DIGITAL MAPPING IN NATMAP

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INTRODUCTION

Early maps were laboriously drawn by hand with fanciful embellishments and were almost works of art in their own right with the amount of art content being generally in inverse proportion to the positional and content accuracy of the map.

In due course, developments in technology in the measurement, photographic and printing processes enabled accurate and reliable maps to be compiled and printed in large quantities, but these only enabled topographic information to be distributed in graphical form and limited by the particular map design parameters.

If further, or different, information was required it had to be extracted by laborious analogue measurement and calculation.

The introduction of computer technology dramatically changed the ability of mapping organisation, not only to collect and store map or spatial information, but also to manipulate and access it.

The result has been the emergence of land, geographic and cartographic information systems, with corresponding organisational arrangements related to them.

These systems provide information concerning a range of land related topics such as:

Engineering projects

Planning schemes

Recreational planning

Transport studies

Public works and services

Land and cadastral administration, etc.

Common to many of these is a topographic, cartographic or geographic information system.

Natmap activity in this area is largely related to the medium and small scales and includes topographic information appropriate at 1:50 000, 1:100 000, 1:250 000 and 1:1 000 000, as well as geographic data for specific systems such as the recently announced Australian Environmental Geographic Information System.

This contribution is reflected in various programs such as:

Topographic compilation at 1:50 000 and 1:100 000 scales

Derivation of 1:250 000 scale compilations

Production of 1:100 000 and 1:250 000 scale repromat

Maintenance and processing of the Master Names File

Digitising and processing the Australian coastline and baseline

Digitising of 1:1 million scale topographic and thematic maps

Production of 1:1 million scale repromat

DEM data acquisition

Census boundary digitising and editing

Production of the Atlas of Population and Housing

Production of precision grids, graticules and base sheets

Supply data files to clients, etc.

The hardware and software currently used to undertake these programs are listed in Attachment A and the general configuration is illustrated in Attachment B.

BASIC DATA ACQUISITION PROCESSES

TOPOGRAPHIC MAPPING

In-house topographic data acquisition at 1:50 000 and 1:100 000 is performed on table and stereodigitisers, and edited with Automap, Eddy or Succer software, as appropriate. Contract topographic data is supplied in AS2482 Format, then converted by Natmap to the Automap format to allow checking and editing.

Automap is a map production Fortran package written by Systemhouse Ltd. Data acquisition is by blind digitising at table or stereodigitisers, in either point or stream (continuous recording) mode, with a range of editing commands also available to station operators. Output is Calcomp data plotter verification plots or fully symbolised repromat from the Kongsberg precision plotter. Other features include a facility for combining or dividing existing data files. Natmap staff have made numerous modifications to Automap, particularly at the user interface.

The Automap software communicates with controllers at the table and stereo digitising stations. The processors perform low-level validations and transformations, removing these tasks from the host computers.

The 1:1 million scale topographic data are acquired by in-house Automap table digitising and by contract scan digitising. The contract scan data is supplied in a vector format which is converted to Automap.

Automap data are stored on disk in files corresponding to map areas, with basic information for each file stored in a directory. Each digitised feature in a file has a Feature Index Record, containing a feature code and modifier, start and end point co-ordinates, minimum and maximum co-ordinates and some address pointers. A Feature Definition Table (Attachment C) contains attribute details for each feature code, describing how the feature is to be processed on input and plotting.

Topographic verification plots are produced on the Calcomp (or Kongsberg) plotters, usually with ball point pens on drafting film or paper (Attachment D). The standard form has four colours and basic symbolisation, but alternatives include colour coded contour lines for verification of contour tagging, and special symbols for use in field checking.

Topographic repromat is produced on the Kongsberg plotter, using the light head to expose photographic film and a cutting tool to cut mask edges on peel coat material. Custom made symbol disks are used to 'flash' standard symbols and text onto the film. Separate plots are produced for each map printing colour.

CENSUS MAPPING

The Census software is a Natmap system to digitise and edit census boundary data, form polygons in a topological structure, and produce various plots. The census data structure and software also supports aggregation of the basic Collection District polygons into other regions such as statistical divisions, local government areas, postcode areas and electorates.

