AREA-CAPACITY COMPUTATION PROGRAM

User Manual

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Denver, Colorado

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FOREWORD

This is the documentation for the computer program ACAP85.

Should a user detect any inaccuracies, it is suggested that he copy the page (or pages) in error and indicate the problem to the office identified below. If users feel that certain topics have been omitted, this information would also be appreciated.

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PREFACE

A potential user of this program need not consider reading this entire manual before using the program. Most of the material included is reference material. If a question arises on how to have this program accomplish a particular task, one should know where to look to find the answer but not try to commit all details to memory.

The style of this manual is directed along the line of a handbook. Each of the various sections are intended to be complete treatments of the topics covered. Thus, the user should not have to search back and forth through the manual to get information on a single topic from several different places. This tends to make the text somewhat repetitious but hopefully easier to use.

Each of the various chapters has been written to accomplish a specific purpose. These are:

1. Introduction. - To describe to a potential user the purpose of and general information about the program.

2. Operation. - To describe in detail all operational (or use) aspects of the program from a conceptual viewpoint. Thus, if a potential user thinks that the program sounds interesting, he should be able to get a good idea of what he needs to do to get results.

3. Chapters III, IV, and V provide the very detailed information required to actually implement an application. Chapter III describes

the computer required to handle the job. Chapter IV describes how to get the input set up. Chapter V documents the various types of output available.

ACKNOWLEDGMENT

This program was originally written and implemented by the late E. A. Cristofano in the middle 1960's. Substantial changes and improvements to the program were made by Robert Main and Fred Dockhorn in the late 1970's. Many portions of the users manual were extracted from notes prepared by Robert Main. The manual was completed in June of 1985 by Don Frevert, Fred Dockhorn and Sharon Nuanes.

I. INTRODUCTION - ACAP85 PROGRAM

1.1 Program Identification

The acronym ACAP85 represents "Area-Capacity Program, 1985 Version".

1.2 Purpose

To develop area-capacity tables for a reservoir given a set of areas in the horizontal plane at various elevations in the reservoir.

1.3 Origin and Background

An investigation carried out in the middle 1960's indicated that there was no Bureau-wide program for computing area-capacity tables. As a result of these investigations a program called CARCAP was developed by the late E. A. Cristofano which was widely used until 1975, when it was significantly modified by Mr. Cristofano. To emphasize the significance of the changes its name was changed to ACAP. The CARCAP version of the program is no longer supported by this office.

Only two aspects of the program were changed in the 1975 modification: (1) It was converted from a batch-oriented program to an interactive program which allows the user to type the input data at the terminal or use a previously prepared data file if desired, and (2) A second method for fitting a curve to the observed data was installed. This was the Cubic Spline Fitting procedure. The previously employed method of fitting a curve to the data - least squares method - was still retained.

In 1984-1985 the ACAP Program was altered to allow clarification of error messages by additional explanation. Additional messages were included to indicate if a negative slope had occurred. In addition the potential for interpolating negative areas by the cubic spline method was eliminated by setting such values to zero. Warning messages were added to the Cubic Spline Fitting procedure to alert the user as to the need for a "well behaved" data set. The finalized version of the program is referred to as ACAP85.

Program ACAP85 is almost completely compatible with all previous versions of CARCAP and ACAP. All line formats remain the same. The only incompatibility is in the ability of CARCAP to have more than one control line in the input file. Program ACAP85 can have only one control line in the input file. Additional controls can be furnished using the "REPEAT" option.

1.4 Methods

As noted in the previous section, two methods of interpolation are available for use in program ACAP85. These are a least squares curve fit approach and a cubic spline procedure.

1.4.1 Least Squares Curve Fitting Procedure or the CARCAP Method

Areas and capacities are interpolated at 0.1-foot (or 0.1-meter) increments using the elevations and areas from the basic data set and slopes of the area-elevation line segment for each data interval. An incremental elevation - the vertical distance from the interpolated elevation to the

elevation of the lower data point - is computed. These values along with the capacities which are interpolated from the basic data (using the areas and the slope of the area-elevation relationship) are used in the least squares analysis. This analysis involves complex matrix manipulation which will not be described in detail here. Once the least squares estimates of the coefficients are completed, capacities are estimated and compared to the interpolated capacities at all incremental elevations over the entire data set. If the error (defined as estimated capacity - interpolated capacity divided by interpolated capacity) exceeds the specified error limit, then the last data interval is dropped and the least squares analysis is repeated for the remaining data intervals. Appendix A provides a more detailed discussion of the least squares fitting method.

1.4.2 Cubic Spline Curve Fitting Procedure

The Cubic Spline curve fitting procedure puts a different cubic function between each pair of points in the observed data set. While fitting the function to a specific interval the procedure also looks at the two adjacent intervals on either side of the interval in question. In this way it ensures that the first and second derivatives will be continuous at the transition points between the functions. This produces a smooth looking overall curve which is made up of a series of segments. The word "spline" is employed to indicate that this procedure is said to closely approximate the curve fitting process one might achieve if one used a draftsman's spline. This process will put the curve directly through all observed points.

Although the cubic spline method produces "smooth" functions which are continous in the first and second derivatives, some problems can result. Experience has shown that without the controls recently added, negative slopes and, in some cases negative areas, can be interpolated between data points; whereas, these would be positive slopes and areas using a least squares approach. For this reason, it is recommended that the cubic spline method be used with great caution.

An inconvenience associated with the cubic spline method is that it does not reveal the coefficients of the derived functions. In order to reveal these coefficients the process would require substantial reorganization.

1.5 Program Files

The following are the names and functions of the files associated with the ACAP85 Program.

1. EACAP85 - A procedure file to get a run of program ACAP85 executed.

A copy of procedure file EACAP85 has been included (table 2-2) to demonstrate how the program has been handled by users at the E&R Center, Denver.

2. ACAPR - Each run will produce a set of results which will be stored in file ACAPR at the end of the run.

3. ACAPI - All input entered during a run will be placed in this file and saved at the end of the run.

4. ACAP85B - Binary version of the Fortran program ACAP85 used to compute the area capacity tables.

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5. R - File used temporarily to hold results to be printed at the end of the run.

1.6 Program Features

1.6.1 Error Limit Value

The Error Limit Value is used only in the least-squares curve fitting procedure. It is used to dictate how closely the fitted functions must conform to the observed data. When the least-squares fitting procedure is employed no attempt is made to fit a single function to the entire data set, but rather to segment the data set and fit a different function to each segment. The error limit value controls the extent of the segmentation required. The fitting process is described in more detail in appendix A. A small error limit .0001 or less is strongly recommended in order to ensure consistency between the input data and the tabulations.

Obviously, the smaller the error limit value picked, the greater the number of equations necessary to describe the elevation-capacity relationship.

More detail on how this number is used is given in section 2.1.3.

1.6.2 Flexibility in Input

Data may be entered either interactively from a terminal or from a previously prepared file. The data in the elevation-area table do not need to

be entered in ascending order of elevation, the table will be sorted into ascending order after all of the data are read. The elevation difference between successive data points does not have to be constant through the data set. Provisions have also been made to allow the initial capacity to be some value other than zero.

1.6.3 Flexibility in Table Generation

Areas and capacities can be generated and printed using 1.0-, 0.1-, or 0.01-foot (or meter) increments of elevation. Program control allows different respective area and capacity increments to be generated at the same time. Areas and capacities may be rounded off to the nearest 10, 100, or 1,000 units.

Tables can be generated starting at any elevation and ending at any elevation as long as both elevations are within the data set. Once a data set is determined, computed area and capacity values will remain the same regardless of starting and ending elevations. However, any change in the data set will, in nearly every case, change the tabular values.

1.6.4 Metric Units Capability

Metric units or English units may be used for input and metric units or English units may be used for output. Selection of units for input and output are independent of each other. It is recommended, however, that input units be the same as output units. The metric units used in this program are the following; elevations printed in meters, areas printed in hectares and capacities printed in 1,000 cubic meters.

When metric units are selected for output the elevation increment may be 1.0 m, 0.1 m, or 0.01 m.

II. OPERATION - ACAP85 PROGRAM

All aspects of how to operate the program will be discussed in this chapter. Primarily this entails describing how to prepare the input and how to make a run on the computer.

2.1 Preparation of Input

This program is intended to be operated from an interactive terminal. In which case, all of the input is typed in at run time at the terminal and there is no need to describe line formats for data entry. One merely answers the questions as they are asked.

Input to this program consists of two types of information: the data set and control information. The "data set" consists of a table of elevations and corresponding horizontal areas. There should be no less than three entries in this table, but no more than 200. The control information consists of starting and ending elevations for table generation (one need not necessarily generate tables over the full range of elevations defined in the data set); the elevation increment to use when generating the tables; which tables to generate, only area tables, only capacity tables, or both; specification of units (English or metric); specification of the interpolation technique to use (least squares or cubic spline); round off of generated values; and the capacity offset feature.

Certain items of control information require a coded entry or some explanation for the user to understand what to input to the program. These are:

The round-off indicators, the table generation control, the error limit value, and the capacity offset feature. These will be explained in the following sections.

2.1.1 Round-Off Indicators

It is possible to have the entries generated for the area and capacity tables rounded off to the nearest 1, 10, 100, or 1,000 units. To do this values of 0, 1, 2, or 3, respectively, should be assigned to the round-off indicator. Tables cannot present decimal values. Thus a round off to at least the nearest unit is required. There are two of these indicators, one for the area table and another for the capacity table.

2.1.2 The Table Generation Control

The table generation control is used to control two functions. It dictates which tables should be generated; only the area table or only the capacity table, or both. It is also used to indicate the elevation increment to be used in generating the tables. The available increments are 1, 0.1, or 0.01 units. Units are either feet or meters. There are nine possible settings for this control which are shown in table 2-1.

Table 2-1. - Settings for the table generation control

Setting	Tabulations produced	Increment
10	Area & cap.	1 ft or 1 m
11	Area only	1 ft or 1 m
12	Cap. only	1 ft or 1 m
20	Area & cap.	0.1 ft or 0.1 m
21	Area only	0.1 ft or 0.1 m
22	Cap. only	0.1 ft or 0.1 m
30	Area & cap.	0.01 ft or 0.01 m
31	Area only	0.01 ft or 0.01 m
32	Cap. only	0.01 ft or 0.01 m

2.1.3 The Error Limit Value

The error limit value (epsilon) is the allowable error bound for the least squares fit procedure. The bound is employed in the following manner. An attempt is made to fit a function over a certain set of points including original input data points and those interpolated at 0.1-foot (meter) intervals. The interpolation is accomplished using the basic area and

elevation data and the slope of the area elevation line segment. After the coefficients for the function have been determined, the function is evaluated for each point computing an estimated capacity value (V). Each estimated value of V is then compared with the known V value (calculated based on the original area-elevation data) by computing delta V (V est-V known) and then computing the ratio (r) of delta V to V est. If r exceeds epsilon the fit is rejected at this point, but retained at all previous data intervals where the test was satisfied. A new function is identified for the interval where the criteria was exceeded.

2.1.4 Capacity Offset Feature

This feature allows the generation of a capacity table where each value in the table is reduced by a certain amount which corresponds to a specified elevation. For example, an active capacity table can be generated by furnishing the elevation of the base of active storage. The capacities below the base of active storage are computed to be negative but are set equal to zero and marked by the program.

2.1.5 Entering the Data Set

There is some flexibility available when entering the data set interactively. Data items do not need to be entered in ascending order of elevation. They will be automatically sorted into ascending order after they are all entered. Thus, a forgotten entry could be added at any time during the entry process and cause no problem. Areas need not be furnished at equal elevation increments (such as at every 5 or 10 feet) for either interpolation method.

Numbers with fractional parts can be used for both the elevation and the area when using the least squares fitting technique, but not when using the cubic spline fitting procedure.

2.2 Optional Features in this Program

This program has a number of optional features which are simply listed below so that the user will be informed as to what options are available before beginning a run.

1. Units of input and output may be metric or English. The choice of units for output is independent of the units for input. It is suggested, however, that input units be the same as output units.

2. Two curve fitting techniques are available - least squares or cubic spline.

3. Table generation can be specified between any two elevations within the range of data set. Values presented in the table need not cover the range of elevations specified in the data set.

4. The elevation increment for table generation may be specified as 1.0, 0.1, or 0.01 units, with the units being either feet or meters.

5. Both area and capacity tables may be generated, as a set or individually.

6. Once the data set has been entered many different tables may be generated without reentering the data.

2.3 Making a Run

This program is designed to be run in the interactive mode using an interactive terminal. The program may utilize a previously prepared data file or data may be entered during the interactive run. A procedure file, table 2-2, is shown as an example of how the program might be used on the CYBER.

A copy of the procedure file (EACAP85) must be on the user number where the run is to be made. The procedure file and program are presently available only on the "EE" computer.

To make a copy of procedure file EACAP85 permanent on a user number type the following (the user command is underlined):

```
OLD,EACAP85/UN=ER07550
READY
SAVE
READY
```

Table 2-2. - Procedure File EACAP85

```
.PROC, EACAP85.
.*
.* PROCEDURE TO RUN THE 1985 VERSION OF ACAP.
.* EXECUTE COMMAND IS :
.*                        -,EACAP85
.*
REWIND,R,ACAPI.
GET,ACAP85B/UN=ER07550.
ACAP85B,,,,R,ACAPI.
SKIP,A1
EXIT.
ENDIF,A1.
IFE,FILE(ACAPI,LO),A2.
REPLACE,ACAPI.
ENDIF,A2.
BEGIN,SAVER,,R,ACAPR.
ENDIF,A3.
NOTE,OUTPUT,NR./ RUN COMPLETE/
EXIT.
```

GET, SAVER/UN=ER07550.

To initiate a run the user merely types "-,EACAP85" or "BEGIN,EACAP85". Use of this procedure file saves the printed output in a permanent file at the end of the run; rather than automatically disposing it to a printer. If the run was good the user can then have the permanent file printed.

The printed results are initially written to local file R, which through the use of procedure file SAVER is saved as permanent file ACAPR. Procedure file SAVER will try first to save the file as an indirect access file, but if the file is too large (which is often the case) it will be saved as a direct access file automatically. All input to the file is automatically written to file ACAPI and saved at the end of the run.

