TRAFFIC, ENVIRONMENTAL & FORENSIC ENGINEERS
CONSULTING

Address PO Box 215, Bondi NSW 2026
Phone 02) 9332 2024
Fax (02) 9332 2022
Mobile 0414 978 067
e-mail o.s@tefconsult.com.au
www http://www.tefconsult.com.au

Transport Roads & Maritime Services
NSW GOVERNMENT

ROADS AND MARITIME SERVICES

VALIDATION TRIP GENERATION SURVEYS

CHILD CARE CENTRES

ANALYSIS REPORT

Report Document Control	
Title	VALIDATION TRIP GENERATION SURVEYS CHILD CARE CENTRES
Date	September 2015
Author(s)	O. Sannikov, A. Tan, Y. Taranova, I. Mileusnic
Client	ROADS AND MARITIME SERVICES
Job No.	15010
Quality Control Reviewer	L. Hawley
Keywords	Trip generation / child care centres / NSW Roads and Maritime Services
Disclaimer	**This report is believed to be true and correct at the time of writing. It is based on the information and data provided by the client and other relevant organisations during preparation. TEF Consulting does not accept any contractual, tortuous or other form of liability for any consequences arising from its use. People using the information in the report should apply and rely on their own skill and judgement to a particular issue they are considering.**

TABLE OF CONTENTS

Tables

Figures

1 Introduction

1.1 Study purpose

The former Roads and Traffic Authority (RTA) published its Guide to Traffic Generating Developments ("Guide") in the mid-1990s. This document drew on the results of a number of trip generation and parking demand surveys covering a wide range of business and land uses. These surveys had been progressively conducted since 1978. The trip generation and parking requirement data in the Guide is becoming increasingly out-of-date, with the last analysis being conducted in 1992. Given the significant expansion in the child care sector in recent years, there is a need to collect fresh trip generation and parking demand data at this land use to assist with traffic impact assessment and planning.

TEF Consulting was appointed to undertake a detailed trip generation analysis of child care centres.

The aim of this project is to:

1) assemble information on all-mode trip generation and parking demand data at a number of child care centres in greater Sydney and NSW regional areas;
2) analyse the data and establish reliable predictive statistical relationships; and
3) report on the findings, comparing the survey results with the data outlined in the Guide.

The study includes surveys of traffic characteristics relating to vehicle and person trips at 4 different types of child care centres:

- Long Day Care Centre (LDCC)
- Occasional Care (OC)
- Before and After School Care/Outside School Hours Care (OSHC, also interchangeably recognised as OOSH)
- Pre-school (PS)

For this study, 4 LDCC child care centres, 4 OOSH child care centres, 3 occasional care centres and 3 preschool child care centres in the Greater Metropolitan Sydney area and in the Regional NSW areas were studied.

1.2 Approach

The approach to this trip generation study is described below:

- The Consultant initially compiled a list of 14 prospective survey sites. A list of required attributes and other criteria for the area selection is provided in the Brief. These attributes and criteria are hereby acknowledged.
- The Consultant has assessed the suitability of the sites for the Study in consultation with the RMS Project.
- The Consultant then undertook site inspections and collection of site characteristics.
- Surveys were undertaken from Monday to Friday between 6:30 a.m. and 9:30 a.m. for the a.m. peak and 2:30 PM and 6:00 PM for the PM peak. The survey data included vehicle counts entering and exiting each site, number of people (parents, staff and children) entering and exiting the site, what mode of transport people used to get to the survey site, number of passengers in the vehicle as well as classification counts of traffic flows on the main road adjacent to the site.
- A count of vehicles parked on site in marked parking spaces as well as outside formal parking areas was also carried out, at 15 minute intervals.
- The Consultant studied the data using linear and non-linear regression analysis and considered the generated data as a function of a number of the key variables.
- The Consultant prepared a report to summarise the findings of the survey and data analysis.
- The reporting is presented in two documents. The first, this report, contains the analysis covering all of the calculations and comparisons. The second report contains the raw data from the surveys and other data such as survey site plans and tabulated vehicle-trip and parking demand data.

1.3 Report structure

This analysis report has the following structure:

- **Chapter 1: Introduction** – This contains the background to the study, approach and report structure;
- **Chapter 2: Survey methodology** – This contains a description of the survey and survey area selection process;
- **Chapter 3: Survey analysis** – This section analyses the survey results using linear and non-linear regression;
- **Chapter 4: Summary**

2 Survey Methodology

2.1 Selection of survey sites

The survey areas were selected according to the specifications set out in the RMS Brief.

2.2 Survey site selection methodology

- Consultation with the RMS.
- Detailed examination of cadastral maps and aerial photographs.
- Identification of survey site characteristics:
    - Survey site location;
    - Identification of access points;
    - Identification of services provided.
- Initial survey planning to check suitability in terms of ease of observations. All sites were mature, operating for more than 5 years (in most cases more than 10 years); all centres except OSHC (for reasons explained in Section 3.4) operated at or near full capacity during the survey period.
- Confirmation of 14 survey sites including one site for a special 5-day survey:
    - Survey area visits and collection of specific details;
    - Questionnaire survey of staff and parents at all sites (to gauge the information about their travel characteristics);
    - Photographic and video records of access locations.

The details of the selected survey sites and survey results are summarised in **Table 2.1** (for full survey data please refer to the Data Report). The locations of the survey areas are shown on **Figure 2.1**.

Table 2.1 Details of the selected survey sites and summary of the survey results.

	Sydney Sites												Regional Sites	
Site ID	**Site S1**	**Site S2**	**Site S3**	**Site S4**	**Site S5**	**Site S6**	**Site S7**	**Site S8**	**Site S9**	**Site S10**	**Site S11**	**Site S12**	**Site R1**	**Site R2**
Name of the development	Wattle Grove Long Day Care Centre	Acre Woods Childcare	Billy Kids Bilgola Early Learning Centre	Acre Woods Childcare	Hilda Booler Kindergarten	KU Maybanke Preschool	Wattle Grove Public School Out of School Hours Care	Kegworth Out of School Hours Care	YMCA Malabar Out of School Hours Care	Duffy's Corner Occasional Child Care Centre	Redfern Occasional Care	Balmain/Rozelle Occasional Care	Nords Wharf Community Pre School	WOOSH Care
Centre type	LDCC	LDCC	LDCC	LDCC	PS	PS	OSHC	OSHC	OSHC	OC	OC	OC	PS	OSHC
Site address	8-10 Burdekin Court, Wattle Grove NSW 2173	22-24 College Street, Gladesville NSW 2111	100 Plateau Road, Bilgola Plateau NSW 2107	81 Clanville Rd, Roseville NSW 2069	Jubilee Park, Eglinton Road, Glebe NSW 2037	99 Harris Street, Pyrmont NSW 2009	Cressbrook Drive, Wattle Grove NSW 2173	Cnr Tebutt St & Lords Road, Leichhardt NSW 2040	231-239 Franklin St, Chifley NSW 2036	419a Beauchamp Road, Maroubra NSW 2035	55 Pitt Street, Redfern NSW 2016	370 Darling Street, Balmain NSW 2041	44 Government Road, Nords Wharf NSW 2281	Woodport Public School Corner Entrance Road and Ernest Street, Erina NSW 2250
Day and date of survey(s)	Mon, 01/06/15	Wed, 03/06/15	Wed, 03/06/15	Wed-Fri, 3-5/06/15 Tue, 09/06/15 Mon, 15/06/15	Thu, 18/06/15	Thu, 25/06/15	Mon, 01/06/15	Mon, 22/06/15	Wed-Thu, 24-25/06/15	Thu, 18/06/15	Thu, 18/06/15	Mon-Tue, 22-23/06/15	Wed, 24/06/15	Thu, 18/06/15
Duration of survey - frontage road	6:30-9:30 14:30-18:00	6:30-9:30 14:30-18:00	6:30-9:30 14:30-18:00	6:30-9:30 14:30-18:00	7:00-10:00 14:00-17:30	7:00-10:00 14:00-17:30	6:30-9:30 14:30-18:00	6:30-9:30 14:30-18:00	6:30-9:30 14:30-18:00	7:00-10:00 14:30-18:00	7:00-10:00 14:30-18:00	7:00-10:00 14:30-18:00	7:00-10:00 14:00-17:30	6:30-9:30 14:30-18:00
Duration of survey - site trip generation	6:30-9:30 14:30-18:00	6:30-9:30 14:30-18:00	6:30-9:30 14:30-18:00	6:30-9:30 14:30-18:00	7:00-10:00 14:00-17:30	7:00-10:00 14:00-17:30	6:30-9:30 14:30-18:00	6:30-9:30 14:30-18:00	6:30-9:30 14:30-18:00	7:00-10:00 14:30-18:00	7:00-10:00 14:30-18:00	7:00-10:00 14:30-18:00	7:00-10:00 14:00-17:30	6:30-9:30 14:30-18:00
Surrounding land uses	Commercial / retail.	Commercial / retail.	Commercial / retail.	Low density residential dwellings.	Low desnisty residential and parklands.	Commercial / retail and residential dwellings.	Low density residential housing and public school.	Low density residential, Kegworth Public School and Leichardt Marketplace.	Low density residential, retail, Malabar Medical Centre and Cromwell Park.	Low density residential housing.	Commercial / retail.	Commercial/retail, industrial site and medical centre.	Low density residential.	Commercial / retail and low density residential.
Frontage road - AM peak period (weekday)	8:00-9:00	8:00-9:00	8:30-9:30	multi-day[1]	8:30-9:30	8:45-9:45	8:30-9:30	8:00-9:00	6:30-7:30	8:00-9:00	8:30-9:30	8:30-9:30	8:30-9:30	8:00-9:00 8:15-9:15
Frontage road - PM peak period (weekday)	15:15-16:15	15:15-16:15	15:00-16:00	multi-day	14:45-15:45	15:30-16:30	15:15-16:15	16:45-17:45	16:30-17:30	16:45-17:45	16:15-17:15	16:15-17:15	15:00-16:00	14:45-15:45
Development details:														
Year opened	1992	2003	2007	2004	not provided	not provided	2004	2003	2003	1990	not provided	not provided	1989	1995
Total site area (m^2)	1304	1309	2318	3014	1312	1014	882	202	303	1368	1049	317	475	112
Total GFA (m^2)	514	1041	302	743	387	197	882	202	303	295	768	317	165	112
No. of licensed places for children	45	90	56	90	40	30	75	105	70	29	36	25	20	70
No. of employees	12	10	10	15	6	5	4	11	6	6	10	4	3	5
Vehicle trips:														
Centre peak hour vehicle trips (in+out) AM	**27**	**80**	**40**	**93**	**39**	**11**	**42**	**39**	**38**	**30**	**8**	**16**	**25**	**4**
Time of Centre peak hour vehicle trips (AM)	7:30-8:30 7:45-8:45	7:30-8:30	8:00-9:00	multi-day[1]	8:30-9:30	8:30-9:30	6:45-7:45	7:15-8:15	8:00-9:00	8:00-9:00 8:15-9:15	8:30-9:30 8:45-9:45 9:00-10:00	8:30-9:30 8:45-9:45 9:00-10:00	8:45-9:45	6:30-7:30 6:45-7:45 7:00-8:00
Centre peak hour vehicle trips per licensed place (AM)	0.60	0.89	0.71	1.03	0.98	0.37	0.56	0.37	0.54	1.03	0.22	0.64	1.25	0.06
Centre peak hour vehicle trips per 100m2 of total GFA (AM)	5.25	7.68	13.25	12.52	10.08	5.58	4.76	19.31	12.54	10.17	1.04	5.05	15.15	3.57
Centre peak hour vehicle trips (in+out) PM	**31**	**73**	**46**	**77**	**32**	**11**	**36**	**53**	**18**	**40**	**26**	**6**	**22**	**34**
Time of Centre peak hour vehicle trips (PM)	16:30-17:30	17:00-18:00	16:00-17:00	multi-day	14:15-15:15	14:00-15:00 14:15-15:15	16:45-17:45	16:15-17:15	16:45-17:45 17:00-8:00	15:45-16:45	15:00-16:00	14:30-15:30 14:45-15:45	14:30-15:30	17:00-18:00
Centre peak hour vehicle trips per licensed place (PM)	0.69	0.81	0.82	0.86	0.80	0.37	0.48	0.50	0.26	1.38	0.72	0.24	1.10	0.49
Centre peak hour vehicle trips per 100m2 of total GFA (PM)	6.03	7.01	15.23	10.36	8.27	5.58	4.08	26.24	5.94	13.56	3.39	1.89	13.33	30.36
Vehicle trips during adjacent road's peak hour (AM)	**18**	**72**	**39**	**58**	**39**	**9**	**0**	**22**	**4**	**30**	**6**	**16**	**24**	**0**
Vehicle trips per licensed place during adjacent road's peak hour (AM)	0.40	0.80	0.70	0.64	0.98	0.30	0.00	0.21	0.06	1.03	0.17	0.64	1.20	0.00
Vehicle trips per 100m^2 of GFA during adjacent road's peak hour (AM)	3.50	6.92	12.91	7.81	10.08	4.57	0.00	10.89	1.32	10.17	0.78	5.05	14.55	0.00
Vehicle trips during adjacent road's peak hour (PM)	**23**	**27**	**14**	**50**	**28**	**4**	**13**	**50**	**16**	**2**	**0**	**0**	**14**	**2**
Vehicle trips per licensed place during adjacent road's peak hour (PM)	0.51	0.30	0.25	0.56	0.70	0.13	0.17	0.48	0.23	0.07	0.00	0.00	0.70	0.03
Vehicle trips per 100m2 of GFA during adjacent road's peak hour (PM)	4.47	2.59	4.64	6.73	7.24	2.03	1.47	24.75	5.28	0.68	0.00	0.00	8.48	1.79
Parking:														
No. of on site parking spaces	13	14	10	18	0	0	0	0	0	0	10	5	4	22
Peak parking accumulation	**13**	**16**	**9**	**14**	**7**	**6**	**5**	**12**	**12**	**10**	**3**	**7**	**6**	**6**
Peak parking accumulation per licensed place	0.29	0.18	0.16	0.16	0.18	0.20	0.07	0.11	0.17	0.34	0.08	0.28	0.30	0.09
Peak parking accumulation per 100m^2 of total GFA	2.53	1.54	2.98	1.88	1.81	3.05	0.57	5.94	3.96	3.39	0.39	2.21	3.64	5.36
Time of peak parking accumulation	8:30-9:30	7:45-8:45 16:15-17:15	8:30-9:30	multi-day	15:30-16:30	9:00-10:00	16:15-17:15	15:45-16:45	16:00-17:00	15:15-16:15	multiple hours	8:30-9:30	8:15-9:15	17:00-18:00

[1] For detailed information please refer to the Trip Generation Surveys Child Care Centres Data Report.

Figure 2.1. Survey site locations – Sydney.

Figure 2.2. Survey site locations - Regional NSW.

2.2.1 Survey site selection and survey conduct issues

- There were no technical issues with the manual counts and video surveys, except obtaining permissions from the child care centres.

2.3 Survey Process

Conduct of surveys

Survey period	June 2015 Outside school holidays and public holidays
Day of the week	School days (Monday to Friday)
Survey times	6:30 a.m. – 9:30 a.m. for the AM peak 2:30 p.m. – 6:00 p.m. for the PM peak

Data Recorded by Traffic Surveyors

- A count of vehicles parked on-site in marked parking spaces at the commencement of the survey, where on-site parking existed; also a count of vehicles parked on street where it was clear for the observer that they belonged to a child care centre.
- A count of vehicles entering and leaving the site, in 15-minute bands, where on-site parking existed; also a count of vehicles arriving to the child care centre and parking on street where it was clear for the observer that they belonged to a child care centre.
- A count of the number of vehicles parked on-site in marked parking spaces taken at 15-minute intervals, where on-site parking existed; also a count of vehicles parked on street where it was clear for the observer that they belonged to a child care centre.
- An hourly vehicle count on the frontage road, to establish the impact of the development on underlying hourly traffic patterns;
- For Site S4 (special survey over 5 days): count of all vehicles entering the development for each day over the full 5-day period, to establish daily and hourly visitation patterns.
- Questionnaire surveys of staff and patients to obtain information about the mode of transport and number of passengers.
- Information about the site – opening times, number of staff, site area, building area and different types of services and facilities that are available on site.

3 Survey Analysis

3.1 Survey output requirements

The survey data was analysed with the key parameters being:

- Peak Vehicle Trips (i.e. the maximum number of vehicle trips to/from the site in any one-hour period)
- Peak Centre vehicle trips during the AM and PM commuter peak hours (i.e. the number of vehicle trips to/from the site during the morning and afternoon peak hours on the frontage road)
- Peak parking demand (from counts that were carried out on site, complemented by the results of questionnaire surveys where needed)

3.2 Average trip and parking demand rates for child care centres

Several variables were interrogated, as listed below.

- Total Gross Floor Area (GFA) of the child care centre
- Total site area of the child care centre
- Number of licensed places for children (centre capacity)
- Total number of staff present
- Number of on-site parking spaces

The detailed survey results are contained in a separate "Data Report".

A review of the data reveals a number of observations

- The surveys were undertaken at medical centres with the following ranges of independent variables
  - GFA varying from 112 m^2 to 1,041 m^2;
  - Total site area varying from 112 m^2 to 3,014 m^2
  - Number of staff varying from 3 to 15
  - Number of licensed places for children varying from 20 to 105
  - Number of on-site parking spaces varying from 0 to 22 spaces
- The results of the analyses for both peak hour and daily trips rates and parking accumulation indicate high values of standard deviation in all cases. The base data is therefore regarded as wide-spread and average rates are not recommended to be used for predicting the trip generation because of wide prediction intervals around the mean estimated values.
- Peak trip generation hours at most centres did not coincide with the commuter peak hours.
- Peak parking accumulation occurred almost with equal frequency in the morning or in the afternoon.

