



TECHNICAL INSTRUCTIONS

29.194 SURVEY CAMP

BATHURST - DECEMBER, 1983

SCHOOL OF SURVEYING



THE UNIVERSITY OF NEW SOUTH WALES

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Technical Instructions

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1. GENERAL

1. SURVEY PROJECTS

The survey projects - field astronomy, triangulation, trigonometric levelling, ground control for photogrammetry, land use survey and cadastral survey - have been chosen so that the work involved will consolidate the third year class material. At the same time, the projects serve to introduce the fourth year. The technical programme, which includes one week of supervised "office work" on campus, can be completed well within the times allocated, providing the weather is suitable.

2. ORGANISATION

2.1 Computation Days

Computation days have been interspersed between the actual field days in order to provide sufficient time to process the field measurements at the camp site. These days should be utilised for this purpose only.

2.2 Use of Equipment

In order to make maximum use of the equipment and the time available, the class will be divided into groups of three. A work schedule is attached which should be strictly adhered to. However, should a group complete a project early, then it may commence work on any other project if the necessary equipment is available.

2.3 Use of Computing Facilities

A HP 9810 calculator, together with cassette memory, will be available at camp and on campus; TI59s and printers will also be available. On campus, the programme SVY041 for computations on the CDC Cyber computer will be available for the parametric solution. You will be encouraged to write your own programmes for the reduction of your work.

2.4 Use of Vehicles

Students will NOT use private vehicles on private property, except with the express permission of a supervisor and the owner of the land in question.

3. PROJECTIONS

Two distinct projections will be used in the calculations. These are the Australian Map Grid (AMG) and the Integrated Survey Grid (ISG) systems. The ISG system should be adopted for all projects except the triangulation survey, where the AMG system shall be chosen. Both projections refer to the Australian National Spheroid ($a = 6378160\text{m}$ and $f = 1:298.25$). The elevations are on Australian Height Datum (AHD).

4. SUBMISSIONS

4.1 Report

Separate reports on each of the survey projects performed at camp shall be submitted by the due dates given in Sec. I-4.3. These reports are to contain the following:

- (a) an index page;
- (b) a summary of results;
- (c) an abstract of all field measurements;
- (d) reductions, calculations and adjustments;
- (e) explanatory remarks to clarify procedures adopted; and
- (f) appropriate cross-referencing where data used in one project is derived in another part.

4.2 Field Notes

The field notes and field books shall also be submitted.

4.3 Deadlines

The deadlines for submissions to the Technical Director will be 1600 hours on December 23, 1983. An extension of time WILL NOT be granted under any circumstances.

5. DATA

5.1 Projections

| QUANTITY | AMG | ISG |
|------------------------|---------------|--------------|
| Zone Width | 6° | 2° |
| Zone Number | 55 | 55/3 |
| Central Meridian | 147°E | 149°E |
| Scale Factor (k_0) | 0.9996 | 0.99994 |
| False Origin - East | -500 000 m | -300 000 m |
| - North | -10 000 000 m | -5 000 000 m |

5.2 Formulae

5.2.1 Arc-to-chord

$$\delta = \frac{(N'_1 - N'_2)(2E'_1 + E'_2)}{6 k_0^2 \rho \nu \sin 1''} \quad [\text{in arc seconds}]$$

5.2.2 Scale factor

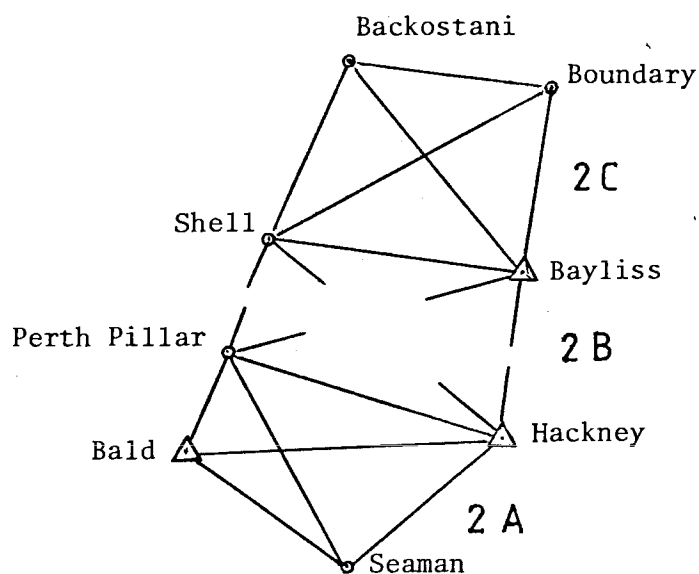
$$\frac{s}{s} = k_0 \left[1 + \frac{E_1'^2 + E_1' E_2' + E_2'^2}{6 k_0^2 \rho \nu} \right]$$

5.2.3

$$\frac{10^8}{\rho \nu \sin 1''} + 0.5083754$$

NOTE: N'_1 N'_2 E'_1 E'_2 refer to true coordinates.

5.3 Triangulation



Scheme 2A: Perth-Pillar, Hackney, Seaman, Bald

2B: Shell, Bayliss, Hackney, Perth Pillar

2C: Backostani, Boundary, Bayliss, Shell

5.4 Coordinates and Elevations

5.4.1 AMG

| POINT | E (m) | N (m) | HT (m) |
|------------|------------|--------------|--------|
| Bayliss | 740 300.49 | 6 294 601.30 | 716.85 |
| Hackney | 740 218.93 | 6 292 453.65 | - |
| Bald | 735 930.76 | 6 292 379.23 | 851.63 |
| Backostani | 738 677.76 | 6 297 777.36 | - |

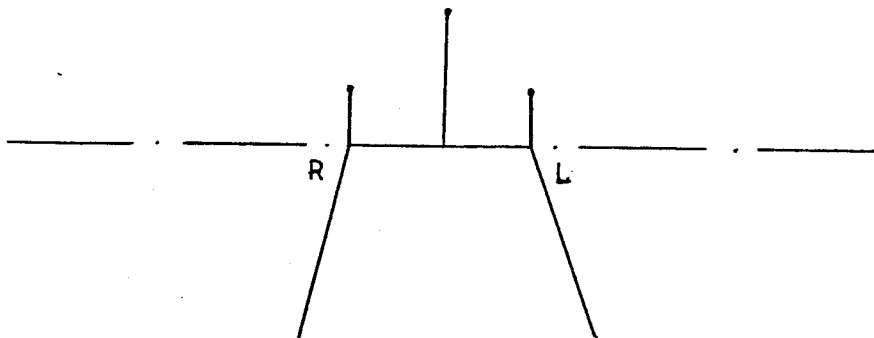
5.4.2 Coordinates in ISG 55/3 system, elevations on AHD

| DATA CASSETTE FILE NO. | STATION | EASTING | NORTHING | ELEVATION |
|---------------------------------|------------------------|------------|--------------|----------------------|
| 90 | Red Hill | 333 166.56 | 1 291 080.33 | |
| 91 | Mulley (CMA) | 352 623.70 | 1 299 490.10 | 731.76(Top pillar) |
| 92 | Durham Court Pillar | 361 005.51 | 1 299 149.74 | 768.07(Top pillar) |
| 93 | Baanya Pillar | 350 940.80 | 1 301 958.80 | 731.82(Top pillar) |
| 94 | Avondale Pillar | 350 502.00 | 1 307 950.10 | 723.52(Top pillar) |
| 95 | Clarke | 330 143.97 | 1 283 996.21 | |
| 96 | Macquarie | 316 673.11 | 1 275 602.25 | |
| 97 | Errol | 322 236.56 | 1 284 793.46 | |
| 98 | Crackersack | 338 149.77 | 1 304 547.17 | |
| 99 | Edrop | 344 963.09 | 1 309 186.82 | |
| 100 | Rankin | 347 444.18 | 1 312 180.98 | |
| 101 | Lowes Pillar | 375 182.00 | 1 281 532.89 | 1 133.52(Top pillar) |
| 102 | Ovens Pillar | 372 099.23 | 1 301 416.35 | 1 273.90(Top pillar) |
| 103 | Rocks Pillar | 337 609.29 | 1 298 393.38 | 1 038.45(Top pillar) |
| 104 | Bald | 350 107.74 | 1 293 874.29 | 851.63 |
| 105 | Bayliss | 354 432.44 | 1 296 179.34 | 716.85 |
| 106 | El Woodara | 342 929.60 | 1 299 282.28 | |
| 107 | Cherry Tree | 349 031.23 | 1 299 106.63 | 827.96 |
| 108 | Evernden Pillar | 350 451.01 | 1 284 884.82 | 990.5* |
| 110 | Hackney | 354 392.26 | 1 294 031.23 | 753.0* |
| 112 | Hollis | 351 552.61 | 1 290 745.47 | 787.97 |
| 113 | Humby | 350 537.41 | 1 299 155.91 | 788.0* |
| 114 | Lenahan | 347 131.77 | 1 292 057.34 | 812.88 |
| 115 | Boundary | 354 869.26 | 1 298 610.71 | 680.5* |
| 117 | Shell | 351 143.71 | 1 296 558.49 | 873.5* |
| 118 | Peel | 363 578.74 | 1 307 341.58 | 878.18 |
| 120 | Seaman | 352 176.26 | 1 292 479.96 | 734.5* |
| 121 | St. Stanislaus | 353 015.28 | 1 299 583.33 | 738.36 (see sketch) |
| 122 | Three Brothers | 336 080.31 | 1 275 516.46 | |
| 124 | Williams | 348 604.89 | 1 292 964.50 | 795.37 |
| 126 | Panorama | 350 822.85 | 1 297 238.54 | 874.02(Top pillar) |
| 127 | Perth-Pillar | 350 579.52 | 1 295 238.07 | 879.5* |
| 128 | Rutherford | 355 518.02 | 1 303 906.86 | 701.98 |
| 131 | Lee Pillar | 358 911.85 | 1 300 003.49 | 740.00 |
| 134 | Bushranger Pillar | 344 729.91 | 1 292 362.33 | 865.37(Top pillar) |
| 135 | Oakleigh Pillar | 358 450.04 | 1 303 347.43 | 771.23(Top pillar) |

| DATA CASSETTE FILE NO. | STATION | EASTING | NORTHING | ELEVATION |
|---------------------------------|------------------------|------------|--------------|--------------------|
| 136 | Tareen Pillar | 358 673.00 | 1 297 009.00 | 754.46(Top pillar) |
| 137 | Hackney Pillar | 354 784.60 | 1 294 999.64 | 741.08(Top pillar) |
| 138 | Gormans Hill Pillar | 354 945.01 | 1 298 271.82 | 687.75(Top pillar) |
| 139 | SSM2234 | 351 784.39 | 1 296 552.98 | |
| 140 | Cadastral | 352 354.25 | 1 296 421.39 | |
| 143 | Tarella Pillar | 359 894.80 | 1 315 005.36 | |
| 150 | Carrawarra | 354 088.39 | 1 305 469.67 | |
| | Carto School | 352 495.86 | 1 299 096.42 | 710.57 |
| | (TAFE) | 5 | | |
| | Backostani | 352 749.45 | 1 299 322.53 | 717.7 |

* Rounded to the nearest 0.5m. If higher accuracy is needed, use your own data determined in the trigonometric levelling project.

Sketch: St. Stanislaus - Central Tower



6. ORGANISATION OF TECHNICAL PROGRAMMES

6.1 Projects and Supervisors

| IDENT. | PROJECT | DAYS ALLOCATED | SUPERVISORS |
|--------|--------------------------------------|-------------------|------------------------------|
| 1 | Reconnaissance & Briefing | 1/2 | Mr. Pollard |
| 2 | Triangulation & Trig. Levelling | 2 | Mr. Pollard |
| 3 | Ground Control for Aerial Mapping | 2 | A/Prof. Trinder/Mr. Ganeshan |
| 4 | Cadastral Survey | 2 | Mr. Holstein/Dr. Forster |
| 5 | Field Astronomy | Nights | Mr. Ganeshan |
| 6 | Land Use Survey | 1 | Mr. Holstein/Dr. Forster |
| C | Computations | | Individual Supervisors |
| R | Rest Day | | |

6.2 Directors

Administrative Director - Mr. L.C. Holstein

Technical Director - Mr. J.R. Pollard

6.3 Post-Camp Supervision

In the one week period following the camp prior to report submission, the following staff will be available for consultation at specific times, which they will notify: A/Prof. J.S. Allman, Dr. B.C. Forster, Dr. A.J. Robinson, Dr. J.M. Rueger and A/Prof. J.C. Trinder.

7. WORK SCHEDULE: DECEMBER, 1983

| GROUP | DAY DATE | MON 5 | TUE 6 | WED 7 | THU 8 | FRI 9 | SAT 10 | SUN 11 | MON* 12 | TUE** 13 | WED 14 | THU 15 | FRI 16 | MON TO FRI 19-23 |
|-------------|---|----------|----------|----------|----------|----------|-----------|-----------|------------|-------------|-----------|-----------|-----------|--|
| 1 | | 1 | 4 | 4 | 3 | 3 | C | 2A | 2A | 6 | C | | | COMPUTATIONS & COMPILATION OF TECHNICAL REPORT. SUBMISSION DUE 4.00 P.M. ON 23/12/83 |
| 2 | | 1 | 4 | 4 | 3 | 3 | C | 2A | 2A | 6 | C | | | |
| 3 | | 1 | 4 | 4 | 2A | 2A | C | 3 | 3 | 6 | C | | | |
| 4 | | 1 | 3 | 3 | 4 | 4 | C | 2C | 2C | 6 | C | | | |
| 5 | | 1 | 3 | 3 | 4 | 4 | C | 2C | 2C | 6 | C | | | |
| 6 | | 1 | 2A | 2A | 4 | 4 | C | 3 | 3 | 6 | C | | | |
| 7 | | 1 | 2A | 2A | 6 | C | 4 | 4 | 3 | 3 | C | | | |
| 8 | | 1 | 2C | 2C | 6 | C | 4 | 4 | 3 | 3 | C | | | |
| 9 | | 1 | 2C | 2C | 6 | C | 4 | 4 | 3 | 3 | C | | | |
| 10 | | 1 | 3 | 3 | 2A | 2A | C | 6 | 4 | 4 | C | | | |
| 11 | | 1 | 3 | 3 | 2C | 2C | C | 6 | 4 | 4 | C | | | |
| 12 | | 1 | 3 | 3 | 2C | 2C | C | 6 | 4 | 4 | C | | | |
| WEATHER DAY | | | | | | | | | | | | | | |
| LEAVE CAMP | | | | | | | | | | | | | | |
| TASK | | | | | | | | | | | | | | |
| 1. | Travel to Bathurst, Briefing, Reconnaissance | | | | | | | | | | | | | |
| 2. | Trig. & Trig. Levelling; 2A - Area A, 2C - Area C | | | | | | | | | | | | | |
| 3. | Ground Control for Aerial Surveying | | | | | | | | | | | | | |
| 4. | Cadastral Surveying | | | | | | | | | | | | | |
| 5. | Field Astronomy - evenings until exercise completed | | | | | | | | | | | | | |
| 6. | Land Use Survey | | | | | | | | | | | | | |
| C. | Computations | | | | | | | | | | | | | |
| * | Visit C.M.A. (a.m.) | | | | | | | | | | | | | |
| ** | Social Occasion (p.m.) | | | | | | | | | | | | | |

II. PROJECTS

1. RECONNAISSANCE

This exercise will involve a familiarisation of the camp area and surrounding control network, erection or dismantling of beacons, and the preparation of access and recovery sketches. (See Appendix A).

Details will be discussed during the briefing session, which is to be given at 1.00 p.m. on the day of arrival at the camp.

2. TRIANGULATION AND TRIGONOMETRIC LEVELLING

2.1 Equipment

- 1 x 1" Theodolite + Tripod
- 1 Plumbob with long string
- 1 x 30m Tape
- 1 Umbrella with steel base
- 1 Hammer

2.2 Project

2.2.1 Triangulation

On all four stations of the quadrilateral, each group member shall measure four arcs of horizontal directions to the stations of the braced quadrilateral which is specified in the network schedule.

Before commencing the daily observations and before leaving the site, all the signals must be checked for verticality, and the offsets in E-W and N-S direction entered in a table in the camp.

