TRICS Research Brief No 3
Hospital Travel

Report

Prepared for
The TRICS Consortium

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summary

Summary

Summary of Research

MVA Limited was commissioned to undertake TRICS Research Brief No 3 - Hospital Travel. The study included the collection of background information to understand how the health sector and establishments within it operate and are influenced. Information from the TRICS database was used to consider trip making and modal share. The influence and effect of Travel Plans was also to be considered.

The way that the NHS operates and its attitude towards transport is undergoing a period of change. The aim is that acute hospitals will have consolidated specialist services, so some staff will have to travel to their centre of expertise for 'hands on' work. At other times, they will be able to work from a local base with the use of high tech communications equipment. More staff will be based in the community, working at or visiting local health centres for outpatient appointments.

Travel Management by Trusts will mean more parking controls for staff required to work at congested acute hospital sites. At the same time, there should be a greater range of viable and sustainable transport choices apart from travel as car driver.

For patients, the necessity to travel to a major hospital site (often some distance from their homes), is likely to decrease as a percentage of all travel to health facilities. Instead more diagnostic/outpatient appointment and aftercare will be carried out at local health centres or at home. However, this should be seen in the context of a trend for the total amount of patient care to increase.

A literature review was undertaken. Significant policy publications are:

- 1998 White Paper New Deal for Transport: Better for Everyone, Transport 2010, DETR, 1998;
- Transport 2010 The 10 Year Plan, DETR, 2000; and
- PPG13, Planning and Policy Guidance – Transport, DETR, 2001.

There are two documents published by NHS Estates that support Government Transport Policy. These are:

- Sustainable Development in the NHS, NHS Estates, HMSO, 2001 (paras 7.67-7.95, 7.121-7.129); and
- New Environmental Strategy for the National Health Service, NHS Estates, HMSO, 2002 (pp 5,6,12,24,25).

Documents designed to give guidance to those who are directly involved in influencing and controlling health site travel are:

- The Healthy Transport Toolkit, A Guide to Reducing Car Trips to NHS Facilities, published in 1998 by Transport 2000 Trust;
- Making Travel Plans Work, 2002 Department of Transport,
- Making T.H.E. Links, Integrating Sustainable Transport, Health and Environmental Policies: A Guide for Local Authorities and Health Authorities, published in by DETR in 1999.

In addition, there are ad hoc journal publications and several web sites worthy of a visit.

There is extensive information on Travel Plans in general. Some have specific references to Hospital Travel Plans.

The main areas for consideration when preparing trip predictions at health sites are highlighted below. The number of person trips needs to be forecast before a modal share is established. The main areas for the prediction of person trip rates are:

- Site type and services offered on a site;
- Number of staff employed;
- Number of patients and visitors by type;
- Number of beds; and
- Other Activity, linked to University, research etc.

Site and patient type/ services offered on different site types are further summarised in the Table below.

Patient Types Generally Experienced at Different Health Sites

Variable	Inpatient	Day Patient	Out Patient	Casualty
General Hospital – with Casualty	Y	Y	Y	Y
General Hospital – No Casualty	Y	Y	Y	N
Special Hospital	Y	Y	Y	N
Private Hospital	Y	Y	Y	N
Clinics	N	Y	Y	N
GP Surgery	N	N	Y	N
Nursing Homes	Y	Y	N	N
Hospice	Y	(Y)	N	N

To assess modal share, the following are required:

- Location;
- Car parking;
- Public Transport Accessibility; and
- The Impact of the Travel Plan if the facility has one.

The health sector has led the way in the development of Travel Plans as Hospital Trusts have often had the most acute travel problems to resolve.

The continuing outcome of implemented travel plans is encouraging with positive publicised results and switch to sustainable modes. Modal switch away from travel as car driver does not occur overnight. It is a process that requires patience. Car parking controls are necessary but these must be in conjunction with a package of measures that make travel alternatives viable.

NHS Estates have confirmed that it is difficult to monitor the number of Trusts with approved Travel Plans. This is because of the organisational changes that have been taking over the last few years that have affected the composition and number of Trusts. The number of Trusts with Travel Plans waiting for approval is not monitored. The quality and content of approved Travel Plans varies by Trust and by local authority requirements.

NHS Estates consider that the profile of Travel Plans within the NHS has improved, but will not be fully successful unless a partnership approach and culture change takes place.

There are 18 multi-modal health facility sites in the TRICS 2004a database for seven different sub-categories.

The vehicular modal share for these health sites ranges between 33% - 97%. Low vehicular modal share is associated with sites in urban areas with very good public transport provision. The presence of a site Travel Plan did not always coincide with a low vehicular modal share although these sites did not demonstrate parking problems (parking supply at these sites exceeded demand).

Regression analysis was undertaken initially for vehicular trips only and then for person trips. It demonstrated that there are strong relationships between trip making and numbers of staff, beds (where applicable), other patient types and Gross Floor Area. There is also a strong relationship between car parking on site and car parking spaces for vehicle only surveys (but this does not take into account any unmet demand and on street parking nearby).

The site type analysis for vehicular trips showed that there were relatively strong relationships for staff (except at Private Hospitals). Other relationship results were more varied.

Vehicular trips by site location produced consistent strong relationship results for edge of town, suburban area and neighbourhood centres.

More detailed analysis focussing upon additional AM and PM peak periods was undertaken for person trips. For all sites, beds (where applicable) and staff numbers produced the strongest relationships, GFA was also strong. The all hospitals test produced a strong relationship for all variables as did the tests for general hospitals with casualty. The same test for all hospitals except general hospital with casualty, produced less strong relationships. Private hospitals on their own produced similarly weak results.

GP surgeries alone and GP surgeries with clinics did not demonstrate strong relationships.

Tests for sites by location and person trips demonstrated strong relationships for edge of town and suburban area locations but not for neighbourhood centres. The neighbourhood centre test only gave a strong test result for vehicular trips and staff.

MVA developed an AM and PM peak vehicular trip prediction model for large hospital sites based initially on data collected in 1992/3. Since then it has been used and recalibrated on data from other large hospital sites. This study has presented the opportunity to develop the model further to cover multi-modal trips.

The model has been adapted with a new set of start parameters to cater for the calculation of person trips for the AM and PM peak hour. This removes the modal share variable which can be considered after person trips have been calculated.

The model parameters should be taken as a starting point to refine and develop the model further which will be possible as more multi-modal health site data is collected. It is seen that this model will evolve in much the same way as the TRICS database in general has

Ranges of the percentage of trips by motor vehicle have been derived from the multi-modal surveys in the TRICS database and are presented. It should be noted that other experience of hospitals in Central London indicate a lower vehicular share of around 5-10%. As more multi-modal data is collected, the range of vehicular modal share will be refined. The Table below shows the vehicular mode share for multi-modal sites on the TRICS database.

Range of Modal Shares for Site Types and Locations in TRICS Dataset

Site Type	Site Location	Public Transport Provision	Vehicle Mode Share Lower - Upper Limit	Public Transport Mode Share Lower - Upper Limit
Large Hospital	Not Town Centre	Low	78% - 93%	1% - 15%
Large Hospital	City Suburban Area	High	66%	26%
Large Hospital	London or City Centre	High	36% - 39%	22% - 40%
Private Hospital	Not London	Medium	88% - 96%	1%
GP Surgery	Not London	Medium	73% - 87%	0% - 3%
GP Surgery	Edge City Centre	High	33%	17%
Hospice	Edge of Town	Low	96%	0%

Summary TRICS Database Development

A trip generation model for person trips for health sites has been presented. Due to the differing types of staff and patient activity at the sites with different characteristics, different parameters for those with complete background information have been calculated. The site types that have been covered to date are General Hospital with Casualty, Private Hospital, Dental Surgery (site with no beds) and Hospice.

Once the number of person trips for a site has been derived, a modal share may be applied. In considering modal share, individual site characteristics are desirable, in particular, location, walk, cycle and public transport accessibility, availability of parking space and if there is/will be an effective travel plan in operation.

As more multi-modal data is collected, the range of vehicular modal share will be refined for each site type.

Opportunities to develop the person trip generation model further perhaps by extending the model times to cover all day should be sought. If it is possible to count the number of trips by person category (staff and various patient types (inpatient, outpatient, day case, accident and emergency), then this would add to the accuracy of the individual parameters. Collecting data at this detailed level however, will be more expensive than the current travel count surveys with limited interviews undertaken at present. If car parking is controlled/organised by staff and patient categories, visual observations may suffice for many trips.

The model can be presented to the user as a static additional forecasting tool within TRICS or the model could be fitted within the TRICS output calculation procedures. If the model is included in the TRICS database, then the user will require a series of prompts to describe the site that they are calculating trip rates for. Mode share could also be included in this model.

As more sites are added to the multi-modal database, the model will become more reliable.

1

1 Introduction

1.1 Background

1.1.1 The TRICS Consortium commissions and undertakes research in areas directly related to the use and understanding of its trip rate database. The objective of such research is to support and complement the application of TRICS in development-related projects. In 2001, a TRICS Research Forum was established to look into future TRICS research projects. A number of key areas were identified with a view to commissioning future research work. From 1999 onwards, TRICS has been adding multi-modal travel data to the database and research projects were identified that either utilise this information or complement its application.

1.1.2 MVA Limited was commissioned to undertake TRICS Research Brief No 3 - Hospital Travel.

1.2 Study Requirements

1.2.1 The broad objectives of the research study are:

- to assess the determinants of travel to health facilities (particularly acute establishments) and what factors may be used to influence the choice of sustainable modes;
- to inform the prediction of travel by mode;
- to develop guidelines for hospitals preparing effective travel plans to minimise car use.

1.3 Scope of Work

1.3.1 The scope of work undertaken included the following:

- Project Inception Study to confirm study methodology, programme and timescale;
- Review of TRICS database and regression analysis of newer sites;
- Identification of existing TRICS data that produced unusually high or low trip rates, in some cases, background data was updated;
- Review of current policies that will affect travel relating to the structure of the NHS and provision of health care facilities;
- Review of other published studies of hospital travel to identify healthcare characteristics of types of health facility;
- Identification of a sample of health sites to be surveyed and develop survey proposals compatible with the research objectives of standard methods of TRICS multi-modal data collection;
- Collate new and database survey information and develop travel prediction model;
- Recommend the inclusion of a suitable trip prediction methodology in TRICS with suggestions for future development and data collection methods; and
- How travel plans can be developed to influence and encourage non-car use.

1.4 Structure of the Report

1.4.1 The report is divided into 8 further Chapters. Chapter 2 sets the healthcare scene by describing the current structure of the NHS and provision of healthcare facilities.

1.4.2 Chapter 3 summarises the findings of the literature review.

1.4.3 Chapter 4 describes the determinants of travel to hospitals and health facilities.

1.4.4 Chapter 5 discusses the impact of Travel Plans on hospital travel.

1.4.5 Chapter 6 introduces the reader to the data sets used for statistical analysis.

1.4.6 Chapter 7 presents the multi-modal regression analysis.

1.4.7 Chapter 8 gives details of the Travel Prediction Model.

1.4.8 The report is summarised in Chapter 9.

1.5 Interim Technical Notes

1.5.1 We have provided Interim Technical Notes as follows:

1 Review of the TRICS database – Hospital Travel;

2 Review of Current Policies relating to the structure of the NHS;

3 Multi-Modal Surveys - General Hospitals with Casualty Departments; and

4 Recommendations to TRICS Consortium.

2

2 Current and Future Structure of the NHS

2.1 Introduction

2.1.1 It is important to set the scene describing how such a large organisation operates by understanding its structure and what the vision for the organisation is when considering travel trends related to health travel. A visit to NHS Estates in Leeds was made and key personnel were interviewed.

2.1.2 We give details of the review of current policies and the structure of the NHS, the provision of healthcare facilities and how it will affect hospital travel.

2.2 Structure of the NHS (Figure 2.1)

2.2.1 The NHS continues to be engaged in major reorganisations. There are:

- Department of Health (DOH);
- Executive Agencies;
- Colleague Agencies (responsible for purchasing, supplies equipment); and
- Trusts/Foundation Hospitals.

2.2.2 The DOH staffing level is currently being downsized with responsibilities delegated to Strategic Health Authorities. There are 28 Strategic Health Authorities (SHA). The responsibilities for each SHA include:

- Performance monitoring in part and strategic planning;
- Capital expenditure; and
- Financial approval.

2.2.3 Finance (75% of the total NHS budget) is mostly supplied through the Primary Care Trusts (PCTs) which include GP practices, and Strategic Health Authorities out to service providers such as the Acute Trusts. Ultimately, each Trust governs its own business.

2.2.4 Each Trust is responsible for shaping transport and travel to and on its site through several controls such as travel plans and parking management. The degree to which these have been developed is often as a result of pressure from local authorities when Trusts submit planning applications for new developments. There is extensive guidance available to the Trusts on how to develop travel plans. The role of Executive Agencies (eg NHS Estates) is to provide advice and guidance.

2.2.5 Finally, within the reorganisation of services, the NHS will have a closer working partnership with Social Services to provide a more complete and seamless service to the patient and to make efficient use of hospital resources.

2.3 Role of NHS Estates

2.3.1 NHS Estates (NHSE) are part of the Department of Health (DOH). They are an executive agency, concerned with healthcare buildings, environmental performance and controls assurance (standards for the Trust concerning energy, water, waste and Health and Safety) and Policy Background.

2.3.2 NHSE need to ensure that the Government's environmental policy and standards that have been set are met within the NHS. NHSE disseminates advice and guidance on these matters.

2.3.3 NHSE have become more involved with transport issues over the last few years as part of their environmental remit. In particular, parking is a major issue.

2.3.4 NHSE want to research whether Transport Standards can be introduced. They want to have confirmed 'what is reasonable parking?' In the Draft PPG13, there were the recommendations of one space per four staff and one space per three visitor episodes but this was removed because each type of health facility can be so different.

2.4 Current Healthcare and Transport Issues

2.4.1 NHSE have recognised that NHS sites need to be sustainable and, in transport terms, that means managing transport options and parking. Travel to NHS sites has to be managed. The NHS relies on the use of vehicles to deliver healthcare within the community setting, to patients living in their own homes.

2.4.2 NHS Trusts were required to have established an Environmental Strategy, including a Travel Plan, by October 2002. The reorganisation of many Trusts has prevented this from being achieved.

2.4.3 An appropriate way for addressing transport problems is to produce a Travel Plan. A Travel Plan is typically a package of practical measures tailored to the circumstances of individual sites to achieve the Trust's objectives including its Environmental Strategy and reductions in travel as car driver. The Travel Plan will include a package of transport and parking policies and measures for business purposes. There may be opportunities to increase use of homeworking and video-conferencing links.

2.4.4 Travel Plans include measures to reduce congestion and pollution, but also to use and manage hospital transport more efficiently and effectively. This will include consideration of more fuel-efficient vehicles and the use of alternative power sources such as LPG and battery units.

2.4.5 With this approach being communicated across the NHS, a change in travel behaviour is becoming apparent at sites where they are actively embracing this new culture. There are many examples (Southampton, Plymouth, Nottingham, Cambridge) of good practice.

2.5 Future Healthcare Provision

2.5.1 Acute hospital facilities will become more 'high tech and high profile'. The aim is for fewer people to need to attend acute facilities, people will only attend if there is no alternative. At the same time there is a continuing trend for a higher turnover of patients.

2.5.2 To achieve this, it is expected that most treatment centres (including diagnostics) will be off-site. As a result GP centres will get larger, say 12 GPs at a typical health centre.

2.5.3 Communications are also improving, for example, X-rays and other results can be sent via email to GPs.

2.5.4 Many Outpatient Clinics are to be moved to secondary and primary care centres.

2.5.5 NHS Direct, is a telephone advice centre that has been set up and this can avoid people having to travel to a GP surgery initially to answer questions on health issues. NHS Direct already reduces the number of people who visit their doctor and A&E departments.

2.5.6 There is ongoing work researching 'telemedicine'. This covers other ways to reduce people's need to travel. Soon, for example, the patient will not have to travel to a specialist site 200 miles away. Information will be sent electronically.

2.5.7 If patients are to spend less time in hospital, then it is more important for Social Services to organise the aftercare of patients who still require assistance. Closer liaison to minimise delays is required.

2.6 Accident and Emergency Facilities

2.6.1 The trend is similar to that of acute hospital facilities, with a concentration of resources and facilities at specialist centres. Paramedics are the first contact at an accident scene or call out. Once they have stabilised the patient and an assessment has been made, the casualty can be transported to the best A&E centre possible.

2.6.2 Accident and Emergency Departments (A&E) may also be known as Casualty Department or Emergency Department (ED).

2.6.3 Drop-in centres take less urgent cases or pre-assess emergency cases and are often provided at city/town centre locations where access is good.

2.7 Social Exclusion

2.7.1 Social exclusion is an issue that has become more prominent within the transport arena. People who do not have a car available or who 'can't afford cars and struggle to afford public transport' tend to be the ones needing more healthcare. Major hospitals are not always located where they are convenient for travel by means other than car.

2.7.2 In Spring 2001, the Prime Minister asked the Social Exclusion Unit (SEU) to explore and make recommendations to overcome, the problems experienced by people facing social exclusion in reaching work and key issues. Two of the problems directly relating to hospitals and health facilities were identified as 'access to work' (employee related) and 'access to healthcare' (patient related). SEU reported in 2003 in the form of a report 'Making the Connections: Final Report on Transport and Social Exclusion'.

2.7.3 The report gives background information, progress and details the Government's Strategy and National Policy Changes. It then goes on to outline how further implementation will occur.

2.7.4 Public transport improvements, frequently need to be considered to alleviate the accessibility problems and the Trusts need to talk to public transport providers and local authorities to provide solutions. Health services need to be placed in accessible locations when opportunities arise. Patient Transport Services also are seen as a solution for some patients who have accessibility problems.

2.8 Summary and Conclusions

2.8.1 The way that the NHS operates and its attitude towards transport is undergoing a period of change. The aim is that acute hospitals will have consolidated specialist services, so some staff will have to travel to their centre of expertise for 'hands on' work. At other times, they will be able to work from a local base with the use of high tech communications equipment. More staff will be based in the community, working at or visiting local health centres for outpatient appointments.

2.8.2 Travel Management by Trusts will mean more parking controls for staff required to work at congested acute hospital sites. At the same time, there should be a greater range of viable and sustainable transport choices apart from travel as car driver.

2.8.3 For patients, the necessity to travel to a major hospital site (often some distance from their homes), is likely to decrease as a percentage of all travel to health facilities. Instead more diagnostic/outpatient appointment and aftercare will be carried out at local health centres or at home. However, this should be seen in the context of a trend for the total amount of patient care to increase.

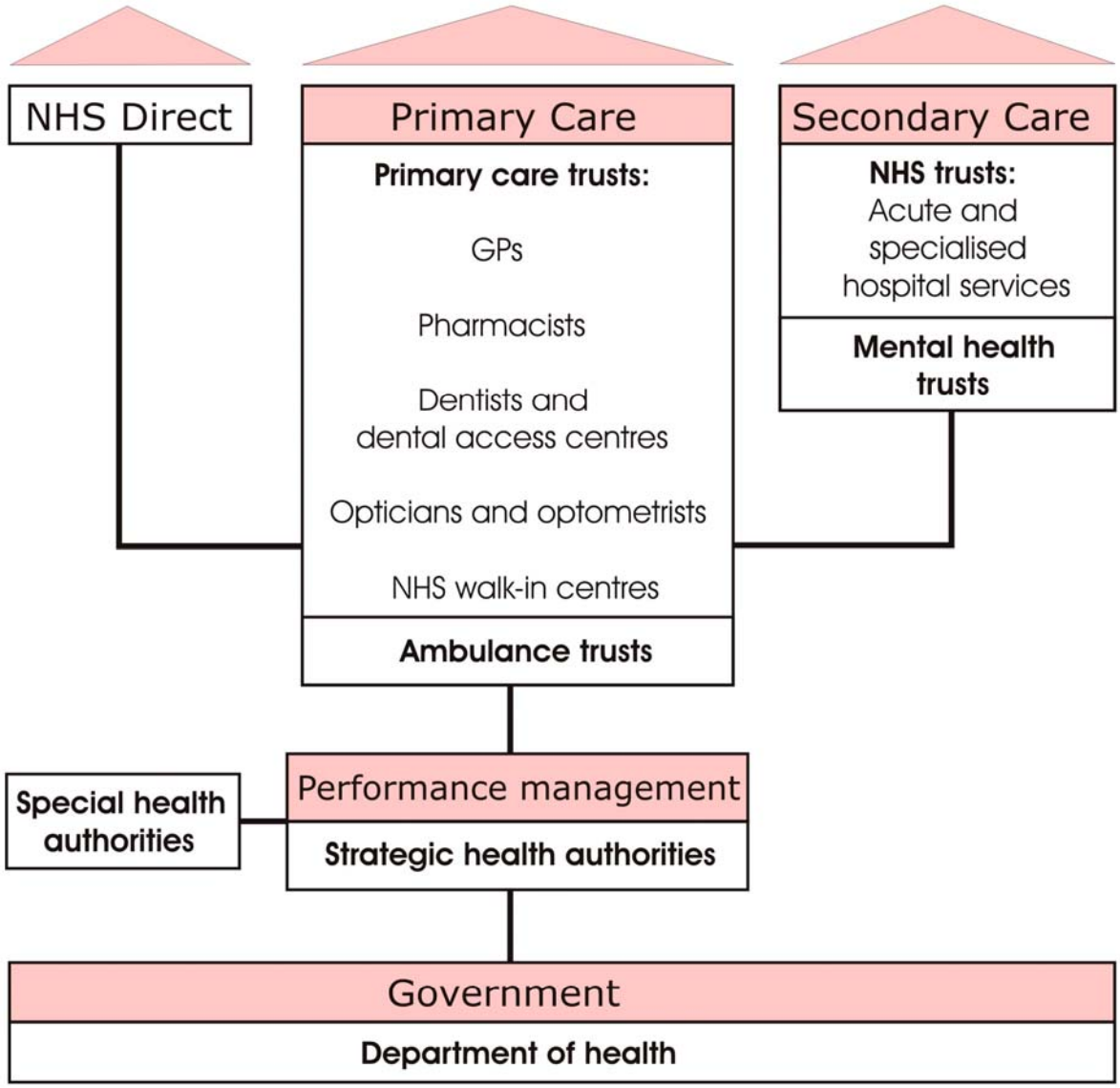


Figure 2.1 - Structure of the NHS

3

3 Literature Review

3.1 Introduction

3.1.1 In contrast to the quantity and diversity of information and guidance available about school travel, there is relatively limited widely published information relating to hospital travel in general. The Healthy Transport Toolkit, published in 1998 remains the document that NHS Estates advise Hospital Trusts to use when developing their travel strategy in conjunction with Changing Journeys to work: An Employers Guide to Green Commuter Plans.

3.1.2 Rather than provide many references to general travel plan guidance at hospitals and health facilities which are subject to travel plan issues, we refer only to key documents in this category with web sites that may give more information.

3.1.3 Many Hospital Trusts have produced reports or Healthy/Green Travel Plans which have been published on their web sites. These types of reports usually give site specific details on modal share for travel by staff and visitors/patients, the reasons for travelling by their chosen means and test the staff willingness to consider other modes. Other reports on hospital related travel tend to be very specific reporting on how a Trust overcame a problem, usually related to a shortfall in parking space. No information relating to private hospitals and health facilities was found.

3.1.4 There appears to be no information differentiating between types of hospital or how the type of services/facilities available at a site (eg A&E, outpatients, research, teaching, etc) affect demand for travel.

3.2 Background Documents

3.2.1 The list following documents has been compiled by a literature search undertaken by MVA and advice from NHS Estates.

3.2.2 Government Transport Policy detailing the vision of transport for the future and how it is to be achieved is set out the in many documents, including:

(i) **1998 White Paper New Deal for Transport: Better for Everyone**, Transport 2010, DETR, 1998;

(ii) **Transport 2010 The 10 Year Plan**, DETR, 2000; and

(iii) **PPG13, Planning and Policy Guidance – Transport**, DETR, 2001.

3.2.3 There are two documents published by NHS Estates that support Government Transport Policy. These are:

(i) **Sustainable Development in the NHS,** NHS Estates, HMSO, 2001 (paras 7.67-7.95, 7.121-7.129); and

(ii) **New Environmental Strategy for the National Health Service**, NHS Estates, HMSO, 2002 (pp 5,6,12,24,25).

3.2.4 **Health Facilities Notes** (HFN), debate current and topical issues of concern across all areas of healthcare provision. HFN21 1996 addresses car parking.

3.2.5 **Health Building Notes** (HBN) NHS Estates, give advice to project teams procuring new buildings or adapting or extending existing buildings. HBN 1 gives information on space allowance and includes parking.

3.3 Studies and Published Documents

3.3.1 **The Healthy Transport Toolkit, A Guide to Reducing Car Trips to NHS Facilities**, published in 1998 by Transport 2000 Trust remains the document that is cited as the best reference document for health organisations who wish to improve travel to their sites. The document gives sound information and examples of travel plan initiatives taken up by large Trust sites or smaller facilities.

3.3.2 **Making Travel Plans Work**, 2002 Department of Transport, reports in detail the results of 20 company case studies which include 4 hospital sites. The summary document is backed up by several supporting volumes. It demonstrates that travel plans can work, particularly if there is some control over car parking.

3.3.3 **Making T.H.E. Links, Integrating Sustainable Transport, Health and Environmental Policies: A Guide for Local Authorities and Health Authorities**, published in by DETR in 1999. This is a document which links transport, health and environmental policy issues together. The aim is to integrate the policies which have a common aim 'to improve the health of the nation'. The document is aimed at those who can influence travel at all levels in all parts of society. This will impact on travel to health facilities but not specifically.

3.3.4 Making T.H.E. Links also has a useful reference section for policy documents, networks and organisations and publications that relate to transport, health and the environment.

3.3.5 Many Trusts have developed their own transport strategies or travel plans which are available on websites or by request, eg Oxford Radcliffe.

3.4 Health Related Newsletters

3.4.1 Sustrans publish a quarterly newsletter called:

- Healthy Travel.

3.4.2 It gives useful information and case studies on current transport issues and achievements within the health sector. Prior to Summer 2002, this newsletter was named Active Travel. The newsletter is produced by The Department of Health and Sustrans. It is also supported by the British Heart Foundation. Contact Telephone 0117 926 8893 or activetravel@sustrans.org.uk for further information.

3.4.3 AEA Technology also publish a quarterly newsletter called:

- Travel Plan News.

3.4.4 This newsletter features travel plan related news and has included case study achievements of Hospital Sites. Royal Marsden and Addenbrooks were featured in Summer 2003 and Torbay in Spring 2003. Contact Telephone 0845 602 1425 or Conrad.haigh@aeat.co.uk for information.

3.5 Ad Hoc Journal Publications

3.5.1 On occasion, various professional transport magazines and journals and transport conferences feature Health Travel related articles. Of note are:

- Hospital Travel and Parking Demand, M Slinn, TRICS, 1998;
- Parking Problems Hospitals Face, V Crawshaw, Highways and Transportation, October 2000; and

- Hospitals Feature, Parking Review, July 2002.

3.6 Useful Web Sites

3.6.1 A selection of web sites are listed that give valuable insight and background information to the health sector and on related travel.

Department of Health

3.6.2 The Department of Health website can be found at:

- www.doh.gov.uk

3.6.3 This site gives extensive monitoring information for all English Health Trusts both in summary and by Trust. Through this site, historic annual Trust statistics can be found, along with patient survey satisfaction results and other monitoring areas.

NHS

3.6.4 The English NHS website is:

- www.nhs.uk

3.6.5 It has pages which include good descriptions of how the NHS works and its 10 year plan.

3.6.6 There are separate NHS websites for Scotland, Wales and Northern Ireland. These are:

- www.show.scot.nhs.uk
- www.wales.nhs.uk and
- www.n-i.nhs.uk

3.6.7 If 'transport', 'car parking' or other key words are typed into the site's search facility, then there are listings of related articles, but many of which are Trust site specific.

NHS Estates

3.6.8 NHS Estates have their own website which gives information on their role and advises health Trusts. Of particular relevance to this project is:

- www.nhsestates.gov.uk/sustainable_development

3.6.9 This site describes the problem that transport poses for the NHS. It gives links to other transport sites that are relevant for health Trust managers, information on advice about site parking problems and advice on NHS backed health campaigns.

3.6.10 Within this site, there are also several down-loadable publications including '**Sustainable Development in the NHS**' and '**New Environmental Strategy in the NHS**' both of which are key documents describing the future management of the organisation.

Individual Trust Web Sites

3.6.11 The majority of Trusts now have their own websites and give public transport and parking details for their site(s). The quality of these sites and detail of information varies greatly.

3.6.12 Some Trusts advertise the work that they have been undertaking towards encouraging sustainable travel and their Travel Plan.

Sustainable Travel Websites

3.6.13 The most notable websites are listed below,

- Sustrans: www.sustrans.org.uk
- Transport 2000: www.transport2000.org.uk
- Association for Commuter Transport: www.act-uk.co.uk
- Energy Saving Trust: www.transportenergy.org.uk

3.6.14 The related organisations periodically run courses focussing upon health related travel and more general sustainable travel information.

4

4 Considerations of Travel to Health Facilities

4.1 Introduction

4.1.1 Travel related to health sites has unique characteristics that require consideration when working on either existing or proposed health site developments. We bring these characteristics to the attention of the reader and explore them in more detail.

4.1.2 The amount of travel associated with a health site cannot necessarily be directly linked to a single variable (such as floor area) although this is often current practice in forecasting travel demand. In addition, the way that hospitals and other health facilities are managed and operated is changing and this will affect future travel and demand for parking.

4.1.3 When predicting trips that are generated to a new or expanding health facility, it is necessary to gain as great an understanding of the services that it will provide as possible. It is also necessary to understand the travel characteristics of the area in which the site is located.

4.1.4 Where appropriate, each area of consideration has been broken down into three site types to reflect the differing patterns of arrival and departure by staff, visitors and patients to the various health facilities. The three groups are:

- Hospitals;- include General Hospitals with and without Casualty Department, Specialist Hospitals, Community Hospitals and Hospitals offering Training and Research;
- Facilities without Beds – include GP Surgeries, Health Centres, Dental Surgeries;
- Long-term Care - include Nursing Homes and Hospices.

4.1.5 Hospitals are sites that by their nature have staff and patients present 24 hours a day all year around. Because of the 24 hour operation, some staff work shifts or start and finish work earlier than other workplaces. Many staff (most administrative and clinical staff) work a 'normal day' (approximately 9-5.30pm) Patient arrivals and departures are high during the day and lower in the evening. If there is a Casualty Department, a small number of patients will also arrive and depart at night.

4.1.6 Facilities without beds have activity associated with them from around 7.30-8.30am onwards until around 6-7pm unless there are evening surgeries/clinics. Patient arrivals and departures occur throughout the day, staff arrivals and departures are concentrated at the start and end of the day.

4.1.7 Long term care facilities have patient presence for 24 hours. Most staff are present during the 'normal day', with a lower number of staff working shifts and overnight. Visitors tend to be highest at weekends and visiting is also in the evening.

4.2 Site Size

4.2.1 The site size or area is not a good indicator of the number of trips that may occur at a site.

4.2.2 The plot size of the site does not take into account the proportion of the site used for surface parking, landscaping or building. Additionally, it does not indicate the operational floor area, ie the number of stories a building or buildings have.

4.2.3 The gross floor area (GFA) is a better indicator, but it is not always known how this floor area is being used, or whether it is being used at all.

4.3 Services Offered on a Site

Hospitals

4.3.1 It is important to identify the services provided by the hospital.

4.3.2 A hospital that provides an acute service (accident and emergency, trauma etc), produce a high number of trips. At the other end of the scale, are those hospitals providing geriatric or mental health care, with a low number of trips per bed. The number of beds is not then, on its own, a good indicator of travel.

4.3.3 There are three hospital categories in the TRICS database:

- General Hospital with Casualty;
- General Hospital without Casualty; and
- Specialist Hospital.

4.3.4 It is sometimes difficult to distinguish between these. In general, if a General Hospital has a Casualty department and is also a specialist hospital, it should be considered as a General Hospital with Casualty as its main trip determinants will be casualty based. If a hospital does not have a Casualty department but offers a wide range of services including certain specialist treatments, then it should be considered a General Hospital without Casualty. Only if it is a hospital with a major or single specialism should it be considered to be in the 'Specialist Hospital' Category.

4.3.5 Community Hospitals offer out-patient services with some beds for non-acute patient cases.

4.3.6 See Section 4.5 about the types of patients associated with hospital activity.

Facilities without Beds

4.3.7 Sites without beds are more straightforward to define however. The distinction between GP surgeries and clinics is becoming less clear as GP surgeries increasingly offer clinic services and health centres have GP surgeries within them.

4.3.8 Most sites without beds offer 'outpatient' type appointments where patients are only on site for a short time.

Long-term Care

4.3.9 Less clinical services are offered at these sites and the ratio of staff numbers to bed numbers is significantly lower than at Hospitals.

4.4 Staff

4.4.1 The way staff are managed varies from Trust to Trust. When requesting information about how many staff work at a site, care must be taken in understanding who this includes and how they are included.

4.4.2 The health sector generally considers its staff numbers as total staff, ie headcount. We are interested in 'Whole Time Equivalents' (WTE), where 1 WTE equals 1 full time staff. As there are so many part time posts of differing hours, this methodology saves on over counting the actual number of persons on site compared with a situation if all staff worked full time.

Hospitals

4.4.3 At training hospitals, some of the "staff" are student nurses or other medical staff. At hospitals with a research unit, some "staff" may be University employees.

4.4.4 To complicate matters, hospitals are dependent upon agency or bank nursing staff to overcome their shortage of nurses. These bank staff will not be on the Trust payroll. Increasingly, Trusts subcontract some of their non medical services out, such as laundry, cleaning, catering and maintenance. These staff will also not be on the Trust payroll.

4.4.5 When a Trust provides staff WTE or headcount information, non Trust staff are seldom included, unless the Trust is asked to assess these numbers. It is often difficult to define the number of people involved in servicing a hospital site because they also work at other sites or are peripatetic community workers.

4.4.6 With public/private partnerships becoming more commonplace, some of the professional management services are also externally provided. Again, these staff may not be included in Trust headcount. Because there can be more than one set of management within a site, the responsibility of keeping the total information on staffing numbers is not always clear.

4.4.7 Other organisations, such as PCTs and Social Services, also have staff based at acute hospital sites. Staff at Community hospitals may be predominately PCT staff.

4.4.8 Staff numbers are a good determinant of travel but it can be difficult to obtain accurate information on numbers.

Facilities without Beds

4.4.9 Forecasting travel at small sites such as doctors surgeries has traditionally been based on the number of doctors based at the site (in the TRICS database). This is no longer a reliable measure because:

- more outpatient services and clinics are placed within community sites;
- more nursing practitioners;
- more partnership practices where doctors may practice at more than one surgery

4.4.10 The GP Surgery is being replaced at some locations by the 'health centre' within which GP services are offered. As a result of more services being offered at these small community based sites, there is more travel by patients.

4.4.11 Staff presence is normally from around 7-8am until around 7pm, unless there are evening appointments/clinics. Some peripatetic staff may use a GP surgery/health centre as a base and visit it at the start and/or end of the day.

Long-term Care

4.4.12 A small overnight staff presence is required at these facilities with the bulk of staff being present during the day. A shift system for nursing and orderly staff is common, whilst administrative staff will tend to work 'a normal day' or part time.

4.5 Patients and Visitors

Hospitals

4.5.1 At large sites, patients can be classified into one of the following:

- Outpatients (short duration of stay) – eg those attending consultant appointments or clinics, (usually) arrivals and departures during the day;
- Accident and Emergency/Casualty (variable duration of stay) – those attending unexpectedly because of injury, arrivals and departures at anytime over 24 hours;
- Daycase/Daypatient (medium duration of stay) – eg those attending for surgery but do not expect to stay overnight, they may or may not take up one of the daybeds. Daybeds are not normally included by a Trust in statistics on number of hospital beds. Patients usually arrive first thing (between 8am and 9am) and leave at any time during the afternoon or additionally arrive at lunch time and leave towards the end of the day. Escorts departure up to about an hour after arrival, escort returns are from late morning onwards and final departures from late morning until the evening; and
- In-patient (longer duration of stay) – eg patient who is admitted to a ward and stays one or more nights in hospital – arrivals and departures may be at any time during the day;

4.5.2 Visitors are associated with each of these patient categories, and include persons accompanying as well as visiting patients. Other types of visitors such as company representatives or others visiting for work purposes are difficult to quantify except through detailed surveys. Unless it is known that they generate a high number of trips on the site, they can be included within the category of Patients and Visitors.

Facilities without Beds

4.5.3 Small sites generally cater for outpatient type appointments as above, although increasingly a wider range of services is being offered. Some Health Centres may offer clinics or classes and these may attract relatively high numbers of people arriving and departing at a similar time.

Long-term Care

4.5.4 Fewer trips are made by outpatients to these facilities. The bulk of non-staff trips are made by visitors to inpatients. For this reason, the pattern of trip making is different to other health facilities with a higher proportion of trips being made in the evenings and at weekends.

4.5.5 Some nursing homes and hospices may have a day care facility or respite care attached to them.

Summary

4.5.6 Site and patient type/services offered on different site types are further summarised in Table 4.1.

Table 4.1 Patient Types Generally Experienced at Different Health Sites (TRICS Categories)

Variable	Inpatient	Day Patient	Out Patient	Casualty
General Hospital – with Casualty	Y	Y	Y	Y
General Hospital – No Casualty	Y	Y	Y	N
Special Hospital	Y	Y	Y	N
Private Hospital	Y	Y	Y	N
Clinics	N	Y	Y	N
GP Surgery	N	N	Y	N
Nursing Homes	Y	Y	N	N
Hospice	Y	(Y)	N	N

4.5.7 It may also be appropriate that there are guidelines in which sub-category a site should be located within TRICS. There are increasingly more sites with 'community facilities' contained in them and they could be classified under more than one sub-category depending on the composition of services offered.

4.6 Beds

Hospitals

4.6.1 The number of beds associated with a hospital is normally the number of beds in in-patient wards. Day beds are not normally included in this number.

Facilities without Beds

4.6.2 Patient visits to small sites can be classified as primarily outpatient visits.

Long-term Care

4.6.3 These will be the number of beds the facility has on site.

4.7 Other Activity

4.7.1 We have noted that some large hospitals have associated activities such as teaching or research. Some sites also have private companies leasing land on their site, sharing access roads and even car parking. The number of staff, students and others associated with these requires identification and if they are to be included in trip prediction for a site, they can usually be treated as staff.

4.8 Car Parking

Hospitals

4.8.1 Maximum standards have replaced minimum standards for parking provision. Parking provision for a hospital varies greatly depending on location and how the hospital site has been developed to accommodate consolidated services in recent years. There are sites within London that offer very limited general public parking and parking to only a small percentage of its staff. By contrast, in rural areas

where a hospital serves a population over a very wide area with little public transport, parking space is more plentiful. Most sites fall somewhere in between.

4.8.2 It is now widely accepted that large acute hospital sites have managed parking which normally entails charging visitors, day-care patients and outpatients. It is usual for staff parking to be controlled by a parking permit system which is occasionally free but more often charges are also levied. Some Trusts have more highly developed and implemented systems than others.

4.8.3 Parking controls have relieved the parking pressure at such large sites, but the problem is not completely resolved. When on-site parking controls are introduced, it is often necessary for parking in the surrounding streets to be controlled if they are not to be swamped by displaced hospital parking.

4.8.4 The NHS Strategy encourages excess space to be sold off and for specialist and acute services within a Trust to be consolidated. This has resulted in intensified land use on large sites, with former car parks being given over to new buildings so that smaller sites elsewhere can be closed and sold off. The result of this is that more staff work at the site, more patients are treated and there is less car parking available.

4.8.5 In the same respect, there is a trend for more outpatient clinics to be located within the community at primary care centres (GP Surgeries) and less urgent accident and emergency cases to be treated in local 'Walk in Centres'. Also, the telephone advice service NHS Direct reduces the need for some patients to attend hospital. Whilst the overall number of patient attendances or visits continues to increase, the percentage of these visits to acute hospitals, as compared with all visits to health facilities, is decreasing.

4.8.6 Overall, it is more common for there to be excess parking demand by those wishing to travel by car than can be accommodated on a site. Together with parking controls, a package of sustainable measures to encourage travel by other modes is necessary at such sites.

Facilities without Beds

4.8.7 At small local facilities, there are less likely to be site parking controls except in city/town centre locations. There are almost without exception reserved spaces for staff, many of whom need to make home visits.

4.8.8 GP surgeries and Health Centres are increasingly experiencing parking problems, proportional in size to the amount of on site activity. Many sites just weren't designed to accommodate the high number of patient clinics that can now be found in local centres. Also group clinics and courses (eg anti-natal) that often run in Health Centres mean that a relatively high number of people arrive and depart at the same time (classes of 15-20 are not unusual). If these people drive, there is the associated parking demand.

4.8.9 A favourable way to plan community health facility car parking provision, is for provision for patients/visitors to be shared with other community facilities such as local shops.

Long-term Care

4.8.10 These facilities often have adequate parking for staff and visitors, but local circumstances will influence this.

4.9 How TRICS Accommodates Health Facilities

4.9.1 There are 8 sub categories in the Health Site category:

- General Hospital – with Casualty;
- General Hospital – No Casualty;
- Special Hospital;
- Private Hospital;
- Clinics;
- GP Surgery;
- Nursing Homes; and
- Hospice.

4.9.2 A further sub category that could be included is:

- General Hospital with Teaching/Research.

4.9.3 This category would be aimed at the General Hospitals that have teaching and research facilities which almost without exception, are the larger type of facility that also has a casualty department.

4.9.4 Generally, the sub-category names have been self-explanatory. But, with increasing services being offered 'in the community', the traditional GP surgery is becoming a 'health centre' or 'community hospital' offering a far wider range of services with a clinical element to it. Does this type of facility fall into the GP surgery or clinic category? Also, we have recently seen 'Walk in Centres' appear in our streets, under the current classification, this would appear under clinic.

4.9.5 It is recommended that there are guidelines in TRICS help in which sub-category a site should be located within as there are increasingly more sites with 'community facilities' contained in them.

4.10 Accessibility

4.10.1 Faber Maunsell were commissioned to undertake TRICS Research Brief 1 which was to explore the relationship between accessibility and parking for new developments. There are a few opportunities for complete new health facilities, but many existing sites are continually being adapted to contain more services and so parking demand and supply varies. Through the planning process, there are opportunities to improve sustainable transport to health sites and influence how parking is controlled.

4.11 Travel Plans

4.11.1 The impact of Travel Plans in general has been assessed under TRICS Research Brief 2 by Steer Davies Gleave. Travel Plans have also been considered specifically for health sites in Chapter 5 of this report.

4.12 Seasonality

4.12.1 Seasonality research was undertaken by JMP Consultants in 2002. One of the sites included in the study was Dorset County Hospital, Dorchester. This is a General Hospital with Casualty Site.

4.12.2 The Study concluded that there was less than a 5% level of variation throughout the year for all months except for August and September. It also concluded that weekday variations were also less than 5% for weekdays except Fridays at that site.

