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Tactical Crime Mapping in South Africa

Antony K. Cooper[1] and Peter M.U. Schmitz[2]

Résumé.— **La lutte contre le crime en Afrique du Sud : réalisations cartographiques.**— *Cet article présente quelques exemples de réalisations (cartographie numérique) faites en Afrique du Sud, notamment par le SAPS (South African Police Service) qui dispose de bases de données et d'outils analytiques. Il s'agit de réalisations destinées à améliorer la lutte contre le crime et susceptibles d'être utilisées devant un tribunal.*

Mots clés.— Bases de données. Cartographie numérique. Crime. Afrique du Sud. Police.

Abstract.— This paper presents a few examples of tactical crime mapping and analysis done in South Africa (SAPS - South African Police Service). In these cases, the police had already arrested the suspects, and the principle objective of our work was to prepare maps for use in court, to facilitate the understanding by the whole of the court of the proceedings of complex cases. In addition, the mapping process often enhanced the quality of the preparation of the case for presentation in court, detecting errors in case dockets and enabling unsolved case dockets to be linked to a crime series - and even helping to unearth unreported cases.

Keywords.— Crime, Databases. Maps. South Africa. Police.

INTRODUCTION

For several years, the CSIR has been helping the South African Police Service (SAPS) to develop its crime mapping and analysis capabilities, and has been providing specialized crime mapping and analysis for detectives working on selected priority cases. Currently, all SAPS case dockets consist of a physical file of paper documents, with selected data fields being captured onto the Crime Administration System (CAS) from all dockets in all but a few parts of South Africa. During 2001, SAPS began rolling out its national crime mapping system to police stations in South Africa, for which the locations of priority crimes are geocoded. While the

1. Information and Communications Technology, CSIR, PO Box 395, Pretoria, 0001, South Africa. E-mail : acooper@csir.co.za ; telephone : +27 12 841 4121 ; facsimile : +27 12 841 4720

2. Information and Communications Technology, CSIR, PO Box 395, Pretoria, 0001, South Africa. E-mail : pschmitz@csir.co.za ; telephone : +27 12 841 3841 ; facsimile : +27 12 841 4720

system aimed primarily at improving crime prevention and police management, it does have some tactical analysis capabilities – that is, it can assist with solving specific cases. In addition, SAPS has several large databases and analytical tools for tactical analysis.

This paper presents a few examples of tactical crime mapping and analysis done by the CSIR and SAPS. In these cases, the police had already arrested the suspects, and the principle objective of our work was to prepare maps for use in court, to facilitate the understanding by the whole of the court of the proceedings of complex cases. In addition, the mapping process often enhanced the quality of the preparation of the case for presentation in court, detecting errors in case dockets and enabling unsolved case dockets to be linked to a crime series - and even helping to unearth unreported cases. These examples are grouped into two main groups namely : mapping cellular telephone conversations and mapping serial killer cases.

MAPPING CELLULAR TELEPHONE CONVERSATIONS

In two high profile criminal cases, namely the hijacking incident of a South African female and her American friend (Cooper *et al*., 2000a ; Cooper *et al*., 2000b ; Cooper and Schmitz, 2001) and the Victoria and Alfred Waterfront shooting incident, both in Cape Town, South Africa the usage of cellular telephones before, during and after the commissioning of crimes was mapped.

For these, the police used a search warrant to obtain from the telephone service providers the billing records for the relevant telephones, the locations of the cellular telephone transmission towers and maps of their areas of coverage (cells). Since the exact location where the call was made from or received within each cell could not be established, the centre of gravity (centroid) for the cell was used as the location (Figure 1).

The placement of the call at the centroid of a cell was of sufficient accuracy to be well within the requirements of the cases. The location of each call made or received was then plotted, together with the time the call was made and a sequence number : in the case of calls between two cellular telephones, we linked the two locations with a directed line to show from which telephone the call was made (Figure 1) (Cooper and Schmitz, 2000). The information to do this was obtained from the billing records of the service providers showing the caller/receiver's number, date and time of call, type of call (call made or received), the other party's number, duration of call, cell identification number and the name of the cell. Where a series of calls were made, each call or linked call was annotated to show the sequence in which the calls were made (Cooper *et al*., 2000b ; Cooper and Schmitz, 2000).

