AN INTERACTIVE PROGRAM TO DISPLAY USER-GENERATED OR FILE-BASED MAPS

ON A PERSONAL COMPUTER MONITOR

By William H. Langer[1] and Rosalie W. Stephens[2]

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ABSTRACT

PC MAP-MAKER is an ADVANCED BASIC program written to provide users of IBM XT, IBM AT, and compatible computers with a straight-forward, flexible method to display geographical data on a color or monochrome PC (personal computer) monitor. Data can be political boundaries such as State and county boundaries; natural curvilinear features such as rivers, drainage areas, and geologic contacts; and points such as well locations and mineral localities. Essentially any point defined by a latitude and longitude and any line defined by a series of latitude and longitude values can be displayed using the program.

PC MAP-MAKER allows users to view tabular data from U.S. Geological Survey files such as WATSTORE (National Water-Data Storage and Retrieval System) in a map format in a time much shorter than required by sending the data to a line plotter. The screen image can be saved to disk for recall at a later date, and hard copies can be printed with a dot matrix printer.

The program is user-friendly, using menus or prompts to guide user input. It is fully documented and structured to allow the user to tailor the program to the user's specific needs. The documentation includes a tutorial designed to introduce users to the programs capabilities using the State of Colorado as a demonstration map area.

INTRODUCTION

This report describes an interactive computer program--PC MAP-MAKER--that was developed by the U.S. Geological Survey, Denver, Colo., in order to display data from the Survey's Ground-Water Site Inventory (GWSI) files of the National Water Data Storage and Retrieval System (WATSTORE). Originally, before the use of personal computers for a graphical display of data, the data usually were retrieved from the computer files, reformatted, printed in tabular form, and hand plotted or sent to a line plotter. The files commonly required editing and replotting several times. PC MAP-MAKER allows a visual previewing capability that in many instances precludes repeated plotting on a line plotter and allows a visual map display of data without using a line plotter at all. PC MAP-MAKER also allows the user to divide the data into intervals and to assign colors and symbols to each interval.

PC MAP-MAKER is written in IBM BASICA,[1] available on IBM PC's (personal computers) and other compatible computers. The program requires a computer with graphics capability, either built in the hardware or with a special board. The program uses approximately 64K (Kilobytes) of memory. Each screen saved to a disk takes about 16K of space on the disk, and the memory screen save takes less than 64K.

The graphical display program was developed to take advantage of the color capabilities of PC's. However, the program will run using a monochrome monitor with colors being replaced with different intensities of the mono-chrome color. The screen displays can be printed by using a dot matrix printer at any time, if the proper Disk Operating System (DOS) commands have been keyed in at the beginning of a session. Depending on parameters and printer capabilities, the image on the monitor can be printed in color or black and white. The image can also be saved and recalled later to be photographed; this provides the capabilities to rapidly generate photographic slides.

PC MAP-MAKER is user-friendly and uses menus or prompts to guide user input. A person unfamilar with computer programming can use this program. However, to tailor the program to individual users needs, the data files used by the program need to be edited and installed by someone who is at least familiar with DOS commands and BASIC programming. Documentation, which is presented in following sections of this report, provides all necessary information to run or adapt this program to specific user needs.

The authors successfully tested the program on IBM equipment (IBM PC XT and IBM AT) and several other personal computers--for example, Compaq porta-ble, Tandy 3000, AT&T 6300, and Leading Edge. The program did not perform adequately on an IBM PC Jr.

Purpose and Scope

Demonstrations described in a later section of the report will guide the user through the general use of PC MAP-MAKER. By following the demonstra-tions, the user will become familiar with the operation and capabilities of PC MAP-MAKER and will learn where the user's data files will fit into the program. The State and county outlines used in this report are for Colorado and were obtained from the Statistical Analysis System (SAS/GRAPH) library, U.S. Geological Survey, Reston, Va. SAS/GRAPH is the registered trademark of SAS Institute Inc., Cary, N.C. Data for Colorado rivers were digitized from a 1:500,000 scale base map of Colorado. Data for well information and water quality were obtained from GWSI and water quality (QW) files of WATSTORE.

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[1]Use of trade or product names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey. Computer names are registered trademarks of the various companies.

PC MAP-MAKER users need to provide similar State, county, or other geographic map files for their area of interest, as well as the other data files to overlay on these maps. Either all data files need to be edited to fit the format described in the section "Preparing Files" or the program needs to be edited to accommodate the new file format.

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DEMONSTRATION PROCEDURES FOR USING INTERACTIVE COMPUTER PROGRAM

The disk containing PC MAP-MAKER should contain two programs, MAPMAKER.BAS and DISPLAY.BAS, as well as the data files necessary for program operation and the demonstration program. If the user does not have an IBM compatible computer, all programs and files for program operation must be keyed in to run the program. The programs are provided in Appendix A and B. Files necessary for program operation are provided in Appendix C. Demonstration files are provided in Appendix D.

This section of the report will guide the user through a typical session with PC MAP-MAKER. The right hand side of these pages is a listing of the dialog between the user and the PC. Prompts from the computer will be shown enclosed by braces, such as:

PROMPT: {Press any key to continue}.

Responses provided by the user will be shown enclosed in square brackets, such as:

RESPONSE: [CORIVER.LIN].

Some prompts will accept a variety of responses.

On the left hand side of the page, the computer/user dialog is keyed with narrative to explain program operations, or to describe what user-supplied files are necessary to tailor the program to the user's own needs.

For this demonstration follow the responses shown. Responses should be keyed in EXACTLY as shown. Do not key in the brackets. Most responses that require a carriage return can be corrected using the backspace (◄-) key. Whenever it is necessary to press the carriage return key (◄─┘) or other special-purpose key (that is, function key F1), it will be shown enclosed in < > brackets, such as:

<CR> or <F1>.

Almost all responses required by PC MAP-MAKER are independent of the type of computer system being used. However, a few responses are dependent on the system configuration, particularly the disk drive designations, and the printer type (if any). These responses are shown in parenthesis within the brackets, such as:

[GRAPHICS (printer type)].

Error-trapping procedures have been incorporated in PC MAP-MAKER to prevent common mistakes from aborting the program. If an input error is encountered, an error message will be displayed, and the program will return to the main menu screen. Misspelling file names will cause the program to return to the main menu.

Getting Started

Use DOS to boot the system. Copy the files from the disk to a disk formatted for the user's computer or a hard disk. Use the copy, saving the original for a backup.

If the user desires the capability to print screen images on a dot matrix printer during this demonstration, the user must now give the proper DOS command. For IBM systems the command is [GRAPHICS (printer type)]. Refer to the DOS manual and printer manual for the proper command.

Use the DOS command for your system to invoke BASICA. The IBM XT and AT have two BASIC interpreters, BASIC and BASICA. BASICA is needed for these programs. Other systems commonly use GWBASIC. Load and run MAPMAKER.BAS. The computer screen should display the PC MAP-MAKER title screen. Press <CR> to continue.

The first screen has the user set up the system for program operation. The first comment is a reminder to the user to set the graphics mode, if screen prints are desired.

PROMPT: {REMINDER: Must enter GRAPHICS command in system to print screen. Press "R" to return to SYSTEM or <CR> to continue}

RESPONSE: <CR>

PROMPT: {WILL YOU USE MORE THAN ONE DISK DRIVE? Y,N}

This option allows the user to read all files from one disk drive or to input files from a number of drives. For this demonstration read all the files from the one drive that contains the demonstration disk.

RESPONSE: [N] <CR>

PROMPT: {ENTER LETTER OF DRIVE}

RESPONSE: [(Select the drive designation that the demo disk is in, either A, B, C, or D.)] <CR>

Had the user responded Y to the original Y,N prompt, the user would be asked to supply a disk drive designation EVERY TIME a file is loaded.

Changing the aspect ratio of PC MAP-MAKER affects the mathematical calculations that determine the ratio of the latitude range versus the longitude range. There are several reasons that the user may wish to do this. 1) The image dimensions on monitors vary from monitor to monitor and change for a single monitor as the monitor ages, which may distort the screen display. This type of distortion can be removed by changing the aspect ratio. 2) Various dot matrix printers print high resolution screens using a different number of lines per inch. The print-outs of some screens may be compressed vertically or horizontally. The screen display can intentionally be distorted to compensate for distortion introduced by the printer. 3) The screen displays are Mercator projections. Map displays of northern latitude areas may appear to be stretched in an east-west direction. Changing the aspect ratio can compensate for this distortion. Changes in aspect ratio are made by trial and error but commonly range from 0.8 to 0.3. The default value is 0.5 as set in this program and as determined imperically for an IBM Enhanced graphics monitor. The default value can be changed permanently in the program, or temporarily at this prompt.

PROMPT: {SET ASPECT RATIO, <CR> FOR DEFAULT}

RESPONSE: <CR>

The screen should now look similar to figure 1.

```
*** Main Menu ***


   1.  Display State outline only
   2.  Display State outline with counties
   3.  Display counties
   4.  Change screen latitude and longitude
   5.  Recall screen from disk or from memory
   6.  Help
   7.  End program


             CHOOSE ONE

   PROGRAM WILL STOP AFTER TITLE OF OVERLAY IS DISPLAYED
USE SHIFT, PrtSc KEYS TO PRINT SCREEN OR RETURN KEY TO CONTINUE
```

Figure 1.--PC MAP-MAKER main menu.

For this example, the areas of major interest have been determined to be the State of Colorado and its included counties. However, PC MAP-MAKER can be tailored for any State and county or State and parish, or it can be tailored to any major project area and subdivision, such as a major drainage area and subbasins.

Many of the functions of PC MAP-MAKER can be executed from the main menu. The first time the main menu is accessed, option 1, 2, or 3 will commonly be selected.

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The disk drive light will flash while the computer accesses a file named "COLORADO.LIN". This section of the program requires minor modifications (as shown in the section "Modifying Programs") to tailor the program to the users' appropriate State (or other project area) file. The computer reads the file, calculates the best-fitting coordinates for the screen, and displays the map in the center of the screen. No additional user input or modification is required as long as a properly formatted file is accessed, and as long as the file is between 60° and 180° west longitude and between 25° and 50° north latitude.

The screen should now display dashed latitude and longitude lines, and an outline of Colorado. Dashed grid lines represent every fifth degree. Larger scale maps (such as county maps) have dotted grid lines at one degree spacing.

This map area has been set as the base map area with the screen coordinates fixed in the computer memory. Until this area is changed, files outside the area can be accessed and read by the program, but data points outside the screen map area will not be plotted.

Overlaying Files

Any choice can be selected by pressing S, R, N, O, or M. A list of all files of points or lines that can be overlaid will now be on the screen. For the tailored program, these files need to be provided for the user's area of interest.

This prompt allows a one-line title to be entered that will be centered under the map. Any title, or no title, can be entered. The screen is now a map and title with no prompts, and will remain like this until <CR> is pressed. This is so the user can print the screen with no extraneous information. If the proper graphics commands were entered in DOS, the screen can be printed by pressing <SHIFT> and <PrtSc> at the same time.

PROMPT: {Save Recall New Lat,Long Overlay Menu}
RESPONSE: [O]
PROMPT: {FILE? (OR <Fl> for list of counties)}}
RESPONSE: [CORIVER.LIN] <CR>
PROMPT: {COLOR: 1(blue) 2(purple) or 3(white)}}
RESPONSE: [1] <CR>
PROMPT: [Title?}
RESPONSE: [COLORADO] <CR>
PROMPT: No prompt appears

RESPONSE: <CR>

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Multiple Overlays

Additional files can continue to be overlaid on the map.

