

MAINTENANCE OF THE AUSTRALIAN 1:100 000 NATIONAL TOPOGRAPH MAP SERIES

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ABSTRACT

The production of first editions of the 1:100 000 scale topographical mapping series of Australia have been under way for over ten years and the need for systematic maintenance of this national asset has become important. The techniques used to do this are explained and include a description of a revision cycle model and the possible use of systematic high level aerial photography.

THE BASIC NEED

The rates at which maps go out of date, and are no longer adequate for their intended use, vary and are related to:

- (1) The rate of development of an area.
- (2) The scale of the map. Minor cultural detail is likely to change at a greater rate than major cultural features and hence maps at larger scales which show this minor detail are more likely to go out of date quicker than small scale maps with major cultural features.

But regardless of the varying rates at which maps go out of date it is true that all maps eventually will be incorrect to varying degrees and thus will not portray ground truth.

The effect of having an out of date series of maps can vary from minor inconvenience to being dangerous for the users where considerations of defence, aircraft operations, fire fighting services, search and rescue operations, etc., are concerned.

Apart from these matters the Commonwealth Government's investment in topographic mapping in Australia by the Division of National Mapping alone is in excess of 150 million dollars and as with any similar investment it would be irresponsible not to maintain it to an adequate standard. Ancient and out-of-date maps may be interesting from an historical point of view, but, of course are of no use for the current intended purpose.

In times of financial restraints, there may not be sufficient funds available to make new maps and at the same time to revise existing maps. Hard decisions have to be taken as to the right balance between these two tasks.

The mapping program for Australia is controlled by the National Mapping Council which comprises representatives from the State mapping organisations and from the Commonwealth, the Division of National Mapping,

the Royal Australian Survey Corps, the R.A.N., and the Australian Survey Office. This Council recognised this problem and the importance of map revision in general and in August 1977 passed a resolution which stated:

"The Council resolves that in the National Topographic Map Series at 1:100 000 scale the revision of existing maps at intervals of not more than ten years should, as a principle, take precedence over the production of new maps".

The thinking behind this resolution was that while Australia may not be covered with 1:100 000 maps for many years, at least what exist would be maintained in a useable condition.

Map revision is a cumulative task and work not done in one year remains to be done in another.

The task, itself, in Australia, in relation to the 1:100 000 scale map series, is formidable, particularly when it is realised that the area of the mainland is about 7.6 million square kilometres and requiring 3065 maps to cover it.

Whilst the eastern seaboard and isolated pockets in the west and north are reasonably well developed much of the remainder is isolated and inaccessible country and so the basic mapping and the maintenance of this mapping presents, in all, a major task.

THE TASK ITSELF

The basic question to be answered in relation to any particular map when it is being considered for revision is whether there is any change in the detail shown on the original map. Some of the detail shown on the map may no longer exist on the ground or there may be new detail on the ground which is not shown on the map.

The second question is, "Does the extent of the change warrant the production of a new edition?" This is probably more an economic consideration than anything else but if the only changes are minor, then the cost of producing a new edition may clearly be not warranted.

The answer to the last question of course can scarcely be properly made until a thorough investigation of the area has been undertaken; and we have a paradox.

It is therefore necessary to be able to assess whether a particular map warrants revision before it is placed on any program and before any real work is undertaken. Also in a country like Australia it is clearly not economic to undertake the revision of single maps. The logistic costs are just too great to set up an operational program consisting of many widely spaced maps.

For this reason the Division of National Mapping has set up a mathematical model which determines a priority order for the revision of 1:100 000 map sheets.

The original National Mapping Council resolution referred to a

revision cycle of not more than ten years but clearly there are many maps which will require revision sooner and there may be some which will not require revision for perhaps double that period and this model indicates a relative priority for each individual map sheet.

The factors that are considered in the map revision model are:

- (a) Reliability date. (expressed as years since publication)
- (b) Rate of cultural development. (assessed within the range 0-100 by reference to local knowledge, census data etc.).
- (c) Client request factor. (either 1, 1.5, or 2 depending on the urgency of the request).
- (d) Annual usage rate. (expressed as 5% of annual sales).

The formula used is -

$$\text{Priority rating} = (a.b.c. + d)$$

The above data for all map sheets is collected and entered into a computer from which a priority list is produced.

In any one operational or financial year, this list is consulted and from it the best program is selected.

This will normally include the sheets at the top of the priority but because of the operational and logistic constraints other sheets may be included. When this program has been finalised then these sheets will, of course, have new model factors and when the model is re-run through a computer a new priority list will appear which forms the basis for the next year's program and so on for subsequent years.

This formula has not been tried yet over a sufficient time period for it to be thoroughly proved but indications are that it will form a good basis from which management can draw up a reasonable revision program within the financial and operational constraints that exist.

MAP REVISION TECHNIQUES

The basic questions to be considered in revising a map are:

- . Is all the information shown still there?
- . If not, what is missing?
- . Is there new information?
- . If so, what is it, and where is it?

Taking into account the scale of the maps and the general nature of the Australian terrain, the efficient way to answer these questions is by obtaining, examining and plotting up-to-date air photography.