Figure 2 shows the hijacking incident, which happened on 5 January 1998 in Cape Town. The map shows the following information, namely cellular telephone conversations between gang members and locations of interest such as where the

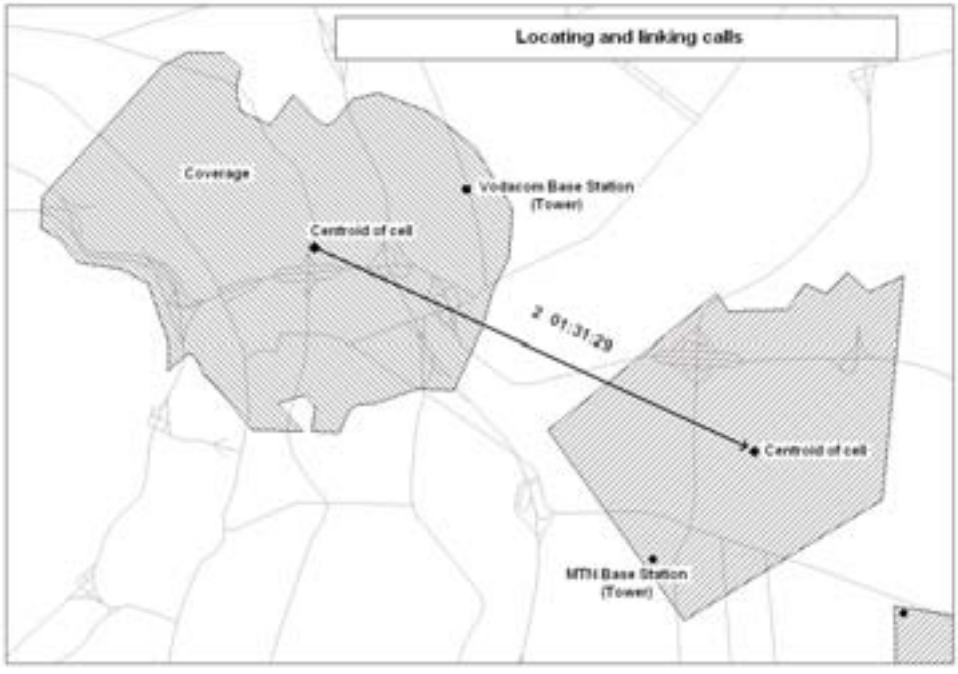

Figure 1.— Locating and Linking calls.

body of the American friend was found, where the female victim was raped and murdered and where the burnt out hijacked vehicle was found.

The gang followed the victims' vehicle in their own vehicle and when they hijacked the victim's vehicle, the gang members took both victims as hostages. In order to keep contact with the gang's vehicle, the gang members in the victims' vehicle used the female victim's cellular telephone. These calls were mapped in sequence, thus enabling the prosecution to break an alibi of one the perpetrators (Cooper *et al*., 2000a). Two of the perpetrators, which could be linked to the rape by DNA, were killed by the police in a shoot out. What made the mapping of the conversations possible was the ability of the principal witness in the case to link the gang members to the female victim's cellular telephone. The gang tried to sell the device to the principal witness. According to the detective and the prosecutor, it would not have been possible without the map, to achieve a positive conviction and the gang members were sentenced to 30 years in prison without the option of parole.

THE VICTORIA AND ALFRED WATERFRONT SHOOTING INCIDENT

The next map (Figure 3) shows the shooting incident at the entrance to the Victoria and Alfred (V&A) Waterfront in Cape Town, South Africa. The incident

