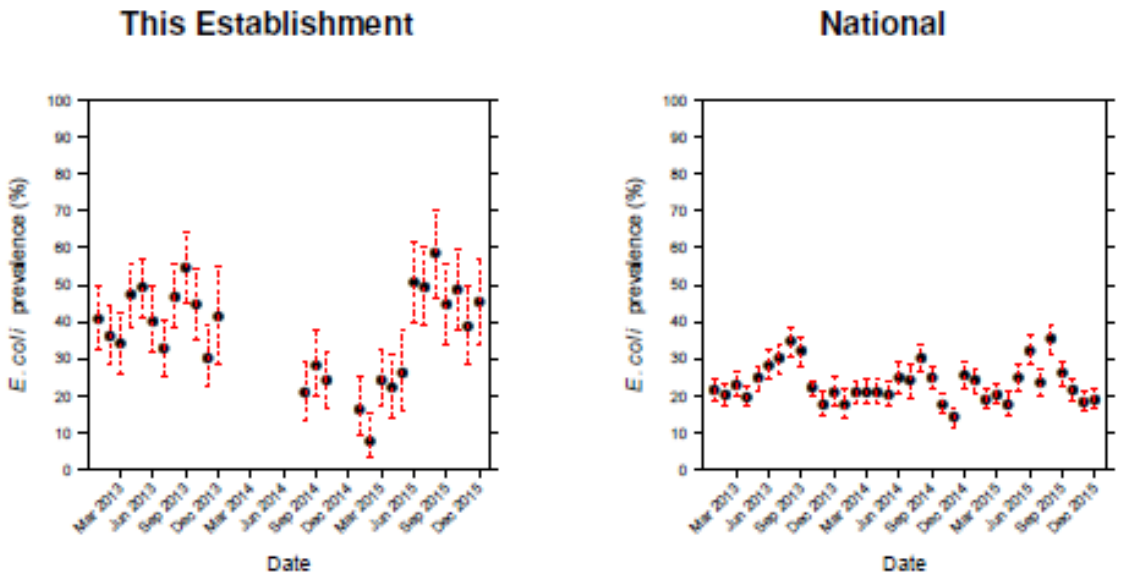


Figure 5: Time plot of monthly *E. coli* prevalence for Establishment XXX and all establishments **over the last 3 years** — the black dots indicate the estimated prevalence in each month (as a percentage) and the red lines indicate 95% confidence intervals for each estimate.

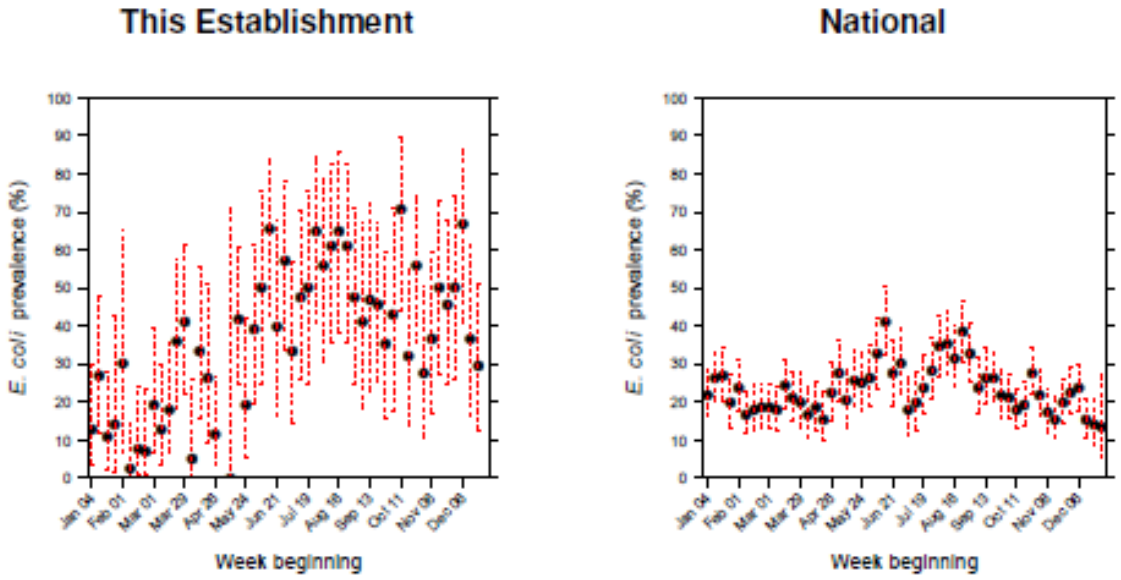


Figure 6: Time plot of weekly *E. coli* prevalences for Establishment XXX and all establishments **over the last year** — the black dots indicate the estimated prevalence in each week (as a percentage) and the red lines indicate 95% confidence intervals for each estimate.

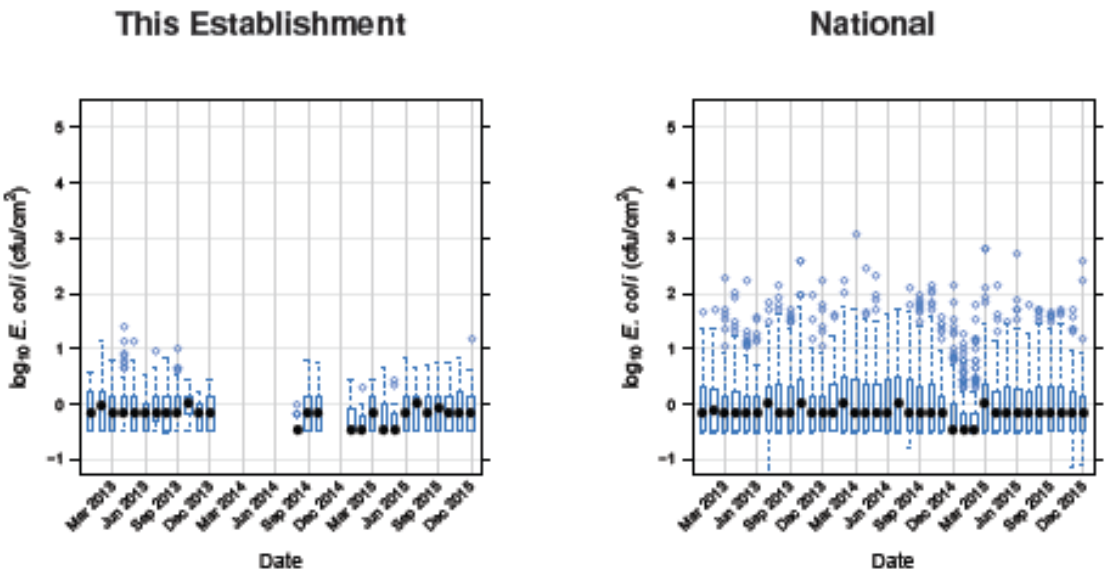


Figure 7: Box plot of monthly *E. coli* positive concentrations for Establishment XXX and all establishments **over the last 3 years**.

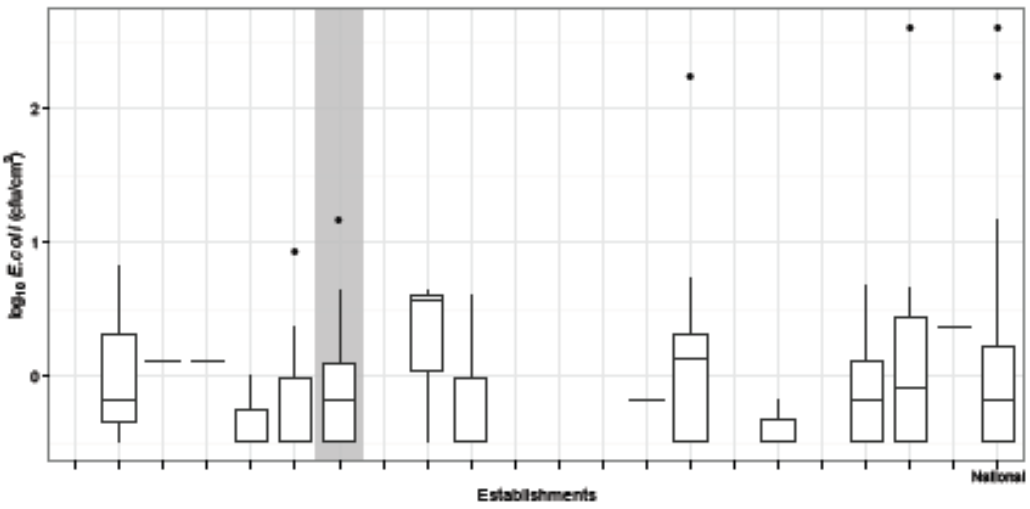


Figure 8: Box plots of this month's *E. coli* counts for all establishments individually and combined into a National box plot. The results for Establishment XXX are identified by the grey background.

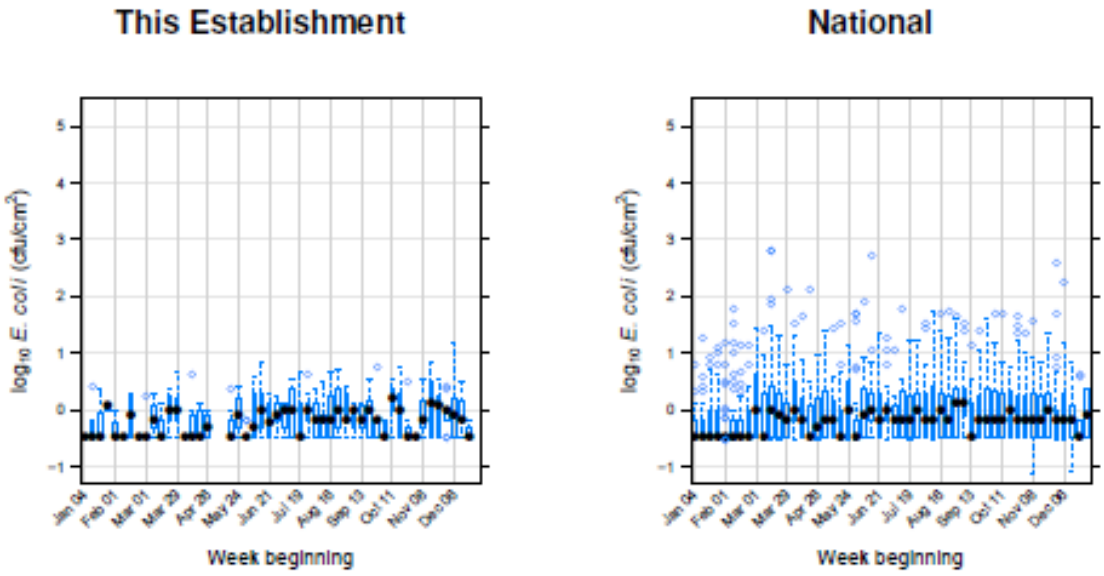


Figure 9: Box plot of weekly *E. coli* for Establishment XXX and all establishments **over the last year**.

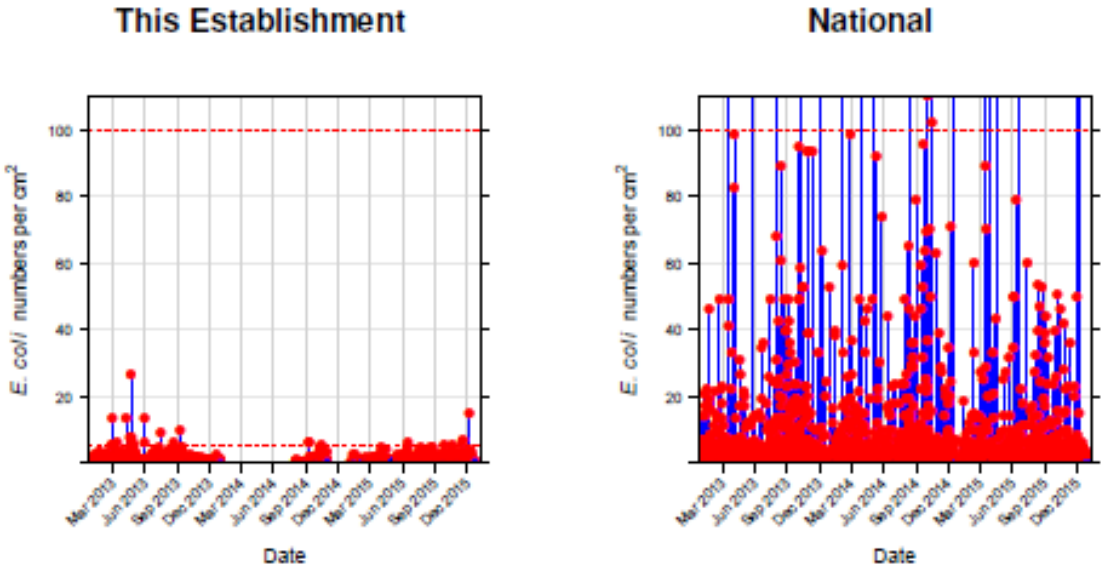


Figure 10: Time plot of *E. coli* tests for Establishment XXX and all establishments — positive tests are represented by red points; negative tests are represented by blue circles.

2.1 *E. coli* Summary: Carton Testing

Table 7: *E. coli* prevalence summary of carton testing results for this establishment and nationally.

	This Establishment			National
	Nov 2015	Dec 2015	Last 3 Years	Last 3 Years
Tests	**177**	**159**	**1438**	**5692**
Positives	**0**	**0**	**9**	**693**
Percent +ve	**0.00**	**0.00**	**0.63**	**12.18**
Lower Bound	0.00	0.00	0.29	11.34
Upper Bound	2.06	2.29	1.19	13.05

Table 8: *E. coli* summary of carton testing results for this establishment and nationally ($\log_{10}$ cfu/cm^2) for samples where *E. coli* was detected.

	This Establishment			National
	Nov 2015	Dec 2015	Last 3 Years	Last 3 Years
Minimum	NA	NA	-0.482	-1.301
Q1	**NA**	**NA**	**-0.482**	**1.000**
Median	**NA**	**NA**	**-0.180**	**1.301**
Mean (+ve)	NA	NA	0.131	1.260
Q3	**NA**	**NA**	**0.954**	**1.602**
90th Percentile	NA	NA	1.014	2.000
95th Percentile	NA	NA	1.135	2.240
99th Percentile	NA	NA	1.231	2.864
Maximum	NA	NA	1.255	3.121
SD	NA	NA	0.726	0.623

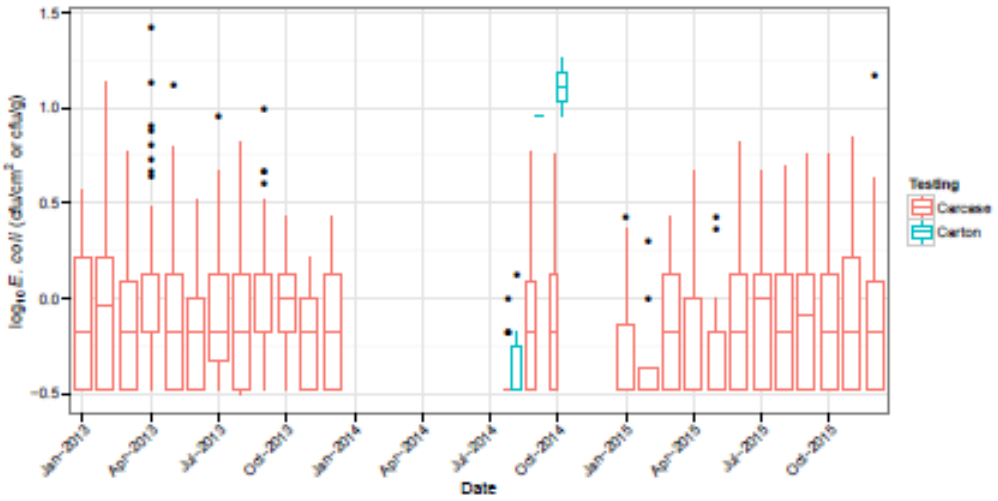


Figure 11: Box plots of *E. coli* counts for this establishment's carcase and carton results.

3 *Coliform* Summary

Table 9: Coliform prevalence summary for this establishment and nationally.

	This Establishment			National
	Nov 2015	Dec 2015	Last 3 Years	Last 3 Years
Tests	**90**	**75**	**2326**	**18212**
Positives	**43**	**40**	**1136**	**4749**
Percent +ve	**47.78**	**53.33**	**48.84**	**26.08**
Lower Bound	37.13	41.45	46.79	25.44
Upper Bound	58.57	64.95	50.89	26.72

Table 10: Coliform summary for this establishment and nationally ($\log_{10}$ cfu/cm^2) for samples where *coliforms* were detected.

	This Establishment			National
	Nov 2015	Dec 2015	Last 3 Years	Last 3 Years
Minimum	-0.482	-0.482	-0.482	-0.523
Q1	**-0.482**	**-0.482**	**-0.180**	**-0.482**
Median	**-0.180**	**-0.092**	**-0.004**	**-0.004**
Mean (+ve)	-0.088	-0.057	0.004	0.060
Q3	**0.169**	**0.145**	**0.218**	**0.364**
90th Percentile	0.473	0.431	0.473	0.924
95th Percentile	0.677	0.567	0.640	1.301
99th Percentile	0.876	1.024	0.938	1.794
Maximum	0.916	1.235	2.749	3.079
SD	0.404	0.404	0.375	0.581

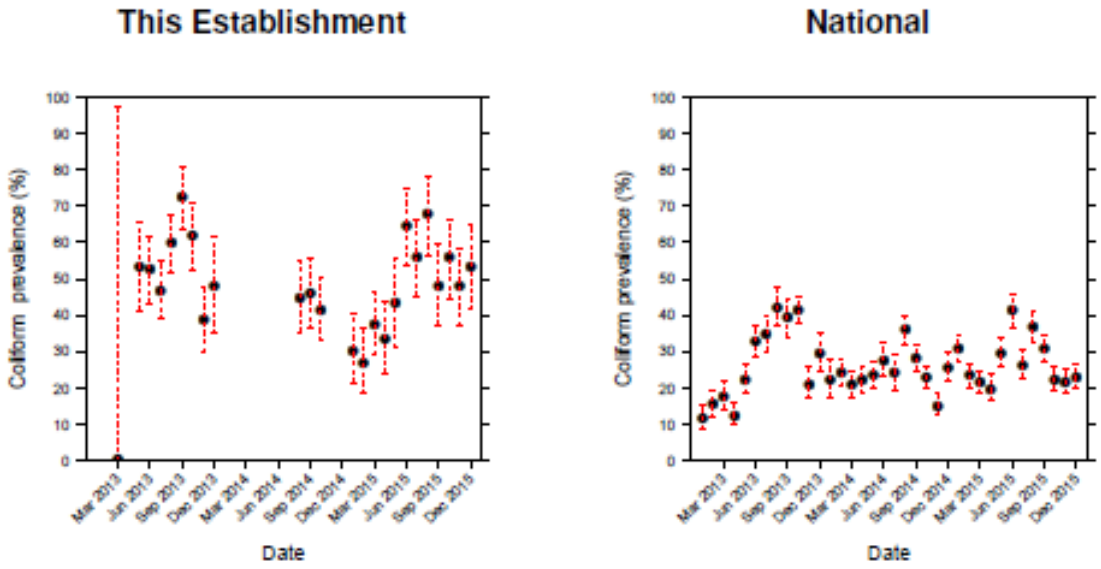


Figure 12: Time plot of monthly coliform prevalence for Establishment XXX and all establishments **over the last 3 years** — the black dots indicate the estimated prevalence in each month (as a percentage) and the red lines indicate 95% confidence intervals for each estimate.

