# AQIS Import Clearance Risk Return
# ACERA 1001 Study A
# External Container Inspection
# Report 3


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# Contents

# 1

# Executive summary

This report defines pathway risk management, and recommends a sequence of activities to be undertaken by various parties that will support the management of the pathway risk of sea containers. This report supplements Robinson et al. (2009c).

## 1.1 Recommendations

The Cargo Analysis and Review Program (CARP) should analyze external container inspection data provided by the regions no less frequently than quarterly, using the algorithms and spreadsheet tools that accompany this report, or similar.

The purpose of the quarterly analysis of inspection data by the Cargo Risk Program is to produce statistical information that can be used to assist the pathway managers in managing the biosecurity risk of the pathway. Pathway managers will use the statistical information as one component of the pathway risk management decision-making process.

Following the catastrophic outbreak of Foot and Mouth Disease in the United Kingdom in 2001, external inspection was mandated for all sea containers in 2001 under Increased Quarantine Intervention (IQI). Recent ACERA reports have recommended a reduction in the required inspection rate (Robinson et al., 2009b,c). The present report provides a strategy that can be used to implement such a reduced inspection regime for sea containers.

We emphasize that in order for such a reduction in inspection rates to be aligned with the principles of risk–return as documented in Beale et al. (2008), *a concomitant increase in inspection effort should be undertaken in pathways that are identified as being of higher risk.*

We recommend a 12-month review of pathway risk management as defined in this report, including the utility and appropriateness of the inspection risk and inspection surveillance (IRIS) algorithm and the analytical strategies that are proposed in this report.

## 1.2 Risk–return context

In order to preferentially allocate resources to the activities that face the highest risk, the Cargo Branch is developing and implementing policies for the application of a risk-return approach on a number of activities.

Under Increased Quarantine Initiatives (IQI), Programs were nominally required to intervene for 100% of volume, and obligated to achieve a minimum level of intervention. The prescribed minimum level varied across AQIS Programs. This approach provided information on the amount of activity that was to be undertaken and a numerical level that was to be achieved, as measures of performance.

Biosecurity risk management principles state that rather than focusing efforts on maintaining a prescribed level of activity or quantitative measure of performance, resources should be allocated on the basis of statistical intelligence and scientific assessment. Intervention levels should be responsive to changing risks, and performance should be measured against maintaining an acceptable level of risk.

Future risk management strategies will entail resourcing and guiding a level of intervention to maintain leakage at less than a determined level, where leakage is considered to be the (estimated) amount of undetected movement of goods or vessels of quarantine concern through an intervention process.

### 1.2.1 Relevance to Beale review

Among the many recommendations made by the Beale report (Beale et al., 2008), this study directly targets:

**44** The balance and level of biosecurity resources across the continuum should be determined by a consistent analysis of risks and returns across programs. The level and allocation of resources should be comprehensively reviewed against risk-return profiles at least every five years.

- This report proposes a risk–sensitive monitoring program that can be deployed for allocating resources.

**52** The National Biosecurity Authority should undertake a continuing program of analysis of risk pathways using data collected from pre–border intelligence and border inspections at control points along the continuum. The results of this analysis should be used to update risk management strategies and measures.

- This report examines the quarantine risk associated with the movement of shipping containers.

# 2

# Background

This project, ACERA project 1001a, extends the conclusions of ACERA projects 0804 (Robinson et al., 2008) and 0804a (Robinson et al., 2009a). Briefly, the earlier reports provided a summary of current AQIS Import Clearance (IC) processes, proposed a risk framework and an analytical strategy for using historical data to identify high-risk import pathways and to prescribe candidate monitoring regimes based on the estimated risk, and demonstrated the application of the strategy using six case studies.

This report supplements the work reported by Robinson et al. (2009c), which presented an analysis of historical AQIS inspection data to assess the likely consequences of a candidate inspection strategy. Here, we present a workflow and a data analysis algorithm that enables the estimation of key components of pathway risk.

## 2.1 Deliverables

The deliverables of ACERA project 1001a are as follows:

1. a report that reviews and critiques the available data sources (Robinson et al., 2009b),
2. a subsequent report that details statistical models and examples of use as noted above (Robinson et al., 2009c), and
3. a training workshop (delivered November 2009) and assistance as necessary for operational deployment (This report).

