URS

Scott Wilson

Manual Security Queue Audit at Heathrow Airport

Final Report

September 2011

Prepared for

Civil Aviation Authority

Revision Schedule

Manual Security Queue Audit at Heathrow Airport
September 2011

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02	07/08/2011	Draft for CAA approval	**Eimear Connery** Airport Planner	**Rob Rushmer** Technical Director	**Rob Rushmer** Technical Director
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04	14/092011	Draft	**Eimear Connery** Airport Planner	**Rob Rushmer** Technical Director	**Rob Rushmer** Technical Director
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1 Introduction

1.1 Background

Following an audit focussing on the application of the service quality and rebate scheme at Heathrow Airport in 2010, URS Scott Wilson was appointed in June 2011 to undertake a manual audit of security queue time measurement in Terminal 5. The security queue measurement is undertaken as part of the rebate scheme whereby 95% of measurements are to be processed through central security in less than 5 minutes and 99% in equal to or less than 10 minutes.

1.2 Scope and Objectives

The key objective of the audit was to conduct a targeted, manual audit of the security queue measurement at Heathrow Airport Terminal 5 North and South entrances to central security.

As set out in the study brief, the objectives of the study were:

- Objective 1: an assessment of the accuracy of the security times provided by Heathrow Airport Limited (HAL);
- Objective 2: an independent view on how representative the measured passenger is of the times of other passengers in the security queues; and
- Objective 3: a comparison of the measured security queue times with those reported by HAL for previous months.

The audit spanned the working week days of the month of July from Tuesday 5 to Friday 29.

URS Scott Wilson was also to report on any other points of interest, in relation to the central security queue measurement at Terminal 5, which came to our attention during the course of the audit.

1.3 Structure of Report

Section 2 sets out the method employed detailing how URS Scott Wilson manually collated independent queue time measurements.

Section 3 sets out the results and analysis.

Section 4 presents and discusses the conclusions of the study.

1.4 Acknowledgements

URS Scott Wilson would like to thank members of staff at Heathrow Airport and Wilson James for their assistance in facilitating our delivery of this audit to the CAA.

2 Method

2.1 Objective 1: Assessment of the Accuracy of Data Provided by HAL

URS Scott Wilson placed two members of staff at Heathrow. One took measurements for the North entrance and the other for the South entrance of the central security area in T5A, from Tuesday 5th July until Friday 29th July. Queue time measurements were taken from live Closed Circuit Television (CCTV). Independent queue time measurements were taken for each week day between these two dates and between the hours of 9.30am to and including 12pm and 1pm to and including 5.30pm. Queue time measurements were taken for every 15 minutes during these time periods. The first passenger on the hour and at 15, 30 and 45 minutes past the hour were observed.

For completeness and following a review at the end of the first week of the audit, URS Scott Wilson also recorded the queue time measurement as measured by the Wilson James employees who undertook the official measurement on behalf of HAL.

To address Objective 1 the Wilson James staff were shadowed in their measurements. The URS Scott Wilson auditor agreed with the Wilson James CCTV operator the passenger being observed. This would be the first easily identifiable passenger to pass the liquid check area and approach the boarding pass presentation desks at each 15 minute period. The URS Scott Wilson auditor made their own measurement, starting and stopping their stopwatch as they independently judged the passenger had started and completed their journey through the security queue, the end being the passenger's first interaction with a tray at the roller bed of the x-ray machine. This time was recorded along with the x-ray machine queue number in order that the unimpeded walk time appropriate to that queue can be applied.

2.2 Objective 2: Assessment of How Representative the Officially Measured Passenger is of the Overall Security Queue

In order to assess how representative the "official" passenger is of the overall queue, between the official measurements every 15 minutes the URS Scott Wilson auditor also observed a "secondary" passenger within the remaining time period before the next official passenger. These two measurements are presented as "primary" and "secondary" in the remainder of this report. Depending upon the duration of observation time for the primary passenger, it was not always possible to record a secondary measurement, as the primary always took priority.

2.3 Objective 3: Comparison of Independent July Data with Previous Months

The CAA provided URS Scott Wilson with the queue times provided by HAL for the months of February 2010 to July 2010 and February 2011 to June 2011. In addition the CAA also provided URS Scott Wilson with the monthly traffic data for the Terminal 5 for those months. The independent observation for the month of July was compared to these previous months.

3 Results and Analyses

This section presents the results of the audit and details of the analyses undertaken to address each of the objectives of the study, the summary conclusions of which are discussed in Section 4.

3.1 Objective 1: Assessment of the Accuracy of Data Provided by HAL

This section compares the result of the analysis of the independent URS Scott Wilson observation of the primary passengers against the data provided to the CAA by HAL. As discussed in Section 2.1 URS Scott Wilson only made observations during the working week and for certain hours of the working day, therefore the same periods were selected from the HAL data to ensure that the same time periods were compared. The URS Scott Wilson and HAL observations of adjusted queue time by time slot by day are presented in Table 3.1 and Table 3.2 respectively for the North Entrance and Table 3.3 and Table 3.4 for the South Entrance on the following two pages. The queue times are as corrected for the unimpeded walk time appropriate to the actual queue used by the passenger.

3.1.1 North Entrance

Figure 3.1 and Figure 3.2 show the URS Scott Wilson observations of the primary passengers over the entire month data set, falling within the queue time periods stated, firstly as the number of observations and secondly as percentages. Figure 3.3 and Figure 3.4 show the equivalent HAL data. Subsequently Figure 3.5 compares the URS Scott Wilson and HAL cumulative frequencies on the same chart.

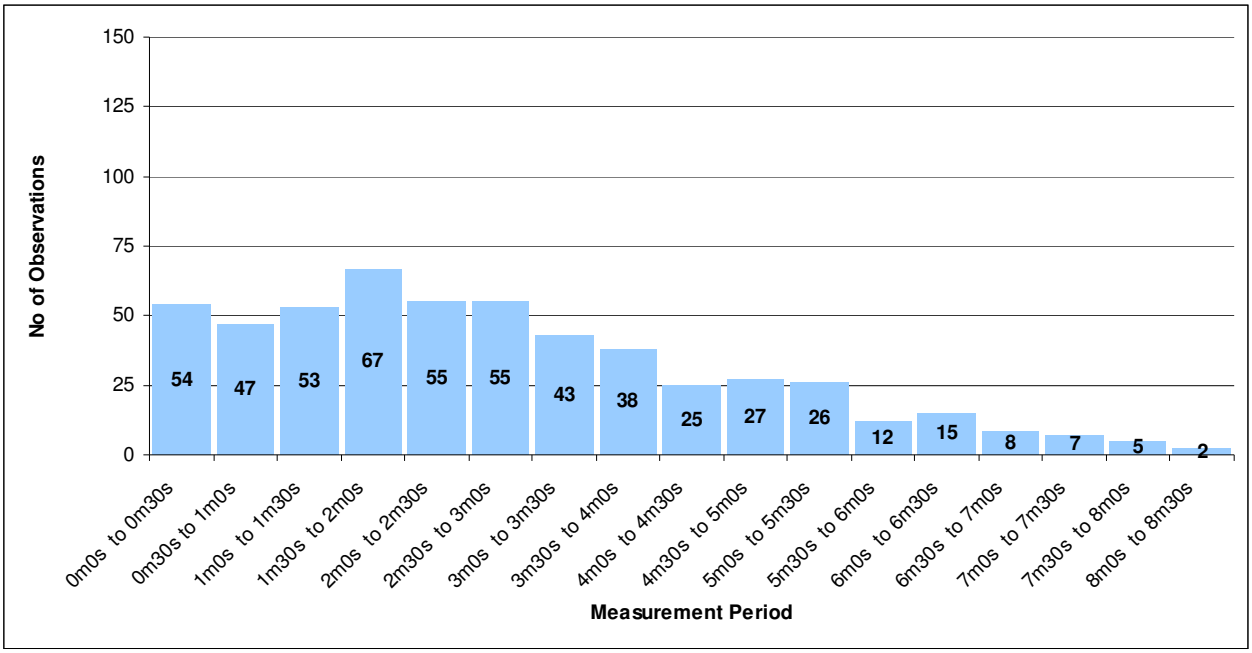

Figure 3.1: URS Scott Wilson North Entrance Primary Queue Time Measurements: Number of Measurements

	09:30	09:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30	12:45	13:00	13:15	13:30	13:45	14:00	14:15	14:30	14:45	15:00	15:15	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30
05/07/2011																						00:00	09:47	05:17	00:22	01:09	01:18	01:35	01:37	03:48	03:15	04:42	02:41
06/07/2011	06:36	05:29	06:14	01:22	06:18	00:44	01:17	02:24	00:13	02:42	03:54				00:50	01:11	03:02	05:11	02:05	01:38	02:16	02:40	03:26	08:29	05:31	04:06	01:32	00:51	02:40	01:07	02:53	03:49	03:45
07/07/2011	01:23	02:26	02:19	02:28	05:15	03:07	01:08	03:33	02:25	02:12	02:59				00:00	00:28	02:55	03:31	02:16	03:59	02:09	00:00	05:08	00:54	04:43	01:44	01:10	00:00	02:29	02:03	03:52	02:09	03:13
08/07/2011	04:31	01:37	04:53	05:10	02:50	03:32	03:33	01:06	01:03	09:49	01:34				04:09	03:40	03:07	01:49	03:21	02:39	00:00	01:06	03:22	00:39	01:53	00:33	00:00	02:05	04:01	03:20	02:42	01:12	01:53
11/07/2011	02:56	04:46	09:48	04:49	06:06	02:24	05:56	02:39	07:59	04:39	04:27				06:11	03:58	02:01	00:51	01:19	04:36	01:56	00:55	05:33	01:55	00:10	01:25	01:52	01:37	02:07	00:49	00:36	00:26	02:23
12/07/2011	02:24	03:04	04:17	03:01	06:56	00:07	02:04	01:37	02:33	03:00	01:09				01:33	01:53	02:37	01:27	02:24	02:15	04:43	00:54	05:20	00:03	00:04	01:14	01:43	01:55	03:43	01:55	02:26	00:39	02:38
13/07/2011	03:35	06:23	05:12	07:35	05:18	06:35	00:18	00:44	04:22	02:50	00:18				02:57	01:49	04:26	00:00	03:39	02:17	02:03	02:01	08:13	00:04	04:52	00:20	01:55	00:24	06:45	01:18	03:20	01:20	02:14
14/07/2011	01:36	02:49	02:36	02:30	02:16	03:08	01:20	03:54	00:44	07:04	01:37				05:19	02:47	02:27	01:40	02:41	01:41	02:51	00:16	00:14	05:54	04:09	00:21	02:23	02:04	00:26	01:55	06:40	03:02	01:19
15/07/2011	04:44	05:25	03:45	04:19	04:20	01:25	06:22	00:51	00:43	00:06	04:33				05:08	07:48	05:10	00:08	04:16	03:04	01:51	01:55	03:26	00:37	01:01	02:22	02:36	01:33	01:14	01:51	00:45	00:57	02:10
18/07/2011	01:45	02:46	00:40	03:57	03:57	01:14	00:46	00:21	05:47	05:19	01:55				04:13	03:58	01:26	01:16	04:48	00:16	01:17	03:11	02:13	02:40	00:00	02:41	01:08	04:58	02:10	00:21	04:11	04:19	05:08
19/07/2011	07:22	03:10	00:47	06:22	03:55	01:16	03:14	01:54	00:00	00:45	03:57				08:33	05:28	00:00	00:21	00:47	00:06	04:39	02:25	00:17	00:33	00:00	01:31	00:56	00:00	00:00	00:09	01:18	03:56	01:56
20/07/2011	03:25	04:10	05:38	03:03	02:54	01:16	00:36	02:45	06:06	07:17	04:55				07:16	07:26	01:57	00:39	04:38	03:09	01:30	02:22	00:44	00:09	00:31	00:08	03:32	01:31	02:40	02:41	01:24	01:48	00:07
21/07/2011	03:12	01:16	06:36	04:55	06:19	01:55	06:38	04:51	11:40	02:53	04:49				01:01	05:40	01:09	02:34	03:59	02:39	01:44	04:22	00:30	00:41	01:19	00:08	02:26	03:11	03:31	03:48	01:30	03:50	02:28
22/07/2011	02:19	09:13	05:14	00:46	07:15	01:49	04:33	00:42	05:58	06:15	02:01				04:45	02:51	02:01	01:43	01:45	02:57	05:27	05:47	02:33	06:29	00:50	03:03	01:07	00:22	01:38	03:00	03:17	02:05	02:48
25/07/2011	04:32	04:31	06:13	01:47	09:17	12:40	01:20	05:45	07:51	04:03	03:25				07:35	01:31	05:24	03:08	00:00	02:19	01:03	01:50	01:38	02:22	01:17	00:25	00:08	06:52	03:04	03:22	00:32	01:33	00:07
26/07/2011	02:52	02:23	03:35	04:00	01:30	01:04	00:00	02:10	02:11	02:03	02:44				02:30	06:15	01:28	02:43	00:39	02:26	03:31	00:40	02:30	02:50	04:58	08:52	10:23	10:46	01:44	03:06	01:19	03:33	02:11
27/07/2011	04:13	05:22	03:18	05:58	03:27	01:23	04:16	04:01	06:11	03:59	05:27				02:47	05:52	01:23	01:35	03:50	01:23	02:42	02:57	00:45	01:34	00:59	01:26	00:39	00:08	05:27	02:49	00:15	02:30	01:54
28/07/2011	01:46	00:58	03:24	02:39	07:02	00:40	03:27	02:55	00:30	05:23	06:03				01:54	02:30	09:04	02:36	03:22	01:33	00:48	04:33	01:59	00:24	00:24	00:00	01:32	03:07	03:05	01:13	03:28	02:52	04:39
29/07/2011	05:04	03:09	05:07	01:57	03:30	02:00	04:07	00:00	02:14	02:00	00:59				04:16	02:27	04:18	01:12	03:27	03:37	04:15	02:49	03:39	01:09	00:30	01:43	03:38	01:11	01:58	01:37	05:04	01:53	03:54

Table 3.1 URS Scott Wilson North Entrance Observed Primary Passenger Queue Times

	09:30	09:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30	12:45	13:00	13:15	13:30	13:45	14:00	14:15	14:30	14:45	15:00	15:15	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30
04/07/2011																						00:01											
05/07/2011																																	
06/07/2011	06:36	05:29	06:46	01:22	06:17	00:44	01:17	02:24	00:13	02:42	03:56				00:57	01:16	03:00	05:07	02:09	01:40	02:13	02:42	03:06	09:12	05:31	04:30	02:19	00:50	02:35	01:07	02:53	03:50	03:53
07/07/2011	01:25	02:58	02:19	02:28	05:28	03:08	01:11	03:37	02:24	01:59	03:00				00:00	00:28	02:57	03:34	02:17	03:59	02:09	00:00	04:50	00:54	04:45	01:43	01:10	00:01	02:24	02:04	03:41	02:09	03:27
08/07/2011	04:29	01:37	04:58	05:11	02:57	03:33	03:34	01:06	01:03	09:48	01:37				04:11	03:40	03:07	01:50	03:23	02:38	03:44	01:08	03:22	00:43	02:06	00:34	00:00	02:05	04:23	03:20	02:47	01:19	02:14
11/07/2011	02:58	04:45	09:49	04:49	06:16	02:24	05:58	02:35	08:25	04:39	04:27				06:07	03:56	02:03	00:51	01:20	04:36	01:58	00:53	05:33	01:54	00:11	01:26	01:54	02:10	02:10	00:46	00:34	00:26	02:23
12/07/2011	02:23	03:03	04:18	03:00	07:09	00:08	02:04	01:38	02:33	02:59	01:09				02:17	01:52	02:37	01:34	02:24	02:15	04:45	00:54	05:04	00:04	00:06	01:17	01:43	01:53	03:43	01:57	02:25	00:41	02:40
13/07/2011	03:36	06:23	05:11	07:38	05:13	06:35	00:15	00:12	04:23	02:53	00:57				02:59	01:50	03:55	00:00	03:40	02:22	02:06	01:59	08:12	00:04	04:39	00:03	01:55	00:27	06:47	01:22	03:20	01:43	02:14
14/07/2011	01:43	02:50	02:35	02:30	02:18	03:10	01:27	03:54	00:39	07:03	01:36				05:18	02:47	02:24	01:41	02:40	01:39	02:53	00:17	00:26	05:54	04:01	00:31	01:04	02:03	00:22	01:54	06:41	02:54	01:21
15/07/2011	04:44	05:25	03:44	04:22	04:30	01:28	06:20	00:49	00:49	00:16	04:30				05:08	07:48	05:09	00:08	04:20	03:05	01:55	01:56	03:27	00:39	01:02	02:26	02:38	01:39	01:16	01:50	00:45	00:58	02:16
18/07/2011	01:45	02:46	00:36	03:57	03:58	01:09	00:46	00:19	05:48	05:18	01:55				04:13	03:57	01:24	01:14	04:49	00:17	01:15	03:14	02:14	02:35	00:00	02:41	01:08	04:57	02:09	00:16	04:06	04:20	05:08
19/07/2011	07:23	03:04	00:47	06:23	03:39	01:21	03:25	01:57	00:00	00:45	04:01				08:34	05:28	00:00	00:25	00:44	00:03	04:39	02:28	00:26	00:32	00:00	01:32	00:55	00:00	00:00	00:06	01:19	03:57	01:53
20/07/2011	03:25	04:06	05:39	03:02	02:54	01:15	00:34	02:41	06:17	07:18	04:49				07:13	07:26	01:58	00:39	04:30	03:08	01:27	02:25	00:53	00:09	00:31	00:08	03:30	01:29	02:39	02:40	01:25	01:50	00:08
21/07/2011	02:48	01:18	06:35	04:56	06:17	01:37	06:08	04:51	11:38	02:51	04:49				00:59	04:55	01:06	02:34	03:58	02:37	01:46	04:20	00:27	00:41	01:26	00:08	02:25	03:09	03:32	03:45	01:32	03:57	02:33
22/07/2011	02:21	09:17	05:14	00:46	07:14	01:48	04:33	00:44	05:56	06:15	02:00				04:45	02:50	02:02	01:43	01:46	02:56	05:27	05:52	02:32	06:30	00:49	03:06	01:07	00:20	01:35	03:00	02:04	02:43	00:43
25/07/2011	04:32	04:34	06:13	01:53	09:16	12:39	01:29	05:44	07:51	04:03	03:32				07:34	01:32	05:23	03:07	00:00	02:20	01:01	01:50	01:37	02:20	01:20	00:24	00:07	06:54	03:01	03:22	00:33	01:33	00:06
26/07/2011	02:54	02:24	03:40	04:04	01:34	01:10	00:00	02:34	02:11	02:03	02:44				02:30	06:16	01:27	02:41	00:40	02:26	03:31	00:40	02:30	02:49	04:58	08:52	10:24	10:48	01:43	03:14	01:19	03:33	02:12
27/07/2011	04:13	05:22	03:20	05:59	03:30	01:26	04:17	04:01	06:09	04:00	05:28				02:44	05:53	01:22	01:34	03:54	01:20	02:48	02:57	00:45	01:34	00:59	01:28	00:38	00:11	05:27	02:39	00:14	02:30	01:55
28/07/2011	01:45	00:59	03:24	02:49	07:03	00:40	03:27	02:55	00:30	05:31	06:04				01:54	02:27	09:04	02:34	03:23	01:33	00:48	04:33	01:59	00:23	00:24	00:00	01:32	03:04	03:05	01:14	03:29	02:50	04:38
29/07/2011	05:05	03:07	05:07	01:54	03:28	01:58	04:07	00:00	02:14	02:00	00:59				04:16	02:29	04:19	01:12	03:15	03:46	04:08	02:50	03:36	01:05	00:30	01:43	03:37	01:09	02:01	01:41	05:03	01:57	04:06

