Department for Economic and Social Affairs - Statistics Division,
Software and Support for Population Activities, INT/96/P74

MapScan for Windows

Software Package for Automatic Map Data Entry

User's Guide and Reference Manual

asdf
United Nations
New York, 1998

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Preface

This manual describes MapScan for Windows, a software package developed by the United Nations for automatic map data entry. This powerful tool converts raster maps, images and drawings into vector format.

MapScan for Windows was developed by the interregional project INT/96/P74 “Computer Software and Support for Population Activities” of the United Nations Statistics Division with special funding from the United Nations Population Fund.

MapScan for Windows offers inexpensive solutions for producing computerized vector maps. The software is designed to transfer printed and hand-drawn maps into a mapping system quickly and easily. UNFPA-supported programmes and developing country government agencies and academic institutions can obtain the software free of charge.

MapScan for Windows is thoroughly tested and believed to be error free. Like any software it is continually being improved and new features are being added.

Please send your order, comments and suggestions to:

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Chapter 1 Introduction

Geographic information systems

A Geographic Information System (GIS) supports spatial decision-making and links descriptions of location with the characteristics of the phenomena found there. A complete GIS consists of the supporting methodology and the required technology: spatial data, hardware, software and organizational structure. GIS technology is powerful for spatial information management and analysis.

Geographic information systems are widely used in facilities management, planning, environmental monitoring, population census analysis, health service provision, hazard mapping and many other applications. GIS technology opens a new way of presenting and analyzing information from different perspectives and in a meaningful way. The tremendous benefits to a very wide and diverse group of users have contributed to its dynamic growth and application.

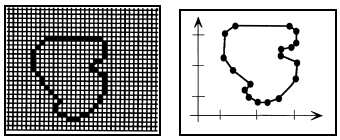
The proliferation and widespread use of GIS has increased efforts to the development of systems and effective techniques for computerizing paper maps.

Maps: paper and digital

A map represents various features of the earth's surface, shows where these features are in the real world and their relations to each other. A GIS captures and stores spatial data from external sources or from paper maps. The process of converting printed or hand-drawn maps into digital format is costly and time-intensive. More than 70% of the cost of an average GIS project is spent on data capture, and this is why the main asset of a GIS is the database.

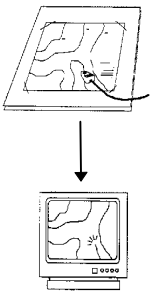
Computerized maps: raster and vector

Map data are captured from a paper map through manual, semi-automatic or automatic means, and the outputs are in either raster or vector formats.



Raster: cell by cell *Vector: points and lines*

Raster format represents points, lines or areas using a matrix of values. The accuracy of a representation depends on the size or resolution of the individual grid cells (pixels). A point is a single cell; a line is several adjacent cells; and an area is an aggregation of cells. Each feature consists of sets of similarly numbered cells. In vector representation the points, lines and areas are produced from *x,y* coordinate pairs. A point is represented by a single coordinate pair, a line by a string of coordinate pairs, and an area by a string of coordinates that start and end at the same point.



Deciding on whether to use a raster or vector format depends on what you will do with the maps. Raster implementation is quick and easy and requires minimal training. It is reliable and supports high volume processing. However, raster maps have certain disadvantages. They are static; quality is lost when you zoom in; large storage space is required; and editing is limited to basic erase and redraw options. Raster maps are good for archiving and printing, like document imaging systems.

Vector maps, on the other hand, have editing advantages, allow smooth generation at any zoom level, and require less storage space.

Most GIS and mapping packages work with vector maps, and dynamic computerized mapping applications require maps in digital vector format.

Methods of computerizing maps

Many mapping applications use vector maps, but currently the tools for converting printed maps into vector format are inadequate, labor-intensive and very costly.

The methods for generating vector data through conversion are manual digitizing, scanning followed by heads-up digitizing, line following, and automated vectorization. For high-quality media, batch vector conversion software is a good choice; source documents of low quality or with much clutter can use interactive line following software; and for scanned photos, heads-up digitizing is appropriate.

Manual digitizing

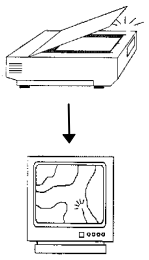
Manual digitizing is the process of tracing the different map features using a digitizer. The map is placed on a special table (digitizer), and a position-sensitive electronic cursor or “puck” connected to the computer is used for the tracing work.

In the automatic ("streaming") mode, the computer program adds points and draws a continuous line as the cursor moves. In manual mode, the operator presses a button or a key to register the starting point, a bend or change of direction in each line, and the end point. The computer program connects the points to form line segments ("dot-to-dot") and displays the output on the screen.

Manual digitizing is tedious and time-consuming. However, it has been the norm for more than 20 years and remains the most popular method.

Scanning

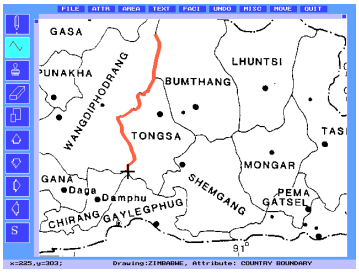
Scanning is the process of converting printed images into digital raster format using an optical scanner.



The process is simple. You insert the source document into the scanner that detects the differences in reflected light intensity from a scene. The light or dark resolution is sensed and stored as a value for a picture element (or pixel) on a fine grid. The operation very much resembles a photocopier.

Heads-up digitizing

Heads-up digitizing uses a scanned raster image and displays this as a backdrop on the computer graphics screen. The map features are digitized directly on top of the raster image.

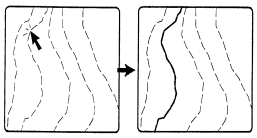


Using interactive graphics, the operator records the coordinates of the features directly from the screen in a manner similar to table-top manual digitizing.

While lines are still manually traced, the accuracy level is higher than using a digitizing tablet because the raster images are scanned at high resolution, normally from 200 to 1200 dpi or more.

With the help of display tools (Zoom In and Zoom Out), the operator can adjust the resolution of the raster data. Make sure that you digitize at a high accuracy level. The accuracy, however, cannot always be guaranteed because it is highly dependent on the operator and how he digitizes. The method is almost as time-consuming as the manual digitizing method.

Line following



Line following requires an operator to locate a section of the linework on the scanned image, and to put the screen cursor on the feature to be digitized. The software takes over from here and follows the line feature by drawing along the raster line. When it encounters an intersection or reaches the end of the line, the process stops and waits for the operator to indicate the proper line to follow or the operation to perform.

This method is an improvement over heads-up digitizing in terms of digitizing accuracy but it is still time-consuming. Line following is good for low-quality or cluttered maps.

Automated vectorization

Automated vectorization is the most complex form of vectorization. It is a fully automated process where the operator sets the vectorization parameters for the computer program to start generating vector data from a raster image. The computer program identifies and differentiates the cartographic features on the map raster images such as text and lines.

Automatic vectorization can automate most of the time-consuming line tracing process, but some vector editing (after the vectorization) is often needed to delete lines, correct intersections and modify layer assignments. These are fairly easy operations for an operator as opposed to manual line tracing.

Vectorizing maps

Paper-to-computer conversion techniques convert the scanned raster into vectors that describe the lines in a geometric coordinate system. Once accomplished, logical relationships can be assigned to certain sets of points and lines. For example, a transportation layer is defined as a set of lines for a transportation network.

In the simplest case a raster image has two colors or data values: a solid color for all the lines and another for the other features. If the lines are only one pixel wide without any breaks or gaps, a simple vectorization process traces the lines dot-to-dot, and converts the cell position of the lines in the raster image into the coordinate point values of the vector data set. The row and column address of each cell is translated into the *x,y* coordinates of a vector point.

Vectorizing maps can be difficult. Even in the simplest situations there are reference lines that have to be removed. In most paper drawings you will find textual annotations with the same color as the lines to be traced.

There can be lines that are difficult to detect against the background. If the printed map is larger than the scanning area, the user will have to reduce the original (photocopier or photographic process) or scan sections of the map, and then tile or mosaic the result.

In the case of printed maps, a manual digitizing tablet or a scanner can be used followed by the automatic vectorization. Digitizing tablets are simple to operate, but are heavily dependent on the operator's endurance and performance. This option is adequate for limited jobs that can be completed quickly. Manual digitizing also can handle complex jobs if the volume of source materials is manageable.

Scanning, followed by automatic vectorization, is recommended for work with much detail, complexity and magnitude. The pressure is too strong on human endurance when there is a large volume of digitizing work, and the operator is prone to commit errors and inaccuracies.

Chapter 2 MapScan presentation

MapScan accepts various formats of scanned maps or drawings, and reads and converts scanned images into vector maps with text references of different formats used by popular mapping systems. Unlike the tedious conventional methods of manual digitizing, MapScan has the ability to move printed maps or drawings quickly and easily into a mapping system.

Vectorizing with MapScan

MapScan vectorizes maps as follows:

Map scanning paper maps and saving them as a raster image.

Pre-processing or **raster image editing** to improve the quality like eliminating unnecessary items, connecting broken lines, rotating an image, and merging multiple pages into one map image.

Text label extracting or **O**ptical **C**haracter **R**ecognition (**OCR)** to locate text identifiers for the regions, areas, cities and towns; identify the reference text and determine the spatial coordinates. Recognized texts are removed from the raster image during the vectorization process, and a text reference file is generated for use in specific mapping and GIS software.

Vectorization to convert (at this stage of the processing) the raster image that contains points, lines and polygons (no reference text) into vector format. A map coordinate file is generated for use in specific mapping and GIS software.

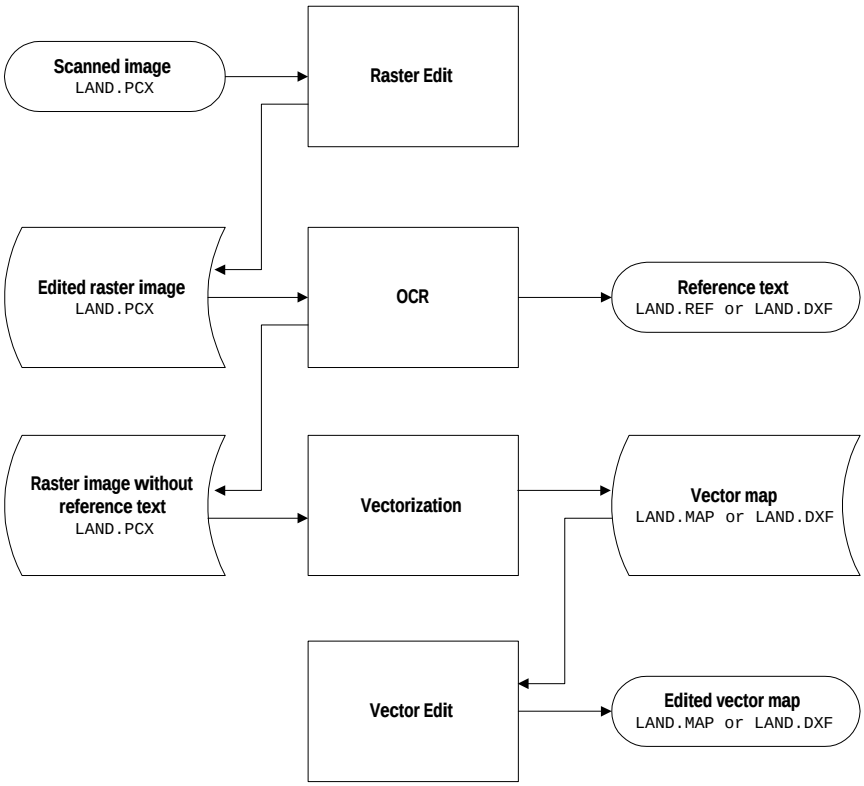
Post-process or **vector map editing** a generated vector map by closing polygons, removing dirt, joining line segments, rotating the map, merging multiple pages into one vector map, selecting line segments and assigning specific layer attributes. Vector maps also can be geo-referenced into real-world coordinates system.

Once the entire process is completed, the reference text file and the vector map file can be used with a mapping system.

MapScan supports inputs of most graphic file formats (bitmaps), including: PC Paintbrush (PCX), Aldus Tagged Image File Format (TIF), CompuServe (GIF), JPEG/JFIF (JPG), Adobe Photoshop (PSD), Kodak Photo CD (PCD), MacPaint (MAC), Windows Metafile (WMF), Microsoft Windows BMP and DIB (uncompressed and RLE compressed), Encapsulated Postscript (EPS raster image only), GEM Raster (IMG), WordPerfect (WPG raster image only).

MapScan outputs (and can also import/export) vector map files in most industry standard formats such as AutoCAD (DXF) an open-ended, widely accepted industry standard format, Atlas GIS (BNA), ArcView Shape file (SHP), MapInfo exchange file (MIF/MID), as well as

MapScan (VEC) , PopMap* for DOS (MAP), and PopMap for Windows (TXM) formats.



System requirements

- IBM PC/AT or compatible with 80386/80486 processor or higher and 640KB RAM. Additional expanded and/or extended memory are recommended.
- One floppy drive and a hard disk drive with minimum 4MB available space.
- VGA color graphics adapter or better.
- Windows 3.1, Windows for Workgroup 3.11, Windows 95, or Windows NT.
- Microsoft mouse or compatible.
- Scanner and Twain driver (optional).

* PopMap is a software developed by the United Nations Population Fund and the United Nations Statistics Division. It is an integrated software package for geographical information, maps and graphics database.

For further information

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Chapter 3 Getting started

Installing MapScan

Before installing MapScan backup the original diskette and use the copy to install the software.

The installation program will run the instructions on the screen. Answer the dialog boxes and select the appropriate options. You can install the software only, but we recommend installing some sample files for the exercises described in this document.

To install MapScan under Microsoft Windows 3.x, Windows 95 and Windows NT, run the **setup** program found in the disk. After the installation a new program group **MapScan for Windows** is created.

Windows 95 or NT 4.0 users: select **Run** from the Task bar **Start** menu and type the filename (e.g., A:\SETUP.EXE). Press <**Enter**> and follow the prompts.

Windows 3.1 or Windows NT 3.x users: activate the Program Manager, select **Run** from the **File** menu and type the filename (for example, A:\SETUP.EXE). Press <**Enter**> and follow the prompts.

To upgrade your version of the MapScan for Windows, follow the instructions above and install the new version in the same location of the old version.

Un-installing MapScan

You can un-install MapScan for Windows at any time by running the **Uninstall** program from the MapScan for Windows program group.

MapScan program files will be deleted but the data files will remain.

Using a scanner with MapScan

The scanner you will use with MapScan has to be configured for your computer with the appropriate driver. Make sure that Twain driver is installed.

Using MapScan

The guiding principle in the development of MapScan is to produce a system that is easy to use. You will find the system straight forward and intuitive, enabling you to start within a relatively short time. The best way to learn MapScan is to use and try the commands before you start a project. Follow this section and go through the steps using the demo images or your own.

MapScan processes and manipulates raster and vector data. It is important to understand well how MapScan handles the different types of data (image, vector lines, control points and text) and how these are generated, displayed and saved into files.

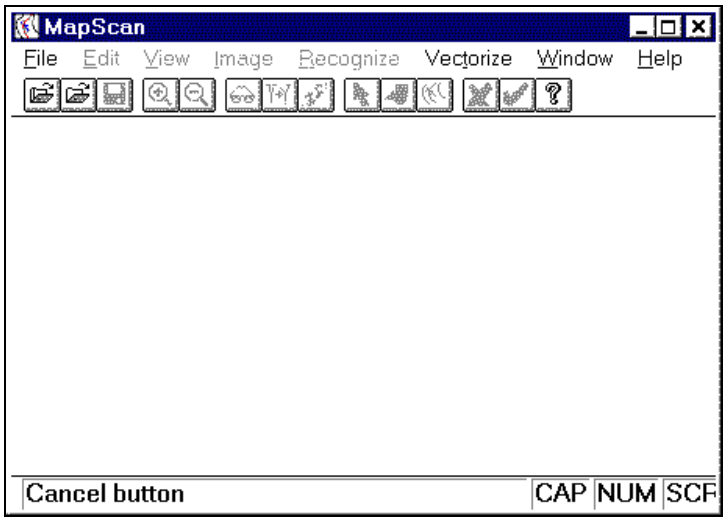
Each type of data (raster image, lines and text) is treated as a separate data layer with its own set of processing and editing functions. Data layers are stored in separate files with different file formats. For example, images are stored in PCX, GIF or JPG format, and vector lines are stored in DXF, BNA or SHP format. Data layers are displayed as graphical layers that can be turned on and off.

While most data layers are derived from another layer (for example, vector lines are automatically vectorized from a scanned raster image), each data layer can be edited with its own editing functions in the Edit menu. Use the **Edit**/**Raster** command to edit raster images, and the **Edit**/**Vector** command to edit vector lines. Follow these steps to experiment with the software and get a better understanding of how data layers are handled, and how raster images are vectorized.

Step 1. Starting MapScan

When you install the software a new program group, MapScan for Windows, is created in the Program Manager. This program group contains the MapScan for Windows icon and the Uninstall program. Double-click on the MapScan for Windows icon to start the program.

MapScan main screen



Getting help

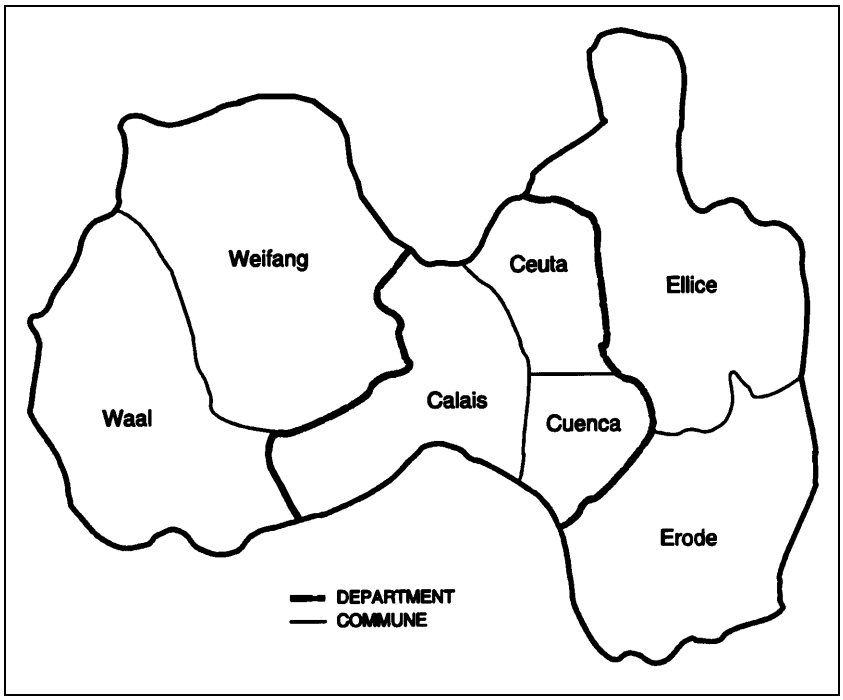
Help is accessible from the MapScan Main menu. It is an on-line version of the User's Guide and Reference Manual in hypertext format.

