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MAPPING FOR THE 1981 CENSUS

by

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ABSTRACT

The next Census of Population and Housing will be conducted on 30 June 1981.

To help the Australian Bureau of Statistics collect the census, the Division of National Mapping has to prepare "field maps" for each of the 28 000 collectors.

Preparation and printing of the field maps is a large task and requires the coordinated efforts of the State and Central Offices of ABS, the Commonwealth Government Printer, all State mapping authorities and local government authorities throughout Australia.

The report describes -

- the planning and development of a new system of mapping for collecting the census;
- the approach used in allocating staff to such a large project;
- the problems of producing, printing and disseminating the maps;
- the current and future use of automated methods.

Although not fully tested in the field both the Australian Bureau of Statistics and the Division of National Mapping are confident that maps produced by the new system will cost less and suit the collectors better.

1. THE CENSUS OF POPULATION AND HOUSING

The Census of Population and Housing to be conducted on Tuesday 30 June 1981 by the Australian Bureau of Statistics (ABS) will be the tenth census to be held nationally. The first was in 1911 and since 1961 a census has been held every 5 years.

The census and associated surveys are the sources from which estimates are made of the population in each State and Local Government Area (LGA). In addition statistical information is provided on such matters as age distribution, population movements, birthplaces, educational qualifications, incomes, occupations and employment, and characteristics of dwellings.

Although the census collects information about individuals and households, it does so entirely in order to compile statistics about groups or categories. The census data is collected at specified points, but it is then aggregated and published for specified areas. These statistics are used to determine electoral representation and monetary grants for the States and LGAs.

To help ABS collect the census, the Division of National Mapping (Natmap) has prepared a "field map" for each of the 28 000 collection districts in the 1981 census.

Preparation and printing of the field maps is a large task and requires the coordinated efforts of the State and Central Offices of ABS, Natmap, the Commonwealth Government Printer, all State mapping authorities and local government authorities throughout Australia.

2. THE GEOGRAPHICAL HIERARCHY OF THE COLLECTION

Every census has used the network of regional offices and personnel of the Electoral Office to supervise the delivery and collection of the census schedules; so before each census the statistical boundaries established by ABS are adjusted to fit electoral or administrative boundaries. The resultant hierarchy is:

- Census divisions are almost the same as federal electoral divisions, but there are some slight deviations to follow LGA boundaries. Because of their size electoral divisions are often split to form two census divisions.

- Census sub-divisions are parts of divisions, containing about 12 to 15 collection districts. Where possible census sub-divisions are aligned to LGAs and in no case do census sub-division boundaries cut LGA boundaries.

- Collection districts (CDs) are parts of census sub-divisions or LGAs and are the basic census collection unit. Each CD is the workload of one collector and may contain 300 dwellings in an urban area or as few as 35 dwellings in a rural area. A metropolitan CD may be a block of flats; a rural CD may cover hundreds of square kilometres in sparsely settled areas.

  The CD is also a unit for statistical comparison so its boundaries are kept as stable as possible. However, as population grows CDs are split, and if population declines CDs are amalgamated. Wherever possible CD boundaries

follow natural or visible features. For the 1981 Census each CD has been allocated a unique six digit code: eg NSW031002 indicated CD 02 of sub-division 10 in NSW division 03.

3. MAPPING FOR THE CENSUS

3.1 Updating the topographic content of the field maps

To produce the maps required by collectors for the whole of Australia, Natmap had to obtain up-to-date base maps which range in scale from 1:10 000 in urban areas to 1:1 million in sparsely settled areas.

Natmap and the Royal Australian Survey Corps are responsible for producing small scale maps of Australia and most maps at scales of 1:100 000 and smaller were supplied by these two organisations.

The State mapping organisations generally enter into a cost sharing arrangement whereby they incorporate the census requirements into their existing air photography and 1:10 000 mapping programs. Where suitable State mapping or photography is not available or not part of a State program then Natmap arranges contracts for private firms to undertake the updating with the work paid for by ABS.

A summary of all the updated base mapping obtained by contracting or from other organisations follows.

3.1.1 Sydney

Sydney was updated by Boddy, Axtell & Wood, 14th floor CML Building, Cnr Creek & Queen Streets, Brisbane, Qld, 4000, in 1979-80. It cost $46 550.

3.1.2 Wollongong; Newcastle-Maitland-Cessnock-Gosford; and Melbourne-Geelong

These three areas were updated by Universal Business Directories Pty Ltd, 64 Talavera Road, North Ryde, NSW, 2113, in 1979-80. It cost $75 236.

3.1.3. Adelaide

Adelaide was updated by Photec Air Surveys Pty Ltd, 5 Durant Road, Croydon Park, SA, 5008, in 1979-80. It cost $11 255.

3.1.4 Brisbane; and major urban centres in Queensland

These were updated by the Department of Mapping and Surveying, 130 William Street, Brisbane, Qld, 4000, in 1978-80. Brisbane cost $14 500 and the urban centres $15 000.

3.1.5 Perth 1:25 000 series; major urban centres in WA

These were updated by the Department of Lands and Surveys, Cathedral Avenue, Perth, WA, 6000, in 1979-80. It cost $7366.

3.1.6 Perth 1:10 000 series

Contact film positives were supplied by the Town Planning Department, Oakley Building, 22 St George's Terrace, Perth, WA, 6000 in 1979-80. It cost $1715.

3.1.7 Miscellaneous 1:25 000 base mapping in NSW

Film positives were supplied by Central Mapping Authority of NSW, PO Box 143, Bathurst, NSW, 2795 in 1978-79. They cost $1927.

3.1.8 Miscellaneous 1:10 000 town maps, and 1:50 000 Standard Edition in SA.

Film positives were supplied by the Lands Department, 144 King William Street, Adelaide, SA, 5001 in 1979-80. They cost $500.

3.1.9 1:2500 half plate negative reference material for the Melbourne metropolitan area

This was updated by Melbourne and Metropolitan Board of Works, 625 Little Collins Street, Melbourne, Vic, 3001 in 1979-80. It cost $350.

3.1.10 Hobart and Launceston 1:12 500 series

Film positives were supplied by the Department of Lands, Box 44A GPO, Hobart, Tas, 7001 in 1979. It cost $2542.

3.1.11 Darwin 1:8000 and 1:30 000

Film positives were supplied by the Survey and Mapping Division, Department of Lands and Housing, PO Box 1680, Darwin, NT, 5794 in Nov 1979. No cost was involved.

3.1.12 Canberra 1:10 000 series

Film positives were made available for copying from the Australian Survey Office, Unit 2, Cameron Offices, Belconnen, ACT 2617. No cost was involved.

3.1.13 Summary of costs

Total cost	1978-79 financial year	$ 16 427
Total cost	1979-80 financial year	$160 514
	Total	$176 941

3.2 1976 Collectors' Comments

As part of his job, each 1976 collector had to indicate any incorrect information, or comment on how portrayal of the information could be improved on the map supplied. This information was collated by the ABS State Offices and sent to Natmap. Natmap manually transferred these corrections and improvements to working copies of the 1976 field maps (internally called Copy 10s) and these master working copies became the start of a data bank of information for the 1981 Census.

The quantity of the information gained in this manner varied with each collector's conscientiousness, but a large amount of useful information was obtained, and about 20 000 comments were processed by Natmap, taking about 150 man-days. The most common type of information which required the base

mapping to be updated was -

- the addition of new roads - in 1293 collection districts
- the addition of new road names - in 1684 collection districts
- road names misspelt - in 38 collection districts
- deletion of roads - in 495 collection districts
- incorrect position of statistical boundaries - in 19 collection districts
- incorrect CD number shown - in 4 collection districts

so that a total of 3533 CDs were affected by the collectors comments.

