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Computer mapping and the scheduled ancient monument record

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27.1 Summary

English Heritage, (Historic Buildings and Monuments Commission for England), has statutory duties and advisory functions which require the curation and use of maps showing the locations of items of constraint, including Scheduled Ancient Monuments, (SAMs). This paper is concerned with the factors which lead to the adoption of a computer-based system to replace existing manual systems. A subsequent paper will deal with the technical aspects of the system as implemented.

27.2 Background

Maps are used by English Heritage in association with the scheduling and listing procedures, in the course of case-work by the Inspectorate and in order to respond to consultations on development proposals. An internal report of 1985 identified a need to re-organise existing systems as part of the preparation for the anticipated increase in the number of SAMs arising from the Monuments Protection Programme (MPP). This need included the professional curation of the record, comprehensive national map-cover, and consistent procedures for the annotation and updating of the map-based record. The report recommended that existing SAMs should be re-plotted on a new OS base at 1:10000 scale, this being the largest scale at which the acquisition of total national cover could be justified, a total of about 6,000 OS maps. The need for larger scale maps (1:2500 or 1250) for specific monuments and areas of archaeological intensity was also identified, although total national cover at these scales could not be justified in view of the number of maps involved (over 90,000) and the associated costs including storage and staffing.

The report considered three main options for the establishment of a new map-based record, *i.e.* digitised graphic data stored on computer, map data stored on microfilm and a new manual system based on transparent film with overlays. The report ruled out the use of a computer system at that time in view of the limited cover of digitised map

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data available from the OS and the costs of hardware and software and recommended that a new manual map record should be established.

27.3 Assessment of the options

From 1 April 1986, a records office was established within the Chief Inspector's Division of English Heritage in order to curate the records of SAMs and listed buildings, including the computerised SAM record, documentation arising from the accelerated resurvey of listed buildings and the existing map-record of SAMs and listed buildings. In view of the impending MPP, urgent consideration was given to how the new 1:10000 map record should be implemented and, during the summer of 1986, a joint feasibility study was carried out with the Cartographic Services Division of the Department of the Environment on whether a computer-based option was possible and, if so, how the costs would compare with a new manual system.

The study confirmed that OS Digital Map Data was only available for a small proportion of the area of England (about 10%) and that contemporary OS programmes for completing the digitisation (*i.e.*2015) were too long-term to be of use to English Heritage in preparation for MPP or, indeed, in the course of MPP itself.

Serious consideration was given to whether English Heritage could sponsor a more speedy digitisation programme, perhaps at a lower specification of feature coding than the OS. However, the lowest estimates which could be obtained at that time for the digitisation of 6,000 maps was £1.2m, bringing the cost of a total system to £1.5m (including hardware and software). Such a project was expected to take three years to complete, depending on whether resources were available for digitising on that scale within the UK. These figures encouraged consideration of cheaper and quicker methods of capturing the map-base.

27.4 'Raster' versus 'vector' for the map-base

The cost of digitising an OS map varies from £800 per sheet for the 160 feature codes to meet the OS specification to about £15 for a wholly automatic scanning process. The OS data is in 'vector' form, ie it is positional data in the form of co-ordinates of the ends of line segments, points and text positions while 'raster' data is expressed as a linear array of pixels, with spatial position implicit in the ordering of the pixels, (Chorley 1987, p. 133-4).

The obvious advantage of vectorised data is that different features can be allocated to different levels, providing the potential to display or output features in different combinations, eg maps can be produced with or without footpaths, or with contours or watercourses only or with place-names suppressed. 'Raster' scanning methods do not recognise these different features, although conversion software can make some limited distinctions, eg between solid lines, pecked lines and text, and can transfer these to different levels. On the other hand, data capture by scanning is cheap and rapid (a few minutes per map-image) and the resources for scanning 6,000 maps are easily available within the UK.

Given the lack of progress on the provision of a national vectorised map-base and the costs and time-scale of developing one, the choices for English Heritage seemed to be either a new manual system or a computer system based on 'raster' map data. The

question to be answered was whether a 'raster' system was feasible and would meet the requirement.

Computerised mapping systems normally have two distinct components (excluding textual data-bases), *i.e.* the standard, background information (OS base) and overlay information added by the user and which is normally created and stored in 'vector' form. The English Heritage requirement was the ability to overlay items such as SAMs and listed buildings on a standard OS base, without manipulating the background. Indeed, it was important that map-related data on monuments and buildings held and distributed by English Heritage should be verified against published OS material. The use of vectorised overlays would provide the ability to distinguish between different types of constraint such as SAMs, listed buildings or conservation areas. Consequently, the concept of holding map 'backcloths' in 'raster' form and displaying and plotting them concurrently with vectorised overlay data appeared to meet the requirement.