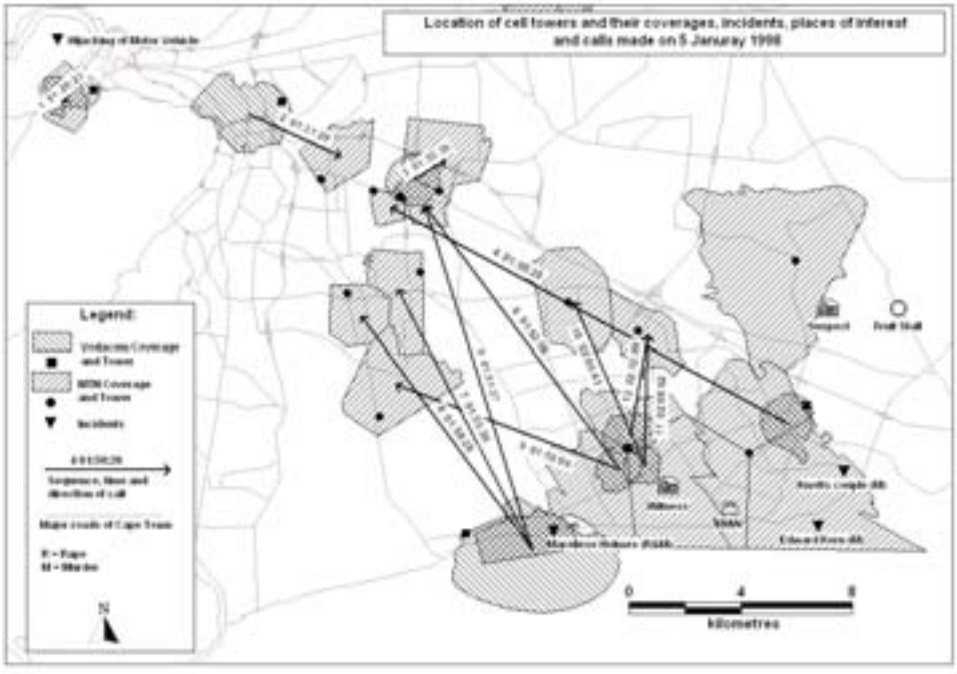

Figure 2.— Hijacking incident and the calls made.

took place on 21 March 1998. The map shows the cells that were used by the perpetrator before and immediately after the shooting incident (sequence number 1 on the map) and his subsequent flight away from the scene (sequence numbers 2 to 6). The difference in colour was used to differentiate overlapping cells. For both cases, the 95 percent probability boundary of the cell, meaning that a caller has a 95 percent reception rate within the area of coverage (Cooper and Schmitz, 2000).

The map shows where the shooting incident took place at 18:00 on the 21st. The location of the incident was within the first two cells (sequence number 1), which placed the perpetrator near the incident. The perpetrator received and made calls prior to the incident; and after the incident the perpetrator made calls (sequence number 2 to 6) to indicate his flight progress from the scene. His hiding place was within the reception area indicated by sequence number 6.

The maps assisted the prosecution to limit the geographic space of the perpetrator to the areas covered by the cells at specific times, thus minimizing the possibilities of alibis. The maps together with other evidence such as ballistics led to a positive conviction and the perpetrator was sentenced to 32 years in prison.

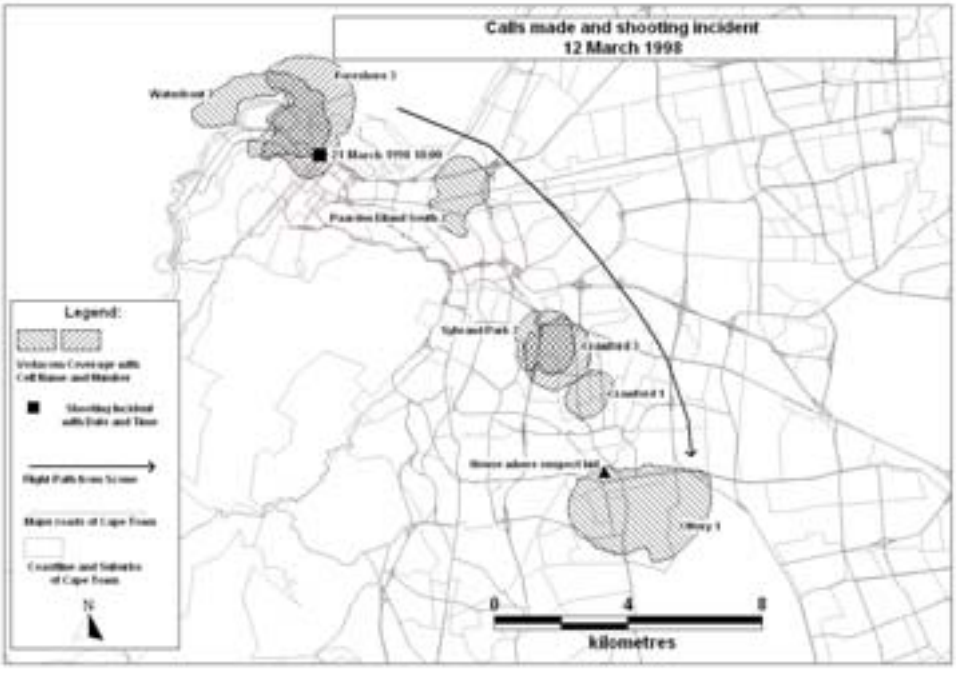

Figure 3.— V & A Waterfront shooting incident.