Table 3.1 Summary of trip and parking rates (all sites).

All sites	Min	Max	Avg	St Dev
Development details:				
Total site area (m^2)	112	3014	1070	823
Total GFA (m^2)	112	1041	445	296
No. of licensed places for children	20	105	56	28
No. of employees	3	15	8	4
Vehicle trips:				
Centre peak hour vehicle trips (in+out) AM	4	93	35	25
Centre peak hour vehicle trips per licensed place (AM)	0.06	1.25	0.66	0.34
Centre peak hour vehicle trips per 100m^2 of total GFA (AM)	1.04	19.31	9.00	5.14
Centre peak hour vehicle trips (in+out) PM	6	77	36	21
Centre peak hour vehicle trips per licensed place (PM)	0.24	1.38	0.68	0.32
Centre peak hour vehicle trips per 100m^2 of total GFA (PM)	1.89	30.36	10.81	8.45
Centre vehicle trips during adjacent road's peak hour (AM)	0	72	24	22
Centre vehicle trips per licensed place during adjacent road's peak hour (AM)	0.00	1.20	0.51	0.40
Centre vehicle trips per 100m^2 of GFA during adjacent road's peak hour (AM)	0.00	14.55	6.32	4.90
Centre vehicle trips during adjacent road's peak hour (PM)	0	50	17	17
Centre vehicle trips per licensed place during adjacent road's peak hour (PM)	0.00	0.70	0.29	0.25
Centre vehicle trips per 100m^2 of GFA during adjacent road's peak hour (PM)	0.00	24.75	5.01	6.31
Parking:				
No of public car spaces	0	22	7	8
Peak parking accumulation	3	16	9	4
Peak parking accumulation per number of licensed places	0.07	0.34	0.19	0.09
Peak parking accumulation per 100m^2 of total GFA	0.39	5.94	2.80	1.61

Table 3.2 Summary of trip and parking rates (without OSHC).

All sites without OSHC	Min	Max	Avg	St Dev
Development details:				
Total site area (m^2)	317	3014	1348	799
Total GFA (m^2)	165	1041	473	288
No. of licenced places for children	20	90	46	25
No. of employees	3	15	8	4
Vehicle trips:				
Centre peak hour vehicle trips (in+out) AM	8	93	37	28
Centre peak hour vehicle trips per licensed place (AM)	0.22	1.25	0.77	0.32
Centre peak hour vehicle trips per 100m^2 of total GFA (AM)	1.04	15.15	8.58	4.41
Centre peak hour vehicle trips (in+out) PM	6	77	36	24
Centre peak hour vehicle trips per licensed place (PM)	0.24	1.38	0.78	0.32
Centre peak hour vehicle trips per 100m^2 of total GFA (PM)	1.89	15.23	8.47	4.53
Centre vehicle trips during adjacent road's peak hour (AM)	6	72	31	21
Centre vehicle trips per licensed place during adjacent road's peak hour (AM)	0.17	1.20	0.69	0.33
Centre vehicle trips per 100m^2 of GFA during adjacent road's peak hour (AM)	0.78	14.55	7.63	4.33
Centre vehicle trips during adjacent road's peak hour (PM)	0	50	16	16
Centre vehicle trips per licensed place during adjacent road's peak hour (PM)	0	1	0	0
Centre vehicle trips per 100m^2 of GFA during adjacent road's peak hour (PM)	0	8	4	3
Parking:				
No of public car spaces	0	18	7	7
Peak parking accumulation	3	16	9	4
Peak parking accumulation per number of licensed places	0.08	0.34	0.22	0.08
Peak parking accumulation per 100m^2 of total GFA	0.39	3.64	2.34	0.98

Table 3.3 Summary of trip and parking rates (LDCC and PS only).

LDCC and PS only	Min	Max	Avg	St Dev
Development details:				
Total site area (m^2)	475	3014	1535	851
Total GFA (m^2)	165	1041	478	317
No. of licensed places for children	20	90	53	28
No. of employees	3	15	9	4
Vehicle trips:				
Centre peak hour vehicle trips (in+out) AM	11	93	45	30
Centre peak hour vehicle trips per licensed place (AM)	0.37	1.25	0.83	0.30
Centre peak hour vehicle trips per 100m^2 of total GFA (AM)	5.25	15.15	9.93	3.89
Centre peak hour vehicle trips (in+out) PM	11	77	42	25
Centre peak hour vehicle trips per licensed place (PM)	0.37	1.10	0.78	0.22
Centre peak hour vehicle trips per 100m^2 of total GFA (PM)	5.58	15.23	9.40	3.73
Centre vehicle trips during adjacent road's peak hour (AM)	9	72	37	22
Centre vehicle trips per licensed place during adjacent road's peak hour (AM)	0.30	1.20	0.72	0.31
Centre vehicle trips per 100m^2 of GFA during adjacent road's peak hour (AM)	3.50	14.55	8.62	4.12
Centre vehicle trips during adjacent road's peak hour (PM)	4	50	23	15
Centre vehicle trips per licensed place during adjacent road's peak hour (PM)	0.13	0.70	0.45	0.22
Centre vehicle trips per 100m^2 of GFA during adjacent road's peak hour (PM)	2.03	8.48	5.17	2.41
Parking:				
No of public car spaces	0	18	8	7
Peak parking accumulation	6	16	10	4
Peak parking accumulation per number of licensed places	0.16	0.30	0.21	0.06
Peak parking accumulation per 100m^2 of total GFA	1.54	3.64	2.49	0.78

Table 3.4 Summary of trip and parking rates. (OSHC only)

OSHC	Min	Max	Avg	St Dev
Development details:				
Total site area (m^2)	112	882	375	347
Total GFA (m^2)	112	882	375	347
No. of licensed places for children	70	105	80	17
No. of employees	3	11	6	4
Vehicle trips:				
Centre peak hour vehicle trips (in+out) AM	4	42	31	18
Centre peak hour vehicle trips per licensed place (AM)	0.06	0.56	0.38	0.23
Centre peak hour vehicle trips per 100m^2 of total GFA (AM)	3.57	19.31	10.05	7.34
Centre peak hour vehicle trips (in+out) PM	18	53	35	14
Centre peak hour vehicle trips per licensed place (PM)	0.26	0.50	0.43	0.12
Centre peak hour vehicle trips per 100m^2 of total GFA (PM)	4.08	30.36	16.65	13.57
Centre vehicle trips during adjacent road's peak hour (AM)	0	22	7	11
Centre vehicle trips per licensed place during adjacent road's peak hour (AM)	0.00	0.21	0.07	0.10
Centre vehicle trips per 100m^2 of GFA during adjacent road's peak hour (AM)	0.00	10.89	3.05	5.26
Centre vehicle trips during adjacent road's peak hour (PM)	2	50	20	21
Centre vehicle trips per licensed place during adjacent road's peak hour (PM)	0.03	0.48	0.23	0.19
Centre vehicle trips per 100m^2 of GFA during adjacent road's peak hour (PM)	1.47	24.75	8.32	11.09
Parking:				
No of public car spaces	0	22	6	11
Peak parking accumulation	5	12	9	4
Peak parking accumulation per licensed place	0.07	0.17	0.11	0.05
Peak parking accumulation per 100m^2 of total GFA	0.57	5.94	3.96	2.41

3.3 Regression analysis

As agreed in the project brief, the data has been analysed to determine the most consistent measure of trip generation, using a simple linear regression approach.

The coefficient of determination (R^2) has been used to provide a measure of the usefulness of the regression equation. It measures the proportion of variation in Y (trip behaviour) that is explained by the independent variable X (such as total gross floor area or the number of pumps) in the regression model. The values range from 0 to 1 with higher values representing a higher degree of correlation. In this study, R^2 above 0.8 are considered to provide the desired level of correlation. In other words, at least 80% of the variation in trip behaviour can be explained by the variability in the independent variable in the acceptable level.

A number of simple linear regression models did not fit the data at an acceptable level, returning low R^2. For this reason, non-linear regression models were trialled as well.

3.3.1 Relationship between the number of trips, parking demand and principal independent variables

The following key independent variables were used for this regression analysis:

- Total building GFA
- Number of licensed places for children.

It is noted, that the 1992 study of child care centres also considered the number of staff and the number of play rooms as independent variables. These were discarded from the present study for the following reasons.

Staff numbers are dependent on the number of children and their age breakdown by government regulations which require that a certain number of staff per child of a certain age be present on site at any one time. Minimum staff to children ratios are strictly controlled. These minimum ratios may be slightly exceeded by child care centres by having additional administrative (non-teaching manager) or support staff (e.g a cook). However, prescribed minimum staff numbers are unlikely to be exceeded significantly due to a reduced financial viability. Therefore, the staff number cannot be considered as an independent variable because the primary variable for both this number and the centre trip and parking characteristics is the same, the number of licensed children places.

Under the National Regulations, the following educator to child ratios apply in NSW for centre based services (home based services were not part of the study):

Age of children	**Educator to child ratio**
Birth to 24 months	1:4
Over 24 months and less than 36 months	1:8 until 31/12/15, then 1:5
Over 36 months and not yet attending school	1:10

With regard to OSHC, under the National Law there are no educator to child ratio requirements in relation to children over preschool age in NSW centre-based services. However, all providers and nominated supervisors of services must ensure that children at the services are adequately supervised at all times. In practice this means that at least two staff are required on premises, the primary reason being the ability to deal with the emergency situations whilst continuing to provide care.

Unlike in 1992, the **number of playrooms** is no longer an independent characteristic used by Councils for determination of development applications for child care centres. Similarly to the staff numbers, the

numbers of play rooms are dependent on the number and the age breakdown of children, as defined by government regulations. OSHC centres, for example, typically have one room regardless of the number of children.

The analysis was carried out for the following trip characteristics:

- Centre peak hour vehicle trips for the AM and PM periods (i.e. the maximum number of vehicle trips to/from the site in any one-hour period).
- Centre vehicle trips during adjacent road's AM and PM peaks (i.e. the number of vehicle trips to/from the site during the morning and afternoon peak hours on the frontage road).
- Peak parking demand.

3.3.1.1 Total building GFA

- R^2 for all trip characteristics for all child care centres is low and indicates little correlation between the Peak 1-hour vehicle trips (AM and PM), parking accumulation and the total GFA.

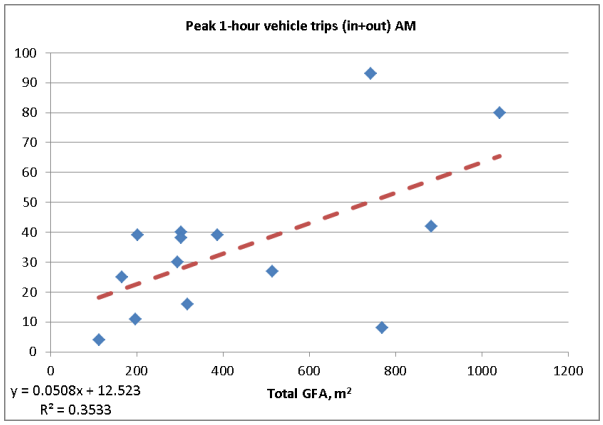

Figure 3.1 **Centre peak hour vehicle trips (AM) vs. Total building GFA – Linear type**

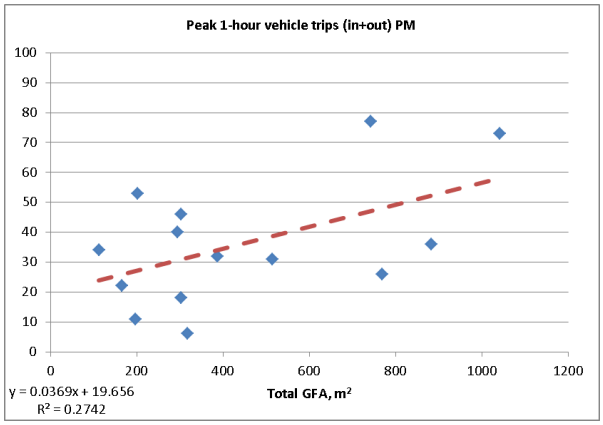

Figure 3.2 **Centre peak hour vehicle trips (PM) vs. Total building GFA – Linear type**

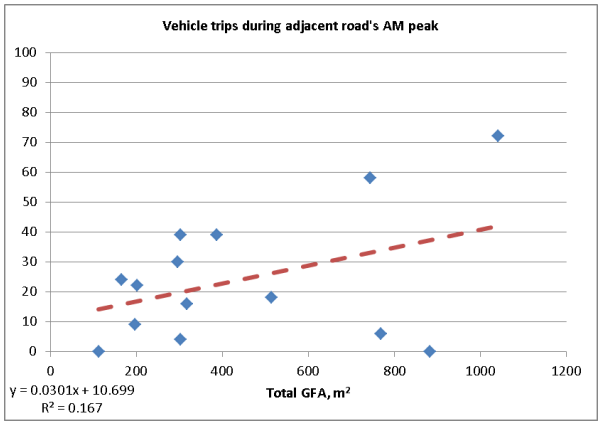

Figure 3.3 **Centre vehicle trips during Peak hour on adjacent road (AM) vs. Total GFA – Linear type**

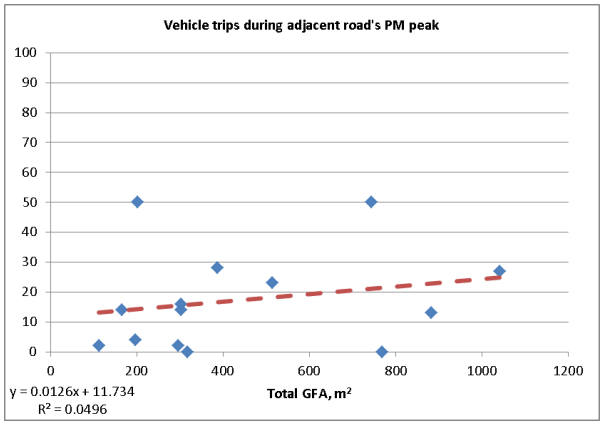

Figure 3.4 **Centre vehicle trips during Peak hour on adjacent road (PM) vs. Total GFA – Linear type**

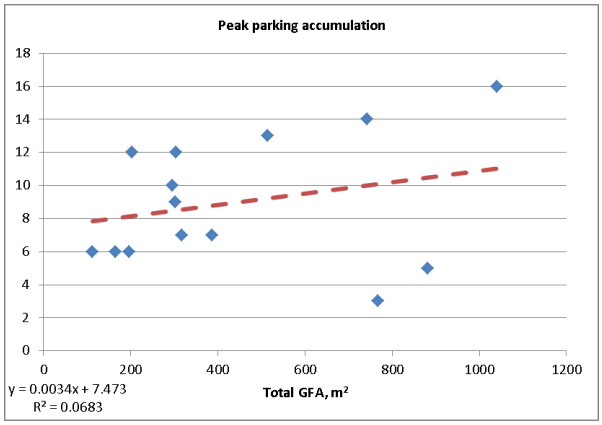

Figure 3.5 **Peak parking accumulation vs. Total GFA – Linear type**

3.3.1.2 Number of licensed places for children

- R^2 for all trip characteristics for all child care centres is low and indicates little correlation between the Centre peak hour vehicle trips (AM and PM), parking accumulation and number of licensed places.

