BFM: Beach Fill Module

Report 1
Beach Morphology Analysis Package (BMAP) — User’s Guide

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Preface

The work described herein was authorized as a part of the Civil Works Research and Development Program by Headquarters, U.S. Army Corps of Engineers (HQUSACE). Work was performed under the Beach Fill Engineering Work Unit 32801 of the Shore Protection and Restoration Program at the Coastal Engineering Research Center (CERC), U.S. Army Engineer Waterways Experiment Station (WES). Messrs. John H. Lockhart, Jr., John G. Housley, and Barry W. Holliday were HQUSACE Technical Monitors. Ms. Carolyn M. Holmes, CERC, was Program Manager.

This report was written by Mr. Barry G. Sommerfeld, Contract Computer Scientist, Coastal Processes Branch (CPB), Research Division (RD), CERC; Mr. John M. Mason, ASCI Corporation Contract Computer Scientist for CPB, RD; Dr. Nicholas C. Kraus, Director, Conrad Blucher Institute for Surveying and Science, Texas A&M University - Corpus Christi; and Dr. Magnus Larson, Associate Professor, Department of Water Resources Engineering, University of Lund, Sweden. Most of the analysis programs described in this report were written by Drs. Larson and Kraus as part of numerical modeling activities. Messrs. Sommerfeld and Mason modified these programs for use on desktop microcomputers and developed the operating shell and graphics routines. Mr. W. Gray Smith, CPB, RD, assisted in debugging of the software package and report preparation. Ms. Allison Abbe, CPB, RD, and Ms. Peggy T. Brown, CPB, Office of the Senior Scientist, CERC, assisted in text entry and formatting. The operating shell was designed by all of the authors. This study was performed under the administrative supervision of Dr. James R. Houston, Director, CERC; Mr. Charles C. Calhoun, Jr., Assistant Director, CERC; Mr. H. Lee Butler, Chief, RD; and Mr. Bruce A. Ebersole, Chief, CPB. Dr. Kraus was the Principal Investigator, Work Unit 32801 during the majority of the development of the software package, and Mr. Smith was the Principal Investigator at the time of publication.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard, EN.
1 Introduction

Background

As part of ongoing research activities, the Beach Fill Engineering work unit of the Shore Protection and Restoration program is developing a microcomputer and work-station-based analysis software package called the Beach Fill Module (BFM). The BFM is an integrated system of analysis and graphics programs that incorporates major engineering and planning functions required in beach fill design as performed by the U.S. Army Corps of Engineers. A series of reports is planned to document the BFM and associated analysis programs.

This report is the first in the BFM series and is a user's guide for the Beach Morphology Analysis Package (BMAP), consisting of automated and interactive procedures to analyze morphologic and dynamic properties of beach profiles. The BMAP can be called from within the BFM or run as a stand-alone program. This guide provides information to operate BMAP as a stand-alone program under the Disk Operating System (DOS) running on a personal computer (PC).

Cross-shore modeling of storm-induced beach erosion is a central component of modern shore-protection planning. The BMAP is a computation utility developed at the Coastal Engineering Research Center (CERC), U.S. Army Engineer Waterways Experiment Station, to support desktop computer simulation studies of cross-shore modeling of storm-induced beach erosion for beach fill design.

Originally, BMAP was conceived to simplify and automate the numerical modeling work flow through analysis of the input data and results of computations from CERC's Storm-induced BEACH change model (SBEACH) (Larson and Kraus 1989; Larson, Kraus, and Byrnes 1990). Because of its utility and convenience, it has evolved to incorporate functions to inspect and analyze beach profiles and beach profile change. The BMAP graphical interface produces on-screen plots of user-selected profiles and calculation results that are easily exported to a printer. The present report covers Version 1 of BMAP, which is capable of two-dimensional analysis; that is, analysis of beach profiles. Further BMAP versions are planned to extend the profile analysis.
capabilities, the shell interface, and to perform three-dimensional analysis of beach morphology.

The BMAP supplies the coastal engineer and scientist, in one compact and convenient software package, with a multitude of capabilities in support of beach profile analysis and cross-shore modeling activities of storm-induced beach erosion. The objective of this report is to describe the features and operation of BMAP.

Chapter 7 is included to exercise and demonstrate BMAP. Profile survey data used in these examples were taken from two sources. One set of data was generated in a field monitoring study at Ocean City, Maryland, site of a major beach fill project. The project and data set are described in Stauble et al. (1993). The other data set pertains to the SUPERTANK Laboratory Data Collection project that was conducted with a large wave tank. The SUPERTANK project is described in Kraus, Smith, and Sollitt (1992).

Scope of Report

This report is intended to serve as a user’s guide and tutorial for operating BMAP. All major features of BMAP version 1.0 are described. Chapter 1 gives the background of BMAP. Chapter 2 gives an overview of the functions in BMAP. Chapter 3 begins step-by-step tracing of BMAP functions with a discussion on the Project Options Menu. Chapter 4 contains a discussion of the various options in the Main Menu. Chapter 5 begins the discussion on the analysis capability of BMAP, continued in Chapter 6 with an explanation of synthetic profiles and how they are generated and used. Chapter 7 leads the user through a test run of BMAP using authentic data collected at Ocean City, Maryland, and in the SUPERTANK project. Appendix A describes the particular format of profile survey data required for use with BMAP and contains the data corresponding to the worked examples. Appendix B provides instructions on how to install and execute BMAP. Appendix C describes the conversion between the two BMAP profile survey data formats. Appendix D contains mathematical notation used in this report.

Name Convention

In this manual, names of keys on the PC console or keyboard are written in capital letters and enclosed in triangular brackets. Menus in BMAP are written in bold Roman script in reference to the menu itself or its functioning, whereas if a menu name refers to a chapter title, it is italicized.
Updates to Manual

Located on the distribution diskette is a file called README.TXT. This file contains information about modifications to BMAP after the printing of the manual. Please consult this file before starting BMAP.
2 Overview

The BMAP complements and is file-compatible with the Interactive Survey Reduction Program (ISRP) (Birkemeier 1984), widely used by U.S. Army Corps of Engineers personnel dealing with coastal processes and beach profile change. The ISRP was developed as an aid to beach profile survey parties and permits "...interactive reduction, editing, and plotting of field survey notes and the corrections of previously entered data" (Birkemeier 1984). In contrast, the BMAP is a stand-alone program that can be executed independently in support of a wide range of beach profile analysis objectives and numerical modeling studies of profile change. The BMAP does not contain utilities (as does ISRP) for assisting survey parties directly, but, rather, provides comprehensive data analysis capability for office studies once reduction and checking of the profile data have been completed.

Capabilities

Capabilities of BMAP 1.0 include:

a. On-screen color plotting and black and white hard copies of multiple profile surveys from one or more input files.

b. Average of multiple profile surveys between a given spatial range. Included within this option is the ability to display the standard deviation and envelope of profile change.

c. Calculation of cut and fill cells giving changes in volume between two profile surveys.

d. Fitting of an equilibrium profile for a single grain size.

e. Calculation of a cross-shore sand transport rate.

f. Calculation of bar properties, including volume, location, and height. These calculations may be performed with or without a reference profile.
g. Calculation of profile volume with respect to specified reference elevation and/or segment along the profile, with the capability to compare two profiles.

h. Specification of user-defined synthetic profiles (four different types) to be used for comparison and analysis with measured profiles.

i. Vertical and horizontal shifting of profiles.

j. Alignment of the profile origin to a specified elevation.

k. A utility to convert ISRP data files to and from free format (two-column format).

l. On-line, context-sensitive help obtained by pressing <F1>.

Calculation and graphical manipulation procedures are presently being developed for aiding beach fill design. A planned upgrade will allow mouse-controlled manual construction and modification of beach fill profile shape, from which added volume may be calculated by BMAP to develop optimal profile cross-section design and support advanced beach profile analysis.

Projects

The package has the option of storing data and associated parameters into uniquely named files called “projects,” allowing different users to access BMAP on the same computer system in analysis of the same or a different project with a common or different subset of a database. Projects would usually contain particular profile surveys for a specific location and different times in the case of field data. In analysis of laboratory data, such as for SUPER-TANK, a project might correspond to a single test involving surveys of profiles generated under the same wave conditions and water level. The advantage of defining projects is that one may have a data file which contains a large amount of data with some profile surveys unrelated to other profiles within the same file; definition of projects readily gives accessibility to a subset of the large file, hence allowing the user to functionally separate the file and group profiles for like locations, times, or test.

Each project must consist of a project file name, the input file name, the length unit, and multipliers related to the number of significant digits for the horizontal and vertical coordinates. Typically, the project consists of one or more profiles from the input data file. The project may also contain output profiles that have been generated by BMAP and may be saved to disk.
Keyboard Functions

The BMAP is operated through a series of menu screens and data edit screens. The BMAP's menu structure is described at length in Chapters 2 through 6. The most widely used keys that control the system are now reviewed.

**ESCape**

Perhaps the most often used key in BMAP is the ESCape key, <ESC>. Pressing the ESCape key on a menu returns the user to the previous menu. The ESCape key also provides the method of exiting BMAP. When the current menu is the Project Options Menu (described in subsequent chapters), and the user presses <ESC>, BMAP prompts for confirmation of the request to exit.

