AQIS Import Clearance Risk Return
ACERA 1001 Study E
Unit Loading Devices
Report 3

Andrew Robinson, ACERA

Rama Karri, AQIS

Ferne Clarke, AQIS

Margaret Theakston, AQIS

Megan Scott, AQIS

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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 Unit Load Devices (aircans, ULDs). This report follows Robinson et al. (2009c).

1.1 Recommendations

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

The quarterly analysis of inspection data by the Cargo Risk Program aims to produce statistical information that can be used to help manage the biosecurity risk of the pathway.

External inspection was mandated for all ULDs under Increased Quarantine Intervention (IQI). Recent ACERA reports have recommended a reduction in the required inspection rate to 20% of ULDs that arrive during 6 am–6 pm on weekdays (Robinson et al., 2009b,c). The present report provides a strategy that can be used to implement such a reduced external inspection regime for ULDs.

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*, such as the Cargo Air Assurance (CAA, also called freeline) or the internal inspection of ULDs.

We recommend a 12-month review of pathway risk management as defined in this report, including the utility and appropriateness of the IRIS tool and the analytical strategies that are proposed in this report. This review should be undertaken before July 2011.

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 Intervention (IQI), programs were 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 historical approach provides, as a measure of performance, information on the level of activity that is to be undertaken and a numerical standard that is to be achieved.

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 Alignment with Beale review

This report is the third in a sequence of three (previous reports are Robinson et al., 2009b,c). The study of which this report is a portion directly targets two of the recommendations made by the Beale report (Beale et al., 2008):

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 study provides an analysis of the risks and returns for the inspection of ULDs.

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 study examines the quarantine risk associated with the ULD pathway using border inspection data.

2

Introduction

2.1 Background

This project, ACERA project 1001e, 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.

The unit load device (ULD) case study initially used identical methodology to that presented in ACERA reports 0804 and 0804a in order to advise on the expected risk from the adoption of Phase 1 of the risk–return strategy for ULDs. The results of that study are reported in Robinson et al. (2009b).

Phase 1 of the Air Cargo risk–return strategy involved the releasing, without external inspection, of ULDs that arrive during the night shift or on weekends, for each of the three most active regional facilities: Sydney, Melbourne, and Brisbane.

Phase 2 of the Air Cargo risk–return strategy involves the releasing, without external inspection, of

- all ULDs that arrive during the night shift or on weekends, and
- no more than 80% of ULDs that arrive during the weekday shifts,

excepting those night and weekend shifts that are randomly nominated for inspection, and those ULDs that arrive on flights that are identified by the CARP as *high-risk flights*[1]. For the purposes of the risk–return study, the day shift is defined as comprising all flights that arrive after 6 am and before 6 pm.

This report describes the implementation and operationalization of Phase 2, including the concomitant data collection, handling, and analysis that are needed for pathway risk management.

2.2 Definitions

Pathway risk management involves the estimation of the pathway contamination risk, and taking such actions as are deemed necessary to ensure that the contamination rate stays

[1] No such flights have been identified to date; all flights are presently low-risk flights.

below a nominated level, with specified statistical confidence.

A component of pathway risk management is the allocation of inspection resources. Inspection plays three important roles: interception of contaminated items, estimation of leakage, and deterrence. Given an estimate of pathway risk,

- If the estimated risk of the pathway is above the program risk cutoff specified by the program then the pathway should be inspected at a sufficient rate that the estimated pathway leakage will be below the cutoff. Fully inspecting the pathway is an option.
- If the estimated risk is below the program risk cutoff, then the pathway should be monitored by random sampling, at a rate advised by the CARP, based on statistical analysis of previous inspection data, for example using the IRIS tool.

2.3 Deliverables

The deliverables of ACERA project 1001e are as follows:

1. a report that reviews the risk associated with the adoption of Phase 1 of the ULD risk–return strategy (delivered: Robinson et al., 2009b),
2. a report that details statistical models and examples of use for more fine-grained risk profiling, with a spreadsheet, an algorithm, and/or business rules to identify high-risk pathways and documentation suitable to implement same (delivered: Robinson et al., 2009c), and
3. a training workshop (delivered in November 2009) and guidelines for operational deployment (this report).

