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The analysis of Neighbourhood Watch Structure Using Geographic Information System (GIS)

A dissertation submitted by

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Abstract

This project explores the use of spatial analysis tool such as Geographic Information System (GIS) in the study of crime prevention schemes. This study is concentrating on the Toowoomba region.

Crime prevention programmes have been established to reduce crime rates in particular communities as well as nationally. The Neighbourhood Watch (NHW) Scheme falls into a category of the crime prevention programmes. This is when a number of areas are set up in which members of a community play an important role in preventing crime within their respective community area.

This study focuses on determining effective performance of Neighbourhood Watch Structure. Datasets used to perform this analysis include a street central line and Toowoomba suburb and district boundary dataset provided by Toowoomba city council. Major data sets such as crime statistics and information on Toowoomba Neighbourhood Watch areas were provided by Toowoomba police department.

The analysis of this study was performed in 3 phases. Mapping of crime distribution within Toowoomba overtime was one of the analysis phases. Further, the analysis also included mapping of individual crime type over a ten month's period. Mapping of individual crime class within selected areas was also performed as part of the analysis methodology.

Findings indicated the possibility in utilizing GIS in the analysis of the crime prevention program such as NHW. Generated results of this project also showed that the useful information supporting policing could be provided through the implementation of analysis methods. These methods were used to provide the final findings of this project.

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Chapter 1: Introduction

"Actually, there are often many truths in a place or an area right before our eyes, and yet we're not aware of those truths (or features, or facts) until a depiction or symbol or even a diagram shows them to us. That is one reason why we need maps not only of far away places we've never seen but of the very regions we live in." (Greenhood 1964, p. x – xi.)

"GIS technology can provide a large framework for coordinating activities to work on common problems such as population, resource consumption, and pollution, more efficiently and effectively, and it enables those activities to be more sustainable and more participatory. Its visual language lets more people in your communities make more conscious decisions." (Dangermond 2001)

"A crime prevention programme might have reduced crime in its area of operation, but without the ability to track the situation in the surrounding areas using spatial data, it is difficult to assess whether the programme has displaced crime to other areas." (Bowers and Hirschfield 2001, p.6.)

1.1 Outline of the Study

The above statements suggest the need for utilising spatial information, in visually identifying situation, problems occurring in our surrounding environments and enhancing a better decision making process together with the safety of communities. These comments also express the role and the usefulness of Geographic Information System (GIS) in supporting policing on a worldwide scale, which can extensively assist secure community environments for both present and future generations.

Greenhood (1964) clearly states that maps are an important element in enhancing the representation of facts and situations not only of faraway places but also in regions we are living in. Representation of the truth can raise awareness and understanding to people about facts occurring in their communities, neighbourhoods and some other such places.

ESRI President Jack Dangermond (2001) indicates that GIS plays an important role in supporting wise decision making when dealing with certain problems which could include population distributions, resource use, pollution management and social security matters. GIS technology can create a large framework from which activities can be coordinated and results can be represented graphically.

Bowers and Hirschfield (2001) suggest that spatial information and its representation can be supported by GIS tools thus forming a key instrument when tracking particular circumstances as they occur in a specific region. Without utilisation of spatial information in crime prevention programmes such as Neighbourhood Watch (NHW) schemes, it would be difficult to assess whether such a scheme has displaced criminal activities from the area of scheme's target to another area where the scheme may not be in effect.

On a worldwide level, GIS has been introduced to support effective and efficient management of many different environmental and social aspects. GIS technology is a tool that enhances analysis of many areas through its ability to link spatial information with attribute information or statistical information.

The analysis of crime prevention programmes, especially Neighbourhood Watch schemes, should involve the utilization of advanced technology like GIS in order to assess the scheme's performance. At the same time, GIS technology should be used in the analysis of Neighbourhood Watch schemes to provide suggestions that will benefit future improvements in crime prevention strategies or policing.

This study graphically maps criminal activities that occurred in Toowoomba over a particular period of time by using GIS technology. The study will conduct an analysis of crime in relation to Neighbourhood Watch structures as well as crime in relation to both Neighbourhood Watch areas and demographic information to evaluate the effectiveness of this crime prevention programme.

The purpose and scope of this study is detailed in section 1.4 Research Objectives.

1.2 Introduction

Crime prevention programmes have been established to reduce crime rates in particular communities as well as nationally. Programs consist of different crime prevention strategies or techniques utilised by participating members. The Neighbourhood Watch Scheme falls into a category of the crime prevention programmes where a number of areas are set up in which members of a community play an important role in the effective reduction of crime within their respective community area.

Though the Neighbourhood Watch programme may help to reduce crimes in communities, there are some questions that need to be addressed:

- How can the effectiveness of Neighbourhood Watch areas be measured?
- Can members of a community including, the police force operating within that area, monitor if there is a decrease or increase in criminal activities within their area?

More information and data are needed to answer such questions. Without the use of spatial information these questions are difficult to answer. The correlation between criminal activities and NHW areas is becoming complicated to manage and analyse. This is because records of crime data are not being combined with a sufficient base mapping layer which enables spatially and statistically analysis of criminal trends within particular as well as surrounding areas.

GIS technology is capable of displaying spatial information and allows different types of analysis to be done (such as type, location, and time analysis). Implementation of this technology will help in terms of making the analysis of Neighbourhood Watch programmes easier by mapping crime incidents. Representing information in map format enables the police to have a visual representation of criminal activates that have occurred in the previous time series and thus allow them to predict future crime occurrences before they happen enabling them to implement strategies to prevent these future crime incidents.

1.3 The Problem

The accomplishment of this project carries out some procedures and steps which at the same time are part of the project's problems. Identifying appropriate data and data sources is the first important part in the project. Once this step is successfully done, the collection of the data needs to be taken into action. Though required data sets and their sources are clearly listed out, some unexpected delay in getting such data sets on the expected date still exists. The format of the obtained data sets is one of the issues that need to be overcome. Additionally, considering appropriate analysis methods that allow the project's aim to be achieved is also one of the most important steps required.

This project requires a vast amount of data from numerous sources. The police department holds most of the required data. However, some of the available data sets are in hard copy format which leads to conversion problems from hard copy to digital format. The lack of up-to-date tools such as GIS, make it difficult to convert information between new and old technological applications because of non-compatibility issues. Additionally, there are problems associated with accessibility to some data because of security and privacy issues (refer to chapter 2).

Representing criminal activity in a geographic location is one of the most important procedures in the analysis of NHW. This is because the process of linking available crime data with true ground coordinates system (precise location) required particular data sets containing (X; Y) coordinates and compatible records which allow the processes to be carried out. Further required procedures will be discussed in greater details in Chapter 4.

Overall, the problem associated with the project is to gather all the relevant data and put them into a system that can both manage and allow multivariate analysis to support planning and management decisions.

1.4 Research Objectives

The project aims to determine the effectiveness of the Neighbourhood watch structure which has been adopted in Toowoomba. NHW effectiveness will be in terms of how well the Neighbourhood Watch scheme has played a part in minimizing criminal activities in certain residential areas. The project will incorporate topographic information within the Neighbourhood watch program to allow for the future prediction of crime in particular areas. It is anticipated that this work will be able to provide a tool by which future improvement of crime prevention strategies can be achieved.

The main objectives of this research include:

- Providing an understanding of how Neighbourhood Watch (NHW) Areas work in Toowoomba.
- Demonstrating the use and analytical benefit of GIS technology in the Neighbourhood Watch programme.
- Provide solutions that can be used to improve crime prevention strategies.

In order to achieve these objectives, four major activities need to be considered:

(a) Define Neighbourhood Watch Areas in Toowoomba by utilizing some information obtained from the police and GIS techniques.

(b) Integrate crime mapping with the analysis of Neighbourhood Watch

(c) Conduct an analysis from topographic information.

(d) Review relevant literature relating to the analysis of Neighbourhood Watch structures. Relevant literature will be grouped into the following classes:

(i) Neighbourhood Watch background
(ii) Neighbourhood Watch analysis using GIS

1.5 Conclusion

This dissertation aims to demonstrate the importance of relating spatial information to the field of policing. This will in clued the benefits of implementing GIS technology in areas of criminal activity and crime prevention strategy analysis for better solutions towards safe and healthy communities within Toowoomba. It also aims to provide methods of how analysis of Neighbourhood Watch schemes can be performed by utilizing GIS technology.

The research is expected to result in graphically representing the correlation between the frequency and movement of crime events related to the Neighbourhood Watch areas within Toowoomba, over a 10 month period, to verify its relevance and usefulness. Some literatures are reviewed as a part of project's completion and will be outlined in the next chapter.

Chapter 2: Literature Review

2.1 Introduction

The Police department has developed strategies geared at crime prevention such as Police Beat, Home Assist Secure and The Security Industry liaison board. Neighbourhood Watch (NHW) schemes are one of the most important crime prevention strategies which bring people closer together by involving them in social able local life

This Chapter will review literature to establish the need for utilising GIS new technology in analysing crime and the effectiveness of crime prevention programs. Another purpose of this chapter is to consider the various findings that the authors concluded. These findings show how GIS system can be used to support improvement of crime fighting techniques. Reviewing literature relevant to crime mapping, crime prevention strategies (particularly NHW programs) and other useful methods for crime mapping can contribute towards the achievement of the major project aims as mentioned above (Chapter1).

This literature review will highlight some background information and history of NHW scheme and the role of GIS in policing. This chapter will consider the potential of GIS in providing a good tool for crime mapping and analysing the effectiveness of NHW structure. Further, this chapter will discuss the fundamental elements that make up an effective crime and NHW analysis systems including hardware, software, data acquisition and relevant knowledge. The chapter will then discuss the main features of GIS softwares that are used in the analysis process in order to know which software is best in performing specific tasks.

2.2 Neighbourhood Watch Background

The Neighbourhood watch program started many years ago in Old England where certain villagers were known as "watchers". The watcher was responsible for watching all the other villagers and reporting anyone who broke their local law (Neighbourhood Watch Association 1999 – 2002).

In the mid 1970's the scheme was implemented in America at a time when there was a massive escalation in criminal activities which affected numerous neighbourhoods. By introducing the Neighbourhood Watch schemes this helped to reduced 50% of criminal incidences. Later the scheme was introduced into The United Kingdom in 1982. There are now more than 92,000 schemes covering more than 5 million homes. David Hunt, the commissioner of South Australia Police, implemented the schemes in 1984 after his research of Neighbourhood Watch programs in America and England. The first program in Australia was launched on 1st May, 1985 at Flinders Park (Neighbourhood watch Association 1999 – 2002). The program finally reached Queensland in 1986 as a pilot program. In July 1988, the first official program in Queensland began and the numbers of program have gradually progressed over Queensland. There are now more than 30 Neighbourhood Watch areas within the Toowoomba region (Neighbourhood Watch Inquirers' Guide).

Neighbourhood Watch is a community-based program that encourages householders to join together and form informal groups to improve the safety of their families and other neighbourhood residents and increase the strength of crime prevention. It is a way of developing close links amongst the communities, police, local authorities and other organizations. Throughout the years, the scheme has grown from an "extra eyes and ears" approach for crime prevention to a much more proactive, community-oriented endeavour (European Group 2004). The success of the program can be contributed to establishing improved communications between neighbours and sustaining an appropriate level of

neighbour involvement to a point where the neighbours realize a reduction of burglaries and other property criminal incidents.

The main aim of Neighbourhood Watch Schemes is to help reduce crime and the fear of crime, and improve personal safety as well as household security by:

- Increasing greater vigilance
- Better crime prevention
- Encouraging a better community spirit.
- Establishing neighbourly co-operation.

"*A stronger community spirit grows as people get to know each other and look out for one another"* (Metropolitan Police Service).

The structure of a Neighbourhood Watch Area (Figure1) is divided into three levels which are area, zones, and blocks (which have area co-ordinator, zone co-ordinators and block co-ordinator, respectively). There are approximately 4 zones in an area, while a zone consists of roughly 10 to 12 blocks depending on local circumstances. Typically, there are about 8 to 12 homes within a block. An area of Neighbourhood Watch has a police officer as Neighbourhood Watch Police Liaison Officer (NHW PLO).

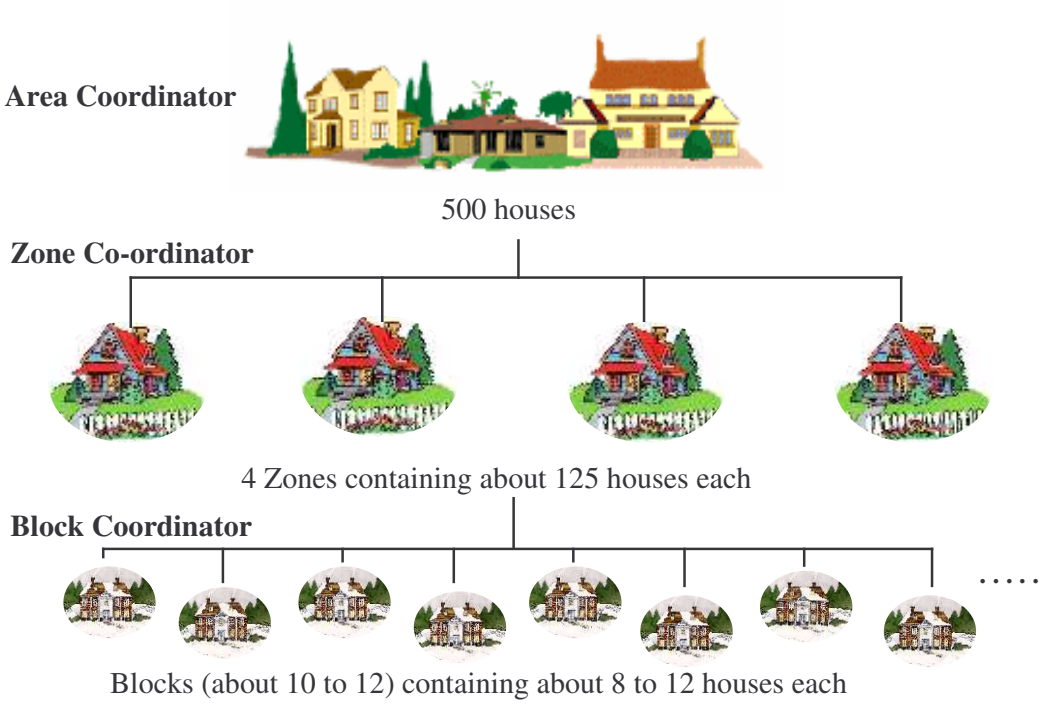


Figure 2.2.1: Structure of a Neighbourhood Watch Area

Area Co-ordinator

The important role of this person is to be responsible for the overseeing of zones and to ensure that the zones within Neighbourhood Watch (NHW) area work with one another. The area coordinator may communicate with the Police Liaison Officer and the District Community Policing Co-ordinator (DCPC) who is responsible for overseeing and co-ordinating all NHW Areas in a police district when required. Whilst the duties performed are primarily a coordinating role, they also assist in gathering information for the area newsletter as well as arranging the distribution of official printed material and information.

Zone Co-ordinator

The Zone Co-ordinator is responsible for organising the functions of block co-ordinators within their zone in a timely and orderly manner. Other than liaising with block coordinators, zone co-ordinators assist with the distribution of printed

material, hiring and supervising property engravers, as well as distributing crime prevention information such as NHW newsletters and various other articles.

Block Co-ordinator

The block co-ordinator assumes responsibility for homes in their own block. They communicate with zone coordinators; gather information for the newsletter and, like zone co-ordinators as well as assisting with the distribution of printed material and information.

2.3 GIS in Policing

Geographic information system (GIS) applications in the field of policing took off in the late 1980s and early 1990s (Harries 1999). Today, they are becoming one of the most valuable tools in an area of policing as they play an important role in law enforcement and criminal justice. These systems have been mainly used in the field of criminal analysis. GIS provides abilities in spatial analysis and spatial clustering which are considered to be important tools for mapping, analysing, and visualising crime data (Bowers and Hirsfchfield 2001). Worldwide, GIS technologies are being employed by many different law enforcement agencies to examine association between crime and environmental features and to pinpoint concentrations of criminal activity. These systems are also used to monitor current crime activity and develop collaborative strategies with the local communities for combating crime or allocate resources for crime prevention to areas where they are most needed (Block *et al* 1995).

Crime mapping is a fundamental technique of criminal analysis as the actual location and amount of crimes are visually represented. This helps in analysing the volume of crime and type of crimes happening in particular locations. Crime mapping also assists in identifying crime trends, clusters, series and patterns, aiding operational police in areas such as targeting ‘hot spots’ (a single place with many crimes) , geographical profiling and predictive assessments. Geographical

profiling is a term that indicates the geographic behavior of a serial offender with a view to predicting his/her probable home location. Geographical profiling has been considered for use in the policing field because research has shown that offenders often commit crime within a certain radius of there home (Bawden and Saywell 2000). .

Crime mapping fundamentally involves process of Geocoding which is the most commonly used way of getting crime or crime-related data into GIS (Harries 1999). This techniques enables a link between map and database, therefore, this makes it possible to investigate information of particular crime spot on a map.

2.4 GIS and the Analysis of Neighbourhood Watch Structure

The most significant element toward community crime prevention appears to be encouraging social interaction, whereby residents of the community maintain a degree of familiarity with each other (Mukherjee and Wilson 1987). Thus, the Neighbourhood Watch scheme has been established to respond to this community crime prevention aspect. The effectiveness of the program can be analysed and enhanced through the utilisation of advanced technology known as GIS. GIS is a computer programs that acquires, stores, manipulates, analyses and displays spatial data and gives the ability of spatially referenced information.

The power of GIS technology comes from the ability of relating different information in a spatial context and reaching a conclusion about this relationship. GIS, therefore, can reveal important new information that leads to better decision-making (USGS Eastern Region Geography 2003). GIS technology can be implemented in crime analysis with the purpose of increasing the effectiveness of police services in communities. By referencing GIS data, police departments can allocate resources to areas where crime is actually happening. Other than identifying areas with high crime rates, GIS technology can be used to improve community relations by demonstrating police effectiveness through maps use to

show actual locations and strategies to curb crime through Neighbourhood Watch and others such groups. Thus GIS can be a valuable aid in maintaining cooperation between the community and the police.

When attempting to answer a geographic question, some basic questions need to be addressed, such as which phenomena are to be examined and how will analysis proceed? GIS technology provides a set of "tools" or computer programs allowing the performance of a specific set of operations on maps and attribute data to operate. These tools are in the form of operating commands permit spatial inquiry, manipulation and analysis. The functional tools in GIS for spatial analysis can be defined in six categories:

- Projection and Spatial Transformation Utilities
- Spatial retrieval, Classification, and Measurement Functions
- Logical and Visual Overlaying Capabilities
- Proximity and Network Functions
- Map Algebra Utilities
- Output Generation.

(Falbo *et al* 2002).

Some of these tools have been chosen and will be discussed in more detail in the next sections.

2.4.1 Projection and Spatial Transformation Utilities

One of the most important steps in performing effective analysis of crime and NHW program is the process of pre-processing which is part of GIS functional tools. Performing various pre-processing operations can brings some benefits by removing errors that are likely to occur while making observations, compiling maps and encoding layers into the database. Different coordinate systems (such as Latitude/Longitude or Universal Transverse Mercator (UTM) units) used in

different map layers can affect map overlay processes which will then lead to analysis problems. Overcoming such problem may involve registration of map themes. Registration of a map layers is a process involving the systematic adjustment which allows the layer to be accurately overlaid onto another layer of the same area (Falbo *et al* 2002).

In short, GIS is able to resolve problems associated with map layer having different data source by mathematically converting the map data from one coordinate and projection system to another. The capability of coordinate adjustment and combining graphics files from different coordinate systems can be derived through projection and spatial transformation utilities.

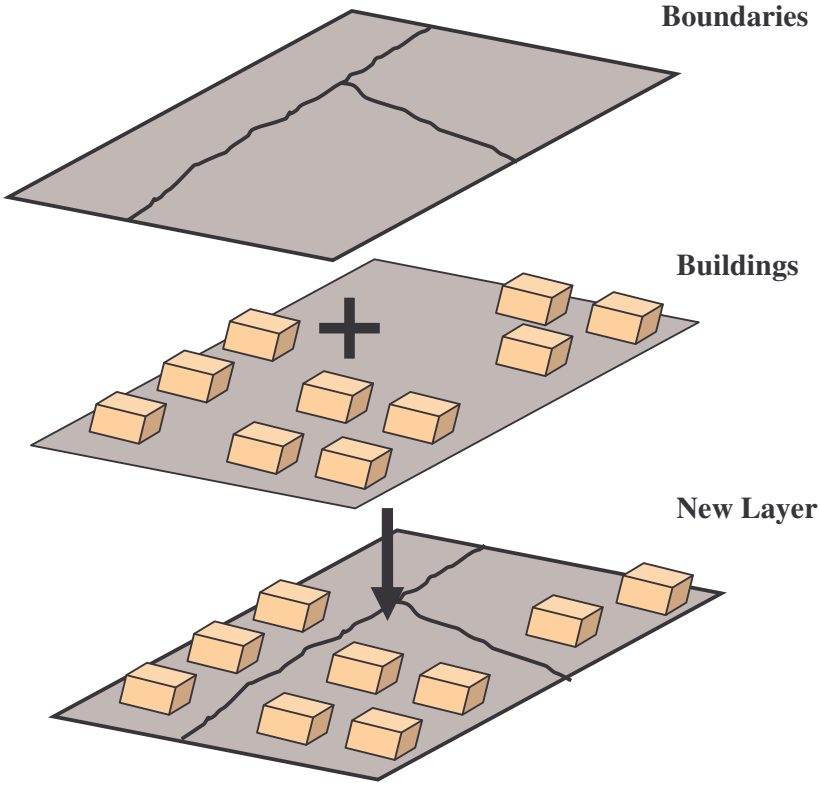
2.4.2 Logical and Visual Overlay Capability

GIS is one of the most powerful technologies capable of building different map layers and evaluating relationship between them. Evaluating relationship between layers or overlaying map layers covering the same area can be done from both logical (mathematical) and graphical perspectives.

In mathematical overlays, layers are superimposed using logical or spatial functions where the result can then be stored in the GIS database as new data layers. This approach examines the quantitative association between the phenomena of interest (Falbo *et al* 2002). Under this operation, new layers are created whose geometry and/or attribute structure are altered. In other words, it involves rebuilding of the topological relationship that makes layers function (Figure 2). This overlaying approach allows the analyst to find overlapping features, as well as to quantify the area or length of overlap. Overlaying various data layers can accurately be done when all the layers have been registered into the same projection or coordinate systems (ESRM 250 2004).

Generally, in GIS, visual or graphical overlays can allow the analyst to graphically view spatial relationships between various layers sharing the same spatial extent via computer screen without having to seek specific mathematical relationship. This GIS overlay capability however does not create new layer in GIS database as the layers are not actually combined. Instead, it only displays all the layers on top of one another at the same time and provides visual cues of the

Figure 2.4.2.1: Overlaying Process



relationships between the layers.

This diagram demonstrates typical overlay process or function that allows the user to combine different map layers in order to produce a new data layer that gives more meaning.

2.5 Fundamental Components of an Effective Spatial Analysis System (GIS)

Effective GIS is a system that combines all the fundamental system elements of hardware, software, data, people, and procedures. This is considered to be essential as the more accurate and sufficient results of analysis such as crime and Neighbourhood Watch scheme analysis require an effective analysis system.

2.5.1 Hardware and Software

Hardware is one of the important GIS components, which brings realistic vision of GIS. It consists of the technical equipment needed for an operation of a GIS including a computer system that has enough power to run the software and enough memory to store large amounts of data. These are the most important things in a computer system because the faster the system is, the quicker the performance and the faster the results can be revealed. Hardware includes input and output devices such as scanners, digitizers, GPS data loggers, media disks and printers. The necessary components will depend on the type of GIS applications.

Software is essential in spatial analysis system or GIS system because it provides the ability to store, analyse and display geographic information graphically. It is also capable of data input, data management, data transformation, and data output. An example of software that can be used in the analysis of Neighbourhood Watch would be ArcView GIS, ArcGIS and MapInfo because they support Geo-referencing or Geolocating, which needs to be done under the analysis process of Neighborhood Watch. Even though these types of software are considered to be suitable software for analysis and implementation in this research project,

ArcView GIS and ArcGIS are chosen to perform the analysis. A comparative study of these softwares needs to be carried out to determine which one is best in performing particular analysis.

2.5.2 Data Acquisition and Knowledge

The system would not be completed and would not function without the combination of data and people called the analyst or GIS user. Geographic data and related tabular data can be purchased from data providers or collected by using GIS data capture techniques such as surveying, using satellite position systems, digitizing, scanning, and photogrammetry. Some types of data are manually entered into the GIS database system for example, the crime statistics. The crime date, time and location are recorded. The implementation of intelligent GIS tools can graphically present crime location. Different types of data are required in the system depending on the purpose of the study.

Effective GIS also requires a person who has GIS knowledge because without this person, the system cannot be run effectively. If the system is given to someone who has no experience and knowledge on how the system works; such as what procedures should be followed and what kind of data provided (type of projections, scales, coordinate system, etc.), the analysis will not be carried out correctly and successfully. Therefore, a certain level of knowledge on GIS and spatial analysis is of paramount importance.

The GIS analyst should plan and follow some certain procedures in order to get what the study aiming for. The procedures are the steps taken to answer the questions need to be resolved. The procedures may include how the data will be retrieved, stored, managed, transformed, analyzed, and finally presented in a final output (Spatial Information Clearinghouse 2004).

2.6 Consideration of GIS Softwares (ArcView GIS 3.2a and ArcGIS)

This section will focus on the discussion about key function available in two different types of software ArcView GIS 3.2a and Arc GIS. The discussion will

cover mainly those features that are essential to the analysis of Neighbourhood Watch program.

