Workbook Exercises for WHEAT EMAP Programs

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Abstract

This manual describes a series of exercises to demonstrate various features of WHEAT electronic mapping programs (EMAP programs). It is laid out as a tutorial and demonstrates many features of the various WHEAT programs. At the end of this tutorial, you should be able to design and use electronic maps with WHEAT, using existing geographic databases.

Introduction

Overview

This workbook explains how to use EMAP3STD and EMAP3LIT. EMAP3STD and EMAP3LIT, are virtually identical except that EMAP3STD allows the user to define themes and EMAP3LIT can only use themes that have definitions stored in a database or can be copied there from another program, such as THMDFEDT.

This workbook contains step-by-step instructions for common tasks in WHEAT EMAP, including opening databases and themes, designing themes, performing spatial queries, and copying data to other applications.

The specific examples are for use with the KC_DCW.MDB database, but illustrate the general idea of how to perform each task. (KC_DCW.MDB is a database of the Kansas City area based on the US Defense Mapping Agency's Digital Chart of the World.)

Before you get started

To perform these exercises, you should be at a computer with WHEAT already installed and a copy of the sample database KC_DCW.MDB on the hard disk, preferably in the same directory as WHEAT or in a sub-directory of WHEAT.

This manual assumes the user is familiar with the Microsoft Windows interface and knows how to perform such tasks as selecting menu items and choosing options. In addition, it assumes a basic familiarity with database concepts.

Ideally, you should have a copy of MSAccess 2.0 available. If you don't have Access available, you might want to download the unsupported database utilities, or use the WHEAT-Excel add-in to convert data back and forth. (I hope to release a version of WHEAT that can use 32-bit Access (95/97...?) databases, but this hasn't been funded as of this writing.)

Some definitions

A **database** contains data about a particular topic or set of topics, as defined by the user/owner/designer of the database. In a database, data is stored in tables, and can be retrieved from tables or queries (virtual tables). (There can also be variety of other things like forms, reports, and programs stored in a database, as well.)

Tables are organized sets of information containing records, one for each individual thing in the database. A record is composed of fields, which are attributes that describe the thing. Thus, a table concerning schools might have records for each school in a county, and the records might include the name (as text), date founded (as date), operating budget (as a floating point number), date closed (as date), number of buses owned (as integer number), principal's name (as text), and number of pupils (as integer number). Usually, a database table is shown as a table, where each record is a row and each field is a column. Some of the fields listed, such as date closed and number of buses, will not occur for each individual school. In these cases, a relational database stores a null, indicating that no information is available.

While a relational database *stores* information in tables, it can *retrieve* information as virtual tables called queries. A **query** is the answer to a question asked about the datatable, such as: "show all schools with an operating budget above $500,000". A query can return data from several related tables by joining them. For example, suppose we had another table containing information about students. It might contain student's name, age, address, and name of school attended. We could then find out who a student's principal is by designing a query which relates the school name field in the student table to the name field in the school table. Queries are generally used for combining information from several tables, selecting subsets of records, or selecting subsets of fields. By allowing data to be stored in a single location (such as the principal's name in the school field) and related at a later time, relational databases can reduce storage requirements, and allow the

updating of data to be considerably easier than if each record contained all data that might ever be needed.

WHEAT uses the word **theme** to describe two slightly different concepts. Most specifically, a theme is a set of features to be shown on the map: it includes the geographic location(s) of the feature, the plot style, and a serial number used for querying. Theme is also used to describe the instructions for assembling this data (specifically, an SQL statement containing a query indicating what data to plot and how). All data in a theme comes from one table or query.

Typographic Conventions

Text on the computer screen is usually shown in this font: Text on a button.

Selecting the File menu, and the Open Theme... menu item within the file menu will be denoted as "Select the menu item File—»Open Theme..."

Lesson 1 Getting Started

Lesson 1 will show you how to open a database, load pre-defined themes and layers, perform a spatial query, and copy the results to a spreadsheet for further analysis.