Click on the **Help** icon of the main menu. Click on **Index** or **Contents** to search for a help topic or to select an item from the table of contents.

Step 2. Scanning a paper map or opening a raster image

To scan a paper map (similar to the one on this page), place it on the scanner. Choose **Acquire** from the **File** menu and select the right scanner driver. Click **OK** to give control to the scanner program in the computer. Specify the area, the resolution and the color depth. Once the map is scanned, a new window opens with the raster image.

Sample map of Metaland.



If there is no scanner or a scanned paper map, open one of the raster images provided by MapScan. Choose **Open Raster or Project...** from the **File** menu. Select **METALAND.GIF** in the **Open File Name** dialog box and click **OK**. The raster map is displayed in the image window.

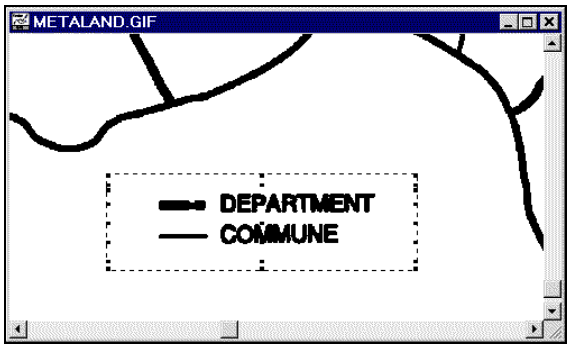
Step 3. Editing a raster image

Raster edit is the pre-processing stage when the quality of the scanned raster image is improved. You can cut and/or erase unwanted elements, draw additional items or correct broken lines, copy part of an image, zoom-in and zoom-out, and rotate an image. You also can merge multiple pages into one raster image. If the raster image is clean, skip this exercise and go to Step 4.

The image window can be resized by dragging the corners with the mouse. The **Zoom-in** and **Zoom-out** tools are used to enlarge or reduce the image respectively. The **Pen** tool is used to draw a missing line or to close a gap; and the **Eraser** is for removing unwanted features, annotations, dirt and spots.

The Metaland map includes a legend for the Department and the Commune boundaries that we will remove. Click on the **Select** tool to enclose the legend in a rectangle. Imagine how you will create a rectangle so position the pointer at a starting point, press and hold the <left> mouse button and drag it to enclose the legend. Once you have done this, click on the **Cut** tool.

Select the legend area and remove it from the raster image.

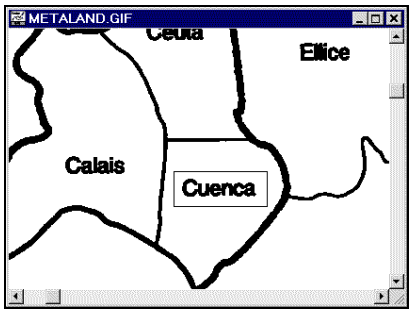


Step 4. Text label recognition

We will identify and recognize the text labels to produce ASCII text and the coordinates that will be used as labels for the map features at a later stage. If the raster image does not have text labels, or you do not want to extract them, skip this step and go to Step 5.

To recognize the text labels (names of the communes) on the Metaland map, choose **Text** from the **Recognize** menu or click on the **Recognize** tool. The arrow changes to a cross pointer. Drag the pointer to enclose the text label. The **Edit Text** dialog box opens and the recognized ASCII text is displayed. You have the option to edit the text before the command is executed. The text label will be removed from the raster image once you press **OK**.

Mark a text label for recognition and confirm the result.

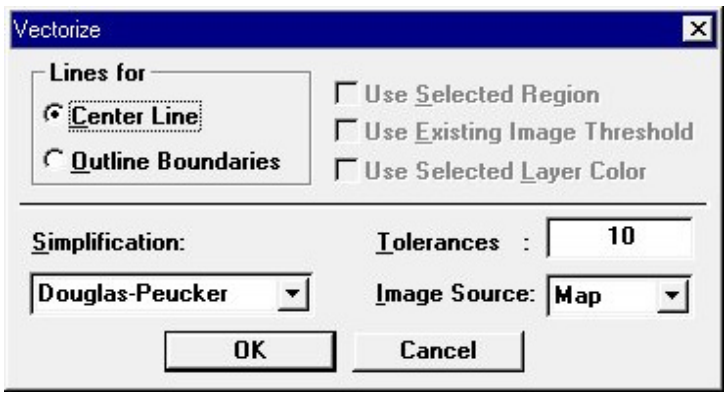


Step 5. Performing vectorization

If the quality of the scanned image is good, start the automatic vectorization process. If the image is complex and has many graphic layers or mixed items, use the interactive tracing function to vectorize the image. Choose **Trace** from the **Vectorize** menu, and click the <left> mouse button on a linework to vectorize it.

There is an option to run (unattended) a vectorization batch job for several raster images. When you vectorize several files, set the default input directory (**File**/**Preference**/**Directories...)** for the raster images you will vectorize, then execute the **Vectorize**/**Batch...** command.

The Metaland map is in good quality so we will execute the **Vectorize**/**Auto** command. The **Vectorize** dialog box appears. Set the vectorization parameters.

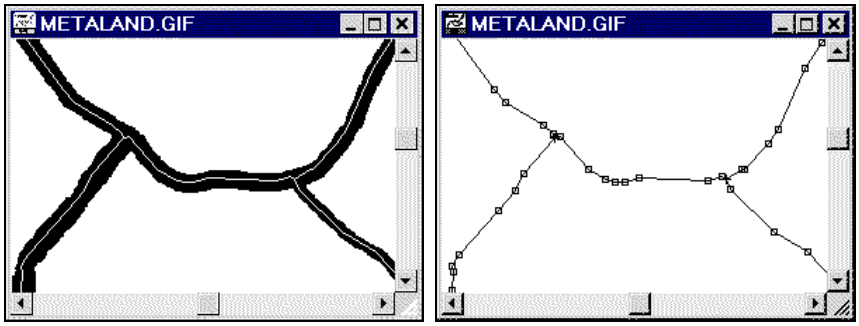


For this exercise we will use the default parameter settings. Click **OK** to start the vectorization process. The cursor changes to an hourglass during the processing and returns to an arrow when done. The extracted lines will be displayed in the image window.

Step 6. Editing a vector map

At this stage the Metaland map is in vector lines. Use the **View** menu commands to turn the items On and Off, such as Raster image, Vector maps and line Nodes.

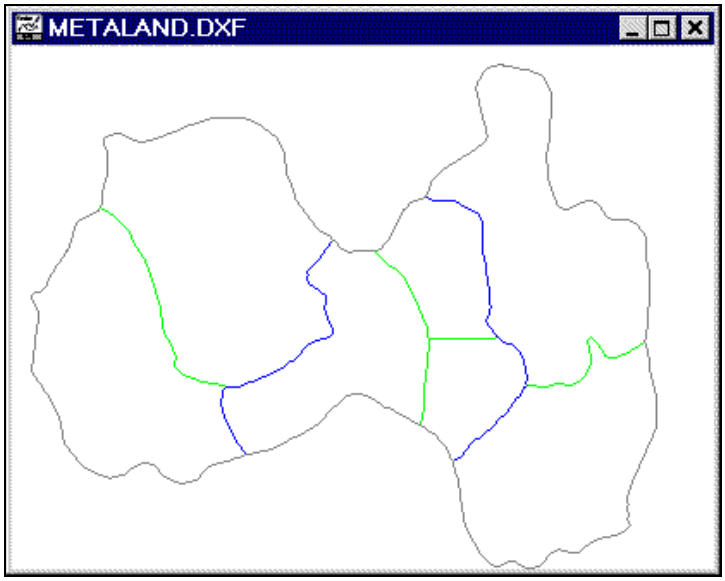
Vector lines with raster background and with nodes turned on.



Open the **Edit** menu and choose the **Vector** command to edit the vector lines. The editing functions can also be accessed through the **Vector Edit** ToolBox. MapScan has several functions to edit a vector map. You can add and delete nodes and line segments, move nodes, split, connect or join line segments. Line segments can also be grouped into different layers.

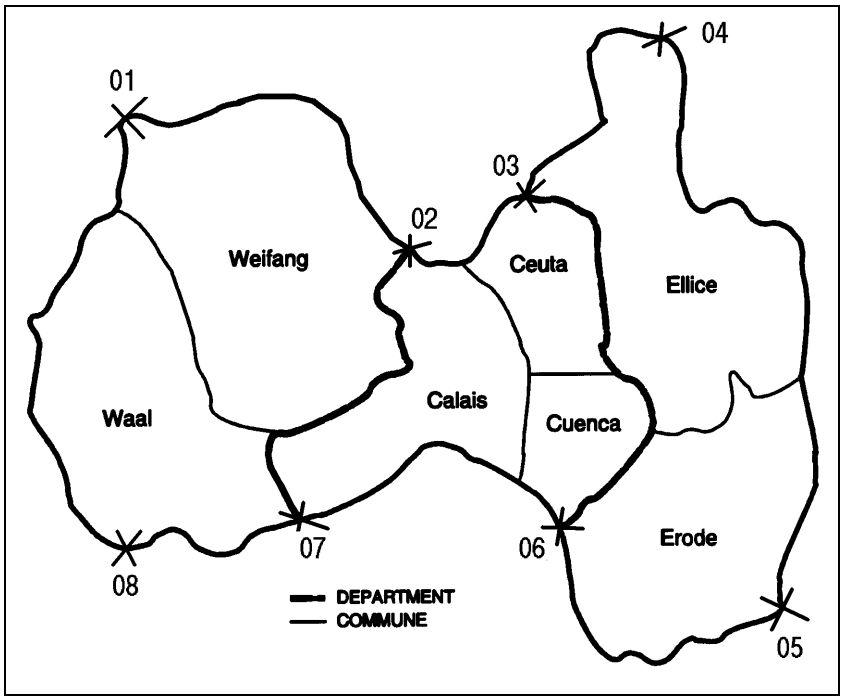
The generated vector map of Metaland is quite perfect and does not need any editing. However, you may wish to assign layer 2 for the department boundaries, and layer 3 for the commune boundaries. The country boundary will remain layer 1. First click on the #**2 layer bar** (blue) in the ToolBox, then on the **Assign Layer** tool. Click on the department boundary lines to set them to layer 2. Repeat the process to assign layer 3 (green) to the commune boundary lines.

Metaland map with three layers: Country, Department and Commune boundaries.



Step 7. Geo-referencing a map

After the vectorization process the map is in a relative coordinate system (plain *x*,*y*). This step will geo-reference the map by converting the generated vector data into a real-world coordinate system (Latitude/Longitude) using known ground control points and information about the map projection.

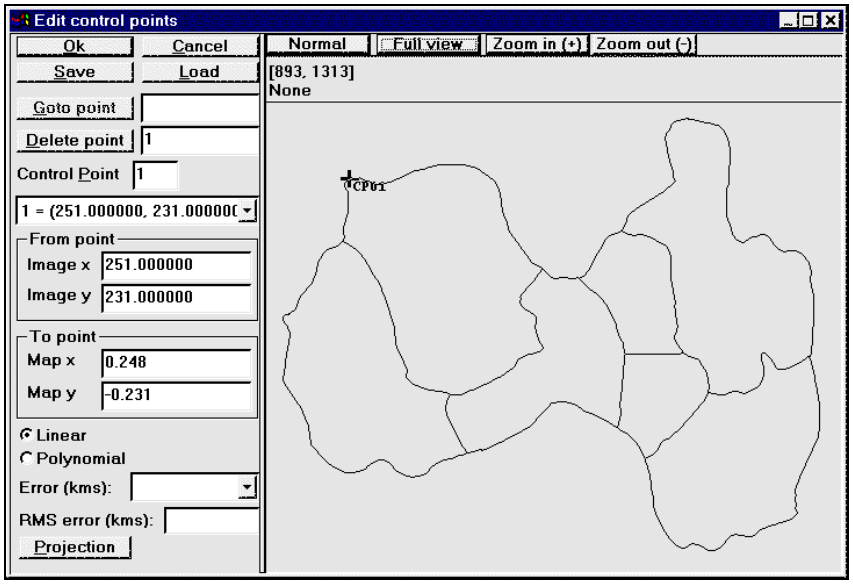


Metaland is a small fictitious country. We will geo-reference the map based on eight ground control points identified on the map. The real world coordinates of the control points are:

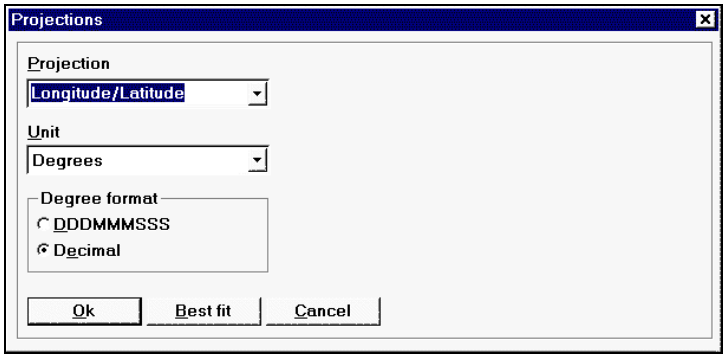
Control point	*Longitude*	*Latitude*
01	0.248 degrees East	0.231 degrees South
02	0.838 degrees East	0.505 degrees South
03	1.079 degrees East	0.390 degrees South
04	1.374 degrees East	0.070 degrees South
05	1.606 degrees East	1.250 degrees South
06	1.156 degrees East	1.079 degrees South
07	0.610 degrees East	1.065 degrees South
08	0.251 degrees East	1.125 degrees South

Click on **Georeferencing** in the **Edit** menu. Specify the control points by digitizing them on the map and entering their longitude/latitude coordinates. Note that East longitudes and North latitudes are entered as positive numbers, while West longitude and South latitudes are entered as negative numbers. Since Metaland occupies a very small area, select **Longitude/Latitude** from the **Projections** list box (this means no projection is applied), specify the unit and format of the coordinates entered in decimal degrees. Click **OK** once completed.

Digitize the control points on the map and enter the longitude/latitude coordinates in the Map X and Map Y boxes respectively.



Select the projection, unit and format.



Step 8. Exporting a vector map

Click on **Export Vector...** in the **File** menu to save the vector data. The generated vector data can be saved in these proprietary formats: ArcView Shapefile (SHP), MapInfo (MIF), AutoCAD DXF, PopMap (MAP and TXM) and MapScan (VEC).

The vector data has been extracted from the scanned image and saved in a file for use with other mapping or GIS software. If you need more practice, repeat the above steps and get more information on certain commands using MapScan's online help or the User's Guide and Reference Manual.

Exiting the program

Click on **Exit** in the **File** menu.

Chapter 4 Working with Raster Images

Acquiring scanned raster images

File/Acquire

MapScan for Windows can handle different formats of raster images. Today most scanners come with a standalone application for controlling the scanner and capturing scanned pictures (e.g., Deskscan for Hewlett Packard scanners), or for performing some OCR for textual pages (e.g., Caere Omnipage). Scanning software scans and saves maps in raster files using TIFF, JPG, PCX, or GIF formats.

In MapScan for Windows you can scan directly using the built-in support for any scanner compliant with the TWAIN standard. The Windows driver that comes with the scanner should be able to scan from any Windows application supporting the TWAIN standard. If the Windows driver does not support TWAIN, you can download* or obtain the most recent version from the scanner manufacturer.

In order to use the **Acquire...** command in the **File** menu, your scanner must be connected to the computer and turned on when you start MapScan. Make sure you have installed the TWAIN driver.

To acquire a scanned raster image

Place the image on the scanner surface.

Open MapScan.

Choose **Acquire...** from the **File** menu.

Select the appropriate software that is installed with your scanner.

Choose **Select**. The scanner software will launch and perform a Preview scan.

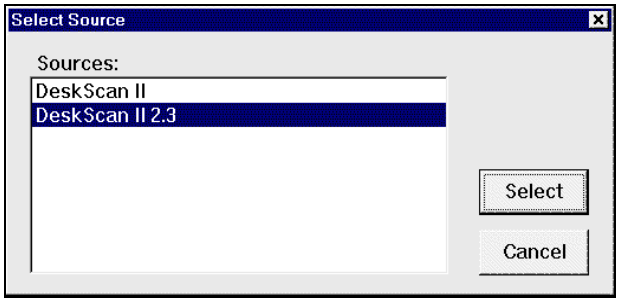
Make the necessary adjustments on the scanned image.

Choose **Final** to send the image directly to MapScan (the scanner software will close automatically).

Note: To get an exact output from detailed color drawings (such as maps), use **Detailed Color**. Always use **Autoexposure**.

Most computer hardware manufacturers provide for free the latest release of drivers for DOS, Windows 3.1, Windows 95 and NT on their web site. A good place to obtain Windows drivers is the WinFiles.com! web site at this address: http://windows95.com/drivers/scanners.html

Select the scanner driver to scan paper maps



The **Select Source** dialog box appears with the scanned raster image.

Shortcuts

Toolbar:

Keys:

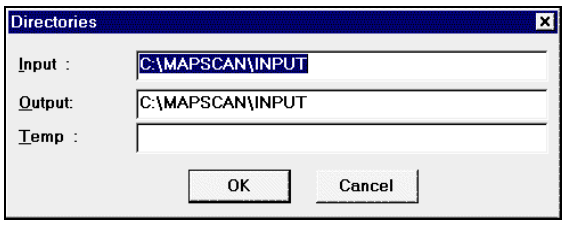
The process of scanning paper maps can be done outside MapScan. See Appendix A on preparing paper maps for scanning.

Handling raster image files

File/Preference/ Directories

This command will set the default input, output and temporary directories. When the **Open** or **Import** command is executed, MapScan searches for files in the default input directory unless a different path is specified. When the **Save** or **Export** command is executed, data will be directed to the default directory unless a different path is specified.

Setting the default directories



File/Open Image or Project

This command will open an existing image in a new window or a MapScan project.

Project file is stored in a MapScan specific ASCII format. The project file is used to save the current status of document windows such as the file names of an image, line data, point data, control points and other information such as color file. All the data (image, lines, points and control points) are saved separately in a file with the user-specified file names.