**ALT-S and ALT-X**

In most data edit screens, i.e., screens where data are entered by the user, the <ALT-X> key terminates the current process without saving changes and takes the user to the previous menu screen, distinguishing it in function with the <ALT-S> key in such screens. The <ALT-S> key exits the data edit screen and saves all changes before performing the next task.

**ENTER**

In menu screens, the <ENTER> key is pressed to make a selection. In most data edit screens, the <ENTER> key moves the cursor to the next field, if it is not the last field. If the cursor already rests upon the last field, pressing the <ENTER> key usually saves the data entered and performs the corresponding calculations.

**ALT-I, ALT-D, ALT-M, TAB**

Some keys are unique to the data edit screens, e.g., the Load Profile Menu discussed in a later chapter. In these screens, <ALT-D> deletes the current line, <ALT-I> inserts a line, <TAB> moves one column to the right, <SHFT-TAB> moves one column to the left, down arrow moves one line down, and up arrow moves one line up. The <ALT-M> key toggles how BMAP handles the command to insert a line (<ALT-I>). Upon entering the Load Profile Menu, pressing <ALT-I> causes BMAP to insert a line before the current line. Pressing <ALT-M> causes lines to be inserted after the current line when <ALT-I> is pressed. These conventions are consistent for all data edit screens.
except for the Output Profile Menu where <ALT-I> and <ALT-M> are deacti-
vated because all output profiles are generated by BMAP.

<ALT-P>

Whenever a graph appears on the screen, the user has the option of obtaining a hardcopy of the graph to an HP Laserjet II-compatible printer. Pressing <ALT-P> on such screens plots the graph to the printer.

<ALT-R>

Whenever data result from calculations, BMAP allows the user to save the data to a file or print a copy on the attached printer. If the user presses <ALT-R> in such a case, BMAP prompts the user of the destination, i.e., file or printer. If the user chooses file, BMAP requests that the user enter the file name. This file name must be a valid DOS file name. No directory should be entered, however. BMAP automatically saves all output to the project's data directory specified in the Project Parameters screen. If the user chooses printer as the destination, the results immediately are sent to the printer.

<F1>

BMAP is equipped with on-line, context-sensitive help. To obtain help for any option in BMAP, you should press <F1>, and a help screen pertaining to the current function will be displayed. For more general help, press <F1> again.

Output Profiles

Whenever calculations are performed and a profile is generated from those calculations, the user may wish to save that profile for later inspection. The BMAP provides a way of saving output profiles. Figure 1 shows a sample of the message displayed by BMAP after output data have been generated by some means. BMAP automatically assigns to all generated graphs a two-letter descriptor followed by a number that is incremented by one for each graph of the same type. Following are the two-letter descriptors and the respective option that generates these output data:

![Figure 1. Output profile saved screen](image)
a. ZM - Zoom Profiles.
b. AV - Averaging.
c. EV - Envelope of profile change (generated by Averaging routine).
d. SD - Standard deviation (generated by Averaging routine).
e. HA - Horizontal Alignment.
f. LS - Least-Square Estimate.
g. TL - Translation.
h. TR - Transport Rate.
i. EP - Equilibrium Profile.
j. IP - Interpolated Profile.
k. MP - Modified Equilibrium Profile.
l. PS - Plane-Sloping Profile.

Consult the section entitled Output Profiles Menu for more information about output profiles and the way they are stored.

Data Format

BMAP input files presently must be formatted to the specifications associated with ISRP, a format more commonly known as “ISRP format.” If output profiles are stored to disk, they are also saved in ISRP format so they may be loaded into BMAP as input. See Appendix A for an explanation of ISRP format. A conversion utility allows BMAP to access and convert between ISRP and two-column free format files. See Appendix C for a discussion of the conversion utility and the format of these files.

BMAP Menus

The BMAP operates through a series of self-explanatory menus. One chapter of this report is devoted to each of the individual menus.

As an overview, Figure 2 shows the hierarchy of menus. The Project Options Menu is the initial menu encountered and serves as BMAP’s internal file handling system, performing such basic functions as loading data, and
creating, copying, and deleting work projects. The Main Menu is the "control center" that leads to the possible routes of analysis, graphics, and input and output of data. BMAP is also exited through the Main Menu and the Project Options Menu.

The remainder of this report concerns the functioning of all selections or capabilities listed on the menus.
Chapter 3  Project Options

The concept of "Projects" was discussed in the previous chapter. In this section, the user will learn how to create and manipulate projects.

Creating Projects

After typing BMAP from the DOS command line, the Project Options Menu appears, as shown in Figure 3. Several selections or options are displayed; however, because you have just entered BMAP, only two options are available, Create Project or Load Project. If you are planning to begin a new project, or if this is the first time you have entered BMAP, you will probably wish to create a project.

Once Create Project has been selected, you are prompted to enter the project name. This name should be no longer than eight characters and must be a valid DOS file name. Do not enter an extension, however, because BMAP automatically appends the extension ".prj" to all project names for storing to your hard disk.

Parameters

After entering the project name, the Parameters menu is displayed (Figure 4). The first field of this menu is the data directory field. This directory should be the directory where all input data files for this project reside. This is also the directory to which BMAP saves all output information. The next
n field is the default input file. This is helpful if most or all of the profiles for this project come from the same data file. Entering the name of the valid ISRP file here will avoid retyping the file many times when loading the profiles. No directory should be entered here as the file must be in the data directory specified above. If this is the first time BMAP has accessed this file, the file is indexed. Depending upon the size of the data file, indexing may take a while, but this one-time wait will save much time in future calculations to be performed. In the units field, tell BMAP whether project data were recorded in meters or in feet. Enter the horizontal (distance, x) and vertical (elevation, z) length multipliers in the next two fields. These multipliers allow flexibility in precision. Standard ISRP format allows no significant digits for x and one significant digit for z. The default multipliers corresponding to standard ISRP format are 1.0 for x and 0.1 for z. In many applications, greater precision is available, so BMAP allows user-specified multipliers. For example, if profile data are stored with one significant digit for x and two significant digits for z, enter 0.1 for x and 0.01 for z.

**Loading profiles**

Following the Parameters screen is the Load Profile Menu (Figure 5). This menu allows you to enter the unique identification information for each profile from the input file.

Each profile is identified by four external attributes: file name, identification (ID) (five characters), date, and time. By pressing <ALT-L>, you are able to view these attributes for all the profiles in the file (Figure 6). You may then scroll with your cursor keys and tag each profile you wish to load by pressing <ALT-T>. Pressing <ALT-T> twice on the same profile untags it. When you have completed making your selection, press <ALT-S> to return to the Load Profile Menu. BMAP automatically copies the tagged information to the Load Profile Menu. Pressing <ALT-X> returns the user to the Load Profile Menu without copying the information. Change to a different file by changing the name of the file on an empty line. Pressing <ALT-L> after

---

1 One foot in American customary units equals 0.3048 meter in metric units.
Figure 5. Load Profile Menu

Figure 6. Example of profile listing
making that change causes BMAP to display the profile information of the new file.

There is another field attribute, internal to your particular BMAP session and attached to each profile, called Active or Activate. In many BMAP analysis procedures, you are given the option of performing calculations with selected profiles (called "active profiles"). It is in the Load Profile Menu that you are able to activate them, thereby allowing you to isolate work to a subset of your larger project-data set.

Within the Load Profile Menu, the following keystrokes apply:

a. <ALT-D> - Delete current row.
b. <ALT-I> - Insert row.
c. <ALT-M> - Toggle insert mode (initially, a row is inserted after current row when <ALT-I> is pressed. Pressing <ALT-M> toggles the insertion point to be before the current row.).
d. <TAB> or <RETURN> - Move right one field.
e. <SHFT-TAB> - Move left one field.
f. <Up Arrow> - Move up one row.
g. <Down Arrow> - Move down one row.
h. <ALT-X> - Exit without saving changes.
i. <ALT-S> - Save and exit.
j. <ALT-L> - List profiles in current data file.
k. <ALT-T> - Tag current profile in the profile listing.

After all requested profiles have been loaded and activated as required, BMAP places you in the Main Menu, ready to perform calculations and to plot profiles.

Erase Project

When you choose this option within the Project Options Menu, the current project is erased from the disk and is removed from the BMAP session. After
the project has been erased, you must either load a new project or create a new project before proceeding.

*Note: Only the project file is erased with this option. Because input files and their associated index file are used for multiple projects, these files are not erased. Output files associated with the erased project will likewise remain on the hard drive, as it is not uncommon for output files to be used to produce graphs external to BMAP.*

**Duplicate Project**

This option allows you to copy the contents of the current project into another project file. When prompted for the file name, you should enter a maximum of eight characters. The name must be a valid DOS file name, but no extension should be given, as BMAP automatically appends the extension ".prj" to all projects. This aids in quick creation of a new project that has parameters similar to those of another, existing project.

**Load Project**

This option displays all projects in the current directory. You may then use your cursor keys (or mouse) to choose the project you wish to load. If you have not saved the project on which you have been working, you are queried as to whether or not you wish to save the project and/or the output profiles, if any. **Load Project** loads all the previously saved parameters of the associated project and places you in the Main Menu ready for calculations.