Census Data Structure

Census boundary data is also acquired both in-house and by contractors. Natmap software is used for in-house digitising and editing. Nine polygon themes (Collection Districts (CD), Local Government Areas, Postcodes etc) are formed from the segments.

The census data set contains about 28 000 collection district polygons, requiring 20Mb storage in the present data structure. The CD's are plotted on 7 000 map sheets and are updated for each Five-yearly census.

DIGITAL ELEVATION MODEL (DEM)

The DEM software is an add-on to Automap for digitising and editing spot heights on the Summagraphics tables.

The DEM data set is based on 1:100 000 NTMS maps using spot elevations and a selection of points from the 20 metre contours.

The DEM itself uses a regular grid format at 500 metre spacing and the full national data set will comprise some 30 million points.

The gridding philosophy adopted is the 'cell' rather than the 'point' approach, where the terrain elevation used is representative for each grid cell rather than the actual height at each grid intersection.

The resultant DEM will thus give a generalised representation of the terrain, but will adequately portray all key features such as mountain peaks etc.

Current application of the data covers the fields of:

Geophysics,

Communication,

Hydrology,

Agriculture,

Conservation,

and the full data set is expected to be available within 2-3 years.

NON-MAPPING APPLICATIONS

Grid/Grat Plot is a Natmap system for producing grids and graticules to a variety of specifications, scales and projections on the Kongsberg. The Master Names File software is a system for maintaining a data base pf place names, employed in the production of text overlays. The Master Names File contains approximately 216,000 names in 25Mb.

SYSTEM UPGRADE

The current DMS can produce very high quality graphics from digital data, however it is inefficient in terms of:

- digitisation of existing graphics

- derivation and generalisation procedures

- data structuring for polygon processing and geographic analysis

A system upgrade is now in progress to overcome these deficiencies and may include a large format raster scanning system.

Scanning Technology

The initial output of scanning equipment is a raster data file. Appropriate software is used to convert this to vector data, edit it, and then add feature symbols. The information is then labelled or tagged and finally transformed to a national reference system.

The technology to achieve all this is still being developed, but significant improvements are expected to emerge shortly, and commercial systems are currently available which have a highly sophisticated software approach to the editing tasks in relation to map areas, lines, point symbols and text features.

A potential difficulty has been identified in the scanning process in that it is essentially two dimensional, whereas the conventional stereoplotter output is three dimensional and in the latter case XYZ co-ordinates are constantly measured and recorded along all linear features. Height data in the form of contours is common to both methods.

At first glance the scanning approach may appear to be at a disadvantage, particularly if the data is required to establish a DEM or has other height related applications.

However, height information can be recorded on two dimensional graphical compilations in the form of contours and spot heights both regularly spaced and situated at terrain discontinuities.

This data can be scanned and tagged and, in addition, suitable software can be used to interpolate heights along linear features between contour intercepts.

The resultant digital height data may well be as comprehensive as that recorded from the three dimensional stereoplotting systems.

Investigations are being undertaken to establish the relative effectiveness between the two approaches including comparative cost factors.

CONCLUSION

The State of Victoria has already established the LANDATA System to record the ownership and description of land parcels and plans are in hand to parallel this with a topographic data base.

This, in conjunction with those established by other authorities in Australia, is contributing towards a network of spatial data bases, and through the associated information transfer processes, will allow users to extract, interpret, analyse, dissect and

forecast from the enormous amount of land related information available now and in the future to an extent that has not been possible in past generations.

The advantages of this to the general economy of Australia are yet to be fully realised but there is little doubt that they will easily justify the cost and effort that will be required to establish the various systems.