Additional information supplied by the collectors covered -

- adding names to existing roads or streets, or changing names;
- verifying the existence of homesteads and buildings;
- new homestead names or misspelling of names;
- correction of stream and creek names;
- location of hospitals, caravan parks and drive-in cinemas;
- new building developments and residential areas;
- realignment of roads;

This additional information helped to start the 1981 Census conversion by -

- providing new physical features on which statistical boundaries could be aligned;
- indicating the CDs which should be split, particularly where new development had occurred.

All information about roads and names is valid only for Census purposes and should be investigated and validated by the relevant nomenclature authority before using for topographic mapping.

Time taken to complete the task was 138 man-days and a similar amount of time will be needed to process the collectors' comments for the 1986 census.

The system should be retained for the next census and contract draftsmen with map reading knowledge and a reasonably high standard of hand lettering be used to help process the comments.

3.3 LGA Information

There are currently about 1100 LGAs in Australia, about 300 in metropolitan areas and 800 in rural areas. Within the LGAs throughout Australia there are about 3500 localities and urban centres.

The ABS defines -

- a locality as a place of settlement where the population is more than 150 and less than 1000; and
- an urban centre as a place with a population of more than 1000.

The task of obtaining up-to-date mapping information from LGAs in some metropolitan areas was left to contractors who successfully tendered for the updating of various 1:10000 series. But each rural LGA, as in past censuses, was asked to supply up-to-date mapping information: each was sent dyelines of the 1976 field maps of the areas under its control:

Vic	-	590 dyelines sent to	170	LGAs
NSW	-	630 dyelines sent to	199	LGAs
SA	-	282 dyelines sent to	110	LGAs
WA	-	272 dyelines sent to	124	LGAs
Qld	-	438 dyelines sent to	138	LGAs
Tas	-	159 dyelines sent to	46	LGAs
Total		2371 dyelines sent to	787	LGAs

The cost of the dyelines was carried by ABS while the cost of mailing the dyelines was borne by Natmap.

The quality of the returns varied: in general authorities with ample resources put more effort into updating the dyelines supplied. Many LGAs supplied copies of their own plans, particularly if the amount of change between the field maps supplied and their own maps was great.

Four-fifths of LGAs replied and as with the collectors' comments all LGA information received was manually transferred to the master working copies. The information was then sent to the relevant ABS State Office which investigated, either in the field or by the use or the latest air photographs, any indication of population change and determined whether or not existing CDs should be split or amalgamated.

All information from the LGAs was generally received 18 months prior to census night. To allow for such occurrences as new land sub-divisions being occupied by June 1981, all LGAs were asked to show on the maps supplied any changes which could reasonably be anticipated within that 18 month period.

The return from the LGAs was a success because -

- LGAs were asked to indicate in pencil, biro or felt pen any new information which could help the census collector find his way around his CD. Time consuming accurate plotting was not asked for.
- Natmap offered free ozafilm copies of updated base maps to each LGA in return for information. The offer was accepted by 170 LGAs and 512 ozafilms were dispatched.
- Natmap dealt directly with each LGA whereas in previous censuses Natmap had to work through ABS. The fact that a mapping organisation requested mapping information may have helped.
- LGAs are becoming more aware, particularly in the current economic climate, that State monetary grants are based on population. In most cases it is financially advantageous to the LGAs to help Natmap and the ABS establish the correct populations under their jurisdiction.

3.4 Updating the statistical content of the field maps

The main reason ABS has to update the statistical content of the field maps before each census is to maintain a stable workload for its supervisors organising the collection. Another reason is that adjustments to electoral boundaries are made from time to time to take account of changes in population numbers and their distribution. Consequently, about two years before the census, ABS updates its field boundaries to fit the current electoral boundaries; CDs are re-grouped into new sub-divisions, which in turn are re-grouped into new divisions. The overall field situation completely changes from one census to another (see Annexes A and B).

ABS carries out this updating of its field boundaries on its own reference maps. Based on these updated reference maps ABS should then issue Natmap with lists which indicate, by State, the previous census division/sub-division/CD numbers converted to the next census division/ sub-division and CD numbers. Using these conversion lists Natmap should then change the previous boundaries on the master working copies to their new positions and add new code numbers; the task is known as the 'conversion'.

For this census ABS was not in a position to supply the lists when Natmap needed them so Natmap had to transcribe the new boundaries and six digit codings from ABS reference maps to Natmap's master working copies.

A major problem was caused by ABS's reference maps not being topographically up-to-date when they carried out their updating of the field boundaries. Topographic information from collectors' comments and from LGAs had only been added to Natmap's master working copies. This meant that ABS were updating their field boundaries but had little or no knowledge of where new urban development or new highways had occurred. This lack of topographic knowledge caused ABS to re-design Tasmania and Victoria. Work already done by Natmap in these States had to be re-done.

For the 1986 Census Natmap and ABS should discuss the possibility of Natmap carrying out the main conversion design, as -

- Natmap will hold the most up-to-date maps;
- Natmap has the potential to carry out the design;
- labour would not be wasted in re-designing and transcribing;
- Natmap would not be reliant on ABS to provide information by a specific date and thus would be better able to organise and program its workflow.

Since ABS reference maps were not up-to-date Natmap was authorised to send "indicators" to the various ABS State offices. The indicators showed where population had changed and suggested where boundary changes might be needed. Natmap was also in a good position to indicate a change in position of a physical feature used as a boundary: a main road used in the 1976 census might have been realigned in 1978 and Natmap would indicate that the boundary be adjusted.

The number of indicators initiated by Natmap was -

NSW	290
Victoria	113
Queensland	140
Western Australia	102
South Australia	32
Tasmania	22
Northern Territory	nil
	699

The time taken for the total conversion was 750 man-days. About the same amount of time will be necessary for the 1986 Census particularly if Natmap carries out the initial design.

3.4.1 Local government boundary changes

In Australia LGA boundaries are ephemeral; there are many boundary changes, amalgamations and creations which are approved by the Department of Local Government in each State during the intercensal period. Because CD boundaries must align with LGA boundaries, all known LGA boundary changes must be incorporated into the census field maps.

As LGA boundary changes were received they were manually transferred to the master working copies as were the collectors' comments and LGA amendments.

For the 1981 Census, ABS wrote to every LGA throughout Australia requesting that any proposed changes between 1 July 1980 and 30 June 1981 be deferred until after 1 July 1981, and advising that Natmap would not show any LGA changes received after 1 July 1980 on the field maps.

Most LGAs honoured the cut-off date but it seemed that some later changes were back-dated to comply nominally with the cut-off date. These changes had to be acted upon by Natmap and ABS.

LGA changes received from 1976 up to 15 July 1980 were -

NSW	85
Victoria	34
Queensland	54
Western Australia	57
South Australia	26
Tasmania	nil
Northern Territory	1
	257

A cut-off date is essential about a year before the census for national field map production and it is recommended that Natmap and ABS retain the same system for the 1986 Census.

3.4.2 CD Splitting

The last statistical information entered on the master working copies was the CD splits. Each division was investigated for possible splitting at a stated time. Divisions where the population was likely to remain relatively stable, usually rural or inner metropolitan, were split first. Conversely divisions on the periphery of the major urban centres were split last. The splitting program started in June 1978 and finished in October 1980.

The splitting of CDs was initiated by -

- ABS State Offices which used air photographs (for a more detailed analysis of the air photography program, see Annex D), field inspection, local knowledge and local building statistics to determine splits in their own States.
- ABS Central Office which was responsible for preparing changes in CDs in the ACT, but sometimes helped out when the workload in some State offices became too great.

