University of Southern Queensland

Faculty of Engineering and Surveying

The Effects of Control Point Shape and Distribution in the Creation of a Numeric Cadastral Data Base

A dissertation submitted by

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ABSTRACT

For centuries information describing a parcel of land has been presented in the form of a hard copy parchment or document. The information displayed on the face of such a document has traditionally shown a direction and a distance along each line of each parcel. Since the advancement of angle and distance reading instruments the accuracy of such plans has improved substantially. In saying this surveyors dealing with older plans must determine, based on a hierarchy of evidence, how to deal with the inconsistences between what is shown on the cadastral survey plan and what is actually marked on the ground.

Recent advancements in processing power and surveying instrument capabilities have led to the creation of what is known as a Numeric Cadastral Data Base (NCDB). Most states in Australia currently utilize what is known as a Digital Cadastral Data Base (DCDB), which has limitations due to the way it was originally created. A NCDB however is created by entering the cadastral/boundary information from the original survey plan into a software package and then adjusting the network in conjunction with the physical survey marks on the ground. The result is a survey accurate data base which has the potential to be used as a means of better defining parcel boundaries.

This dissertation will investigate the processes involved in the creation of a NCDB and the effects of control point selection within the cadastral adjustment. The results will show that the closest representation to the boundaries actual position is achieved from the adjustment by using all of the original survey marks. It was found that as control is added to the adjustment the mean difference between the actual boundary corners and the adjusted corners became less over a test area of 49 parcels consisting of 147 corners. The research is supported by the Northern Territory Department of Lands, Planning and the Environment (DLPE) and will contribute to the developing NCDB of the town of Alice Springs.

University of Southern Queensland

Faculty of Health, Engineering and Sciences

ENG4111 & ENG4112 Research Project

Limitations of Use

Certification

I certify that the ideas, designs and experimental work, results, analyses and conclusions set out in this dissertation are entirely my own effort, except where otherwise indicated and acknowledged.

I further certify that the work is original and has not been previously submitted for assessment in any other course or institution, except where specifically stated.

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INTRODUCTION

1.1 The Problem

With the advancement in aerial photography came the potential to measure large areas of the earth's surface to a relatively high degree of accuracy. In conjunction with aerial photography cartographers and surveyors were able to digitize old survey plans into a data base which was later to be known as a Digital Cadastral Data Base (DCDB). The DCDB was however only as accurate as the digitizing software and the base map at the time and could not be used as a sole source of boundary definition.

Due to the inaccuracies of the DCDB a new data base is being developed called the Numeric Cadastral Data Base (NCDB). A NCDB is created by inputting the information from the original cadastral plan into a software package and then adjusting the area in conjunction with the original survey marks on the ground, ultimately to find the solution of best fit between the documentary and physical evidence. The user is left with a mathematically consistent data base which shows the individual parcels of an area relative to one another to a survey accurate standard.

Each point within the data base has its own coordinate value and the bearings and distances of each line can also be reviewed. Because this data is already in a digital format to a high degree of accuracy it has the potential to be loaded straight onto a total station or a global navigation satellite system (GNSS) for the purpose of marking a parcel boundary.

Queensland is working on a NCDB through a company called SDX (Spatial Data eXchange) and NSW has over 4 million parcels in a well-managed registry. NCDB's are currently being used throughout the world in countries such as the USA, South Africa and the Philippines (Elfick, Mclennan & Somers, unpub).

The Northern Territory is almost at a point where every parcel has been coordinated into a local NCDB. This has mainly been done by the Northern Territory Government, Department of Lands Planning and the Environment (DLPE), in conjunction with surveyors from private companies. Because areas still need to be incorporated into the NCDB the potential for undergraduates to contribute to the work done by the DLPE presents itself. The student has been assigned an urban area in the western suburbs of the town of Alice Springs consisting of 280 parcels for research purposes.

1.2 Project Aims, (To investigate the effects of control point shape and distribution in the creation of a NCDB)

Although NCDB's are currently being developed in most states of Australia considerable research is still required before any legal status can be assigned to such a data base. One area in particular is the effect that control point shape and distribution has within the cadastral adjustment process. This dissertation will investigate this area of research and aim to determine the effect of control point shape and distribution in the creation of a NCDB. In order to investigate the project question the following objectives have been created:

- Gather the required information, relevant survey plans and/or digital data, to form the cadastral fabric to be used within the NCDB.
- Conduct the necessary field work by establishing a network of Coordinated Reference Marks (CRMs) and traverse to original survey marks (ORMs) within the area.
- Reduce all field data within the necessary software packages before making the cadastral adjustment within the adjustment program GeoCadastre.
- Using the cadastral fabric, generated from the original survey plans, combined with the data gathered from field measurements analyse the effects of control point shape and distribution.

The creation of NCDBs vary from state to state and it should be noted that this project will be conducted in accordance with the methods put forward by the Northern Territory Department of Lands, Planning and the Environment. Field work will be conducted in accordance with SP1 standards (Standard for the Australian Survey Control Network Special Publication 1, Version 2.1, October 2014). In particular the Guidelines for Control Surveys by GNSS V2.1, Guidelines for Conventional Traverse Surveys V2.1 and Guidelines for Installation and Documentation of Survey Control Marks V2.1 (*Publications: Surveying Standards and Practices (SP1)* 2016).

All data entry and field processing will be done under supervision of the Department of Lands, Planning and the Environment to ensure quality as there is potential for this work to contribute to the existing NCDB of Alice Springs. The area consists of 280 parcels and is made up of 33 survey plans ranging from 1970 to 2014.

1.3 Expected Outcomes and Benefits

The project will provide the reader with specific information in regards to creating an NCDB and make recommendations on the desired number and configuration of control points to be used during the cadastral adjustment within the software package GeoCadastre.

The expected outcomes of the project include:

- Identification of the process in developing a Numeric Cadastral Data Base using modern surveying instruments and software packages.
- Identify the effects of control point shape and distribution in the cadastral adjustment process by comparing a range of adjustments using different control configurations to a manually reinstated area.
- Determine the expected accuracies of the Numeric Cadastral Data Base relative to the actual position of the boundary corners on the earth’s surface at present.

CHAPTER 2

LITERATURE REVIEW

2.1 Gathering of Information

Further literature has been reviewed to develop the ideas towards the research project. The purpose of the review was to gather relevant information in regards to:

- The use of a NCDB in defining boundaries
- Current Projects/Legislation
- General characteristics of a NCDB
- Geodata, GeoCadastre and GeoSurvey
- The Adjustment Process and Control Points
- Previous NCDB Test Procedures

2.1.1 The use of a NCDB in defining boundaries

A NCDB provides a survey accurate coordinate system which can provide a means of transition from the current dimensional cadastral system to one based on fixed coordinates (Elfick, unpub, ACGMS). Modern computer based Geographic Information Systems (GIS) and survey packages such as Computer Aided Drafting (CAD) programs are position or coordinate orientated. Each point has an easting, northing and height, in some cases, as well as different attributes such as description code assigned to each point.

The survey instruments of today also utilise positional data in the form of co-ordinated values and are able to locate a point on the earth's surface to a much higher degree of accuracy then previous methods. Because computer based geographical information systems are position orientated it can be argued that there is a need for the cadastral system to be in a form compatible with all other geographical based data sets (Elfick 1997).

In saying this careful considerations must be made if such a system is to be put in place. The co-ordinate system currently used throughout Australia is the Geocentric Datum of Australia which is based on the position, or epoch, of Australia in 1994. This forms the datum for grid coordinates Map Grid of Australia 1994 (MGA94). Since this datum was established the continent of Australia has moved under the MGA94 grid in a north easterly direction approximately seven centimetres a year (ICSM 2015). This means that in the near future Australia will most likely adopt a more recent epoch and in doing so will have to consider the effect on cadastral coordinate systems.

2.1.2 Current Projects/Legislation

Torrens Title is the system of land registration currently used in Australia and is historically based on surveying land parcels and recording the ownership titles in the land registry. The Torrens system, introduced in Australia between 1857 and 1875, is a system of title registration where the state guarantees that the person shown on the title register is the registered proprietor (Dalrymple, Williamson & Wallace, unpub).

This system proved to be much simpler than the previous method of deeds conveyancing which was subject to problems caused by the nature of the chain of title. Under Torrens Title surveys of individual parcel boundaries are carried out in relation to neighbouring parcels to a high mathematical standard with support from the information shown on the original survey plans. This system has been in place for 140 years and has proved to be effective. However, some issues do arise when conducting surveys over large areas where there is poor connectivity between survey plans.

South Australia has started generating an accurate NCDB and Tasmania awarded a tender to generate and integrate a NCDB into their existing system (Sandy & Harper 2012). Queensland is also working on a NCDB through a company called SDX (Spatial Data eXchange). Rather than waiting for new subdivision data SDX will receive spatial information directly where it will then be managed in a digital environment (Elfick, Mclennan & Somers, unpub). NSW has over 4 million parcels in a well-managed registry and are currently looking at introducing electronic plan examination during the registration process (Elfick, Mclennan & Somers, unpub).

Under section 46A of the *Northern Territory of Australia Licensed Surveyors Act 2013* the Surveyor General may declare an area of land in the Territory to be a coordinated survey area. The act also states that surveys within a coordinated survey area must be done in accordance with an approved methodology to delimit land boundaries by geodetic coordinates. The Northern Territory is almost at a point where every parcel has been coordinated into a local NCDB and in July 2014 three areas were gazetted and became the first declared areas in Australia, (Sandy 2014). These areas are Gunbalanya, Milingimbi and Gapuwiak and are remote communities in the Arnhem Land area east of Darwin.

2.1.3 General Characteristics of a NCDB

A NCDB should ideally be constructed directly from original survey plans by entering the data from the face of the plan into the software package. In general the plans kept within the land titles record system contain all the necessary information for surveyors to build an NCDB. If the data is adequate for surveyors to re-establish boundaries, then it is adequate to build a numerical data set (Elfick 2001). In saying this necessary field verification must be undertaken to ensure a healthy balance between the adoption of dimensions shown on documents and the existing survey marks on the ground.

For practical reasons a group of between 100 to 300 parcels are worked on at a time (Maddocks & West, unpub). All the data for each area should be entered and adjusted to a local area and a number of survey marks coordinated and used as absolute control. The adjustment is then re-run to compute geodetic coordinates for each parcel corner and then the accuracy of the plan data assessed. Once the framework has been adequately adjusted the remaining surveys can be added to complete the data base. Any isolated parcels can be measured with Global Positioning Systems (GPS) or gathered from previous survey data and brought straight into the system (Maddocks & West, unpub). The final NCDB is a combination of a number of survey plans and subdivision data where all necessary information is included in the system.

2.1.4 Geodata, GeoCadastre and GeoSurvey

Geodata Information Systems Pty. Ltd. (Geodata) is a company formed in 2007 to provide specialised skills in survey and GIS cadastral database management. It is responsible for the creation of the adjustment software “GeoCadastre” and the survey software “GeoSurvey” which will be used throughout this project. This software has been developed over the last twenty years by the recognised leaders from Geodata Michael Elfick and Michael Fletcher. The Environmental Systems Research Institute (ESRI) has recently bought the rights to use the GeoCadastre software in its GIS software packages confirming that the Geodata software is one of the most effective models in cadastral parcel management systems (Smith 2012).

GeoCadastre is a Microsoft Windows based program specifically designed to adjust the survey parcel networks by least squares methods. Geodata describes GeoCadastre as a record to fabric program designed to build a parcel network from survey plans and survey data, ultimately the creation of a NCDB. GeoSurvey, described as a Survey Data and Coordinate Geometry Tool by GeoData, utilises the adjusted parcel network from GeoCadastre for practical surveying purposes. It allows the user to view parcel information in geodetic coordinate systems, MGA94, and configure unit settings from grid bearings to true bearings and grid distances to ground distances. GeoSurvey conversions include ACS, Autocad, Trimble and LandXML as well as a range of other file types (Software Solutions: Converting raw data to knowledge 2016).

2.1.5 The Adjustment Process and Control Points

The adjustment process is a weighted least squares adjustment, where weight is allocated depending on the time of survey. This information is allocated to the parcel during the initial data input when the date of the survey is assigned. Parcels with a higher accuracy level from recent plans (higher weight) adjust less than those with a lower accuracy level from older plans (lower weight) (The Least Squares Adjustment Process: About the least squares adjustment 2009). Having said this some cadastral surveyors may argue that those marks closest in time to the original survey have the highest status and weight.

The first step of the adjustment process determines the transformation parameters (rotation, scale and translation) between the original coordinates of the control points and the corresponding coordinates of their underlying parcel points. The control points used in the creation of the NCDB are the Original Reference Marks, (ORMs), related to the original cadastral plan and should be permanent physical features which can be adopted by future surveyors. It should be noted that the control point coordinate values are held fixed in the least-squares adjustment and a minimum of two control points are required to run the least-squares adjustment (The Least Squares Adjustment Process: About the least squares adjustment 2009).

If the transformation residuals are within the specified limits, (based on the relationship between the documentary and physical evidence), the parameters are applied to all the parcel corners to transform them into the coordinates of the control system. The original bearing and distance of each line from the initial survey plan input is compared with the bearings and distances in the transformed coordinate system and any line that exceeds the set bearing and distance tolerance, (set by the user), is reported. Once the coordinates have been transformed into the control system the adjustment engine varies the coordinates and determines a best fit solution for all the points in the network (The Least Squares Adjustment Process: About the least squares adjustment 2009).

2.1.6 Previous NCDB Test Procedures

After the cadastral data has been entered into the software package and the necessary adjustment made, by least squares, a comparison can be conducted between the control co-ordinates and the original cadastral values. An example can be shown within the town of Bachelor NT in a study conducted by Maddocks. 16 cadastral plans were compiled consisting of 190 parcels and 35 co-ordinated points. Once the parcels had been joined four of the co-ordinated points were used as control and the area adjusted. The remaining points were then used as a check to test the agreement between the adjusted cadastre and the physical marks on the ground.

It was found that four control points with fixed values held the original parcel dimensions well with the standard residuals on the test points being 19mm and the largest error 38mm (Maddocks & West, unpub). It was proven that the quality of the data largely depends on the age of the surveys and for this reason considerations need to be made when comparing plan measurements to the geodetic control. When assessing accuracy, it is also necessary to assess the quality of the instruments used at the time of survey.

- Steel chain and theodolite – by regulation needed to be good to 1:5,000 in country with slopes not exceeding 4 degrees, however it could be as good as 1:10,000.
- Invar Chain and theodolite – The expectation of work done with these instruments was accuracies of better than 1:25,000.
- EDM and theodolite – Expected to yield accuracies better than 1:30,000

(Maddocks & West, unpub)

2.2 Review of Information

A NCDB should be constructed directly from original survey plans by entering the data from the face of the plan into the appropriate software package. It has been found that if the survey plans are of a high enough standard to define property boundaries then they are suitable to be used for the creation of a NCDB. Modern surveying software packages are position orientated as are the instruments of today which are capable of defining a point on the earth's surface to a much higher degree of accuracy than ever before.

The control points used in the creation of the NCDB are the Original Survey Marks related to the original cadastral plan and should be permanent physical features which can be adopted by future surveyors. Previous studies have found that if a NCDB is created and adjusted correctly it can produce results of a high degree of accuracy, (Maddocks & West, unpub). It is important to keep in mind the age of the original survey and the instruments and methods that were used during that period of time.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The aim of this chapter is to precisely describe the method and materials required to create a NCDB. It will also discuss the procedures used to test the effects of control point shape and distribution within the cadastral adjustment. Firstly the procedures required to gather the necessary data for a NCDB will be investigated and then an overview of the cadastral adjustment program GeoCadastre will be discussed. The area of interest allocated to the student by the DLPE within the Town of Alice Springs is shown in the aerial image outlined in yellow below.

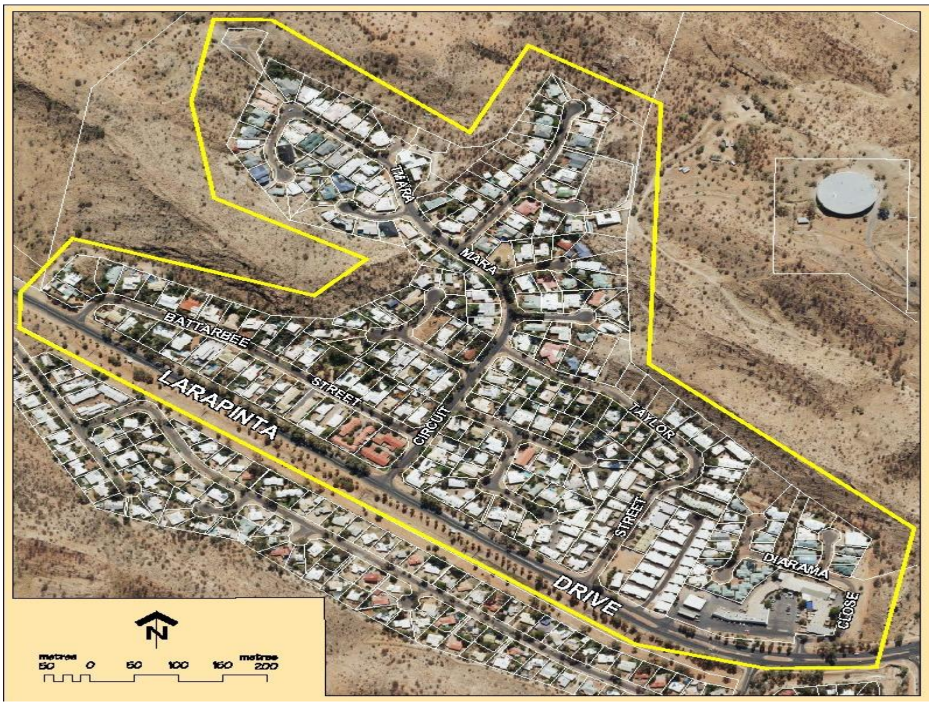

Figure 1: Research Area

3.2 NCDB Creation

3.2.1 Original Survey Plan and Digital Data Acquisition (The Cadastral Fabric)

The subject area consists of 280 parcels and is made up of 33 survey plans ranging from 1970 to 2014. The information shown within these plans, (boundary dimensions and directions/bearings), formed the basis of the cadastral fabric. The cadastral fabric is a continuous surface of connected parcels and represents the original plan information. It is created within GeoCadastre by entering in the bearing and distance for each line of every parcel from the cadastral plan data. This surface is adjusted with the physical survey marks on the ground to form the NCDB. As the subject area was of interest to the DLPE the initial data entry had already been completed.

This file, (the cadastral fabric), was in ACS format, (compatible with GeoCadastre), and represented the original plan information. The file approximately fell on MGA94 Zone 53 as it had been temporarily combined with the surrounding adjusted parcels in the local cadastre. All parcel dimensions and bearings within the cadastral fabric represented original bearings and original ground distances shown on the cadastral survey plans. In total the ACS file consisted of 898 corners 2,119 bearings and 1,941 distances.

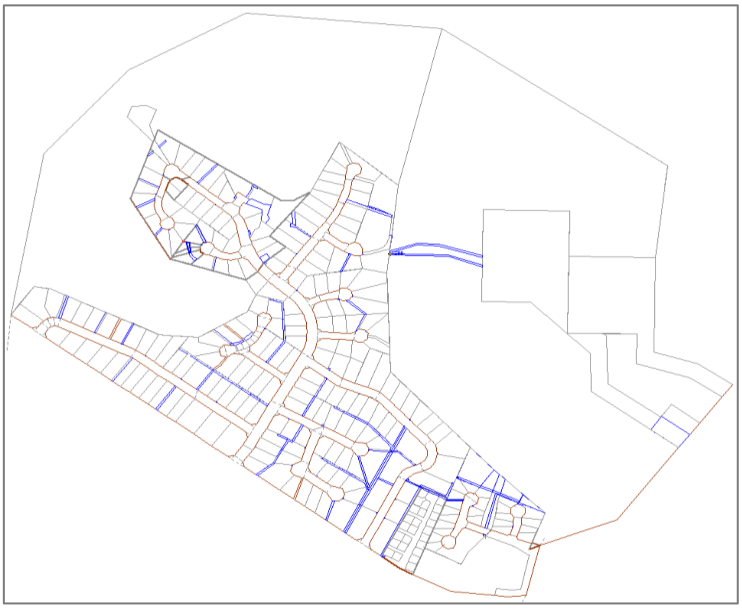

Figure 2 : ACS File provided to the Student by the DLPE

3.2.2 Field Reconnaissance and Field Work Planning

By using the ACS file provided by the DLPE the total number of original survey marks within the subject area could be estimated. This was done by looking at each survey plan in chronological order and plotting the ORMs position within the cadastral fabric. As the file was approximately coordinated on MGA94 it could be loaded onto a Global Navigation Satellite System (GNSS) controller, and in conjunction with a GNSS receiver used to search for the ORMs to be used in the creation of the NCDB.

As the majority of ORMs within the area were drill holes located in the kerb of the road they were easily identified and when located painted with a white circle to aid in future recovery. A note was also made if the ORM was located, disturbed or gone. During this process a proposed position to place the Coordinated Reference Marks (CRMs) was measured. These marks would later be used as traverse stations to accurately measure the ORMs and will be discussed in more detail in the following section.

Within the subject area 28 Brass Plugs were located, 10 nails, 76 drill holes and 9 spikes. 31 ORMs were gone as they had been lost in driveways, footpaths or pram ramps and 89 ORMs were not located as the back of the parcels were inaccessible and beyond the extent of the research project. This would not affect the future analysis on the control selection as the area later selected for testing was fully encompassed by ORMs. It was estimated that 45 CRMs would be required to traverse the ORMs due to the irregular street network and undulating terrain of the subject area.

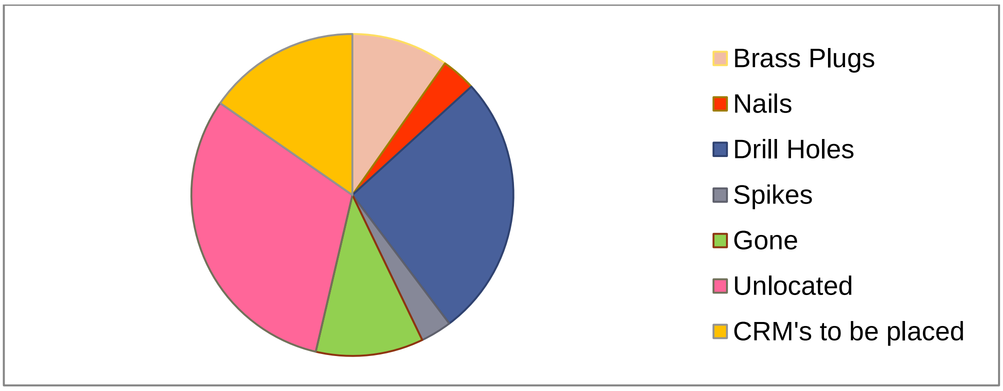

Figure 3 : Summary of Survey Marks within the Subject Area

3.2.3 Coordinated Reference Mark (CRM) Placement

In order to gather the required data for the creation of the NCDB a network of CRMs needed to be established from which the ORMs could be measured. The placement of the CRMs throughout the subject area was done in accordance with the ICSM Guideline for the Installation and Documentation of survey Control Marks Special Publication 1 Version 2.1 and the Northern Territory of Australia Survey Practice Directions – Surveys within Coordinated Survey Areas 2003 (NT). The ICSM Guidelines state the survey control mark should be made of good quality, durable, corrosion resistant materials and be placed where it is least likely to be disturbed, damaged or removed.

Under the Northern Territory Practice Directions the surveyor must ensure that the CRM is constructed of a material that will resist destruction by fire, decay and termites. The CRM itself should be permanently marked with a unique station identifier to ensure unambiguous identification and a station identifier associated with the survey mark. The mark should be located in a position that maximises the use of different measurement techniques and connection to future marks. This was necessary to ensure that the CRMs could be measured directly using conventional traversing methods as well as GNSS techniques.

In total 46 new CRMs were placed, 31 by the student and 15 by the DLPE. The majority of the marks were placed roughly 0.3m from the back of the road kerb at street intersections and at the end of cul-de-sac's. These marks, Polyroc FENO Mark, were placed at intervisible locations from which the ORMs could be measured. The FENO mark, developed in the 1970's by the French company Faynot consists of three components; a 610mm anchor or spike, a polyroc head and an aluminium insert.

The FENO mark is placed by first driving the anchor into the ground with the Polyroc Head between the natural surface and the lip of the anchor. A driving tool is then placed in the anchor tube and driven down to cause the extension of the three prongs which firmly lock the mark to the ground. The aluminium insert which has the CRM number and centering hole punch is then inserted into the anchor, (MAPC 2009).

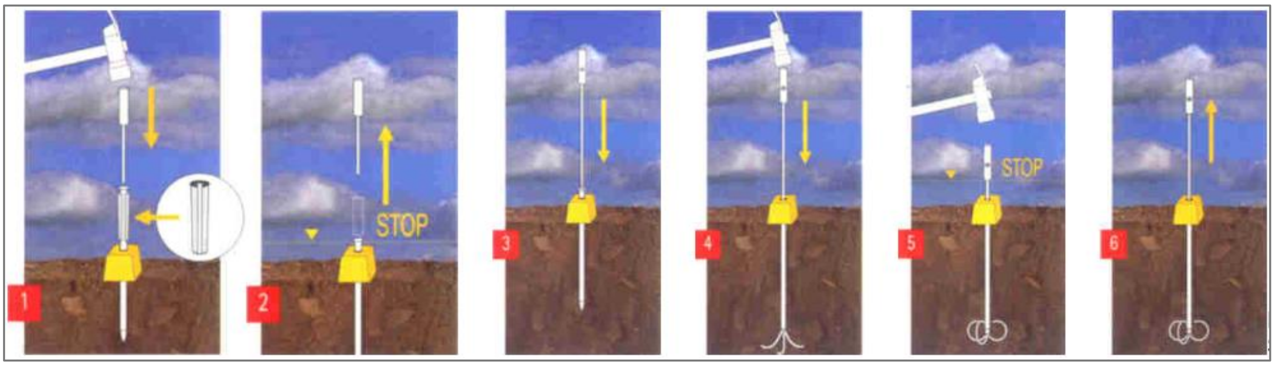

Figure 4 : Feno Mark Installation Diagram

The aluminium insert was stamped with the unique CRM identifier which consisted of the survey plan number S16064, allocated by the Surveyor General, followed by the point number, e.g. S16064002. Part 5 of the Northern Territory of Australia Survey Practice Directions states that the surveyor must ensure that the CRM is accompanied with a warning tag affixed to a witness mark or other substantial structure. In the case of the research area a witness plate with recovery information, (magnetic bearing and distance from the plate to the CRM), and CRM number was placed adjacent to the CRM in the kerb of the road or footpath.

3.2.4 Conventional Field Traverse

The field traverse was conducted in accordance with the Guideline for Conventional Traverse Surveys Special Publication 1. The student traversed CRMs 1 - 31 and the DLPE traversed the remaining 32 - 46. A Leica TCR1105 Total Station, (5 second angle measuring accuracy), was used to conduct the field traverse to accurately measure the position of the ORMs in relation to the CRMs. Before the commencement of field work the instrument was calibrated at the Morrie Hocking Baseline, Alice Springs.

Tribrach's with Optical Plummet and precision carriers, (GDF322 Tribrach with Optical Plummet and Leica GZR3 Precision Carrier), and Leica GPR1 Circular Prism's were used with Wooden Tripods, (Leica GST20 Wooden Tripod), when measuring between traverse stations. Observations to ORMs less then 30m away were taken using a low set Leica mini prism positioned low on the pole to ensure verticality. If the ORM was further then 30m away from the CRM it would be measured to using a tripod. This helped eliminate incorrect angle reading errors which are exaggerated as distance increases, (20 seconds of arc is the equivalent to 10mm over 100m). This equipment satisfied a Survey Uncertainty, SU, and Relative Uncertainty, RU, of less than 10mm (ICSM 2014).

The field traverse consisted of measuring face left and face right horizontal angles, vertical angles, horizontal distances and slope distances between traverse stations (CRMs) and radiations to ORMs. Naming of ORMs were with sequential alpha suffixes clockwise from north, e.g. S16064023A, S16064023B, S16064023C etc for all marks radiated from CRM S16064023. The mean of any angle did not exceed 10” over an observation greater than 50m. Instrument and target heights were measured and temperature and pressure readings taken on a regular basis, or at pronounced changes in conditions.

These readings were input into the atmospheric corrections within the Total Station in the field. This was done to ensure that the correct ppm (parts per million) correction was applied to the measured distances. This compensates for errors in the Electric Distance Measurement (EDM) due to fluctuations in the speed of light caused by temperature and pressure through which light passes through (Professional Surveyor Magazine 2004). These procedures satisfied a SU and RU of less than 10mm (ICSM 2014).

3.2.5 GNSS Survey

In conjunction with the conventional field traverse CRMs 1-46 were measured by the DLPE using Static GNSS techniques. Four dual frequency geodetic receivers were used in each session and three Continually Operating Reference Stations (CORS) were used to resolve the ambiguities. Further redundancy was achieved by occupying the CRMs twice.

3.2.6 NEWGAN Adjustment

The three dimensional least squares adjustment program NEWGAN was used by the DLPE to determine the final coordinates of the CRMs and ORMs within the subject area. Only CRMs 1-31 were input into the adjustment program as the required terrestrial information was not available for CRMs 32-46.

In total 115 stations were input into NEWGAN, (3 CORS Stations, 31 CRMs and 81 ORMs). One CORS station was assigned as constrained. Latitude, Longitude and Elevation gathered from the GNSS survey were input for the CRMs and for the ORMs an approximate co-ordinate which was extracted from the cadastral fabric.

The terrestrial directions and distances, (slope), were also input into the program. AHD elevations were obtained for the CRMs by conventional levelling techniques from neighbouring bench marks within the area by the DLPE. The following information extracted from the NEWGAN report further summarises the variables of the adjustment.

```
      |  THREE DIMENSIONAL ADJUSTMENT PROGRAM  NEWGAN  |
      DATE OF COMPUTATION 20-Jun-16
      S2016/064 TOM ROBERTS PROJECT                  GRS80
      ---------------------------------------------------------   -----------------
   THE ESTIMATE OF THE VARIANCE FACTOR AFTER ADJUSTMENT IS   1.199
   THE A PRIORI VARIANCE FACTOR WAS   1.000
   THIS GIVES A VARIANCE RATIO OF    1.199

      489  DEGREES OF FREEDOM
      1  CONSTRAINT STATIONS
      388  TERRESTRIAL OBSERVATIONS
      -3  POSITION EQUATIONS
      0  POINT POSITIONS
      0  MULTI-STATION FIGURES
      167  MULTI-BASELINE FIGURES
      0  BASELINES
      55.2  PER CENT REDUNDANCY
      115  FREE STATIONS
      4.25  DEGREES OF FREEDOM PER FREE STATION
      0.97  RATIO OF REDUNDANCIES/PARAMETERS

      3  ITERATIONS REQUIRED FOR CONVERGENCE

      THE VALUE OF THE MINIMUM IS  586.2

THE VARIANCE RATIO TEST IS    SATISFIED AT THE 99 % CONFIDENCE LEVEL
AND HENCE RESULTS ARE CONSISTENT WITH THE MATHEMATICAL MODEL
F TEST FACTOR =  0.9591
```

Figure 5 : NEWGAN Adjustment Summary

The results file from the NEWGAN adjustment produced MGA94 Zone 53 coordinates and AHD levels for CRMs 1-31, (shown as squares), and 81 ORMs, (shown as crosses). These coordinates would later be used when testing the cadastral adjustment within GeoCadastre, (see appendix B).

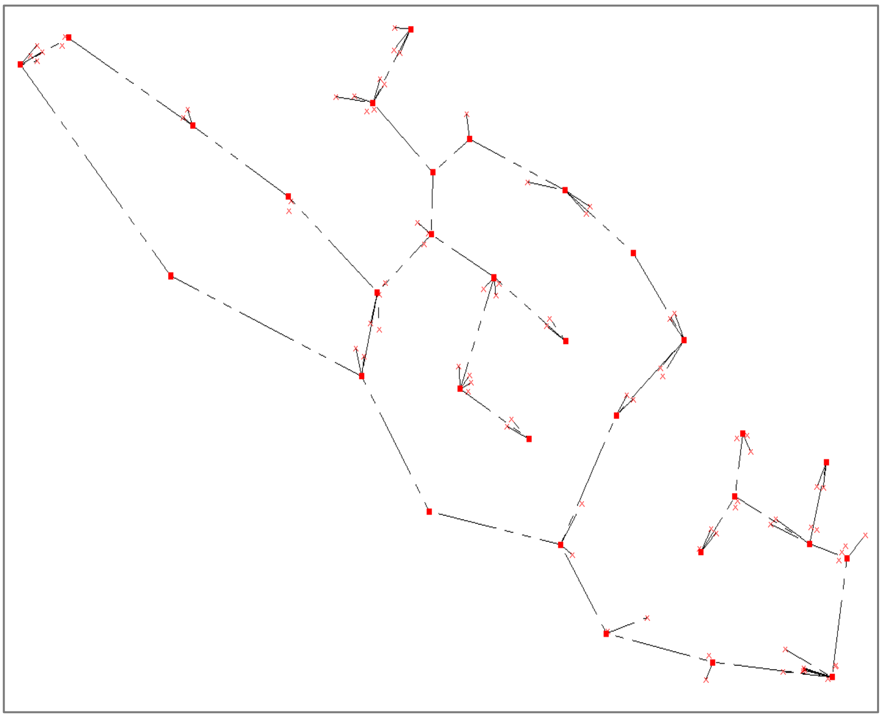

Figure 6 : Outputted CRMs and ORMs from NEWGAN Adjustment

3.2.7 GeoCadastre Cadastral Adjustment

Ten adjustments were made in GeoCadastre using different control shapes resembling similar configurations commonly used by Surveyors. The first step within the adjustment is selecting points within the cadastral fabric of GeoCadastre and assigning them as ‘control’. This is done by first adding the ORM to the cadastral fabric. To add points to the cadastral fabric the properties of the parcel are selected by right clicking on the parcel and then selecting ‘Properties’.