ATTACHMENT A

Hardware Systems

- 1 x DEC PDP 11/70 computer (1Mb memory)
- 2 x DEC RPO6 disk drives (176Mb each)
- 2 x CDC 9762 disk drives (67Mb each)
- 2 x DEC TE16 800/1600bpi 9 track tape drives
- 1 x DEC LA120 Decwriter console

- 1 x Tektronix 4115B graphics terminal (2 proposed 85/86)
- 1 x Tektronix 4010 graphics terminal
- 15 x DEC VT100 compatible alphanumeric terminals
- 2 x Altek ACT 34/2 digitising tables (with Systemhouse Ltd model 100 controllers and GT100 terminals)
- 3 x Summagraphics Series 2000 digitising tables (with NFPA Type II controllers and Teleray alphanumeric terminals)
- 1 x Kongsberg GT5000 flat bed plotter (offline), 800bpi tape drive, controller, photo exposure device with 2 symbol disks
- 2 x Calcomp 563 drum plotters (+1 Calcomp 960, proposed to be transferred from Dandenong in 85/86)
- 1 x DEC LP05 lineprinter
- 1 x Silver Reed daisy wheel printer

- 1 x DEC PDP 11/40 computer (256kb memory)
- 2 x DEC RK05 disk drives (2.5Mb each)