The initial photography of Australia from which the 1st edition 1:100 000 map series was produced, is at a nominal scale of 1:80 000 and model control used for photogrammetric plotting is related to that photography. This old photography is flown at a height of 25,000 feet with a super-wide-angle lens to give this nominal 1:80 000 scale.

In recent years, the availability of small jet aircraft has enabled wide-angle lenses to be used to obtain the same scale by flying at an appropriate higher altitude. The greater speed of these aircraft has enabled rapid deployment to cloud free areas.

For total systematic photographic coverage of large areas it seems likely that this type of aircraft would prove relatively economical and enable the job to be done quickly.

However map revision photography requires limited and specific coverage related to a pre-determined annual program, and the lower altitude, super-wide-angle photography using turbine or piston engined aircraft may prove to be the most cost effective for this purpose.

The resolution of the wide angle photography, specifically in the corners, is better than that of the super-wide-angle, but the latter is adequate for revision purposes.

The Division of National Mapping is now engaged in comparative tests to resolve these matters.

In order that the same model control could be used, if necessary, for revision plotting, the new photography is flown at the same scale and along the same flight lines.

Using this new photography, the original base compilation is amended by deletion or addition of information.

This has proved a difficult task, as decisions constantly have to be made as to whether the map detail has changed or not.

Various techniques have been tried to simplify this task, including superimposition of the compilation image onto the stereo model. In flat country the Bausch and Lombe "Stereo Zoom Transferscope" has proved useful but the problem has yet to be solved where the normal stereo plotter equipment must be used.

When plotting new map detail, care must be taken that the accuracy of the original basic compilation is not degraded. Whilst in limited cases it may be sufficient to scale new detail in relation to existing map detail where there are well defined points, care must be taken that small plotting errors are not allowed to accumulate to the stage where they become significant. If a major replotting is required, then it is necessary to position the new detail in relation to the original model control so that the original standard of accuracy is maintained.

Map accuracy specification for the 1:100 000 series require that well defined points of map detail are within 0.5 mm of their true

position. If plotting errors are normally within 0.15 mm., then three successive revisions, where scaling is based on existing map detail, could, in the worst case, bring the errors close to the acceptable limit. Any further revision would involve re-plotting.

To assist in the interpretation aspects of this plotting, reference to maps and plans and other documents produced by local authorities is made.

In most cases, these are not accurate enough to be added directly to the compilation but nevertheless give valuable information about many of the newer developments in the area such as new roads, road surface data, water storage and reticulation facilities, housing developments etc.

An officer of the Division usually visits the project area and by personal contact and investigation collect this information prior to the plotting commencing.

With this reference material available to assist in the plotting and interpretation of the new photography, the new compilation will reflect the ground situation almost completely.

However, in the course of the plotting there will inevitably be a few instances where the interpretation is doubtful or difficult and these matters must still be resolved in the field.

This inspection is undertaken on the ground or from a light aircraft or both, the problems resolved, and the whole compilation verified.

If features are discovered during these inspections that were not discernable on the 1:80 000 photography, they are photographed with a small-format camera to obtain positive identification. Their position is identified on the 1:80 000 photography by comparison of surrounding detail and they are added to the compilations.

A valuable source of information for map revision are the map correction reports prepared by map users. These indicate, in sketch form, errors or omissions that they have detected.

Their use is greatly encouraged and value readily acknowledged by the Division but the information is verified by Division Officers in the field in the same way as other reference material.

NOMENCLATURE

This is an important aspect of the revision process and during the ground inspection phases, all new or changed feature names are obtained.

These may be obtained from road signposts, land owners, local authority records, etc., and are added to the compilation but the names of significant topographic features must first be submitted to the appropriate Place Names Boards for ratification.

DRAWING AND PUBLICATION

The compilation amendments are prepared in the form of overlays to the original compilation.

If the changes are small and there is an urgent requirement for the map, an overprint edition, with the amendments in purple, is produced.

Normally, the revision overlays are used to amend the scribed sheets and the masks used for Edition 1. These are combined with the unchanged relief and hydrographic drawings for printing in the normal way for the new edition.

SUMMARY

In undertaking the task of map revision in the Division of National Mapping, the following factors have been seen to be important -

- Revision should take priority over new mapping when resources do not allow both.
- It is necessary to have a revision program based on logically determined priorities.
- The procedure of systematic re-photography at the same scale and on the same flight lines ensures that the standard air photograph coverage of Australia is kept up to date in step with the mapping.
- Visual inspection of the map area either from the ground, the air, or both is essential for verification of detail.
- The extensive use of data from local authorities and map user reports, is an essential element in the revision process.
- The checking and collection of feature names is essential as the average map user will often locate his position on the map in relation to named ground features.
- Care must be taken that the revision plotting processes do not degrade the map accuracy.

Better procedures will doubtless develop with further experience but the methods outlined in this paper have already proved that, in practice, they give value for money to the taxpayer and satisfy the requirements of the map user.

GENERAL REFERENCES

- Division of National Mapping, "Statement of Activities" 1978-79
- W.A. Thomson and J.D. Madden, "The 1:100 000 Mapping Program And Ground Truth", presented at the 21st Australian Survey Congress, Adelaide, April 1978.

- A.G. Bomford and W.A. Thomson, "Revision of Topographic Maps", presented at the 3rd Australian Cartographic Conference, Brisbane, October 1978.