Every time a .PNT file is to be displayed, this prompt is shown. This option allows the user to plot data as single pixels on the screen, or as multicolor symbols. The multicolor symbol option (which will be demonstrated later) also allows for file sorting. However, at this scale, data point distribution commonly is too dense to be clearly displayed using symbols.

During the middle of the plot, there is a pause. Data are being read during the pause but are not being plotted because the data are outside the screen coordinates.

Save

Any time this prompt is encountered, the current screen image can be saved either permanently on a disk or temporarily in memory. Numerous screen images can be saved to disk, with the available disk space limiting the number of saves. Each save requires approximately 16K of memory. Only one screen image can be saved in memory. Any additional save overwrites the previous screen save. Memory saves are particularly useful when preparing multiple overlays. The screen image can be saved to memory, and a new file can be overlaid on the current screen image. If the results are not satisfactory the original screen image can be recalled from memory.

The title is saved along with the screen image but can be omitted by pressing <CR>.

PROMPT: {Save Recall New Lat,Long Overlay Menu}
RESPONSE: [O]
PROMPT: {FILE? (OR <F1> for list of counties)}
RESPONSE: [WELLS.PNT] <CR>

PROMPT: {Data plotted as points, all one color (1)
            OR Multicolor symbols (2)}
RESPONSE: [1]
PROMPT: {COLOR: 1(blue) 2(purple) or 3(white)}
RESPONSE: [2] <CR>
PROMPT: {Title?}
RESPONSE: <CR><CR>
PROMPT: {Save Recall New Lat,Long Overlay Menu}
RESPONSE: [O]
PROMPT: {FILE? (OR <F1> for list of counties)}
RESPONSE: [UTAH.LIN] <CR>
PROMPT: {COLOR: 1(blue) 2(purple) or 3(white)}
RESPONSE: [1] <CR>
PROMPT: {Title?}
RESPONSE: <CR>

PROMPT: {Save Recall New Lat,Long Overlay Menu}

RESPONSE: [S]
PROMPT: {Save Screen to (1) Disk, (2) Memory?}
RESPONSE: [2]

PROMPT: {Title?}
RESPONSE: [TEST SCREEN] <CR>
PROMPT: {Save Recall New Lat,Long Overlay Menu}

Erase

Any file previously plotted can be erased from the current screen image by overlaying the file again in the background color ("0" response to color prompt). CAUTION, this technique will erase data points of other files that were previously overwritten by the file being erased.

RESPONSE: [0]
PROMPT: {FILE? (OR <F1> for list of counties)}
RESPONSE: [CORIVER.LIN] <CR>
PROMPT: {Color 1(blue) 2(purple) 3(white)}
RESPONSE: [0] <CR>
PROMPT: {Title?}
RESPONSE: <CR> <CR>

Recall

A screen image previously saved to memory can be recalled at this prompt.

PROMPT: {Save Recall New Lat,Long Overlay Menu}
RESPONSE: [R]
PROMPT: {Recall screen from (1) Disk, (2) Memory}
RESPONSE: [2]
PROMPT: No Prompt (allows Print Screen option)
RESPONSE: <CR>

New Latitude and Longitude

This option allows the user to set screen coordinates independent of the computer-generated coordinates. This permits zooming in on an area for more detail, or zooming out to expand the area of the map to display adjacent features.

The WELLS.PNT overlay in the southwestern part of the State shows 16 points at this scale. The data file actually contains 19 points in this area; however, some data points are so close that they show up as one pixel at this scale. To increase the detail, continue with:

New coordinates can be entered either as degrees and decimals, or as degrees, minutes, and seconds. Continue with:

Using the five degree grid, estimate the setting for the top of the screen.

PROMPT: {Save Recall New Lat,Long Overlay Menu}
RESPONSE: [N]
PROMPT: {ENTER DEGREES AND DECIMALS OR ENTER 999 FOR DEG, MIN, AND SEC max lat, now: 41.41966} {?}
RESPONSE: [38.5] <CR>
PROMPT: {west long, now: 111.1996} {?}

Using the five degree grid, estimate the setting for the left side of the screen.
Using the five degree grid, estimate the setting for the right side of the screen.
The difference between the east and west longitudes must be at least 1.1 degrees. No latitude or longitue value can be 0.
The base map (State or county map) that was most recently accessed is recalled and plotted on the screen. In this case, for instance, the Colorado base is plotted. However, all overlay plots are lost when new coordinates are set. It is necessary to reconstruct the overlay maps that were previously on the screen.

At this scale 18 points from the WELLS file plot on the screen.
To help orient the map:

A list of all Colorado counties is now on the screen. For the tailored program, these files need to be provided for the user's area of interest.

La Plata county is plotted to help orient the map.

RESPONSE: [110] <CR>

PROMPT: {east long, now: 99.90836}{?}
RESPONSE: [105] <CR>

PROMPT: {Title?}
RESPONSE: <CR> <CR>
PROMPT: {Save Recall New Lat,Long Overlay Menu}
RESPONSE: [0]
PROMPT: {FILE? (OR <F1> for list of counties)}
RESPONSE: [CORIVER.LIN] <CR>
PROMPT: {COLOR: 1(blue) 2(purple) or 3(white)}
RESPONSE: [1] <CR>
PROMPT: {Title?}
RESPONSE: <CR><CR>
PROMPT: {Save Recall New Lat, Long Overlay Menu}
RESPONSE: [0]
PROMPT: {File? (or <F1> for list of counties)}
RESPONSE: [WELLS.PNT] <CR>
PROMPT: {Data plotted as points, all one color (1) OR Multicolor symbols (2)}
RESPONSE: [1]
PROMPT: {Color: 1(blue) 2(purple) 3(white)}
RESPONSE: [2] <CR>
PROMPT: {Title?}
RESPONSE: <CR><CR>
PROMPT: {Save Recall New Lat,Long Overlay Menu}
RESPONSE: [0]
PROMPT: {FILE? (OR <F1> for list of counties)}
RESPONSE: <F1> (Function Key 1)
PROMPT: {File?}
RESPONSE: [LAPLATA.CNT] <CR>
PROMPT: {Color: 1(blue) 2(purple) 3(white)}
RESPONSE: [1] <CR>
PROMPT: {TITLE?}
RESPONSE: <CR><CR>
PROMPT: {Save Recall New Lat, Long Overlay Menu}

A similar approach would be to display the county directly. In this example, the computer-generated coordinates for La Plata County became the coordinates set in memory.

RESPONSE: [M]
PROMPT: {CHOOSE ONE.}
RESPONSE: [3]
PROMPT: {FILE NAME SELECTED?}
RESPONSE: [LAPLATA.CNT] <CR>
PROMPT: {color; 1(blue) 2(purple) 3(white)}
RESPONSE: [1] <CR>
PROMPT: {Title?}
RESPONSE: <CR><CR>

Multicolor Symbols

When the WELLS.PNT was plotted earlier, it appeared that the point scatter was sufficient to display the points using symbols.

PROMPT: {Save Recall New Lat.Long Overlay Menu}
RESPONSE: [0]
PROMPT: {FILE? (OR <F1> for list of counties)}
RESPONSE: [WELLS.PNT] <CR>
PROMPT: {Data plotted as points, all one color
            (1) OR Multicolor symbols (2)}
RESPONSE: [2]

This operation provides the maximum and minimum values of the file to help select intervals.

PROMPT: {DO YOU WANT TO DETERMINE THE MAXIMUM
            AND MINIMUM VALUES OF THE FILE? (Y/N)}
RESPONSE: [Y]
PROMPT: {PRESS ANY KEY TO CONTINUE}
RESPONSE: [(Press any key)]
PROMPT: {NUMBER OF INTERVALS? (1-10)}
RESPONSE: [2] <CR>
PROMPT: {INTERVAL FROM} {TO} {COLOR} {SYMBOL}
RESPONSE: [0] <CR> [.9] <CR> [1] <CR> [3] <CR>
PROMPT: {TO} {COLOR} {SYMBOL}
RESPONSE: [54] <CR> [2] <CR> [3] <CR>
PROMPT: {ALL OK? (Y,N)}
RESPONSE: [Y]

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The file is sorted and displayed. At this scale, all
19 points from the WELLS.PNT file plot are on the screen.

PROMPT: {TITLE?}
RESPONSE: <CR><CR>

PROMPT: {PRESS <E> FOR EXPLANATION OR <CR> TO
            CONTINUE}
RESPONSE: [E]
PROMPT: {PRESS <CR> TO CONTINUE}
RESPONSE: <CR>

PROMPT: No prompt is displayed.
RESPONSE: <CR>

A printout of the explanation can be made by pressing
<SHIFT> and <PrtSc> at the same time, before pressing <CR>.

The map display returns.

Saving and Recalling Screen on Disk

PROMPT: {Save Recall New Lat, Long Overlay Menu}
RESPONSE: [S]
PROMPT: {Save screen to (1)Disk, (2)Memory?}
RESPONSE: [1]
PROMPT: {Your file name}
RESPONSE: [LAPLATA] <CR>
PROMPT: {Title?}
RESPONSE: [SELECTED WELLS IN LAPLATA CTY] <CR>
PROMPT: {Save Recall New Lat, Long Overlay Menu}
RESPONSE: [M]

The program automatically supplies the ".MAP" extension
required for all disk-saved maps.

Data can be overlaid on disk-saved screens in the same manner that it is overlayed on a screen that is constructed during program execution, with one important exception. Screens recalled from disk are recalled with no screen coordinates. Screen image coordinates for the map area currently in memory remain as the active coordinates, even though a new map area is recalled from disk. For example, La Plata County computer-generated coordinates are currently the active screen coordinates. If a Colorado State map were recalled from disk, any data overlaid on that screen would erroneously be plotted as if La Plata County was on the screen. Therefore, it is necessary to reestablish the map coordinates. In the example of the Colorado State map, selecting option 1 from the main menu would have the computer recalculate the coordinates and fix them in memory. A second method to re-establish the screen coordinates would be to do so by using the New Lat,Long option. Coordinates for a screen can be saved as part of a title to facilitate this approach. As an example, recall JEFTEST.MAP from disk. JEFTEST.MAP was originally plotted on the Jefferson County base map and was reset using New Lat,Long.

Before recalling JEFTEST.MAP for overlay purposes, the current base must be changed from La Plata County (the most recently set base map) back to Jefferson County.

After the base map is set, the screen coordinates that were used for JEFTEST.MAP must be reestablished using New Lat,Long. The new coordinates are: max lat. 40; west long. 106; and east long. 104. These are included in the screen title of JEFTEST.MAP and could be recalled from disk if they were unknown or forgotten.

PROMPT: {CHOOSE ONE}
RESPONSE: [3]
PROMPT: {FILE NAME SELECTED?}
RESPONSE [JEFFERSO.CNT] <CR>
PROMPT: {color: (1) blue (2) purple (3) white}
RESPONSE: [1] <CR>
PROMPT: {Title?}
RESPONSE: <CR><CR>
PROMPT: {Save Recall New Lat,Long Overlay Menu}
RESPONSE: [N]
PROMPT: {max lat, now: 39.99142} {?}
RESPONSE: [40] <CR>
PROMPT: {west long, now: 106.329} {?}
RESPONSE: [106] <CR>
PROMPT: {east long, now: 104.122} {?}
RESPONSE: [104] <CR>.

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The map area has been corrected to match the coordinates for JEFTEST.MAP.