- 2 x CDC 9762 disk drives (67 Mb each)
- 2 x DEC TU10 800 bpi 9 track tape drives
- 1 x DEC LA36 Decwriter console

- 1 x DEC VAX 750 computer (3Mb memory)
- 1 x DEC RA81 disk drive (456Mb)
- 1 x DEC RA60 disk drive (205Mb)
- 2 x DEC TU77 800/1600 bpi 9 track tape drives
- 1 x DEC LA120 Decwriter console
- 1 x B300 line printer
- 4 x Tektronix 4115B graphics terminals
- 1 x Tektronix 4014 graphics terminal
- 1 x Tektronix 4010 graphics terminal
- 10 x DEC VT100 compatible alphanumeric terminals

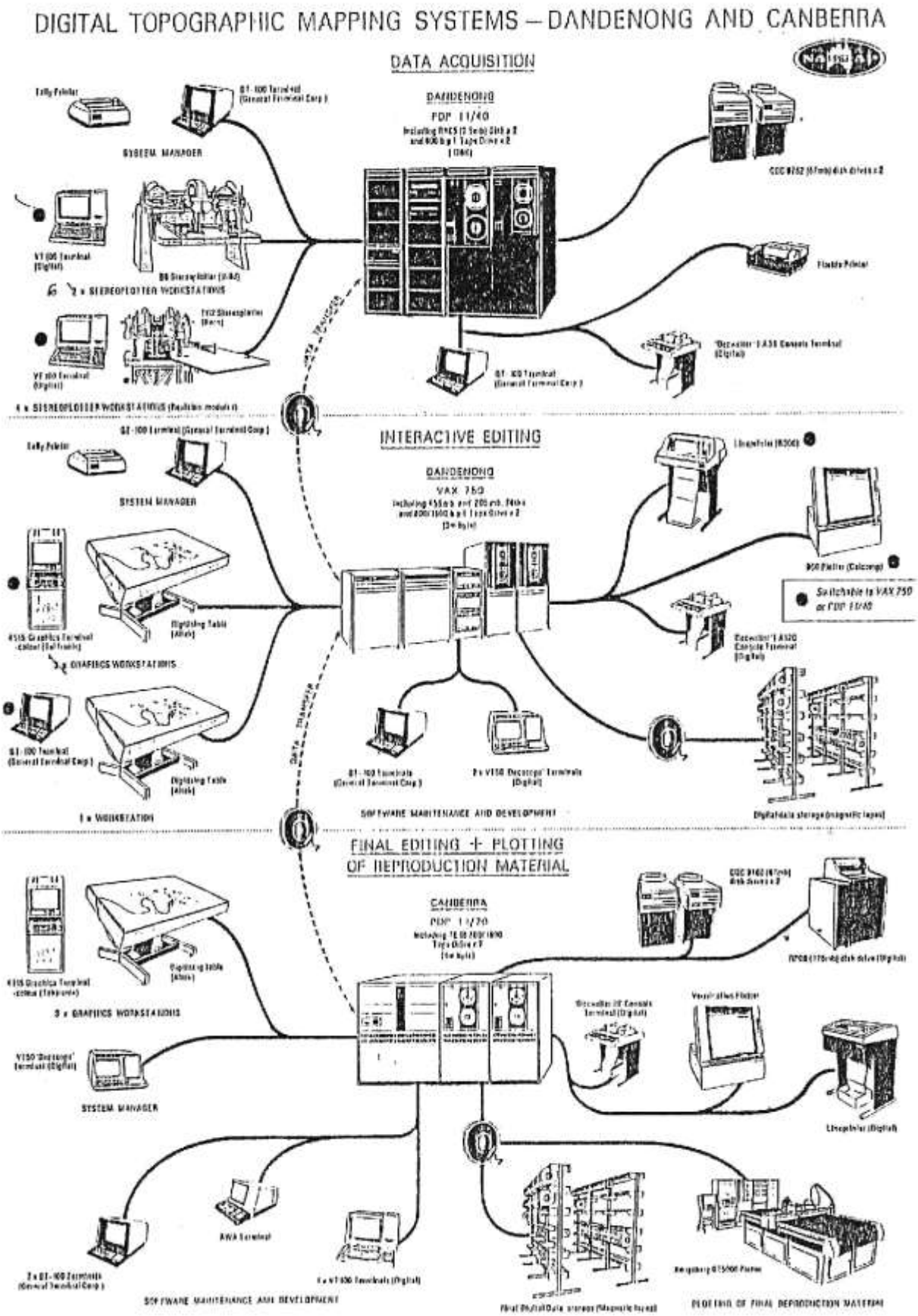
- 2 x Wild B8 stereodigitisers (with triaxis encoders, GT100 terminals and Aust-Am Macromap controllers)
- 4 x Kern PG2 stereodigitisers (with triaxis encoders, GT100 terminals and Aust-Am Macromap controllers)
- 4 x Altek ACT 34/2 digitising tables (with Systemhouse Ltd. controllers and GT100 terminals)
- 1 x Calcomp 960 drum plotter (a 4 pen / continuous paper drum plotter is proposed for 85/86, with 960 moved to Belconnen)