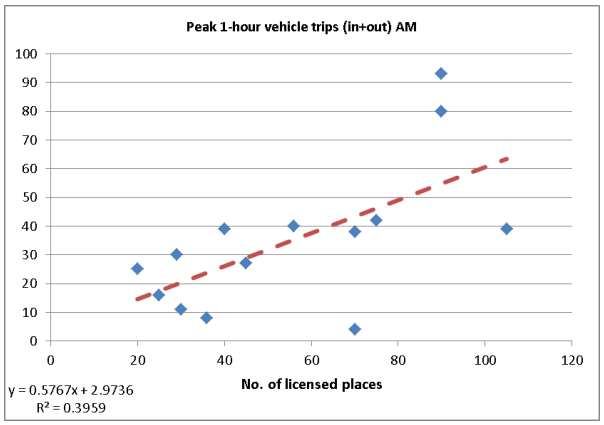

Figure 3.6 **Centre peak hour vehicle trips (AM) vs. Number of licensed places – Linear type**

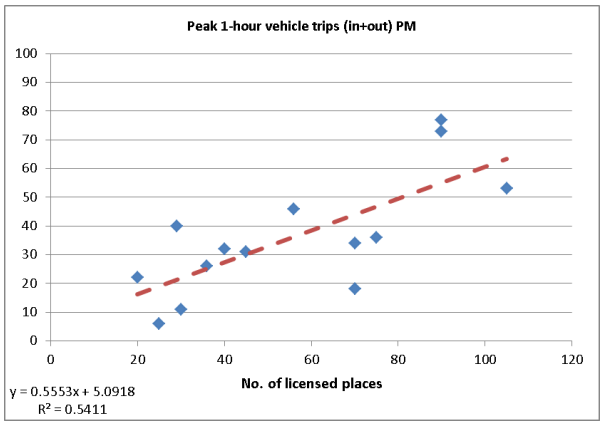

Figure 3.7 **Centre peak hour vehicle trips (PM) vs. Number of licensed places – Linear type**

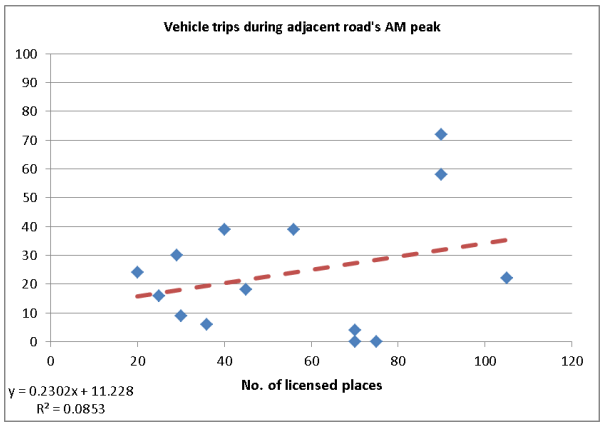

Figure 3.8 **Centre vehicle trips during Peak hour on adjacent road (AM) vs. Number of licensed places – Linear type**

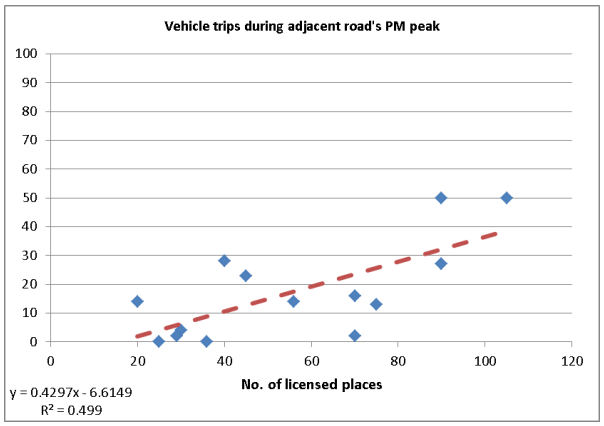

Figure 3.9 **Centre vehicle trips during Peak hour on adjacent road (PM) vs. Number of licensed places – Linear type**

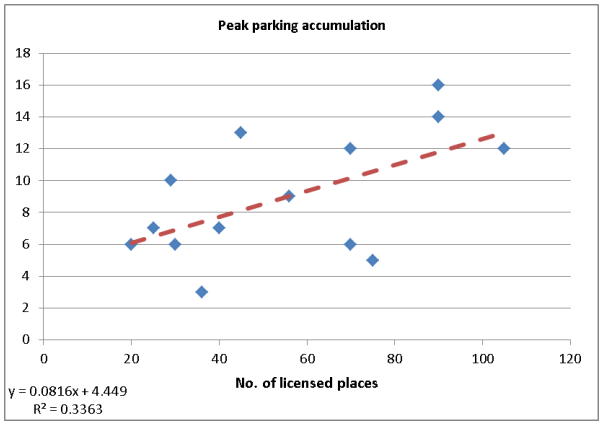

Figure 3.10 **Peak parking accumulation vs. Number of licensed places – Linear type**

- Based on the observation of the above scatter diagrams it was considered worthwhile analysing whether application of a non-linear relationship would improve the correlation between the independent and dependent variables. The results of this analysis are presented in the next subsection.

3.3.1.2.1 Non-linear regression analysis

- R^2 for all trip characteristics for all child care centres is low and indicates little correlation between the Centre peak hour vehicle trips (AM and PM), parking accumulation and the total GFA.

3.3.1.2.2 Total building GFA

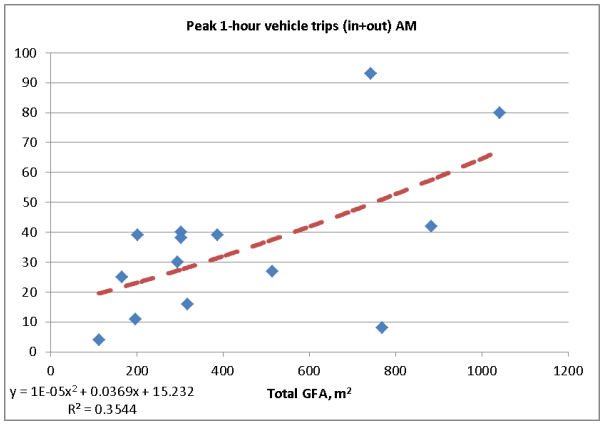

Figure 3.11 Centre peak hour vehicle trips (AM) vs. Total GFA – Non-linear type

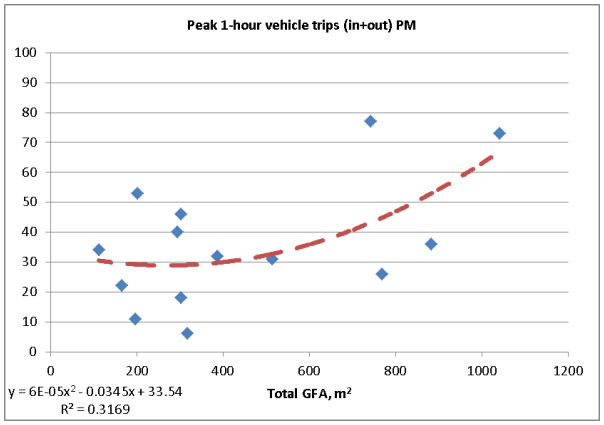

Figure 3.12 Centre peak hour vehicle trips (PM) vs. Total GFA – Non-linear type

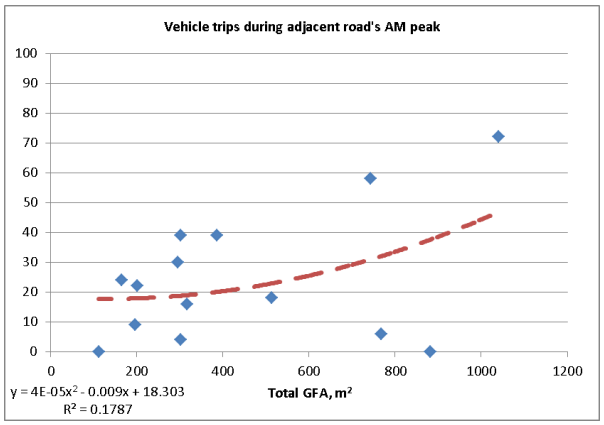

Figure 3.13 Centre vehicle trips during Peak hour on adjacent road (AM) vs. Total GFA – Non-linear type

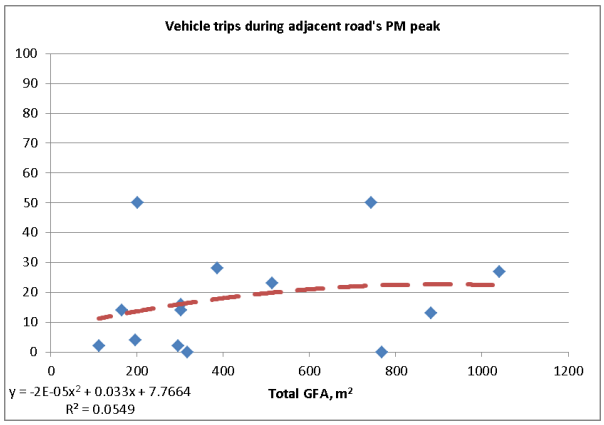

Figure 3.14 Centre vehicle trips during Peak hour on adjacent road (PM) vs. Total GFA – Non-linear type

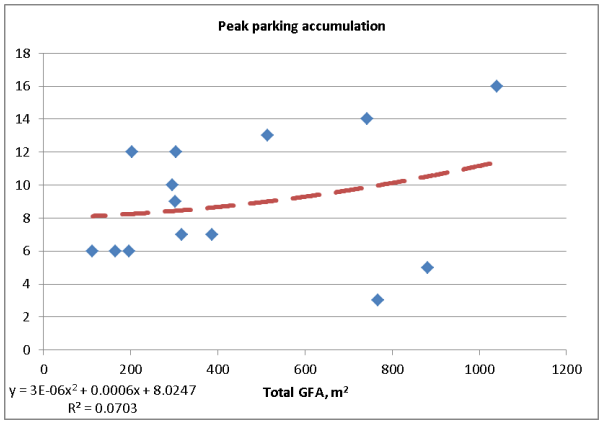

Figure 3.15 Peak parking accumulation vs. Total GFA – Non-linear type

3.3.1.2.3 Number of licensed places for children

- R^2 for Centre vehicle trips during adjacent road's PM peak vs. number of licensed places (0.5986) improved slightly, however it remained at a level which is not high enough to be utilised for trip prediction for new developments.

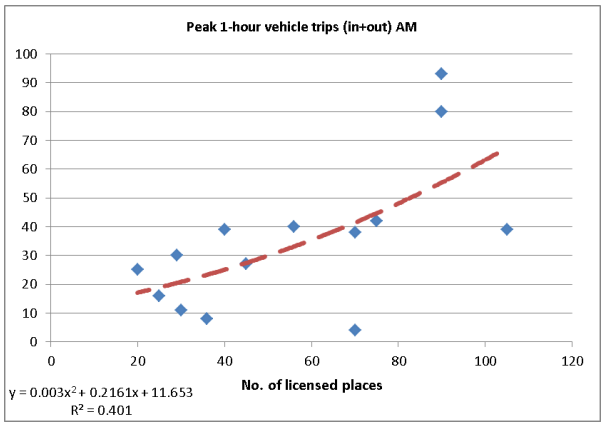

Figure 3.16 Centre peak hour vehicle trips (AM) vs. Number of licensed places – Non-linear type

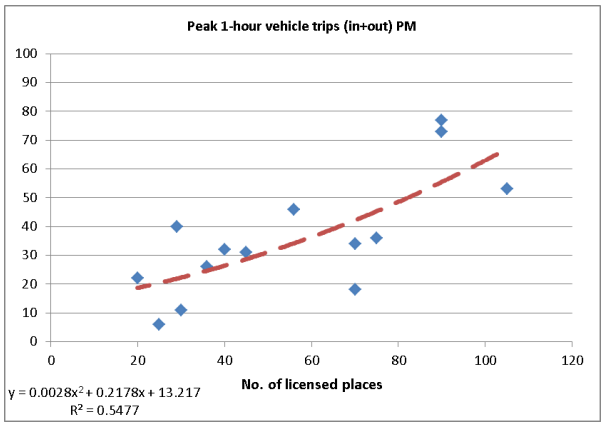

Figure 3.17 Centre peak hour vehicle trips (PM) vs. Number of licensed places – Non-linear type

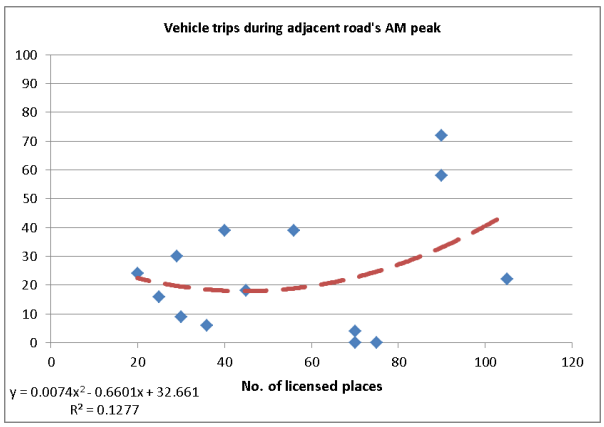

Figure 3.18 Centre vehicle trips during Peak hour on adjacent road (AM) vs. Number of licensed places – Non-linear type

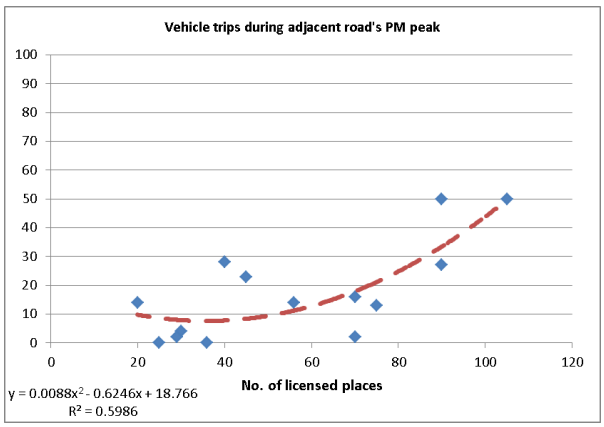

Figure 3.19 Centre vehicle trips during Peak hour on adjacent road (PM) vs. Number of licensed places – Non-linear type

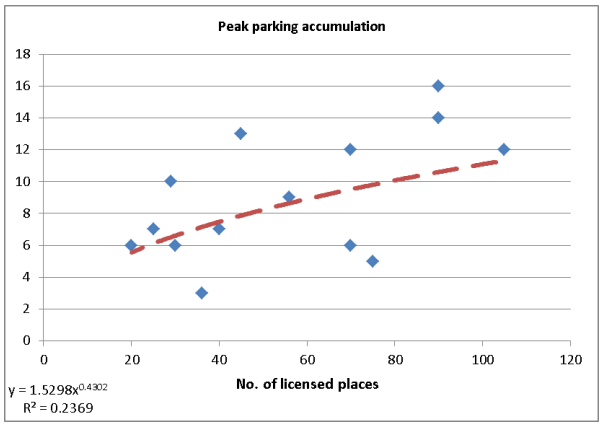

Figure 3.20 Peak parking accumulation vs. Number of licensed places

- Given the low R^2 values for the non-linear type analysis it was decided to conduct a multi regression analysis to see whether a more reliable connection could be determined between the variables.

3.3.1.3 Multiple regression analysis

- Further analysis has been undertaken to determine whether multiple regression based on two independent variables (GFA and the number of places) yields a more reliable estimate of peak daily trip or parking accumulation behaviour.
- A check for inter-correlation between the above two independent variables has been carried out in the form of linear regression analysis and revealed low correlation level ($R^2 = 0.168$).

Table 3.5 Peak parking accumulation vs. (Total GFA & Number of licensed places for children).

Regression Statistics	
Multiple R	0.5826
R Square	0.3394
Adjusted R Square	0.2193
Standard Error	3.4309
Observations	14

ANOVA

	df	*SS*	*MS*	*F*
Regression	2	66.516	33.258	2.825
Residual	11	129.484	11.771	
Total	13	196		

	Coefficient	*Standard Error*	*t Stat*	*P-value*
Intercept	4.271	2.272	1.880	0.087
Total GFA (m2)	0.001	0.003	0.226	0.826
No. of licensed places for children	0.079	0.037	2.124	0.057

- Adjusted R^2 of 0.2193 is less than the 0.80 benchmark.

Table 3.6 Centre peak hour vehicle trips (AM) vs. (Total GFA & Number of licensed places for children).

Regression Statistics	
Multiple R	0.742
R Square	0.5506
Adjusted R Square	0.4689
Standard Error	18.437
Observations	14

ANOVA

	df	*SS*	*MS*	*F*
Regression	2	4580.758	2290.379	6.738
Residual	11	3738.956	339.905	
Total	13	8319.714		

	Coefficient	*Standard Error*	*t Stat*	*P-value*
Intercept	-5.2777	12.209	-0.432	0.674
Total GFA (m2)	0.0361	0.019	1.946	0.078
No. of licensed places for children	0.4367	0.199	2.198	0.050

- Adjusted R^2 of 0.4689 is less than the 0.80 benchmark.

Table 3.7 Centre peak hour vehicle trips (PM) vs. (Total GFA & Number of licensed places for children).

Regression Statistics	
Multiple R	0.7857
R Square	0.6174
Adjusted R Square	0.5478
Standard Error	14.013
Observations	14

ANOVA

	df	*SS*	*MS*	*F*
Regression	2	3485.049	1742.525	8.874
Residual	11	2159.880	196.353	
Total	13	5644.929		

	Coefficient	*Standard Error*	*t Stat*	*P-value*
Intercept	0.3194	9.279	0.034	0.973
Total GFA (m2)	0.0209	0.014	1.481	0.167
No. of licensed places for children	0.4744	0.151	3.141	0.009

- Adjusted R^2 of 0.5478 is less than the 0.80 benchmark.
- All of the relationships are below the 0.80 benchmark and thus cannot be used for reliable estimates.

3.4 Regression analysis without OSHC

The previous Sections of the present report described the regression analysis of all centres combined, similarly to the 1992 Study. It is noted, however, that there is a substantial difference between the operation of child care centres for children under the school age and Outside School Hours Care centres (OSHC) which cater for school children.

Due to a high demand for children places, the number of children attending LDCC, PS and OC centres is typically near their capacity (number of licensed places). It is a common situation that all places are signed up for on a daily basis. This situation makes the capacity of a child care centre a logical predictor for its trip characteristics. There is also a certain relationship between the GFA of a centre and its capacity, because of the government requirements to provide minimum floor space per child for play rooms and outdoor play areas and also the size and the number of ancillary facilities (e.g. toilets).

LDCC, PS and OC can be either purpose built or established in existing buildings converted into child care centres. In the former case, the centre building would typically be built with minimum allowed area to fit the designed number of children. In the latter case, the converted buildings are typically licensed and used for the maximum number of children which can fit in the available floor area. The actual relationship between the floor area and the number of children varies depending on the children age mix, as different ages require different facilities. Of the above three types of child care centres, OC centres may exhibit lower than capacity and non-consistent use on a daily basis due to the nature of their service to parents/carers, which is on an occasional needs basis, rather than permanent.

The Outside School Hours Care (OSHC) centres operate differently to LDCC, PS and OC centres. Firstly, they cater for school children before and after the classes. Unlike the other types of child care centres, where children arrive in the morning and stay all day, OSHC centres have two separate intakes – one before and one after the classes. These two intakes may have completely different children in them. As may be seen from the survey results, the numbers of children in the morning and in the afternoon can also differ significantly. Unlike for centres for preschool aged children, the number of children per staff member are not controlled and can be rather high (up to 20-25 per one educator). In many cases there can be only two staff on duty (the minimum number to allow for one of them to deal with emergency situations, so that children are not left unattended).