Several samples of runs at an interactive terminal are shown in appendix C and in table 2-3. In these samples the underlined text was typed by the user.

For those who intend to operate this program using a procedure file other than the one shown in table 2-2, it may be helpful to note that the file ACAP85B contains the binary version of the ACAP85 program.

2.4 Clarification of Various Outputs Printed at the Terminal

Numbered comments below refer to circled numbers on the example run on table 2-3.

1. To start a run you must always type "-,EACAP85" or "BEGIN,EACAP85".

2. Date and time the run is started is furnished automatically and should correspond exactly with the date and time saved in the result file.

3. Enter the units of input and output. It is recommended that they be the same.

4. The options here are to type either a file name or press the carriage return key (CR). If a file name is typed, the file named will be used as

input - otherwise all input will come from the terminal. If a file name is given control skips to item 14.

5. Enter the number of title lines (1 or 2) followed by the title of the table on one or two lines.

6. Lowest elevation to be used for generating tables.

7. Highest elevation to be used for generating tables.

8. Lowest elevation for table generation.

9. This is the capacity which corresponds to the initial elevation.

10. Lowest elevation of input data.

11. Highest elevation of input data.

12. The round-off values can range from 0 to 3 and are used to indicate the number of places to the left of the decimal which will be rounded off.

13. The table generation value controls which tabulations will be produced (area and/or capacity) and the elevation increment to be used (.01, .1, and 1.0 foot).

Setting	Tabulations Produced	Increment
10	Area & cap.	1 ft or 1 m
11	Area only	1 ft or 1 m
12	Cap. only	1 ft or 1 m
20	Area & cap.	0.1 ft or 0.1 m
21	Area only	0.1 ft or 0.1 m
22	Cap. only	0.1 ft or 0.1 m
30	Area & cap.	0.01 ft or 0.01 m
31	Area only	0.01 ft or 0.01 m
32	Cap. only	0.01 ft or 0.01 m

14. The options here are to type either "A" or "B". Option "A", is a segmented least squares fit where a second-degree polynomial is fitted to as many points as permitted by the error term epsilon (furnished as part of the input). To accomplish the task of interpolation, a number of second-degree polynomials will be set up to cover the range of interest. Appendix A describes the least squares method in detail.

Option "B", the cubic spline fit establishes a new third-degree function between each pair of input points. These functions are continuous in the

first and second derivatives; however, this requirement may cause interpolation problems including negative areas and slopes. It is recommended that this method be used with extreme caution. Appendix B gives a more detailed description of the cubic spline method and problems which might be encountered.

15. An error limit value must be entered (but can be zero). This is the allowable error bound for the least squares fit procedure.

16. The elevation-area data are entered in pairs. It is terminated after the last point has been entered by giving a carriage return in response to the computer's request for more data.

17. Elevations shown here (INELEV, FNELEV, FIRST, INDATA, KDATA) are all multiplied by 100 (within the program) and presented as integers. If data is incorrect a file is created called ACAPI that can be edited and resubmitted using the file name option described in item 4.

18. If the data are correct, program execution will begin. You can continue with the same data set or create a new data set to create other tables.

Table 2-3
Sample Run (1 of 3)

```
-,EACAP85  (1)

 THIS PROGRAM GENERATES AREA-CAPACITY TABLES FROM ELEVATION-AREA DATA.

  06/26/85   16.46.08.  (2)

 INPUT MUST BE ENTERED AS:
  ELEVATION=FEET OR METERS
  AREA=ACRES OR HECTARES
  CAPACITY=ACRE FEET OR 1000 CUBIC METERS

 ENTER THE UNITS OF THE INPUT AND OUTPUT  (3)
 TYPE "E" FOR ENGLISH UNITS
 TYPE "M" FOR METRIC UNITS
 ENTER INPUT UNITS
? E

 ENTER OUTPUT UNITS
? E

 INPUT TO THIS PROGRAM MAY COME FROM THE TERMINAL, OR A FILE.
 IF INPUT IS TO BE FROM A FILE GIVE THE NAME OF THE FILE.
 OTHERWISE GIVE A -CR-
? ___  (4)

 ENTER NUMBER OF TITLE LINES.
 NO MORE THAN TWO OR LESS THAN ONE  (5)
? 1

 ENTER A TITLE LINE (MUST BE MORE THAN 10 AND LESS THAN OR
 EQUAL TO 80 CHARACTERS).
? EXAMPLE RESERVOIR

 ENTER THE LOWEST ELEVATION FOR TABLE GENERATION  (6)
? 3202

 ENTER THE HIGHEST ELEVATION FOR TABLE GENERATION  (7)
? 3310

 ENTER THE LOWEST EVEN ELEVATION FOR TABLE GENERATION  (8)
? 3202

 ENTER INITIAL CAPACITY  (9)
? 0

 ENTER THE LOWEST ELEVATION OF THE INPUT DATA  (10)
? 3202

 ENTER THE HIGHEST ELEVATION OF THE INPUT DATA  (11)
? 3310

 ENTER AREA ROUNDOFF AS INTEGER POWER OF 10
 COMMA THEN CAPACITY ROUNDOFF AS INTEGER POWER OF 10  (12)
? 0,0
```

Table 2-3
Sample Run (2 of 3)

```
 ENTER THE VALUE FOR THE TABLE GENERATION CONTROL
 IF YOU NEED HELP GIVE A -CR-
?
 ENTER 10 TO PRINT DATA EVERY 1 FOOT OR METER
 ENTER 20 TO PRINT DATA EVERY 0.1 FOOT OR METER          (13)
 ENTER 30 TO PRINTDATA EVERY 0.01 FOOT OR METER
? 30

 ENTER WHICH PROCEDURE YOU WISH TO USE, "A" OR "B".      (14)
 IF YOU NEED HELP GIVE A -CR-
?
 ENTER "A" FOR LEAST SQUARES FIT
 ENTER "B" FOR CUBIC SPLINE FIT. (NOT GENERALLY RECOMMENDED)
 NOTE: ELEVATIONS IN DATA SET MUST NOT BE FRACTIONS
       WHEN USING THE CUBIC SPLINE FIT PROCEDURE.
? A

 ENTER ERROR LIMIT VALUE (DECIMAL POINT MUST BE INCLUDED)   (15)
 TYPICAL VALUE=.00001
? .00001

 ENTER ELEVATION AREA-DATA                               (16)
 ENTER ELEVATION COMMA THEN AREA
 TERMINATE DATA ENTRY WITH A CARRIAGE RETURN
? 3202,0
? 3210,33
? 3220,165
? 3230,412
? 3240,1227
? 3250,2257
? 3260,5459
? 3270,12208
? 3280,19741
? 3290,28147
? 3300,36745
? 3310,45499
?

 IF YOU WISH TO USE THE CAPACITY OFFSET FEATURE GIVE THE BASE ELEVATION
 IF NOT GIVE A -CR-
 NEED HELP? (TYPE 0)
? 0

 THIS FEATURE ALLOWS ONE TO GENERATE A CAPACITY TABLE WHERE EACH VALUE
 HAS BEEN REDUCED BY A CERTAIN AMOUNT.
 THIS FEATURE COULD BE USED TO GENERATE AN ACTIVE CAPACITY TABLE
 TO DO THIS GIVE THE ELEVATION OF THE BASE OF ACTIVE STORAGE
?

 WANT TO CHECK YOUR INPUT DATA (YES OR NO)              (17)
? YES
```

Table 2-3
Sample Run (3 of 3)

```
 THE INPUT IS LISTED BELOW FOR REVIEW
 INELEV =   320200  FNELEV =   331000  FIRST =   320200  BEGCAP =
 INDATA =   320200  KDATA =   331000  RDAREA =    0
 RDCAPY =    0  JCODE =   10  REP =  0  EPSLON =      .0000100000
 METRICI= 0  METRIC= 0
                                        EXAMPLE RESERVOIR
  NO.    ELEVATION      AREA
    1    3202.00         0.00
    2    3210.00        33.00
    3    3220.00       165.00
    4    3230.00       412.00
    5    3240.00      1227.00
    6    3250.00      2257.00
    7    3260.00      5459.00
    8    3270.00     12208.00
    9    3280.00     19741.00
   10    3290.00     28147.00
   11    3300.00     36745.00
   12    3310.00     45499.00

 IF DATA IS CORRECT TYPE IN YES; OTHERWISE NO
? YES

 DO YOU WANT TO SET UP ANOTHER JOB-TYPE YES OR NO
? YES

 ENTER "NEW" FOR NEW DATA SET. ENTER
 "REPEAT" FOR TABLES WITH PREVIOUSLY ENTERED DATA SET
? REPEAT

  06/26/85    16.44.12.

 ENTER OUTPUT UNITS
? E

 ENTER THE VALUE FOR THE TABLE GENERATION CONTROL
 IF YOU NEED HELP GIVE A -CR-
? 30
 A NEW TABLE WILL BE GENERATED WITH THE OLD DATA SET


 DO YOU WANT TO SET UP ANOTHER JOB-TYPE YES OR NO
? NO
 NORMAL COMPLETION
 RUN COMPLETE


 READY.
```

(18)

2.5 Error Correction Capability

When data are entered at an interactive terminal, a handy error correction capability is available. If an error is made while typing the data do not abort processing, but rather continue until all data are input. Then ask to review the input data. After all of the data have been printed back out it will ask if the data are OK; say, "NO". The program will then automatically build a line file of the input just obtained and save this as a permanent file under the name "ACAPI". It does this in conjunction with the procedure file shown in table 2-2. The errors in this file may then be easily corrected using the EDIT or XEDIT utility on the CYBER. The corrected file may then be used as input on a subsequent run of the ACAP85 program.

The file ACAPI is saved at the end of each run, regardless of whether the run was good or not and regardless of whether the input was interactive or not.

III. JOB ENVIRONMENT AND RESOURCE REQUIREMENTS - ACAP85 PROGRAM

3.1 Job Environment

Herein is described the computer that the program operates on, the operating scheme employed on the computer, and the language used to write the program.

3.1.1 Computer Utilized

This program is presently installed on a Control Data Corporation CYBER 170/730 computer. The CYBER is a large, high-speed mainframe computer with 400,000 (octal) 60-bit words of main memory. An extensive communication network supports over 750 interactive terminals located in over 60 cities.

At present the program is not available in a form compatible with microcomputers. Development of such a version would require an extensive effort and possibly a complete reprogramming. This office is willing to consider such an effort if there is sufficient interest.

3.1.2 Operating System Characteristics

The operating system presently in use on the CYBER is called NOS. This enables the computer to operate as a multitask processor, handling a large number of remote time-share terminals and batch jobs submitted from remote job entry terminals simultaneously. Because of its ability to handle many jobs simultaneously, no single job is able to tie up the full capability of the machine very long. Jobs are continually rotated through the CPU, alternating between short bursts of execution and then back to waiting in line

for another chance at the CPU. As the computer acquires jobs (and thus becomes loaded), the line of jobs waiting becomes longer and longer. Consequently, the time utilized by the computer to process a job varies considerably between the actual time required and the total elapsed time from submission of the job to its completion.

3.1.3 Programming Language

The program is written in FORTRAN 4 Extended conforming to ANSI standard X3.9-1966.

3.2 Run Time Requirements

On a multiprocessing computer, the run time is not as important as it is on a computer which handles only one job at a time. On the one-at-a-time computer, the run time was an important indicator of job cost and turnaround time. On the multiprocessing computer, since the computer resources are shared, turnaround time is no longer closely connected to the run time, and the cost of the job depends upon both the run time and the resources used.

A typical run using ACAP85 is completed in less than 1 minute after all of the data have been obtained and costs are typically minimal (a few dollars). The cost of printing the tables is generally the major item of cost.

3.3 Computer Memory Requirements

This program presently requires slightly less than 60,000 (octal) words of storage.

3.4 Peripheral Device Requirements

This program utilizes five logical file units, all of which are simulated on the disk.

INPUT - used to communicate with the interactive terminal (to read data from the terminal)

OUTPUT - used to communicate with the interactive terminal (to write messages to the terminal)

TAPE5 - for permanent file input

TAPE6 - for printed output (ACAPR)

TAPE7 - for file which saves the input used for the current run (ACAPI)

IV. INPUT - ACAP85 Program

4.1 General

Input to this program may come from one or both of two sources. Input may come entirely from an interactive terminal or the data may be stored as a file. It is recommended that in storing the data, the user utilize the interactive capabilities of the program as shown in table 2-3. In this chapter only the structure of the input file will be discussed.

4.2 Description of the Input File

The input file consists of four line types; a CONTROL line, one or two title lines, a group of ARDATA lines, and an ENDATA line. These are described in more detail in section 4.4.

4.3 Entering Data into the File

Input data for the program ACAP85 consists of both integer and real numbers. They are usually entered with a decimal point. When entering an integer number into a field specified to be integer it must be right justified; that is, the rightmost digit of the number must be in the rightmost position specified for the field. Real numbers may be entered in either of two ways; they may be entered with a decimal point and then the number may be entered without regard to its location within the field (as long as the number is totally within the field) and without regard to the number. If a real number is entered without a decimal point, it must meet two conditions. It must have exactly the number of decimal places specified by

the programmer and the number must be right justified within the field. A blank field is interpreted as a zero entry for both types of numbers.

Interactive capabilities of the program should be used in building an input file.

4.4 Line Format Descriptions

There are four different line formats used as input to this program. They are identified by a word typed in columns 1-6 (the title lines are exception to this rule). This word will be used in the following to identify the format. In the following each of the formats will be discussed in detail.

1. Format for CONTROL line

   Cols. 1-6 - Always typed as "CONTRL".

   Cols. 7-15 - Initial table generation elevation times 100 (integer).

   Cols. 16-24 - Final table generation elevation times 100 (integer).

   Cols. 25-33 - First even foot (or meter) elevation above the starting elevation of the data set times 100 (integer).

   Cols. 34-42 - Capacity of reservoir at the initial elevation of the data set (integer).

   Cols. 43-51 - Initial elevation in the data set times 100 (integer).

   Cols. 52-60 - Final elevation in the data set times 100 (integer).

Cols. 61-64 - Round-off indicator for area values in the generated tables (integer).

Indicator value	Rounded to nearest
0	1
1	10
2	100
3	1,000

Cols. 65-68 - Round-off indicator for capacity values in the generated tables (integer). Indicator values are the same as for the area (above).