JEFTEST.MAP can now be recalled from disk.

```
PROMPT:   {Title?}
RESPONSE: <CR><CR>
PROMPT:   {Save Recall New Lat,Long Overlay Menu}
RESPONSE: [R]
PROMPT:   {recall screen from (1) Disk, (2) Memory}
RESPONSE: [1]
PROMPT:   {File name of screen}
RESPONSE: [JEFTEST.MAP] <CR>
PROMPT:   No prompt
RESPONSE: <CR>
```

Data can now be overlaid on the recalled map just as it was originally constructed on the screen. To test this, overlay CORIVER.LIN in purple. It should overwrite the blue line exactly.

```
PROMPT:   {Save Recall New Lat,Long Overlay Menu}
RESPONSE: [O]
PROMPT:   {FILE? (OR <F1> for list of counties)
RESPONSE: [CORIVER.LIN] <CR>
PROMPT:   {COLOR: 1(blue) 2(purple) or 3(white)
RESPONSE: [2] <CR>
PROMPT:   (Title?)
RESPONSE: <CR><CR>
PROMPT:   {Save Recall New Lat,Long Overlay Menu}
```

Displaying Data Outside of the Major Project Area

It is possible to use this program or a program tailored to a specific area to display data outside the area.

```
RESPONSE: [M]
PROMPT:   {CHOOSE ONE}
RESPONSE: [3]
PROMPT:   {file?}
```

Ignore the files on the screen and key in the name of the file to display. Similar results can be achieved using the New Lat, Long routine.

```
RESPONSE: [HAWAII.LIN] <CR>
PROMPT:   {color: 1(blue), 2(purple), 3(white)?}
RESPONSE: [1] <CR>
PROMPT:   {Title?}
RESPONSE: <CR><CR>
PROMPT:   {Save Recall New Lat,Long Overlay Menu}
RESPONSE: [M]
PROMPT:   {CHOOSE ONE}
RESPONSE: [7]
```

End the demonstration and exits to the system.

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Map Display

DISPLAY.BAS is a special-purpose utility program that allows screens saved to disk to be displayed without using PC MAP-MAKER. The files displayed with DISPLAY.BAS must have the extension .MAP. DISPLAY.BAS is particularly useful for recalling numerous maps, such as during a formal presentation, or when making photographic slides or dot-matrix prints of previously saved images. If DISPLAY.BAS is to be used for dot-matrix printing, the proper GRAPHICS command must be given in DOS. Boot BASICA.

A list of files with extension .MAP is deplayed on the screen.

PROMPT: {OK}
RESPONSE: [LOAD"DISPLAY.BAS] <CR>
PROMPT: {OK}
RESPONSE: [RUN] <CR>
PROMPT: {DISK DRIVE FOR SCREEN FILES?}
RESPONSE: [(Enter drive designation)] <CR>
PROMPT: {NAME OF FILE WANTED?}
RESPONSE: [(Select file, typing EXACTLY as shown)]
           <CR>
PROMPT: No prompt. Print screen option.
RESPONSE: Press <SHIFT><PrtSc> at the same time
           to print screen, or <CR> to continue
PROMPT: {ANY MORE SCREEN FILES WANTED (Y,N?}
RESPONSE: [(Press Y or N)]<CR>

MODIFICATIONS FOR NEW PROJECT AREAS

Modifying Programs

MAPMAKER.BAS PC MAP-MAKER requires very little modification to tailor it to a new area of concern. The BASIC program line numbers and modifications are included in the program HELP option and are listed below.

If MAPMAKER.BAS will primarily be used to display boundaries other than State and county boundaries, change lines 320, 330 and 340.

Change the default filename "COLORADO.LIN" in lines 1005 and 9005 to the new filename that contains the points for the new State boundary. The filename MUST have the extension .LIN.

Change the default filename "COCNTY.CNT" in lines 2005 and 10005 to the new filename that contains the points for the new county boundaries. The filename MUST have the extension .CNT.

If areas outside the range 25° to 50° north latitude and 60° to 180° west longitude are to be plotted, those values must be changed in lines 8020 and 8110.

DISPLAY.BAS DISPLAY.BAS contains no lines that need to be modified to tailor the program to a new geographic locality.

Preparing Files

There are four types of files accessed by PC MAP-MAKER. These files have the following extensions; .LIN, .CNT, .PNT, and .MAP. These extensions are used in the program to identify file type and to determine whether to plot files as lines connecting points, as independent points, or as screen plots. The program also uses the extension for identification purposes when displaying lists of files on the screen. Any files without one of these four extensions will be ignored by PC MAP-MAKER.

Files with the extensions .LIN and .CNT are files that are plotted as lines connecting points. Files with the extension .CNT designate county borders and therefore have a separate extension from other .LIN files. Both of these types of files require data to be in the following form:

Line number, latitude, longitude

as variables N, YA, XA. Variables may be delimited by a space or comma. The line number (N) must change if, and only if, the "pen" should be lifted to start a new line. Figure 2 demonstrates the purpose of the line number. Latitude and longitude must be in degrees and decimals, not in degrees, minutes, and seconds. All line file names require the extension .LIN, or .CNT if they are a county line file.

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Files with the extension .PNT plot data as points. Data must be in the following form:

latitude, longitude, attribute

as variables YA, XA, D. The attribute, variable D, is a value such as depth to water, temperature, well location number, etc. This value is used to sort data into intervals. This value cannot contain symbols such as ">" or "<". Latitude and longitude variables must be in degrees and decimals, not in degrees, minutes, and seconds. All point file names require the extension .PNT. Sample line and point files are at Appendix E.

Files with the extension .MAP are computer-generated files containing data from the screen save routine. The format of these files is set by the computer and cannot be modified. PC MAP-MAKER provides the required extension .MAP.
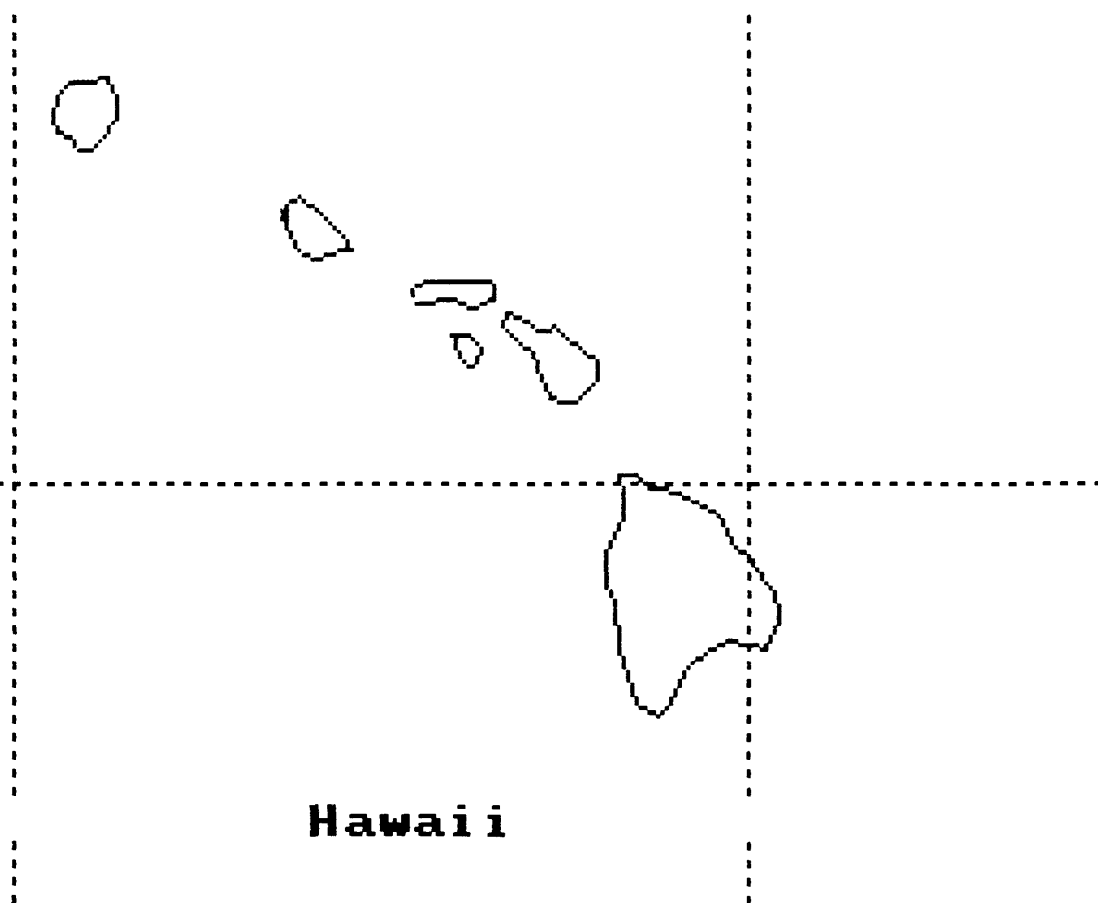
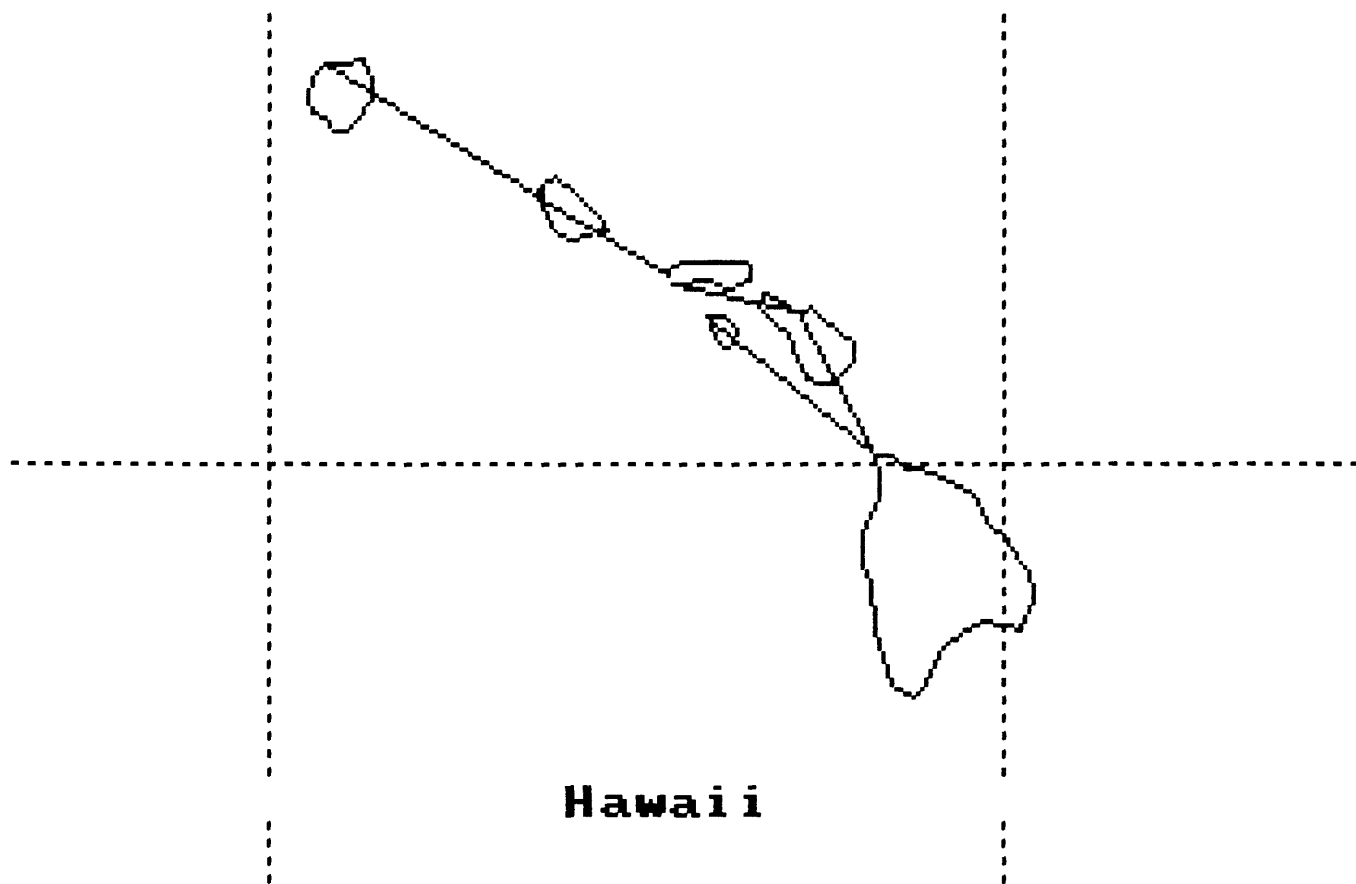Figure 2a.--Screen-image print of Hawaii using unique line numbers.