OSHC centres are typically not purpose built, but occupy a suitable building on the base school grounds (or near) which can be used for other activities during the school hours (OSHC centres, by definition, operate only before and after the school hours). It can be a sports hall or a classroom. When it comes to licensing OSHC premises, the application for operation is usually made for the maximum number of children which can fill the floor area, just in case. The approved capacity is therefore typically a large number (refer to the site information) and is rarely matched by the actual demand. It is more likely to be dependent on the number of children enrolled in the base school (the larger the school, the larger the number of children requiring OSHC, assuming a similar proportion of children requiring OSHC at all schools) and socio-demographic characteristics of the catchment area (for example the proportion of parents who are not in full-time employment and therefore do not require OSHC for their children). An attempt to analyse these relationships has been made in Section 3.6 of this report.

Given the above considerations, analysis of centres other than OSHC has been carried out separately. The results are presented in the following Sections.

3.4.1 Linear regression

Similarly to the previous section, a linear regression analysis was carried out to examine correlation between the variables, without OSHC centres.

3.4.1.1 Total building GFA (without OSHC)

- R^2 for all trip characteristics for all child care centres is low and indicates little correlation between the Centre peak hour vehicle trips (AM & PM) and the total GFA.

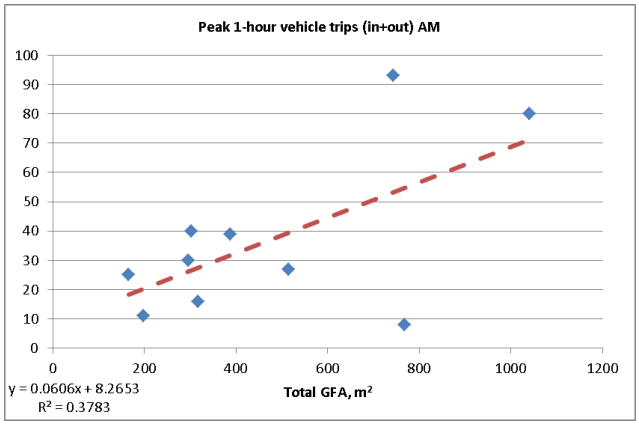

Figure 3.21 Centre peak hour vehicle trips (AM) vs. Total building GFA – Linear type

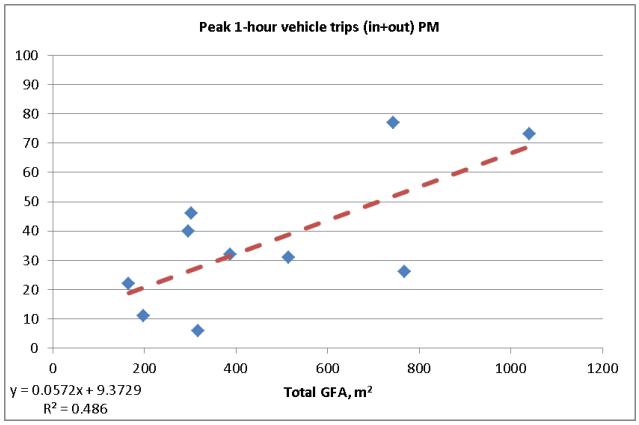

Figure 3.22 Centre peak hour vehicle trips (PM) vs. Total building GFA – Linear type

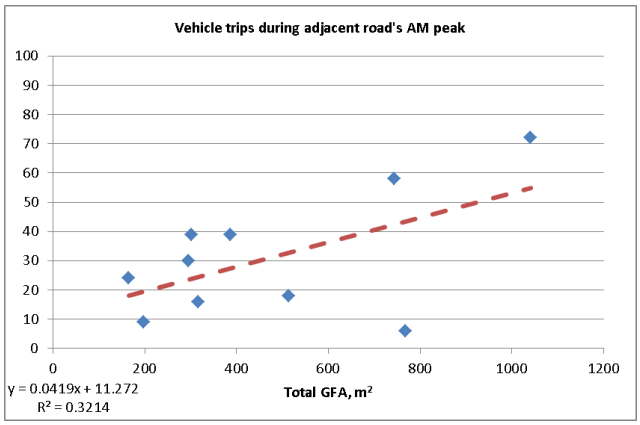

Figure 3.23 Centre vehicle trips during Peak hour on adjacent road (AM) vs. Total building GFA – Linear type

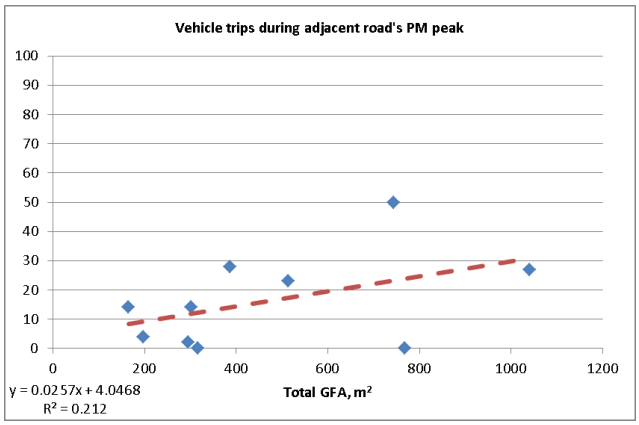

Figure 3.24 Centre vehicle trips during Peak hour on adjacent road (PM) vs. Total building GFA – Linear type

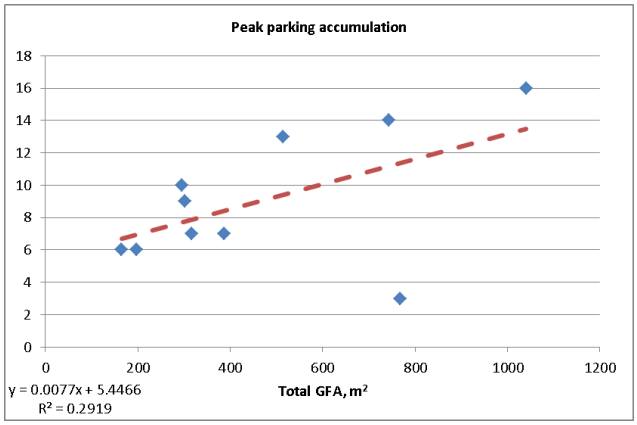

Figure 3.25 Peak parking accumulation vs. Total GFA – Linear type

3.4.1.2 Number of licensed places for children (without OSHC)

- R^2 for Centre peak hour vehicle trips (AM & PM) and the number of licensed places for children is high which indicates that there is a reliable dependency between the variables (R^2 = 0.8497 for AM & R^2 = 0.8573 for PM).

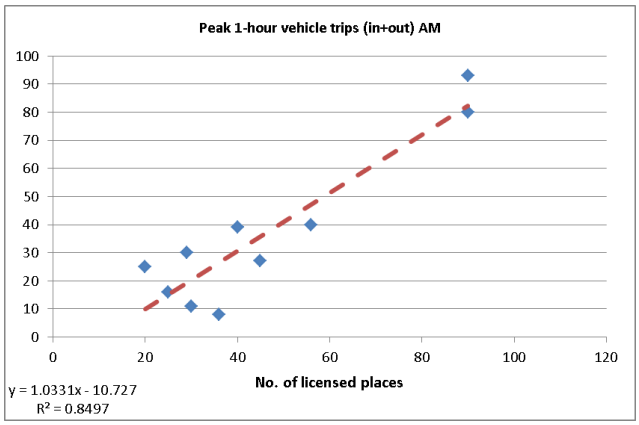

Figure 3.26 Centre peak hour vehicle trips (AM) vs. Total building GFA – Linear type

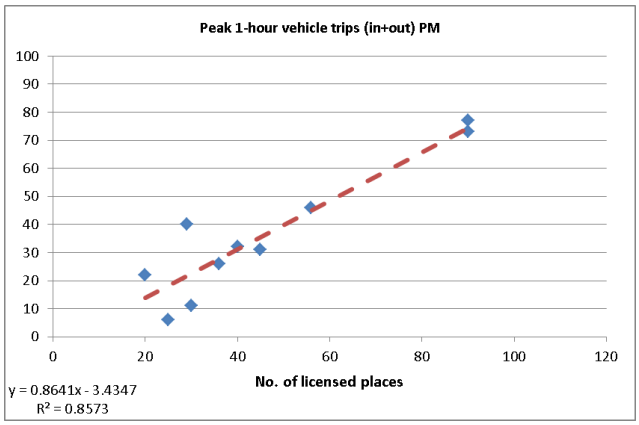

Figure 3.27 Centre peak hour vehicle trips (PM) vs. Total building GFA – Linear type

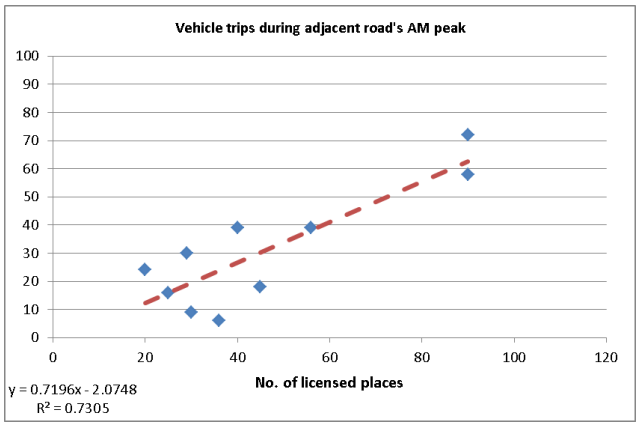

Figure 3.28 Centre vehicle trips during Peak hour on adjacent road (AM) vs. Number of licensed places – Linear type

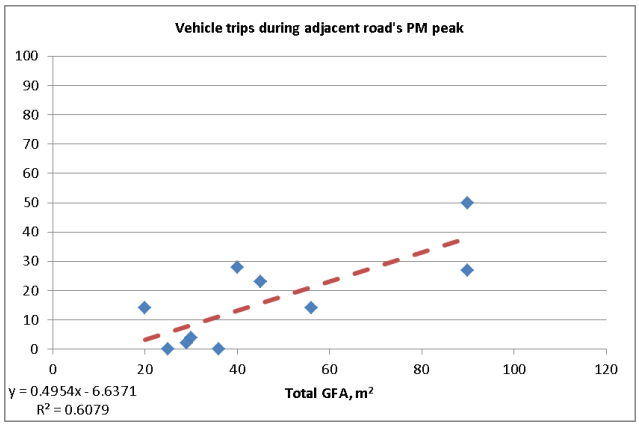

Figure 3.29 Centre vehicle trips during Peak hour on adjacent road (PM) vs. Number of licensed places – Linear type

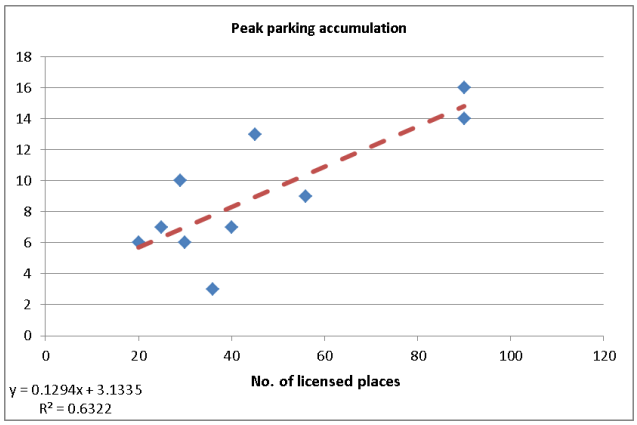

Figure 3.30 Peak parking accumulation vs. Number of licensed places – Linear type

3.4.2 Non-linear regression

Further non-linear regression was performed to determine whether there was any improvement in the relationship between our variables (mainly peak parking accumulation).

3.4.2.1 Total building GFA (without OSHC)

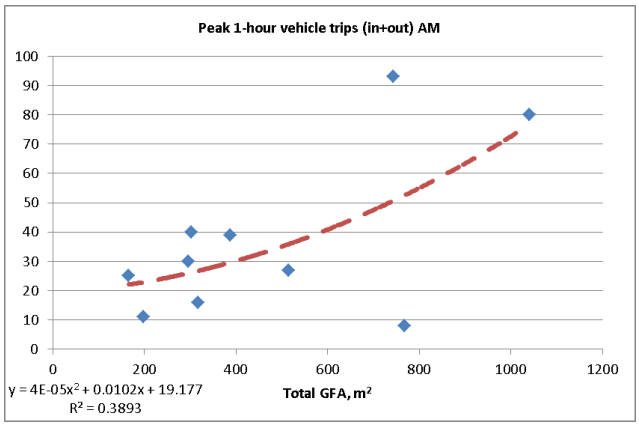

Figure 3.31 Centre peak hour vehicle trips (AM) vs. Total GFA – Non-linear type

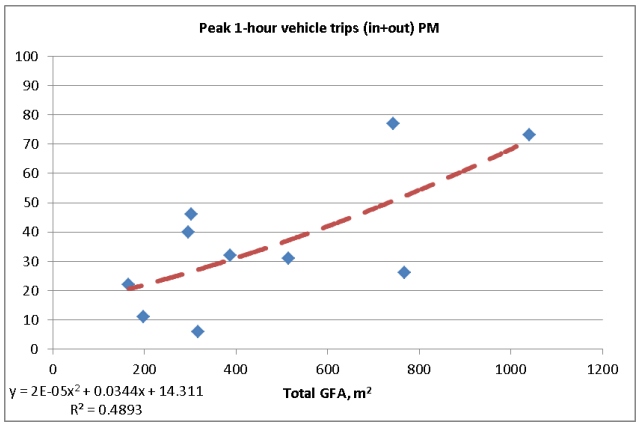

Figure 3.32 Centre peak hour vehicle trips (PM) vs. Total GFA – Non-linear type

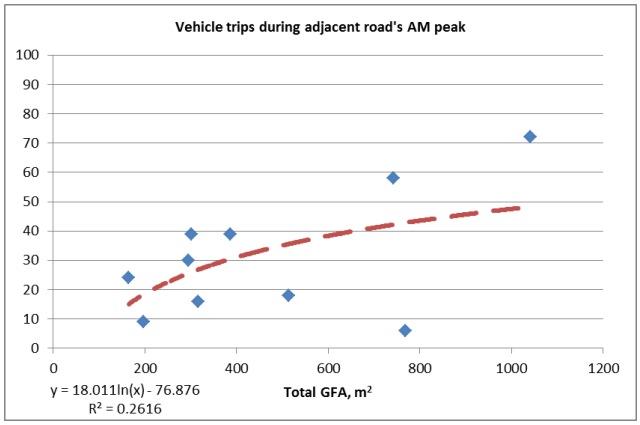

Figure 3.33 Centre vehicle trips during Peak hour on adjacent road (AM) vs. Total GFA – Non-linear type

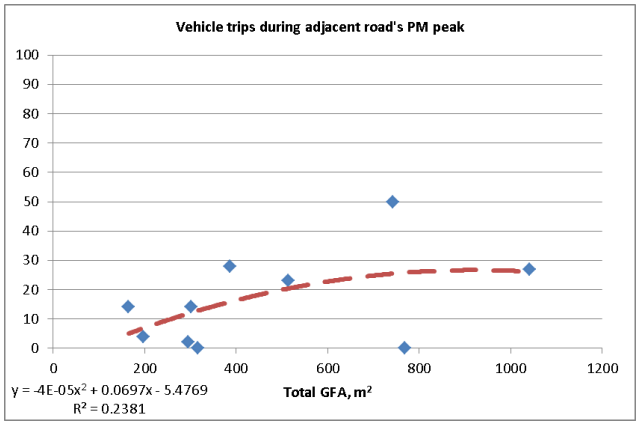

Figure 3.34 Centre vehicle trips during Peak hour on adjacent road (PM) vs. Total GFA – Non-linear type

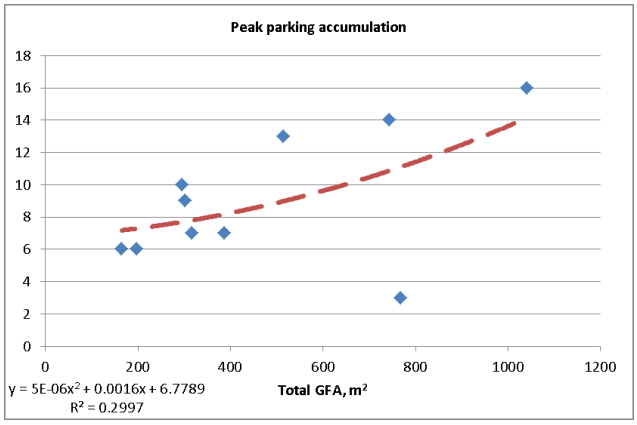

Figure 3.35 Peak parking accumulation vs. Total GFA – Non – linear type.

3.4.2.2 Number of licensed places for children (without OSHC)

- There were increases in the R^2 value for all interrogated variables, however only Centre peak hour vehicle trips AM (R^2 = 0.8972) and PM (R^2 = 0.8599) remained above the 0.80 benchmark.