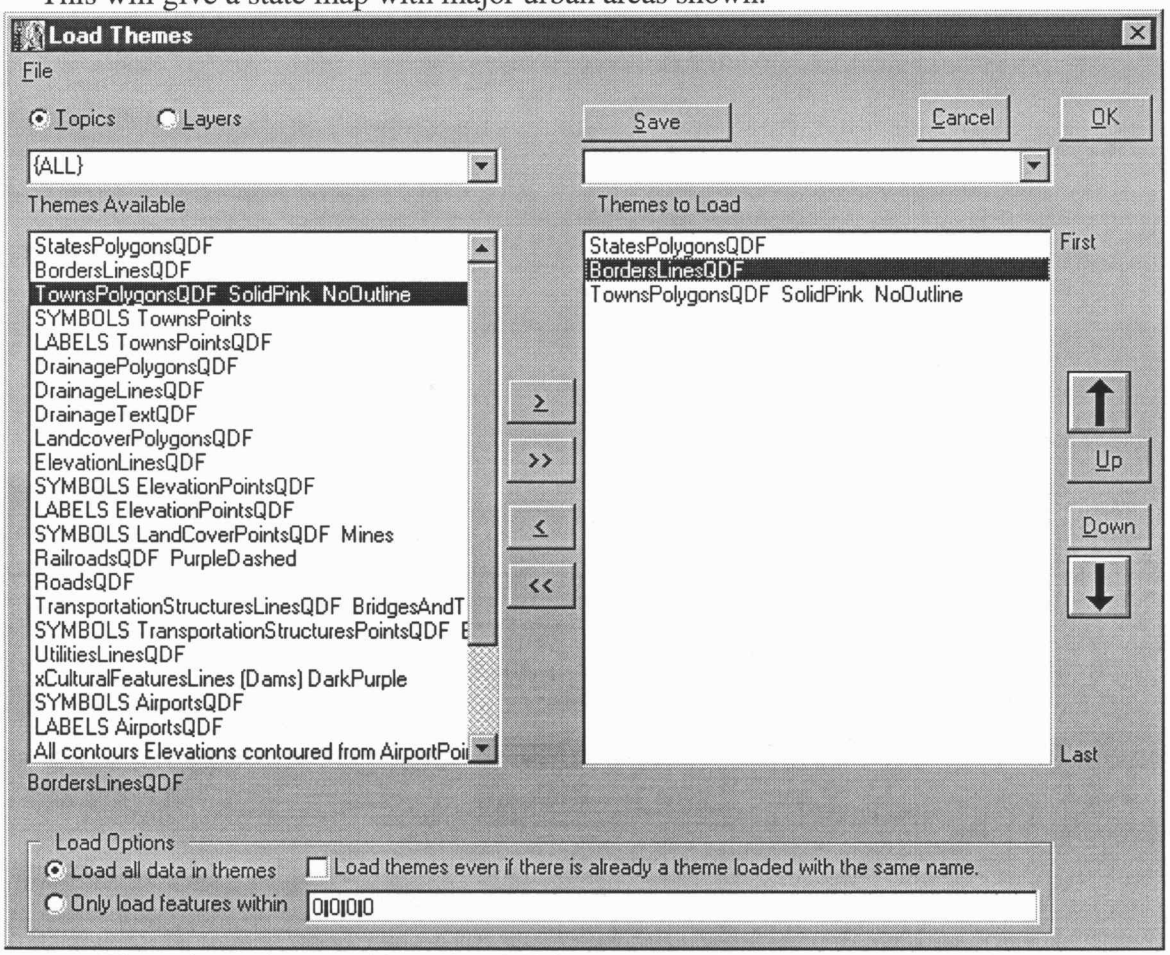
1) Start EMAP (EMAP3STD or EMAP3LIT, preferably EMAP3STD) by double-clicking on its icon in Program Manager.

   This will start EMAP and the main window will contain at least two windows. The window you will spend most of your time in is the MapView window (you can open several of these at once). The other window that appears at startup is the MapCabinet, which you use to open databases and manipulate themes. When you first start EMAP, it automatically goes to the MapCabinet and opens the file menu. You should select Open Database... or choose a previously-opened database from the list of recently-used files.

2) Open the KC_DCW.MDB database. (Under Windows95 and Windows NT, extensions might not be visible.)

   As soon as you open a database, EMAP automatically brings up a dialog box asking what themes you want to load.

3) Load the themes StatesPolygonsQDF, BordersLinesQDF and TownsPolygonsQDF. This will give a state map with major urban areas shown.