4.13 Modal Share

4.13.1 The modal share at health sites is determined by:

- Location;
- Car parking availability and charges;
- Accessibility by Non-Car modes; and
- The Impact of the Travel Plan if the facility has one.

4.13.2 Location often determines the extent to which the other factors have a part to play in influencing modal split.

4.14 Summary

4.14.1 This chapter has highlighted the main areas for consideration when preparing trip predictions at health sites. The number of person trips needs to be forecast before a modal share is established. The main areas for the prediction of person trip rates are:

- Site type and services offered on a site;
- Number of staff employed;
- Number of patients and visitors by type;
- Number of beds; and
- Other activity, linked to University, research etc.

4.14.2 Site and patient type/services offered on different site types may be broken down either as:

- Inpatients;
- Day patients;
- Outpatients; or
- Casualty.

4.14.3 TRICS health sites sub-categories cover the range of health travel sites, but a further Health Facility sub-category could be added:

- General Hospital with Teaching/Research.

4.14.4 It is recommended that there are guidelines in which sub-category a site should be located within TRICS as there are increasingly more sites with 'community facilities' contained in them and could be classified under more than one sub-category.

4.14.5 To assess modal share and vehicle trips, the following are required:

- Location;
- Car parking availability and charges;
- Accessibility by Non-Car modes; and
- The Impact of the Travel Plan if the facility has one.

5

5 Impact of Travel Plans

5.1 Introduction

5.1.1 Travel Plan work in the UK has been ongoing for over five years and firm guidance in published form is available for preparing Travel Plans.

5.1.2 Large hospitals have traditionally suffered some of the worst outcomes of uncontrolled car travel. At congested sites, inconsiderate or dangerous parking is observed. Parking spills onto nearby streets, often resulting in poor neighbour relationships.

5.1.3 By the start of the 1990s, several hospitals were actively starting to attempt to control the problems that their organisation was causing, by introducing parking controls. Some establishments were starting to recognise that staff required assistance to help find travel alternatives. However, it was not expected in the early days that employees would help financially, either directly (cash payments, reduced price season tickets etc.) or indirectly (subsidising a bus service, contributing towards new cycle lanes, providing changing facilities).

5.1.4 The introduction of Travel Plans supported the efforts that were already going on in hospitals with the most acute problems. The health sector has led in the development of Travel Plans as the large staff and visitor numbers generate high trip frequencies and parking usage throughout the working day. Hospitals have acted as test beds for the evolution of Healthy or Green Commuter Plans into what we recognise today as the Travel Plan.

5.1.5 Publicised results are encouraging as sites with a good package of measures and supporting commitment are achieving reduced percentage of car travel.

5.1.6 In The Healthy Travel Toolkit published in 1998, there were case studies to encourage other Trusts to invest in developing a Travel Plan. These included numerous examples of Trusts who had provided sustainable alternatives, but at that time, there were few monitoring studies or survey results to demonstrate the effect that they had. Also, several of the case study initiatives were standalone examples and not part of a package as is now recommended.

5.1.7 Research published by the Department for Transport in Summer 2002, was based on 20 UK case studies. Four of these case studies were large Hospital Trusts, all with Travel Plans. These are shown in Table 5.1.

Table 5.1 Travel Plan Monitoring Results

Hospital	Date 1st Monitoring	Car Use %	Date 2nd Monitoring	Car Use %	Difference
Addenbrooks, NHS Trust Cambridge	1993	74%	1999	60%	14%
Nottingham City Hospital NHS Trust	1997	72% (driver)	2000	55% (driver)	17%
Oxford Radcliffe Hospital NHS Trust	2000		2001		4%
Plymouth Hospitals NHS Trust	1995	78% (driver)	2001	54% (driver)	24%

5.1.8 It was concluded that the measure that makes the greatest impact on car usage for travel to hospitals, is efficient car parking management in the form of car parking charges and a clear set of criteria being met to obtain a permit to park on site.

5.1.9 Before parking controls can be successfully introduced and accepted, a package of 'soft measures' is necessary. The aim of these measures is to encourage consideration of car alternatives, namely walk, cycle, bus or rail and car share. Staff are seen as the group where greatest changes can be made as they make regular trips and become familiar with the area. There is limited scope to encourage patients not to travel by car as they are often sick, have to travel some distance and are unfamiliar with the area surrounding the hospital.

5.1.10 It is accepted that Travel Plan measures cannot change the car culture overnight. Rather, small positive changes for each measure can add together within a package to make significant progress in meeting Travel Plan targets.

5.2 Southampton University Hospitals NHS Trust Travel Plan

5.2.1 Southampton University Hospitals NHS Trust is committed to controlling and reducing staff and visitor/patient car travel to and from its Hospital sites.

5.2.2 Since 1994, the Trust has been actively trying to reduce the dependence on the car through the promotion of alternative means of transport.

5.2.3 The three-year Travel Plan covering the period between 1997 and mid 2000 has just expired. Table 5.2 below details the targets, and actual figures that have been achieved from the 1997 to 2000 Travel Plan measures and initiatives. The final column in the table shows the overall figures for each of the initiatives that include for the period prior to the 1997 to 2000 Travel Plan.

Table 5.2 Southampton University Hospital NHS Trust Commuter Plan Update – Number of Staff Mode of Travel (as at 31 March 2000)

Measures Included in Travel Plan	1997 Actual	2000 Target	Overall Figures for Each Incentive
New Car Parking	-	120	N/A
Car Share	8	120	109
Cyclist	8	80	43
Bus Service	0	75	142
Pedestrian	4	30	20
Park and Ride	118	165	387
Park and Walk	81	0	154
Total Reduction	**219**	**590**	**706**

5.2.4 It can be seen from the figures that there has been a significant increase in the use of alternative means of transport to and from the hospital sites over the past three years. The numbers of those switching to bus, Park and Ride, and Park and Walk have all greatly exceeded their respective targets. The switch to walk and cycling has been more limited, both only reaching half of their targets. The Travel Plan had resulted in a saving of 706 parking spaces.

5.3 View from NHS Estates

5.3.1 Travel Plans are required not only through the DoH's Controls Assurance Corporate Governance risk management process (an annual mandatory requirement) but also through the NHS Estates New Environmental Strategy for the NHS. Monitoring data is collected by NHS Estates through their Estates Returns Information Collection system (ERIC), statistics on the number or proportion of Trusts with agreed travel plans is meaningless for the following reasons:

- Any type of comparison will be misleading given that the NHS Estate has changed considerably over recent times - for example in 2001 there were about 350 Trusts and the numbers were decreasing, in 2003, there are about 600 Trusts and the numbers are increasing;
- A significant number of Trusts had actually produced and had Travel Plans agreed but because of the reorganisation of the NHS Estate, the Plans are no longer appropriate and have to be redone;
- Many Trusts have produced Travel Plans but are awaiting approval either by local authorities or Trust Boards;
- Many Travel Plans have been produced but are delayed awaiting the outcome of negotiations with public transport providers to improve service provision to, or near, the Trust site;
- Many Travel Plans have been produced but are waiting financial investment from the Trust to put the right infrastructure in place.

5.3.2 A significant part of the NHS estate is made up of Primary Care Trusts (PCTs). The difficulty these Trusts face is one of logistics given that some PCTs can have anything like 100+ small community sites. Some of the PCTs have only now identified and resolved their final estate portfolio. It is not possible to produce a Travel Plan for a Trust until the extent of the estate, the boundaries, the services and the facilities are clearly defined. Also what this means is that potentially they have to enter into negotiations with different public transport co-ordinators in different geographical areas that form part of their overall estate.

5.3.3 Within NHS Estates, there is comfort in acknowledging that the profile is improving within the NHS in England. However, the NHS will never achieve true success in isolation. It can only be achieved by a partnership approach and by a culture change taking place. The NHS has a difficulty in many areas:

- changing the travel patterns of staff - the NHS has issues of recruitment and retention of staff, particularly nursing staff - accessibility and car parking will feature as issues to address;
- increasing provision of community and home care based healthcare services which means more staff need private transport to take medication, equipment, patients notes etc whilst treating and caring for patients - this is unlikely to be achieved by public transport;
- NHS resources are limited and primarily for healthcare provision – harsh decisions have to be taken where public transport services refuse to provide services without being subsidised (a local decision - some will be amenable to altering times or routes or trying out new services, others charge for any and every change and variation required);

- The NHS is made up of individuals who make their own decisions about how they will travel. The NHS can advise and guide but are not in a position to force people not to use their cars, especially if the area is known for having a poor public transport service.

5.3.4 NHS Estates continues to promote the need for transport plans and is not relaxed on this part of the Agenda. They are also in discussion with Dept for Transport. On the NHS Estates website (www.nhsestates.gov.uk), under Sustainable Development on the transport page, there is a link with the Dept for Transport's Travel Plan Evaluation Tool to help the NHS. NHS Estates have also sent out for consultation (Late Summer 2003) to 20-30 Trusts, a Sample Local Transport Strategy with a view to assisting and encouraging those within the NHS who have not yet tackled this issue.

5.4 Summary

5.4.1 The health sector has led the way in the development of Travel Plans as Hospital Trusts have often had the most acute travel problems to resolve.

5.4.2 The continuing outcome of implemented travel plans is encouraging with positive publicised results and switch to sustainable modes.

5.4.3 Car parking controls are necessary but these must be in conjunction with a package of measures that make travel alternatives viable.

5.4.4 Modal switch away from travel as car driver does not occur overnight. It is a process that requires patience.

5.4.5 NHS Estates have confirmed that it is difficult to monitor the number of Trusts with approved Travel Plans because of the organisational changes that have been taking over the last few years that have affected the composition and number of Trusts. The number of Trusts with Travel Plans waiting for approval is not monitored. The quality and content of approved Travel Plans varies by Trust and by local authority requirements.

5.4.6 NHS Estates consider that the profile of Travel Plans within the NHS has improved, but will not be fully successful unless a partnership approach and culture change takes place.

6

6 Data Sets Used for Statistical Analysis

6.1 Introduction

6.1.1 The aim of the statistical analysis was to test relationships between site variables, with a view to developing a model for predicting health site travel.

6.1.2 Two sets of analyses were undertaken, initially using the data set available in TRICS v5.2 for vehicular data only. A more detailed multi-modal analysis was undertaken with data from TRICS v5.3 with supplementary sites as available for TRICS 2003.2.

6.1.3 It is very difficult to obtain additional information from sites after the survey has been undertaken, so complete background information is required at the survey stage. Any questionable information collected should be backed up with explanations at the time it is collected.

6.2 TRICS Version 5.2 Data Set

6.2.1 This data set contained up to 82 sites from all health categories and was used to initially investigate the strength of relationships between trip making and hospital statistics such as floor area and staff numbers. Initial plots highlighted outliers and the sites that were surveyed over three years ago were omitted from the sample as the accuracy of associated hospital statistics could not be easily checked.

6.2.2 Outlier sites which had been surveyed within the last three years were revalidated. This was achieved by contacting the hospital/health facility direct and collecting information on the operation of the site. This time consuming exercise produced poor results. The contacts gave as much information as they were able but this was limited due to their personal time constraints.

6.3 TRICS Version 5.3/(2003b) with three additional surveys from 2004a Data Set

6.3.1 A total of 18 multi-modal sites were available for this analysis (Figure 6.1). Their site details are listed below and a summary of the daily modal shares for each site is given in Table 6.1. Some background details were not specified on the database and were not able to be collected during the validation exercise. Three general hospital with casualty sites were added to the dataset as part of this study.

SC-05-A-04 General Hospital with Casualty, Redhill (2004a)

6.3.2 The site is located on Canada Road, in an out-of-town location. Earlswood railway station is 1 mile away from the site. This site has 2485 members of staff and 440 hospital beds. The Gross Floor Area of the site (GFA) is 40,000m^2. There is not a dedicated bus service to the hospital, however, there are two bus stops located within the site. The site survey was undertaken on Thursday 3 July 2003.

WS-05-A-01 General Hospital with Casualty, Chichester (2004a)

6.3.3 This site is located on Spitalfield Lane, on the edge of Chichester town centre. There are residential areas located toward the south of the site, whilst there is a cemetery towards the southeast of the site. The total staff numbers for the site is 3000 and it has 520 hospital beds. The area (gross) of this site is 54,840m^2. There are two bus stops located on Spitalfields Lane. The site survey was undertaken on Tuesday 24 June 2003.

EB-05-A-01 General Hospital with Casualty, Edinburgh (2004a)

6.3.4 This site is located off Old Dalkeith Road, in a suburban area. Residential areas are located towards the north and west of the site. This hospital has 872 beds and 6023 members of staff. It is also a teaching hospital where many of the lecturers are medical staff, but it is not known how many students attend the site. The GFA of the site is 120,000 m^2. There are bus stops located within the site, served by many buses. The site survey was undertaken on Wednesday 18 June 2003.

DC-05-B-01 Community Hospital, Bridport

6.3.5 The site is located on Hospital Lane, to the northwest of the centre of Bridport. The site is just off the B3162, which heads north away from Bridport, access to the site is also available from the A3066. The main vehicle access point to the site is to the southern edge of the site. The GFA of the site is 5692m^2. The site has a bus stop in the hospital grounds, however there is no railway nearby. The site survey was undertaken on Monday 21 October 2002.

ES-05-B-03 Community Hospital, Uckfield

6.3.6 The site is situated on the southeast edge of Uckfield. It is off the Framley Road, which heads east away from Uckfield. The total staff numbers of the site is 300, and there are 20 beds. There is light residential development to the west, north and northeast and south, whilst to the east there is open land. The hospital has 56 beds and 300 employees. The GFA of the site is 12908 m^2. There are two bus stops near the site, one within the site grounds and the other in front of the site. The site survey was undertaken on Thursday 12 September 2002.

TW-05-C-01 Eye Infirmary, Sunderland

6.3.7 The site is located in the Hillview area of Sunderland, off the Queen Alexandra Road. The site is in a residential area, which stretches in all directions. The main roads in the area are the A1018 and the A690. The hospital has 20 beds and 219 employees. The site floor area (gross) is 6400 m^2. There are two bus stops on Queen Alexandra Road outside the site access. The site survey was undertaken on Tuesday 17 September 2002.

GL-05-C-01 Private Hospital, St Johns Wood

6.3.8 This site is located on Wellington Road (A41), in the St Johns area in central London. It is situated close to the western edge of Regent's Park. And north of Lord's cricket grounds. Routes to all other parts of London can be found nearby. The site is accessed by all modes from Circus Road, at the side of the building. The hospital has 100 beds and 200 employees. St Johns Wood underground station is close to the site, and there is a bus stop at either end of the site. The site GFA is 5700 m^2. The site survey was undertaken on Thursday 13 June 2002.

KC-05-D-01 Private Hospital, (BUPA), Maidstone

6.3.9 This site is located on London Road (A20) which heads northwest towards West Malling. The site has single access for all modes of transport off the A20. Residential boundaries lie towards the north, west, east and southern of the site. The site is has 44 beds and 141 employees. There is a railway station that lies to the east and west of the site, and bus stops are located at the site access. The floor area of the site GFA is 4330m^2. The site survey was undertaken on Monday 24 June 2002.

LN-05-D-01 Private Hospital, Lincoln

6.3.10 The site is situated on Nettleham Road, which heads northeast towards the St Giles area of Lincoln. There are 4 bus stops within 400 metres of the site - two at the north and south of the hospital. At this hospital there are 40 beds and 132 members of staff employed. The site is surrounded by a variety of light developments, there are also some residential developments towards the east of the site. The site's GFA is 2548m^2. The site survey was undertaken on Tuesday 10 September 2002.

WO-05-D-02 Private Hospital, (BUPA), Worcester

6.3.11 The site is located off the A38 Bath Road, near the southern edge of Worcester. The site has single road access off the Bath Road. The main residential area lies south of the site. The site has 41 beds and employs 140 members of staff on a permanent basis as well as 70 non-contract 'bank' staff. The site's GFA is 2140m^2. There are two bus stops located outside the site. The site survey was undertaken on Thursday 5 September 2002.

GL-05-G-01 Island Health, Isle of Dogs

6.3.12 This site is located in East Ferry Road, in the Crossharbour area of the Isle of Dogs, towards Poplar and Stepney. The site has its own private car park at the rear of the site, with a single access point. This site has 37 members of staff. The GFA of this site is 1650 m^2. Bus stops are close to the site on the East Ferry Road, and also the Docklands Light Railway is to the west of East Ferry Road. The site survey was undertaken on Thursday 20 June 2002.

Ln-05-E-01 Dental Clinic, Lincoln

6.3.13 This site is a suburban location in southwest Lincoln off the B1190 Doddington Road. The site is at the junction of the B1190 and B1003. There are three bus stops close to the site. This site has 18 employees. The sites GFA is 366m^2, and its surrounding area is residential development. The site survey was undertaken on Tuesday 10 September 2002.

CB-05-G-01 GP Surgery, Carlisle

6.3.14 The site is located on Port Road in a suburban area to the west of the centre of Carlisle. At the sites eastern boundary is a factory, and the port Road Business Park is located to the north of the site, whilst residential developments lie to the south and southeast of the site. The site has two main access points. There are five bus stops within 400 metres of the site, the closest being the two on either side of Port Road. The site has a GFA is 995m^2 and the surgery employs seven doctors. The site survey was undertaken on Wednesday 4 September 2002.

DC-05-G-02 GP Surgery, Weymouth

6.3.15 This site is located off the A353 Preston Road, The site has single Road access for all modes off the Preston Road. Residential buildings are located to the west of the site. Towards the northern of the site there is a pelican crossing which connects both sides of Preston Road to a Pharmacy. There is a bus stop on either side of Preston Road. This site has six doctors and a GFA of 370m^2. The site survey was undertaken on Monday 8 July 2002.

HG-05-G-02 GP Surgery, Romsey

6.3.16 This site is located on the Alma Road, to the northeast of Romsey town centre. The two main roads nearby are the A3057 and the M27. There are offices located toward the northwest and a residential area to the north, south and southeast of the site. The nearest pedestrian crossing is located 60m south of the site. The nearest bus stop is adjacent to the Texaco PFS on the Winchester Road. There are seven doctors on this site and 36 staff in total. The site GFA is 482m^2. The site survey was undertaken on Thursday 11 November 2002.

HC-05-G-03 GP Surgery, Winchester

6.3.17 This site is situated on the eastern edge of Winchester city centre. The site has one main pedestrian access point as well as two staff car parking access points. Various types of developments surround the site. There are no bus stops within the site, however the nearest one is in the city centre around 200 metres from the site. This surgery has seven doctors and 22 total staff. The site's GFA is 1000m^2. The site survey was undertaken on Thursday 11 November 2002.

ST-05-G-01 GP Surgery, Stoke-on-Trent

6.3.18 The site is situated in the Hanford area at the southern edge of Stoke-on-Trent off the New Inn Lane. Directly to the south of the site is Edith Beddow Home, residential buildings are located to the north and southeast. There are two bus stops close to the site, on either side of New Inn Lane. This surgery has four doctors and 45 staff. The site's GFA is 897m^2. The site survey was undertaken on Tuesday 16 July 2002.

CB-05- H-01 Hospice, Carlisle

6.3.19 This site is located on the southern edge of Carlisle in a suburban residential area. It is on the Durdar Road, which provides the main single access point for the site. A Race course is a short distance to the south of the site, with open land to the east and west and residential properties opposite the Durdar Road. There is a bus stop within 400 metres of the site. This site has 74 employees (2 doctors) and 28 patients. The site GFA is 2495m^2. The site survey was undertaken on Wednesday 26 June 2002.

6.4 Modal Share

6.4.1 The summary of modal share for the multi-modal sites are shown in Table 6.1 and Figure 6.2 for the 7am-7pm time period. From these, three very clear groupings for vehicular modal share are shown. The first group is those with a vehicular modal share ranging 33%-39% in the sample. They comprise of two Edge of Town Centre sites and one Neighbourhood Centre site. Two of the sites are within London and one in the City of Winchester all with excellent or very good public transport and with a high number of walk trips from the local built up area.

6.4.2 The second group is a composed of a single hospital site in the suburban area of Edinburgh with a vehicular modal share of 66%. It too has excellent public transport provision, but there is a lower number of walk trips. Although there is housing nearby, it is not high density.

6.4.3 The remaining sites comprise of a variety of types and locations and have a vehicular modal share of between 73%-97%. Public transport availability is much lower and it is only at GP surgeries that are well placed in residential areas that a high number of walk trips are achieved.

6.4.4 The main alternative mode used by sites with a low percentage of private vehicular trips is predominantly public transport, ranging between 17%-40%. The provision of public transport has to be excellent or very good and be well established. Walking is also a significant mode for these sites ranging between 20%-46%. This is dependent upon site location in relation to the population that they serve. Also, it is dependent upon the size of catchment area and what proportion of the catchment area live within reasonable walking distance.

Table 6.1 Modal Share for TRICS Multi-Modal Sites

TRICS Reference	Site Name	Site Location	Mode (%)			
			Vehicle	Walk	Cycle	Public Transport
WS-05-A-01	GHWC Chichester	ET	84	11	3	2
EB-05-A-01	GHWC Edinburgh	SA	66	6	2	26
SC-05-A-04	GHWC Redhill	FS	89	4	1	6
DC-05-B-01	CH Bridport	ET	93	5	1	1
ES-05-B-03	CH Uckfield	ET	92	8	0	0
TW-05-C-01	EI Sunderland	SA	78	7	0	15
GL-05-D-01	PH St John's, London	ETC	39	20	1	40
KC-05-D-01	PH Maidstone	SA	97	2	0	1
LN-05-D-01	PH Lincoln	ETC	88	9	2	1
WO-05-D-02	PH Worcester	SA	96	2	1	1
GL-05-E-01	CL Isle of Dogs, London	NC	36	42	0	22
LN-05-E-01	DC Lincoln	SA	88	7	5	0
CB-05-G-01	GP Carlisle	SA	79	20	0	1
DC-05-G-03	GP Weymouth	NC	87	12	0	1
HC-05-G-02	GP Romsey	ETC	73	23	1	3
HC-05-G-03	GP Winchester	ETC	33	46	4	17
ST-05-G-01	GP Stoke-on-Trent	NC	74	26	0	0
CB-05-H-01	Hospice Carlisle	ET	96	3	1	0

Site Name: GHWC – General Hospital with Casualty; CH – Community Hospital; EI – Eye Infirmary; PH – Private Hospital; CL – Clinic; DC – Dental Centre

Site Location Type: FS Free Standing, SA Suburban Area, ETC Edge of Town Centre, NC Neighbourhood Centre, ET Edge of Town

6.5 Car Parking Provision

6.5.1 Car parking supply and maximum parking demand (survey accumulation) was compared for the multi-modal sites in the sample and a ratio for each site was calculated. The results are shown in Table 6.2.

6.5.2 Sites with travel plans known to be in place, had a higher supply/demand ratio, ie an excess of parking space. Some sites known to be without travel plans also had high supply/demand ratios, although more sites without travel plans had an excess of demand to parking supply. This assessment is inconclusive.

6.5.3 Private hospitals, except in London, had a higher level of parking available than the maximum demand.

6.5.4 The London clinic parking supply met peak demand levels.

6.5.5 GP Surgeries also tend to have a higher level of parking available than the maximum demand, but of the four in the sample, one had higher demand than supply.

6.5.6 The hospice car park did not meet the peak parking demand.

6.5.7 The inconsistency in levels of parking supply to demand show that car parking is not a good estimator of trips to a health facility.

Table 6.2 Car Parking Supply and Demand

TRICS Reference	Site Name	Site Location	Travel Plan Y/N	Vehicle Modal Share (%)	On Site Supply (parking spaces)	Maximum Parking Demand (vehicles)	Ratio Supply/ Demand
WS-05-A-01	GHWC Chichester	ET	N	84	1041	1353	0.77
EB-04-A-01	GHWC Edinburgh	SA	Y	66	1769	874	2.02
SC-05-A-04	GHWC Redhill	FS	N	89	947	1359	0.70
DC-05-B-01	CH Bridport	ET		93	100	108	0.93
ES-05-B-03	CH Uckfield	ET	N	92	134	111	1.21
TW-05-C-01	EI Sunderland	SA		78	146	169	0.86
GL-05-D-01	PH St John's, London	ETC		39	18	43	0.42
KC-05-D-01	PH Maidstone	SA		97	120	116	1.03
LN-05-D-01	PH Lincoln	ETC		88	53	47	1.13
WO-05-D-02	PH Worcester	SA	Y	96	124	94	1.32
GL-05-E-01	CL Isle of Dogs, London	NC		36	27	26	1.04
LN-05-E-01	DC Lincoln	SA		88	28	31	0.90
CB-05-G-01	GP Carlisle	SA		79	Not Known	55	-
DC-05-G-03	GP Weymouth	NC		87	18	22	0.82
HC-05-G-02	GP Romsey	ETC	N	73	45	20	2.25
HC-05-G-03	GP Winchester	ETC	N	33	40	22	1.82
ST-05-G-01	GP Stoke-on-Trent	NC		74	41	35	1.17
CB-05-H-01	Hospice Carlisle	ET	N	96	35	44	0.80

Site Location Type: FS Free Standing, SA Suburban Area, ETC Edge of Town Centre, NC Neighbourhood Centre, ET Edge of Town

6.6 Summary

6.6.1 There are 18 multi-modal health facility sites in the TRICS 2004a database for seven different sub-categories.

6.6.2 The vehicular modal share for the health sites ranges between 33% - 97%.

6.6.3 Low vehicular modal share is associated with sites in urban areas with very good public transport provision. The presence of a site Travel Plan did not always coincide with a low vehicular modal share although these sites did not demonstrate parking problems (parking supply at these sites exceeded demand).

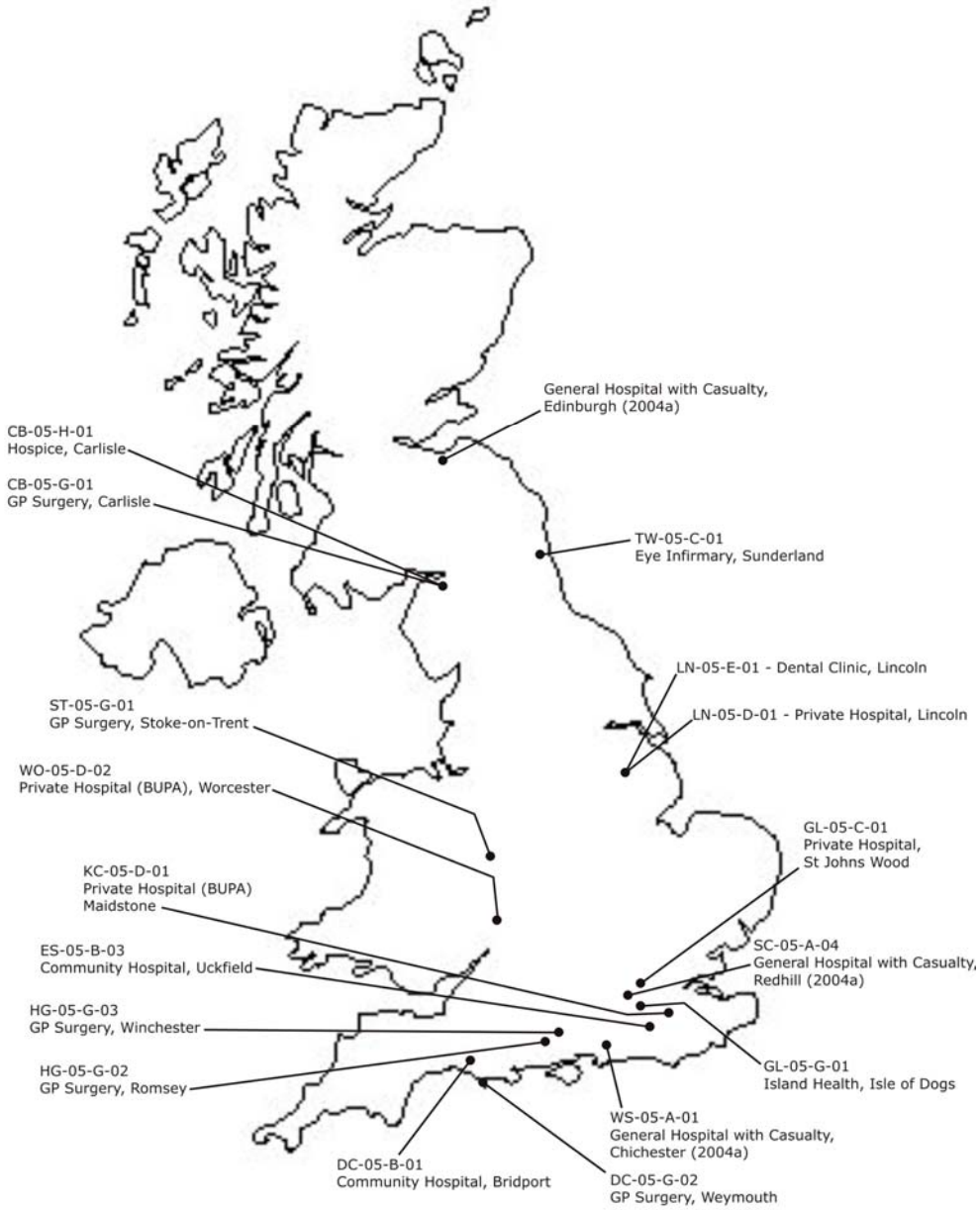
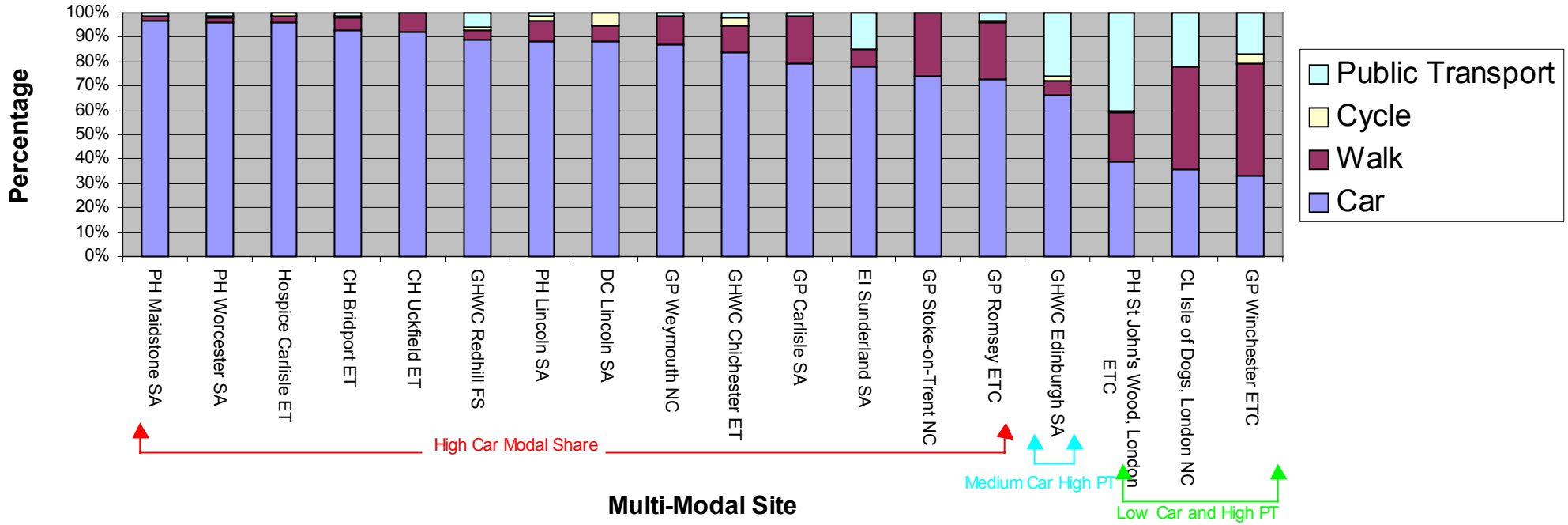


Figure 6.1 - Location of TRICS Multi-Modal Health Sites

Figure 6.2 Modal Share for TRICS Multi-Modal Sites



7

7 Regression Analysis

7.1 Introduction

7.1.1 Using the TRICS data linear regression analysis was undertaken to establish the strength of relationships and identify significant trends for grouping of health sites.

7.1.2 Initial investigations were for vehicular trips only for the large data-set from TRICS version 5.2 only. More detailed analysis was undertaken for the sites with multi-modal information available from the TRICS version 5.3 (2003b) data-set supplemented by additional multi-modal surveys that will be available in TRICS version 2004a.

7.2 Initial Regression Analysis Investigation for Vehicular Trips

7.2.1 An initial analysis was made using vehicular trips only because of the low number of multi-modal sites available at the time, (TRICS 5.2 data-set). Sites with very high or very low trip rates and were less than three years old had background information revalidated where possible. Older outlier sites were removed from the sample.

7.2.2 The relationships between trip rate and the other variables for our sites was investigated by regression analysis. Regression analysis produces a line of best fit using the 'ordinary least squares' (OLS) method. The R-Squared value indicates the proportion of total variation in the X variable that can be explained by the Y variable. The plot data is contained in Appendix A.

7.2.3 A cautionary note, a bias is possible from a predominance of certain health sites. The largest group was General Hospital with Casualty with 22 different sites, GP surgeries had 11 sites, Nursing Homes 10 sites, Special Hospitals five sites, Private Hospitals seven sites, Clinics eight sites and Hospices one site.

7.2.4 All sites in the sample were plotted against the daily number of two way trips (7am-7pm) and AM peak hour for the numerical variables of GFA, number of beds, staff and parking spaces. The results for the total sample are produced in Table 7.1 below.

Table 7.1 Regression Coefficients for Total Sample – Daily and Am Peak Two-Way Vehicular Trips

Variable	Sample Size	Daily Trips (7am-7pm)	Am Peak Hour
Gross Floor Area	64-67	*0.8351	*0.7505
Number of Beds	42-46	*0.8675	*0.7722
Number of Staff	75-78	*0.8916	*0.8490
Number of Parking Spaces	79-82	*0.9235	*0.8894

* Significant at the 95% confidence level

7.2.5 The strongest relationship for vehicular trip rate is for the number of parking spaces. This is a expected as only vehicles entering and leaving the site were recorded in the associated surveys. The relationship could be weaker if there was a surplus of parking (which is rare) or if some vehicles enter and leave the site without managing to park.

7.2.6 The number of staff at a site produced the second strongest relationship, followed by number of beds (where relevant), then GFA.

7.2.7 These results imply that more than one variable can be used to predict trips to a health facility.

7.2.8 We note that the number of parking spaces is not a reliable measure of total person or vehicular trip demand as health facilities concentrate more facilities on their sites and travel plans become more widespread. These have the effect of reducing the proportion of travel by car. Also, non-multi-modal surveys do not take into account off site parking also associated with the facility.

7.2.9 Further tests were undertaken to examine the strength of the relationships for each site type and for site location. These are also for vehicular trips only.

7.2.10 The site type test results are produced in Table 7.2. The number of parking spaces shows strong relationships in most tests, but as already stated they cannot be used to predict total person or vehicular trips. For General Hospitals with No Casualty, Special Hospitals and Clinics, the number of staff give the strongest relationships. In most cases, the GFA gives a relatively poor relationship for all sites and bed numbers for hospitals falls somewhere in between.

Table 7.2 Regression Coefficients for Total Sample – Daily Vehicular Trips by Site Type

Site Type	Sample Size	GFA	Beds	Staff	Car Spaces
General Hospital – with Casualty	15-17	*0.3846	*0.5958	*0.6693	*0.7126
General Hospital – No Casualty	9	*0.7859	*0.8853	*0.9392	*0.8387
Special Hospital	5-6	0.0979	0.3659	0.5704	0.3667
Private Hospital	14	0.2473	0.3750	0.1327	*0.6534
Clinics	8-9	0.2143	-	*0.5303	0.3749
GP Surgery	14	*0.4172	-	*0.3829	*0.5447
Nursing Homes	12	-	-	*0.4575	*0.7245

* Significant at the 95% confidence level

7.2.11 Table 7.3 shows the tabulated results for the tests considering trips by location. All tests demonstrated strong relationships except for the 'free standing – car spaces' test and 'not known – beds' test. The small sample sizes may have influenced the latter in particular. It is possible that the free standing sites generally have a wider range parking availability than sites in urban locations which are almost without exception constrained.

Table 7.3 Regression Coefficients for Total Sample – Daily vehicular Trips by Location

Location Type	Sample Size	GFA	Beds	Staff	Car Spaces
Edge of Town	21-32	*0.6800	*0.8087	*0.8932	*0.8787
Suburban Area	20-30	*0.9248	*0.8379	*0.9291	*0.9903
Neighbourhood Centre	4	*0.9805	-	*0.9940	*0.9957
Free Standing	3	0.8516	0.9143	0.8508	0.0105
Not Known	5-6	*0.7788	0.1849	*0.8866	0.5411

* Significant at the 95% confidence level

7.3 Multi-Modal Linear Regression Analysis

7.3.1 Vehicular and person two-way trips were plotted for each of the AM and PM peak and 12 hour day for health sites in the TRICS 2003b (with additional 2004a surveys) data-set. Again, the ordinary least squares method was used.

7.3.2 The AM peak consists of trips made between 7am – 10am and the PM peak consists of trips made between 4pm – 7pm. Twelve hour trips consist of 7am – 7pm.

7.3.3 The 18 TRICS multi-modal sites were included in the analysis and the relationships between trip making and explanatory hospital variables such as GFA, Staff and Beds were explored. The number of patients for many of the sites was not available, and because of the varying trip characteristics of patients discussed in Chapter 4, these have not been explored. Bed numbers for hospital sites, however, gives a clear indication of the relevance of patient numbers.

7.3.4 The sequence of tests are listed and reported upon below and the plot data is shown in Appendix B. The summaries show that consistently stronger relationships are evident for person trips rather than vehicular trips reflecting the variation caused by modal share. Regressions that are significant at the 95% confidence level are highlighted in the tables below.

All Sites in the Sample

7.3.5 The relationships between the sites for staff numbers, number of beds and GFA proved to be high for this group. The strongest relationship was for bed numbers followed by the number of staff. All the regression coefficients are significant at the 95% confidence level. Table 7.4 presents the results.

Table 7.4 Relationship for All Sites in the Sample

	Sample Size	Person 7am-7pm	Person 7am-10am	Person 4pm-7pm	Vehicles 7am-7pm	Vehicles 7am-10am	Vehicles 4pm-7pm
Beds	11	*0.9678	*0.9861	*0.9898	*0.9082	*0.9166	*0.9266
Staff	18	*0.9630	*0.9886	*0.9837	*0.8968	*0.9081	*0.9134
GFA	18	*0.9169	*0.9575	*0.9500	*0.8334	*0.8454	*0.8541

*Significant at the 95% confidence level

All Hospitals (Sites with Beds excluding Hospice)

7.3.6 The relationship between sites with beds (excluding Hospice) and the three variables proved to be very strong. The strongest relationship is for the number of beds and then the number of staff. The regression coefficients are all significant at the 95% confidence level. The results are presented in Table 7.5.

Table 7.5 The Relationship for All Hospitals

	Sample Size	Person 7am-7pm	Person 7am-10am	Person 4pm-7pm	Vehicles 7am-7pm	Vehicles 7am-10am	Vehicles 4pm-7pm
Beds	10	*0.9662	*0.9854	*0.9894	*0.9036	*0.9124	*0.9229
Staff	10	*0.9581	*0.9888	*0.9820	*0.8788	*0.8922	*0.8978
GFA	10	*0.9029	*0.9518	*0.9419	*0.8021	*0.8165	*0.8263

*Significant at the 95% confidence level

General Hospital with Casualty

7.3.7 The relationship between the variables and the three General Hospitals with Casualty in the sample proved to be very strong. Strength of the relationships are very similar for all three variables, with Staff and GFA being the strongest in most cases. Due to the low sample size the only tests that are statistically significant at the 95% confidence level are Person Trips 7am-10pm and 4pm-7pm. The results are presented in Table 7.6.

Table 7.6 The Relationship for General Hospitals with Casualty

	Sample Size	Person 7am-7pm	Person 7am-10am	Person 4pm-7pm	Vehicles 7am-7pm	Vehicles 7am-10am	Vehicles 4pm-7pm
Staff	3	0.9899	*0.9998	*0.9997	0.9234	0.9552	0.9441
GFA	3	0.9862	*0.9991	*1.0000	0.9141	0.9478	0.9360
Beds	3	0.9732	*0.9942	*0.9980	0.8862	0.9252	0.9113

*Significant at the 95% confidence level

All Sites Excluding General Hospital with Casualty

7.3.8 The relationship for this group was weak indicating that the excluded group has a strong relationship and that those that are included are diverse. Statistically significant relationships were found for all Staff trips. Statistically significant relationships were also found for GFA, excluding person 7am-7pm and 7am-10am trips. Table 7.7 presents the results.

Table 7.7 The Relationship for All Sites Excluding General Hospital with Casualty

	Sample Size	Person 7am-7pm	Person 7am-10am	Person 4pm-7pm	Vehicles 7am-7pm	Vehicles 7am-10am	Vehicles 4pm-7pm
Staff	15	*0.5915	*0.5920	*0.5214	*0.6082	*0.5742	*0.5931
GFA	15	0.2445	0.2096	*0.3144	*0.4076	*0.2682	*0.4793
Beds	8	0.0004	0.0016	0.1141	0.0219	0.0806	0.0021

*Significant at the 95% confidence level

Private Hospitals

7.3.9 The relationship strength between Private Hospitals and the three variables proved to be weak suggesting the sites in the sample have diverse properties. The strongest relationship was found to be beds and then GFA. None of the relationships for Private Hospitals produced statistically significant results. The results are presented in Table 7.8.

Table 7.8 The Relationship for Private Hospitals

	Sample Size	Person 7am-7pm	Person 7am-10am	Person 4pm-7pm	Vehicles 7am-7pm	Vehicles 7am-10am	Vehicles 4pm-7pm
Beds	4	0.4587	0.4985	0.6371	0.1529	0.2463	0.0786
GFA	4	0.3448	0.5018	0.3269	0.0919	0.1375	0.0956
Staff	4	0.1756	0.2087	0.3552	0.4292	0.5468	0.3054

*Significant at the 95% confidence level

GP Surgeries

7.3.10 The relationship for GP surgeries is very weak as no significant relationships were found. This suggests that GP surgery sites are very diverse in character. None of the relationships produced statistically significant relationships. The results are shown in Table 7.9.

Table 7.9 The Relationship for GP Surgeries

	Sample Size	Person 7am-7pm	Person 7am-10am	Person 4pm-7pm	Vehicles 7am-7pm	Vehicles 7am-10am	Vehicles 4pm-7pm
Staff	5	0.0479	0.1337	0.0312	0.2159	0.3245	0.1527
GFA	5	0.0001	0.0132	0.0462	0.0377	0.0444	0.0071

*Significant at the 95% confidence level

GP Surgeries and Clinics

7.3.11 The relationship for GP Surgeries and Clinics is also very weak with no significant correlation being found. None of the relationships are statistically significant. The results are presented in Table 7.10.