Cols. 69-71 - Table generation control. This control is used to indicate the desired elevation increment for table generation and which tables are to be generated. It has nine possible settings which are described in the table below (integer):

Code	Tables	Increment
10	Area & cap.	1 ft or 1 m
11	Area only	1 ft or 1 m
12	Cap. only	1 ft or 1 m
20	Area & cap.	0.1 ft or 0.1 m
21	Area only	0.1 ft or 0.1 m
22	Cap. only	0.1 ft or 0.1 m
30	Area & cap.	0.01 ft or 0.01 m
31	Area only	0.01 ft or 0.01 m
32	Cap. only	0.01 ft or 0.01 m

Cols. 72-77 - Error limit value (see Chapter II for explanation). Typical values range from 0.0001 to 0.00001. Small values like these should generally be used to ensure consistency of the tables with the input data.

Cols. 78-79 - Leave blank (enter nothing in these columns).

Col. 80 - The number of title cards to be used (1 or 2) (integer).

2. Format for title line

Cols. 1-80 - Any desired alphanumeric title (must have at least ten characters) .

3. Format for second title line if needed

Cols. 1-80 - Any desired alphanumeric title.

4. Format for ARDATA lines (all areas and elevations are entered as real or floating point variables)

Cols. 1-6 - Always typed as "ARDATA".

Cols. 7-14 - Elevation

Cols. 15-24 - Area

Cols. 25-80 - Not used.

5. Format for ENDATA line

Cols. 1-6 - Always punched as "ENDATA".

Cols. 7-80 - Not used.

4.5 Sample Input Files

Sample input files are shown in table 4-1

Table 4-1 Sample Input Files

```
FILE  ACAPI1
85/04/10.  10.04.31.

CONTRL    10000    15000    10000        0    10000    15000   0   0 20.00001  01
          TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)
ARDATA  100.00    100.00
ARDATA  110.00    210.00
ARDATA  120.00    300.00
ARDATA  130.00    400.00
ARDATA  140.00    490.00
ARDATA  150.00    600.00
ENDATA

FILE  ACAPI2
85/04/10.  10.05.06.

CONTRL    10000    10500    10000        0    10000    10500   0   0 20.00001  01
                                        TEST PROBLEM FOR CUBIC SPLINE
ARDATA  100.00      0.00
ARDATA  101.00      5.00
ARDATA  102.00     20.00
ARDATA  103.00     25.00
ARDATA  104.00     50.00
ARDATA  105.00     70.00
ENDATA

FILE  ACAPI3
85/04/10.  10.05.33.

CONTRL    10000    15000    10000        0    10000    15000   0   0 20.01000  01
        SAMPLE PROBLEM SHOWING CUBIC SLINE METHOD ON POORLY BEHAVED DATA
ARDATA  100.00      0.00
ARDATA  110.00     50.00
ARDATA  120.00     51.00
ARDATA  130.00    200.00
ARDATA  140.00    350.00
ARDATA  150.00    600.00
ENDATA

FILE  ACAPI4
85/04/10.  10.06.22.

CONTRL    10000    15000    10000        0    10000    15000   0   0 20.00001  02
             TEST PROBLEM TO PRODUCE NEGATIVE AREAS AND NEGATIVE CAPACITIES
                                        (CUBIC SPLINE)
ARDATA  100.00      0.00
ARDATA  110.00      1.00
ARDATA  120.00    100.00
ARDATA  130.00    150.00
ARDATA  140.00    250.00
ARDATA  150.00    500.00
ENDATA
```

V. OUTPUT - ACAP85 PROGRAM

5.1 General

Two types of output are produced by this program. The tables generated during the run are of primary interest, but the program also produces a file of the input. Having this file available makes it possible to quickly recover without retyping the input if an error is made while entering the input interactively. This file may be used as input on subsequent runs.

The date and time the run is started is furnished automatically and should correspond exactly with the date and time saved in the result file.

5.2 Printed Output

There are only two formats of printed output produced by this program: the format for the generated tables and a print of the coefficients for the capacity equations generated during the run (this table is generated only if the least-squares fitting technique is utilized).

Although the format of the generated tables is fairly constant for all types of tables generated there are some variations. Examples of some of these variations and an example of the table of coefficients is shown after the text of this chapter. The examples given are:

Table	Description
5-1	Area Table, 1.0-foot increments
5-2	Capacity Table, 1.0-foot increments
5-3	Capacity Table, 0.1-foot increments
5-4	Capacity Table, 0.01-foot increments
5-5	Area Table, 1.0-meter increments
5-6	Capacity Table 1.0-meter increments
5-7	Equation Table

5.3 The Equation Table

Coefficients are shown for each of the capacity equations generated during the run when the least squares technique is used. The range of elevation a particular equation is to be applied over is from its base elevation to the base elevation of the next equation above.

The capacity equation takes the following form:

$$V=A_1+A_2(y-y_b)+A_3(y-y_b)^2$$

Where: A_1, A_2 and A_3 are coefficients which provide the basis for the interpolation with dimensions 1^3, 1^2 and 1 respectively,

y_b is the elevation corresponding to the bottom of the interval (dimension 1), and

V is the total volume contained below elevation y with dimension 1^3.

The Area relationship is:

$$S=A_2+2A_3(y-y_b)$$

Where S is the surface area at elevation y (dimension l^2).

5.4 Input File Created

One of the functions this program performs is to write most of the input back out to another file (ACAPI) suitable for reuse at a later time. This is the recommended method for creating input to the program.

EXAMPLE RESERVOIR

(ACAP85) COMPUTED
05/01/85
15.48.46.

AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE FOOT

ELEV. FEET	0	1	2	3	4	5	6	7	8	9
3200			0	4	8	12	16	21	25	29
3210	33	46	59	73	86	99	112	125	139	152
3220	165	190	214	239	264	288	313	338	363	387
3230	412	493	575	656	738	819	901	983	1064	1146
3240	1227	1330	1433	1536	1639	1742	1845	1948	2051	2154
3250	2257	2577	2897	3218	3538	3858	4178	4498	4819	5139
3260	5459	6134	6809	7484	8159	8833	9508	10183	10858	11533
3270	12208	12961	13715	14468	15221	15974	16728	17481	18234	18988
3280	19741	20582	21422	22263	23103	23944	24785	25625	26466	27306
3290	28147	29007	29867	30726	31586	32446	33306	34166	35025	35885
3300	36745	37620	38496	39371	40247	41122	41997	42873	43748	44624
3310	45499									

Table 5-1
Area Table, 1.0 foot inc.

EXAMPLE RESERVOIR

(ACAP85) COMPUTED
05/01/85
15.48.46.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE FOOT

ELEV. FEET	0	1	2	3	4	5	6	7	8	9
3200			0	2	8	19	33	52	74	101
3210	132	172	224	290	370	462	568	686	818	964
3220	1122	1299	1501	1728	1980	2256	2557	2882	3232	3607
3230	4007	4460	4994	5610	6307	7086	7946	8888	9911	11016
3240	12202	13480	14862	16346	17934	19624	21418	23314	25314	27416
3250	29622	32039	34776	37834	41212	44909	48928	53266	57924	62903
3260	68202	73998	80470	87616	95437	103933	113104	122950	133471	144666
3270	156537	169122	182460	196551	211395	226993	243344	260449	278307	296918
3280	316282	336443	357445	379288	401971	425494	449859	475064	501109	527995
3290	555722	584299	613736	644032	675188	707204	740080	773816	808412	843867
3300	880182	917365	955423	994356	1034165	1074849	1116409	1158844	1202155	1246341
3310	1291402									

Table 5-2
Capacity Table, 1.0 foot inc.

EXAMPLE RESERVOIR

(ACAP85) COMPUTED
05/09/85
13.41.27.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
3202	0	0	0	0	0	1	1	1	1	2
3203	2	2	3	3	4	5	5	6	7	7
3204	8	9	10	11	12	13	14	15	16	17
3205	19	20	21	22	24	25	27	28	30	31
3206	33	35	36	38	40	42	44	46	48	50
3207	52	54	56	58	60	62	65	67	69	72
3208	74	77	79	82	84	87	90	93	95	98
3209	101	104	107	110	113	116	119	122	125	129
3210	132	135	139	142	146	150	154	158	163	167
3211	172	176	181	186	191	196	202	207	213	219
3212	224	230	237	243	249	256	262	269	276	283
3213	290	298	305	313	320	328	336	344	353	361
3214	370	378	387	396	405	414	423	433	442	452
3215	462	472	482	492	503	513	524	535	545	556
3216	568	579	590	602	614	625	637	649	662	674
3217	686	699	712	725	738	751	764	777	791	805
3218	818	832	846	861	875	889	904	919	934	948
3219	964	979	994	1010	1025	1041	1057	1073	1089	1106
3220	1122	1139	1155	1173	1190	1208	1225	1244	1262	1281
3221	1299	1318	1338	1357	1377	1397	1418	1438	1459	1480
3222	1501	1523	1545	1567	1589	1612	1634	1658	1681	1704
3223	1728	1752	1776	1801	1826	1851	1876	1902	1927	1953
3224	1980	2006	2033	2060	2087	2115	2142	2170	2199	2227
3225	2256	2285	2314	2343	2373	2403	2433	2464	2494	2525
3226	2557	2588	2620	2652	2684	2716	2749	2782	2815	2848
3227	2882	2916	2950	2985	3019	3054	3089	3125	3160	3196
3228	3232	3269	3305	3342	3379	3417	3454	3492	3530	3569
3229	3607	3646	3685	3725	3764	3804	3844	3885	3925	3966
3230	4007	4049	4091	4134	4178	4223	4269	4315	4363	4411
3231	4460	4510	4560	4611	4664	4717	4771	4825	4881	4937
3232	4994	5052	5111	5170	5231	5292	5354	5416	5480	5545
3233	5610	5676	5743	5810	5879	5948	6018	6089	6161	6234
3234	6307	6381	6456	6532	6609	6686	6764	6844	6923	7004
3235	7086	7168	7251	7335	7420	7506	7592	7679	7767	7856
3236	7946	8037	8128	8220	8313	8407	8501	8597	8693	8790
3237	8888	8986	9086	9186	9287	9389	9492	9595	9700	9805
3238	9911	10018	10125	10234	10343	10453	10564	10676	10788	10902
3239	11016	11131	11246	11363	11480	11599	11718	11838	11958	12080

Table 5-3
Capacity Table, 0.1 foot inc.

EXAMPLE RESERVOIR

(ACAP85) COMPUTED
05/08/85
10.46.17.

CAPACITY TABLE IN ACRE FEET , ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
3202.0	0	0	0	0	0	0	0	0	0	0
3202.1	0	0	0	0	0	0	0	0	0	0
3202.2	0	0	0	0	0	0	0	0	0	0
3202.3	0	0	0	0	0	0	0	0	0	0
3202.4	0	0	0	0	0	0	0	0	0	0
3202.5	1	1	1	1	1	1	1	1	1	1
3202.6	1	1	1	1	1	1	1	1	1	1
3202.7	1	1	1	1	1	1	1	1	1	1
3202.8	1	1	1	1	1	1	2	2	2	2
3202.9	2	2	2	2	2	2	2	2	2	2
3203.0	2	2	2	2	2	2	2	2	2	2
3203.1	2	3	3	3	3	3	3	3	3	3
3203.2	3	3	3	3	3	3	3	3	3	3
3203.3	3	4	4	4	4	4	4	4	4	4
3203.4	4	4	4	4	4	4	4	4	5	5
3203.5	5	5	5	5	5	5	5	5	5	5
3203.6	5	5	5	5	6	6	6	6	6	6
3203.7	6	6	6	6	6	6	6	6	7	7
3203.8	7	7	7	7	7	7	7	7	7	7
3203.9	7	8	8	8	8	8	8	8	8	8
3204.0	8	8	8	8	9	9	9	9	9	9
3204.1	9	9	9	9	9	10	10	10	10	10
3204.2	10	10	10	10	10	10	11	11	11	11
3204.3	11	11	11	11	11	11	11	12	12	12
3204.4	12	12	12	12	12	12	12	13	13	13
3204.5	13	13	13	13	13	13	14	14	14	14
3204.6	14	14	14	14	14	14	15	15	15	15
3204.7	15	15	15	15	15	16	16	16	16	16
3204.8	16	16	16	17	17	17	17	17	17	17
3204.9	17	17	18	18	18	18	18	18	18	18
3205.0	19	19	19	19	19	19	19	19	20	20
3205.1	20	20	20	20	20	20	21	21	21	21
3205.2	21	21	21	22	22	22	22	22	22	22
3205.3	22	23	23	23	23	23	23	23	24	24
3205.4	24	24	24	24	24	25	25	25	25	25
3205.5	25	25	26	26	26	26	26	26	26	27
3205.6	27	27	27	27	27	27	28	28	28	28
3205.7	28	28	29	29	29	29	29	29	29	30
3205.8	30	30	30	30	30	31	31	31	31	31
3205.9	31	32	32	32	32	32	32	33	33	33

Table 5-4
Capacity Table, 0.01 foot inc

EXAMPLE RESERVOIR

(ACAP85) COMPUTED
05/08/85
10.51.47.

AREA TABLE IN HECTARES — ELEVATION INCREMENT IS ONE METER

ELEV. METERS	0	1	2	3	4	5	6	7	8	9
970								6	11	24
980	41	59	85	117	150	220	329	437	558	695
990	831	1083	1509	1934	2525	3421	4317	5244	6245	7245
1000	8275	9391	10507	11628	12770	13911	15056	16218	17381	

Table 5-5
Area Table, 1.0 meter inc.

EXAMPLE RESERVOIR

(ACAP85) COMPUTED
05/08/85
10.51.47.

CAPACITY TABLE IN THOUSANDS OF CU.METERS ELEVATION INCREMENT IS ONE METER

ELEV. METERS	0	1	2	3	4	5	6	7	8	9
970								29	113	273
980	598	1098	1796	2806	4144	5903	8648	12475	17413	23675
990	31304	40532	53492	70703	92457	122184	160870	208566	266011	333458
1000	410945	499271	598758	709412	831400	964805	1109628	1266000	1433996	

Table 5-6
Capacity Table, 1.0 meter inc.