# 3

# Workflow

The purpose of the quarterly analysis of inspection data by the Cargo Analysis and Review Program (CARP) is to produce statistical information that can be used to assist in managing the biosecurity risk of the external sea-container pathway. Pathway risk managers will use the statistical information as one component of the pathway risk management decision-making process.

The recommended workflow is as follows.

1. The regional offices will perform inspections on sea containers using a protocol that is based on risk–return principles, and communicated to them by the pathway manager (see Chapter 4).
2. The outcomes of the inspections will be recorded on spreadsheet templates that are provided by the pathway manager, which are to be returned to the pathway manager each quarter. The pathway manager provides these templates to the CARP.
3. The CARP analyzes the data on the templates and:

    (a) estimates the risk of the pathway and any sub-pathways, and

    (b) identifies any sub-pathways that show evidence of particularly high risk (e.g., risky load ports).

    The CARP reports the analysis to the pathway manager, providing estimates of risk, interpretation, and context (see Chapter 5).
4. The pathway manager decides whether the level of risk in the pathway and sub-pathways is acceptable, and may solicit further guidance from the CARP as to appropriate remedial actions. Examples of such guidance would be a recommendation for increased inspections, or the identification of sub-pathways that should be inspected at a higher rate.
5. The pathway manager advises the regions of any changes to the inspection protocol that are necessary.

The spreadsheet templates for reporting the quarterly inspection statistics to the CARP by the pathway manager should be designed by CARP and the pathway manager to facilitate data handling and data checking.[1]

[1] The "contam.xls" spreadsheet constructed by GH is an excellent resource.

# 4

# Inspections

The process of container inspection depends upon whether the load port is in a country that is included in the AQIS Country Action List.

1. If so, then the container is subjected to a 5–6-sided inspection.
2. If not, the inspection process is as follows: the Officer inspects the front coming towards them, the closest side and if a skeletal, which is a container with an external frame, underneath as far as possible and then the other end. This process represents a 3–4 sided inspection regime.

# 5

# Analysis

The purpose of the quarterly analysis of inspection data by the Cargo Risk Program is to produce statistical information that can be used to assist in managing the biosecurity risk of the pathway. Pathway risk managers will use the statistical information as one component of the pathway risk management decision-making process.

This chapter describes the process by which the quarterly inspection data are used to determine whether or not the pathway should be fully inspected, and if not, at what rate the random inspections should proceed.

## 5.1 Background: Managing the Biosecurity Risk

Management of the pathway biosecurity risk, as defined here, proceeds as follows. The pathway program nominates a cutoff, a level below which the leakage rate of actionable biosecurity risk material is to be reliably kept. This cutoff is possibly chosen with input from other stakeholders, and may vary for different components of the pathway. The cutoff is determined in the context of the definition of biosecurity risk material (BRM) that is considered *actionable*. In addition, the pathway program nominates a confidence, which can be interpreted as the level of confidence with which the program wishes to state that the BRM leakage rate is below the risk cutoff.

For example, the program might use the figures of a risk cutoff of 1% with statistical confidence 95%. Then,

- the risk of the pathway is estimated using the ACERA IRIS method (Inspection Risk and Inspection Surveillance, see Section 5.2) ;
- if the estimated risk of the pathway is above the cutoff specified by the program then the pathway should be either inspected at 100% or inspected at a sufficient rate that the estimated pathway leakage will be below the program risk cutoff; and
- if the estimated risk is below the program risk cutoff, then the pathway should be monitored by random sampling, as specified in Chapter 4.

The purpose of increasing the inspection rate of a pathway is to decrease the pathway leakage. Alternative measures to reduce the risk of the pathway may be worth considering. For example,

- the pathway manager could decrease the pathway leakage by rigorously following up on interceptions, and determining whether or not the interceptions represented a genuine biosecurity risk; and

- effective use of profiling could be used to alter the balance of inspections on sub-pathways. If risk on sub-pathways can be demonstrated to vary then inspection resources can be preferentially and profitably directed towards the high-risk sub-pathways. An example of such a collection of sub-pathways in the context of containers might be load ports, or country risk, e.g., on the Country Action List (CAL).