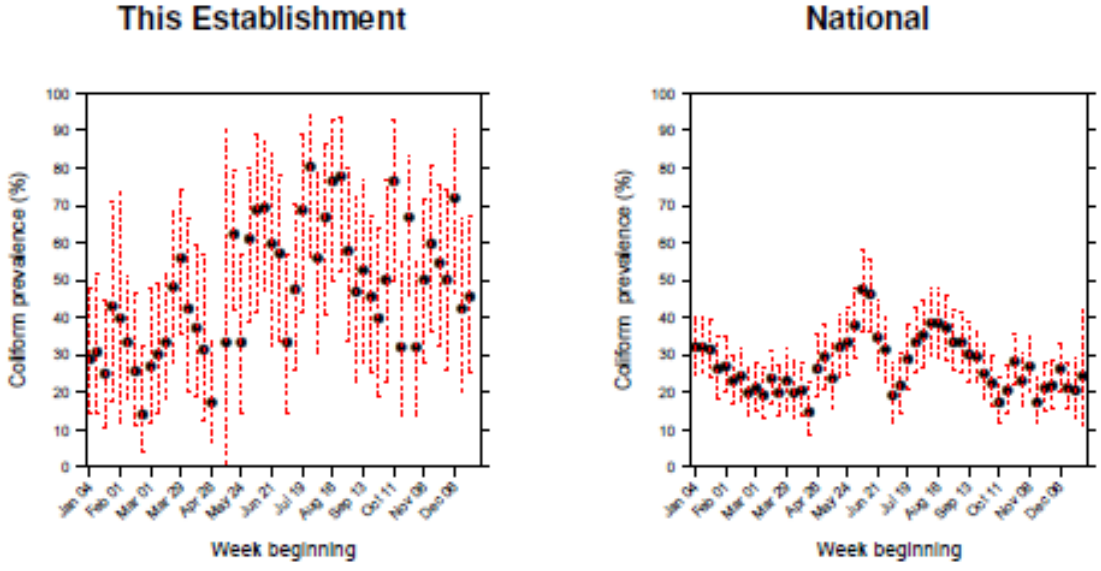


Figure 13: Time plot of weekly coliform prevalences for Establishment XXX and all establishments **over the last year** — the black dots indicate the estimated prevalence in each week (as a percentage) and the red lines indicate 95% confidence intervals for each estimate.

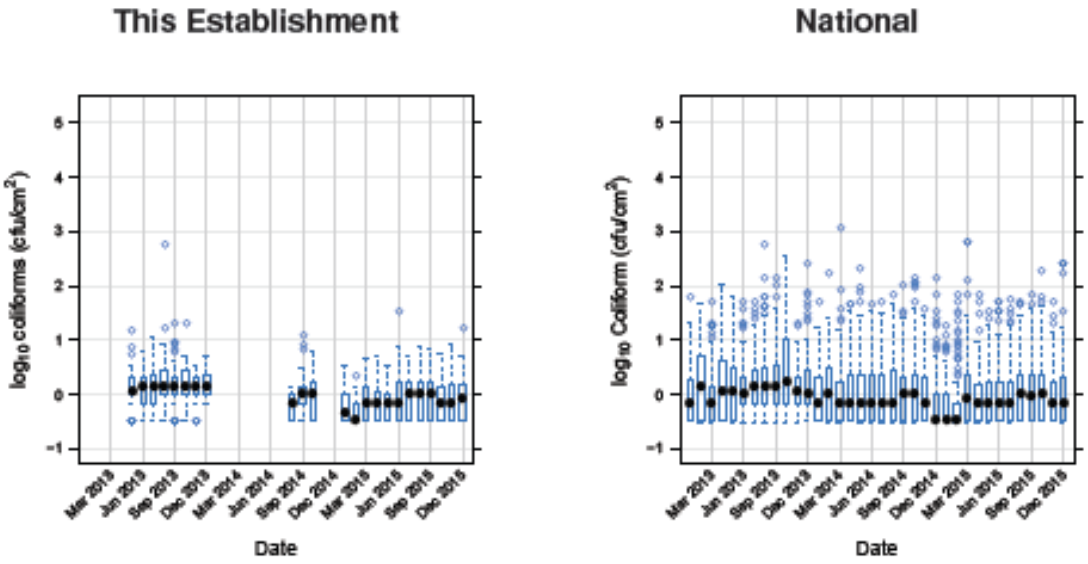


Figure 14: Box plot of monthly coliform positive concentrations for Establishment XXX and all establishments **over the last 3 years**.

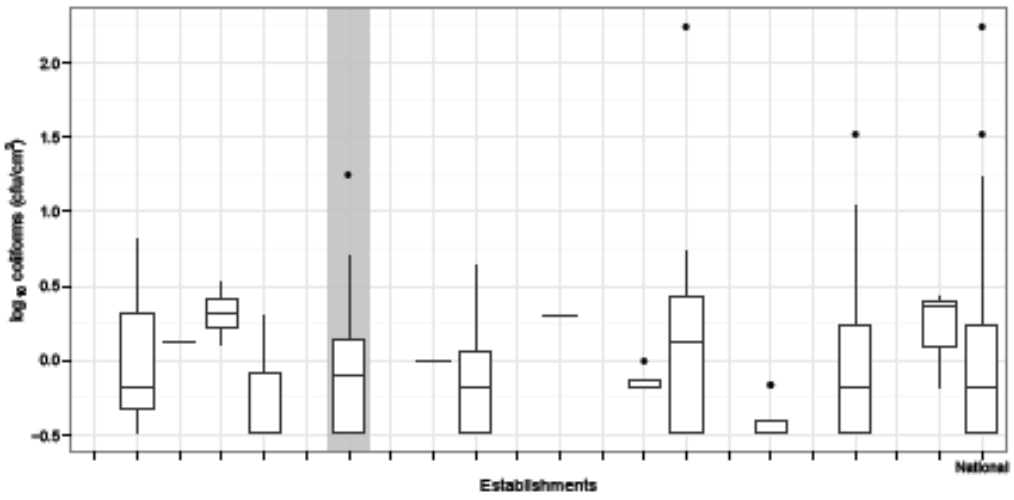


Figure 15: Box plots of this month's coliform counts for all establishments individually and combined into a National box plot. The results for Establishment XXX are identified by the grey background.

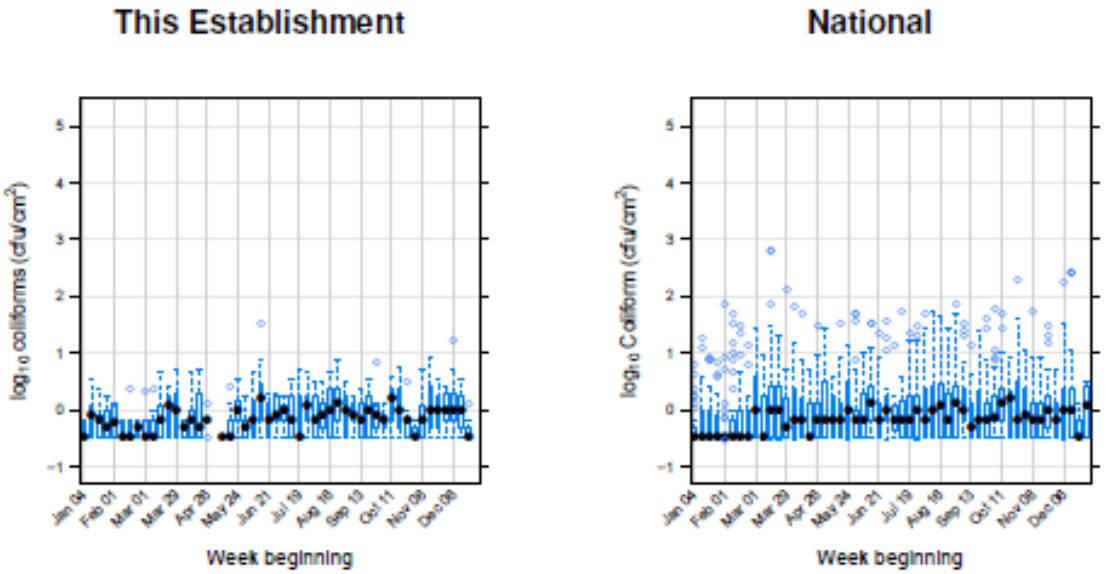


Figure 16: Box plot of weekly coliform concentrations for Establishment XXX and all establishments **over the last year**.

4 *Coliform* Summary: Carton Testing

Table 11: Coliform prevalence summary of carton testing results for this establishment and nationally.

	This Establishment			National
	Nov 2015	Dec 2015	Last 3 Years	Last 3 Years
Tests	**177**	**159**	**1438**	**12388**
Positives	**0**	**0**	**48**	**2254**
Percent +ve	**0.00**	**0.00**	**3.34**	**18.20**
Lower Bound	0.00	0.00	2.47	17.52
Upper Bound	2.06	2.29	4.40	18.89

Table 12: Coliform summary of carton testing results for this establishment and nationally ($\log_{10}$ cfu/cm^2) for samples where *coliforms* were detected.

	This Establishment			National
	Nov 2015	Dec 2015	Last 3 Years	Last 3 Years
Minimum	NA	NA	-0.482	-1.301
Q1	**NA**	**NA**	**0.193**	**1.000**
Median	**NA**	**NA**	**0.954**	**1.301**
Mean (+ve)	NA	NA	0.925	1.388
Q3	**NA**	**NA**	**1.463**	**1.653**
90th Percentile	NA	NA	1.978	2.079
95th Percentile	NA	NA	2.187	2.380
99th Percentile	NA	NA	2.314	2.878
Maximum	NA	NA	2.386	4.914
SD	NA	NA	0.792	0.517

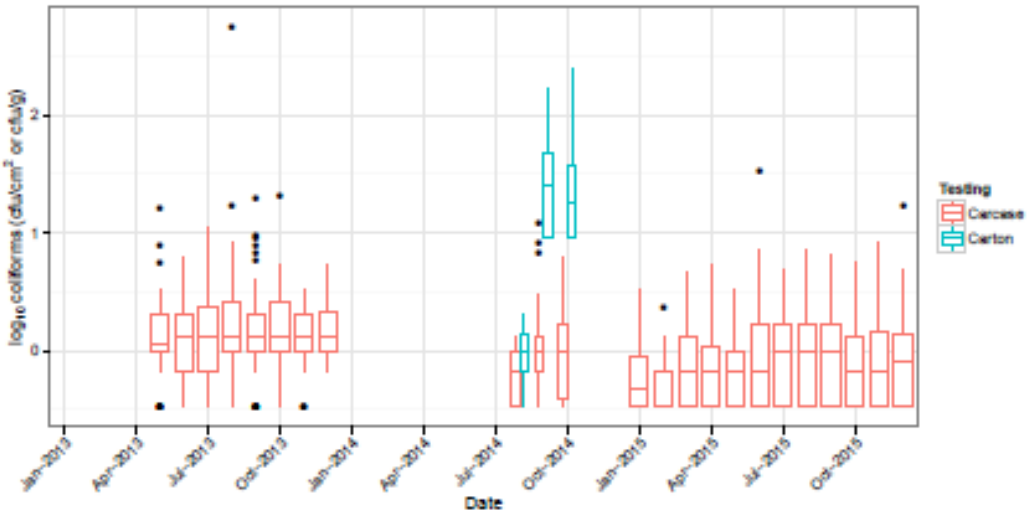


Figure 17: Box plots of coliform counts for this establishment's carcase and carton results.

5 *Salmonella* Summary

Table 13: *Salmonella* prevalence summary for this establishment and nationally.

	This Establishment			National
	Nov 2015	Dec 2015	Last 3 Years	Last 3 Years
Tests	**0**	**19**	**536**	**5184**
Positives	**0**	**0**	**1**	**33**
Percent +ve	**NA**	**0.000**	**0.187**	**0.637**
Lower Bound	NA	0.000	0.005	0.439
Upper Bound	NA	17.647	1.035	0.893

Table 14: *Salmonella* serovars for this establishment.

TestDate	Serotype
2014-09-09	

6 Glossary of Terms

6.1 Prevalence summary

Tests: The total number of samples (TVC, *E. coli* or *Salmonella*) in the ESAM database during the reporting period.

Positives: The number of samples with positive concentrations (ie. concentrations > 0).

Percent +ve: 100 $\times$ Positives/Tests.

Lower Bound & Upper Bound: Lower and Upper 95% Confidence Bounds. The "true" prevalence is expected to be in this range.

6.2 TVC and *E. coli* concentration summary

All concentration data are converted into logarithms with base 10, given by $\log_{10}$ cfu/cm^2.

Minimum: Minimum concentration.

Q1 or 1st Quartile: 25% of the data are less than this value, 75% are more.

Q3 or 3rd Quartile: 75% of the data are less than this value, 25% are more.

Median: 50% of the data are less than this concentration, 50% are more,

90th Percentile: 90% of the data are less than this value, 10% are more.

95th Percentile: 95% of the data are less than this value, 5% are more.

99th Percentile: 99% of the data are less than this value, 1% are more.

Maximum: Maximum concentration.

Mean: The average.

Standard Deviation (SD): A measure of spread (or variability) about the mean.

6.3 Box plot

A graphical tool to assess the data.

- The solid dot is the median.
- The box contains half the data.
- The lower and upper bounds of the box are the 1st and 3rd quartile.
- The inter-quartile range (IQR) = Q3 - Q1
- The length of the whiskers is calculated by $\pm 1.5\times$ IQR. The end of the whiskers corresponds to the observation in the dataset that is closest to this defined value.
- Observations falling outside the extent of the whiskers are indicated separately. Values falling far outside the whiskers indicate unusual or extreme values.

6.4 Time plot of *E. coli* concentrations over time

This plot is useful to compare the level of *E. coli* at individual plants over time compared to that found nationally over the same sampling period.

- Positive tests are represented as red dots; negative tests as blue open circles.
- Red (dashed) horizontal lines show the 'm' and 'M' values for that species.
  - The value of 'm' and 'M' for each species is defined in Appendix 1 of AQIS Meat Notice 2003/6.
  - Observations **below** the defined value 'm' are considered to have Acceptable levels of *E. coli*.
  - Observations **above** the defined value 'M' are considered to have Unacceptable levels of *E. coli*.
  - The observations between 'm' and 'M' are considered to have Marginal levels of *E. coli*.

6.5 Company Group ESAM Report

XYZ Group

E. coli and *Salmonella* Monitoring Report

LAMB

Reporting Period:
Jan-2015 to Dec-2015

Generated
February 16, 2016 at 22:28

Prepared by
Jessica Tan
SARDI Food Safety Research
GPO Box 397
ADELAIDE, SA 5001, Australia
Ph: +61 8 8303 9771
Fax: +61 8 8303 9424

Government of South Australia

SARDI RESEARCH AND DEVELOPMENT INSTITUTE

1 Total Viable Count Summary

1.1 TVC Counts

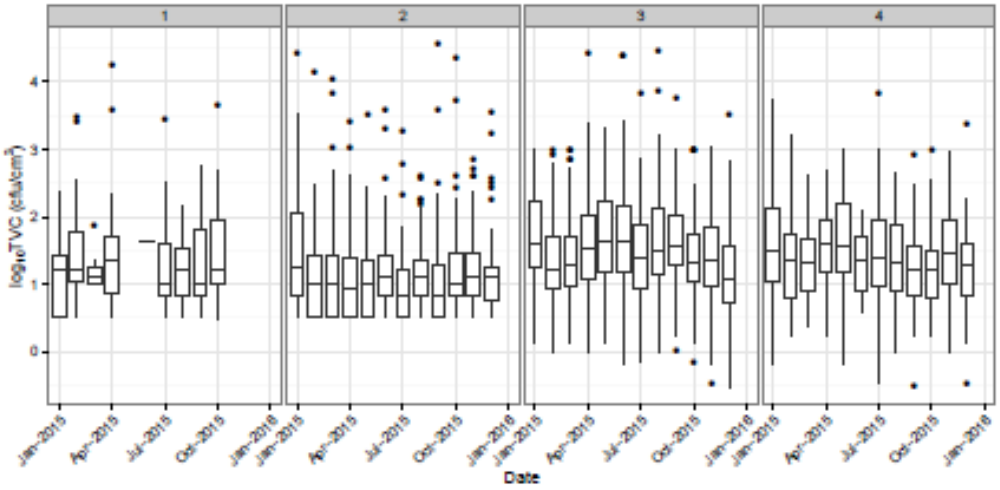


Figure 1: Box plot of monthly Total Viable Counts for XYZ Group plants **in the last 12 months**.

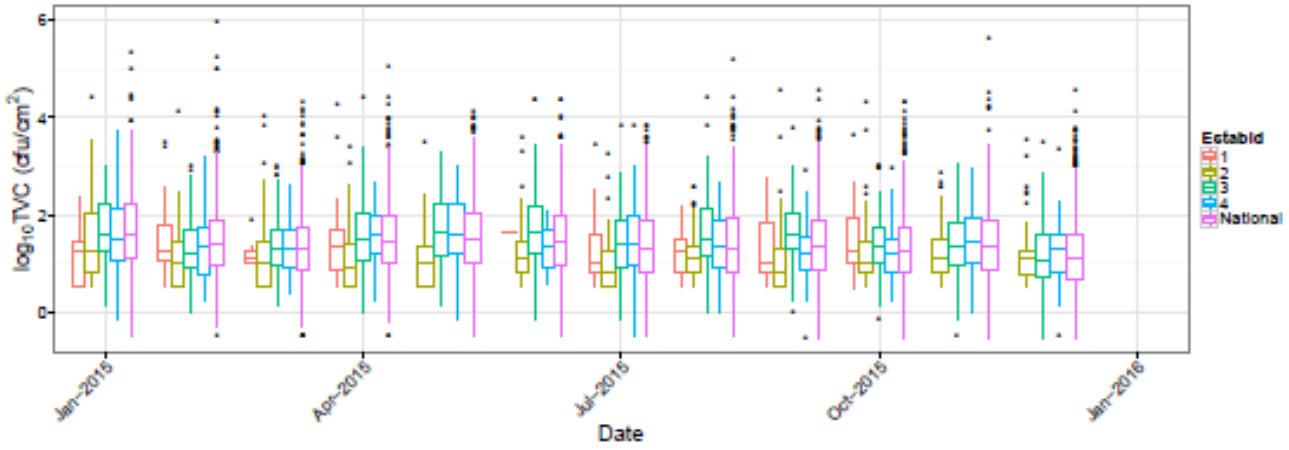


Figure 2: Box plot of monthyly Total Viable Counts for XYZ Group plants and all establishments (national) **in the last 12 months**.

Table 1: Total Viable Count summary **nationally** ($\log_{10}$ cfu/cm^2) for samples where TVC was greater than the limit of detection.The Overall data is of the last 12 months.

	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Mean (+ve)	1.393	1.423	1.416	1.308	1.422	1.209	1.439
SD	0.782	0.814	0.768	0.767	0.775	0.789	0.776

Table 2: Total Viable Count summary.

	Plant 1						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Mean (+ve)	1.314	1.230	1.299	1.469	NA	NA	1.356
SD	0.824	0.474	0.708	0.791	NA	NA	0.749

Table 3: Total Viable Count summary.