The number of splits processed was -

NSW	816
Victoria	383
Queensland	908
South Australia	226
Western Australia	355
Northern Territory	nil
ACT	nil
	2755

For the 1981 Census the success of the splitting program determined the success of the whole field mapping program. For the 1986 Census it is critical that splits be received on a divisional basis and that delivery dates on the splitting program be strictly adhered to. Once the splitting program is agreed between Natmap and ABS then formulating the base mapping and air photography programs and carrying out actual field map production is relatively simple.

The estimated and actual timetable of the 1981 Census splitting program is at Annex C.

3.4.3 Miscellaneous Tasks

Many other things had to be done:

- planning the project;
- designing the field maps;
- testing drafting materials, equipment and reproduction materials;
- setting up control systems: filing systems, flow charts and work schedules;

- writing work instructions and preparing other educational tools;
- organising the supply of necessary materials;
- supervision.

The time taken to complete these tasks was 999 man-days. The fact that the mapping was completed on time is largely due to the amount of time spent in researching and controlling the project. If the existing system is retained for the 1986 Census about 100 man-days could be saved in initial research but the time spent in controlling the system would remain the same, ie, about 900 man-days.

3.5 Producing the 1981 Field Maps

3.5.1 Planning objectives

In planning the 1981 field maps the objectives were threefold:

1. To try to produce a better product for both the collectors and ABS Central and State Offices. After liaison with the ABS it was agreed that printing in two colours would make the maps far easier for the collectors to read, particularly under torchlight, and would eliminate many ambiguities that occurred in the one-colour 1976 maps.

   It was decided to print the maps in red and black: red for statistical information and black for topographic information. The printing of an index map on the back of each map would give each Divisional Field Supervisor and ABS State and Central Offices a pre-census look at the relationship between LGAs and sub-divisions. This would make supervision of the collection much easier.

It was decided to print the index maps in red and dark grey: red for all statistical information and dark grey for the topographic base. Dark grey was preferred to black as it eliminated bleed-through in printing.

Feed back from ABS State Offices and State Electoral Offices indicates a better product has been produced for the organisers of the census, but until the Census is collected it is still unknown whether or not the full objective has been achieved.

2. To design a system of producing the maps at minimum unit cost.

   Any printing system involving negatives and metal plates for short runs is expensive. As the field maps were not being published and only had to be clear and legible to the collector, lower quality was acceptable. Paper plates were investigated and found satisfactory and economical. A C3[1] size paper plate was adopted as it gave the maximum image area the available small offset press could handle.

[1] International envelope size - 324 x 458 mm

Paper plates were used for all maps printed on the front: about 12 500 plates should have been needed. However due to plate instability (see below), there was a high wastage rate and the actual number used may have been as high as 25 000. Negatives and metal plates had to be used for index maps on the reverse as the runs were much longer. About 300 negatives and 300 plates were used.

3. To ensure there was no overloading in Natmap's photolitho section.

Paper platemaking lent itself to a positive working repromat system. Base mapping, whether obtained from other authorities or updated by contractors, was generally supplied in a normal, composite film positive form. Sepia or black double-clear ozafilm working copies were made from the original composites supplied and used in assembling the divisions - see below.

The statistical information was depicted on a separate overlay and was either inked or fixed to double matte cartographic film, using 3M 'INT' rub-on lettering for the six digit codings and LGA names.

These two overlays were the final repromat given to the platemaker. Production of this type of repromat only involved using the photo-mechanical equipment and staff set up for the 1976 Census and had minimal impact on Natmap's photolitho section.

Photolitho was only called on for unforeseen service when the base mapping supplied for Adelaide and parts of Sydney and Wollongong was so poor in quality that silver bromide positives were needed to achieve an acceptable standard.

3.6 Staff

It was expected that Natmap would, as at previous censuses, obtain a number of temporary positions to help produce the maps. The positions had always been created 2 to 3 years prior to the census and recruitment generally involved employing temporary drafting assistants to carry out the simple drafting.

For the 1981 Census Natmap was not permitted to recruit any temporary staff and had to absorb production of the field maps out of its own resources. Consequently, great efforts were made to reduce the labour needed to produce the field maps. A section of eight started work in June 1977. Staff members gradually increased to 25 in February 1980, and were retained until Christmas 1980.

The ABS obtained funds to employ eight contract draftsmen for eighteen months thus bringing the maximum number employed on the project to 33.

3.6.1 Contract staff

All contract staff worked in Natmap's office under the same conditions as Natmap Staff.

Attempts were made to integrate, both socially and at the workface, contract and Natmap staff. These attemps were not entirely successful. There tended to be a "them" and "us" situation. All supervisors received complaints from contract staff who thought Natmap staff received preferential treatment. If contract staff are used in the next Census it is recommended that either:

(a) work is sent to the contractor where it would be worked on under Natmap supervision as set out under the existing period contract, or

(b) the contract staff are kept as a distinct group within the Natmap office under Natmap supervision.

Natmap requested the contractor to recruit draftsmen for a period of eighteen months. The contractor was also asked to ensure that there was the least possible turnover of draftsmen. During the eighteen months period seventeen contract draftsmen started on census work and twelve left. This involved considerable re-training, interrupted work flow, difficulties in organising work and losses in supervisory potential. The high turnover of people was due to -

- people leaving the contractor's employ;
- Natmap changing contract staff to other areas;
- the contractor changing staff to other work areas.

For the next Census it is recommended loose arrangements such as these be formalised.

Most contracting staff on Census work were employed on a subcontract or casual basis, were paid hourly and were able to work a maximum of 40 hours per week. Most contract staff fitted in with Natmap's normal flex time system but some did not. Supervisors did not know whether some staff would be in the office from one day to the next. This caused difficulties in organising and planning work. For the next Census it is recommended that all contracting staff employed on the Census be either permanent contractor's staff or they formally agree to work times according to the normal Natmap flex time system.

Most contract staff who worked on the Census had been trained in other fields and consequently lacked expertise in cartographic work. All supervisors agreed that contract staff were useful for simple, repetitive and less complicated cartographic drafting. They were less successful when attempting more complex work. All except two lacked any initiative to become a team leader and most showed little inclination to want to learn the basic fundamentals of field mapping. During the eighteen months they were with Natmap the main task was drafting, assembling and checking the field maps; a task where initiative, a reasonable knowledge of basic cartographic procedures and an ability to check accurately were needed but were not always forthcoming. For the 1986 Census it is recommended that contract staff be used not at assembly time but for other earlier, simpler tasks such as updating base mapping and processing the collector's comments.

Cost of contract staff:

	Financial Year	Cost	
ABS	1978-79	$ 3 528	
	1979-80	$142 265	
	1980-81	$ 62 229	
			$208 022
NATMAP	1979-80	$ 11 908	
	1980-81	$ 12 013	
			$ 23 921
Total Cost			$231 943

3.6.2 Natmap staff

Over the entire project 38 started and 12 left. It is recommended for the 1986 Census that Natmap ensures continuity of staff on census work particularly during the conversion and assembly stages.

For the 1981 Census emphasis was placed on communication. A meeting was held weekly (more often when the situation warranted it) between the chief draftsman, supervising draftsmen and all senior draftsmen to discuss the program and any problems that had occurred. As soon as the meeting was finished any decision or new technique was relayed to all staff by one person. The system worked and should be retained for the next Census.

Overtime was necessary to maintain a stockpile of maps for the printer and to reduce the backlog of checking. Overtime on two mights per week was used in two main periods: from October 1979 to February 1980 and from May 1980 to December 1980. Attendance at overtime was good; about 15 people worked each night. As the government printer worked Saturdays it was necessary to have an officer on standby to check the quality of the printing. The cost of overtime was -

	Financial Year	Cost
NATMAP	1978-79	$ 1 000
	1979-80	$ 11 586
	1980-81	$ 15 781
	Total	$ 28 367

Natmap supplied all overtime funds except for $3500 supplied by ABS in 1980-81. Meal allowances cost -

	Financial Year	Cost
NATMAP	1978-79	$ 135
	1979-80	$ 1 613
	1980-81	$ 2 647
	Total	$ 4 394

3.7 Production

The "service" and "production" team approach to production differed from the 1976 Census. In that Census a major difficulty was the high turnover of temporary staff, attributed to the fact that all the interesting work was done by Natmap staff. Only minimum training was given to temporary staff who were confined to repetitive tasks and basic drafting; the temporary staff were not involved in the project and many became bored and left.