Figure 2*b*.--Screen-image print of Hawaii without unique line numbers.

APPENDIX A

List of subroutines, variables, and source code for MAPMAKER.BAS.

Routines from main menu:

Line number	Routine
1000	Display state outline
2000	Display state outline with counties
6000	Display individual counties
3000	Change screen latitude and longitude
5000	Recall screen from disk or memory
36000	HELP facility
700	END program

Routines from choice line, after screen display

4000	Save screen to disk or memory
5000	Recall screen from disk or memory
3000	New latitude and longitude
12000	Overlay screen display
300	Return to main menu

Other subroutines

500	Screen display choice line
4400, 4500	Routine to save screen to disk. memory
4800	Routine to get and center title for display
5400, 5500	Routine to recall screen from disk, memory
6500, 12005, 12010	Display county. line. and point files
7000, 7500	Calculate x, y coordinates, Start new line
8000, 8500	Draw lat. long lines – 1 or 5 degree span
9000	Routine to draw state boundary
10000	Routine to draw county borders
10500	Routine to change latitude. longitude
10600	Routine to convert deg, min, sec to decimal
11000	Routine to get key input for file names and titles
11500	Routine to get file name for disk save
12090	Routine to draw overlay files as lines
12400, 12416	Routines for symbols for .PNT files
12407, 12700	Routines to determine range of values of file
12500	Routine to draw overlay files as points
12575	Routine to draw overlay files as symbols
12600	Routine to retrieve file after new lat, long
12800	Routine to display explanation of symbols
13000	Routine to get list of files saved to disk
14000	Routine to wait for key input
15000	Routine to compute screen lat, long
28900	Error trap

LIST OF VARIABLES USED IN MAPMAKER.BAS PROGRAM

Variable   Description

Arrays
A()   Used to save screen to memory
V()   Value for symbols routine

Flags
DKFL   Flag for one drive (0) or more than one (1)
F   Flag to flash first letter of choice line
FLAG   Screen in memory (Y,N) 0=no, 1=yes
SCRF   Flag for screen 0 = screen 0, 1 = screen 1
SYMBFL   Flag for symbol routine 0 = no, 1 = yes

DY$ More than 1 drive (Y,N)
Z$ All OK (Y,N)

Inkey$
A$, K$, R$, S$ Used in Inkey routines

Key Input Routine
B   Sets column for display
LTR$ Gets next letter
T$ Title
XP$ Builds title or file name
V   Centers title

Screen Coordinates
AR   Aspect Ratio
EL, WL   East, West Longitude
LA   Maximum Latitude
X1, X2, Y1, Y2   Used to compute screen coordinates

Latitude and Longitude for file
LADIF. LODIF   Latitude. Longitude difference
MAXLA. MAXLO   Maximum Latitude, Longitude
MINLA. MINLO   Minimum Latitude. Longitude
SPACE   Adjusts space for display

File display
C   Color
K, L   Counter
N, N1   Line number, line number reset
P1, Q1   Resets point for new line
VL, VH   Lowest, Highest value in file

Data Input
D, N   Code number, Line number
XA, XB, YA. YB   Longitude. Latitude

Other
DL$ Disk Drive Letter
N$ File name for display
NAM$ File name for files saved to disk
O$ File name for file to retrieve
T   Timer

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```
10 'Program "MAPMAKER.BAS" to display and preview files
15 'Program being developed by Task I, Geological Survey, March 1986
20 'By William H. Langer and Rosalie W. Stephens
25 'Address: Box 25046, Mail Stop 417, Denver, CO 80225.
30 'logo to start program
31 KEY OFF:FOR I=1 TO 10:KEY I,"":NEXT 'disable function keys
35 SCREEN 0,0,0:CLS:WIDTH 80:COLOR 14,1
36 LOCATE 5,26:FOR N=1 TO 31:PRINT"*";:NEXT
37 LOCATE 6,26:PRINT"*";:PRINT STRING$(29,32);:PRINT"*"
38 LOCATE 7,26:PRINT"*         PC MAP-MAKER          *":LOCATE 8,26:
   PRINT"*    AN INTERACTIVE PROGRAM      *"
39 LOCATE 9,26:PRINT"*  TO DISPLAY USER-GENERATED  *":LOCATE 10,26:
   PRINT"*       OR FILE-BASED MAPS       *"
40 LOCATE 11,26:PRINT"*          ON A PC MONITOR        *":LOCATE 12,26:
   PRINT"*";:PRINT STRING$(29,32);:PRINT"*"
41 LOCATE 13,26:FOR N=1 TO 31:PRINT"*";:NEXT
42 LOCATE 18,26:PRINT"UNITED STATES GEOLOGICAL SURVEY";
   :LOCATE 19,29:PRINT"OPEN-FILE REPORT XX-XXXX"
43 LOCATE 21,38:PRINT"1986"
44 '
45 '
50 LOCATE 24,30:PRINT "PRESS <CR> TO START";
55 K$=INKEY$:IF K$="" THEN 55:IF K$=CHR$(13) THEN 70
60 '
70 'set variables
71 DEFINT B-D,F,K,N,S,V
72 X1=0:X2=0:Y1=0:Y2=0:XA=0:XB=0:YA=0:YB=0
73 SYMBFL=0 'zero symbol routine flag
74 CLEAR:CLOSE 'clear memory, close files
75 DEF SEG = &HB800
80 DIM A(4000):DIM B(4000) 'array for temporary screen save
90 ON ERROR GOTO 29000
100 'set screen to start program
120 KEY OFF:CLS:WIDTH 80:SCREEN 0,0,0:SCRF=0 'set flag for screen
130 COLOR 15,0:LOCATE 5,21:FOR I=1 TO 40:PRINT "*";:NEXT
140 LOCATE 6,21:PRINT "* PROGRAM TO DISPLAY AND PREVIEW FILES *"
150 LOCATE 7,21:FOR I=1 TO 40:PRINT "*";:NEXT
154 COLOR 7,1:LOCATE 10,10:PRINT "REMINDER: Must enter GRAPHICS
    command in SYSTEM to print screen"
155 LOCATE 11,10:PRINT "       Press 'R' to return to SYSTEM, oι
    <CR> to continue      "
156 K$=INKEY$:IF K$="" THEN 156
157 IF K$="R" OR K$="r" THEN SAVE"MAPMAKER.BAS":SYSTEM:END
158 IF K$=CHR$(13) GOTO 160
159 GOTO 156
160 LOCATE 14,18:INPUT "WILL YOU USE MORE THAN ONE DISK DRIVE?
    (Y,N)";DY$
166 DKFL=0 'flag for only one data drive
168 IF DY$="Y" OR DY$="y" THEN DKFL=1:GOTO 172 'set flag to ask
```

```
          for drive
170 LOCATE 16,29:INPUT "ENTER LETTER OF DRIVE:";DL$
172 LOCATE 18,21:INPUT "ASPECT RATIO (OR <CR> FOR DEFAULT of .5)";AR
174 IF AR = 0 THEN AR = .5
190 LOCATE 20,34:INPUT "ALL OK (Y,N)";Z$
210 IF Z$="Y" OR Z$="y" THEN GOTO 300
215 IF Z$="N" OR Z$="n" THEN CLS:GOTO 100
220 GOTO 190
230 '
300 'main menu
305 CLS:SCREEN 0,0,0:WIDTH 80:SCRF=0
310 COLOR 14,1:CLS:LOCATE 5,32:PRINT "*** Main Menu ***":PRINT:PRINT
320 PRINT "                         1. Display State outline only"
330 PRINT "                         2. Display State outline with Counties"
340 PRINT "                         3. Display Counties"
350 PRINT "                         4. Change Screen Latitude and
    Longitude"
360 PRINT "                         5. Recall Screen from Disk or from
    memory"
370 PRINT "                         6. Help"
380 PRINT "                         7. End Program"
390 LOCATE 20,8:COLOR 15,0:PRINT "      PROGRAM WILL STOP AFTER
    TITLE OF OVERLAY IS DISPLAYED      "
400 LOCATE 21,8:PRINT" USE SHIFT, PrtSc KEYS TO PRINT SCREEN OR
    RETURN KEY TO CONTINUE ";
405 COLOR 14,1
406 F=0
407 F=F+1: IF F=2 THEN F=0
408 IF F=1 THEN 411
409 LOCATE 17,35:PRINT"              "
410 FOR T=1 TO 1000:NEXT
411 LOCATE 17,35:PRINT "CHOOSE ONE"
430 GOTO 600 'inkey routine
440 '
450 'routine to display choice on screen
500 F=0
501 F=F+1:IF F=2 THEN F=0
502 IF F=1 THEN 505
503 LOCATE 23,1:PRINT " ave   ecall   ew Lat,Long   verlay   enu"
    :FOR T=1 TO 500:NEXT:GOTO 510
505 LOCATE 23,1::PRINT "Save Recall New Lat,Long Overlay Menu"
506 FOR T=1 TO 2000:NEXT
510 A$=INKEY$:IF A$="" THEN 501
520 IF A$="S" OR A$ = "s" THEN SYMBFL=0:GOSUB 4000
522 IF A$="R" OR A$ = "r" THEN SYMBFL=0:GOSUB 5000
524 IF A$="N" OR A$ = "n" THEN SYMBFL=0:GOSUB 3000
525 IF A$="O" OR A$ = "o" THEN GOSUB 12000
527 IF A$="M" OR A$ = "m" THEN SYMBFL=0:GOTO 300
528 GOTO 500
530 '
540 '
600 'routine for key entry
602 FOR T=1 TO 2000:NEXT
605 A$=INKEY$:IF A$="" THEN 407
```