The balance of this report is structured as follows. Chapter 3 provides a summary of the recommended workflow of the use of the IRIS tool to support pathway risk management, as performed by the Air Cargo program with support from CARP. Chapter 4 details the recommended inspection regime to be carried out within each region. Chapter 5 describes the data template to be used by the regions to capture the inspection data and to report the data to the pathway manager. Finally, Chapter 6 describes the quarterly operations that should be undertaken by CARP to provide the Air Cargo program with guidance about the level of quarantine risk that is reflected in the inspection data.

3

Workflow

The purpose of the quarterly analysis of inspection data by CARP 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.

The workflow is as follows.

1. The regional offices will perform inspections on ULDs using a protocol that is based on risk–return principles, and communicated to them by the pathway manager (Chapter 4).
2. The outcomes of the inspections will be recorded on templates that are provided by the pathway manager, which are to be returned to the pathway manager each quarter (Chapter 5). 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 flights).

   The CARP reports the analysis to the pathway manager, providing estimates of risk, interpretation, and context (Chapter 6).
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.

4

Inspection Strategy

We recommend the following inspection regime for ULD for all regions. Inspection comprises both external, and where possible, internal inspection. Inspection rates refer to the rates of inspection of flights, not ULDs.

- a minimum 20% inspection rate of flights arriving between 6 am and 6 pm on weekdays, selected randomly except as noted below;
- Targeted inspection — flights that are suspected of being high-risk should be targeted in addition to the 20%. Here we refer to *high-risk* as meaning either (i) that there is an unusually high probability of contamination, determined using inspection records, or (ii) that the consequences associated with contamination are of particular concern.
- Night inspection — once per calendar month for any regions with flights arriving between 6pm and 6am, inspect at least 20% of those flights, selected randomly except as noted above.
- Weekend inspection — one weekend day per calendar month for any regions with flights arriving on weekend days, inspect at least 20% of those flights, selected randomly except as noted above.
- Leakage inspections will proceed on a region-specific basis, to be determined and advised.
- Inspection results will be provided quarterly to CARP for analysis and risk–return update.

The inspection rate should average or exceed 20% of week-day flights across a year. The inspection rate may exceed 20% due to random fluctuations and/or targeted inspections. The inspection level of one weekend day per month is chosen based on striking an informal balance between convenience and data collection. It should not be interpreted as a hard–and–fast prescription by the managing program. However, some hard–and–fast prescription should be made to provide guidance for the regional offices.

4.1 Random selections

The best approach for random selection of flights will be specific to individual regions. Regional offices should be encouraged to suggest alterations for operational clarity and convenience.

The designs laid out below should be run as a trial for at least four quarters, as a burn-in period. At that point the CARP should review the estimated risk and provide guidance as necessary for changes to inspection rates or protocols, based on the statistical analysis of the historical inspection data.

The number of ULDs on flights that are not inspected does not need to be recorded. This information will be obtained by the CARP from Customs if necessary.

Note that the sample designs that are described below for each of the regions are only recommendations, arrived at after discussions with each region. They should be considered as guidelines, not hard–and–fast prescriptions.

4.1.1 Adelaide

On average, five ULD–bearing flights arrive per day at Adelaide International airport between 6 am and 6 pm. All ULD movements pass through Australian Air Express, so all inspections can take place there.

The region externally and internally inspects all the ULDs that arrive on a single specific flight each week day, rotating the flight/day combination so that all flights are approximately equally covered. That is, each week day, a single flight is selected for external inspection of all ULDs.

20% of flights on one random weekend shift will also be inspected each month.