USING MAPS TO ASSIST IN SERIAL CRIME INVESTIAGTIONS

The CSIR assisted the SAPS in producing maps to help in the preparation of cases involving serial criminals. Unfortunately, serial criminals in South Africa tend to have wide-ranging activity spaces, they tend to be marauders rather than stalkers, and they tend to have multiple modi operandi, making it much more difficult to link a series of crimes together. We have mapped the data on both digital street networks and digital orthophotographs (Figure 4 and 5), with the latter being particularly useful in areas without formal street networks, such as open spaces and informal settlements (Cooper *et al*., 2000c). The Wemmerpan and the NASREC serial killer cases are used as examples for discussion.

Wemmerpan is a recreational area south of downtown Johannesburg, South Africa. Apart from mapping the locations of the crime scenes of the 86 cases associated with the Wemmerpan serial killer, representing the crimes committed, ranging from murder and rape to assault with intent to cause grievous bodily harm between 17 September 1995 and 19 December 1997, the following variables from the dockets were also captured:

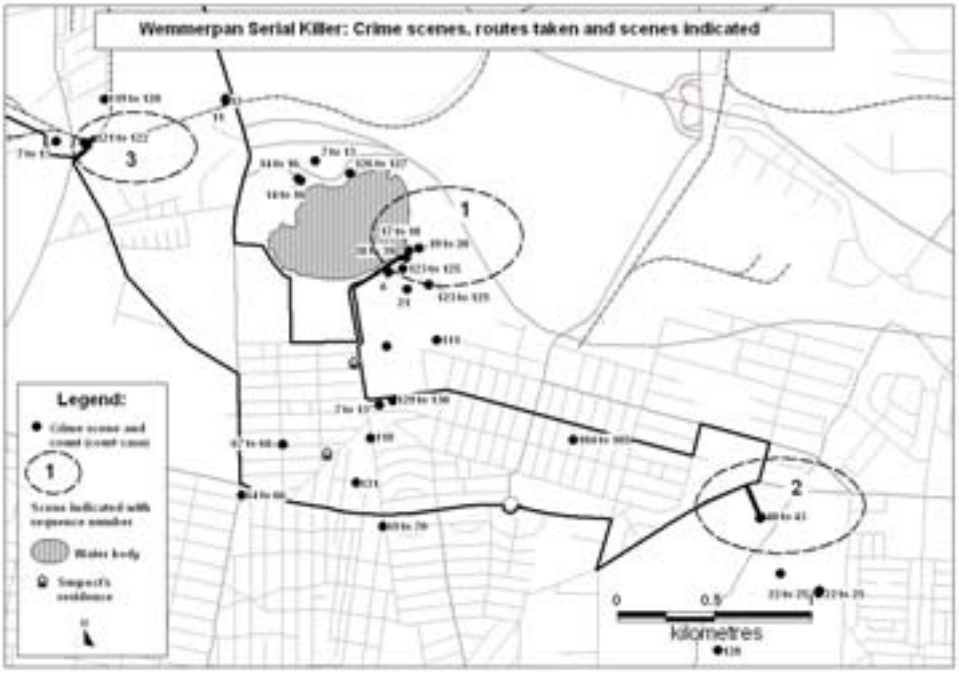

Figure 4.— Mapping scenes on digital street networks

- Map Number - this was the original number assigned to the scenes by the investigating officer on a normal paper map before the scenes were plotted onto a GIS,
- File Number - for each map number one or more file numbers were allocated. Each file contained the docket for a specific case. In some instances, such as when a couple was murdered at the same scene, two file numbers were allocated to one map number,
- Case Number - the unique case number allocated by the police station in whose jurisdiction the crime occurred, to register the reported criminal act(s) on the CAS,
- Date - the actual date or, where not known, the estimated date when the incident occurred,
- Time - the actual time or, where not known, the estimated time when the incident occurred,
- Sex - the sex of the victim (male or female),
- Crime Type - the crime committed, e.g.: murder, rape and murder, or assault,
- Address - the location where the incident occurred,