```
610 IF A$="1" GOTO 1000
611 IF A$="2" GOTO 2000
612 IF A$="3" GOTO 6000
613 IF A$="4" GOTO 3000
614 IF A$="5" GOTO 5000
615 IF A$="6" GOTO 36000
616 IF A$="7" GOTO 700
617 GOTO 605
620 '
630 '
700 'routine to end program
710 LOCATE 23,1:PRINT SPC(40):LOCATE 23,20:PRINT "ARE YOU SURE YOU
    WANT TO QUIT?  <Y or N> "
720 A$=INKEY$:IF A$="" THEN 720
730 IF A$="y" GOTO 780
740 IF A$="Y" GOTO 780
750 IF A$="n" GOTO 300
760 IF A$="N" GOTO 300
770 GOTO 720
780 SYSTEM
790 '
800 '
1000 'routine to draw state boundaries
1001 IF DKFL = 0 THEN GOTO 1005
1002 IF DKFL = 1 THEN LOCATE 23,1:INPUT "DISK DRIVE";DL$
1005 O$=DL$+":"+"COLORADO.LIN" 'set file name to "O$" for recall
     after new lat
1006 N$=O$
1010 GOSUB 15000 'compute latitude and longitude
1030 IF LODIF => 5 THEN GOSUB 8500 'draw lat, long lines
1035 IF LODIF < 5 THEN GOSUB 8000
1040 GOSUB 9000 'draw state bountaries
1050 GOTO 500 'print options on screen
1060 '
1070 '
2000 'routine to draw county borders
2002 IF DKFL = 1 THEN LOCATE 23,1:INPUT "DISK DRIVE";DL$
2005 O$=DL$+":"+"COCNTY.CNT" 'set file name to O$ for recall after
     new lat,long
2006 N$=O$
2010 GOSUB 15000 'compute latitude and longitude
2030 GOSUB 8500 'draw lat, long lines
2040 GOSUB 10000 'draw county boundaries
2060 GOTO 500 'next option
2070 '
2080 '
3000 'routine to change lat, long
3002 IF DKFL = 0 GOTO 3010
3003 INPUT "DISK DRIVE";DL$
3010 GOSUB 10500 'subroutine to change lat,long
3020 IF WL-EL=>5 THEN GOSUB 8500: GOTO 3030
3022 GOSUB 8000
3030 GOTO 12600
3031 GOTO 12600
```

```
3050 GOTO 500 'return to choice line on screen
3060 '
3070 '
4000 'routine to save screen
4005 LOCATE 23,1:PRINT STRING$(40,32);
4010 LOCATE 23,1:PRINT "save screen to (1)Disk, (2)Memory?
     "STRING$(40-POS(C),32);
4020 S$=INKEY$:IF S$="" THEN 4020
4025 IF S$ = "1" THEN GOTO 4400
4030 IF S$ = "2" THEN GOTO 4500
4035 GOTO 4020 'GET 1 OR 2
4040 GOTO 500
4050 '
4060 '
4400 'routine to save screen to disk
4402 IF DKFL = 1 GOTO 4406
4404 LOCATE 23,1:PRINT STRING$(39,32);
4405 LOCATE 23,1:PRINT "Your filename";:GOTO 4411
4406 LOCATE 23,1:PRINT STRING$(39,32);
4407 LOCATE 23,1:PRINT "Disk Drive";
4408 K$=INKEY$:IF K$="" THEN 4408:DL$=K$:LOCATE 23,1:PRINT
     STRING$(39,32);
4410 LOCATE 23,1:PRINT "Your filename";
4411 B=15:GOSUB 11500 'key input for file name
4413 LOCATE 23,1:NAM$=XP$:PRINT NAM$ STRING$(40-POS(C),32);
4415 GOSUB 4800
4417 NAM$=DL$+":"+NAM$+".MAP" 'rename file for listing
4425 BSAVE NAM$,0,&H4000
4430 GOTO 500
4440 '
4450 '
4500 'routine to save screen to memory
4505 FLAG = 0 'no screen saved to memory yet
4600 GOSUB 4800
4610 GOSUB 4700:GET (0,0)-(X2,Y2),A
4615 FLAG = 1:GOTO 500 'screen in memory, return to main menu
4670 '
4680 '
4700 X2=WL-EL:Y2=(X2*AR)
4710 RETURN
4800 'routine to get title for screen
4810 LOCATE 23,1:PRINT "Title?" STRING$(40-POS(C),32);:B=8:GOSUB
     11000 'input
4820 T$=XP$:V=LEN(T$) 'center title
4825 LOCATE 23,1:PRINT STRING$ (20-V/2,32); T$; STRING$(40-POS(C),32);
4830 RETURN
4840 '
4850 '
5000 'routine to recall screen
5005 SCREEN 1:SCRF=1
5010 LOCATE 23,1:PRINT "recall screen from (1)Disk, (2)Memory"
5015 R$=INKEY$:IF R$="" GOTO 5015
5020 IF R$="1" THEN GOTO 5400
5030 IF R$="2" THEN GOTO 5500
```

```
5035 GOTO 5015 'get 1 or 2
5040 GOTO 500
5050 '
5060 '
5400 'routine to recall screen from disk
5401 IF DKFL = 1 GOTO 5404
5402 GOTO 5405
5404 LOCATE 22,1:INPUT "Disk Drive";DL$
5405 GOSUB 13000 'get list of screen files saved to disk
5410 LOCATE 22,1:PRINT "File name of screen"STRING$(40-POS(C),32);
5412 B=1:GOSUB 11000 'get key input
5413 LOCATE 23,1:NAM$=XP$:PRINT NAM$ STRING$(40-POS(C),32);
5414 NAM$=DL$+":"+NAM$
5415 CLS:SCREEN 1
5420 BLOAD NAM$,0
5425 K$=INKEY$:IF K$="" THEN 5425
5435 IF K$=CHR$(13) THEN LOCATE 23,1:PRINT STRING$(40,32);
5440 X2=WL-EL:Y2=X2*AR:WINDOW SCREEN (0,0)-(X2,Y2):GET (0,0)-(X2,Y2),
     B:SYMBFL=2 'save disk file for overlay
5445 GOTO 500
5495 '
5497 '
5500 'routine to recall screen from memory
5505 IF FLAG = 1 THEN GOTO 5600
5510 IF FLAG = 0 THEN PRINT "NO SCREEN SAVED TO MEMORY. PRESS ANY KEY"
5520 K$=INKEY$:IF K$="" THEN 5520
5530 IF K$<> "" THEN GOTO 300
5600 CLS:PUT (0,0),A:GOTO 14000
5650 '
5660 '
6000 'routine to display counties
6020 'list counties on screen
6022 IF DKFL = 1 THEN GOTO 6025
6024 GOTO 6040
6025 COLOR 31:LOCATE 23,1:INPUT "DISK DRIVE WITH COUNTY FILES";DL$
6040 CLS:SCREEN 0,0,0:SCRF=0:WIDTH 80:COLOR 7,0 'return to full screen
6050 LOCATE 15,2:PRINT "LIST OF COUNTIES"
6060 IF (DL$="A") OR (DL$="a") THEN PRINT:FILES "A:*.CNT"
6070 IF (DL$="B") OR (DL$="b") THEN PRINT:FILES "B:*.CNT"
6080 IF (DL$="C") OR (DL$="c") THEN PRINT:FILES "C:*.CNT"
6085 IF (DL$="D") OR (DL$="d") THEN PRINT:FILES "D:*.CNT"
6090 LOCATE 23,1:PRINT "FILE SELECTED:";
6091 B=16:GOSUB 11000 ' get file name
6092 N$=XP$
6093 O$=DL$+":"+N$
6094 N$=O$
6095 GOSUB 15000 'determine latitude and longitude
6097 INPUT "color: 1(blue), 2(purple), 3(white)";C
6100 CLS:SCREEN 1:SCRF=1 'graphics screen
6102 IF MAXLO => 140 THEN GOSUB 8500 '5 degree increments
6103 IF MAXLO < 140 THEN GOTO 6105
6104 GOTO 6110
6105 IF LODIF < 5 THEN GOSUB 8000 'draw dotted lines for latitude
```

```
      and longitude
6107  IF LODIF => 5 THEN GOSUB 8500 'draw latitude and longitude
      with dashes
6110  GOTO 12090 'draw county lines
6120  '
6130  '
6500  'routine to display county files for overlay
6502  LOCATE 23,1:PRINT STRING$(70,32)
6503  IF DKFL=1 THEN GOTO 6505
6504  GOTO 6510
6505  LOCATE 23,1:INPUT "DISK DRIVE FOR COUNTY FILES";DL$
6510  CLS:SCREEN 0,0,0:WIDTH 80:SCRF=0
6520  LOCATE 15,2:PRINT "LIST OF COUNTY FILES FOR OVERLAY"
6530  IF (DL$="A") OR (DL$="a") THEN PRINT:FILES "A:*.CNT"
6540  IF (DL$="B") OR (DL$="b") THEN PRINT:FILES "B:*.CNT"
6550  IF (DL$="C") OR (DL$="c") THEN PRINT:FILES "C:*.CNT"
6560  IF (DL$="D") OR (DL$="d") THEN PRINT:FILES "D:*.CNT"
6570  LOCATE 23,1:PRINT "File?";:GOTO 12020
6575  N$=XP$:N$=DL$+":"+N$
6590  GOTO 12050 'draw county borders
6600  '
6610  '
7000  'routine to calculate x,y coordinates
7005  SCREEN 1:SCRF=1
7010  X2=WL-EL:Y2=(X2*AR)
7020  WINDOW SCREEN (0,0)-(X2,Y2)
7030  X1=WL-XA:Y1=(LA-YA)
7040  X2=WL-XB:Y2=(LA-YB)
7050  RETURN
7060  '
7070  '
7500  'routine to start new line
7505  P1=X1:Q1=Y1 'set first part of new line
7510  PSET (X1,Y1):RETURN
7520  '
7530  '
8000  'routine to draw lat, long lines
8010  CLS:SCREEN 1:SCRF=1
8015  YA=0:YB=90
8020  FOR L=60 TO 180
8030  XA=L:XB=L
8050  GOSUB 7000 'calculate x,y coordinates
8060  LINE (X1,Y1)-(X2,Y2),,,&HAAAA 'draw dotted line
8070  NEXT L
8100  XA=0:XB=180
8110  FOR L=25 TO 50
8120  YA=L:YB=L
8130  GOSUB 7000 'calculate x,y coordinates
8140  LINE (X1,Y1)-(X2,Y2),,,&HAAAA 'draw dotted line
8150  NEXT L
8160  RETURN
8170  '
8500  'routine to draw lat, long lines when longitude spans 5+ degrees
8510  CLS:SCREEN 1:SCRF=1
```