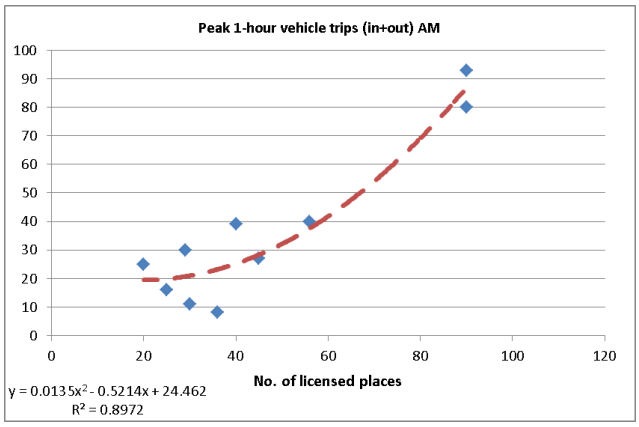

Figure 3.36 Centre peak hour vehicle trips (AM) vs. Number of licensed places – Non-linear type

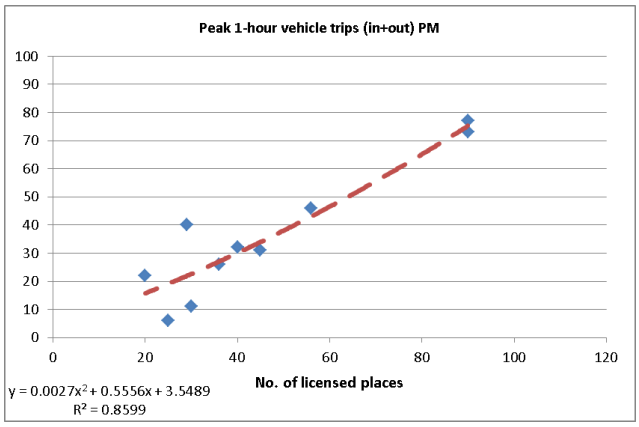

Figure 3.37 Centre peak hour vehicle trips (PM) vs. Number of licensed places – Non-linear type

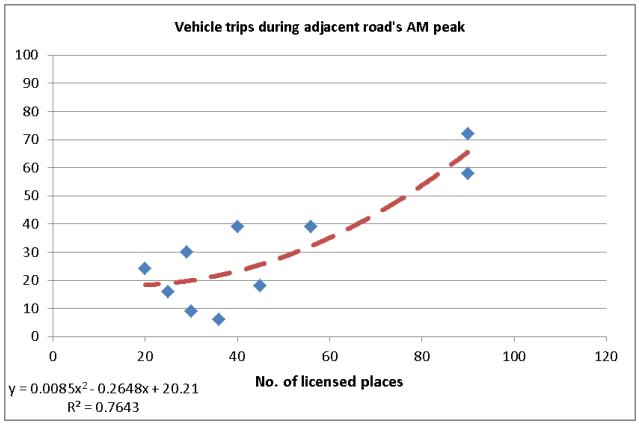

Figure 3.38 Centre vehicle trips during Peak hour on adjacent road (AM) vs. Number of licensed places – Non-linear type

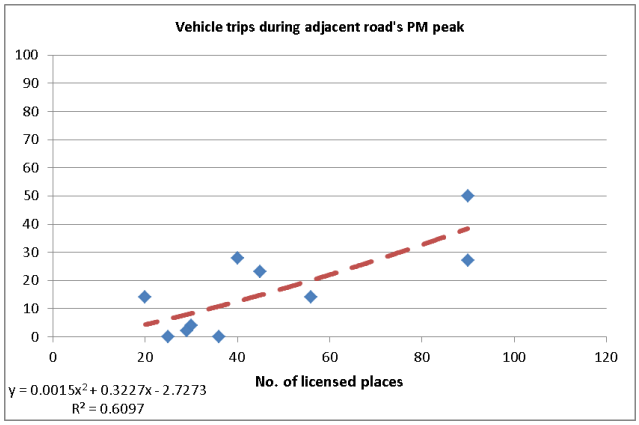

Figure 3.39 Centre vehicle trips during Peak hour on adjacent road (PM) vs. Number of licensed places – Non-linear type

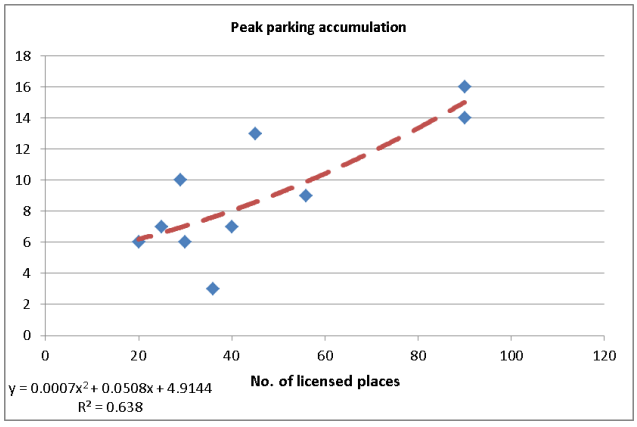

Figure 3.40 Peak parking accumulation vs. Number of licensed places –Non-linear type.

- The above results indicate a strong relationship between the numbers of licensed places for children and Centre peak hour vehicle trips (both AM and PM).
- However, the R^2 values for peak parking accumulation against both total GFA and number of licensed places were still under 0.8 and therefore further multiple regression analysis was undertaken.

3.4.3 Multiple regression analysis

- Further analysis has been undertaken to determine whether multiple regression based on two or more independent variables yields a more reliable estimate of peak daily trip or parking accumulation behaviour.
- However, all R^2 values for the relationships between the independent variables and a combination of total GFA and number of licensed places were lower than those obtained from the single variable analysis. The results of the single variable analysis are thus recommended to be used.

Table 3.8 Peak parking accumulation vs. (total GFA & number of licensed places for children).

Regression Statistics	
Multiple R	0.806
R Square	0.650
Adjusted R Square	0.549
Standard Error	2.767
Observations	10

ANOVA

	df	*SS*	*MS*	*F*
Regression	2.000	99.315	49.658	6.487
Residual	7.000	53.585	7.655	
Total	9.000	152.900		

	Coefficient	*Standard Error*	*t Stat*	*P-value*
Intercept	3.321	1.920	1.730	0.127
Total GFA (m2)	-0.003	0.005	-0.588	0.575
No. of licensed places for children	0.156	0.059	2.673	0.032

Table 3.9 Centre peak hour vehicle trips (AM) vs. (total GFA & number of licensed places for children).

Regression Statistics	
Multiple R	0.937
R Square	0.879
Adjusted R Square	0.844
Standard Error	11.199
Observations	10

ANOVA

	df	*SS*	*MS*	*F*
Regression	2.000	6371.052	3185.526	25.402
Residual	7.000	877.848	125.407	
Total	9.000	7248.900		

	Coefficient	*Standard Error*	*t Stat*	*P-value*
Intercept	-9.048	7.772	-1.164	0.282
Total GFA (m2)	-0.027	0.021	-1.298	0.235
No. of licensed places for children	1.274	0.237	5.379	0.001

Table 3.10 Centre peak hour vehicle trips (PM) vs. (total GFA & number of licensed places for children).

Regression Statistics	
Multiple R	0.938
R Square	0.880
Adjusted R Square	0.840
Standard Error	9.298
Observations	9

ANOVA

	df	*SS*	*MS*	*F*
Regression	2.000	3790.834	1895.417	21.924
Residual	6.000	518.722	86.454	
Total	8.000	4309.556		

	Coefficie	Standard Error	t Stat	P-value
Intercept	0.890	6.987	0.127	0.903
Total GFA (m2)	-0.013	0.018	-0.717	0.500
No. of licensed places for children	0.935	0.197	4.747	0.003

3.5 Regression analysis - LDCC and PS only

Although suitable R^2 values have been found for Peak 1 hour vehicle movements for all centres excluding OSHC, no reliable relationship was found for parking accumulation. Of the three preschool age types of child care centres, OC is different in its operation, with children attendances being irregular and more prone to run below the centre capacity. During this analysis, it was decided that the data from OSHC and OC would be omitted given the similarity in which the two centres would operate (not at full capacity).

3.5.1 Linear regression

3.5.1.1 Total building GFA (LDCC and PS only)

- R^2 of 0.8735 for peak parking accumulation against GFA shows a strong relationship between the variables.

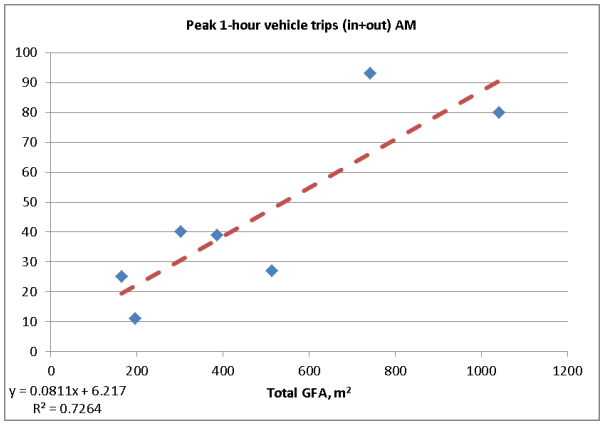

Figure 3.41 Centre peak hour vehicle trips (AM) vs. Total GFA – Linear type

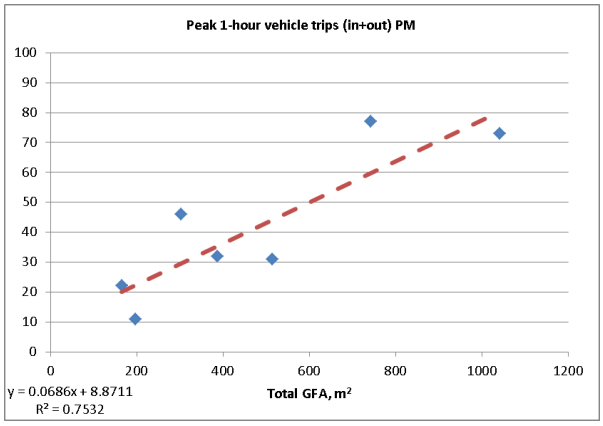

Figure 3.42 Centre peak hour vehicle trips (PM) vs. Total GFA – Linear type

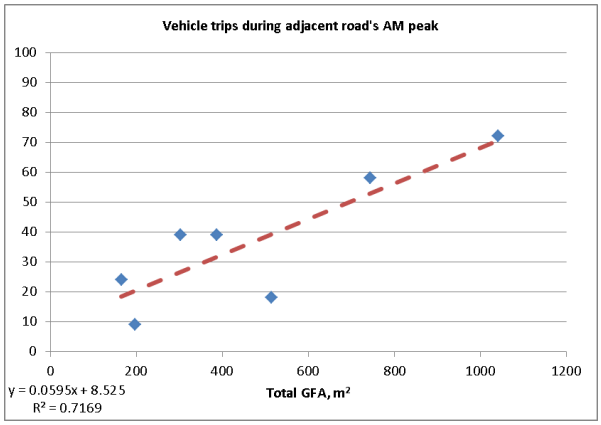

Figure 3.43 Centre vehicle trips during Peak hour on adjacent road (AM) vs. Total GFA – Linear type

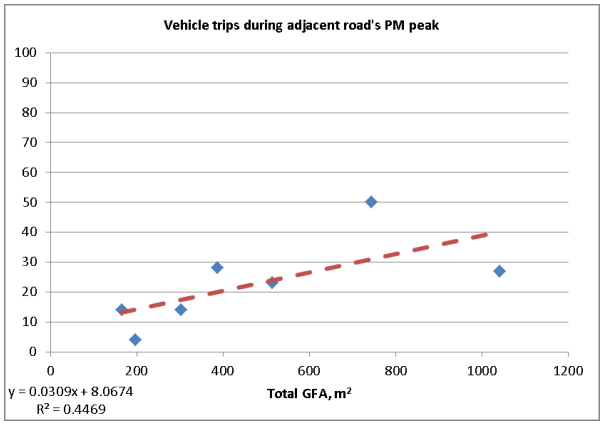

Figure 3.44 Centre vehicle trips during Peak hour on adjacent road (PM) vs. Total GFA – Linear type

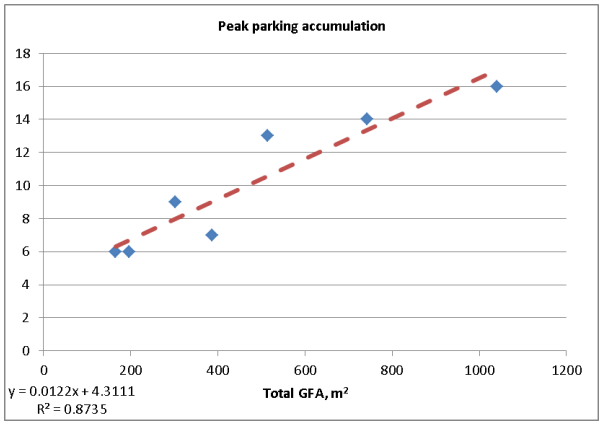

Figure 3.45 Peak parking accumulation vs. Total GFA – Linear type

3.5.1.2 Number of licensed places for children (LDCC and PS only)

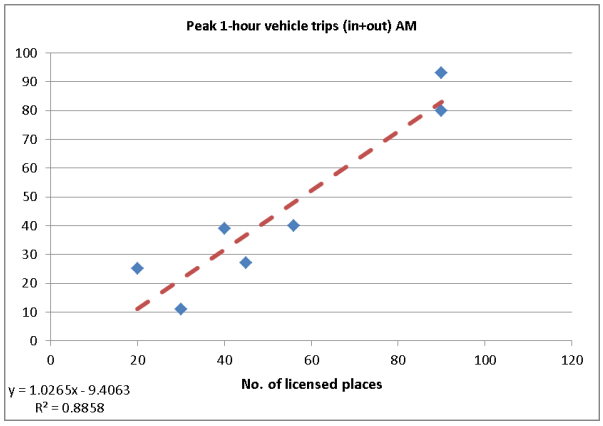

Figure 3.46 **Centre peak hour vehicle trips (AM) vs. Number of licensed places – Linear type**

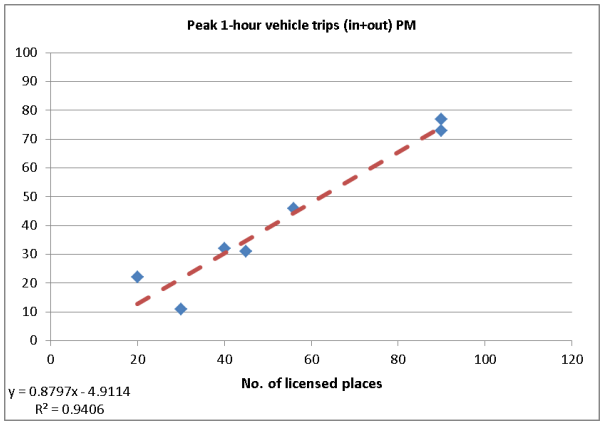

Figure 3.47 **Centre peak hour vehicle trips (PM) vs. Number of licensed places – Linear type**

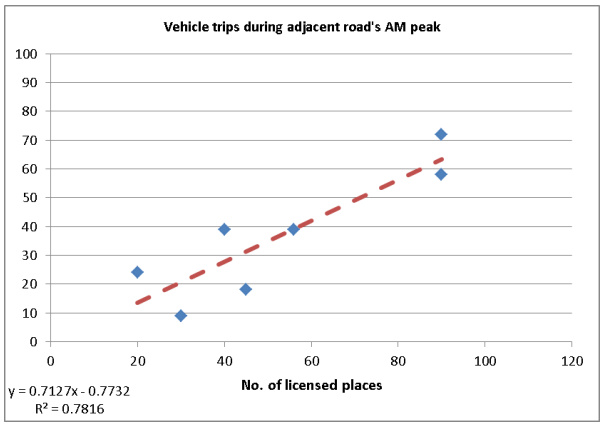

Figure 3.48 **Centre vehicle trips during Peak hour on adjacent road (AM) vs. Number of licensed places – Linear type**

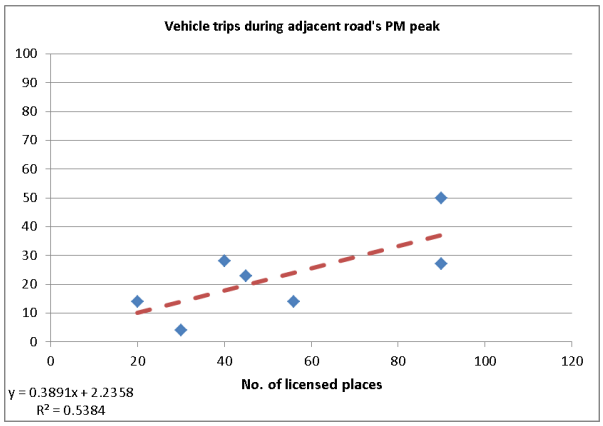

Figure 3.49 **Centre vehicle trips during Peak hour on adjacent road (PM) vs. Number of licensed places –-Linear type**

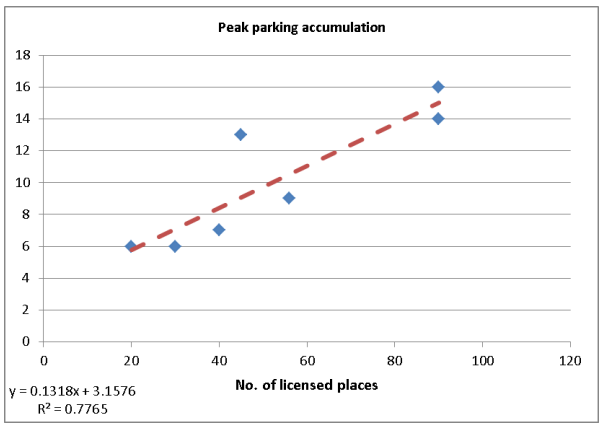

Figure 3.50 **Peak parking accumulation vs. Number of licensed places – Linear type**

- A non-linear regression analysis was carried out as well, in order to determine whether better dependency relationship formulae could be found.

3.5.2 Non-linear regression

3.5.2.1 Total building GFA (LDCC and PS only)

- R^2 for peak parking demand vs. total GFA has increased to 0.9031 compared with 0.8735 from the linear regression analysis.