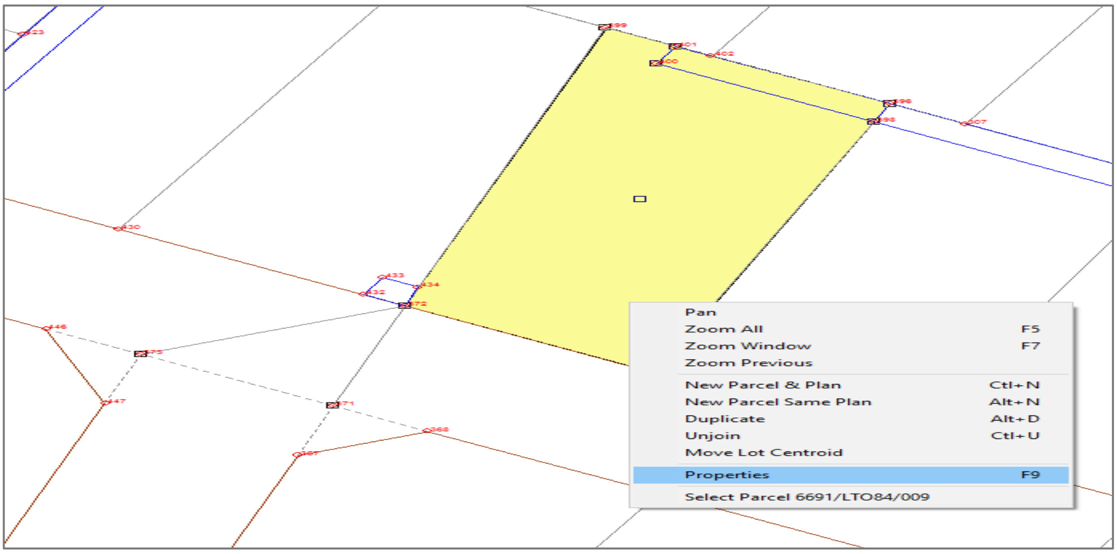

Figure 7 : Parcel Properties

Once the parcel properties has been selected the ORM can be added by entering the bearing and distance from the selected parcel corner using the radiation information from the original survey plan. This is done in the Lines Tab.

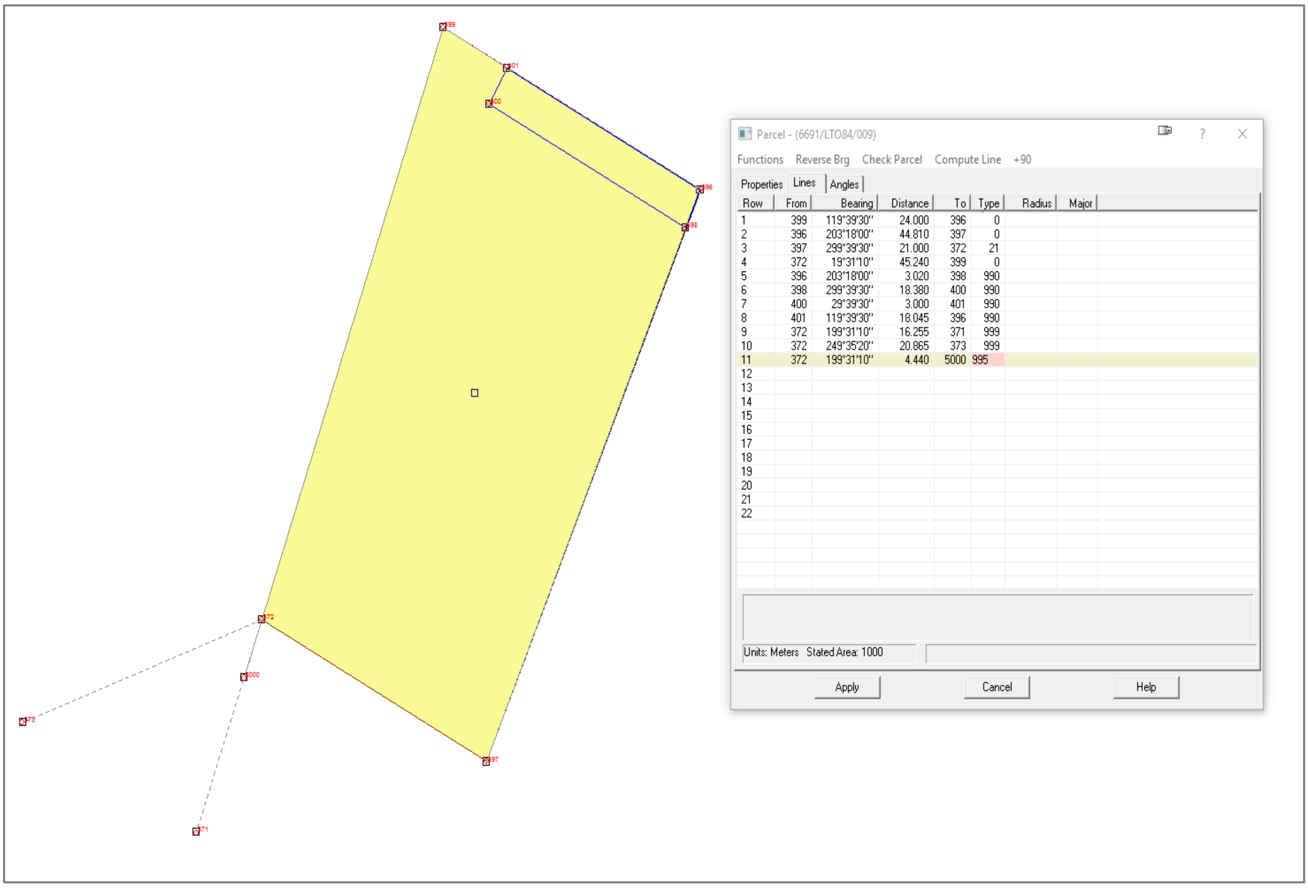

Figure 8 : Lines Tab

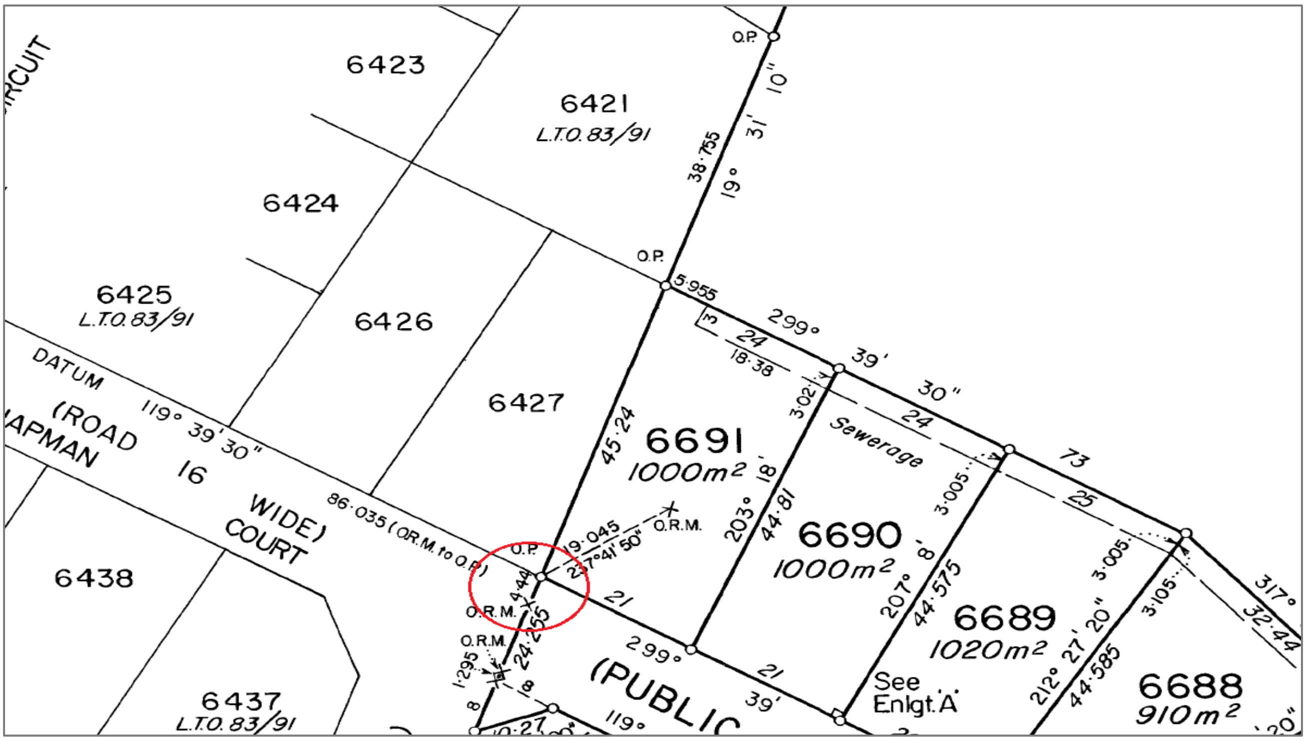

Figure 9 : Original Cadastral Plan Information

The 'From' point can be selected from the existing points within the file, however the 'Bearing' and 'Distance' must be manually entered. The 'To' column is the point number given to the new point, if an existing number is input a new number will automatically be assigned. The 'Type' is set to 995 for a control point; this will hold the connection from the ORM to the boundary corner fixed in the adjustment and will be represented by a red dashed line.

Once the ORM has been input into to the cadastral fabric it can then be added to the control list to be used in the least squares adjustment. This is done by selecting the 'Adjust' tab and then 'Control'. In the Control function 'Add' is then selected and the ORM highlighted using the cursor or the point number manually keyed in.

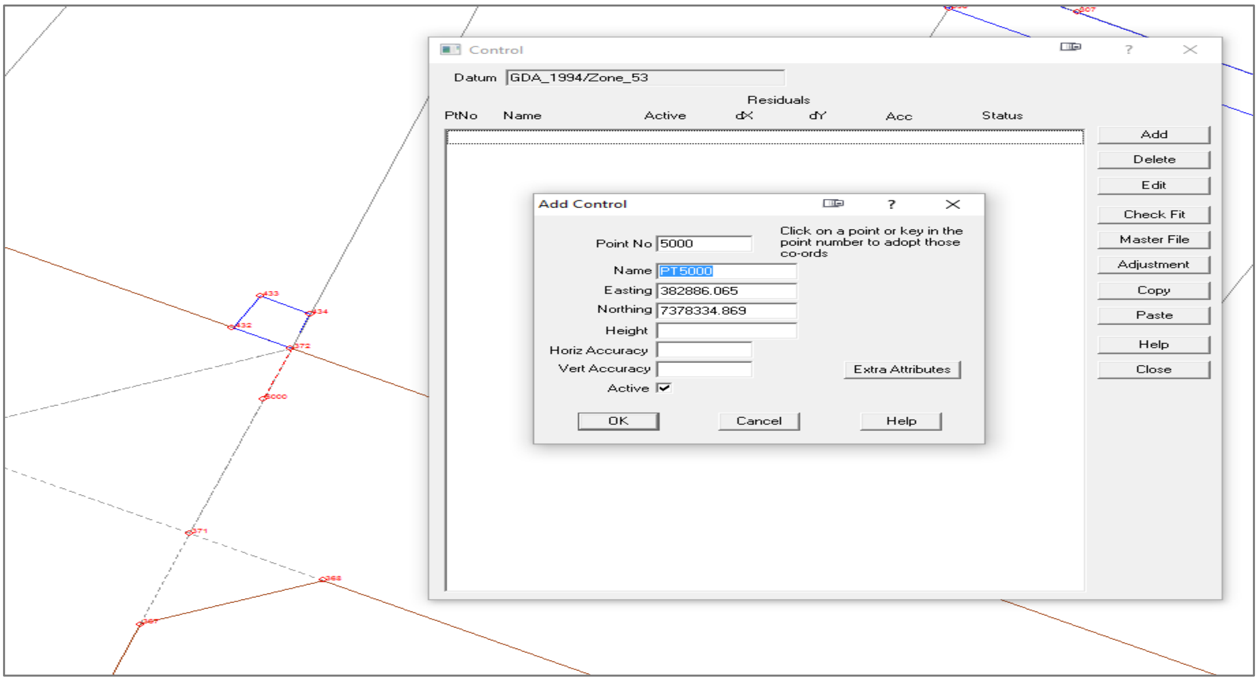

Figure 10 : Add Control 1

The coordinates of the control point displayed at this stage are the unadjusted coordinates from the cadastral fabric, approximately MGA94 Zone 53 as previously discussed in 3.2.1. It is here that the measured coordinates and height from the NEWGAN adjustment are input. The correct Name for the control point should also be entered.

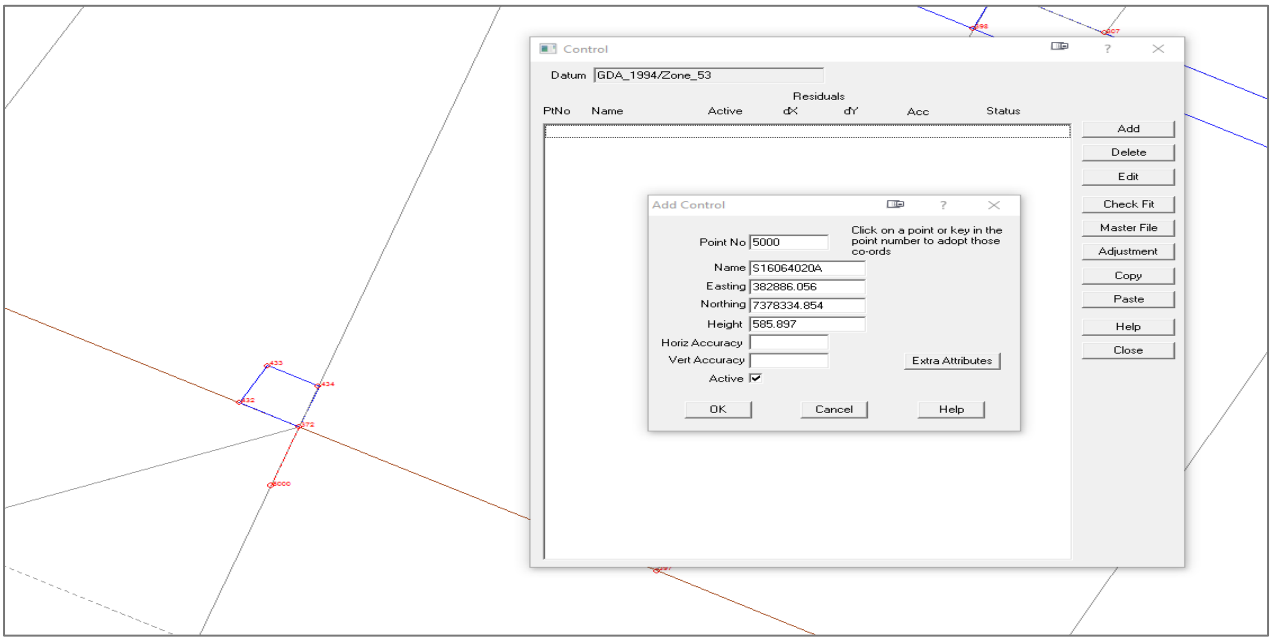

Figure 11 : Add Control 2

When manually adding control points the association between the fabric point and the control point can be immediately established, (EΔ 0.011m and NΔ .015m). Having the control point active will assign the point as active once the ok box is selected. Active control points are used in the least squares adjustment, inactive control points are excluded from the adjustment. This procedure is repeated for each ORM until the desired number of control points has been reached. Within the 'Control' function 'Adjustment' is then selected which will open the 'Adjust Job' function. Within the 'Adjust Job' the adjustment tolerances can be set which will report on the bearings, distances, line points and close points which exceed the set tolerances between the difference of the adjusted line and the original recorded line.

The adjustment settings can also be configured to force line points or straight lines. These options were not selected for the testing of the adjustment. Parcels can be isolated and adjusted individually by selecting the 'Adjust Selected' box and easements also included in the adjustment by selecting 'Include Easements'. These two settings were also unselected during the testing of different control configurations. The 'Include Historical' box was selected during the testing phase. As mentioned in 2.1.5 weight is allocated depending on the date of survey which is assigned to each parcel during the creation of the cadastral fabric.

The 'Listing Type' can be configured to produce a more detailed report of the adjustment however as the adjusted coordinates of the boundary corners were all that was required for future testing, the standard setting was used. 'Hold Boundary Fixed' was not selected as the purpose of the adjustment was to generate adjusted boundary corners from different ORM configurations. Once all settings have been configured the adjustment is initiated by selecting proceed.

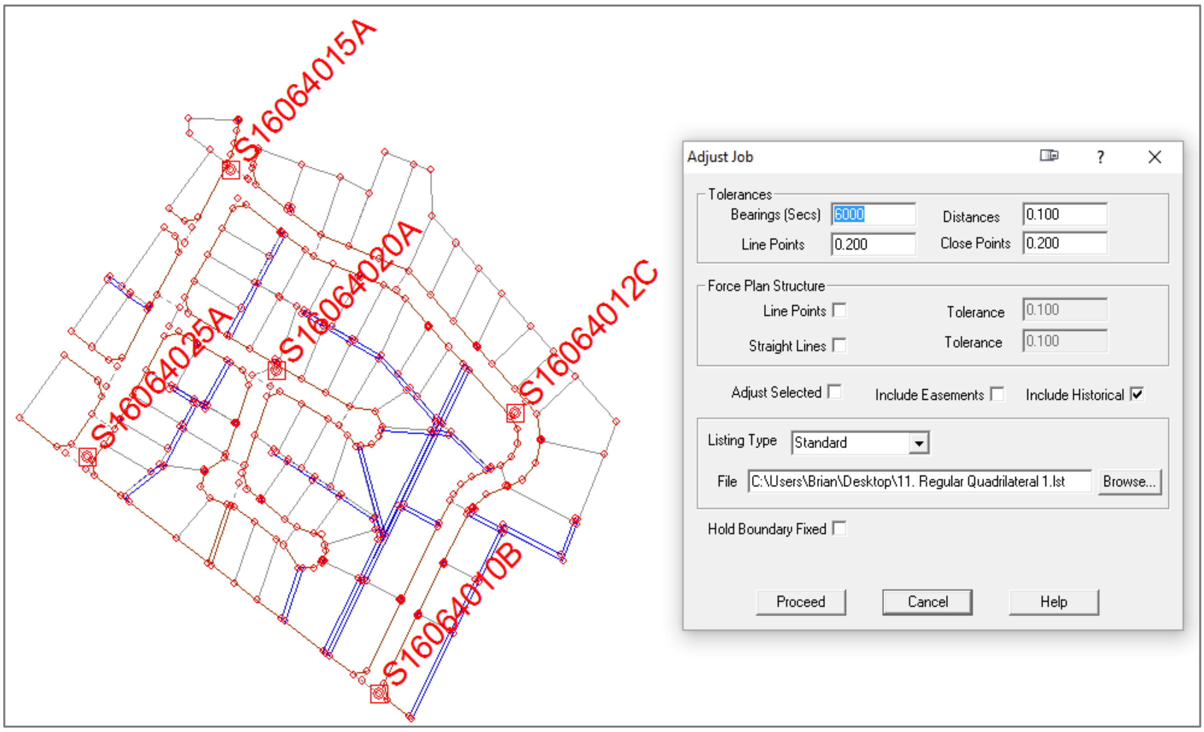

Figure 12 : Adjust Job

The Adjustment will then run and if successful generate an adjustment summary. The report gives a statistical summary on the number of points and lines in the adjustment and alerts if any tolerances were exceeded. The maximum and average shift is reported between the original cadastral fabric and the adjusted parcel corners. A results file is also produced which gives a summary of the effect of the adjustment on each parcel and every line within the fabric.

A complete list of the final boundary coordinates is given in the results file. These were in the form of MGA94 Zone 53 coordinates and were extracted from the results file after each adjustment was run. These coordinates would be used for comparison and future testing of control configuration.

3.3 Preliminary Testing Considerations

From the adjusted NEWGAN coordinates 15 CRMs were selected which encompassed an area consisting of 48 parcels, 147 corners and 32 ORMs. The area was reinstated manually which formed a base file to be used as a comparison against results obtained from GeoCadastre adjustments. As the

NEWGAN coordinates were MGA94 the area was reinstated in a Universal Transverse Mercator Projection, (UTM), Map Grid Australia 94 Zone 53. Reinstating the boundaries in MGA94 was necessary as the adjusted boundaries from GeoCadastre would also be in the form of grid coordinates.

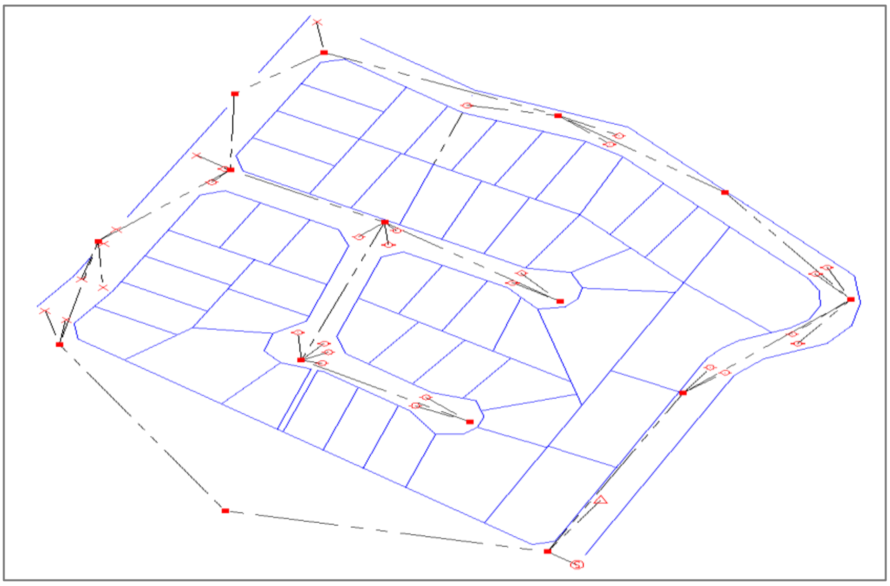

Figure 13 - Manually Reinstated Lots

Liscad SEE, Surveying and Engineering Environment Version 12.0, was used to conduct the manual reinstatement. Unit configurations were set to ground distances and bearings set to Azimuth/True Bearings. The difference between MGA94 Grid Bearings and True Bearings, (Grid Convergence), in the subject area was between - 27’ 40’’ and - 27’45”. For example at CRM S16064020A (Lat -23° 42’ 5.86”, Long 133° 51’ 4.49”):

Tan Grid Convergence = –Sin Lat point. Tan (Long point – Long CM)

Where CM is the Central Meridian (135° for zone 53)

Lat Point is the latitude of the point of interest

Long Point is the Longitude of the point of interest

(Department of Sustainability and Environment)

Tan Grid Convergence = -Sin -23.7016277778. Tan(133.851247222 – 135)

= 0.401973790543. -0.0200522052226

= -0.00806046094181

= Arc Tan (-0.0080604694181)

= -0.461820391419 (Decimal Degree's)

= - 27' 43"

The same convergence is achieved when analysing the point within Liscad as seen in the figure below.

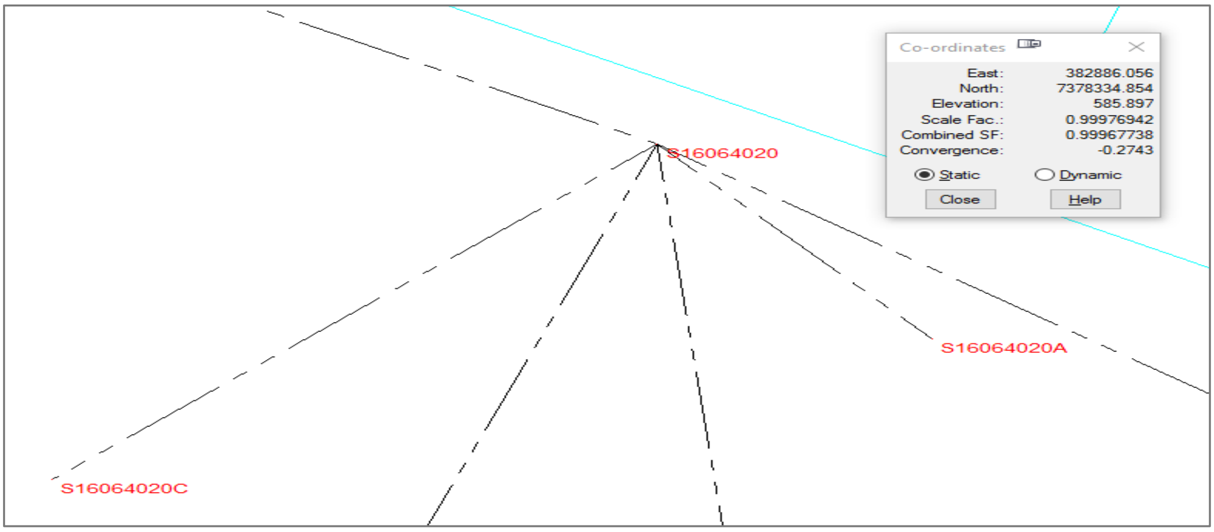

Figure 14 : Convergence Calculated by Surveying Software

Cadastral survey plans within Alice Springs use grid bearings which are based on a local grid of the town. The local grid was determined by measuring an azimuth from the centre of the town, at ANZAC Fundamental to Mt. Everard, which became the datum of the grid. At this line the observation was a true bearing however as surveys were taken further from the datum line the bearings no longer resembled a true bearing. The subject area was roughly 3.2km west from the initial point of the local grid. When comparisons made between the field data, with units configured to true bearings, and the original survey plan data the convergence between the local grid and true bearings was negligible. Some comparisons between the manual reinstatement and the original survey plan can be seen below.

Plan 1 – 2 =	27° 28'	118.765m	Plan 1 – 2 =	209° 39' 30''	163.035m
Field 1 – 2 =	27° 27' 50''	118.730m	Field 1 – 2 =	209° 39' 39''	163.045m
Plan 8 – 9 =	27° 28'	142.610m	Plan 10 – 11=	126° 50' 30''	107.710m
Field 8 – 9 =	27° 27' 57''	142.580m	Field 10 – 11=	126° 50' 27''	107.710m
Plan 8 – 7 =	19° 31' 10''	83.995m	Plan 12 – 13=	126° 50' 30''	134.655m
Field 8 – 7 =	19° 31' 13''	83.998m	Field 12 – 13=	126° 50' 35''	134.636m

Figure 15 - Field Survey vs Original Survey

From the NEWGAN coordinates, with units configured to ground distances and the azimuth to true bearings, the subject area was reinstated from the ORM's using the local cadastral grid bearings and distances from the original survey plans. Excess and shortage was distributed evenly throughout the area so that no lot was favoured over another. No major disagreement was found between the original survey plans and the measured field data. This became the base file which would be used to compare the position of the boundary corners created after each adjustment within GeoCadastre.

3.4 Test Cadastral Adjustment Configurations

Initially 9 cadastral adjustments were conducted in GeoCadastre using configurations commonly used in surveying practices. The resulting 147 boundary corners from each adjustment would then be compared to the corners from the manual reinstatement in 9 separate comparison files. The different configurations included two Regular Quadrilateral, two Regular Triangle, two Skewed East West, two Skewed North South and one Fully Constrained adjustment. It should be noted that the skewed adjustments were included to deliberately resemble a poor adjustment and would not be normally used as a configuration. The configurations can be seen on the following pages.