```
8515 YA=0:YB=90
8520 FOR L=0 TO 180 STEP 5
8530 XA=L:XB=L
8540 'routine to draw state boundary
8550 GOSUB 7000 'calculate x,y coordinates
8560 LINE (X1,Y1)-(X2,Y2),,,&HCCCC 'draw line with dashes
8570 NEXT
8600 XA=0:XB=180
8610 FOR L=0 TO 90 STEP 5
8620 YA=L:YB=L
8630 GOSUB 7000 'calculate x,y coordinates
8640 LINE (X1,Y1)-(X2,Y2),,,&HCCCC 'draw line with dashes
8650 NEXT
8660 RETURN
8670 '
9000 'routine to draw state boundary
9005 N$=DL$+":"+"COLORADO.LIN"
9010 OPEN N$ FOR INPUT AS #1
9020 K=0 'set counter to start new line
9030 IF EOF(1) THEN CLOSE #1:RETURN
9040 K=K+1
9050 INPUT #1, N, YA, XA
9060 GOSUB 7000 'calculate x,y coordinates
9070 IF K=1 THEN GOSUB 7500 'start new line
9080 LINE (P1,Q1)-(X1,Y1),1:P1=X1:Q1=Y1'draw state in blue
9090 GOTO 9030 'read next value
9100 '
9110 '
10000 'routine to draw county borders
10005 N$=DL$ + ":"+"COCNTY.CNT"
10010 OPEN N$ FOR INPUT AS #1
10020 K=0:N=0:N1=0 'set counters to draw each line separately
10030 IF EOF(1) THEN CLOSE #1:RETURN
10040 K=K+1
10050 INPUT #1, N, YA, XA
10060 GOSUB 7000 'calculate x,y coordinates
10070 IF K=1 THEN GOSUB 7500 'start new line
10080 IF N <> N1 THEN GOSUB 7500 'start new line
10090 LINE (P1,Q1)-(X1,Y1),1:P1=X1:Q1=Y1:N1=N 'draw line
10100 GOTO 10030
10110 '
10120 '
10500 'routine to change lat, long
10510 LOCATE 23,1:PRINT STRING$(39,32)
10514 LOCATE 21,7:PRINT "ENTER DEGREES AND DECIMALS"
10516 LOCATE 22,3:PRINT "OR ENTER 999 FOR DEG, MIN, AND SEC"
10520 LOCATE 23,1:PRINT "max lat, now:"LA
10525 INPUT LA:PRINT "new lat:";LA
10527 IF LA = 0 THEN 10520
10528 IF LA = 999 THEN 10600
10530 IF LA > 80 OR LA < 0 THEN PRINT "latitude out of range:GOTO 10520
10540 PRINT "west long,now:";WL:INPUT WL:PRINT "new west long:";WL
10545 IF WL = 0 THEN 10540
10550 PRINT "east long,now:";EL:INPUT EL:PRINT "new east long:";EL
```

```
10552 IF EL= 0 THEN 10550
10555 IF WL < (EL + 1.1) THEN PRINT "ERROR! west long must be >1.1
      deg more than east":GOTO 10500
10570 '
10590 RETURN
10600 '
10610 '
10611 ' routine to convert deg,mim,sec to decimal
10620 PRINT "new lat. (degrees):";:INPUT DG
10625 PRINT "new lat. (minutes):    "DG CHR$(248);:INPUT MN
10630 PRINT "new lat. (seconds):    "DG CHR$(248) MN CHR$(39);:INPUT SC
10635 PRINT "new lat. : " DG CHR$(248) MN CHR$(39) SC CHR$(34)
10640 IF DG = 0 OR DG > 80 THEN PRINT "ERROR - OUT OF RANGE"
      :GOTO 10620
10645 IF MN > 59 OR SC > 59 THEN PRINT "ERROR - MIN OR SEC TOO
      LARGE":GOTO 10620
10650 LA=DG+((MN*60+SC)/3600):PRINT "new lat.:"LA
10655 PRINT "west long now:"WL
10660 PRINT "new west long (degrees):";:INPUT DG
10665 PRINT "new west long (minutes):"DG CHR$(248);:INPUT MN
10670 PRINT "new west long (seconds):"DG CHR$(248) MN CHR$(39);
      :INPUT SC
10675 PRINT "new west long:" DG CHR$(248) MN CHR$(39) SC CHR$(34)
10680 IF DG = 0 OR DG > 180 THEN PRINT "ERROR - OUT OF RANGE"
      :GOTO 10620
10685 IF MN > 59 OR SC > 59 THEN PRINT "ERROR - MIN OR SEC TOO LARGE"
      :GOTO 10620
10690 WL=DG+((MN*60+SC)/3600):PRINT "new west long:"WL
10695 PRINT "east long now:"EL
10700 PRINT "new east long (degrees):";:INPUT DG
10705 PRINT "new east long (minutes):"DG CHR$(248);:INPUT MN
10710 PRINT "new east long (seconds):"DG CHR$(248) MN CHR$(39);
      :INPUT SC
10715 PRINT "new east long:" DG CHR$(248) MN CHR$(39) SC CHR$(34)
10720 IF DG = 0 OR DG > 180 THEN PRINT "ERROR - OUT OF RANGE"
      :GOTO 10620
10725 IF MN > 59 OR SC > 59 THEN PRINT "ERROR - MIN OR SEC TOO LARGE"
      :GOTO 10620
10730 EL=DG+((MN*60+SC)/3600):PRINT "new east long:"EL
10735 GOTO 10555
11000 'routine to get key input
11002 KEY 1, CHR$(43) 'set <F1> key
11005 K$=INKEY$:IF K$=CHR$(13) THEN 11005
11010 XP$=""
11020 LTR$=INKEY$:IF LTR$="" GOTO 11020
11025 IF LTR$ = CHR$(43) THEN GOTO 6500 'function key
11030 IF LEN(LTR$)>1 GOTO 11020: 'no extended lines
11040 IF LEN (XP$)=0 AND LTR$=CHR$(8) GOTO 11020 'limit backspaces
11050 IF LTR$=CHR$(8) THEN XP$=LEFT$(XP$,LEN(XP$)-1):GOTO 11100
11060 IF LTR$=CHR$(13) THEN RETURN
11070 XP$=XP$+LTR$
11080 LOCATE 23,B+LEN(XP$)-1:PRINT LTR$
11090 IF LEN(XP$)>31 THEN 11120 ELSE 11020 'not too long
11100 LOCATE 23,B:PRINT XP$" " 'show backspace
```

```
11110 GOTO 11020
11120 RETURN
11130 '
11140 '
11500 'routine to get file name for disk save
11505 K$=INKEY$:IF K$=CHR$(13) THEN 11505
11510 XP$=""
11515 LTR$=INKEY$:IF LTR$ = CHR$(13) THEN 11515:GOTO 11520   'first
      key not a carriage return
11520 LTR$=INKEY$:IF LTR$="" GOTO 11520
11530 IF LEN(LTR$)>1 GOTO 11520 'no extended lines
11540 IF LEN(XP$)=0 AND LTR$=CHR$(8) GOTO 11520 'limit backspaces
11550 IF LTR$=CHR$(8) THEN XP$=LEFT$(XP$,LEN(XP$)-1):GOTO 11600
11560 IF LTR$=CHR$(13) THEN RETURN
11570 XP$=XP$+LTR$:XP$=LEFT$(XP$,8)
11575 IF LEN(XP$) > 8 AND LTR$ <> CHR$(13) THEN RETURN
11580 LOCATE 23,B+LEN(XP$)-1:PRINT LTR$ + ".MAP"
11590 IF LEN(XP$)>31 THEN 11620 ELSE 11520 'not too long
11600 LOCATE 23,B:PRINT XP$" " 'show backspace
11610 GOTO 11520
11620 RETURN
11630 '
11640 '
12000 'routine to select and display overlay file
12001 IF SYMBFL <> 0 THEN GOTO 12003 'use screen already saved
12002 X2=WL-EL:Y2=(X2*AR):GET (0,0)-(X2,Y2),B 'save screen for overlay
12003 SYMBFL=0:IF DKFL = 1 THEN GOTO 12005
12004 GOTO 12006
12005 INPUT "DISK DRIVE FOR OVERLAY FILES";DL$
12006 CLS:SCREEN 0,0,0:SCRF=0:WIDTH 80:LOCATE 5,5:PRINT "FILES
      DISPLAYED WITH LINES"
12007 IF (DL$= "A") OR (DL$="a") THEN FILES "A:*.LIN"
12008 IF (DL$= "B") OR (DL$="b") THEN FILES "B:*.LIN"
12009 IF (DL$= "C") OR (DL$="c") THEN FILES "C:*.LIN"
12010 IF (DL$= "D") OR (DL$="d") THEN FILES "D:*.LIN"
12011 PRINT:PRINT "FILES DISPLAYED WITH POINTS"
12012 IF (DL$= "A") OR (DL$="a") THEN FILES "A:*.PNT"
12013 IF (DL$= "B") OR (DL$="b") THEN FILES "B:*.PNT"
12014 IF (DL$= "C") OR (DL$="c") THEN FILES "C:*.PNT"
12016 IF (DL$= "D") OR (DL$="d") THEN FILES "D:*.PNT"
12017 LOCATE 23,1:PRINT "FILE?              (or <F1> for list
      of counties)";
12018 LOCATE 23,6 'move cursor
12020 B=8:GOSUB 11000
12027 N$=XP$ 'sets variable to file name
12030 N$=DL$+":"+N$
12045 IF SCRF=0 THEN LOCATE 23,1:PRINT STRING$(70,32);
12050 IF SCRF=1 THEN LOCATE 23,1:PRINT STRING$(39,32);
12060 IF RIGHT$(N$,3) = "PNT" OR RIGHT$(N$,3)="pnt" THEN GOTO 12400
12070 LOCATE 23,1:INPUT "color: 1(blue),2(purple),or3(white)";C
      :PRINT STRING$(40-POS(C),32);
12080 SCREEN 1:SCRF=1:PUT (0,0),B 'recall screen
12085 '
12087 '
```

```
12090 'routine to draw overlay file as lines
12095 LOCATE 23,1:PRINT "          PLOTTING DATA......          ";
12100 OPEN N$ FOR INPUT AS #1
12110 K=0:N=0:N1=0 'zero variables to start new line
12120 IF EOF(1) THEN CLOSE #1:GOSUB 4800:GOSUB 14000:GOTO 500 'next
      option
12130 K=K+1
12140 INPUT #1, N, YA, XA
12150 GOSUB 7000 'calculate x,y coordinates
12160 IF K = 1 THEN GOSUB 7500 'start new line
12170 IF N <> N1 THEN GOSUB 7500 'start new line
12180 LINE (P1,Q1)-(X1,Y1),C:P1=X1:Q1=Y1:N1=N:GOTO 12120 'draw line,
      read next value
12190 '
12200 '
12400 'routine to separate data for symbols
12402 PRINT "Data plotted as points, all one color (1) OR Multicolor
      symbols (2)"
12403 K$=INKEY$:IF K$="" THEN GOTO 12403
12404 IF K$="1" THEN 12500
12405 IF K$ = "2" THEN 12407
12406 GOTO 12403
12407 'routine to determine range of files
12408 CLS:COLOR 14,1:LOCATE 8,4:PRINT"DO YOU WANT TO DETERMINE THE
      MAXIMUM AND MINIMUM VALUES OF THE FILE? (Y/N)"
12409 'routine to determine range of files
12410 K$=INKEY$:IF K$="" THEN 12410
12411 IF K$="Y" OR K$="y" THEN GOTO 12700
12412 IF K$="N" OR K$="n" THEN GOTO 12416
12413 GOTO 12410
12416 'routine to select color and symbol for each interval
12418 CLS:WIDTH 80:SCREEN 0,0,0
12420 LOCATE 8,27:INPUT "NUMBER OF INTERVALS? (1-10)";IN
12422 COLOR 7,0:CLS:LOCATE 2,28:PRINT "PRINT POINTS IN " IN "INTERVALS"
12423 LOCATE 20,16:PRINT "COLOR: 0 (ERASE), 1 (BLUE), 2 (PURPLE),
      3(WHITE)"
12424 LOCATE 22,16:PRINT "SYMBOL: 1 ("CHR$(249)"), 2 (X), 3 (+),
      4 ("CHR$(254)")"
12426 LOCATE 4,10:PRINT"INTERVAL        FROM        TO        COLOR
       SYMBOL"
12428 FOR I=1 TO 10:V(I)=0:C(I)=0:S(I)=0:NEXT
12430 FOR X=1 TO IN
12432 IF X > 1 GOTO 12436
12434 LOCATE 5+X,14:PRINT X:LOCATE 5+X,26:INPUT "",V(0)
      :LOCATE 5+X,38:INPUT "",V(X):GOTO 12440
12436 LOCATE 5+X,14:PRINT X:LOCATE 5+X,24:PRINT ">";:PRINT V(X-1)
      :LOCATE 5+X,38:INPUT "",V(X):IF V(X) < V(X-1) OR V(X) = V(X-1)
      THEN BEEP:GOTO 12436
12440 LOCATE 5+X,53:INPUT "",C(X):LOCATE 5+X,50
12442 IF  C(X) > 3 THEN BEEP:GOTO 12440
12444 ON C(X) GOSUB 12480, 12482, 12484
12446 LOCATE 5+X,62:INPUT "",S(X):LOCATE 5+X,62
12448 IF S(X) < 1 OR S(X) > 4 THEN BEEP:GOTO 12446
12450 ON S(X) GOSUB 12490, 12492, 12494, 12496
```