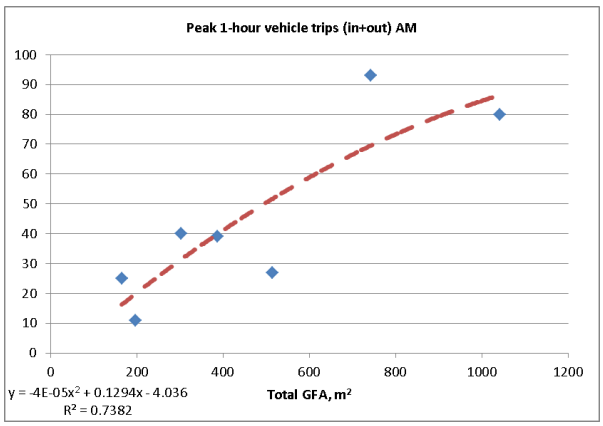

Figure 3.51 Centre peak hour vehicle trips (AM) vs. Total GFA – Non - linear type

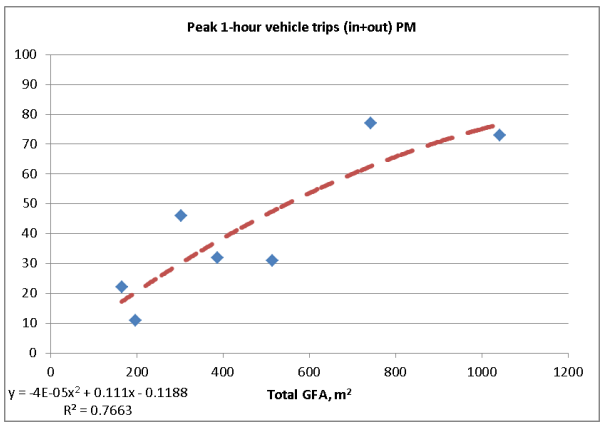

Figure 3.52 Centre peak hour vehicle trips (PM) vs. Total GFA – Non - linear type

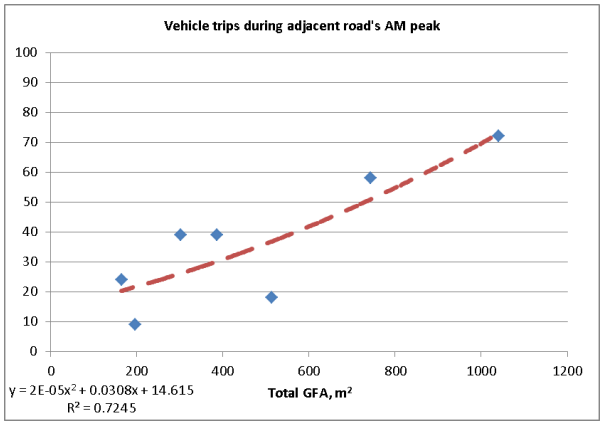

Figure 3.53 Centre vehicle trips during Peak hour on adjacent road (AM) vs. Total GFA – Non-linear type

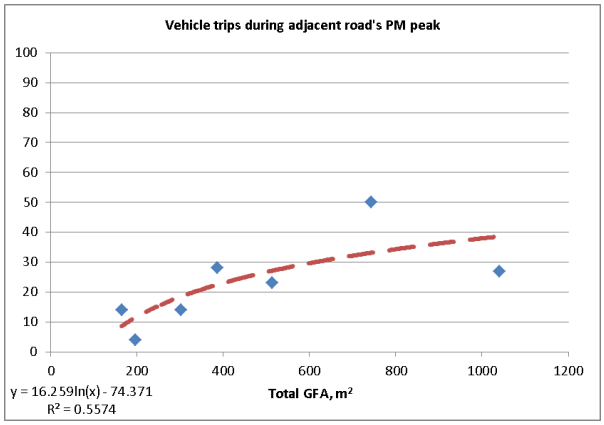

Figure 3.54 Centre vehicle trips during Peak hour on adjacent road (PM) vs. Total GFA – Non-linear type

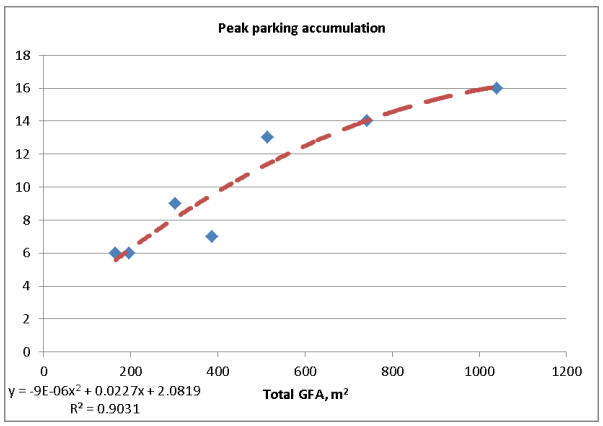

Figure 3.55 Peak parking accumulation vs. Total GFA – Non-linear type.

3.5.2.2 Number of licensed places for children (LDCC and PS only)

- The non-linear analysis returned very high R^2 values for Centre peak hour vehicle trips AM & PM (0.9286 & 0.9476, respectively) and Centre vehicle trips during adjacent road's AM peak (0.8051), showing a strong relationship with the number of licensed places.

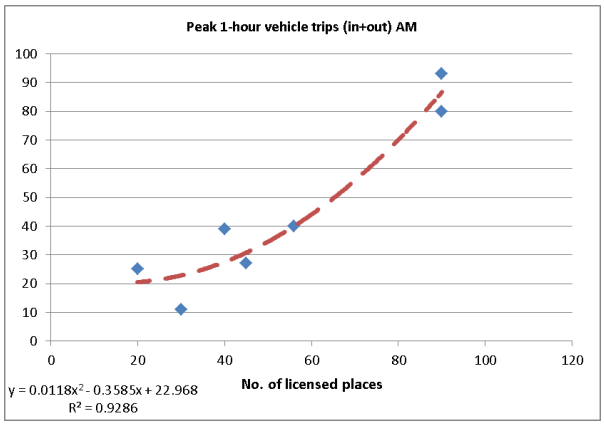

Figure 3.56 Centre peak hour vehicle trips (AM) vs. Number of licensed places – Non-linear type

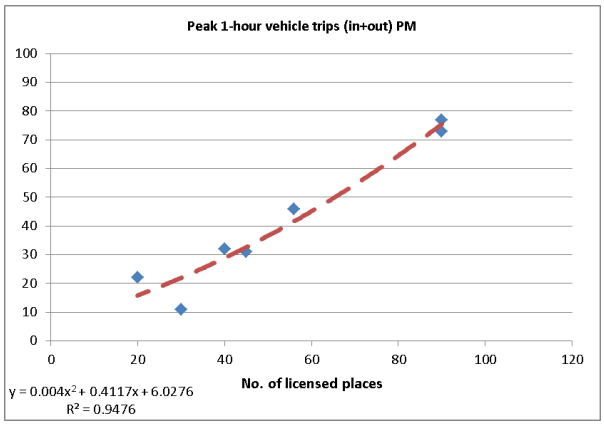

Figure 3.57 Centre peak hour vehicle trips (PM) vs. Number of licensed places– Non-linear type

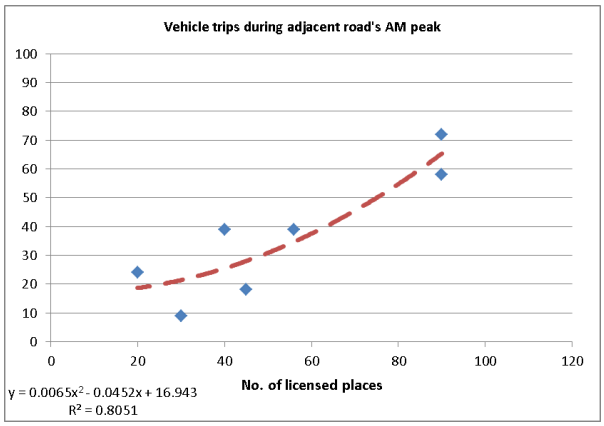

Figure 3.58 Centre vehicle trips during Peak hour on adjacent road (AM) vs. Number of licensed places – Non-linear type

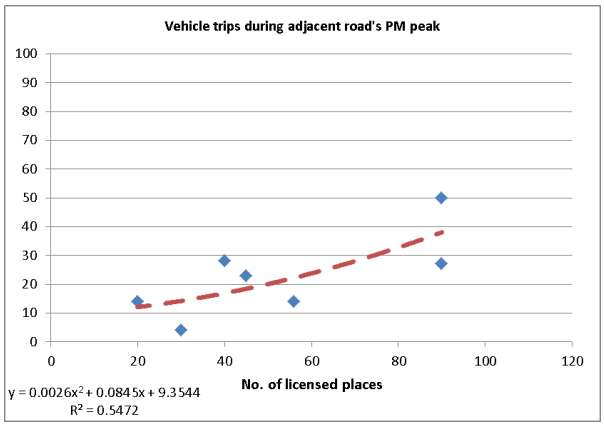

Figure 3.59 Centre vehicle trips during Peak hour on adjacent road (PM) vs. Number of licensed places –-Non-linear type

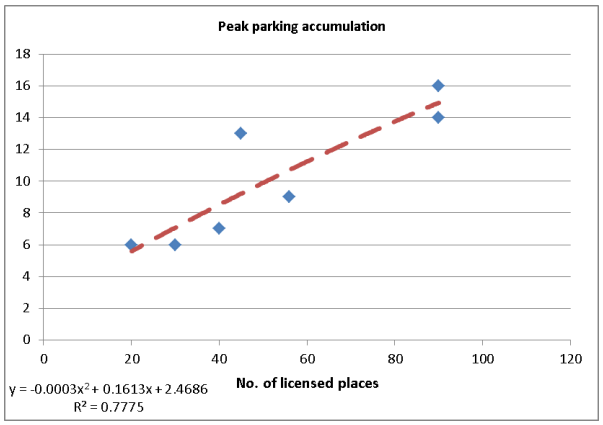

Figure 3.60 Peak parking accumulation vs. Number of licensed places – Non-linear type.

- Given the satisfactory results of the non-linear regression analysis, a multiple regression analysis was deemed unnecessary.

3.6 Regression analysis - OSHC only

OSHC centres, as mentioned previously in this report, are different from other centres. They are normally attached to a school and cater for school aged children. They also do not operate all day, but before and after school hours only.

It was thus considered worthwhile investigating the relationships of OSHC trips characteristics separately, taking into account the previously described hypotheses that there could be a dependency of these characteristics on the number of children in the base school or on the percent of employed people in the area.

The results of the analyses presented in Section shall not be used for any predictions of trip generation or parking demand of OSHC centres, due to a very small data sample (4 sites). Rather, the intention of this analysis is to assess whether specific dependencies may need to be investigated in more detail.

3.6.1 Linear regression

3.6.1.1 Total building GFA (OSHC only)

- R^2 for all trip characteristics is low and indicates little correlation between the dependable variables and the floor area.

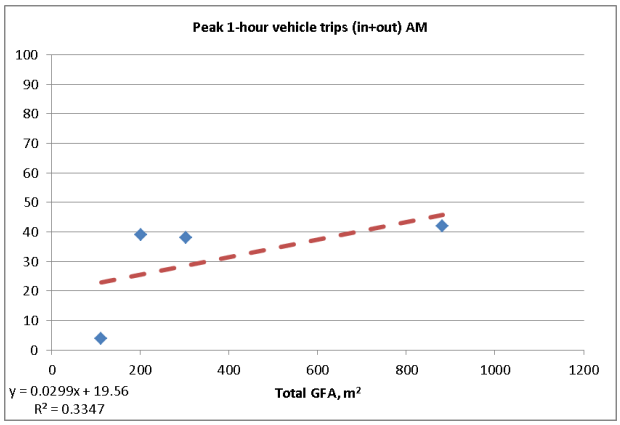

Figure 3.61 Centre peak hour vehicle trips (AM) vs. Total GFA – Linear type

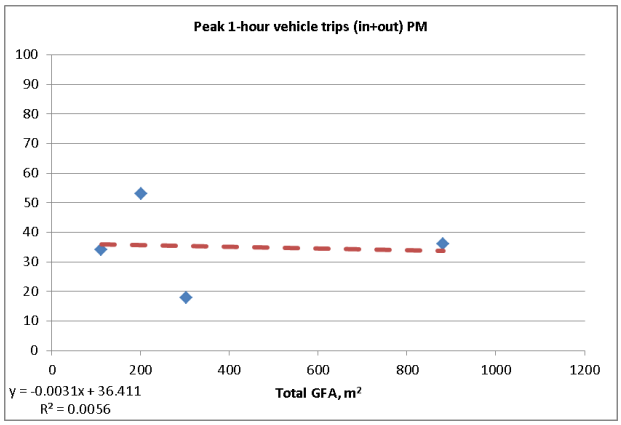

Figure 3.62 Centre peak hour vehicle trips (PM) vs. Total GFA – Linear type

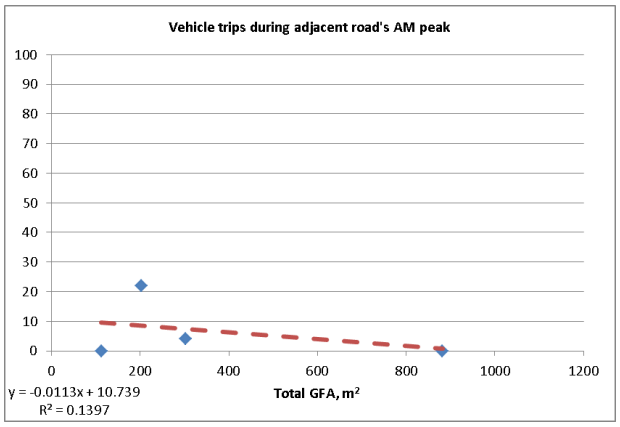

Figure 3.63 Centre vehicle trips during Peak hour on adjacent road (AM) vs. Total GFA – Linear type

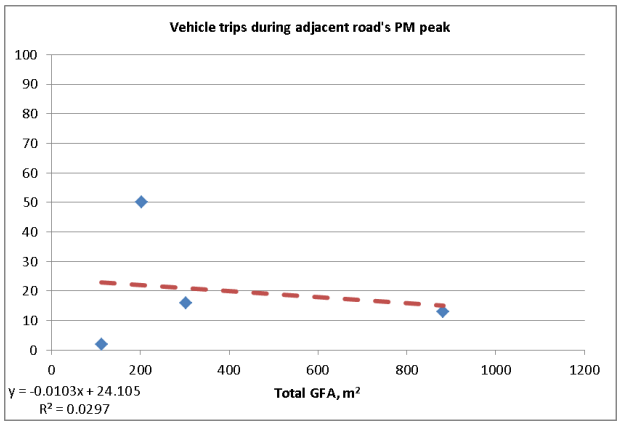

Figure 3.64 Centre vehicle trips during Peak hour on adjacent road (PM) vs. Total GFA – Linear type

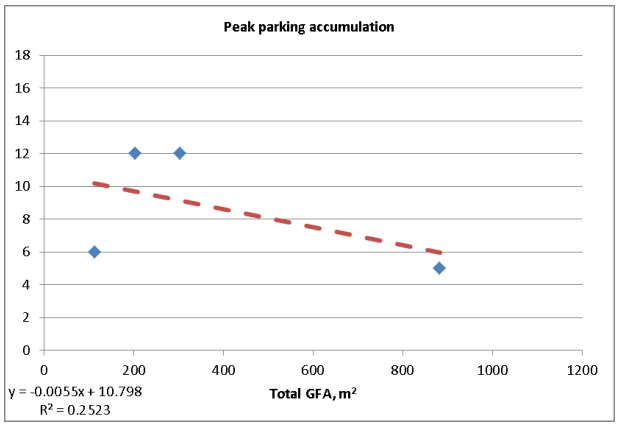

Figure 3.65 Peak parking accumulation vs. Total GFA – Linear type

3.6.1.2 Number of licensed places for children (OSHC only)

- The linear analysis returned very high R^2 values for Centre vehicle trips during adjacent road's peaks AM & PM (0.9245 & 0.922, respectively). Additionally, an R^2 value of 0.7476 was found for the relationship between Centre peak hour vehicle trips PM and the number of licensed places.
- Noting again the small data sample, it is also important to observe that
  - The slopes of trend lines for PM peak hours (both of the facility and during adjacent road's peak) are mostly determined by a remote value of 105 children places. The other values, if considered separately, would have a trend line close to vertical, in which case no significant relationship between the variables would exist.
  - For AM peak on the adjacent road, two of the four vehicle trip values are zero, which even further reduces confidence in the resulting R^2.
  - In both cases, more data points required to confirm or otherwise the likely dependency.