4.1.2 Brisbane

Up to 40 flight numbers arrive each month between 6 am and 6 pm. Some flights arrive daily, others are sparse. The region sees up to 12 unique flights per day bearing ULDs. Ten daily flights arrive regularly. The ULDs are unloaded and delivered to one of four cargo terminal operators (CTOs): QANTAS (30 flight numbers), Toll (6), AAE (3), and Menzies Aviation (1). Inspections are performed by officers who will be on-site at the CTO for SAC inspection and other surveillance duties.

Daily flights are inspected at least twice in a week but all other flights which arrive irregularly or outside normal business hours are inspected at least once in a month. Flights that arrive after 6 pm are held over until the next day.

This design represents a compromise between effort and complexity. It will result in over-sampling of the flights that arrive less frequently than daily, but that is perfectly acceptable from the statistical point of view.

4.1.3 Melbourne

Approximately 34 ULD–bearing flights arrive each day between 6 am and 6 pm.

The regional office will create a weekly checklist of the daily flights. This checklist will be monitored by the region and will be completed each week, so that each daily flight will be inspected once per week. The order in which the flights appear on the checklist will be altered each month to protect against too regular a pattern. The checklist will include some guidance as to 'sets' of flights that will be convenient to inspect simultaneously.

One random evening shift per month will be included, which comprises the inspection of ULDs from all flights arriving outside 6am to 6 pm. CTOs will be asked to hold over ULDs that arrive after 6 pm.

One random Saturday shift and one random Sunday shift will also be inspected each month. These shifts do not need to be on the same weekend. This design was decided before the policy was finalised, and can be reduced to one weekend shift per month.

4.1.4 Perth

Approximately 22 flights per week deliver ULDs to Perth, which are then dispersed among two CTOs: QANTAS and Perth Cargo Centre. Each CTO will be visited one different day per week; all ULDs arriving at that CTO between 6 am and 6 pm will be inspected. The CTO day will be rotated approximately monthly.

One weekday per month will be selected by the region; on that day, all ULDs that arrive after 6 pm will also be inspected.

One random Saturday shift and one random Sunday shift will also be inspected each month. These shifts do not need to be on the same weekend. This design was decided before the policy was finalised, and can be reduced to one weekend shift per month.

4.1.5 Sydney

Sydney is the major hub for ULDs. Approximately 80 ULD–bearing flights arrive each day between 6 am and 6 pm.

The ULDs will be externally inspected on the tarmac by crews that are assigned to meet high-risk movements (HRMs). This inspection strategy reflects the current operation. Therefore, the 20% sample will be easily collected. The sample may not be balanced across all daylight flights. Whether or not the degree of imbalance will be cause for concern will be assessed by the CARP after at least one quarter of data collection. These crews operate all days of the week, so there will be no need to proscribe specific weekend inspections.

4.2 Targeted selections

Currently, no flights are identified as high-risk flights in any region for this pathway.

4.3 Inspection Effectiveness

Leakage surveys must be performed to provide timely statistical information about pathway-level effectiveness. Leakage surveys also satisfy subsidiary roles of motivation and interception.

Leakage surveys for ULDs are more complicated in the risk–return setting than they were under IQI. This increased complication is because under IQI, all ULDs were inspected, which meant that any random sample of ULDs that was selected for a leakage survey could be assumed to have been previously inspected. Therefore, any biosecurity risk material (BRM) that was intercepted would automatically be leakage. However, under risk–return, some ULDs in a leakage survey may not have been inspected, and therefore are not admissible as evidence of leakage.

Each region will need to conduct regular leakage snapshot surveys to estimate the effectiveness of the inspection process, which is a component of pathway risk management. We are in the process of determining an acceptable leakage survey strategy that delivers useful and timely intelligence without creating an unnecessary burden[1]. This strategy will most likely be tailored to specific regional constraints.

[1] Work ongoing!

4.4 Purposive Sampling

At any time, AQIS may gain intelligence about the expected contamination of any of the pathways described in this report. The intelligence might suggest, for example, that a particular flight or courier or carrier should be targeted with extra inspections, in addition to the 20% prescribed herein. The pathway manager should act on this intelligence without concern about the statistical ramifications of unbalanced pathway monitoring.