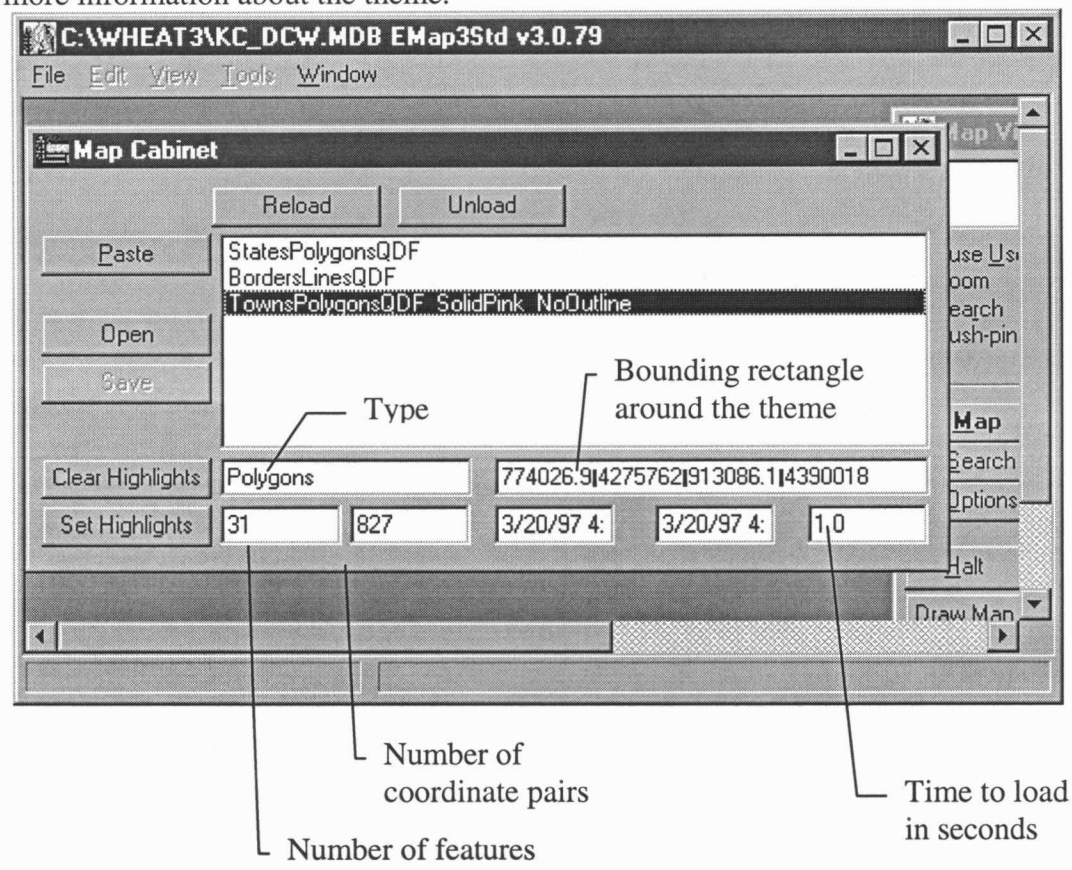


If you haven't seen this style of dialog, you need to learn how to use it, as they are quite common. The list on the left contains a set of possible items. The list on the right contains your selections. To copy an item from Available to the Chosen list, you can either click on the item in the list at left, then click on the > button; or double-click on the desired item in the list at left. This will add them to the list at right. To remove an item from the list at right, double-click on it or click on it and click on < .

If nothing is highlighted at right, items will be added to the end of the list. If something is highlighted, new items will be inserted before it. (You can un-highlight something with the ESCape key.) You can move an item up or down in the list at right by selecting and clicking on the Up and Down buttons or arrows. EMAP will load the item listed at top first and work its way down the list.

When you click OK, the themes listed at right will be loaded. You can also choose Cancel to not perform the action. The options at the bottom control what themes or features to load. You can load all data specified in a theme, or only the data that lies in the rectangle specified in the box at the bottom.

4) After choosing to load the themes, select one of the themes in the MapCabinet to see more information about the theme.