EXAMPLE RESERVOIR

EQUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	3202.00	0	.0000	-.0000	2.0625
2	3210.00	132	132.0000	33.0000	6.6000
3	3220.00	1121	1122.0000	165.0000	12.3500
4	3230.00	4006	4007.0000	412.0000	40.7500
5	3240.00	12201	12202.0000	1227.0000	51.5000
6	3250.00	29621	29622.0000	2257.0000	160.1000
7	3260.00	68201	68202.0000	5459.0000	337.4500
8	3270.00	156536	156537.0000	12208.0000	376.6500
9	3280.00	316281	316282.0000	19741.0000	420.3000
10	3290.00	555721	555721.9999	28147.0000	429.9000
11	3300.00	880181	880181.9999	36745.0000	437.7000

Table 5-7
Equation Table

Appendix A

Discussion of the Least Squares Fitting Procedure

A.1 General Information

The least squares fitting option in program ACAP85 predicts the Volume V at a given elevation (y) using an equation of the form:

$$V = A_1 + A_2(y-y_b) + A_3 (y-y_b)^2 \qquad (1)$$

to compute capacities over an appropriate elevation interval. In equation (1):

A_1, A_2 and A_3 are coefficients which provide the basis for the interpolation with dimensions 1^3, 1^2 and 1 respectively,

y_b is the elevation corresponding to the bottom of the interval dimension 1, and

V is the total volume contained below elevation y with (dimension 1^3).

The corresponding equation for area is obtained by differentiating with respect to y:

$$S = A_2 + 2A_3 (y-y_b) \qquad (2)$$

where S is the surface area at elevation y (dimensions 1^2)

Units for the above equations are feet, acres and acre-feet in the English system, but metric units (meters, hectares and thousand cubic meters) can also be used.

The program allows for use of more than two pairs of data points in an interval through the use of a large "epsilon" term - the allowable difference between capacities given by equation (1) and those computed from actual input data. Such large epsilon values are not recommended however, as they produce tables which do not fit the input data exactly. Section A.3 illustrates such a situation. Use of an epsilon term in the area of .0001 or smaller will generally insure that the derived tables will use unique equations between each pair of data points and, as a result, the tables will fit all data points exactly.

The estimation of the least squares coefficients is accomplished in ACAP85 through a series of matrix operations. The theory underlying this procedure is explained in the following section.

A.2 Description of Estimation Procedure

The coefficients A_1, A_2 and A_3 for equation (1) are estimated using the values which are interpolated between the data points provided by the user, areas and capacities are interpolated at 0.1 foot (or 0.1 meter) increments using the elevations, areas and slopes of the area-elevation line segment for each data interval. Thus the capacities are interpolated using a second order polynomial. An incremental elevation - the vertical distance from the interpolated elevation to the elevation of the lower data point - is computed. This value, represented in the program by the variable "X", along with the interpolated capacities "TEMP1", are used in deriving the data for the least squares analysis. Summations of X, X^2, X^3, and X^4 are used in conjunction with the summation of interpolated capacities (TEMP1) and the

summations of the products (X)(TEMP1) and (X^2)(TEMP1) are used to estimate the coefficients A_1, A_2 and A_3. This process involves complex matrix manipulation which will not be described in detail here. A good discussion of the use of the method of least squares in polynomial regression is contained in Wylie (1966) and the program's methodology parallels Wylie's discussion.

Once the least squares estimates of A_1, A_2, and A_3 are completed, capacities are estimated (V_E) using equation (1) and compared to the interpolated capacities (V_I) at all incremental elevations over the entire data set. If the error defined as:

$$\frac{V_E - V_I}{V_I}$$

exceeds the specified tolerance (the error limit value), then the last data interval is dropped and the least squares analysis repeated for the remaining data intervals. Through the repetition of this process suitable coefficients are developed for all data intervals and, used in generation of the tables. The following example will illustrate this process and some of the dangers associated with using a large ε term.

A.3 Samples of Least Squares Analysis

The following tables show basic input data and results of a least squares analysis of the same data set using both a large (.05) and small (0.00001) epsilon term. Table A-1 shows a typical input file and table A-2 shows the equation and area-elevation table derived for a large epsilon value (0.05).

Only two equations were used in deriving the tables and, as a result, the tables do not fit the input data very well. A related problem which results from the second equation not fitting the data at elevation 110) is shown by the constant area-elevation relationship extending from elevation 110.0 ft through 110.4 ft. This problem is shown graphically in figure A-1 the same figure also shows the fit provided by the smaller ε term (0.00001) which fits every data point. It should be noted that the minor perturbations in the figure are due to round-off effects. The complete area-elevation tabulation derived using this ε term is given in table A-3 and table A-4 compares the generated area and capacity values at various points.

Table A-1
Hypothetical Input Data for
Sample Problems - Least Squares Fit

```
                 LISTING OF FILE   ACAPI       85/06/05.  08.35.54.          PAGE    1

CONTRL     10000     15000     10000          0     10000     15000   0    0 20.00001  0
                TEST PROBLEM SHOWING A TYPICAL DATA SET
ARDATA  100.00     100.00
ARDATA  110.00     210.00
ARDATA  120.00     300.00
ARDATA  130.00     400.00
ARDATA  140.00     490.00
ARDATA  150.00     600.00
ENDATA
```

Table A-2
Area-Elevation Table
(Using Large ε Term)
for Hypothetical Data

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

EQUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	100.00	0	-.0000	100.0000	5.5000
2	110.00	1550	1560.1322	205.8136	4.8021

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
03/29/85
16.09.54.

AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
100	100	101	102	103	104	106	107	108	109	110
101	111	112	113	114	115	117	118	119	120	121
102	122	123	124	125	126	128	129	130	131	132
103	133	134	135	136	137	139	140	141	142	143
104	144	145	146	147	148	150	151	152	153	154
105	155	156	157	158	159	160	162	163	164	165
106	166	167	168	169	170	171	173	174	175	176
107	177	178	179	180	181	182	184	185	186	187
108	188	189	190	191	192	193	195	196	197	198
109	199	200	201	202	203	204	206	207	208	209
110	210	210	210	210	210	211	212	213	213	214
111	215	216	217	218	219	220	221	222	223	224
112	225	226	227	228	229	230	231	232	233	234
113	235	236	237	238	238	239	240	241	242	243
114	244	245	246	247	248	249	250	251	252	253
115	254	255	256	257	258	259	260	261	262	262
116	263	264	265	266	267	268	269	270	271	272
117	273	274	275	276	277	278	279	280	281	282
118	283	284	285	286	286	287	288	289	290	291
119	292	293	294	295	296	297	298	299	300	301
120	302	303	304	305	306	307	308	309	310	310
121	311	312	313	314	315	316	317	318	319	320
122	321	322	323	324	325	326	327	328	329	330
123	331	332	333	334	335	335	336	337	338	339
124	340	341	342	343	344	345	346	347	348	349
125	350	351	352	353	354	355	356	357	358	359
126	359	360	361	362	363	364	365	366	367	368
127	369	370	371	372	373	374	375	376	377	378
128	379	380	381	382	383	383	384	385	386	387
129	388	389	390	391	392	393	394	395	396	397
130	398	399	400	401	402	403	404	405	406	407
131	408	408	409	410	411	412	413	414	415	416
132	417	418	419	420	421	422	423	424	425	426
133	427	428	429	430	431	432	432	433	434	435
134	436	437	438	439	440	441	442	443	444	445
135	446	447	448	449	450	451	452	453	454	455
136	456	456	457	458	459	460	461	462	463	464
137	465	466	467	468	469	470	471	472	473	474
138	475	476	477	478	479	480	480	481	482	483
139	484	485	486	487	488	489	490	491	492	493

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
03/29/85
16.09.54.

AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
140	494	495	496	497	498	499	500	501	502	503
141	504	505	505	506	507	508	509	510	511	512
142	513	514	515	516	517	518	519	520	521	522
143	523	524	525	526	527	528	529	529	530	531
144	532	533	534	535	536	537	538	539	540	541
145	542	543	544	545	546	547	548	549	550	551
146	552	553	553	554	555	556	557	558	559	560
147	561	562	563	564	565	566	567	568	569	570
148	571	572	573	574	575	576	577	577	578	579
149	580	581	582	583	584	585	586	587	588	589
150	590									

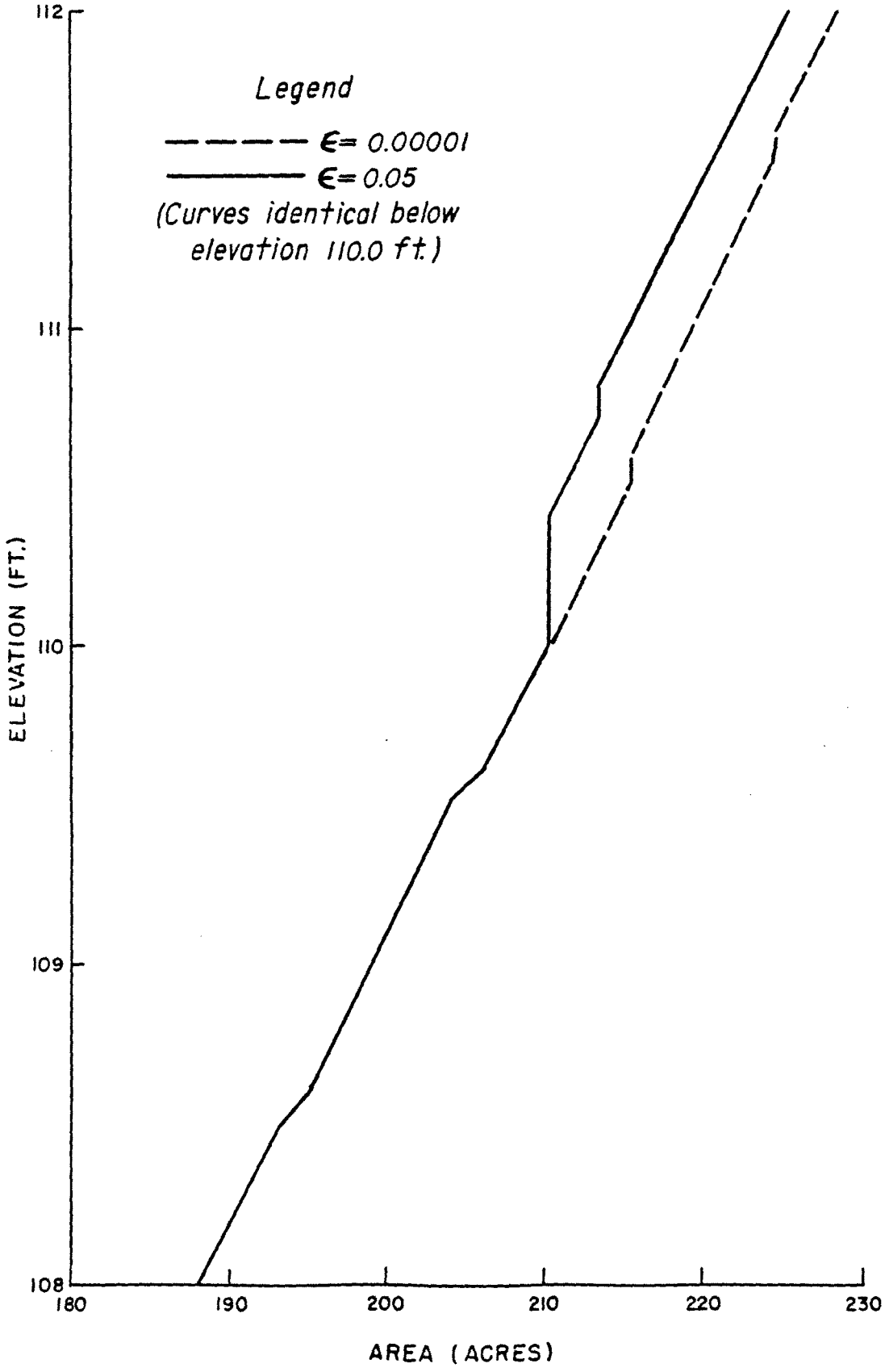

FIGURE A-1 Comparison of low and high epsilon least squares fits for hypothetical data sets.

Table A-3
Area-Elevation Table
(Using Small ε Term)
for Hypothetical Data

TEST PROBLEM SHOWING THE EFFECTS OF A SMALL EPSILON VALUE (.00001)

EQUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	100.00	0	-.0000	100.0000	5.5000
2	110.00	1550	1550.0000	210.0000	4.5000
3	120.00	4099	4100.0000	300.0000	5.0000
4	130.00	7599	7600.0000	400.0000	4.5000
5	140.00	12049	12050.0000	490.0000	5.5000

TEST PROBLEM SHOWING THE EFFECTS OF A SMALL EPSILON VALUE (.00001)

(ACAP85) COMPUTED
03/29/85
16.15.43.

AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
100	100	101	102	103	104	106	107	108	109	110
101	111	112	113	114	115	117	118	119	120	121
102	122	123	124	125	126	128	129	130	131	132
103	133	134	135	136	137	139	140	141	142	143
104	144	145	146	147	148	150	151	152	153	154
105	155	156	157	158	159	160	162	163	164	165
106	166	167	168	169	170	171	173	174	175	176
107	177	178	179	180	181	182	184	185	186	187
108	188	189	190	191	192	193	195	196	197	198
109	199	200	201	202	203	204	206	207	208	209
110	210	211	212	213	214	215	215	216	217	218
111	219	220	221	222	223	224	224	225	226	227
112	228	229	230	231	232	233	233	234	235	236
113	237	238	239	240	241	242	242	243	244	245
114	246	247	248	249	250	251	251	252	253	254
115	255	256	257	258	259	260	260	261	262	263
116	264	265	266	267	268	269	269	270	271	272
117	273	274	275	276	277	278	278	279	280	281
118	282	283	284	285	286	287	287	288	289	290
119	291	292	293	294	295	296	296	297	298	299
120	300	301	302	303	304	305	306	307	308	309
121	310	311	312	313	314	315	316	317	318	319
122	320	321	322	323	324	325	326	327	328	329
123	330	331	332	333	334	335	336	337	338	339
124	340	341	342	343	344	345	346	347	348	349
125	350	351	352	353	354	355	356	357	358	359
126	360	361	362	363	364	365	366	367	368	369
127	370	371	372	373	374	375	376	377	378	379
128	380	381	382	383	384	385	386	387	388	389
129	390	391	392	393	394	395	396	397	398	399
130	400	401	402	403	404	404	405	406	407	408
131	409	410	411	412	413	413	414	415	416	417
132	418	419	420	421	422	422	423	424	425	426
133	427	428	429	430	431	432	432	433	434	435
134	436	437	438	439	440	441	441	442	443	444
135	445	446	447	448	449	450	450	451	452	453
136	454	455	456	457	458	459	459	460	461	462
137	463	464	465	466	467	468	468	469	470	471
138	472	473	474	475	476	477	477	478	479	480
139	481	482	483	484	485	486	486	487	488	489

TEST PROBLEM SHOWING THE EFFECTS OF A SMALL EPSILON VALUE (.00001)

(ACAP85) COMPUTED
03/29/85
16.15.43.

AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
140	490	491	492	493	494	495	497	498	499	500
141	501	502	503	504	505	506	508	509	510	511
142	512	513	514	515	516	517	519	520	521	522
143	523	524	525	526	527	528	530	531	532	533
144	534	535	536	537	538	540	541	542	543	544
145	545	546	547	548	549	551	552	553	554	555
146	556	557	558	559	560	562	563	564	565	566
147	567	568	569	570	571	573	574	575	576	577
148	578	579	580	581	582	584	585	586	587	588
149	589	590	591	592	593	595	596	597	598	599
150	600									

As can be seen from table A-4, some significant differences exist between the approach which fits the data points exactly (ε = 0.00001) and the approach which doesn't (ε = 0.05).

Table A-4 - Comparison of
Area and Capacity Estimates for
Differing Values

	Area (acres)		Capacity (acre-feet)	
Elevation (ft)	ε=0.00001	ε=0.05	ε=0.00001	ε=0.05
100	100	100	0	0
110	210	210	1550	1550
120	300	302	4100	4098
130	400	398	7600	7597
140	490	494	12050	12056
150	600	590	17500	17476

Appendix B

Discussion of the Cubic Spline Fitting Procedure

B.1 General

Although the cubic spline is not generally recommended, a brief description will be provided here for information purposes.

The method offers the advantage of fitting all data points with a smooth slope (continuous in the first derivative) this property can also cause severe aberrations in "poorly behaved" data sets.

The method fits area equations of the general form:

$$S_i = S_b + (Y_i - Y_b)\, S_b' + (1/6)\,(Y_i - Y_b)(Y_i - Y_t)(2S_b'' + S''_t + (Y_i - Y_b)\, S_b''') \quad (1)$$

Where S_i and Y_i are the area and elevation at the point of interest,

S_b and Y_b are the area and elevation at the bottom of the corresponding data interval,

S_t and Y_t are the area and elevation at the top of the corresponding data interval, and

S', S" and S"' are the first, second and third derivatives of the area-elevation relationship at indicated points in the corresponding data interval. These derivatives are adjusted to assure continuity as described above.

This fitting process is performed at a large number of reference points (at unit intervals). These reference values are subsequently used for linear interpolation of the final values for the table.

A similar fitting procedure is used for computing volumes based on the areas computed at the reference points. Although derivation of the equation

involves complex mathematical procedures beyond the scope of this discussion, the equation follows the form:

$$V_{i+1} = V_i + \tfrac{1}{2}(Y_{i+1}-Y_i)(S_{i+1}+S_i)$$
$$-(.0425)(Y_{i+1}-Y_i)^3[(S_b"+(Y_i-Y_b)S_b"')+(S_b"+(Y_{i+1}-Y_b)S_b"')] \quad (2)$$

Where V_i is the volume at reference point i and

V_{i+1} is the volume at reference point $i+1$.

Base volumes for the bottom of the reservoir are provided by use of the capacity offset feature or taken to be zero if the feature is not used. It should also be noted that the b subscript refers to the base data point in the interval corresponding to a given reference point. Thus the Y_b volume for point i+1 could be different from the Y_b value for point i.

An example of the potential problems associated with the use of the cubic spline method is shown below. Table B-1 shows the input data file used in generating the table and table B-2 shows the results. These show a typical problem associated with applying the cubic spline method to a "poorly behaved" data set (one with a great deal of scatter). Areas between elevations 120 feet and 127 feet, as shown in table B-2 decrease with elevation even though the area elevation data given in table B-1 increases slightly.

Table B-1
Hypothetical Input Data for
Sample Problems - Cubic Spline Fit

```
                LISTING OF FILE   ACAPI       85/04/02.  10.26.56.         PAGE   1

CONTRL     10000     15000     10000          0     10000     15000    0    0 20.00001  0
      TEST PROBLEM SHOWING CUBIC SPLINE METHOD ON A POORLY BEHAVED DATA SET
ARDATA  100.00       0.00
ARDATA  110.00      50.00
ARDATA  120.00     100.00
ARDATA  130.00     101.00
ARDATA  140.00     200.00
ARDATA  150.00     300.00
ENDATA
```

TEST PROBLEM SHOWING CUBIC SPLINE METHOD ON A POORLY BEHAVED DATA SET

(ACAP85) COMPUTED
04/02/85
10.12.14.

AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
100	0	0	1	1	2	2	3	3	4	4
101	4	5	5	6	6	7	7	8	8	9
102	9	9	10	10	11	11	12	12	13	13
103	14	14	14	15	15	16	16	17	17	18
104	18	19	19	20	20	21	21	22	22	23
105	23	23	24	24	25	25	26	26	27	27
106	28	28	29	29	30	31	31	32	32	33
107	33	34	34	35	35	36	36	37	37	38
108	38	39	40	40	41	41	42	42	43	44
109	44	45	45	46	46	47	48	48	49	49
110	50	51	51	52	52	53	54	54	55	56
111	56	57	57	58	59	59	60	61	61	62
112	63	63	64	64	65	66	66	67	68	68
113	69	70	70	71	71	72	73	73	74	75
114	75	76	76	77	78	78	79	79	80	80
115	81	82	82	83	83	84	84	85	85	86
116	86	87	87	88	88	89	89	90	90	91
117	91	92	92	92	93	93	94	94	94	95
118	95	95	96	96	96	97	97	97	98	98
119	98	98	99	99	99	99	99	99	100	100
120	100	100	100	100	100	100	100	100	101	101
121	101	101	101	101	101	100	100	100	100	100
122	100	100	100	100	100	100	100	100	100	99
123	99	99	99	99	99	99	99	98	98	98
124	98	98	98	98	97	97	97	97	97	97
125	97	97	96	96	96	96	96	96	96	96
126	96	96	96	96	95	95	95	95	95	95
127	95	95	95	95	95	96	96	96	96	96
128	96	96	96	96	97	97	97	97	97	97
129	98	98	98	99	99	99	100	100	100	101
130	101	102	102	103	103	104	104	105	105	106
131	106	107	108	108	109	110	110	111	112	112
132	113	114	115	116	116	117	118	119	120	121
133	121	122	123	124	125	126	127	128	129	130
134	131	132	133	134	135	136	137	138	139	140
135	141	143	144	145	146	147	148	149	150	152
136	153	154	155	156	157	159	160	161	162	163
137	164	166	167	168	169	170	172	173	174	175
138	176	178	179	180	181	182	183	185	186	187
139	188	189	191	192	193	194	195	196	198	199

Table B-2
Area-Elevation Table Generated
Using Cubic Spline Method and
Hypothetical Data

TEST PROBLEM SHOWING CUBIC SPLINE METHOD ON A POORLY BEHAVED DATA SET

(ACAP85) COMPUTED
04/02/85
10.12.14.

AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
140	200	201	202	203	205	206	207	208	209	210
141	211	212	213	215	216	217	218	219	220	221
142	222	223	224	225	226	227	229	230	231	232
143	233	234	235	236	237	238	239	240	241	242
144	243	244	245	246	247	248	249	250	251	252
145	253	254	255	256	257	258	259	260	261	262
146	263	264	264	265	266	267	268	269	270	271
147	272	273	274	275	276	277	278	279	280	281
148	281	282	283	284	285	286	287	288	289	290
149	291	292	293	294	294	295	296	297	298	299
150	300									

TEST PROBLEM SHOWING CUBIC SPLINE METHOD ON A POORLY BEHAVED DATA SET

(ACAP85) COMPUTED
04/02/85
10.12.14.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
100	0	0	0	1	1	1	1	2	2	2
101	2	3	4	4	5	6	6	7	8	8
102	9	10	11	12	13	15	16	17	18	19
103	20	22	23	25	27	28	30	31	33	34
104	36	38	40	42	44	46	48	50	52	55
105	57	59	62	64	67	69	72	74	77	80
106	82	85	88	91	94	97	100	103	106	109
107	113	116	120	123	127	130	134	138	141	145
108	148	152	157	161	165	169	173	177	181	185
109	190	194	199	204	208	213	218	222	227	232
110	237	242	247	252	258	263	268	274	279	284
111	290	296	301	307	313	319	325	331	337	343
112	349	356	362	369	375	382	388	395	402	408
113	415	422	429	436	444	451	458	465	472	480
114	487	495	503	510	518	526	534	542	549	557
115	565	573	582	590	599	607	615	624	632	640
116	649	658	667	676	684	693	702	711	720	729
117	738	747	756	766	775	784	794	803	812	822
118	831	841	850	860	870	879	889	899	908	918
119	928	938	948	958	967	977	987	997	1007	1017
120	1027	1037	1047	1057	1067	1077	1087	1097	1107	1117
121	1127	1137	1147	1158	1168	1178	1188	1198	1208	1218
122	1228	1238	1248	1258	1268	1278	1288	1298	1308	1318
123	1328	1338	1347	1357	1367	1377	1387	1397	1407	1417
124	1426	1436	1446	1456	1465	1475	1485	1494	1504	1514
125	1524	1533	1543	1553	1562	1572	1581	1591	1601	1610
126	1620	1629	1639	1648	1658	1667	1677	1687	1696	1706
127	1715	1725	1734	1744	1753	1763	1772	1782	1791	1801
128	1811	1820	1830	1840	1849	1859	1868	1878	1888	1897
129	1907	1917	1927	1937	1947	1957	1967	1977	1986	1996
130	2006	2017	2027	2037	2048	2058	2068	2079	2089	2099
131	2110	2121	2132	2143	2154	2165	2175	2186	2197	2208
132	2219	2231	2243	2254	2266	2278	2290	2301	2313	2325
133	2336	2349	2362	2374	2387	2400	2412	2425	2437	2450
134	2463	2476	2490	2503	2517	2531	2544	2558	2571	2585
135	2599	2613	2628	2643	2658	2672	2687	2702	2716	2731
136	2746	2762	2777	2793	2809	2825	2841	2857	2873	2888
137	2904	2921	2938	2955	2972	2989	3006	3023	3040	3058
138	3075	3093	3111	3129	3147	3166	3184	3202	3220	3239
139	3257	3276	3296	3315	3335	3354	3373	3393	3412	3432

Table B-3
Capacity-Elevation Table Generated
Using Cubic Spline Method and
Hypothetical Data

TEST PROBLEM SHOWING CUBIC SPLINE METHOD ON A POORLY BEHAVED DATA SET

(ACAP85) COMPUTED
04/02/85
10.12.14.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
140	3451	3472	3492	3513	3533	3554	3574	3595	3616	3636
141	3657	3678	3700	3722	3743	3765	3787	3808	3830	3852
142	3874	3896	3919	3942	3965	3987	4010	4033	4056	4078
143	4101	4125	4149	4172	4196	4220	4244	4268	4291	4315
144	4339	4364	4388	4413	4438	4463	4488	4512	4537	4562
145	4587	4613	4638	4664	4690	4716	4741	4767	4793	4819
146	4845	4871	4898	4925	4952	4978	5005	5032	5058	5085
147	5112	5140	5167	5195	5223	5250	5278	5306	5333	5361
148	5389	5417	5446	5475	5503	5532	5560	5589	5618	5646
149	5675	5704	5734	5763	5793	5823	5852	5882	5911	5941
150	5970									

Appendix C - Sample Runs

Appendix C - Sample Runs

C.1 General

Four samples of sessions using this program at an interactive terminal are shown.