Table 7.10 The Relationship for GP Surgeries and Clinics

	Sample Size	Person 7am-7pm	Person 7am-10am	Person 4pm-7pm	Vehicles 7am-7pm	Vehicles 7am-10am	Vehicles 4pm-7pm
Staff	7	0.0606	0.0570	0.0145	0.0191	0.0167	0.0152
GFA	7	0.0196	0.0726	0.0328	0.0841	0.0485	0.0733

*Significant at the 95% confidence level

Edge of Town Location

7.3.12 The relationship for health sites located at the edge of town for all three variables was found to be very strong. The strongest relationship was found to be the number of staff, followed by the number of beds. All the relationships for Edge of Town locations are statistically significant at the 9%% confidence level. The results are presented in Table 7.11.

Table 7.11 The Relationship for Sites with an Edge of Town Location

	Sample Size	Person 7am-7pm	Person 7am-10am	Person 4pm-7pm	Vehicles 7am-7pm	Vehicles 7am-10am	Vehicles 4pm-7pm
Staff	4	*0.9984	*0.9994	*0.9999	*0.9983	*0.9996	*0.9994
Beds	4	*0.9995	*0.9986	*0.9973	*0.9991	*0.9982	*0.9968
GFA	4	*0.9860	*0.9858	*0.9867	*0.9900	*0.9878	*0.9916

*Significant at the 95% confidence level

Edge of Town Centre Location

7.3.13 The sites located at the edge of the town centre produced predominately weak relationships. Strong relationships were only found for person and vehicle trips during the PM period. None of the relationships are statistically significant. The results are presented in Table 7.12 below.

Table 7.12 The Relationship for Sites with an Edge of Town Centre Location

	Sample Size	Person 7am-7pm	Person 7am-10am	Person 4pm-7pm	Vehicles 7am-7pm	Vehicles 7am-10am	Vehicles 4pm-7pm
GFA	4	0.1949	0.2489	0.7632	0.2079	0.0000	0.5774
Staff	4	0.1410	0.1958	0.6267	0.2805	0.0073	0.6387

*Significant at the 95% confidence level

Neighbourhood Centre Location

7.3.14 The relationship for sites located in neighbourhood centres did not produce any significant correlation's for person trips. The relationships did not produce any statistically significant relationships. The results are presented in Table 7.12.

Table 7.13 Relationship for Sites in a Neighbourhood Centre

	Sample Size	Person 7am-7pm	Person 7am-10am	Person 4pm-7pm	Vehicles 7am-7pm	Vehicles 7am-10am	Vehicles 4pm-7pm
GFA	3	0.2275	0.5633	0.2357	0.9543	*0.9997	0.8866
Staff	3	0.2613	0.0338	0.2529	0.0999	0.2773	0.0370

*Significant at the 95% confidence level

Suburban Area Location

7.3.15 The relationship between health sites located in the suburban area and the three variable was found to be very strong. Significant regression relationships exist for all variables with staff and GFA being the strongest. All the relationships are statistically significant at the 95% confidence level. The results are present in Table 7.13.

Table 7.14 Relationship for Sites in Suburban Areas

	Sample Size	Person 7am-7pm	Person 7am-10am	Person 4pm-7pm	Vehicles 7am-7pm	Vehicles 7am-10am	Vehicles 4pm-7pm
Staff	6	*0.9971	*0.9977	*0.9984	*0.9971	*0.9960	*0.9985
GFA	6	*0.9953	*0.9965	*0.9988	*0.9956	*0.9944	*0.9984
Beds	4	*0.9877	*0.9904	*0.9965	*0.9904	*0.9892	*0.9957

*Significant at the 95% confidence level

7.4 Summary

7.4.1 Regression analysis was undertaken initially for vehicular trips only and then for person trips. It demonstrated that there are strong relationships between trip making and numbers of staff, beds (where applicable), other patient types and Gross Floor Area. There is also a strong relationship between car parking on site and car parking spaces (but this does not take into account any unmet demand an on street parking nearby).

7.4.2 The site type analysis for vehicular trips showed that there were relatively strong relationships for staff (except at Private Hospitals). Other relationship results were more varied.

7.4.3 Vehicular trips by site location produced consistent strong relationship results for edge of town, suburban area and neighbourhood centres.

7.4.4 More detailed analysis focussing upon additional AM and PM peak periods was undertaken for person trips. For all sites, beds (where applicable) and staff numbers produced the strongest relationships, GFA was also strong. The all hospitals test produced a strong relationship for all variables as did the tests for general hospitals with casualty. The same test for all hospitals except general hospital with casualty, produced less strong relationships. Private hospitals on their own produced similarly weak results.

7.4.5 GP surgeries alone and GP surgeries with clinics did not demonstrate strong relationships.

7.4.6 Tests for sites by location and person trips demonstrated strong relationships for edge of town and suburban area locations but not for neighbourhood centres. The neighbourhood centre test only gave a strong test result for vehicular trips and staff.

8

8 Travel Prediction Model

8.1 Introduction

8.1.1 MVA developed an AM and PM peak vehicular trip prediction model for large hospital sites based initially on data collected in 1992/3 from a roadside interview survey at the Oxford Radcliffe Hospital for each traveller category. Since then it has been used and recalibrated on travel count data from other large hospital sites. This study has presented the opportunity to develop the model further to cover multi-modal trips.

8.1.2 In general, the types of site that it was originally applied to were those outside city centres and prior to any travel plan being implemented. The sites were generally in areas with high reliance on car travel for access by both staff and patients. We found that the vehicular trip prediction model only required a low level of recalibration for the next site studied.

8.1.3 We found that, for sites in city centres or with travel plans and/or high public transport accessibility, the original model required a higher level of recalibration because of the relatively lower number of vehicle trips.

8.1.4 The model has been adapted with a new set of start parameters to cater for the calculation of person trips for the AM and PM peak hour. This should provide a consistent calculation for large hospital sites in all locations. Modal share can be considered after person trips have been calculated. There was only sufficient information on staff, bed and patient numbers for us to validate the model at six sites.

8.2 The Trip Generation Model

8.2.1 Multi-modal survey results have been used and the original travel demand relationships have been adapted to estimate total peak hour person trips. The relationships used in our model are:

Trips =

a * peak period staff

\+ b * (outpatients + A&E patients)/1000 per annum

\+ c * beds nights/night

\+ 0.5 * number of day cases per day.

8.2.2 These four elements measure:

- staff movements;
- outpatient and casualty movements (and associated visitors/attendees) - ;
- bed nights/night, the equivalent to the number of beds on a site and proportion used to account for inpatient movements (and associated visitors/attendees) – those who are inpatients in wards and trips associated with them;
- daypatient movements (and associated visitors/attendees) – those who visit for treatment lasting for the whole or greater part of the day, some admissions are also at lunchtime.

8.2.3 Descriptions of staff are given in Section 4.3 and Patient Types are given in Section 4.5.

8.2.4 An example of the trip generation model is given in Appendix C.

8.2.5 Parameters for a variety of sites are given in the following sections. These should be taken as a starting point to refine and develop the model further which will be possible as more multi-modal health site data is collected. It is seen that this model will evolve in much the same way as the TRICS database in general has.

8.3 Hospitals

General Hospital with Casualty

8.3.1 Peak period staff levels are based on the number of whole-time equivalent staff present on average at the hospital on a typical weekday between 1000-1600 hours. Findings from several General Hospitals with Casualty Departments, gives an approximate 74% WTE staff presence during core daytime hours. The presence for other hospitals may be slightly different and, if known, could be collected and input into the model as a site specific figure.

8.3.2 The WTE daytime staff presence was chosen instead of total staff levels to avoid variations between hospitals caused by different shift working arrangements and percentages of part-time to full-time staff employed.

8.3.3 Detailed survey information on total person trip data for three General Hospital Sites with Casualty Departments (Chichester, Edinburgh and Redhill) were input into the model and adjusted parameters for each were calculated. The resultant average parameters are shown in Table 8.1. Parameters a, b and c are described in 8.2.1.

Table 8.1 General Hospital with Casualty – Person Trip Average Parameters

Time Traffic Movement	Parameters		
	a	B	C
AM peak hour arrivals	0.41	0.29	0.29
AM peak hour departures	0.09	0.13	0.13
PM peak hour arrivals	0.13	0.25	0.25
PM peak hour departures	0.43	0.22	0.22

8.3.4 The parameters were then applied to each of the three survey sites to demonstrate the difference between the model predictions and actual observations. Table 8.2 and Figure 8.1 show the total calculated trips, observed trips and percentage difference for each site.

Table 8.2 General Hospital with Casualty - Comparison of Model Results and Observed Person Trips

	AM arrivals	AM departures	PM arrivals	PM departures
East Surrey				
Total Calculated	708	198	316	699
Total Observed	807	200	379	784
% Difference	13%	1%	17%	11%
St Richards				
Total Calculated	781	237	366	767
Total Observed	813	334	379	815
% Difference	4%	29%	3%	6%
New Royal Infirmary				
Total Calculated	1906	561	831	1913
Total Observed	1572	347	704	1596
% Difference	-21%	-62%	-18%	-20%

8.3.5 It can be seen that the model predicted relatively accurately for all three sites except for the AM departures generation for Edinburgh Infirmary, that is the minor flow in the non-peak direction. The exception is probably due to differences in night-time working hours.

8.3.6 This model was then applied to the limited sites of other types of hospital and health facility for which full staff and patient information was available. As the information was not collected in a disaggregated form by traveller category, equal adjustments were made to all three site parameters a, b and c.

Private Hospital

8.3.7 It was found that the model parameters for the one Private Hospital (Lincoln) in the dataset were similar for the AM peak arrivals and departures and PM peak arrivals to those for three General Hospital sites. The PM peak hour departures were lower, suggesting that at this one site, the staff shift hours may be different. Table 8.3 shows the resultant parameters.

Table 8.3 Private Hospital – Person Trip Average Parameters

Time Traffic Movement	Parameters		
	a	B	C
AM peak hour arrivals	0.39	0.27	0.27
AM peak hour departures	0.07	0.10	0.10
PM peak hour arrivals	0.10	0.18	0.18
PM peak hour departures	0.32	0.16	0.16

8.4 Sites with No Beds

8.4.1 The parameters for the one site (Lincoln Dental Centre) with no beds differ for staff arrivals and departures on account of different work patterns (ie no overnight shift cover required). Patient appointments may be represented as outpatients, but there is a higher turnover in the PM peak hour.

8.4.2 The dental surgery parameters did not match the major model parameters except for the AM peak which were similar. Dental surgery parameters are shown in Table 8.4.

Table 8.4 Dental Surgery – Person Trip Average Parameters

Time Traffic Movement	Parameters	
	a	B
AM peak hour arrivals	0.45	0.32
AM peak hour departures	0.02	0.03
PM peak hour arrivals	0.29	0.55
PM peak hour departures	0.90	0.47

8.5 Sites Giving Long Term Care

8.5.1 Hospices and residential care homes require overnight staff presence and a shift system like hospitals but do not have the high turnover of outpatient visits. Visits are focussed upon visitors at the end of the working day and at weekends.

8.5.2 The hospital model was tested on one site (Carlisle Hospice). The AM peak arrival results were similar suggesting a similar staff arrival profile (over a few hours) but with a lower overall departure profile. The PM peak hour parameters did not match, possibly on account of the staff profile (high PM peak departures) and visitors (higher arrivals and departures).

8.5.3 The parameters calculated from the Carlisle Hospice are shown in Table 8.5. These are significantly different from those calculated for the previous five sites (as Tables 8.1, 8.3 and 8.4).

Table 8.5 Long Term Care – Person Trip Average Parameters

Time Traffic Movement	Parameters		
	A	b	C
AM peak hour arrivals	0.38	0.27	0.27
AM peak hour departures	0.05	0.07	0.07
PM peak hour arrivals	0.16	0.30	0.30
PM peak hour departures	0.70	0.36	0.36

8.6 Modal Share

8.6.1 The modal share for sites is not estimated within this trip generation model.

8.6.2 Once the number of person trips to and from a site has been estimated, a realistic modal share could be applied depending on site characteristics of:

- Location (town centre, edge of town centre, edge of town, suburban area, etc);
- Accessibility by walk and cycle;
- Accessibility by public transport (number of buses, trains, how well they serve the population and how well established they are);
- Availability of parking space on and off site and how they are controlled;

- Travel Plan measures and effectiveness of them.

8.6.3 These variables have not been tested due to the limited number of sites surveyed for multi-modal travel data and with quality records of staff and patient numbers. The multi-modal shares for the sites in the TRICS dataset have been examined and a probable/rule of thumb shares is suggested in Table 8.6 from these. As more multi-modal sites are added to the dataset, then the Table can be updated.

8.6.4 Public transport provision has been labelled either 'low', 'medium' or 'high' in Table 8.6 depending on provision for the site. Low provision meant less than 80 services a day, high provision meant over 20 services an hour as in a city environment and medium provision fell between the two. The background dataset information did not categorise services above 80 services a day, but it is known that the 'city' sites have very high frequency services.

8.6.5 Our experience of other hospitals in Central London indicates a vehicle share of only around 5-10%. The Table clearly needs refining with more survey data.

Table 8.6 Range of Modal Shares for Site Types and Locations in TRICS Dataset

Site Type	Site Location	Public Transport Provision	Vehicle Mode Share Lower - Upper Limit	Public Transport Mode Share Lower - Upper Limit
Large Hospital	Not Town Centre	Low	78% - 93%	1% - 15%
Large Hospital	City Suburban Area	High	66%	26%
Large Hospitals	London or City Centre	High	36% - 39%	22% - 40%
Private Hospital	Not London	Medium	88% - 96%	1%
GP Surgery	Not London	Medium	73% - 87%	0% - 3%
GP Surgery	Edge City Centre	High	33%	17%
Hospice	Edge of Town	Low	96%	0%

8.6.6 Walk and cycle modes have not been broken down, but cycling to any site was never more than 5% (Lincoln), with an overall average of 1.2%. Local factors must be considered.

8.7 Further Development of the Model

8.7.1 As more multi-modal data is collected, there will be further opportunity to refine the trip generation model further and to consider adding a mode share model. The enhancements listed below were outside the budget of this study, but could be achieved at the same time as further survey results become available:

- Increase the multi-modal sample size and at the same time collect more detailed site background data;
- Refine the trip generation model with this new survey data and extend the model to a 12 hour output by hour.
- Add a mode share model.

8.8 Extension and Refinement of the Model

8.8.1 To extend the model to cover 12 hours requires the collection of 12-hour data. The refinement of the model to cover a wide range of sites should be achievable given careful selection of survey sites. An additional refinement would be to add to the accuracy of the individual parameters by collecting information separately for the different traveller categories:

- Inpatient;
- Outpatient;
- Day Case;
- Accident and Emergency;
- Staff;
- Other (deliveries, etc).

8.8.2 We recognise that to do this may require interview surveys which would be more expensive than the current travel count surveys with limited interviewing undertaken by the TRICS Consortium.

8.8.3 If car parking is controlled by staff or patient category, visual surveys only may suffice. However, it is more likely to be necessary to survey by questionnaire everyone who enters the site to ensure an accurate categorisation of the traveller.

8.9 How the Model Could Fit into the TRICS Database

8.9.1 The model can be presented to the user as a static additional forecasting tool within TRICS documentation. Alternatively, the user could be given on-line assistance by fitting the model within the TRICS output calculation procedures.

8.9.2 The model could be included in the TRICS database by extending the existing user interface. The user would be asked to complete a set of variables that would best describe their proposed site. The user would be required to know the likely number of staff, outpatients and beds for the development they are considering. These will include:

- Site type;
- Location;
- Staff numbers (WTE);
- Outpatients and day patients and Accident and Emergency attendees;
- Number of beds;
- Location and accessibility issues (if a mode share model was added).

8.9.3 Different parameters for site types would be required because of the differing staff and patient/visitor characteristics. The user would select site type.

8.9.4 As more sites with the fully detailed information are added to the database the model would be refined to become more reliable.

8.9.5 The model could predict for both person trips and for vehicle trips if a mode share model was added. Pending this addition, the range of modal shares and averages could be given for the site location.

8.10 Summary

8.10.1 A trip generation model for person trips for health sites has been presented. Due to the differing types of staff and patient activity at the sites with different characteristics, different parameters for those with complete background information have been calculated. The site types that have been covered to date are General Hospital with Casualty, Private Hospital, Dental Surgery (site with no beds) and Hospice.

8.10.2 Once the number of person trips for a site has been derived, a modal share may be applied. In considering modal share, individual site characteristics are desirable, in particular, location, walk, cycle and public transport accessibility, availability of parking space and if there is/will be an effective travel plan in operation.

8.10.3 Ranges of the percentage of trips by motor vehicle have been derived from the multi-modal surveys in the TRICS database and are presented. It should be noted that other experience of hospitals in Central London indicate a lower vehicular share of around 5-10%. As more multi-modal data is collected, the range of vehicular modal share will be refined.

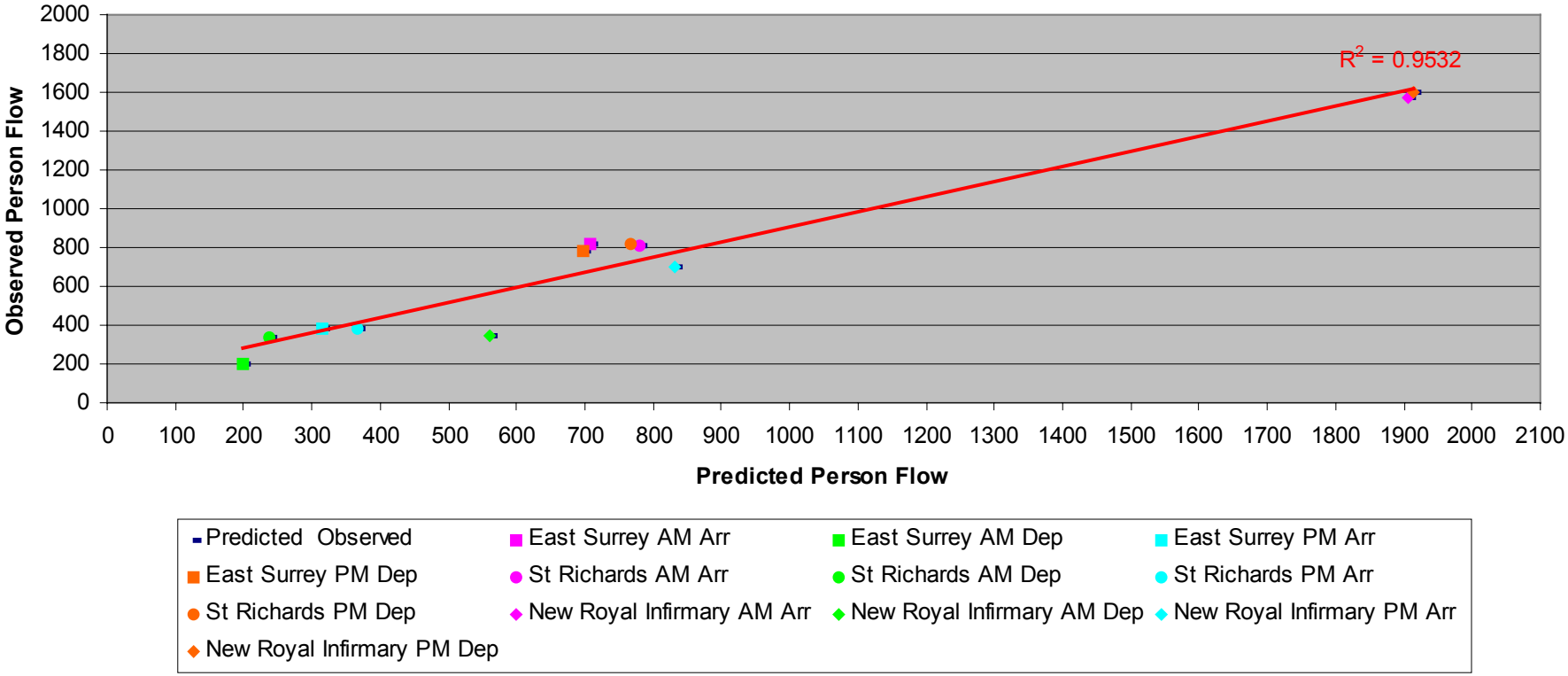
8.10.4 It is recommended that TRICS background data forms for Health Land Use are modified to collect more detailed staff and patient information. Other minor alterations have been suggested.

8.10.5 Opportunities to develop the person trip generation model further perhaps by extending the model times to cover all day should be sought. If it is possible to count the number of trips by person category (staff and various patient types (inpatient, outpatient, day case, accident and emergency), then this would add to the accuracy of the individual parameters. Collecting data at this detailed level however, will be more expensive than the current travel count surveys with limited interviews undertaken at present. If car parking is controlled/organised by staff and patient categories, visual observations may suffice for many trips.

8.10.6 The model can be presented to the user as a static additional forecasting tool within TRICS or the model could be fitted within the TRICS output calculation procedures. If the model is included in the TRICS database, then the user will require a series of prompts to describe the site that they are calculating trip rates for. Mode share could also be included in this model.

8.10.7 As more sites are added to the multi-modal database, the model will become more reliable.

Figure 8.1 Regression Analysis of Hospital Model Observed and Predicted Person Trip Flows



appendices

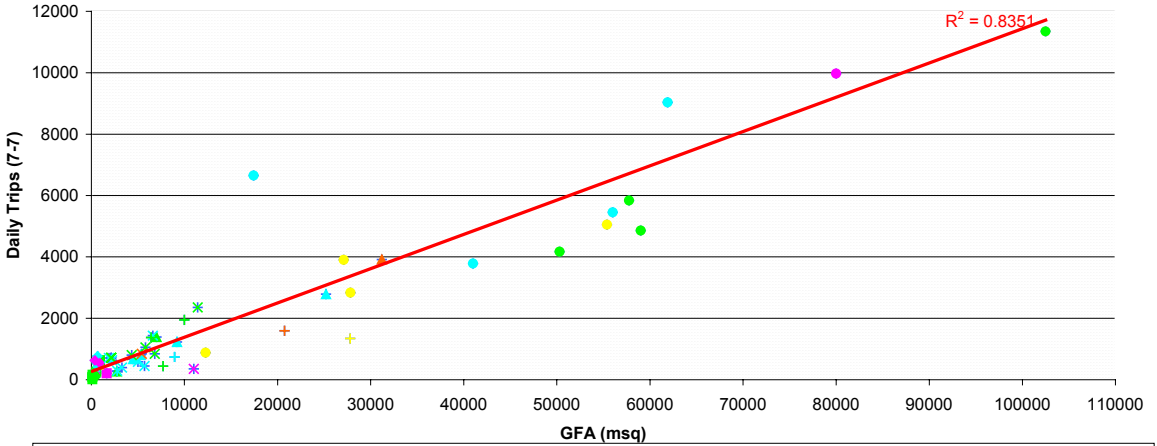
Appendix A

TRICS Version 5.2 Plot Data

Appendix A

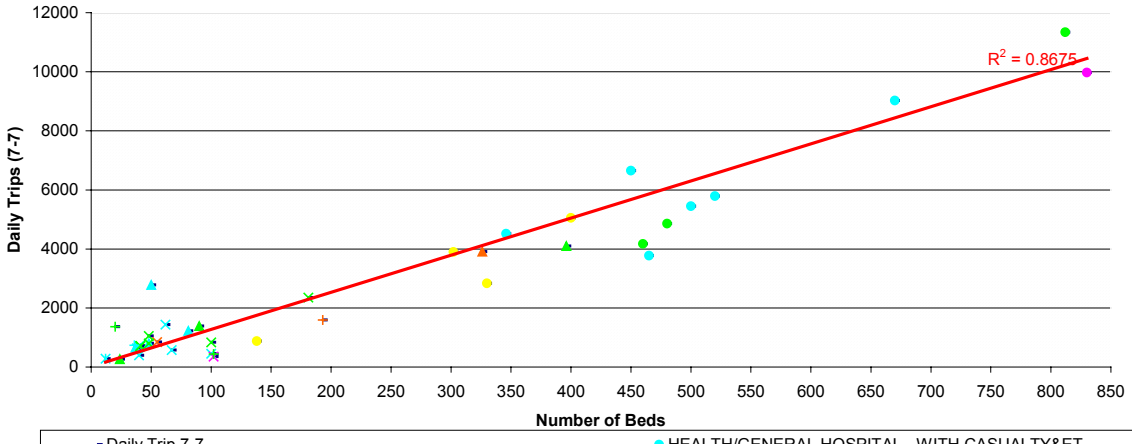
Table 7.1 Plot Data: Regression Analysis of the Total TRICS 5.2 Sample-Daily and Am Peak Two-Way Vehicular Trips.

Gross Floor Area and Daily Vehicle Trip for Total TRICS 5.2 Sample



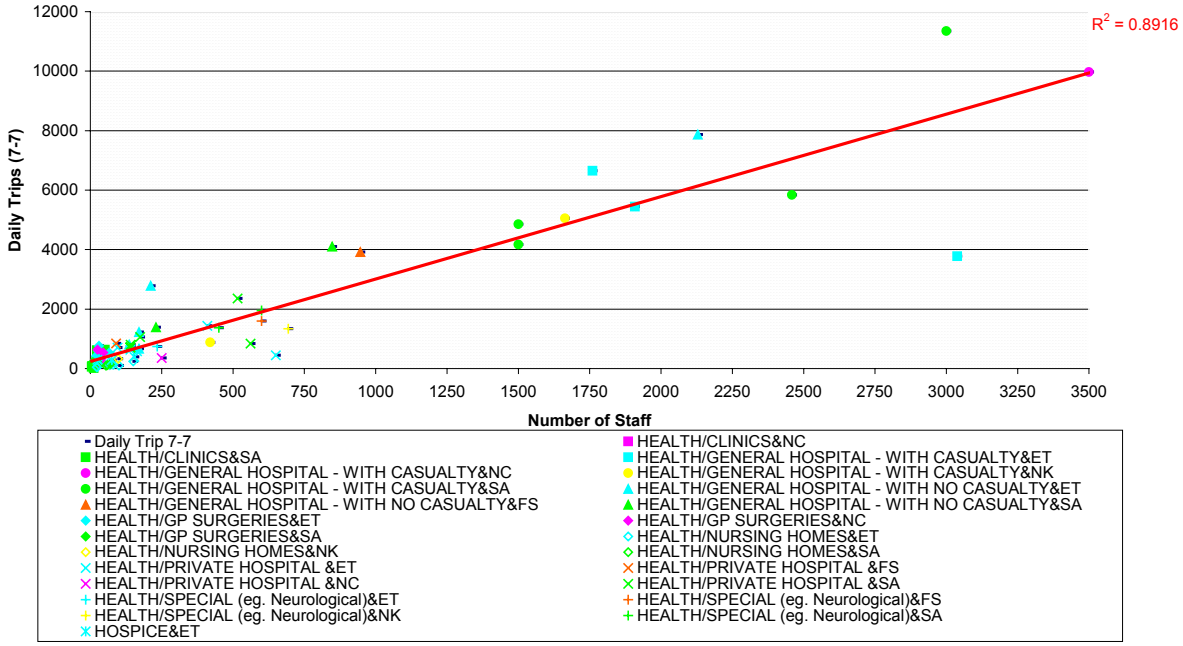
- Daily Trip 7-7
- HEALTH/CLINICS&NC
- HEALTH/CLINICS&NK
- HEALTH/CLINICS&SA
- HEALTH/GENERAL HOSPITAL - WITH CASUALTY&ET
- HEALTH/GENERAL HOSPITAL - WITH CASUALTY&NC
- HEALTH/GENERAL HOSPITAL - WITH CASUALTY&NK
- HEALTH/GENERAL HOSPITAL - WITH CASUALTY&SA
- HEALTH/GENERAL HOSPITAL - WITH NO CASUALTY&ET
- HEALTH/GENERAL HOSPITAL - WITH NO CASUALTY&FS
- HEALTH/GENERAL HOSPITAL - WITH NO CASUALTY&SA
- HEALTH/GP SURGERIES&ET
- HEALTH/GP SURGERIES&NC
- HEALTH/GP SURGERIES&SA
- HEALTH/PRIVATE HOSPITAL &ET
- HEALTH/PRIVATE HOSPITAL &FS
- HEALTH/PRIVATE HOSPITAL &NC
- HEALTH/PRIVATE HOSPITAL &SA
- HEALTH/SPECIAL (eg. Neurological)&ET
- HEALTH/SPECIAL (eg. Neurological)&FS
- HEALTH/SPECIAL (eg. Neurological)&NK
- HEALTH/SPECIAL (eg. Neurological)&SA
- HOSPICE&ET

Number of Beds and Daily Vehicle Trips for the Total TRICS 5.2 Sample

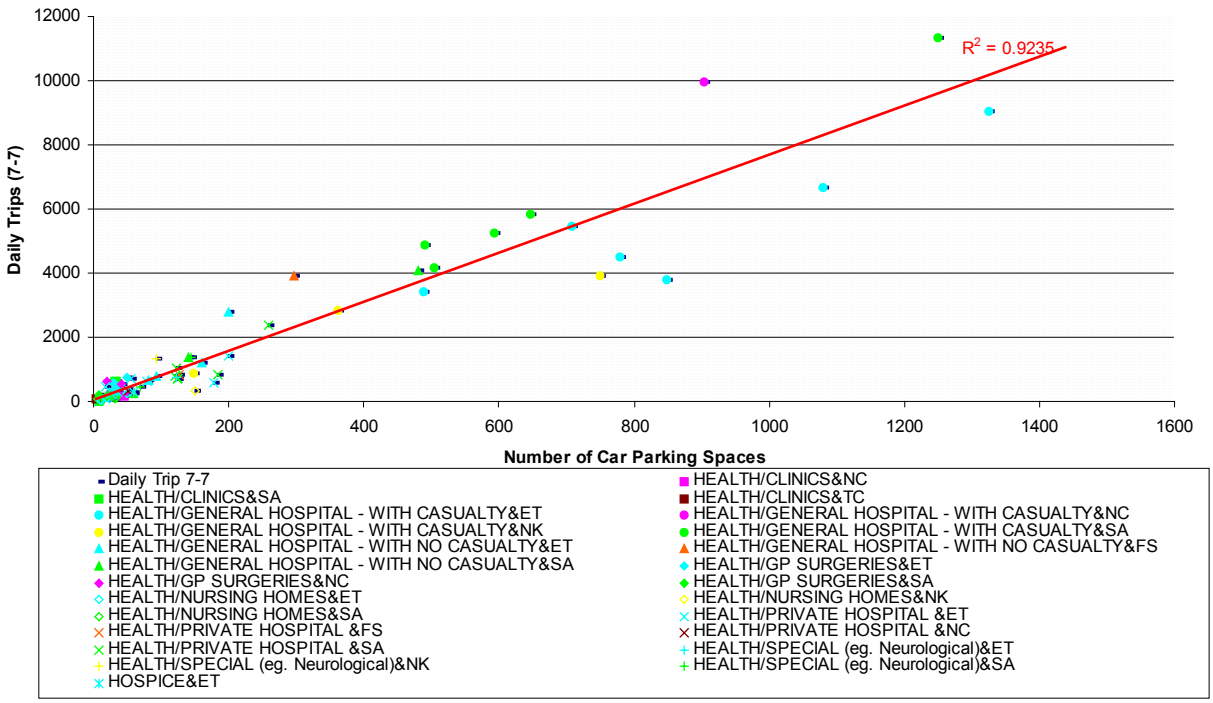


- Daily Trip 7-7
- HEALTH/GENERAL HOSPITAL - WITH CASUALTY&ET
- HEALTH/GENERAL HOSPITAL - WITH CASUALTY&NC
- HEALTH/GENERAL HOSPITAL - WITH CASUALTY&NK
- HEALTH/GENERAL HOSPITAL - WITH CASUALTY&SA
- HEALTH/GENERAL HOSPITAL - WITH NO CASUALTY&ET
- HEALTH/GENERAL HOSPITAL - WITH NO CASUALTY&FS
- HEALTH/GENERAL HOSPITAL - WITH NO CASUALTY&SA
- HEALTH/PRIVATE HOSPITAL &ET
- HEALTH/PRIVATE HOSPITAL &FS
- HEALTH/PRIVATE HOSPITAL &NC
- HEALTH/PRIVATE HOSPITAL &SA
- HEALTH/SPECIAL (eg. Neurological)&ET
- HEALTH/SPECIAL (eg. Neurological)&FS
- HEALTH/SPECIAL (eg. Neurological)&SA
- HOSPICE&ET

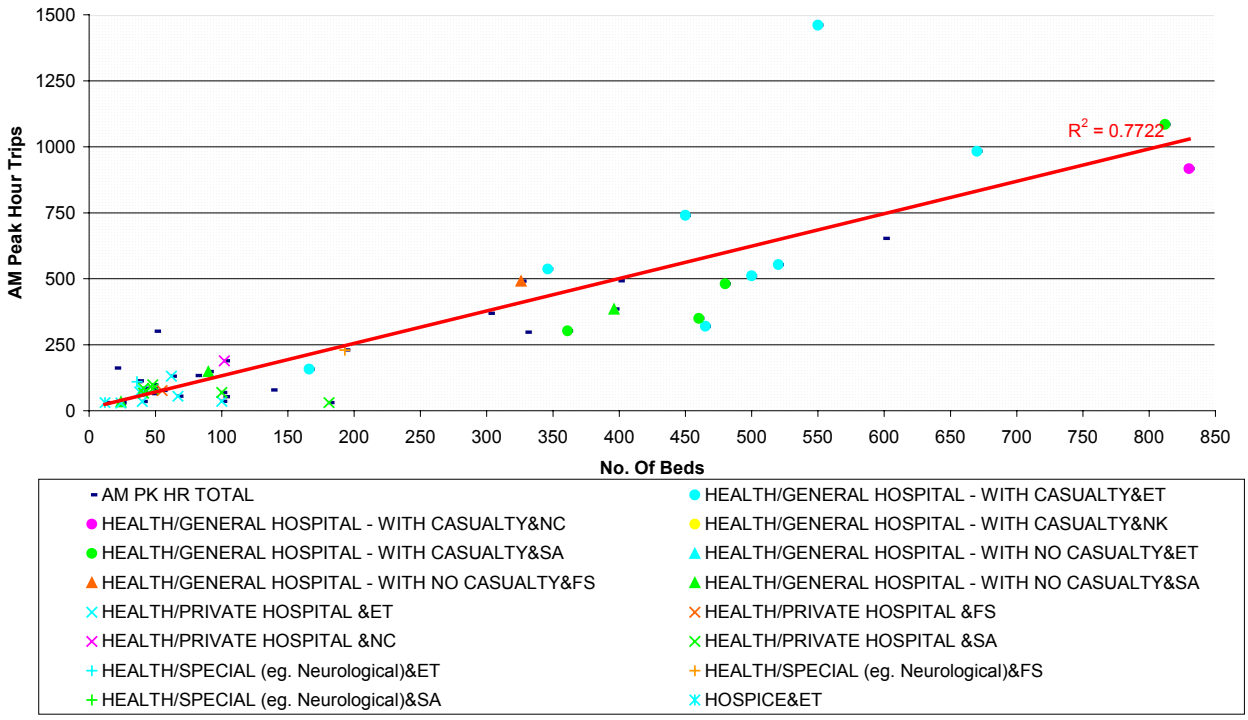
Number of Employees and Daily Vehicle Trips for the Total TRICS 5.2 Sample



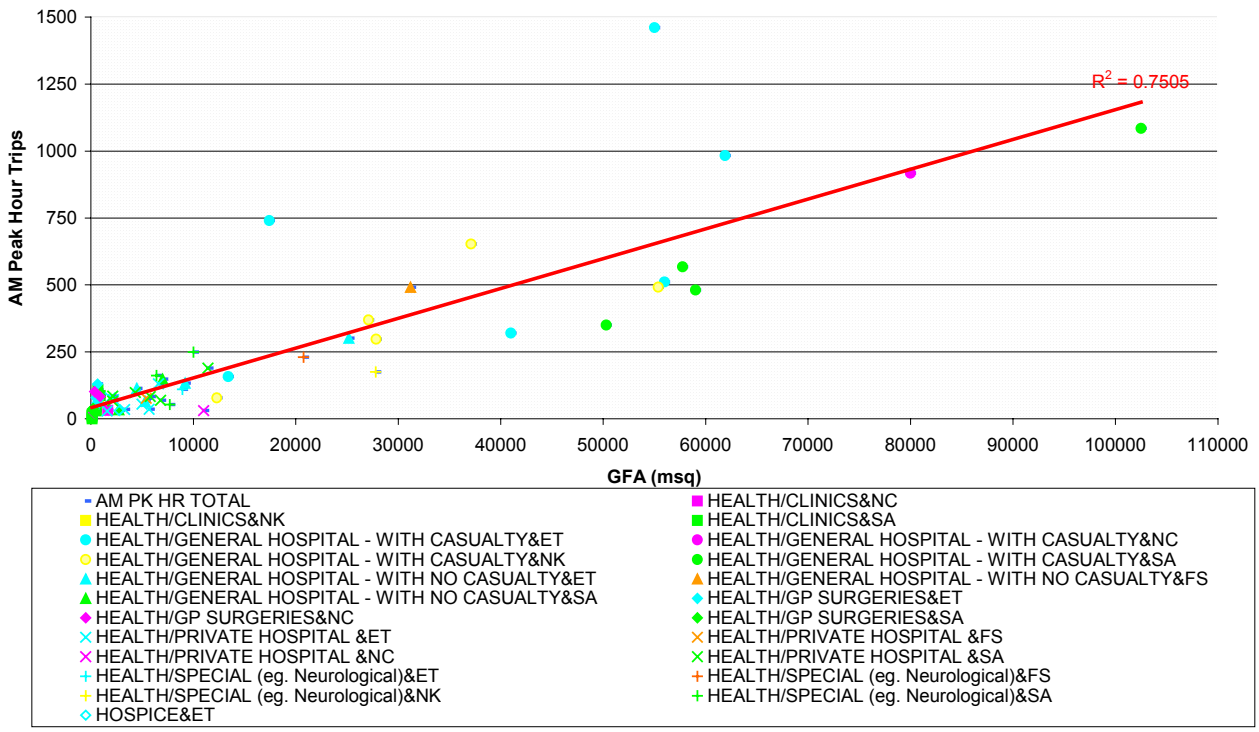
Number of Parking Spaces and Daily Vehicle Trips for the Total TRICS 5.2 Sample



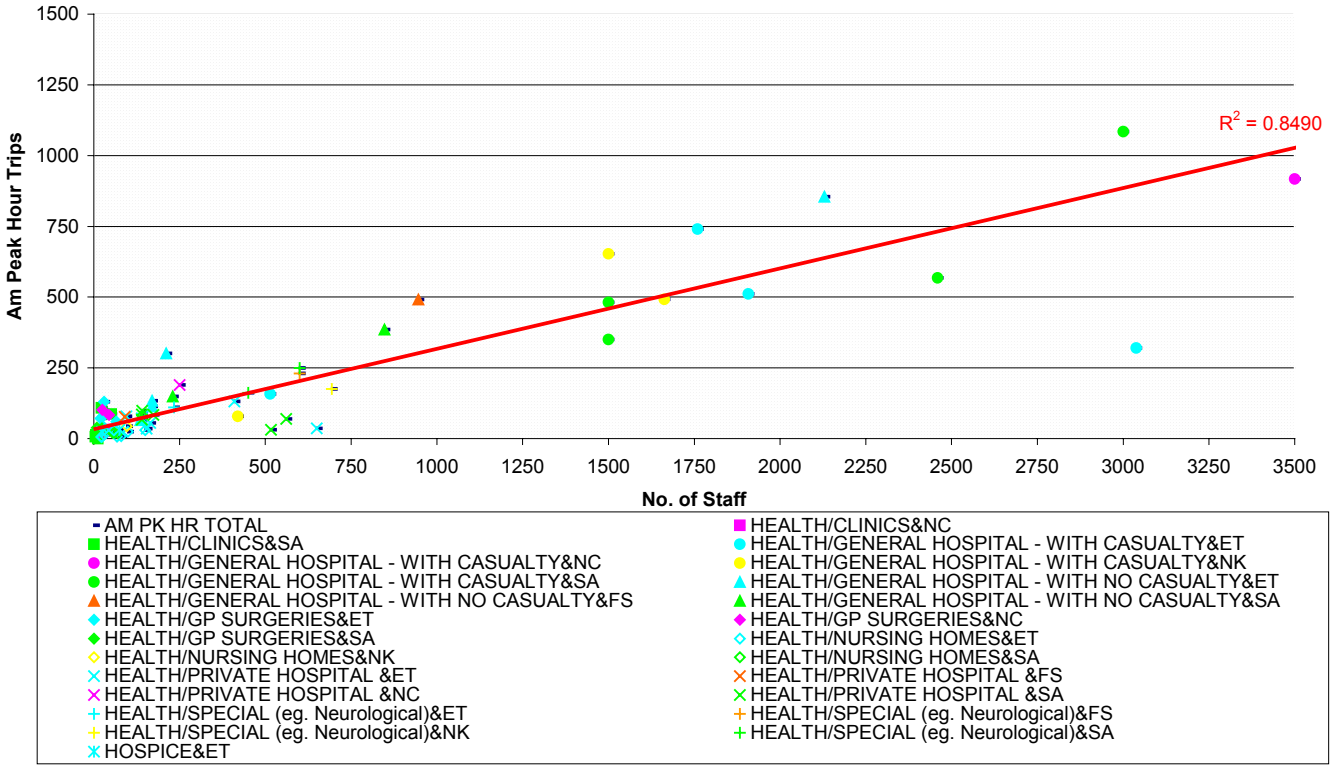
Number of Beds and Am Peak Hour Vehicle Trips for the Total TRICS 5.2 Sample



Gross Floor Area and Am Peak Hour Vehicle Trips for the Total TRICS 5.2 Sample



No. of Staff and AM Peak Hour Vehicle Trips for the Total TRICS 5.2 Sample



No. of Car Parking Spaces and AM Peak Hour Vehicle Trips for the Total TRICS 5.2 Sample