At each station, the reduced observations shall be statistically tested by the Variance Ratio Test to confirm the hypothesis that the internal precision is consistent with previous experience with 1 second theodolites, i.e. a sample of a population with a variance of $(6.25 \text{ sec}^2/2)$ for the mean of Face Left and Face Right.

On completion of the field work, the observations will be corrected for arc-to-chord. Students shall check quadrilateral observations for angular and side equation closures, tolerances for which will be specified by your Supervisor. Observations will then be adjusted by the "parametric" method to give corrections to the observations, the station coordinates and the error ellipses. The variance of the observations is given by:

$$\sigma^2 \text{ mean} = \left(\frac{6.25}{2n} + 0.3 \right) \text{ sec}^2$$

where n is the number of arcs and 0.3 is an external component to allow for plumbing and atmospheric uncertainties. Each student is to use his own observations in the performance of the above tasks. Refer to Appendix B for the form of the observation equations and other details.

D.3

- (7) All surveys shall be made in accordance with the Survey Practice Regulations.

See ss 8-13 Survey Practice

 s 21 Country Surveys

 ss 25-29 Redetermination of Boundaries

 ss 41, 42A-44 Accuracy

 ss 47-48, 50-53 Field Notes

 ss 54-57 Plans

Reference should also be made to the N.S.W. Crown Lands Office Survey Directions, 1981.

- (8) Check all equipment before commencing survey. In particular, check you are familiar with the operation of your particular EDM instrument and that each tribrach is in adjustment. You are required to standardise your steel band with a nominated baseline, located in the racetrack area.
- (9) Traverses should be connected into at least two of the following control marks - SSM 2234 "CADASTRAL" and "CADASTRAL 2". The location of "CADASTRAL 2" will be available at survey camp.
- (10) Traverse closures and final adjusted coordinates of boundary corners should be approved by the supervisor before traverse marks are removed.
- (11) Every mark shown on a plan which refers to the boundaries of the subject property must be shown as either "found", "found (disturbed)", or "gone".
- (12) You will be required to calculate radiations to nominated "missing" corners on the area under survey.

SUBMISSIONS

The report is to comprise both an individual and group submission.

Group Submission:

- (1) Field notes - final adjusted bearings and distances of all observations must be shown in the field notes, preferably in a different colour.
- (2) Calculations and report - this will include the traverse misclosures and adjustments, the calculation of boundaries, the comparisons, the coordination of the boundaries and the work sheet.
- (3) A graphical metric interpretation of the old system metes and bounds description.

Booking observations should conform with the example shown in Appendix B.6. Special booking forms will be supplied and your supervisor will advise you on the booking method to be adopted.

2.2.2 Trigonometric levelling

Each student will measure two arcs of vertical angles to the remaining stations of the braced quadrilateral before and after the horizontal direction observations. The measurement of height of instrument and signal is important.

The measurement of two arcs of vertical angles should be carried out in the following sequence: $O_L O_R O_R O_L$, where O_L (O_R) is the reading of the centre hair on Face Left (Right). Some simple meteorological observations will also be required. Special booking forms will be supplied.

The individual height differences are to be calculated using the following formulae (dimensions are in metres):

$$\Delta h = d \left(1 + \frac{H}{R}\right) \left[\cot Z + \frac{(1-k)d}{2R}\right] + (HI - HO)$$

where

- h is the height difference;
- d is the spheroidal distance at sea level;
- H is the altitude of observation station;
- R is the radius of spheroidal section (6369 700m for this project);
- Z is the observed zenith distances;
- k is the refraction coefficient (+0.14 for this project);
- HI is the height of instrument; and
- HO is the height of object.

The spheroidal distance d should be computed from the given I.S.G. coordinates (see I-5.4.2).

The mean height difference for each line will then be entered into a least squares adjustment to produce the adjusted heights of the stations. The variance of a mean height difference from reciprocal observations should be estimated by the formula:

$$S_{\Delta h}^2 = 0.20 D^2 (S_z^2 + 0.4 D^2)$$

where

- $S_{\Delta h}^2$ is the variance of the mean height difference in cm^2 ;
- D is the distance in km; and
- S_z is the estimated standard deviation of the zenith distance in seconds of arc ($\pm 2''$ to be assumed for this project).

2.3 Submission

Each student shall submit for assessment the field notes, calculations and a report on the project, including a discussion of the achieved precision.

The submissions for the project are to be prepared in accordance with Section I-4 of these instructions.

3. GROUND CONTROL FOR PHOTOGRAMMETRY

3.1 Equipment

- 1 x 1" Theodolite + Tripod
- 1 100m Steel band
- 1 EDM instrument + Ancillary equipment (when available)
- 1 Pair of photographs
- 1 Pocket stereoscope

3.2 Ground Control

The task at camp will be to reconnoitre, identify and fix two ground control points whose approximate positions will be marked in the photograph by the supervisor. See Appendix C1 and C2 for examples of typical control points. The points should be fixed in plan and height with a precision of 0.10m or better, but separate plan and height controls may be chosen in each of the two locations if a suitable single point cannot be found.

The control points may be fixed by traverse, triangulation or resection, provided that there are redundant observations for each point fixed. The calculation of the coordinates must include all observations that are made. Repeated arcs or repeated measurements of the same distance will not count as redundant observations. This means that there must be an independent geometric check for each point.

All trig. stations may be used for fixing the photo control with the exception of those having the following data cassette file numbers: 104, 105, 107, 110, 112, 113, 114, 115, 117, 120, 121, 124, 140. This restriction may be reviewed when the exact location of planned new photography is known.

3.3 Submissions

A single group report will be submitted including reconnaissance sketches, computations and field notes. Photo identification diagrams and summary of coordinates should be submitted by each person in the group.

4. CADASTRAL SURVEY OF CAMP BOUNDARY

4.1 Object

The purpose of the exercise is to redefine the boundaries for the consolidation of title and Real Property Application of nominated land adjacent to Karingal Village, and to coordinate the corners in the I.S.G. system. Information relating to procedures can be found in Appendix D.

4.2 Equipment

1 x 10" Theodolite + Tripod
1 100m Steel band + Spring balance + Thermometer
1 Short Range EDM instrument + Accessories (available 1 day only for selected lines)
2 Sighting Targets + Tripods + Tribrachs
Plus other necessary aids.

4.3 Survey

The method of survey will consist of a loop traverse around the boundaries together with connections to two of the listed controls. Cutting of scrub and timber is not permitted. Please take care not to break branches or stand on any seedlings, especially if working on the south side of the Campsite. Traverse lines must therefore be selected so as to be clear of all obstacles.

Details on survey techniques to be employed will be discussed at a briefing session prior to the commencement of the project.

4.4 Computations

The control survey should be adjusted by an appropriate method. Projection distances will be derived and shown on the plan of survey. The report on the project will contain a comparison between measured ground distances (reduced for slope) and distances shown on the relevant survey plans. At a final stage in the computations, I.S.G. coordinates will be derived for all boundary corners.

4.5 Submissions

Each group is required to submit field notes and calculations, together with an individual plan of survey, and report on the project prepared by each student. The plan should be at suitable scale and drawn on tracing linen in accordance with the specifications of the Registrar General's Office. (See Appendix D).

5. FIELD ASTRONOMY

5.1 Equipment

1 x 1" Theodolite + Tripod
1 Plumbob
1 x 4V Battery
1 Stop watch
1 Illumination Unit
1 Torch

Radio, thermometer, barometer and observing sheets will be available. Eyepiece filters will be provided for the sun observations.

5.2 Project

5.2.1 Approximate position and orientation

The approximate values of the latitude and longitude of the observing site from a map of the area are $\phi = 33^{\circ}27'30''S$, $\lambda = 9^{\circ}58'15''E$.²⁹⁻³⁰ The azimuth of the R.O., which is a red aircraft navigation light situated near Oakleigh Pillar, may be taken as $42^{\circ}00'$.^{14.7}

5.2 Azimuth Observations

Each student must:

Determine the azimuth of a traverse line in the Cadastral Survey by observations to the sun by the hour angle method. Chapter 8 of Field Astronomy for Surveyors gives all the necessary background information. Two arcs of observations will be sufficient for this work as follows:

| Arc 1 | | Arc 2 | |
|-------|----|-------|----|
| FL | RO | FR | RO |
| | p | | p |
| FR | q | FL | q |
| | RO | | RO |

Observations are to be reduced using the HP 9810 programme provided. The latitude and longitude values used in these reductions are to be derived from those values obtained from the star observations.

5.2.3 Latitude and Longitude Observations

Each student must:

- (1) Determine the latitude from one pair of well balanced circum-meridian observations.

Limits: Zenith distance - 40° - 60° (with a preference for high altitude observations)
Balance in zenith distance - $\pm 5^{\circ}$
Difference in RA - $\pm 40^m$

Six acceptable observations on each face on each star. Timing is to be done with a stop watch by the recorder to the NEAREST SECOND.

Time checks must be taken before and after the observations.

NOTE: When preparing the programme, make use of the additional stars available in the supplementary and circum-polar lists. An example of part of a working list is given in Appendix E.2.

- (2) Determine the longitude from a pair of well balanced near prime vertical observations.

Limits: Zenith distance - 40° - 60°
Azimuth - prime vertical $\pm 10^{\circ}$
Declination balance - $\pm 2^{\circ}$

Six acceptable observations on each face on each star.

Timing must be done as accurately as possible BY THE OBSERVER both on the stars and for the time checks. At least three time checks must be taken, which must include one before and one after the star observations.

To assist in the preparation of an observing programme, computer printouts are given in Appendices E.3-E.5 listing pairs of stars suitable for the determination of longitude and which meet the above criteria. From this information, a working list is to be prepared. An example is given in Appendix E.2.

5.3 Field Notes

Observations must be booked on the field sheets provided and these must be signed by the observer and the supervisor at the end of the observations. A carbon copy of these signed field notes is to be handed to the supervisor before leaving. The front sheet, containing clock corrections, etc., must be filled in correctly. Field notes must be of an acceptable standard.

5.4 Report 1 (Latitude and Longitude only)

The report must include the following:

- (a) Title page
- (b) List of contents
- (c) Summary of final results including estimates of precision
- (d) Original field notes including calculations and graph of clock corrections on front sheet.
- (e) Manual calculations properly set out and showing formulae used.
- (f) Computer output mounted on ordinary sheets.
- (g) Tabulation of individual results of each pointing showing the residuals (v 's). If any observations are rejected, the reason for rejection must be given.
- (h) Calculation of the adjusted values (final results) and the estimates of precision. The estimates of precision required are the standard deviation of a single observation and the standard deviation of the adjusted values.
- (i) Conclusions and comments.

The field sheets and calculations should be properly cross referenced.

5.5 Report 2 (Azimuth only)

The report must include the following:

- (a) Title page
- (b) List of contents
- (c) Summary of final results (azimuth and I.S.G. bearing of the line)
- (d) Original field notes including graph of clock corrections on front sheet.
- (e) The derivation of the latitude and longitude values used in the reduction.
- (f) Computer output mounted on ordinary sheets.
- (g) Calculation of grid convergence
- (h) Conclusion and comments

6. LAND USE SURVEY

6.1 Purpose

The purpose of this exercise is for each group of students to carry out a land use survey of a selected area in the environs of Bathurst. Information relating to detailed procedures can be found in Appendix F.

6.2 Equipment

- 1 Pair of photographs
- 1 Mirror stereoscope
- 1 1:25 000 Map sheet
- Tracing paper overlays

6.3 Survey

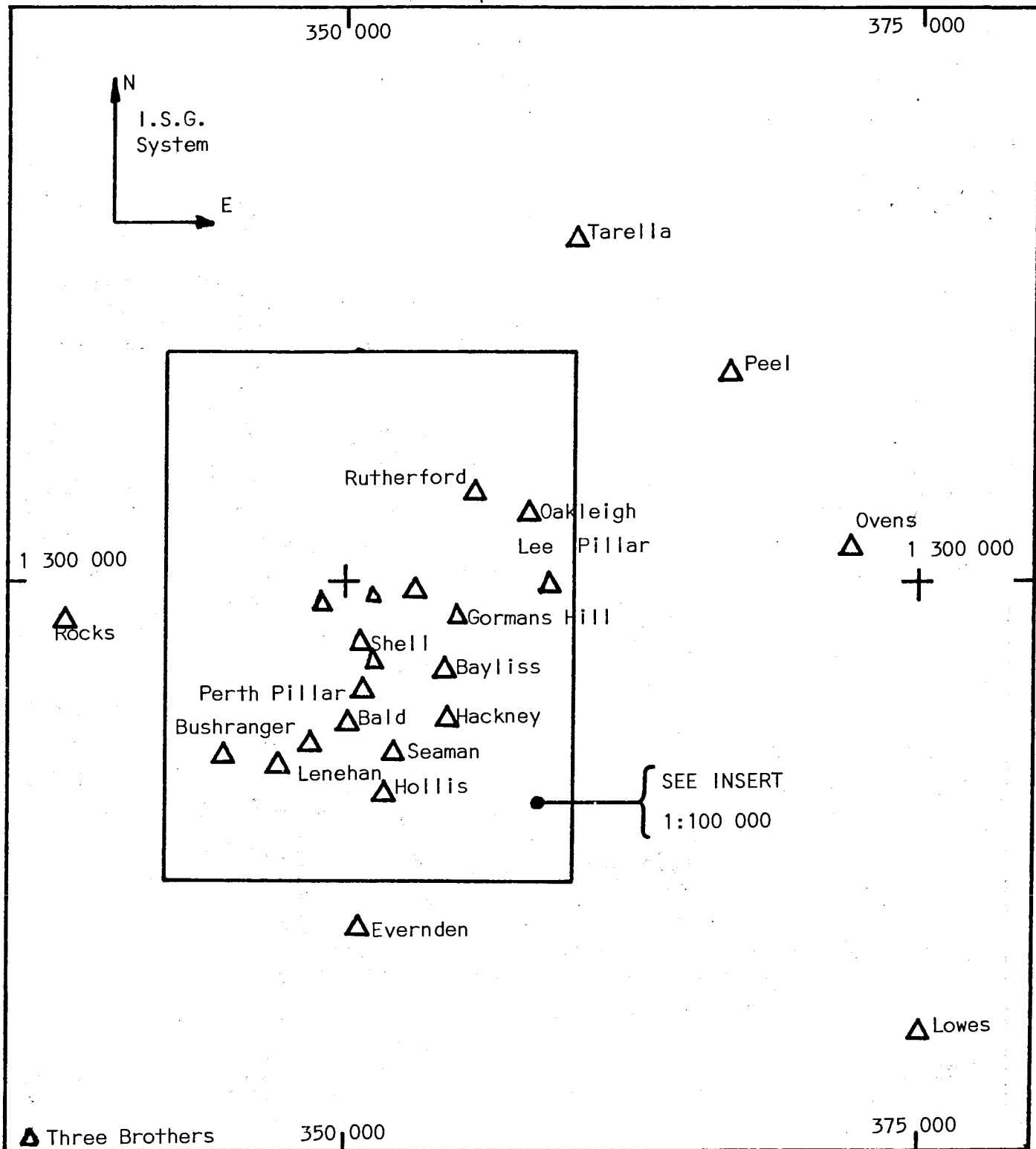
In making this survey, both field sampling and air photo interpretation techniques will be employed to produce a coded and symbolised land use map. The task will entail three distinct stages:

- (1) Air photograph selection of representative areas.
- (2) Ground inspection and interpretation of those selected areas.
- (3) Air photo interpretation based on ground inspected areas.

6.4 Submissions

Each group is required to submit photo overlay, field notes of site visits, coded land use map and a report.