5

Data Template

The template to be used by regional offices for recording ULD inspection data will be constructed as follows. It will be a spreadsheet that contains two worksheets:

1. **Inspections** will report the inspection effort, and
2. **Interceptions** will report the details of contaminated ULDs.

The ULD inspections will be subject to validation inspections, the design of which is still under consideration. The present template will not provide for validation.

5.1 Inspections

The Inspections sheet will report the inspection effort. It will comprise eight columns (Figure 5.1):

1. **Date** of inspection, in dd/mm/yy format,
2. **Flight** flight number,
3. **Port of Loading**,
4. **Sighted** the number of ULDs inspected *externally*,
5. **Reported on CPM** the number of ULDs reported on the CPM[1],
6. **Officer's Name**, and
7. **Comments**

5.2 Interceptions

The Interceptions sheet will report the details of contaminated ULDs. It will comprise 16 columns, labeled as follows (Figure 5.2).

1. **Date** of inspection, in dd/mm/yy format,
2. **Flight** flight number,
3. **ULD Rego** registration number of the ULD,

[1]Cargo positioning manifest

Date	Flight	Port Of Loading	Sighted	Reported on CPM	Officer's Name	Comments
15/03/09	FLIGHT NUMBER	Kuala lumpur	20	21	JOHN SMITH	EXAMPLE ONLY
1/06/10	LA 0801	AKL	3		G Organ/ G Daly	
1/06/10	QF 0012	LAX	8	8	G Organ/ G Daly	
1/06/10	JQ 0038	DPS	5	5	G Organ/ G Daly	
1/06/10	GA 0714	DPS	11	11	G Organ/ G Daly	
1/06/10	QF 0128	HKG	8	8	G Organ/ G Daly	
1/06/10	MH 0123	KUL	7		G Organ/ G Daly	
1/06/10	NZ 0101	AKL	10	10	G Organ/ G Daly	
1/06/10	NZ 0187	CHC	3	3	G Organ/ G Daly	
1/06/10	QF 0130	PVG	6	6	G Organ/ G Daly	
1/06/10	MU 0561	PVG	4	4	G Organ/ G Daly	
1/06/10	QF 7524	CHC	26		G Organ/ G Daly	
1/06/10	QF 0018		5	9	S.Brown/R.Stares	
1/06/10	JQ 0004	HNL	7	7	S.Brown/R.Stares	
1/06/10	SQ 0233	SIN	17	17	S.Brown/R.Stares	
1/06/10	NZ 0149	WLG	1	1	S.Brown/R.Stares	
1/06/10	JQ 0150	??	1	1	S.Brown/R.Stares	

Figure 5.1: Screen capture of the worksheet that captures the inspection effort.

Date	Flight	ULD Rego	ULD Owner	OIQ No	Port of Loading	Actionable Non-Actionable	Internal (IN) or External (EX)	Type of Contamination
2/01/2012	Flight Number	AKE75869QF	Qantas	N/A	Singapore	Actionable/Non-Actionable	EX	Soil
2/06/2010	SQ 7298	PGA62104SQ	Singapore Airlines		Singapore	Actionable	EX	SOIL
2/06/2010	SQ 7298	PGA62067SQ	Singapore Airlines		Singapore	Actionable	EX	SOIL
2/06/2010	SQ 7298	PMC52899SQ	Singapore Airlines		Singapore	Actionable	EX	SOIL
2/06/2010	SQ 7298	PGA62194SQ	Singapore Airlines		Singapore	Actionable	EX	ORGANIC
2/06/2010	SQ 7298	PGA62074SQ	Singapore Airlines		Singapore	Actionable	EX	ORGANIC

Description of Contamination found (Provide full details)	Location	CTO	Completed Yes / No / In Progress	Completion Date	Officer(s)	Additional Comments
soil and mud with leaf litter	Qantas Bond	Qantas	Yes	2/01/12	John Smith	Example Only
sand, gravel	QANTAS	QANTAS	Yes	2/06/10	Forrest/G Wagemar	photo in folder
soil	QANTAS	QANTAS	Yes	2/06/10	Forrest/G Wagemar	photo in folder
black sand	QANTAS	QANTAS	Yes	2/06/10	Forrest/G Wagemar	photo in folder
sand,gravel, leaves	QANTAS	QANTAS	Yes	2/06/10	Forrest/G Wagemar	photo in folder
sand, gravel, insect	QANTAS	QANTAS	Yes	2/06/10	Forrest/G Wagemar	photo in folder

Figure 5.2: Screen capture of the worksheet that captures the interception results (split into two pieces for easy reading).