2.6.1 Key Feature of ArcView GIS 3.2

a. Software Interface

The interface of this software is considered to be quite user friendly and easy to use. Interface enhancements contained in ArcView include:

- Displaying coordinates in Latitude/Longitude or Universal Transverse Mercator (UTM) while moving cursor along features presenting on screen.
- Displaying scale changes as the user zooms the image in and out.
- Standard icons such as query builder, zoom to active theme, zoom to selected features, clear selected features, text editing, drawing, etc are available at all time on View Window.
- Project window gives users ability to add more than one view and layout in one project.
- Project window displays lists of added table, created charts, views, and layouts which make it easy to manage.
- All the windows in ArcView project can be arranged by selecting windows arrangement options under Window menu. User can then view all the windows at the same time.

b. Address Matching and Geocoding

ArcView provides an easy and high quality address matching and Geocoding application. The application of address matching allows any level of addresses to be matched including country, state, city and zip code. ArcView also includes various Geocoding extensions that support wide range of addressing styles.

c. Shapefile Conversion

Selected features can be converted to shapefile easily in ArcView. The new shapefile therefore can be used in further analysis. New shapefile or

map theme of different feature types can be created and automatically added into the view

d. Creating and Editing Spatial Data

Other than ability to create new shapefile, ArcView also enables the process of editing and creating new spatial features. It provides drawing tools which are easy to use and users can simply draw new features into existing layers once the layers are set to the Start Editing option. The created features can be cut or extended without having to change editing task categories like ArcGIS.

e. Adding tabular data to the view

The process of adding tabular data to the view is known as Geolocating. ArcView also supports this application. Once the tabular data is represented in spatial data format on the View Window, it can then easily be converted to a new shape file.

f. Map layout

There are a number of layout templates available in ArcView for users to choose in order to represent final results in a standard map format. Users can also design there own map layout and display maps in different projection that suite the study areas. Charts and tables can also be added into layouts; however, there are limited symbols and pattern styles that can be used to represent different features on a map in ArcView compared to ArcGIS.

2.6.2 Key Features of ArcGIS

ArcGIS also known as ArcView 8, however, there are some changes in its interface compared to ArcView 3.2. This software consists of three desktop applications which are ArcMap, ArcCatalog, and ArcToolbox. ArcGIS performs many of the same functions as ArcView does, but it incorporates several new

extensions which are friendlier to 3D applications. Windows interfaces appear to be smoother and nicer in ArcGIS than ArcView. The interface of ArcGIS can be quite complicated for some users even though it provides more powerful new applications while ArcView offers a simpler interface to perform particular tasks such as address matching and Geolocating.

a. ArcMap

ArcMap is a basic GIS browser, where a majority of the tasks of mapping take place that appear to be similar to the ArcView interface. In ArcMap, shapefiles are added, table edited and layouts manipulated. Other than that, TIN and Raster Datasets can be initially generated in ArcMap working space. This application can be easily activated by clicking on the  button while in ArcCatalog, or by launching the program separately from the Windows taskbar (Geoprice.Net 2003).

b. ArcCatalog

ArcCatalog is an ArcGIS' subsidiary file management program which provides the user with the ability to quickly preview the various components of a particular dataset and explore metadata within an enhanced Windows file explorer framework. This program can also be activated by clicking on the  button while in ArcMap. Different type of new shapefiles can be created here, moved and copied to different folders easily.

c. ArcToolbox

This is a set of Windows based wizards that assist in certain tasks. The tools in ArcToolbox are set in different categories and provide ability to convert data into different formats and to manage projections.

d. Extensions

There are a number of extensions that ARCIS provides which give greater flexibility and compatibility than ArcView. Those extensions are:

- 3D Analyst
- ArcPress
- ArcGIS Publisher
- ArcScan
- Geostatistical Analyst
- Spatial Analyst
- StreetMap Europe
- StreetMap USA
- Survey Analyst
- Tracking Analyst

e. Importing and Exporting File

ArcGIS allows an ArcView layout to be imported into ArcMap to perform further editing. Maps in ArcGIS can be exported into PDF format, which is a suitable format for exported maps, and this format can be opened on any computers that have Acrobat Reader installed. This is considered to be quite a portable format as it does not require ArcGIS to be installed in order to read the file. It also allows maps to be exported in other format such as TIFF, GPEG, BMP, PCX, PNG and EPS; the better advantage that it has over ArcView is in terms of exporting maps and the ability to export file into PDF format. Other than exporting maps, ArcGIS also gives the ability to export tables and selected records which can be viewed and exported as a new table.

f. Working with style and Symbols

Another advantage that ArcGIS has over ArcView is the provision of wider range of symbols and styles that can in creating a nice looking map. There are varieties of symbols to be chosen to present particular

features on the map. Texts can be edited and presented in many different colourful styles.

g. Map Layout

The layout of a map can be easily generated in ArcMap. Different styles of data frames are provided and spatial data can be directly edited in the layout view while changes can be updated at the same time in the data view. Scales of maps can be adjusted in the layout view. Users can customise percentage of layer transparency in order to make particular features more outstanding than others. Additionally, labelling styles can be set to make the babels appear in different ways following the feature classes.

h. XTools

XTools can be used in ArcMap to quickly and easily calculate the areas, length or coordinates of features. The calculated resulted will then be added into map attributes.

2.7 Summary

The literature review has shown that Neighbourhood Watch programs have been adopted in many countries as part of crime prevention strategies. The program aims to encourage people in the community to communicate and work together to prevent crimes. Cooperation between the police force and Neighbourhood Watch community people can increase strength of crime fighting in a community.

Worldwide, GIS applications have been adopted to enhance better policing process. Many law enforcement agencies have come to address the use of spatial analysis systems. As mentioned above, GIS offers an ability to link spatial referenced data to its attributes which enables more effective operational policing. This system allows spatial analysis and spatial clustering of crime data to be

carried out. GIS provides ability in criminal mapping that is considered to be very useful for policing. Mapping of crime assist policing in predicting future crime spots, allocating resources for crime prevention, and analysing pattern of crimes, criminal extend, and crime volume.

The ability to perform criminal analysis in GIS applications provides great opportunity for the analysis of crime prevention scheme such as Neighbourhood Watch system to be handled. Crime mapping generated through GIS can assist in the analysis of neighbourhood Watch structure in terms of determining the effectiveness of the program. To achieve the analysis of Neighbourhood Watch programs, there is a need to establish the necessary steps that should be undertaken in performing analysis. Chapter 3 will outline methods used in retrieving project goals.

From reviewing key features of ArcView and ArcGIS, it has shown that ArcView offers more simple ways for address matching and Geolocating which can make the process of crime mapping possible. On the other hand, ArcGIS provides better range of symbols that can be used to generate better looking final products and it supports importing, especially ArcView, layouts and exports maps in a portable format. These softwares will be used to assist the analysis in this project. The software to be used for particular tasks will be determined by its key features and personal familiarity to the software applications.

Chapter 3: Datasets

3.1 Introduction

Map themes or layers are the fundamental elements that allow an operator of geographic information system (GIS) to perform all the statistical and spatial analysis defined by the analyst. Without map layers and datasets relevant to the purpose of study, the analyst will not be able to successfully complete his/ her project.

Determining the effectiveness of Neighbourhood Watch programs within Toowoomba region requires a number of datasets. To achieve reasonable analysis result, the project required datasets including Toowoomba street central line layers, Toowoomba street addresses, Toowoomba suburb district boundary themes, Neighbourhood Watch area boundary dataset and crime statistics. This chapter will base the discussion on the details of each these datasets.

3.2 Street Central Line Dataset

Street central line datasets are line feature maps as shown in *figure 3.2.1*. This map layer consists of hundreds of line segments that make up street central lines of Toowoomba district. The attributes of this layer consist of records presenting street names, road types, road hierarchy type and speed limit of each road as can be seen in *figure 3.2.2*. This layer will be used as a base map in the analysis to show the exact location of criminal events.

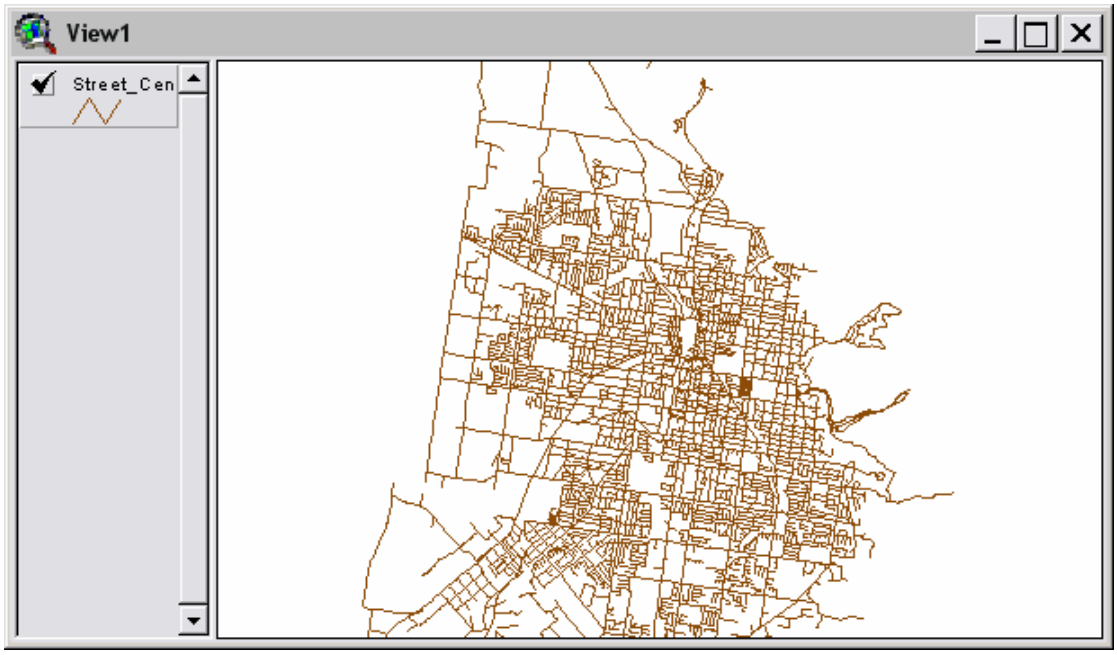


Figure 3.2.1: Street Central Line of Toowoomba

Roadname	Road_type	Hierarchy	Speedlimit
HOGG STREET	SEALED	LOCAL	70KM
NEW ENGLAND HIGHV	SEALED	ARTERIAL	DECLARED ROADS / 80KM
LEMWAY AVENUE	SEALED	LOCAL	50KM
TOR STREET	SEALED	ARTERIAL	DECLARED ROADS / 60KM
CHALK DRIVE	SEALED	ARTERIAL	DECLARED ROADS / 60KM
HOGG STREET	SEALED	LOCAL	70KM
RUTHVEN STREET	SEALED	ARTERIAL	DECLARED ROADS / 60KM
HUME STREET	SEALED	ARTERIAL	DECLARED ROADS / 60KM
CHALK DRIVE	SEALED	ARTERIAL	DECLARED ROADS / 60KM
TOR STREET	SEALED	ARTERIAL	DECLARED ROADS / 60KM
RUTHVEN STREET	SEALED	ARTERIAL	DECLARED ROADS / 60KM
MULLER STREET	SEALED	LOCAL	50KM
RUTHVEN STREET	SEALED	ARTERIAL	DECLARED ROADS / 60KM
O'QUINN STREET	SEALED	LOCAL	50KM
JAMES STREET	SEALED	ARTERIAL	DECLARED ROADS / 60KM
NEW ENGLAND HIGHV	SEALED	ARTERIAL	DECLARED ROADS / 60KM
JAMES STREET	SEALED	ARTERIAL	DECLARED ROADS / 60KM
ALDERLEY STREET	SEALED	COLLECTOR	60KM

Figure 3.2.2: Attributes of Street Central Line Layer

3.3 Street Address Dataset

The Toowoomba street address dataset or theme (*Figure 3.3.1)* is in point feature type. This theme represents existing street address that can be used later on in the analysis for address matching. The attribute table *(Figure 3.3.2)* of this layer contains an address field including house number and street name. Other than the address field, the attribute table also includes both X and Y fields containing real world coordinates which are very important for geo-referencing each address so that they can be displayed as spatial features.

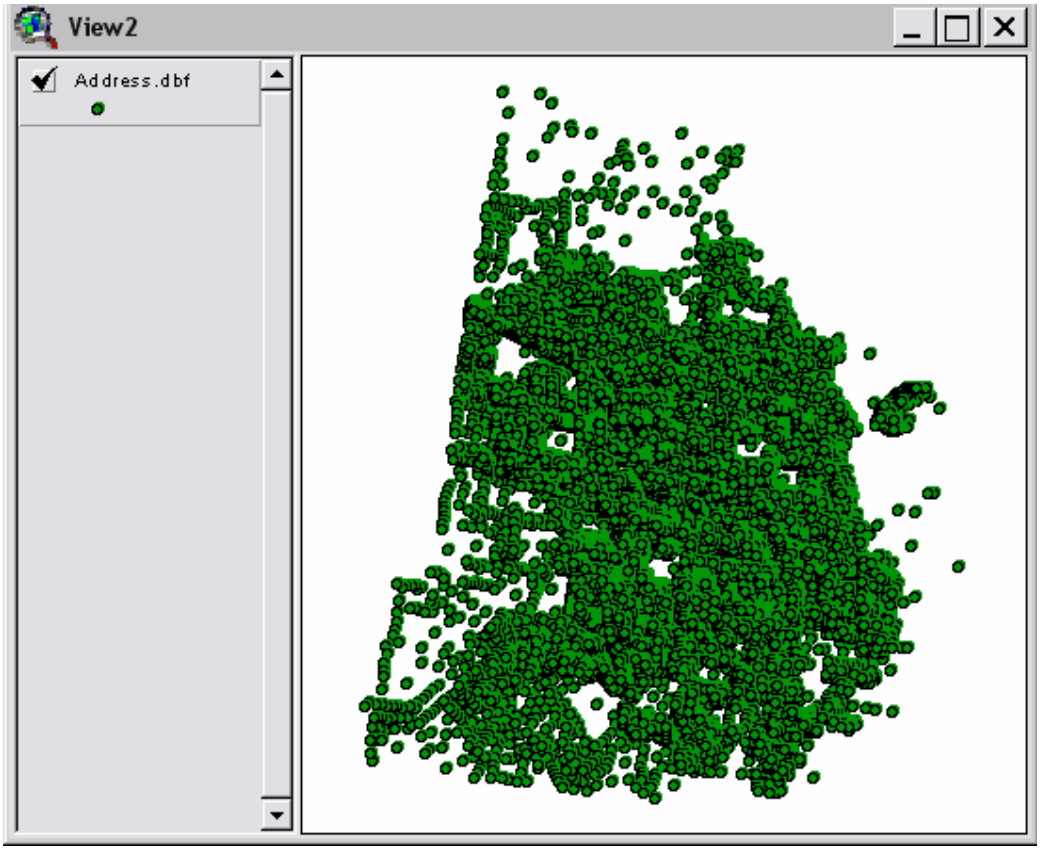


Figure 3.3.1: Street Address Theme

Shape	X	Y	Address
Point	397241.3000	6953009.4000	1 ABELIA STREET
Point	398135.2000	6949464.1000	1 ACACIA STREET
Point	397658.6000	6952616.5000	1 ADAM STREET
Point	398611.5000	6949557.5000	1 ADINA STREET
Point	398119.2250	6947528.0500	1 AGNES STREET
Point	396436.1000	6949128.7000	1 ALAND STREET
Point	394456.8000	6947254.0000	1 ALAYNE COURT
Point	395138.9000	6951008.1000	1 ALBERT STREET
Point	395908.0000	6945879.7000	1 ALBION STREET
Point	399884.1000	6947639.2000	1 ALDERLEY STREET
Point	396587.1000	6952057.6000	1 ALEXANDER STREET
Point	398461.4000	6951952.9000	1 ALFORD STREET
Point	398056.1000	6953180.7000	1 ALFRED STREET
Point	398053.1000	6951043.8000	1 ALICE STREET
Point	396946.3000	6952358.4000	1 ALLAN STREET
Point	394695.6000	6950839.6000	1 ALLENBY STREET
Point	396130.0000	6949268.6000	1 ALLOM STREET
Point	396050.3000	6945743.1000	1 ALROE COURT
Point	397936.1000	6947523.8000	1 AMANDA DRIVE
Point	394424.4000	6946689.1000	1 AMBER COURT
Point	398265.9000	6950759.6000	1 ANDERSON STREET
Point	397393.3000	6952762.1000	1 ANDREWS STREET
Point	399067.2500	6948726.4500	1 ANGLE STREET
Point	398862.3000	6948200.3000	1 ANGUS STREET
Point	396612.5500	6950728.3000	1 ANNAND STREET
Point	396445.2000	6947301.7000	1 ANNIE CLOSE
Point	392750.7000	6953429.9000	1 ANSETT COURT
Point	397020.2000	6951307.9000	1 ANTHONY STREET
Point	395517.2000	6951156.4000	1 ANZAC AVENUE
Point	393896.5000	6948456.1000	1 ARABIAN STREET
Point	395677.4000	6947550.2000	1 ARALUEN COURT

Figure 3.3.2: Attributes Table of Street Address Theme

3.4 Toowoomba Suburb District Dataset

This layer, as presenting in *Figure 3.4.1*, is a polygon feature theme. This map layer can be extract from Digital Cadastral Database (DCDB). Different colours of polygon features demonstrate different suburb districts in Toowoomba. This theme is required in the analysis of Neighbourhood Watch program for the purpose of displaying a base map together with street central line layers. Using this theme, combined with street central line layer as a base map, can assist in the analysis of crime within Toowoomba.

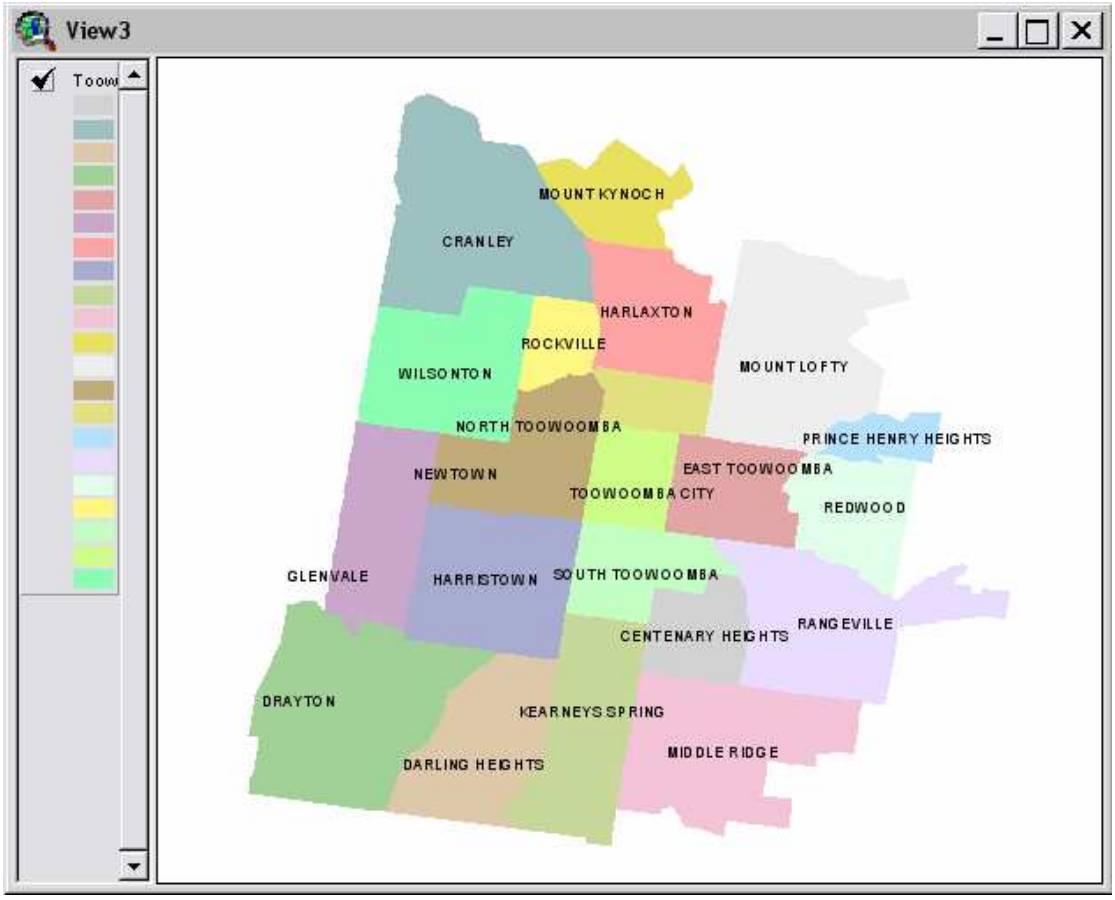


Figure 3.4.1: Toowoomba Suburb District

DCDB used to present this layer has an attribute table (*Figure 3.4.2*) containing records of:

- Lot Number
- Plan Number
- Lot/Plan Number
- Land Tenure Type
- Parish
- Locality
- Shire Name and Lot Area

Lot	Plan	Lotplan	Tenure	Parish	County	Shire_name	Locality	Lot_area
1	RP136388	1RP136388	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	HARLAXTON	1819.00000000000
1	RP90149	1RP90149	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	MOUNT LOFTY	809.00000000000
1	RP150218	1RP150218	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	HARRISTOWN	726.00000000000
1	RP65309	1RP65309	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	SOUTH TOOWOOMBA	1328.00000000000
1	RP16584	1RP16584	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	NORTH TOOWOOMBA	837.00000000000
1	RP17777	1RP17777	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	MOUNT LOFTY	486.00000000000
1	RP55382	1RP55382	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	SOUTH TOOWOOMBA	809.00000000000
1	RP17774	1RP17774	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	MOUNT LOFTY	911.00000000000
1	RP87963	1RP87963	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	KEARNEYS SPRING	971.00000000000
1	RP194744	1RP194744	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	SOUTH TOOWOOMBA	107.00000000000
1	RP71057	1RP71057	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	SOUTH TOOWOOMBA	880.00000000000
1	RP71900	1RP71900	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	HARRISTOWN	524.00000000000
1	RP5410	1RP5410	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	SOUTH TOOWOOMBA	258.00000000000
1	RP16511	1RP16511	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	NORTH TOOWOOMBA	2651.00000000000
1	RP16484	1RP16484	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	NORTH TOOWOOMBA	413.00000000000
1	RP143153	1RP143153	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	RANGEVILLE	720.00000000000
1	BUP6713	1BUP6713	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	KEARNEYS SPRING	79.00000000000
1	RP885049	1RP885049	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	SOUTH TOOWOOMBA	2289.00000000000
1	RP98224	1RP98224	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	RANGEVILLE	506.00000000000
1	RP129747	1RP129747	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	EAST TOOWOOMBA	774.00000000000
1	BUP6610	1BUP6610	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	EAST TOOWOOMBA	84.00000000000
1	BUP7263	1BUP7263	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	NEWTOWN	78.00000000000
1	RP844702	1RP844702	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	MOUNT LOFTY	565.00000000000
1	RP839788	1RP839788	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	DRAYTON	3291.00000000000
1	RP62231	1RP62231	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	HARRISTOWN	546.00000000000
1	RP106014	1RP106014	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	MOUNT LOFTY	903.00000000000
1	RP105769	1RP105769	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	NEWTOWN	936.00000000000
1	BUP12180	1BUP12180	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	KEARNEYS SPRING	113.00000000000
1	RP121152	1RP121152	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	EAST TOOWOOMBA	885.00000000000
1	RP134718	1RP134718	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	MOUNT LOFTY	948.00000000000
1	RP68794	1RP68794	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	HARRISTOWN	1335.00000000000
1	RP55556	1RP55556	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	SOUTH TOOWOOMBA	599.00000000000
1	RP58881	1RP58881	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	SOUTH TOOWOOMBA	701.00000000000
1	RP5518	1RP5518	FH	DRAYTON	AUBIGNY	TOOWOOMBA CITY	EAST TOOWOOMBA	653.00000000000

Figure 3.4.2: Attribute Table of DCDB

3.5 Neighbourhood Watch Area Boundary Layer

Neighbourhood Watch area boundaries were generated from street central line map layers by utilizing digitizing methods. This dataset is represented in polygon feature. It can be used in the analysis to determine correlation between crimes and the Neighbourhood Watch areas. This layer can be seen in *Figure 3.5.1* below.

Figure 3.5.1: Neighbourhood Watch Boundaries

3.6 Crime Location Dataset

This dataset is presented in a point feature as shown in Figure 3.6.1. All points on the layer represent location of crimes in Toowoomba over a one month period. This layer will be used in the analysis together with other required datasets. There are nine other crime location datasets which are similar to the one shown in Figure 3.6.1 that will be used in the analysis. Each of those layers presents different types of crimes happenings during a period of one month.

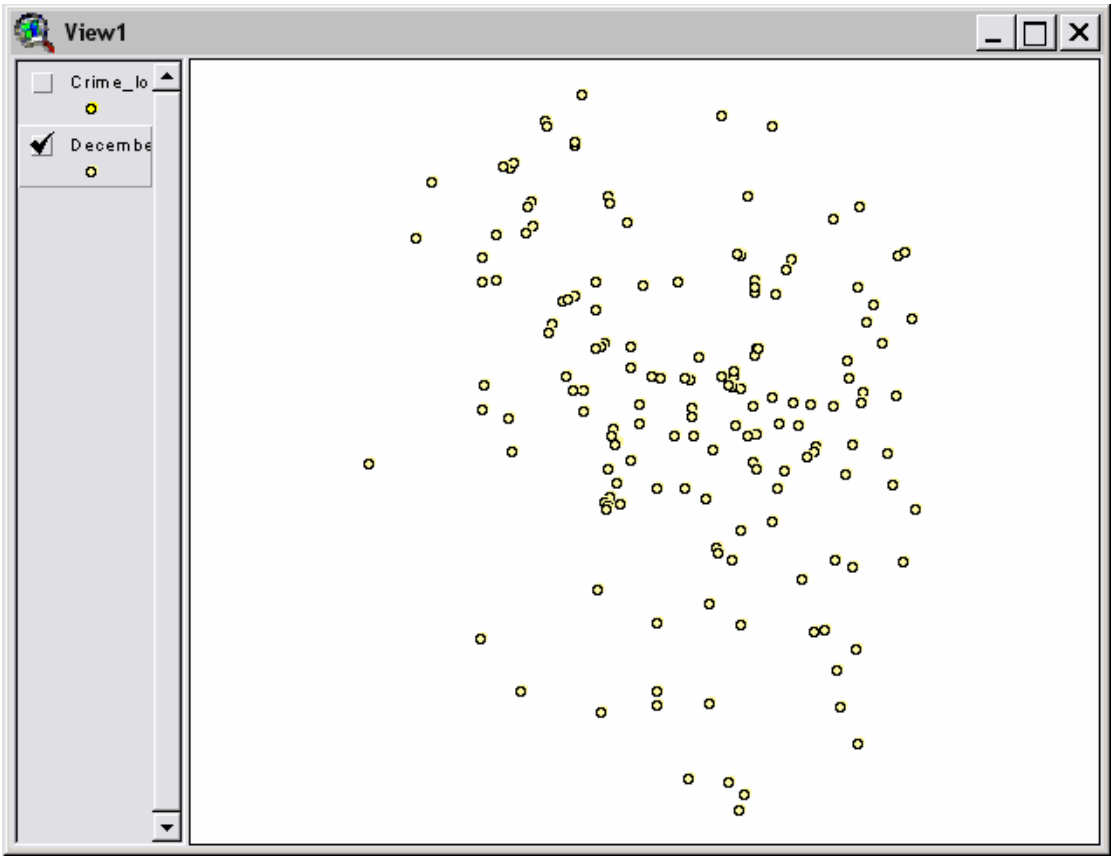


Figure 3.6.1: Crime Location in Toowoomba in December 2002

Main attributes of each crime location include date, address, crime code and type of offence. There are four different types of offences covered in crime location layer and each type has its own code number as shown in table below.