```
12452 NEXT X
12454 PRINT:PRINT"                                    ALL OK? (Y,N)"
12456 K$=INKEY$:IF K$="" THEN 12456
12457 IF K$="Y" OR K$="y" THEN 12575
12458 IF K$<> "Y" OR K$<> "y" THEN 12418
12459 '
12460 IF S=1 THEN PSET (X1,Y1),C:RETURN'plot point
12461 IF S=2 THEN PSET (X1,Y1),C:DRAW "H1 BR2 R0 BD2 D0 BL2 L0"
      :RETURN 'draw x
12462 IF S=3 THEN PSET (X1,Y1),C:DRAW "U1 D2 H1 R2":RETURN 'draw +
12464 IF S=4 THEN PSET (X1,Y1),C:DRAW "BH1 H0 R2 D2 L2 U2"
      :RETURN 'draw square
12465 '
12480 IF C(X)=1 THEN COLOR 3:PRINT "BLUE":RETURN
12481 IF C(X)=O THEN COLOR 7:PRINT "ERASE":RETURN
12482 IF C(X)=2 THEN COLOR 5:PRINT "PURPLE":RETURN
12484 IF C(X)=3 THEN COLOR 7:PRINT "WHITE":RETURN
12486 '
12490 IF S(X)=1 THEN PRINT CHR$(249):COLOR 7:RETURN
12492 IF S(X)=2 THEN PRINT CHR$(88):COLOR 7:RETURN
12494 IF S(X)=3 THEN PRINT CHR$(43):COLOR 7:RETURN
12496 IF S(X)=4 THEN PRINT CHR$(254):COLOR 7:RETURN
12500 'routine to draw overlay file as points
12501 LOCATE 23,1:PRINT "color: 1(blue),2(purple),or3(white)";C
      :LOCATE 23,36:PRINT STRING$(40,32);
12502 LOCATE 23,37:INPUT C
12505 SCREEN 1:SCRF=1:PUT (0,0),B 'recall screen
12507 LOCATE 23,1:PRINT "            PLOTTING DATA...            ";
12510 OPEN N$ FOR INPUT AS #1
12520 IF EOF(1) THEN CLOSE #1:GOSUB 4800:GOSUB 14000:GOTO 500 'next
      option
12530 INPUT #1, YA, XA, D
12540 GOSUB 7000 'calculate x,y coordinates
12550 PSET (X1,Y1),C 'display point
12560 GOTO 12520 'read next value
12570 '
12575 'routine to plot symbols
12576 SCREEN 1:SCRF=1:PUT (0,0),B 'recall screen
12578 LOCATE 23,1:PRINT "            PLOTTING DATA...            ";
12580 OPEN N$ FOR INPUT AS #1
12582 IF EOF(1) THEN CLOSE #1:GOSUB 4800:X2=WL-EL:Y2=(X2*AR)
      :GET (0,0)-(X2,Y2),B:GOTO 12800
12584 INPUT #1, YA, XA, D
12585 GOSUB 7000 'calculate x,y coordinates
12586 IF D <= V(1) AND D => V(0) THEN S=S(1):C=C(1):ON S GOSUB
      12460, 12461, 12462, 12464
12587 IF D <= V(2) AND D > V(1) THEN S=S(2):C=C(2):ON S GOSUB
      12460, 12461, 12462, 12464
12588 IF D <= V(3) AND D > V(2) THEN S=S(3):C=C(3):ON S GOSUB
      12460, 12461, 12462, 12464
12589 IF D <= V(4) AND D > V(3) THEN S=S(4):C=C(4):ON S GOSUB
      12460, 12461, 12462, 12464
12590 IF D <= V(5) AND D > V(4) THEN D=5:S=S(5):C=C(5):ON S GOSUB
```

```
        12460, 12461, 12462, 12464
12591 IF D <= V(6) AND D > V(5) THEN D=6:S=S(6):C=C(6):ON S GOSUB
        12460, 12461, 12462, 12464
12592 IF D <= V(7) AND D > V(6) THEN D=7:S=S(7):C=C(7):ON S GOSUB
        12460, 12461, 12462, 12464
12593 IF D <= V(8) AND D > V(7) THEN D=8:S=S(8):C=C(8):ON S GOSUB
        12460, 12461, 12462, 12464
12594 IF D <=  V(9) AND D > V(8) THEN D=9:S=S(9):C=C(9):ON S GOSUB
        12460, 12461, 12462, 12464
12595 IF D<= V(10) AND D > V(9) THEN D=10:S=S(10):C=C(10):ON S GOSUB
        12460,12461,12462,12464
12596 GOTO 12582 'read next value
12597 '
12598 '
12599 'routine to retrieve line file after new lat, long
12600 IF O$=""THEN GOSUB 4800:GOSUB 14000:GOTO 500 ' NEXT OPTION
        IF NO FILE
12602 OPEN O$ FOR INPUT AS #1
12605 C=1
12610 K=0:N=0:N1=0 'zero variables to start new line
12620 GOTO 12120 'draw lines from overlay routine
12680 '
12690 '
12700 'routine to determine max and min values of files
12710 CLS:LOCATE 8,26:PRINT"READING FILE.....PLEASE WAIT"
12715 OPEN N$ FOR INPUT AS #1
12720 IF EOF(1) THEN CLOSE:GOTO 12770
12725 INPUT #1, YA, XA. D
12730 VL=D:VH=D
12735 IF EOF(1) THEN CLOSE:GOTO 12770
12740 INPUT #1, YA, XA, D
12745 IF D>VH THEN VH=D
12750 IF D<VL THEN VL=D
12760 GOTO 12735
12770 CLS:LOCATE 8,30:PRINT"MINIMUM VALUE ="VL:LOCATE 9,30
        :PRINT"MAXIMUM VALUE ="VH:LOCATE 12,25:PRINT"PRESS ANY
        KEY TO CONTINUE"
12775 K$=INKEY$:IF K$="" THEN 12775
12780 CLS:GOTO 12416
12785 '
12790 '
12800 'routine to display explanation or continue
12810 F$=INKEY$:IF F$="" GOTO 12810 'need <CR> to continue
12815 IF F$=CHR$(13) GOTO 12820
12817 GOTO 12810
12820 '
12825 CLS:SCREEN 0,0,0:SCRF=0:WIDTH 80:COLOR 14,1:LOCATE 10,18
        :PRINT"PRESS <E> FOR EXPLANATION OR <CR> TO CONTINUE"
12830 F$=INKEY$:IF F$="" THEN GOTO 12830
12832 IF F$=CHR$(13) THEN GOTO 12879
12834 IF F$="E" OR F$="e" THEN 12840
12836 GOTO 12830
12840 COLOR 7,0,0:CLS:LOCATE 5,1 ' center title
```

```
12842 V=LEN(T$):PRINT STRING$ (40-V/2,32);T$;STRING$(80-POS(C),32);
12850 X=1:LOCATE 8,25:PRINT"FROM          TO          SYMBOL"
      :LOCATE 10,25:PRINT V(0):LOCATE 10,38:PRINT V(1):ON C(1)
      GOSUB 12870, 12872, 12874
12851 LOCATE 10,51:ON S(1) GOSUB 12490, 12492, 12494, 12496
12852 FOR X=2 TO 10
12854 IF V(X)=0 THEN X=10:GOTO 12862
12856 LOCATE 9+X,24:PRINT ">" V(X-1):LOCATE 9+X,38:PRINT V(X)
12858 ON C(X) GOSUB 12870, 12872, 12874
12860 LOCATE 9+X,51:ON S(X) GOSUB 12490, 12492, 12494, 12496
12862 NEXT
12863 LOCATE 20,27:COLOR 14,1:PRINT"PRESS <CR> TO CONTINUE"
12864 K$=INKEY$:IF K$=CHR$(13) THEN 12866
12865 GOTO 12864
12866 GOTO 12879
12870 IF C(X)=1 THEN COLOR 3:RETURN
12872 IF C(X)=2 THEN COLOR 5:RETURN
12874 IF C(X)=3 THEN COLOR 7:RETURN
12876 'RETURN
12879 '
12880 CLS:SCREEN 1:SCRF=1:PUT (0,0),B 'recall screen
12881 SYMBFL=1 'set flag to use screen already saved for overlay
12882 GOSUB 14000:GOTO 500
12890 '
13000 'routine to get list of files saved to disk
13010 CLS:SCREEN 0,0,0:WIDTH 80:LOCATE 5,5:PRINT "SCREEN FILES ON DISK"
13020 PRINT:PRINT
13025 IF (DL$="A") OR (DL$="a") THEN FILES "A:*.MAP"
13030 IF (DL$="B") OR (DL$="b") THEN FILES "B:*.MAP"
13035 IF (DL$="C") OR (DL$="c") THEN FILES "C:*.MAP"
13037 IF (DL$="D") OR (DL$="d") THEN FILES "D:*.MAP"
13040 GOTO 5410 'select file
13050 '
13060 '
14000 'routine to wait for key input
14010 F$=INKEY$:IF F$="" GOTO 14010
14020 IF F$ =CHR$(13) THEN RETURN
14030 '
14140 '
15000 'routine to compute screen latitude and longitude
15005 CLS:LOCATE 10,27:PRINT"READING FILE...PLEASE WAIT":PRINT
15010 'find maximum latitude and longitude
15015 MAXLA=0:MINLA=90:MAXLO=0:MINLO=180
15020 OPEN N$ FOR INPUT AS #1
15030 IF EOF(1) THEN CLOSE:GOTO 15500
15040 INPUT #1, N, YA, XA
15050 IF YA > MAXLA THEN MAXLA =YA
15060 IF YA < MINLA THEN MINLA =YA
15070 IF XA > MAXLO THEN MAXLO =XA
15080 IF XA < MINLO THEN MINLO =XA
15090 GOTO 15030
15500 'compare lat and long, set values for lat and long
15510 LODIF=MAXLO-MINLO:LADIF=MAXLA-MINLA
15530 IF (LODIF * AR)-LADIF >=0 THEN GOTO 15700
```