**Rename Project**

This option allows you to rename the current project. The name of the project should be no more than eight characters long and must be a valid DOS file name. No extension should be added, as BMAP automatically appends the extension ".prj" to all project names.

**Save Project**

The **Save Project** option saves the project currently in memory to disk. It is stored on disk as the name of the project (already specified) with the extension ".prj." If output profiles have been generated in the current session, but have not been saved to disk, **BMAP** allows you to do so at this time before the project is saved. If output profiles are not stored on disk, they are not kept within the project file when saving the project.
4 Main Menu

After a project has been created or loaded into memory, you are ready to start performing calculations and other tasks such as viewing and cleaning data and making graphical comparisons. At this point you are brought to the Main Menu (Figure 7). The Main Menu serves as an intersection and junction to other menus and basic operations.

Analysis Menu

Choosing this option places you in the Analysis Menu, where all calculations are performed. For an extended discussion on available calculations, see Chapter 5, "Analysis."

Convert Files

*BMAP* allows the user to conveniently convert free format files to *ISRP* files so that they may be used in *BMAP*. The user may also convert *ISRP* files to free format so that they may be used in other applications such as spreadsheet packages. When the user chooses Convert Files from the Main Menu, the Convert Files screen is displayed (Figure 8). The user chooses the option desired. *BMAP* then allows the user to enter the respective file names. If *BMAP* successfully converts the file, it displays a message. If there is an error, *BMAP* notifies the user. Errors typically occur if the free format file is not consistent with *BMAP's* free format. See Appendix C for an explanation of the *BMAP* free format.
Graph Menu

Choosing this option places you in the Graph Menu, which provides various options for graphing the profiles in memory. *BMAP* offers four options for graphing profiles (Figure 9). Choosing All Profiles displays all input profiles (both active and inactive) and all output profiles located in memory. Choosing Input Profiles displays all input profiles (both active and inactive). To display only the output profiles, you should choose Output Profiles. By choosing Active Input Profiles, you receive a graph of all input profiles that have been tagged as active in the Load Profile Menu.

Load Profile Menu

This option allows you to load the profile data into memory. For an extended discussion on loading profiles, see the section entitled *Loading Profiles* in Chapter 3, "Project Options."

Output Menu

After a calculation is performed and a new profile results, *BMAP* stores the profile (called an "output profile") to memory under a unique name. The data associated with this profile are stored only to memory. In order to store such profiles to the hard drive you must select Output Menu from the Main Menu. Figure 10 shows a sample session with the Output Menu selected.

Figure 10 displays the Output Profile screen before any editing has been done. Note that the names (file names if stored to disk) are blank at this time, and the ID information has limited meaning apart from the fact that each calculated profile has a unique two-letter prefix. In this case there are five...
Figure 10. Sample Output Profile Menu

"zoomed profiles" (profile data calculated by zooming on the input profiles), an "average profile" (profile data calculated by averaging one or more input profiles), and three "horizontally aligned profiles" (profile data produced by requested alignment of input profiles). For a listing of each two-letter identification and its corresponding function, consult the section entitled Output Profiles in Chapter 2. All file names may be changed in this menu to be more descriptive to the user. The file name must be a valid DOS file name. No extension should be entered as BMAP automatically appends the extension "prf" to output data files. The user should not enter a directory as BMAP stores all output data to the data directory of the project. A description may also be included. All parameters here are saved to an ISRP data file. The descriptions are saved to the project file if the project is saved. Figure 11 shows the same set of output profiles, but the descriptive information has now been changed.

Output profiles may also be deleted from the list, as well as from memory, by pressing <ALT-D>. Figure 12 shows the same set of output profiles, but this time "AV_1" (No. 6) has been deleted, not being required by the user.

To exit this menu, saving all modifications to disk, press <ALT-S>. To abort without saving any changes, press <ALT-X>.

Project Options Menu

The Project Options Menu allows you to enter all associated parameters pertaining to a project and to save these parameters. You may also erase, duplicate, and rename projects in this menu. For a detailed discussion on the Project Options Menu, see Chapter 3, "Project Options."
Reindex Data Files

The BMAP makes use of index files to reduce time spent reading from and writing to the hard drive. Each data file that is used by BMAP has an associated index file. Occasionally, these files may become invalid due to the addition or deletion of profiles from the input or output files. If you are experiencing problems with profiles seeming incorrect, you should re-index your files before proceeding.
Shell to Operating System

This option allows you to go to DOS and perform DOS applications without exiting BMAP, while keeping all current parameters in memory. When you have completed your DOS tasks, you may type “exit” at the command prompt, which brings you back in the Main Menu of BMAP where you left off.

Zoom Profiles

Occasionally the user wishes to inspect more closely a section of a plot of profiles in order to make better decisions. The Zoom Profiles option has been included in BMAP specifically for that purpose.

Upon choosing Zoom Profiles, you are presented with a graph of all active input profiles. A screen to the right of the graph requests you to enter values for the parameters XON and XOFF. These are the beginning and ending points on the horizontal axis. After these values have been entered, BMAP shows this section on the graph, i.e., every data pair whose x-value is greater than or equal to XON and less than or equal to XOFF. No interpolation is performed for this option. Note that the value of XON must be less than the value of XOFF. Any of the Zoom Profiles may be saved to disk within the Output Menu.
5 Analysis

After you have selected Analysis Menu (Figure 13) from the Main Menu, you are ready to begin calculating with the active profiles. You should now make your choice as to which type of calculation procedure you would like to access.

Averaging

This option averages all active profiles, creating one output profile that is given the temporary name “AV###,” where ### is the sequential number in the order of averaged profiles created. (For an explanation of Active Profiles, see section entitled Loading Profiles in Chapter 3, “Project Options.”). Once you select this option, plots of all active profiles are displayed on the screen, and BMAP prompts you to enter Xon, Xoff, and Dx. Xon is the position on the x-axis where you wish to begin averaging; Xoff is the position on the x-axis where you wish to terminate averaging; and Dx is the interval increment for the calculation of the average profile and determines the number of points that will be contained in the output (average) profile. As at any time in BMAP when a graph appears on screen, you have the option of printing the graph to your printer. By pressing <ALT-P>, you will receive a hard copy of the screen graph. You are now ready to enter the parameters.
Average, Envelopes, and Standard Deviation

After you have entered values for the parameters, and calculations have been performed, BMAP displays the output profile. You now have six options. First, you may redisplay the original input profiles. You may display the input profiles with the standard deviation. The average profile may also be displayed. The user may plot the average profile along with the standard deviation, minimum and maximum envelopes, or both. Once again, for any of these plots you may either press <ALT-P> to obtain a hard copy of the profiles, or you may press <ESC> to return to the Analysis Menu. Once you press <ESC>, BMAP informs you that it has saved the output profiles to memory. It also displays the default names to which they have been saved. For a listing of each two-letter identification and its corresponding function, consult the section entitled Output Profiles in Chapter 2. You may later wish to change the default names as well as save them to your hard disk. This can be done in the Output Menu. Consult the Output Menu section in Chapter 4, “Main Menu” for instructions on output profiles.

Bar Properties

In this section, you are able to determine various properties pertaining to a bar including minimum depth and location, maximum height and location, volume, and the distance to the center of mass.

The BMAP provides two different ways to calculate bar properties. If you have an adequate equilibrium profile associated with the profile containing the bar, you may wish to perform calculations with the equilibrium profile as the reference profile (Larson and Kraus 1992). Choose With a Reference Profile from the Bar Properties Menu (Figure 14). If you do not have an adequate equilibrium profile associated with the profile containing the bar, choose Without a Reference Profile. This option requires you to estimate beginning and ending points of the bar.

Using a reference profile

If you choose to use the reference profile, you are prompted to specify the source of this profile (Figure 15). If the profile has been loaded from your input file, choose Input File; if it has been generated by BMAP, e.g., a Dean equilibrium profile (Dean 1977), choose Output File.
Once the source file for the profile is chosen, BMAP graphically displays all the profiles (either input or output) which it has loaded into memory. Inform BMAP of your choice by moving the box to the correct profile and pressing <ENTER>.

You must perform the same operation for the profile containing the bar (specific profile).

Once you have chosen both profiles, BMAP plots them to the screen and displays a menu of crossing points from which you may choose Xon (shoreward crossing point) and Xoff (seaward crossing point). In order to locate these cross pairs, BMAP has found where the target profile intersects the reference profile such that the elevation of the next point is greater than the reference profile's elevation at the next point. However, before this intersection is included in the list of cross pairs, there must be a corresponding second intersection where the target profile's elevation at the next point is less than that of the reference profile. These two intersections define a bar and therefore may be considered a valid pair. It is common for multiple pairs to occur on the lower portion of the profile survey, and the plot on the screen allows one to recognize the pair corresponding to a well-defined bar. When you have found the corresponding pair, use the cursor key to move the selection bar to that pair and press enter. The BMAP proceeds to perform the calculations and returns results.

Omitting the reference profile

If an adequate equilibrium profile is not available for the corresponding profile containing the bar, or manual definition is desired, BMAP provides the opportunity of specifying the starting and ending positions of a bar. This is done by visual estimation.