At this point, English Heritage engaged a consultant, DWH Associates Ltd, to investigate the state of the market. Their first report concluded that a joint raster/vector approach was a feasible option and identified four suppliers in the UK who had addressed the requirement for the use of OS maps in 'raster' form, combined with a vectorised foreground created through Computer Aided Design and three of these were shortlisted for the submission of proposals.

27.5 Specification for the submission of proposals

Proposals were invited on the basis of the supply of hardware and software for the electronic storage of 6,000 OS maps at 1:10,000 scale together with the ability to overlay a number of layers of graphical information. Other requirements included;

- The ability to display and plot copies of maps including any combination of overlay data.
- The storage of summary textual information associated with monuments and buildings and the rapid generation of hard-copy map-extracts showing individual monuments/buildings together with textual information.
- The ability to join maps, thus overcoming the problems of map boundaries.
- Software for image scanning and rectification, Computer Aided Design, including a wide range of draughting facilities, and document preparation.
- Access to the data-base by National Grid Reference, OS sheet number or monument/building reference.

Two suppliers submitted proposals and in due course the successful company was Advent System Ltd of Wokingham. The total cost of the project was estimated at £525,000, including the cost of scanning 6,000 maps, *i.e.* approximately one-third of the cost of the cheapest fully vectorised alternative.

27.6 Investment appraisal

The proposal was subject to an assessment on the lines of HM Treasury Guidelines for Investment Appraisal, (unknown 1984). The costs of a manual and a computer-based

solution were costed over a 7 year period, including staffing, equipment, consumables and maintenance. The computer option was a more expensive one, but the additional expenditure was considered to be justified (a) on grounds of additional benefits and (b) the potential for eroding the cost differential if a subsequent decision was taken to expand the system to include the estimated 500,000 listed buildings in England.

27.7 The system as supplied

The Advent software runs under Unix and includes (a) *Imager 40* for the capture of map images as pixels for immediate display on high resolution screens, (b) *Rectify* for the accurate re-scale of scanned images and to convert 1:10560 maps to 1:0000, (c) *Paint* which is an interactive raster editor which can annotate and extract parts of an image, (in effect, a free-hand drawing system), and (d) *Designer 40* which is a CAD product which allows for the combination of raster and vector data with up to 255 vector layers and which also incorporates the map management system.

'Bespoke' software was commissioned from Advent for certain aspects of the English Heritage requirement. This includes (a) the ability to access the system through grid reference or monument reference, (b) the facility to generate standard map extracts combined with text and (c) the provision of 'data-sheets' for each constraint plotted on the system.

The hardware configuration was based on the need to store about 3540 Mb of map background data, 256 Mb of vector markers and system space of 200 Mb. At the centre of the system are two Sun File servers, each provided with four 575 Mb disk drives (Fujitsu M2361A), *i.e.* total storage of 4600 Mb to allow for a reasonable disk utilisation. There are two system administration terminals (Wyse 85). At present there are three Sun high resolution graphics work-stations (3/75s), each with tablet and mouse and local hard-disc to provide memory and processing capability to manage a 200 dpi map image and to display up to 4 rectified maps using *Designer*.

Hard-copy output is provided through (a) a Versatec A1 Electrostatic printer for large extracts and complete maps and (b) a QMS laser printer for A4 map extracts. The file servers, work stations and printers are all connected on an Ethernet local area network.

27.8 The present position

The system was installed in the summer of 1987. The re-plotting of existing SAMs has been in progress for several months as part of a programme to complete the transfer within 12 months. There have been some software 'bugs' but a major update was expected to correct most of these at the end of March 1988. So far, the Sun hardware has proved to be reliable and maintenance arrangements satisfactory.

The system was tailored to the English Heritage specification and it has not yet been necessary to carry out any significant development or programming 'in-house'. Only introductory training has been provided in the Unix operating system, and data and system administration is currently carried out on the basis of menus provided. However, further knowledge of the operating system may prove to be useful in due course in terms of the most efficient management and the system has facilities which go well beyond the basic requirement. Further papers will deal with these other aspects.