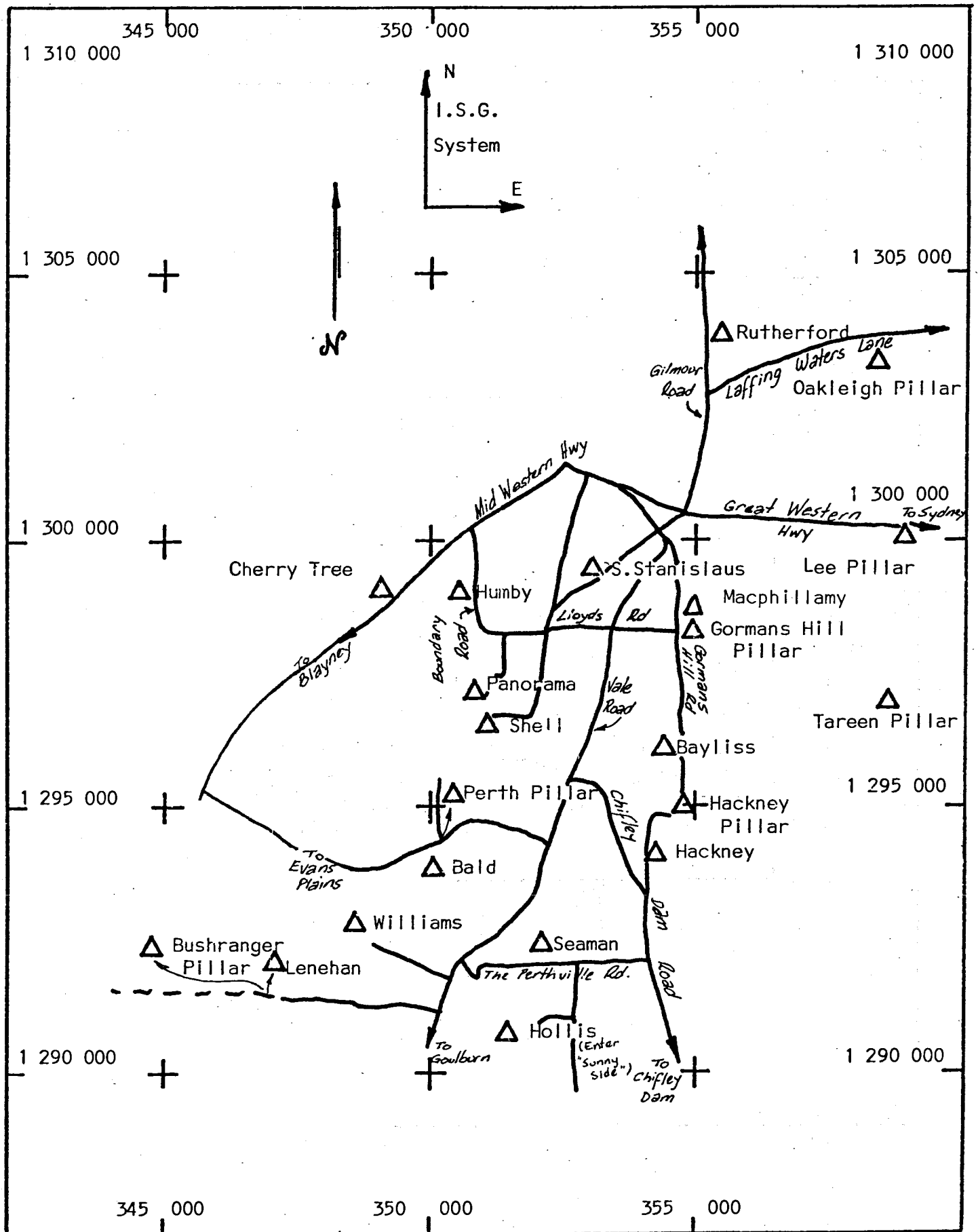
Appendix A.



PLAN

SHOWING TRIG STATIONS IN THE BATHURST AREA.

SCALE: 1:250 000



INSERT

SHOWING TRIG STATIONS AND LOCAL ROAD SYSTEMS.

SCALE: 1:100 000

RECONNAISSANCE and MAINTENANCE REPORT

STATION DOME T.S.

This Trig. Station has been:-

Note: Cross out word or words which do not apply

1. Completely cleared to permit 360° vision to surrounding Trigs.
2. Cleared by lanes bearing..... from Trig. Mast
3. Trig. Mast & Vanes have been painted white & black respectively.
4. The Trig. was unpiled/~~not-unpiled~~, dimensions now being:

Description of mark. CORNER. CAST-IRON. CASE...... should be explicit, e.g. Steel plug, Brass plug, Bolt, G.I. PipeHeight of mark..... 0.022..... m above ~~below~~ rock/concrete ... 0.20..... m ~~above~~ below G.L.Height of Top Vanes to Top Mark. 3.444 m. Diameter of Vanes (vertical) 0.216 m.Height of Cairn. 0.510 m. Diameter of Cairn. 2.0 m.Length of Mast. 2.520 m. (approximate if not unpiled)5. ACU. NAIL..... set in conc./~~rock~~ has been placed. 2.600 m. bearing.. 04.....°M from Trig. Mast6. A.G.I. PIPE..... set in conc./~~soil~~ has been placed. 2.065 m. bearing.. 23.....°M from Trig. Mast7. A..... set in conc./soil has been placed..... m. bearing.....°M from Trig. Mast8. A..... set in conc./rock has been placed..... m. bearing.....°M from Trig. Mast9. Connection P446..... to CU NAIL : 2.600 m. bearing 266 °M10. Connection P446..... to G.I.P. : 2.665 m. bearing 113 °M11. Connection G.I.P...... to CU NAIL : 4.595 m. bearing. 279 °M

12. Connection..... to..... m. bearing.....°M

13. Diff. Ht. TAKE PLUS..... is 0.210 m. ~~above~~ CU NAIL.....14. Diff. Ht. TAKE PLUS..... is 0.190 m. ~~above~~ G.I. PIPE.....

15. Diff. Ht. is

16. Diff. Ht. is

Prepared by:

Checked:

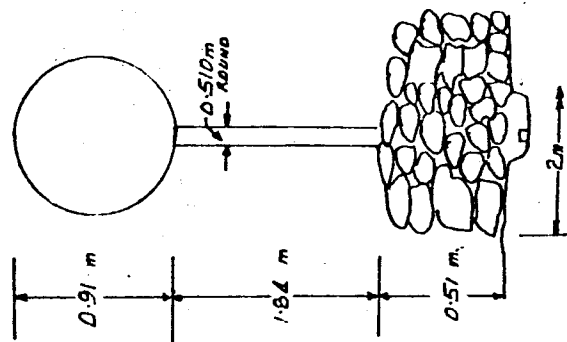
Noted on U.T.M. Card

13/74

Checked

Beacon Diagram

Not to Scale



Date

Record of Station

Not to Scale

STATION DOME T.S.

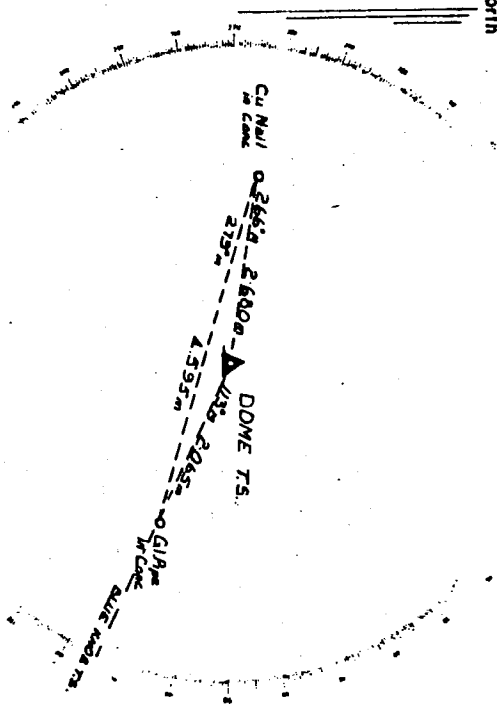
Owners Name.....

Current Occupant.....

Address.....

Address

North



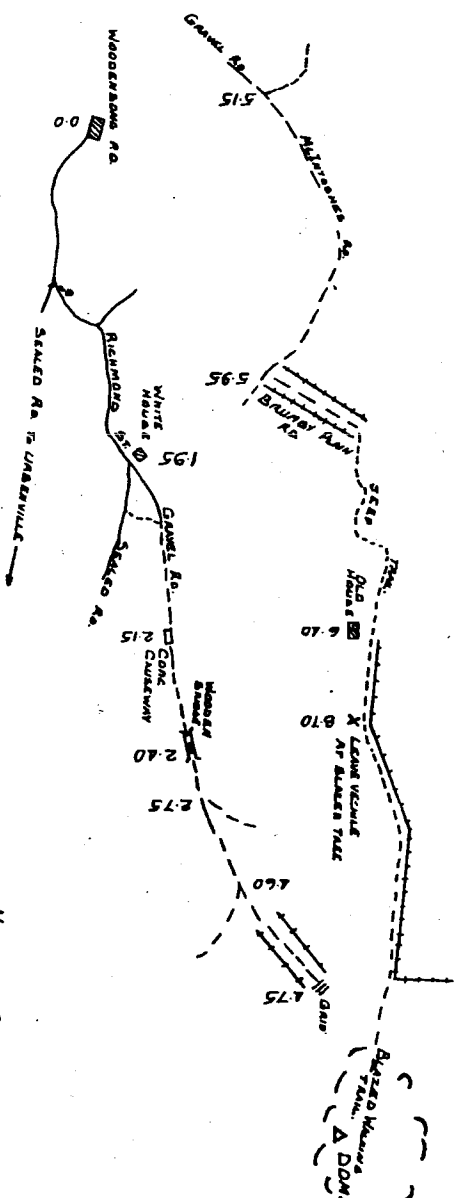
List of Observed Directions:-

[illegible][illegible]

Access

AT WOODBRIDGE POST OFFICE AT 0.0 MILES ON MACPHERSON STREET TRAIL TOWARDS LANSDEVILLE BOUNDARY

| | |
|------|--|
| 0.05 | TURN LEFT INTO "OLEWINE STREET" N/SW/ST |
| 1.05 | TURN RIGHT ON "RICHMOND STREET" S/W/ST FOLLOW SIGNAL ROAD |
| 1.95 | PAVE WHITE HOUSE ON LEFT |
| 2.00 | THE GRAYL ROAD ON LEFT |
| 2.15 | CROSS OVER CONCRAVE CREEKWAY |
| 2.40 | CROSS BRIDGE ACROSS OVER CREEK, RALLY ROAD SIGNAL ROAD |
| 2.75 | THE RIGHT FOLLY ON ROAD UP RALLY ROAD SIGNAL ROAD |
| 4.60 | THE LEFT FOLLY ON ROAD UP LANE BETWEEN FIELDS |
| 4.75 | CROSS OVER GRD SHEDD AT GRD "HORN YAMMA ROAD" |
| 5.15 | THE RIGHT TURN ONTO "HORN YAMMA ROAD" S/W/ST |
| 5.95 | THE GRAYL ROAD ON LEFT, RALLY PLANK FOLLY ROAD |
| 6.10 | PAVE AND SIGNAL HOUSE ON LEFT FOLLY SIGNAL ROAD |
| 6.70 | END OF TRAIL, SIGNAL HOUSE, FOLLY ON LEFT LEAVE VEHICLE AND FOLLOW |

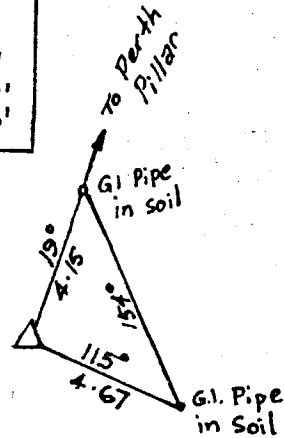
[illegible]

NOT TO SCALE.

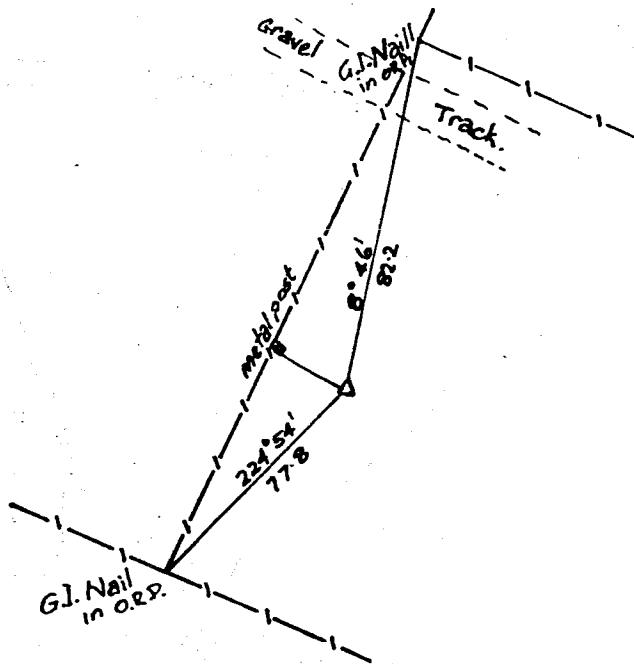
A.5

'BALD T.S.'

| STATION | DIRN |
|--------------|----------|
| Perth Pillar | 19° 06' |
| Bayliss | 61° 57' |
| Hackney | 87° 54' |
| Seaman | 123° 59' |
| Lenahan | 238° 36' |
| Williams | 238° 49' |
| Bushranger | 254° 20' |



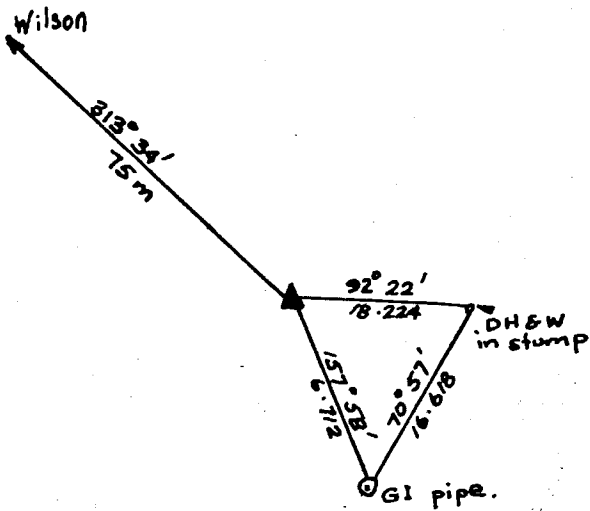
'BAYLISS T.S.'



| STATION | DIRN |
|--------------|----------|
| Mc Phillammy | 9° 33' |
| Hackney | 181° 04' |
| Bald | 241° 57' |
| Perth Pillar | 256° 16' |
| Shell | 276° 35' |
| Cherry Tree | 298° 27' |
| Humby | 307° 23' |

A.6

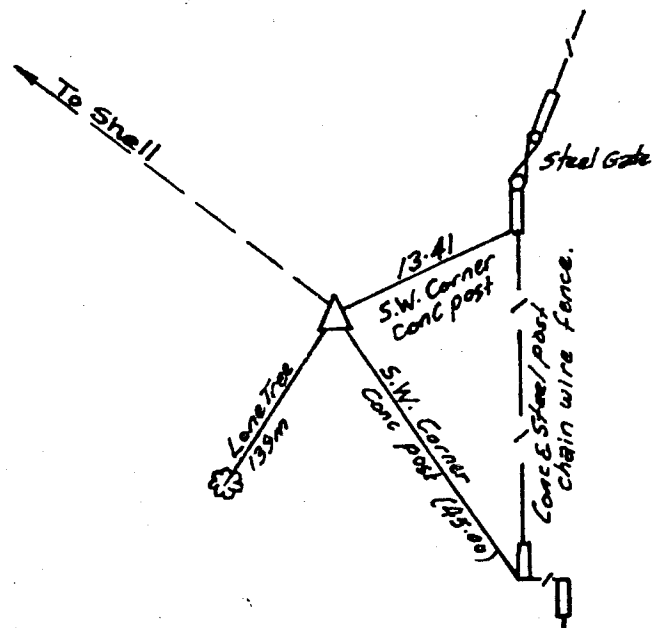
'CHERRY TREE T.S.'