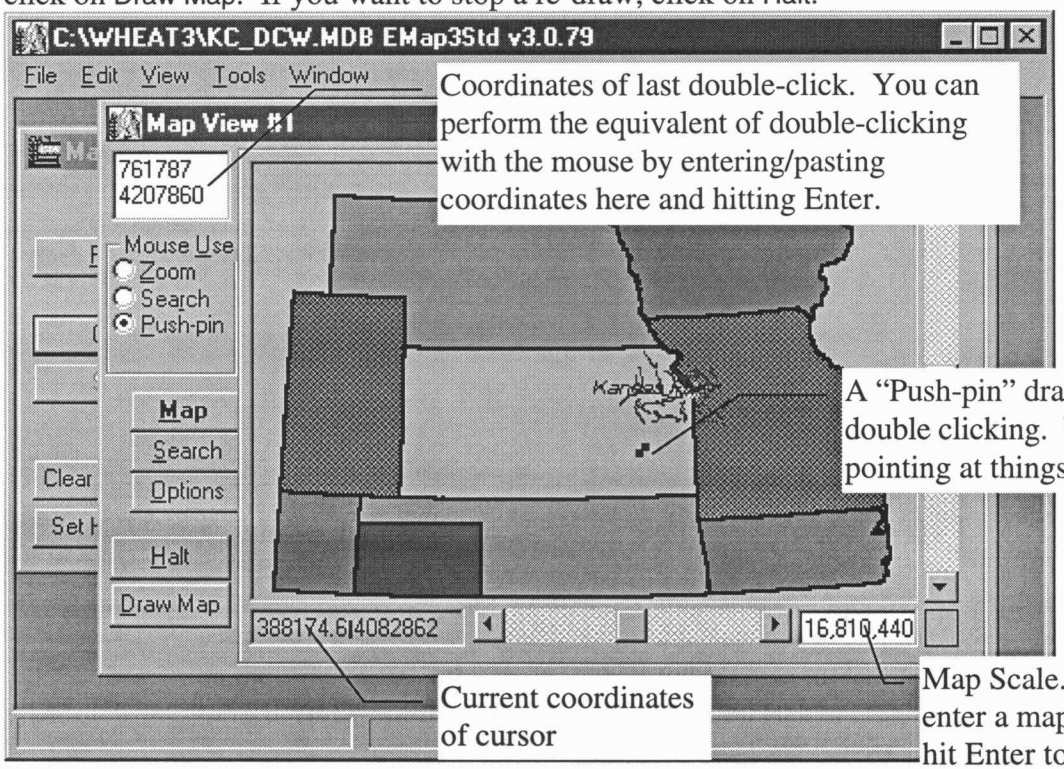


You use the map cabinet to load pre-defined themes, unload themes, and open and close databases, among other things. In the standard edition, you can also define themes.

5) Load a layer of data. Go to the MapCabinet and choose the Open button to load pre-defined themes. Select the option button for Layers at the upper left. This will cause the upper-left dropdown list to be filled with a list of available layers. Select Drainage, then click on the >> button to add all of them to the list. Click on OK to load them.

A layer is an ordered list of themes. By using layers, you can load a group of themes in a particular order. A topic is an un-ordered group of themes, which you can use to organize related themes that you don't want to plot in any particular order.

6) Go to the MapView window and have a look at the map so far. If the map is blank, click on Draw Map. If you want to stop a re-draw, click on Halt.



7) Zoom in on the Kansas City area by selecting Zoom as the Mouse Use (upper-left part of the MapView window) and drag a rectangle around the area containing the rivers. (This is the main area of the database.)

8) Go to the file menu and select File—»Open Theme... Load the theme "AirportsQDF Symbols". Note that the view shifted to include all features loaded so far. Go the View menu and select Previous View to re-set the view area.
Go to the Options page of the MapView window and de-select "Automatically expand view area to include new themes" Load the theme "AirportsQDF Labels". Note that the view area doesn't shift this time.

9) Go to the Search page of the MapView Window. From the list, select the theme "AirportsQDF Symbols". Choose the option to Run Query (at the top under Action to take on a double click) and select Closest Point for the Type of Spatial Search .
Go back to the Map page and double-click somewhere. Note that the symbol closest to where you double-clicked is bold and a different color, and there is a marker showing where you clicked. Go back to the Search page and notice that you can now see the search results in the text box. Copy the text to a spreadsheet, and notice that it's laid out as spreadsheet data.