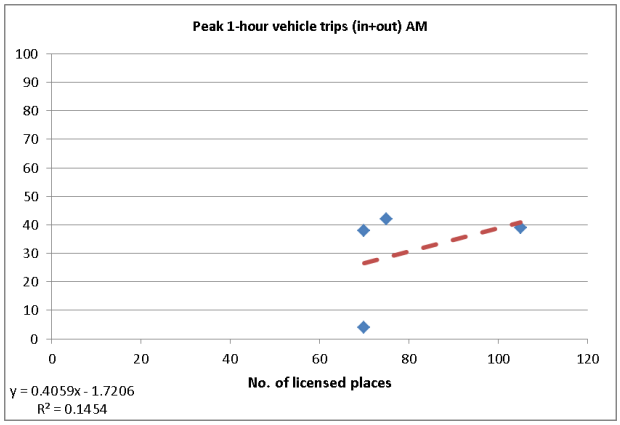

Figure 3.66 **Centre peak hour vehicle trips (AM) vs. Number of licensed places – Linear type**

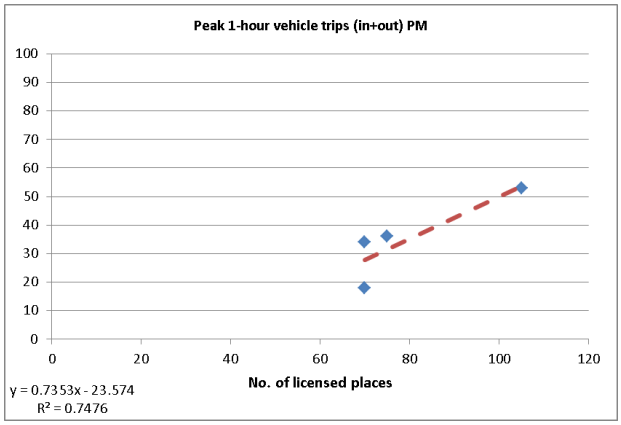

Figure 3.67 **Centre peak hour vehicle trips (PM) vs. Number of licensed places – Linear type**

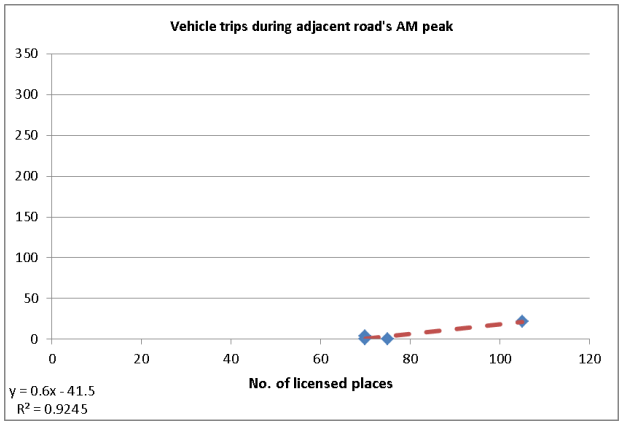

Figure 3.68 **Centre vehicle trips during Peak hour on adjacent road (AM) vs. Number of licensed places – Linear type**

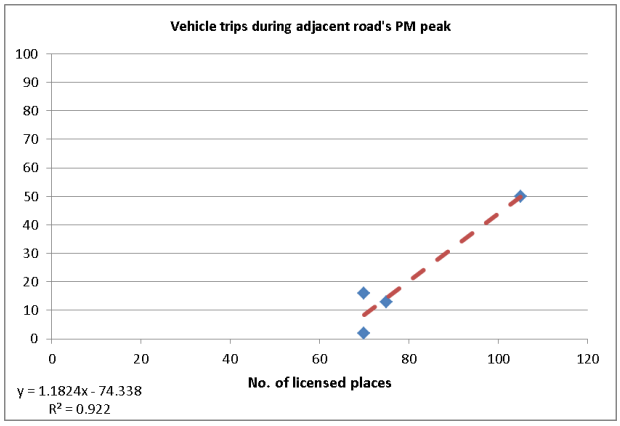

Figure 3.69 **Centre vehicle trips during Peak hour on adjacent road (PM) vs. Number of licensed places –-Linear type**

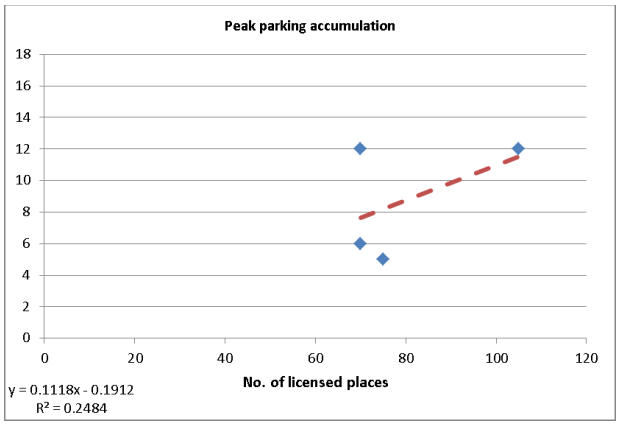

Figure 3.70 Peak parking accumulation vs. Number of licensed places – Linear type

- Given the limited number of sites surveyed, a non-linear regression analysis was not included as the results would have returned an inaccurate relationship between the different variables. .

3.6.1.3 Total children in public school (OSHC only)

- Further linear regression analysis was conducted to examine a possible relationship between the number of children enrolled in the public school and the independent variables.
- R^2 for all trip characteristics for OSHC is low and indicates little correlation between the dependent variables and the total number of children in base public school.

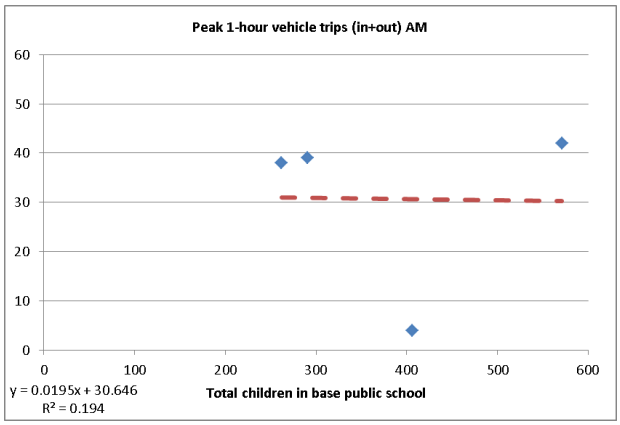

Figure 3.71 Centre peak hour vehicle trips (AM) vs. Total children in base public school – Linear type

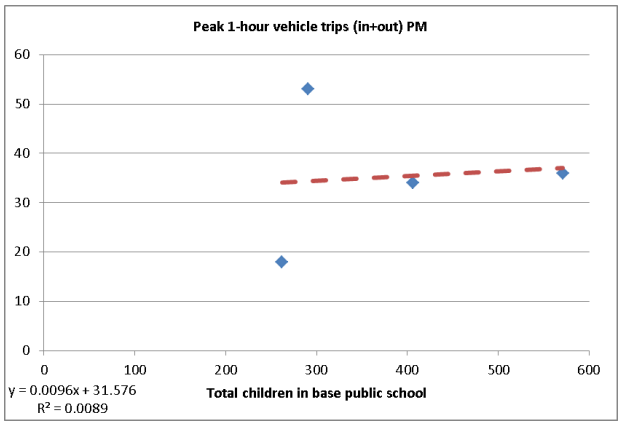

Figure 3.72 Centre peak hour vehicle trips (PM) vs. Total children in base public school – Linear type

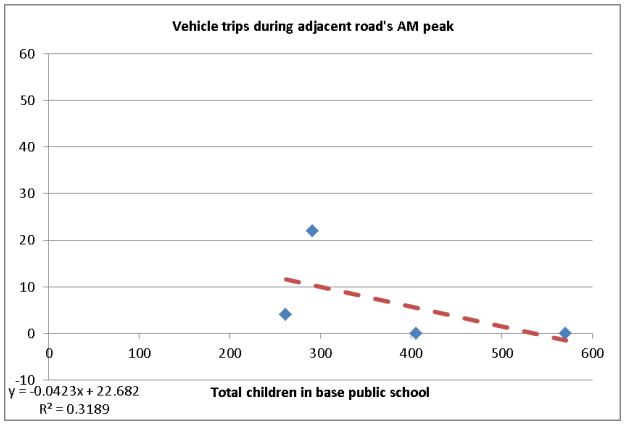

Figure 3.73 Centre vehicle trips during Peak hour on adjacent road (AM) vs. Total children in base public school – Linear type

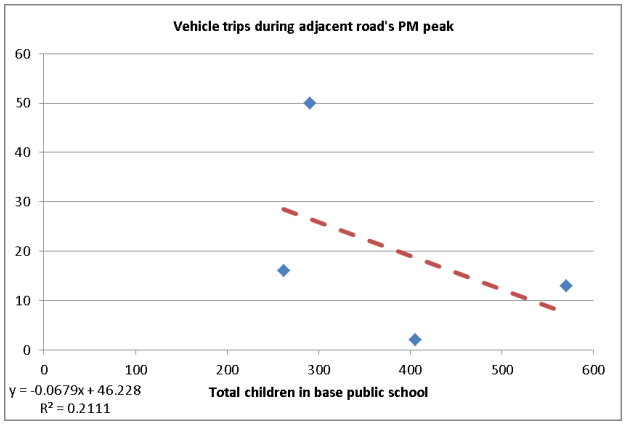

Figure 3.74 Centre vehicle trips during Peak hour on adjacent road (PM) vs. Total children in base public school – Linear type

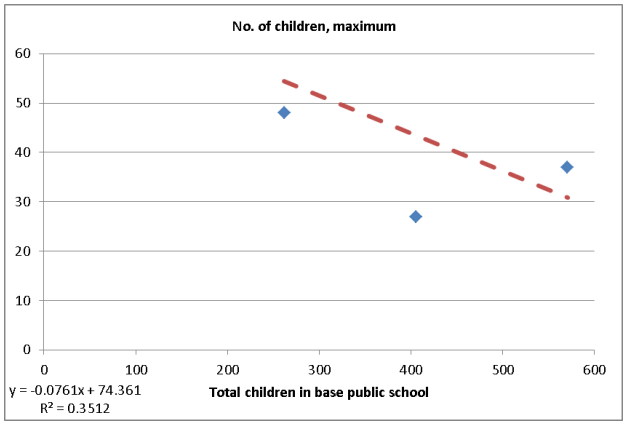

Figure 3.75 Number of children, maximum vs. Total children in base public school – Linear type

3.6.1.4 Percentage of employed people (OSHC only)

- A linear regression analysis was conducted to examine the relationship between the percentage of employed people in the surrounding area and the independent variables.
- Employment statistics were taken from the 2011 census data obtained from the Australian Bureau of Statistics website (http://www.censusdata.abs.gov.au/)

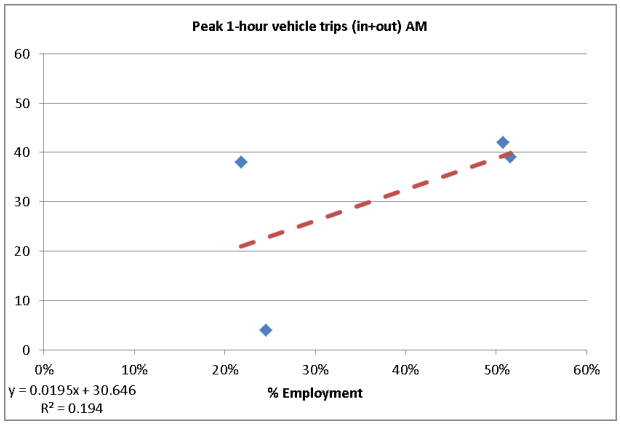

Figure 3.76 Centre peak hour vehicle trips (AM) vs. Percentage of employment – Linear type

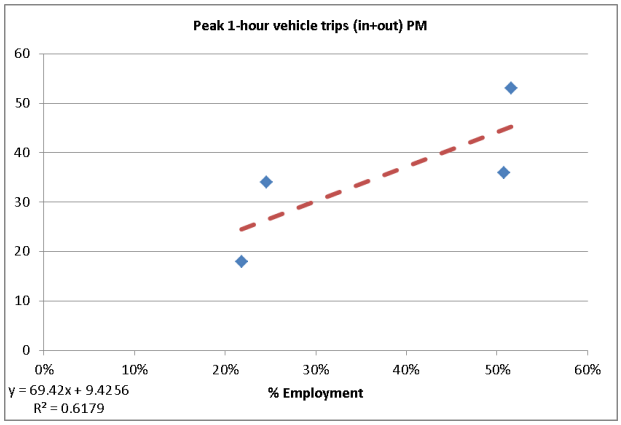

Figure 3.77 Centre peak hour vehicle trips (PM) vs. Percentage of employment – Linear type

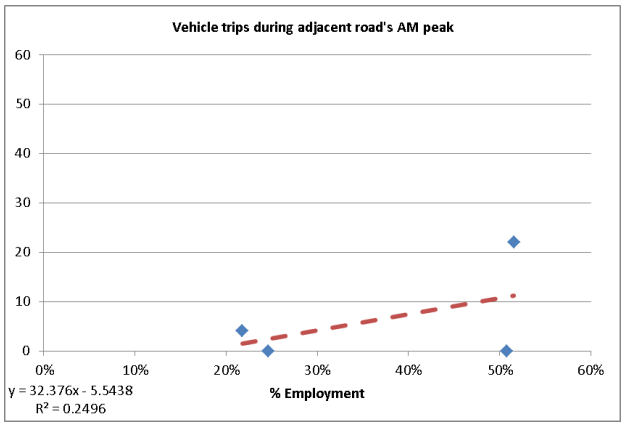

Figure 3.78 Centre vehicle trips during Peak hour on adjacent road (AM) vs. Percentage of employment – Linear type – Linear type

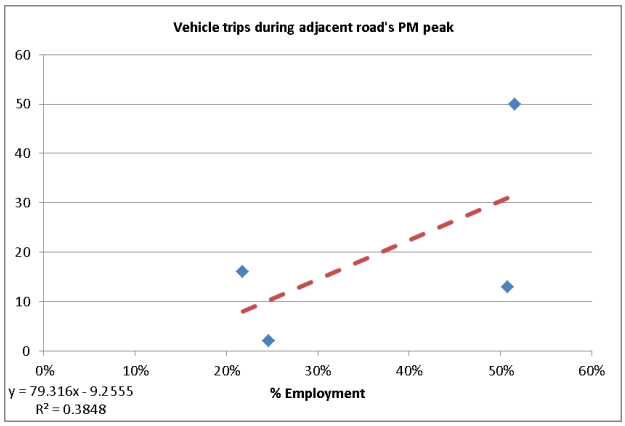

Figure 3.79 Centre vehicle trips during Peak hour on adjacent road (PM) vs. Percentage of employment – Linear type

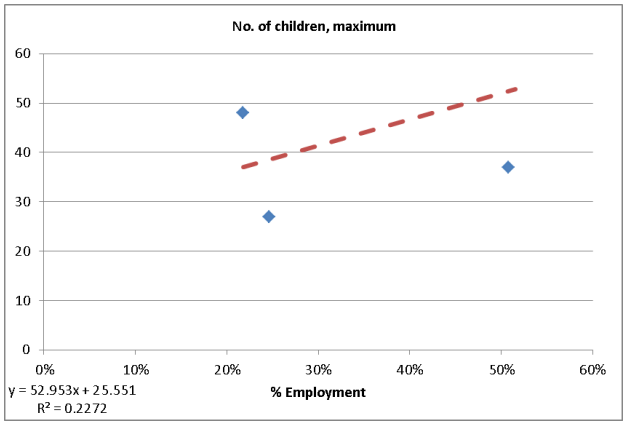

Figure 3.80 Number of children, maximum vs. Percentage of employment – Linear type

- The results from the linear regression analysis indicated that there may be a relationship between the dependable variables and the percentage of people employed. However, to improve the accuracy of the results further surveys are required to obtain more data from a greater range of sites.

3.7 Operational parameters

3.7.1 Average length of stay

- The average length of stay of vehicles delivering and collecting children was determined based on a vehicle number plate survey.

Table 3.11 Average length of stay (minutes:seconds).

Morning				
Site type	Min	Max	Average	85th per-le
LDCC	01:00	21:00	05:41	08:00
PS	01:00	19:00	07:45	12:36
OC	02:00	17:00	08:35	12:00
OSHC	01:00	20:00	03:21	06:00
ALL	01:00	21:00	05:37	09:00

Afternoon				
Site type	Min	Max	Average	85th per-le
LDCC	01:00	22:00	08:16	14:00
PS	01:00	20:00	09:05	15:00
OC	01:00	17:00	08:21	12:30
OSHC	01:00	18:00	04:53	07:00
ALL	01:00	22:00	07:46	13:00

All day				
Site type	Min	Max	Average	85th per-le
LDCC	01:00	22:00	06:57	11:00
PS	01:00	20:00	08:26	14:45
OC	01:00	17:00	08:27	12:00
OSHC	01:00	20:00	04:09	07:00
ALL	01:00	22:00	06:42	11:00

- The average length of stay for any time of the day (6 minutes 42 seconds / 6.7 minutes) was very similar to that found in the 1992 Study (6.8 minutes).

3.7.2 On-street drop-offs and pick-ups

- Regardless of whether off-street parking was provided on site, some or all children drop-offs and pick-ups occurred on street as well. In some cases this was happening because no off-street parking was available, in other cases it was done by parents by choice, mostly due to convenience, particularly for shorter stays.
- It is noted that RMS (2002) Guide to Traffic Generating Developments, based on the findings of the 1992 Study, allows for a reduction of the number of off-street car parking spaces "if convenient and safe on-street parking is available (e.g. indented parking bays)".
- Apart from the Wattle Grove OSHC centre, where an indented bus zone was used for some drop-offs, none of other centres had indented parking bays nearby. Availability of indented parking bays on street is rather rare. However, in most cases the situation with on-street drop-offs and pick-ups was considered safe due to low traffic volumes and availability of footpaths. None of the studied centres were located with direct access to busy roads.
- Requirement for "indented bays" in place of some off-street parking is difficult, if not impossible, to fulfil in most cases. It is recommended that such a requirement be replaced with "low traffic volumes" and "availability of a footpath for the length of the road required for on-street drop-off and pick-up". In terms of traffic volumes, it is suggested that the environmental capacity of the access street be used as a guide (200 veh/h for local streets and 300 veh/h for collector roads).

3.7.3 Special survey

A special 5-day survey designed to establish daily and hourly visitation patterns revealed the following.

- Friday was the least busy day of the week, whilst other days were similar in terms of the number of children attending.