4. **ULD Owner** owner of the ULD,
5. **OIQ No.** Order into Quarantine.
6. **Port of Loading**,
7. **Actionable / Non-actionable** a description of the severity of the contamination,
8. **Internal or External**, the location on the ULD of the contamination,
9. **Type of Contamination**, report the Biosecurity Incident Category as per the INCIDENTS database; see below.
10. **Description of Contamination**
11. **Location** of the ULD,
12. **CTO**, Cargo Terminal Operator
13. **Completed**, describing the status of treatment of the contamination,
14. **Completion Date**
15. **Officer's Name**, and
16. **Additional Comments**

5.2.1 Biosecurity Incident Category

(INCIDENTS database)

- Animal residue
- Bark
- Failed Fumigations
- Frass/Fresh Borer Holes
- Incorrect documentation
- Insect
- Live Animals
- Mis-declaration
- Other Invertebrates
- Plant Diseases
- Plant Material
- Seeds
- Soil/Earth/Sand
- Straw
- Undeclared Timber
- Water

6

Analysis

The purpose of the quarterly analysis of inspection data by CARP 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.

6.1 Background: Managing the Biosecurity Risk

Management of the pathway biosecurity risk 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 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 (Inspection Risk and Inspection Surveillance, see Section 6.2) algorithm, for example as captured in the reported spreadsheet tool;
- 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 ULDs might be airlines, or load ports.

6.2 Quarterly Risk Calculations

6.2.1 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.

6.2.2 Preparation

The first five columns of the inspection record spreadsheet (Figure 6.1) are to be copied directly from the inspection tab of the regional monthly ULD inspection template (see Figure 5.1). Each row in these spreadsheets represents the inspection of the ULDs of a single flight.

The next two columns (AE and NE) represent the number of detections of actionable and non-actionable external contamination on ULDs for each flight. These values are manually transcribed from the interceptions tab of the regional template (see Figure 5.2). That is, the counts of external contamination by flight and date are summarized from the regional template and entered into the inspection record spreadsheet.

The final column is used to determine which rows are included in the pivot table to the right, which computes the relevant statistics.

Ordinarily the rows corresponding to the previous year's worth of inspections will be included. When the data have been entered and the rows selected (using the Scope column), then refresh the pivot table (select the table with the mouse, right-click, and select Refresh Data).

The results from the pivot table should then be discussed with the pathway manager. Briefly, the results are interpreted as follows. Each row corresponds to all of the inspections that have been performed for a particular flight number. The first column (Flights) reports the number of times that flight was inspected. This number can be used to see whether the correct number of inspections per flight is being approximately achieved. The second column (ULDs) reports the total number of ULDs that have been inspected per flight and overall. The third column reports the rate (from 0 to 1) of actionable external contamination by flight, and should be used to identify risky flights, either formally or informally. The fourth column reports the rate (from 0 to 1) of non-actionable external contamination by flight.

6.2.3 Calculation

A screen capture of the IRIS tool is presented in Figure 6.2. 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 IRIS algorithm spreadsheet.