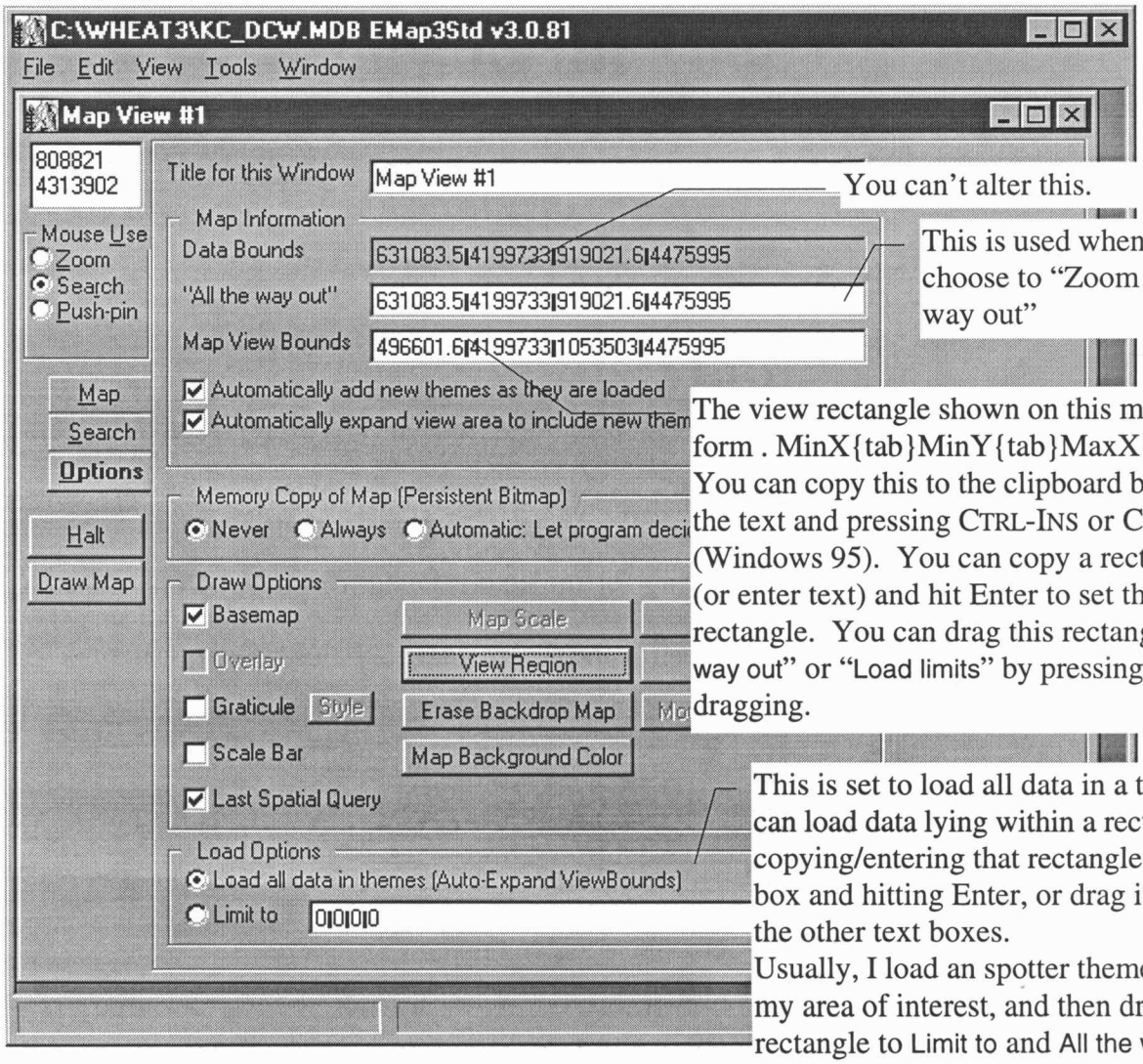
10) Go back to EMAP and go to the Map page. From the Edit menu, select Copy Map to the Clipboard. Wait until you hear a beep, indicating that the clipboard now contains a copy of the map. Go back to the spreadsheet. Choose Edit Paste Special and choose Picture for the format. You now have a copy of the map in the spreadsheet along with the data retrieved for the spatial query.

11) Go back to EMAP and go to the Search page. In the frame for Action to take on double-click, check the box for Open Editor. Change the Type of Spatial Query to All within radius and set the radius to 32000 (in this case, meters or 20 miles). Go to the Map page and double-click. This will bring up a spreadsheet-like window containing Spatial Query Results. Using this window, you can see the same information as on the Search page of MapView, but you can also edit it. If you edit something here, your database is automatically updated: THERE IS NO UN-DO!!! You can bring up a similar window to view or edit a table by choosing Tools—»Database Viewer; there, you choose the table or query and can apply a filter to the data.