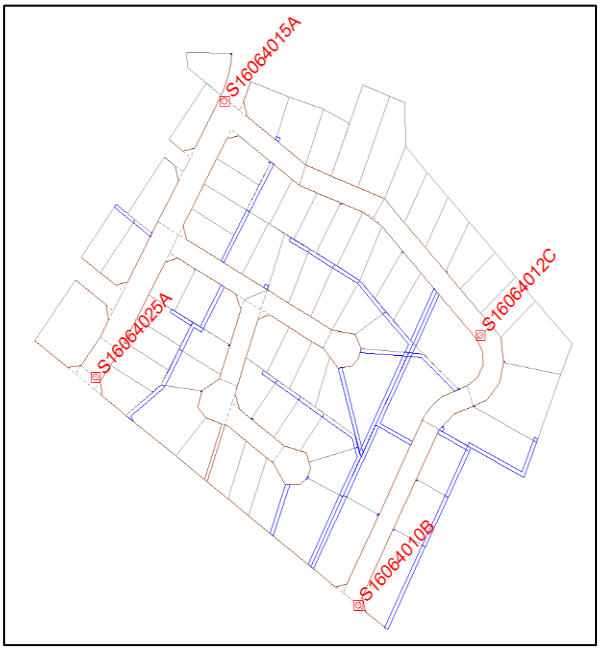

Figure 16 : Regular Quadrilateral 1

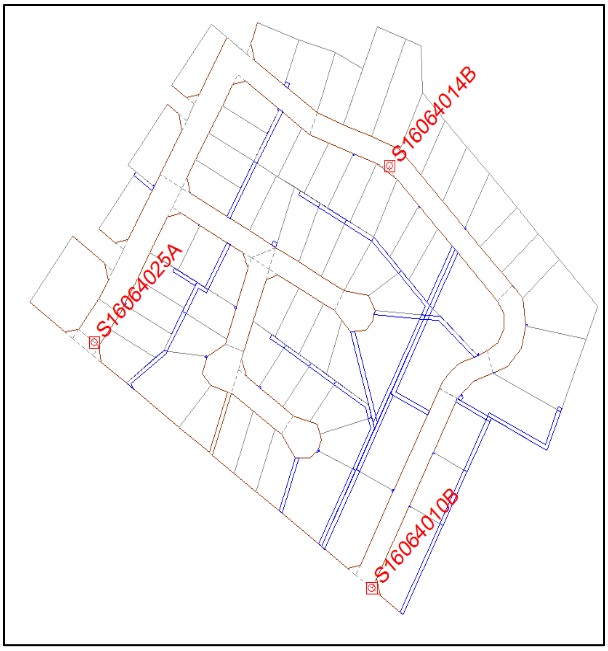

Figure 18 : Regular Triangle 1

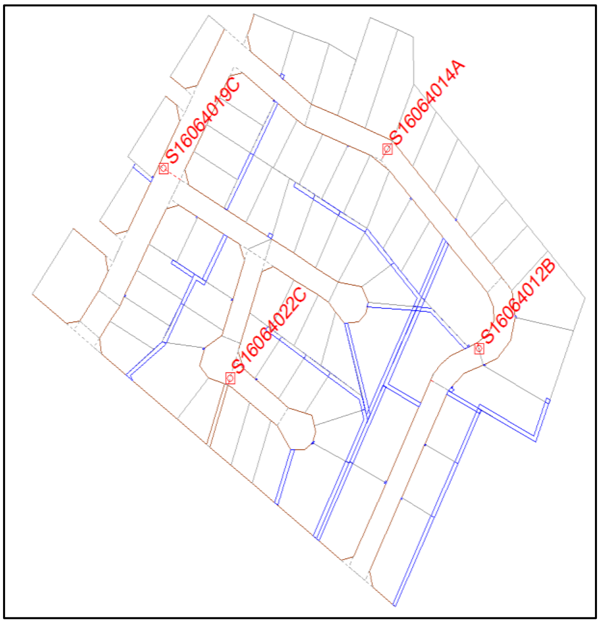

Figure 17 : Regular Quadrilateral 2

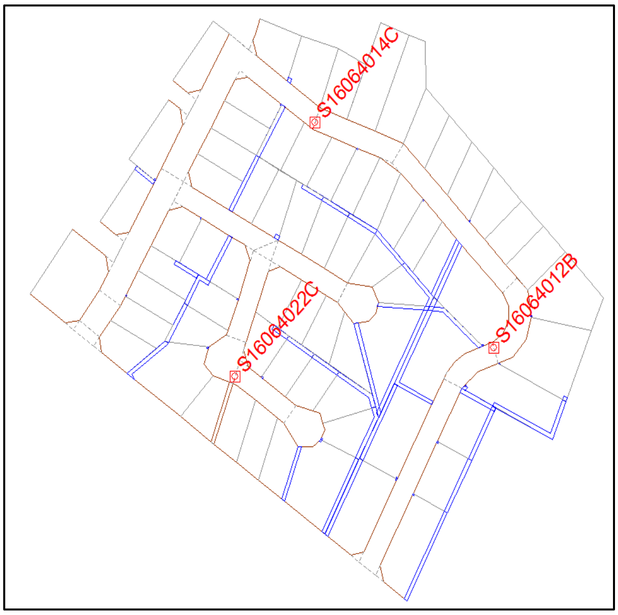

Figure 19 : Regular Triangle 2

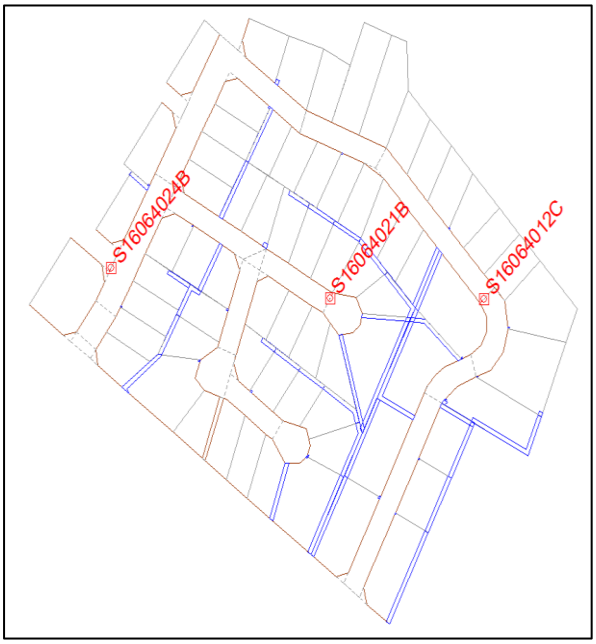

Figure 20 : Skewed East West Triangle 1

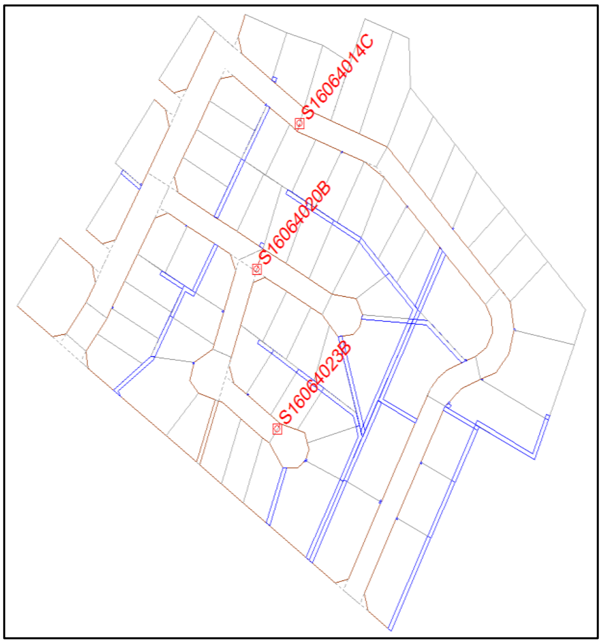

Figure 22 : Skewed North South Triangle 1

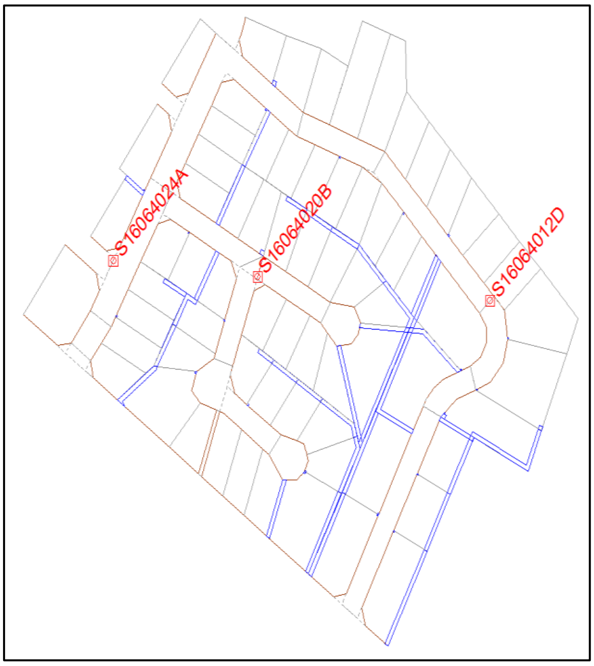

Figure 21 : Skewed East West Triangle 2

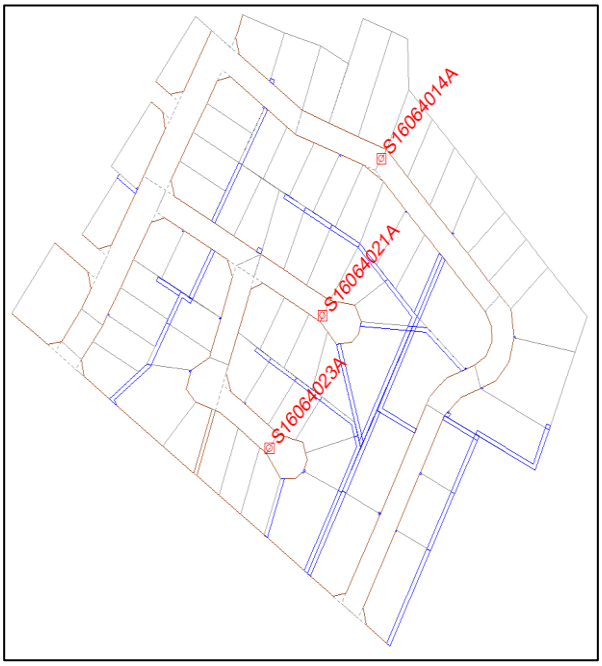

Figure 23 : Skewed North South Triangle 2

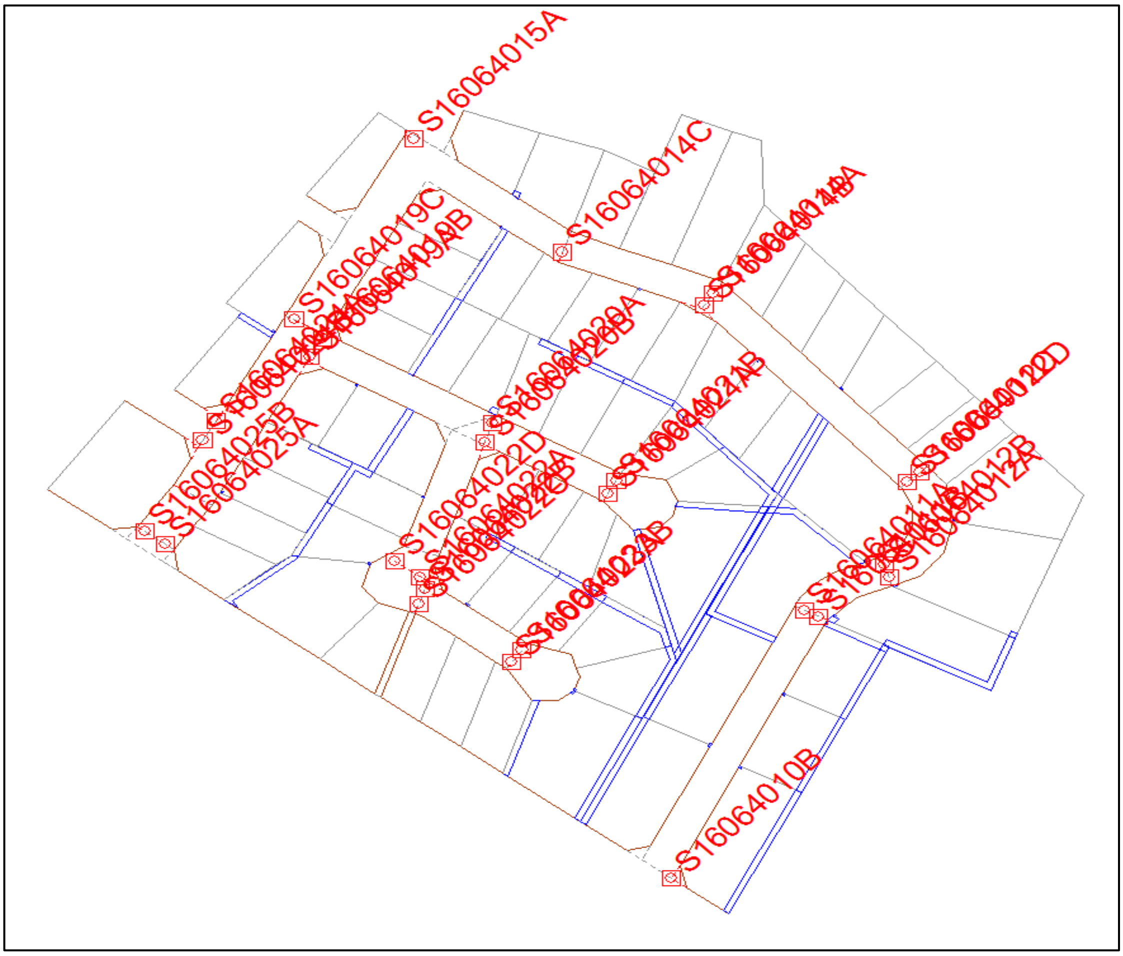

Figure 24 : Fully Constrained

CHAPTER 4

RESULTS

4.1 Introduction

If we compare the coordinates of the 147 corners generated from each adjustment to the manual reinstatement the results can be expressed in a number of different ways. This chapter displays the findings of the test adjustments through a series of graphs and visual plots. A detailed discussion of the findings will be presented in Chapter 5. Four different graphical representations of the findings have been included in this chapter to aid the reader in understanding the relationship between the manual reinstatement and the GeoCadastre/Cadastral adjustment's.

4.2 Easting and Northing Boundary Corner Comparison

These graphs compare the difference in easting and northing between the manual reinstatement and the cadastral adjustment. The horizontal axis represents the boundary corner and the vertical axis represents the difference in easting and northing between the two points.

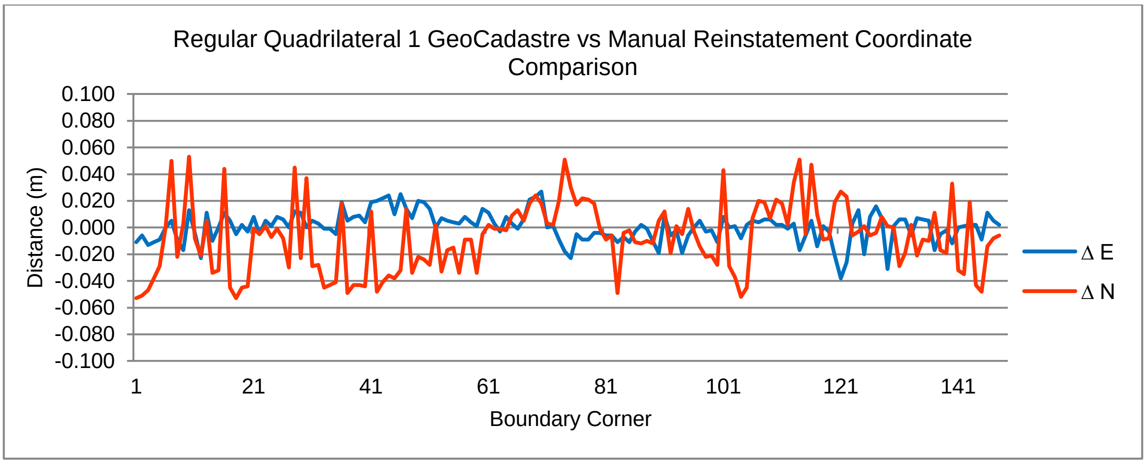

Figure 25 : Regular Quadrilateral 1 Scatter Plot

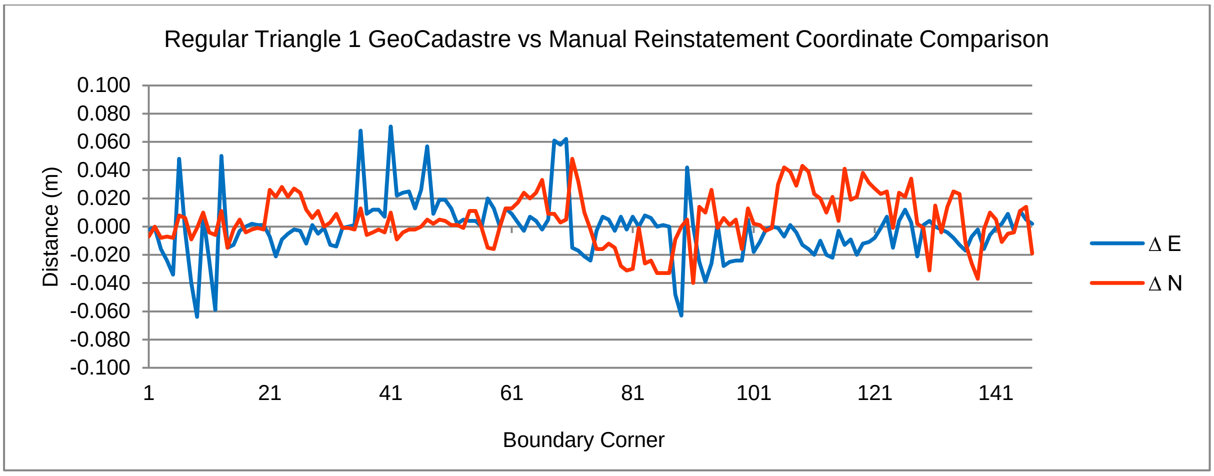

Figure 26 : Regular Triangle 1 Scatter Plot

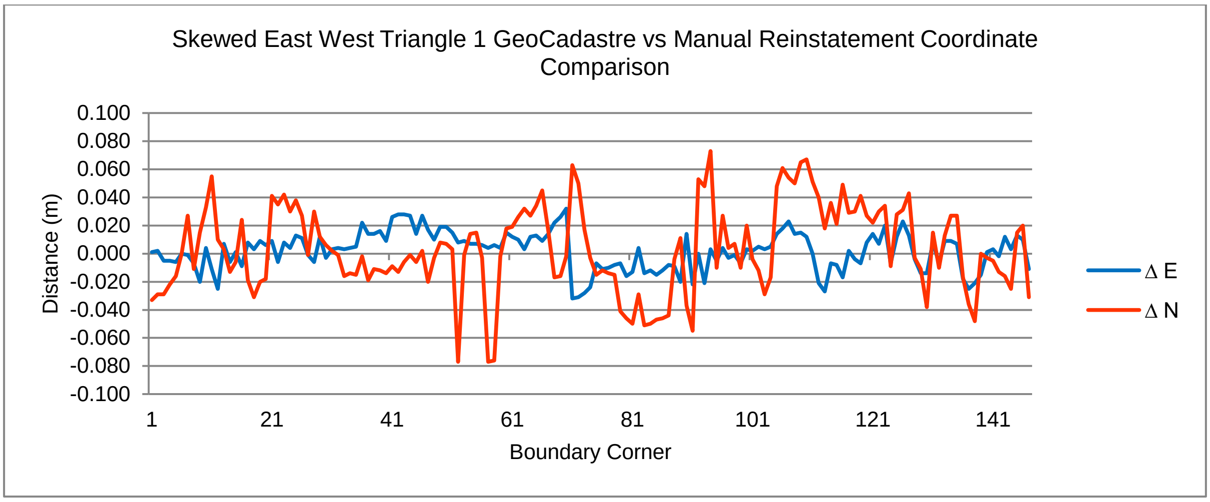

Figure 27 : Skewed East West Triangle 1 Scatter Plot

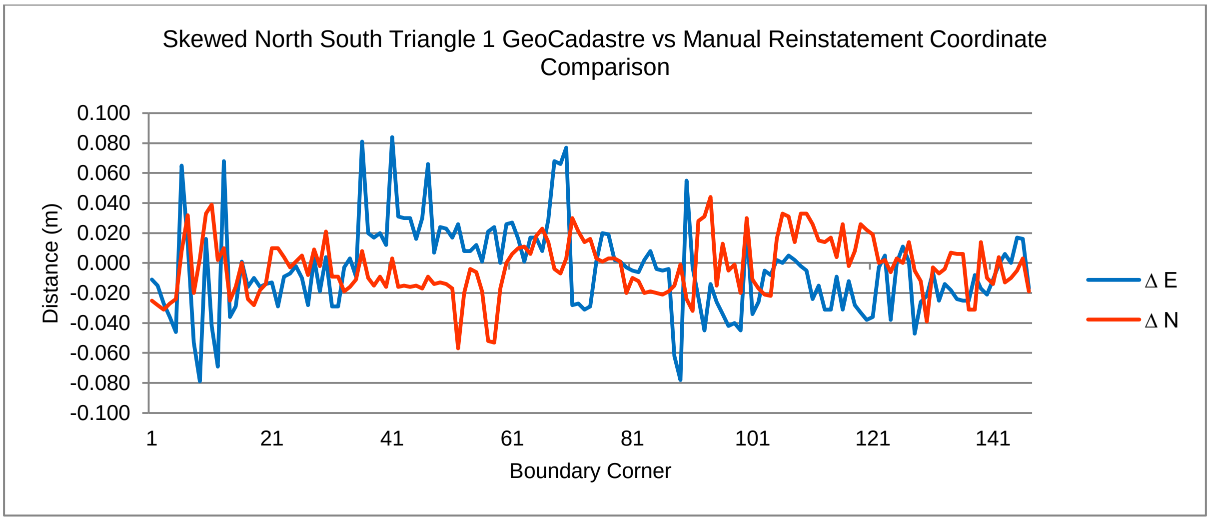

Figure 28 : Skewed North South Triangle 1 Scatter Plot

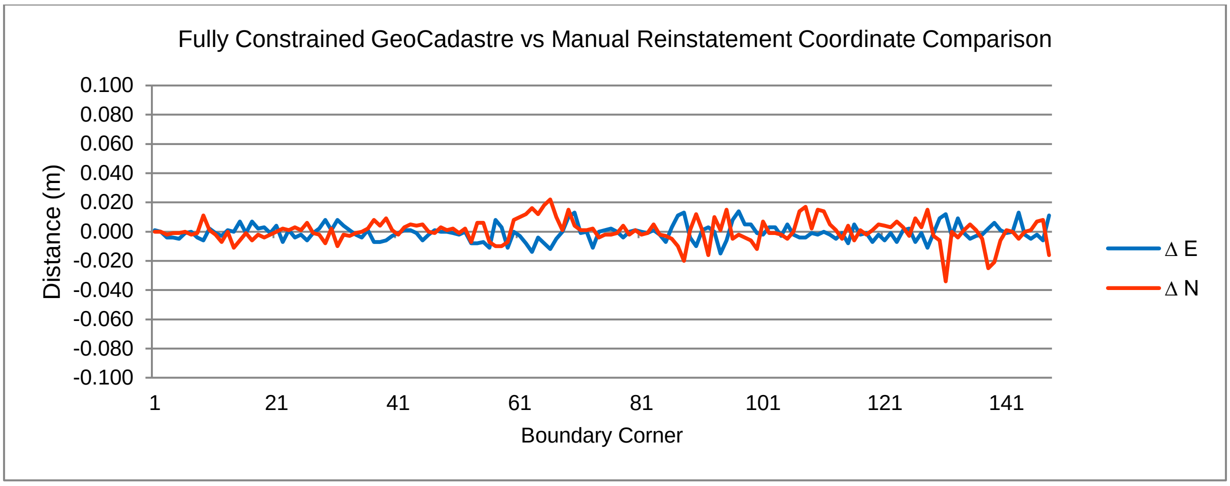

Figure 29 : Fully Constrained Scatter Plot

4.3 Distance Comparison

If the distances between the cadastral adjustment corner and the manual reinstatement corner are compared the results can be expressed by a column graph. The horizontal axis represents the boundary corner and the vertical axis the difference between the position of the GeoCadastre boundary corner and the manually reinstated corner.

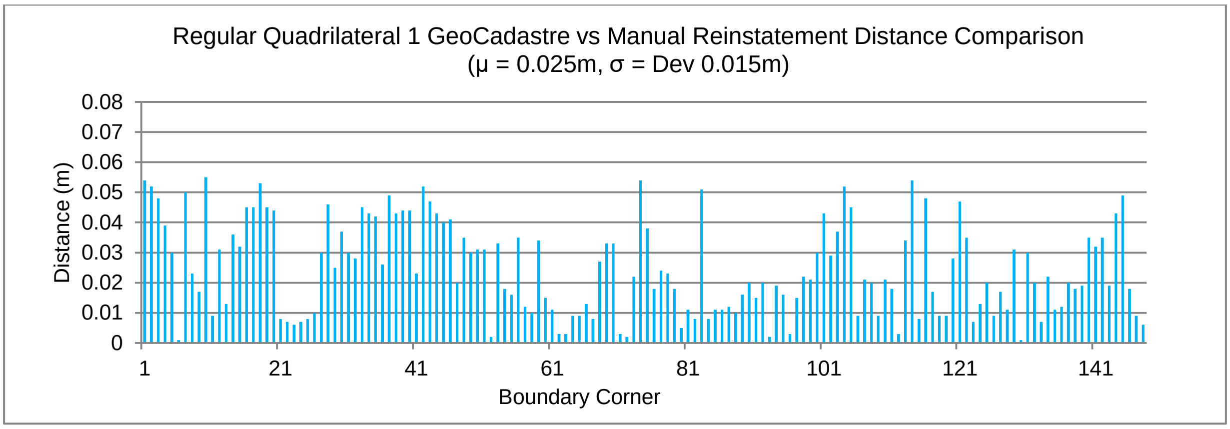

Figure 30 : Regular Quadrilateral 1 Column Graph

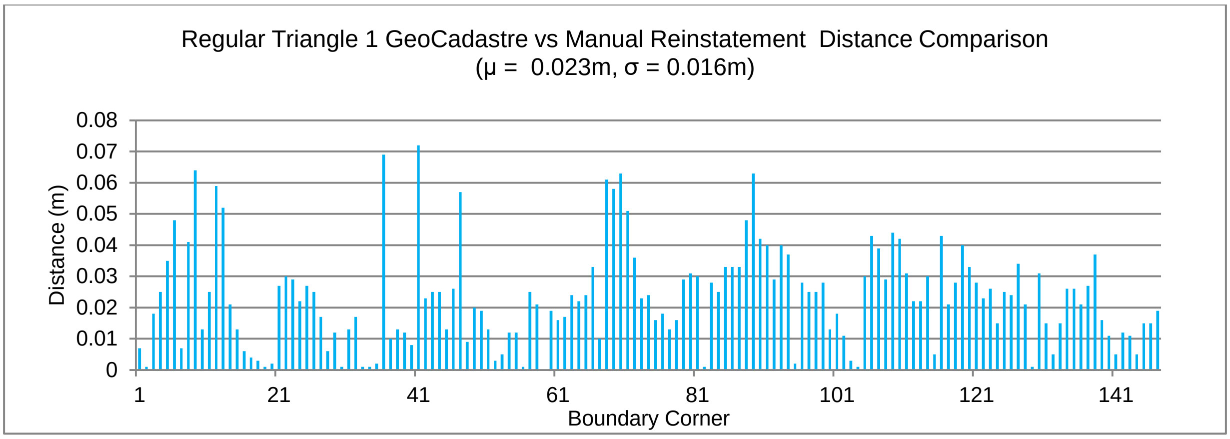

Figure 31 : Regular Triangle 1 Column Graph

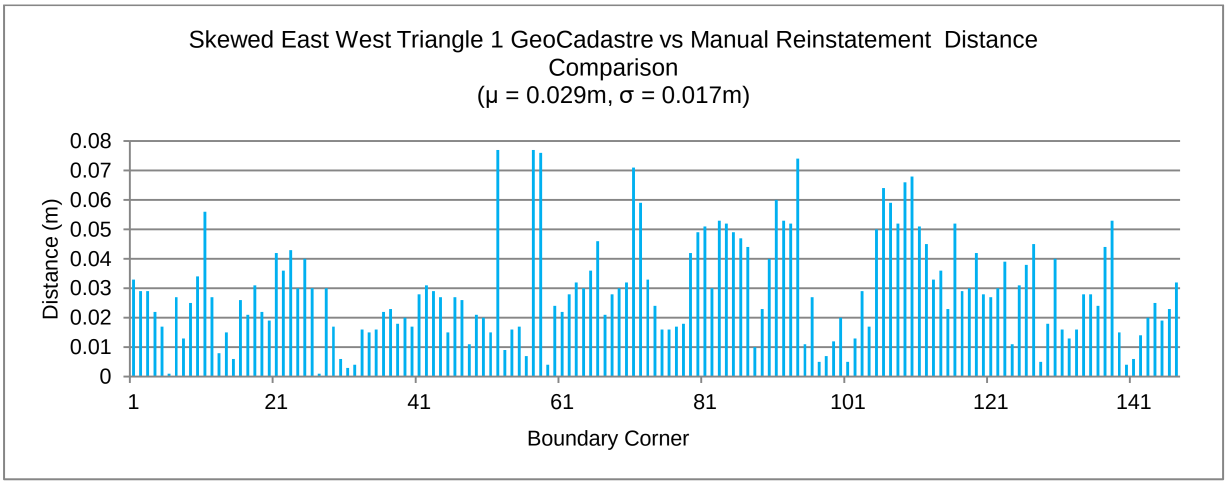

Figure 32 : Skewed East West Triangle 1 Column Graph

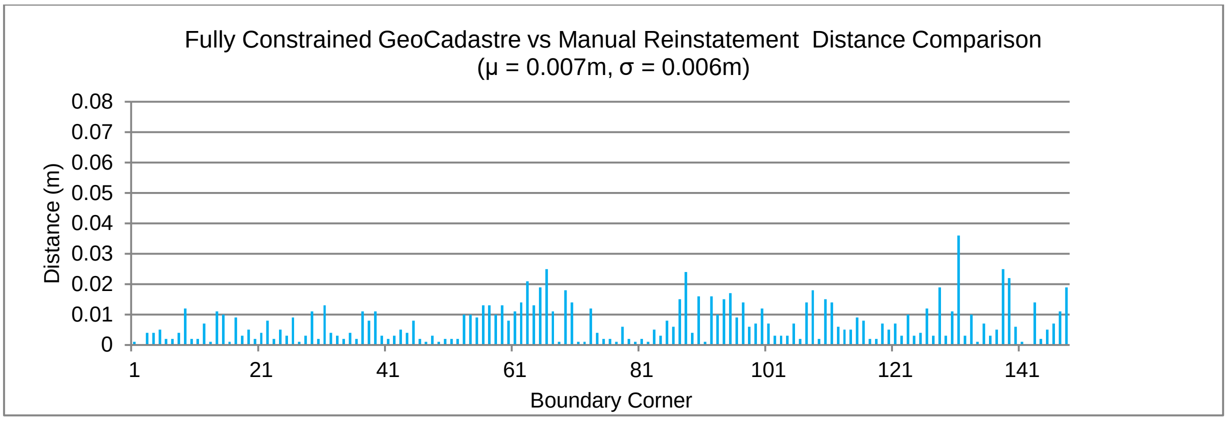

Figure 33 : Fully Constrained Column Graph

4.4 Distance Comparison Histograms and Normal Distribution

These histograms represent the number of times a boundary corner generated from the cadastral adjustment fell within a specified difference to the manual reinstatement. Using the distance comparison means and standard deviations we can also create a normal distribution curve to analyse the spread of the data and the probability of arriving at a value.

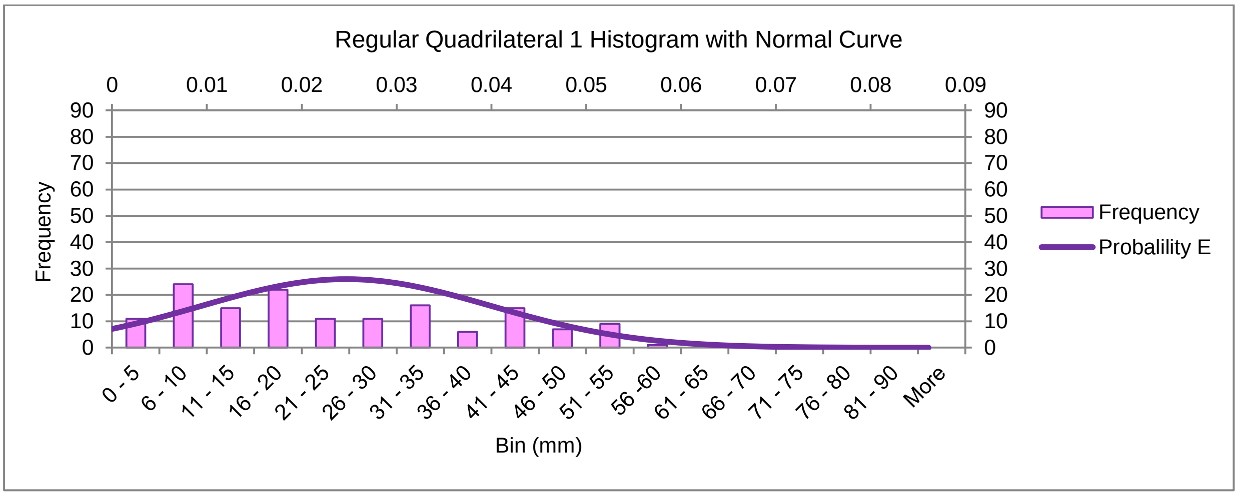

Figure 34 : Regular Quadrilateral 1 Histogram

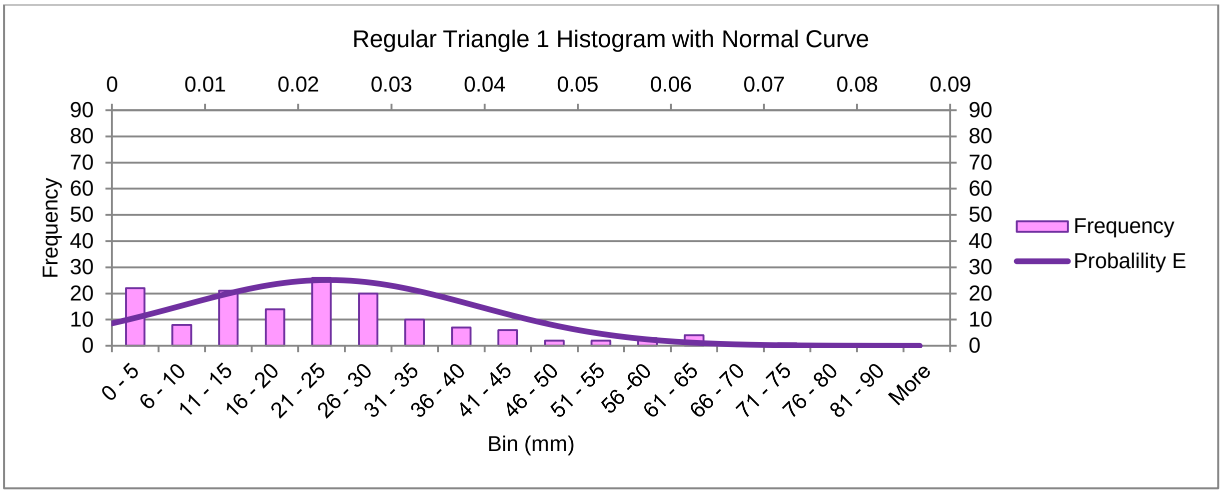

Figure 35 : Regular Triangle 1 Histogram

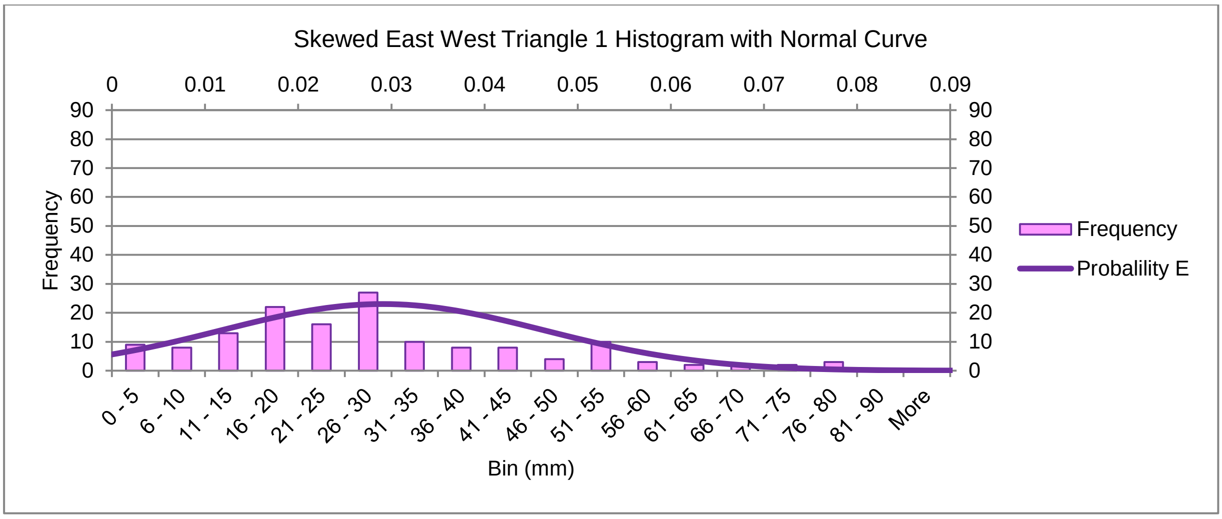

Figure 36 : Skewed East West Triangle 1 Histogram

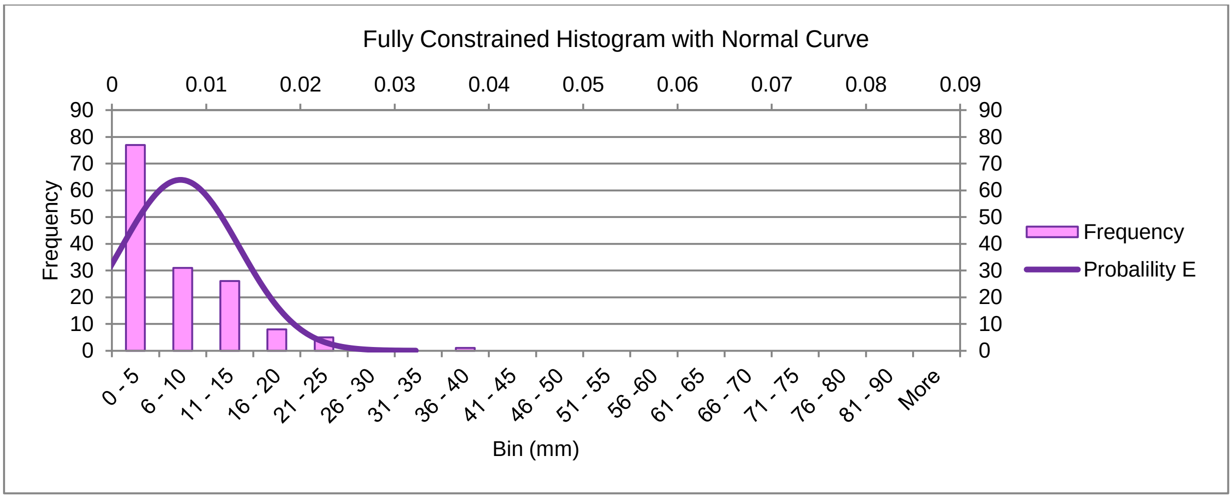

Figure 37 : Fully Constrained Histogram

4.5 Manual Reinstatement vs Cadastral Adjustment Distance Vector Plots

The following vector plots have been generated to examine the direction and magnitude of the difference between the manual reinstatement and the cadastral adjustment. The direction of the arrow is from the manually reinstated corner to the outputted corner from the GeoCadastre adjustment. The length of the line displays the difference in metres between the two points in conjunction with the scale bar. The blue triangles represent the position of the control points used in the adjustment.