Crime Code	Type of Offence
3111	BURGLARY, WITH BREAKING
3121	SHOP, B&E WITH INTENT
3511	MOTOR VEHICLE - STREETEAL ETC
3994	VEH, STREETEAL FROM/ENT.W.INT

Table 3.6.1: Crime Codes and type of Offences

3.7 Summary

This chapter has outlined datasets required to perform the analysis. Some datasets are represented as point features and others are represented as line features. Some datasets such as Neighbourhood Watch boundaries and suburb district of the Toowoomba map layer are represented using a polygon feature. Each map layer contains attributes which are linked to each spatial feature that make analysis easier. The next chapter will concentrate on acquisition of the mentioned datasets and methods adopted to perform the analysis.

Chapter 4: Methodology

4.1 Introduction

This chapter will firstly emphasize the processes in which the datasets outlined in the last chapter were acquired. Further, detailed descriptions of how data sets were obtained will be discussed along with issues about data format, sources and availability. The chapter further discuss on data processing undertaken in the area of data entry, how neighbourhood watch boundary theme were developed and coordinate systems used for all the datasets. One of the most important procedures adopted is the address geolocating process which will also be discussed as part of the data processing section.

Following the discussion on data processing, the chapter will highlight the process of data analysis. This section will involve mapping Toowoomba crime happenings in each particular month of a ten months series, mapping of individual crime type in Toowoomba and mapping of individual crime types in selected areas. Included in the discussion will be an overview of how each type of the analysis was performed and what datasets and ArcView/ArcGIS function were used to produce the final products.

4.2 Data Acquisition

A number of datasets have been collected from different sources including crimes statistics, neighbourhood watch areas information, the Toowoomba street central lines map, Digital Cadastral Database (DCDB) and the Toowoomba street address.

The crime statistic dataset have been obtained from the police office through co-operation from Mr Scott McGrath (the police officer who is in charged of Toowoomba crim prevention Unit). Mr McGrath provided crime statistics in

different series' of months that range from September 2002 to June 2003; however, the recent crime statistics such as crime statistics of 2004 were not made available for use outside the police office which makes the analysis and the results limited in use. There are limiting issues associated with the received dataset. For example, the exact locations of crimes have been deleted due to security reasons. This causes some problems in project performance processes by creating delay in the data analysis process because all the obtained data attributes need to be adjusted. Other than that, the final result of this project cannot be used directly to improve crime prevention strategies nor can it be applied directly to the study areas. This project however is a model of how the analysis of Neighbourhood Watch Structure can be done by adopting GIS technology. Crime statistics were given in Microsoft Excel format which requires some adjustment to be compatible with GIS systems.

The information on Neighbourhood Watch Areas consists of the allocated code number of the areas and the location boundary information. This information again was provided by the police officer Mr. Scott McGrath. The information was available only in hard copy format which requires further processing because there is need to transform the provided information into a digital map format.

The Toowoomba street central lines map and street address dataset were obtained from Toowoomba City Council by request. Toowoomba street central lines maps were available in digital format that is compatible with available GIS system. The street address dataset was available in DBF format which does not require any further adjustment as it is in the form that can be directly imported into GIS system.

DCDB of Toowoomba was supplied by the Faculty of Engineering and Surveying, University of Southern Queensland (USQ). Dr Frank Young, project supervisor, assisted in lodging an application to purchase Toowoomba DCDB by the Faculty of Engineering and Surveying. The application was accepted and the dataset was made available for use within the bounds of the area of study.

4.3 Data Processing

Within data processing, there are a number of procedures that are required to be undertaken. The procedures involve data entry and address matching for geolocating. The geolocating process is one of the most important steps required for the project.

4.3.1 Data Entry

As mentioned in section 4.2, some information on crime location has been deleted for some security reasons; therefore, this missing data needs to be replaced. Street numbers of crime locations were replaced by entering some random numbers. Performing this process requires checking the exact number of houses along a particular street in order to make sure that the entered number exists. Looking up all the houses lying along particular streets was easily done by utilizing DCDB dataset and querying function available in ArcGIS (*Figure 4.3.1.1*). This however was the most time consuming process which creates delay in getting analysis result on expected time line.

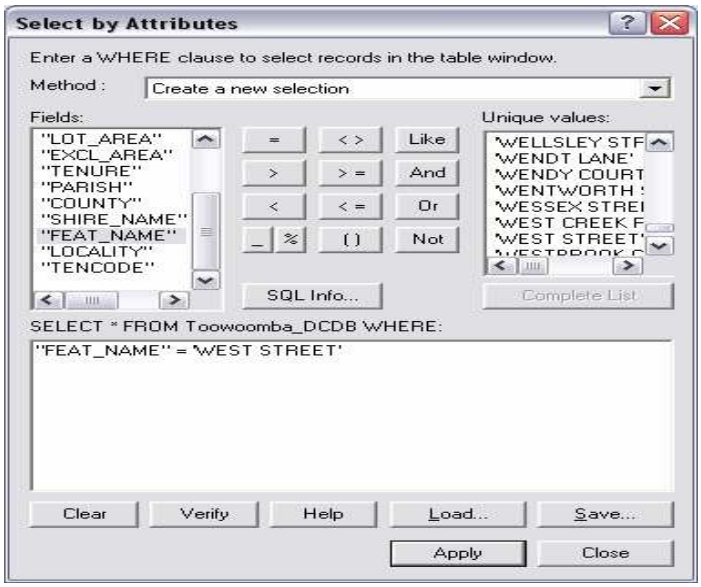


Figure 4.3.1.1: ArcGIS Query Builder Dialog Box

After processing the entered data all criminal statistics files that were in Microsoft Excel format were converted into DBF format which can be imported into ArcView to perform further analysis. The information on Neighbourhood Watch area boundaries, which were in hard copy format, was converted into digital map format. This procedure was done by adopting the method of digitizing. Toowoomba Street central lines digital map layer was used as a map based to perform the digitizing process. The streets that each particular Neighbourhood Watch area was adjacent to were selected by again using query builder available through ArcGIS. The selected streets were highlighted on the map intersecting each other and forming a polygon shape which was exactly the Neighbourhood Watch area boundary. From there, the digitizing was done along the highlighted polygon as shown in *Figure 4.3.1.2*. The step was repeated for the rest of the Neighbourhood Watch areas.

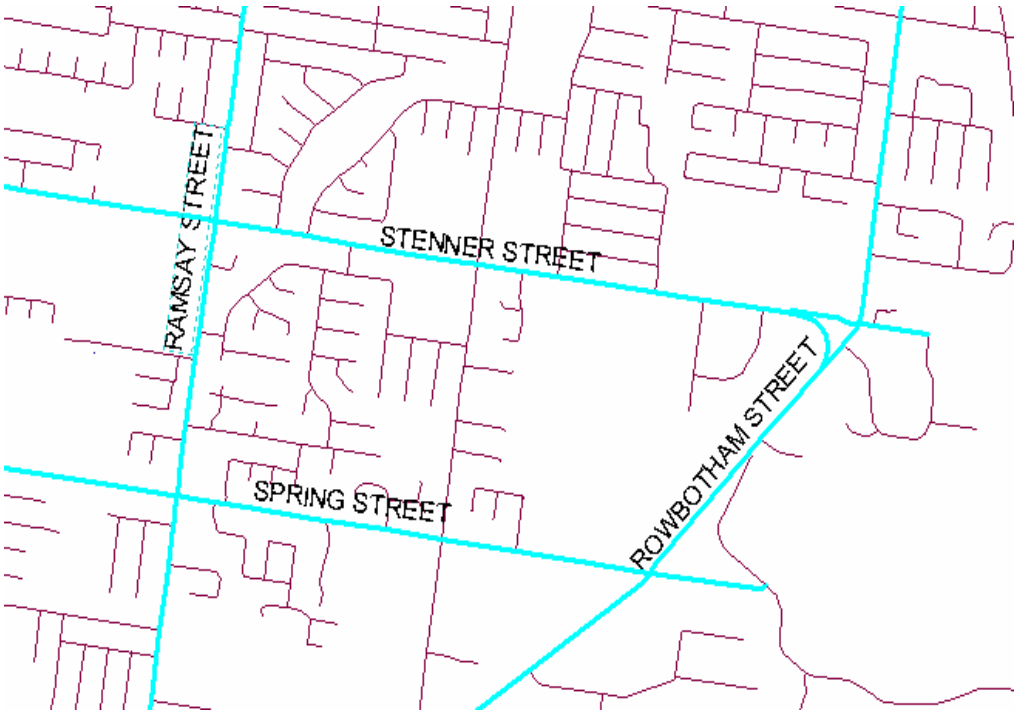


Figure 4.3.1.2: Selected Streets Adjacent to Neighbourhood Watch Area 29

4.3.2 Coordinate System

The received datasets were in different a coordinate system. Before any further analysis was performed these datasets needed to be assigned into the same coordinate system in order to make the map over lay process possible. For this project, all the map layers were assigned into GDA_1994_MGA_Zone_56 which is the surveying and mapping coordinate system adopted in Australia. The process of converting from one coordinate system to another that matches with other layer using different coordinate system was done by implementing Projection Wizard (shapefiles, geodatabase) (*Figure 4.3.2.1*) that were available in ArcToolbox of ArcGIS software.

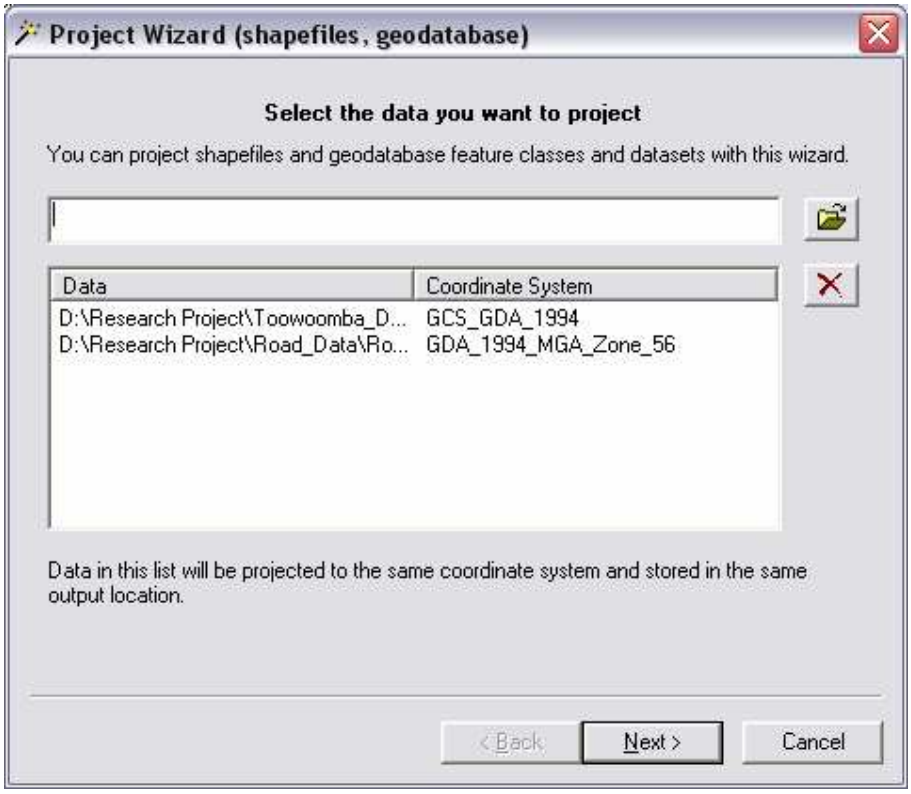


Figure 4.3.2.1: Project Wizard (shapefiles, geodatabase) Dialog for Projecting Data Layer into the Same Coordinate System

4.3.3 Address Geolocating

Address geolocating procedure in the software such as ArcView is the process of transforming an address in the attribute form into geographical coordinates (Crosier et al, 1999 - 2002). This process was used in converting crime locations in tabular form into spatial features.

Since the crime locations data did not contain the values of real world coordinates (X, Y), the attribute table of crime location needed to be linked with the attribute of Toowoomba street addresses datasets. This process was done using ArcView where the two tables can be easily joined. Minimum requirement for joining two attributes is that they need to have at least one common field attribute to allow the process of linking to become possible. Another thing needed to be taken into account before performing this step is the spelling and case of the letter used in those common fields. It is necessary to make sure that both common fields contain the same writing style.

The common field used for joining the attribute table of crime location and street address is “Address” field. The table of crime location (december 2002.dbf) was imported into ArcView as well as street address (address.dbf). In ArcView, the two attribute tables were open and the “Address” field in “address” table was first selected, followed this, the “Address” field in “december 2002” table was selected (*Figure 4.3.3.1*). These two tables could then be joined by clicking on the Join  button in ArcView. The “december 2002” table now contains two extra fields of X and Y as shown in *Figure 4.3.3.2*.

It is important to note that the “Address” field contained in the destination table (december 2002.dbf) should be selected after selecting the “Address” field in the source table before clicking the Join button.

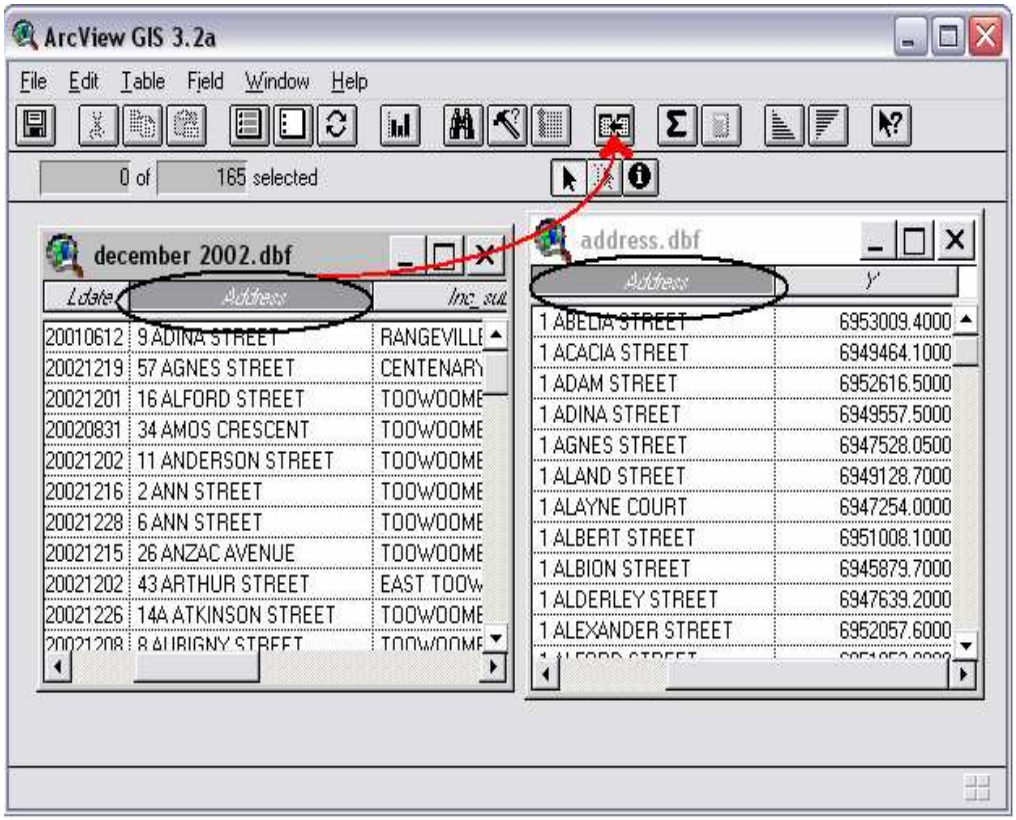


Figure 4.3.3.1: Joining Attribute Tables

Address	Class	Offence	X	Y
9 ADINA STREET	3111	BURGLARY, WITH BREAKIN	398532.5000	6949568.7000
57 AGNES STREET	3111	BURGLARY, WITH BREAKIN	397512.4000	6947632.3000
16 ALFORD STREET	3111	BURGLARY, WITH BREAKIN	398294.0000	6951930.0000
34 AMOS CRESCENT	3111	BURGLARY, WITH BREAKIN	397757.0000	6953059.8000
11 ANDERSON STREET	3111	BURGLARY, WITH BREAKIN	398152.7000	6950775.7000
2 ANN STREET	3994	VEH, STREETEAL FROM/EN	396745.9333	6951352.6667
6 ANN STREET	3994	VEH, STREETEAL FROM/EN	396738.9667	6951304.1333
26 ANZAC AVENUE	3121	SHOP, B&E WITH INTENT	395361.1000	6950994.1500
43 ARTHUR STREET	3111	BURGLARY, WITH BREAKIN	397960.7000	6950952.8000
14A ATKINSON STREET	3111	BURGLARY, WITH BREAKIN	396532.5000	6948974.4000
8 AUBIGNY STREET	3994	VEH, STREETEAL FROM/EN	397053.5000	6950367.8000
179 BAKER STREET	3111	BURGLARY, WITH BREAKIN	393641.0000	6946845.9000
12 BALLIN DRIVE	3111	BURGLARY, WITH BREAKIN	398054.6000	6947391.1000
37 BANKSIA STREET	3994	VEH, STREETEAL FROM/EN	393135.7000	6950544.2000

Figure 4.3.3.2: Joined Table

Once the tables are joined, the process of geolocating can then be carried out. In View Window (in ArcView), geolocating can be done by selecting "Add Event Theme..." option under View menu. In the "Add Event Theme" dialog, the joined table can be selected in the Table field as shown in *Figure 4.3.3.3* and the table can then be brought to view after clicking the "OK" button. The result of geolocating can be seen in *Figure 4.3.3.4*.

The crime location layer showing in the View Window can then be converted to shapefile. Converting crime location data to shapefile will allow it to be used in either ArcView or ArcGIS projects.

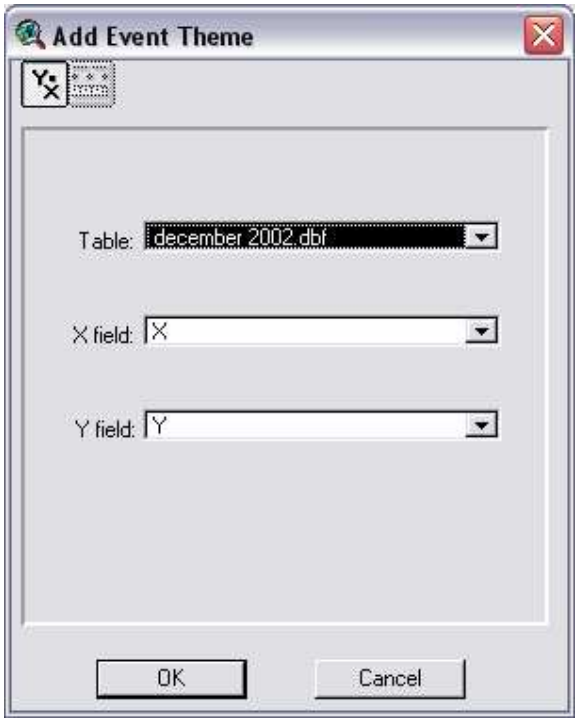


Figure 4.3.3.3: Add Event Theme Dialog

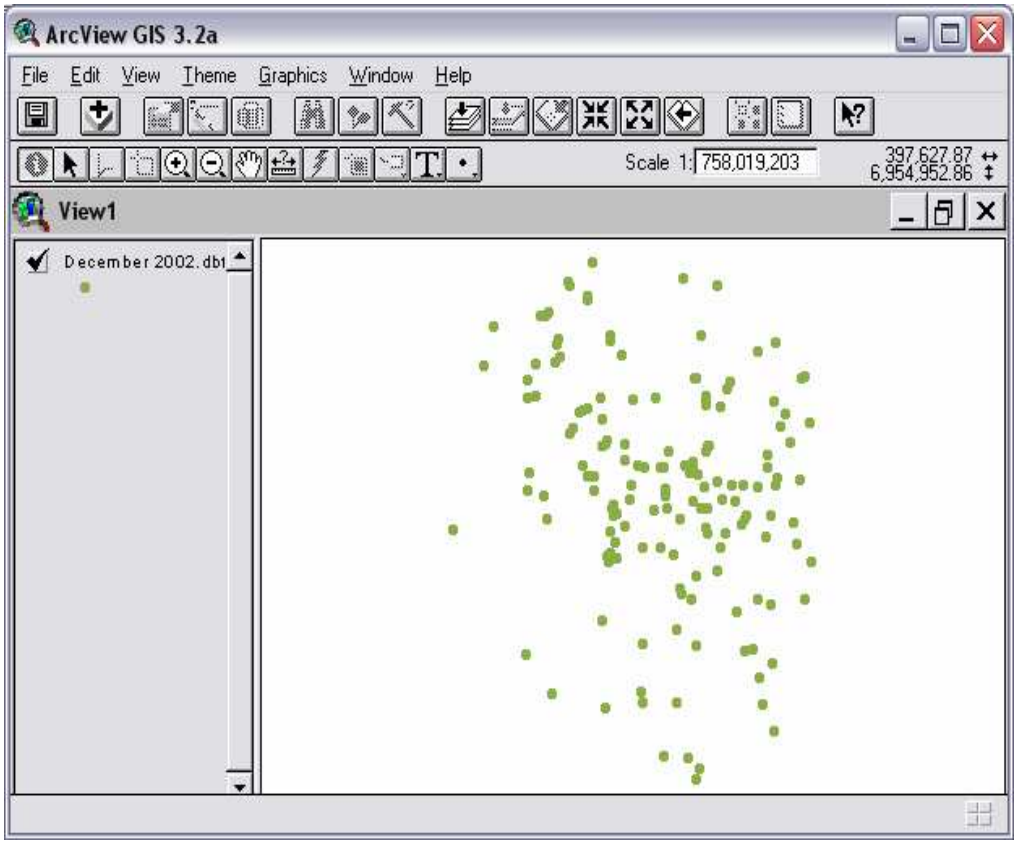


Figure 4.3.3.4: Geolocating of December 2002 Crime Location Data

4.4 Analysis

The Analysis of Neighbourhood watch can be broken down into different stages. This includes mapping of crime distributed within Toowoomba in each particular month, mapping of individual crime type over ten months period and mapping of each individual crime type within selected Neighbourhood Watch areas.

4.4.1 Mapping of crime distributed within Toowoomba

Mapping of crime distributed within Toowoomba over a one month period involves displaying the Toowoomba street network theme as a background with

Neighbourhood Watch area boundaries theme and crime location displayed on top. Crime location themes represent different types of crimes happenings within a one month period using different colours and symbols. The process of representing crime types in different symbols and colours is known as reclassification of crime type.

Reclassification of crime types is done for the purpose of representing what types of crime happened in the particular areas, therefore allowing an analysis according to the types of crimes. This process can be done within Legend Editor Dialog in ArcView as shown in *Figure 4.4.1.1*. In ArcGIS the classification can be done within Layer Properties.

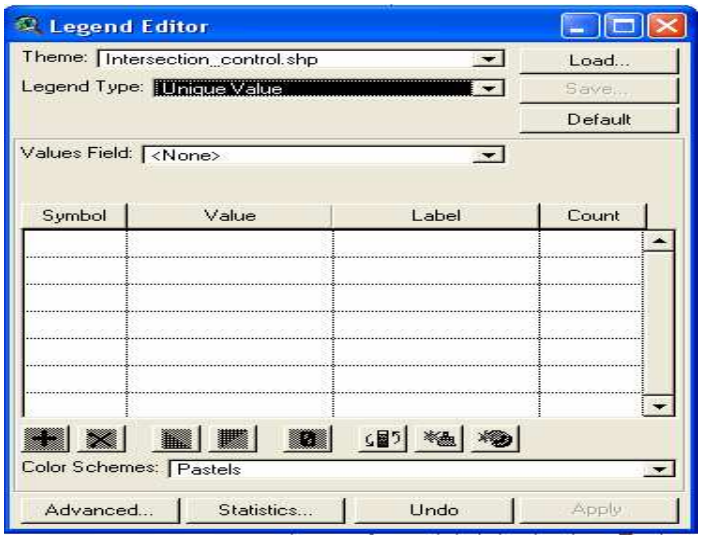


Figure 4.4.1.1: Legend Editor in ArcView

There are ten maps created at this stage and each map shows relationship between crimes happened in one month and neighbourhood watch areas in Toowoomba. The series of months that these ten maps covered is ranged from September 2002 to June 2003. Table representing total number of crime classes and chart graph presenting changes in total number of crime from September 2002 to June 2003 were also created in Microsoft Excel.

4.4.2 Mapping of Individual Crime Type

Mapping of individual crime types involve displaying the Toowoomba suburb district theme and street network theme as a background with Neighbourhood Watch area boundaries theme and particular crime type locations displayed on top. There are four major crime types that this project looking at including:

- Breaking into dwellings
- Unlawful use of motor vehicles
- Breaking in and stealing from the shops and
- Stealing from motor vehicles.

A map represents one particular crime type over ten month's period. Different symbols and colours were used to show crime location for each month. There are some steps undertaken while performing the mapping of individual crime types over the ten months. Firstly, the attributes of an individual crime type, such as breaking into dwellings, over the 10 months was created using Excel Spreadsheet (Figure 4.4.2.1). The attribute table was then saved as dBase file or .dbf to enable importing the table into ArcView. The location of breaking into dwellings crime type over 10 months for instance could then be mapped by implementing the method of geolocating and converting it into shapefile as mentioned in section 4.3.3. For any other crime types, the same procedures were applied.