Date	Flight	Port of Loading	Sighted	Reported on CPM	AE	NE	In Scope
6/04/10		Singapore	27	27	0	0	1
8/04/10		DUBAI	34	34	0	0	1
12/04/10		SINGAPORE	31	31	0	0	1
16/04/10		Singapore	35		0	0	1
19/04/10		Singapore	22	22	0	0	1
20/04/10		DUBAI	29	29	0	0	1
28/04/10		Singapore	22	22	0	0	1
28/04/10		Dubai	45	45	0	0	1
3/05/10		SINGAPORE	35	35	0	0	1
4/05/10		SINGAPORE	29	29	0	0	1
10/05/10		SINGAPORE	25	25	0	0	1
11/05/10		SINGAPORE	32	32	0	0	1
17/05/10		SINGAPORE	35	35	0	0	1
18/05/10		SINGAPORE	25	25	0	0	1
24/05/10		SINGAPORE	32	32	0	0	1
25/05/10		SINGAPORE	28	28	0	0	1
31/05/10		SINGAPORE	26	26	0	0	1
1/06/10	QF78	Singapore	18	18	0	0	1
9/06/10	QF78	Singapore	27	27	0	0	1
10/06/10	QF78	Singapore	23	23	0	0	1
14/06/10	QF78	Singapore	22	22	0	0	1
14/06/10	EK420	Dubai	27	27	0	0	1
21/06/10	QF78	Singapore	31	31	0	0	1
24/06/10	QF78	Singapore	24	24	0	0	1
28/06/10	QF78	Singapore	32	32	0	0	1

In Scope: 1

	Data			
Flight	Flights	ULDs	AE rate	NE rate
EK420	1	27	0	0
QF78	7	177	0	0
(blank)	17	512	0	0
Grand Total	25	716	0	0

PivotTable

Figure 6.1: Screen capture of inspection spreadsheet holding WA ULD inspection data. See Section 6.2.2 for description of usage.

1. The total number of ULDs actually inspected during the quarter (Column B),
2. The total number of ULDs for which actionable external BRM was detected during the quarter (Column C),
3. The total number of ULDs 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 IRIS algorithm 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 6.1 and 6.2.

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

- 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 6.1: IRIS — ACERA cargo risk model guidance colour key.