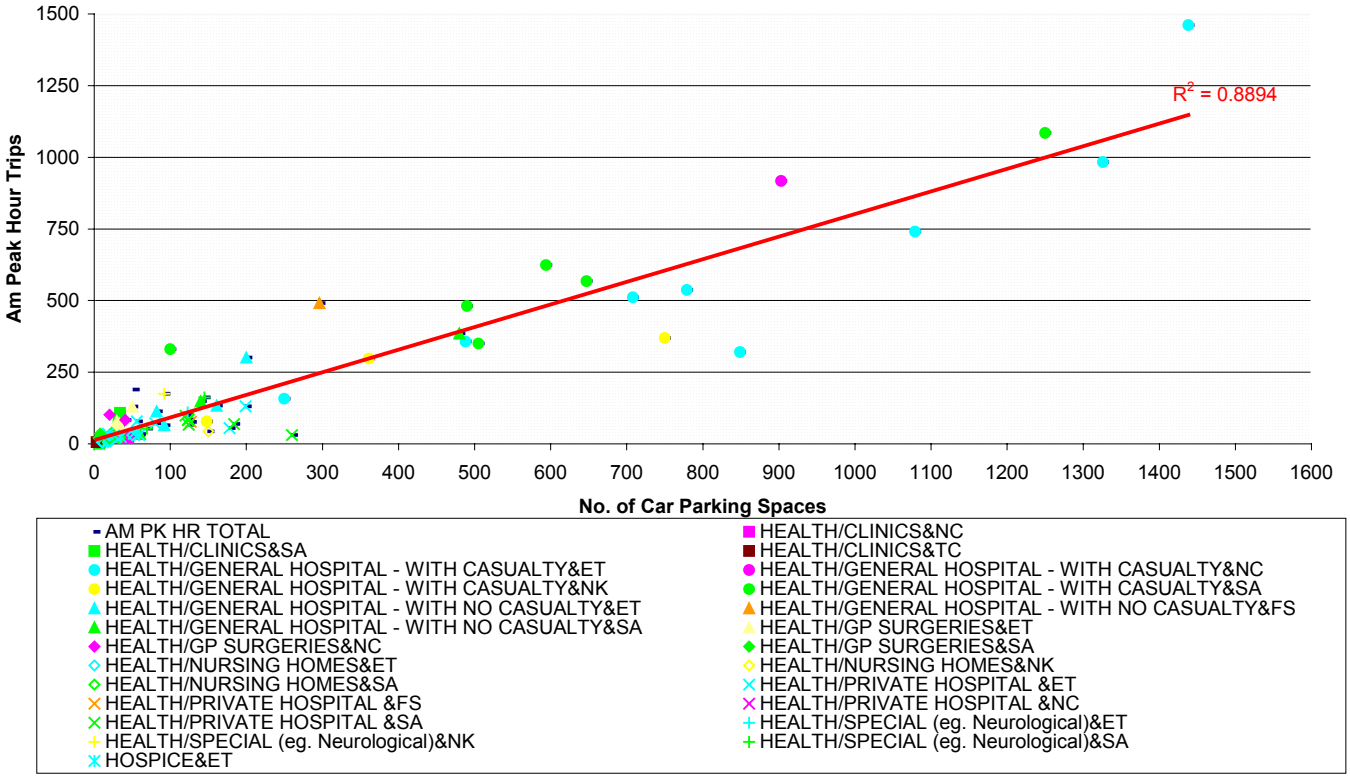
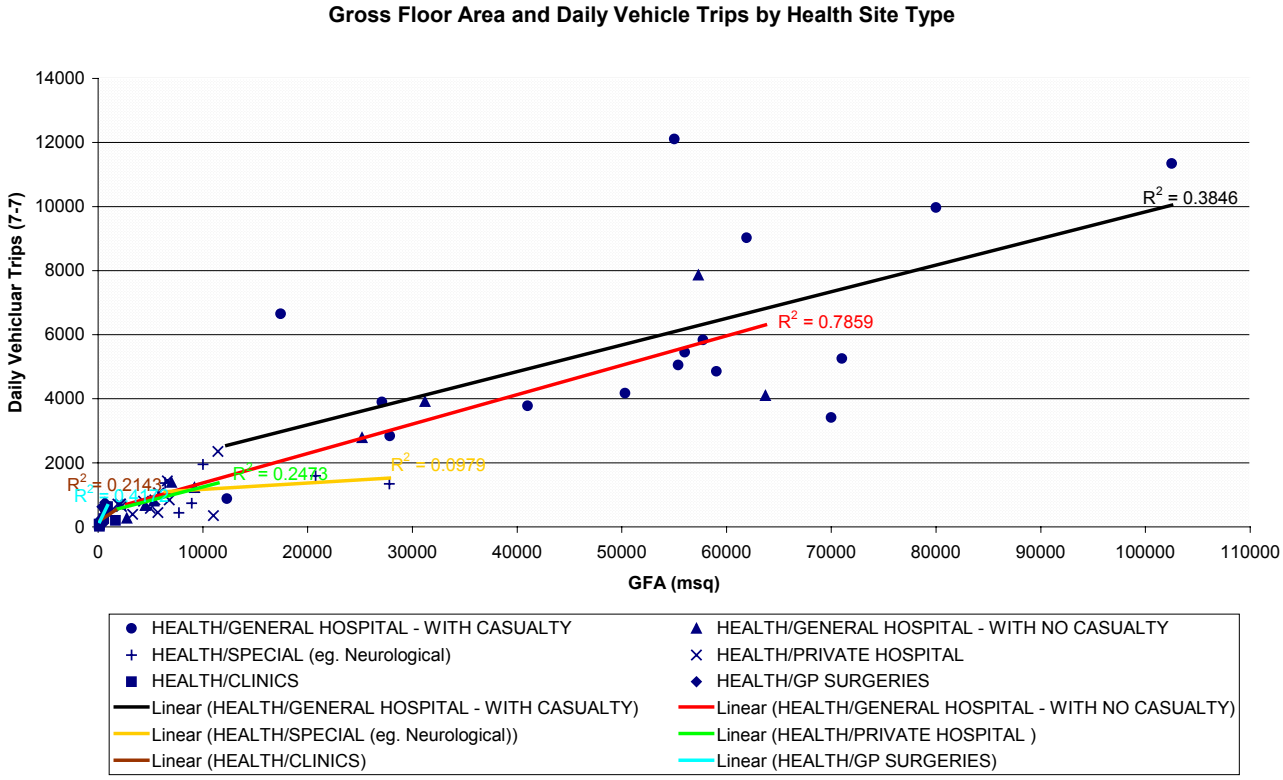
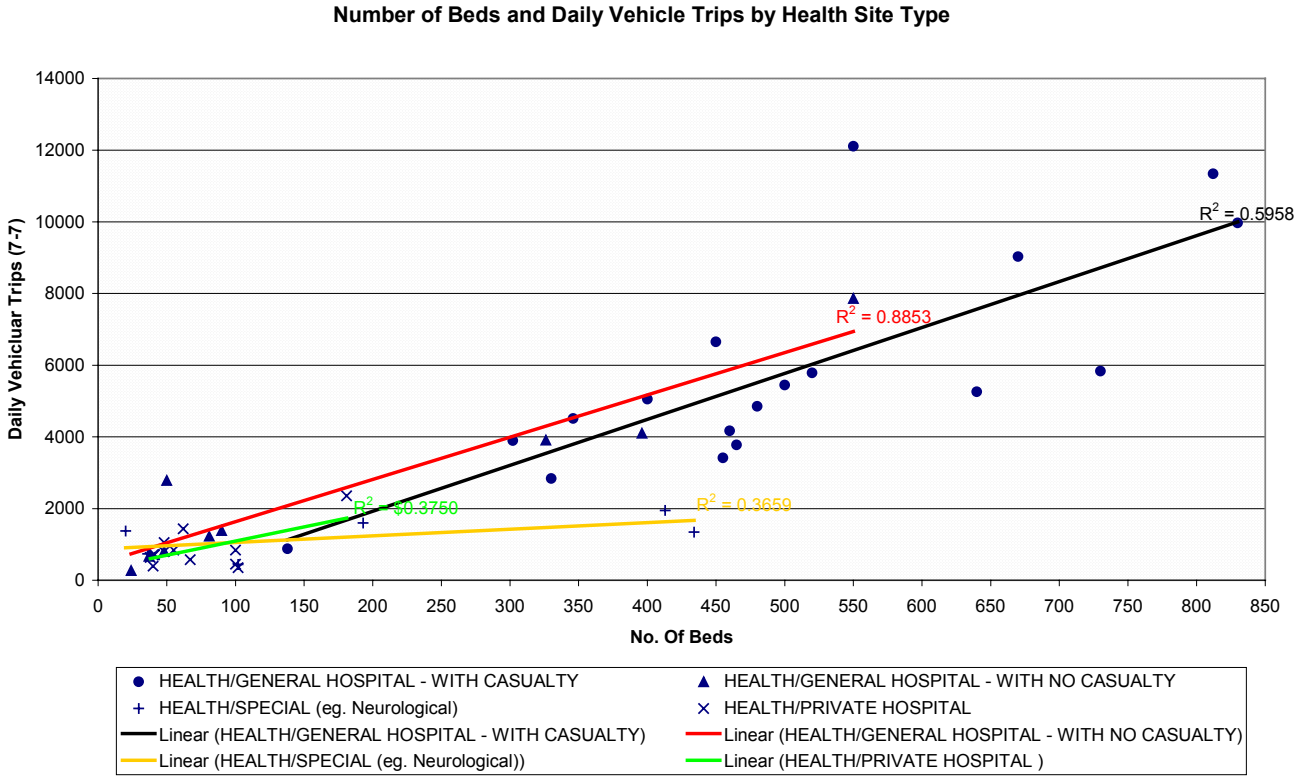
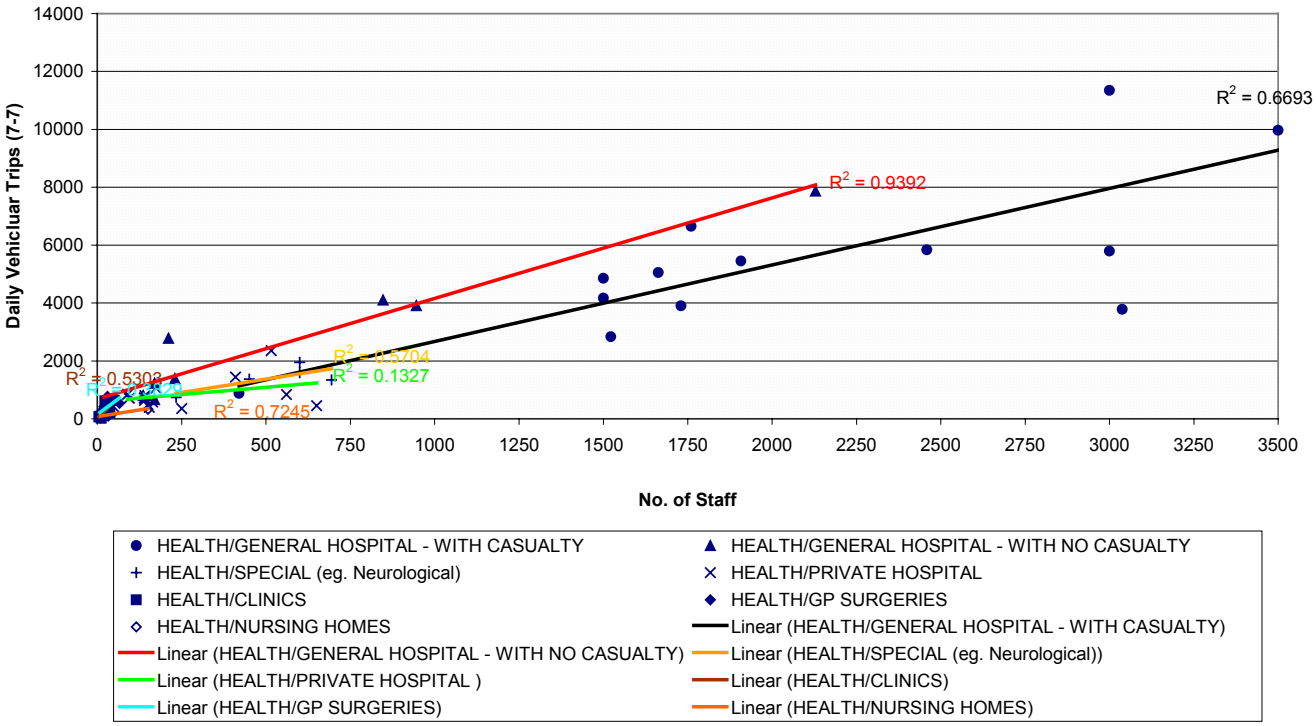


Table 7.2 Plot Data: Regression Analysis of the Total TRICS 5.2 Sample, Daily Vehicular Trips by Site Type





No. of Staff and Daily Vehicle Trips by Health Site Type



Number of Car Parking Spaces and Daily Vehicle Trips by Health Site Type

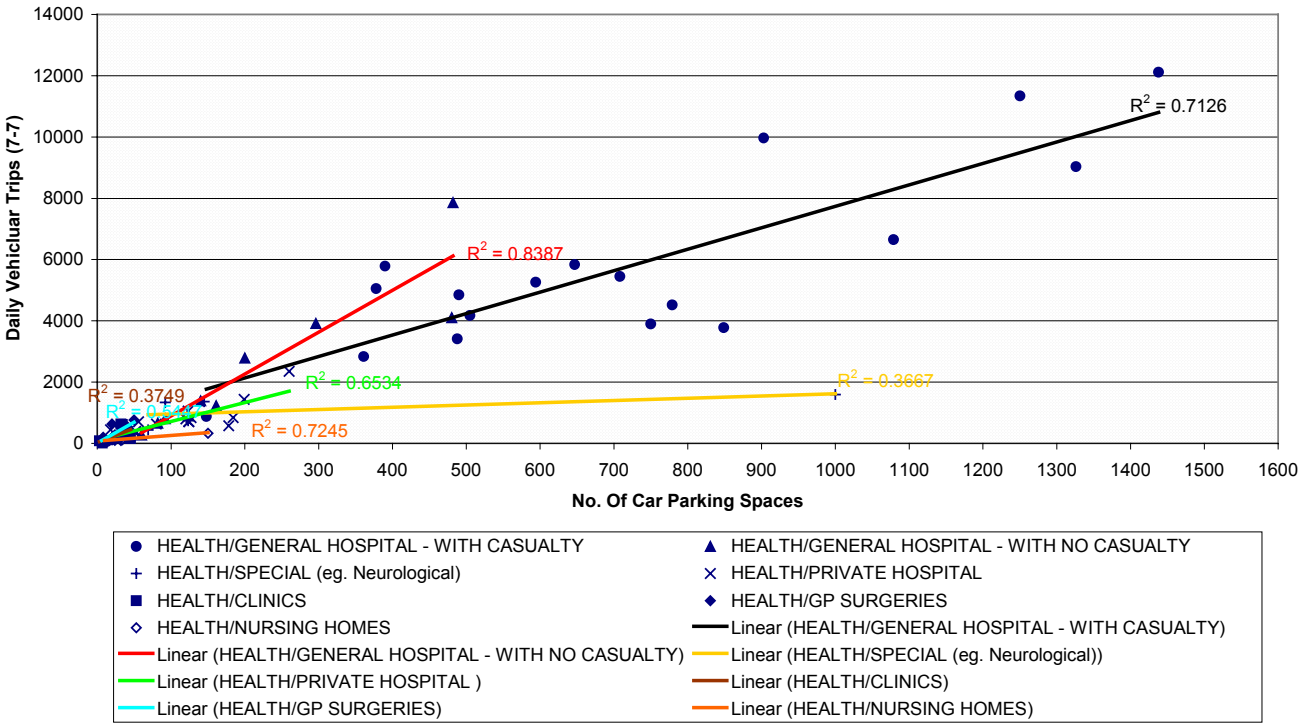
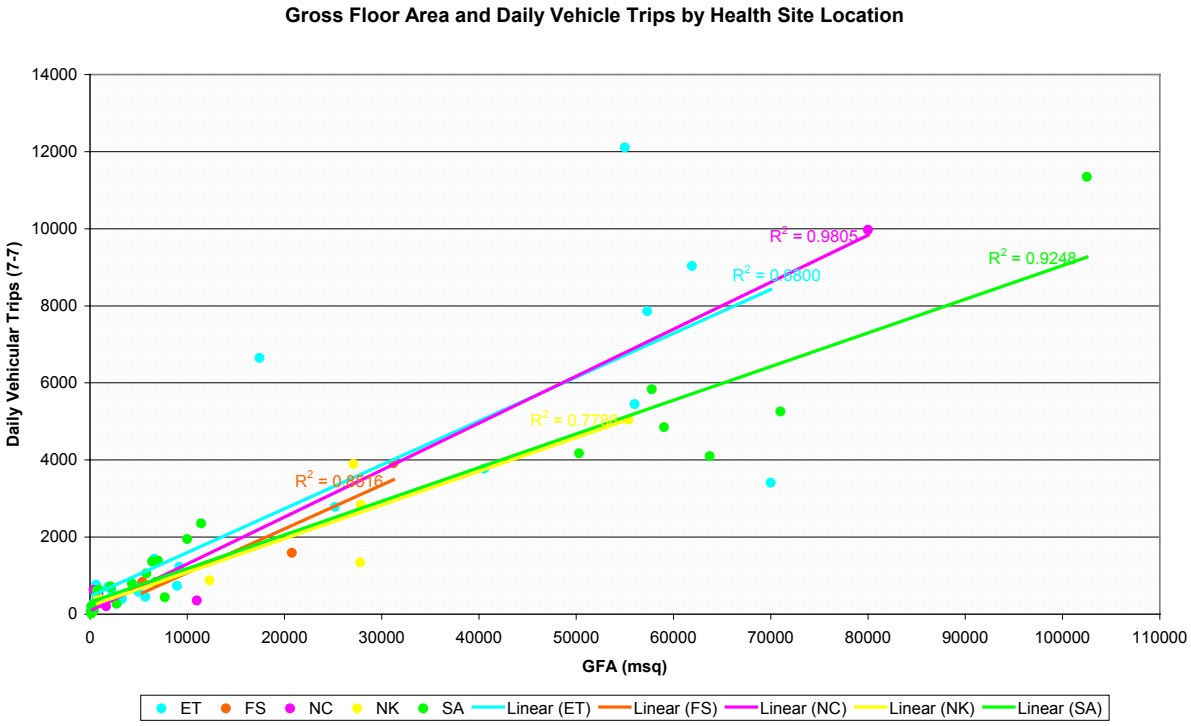
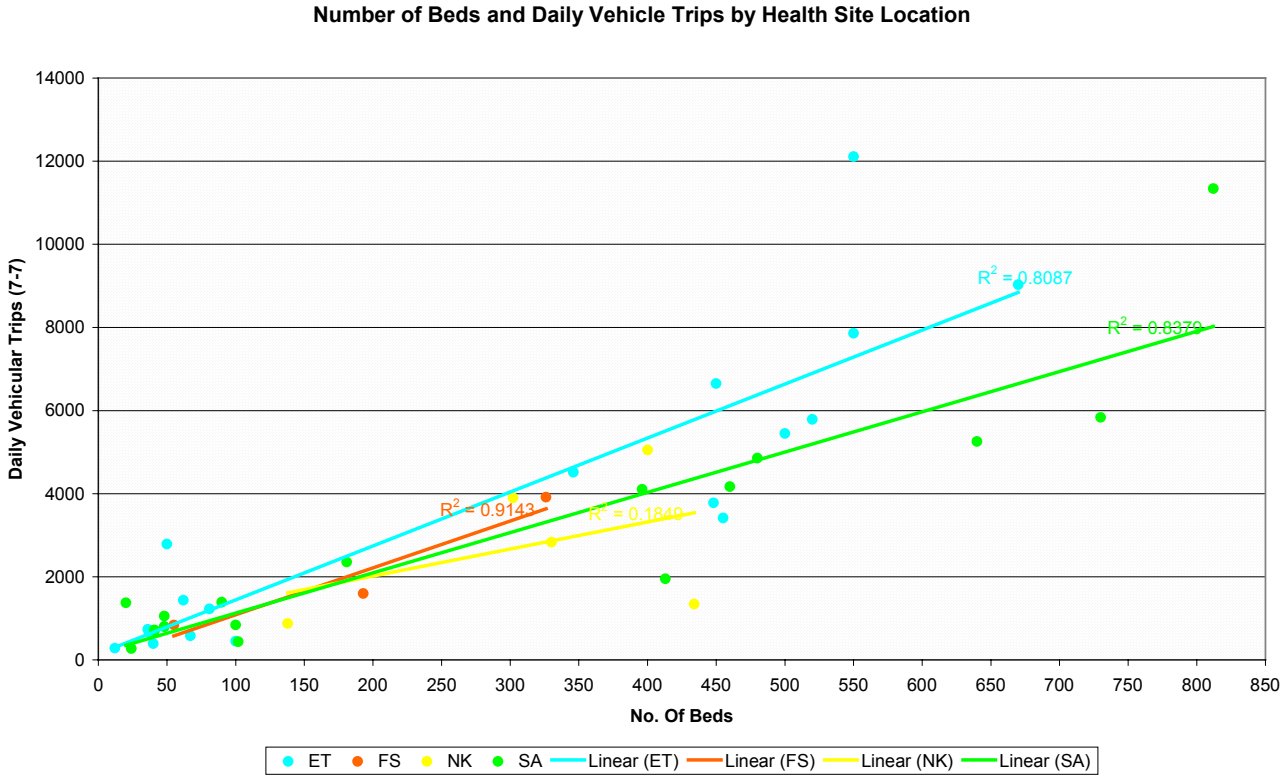
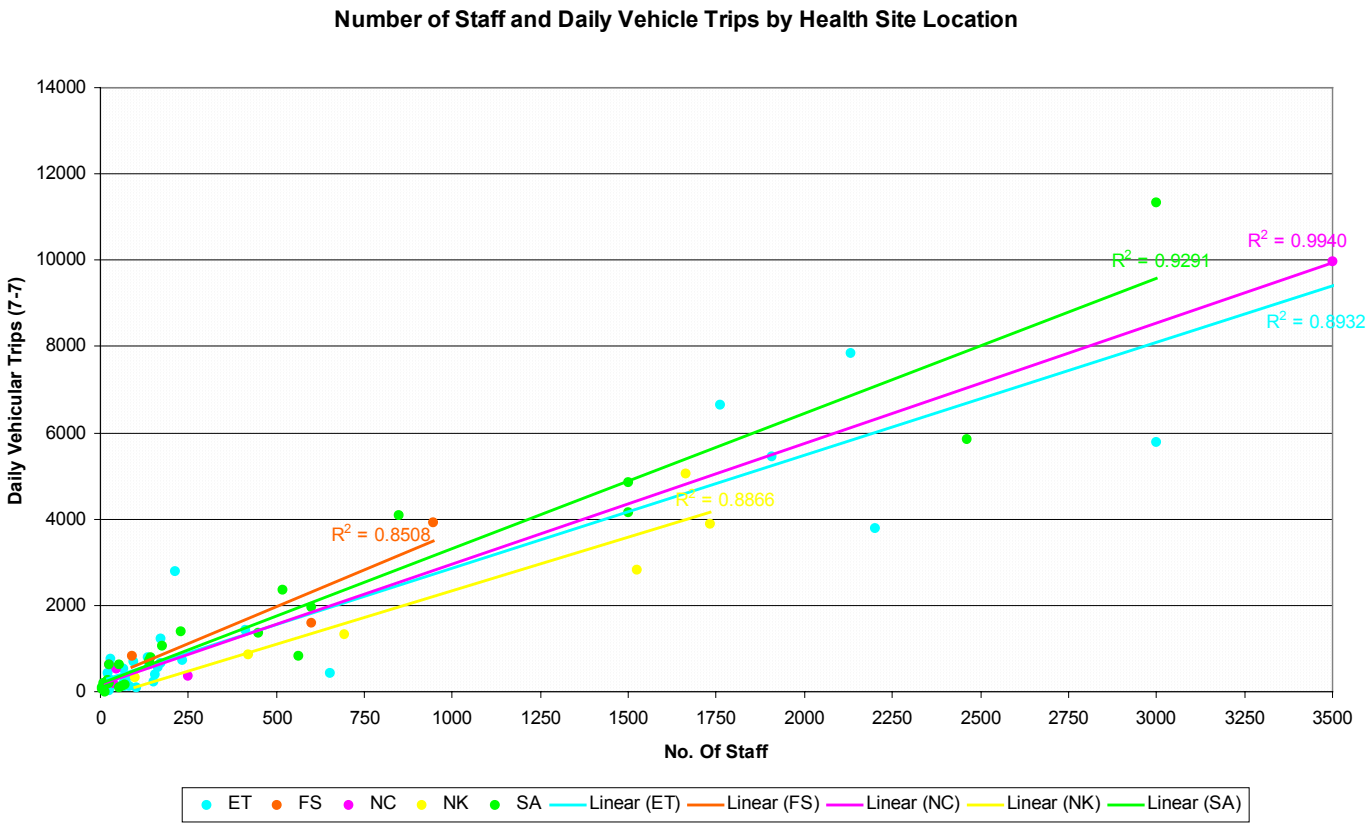
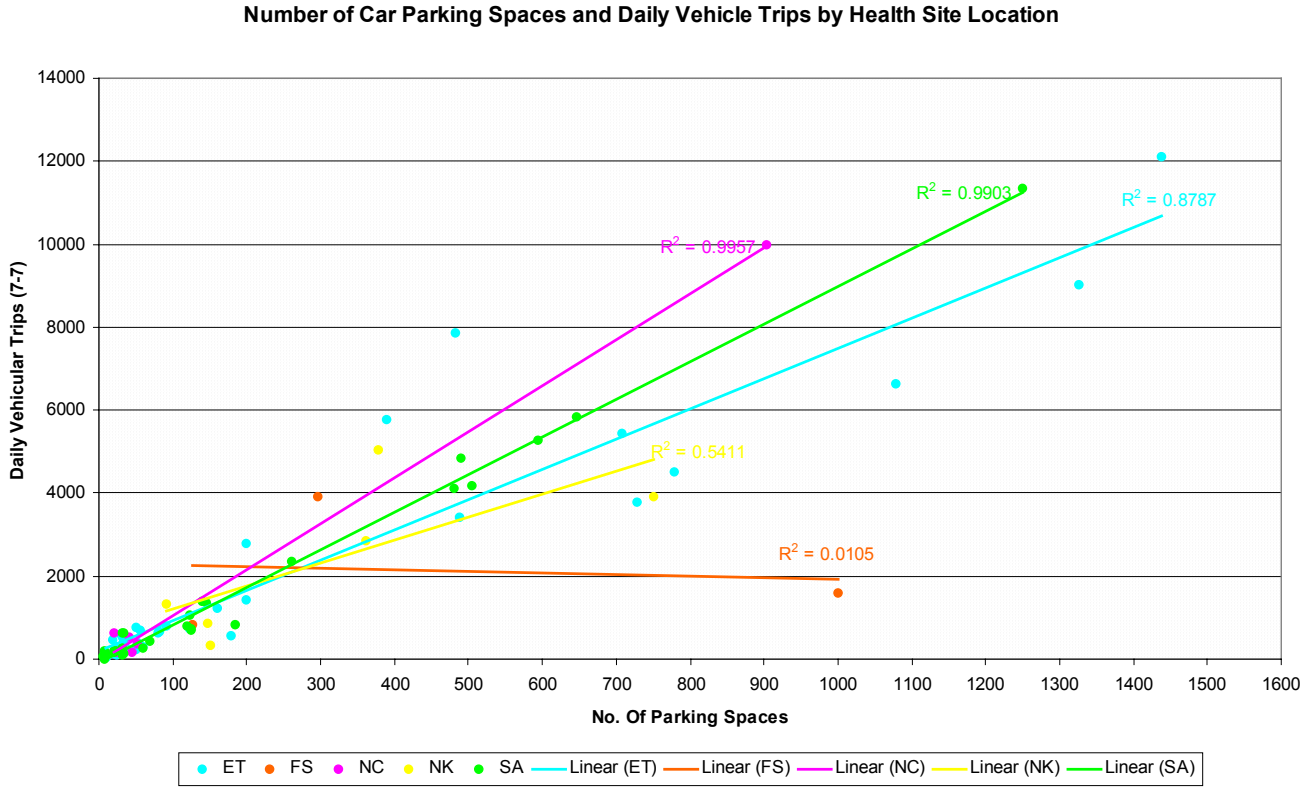


Table 7.3 Plot Data: Regression Analysis of the Total TRICS 5.2 Sample, Daily Vehicular Trips by Health Site Location






Number of Staff and Daily Vehicle Trips by Health Site Location
Daily Vehicular Trips (7-7)
No. Of Staff
R2 = 0.8508
R2 = 0.8866
R2 = 0.9291
R2 = 0.9940
R2 = 0.8932
ET FS NC NK SA Linear (ET) Linear (FS) Linear (NC) Linear (NK) Linear (SA)

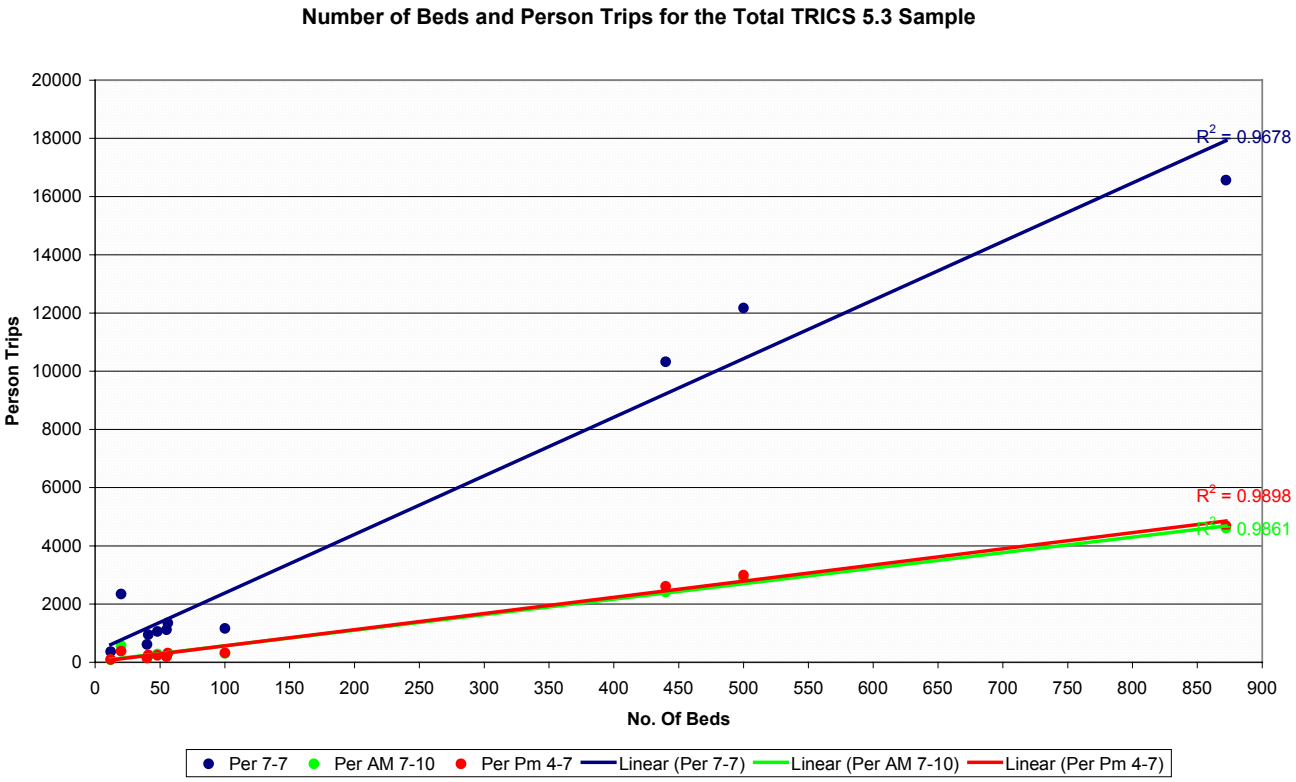

Number of Car Parking Spaces and Daily Vehicle Trips by Health Site Location
Daily Vehicular Trips (7-7)
No. Of Parking Spaces
R2 = 0.5411
R2 = 0.0105
R2 = 0.9957
R2 = 0.9903
R2 = 0.8787
ET FS NC NK SA Linear (ET) Linear (FS) Linear (NC) Linear (NK) Linear (SA)

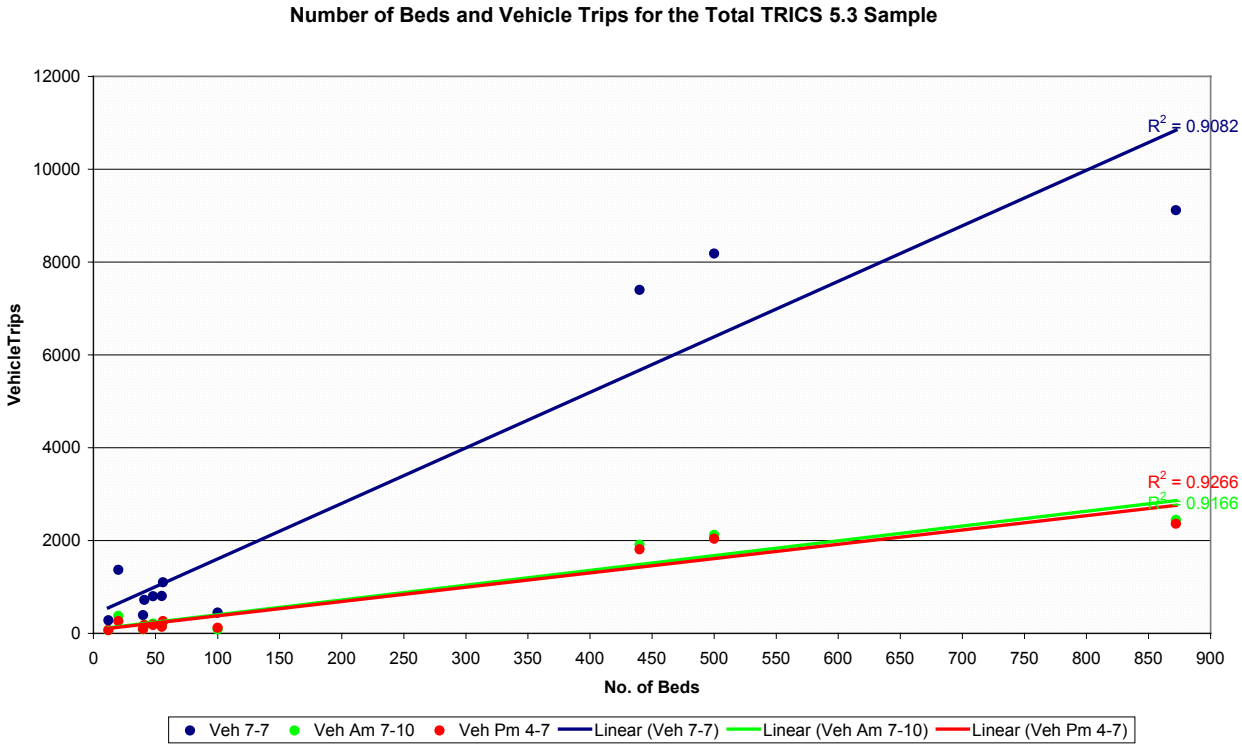
Appendix B

TRICS Version 5.3 Plot Data

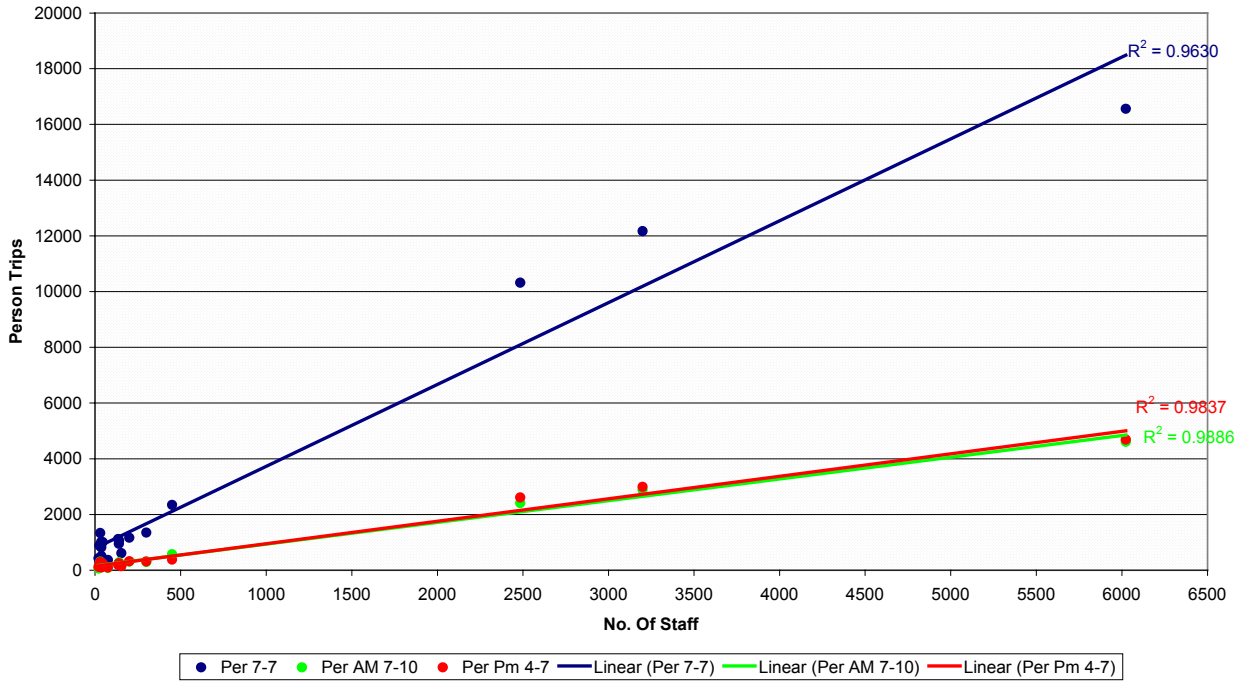
Appendix B

Table 7.4 Plot Data: Regression Analysis for the Total TRICS 5.3 Sample, Person and Vehicle Trips.