D	E	F	G	H	I
LDATE	Address	INC SUBURB	PCODE	CLAS	OFFENCE
17/01/2003	152 ALDERLEY STREET	CENTENARY HEIGH	4350	3111	BURGLARY
25/01/2003	3 BARAH STREET	ROCKVILLE	4350	3111	BURGLARY
27/01/2003	52 BARLOW STREET	WILSONTON	4350	3111	BURGLARY
9/01/2003	407 BRIDGE STREET	NEWTOWN TOOWO	4350	3111	BURGLARY
16/01/2003	18 CATALINA DRIVE	WILSONTON	4350	3111	BURGLARY
21/01/2003	7A CECIL STREET	TOOWOOMBA CITY	4350	3111	BURGLARY
9/01/2003	23 CHARTER CRESCENT	WILSONTON	4350	3111	BURGLARY
13/01/2003	32 COOLOOLA DRIVE	RANGEVILLE	4350	3111	BURGLARY
20/01/2003	20 CURZON STREET	EAST TOOWOOMBA	4350	3111	BURGLARY
22/01/2003	14 DALSTON COURT	MOUNT LOFTY	4350	3111	BURGLARY
9/01/2003	16 DRAYTON ROAD	HARRISTOWN	4350	3111	BURGLARY
23/01/2003	5 EAST STREET	EAST TOOWOOMBA	4350	3111	BURGLARY
8/01/2003	18 ELIZABETH STREET	TOOWOOMBA	4350	3111	BURGLARY
28/01/2003	6 ESMOND STREET	ROCKVILLE	4350	3111	BURGLARY
3/01/2003	7 FEATHERSTONE COURT	ROCKVILLE	4350	3111	BURGLARY
16/01/2003	5 GENTLE STREET	NORTH TOOWOOME	4350	3111	BURGLARY
8/01/2003	61 GEOFFREY STREET	MOUNT LOFTY	4350	3111	BURGLARY
26/01/2003	15 GIBSON STREET	WILSONTON	4350	3111	BURGLARY
4/01/2003	52 GIPPS STREET	DRAYTON	4350	3111	BURGLARY
18/01/2003	15 GOODE STREET	NEWTOWN TOOWO	4350	3111	BURGLARY
30/08/2002	133 GORMAN STREET	DARLING HEIGHTS	4350	3111	BURGLARY
28/01/2003	4 GREY STREET	SOUTH TOOWOOME	4350	3111	BURGLARY
28/01/2003	15 GREY STREET	SOUTH TOOWOOME	4350	3111	BURGLARY
12/01/2003	16 HAMWOOD STREET	NEWTOWN TOOWO	4350	3111	BURGLARY
7/01/2003	83 HILL STREET	NEWTOWN TOOWO	4350	3111	BURGLARY
12/01/2003	132 HOLBERTON STREET	WILSONTON	4350	3111	BURGLARY
12/01/2003	28A HOLBERTON STREET	WILSONTON	4350	3111	BURGLARY
29/01/2003	53A HOLBERTON STREET	WILSONTON	4350	3111	BURGLARY
26/01/2003	22 ISABEL STREET	TOOWOOMBA CITY	4350	3111	BURGLARY
23/01/2003	227 JAMES STREET	TOOWOOMBA CITY	4350	3111	BURGLARY

Figure 4.4.2.1: Breaking into Dwellings Crime Type Over 10 Months Spreadsheet

4.4.3 Mapping of Individual Crime Type within Selected Areas

Before this analysis stage was preceded, some areas of interest were identified based on some criteria. Some GIS applications of GeoProcessing Wizard tools such as dissolve, clip, intersect and union two layers were considered in the process of creating individual crime type within selected areas maps.

4.4.3.1 Selecting Study Areas

Completing of all individual crime type over the ten month period allowed the selection of study areas. Looking at these maps gives chance to compare and contrast criminal activity changes in each Neighbourhood Watch Area over time. It also provides the ability of comparing crime intensity of one area to others in each month. The most appropriate study areas can thus be selected.

The criteria of selecting suitable study areas included high crime rate areas that will give the more obvious changes in crime rates over periods of time. The areas of low intensity of crime also need to be selected to allow comparing and contrasting between those two types of areas (high and low density of crimes). The selected study areas consist of 8 residential areas and one commercial area. The selected residential areas include area 2, 6, 7, 8, 9, 23, 26 and 29 as shown in Figure 4.4.3.1.1.

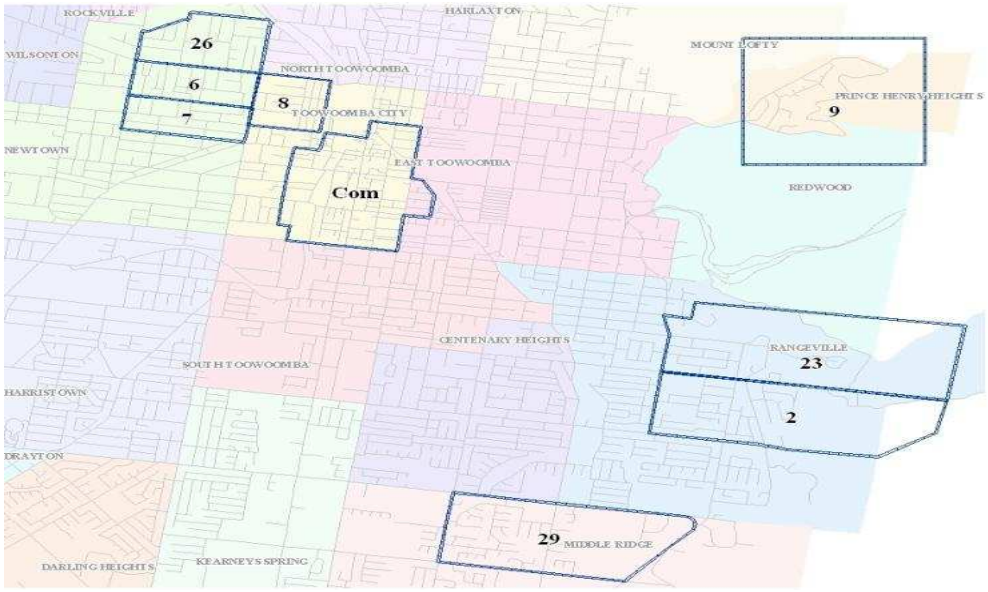


Figure 4.4.3.1.1: Selected Study Areas

4.4.3.2 Mapping of Crime in Selected area

Once the study areas have been identified, mapping procedures were carried out. In order to presents individual crime type locations over the ten months, one of the GeoProcessing Wizard functions was chosen (Clip Layer or Cookie Cutter). GeoProcessing is a way of creating new datasets based on existing themes. This process will alter the geometric properties of the features in a dataset while controlling some aspects of how its attribute data is handled.

Clipping one theme based on another was a process used in the analysis stage where a new theme can be created using a polygon theme (selected study areas) as a cookie cutter on another point (crime locations), line or polygon theme. The output theme will contain only data that falls within the cookie cutter theme (selected study areas). *Figure 4.4.3.2.1* illustrates the GeoProcessing dialog box showing different operators including Clip Layer operator.

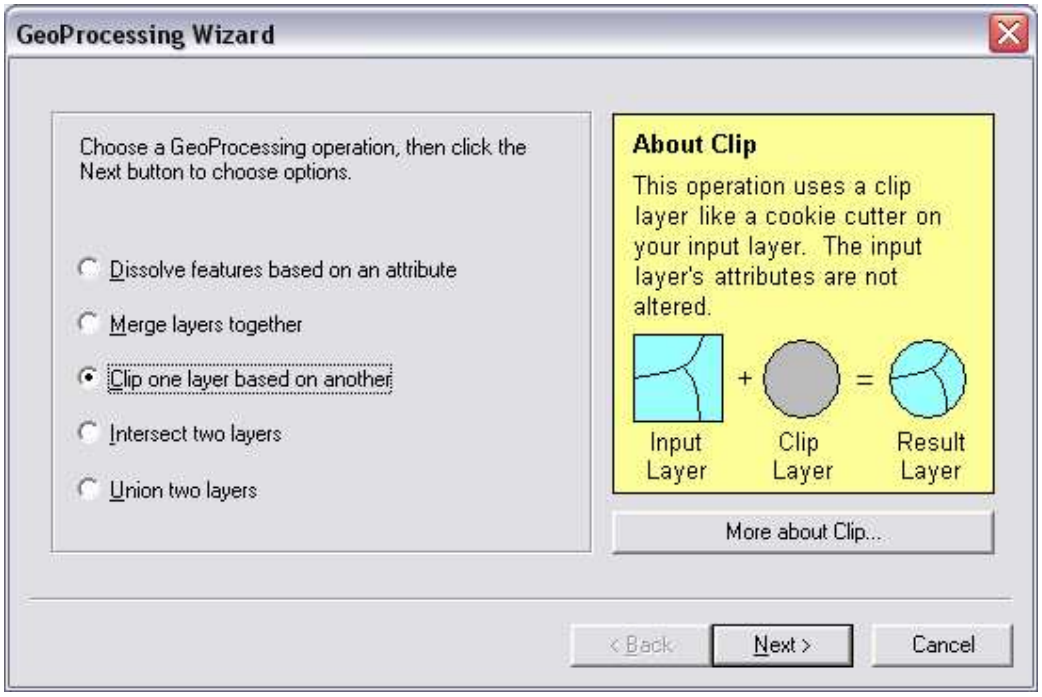


Figure 4.4.3.2.1: GeoProcessing Wizard Dialog Box

Individual crime type maps were used as input layer in this analysis. Four maps were created according to four particular types of criminal offences. The maps created by overlaying the themes including selected study areas, the selected crime spots, Toowoomba street network and suburb district theme on top of one another.

4.5 Conclusion

Towards completion of the project, many steps were undertaken including data acquisition and data processing. The datasets were obtained from various sources such as Toowoomba Police Department, Toowoomba City Council and the Faculty of Engineering and Surveying (USQ). There are some issues associated with criminal statistics obtained as some details were deleted due to security reasons. This has limited the result of the analysis in terms of not being directly applicable to the study areas.

Steps of data processing were carried out in many stages including data entry, adjusting dataset coordinate systems using ArcToolbox and address geolocating. All crime locations datasets adopted geolocating process in order to transform the datasets from tabular format to map format or spatial features. ArcView was used to perform this process due its user friendly interface which allows this process to be carried out easily (personal familiarity with the software interface was also a factor).

Mapping of crime in each individual month for 10 month series was done using basic map overlaying process. Toowoomba street network layer and suburb district layer were used as map base for each type of mapping to indicate the exact location of crimes happened in Toowoomba. Attribute tables of each criminal offence type over period of ten months were created using Excel Spreadsheet and converted to dbf format compatible with ArcView. Four maps of four different crime types were then created using the same procedures as the previous mapping techniques. Some study areas were selected to narrow the focus of the analysis.

GeoProcessing application allows crime locations of each particular crime type over a period of ten months to be clipped based on selected study areas. Basic map overlay techniques are then applied to produce the final maps.

As mentioned before, the original crime locations statistics supplied by Toowoomba Police Department could not be obtained, the discussion in the next chapter will be based on the results of the project's analysis. Chapter 5 will highlight and discuss about the results of the analysis.

Chapter 5: Results and Discussion

5.1 Introduction

This chapter will highlight the final results of the analysis performed in this project. Firstly, the chapter will address the findings from the mapping of criminal locations distributed in Toowoomba within one month for a ten month series and some discussion relating to these specific findings. The results from the mapping of individual crime types over a 10 month study period will also be addressed in this chapter along with some discussion on the results. Finally, the chapter will underline results relating to the mapping of individual crime types within selected study areas and cover result discussion. The discussion of each analysis results will be entirely based on the final findings of this project analysis.

5.2 Mapping of Crime Distributed in Toowoomba

Results

The aim of this analysis was to produce maps and a spreadsheet of crimes happened in Toowoomba over each particular month from September 2002 to June 2003. This analysis also aimed to produce and graphically show changes crimes occurrences over period the ten months. The results of this analysis are included in Appendix B which consists of 10 maps representing relationship between Neighbourhood Watch areas and criminal events within Toowoomba. Each map graphically presents the different symbols for four different crime types that happened during a one month period. Included in Appendix B is a spreadsheet showing total number of the distribution of criminal classes from September 2002 to June 2003.

Discussion

There are a few aspects that this section will cover including the interpretation of results, what can be achieved through the results in relation to determination of effectiveness of the Neighbourhood Watch program, and usefulness of the results.

Final products of this analysis simply illustrate crime spots of each particular month in Toowoomba regions. The maps show different type of crimes which were committed in different locations and their relationship with the Neighbourhood Watch areas. Each map shows that "breaking into dwelling" crime types tend to cover the highest proportion of total crimes happenings in Toowoomba. The distribution of this crime type can also be seen as relatively scattered compared to other classes of crimes.

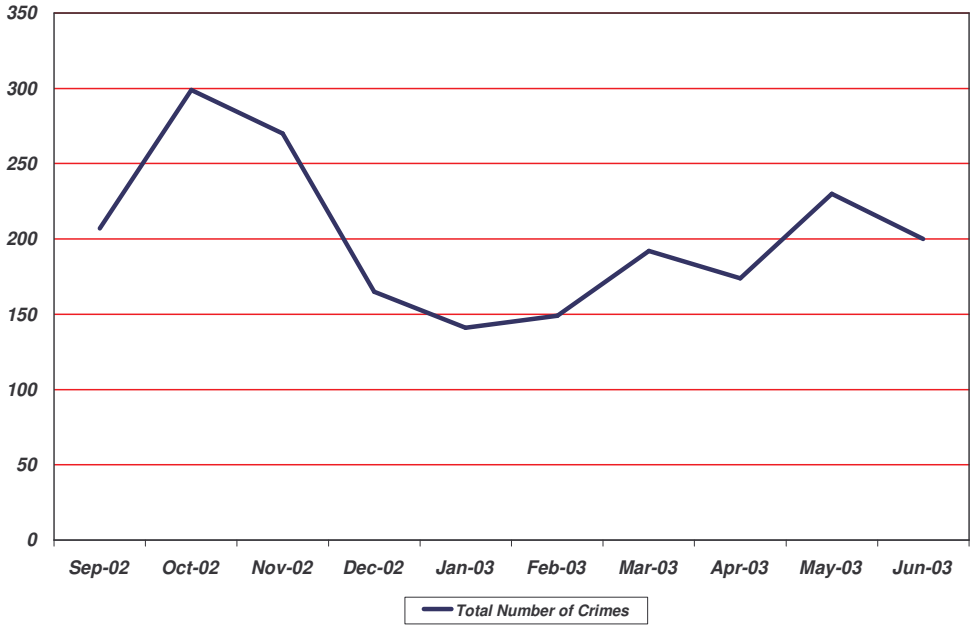


Figure 5.1.1: Chart of Changes in Number of Crimes over Period of 10 Months

From Figure 5.1.1, it is can be seen that the number of crimes increased dramatically from September 2002 to October 2002. This could be because of the lack of awareness in Toowoomba criminal situations which makes people in the communities become quite careless about their own safety and because of a lack of communication between police and the residents.

The graph starts to drop from October 2002 to January 2003 which indicates decreasing number of crimes during that period. The rapid change between September and October could have played a major role in pushing the police to develop better crime prevention strategies which resulted in the decreasing crime rates. There are some fluctuations in crime rates from January 2003 as can bee seen in the graph. This type of changes could be the result of a major change in the operation of the criminal justice system such as a new law, changes in police recording practices, a change in police procedures, or a change in the courts (Brantingham and Brantingham, 1984, pp.99).

Due to the fact that these crime maps are produced according to different months, it is difficult to use them to determining the effectiveness of Neighbourhood Watch program as it is hard to compared criminals events in same particular areas from ten separate maps. The findings of this analysis stage however provided some guidance as to what should be carried out as further analysis procedures in order to enable project aims to be achieved.

Even though the effectiveness of the watch scheme can not be determined through these analysis results the findings can significantly contribute to assist in terms of stimulating awareness of existing crimes within Toowoomba for people in Neighbourhood Watch communities as well as police. This is because the maps show relative location of each crime event which can give a clearer picture of where exactly these crimes happened in

Toowoomba over a particular month. Graphs and tables provided through this type of analysis can also help the user of this information to get the general idea of the exact number of crime locations in a single month and to see the changes in number of crimes over time. This type of information can be useful as supplied data from the police to those who are in charge of Neighbourhood Watch programs as this can help to encourage stronger cooperation amongst them and working together towards the prevention of crime.

5.3 Mapping of Individual Crime Type over the Study Period

Results

This analysis aimed to produce maps and graphs of the movement of crime classes in Toowoomba over the selected study period of ten months. This was to represent the overall trends in each crime types from month to month.

This analysis resulted in final products to be produced as four maps of four different types of crime happenings from September 2002 to June 2003. The results include a map of break and enter into houses, a map of break and enter into shops, a map of unlawful use of motor vehicles and a map of stealing from vehicles. These maps can be found in Appendix C, additionally, included in the appendix are some graphs of changes in trends of each criminal activity over time.

Discussion

The discussion of the results will be carried out for the maps to emphasize the main messages contained within each map. Firstly, it can be seen on the map of breaking and entering dwellings over ten months that the distribution of this criminal activity is quite scattered. There is high concentration of this crime type in some areas. The overall message

presented through the map is the seriousness of the problem within Toowoomba region as this type of crimes tend to happen in relatively high numbers compared to other types of crimes. According to this, many crime prevention programs did seem to play a major role in combating the problem. However, the map has also shown that this crime type tends to happen along the edge of some Neighbourhood Watch areas. In this case, it indicates that Neighbourhood Watch areas may have had a role in displacing the crimes from the areas to other places surrounding the areas. All the messages that were received from interpreting the map Although various messages could be drawn out from the interpretation of the map, the result is still considered as not adequate enough to determine the effectiveness of the Neighbourhood Watch scheme.

In the map of breaking and entering the shops as a result of this analysis, it can be seen that this criminal activity concentrated mainly within central area of Toowoomba. This is because there are more shops located in that area. Due to the represented crime locations on the map, it can be seen that most of the shops in Toowoomba have experienced this type of problem. The number of this crime type tends to continuously drop from September 2002 until February 2003. The reasons to this could be an implementation of highly advanced security system by most of the shops in Toowoomba. The crime rate again starts to increase from February 2003 until May 2003 where there is a significant drop. Some reasonable explanations to this kind of situation are hard to find. The map also shows that this type of crime increased in the new areas and some took place near the area where crimes happened 5 to 7 months before.

From the unlawful use of motor vehicles (UUMV) type of crimes map, the highest number of offences happened in Jun 2003. Toowoomba City area again tends to account majority of offences from UUNV crime type. This could be because of the commercial activities are confined within the area,

which is considered to be quite busy and hard to monitor. There were a smaller number of crimes in September 2002 compared to any other months which shows that crime rates actually increased. Some possible reasons to this could be that most people were unaware of such a problem and did not realise how serious the problem was in the areas where they live. It is noticeable from the map that this type of crimes happened in each month and tends to cluster mostly in areas that are close to each other.

It can be seen from the map of stealing from vehicles over ten months that the distribution of crimes is considered to be quite scattered similarly to the problem associated to breaking and entering of houses. The map also shows the seriousness of the problem. Overall, it seemed like these crimes happened everywhere regardless of the existence of Neighbourhood Watch areas, however, information is still not sufficient enough to make such valid conclusion. This information can be a very beneficial source for not only Neighbourhood watch people and police but also for car insurance companies. The information can be used to assist the companies in developing strategies to minimize problems that can cost a huge loss to the companies themselves. Stronger cooperation amongst police, car insurance company and community people can then be enhanced.

Overall, the results of this analysis provide the type of information that can bring great benefit in developing future crime prevention techniques. Supplying this type of information by the police to the Neighbourhood Watch communities can help them to realise the seriousness of criminal problems within their environments. This is because they can see the happening of crimes within there neighbourhood and the trends of each crime types. This can then help to increase a better level of communication between them and the police.

At this stage of analysis, the determination of how well Neighbourhood Watch program in Toowoomba is performing in combating crimes is still considered to be difficult. This is due to the fact that there are many areas to examine at a time which can be complicated and hard to distinguish and compare the differences in changes of crimes happened over time between them. Considering a small number of areas of Neighbourhood Watch at a time can therefore be easier.

5.4 Mapping of Each Crime Class Overtime Within Selected Areas

Results

The results of this analysis are 4 maps that graphically represent the distribution of 4 different crime types within selected study areas. There are a map of breaking and entering dwellings, a map of breaking and stealing from shops, a map of unlawful use of motor vehicles and a map of stealing from vehicles. These results can be viewed in Appendix D. Each map represents each criminal type happened over 10 months within selected areas.

Discussion

From the final map products of this analysis, it appeared to be that the commercial area accounts quite a number of criminal events. There is also considerably high concentration of crime whin the surrounding areas of commercial area. According to the lack of differences between Neighbourhood Watch area in commercial area and its surrounding areas in terms of decreasing number of crimes over time, the Commercial Neighbourhood Watch area did not seem to have a significant role in minimizing crimes within the area. Some explanations to this could be because of the lack of strong cooperation amongst the residents of the area and it could be that it is hard to look after the area as a majority of the area is covered by shops which make the area become quite busy.

The results show that there is a decrease in crimes over time in some Neighbourhood Watch areas including area 2, 9, 23 and 29. Some possible reasons to this could be the fact that there is low housing density which makes it easy to look after or there could be good cooperation between residents. Location of those areas could be another factor effecting small number of crimes happening overtime as they are considered to be quite difficult to get. Highly advanced security system could be afforded by the residents living within the areas; which is one of the reasons for the mentioned situation. The results also indicates that Neighbourhood Watch area 6, 7, 8 and 26 tend to have a decrease over time in number of offences of certain criminal type such as stealing from vehicles crime type.

The results of this analysis are still not very sufficient information to be used as a factor that determines the effectiveness of those Neighbourhood Watch areas. Nevertheless, combination of this information and demographic information could be more practical for analysing the Neighbourhood Watch structures. No practical suggestions related to the development and improvement of future crime prevention strategies could be made based on the analysis results. There are some reasons to this where one being the crime data used in this project is not an original dataset and the second reason being the effectiveness of selected study Neighbourhood Watch areas have not been clearly measured.

5.5 Conclusion

This chapter has covered and presented the results of the three performed stages of analysis. The analysis of results concerning Toowoomba's criminal records has also been discussed. The findings are considered as not exceptionally sufficient to prove whether or not the selected Neighbourhood Watch areas have great effects

in fighting and minimizing crimes within their communities. The next chapter will include some discussion on what should be done to take this study further and what are the requirements for completion of further study.

Chapter 6: Conclusions and Recommendations

6.1 Introduction

The purpose of this chapter is to highlight some concluding remarks on findings of this research project and some problems encountered that affect the analysis results. Further, the chapter will also discuss and recommend what should be done for future improvement of analysis and what should be additional requirements to complete the further study and to get more relevant conclusions of the results for the study.

6.2. Findings of Research Project

The aim of this study is to analyse the performance of Neighbourhood Watch (NHW) program within Toowoomba. The results achieved through the analysis of this project were not sufficient enough to establish the actual performance of this Toowoomba crime prevention program. Recommendations to improve the problem associated with criminal events in Toowoomba could not be provided as well as expected by the researcher. Due to some limiting factors findings were not consistent.

One of the factors that limit the scope of the study as well as the consistency of the results is the available range of the crime location datasets. The datasets were provided in a range from September 2002 to June 2003 which was quite limited for the performance of further analysis. The most up to date datasets were not included in the range which makes analysis results inconsistent to apply to the current situation.

Another important factor that affected reliability of the results and limited the suggestion to the improvement of Neighbourhood Watch scheme to be made is the missing of original information such as address location of crime in the available datasets. This factor did not only result in unreliable findings, it also

resulted in generating delay in the analysis process which limited the further analysis. Additionally, the analysis of crime pattern was limited from being carried out as the original criminal pattern in Toowoomba could not be found.

Although findings of this study did not progress to any concrete conclusions to justify the effectiveness of Neighbourhood Watch program, the results have shown the possibility in utilizing Geographic Information System in the analysis of the crime prevention program. Generated results of this project have also shown that the useful information supporting policing can be provided through the implementation of analysis methods used to provide the final findings of this project. However, this study could be broadened to expand a much wider range of analysis through the inclusion of additional information and more accurate data.

Thus, this study has shown that GIS can be employed as a successful tool in policing as crime fighting tool and for analysing crime prevention programmes such as the discussed Neighbourhood Watch Program.

6.3 Further Research and Recommendations

Further Research

In order to fulfil the main aim of this study and generate more effective analysis methods, a number of things may need to be considered for future study. Firstly, future study needs to consider incorporating demographic information of Toowoomba into the analysis. Combination of criminal mapping and mapping of population distribution or mapping of other demographic information could provide more sufficient justification to the performance of the discussed Neighbourhood Watch structure. More research on criminal analysis using GIS and GIS in mapping of various demographic aspects need to be carried out. Additionally, considering the range of the datasets and the currency of the datasets that required for further analysis is also important as this can significantly affect the usefulness of final findings.

Recommendations

Due to the fact that data which was used in this project is not original (due to privacy concerns), the projects final result cannot be used directly to improve crime prevention strategies or cannot be applied directly to the study areas. In other words, the findings of this project can purely serve as an indication and overview of Toowoomba's Neighbourhood Watch situation. However, if unimpaired, up-to-date crime statistic information and other information such as demographics could be obtained and incorporated into the analysis, the final results could demonstrate wether the studied NHW areas in crime prevention are effective.

With this in mind, if the results of current studies had been more precise, the result would have shown a decrease in criminal activity in some studied areas while other areas may not decrease. This could suggest that some areas might have better security systems or may have better cooperation amongst community members' compared to other areas. It is recommended that Neighbourhood Watch areas should be placed under the responsibility of the police department. Furthermore, investigation and interaction in the programme by police force may be needed to raise the level of residents' communication. For example, specific areas should have more police presence and policing duties should include activities that involve increased surveillance of the area. Awareness should be raised on such situations as they occur to encourage better communication amongst residents.

Cooperation amongst residents in Neighbourhood Watch areas and between residents and police can also be encouraged by making communication among them easy. This can be done through the use of email or providing free call number directly to NHW units in police departments. Methods of implementing NHW program should also be improved within the areas by organizing more frequent meetings within

the community. Identification of appropriate coordinators, who can be very active and enthusiastic in working towards creating crime prevention strategies, could help. Awareness on situations in criminal aspects of those particular NHW areas can be raised through the provision of more information such as crime maps showing criminal extents.

Appendix A:

Project specification

University of Southern Queensland
FACULTY OF ENGINEERING AND SURVEYING

ENG 4111/412 Research Project
PROJECT SPECIFICATION

FOR: **Akchousanh RASPHONE**

TOPIC: Analysis of the Neighbourhood Watch Structure Using GIS

SUPERVISOR: Dr Frank Young

ENROLMENT: Commence March 2004;
Enroll S1, 2004 and complete in November 2004

PROJECT AIM: This project seeks to determine the effectiveness of the neighbourhood watch structure that has been adopted within Toowoomba region by analyzing and mapping the annual Crime locations within particular neighbourhood watch areas.