Table 3.2 HAL Observed North Entrance Primary Passenger Queue Times

	09:30	09:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30	12:45	13:00	13:15	13:30	13:45	14:00	14:15	14:30	14:45	15:00	15:15	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30
05/07/2011																						03:54	02:44	02:09	01:41	00:13	00:53	02:12	01:00	03:33	01:57	01:51	03:55
06/07/2011	08:03	05:31	02:51	05:31	05:22	03:18	00:00	02:02	03:09	03:05	03:07				02:29	02:17	01:46	03:10	00:01	01:35	03:41	04:00	02:24	02:03	02:40	04:00	04:16	06:24	00:36	01:20	01:17	06:37	03:44
07/07/2011	00:19	02:03	02:13	00:37	00:49	00:00	01:49	01:14	00:06	01:01	08:12				00:21	02:26	00:57	00:15	00:04	05:14	00:58	01:25	03:11	00:51	00:27	01:39	00:41	03:58	02:12	05:15	01:07	01:16	01:05
08/07/2011	01:23	00:47	06:27	03:18	05:08	01:27	01:36	01:36	05:17	04:23	00:48				00:46	03:22	03:23	02:23	02:44	02:07	00:00	05:21	00:33	04:31	00:55	00:10	02:01	00:17	01:26	01:30	01:02	02:49	00:32
11/07/2011	01:21	07:08	02:36	06:48	02:54	03:04	04:14	00:13	02:58	02:01	04:41				02:00	03:17	02:57	00:23	00:26	04:18	01:00	04:59	00:01	01:53	00:27	00:46	00:22	01:11	00:00	02:50	01:44	00:19	00:00
12/07/2011	04:59	03:42	00:58	00:30	00:01	06:37	01:37	00:32	01:36	00:59	03:13				04:01	00:54	02:41	02:41	04:54	03:22	01:48	04:41	00:00	01:00	02:51	00:10	02:04	02:43	00:00	04:11	02:20	00:00	03:38
13/07/2011	01:08	02:26	03:27	02:48	01:57	03:30	00:31	00:00	00:08	04:29	02:23				00:00	00:00	02:11	00:42	02:46	03:42	01:01	02:21	01:41	01:45	00:51	02:23	02:50	06:06	08:09	04:56	03:17	02:16	00:36
14/07/2011	03:15	01:21	01:13	01:45	01:37	01:22	01:50	00:00	01:24	02:22	03:06				02:40	06:17	03:29	00:31	00:13	00:59	00:00	04:40	00:42	03:57	00:46	01:23	08:30	00:34	05:44	05:47	00:02	04:23	02:50
15/07/2011	06:09	03:10	01:07	00:27	05:12	01:54	00:09	01:36	02:31	00:19	00:59				00:00	03:06	00:18	08:21	03:23	02:20	01:24	06:41	00:00	00:00	00:00	00:27	00:00	01:26	00:22	00:47	02:25	00:55	00:59
18/07/2011	00:26	02:46	01:24	00:00	02:04	02:52	04:24	02:13	02:46	00:29	06:53				01:00	00:07	03:37	00:02	02:13	02:36	03:38	03:13	00:01	01:51	02:07	00:53	03:15	02:22	01:43	01:27	01:19	01:57	04:39
19/07/2011	00:57	01:24	01:30	00:40	01:50	02:13	02:25	02:06	00:00	00:57	01:03				00:00	02:45	03:19	00:00	01:59	03:36	02:49	00:00	00:41	04:45	01:42	01:40	01:34	04:33	01:12	02:18	00:02	05:16	05:31
20/07/2011	01:24	03:47	00:01	02:29	00:00	03:54	02:52	00:30	01:33	00:21	01:36				05:11	04:24	08:04	03:08	04:06	00:29	00:48	03:26	01:27	00:00	00:40	00:40	01:57	00:17	01:07	03:15	01:15	01:49	05:59
21/07/2011	01:01	01:36	01:01	01:40	02:38	02:00	04:45	01:09	00:30	02:31	05:16				00:00	03:15	03:09	02:11	04:14	01:20	03:01	02:22	01:52	02:06	01:14	01:36	00:00	00:48	03:53	03:59	03:33	01:04	01:03
22/07/2011	02:50	00:07	02:28	01:00	01:58	05:16	03:34	01:15	02:44	02:12	04:23				02:11	00:34	02:25	05:15	02:19	01:39	06:03	02:00	00:48	05:27	04:27	00:01	00:44	00:51	01:52	02:46	00:38	02:20	02:49
25/07/2011	02:52	00:12	03:55	01:29	02:36	01:04	05:54	02:30	02:35	01:31	02:09				02:07	05:31	07:00	02:39	03:44	03:25	00:15	00:00	00:49	02:31	00:41	00:00	00:00	00:05	07:22	07:02	01:00	01:26	00:01
26/07/2011	01:57	00:06	04:55	00:49	04:48	00:37	03:45	01:31	04:59	06:17	00:40				06:00	00:17	03:15	02:09	02:24	04:23	04:12	02:38	02:40	00:40	00:46	02:48	04:45	01:30	06:12	00:07	03:29	03:45	03:03
27/07/2011	05:45	02:31	01:35	02:31	02:09	01:49	01:00	04:12	03:30	03:43	01:48				02:02	01:52	02:52	03:12	01:00	02:12	02:40	00:53	00:43	02:29	00:42	00:01	01:05	00:15	00:28	02:39	02:43	00:06	00:30
28/07/2011	00:16	08:24	00:30	04:31	02:53	01:38	03:13	04:02	03:13	04:56	04:07				03:39	03:36	01:05	04:42	02:20	07:07	03:36	00:27	00:59	03:46	00:25	02:49	01:49	00:55	02:02	01:43	02:35	04:10	04:59
29/07/2011	05:08	05:49	00:00	02:00	02:00	02:38	01:00	00:13	02:06	03:50	03:54				04:45	01:08	01:02	00:03	01:05	06:07	02:00	03:00	01:13	01:54	01:37	01:24	02:52	01:01	02:05	00:30	02:03	00:00	01:03

Table 3.3 URS Scott Wilson South Entrance Observed Primary Passenger Queue Times

	09:30	09:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30	12:45	13:00	13:15	13:30	13:45	14:00	14:15	14:30	14:45	15:00	15:15	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30
04/07/2011																																	
05/07/2011																																	
06/07/2011	08:03	12:34	02:48	08:58	05:22	03:18	00:00	02:04	03:09	03:05	03:06				02:30	02:21	01:46	03:11	00:01	01:36	03:41	04:19	03:04	02:03	02:42	04:02	04:15	06:33	00:37	01:20	01:18	05:57	03:45
07/07/2011	00:20	02:03	02:12	00:37	00:47	00:00	01:52	01:15	00:06	01:22	08:12				00:24	02:30	01:00	00:20	00:05	05:14	00:59	01:32	03:10	01:18	00:23	01:39	00:40	03:59	02:10	05:16	01:15	01:18	01:06
08/07/2011	01:25	00:40	06:25	03:17	05:07	01:20	01:37	01:36	05:15	04:13	00:49				00:42	03:20	03:23	02:20	02:45	02:09	00:20	05:19	00:31	04:47	00:59	00:00	02:07	00:17	01:25	00:23	00:55	02:45	00:34
11/07/2011	01:20	07:08	02:36	06:50	02:52	03:04	04:16	00:15	02:57	01:59	04:42				02:02	03:16	02:58	00:23	00:26	04:17	01:06	04:59	00:01	01:53	00:30	00:42	00:23	01:10	00:00	02:50	01:40	00:19	00:00
12/07/2011	04:59	03:44	00:58	00:30	00:49	06:37	01:35	00:37	01:55	00:58	03:14				04:02	01:24	02:39	02:41	04:49	03:16	01:48	04:40	00:00	01:00	02:53	00:10	02:04	02:44	00:00	04:11	02:20	00:00	03:41
13/07/2011	01:07	02:25	03:27	03:00	01:57	03:30	00:31	00:01	00:08	04:29	02:23				00:00	00:00	02:10	00:42	02:46	03:44	01:01	02:24	01:40	01:45	00:51	02:13	02:50	06:05	08:09	04:56	03:16	02:16	00:36
14/07/2011	02:53	01:11	01:07	02:04	01:01	00:47	02:20	00:00	03:03	02:22	03:15				03:11	06:29	03:27	00:35	00:00	00:24	00:03	05:10	00:18	04:15	00:58	02:11	07:42	00:00	05:04	05:41	00:01	04:24	03:26
15/07/2011	06:14	02:41	00:50	00:57	06:06	02:34	00:50	00:48	03:15	00:37	01:41				00:00	03:06	00:07	08:28	03:37	02:09	02:38	06:53	00:12	00:41	00:32	00:00	00:06	01:19	00:23	00:00	02:37	00:25	01:41
18/07/2011	00:24	02:46	01:52	00:00	02:03	02:51	04:54	02:14	02:46	00:29	06:53				01:12	00:08	03:37	00:02	02:15	02:48	03:37	03:14	00:01	01:48	02:07	00:53	03:16	02:23	01:45	01:24	01:20	01:24	04:39
19/07/2011	00:58	02:14	01:29	00:40	01:50	02:13	02:27	02:07	00:21	00:56	01:04				00:00	02:46	03:19	00:00	02:00	03:36	02:50	00:13	00:41	04:46	01:43	01:40	01:34	04:33	01:14	02:18	09:59	05:17	05:31
20/07/2011	01:55	03:45	00:01	02:30	00:00	04:36	02:52	00:29	00:53	00:21	01:36				05:11	05:24	08:04	03:08	04:46	00:32	01:28	03:26	01:27	00:00	00:40	00:40	01:59	00:23	01:09	03:16	01:14	01:49	05:59
21/07/2011	01:01	01:36	00:32	01:40	02:38	02:00	04:45	01:09	00:30	02:31	05:16				00:40	03:14	03:08	02:10	04:14	01:20	03:01	02:23	01:53	02:06	01:15	01:36	00:00	01:17	03:53	03:58	03:33	01:04	01:03
22/07/2011	02:50	00:07	02:28	01:03	02:00	05:16	03:34	01:16	00:11	02:52	04:25				02:11	02:27	02:25	05:15	02:20	01:40	06:03	02:00	00:47	05:27	04:26	00:50	00:45	00:51	01:51	02:46	00:42	02:25	02:49
25/07/2011	02:52	00:00	03:56	01:35	02:00	09:46	05:12	01:57	02:30	01:37	01:22				02:00	05:36	07:30	02:38	03:44	03:18	00:51	00:00	00:55	02:24	00:38	00:05	00:05	00:17	06:53	06:26	00:37	00:52	00:42
26/07/2011	01:58	00:07	05:44	00:49	04:48	00:39	03:45	01:31	04:59	06:17	00:40				06:30	00:18	03:16	02:09	02:25	04:24	04:12	02:38	02:41	00:40	00:47	02:48	04:45	01:30	06:42	00:07	03:29	03:45	03:03
27/07/2011	05:46	02:32	01:34	02:31	02:10	02:38	00:59	04:12	03:30	03:43	01:48				02:02	01:52	02:56	03:12	01:20	02:13	02:41	00:53	00:44	02:29	00:41	00:02	01:05	00:15	00:28	02:40	02:44	00:27	00:30
28/07/2011	00:16	08:24	00:31	04:31	02:53	01:38	03:12	04:01	03:14	04:56	04:08				03:40	03:34	01:05	04:42	02:20	07:08	03:26	00:27	00:59	03:37	00:25	02:49	01:50	00:55	02:02	01:42	02:36	04:10	04:59
29/07/2011	05:09	05:49	00:01	02:31	02:05	02:38	00:26	00:13	02:06	03:51	04:05				04:45	01:09	01:02	00:03	01:05	06:08	02:50	03:00	01:15	01:54	01:36	01:54	02:18	00:27	02:37	00:30	02:03	00:30	01:05

Table 3.4 HAL Observed South Entrance Primary Passenger Queue Times

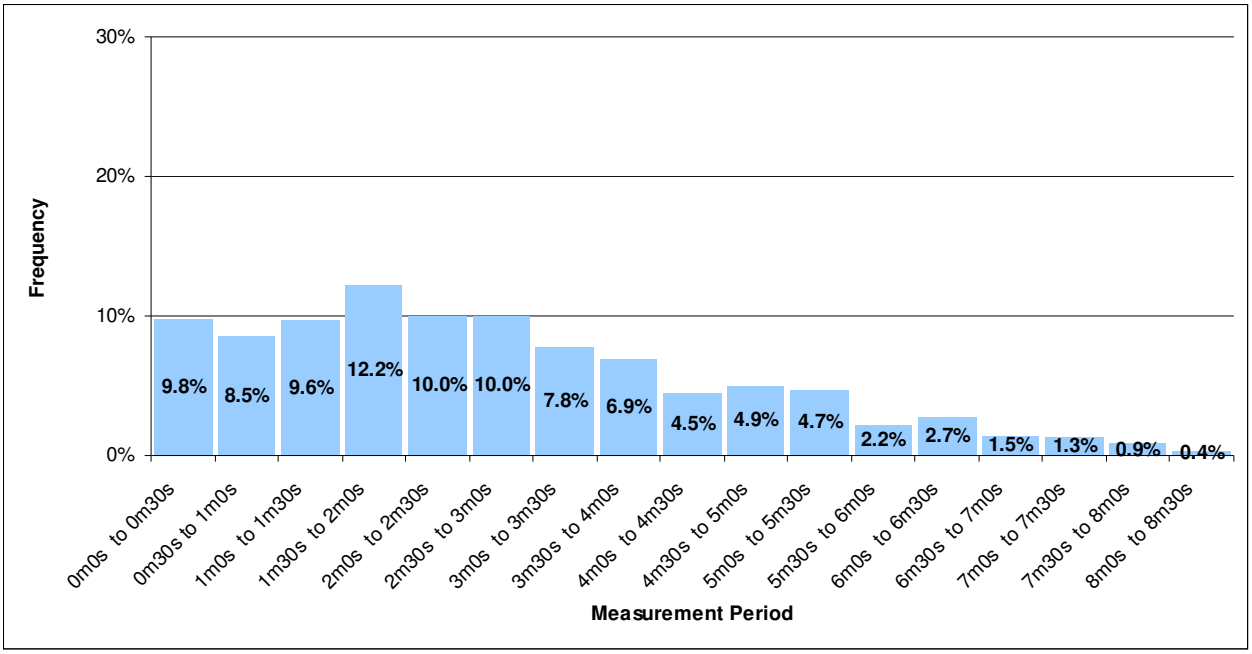

Figure 3.2: URS Scott Wilson North Entrance Primary Queue Time Measurements: Frequency