Sample A - All data entered at an interactive terminal

Sample B - Data entered from a file

Sample C - Using the repeat option

Sample D - Data entered to get different message responses

Samples of output for different values:

Sample E - Test problem showing the effects of a large epsilon value (0.050)

Sample F - Area tables in 1/10-foot increments

Sample G - Capacity tables in 1/10-foot increments

Sample H - Area tables in 1/100-foot increments

Sample I - Capacity tables in 1/100-foot increments

Sample Run A (1 of 3)
All Data Entered at an Interactive Terminal

```
-,EACAP85
 THIS PROGRAM GENERATES AREA-CAPACITY TABLES FROM ELEVATION-AREA DATA.

  06/26/85   16.39.45.

 INPUT MUST BE ENTERED AS:
  ELEVATION=FEET OR METERS
  AREA=ACRES OR HECTARES
  CAPACITY=ACRE FEET OR 1000 CUBIC METERS

 ENTER THE UNITS OF THE INPUT AND OUTPUT
 TYPE "E" FOR ENGLISH UNITS
 TYPE "M" FOR METRIC UNITS
 ENTER INPUT UNITS
? E

 ENTER OUTPUT UNITS
? E

 INPUT TO THIS PROGRAM MAY COME FROM THE TERMINAL, OR A FILE.
 IF INPUT IS TO BE FROM A FILE GIVE THE NAME OF THE FILE.
 OTHERWISE GIVE A -CR-
? _

 ENTER NUMBER OF TITLE LINES.
 NO MORE THAN TWO OR LESS THAN ONE
? 1

 ENTER A TITLE LINE (MUST BE MORE THAN 10 AND LESS THAN OR
 EQUAL TO 80 CHARACTERS).
? EXAMPLE RESERVOIR

 ENTER THE LOWEST ELEVATION FOR TABLE GENERATION
? 3202

 ENTER THE HIGHEST ELEVATION FOR TABLE GENERATION
? 3310

 ENTER THE LOWEST EVEN ELEVATION FOR TABLE GENERATION
? 3202

 ENTER INITIAL CAPACITY
? 0

 ENTER THE LOWEST ELEVATION OF THE INPUT DATA
? 3202

 ENTER THE HIGHEST ELEVATION OF THE INPUT DATA
? 3310

 ENTER AREA ROUNDOFF AS INTEGER POWER OF 10
 COMMA THEN CAPACITY ROUNDOFF AS INTEGER POWER OF 10
? 0,0
```

```
 ENTER THE VALUE FOR THE TABLE GENERATION CONTROL
 IF YOU NEED HELP GIVE A -CR-
?
 ENTER 10 TO PRINT DATA EVERY 1 FOOT OR METER
 ENTER 20 TO PRINT DATA EVERY 0.1 FOOT OR METER
 ENTER 30 TO PRINTDATA EVERY 0.01 FOOT OR METER
? 10

 ENTER WHICH PROCEDURE YOU WISH TO USE, "A" OR "B".
 IF YOU NEED HELP GIVE A -CR-
?
 ENTER "A" FOR LEAST SQUARES FIT
 ENTER "B" FOR CUBIC SPLINE FIT. (NOT GENERALLY RECOMMENDED)
 NOTE: ELEVATIONS IN DATA SET MUST NOT BE FRACTIONS
       WHEN USING THE CUBIC SPLINE FIT PROCEDURE.
? A

 ENTER ERROR LIMIT VALUE (DECIMAL POINT MUST BE INCLUDED)
 TYPICAL VALUE=.00001
? .00001

 ENTER ELEVATION AREA-DATA
 ENTER ELEVATION COMMA THEN AREA
 TERMINATE DATA ENTRY WITH A CARRIAGE RETURN
? 3202,0
? 3210,33
? 3220,165
? 3230,412
? 3240,1227
? 3250,2257
? 3260,5459
? 3270,12208
? 3280,19741
? 3290,28147
? 3300,36745
? 3310,45499
?

 IF YOU WISH TO USE THE CAPACITY OFFSET FEATURE GIVE THE BASE ELEVATION
 IF NOT GIVE A -CR-
 NEED HELP? (TYPE 0)
? 0

 THIS FEATURE ALLOWS ONE TO GENERATE A CAPACITY TABLE WHERE EACH VALUE
 HAS BEEN REDUCED BY A CERTAIN AMOUNT.
 THIS FEATURE COULD BE USED TO GENERATE AN ACTIVE CAPACITY TABLE
 TO DO THIS GIVE THE ELEVATION OF THE BASE OF ACTIVE STORAGE
?

 WANT TO CHECK YOUR INPUT DATA (YES OR NO)
? YES
```

```
 THE INPUT IS LISTED BELOW FOR REVIEW
 INELEV =   320200  FNELEV =   331000  FIRST =   320200  BEGCAP =
 INDATA =   320200  KDATA =   331000  RDAREA =    0
 RDCAPY =    0  JCODE =   30  REP =  0  EPSLON =      .0000100000
 METRICI= 0  METRIC= 0
                                    EXAMPLE RESERVOIR
  NO.    ELEVATION     AREA
    1    3202.00        0.00
    2    3210.00       33.00
    3    3220.00      165.00
    4    3230.00      412.00
    5    3240.00     1227.00
    6    3250.00     2257.00
    7    3260.00     5459.00
    8    3270.00    12208.00
    9    3280.00    19741.00
   10    3290.00    28147.00
   11    3300.00    36745.00
   12    3310.00    45499.00

 IF DATA IS CORRECT TYPE IN YES; OTHERWISE NO
? YES

 DO YOU WANT TO SET UP ANOTHER JOB-TYPE YES OR NO
? NO
 NORMAL COMPLETION
 RUN COMPLETE


 READY.
```

Sample Run B
Data Entered From A File

```
-,EACAP85
 THIS PROGRAM GENERATES AREA-CAPACITY TABLES FROM ELEVATION-AREA DATA.

  06/26/85   16.50.34.

 INPUT MUST BE ENTERED AS:
  ELEVATION=FEET OR METERS
  AREA=ACRES OR HECTARES
  CAPACITY=ACRE FEET OR 1000 CUBIC METERS

 ENTER THE UNITS OF THE INPUT AND OUTPUT
 TYPE "E" FOR ENGLISH UNITS
 TYPE "M" FOR METRIC UNITS
 ENTER INPUT UNITS
? E

 ENTER OUTPUT UNITS
? E

 INPUT TO THIS PROGRAM MAY COME FROM THE TERMINAL, OR A FILE.
 IF INPUT IS TO BE FROM A FILE GIVE THE NAME OF THE FILE.
 OTHERWISE GIVE A -CR-
? ACAPI

 ENTER WHICH PROCEDURE YOU WISH TO USE, "A" OR "B"
 IF YOU NEED HELP GIVE A -CR-
?

 ENTER "A" FOR LEAST SQUARES FIT
 ENTER "B" FOR CUBIC SPLINE FIT. (NOT GENERALLY RECOMMENDED)
 NOTE: ELEVATIONS IN DATA SET MUST NOT BE FRACTIONS
       WHEN USING THE CUBIC SPLINE FIT PROCEDURE.
? A

 IF YOU WISH TO USE THE CAPACITY OFFSET FEATURE GIVE THE BASE ELEVATION
 IF NOT GIVE A -CR-
 NEED HELP? (TYPE 0)
?

 WANT TO CHECK YOUR INPUT DATA (YES OR NO)
? NO


 DO YOU WANT TO SET UP ANOTHER JOB-TYPE YES OR NO
? YES
```

```
 DO YOU WANT TO SET UP ANOTHER JOB-TYPE YES OR NO
? YES

 ENTER "NEW" FOR NEW DATA SET. ENTER
 "REPEAT" FOR TABLES WITH PREVIOUSLY ENTERED DATA SET
? REPEAT

  06/26/85    16.51.40.

 ENTER OUTPUT UNITS
? E

 ENTER THE VALUE FOR THE TABLE GENERATION CONTROL
 IF YOU NEED HELP GIVE A -CR-
? 10
 A NEW TABLE WILL BE GENERATED WITH THE OLD DATA SET


 DO YOU WANT TO SET UP ANOTHER JOB-TYPE YES OR NO
? NO
 NORMAL COMPLETION
 RUN COMPLETE


 READY.
```

Sample Run D (1 of 2)
Data Entered to Get Different Message Response

```
-.EACAP85

 THIS PROGRAM GENERATES AREA-CAPACITY TABLES FROM ELEVATION-AREA DATA.

  05/15/85   09.47.15.

 INPUT MUST BE ENTERED AS:
  ELEVATION=FEET OR METERS
  AREA=ACRES OR HECTARES
  CAPACITY=ACRE FEET OR 1000 CUBIC METERS

 ENTER THE UNITS OF THE INPUT AND OUTPUT
 TYPE 'E' FOR ENGLISH UNITS
 TYPE 'M' FOR METRIC UNITS
 ENTER INPUT UNITS
? E

 ENTER OUTPUT UNITS
? M

 TO REQUEST DIFFERENT UNITS, I.E., METRIC INPUT AND ENGLISH OUTPUT OR
 ENGLISH INPUT AND METRIC OUTPUT IS NOT RECOMMENDED AND SHOULD BE
 DONE WITH GREAT CAUTION.
 DO YOU WANT TO RECONSIDER? (Y OR N)
? Y

 ENTER THE UNITS OF THE INPUT AND OUTPUT
 TYPE 'E' FOR ENGLISH UNITS
 TYPE 'M' FOR METRIC UNITS
 ENTER INPUT UNITS
? E

 ENTER OUTPUT UNITS
? E

 INPUT TO THIS PROGRAM MAY COME FROM THE TERMINAL, OR A FILE.
 IF INPUT IS TO BE FROM A FILE GIVE THE NAME OF THE FILE.
 OTHERWISE GIVE A -CR-
? ACAPII

 ENTER WHICH PROCEDURE YOU WISH TO USE, 'A' OR 'B'.
 IF YOU NEED HELP GIVE A -CR-
?

 ENTER 'A' FOR LEAST SQUARES FIT
 ENTER 'B' FOR CUBIC SPLINE FIT. (NOT GENERALLY RECOMMENDED)
 NOTE: ELEVATIONS IN DATA SET MUST NOT BE FRACTIONS
       WHEN USING THE CUBIC SPLINE FIT PROCEDURE.
? B

 CAUTION: CUBIC SPLINE SHOULD BE USED WITH CAUTION AND SHOULD BE USED
 ONLY WITH 'WELL-BEHAVED' DATA SETS. REFER TO THE USER'S MANUAL.
```

Sample Run D (2 of 2)
Data Entered to Get Different Message Response

```
 DO YOU WANT TO TRY ANOTHER METHOD? (Y OR N)
? Y

 ENTER WHICH PROCEDURE YOU WISH TO USE, 'A' OR 'B'.
 IF YOU NEED HELP GIVE A -CR-
? A

 IF YOU WISH TO USE THE CAPACITY OFFSET FEATURE GIVE THE BASE ELEVATIO
 IF NOT GIVE A -CR-
 NEED HELP? (TYPE 0)
?

 WANT TO CHECK YOUR INPUT DATA (YES OR NO)
? NO


 DO YOU WANT TO SET UP ANOTHER JOB-TYPE YES OR NO
? NO
 NORMAL COMPLETION
 RUN COMPLETE


 READY.
```

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE(0.050)

EQUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	100.00	0	-.0000	100.0000	5.5000
2	110.00	1550	1550.0000	210.0000	4.5000
3	120.00	4099	4100.0000	300.0000	5.0000
4	130.00	7599	7600.0000	400.0000	4.5000
5	140.00	12049	12050.0000	490.0000	5.5000

Sample E for Large Epsilon Coefficients

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE(0.050)

(ACAP85) COMPUTED
05/01/85
09.25.37.

AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
100	100	101	102	103	104	106	107	108	109	110
101	111	112	113	114	115	117	118	119	120	121
102	122	123	124	125	126	128	129	130	131	132
103	133	134	135	136	137	139	140	141	142	143
104	144	145	146	147	148	150	151	152	153	154
105	155	156	157	158	159	160	162	163	164	165
106	166	167	168	169	170	171	173	174	175	176
107	177	178	179	180	181	182	184	185	186	187
108	188	189	190	191	192	193	195	196	197	198
109	199	200	201	202	203	204	206	207	208	209
110	210	211	212	213	214	215	215	216	217	218
111	219	220	221	222	223	224	224	225	226	227
112	228	229	230	231	232	233	233	234	235	236
113	237	238	239	240	241	242	242	243	244	245
114	246	247	248	249	250	251	251	252	253	254
115	255	256	257	258	259	260	260	261	262	263
116	264	265	266	267	268	269	269	270	271	272
117	273	274	275	276	277	278	278	279	280	281
118	282	283	284	285	286	287	287	288	289	290
119	291	292	293	294	295	296	296	297	298	299
120	300	301	302	303	304	305	306	307	308	309
121	310	311	312	313	314	315	316	317	318	319
122	320	321	322	323	324	325	326	327	328	329
123	330	331	332	333	334	335	336	337	338	339
124	340	341	342	343	344	345	346	347	348	349
125	350	351	352	353	354	355	356	357	358	359
126	360	361	362	363	364	365	366	367	368	369
127	370	371	372	373	374	375	376	377	378	379
128	380	381	382	383	384	385	386	387	388	389
129	390	391	392	393	394	395	396	397	398	399
130	400	401	402	403	404	404	405	406	407	408
131	409	410	411	412	413	413	414	415	416	417
132	418	419	420	421	422	422	423	424	425	426
133	427	428	429	430	431	432	432	433	434	435
134	436	437	438	439	440	441	441	442	443	444
135	445	446	447	448	449	450	450	451	452	453
136	454	455	456	457	458	459	459	460	461	462
137	463	464	465	466	467	468	468	469	470	471
138	472	473	474	475	476	477	477	478	479	480
139	481	482	483	484	485	486	486	487	488	489

Sample F for a Large Epsilon

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE(0.050)

(ACAP85) COMPUTED
05/01/85
09.25.37.

AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
140	490	491	492	493	494	495	497	498	499	500
141	501	502	503	504	505	506	508	509	510	511
142	512	513	514	515	516	517	519	520	521	522
143	523	524	525	526	527	528	530	531	532	533
144	534	535	536	537	538	540	541	542	543	544
145	545	546	547	548	549	551	552	553	554	555
146	556	557	558	559	560	562	563	564	565	566
147	567	568	569	570	571	573	574	575	576	577
148	578	579	580	581	582	584	585	586	587	588
149	589	590	591	592	593	595	596	597	598	599
150	600									

Sample F (cont.)