## 5.2 Quarterly Risk Calculations

### 5.2.1 Introduction

In order to facilitate this management, the CARP will produce statistical estimates of risk at the pathway level, and sub-pathway levels as appropriate. The following instructions provide one possible strategy for preparation and analysis of the data. Alternatives that are more convenient may be developed by the CARP and the program that manages the pathway.

### 5.2.2 Preparation

The pathway manager will provide to the CARP the following quarterly figures:

1. number of containers inspected,
2. number of containers detected with high-level contamination, and
3. expected volume of containers for next quarter.

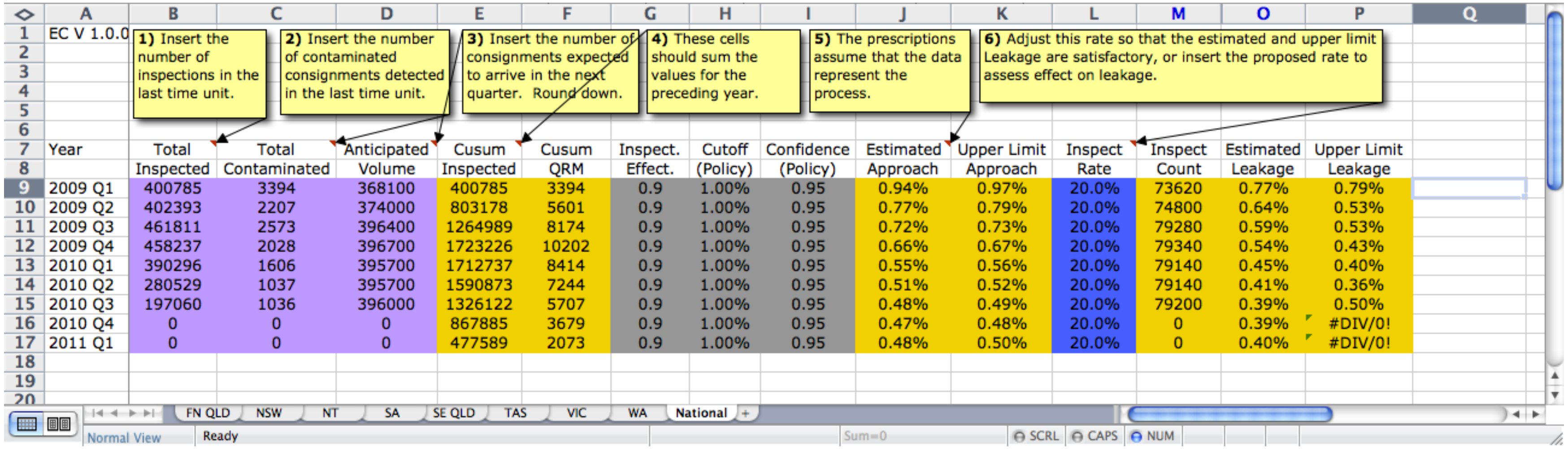
### 5.2.3 Calculation

A screen capture of a spreadsheet implementation of the IRIS algorithm is presented in Figure 5.1. Four key statistics must be entered in order to prescribe an inspection strategy. Each of the four key characteristics is identified below along with the column for entry in the spreadsheet.

1. The total number of containers actually inspected during the quarter (Column B),
2. The total number of containers for which actionable BRM was detected during the quarter (Column C), here assumed to be the number of containers sent for wash,
3. The total number of containers expected to arrive in the next quarter (Column D), and
4. An estimate of the inspection leakage rate, that is, the rate at which inspections miss existing actionable BRM. This quantity is also referred to as the inspection effectiveness (Column G).

The spreadsheet then combines these four statistics with the pre-determined cutoff (Column H), and the confidence with which the program wishes to state that the rate is below the cutoff (Column I). The spreadsheet is more completely detailed in Tables 5.1 and 5.2.