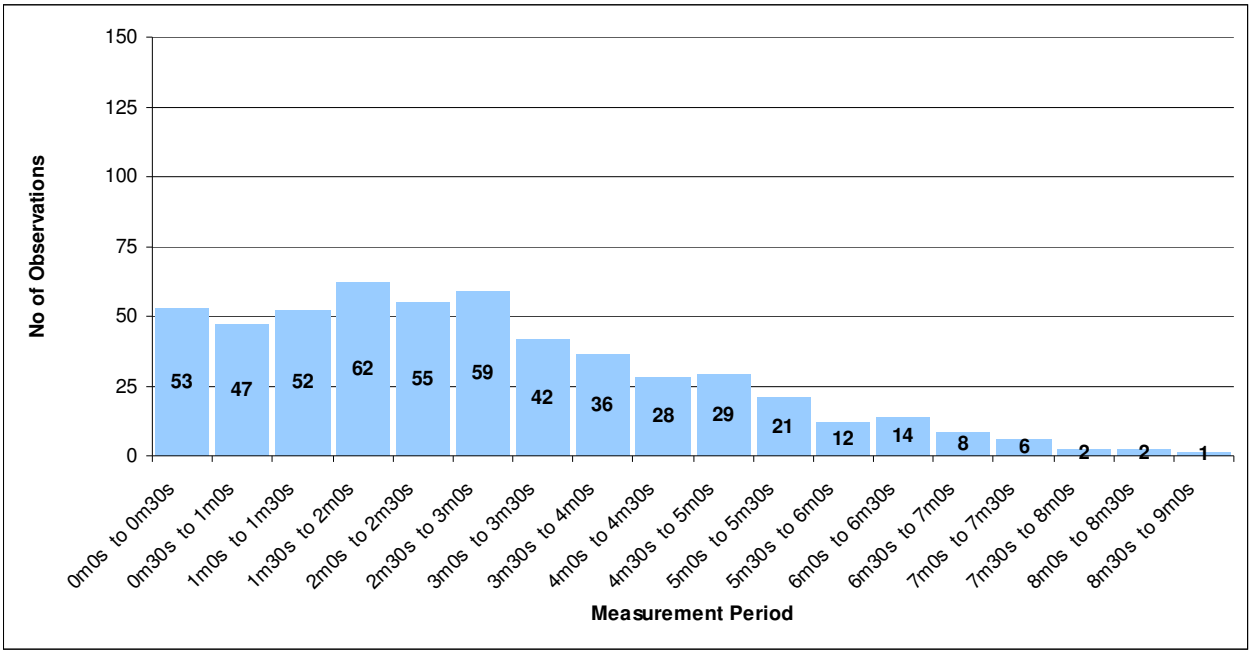

Figure 3.3: HAL North Entrance Queue Time Measurements: Number of Observations

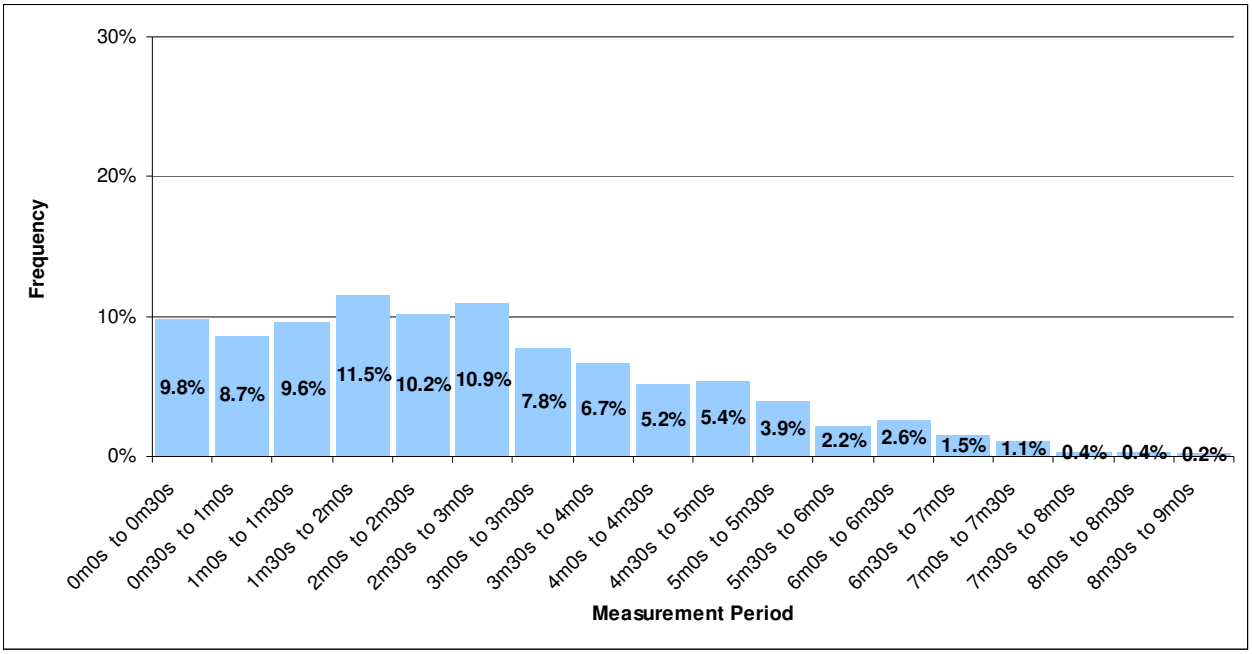

Figure 3.4: HAL North Entrance Queue Time Measurements: Frequency

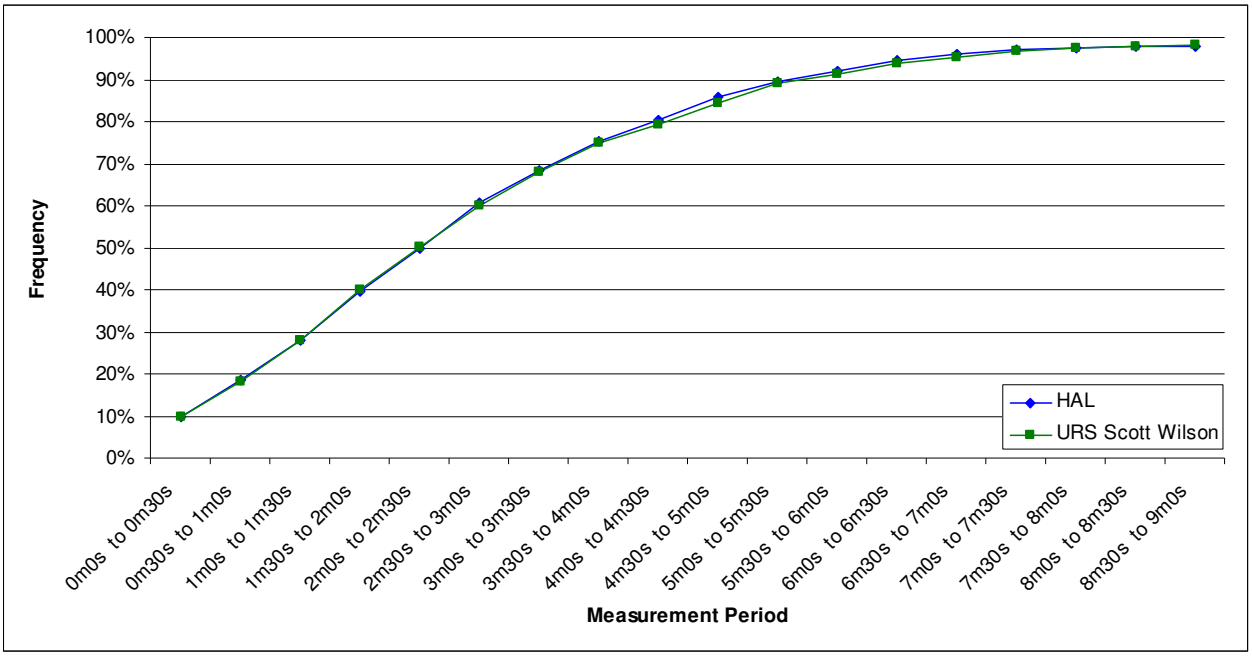

Figure 3.5: North Entrance Primary Queue Time Measurements: Cumulative Frequency HAL and URS Scott Wilson Data Comparison

Figure 3.6 and Figure 3.7 present the above data, for URS Scott Wilson and HAL data respectively, grouped into the following sets of pass/breach with respect to the target 5 minute queue time target:

- Group 1 is where a breach occurs (queue time 5:00 or greater)
- Group 2 indicates a near breach (queue time between 4:30 and 5:00)
- Group 3 is all other measurements, clearly passing the criterion (queue time below 4:30)

The percentage of all observations during the month that fall into each group is presented for each 15 minute time slot during the audited day.

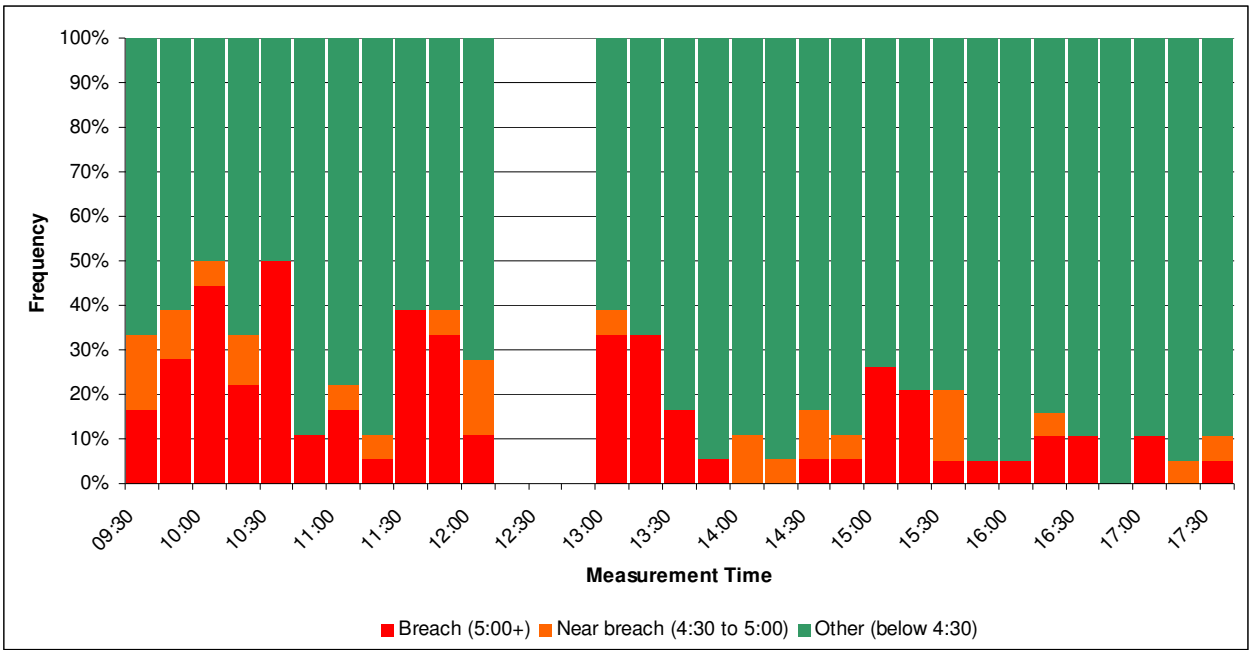

Figure 3.6: URS Scott Wilson North Entrance Groups of Primary Time Measurements

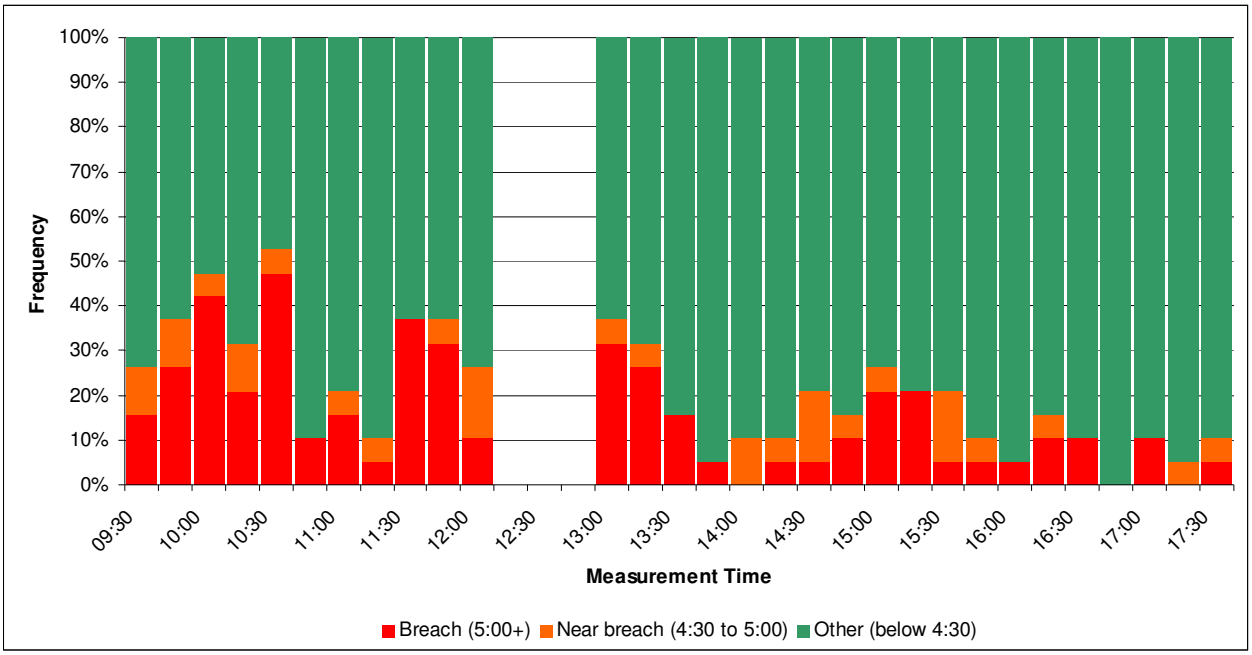

Figure 3.7: HAL North Entrance Groups of Time Measurements

Figure 3.8 compares the above groups (breach, near breach, pass) over the whole month for the URS Scott Wilson and HAL data.

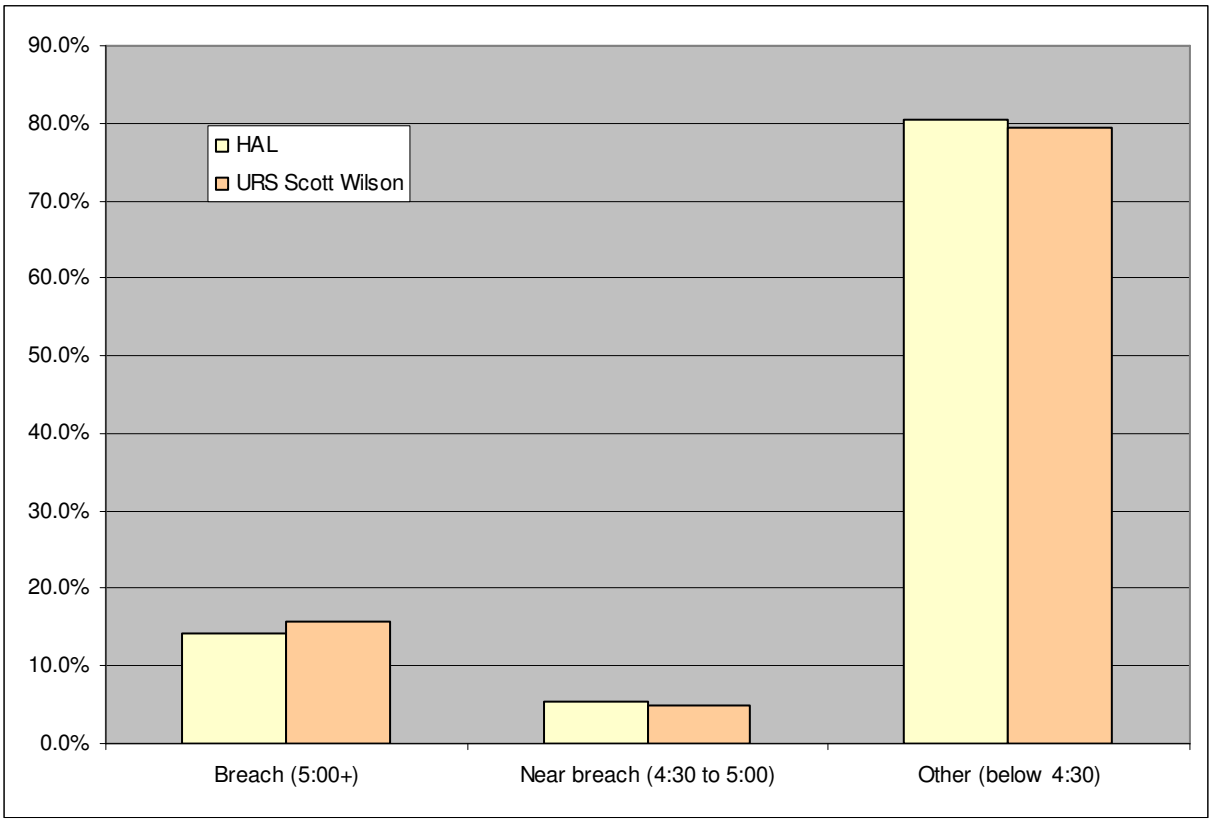

Figure 3.8: Comparison of URS Scott Wilson Primary and HAL North Entrance Groups of Time Measurements

By inspection Figure 3.5 to Figure 3.8 show observations that are highly similar. This is confirmed by testing[1] for a difference between the number of observations that pass or breach the service quality criterion (as shown in Figure 3.8), which shows a less than 30% confidence of any difference.

3.1.2 South Entrance

A similar analysis was conducted for the South Entrance data with results as follows.

[1] Throughout this report statistical testing for significance was undertaken by using a χ^2 test with URS Scott Wilson's observations as the expected values and null hypothesis being no difference between observations.