For the 1981 Census, the philosophy was to place the responsibility for producing the maps to where it should be - with the draftsman. Small production teams and a service team were designed to achieve this objective.

3.7.1 The service team

The service team's task was coordination and support. It gathered all the source materials of each division into a package for the production teams and controlled the printing and distribution of the maps.

The specific tasks of the service team were to:

- Maintain an up-to-date filing system which showed all LGA changes since the 1976 Census.
- Plot boundary changes onto the master working copies and liaise with ABS to solve problems caused by CD splitting.
- Check the unchanged LGA boundaries on the master working copies against the 1976 aperture cards and the 1971 records to eliminate transposition errors of the previous censuses.
- Prepare standardised frames for all divisions and supply the production teams with ozafilm copies.
- Organise working copies of base mapping required by the production teams.
- Obtain computer plots which were used as compilations for the index maps.
- Process the CD splits and transfer them to the master working copies.
- Maintain work progress charts.
- Collect and store repromat for checking and printing.
- Check work as production teams completed assemblies and check repromat prior to printing.
- Carry out corrections after the ABS check was completed.
- Prepare printing instructions.
- Order and prepare film negatives for each index map.
- Check the quality of the printing.
- Maintain an up-to-date filing system, for -
  - the printing program;
  - reprints;
  - maps to be supplied to Natmap's computer and census mapping groups and for ABS's cut-and-stick program.

Time spent by the service team on the above functions amounted to 2981 man-days.

The service team was a success. Large amounts of reproduction and printing materials were monitored daily. For the 1986 Census the work of the service team will be further streamlined if the turnover of both contract and Natmap staff can be minimised and if a more senior staff structure is adopted (see below).

3.7.2 The production teams

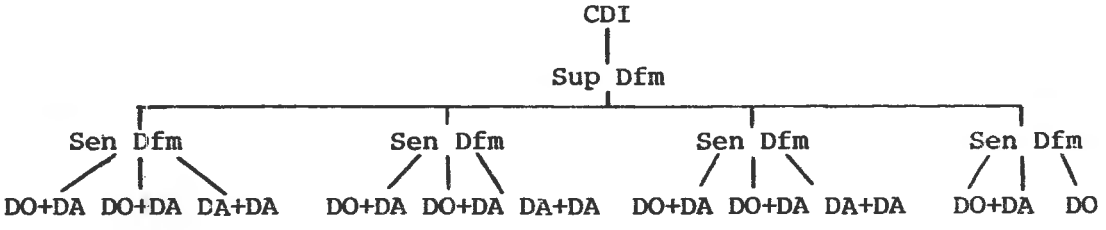
These were set up to assemble and draw the maps to the prescribed specifications. The size of the production teams was dependent upon the characteristic of the package received from the service team; generally it consisted of a team leader (an operative draftsman) and two assistants.

The specific tasks of the production teams were to:

- Determine mapping scales.
- Assemble base mapping into manageable units.
- Draft boundaries and affix type.
- Integrate locality and urban mapping with rural mapping.
- Prepare repromat for printing.
- Check and edit completed work.
- Compile, fairdraw, check and edit index maps.

Using small production teams was a success. Staff reacted well to the responsibility of working with other staff and organising their own workload. At the same time staff gained a comprehensive appreciation of field mapping as a whole.

However the staff structure used was not entirely satisfactory. The system was originally designed so that two supervising draftsmen would have equal responsibility; one in charge of the production teams and the other in charge of the service team. With three supervising draftsmen it was difficult to define each supervisor's area of responsibility. Even with two supervising draftsmen subjective approaches to a problem sometimes led to staff confusion. For the next census a more efficient structure should be -



requiring 27 staff in all.

3.7.3 Drafting methods

Ink was used to draw the statistical boundaries; no other medium could have been used to fairdraw big rural divisions.

The type used on the field maps was successful. The rub-on lettering was easy to apply and could be handled by all staff. A fixitive was applied after each type stick-up was completed as a protection against further handling by Natmap, ABS and printing staff.

The original typesetting was carried out by the Government Printer using a Photon typesetter. A total cost of about $13 000, paid by Natmap, included both typesetting and processing.

Hundreds of thousands of words were produced and the system proved to be very dynamic as additional type could be processed 'in-house' in emergency situations within minutes. (See Annex E for cost of processing materials and equipment supplied by ABS.)

Overall, the rub-on lettering used was considered to be superior to stripping film as considerable labour was saved and supply was fast. For the census it is recommended that a similar system is used to set and fix the type but a more robust quality should be sought.

The type face used for the six digit codings was the best available at the time, but it was found to be nearly illegible when used on metropolitan field maps. As a result the background was eliminated from behind the codings. For the next census it is recommended that a bolder type face be used on all maps at 1:15 000 and larger. The same type face but a larger type size should be used for all scales smaller than 1:15 000. If the base mapping background can be left intact, much labour will be saved.

3.8 Assembly

The division was chosen as the best unit to assemble the field maps. ABS agreed with this approach and organised their splitting program by divisions. The splitting for each division was completed before it was assembled thus avoiding wasteful repetition.

This differed from the 1976 Census where assembly often occurred before the splitting was complete which caused many areas to be dismantled and reassembled, some as many as six times, as late splits were received.

The first step for each production team, after receiving the prepackaged material for a division, was to assemble the base mapping so that complete cover of the division was obtained. In a metropolitan division this usually involved butt-joining the 1:10 000 bases to form an assembled area of about three metres square. In rural areas the system was different. As rural divisions cover huge areas, three scales of maps were often necessary. The scales used were dependent on the size of CDs. Rural CDs were not to be larger than A3 paper size and metropolitan CDs were not to be smaller than a ten cent piece.

With every scale used, the next step was to tape a cartographic drafting film overlay to the base map. The boundaries were drawn in ink on the overlay using the master working copies as a guide to position.

After all boundaries had been drawn and checked both base and overlay were cut into pieces slightly smaller than C3 in size. A guide was used before cutting, so as to determine the least possible number of pieces. These pieces were taped onto sepia ozafilm pre-registered, standardised frames which contained all the surrounding statistical and margin information.

The use of high density sepia ozafilm for the standardised frames caused problems in platemaking. The decision to use sepia film was based on tests carried out by the Government Printer without Natmap participation. Consequently large stocks of the standardised frames were obtained. With the blackline topo bases attached to the sepia frames it was impossible for the platemaker to adopt the correct exposure for both. The compromise resulted in a poorer quality but still acceptable finished product. If the system is retained for the next census both the frame and the topo base should be of double clear blackline.

3.8.1 Equipment

One Admel ammonia printer
One large contact frame
One pulsed zenon lamp

3.8.2 Staff

One full time operator supplied by the Government Printer, the operator's labour paid for by ABS. All staff and equipment were housed in the Government Printer's sub-printery at the Cameron Offices.

3.8.3 Material

0.05 mm ozafilm high density sepia double matte film (a polyester base material matted on both sides and sensitised on one).

0.08 mm ozafilm blackline double clear film (a polyester based film).

0.05 mm GAF double clear blackline film (an acetone based film).

Ozafilm blackline paper.