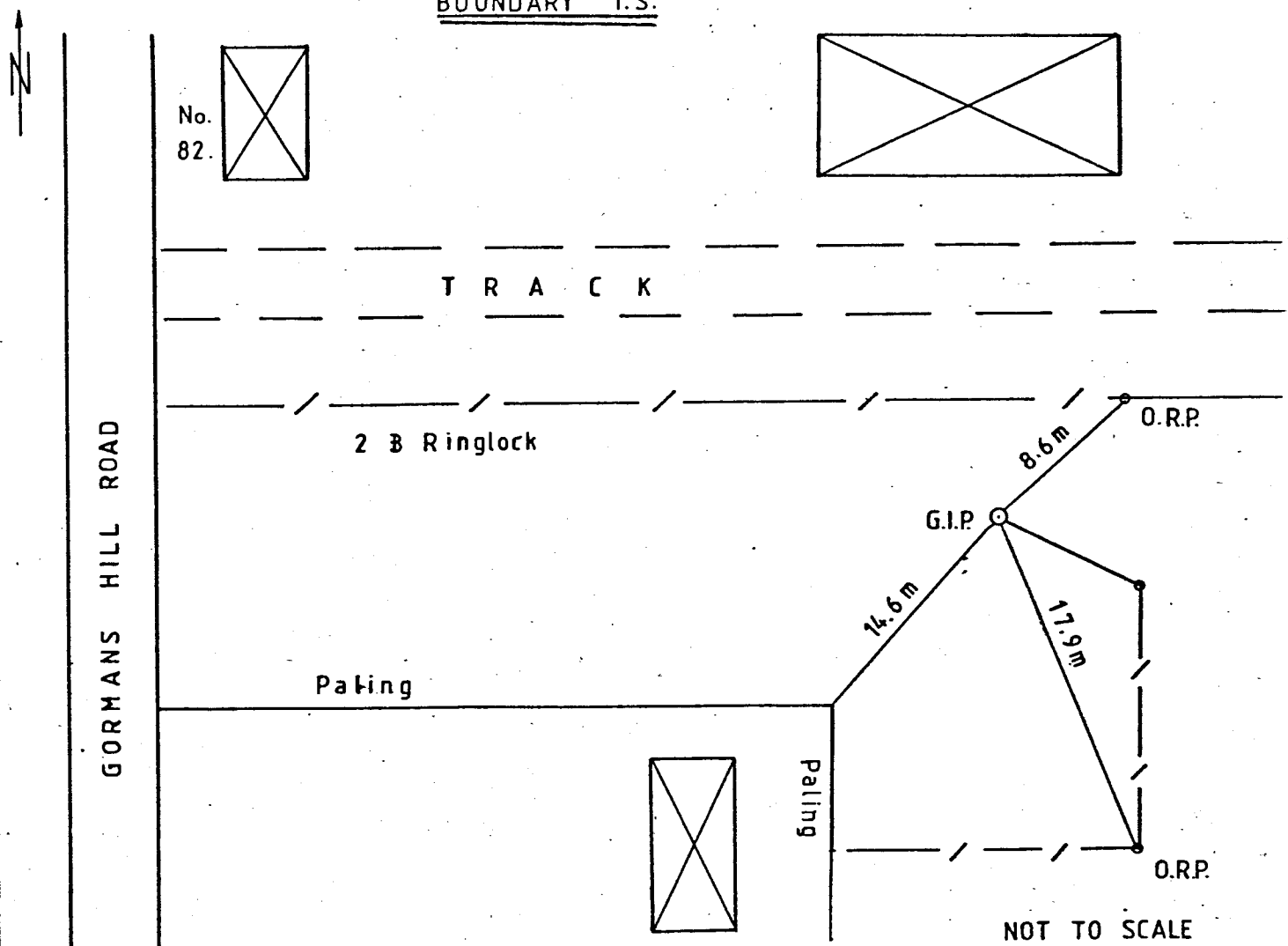
| STATION | DIR N |
|---------------|----------|
| Tarella | 34° 20' |
| Peel | 60° 29' |
| St Stanislaus | 83° 11' |
| Humby | 88° 08' |
| MacPhillamy | 94° 51' |
| Bayliss | 118° 27' |
| Panorama | 88° |
| Perth Pillar | 158° 11' |
| Bald | 168° 22' |
| Everden | 174° 17' |
| Williams | 183° 58' |
| Lenahan | 195° 05' |
| Bushranger | 212° 33' |
| Wilson | 331° 34' |

'HACKNEY T.S.'

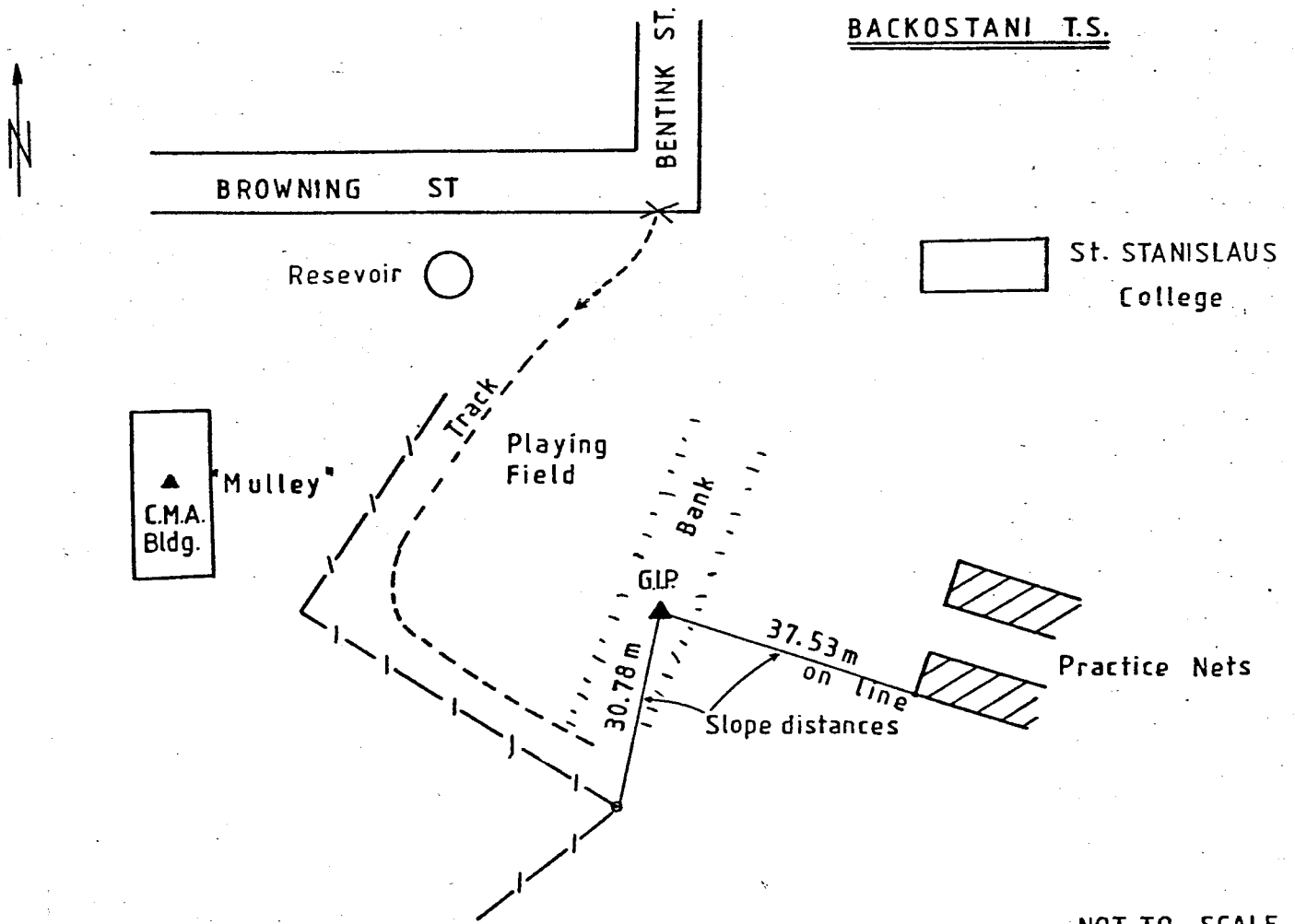
| STATION | DIR N |
|----------------|----------|
| Shell Tower | 0° 00' |
| St. Stanislaus | 38° 10' |
| Bayliss | 53° 10' |
| McPhillamy | 57° 42' |
| Seaman | 287° 04' |
| Williams | 311° 36' |
| Bald | 319° 57' |
| Perth | 339° 37' |



BOUNDARY T.S.

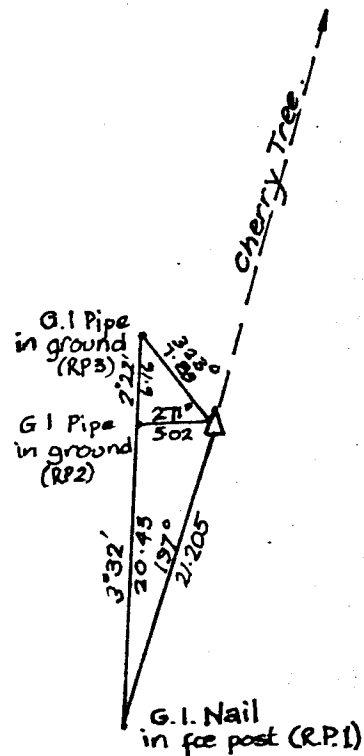


BACKOSTANI T.S.



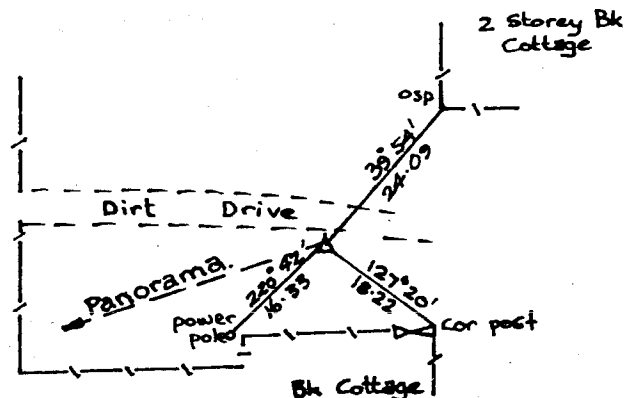
MARK: G.I.Pipe

A.8
'LENEHAN T.S.'



'M^cPHILLAMY T.S.'

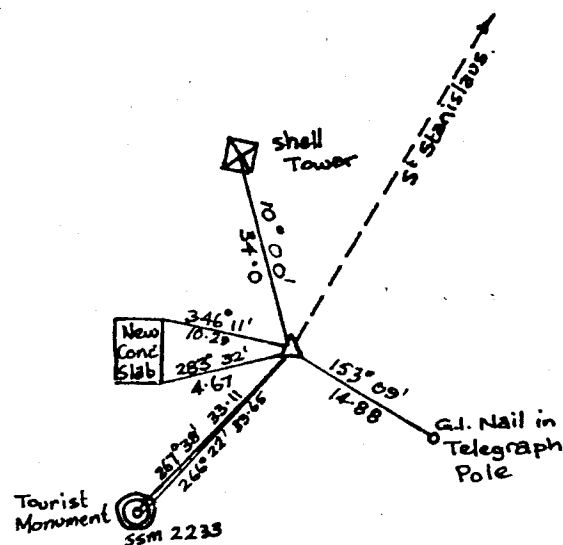
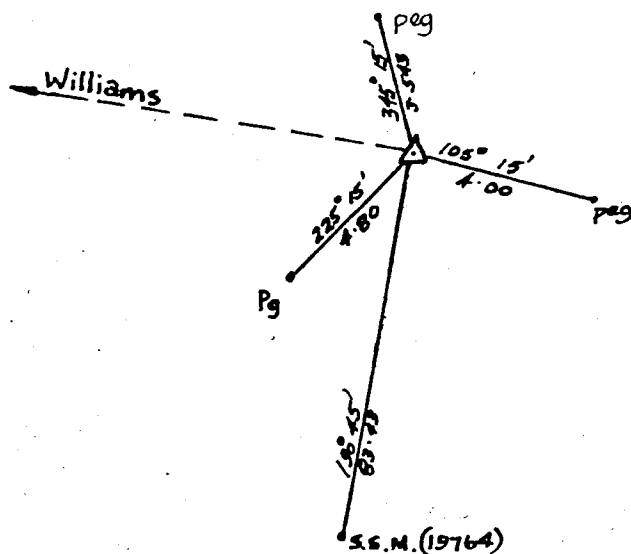
| STATION | DIR ⁿ |
|--------------|------------------|
| Cherry Tree | 0°00'00" |
| Perth Pillar | 32°13' |
| Bald | 43°31' |
| Bushranger | 262°11' |



| STATION | DIR ⁿ |
|---------------------------|------------------|
| Hackney | 185°37' |
| Perth Pillar | 231°37' |
| Shell | 240°56' |
| Panorama | 251°06' |
| Cherry Tree | 274°51' |
| Humby | 277°10' |
| S ^c Stanislaus | 297°57' |
| Tarella | 17°08' |

SEAMAN T.S. A.9

SHELL T.S.

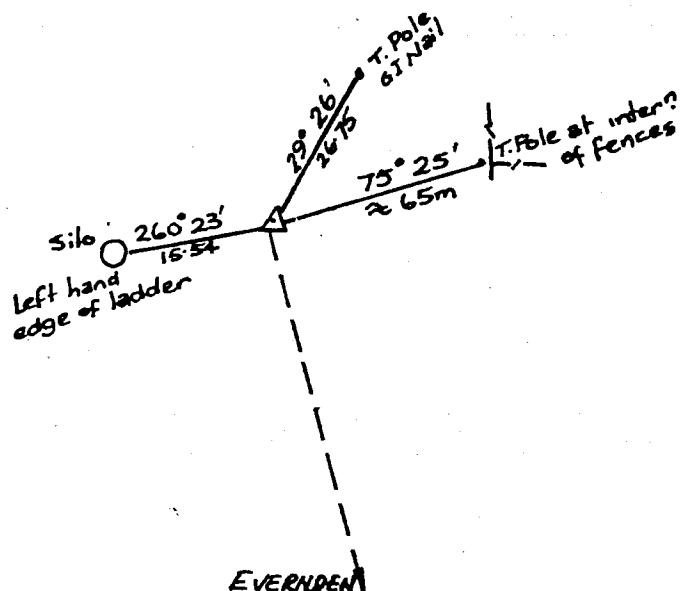


| STATION | DIRN |
|----------------|----------|
| Lenahan | 265° 13' |
| Williams | 277° 44' |
| Bald | 303° 59' |
| Perth | 329° 56' |
| Shell | 345° 48' |
| Hackney | 55° 01' |
| Three Brothers | 225° 15' |

| STATION | DIRN |
|-------------------------|----------|
| Panorama | 334° 45' |
| Humby | 346° 52' |
| St Stanislaus | 31° 45' |
| M ^c Phillamy | 60° 56' |
| Bayliss | 96° 35' |
| Hackney | 127° 53' |
| Perth Pillar | 203° 08' |

WILLIAMS. T.S.

| STATION | DIRN |
|----------------|----------|
| Everden | 0° 00' |
| Three Brothers | 48° 33' |
| Lenahan | 71° 16' |
| Cherry Tree | 196° 52' |
| Perth Pillar | 283° 52' |
| Seaman | 290° 37' |



Appendix B

COMPENDIUM OF FORMULAE
for the
LEAST SQUARES ADJUSTMENT
of
CONTROL NETWORKS
by the
VARIATION OF COORDINATES

1. NOTATION AND BACKGROUND

A set of n linearized observation equations is given by:

$$v = Bx + T$$

where v is the vector of residuals of the n observations p_i
 B is the matrix of coefficients b_{ij} (calculated from approximate values of parameters \bar{x}),
 x is the vector of u independent parameters, and
 T is the vector of absolute terms.

The vector of absolute terms is calculated from

$$T = p^0 - p$$

where p is the vector of observed values, and
 p^0 is the vector of constant terms, calculated from approximate values of parameters \bar{x} .

The number of redundancies, r , is given by

$$r = n - u$$

The population variance σ_i^2 of each observation p_i can be expressed by a variance estimator S_i^2 :

$$S_i^2 = S^2 \cdot g_{ii},$$

where S^2 is the a priori (dimensionless) variance factor, and
 g_{ii} is the weight coefficient of the particular observation.