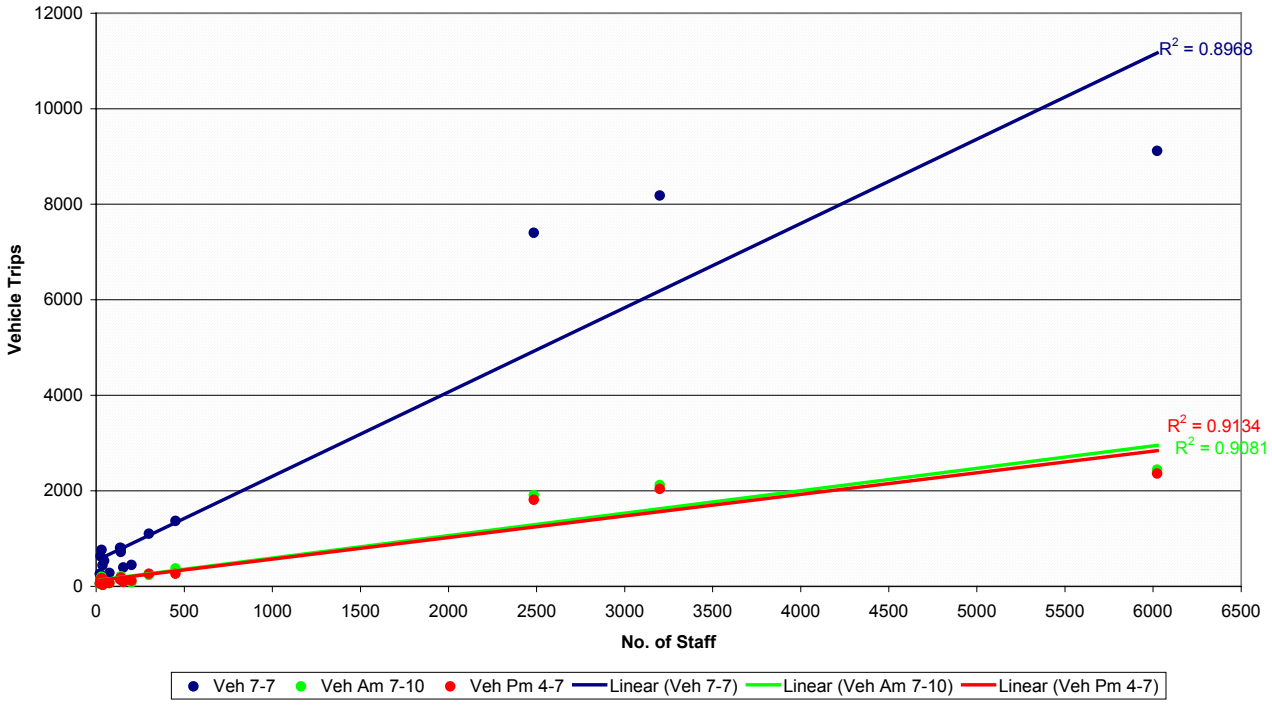




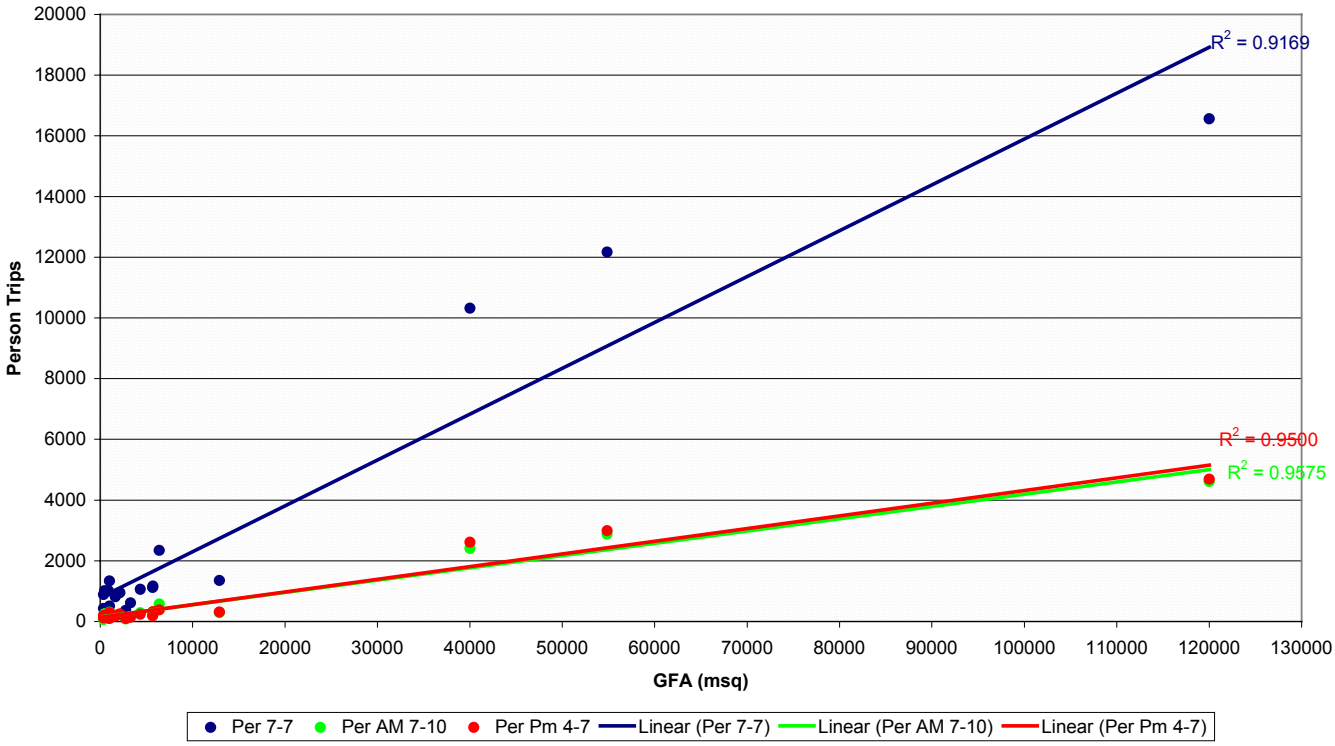
Number of Staff and Person Trips for the Total TRICS 5.3 Sample



Number of Staff and Vehicle Trips for the Total TRICS 5.3 Sample



GFA and Person Trips for the Total TRICS 5.3 Sample



GFA and Vehicle Trips for the Total TRICS 5.3 Sample

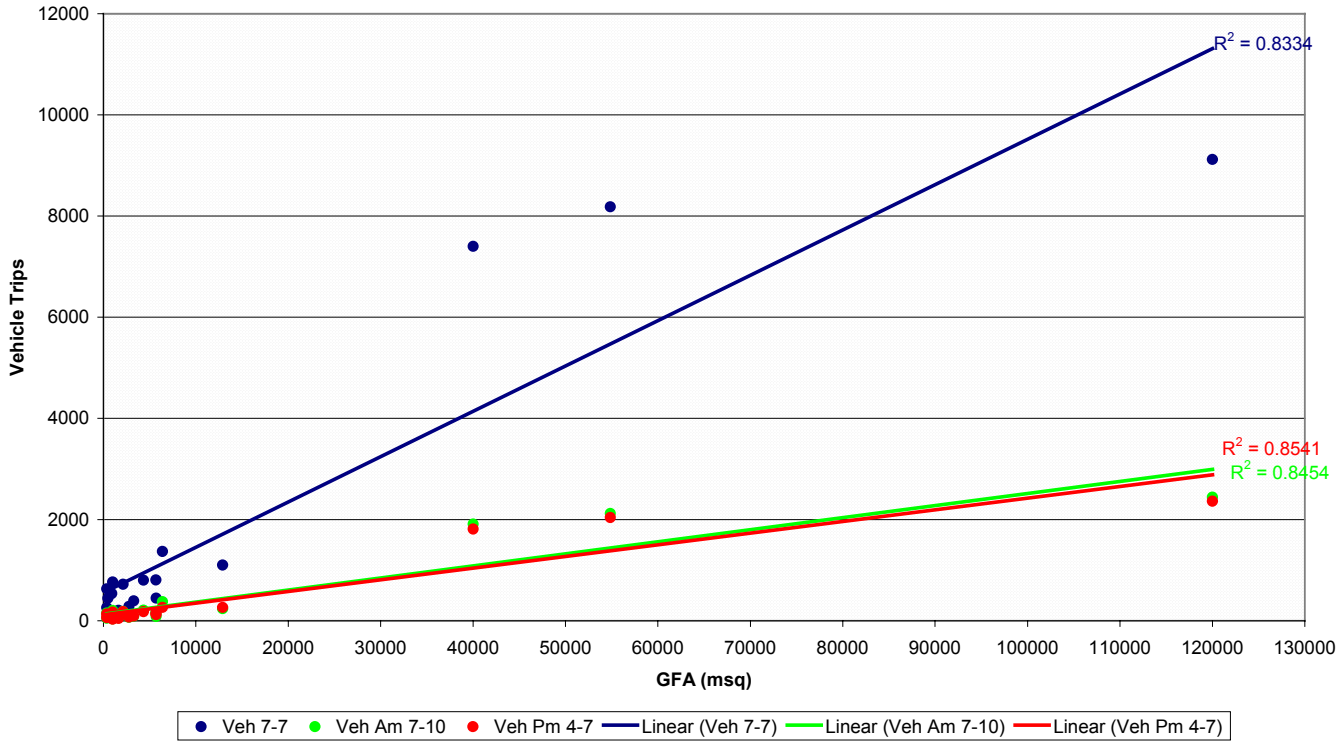
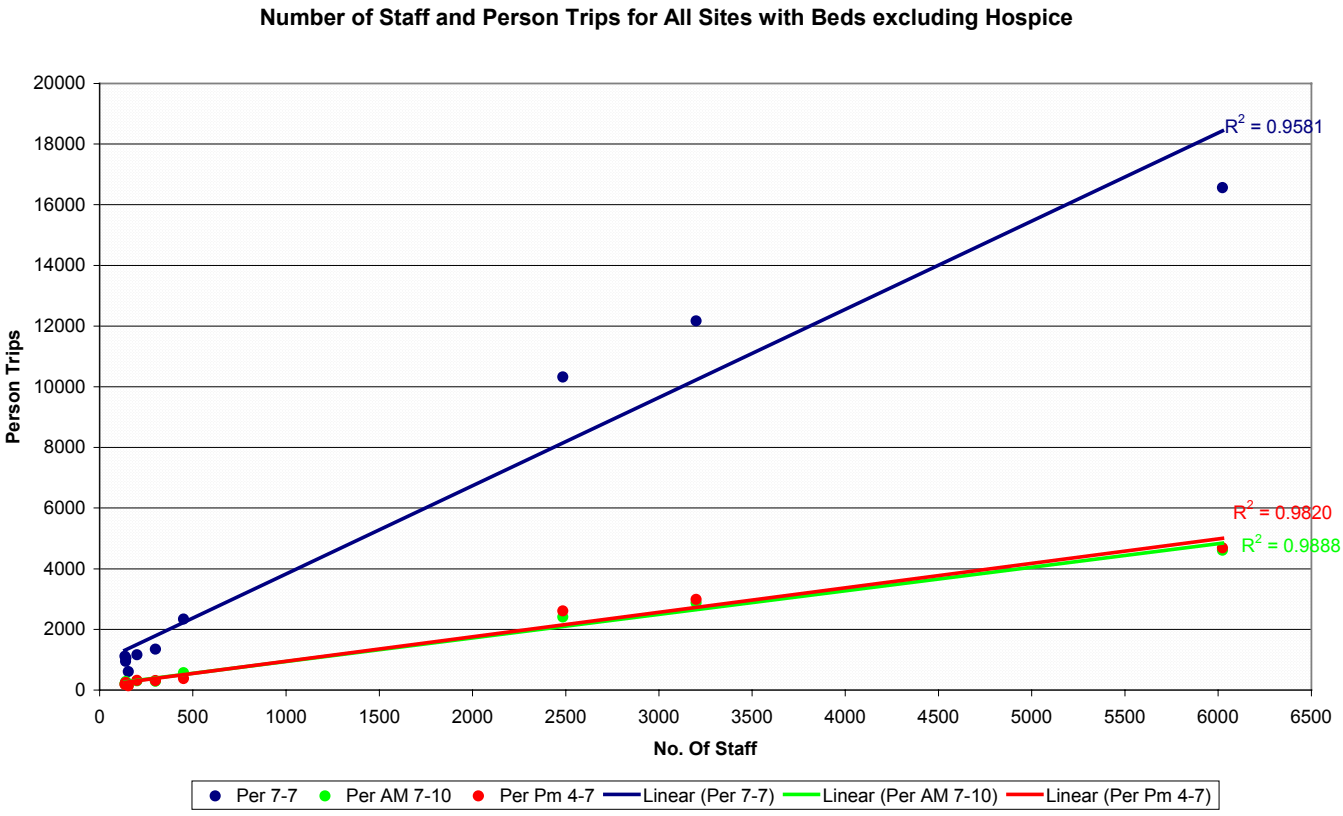
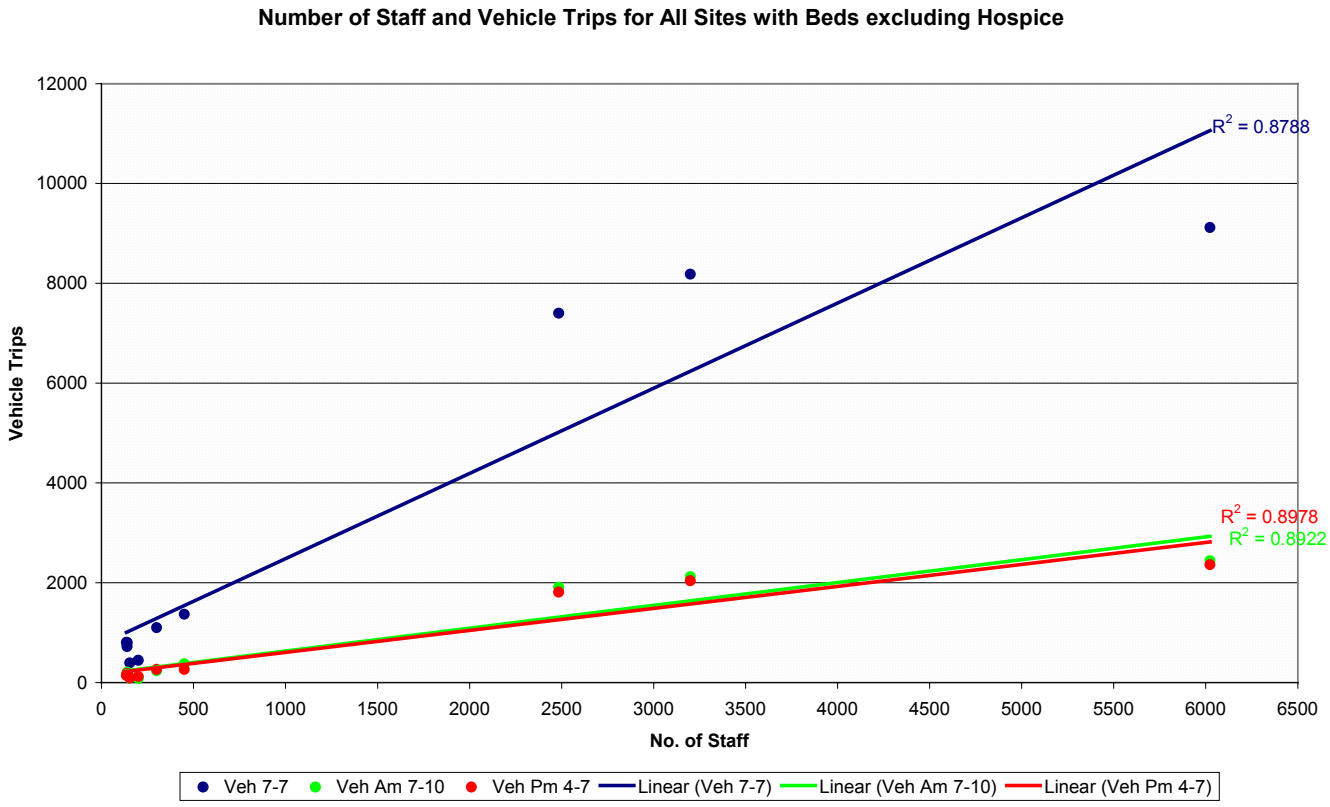
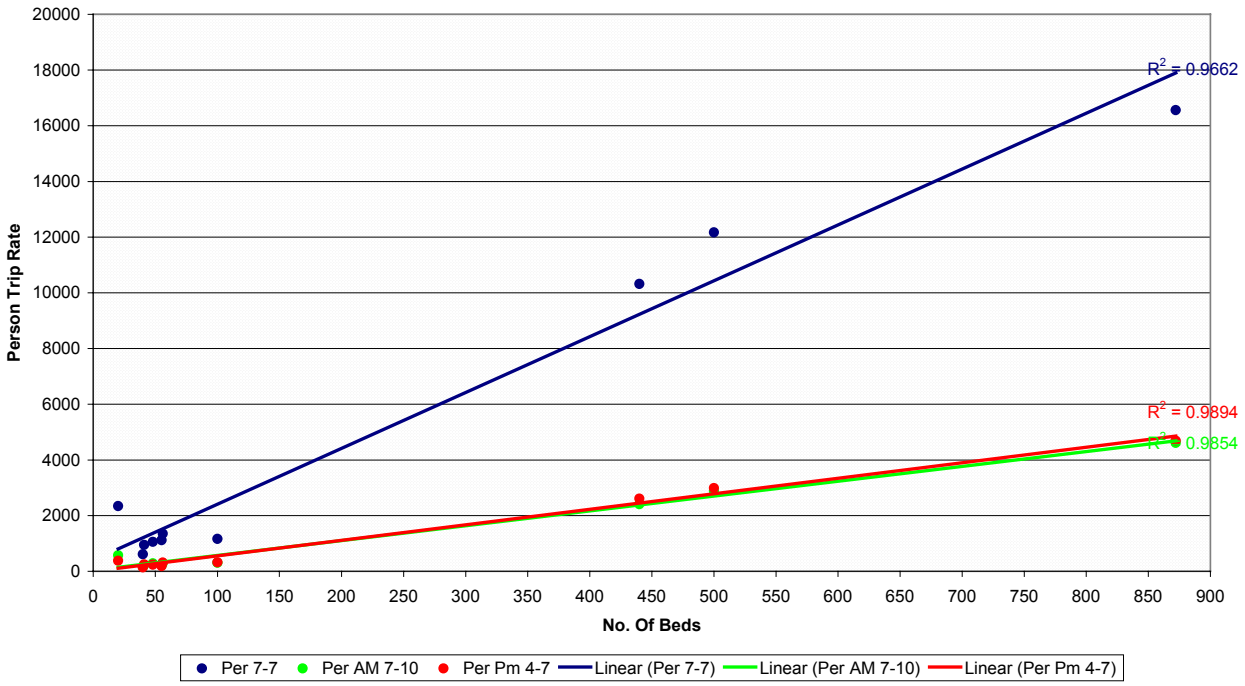


Table 7.5 Plot Data: Regression Analysis for All sites with beds excluding Hospices, Person and Vehicle Trips.

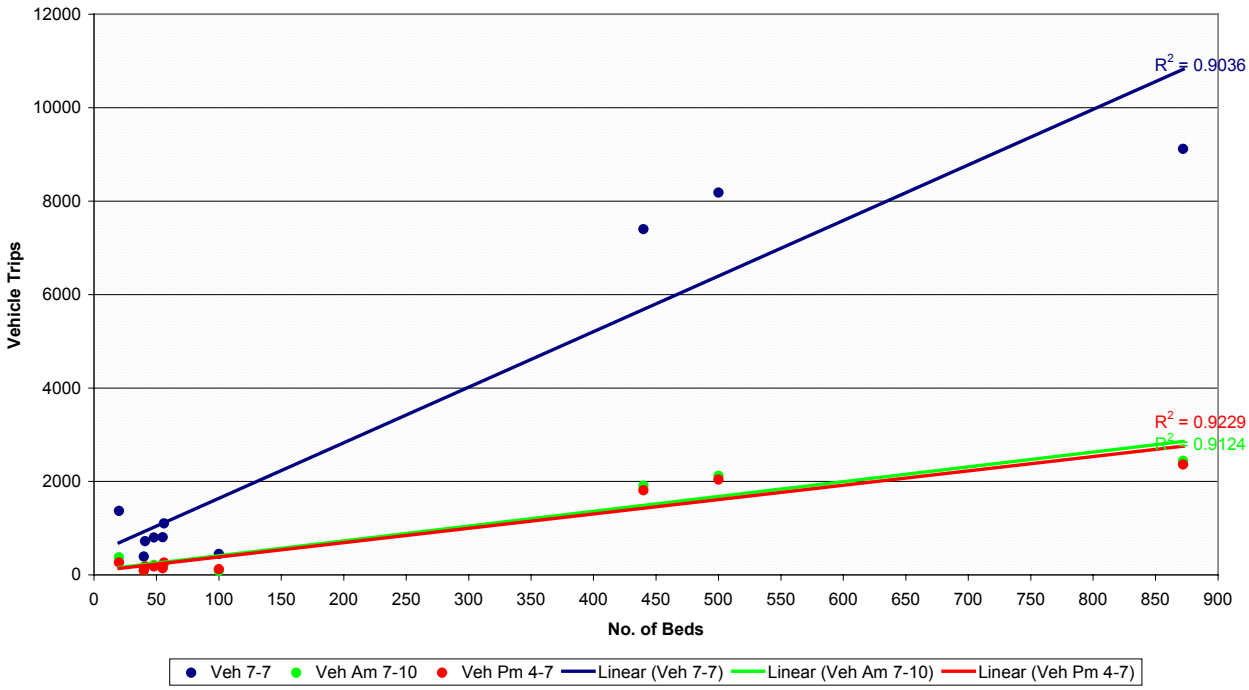




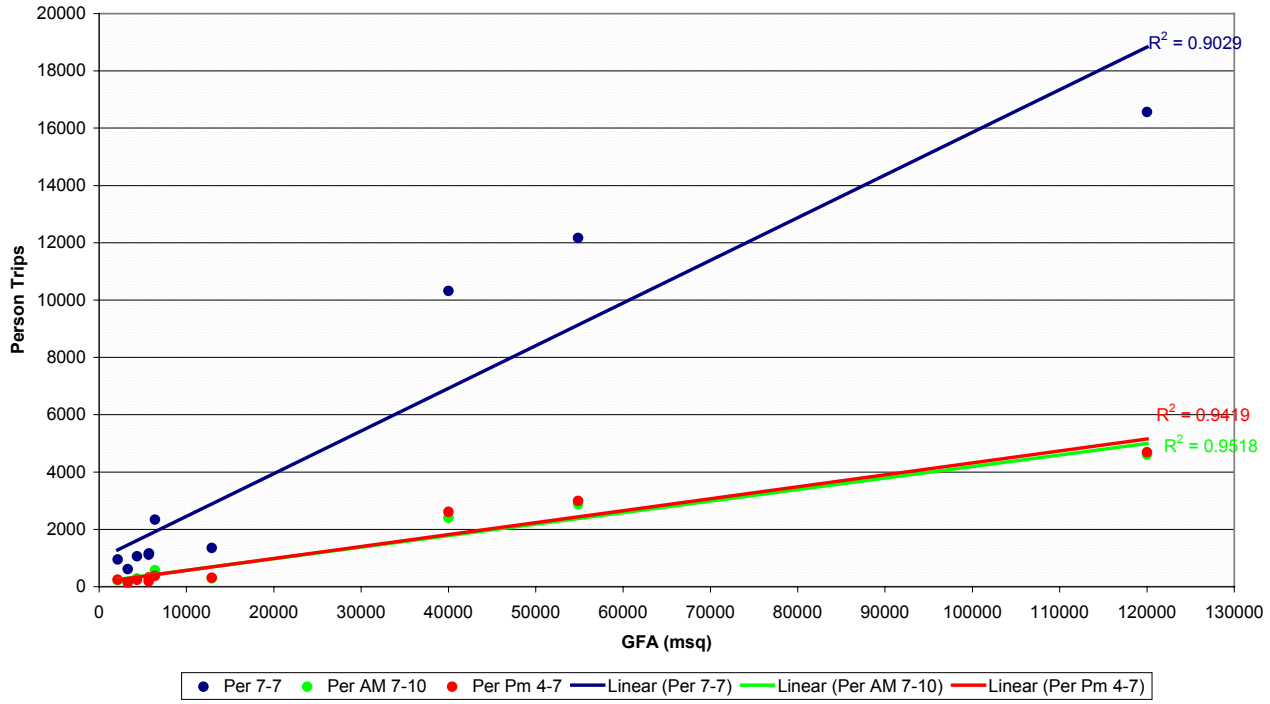
Number of Beds and Person Trips for All Sites with Beds excluding Hospice



Number of Beds and Vehicle Trips for All Sites with Beds excluding Hospice



GFA and Person Trips for All Sites with Beds excluding Hospice



GFA and Vehicle Trips for All Sites with Beds excluding Hospice

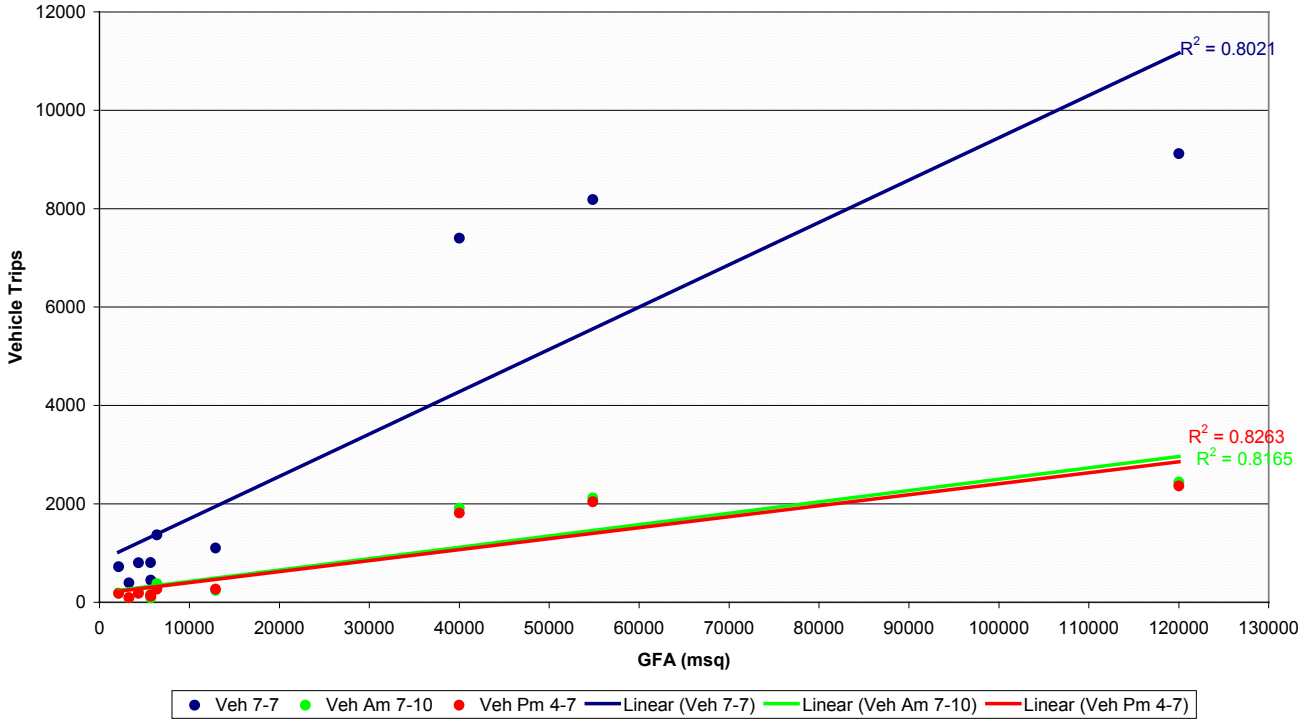
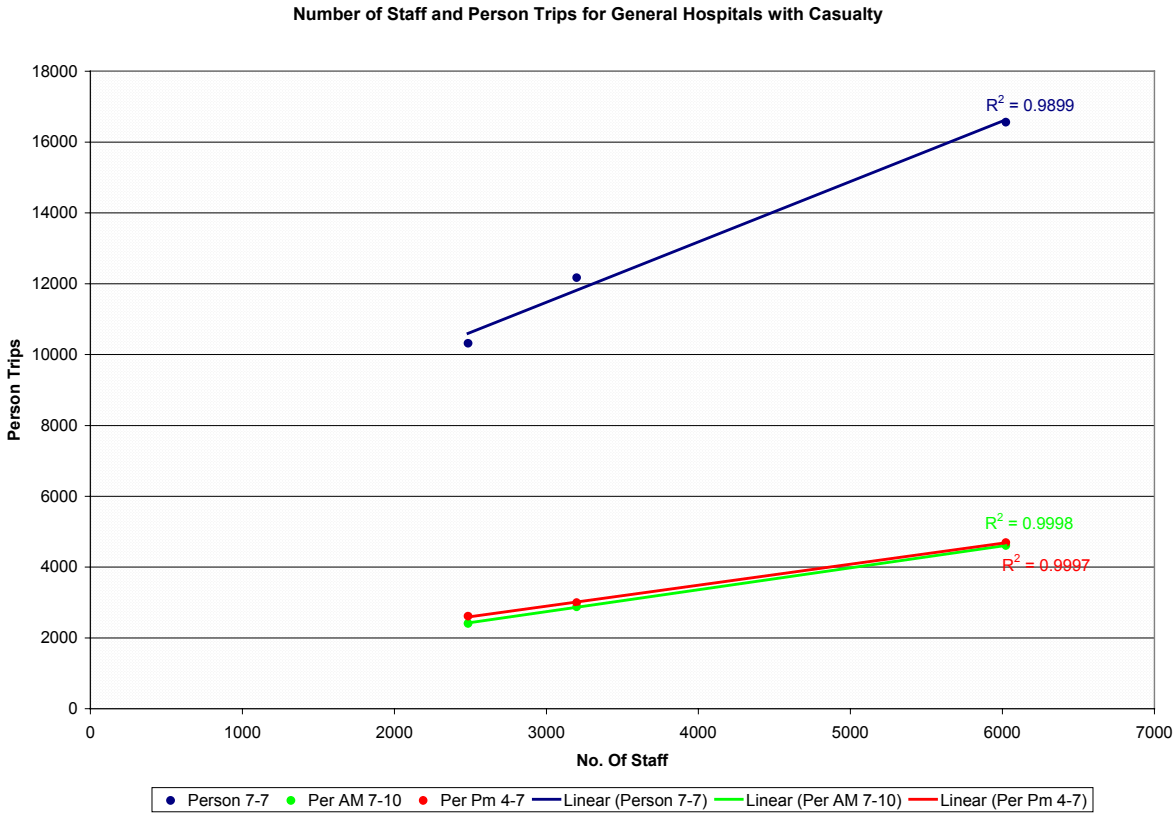
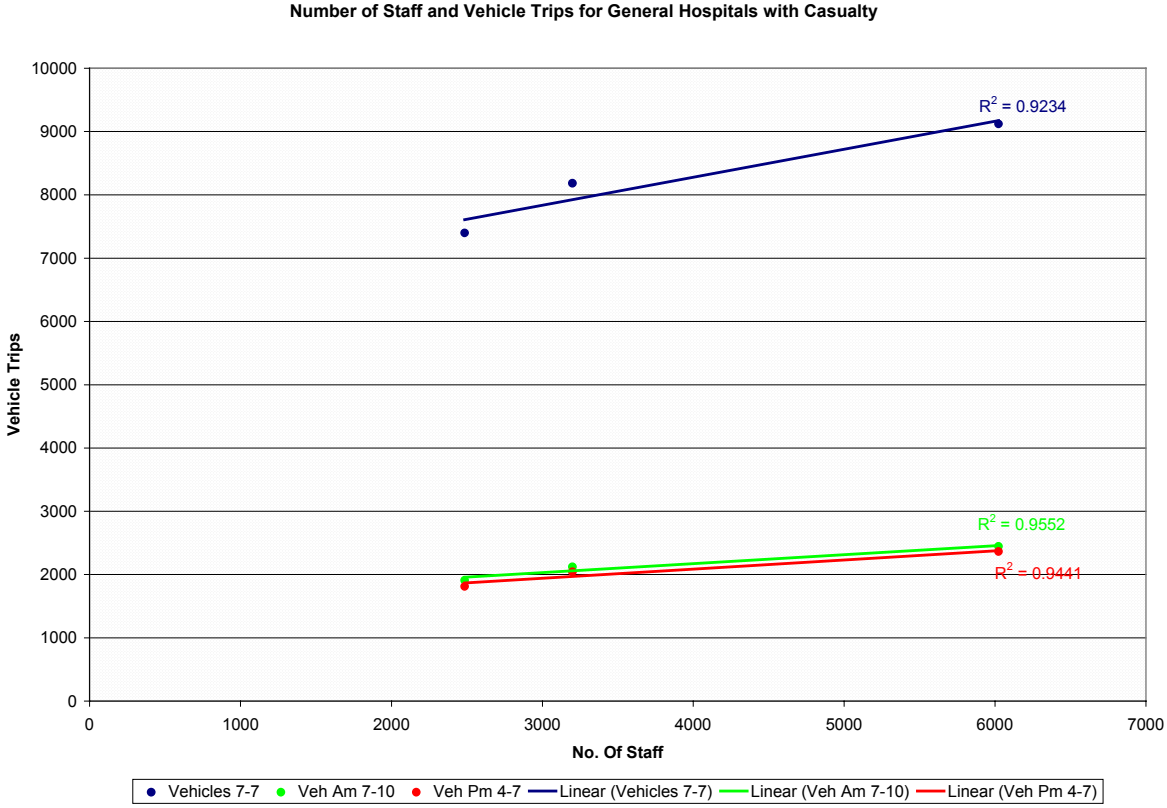
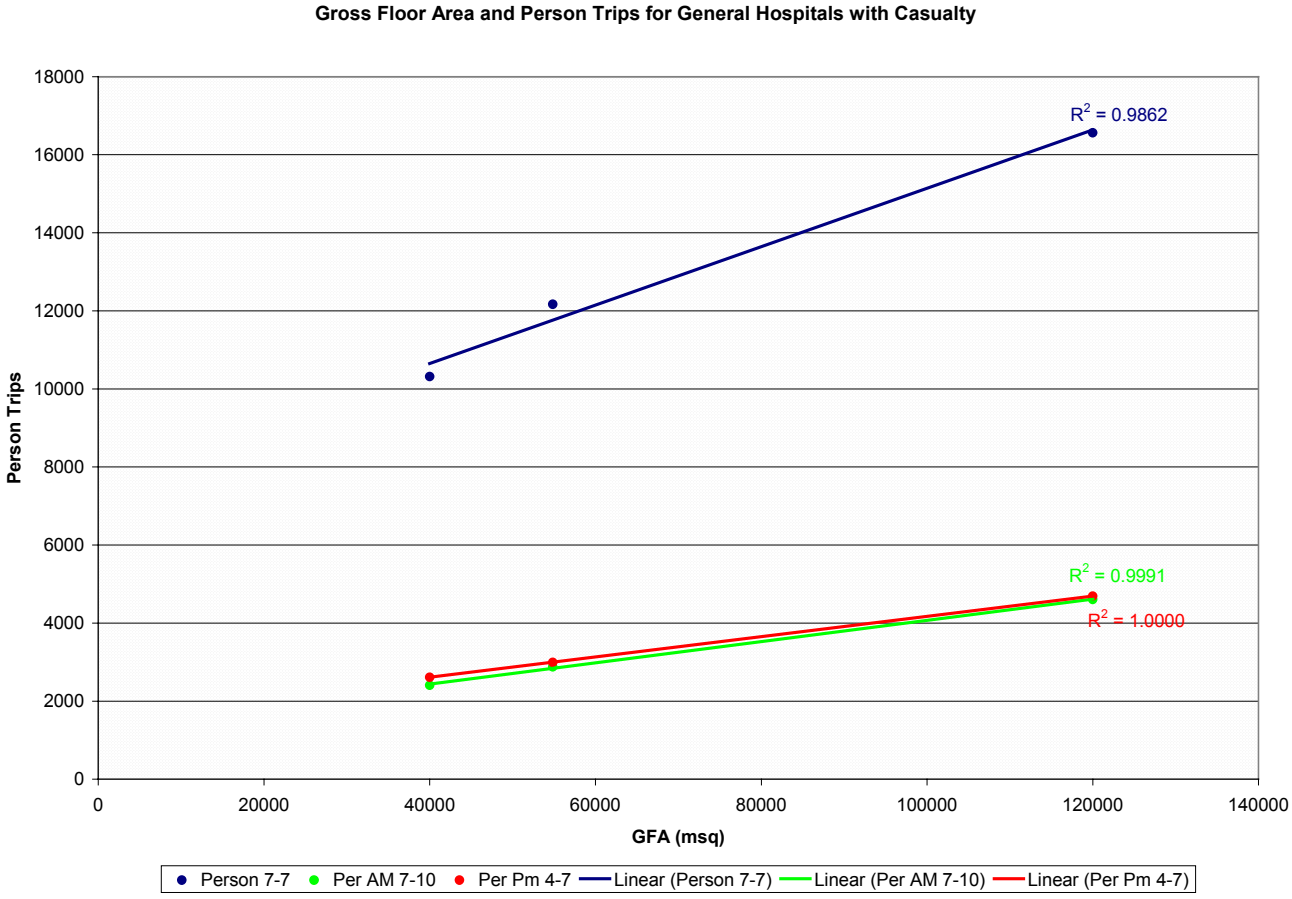
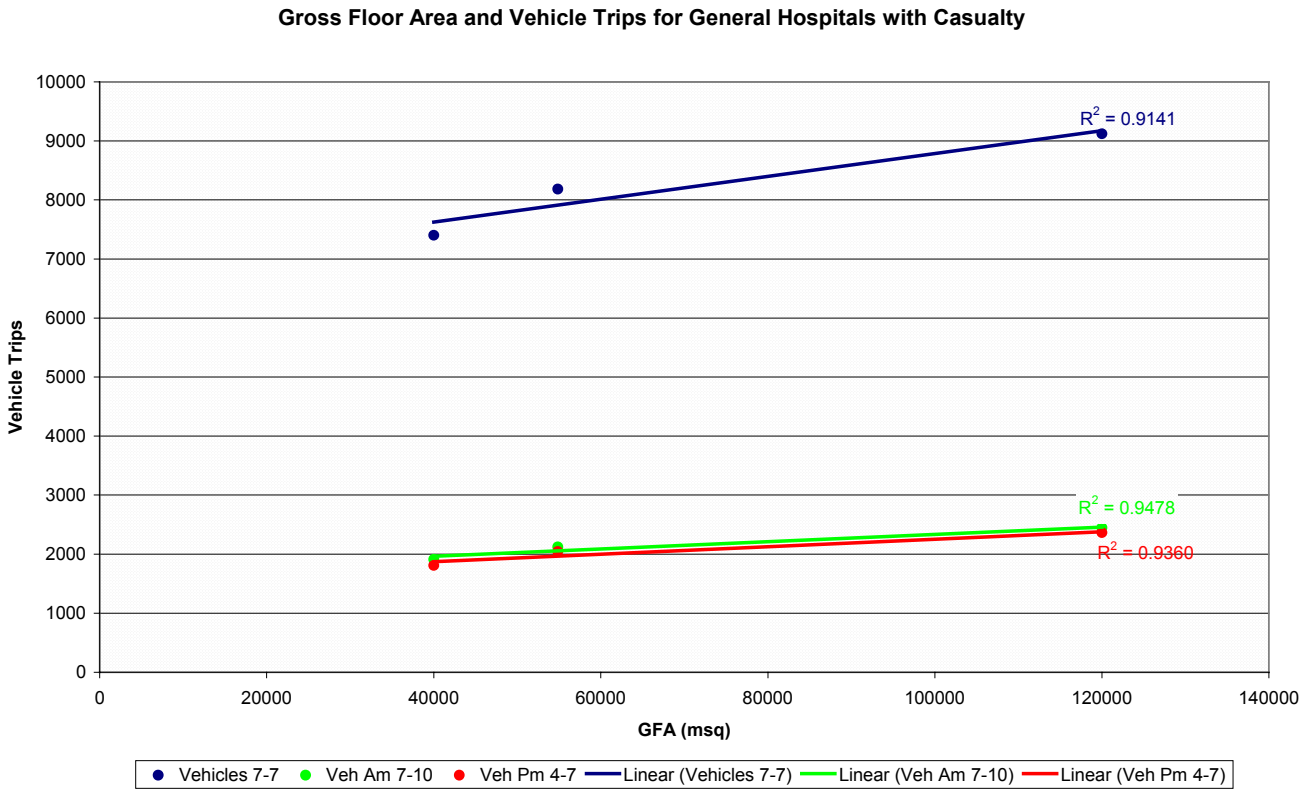


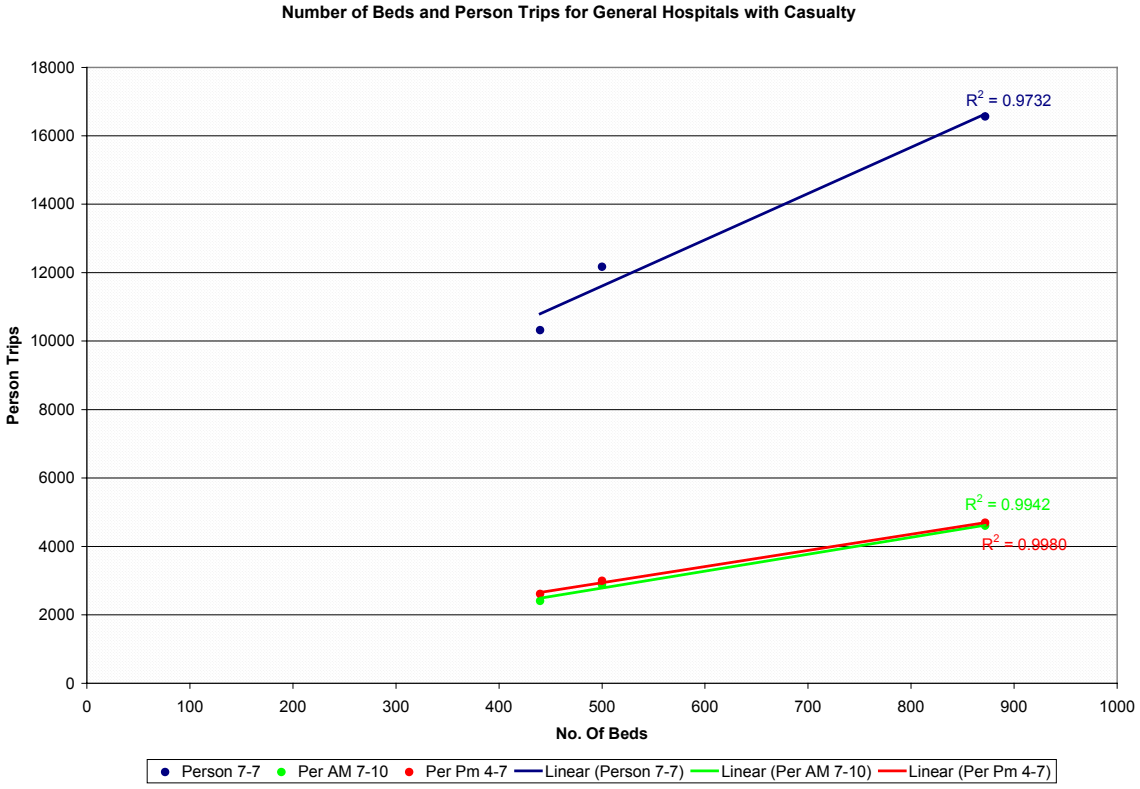
Table 7.6 Plot Data: Regression Analysis for General Hospitals with Casualty, Person and Vehicle Trips.