When the data noted above have been entered, the goldenrod cells can be *interpreted*. Specifically,




| Year | Total Inspected | Total Contaminated | Anticipated Volume | Cusum Inspected | Cusum QRM | Inspect. Effect. | Cutoff (Policy) | Confidence (Policy) | Estimated Approach | Upper Limit Approach | Inspect Rate | Inspect Count | Estimated Leakage | Upper Limit Leakage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2009 Q1 | 400785 | 3394 | 368100 | 400785 | 3394 | 0.9 | 1.00% | 0.95 | 0.94% | 0.97% | 20.0% | 73620 | 0.77% | 0.79% |
| 2009 Q2 | 402393 | 2207 | 374000 | 803178 | 5601 | 0.9 | 1.00% | 0.95 | 0.77% | 0.79% | 20.0% | 74800 | 0.64% | 0.53% |
| 2009 Q3 | 461811 | 2573 | 396400 | 1264989 | 8174 | 0.9 | 1.00% | 0.95 | 0.72% | 0.73% | 20.0% | 79280 | 0.59% | 0.53% |
| 2009 Q4 | 458237 | 2028 | 396700 | 1723226 | 10202 | 0.9 | 1.00% | 0.95 | 0.66% | 0.67% | 20.0% | 79340 | 0.54% | 0.43% |
| 2010 Q1 | 390296 | 1606 | 395700 | 1712737 | 8414 | 0.9 | 1.00% | 0.95 | 0.55% | 0.56% | 20.0% | 79140 | 0.45% | 0.40% |
| 2010 Q2 | 280529 | 1037 | 395700 | 1590873 | 7244 | 0.9 | 1.00% | 0.95 | 0.51% | 0.52% | 20.0% | 79140 | 0.41% | 0.36% |
| 2010 Q3 | 197060 | 1036 | 396000 | 1326122 | 5707 | 0.9 | 1.00% | 0.95 | 0.48% | 0.49% | 20.0% | 79200 | 0.39% | 0.50% |
| 2010 Q4 | 0 | 0 | 0 | 867885 | 3679 | 0.9 | 1.00% | 0.95 | 0.47% | 0.48% | 20.0% | 0 | 0.39% | #DIV/0! |
| 2011 Q1 | 0 | 0 | 0 | 477589 | 2073 | 0.9 | 1.00% | 0.95 | 0.48% | 0.50% | 20.0% | 0 | 0.40% | #DIV/0! |

**Figure 5.1:** Screen capture of IRIS algorithm spreadsheet with national inspection data for containers, for the purposes of demonstration. See Section 5.2.3 for description of usage.

- The estimated approach (Column J) reports an estimate of the inherent rate at which BRM approaches on the pathway.
- The upper limit approach (Column K) reports an estimate of the inherent risk of the pathway, following the definition of risk recommended by Robinson et al. (2008), which is the estimate of the rate inflated to reflect ignorance about the rate. The level of the limit is determined by the confidence level (Column I).
- The nominal inspection rate is inserted in Column L.
- The nominal inspection rate is converted by IRIS into a proposed inspection count using Column D.
- The future leakage is predicted by IRIS in Column O. This prediction of the leakage takes account of the estimated approach rate (Column J), the proposed inspection rate (Column L), and the inspection effectiveness (Column G).
- A conservative prediction of the future leakage is presented by IRIS in Column P. This prediction takes account of the same factors as does the prediction of the future leakage in Column O, but produces an upper limit instead of a best guess. The level of the limit is determined by the confidence level (Column I).

If the results of IRIS suggest that the pathway risk is higher than desirable, then the blue cells can be *changed* to reflect alternative inspection regimes. Increasing the inspection rate will decrease the expected and upper-limit leakage.

**Table 5.1:** IRIS — ACERA cargo risk model guidance colour key.

| Colour | Key |
|---|---|
| Orchid | Data inserted by Cargo Risk, quarterly, from Pathway Manager. |
| Goldenrod | ACERA Cargo Risk Model outputs. |
| Gray | Data and policy levels inserted by Cargo Risk, reviewed regularly (e.g., annually) with Pathway Manager. |
| ProcessBlue | Inspection rate can be adjusted by Cargo Risk to affect projected leakage rate. |

## 5.3 Limitations

The IRIS tool is designed to produce statistical information about the risk of contamination on a pathway, and to guide decision-making about the amount of future inspection effort to invest in a pathway. IRIS will not provide guidance as to the severity of the contamination, and the statistics that are reported by IRIS do not reflect the severity of contamination.