You can open multiple MapScan projects. Use the **Window** menu to switch between the multiple open documents. See Window 1, 2, ... command.

MapScan supports black and white, gray scale and color raster images of these formats: PC Paintbrush (PCX), Aldus Tagged Image File Format (TIF), CompuServe (GIF), JPEG/JFIF (JPG), Adobe Photoshop (PSD), Kodak Photo CD (PCD), MacPaint (MAC), Windows Metafile (WMF),

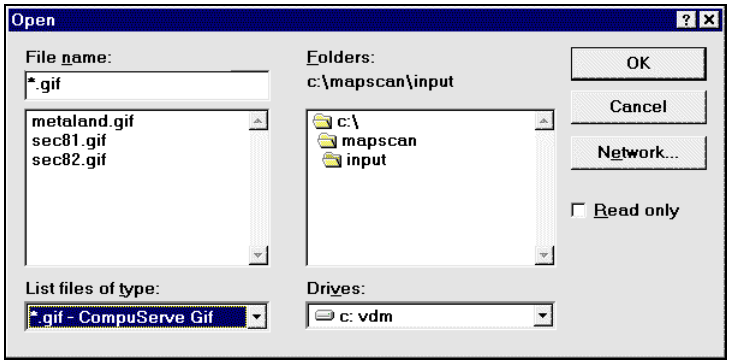
Microsoft Windows BMP and DIB (uncompressed and RLE compressed), Encapsulated Postscript (EPS raster image only), GEM Raster (IMG), WordPerfect (WPG raster image only).

Some other bitmap formats are supported as well: Cals (.CAL), MacIntosh Pict (.PCT), True Vision (.TGA), Multi-Page PCX (.DCX), Kofax (.KFX), Laser View (.LV), IFF ILBM (.IFF), Windows RLE BMP (.RLE), AT&T Group 4 (.ATT), Clip Board (.CLP), Windows Icon (.ICO), IOCA (.ICA), Story Board (.GX2), Halo Cut (.CUT), Brook Trout (.301), Microsoft Paint (.MSP), Sun Raster (.RAS), X Windows Dump (.XWD), X Paxmap (.XPM), and X Bitmap (.XBM).

To open a raster image for editing

1. Choose **Open Raster or Project...** from the **File** menu.
2. Specify the directory and the file in the **Open** dialog box.
3. Click the **OK** button.

The Raster Image or Project dialog box



Shortcuts

Toolbar: 

Keys: **Ctrl+O**

File/Save Project

This command will save a project file containing data layers, such as raster image, recognized text labels and vectorized line segments created with the MapScan processing functions. Use **File/Open Raster or Project...** command to open a project file.

Shortcuts

Toolbar:

Keys:

File/Save Image

This command will save the active document with its existing name and directory.

Shortcuts

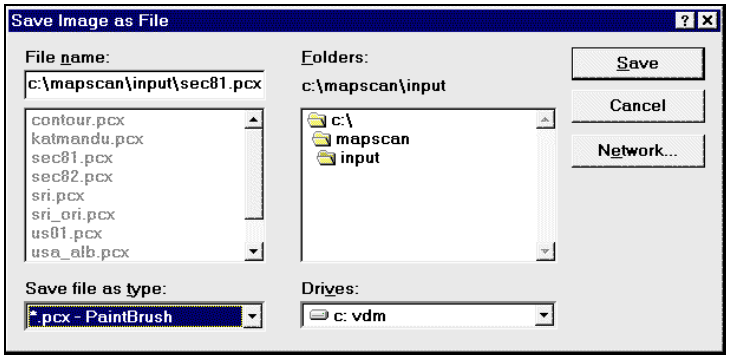
Toolbar: 

Keys: **Ctrl+S**

File/Save Image As

This command will save and name the active document. The **Save Image as File** dialog box opens for assigning the document's format and name.

Saving a raster image into a new file



Note: the **Save Image As...** command converts a raster map from one format into another.

Shortcuts

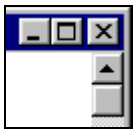
Toolbar:

Keys: **Ctrl+A**

File/Close

This command will close all windows. Save the changes on your document before you close it or all the changes will be lost. Use the **Save Image as File** dialog box to save the modified image into a new file. The original image will be maintained.

Clicking on the **Close** icon **X** at the upper right corner of the document window also closes the document.



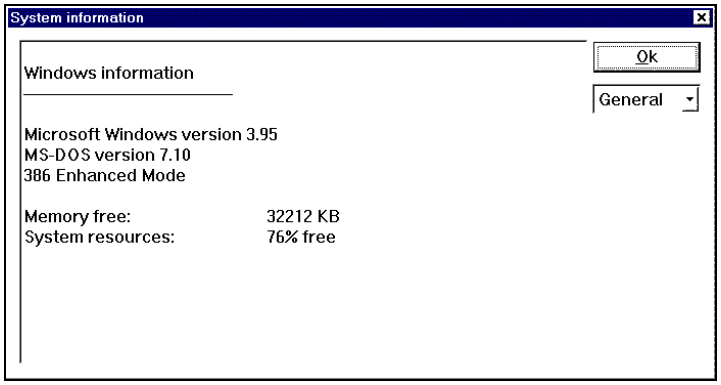
Shortcuts

Toolbar:

Keys:

File/System Information

This command will display the computer's configuration.



Shortcuts

Toolbar:

Keys:

File/Print/Raster

1. Choose the **Print** command from the **File** menu and select the **Raster** option.
2. A **Print Image** dialog box appears. Specify the range of pages, the number of copies, the destination printer, and other printer setup options.

Shortcuts

Toolbar:

Keys:

File/Print Setup

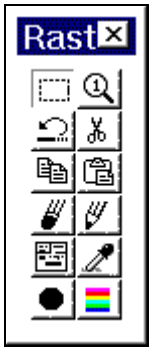
1. Choose **Print Setup** command from the **File** menu.
2. Specify the printer and the connection in the **Print Setup** dialog box.

Viewing raster images

View/ToolBox/Raster

This command will turn the **Raster** edit toolbox On or Off. By default the Raster edit toolbox is turned on when a raster image is opened. It is recommended to leave the toolbox ON during the raster editing process.

Raster edit toolbox



Shortcuts

Toolbar: 

Keys:

View/Toolbar

This command will turn the **Toolbar** On or Off. The Toolbar is located below the menus and contains icons representing (among others) a number of editing tools for raster images and/or vector maps. By default the Toolbar is turned on when a raster image or a vector map is opened. It is recommended to leave the Toolbar On during the editing process.

ToolBar

Shortcuts

Toolbar:

Keys:

View/Full View

This command will display the whole image on the screen.

Choose **Full View** from the **View** menu.

Shortcuts

Toolbar:

Keys:

View/Actual View

This command will allow you to view the raster image in its actual scale. Click on the **Actual View** command from the **View** menu, or click on the tool in the **Raster** Toolbox.

Shortcuts

ToolBox:

Keys:

View/Original View

This command will allow you to view the raster image in its original scale.

Shortcuts

Toolbar:
Keys:

View/Zoom-In

To enlarge the raster image on the screen

1. Click on the **Zoom In** command from the **View** menu, or click on the **Zoom In** tool .
2. Position the **Zoom In** tool on the desired area and click the <left> mouse button.
3. Apply step 2 several times to increase the zoom-in factor.

Shortcuts

Toolbar:
Keys: [F2].

View/Zoom-Out

To reduce the raster image on the screen

1. Click on the **Zoom Out** command from the **View** menu, or click on the **Zoom Out** tool .
2. Position the **Zoom Out** tool on the desired area and click the <left> mouse button.
3. Apply step 2 several times to increase the zoom-out factor.

Shortcuts

Toolbar:
Keys: [F3].

Editing raster images

Raster edit is the pre-processing stage when the quality of the scanned raster image is improved. This is when unwanted elements are cut and/or erased, additional items or correct broken lines are drawn, part of an image is copied, zoomed-in and out, an image is rotated, and multiple pages are merged into one raster image.

Editing is done methodically. Since a raster image is usually larger than the display monitor, the editing is done one screen at a time. Start with the top left corner of the image, and use the arrow key to canvas the image up/down and left/right.

MapScan supports black and white, gray scale and color raster images of these formats: PC Paintbrush (PCX), Aldus Tagged Image File Format (TIF), CompuServe (GIF), JPEG/JFIF (JPG), Adobe Photoshop (PSD), Kodak Photo CD (PCD), MacPaint (MAC), Windows Metafile (WMF), Microsoft Windows BMP and DIB (uncompressed and RLE compressed), Encapsulated Postscript (EPS raster image only), GEM Raster (IMG), WordPerfect (WPG raster image only).

The **Raster Edit** options are: Cut, Copy, Paste, Fat Cell Edit, Draw, Erase, Rotation, and Merge. These are in the **Edit** menu and are accessed through the **Raster** command, or through the **ToolBox** or the **Toolbar** in the **View** menu.

ToolBox

Here are the icons in the Raster edit ToolBox and the associated commands.

Icon	*Command*
	Selection
	Actual View tool (View menu)
	Undo (Edit menu)
	Fat Cell Edit (Edit menu)
	Cut (Edit menu)
	Copy (Edit menu)

Icon	*Command*
	Paste (Edit menu)
	Erase (Edit menu)
	Draw (Edit menu)
	Eye Dropper
	Show/Hide Brush Shape panel (View menu)
	Show/Hide Color Palette panel (View menu)

ToolBar

Raster edit tools in the ToolBar

Icon	*Command*
	Open Raster or Project (File menu)
	Save (File menu)
	Zoom-in (Edit menu)
	Zoom-out (Edit menu)
	Show/Hide Raster Edit ToolBox (View menu)

Selecting area

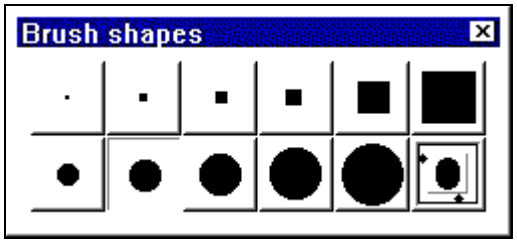
The **Raster Edit** commands (Cut and Copy for example) work only when there is a selected area (rectangle region) on the image.

To select an area

1. Click on the **Select** tool from the **Raster Edit** ToolBox.
2. Place the pointer on the top-left of the area.
3. Press and hold down the <left> mouse button, drag it to form a rectangle around the area and release the button.

Brush Shapes

The **Pen** and the **Eraser** can take different shapes and sizes. Use the **Brush shapes** panel to make your selection.



The items on the panel represent the shape and size of the drawing pen and the eraser. Click on the desired item to set the drawing and erasing tools.

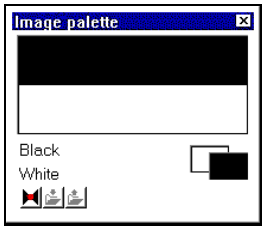
Choose the **Show Brush Shapes** command from the **View** menu to turn the **Brush shapes** panel On or Off, or click on the icon in the ToolBox.

Shortcuts

ToolBox:
Keys:

Drawing Pen Color

The **Pen** can be in black or white. Click on the desired color in the **Image palette**.



Choose the **Show Palette** command from the **View** menu to turn the image color palette On or Off, or click on the icon in the ToolBox.

Shortcuts

ToolBox:
Keys:

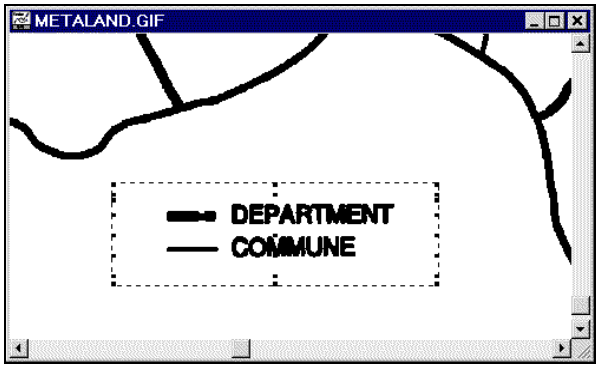
Edit/Raster/Cut

The **Cut** command is available only when the active image contains a selection. This command will remove the selection from the image and send it to the Windows Clipboard. The resulting "hole" is filled with the current background color.

To remove part of an image

1. Click on the **Select** tool tool and drag a rectangle to enclose the specific area of the image.
2. Click on the **Raster** command from the **Edit** menu and select the **Cut** option, or click on the tool .

Select and cut a region



Shortcuts

ToolBox: 
Keys:

Note: Use this tool to erase large unwanted features and annotations, dirt and spots on the raster image.

Edit/Raster/Copy

This command will copy and store an area of the raster image in the Windows Clipboard without affecting the image for use with the **Paste** command.

To copy part of an image

1. Click on the **Select** tool  tool and drag a rectangle to enclose a specific area of the image.
2. Click on the **Raster** command from the **Edit** menu and select the **Copy** option.

Shortcuts

ToolBox: 
Keys:

Note: The **Cut** and the **Copy** commands are not the same. When you **Cut** an area of the image the source area disappears; when you **Copy** the source area remains.

Edit/Raster/Paste

To paste the content of the Windows Clipboard into the raster image

1. Click on the **Raster** command from the **Edit** menu and select the **Paste** option, or click on the tool  . The content of the buffer appears at the top-left corner of the display.
2. Place the cursor on the pasted area. Press and hold the <left> mouse button, drag it to the desired location and release the button.

Shortcuts

ToolBox: 
Keys:

Edit/Undo

This command will reverse the last edit on the active image. It can remove painting or drawing commands, cut/copy/paste and color alterations.

Choose **Undo** from the Edit menu, or click on the tool  .

Shortcuts

ToolBox: 
Keys:

Edit/Raster/Fat Cell Edit

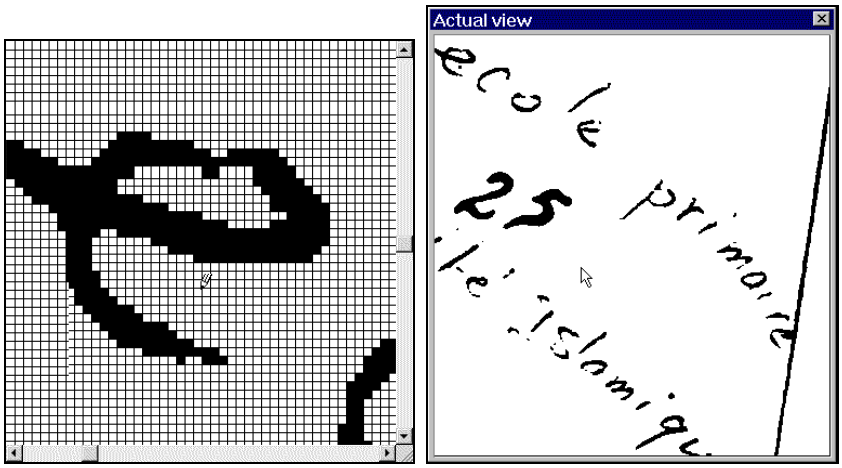
To edit the pixels of a raster image

1. Choose the **Raster** command from the **Edit menu** and select the **Fat Cell Edit** option, or click on the tool  . MapScan magnifies

the raster image in a grid window for the pixel editing. An **Actual view** window shows the actual size of the raster image.

2. To edit a grid pixel on the magnified window, point to a pixel and use the <left> mouse button to darken it, or the <right> mouse button to clear it. Changes are reflected in the **Actual view** window.
3. To exit the pixel editing mode select another editing tool or command.

Pixel editing screen on the left and the associated Actual view screen on the right showing the current location of the cursor



Shortcuts

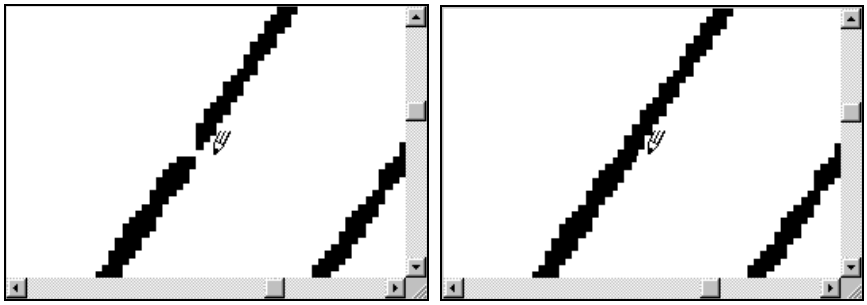
ToolBox: 
Keys:

Edit/Raster/Draw

To draw a missing linework or to close a gap

1. Choose the **Raster** command from the **Edit** menu and select the **Draw** option, or click on the tool  . The cursor changes to a pen.
2. Change the size of the brush by clicking on the tool. The Raster edit toolbox opens. Click on the desired brush size from the **Brush shapes** panel to set the size of the pen and select the color.
3. Position the tool where you will start painting. Press and hold the <left> mouse button and start coloring the image by moving the mouse.
4. When you have completed painting release the mouse button.
5. Exit the drawing mode by choosing another tool or another option in the menu.

Use the Pen to close the gap of a linework before and after editing.



Shortcuts

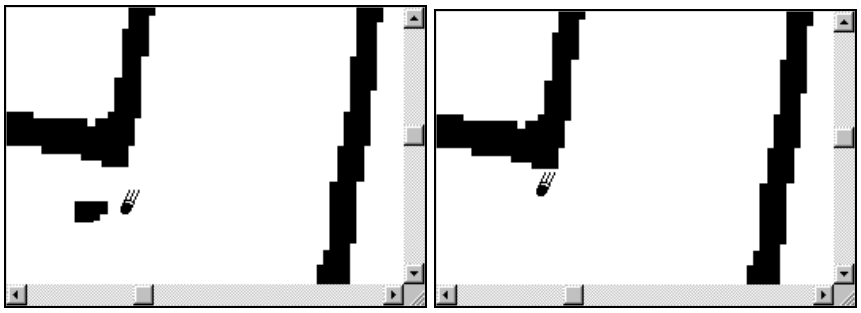
ToolBox: 
Keys:

Edit/Raster/Erase

To erase unwanted features on the raster image, unwanted annotations, dirt and spots

1. Choose **Tools** and the **Erase** option, or click on the tool  . The cursor changes to a square box.
2. Click on the desired size in the **Brush shapes** panel. Place the icon where you will start erasing. Press and hold the <left> mouse button. Release the mouse button once you are finished.
3. To end the command, select another icon in the toolbox or another option in the menu.

Use the Eraser to remove unwanted features on the raster image before and after editing.