```
15540 IF (LODIF * AR)-LADIF < 0 THEN GOTO 15800
15700 WL = MAXLO + (.2 * LODIF):EL =MINLO-(.2*LODIF)
15710 SPACE = (AR * (LODIF + (2*.2*LODIF))-LADIF)/2 '.5 adjusts space
15720 LA = MAXLA + SPACE
15730 IF WL - EL > 1.1 THEN RETURN
15740 WL = MAXLO - (LODIF/2) + .59:EL = WL - 1.18
15750 LA = MAXLA - (LADIF/2) + .25
15760 RETURN
15800 SPACE = (1/AR * (LADIF + (2*.2* LADIF))-LODIF)/2 '.5 adjusts space
15810 WL = MAXLO + SPACE
15820 EL = MINLO - SPACE
15830 LA = MAXLA + (.1 * LADIF)
15840 IF WL - EL > 1.1 THEN RETURN
15850 WL = MAXLO - (LODIF/2) + .59:EL = WL - 1.18
15860 LA = MAXLA - (LADIF/2) + .25
15870 RETURN
15900 '
15910 '
28900 'error trap
29000 IF (ERR=53) THEN PRINT "FILE NOT FOUND - ";
29002 IF (ERR=64) THEN PRINT "NO FILES TO LIST -PRESS ANY KEY";
29005 PRINT " ERROR! PRESS ANY KEY TO RETURN";
29010 E$=INKEY$:IF E$="" THEN 29010
29020 IF E$ <> "" THEN RESUME 300
29030 '
29040 '
36000 'HELP routine
36010 CLS:SCREEN 0,0,0:WIDTH 80:COLOR 14,1
36020 LOCATE 5,5:PRINT "************************HELP************
      *************"
36030 PRINT:PRINT "Option 1 displays state outline only. Defaults
      to Colorado. Computer calculates latitude and longitude values
      for screen settings and to center display. For     another
      state, see DATA Input, below."
36040 PRINT:PRINT "Option 2 displays state and county outlines.
      Defaults to Colorado. Computer       calculates latitude and
      longitude values for screen settings and to center
         display."
36050 PRINT:PRINT "Option 3 displays one county from list.  Computer
      calculates latitude and        longitude values for screen
      settings and to center display. Enter file name, no space,
      then '.CNT'."
36060 PRINT:PRINT "Option 4 is used to change latitude and longitude
      parameters to zoom in on an    area.  Follow user prompts."
36070 PRINT:PRINT "Option 5 will recall a screen saved to a disk
      or in memory. Follow user prompts."
36080 PRINT "Option 6 is this HELP facility."
36090 PRINT:PRINT "Option 7 ends program, restores function keys
      and screen."
36095 PRINT:PRINT "****** press any key to continue *********"
36097 K$=INKEY$:IF K$="" THEN 36097
36098 IF K$ <> "" THEN 36100
36100 PRINT:PRINT "DATA Input:  Files using lines for display, such
      as state and county borders       require DATA to be in the
```

```basic
            form:"
36110 PRINT:PRINT " 'Line number, Latitude, Longitude' as variables
      N, YA, XA  Variables may be    separated by a space(s) or comma.
      County file names require the extension        '.CNT'. All other
      line files require the extension '.LIN'.
36120 PRINT:PRINT " Files using points for display, as GWSI files,
      well locations, etc. require    DATA to be in the form:"
36125 PRINT:PRINT " 'Latitude, Longitude, Attribute' as variables
      YA, XA, D."
36130 PRINT:PRINT" The attribute, variable 'D' is an identifying
      number such as a depth code for   depth to water. Used to
      separate file into sections."
36131 PRINT "All point files require the extension ' PNT'"
36132 PRINT:PRINT:PRINT
36135 PRINT:PRINT "********** press any key to continue ************"
36136 K$=INKEY$:IF K$="" THEN 36136
36137 IF K$ <> "" THEN 36140
36140 PRINT:PRINT "GENERAL INFORMATION"
36145 PRINT:PRINT "** NOTE: After screen display, an option line
      appears at bottom of screen. The  first letter of each word
      will blink on and off. To select, key in that letter."
36150 PRINT:PRINT "Use capital letters except when writing titles.
      Then either upper or lower case may be used."
36160 PRINT:PRINT "Use Carriage Return <Enter> after input when
      program is not responding. Many    times input does not
      require a Return."
36170 PRINT:PRINT "Errors are caught in most cases. A message will
      appear with instructions. If all else fails, use Ctrl Break
      keys or reboot to restart."
36180 PRINT:PRINT "This program was developed for Colorado and
      Colorado counties. To change for   your area, prepare files
      according to DATA input section, and enter aspect ratio at first
      data entry screen*"
36190 PRINT "change lines 1005 and 9005 to correct state file name
      and lines 2005 and 10005  to correct county borders file."
36195 PRINT:PRINT "*The screen display utilizes a Mercator projection.
       For some monitors and for  areas with high or low latitudes,
      aspect ratio should be changed for a truer    picture.
      Experiment with aspect ratio settings as necessary."
36200 PRINT:PRINT "********* press any key to return ************"
36210 K$=INKEY$:IF K$="" THEN 36210
36220 IF K$ <> "" THEN 300
40000 'end of coding
```

APPENDIX B

Source code for DISPLAY.BAS.

```
10 'program "DISPLAY.BAS" to retrieve screen files saved to disk
20 DEF SEG =&HB800
22 CLS:KEY OFF:SCREEN 1
25 INPUT "DISK DRIVE FOR SCREEN FILES";D$
30 GOTO 40
35 INPUT "ANY MORE SCREEN FILES WANTED (Y,N)";Y$
37 IF Y$ = "N" OR Y$="n" THEN GOTO 90
40 CLS:PRINT "LIST OF SCREEN FILES SAVED TO DISK"
42 IF D$="A" OR D$="a" THEN PRINT:PRINT:FILES "A:*.MAP"
44 IF D$="B" OR D$="b" THEN PRINT:PRINT:FILES "B:*.MAP"
46 IF D$="C" OR D$="c" THEN PRINT:PRINT:FILES "C:*.MAP"
50 IF D$="D" OR D$="d" THEN PRINT:PRINT:FILES "D:*.MAP"
60 INPUT "NAME OF FILE WANTED";NAM$
64 NAM$=D$+":"+NAM$
70 CLS:BLOAD NAM$,0
75 K$=INKEY$:IF K$="" THEN 75:IF K$=CHR$(13) THEN 35
80 GOTO 35
90 CLS:SCREEN 0,0,0:WIDTH 80:KEY ON:END
```

APPENDIX C

Data files necessary to run program with Colorado State and counties
as principal map areas.

COLORADO.LIN should be entered in order to use Main Menu option 1.

COCNTY.CNT should be entered in order to use Main Menu option 2.

Instructions are included at end of appendix describing how to enter
individual county files necessary to use Main Menu option 3.

```
8 40.0114 102.0544
8 40.0026 102.0599
8 39.5794 102.0568
8 39.5695 102.0529
8 39.1341 102.0555
8 39.0527 102.0539
8 38.6941 102.0500
8 38.6135 102.0509
8 38.2643 102.0524
8 38.2540 102.0509
8 37.7365 102.0459
8 37.6467 102.0457
8 37.3873 102.0471
8 36.9993 102.0484
8 36.9913 102.1224
8 36.9927 102.2763
8 36.9908 102.4873
8 36.9906 102.7502
8 36.9906 102.8876
8 36.9993 103.0080
8 36.9963 103.0837
8 36.9920 103.1669
8 36.9909 103.3919
8 36.9900 103.6358
8 36.9867 103.8797
8 36.9890 104.0122
8 36.9864 104.1141
8 36.9871 104.4004
8 36.9861 104.7980
8 36.9856 105.1056
8 36.9865 105.2404
8 36.9838 105.3871
8 36.9840 105.6024
8 36.9878 105.7206
8 36.9847 106.0093
8 36.9902 106.4728
8 36.9896 106.6005
8 36.9919 106.9080
8 36.9937 107.2769
8 36.9923 107.4401
8 36.9979 107.4590
8 36.9962 107.5513
8 36.9960 107.9179
8 36.9985 108.2704
8 36.9960 108.3910
8 36.9991 108.4904
8 36.9958 108.6914
8 36.9955 108.9185
8 36.9979 109.0416
8 37.6329 109.0486
```

```
8 37.8694 109.0482
8 38.1524 109.0487
8 38.5061 109.0578
8 39.3607 109.0595
8 39.5022 109.0623
8 39.6550 109.0554
8 40.2194 109.0540
8 40.6590 109.0576
8 40.9940 109.0539
8 40.9908 109.0542
8 41.0164 107.9234
8 41.0155 107.3114
8 41.0146 106.8594
8 41.0093 106.3287
8 41.0071 106.2049
8 41.0102 106.2075
8 41.0070 105.2840
8 41.0103 104.9443
8 41.0069 104.0624
8 41.0050 103.5733
8 41.0066 103.3724
8 41.0039 102.6562
8 41.0041 102.6162
8 41.0020 102.0635
8 40.7464 102.0613
8 40.7047 102.0692
8 40.6940 102.0621
8 40.4378 102.0638
8 40.3481 102.0641
8 40.0114 102.0544
```

1,39.7915,105.0524
1,39.9126,105.0554
1,40.0114,105.0567
1,40.0115,104.1492
1,40.0134,103.7125
1,39.7413,103.7127
1,39.7452,104.0885
1,39.7492,104.7419
1,39.7376,104.8898
1,39.7674,104.8862
1,39.7743,104.8614
1,39.7779,104.8588
1,39.7878,104.883
1,39.7854,104.942
1,39.7968,104.9514
1,39.7915,105.0524
3,37.7377,105.4619
3,37.719,105.4577
3,37.6933,105.48
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Instructions for Separating COCNTY.CNT file

The first number of each record refers to a unique county.
Counties are drawn alphabetically, and are complete (no shared
lines).

To copy one county from attached file list:

1. Choose county number from list below.
2. Using EDLIN or any editor, key in data by copying all lines
    beginning with number of county desired.
3. Separate county number, latitude, and longitude with a space
    or a comma. (BASIC programs read data using commas or
    space(s) as delimiters)
4. Example: for ADAMS county (number 1)
    first line of your file could be either
    1,39.7915,105.0524 or: 1 39.7915 105.0524
5. When all 16 lines for ADAMS county are copied, complete
    editing, according to rules for your editer, then copy file
    to disk for use in MAPMAKER.BAS program

LIST OF COLORADO COUNTIES

Number	County	Number	County
1	Adams	65	Lake
3	Alamosa	67	La Plata
5	Arapahoe	69	Larimer
7	Archuleta	71	Las Animas
9	Baca	73	Lincoln
11	Bent	75	Logan
13	Boulder	77	Mesa
15	Chaffee	79	Mineral
17	Cheyenne	81	Moffat
19	Clear Creek	83	Montezuma
21	Conejos	85	Montrose
23	Costilla	87	Morgan
25	Crowley	89	Otero
27	Custer	91	Ouray
29	Delta	93	Park
31	Denver	95	Phillips
33	Dolores	97	Pitkin
35	Douglas	99	Prowers
37	Eagle	101	Pueblo
39	Elbert	103	Rio Blanco
41	El Paso	105	Rio Grande
43	Fremont	107	Routt
45	Garfield	109	Saguache
47	Gilpin	111	San Juan
49	Grand	113	San Miguel
51	Gunnison	115	Sedgwick
53	Hinsdale	117	Summit
55	Huerfano	119	Teller
57	Jackson	121	Washington
59	Jefferson	123	Weld
61	Kiowa	125	Yuma
63	Kit Carson		

APPENDIX D

Data Files necessary to run demonstration program.   JEFTEST.MAP
is not included.

CORIVER.LIN   File to draw major Colorado rivers.

UTAH.LIN   File to draw outline map of Utah.

LAPLATA.CNT   File to outline Laplata County, Colorado.

WELLS.PNT   File to locate some wells in Colorado.

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