Upon selecting Without a Reference Profile, you must choose your profile containing the bar (specific profile). See note above under Using a reference profile concerning choosing profiles.

Once you have chosen the profile, BMAP displays it on the screen, and you must now enter the starting and ending points of the bar (Xon and Xoff). Bar volume will be calculated with respect to a straight line connecting the two points (Keulegan 1948). The BMAP then plots the resulting reference line under the bar so you may determine the reasonability of the calculations. It also returns all other results. If you wish to save this information, you may
press <ALT-R> for a report. The BMAP asks if you wish to send the report to a file or a printer. If you choose file, you must enter the file name. You should not enter the directory because BMAP automatically stores the file in the data directory of the project. If you choose printer, BMAP immediately begins to print the report to your connected printer.

If the requested Xon and Xoff positions do not seem reasonable, you may press <ENTER>, and BMAP gives you the opportunity to try again. When you have finished, you should press <ESC> to return to the Analysis Menu.

**Cut and Fill**

The Cut and Fill option is similar to that found in ISRP and calculates losses and gains, respectively, in volume. Cut and fill areas are determined with respect to distance across shore in cells defined by successive intersections of two profiles, or by the most landward and most seaward common points of survey data along the profiles for the first and last cells if there is no intersection at the beginning and end of the profiles. Two profiles must be chosen to perform the cut and fill calculation. Refer to the subsection in this chapter entitled Using a reference profile under the section entitled Bar Properties for instructions on how to choose profiles.

Once the two profiles are chosen, BMAP calculates and displays the results in two windows. The window on the right side of the screen contains the most landward and most seaward distances common to both profiles, called Xon and Xoff, volume change above and below the datum taken to be 0, change in shoreline position at the datum, and the starting and ending positions of the zero-depth contour. The bottom window displays the following information for each cut and fill cell: distance to the seaward end of the cell, elevation of the seaward end of the cell, cell volume (including a sign), average cell thickness (including a sign), cumulative volume, and gross volume. If there are more than three cells, additional cells are viewed by scrolling through the window with the UP and DOWN arrow keys. The cumulative volume at the last cell would be zero if there were sand conservation across shore; that is, if the sum of all cut volumes equalled the sum of all fill volumes. The gross volume, which is the sum of the absolute values of all cut and fill volumes, gives an indication of profile change or “activity” of the profile. If you wish to save the information, press <ALT-R> for a report. The BMAP asks for the target device as a file on disk or a printer. If you choose file, a file name is required. The directory should not be entered because BMAP automatically stores the file in the data directory of the project. If you choose printer, BMAP immediately begins to print the report to your connected printer. Like all other screens in BMAP where a graph appears, you may obtain a hard copy of the graph by pressing <ALT-P>.
Profile Comparison

Profile comparison calculates volume change and contour change between two profiles given specified contour elevations. You must first choose the profiles for comparison. See the subsection entitled *Using a reference profile* under the section *Bar Properties* above for instructions on how to choose profiles.

Once the profiles are chosen, the contours to be compared should be specified. You may enter multiple contours. Enter the first contour, and, if you desire to enter a second, press <ALT-I> to insert another row. When you have entered the last requested contour, press <ALT-S> to begin calculating. *BMAP* displays the volume and contour change of each contour. If you wish to save this information, press <ALT-R> for a report. *BMAP* asks if you wish to send the report to a file or a printer. If you choose file, you must enter the file name. Do not enter the directory because *BMAP* automatically stores the file in the data directory of the project. If you choose printer, *BMAP* immediately begins to print the report to your connected printer. Like all other screens in *BMAP* where a graph appears, you may obtain a hard copy of the graph by pressing <ALT-P>.

Horizontal Alignment

Sometimes it becomes necessary to shift profiles back and forth so that they cross at a specific elevation (the most shoreward elevation is used if the chosen elevation occurs several times along the profile). For example, a natural elevation on which to align profiles would be zero elevation, i.e., the shoreline or datum plane. After selecting an alignment elevation, the horizontal (distance) coordinate will begin at the profile elevation chosen for the alignment. The horizontal alignment location may be selected from the profiles or assigned as required. The *BMAP* offers this option in Horizontal Alignment.

Horizontal Alignment plots all active profiles and prompts you to enter the alignment factor, the elevation to which the profiles will be aligned. Once this is entered, *BMAP* aligns all the profiles to that location and stores them temporarily in memory. You may later choose *Output Menu* from the *Main Menu* to store them to your hard drive. See section entitled *Output Menu* in Chapter 4, "Main Menu" for a discussion on storing output profiles. Like all other screens in *BMAP* where a graph appears, you may obtain a hard copy of the graph by pressing <ALT-P>.

Least-Square Estimate

This option generates a best-fit equilibrium profile to a given profile. The target profile must first be chosen to which the equilibrium profile will be fit. See the subsection entitled *Using a reference profile* under the section entitled...
Bar Properties above for instructions on how to choose profiles. After you have chosen the profile, enter the beginning (Xon) and ending (Xoff) points of the generated profile. As a default, Xon is automatically computed as the location where the profile crosses the zero elevation. You have the option of changing this value. BMAP generates the best-fit profile and plots it on top of the reference profile. It also displays the A-parameter (shape parameter for the equilibrium profile), the correlation coefficient squared $R^2$, and the grain size $d_{50}$. The relation between $A$ and $d_{50}$ is calculated from data given by Moore (1982) as implemented by Hanson and Kraus (1989). The resulting best-fit profile is stored temporarily in memory. You may later choose Output Menu from the Main Menu to store it to your hard drive. See the section entitled Output Menu in Chapter 4, “Main Menu” for a discussion on storing output profiles. If you wish to save the other data relating to the least-square estimate, e.g., A-parameter, coefficient, and grain size, press <ALT-R> for a report. The BMAP asks if you wish to send the report to a file or a printer. If you choose file, you must enter the file name. Do not enter the directory because BMAP automatically stores the file in the data directory of the project. If you choose printer, BMAP immediately begins to print the report to your connected printer. Like all other screens in BMAP where a graph appears, you may obtain a hard copy of the graph by pressing <ALT-P>.

Synthetic Profiles

The BMAP offers the option of generating synthetic profiles given certain parameters. This may be done in the Synthetic Profile Menu. See Chapter 6, “Synthetic Profiles,” for detailed instructions concerning synthetic profiles.

Translation

Translation allows you to shift profiles vertically and horizontally a specified distance. The BMAP displays all active profiles and prompts you to enter the vertical and horizontal shift (for a discussion on active profiles see the section entitled Loading Profiles in Chapter 3, “Project Options”). The BMAP shifts all the profiles the specified distance and stores the results temporarily in memory. You may later choose Output Menu from the Main Menu to store them to your hard drive. See section entitled Output Menu in Chapter 4, “Main Menu,” for a discussion on storing output profiles. Like all other screens in BMAP where a graph appears, you may obtain a hard copy of the graph by pressing <ALT-P>.

Transport Rate

This option computes the cross-shore transport rate from the starting point of two profiles to the ending point. The transport rate is calculated by integrating the equation for conservation of sand (Larson and Kraus 1989). First
choose two profiles for calculations. See the subsection above entitled *Using a reference profile* in the section entitled *Bar Properties* for an explanation on choosing profiles. You are then prompted to enter Dx (horizontal increment factor) and the time difference, in decimal hours, between two profiles. A default time difference is automatically computed by *BMAP*, which looks at the dates and times of the profiles. You have the option to change this value if needed, e.g., if only dummy time information is contained in the header. A plot of the resulting transport rates is then displayed together with additional information on maximum and minimum transport rates and their locations. The *BMAP* also displays the transport rate at the most seaward point. The transport rate is stored temporarily to memory. You may later choose Output Menu from the Main Menu to store the rates to your hard drive. See section entitled *Output Menu* in Chapter 4, "Main Menu," for a discussion on storing output profiles. If you wish to save the other data relating to the transport rate, you may press <ALT-R> for a report. *BMAP* asks if you wish to send the report to a file or a printer. If you choose file, you must enter the file name. Do not enter the directory because *BMAP* automatically stores the file in the data directory of the project. If you choose printer, *BMAP* immediately begins to print the report to your connected printer. Like all other screens in *BMAP* where a graph appears, you may obtain a hard copy of the graph by pressing <ALT-P>.

**Volume**

There are two options for *BMAP* to compute profile volume. You may specify a section of the profile along which *BMAP* computes the volume between the entered values of Xon and Xoff. Another option is to specify a contour above which you wish to compute volume. These options are illustrated schematically in Figure 16.

If you choose From Xon to Xoff, *BMAP* prompts you for three parameters: the starting point of the section (shoreward point or Xon), the ending point of the section (seaward point or Xoff), and zero elevation. If you choose instead Above a Chosen Contour, you are prompted to enter that contour. In either case *BMAP* computes the volume of each active profile and displays it, along with the contour location, if applicable, for each profile, in a data screen to the right of the graph, which you may scroll to view all volumes. If you wish to save this information, you may press <ALT-R> for a report. *BMAP* asks if you wish to send the report to a file or a printer. If you choose file, you must enter the file name. Do not enter the directory because *BMAP* automatically stores the file in the data directory of the project. If you choose printer, *BMAP* immediately begins to print the report to your connected printer. Like all other screens in *BMAP* where a graph appears, you may obtain a hard copy of the graph by pressing <ALT-P>.
Figure 16. Definition sketch for the profile volume calculation
Not only does BMAP produce profile data generated from various calculations performed upon other profiles, but it also provides an option for creating artificial profiles defined by certain parameters. Here we discuss the available synthetic profiles and how they are generated.