PROGRAME: Issue A, March 2004

1. Conduct risk assessment including data confidentiality
2. Review Literature.
3. Acquire data sets both spatial and statistical data.
4. Identify the methods of analysis (e.g. what software should be used).
5. Perform data processing by reviewing and restructuring data for compatibility with GIS system.
6. Allocate a few most suitable neighbourhood watch areas by looking at criminal statistics in each zone and produce maps containing neighbourhood watch boundaries and location of crimes.
7. Conduct an analysis from the final neighbourhood watch maps.
8. Complete writing up and submit Dissertation.

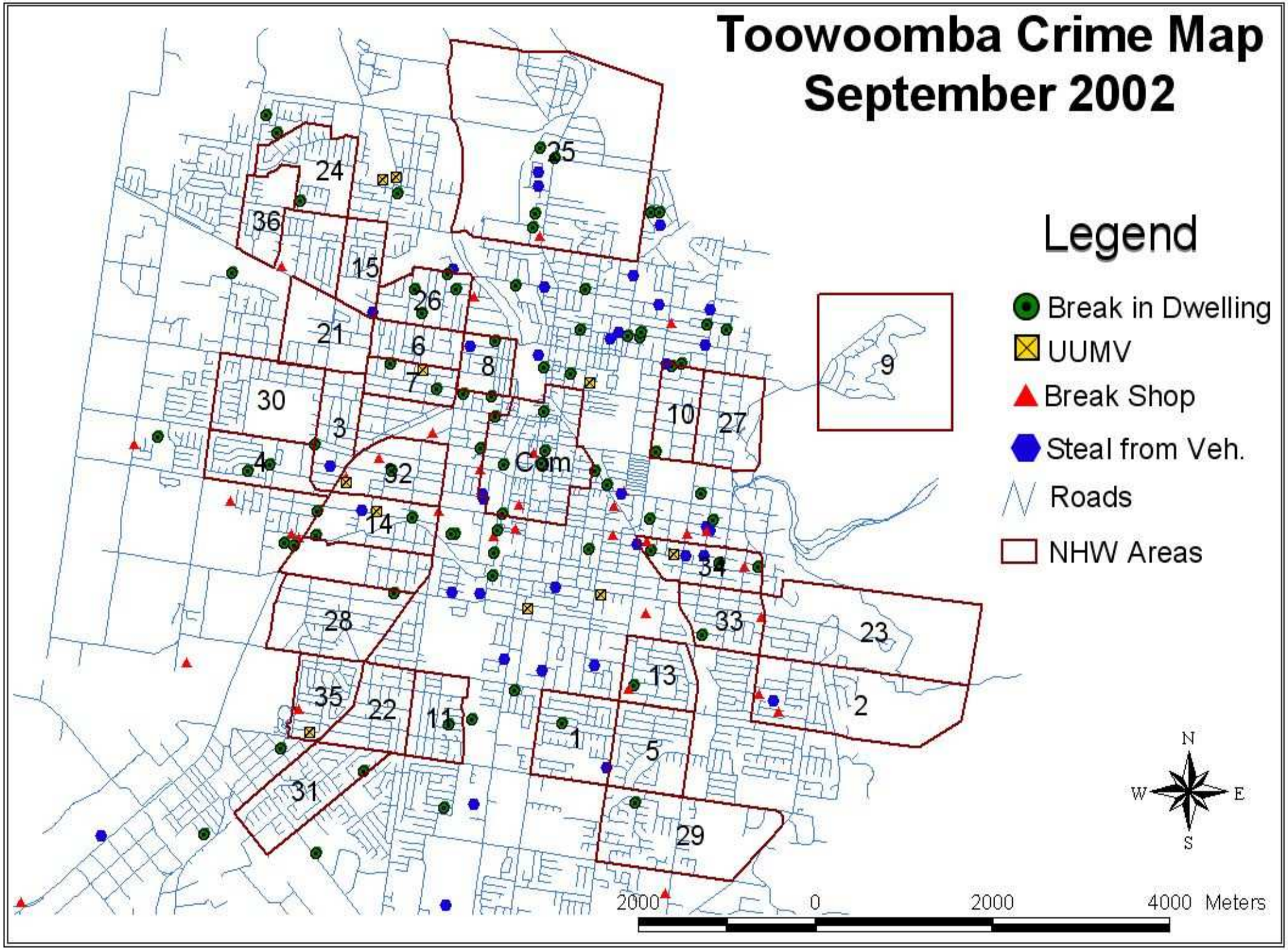
AGREED: _____ (Student) _____ (Supervisor)

DATE: ___/___/___ ___/___/___

Copies Akchousanh RASPHONE
Dr Frank Young
ENG 4111/412

Appendix B:

Maps of crime Locations September 2002 until June 2003


Toowoomba Crime Map
September 2002
Legend
Break in Dwelling
UUMV
Break Shop
Steal from Veh.
Roads
NHW Areas
24
36
25
15
26
21
6
7
8
9
30
3
10
27
4
32
Com
14
34
28
33
23
13
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22
11
1
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31
29
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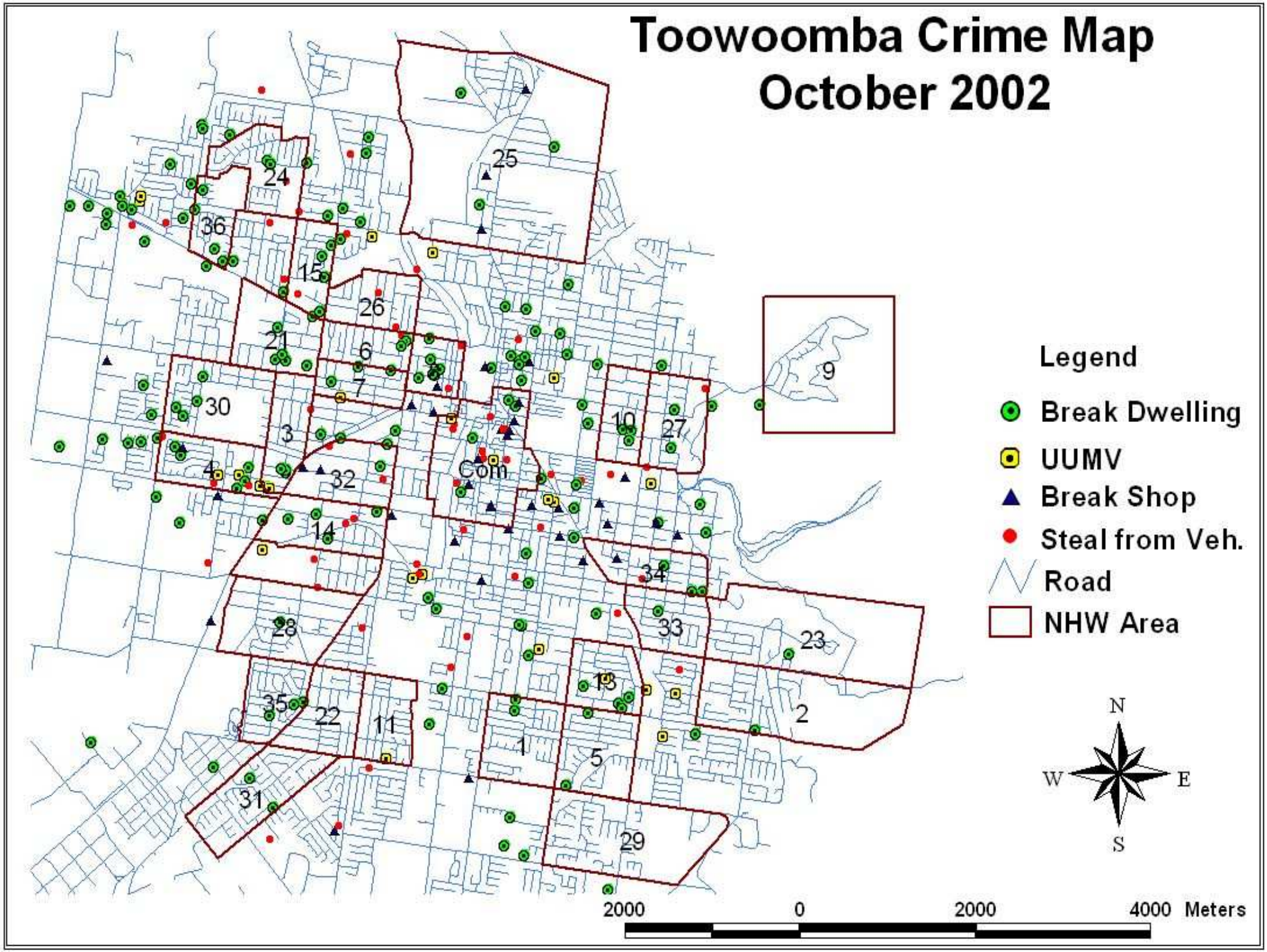
2000
0
2000
4000 Meters


Toowoomba Crime Map
October 2002
Legend
Break Dwelling
UUMV
Break Shop
Steal from Veh.
Road
NHW Area
N
W
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2000
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2000
4000 Meters
Com
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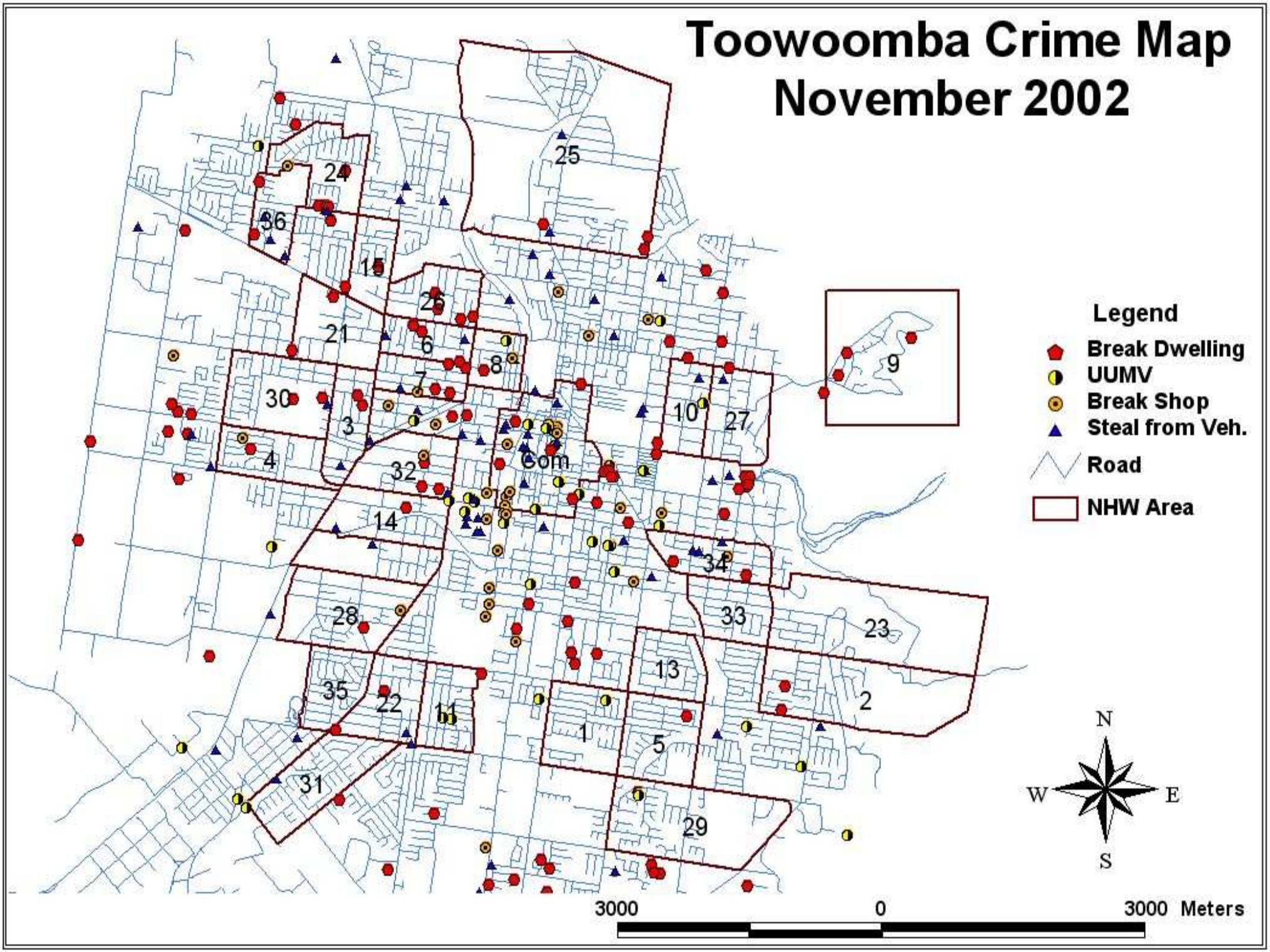
Toowoomba Crime Map
November 2002
Legend
Break Dwelling
UUMV
Break Shop
Steal from Veh.
Road
NHW Area
N
W
E
S
3000
0
3000 Meters
Com
1
2
3
4
5
6
7
8
9
10
11
13
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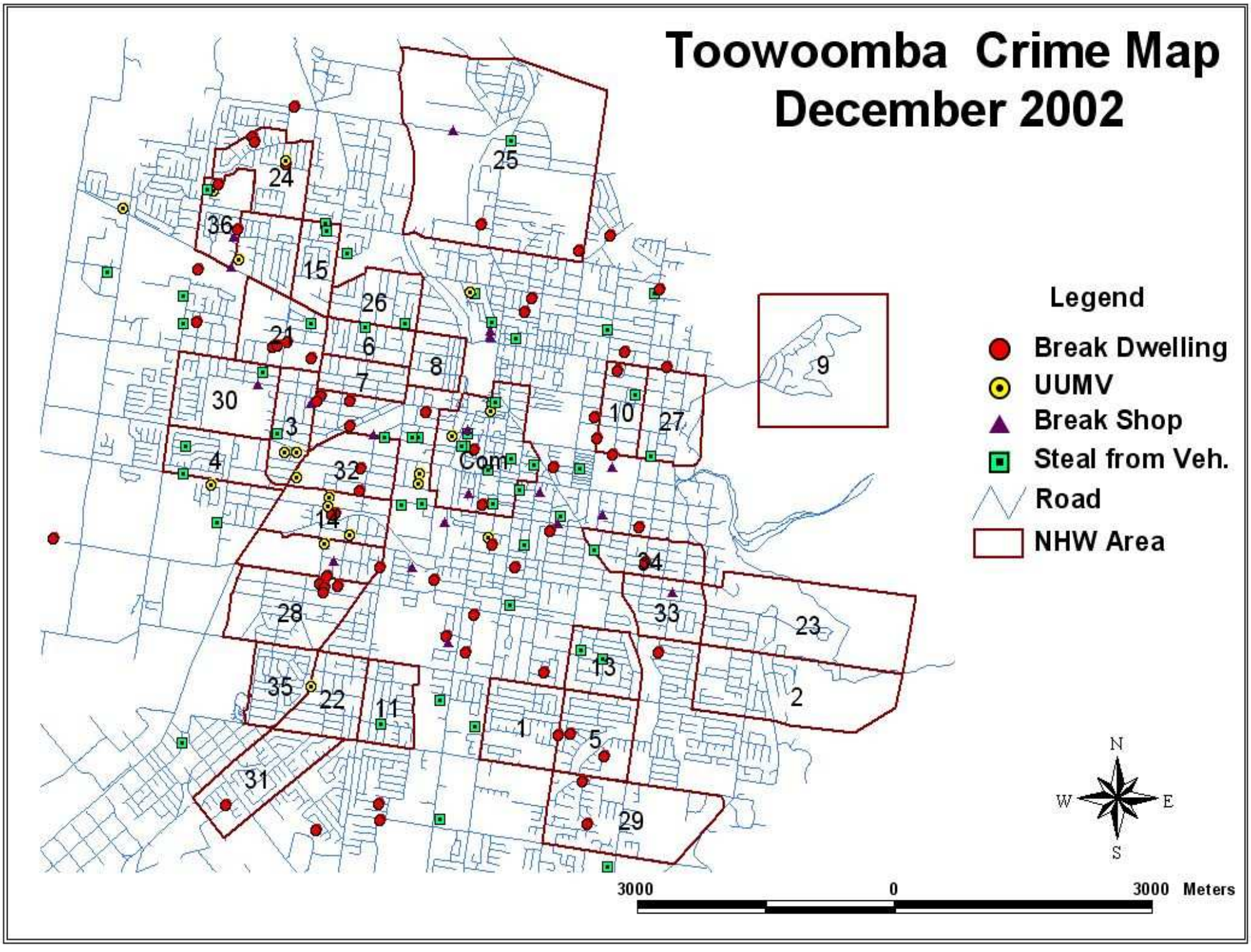
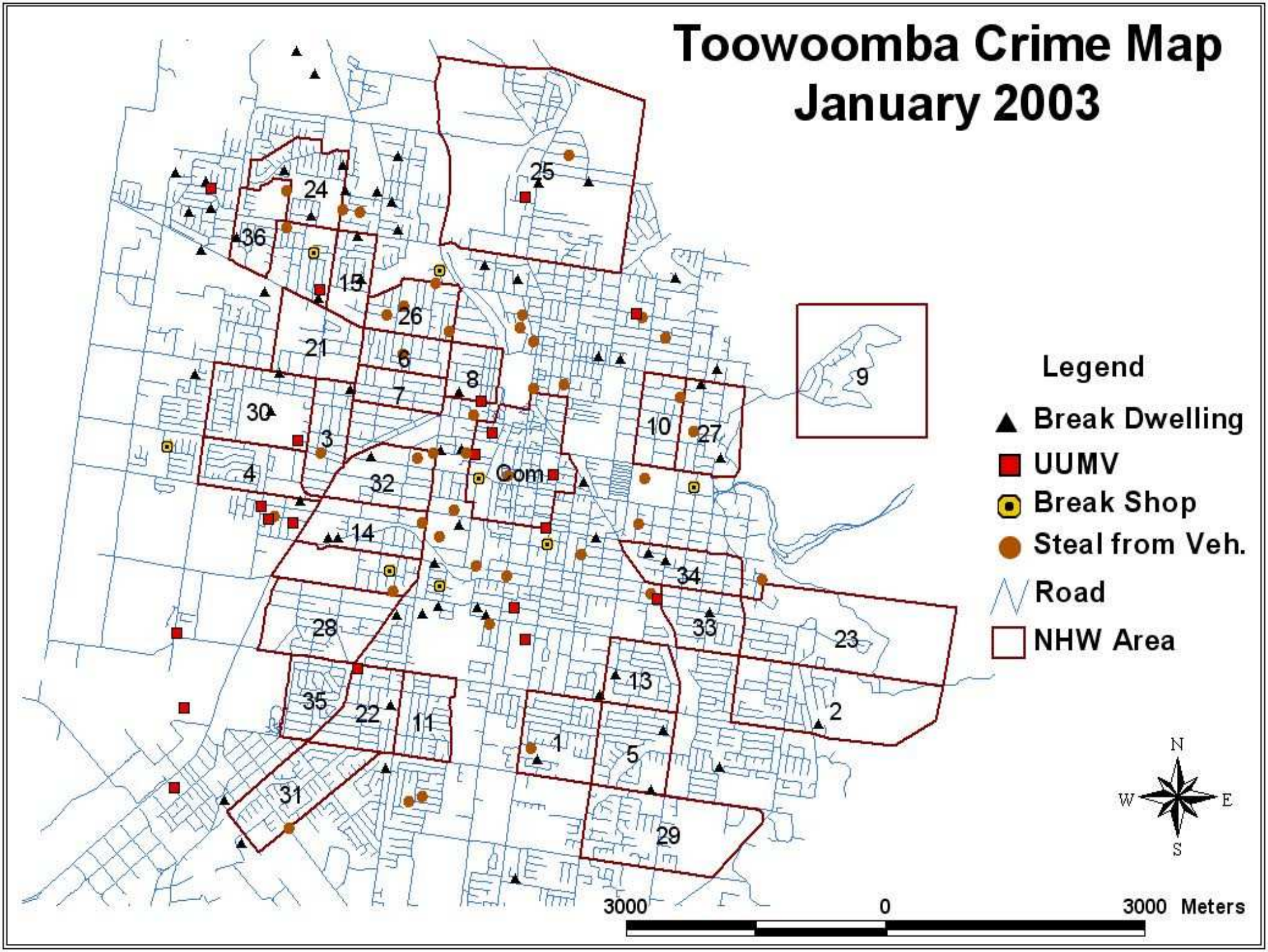
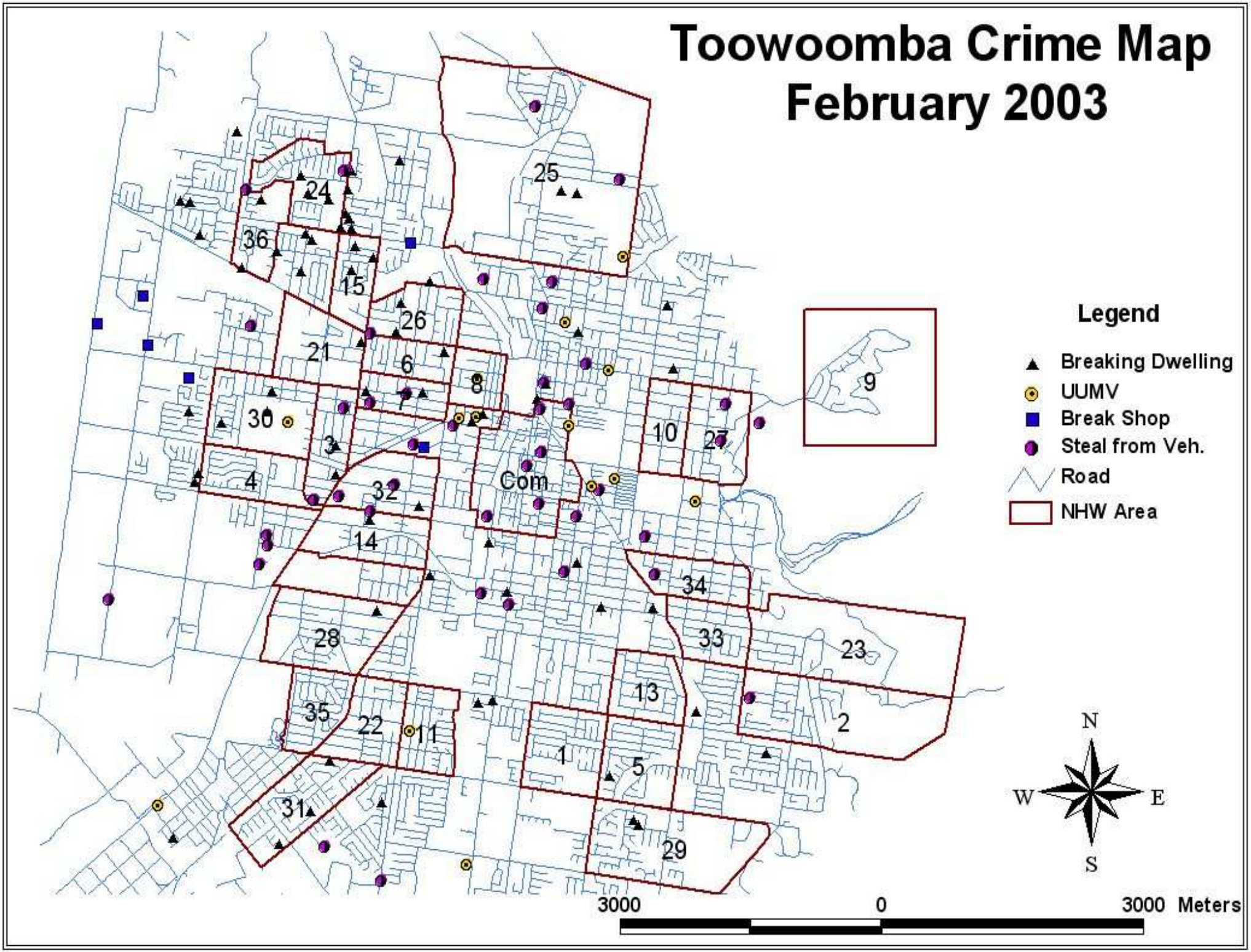
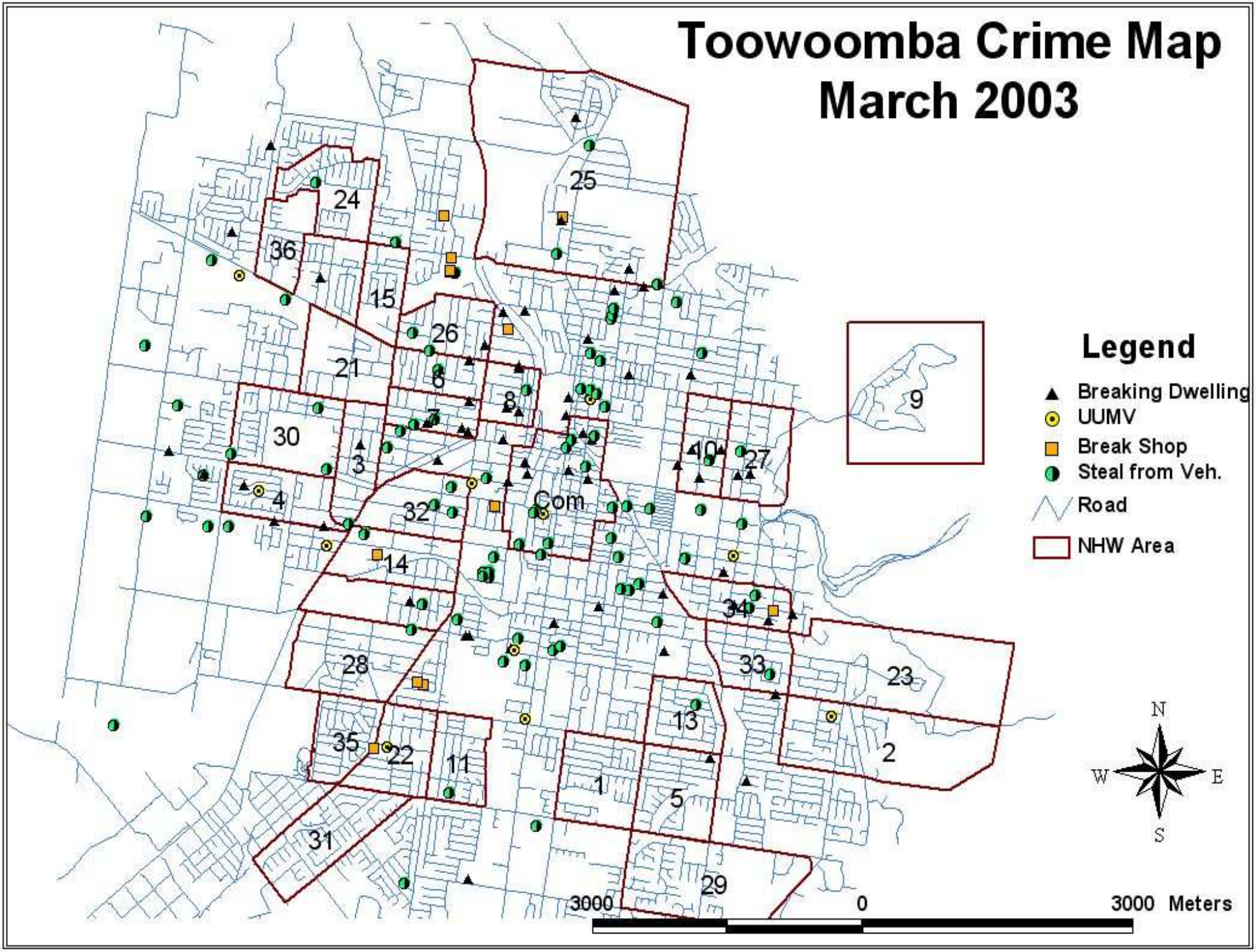
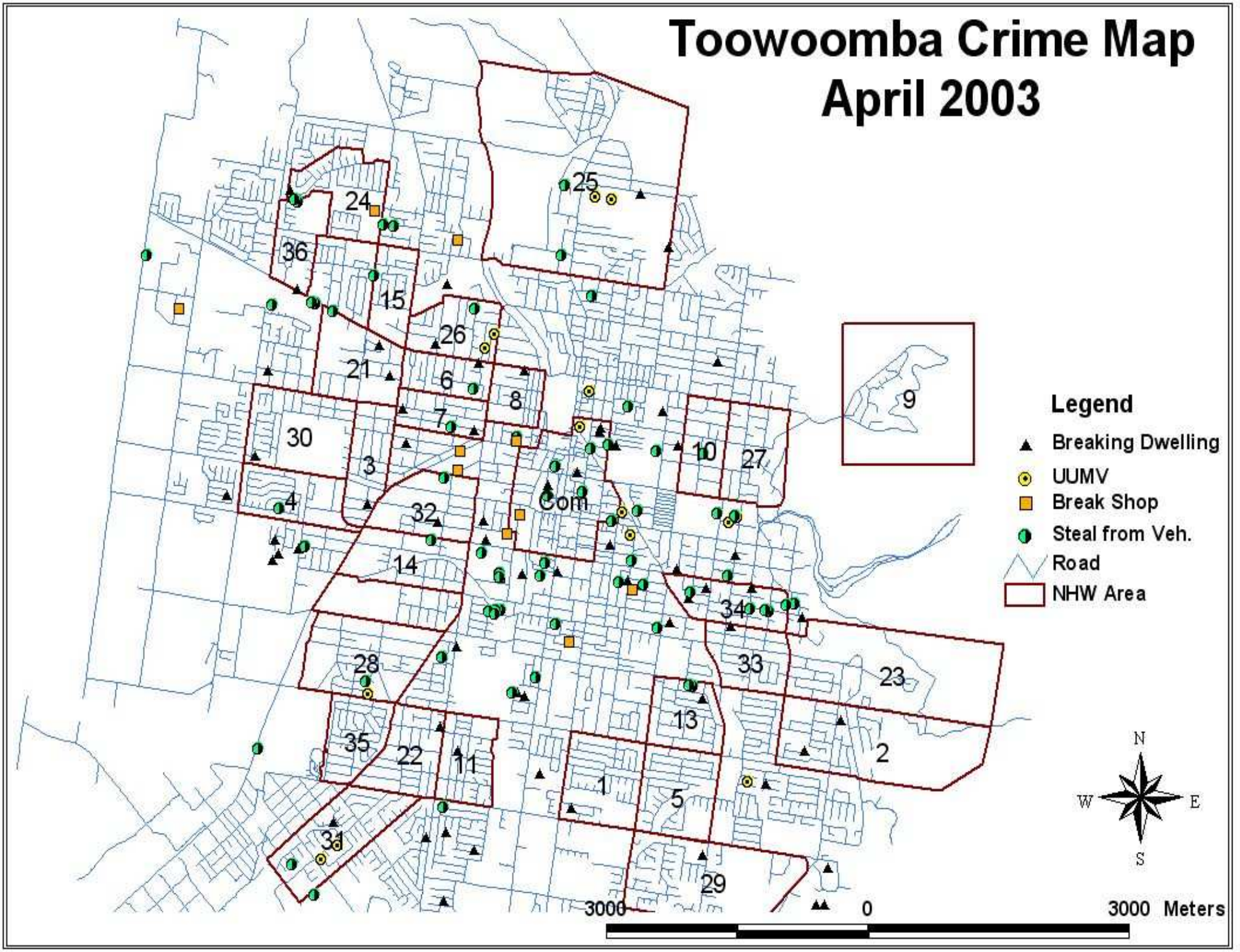
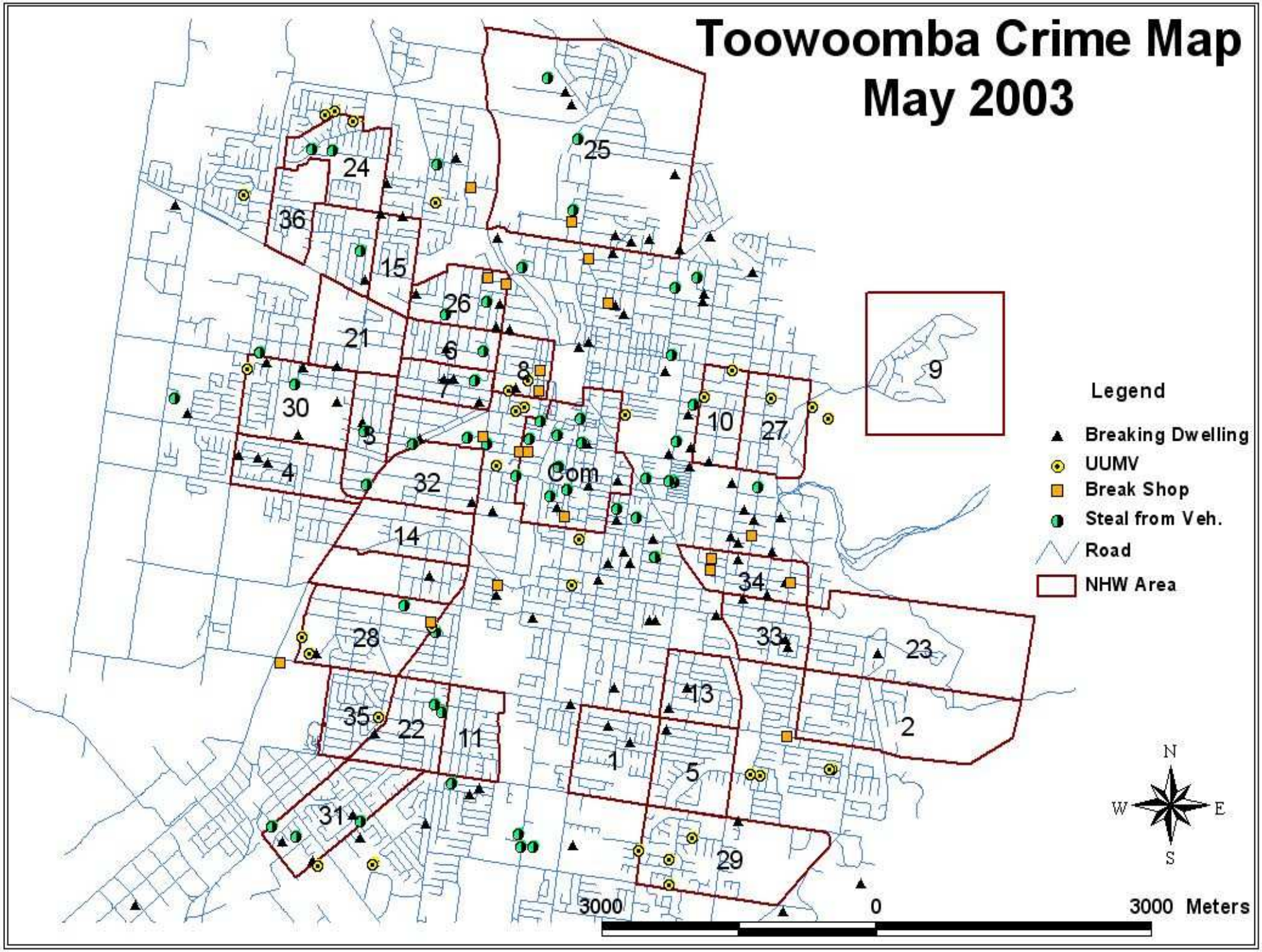