Shortcuts

ToolBox: 
Keys:

Edit/Raster/ Rotation

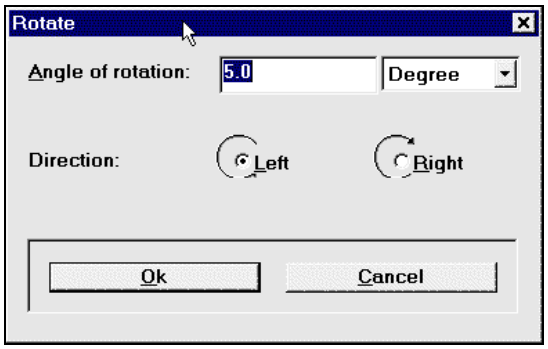
The **Rotate** command will spin an image clockwise 90 degrees and counter-clockwise 180 degrees, or an arbitrary angle.

To rotate the image

1. Choose the **Raster** command from the **Edit** menu and the **Rotation** option.
2. The **Rotation** list box opens. Select one of the prefixed angles +90, -90, 180 degrees, Others.

3. Select **Others** if you want an arbitrary angle. Specify the angle of rotation, unit and direction in the **Rotate** dialog box: right is clockwise, left is counter-clockwise.
4. Click on **OK** to rotate the image.

Control the rotation of raster image with an arbitrary angle.



Shortcuts

Toolbar:
Keys:

File/Preference/Merge Mode

This command will set the mode for the **Merge** command. The two modes are **Overwrite** and **Transparent**.

The **Overwrite** mode merges the second image page on top of the first image page. The portion of the first page that is hidden by the second page will be ignored. This mode is recommended if the edges of the two pages are well cut for the **Merge** to produce a clear edge intersection.

The **Transparent** mode produces a “transparent” background of the second page. The merged image will include all the features of the first page underneath it.

Edit/Raster/Merge

This command will merge multiple pages into one raster image. It is useful when the paper map exceeds the size of the scanner, or when there are multiple pages to scan. It is important for each pair of adjacent scanned map pages to have a common border area (overlap area) where you can mark the registration points. Use a dark pen to mark the registration points on the common border areas to easily identify them in the scanned images. The **Merge** command processes two pages at a time and can be repeated as many times.

Instead of merging pages of a raster image, there is an option to vectorize each page. After this, use **Vector**/**Merge** from the **Edit** menu to merge the vectorized pages and produce a seamless vector map.

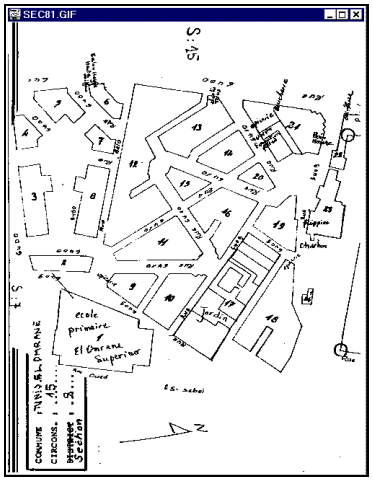
Shortcuts

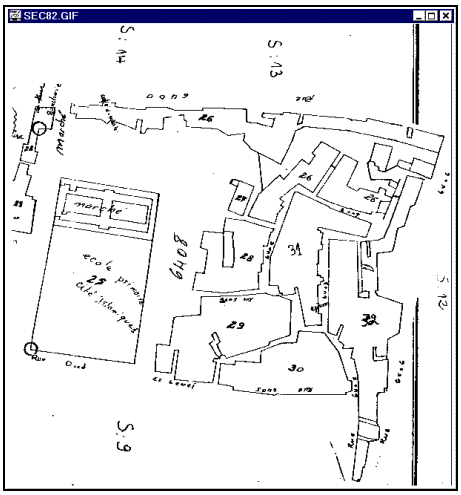
Toolbar:
Keys:

To merge pages of an image

1. Open the two pages you will merge. For this exercise open the two files SEC81.GIF and SEC82.GIF. These are two pages of a census block map supplied with MapScan.

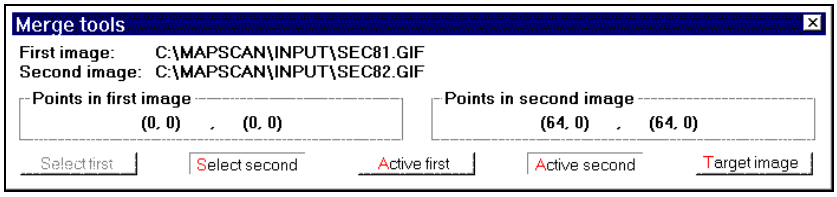
Open the two pages for the Merge command. Note that there is an overlap area on the left side of SEC81 and on the right side of SEC82, and two markers (control points) are specified with circles in the overlap area on each page.





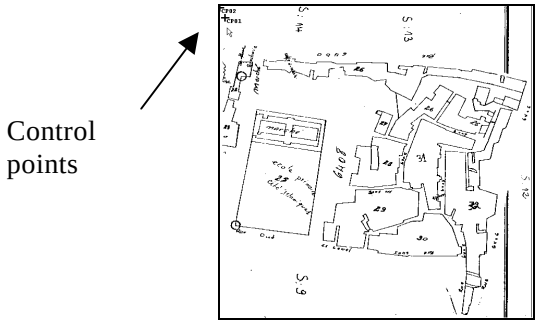
2. Specify the merge option by clicking on **Preference** from the **File** menu. Select **Merge Mode** and the **Overwrite** option.
3. Perform the merging operation with the **Raster** command from the **Edit** menu and the **Merge...** option. The **Merge tools** dialog box appears.
4. Click on the **First image** to activate it, then click on the **Select first** button to set the first page. Repeat the proces to set the **Second image**.

Set the First and Second page image



5. To access the first and second merged page for setting the control points, click on the **Active first** and **Active second** buttons respectively. The two control points CP01 and CP02 are shown at the upper left corner of the first and the second merged page.

Image page screen with the marker for the merge command

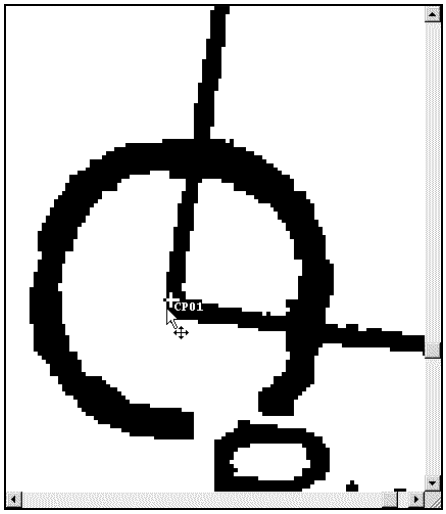


Place the control points in the circled markers of the overlap area of each merged page: CP01 at the lower one and CP02 at the upper one. Activate the first page. Move the cursor near the CP01 control point and notice that it changes to a cross. Now click and hold the <left> mouse button and drag the CP01 control point to the lower marker. Release the button to anchor the control point. Repeat the procedure to place the second control point for the first merged page, and the two control points for the second merged page.

The location of the control points is very important in merging pages. The **Merge Mode** command will not produce the right target image if the control points are incorrectly located. Use **Full view** to locate the control points globally, then **Zoom In** on the page for fine-tuning. Make sure you are in Selection mode when you get and move a control point.

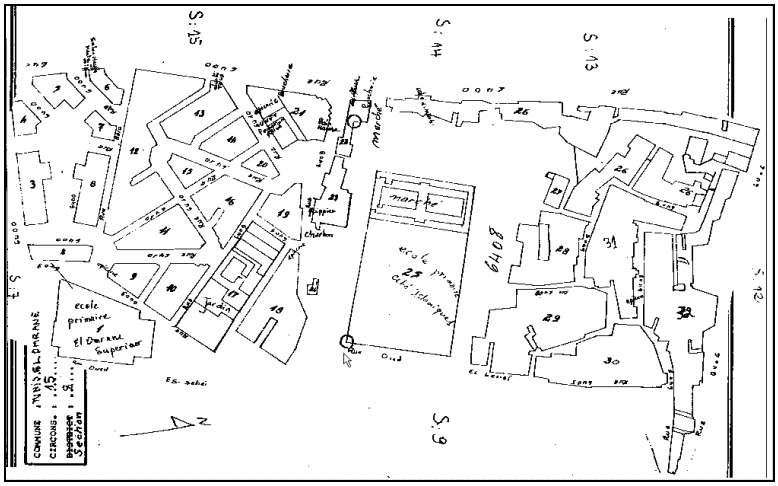
Click on the **Select** tool to activate the Selection mode.

Enlarge image to locate the marker more accurately.



6. Click on the **Target Image** button to check the raster image output. If the first page does not match with the second page return to step 3 and adjust the locations of the markers.

The first and second pages are merged at the control points



Use the **Save As** command to save the target raster image.

Processing raster images

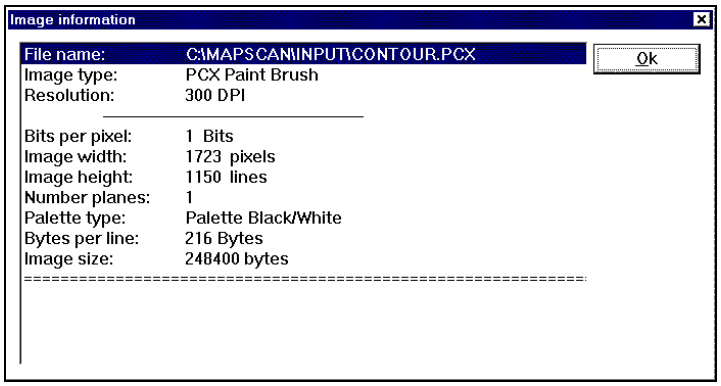
The image processing functions improve the quality and produce better vectorizing results. For example, image erosion can be applied to grayscale and monochrome image respectively to remove image noise. To change the image orientation, use the Rotate command (for 90 degrees, 180 degrees or a specified angle).

For 1-bit monochrome (black and white) or grayscale images, go to the next step to start the vectorization process. For a color image you may first perform a classification to clean the color image before vectorizing it. Other image processing functions in the Image menu can correct the image orientation, set up threshold, crop a section, set up a region of interest to vectorize and to resample.

Image/Information

This command displays information about the raster image in the active window, such as the file name, graphic format, scanned resolution, color depth and image size.

The image information screen



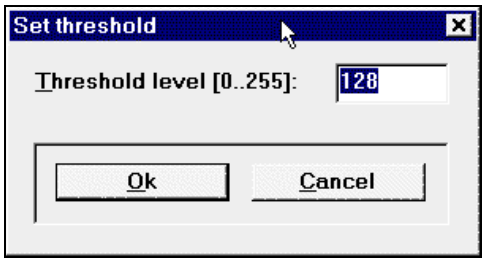
Shortcuts

Toolbar:
Keys:

Image/Set Threshold

The **Image/Set Threshold** command will set a grayscale value threshold. When you convert a grayscale image into black and white, values higher than the threshold will be changed to white and those with lesser values to black. This command is applicable only for raster images of 256 (8-bit) grayscales.

The Set threshold dialog box



Shortcuts

Toolbar:
Keys:

Image/Set Layer Color

Color images are vectorized one color class at a time. The **Image/Set Layer color...** command sets a color class for the vectorization process. You can apply this command only for color-classified raster images.

Use the **Vectorize/Auto** command to vectorize lineworks for the active color selected in the color palette. Zoom-in on the raster image to easily select the color zone.

A specific layer can be assigned to the vector line segments generated from a linework. By doing this you can produce, for example, ROAD from RED line, RIVER from BLUE line, COUNTRY BOUNDARIES from BLACK line, ... and you can skip the Layer Assignment process for the vector map.

Shortcuts

Toolbar:
Keys:

Image/Supervised Classification

The **Image**/**Supervised Classification** command will reduce the number of colors on the raster image in a supervised manner. This can be applied only to 8-bit grayscale or 8-bit color raster images. The user specifies the number of color classes and MapScan will reduce the color depth by forcing colors on the original image into the specified color classes of the new image. Similar colors that are near a specified color class will be converted into this color class.

To execute the command

1. Make sure the raster image is an 8-bit grayscale or 8-bit color (refer to the **Image/Enhancement**/**Conversion** command on how to convert images.)
2. Choose **Supervised Classification** from the **Image** menu.
3. Drag a small rectangle over a region to select it as a training pattern (representative of classes). A training pattern should be identified as one color class.
4. Repeat the process to select other training patterns. The number of selected regions is the number of classes.
5. Click on **OK**.

The Supervised Classification command will display the classification results.

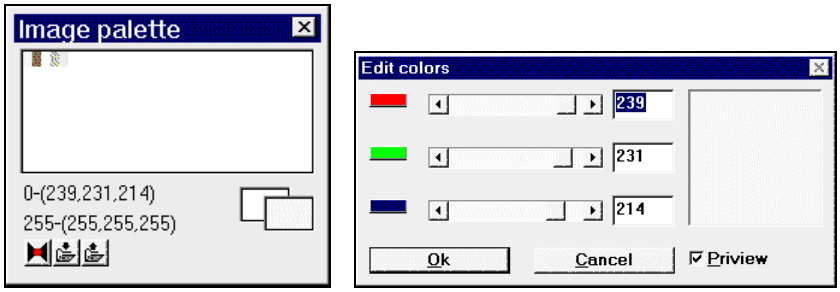
In order to easily select the color zone, zoom-in on the raster image.

To change the color of classification result of one or all classes

1. Click on the **Image palette** tool  to turn it on.
2. Select the color you will change from dialog box. The selected color appears in the lower right corner of the palette box.

3. Click on the color box to open the **Edit colors** dialog box. Prepare the colors and when done, click **OK**.

Select and change the color of a color class



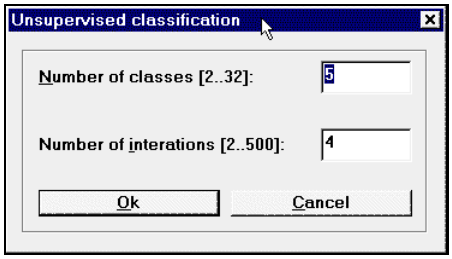
Shortcuts

Toolbar:
Keys:

Image/Unsupervised Classification

The **Image/Unsupervised Classification** command will reduce the number of colors on the raster image in an unsupervised manner. This command applies only to 8-bit grayscale or 8-bit color raster images. The user decides on the number of color classes for the target image, and MapScan decides on the colors and then converts the image colors.

The dialog box to set the parameters for the Unsupervised Classification command



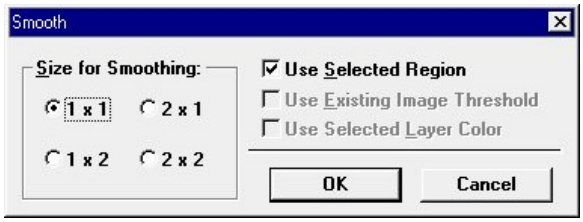
Shortcuts

Toolbar:
Keys:

Image/Smooth

This command is used to smooth the line work with noise on the border. In the dialog box, specify the desired option and click OK to execute the command.

If a region was selected prior to starting the command, there is an option to specify whether the command should apply to the whole raster image, or only to the selected region.



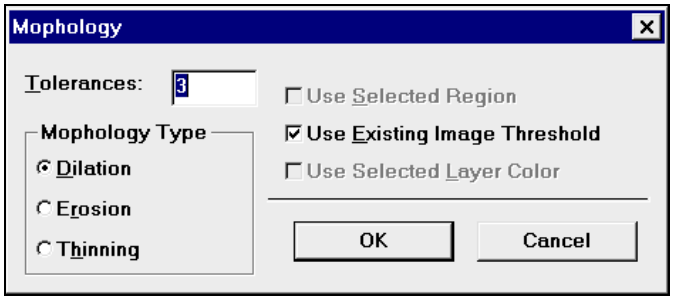
The command uses a matrix of pixels to smooth the edges and remove artifacts and minor defects. The following masks (matrix of pixels) are available: 1x2, 2x1, 1x1, 1x2. Each mask eliminates and smooths different configurations of pixels. This command can remove the following noises based on the selected mask:

Mask (1x1)	*Mask (1x2)*	*Mask (2x1)*	*Mask (2x2)*
x xxxxxxx	xx xxxxxxxxxx xxxxxxxxxx	x x xxxxxxxxxx	xx xx
X	Xx	x x	xx xx

Image/Digital Morphology

This command will make changes on the linework, such as increase and/or decrease the size of the linework, and thin the linework to one pixel width.

The Digital Morphology dialog box



To increase the size of the linework, choose **Digital Morphology** from the **Image** menu and the **Dilation** option.

The **Morphology Type** has three options. **Dilation** increases the size of the linework; **Erosion** decreases the size of the linework; and **Thinning** thins the linework and reduces the width.

Tolerances is for setting the number of pixels for the **Dilation** and the **Erosion** operations. The thinning operation always thins the linework and reduces the width to one pixel.

Digital Morphology can apply to a rectangle region or to the entire raster image. To use it for a region, select and drag a rectangle region on the raster image before selecting the command.

It also can apply to a linework of a specific color in a classified grayscale or color raster image. Select a color class before executing the command.

Boundaries are presented sometimes as broken lines. Use an appropriate **Tolerance** setting to enable the **Dilation** process to close the gaps and produce a continuous linework from these broken boundary lines for the vectorization process.

In some cases a scanned image may have tiny dots for the dirt or noises. An appropriate Tolerance setting for the Erosion process will clean the dots and avoid vectorizing these unwanted features.

Shortcuts

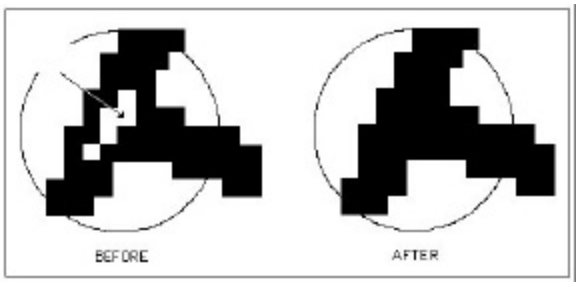
Toolbar:
Keys:

Image/Filtering

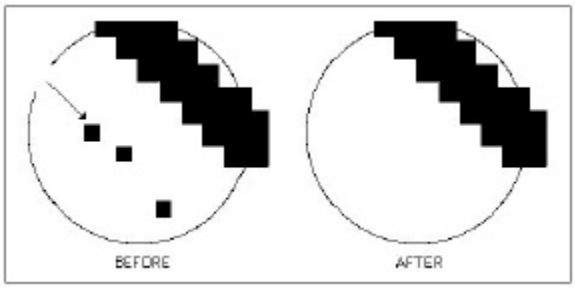
This command has two functions: (1) fill the holes in the middle of the line work, and (2) remove noises. It can be applied globally on the whole raster image or on a selected region.