27.9 Future developments

Future development must wait proper justification and the availability of resources. However, subject to this, it is hoped to incorporate some maps at larger scales and to re-plot listed buildings, as well as to provide work-stations for the Inspectorate. However, any major development of number of map images held is likely to depend on new and cheaper ways of storing the raster data in view of the high storage requirement.

It is hoped to replace the existing SAM textual systems in 1988/9 and it would clearly be desirable to provide a direct link between the text record and the map record in due course.

27.10 Conclusions

It is too early to carry out a full post-implementation review of the system. However, it appears that the English Heritage requirement is likely to be met and that the claims made by the supplier for the benefits of the system are justified.

On the issue of raster v. vector data, there has been recent talk on speeding the programme for the digitisation of OS data. However, costs, time-scales and even the availability of resources for digitisation are still quite uncertain. The raster system seems likely to provide an interim solution for some years to come. It is also relevant that the vectors within a vector/raster system could be formatted on an entirely fully vectorised system at some future date and that the raster map data within the Advent system could be replaced by vector map-data should this become available. These are considerations for the longer-term. In the meantime, the raster solution has enabled English Heritage to establish a national computer-based system for use in the MPP and other statutory and advisory functions.

Appendix

The figures (Figs. 27.1–27.5) give examples of output from the system.

References

CHORLEY 1987. "Handling Geographic Information, Report of the Committee of Enquiry chaired by Lord Chorley", London.

UNKNOWN 1984. "Investment Appraisal in the Public Sector : A Technical Guide for Government Departments", London.