**Equilibrium Profile**

The equilibrium profile has been made popular by Dean (1977, 1991) and is a concave monotonic profile given by the power-law relation

\[ h = Ax^{23} \]  \hspace{1cm} (1)

where \( h \) is water depth, \( A \) is the shape parameter, or simply, \( A \)-parameter, and \( x \) is distance offshore from the shoreline. The shoreline is defined as \( h=0 \) and \( x=0 \) by this simple equation. The \( A \)-parameter is a function of median grain size (Moore 1982). An equilibrium profile can be generated by specifying either \( A \) directly or by specifying the median grain size \( d_{50} \) from which BMAP determines the required value of \( A \).

Upon choosing Equilibrium Profile, BMAP queries for the parameters needed to produce the equilibrium profile (Figure 17). These parameters are: \( X_{on} \) (the beginning horizontal position or shoreline), \( X_{off} \) (the ending horizontal position), \( D_{x} \) (horizontal increment), choice between grain size (option G) or \( A \)-parameter (option A), and the median grain size value \( d_{50} \) or \( A \)-parameter value (whichever was chosen).

After all parameters have been entered, BMAP displays the generated equilibrium profile, which is stored to memory under the displayed name. You may later choose Output Menu from the Main Menu to store it to your hard drive. See section entitled Output Menu in Chapter 4, "Main Menu," for a discussion on storing output profiles. Like all other screens in BMAP where a graph appears, you may obtain a hard copy of the graph by pressing <ALT-P>.
Interpolated Profile

This option of BMAP allows you to interpolate a selected profile already in memory. After you have selected Interpolated Profile, you must choose the profile which is to be interpolated. For a discussion related to choosing profiles, see the subsection entitled Using a reference profile under the section entitled Bar Properties in Chapter 5, “Analysis.”

The BMAP then plots that profile to the screen; you should then enter the horizontal starting point Xon, ending point Xoff, and the horizontal increment Dx. The BMAP displays the interpolated profile along with the original profile, and the interpolated profile is stored to memory under the displayed name. You may later choose Output Menu from the Main Menu to store it to your hard drive. See the section entitled Output Menu in Chapter 4, “Main Menu,” for a discussion on storing output profiles. Like all other screens in BMAP where a graph appears, you may obtain a hard copy of the graph by pressing <ALT-P>.

Modified Equilibrium Profile

The modified equilibrium beach profile (Larson 1991) is a concave monotonic profile shape developed to describe beaches that may be steeper near to shore than in the offshore, corresponding to a decrease in grain size from coarser near the shoreline to finer in the offshore. The modified equilibrium profile depends on two empirical parameters (in addition to the A-parameter of the equilibrium profile). These are an energy dissipation ratio called $D_{ree}$ in BMAP and a parameter $\lambda$ which controls change in grain size from coarser to finer. The modified equilibrium profile equation is
\[ h = A \left[ x + \frac{1}{\lambda} \left( D_{ratio} - 1 \right) \left( 1 - \exp(-\lambda x) \right) \right]^{2/3} \]  

(2)

Values of \( D_{ratio} \) typically lie between 1 and 5, and values of \( \lambda \) typically lie between 0.005 and 0.03 m\(^{-1}\).

The Modified Equilibrium Profile option requires entry of values for \( X_{on} \), \( X_{off} \), and \( D_{x} \). It also requires an A-parameter value (no choice of grain size). In addition, you must enter values for \( D_{ratio} \) and the coefficient \( \lambda \).

After all parameters have been entered, \( BMAP \) displays the generated equilibrium profile, which is stored to memory under the displayed name. You may later choose Output Menu from the Main Menu to store it to your hard drive. See the section entitled Output Menu in Chapter 4, “Main Menu,” for a discussion on storing output profiles. Like all other screens in \( BMAP \) where a graph appears, you may obtain a hard copy of the graph by pressing <ALT-P>.

**Plane-Sloping Profile**

After you have made the choice to calculate a plane-sloping profile, \( BMAP \) prompts you for the following parameters: \( X_{on} \) (horizontal starting point), \( X_{off} \) (horizontal ending point), \( D_{x} \) (horizontal increment), elevation at \( X_{on} \), and elevation at \( X_{off} \).

After all parameters have been entered, \( BMAP \) displays the generated plane-sloping profile, which is stored to memory under the displayed name. You may later choose Output Menu from the Main Menu to store it to your hard drive. See the section entitled Output Menu in Chapter 4, “Main Menu,” for a discussion on storing output profiles. Like all other screens in \( BMAP \) where a graph appears, you may obtain a hard copy of the graph by pressing <ALT-P>.
7 Examples

In Chapters 2 to 6, all functions implemented in BMAP Version 1.0 are discussed. This chapter presents two examples for which the options of BMAP are accessed, and you have the opportunity to view the screens as we proceed. Selected data for these examples are listed in Appendix A, and they are also included on the installation diskette. It is recommended that you read this chapter at your computer with BMAP running and follow the examples by operating BMAP along with us. If BMAP is not yet installed, consult Appendix B.

There are two example projects. Most of the options will be exercised using a small number of profile surveys from the Ocean City, Maryland, beach fill monitoring project (Kraus 1993, Stauble et al. 1993). The second example mainly concerns changes of length unit precision, and for this we use a small subset of the SUPERTANK profile survey data set (Kraus, Smith, and Sollitt 1992).

Ocean City

Create project

First, we will begin BMAP by typing BMAP at the DOS prompt from within our BMAP directory.

C:\BMAP>BMAP

The BMAP loads and the Project Options Menu is displayed (Figure 18). In order to begin, we must first create a project. The project will be called OC_TEST (Figure 19).

After we have told BMAP the name of the project, the Project Parameters screen is displayed (Figure 20). The first field required for this screen is the data directory. For our example, we have stored the data in the \BMAP\ DATA directory. If your data files are located in a different directory, enter the correct location here. BMAP asks for a default input file. This file name
automatically is displayed later in the Load Profile Menu. The data file associated with this project is OC37OFF.ISR. The profile survey data contained in this file were taken from ISRP-processed files from the Ocean City, Maryland, monitoring project. The profile elevation is referenced to National
Figure 20. Input file name

Geodetic Vertical Datum (NGVD). Next we must tell BMAP the length multipliers and the units. Ocean City profile survey data are in standard ISRP format and are recorded in feet. So our length multipliers are 1.0 for distance and 0.1 for elevation, and the units are feet. Note that the project name appears on the upper right side of the screen, and the data directory, length units, and the default input file name are on the bottom of the screen.

Load profiles

The BMAP now displays the Load Profile Menu with the default file name in the left column of the first row (Figure 21). By pressing <ALT-L>, we obtain a listing of all the profiles in this file (Figure 22). Move the cursor to the desired profiles and press <ALT-T> to tag each profile. After tagging all desired profiles, you should press <ALT-S> to copy the profile information to the Load Profile Menu.

All profiles are active by default. If you wish to make some profiles inactive, move to the Active field and press "N." For our application we want all profiles to be active. Figure 23 shows the profiles we have chosen for our example.

We have told BMAP all the profiles we want to load from the input file. Press <ALT-S>, and BMAP will begin to load the profiles.

After the profiles have been loaded, you are returned to the Main Menu (Figure 24).
Figure 21. Load Profile Menu

Figure 22. Listing profiles
Figure 23. Activating profiles

Figure 24. Main Menu; after loading profiles
Graph profiles

Before proceeding to analysis, visually inspect the data. To do this, choose Graph Menu and graph all the Input Profiles (Figure 25).

Figure 25. Graph Menu; select Input Profiles

The profile data are plotted, and the graph should look like Figure 26.

If you would like to place a mark (*) where each point is plotted to see the density of actual data points, press <DWN-ARROW> and the lines will be replaced with asterisks at the data points (Figure 27).

Press <ALT-P> to receive a hard copy of this graph. Press any other key to return to the Graph Menu. After returning to the Graph Menu, press <ESC> to return to the Main Menu.

You may notice that the Output Menu is invalid at the time, because we have not yet generated any output profiles. BMAP does not allow selection of this option until output data are generated.

Reindex data files

Another option included in the Main Menu is the Reindex Data Files option. This command re-indexes the input file. Spurious loss of indexing may be the cause of odd results. Use this option if you begin to have unexplained problems with the data.
Figure 26. Graph of Ocean City active profiles

Figure 27. Graph of Ocean City test profiles; data points option
**Zoom profiles**

The Zoom Profiles option is included to assist you in zooming in on a certain part of the profiles to view things such as crossing points and bars. This option is displayed in Figures 28 and 29 for our example.

![Figure 28. Selecting zoom between 0 and 1,000 ft](image)

**Averaging**

Now that we have exercised the valid options in the Main Menu, we explore the analysis options. Choose the Analysis Menu, as shown in Figure 30.