The weight coefficients g_{ii} form a matrix G , which is a diagonal matrix for the case of uncorrelated observations.

2. SOLUTION

The most probable values for the parameters x are found according to the Principle of Least Squares by minimizing the quadratic form M by variation of the parameters.

$$M = v^T G^{-1} v = \left[\frac{vv}{g} \right]$$

This minimization leads to the normal equation system:

$$N x + C = 0 ,$$

which can be solved by suitable methods. The matrix of normal equation coefficients N and vector of constant terms are given by:

$$N = B^T G^{-1} B$$

$$C = B^T G^{-1} T$$

The solution for the parameters is found by

$$\begin{aligned} \Delta x &= -N^{-1} B^T G^{-1} T \\ &= -N^{-1} C. \end{aligned}$$

Values of final parameters x are calculated from

$$x = \bar{x} + \Delta x.$$

3. CHECK CALCULATIONS

Values for the adjusted observations p_i are calculated from the final parameters x . Hence the residuals are found as the difference between p_i^a and the original observations p_i :

$$v_i = p_i^a - p_i \quad i = 1, \dots, n$$

i) As an important check calculation the individual residuals v_i also may be calculated by substitution of the parameters x into the observation equations:

$$v = B \Delta x + T.$$

ii)

$$\left[\frac{B_{ij} v_i}{g_{ii}} \right] = 0 \quad \text{for all } j = 1, \dots, u.$$

iii) The minimum (least squares) is found by the equation

$$M = (B^T G^{-1} T)^T \Delta x + T^T G^{-1} T ,$$

and is compared as a check calculation with

$$M = \left[\frac{v_i v_i}{g_{ii}} \right] ,$$

calculated from individual residuals v_i .

4. INVESTIGATION OF PRECISION

4.1 A posteriori Variance factor

An a posteriori estimate \bar{S}^2 for the variance factor may be obtained from the minimum M :

$$\bar{S}^2 = \frac{M}{r}.$$

The null hypothesis that both variance factors (a priori and a posteriori) belong to the same population, can be tested using the F-distribution. If the variance ratio

$$\frac{\bar{S}^2}{S^2} < F_{(1-\alpha, r_1, r_2)},$$

the null hypothesis has to be accepted at the α significance level, and for r_1 and r_2 as the number of degrees of freedom used in determining \bar{S}^2 and S^2 respectively. If S^2 has been taken from experience r_2 is to be assumed equal to ∞ .

4.2 Precision of adjusted parameters

An estimate of the variance -covariance matrix of the adjusted parameters (S_x) is found by application of the general law of propagation of variances as:

$$(S_x) = S^2 Q_{xx},$$

where the cofactor matrix Q_{xx} is the inverse of N :

$$Q_{xx} = N^{-1}.$$

5. OBSERVATION EQUATIONS FOR A CONTROL NETWORK

i) Direction from station P to station Q, D_{PQ} :

$$P \text{ to } Q : v_D = a_{PQ} dN_P + b_{PQ} dE_P - a_{PQ} dN_Q - b_{PQ} dE_Q - dO_P + T_D$$

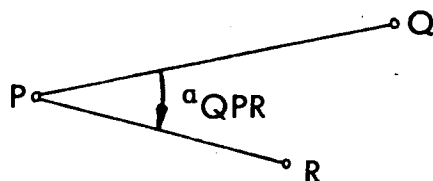
$$T_D = \theta_{PQ} - (D_{PQ} + \bar{O}_P)$$

ii) Distance between stations P and Q, d_{PQ} :

$$P \text{ to } Q : v_d = -\cos \theta_{PQ} dN_P - \sin \theta_{PQ} dE_P + \cos \theta_{PQ} dN_Q + \sin \theta_{PQ} dE_Q + T_d$$

$$T_d = d_{PQ}^{\text{calc.}} - d_{PQ}^{\text{observ.}}$$

iii) Angle at station P between stations Q and R, α_{QPR} :



$$v_{\alpha} = (a_{PR} - a_{PQ}) dN_P + (b_{PR} - b_{PQ}) dE_P + a_{PQ} dN_Q + b_{PQ} dE_Q \\ - a_{PR} dN_R - b_{PR} dE_R + l_{\alpha}$$

$$l_{\alpha} = (\theta_{PR} - \theta_{PQ}) - \alpha_{QPR}$$

NOTATION

For these observation equations the following notation has been adopted:

\bar{E} , \bar{N} : are approximate coordinates of stations

dE , dN : are the least squares parameters for the unknown coordinates

$E = \bar{E} + dE$, and

$N = \bar{N} + dN$: are the adjusted final coordinates

\bar{O}_P : is the approximate orientation of the direction observations at station P, with respect to the coordinate system.

dO_P : is the least squares parameter for the orientation at station P.

$O_P = \bar{O}_P + dO_P$: is the adjusted final orientation at station P.

D , d , α : are the observed values for direction, distance and angle respectively.

v_D , d_d , v_{α} : are the corrections (residuals) to these observed values

T_D , T_d , T_{α} : are the absolute terms

θ , S : are the preliminary bearing and distance, calculated from approximate coordinates \bar{E} , \bar{N} .

a , b : are the direction coefficients, calculated according to the equations

$$a_{PQ} = \frac{\rho'' \sin \theta_{PQ}}{S_{PQ}} , \quad b_{PQ} = -\frac{\rho'' \cos \theta_{PQ}}{S_{PQ}}$$

$$\rho'' = 206\,264.81''$$

Attention: Dimensions.

6. CALCULATION OF POINT ERROR ELLIPSES

The weight coefficient Q of the adjusted parameters dN_i , dE_i and dO_i is of the general form: Q_{xx}

$$Q_{xx} = \begin{bmatrix} Q_{N_1N_1} & Q_{N_1E_1} & \dots & \dots & \dots \\ Q_{E_1N_1} & Q_{E_1E_1} & & & \\ \vdots & & Q_{N_iN_i} & Q_{N_iE_i} & \vdots \\ \vdots & & Q_{E_iN_i} & Q_{E_iE_i} & \vdots \\ \vdots & & & & Q_{O_jO_j} \end{bmatrix}$$

The basic parameters of the error ellipse at the station i are calculated from the following equations:

i) The a priori variance factor S^2

ii) The eigen values $\lambda_{1,2}$ of the cofactor matrix for the station i :

$$\lambda_{1,2} = \frac{1}{2}(Q_{N_iN_i} + Q_{E_iE_i}) \pm \frac{1}{2}\sqrt{(Q_{N_iN_i} - Q_{E_iE_i})^2 + 4Q_{N_iE_i}^2}$$

(positive sign for λ_1)

iii) Semi major and minor axis of the point error ellipse:

$$\text{Semi major axis : } \sqrt{S^2 \lambda_1}$$

$$\text{Semi minor axis : } \sqrt{S^2 \lambda_2}$$

iv) Orientation of semi major axis θ_i :

$$\theta_i = \frac{1}{2} \arctan \frac{2 \cdot Q_{N_iE_i}}{Q_{N_iN_i} - Q_{E_iE_i}}$$

VARIANCE ESTIMATES.

single direction observation (mean FL, FR)

$$S_{S.D.}^2 = \frac{[VV]}{(n-1)(k-1)}$$

APPENDIX C

Photogrammetric Control

The following sketches illustrate a selection of suitable and unsuitable points to be considered during photo-identification for planimetric and height control. They should be used as a general guide only, as the selection of suitable points will depend on the photo scale. For small scale photography points marked "Bad" in these sketches may prove to be satisfactory.

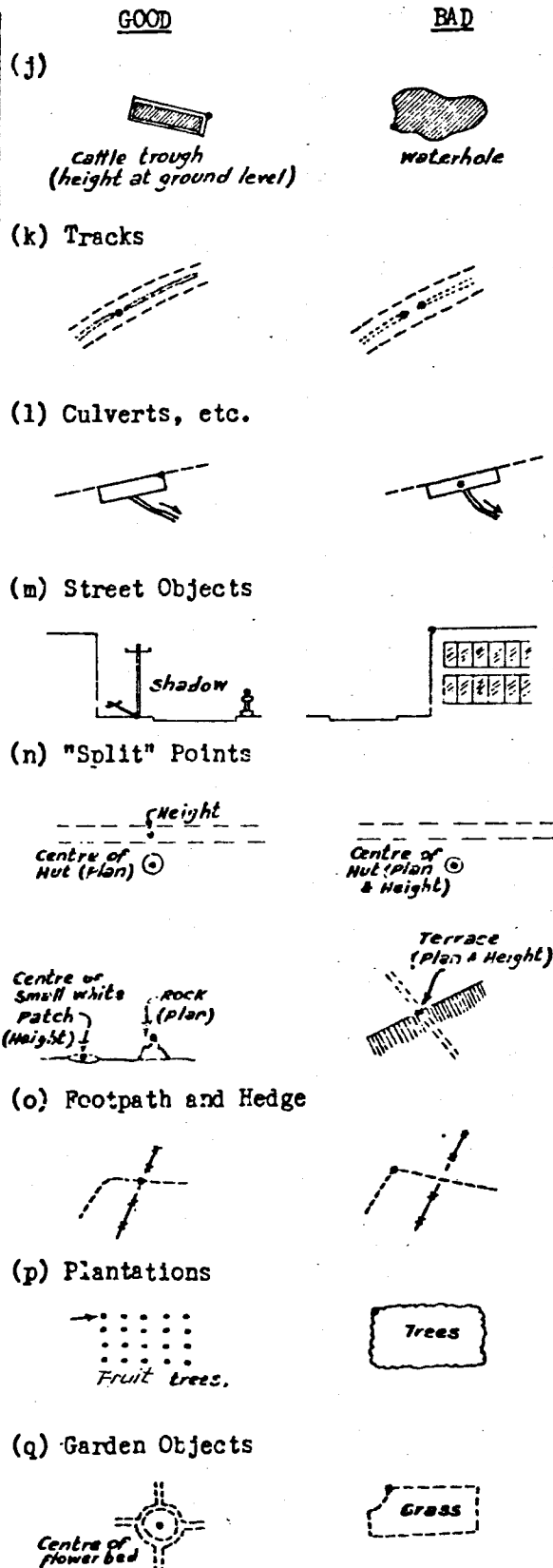
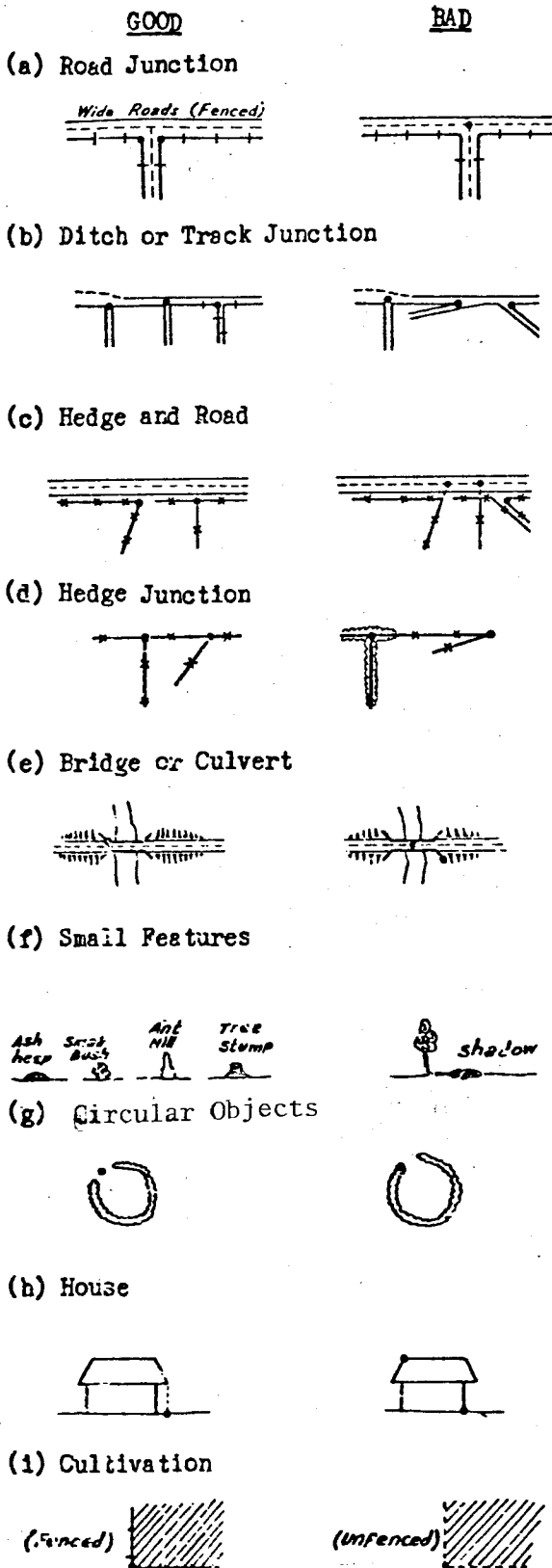


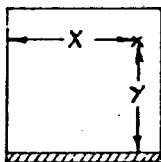
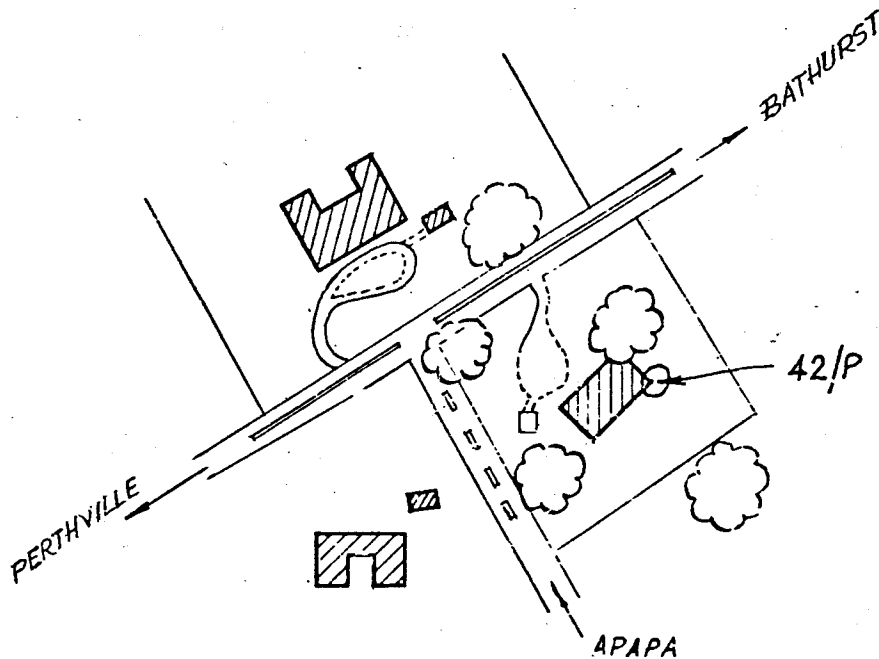
PHOTO POINT DESCRIPTION
SPECIMEN

Survey: BATHURST 1:10.000

Page 7

Job no. 1961/2

Station 42/P



Circled on photograph n.o. 261

Photograph co-ordinates X 17.8 mm

Y 18.4 mm

Description of mark: Corner of house

Location of station: S.E. Corner of house south of BATHURST-PERTHVILLE Road

Co-ordinates: E 364 210.71

Drawn by E. X. PERT.

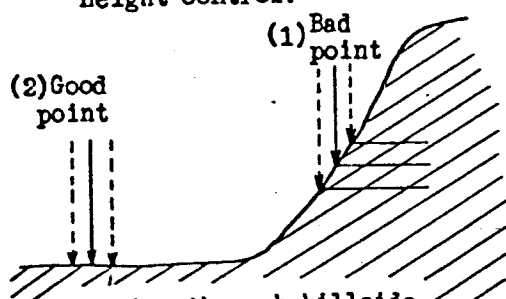
N 241 365.81

Date 3-6-61

Height: —

Signed O. B. SERVER

Height Control:-



It can be seen clearly that any slight error in field identification or in placing the floating mark during the plotting process, will cause considerable height error in (1), but will have no appreciable effect in (2).