Scheduled Ancient Monument

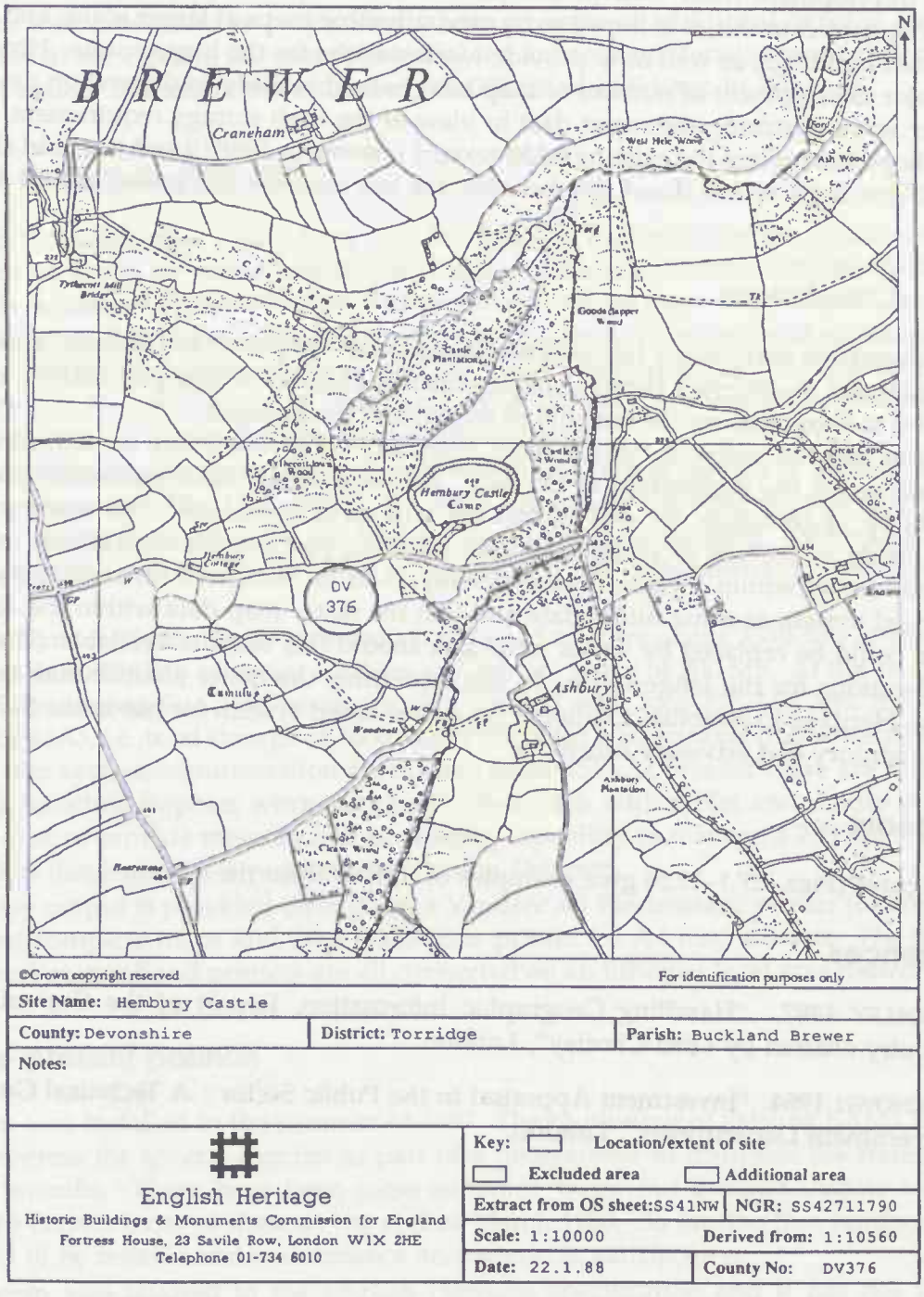

Figure 27.1: Map extract for particular monument (Devon 376) with textual data (properties) automatically transferred from a 'data-sheet'. Large numbers of these have to be prepared for the administrative and consultative processes leading to a monument being scheduled. The automatic generation of these results in savings in staff time.

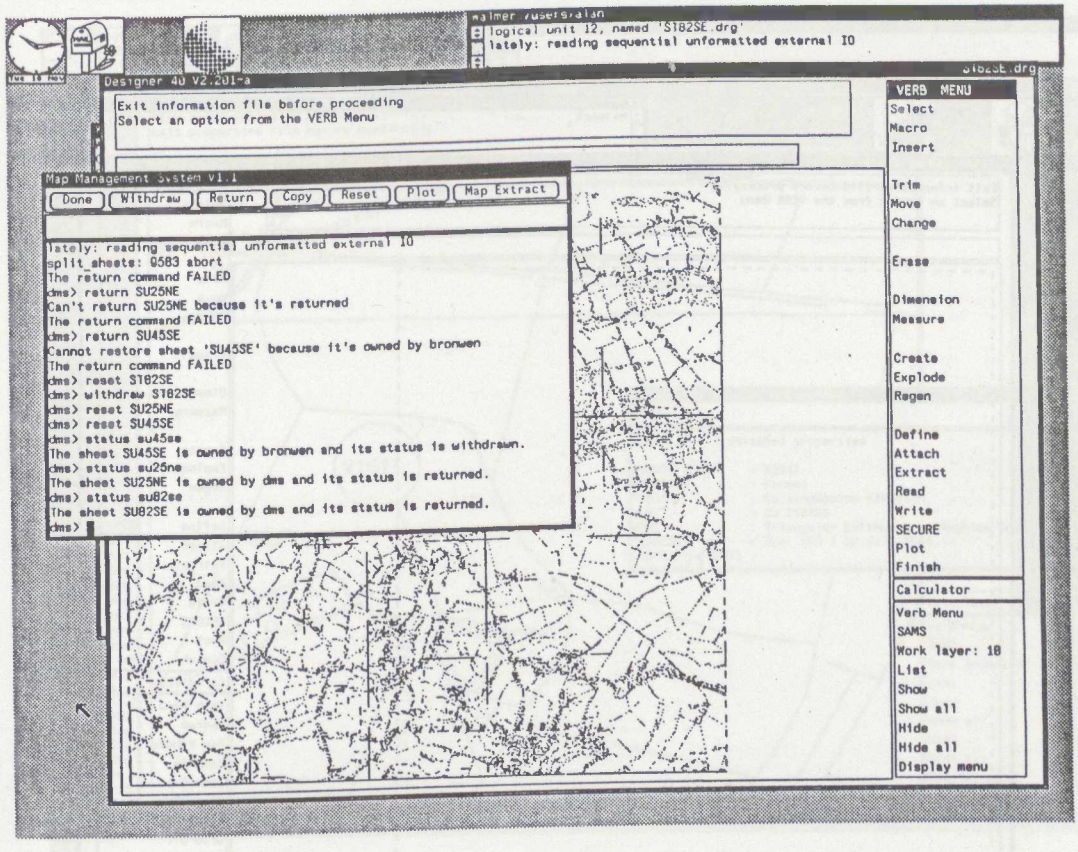

Figure 27.2: Screen dump showing a complete OS sheet and Designer menu with a map management window (containing error reports) superimposed