Gross Floor Area and Person Trips for General Hospitals with Casualty
Person Trips
GFA (msq)
R2 = 0.9862
R2 = 0.9991
R2 = 1.0000
Person 7-7
Per AM 7-10
Per Pm 4-7
Linear (Person 7-7)
Linear (Per AM 7-10)
Linear (Per Pm 4-7)


Gross Floor Area and Vehicle Trips for General Hospitals with Casualty
Vehicle Trips
GFA (msq)
R2 = 0.9141
R2 = 0.9478
R2 = 0.9360
Vehicles 7-7
Veh Am 7-10
Veh Pm 4-7
Linear (Vehicles 7-7)
Linear (Veh Am 7-10)
Linear (Veh Pm 4-7)


Number of Beds and Person Trips for General Hospitals with Casualty
Person Trips
No. Of Beds
R2 = 0.9732
R2 = 0.9942
R2 = 0.9980
Person 7-7
Per AM 7-10
Per Pm 4-7
Linear (Person 7-7)
Linear (Per AM 7-10)
Linear (Per Pm 4-7)

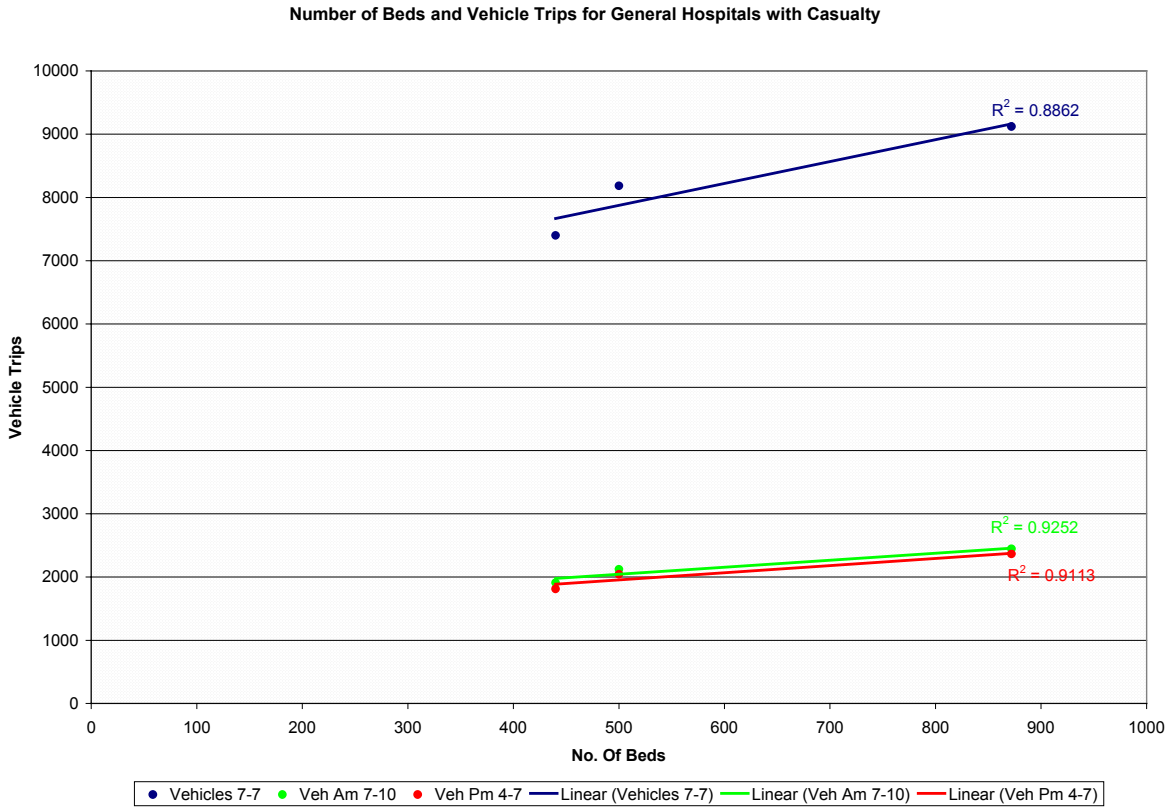
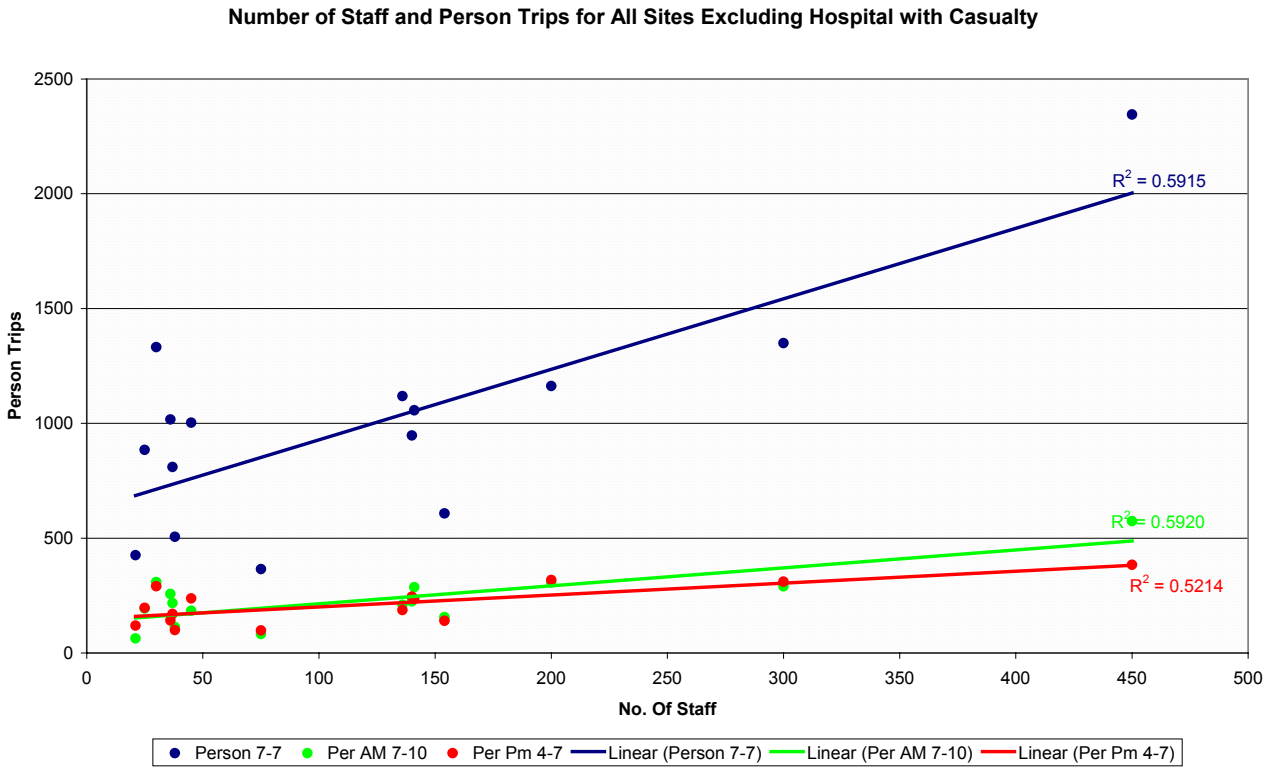
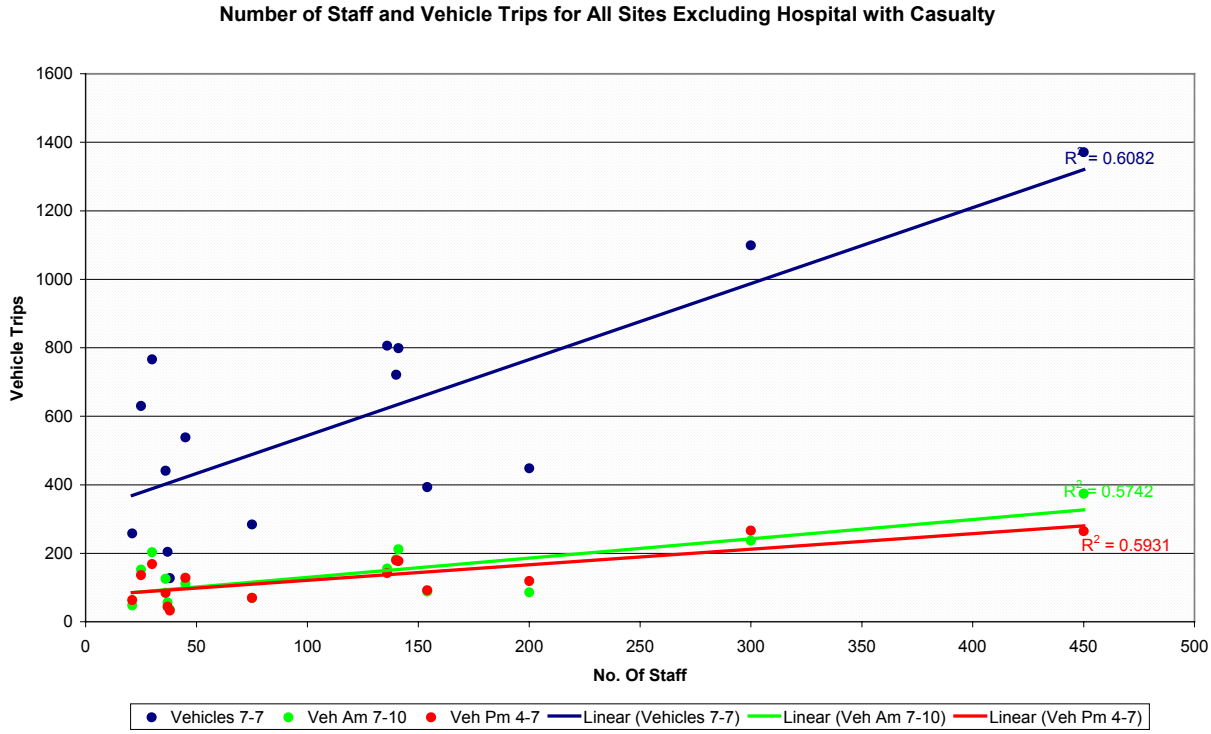
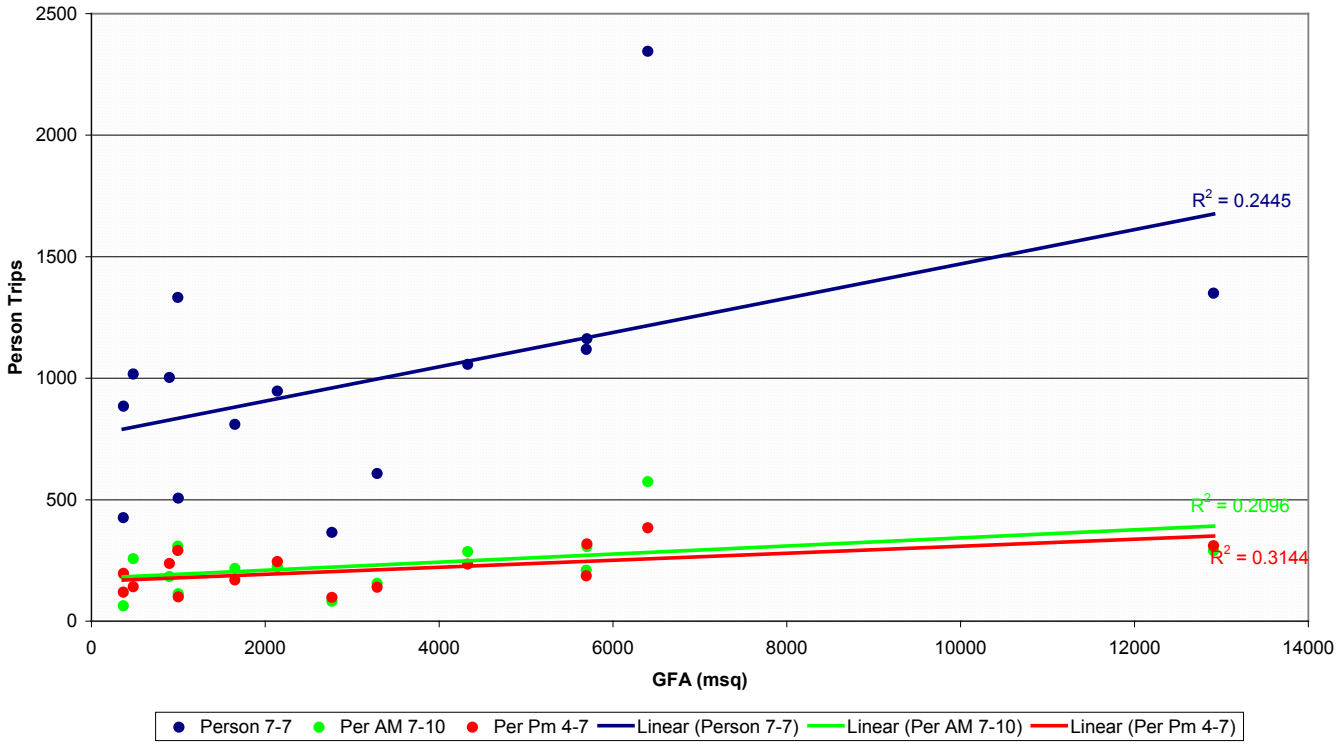

Number of Beds and Vehicle Trips for General Hospitals with Casualty
Vehicle Trips
No. Of Beds
R2 = 0.8862
R2 = 0.9252
R2 = 0.9113
Vehicles 7-7
Veh Am 7-10
Veh Pm 4-7
Linear (Vehicles 7-7)
Linear (Veh Am 7-10)
Linear (Veh Pm 4-7)

Table 7.7 Plot Data: Regression Analysis for All Sites Excluding General Hospitals with Casualty.

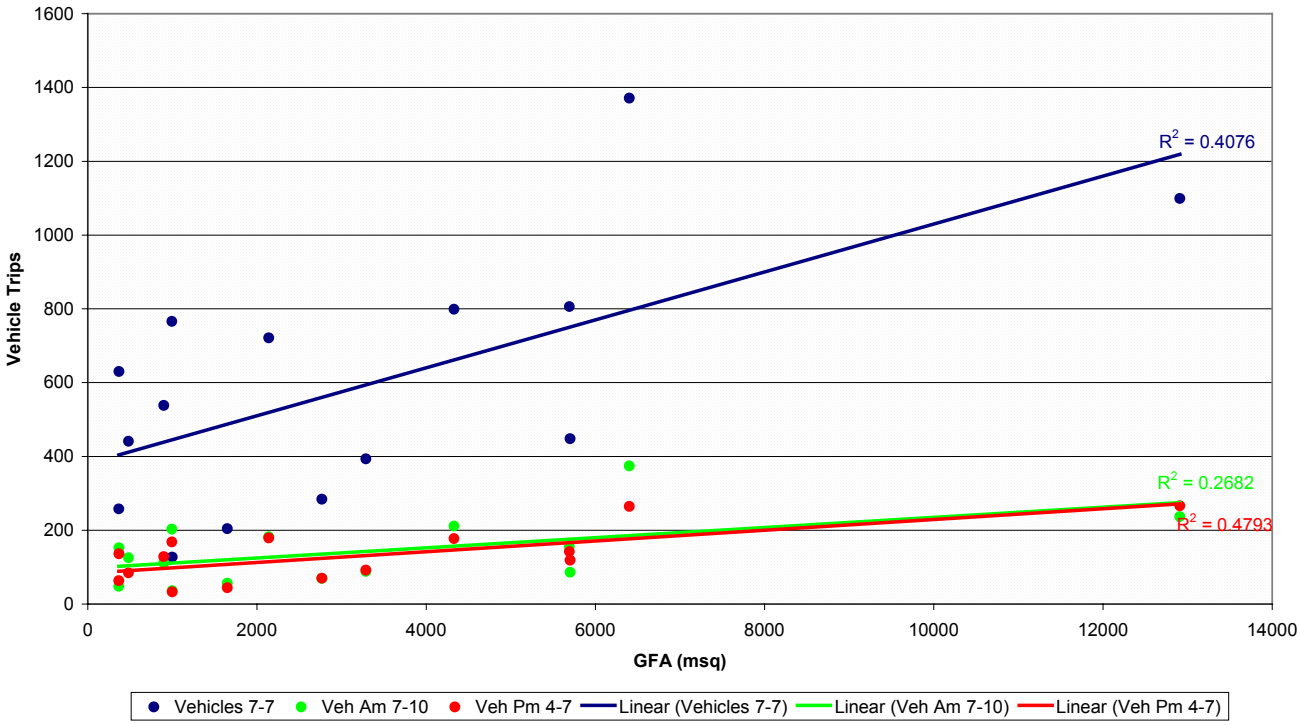




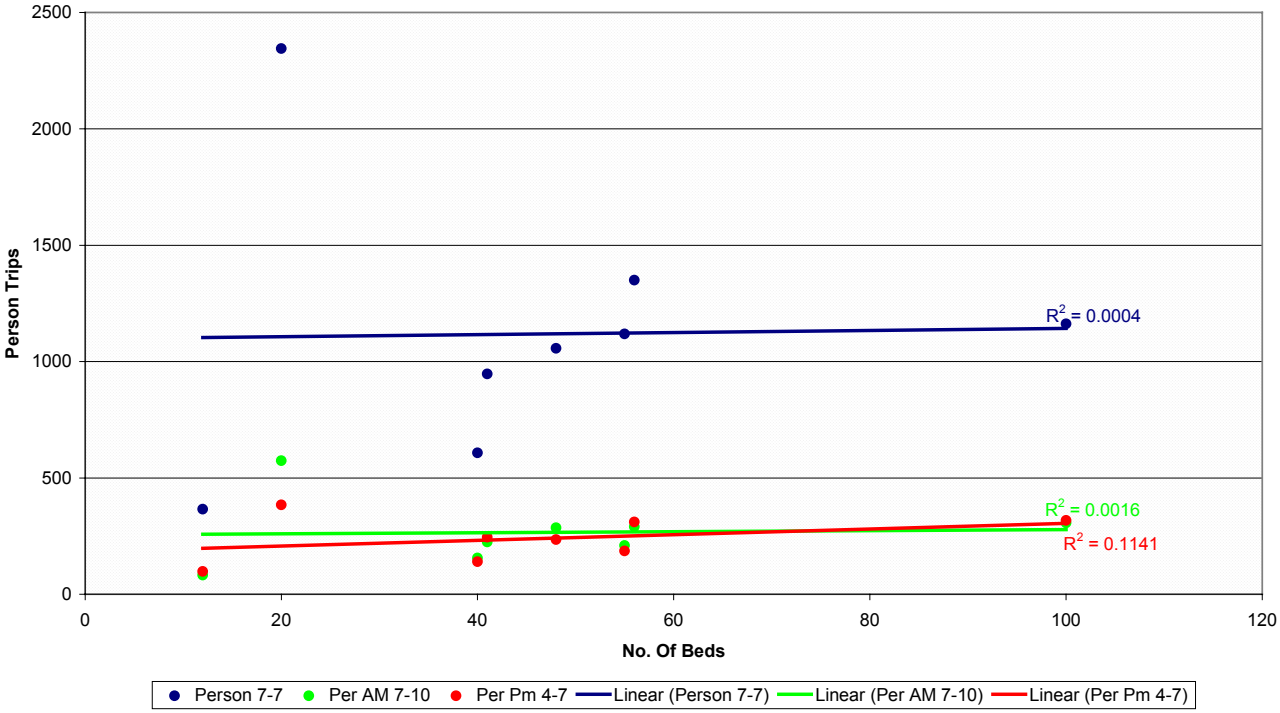
Gross Floor Area and Person Trips for All Sites Excluding Hospital with Casualty



Gross Floor Area and Vehicle Trips for All Sites Excluding Hospital with Casualty



Number of Beds and Person Trips for All Sites Excluding Hospital with Casualty



Number of Beds and Vehicle Trips for All Sites Excluding Hospital with Casualty

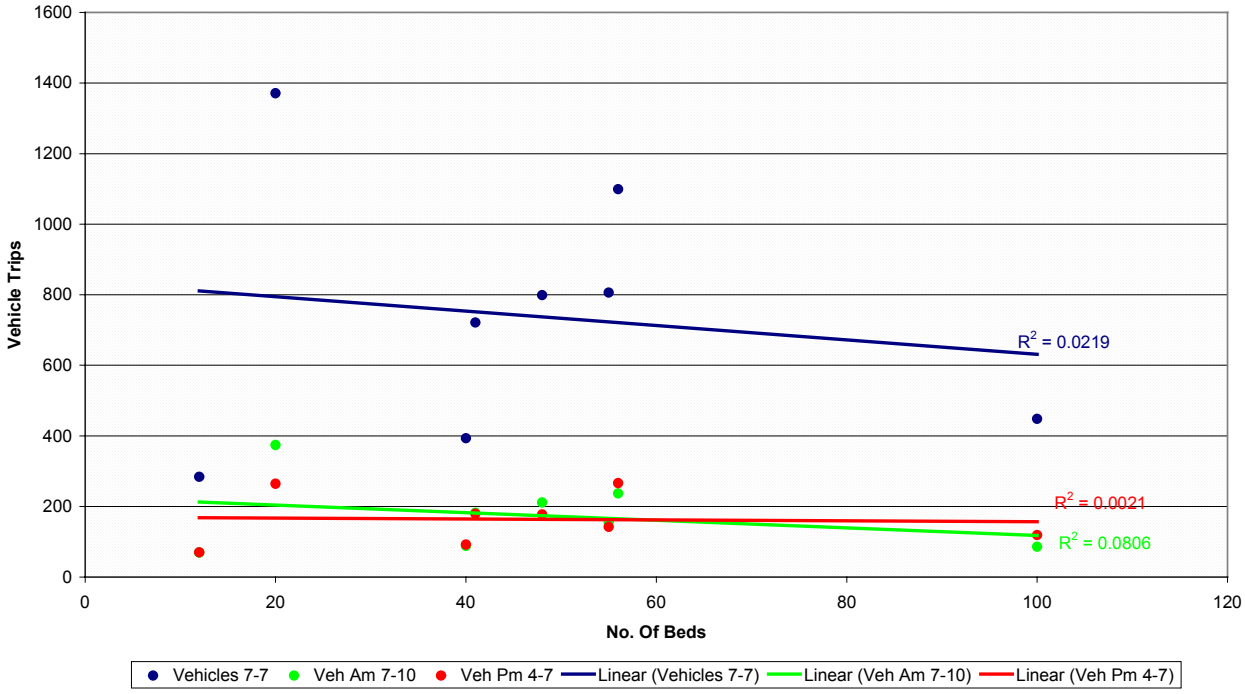
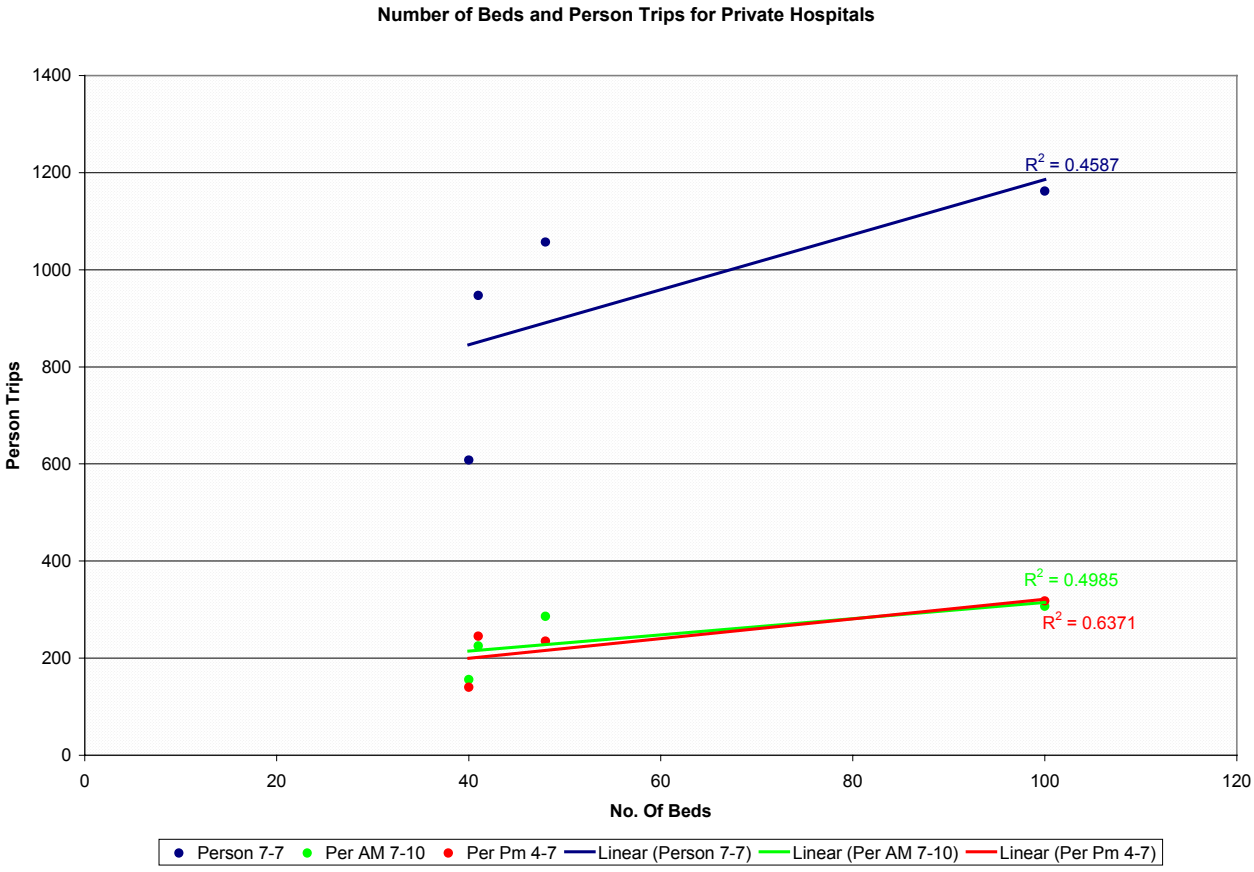
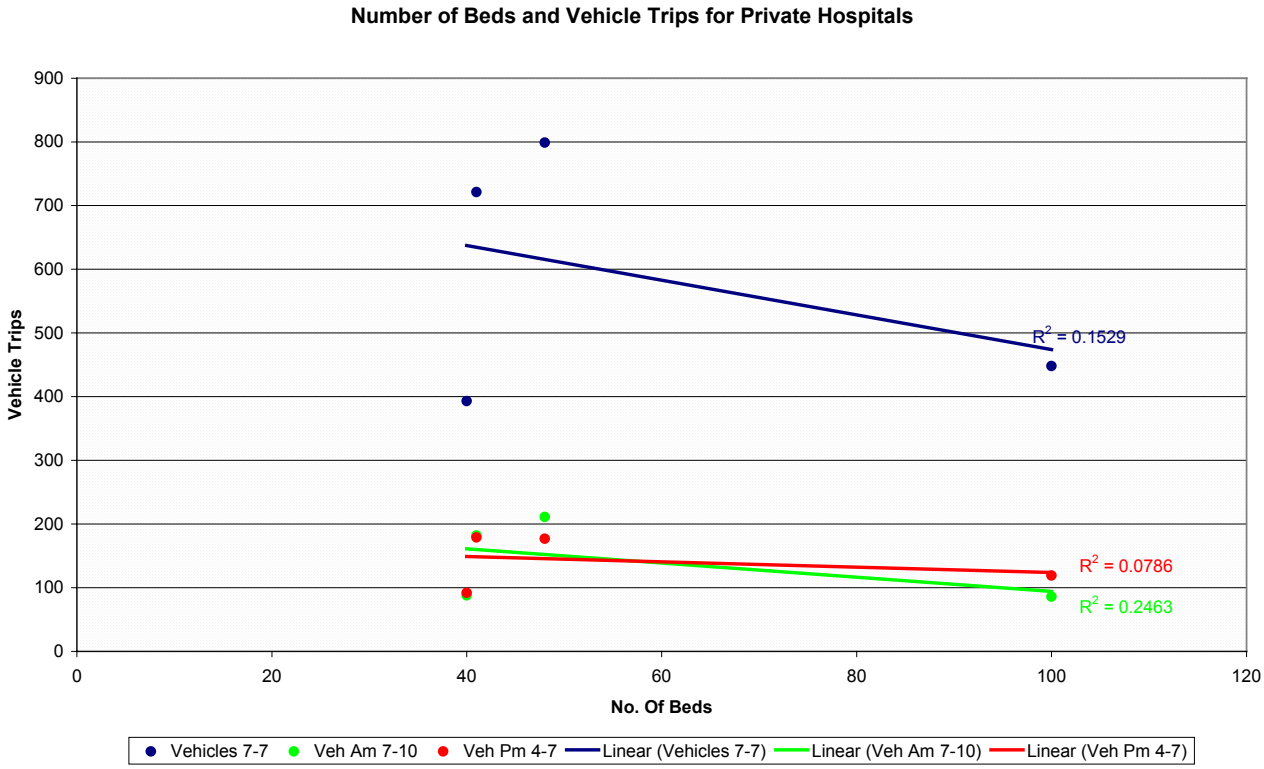
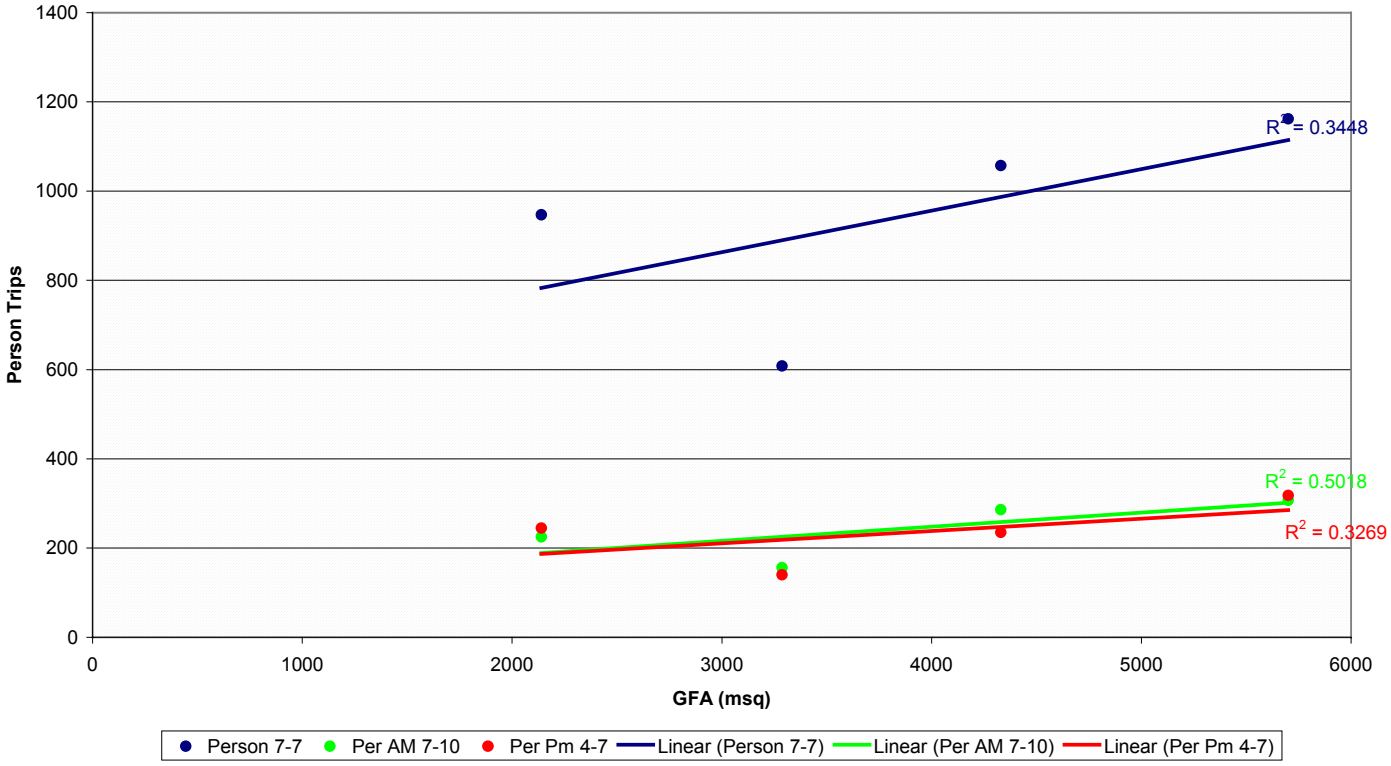


Table 7.8 Plot Data: Regression Analysis for Private Hospitals, Person and Vehicle Trips.

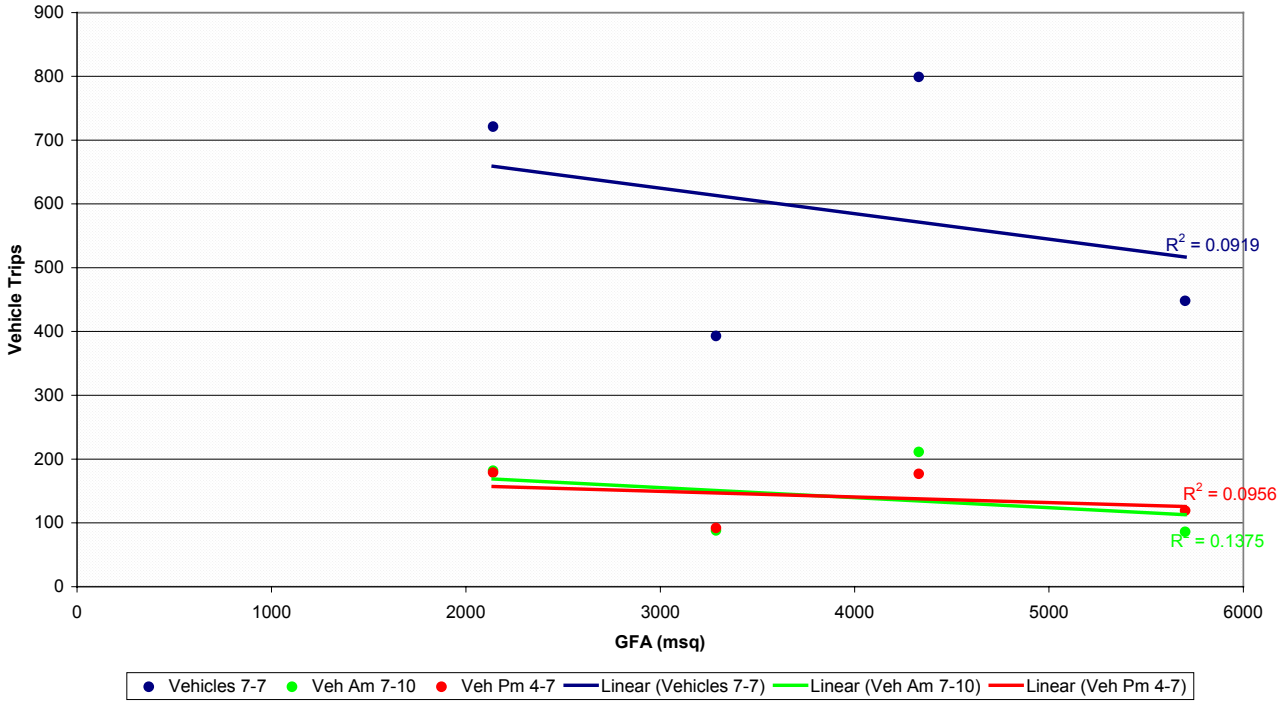


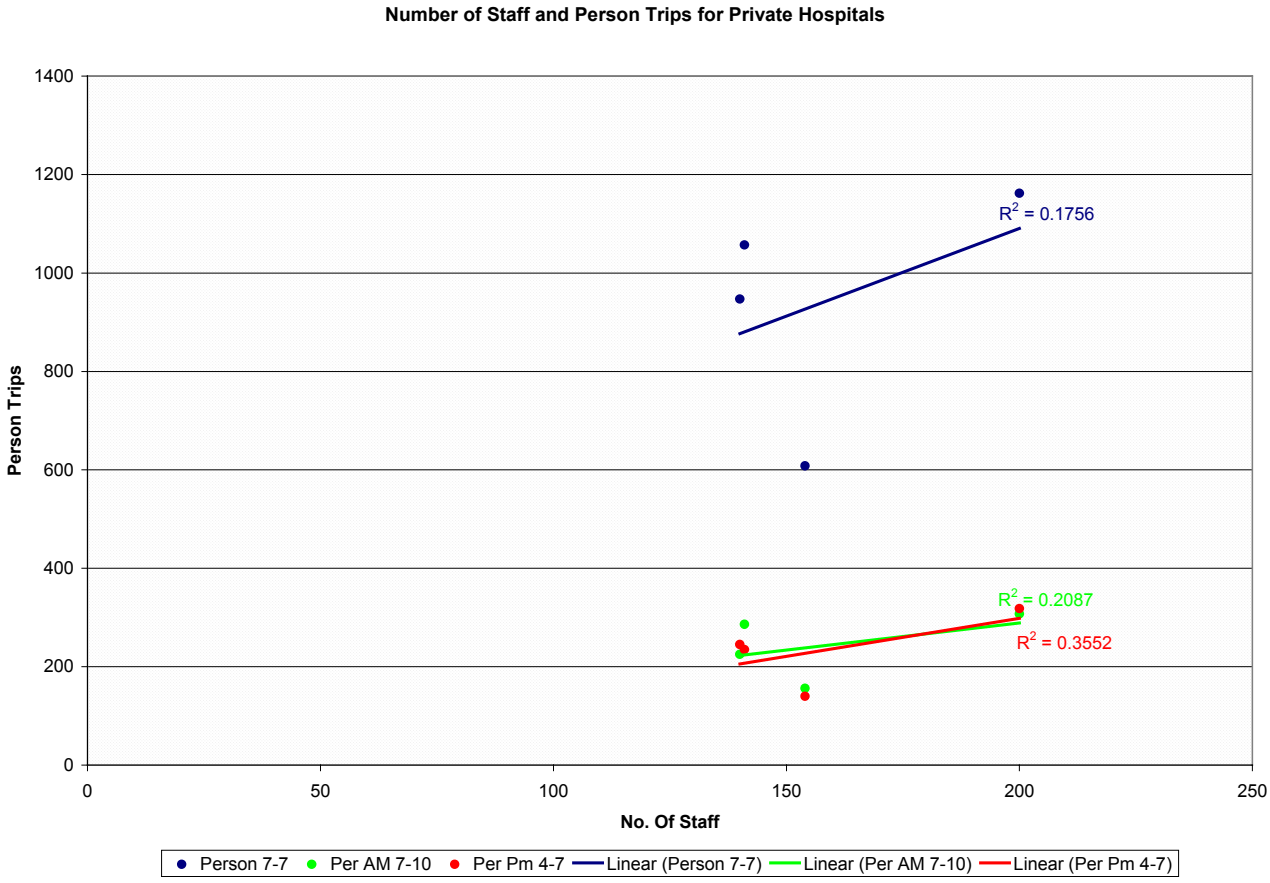


Gross Floor Area and Person Trips for Private Hospitals



Gross Floor Area and Vehicle Trips for Private Hospitals




Number of Staff and Person Trips for Private Hospitals
Person Trips
No. Of Staff
0
200
400
600
800
1000
1200
1400
0
50
100
150
200
250
R2 = 0.1756
R2 = 0.2087
R2 = 0.3552
Person 7-7
Per AM 7-10
Per Pm 4-7
Linear (Person 7-7)
Linear (Per AM 7-10)
Linear (Per Pm 4-7)

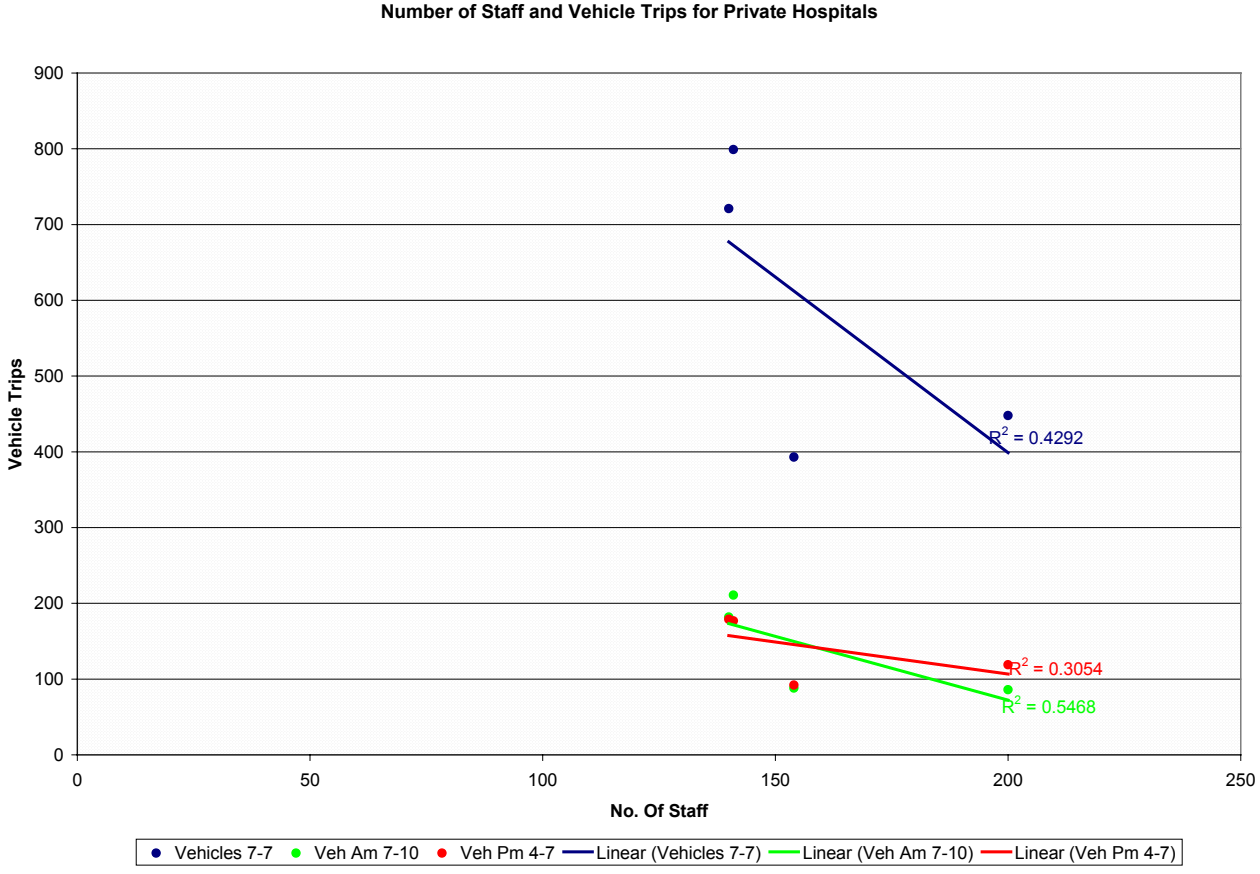
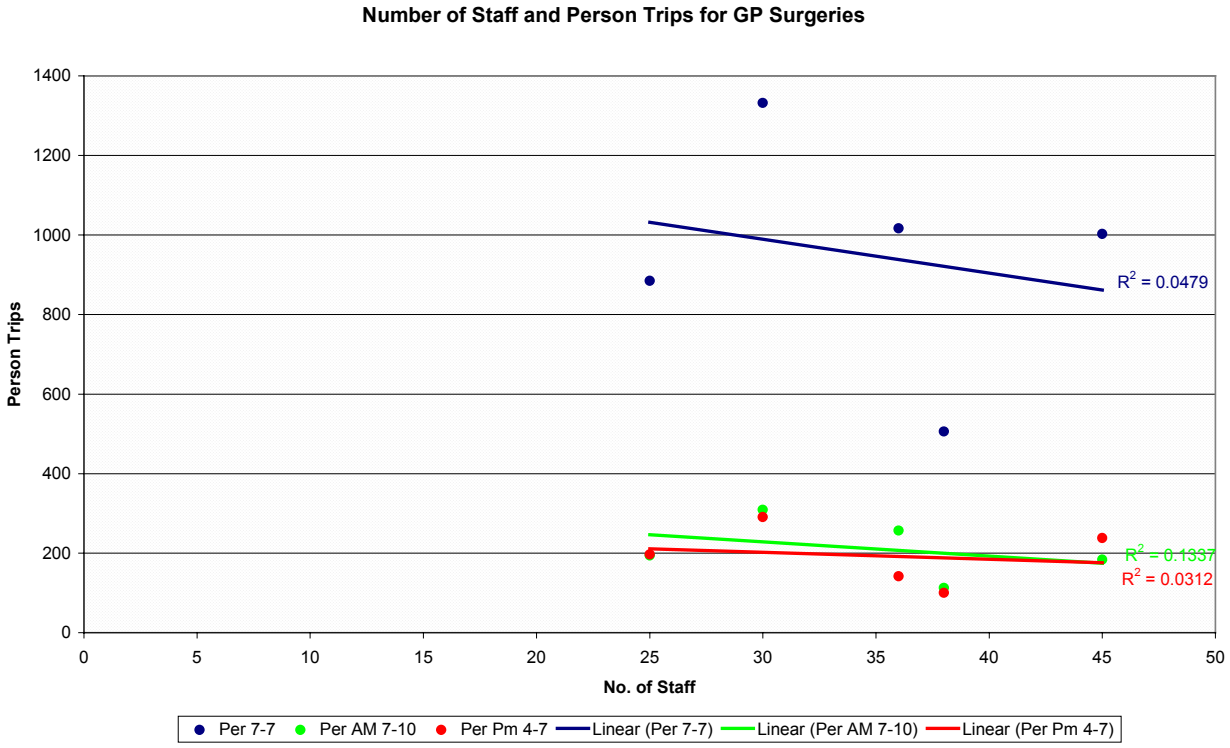
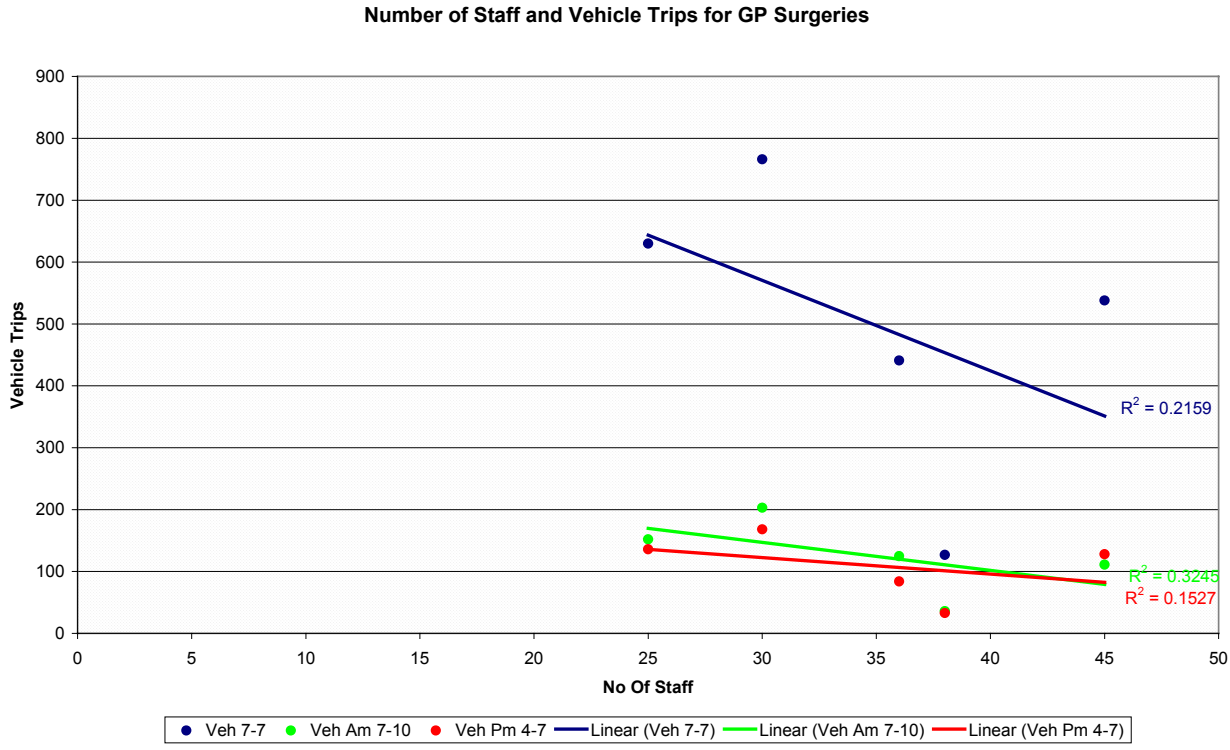
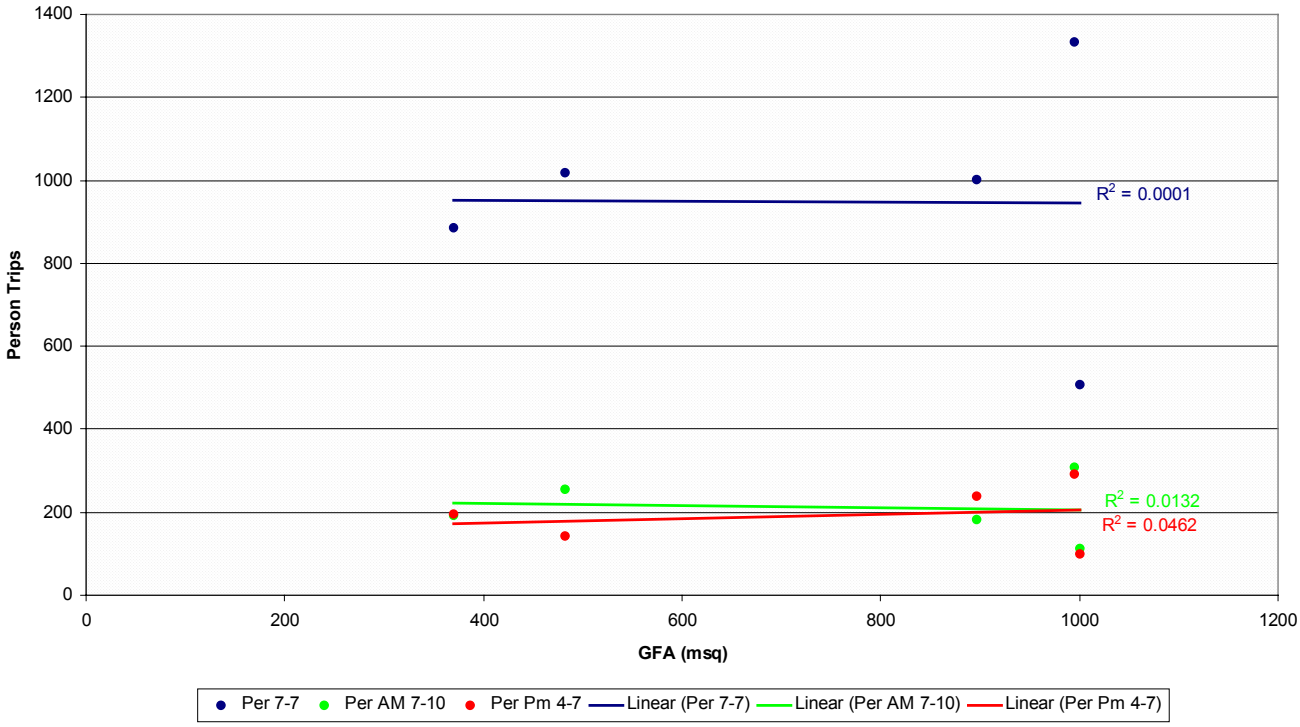