Let's choose Averaging so that we may calculate the average profile for the five profiles we have loaded in memory (the active profiles). We will enter an Xon value of -500, an Xoff value of 2,500, and our Dx will be 50, as shown in Figure 31. After pressing <ENTER>, BMAP will use linear interpolation to produce an average profile at 50-ft increments starting from 500 ft behind the baseline (Figure 32). The averaging routine automatically adjusts if the number of lines changes at a given distance. For example, at 2500 ft, there is only one profile, so only one profile is used in the averaging process there. Notice that a menu appears in the right window with six options. Choosing one of these options displays the corresponding graph.
Figure 29. Zoomed profiles from Figure 28

Figure 30. Analysis Menu; averaging selected
Figure 31. **Average Profiles** screen; averaging parameters selected

Figure 32. **Average profile** for the screen in Figure 31
Output profiles

After viewing the calculated profiles, press <ESC> and BMAP indicates the name it has assigned to these profiles (Figure 33). You may change these names, add descriptions, and save the profiles to disk in the Output Menu. Let’s do that at this time.

![Profile saved to Memory as AV__1.png](image)

Figure 33. Average profile saved as an output profile

Press <ESC> twice to return to the Main Menu. Choose Output Menu. The first five rows include information about the profiles generated from the Zoom Profiles option (Figure 34). Scroll down the list until the profile AV__1 (No. 6) is selected. Insert OC37AVG to the first blank name field. This serves as the file name for the data. Change the ID and add a description to this profile (Figure 35). Save these changes by pressing <ALT-S>.

Bar properties; least-square estimate

The next option available on the Analysis Menu is Bar Properties. Generate a best-fit equilibrium profile to use in calculating bar properties. The option is Least-Square Estimate. So, before we invoke the Bar Properties option, we choose Least-Square Estimate to generate the equilibrium profile.

The Least-Square Estimate option generates a best-fit equilibrium profile with respect to a target profile. First tell BMAP the source of the input target profile. To determine the bar properties of one of our input profiles, we choose Input File as our source. The BMAP then graphically displays all the input profiles from which a selection is made (Figure 36). Choose Profile
Figure 34. Output Profile Menu

Figure 35. Average profile; new name assigned
OC 37 890420 1100 because it has a well-defined bar. Move the selection box to the desired profile and press <ENTER> to select. An alternative and preferred method would be to fit the equilibrium profile to the average profile that we have generated and saved as an output profile. We leave this as an exercise to the reader. Our aim here is to demonstrate the profile selection procedure of the Profile Display Menu.

After selecting Profile OC 37 890420 1100, we are ready to do our calculations. BMAP asks for Xon and Xoff for defining the equilibrium profile. As a default, Xon is automatically computed by BMAP as the location where the profile crosses the zero elevation. You have the option of changing this value. For our case, we will keep that contour and enter 2,500 for Xoff. Press <ENTER>, and Figure 37 shows the resulting equilibrium profile, together with the original profile.

In viewing Figure 37, we see at the right-hand box that the best-fit A-parameter was determined by BMAP to be 0.13 ft$^{1/3}$ with a corresponding median grain size $d_{50} = 0.29$ mm. This value of grain size is close to that determined by sediment samples in the nearshore (Stauble et al. 1993). If a visual appraisal of the resultant profile were deemed unacceptable, we could press any key and be in a position to enter different parameters. Instead we will press <ALT-S> and keep the equilibrium profile. BMAP has the capability to print a hard copy of the calculated data in the right window of the screen. To do this, press <ALT-R>. BMAP asks if you wish to send the information to the printer or to a file. If you choose printer, BMAP immediately begins to print the information. If you choose file, enter a valid DOS file name. Do not
include the directory because *BMAP* automatically saves the file in the data directory of the project.

**Bar properties; with a reference profile**

We now have an adequate equilibrium profile. Let's use that profile to determine bar properties. First, choose Bar Properties from the Analysis Menu. Because we have the equilibrium profile, choose With a Reference Profile, Figure 38. We will choose Output file as our source because the equilibrium (reference) profile was generated by *BMAP*. Choose the LS_1 profile (the generated equilibrium profile).

Choose Input File as the source for the specific target profile (Figure 39). Because we used Profile OC 37 890420 1100 to generate the equilibrium profile, let's choose it here as our specific profile.

The *BMAP* automatically computes the crossing pairs of the two profiles, indicating the presence of a bar (Figure 40) located from approximately 261 ft to 761 ft.

Choose the pair by pressing <ENTER>. The *BMAP* then computes the bar properties and displays them to the side of the screen, as shown in Figure 41.

According to Figure 41, the minimum depth (referenced to NGVD) over the bar, called the bar crest depth, was 3 ft, and the crest was located 307 ft from the shoreline. The maximum bar height with respect to the equilibrium profile...
was 4 ft, located 394 ft from the shoreline. The volume of the bar was 50 yd$^3$/ft, and its length was 500 ft. The center of mass of the bar was located approximately 492 ft from shore. BMAP has the capability to print a hard copy of the calculated data in the right window of the screen. To do this,
Figure 40. Bar defined by cross pair intersection

Figure 41. Results of bar properties calculation
Figure 42. Specifying depth contours for comparison

Press <ALT-R>. BMAP asks if you wish to send the information to the printer or to a file. If you choose printer, BMAP immediately begins to print the information. If you choose file, enter a valid DOS file name. Do not include the directory because BMAP automatically saves the file in the data directory of the project.

**Compare profiles**

Return to the Analysis Menu by pressing <ESC>. We are now going to compare two profiles. You already know how to choose profiles, so we will omit explanation of choosing profiles from here on. We chose Profiles OC 37 920111 1500 and OC 37 890117 700 from the input file (Figure 36) as the two target profiles to compare, using the Comparison option. After you have chosen the two profiles, BMAP displays them and prompts you to enter the contours between which the quantitative comparison will be made. Enter the first contour and press <ALT-I> to add a row for the next contour. Enter the contours that are written in Figure 42. When you have finished entering the contours, press <ALT-S> to compare, giving the results shown in Figure 43.

After the comparison has been made, BMAP displays the volume change and contour location for each profile in a scroll box (Figure 43). BMAP has the capability to print a hard copy of the calculated data in the right window of the screen. To do this, press <ALT-R>. BMAP asks if you wish to send the information to the printer or to a file. If you choose printer, BMAP
immediately begins to print the information. If you choose file, enter a valid DOS file name. Do not include the directory because BMAP automatically saves the file in the data directory of the project.

In the scroll box in Figure 43, the units of volume change are \( \text{yd}^3/\text{ft} \) for American customary units and \( \text{m}^3/\text{m} \) if the project data are in metric units.

**Cut and Fill**

For this example, Profiles OC 37 891001 813 and OC 37 890117 700 were chosen from the Input file list (Figure 36). The BMAP calculates and the results are displayed (Figure 44). Press the <DWN-ARROW> or <UP-ARROW> to scroll through the list of cells. As seen in the information box to the right, the cut and fill volumes were calculated between the most common location points having elevations, -108 ft as the landward starting point, and 2,092 ft as the most seaward point. If you would like a hard copy of the results or to save the results to a file, press <ALT-R>. If you choose to save the results to a file, enter a valid DOS file name without the directory. The BMAP automatically saves the file to the data directory of the project. Choosing printer as the destination immediately sends the output to the connected printer.
Figure 44. Cut and fill results

**Horizontal Alignment**

The next option is **Horizontal Alignment**. This option allows us to align all profiles to a specified location. The graph is displayed in Figure 45 after we have selected this option, and we will enter the 5-ft elevation as our location. Next the user specifies the horizontal position of the aligned profiles. This option allows the profiles to be aligned to other profile locations or zero. For this example choose an X-reference equal to 0 ft. All profiles are translated horizontally to coincide at the 5-ft elevation, as shown in Figure 46.

After you press a key, you may notice that the message informing you of the name of the saved profile is in a different form than earlier output profiles. You see that the name of the profile is `HA_#`. The symbols `##` are inserted because more than one profile has been generated from a single option. The profiles are saved starting with the next value for `HA` and incremented by one for each generated profile. It is recommended that you change these names if you plan to use these output profiles later, because output profile data tend to accumulate in the course of analysis, and it is easy to forget what was done. For a listing of each two-letter identification and its corresponding function, consult the section entitled **Output Profiles** in Chapter 2.
Figure 45. Profiles prior to horizontal alignment

Figure 46. Profiles aligned at the 5-ft elevation
Translation

The next option we will discuss is Translation, having already discussed the least-square fit option and saving synthetic profiles for later. The Translation option is similar to Horizontal Alignment and may be confused with it. Translation shifts (or translates) all values of all profiles by specified horizontal and vertical amounts, whereas the Alignment option aligns all profiles at a certain elevation. When you select Translation, BMAP displays the profiles and prompts you to enter the horizontal and vertical shifts. These values are added to the profile data to shift the profiles the specified amount. Here we will enter -5 ft for the vertical shift and 100 ft for the horizontal shift (Figure 47). Figure 48 shows the results of translating the profiles. Note that as you exit, these profiles are saved as TL_##.