3.8.4 Expenditure (all borne by ABS)

(a) Lease, labour and depreciation

Jan 77 to June 78	$ 6 967.32
1978-79	$ 17 033.00
1979-80	$ 21 759.70
1980-81	$ 10 651.03
	$56 411.05

(b) Materials

1978-79	$ 6 925.56	
1979-80	$ 24 006.63	
1980-81	$ 9 168.12	$40 100.31
Total		$96 511.36

3.8.5 Performance and Problems

The quality of the copies produced was good but the image state was sometimes reversed. This caused problems in drawing and printing. Overall the service was good. Problems experienced were:

- The printer twice ran out of material and was unable to obtain supplies for up to six weeks. This created programming problems which were largely overcome by borrowing material from other agencies.

- The Admel printer broke down about a dozen times, and was not really in top condition until August 1980. Previously the quality of the duplicating was not first class, but satisfactory. It was important to minimise the drop-off in quality from original repromat to working copy as there was a substantial drop-off from working copy to plate and to print.

If the same procedure is used for the 1986 Census it is recommended that the Government Printer be requested to replace the Admel with a more modern printer. The Admel was originally purchased after the 1971 Census.

3.9 Platemaking and Printing

Printing started in February 1980 at the sub-printery at Cameron and finished, except for minor reprinting, at the end of February 1981. Printing was continuous except for a one-month stoppage so Natmap could build up a fresh stockpile, and a six-week shut-down over Christmas 1980.

3.9.1 Equipment

- One Addressograph multilith electrostatic master imager 805 paper platemaker;
- Two Hamada Star one colour offset printing presses;
- One Mandelli model 9657 guillotine.

3.9.2 Staff

The Government Printer rotated staff through the sub-printery so that there were always two full-time operators available for printing the field maps. Metal plates were made by the Government Printer at Kingston from negatives supplied by Natmap. Paper plates were made in the Cameron sub-printery.

3.9.3 Materials

- 85 gsm white offset paper;
- Black printing ink - Truscotts Timson Wunup Offset Black J18/O
- Grey printing ink - Collies Uniglo National Mapping LF 423 Grey Offset 221834
- Red printing ink - Collies Uniglo Pantone Warm Red Offset 062553
- Paper plates - Multigraphics Multilith Masters Electrostatic Series 8-2007

3.9.4 Expenditure

$ 94 017	-	this includes bulk payment of $55 293 for paper
$ 48 436	-	this is until the end of December 1980. About $20 000 will be required before printing is completed.
$142 453		

The actual number of maps per division was not known until after the division was cut into its C3 size pieces. Thus the total number of maps was not known until the last division had been assembled.

Front of Sheet Maps

Divisions printed	-	139
Impressions per sheet	-	2
Copies of each map	-	150
Maps to cover 139 divisions	-	5 678
Front of sheet maps printed	-	851 700

Index Maps

Division printed (excluding maritime divisions)	-	132
Impressions per sheet	-	2
Copies of each map	-	150
Maps for 132 divisions	-	5 597
Index maps printed	-	839 550

Blank Sheets for Cut and Stick

Using this system of standard size rectangular sheets, two or more maps are needed to cover many of the CDs. A composite for each of these CDs was made by cutting up the relevant maps and sticking the pieces together on sheets with the standard legend on the bottom and the index map for the division on the back. To provide the blanks for this cut and stick program, an additional quantity of sheets was printed for each division with no map on the front, a total of 41 977 sheets printed both sides.

3.9.5 Reprints

At the end of February 1981, 567 CDs had been reprinted for various reasons, a total of 85 050 maps printed both sides.

3.9.6 Summary

Front of sheets printed	=	851 700 + 41 977 + 85 050	=	978 727
Index maps printed	=	839 550 + 41 977 + 85 050	=	966 577
Total maps printed	=			1 945 304
Total impressions	= 3 890 608			

Some variation in quality of printing did occur and could possibly have been caused by the rotation of printing staff. If the variation causes ambiguity to the collectors it may mean two operators working full time on the project for the next census.

Reprints were caused by Natmap rejecting the printing quality or by errors and late statistical boundary changes. A reprint rate of about 10% seems to be inevitable.

Problems were encountered in the platemaking of two sorts:

- The quality of the repromat given to the platemaker was variable. One piece of repromat could contain pieces of base mapping which varied in quality. Use of double-clear black ozafilm copies in the assembly stage helped to make the repromat more uniform.

- Positioning the image on the plate. When the first paper plates were made it was found that although successive pieces of repromat were positioned accurately on the copy board, the position of the image varied on the plates. This made make-ready time excessive. By modifying the feed of the plates through the machine and more precise positioning of the repromat on the copy board, images on later plates were more accurately positioned and make-ready time was minimised.

Two problems were encountered in printing the maps and both were caused by the fragility of the paper plates. The paper plates often cracked and successive plates stretched unevenly when first wetted. Ensuring that plates were put on the press as soon as possible after drying largely overcame the cracking problem. The stretch problem was minimised by the printer meaning the registration east and west of the centre of the maps. The registration of the resultant maps was acceptable.

The main problem with the current system is that an index map is printed on the back of every field map. The index maps are not needed by the collectors. They were primarily designed for office use and the supervisors of the collection, and should be printed separately from the field maps. As it is, if a late LGA change occurs after a

division has been printed, all the maps have to be discarded, the repromat changed, new plates made and the whole division printed again.

If the index maps were separate, late LGA changes would require only the index maps and the affected field maps to be reprinted.

If the index maps were printed separately, considerable printing effort would be saved. With the current system of having the index map on the back of every field map, blank and reprint, about 1.9 million impressions are necessary. With the index map printed separately and some of them in three colours about 60 000 impressions would be required. Considerable savings in costs and labour would also be made by eliminating metal plates and negatives.

It is recommended that the index maps be printed as separate entities for the next census.

Another problem was the inflexibility of using only two colours on the index maps. With up to five different scales of field maps to portray on the index it was difficult to show the difference in scale by lineweight only. If the index maps are printed separately it is also recommended that those with more than two scales be printed in three colours or that screens be introduced.

3.10 Dissemination of the 1981 field maps

The ABS needed complete sets of the field maps for internal use, external distribution, and for archival purposes. Problems of transporting and storing complete sets of field maps made the possibility of microfiching attractive.

Initial research indicated that while coloured microfiche originals were satisfactory, copies from the originals were not. They were also expensive, and the idea was dropped.

Black and white microfiche was economical but it was not obvious that a two-colour map could be portrayed in black and white.

An attempt was made to microfiche the two-colour map but it was unsuccessful: the red statistical information appeared black on the microfiche and obliterated the topographic information beneath it.

Later testing using plain paper copies was successful (the method of obtaining the paper copy of each map is illustrated in figure 1). It was possible to diffuse the boundary lines so that names could be read through them.

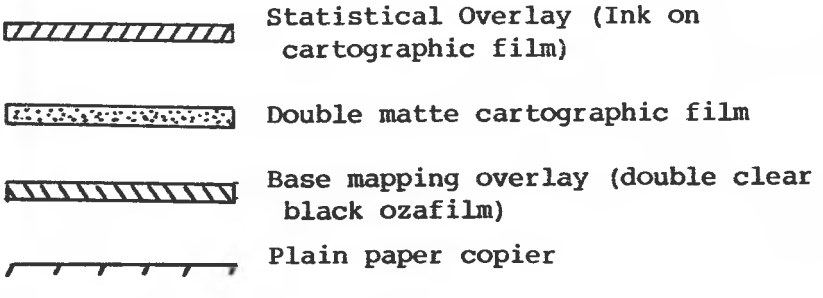


Figure 1 Obtaining paper copies

However, both Natmap and ABS finally decided that the extra cost and labour involved in producing the paper copies was not warranted. Microfiching straight from the printed two-colour map was decided upon.

The Government Printer used Kodak AHU silver bromide film for the original microfiche. Fifty diazo copies, complete with colour titling, were made from each original. All the maps got in 243 fiche.