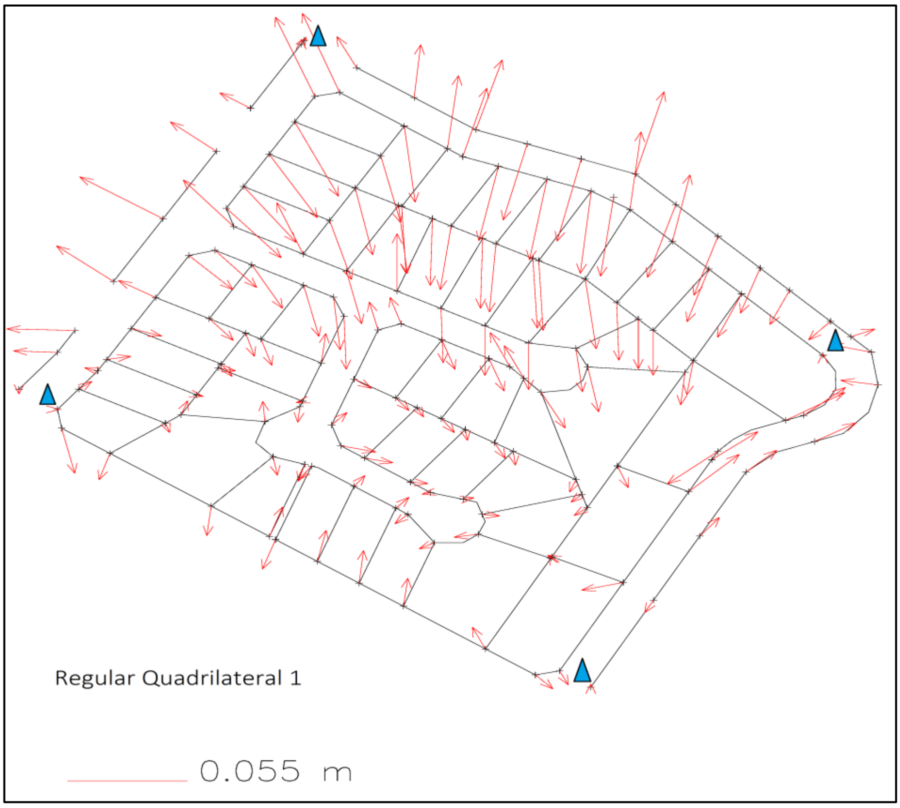

Figure 38 : Regular Quadrilateral 1 Distance Difference Vector

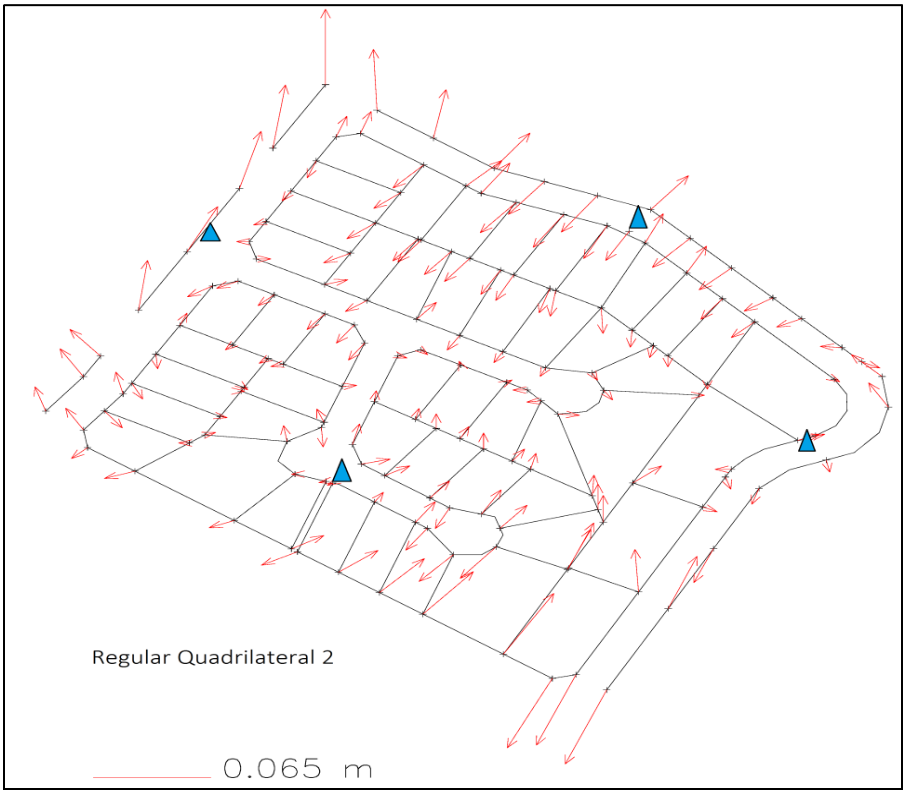

Figure 39 : Regular Quadrilateral 2 Distance Difference Vector

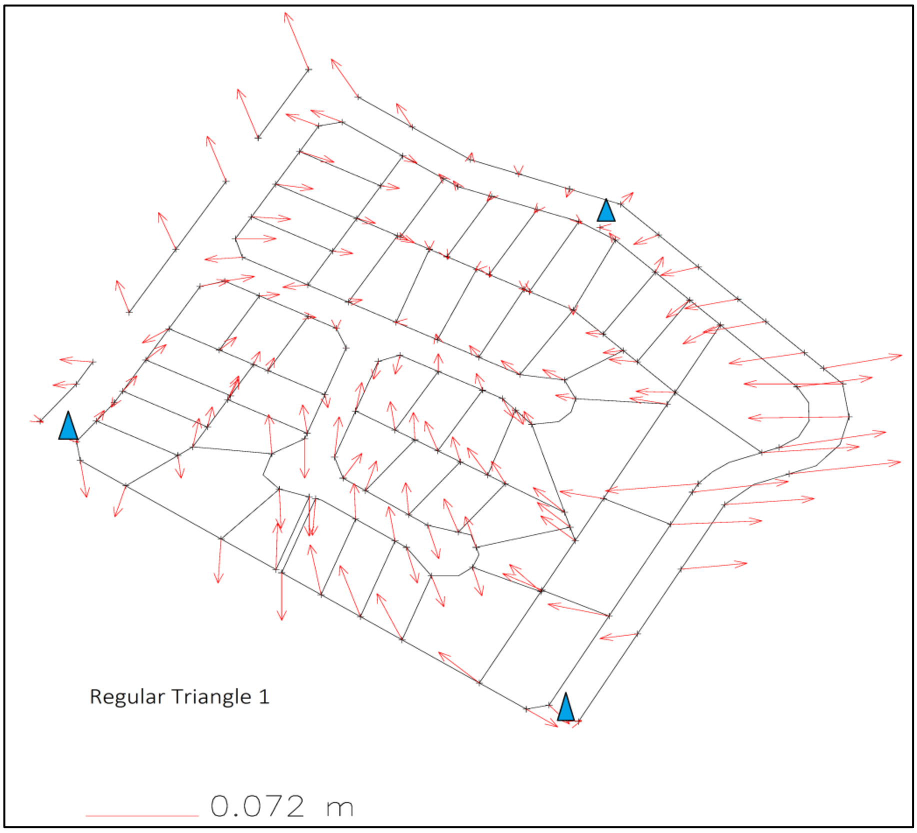

Figure 40 : Regular Triangle 1 Distance Difference Vector

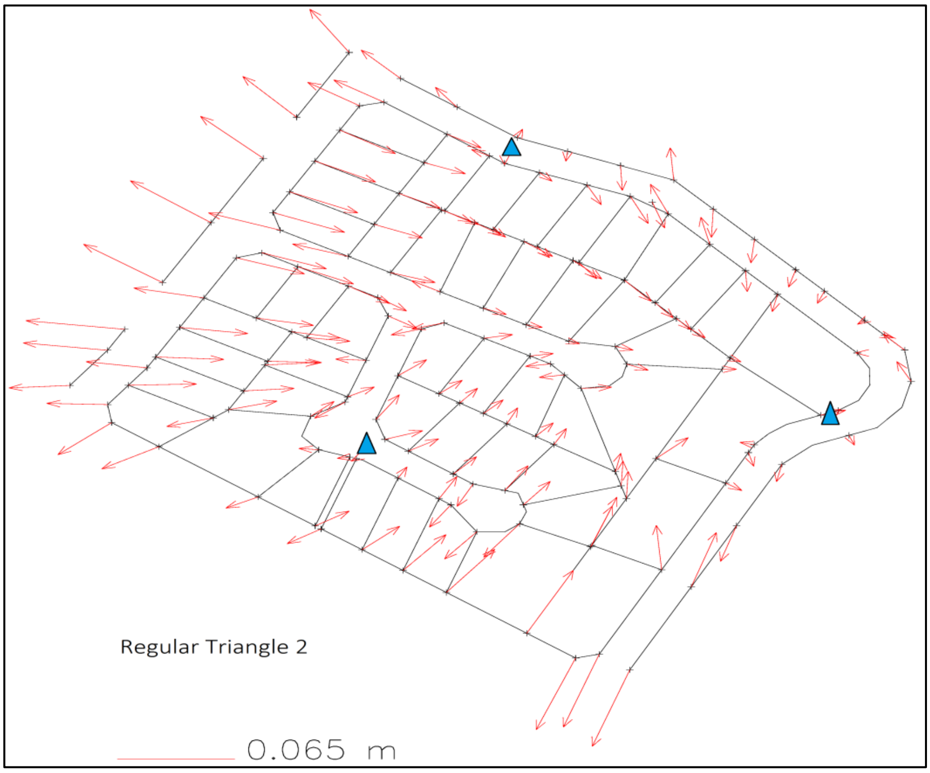

Figure 41 : Regular Triangle 2 Distance Difference Vector

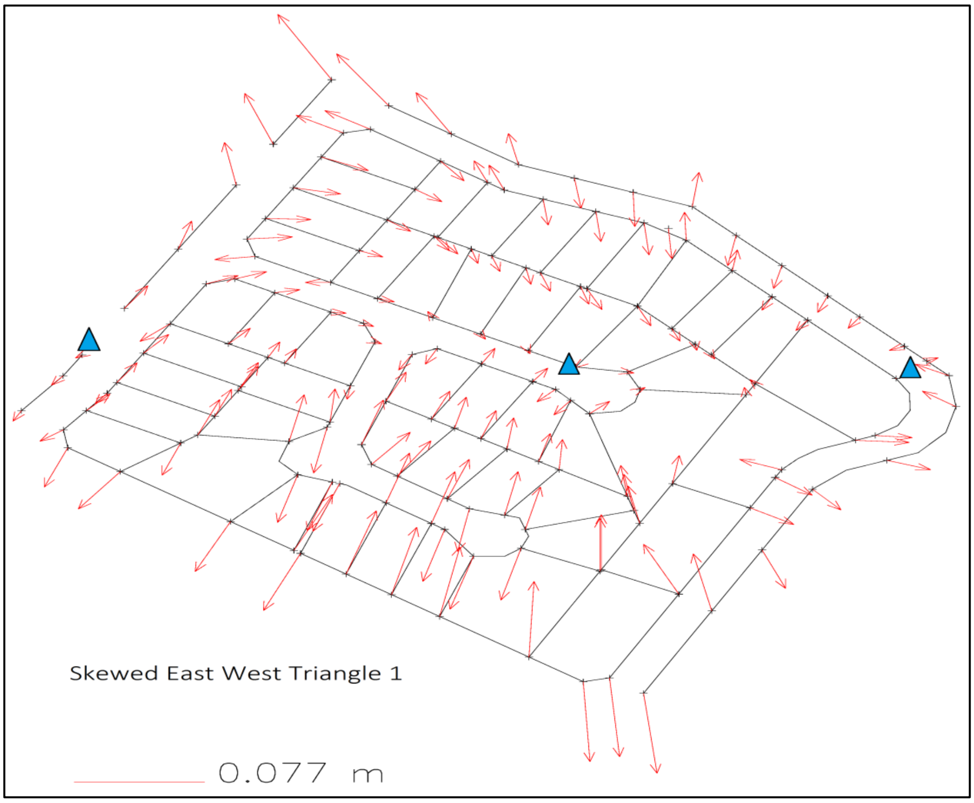

Figure 42 : Skewed East West Triangle 1 Distance Difference Vector

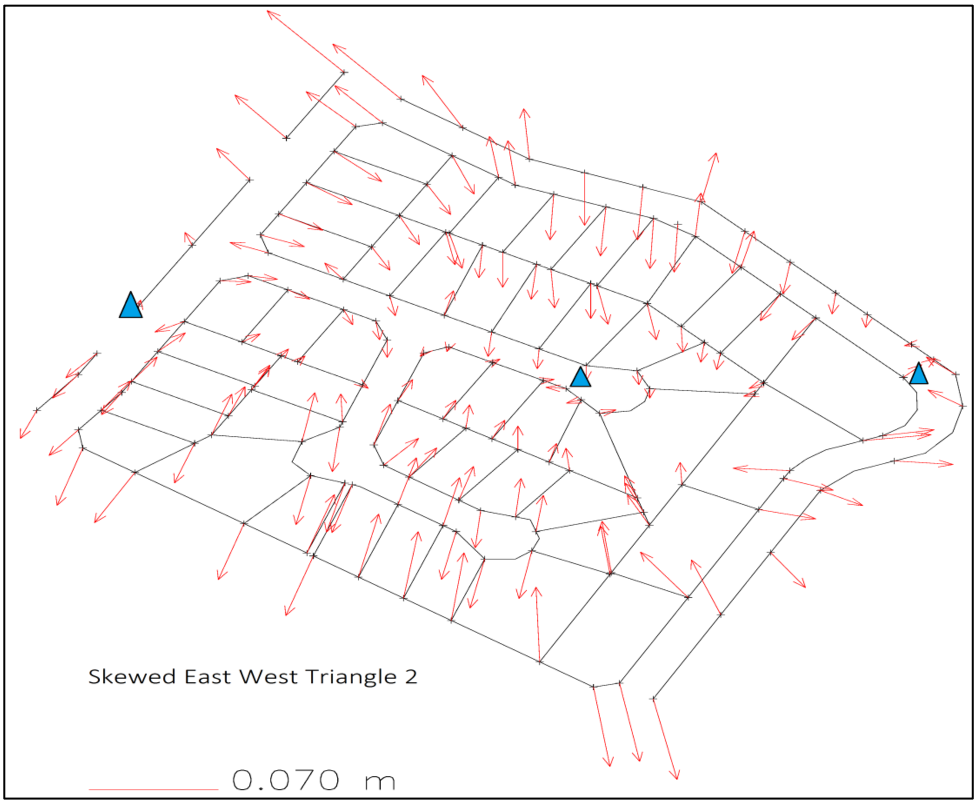

Figure 43 : Skewed East West Triangle 2 Distance Difference Vector

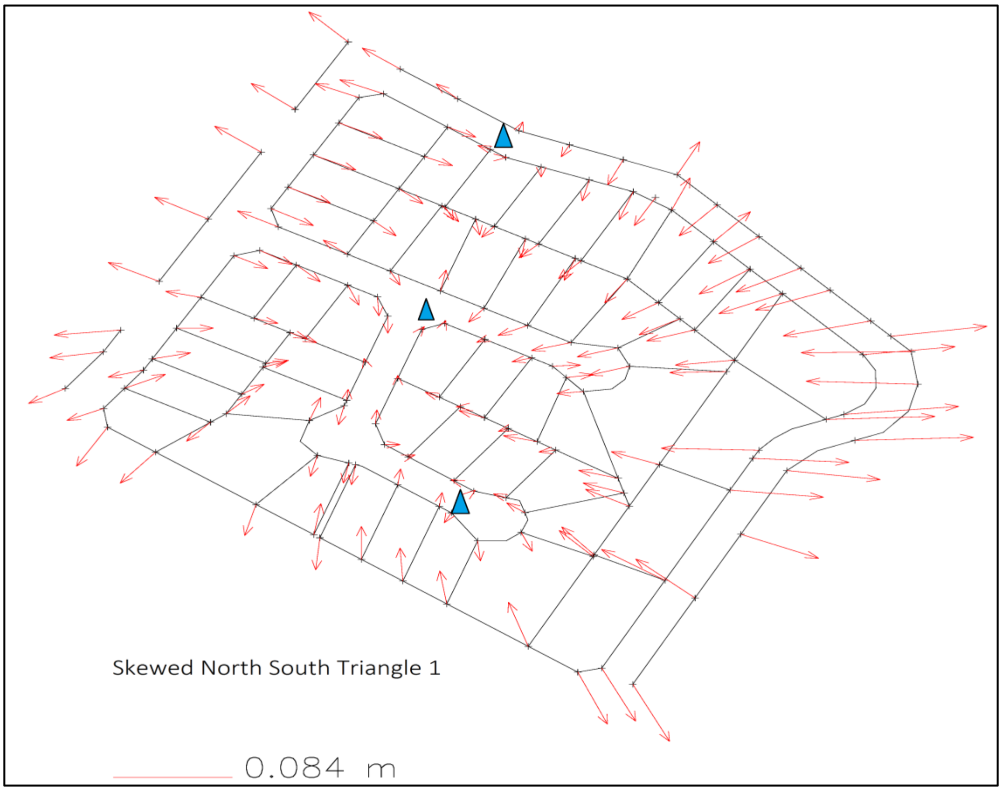

Figure 44 : Skewed North South Triangle 1 Distance Difference Vector

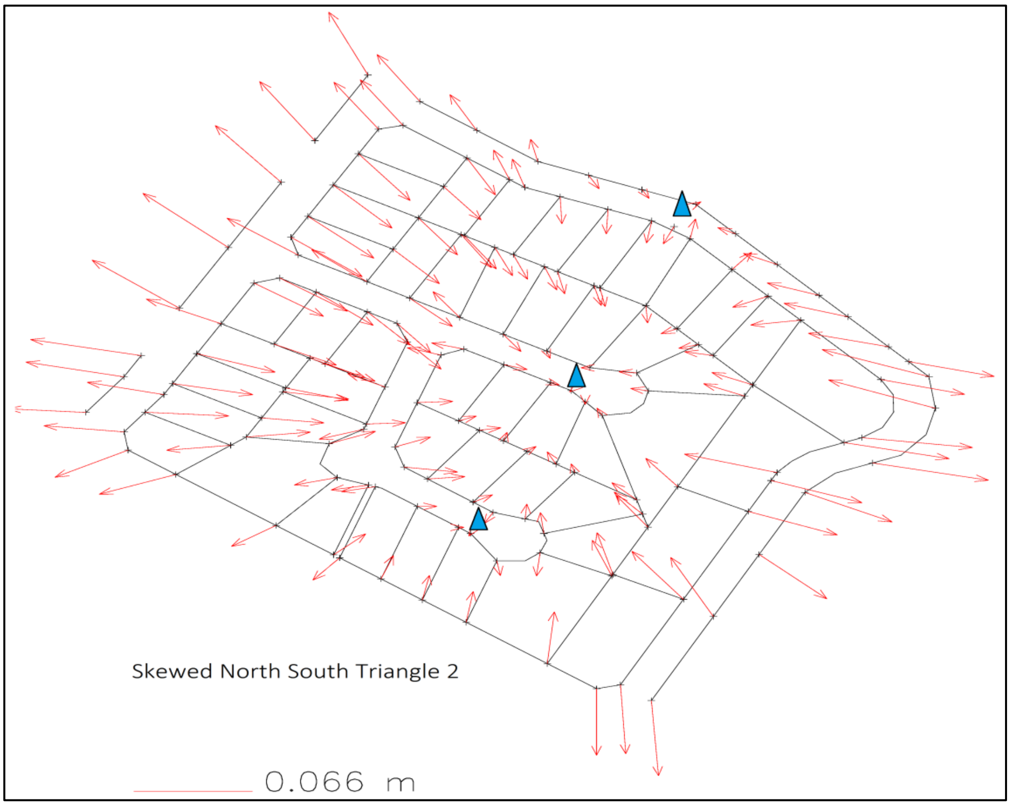

Figure 45 : Skewed North South Triangle 2 Distance Difference Vector

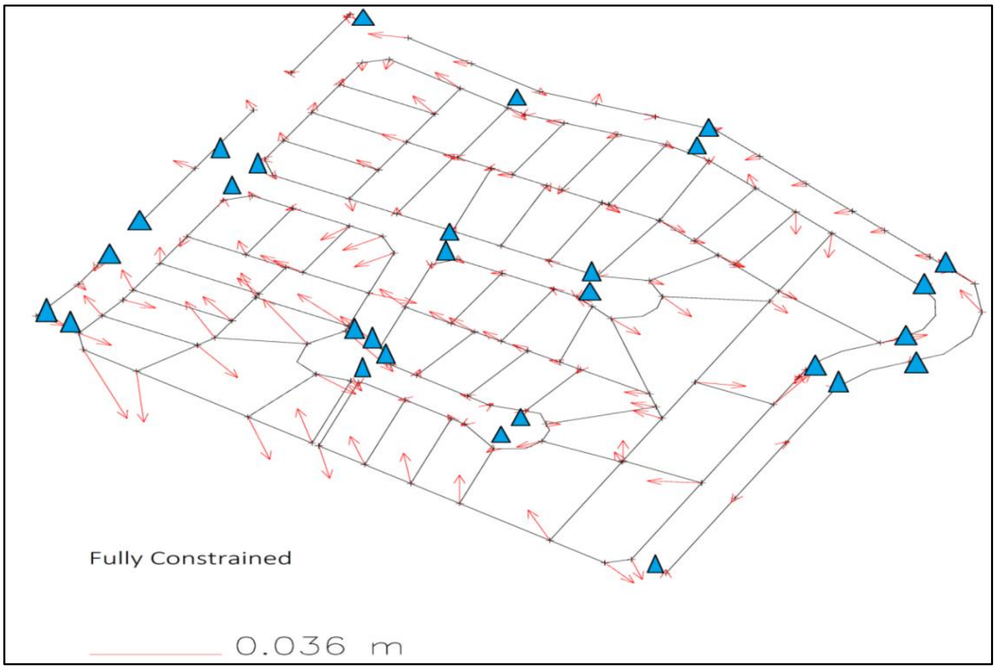

Figure 46 : Fully Constrained Distance Difference Vector

4.6 Manual Reinstatement vs Cadastral Adjustment Mean Prediction

In order to analyse the effects of control point density, 6 additional adjustments were run removing points from the fully constrained configuration by five at a time. It was predicted that as more points are removed, the mean difference between the manual reinstatement and the cadastral adjustment would become greater.

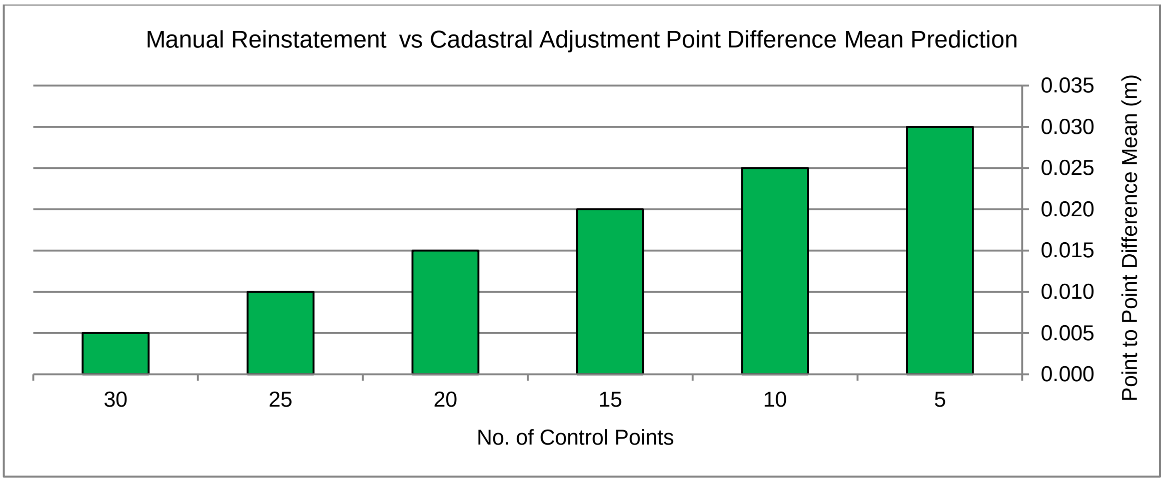

Figure 47 : Manual Reinstatement vs Cadastral Adjustment Prediction

4.7 Control Density Test

This graph presents the findings after having run the adjustments mentioned in 4.6 and shows us that as control is extracted from the adjustment the mean difference between the manual reinstatement and the cadastral adjustment becomes greater.

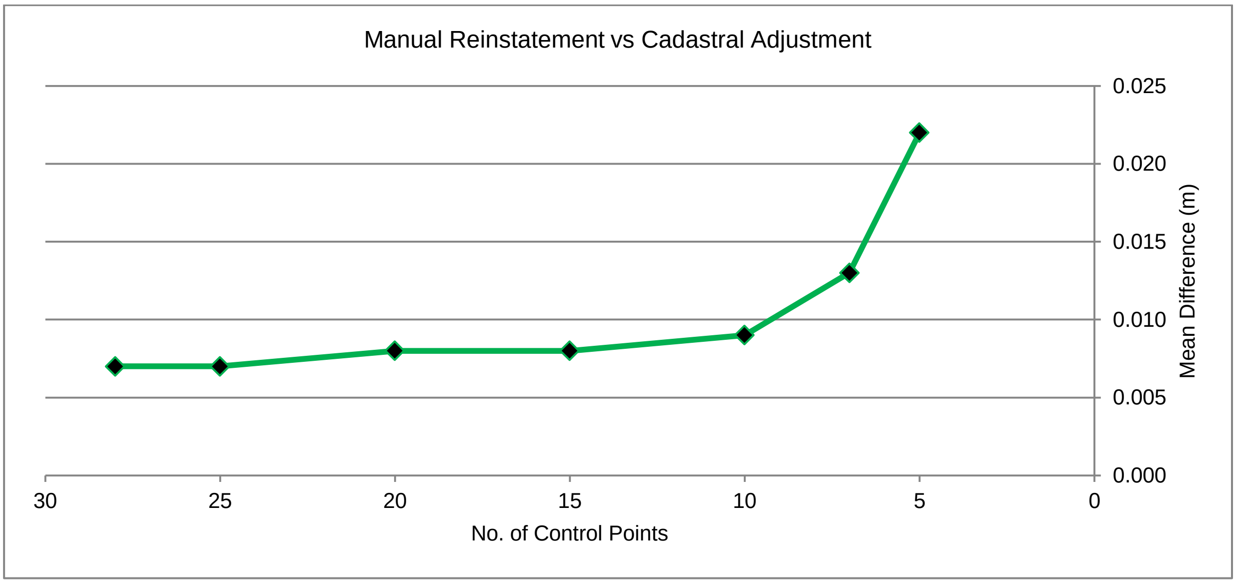

Figure 48 : Control Density Test

CHAPTER 5

DISCUSSION

5.1 Introduction

The results obtained in Chapter 4 revealed that the configuration and density of control within the cadastral adjustment has a direct effect on the final position of the boundary corner. This chapter will discuss in detail the results obtained in Chapter 4 and will then lead into a deliberation on the implications of the results in the following chapter.

5.2 Easting and Northing Boundary Corner Comparison

When comparing the coordinates of the manual reinstatement to the cadastral adjustment a scatter plot can be generated to analyse the relationship between the two data sets. If the difference between the manual reinstatement and the cadastral adjustment is significant then we would expect the scatter plot to vary from the middle of the graph at the zero difference line. If the two data sets resemble similar coordinates over the 147 corners then we would expect that the scatter plot be clustered around the centre of the graph.

When analysing the regular quadrilateral configuration we can see that the easting of the corners generated from the cadastral adjustment resembled the easting of the manual reinstatement slightly better than that of the northing. We can also see from the graph that the largest difference in the easting was 38mm and the largest difference in the northing 53mm. The standard deviation between the regular quadrilateral and the manual reinstatement was 11mm in the easting and 26mm in the northing when using this configuration.

If we look at the regular triangle configuration it can be seen that both the difference in easting and northing fluctuate around the centre of the graph. Using this configuration gave a largest difference in easting of 71mm and a largest difference in northing of 48mm. The standard deviation of the data set was 21mm in the easting and 18mm in the northing.

Interesting observations can be made when analysing the skewed east west triangle and skewed north south triangle scatter plot. It can be seen that if the control is skewed in an east west running line then the effect on the northing will be greater than the effect on the easting. The same can be said when the control is running in a north south direction. If the control is skewed in a north south running line then the effect of the easting will be greater than that of the northing. This is supported by the high and low differences between the data sets.

With the skewed east west configuration the largest difference in the easting was 32mm and the largest difference in the northing was 77mm. With the skewed north south triangle the largest difference in easting was 84mm and the largest difference in the northing was 57mm. It was found that the standard deviation between the manual reinstatement and the skewed east west triangle was 13mm in the easting and slightly more in the northing with 31mm. The skewed north south triangle had a standard deviation of 29mm in the easting and slightly less in the northing of 19mm.

When analysing the fully constrained scatter plot it can be seen that the data is much more clustered around the centre of the graph giving a better representation of the manual reinstatement. The largest difference in easting was 15mm and the largest difference in northing was 34mm. The standard deviation in the easting and northing was therefore much lower than all other configurations with a 5mm standard deviation in easting and 8mm standard deviation in northing.

5.3 Distance Comparison

If the distances between the cadastral adjustment corner and the manual reinstatement corner are compared the results can be expressed by a simple column graph. By comparing the distance vector between the two data sets a mean difference can be calculated as all distances are positive. This could not be done when analysing the difference in easting and northing as values can be negative when comparing coordinates. If the data is represented by differences close to zero then the adjustment has closely resembled the manual reinstatement.

The regular quadrilateral column graph shows us that the difference between the two data sets fluctuated over the 147 corners. At points around corners 21, 61, 81 and 121 the difference between the cadastral adjustment and the manual reinstatement was within 10mm however the difference often reached 50mm over the rest of the graph. The mean difference generated from the regular quadrilateral was 25mm with a standard deviation of 15mm when comparing the distance vector.

The regular triangle generated similar results when comparing the difference in distance between the two data sets over the 147 corners. Again at points around corners 21, 61, 81,100 and 141 the difference between the cadastral adjustment and the manual reinstatement was relatively low however over the rest of the area the difference exceeded 20mm with one corner differing by 71mm. The mean difference generated from the regular triangle was 23mm with a standard deviation of 16mm.

As expected when using the skewed configurations the difference between the two data sets became greater. When using these configurations very few corners fell within a difference of 10mm and a number of points exceeded a difference greater than 50mm. Both configurations generated similar mean and standard deviations. The skewed east west configuration had a mean difference of 29mm and a standard deviation of 17mm while the skewed north south triangle had a mean of 30mm and a standard deviation of 18mm.

If we look at the fully constrained column graph we can see that the values of the point differences are much smaller meaning that the configuration closely resembled the manual reinstatement. We can see that only one point exceeded a difference of 30mm and the majority of points only differed by 10mm or less. Using all of the control in the adjustment generated a mean difference of 7mm and a standard deviation of 6mm.

5.4 Distance Comparison Histograms and Normal Distribution

The histograms presented in chapter four represent the number of times a boundary corner generated from the cadastral adjustment fell within a specified difference to the manual reinstatement. For example if we look at the regular quadrilateral we can see the difference between the two data sets was relatively evenly distributed from 11 corners differing by 0 to 5mm through to 15 corners differing by 41 to 45mm. Similar observations can be made with the regular triangle with the 21 to 25mm bin making up 26 corners and 27 corners differing by 26 to 30mm in the skewed east west triangle. The fully constrained histogram shows us that 77 out of the 147 boundary corners varied by 0 to 5mm between the cadastral adjustment and the manual reinstatement.

When the distance comparison mean and standard deviations are represented by a normal distribution curve the spread of the data and the probability of arriving at a value can be determined. From what we know about the normal distribution curve one standard deviation below the mean and one standard deviation above the mean represents approximately 68% of the area within the curve. In the case of the Regular Quadrilateral 68% of the area falls within 9 and 40mm. This means that with the mean and standard deviation generated from the regular quadrilateral there is a 68% probability that the difference between the manual reinstatement and the cadastral adjustment will be between 9 and 40mm.

Similar results can be seen with the regular triangle and skewed east west adjustment. At one standard deviation 68% of the area falls between a difference of 7 and 39mm using the regular triangle and 12 and 46mm when using the skewed east west configuration. If we look at the fully constrained adjustment which is represented by a more clustered curve one standard deviation below the mean is the equal to 1mm and one standard deviation above the mean is equal to 14mm. This means that when using all the control within the adjustment there is a 68% probability that the difference between a manually reinstated corner and a corner generated from the cadastral adjustment will be between 1 and 14mm.

5.5 Manual Reinstatement vs Cadastral Adjustment Distance Vector Plots

The distance difference vector plots can be used to examine the direction and magnitude of the difference between the manual reinstatement and the cadastral adjustment. The direction of the arrow is from the manually reinstated corner to the outputted corner from the GeoCadastre adjustment. The length of the line displays the difference in metres between the two points in conjunction with the scale bar.

The regular quadrilateral vectors show us that the corners within the control configuration tend to converge towards the centre of the rectangle. In the case of the regular quadrilateral 1 configuration the converging point is slightly to the south of the centre while the regular quadrilateral 2 configuration is converging more towards the centre. It can be seen that at the converging point the length of the vector is smaller than the length of the vector around and outside the perimeter of the quadrilateral. This means that when using this configuration, lots closer to the centre of the quadrilateral will be better represented by their actual boundary position then lots away from the centre of the control configuration.

When analysing the regular triangle configurations similar observations can be made. Points outside the configuration tend to be forced towards the triangle resulting in larger difference vectors at these corners. We can see that the regular triangle 1 configuration has a converging point slightly to the north of the centre of the triangle. At this point the distance vector is at its smallest and the majority of the points are again converging towards this point. Lots to the east of the triangle that are outside of the control network are being heavily distorted. Similar observations can be made when analysing the regular triangle 2 configuration. The converging point is slightly to the east of the centre of the triangle and the data set is again being pushed towards this position. Lots to the west of the triangle, outside the network, are being affected the most with the majority of arrows being within the lot meaning that these parcels are becoming smaller.

The skewed east west and skewed north south distance vectors support the findings from 5.2. That is, if the control is skewed in an east west direction than the effect on the boundary corners will be greater in a north south direction. The same can be said when the control is running in a north south direction. If the control is skewed in a north south running line than the effect of the boundary corners will be in an east west direction. If we look at the skewed east west triangle vectors we can see that the corners to the north of the control are being pulled down towards the configuration and points to the south are being forced to the north. This is making the dimensions of the lots less than their actual sizes. Similar observations can be made when analysing the skewed north south configurations. We can see that the corners along the control line closely resemble their actual position however points outside the line are being pulled towards the control. Points to the west of the line are being pulled to the east and points to the east are being pulled to the west.

When analysing the fully constrained distance vector it can be seen that the adjustment closely resembles the manual reinstatement. At the corners where a control point is present the boundary corner is in good agreement with the manual reinstatement. If a corner or a line is not constrained by a control point then the error vector becomes greater. This can be seen on the most southern line within the distance vector plot which is not accompanied by any control. Because the line is not constrained it is being forced towards the other control points in order to maintain the deed measurements within the cadastral fabric.