The IRIS tool is not designed to produce statistical information about temporal trend or spatial patterns of contamination. However, the user interface of IRIS is generic, and its algorithms can be updated as deemed necessary or useful in time.

As presented, the IRIS tool does not distinguish between the inspections that are performed on the containers from CAL and non–CAL origins. These inspections are assumed for the purposes of this exercise to be of equal effectiveness and are analyzed together.

**Table 5.2:** IRIS — Inspection Risk and Inspection Surveillance ACERA cargo risk model guidance notes. See Table 5.1 for colour key.

| Col | Column Name | Notes |
|---|---|---|
| A | Year / Quarter | Year and financial quarter |
| B | Total Inspected | Total number of inspections per quarter. E.g. For the current pathway, total number of sea containers inspected. Insert the number of inspections in the last quarter. |
| C | Total Contaminated | Total number of contaminated containers found. Insert the number of contaminated containers detected in the last quarter. |
| D | Anticipated Volume | Insert the number of containers expected to arrive in the next quarter. Round down. |
| E | Cusum Inspected | Cumulative sum of the inspected containers. These cells sum the values of the preceding year. |
| F | Cusum BRM | Cumulative sum of the containers that contained BRM. These cells sum the values of the preceding year. |
| G | Inspection Effectiveness | If there is BRM present in or on the item, what is the probability that it is found? This rate is estimated using previous effectiveness surveys conducted by AQIS. |
| H | Cutoff (Policy) | The cutoff rate is set by the pathway manager, and differs for each pathway. [The cutoff rate is a policy decision yet to be decided. Current modeling is based on 1%] |
| I | Confidence (Policy) | Represents the confidence we need to have that the leakage rate is below cutoff. [The confidence rate is a policy decision yet to be decided. Current modeling is based on 95%.] |
| J | Estimated Approach | An estimate of the actual rate at which BRM comes along the pathway. (N.B. The quality of this and the following estimates depends on how well the data represent the actual process). |
| K | Upper Limit Approach | Estimated upper limit for actual approach rate. The estimated number that we are 95% confident that the actual, unknown rate is below. (Upper limit of a reasonable range). |
| L | Inspect Rate | Inspection Rate. The inspection rate can be adjusted so that the estimated and upper limit leakage is satisfactory, or to reflect a level nominated by the Pathway Manager. |
| M | Inspect Count | Inspection Count. Number of containers to be inspected according to the Inspect Rate. |
| N | (No Label) | (Hidden column) |
| O | Estimated Leakage | Estimated future leakage. |
| P | Upper Limit Leakage | Estimated upper limit for future leakage. The number that we are 95% confident that the future, unknown leakage will be below. (Upper limit of a reasonable range). |

## 5.4 Leakage

The leakage of contamination through the external container inspection will be estimated using the subsequent surveys for rurally-destined containers.

## 5.5 Sub-pathway analysis

Analysis of components of the pathway should be performed by the CARP quarterly, where possible. The analysis of sub-pathways, such as country status (CAL / non–CAL), regions or load ports, involves two phases.

1. The CARP should assess how many containers have been inspected for each sub-pathway, and therefore the rate of inspection. Counting the number of times each sub-pathway is inspected will help to identify whether any sub-pathways seem to be over- or under-inspected.

2. The CARP should estimate the risk of each sub-pathway. This could be performed either by simply dividing the BRM interceptions against the number of inspections for the sub-pathway, or even using a risk tool similar in scope to the spreadsheet for the IRIS algorithm. Reporting the estimated risk of each sub-pathway will help to identify whether any sub-pathways seem to be of substantially higher risk than the others. If so, then the pathway-level risk may be reduced by using a profile to increase inspection efforts on the high-risk sub-pathways.

   This step is provided by the pivot table included in the inspection record spreadsheet.

The spreadsheets are designed to be applied quarterly, but at each quarter to use the previous 12 months data when they are available.

# Bibliography

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# Appendix A

# Change Log

**5 November 2009** Initial version. This report supplements Robinson et al. (2009c).