	Plant 2						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Mean (+ve)	0.995	1.158	1.083	1.218	1.258	1.133	1.174
SD	0.511	0.523	0.737	0.728	0.549	0.617	0.657

Table 4: Total Viable Count summary.

	Plant 3						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Mean (+ve)	1.459	1.640	1.653	1.384	1.396	1.149	1.490
SD	0.832	0.727	0.603	0.588	0.630	0.631	0.689

Table 5: Total Viable Count summary.

	Plant 4						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Mean (+ve)	1.472	1.375	1.242	1.246	1.474	1.234	1.408
SD	0.734	0.613	0.629	0.617	0.642	0.632	0.667

1.2 TVC Prevalence

Table 6: Total Viable Count prevalence summary **nationally**. The Overall data is of the last 12 months.

	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**878**	**1135**	**1076**	**1251**	**1255**	**947**	**13453**
Positives	**717**	**947**	**862**	**980**	**1037**	**765**	**10973**
Percent +ve	**81.66**	**83.44**	**80.11**	**78.34**	**82.63**	**80.78**	**81.56**

Table 7: Total Viable Count prevalence summary.

	Plant 1						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**24**	**24**	**29**	**29**	**NA**	**NA**	**188**
Positives	**18**	**17**	**21**	**26**	**NA**	**NA**	**154**
Percent +ve	**75.00**	**70.83**	**72.41**	**89.66**	**NA**	**NA**	**81.92**

Table 8: Total Viable Count prevalence summary.

	Plant 2						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**135**	**126**	**133**	**121**	**132**	**122**	**1481**
Positives	**86**	**88**	**68**	**71**	**95**	**72**	**954**
Percent +ve	**63.70**	**69.84**	**51.13**	**58.68**	**71.97**	**59.02**	**64.42**

Table 9: Total Viable Count prevalence summary.

	Plant 3						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**42**	**151**	**160**	**161**	**174**	**159**	**1696**
Positives	**42**	**151**	**160**	**161**	**174**	**159**	**1694**
Percent +ve	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**99.88**

Table 10: Total Viable Count prevalence summary.

	Plant 4						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**59**	**52**	**57**	**64**	**62**	**51**	**609**
Positives	**59**	**52**	**57**	**64**	**62**	**51**	**606**
Percent +ve	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**99.51**

2 *E. coli* Summary

2.1 *E. coli* Counts

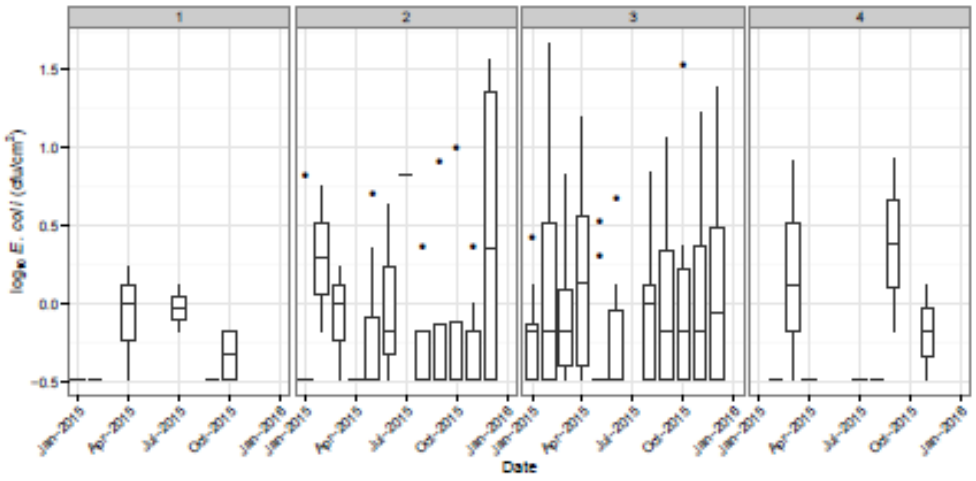


Figure 3: Box plot of monthly *E. coli* positive concentrations for XYZ Group plants **in the last 12 months**.

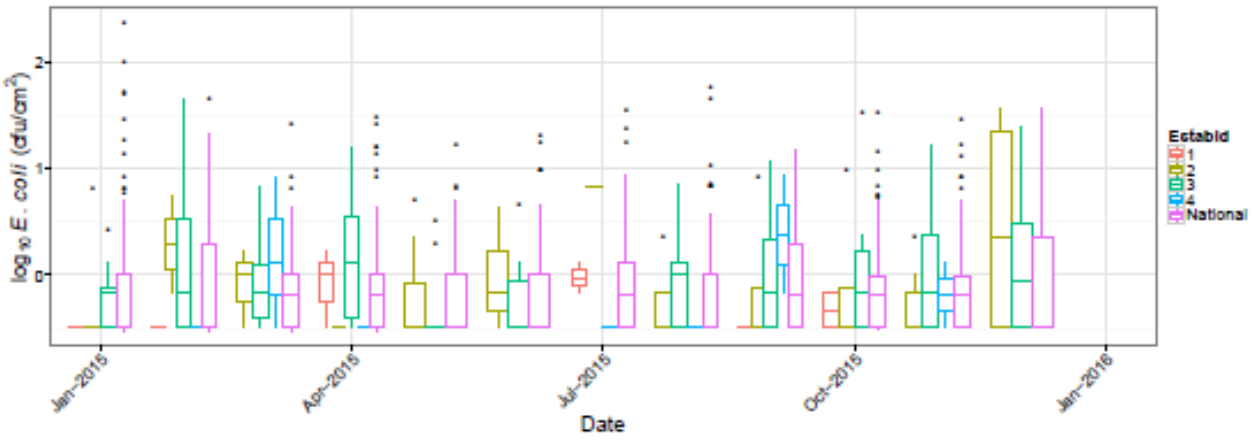


Figure 4: Box plot of monthly *E. coli* positive concentrations for XYZ Group plants and all establishments (national) **in the last 12 months**.

Table 11: *E. coli* counts summary **nationally** ($\log_{10}$ cfu/cm^2) for samples where *E. coli* was detected. The Overall data is of the last 12 months.

	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Mean (+ve)	-0.084	-0.148	-0.050	-0.161	-0.115	-0.050	-0.121
SD	0.481	0.481	0.497	0.433	0.464	0.563	0.483

Table 12: *E. coli* counts summary ($\log_{10}$ cfu/cm^2) for samples where *E. coli* was detected.

	Plant 1						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Mean (+ve)	-0.030	NA	-0.481	-0.328	NA	NA	-0.288
SD	0.204	NA	NA	0.178	NA	NA	0.256

Table 13: *E. coli* counts summary ($\log_{10}$ cfu/cm^2) for samples where *E. coli* was detected.

	Plant 2						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Mean (+ve)	0.826	-0.299	-0.131	-0.111	-0.288	0.466	-0.126
SD	NA	0.301	0.700	0.741	0.290	0.978	0.542

Table 14: *E. coli* counts summary ($\log_{10}$ cfu/cm^2) for samples where *E. coli* was detected.

	Plant 3						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Mean (+ve)	NA	-0.048	0.016	-0.079	0.012	0.115	-0.055
SD	NA	0.418	0.489	0.556	0.599	0.709	0.506

Table 15: *E. coli* counts summary ($\log_{10}$ cfu/cm^2) for samples where *E. coli* was detected.

	Plant 4						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Mean (+ve)	-0.481	-0.481	0.382	NA	-0.184	NA	-0.193
SD	NA	0.000	0.786	NA	0.421	NA	0.503

2.2 *E. coli* Prevalence

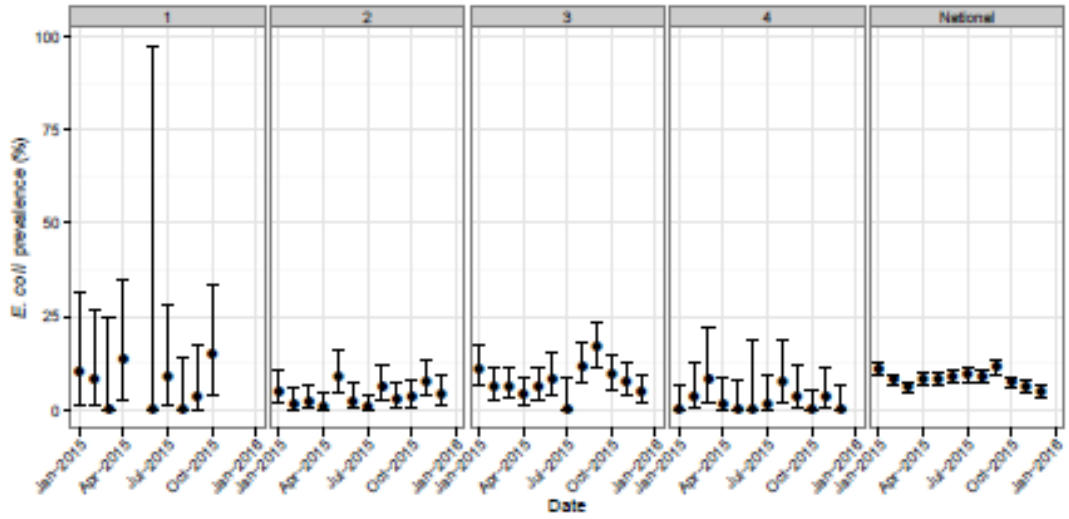


Figure 5: Plot of monthly *E. coli* prevalence for XYZ Group plants and all establishments (national) **in the last 12 months** - the black dots indicate the estimated prevalence in each month (as a percentage) and the bars indicate 95% confidence intervals for each estimate.

Table 16: *E. coli* prevalence summary **nationally**. The Overall data is of the last 12 months.

	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**876**	**1134**	**1076**	**1251**	**1251**	**947**	**13442**
Positives	**82**	**99**	**122**	**93**	**79**	**47**	**1098**
Percent +ve	**9.36**	**8.73**	**11.34**	**7.43**	**6.32**	**4.96**	**8.17**

Table 17: *E. coli* prevalence summary.

	Plant 1						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**23**	**24**	**29**	**27**	**NA**	**NA**	**183**
Positives	**2**	**0**	**1**	**4**	**NA**	**NA**	**14**
Percent +ve	**8.70**	**0.00**	**3.45**	**14.81**	**NA**	**NA**	**7.65**

Table 18: *E. coli* prevalence summary.

	Plant 2						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**135**	**125**	**133**	**121**	**132**	**122**	**1480**
Positives	**1**	**8**	**4**	**4**	**10**	**5**	**58**
Percent +ve	**0.74**	**6.40**	**3.01**	**3.31**	**7.58**	**4.10**	**3.92**

Table 19: *E. coli* prevalence summary.

	Plant 3						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**42**	**151**	**160**	**161**	**174**	**159**	**1696**
Positives	**0**	**18**	**27**	**15**	**13**	**8**	**141**
Percent +ve	**0.00**	**11.92**	**16.88**	**9.32**	**7.47**	**5.03**	**8.31**

Table 20: *E. coli* prevalence summary.

	Plant 4						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**59**	**52**	**57**	**64**	**59**	**51**	**606**
Positives	**1**	**4**	**2**	**0**	**2**	**0**	**15**
Percent +ve	**1.70**	**7.69**	**3.51**	**0.00**	**3.39**	**0.00**	**2.48**

3 Coliform Summary

3.1 Coliform Counts

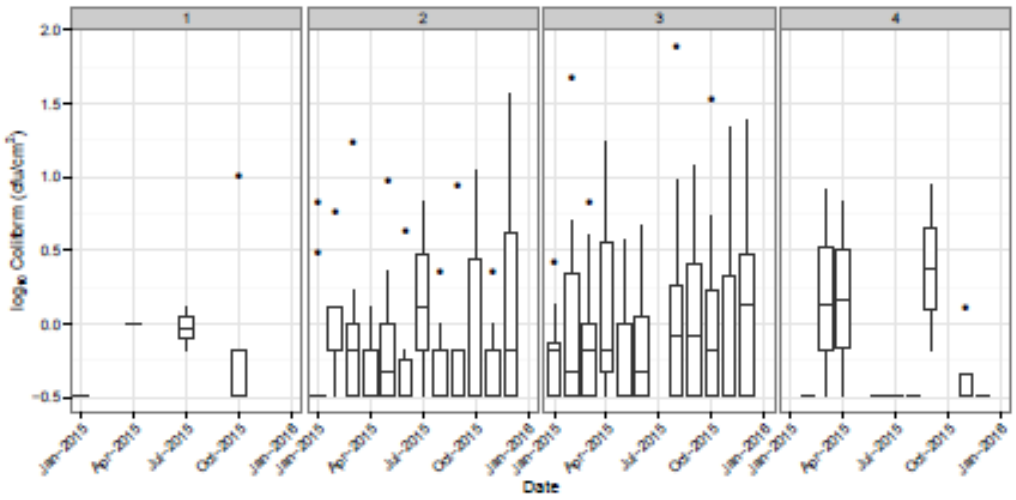


Figure 6: Box plot of monthly coliform positive concentrations for XYZ Group plants **in the last 12 months**.

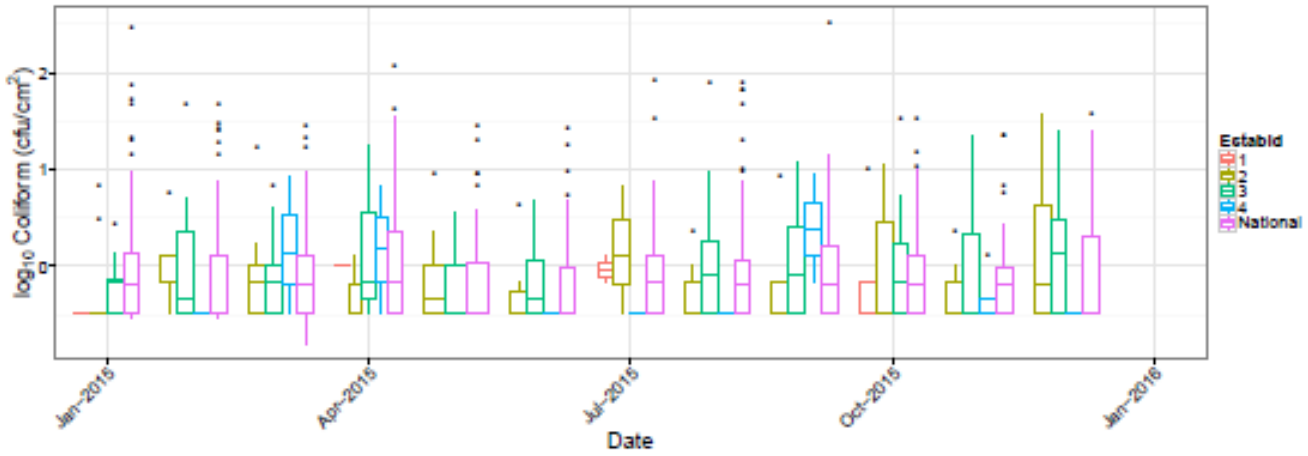


Figure 7: Box plot of monthyly coliform positive concentrations for XYZ Group plants and all establishments (national) **in the last 12 months**.

Table 21: Coliform counts summary **nationally** ($\log_{10}$ cfu/cm^2) for samples where coliforms was detected. The Overall data is of the last 12 months.

	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Mean (+ve)	-0.057	-0.081	-0.069	-0.097	-0.192	-0.048	-0.099
SD	0.495	0.568	0.533	0.490	0.397	0.584	0.510

Table 22: Coliform counts summary ($\log_{10}$ cfu/cm^2) for samples where coliforms was detected.

	Plant 1						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Mean (+ve)	-0.030	NA	NA	-0.062	NA	NA	-0.133
SD	0.204	NA	NA	0.613	NA	NA	0.454

Table 23: Coliform counts summary ($\log_{10}$ cfu/cm^2) for samples where coliforms was detected.

	Plant 2						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Mean (+ve)	0.153	-0.300	-0.136	-0.021	-0.248	0.187	-0.133
SD	0.655	0.304	0.616	0.718	0.265	0.858	0.503

Table 24: Coliform counts summary ($\log_{10}$ cfu/cm^2) for samples where coliforms was detected.

	Plant 3						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Mean (+ve)	NA	0.029	0.009	-0.060	-0.041	0.178	-0.044
SD	NA	0.624	0.507	0.554	0.608	0.662	0.528

Table 25: Coliform counts summary ($\log_{10}$ cfu/cm^2) for samples where coliforms was detected.

	Plant 4						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Mean (+ve)	-0.481	-0.481	0.382	NA	-0.333	-0.481	-0.213
SD	NA	0.000	0.786	NA	0.298	NA	0.499

3.2 Coliform Prevalence

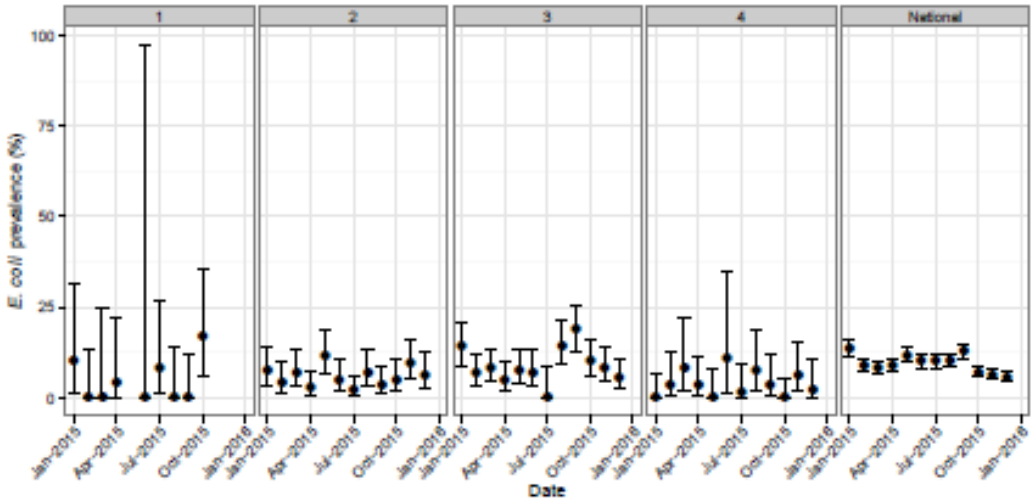


Figure 8: Plot of monthly coliform prevalence for XYZ Group plants and all establishments (national) **in the last 12 months** - the black dots indicate the estimated prevalence in each month (as a percentage) and the bars indicate 95% confidence intervals for each estimate.

Table 26: Coliform prevalence summary **nationally**. The Overall data is of the last 12 months.

	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**837**	**1086**	**1043**	**1171**	**1197**	**894**	**12695**
Positives	**85**	**111**	**132**	**85**	**79**	**53**	**1197**
Percent +ve	**10.15**	**10.22**	**12.66**	**7.26**	**6.60**	**5.93**	**9.43**

Table 27: Coliform prevalence summary.

	Plant 1						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**24**	**24**	**29**	**29**	**NA**	**NA**	**188**
Positives	**2**	**0**	**0**	**5**	**NA**	**NA**	**10**
Percent +ve	**8.33**	**0.00**	**0.00**	**17.24**	**NA**	**NA**	**5.32**

Table 28: Coliform prevalence summary.

	Plant 2						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**135**	**125**	**133**	**121**	**132**	**122**	**1480**
Positives	**3**	**9**	**5**	**6**	**13**	**8**	**90**
Percent +ve	**2.22**	**7.20**	**3.76**	**4.96**	**9.85**	**6.56**	**6.08**

Table 29: Coliform prevalence summary.