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

A	B	C	D	E	F	G	H	I	J	K	L	M	O	P
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
2003 Q3	167240	184	186300	167240	184	0.9	1.00%	0.95	0.12%	0.14%	20.0%	37260	0.10%	0.14%
2003 Q4	196701	221	192300	363941	405	0.9	1.00%	0.95	0.12%	0.13%	20.0%	38460	0.10%	0.14%
2004 Q1	189367	108	188300	553308	513	0.9	1.00%	0.95	0.10%	0.11%	20.0%	37660	0.08%	0.13%
2004 Q2	212101	254	188300	765409	767	0.9	1.00%	0.95	0.11%	0.12%	20.0%	37660	0.09%	0.13%
2004 Q3	188971	289	175300	787140	872	0.9	1.00%	0.95	0.12%	0.13%	20.0%	35060	0.10%	0.15%
2004 Q4	176742	321	175300	767181	972	0.9	1.00%	0.95	0.14%	0.15%	20.0%	35060	0.12%	0.16%
2005 Q1	156732	319	174300	734546	1183	0.9	1.00%	0.95	0.18%	0.19%	20.0%	34860	0.15%	0.20%
2005 Q2	169826	254	174300	692271	1183	0.9	1.00%	0.95	0.19%	0.20%	20.0%	34860	0.16%	0.21%
2005 Q3	175380	269	174300	678680	1163	0.9	1.00%	0.95	0.19%	0.20%	20.0%	34860	0.16%	0.21%
2005 Q4	173970	126	174300	675908	968	0.9	1.00%	0.95	0.16%	0.17%	20.0%	34860	0.13%	0.18%
2006 Q1	158499	72	174300	677675	721	0.9	1.00%	0.95	0.12%	0.13%	20.0%	34860	0.10%	0.14%
2006 Q2	175139	73	174300	682988	540	0.9	1.00%	0.95	0.09%	0.09%	20.0%	34860	0.07%	0.07%
2006 Q3	180457	80	174300	688065	351	0.9	1.00%	0.95	0.06%	0.06%	20.0%	34860	0.05%	0.08%
2006 Q4	180082	103	174300	694177	328	0.9	1.00%	0.95	0.05%	0.06%	20.0%	34860	0.04%	0.09%
2007 Q1	162900	130	174000	698578	386	0.9	1.00%	0.95	0.06%	0.07%	20.0%	34800	0.05%	0.11%
2007 Q2	171920	167	174000	695359	480	0.9	1.00%	0.95	0.08%	0.08%	20.0%	34800	0.06%	0.13%
2007 Q3	181633	107	174000	696535	507	0.9	1.00%	0.95	0.08%	0.09%	20.0%	34800	0.07%	0.09%
2007 Q4	185911	158	174000	702364	562	0.9	1.00%	0.95	0.09%	0.10%	20.0%	34800	0.07%	0.12%
2008 Q1	171387	111	174000	710851	543	0.9	1.00%	0.95	0.08%	0.09%	20.0%	34800	0.07%	0.10%
2008 Q2	0	0	800	538931	376	0.9	1.00%	0.95	0.08%	0.08%	20.0%	160	0.06%	#DIV/0!
2008 Q3	0	0	800	357298	269	0.9	1.00%	0.95	0.08%	0.09%	20.0%	160	0.07%	#DIV/0!
2008 Q4	0	0	800	171387	111	0.9	1.00%	0.95	0.07%	0.08%	20.0%	160	0.06%	#DIV/0!
2009 Q1	0	0	800	0	0	0.9	1.00%	0.95	#DIV/0!	110.43%	20.0%	160	#DIV/0!	#DIV/0!
2009 Q2	0	0	800	0	0	0.9	1.00%	0.95	#DIV/0!	110.43%	20.0%	160	#DIV/0!	#DIV/0!
2009 Q3	0	0	800	0	0	0.9	1.00%	0.95	#DIV/0!	110.43%	20.0%	160	#DIV/0!	#DIV/0!
2009 Q4	0	0	800	0	0	0.9	1.00%	0.95	#DIV/0!	110.43%	20.0%	160	#DIV/0!	#DIV/0!
2010 Q1	1540	0	800	1540	0	0.9	1.00%	0.95	0.00%	0.14%	20.0%	160	0.00%	2.73%
2010 Q2	1432	0	801	2972	0	0.9	1.00%	0.95	0.00%	0.07%	20.0%	160.2	0.00%	2.72%
2010 Q3	0	0	802	2972	0	0.9	1.00%	0.95	0.00%	0.07%	20.0%	160.4	0.00%	#DIV/0!
2010 Q4	0	0	803	2972	0	0.9	1.00%	0.95	0.00%	0.07%	20.0%	160.6	0.00%	#DIV/0!
2011 Q1	0	0	804	1432	0	0.9	1.00%	0.95	0.00%	0.15%	20.0%	160.8	0.00%	#DIV/0!

Figure 6.2: Screen capture of IRIS algorithm spreadsheet with national ULD inspection data. See Section 6.2.3 for description of usage.

Table 6.2: IRIS — Inspection Risk and Inspection Surveillance ACERA cargo risk model guidance notes. See Table 6.1 for colour key.

Label	Column Name	Notes
A	Year / Quarter	Year and financial quarter
B	Total Inspected	Total number of inspections per quarter. E.g. For ECIR pathway, total number of sea containers inspected. Insert the number of inspections in the last quarter.
C	Total Contaminated	Total number of contaminated items found. Insert the number of contaminated items detected in the last quarter.
D	Anticipated Volume	Insert the number of items expected to arrive in the next quarter. Round down.
E	Cusum Inspected	Cumulative sum of the inspected items. These cells sum the values of the preceding year.
F	Cusum BRM	Cumulative sum of the items 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 items 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).

6.3 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.

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.

6.4 Sub-pathway analysis

Analysis of components of the pathway should be performed by the CARP quarterly. The analysis of sub-pathways, such as flights, involves two phases.