5.6 Manual Reinstatement vs Cadastral Adjustment Mean Findings

A hypothesis was made that as more control is added to the adjustment the closer the adjustment would resemble the manual reinstatement and the true position of the boundary corners. In order to test this six additional adjustments where run, (known as the control density test), by removing points from the fully constrained configuration and then calculating the mean difference between the adjustment and the manual reinstatement. The first adjustment removed three points from the control list and generated a mean difference of 7mm. 20 and 15 points generated a mean difference between the two data sets of 8mm and when 10 points were used the mean became 9mm. When only five points were used in the adjustment a mean of 22mm was generated.

To better understand where the change in grade was between the 10 and 5 point adjustment another configuration was run using 7 points. The mean difference between the cadastral adjustment and the manual reinstatement when using 7 points was 13mm. This testing supported the hypothesis that as more control is added to the adjustment the closer the boundary corners would resemble their true positions. Keeping this in mind, based on the results, it can be seen that there is a point of diminishing returns. It would appear that this was at the ten point mark where adding more control would have minimal effects on the accuracy of the adjustment.

5.7 Summary

The fully constrained scatter plot and column graph found that the fully constrained adjustment resembled the manual reinstatement the best. The fully constrained histogram revealed that 77 out of the 147 boundary corners varied by 0 to 5mm between the cadastral adjustment and the manual reinstatement. The distance difference vector plots supported these discoveries.

In summary three key findings have been made which will be further discussed in Chapter 6:

1. The regular quadrilateral distance vectors revealed that the boundary corners tended to converge towards a point within the rectangle, slightly off centre, with the effects increasing further from this point. Similar results can be seen with the regular triangle.
2. The skewed east west and skewed north south distance vectors support the findings in 5.2. That is, if the control is skewed in an east west direction than the effect on the boundary corners will be greater in a north south direction and vice versa with a north south running control line.
3. The control density test found, that as ORMs were extracted from the adjustment the greater the difference between the cadastral adjustment and the manual reinstatement became.

CHAPTER 6

IMPLICATIONS AND CONCLUSIONS

6.1 Introduction

This chapter will discuss the implications of the three key findings outlined in 5.7. It will discuss the effect on parcels that are adjusted inside and outside of the control configuration and then look at the ramifications of running a skewed adjustment. The feasibility and benefits of using all of the control in the adjustment will also be discussed. Recommendations and further research suggestions will then be made followed by the dissertation's conclusions.

6.2 Implications

6.2.1 Points Inside and Outside the Control Configuration

It was found in 5.5 that within the regular quadrilateral and regular triangle adjustments that there tended to be a converging point to which the majority of corners were forced towards. This point tended to be within the control configuration, slightly off centre. It was also found at this converging point the length of the distance vector was less than the length of the vector around and outside the perimeter of the configurations.

This means that lots closer to the centre of the configurations were better represented by their actual boundary positions then lots away from the converging point within the configuration. It can be seen from the distance vectors that the corners that fell completely outside of the configurations were distorted the most. This ultimately means that if an adjustment is run with corners outside of the control configuration the lots attached to these corners are less likely to resemble the true position of the actual boundary. For this reason it could be said that boundary corners should not be included in the adjustment if they fall outside of the control configuration.

6.2.2 Skewed Adjustments

By analysing the scatter plots from 4.2 and the distance difference vector plots in 4.5, it was found that corners along the skewed control line closely resembled their actual position however points outside the line did not. In the north south configuration points to the west of the line were being pulled to the east, and points to the east were being pulled to the west towards the control line. The skewed east west triangle revealed that the corners to the north of the control were pulled south towards the configuration and points to the south were being forced north.

Based on the findings if a skewed east west line is used in an adjustment the corners of the subject parcels will most likely be affected in a north south direction and if a skewed north south line is used then the corners of the parcels will be affected in an east west direction. Any lots with corners found along the control line will most likely be affected the least with the distortion becoming greater further from this point. As previously mentioned in 3.4 the skewed adjustments have been included in this investigation for research purposes only and would not normally be used as a control configuration.

6.2.3 Fully Constrained, at What Cost?

Based on the findings within Chapter 4 it was found the adjustment that resembled the manual reinstatement the closest was the fully constrained adjustment. This adjustment used all 27 ORMs within the test area and produced a mean difference between the manual reinstatement and the cadastral adjustment of 7mm over the 147 corners. The corners affected most within this adjustment were those along the most southern line of the test area that were not connected to ORMs.

It was evident throughout all distance vector plots that corners held fixed by a connection to an ORM resembled their true position and as corners became further from these connections they began to deviate from the manual reinstatement. Based on these findings it can be said that if corners are not constrained to their actual positions by a connection to an ORM then there is nothing stopping the adjustment from calculating a solution of best fit which may not resemble the true position of the boundary corner. This is because when a control point is added to the adjustment the connection from the ORM to the boundary corner is held fixed. For example if the connection from the ORM to the boundary corner is 1m then that 1m connection will be held throughout the adjustment. This means that a corner connected to the ORM within the adjustment will always resemble the true position of the boundary corner and the neighbouring corners will then be adjusted between the next connection to an ORM.

It was found when removing control that as ORMs were extracted from the adjustment the greater the difference between the cadastral adjustment and the manual reinstatement became. Keeping this in mind it would appear, based on the results, that there was a point of diminishing returns around the 10 control point mark. Similar results were achieved when using all 27 ORMs to the results gained from using less than half of the total number of marks in the area. When 7 ORMs were used the mean difference became slightly larger and larger again when only 5 ORMs were used. This potentially means that 10 ORMs could have been measured in the field rather than 27 and similar results would have been achieved to those from using all of the ORMs. The same could possibly be said over larger sites. Is it really necessary to measure all of the ORMs in the area? Could time and money be saved while still arriving at the true position of the boundary corners?

In the case of the test area of 48 parcels it can be seen that the survey required to measure 27 ORMs would also be required to measure 10 ORMs. The 10 ORM survey would still require the same number of traverse stations and if the surveyor was in a position where an ORM could be measured it would be unwise not to do so knowing that the best results are achieved from using more control in the adjustment. Based on the adjustments conducted in the test area no cost benefits would be gained from measuring 10 ORMs rather than all 27 ORMs.

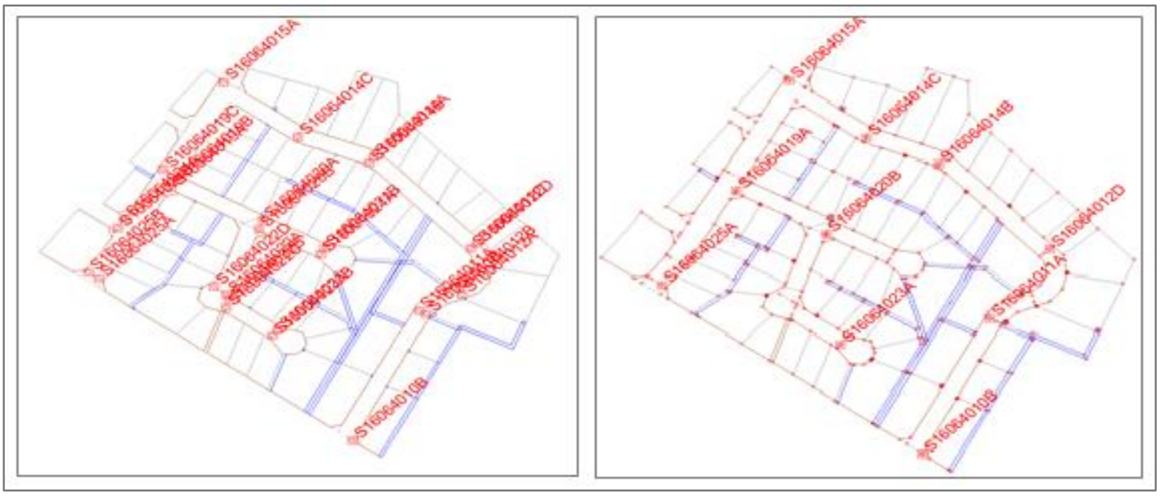

Figure 49 : Fully Constrained and 10 Point Traverse

The same could be said for a larger site. Given the nature of the placement of ORMs which are normally grouped in pairs, on either side of a road, very little time would be saved in measuring one ORM instead of two. The test area showed that accurate results can be achieved using a mini prism on a low set pole for measuring the ORMs. If this technique is used setup time is further reduced and the time to measure a set of marks compared to just one would be negligible.

Based on these findings the results would suggest that when conducting a cadastral adjustment of similar size, and potentially larger areas, the best representation of the actual boundary corners would be achieved using all the available ORMs within the adjustment area. It could also be said that there is no supportable argument to suggest there is any real cost benefit in measuring a reduced number of ORMs. There is however, based on the results, a point of diminishing returns.

6.3 Further Research and Recommendations

Time could potentially be saved in traversing the ORMs directly rather than establishing a network of new coordinated marks. In the case of the initial research area of 280 parcels 45 Coordinated Reference Marks were installed despite 123 ORMs having been located which could have potentially been used as traverse stations. This equates to one FENO mark for every six lots. The ORMs within the area satisfied the requirements outlined in the Northern Territory Practice Directions; that the CRM must be constructed of a material that will resist destruction by fire, decay and termites.

The ORMs which were mainly drill holes in the road kerb could have been adopted and a witness plate accompanied with the mark to aid in future recovery and identification. This would have eliminated the need of acquiring and installing the FENO mark which is a physical and sometimes tedious procedure depending on soil type. Why does the Northern Territory Government insist on placing additional survey marks?

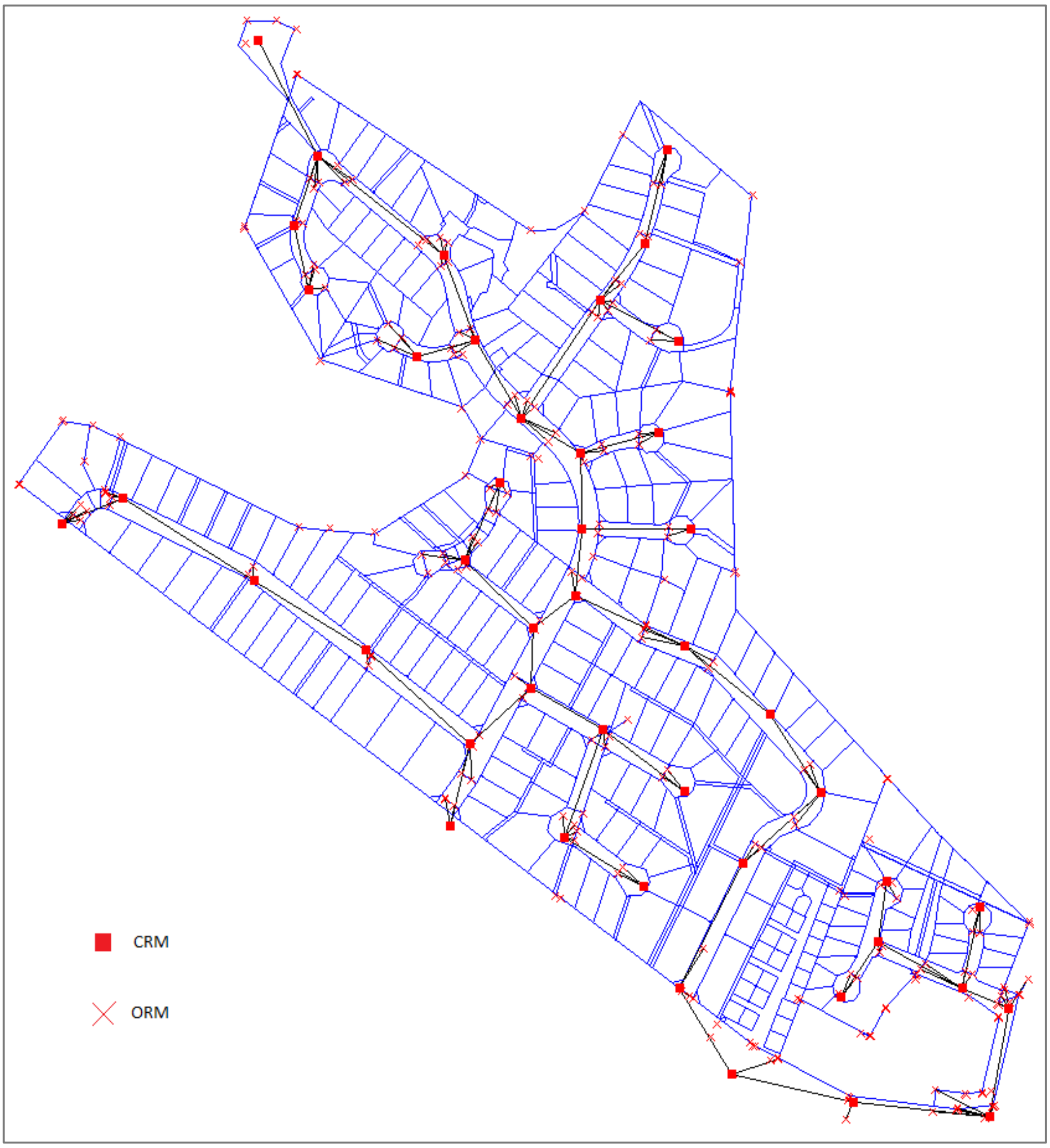

Figure 50 : Research Area Established CRM Network

Given that the research area was irregular in shape to accommodate for the undulating terrain it could be said that a more than normal amount of CRMs was required to traverse the area. An interesting comparison could be made against an area with lots in traditional grid arrangement. How many CRMs would be required for an area consisting of 280 parcels in a normal street configuration? Should there be a standard based on the number of lots or nature of the terrain and street layout?

To change to a coordinate based cadastre will be at least as significant as the change to Torrens Title in the 1860's (Maddocks & West, unpub). A study based around the transition process to a coordinated survey area in urban areas could investigate this statement. As mentioned in 2.1.2 the Northern Territory already has legislated coordinated cadastre areas. These areas are remote communities and have been specially selected.

In most of these areas the fencing was located as an indicator of the boundary and therefore the fencepost can represent the coordinate. The partitions, (not subdivision), are like greenfield subdivisions, there is limited or no existing survey data. In urban areas there are many surveys and so the process of determining the coordinates for the corners is more complex. Handling the coordinates on lodged surveys also becomes an issue as they will change over time. Hence the coordinates do not appear on the survey plan, they will reside in the acs file (Sandy, C 2016, pers. comm., 14 September).

This study has shown that adjusting a small area of 48 parcels can produce accurate coordinates for the boundary corners. Further research could investigate the effects of adjusting larger networks within the town of Alice Springs. Hunter Water in NSW run some very large adjustments, up to about 4000 parcels, approximately half the size of Alice Springs (Elfick, M 2015, pers. comm., 3 November). Is this a good idea?

6.4 Conclusions

This dissertation has provided the reader with specific information in regards to creating a NCDB. It has made recommendations on the optimal number and configuration of control points to be used during the cadastral adjustment within the software package GeoCadastre. These recommendations are based on the findings from conducting adjustments in a test area consisting of 48 parcels with ORMs in good agreement with the original cadastral plan data.

The study has revealed that when using a control configuration such as a quadrilateral or a triangle that lots closer to the centre of the configurations are better represented by their actual boundary corners. It was found that the corners that fell completely outside of the configurations were distorted the most and for this reason it could be said that boundary corners should not be included in the adjustment if they are outside of the control configuration. It was also found that if a skewed east west line is used in an adjustment the corners of the subject parcels will most likely be affected in a north south direction and if a skewed north south line is used then the corners of the parcels will be affected in an east west direction.

The results revealed that the adjustment that resembled the manual reinstatement the closest was achieved when using the fully constrained configuration. This adjustment used all 27 ORMs within the test area and produced a mean difference between the manual reinstatement and the cadastral adjustment of 7mm over 147 corners. It was found when removing control, that as ORMs were extracted from the adjustment the greater the difference between the cadastral adjustment and the true boundary's became. It was also found, based on the results, that there is a point of diminishing returns at which adding more control has minimal impact on improving the accuracy of the adjustment. However as field costs are virtually unaffected by measuring additional marks, there is no supportable argument to suggest any real cost benefit in measuring a reduced number of ORMs.

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APPENDICIES

APPENDIX A

ENG4111/4112 Research Project

Project Specification

For: David Roberts

Title: The effects of control point shape and distribution in the creation of a Numeric Cadastral Data Base, NCDB, in an urban area of Alice Springs NT

Major: Surveying

Supervisors: Glenn Campbell

Sponsorship: Department of Lands Planning and Environment NT

Brian Blakeman Surveys

Enrolment: ENG4111 – EXT S1, 2016 ENG4112 – EXT S2, 2016

Project Aim: To investigate the creation of a Numeric Cadastral Data Base in an urban area of Alice Springs NT and the effects of control point shape and distribution in the adjustment process on the final position of parcel corners

Programme: Issue B, 6th April 2016

1. Search for existing research in regards to Numeric Cadastral Data Bases and effects of control point geometry

2. Collect necessary documentation, survey plans, to be used throughout the course of the research project

3. Enter original survey data from compiled plans into software package to be used for future adjustments and original reference mark reconnaissance

4. Establish Coordinated Reference Marks, CRM's, and traverse to original survey marks on street frontages and back of parcels

5. Reduce and plot traverse data using appropriate survey software packages

6. Run least squares adjustment of traverse and original data using conventional methods currently used by the Department of Lands Planning and Environment NT to create the NCDB

7. Analyse the effects of running the least squares adjustment using different nominated points as control by comparing the position of the adjusted parcel corners with that of the original parcel corner position

8. Determine the effect of control point shape and distribution when creating a NCDB

APPENDIX B

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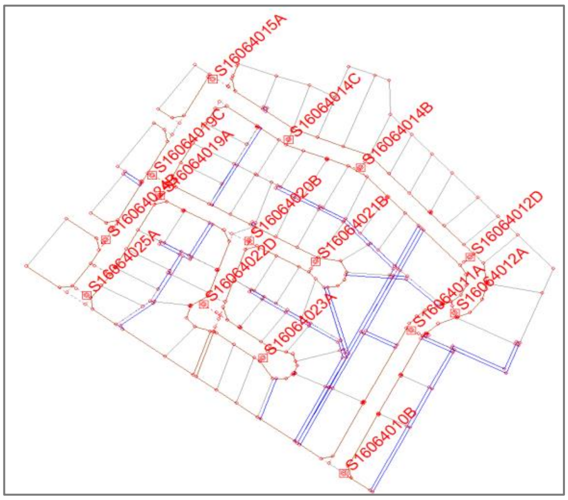
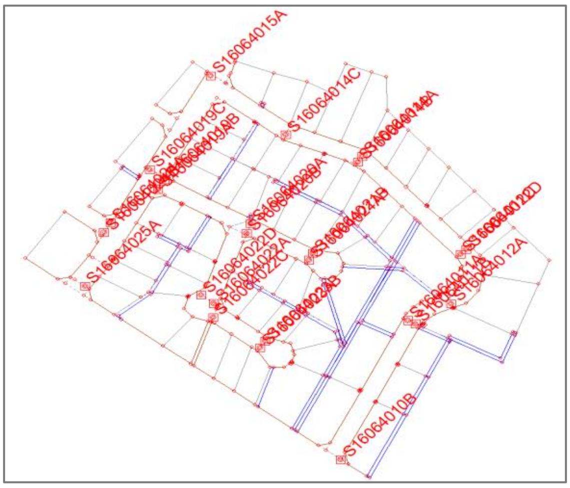
4	S16064010B	?C	U53	382964.701	7378098.206	581.370?	0.005	0.002	36.4	0.032
4	S16064011	?C	U53	383011.031	7378220.099	582.930?	0.001	0.001	114.7	0.006
4	S16064011A	?C	U53	383022.734	7378237.594	582.770?	0.006	0.002	124.2	0.032
4	S16064011B	?C	U53	383029.120	7378234.344	582.770?	0.006	0.002	142.1	0.032
4	S16064012	?C	U53	383083.802	7378286.062	585.568?	0.001	0.001	67.5	0.006
4	S16064012A	?C	U53	383060.404	7378254.514	585.406?	0.011	0.002	126.9	0.032
4	S16064012B	?C	U53	383058.366	7378261.510	585.406?	0.010	0.002	136.3	0.032
4	S16064012C	?C	U53	383068.331	7378304.205	585.406?	0.007	0.002	50.0	0.032
4	S16064012D	?C	U53	383073.542	7378309.083	585.406?	0.008	0.002	66.4	0.032
4	S16064013	?C	U53	383029.128	7378361.998	588.361?	0.002	0.001	42.4	0.010
4	S16064014	?C	U53	382956.545	7378416.400	591.801?	0.002	0.001	32.9	0.011
4	S16064014A	?C	U53	382983.014	7378402.203	591.643?	0.008	0.002	28.8	0.032
4	S16064014B	?C	U53	382979.023	7378396.251	591.643?	0.008	0.002	42.0	0.032
4	S16064014C	?C	U53	382916.729	7378423.641	591.643?	0.010	0.002	11.2	0.032
4	S16064015	?C	U53	382854.797	7378460.951	587.259?	0.002	0.001	3.9	0.012
4	S16064015A	?C	U53	382851.376	7378482.704	587.265?	0.007	0.002	80.8	0.032
4	S16064016	?C	U53	382815.649	7378431.826	586.539?	0.001	0.001	21.9	0.008
4	S16064017	?C	U53	382751.609	7378492.557	588.900?	0.002	0.001	19.5	0.008
4	S16064017A	?C	U53	382759.268	7378513.542	588.735?	0.006	0.002	110.1	0.032
4	S16064017B	?C	U53	382763.759	7378508.996	588.735?	0.006	0.002	127.2	0.032
4	S16064017C	?C	U53	382753.178	7378487.219	588.735?	0.003	0.002	70.1	0.032
4	S16064017D	?C	U53	382745.092	7378485.046	588.735?	0.004	0.002	134.0	0.032
4	S16064017E	?C	U53	382711.883	7378497.975	588.735?	0.010	0.002	8.3	0.032
4	S16064017F	?C	U53	382731.549	7378498.372	588.735?	0.006	0.002	16.6	0.032
4	S16064018	?C	U53	382791.674	7378557.060	592.624?	0.002	0.002	179.8	0.008
4	S16064018D	?C	U53	382774.665	7378558.248	592.457?	0.006	0.002	5.0	0.032
4	S16064018B	?C	U53	382780.693	7378536.081	592.457?	0.007	0.003	118.5	0.032
4	S16064018C	?C	U53	382773.655	7378538.603	592.457?	0.008	0.002	135.3	0.032
4	S16064019	?C	U53	382813.863	7378377.864	585.774?	0.001	0.001	20.2	0.008
4	S16064019A	?C	U53	382805.842	7378369.234	585.607?	0.005	0.002	134.6	0.032
4	S16064019B	?C	U53	382811.211	7378378.833	585.607?	0.003	0.002	20.5	0.032
4	S16064019C	?C	U53	382798.820	7378388.623	585.607?	0.006	0.002	35.7	0.032
4	S16064020	?C	U53	382880.957	7378340.716	586.070?	0.002	0.001	43.8	0.012
4	S16064020A	?C	U53	382886.056	7378334.854	585.897?	0.004	0.002	48.4	0.032
4	S16064020B	?C	U53	382882.626	7378324.931	585.897?	0.005	0.002	82.1	0.032
4	S16064020C	?C	U53	382869.768	7378330.647	585.897?	0.005	0.003	138.8	0.032
4	S16064021	?C	U53	382957.190	7378284.767	584.275?	0.002	0.002	46.9	0.012
4	S16064021A	?C	U53	382936.624	7378298.127	584.112?	0.008	0.002	33.8	0.032
4	S16064021B	?C	U53	382940.312	7378304.734	584.112?	0.008	0.002	50.3	0.032
4	S16064022	?C	U53	382844.819	7378243.129	583.805?	0.002	0.001	88.8	0.009
4	S16064022B	?C	U53	382856.317	7378248.740	583.645?	0.004	0.002	153.6	0.032
4	S16064022C	?C	U53	382853.542	7378240.751	583.645?	0.004	0.002	17.0	0.032
4	S16064022D	?C	U53	382843.279	7378263.088	583.645?	0.006	0.002	85.7	0.032
4	S16064022A	?C	U53	382854.477	7378254.836	583.645?	0.005	0.002	128.9	0.032
4	S16064023	?C	U53	382918.245	7378199.378	583.244?	0.002	0.002	66.0	0.009
4	S16064023A	?C	U53	382894.553	7378210.613	583.082?	0.008	0.002	25.9	0.032
4	S16064023B	?C	U53	382899.081	7378216.758	583.082?	0.008	0.002	42.9	0.032
4	S16064024	?C	U53	382756.408	7378327.382	584.410?	0.002	0.001	143.0	0.009
4	S16064024A	?C	U53	382764.377	7378336.015	584.247?	0.005	0.002	134.1	0.032
4	S16064024B	?C	U53	382758.687	7378325.826	584.247?	0.003	0.002	32.9	0.032
4	S16064024C	?C	U53	382758.427	7378294.754	584.247?	0.010	0.002	87.0	0.032
4	S16064024D	?C	U53	382749.110	7378300.753	584.247?	0.008	0.002	105.8	0.032
4	S16064025	?C	U53	382739.523	7378254.218	583.620?	0.002	0.002	24.5	0.009
4	S16064025A	?C	U53	382742.235	7378271.983	583.456?	0.006	0.002	98.9	0.032
4	S16064025B	?C	U53	382733.373	7378278.513	583.456?	0.008	0.002	75.8	0.032
4	S16064026	?C	U53	382811.579	7378136.450	582.540?	0.002	0.001	25.6	0.010
4	S16064027	?C	U53	382660.910	7378411.114	586.080?	0.003	0.001	33.3	0.010
4	S16064027A	?C	U53	382664.151	7378406.919	585.915?	0.004	0.002	43.9	0.032
4	S16064027B	?C	U53	382661.660	7378398.560	585.915?	0.005	0.003	75.5	0.032
4	S16064028	?C	U53	382559.136	7378472.828	589.358?	0.002	0.001	34.9	0.010
4	S16064028A	?C	U53	382549.440	7378480.088	589.199?	0.005	0.002	37.0	0.032
4	S16064028B	?C	U53	382553.680	7378487.175	589.199?	0.005	0.002	67.3	0.032
4	S16064029	?C	U53	382426.746	7378549.295	590.834?	0.002	0.001	29.6	0.010
4	S16064029A	?C	U53	382420.112	7378542.520	590.664?	0.004	0.002	136.7	0.032
4	S16064029B	?C	U53	382422.766	7378550.289	590.664?	0.003	0.002	17.1	0.032
4	S16064030	?C	U53	382375.597	7378525.813	590.331?	0.002	0.002	26.1	0.013
4	S16064030A	?C	U53	382393.112	7378542.884	590.174?	0.007	0.003	136.3	0.032
4	S16064030B	?C	U53	382386.559	7378534.078	590.174?	0.005	0.002	144.3	0.032
4	S16064030C	?C	U53	382399.143	7378537.271	590.174?	0.008	0.002	154.8	0.032
4	S16064030D	?C	U53	382393.210	7378529.178	590.174?	0.006	0.002	170.3	0.032
4	S16064031	?C	U53	382535.682	7378341.865	586.290?	0.002	0.001	33.0	0.011

APPENDIX C

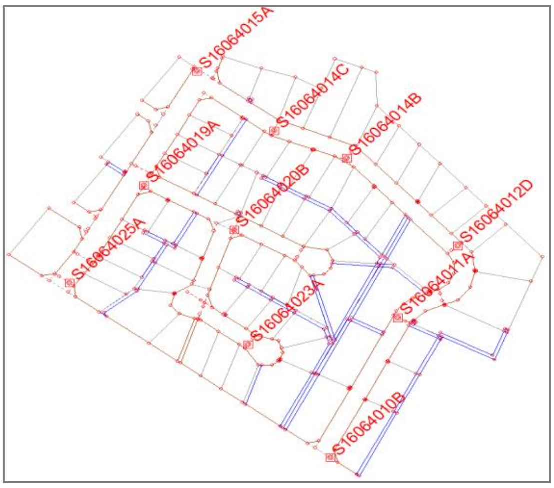
27 Points (Fully Constrained)



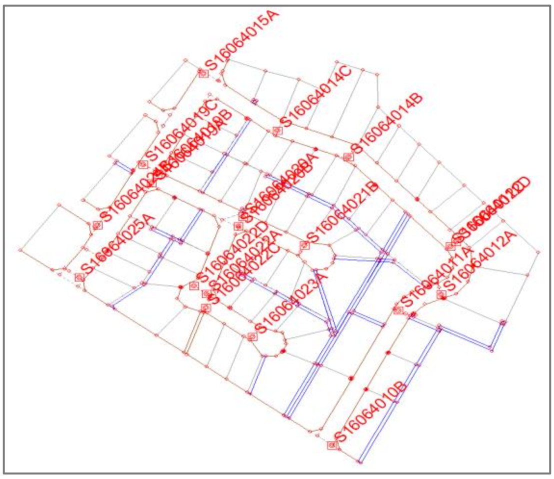
15 Points



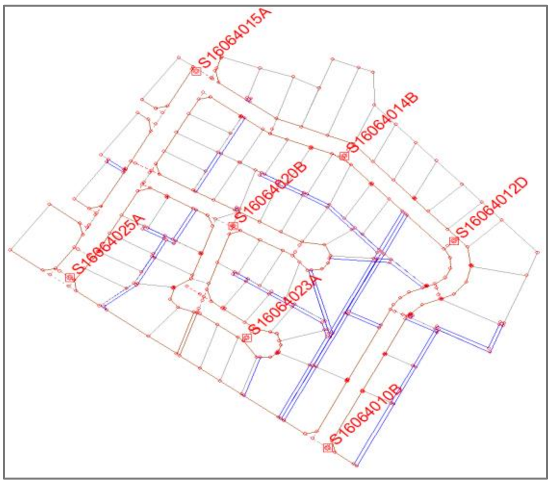
25 Points



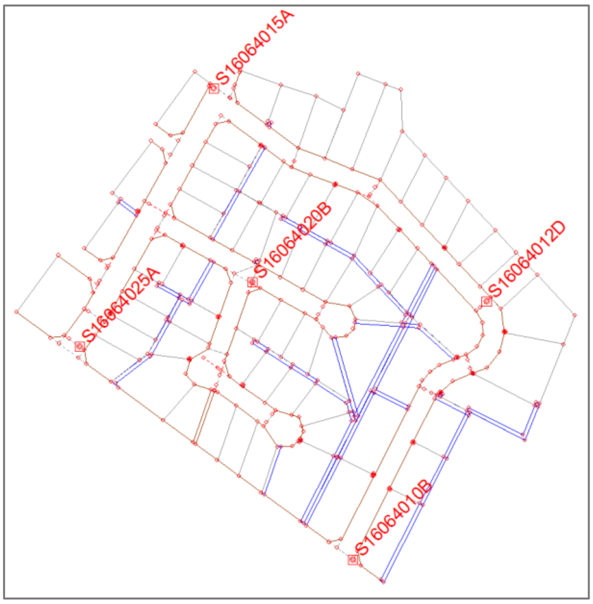
10 Points



20 Points



7 Points


S16064015A
S16064020B
S16064012D
S16064025A
S16064010B

5 Points

APPENDIX D

LISCAD Report: Point Comparison
Sunday, July 24, 2016 15:19

File: 20. Fully Constrained
Projection: Map Grid Australia 94 Zone 53
File Date: Thursday, July 14, 2016

Method: Location (Radius=0.100m.)