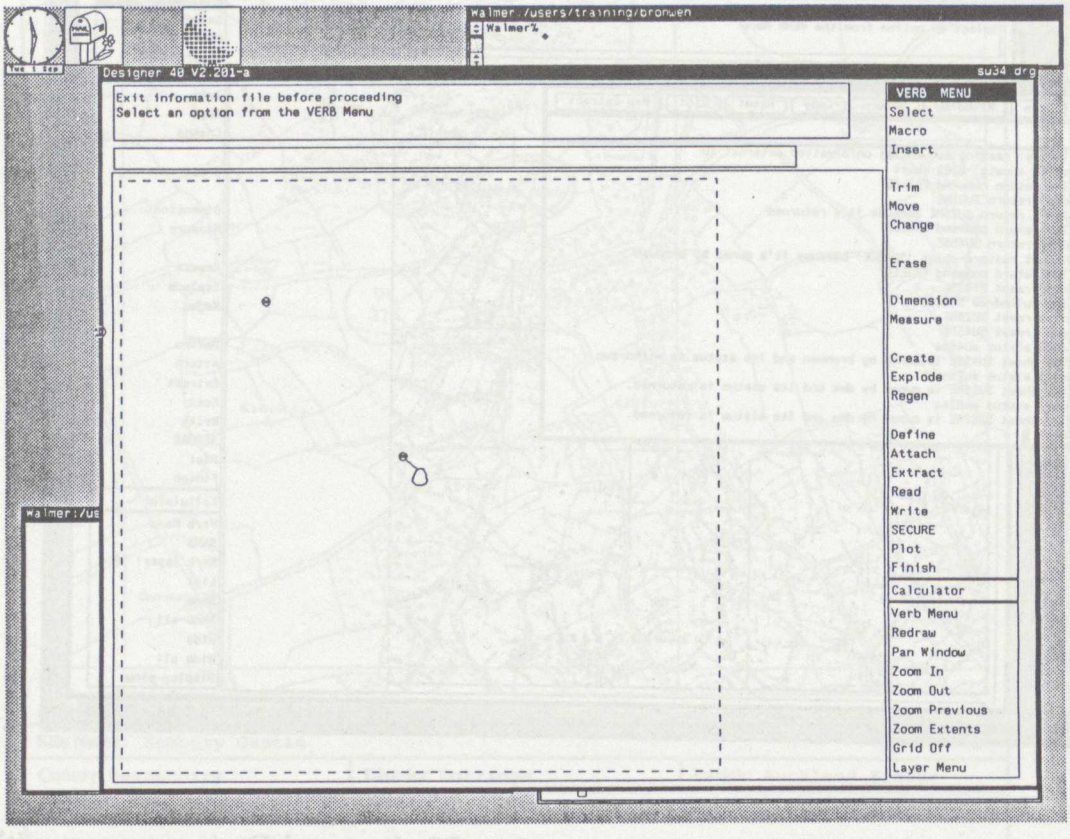

Figure 27.3: Screen dump showing vectors, but with the raster map-base masked

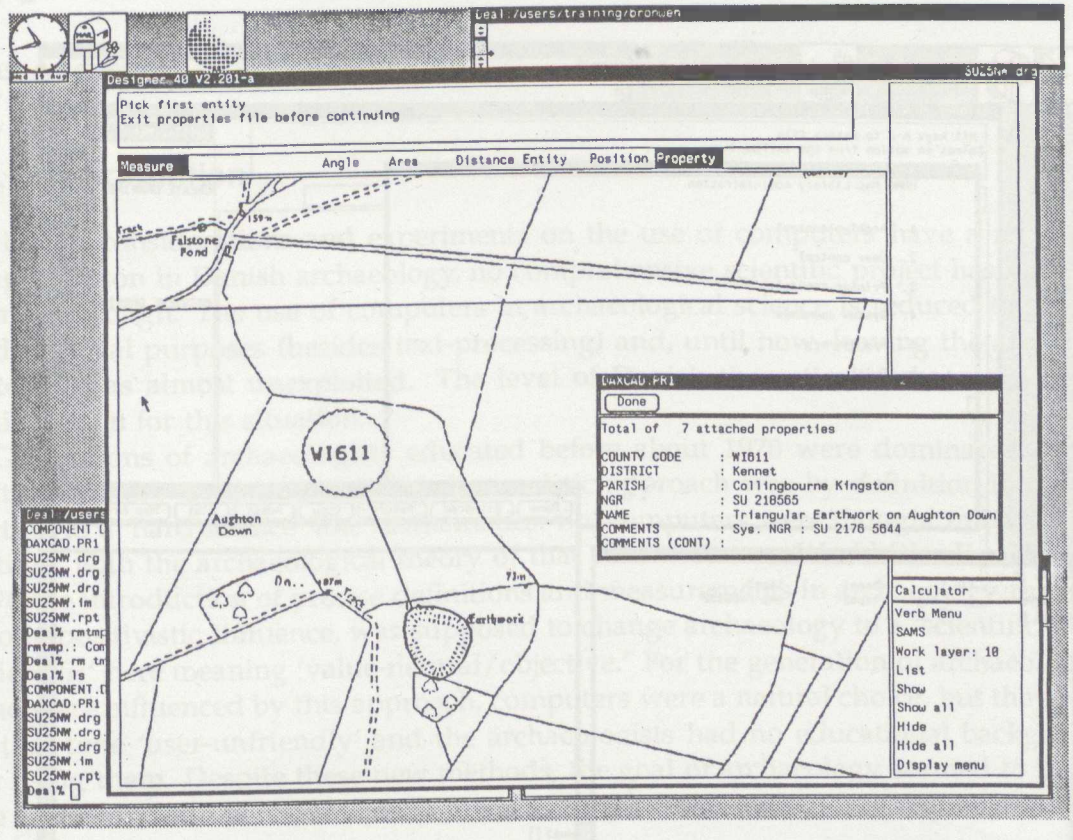

Figure 27.4: Screen dump showing a map which has been loaded into Designer and 