APPENDIX D

Cadastral Project

PURPOSE

The assumed purpose of the survey is for a primary application to bring the old system title (as occupied by the Church of England Diocesan Centre) and surrounding lands to a Torrens title, i.e. to bring the land under the provisions of the Real Property Act. This survey should include not only the land held under the old system title but also any easements that may be appurtenant to the land.

BACKGROUND

As an example of the land that you will survey, the camp site is part of POR. 38 Parish of Bathurst originally granted to William Lane and known as Orton Park.

This land is described in the conveyance no. 248 Book 2594 which was based in part on the survey made by Mr. Surveyor Bayliss on the 10th September, 1959. Please note the reference to easements which form part of the title. Exact details of the land you will survey will be given to you at Survey Camp.

A number of other surveys defining Con Rod Straight and the lots surrounding all have a bearing on the redefinition of the boundary of the subject land. Copies of the most important documents will be issued to students at the survey camp. Other plans of lesser importance, which nevertheless should still be examined, will also be available.

BASIC CONSIDERATIONS

A number of considerations will determine what survey information is most necessary and what boundary adoptions should be made.

- (1) Where the land is surrounded by other old system land, attention should be given to the position and age of existing occupations as this will help to indicate the position of the boundaries as originally surveyed.
- (2) Where the land is surrounded by land held under Torrens title, greatest consideration should be given to preserving those titles, the balance then going to the land which is the subject of the primary application. If substantial differences with occupations exist, consideration would need to be given to an application based on adverse possession.
- (3) When the land in question has been the subject of a previous survey or surveys that have been accepted by the Registrar General's Office, greatest weight should be given to any marks established or monuments fixed under those previous surveys.

D.2

- (4) Where a number of previous surveys relating to the same boundaries are in existence, some minor disagreement in dimensions will usually be found. While always considering the pre-eminence of marks (where by measurement they can be shown not to have moved), the survey that has redefined the boundaries by interpolation from surrounding information, as compared to one which has extrapolated from information to the subject land, should be given greatest weight.
- (5) In most surveys, the road alignment (if any) should be given particular consideration. This alignment should be such that sufficient dimensions exist between it and the boundaries forming the opposite side of the road.
- (6) When examining the primary application, the Registrar General's Office is only concerned with the re-established external boundaries of the land in question (and in the position of any easements) and not with the position of any internal boundaries created by parcels that are part of the total application. There must be a one to one relationship between the parcel of land and easements defined by survey and the ensuing title that issues.

SURVEY HINTS AND REQUIREMENTS

- (1) The traverse legs which form the framework from which the boundary evidence is measured should, where possible, clearly parallel the occupation. Long radiations from instrument stations to pegs, corner posts, etc., should be kept to a minimum.
- (2) All marks measured from the basic traverse framework must have in addition at least one redundant measurement for checking purposes. Note that whilst the traverse surround can be checked by closure, the measurements to any marks connected to this traverse by radiation or offset are not checked as part of the total closure.
- (3) Where short boundaries are traversed, an extended backsight should be provided for the transfer of azimuth to the subsequent traverse leg.
- (4) The bearings and distances shown on any old plans that are to be utilised in the survey must be checked by calculation prior to any final adopted boundaries being determined. Errors in old plans are not without precedent.
- (5) Measurements to and description of occupation (particularly corner posts) should be made, as these can act in future years as monuments. Measurements are usually made to the centre base of the post, the position of which should be projected onto the top or face of the post. Where the centre base obviously does not represent the true corner position, the intersection of the line of fences can be taken.
- (6) Field notes should be clear and concise, indicating all measurements and the sketched relationships between all marks measured. Information must be immediately entered into the field book. All pages should be signed and dated by the group and the supervisor.

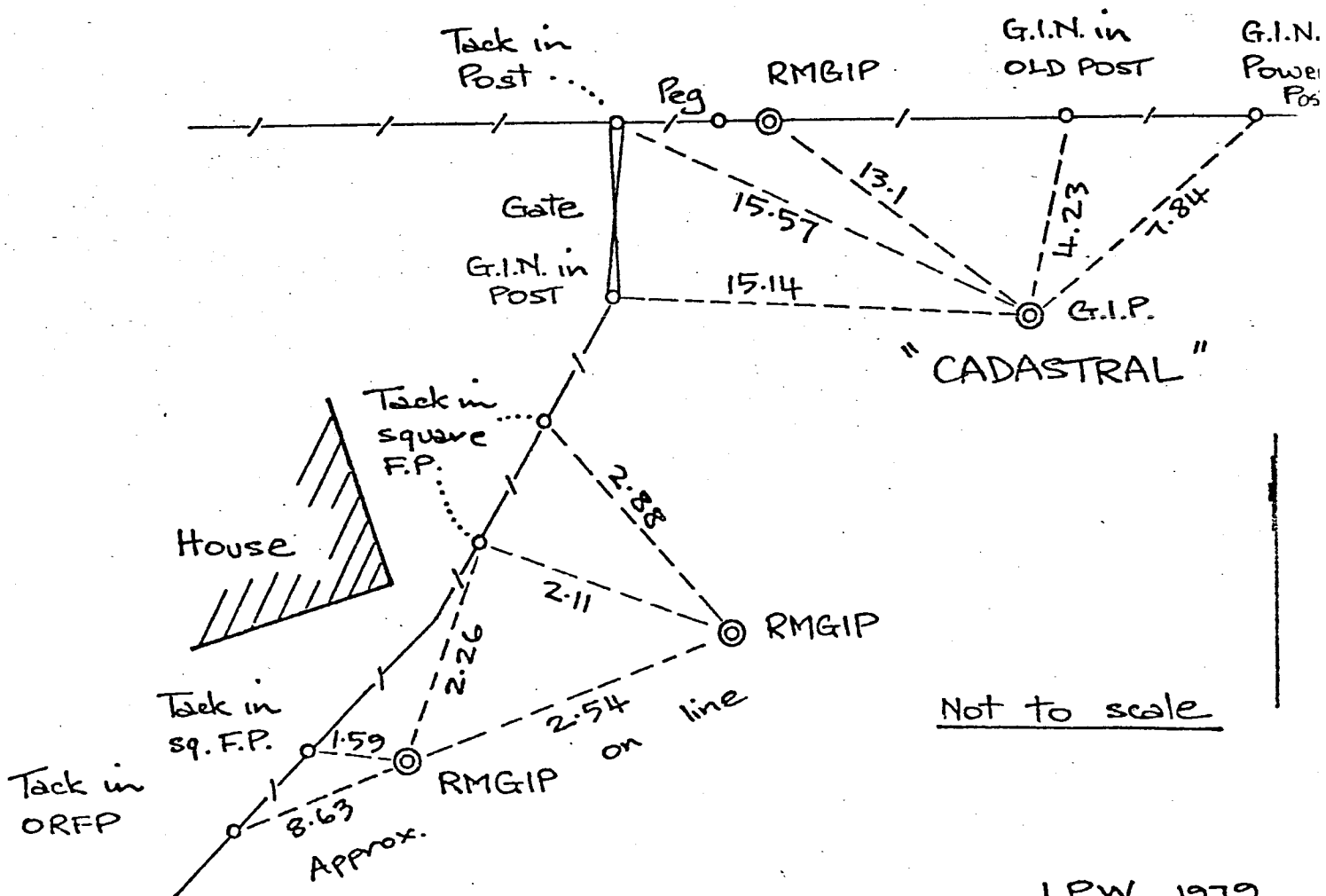
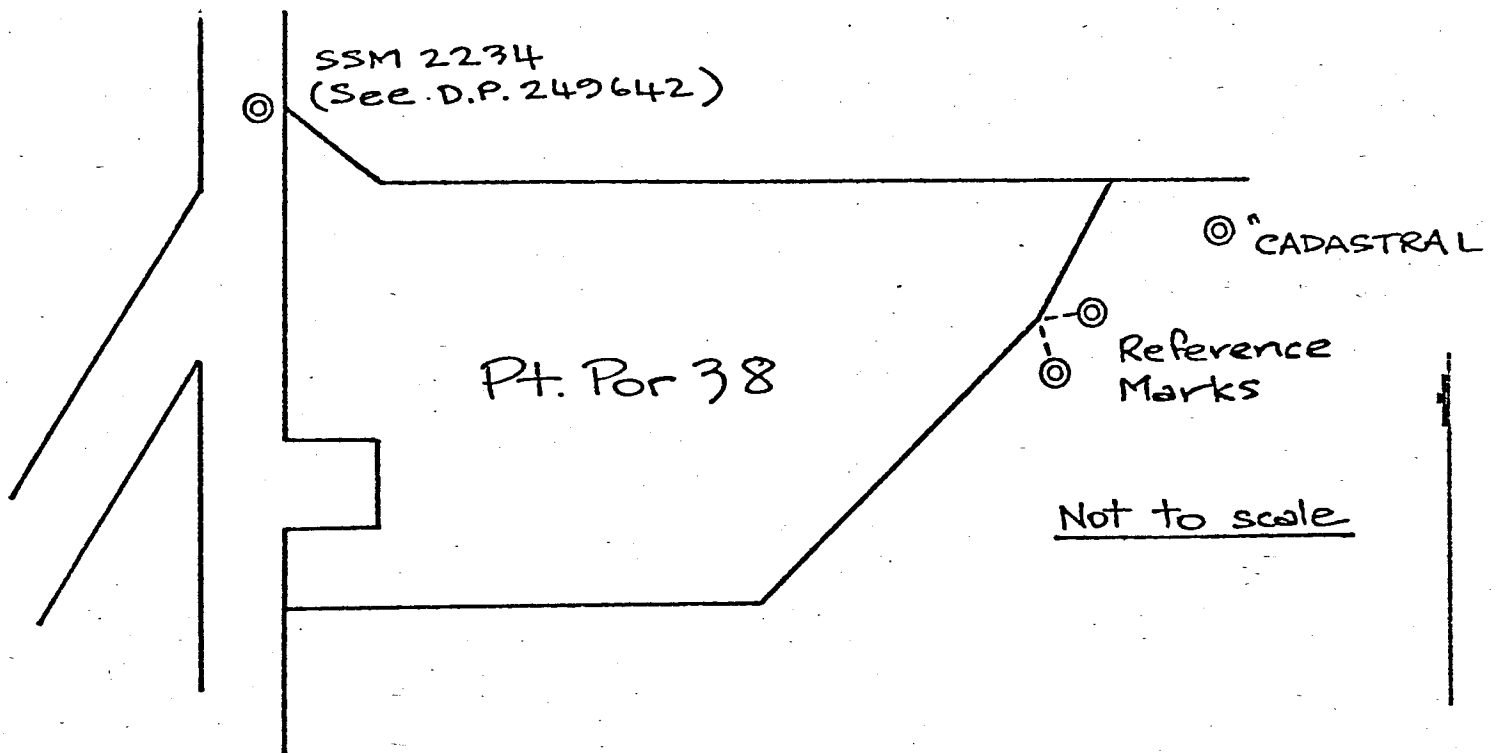
D.4

Individual Submissions:

- (1) A formal report including the following aspects relating to the survey:
 - (a) method of survey
 - (b) any problems in interpreting the old system description or any of the plans of survey
 - (c) a discussion on any differences between various plans of survey and the measured values
 - (d) the method of fixation of boundaries and any problems confronted in the boundary definition. Discuss each boundary separately.
- (2) A neatly drawn plan of survey is to be submitted. It is to be drafted in a manner acceptable for lodgement for registration at the Registrar General's Office. Reference should be made to the Survey Practice Regulations, Real Property Act Regulations, Conveyancing Act Regulations and the directions issued by the Registrar General on plan preparation.

Briefly, the plan will be drafted with black ink on the standard Plan Form 2, which will be supplied.

CONTROL and REFERENCE MARKS for CADASTRAL EXERCISE



APPENDIX E

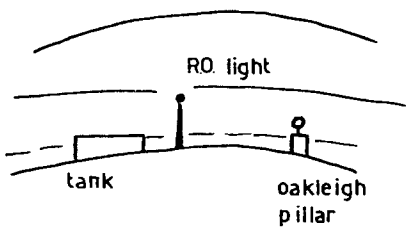
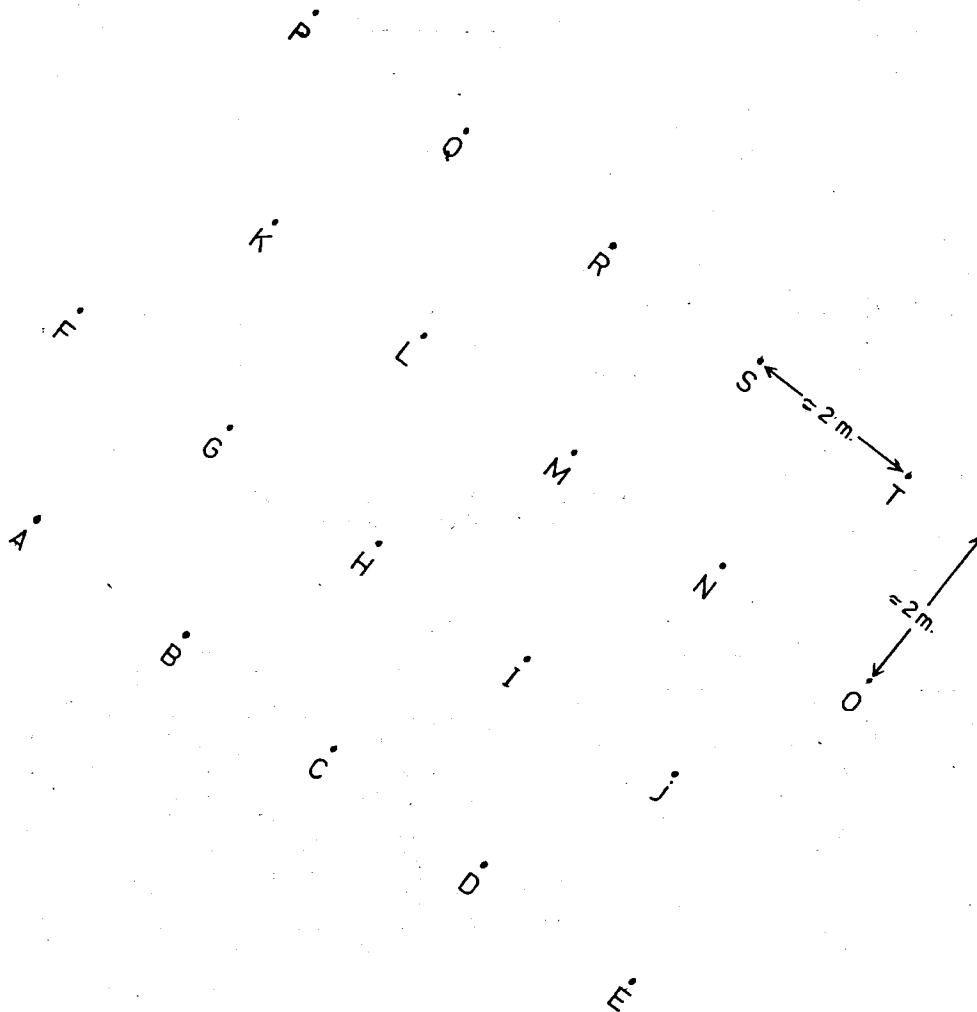
FIELD ASTRONOMY

ASTRO STATIONS

BATHURST

RO. 031 MAG.

AIRCRAFT NAVIGATION LIGHT. (RED)



LOCATION OF RO. LIGHT

NOT TO SCALE

EACH STATION IS MARKED WITH
A SMALL WOODEN PEG AND A
SMALL INDICATOR.