The format for the microfiche is nine columns by seven rows with the index map for the division in the bottom right hand corner of the fiche. All the maps in a census division are shown in their relative geographical position.

4. FUTURE TRENDS

4.1 Mailing the Census

In recent years there has been some pressure in Australia to collect the census by mail and thus supersede the current collection areas. ABS investigated mail-back systems in use in Canada and the United States and found that the quality of data received by both systems was unsatisfactory. It is probable that the existing system of collection and field mapping in Australia will be used for the 1986 Census.

4.2 Current Use of Automated Methods

Over the past five years Natmap's main aim in digitising boundaries has been the production of post-census publications, notably the Atlas of Population and Housing. To achieve this, the 1976 census sub-division boundaries were digitised in metropolitan areas.

The only use of 1976 digitised data for the 1981 field maps was for the index maps. Computer plots were obtained for every new census division, broken into sub-divisions, and these served as compilations for the index maps. Although this was only a minor task, about 300 man-days were saved.

4.3 The Future Use of Automated Methods

If the same mapping system is used for the 1986 census, digitised boundaries could save much work. When all CDs are digitised, it will be possible to eliminate some of the tasks that have been done by hand, both in pre-census field mapping and in post-census publication mapping.

With pre-census mapping, the statistical conversion (see para 3.4.1), the index maps and other planning aids may be produced in their final form by computer: about 1500 man-days might be saved.

5. THE 1986 CENSUS

5.1 The Ideal Program

With a continuation of the current economic climate, resources for the 1986 Census will be at a premium. However, Natmap now has a system which does work and which can be further refined before 1986. Less staff will be necessary and a large amount of base mapping material produced for the 1981 Census can be re-used.

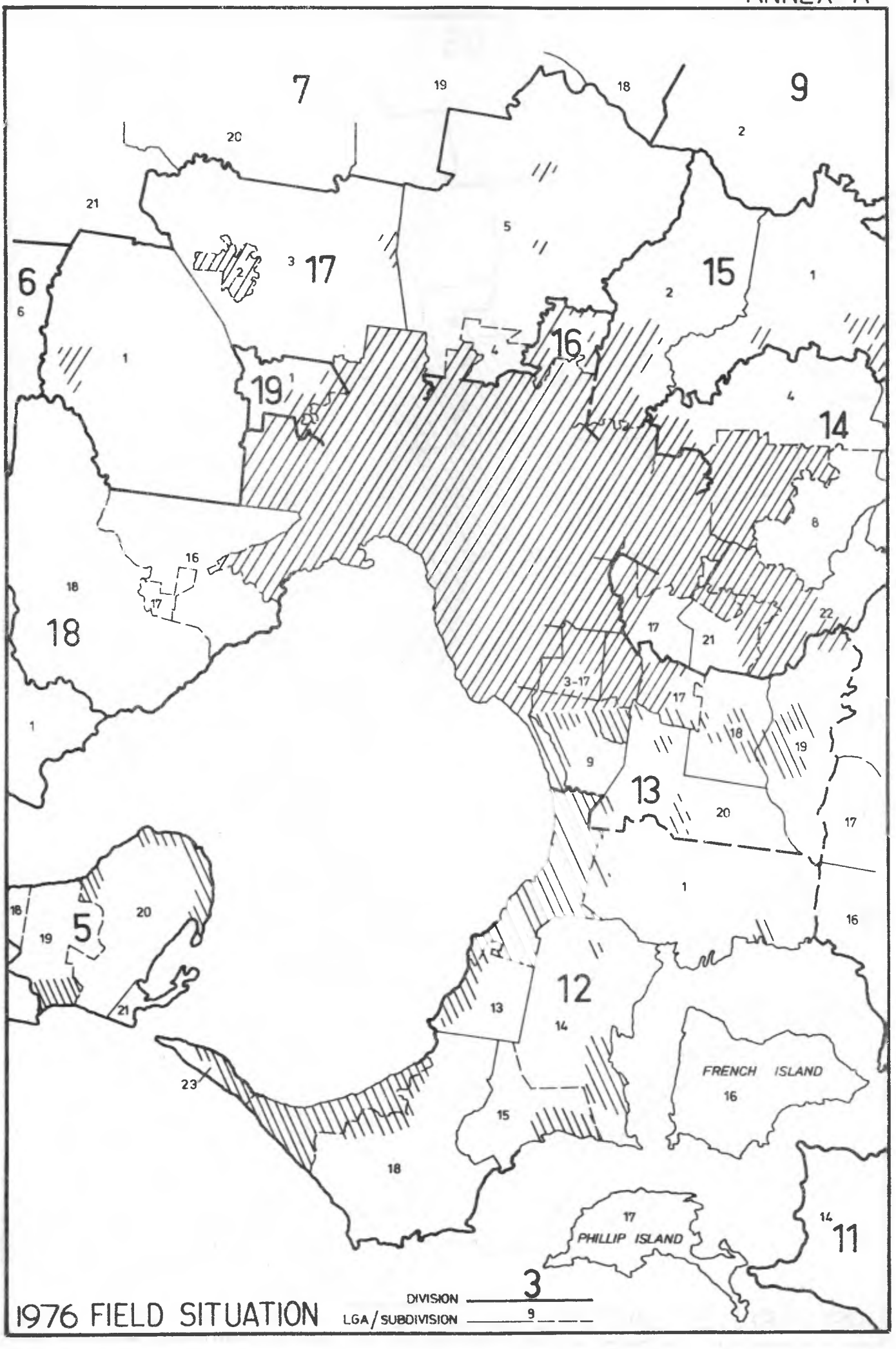
The planning objectives will not substantially change with Natmap's main objectives being to minimise the large input of labour needed in the twelve to eighteen months prior to the date when all mapping has to be completed and to produce the best possible product for ABS.

As previously mentioned the key to success in achieving the first objective will depend on ABS defining and adhering to it's splitting program. All Natmap tasks before, and as a consequence of, this program can then be timetabled (see Annex G). Detailed programs of each task eg the assembly program, can then be determined and organised separately (see Annex H).

The Commonwealth and State mapping authorities' normal production of updated topographic maps before 1986 will mean better rural field mapping will be available. Urban and locality mapping will also be of a comparable, if not better, standard than the 1981 field maps if the current system is used and if recommendations outlined in this paper are followed.