- 2 x Tally printers
- 1 x Silver Reed daisy wheel printer

Software Systems

- RSX 11M+ Version 2.1
- Fortran 77
- Automap
- Cardit and Colour Cardit
- Succer
- AS2482 Read/Write
- Census
- Grid/Grat Plot
- DEM
- Master Names file
- RSX Version 4.0 (PDP 11/40)
- Fortran 4 (PDP 11/40)
- VMS Version 4.0 (VAX 750)
- Fortran 77 (VAX 750)
- Other non mapping software

ATTACHMENT B

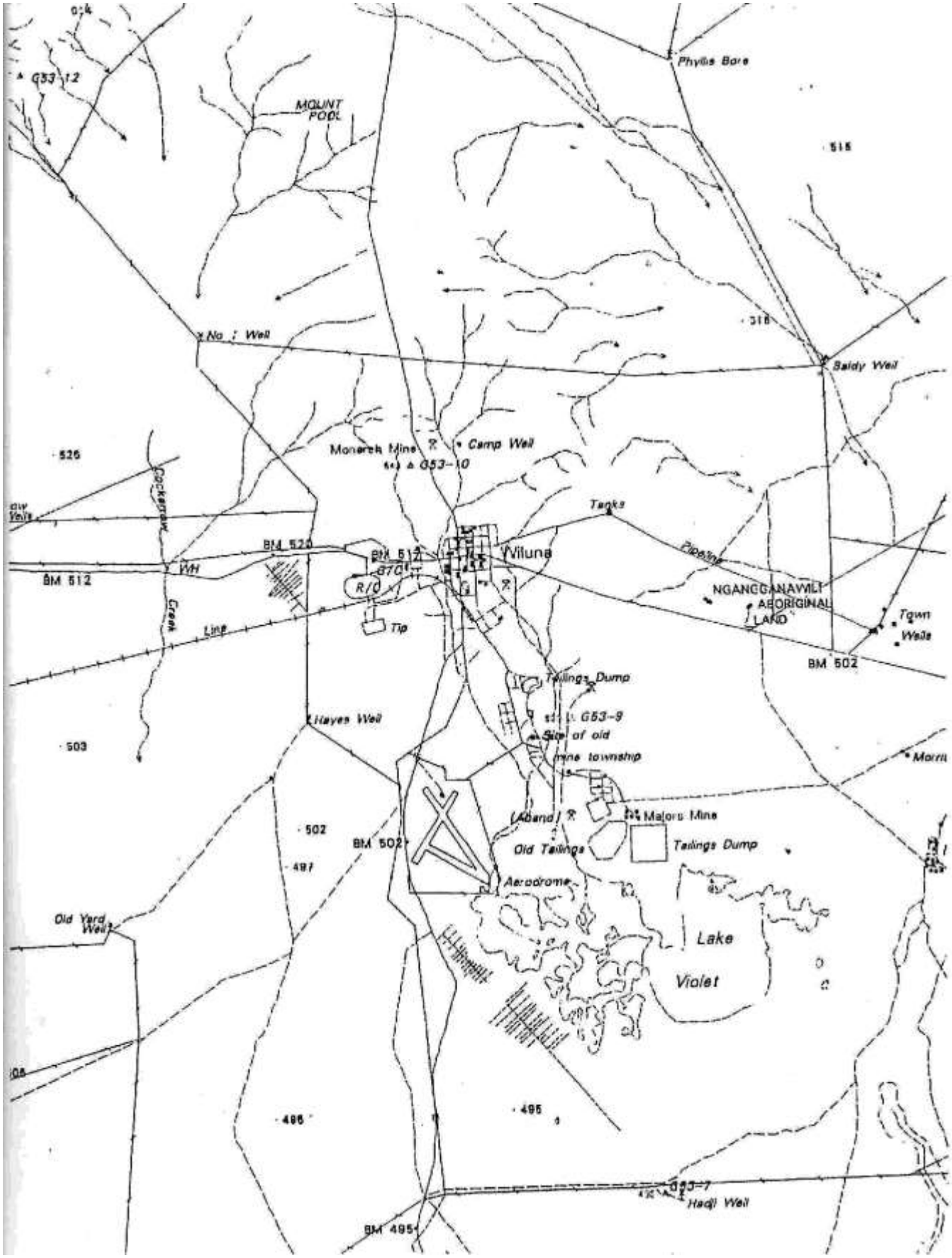


ATTACHMENT C

86/12/01 09:16:47 FEATURE DEFINITION TABLE PAGE: 1

FC	DESCRIPTION	MOD CONS	CAP TMODE	PTS	SUB FILE	HOUSAGE	QUALPEH	SCRIBE1	SCRIBE2	APERTUR1	APERTURZ	VPPEN	OVERLAY	SYM DEP	MOSCALE	MINSCALE	SCALEPAC	OUPLICAT	SPECLCAP	INTERP	DASH LEN	GAP LEN	DRAW CODE
1047	BUILDING - SYMBOLIZED (ONE-POINT)	0000	1	1	1	0	1	0	1	1	0	1	0	374	0	50	50	1	0	2	0	0	2131
1048	BUILDING (PLOTTED TO SCALE)	0000	1	0	1	0	1	0	0	2	0	1	0	264	0	100	100	1	0	0	0	0	0
1049	BUILDING (SYMBOLISED)	0000	1	2	1	0	1	0	0	2	0	1	0	374	0	50	50	1	0	2	0	0	2131
1204	MICROWAVE TOWER	0000	1	1	1	0	1	0	0	2	0	1	0	57	0	75	75	1	0	0	0	0	2642
1460	SEWAGE TREAT. PLANT(TO SCALE) SUPERCEDED BY 1961	0000	1	0	1	0	1	0	0	2	0	1	0	264	0	100	100	0	0	0	0	0	0
1551	CHURCH	0000	1	2	1	0	1	0	0	2	0	1	0	374	0	50	50	1	0	0	0	0	2131
1656	WINDMILL	0000	1	1	1	0	1	0	0	2	0	1	0	17	0	150	150	1	0	0	0	0	2072
1755	RAILWAY STATION	0000	1	1	1	0	1	0	0	2	0	1	0	19	0	75	75	1	0	0	0	0	2023
1800	RUIN (SYMBOLIZED) SUPERCEDED BY 1999	0000	1	1	1	0	1	0	0	2	0	1	0	31	0	65	65	1	0	0	0	0	2103
1950	SEWAGE TREATMENT PLANT (SYMBOLIZED)	0000	1	2	1	0	1	0	0	2	0	1	0	31	0	100	100	1	0	0	0	0	2103
1961	SEWAGE TREATMENT PLANT(TO SCALE) SUPERCEDES 1460	0000	1	0	1	0	1	0	0	2	0	1	0	264	0	100	100	0	0	0	0	0	0
1998	RUIN (PLOTTED TO SCALE)	0000	1	0	1	0	1	0	0	2	0	1	0	274	0	100	100	1	0	0	75	30	-3