Figure 5.— Mapping scenes and waypoints on digital orthophotographs

- Instrument - the type of instrument used when the criminal act was committed, such as a hammer or a pistol,
- *Modus operandi* - the method used to commit the crime, e.g.: hammer blows to the back of the head of the victim, when the victim was alone in his shop,
- Raped - if the victim was a female, was she raped or not during the incident, and
- Evidence - pieces of evidence found at the crime scene (the database allowed for up to five pieces to be recorded for each case).

These variables can be used to determine what should be shown on the map, and how, by using combinations of colours, symbols, font sizes and annotation. The aim is to provide the judge, prosecution and defence with clear, easy-to-use maps that give them a good overview of the crimes that were committed, so that they can clearly follow the proceedings of the trial. Additional maps allow the court to focus on a subset of all the cases, such as those committed in a specific area, or with a specific weapon, or on a specific day of the week. A symbol on the map can be used to represent the instrument used to commit the crime (such as a pistol or a hammer) and the colour of the symbol can be used to indicate the day of the week, etc (Figure 6).

Although very informative, it leads to massive information overload and the map had to be simplified as shown in Figure 4. Figure 4 also shows the scenes indicated by the suspect to independent officers, routes taken by the suspect with the independent officers. The small numbers indicate the count (charge number of the case, a single crime scene can have several charges, such as murder and rape) and the blue ellipses and the number indicates the scene to independent officers (Cooper *et al*., 2000c).

In collaboration with the Vancouver Police Department, we also used the data to draw up a post hoc geographic profile of the case. In spite of the complexity of the case (one of the worst serial killers on record, three different modi operandi and short intervals between attacks), the analysis showed that most of the attacks were located around the suspect's two places of residence, with the others being where he worked, where his girlfriend lived and where his brother lived (Figure 7 and 8) (Cooper *et al*., 2000c).