Toowoomba Crime Map
December 2002
Legend
Break Dwelling
UUMV
Break Shop
Steal from Veh.
Road
NHW Area
24
25
36
15
26
21
6
8
7
9
30
10
27
3
4
32
Com
14
34
28
33
23
13
35
22
11
1
5
2
31
29
N
W
E
S
3000
0
3000 Meters

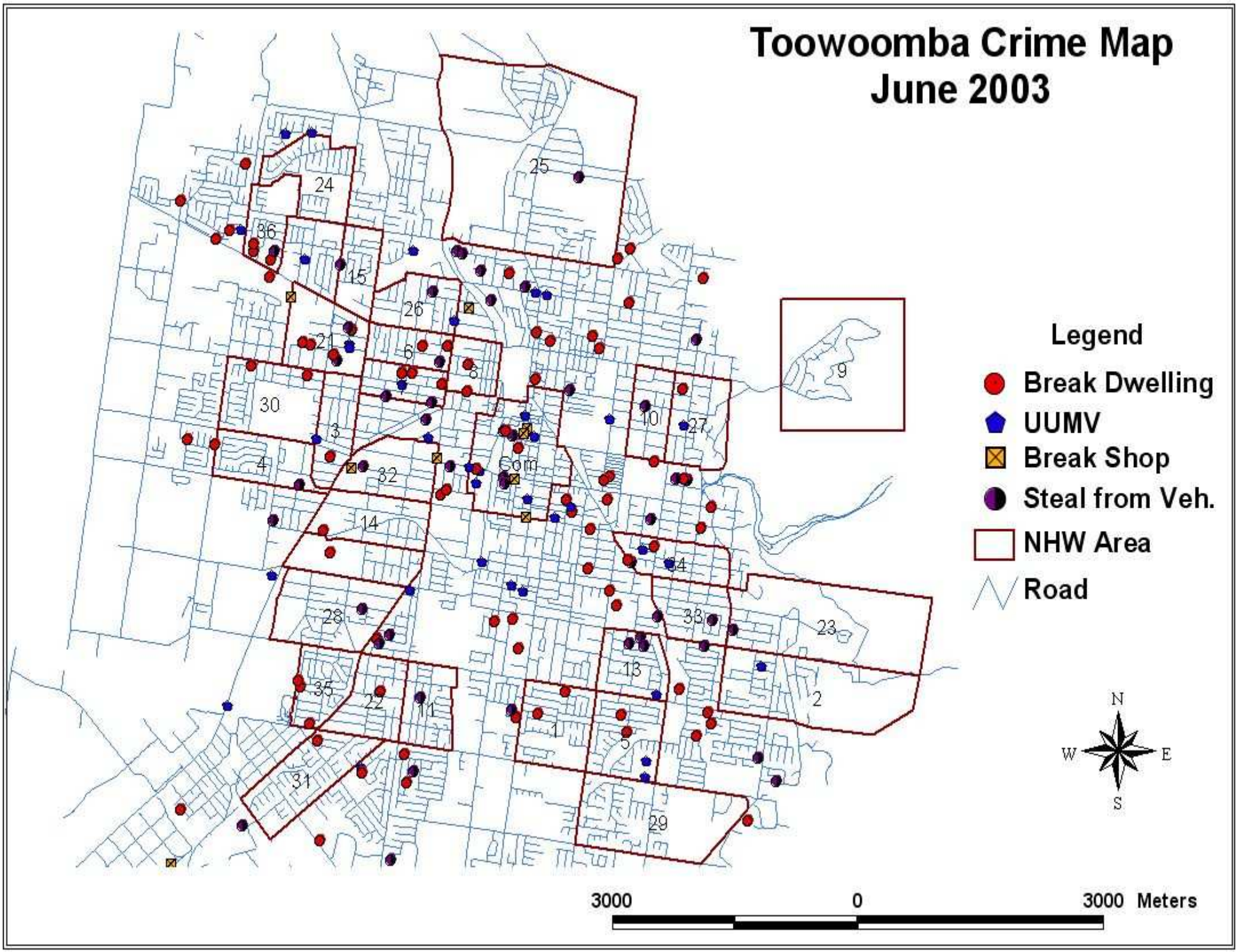

Toowoomba Crime Map
January 2003
Legend
Break Dwelling
UUMV
Break Shop
Steal from Veh.
Road
NHW Area
N
W
E
S
3000
0
3000 Meters
Com
24
25
36
15
26
21
6
8
7
9
30
3
10
27
4
32
14
34
28
33
23
13
35
22
11
2
1
5
31
29


Toowoomba Crime Map
February 2003
Legend
Breaking Dwelling
UUMV
Break Shop
Steal from Veh.
Road
NHW Area
25
24
36
15
26
21
6
8
7
9
30
3
10
27
4
32
Com
14
34
28
33
23
13
35
22
11
2
1
5
31
29
N
W
E
S
3000
0
3000 Meters


Toowoomba Crime Map
March 2003
Legend
Breaking Dwelling
UUMV
Break Shop
Steal from Veh.
Road
NHW Area
24
36
25
15
26
21
6
8
7
30
3
4
9
10
27
32
Com
14
34
28
33
23
13
35
22
11
2
1
5
31
29
N
W
E
S
3000
0
3000 Meters


Toowoomba Crime Map
April 2003
Legend
Breaking Dwelling
UUMV
Break Shop
Steal from Veh.
Road
NHW Area
N
W
E
S
3000
0
3000 Meters
Com
24
25
36
15
26
21
6
8
7
9
30
3
10
27
4
32
14
34
28
33
23
13
35
22
11
2
1
5
31
29

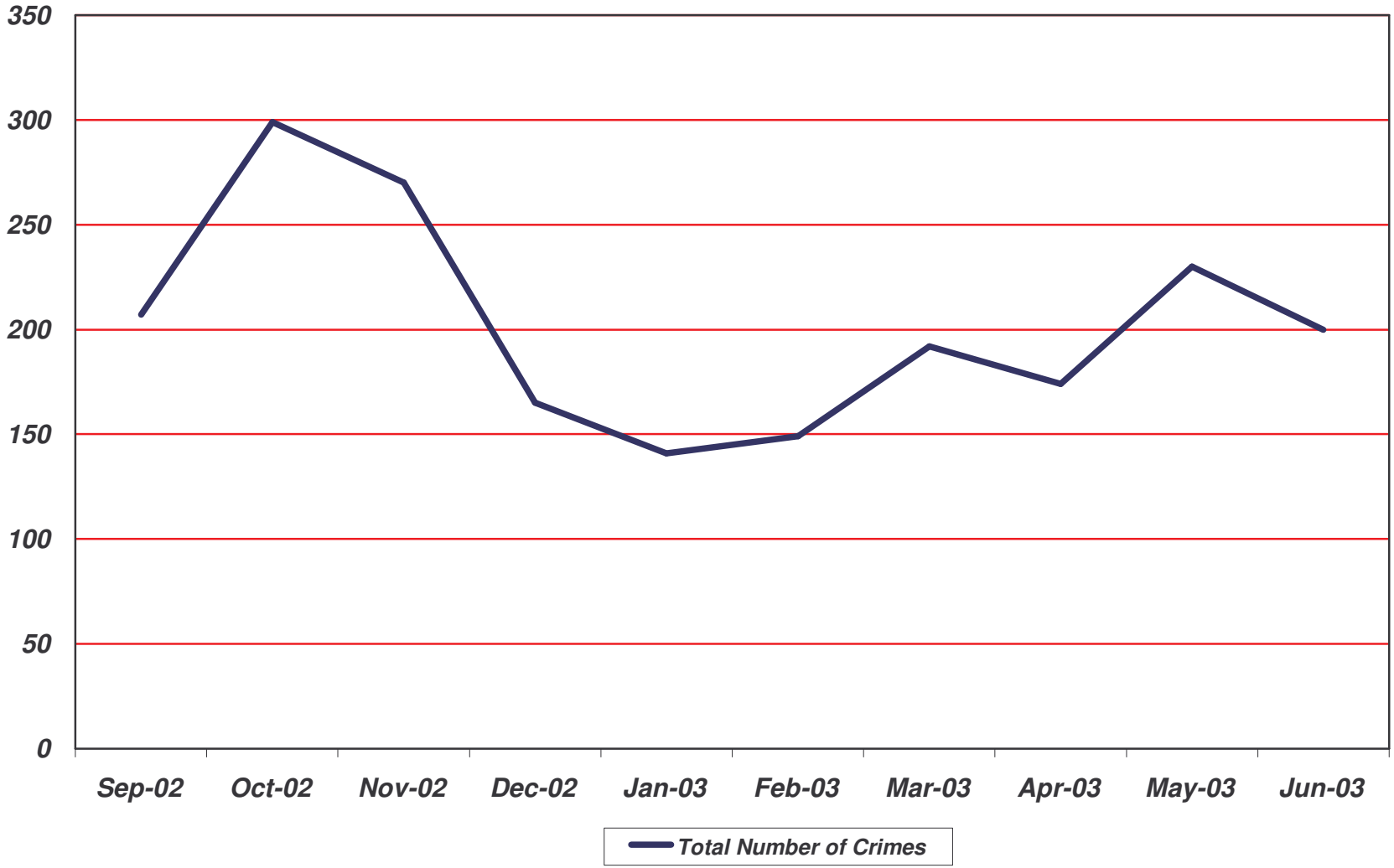

Toowoomba Crime Map
May 2003
24
25
36
15
26
21
6
8
7
9
30
3
10
27
4
32
Com
14
34
28
33
23
13
35
22
11
2
1
5
31
29
Legend
Breaking Dwelling
UUMV
Break Shop
Steal from Veh.
Road
NHW Area
N
W
E
S
3000
0
3000 Meters


Toowoomba Crime Map
June 2003
Legend
Break Dwelling
UUMV
Break Shop
Steal from Veh.
NHW Area
Road
N
W
E
S
3000
0
3000 Meters
Com
24
25
36
15
26
21
6
8
9
30
3
10
27
4
32
14
4
28
33
23
13
35
22
11
1
5
2
31
29

Total Number for Each Crime Class per Month from September 2002 to June 2003

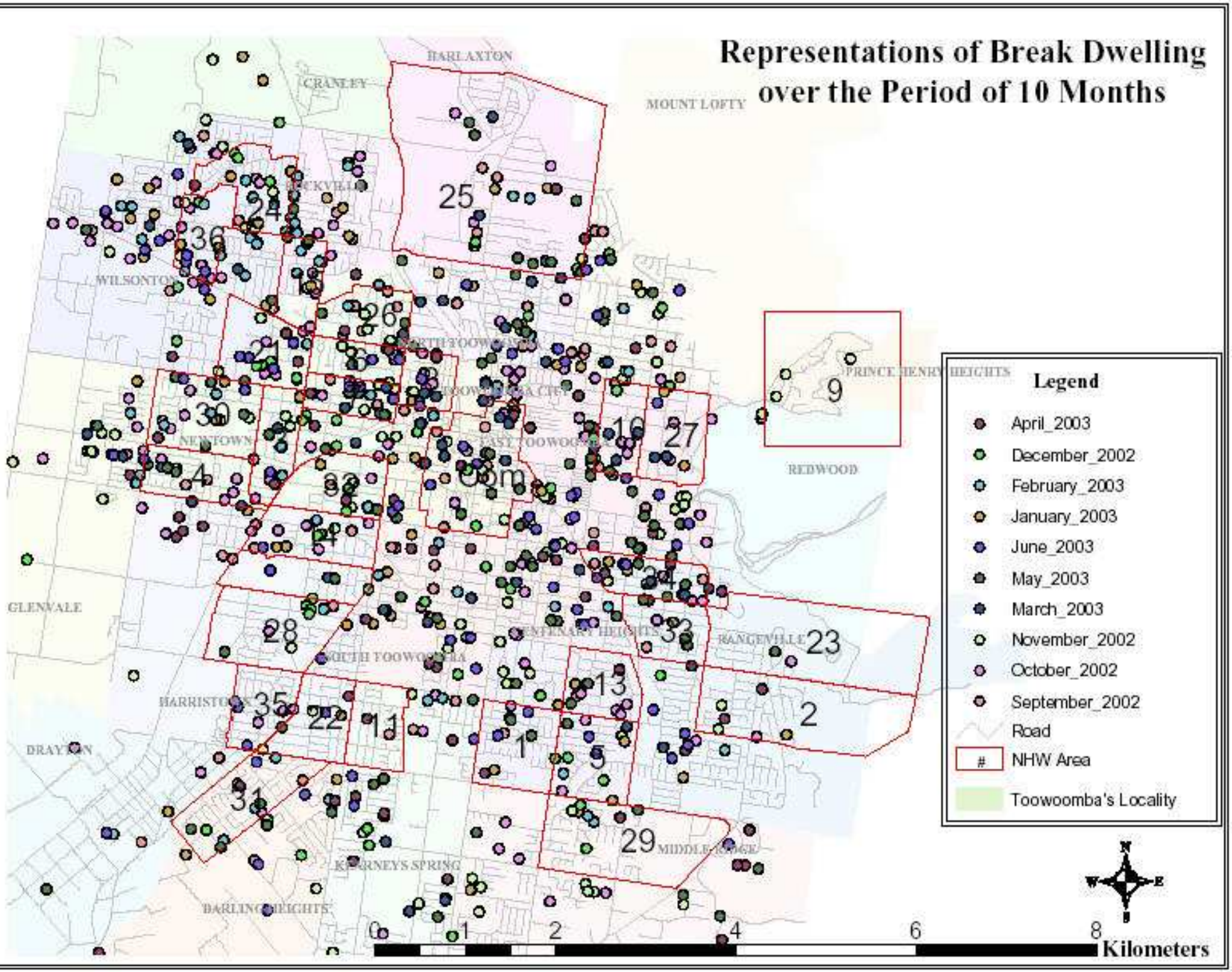
Month	Break Dwelling	UUMV	Break Shop	Steal from Vehicles	Total Number of Crimes
September 2002	102	13	43	49	**207**
October 2002	173	25	41	60	**299**
November 2002	119	38	35	78	**270**
December 2002	70	20	19	56	**165**
January 2003	66	23	8	44	**141**
February 2003	77	16	6	50	**149**
March 2003	74	14	13	91	**192**
April 2003	76	16	14	68	**174**
May 2003	116	36	23	55	**230**
June 2003	91	44	10	55	**200**