Specify the filter type in the dialog box (fill holes or remove noises) and the threshold measured in pixel. If a region has been selected before starting the command, there is an option to specify whether the command should apply to the whole raster image or only to the selected region.

The **Fill Holes** option will fill holes (blank pixels) that do not reach the threshold. This can make the linework "solid" (continuous) and produce smoother line segments during the vectorization process.

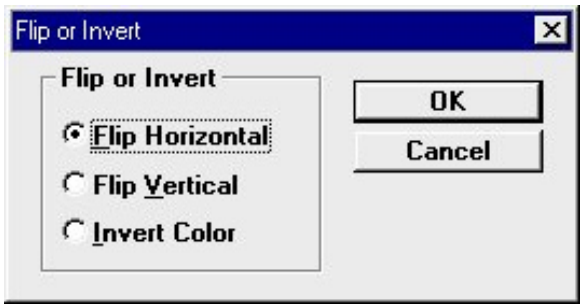


The **Remove Noises** option will remove noises that do not reach the threshold and will not vectorize unwanted features on the raster image.



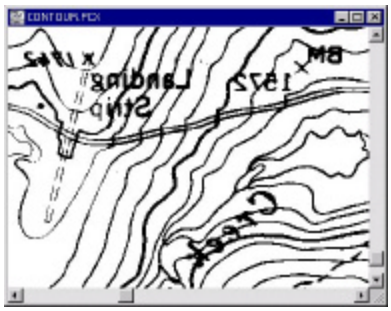
Image/Flip or Invert

This command will flip a raster image horizontally or vertically, and invert the color of a raster image. From the dialog box, select the desired option and click **OK** to execute the command.

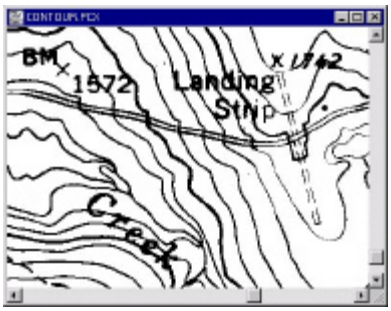


Flip horizontal

Before

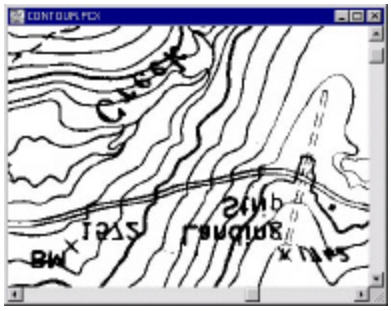


After

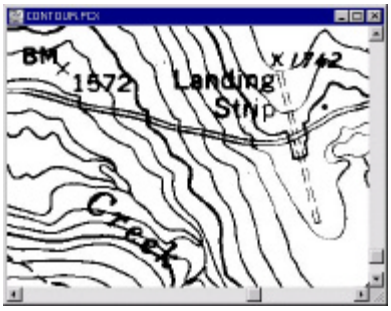


Flip vertical

Before



After



Image/Enhancement

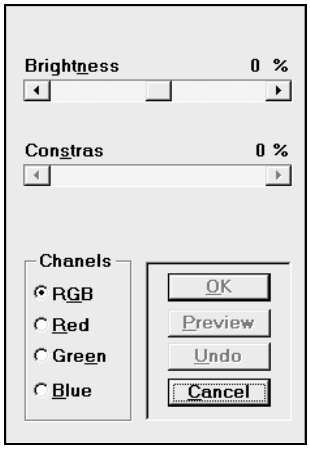
The three functions for adjusting an image are:

- Brightness & Contrast
- Gamma Correction
- Color Separation

Brightness & Contrast

Use **Brightness & Contrast** to brighten or darken an entire image or a selected part, or increase or decrease the range of luminance (contrast). In other words, the Brightness setting shifts the entire histogram, and the Contrast setting stretches or compresses it.

Brightness and Contrast controls

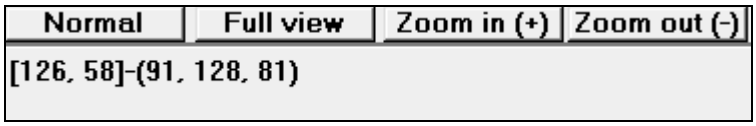


Brightness shifts the entire histogram in the direction of change. Positive 100% turns an image or a selected part pure white; negative 100% turns it pure black.

Contrast with a positive change flattens the histogram and produces a wider range of luminance. A negative change tightens the histogram and produces a narrower range of luminance.

In adjusting the brightness and contrast of the image, MapScan creates a separate window with a copy of the image, allowing the user to control the display of the image as well as to preview the adjustment effect.

The button controls for the display of the image



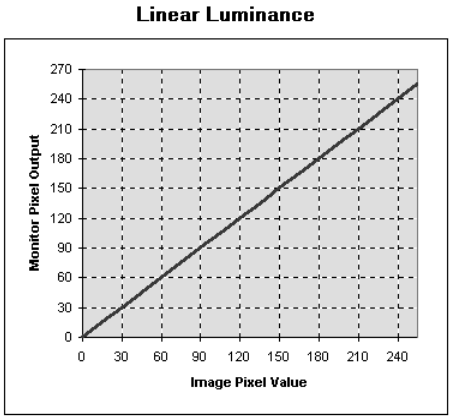
Gamma Correction

Gamma Correction will compensate for any difference in the gamma levels between the computer monitor and the equipment that originally produced the image.

An image is stored in computer memory as a series of numbers. The value of a pixel can be described in several ways depending on the image's format. All formats have one thing in common: a higher number means a brighter color value. This rule has two corollaries: the highest possible combination of values for a pixel produces pure white, and the lowest possible combination produces pure black.

It would logically follow that a value halfway up any scale would have a luminance exactly between black and white. This assumes that our hypothetical scale would allow an integer value exactly in the middle that in reality would not: image formats are based on powers of two so integer midpoints are not possible.

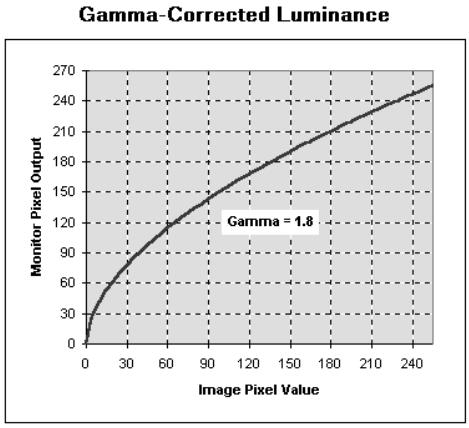
To overcome this hurdle, let us consider an approximate midpoint. To put it in reality let us assume that the image is in a 256-color gray scale format. The graph of a monitor's pixel output over the potential pixel values of an image would look like the diagram entitled "Linear Luminance" below. Our approximate midpoint - say 120 - would produce an identical luminance on the monitor.



A computer monitor displays colors by exciting phosphors on the screen. Unfortunately, phosphors do not excite linearly. For example, if a computer reads a luminance value from a photographic image and sends it directly to the monitor, the displayed color will be dimmer than in the original photograph.

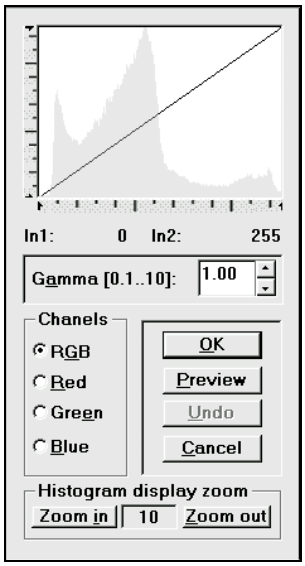
As you may have already guessed, this is where **Gamma Correction** comes in. A gamma correction value adjusts for the non-linearity of

Luminance" below provides an example of how gamma correction can alter the color values sent to a computer monitor. In this case, our approximate midpoint of 120 produces a monitor value of 168.



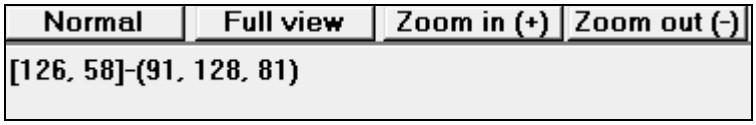
To enhance the raster image, choose the **Enhancement** command from the **Image** menu and the option **Gamma**. Adjust the Gamma value using the Up and Down arrow icons. Click on **Preview** to observe the changes. Gamma correction can be applied to the **RGB**, **Red**, **Green** and **Blue** channels. Click on **OK** when the adjustment is satisfactory.

Control panel for the Gamma Correction command



When the brightness and contrast of the image is being adjusted, a window appears with a copy of the image to allow the user to control the display of the image and to preview the adjustment effect.

The control buttons for the image display



Color Separation

There are color definition methods for defining the color display of a computer monitor. The two most common methods are (1) the red, green and blue method (RGB), and (2) the hue, saturation, and luminance method (HSL). The table below outlines the RGB and HSL settings for the standard, white light color spectrum.

Color	***RGB***	***Settings***	***HSL***	***Settings***		
Red	Green	Blue	Hue	Saturation	Luminance	
Red	255	0	0	0	240	120
Orange	255	128	0	20	240	120
Yellow	255	255	0	80	240	120
Green	0	255	0	80	240	120
Azure	0	255	255	120	240	120
Indigo	0	0	255	160	240	120
Violet	255	0	255	200	240	120

The red, green and blue method (RGB) is the most popular for defining a projected color. For example, pure red is defined by red = 100%, green = 0%, and blue = 0%. Pure black has red, green, and blue values of 0%, and pure white has red, green, and blue values of 100%.

A projected color can be defined by the three components of hue, saturation, and luminance.

Hue describes the shade or tint of a color. It is measured on a circular spectrum running from red to green to blue and returning to red.

Saturation describes the hue's purity. A color with a saturation of 100% is bright and vivid, and a color with a saturation of 0% is a shade of gray.

Luminance describes the brightness of a color. A luminance of 100% is always pure white, and a luminance of 0% is always pure black.

Color Channels Functions

The **RGB Channels** is used to split the RGB color channel data.

When you split the color channels of an image, you create three gray scale images based on the source image's RGB channels. The images will be named "*-R.PCX" (Red), "*-G.PCX" (Green), and "*-B.PCX" (Blue) prefixed by a common numbered name (for example, "IMG03").

Choose **Enhancement** from the **Image** menu to split the active image. Select the **Color Separation** option and the **RGB Channel** from the list box.

Image/Conversion

This command will convert a raster image to:

- **8-bit grayscale**
- **4-bit grayscale**
- **8-bit color**
- **4-bit color**
- **black/white (1-bit)**

All conversions apply to color images. For grayscale images, the 8- and 4-bit color conversions are not applicable.

Chapter 5 Extracting Text Labels

(bitmap) contains text labels that are treated as pictures and therefore cannot be edited. **O**ptical **C** **R**ecognition (**OCR**) module is needed to process these text labels. OCR reads, recognizes and stores the ASCII text with the coordinates into a reference text file.

The OCR process is interactive. The user marks a text label; MapScan proceeds the recognition and shows the enlarged raster text label and the recognized ASCII text. The user has the option to edit the recognized text and confirm the text label. MapScan will erase the text label from the raster image once the recognition result is confirmed.

The recognized text and associated coordinates, together with vector lines, can be saved in different geographic file formats for later use.

The MapScan OCR uses a pattern recognition technique known as *feature extraction*. In this structural classification method each character is broken down into various features: diagonal lines, horizontal lines, curves, and so on. The program then matches these features to its understanding of what characters look like. If it sees two vertical lines connected by a horizontal bar in the middle, it figures this is probably an "H".

The good thing about feature extraction is that it can recognize a number of different fonts because their basic makeup is so similar. That is an "s" in one font is pretty similar to an "s" in another font. Difficulties arise when many fonts are to be handled for example decorative fonts with unusual forms or a poor quality document.

Things to remember using MapScan:

The print should be reasonably clean and crisp. Characters must be distinct and separated from each other, not overlapping, and not blotched together.

The document should be free of notes, lines, or doodles. Anything that is not a printed character slows recognition, and any character distorted by a mark will be unrecognizable.

The document font should be non-stylized; for example, MapScan cannot recognize the Zapf Chancery font accurately. Underlined text is difficult to recognize because the underline changes the shape of descenders on the letters q, g, y, p, and j (notice: q, g, y, p, j).

What MapScan can and cannot read

MapScan recognizes most serif fonts (i.e.: Courier, Times Roman, etc.), and sans-serif fonts (i.e.: Helvetica, Arial, etc.) regardless of the size and style (normal or bold). However, italic text might not be well interpreted. Handwritten text, cursive fonts and non-roman character sets (Arabic, Chinese, Japanese, Cyrillic, etc.) cannot be recognized.

If you have such documents, you can either (a) erase the text labels on the paper or on the image (manually or using some image processing 25, -36
and trace interactively only the boundary line features (see pages).

If you keep the text on the map and use the automatic vectorization

into lines. In this case, use the **Edit/Vector Remove Dirt** command to remove below a given threshold size the relatively small lines that make *Remove Dirt*, page and
Preference/Tolerances/Vector Editing 62)

Note: Most OCR programs, including MapScan, have difficulties with text scanned at an angle or with skewed labels in general. Scanning the page straight is important to obtain good results. You can also rotate images with an image editing software, but generally the image quality degrades with the rotation and makes character recognition more difficult.

File/Preferences/ Recognize Mode

This command will set the mode of the text label recognition process. In **Interactive** mode the user marks a text label, and MapScan proceeds the recognition. A dialog box appears with the magnified raster text label and the recognized ASCII text. The user can interactively edit the text and confirm the recognition result.

In **Auto** mode, the user marks a text label, and MapScan proceeds the

The future release of MapScan will support the use of PopMap geographic area names and area IDs. Recognized text labels will be

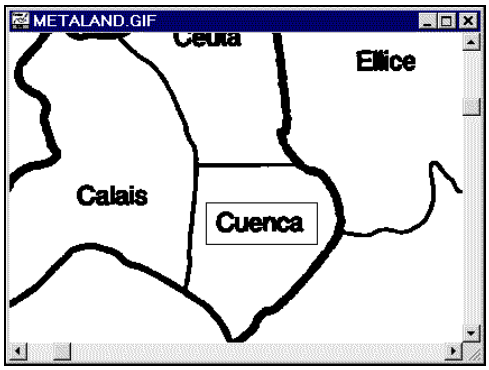
database, and the geo-code associated with text label will be generated for immediate use in PopMap.

Recognition/Text

To mark the labels for the OCR

1. Put the cursor on the upper left corner of the text area, and press and hold the <left> button.
2. Drag the cursor to the lower right corner of the text area to put the entire text in the box.
3. Release the mouse button.

Mark text labels for the recognition



Recognizing a text label with the option to edit and confirm the result

Shortcuts

Toolbar:
Keys:

A text that overlaps with a linework is considered critical and will be treated differently. MapScan will retain the linework that overlaps with the text.

This command recognizes each marked text label. MapScan shows the enlarged raster text label and displays the recognized ASCII text that can be edited. Use the arrow keys to move the cursor on the line and edit the text. When completed, click on the **OK** button. MapScan erases the text label from the raster image, and appends the recognized text and its coordinates into the reference text file.

If a text label overlaps with a linework (critical text area), MapScan will keep the overlapping area intact. You can use the Raster Edit module to clean the raster image (refer to the *Cut* and *Erase* tools), or the Vector Edit module to delete the unwanted line segments (see *Delete segment*).

Note: If the page is crooked in the zone window, or the text is slanted in

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Recognition/ Symbol

This command is used to recognize the symbols on the raster image.

Shortcuts

Keys:

Chapter 6 Vectorization

MapScan accepts bitmap source images (black and white, gray scale or color) in any of the following formats: PC Paintbrush (PCX), Aldus Tagged Image File Format (TIF), CompuServe (GIF), JPEG/JFIF (JPG), Adobe Photoshop (PSD), Kodak Photo CD (PCD), MacPaint (MAC), Windows Metafile (WMF), Microsoft Windows BMP and DIB (uncompressed and RLE compressed), Encapsulated Postscript (EPS raster image only), GEM Raster (IMG), WordPerfect (WPG raster image only).

It produces output vector maps in AutoCAD (DXF), Atlas GIS (BNA), ArcView Shape file (SHP), MapInfo exchange file (MIF/MID), as well as MapScan (VEC) , PopMap* for DOS (MAP), and PopMap for Windows (TXM) formats.. There are two vectorization modes: automatic and interactive tracing, with an option to run (unattended) a vectorization batch job for several raster images.

The raster-to-vector conversion involves three basic operations: skeletonization or line thinning, line extraction or vectorization, and topology reconstruction.

Line thinning is an automatic process of thinning the lines in a raster object until these are uniformly one cell wide. The process starts from the edges of the line, then moves inward to the center, successively peeling off outside layers of cells. The thinned raster line is the center of a wider line peeled from the scanned image.

Line extraction is an automatic process of identifying a series of data entities or coordinates that constitute an individual line segment portrayed on the input document. The required input is a raster object with lines that are continuous and uniformly one pixel wide, such as the output from the raster line thinning process. It is essential that the boundaries of the mapping units form closed polygons, and all unwanted notations and text are removed.

Unwanted vector elements after the line extraction process can be removed during the vector editing. An automatic vector tolerance can be set as part of the vectorization. The tolerance level varies from 0 to 99. The lower the tolerance, the more precise the vectorization, but more nodes will be generated for the vector output file. For further details, see page .

Topology reconstruction is the process of determining the adjacency relationships among the line segments. Individual line segments are joined into whole line features and maps are built as continuous area representation.

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* PopMap is a software developed by the United Nations Population Fund and the United Nations Statistics Division. It is an integrated software package for geographical information, maps and graphics database.

To vectorize a raster image

1. Open a raster image.
2. Specify the tolerance for the vectorization.
3. Specify the vectorization mode.
4. Perform the vectorization.
5. Save the output vector map.

The line vectorization method (also called centerline method) is good for

images that are mainly line drawings.