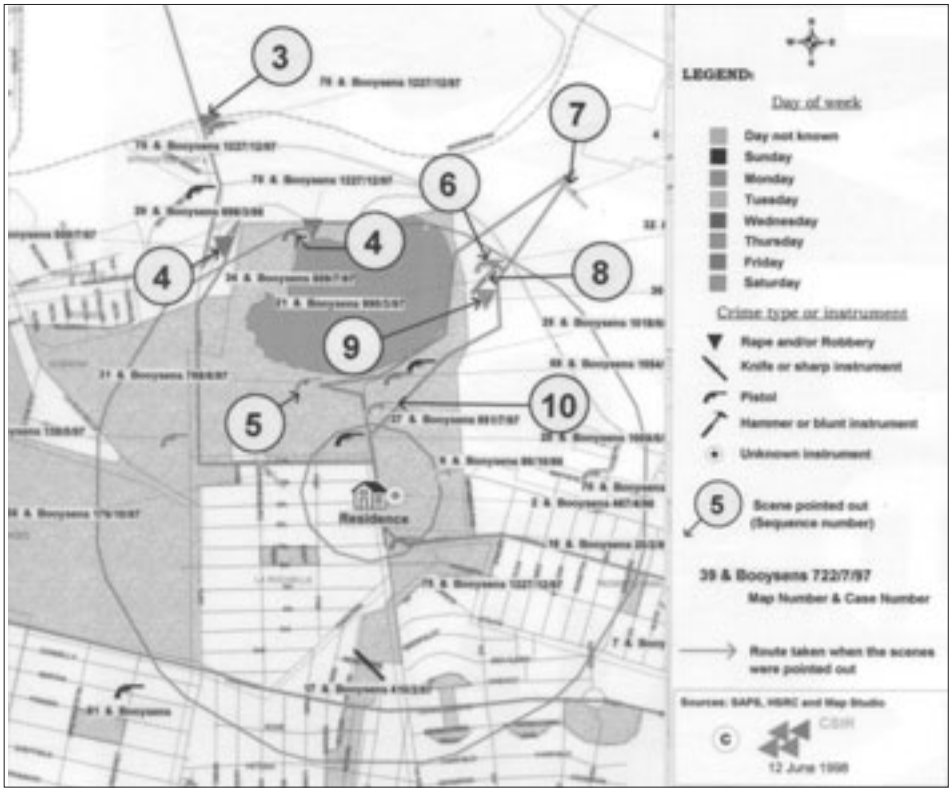

Figure 6.— Information overload

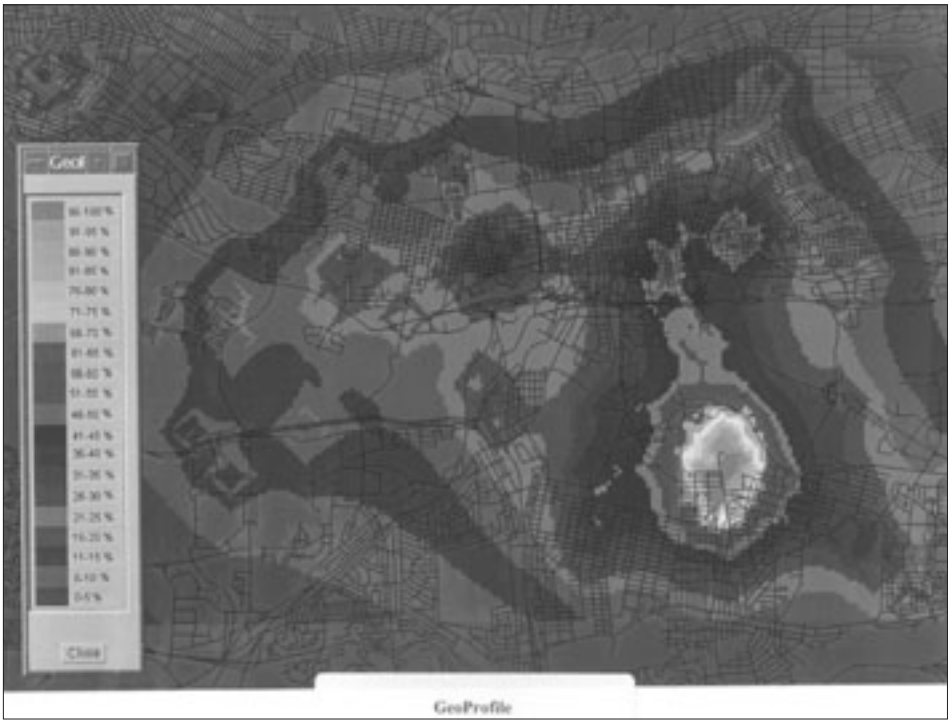

Figure 7.— The geographical profile of the serial killer

For the NASREC serial killer, the crime scenes, encounter sites, body dump-sites, waypoints, routes and scenes indicated to independent officers were mapped. NASREC is just east of Soweto, Johannesburg, South Africa. These maps have enabled the police to find errors in dockets and to link additional cases to the series as shown in Figure 9 (Cooper *et al*., 2001).

CONCLUSION

The mapping techniques we have used for all these cases are standard for computerised mapping. What is crucial is ensuring the quality of the digitising done for the maps and taking great care over the preparation of the maps, to ensure they are not cluttered, are easy for the court to understand and present all the data truthfully. We believe that these maps have made a significant contribution in helping the courts to understand the proceedings of complex cases and have helped to improve the quality of the cases being presented. We also believe that, in some cases, they have made a significant contribution to securing the conviction of dangerous criminals.