Lesson 2 Adjusting the Map

This lesson explains how to control what area you look at with a MapView window and how to control the appearance of the map. Try things: the very worst that can happen is your computer might lock up and need to be re-booted.

1) If you closed EMAP down after completing lesson 1, start it up, open the database, and load some themes.
2) Go to the options page. Play with these options and view the results until you're ready to move on.

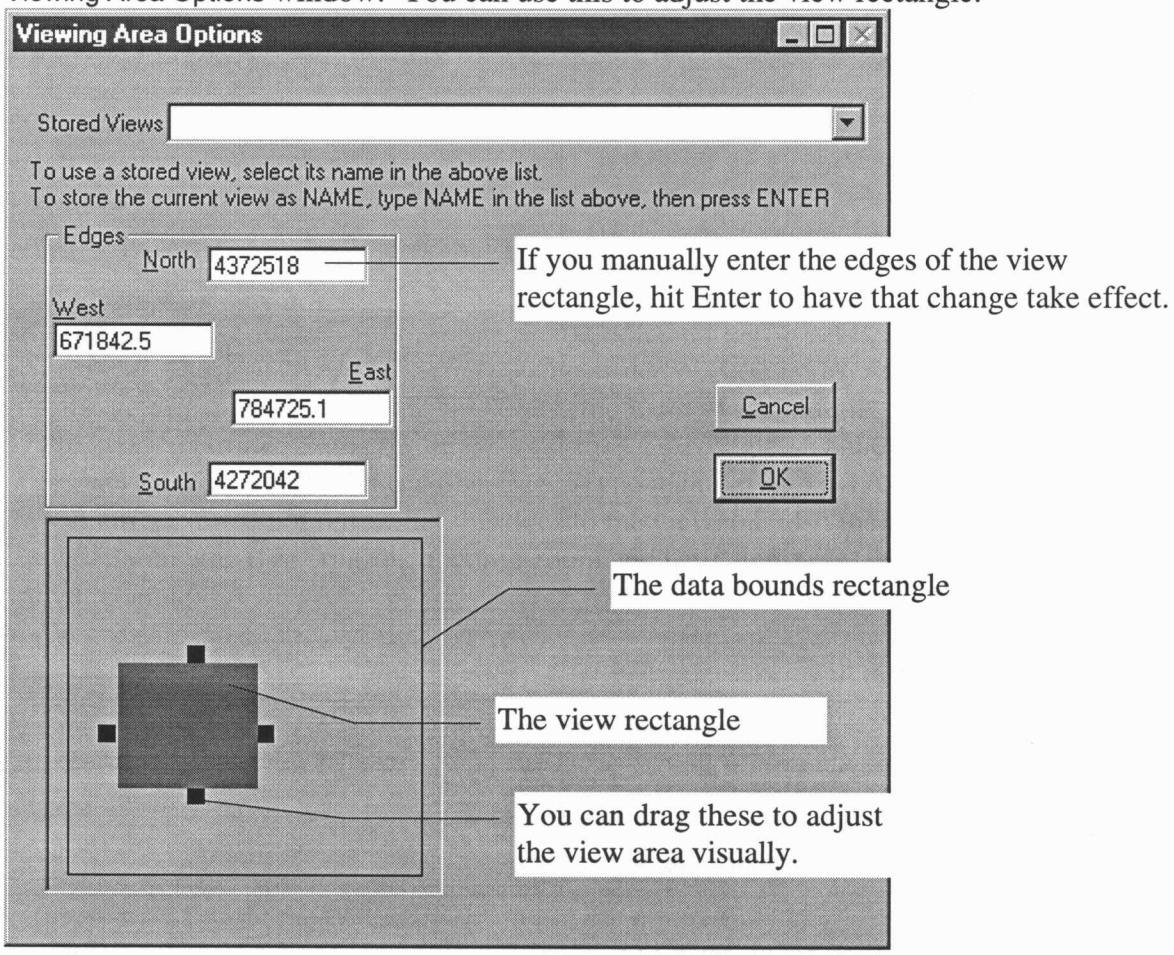


The view rectangle shown on this map, in the form . MinX{tab}MinY{tab}MaxX{tab}MaxY You can copy this to the clipboard by selecting the text and pressing CTRL-INS or CTRL-C (Windows 95). You can copy a rectangle here (or enter text) and hit Enter to set the view rectangle. You can drag this rectangle to "All the way out" or "Load limits" by pressing shift and dragging.