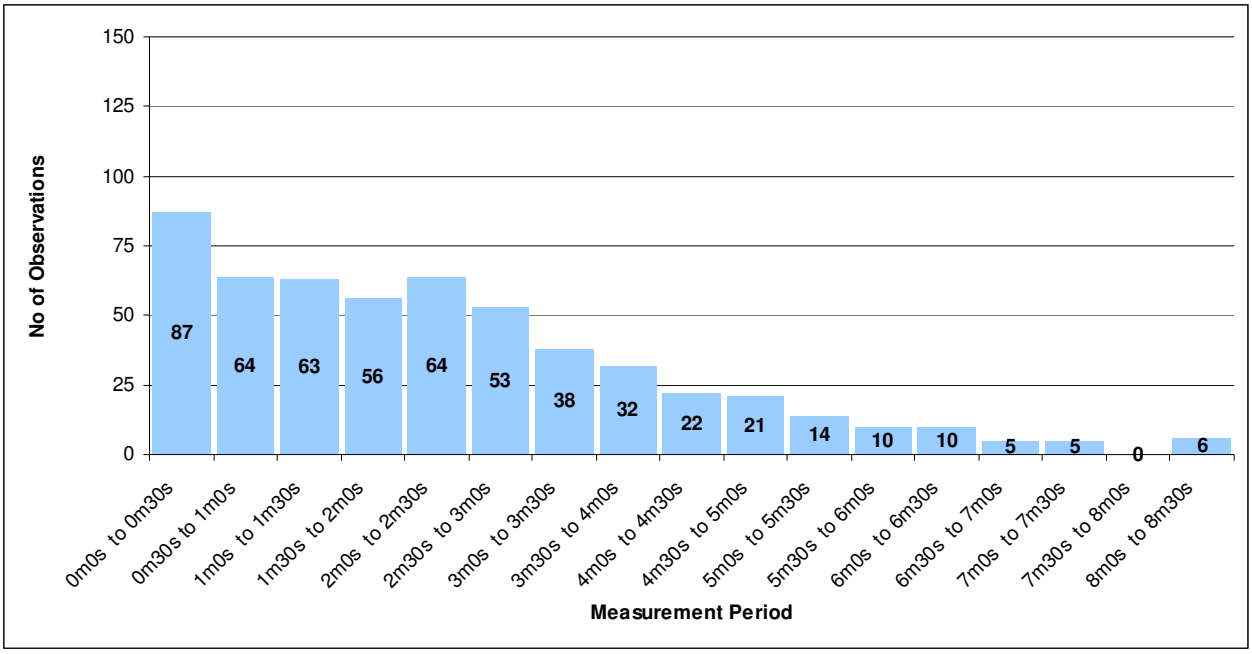

Figure 3.9: URS Scott Wilson South Entrance Primary Queue Time Measurements: Number of Measurements

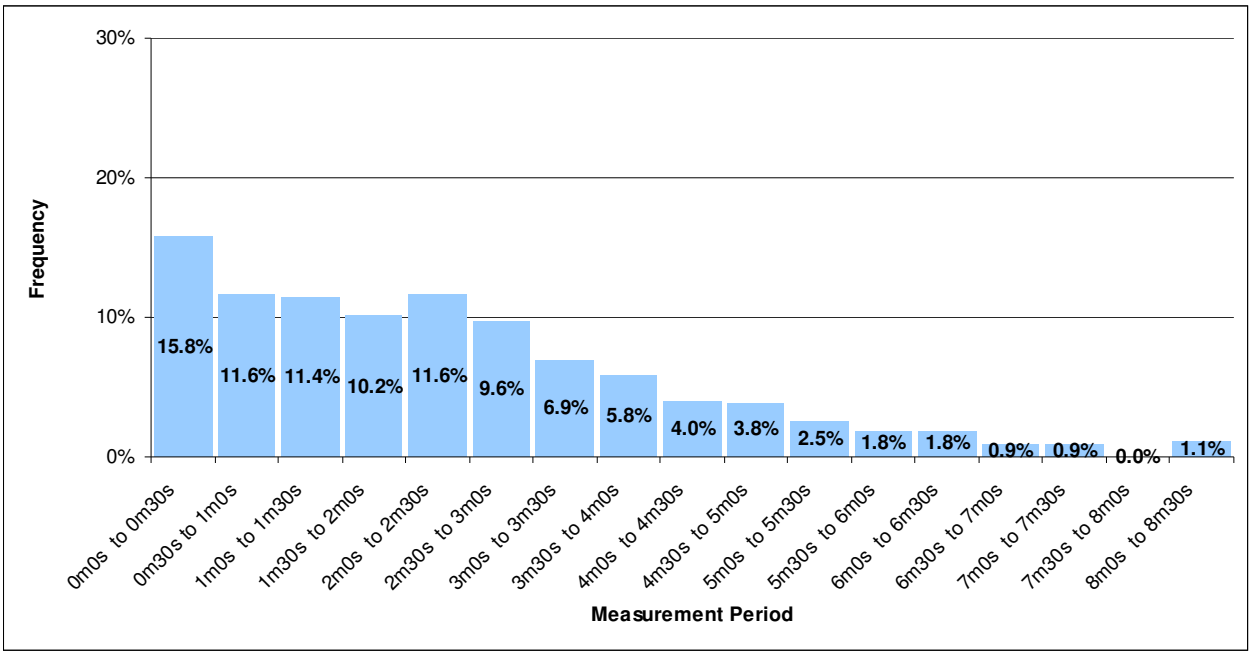

Figure 3.10: URS Scott Wilson South Entrance Primary Queue Time Measurements: Frequency

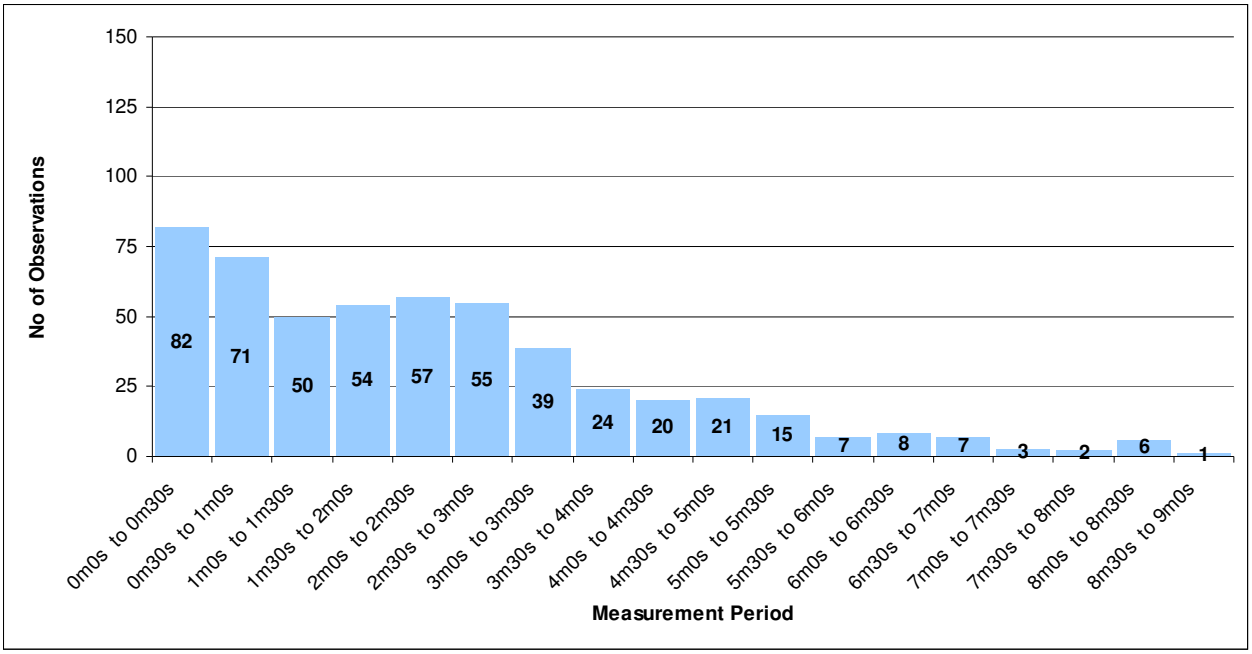

Figure 3.11: HAL South Entrance Queue Time Measurements: Number of Observations

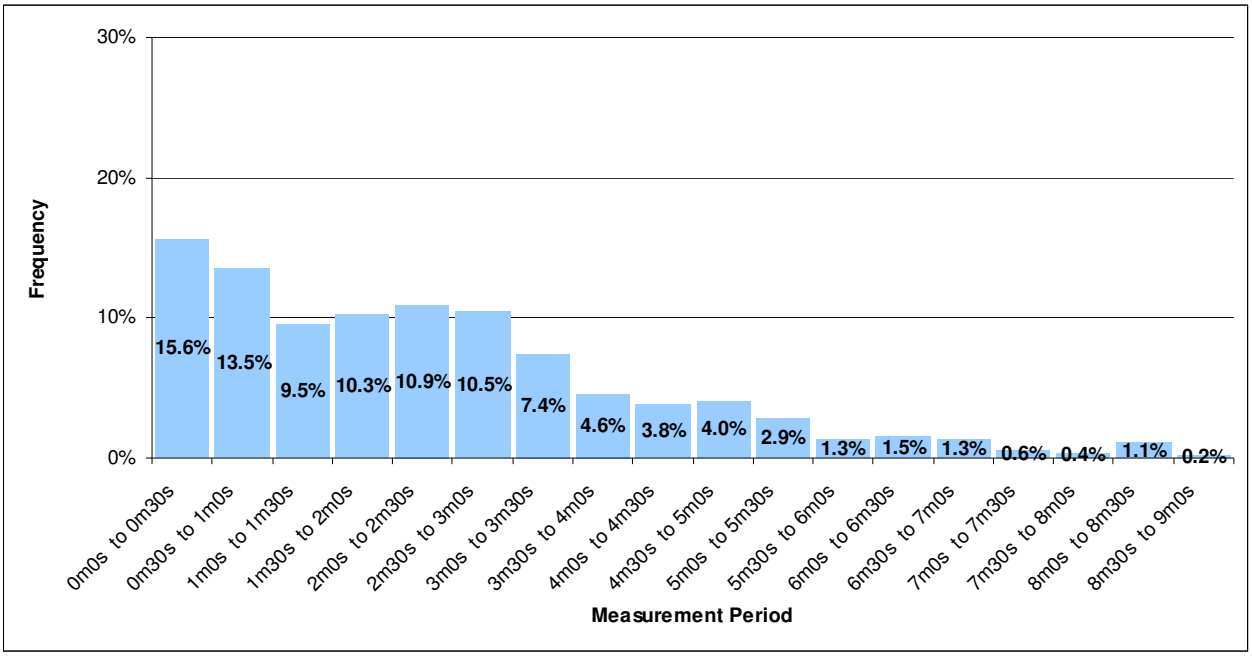

Figure 3.12: HAL South Entrance Queue Time Measurements: Frequency

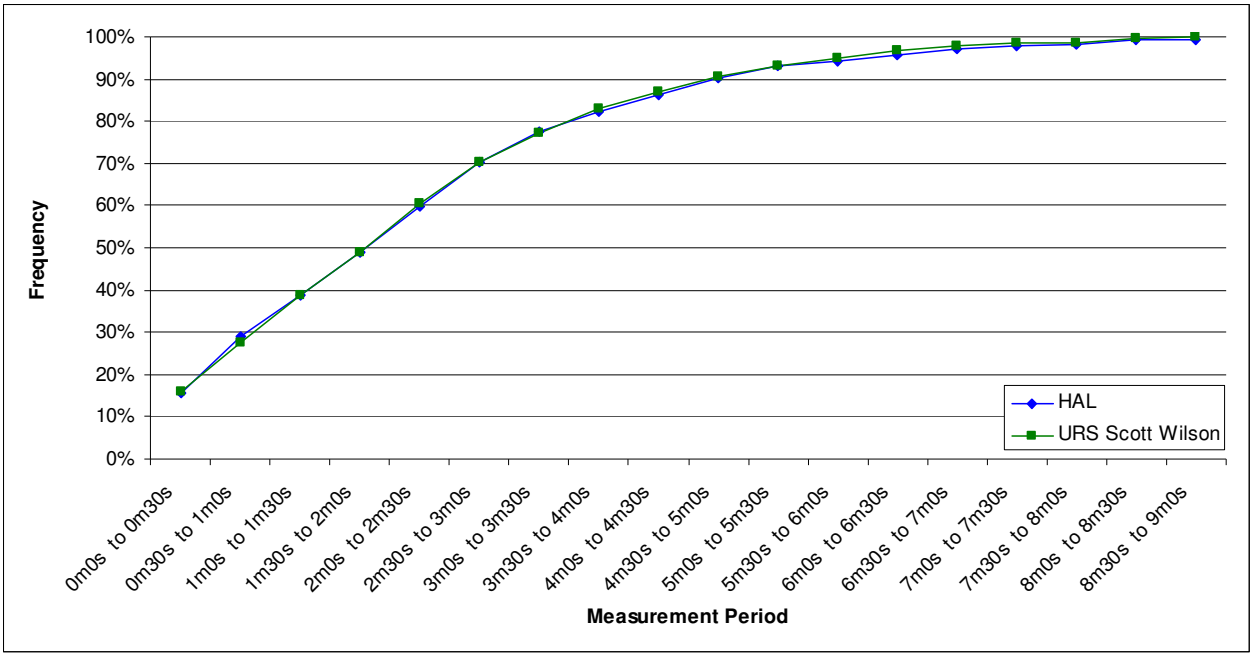

Figure 3.13: South Entrance Primary Queue Time Measurements: Cumulative Frequency HAL and URS Scott Wilson Data Comparison

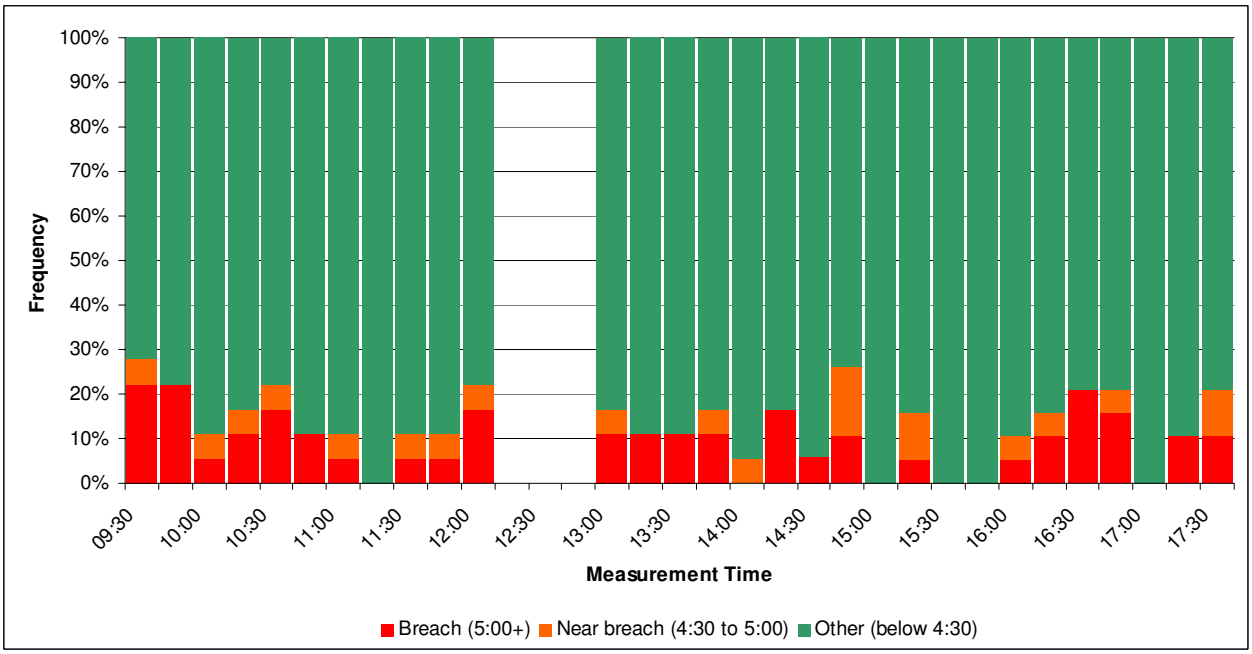

Figure 3.14: URS Scott Wilson South Entrance Groups of Primary Time Measurements

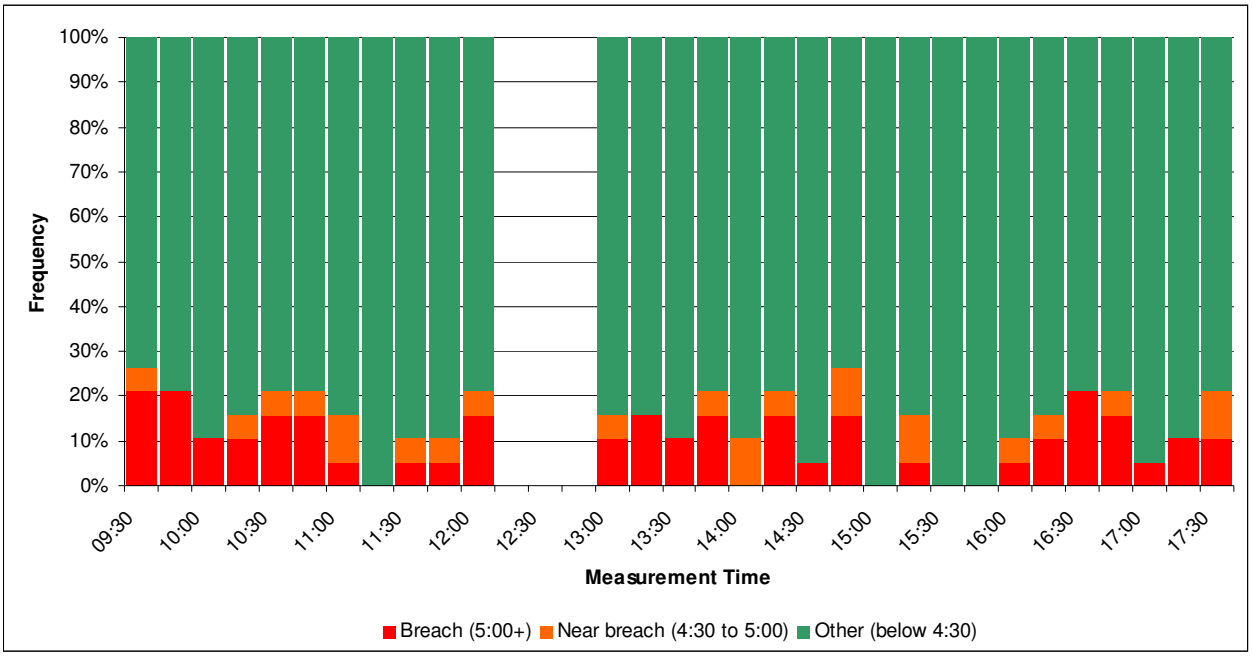

Figure 3.15: HAL South Entrance Groups of Time Measurements

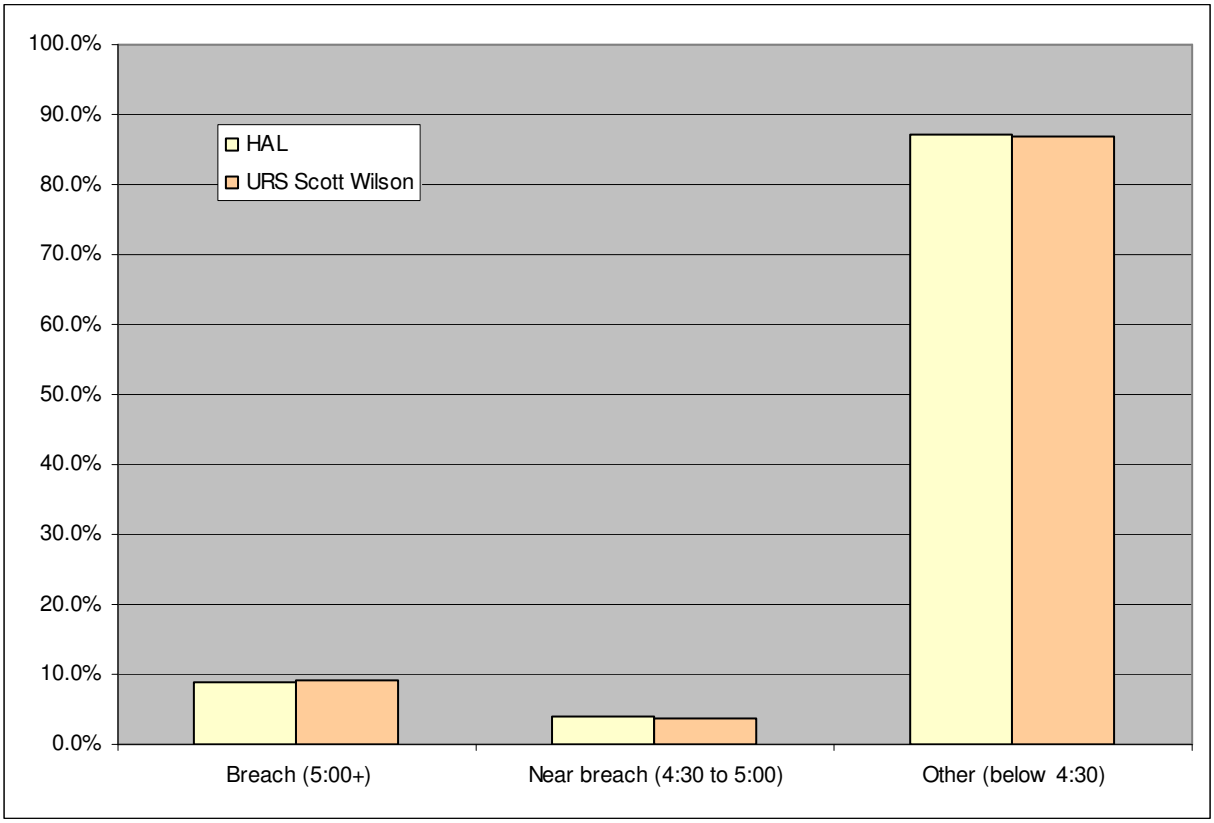

Figure 3.16: Comparison of URS Scott Wilson and HAL South Entrance Primary Groups of Time Measurements