E.2

EXTRACT FROM THE WORKING LIST
FOR A LATITUDE OBSERVATION

Friday 5th March 1976

 $\phi - 33^{\circ}27'$
 $\lambda + 9^{\text{h}}58^{\text{m}}$

| Pair | Aspect | No. | Mag. | L.S.T. | Std. Time | FL | | FR | |
|------|--------|-----|------|--------------------------------|---------------------------------|--------|--------|---------|---------|
| | | | | | | VØ | HØ | VØ | HØ |
| 1 | N | 256 | 3.8 | 9 ^h 02 ^m | 23 ^h 10 ^m | 70°21' | 3°11' | 289°39' | 183°11' |
| | | | | 9 07 | 23 15 | | 2 07 | | 182 07 |
| | | | | 9 12 | 23 20 | | 1 03 | | 181 03 |
| | | | | 9 17 | 23 25 | | 0 00 | | 180 00 |
| | | | | 9 22 | 23 30 | | 358 57 | | 178 57 |
| | | | | 9 27 | 23 35 | | 357 53 | | 177 53 |
| | | | | 9 32 | 23 40 | | 356 49 | | 176 49 |
| | | | | | | | | | |
| | S | 596 | 3.7 | 9 34 | 23 42 | 68 57 | 179 43 | 291 03 | 359 43 |
| | | | | 9 39 | 23 47 | | 180 00 | | 0 00 |
| | | | | 9 44 | 23 52 | | 180 17 | | 0 17 |
| | | | | 9 49 | 23 57 | | 180 34 | | 0 34 |
| | | | | 9 54 | 0 02 | | 180 52 | | 0 52 |
| | | | | 9 59 | 0 07 | | 181 09 | | 1 09 |
| | | | | 10 04 | 0 12 | | 181 26 | | 1 26 |
| | | | | | | | | | |

EXTRACT FROM THE WORKING LIST
FOR A LONGITUDE OBSERVATION $\phi - 33^{\circ}27'$
 $\lambda + 9^{\text{h}}58^{\text{m}}$

Friday 5th March 1976

WEST

PREDICTION

EAST

| Pair | No. | Mag. | FL | | FR | | LST | Std. Time | FL | | FR | | Mag. | No. |
|------|-----|------|--------|---------|---------|---------|--------------------------------|---------------------------------|--------|--------|---------|---------|------|-----|
| | | | VØ | HØ | VØ | HØ | | | VØ | HØ | VØ | HØ | | |
| 1 | 59 | 4.4 | 50°18' | 280°00' | 309°42' | 100°00' | 6 ^h 09 ^m | 20 ^h 18 ^m | 58°36' | 83°54' | 301°24' | 263°54' | 3.8 | 274 |
| | | | 51 20 | 279 12 | 308 40 | 99 12 | 6 14 | 20 23 | 57 33 | 83 07 | 302 27 | 263 07 | | |
| | | | 52 22 | 278 22 | 307 38 | 98 22 | 6 19 | 20 28 | 56 30 | 82 20 | 303 30 | 262 20 | | |
| | | | 53 23 | 277 32 | 306 37 | 97 32 | 6 24 | 20 33 | 55 27 | 81 34 | 304 33 | 261 34 | | |
| | | | 54 24 | 276 42 | 305 36 | 96 42 | 6 29 | 20 38 | 54 24 | 80 48 | 305 36 | 260 48 | | |
| | | | 55 27 | 275 57 | 304 33 | 95 57 | 6 34 | 20 43 | 53 22 | 79 59 | 306 38 | 259 59 | | |
| | | | 56 30 | 275 12 | 303 30 | 95 12 | 6 39 | 20 48 | 52 21 | 79 10 | 307 39 | 259 10 | | |
| | | | 57 33 | 274 27 | 302 27 | 94 27 | 6 44 | 20 53 | 51 19 | 78 20 | 308 41 | 258 20 | | |
| | | | 58 36 | 273 42 | 301 24 | 93 42 | 6 49 | 20 58 | 50 18 | 77 30 | 309 42 | 257 30 | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

E.3

| LATITUDE = -33.45 | | | | | | | | | |
|-------------------|-----|----------------------|-------------------------|--------------|----------------|----------------------|----------------------|-----|-------|
| WEST STAR | | | | | | | EAST STAR | | |
| CATNO | MAG | Z.D. | AZ | L.S.T. | | AZ | Z.D. | MAG | CATNO |
| 562 | 3.3 | 50.8 55.0 59.1 | 278.2 275.1 272.1 | 23 0 0 | 50 10 30 | 86.1 83.1 79.9 | 59.1 55.0 50.8 | 3.2 | 96 |
| 591 | 3.9 | 36.2 40.3 44.5 | 277.3 274.0 271.0 | 0 0 0 | 3 23 43 | 87.9 84.9 81.5 | 44.5 40.3 36.2 | 4.0 | 73 |
| 562 | 3.3 | 54.8 58.9 63.1 | 275.2 272.3 269.5 | 0 0 0 | 9 29 49 | 89.9 87.1 84.1 | 63.1 58.9 54.8 | 4.0 | 119 |
| 591 | 3.9 | 37.7 41.8 46.0 | 276.0 272.9 270.0 | 0 0 0 | 10 30 50 | 88.7 85.8 82.5 | 46.0 41.8 37.7 | 4.3 | 81 |
| 581 | 4.2 | 52.6 56.8 61.0 | 273.2 270.3 267.6 | 0 1 1 | 50 10 30 | 90.9 88.2 85.2 | 61.0 56.8 52.6 | 3.3 | 134 |
| 601 | 3.0 | 45.5 49.7 53.8 | 280.3 277.0 273.9 | 0 1 1 | 54 14 34 | 83.4 80.1 76.6 | 53.8 49.7 45.5 | 4.0 | 119 |
| 591 | 3.9 | 47.1 51.2 55.4 | 269.3 266.7 264.2 | 0 1 1 | 55 15 35 | 95.7 93.2 90.5 | 55.4 51.2 47.1 | 3.3 | 130 |
| 588 | 4.3 | 51.0 55.2 59.4 | 274.9 272.0 269.2 | 0 1 1 | 57 17 37 | 89.9 87.1 84.1 | 59.4 55.2 51.0 | 3.3 | 134 |
| 595 | 3.8 | 49.2 53.4 57.5 | 276.5 273.5 270.6 | 1 1 1 | 6 26 46 | 88.7 85.8 82.7 | 57.5 53.4 49.2 | 3.3 | 134 |
| 591 | 3.9 | 49.8 54.0 58.1 | 267.6 265.0 262.6 | 1 1 1 | 8 28 48 | 95.2 92.6 89.9 | 58.1 54.0 49.8 | 3.0 | 142 |
| 591 | 3.9 | 51.1 55.3 59.4 | 266.8 264.2 261.8 | 1 1 1 | 15 35 55 | 98.1 95.4 93.2 | 59.4 55.3 51.1 | 3.8 | 154 |
| 591 | 3.9 | 52.2 56.3 60.5 | 266.1 263.6 261.2 | 1 2 2 | 20 40 0 | 96.7 94.2 91.6 | 60.5 56.3 52.2 | 3.9 | 161 |
| 605 | 4.4 | 48.7 52.8 57.0 | 281.3 277.9 274.8 | 1 1 2 | 23 43 3 | 84.1 80.9 77.5 | 57.0 52.8 48.7 | 4.3 | 138 |
| 595 | 3.8 | 53.1 57.3 61.4 | 273.7 270.8 268.1 | 1 1 2 | 25 45 5 | 89.4 86.6 83.6 | 61.4 57.3 53.1 | 3.7 | 155 |
| 601 | 3.0 | 52.5 56.7 60.9 | 274.9 271.9 269.1 | 1 2 2 | 28 48 8 | 89.0 86.1 83.1 | 60.9 56.7 52.5 | 3.7 | 155 |
| 637 | 3.8 | 39.4 43.5 47.7 | 276.9 273.7 270.6 | 1 2 2 | 58 18 38 | 88.5 85.5 82.2 | 47.7 43.5 39.4 | 3.0 | 142 |
| 631 | 3.5 | 45.6 49.7 53.9 | 280.7 277.4 274.3 | 2 2 2 | 1 21 41 | 84.1 80.9 77.5 | 53.9 49.7 45.6 | 3.7 | 155 |
| 631 | 3.5 | 46.7 50.9 55.0 | 279.8 276.5 273.5 | 2 2 2 | 7 27 47 | 84.0 80.8 77.4 | 55.0 50.9 46.7 | 3.8 | 163 |
| 637 | 3.8 | 41.7 45.9 50.1 | 275.0 272.0 269.2 | 2 2 2 | 10 30 50 | 90.2 87.4 84.3 | 50.1 45.9 41.7 | 3.9 | 161 |
| 627 | 4.2 | 54.4 58.5 62.7 | 277.1 274.1 271.2 | 2 2 3 | 33 53 13 | 86.5 83.6 80.4 | 62.7 58.5 54.4 | 4.3 | 190 |
| 631 | 3.5 | 53.3 57.5 61.7 | 274.7 271.8 269.0 | 2 2 3 | 39 59 19 | 90.6 87.8 84.9 | 61.7 57.5 53.3 | 4.1 | 195 |

E.4

LATITUDE = -33.45

| WEST STAR | | | | | | | | EAST STAR | |
|-----------|------|----------------------|-------------------------|-------------------------|-----------------------|----------------------|-----|-----------|--|
| CATNO | MAG | Z.D. | AZ | L.S.T. | AZ | Z.D. | MAG | CATNO | |
| 20 | 4.4 | 36.8 41.0 45.1 | 264.2 262.0 260.0 | 3 51 4 11 4 31 | 99.7 97.6 95.5 | 45.1 41.0 36.8 | 2.4 | 205 | |
| 59 | 4.4 | 50.3 54.4 58.6 | 280.0 276.7 273.7 | 6 9 6 29 6 49 | 83.9 80.8 77.5 | 58.6 54.4 50.3 | 3.8 | 274 | |
| 89 | 4.3 | 51.5 55.6 59.7 | 265.4 263.0 260.6 | 7 38 7 58 8 18 | 98.4 96.0 93.5 | 59.7 55.6 51.5 | 3.2 | 321 | |
| 89 | 4.3 | 53.8 57.9 62.1 | 264.0 261.6 259.3 | 7 50 8 10 8 30 | 100.7 98.4 96.0 | 62.1 57.9 53.8 | 2.8 | 335 | |
| 145 | 2.7 | 43.5 47.6 51.8 | 279.4 276.1 273.0 | 8 34 8 54 9 14 | 86.4 83.3 79.9 | 51.8 47.6 43.5 | 2.8 | 324 | |
| 145 | 2.7 | 45.2 49.3 53.5 | 278.0 274.8 271.9 | 8 42 9 2 9 22 | 86.1 83.0 79.7 | 53.5 49.3 45.2 | 3.1 | 330 | |
| 177 | 2.0 | 40.0 44.1 48.3 | 282.3 278.7 275.4 | 9 7 9 27 9 47 | 82.2 78.8 75.0 | 48.3 44.1 40.0 | 3.1 | 330 | |
| 193 | 3.1 | 37.9 42.1 46.3 | 273.5 270.5 267.8 | 9 51 10 11 10 31 | 91.0 88.3 85.2 | 46.3 42.1 37.9 | 3.3 | 350 | |
| 192 | 3.7 | 41.6 45.7 49.8 | 264.2 262.0 259.8 | 10 14 10 34 10 54 | 98.3 96.0 93.6 | 49.8 45.7 41.6 | 3.5 | 366 | |
| 177 | 2.0 | 54.7 58.9 63.0 | 270.9 268.1 265.5 | 10 18 10 38 10 58 | 91.9 89.2 86.3 | 63.0 58.9 54.7 | 2.9 | 388 | |
| 200 | 3.8 | 40.4 44.6 48.7 | 266.8 264.4 262.1 | 10 20 10 40 11 0 | 97.7 95.4 92.9 | 48.7 44.6 40.4 | 3.5 | 366 | |
| 185 | -1.6 | 52.7 56.8 61.0 | 274.1 271.2 268.4 | 10 28 10 48 11 8 | 90.6 87.8 84.9 | 61.0 56.8 52.7 | 2.9 | 388 | |
| 196 | 2.0 | 47.4 51.5 55.6 | 263.4 261.1 258.9 | 10 46 11 6 11 26 | 99.6 97.3 94.9 | 55.6 51.5 47.4 | 3.4 | 393 | |
| 200 | 3.8 | 46.7 50.8 54.9 | 263.2 261.0 258.8 | 10 50 11 10 11 30 | 99.2 96.9 94.5 | 54.9 50.8 46.7 | 3.4 | 393 | |
| 193 | 3.1 | 54.9 59.0 63.1 | 262.7 260.4 258.0 | 11 12 11 32 11 52 | 100.4 98.0 95.6 | 63.1 59.0 54.9 | 2.5 | 428 | |
| 222 | 2.9 | 48.1 52.2 56.4 | 266.1 263.6 261.3 | 11 45 12 5 12 25 | 96.5 94.0 91.4 | 56.4 52.2 48.1 | 2.5 | 428 | |
| 241 | 4.2 | 42.1 46.2 50.3 | 264.4 262.1 260.0 | 12 5 12 25 12 45 | 97.8 95.5 93.1 | 50.3 46.2 42.1 | 3.0 | 426 | |
| 241 | 4.2 | 45.2 49.3 53.4 | 262.7 260.5 258.3 | 12 20 12 40 13 0 | 100.0 97.7 95.4 | 53.4 49.3 45.2 | 1.2 | 441 | |
| 283 | 4.1 | 44.3 48.4 52.6 | 280.5 277.2 274.1 | 13 28 13 48 14 8 | 84.4 81.2 77.8 | 52.6 48.4 44.3 | 2.6 | 464 | |
| 283 | 4.1 | 47.2 51.3 55.5 | 278.1 275.0 272.0 | 13 42 14 2 14 22 | 86.1 83.0 79.7 | 55.5 51.3 47.2 | 3.6 | 483 | |
| 293 | 3.3 | 45.0 49.1 53.2 | 281.0 277.7 274.5 | 13 53 14 13 14 33 | 84.4 81.3 77.8 | 53.2 49.1 45.0 | 3.6 | 483 | |