	Plant 3						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**42**	**151**	**160**	**161**	**174**	**159**	**1697**
Positives	**0**	**22**	**30**	**17**	**15**	**9**	**162**
Percent +ve	**0.00**	**14.57**	**18.75**	**10.56**	**8.62**	**5.66**	**9.55**

Table 30: Coliform prevalence summary.

	Plant 4						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**59**	**52**	**57**	**64**	**62**	**51**	**609**
Positives	**1**	**4**	**2**	**0**	**4**	**1**	**21**
Percent +ve	**1.70**	**7.69**	**3.51**	**0.00**	**6.45**	**1.96**	**3.45**

4 Salmonella Summary

Table 31: *Salmonella* prevalence summary **nationally**. The Overall data is of the last 12 months.

	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**177**	**223**	**197**	**240**	**249**	**176**	**2598**
Positives	**0**	**0**	**1**	**1**	**0**	**0**	**4**
Percent +ve	**0.00**	**0.00**	**0.51**	**0.42**	**0.00**	**0.00**	**0.15**

Table 32: *Salmonella* prevalence summary.

	Plant 1						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**5**	**4**	**6**	**6**	**NA**	**NA**	**36**
Positives	**0**	**0**	**0**	**0**	**NA**	**NA**	**0**
Percent +ve	**0.000**	**0.000**	**0.000**	**0.000**	**NA**	**NA**	**0.000**

Table 33: *Salmonella* prevalence summary.

	Plant 2						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**28**	**24**	**23**	**24**	**26**	**23**	**290**
Positives	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Percent +ve	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Table 34: *Salmonella* prevalence summary.

	Plant 3						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**9**	**30**	**33**	**31**	**36**	**34**	**341**
Positives	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Percent +ve	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Table 35: *Salmonella* prevalence summary.

	Plant 4						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**10**	**10**	**12**	**13**	**12**	**9**	**114**
Positives	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Percent +ve	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

5 Glossary of Terms

5.1 Prevalence summary

Tests: The total number of samples (TVC, *E. coli* or *Salmonella*) in the ESAM database during the reporting period.

Positives: The number of samples with positive concentrations (ie. concentrations > 0).

Percent +ve: 100 $\times$ Positives/Tests.

Lower Bound & Upper Bound: Lower and Upper 95% Confidence Bounds. The "true" prevalence is expected to be in this range.

5.2 TVC and *E. coli* concentration summary

All concentration data are converted into logarithms with base 10, given by $\log_{10}$ cfu/cm^2.

Mean: The average.

Standard Deviation (SD): A measure of spread (or variability) about the mean.

5.3 Box plot

A graphical tool to assess the data.

- The solid dot is the median.
- The box contains half the data.
- The lower and upper bounds of the box are the 1st and 3rd quartile.
- The inter-quartile range (IQR) = Q3 - Q1
- The length of the whiskers is calculated by $\pm 1.5\times$ IQR. The end of the whiskers corresponds to the observation in the dataset that is closest to this defined value.
- Observations falling outside the extent of the whiskers are indicated separately. Values falling far outside the whiskers indicate unusual or extreme values.

6.6 Comparison of shifts report

Plant XXX Shift Comparison

E. coli and *Salmonella* Monitoring Report

COW/BULL

Reporting Period:
Jan-2015 to Dec-2015

Generated
February 16, 2016 at 20:45

Prepared by
Jessica Tan
SARDI Food Safety Research
GPO Box 397
ADELAIDE, SA 5001, Australia
Ph: +61 8 8303 9771
Fax: +61 8 8303 9424

Government of South Australia

SARDI RESEARCH AND DEVELOPMENT INSTITUTE

1 Total Viable Count Summary

1.1 TVC Counts

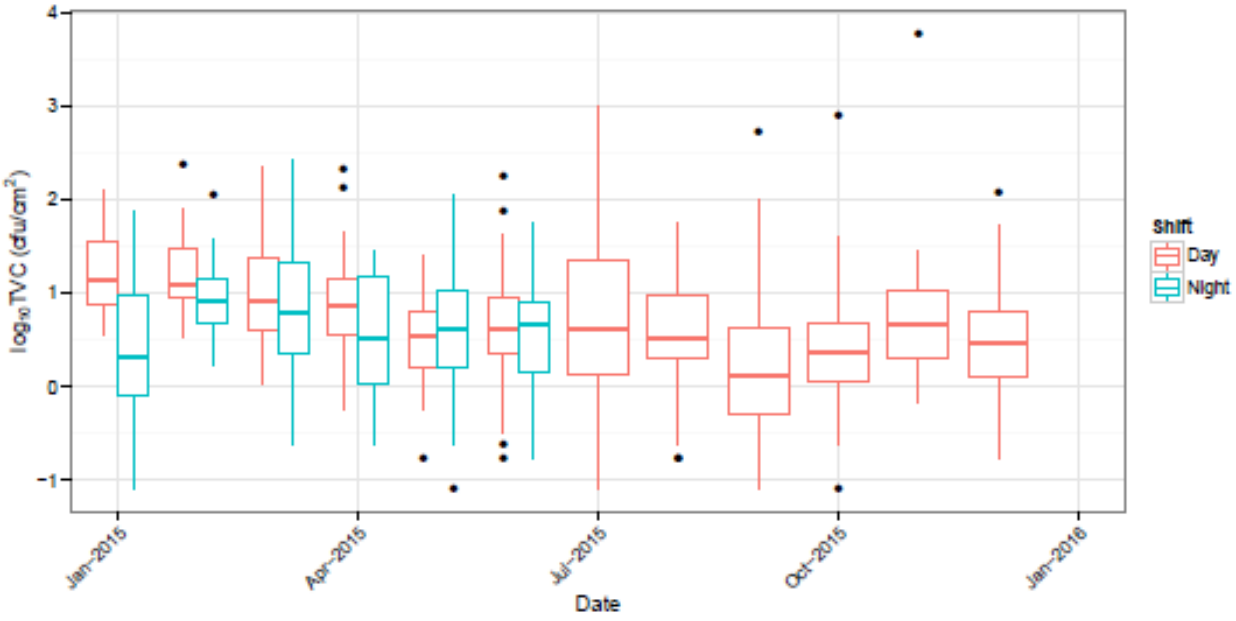


Figure 1: Box plot of monthly Total Viable Counts for Plant XXX shifts **in the last 12 months**.

Table 1: Total Viable Count summary.

	Plant XXX: Day Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Median	0.611	0.522	0.124	0.375	0.677	0.477	0.677
Mean (+ve)	0.734	0.539	0.262	0.422	0.728	0.528	0.719
SD	0.872	0.637	0.823	0.728	0.739	0.644	0.725

Table 2: Total Viable Count summary.

	Plant XXX: Night Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Median	NA	NA	NA	NA	NA	NA	0.692
Mean (+ve)	NA	NA	NA	NA	NA	NA	0.657
SD	NA	NA	NA	NA	NA	NA	0.661

1.2 TVC Prevalence

Table 3: Total Viable Count prevalence summary.

	Plant XXX: Day Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**33**	**32**	**35**	**32**	**29**	**31**	**356**
Positives	**33**	**31**	**35**	**32**	**29**	**31**	**355**
Percent +ve	**100.00**	**96.88**	**100.00**	**100.00**	**100.00**	**100.00**	**99.72**

Table 4: Total Viable Count prevalence summary.

	Plant XXX: Night Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**139**
Positives	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**139**
Percent +ve	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**100.00**

1.3 TVC Counts: Carton Testing

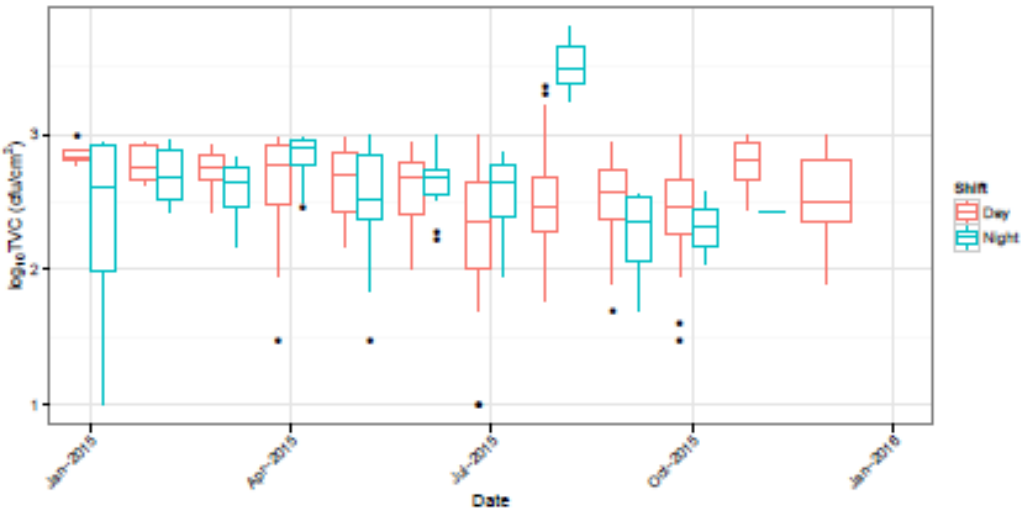


Figure 2: Box plot of monthly Total Viable Counts from cartons for Plant XXX shifts **in the last 12 months**.

Table 5: Total Viable Count summary for cartons.

	Plant XXX: Day Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Median	2	2	3	2	3	2	3
Mean (+ve)	2	2	3	2	3	3	3
SD	0.46	0.39	0.33	0.35	0.16	0.30	0.36

Table 6: Total Viable Count summary for cartons.

	Plant XXX: Night Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Median	3	3	2	2	2	NA	3
Mean (+ve)	3	4	2	2	2	NA	3
SD	0.31	0.27	0.35	0.38	NA	NA	0.39

1.4 TVC Prevalence: Carton Testing

Table 7: Total Viable Count prevalence summary for cartons.

	Plant XXX: Day Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**36**	**36**	**25**	**34**	**17**	**24**	**281**
Positives	**36**	**36**	**25**	**34**	**17**	**24**	**281**
Percent +ve	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table 8: Total Viable Count prevalence summary for cartons.

	Plant XXX: Night Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**11**	**3**	**6**	**2**	**1**	**NA**	**85**
Positives	**11**	**3**	**6**	**2**	**1**	**NA**	**85**
Percent +ve	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**NA**	**100.00**

2 *E. coli* Summary

2.1 *E. coli* Counts

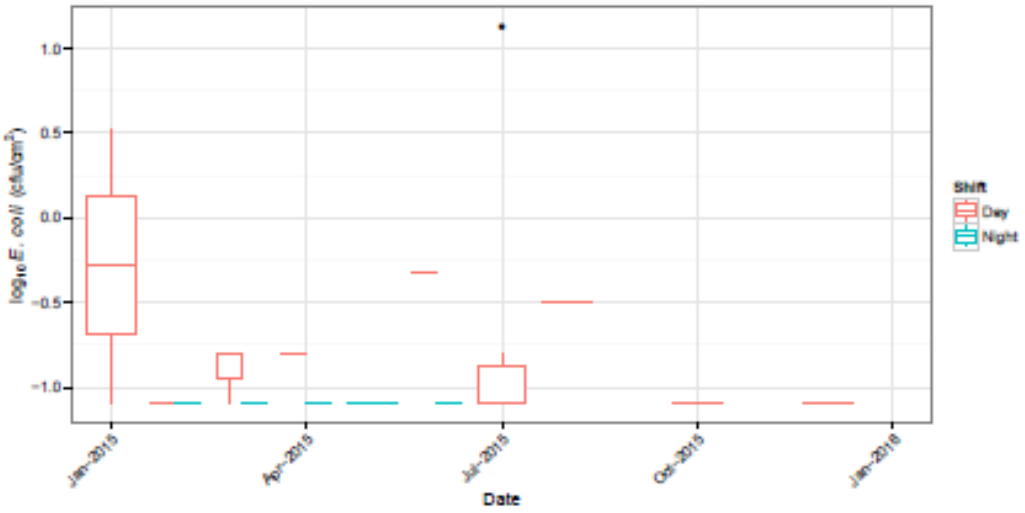


Figure 3: Box plot of monthly *E. coli* positive concentrations for Plant XXX shifts **in the last 12 months**.

Table 9: *E. coli* counts summary ($\log_{10}$ cfu/cm^2) for samples where *E. coli* was detected.

	Plant XXX: Day Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Median	-1.097	-0.495	NA	-1.097	NA	-1.097	-1.097
Mean (+ve)	-0.675	-0.495	NA	-1.097	NA	-1.097	-0.775
SD	0.893	NA	NA	0.000	NA	NA	0.601

Table 10: *E. coli* counts summary ($\log_{10}$ cfu/cm^2) for samples where *E. coli* was detected.

	Plant XXX: Night Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Median	NA	NA	NA	NA	NA	NA	-1.097
Mean (+ve)	NA	NA	NA	NA	NA	NA	-1.097
SD	NA	NA	NA	NA	NA	NA	0.000

2.2 *E. coli* Prevalence

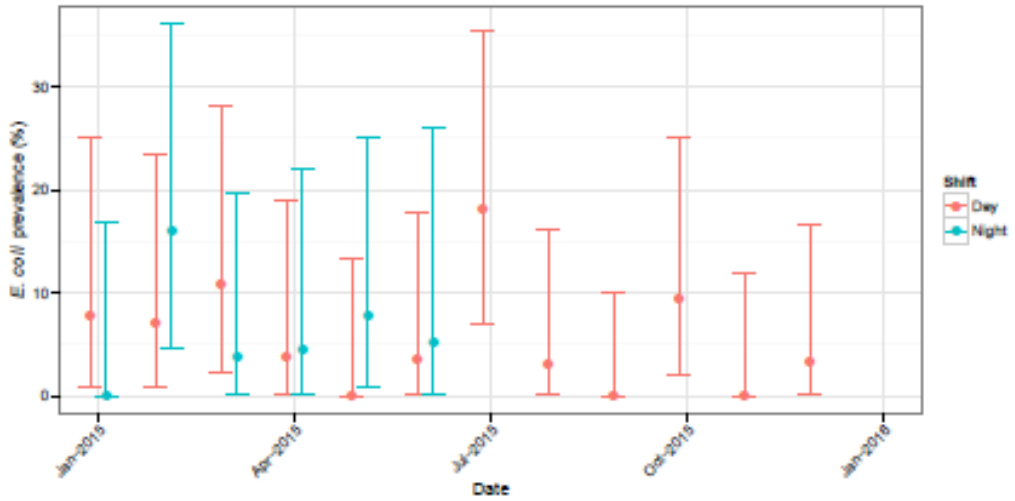


Figure 4: Plot of monthly *E. coli* prevalence for Plant XXX shifts **in the last 12 months** - the black dots indicate the estimated prevalence in each month (as a percentage) and the bars indicate 95% confidence intervals for each estimate.

Table 11: *E. coli* prevalence summary.

	Plant XXX: Day Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**33**	**32**	**35**	**32**	**29**	**31**	**356**
Positives	**6**	**1**	**0**	**3**	**0**	**1**	**20**
Percent +ve	**18.18**	**3.12**	**0.00**	**9.38**	**0.00**	**3.23**	**5.62**

Table 12: *E. coli* prevalence summary.

	Plant XXX: Night Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**139**
Positives	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**9**
Percent +ve	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**6.47**

3 Coliform Summary

3.1 Coliform Counts

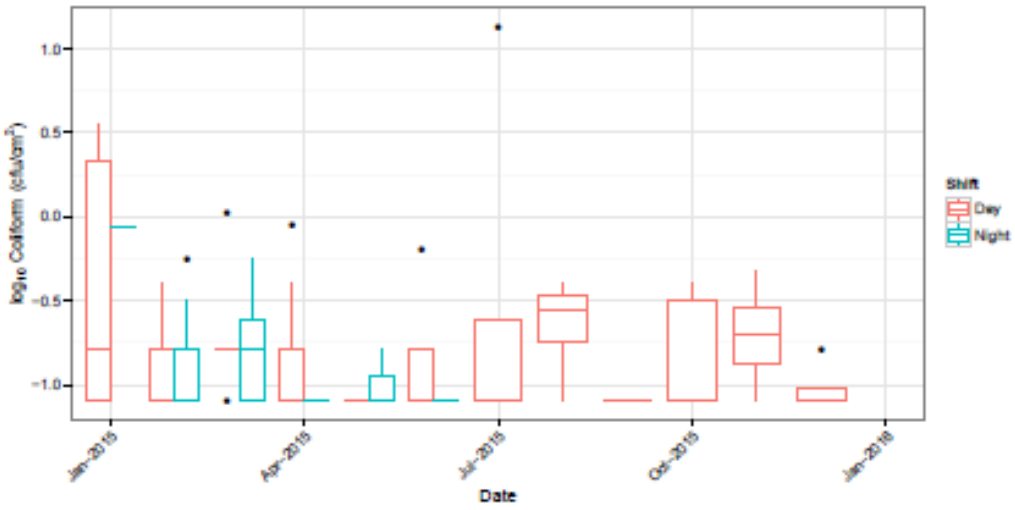


Figure 5: Box plot of monthly coliform positive concentrations for Plant XXX shifts **in the last 12 months**.

Table 13: Coliform counts summary ($\log_{10}$ cfu/cm^2) for samples where coliforms was detected.

	Plant XXX: Day Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Median	-1.097	-0.557	-1.097	-1.097	-0.708	-1.097	-0.946
Mean (+ve)	-0.737	-0.652	-1.097	-0.837	-0.708	-1.022	-0.776
SD	0.657	0.310	NA	0.358	0.326	0.151	0.460

Table 14: Coliform counts summary ($\log_{10}$ cfu/cm^2) for samples where coliforms was detected.

	Plant XXX: Night Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Median	NA	NA	NA	NA	NA	NA	-1.097
Mean (+ve)	NA	NA	NA	NA	NA	NA	-0.868
SD	NA	NA	NA	NA	NA	NA	0.325

3.2 Coliform Prevalence

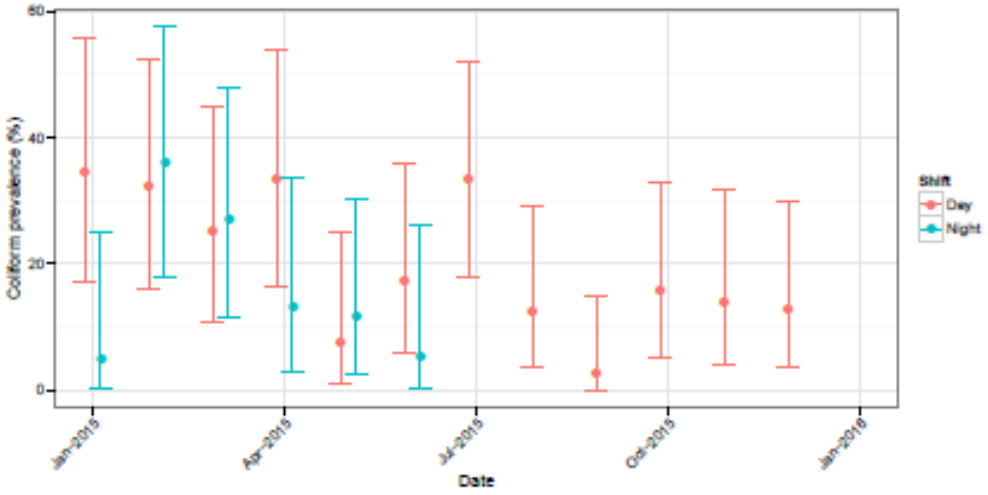


Figure 6: Plot of monthly coliform prevalence for Plant XXX shifts **in the last 12 months** - the black dots indicate the estimated prevalence in each month (as a percentage) and the bars indicate 95% confidence intervals for each estimate.