As previously, by inspection these Figures show observations that are highly similar. This is confirmed by testing for a difference between the number of observations that pass or breach the service quality criterion (as shown in Figure 3.16), which shows a less than 10% confidence of any difference.

3.2 Objective 2: Assessment of How Representative the Officially Measured Passenger is of the Overall Security Queue

This section compares the results of the analysis of the URS Scott Wilson primary and secondary times observed to assess how representative the primary observations are of the overall security queue. The primary observations are as presented in Section 3.1; the secondary observations are presented below.

3.2.1 North Entrance

Figure 3.1 above and Figure 3.17 below present the number of observations of the primary and secondary passengers respectively, over the entire month data set, falling within the queue time period indicated.

Figure 3.18 presents the same data as cumulative frequency curves on the same chart. Data grouped into the previous breach, near-breach and pass categories are presented in Figure 3.19.

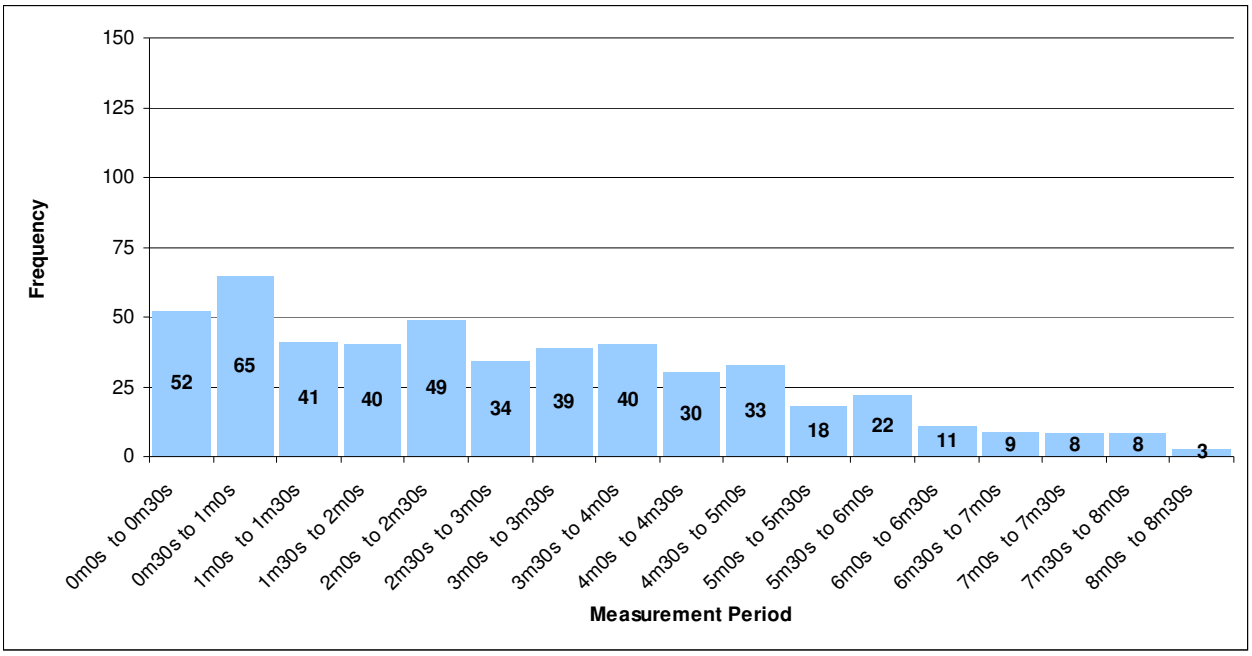

Figure 3.17: North Entrance Secondary Queue Time Measurements: Number of Measurements

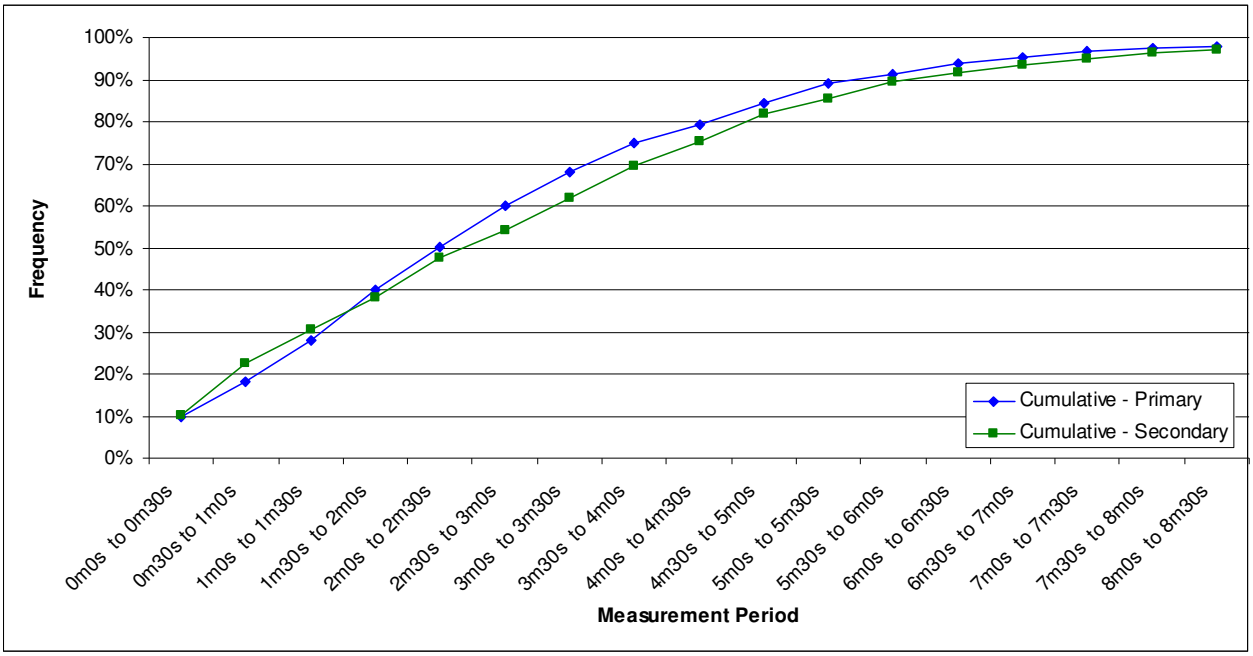

Figure 3.18: North Entrance Cumulative Frequency Primary and Secondary Passenger Queue Time Measurements

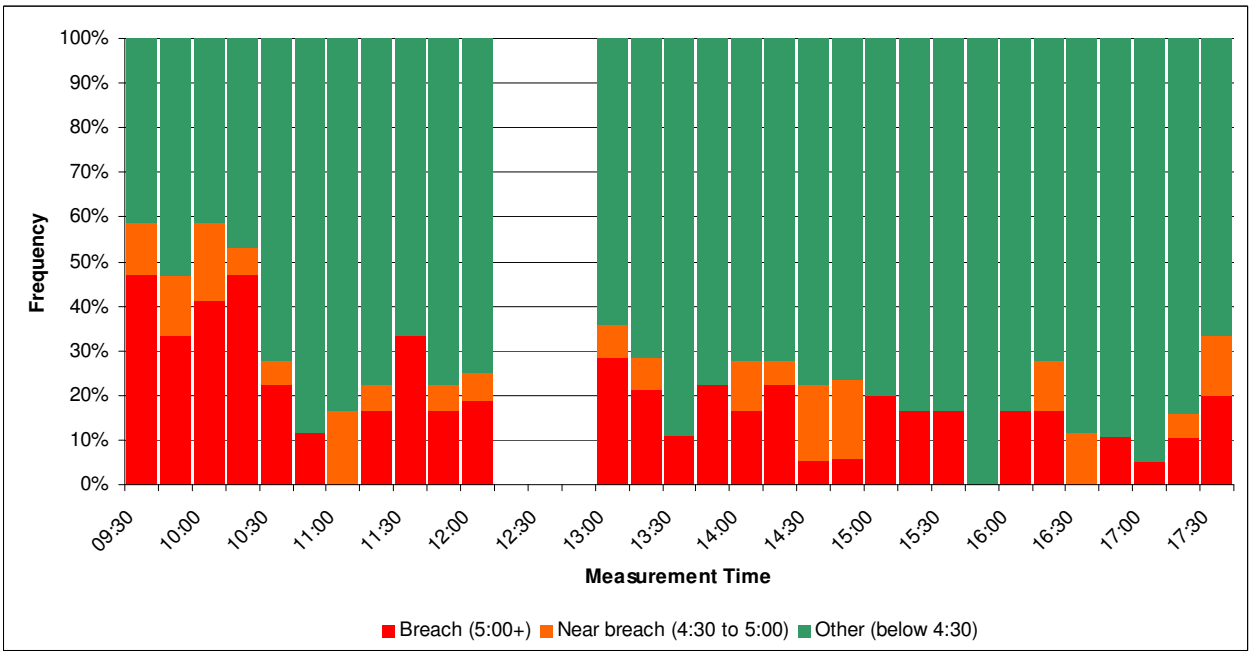

Figure 3.19: North Entrance Secondary Groups of Time Measurements

Figure 3.20 compares the above groups (breach, near breach, pass) over the whole month data set for the primary and secondary observations.

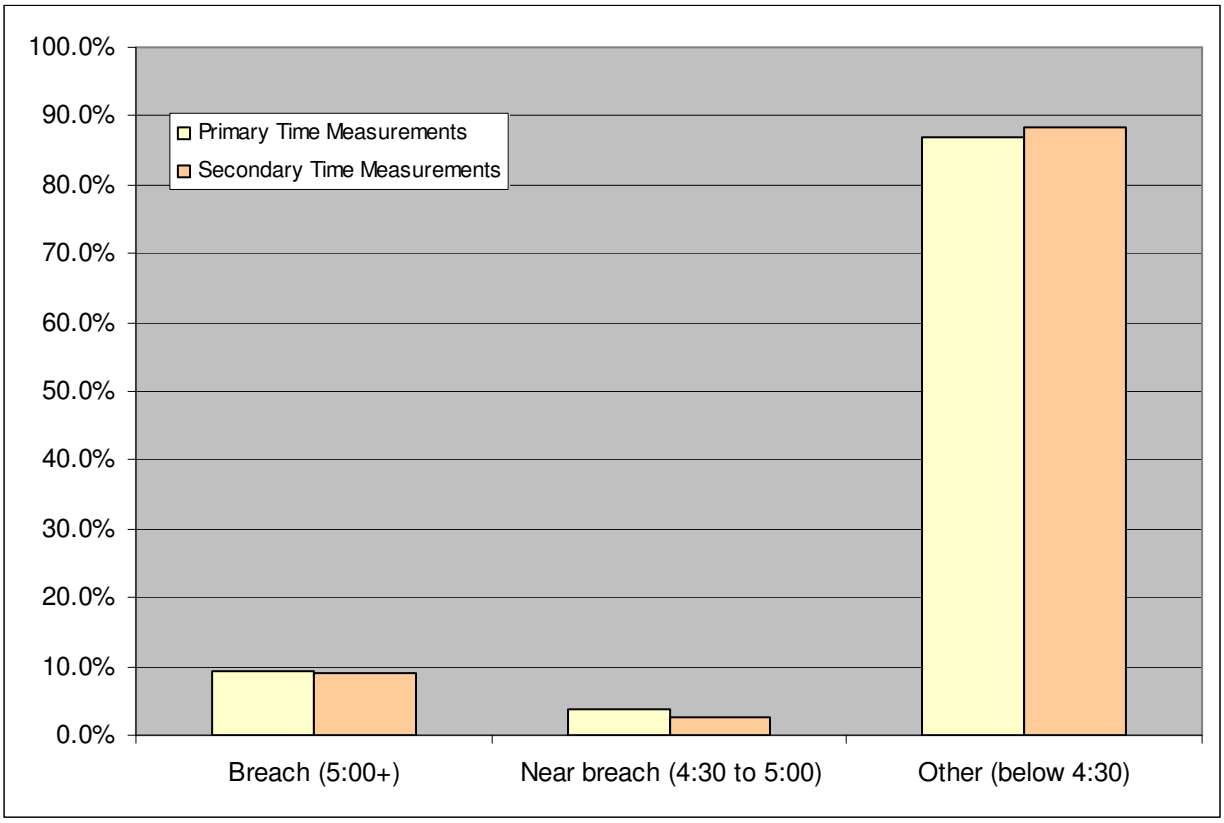

Figure 3.20: Comparison of Primary and Secondary Time Measurements

A χ^2 test for equality of proportions from independent samples was carried out. Although there are visual differences between the distribution of primary and secondary observations (see Figure 3.18), Figure 3.20 shows good agreement between the primary and secondary observations with respect to the service quality criterion, with no statistically significant difference observed between these data (although the difference is significant at a 70% confidence level).

3.2.2 South Entrance

Figure 3.9 above and Figure 3.21 below present the number of observations of the primary and secondary passengers respectively, over the entire month data set, falling within the queue time period indicated.

Figure 3.22 presents the same data as cumulative frequency curves on the same chart. Data grouped into the previous breach, near-breach and pass categories are also presented.