- Morning drop-offs generally occurred between 7:30 and 9:00. Afternoon pick-ups were stretched over a longer period, from 15:15 to 18:00; the numbers of trips per hour were approximately two thirds of those in the morning.

3.7.4 Average number of children delivered

The number of children delivered and picked up by the same parent/carer in one trip was recorded as part of the survey. The results are contained in Table 3.12 below.

Table 3.12 Average number of children delivered or picked up.

All travel modes			AM	PM
Site type	**Site no.**	**Suburb**	**Children per drop-off**	**Children per pick-up**
LDCC	Site S1	Wattle Grove	1.24	1.24
LDCC	Site S2	Gladesville	1.19	1.21
LDCC	Site S3	Bilgola	1.35	1.47
LDCC	Site S4	Roseville 03.06.2015	1.32	1.12
LDCC	Site S4	Roseville 04.06.2015	1.41	1.53
LDCC	Site S4	Roseville 05.06.2015	1.26	1.16
LDCC	Site S4	Roseville 09.06.2015	1.11	1.11
LDCC	Site S4	Roseville 15.06.2015	1.44	1.57
PS	Site S5	Glebe	1.21	1.19
PS	Site S6	Pyrmont	1.43	1.43
PS	Site R1	Nords Wharf	1.53	1.13

Average children per delivery for all sites	**1.32**	**1.29**
Average children per delivery for the whole day	**1.30**	

4 Summary

The former Roads and Traffic Authority (RTA, now Roads and Maritime Services) published its Guide to Traffic Generating Developments ("Guide") in the mid-1990s. The trip generation and parking requirement data in the Guide is becoming increasingly out-of-date. The Guide contains trip generation and parking demand information derived from a 1992 survey of 20 Child Care Centres across greater Sydney. Five of the sites were Pre-Schools, nine were Long Day Care and six were Before and After Care. A number of changes have occurred since then in terms of child care centres' mode of operations, services provided and different types of child cares available. Given these changes, there is now a need to validate (or otherwise) the 1992 trip generation and parking demand data for Child Care Centres, to assist with traffic impact assessment and planning.

Twelve (12) sites within the Sydney Metropolitan Area (SMA) and two (2) sites outside SMA were selected in consultation with RMS Project Manager.

There were no technical issues with the conduct of the surveys, except obtaining permissions from the centre operators and collecting information about the year when the centre was opened.

Surveys of trips generation were carried out in June 2015, outside school holidays. Classification counts of vehicles entering and leaving sites were undertaken at each site generally between 6.30 a.m. and 9:30 a.m., and 2:30 p.m. to 6:30 p.m. on Monday, Tuesday, Wednesday or Thursday. Site S4 was chosen for a special survey where the entering and leaving traffic was counted over a full 7-day period, to establish daily and hourly visitation patterns.

4.1 Average rates

A review of the data revealed a number of observations:

- The surveys were undertaken at child care centres with the floor space varying from 112 m^2 to 1041 m^2 and with the total site area varying from 112 m^2 to 3014 m^2.
- The number of staff ranged from 3 to 15 members.
- Number of licensed places for children ranged from 20 to 105 places.
- Number of public parking spaces ranging from 0 to 22 spaces.

Table 4.1 Summary of trip and parking rates.

All sites	Min	Max	Avg	St Dev
Development details:				
Total site area (m^2)	112	3014	1070	823
Total GFA (m^2)	112	1041	445	296
No. of licensed places for children	20	105	56	28
No. of employees	3	15	8	4
Vehicle trips:				
Centre peak hour vehicle trips (in+out) AM	4	93	35	25
Centre peak hour vehicle trips per licensed place (AM)	0.06	1.25	0.66	0.34
Centre peak hour vehicle trips per 100m^2 of total GFA (AM)	1.04	19.31	9.00	5.14
Centre peak hour vehicle trips (in+out) PM	6	77	36	21
Centre peak hour vehicle trips per licensed place (PM)	0.24	1.38	0.68	0.32
Centre peak hour vehicle trips per 100m^2 of total GFA (PM)	1.89	30.36	10.81	8.45
Centre vehicle trips during adjacent road's peak hour (AM)	0	72	24	22
Centre vehicle trips per licensed place during adjacent road's peak hour (AM)	0.00	1.20	0.51	0.40
Centre vehicle trips per 100m^2 of GFA during adjacent road's peak hour (AM)	0.00	14.55	6.32	4.90
Centre vehicle trips during adjacent road's peak hour (PM)	0	50	17	17
Centre vehicle trips per licensed place during adjacent road's peak hour (PM)	0.00	0.70	0.29	0.25
Centre vehicle trips per 100m^2 of GFA during adjacent road's peak hour (PM)	0.00	24.75	5.01	6.31
Parking:				
No of public car spaces	0	22	7	8
Peak parking accumulation	3	16	9	4
Peak parking accumulation per number of licensed places	0.07	0.34	0.19	0.09
Peak parking accumulation per 100m^2 of total GFA	0.39	5.94	2.80	1.61

The results of the analyses for both peak hour and daily trip and parking rates indicated high values of standard deviation in all cases. The base data was therefore regarded as wide-spread. The average rates

are thus not recommended to be used for predicting the trip generation and parking demand because of wide prediction intervals around the mean estimated values.

4.2 Results of the regression analysis

The trip generation rates were then analysed in terms of their dependency on a number of variables, using linear and non-linear regression analysis. The interrogated variables are listed below.

- total building GFA
- number of licensed places for children (capacity)

As explained earlier in this report, OSHC centres were excluded from the analysis due to the differences in their set up and operation. The results are summarised in **Table 4.1**. In some cases, in the absence of a better value, regression equations with R^2 between 0.6 and 0.8 are shown for information. Further investigation is required for such cases.

Table 4.2 Trip generation and parking accumulation relationships.

		Variable	
		X_1 = Total GFA, m^2	**X_2 = Number of licensed places for children**
Variable range	**Valid for**	165 m^2 to 1041 m^2	20-90
Y = Centre peak hour vehicle trips (in+out) AM	LDCC / PS / OC	No reliable relationship has been found	$Y = 0.0135 X_2^2 – 0.5214 X_2 + 24.462$ **R^2=0.8972**
Y = Centre peak hour vehicle trips (in+out) AM	LDCC / PS	$Y = - 4E\text{-}05X_1^2 + 0.1294 X_1 – 4.036$ **R^2=0.7382**	$Y = 0.0118 X_2^2 – 0.3585 X_2 + 22.968$ **R^2=0.9286**
Y = Centre peak hour vehicle trips (in+out) PM	LDCC / PS / OC	No reliable relationship has been found	$Y = 0.0027X_1^2 + 0.5556 X_1 + 3.5489$ **R^2=0.8599**
Y = Centre peak hour vehicle trips (in+out) PM	LDCC / PS	$Y = - 4E\text{-}05 X_1^2 + 0.111 X_1 – 0.1188$ **R^2=0.7663**	$Y = 0.004 X_2^2 + 0.4117 X_2 + 6.0276$ **R^2=0.9476**
Y = Centre vehicle trips (in+out) during AM peak hour on adjacent road	LDCC / PS / OC	No reliable relationship has been found	$Y = 0.0085 X_2^2 – 0.2648 X_2 + 20.21$ **R^2=0.7643**
Y = Centre vehicle trips (in+out) during AM peak hour on adjacent road	LDCC / PS	$Y = 2E\text{-}05 X_1^2 + 0.0308 X_1 + 14.615$ **R^2=0.7245**	$Y = 0.0065 X_2^2 – 0.0452 X_2 + 16.943$ **R^2=0.8051**
Y = Centre vehicle trips (in+out) during PM peak hour on adjacent road	LDCC / PS / OC	No reliable relationship has been found	$Y = 0.0015 X_2^2 + 0.3227 X_2 – 2.7273$ **R^2=0.6097**
Y = Centre vehicle trips (in+out) during PM peak hour on adjacent road	LDCC / PS	No reliable relationship has been found	No reliable relationship has been found
Y = Peak parking accumulation	LDCC / PS / OC	No reliable relationship has been found	$Y = 0.0007 X_2^2 + 0.0508 X_2 + 4.9144$ **R^2=0.638**
Y = Peak parking accumulation	LDCC / PS	$Y = - 9E\text{-}06 X_1^2 + 0.0227 X_1 + 2.0819$ **R^2=0.9031**	$Y = -0.0003 X_2^2 + 0.1613 X_2 + 2.4686$ **R^2=0.7775**

In summary, the analysis of data highlighted the following facts:

- Average trip rates should not be utilised for planning purposes.
- Good linear and non-linear relationships were established between the Centre peak hour vehicle trips AM and PM, Centre vehicle trips (in+out) during AM peak hour on adjacent road and the independent variable "number of licensed places for children" for all centres except OSHC.
- Good linear and non-linear relationships were established between the peak parking accumulation and the independent variable "total building GFA" for LDCC and PS centres.
- It is noted that the current rate of parking provision in the RMS (2002) Guide, based on 1992 data, is 1 parking space per 4 children. For comparison with this rate, the Peak Parking Accumulation formula from Table 4.2 was used for a range of numbers of children places. The resulting calculations indicate the following average rates:
    - Centres with 20 to 35 children – 1 space per 4 children
    - Centres with 40 to 65 children – 1 space per 5 children
    - Centres with 70 to 100 children – 1 space per 6 children

4.3 Comparison with 1992 data

- In this study, the sample sizes for each type of the centre were smaller than those in the 1992 study. However, analysis of the combined 2015 data for LDCC and PS centres returned reliable regression equations. In the 1992 study these types of child care centres were analysed separately.
- The following graphs show comparisons of trip generation and parking demand trend lines for regression analysis of LDCC and PS centres. Graphs for 1992 LDCC and PS data were overlayed separately on the combined 2015 LDCC/PS data.

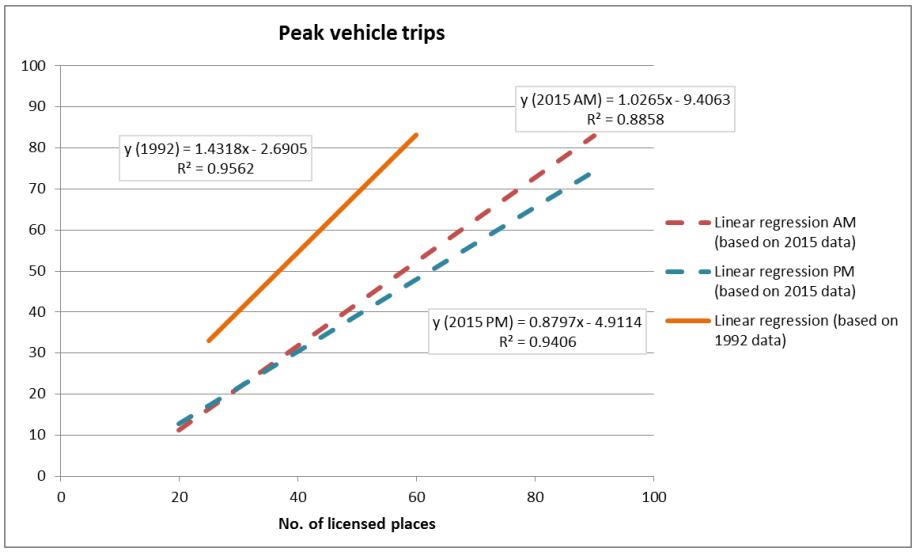

Figure 4.1 **Centre peak hour vehicle trips vs. Number of licensed places – comparison of 1992 PS and 2015 LDCC/PS data.**

- Peak trip generation of PS centres in 1992 was generally higher and the rate of its increase with the increase of the centre capacity was greater than those from the 2015 LDCC/PS data.

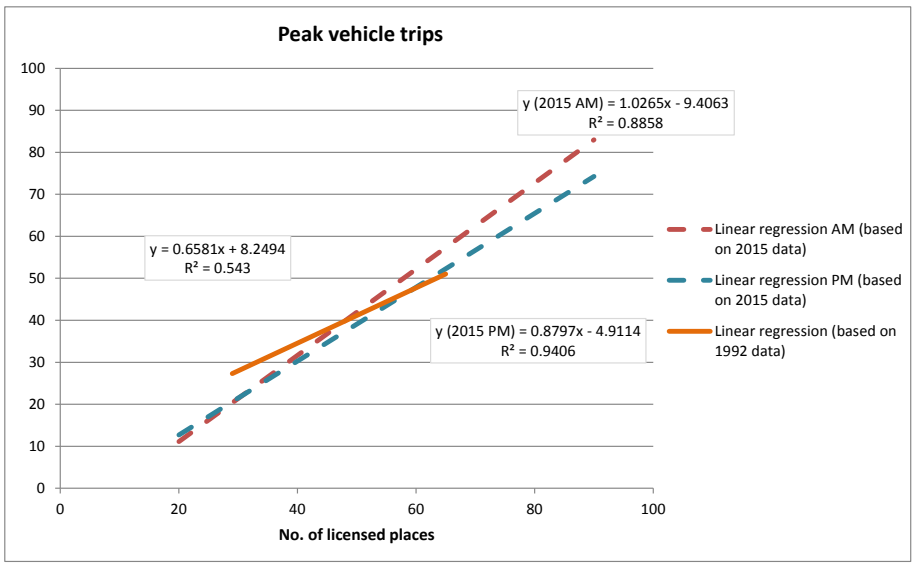

Figure 4.2 **Centre peak hour vehicle trips vs. Number of licensed places – comparison of 1992 LDCC and 2015 LDCC/PS data.**

- Peak trip generation of LDCC centres in 1992 was very similar to the 2015 LDCC/PS data, although the rate of its increase with the increase of the centre capacity was slightly slower.

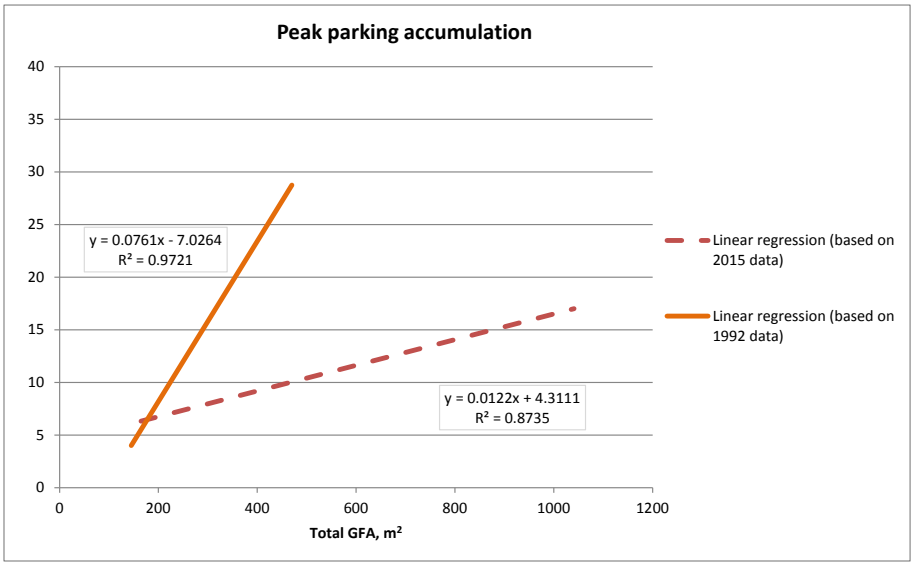

Figure 4.3 **Peak parking accumulation vs. Total GFA – comparison of 1992 PS and 2015 LDCC/PS data.**

- Peak parking accumulation of PS centres in 1992 was substantially higher and the rate of its increase with the increase of the centre GFA was greater than those from the 2015 LDCC/PS data.

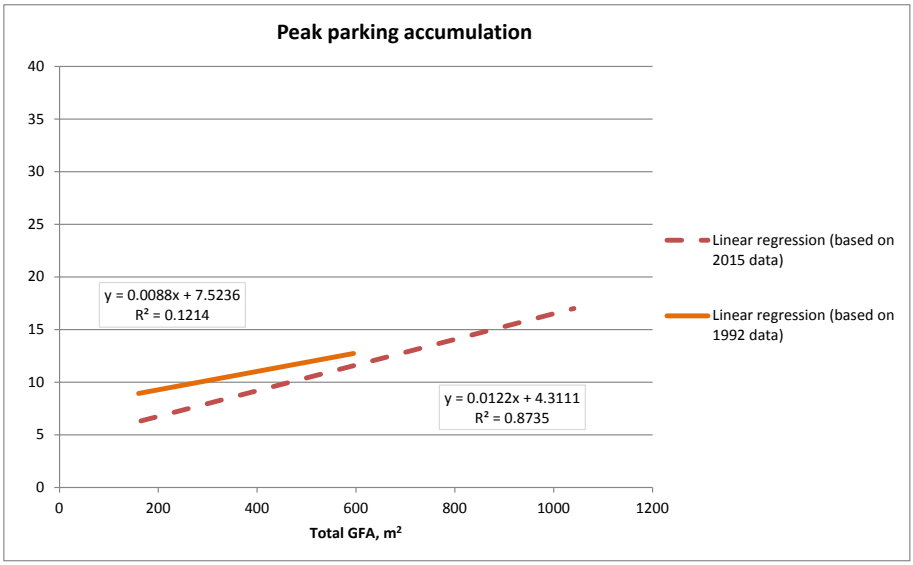

Figure 4.4 **Peak parking accumulation vs. Total GFA – comparison of 1992 LDCC and 2015 LDCC/PS data.**

- As with the peak trip generation, peak parking demand of LDCC centres in 1992 was very similar to the 2015 LDCC/PS data, although the rate of its increase with the increase of the centre capacity was slightly slower. It must be noted, however, that in this particular case R^2 for the 1992 data is very low.