Number of Staff and Vehicle Trips for Private Hospitals
Vehicle Trips
No. Of Staff
0
100
200
300
400
500
600
700
800
900
0
50
100
150
200
250
R2 = 0.4292
R2 = 0.3054
R2 = 0.5468
Vehicles 7-7
Veh Am 7-10
Veh Pm 4-7
Linear (Vehicles 7-7)
Linear (Veh Am 7-10)
Linear (Veh Pm 4-7)

Table 7.9 Plot Data: Regression Analysis for GP Surgeries, Person and Vehicle Trips





Gross Floor Area and Person Trips for GP Surgeries



Gross Floor Area and Vehicle Trips for GP Surgeries

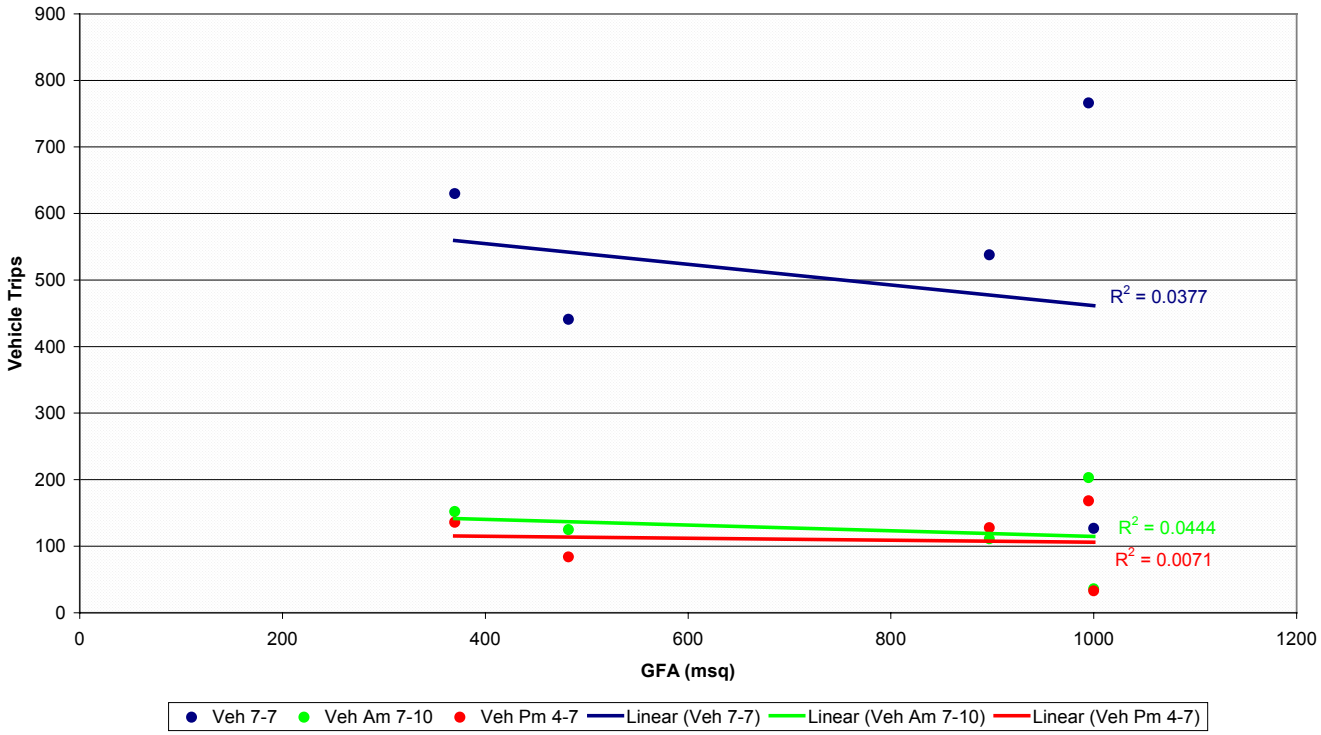
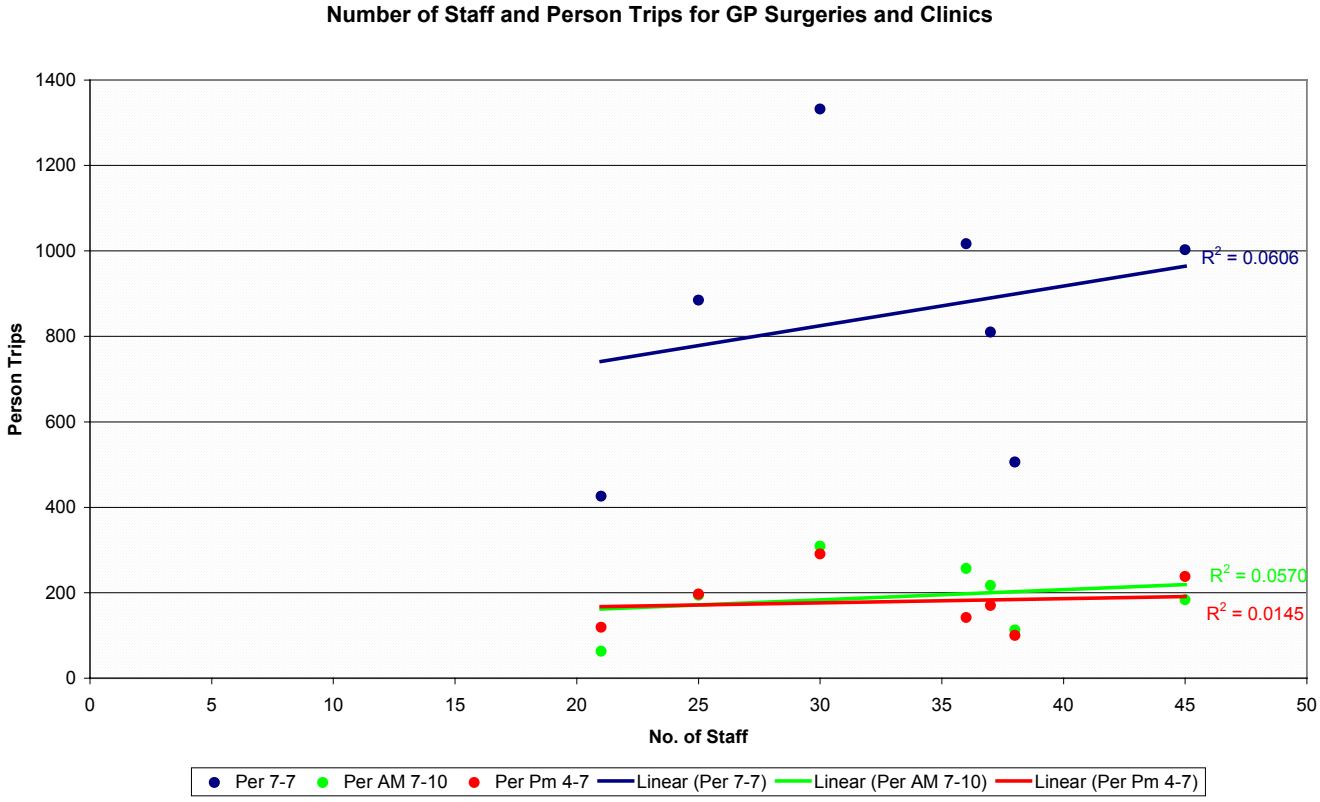
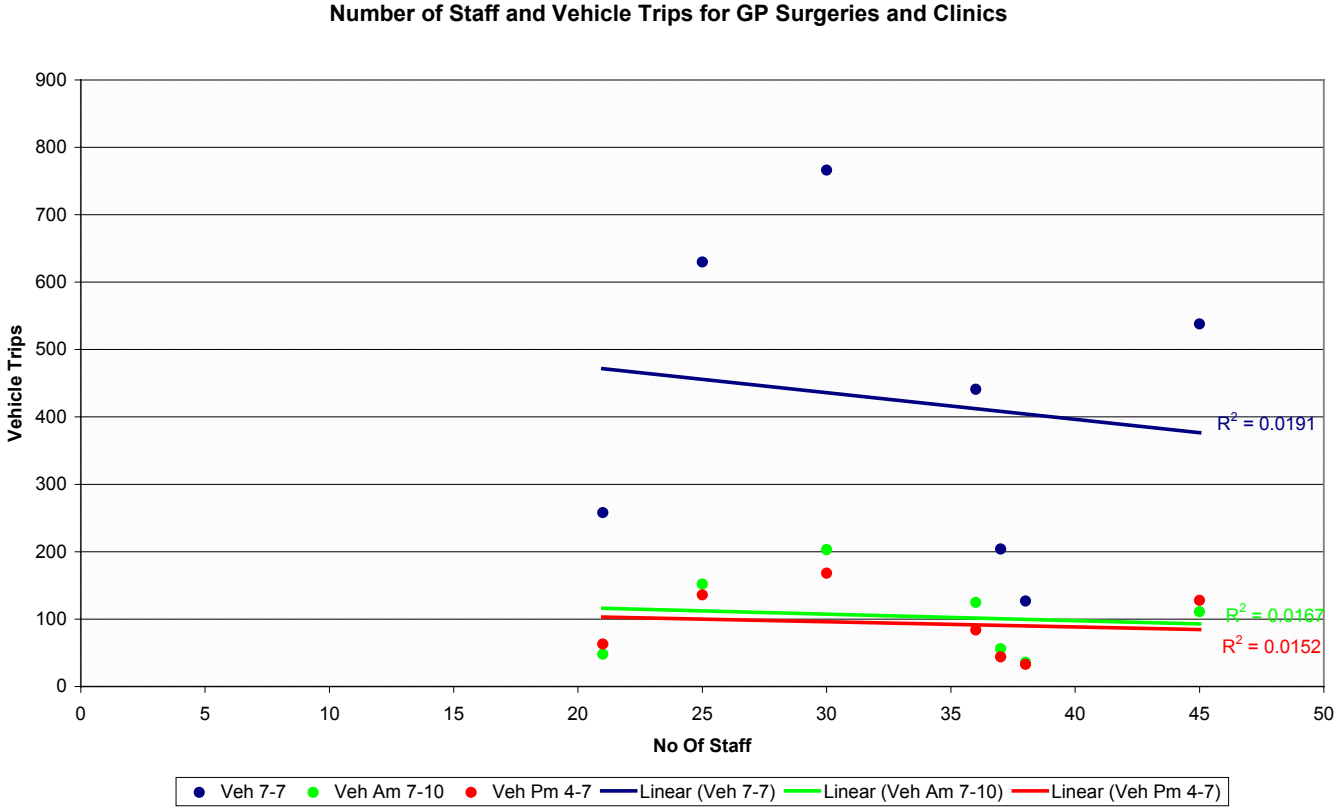
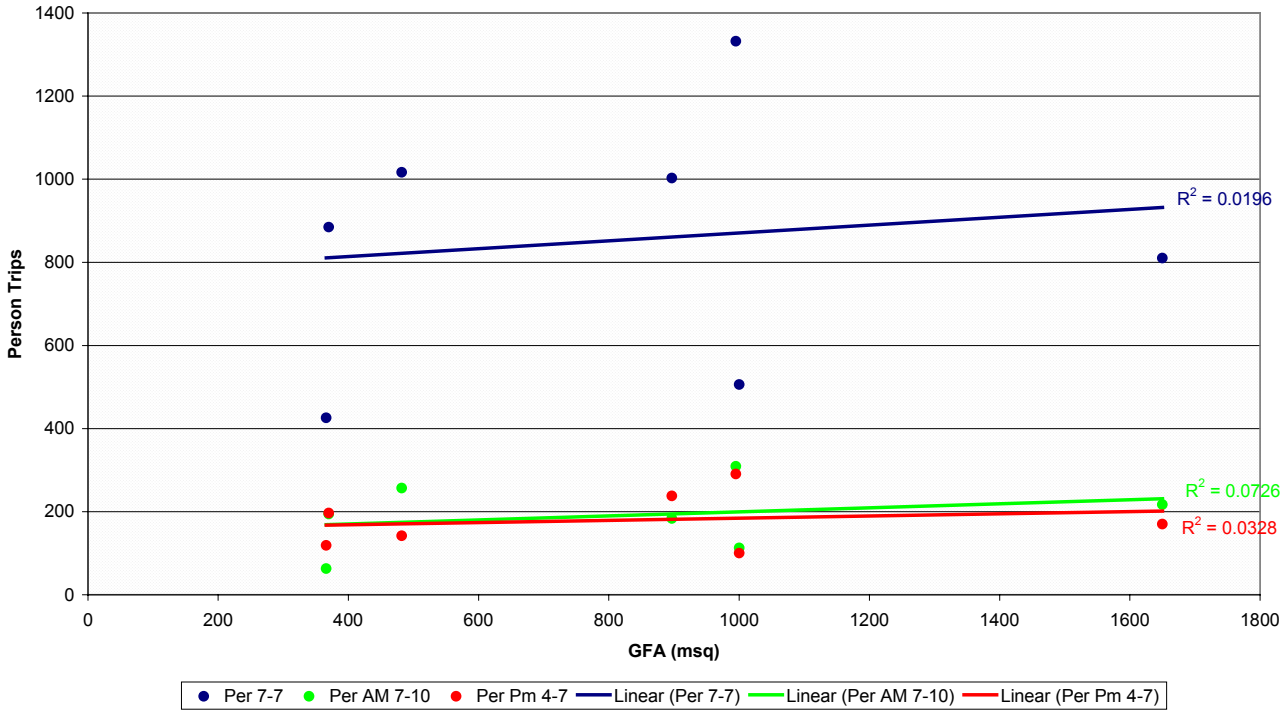


Table 7.10 Plot Data: Regression Analysis for GP Surgeries and Clinics, Person and Vehicle Trips





Gross Floor Area and Person Trips for GP Surgeries and Clinics



Gross Floor Area and Vehicle Trips for GP Surgeries and Clinics

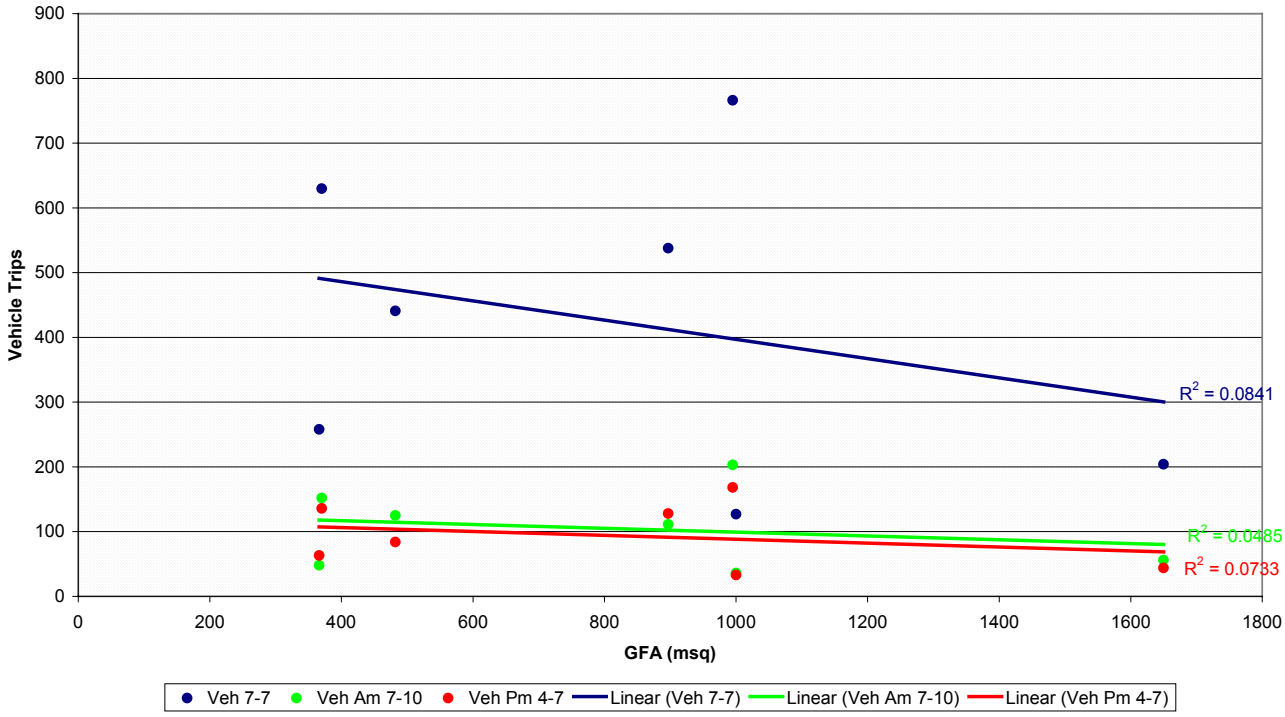
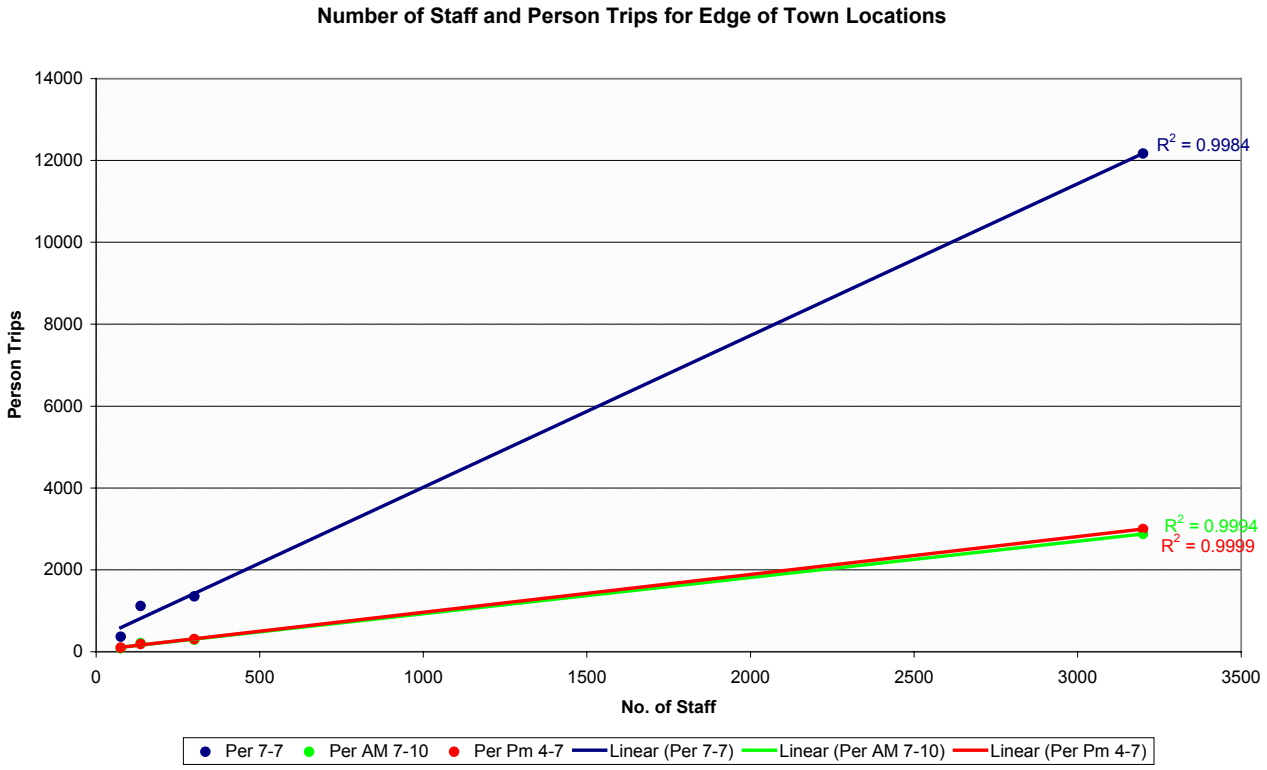
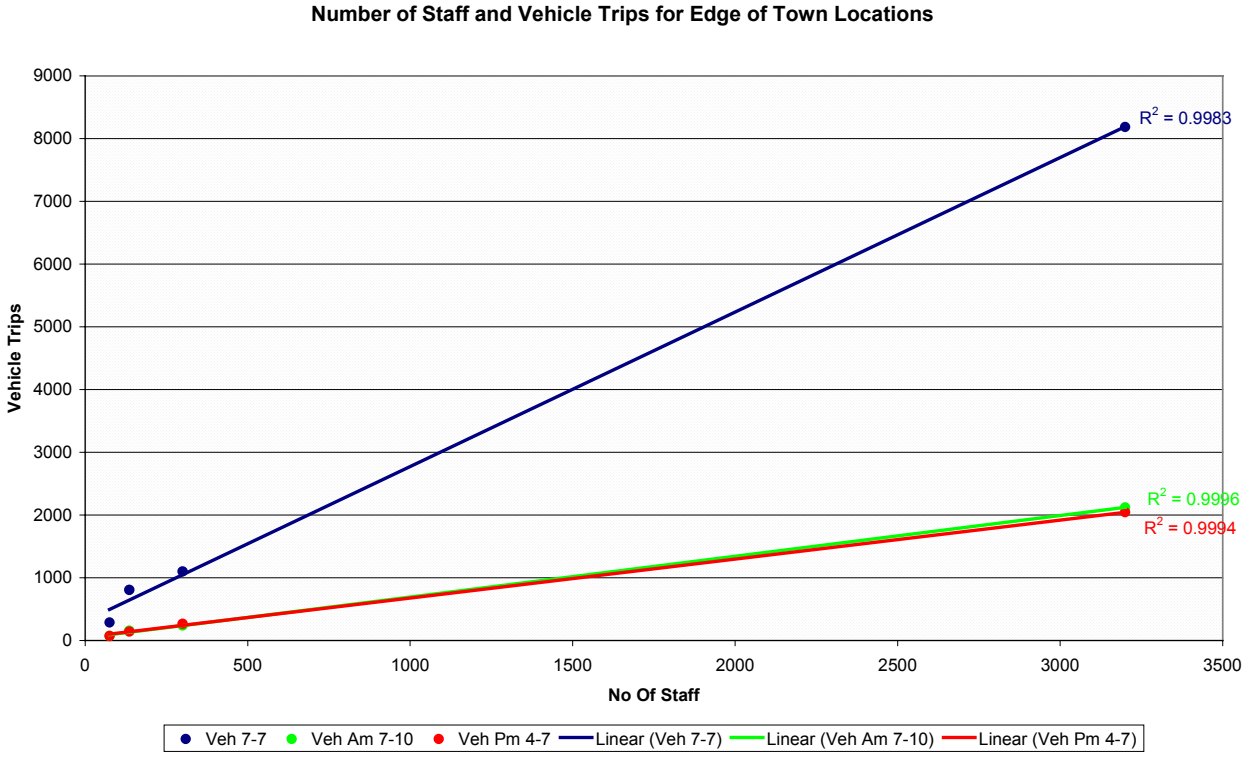
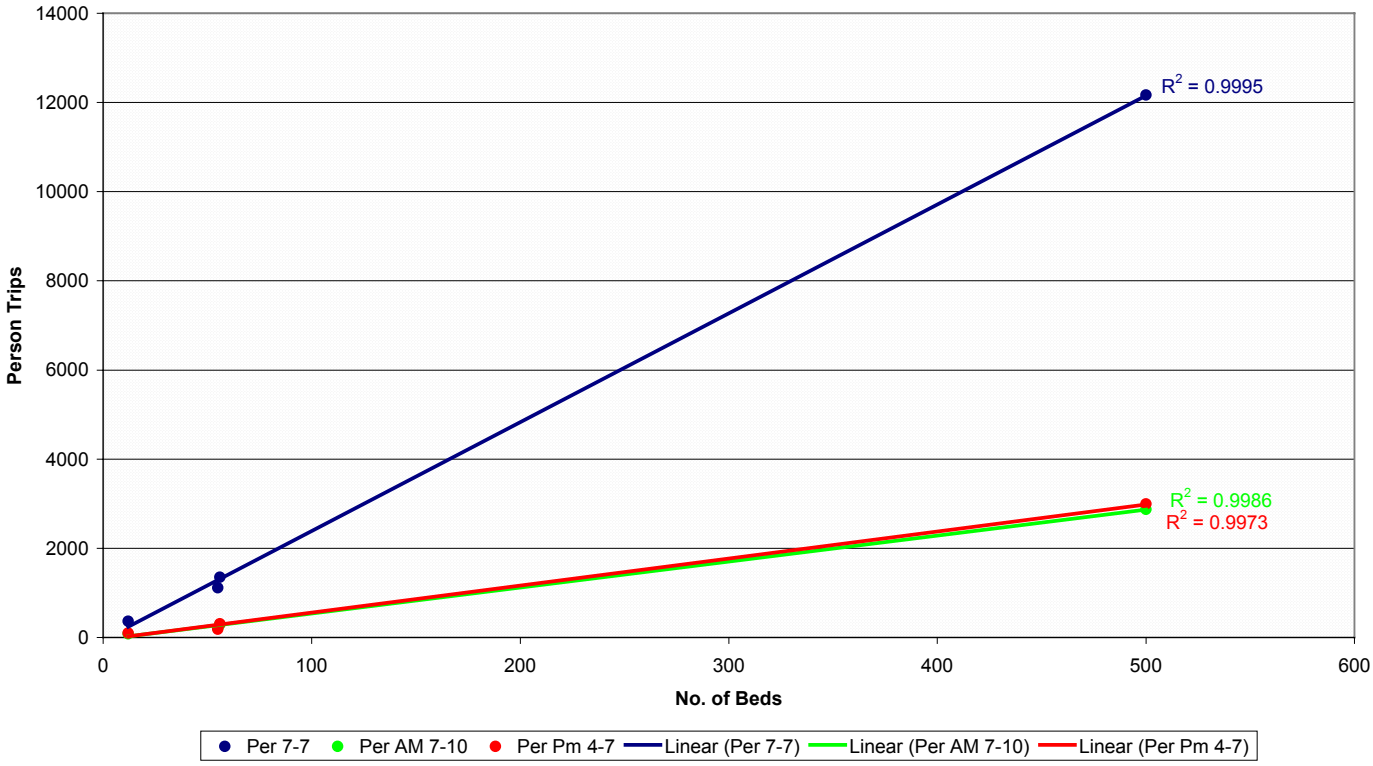


Table 7.11 Plot Data: Regression Analysis for Sites with an Edge of Town Location

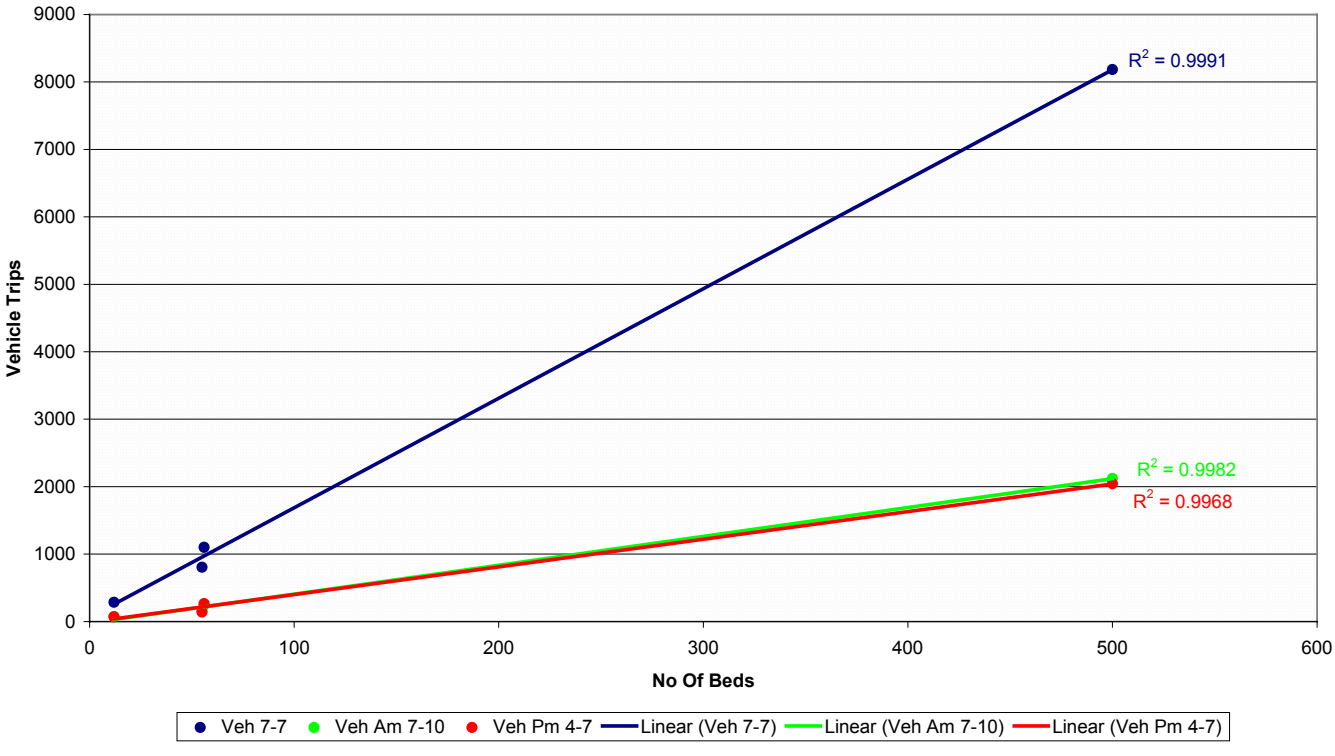




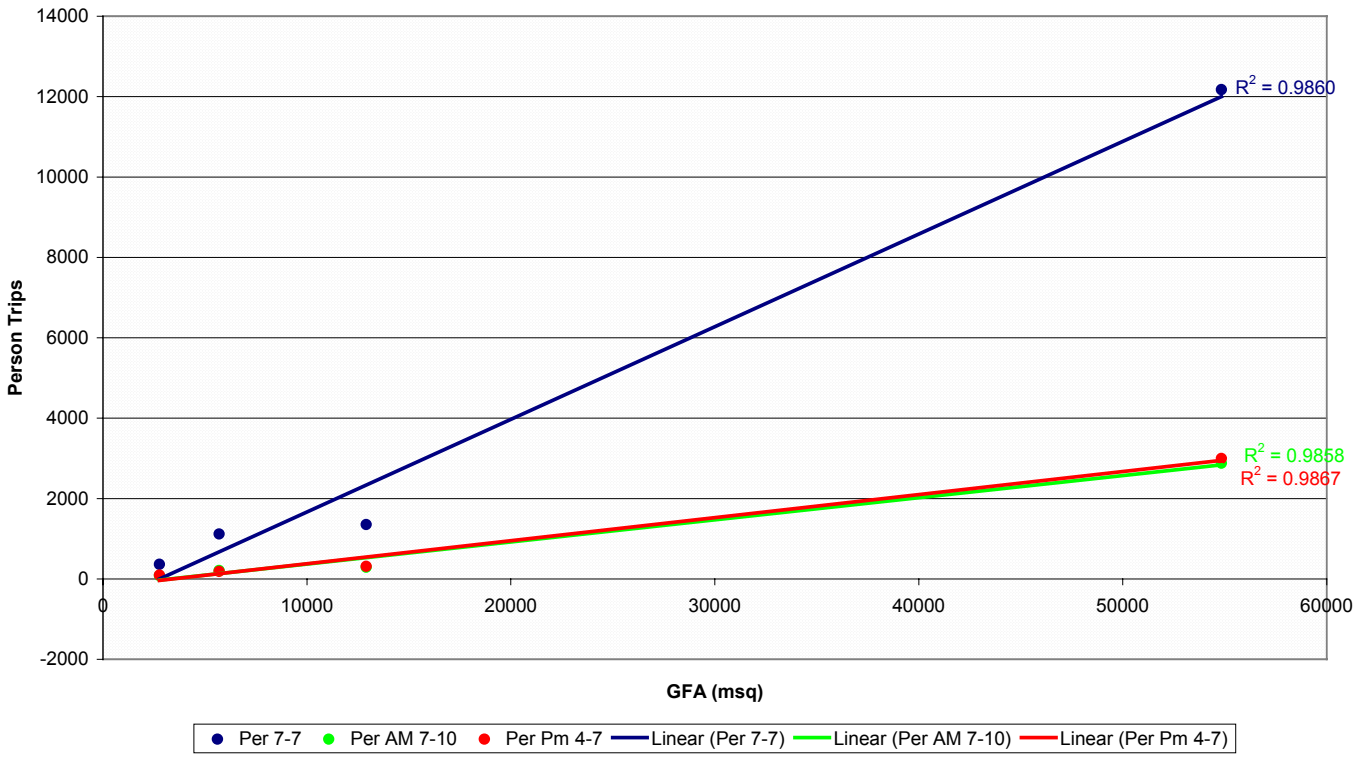
Number of Beds and Person Trips for Edge of Town Locations



Number of Beds and Vehicle Trips for Edge of Town Locations



Gross Floor Area and Person Trips for Edge of Town Locations



Gross Floor Area and Vehicle Trips for Edge of Town Locations

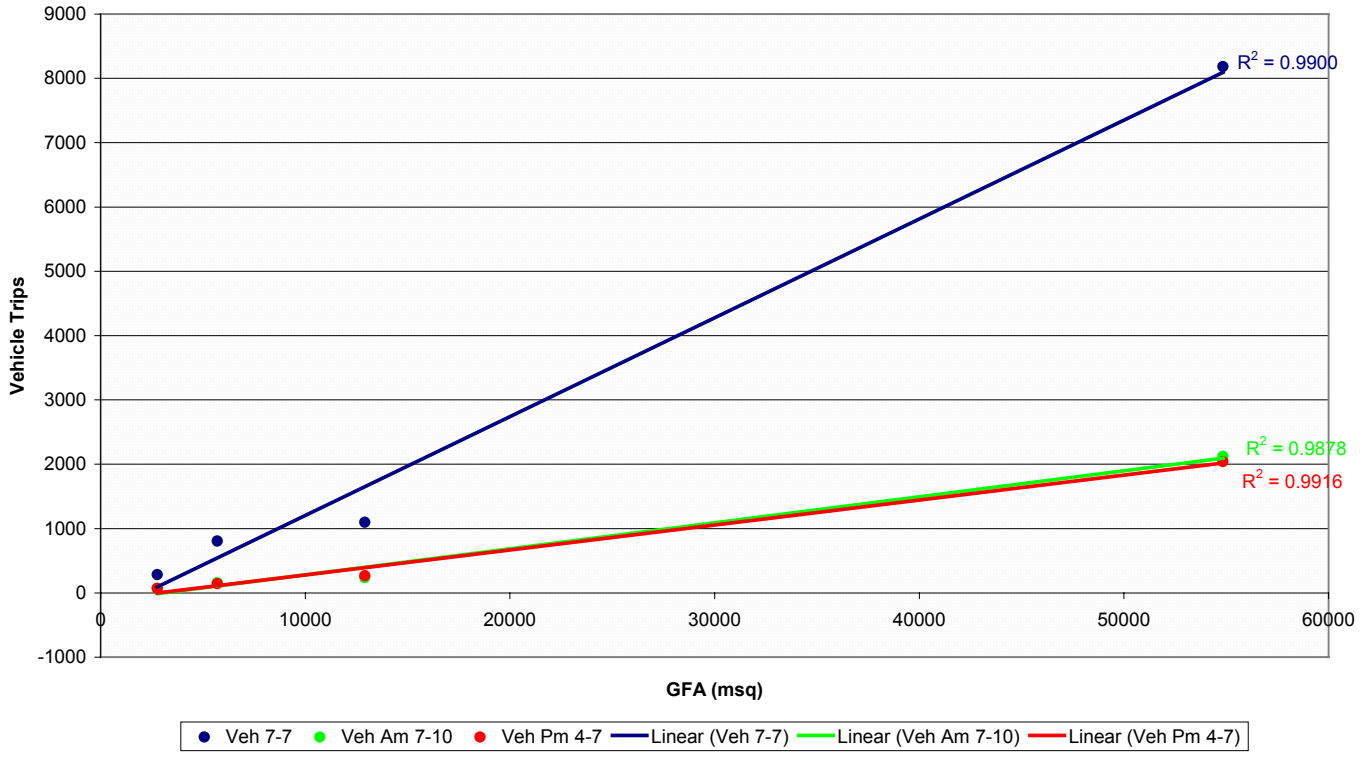
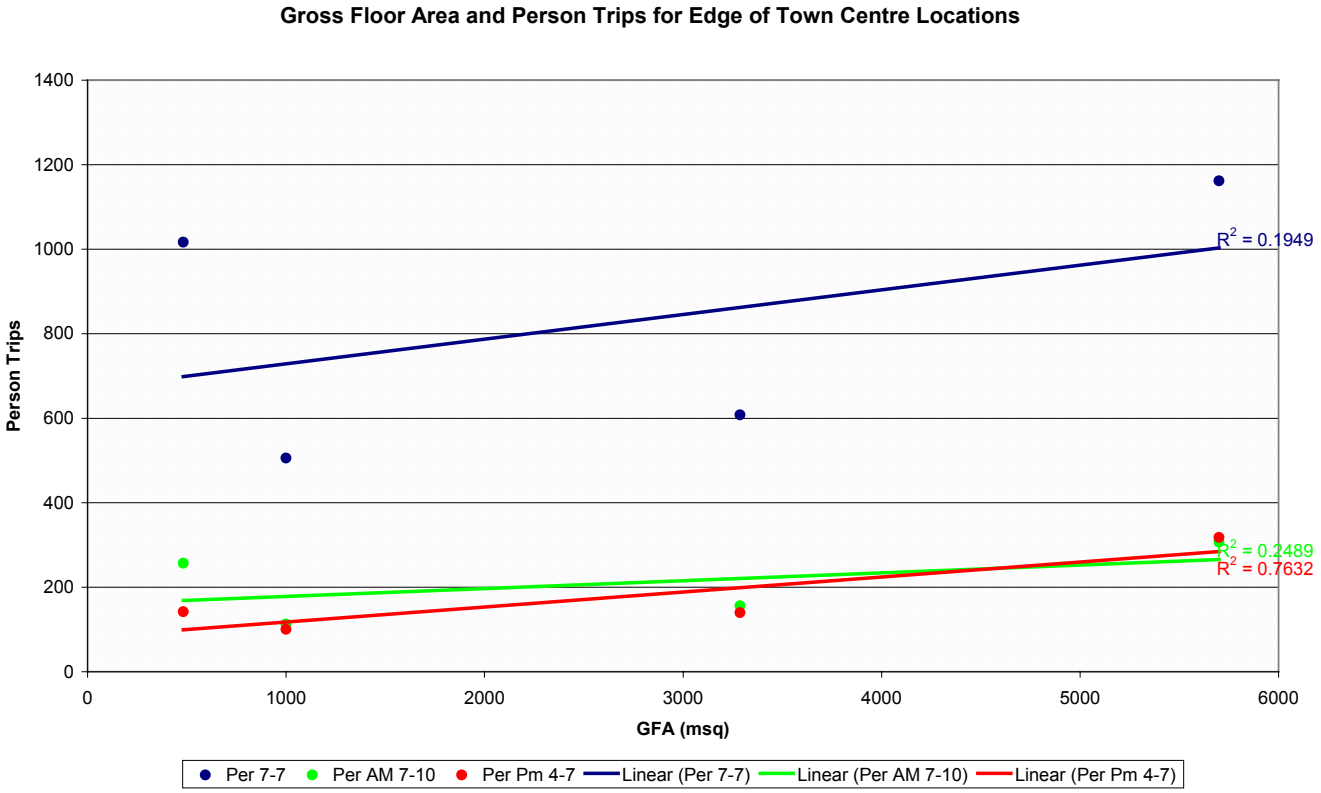
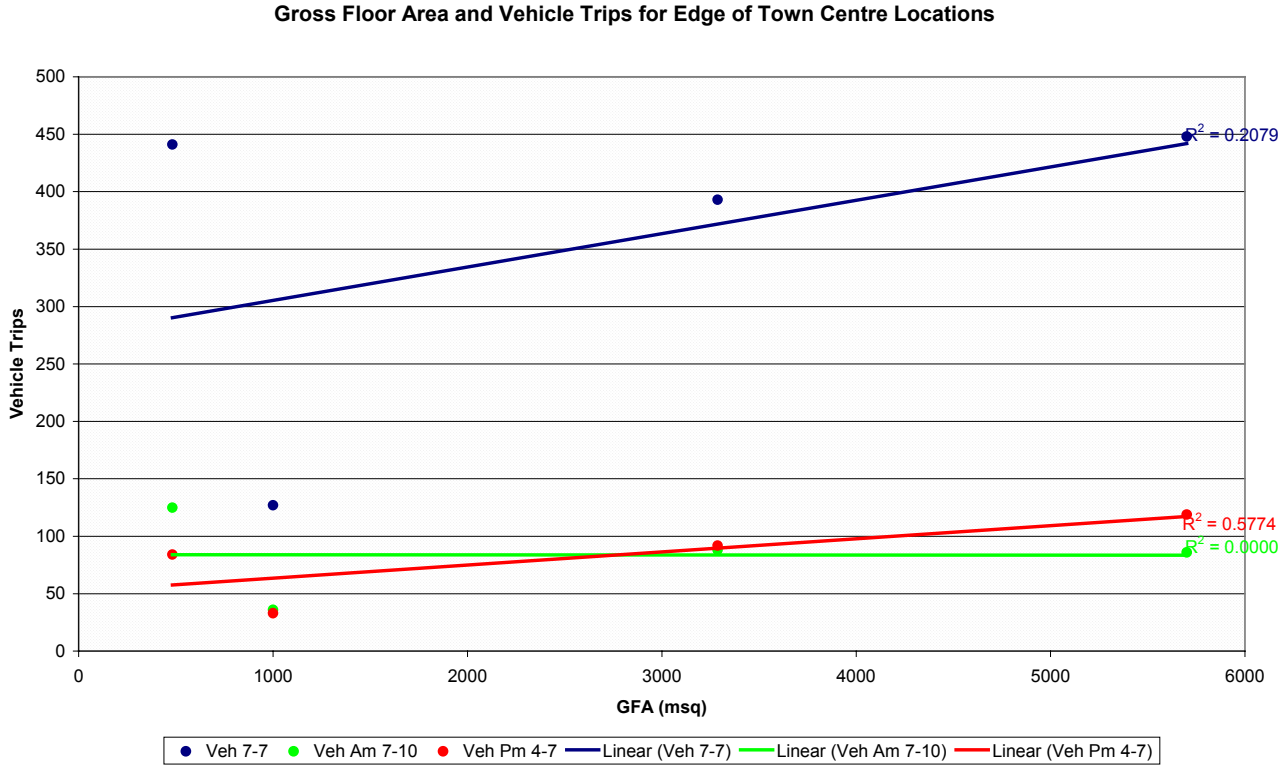
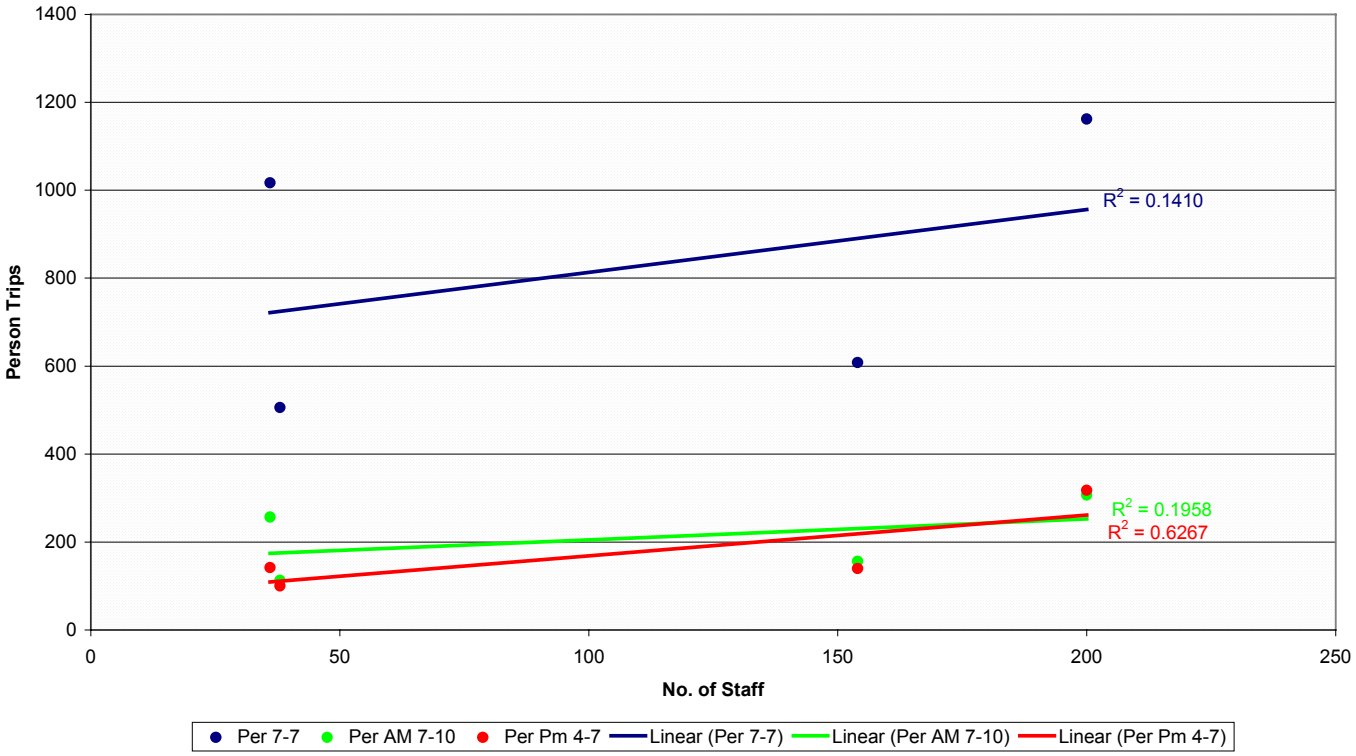


Table 7.12 Plot Data: Regression Analysis for Edge of Town Centre Location, Person and Vehicle Trips.