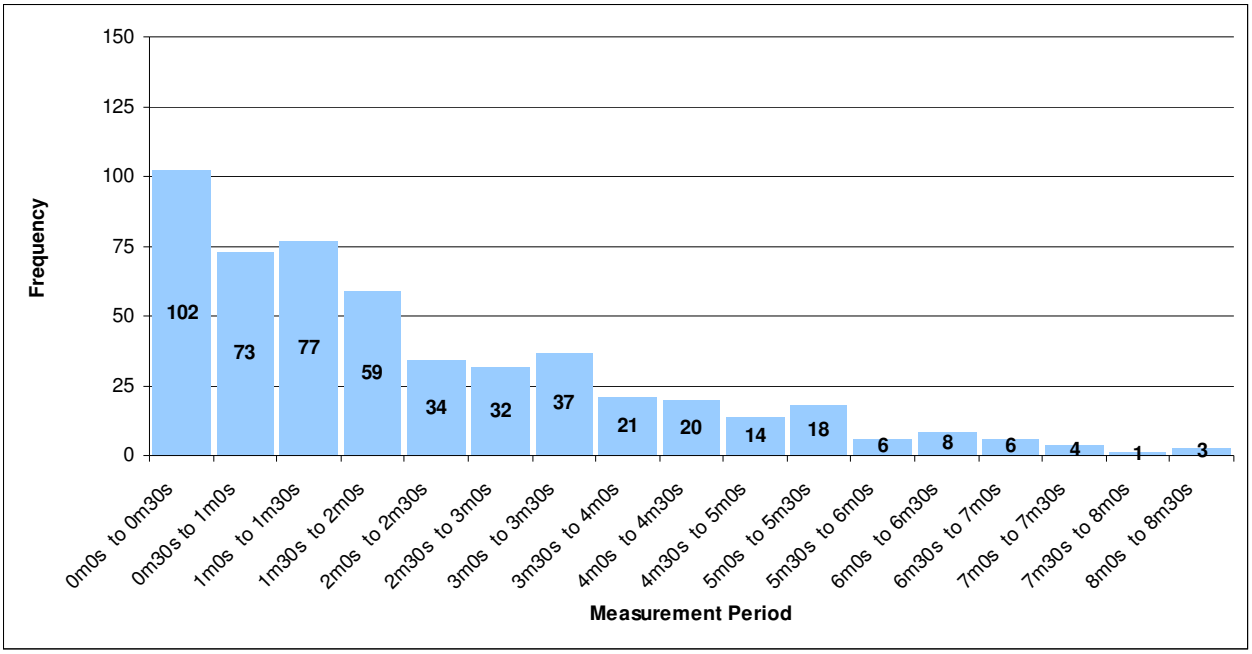

Figure 3.21: South Entrance Secondary Time measurements: Number of Measurements

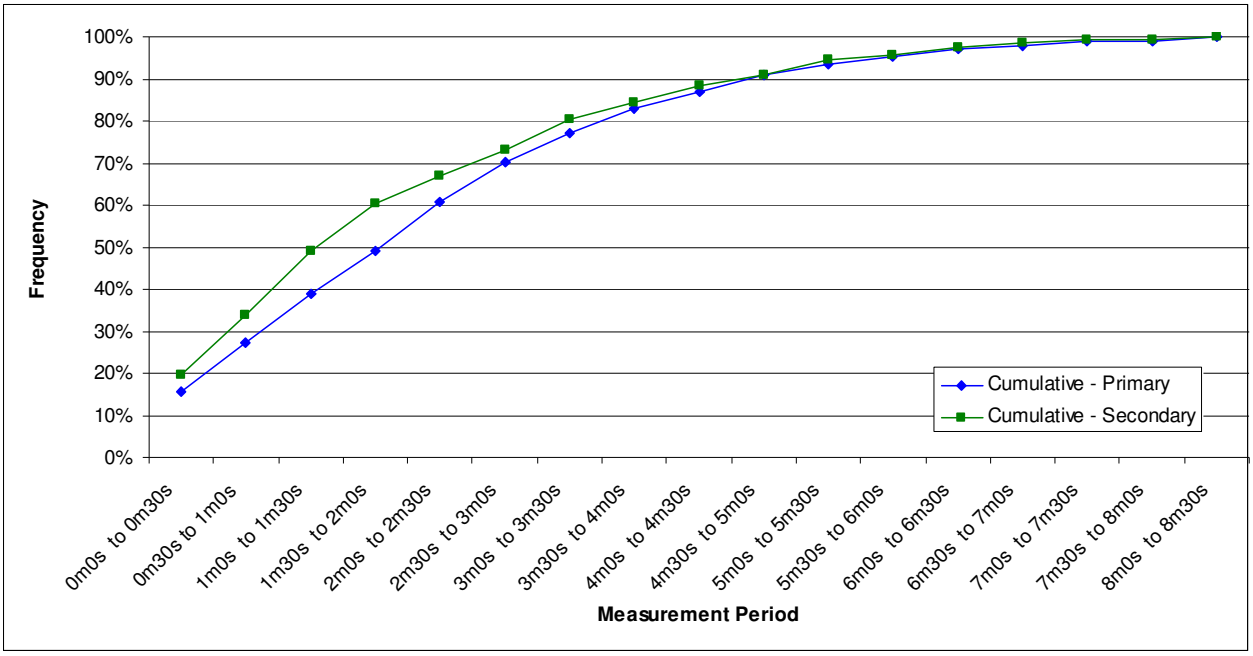

Figure 3.22: South Entrance Cumulative Frequency Primary and Secondary Passenger Queue Time Measurements

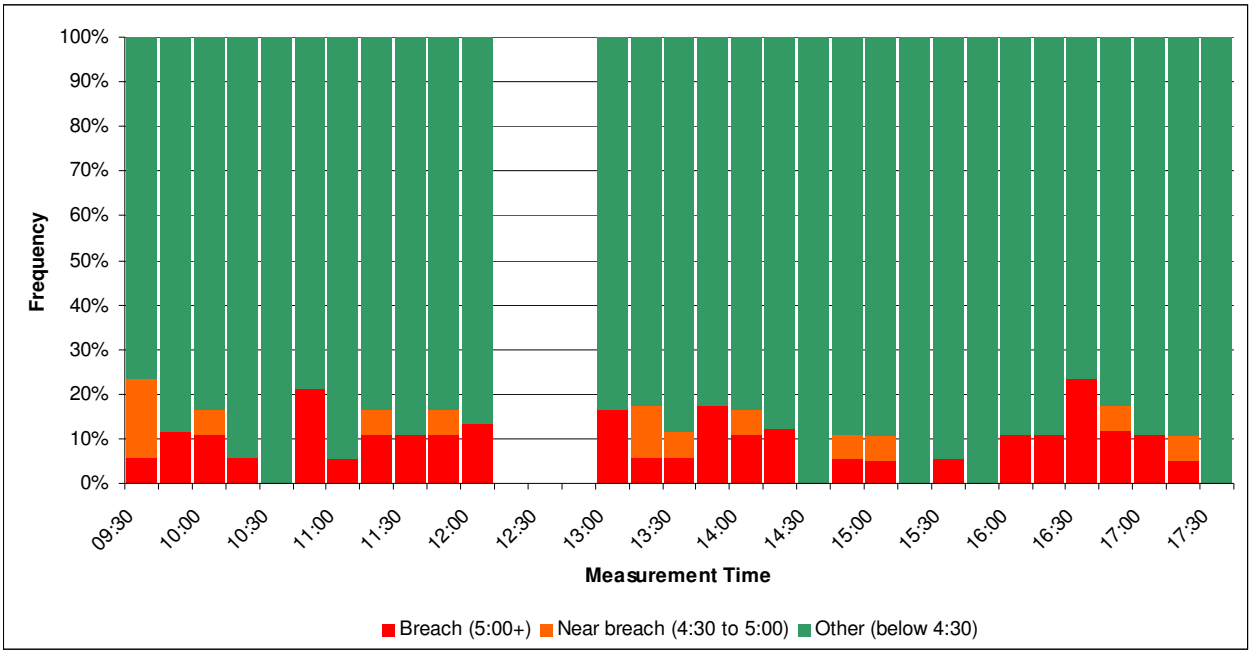

Figure 3.23: South Entrance Secondary Groups of Time Measurements

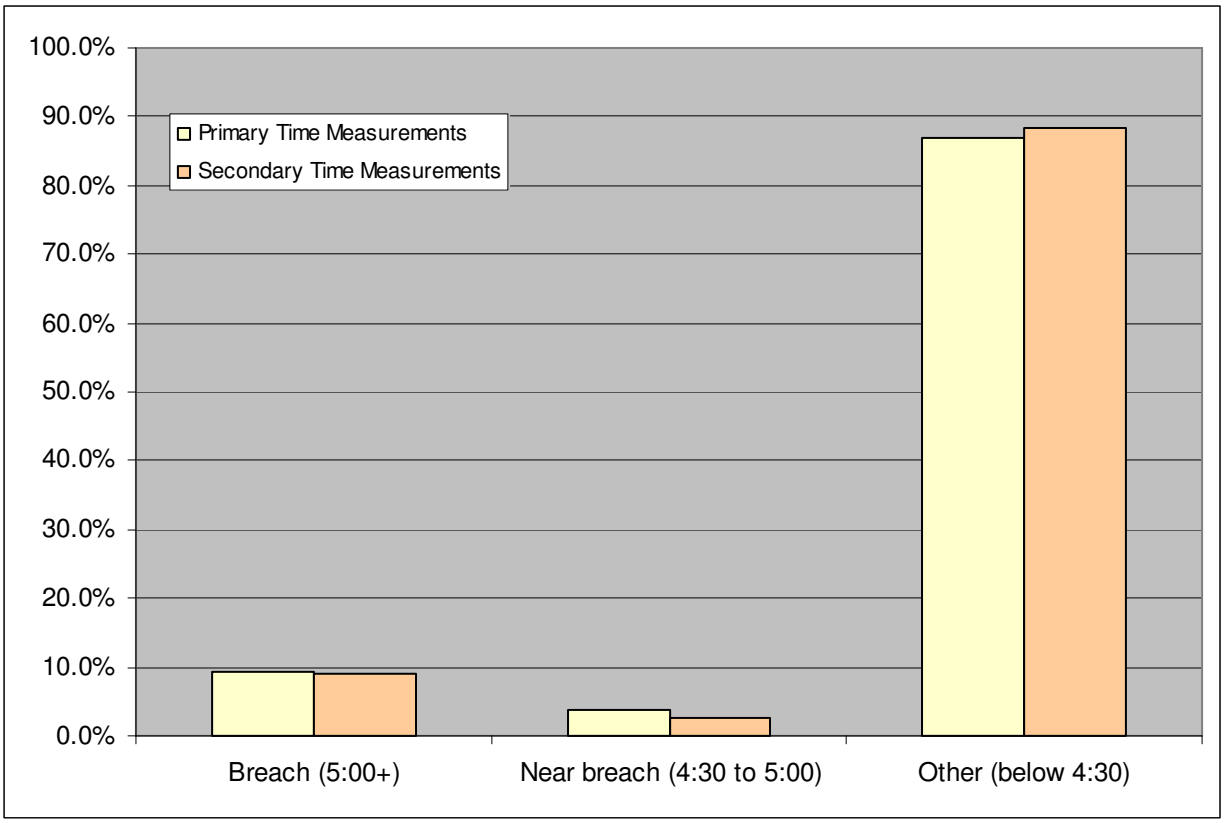

Figure 3.24: Comparison of Primary and Secondary Time Measurements

Inspection of Figure 3.22 shows a marked visual difference between the two distributions. However, Figure 3.24 shows good agreement between the primary and secondary observations with respect to the service quality criterion, with no statistically significant difference observed between these data.

Therefore if it is assumed that the randomly chosen secondary passenger is more representative of the overall queue, the primary passenger does not accurately reflect the queuing time of the secondary passenger at shorter queue durations as shown by Figure 3.22. However, importantly for the service quality criterion, this difference was not observed at longer queue durations and the primary passenger was representative of the overall breach or pass rate of the quality criterion.

3.3 Objective 3: Comparison of Independent July Data with Previous Months

This section presents the result of the comparison of the URS Scott Wilson independent primary observations against the previous month's historical observations as reported by HAL to the CAA.

3.3.1 North Entrance

Figure 3.25 presents the HAL previous months data of the percentage of north entrance passengers meeting the 5 minute queue time criterion per month against the passenger throughput for Terminal 5. The HAL breach/pass data have been amended to only include the hours of the day for the previous months during which the URS Scott Wilson audit was undertaken in July. (This had the effect of reducing the proportion of passengers meeting the 5 minute criterion in the HAL data set as more passengers during off peak times outside the URS Scott Wilson audit times passed the quality criterion raising the overall monthly average.) The HAL and URS Scott Wilson observations for the month of July 2011 are also shown.

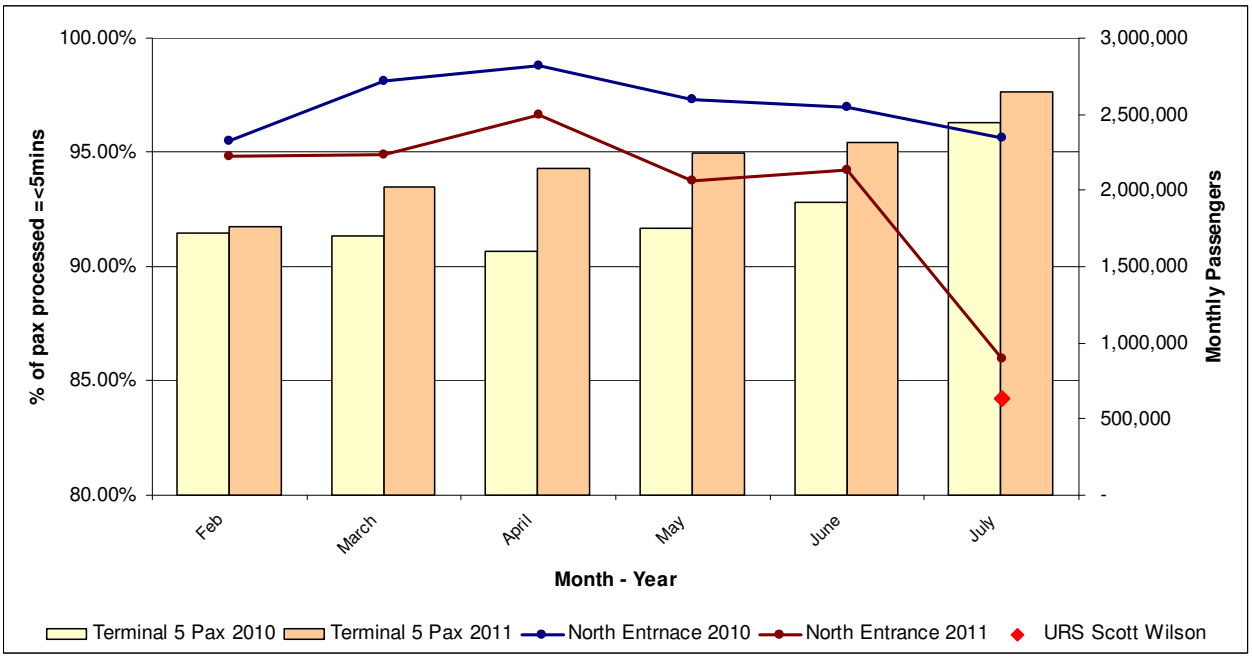

Figure 3.25: Percentage of North Entrance Monthly Observations Above 5 Minutes Against Monthly Passenger Throughput

Two analyses were undertaken. As Figure 3.25 shows, 2011 passenger throughput has seen a constant rising trend. Therefore firstly, correlation between passenger throughput and the proportion of passengers meeting the quality criterion was tested. Figure 3.26 shows previous scatter data from the previous months.

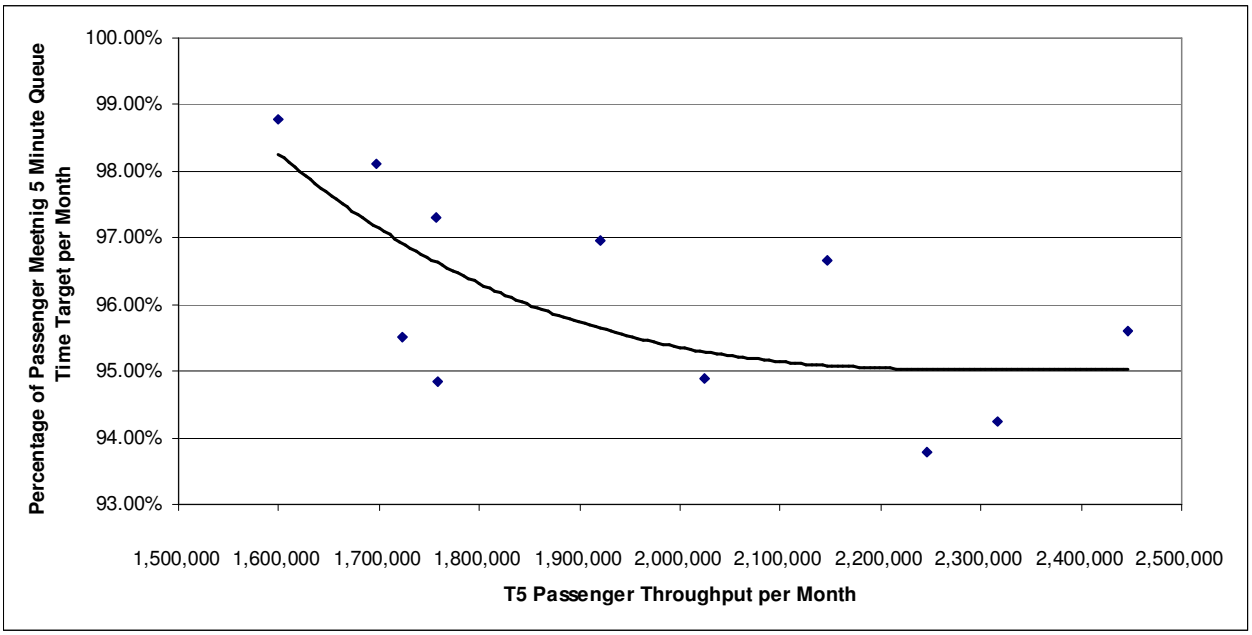

Figure 3.26: Percentage of North Entrance Monthly Observations Above 5 Minutes Against Monthly Passenger Throughput

No correlation was found. The best fit line shown has a correlation coefficient of less than 50%. With processing capacity provided in discrete steps, this conclusion is not unexpected. However, July 2011 throughput was only 8% greater than that in July 2010. Therefore although this additional throughput may have represented the additional increase that the process was unable to accommodate, given the year to date trend for increasing passenger throughput, it does not seem unreasonable for the July throughput to have been predicted and accommodated.

Secondly, the URS Scott Wilson observation of the number of passengers failing the quality criterion from July 2011 was tested against all previous months HAL data. As Figure 3.25 visually suggests, July's data were significantly different from a data set of all previous months with a confidence level above 95%. It is therefore concluded that the observations from July 2011 are not comparable with previous months.

3.3.2 North Entrance: Intra-Month Analysis

A further analysis of the HAL data for the audited days of July was undertaken to compare the data from the hours audited by URS Scott Wilson and the hours outside of those periods (i.e. from the start of the operating day to 09:15, between 12:15 and 12:45 and after 17:30).

Figure 3.27 is a repetition of Figure 3.4 showing the HAL observations during the hours of the audit. Figure 3.28 shows the HAL observations outside those hours. The two distributions are shown cumulatively in Figure 3.29.