This is set to load all data in a theme. You can load data lying within a rectangle by copying/entering that rectangle in the text box and hitting Enter, or drag it form on e of the other text boxes.
Usually, I load an spotter theme, zoom in on my area of interest, and then drag that rectangle to Limit to and All the way out and turn Automatically expand view area... off.

This page lets you set a variety of options, including whether to load all features or just those inside a rectangle, whether to have bitmap copy of the current map instead of re-drawing each time (slower to re-draw the first time, but if you're seeing a lot of re-draws, it might be faster overall), whether to show a scale bar, whether to show a graticule (map coordinate grid), the map background color, the window's caption,
3) Play with the following items on the View menu: Zoom In, Zoom Out, Zoom all the way out, Shift Right, Shift Left, Shift Up, Shift Down. The menu gives keyboard shortcuts for these items. Notice not only what this does to the view, but also the scroll bars. View—»Zoom Step Size controls how big zoom and shift steps are: it does not move the view rectangle.

4) Choose the menu item View—»Specify View Region... which will display the Viewing Area Options window. You can use this to adjust the view rectangle.



Play with this window for a while. Select a stored view. Store a view. Drag the sizing boxes, and notice that the text boxes above change to reflect those changes. Change the text in one of the text boxes, hit Enter, and notice that the view rectangle box changes size.

If you cancel, the view rectangle in the MapView remains the same. If you click OK, the view rectangle is set from here. The view area that results will be this rectangle plus a border zone to make it fit the screen.

5) Choose the menu-item Tools—»Themes Visible... Un-check some themes, click OK, and notice that the themes are not shown, although they are still loaded.

6) Choose the menu-item Tools—»Themes Order... Move some themes up or down in the plot order using the Up and Down buttons or arrows.
If you remove a theme using the < button, it is no longer in the themes visible list for this MapView; you can add it back later using the > button. All themes in the MapView subset of themes are visible after re-ordering themes.

Lesson 3 Themes

This lesson will show you how to design a theme, load and un-load themes, and perform a number of other operations on themes.

1) Start EMAP and open the database. If you 're not in the MapCabinet window, go there.

2) Choose the menu-item File—»New Theme—»Symbols...

3) From the dropdown list labeled Table or Query , choose Airports Points.
All the other list boxes are filled with fields from this table/query and constants. EMAP will guesses at what fields to use for what. You get to choose the table/query, where the coordinates come from, the serial number (unique number) used for spatial queries, and the plot style. You can set the title for this theme by entering it in the text box.

4) Design the theme.
EMAP needs to know what data to plot and how. You decide this. You have already selected the source (table or query), and EMAP has guessed that Coordinate_X_ and Coordinate_Y_ contain the X and Y coordinates respectively, and has already chosen defaults for plot style.
Each aspect of the theme definition is under your control. Coordinates have to come from a field (lines and polygons) or fields (point, text, tile) in the database. Other parts of the feature description can be based on a field or constant. (e.g., you could use a field named [FontSize] to set the font size of the symbols if you had entered sizes for each airport, or you could have all symbols in a theme be 12 point by using 12 for the value of size.)
For most aspects of a theme definition, EMAP provides a dropdown list, usually containing constants and fields as appropriate. You can select any of these field

names or constants, manually enter a constant, copy a constant from the clipboard, or drag a field name and drop it on the list or the adjacent label or button.

When a button is adjacent to a dropdown list, you can click on it and bring up a window that lets you set the style. To drag a field name from the list of available fields, select the field and click on the Drag Field button. You can copy a field name by clicking on it and copy/paste using standard keyboard shortcuts.

You can also set criteria to limit the features loaded based on field values (e.g., you could load only airports with an elevation below 1000 feet by entering [AEPTVAL] <1000 in the criteria box [I happen to know that [AEPTVAL] is the airport elevation in feet. Generally, you need to know what's in the fields of a table or query to use it, and this one has oddly cryptic names.]) You would do this by finding the field of interest and dragging or copying it to the criteria box and enter whatever else (the <1000)was needed to complete the criteria. (Criteria use SQL syntax)

Back to the main story line. You've already selected the table Airports and EMAP automatically selected default fields and constants.