LATITUDE = -33.45

| WEST STAR | | Z.D. | AZ | L.S.T. | | A7 | Z.D. | EAST STAR | |
|-----------|-----|------|-------|--------|----|-------|------|-----------|-------|
| CATNO | MAG | | | | | | | MAG | CATNO |
| 296 | 4.2 | 53.5 | 271.3 | 14 | 50 | 93.7 | 61.9 | 4.0 | 537 |
| | | 57.7 | 268.6 | 15 | 10 | 91.0 | 57.7 | | |
| | | 61.9 | 265.9 | 15 | 30 | 88.2 | 53.5 | | |
| 321 | 3.2 | 37.4 | 276.2 | 14 | 52 | 87.6 | 45.7 | 4.0 | 502 |
| | | 41.6 | 273.1 | 15 | 12 | 84.5 | 41.6 | | |
| | | 45.7 | 270.2 | 15 | 32 | 81.1 | 37.4 | | |
| 321 | 3.2 | 42.0 | 272.8 | 15 | 14 | 90.8 | 50.3 | 3.6 | 524 |
| | | 46.1 | 269.9 | 15 | 34 | 88.0 | 46.1 | | |
| | | 50.3 | 267.3 | 15 | 54 | 84.9 | 42.0 | | |
| 321 | 3.2 | 42.5 | 272.4 | 15 | 17 | 92.0 | 50.9 | 3.9 | 528 |
| | | 46.7 | 269.5 | 15 | 37 | 89.3 | 46.7 | | |
| | | 50.9 | 266.9 | 15 | 57 | 86.4 | 42.5 | | |
| 321 | 3.2 | 43.2 | 271.9 | 15 | 20 | 91.5 | 51.6 | 3.0 | 533 |
| | | 47.4 | 269.1 | 15 | 40 | 88.7 | 47.4 | | |
| | | 51.6 | 266.5 | 16 | 0 | 85.8 | 43.2 | | |
| 335 | 2.8 | 39.8 | 273.0 | 15 | 30 | 90.3 | 48.2 | 3.9 | 528 |
| | | 44.0 | 270.1 | 15 | 50 | 87.5 | 44.0 | | |
| | | 48.2 | 267.4 | 16 | 10 | 84.4 | 39.8 | | |
| 330 | 3.1 | 51.5 | 275.3 | 16 | 6 | 88.4 | 59.9 | 3.3 | 562 |
| | | 55.7 | 272.4 | 16 | 26 | 85.5 | 55.7 | | |
| | | 59.9 | 269.6 | 16 | 46 | 82.4 | 51.5 | | |
| 335 | 2.8 | 54.5 | 263.6 | 16 | 40 | 100.1 | 62.7 | 3.9 | 591 |
| | | 58.6 | 261.3 | 17 | 0 | 97.7 | 58.6 | | |
| | | 62.7 | 258.9 | 17 | 20 | 95.3 | 54.5 | | |
| 350 | 3.3 | 49.9 | 266.7 | 17 | 2 | 97.5 | 58.2 | 3.9 | 591 |
| | | 54.1 | 264.2 | 17 | 22 | 95.0 | 54.1 | | |
| | | 58.2 | 261.6 | 17 | 42 | 92.5 | 49.9 | | |
| 366 | 3.5 | 39.5 | 267.6 | 17 | 6 | 95.4 | 47.8 | 4.3 | 573 |
| | | 43.6 | 265.2 | 17 | 26 | 92.9 | 43.6 | | |
| | | 47.8 | 262.8 | 17 | 46 | 90.3 | 39.5 | | |
| 388 | 2.9 | 48.2 | 278.5 | 18 | 10 | 84.8 | 56.5 | 4.4 | 605 |
| | | 52.3 | 275.4 | 18 | 30 | 81.7 | 52.3 | | |
| | | 56.5 | 272.4 | 18 | 50 | 78.3 | 48.2 | | |
| 388 | 2.9 | 52.7 | 275.1 | 18 | 32 | 90.6 | 61.0 | 3.5 | 631 |
| | | 56.9 | 272.2 | 18 | 52 | 87.8 | 56.9 | | |
| | | 61.0 | 269.4 | 19 | 12 | 84.8 | 52.7 | | |
| 413 | 3.8 | 41.4 | 264.1 | 18 | 46 | 99.0 | 49.6 | 4.2 | 620 |
| | | 45.5 | 261.9 | 19 | 8 | 96.8 | 45.5 | | |
| | | 49.6 | 259.7 | 19 | 28 | 94.4 | 41.4 | | |
| 411 | 4.0 | 48.5 | 280.3 | 18 | 53 | 84.6 | 56.7 | 4.2 | 627 |
| | | 52.6 | 277.0 | 19 | 13 | 81.5 | 52.6 | | |
| | | 56.7 | 274.0 | 19 | 33 | 78.1 | 48.5 | | |
| 428 | 2.5 | 44.2 | 271.1 | 19 | 15 | 92.4 | 52.5 | 3.8 | 637 |
| | | 48.4 | 268.4 | 19 | 35 | 89.7 | 48.4 | | |
| | | 52.5 | 265.8 | 19 | 55 | 86.8 | 44.2 | | |
| 430 | 2.9 | 54.8 | 268.3 | 20 | 5 | 94.8 | 63.2 | 2.2 | 14 |
| | | 59.0 | 265.7 | 20 | 25 | 92.1 | 59.0 | | |
| | | 63.2 | 263.1 | 20 | 45 | 89.4 | 54.8 | | |
| 505 | 2.8 | 38.0 | 262.9 | 21 | 19 | 100.6 | 46.3 | 4.4 | 20 |
| | | 42.2 | 260.9 | 21 | 39 | 98.6 | 42.2 | | |
| | | 46.3 | 258.9 | 21 | 59 | 96.4 | 38.0 | | |
| 528 | 3.9 | 43.0 | 273.3 | 22 | 12 | 91.5 | 51.3 | 4.2 | 42 |
| | | 47.1 | 270.4 | 22 | 32 | 88.7 | 47.1 | | |
| | | 51.3 | 267.7 | 22 | 52 | 85.7 | 43.0 | | |
| 537 | 4.0 | 41.7 | 280.8 | 22 | 14 | 83.0 | 50.0 | 3.7 | 34 |
| | | 45.8 | 277.4 | 22 | 34 | 79.6 | 45.8 | | |
| | | 50.0 | 274.2 | 22 | 54 | 76.0 | 41.7 | | |
| 512 | 2.9 | 52.0 | 262.1 | 22 | 26 | 100.2 | 60.2 | 4.2 | 67 |
| | | 56.1 | 259.6 | 22 | 46 | 97.8 | 56.1 | | |
| | | 60.2 | 257.6 | 23 | 6 | 95.4 | 52.0 | | |
| 528 | 3.9 | 52.6 | 266.9 | 22 | 58 | 98.0 | 60.9 | 4.3 | 81 |
| | | 56.8 | 264.3 | 23 | 18 | 95.6 | 56.8 | | |
| | | 60.9 | 261.9 | 23 | 38 | 93.0 | 52.6 | | |
| 573 | 4.3 | 37.6 | 271.0 | 23 | 35 | 91.8 | 45.9 | 4.2 | 67 |
| | | 41.8 | 268.3 | 23 | 55 | 89.1 | 41.8 | | |
| | | 45.9 | 265.7 | 24 | 15 | 86.1 | 37.6 | | |

APPENDIX F

Bathurst Land Use Survey

AIM AND SCOPE

The aim and scope of the land use survey is for each group of three students to undertake a survey in the environs of Bathurst. In making this survey, both field sampling and air photograph interpretation techniques will be employed. The final result will be a coded and symbolised map showing the land use of an area about one stereomodel in extent.

SCENARIO

This type of survey could well be undertaken to provide land use information for a local government authority or a land data bank. Other information within that data bank could be the legal description, coordinates, rate and valuation information, soil information and census data. The smallest unit or reference for this type of data bank is usually the land parcel. Therefore, we require the land use survey in this exercise to be property based. Accordingly, in this exercise, make your land use decision based on the most predominant use within the properties' boundaries as portrayed on the scale 1:25 000 map as far as possible.

METHOD

Each group will produce a land use map of the area covered by one stereo-pair of the aerial photographs of the scale 1:25 000 photography. The task will entail three distinct stages:

- (1) Air photograph selection of representative areas
- (2) Ground inspection and interpretation of those selected areas
- (3) Air photograph interpretation based on the ground inspected areas

STAGE 1

Selection of Representative Areas:

This stage will be carried out at base, using mirror stereoscopes. Time involved \approx about 2 hours. The aim of this stage is to select areas, which appear to represent many similar areas in the model, suitable for ground inspection. These areas will become the key to the whole survey.

This selection will be carried out by, firstly, broadly classifying the land patterns over the whole model according to the photographic TONE, TEXTURE and PATTERN, and secondly, by picking out 2 or 3 areas in each class with suitable road access for easy ground inspection.

F.2

To achieve these ends, a systematic inspection of the model under the mirror stereoscope will be made. Evolve a simple classification system based on the tone, texture and pattern of the photograph - whether an area is light or dark, or has a rough or smooth appearance. The whole model should be classified according to your system. A suggested classification system for your black and white photography may be:

- 3 Tones - light, medium dark
- 2 Textures - rough, smooth
- 2 Patterns - no, yes

This information should be recorded on an overlay to one of the black and white photographs. This classification system should not be based on land use, but on the appearance it has in the photograph. At this stage, inspect the colour prints that will be available for any additional or conflicting information that may be evident. On completion of this classification over the whole model, select two to three areas in each class suitable for ground inspection. In contemplating this, remember that you will not be able to venture onto private property. The total number selected should be between 15-20 representative areas, preferably with some of differing classes being adjacent to each other.

STAGE 2

Ground Inspection and Land Use Interpretation of Selected Areas:

In this stage, the TONE, TEXTURE and PATTERN classification will be matched with the Land Use categories (as listed on last page of this Appendix). Time involved in field \approx about three hours.

Upon reaching the site of the selected area, make a brief note of the activity carried out on the land (in excess of the land use category) and re-inspect the aerial photography.

Decide into which category this land should fall.

STAGE 3

Air Photo Interpretation:

Armed with the "ground truth" information gathered from Stages 1 and 2, you are now in a position to carry out a land use survey. Using the mirror stereoscope, re-examine the whole model making land use decisions under the categories listed. The information should be recorded on a map dyeline using the appropriate code and a land use decision made for each property/portion as delineated on the scale 1:25 000 map. Where the property does not appear on the map, note the land use regardless of this handicap. Finally, on this map or on another dyeline, show the land use by colours. This is a map and therefore it will need a key, a date, title, who surveyed it, methods used and the location of the survey to be shown.

SUBMISSION

This whole exercise is a GROUP EXERCISE, including the REPORT.

1. Overlay to the photograph showing the TONE/TEXTURE/PATTERN classification from Stage 1 as well as portraying the actual sites visited on the ground.
2. The "field notes" of the visits to the selected sites stating the actual land use at each site and any immediate implications of your findings on the ground.
3. The Land Use map showing the land coded in both numbers and colours. This may be completed on one or two separate maps, as you wish.
4. A report of about 2 pages in length that should include the following considerations: brief introduction giving methods used and any problem encountered; suggestions for improvements to the methods used; how would your group organise a land use survey over the whole of the Bathurst/Orange area? Would different types of aerial photography flown at a chosen time of year assist in this task? General comments and conclusions.

F.4

CODES FOR THE BATHURST LAND USE SURVEY

| Code No. | Attribute/or Class/or Sub-Class | Colour or Symbol |
|----------|--|----------------------------|
| 1 | Non-urban (rural) | |
| 1.1 | under cultivation (crops except grass) | brown |
| 1.12 | cereals | light brown |
| 1.14 | vegetables/flowers/vines | brown |
| 1.16 | orchard | brown stripes |
| 1.2 | forest (including scrub) | green |
| 1.22 | plantations (cultivated) | lime green |
| 1.24 | natural | dark green |
| 1.242 | dense timber | green & label (D) |
| 1.244 | open (scattered) timber | green & label (O) |
| 1.26 | scrub | very light green |
| 1.3 | pasture (grazing) | yellow |
| 1.32 | improved | light yellow |
| 1.34 | natural | yellow |
| 1.4 | water | blue |
| 1.42 | man-made | light blue |
| 1.44 | natural | dark blue |
| 1.46 | swamp | dark blue & label (S) |
| 1.5 | unused/unclass/waste | blank (white) |
| 1.6 | intensive animal production | purple stripes |
| 1.62 | poultry sheds, pigs | purple stripes & label (P) |
| 1.64 | stud yards, lot feed cattle | purple stripes & label (S) |
| 1.7 | mining and quarrying | purple & label (Q) |
| 2 | Residential (urban) | light red |
| 3 | Business (urban) | red |
| 4 | Industrial (urban) | purple |
| 5 | Special Uses | light grey |
| | Label accordingly, e.g. school, hospital, church and parking | |
| 6 | Open Space (recreation) | |
| 6.1 | passive | green stripes & label (P) |
| 6.2 | active | green stripes & label (A) |
| 7 | Roads | black line |
| 7.1 | bitumen | black line & label (B) |
| 7.2 | loose metal | black line & label (M) |

APPENDIX G

Constants of EDM Instruments

| INSTRUMENT | SERIAL NUMBER | ADD. CONST. | σ ADD CONST. | DATE OF CALIBRATION | REFLECTOR TO WITH ADD. CONST. REFERS |
|-------------------------|----------------|-----------------|------------------------|------------------------|--|
| AGA 14 | 14075 | -4mm | ± 0.9 mm | 15.8.81 | New AGA |
| HP 3800B | 1141A00110 | -1mm | ± 0.6 mm | 7.78 | HP/Old AGA |
| HP 3800B | 1226A00368 | +1mm | ± 0.5 mm | 7.78 | HP/Old AGA |
| HP 3805A | 1338A00123 | -2mm | ± 0.7 mm | 23.4.83 | HP/Old AGA |
| HP 3805A | 1440A01439 | +3mm | ± 0.4 mm | 4.6.81 | HP/Old AGA |
| HP 3820A | 1650A00131 | -1mm | ± 1.5 mm | 23.4.83 | HP/Old AGA |
| KERN DM501 | 250942 | (SEE NEXT PAGE) | | | KERN |
| TELLUROMETER CA 1000 | 6249-E, 6250-E | -23mm | ± 1 mm | 16.8.80 | N.A. |
| TOPCON DM-C2 | 911266 | +4mm | ± 0.4 mm | 9.8.80 | New AGA |
| TOPCON GTS-2 | B45056 | +1mm* | ± 0.2 mm | 20.10.83 | Topcon |

* Internal additive constant setting = -07 (mm)

DM 501 ADD. CONST.:

→ EITHER SCALE OF DIAGRAM BELOW OR COMPUTE FROM EQ. USING ALL TERMS!

DISTANCES < 100 m → CLOSED DIAPHRAGM

> 100 m → OPEN DIAPHRAGM

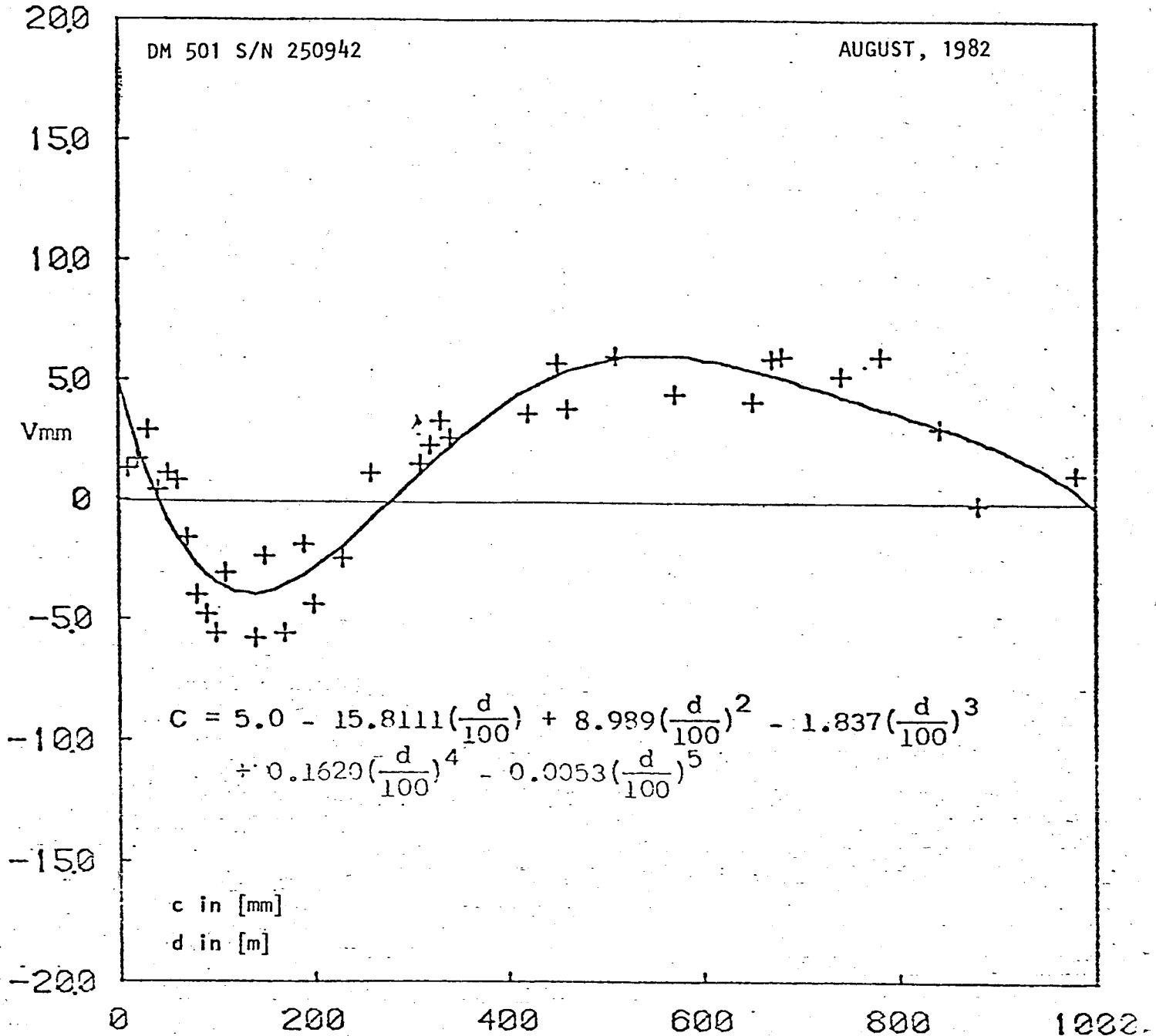


Fig. 15: Curve fitted to residuals from Regents

Park and 100m Baseline.