Table 15: Coliform prevalence summary.

	Plant XXX: Day Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**33**	**32**	**35**	**32**	**29**	**31**	**356**
Positives	**11**	**4**	**1**	**5**	**4**	**4**	**70**
Percent +ve	**33.33**	**12.50**	**2.86**	**15.62**	**13.79**	**12.90**	**19.66**

Table 16: Coliform prevalence summary.

	Plant XXX: Night Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**139**
Positives	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**24**
Percent +ve	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**17.27**

3.3 Coliform Counts: Carton Testing

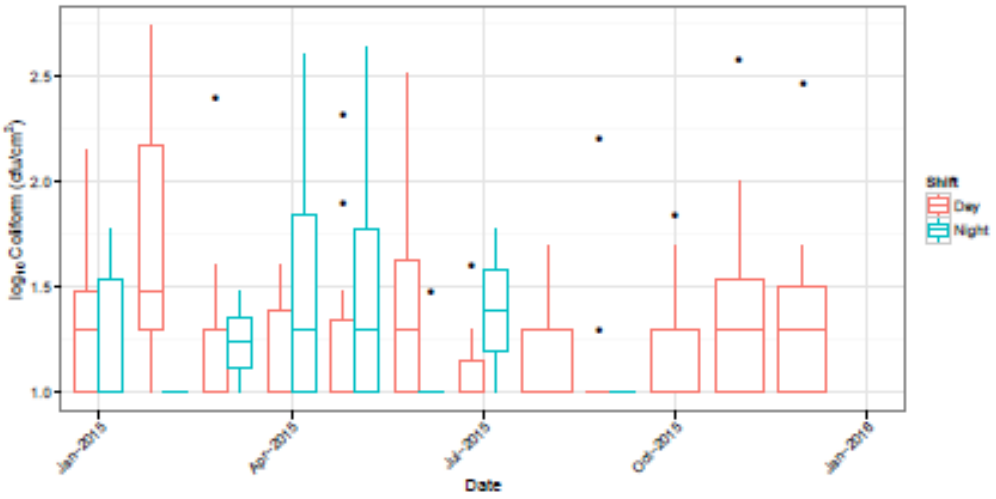


Figure 7: Box plot of monthly coliform positive concentrations from cartons for Plant XXX shifts **in the last 12 months**.

Table 17: Coliform counts summary ($\log_{10}$ cfu/cm^2) for carton samples where coliforms was detected.

	Plant XXX: Day Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Median	1.000	1.301	1.000	1.000	1.301	1.301	1.301
Mean (+ve)	1.129	1.229	1.167	1.222	1.373	1.345	1.335
SD	0.237	0.256	0.401	0.305	0.420	0.433	0.418

Table 18: Coliform counts summary ($\log_{10}$ cfu/cm^2) for carton samples where coliforms was detected.

	Plant XXX: Night Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Median	1.389	NA	1.000	NA	NA	NA	1.000
Mean (+ve)	1.389	NA	1.000	NA	NA	NA	1.336
SD	0.550	NA	0.000	NA	NA	NA	0.481

3.4 Coliform Prevalence: Carton Testing

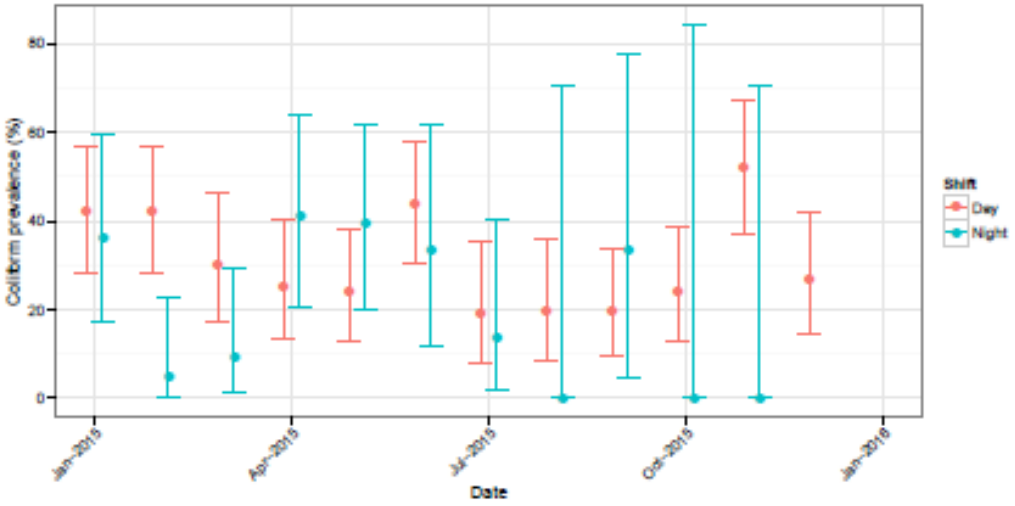


Figure 8: Plot of monthly coliform prevalence for Plant XXX shifts **in the last 12 months** - the black dots indicate the estimated prevalence in each month (as a percentage) and the bars indicate 95% confidence intervals for each estimate.

Table 19: Coliform prevalence summary for cartons.

	Plant XXX: Day Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**37**	**36**	**46**	**46**	**46**	**45**	**548**
Positives	**7**	**7**	**9**	**11**	**24**	**12**	**172**
Percent +ve	**18.92**	**19.44**	**19.57**	**23.91**	**52.17**	**26.67**	**31.39**

Table 20: Coliform prevalence summary for cartons.

	Plant XXX: Night Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**15**	**3**	**6**	**2**	**3**	**NA**	**155**
Positives	**2**	**0**	**2**	**0**	**0**	**NA**	**38**
Percent +ve	**13.33**	**0.00**	**33.33**	**0.00**	**0.00**	**NA**	**24.52**

4 Salmonella Summary

Table 21: *Salmonella* prevalence summary.

	Plant XXX: Day Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**7**	**6**	**7**	**6**	**8**	**6**	**71**
Positives	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Percent +ve	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Table 22: *Salmonella* prevalence summary.

	Plant XXX: Night Shift						
	Jul-2015	Aug-2015	Sep-2015	Oct-2015	Nov-2015	Dec-2015	Overall
Tests	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**27**
Positives	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0**
Percent +ve	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0.000**

There were no *Salmonella* detections at this establishment over the reporting period and consequently no serovar information is provided.

6.7 Explanatory Guide to the ESAM Reports

The explanatory guide to the ESAM reports was updated to reflect changes in the ESAM reports.

Explanatory Guide for the *E. coli* and *Salmonella* Monitoring (ESAM) Reports

Jessica Tan
SARDI
Phone: 08 8303 9771
Email: Jessica.Tan@sa.gov.au

Explanatory Guide for the *E. coli* and *Salmonella* Monitoring (ESAM) Reports

Background

The National Microbiological Database (NMD), also known as the ESAM database, was established to help Australia meet market access requirements to the US. Export slaughter establishments are required to collect and analyse carcase samples for *E. coli* and *Salmonella* and carton samples from all species slaughtered. From 2014, ESAM data is now reported in the Product Hygiene Index (PHI) database, with the inclusion of data on *E. coli* and *Salmonella, E. coli* O157 and *Shiga* toxin-producing *E. coli* (STECs) each month. In the ESAM database, STECs refers to the 'Big 6' non-O157 *Shiga* toxin-producing *E. coli,* O26, O45, O103, O121, O111 and O145.

The ESAM data provides useful information for benchmarking Australia's performance and can be used in market access negotiations. Meat and Livestock Australia provide funding for a reporting system for the ESAM database to be developed and to give feedback to establishments on their consolidated ESAM results. SARDI Food Safety and Innovation now provides establishments with regular (monthly) reports so that they can compare their performance with that found nationally for the same reporting period.

This guide has been developed to assist QA staff interpret their establishment's monthly ESAM reports.

The Data

The ESAM data includes a combination of descriptive or **categorical variables** and **continuous measurement variables**.

Categorical variables refer to those variables which have a finite number of values. Examples of categorical variables in the database are:

- *Species* – Calf, Cow/Bull, Steer/Heifer, Sheep, Lambs, Goat Skin on or Goat Skin off
- *Dressing* – Bed, Conventional, Gravity Rail or Inverted
- *Shift* - First, Second or Third
- *Swabbed* - Hot or Cold

At present the only categorical variables used in the reports are *Species* and *Swabbed*.

Continuous variables refer to those variables which can take on any value and are measured or counted. Examples are the concentration of *E. coli* and the Total Viable Count (cfu/cm^2).

The Reports

A separate report is generated for each species at each establishment. The species are: Calf, Cow/Bull, Steer/Heifer, Sheep, Lambs, Goat Skin On and Goat Skin Off. A separate report on *E.coli* O157 and STECs is also generated for each establishment testing for *E.coli* O157 and STECs.

Some establishments may also receive a separate Hot Swabbed report for Cow/Bull or Sheep carcases from hot boned operations.

Summary tables and graphs are presented for prevalence and positive concentrations for the individual establishment and the national baseline.

A 3-year moving window of data is used to generate the reports. Every month the oldest month is dropped from the dataset and the newest month added. The information presented in the tables is summarised over the given 3-year sampling period.

As of August 2010, monthly summaries for the most recent two months are reported to assist establishments verify the accuracy of the data entered into the ESAM database.

Definition of Terms

Prevalence

Prevalence refers to the percentage of samples found to have at least **one** colony of TVC or *E. coli*. For *Salmonella,* it is the number of samples that have recorded a **Fail** result, i.e. tested positive for *Salmonella*. This is then divided by the total number of tests performed during the sampling period and multiplied by 100 to give the percentage of positive tests. In the reports, prevalence is referred to as **Percent +ve**.

Percent +ve: Positives/Tests*100.

Where:

Tests: The total number of samples in the ESAM database during the reporting period.

Positives: The number of samples with positive concentrations (at least one colony) or a failed (positive) test.

95% Confidence Interval

A **Confidence Interval** gives a 'ballpark' of where the *true prevalence* may be. The true prevalence is unknown as not every carcase is tested and neither is the total surface area of each carcase.

The **Upper** and **Lower Bound** describe the bounds of a 95% Confidence Interval.

If nothing in the process changes, then it is expected that the prevalence in the future will lie within those bounds 95% of the time.

Note that the width of the confidence interval is influenced by the total number of tests performed during the sampling period. If only a small number of tests have been performed, it is likely that the confidence intervals will be wider. As such, the widths of the confidence intervals for the national summaries are likely to be smaller than those found at an individual establishment.

Median and Mean

The median and the mean are both measures to determine values that are typical. They describe the 'middle' of the dataset and what could be called an 'expected' concentration in the data.

The **median** describes the midpoint concentration of the data. As such, 50% of values are less than the median and 50% of values are greater than the median.

The median is a 'resistant' measure, because it is not influenced by extreme observations.

An alternate measure is the **mean** or average. It is calculated by adding all values in the sampling period and dividing by the number of tests. Because the mean is calculated from the actual values it is easily influenced by extreme observations.

Standard Deviation

The **standard deviation** is another measure of variability which is commonly used in conjunction with the mean. The standard deviation is also susceptible to the effects of unusually large or small observations.

- For those who are not mathematically inclined, it is sufficient to know that the standard deviation is calculated by looking at how far each observation is from the mean of the observations.
- For the mathematically inclined, a description of the calculation can be found on Wikipedia at

  http://en.wikipedia.org/wiki/Standard_deviation#With_sample_standard_deviation.

It is important to note that the standard deviation will be small if the observations are very consistent, i.e. they lie close together. However, if the observations are inconsistent, i.e. sometimes high and sometimes low, then the standard deviation will be large.

A slaughter and dressing process with a small standard deviation produces more consistent and predictable end product.

Log_{10} Transformation

It is standard practice for microbiological concentration data to be transformed using a mathematical logarithm function (base 10), denoted by log_{10}. After this transformation, the distribution of concentrations is made more symmetrical.

The effect of the log_{10} transformation on the concentration data is also shown in Table 1.

Table 1: Pattern of counts before and after log_{10} transformation

Count		log_{10}
0.1	1×10^{-1}	-1
1	1×10^{0}	0
10	1×10^{1}	1
100	1×10^{2}	2
1,000	1×10^{3}	3
2,000	2×10^{3}	3.3
10,000	1×10^{4}	4
20,000	2×10^{4}	4.3
35,000	3.5×10^{4}	4.5
100,000	1×10^{5}	5
200,000	2×10^{5}	5.3
500,000	5×10^{5}	5.7

Note that:

- A 1 $\log_{10}$ reduction equates to a 90% reduction in the concentration on the original scale (i.e. a change from 1000 to 100 or 10,000 to 1000, etc).
- A 2 $\log_{10}$ reduction equates to a 99% reduction in the concentration on the original scale (i.e. a change from 10,000 to 100 or 100,000 to 1000 etc).
- A 3 $\log_{10}$ reduction equates to a 99.9% reduction in the concentration on the original scale (i.e. a change from 100,000 to 100, etc).

The original count can be obtained from the transformed value by performing the reverse transformation. This is done by calculating 10 to the power of the value of interest. For example, 2.176 $\log_{10}$ cfu/cm^2 (the $\log_{10}$ value) = $10^{2.176}$ cfu/cm^2 = 150 cfu/cm^2 (the original value).

Limit of Detection and Minimum Concentration

The AQIS Meat Notice (2003/6) includes procedures to convert concentrations to cfu/cm^2 of carcase surface. This conversion includes information regarding the number of colonies found, the appropriate dilution factor and the sampling factor. The sampling factor relates to the amount of surface area that each ml of the undiluted sample represents.

For cows/bulls, steers/heifers and pigs the sampling factor is:

- 0.08 cfu/cm^2
- On the transformed scale this is -1.097 $\log_{10}$ cfu/cm^2.

For sheep, lambs, calves and goats the sampling factor is:

- 0.33 cfu/cm^2
- On the transformed scale this is -0.48 $\log_{10}$ cfu/cm^2.

For an undiluted sample with **no colonies** and a sampling factor of 0.08 the concentration is estimated to be **less than** the limit of detection or <0.08 cfu/cm^2.

Similarly for an undiluted sample with **no colonies** and a sampling factor of 0.33 the concentration is estimated to be **less than** the limit of detection or <0.33 cfu/cm^2.

For an undiluted sample with **one colony** and a sampling factor of 0.08 the concentration is estimated to be **equal** to the limit of detection or 0.08 cfu/cm^2.

Similarly, for an undiluted sample with **one colony** and a sampling factor of 0.33 the concentration is estimated to be **equal** to the limit of detection or 0.33 cfu/cm^2.

Therefore, it is expected that the minimum $\log_{10}$ concentration (i.e. 1 colony) reported in the tables should be equal to the $\log_{10}$ of the sampling factor for that species. In other words, the minimum concentration (on the $\log_{10}$ scale) that can be expected in the tables should be:

- -1.097 $\log_{10}$ cfu/cm^2 for cows/bulls, steers/heifers and pigs and
- -0.48 $\log_{10}$ cfu/cm^2 for sheep, lambs, calves and goats.

If minimum values less than these are reported in the summary tables, then QA staff should check the original records to ensure that the data were entered correctly and/or the dilution and method of analysis used by the laboratory (see also Example 7).

Percentiles and Quartiles

Percentiles are those points where only a pre-determined percentage of values exceed the percentile. They are useful for making statements about the process.

90th Percentile: 90% of the data are less than this value, 10% are greater.

95th Percentile: 95% of the data are less than this value, 5% are greater.

99th Percentile: 99% of the data are less than this value, 1% are greater.

A special percentile is the **median**, which equals the 50^{th} percentile. Two other special percentiles are the 25^{th} and the 75^{th} percentiles – these are also known as **quartiles**.

The **first or lower quartile (Q1)** is the value which divides the data set in such a way that one quarter (25%) of the data fall below and three quarters (75%) of the data fall above Q1.

The **third or upper quartile (Q3)** is the value which divides the data set in such a way that three quarters (75%) of the data fall below and one quarter (25%) of the data fall above Q3.

Inter-Quartile Range (IQR)

The **inter-quartile range (IQR)** is the difference between **Q3** and **Q1** (IQR = Q3 – Q1). It describes the range of the middle 50% of concentrations found in the data set. Because it uses only the middle 50% of data, it is not affected by unusual or extreme observations.

Box Plot

A box plot is a convenient way to present groups of data. It utilises the descriptive statistics from above, namely the minimum, Q1, median, Q3 and maximum. Box plots help to identify differences between groups (in the reports between months) of concentrations, showing the spread of the data within each sampling month. They can also help to identify seasonal trends and extreme or unexpected concentrations. In the box plots, the $\log_{10}$ concentrations are summarised on a monthly basis over the 3-year period for only **positive samples**. See Appendix 1 for some additional details on box plots.

Time Plot

In the time plots, all observations are used on the original (untransformed) scale, including negative samples (or those less than the limit of detection).

This plot can be used to detect 'hot spots' or periods where contamination is more common. They may also assist in summarising the number of 'alerts' an establishment has had over the sampling period.

Examples: Main Concepts

Example 1: Median and Mean

The following $\log_{10}$ concentration data (11 values) are ordered from lowest to highest:

-0.22	0.16	0.23	0.30	0.48	**0.69**	0.75	0.97	1.10	1.32	1.57

The **median** or midpoint corresponds to the 6th largest observation and equals **0.69** $\log_{10}$ cfu/cm^2. Five samples are below the median and five are above. If there were an even number of observations we would have two midpoints. The median is then defined as being halfway between these two midpoints.

The **mean** is calculated by adding up all the concentrations and dividing by 11 (the sample size). For this example, the mean is 0.67 $\log_{10}$ cfu/cm^2.

Note that the mean and median concentrations are very similar. Therefore, it can be concluded that there are few (if any) highly unusual observations in the data. Of course, this is easily verified in such a small dataset, but more difficult in a larger dataset, such as those obtained from the ESAM database. In those cases, unusual observations are assessed better with the box plots.

Example 2: Effect of data entry error on median and mean

This is the same data, but the largest observation has been changed from 1.57 to ***4.57***, as might occur if a data entry error had been made.

-0.22	0.16	0.23	0.30	0.48	**0.69**	0.75	0.97	1.10	1.32	***4.57***

The **median** again corresponds to the 6th largest observation and equals **0.69** $\log_{10}$ cfu/cm^2. Five observations are below the median and five are above. It is unaffected by the change in the largest value.

The **mean** is again calculated by adding up all the concentrations and dividing by 11. For this example, the mean is 0.94 $\log_{10}$ cfu/cm^2. This shows how the mean concentration is influenced (shifted upwards in this case) by an unusual (or extreme) observation.

Example 3: Inter-Quartile Range (IQR)

The $\log_{10}$ concentration (n=11) data presented in **Example 1** is reproduced below.

-0.22	0.16	***0.23***	0.30	0.48	**0.69**	0.75	0.97	***1.10***	1.32	1.57

The median, as shown earlier, is **0.69** $\log_{10}$ cfu/cm^2.