Click on the symbol button and choose to bring up the Symbol selection window. If "Wheat Point Symbols 3" is not the font listed in the dropdown, choose it. Pick a symbol from the grid (maybe one of the airplane symbols?). Click on OK. (If the right symbol is not shown in the sample box, click on the font list and select the font again. The red box labeled Font Code should have a number showing.)

Click on the button Color, and choose some color that you're sure isn't already on the map, like orange or dark green. Click OK, and notice the sample.

Set the font size to 15 (or whatever). You can choose from the list or enter the font size manually. If you use too small a size for symbol fonts, the results are unpredictable.

We're going to accept EMAP's guesses at coordinates and the serial number field. Add the criteria [AEPTVAL] <1000. Change the theme title to "Airports below 1000 ft" and click OK.

5) Go to MapCabinet, select the theme you just created, and Save it. This saves the theme definition to the database so you can later load it.

6) Un-load the theme by clicking on the Unload button.

7) Open the theme you just unloaded. Select it and notice the theme information displayed.

8) Go to the MapView window and zoom in on some small area that contains a few airports. Go to the Options page and set it to Limit Load to the current view rectangle.

9) Go back to the MapCabinet, select the new airports theme, and Reload it. Select it again, and notice that fewer features are loaded. This happened because you're only loading features within the current load-bounds rectangle. (For point and text themes, this

applies strictly. For lines and polygons, if the bounding rectangle of the feature overlaps the load-bounds, the feature gets loaded.

10) Go to MapView and perform a spatial query on the theme, setting it to Open Editor when you perform a spatial query. Redraw the map and notice that the features found by the spatial query are highlighted. Alter the elevation to be above 1000 ft (change the column AEPTVAL). Pay close attention to where that airport is, because it will vanish in the next step.

11) Go to the MapCabinet and Reload the theme, then go to MapView. When it redraws, notice that the airport whose elevation you just set is no longer there. (The record is still there, but this theme excluded it because of the elevation.)

12) Perform a spatial query to select another airport. Go to MapCabinet, and Clear Highlights. Go back to MapView and notice that the airport is no longer highlighted. Perform another spatial query, go to the Search page, and copy the zqFeatureID value (the serial number). Go back to the map page and perform another spatial query. Redraw the map. Go the MapCabinet and Highlight by Serial Number and paste the serial number to the list. Redraw the map again.. This time, all the features whose serial numbers were selected in Highlight by Serial Number are highlighted. Although this example was not terribly useful, you could use this technique to select a subset of features using their attributes in Access and highlight them in EMAP using their serial numbers.

13) If you're familiar with databases, this might be interesting: theme definitions in WHEAT are SQL statements. You can manually edit these, and you can see them in the lower part of the MapCabinet or on a theme definition form on the right.

Lesson 4 Layers

Layers are ordered groups of themes, usually related to each other. Topics are un-ordered sets of themes. You can use either or both to help you organize themes, and you can use layers to load a set of themes quickly.

1) Start to load some themes, either from MapCabinet or MapView. Click on the Layers button.

2) Select {All} from the list on the left, which brings up a list of all themes definitions stored in the database.

3) Add the following themes to the list on the left: "TownsPolygons QDF SolidPink NoOutline", "TownsQDF Symbols", and "TownsQDF Labels".

4) In the dropdown list box on the left, enter a name for this layer like "Urban Areas" then click on the Save button.

5) Click on Cancel, then choose to load themes again, then choose layers again. The Miscellaneous Transportation layer is now in the list of themes. Click on the >> button to load all the features in that order, then click on OK to load them.

6) Start to load some themes from layers again, but this time, choose Urban Areas in the dropdown list at right. Move one of the themes up in the list, then click on Save. Choose the layer in the dropdown on the left, and notice that the order has changed.

7) Deleting is as important as adding. Choose the Urban Areas layer in the right list and select a theme. Hit the Delete key or choose File—»Delete and that theme is deleted from that list. To save the modified layer, click on the Save button. Put the cursor in the right dropdown list above the theme list and choose File—»Delete and the layer will be deleted. (If you somehow end up with blanks in a layer list, the easy solution is to select and delete each blank, then save the layer.)

8) Topics work a lot like themes, but without the ordering aspect.

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