Number of Staff and Person Trips for Edge of Town Centre Locations



Number of Staff for Vehicle Trips and Edge of Town Centre Locations

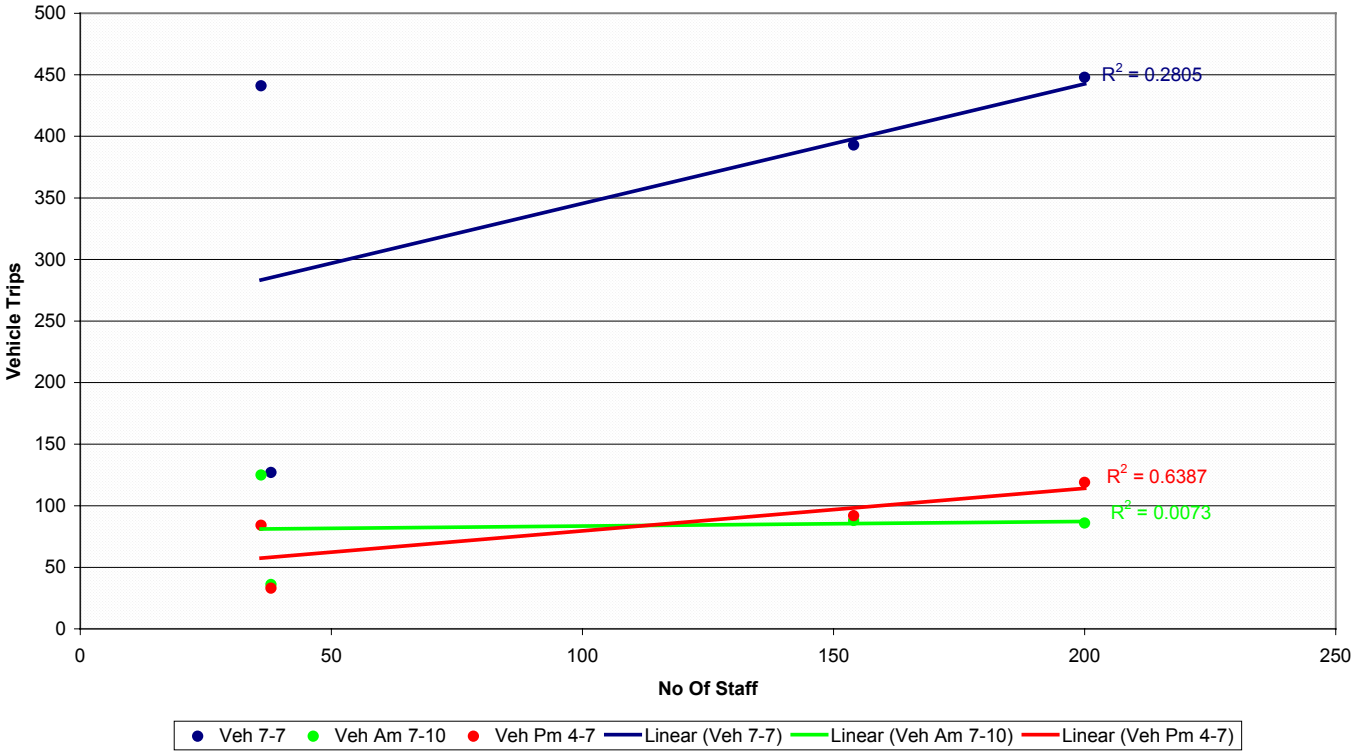
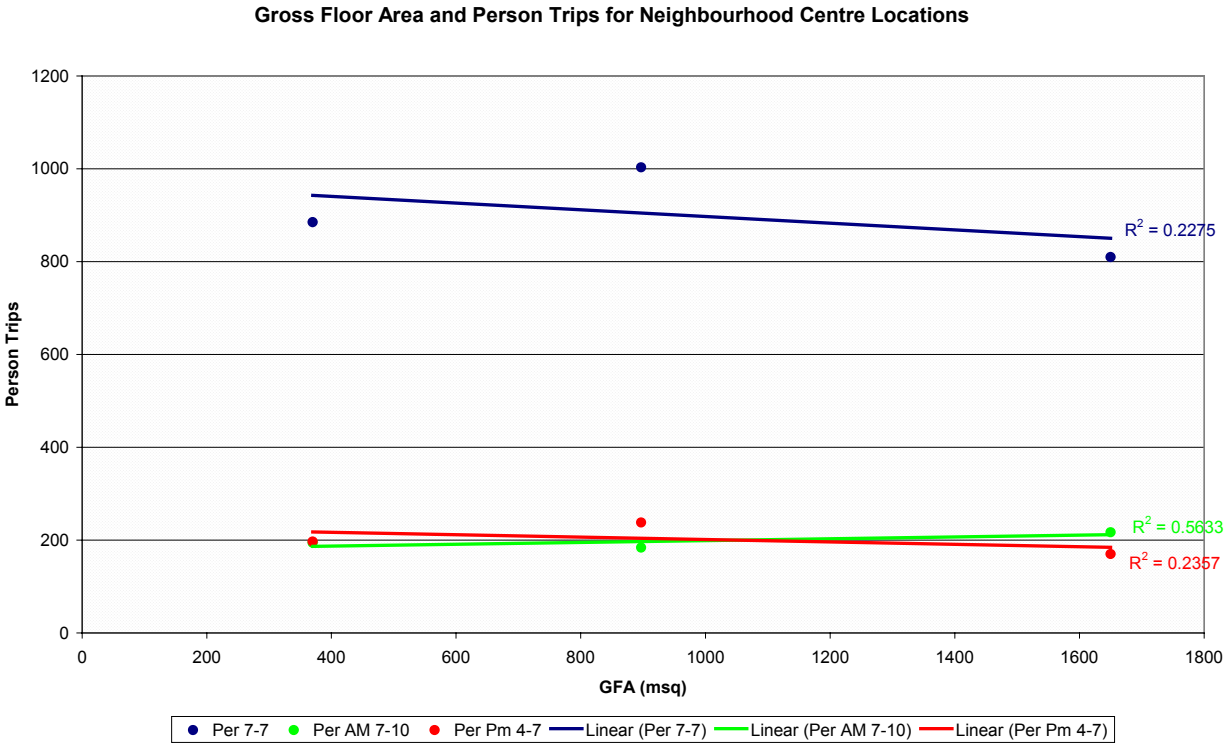
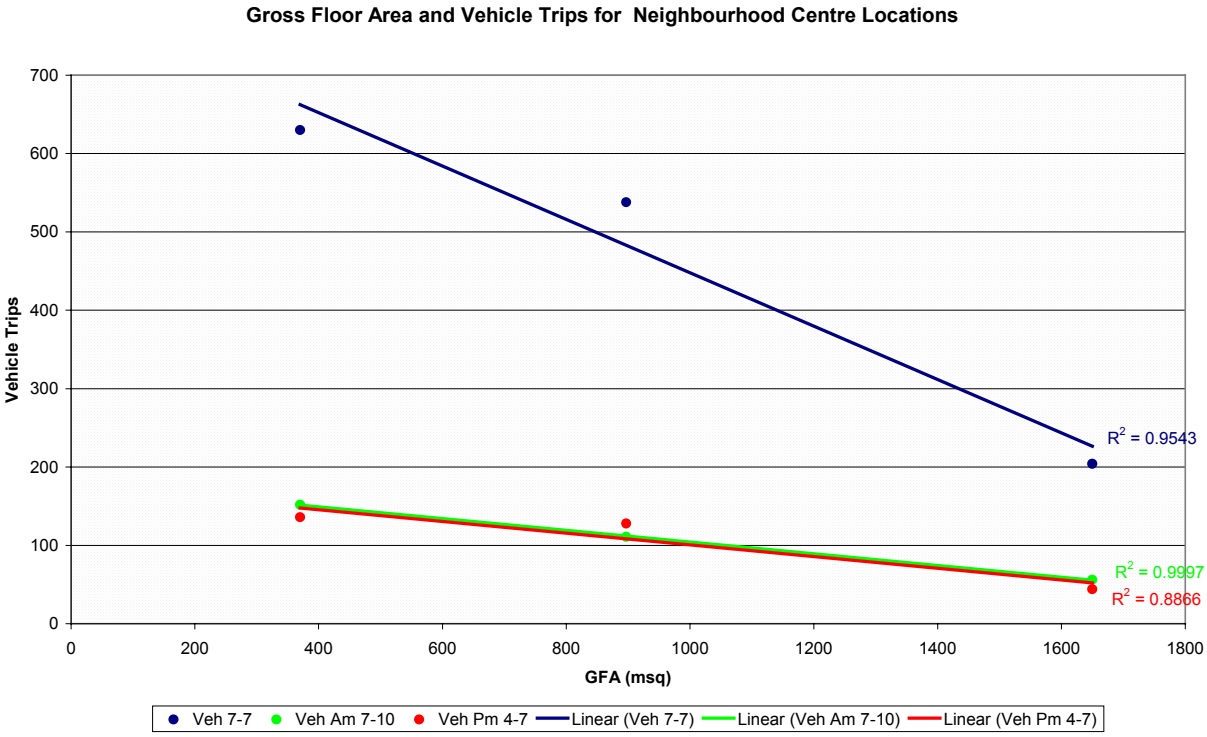
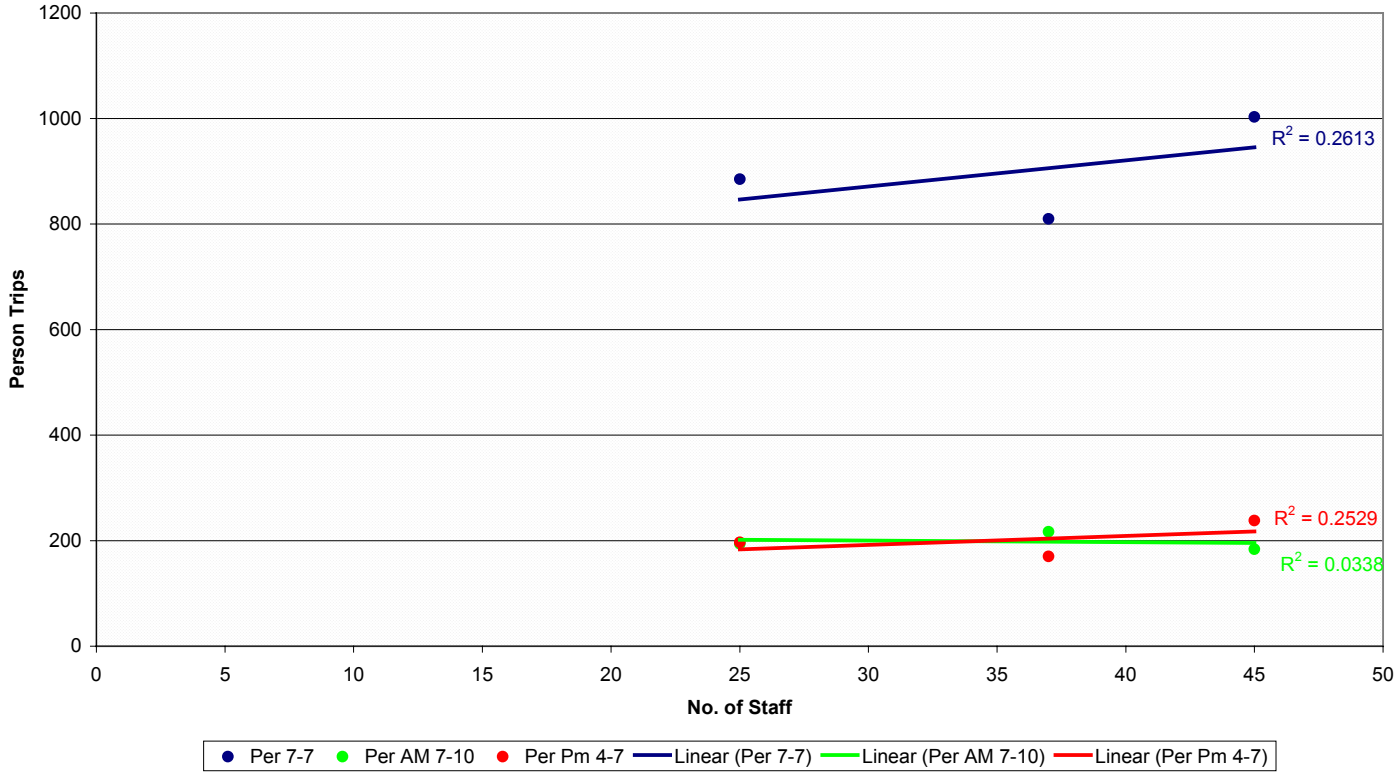


Table 7.13 Plot Data: Regression Analysis for sites in a Neighbourhood Centre, Person and Vehicle Trips





Number of Staff and Person Trips for Neighbourhood Centre Locations



Number of Staff and Vehicle Trips for Neighbourhood Centre Locations

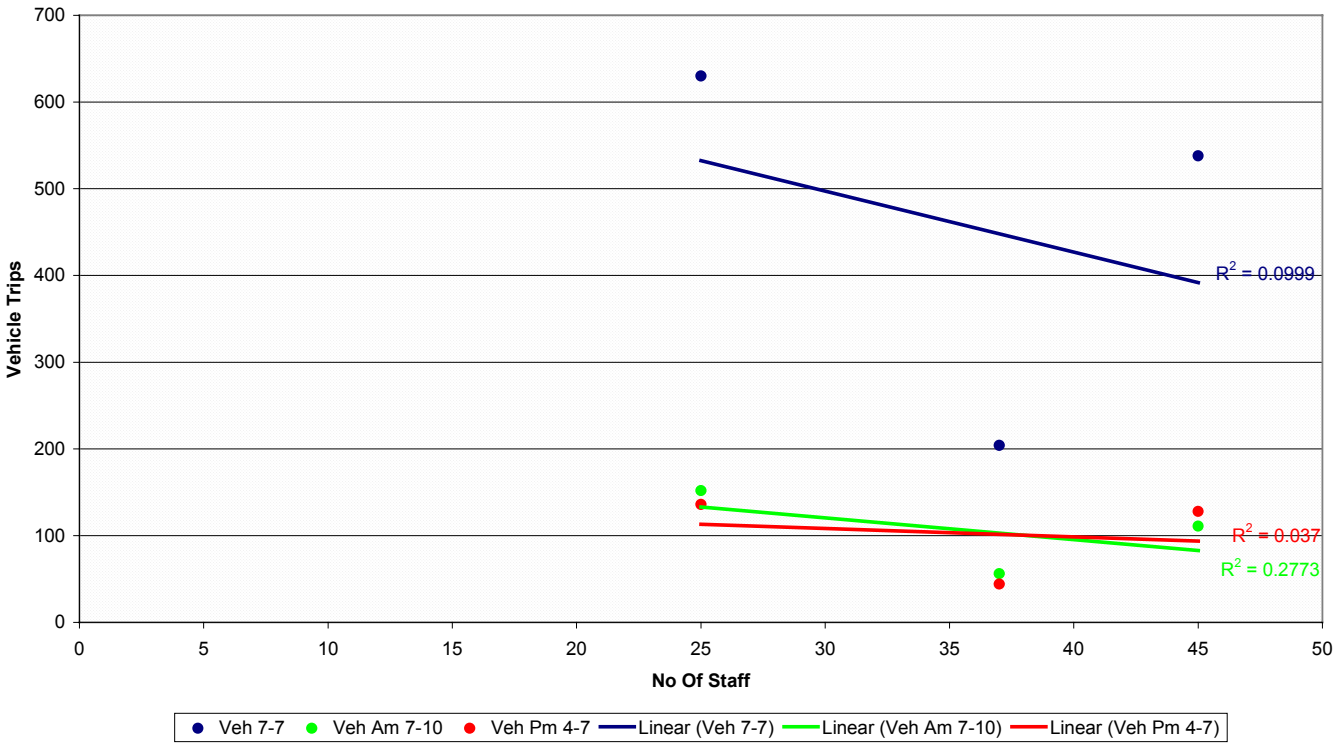
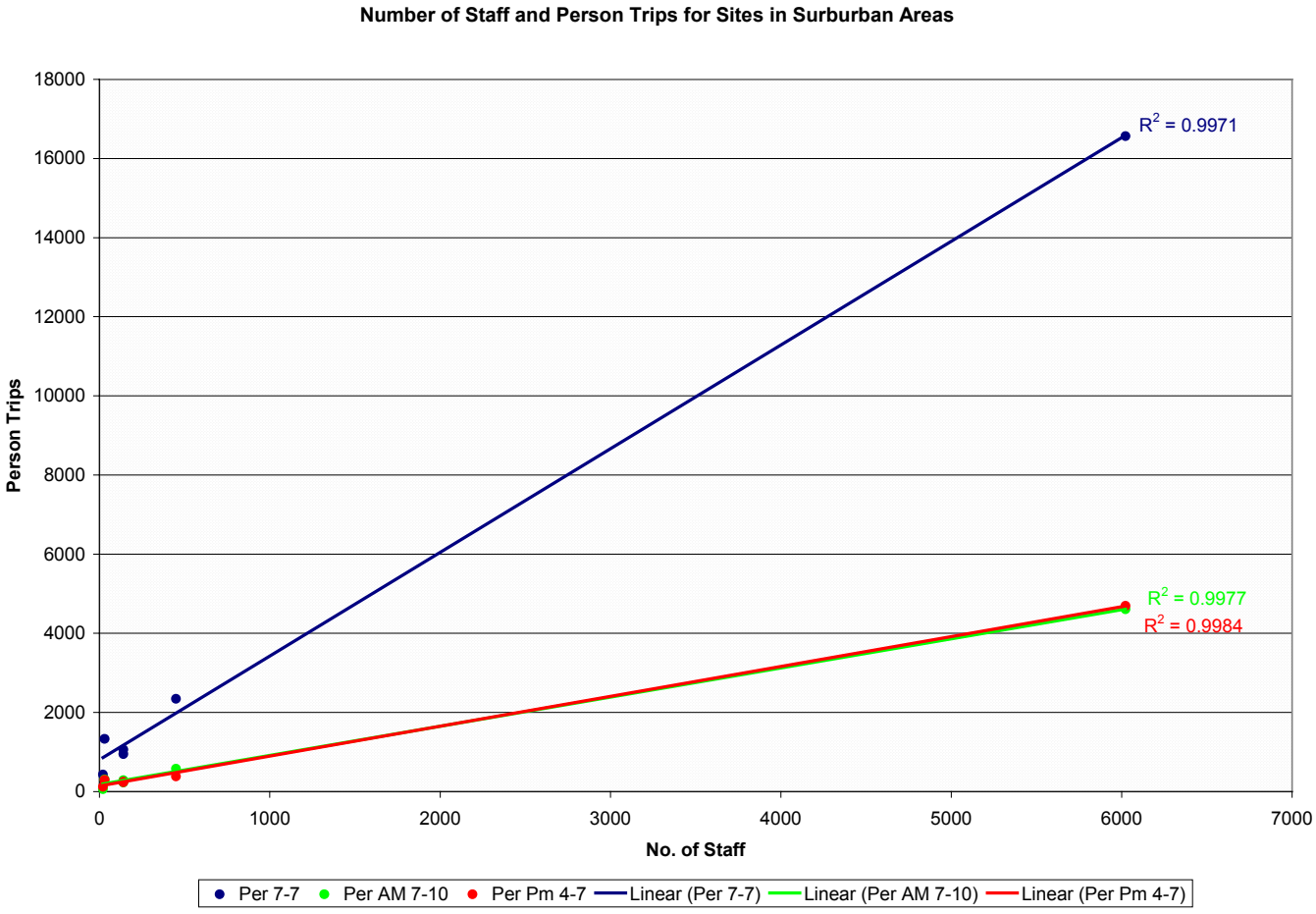
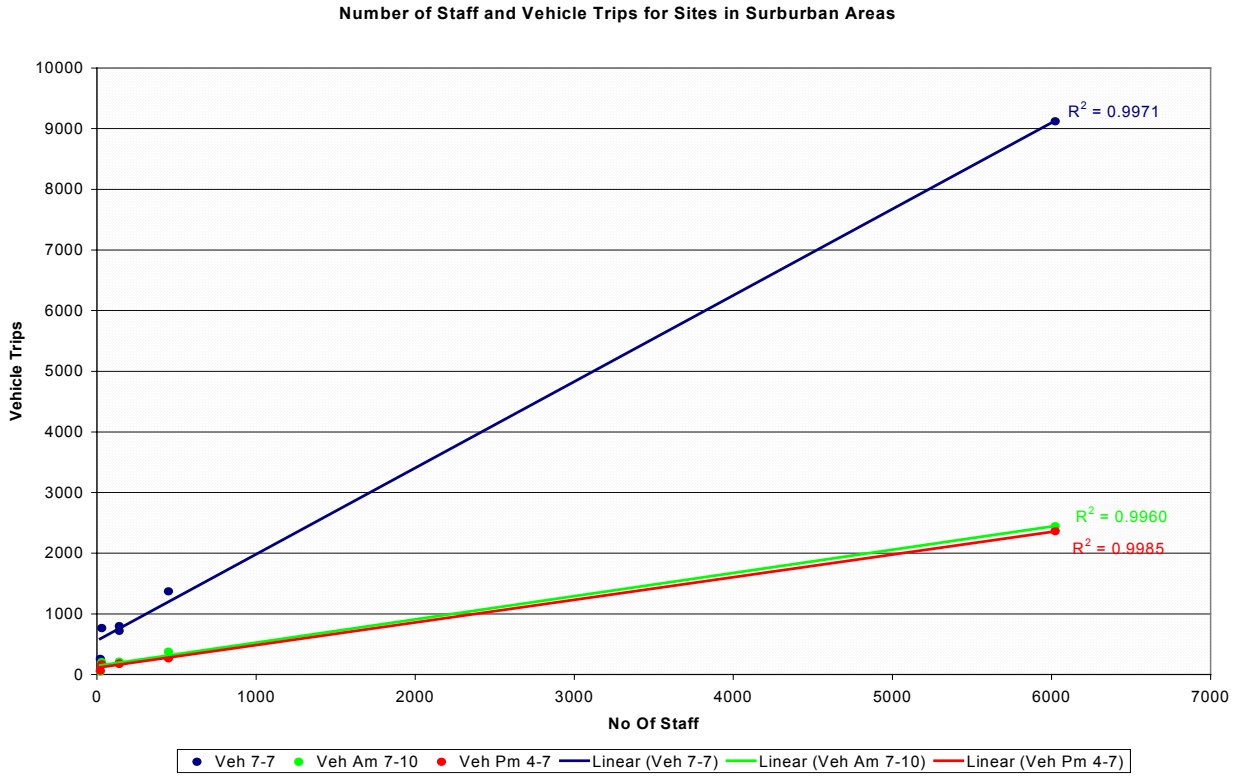
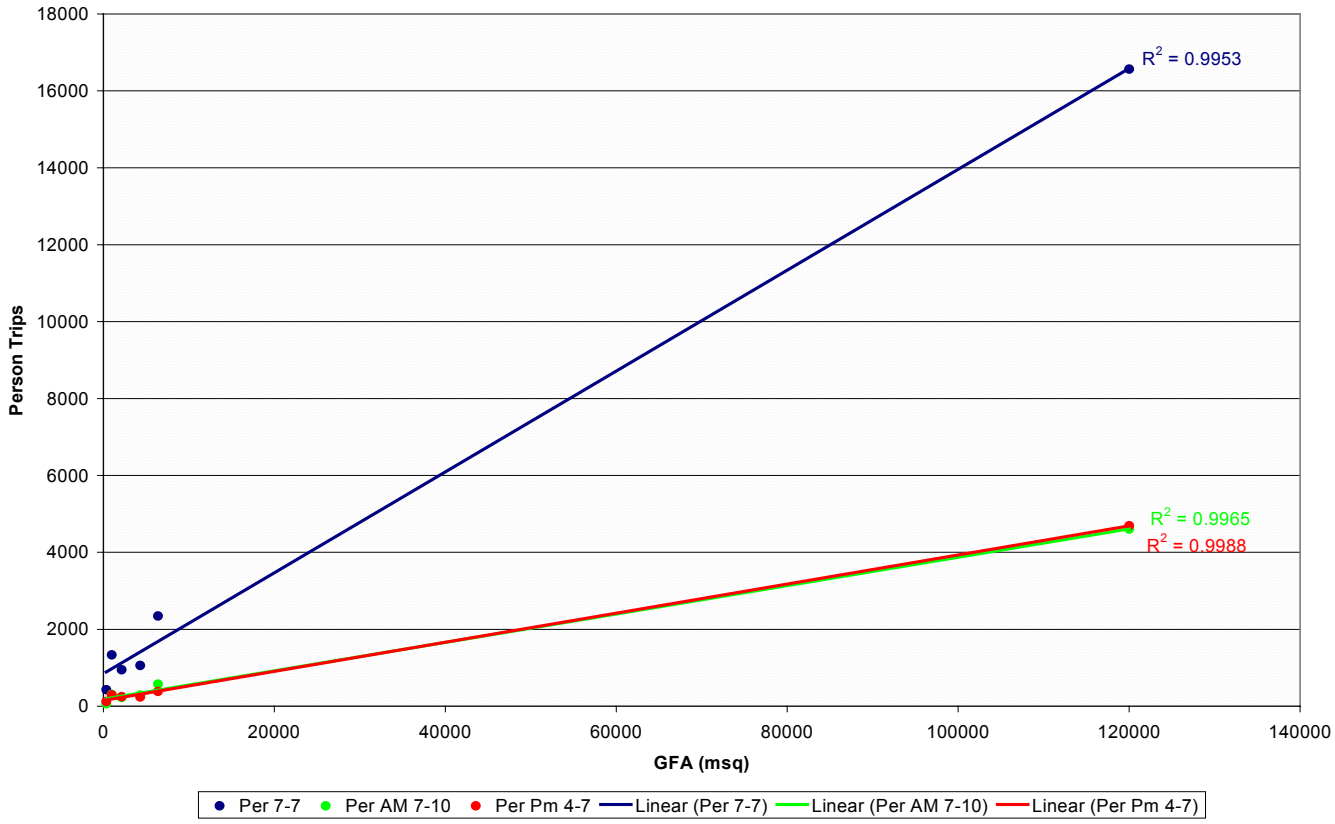


Table 7.14 Plot Data: Regression Analysis for Sites in Suburban Area, Person and Vehicle Trips.

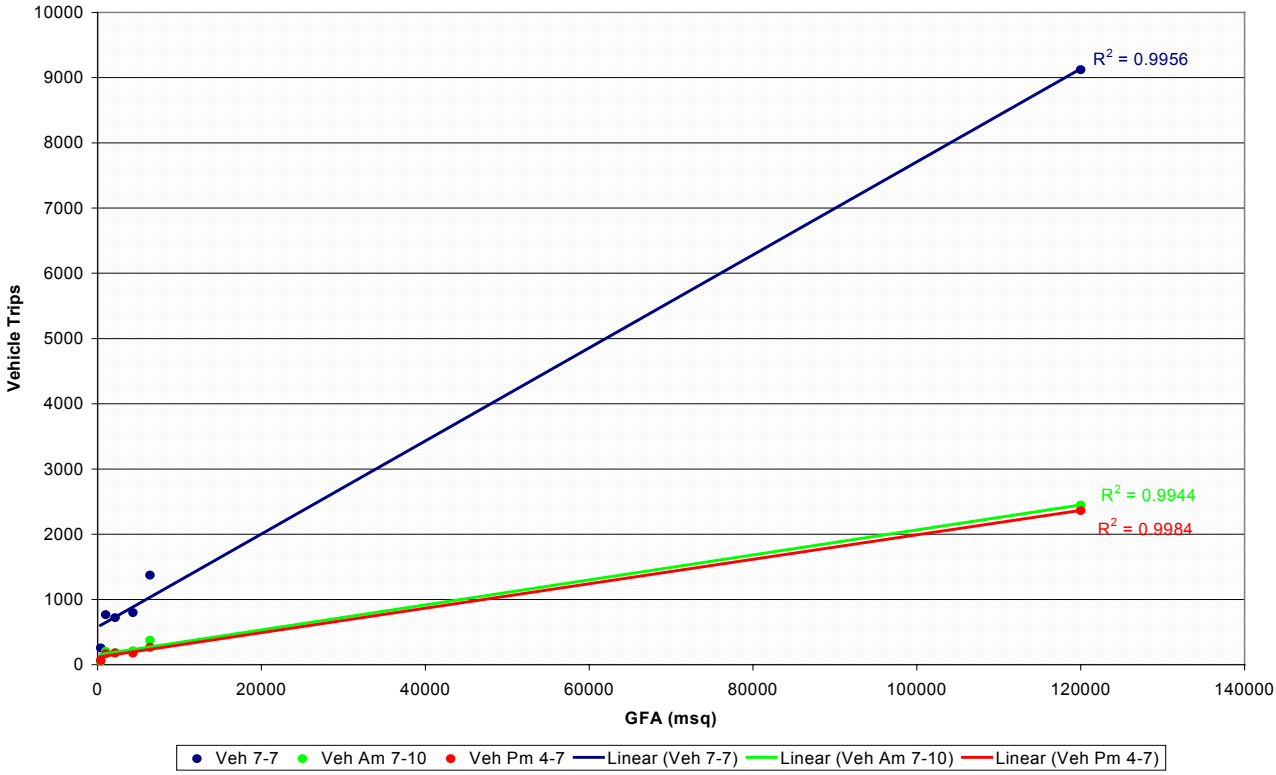




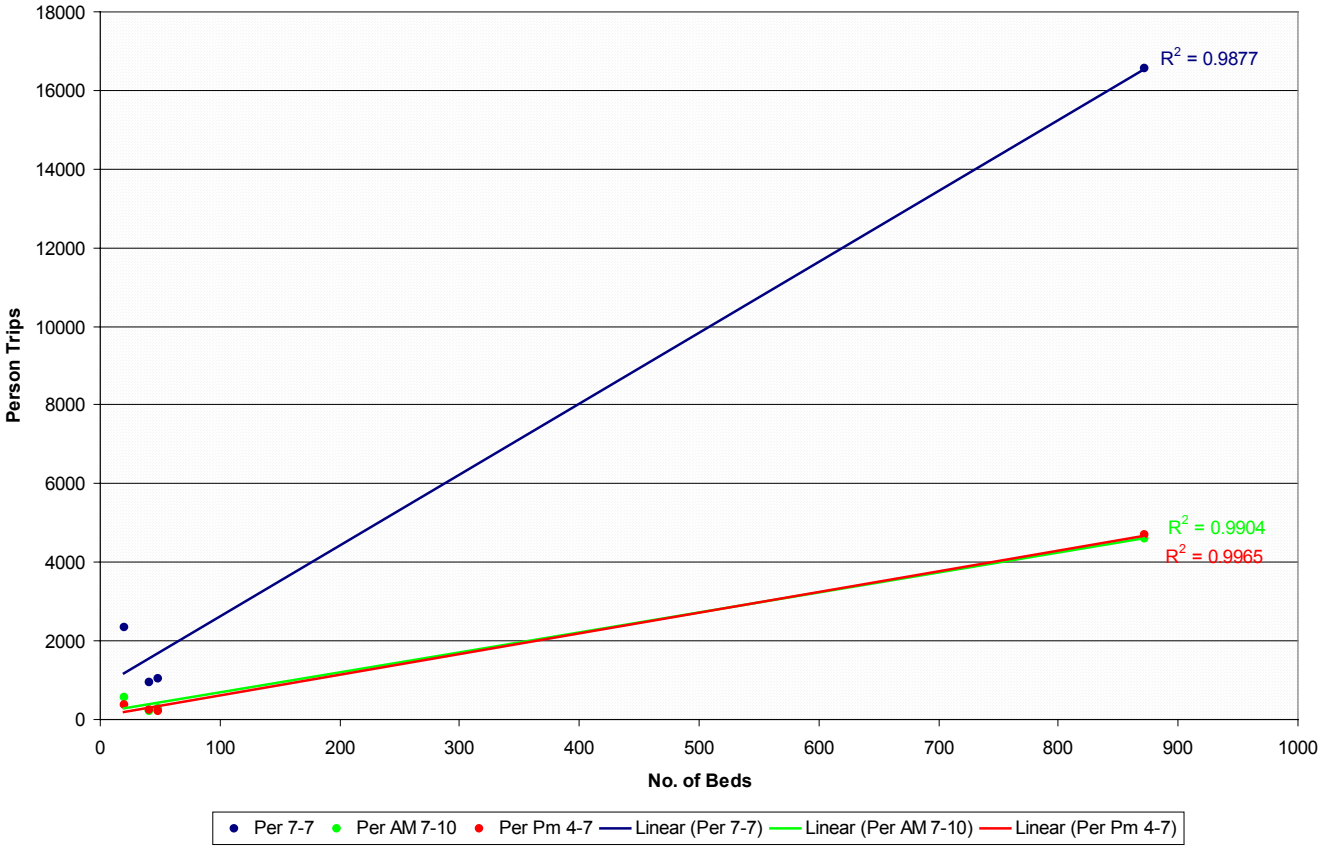
Gross Floor Area and Person Trips for Sites in Surburban Areas



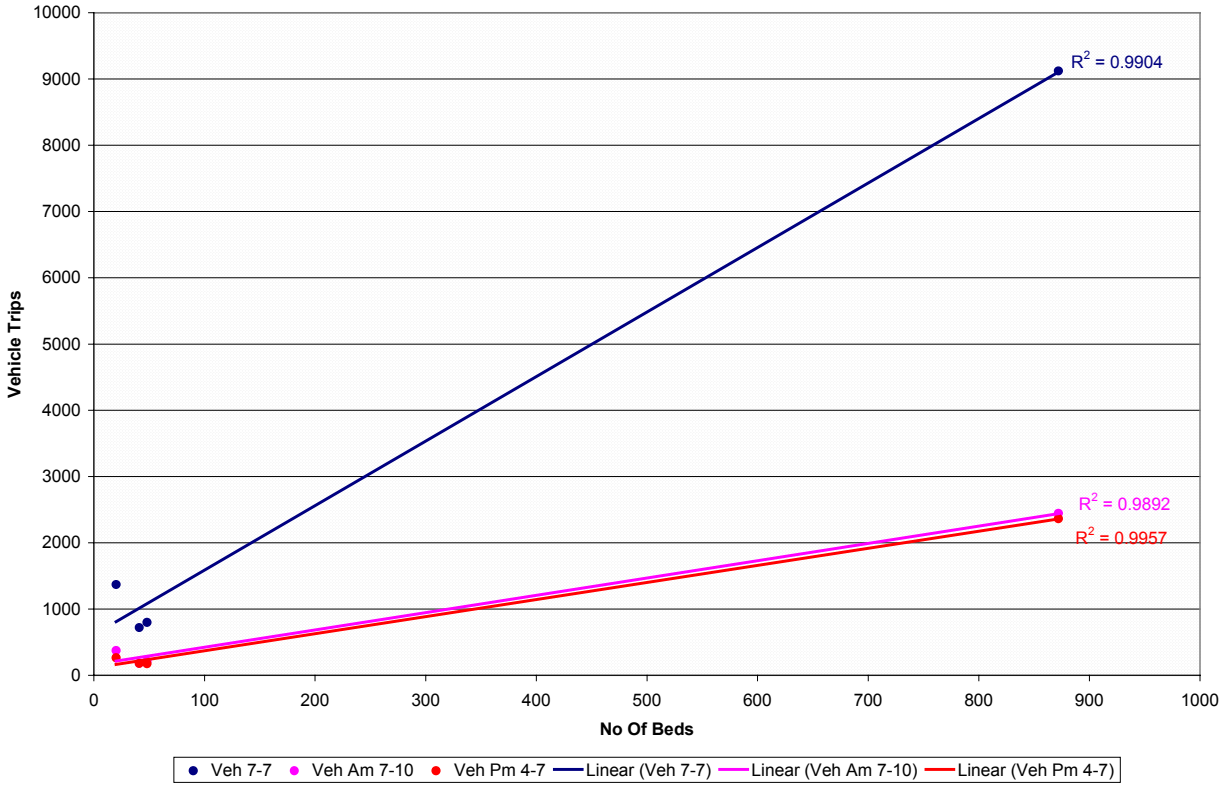
Gross Floor Area and Vehicle Trips for Sites in Surburban Areas



Number of Beds and Person Trips for Sites in Surburban Areas



Number of Beds and Vehicle Trips for Sites in Surburban Areas



Appendix C

Example of Travel Prediction Model Calculation

Estimation of PERSON TRIPS

A General Hospital with Casualty

Input Cells

Trip Type	Associated Parameter	Hospital Statistics	Factor	Parameter Multiplier
WTE Staff	a	1765	0.74	1306
Outpatients pa	b	110000	1000	110
A+E Attendance's pa	b	32704	1000	33
Beds	c	440	1	440
Avg day cases day		0	1	0

Factors	
WTE staff	0.74 to reflect the number of staff on site during the core day (10am-4pm)
Outpatients and A&E attendance's pa	divide by 1000 to allow for trips during a daily peak hour

Parameters	Traffic Generation Parameters from other Hospitals (Start)		
	a	b	c
AM Peak Hr Arrivals	0.41	0.29	0.29
AM Peak Hr Departures	0.09	0.13	0.13
PM Peak Hr Arrivals	0.13	0.25	0.25
PM Peak Hr Departures	0.43	0.22	0.22

Calculation of Person Trips

Trips =	a *	peak period staff
+	b *	Outpatients + A&E Patients per annum /1000
+	c *	bed nights/night
+	0.5	day cases per day

Results	AM Arrivals	AM Departures	PM Arrivals	PM Departures
Staff	536	118	170	562
Outpatients + A&E	41	19	36	31
Beds	128	57	110	97
Day Care	0	0	0	0
Total Calculated	**704**	**193**	**315**	**690**
Observed (if known)	817	200	379	784
Calibrate factors	1.16	1.03	1.20	1.14
% Difference	14%	3%	17%	12%

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