1. The CARP should assess how many times each flight has been inspected, and therefore the rate of inspection for the flights. This information requires the number of incoming flights, long-term trends of which can be made available to CARP via the regional offices. Counting the number of times each flight is inspected will help to identify whether any flights seem to be over- or under-inspected. As noted above, at least 20% of all week-day flights for each region should have all ULDs externally inspected. For some regions, this level of intervention will be readily verified, for others, it may be necessary to construct some summary statistics to be confident that the inspection level is reasonable for each flight.

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

2. The CARP should estimate the risk of each flight. This could be performed either by simply dividing the BRM interceptions against the number of inspections for the flight, or even using a risk tool similar in scope to the IRIS algorithm spreadsheet tool. Reporting the estimated risk of each flight will help to identify whether any flights 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 flights.

   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

Beale, R., Fairbrother, J., Inglis, A., and Trebeck, D. (2008). *One Biosecurity: a Working Partnership*. Commonwealth of Australia.

Robinson, A., Burgman, M., Atkinson, W., Cannon, R., Miller, C., and Immonen, H. (2008). AQIS Import Clearance Data Framework. Technical Report 0804, Australian Centre of Excellence for Risk Analysis.

Robinson, A., Burgman, M., Langlands, R., Cannon, R., and Clarke, F. (2009a). AQIS Import Clearance Risk Framework. Technical Report 0804a, Australian Centre of Excellence for Risk Analysis.

Robinson, A., Karri, R., and Luckman, G. (2009b). AQIS Import Clearance Risk Return: ULD Report 1. Technical Report 1001e 1, Australian Centre of Excellence for Risk Analysis.

Robinson, A., Karri, R., and Luckman, G. (2009c). AQIS Import Clearance Risk Return: ULD Report 2. Technical Report 1001e 2, Australian Centre of Excellence for Risk Analysis.

Appendix A

Definitions / Acronyms

ACERA	Australian Centre of Excellence for Risk Analysis
AQIS	Australian Quarantine Inspection Service
BRM	Biosecurity Risk Material
CARP	Cargo Analysis and Review Program
CPM	Cargo Positioning Manifest, which shows the position and type of ULD in the aircraft. Used by the leading hand to co-ordinate the loading and unloading of the aircraft.
CTO	Cargo Terminal Operator, which controls the area of the airport or wharf in which cargo is loaded and unloaded from aircraft or ships. This role also encompasses cargo handlers such as stevedores, who load international sea cargo.
Cusum	Cumulative Sum
ECIR	External Container Inspection Regime. External inspection of containers at the wharf. Relates to sea cargo only.
HRM	High-Risk Movement
IC	Import Clearance
IQI	Increased Quarantine Intervention
IRIS	Inspection Risk and Inspection Surveillance; IRIS is an algorithm that is presented in a spreadsheet tool developed by ACERA to calculate pathway risk using inspection and contamination data
Items	The material, unit, vessel or object undergoing inspection for BRM.
Leakage Rate	The rate of items crossing the border that still contain BRM.
Pathway manager	The AQIS manager responsible for resourcing, monitoring and reporting for the pathway. E.g. Ferne Clarke
ULD	Unit Load Device (air can). Air container used for transporting goods on aircraft.

Appendix B

Extensions

1. Should we include low-level contamination for the purposes of estimating inspection leakage? Presumably the high-level contamination is harder to miss, which would argue against so doing. Perhaps an estimate of both would be interesting. If so, we should aggregate risk over a year at least.
2. Should we use low-level contamination to try to predict the risk of high-level contamination? The idea is plausible, and we may be able to develop a model with existing data resources. It is more likely to be successful and useful in pathways that reflect higher contamination rates than those in Air Cargo, however.

Appendix C

Change Log

19-12-2010 Typographical errors in Appendix B fixed.

12-12-2010 Final draft with references to “surveillance” inspections” renamed.

25-11-2010 Updated description of Brisbane workflow after conversation with Rafi Alam and Melbourne workflow after discussion with Adam Bennett and Marisa Perri.

20-08-2010 Added extra detail on Cargo Risk Program workflow.

20-06-2010 Initial draft.