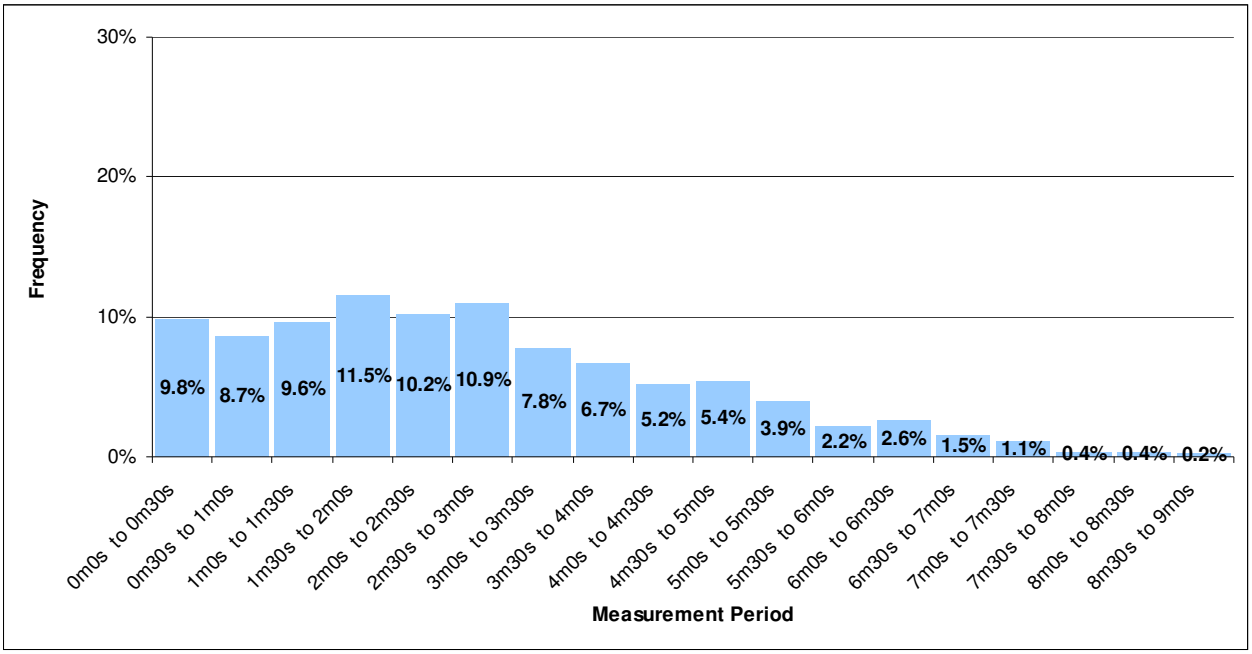

Figure 3.27: HAL North Entrance Queue Time Measurements During Audit Times July 2011: Frequency

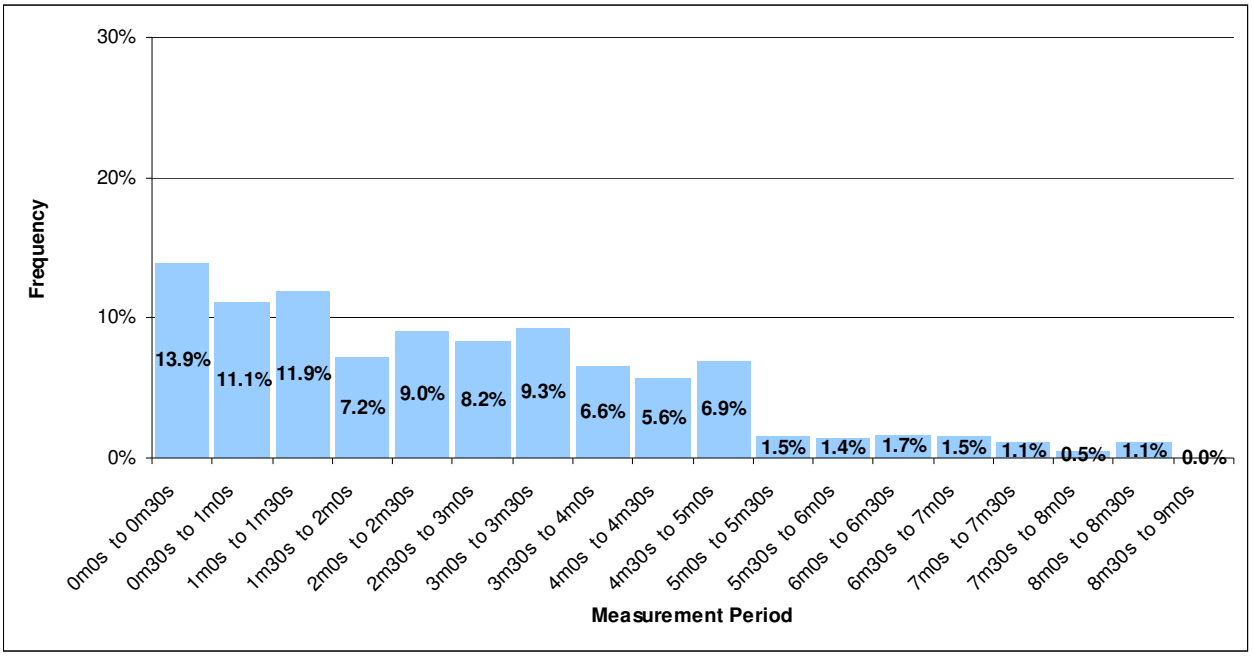

Figure 3.28: HAL North Entrance Queue Time Measurements Outside Audit Times July 2011: Frequency

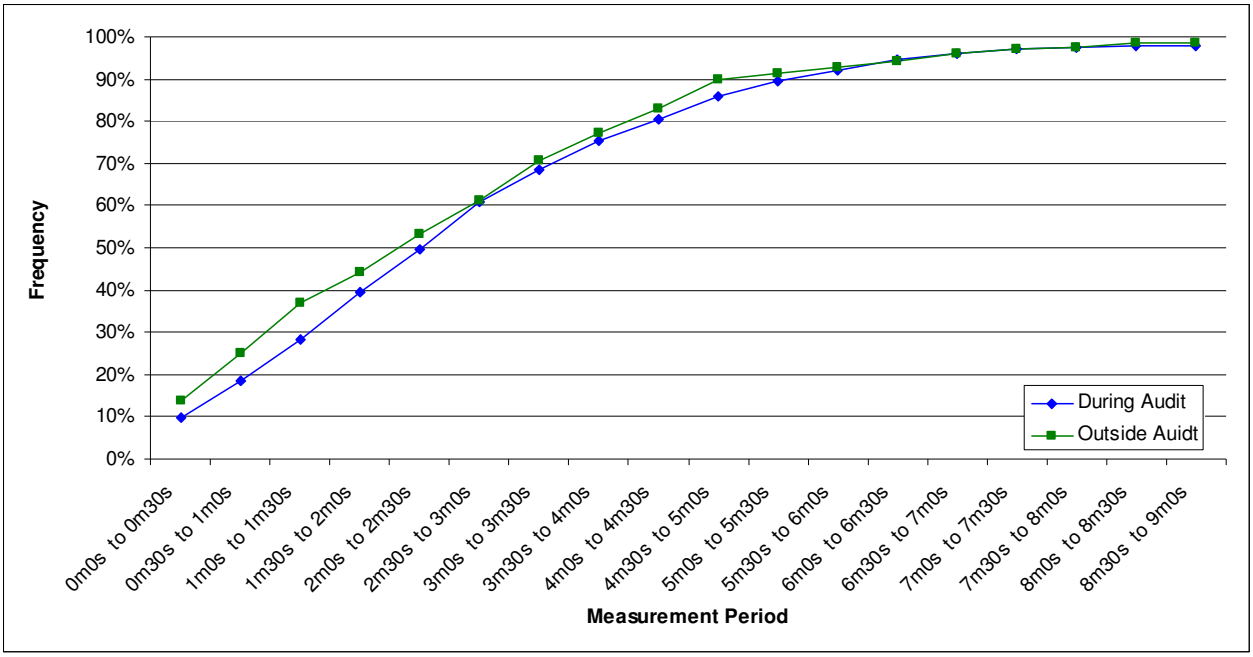

Figure 3.29: HAL North Entrance Queue Time Measurements In and Outside Audit Times in July 2011: Cumulative Frequency

These charts imply a difference in behaviour of observed passengers between the time being audited and other times during the month of July 2011, with a distinct drop-off of queue times after 5 minutes observed outside of audited hours compared to during the audit periods. To assess whether this was representative of previous months, HAL data for all months shown in Figure 3.25 were assessed within and without the audited hours. The results are shown in Figure 3.30 and Figure 3.31.

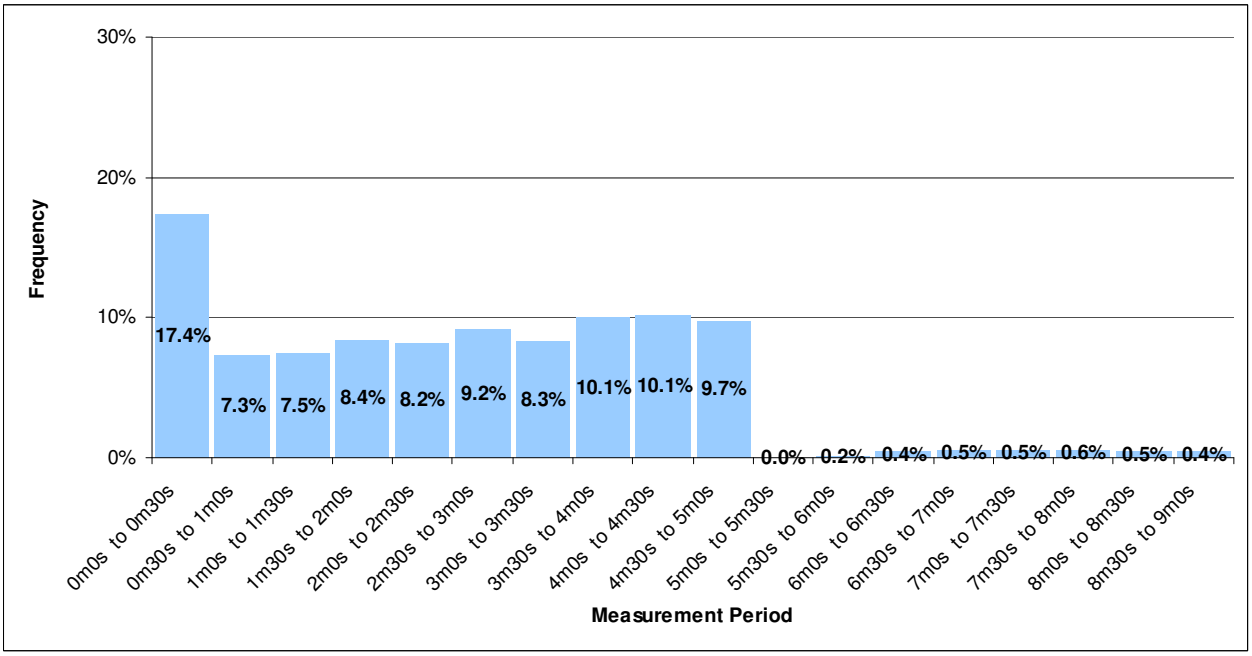

Figure 3.30: All previous HAL North Entrance Queue Time Measurements During Audit Times: Frequency

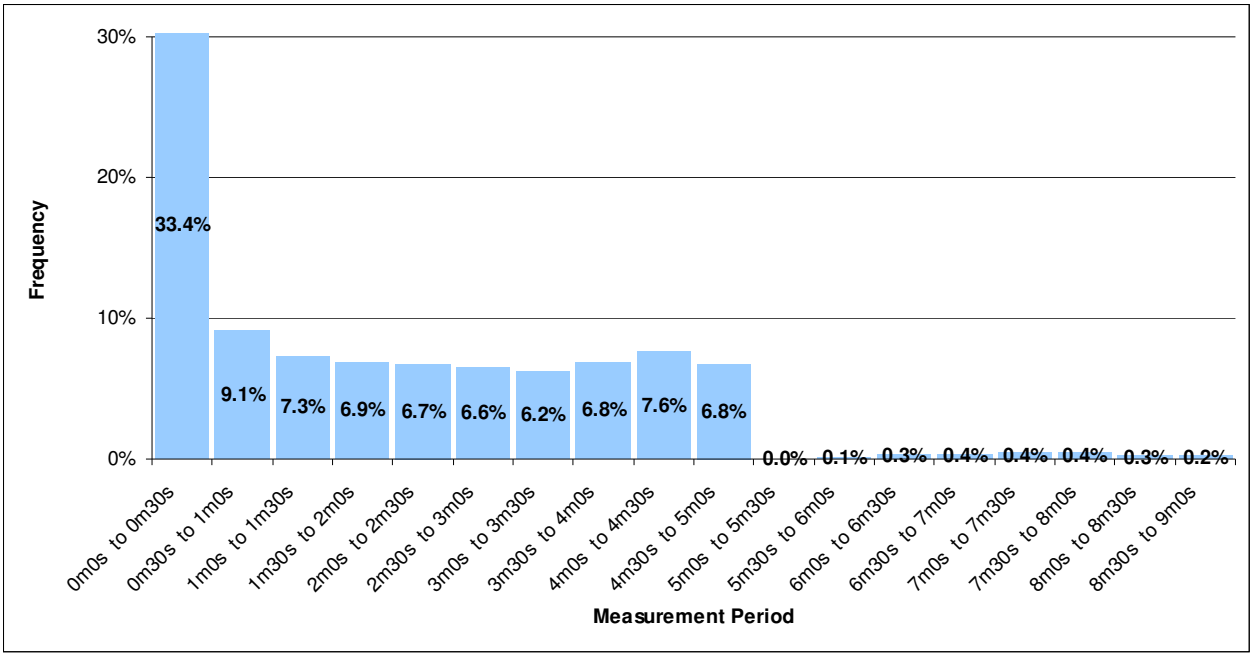

Figure 3.31: All previous HAL North Entrance Queue Time Measurements Outside Audit Times: Frequency

These charts show a consistency of previous observation with a distinct pattern of observed queuing times of or below 5 minutes. The smoother profile observed during the audit, as shown in Figure 3.27 is therefore unexplained and different from HAL data from all previous months.

3.3.3 South Entrance

Figure 3.32 presents the HAL previous months data of the percentage of south entrance passengers meeting the 5 minute queue time criterion per month against the passenger throughput for Terminal 5. The HAL data have been amended to only include the hours of the day for the previous months during which the URS Scott Wilson audit was undertaken in July. (This had the effect of reducing the proportion of passengers meeting the 5 minute criterion in the HAL data as more passengers during off peak times outside the URS Scott Wilson audit times passed the quality criterion raising the overall monthly average.) The HAL and URS Scott Wilson observations for the month of July 2011 are also shown.

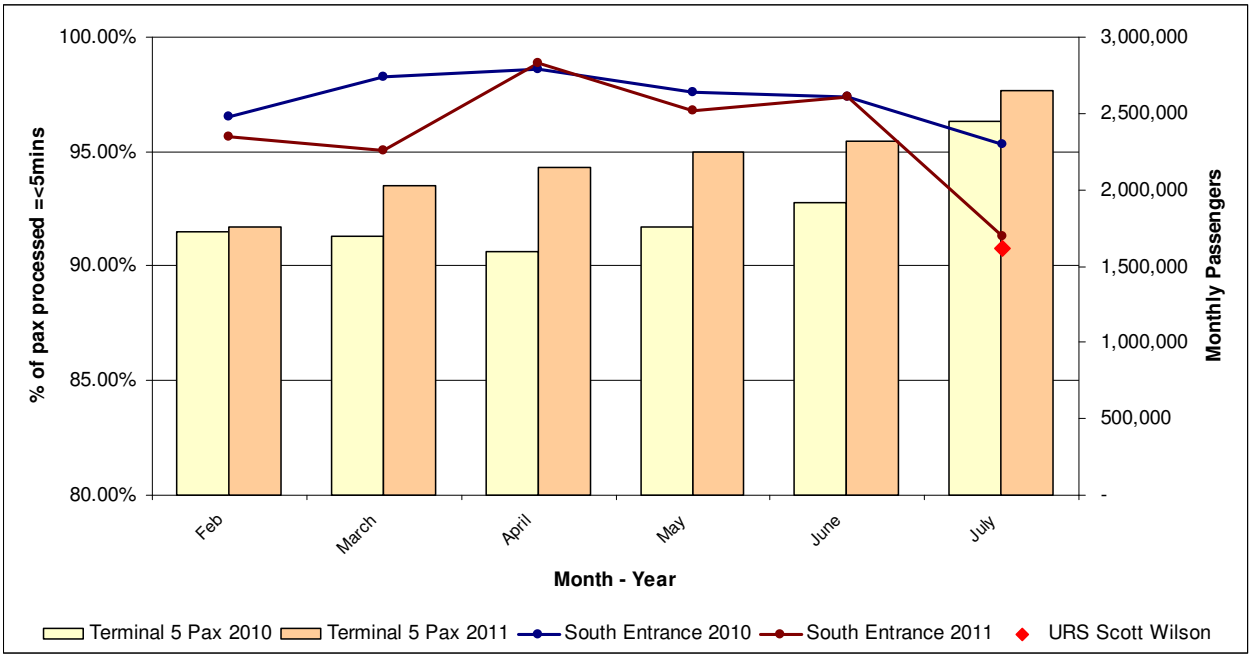

Figure 3.32: Percentage of South Entrance Monthly Observations Above 5 Minutes Against Monthly Passenger Throughput

The same analyses as discussed above were undertaken. Figure 3.33 shows the previous months scatter data. The best fit line has a correlation coefficient of 10% suggesting that no reliable correlation exists.