1999	RUIN (SYMBOLIZED) SUPERCEDES FC 1800	0000	1	1	1	0	1	0	0	2	0	1	0	31	0	65	65	1	0	0	0	0	2103
2000	ROAD - UNCLASSIFIED	0000	0	0	1	0	2	0	0	4	0	2	0	264	1	100	0	0	0	0	0	0	0
2019	ROAD UNDER CONSTRUCTION	0000	0	0	1	0	2	0	0	4	0	2	0	274	0	100	100	0	0	0	150	40	-3
2034	FOOT TRACK	0000	0	0	1	0	1	0	0	4	0	1	0	274	1	100	0	0	0	0	75	30	-3
2037	PRINCIPAL ROAD & HIGHWAY - DIVIDED (SYMBOLISED)	0000	0	0	1	0	2	0	0	6	0	2	0	262	1	100	0	0	0	0	0	0	0
2050	PRINCIPAL ROAD & HIGHWAY - SEALED	000N	0	0	1	0	2	0	0	11	0	2	0	264	1	100	0	0	0	0	0	0	0
2051	PRINCIPAL ROAD & HIGHWAY - UNSEALED	000N	0	0	1	0	2	0	0	11	0	2	0	264	1	100	0	0	0	0	0	0	0
2052	ROAD SECONDARY SEALED	000N	0	0	1	0	2	0	0	8	0	2	0	264	1	100	0	0	0	0	0	0	0
2053	ROAD SECONDARY UNSEALED	000N	0	0	1	0	2	0	0	8	0	2	0	264	1	100	0	0	0	0	0	0	0
2054	ROAD MINOR SEALED	000N	0	0	1	0	2	0	0	4	0	2	0	264	1	100	0	0	0	0	0	0	0
2055	ROAD MINOR UNSEALED	000N	0	0	1	0	2	0	0	4	0	2	0	264	1	100	0	0	0	0	0	0	0
2056	ROAD OTHER SEALED	000N	0	0	1	0	2	0	0	4	0	2	0	264	1	100	0	0	0	0	0	0	0
2057	ROAD OTHER UNSEALED	000N	0	0	1	0	2	0	0	4	0	2	0	264	1	100	0	0	0	0	0	0	0
2058	VEHICLE TRACK	0000	0	0	1	0	2	0	0	4	0	2	0	274	1	100	0	0	0	0	200	40	-3
2059	VEHICLE TRACK PUBLIC (USE FC 2058 INSTEAD)	0000	0	0	1	0	2	0	0	4	0	2	0	274	1	100	0	0	0	0	200	40	-3
2101	NATIONAL ROUTE MARKER	0000	1	1	1	1	1	0	0	2	0	1	0	250	0	200	250	1	4	0	0	0	2517
2103	ROAD DESTINATION ARROW	0000	1	0	1	0	1	0	0	2	0	1	0	34	0	400	400	1	0	0	0	0	2551
2104	CULVERT	0000	1	2	1	0	1	0	0	2	0	1	0	38	0	125	125	1	0	0	0	0	2304
2105	GATE	0000	1	2	1	0	1	0	0	3	0	1	0	35	0	150	150	1	0	0	0	0	2552
2106	GRID	0000	1	2	1	0	1	0	0	2	0	1	0	36	0	100	100	1	0	0	0	0	2353

ATTACHMENT D



ATTACHMENT E