To determine the lower quartile (Q1), the median of the five observations **less** than the median value of 0.69 is taken. This gives a value of ***0.23*** $\log_{10}$ cfu/cm^2.

To determine the upper quartile (Q3), the median of the five observations **above** the median value of 0.69 is taken. This gives a value of ***1.10*** $\log_{10}$ cfu/cm^2.

To determine the **inter-quartile range**, the difference between Q3 and Q1 is taken. That is, the **IQR** = 1.10 – 0.23 = **0.87**.

Example 4: Standard Deviation (SD)

The following example contains two data sets of $\log_{10}$ concentrations.

Data 1	0.8	0.9	1.0	1.1	1.2
Data 2	0.4	0.7	1.0	1.3	1.6

Both data sets have the same sample mean of 1.0 $\log_{10}$ cfu/cm^2. However, the standard deviation for Data 1 equals 0.16 $\log_{10}$ cfu/cm^2, while that for Data 2 equals 0.47 $\log_{10}$ cfu/cm^2. Therefore, the process from which Data 1 originate is more likely to produce more consistent results.

Examples: Interpretation of the Reports

Example 1: Prevalence summary for TVC

A TVC prevalence summary is shown in Table 1.

Table 1: Total Viable Count prevalence summary for an establishment and nationally

	This Establishment			National
	2 Months Ago	Last Month	Last 3 Years	Last 3 Years
Tests	**36**	**26**	**1472**	**37265**
Positives	**34**	**26**	**1462**	**30535**
Percent +ve	**94.44**	**100.00**	**99.32**	**81.94**
Lower bound	81.34	86.77	*98.75*	*81.55*
Upper bound	99.32	100.00	*99.67*	*82.33*

Interpretation:

- Of the 30535 positive TVC samples found nationally, 1462 (1462/30535 or 4.79%) were from this establishment.
- The prevalence (Percent +ve) at this establishment was higher than the national prevalence during the same period (99.32% versus 81.94%).
- From the national summary we can be fairly confident that the national prevalence falls between *81.55* and *82.33*%.
- From the establishment summary (Last 3 Years) it can be concluded that the slaughter and dressing process results in between *98.75* and *99.67*% of carcases with TVC above the limit of detection.

Note that the prevalence summary considers positive samples only and does not take into account the actual TVC value for the sample. This means that even though 100% of the samples could be positive, they could all be at the limit of detection (which would be acceptable) or (the other extreme) they could all be unacceptable.

Example 2: Prevalence summary for *E. coli*

An *E.coli* prevalence summary is shown in Table 2.

Table 2: E. coli prevalence summary for an establishment and nationally.

	This Establishment			National
	2 Months Ago	Last Month	Last 3 Years	Last 3 Years
Tests	**31**	**24**	**1015**	**49299**
Positives	**2**	**1**	**42**	**1817**
Percent +ve	**6.45**	**4.17**	**4.14**	**3.69**
Lower bound	0.79	0.10	*3.00*	*3.52*
Upper bound	21.42	21.12	*5.55*	*3.86*

Interpretation:

- Of the 1817 *E. coli* detections nationally, 42 (42/1817 or 2.31%) were from this establishment.
- The prevalence (Percent +ve) at this establishment was slightly higher than the national prevalence during the same period (4.14% versus 3.69%).
- From the national summary we can be fairly confident that the national prevalence falls between *3.52* and *3.86%*.
- From the summary for this establishment it can be concluded that the slaughter and dressing process results in between *3.00* and *5.55%* of carcases with *E. coli* above the limit of detection.

Note that the prevalence summary is only part of the story – it doesn't tell you how 'bad' the contamination was.

Example 3: Prevalence summary for *Salmonella*

A *Salmonella* prevalence summary is shown in Table 3.

Table 3: *Salmonella* prevalence summary for an establishment and nationally

	This Establishment			National
	2 Months Ago	Last Month	Last 3 Years	Last 3 Years
Tests	**11**	**14**	**136**	**5745**
Positives	**0**	**1**	**2**	**41**
Percent +ve	**0.000**	**7.143**	**1.471**	**0.714**
Lower bound	0.000	0.181	*0.179*	*0.513*
Upper bound	28.491	33.868	*5.211*	*0.967*

Interpretation:

- This establishment had 2 positive *salmonella* tests over the last three years, one of which occurred in the last month.
- The national prevalence of *Salmonella* is low (about 0.7%).
- The prevalence is higher at this establishment than that found nationally (1.471% compared to 0.714%).
- Compared to the national level, this establishment appears to perform worse.
- Based on the bounds of the confidence intervals, it may be expected that at this establishment as few as 17-18 carcases in 10,000 (*0.179*%) to as many as 52 carcases in 1000 (*5.211*%) contain *Salmonella*.

Example 4: Log_{10} TVC concentration summary

A log_{10} TVC concentration summary for an export establishment is compared against national levels in Table 4.

Table 4: Total Viable Count summary for an establishment and nationally (log_{10} cfu/cm2) for samples where TVC was greater than the limit of detection.

	This Establishment			National
	2 Months Ago	Last Month	Last 3 Years	Last 3 Years
Minimum	-1.097	-0.284	-1.097	-1.745
Q1	**-0.103**	**0.735**	**0.813**	**0.545**
Median	**0.530**	**1.779**	**1.447**	**0.928**
Mean (+ve)	0.648	1.671	1.375	1.063
Q3	**1.439**	**2.249**	**2.000**	**1.519**
90th Percentile	1.968	2.895	2.415	2.079
95th Percentile	2.581	3.610	2.716	2.462
99th Percentile	3.240	3.904	3.266	3.318
Maximum	3.380	3.940	4.380	6.881
SD	1.123	1.113	0.883	0.804

Interpretation:

- TVC concentrations for the last three years for this establishment were generally higher/worse than those found nationally when comparing **Q1**, **Median**, Mean, **Q3**, 90th percentile and 95th percentile.
- Microbiologists often consider a difference of 0.5 to 1 log_{10} to be of practical significance. So based on the medians (for this establishment for the last three years and nationally), this establishment could be considered to be worse than the national baseline.

Example 5: *E. coli* concentration summary

An *E. coli* concentration summary for an export establishment is compared against national levels in Table 5. Note that it is important to summarise the concentrations in context of the prevalence Table for *E. coli*, discussed in Example 2.

Table 5: *E. coli* summary for an establishment and nationally (log_{10} cfu/cm2) for samples where *E. coli* was detected.

	This Establishment			National
	2 Months Ago	Last Month	Last 3 Years	Last 3 Years
Minimum	-1.097	1.114	-1.097	-1.097
Q1	**-0.532**	**1.114**	**-1.044**	**-1.097**
Median	**0.032**	**1.114**	**-0.770**	**-1.097**
Mean (+ve)	0.032	1.114	-0.557	-0.784
Q3	**0.597**	**1.114**	**-0.496**	**-0.620**
90th Percentile	0.936	1.114	0.515	-0.081
95th Percentile	1.048	1.114	1.159	0.384
99th Percentile	1.139	1.114	1.298	1.147
Maximum	1.161	1.114	1.383	3.079
SD	1.597	NA	0.688	0.545

Interpretation:

- Example 2 demonstrated that 4.14% of samples from this establishment were found to have *E. coli* above the limit of detection, compared to only 3.69% nationally (Percent +ve).
- It can be concluded from the above summary for the national data that although *E.coli* was detected in 1817 samples (from Table 2), 50% of these had concentrations that were at the limit of detection (using the **Median**). *Consequently, QA Managers may wish to check that data are entered correctly, namely that values "< 0.08" are entered as "0" rather than as "0.08".*
- In addition, for this establishment over the last three years, 75% of samples where *E. coli* was detected had concentrations less than $10^{-0.496}$ = 0.32 cfu/cm^2 (using Q3) and 90% were less than $10^{0.515}$ = 3.27 cfu/cm^2 (using the 90th percentile).
- There is no standard deviation for the data for the last month because there was only one *E. coli* detection. Calculating a standard deviation requires two or more observations.

Example 6: Box plot of monthly TVC

Box plots of monthly Total Viable Counts for one establishment and all establishments are shown in Figure 1.

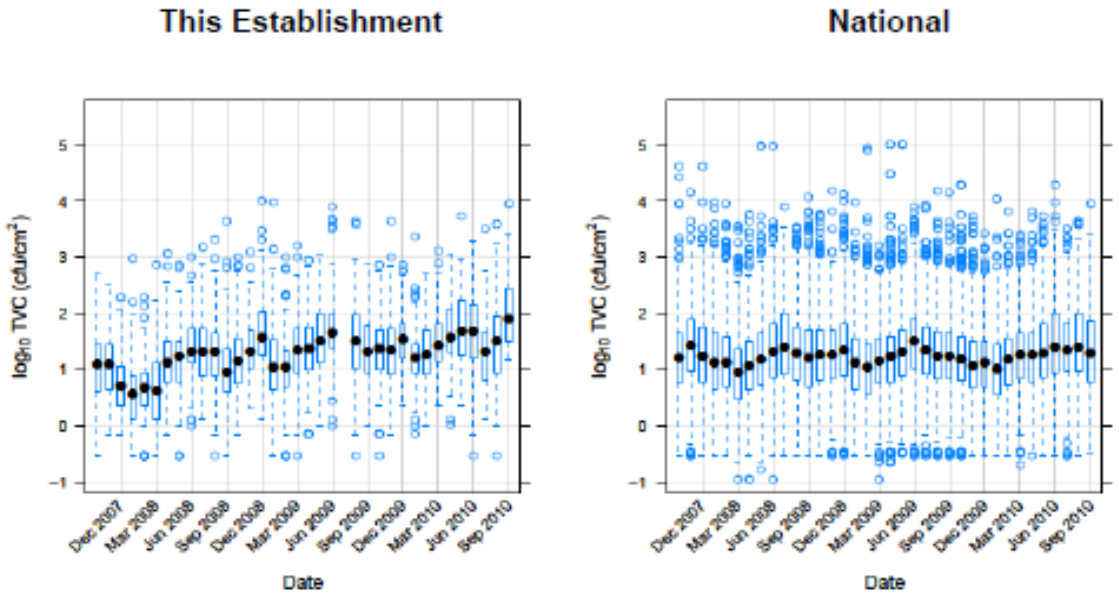


Figure 1: Box plot of monthly Total Viable Counts for an establishment and all establishments

Interpretation:

- The concentrations of TVC at this establishment are reasonably similar to those found nationally over the 3 year sampling period (the monthly median is around 1-1.5 $\log_{10}$ cfu/cm^2).
- Over the three years, the median $\log_{10}$ TVC concentration appears to have increased. In particular there appears to be an increase over the most recent three months.
- There are short term trends, for example, the consistent increase from September 2008 to December 2008. *Could there be a reason for these?*

Example 7: Box plot of monthly *E. coli* Counts

Box plots of monthly *E. coli* counts for one establishment and all establishments are shown in Figure 2.

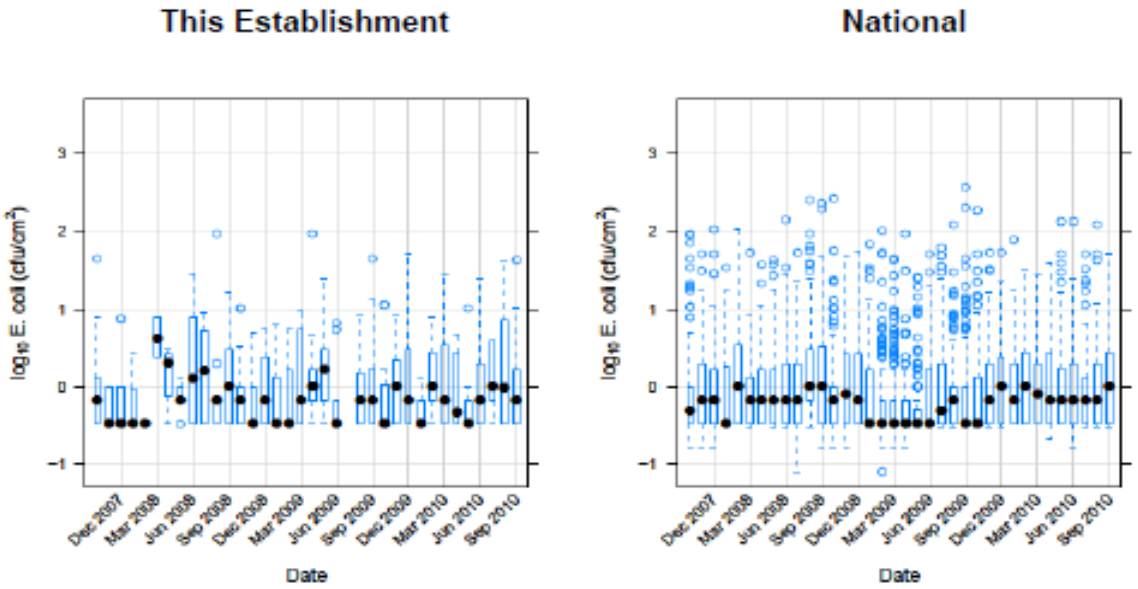


Figure 2: Box plot of monthly *E. coli* positive concentrations for an establishment and all establishments

Interpretation:

- The concentrations for samples where *E. coli* was detected at this establishment are similar to those found nationally over the 3 year sampling period, although some months show some higher values (e.g. March 2008).
- The lowest *E. coli* values should be -0.48 $\log_{10}$ cfu/cm^2 for this species, unless different sized areas were sampled or different dilutions were undertaken. Consequently, concentrations below the limit of detection should be checked to ensure they are 'real'. Note that this is not an issue for this establishment.
- There are several months for which the extreme observations (indicated by small circles) for this establishment are considerably higher than the remainder of that month's *E. coli* concentrations, e.g. April 2009 and May 2010. These extreme observations should, as far as possible, be investigated.

Example 8: Box plot of monthly individual establishment and national TVC counts

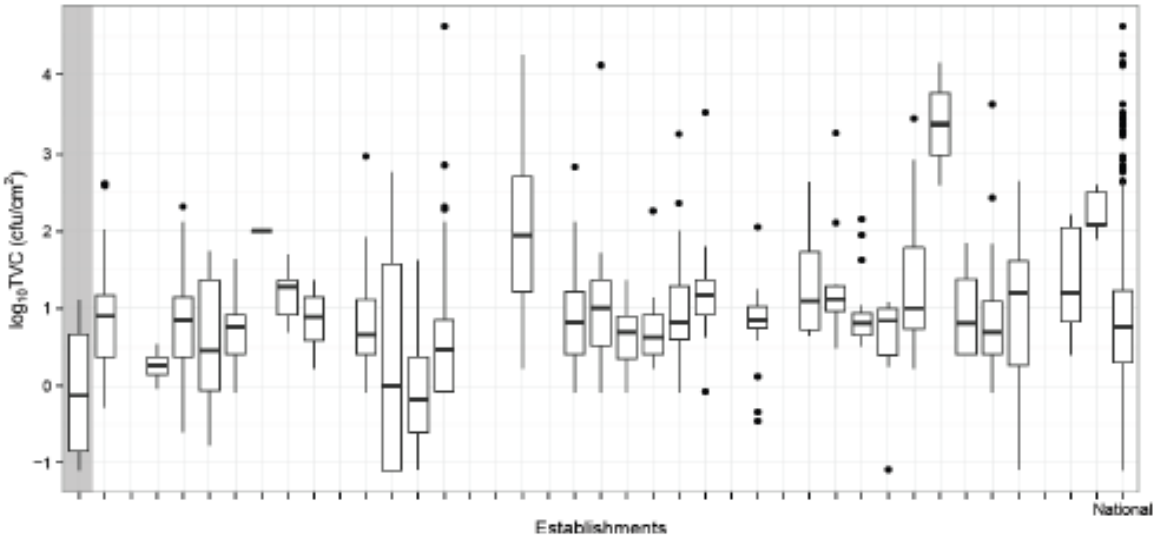


Figure 3: Box plots of this month's Total Viable Counts for all establishments individually and combined into a National box plot. The results for an establishment are identified by the grey background.

Interpretation:

- The concentrations of TVC vary between establishments - some plants have higher counts on average compared to other establishments.
- The variability in results within establishments also ranges from tight, short box plots to spread-out, long box plots.
- Establishment results can be benchmarked against national results in the right-most box plot.

Example 9: Box plot of monthly individual establishment and national E.coli counts

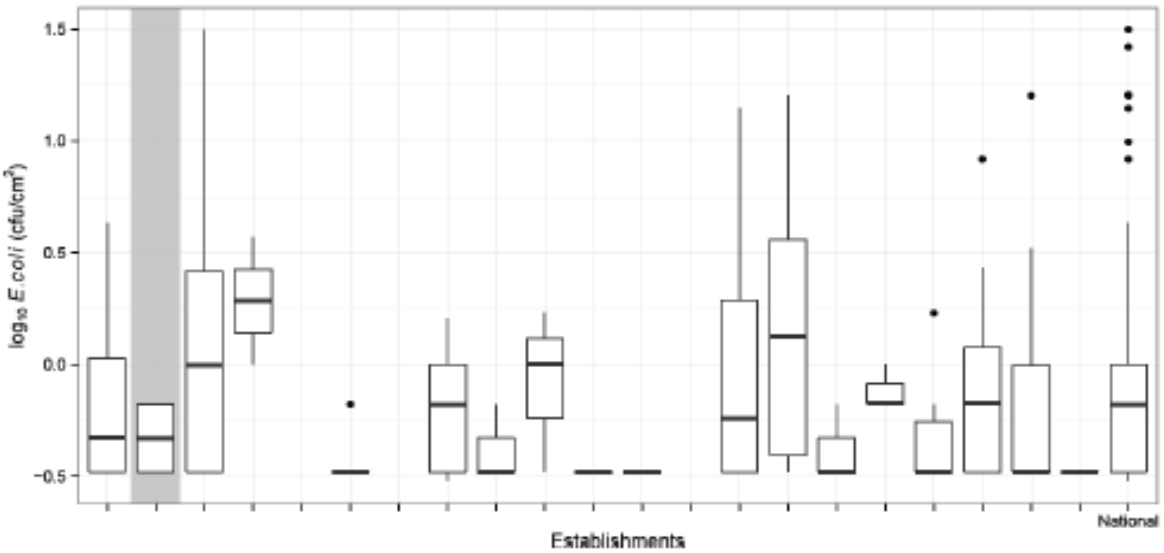


Figure 4: Box plots of this month's *E. coli* counts for all establishments individually and combined into a National box plot. The results for an establishment are identified by the grey background.

Interpretation:

- The concentrations of *E. coli* vary between establishments – some plants have higher counts on average compared to other establishments.
- The variability in results within establishments also ranges from tight, short box plots to spread-out, long box plots.
- Establishment results can be benchmarked against national results in the right-most box plot.

Example 10: Time plot for the concentration of *E. coli*

The time plot for the concentration of *E. coli* for one establishment and all establishments are shown in Figure 5. In the time plot:

- Tests where *E. coli* was detected are represented as red dots.
- Tests where *E. coli* was not detected are represented as blue open circles.
- Red (dashed) horizontal lines show the marginal 'm' and unacceptable 'M' limits for that species, as defined in Appendix 1 of AQIS Meat Notice 2003/6. For the species in Figure 5, the values are m=5 and M=100.
  - Observations below or equal to 'm' are considered to have **Acceptable** levels of *E. coli*
  - Observations above the 'M' are considered to have **Unacceptable** levels of *E. coli*
  - The observations between 'm' and 'M' are considered to have **Marginal** levels of *E. coli*.