![Figure 47. Before translating profiles](image)

Transport rate

Let us now move to the Transport Rate option. To illustrate the Transport Rate option, we return to the Load Profile Menu to load the OC_37 survey of 911103, the last survey prior to the severe 4 January 1992 storm that impacted Ocean City. We will calculate the cross-shore transport rate between the profile surveys of 911103 and 920111, under the assumption that cross-shore transport was solely responsible for beach profile change during the approximately 2-month time interval. After you choose the profiles, BMAP plots them and prompts you to enter Dx (horizontal increment) and the time difference that has been automatically computed by BMAP from the time in
Figure 48. After translating profiles

the header of each profile (Figure 49). We have entered a value of 100 for the Dx and a value of 24 for the time difference under the assumption that the storm lasted 24 hr. After you have entered the values, BMAP plots a graph of

Figure 49. Entering values to calculate the transport rate
the cross-shore transport rate and displays basic information to the right (Figure 50).

Figure 50. Results of transport rate calculation

Figure 50 shows that the cross-shore transport rate was positive, indicating offshore transport because the x-axis is positive directed offshore. Of course, during the time between surveys, longshore transport and other factors such as beach fill placement and artificial manipulation of the subaerial profile may have occurred, so that the resultant profile change was not solely a result of cross-shore transport. The calculated maximum and minimum transport rates shown in the information box have units of m$^3$/m/hr if the project is in metric units and yd$^3$/ft/hr if in American customary units as in our example.

BMAP has the capability to print a hard copy of the calculated data in the right window of the screen. To do this, press <ALT-R>. BMAP asks if you wish to send the information to the printer or to a file. If you choose printer, BMAP immediately begins to print the information. If you choose file, enter a valid DOS file name. Do not include the directory because BMAP automatically saves the file in the data directory of the project.

Volume

After Volume is chosen, you will notice that there are two options (Figure 51). We will first choose From Xon to Xoff. A graph appears with the prompt to enter Xon, Xoff, and Zero elevation. We shall enter 0 for Xon, 1000 for Xoff, and 0 for Zero elevation (Figure 52). The BMAP then displays
a scroll screen with the volume of each profile over that distance with respect to zero elevation (Figure 53).

The results of the volume calculation are shown in the scroll box in the right-hand window of the screen. In metric units, the volume will be given in
m³/m. For the present situation of American customary units, the output is in yd³/ft.

ESCape from that screen and choose Volume again, but this time choose Above a chosen contour. The BMAP now waits for you to enter the contour, which we choose as -5 ft (Figure 54). BMAP shows a scroll screen with the volume of all of the profiles, and this time it displays the location of the -5 ft elevation contour (Figure 55). The BMAP has the capability to print a hard copy of the calculated data in the right window of the screen. To do this, press <ALT-R>. The BMAP asks if you wish to send the information to the printer or to a file. If you choose printer, BMAP immediately begins to print the information. If you choose file, enter a valid DOS file name. Do not include the directory because BMAP automatically saves the file in the data directory of the project.

Synthetic profiles

Now choose the option Synthetic Profiles, and we can discuss the four different types of artificial profiles that can be generated. Choose Equilibrium Profile. You are prompted to enter Xon, Xoff, Dx, and the A-parameter or grain size. Choose the values as entered in Figure 56. We selected the G-option, grain size, and entered 0.30 mm as a round value based on our best-fit equilibrium profile exercise performed previously. The BMAP now plots the equilibrium $x^{1/3}$ profile to the screen (Figure 57).
Figure 54. Entering contour for volume calculation

Figure 55. Results for profile volume above a chosen contour
Figure 56. Entering values for Equilibrium Profile option

Figure 57. Generated equilibrium profile

ESCape back and we will now compute an interpolated profile. The Interpolate Profile option requires that we choose a profile to interpolate. We have chosen Profile OC 37 891001 813 from the input file (Figure 36). After you have chosen the profile, enter Xon, Xoff, and Dx (Figure 58). Enter 0 for Xon, 1500 for Xoff, and 100 for Dx. The BMAP then displays the
Figure 58. Entering values for Interpolated Profile option

interpolated profile (Figure 59). Note that the interpolated profile (IP_1) has
lost some resolution of profile features as compared to the input profile, the
actual profile based on measurements, because the interpolation interval of
100 ft typically spans (omits) several survey points.

Next we come to Modified Equilibrium Profile, which is similar to Equi-
librium Profile. Enter the values as they are shown in Figure 60. The BMAP
then plots the resulting equilibrium profile (Figure 61).

The last-listed synthetic profile option included within BMAP is the plane-
sloping profile. Here you need only enter Xon, Xoff, Dx, elevation at Xon,
and elevation at Xoff. If you enter the values shown in Figure 62, the profile
displayed in Figure 63 should result.

We have now covered all the options of BMAP and are ready to exit the
program. To do this, return to the Main Menu (press ESCape until the Main
Menu is displayed). Now press <Q> to quit. You will return to the screen as
shown in Figure 64. Choose “YES” to exit. You will then be prompted with
the screen shown in Figure 65. Choose “YES” to save the project. You will
then be prompted with the screen shown in Figure 66. Choose “YES” again to
prepare to save some of the output profiles from our session.
Figure 59. Interpolated profile, DX = 100

Figure 60. Entering values for modified equilibrium profile
Figure 61. Generated modified equilibrium profile

Figure 62. Entering values for plane-sloping profile
Figure 63. Generated plane sloping profile

Figure 64. Exit confirmation
Figure 65. "Save Project" message

Figure 66. "Save Output Profiles" message

You are now in the Output Profiles Menu. Here you may change the names and descriptions of the output profiles. You also have the option to save the profiles to disk. The file you specify should contain no extension.
The BMAP automatically appends ".prf" to the file name. Figure 67 shows the profiles as we have saved them. You may or may not wish to save these profiles at this time.

Figure 67. Saving output profiles

When completed renaming files and entering descriptions, press <ALT-S> to save the changes. You will be returned to the DOS prompt outside of BMAP.

This concludes our example using data from Ocean City. You may now wish to review the next example, which makes use of data from the SUPER-TANK Laboratory Data Collection Project involving a large wave tank.

SUPERTANK

In this example, we will only discuss a few operations that provide interesting differences from those of the Ocean City example. We have created a project for SUPERTANK and entitled it ST_TEST. The default input file, which is found on your installation diskette, is entitled ST_10.2D, which is a test with monochromatic waves. We will be calculating the bar properties for these profiles.

SUPERTANK data were recorded with a higher precision than standard ISRP, and, therefore, different length multipliers must be used. When creating the project, the Project Parameters screen is displayed (Figure 68). Change the distance and elevation multipliers to 0.01 to confirm how SUPERTANK
profile survey data were recorded, which was to the 0.001 ft in horizontal distance and elevation.

The profiles that we have loaded for this test are listed in Figure 69. All five of the available profiles have been activated.
Now we calculate bar properties. Enter on Bar Properties from the Analysis Menu, then choose With a Reference Profile. For this example, we chose Profile ST 6 910805 1005 for the reference and Profile ST 6 910808 1240 as the specific target profile. Figure 70 shows the two profiles and the crossing pairs, and Figure 71 shows the results of the calculations.

Figure 70. Choosing cross pairs for bar properties for ST_TEST

Figure 71. Results of bar properties for ST_TEST
In Figure 70, we see that several bars have been located. Some of these are observed on the graph to simply be large ripples generated by the monochromatic waves. There is only one large break-point bar, located in the region between 73.68 and 100.40 ft. Therefore, enter on this bar to calculate bar properties in Figure 71.

This concludes the example chapter. For more detailed instructions on running BMAP, consult Chapters 1 through 6 of this manual.
References


Moore, B. D. (1982). “Beach profile evolution in response to changes in water level and wave height,” M.S. thesis, Department of Civil Engineering, University of Delaware, Newark, DE.

Appendix A
Example Data and Format

This appendix reviews the Interactive Survey Reduction Program (ISRP) format (Birkemeier 1984)1 and lists the survey data used in the examples given in the main text of the report.

ISRP Format

The ISRP format is summarized in Table A1. The format is defined by record line number, position on the line, and the content of the information. The Beach Morphology Analysis Package (BMAP) will look for profile survey information in exactly this format; errors in format may produce either runtime errors or spurious results. Examples of survey data in ISRP format are given in the next section.

Example Survey Data

The survey data for the Ocean City, Maryland, and SUPERTANK example projects are given respectively in Figures A1 and A2.

In Figure A1, the entry “OC_37” identifies the survey line as “Ocean City, profile line No. 37.” The “41” leading the next entry indicates that this entry is “line 1 of card 4,” is not necessary, and is not read by BMAP. The date of the survey is “890117” (17 January 1989). The entry “700” is the time of the survey (0700), and there are 59 coordinate (horizontal, elevation) pairs. The entry “-286” indicates that the minimum elevation is -28.6 ft. The entry “Ocean City” is optional material treated as blank space by BMAP. The next entry, “-108 134” is the first coordinate pair, indicating a horizontal distance of 108 ft behind the baseline, and a profile elevation of 13.4 ft. (These entries are in standard ISRP format with regard to precision.) The other entries follow similarly.