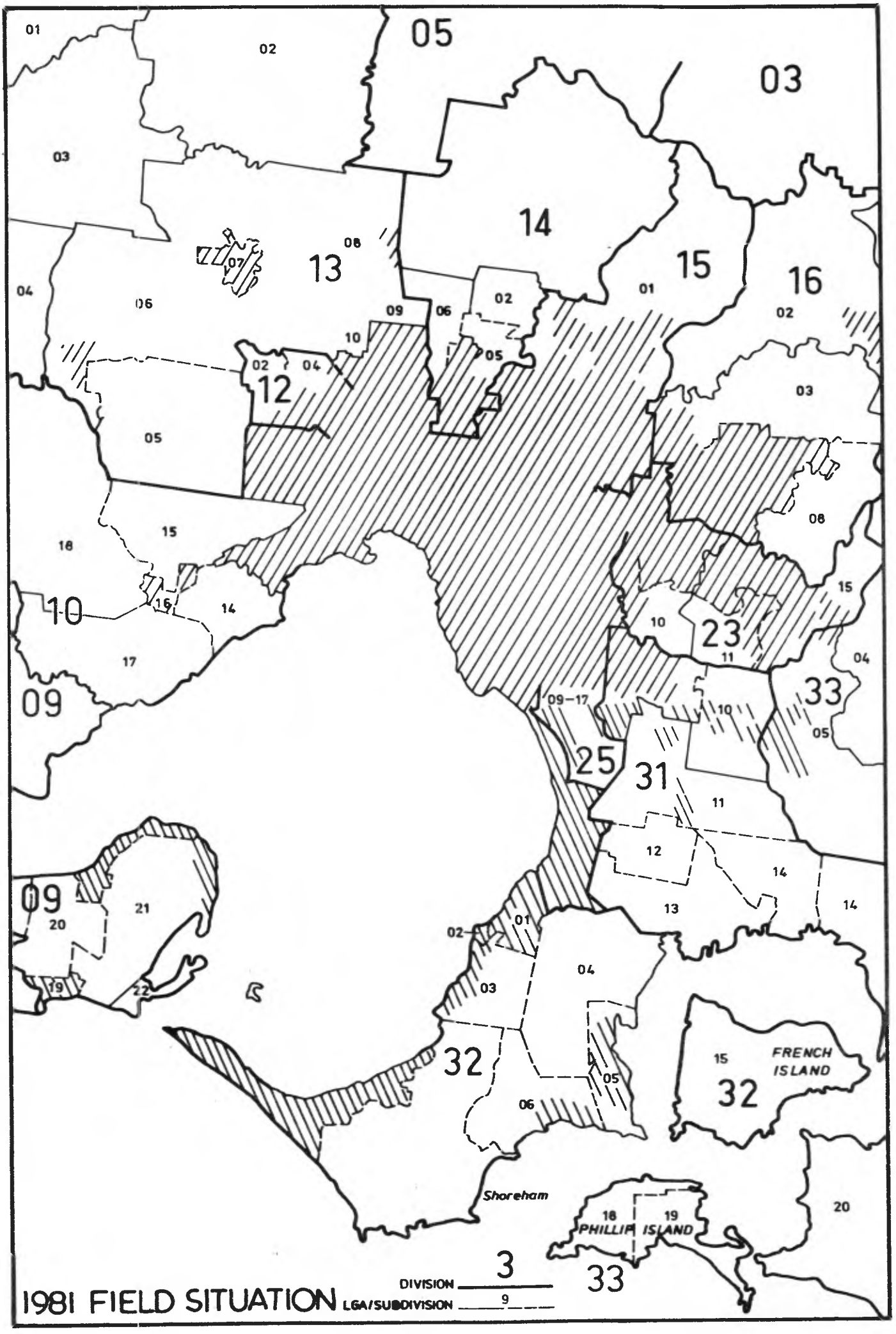
With effective use of available resources, realistic programming and constant monitoring of the project there is no reason why both objectives cannot be achieved to the satisfaction of both Natmap and ABS.

ANNEX A

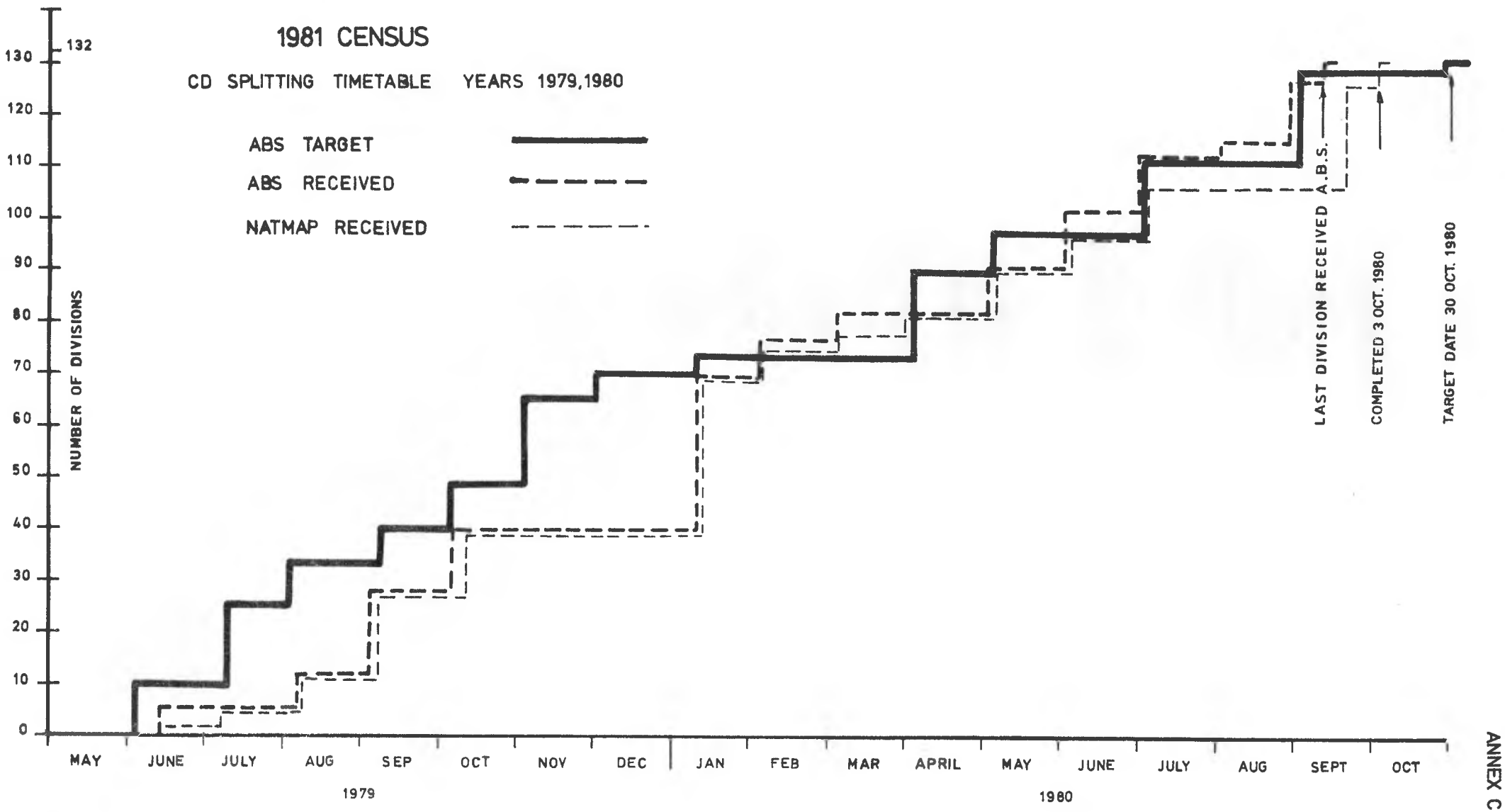


1976 FIELD SITUATION

ANNEX B



1981 FIELD SITUATION DIVISION 3 LGA/SUBDIVISION 9


1981 CENSUS
CD SPLITTING TIMETABLE YEARS 1979,1980
ABS TARGET
ABS RECEIVED
NATMAP RECEIVED
NUMBER OF DIVISIONS
0
10
20
30
40
50
60
70
80
90
100
110
120
130
132
MAY
JUNE
JULY
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APRIL
MAY
JUNE
JULY
AUG
SEPT
OCT
1979
1980
LAST DIVISION RECEIVED A.B.S.
COMPLETED 3 OCT. 1980
TARGET DATE 30 OCT. 1980

ANNEX C

Annex D

AIR PHOTOGRAPHY PROGRAM - 1981 CENSUS

As with previous censuses, Natmap arranged procurement of air photography for ABS. All State mapping authorities were approached to incorporate the census air photography program within their own programs. Where an authority could not provide service Natmap flew the photography with its own aircraft. Normally Natmap's aircraft would have been fully occupied on topographic work and ABS would have had to let private contracts.