However, avoid vectorizing maps with dark backgrounds and large

the outline and will attempt to reduce the area to a dot. A workaround is to (a) use correction fluid ("whiteout") to erase or fill in the area(s). You

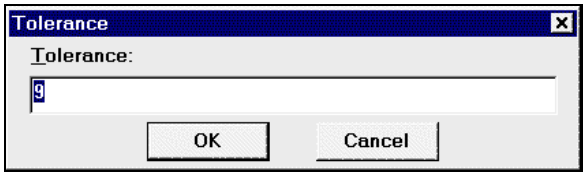
as MapScan Raster Editor, Adobe Photoshop or JASC Paint Shop Pro, before processing the image, or (b) trace interactively only the boundary

Setting parameters

File/Preference/ Tolerances/For Vectorizing…

To set the tolerance level for the vectorization process

1. **Preferences** from the **File** **Tolerances…** option. Select **For Vectorizing…**
2. lower the tolerance, the more precise is the vectorization, but more nodes will be generated for the vector output file. We recommend



Press <**Enter**>.

Note: A 0-tolerance level gives the most detailed tracing. A 2-5 tolerance level can be used to smooth unwanted line defects and to generalize boundaries. Greater tolerance levels generally produce a high level of simplification and should be used only when required.

File/Preference/ Vectorization

This option is used to set the mode of the vectorization process to **Center Line** or **Boundary Line**. In Center Line mode line segments are extracted by tracing the center of all line features. In Boundary Line mode, line segments are extracted by tracing the outer boundaries of all features.

File/Preference/ Simplification

This option is used to set the simplification mode for the vectorization process. MapScan simplifies a vector map by eliminating nodes that are not significant under a chosen criteria.

The user can decide not to use any simplification or select one of the three simplification methods: **Douglas-Peucker**, **Band Width** and **Angle**. If no simplification is specified, MapScan will preserve every node that is generated from the vectorization process.

Douglas-Peucker method

Given a polyline with a staring and an ending node and a tolerance theta, a node is identified so that its distance to the straight line connecting the starting and ending node is maximal. If this distance is less than theta, only the starting and the ending node are keep from the polyline. In other case, repeat the procedure for the two new polylines that were split at the specified node.

Bandwidth method

Given a polyline of nodes 1, 2, … and N and a tolerance theta as the bandwidth, a node k is identified so that the distance from all nodes 1, 2, … and k to the straight line connecting node 1 and node N is less than theta. Keep node 1 and node k. If k is less than n, repeat the procedure for the polyline of nodes k+1, k+2, … and N. In other case, stop the procedure.

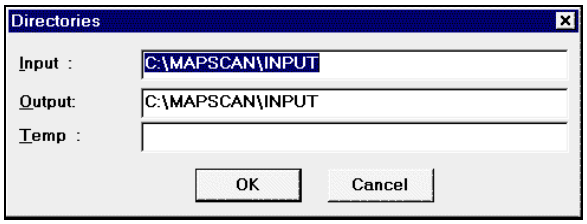
Angle method

The tolerance theta is an angle (measured in degrees, in general, theta must be close to 180 to produce an acceptable simplification). A node k is identified so that the angle formed from the three nodes k-1, k and k+1 is greater than theta. Delete node k and repeat the procedure for the new polyline. Stop the procedure, if no node satisfies the condition.

File/Preference/ Directory

This command will set the default input, output and temporary directories. When the **Open** or Import command is executed, MapScan will look for files in the default input directory unless another path is specified. When you **Save** or export a file, this will be directed to the default directory unless another path is specified. For the batch vectorization, MapScan will process all raster image files in the default input directory.

The setting default directories dialog box



Proceeding vectorization

Vectorize/Auto

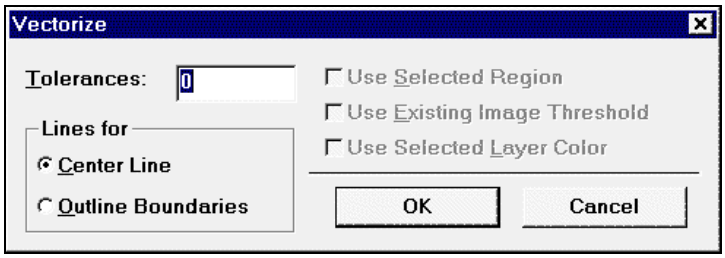
The **Vectorization**/**Auto** command will execute the raster-to-vector conversion. Depending on the raster image, either the Center Line or the Boundary Line mode can be selected.

This command will automatically vectorize the raster image in the active window.

To vectorize one file

1. Open the raster image file.
2. Set the complexity of the output vector map by using the **File**/**Preference**/**Tolerances**/**For Vectorizing...** command.
3. Select the automatic vectorization mode by using the **Vectorize**/**Auto** command).

The dialog box with the controls to set the parameters and the mode for the vectorization process



There is an option to vectorize only a specific region.

To select and vectorize a selected region (rectangle area)

1. Click on the Select tool.
2. Drag a rectangle over the target area.
3. Choose **Auto** from the **Vectorize** menu. The Vectorize dialog box appears with the option **Use Selected Region**.
4. Click on **OK** to vectorize the selected region. Click on **Cancel** to ignore the process.

Vectorize/Batch

This command will perform a raster-to-vector conversion of all the raster image files in the default input directory.

To vectorize several files

1. The first step is to enter the default input and output directories. Choose **Preference** from **File** menu and select **Directories** from the list box. The Directories dialog box appears.
2. Set the complexity of the resulting vector map. Return to **Preference**; select **Tolerances** from the list box and the option **For Vectorizing...** to open the Tolerance dialog box.
3. Select the raster image files. Choose **Batch** from the **Vectorize** menu and press on the **Add** button. A dialog box appears to display the listing of files and directories. Select one or several raster image files.

4. Set the output vector map file and specify the format. The selected raster image files will be displayed in the **Batch Vectorization** dialog screen. Before the command is executed, specify the output vector file type and format (AutoCAD .DXF, …)

Shortcuts

Toolbar:
Keys:

Before a raster image is vectorized, MapScan will run the *thinning process* to reduce the width of the linework to one pixel.

There are different steps and loops in processing a large image. The status bar gives the input and output files, the image size, and the work status.

When the process is completed this message appears **Vectorizing finished**. Press <**Esc**> to exit the process.

Vectorize/Trace

The **Trace mode** is the interactive vectorization process. Locate a section of the linework on the scanned image and put the screen cursor on the feature to be traced. The software takes over from here. It follows the linework and generates a vector line segment. If the raster image has many different features, the trace mode will vectorize only the needed features.

To work in trace mode

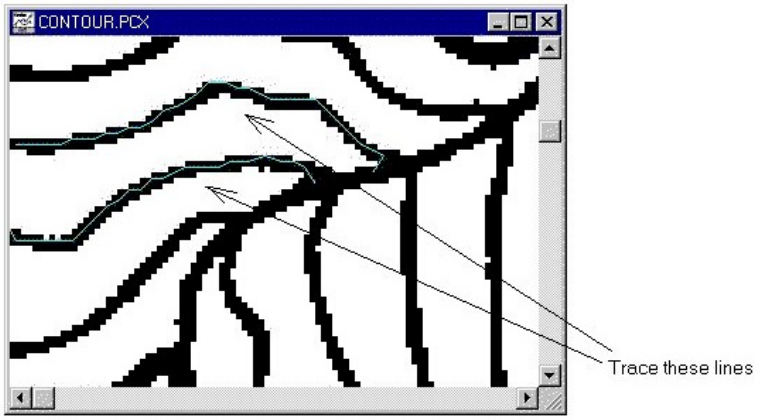
1. Open a raster image file.
2. Choose **Preference** from the **File** menu. Select **Tolerances** and click on **For Vectorizing...** to set the tolerance level.
3. Choose **Trace** from the **Vectorize** menu.
4. Click on **ToolBox** in the **View** menu to open the Vector toolbox.

   At the bottom of the toolbox are eight color bars representing the eight layers (1-top, 8-bottom) for the output vector map. Click on a specific layer bar.

5. Click on the **Assign layer** tool  . Point the cursor on the desired linework. The cursor changes to a crosshair; click the <left> mouse button. MapScan will begin vectorizing the linework, starting from the specified location. It follows the line and completes the tracing until it reaches a junction or the end of the linework.
6. Repeat step (7) to trace other lineworks.

You can scroll your raster image, select another layer (color bar) to vectorize another linework.

Use the trace mode to vectorize selected line features



Note: You can temporarily save the traced vector map to continue at a later time. MapScan will load both the raster image and the vectorized line segments to facilitate the tracing work.

Chapter 7 Working with Vector Maps

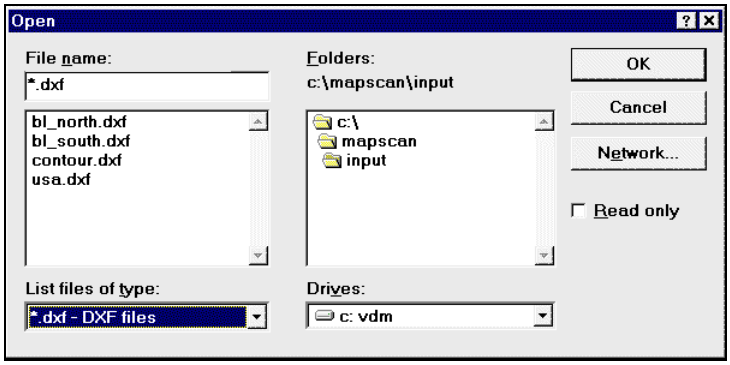
Handling vector map files

File/Open Vector

This command will open an existing vector map in a new window. You can open multiple vector maps at once. Use the Window menu to switch between multiple open documents. See the Window 1, 2, ... command.

MapScan supports AutoCAD (.DXF), ArcView Shape file (.SHP), Atlas GIS (.BNA), MapInfo exchange file (MIF/MID), as well as PopMap (.MAP and .TXM) and MapScan (.VEC) formats.

The vector map dialog box



Shortcuts

Toolbar: 

Keys:

File/Import Vector

This command will import and display an existing vector map file in an open window. When the File Open dialog box appears, specify the type of the file you will import: AutoCAD (DXF), Atlas GIS (BNA), ArcView Shape file (SHP), MapInfo exchange file (MIF/MID), PopMap (MAP) or MapScan (VEC).

MapScan does not handle attribute data associated with vector features.

The original **Open** window can have an image or an empty window created using the **New** command for vector manipulation. If there is vector data in the current window, you will be asked if you want to delete the current data set. If you press **Yes**, only the vectors imported from the file are kept for future processing. If you press **No**, the imported vectors will be appended to the current data. The two data sets will be merged into one set.

Using this command repeatedly will enable you to merge any number of vector files into one set. When the original map or drawing is too large to scan into one image, split it into parts. Then use MapScan to process the parts, get the vector data, and merge them by selecting the proper control points for each scanned part.

The **Import Vector** command will import a geo-referenced vector file that can use all the MapScan editing and processing tools to update or edit the data.

When the processing is completed, you can export the data using the **File/Export Vector...** command.

Shortcuts

Toolbar:
Keys:

File/Export Vector

This command will save the extracted vector data to a vector data file including lines, points, and text notes for some formats. Specify the output vector file format you will export. MapScan supports these formats: BNA (Atlas GIS), SHP (Shape File format) for ArcView, MIF (MapInfo vector format), DXF (CAD drawing exchange file) format, PopMap (MAP and TXM) and MapScan (VEC) proprietary formats, .

The ArcView Shape File generates three files for a set of vector data with the extensions, .SHP (main shape file), .SHX (index file) and .DBF (attribute file in dBASE format). Point and line data need to be saved into separate files using the Shape File format. Labeled ID values are kept and saved in the corresponding DBF file. Text data is not supported by this format.

The MapInfo MIF file can save all different items into one file, including lines, polygons, points and text strings. Use the option dialog box to select the layers for export. MIF supports many projection systems so make sure the parameters are set properly. In case of doubt, you can export the vector data into a Latitude/Longitude projection system that does not need projection parameters. The control points, however, must be selected in order to map the vector data into the latitude and longitude coordinate system.

The DXF file can save all different items into one file, including lines, polygons, points and text strings. Use the option dialog box to select layers for export.

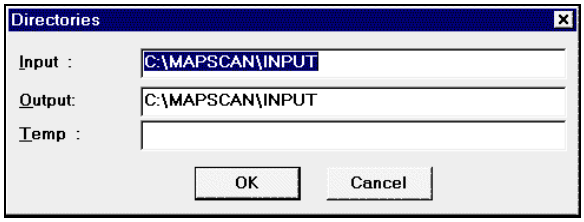
Shortcuts

Toolbar:
Keys:

File/Preference/ Directory

This command will set the default input, output and temporary directories. In executing the Open and Import commands, MapScan looks for files in the default input directory unless a different path is specified. In executing the Save and Export commands, the data are directed to the default directory unless a different path is specified. In executing the Batch Vectorization command, MapScan processes all raster image files in the default input directory.

Setting default directories



File/Print/Vector

This command will print a document. A Print dialog box prompts for the range of pages to be printed, the number of copies, the destination printer, and other printer setup options.

Shortcuts

Toolbar:

Keys:

File/Printer Setup

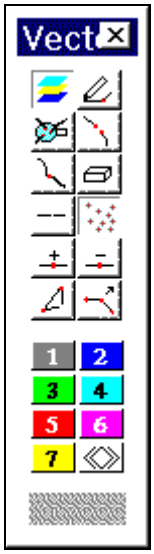
This command will set up the printer and the printer connection. The Print Setup dialog box prompts for the printer model and its connection.

Viewing vector maps

View/ToolBox/Vector

This command will turn the **Vector Editing ToolBox** On or Off. By default the Vector Edit ToolBox is turned on when a vector map is opened. It is recommended to leave the toolbox ON during the vector editing process.

The vector edit toolbox



Shortcuts

Toolbar: 

Keys:

View/ToolBar

This command will turn the **Toolbar** On and Off and is located below the menu bar. The Toolbar contains icons representing the editing tools for raster images and/or vector maps. By default the Toolbar is turned on

when a raster image or a vector map is opened. It is recommended to leave the ToolBar On during the editing process.

ToolBar

Shortcuts

Toolbar:
Keys:

View/Full View

This command will display the whole image on the screen. Choose **Full view** from the **View** menu.

Shortcuts

Toolbar:
Keys:

View/Actual View

This command will display the raster image in its actual scale.

Shortcuts

Toolbar:
Keys:

View/Original View

This command will display the raster image in its original scale.

Shortcuts

Toolbar:
Keys:

View/Zoom In

To enlarge the raster image on the screen

1. Choose **Zoom In from** the **View** menu, or click on the tool  .
2. Position the cursor with the Zoom In icon to the desired area and click the <left> mouse button.
3. Apply step 2 several times to increase the zoom-in factor.

Shortcuts

Toolbar: 
Keys:

View/Zoom Out

To reduce the raster image on the screen

1. Choose **Zoom Out** from the **View** menu, or click on the tool  .
2. Position the cursor with the Zoom Out icon to the desired area and click the <left> mouse button.
3. Apply step 2 several times to increase the zoom-out factor.

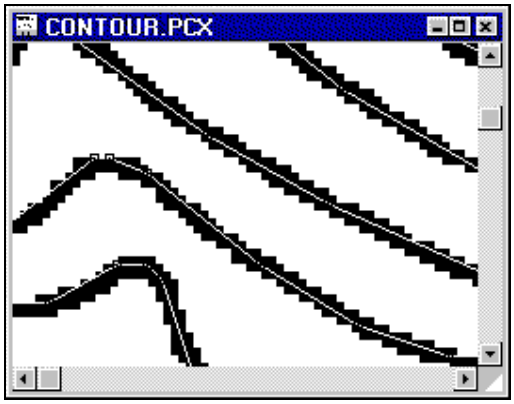
Shortcuts

Toolbar: 
Keys:

View/View Raster

This original raster image can be used as a backdrop for editing a vector map. Use the View Raster command to turn the backdrop image Off or On.

Turn on a raster image background of the vector lines



Shortcuts

Toolbar:
Keys:

View/View Vector

This command will turn the vector map On or Off.

Shortcuts

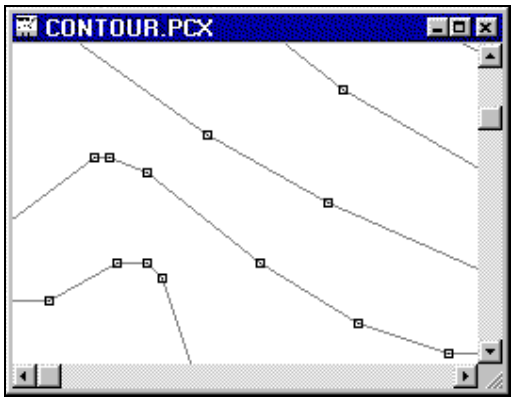
Toolbar:
Keys:

Show Nodes

This command will turn the line nodes On or Off. Node editing commands, such as **Add Node**, **Delete Node**, and **Move Node** are accessible only when the line nodes are turned on.

When the nodes are On, small boxes represent the middle of the line segments nodes, and crosses represent the starting or ending nodes of line segments.

Display of Line nodes when turned On



Shortcuts

ToolBox: 
Keys:

View Projected Map

If you have a geo-referenced map, this command will display your map in a different projection.

Shortcuts

Toolbar:
Keys:

Editing Vector Maps

Vector edit is a post-processing step to fine-tune a vector map. A raster image's unwanted features have to be removed after the vectorization process.

A scanned document have imperfections, such as background, dirt and residue, or stray markings on the original source documents are converted and stored along with original drawing content. The MapScan vector clean-up command removes much of the background "noise" and "dirt" (see *Remove dirt*).

The **Edit**/**Vector** command also corrects the map's topology by removing unwanted vector lines to edit nodes, join line segments, close polygons, and to assign layer attributes to line segments. There are facilities to rotate the map and to merge multiple pages into one vector map.

The **Edit**/**Vector** commands are Layer Assignment, node editing (Add Node, Move Node, Delete Node, Split Node) line editing (Add New Segment, Join Segments, Delete Segment, Correct Cross, Connect Segments, Remove Dirt), Fill area, and Rotation.

To use these commands, click on the **Vector** command from the **Edit** menu. You also can turn On the **Vector Edit ToolBox** by clicking on ToolBox in the View menu.

ToolBox

Each icon in the toolbox represents a command in the menu system.

Icon	*Command*
	**Assign Layer** (Edit menu)
	**Add Line Segment** (Edit menu)
	**Correct Cross** (Edit menu)
	**Connect Line Segments** (Edit menu)
	**Join Line Segments** (Edit menu)
	**Remove Dirt** (Edit menu)
	**Delete Line Segment** (Edit menu)
	**Show/Hide Nodes** (View menu)
	**Add Node** (Edit menu)

Icon	*Command*
	Delete Node (Edit menu)
	Split Node (Edit menu)
	Move Node (Edit menu)
1 2 3 4 5 6 7	**Select Layer** (Edit menu). The seven colored bars correspond to the first seven layers. *The eighth bar <> (blank per default) is used to define additional layers for features in the vector map.*

ToolBar

The Edit Vector commands and the icons in the ToolBar

Icon	*Command*
	Open Vector (File menu)
	Save (File menu)
	Zoom-in (Edit menu)
	Zoom-out (Edit menu)
	Show/Hide Vector Edit ToolBox (View menu)

Edit/Undo

This command will cancel the operation of the last editing command. Choose **Undo** from the Edit menu.