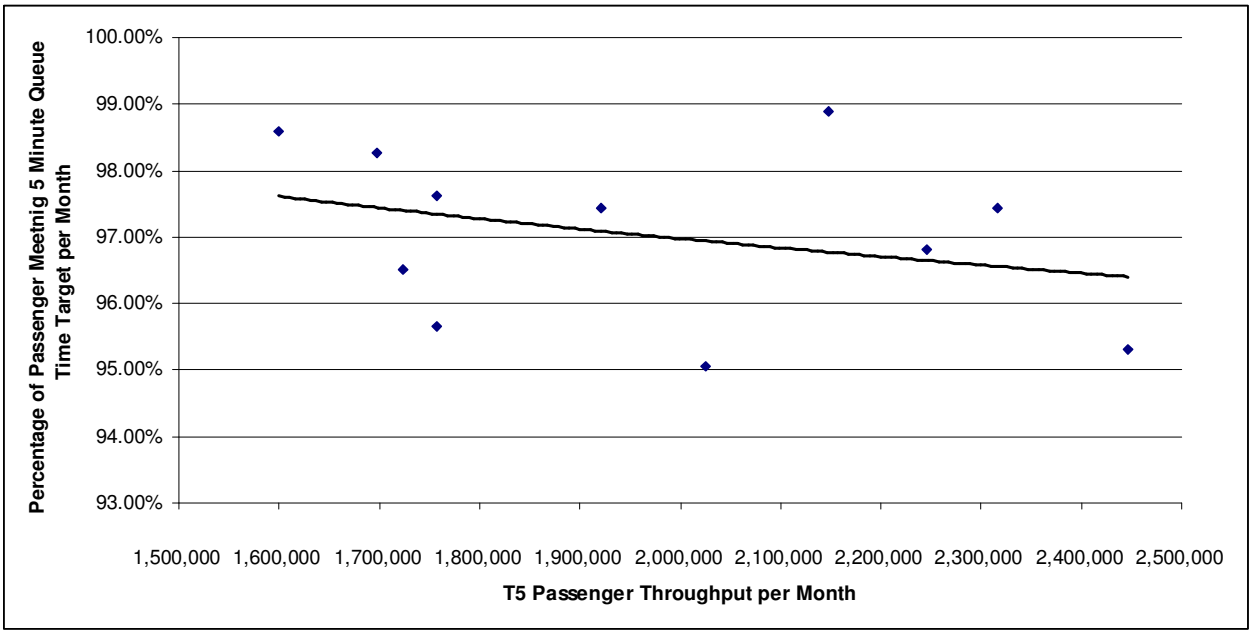

Figure 3.33: Percentage of South Entrance Monthly Observations Above 5 Minutes Against Monthly Passenger Throughput

Secondly, the URS Scott Wilson observation of the number of passengers failing the quality criterion from July 2011 was tested against all previous months HAL data. As Figure 3.32 visually suggests, July's data were significantly different from a data set of all previous months

with a confidence level above 95%. It is therefore concluded that the observations from July 2011 are not comparable with previous months.

3.3.4 South Entrance: Intra-Month Analysis

A further analysis of the HAL data for the audited days of July was undertaken to compare the data from the hours audited by URS Scott Wilson and the hours outside of those periods (i.e. from the start of the operating day to 09:15, between 12:15 and 12:45 and after 17:30).

Figure 3.34 is a repetition of Figure 3.12 showing the HAL observations during the hours of the audit. Figure 3.35 shows the HAL observations outside those hours. The two distributions are shown cumulatively in Figure 3.36.

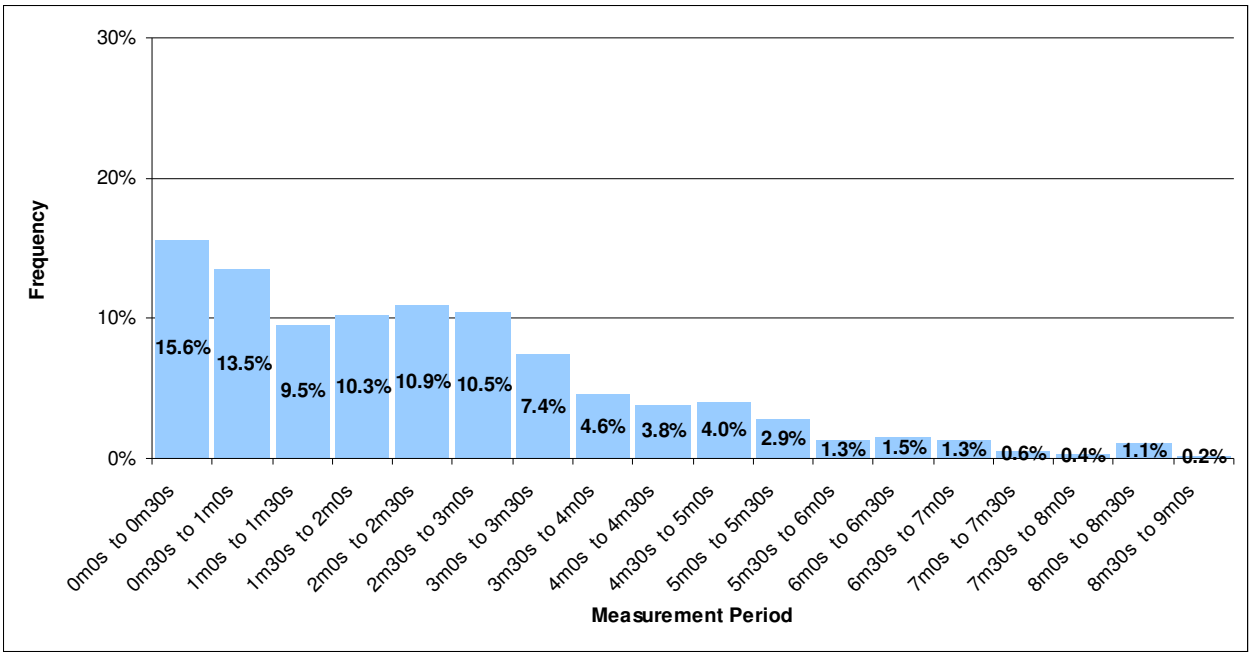

Figure 3.34: HAL South Entrance Queue Time Measurements During Audit Times July 2011: Frequency

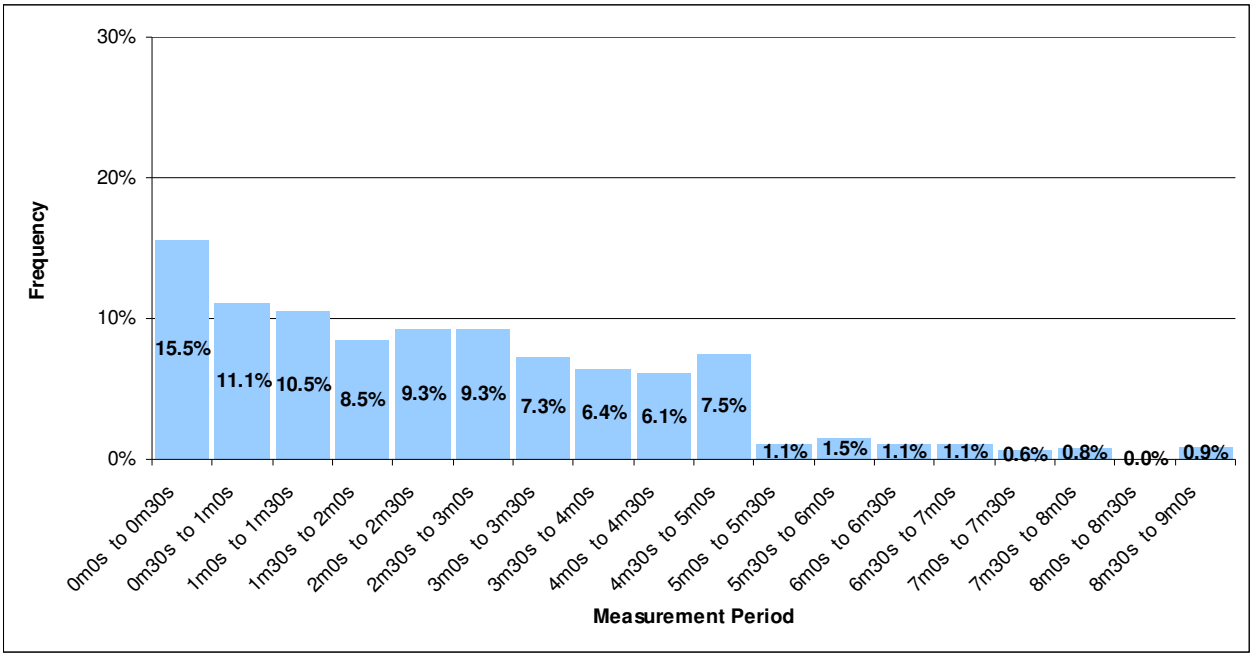

Figure 3.35: HAL South Entrance Queue Time Measurements Outside Audit Times July 2011: Frequency

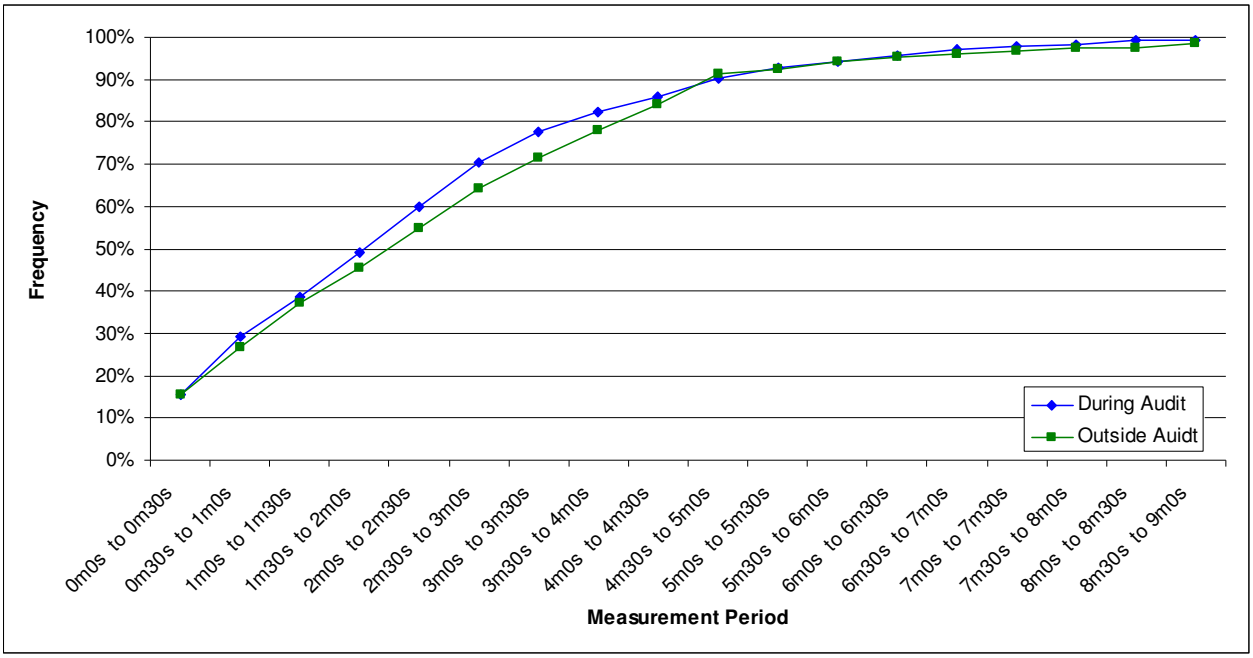

Figure 3.36: HAL South Entrance Queue Time Measurements In and Outside Audit Times in July 2011: Cumulative Frequency

These charts imply a difference in behaviour of observed passengers between the times being audited and other times during the month of July 2011, with a distinct drop-off of queue times after 5 minutes observed outside of audited hours compared to during the audit periods. To assess whether this was representative of previous months, HAL data for all months shown in Figure 3.32 were assessed within and without the audited hours. The results are shown in Figure 3.37 and Figure 3.38.

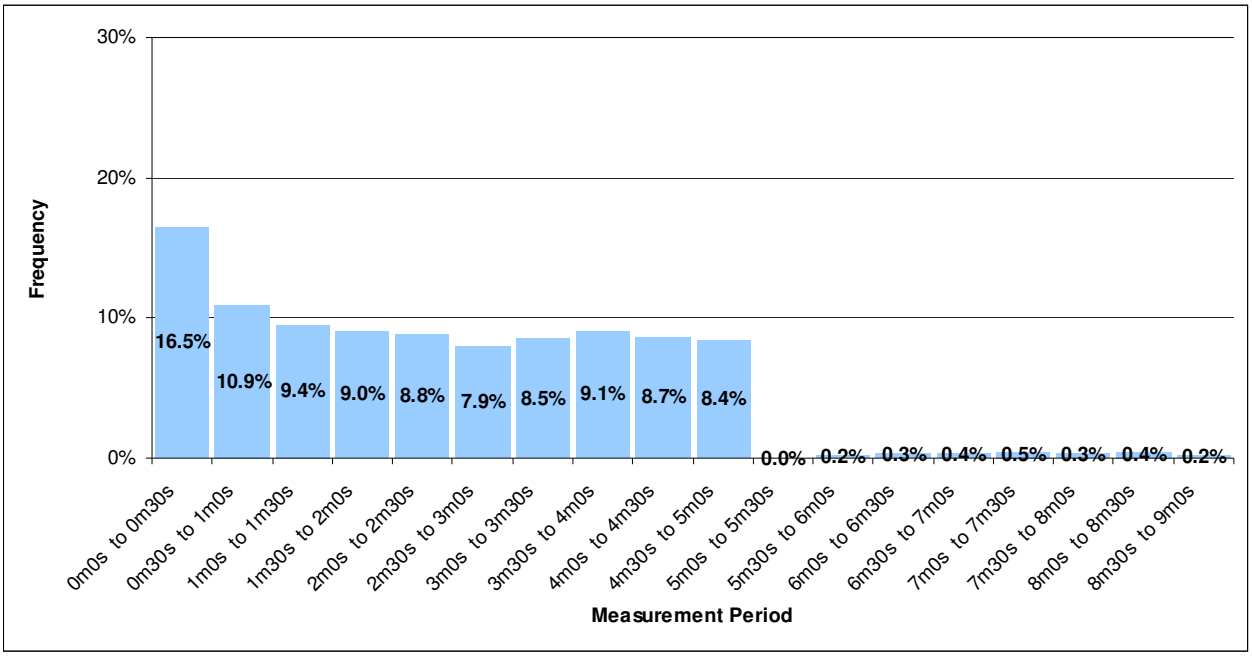

Figure 3.37: All previous HAL South Entrance Queue Time Measurements During Audit Times: Frequency

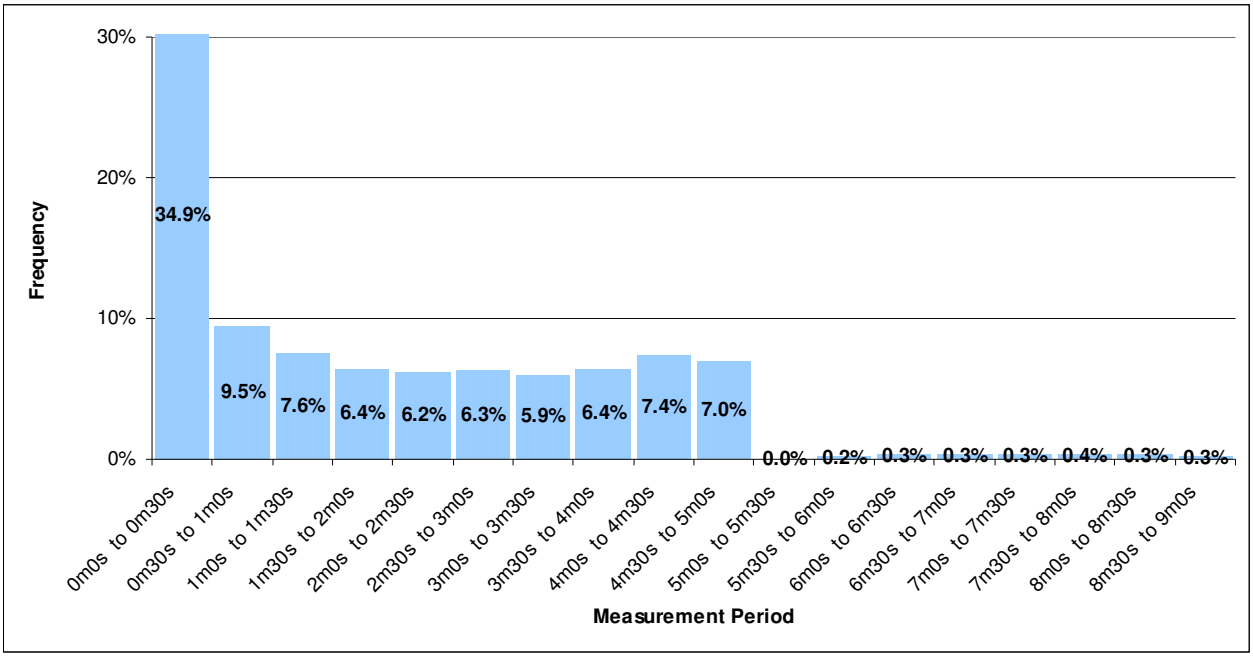

Figure 3.38: All previous HAL South Entrance Queue Time Measurements Outside Audit Times: Frequency

These charts show a consistency of previous observation with a distinct pattern of observed queuing times of or below 5 minutes. The smoother profile observed during the audit, as shown in Figure 3.34 is therefore unexplained and different from HAL data from all previous months.

4 Conclusions

The following summarises the conclusions set out in Section 3:

- **Objective 1**: the URS Scott Wilson observations agree with the data provided by HAL to the CAA for the audited hours and days of month of July 2011 for both the North and South entrances.
- **Objective 2: North Entrance:** no statistical difference was observed between the primary and secondary passenger observations, it is therefore concluded that if the randomly chosen secondary passenger is representative of the overall queue, the primary passenger is reasonably representative of the overall security queue. This conclusion was supported by the anecdotal observations of our auditors of the general behaviour of the queue and the officially measured passenger within it.
- **Objective 2: South Entrance:** no statistical difference was observed between the breach/pass rate of the 5 minute quality criterion for primary and secondary passenger observations. Therefore it is concluded that the primary passenger reasonably reflects the breach/pass rate of the overall queue. However, a difference between the distribution of queue time between the primary and secondary passengers was found. Therefore, it is concluded that the primary passenger does not reasonably reflect the experience of queuing in terms of the time spent in the queue. This difference was most significant at queue time durations less than 4 minutes.
- **Objective 3**: although, as established by Objective 1, the URS Scott Wilson and HAL data for the month of July were similar, both observations differ significantly from all previous months' data. With a confidence level above 95%, the observations for July 2011 were different from previous months. No significant correlation was observed in the previous months' data between terminal passenger throughput and the number of passengers passing the service quality criterion, and therefore the causal factor of the observed difference in the July data is to be determined. Furthermore the previously observed "squarer" distribution with almost observations in previous months being beneath 5 minutes was not replicated during the audit hours. Previously this pattern was represented in HAL's data during and outside the audited hours.