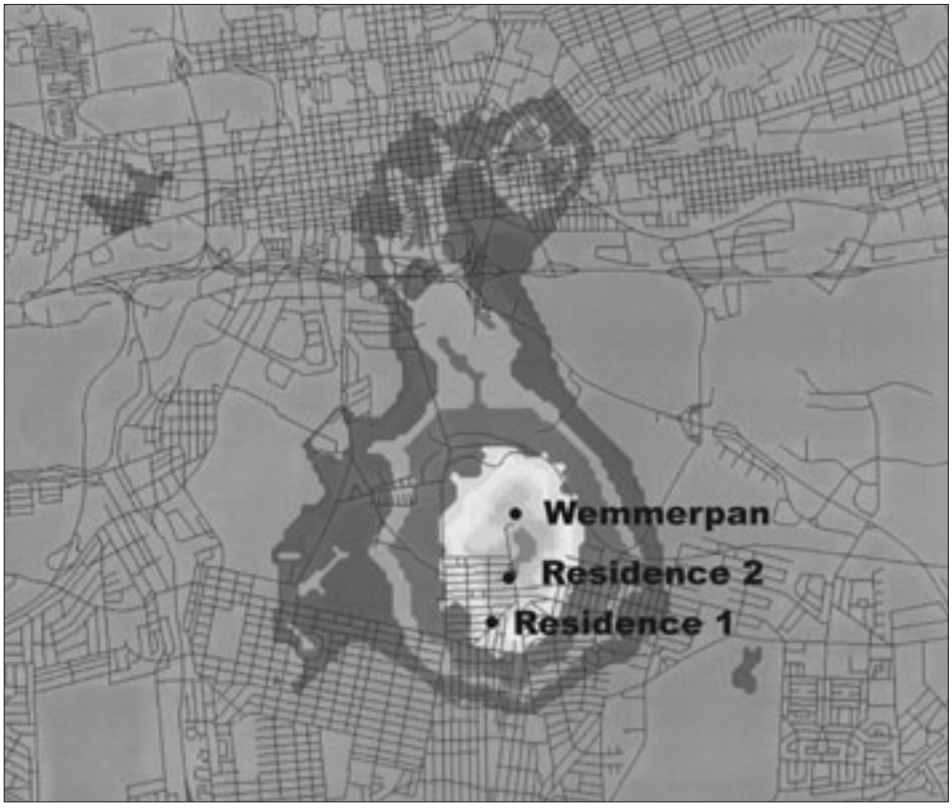

Figure 8.— The top 10% of the geographic profile showing the residences.

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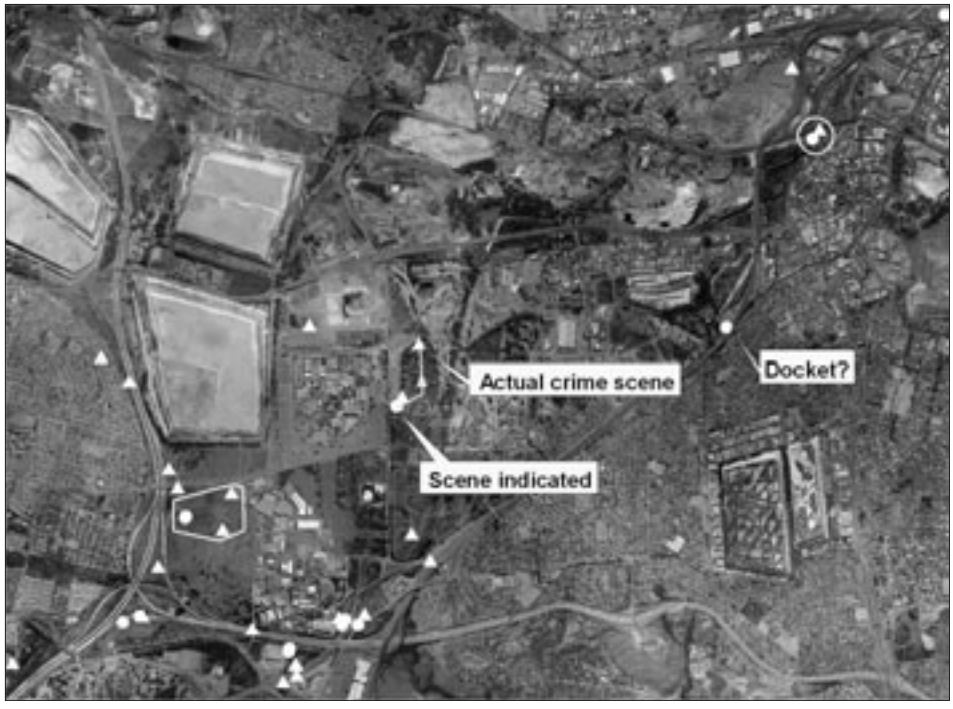

Figure 9.— Mapping anomalies.

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