Shortcuts

Toolbar:
Keys:

Edit/Vector/Layer Assignment

A vector map may consist of different layers, such as administrative boundaries, roads and rivers. Administrative boundaries can be differentiated as country, department and commune boundaries. By default, MapScan generates and assigns all vector lines to one layer.

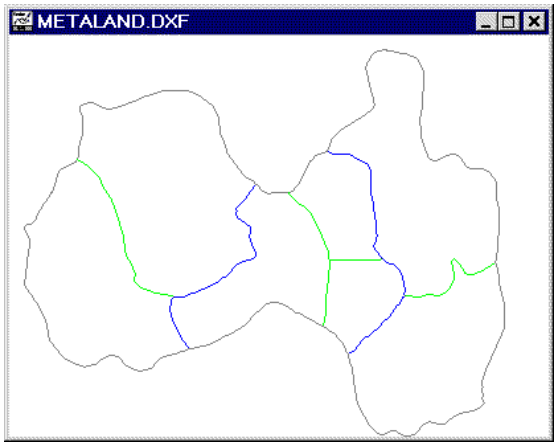
This command will assign different layers to different line segments. At the bottom of the ToolBox are eight color bars. The first seven are fixed colors representing the first seven layers of the vector map. The eighth bar is for defining an additional layer, including its name and color. To select one of the first seven layers, click on the appropriate color bar. To select one of the additional layers, click on the eighth color bar and select the appropriate one from the list box. The active layer is displayed below the color bar block.

Define “Road” as a new layer.

To assign a layer attribute to line segments

1. Choose **Vector** from the **Edit** menu and the option **Layer Assignment**, or click on the **Assign layer** tool .
2. Click on the scroll arrow of the **Description** list box to select the layer. You can add and save new layers and rename existing ones. Layers 1-8 are maintained by the system and cannot be changed.
3. Click the <left> mouse button on the line segment to assign the layer attribute. The line segment changes color to confirm the assignment.
4. Repeat steps 2 and 3 to set all the layers.

Assign different layers to country, department and commune boundaries



Shortcuts

ToolBox:

Keys:

Edit/Vector/Add Node

This command will add a node to an existing line segment. Locate the cursor where you want to add a node, and click the <left> mouse button. The node should be close to the line so the system knows the node should be added to it. If you cannot put the node close to the line, then first add one near the line and use Move Node to move it to the desired location.

You can switch to a different editing command by selecting another command from the menu or icon from the ToolBox.

This command operates only if the nodes of the vector map are turned **ON** (see *Show/Hide Nodes*).

Shortcuts

ToolBox: 
Keys:

Edit/Vector/Move Node

This command will move a node of an existing line. Point the cursor at a node and press the <left> mouse button. Move it to the desired location and then release the mouse.

Repeat this process to move another node. If a location on a line does not have a node, then add a node using the Add Node command. Once you have done this, move the new node to the desired location with the Move Node command.

You can switch to a different editing command by selecting another option from the menu or icon from the ToolBox.

The command operates only if the nodes of the vector map are turned **ON** (see *Show/Hide nodes*).

Shortcuts

ToolBox: 
Keys:

Edit/Vector/Delete Node

This command will delete one or more nodes on an existing line. Point the cursor on the node you will delete and click the <left> mouse button. The system will remove the closest node to the location you selected. Therefore, try to be as close as possible to the node you are deleting.

You can switch to a different editing command by selecting another option from the menu or icon from the ToolBox.

This command operates only if the nodes of the vector map are turned **ON** (see *Show/Hide nodes*).

Shortcuts

ToolBox: 
Keys:

Edit/Vector/Split Node

This command will split an existing line segment into two lines. Point the cursor at a location on the line and click the <left> mouse button to split it. Repeat the process to split another line.

You can switch to a different editing command by selecting another option from the menu or icon from the ToolBox.

This command operates only if the nodes of the vector map are turned **ON** (see *Show/Hide nodes*).

Shortcuts

ToolBox: 
Keys:

Edit/Vector/Add New Segment

This command will add a new line segment to the vector map. Point the cursor where you want to start your line segment and click the <left> mouse button. From this starting node, continue to click the <left> mouse to plot and connect the other nodes. This is the process of drawing a free-hand line segment. Double click <left> mouse button at the last node to complete the line segment. Repeat the process to draw other line segments.

You can switch to a different editing command by selecting another option from the menu or icon from the ToolBox.

Shortcuts

ToolBox: 
Keys:

File/Preference/ Tolerances/For Vector Editing

The vector editing commands, such as **Remove Dirt**, **Correct Cross**, and **Connect Segments** are sensitive based on the threshold level you set for the Tolerance. The size of the features and the distances to be snapped determine the threshold level.

This command will set the threshold for the vector editing operations. A low threshold will allow the **Remove Dirt** command to remove only short line segments; and the **Correct Cross** and **Connect Segments** commands to snap line segments that are very close to each other. To increase the effect of these command, you have to increase the threshold level. However, a high threshold level might remove needed features and snap the wrong line segments.

Edit/Vector/Join Segments

This command will join two existing line segments into one. Point the cursor close to the end of a line that will be joined to the first line segment. Click the <left> mouse button to select and the line is displayed on reversed color. Repeat this step to select the second line segment.

When both lines are selected, click on **OK**  to confirm. Repeat the process to join another set of line segments.

You can switch to a different editing command by selecting another option from the menu or icon from the ToolBox.

Shortcuts

ToolBox: 
Keys:

Edit/Vector/Delete Segment

This command will delete an existing line segment. Point the cursor at a node on the line segment to be deleted. Click the <left> mouse button to remove the line segment. The system will remove the closest line segment to the location, therefore, try to be as close as possible to avoid deleting the wrong line segment.

You can switch to a different editing command by selecting another option from the menu or icon from the ToolBox.

Shortcuts

ToolBox:

Keys:

Edit/Vector/Correct Cross

This command will correct open line intersections (two or more line segments). The open line intersections will automatically be connected to the closest line node, and a line junction will be created.

To correct open line intersections

1. Set the tolerance level for vector editing. Click on **Preferences** in the **File** menu and select **Tolerances**.
2. Choose **Vector** from the **Edit** menu and select **Correct Cross**, or click on the tool .
3. Specify the area with open line intersection(s). Use the **Zoom In** tool to enlarge the gap between line segments and facilitate the corrections.
4. Click on the **OK** icon to confirm.
5. Apply a higher tolerance level if the intersection remains open and reuse the **OK** icon .

Shortcuts

ToolBox:

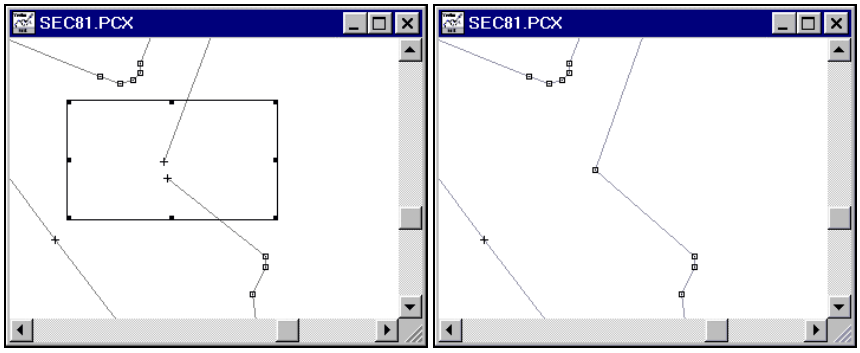
Keys:

Edit/Vector/Connect Segments

To connect two line segments

1. Set the tolerance level for vector editing. Click on **Preferences** in the **File** menu and select **Tolerances**.
2. Choose **Connect Segments** from the **Edit** menu, or click on the tool .
3. Specify the area with two open-ended line segments and click on the **OK** icon to confirm.
4. Apply a higher tolerance level if the two ends are not connected and reuse the **OK** icon .

Line segments before and after they are connected.



Shortcuts

ToolBox: 

Keys:

Figure 1. Connect two line segments

Edit/Vector/Remove Dirt

This command will remove unnecessary short line segments and isolated nodes.

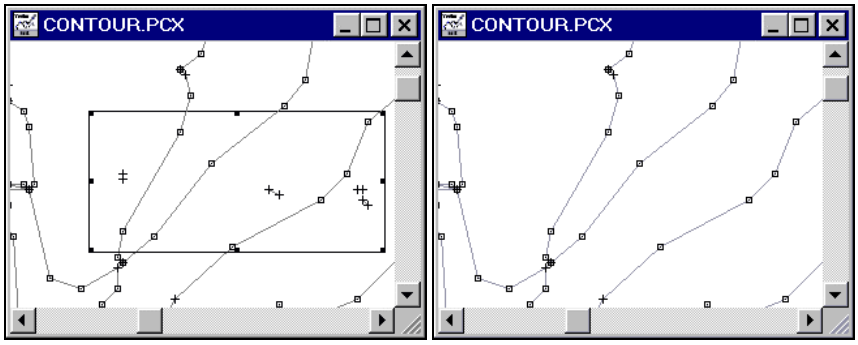
Scanned maps can have a certain amount of noise. Noise is data that do not have informational content. Low quality maps have higher noise content. One common type of noise is a tiny spot called speckles that are an artifact of the scanning process. Speckles are unwanted in the final vector output.

Note: In cases where lettering (annotation) have been vectorized, this command can also be useful to remove - below a given threshold size - the relatively small lines that make up the letters.

To remove dirt

1. Set the tolerance level for vector editing. Click on **Preferences** in the **File** menu and select **Tolerances**.
2. Click on **Vector** in the **Edit** menu and select **Remove Dirt**, or click on the tool  .
3. Select the area with unnecessary small line segments and isolated nodes.
4. Click on the **OK** icon  to confirm.
5. Apply a higher tolerance level if the dirt remains and reuse the **OK** icon  .

Small line segments are removed from the vector map



Shortcuts

ToolBox: 
Keys:

Figure 2. Remove unnecessary line segments and nodes

Edit/Vector/Fill

This command will color an area of the vector map to test if the polygon is well closed.

To color fill an area

1. Choose the **Vector** command from the **Edit** menu and select the option **Fill**.
2. Move the cursor to the area and click the <left> mouse button. The color will overflow if the selected polygon is not closed.

Shortcuts

Toolbar:
Keys:

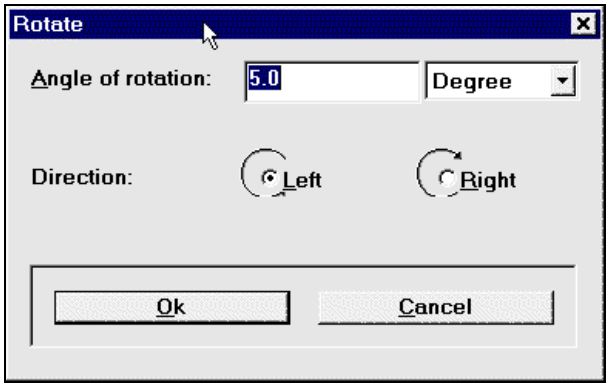
Edit/Vector/ Rotation

The command will spin a vector map clockwise 90 degrees, counter-clockwise 180 degrees, or by an arbitrary angle.

To rotate a map

1. Choose **Vector** from the **Edit** menu and select **Rotation**. Select a prefixed angle (+90, -90, and 180 degrees) from the list box, or an arbitrary angle.
2. If arbitrary angle is selected, a new dialog box appears. Specify the angle, the unit and the direction. Right is clockwise, and left is counter-clockwise. Select the Direction by clicking on the option button.
3. Click on the **OK** button. MapScan will rotate the image.

Control the rotation of a vector map with an arbitrary angle.



Shortcuts

Toolbar:
Keys:

File/Preference/Merge Mode

This command will set the mode for the **Merge** to **Overwrite** or **Transparent**.

Overwrite mode will merge the second vector page on top of the first vector page. The portion of the first page that is hidden by the second page will be ignored. This mode is recommended if the edges of the two pages are well cut for the Merge to produce a clear edge intersection.

Transparent mode produces a “transparent” background of the second page. The merged vector map will include all the features of the first page underneath it.

Edit/Vector/Merge

This command will merge multiple pages into one vector map. It is useful when you consolidate map pages of different scales and orientations that have been scanned and vectorized separately. Make sure there is a common border area for each pair of adjacent vector map pages. This is important when you mark the two registration points.

The **Merge** command will take only two pages at a time. Repeat the command as many times if you have multiple pages to consolidate the entire map.

To merge two vector map pages

1. Choose **Vector** from the **Edit** menu and the **Merge** option**.**
2. The Merge tools dialog box appears. Open the first vector map then the second. At the bottom are five buttons: **Select first**, **Select second**, **Active first**, **Active second** and **Target image**. MapScan will show the first vector map. Press on the **Select second** button to display the second vector map screen.
3. There are two markers below each other at the upper left corner of the first and the second vector map screens. Click on the marker and hold the <left> mouse button. Move it to the location of the registration point and release the button to anchor the marker. The marker locations are very important for merging pages. Markers must be correctly located or the merging will not produce the target vector map. Use **Full view** to locate the markers globally, then

Zoom In on the page for fine-tuning. Use these techniques to locate the two markers for the first and the second image screens.

4. Select **Target image** to check the vector map output. The first vector image is intact and serves as the reference page. The second vector map is rotated and re-scaled to assure the matching of the corresponding registration points. If the first vector map is not perfect, match it with the second and repeat step 3 to adjust the markers' locations.
5. Go to the **File** menu and choose the **Save Image As...** command to save the target vector map. You will be asked for a filename.

Geo-referencing

Map files must have a real-world coordinate system in order to have a valid coverage for spatial analysis. This is done by vectorizing the map to convert it in a relative coordinate system (plain *x*,*y*).

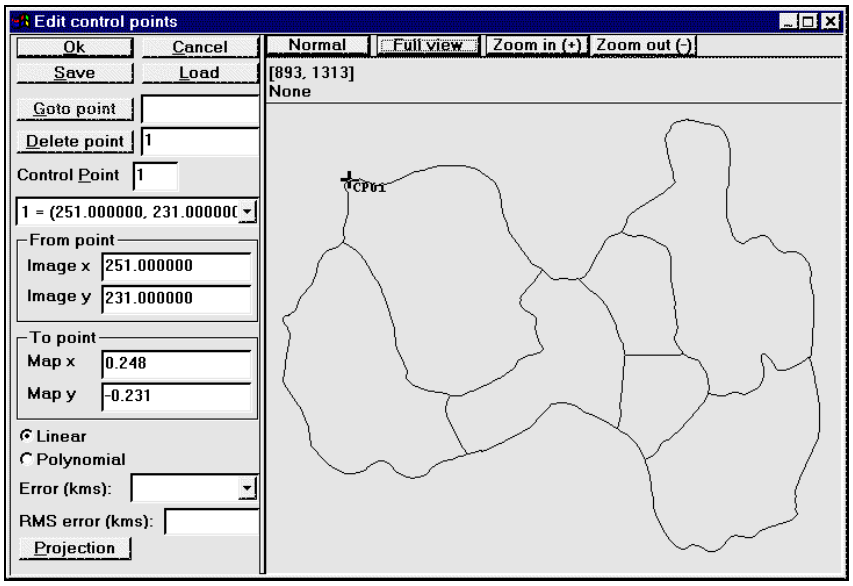
Geo-referencing is the process of changing or transforming the *x*,*y* coordinates into real-world coordinates (latitude-longitude). Control points on a map have known coordinates. In geo-referencing a map, the ground control points are applied. MapScan uses these control points to calculate a geometric map transformation, a process that translates the positions on the vector map to real-world coordinates.

The process of geo-referencing

Decide on the control points of your map and select at least 6 control points, but 10 or more are recommended. Good control points should be distributed over the whole area. Use locations that are easy to identify and for which you can easily obtain the latitude/longitude coordinates (use topographic maps or gazetteers, atlases or geo-referenced digital databases). Locations that work well for control points are cities, towns, and villages, major landmarks, major road intersections, coast line or river intersections, corners of land area boundaries, map graticules or grid intersections, section corner tick marks, or other permanent features.

1. Choose **Georeferencing** from the **Edit** menu. The **Edit control points** dialog box opens to enable us to digitize the control points and enter their coordinates. The map where the control points will be digitized is displayed. On the left side is a control panel for entering the coordinates of the control points and for setting the parameters.
2. Digitize the control points by pointing the cursor to the location of each control point and click the <left> mouse button. Control points are labeled CP01, CP02, CP03, ... in the order these were digitized. Use **Full View** to digitize all the control points, and the **Zoom In** command to fine-tune the locations. You may relocate a control point. Move the cursor towards it and when it changes shape press and hold the <left> mouse button. Drag the control point to the new location and release the mouse button.

Digitize the control points on the map and enter longitude/latitude coordinates in the Map X, Map Y boxes respectively.



The left panel gives all the information about the active control point with its original digitized coordinates displayed in the **From point** box. Use the Control Point list box to select any control point.

3. Enter the ground coordinates for the control points in decimal degree values (up to 6 decimal places) in the **To point** box. Enter first the longitude (*x-axis*) and then the (*y-axis*).

Note: The valid coordinates for the longitude are between -180 (180 West) and 180 (180 East) and between -90 (90 South) and 90 (90 North) for the latitude. The East longitudes and North latitudes are entered as positive numbers while the West longitude and South latitudes are negative numbers. Coordinates in degrees, minutes and seconds (DMS) have to be converted into decimal degrees (DD). A minute has 60 seconds and a degree has 60 minutes. The formula to compute decimal degrees is:

Decimal degrees = Degrees + Minutes/60 + Seconds/3600.

MapScan will calculate the transformation error and the root mean square (RMS) of errors for each control point.

If the vector map is skewed, shifted and scaled to fit the control point locations, MapScan will perform a good transformation or a more complex geometric transformation depending on the number of control points. These errors are the difference between the user-provided map coordinates and those calculated by MapScan. If the error value is relatively small, the control points are acceptable. Large values can be caused by (a) incorrect map coordinates; (b) incorrectly digitized control points; (c) insufficient number of control points; or (d) wrong paper map projection. Identify and correct the sources of the errors.