R - Resolved point
M - Main point

Point ID		Co-ordinates East	North	Elevation	Bearing	Distance
4	M	382964.346	7378417.030			
307	M	+0.001	+0.000		88°37'25"	0.001
6	M	382977.856	7378394.512			
13	M	+0.000	-0.000		143°22'18"	0.000
8	M	383003.818	7378390.177			
301	M	-0.004	-0.002		246°50'21"	0.004
10	M	383021.386	7378371.397			
302	M	-0.004	-0.001		261°50'16"	0.004
11	M	383038.954	7378352.618			
303	M	-0.005	-0.001		262°45'33"	0.005
12	M	383065.133	7378301.213			
209	M	-0.001	-0.000		256°12'26"	0.002
14	M	382984.687	7378387.211			
26	M	+0.000	-0.002		174°28'13"	0.002
16	M	383051.244	7378339.479			
304	M	-0.004	-0.001		260°40'36"	0.004
18	M	383088.111	7378283.675			
274	M	-0.006	+0.011		329°55'33"	0.012
19	M	382987.001	7378408.148			
191	M	+0.002	+0.001		47°31'28"	0.002
20	M	382994.477	7378156.633			
216	M	-0.001	-0.002		215°53'29"	0.002
22	M	383021.276	7378244.455			
102	M	-0.003	-0.007		202°08'26"	0.007
23	M	383076.813	7378312.143			
208	M	+0.001	+0.000		85°42'27"	0.001
24	M	383017.566	7378352.074			
291	M	+0.000	-0.011		178°14'29"	0.011
25	M	382988.132	7378322.523			
447	M	+0.007	-0.006		129°24'26"	0.010
27	M	382914.927	7378418.425			
411	M	-0.001	-0.001		228°58'02"	0.001
28	M	382965.982	7378346.198			
422	M	+0.007	-0.006		131°34'24"	0.009
29	M	382968.508	7378398.064			
32	M	+0.002	-0.002		136°00'14"	0.003
30	M	382946.601	7378357.030			
423	M	+0.003	-0.004		141°47'12"	0.005
31	M	382928.769	7378366.996			
424	M	-0.001	-0.002		199°46'13"	0.002
33	M	382922.986	7378207.293			
189	M	+0.004	+0.000		85°30'10"	0.004
34	M	382964.628	7378219.054			
456	M	-0.007	+0.002		287°20'49"	0.008
35	M	382915.057	7378216.194			
186	M	+0.001	+0.001		63°44'13"	0.002
36	M	382915.970	7378257.379			
462	M	-0.004	+0.003		306°58'37"	0.005
37	M	382893.120	7378226.366			
419	M	-0.002	+0.001		298°55'39"	0.003
39	M	382887.025	7378275.936			
460	M	-0.006	+0.006		319°50'04"	0.009
40	M	382942.361	7378308.400			
145	M	-0.001	-0.001		230°15'46"	0.001
42	M	382920.398	7378434.262			
58	M	+0.002	-0.002		139°05'13"	0.003
43	M	382947.603	7378279.298			
158	M	+0.008	-0.008		135°11'23"	0.011
44	M	382887.505	7378339.049			
372	M	+0.001	+0.002		23°36'07"	0.002
45	M	382967.031	7378294.307			
155	M	+0.008	-0.010		142°39'32"	0.013
46	M	382962.099	7378305.233			
154	M	+0.004	-0.002		112°53'00"	0.004
47	M	382923.221	7378370.097			
445	M	+0.001	-0.003		163°08'01"	0.003
48	M	382902.277	7378381.803			
312	M	-0.002	-0.001		238°21'56"	0.002
49	M	382910.094	7378377.434			
444	M	-0.004	-0.000		267°16'58"	0.004
50	M	383057.137	7378265.723			
220	M	+0.001	+0.002		17°33'48"	0.002
52	M	382890.519	7378436.406			
343	M	-0.007	+0.008		317°49'58"	0.011
53	M	382870.065	7378399.806			
437	M	-0.007	+0.004		302°50'12"	0.008
54	M	382880.735	7378418.898			
436	M	-0.006	+0.009		324°00'22"	0.011
55	M	382888.108	7378389.721			
438	M	-0.003	+0.001		294°29'46"	0.003
56	M	383061.633	7378250.301			
214	M	-0.001	-0.002		198°09'56"	0.002
59	M	382844.817	7378438.971			
136	M	+0.001	+0.003		12°58'32"	0.003
61	M	382834.148	7378419.878			
135	M	+0.001	+0.005		17°33'19"	0.005
62	M	382823.482	7378400.787			
134	M	-0.001	+0.004		350°13'41"	0.004
63	M	382859.396	7378380.714			
440	M	-0.006	+0.005		309°21'44"	0.008
64	M	382816.334	7378387.997			
133	M	-0.002	-0.000		264°33'22"	0.002
66	M	383033.057	7378232.338			
223	M	+0.001	-0.001		117°25'46"	0.001
69	M	382866.385	7378350.853			
392	M	-0.000	+0.003		359°37'00"	0.003
70	M	382800.720	7378360.069			
210	M	+0.000	+0.001		5°54'13"	0.001
71	M	382811.606	7378363.149			
204	M	-0.001	+0.002		325°54'47"	0.002
72	M	382826.966	7378354.565			
400	M	-0.002	-0.001		254°58'14"	0.002
73	M	382968.333	7378105.332			
249	M	+0.000	+0.002		11°34'14"	0.002
74	M	382848.544	7378342.511			
401	M	-0.008	-0.007		231°59'47"	0.010
75	M	382830.780	7378310.720			
468	M	-0.008	+0.006		308°14'10"	0.010
76	M	382824.391	7378314.290			
469	M	-0.007	+0.006		313°20'46"	0.009
77	M	382861.043	7378335.526			
396	M	-0.011	-0.007		236°00'33"	0.013
78	M	382945.211	7378112.565			
259	M	+0.008	-0.010		141°18'09"	0.013
79	M	382955.281	7378114.947			
258	M	+0.003	-0.010		161°42'30"	0.010
80	M	382865.414	7378324.064			
399	M	-0.011	-0.007		239°41'53"	0.013
81	M	382776.649	7378316.993			
380	M	+0.000	+0.008		2°00'58"	0.008
82	M	382766.443	7378298.723			
379	M	-0.003	+0.010		341°45'05"	0.011
83	M	382803.976	7378277.751			
471	M	-0.008	+0.012		326°02'13"	0.014
84	M	382848.148	7378274.071			
403	M	-0.014	+0.016		319°55'01"	0.021
85	M	382812.917	7378293.756			
472	M	-0.004	+0.012		344°09'45"	0.013
86	M	382797.472	7378266.110			
465	M	-0.008	+0.018		335°45'02"	0.019
87	M	382832.442	7378262.066			
199	M	-0.012	+0.022		332°26'59"	0.025
88	M	382754.763	7378281.244			
466	M	-0.005	+0.010		332°52'00"	0.011
99	M	383018.801	7378239.598			
234	M	-0.000	+0.001		330°38'13"	0.001
100	M	383009.175	7378220.710			
267	M	+0.010	+0.015		33°16'25"	0.018
106	M	383049.549	7378262.730			
272	M	+0.013	+0.004		72°04'24"	0.014
120	M	382847.549	7378484.842			
1450	M	-0.001	+0.001		297°24'05"	0.001
121	M	382848.778	7378487.042			
585	M	-0.000	+0.001		353°58'20"	0.001

126	M	382870.657	7378470.926		
896	M	-0.011	+0.002	279°41'03"	0.012
138	M	382853.228	7378454.025		
415	M	+0.000	-0.004	179°49'24"	0.004
139	M	382819.412	7378377.113		
426	M	+0.001	-0.002	160°27'32"	0.002
148	M	382889.185	7378319.806		
368	M	+0.002	-0.002	135°28'39"	0.002
151	M	382934.566	7378294.444		
376	M	-0.000	-0.001	181°08'43"	0.001
157	M	382940.436	7378287.625		
377	M	-0.004	+0.004	314°58'09"	0.006
164	M	382879.591	7378316.147		
367	M	-0.000	-0.002	191°56'40"	0.002
176	M	382901.571	7378220.138		
325	M	+0.001	+0.001	44°49'35"	0.001
179	M	382851.845	7378235.837		
313	M	+0.000	-0.002	169°46'13"	0.002
183	M	382892.086	7378207.265		
322	M	-0.001	-0.001	241°46'26"	0.001
188	M	382941.804	7378425.864		
308	M	+0.001	+0.005	8°10'21"	0.005
192	M	382903.134	7378190.598		
323	M	-0.002	-0.002	219°25'03"	0.003
194	M	382921.380	7378195.617		
327	M	-0.007	-0.003	245°21'24"	0.008
195	M	382849.010	7378236.817		
318	M	+0.003	-0.005	144°15'22"	0.006
196	M	382835.780	7378241.387		
482	M	+0.011	-0.010	131°59'29"	0.015
200	M	382847.008	7378270.827		
366	M	+0.013	-0.020	146°27'24"	0.024
205	M	383068.316	7378321.228		
305	M	-0.004	+0.001	280°36'07"	0.004
207	M	383085.387	7378302.977		
273	M	-0.010	+0.012	320°08'27"	0.016
217	M	383013.766	7378194.484		
236	M	+0.001	+0.001	38°46'39"	0.001
241	M	382836.841	7378192.406		
317	M	+0.003	-0.016	171°10'05"	0.016
256	M	382952.119	7378182.263		
429	M	+0.000	+0.010	1°11'24"	0.010
257	M	382981.874	7378167.104		
269	M	-0.015	+0.001	273°39'45"	0.015
260	M	382924.408	7378127.880		
390	M	-0.006	+0.015	339°13'25"	0.017
263	M	382729.823	7378281.128		
480	M	+0.008	-0.005	123°41'22"	0.009
266	M	382979.431	7378235.887		
428	M	+0.014	-0.002	98°55'44"	0.014
271	M	383011.091	7378297.985		
427	M	+0.005	-0.004	131°50'53"	0.006
279	M	383007.611	7378291.159		
451	M	+0.005	-0.006	140°38'50"	0.007
284	M	383031.222	7378337.477		
292	M	-0.001	-0.012	183°35'13"	0.012
290	M	383002.354	7378368.324		
296	M	-0.002	+0.007	341°15'48"	0.007
293	M	382994.329	7378315.900		
430	M	+0.003	-0.001	118°44'09"	0.003
297	M	382979.115	7378332.160		
431	M	+0.003	-0.001	107°15'32"	0.003
306	M	382950.055	7378405.078		
310	M	-0.003	-0.002	235°32'14"	0.003
311	M	382944.164	7378358.392		
446	M	+0.005	-0.005	136°11'06"	0.007
315	M	382869.594	7378223.838		
420	M	-0.002	+0.000	283°58'41"	0.002
316	M	382854.292	7378179.538		
385	M	-0.004	+0.014	346°21'37"	0.014
319	M	382834.316	7378194.252		
382	M	-0.004	+0.017	346°12'39"	0.018
320	M	382887.018	7378210.998		
421	M	-0.001	+0.002	324°43'19"	0.002
321	M	382871.713	7378166.701		
386	M	-0.002	+0.015	354°21'35"	0.015
324	M	382890.177	7378153.097		
389	M	-0.000	+0.014	359°21'56"	0.014
328	M	382951.643	7378181.329		
455	M	-0.002	+0.005	336°12'30"	0.006
336	M	382894.635	7378453.252		
895	M	-0.005	+0.001	277°59'26"	0.005
337	M	382863.571	7378456.264		
416	M	-0.001	-0.005	191°45'12"	0.005
338	M	382966.856	7378211.166		
454	M	-0.008	+0.004	293°54'48"	0.009
342	M	382908.527	7378423.141		
404	M	+0.005	-0.006	137°28'40"	0.008
344	M	382826.378	7378446.959		
586	M	-0.002	+0.001	302°39'45"	0.002
345	M	382935.962	7378244.563		
463	M	-0.001	-0.002	208°49'44"	0.002
346	M	382962.169	7378227.760		
457	M	-0.007	+0.001	276°53'55"	0.007
349	M	382812.183	7378421.558		
562	M	-0.002	+0.005	343°09'54"	0.005
350	M	382789.936	7378381.750		
555	M	-0.006	+0.004	305°21'27"	0.007
351	M	382769.257	7378344.747		
556	M	-0.001	+0.003	350°16'58"	0.003
353	M	382895.860	7378270.272		
461	M	-0.007	+0.007	313°34'53"	0.010
354	M	382873.927	7378240.504		
418	M	+0.001	+0.003	11°01'55"	0.003
358	M	382745.845	7378302.856		
475	M	+0.002	-0.003	146°44'48"	0.004
359	M	382869.574	7378287.124		
414	M	-0.007	+0.009	322°50'37"	0.012
360	M	382864.063	7378247.773		
417	M	-0.001	+0.003	341°05'22"	0.003
361	M	382860.235	7378260.079		
413	M	-0.011	+0.015	324°50'55"	0.019
362	M	382753.110	7378315.846		
492	M	-0.001	-0.003	204°40'41"	0.003
363	M	382745.925	7378269.264		
476	M	+0.009	-0.006	126°25'39"	0.011
364	M	382747.612	7378258.139		
478	M	+0.012	-0.034	161°04'36"	0.036
369	M	382906.220	7378310.288		
409	M	-0.003	-0.000	263°07'35"	0.003
370	M	382762.680	7378292.007		
473	M	+0.009	-0.004	117°01'29"	0.010
374	M	382925.836	7378299.322		
410	M	-0.001	+0.001	337°21'54"	0.001
375	M	382905.976	7378263.786		
459	M	-0.005	+0.005	314°16'17"	0.007
378	M	382928.115	7378249.593		
458	M	-0.003	+0.001	286°47'02"	0.003
381	M	382786.859	7378335.269		
435	M	-0.002	-0.005	203°06'34"	0.005
383	M	382767.784	7378243.279		
477	M	+0.002	-0.025	175°08'02"	0.025
384	M	382810.006	7378212.174		
483	M	+0.006	-0.021	165°36'55"	0.022
391	M	382848.340	7378360.943		
425	M	+0.001	-0.006	168°14'50"	0.006
393	M	382924.157	7378318.570		
407	M	-0.001	+0.001	318°19'41"	0.001
397	M	382905.831	7378328.810		
406	M	-0.000	+0.000	298°49'45"	0.000
402	M	382855.936	7378296.662		
448	M	+0.013	-0.005	113°01'10"	0.014
405	M	382889.442	7378388.976		
442	M	-0.002	-0.000	269°49'32"	0.002
412	M	382929.838	7378412.759		
443	M	-0.005	+0.001	284°02'14"	0.005
439	M	382809.202	7378322.776		
467	M	-0.002	+0.007	341°13'33"	0.007
452	M	382814.184	7378296.022		
470	M	-0.006	+0.008	323°24'38"	0.011
464	M	382790.889	7378261.066		
474	M	+0.011	-0.016	144°18'27"	0.019

Analysis of Differences

Range		
High:	+0.014	+0.022
Low:	-0.015	-0.034
No.Obs:	148	148
Mean:	-0.001	+0.000
StdDev:	0.005	0.008

APPENDIX E

LISCAD Report: Point Comparison
Monday, September 26, 2016 18:58

File: 21. 25 Points
Projection: Map Grid Australia 94 Zone 53
File Date: Thursday, July 14, 2016

Units
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Distance: Metres

Method: Location (Radius=0.150m.)

R - Resolved point
M - Main point

Point ID		Co-ordinates East	North	Elevation	Bearing	Distance
4	M	382964.346	7378417.030			
307	M	+0.001	+0.000		88°37'25"	0.001
6	M	382977.856	7378394.512			
13	M	+0.000	-0.000		143°22'18"	0.000
8	M	383003.818	7378390.177			
301	M	-0.004	-0.002		246°50'21"	0.004
10	M	383021.386	7378371.397			
302	M	-0.004	-0.001		261°50'16"	0.004
11	M	383038.954	7378352.618			
303	M	-0.005	-0.001		262°45'33"	0.005
12	M	383065.133	7378301.213			
209	M	-0.001	-0.000		256°12'26"	0.002
14	M	382984.687	7378387.211			
26	M	+0.000	-0.002		174°28'13"	0.002
16	M	383051.244	7378339.479			
304	M	-0.004	-0.001		260°40'36"	0.004
18	M	383088.111	7378283.675			
274	M	-0.006	+0.011		329°55'33"	0.012
19	M	382987.001	7378408.148			
191	M	+0.002	+0.001		47°31'28"	0.002
20	M	382994.477	7378156.633			
216	M	-0.001	-0.002		215°53'29"	0.002
22	M	383021.276	7378244.455			
102	M	-0.003	-0.007		202°08'26"	0.007
23	M	383076.813	7378312.143			
208	M	+0.001	+0.000		85°42'27"	0.001
24	M	383017.566	7378352.074			
291	M	+0.000	-0.011		178°14'29"	0.011
25	M	382988.132	7378322.523			
447	M	+0.007	-0.006		129°24'26"	0.010
27	M	382914.927	7378418.425			
411	M	-0.001	-0.001		228°58'02"	0.001
28	M	382965.982	7378346.198			
422	M	+0.007	-0.006		131°34'24"	0.009
29	M	382968.508	7378398.064			
32	M	+0.002	-0.002		136°00'14"	0.003
30	M	382946.601	7378357.030			
423	M	+0.003	-0.004		141°47'12"	0.005
31	M	382928.769	7378366.996			
424	M	-0.001	-0.002		199°46'13"	0.002
33	M	382922.986	7378207.293			
189	M	+0.004	+0.000		85°30'10"	0.004
34	M	382964.628	7378219.055			
456	M	-0.007	+0.001		280°05'00"	0.008
35	M	382915.056	7378216.194			
186	M	+0.002	+0.001		73°43'58"	0.003
36	M	382915.968	7378257.381			
462	M	-0.002	+0.001		296°59'20"	0.002
37	M	382893.118	7378226.367			
419	M	-0.000	+0.000		306°20'15"	0.001
39	M	382887.023	7378275.937			
460	M	-0.004	+0.005		327°29'11"	0.007
40	M	382942.361	7378308.400			
145	M	-0.001	-0.001		230°15'46"	0.001
42	M	382920.398	7378434.262			
58	M	+0.002	-0.002		139°05'13"	0.003
43	M	382947.603	7378279.299			
158	M	+0.008	-0.009		138°35'35"	0.012
44	M	382887.505	7378339.049			
372	M	+0.001	+0.002		23°36'07"	0.002
45	M	382967.031	7378294.308			
155	M	+0.008	-0.011		145°09'42"	0.014
46	M	382962.098	7378305.233			
154	M	+0.005	-0.002		108°46'45"	0.005
47	M	382923.221	7378370.097			
445	M	+0.001	-0.003		163°08'01"	0.003
48	M	382902.277	7378381.803			
312	M	-0.002	-0.001		238°21'56"	0.002
49	M	382910.094	7378377.434			
444	M	-0.004	-0.000		267°16'58"	0.004
50	M	383057.137	7378265.723			
220	M	+0.001	+0.003		11°24'26"	0.003
52	M	382890.519	7378436.406			
343	M	-0.007	+0.008		317°49'58"	0.011
53	M	382870.065	7378399.806			
437	M	-0.007	+0.004		302°50'12"	0.008
54	M	382880.735	7378418.898			
436	M	-0.006	+0.009		324°00'22"	0.011
55	M	382888.108	7378389.721			
438	M	-0.003	+0.001		294°29'46"	0.003
56	M	383061.633	7378250.301			
214	M	-0.001	-0.002		198°09'56"	0.002
59	M	382844.817	7378438.971			
136	M	+0.001	+0.003		12°58'32"	0.003
61	M	382834.148	7378419.878			
135	M	+0.001	+0.005		17°33'19"	0.005
62	M	382823.482	7378400.787			
134	M	-0.001	+0.004		350°13'41"	0.004
63	M	382859.396	7378380.714			
440	M	-0.006	+0.005		309°21'44"	0.008
64	M	382816.334	7378387.997			
133	M	-0.002	-0.000		264°33'22"	0.002
66	M	383033.057	7378232.338			
223	M	+0.001	-0.001		117°25'46"	0.001
69	M	382866.385	7378350.853			
392	M	-0.000	+0.003		359°37'00"	0.003
70	M	382800.720	7378360.069			
210	M	+0.000	+0.001		5°54'13"	0.001
71	M	382811.606	7378363.149			
204	M	-0.001	+0.002		325°54'47"	0.002
72	M	382826.966	7378354.566			
400	M	-0.002	-0.002		235°13'03"	0.003
73	M	382968.333	7378105.332			
249	M	+0.000	+0.002		11°34'14"	0.002
74	M	382848.544	7378342.511			
401	M	-0.008	-0.007		231°59'47"	0.010
75	M	382830.780	7378310.721			
468	M	-0.008	+0.005		303°13'47"	0.009
76	M	382824.390	7378314.291			
469	M	-0.006	+0.005		312°57'08"	0.008
77	M	382861.043	7378335.527			
396	M	-0.011	-0.008		232°34'29"	0.014
78	M	382945.211	7378112.565			
259	M	+0.008	-0.010		141°18'09"	0.013
79	M	382955.281	7378114.947			
258	M	+0.003	-0.010		161°42'30"	0.010
80	M	382865.414	7378324.065			
399	M	-0.011	-0.008		236°07'39"	0.014
81	M	382776.649	7378316.994			
380	M	+0.000	+0.007		2°14'18"	0.007
82	M	382766.443	7378298.724			
379	M	-0.003	+0.009		339°54'13"	0.010
83	M	382803.975	7378277.753			
471	M	-0.007	+0.010		324°34'45"	0.012
84	M	382848.146	7378274.073			
403	M	-0.012	+0.014		320°36'39"	0.018
85	M	382812.916	7378293.757			
472	M	-0.003	+0.011		347°30'45"	0.012
86	M	382797.471	7378266.112			
465	M	-0.007	+0.016		335°59'37"	0.017
87	M	382832.441	7378262.068			
199	M	-0.011	+0.020		332°18'17"	0.022
88	M	382754.764	7378281.244			
466	M	-0.006	+0.010		328°21'10"	0.011
99	M	383018.801	7378239.598			
234	M	-0.000	+0.001		330°38'13"	0.001
100	M	383009.175	7378220.710			
267	M	+0.010	+0.015		33°16'25"	0.018
106	M	383049.549	7378262.730			
272	M	+0.013	+0.005		68°17'01"	0.014
120	M	382847.549	7378484.842			
1450	M	-0.001	+0.001		297°24'05"	0.001

121	M	382848.778	7378487.042		
585	M	-0.000	+0.001	353°58'20"	0.001
126	M	382870.657	7378470.926		
896	M	-0.011	+0.002	279°41'03"	0.012
138	M	382853.228	7378454.025		
415	M	+0.000	-0.004	179°49'24"	0.004
139	M	382819.412	7378377.113		
426	M	+0.001	-0.002	160°27'32"	0.002
148	M	382889.185	7378319.806		
368	M	+0.002	-0.002	135°28'39"	0.002
151	M	382934.566	7378294.444		
376	M	-0.000	-0.001	181°08'43"	0.001
157	M	382940.436	7378287.625		
377	M	-0.005	+0.005	315°03'49"	0.007
164	M	382879.591	7378316.147		
367	M	-0.000	-0.002	191°56'40"	0.002
176	M	382901.571	7378220.138		
325	M	+0.001	+0.001	44°49'35"	0.001
179	M	382851.845	7378235.837		
313	M	-0.001	-0.002	194°30'54"	0.002
183	M	382892.086	7378207.265		
322	M	-0.001	-0.001	241°46'26"	0.001
188	M	382941.804	7378425.864		
308	M	+0.001	+0.005	8°10'21"	0.005
192	M	382903.134	7378190.598		
323	M	-0.002	-0.001	234°31'36"	0.002
194	M	382921.380	7378195.617		
327	M	-0.008	-0.003	248°07'26"	0.009
195	M	382849.010	7378236.817		
318	M	+0.003	-0.004	137°20'07"	0.005
196	M	382835.780	7378241.387		
482	M	+0.010	-0.008	128°12'11"	0.013
200	M	382847.008	7378270.827		
366	M	+0.011	-0.018	147°55'41"	0.021
205	M	383068.316	7378321.228		
305	M	-0.004	+0.001	280°36'07"	0.004
207	M	383085.387	7378302.977		
273	M	-0.010	+0.012	320°08'27"	0.016
217	M	383013.766	7378194.484		
236	M	+0.001	+0.001	38°46'39"	0.001
241	M	382836.841	7378192.406		
317	M	+0.001	-0.015	177°58'54"	0.015
256	M	382952.119	7378182.263		
429	M	+0.000	+0.010	1°11'24"	0.010
257	M	382981.874	7378167.104		
269	M	-0.015	+0.001	273°39'45"	0.015
260	M	382924.408	7378127.879		
390	M	-0.006	+0.016	340°24'33"	0.018
263	M	382729.823	7378281.128		
480	M	+0.014	-0.009	123°53'42"	0.016
266	M	382979.431	7378235.887		
428	M	+0.014	-0.002	98°55'44"	0.014
271	M	383011.091	7378297.985		
427	M	+0.005	-0.004	131°50'53"	0.006
279	M	383007.611	7378291.159		
451	M	+0.005	-0.006	140°38'50"	0.007
284	M	383031.222	7378337.478		
292	M	-0.001	-0.013	183°20'28"	0.013
290	M	383002.354	7378368.324		
296	M	-0.002	+0.007	341°15'48"	0.007
293	M	382994.329	7378315.900		
430	M	+0.003	-0.001	118°44'09"	0.003
297	M	382979.115	7378332.160		
431	M	+0.003	-0.001	107°15'32"	0.003
306	M	382950.055	7378405.078		
310	M	-0.003	-0.002	235°32'14"	0.003
311	M	382944.164	7378358.392		
446	M	+0.005	-0.005	136°11'06"	0.007
315	M	382869.593	7378223.838		
420	M	-0.001	+0.000	305°57'40"	0.001
316	M	382854.290	7378179.538		
385	M	-0.002	+0.014	354°14'49"	0.014
319	M	382834.314	7378194.253		
382	M	-0.002	+0.016	352°10'44"	0.016
320	M	382887.017	7378210.998		
421	M	-0.000	+0.002	347°43'35"	0.002
321	M	382871.712	7378166.701		
386	M	-0.001	+0.015	358°15'27"	0.015
324	M	382890.177	7378153.096		
389	M	-0.000	+0.015	359°26'16"	0.015
328	M	382951.643	7378181.329		
455	M	-0.002	+0.005	336°12'30"	0.006
336	M	382894.635	7378453.252		
895	M	-0.005	+0.001	277°59'26"	0.005
337	M	382863.571	7378456.264		
416	M	-0.001	-0.005	191°45'12"	0.005
338	M	382966.856	7378211.166		
454	M	-0.008	+0.004	293°54'48"	0.009
342	M	382908.527	7378423.141		
404	M	+0.005	-0.006	137°28'40"	0.008
344	M	382826.378	7378446.959		
586	M	-0.003	+0.001	292°40'18"	0.003
345	M	382935.961	7378244.563		
463	M	-0.000	-0.002	182°14'02"	0.002
346	M	382962.168	7378227.760		
457	M	-0.006	+0.001	278°02'49"	0.006
349	M	382812.183	7378421.558		
562	M	-0.003	+0.005	333°42'10"	0.006
350	M	382789.936	7378381.750		
555	M	-0.007	+0.005	306°58'39"	0.009
351	M	382769.257	7378344.747		
556	M	-0.001	+0.003	350°16'58"	0.003
353	M	382895.856	7378270.274		
461	M	-0.003	+0.005	326°47'51"	0.006
354	M	382873.923	7378240.506		
418	M	+0.005	+0.001	81°14'59"	0.005
358	M	382745.845	7378302.856		
475	M	+0.004	-0.005	141°59'32"	0.007
359	M	382869.570	7378287.127		
414	M	-0.003	+0.006	333°25'31"	0.007
360	M	382864.056	7378247.777		
417	M	+0.006	-0.001	102°36'44"	0.006
361	M	382860.229	7378260.084		
413	M	-0.005	+0.010	334°53'30"	0.011
362	M	382753.110	7378315.846		
492	M	-0.001	-0.003	204°40'41"	0.003
363	M	382745.925	7378269.264		
476	M	+0.009	-0.006	126°25'39"	0.011
364	M	382747.612	7378258.139		
478	M	+0.013	-0.033	159°00'41"	0.035
369	M	382906.218	7378310.288		
409	M	-0.001	-0.000	253°20'40"	0.002
370	M	382762.680	7378292.007		
473	M	+0.009	-0.003	111°28'16"	0.009
374	M	382925.835	7378299.323		
410	M	+0.000	+0.000	63°27'49"	0.001
375	M	382905.975	7378263.786		
459	M	-0.004	+0.005	320°40'55"	0.006
378	M	382928.115	7378249.593		
458	M	-0.003	+0.001	286°47'02"	0.003
381	M	382786.859	7378335.269		
435	M	-0.002	-0.004	208°27'07"	0.004
383	M	382767.784	7378243.279		
477	M	+0.002	-0.024	174°54'44"	0.024
384	M	382810.006	7378212.174		
483	M	+0.006	-0.019	164°08'40"	0.020
391	M	382848.340	7378360.943		
425	M	+0.001	-0.006	168°14'50"	0.006
393	M	382924.157	7378318.570		
407	M	-0.001	+0.001	318°19'41"	0.001
397	M	382905.831	7378328.810		
406	M	-0.000	+0.000	298°49'45"	0.000
402	M	382855.936	7378296.662		
448	M	+0.012	-0.004	110°38'23"	0.013
405	M	382889.442	7378388.976		
442	M	-0.002	-0.000	269°49'32"	0.002
412	M	382929.838	7378412.759		
443	M	-0.005	+0.001	284°02'14"	0.005
439	M	382809.202	7378322.777		
467	M	-0.002	+0.006	338°09'04"	0.006
452	M	382814.183	7378296.023		
470	M	-0.005	+0.007	324°38'17"	0.009
464	M	382790.889	7378261.066		
474	M	+0.011	-0.014	140°30'29"	0.018

Analysis of Differences

Range						
High:		+0.014	+0.020			
Low:		-0.015	-0.033			
No.Obs:		148	148			
Mean:		-0.000	+0.000			
StdDev:		0.005	0.007			

APPENDIX F

LISCAD Report: Point Comparison
Monday, September 26, 2016 18:59

File: 22. 20 Points
Projection: Map Grid Australia 94 Zone 53
File Date: Thursday, July 14, 2016

Units

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Distance: Metres

Method: Location (Radius=0.150m.)

R - Resolved point
M - Main point

Point ID		Co-ordinates			Bearing	Distance
		East	North	Elevation		
4	M	382964.351	7378417.034			
307	M	-0.004	-0.004		224°21'06"	0.005
6	M	382977.856	7378394.512			
13	M	+0.000	-0.000		143°22'18"	0.000
8	M	383003.822	7378390.180			
301	M	-0.008	-0.005		239°37'55"	0.009
10	M	383021.389	7378371.400			
302	M	-0.007	-0.004		244°06'53"	0.008
11	M	383038.956	7378352.619			
303	M	-0.007	-0.002		256°59'26"	0.007
12	M	383065.133	7378301.213			
209	M	-0.001	-0.000		256°12'26"	0.002
14	M	382984.687	7378387.211			
26	M	+0.000	-0.002		174°28'13"	0.002
16	M	383051.246	7378339.480			
304	M	-0.006	-0.002		254°29'40"	0.006
18	M	383088.111	7378283.674			
274	M	-0.006	+0.012		332°07'35"	0.013
19	M	382987.001	7378408.148			
191	M	+0.007	+0.006		45°56'40"	0.009
20	M	382994.473	7378156.633			
216	M	+0.003	-0.002		127°55'11"	0.003
22	M	383021.276	7378244.455			
102	M	-0.003	-0.007		202°08'26"	0.007
23	M	383076.813	7378312.143			
208	M	+0.001	+0.000		85°42'27"	0.001
24	M	383017.566	7378352.073			
291	M	+0.000	-0.010		178°01'46"	0.010
25	M	382988.133	7378322.521			
447	M	+0.006	-0.004		122°21'55"	0.008
27	M	382914.927	7378418.425			
411	M	-0.001	-0.001		228°58'02"	0.001
28	M	382965.982	7378346.198			
422	M	+0.007	-0.006		131°34'24"	0.009
29	M	382968.509	7378398.064			
32	M	+0.001	-0.002		152°33'54"	0.003
30	M	382946.601	7378357.030			
423	M	+0.003	-0.004		141°47'12"	0.005
31	M	382928.769	7378366.996			
424	M	-0.001	-0.002		199°46'13"	0.002
33	M	382922.982	7378207.288			
189	M	+0.008	+0.005		56°55'09"	0.010
34	M	382964.625	7378219.050			
456	M	-0.004	+0.006		325°00'11"	0.008
35	M	382915.054	7378216.188			
186	M	+0.004	+0.007		34°03'28"	0.008
36	M	382915.968	7378257.377			
462	M	-0.002	+0.005		337°28'24"	0.006
37	M	382893.114	7378226.363			
419	M	+0.004	+0.004		39°38'13"	0.006
39	M	382887.022	7378275.938			
460	M	-0.003	+0.004		330°46'34"	0.005
40	M	382942.361	7378308.400			
145	M	-0.001	-0.001		230°15'46"	0.001
42	M	382920.398	7378434.262			
58	M	+0.003	+0.001		73°29'02"	0.003
43	M	382947.601	7378279.297			
158	M	+0.010	-0.007		125°08'50"	0.012
44	M	382887.505	7378339.049			
372	M	+0.001	+0.002		23°36'07"	0.002
45	M	382967.030	7378294.306			
155	M	+0.009	-0.009		136°31'30"	0.013
46	M	382962.098	7378305.232			
154	M	+0.005	-0.001		98°03'35"	0.005
47	M	382923.221	7378370.097			
445	M	+0.001	-0.003		163°08'01"	0.003
48	M	382902.277	7378381.803			
312	M	-0.002	-0.001		238°21'56"	0.002
49	M	382910.094	7378377.434			
444	M	-0.004	-0.000		267°16'58"	0.004
50	M	383057.137	7378265.723			
220	M	+0.002	+0.001		65°58'56"	0.002
52	M	382890.519	7378436.406			
343	M	-0.007	+0.008		317°49'58"	0.011
53	M	382870.065	7378399.806			
437	M	-0.007	+0.004		302°50'12"	0.008
54	M	382880.735	7378418.898			
436	M	-0.006	+0.009		324°00'22"	0.011
55	M	382888.108	7378389.721			
438	M	-0.003	+0.001		294°29'46"	0.003
56	M	383061.633	7378250.301			
214	M	-0.001	-0.002		198°09'56"	0.002
59	M	382844.817	7378438.971			
136	M	+0.001	+0.003		12°58'32"	0.003
61	M	382834.148	7378419.878			
135	M	+0.001	+0.005		17°33'19"	0.005
62	M	382823.482	7378400.787			
134	M	-0.001	+0.004		350°13'41"	0.004
63	M	382859.396	7378380.714			
440	M	-0.006	+0.005		309°21'44"	0.008
64	M	382816.334	7378387.997			
133	M	-0.002	-0.000		264°33'22"	0.002
66	M	383033.057	7378232.338			
223	M	-0.006	-0.003		247°32'45"	0.006
69	M	382866.385	7378350.853			
392	M	-0.000	+0.003		359°37'00"	0.003
70	M	382800.720	7378360.069			
210	M	+0.000	+0.001		5°54'13"	0.001
71	M	382811.606	7378363.149			
204	M	-0.001	+0.002		325°54'47"	0.002
72	M	382826.966	7378354.566			
400	M	-0.002	-0.002		235°13'03"	0.003
73	M	382968.333	7378105.332			
249	M	+0.000	+0.002		11°34'14"	0.002
74	M	382848.544	7378342.511			
401	M	-0.008	-0.007		231°59'47"	0.010
75	M	382830.780	7378310.721			
468	M	-0.008	+0.005		303°13'47"	0.009
76	M	382824.390	7378314.291			
469	M	-0.006	+0.005		312°57'08"	0.008
77	M	382861.043	7378335.527			
396	M	-0.011	-0.008		232°34'29"	0.014
78	M	382945.211	7378112.565			
259	M	+0.008	-0.011		143°58'06"	0.014
79	M	382955.281	7378114.947			
258	M	+0.003	-0.011		163°19'18"	0.011
80	M	382865.414	7378324.065			
399	M	-0.011	-0.008		236°07'39"	0.014
81	M	382776.649	7378316.994			
380	M	+0.000	+0.007		2°14'18"	0.007
82	M	382766.443	7378298.723			
379	M	-0.003	+0.010		341°45'05"	0.011
83	M	382803.975	7378277.752			
471	M	-0.007	+0.011		327°11'41"	0.013
84	M	382848.146	7378274.072			
403	M	-0.012	+0.015		322°33'04"	0.019
85	M	382812.917	7378293.757			
472	M	-0.004	+0.011		342°48'35"	0.012
86	M	382797.471	7378266.112			
465	M	-0.007	+0.016		335°59'37"	0.017
87	M	382832.441	7378262.068			
199	M	-0.011	+0.020		332°18'17"	0.022
88	M	382754.764	7378281.244			
466	M	-0.006	+0.010		328°21'10"	0.011
99	M	383018.801	7378239.598			
234	M	-0.000	+0.001		330°38'13"	0.001
100	M	383009.175	7378220.710			
267	M	+0.008	+0.014		29°17'57"	0.016
106	M	383049.549	7378262.730			
272	M	+0.012	+0.003		74°55'06"	0.013
120	M	382847.549	7378484.842			
1450	M	-0.001	+0.001		297°24'05"	0.001
121	M	382848.778	7378487.042			