Changes in Number of Crime from September 2002 to June 2003

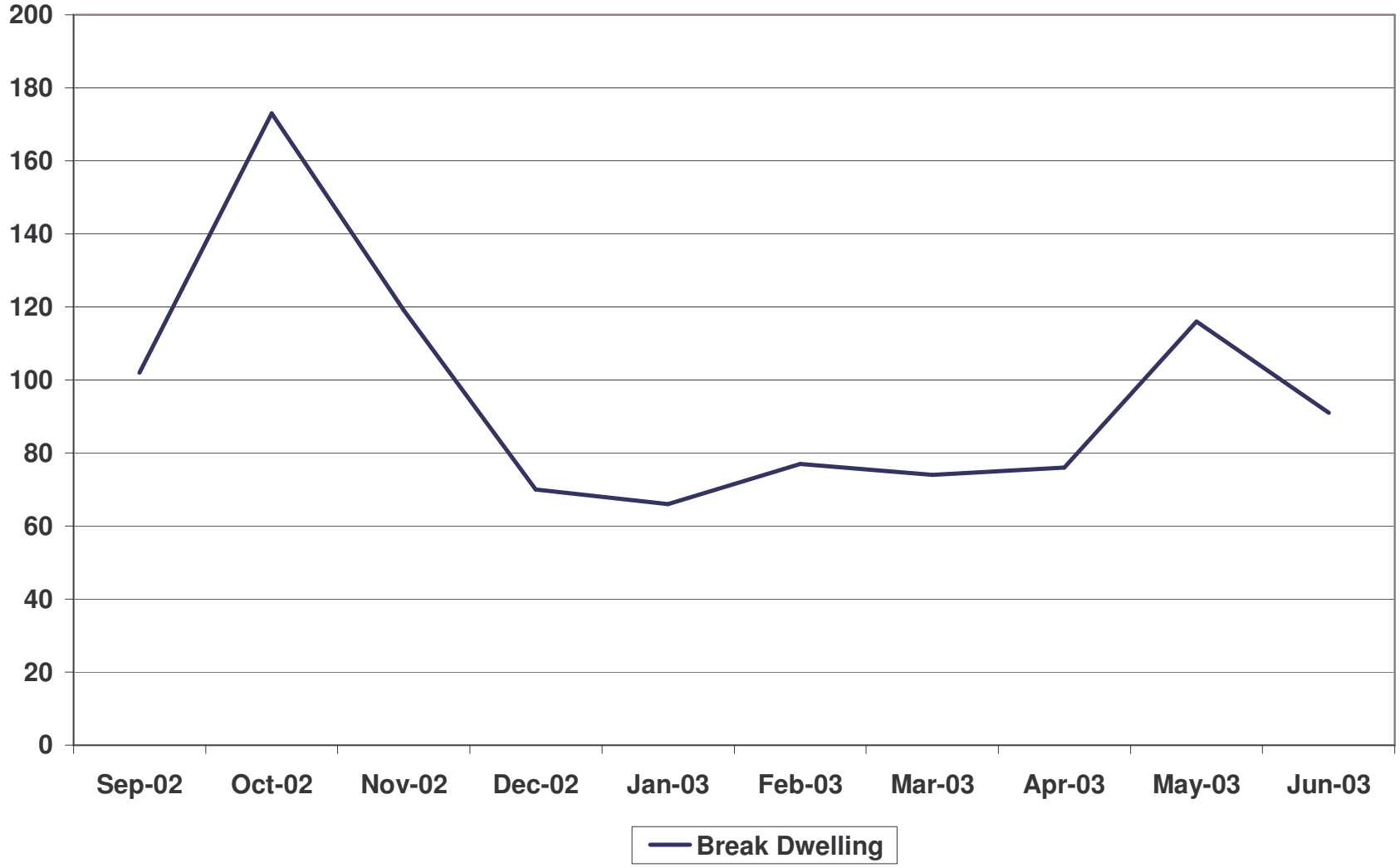


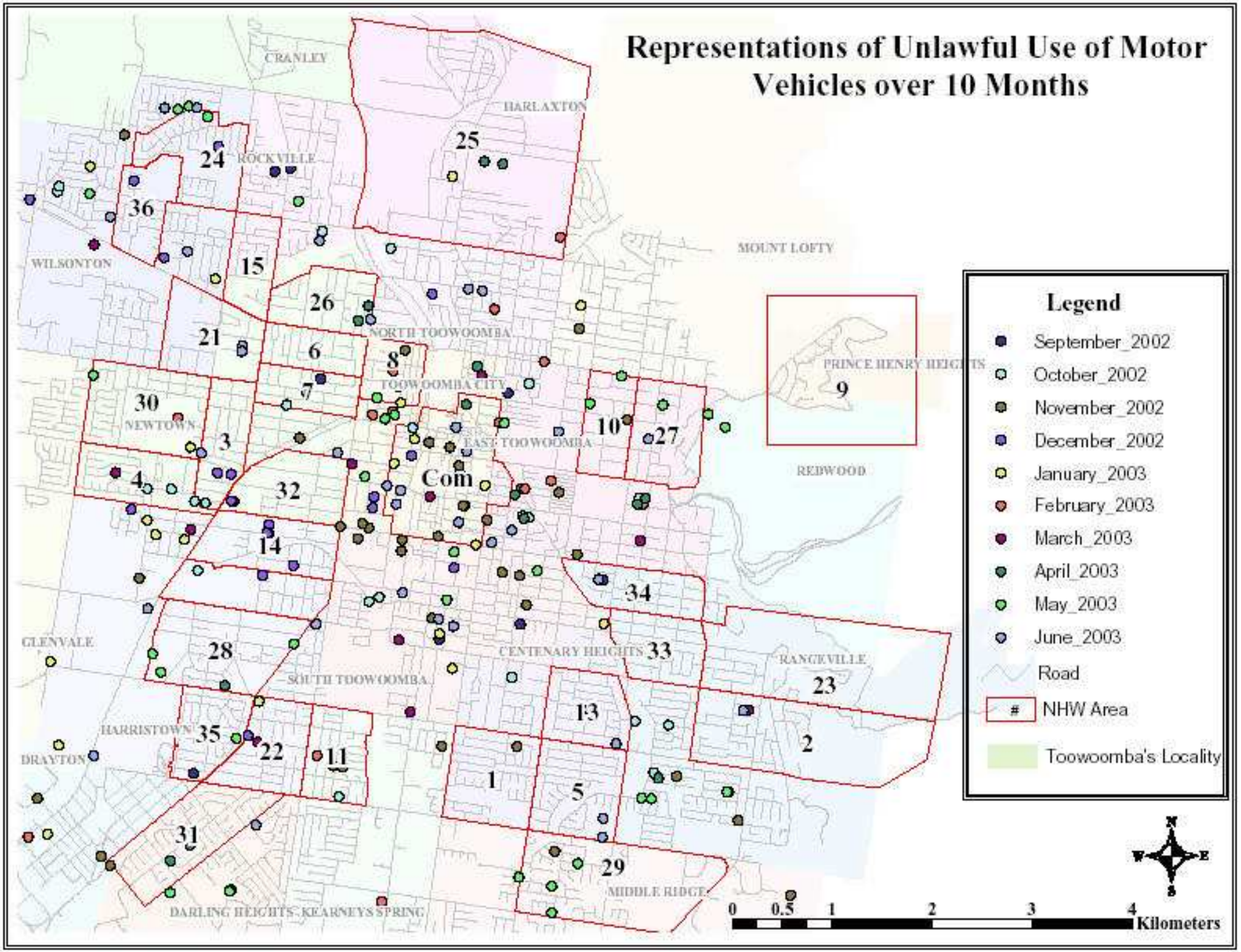
Appendix C:

Four Maps and Graphs of Different Criminal Activities during 10 Months

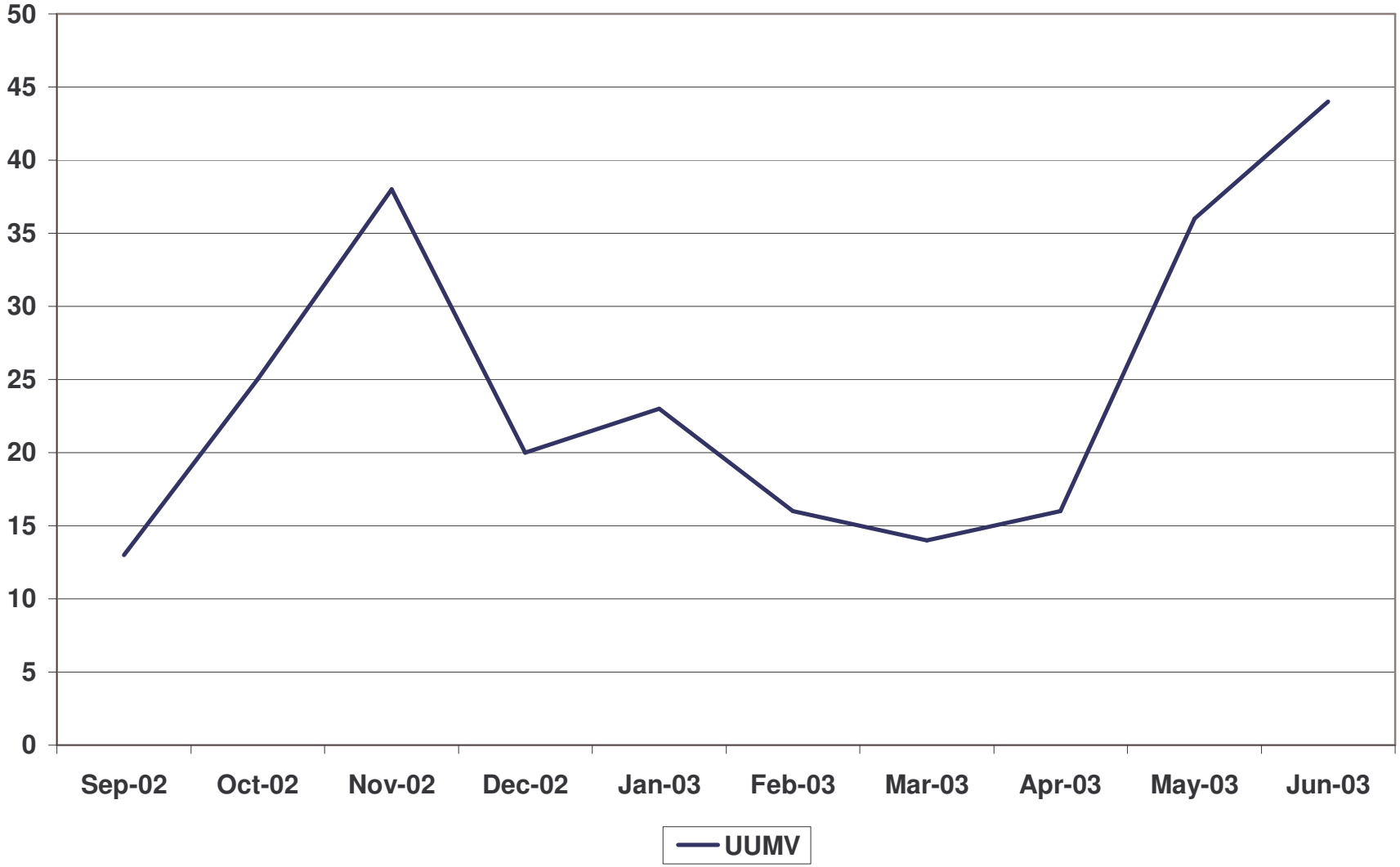

Representations of Break Dwelling over the Period of 10 Months
BARLAXTON
CRANLEY
MOUNT LOFTY
WILSONTON
NEWTOWN
EAST TOOWOOMBA
PRINCE HENRY HEIGHTS
REDWOOD
GLENVALE
RANGEVILLE
HARRISTOWN
DRAYTON
KEARNEYS SPRING
MIDDLE RIDGE
BARLING HEIGHTS
Legend
April_2003
December_2002
February_2003
January_2003
June_2003
May_2003
March_2003
November_2002
October_2002
September_2002
Road
NHW Area
Toowoomba's Locality
N
W
E
S
0
1
2
4
6
8
Kilometers

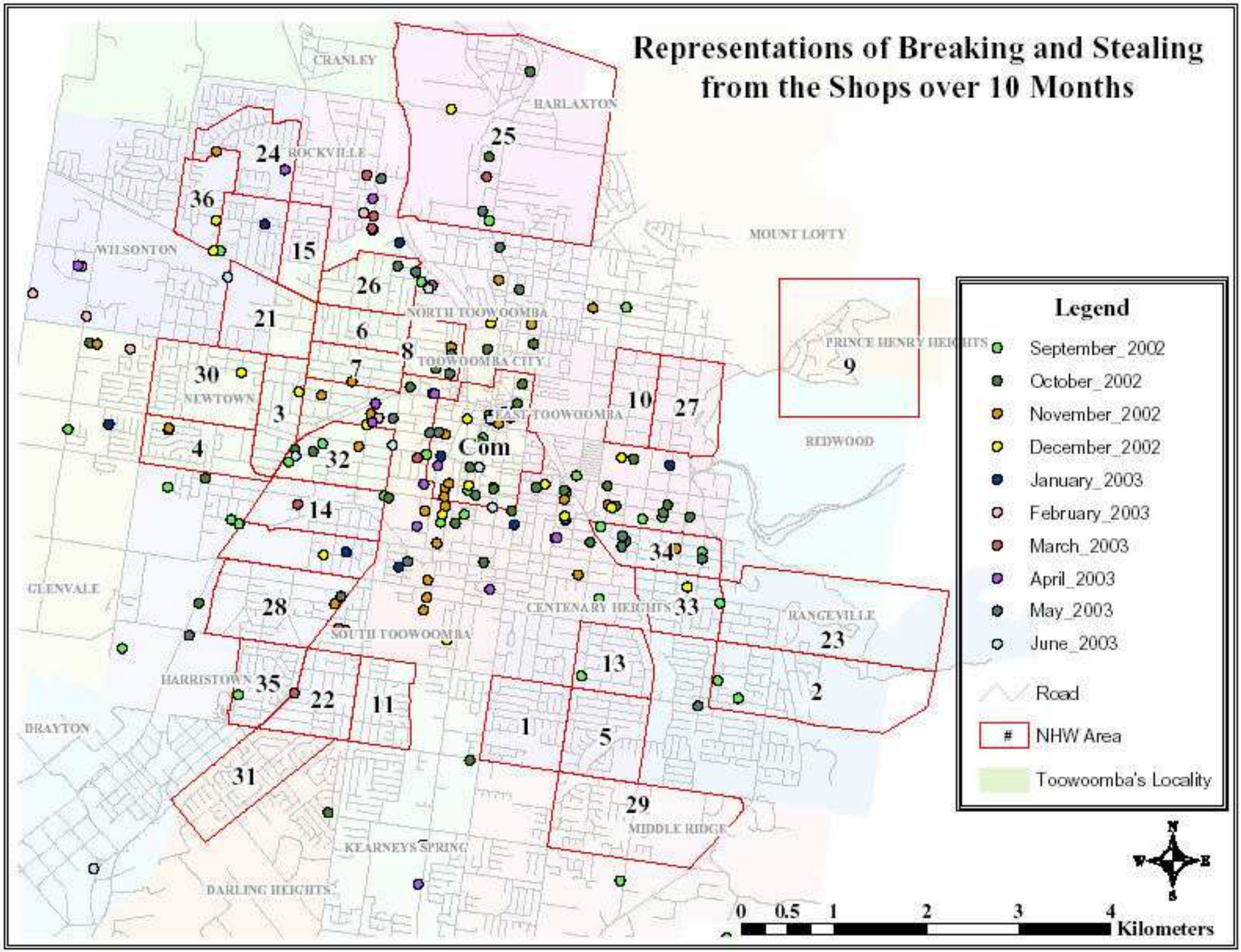
Breaking and Entering Dwellings



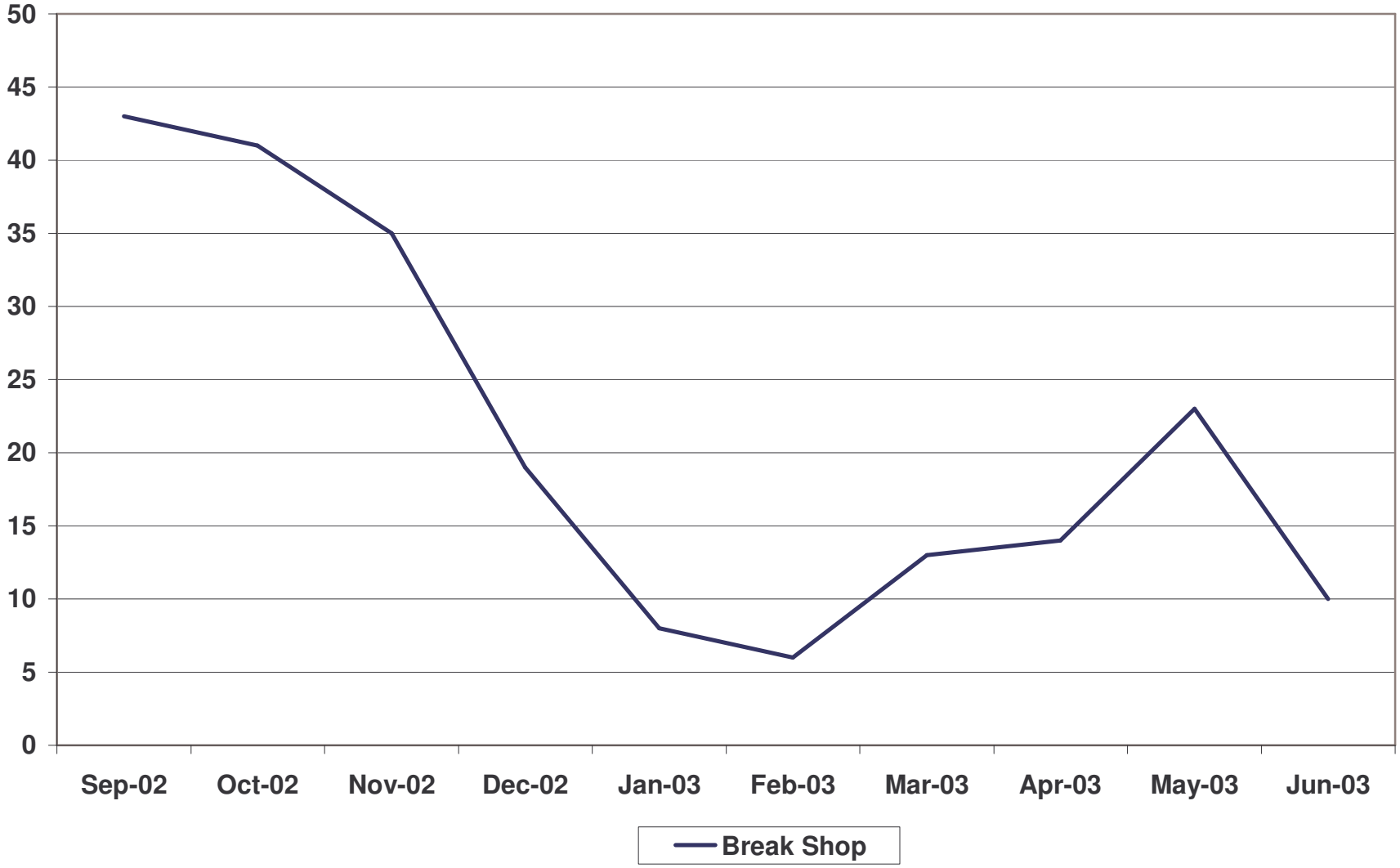

Representations of Unlawful Use of Motor Vehicles over 10 Months
CRANLEY
HARLAXTON
ROCKVILLE
MOUNT LOFTY
WILSONTON
NORTH TOOWOOMBA
TOOWOOMBA CITY
PRINCE HENRY HEIGHTS
NEWTOWN
EAST TOOWOOMBA
REDWOOD
Com
GLENVALE
CENTENARY HEIGHTS
RANGEVILLE
SOUTH TOOWOOMBA
HARRISTOWN
DRAYTON
MIDDLE RIDGE
DARLING HEIGHTS
KEARNEYS SPRING
24
25
36
15
26
21
6
8
7
9
30
10
27
3
4
32
14
34
28
33
23
13
2
35
22
11
1
5
31
29
Legend
September_2002
October_2002
November_2002
December_2002
January_2003
February_2003
March_2003
April_2003
May_2003
June_2003
Road
NHW Area
Toowoomba's Locality
N
W
E
S
0
0.5
1
2
3
4
Kilometers

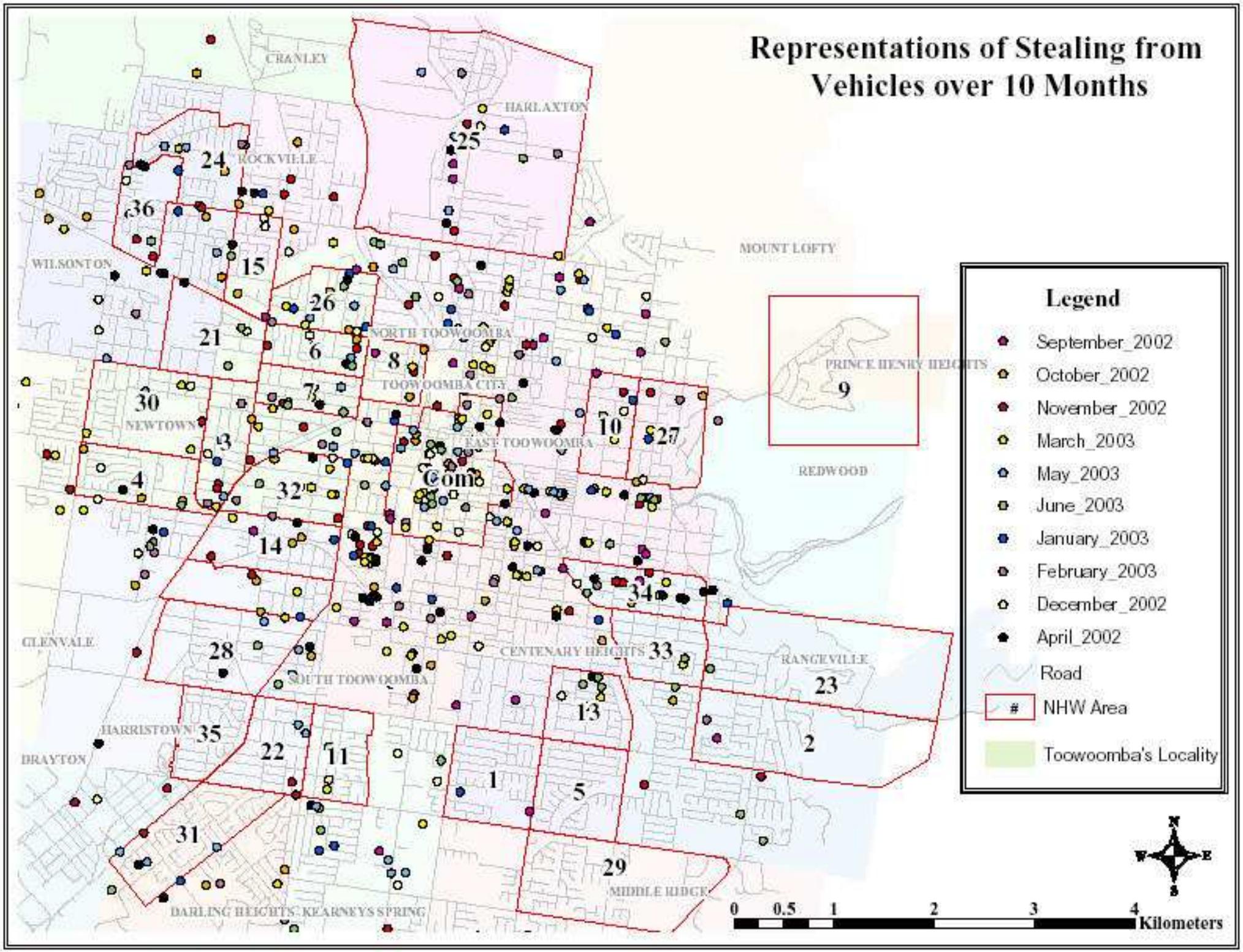
Unlawful Use of Motor Vehicles

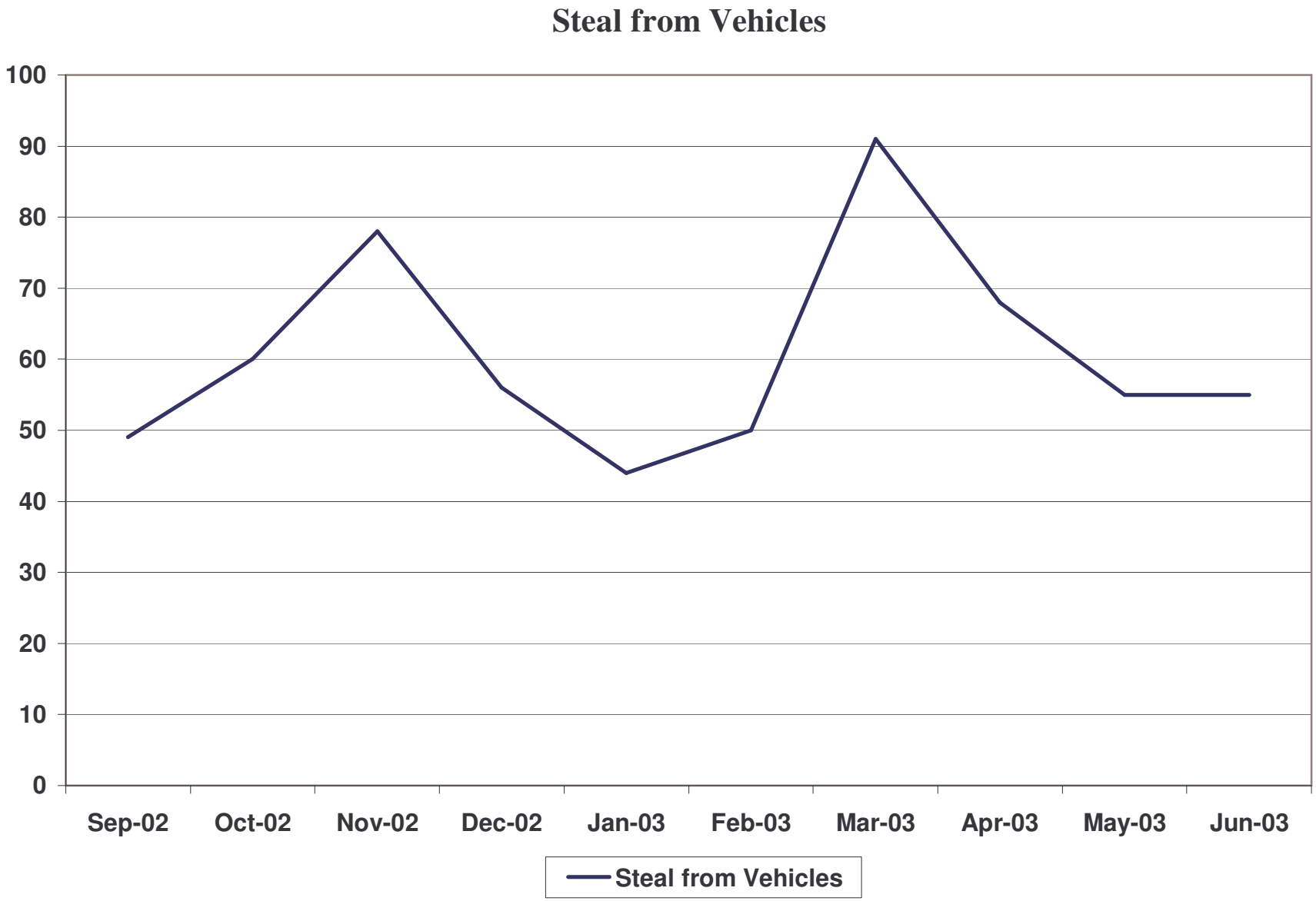



Representations of Breaking and Stealing from the Shops over 10 Months
CRANLEY
HARLAXTON
ROCKVILLE
WILSONTON
MOUNT LOFTY
NORTH TOOWOOMBA
TOOWOOMBA CITY
PRINCE HENRY HEIGHTS
NEWTOWN
REDWOOD
Com
GLENVALE
CENTENARY HEIGHTS
RANGEVILLE
SOUTH TOOWOOMBA
HARRISTOWN
BRAYTON
MIDDLE RIDGE
KEARNEYS SPRING
DARLING HEIGHTS
24
25
36
15
26
21
6
8
7
30
3
4
32
14
10
27
9
34
28
33
23
13
2
35
22
11
1
5
31
29
Legend
September_2002
October_2002
November_2002
December_2002
January_2003
February_2003
March_2003
April_2003
May_2003
June_2003
Road
NHW Area
Toowoomba's Locality
N
W
E
S
0 0.5 1 2 3 4
Kilometers