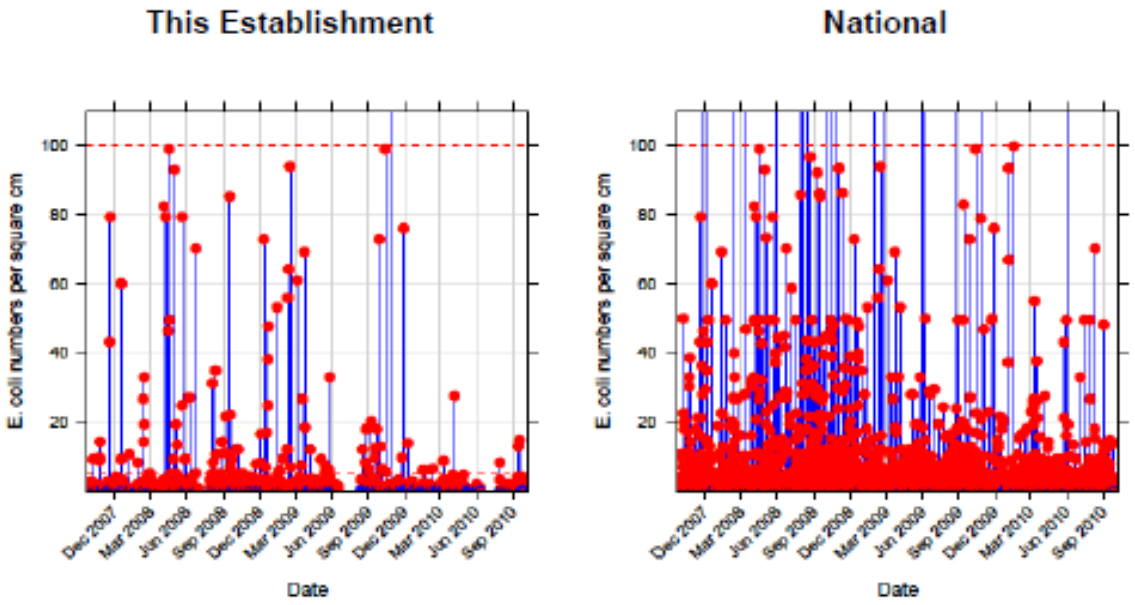


Figure 5: Time plot of *E. coli* tests for an establishment and all establishments – positive tests are presented as red points; negative tests are represented as blue circles

Interpretation:

- There seem to be some "clusters" of high values around May 2008, February/March 2009 and October/November 2009. *What could be causing these?*
- This establishment had one *E.coli* concentration that is considered unacceptable, and two that border on unacceptable.
- There have been much lower concentrations in the last few months. *Has the process been improved?*

Example 11: Box plot of monthly carcase and carton TVC

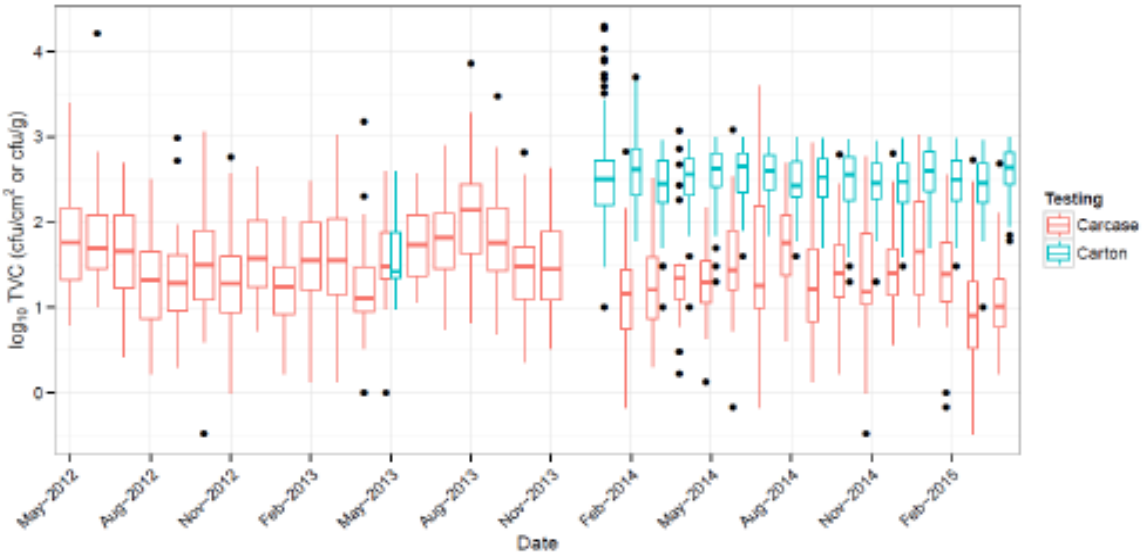


Figure 6: Box plots of Total Viable Counts for an establishment's carcase and carton results.

Interpretation:

- Carton results are fairly consistent from February 2014 to April 2015 while carcase results vary more over time.

- There were no carton results from June 2013 to December 2013 – *why might this be the case?*

Example 12: Box plot of monthly carcase and carton Coliform counts

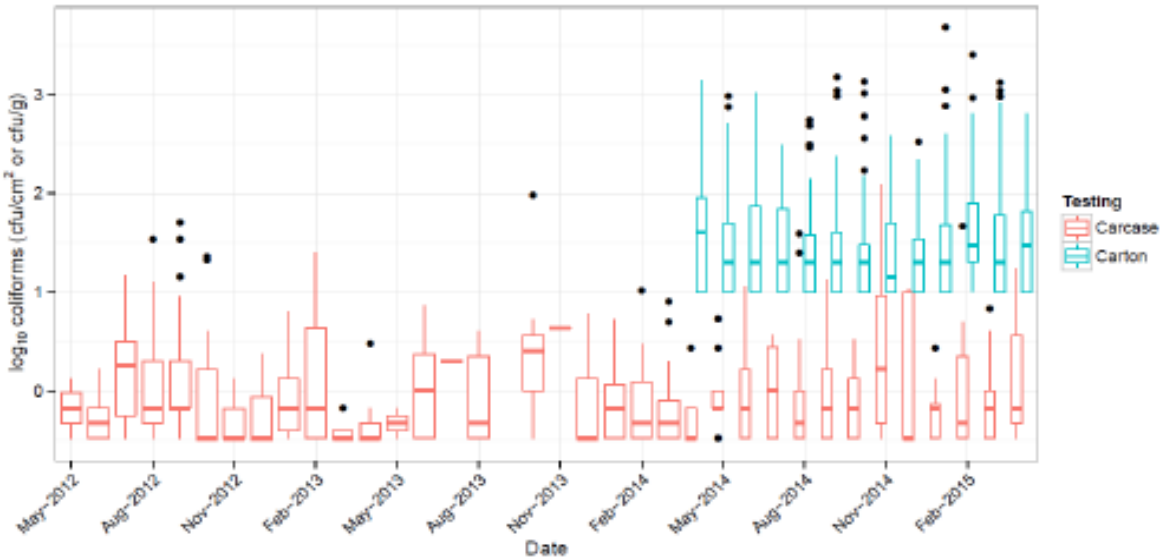


Figure 7: Box plots of Coliform counts for an establishment's carcase and carton results.

Interpretation:

- As in Example 11, monthly carcase and carton coliform results can be compared to see whether simultaneous trends occur, that is, when carcase coliform results increase/decrease, carton results also increase/decrease.

Example 13: *E. coli* O157 prevalence summary

An *E.coli* O157 prevalence summary is shown in Table 6.

Table 6: *E. coli* O157 and STEC prevalence summary for an establishment and all establishments (on-plant and DA verification tests)

	This Establishment			National
	Mar 2015	Apr 2015	Last 3 Years	Last 3 Years
Tests	**98**	**65**	**1178**	**81459**
Total Confirmed	**1**	**1**	**17**	**342**
O157	1	1	12	164
O26	0	0	3	119
O45	0	0	3	8
O103	0	0	1	36
O111	0	0	0	20
O121	0	0	0	9
O145	0	0	0	2
Percent +ve O157	**1.02**	**1.54**	**1.02**	**0.20**
Lower Bound O157	0.03	0.04	0.53	0.17
Upper Bound O157	5.55	8.28	1.77	0.23

Interpretation:

- Of the 164 *E. coli* O157 detections nationally, 12 (12/164 or 7.32%) were from this establishment.
- The prevalence of *E. coli* O157 (Percent +ve O157*)* at this establishment was five times higher than the national prevalence during the same period (1.02% versus 0.20%).
- From the national summary we can be fairly confident that the national prevalence falls between *0.17* and *0.23*%.
- From the summary for this establishment it can be concluded that the slaughter and dressing process results in between *0.53* and 1.77% of carcases with *E. coli* O157 above the limit of detection.

Example 14: Time plot for the prevalence of *E. coli* O157

Time plots of monthly *E. coli* O157 counts for one establishment and all establishments are shown in Figure 8. In the time plot:

- If *E. coli* O157 was detected in one or more tests for a particular month, then a red dot is used to indicate the number of detections in that month.
- If tests were conducted but *E. coli* O157 was not detected in a particular month, then a blue dot is used to indicate that there were zero detections in that month.
- If no tests were conducted in a particular month then there is no dot for that month.

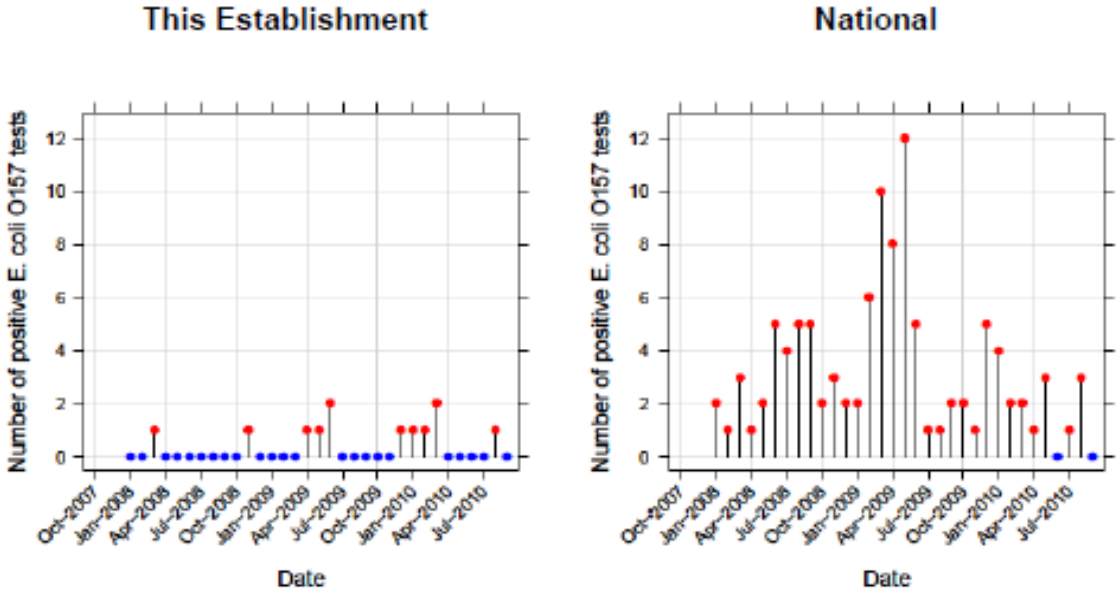


Figure 8: Time plot of confirmed detections of *E. coli* O157 for an establishment and all establishments (on-plant and DA verification tests) - no dot indicates no tests, blue dots indicate no detections and red dots indicate detections

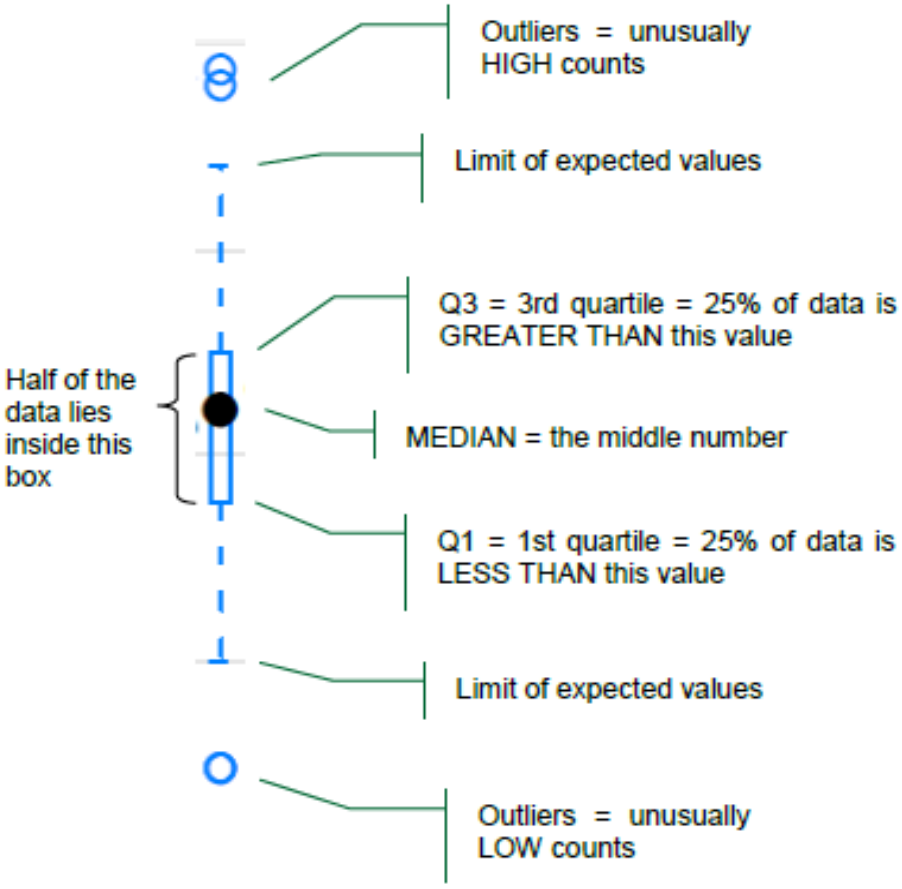
Interpretation:

- There are two clusters of detections (April 2009 to June 2009 and December 2009 to March 2010) and several apparently unrelated detections. *Is there a reason for the clusters?*

Appendix 1: The Box plot

To construct a box plot:

- Draw a box from Q1 to Q3. Half of the data will fall within this box.
- Draw the median (a dot inside the box).
- Draw the "whiskers", the length of which is at most 1.5*Inter-quartile Range. The lower whisker starts at the first observation *greater than or equal to* 1.5*Inter-quartile Range and ends at the box. The upper whisker starts at the box and ends at the last observation *less than or equal to* 1.5*Inter-quartile Range. The whiskers indicate the maximum and minimum after excluding "extreme" counts, and can be thought of as the limit of expected values.
- Observations falling outside the whiskers are indicated separately. Values falling far outside the whiskers indicate potentially unusual or extreme observations. They should be investigated (if possible) to determine the reason for such an unusual observation.



6.8 National *E. coli* O157 and STEC Monitoring Report

E. coli O157 and STEC Monitoring Report

Reporting Period:
01 Jan 2013 to 31 Dec 2015

Generated
February 4, 2016 at 14:12

Prepared by
SARDI Food Safety Research
GPO Box 397
ADELAIDE, SA 5001, Australia
Ph: +61 8 8303 9771
Fax: +61 8 8303 9424

Government of South Australia

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

1 *E. coli* O157 and STEC Summary

Table 1: *E. coli* O157 and STEC prevalence summary for all establishments (on-plant and DA verification tests).

	National
Tests	**87363**
Total Confirmed	**349**
O157	161
O26	133
O45	12
O103	33
O111	18
O121	13
O145	4
Percent +ve O157	**0.18**
Lower Bound O157	0.16
Upper Bound O157	0.22

Table 2: *E. coli* O157 and STEC prevalence summary for all establishments (DA verification tests only).

	O157	O26	O45	O103	O111	O121	O145
Tests	**1622**	**1622**	**1622**	**1622**	**1622**	**1622**	**1622**
Confirmed	**1**	**8**	**4**	**4**	**0**	**4**	**1**
Percent +ve	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Lower Bound	0.00	0.21	0.07	0.07	0.00	0.07	0.00
Upper Bound	0.34	0.97	0.63	0.63	0.23	0.63	0.34

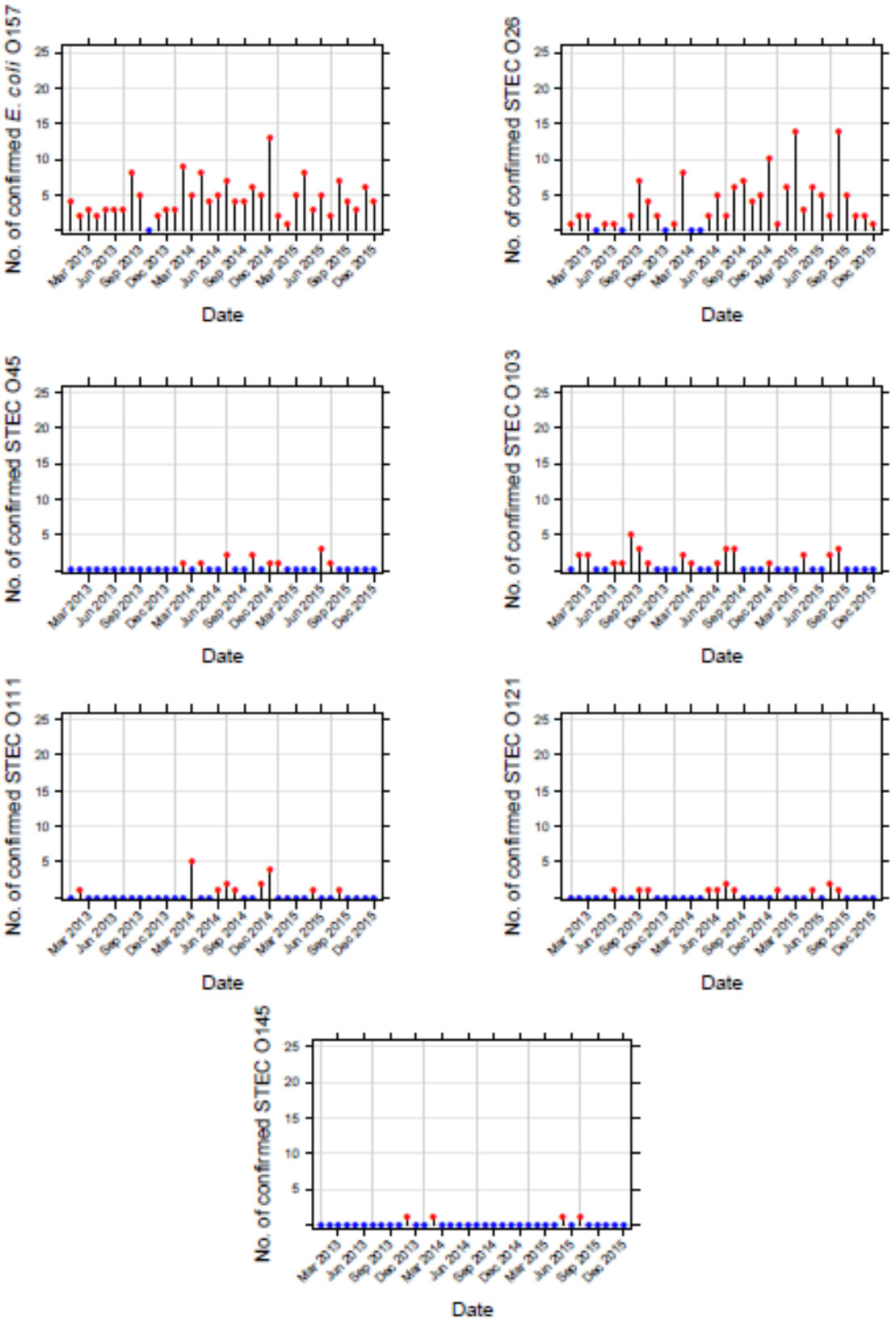


Figure 1: Time plot of positive *E. coli* O157 and STEC tests for all establishments (on-plant and DA verification tests) **over the last 3 years** — no dot indicates no tests, blue dots indicate no detections and red dots indicate detections.