585	M	-0.000	+0.001	353°58'20"	0.001
126	M	382870.657	7378470.926		
896	M	-0.011	+0.003	284°30'34"	0.012
138	M	382853.228	7378454.025		
415	M	+0.000	-0.004	179°49'24"	0.004
139	M	382819.412	7378377.113		
426	M	+0.001	-0.002	160°27'32"	0.002
148	M	382889.185	7378319.806		
368	M	+0.002	-0.002	135°28'39"	0.002
151	M	382934.566	7378294.444		
376	M	-0.004	+0.002	295°14'49"	0.004
157	M	382940.436	7378287.625		
377	M	-0.006	+0.004	304°13'38"	0.008
164	M	382879.591	7378316.147		
367	M	-0.000	-0.002	191°56'40"	0.002
176	M	382901.571	7378220.138		
325	M	-0.002	-0.005	204°52'15"	0.006
179	M	382851.845	7378235.837		
313	M	-0.001	-0.002	194°30'54"	0.002
183	M	382892.086	7378207.265		
322	M	-0.001	-0.001	241°46'26"	0.001
188	M	382941.807	7378425.868		
308	M	-0.002	+0.001	287°27'28"	0.002
192	M	382903.134	7378190.598		
323	M	-0.003	-0.002	231°10'43"	0.004
194	M	382921.380	7378195.617		
327	M	-0.011	-0.005	244°49'40"	0.012
195	M	382849.010	7378236.817		
318	M	+0.003	-0.004	137°20'07"	0.005
196	M	382835.780	7378241.387		
482	M	+0.010	-0.008	128°12'11"	0.013
200	M	382847.008	7378270.827		
366	M	+0.011	-0.019	149°20'17"	0.022
205	M	383068.317	7378321.228		
305	M	-0.005	+0.001	278°24'40"	0.005
207	M	383085.388	7378302.976		
273	M	-0.011	+0.013	319°45'55"	0.018
217	M	383013.766	7378194.484		
236	M	-0.005	-0.000	269°08'40"	0.005
241	M	382836.841	7378192.406		
317	M	-0.000	-0.015	181°44'03"	0.015
256	M	382952.117	7378182.263		
429	M	+0.002	+0.010	12°15'26"	0.010
257	M	382981.872	7378167.104		
269	M	-0.013	+0.001	274°09'43"	0.013
260	M	382924.406	7378127.879		
390	M	-0.004	+0.016	346°46'55"	0.017
263	M	382729.823	7378281.128		
480	M	+0.013	-0.008	122°48'04"	0.015
266	M	382979.429	7378235.887		
428	M	+0.016	-0.002	97°53'37"	0.016
271	M	383011.090	7378297.983		
427	M	+0.006	-0.002	111°28'25"	0.006
279	M	383007.611	7378291.157		
451	M	+0.005	-0.004	128°28'08"	0.006
284	M	383031.222	7378337.476		
292	M	-0.001	-0.011	183°52'41"	0.011
290	M	383002.354	7378368.324		
296	M	-0.001	+0.007	349°20'50"	0.007
293	M	382994.328	7378315.899		
430	M	+0.004	-0.000	97°37'47"	0.004
297	M	382979.115	7378332.159		
431	M	+0.003	+0.000	89°40'50"	0.003
306	M	382950.055	7378405.078		
310	M	-0.003	-0.002	235°32'14"	0.003
311	M	382944.164	7378358.392		
446	M	+0.005	-0.005	136°11'06"	0.007
315	M	382869.593	7378223.838		
420	M	-0.001	+0.000	305°57'40"	0.001
316	M	382854.290	7378179.538		
385	M	-0.002	+0.014	354°14'49"	0.014
319	M	382834.314	7378194.253		
382	M	-0.002	+0.016	352°10'44"	0.016
320	M	382887.018	7378210.998		
421	M	-0.001	+0.002	324°43'19"	0.002
321	M	382871.712	7378166.701		
386	M	-0.001	+0.015	358°15'27"	0.015
324	M	382890.176	7378153.096		
389	M	+0.001	+0.015	3°12'28"	0.015
328	M	382951.640	7378181.327		
455	M	+0.001	+0.007	5°04'39"	0.007
336	M	382894.635	7378453.252		
895	M	-0.004	+0.003	305°41'22"	0.005
337	M	382863.571	7378456.264		
416	M	-0.001	-0.005	191°45'12"	0.005
338	M	382966.852	7378211.163		
454	M	-0.004	+0.007	327°15'59"	0.008
342	M	382908.527	7378423.141		
404	M	+0.005	-0.006	137°28'40"	0.008
344	M	382826.378	7378446.959		
586	M	+0.000	+0.003	3°17'38"	0.003
345	M	382935.960	7378244.559		
463	M	+0.001	+0.002	25°13'54"	0.002
346	M	382962.165	7378227.756		
457	M	-0.003	+0.005	332°13'08"	0.005
349	M	382812.183	7378421.558		
562	M	+0.004	+0.010	23°45'16"	0.011
350	M	382789.936	7378381.750		
555	M	+0.003	+0.012	14°00'54"	0.013
351	M	382769.257	7378344.747		
556	M	+0.009	+0.015	31°48'48"	0.018
353	M	382895.857	7378270.273		
461	M	-0.004	+0.006	324°30'38"	0.007
354	M	382873.922	7378240.506		
418	M	+0.006	+0.001	82°54'01"	0.006
358	M	382745.845	7378302.856		
475	M	+0.003	-0.005	149°21'35"	0.006
359	M	382869.570	7378287.126		
414	M	-0.003	+0.007	336°36'31"	0.008
360	M	382864.056	7378247.777		
417	M	+0.006	-0.001	102°36'44"	0.006
361	M	382860.229	7378260.084		
413	M	-0.005	+0.010	334°53'30"	0.011
362	M	382753.110	7378315.846		
492	M	-0.001	-0.003	204°40'41"	0.003
363	M	382745.925	7378269.264		
476	M	+0.009	-0.006	126°25'39"	0.011
364	M	382747.612	7378258.139		
478	M	+0.012	-0.034	161°04'36"	0.036
369	M	382906.218	7378310.289		
409	M	-0.001	-0.001	225°20'36"	0.002
370	M	382762.680	7378292.007		
473	M	+0.009	-0.004	117°01'29"	0.010
374	M	382925.834	7378299.325		
410	M	+0.001	-0.002	140°34'09"	0.002
375	M	382905.972	7378263.787		
459	M	-0.001	+0.004	346°03'13"	0.004
378	M	382928.111	7378249.592		
458	M	+0.001	+0.002	36°59'40"	0.002
381	M	382786.859	7378335.269		
435	M	-0.002	-0.004	208°27'07"	0.004
383	M	382767.784	7378243.279		
477	M	+0.002	-0.024	174°54'44"	0.024
384	M	382810.006	7378212.174		
483	M	+0.005	-0.019	166°56'09"	0.020
391	M	382848.340	7378360.943		
425	M	+0.001	-0.006	168°14'50"	0.006
393	M	382924.158	7378318.570		
407	M	-0.002	+0.001	292°22'02"	0.002
397	M	382905.831	7378328.810		
406	M	-0.000	+0.000	298°49'45"	0.000
402	M	382855.936	7378296.662		
448	M	+0.012	-0.004	110°38'23"	0.013
405	M	382889.442	7378388.976		
442	M	-0.002	-0.000	269°49'32"	0.002
412	M	382929.838	7378412.760		
443	M	-0.005	+0.000	272°05'06"	0.005
439	M	382809.202	7378322.777		
467	M	-0.002	+0.006	338°09'04"	0.006
452	M	382814.183	7378296.023		
470	M	-0.005	+0.007	324°38'17"	0.009
464	M	382790.889	7378261.066		
474	M	+0.010	-0.014	143°03'54"	0.017

Analysis of Differences

Range					
High:		+0.016	+0.020		
Low:		-0.013	-0.034		
No.Obs:		148	148		
Mean:		-0.000	+0.001		
StdDev:		0.006	0.008		

APPENDIX G

LISCAD Report: Point Comparison
Monday, September 26, 2016 19:00

File: 23. 15 Points
Projection: Map Grid Australia 94 Zone 53
File Date: Thursday, July 14, 2016

Units
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Distance: Metres

Method: Location (Radius=0.150m.)

R - Resolved point
M - Main point

Point ID		Co-ordinates East	North	Elevation	Bearing	Distance
4	M	382964.351	7378417.035			
307	M	-0.004	-0.005		217°59'23"	0.006
6	M	382977.856	7378394.512			
13	M	+0.000	-0.000		143°22'18"	0.000
8	M	383003.822	7378390.181			
301	M	-0.008	-0.006		234°32'40"	0.010
10	M	383021.390	7378371.400			
302	M	-0.008	-0.004		246°53'17"	0.009
11	M	383038.957	7378352.620			
303	M	-0.008	-0.003		251°57'28"	0.008
12	M	383065.133	7378301.213			
209	M	-0.004	+0.002		290°21'05"	0.005
14	M	382984.687	7378387.211			
26	M	+0.000	-0.002		174°28'13"	0.002
16	M	383051.247	7378339.480			
304	M	-0.007	-0.002		256°45'32"	0.007
18	M	383088.111	7378283.673			
274	M	-0.006	+0.013		334°03'09"	0.014
19	M	382987.001	7378408.148			
191	M	+0.008	+0.006		49°58'37"	0.010
20	M	382994.473	7378156.633			
216	M	+0.003	-0.002		127°55'11"	0.003
22	M	383021.277	7378244.455			
102	M	-0.004	-0.007		209°08'42"	0.008
23	M	383076.813	7378312.143			
208	M	+0.001	+0.000		85°42'27"	0.001
24	M	383017.566	7378352.073			
291	M	+0.000	-0.010		178°01'46"	0.010
25	M	382988.133	7378322.521			
447	M	+0.006	-0.004		122°21'55"	0.008
27	M	382914.927	7378418.425			
411	M	-0.001	-0.001		228°58'02"	0.001
28	M	382965.982	7378346.198			
422	M	+0.007	-0.006		131°34'24"	0.009
29	M	382968.509	7378398.064			
32	M	+0.001	-0.002		152°33'54"	0.003
30	M	382946.600	7378357.031			
423	M	+0.004	-0.005		140°23'17"	0.006
31	M	382928.770	7378366.998			
424	M	-0.002	-0.004		203°53'51"	0.004
33	M	382922.982	7378207.288			
189	M	+0.008	+0.005		56°55'09"	0.010
34	M	382964.625	7378219.051			
456	M	-0.004	+0.005		320°10'53"	0.007
35	M	382915.053	7378216.189			
186	M	+0.005	+0.006		44°06'42"	0.008
36	M	382915.966	7378257.379			
462	M	-0.000	+0.003		357°36'56"	0.003
37	M	382893.112	7378226.364			
419	M	+0.006	+0.003		59°22'20"	0.006
39	M	382887.020	7378275.939			
460	M	-0.001	+0.003		351°32'47"	0.004
40	M	382942.361	7378308.400			
145	M	-0.001	-0.001		230°15'46"	0.001
42	M	382920.398	7378434.262			
58	M	+0.003	+0.001		73°29'02"	0.003
43	M	382947.601	7378279.297			
158	M	+0.010	-0.007		125°08'50"	0.012
44	M	382887.505	7378339.049			
372	M	+0.002	+0.008		12°51'39"	0.008
45	M	382967.029	7378294.307			
155	M	+0.010	-0.010		136°25'17"	0.015
46	M	382962.098	7378305.232			
154	M	+0.005	-0.001		98°03'35"	0.005
47	M	382923.221	7378370.099			
445	M	+0.001	-0.005		170°34'42"	0.005
48	M	382902.276	7378381.805			
312	M	-0.001	-0.003		198°43'59"	0.003
49	M	382910.095	7378377.435			
444	M	-0.005	-0.001		256°36'03"	0.005
50	M	383057.137	7378265.723			
220	M	+0.001	+0.002		17°33'48"	0.002
52	M	382890.520	7378436.405			
343	M	-0.008	+0.009		317°33'44"	0.012
53	M	382870.067	7378399.805			
437	M	-0.009	+0.005		301°35'01"	0.010
54	M	382880.736	7378418.897			
436	M	-0.007	+0.010		323°00'06"	0.012
55	M	382888.108	7378389.723			
438	M	-0.003	-0.001		255°35'22"	0.003
56	M	383061.633	7378250.301			
214	M	-0.001	-0.002		198°09'56"	0.002
59	M	382844.818	7378438.968			
136	M	-0.000	+0.006		357°42'11"	0.006
61	M	382834.151	7378419.875			
135	M	-0.002	+0.008		349°10'32"	0.008
62	M	382823.486	7378400.785			
134	M	-0.005	+0.006		323°16'43"	0.008
63	M	382859.398	7378380.713			
440	M	-0.008	+0.006		306°33'31"	0.010
64	M	382816.337	7378387.995			
133	M	-0.005	+0.002		288°47'54"	0.006
66	M	383033.057	7378232.338			
223	M	-0.006	-0.003		247°32'45"	0.006
69	M	382866.387	7378350.854			
392	M	-0.002	+0.002		307°57'19"	0.003
70	M	382800.719	7378360.069			
210	M	+0.001	+0.001		54°38'55"	0.001
71	M	382811.605	7378363.149			
204	M	-0.000	+0.002		355°36'47"	0.002
72	M	382826.964	7378354.565			
400	M	-0.000	-0.001		207°26'57"	0.001
73	M	382968.333	7378105.332			
249	M	+0.000	+0.002		11°34'14"	0.002
74	M	382848.540	7378342.513			
401	M	-0.004	-0.009		206°41'39"	0.009
75	M	382830.777	7378310.722			
468	M	-0.005	+0.004		310°40'16"	0.006
76	M	382824.388	7378314.292			
469	M	-0.004	+0.004		319°22'42"	0.005
77	M	382861.039	7378335.530			
396	M	-0.007	-0.011		211°23'37"	0.013
78	M	382945.211	7378112.565			
259	M	+0.008	-0.011		143°58'06"	0.014
79	M	382955.281	7378114.947			
258	M	+0.003	-0.011		163°19'18"	0.011
80	M	382865.410	7378324.068			
399	M	-0.007	-0.011		214°54'02"	0.013
81	M	382776.647	7378316.994			
380	M	+0.002	+0.007		18°03'44"	0.007
82	M	382766.442	7378298.723			
379	M	-0.002	+0.010		346°52'18"	0.011
83	M	382803.973	7378277.752			
471	M	-0.005	+0.011		335°17'46"	0.012
84	M	382848.143	7378274.073			
403	M	-0.009	+0.014		328°41'25"	0.016
85	M	382812.914	7378293.756			
472	M	-0.001	+0.012		357°39'15"	0.012
86	M	382797.469	7378266.111			
465	M	-0.005	+0.017		343°25'34"	0.017
87	M	382832.436	7378262.066			
199	M	-0.006	+0.022		346°07'42"	0.022
88	M	382754.763	7378281.244			
466	M	-0.005	+0.010		332°52'00"	0.011
99	M	383018.801	7378239.598			
234	M	-0.000	+0.001		330°38'13"	0.001
100	M	383009.175	7378220.710			
267	M	+0.008	+0.015		27°42'11"	0.017
106	M	383049.549	7378262.730			
272	M	+0.012	+0.004		70°41'23"	0.013
120	M	382847.549	7378484.842			
1450	M	-0.001	+0.001		297°24'05"	0.001
121	M	382848.778	7378487.042			
585	M	-0.001	+0.001		318°36'43"	0.002
126	M	382870.657	7378470.926			

896	M	-0.011	+0.003	284°30'34"	0.012
138	M	382853.228	7378454.025		
415	M	+0.001	-0.006	170°10'56"	0.006
139	M	382819.412	7378377.113		
426	M	+0.004	-0.005	144°20'37"	0.006
148	M	382889.185	7378319.806		
368	M	+0.002	-0.002	135°28'39"	0.002
151	M	382934.566	7378294.444		
376	M	-0.004	+0.002	295°14'49"	0.004
157	M	382940.436	7378287.625		
377	M	-0.007	+0.004	300°25'15"	0.008
164	M	382879.591	7378316.147		
367	M	-0.000	-0.002	191°56'40"	0.002
176	M	382901.571	7378220.138		
325	M	-0.003	-0.004	218°22'43"	0.006
179	M	382851.845	7378235.837		
313	M	-0.006	-0.008	214°23'59"	0.010
183	M	382892.086	7378207.265		
322	M	-0.001	-0.001	241°46'26"	0.001
188	M	382941.807	7378425.868		
308	M	-0.002	+0.001	287°27'28"	0.002
192	M	382903.134	7378190.598		
323	M	-0.002	-0.002	219°25'03"	0.003
194	M	382921.380	7378195.617		
327	M	-0.011	-0.004	249°09'23"	0.012
195	M	382849.010	7378236.817		
318	M	-0.002	-0.010	190°13'50"	0.010
196	M	382835.780	7378241.387		
482	M	+0.006	-0.014	156°54'34"	0.015
200	M	382847.008	7378270.827		
366	M	+0.007	-0.019	159°09'18"	0.020
205	M	383068.318	7378321.228		
305	M	-0.006	+0.001	276°59'44"	0.006
207	M	383085.388	7378302.975		
273	M	-0.011	+0.014	321°47'56"	0.018
217	M	383013.766	7378194.484		
236	M	-0.005	-0.000	269°08'40"	0.005
241	M	382836.841	7378192.406		
317	M	-0.002	-0.019	187°23'08"	0.019
256	M	382952.117	7378182.263		
429	M	+0.002	+0.010	12°15'26"	0.010
257	M	382981.872	7378167.104		
269	M	-0.013	+0.001	274°09'43"	0.013
260	M	382924.407	7378127.879		
390	M	-0.005	+0.016	343°32'30"	0.017
263	M	382729.823	7378281.128		
480	M	+0.013	-0.008	122°48'04"	0.015
266	M	382979.429	7378235.888		
428	M	+0.016	-0.003	101°20'52"	0.016
271	M	383011.090	7378297.984		
427	M	+0.006	-0.003	119°33'49"	0.007
279	M	383007.610	7378291.158		
451	M	+0.006	-0.005	129°47'18"	0.007
284	M	383031.222	7378337.477		
292	M	-0.001	-0.012	183°35'13"	0.012
290	M	383002.354	7378368.324		
296	M	-0.002	+0.007	341°15'48"	0.007
293	M	382994.328	7378315.900		
430	M	+0.004	-0.001	111°57'10"	0.004
297	M	382979.115	7378332.160		
431	M	+0.003	-0.001	107°15'32"	0.003
306	M	382950.056	7378405.078		
310	M	-0.004	-0.002	243°54'49"	0.004
311	M	382944.165	7378358.392		
446	M	+0.004	-0.005	143°01'30"	0.006
315	M	382869.589	7378223.835		
420	M	+0.003	+0.003	46°32'28"	0.005
316	M	382854.290	7378179.534		
385	M	-0.002	+0.018	355°36'59"	0.018
319	M	382834.311	7378194.249		
382	M	+0.001	+0.020	2°19'41"	0.020
320	M	382887.016	7378210.998		
421	M	+0.001	+0.002	15°26'37"	0.002
321	M	382871.713	7378166.698		
386	M	-0.002	+0.018	355°23'35"	0.018
324	M	382890.178	7378153.095		
389	M	-0.001	+0.016	355°58'15"	0.016
328	M	382951.641	7378181.328		
455	M	-0.000	+0.006	356°47'20"	0.006
336	M	382894.635	7378453.252		
895	M	-0.004	+0.003	305°41'22"	0.005
337	M	382863.571	7378456.264		
416	M	+0.000	-0.007	180°01'16"	0.007
338	M	382966.852	7378211.164		
454	M	-0.004	+0.006	322°50'06"	0.007
342	M	382908.527	7378423.141		
404	M	+0.006	-0.006	132°36'01"	0.009
344	M	382826.378	7378446.959		
586	M	+0.001	+0.003	20°33'20"	0.003
345	M	382935.959	7378244.560		
463	M	+0.002	+0.001	62°21'43"	0.002
346	M	382962.165	7378227.757		
457	M	-0.003	+0.004	326°12'47"	0.005
349	M	382812.183	7378421.558		
562	M	+0.005	+0.010	28°19'37"	0.012
350	M	382789.936	7378381.750		
555	M	+0.006	+0.011	28°22'45"	0.013
351	M	382769.257	7378344.747		
556	M	+0.010	+0.014	36°15'02"	0.018
353	M	382895.853	7378270.275		
461	M	-0.000	+0.004	359°03'11"	0.004
354	M	382873.918	7378240.509		
418	M	+0.010	-0.002	103°52'46"	0.010
358	M	382745.845	7378302.856		
475	M	+0.003	-0.005	149°21'35"	0.006
359	M	382869.566	7378287.129		
414	M	+0.001	+0.004	9°12'19"	0.005
360	M	382864.049	7378247.782		
417	M	+0.013	-0.006	116°14'20"	0.014
361	M	382860.222	7378260.089		
413	M	+0.002	+0.005	22°53'02"	0.006
362	M	382753.110	7378315.846		
492	M	-0.001	-0.003	204°40'41"	0.003
363	M	382745.925	7378269.264		
476	M	+0.009	-0.006	126°25'39"	0.011
364	M	382747.612	7378258.139		
478	M	+0.012	-0.034	161°04'36"	0.036
369	M	382906.217	7378310.289		
409	M	-0.000	-0.001	197°17'46"	0.002
370	M	382762.680	7378292.007		
473	M	+0.008	-0.004	119°56'59"	0.009
374	M	382925.833	7378299.325		
410	M	+0.002	-0.002	125°55'12"	0.003
375	M	382905.971	7378263.787		
459	M	+0.000	+0.004	0°57'35"	0.004
378	M	382928.110	7378249.592		
458	M	+0.002	+0.002	52°55'15"	0.003
381	M	382786.859	7378335.269		
435	M	-0.004	-0.003	236°31'32"	0.005
383	M	382767.784	7378243.279		
477	M	+0.000	-0.025	179°43'23"	0.025
384	M	382810.006	7378212.174		
483	M	+0.002	-0.023	176°29'12"	0.023
391	M	382848.340	7378360.943		
425	M	+0.004	-0.007	148°29'46"	0.008
393	M	382924.157	7378318.572		
407	M	-0.001	-0.001	203°08'38"	0.001
397	M	382905.831	7378328.814		
406	M	-0.000	-0.004	182°01'35"	0.004
402	M	382855.936	7378296.662		
448	M	+0.009	-0.003	111°11'58"	0.010
405	M	382889.443	7378388.976		
442	M	-0.003	-0.000	270°04'27"	0.003
412	M	382929.838	7378412.760		
443	M	-0.005	+0.000	272°05'06"	0.005
439	M	382809.199	7378322.777		
467	M	+0.001	+0.006	7°10'12"	0.006
452	M	382814.181	7378296.023		
470	M	-0.003	+0.007	336°09'22"	0.008
464	M	382790.889	7378261.066		
474	M	+0.009	-0.015	147°40'45"	0.017

Analysis of Differences

Range		
High:	+0.016	+0.022
Low:	-0.013	-0.034
No.Obs:	148	148
Mean:	-0.000	+0.000
StdDev:	0.005	0.008

APPENDIX H

LISCAD Report: Point Comparison
Monday, September 26, 2016   19:01

File: 24. 10 Points
Projection: Map Grid Australia 94 Zone 53
File Date: Thursday, July 14, 2016

Units
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Distance: Metres

Method: Location (Radius=0.150m.)

R - Resolved point
M - Main point

Point ID		Co-ordinates			Bearing	Distance
		East	North	Elevation		
4	M	382964.351	7378417.034			
307	M	-0.004	-0.004		224°21'06"	0.005
6	M	382977.856	7378394.512			
13	M	+0.000	-0.000		143°22'18"	0.000
8	M	383003.822	7378390.180			
301	M	-0.008	-0.005		239°37'55"	0.009
10	M	383021.389	7378371.399			
302	M	-0.007	-0.003		250°39'01"	0.008
11	M	383038.956	7378352.617			
303	M	-0.007	+0.000		273°07'04"	0.007
12	M	383065.133	7378301.213			
209	M	+0.002	+0.005		18°36'19"	0.005
14	M	382984.687	7378387.211			
26	M	+0.000	-0.002		174°28'13"	0.002
16	M	383051.246	7378339.478			
304	M	-0.006	+0.000		273°56'46"	0.006
18	M	383088.118	7378283.674			
274	M	-0.013	+0.012		311°42'40"	0.018
19	M	382987.001	7378408.148			
191	M	+0.007	+0.005		50°43'19"	0.009
20	M	382994.477	7378156.632			
216	M	-0.001	-0.001		235°35'15"	0.002
22	M	383021.277	7378244.456			
102	M	-0.004	-0.008		205°54'44"	0.009
23	M	383076.813	7378312.143			
208	M	+0.001	+0.001		53°17'31"	0.002
24	M	383017.566	7378352.074			
291	M	+0.000	-0.011		178°14'29"	0.011
25	M	382988.135	7378322.520			
447	M	+0.004	-0.003		124°35'56"	0.005
27	M	382914.927	7378418.425			
411	M	-0.001	-0.001		228°58'02"	0.001
28	M	382965.983	7378346.196			
422	M	+0.006	-0.004		124°39'18"	0.007
29	M	382968.508	7378398.064			
32	M	+0.002	-0.002		136°00'14"	0.003
30	M	382946.600	7378357.030			
423	M	+0.004	-0.004		133°51'01"	0.006
31	M	382928.769	7378366.998			
424	M	-0.001	-0.004		189°18'50"	0.004
33	M	382922.984	7378207.286			
189	M	+0.006	+0.007		40°01'28"	0.010
34	M	382964.627	7378219.050			
456	M	-0.006	+0.006		314°34'30"	0.009
35	M	382915.054	7378216.187			
186	M	+0.004	+0.008		30°30'45"	0.009
36	M	382915.966	7378257.377			
462	M	-0.000	+0.005		358°44'11"	0.005
37	M	382893.113	7378226.360			
419	M	+0.005	+0.007		32°10'36"	0.009
39	M	382887.020	7378275.934			
460	M	-0.001	+0.008		356°47'26"	0.008
40	M	382942.363	7378308.396			
145	M	-0.003	+0.003		320°56'10"	0.004
42	M	382920.398	7378434.262			
58	M	+0.003	+0.001		73°29'02"	0.003
43	M	382947.603	7378279.296			
158	M	+0.008	-0.006		126°58'07"	0.010
44	M	382887.505	7378339.049			
372	M	+0.002	+0.008		12°51'39"	0.008
45	M	382967.031	7378294.305			
155	M	+0.008	-0.008		136°39'12"	0.012
46	M	382962.100	7378305.229			
154	M	+0.003	+0.002		53°13'29"	0.004
47	M	382923.222	7378370.098			
445	M	-0.000	-0.004		183°52'54"	0.004
48	M	382902.276	7378381.806			
312	M	-0.001	-0.004		194°41'34"	0.004
49	M	382910.093	7378377.437			
444	M	-0.003	-0.003		222°51'50"	0.004
50	M	383057.137	7378265.723			
220	M	+0.016	+0.009		61°12'37"	0.018
52	M	382890.509	7378436.413			
343	M	+0.003	+0.001		67°55'13"	0.003
53	M	382870.056	7378399.811			
437	M	+0.002	-0.001		107°22'18"	0.002
54	M	382880.725	7378418.904			
436	M	+0.004	+0.003		56°19'50"	0.004
55	M	382888.103	7378389.726			
438	M	+0.002	-0.004		150°09'50"	0.004
56	M	383061.633	7378250.301			
214	M	+0.017	+0.003		79°36'07"	0.018
59	M	382844.805	7378438.975			
136	M	+0.013	-0.001		94°12'55"	0.013
61	M	382834.136	7378419.881			
135	M	+0.013	+0.002		83°06'46"	0.014
62	M	382823.470	7378400.788			
134	M	+0.011	+0.003		74°06'04"	0.012
63	M	382859.389	7378380.719			
440	M	+0.001	-0.000		102°59'12"	0.001
64	M	382816.324	7378387.995			
133	M	+0.008	+0.002		77°33'40"	0.008
66	M	383033.057	7378232.338			
223	M	+0.000	-0.005		180°05'10"	0.005
69	M	382866.384	7378350.858			
392	M	+0.001	-0.002		158°54'51"	0.003
70	M	382800.720	7378360.068			
210	M	+0.000	+0.002		2°50'37"	0.002
71	M	382811.606	7378363.149			
204	M	-0.001	+0.002		325°54'47"	0.002
72	M	382826.966	7378354.568			
400	M	-0.002	-0.004		213°01'56"	0.004
73	M	382968.333	7378105.332			
249	M	+0.000	+0.002		11°34'14"	0.002
74	M	382848.542	7378342.513			
401	M	-0.006	-0.009		216°30'34"	0.011
75	M	382830.779	7378310.722			
468	M	-0.007	+0.004		300°59'39"	0.008
76	M	382824.390	7378314.291			
469	M	-0.006	+0.005		312°57'08"	0.008
77	M	382861.040	7378335.530			
396	M	-0.008	-0.011		214°56'01"	0.014
78	M	382945.211	7378112.565			
259	M	+0.009	-0.011		140°43'17"	0.014
79	M	382955.281	7378114.947			
258	M	+0.004	-0.011		158°39'30"	0.012
80	M	382865.411	7378324.068			
399	M	-0.008	-0.011		218°21'39"	0.014
81	M	382776.648	7378316.992			
380	M	+0.001	+0.009		8°10'18"	0.009
82	M	382766.440	7378298.721			
379	M	-0.000	+0.012		358°09'58"	0.012
83	M	382803.974	7378277.749			
471	M	-0.006	+0.014		336°42'40"	0.015
84	M	382848.144	7378274.070			
403	M	-0.010	+0.017		330°50'12"	0.019
85	M	382812.915	7378293.754			
472	M	-0.002	+0.014		354°04'18"	0.014
86	M	382797.470	7378266.108			
465	M	-0.006	+0.020		343°12'35"	0.020
87	M	382832.439	7378262.063			
199	M	-0.009	+0.025		341°22'47"	0.026
88	M	382754.762	7378281.242			
466	M	-0.004	+0.012		341°24'22"	0.012
99	M	383018.801	7378239.598			
234	M	-0.000	+0.001		330°38'13"	0.001
100	M	383009.175	7378220.710			
267	M	+0.010	+0.015		33°16'25"	0.018
106	M	383049.549	7378262.730			
272	M	+0.018	+0.007		68°23'10"	0.020
120	M	382847.549	7378484.842			
1450	M	-0.001	+0.002		324°19'31"	0.002
121	M	382848.778	7378487.042			
585	M	-0.000	+0.001		353°58'20"	0.001
126	M	382870.657	7378470.926			

896	M	-0.011	+0.003	284°30'34"	0.012
138	M	382853.228	7378454.025		
415	M	-0.013	+0.001	275°59'56"	0.013
139	M	382819.412	7378377.113		
426	M	-0.007	-0.004	240°04'37"	0.008
148	M	382889.185	7378319.806		
368	M	+0.002	-0.002	135°28'39"	0.002
151	M	382934.566	7378294.444		
376	M	-0.001	-0.001	221°56'22"	0.002
157	M	382940.436	7378287.625		
377	M	-0.005	+0.002	293°00'23"	0.006
164	M	382879.591	7378316.147		
367	M	-0.000	-0.002	191°56'40"	0.002
176	M	382901.571	7378220.138		
325	M	-0.005	-0.006	220°44'07"	0.008
179	M	382851.845	7378235.837		
313	M	+0.002	-0.015	171°25'28"	0.015
183	M	382892.086	7378207.265		
322	M	-0.001	-0.002	216°52'36"	0.002
188	M	382941.807	7378425.868		
308	M	-0.002	+0.001	287°27'28"	0.002
192	M	382903.134	7378190.598		
323	M	+0.000	-0.004	179°51'05"	0.004
194	M	382921.380	7378195.617		
327	M	-0.009	-0.006	235°40'50"	0.011
195	M	382849.010	7378236.817		
318	M	+0.004	-0.017	165°45'20"	0.017
196	M	382835.780	7378241.387		
482	M	+0.009	-0.020	155°58'40"	0.022
200	M	382847.008	7378270.827		
366	M	+0.007	-0.024	163°21'17"	0.025
205	M	383068.319	7378321.226		
305	M	-0.007	+0.003	292°21'20"	0.007
207	M	383085.392	7378302.974		
273	M	-0.015	+0.015	315°13'01"	0.022
217	M	383013.766	7378194.484		
236	M	+0.001	-0.002	162°21'20"	0.002
241	M	382836.841	7378192.406		
317	M	+0.005	-0.026	170°23'51"	0.027
256	M	382952.119	7378182.263		
429	M	+0.000	+0.010	1°11'24"	0.010
257	M	382981.874	7378167.104		
269	M	-0.015	+0.001	273°39'45"	0.015
260	M	382924.409	7378127.878		
390	M	-0.007	+0.017	338°35'27"	0.019
263	M	382729.823	7378281.128		
480	M	+0.010	-0.008	130°13'23"	0.012
266	M	382979.432	7378235.887		
428	M	+0.013	-0.002	99°33'42"	0.013
271	M	383011.093	7378297.984		
427	M	+0.003	-0.003	139°32'53"	0.004
279	M	383007.613	7378291.156		
451	M	+0.003	-0.003	134°59'35"	0.004
284	M	383031.222	7378337.479		
292	M	-0.001	-0.014	183°07'53"	0.014
290	M	383002.354	7378368.324		
296	M	-0.001	+0.007	349°20'50"	0.007
293	M	382994.330	7378315.899		
430	M	+0.002	-0.000	105°37'31"	0.002
297	M	382979.116	7378332.159		
431	M	+0.002	+0.000	89°19'14"	0.002
306	M	382950.055	7378405.079		
310	M	-0.003	-0.003	222°50'44"	0.004
311	M	382944.166	7378358.391		
446	M	+0.003	-0.004	145°20'15"	0.005
315	M	382869.594	7378223.830		
420	M	-0.002	+0.008	350°14'16"	0.008
316	M	382854.295	7378179.528		
385	M	-0.007	+0.024	345°16'21"	0.025
319	M	382834.317	7378194.243		
382	M	-0.005	+0.026	348°53'30"	0.027
320	M	382887.019	7378210.996		
421	M	-0.002	+0.004	329°03'25"	0.005
321	M	382871.717	7378166.695		
386	M	-0.006	+0.021	345°21'45"	0.021
324	M	382890.180	7378153.093		
389	M	-0.003	+0.018	350°15'55"	0.018
328	M	382951.642	7378181.327		
455	M	-0.001	+0.007	349°36'48"	0.007
336	M	382894.635	7378453.252		
895	M	-0.004	+0.003	305°41'22"	0.005
337	M	382863.571	7378456.264		
416	M	-0.013	+0.001	275°59'01"	0.013
338	M	382966.854	7378211.163		
454	M	-0.006	+0.007	316°43'40"	0.009
342	M	382908.527	7378423.141		
404	M	+0.000	-0.002	168°21'50"	0.002
344	M	382826.378	7378446.959		
586	M	-0.004	+0.004	317°43'57"	0.006
345	M	382935.959	7378244.558		
463	M	+0.002	+0.003	33°02'04"	0.004
346	M	382962.167	7378227.755		
457	M	-0.005	+0.006	322°04'47"	0.007
349	M	382812.183	7378421.558		
562	M	-0.005	+0.010	336°05'17"	0.011
350	M	382789.936	7378381.750		
555	M	-0.011	+0.012	318°20'11"	0.016
351	M	382769.257	7378344.747		
556	M	-0.007	+0.012	332°24'42"	0.014
353	M	382895.853	7378270.271		
461	M	-0.000	+0.008	359°47'26"	0.008
354	M	382873.920	7378240.500		
418	M	+0.008	+0.007	48°35'24"	0.010
358	M	382745.845	7378302.856		
475	M	-0.007	-0.006	228°10'12"	0.009
359	M	382869.565	7378287.124		
414	M	+0.002	+0.009	10°33'47"	0.010
360	M	382864.053	7378247.769		
417	M	+0.009	+0.007	53°57'55"	0.011
361	M	382860.224	7378260.075		
413	M	+0.000	+0.019	0°51'40"	0.019
362	M	382753.110	7378315.846		
492	M	-0.016	-0.008	244°07'02"	0.018
363	M	382745.925	7378269.264		
476	M	+0.009	-0.006	126°25'39"	0.011
364	M	382747.612	7378258.139		
478	M	+0.013	-0.035	160°08'11"	0.037
369	M	382906.217	7378310.287		
409	M	-0.000	+0.001	322°24'47"	0.001
370	M	382762.680	7378292.007		
473	M	+0.006	-0.007	142°52'57"	0.009
374	M	382925.835	7378299.322		
410	M	+0.000	+0.001	21°15'58"	0.001
375	M	382905.973	7378263.783		
459	M	-0.002	+0.008	346°14'42"	0.008
378	M	382928.113	7378249.589		
458	M	-0.001	+0.005	352°23'39"	0.005
381	M	382786.859	7378335.269		
435	M	-0.001	-0.006	189°54'49"	0.006
383	M	382767.784	7378243.279		
477	M	+0.002	-0.026	175°20'19"	0.026
384	M	382810.006	7378212.174		
483	M	+0.006	-0.028	169°11'48"	0.029
391	M	382848.340	7378360.943		
425	M	-0.002	-0.002	223°59'27"	0.003
393	M	382924.157	7378318.570		
407	M	-0.001	+0.001	318°19'41"	0.001
397	M	382905.831	7378328.813		
406	M	-0.000	-0.003	182°33'29"	0.003
402	M	382855.936	7378296.662		
448	M	+0.010	-0.003	109°19'03"	0.011
405	M	382889.438	7378388.980		
442	M	+0.002	-0.004	149°10'03"	0.005
412	M	382929.837	7378412.761		
443	M	-0.004	-0.001	257°14'43"	0.004
439	M	382809.203	7378322.777		
467	M	-0.003	+0.006	330°04'38"	0.007
452	M	382814.182	7378296.021		
470	M	-0.004	+0.009	335°40'07"	0.010
464	M	382790.889	7378261.066		
474	M	+0.010	-0.017	148°23'08"	0.020

Analysis of Differences

Range			
High:		+0.018	+0.026
Low:		-0.016	-0.035
No.Obs:		148	148
Mean:		-0.000	+0.001
StdDev:		0.006	0.010

APPENDIX I

LISCAD Report: Point Comparison
Sunday, October 2, 2016 17:34

File: 7 Points
Projection: Map Grid Australia 94 Zone 53
File Date: Thursday, July 14, 2016

Units
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Distance: Metres

Method: Location (Radius=0.150m.)