Because of population growth, air photography of all the main metropolitan areas was necessary. The decision on what urban centre and locality photography was required depended on the -

- population growth;
- date of the latest available photography;
- cost of flying new photography

Thus, if in 1980 the photographs of a locality were four years old and its growth rate was only 3%, then it was most probable the workload of the CDs in the locality would not have altered very much since the time the area was last flown. ABS would decide not to photograph the locality for the 1981 census but have it flown for the 1986 census.

The main purpose in obtaining air photography has been to enable ABS to carry out their CD splitting program. In past censuses ABS State Offices split CDs after field inspection with photographs mainly being used to verify the field inspection and to delineate locality boundaries. For the 1981 Census the system was reversed; the air photographs were used for splitting with a little field inspection for verification. As a result ABS saved both time and money and ABS State Offices were able to stick to the splitting timetable. Using air photographs has been successful for ABS and it is likely to use a similar system for the 1986 Census.

COST OF AIR PHOTOGRAPHY

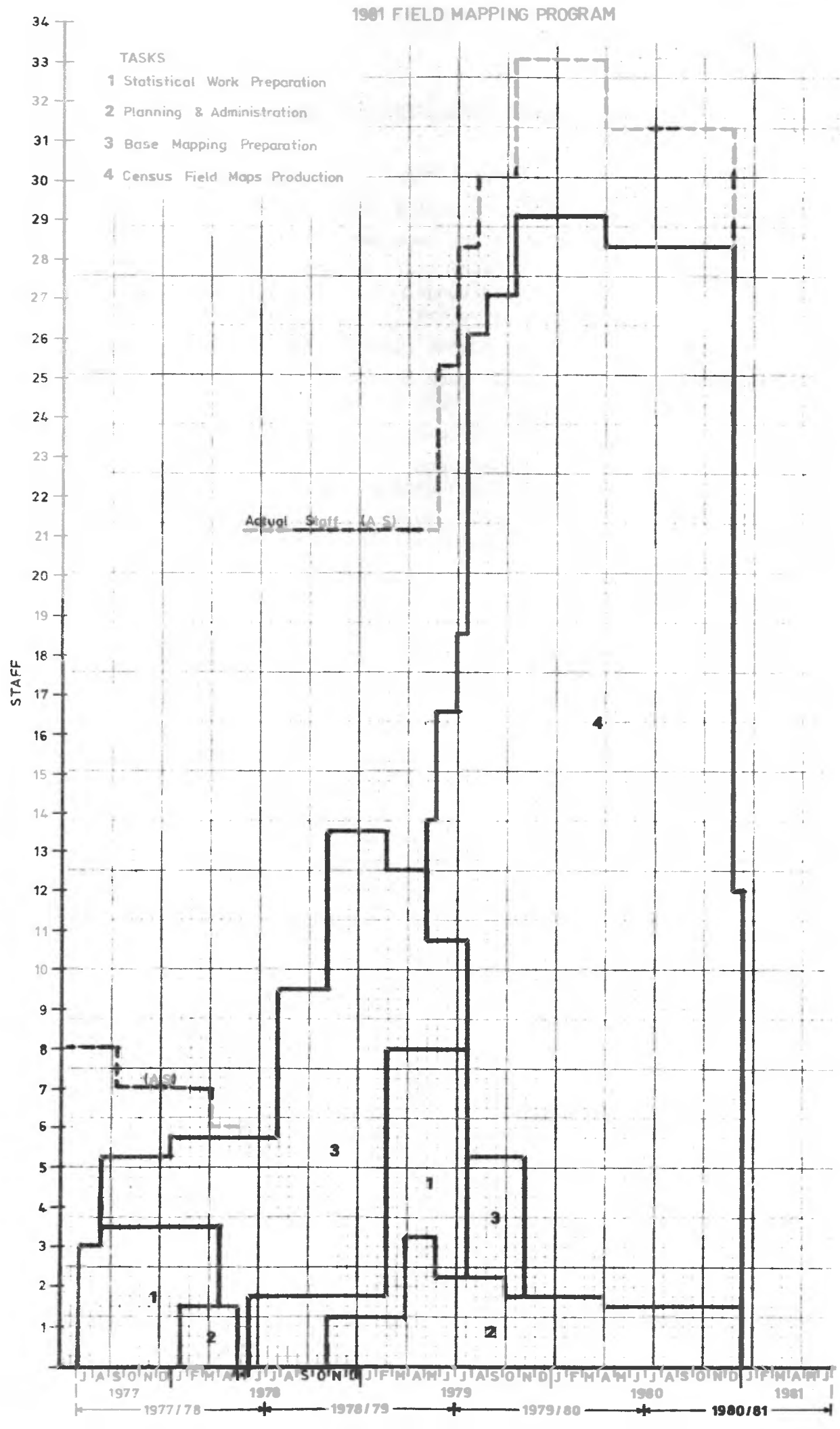
State	Type of Arrangement	Financial Year	Cost
Queensland	Prints purchased from Department of Mapping and Surveying	1978-79	$ 200
	Cost of Natmap flying urban centres and localities	1979-80	$ 6 300
	Developing and printing by Air Photographs Pty Ltd	1979-80	$ 2 000
New South Wales	Flying by CMA) Prints purchased from CMA)	1979-80	$23 300

State	Type of Arrangement	Financial Year	Cost
Tasmania	Flying by Taslands) Prints purchased from Taslands)	1979-80	$11 800
Northern Territory	Flying by NT Lands) Prints purchased from NT Lands)	1979-80	$ 500
South Australia	Flying by SA Lands) Prints purchased from SA Lands)	1979-80	$ 7 500
Western Australia	Flying by WA Lands) Prints purchased from WA Lands)	1979-80	$ 600
Victoria	Flying by Natmap	1979-80	$ 2 000
	Developing and printing by Air Photographs Pty Ltd	1979-80	$10 200
	Additional prints purchased from Vic Lands	1978-79	$ 2 700
	Total Cost		$67 100

Annex E

EQUIPMENT SUPPLIED BY ABS

1.	50 Rotring Isograph 1 mm and 2 mm reservoir pens @ $6.16 each	= $308
2.	12 Uchida 90 x 40 cm translucent cutting mats @ $50.40 each	= $605
3.	Developer for 3M Image "On" transfer material - 9 US quarts @ $3.96 per quart	= $ 36
4.	Lambswool pad	= $ 5
5.	3M Brand Image "On" transfer material - 5 boxes @ $89.20 per box	= $446
6.	2 RI8B Filex cabinets @ $216 each	= $432
7.	6 rail assemblies @ $11 each	= $ 66
8.	260 triple Filex folders @ $220 per 100	= $572
	Total cost	$2 470


1981 FIELD MAPPING PROGRAM
TASKS
1 Statistical Work Preparation
2 Planning & Administration
3 Base Mapping Preparation
4 Census Field Maps Production
Actual Staff (A S)
(AS)
STAFF
1977
1978
1979
1980
1981
1977/78
1978/79
1979/80
1980/81

Annex G

PROPOSED 1986 CENSUS PROGRAM

July 1981	Rural mapping base preparation.
February 1982	Processing collectors comments.
April 1982	Urban base mapping preparation.
April 1982	Visit State mapping authorities (arrange 1:10 000 and air photography programs).
January 1983	Request LGAs for updated base information.
January 1983	Prepare contracts for updating 1:10 000 metropolitan base mapping.
February 1983	1986 Census conversion.
April 1983	Delivery of 1:10 000 material from State authorities.
May 1983	Let 1:10 000 metropolitan base mapping contracts.
March 1984	Plan printing facilities required.
April 1984	Splitting required from ABS.
May 1984	Delivery 1:10 000 metropolitan base mapping.
June 1984	Census division assemblies.
July 1984	Delivery air photography.
August 1985	Printing field maps.
October 1985	Plan printing requirement cease.
December 1985	Assemblies completed.
February 1986	Printing completed.

ANNEX H

1986 FIELD MAPPING PROGRAM