'zoomed'. The other window facilitates the entry of properties for use in the map extract

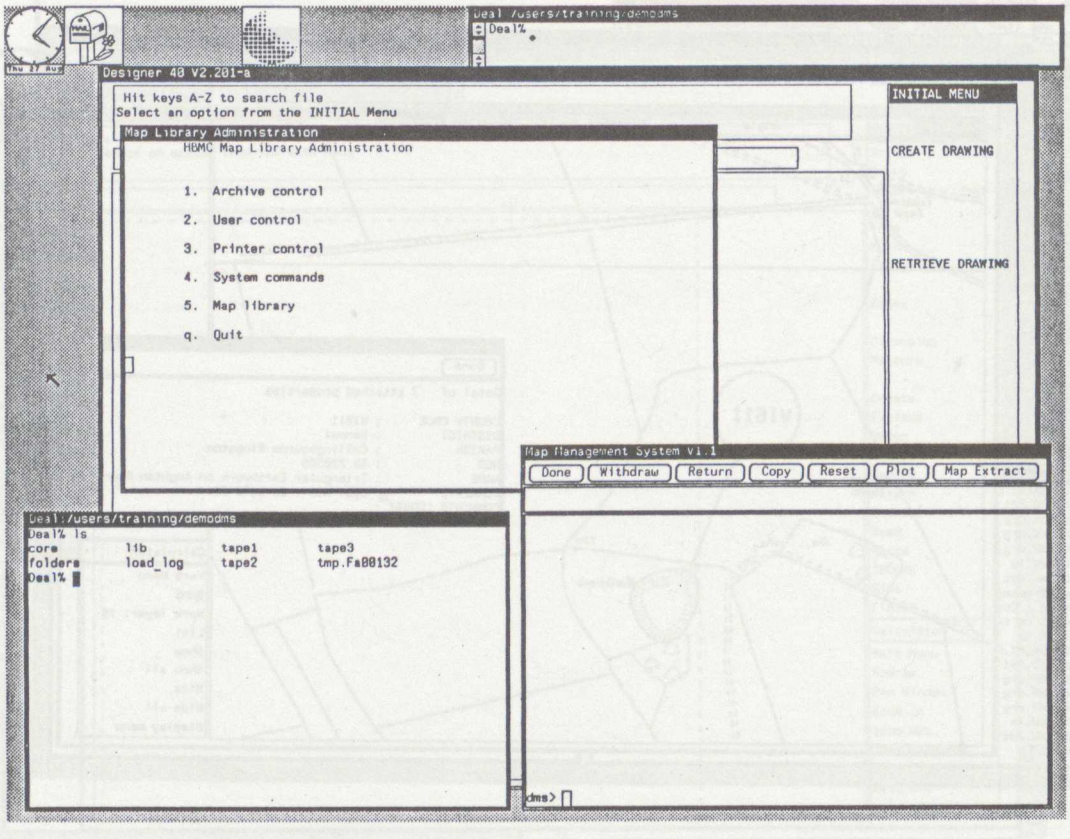

Figure 27.5: Screen dump showing a number of windows for map library administration, designer and users work space