R - Resolved point
M - Main point

Point ID		East	North	Elevation	Bearing	Distance
4	M	382964.355	7378417.037			
307	M	-0.008	-0.007		228°45'08"	0.010
6	M	382977.856	7378394.512			
13	M	+0.000	-0.000		143°22'18"	0.000
8	M	383003.822	7378390.179			
301	M	-0.008	-0.004		245°19'14"	0.009
10	M	383021.388	7378371.397			
302	M	-0.006	-0.001		264°30'21"	0.006
11	M	383038.954	7378352.615			
303	M	-0.005	+0.002		295°25'08"	0.006
12	M	383065.133	7378301.213			
209	M	+0.009	+0.009		45°06'02"	0.012
14	M	382984.687	7378387.211			
26	M	+0.000	-0.002		174°28'13"	0.002
16	M	383051.245	7378339.475			
304	M	-0.005	+0.003		305°35'13"	0.006
18	M	383088.126	7378283.676			
274	M	-0.021	+0.010		294°50'46"	0.023
19	M	382987.001	7378408.148			
191	M	+0.009	+0.006		53°26'21"	0.011
20	M	382994.489	7378156.635			
216	M	-0.013	-0.004		253°55'07"	0.014
22	M	383021.308	7378244.457			
102	M	-0.035	-0.009		256°23'35"	0.036
23	M	383076.813	7378312.143			
208	M	+0.001	+0.001		53°17'31"	0.002
24	M	383017.568	7378352.073			
291	M	-0.002	-0.010		188°54'50"	0.011
25	M	382988.140	7378322.520			
447	M	-0.001	-0.003		191°27'04"	0.003
27	M	382914.927	7378418.425			
411	M	+0.009	+0.008		48°24'50"	0.012
28	M	382965.985	7378346.197			
422	M	+0.004	-0.005		142°47'08"	0.006
29	M	382968.509	7378398.065			
32	M	+0.001	-0.003		160°25'41"	0.003
30	M	382946.599	7378357.034			
423	M	+0.005	-0.008		147°31'05"	0.009
31	M	382928.768	7378367.003			
424	M	+0.000	-0.009		177°32'16"	0.009
33	M	382922.989	7378207.285			
189	M	+0.001	+0.008		7°47'50"	0.008
34	M	382964.632	7378219.049			
456	M	-0.011	+0.007		302°49'47"	0.014
35	M	382915.057	7378216.187			
186	M	+0.001	+0.008		11°17'15"	0.008
36	M	382915.967	7378257.377			
462	M	-0.001	+0.005		347°39'45"	0.005
37	M	382893.114	7378226.360			
419	M	+0.004	+0.007		26°10'51"	0.008
39	M	382887.021	7378275.934			
460	M	-0.002	+0.008		350°07'37"	0.009
40	M	382942.364	7378308.395			
145	M	-0.004	+0.004		319°35'34"	0.006
42	M	382920.398	7378434.262			
58	M	+0.012	+0.006		64°07'28"	0.013
43	M	382947.608	7378279.293			
158	M	+0.003	-0.003		134°43'43"	0.004
44	M	382887.505	7378339.049			
372	M	+0.003	+0.011		14°36'51"	0.011
45	M	382967.038	7378294.302			
155	M	+0.001	-0.005		168°57'04"	0.006
46	M	382962.105	7378305.228			
154	M	-0.002	+0.003		330°11'23"	0.004
47	M	382923.226	7378370.101			
445	M	-0.004	-0.007		213°16'53"	0.008
48	M	382902.280	7378381.811			
312	M	-0.005	-0.009		209°08'18"	0.011
49	M	382910.094	7378377.443			
444	M	-0.004	-0.009		203°35'59"	0.010
50	M	383057.137	7378265.723			
220	M	+0.032	+0.011		71°43'24"	0.033
52	M	382890.512	7378436.428			
343	M	-0.000	-0.014		182°12'56"	0.014
53	M	382870.053	7378399.824			
437	M	+0.005	-0.014		159°49'49"	0.015
54	M	382880.724	7378418.918			
436	M	+0.005	-0.011		158°09'55"	0.012
55	M	382888.104	7378389.735			
438	M	+0.001	-0.013		175°07'56"	0.013
56	M	383061.633	7378250.301			
214	M	+0.036	+0.006		80°34'55"	0.037
59	M	382844.804	7378438.994			
136	M	+0.014	-0.020		145°49'17"	0.024
61	M	382834.132	7378419.899			
135	M	+0.017	-0.016		133°26'17"	0.024
62	M	382823.462	7378400.805			
134	M	+0.019	-0.014		125°56'47"	0.024
63	M	382859.383	7378380.732			
440	M	+0.007	-0.013		152°14'29"	0.015
64	M	382816.312	7378388.010			
133	M	+0.020	-0.013		124°22'55"	0.024
66	M	383033.057	7378232.338			
223	M	+0.030	+0.005		80°07'36"	0.031
69	M	382866.380	7378350.866			
392	M	+0.005	-0.010		155°01'58"	0.012
70	M	382800.706	7378360.077			
210	M	+0.014	-0.007		117°38'13"	0.016
71	M	382811.591	7378363.159			
204	M	+0.014	-0.008		121°30'38"	0.016
72	M	382826.956	7378354.576			
400	M	+0.008	-0.012		147°05'15"	0.014
73	M	382968.333	7378105.332			
249	M	+0.001	+0.001		49°14'22"	0.002
74	M	382848.537	7378342.519			
401	M	-0.001	-0.015		185°09'42"	0.015
75	M	382830.773	7378310.728			
468	M	-0.001	-0.002		196°49'52"	0.002
76	M	382824.385	7378314.297			
469	M	-0.001	-0.001		215°12'58"	0.001
77	M	382861.037	7378335.534			
396	M	-0.005	-0.015		197°55'49"	0.016
78	M	382945.211	7378112.565			
259	M	+0.012	-0.010		129°51'08"	0.016
79	M	382955.281	7378114.947			
258	M	+0.007	-0.011		146°26'42"	0.013
80	M	382865.409	7378324.071			
399	M	-0.006	-0.014		205°20'52"	0.015
81	M	382776.641	7378316.994			
380	M	+0.008	+0.007		50°04'58"	0.011
82	M	382766.436	7378298.722			
379	M	+0.004	+0.011		17°40'42"	0.012
83	M	382803.972	7378277.754			
471	M	-0.004	+0.009		335°37'16"	0.010
84	M	382848.142	7378274.076			
403	M	-0.008	+0.011		325°33'12"	0.013
85	M	382812.911	7378293.758			
472	M	+0.002	+0.010		13°31'15"	0.011
86	M	382797.468	7378266.111			
465	M	-0.004	+0.017		346°38'55"	0.017
87	M	382832.438	7378262.067			
199	M	-0.008	+0.021		340°26'12"	0.022
88	M	382754.759	7378281.242			
466	M	-0.001	+0.012		355°34'47"	0.012
99	M	383018.801	7378239.598			
234	M	+0.035	+0.008		77°39'47"	0.035
100	M	383009.175	7378220.710			
267	M	+0.037	+0.009		76°11'10"	0.038
106	M	383049.549	7378262.730			
272	M	+0.037	+0.008		77°44'22"	0.038
120	M	382847.549	7378484.842			
1450	M	-0.000	+0.002		354°40'44"	0.002
121	M	382848.778	7378487.042			
585	M	+0.001	+0.002		21°01'00"	0.002
126	M	382870.657	7378470.926			

896	M	-0.006	+0.004	301°32'48"	0.007
138	M	382853.228	7378454.025		
415	M	-0.011	+0.021	333°11'22"	0.024
139	M	382819.412	7378377.113		
426	M	-0.019	+0.011	299°47'22"	0.022
148	M	382889.185	7378319.806		
368	M	+0.002	-0.002	135°28'39"	0.002
151	M	382934.566	7378294.444		
376	M	+0.001	-0.002	155°47'04"	0.002
157	M	382940.436	7378287.625		
377	M	-0.001	+0.001	313°45'21"	0.002
164	M	382879.591	7378316.147		
367	M	-0.000	-0.002	191°56'40"	0.002
176	M	382901.571	7378220.138		
325	M	-0.004	-0.005	219°47'29"	0.007
179	M	382851.845	7378235.837		
313	M	+0.001	-0.013	174°18'54"	0.013
183	M	382892.086	7378207.265		
322	M	-0.001	-0.002	216°52'36"	0.002
188	M	382941.814	7378425.873		
308	M	-0.009	-0.004	245°53'54"	0.010
192	M	382903.134	7378190.598		
323	M	+0.002	-0.005	159°45'20"	0.006
194	M	382921.380	7378195.617		
327	M	-0.004	-0.006	213°32'00"	0.008
195	M	382849.010	7378236.817		
318	M	+0.004	-0.015	163°50'35"	0.015
196	M	382835.780	7378241.387		
482	M	+0.009	-0.018	153°35'15"	0.020
200	M	382847.008	7378270.827		
366	M	+0.005	-0.020	165°25'06"	0.020
205	M	383068.320	7378321.223		
305	M	-0.008	+0.006	307°09'52"	0.009
207	M	383085.396	7378302.974		
273	M	-0.019	+0.015	308°41'47"	0.025
217	M	383013.766	7378194.484		
236	M	+0.022	+0.005	77°47'19"	0.022
241	M	382836.841	7378192.406		
317	M	+0.004	-0.023	171°31'03"	0.024
256	M	382952.129	7378182.265		
429	M	-0.010	+0.008	310°10'25"	0.013
257	M	382981.885	7378167.101		
269	M	-0.026	+0.004	278°54'12"	0.026
260	M	382924.415	7378127.879		
390	M	-0.013	+0.016	322°07'49"	0.021
263	M	382729.823	7378281.128		
480	M	+0.008	-0.009	140°17'53"	0.012
266	M	382979.453	7378235.885		
428	M	-0.008	-0.000	269°40'14"	0.008
271	M	383011.102	7378297.983		
427	M	-0.006	-0.002	250°43'14"	0.007
279	M	383007.623	7378291.154		
451	M	-0.007	-0.001	264°37'21"	0.007
284	M	383031.226	7378337.479		
292	M	-0.005	-0.014	199°09'45"	0.014
290	M	383002.354	7378368.324		
296	M	-0.000	+0.007	357°54'08"	0.007
293	M	382994.336	7378315.898		
430	M	-0.004	+0.001	277°32'55"	0.004
297	M	382979.119	7378332.158		
431	M	-0.001	+0.001	321°56'24"	0.001
306	M	382950.059	7378405.082		
310	M	-0.007	-0.006	229°00'04"	0.009
311	M	382944.169	7378358.392		
446	M	-0.000	-0.005	184°36'07"	0.005
315	M	382869.594	7378223.830		
420	M	-0.002	+0.008	350°14'16"	0.008
316	M	382854.295	7378179.530		
385	M	-0.007	+0.022	343°58'01"	0.023
319	M	382834.317	7378194.245		
382	M	-0.005	+0.024	347°57'39"	0.025
320	M	382887.019	7378210.996		
421	M	-0.002	+0.004	329°03'25"	0.005
321	M	382871.718	7378166.696		
386	M	-0.007	+0.020	341°57'53"	0.021
324	M	382890.183	7378153.094		
389	M	-0.006	+0.017	340°24'59"	0.018
328	M	382951.650	7378181.325		
455	M	-0.009	+0.009	315°15'55"	0.013
336	M	382894.635	7378453.252		
895	M	+0.003	+0.006	30°45'26"	0.007
337	M	382863.571	7378456.264		
416	M	-0.010	+0.020	334°18'02"	0.023
338	M	382966.860	7378211.160		
454	M	-0.012	+0.010	308°24'33"	0.016
342	M	382908.527	7378423.141		
404	M	+0.006	+0.010	32°25'04"	0.012
344	M	382826.378	7378446.959		
586	M	-0.010	+0.007	306°29'49"	0.012
345	M	382935.962	7378244.558		
463	M	-0.001	+0.003	341°11'55"	0.003
346	M	382962.173	7378227.754		
457	M	-0.011	+0.007	303°02'25"	0.013
349	M	382812.183	7378421.558		
562	M	-0.014	+0.014	316°38'18"	0.020
350	M	382789.936	7378381.750		
555	M	-0.026	+0.019	306°52'55"	0.032
351	M	382769.257	7378344.747		
556	M	-0.016	+0.016	316°53'18"	0.023
353	M	382895.853	7378270.272		
461	M	-0.000	+0.007	359°41'22"	0.007
354	M	382873.920	7378240.501		
418	M	+0.008	+0.006	53°06'39"	0.009
358	M	382745.845	7378302.856		
475	M	-0.012	-0.006	242°43'49"	0.013
359	M	382869.565	7378287.125		
414	M	+0.002	+0.008	11°43'28"	0.009
360	M	382864.052	7378247.770		
417	M	+0.010	+0.006	60°55'06"	0.012
361	M	382860.224	7378260.077		
413	M	+0.000	+0.017	0°54'27"	0.017
362	M	382753.110	7378315.846		
492	M	-0.022	-0.006	255°10'30"	0.023
363	M	382745.925	7378269.264		
476	M	+0.009	-0.006	126°25'39"	0.011
364	M	382747.612	7378258.139		
478	M	+0.014	-0.035	158°42'28"	0.038
369	M	382906.218	7378310.287		
409	M	-0.001	+0.001	291°40'41"	0.002
370	M	382762.680	7378292.007		
473	M	+0.002	-0.006	166°00'09"	0.007
374	M	382925.836	7378299.322		
410	M	-0.001	+0.001	337°21'54"	0.001
375	M	382905.975	7378263.783		
459	M	-0.004	+0.008	333°23'55"	0.009
378	M	382928.117	7378249.587		
458	M	-0.005	+0.007	325°52'24"	0.008
381	M	382786.859	7378335.269		
435	M	-0.012	-0.002	262°35'11"	0.012
383	M	382767.784	7378243.279		
477	M	+0.003	-0.024	172°32'49"	0.024
384	M	382810.006	7378212.174		
483	M	+0.007	-0.025	165°44'38"	0.026
391	M	382848.340	7378360.943		
425	M	-0.010	+0.010	316°42'22"	0.014
393	M	382924.158	7378318.571		
407	M	-0.002	-0.000	257°17'04"	0.002
397	M	382905.831	7378328.816		
406	M	-0.000	-0.006	181°30'00"	0.006
402	M	382855.936	7378296.662		
448	M	+0.007	+0.002	78°35'00"	0.007
405	M	382889.438	7378388.989		
442	M	+0.002	-0.013	169°50'12"	0.013
412	M	382929.844	7378412.768		
443	M	-0.011	-0.008	234°06'58"	0.013
439	M	382809.195	7378322.784		
467	M	+0.005	-0.001	106°13'34"	0.005
452	M	382814.178	7378296.026		
470	M	-0.000	+0.004	356°00'32"	0.004
464	M	382790.889	7378261.066		
474	M	+0.009	-0.014	145°48'33"	0.017

Analysis of Differences

Range					
High:		+0.037	+0.024		
Low:		-0.035	-0.035		
No.Obs:		148	148		
Mean:		+0.000	+0.000		
StdDev:		0.011	0.011		

APPENDIX J

LISCAD Report: Point Comparison
Monday, September 26, 2016   19:01

File: 25. 5 Points
Projection: Map Grid Australia 94 Zone 53
File Date: Thursday, July 14, 2016

Units
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Distance: Metres

Method: Location (Radius=0.150m.)

R - Resolved point
M - Main point

Point ID		Co-ordinates East	North	Elevation	Bearing	Distance
4	M	382964.356	7378417.075			
307	M	-0.009	-0.045		191°32'58"	0.046
6	M	382977.860	7378394.557			
13	M	-0.004	-0.045		185°07'59"	0.046
8	M	383003.823	7378390.215			
301	M	-0.009	-0.040		193°01'26"	0.041
10	M	383021.386	7378371.428			
302	M	-0.004	-0.032		188°23'03"	0.032
11	M	383038.951	7378352.639			
303	M	-0.002	-0.022		185°43'07"	0.022
12	M	383065.133	7378301.213			
209	M	+0.012	+0.014		40°40'05"	0.018
14	M	382984.687	7378387.211			
26	M	+0.005	+0.043		7°22'46"	0.043
16	M	383051.241	7378339.493			
304	M	-0.001	-0.015		183°26'40"	0.015
18	M	383088.121	7378283.679			
274	M	-0.016	+0.007		292°40'08"	0.018
19	M	382987.001	7378408.148			
191	M	+0.010	+0.046		12°06'47"	0.047
20	M	382994.485	7378156.638			
216	M	-0.009	-0.007		233°53'04"	0.012
22	M	383021.306	7378244.467			
102	M	-0.033	-0.019		240°41'07"	0.038
23	M	383076.813	7378312.143			
208	M	+0.001	+0.001		53°17'31"	0.002
24	M	383017.579	7378352.097			
291	M	-0.013	-0.034		200°28'36"	0.037
25	M	382988.145	7378322.544			
447	M	-0.006	-0.027		192°08'37"	0.028
27	M	382914.927	7378418.425			
411	M	+0.009	+0.033		15°32'24"	0.034
28	M	382965.987	7378346.229			
422	M	+0.002	-0.037		177°37'26"	0.037
29	M	382968.512	7378398.109			
32	M	-0.002	-0.047		182°40'45"	0.047
30	M	382946.603	7378357.062			
423	M	+0.001	-0.036		178°41'29"	0.036
31	M	382928.771	7378367.027			
424	M	-0.003	-0.033		184°57'11"	0.033
33	M	382922.990	7378207.285			
189	M	+0.000	+0.008		0°58'43"	0.008
34	M	382964.634	7378219.053			
456	M	-0.013	+0.003		284°05'41"	0.014
35	M	382915.061	7378216.183			
186	M	-0.003	+0.012		348°21'30"	0.012
36	M	382915.971	7378257.378			
462	M	-0.005	+0.004		308°47'50"	0.007
37	M	382893.118	7378226.356			
419	M	-0.000	+0.011		358°06'30"	0.011
39	M	382887.021	7378275.934			
460	M	-0.002	+0.008		350°07'37"	0.009
40	M	382942.366	7378308.418			
145	M	-0.006	-0.019		197°38'39"	0.020
42	M	382920.398	7378434.262			
58	M	+0.010	+0.035		16°15'50"	0.036
43	M	382947.606	7378279.303			
158	M	+0.005	-0.013		159°20'32"	0.014
44	M	382887.505	7378339.049			
372	M	+0.005	+0.021		13°14'17"	0.021
45	M	382967.041	7378294.319			
155	M	-0.002	-0.022		185°16'12"	0.023
46	M	382962.107	7378305.251			
154	M	-0.004	-0.020		191°47'16"	0.020
47	M	382923.225	7378370.126			
445	M	-0.003	-0.032		186°16'36"	0.032
48	M	382902.278	7378381.831			
312	M	-0.003	-0.029		186°29'13"	0.029
49	M	382910.095	7378377.463			
444	M	-0.005	-0.029		190°03'24"	0.030
50	M	383057.137	7378265.723			
220	M	+0.029	+0.019		57°13'14"	0.034
52	M	382890.506	7378436.449			
343	M	+0.006	-0.035		171°23'47"	0.035
53	M	382870.051	7378399.837			
437	M	+0.007	-0.027		165°27'54"	0.028
54	M	382880.721	7378418.935			
436	M	+0.008	-0.028		165°19'02"	0.030
55	M	382888.102	7378389.751			
438	M	+0.003	-0.029		174°07'53"	0.029
56	M	383061.633	7378250.301			
214	M	+0.031	+0.012		69°02'01"	0.034
59	M	382844.797	7378439.004			
136	M	+0.021	-0.030		145°42'12"	0.036
61	M	382834.127	7378419.907			
135	M	+0.022	-0.024		137°40'43"	0.033
62	M	382823.459	7378400.810			
134	M	+0.022	-0.019		130°32'49"	0.029
63	M	382859.382	7378380.741			
440	M	+0.008	-0.022		160°26'07"	0.024
64	M	382816.309	7378388.011			
133	M	+0.023	-0.014		122°34'33"	0.027
66	M	383033.057	7378232.338			
223	M	+0.025	+0.013		62°09'47"	0.028
69	M	382866.382	7378350.874			
392	M	+0.003	-0.018		171°20'04"	0.019
70	M	382800.704	7378360.075			
210	M	+0.016	-0.005		108°28'12"	0.017
71	M	382811.589	7378363.158			
204	M	+0.016	-0.007		115°18'29"	0.017
72	M	382826.954	7378354.575			
400	M	+0.010	-0.011		138°12'25"	0.014
73	M	382968.333	7378105.332			
249	M	+0.001	+0.001		49°14'22"	0.002
74	M	382848.533	7378342.520			
401	M	+0.003	-0.016		170°12'07"	0.016
75	M	382830.772	7378310.727			
468	M	+0.000	-0.001		161°11'27"	0.001
76	M	382824.385	7378314.295			
469	M	-0.001	+0.001		332°26'26"	0.001
77	M	382861.033	7378335.536			
396	M	-0.001	-0.017		183°17'32"	0.017
78	M	382945.211	7378112.565			
259	M	+0.012	-0.012		135°04'49"	0.017
79	M	382955.281	7378114.947			
258	M	+0.008	-0.012		145°23'04"	0.015
80	M	382865.406	7378324.074			
399	M	-0.003	-0.017		191°53'34"	0.017
81	M	382776.640	7378316.992			
380	M	+0.009	+0.009		46°10'57"	0.013
82	M	382766.436	7378298.720			
379	M	+0.004	+0.013		15°12'52"	0.014
83	M	382803.972	7378277.751			
471	M	-0.004	+0.012		341°26'47"	0.012
84	M	382848.143	7378274.074			
403	M	-0.009	+0.013		326°44'57"	0.016
85	M	382812.911	7378293.756			
472	M	+0.002	+0.012		11°27'31"	0.013
86	M	382797.468	7378266.108			
465	M	-0.004	+0.020		348°42'28"	0.020
87	M	382832.438	7378262.063			
199	M	-0.008	+0.025		343°28'35"	0.026
88	M	382754.759	7378281.241			
466	M	-0.001	+0.013		355°58'03"	0.013
99	M	383018.801	7378239.598			
234	M	+0.031	+0.016		63°01'42"	0.034
100	M	383009.175	7378220.710			
267	M	+0.034	+0.020		59°26'54"	0.040
106	M	383049.549	7378262.730			
272	M	+0.037	+0.019		62°57'19"	0.042
120	M	382847.549	7378484.842			
1450	M	-0.000	+0.002		354°40'44"	0.002
121	M	382848.778	7378487.042			
585	M	+0.001	+0.002		21°01'00"	0.002
126	M	382870.657	7378470.926			

896	M	-0.010	+0.016	327°13'51"	0.019
138	M	382853.228	7378454.025		
415	M	-0.020	+0.034	330°14'10"	0.040
139	M	382819.412	7378377.113		
426	M	-0.020	+0.012	300°43'33"	0.023
148	M	382889.185	7378319.806		
368	M	+0.002	-0.001	113°11'44"	0.002
151	M	382934.566	7378294.444		
376	M	-0.003	+0.009	341°39'47"	0.009
157	M	382940.436	7378287.625		
377	M	-0.003	+0.010	342°44'25"	0.011
164	M	382879.591	7378316.147		
367	M	-0.000	-0.001	199°47'17"	0.001
176	M	382901.571	7378220.138		
325	M	+0.004	-0.012	164°42'47"	0.013
179	M	382851.845	7378235.837		
313	M	+0.002	-0.021	173°56'48"	0.021
183	M	382892.086	7378207.265		
322	M	+0.002	-0.016	174°02'43"	0.016
188	M	382941.814	7378425.908		
308	M	-0.009	-0.039	193°51'58"	0.040
192	M	382903.134	7378190.598		
323	M	+0.001	-0.012	175°38'28"	0.012
194	M	382921.380	7378195.617		
327	M	-0.002	-0.010	192°05'37"	0.011
195	M	382849.010	7378236.817		
318	M	+0.005	-0.023	167°07'43"	0.023
196	M	382835.780	7378241.387		
482	M	+0.008	-0.024	161°51'53"	0.025
200	M	382847.008	7378270.827		
366	M	+0.006	-0.023	164°57'49"	0.024
205	M	383068.315	7378321.233		
305	M	-0.003	-0.004	210°52'53"	0.005
207	M	383085.392	7378302.977		
273	M	-0.015	+0.012	309°02'28"	0.020
217	M	383013.766	7378194.484		
236	M	+0.017	+0.011	57°22'20"	0.020
241	M	382836.841	7378192.406		
317	M	+0.003	-0.030	175°26'11"	0.030
256	M	382952.130	7378182.268		
429	M	-0.011	+0.005	296°01'05"	0.012
257	M	382981.886	7378167.106		
269	M	-0.027	-0.001	267°57'13"	0.027
260	M	382924.417	7378127.876		
390	M	-0.015	+0.019	322°48'39"	0.025
263	M	382729.823	7378281.128		
480	M	+0.008	-0.009	140°17'53"	0.012
266	M	382979.450	7378235.895		
428	M	-0.005	-0.010	206°02'25"	0.011
271	M	383011.106	7378298.001		
427	M	-0.010	-0.020	207°13'54"	0.023
279	M	383007.625	7378291.170		
451	M	-0.009	-0.017	209°18'04"	0.019
284	M	383031.237	7378337.495		
292	M	-0.016	-0.030	208°13'39"	0.034
290	M	383002.354	7378368.324		
296	M	+0.009	+0.040	12°51'47"	0.041
293	M	382994.338	7378315.924		
430	M	-0.006	-0.025	194°17'15"	0.026
297	M	382979.121	7378332.189		
431	M	-0.003	-0.030	185°51'32"	0.030
306	M	382950.057	7378405.119		
310	M	-0.005	-0.043	186°29'25"	0.043
311	M	382944.170	7378358.422		
446	M	-0.001	-0.035	182°40'39"	0.035
315	M	382869.594	7378223.819		
420	M	-0.002	+0.019	356°00'28"	0.019
316	M	382854.293	7378179.521		
385	M	-0.005	+0.031	352°09'42"	0.031
319	M	382834.315	7378194.239		
382	M	-0.003	+0.030	354°07'21"	0.030
320	M	382887.019	7378210.983		
421	M	-0.002	+0.017	352°14'50"	0.017
321	M	382871.718	7378166.685		
386	M	-0.007	+0.031	348°21'49"	0.031
324	M	382890.184	7378153.084		
389	M	-0.007	+0.027	345°29'19"	0.028
328	M	382951.650	7378181.325		
455	M	-0.009	+0.009	315°15'55"	0.013
336	M	382894.635	7378453.252		
895	M	+0.001	+0.027	3°13'32"	0.027
337	M	382863.571	7378456.264		
416	M	-0.019	+0.035	332°12'13"	0.040
338	M	382966.862	7378211.168		
454	M	-0.014	+0.002	276°52'52"	0.014
342	M	382908.527	7378423.141		
404	M	+0.003	+0.034	6°06'05"	0.034
344	M	382826.378	7378446.959		
586	M	-0.010	+0.007	306°29'49"	0.012
345	M	382935.966	7378244.560		
463	M	-0.005	+0.001	282°01'29"	0.005
346	M	382962.173	7378227.760		
457	M	-0.011	+0.001	274°28'02"	0.011
349	M	382812.183	7378421.558		
562	M	-0.015	+0.015	316°33'34"	0.021
350	M	382789.936	7378381.750		
555	M	-0.027	+0.019	305°51'25"	0.033
351	M	382769.257	7378344.747		
556	M	-0.016	+0.016	316°53'18"	0.023
353	M	382895.856	7378270.271		
461	M	-0.003	+0.008	338°26'27"	0.008
354	M	382873.923	7378240.496		
418	M	+0.005	+0.011	23°15'20"	0.012
358	M	382745.845	7378302.856		
475	M	-0.012	-0.007	239°04'24"	0.014
359	M	382869.566	7378287.123		
414	M	+0.001	+0.010	4°13'35"	0.011
360	M	382864.054	7378247.766		
417	M	+0.008	+0.010	40°09'56"	0.013
361	M	382860.225	7378260.072		
413	M	-0.001	+0.022	358°13'26"	0.022
362	M	382753.110	7378315.846		
492	M	-0.022	-0.007	252°49'25"	0.024
363	M	382745.925	7378269.264		
476	M	+0.009	-0.006	126°25'39"	0.011
364	M	382747.612	7378258.139		
478	M	+0.013	-0.036	160°39'27"	0.038
369	M	382906.217	7378310.291		
409	M	-0.000	-0.003	187°41'14"	0.003
370	M	382762.680	7378292.007		
473	M	+0.002	-0.007	167°54'44"	0.007
374	M	382925.834	7378299.330		
410	M	+0.001	-0.007	168°11'02"	0.007
375	M	382905.974	7378263.785		
459	M	-0.003	+0.006	333°13'37"	0.006
378	M	382928.116	7378249.592		
458	M	-0.004	+0.002	296°20'23"	0.004
381	M	382786.859	7378335.269		
435	M	-0.013	-0.005	250°41'25"	0.014
383	M	382767.784	7378243.279		
477	M	+0.002	-0.026	175°20'19"	0.026
384	M	382810.006	7378212.174		
483	M	+0.005	-0.030	171°46'22"	0.031
391	M	382848.340	7378360.943		
425	M	-0.010	+0.016	329°24'18"	0.019
393	M	382924.162	7378318.591		
407	M	-0.006	-0.020	195°45'39"	0.021
397	M	382905.835	7378328.831		
406	M	-0.004	-0.021	191°33'33"	0.021
402	M	382855.936	7378296.662		
448	M	+0.007	+0.003	71°12'54"	0.008
405	M	382889.438	7378389.005		
442	M	+0.002	-0.029	175°39'05"	0.029
412	M	382929.840	7378412.798		
443	M	-0.007	-0.038	190°29'01"	0.038
439	M	382809.193	7378322.781		
467	M	+0.007	+0.002	76°18'14"	0.007
452	M	382814.178	7378296.024		
470	M	-0.000	+0.006	357°23'49"	0.006
464	M	382790.889	7378261.066		
474	M	+0.010	-0.016	146°46'03"	0.019

Analysis of Differences

Range			
High:	+0.037	+0.046	
Low:	-0.033	-0.047	
No.Obs:	148	148	
Mean:	-0.000	-0.004	
StdDev:	0.011	0.021	