---

1 References cited in this appendix can be found in the reference list at the end of the main text.
<table>
<thead>
<tr>
<th>Position</th>
<th>Description of Entry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Data Line in Each Record</strong></td>
<td></td>
</tr>
<tr>
<td>1-5</td>
<td>Profile Location Number</td>
</tr>
<tr>
<td>6-10</td>
<td>Blank</td>
</tr>
<tr>
<td>11-16</td>
<td>Date of Survey (year, month, day)</td>
</tr>
<tr>
<td>17-21</td>
<td>Time of Survey (e.g., 1250 = 12:50)</td>
</tr>
<tr>
<td>22-24</td>
<td>Number of coordinate pairs in the survey</td>
</tr>
<tr>
<td>25-29</td>
<td>Minimum elevation in the survey (e.g., -258 = -25.8 units)</td>
</tr>
<tr>
<td>30-40</td>
<td>Blank</td>
</tr>
<tr>
<td>41-80</td>
<td>First four distance-elevation pairs. Elevation values have one significant digit (e.g., 90 45 = Horizontal Distance 90 units, Elevation 4.5 units)</td>
</tr>
<tr>
<td><strong>Following Data Lines in Each Record</strong></td>
<td></td>
</tr>
<tr>
<td>1-10</td>
<td>Same as first data line</td>
</tr>
<tr>
<td>11-80</td>
<td>Seven distance-elevation pairs</td>
</tr>
</tbody>
</table>

Values of the coordinate pairs for the SUPERTANK example data set include an extra precision value which differs from standard ISRP format. Under the Project Options Menu, there is an option called Units, in which the length and elevation multipliers (cf, Chapter 2) can be changed to account for extra survey precision. For SUPERTANK, the distance length multiplier was 0.01 and the elevation length multiplier was 0.01. Therefore, the first coordinate-pair entry “10 -5” is read as horizontal distance of 0.10 ft from the baseline with an elevation of -.05 ft. Other header information in the first line follows standard ISRP format. The “ST_6” entry indicates Test 6 of the SUPERTANK series (Kraus, Smith, and Sollitt 1992), and the first survey shown in Figure A2 was done on 5 August 1991 at 0945. There are 130 coordinate pairs in the survey.
Figure A1. Ocean City, Maryland, test data set
### Example Data and Format

<table>
<thead>
<tr>
<th>Example Data and Format</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Data Set</th>
<th>1996/05/01</th>
<th>1997/01/12</th>
<th>1998/06/27</th>
<th>1999/11/30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data 1</td>
<td>123.456</td>
<td>78.901</td>
<td>45.678</td>
<td>90.123</td>
</tr>
<tr>
<td>Data 2</td>
<td>56.789</td>
<td>23.456</td>
<td>90.123</td>
<td>34.567</td>
</tr>
<tr>
<td>Data 3</td>
<td>45.678</td>
<td>90.123</td>
<td>34.567</td>
<td>23.456</td>
</tr>
</tbody>
</table>

**Figure A2. SUPERTANK test data set**
Appendix B
Installation of BMAP

This appendix describes system requirements for running the Beach Morphology Analysis Package (BMAP) and the installation procedure for transfer of the package from the distribution diskette to your computer.

System Requirements

System requirements for BMAP include at minimum a Disk Operating System (DOS) 386-compatible personal computer, Video Graphics Array (VGA) monitor, 1.5 Mb of hard drive space, and 640 K of memory. A mouse is recommended but not required. BMAP is supplied on a 3.5-in. (1.44-Mb) diskette. It is recommended that a backup copy of the BMAP distribution diskette be made prior to attempting installation.

If hard copy printouts of BMAP graphs are desired, the user must have a Hewlett-Packard LaserJet II compatible printer.

Installation

For installing the software package, it is recommended that BMAP be placed into a separate directory called BMAP. It will be assumed that your hard drive is the “C” drive. To create this directory and move to it, type:

```
C:> MKDIR BMAP <ENTER>
C:> CD BMAP <ENTER>
```

Insert the BMAP distribution diskette into the available 3.5-in. drive (A or B). To complete the installation for a target A drive, type:

```
C:BMAP> COPY A:*.* <ENTER>
```

BMAP is now installed on the hard drive. Please store the distribution diskette in a safe place.
Running **BMAP**

*BMAP* can only be started from within the BMAP directory, where BMAP.EXE is present. There are two ways to start *BMAP*. For method one, type:

```
C:\BMAP\> BMAP <ENTER>
```

*BMAP* will start and the **PROJECT OPTIONS** menu will be displayed.

To use the second method of starting *BMAP*, a project must already exist. Start *BMAP* with a project file (excluding extension) as a command line option. Following is an example using a project called OCEANCTY found in the current directory:

```
C:\BMAP\> BMAP OCEANCTY
```
Appendix C
Converting Files

This appendix describes the procedure for conversion between the Interactive Survey Reduction Program (ISRP) format files and the Beach Morphology Analysis Package (BMAP) Free-format (FRE) files. The arrangement of a FRE file and an example are given. The FRE format, which is basically a two-column format of distance elevation pairs, is convenient for entry to plotting packages. Two-column format data files are typically generated in numerical simulation models. In the FRE format, the first two lines of each record may be treated as headers for the file containing distance elevation data pairs in two-column format.

Convert Files

Converting profile data files, either to or from ISRP and FRE format, is accomplished through the Main Menu option Convert Files. At the Convert Files data entry screen, choose the first option for conversion of ISRP to FRE, or the second option for conversion of FRE to ISRP. When the next screen is displayed, enter the corresponding file names. If the ISRP or FRE data file is currently in another directory, precede the data file name with the complete path for each of the specified file names. BMAP will then proceed with the specified conversion.

BMAP Free-Format (FRE)

The FRE format is summarized in Table C1. The format is defined by record line number, position on the line, and the content of the information. The BMAP will look for profile survey information in exactly this format; errors in format may produce invalid or erroneous results. Examples of survey data in FRE format are given in the next section.
### Table C1

**Explanation of BMAP FRE Data Format**

<table>
<thead>
<tr>
<th>Position</th>
<th>Description of Entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Data Line in Each Record</td>
<td></td>
</tr>
<tr>
<td>1 - 5</td>
<td>Profile Location Number (ID)</td>
</tr>
<tr>
<td>6</td>
<td>Blank</td>
</tr>
<tr>
<td>7 - 11</td>
<td>Date of Survey (year, month, day)</td>
</tr>
<tr>
<td>12</td>
<td>Blank</td>
</tr>
<tr>
<td>13 - 18</td>
<td>Time of Survey (e.g., 1850 = 6:50 pm)</td>
</tr>
<tr>
<td>Second Data Line in Each Record</td>
<td></td>
</tr>
<tr>
<td>1 - 3</td>
<td>Number of coordinate pairs in the survey</td>
</tr>
<tr>
<td>4</td>
<td>Blank</td>
</tr>
<tr>
<td>5 - 20</td>
<td>Minimum elevation in the survey</td>
</tr>
<tr>
<td>Following Data Lines in Each Record</td>
<td></td>
</tr>
<tr>
<td>1 - EOL</td>
<td>One distance elevation pair (e.g., 10.24056 -28.634) delimited by a blank. EOL means end of line</td>
</tr>
</tbody>
</table>

---

### Example Survey Data

Selected survey data for the Ocean City, Maryland, example project are given in Figure C1. In Figure C1, the entry “OC 37” identifies the survey line as “Ocean City, profile line No. 37.” The entry “890117” is the date of the survey (year, month, day), and the “700” indicates the time of the survey (0700). The “59” on the second line of the first record indicates that there are 59 coordinate (distance, elevation) pairs, and the “-28.600000” indicates that the minimum elevation is -28.6 ft. The next entry, “-108.000000 13.400000” on the third line of the first record, is the first coordinate pair, indicating a
horizontal distance of 108 ft behind the baseline, and a profile elevation of 13.4 ft. The other entries follow similarly.
Appendix D
Notation

$A$  Shape parameter describing the equilibrium beach profile, m$^{1/3}$ or ft$^{1/3}$

$d_{s0}$  Median grain size, mm

$D_{ratio}$  Ratio of energy dissipation at the shoreline to energy dissipation in the offshore

$Dx$  Horizontal increment factor

$h$  Water depth

$R^2$  Correlation coefficient squared

$x$  Horizontal coordinate, m or ft

$z$  Vertical coordinate or elevation, m or ft

$\lambda$  Spatial gradient at which the equilibrium energy dissipation the approaches dissipation in the offshore, m$^{-1}$ or ft$^{-1}$
This report is a user's guide for the Beach Morphology Analysis Package (BMAP), which consists of automated and interactive procedures to analyze morphologic and dynamic properties of beach profiles. The BMAP is a computation utility developed to support desktop computer simulation studies of cross-shore modeling of storm-induced beach erosion for beach fill design. The BMAP includes a graphical interface that produces on-screen plots of user-selected profiles and calculation results that are easily exported to a printer. The present report covers Version 1 of BMAP which is capable of two-dimensional analysis, that is, analysis of beach profiles. This guide provides information to operate BMAP as a stand-alone program under the Disk Operating System (DOS) running on a personal computer (PC).
7. (Concluded).

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