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE(0.050)

(ACAP85) COMPUTED
05/01/85
09.25.37.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
100	0	10	20	30	41	51	62	73	84	94
101	105	117	128	139	151	162	174	186	198	210
102	222	234	247	259	272	284	297	310	323	336
103	349	363	376	390	404	417	431	445	459	474
104	488	502	517	532	546	561	576	591	607	622
105	637	653	669	684	700	716	732	749	765	781
106	798	815	831	848	865	882	900	917	934	952
107	969	987	1005	1023	1041	1059	1078	1096	1115	1133
108	1152	1171	1190	1209	1228	1247	1267	1286	1306	1326
109	1345	1365	1386	1406	1426	1446	1467	1487	1508	1529
110	1550	1571	1592	1613	1635	1656	1678	1699	1721	1743
111	1764	1786	1808	1831	1853	1875	1898	1920	1943	1965
112	1988	2011	2034	2057	2080	2103	2126	2150	2173	2197
113	2220	2244	2268	2292	2316	2340	2364	2389	2413	2437
114	2462	2487	2511	2536	2561	2586	2611	2636	2662	2687
115	2712	2738	2764	2789	2815	2841	2867	2893	2919	2946
116	2972	2998	3025	3052	3078	3105	3132	3159	3186	3213
117	3240	3268	3295	3323	3350	3378	3406	3434	3462	3490
118	3518	3546	3575	3603	3632	3660	3689	3718	3746	3775
119	3804	3834	3863	3892	3922	3951	3981	4010	4040	4070
120	4100	4130	4160	4190	4221	4251	4282	4312	4343	4374
121	4405	4436	4467	4498	4530	4561	4593	4624	4656	4688
122	4720	4752	4784	4816	4849	4881	4914	4946	4979	5012
123	5045	5078	5111	5144	5178	5211	5245	5278	5312	5346
124	5380	5414	5448	5482	5517	5551	5586	5620	5655	5690
125	5725	5760	5795	5830	5866	5901	5937	5972	6008	6044
126	6080	6116	6152	6188	6225	6261	6298	6334	6371	6408
127	6445	6482	6519	6556	6594	6631	6669	6706	6744	6782
128	6820	6858	6896	6934	6973	7011	7050	7088	7127	7166
129	7205	7244	7283	7322	7362	7401	7441	7480	7520	7560
130	7600	7640	7680	7720	7761	7801	7842	7882	7923	7964
131	8004	8045	8086	8128	8169	8210	8252	8293	8335	8376
132	8418	8460	8502	8544	8586	8628	8670	8713	8755	8798
133	8840	8883	8926	8969	9012	9055	9098	9142	9185	9228
134	9272	9316	9359	9403	9447	9491	9535	9579	9624	9668
135	9712	9757	9802	9846	9891	9936	9981	10026	10071	10117
136	10162	10207	10253	10299	10344	10390	10436	10482	10528	10574
137	10620	10667	10713	10760	10806	10853	10900	10947	10994	11041
138	11088	11135	11183	11230	11278	11325	11373	11421	11468	11516
139	11564	11613	11661	11709	11758	11806	11855	11903	11952	12001

Sample G for a Large Epsilon
Capacity Table - 0.1 foot inc

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE(0.050)

(ACAP85) COMPUTED
05/01/85
09.25.37.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
140	12050	12099	12148	12197	12247	12296	12346	12396	12446	12495
141	12545	12596	12646	12696	12747	12797	12848	12899	12950	13001
142	13052	13103	13155	13206	13258	13309	13361	13413	13465	13517
143	13569	13622	13674	13727	13780	13832	13885	13938	13991	14045
144	14098	14151	14205	14259	14312	14366	14420	14474	14529	14583
145	14637	14692	14747	14801	14856	14911	14966	15022	15077	15132
146	15188	15244	15299	15355	15411	15467	15524	15580	15636	15693
147	15749	15806	15863	15920	15977	16034	16092	16149	16207	16264
148	16322	16380	16438	16496	16554	16612	16671	16729	16788	16847
149	16905	16964	17024	17083	17142	17201	17261	17320	17380	17440
150	17500									

Sample G (cont.)

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
108.0	188	188	188	188	188	189	189	189	189	189
108.1	189	189	189	189	190	190	190	190	190	190
108.2	190	190	190	191	191	191	191	191	191	191
108.3	191	191	192	192	192	192	192	192	192	192
108.4	192	193	193	193	193	193	193	193	193	193
108.5	193	194	194	194	194	194	194	194	194	194
108.6	195	195	195	195	195	195	195	195	195	196
108.7	196	196	196	196	196	196	196	196	197	197
108.8	197	197	197	197	197	197	197	198	198	198
108.9	198	198	198	198	198	198	199	199	199	199
109.0	199	199	199	199	199	200	200	200	200	200
109.1	200	200	200	200	201	201	201	201	201	201
109.2	201	201	201	202	202	202	202	202	202	202
109.3	202	202	203	203	203	203	203	203	203	203
109.4	203	204	204	204	204	204	204	204	204	204
109.5	204	205	205	205	205	205	205	205	205	205
109.6	206	206	206	206	206	206	206	206	206	207
109.7	207	207	207	207	207	207	207	207	208	208
109.8	208	208	208	208	208	208	208	209	209	209
109.9	209	209	209	209	209	209	210	210	210	210
110.0	210	210	210	210	210	210	211	211	211	211
110.1	211	211	211	211	211	211	211	212	212	212
110.2	212	212	212	212	212	212	212	212	213	213
110.3	213	213	213	213	213	213	213	213	213	214
110.4	214	214	214	214	214	214	214	214	214	214
110.5	215	215	215	215	215	215	215	215	215	215
110.6	215	215	216	216	216	216	216	216	216	216
110.7	216	216	216	217	217	217	217	217	217	217
110.8	217	217	217	217	218	218	218	218	218	218
110.9	218	218	218	218	218	219	219	219	219	219
111.0	219	219	219	219	219	219	220	220	220	220
111.1	220	220	220	220	220	220	220	221	221	221
111.2	221	221	221	221	221	221	221	221	222	222
111.3	222	222	222	222	222	222	222	222	222	223
111.4	223	223	223	223	223	223	223	223	223	223
111.5	224	224	224	224	224	224	224	224	224	224
111.6	224	224	225	225	225	225	225	225	225	225
111.7	225	225	225	226	226	226	226	226	226	226
111.8	226	226	226	226	227	227	227	227	227	227
111.9	227	227	227	227	227	228	228	228	228	228

Sample H for Large Epsilon
Area Table - 0.01 foot inc

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
112.0	228	228	228	228	228	228	229	229	229	229
112.1	229	229	229	229	229	229	229	230	230	230
112.2	230	230	230	230	230	230	230	230	231	231
112.3	231	231	231	231	231	231	231	231	231	232
112.4	232	232	232	232	232	232	232	232	232	232
112.5	233	233	233	233	233	233	233	233	233	233
112.6	233	233	234	234	234	234	234	234	234	234
112.7	234	234	234	235	235	235	235	235	235	235
112.8	235	235	235	235	236	236	236	236	236	236
112.9	236	236	236	236	236	237	237	237	237	237
113.0	237	237	237	237	237	237	238	238	238	238
113.1	238	238	238	238	238	238	238	239	239	239
113.2	239	239	239	239	239	239	239	239	240	240
113.3	240	240	240	240	240	240	240	240	240	241
113.4	241	241	241	241	241	241	241	241	241	241
113.5	242	242	242	242	242	242	242	242	242	242
113.6	242	242	243	243	243	243	243	243	243	243
113.7	243	243	243	244	244	244	244	244	244	244
113.8	244	244	244	244	245	245	245	245	245	245
113.9	245	245	245	245	245	246	246	246	246	246
114.0	246	246	246	246	246	246	247	247	247	247
114.1	247	247	247	247	247	247	247	248	248	248
114.2	248	248	248	248	248	248	248	248	249	249
114.3	249	249	249	249	249	249	249	249	249	250
114.4	250	250	250	250	250	250	250	250	250	250
114.5	251	251	251	251	251	251	251	251	251	251
114.6	251	251	252	252	252	252	252	252	252	252
114.7	252	252	252	253	253	253	253	253	253	253
114.8	253	253	253	253	254	254	254	254	254	254
114.9	254	254	254	254	254	255	255	255	255	255
115.0	255	255	255	255	255	255	256	256	256	256
115.1	256	256	256	256	256	256	256	257	257	257
115.2	257	257	257	257	257	257	257	257	258	258
115.3	258	258	258	258	258	258	258	258	258	259
115.4	259	259	259	259	259	259	259	259	259	259
115.5	260	260	260	260	260	260	260	260	260	260
115.6	260	260	261	261	261	261	261	261	261	261
115.7	261	261	261	262	262	262	262	262	262	262
115.8	262	262	262	262	263	263	263	263	263	263
115.9	263	263	263	263	263	264	264	264	264	264

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
116.0	264	264	264	264	264	264	265	265	265	265
116.1	265	265	265	265	265	265	265	266	266	266
116.2	266	266	266	266	266	266	266	266	267	267
116.3	267	267	267	267	267	267	267	267	267	268
116.4	268	268	268	268	268	268	268	268	268	268
116.5	269	269	269	269	269	269	269	269	269	269
116.6	269	269	270	270	270	270	270	270	270	270
116.7	270	270	270	271	271	271	271	271	271	271
116.8	271	271	271	271	272	272	272	272	272	272
116.9	272	272	272	272	272	273	273	273	273	273
117.0	273	273	273	273	273	273	274	274	274	274
117.1	274	274	274	274	274	274	274	275	275	275
117.2	275	275	275	275	275	275	275	275	276	276
117.3	276	276	276	276	276	276	276	276	276	277
117.4	277	277	277	277	277	277	277	277	277	277
117.5	278	278	278	278	278	278	278	278	278	278
117.6	278	278	279	279	279	279	279	279	279	279
117.7	279	279	279	280	280	280	280	280	280	280
117.8	280	280	280	280	281	281	281	281	281	281
117.9	281	281	281	281	281	282	282	282	282	282
118.0	282	282	282	282	282	282	283	283	283	283
118.1	283	283	283	283	283	283	283	284	284	284
118.2	284	284	284	284	284	284	284	284	285	285
118.3	285	285	285	285	285	285	285	285	285	286
118.4	286	286	286	286	286	286	286	286	286	286
118.5	287	287	287	287	287	287	287	287	287	287
118.6	287	287	288	288	288	288	288	288	288	288
118.7	288	288	288	289	289	289	289	289	289	289
118.8	289	289	289	289	290	290	290	290	290	290
118.9	290	290	290	290	290	291	291	291	291	291
119.0	291	291	291	291	291	291	292	292	292	292
119.1	292	292	292	292	292	292	292	293	293	293
119.2	293	293	293	293	293	293	293	293	294	294
119.3	294	294	294	294	294	294	294	294	294	295
119.4	295	295	295	295	295	295	295	295	295	295
119.5	296	296	296	296	296	296	296	296	296	296
119.6	296	296	297	297	297	297	297	297	297	297
119.7	297	297	297	298	298	298	298	298	298	298
119.8	298	298	298	298	299	299	299	299	299	299
119.9	299	299	299	299	299	300	300	300	300	300

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
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AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
120.0	300	300	300	300	300	301	301	301	301	301
120.1	301	301	301	301	301	302	302	302	302	302
120.2	302	302	302	302	302	303	303	303	303	303
120.3	303	303	303	303	303	304	304	304	304	304
120.4	304	304	304	304	304	305	305	305	305	305
120.5	305	305	305	305	305	306	306	306	306	306
120.6	306	306	306	306	306	307	307	307	307	307
120.7	307	307	307	307	307	308	308	308	308	308
120.8	308	308	308	308	308	309	309	309	309	309
120.9	309	309	309	309	309	310	310	310	310	310
121.0	310	310	310	310	310	311	311	311	311	311
121.1	311	311	311	311	311	312	312	312	312	312
121.2	312	312	312	312	312	313	313	313	313	313
121.3	313	313	313	313	313	314	314	314	314	314
121.4	314	314	314	314	314	315	315	315	315	315
121.5	315	315	315	315	315	316	316	316	316	316
121.6	316	316	316	316	316	317	317	317	317	317
121.7	317	317	317	317	317	318	318	318	318	318
121.8	318	318	318	318	318	319	319	319	319	319
121.9	319	319	319	319	319	320	320	320	320	320
122.0	320	320	320	320	320	321	321	321	321	321
122.1	321	321	321	321	321	322	322	322	322	322
122.2	322	322	322	322	322	323	323	323	323	323
122.3	323	323	323	323	323	324	324	324	324	324
122.4	324	324	324	324	324	325	325	325	325	325
122.5	325	325	325	325	325	326	326	326	326	326
122.6	326	326	326	326	326	327	327	327	327	327
122.7	327	327	327	327	327	328	328	328	328	328
122.8	328	328	328	328	328	329	329	329	329	329
122.9	329	329	329	329	329	330	330	330	330	330
123.0	330	330	330	330	330	331	331	331	331	331
123.1	331	331	331	331	331	332	332	332	332	332
123.2	332	332	332	332	332	333	333	333	333	333
123.3	333	333	333	333	333	334	334	334	334	334
123.4	334	334	334	334	334	335	335	335	335	335
123.5	335	335	335	335	335	336	336	336	336	336
123.6	336	336	336	336	336	337	337	337	337	337
123.7	337	337	337	337	337	338	338	338	338	338
123.8	338	338	338	338	338	339	339	339	339	339
123.9	339	339	339	339	339	340	340	340	340	340

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
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AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
124.0	340	340	340	340	340	341	341	341	341	341
124.1	341	341	341	341	341	342	342	342	342	342
124.2	342	342	342	342	342	343	343	343	343	343
124.3	343	343	343	343	343	344	344	344	344	344
124.4	344	344	344	344	344	345	345	345	345	345
124.5	345	345	345	345	345	346	346	346	346	346
124.6	346	346	346	346	346	347	347	347	347	347
124.7	347	347	347	347	347	348	348	348	348	348
124.8	348	348	348	348	348	349	349	349	349	349
124.9	349	349	349	349	349	350	350	350	350	350
125.0	350	350	350	350	350	351	351	351	351	351
125.1	351	351	351	351	351	352	352	352	352	352
125.2	352	352	352	352	352	353	353	353	353	353
125.3	353	353	353	353	353	354	354	354	354	354
125.4	354	354	354	354	354	355	355	355	355	355
125.5	355	355	355	355	355	356	356	356	356	356
125.6	356	356	356	356	356	357	357	357	357	357
125.7	357	357	357	357	357	358	358	358	358	358
125.8	358	358	358	358	358	359	359	359	359	359
125.9	359	359	359	359	359	360	360	360	360	360
126.0	360	360	360	360	360	361	361	361	361	361
126.1	361	361	361	361	361	362	362	362	362	362
126.2	362	362	362	362	362	363	363	363	363	363
126.3	363	363	363	363	363	364	364	364	364	364
126.4	364	364	364	364	364	365	365	365	365	365
126.5	365	365	365	365	365	366	366	366	366	366
126.6	366	366	366	366	366	366	367	367	367	367
126.7	367	367	367	367	367	367	368	368	368	368
126.8	368	368	368	368	368	368	369	369	369	369
126.9	369	369	369	369	369	369	370	370	370	370
127.0	370	370	370	370	370	370	371	371	371	371
127.1	371	371	371	371	371	371	372	372	372	372
127.2	372	372	372	372	372	372	373	373	373	373
127.3	373	373	373	373	373	373	374	374	374	374
127.4	374	374	374	374	374	374	375	375	375	375
127.5	375	375	375	375	375	375	376	376	376	376
127.6	376	376	376	376	376	376	377	377	377	377
127.7	377	377	377	377	377	377	378	378	378	378
127.8	378	378	378	378	378	378	379	379	379	379
127.9	379	379	379	379	379	379	380	380	380	380