Table 3: *E. coli* O157 and STEC summary for all establishments (on-plant and DA verification tests) **over the last year**.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Potential	29	32	49	30	31	42	57	85	25	19	24	22
Total Confirmed	5	7	19	13	11	11	8	23	7	3	8	4
Confirmed O157	2	1	5	8	3	5	2	7	4	3	6	4
Confirmed O26	1	6	14	3	6	5	2	14	5	2	2	1
Confirmed O45	1	0	0	0	0	3	1	0	0	0	0	0
Confirmed O103	0	0	0	2	0	0	2	3	0	0	0	0
Confirmed O111	0	0	0	0	1	0	0	1	0	0	0	0
Confirmed O121	1	0	0	0	1	0	2	1	0	0	0	0
Confirmed O145	0	0	0	0	1	0	1	0	0	0	0	0

Key:

Potential
1-5
6-10
11-15
16-20
21+

Confirmed
1-2
3-4
5-6
7-8
9+

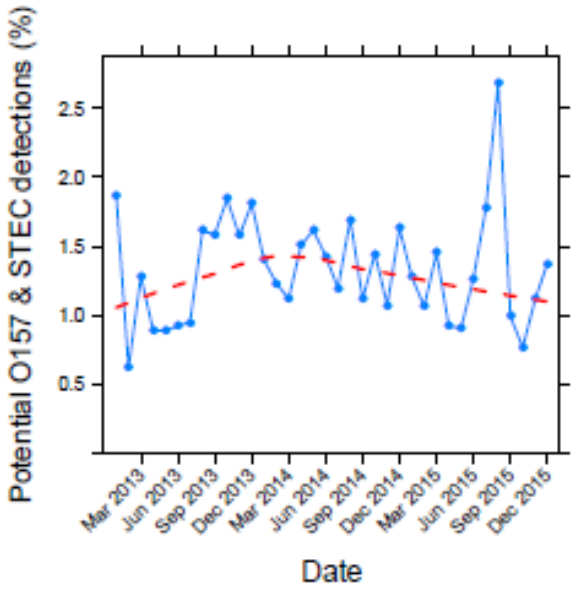


Figure 2: Potential positive *E. coli* O157 and STEC tests for all establishments (on-plant and DA verification tests) **over the last 3 years**

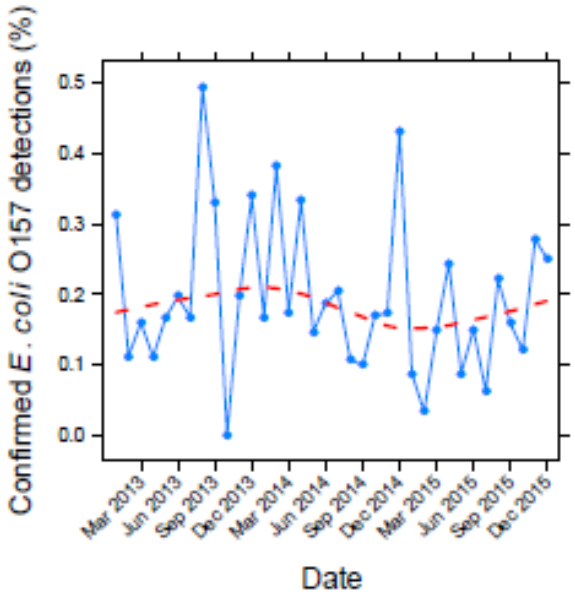


Figure 3: Confirmed positive *E. coli* O157 tests for all establishments (on-plant and DA verification tests) **over the last 3 years**

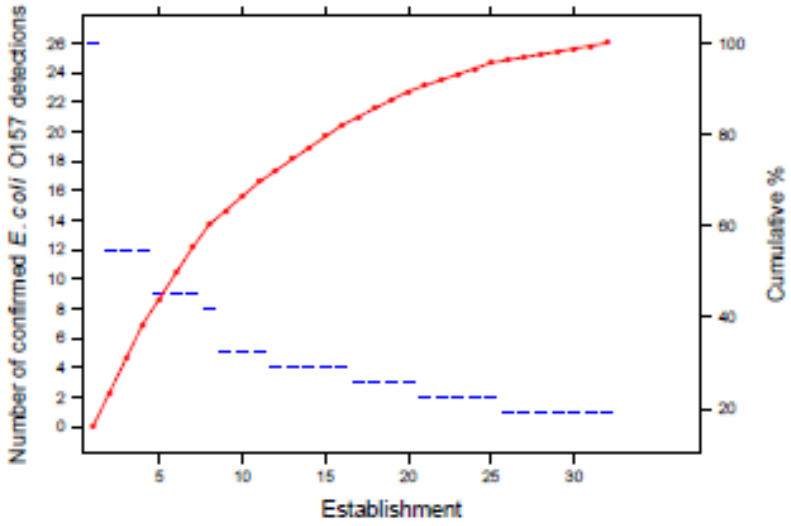


Figure 4: Number of confirmed positive *E. coli* O157 counts for each establishment (on-plant and DA verification tests) **over the last 3 years**

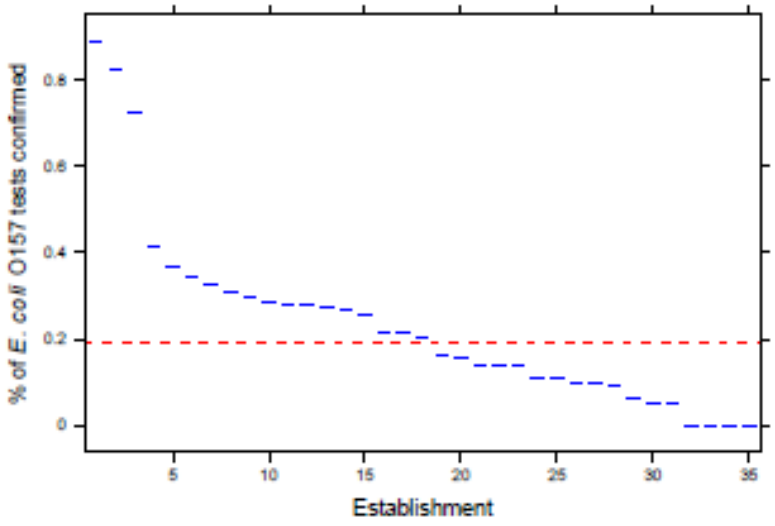


Figure 5: Percentage of confirmed positive *E. coli* O157 counts for each establishment (on-plant and DA verification tests) **over the last 3 years**. The red dashed line is the national average.

Table 4: *E. coli* O157 and STEC summary for all establishments (on-plant and DA verification tests) **over the last 3 years** - note that 12 establishments had no detections and are not included in this table.

Establishment Alias	Total Confirmed	O157	O26	O45	O103	O111	O121	O145
8126	41	26	14	0	3	1	0	0
7264	34	12	17	1	6	2	1	0
897	30	8	11	0	5	0	3	1
650	22	5	12	1	2	3	0	0
987	21	3	10	1	7	0	0	1
8432	21	12	9	3	1	0	0	0
853	20	12	8	1	0	1	2	0
762	18	9	4	0	0	5	0	0
796	17	9	2	1	2	1	2	0
720	14	1	12	0	0	0	1	0
2584	12	4	5	1	1	0	0	1
752	9	9	0	0	0	0	0	0
8965	9	4	3	0	1	1	0	0
793	8	5	0	0	1	0	1	1
833	7	3	3	0	1	1	0	0
8395	7	5	2	3	1	0	0	0
740	6	3	2	0	0	0	0	0
765	6	3	1	0	0	0	1	0
937	6	2	4	0	0	1	0	0
9198	5	1	2	0	1	1	1	0
652	4	4	0	0	0	0	0	0
677	4	2	2	0	0	0	0	0
768	4	4	0	0	0	0	0	0
8949	4	2	2	0	0	0	0	0
728	2	2	0	0	0	0	0	0
802	2	1	0	0	0	1	0	0
953	2	2	2	0	0	0	0	0
1295	2	4	0	0	0	0	0	0
1692	2	1	0	0	1	0	0	0
8860	2	0	2	0	0	0	0	0
10264	2	1	1	0	0	0	0	0
910	1	0	1	0	0	0	0	0
949	1	1	0	0	0	0	0	0
6828	1	0	0	0	0	0	1	0
7627	1	1	0	0	0	0	0	0
9456	1	0	1	0	0	0	0	0
45261	1	0	1	0	0	0	0	0

2 Glossary of Terms

2.1 Prevalence summary

Tests: The total number of samples in the ESAM database during the reporting period.

Confirmed: The number of samples where *E. coli* O157 and STECs was confirmed.

Percent +ve: 100 $\times$ Confirmed/Tests.

Lower Bound & Upper Bound: Lower and Upper 95% Confidence Bounds. The "true" prevalence is expected to be in this range.

STEC: Refers to the 'Big 6' non-O157 *Shiga* toxin-producing *E. coli* including *E. coli* O26, O45, O103, O121, O111 and O145.

6.9 Establishment *E. coli* O157 and STEC Monitoring Report

E. coli O157 and STEC Monitoring Report

Establishment XXX

Reporting Period:
01 Apr 2012 to 31 Mar 2015

Generated
May 11, 2015 at 10:17

Prepared by
SARDI Food Safety Research
GPO Box 397
ADELAIDE, SA 5001, Australia
Ph: +61 8 8303 9771
Fax: +61 8 8303 9424

1 *E. coli* O157 and STEC Summary

Table 1: *E. coli* O157 and STEC prevalence summary (on-plant and DA verification tests).

	This Establishment			National
	Feb 2015	Mar 2015	Last 3 Years	Last 3 Years
Tests	**246**	**0**	**5365**	**80040**
Total Confirmed	**0**	**0**	**14**	**334**
O157	0	0	8	156
O26	0	0	2	114
O45	0	0	1	8
O103	0	0	1	34
O111	0	0	0	20
O121	0	0	2	9
O145	0	0	0	2
Percent +ve O157	**0.00**	**NA**	**0.15**	**0.19**
Lower Bound O157	0.00	NA	0.06	0.17
Upper Bound O157	1.49	NA	0.29	0.23

Table 2: *E. coli* O157 and STEC prevalence summary (DA verification tests only).

	This Establishment						
	O157	O26	O45	O103	O111	O121	O145
Tests	**65**	**65**	**65**	**65**	**65**	**65**	**65**
Confirmed	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Percent +ve	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Lower Bound	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Bound	5.52	5.52	5.52	5.52	5.52	5.52	5.52

	National						
	O157	O26	O45	O103	O111	O121	O145
Tests	**1971**	**1707**	**1707**	**1707**	**1707**	**1707**	**1707**
Confirmed	**2**	**11**	**3**	**4**	**0**	**2**	**1**
Percent +ve	**0**	**1**	**0**	**0**	**0**	**0**	**0**
Lower Bound	0.01	0.32	0.04	0.06	0.00	0.01	0.00
Upper Bound	0.37	1.15	0.51	0.60	0.22	0.42	0.33

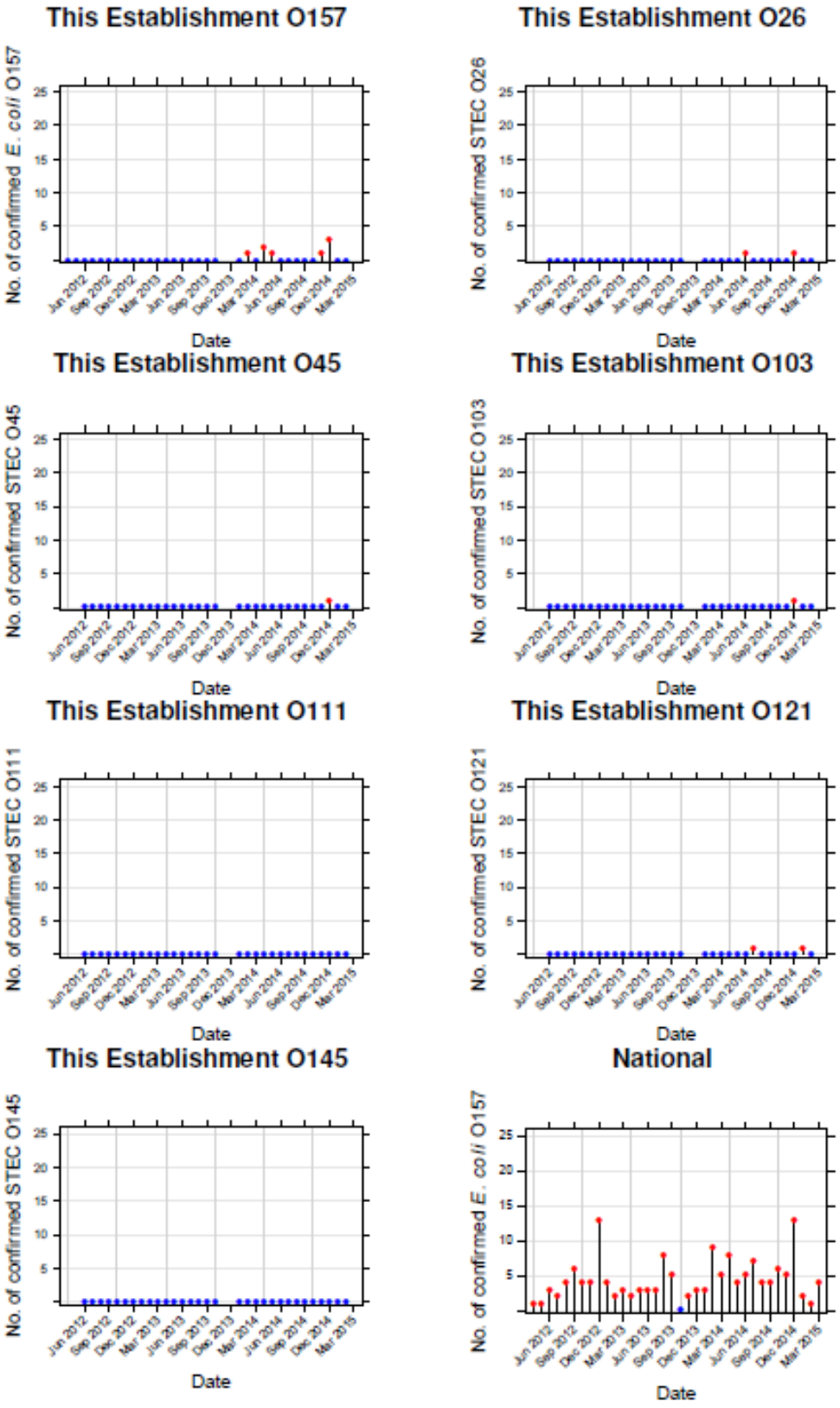


Figure 1: Time plot of confirmed detections of *E. coli* O157 and STECs for Establishment XXX and all establishments (on-plant and DA verification tests) **over the last 3 years** — no dot indicates no tests, blue dots indicate no detections and red dots indicate detections.

Table 3: Potential detections of STECs (O157 and non O157) and confirmed detections of *E. coli* O157 and STECs from on-plant tests for this establishment.

Date	Potential	Confirmed	O157	O26	O45	O103	O111	O121	O145
26/02/2014	YES	YES	1	0	0	0	0	0	0
03/03/2014	YES	NO	0	0	0	0	0	0	0
25/03/2014	YES	NO	0	0	0	0	0	0	0
02/04/2014	YES	NO	0	0	0	0	0	0	0
24/04/2014	YES	YES	1	0	0	0	0	0	0
24/04/2014	YES	YES	1	0	0	0	0	0	0
29/05/2014	YES	YES	1	0	0	0	0	0	0
26/06/2014	YES	YES	0	1	0	0	0	0	0
25/07/2014	YES	YES	0	0	0	0	0	1	0
11/09/2014	YES	NO	0	0	0	0	0	0	0
16/09/2014	YES	NO	0	0	0	0	0	0	0
31/10/2014	YES	NO	0	0	0	0	0	0	0
05/11/2014	YES	NO	0	0	0	0	0	0	0
11/11/2014	YES	NO	0	0	0	0	0	0	0
19/11/2014	YES	YES	1	0	0	0	0	0	0
19/11/2014	YES	NO	0	0	0	0	0	0	0
06/12/2014	YES	NO	0	0	0	0	0	0	0
08/12/2014	YES	YES	1	0	0	0	0	0	0
08/12/2014	YES	YES	1	0	0	0	0	0	0
13/12/2014	YES	YES	1	0	0	0	0	0	0
15/12/2014	YES	YES	0	0	0	1	0	0	0
15/12/2014	YES	YES	0	1	0	0	0	0	0
24/12/2014	YES	YES	0	0	1	0	0	0	0
12/01/2015	YES	YES	0	0	0	0	0	1	0
22/01/2015	YES	NO	0	0	0	0	0	0	0
23/01/2015	YES	NO	0	0	0	0	0	0	0
23/01/2015	YES	NO	0	0	0	0	0	0	0
13/02/2015	YES	NO	0	0	0	0	0	0	0
20/02/2015	YES	NO	0	0	0	0	0	0	0

Table 4: Potential detections of STECs (O157 and non O157) and confirmed detections of *E. coli* O157 and STECs from DA verification tests only for this establishment.

Date	Potential	Confirmed	O157	O26	O45	O103	O111	O121	O145
03/04/2012	YES	NO	0	0	0	0	0	0	0

Table 5: *E. coli* O157 and STEC summary for this establishment (on-plant and DA verification tests) **over the last year**.

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Potential	3	1	1	1	0	2	1	4	7	4	2	
Total Confirmed	2	1	1	1	0	0	0	1	6	1	0	
Confirmed O157	2	1	0	0	0	0	0	1	3	0	0	
Confirmed O26	0	0	1	0	0	0	0	0	1	0	0	
Confirmed O45	0	0	0	0	0	0	0	0	1	0	0	
Confirmed O103	0	0	0	0	0	0	0	0	1	0	0	
Confirmed O111	0	0	0	0	0	0	0	0	0	0	0	
Confirmed O121	0	0	0	1	0	0	0	0	0	1	0	
Confirmed O145	0	0	0	0	0	0	0	0	0	0	0	

Key:

Potential
1
2
3
4
5+

Confirmed
1
2
3
4
5+

2 Glossary of Terms

2.1 Prevalence summary

Tests: The total number of samples in the ESAM database during the reporting period.

Confirmed: The number of samples where *E. coli* O157 and/or STECs was confirmed.

Percent +ve: 100 $\times$ Confirmed/Tests.

Lower Bound & Upper Bound: Lower and Upper 95% Confidence Bounds. The "true" prevalence is expected to be in this range.

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