Specify the map projection whenever possible to improve the accuracy of the geo-referencing. One of the most commonly used map projections for

national, sub-national and local maps is the Universal Transverse Mercator (UTM). If you do not know the map projection, try the UTM zone and select one that covers all the area or most of it. The UTM projection will need these parameters: Center Latitude/Center Longitude/Zone Code; First and second standard parallels; and Scale factor at central meridian.

If the information about the map projection is unknown use the **Best Fit** projection option to geo-reference the map. Select the possible projection for your map from the **Projection** list box. MapScan will process the projection that best fits the map and use this, along with the specified control points, during the transformation process.

If you do not wish to apply the **Best Fit** projection option, MapScan will use the set of control points to compute a transformation equation that will generate the coordinates for the vectors. There are two cases: (1) if the coordinates are in units of meters or kilometers, select the **Non-Earth** option from the projection list. MapScan will calculate the errors in kilometers and generate vector map coordinates in meters/kilometers; and (2) if the coordinates are in Longitudes/Latitudes, select the **Longitude/Latitude** option. MapScan will calculate errors in kilometers and generate Lat/Long coordinates for the geo-referenced vector map. Note that only maps with very small areas should be geo-referenced using this method.

MapScan will geo-reference vector maps using either the **Linear** or **Polynomial** method. Maps with minor distortions or a limited number of control points for which the latitude/longitude can be obtained can use the linear method. Apply the Polynomial method to get a higher quality of geometric transformation using more control points. Click on the option button to select the method.

If the error is acceptable, click **OK** to proceed geo-referencing the map. Otherwise check the control points and the coordinates and the map projection parameters. Remember geo-referencing can always be improved. Add more control points, remove bad ones, correct the coordinates of some control points, or change the map projection.

When you apply the control points on the geo-referenced vector map in the new window, you can display the map using a specific project. Use the **View**/**View Projected Map** command. Use **Degrees** for the **Unit** to show the Latitude/Longitude values of the map coordinates at the location of the mouse cursor. If you select **Meter** as the Unit, the values in degrees will be transformed into meters using the selected projection.

The defined control points can be saved to a disk file and loaded at a later stage for editing and re-georeferencing. The control point file is in ASCII format with a .CTP extension. It contains information about the number of the control points, their coordinates and the projection. Press the **Save** button of the **Edit** control points dialog box.

Appendix A Preparing and scanning maps

Scanning paper maps can be done in or outside MapScan, but whatever you use make sure you have a good scanned raster image. Poor quality paper maps can be scanned but will require more operator data cleanup. Remember that raster to vector conversion can only be useful and cost-effective with high-quality maps. The input material has to be well prepared when you scan and vectorize paper maps.

Proper scanning procedures, such as choosing the best resolution, can greatly reduce post-processing. Naturally the less noise and clutter in the source documents, the less pre- and post-processing is required.

Most data will need some amount of pre-processing, post-processing, or both. For this reason, most scanning map data entry projects require human judgment and intervention in the conversion process. This does not imply scanning map data entry is difficult to use, but it reduces the amount of unattended automation and, consequently, the amount of time you can save.

Preparing maps

Here is a basic guide in preparing maps depending on the their type, size, quality and complexity:

1. Mark or edit the cartographic errors and open line gaps on the original source material.
2. Reduce or enlarge maps by photocopying them to fit the scanner surface.
3. Trace the required lines on a tracing paper overlay (Mylar or other transparent layer), and then scan the overlay.

Typical examples include administrative boundary layers, roads, and rivers on color topographic maps. In most instances, a very large number of features are displayed on the map, including unwanted data layers: elevation contour lines, utility lines, symbols, annotations, etc. Tracing each feature layers on separate sheets can reduce greatly processing requirements, and eliminate unwanted clutter.

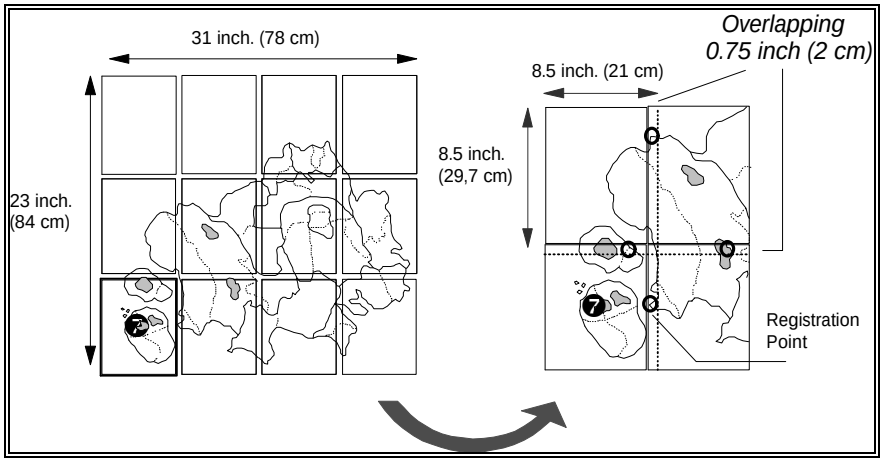
These simple and low-tech preparations will facilitate and simplify the work. Remember the best way to emphasize a line on a paper is to use a pen and to draw over it.

Large maps

MapScan will process maps of virtually any size, including large maps up to A0 format (0.8 x 1.2 m²) or up to 36”wide by 100” in length. To handle oversize documents, some special sheet feed scanners can be used or this technique to process 11” x 17” (B format) and A3 format, or larger maps like 36” x 44” (E format), or A0 format with low-cost scanners typically having an A4 or US legal size scanning area.

When the paper map exceeds the size of the scanner, scan the map in different parts (or pages) with overlaps to create a mosaic. It is important for each pair of adjacent scanned map pages to have a common border area (at least .75” or 2 cms) where you can mark the registration points (crosshair marks or other easily identifiable marks). Use a dark pen to easily identify registration points on the common border areas.

Map tiling for maps larger than the scanning area



The **Merge** command processes two pages at a time, but can be repeated many times. Merging can be done on raster images (see page 29), or later on the vectorized map pages (see page).

Preparation tips

The quality of the scanned image will depend on the quality of the original map. Avoid maps that are damaged or stained, ripped or torn to minimize the editing job. To reduce the number of recognition errors and to speed up the processing, consider these suggestions before scanning maps:

Noise removal. Unless you want to preserve these on the map, erase pencil marks and use a correction fluid ("whiteout") or a correction tape to remove ink marks, annotations and extraneous spots. You can also remove these marks with MapScan for Windows or an image editing software, such as Adobe Photoshop or JASC Paint Shop Pro.

Orientation. Depending on the page format and the map orientation, you can scan in either portrait or landscape mode, and rotate the scanned image or the vector map in MapScan (see pages 28 and 65).

Note: Rotating the image or the map by 90, 180 or 270 degrees does not affect the accuracy.

Exposure. Avoid maps that are faded, blurred, over- or under-exposed, otherwise use the scanning software features to adjust the contrast.

Folding. If pages are folded, press them under a heavyweight to remove the creases (creases create shadows that may be recognized as lines).

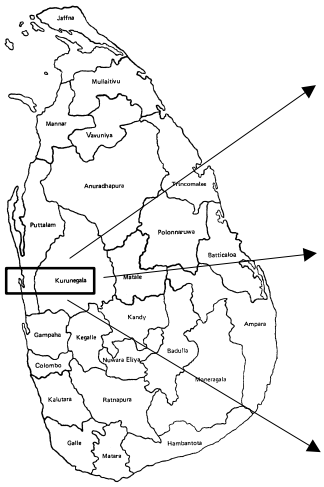
Scanning maps

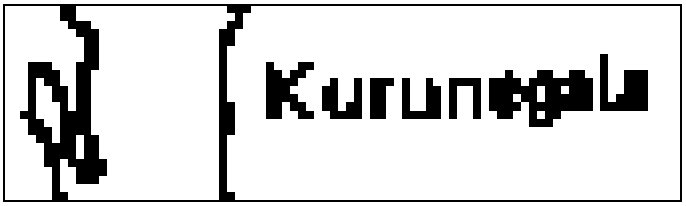
A scanner device takes a "digital snapshot" of the source material and produces three types of raster outputs: **binary**, **gray scale** and **color**. The binary output is commonly used because it simplifies the subsequent processes. Most scanners (color or black and white) have sensitivity setting (brightness and contrast levels) or “thresholding” that disregards unwanted elements, thus improving the visual presentation of the source document. This thresholding capability varies. Use first the auto-detect mode and adjust manually if required.

Scanned files are made up of pixels or cells stored by lines. Each pixel is assigned a value “0” (off) or “1” (on) based on the degree of resolution. Pixels with a bright resolution get the value “1” and those with a dark resolution get the value “0”.

Scanning resolution

Scanning resolution is measured in dots per inch (dpi) that determine the amount of visible detail in an image. To get the best possible results, choose carefully the most suitable resolution for the map you are scanning.





75 dpi

200 dpi

300 dpi

The most commonly used resolutions range from 200 to 400 dpi. You may have to experiment for the best one and the number may vary between drawings. In most cases a 200 dpi is adequate for hand-drafted originals that often have coarse linework. Where there is a finer linework and/or small text labels are present, 300 or 400 dpi might be better. When there closely drawn "tight" contours, a scanner with at least 800 or 1200 dpi optical resolution might be required.

Note: Scanning data at a resolution greater than that required by the source document will only increase data storage requirements with no appreciable improvement in data quality. Unneeded input resolution can create processing problems by exaggerating errors in poor quality maps (e.g., additional “noise”, line gaps, and spurs).

Color depth

Binary scanning (or bi-tonal, black and white, 1-bit, line art) works best on black and white line drawings as in administrative area maps.

Use the *gray scale scanning* for non-color materials with intensity gradations that cannot easily be handled by a scanner's binary control. Gray scale is ideal for reading source materials with text labels.

Color scanning is recommended for materials with point and line information in a variety of colors. Color raster is good for interactive line following processes, or in making color separations to isolate particular lines.

File size

The map dimensions affect the bitmap file size, the scanning resolution, and the bit depth (1-bit for black and white, 8-bit for 256 colors, etc.). Calculate the virtual file size with this formula:

File size = Resolution^2 x Width x Height x Bits

To obtain the size in kilobytes, divide the result by 8,192 (the number of bits in a kilobyte). For example, the file size for a typical 8.5" x 11" or A4 page (with .5 inch margins) scanned at 300-dpi in black and white (1-bit) is 830K.

Sample image size in dots per inch for several standard map sizes scanned in black and white at various resolutions.

		Scanning Resolution (dpi)					
Map size		***75***	***200***	***300***	***400***	***800***	***1200***
8.5" x 11" (Letter) or A4	rows	750	2000	3000	4000	8000	12000
	columns	560	1500	2250	3000	6000	9000
17" x 11" (Tabloid) or A3	rows	750	2000	3000	4000	8000	12000
	columns	1200	3200	4800	6400	12800	19200
36" x 44" (E) or A0	rows	3225	8600	12900	17200	34400	51600
	columns	2625	7000	10500	14000	28000	42000

File size (in Kb or Mb) for several standard map sizes scanned in black and white at various resolutions.

	Scanning Resolution (dpi)					
Map size	***75***	***200***	***300***	***400***	***800***	***1200***
8.5" x 11" (Letter) or A4	50K	370K	830K	1.5M	5.6M	13.2M
17" x 11" (Tabloid) or A3	110K	780K	1.8M	3.1M	12.5M	28.1M
36" x 44" (E) or A0	1.0M	7.3M	16.5M	29.4M	117.5M	264.5M

Increasing the number of dots per inch increases the file size geometrically: 200-dpi bitmaps are four times as big as 100-dpi bitmaps, and 300-dpi bitmaps are nine times larger.

Increasing the bit depth increases file size arithmetically. A 24-bit image (16 million colors) is three times as large as an 8-bit image (256 colors or gray shades).

Image file formats

The Windows version of MapScan supports many formats of raster images including Paintbrush (.PCX), version 5; JPEG and Tagged Image File Format, TIFF (.TIF) (un)compressed formats. Save scanned map(s)

using one these file formats, and preferably the PCX (Paintbrush), TIFF (TIF), GIF or JPG formats.

The PCX/TIF/GIF format offers several advantages: they are among the most widely supported bitmap formats, and they offer data compression through run-length encoding (RLE).

Run-length encoding is one of the simplest ways to compress a file where a series of repeated values (pixel values of the same color, for instance) is replaced by a single value and a count. Images with large areas of a constant shade or hue (black or white, for instance), such as maps and line drawings, can easily be reduced to ten times the actual size.

The amount of actual data reduction will depend on the compression algorithm used and the complexity of the data. Typically, denser more complex data cannot be compressed to the extent that sparse data can be compressed (see below Table).

File size (in Kb) for several standard map sizes scanned in black and white at 300-dpi resolutions and saved in various file formats.

	File Format		
Map size	***TIFF or IMG***	***PCX***	***% PCX/TIFF***
8.5” x 11” (Letter) or A4	660 KB	130 KB	20 %
17” x 11” (Tabloid) or A3	1430 KB	315 KB	22 %
36” x 44” (E) or A0	16,950 KB	1,230 KB	7 %

Scanning tips

Here are suggestions to minimize the number of recognition errors and to speed vectorization while scanning:

Scanner glass clarity. The glass on the flatbed of the scanner must be clean and clear to avoid smudges and debris that might confuse the scanner and get interpreted into the map.

Paper flattening. Cut maps out of publications, books and other bound documents so that they lie flat on the scan bed. If you cannot cut the map, place a heavy object on the lid of the scanner to flatten it.

Scanning angle. Make sure that the edges of the map are aligned correctly on the scan bed, not slanted or turned slightly. Although you can use image editors to correct the skew and rotate the map a few degrees later, processing is less accurate with incorrectly positioned maps.

Paper thickness. For thin maps with printing on both sides (as with a newspaper page); put a piece of black paper between the page and the lid of the scanner. (With thin papers, the text on the back sometimes shows through and obscures the text on the front).

Scanning setting options. Familiarize yourself with the scanner software. Experiment with the scanner settings to get the best results for different types of maps and layouts.

Black and White scanning. Unless the scanner supports the HP Accupage technology (see below) or some kind of dynamic threshold

feature, set up the scanner to create black-and-white images. The black-and-white setting of some scanners is called line art, bi-tonal, one-bit art or image.

too light

too dark

Autoexposure. Apply Autoexposure and the default settings first. Adjust the resolution to lighten or darken line drawings so that all the lines are clear, not too thin and not too bold.

Increasing the brightness makes the lines appear thinner, but can easily create broken lines. Decreasing the brightness makes the lines bolder but can cause adjacent lines to merge.

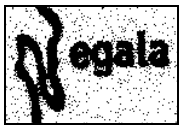
No halftoning. Do not use Diffuse, Dither, or Halftone scanner settings. They can improve the appearance of photographic images, but can also make it difficult to recognize text and lines.

without sharp

with sharpen

Sharpening. Sharpening works by accentuating the differences between adjacent light and dark dots in an image. Use this only if required in which case adjust the threshold level (the point where gray pixels jump to white or black) to make lines thinner and thicker in the process.

HP Accupage. The HP Accupage technology automatically enhances text regions for optimum character recognition. This technology helps MapScan recognize text and lines that otherwise are difficult to recognize, such as text or lines printed on a shaded background and text on faded, yellowed paper.



unwanted noise

Background and noise removal. Get a clean background by setting the highlight flag in a clean portion of the background. Adjust the brightness to eliminate or minimize most unwanted "noise" (e.g.: tiny spots called speckles that are an artifact of the scanning process) from the paper texture or poor paper condition (old map, sketch map, CAD plotter output, blue prints, etc.).

Resolution. Setting up the scanner to scan at 300 dpi produces the best results. If a map has many unrecognized words or very small text, try scanning the map at 400 dpi.

Preview and cropping. Most scanning software programs offer complete control of the scanner, letting users preview the page image, select and scan a portion of the page or picture, select the kind of image (grayscale or black-and-white), and the resolution of the image in dots-per-inch (dpi).

Scanning with HP DeskScan II software

1. Double-click on the DeskScan II icon to open the HP DeskScan II software.
2. Put the image on the scanner glass.
3. Select **Preview**. Three things happen automatically. The software (a) finds the image and makes a selection box around it; (b) selects the proper image type; and (c) autoexposes the image. The benefits are a faster scanning process and ease of use.

4. If necessary adjust the selection box around the part of the image you want to scan by using **Auto Exposure**. Make sure the **Image Type** is set to *Black and White Drawing* or *Line-art*.
5. Choose **Image Type** from the **Custom Menu**.
6. Use sharpening only if required (see page). Open **Sharpening** and select the **Extra-Heavy** option in the **Custom Image Type** dialog box. Press **OK**.
7. Set the **Print Path** to either Fax [High Quality] (200 dpi), HP LaserJet II (300 dpi) or HP LaserJet 4 (400 dpi).
8. Choose **Final** to save the image into a file.

Appendix B Using the output files

MapScan outputs

The **Reference text file** output from the OCR process has an **.REF** extension and the same filename as the input raster image file. The file is in the default output directory and is accessible by using **OCR** in the **Options** menu.

The **Vector coordinate file** output from the vectorization process contains vector coordinates that can be exported into a geographic file of different standard format, such as AutoCAD (.DXF), ArcView Shape file (.SHP) and Atlas GIS (.BNA) as well as in PopMap for DOS (.MAP) and PopMap for Windows (.TXM) formats. These files are in the default output directory that you can set by using **Preference** from the **File** menu.

The PopMap Map Editor and most mapping and GIS software can directly import these files. Check the manual for more information on this topic.

How to use a MapScan output in PopMap for DOS

1. Define the PopMap country application, for example Popland, in the directory C:\POPMAP\POPLAND. PopMap automatically assigns an internal geographic code for all applications. The Popland code is 01000000.
2. Use MapScan to vectorize the Popland country map. From the source material, the MapScan Edit Raster module will produce the POPLAND.PCX raster file, generate the POPLAND.REF and the POPLAND.MAP files.
3. Copy POPLAND.REF and POPLAND.MAP into the application sub-directory C:\POPMAP\POPLAND\TMP as 01000000.TXT and 01000000.MAP respectively.
4. Go to the PopMap Map Editor and load the Popland vector map using the **Load** command of the **File** menu.

In the current release of MapScan the reference texts are not properly coded and cannot be used for mapping within PopMap. Please see the PopMap User's Guide and Reference Manual for more information on how to assign names for areas.

How to use a MapScan output in PopMap for Windows

The Map Editor of PopMap for Windows can import directly all output files of MapScan with the exception of the MapScan proprietary format (.VEC).

Refer to PopMap for Windows User's Guide and Reference Manual on how to import external geographic data.

Glossary of Terms

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