Breaking and Entering Shops

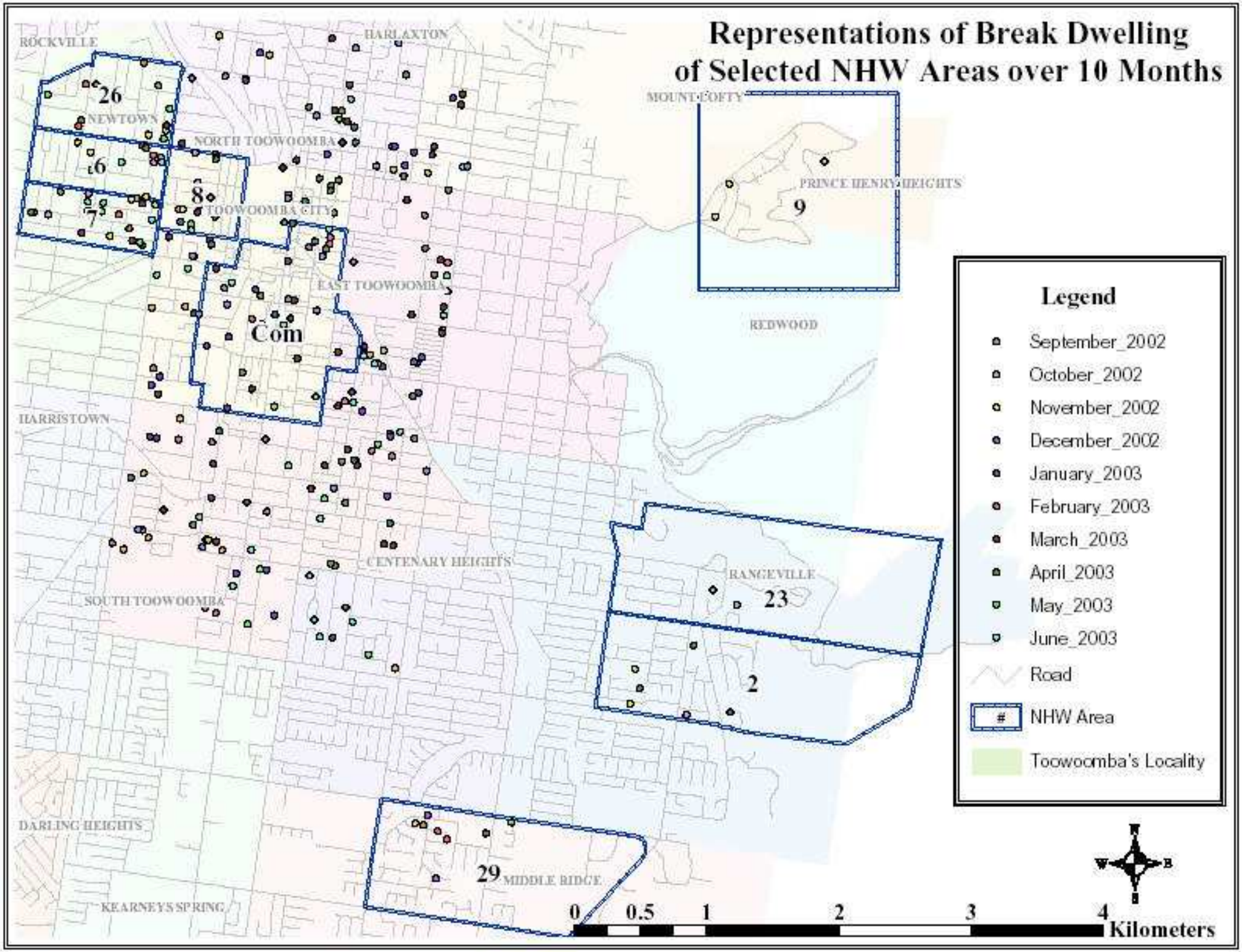


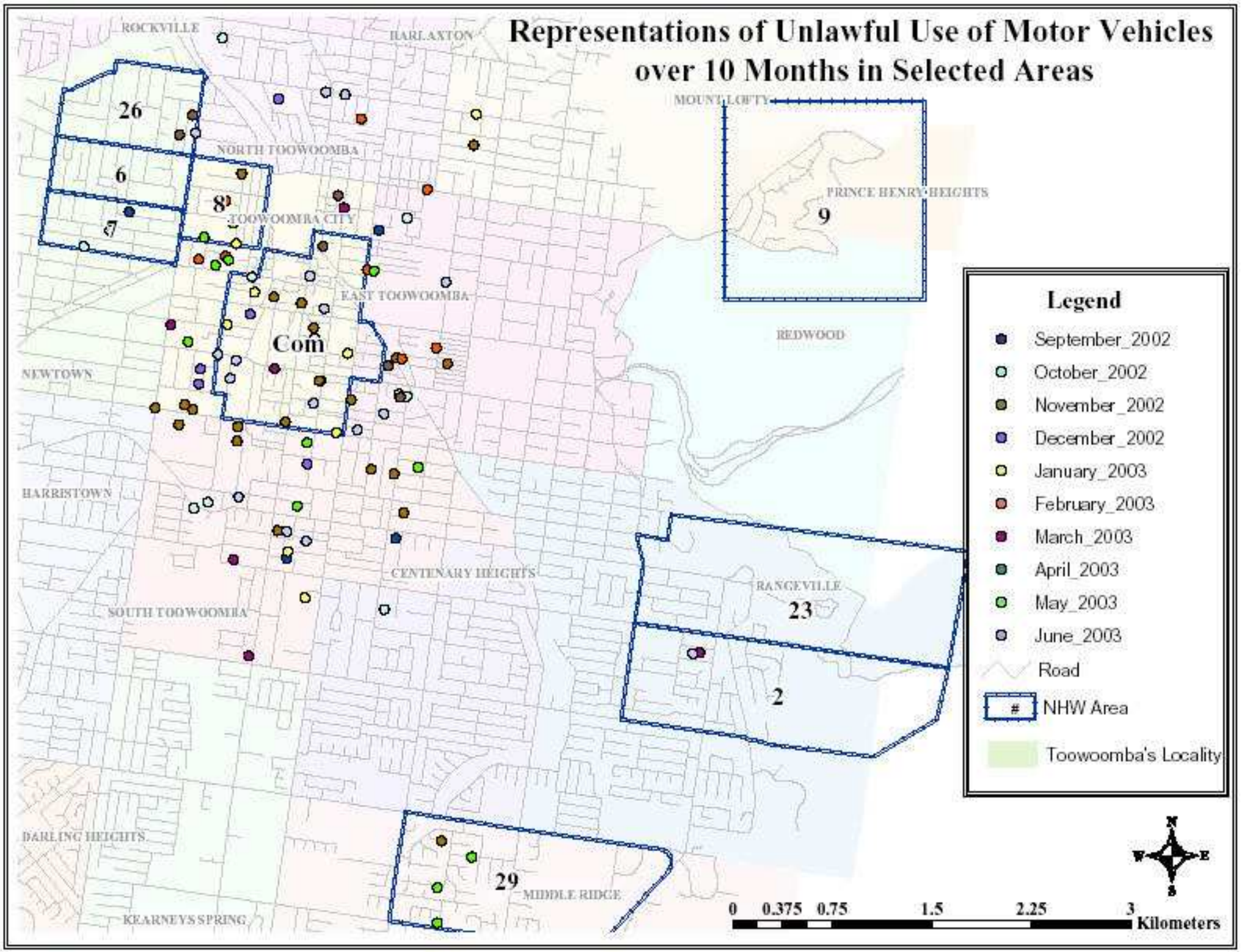

Representations of Stealing from Vehicles over 10 Months
Legend
September_2002
October_2002
November_2002
March_2003
May_2003
June_2003
January_2003
February_2003
December_2002
April_2002
Road
NHW Area
Toowoomba's Locality
CRANLEY
HARLAXTON
ROCKVILLE
MOUNT LOFTY
WILSONTON
NORTH TOOWOOMBA
TOOWOOMBA CITY
PRINCE HENRY HEIGHTS
NEWTOWN
EAST TOOWOOMBA
REDWOOD
CENTENARY HEIGHTS
GLENVALE
SOUTH TOOWOOMBA
RANGEVILLE
HARRISTOWN
DRAYTON
MIDDLE RIDGE
DARLING HEIGHTS
KEARNEYS SPRING
0 0.5 1 2 3 4 Kilometers

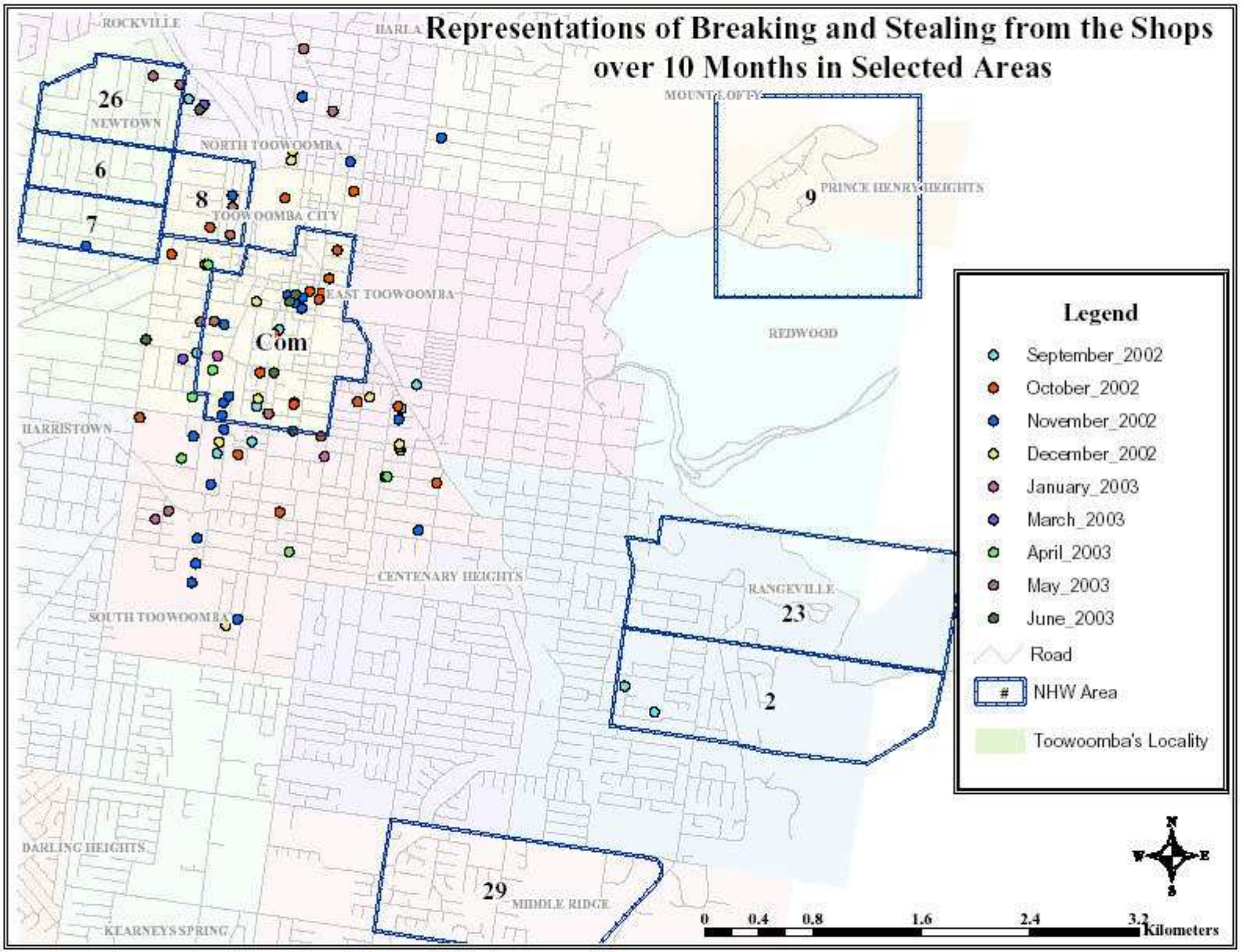

Steal from Vehicles
100
90
80
70
60
50
40
30
20
10
0
Sep-02
Oct-02
Nov-02
Dec-02
Jan-03
Feb-03
Mar-03
Apr-03
May-03
Jun-03
Steal from Vehicles

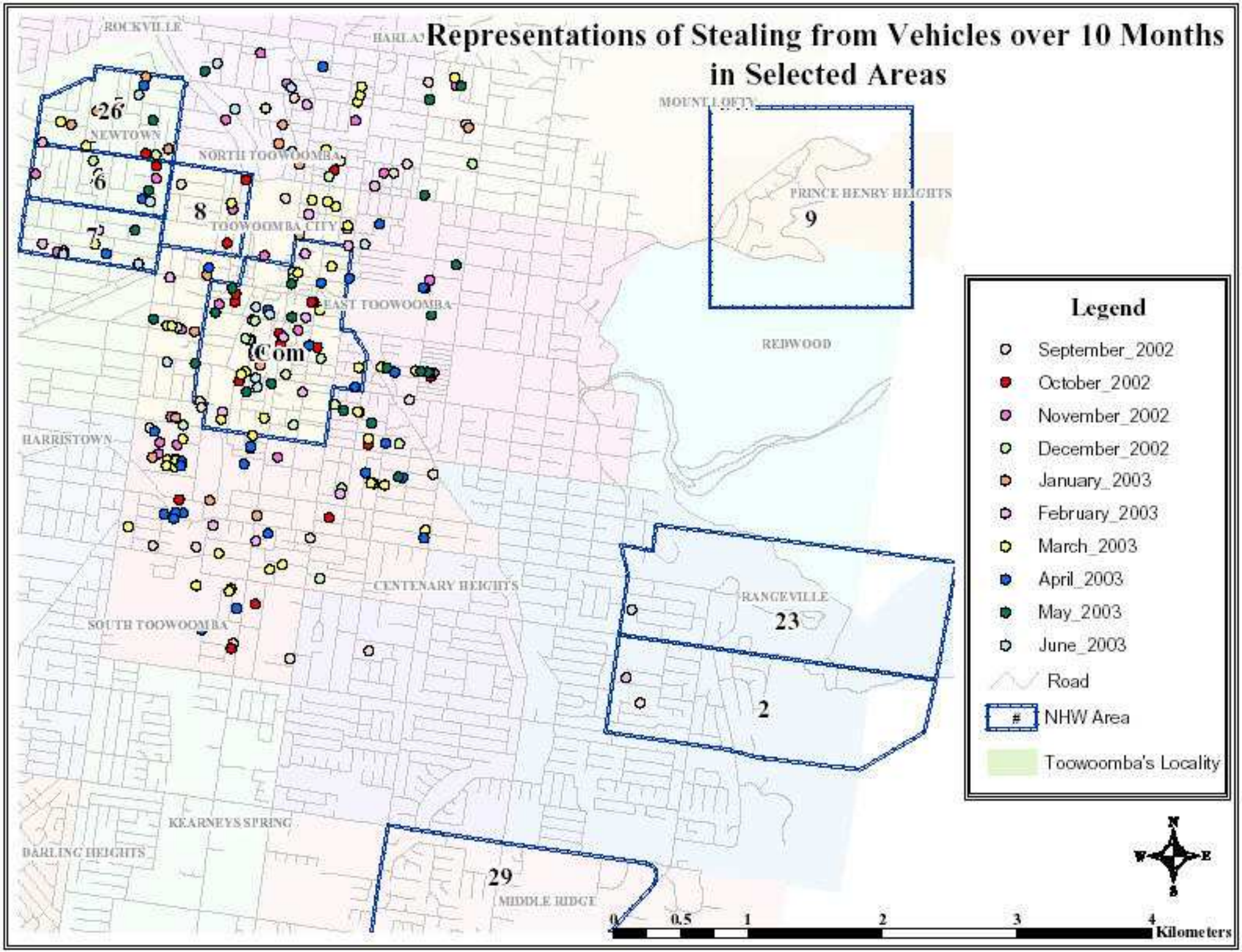
Appendix D:

Four Maps of Different Criminal Activities within Selected Areas during 10 Months


Representations of Break Dwelling
of Selected NHW Areas over 10 Months
ROCKVILLE
HARLAXTON
MOUNT COTTY
NEWTOWN
NORTH TOOWOOMBA
TOOWOOMBA CITY
PRINCE HENRY HEIGHTS
EAST TOOWOOMBA
REDWOOD
HARRISTOWN
CENTENARY HEIGHTS
RANGEVILLE
SOUTH TOOWOOMBA
DARLING HEIGHTS
MIDDLE RIDGE
KEARNEYS SPRING
26
6
8
7
Com
9
23
2
29
Legend
September_2002
October_2002
November_2002
December_2002
January_2003
February_2003
March_2003
April_2003
May_2003
June_2003
Road
NHW Area
Toowoomba's Locality
0
0.5
1
2
3
4
Kilometers


Representations of Unlawful Use of Motor Vehicles over 10 Months in Selected Areas
ROCKVILLE
HARLAXTON
MOUNT LOFTY
PRINCE HENRY HEIGHTS
NORTH TOOWOOMBA
TOOWOOMBA CITY
EAST TOOWOOMBA
REDWOOD
NEWTOWN
HARRISTOWN
CENTENARY HEIGHTS
RANGEVILLE
SOUTH TOOWOOMBA
DARLING HEIGHTS
MIDDLE RIDGE
KEARNEYS SPRING
26
6
8
7
Com
9
23
2
29
Legend
September_2002
October_2002
November_2002
December_2002
January_2003
February_2003
March_2003
April_2003
May_2003
June_2003
Road
NHW Area
Toowoomba's Locality
N
W
E
S
0 0.375 0.75 1.5 2.25 3
Kilometers


Representations of Breaking and Stealing from the Shops over 10 Months in Selected Areas
ROCKVILLE
HARLA
MOUNT LOFTY
NEWTOWN
NORTH TOOWOOMBA
TOOWOOMBA CITY
EAST TOOWOOMBA
PRINCE HENRY HEIGHTS
REDWOOD
HARRISTOWN
CENTENARY HEIGHTS
RANGEVILLE
SOUTH TOOWOOMBA
DARLING HEIGHTS
MIDDLE RIDGE
KEARNEYS SPRING
26
6
7
8
9
Com
23
2
29
Legend
September_2002
October_2002
November_2002
December_2002
January_2003
March_2003
April_2003
May_2003
June_2003
Road
NHW Area
Toowoomba's Locality
N
W
E
S
0 0.4 0.8 1.6 2.4 3.2
Kilometers


Representations of Stealing from Vehicles over 10 Months in Selected Areas
ROCKVILLE
HARLAXTON
MOUNT LOFTY
NEWTOWN
NORTH TOOWOOMBA
TOOWOOMBA CITY
EAST TOOWOOMBA
PRINCE HENRY HEIGHTS
REDWOOD
HARRISTOWN
CENTENARY HEIGHTS
RANGEVILLE
SOUTH TOOWOOMBA
KEARNEYS SPRING
DARLING HEIGHTS
MIDDLE RIDGE
26
6
7
8
Com
9
23
2
29
Legend
September_2002
October_2002
November_2002
December_2002
January_2003
February_2003
March_2003
April_2003
May_2003
June_2003
Road
NHW Area
Toowoomba's Locality
N
W
E
S
0
0.5
1
2
3
4
Kilometers

References

Bawden, P and Saywell, J 2000, *Crime Mapping from an Intelligence Perspective*, Submitted to the Australian Institute of Criminology, Crime Mapping Conference: Adding Value to Crime Prevention and Control, Australian Mineral Foundation Adelaide (Sept 20&21 2000).

Block, C.R. (1995) 'STAC hotspot areas: a statistical tool for law enforcement decisions', in C. Block, M. Daboub and S. Fregly (eds) *Crime Analysis Through Computer Mapping*, Washington, DC: Police Exclusive Research Forum, pp.15 – 32.

Bowers, K & Hirschfield, A 2001, Mapping *and Analysing Crime Data: Lessons from Research and Practice*, Taylor & Francis, London.

Brantingham, P and Brantingham, P 1984, *Patterns in Crime*, Macmillan Publishing Company, USA.

Crosier, S, Booth, B and Mitchell, A 1999 – 2002, *Getting Started with ArcGIS*, ESRI, USA.

ESRI 2001, *President Jack Dangermond* :'Grassroots Geography Sets Tone for 21st User Conference: GIS Communities are Poised to Take the Pulse of the Planet', *ArcNews, [Online]*, Available at : http://www.esri.com/news/arcnews/fall01articles/giscommunities.html, [Accessed on 27 July 2004].

ESRM 250 2004, *Introduction to Geographic Information System in Forest Resources*, [Online], Available at: http://gis.washington.edu/cfr250/lessons/vector_analysis2/#topo_overlay, [Accessed on 22 May 2004].

European Group 2004, *Critical Perspective on Crime Prevention*, [online], Available at: http://www.europeangroup.org/2003abstracts.pdf, [Accessed 14 May 2004].

Falbo, D. L, Queen, L. P. and. Blinn, C R 2002, *Introduction to Data Analysis Using Geographic Information Systems,* Regents of the University of Minnesota, USA.

Geoprice.Net 2003, ArcGIS ArcView 8.x, [Online], Available at: http://geoprise.net/products/ESRI/arcview8x.html, [Accessed on 27 May 2004].

Greenhood, D 1964, *Mapping*, The University of Chicago America.

Harries, K 1999, Mapping Crime: Principle and Practice, [Online], Available at: http://www.cslj.net/library/dk_files/Law Enforcement/ L E Technology/L E Information Technology/Crime Mapping & GIS/1999 NIJ Mapping Crime 1299.pdf, [Accessed on 15 May 2004].

Mukherjee, S and Wilson, P 1987, *Neighbourhood Watch: Issues and Policy Implications*, Australian Institute of Criminology, Canberra.

Neighbourhood Watch Association (South Australia) 1999-2002, *Neighbourhood Watch History*, [online], Available at: http://www.nhwatch.asn.au/history.htm, [Accessed 14 May 2004].

Queensland Police Service- "Neighbourhood Watch, Inquires Guide: Commercial Union Insurance, Community Caring A.C.N. 004478371", Queensland Police Service. The Commissioner's Office, Brisbane.

Spatial Information Clearinghouse 2004, *Component of a GIS*, Mine Action Information Center, James Madison University, USA, [Online], Available at: http://maic.jmu.edu/sic/gis/components.htm, [Accessed on 22 May 2004].

The Metropolitan Police Service, *Neighbourhood Watch*, [Online], Available at: http://www.met.police.uk/crimeprevention/neighbor.htm, [Accessed 11 May 2004].

USGS Eastern Region Geography 2003, *Geographic Information System*, [Online], Available at: http://erg.usgs.gov/isb/pubs/gis_poster/, [Accessed on 15 May 2004].

Bibliography

Antenucci, J. C, Archer, H, Brown K, Croswell, P. L, Kevanny, M. J, 1991. *Geographic Information Systems: A Guide to the Technology.* Van Nostrand Reinhold, USA.

Author Unknown, *Crime Mapping: GIS Goes Main Stream 1999-2004*, GIS Lounge, [Online], Available at: http://gislounge.com/features/aa101100.shtml, [Assessed 12 May 2004]

Bawden, P and Saywell, J 2000, *Crime Mapping from an Intelligence Perspective*, Submitted to the Australian Institute of Criminology, Crime Mapping Conference: Adding Value to Crime Prevention and Control, Australian Mineral Foundation Adelaide (Sept 20&21 2000).

Block, C.R. (1995) 'STAC hotspot areas: a statistical tool for law enforcement decisions', in C. Block, M. Daboub and S. Fregly (eds) *Crime Analysis Through Computer Mapping*, Washington, DC: Police Exclusive Research Forum, pp.15 – 32.

Bowers, K & Hirschfield, A 2001, Mapping *and Analysing Crime Data: Lessons from Research and Practice*, Taylor & Francis, London.

Bernhardsen. T 1999, *Geographic Information Systems: An Introduction Second Edition,* John Wiley and Sons Inc Printed USA.

Brantingham, P and Brantingham, P 1984, *Patterns in Crime*, Macmillan Publishing Company, New York.

Components of GIS 2002, Spatial Information Clearinghouse, Mine Action Information Centre, [Online], Available at: http://maic.jmu.edu/sic/gis/components.htm, [Assessed on 12 May 2004].

Crosier, S, Booth, B and Mitchell, A 1999 – 2002, *Getting Started with ArcGIS*, ESRI, USA.

Data Analysis Using Geographic Information System 1991, Communication and Educational Technology Services, University of Minnesota Extension Service, U.S., Viewed 12 May 2004, http://www.extension.umn.edu/distribution/naturalresources/components/5740aaof.html , [Assessed on 12 May 2004]

ESRI 2001, *President Jack Dangermond* :'Grassroots Geography Sets Tone for 21st User Conference: GIS Communities are Poised to Take the Pulse of the Planet', *ArcNews, [Online]*, Available at : http://www.esri.com/news/arcnews/fall01articles/giscommunities.html, [Accessed on 27 July 2004].

ESRM 250 2004, *Introduction to Geographic Information System in Forest Resources*, [Online], Available at: http://gis.washington.edu/cfr250/lessons/vector_analysis2/#topo_overlay, [Accessed on 22 May 2004].

Estets, J and Star J 1990, *Geographic Information Systems: An Introduction,* Prentice-Hall, Inc, USA.

European Group 2004, *Critical Perspective on Crime Prevention*, [online], Available at: http://www.europeangroup.org/2003abstracts.pdf, [Accessed 14 May 2004].

Falbo, D. L, Queen, L. P. and. Blinn, C R 2002, *Introduction to Data Analysis Using Geographic Information Systems,* Regents of the University of Minnesota, USA.

Geoprice.Net 2003, ArcGIS ArcView 8.x, [Online], Available at: http://geoprise.net/products/ESRI/arcview8x.html, [Accessed on 27 May 2004].

Goodchild, F.M, Longley, A. P, Maguire, J. D, and Rhind, W. D 2001, Geographic Information Systems and Science, John Willey and Sons, Ltd, England.

Greenhood, D 1964, *Mapping*, The University of Chicago America.

Harries, K 1999, Mapping Crime: Principle and Practice, [Online], Available at: http://www.cslj.net/library/dk_files/Law Enforcement/ L E Technology/L E Information Technology/Crime Mapping & GIS/1999 NIJ Mapping Crime 1299.pdf, [Accessed on 15 May 2004].

Korte, G. B., 2001, *The GIS Book: 5th Edition, How to Implement, Mange, And Assess the Value of Geographic Information Systems.* Onword Press, Canada.

Mather, P.M 1993, *Geographic Information Handling – Research and Applications,* John Wiley & Sons, England.

Mukherjee, S and Wilson, P 1987, *Neighbourhood Watch: Issues and Policy Implications*, Australian Institute of Criminology, Canberra.

Neighbourhood Watch Association (South Australia) 1999-2002, *Neighbourhood Watch History*, [online], Available at: http://www.nhwatch.asn.au/history.htm, [Accessed 14 May 2004].

Queensland Police Service- “Neighbourhood Watch, Inquires Guide: Commercial Union Insurance, Community Caring A.C.N. 004478371”, Queensland Police Service. The Commissioner’s Office, Brisbane.

Razavi, H. A1995, *ArcView Developer’s Guide*, OnWord Press, USA.

Spatial Information Clearinghouse 2004, *Component of a GIS*, Mine Action Information Center, James Madison University, USA, [Online], Available at: http://maic.jmu.edu/sic/gis/components.htm, [Accessed on 22 May 2004].

The Metropolitan Police Service, *Neighbourhood Watch*, [Online], Available at: http://www.met.police.uk/crimeprevention/neighbor.htm, [Accessed 11 May 2004].

USGS Eastern Region Geography 2003, *Geographic Information System*, [Online], Available at: http://erg.usgs.gov/isb/pubs/gis_poster/, [Accessed on 15 May 2004].