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
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AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
128.0	380	380	380	380	380	380	381	381	381	381
128.1	381	381	381	381	381	381	382	382	382	382
128.2	382	382	382	382	382	382	383	383	383	383
128.3	383	383	383	383	383	383	384	384	384	384
128.4	384	384	384	384	384	384	385	385	385	385
128.5	385	385	385	385	385	385	386	386	386	386
128.6	386	386	386	386	386	386	387	387	387	387
128.7	387	387	387	387	387	387	388	388	388	388
128.8	388	388	388	388	388	388	389	389	389	389
128.9	389	389	389	389	389	389	390	390	390	390
129.0	390	390	390	390	390	390	391	391	391	391
129.1	391	391	391	391	391	391	392	392	392	392
129.2	392	392	392	392	392	392	393	393	393	393
129.3	393	393	393	393	393	393	394	394	394	394
129.4	394	394	394	394	394	394	395	395	395	395
129.5	395	395	395	395	395	395	396	396	396	396
129.6	396	396	396	396	396	396	397	397	397	397
129.7	397	397	397	397	397	397	398	398	398	398
129.8	398	398	398	398	398	398	399	399	399	399
129.9	399	399	399	399	399	399	400	400	400	400
130.0	400	400	400	400	400	400	401	401	401	401
130.1	401	401	401	401	401	401	401	402	402	402
130.2	402	402	402	402	402	402	402	402	403	403
130.3	403	403	403	403	403	403	403	403	403	404
130.4	404	404	404	404	404	404	404	404	404	404
130.5	404	405	405	405	405	405	405	405	405	405
130.6	405	405	406	406	406	406	406	406	406	406
130.7	406	406	406	407	407	407	407	407	407	407
130.8	407	407	407	407	408	408	408	408	408	408
130.9	408	408	408	408	408	409	409	409	409	409
131.0	409	409	409	409	409	409	410	410	410	410
131.1	410	410	410	410	410	410	410	411	411	411
131.2	411	411	411	411	411	411	411	411	412	412
131.3	412	412	412	412	412	412	412	412	412	413
131.4	413	413	413	413	413	413	413	413	413	413
131.5	413	414	414	414	414	414	414	414	414	414
131.6	414	414	415	415	415	415	415	415	415	415
131.7	415	415	415	416	416	416	416	416	416	416
131.8	416	416	416	416	417	417	417	417	417	417
131.9	417	417	417	417	417	418	418	418	418	418

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
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AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
132.0	418	418	418	418	418	418	419	419	419	419
132.1	419	419	419	419	419	419	419	420	420	420
132.2	420	420	420	420	420	420	420	420	421	421
132.3	421	421	421	421	421	421	421	421	421	422
132.4	422	422	422	422	422	422	422	422	422	422
132.5	422	423	423	423	423	423	423	423	423	423
132.6	423	423	424	424	424	424	424	424	424	424
132.7	424	424	424	425	425	425	425	425	425	425
132.8	425	425	425	425	426	426	426	426	426	426
132.9	426	426	426	426	426	427	427	427	427	427
133.0	427	427	427	427	427	427	428	428	428	428
133.1	428	428	428	428	428	428	428	429	429	429
133.2	429	429	429	429	429	429	429	429	430	430
133.3	430	430	430	430	430	430	430	430	430	431
133.4	431	431	431	431	431	431	431	431	431	431
133.5	432	432	432	432	432	432	432	432	432	432
133.6	432	432	433	433	433	433	433	433	433	433
133.7	433	433	433	434	434	434	434	434	434	434
133.8	434	434	434	434	435	435	435	435	435	435
133.9	435	435	435	435	435	436	436	436	436	436
134.0	436	436	436	436	436	436	437	437	437	437
134.1	437	437	437	437	437	437	437	438	438	438
134.2	438	438	438	438	438	438	438	438	439	439
134.3	439	439	439	439	439	439	439	439	439	440
134.4	440	440	440	440	440	440	440	440	440	440
134.5	441	441	441	441	441	441	441	441	441	441
134.6	441	441	442	442	442	442	442	442	442	442
134.7	442	442	442	443	443	443	443	443	443	443
134.8	443	443	443	443	444	444	444	444	444	444
134.9	444	444	444	444	444	445	445	445	445	445
135.0	445	445	445	445	445	445	446	446	446	446
135.1	446	446	446	446	446	446	446	447	447	447
135.2	447	447	447	447	447	447	447	447	448	448
135.3	448	448	448	448	448	448	448	448	448	449
135.4	449	449	449	449	449	449	449	449	449	449
135.5	450	450	450	450	450	450	450	450	450	450
135.6	450	450	451	451	451	451	451	451	451	451
135.7	451	451	451	452	452	452	452	452	452	452
135.8	452	452	452	452	453	453	453	453	453	453
135.9	453	453	453	453	453	454	454	454	454	454

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
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AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
136.0	454	454	454	454	454	454	455	455	455	455
136.1	455	455	455	455	455	455	455	456	456	456
136.2	456	456	456	456	456	456	456	456	457	457
136.3	457	457	457	457	457	457	457	457	457	458
136.4	458	458	458	458	458	458	458	458	458	458
136.5	459	459	459	459	459	459	459	459	459	459
136.6	459	459	460	460	460	460	460	460	460	460
136.7	460	460	460	461	461	461	461	461	461	461
136.8	461	461	461	461	462	462	462	462	462	462
136.9	462	462	462	462	462	463	463	463	463	463
137.0	463	463	463	463	463	463	464	464	464	464
137.1	464	464	464	464	464	464	464	465	465	465
137.2	465	465	465	465	465	465	465	465	466	466
137.3	466	466	466	466	466	466	466	466	466	467
137.4	467	467	467	467	467	467	467	467	467	467
137.5	468	468	468	468	468	468	468	468	468	468
137.6	468	468	469	469	469	469	469	469	469	469
137.7	469	469	469	470	470	470	470	470	470	470
137.8	470	470	470	470	471	471	471	471	471	471
137.9	471	471	471	471	471	472	472	472	472	472
138.0	472	472	472	472	472	472	473	473	473	473
138.1	473	473	473	473	473	473	473	474	474	474
138.2	474	474	474	474	474	474	474	474	475	475
138.3	475	475	475	475	475	475	475	475	475	476
138.4	476	476	476	476	476	476	476	476	476	476
138.5	477	477	477	477	477	477	477	477	477	477
138.6	477	477	478	478	478	478	478	478	478	478
138.7	478	478	478	479	479	479	479	479	479	479
138.8	479	479	479	479	480	480	480	480	480	480
138.9	480	480	480	480	480	481	481	481	481	481
139.0	481	481	481	481	481	481	482	482	482	482
139.1	482	482	482	482	482	482	482	483	483	483
139.2	483	483	483	483	483	483	483	483	484	484
139.3	484	484	484	484	484	484	484	484	484	485
139.4	485	485	485	485	485	485	485	485	485	485
139.5	486	486	486	486	486	486	486	486	486	486
139.6	486	486	487	487	487	487	487	487	487	487
139.7	487	487	487	488	488	488	488	488	488	488
139.8	488	488	488	488	489	489	489	489	489	489
139.9	489	489	489	489	489	490	490	490	490	490

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

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AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
140.0	490	490	490	490	490	491	491	491	491	491
140.1	491	491	491	491	492	492	492	492	492	492
140.2	492	492	492	493	493	493	493	493	493	493
140.3	493	493	494	494	494	494	494	494	494	494
140.4	494	495	495	495	495	495	495	495	495	495
140.5	495	496	496	496	496	496	496	496	496	496
140.6	497	497	497	497	497	497	497	497	497	498
140.7	498	498	498	498	498	498	498	498	499	499
140.8	499	499	499	499	499	499	499	500	500	500
140.9	500	500	500	500	500	500	501	501	501	501
141.0	501	501	501	501	501	502	502	502	502	502
141.1	502	502	502	502	503	503	503	503	503	503
141.2	503	503	503	504	504	504	504	504	504	504
141.3	504	504	505	505	505	505	505	505	505	505
141.4	505	506	506	506	506	506	506	506	506	506
141.5	506	507	507	507	507	507	507	507	507	507
141.6	508	508	508	508	508	508	508	508	508	509
141.7	509	509	509	509	509	509	509	509	510	510
141.8	510	510	510	510	510	510	510	511	511	511
141.9	511	511	511	511	511	511	512	512	512	512
142.0	512	512	512	512	512	513	513	513	513	513
142.1	513	513	513	513	514	514	514	514	514	514
142.2	514	514	514	515	515	515	515	515	515	515
142.3	515	515	516	516	516	516	516	516	516	516
142.4	516	517	517	517	517	517	517	517	517	517
142.5	517	518	518	518	518	518	518	518	518	518
142.6	519	519	519	519	519	519	519	519	519	520
142.7	520	520	520	520	520	520	520	520	521	521
142.8	521	521	521	521	521	521	521	522	522	522
142.9	522	522	522	522	522	522	523	523	523	523
143.0	523	523	523	523	523	524	524	524	524	524
143.1	524	524	524	524	525	525	525	525	525	525
143.2	525	525	525	526	526	526	526	526	526	526
143.3	526	526	527	527	527	527	527	527	527	527
143.4	527	528	528	528	528	528	528	528	528	528
143.5	528	529	529	529	529	529	529	529	529	529
143.6	530	530	530	530	530	530	530	530	530	531
143.7	531	531	531	531	531	531	531	531	532	532
143.8	532	532	532	532	532	532	532	533	533	533
143.9	533	533	533	533	533	533	534	534	534	534

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

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AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
144.0	534	534	534	534	534	535	535	535	535	535
144.1	535	535	535	535	536	536	536	536	536	536
144.2	536	536	536	537	537	537	537	537	537	537
144.3	537	537	538	538	538	538	538	538	538	538
144.4	538	539	539	539	539	539	539	539	539	539
144.5	540	540	540	540	540	540	540	540	540	540
144.6	541	541	541	541	541	541	541	541	541	542
144.7	542	542	542	542	542	542	542	542	543	543
144.8	543	543	543	543	543	543	543	544	544	544
144.9	544	544	544	544	544	544	545	545	545	545
145.0	545	545	545	545	545	546	546	546	546	546
145.1	546	546	546	546	547	547	547	547	547	547
145.2	547	547	547	548	548	548	548	548	548	548
145.3	548	548	549	549	549	549	549	549	549	549
145.4	549	550	550	550	550	550	550	550	550	550
145.5	551	551	551	551	551	551	551	551	551	551
145.6	552	552	552	552	552	552	552	552	552	553
145.7	553	553	553	553	553	553	553	553	554	554
145.8	554	554	554	554	554	554	554	555	555	555
145.9	555	555	555	555	555	555	556	556	556	556
146.0	556	556	556	556	556	557	557	557	557	557
146.1	557	557	557	557	558	558	558	558	558	558
146.2	558	558	558	559	559	559	559	559	559	559
146.3	559	559	560	560	560	560	560	560	560	560
146.4	560	561	561	561	561	561	561	561	561	561
146.5	562	562	562	562	562	562	562	562	562	562
146.6	563	563	563	563	563	563	563	563	563	564
146.7	564	564	564	564	564	564	564	564	565	565
146.8	565	565	565	565	565	565	565	566	566	566
146.9	566	566	566	566	566	566	567	567	567	567
147.0	567	567	567	567	567	568	568	568	568	568
147.1	568	568	568	568	569	569	569	569	569	569
147.2	569	569	569	570	570	570	570	570	570	570
147.3	570	570	571	571	571	571	571	571	571	571
147.4	571	572	572	572	572	572	572	572	572	572
147.5	573	573	573	573	573	573	573	573	573	573
147.6	574	574	574	574	574	574	574	574	574	575
147.7	575	575	575	575	575	575	575	575	576	576
147.8	576	576	576	576	576	576	576	577	577	577
147.9	577	577	577	577	577	577	578	578	578	578

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

AREA TABLE IN ACRES

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
148.0	578	578	578	578	578	579	579	579	579	579
148.1	579	579	579	579	580	580	580	580	580	580
148.2	580	580	580	581	581	581	581	581	581	581
148.3	581	581	582	582	582	582	582	582	582	582
148.4	582	583	583	583	583	583	583	583	583	583
148.5	584	584	584	584	584	584	584	584	584	584
148.6	585	585	585	585	585	585	585	585	585	586
148.7	586	586	586	586	586	586	586	586	587	587
148.8	587	587	587	587	587	587	587	588	588	588
148.9	588	588	588	588	588	588	589	589	589	589
149.0	589	589	589	589	589	590	590	590	590	590
149.1	590	590	590	590	591	591	591	591	591	591
149.2	591	591	591	592	592	592	592	592	592	592
149.3	592	592	593	593	593	593	593	593	593	593
149.4	593	594	594	594	594	594	594	594	594	594
149.5	595	595	595	595	595	595	595	595	595	595
149.6	596	596	596	596	596	596	596	596	596	597
149.7	597	597	597	597	597	597	597	597	598	598
149.8	598	598	598	598	598	598	598	599	599	599
149.9	599	599	599	599	599	599	600	600	600	600
150.0	600									

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
100.0	0	1	2	3	4	5	6	7	8	9
100.1	10	11	12	13	14	15	16	17	18	19
100.2	20	21	22	23	24	25	26	27	28	29
100.3	30	32	33	34	35	36	37	38	39	40
100.4	41	42	43	44	45	46	47	48	49	50
100.5	51	52	53	55	56	57	58	59	60	61
100.6	62	63	64	65	66	67	68	69	71	72
100.7	73	74	75	76	77	78	79	80	81	82
100.8	84	85	86	87	88	89	90	91	92	93
100.9	94	96	97	98	99	100	101	102	103	104
101.0	105	107	108	109	110	111	112	113	114	116
101.1	117	118	119	120	121	122	123	125	126	127
101.2	128	129	130	131	132	134	135	136	137	138
101.3	139	140	142	143	144	145	146	147	148	150
101.4	151	152	153	154	155	157	158	159	160	161
101.5	162	164	165	166	167	168	169	171	172	173
101.6	174	175	176	178	179	180	181	182	184	185
101.7	186	187	188	189	191	192	193	194	195	197
101.8	198	199	200	201	203	204	205	206	207	209
101.9	210	211	212	213	215	216	217	218	220	221
102.0	222	223	224	226	227	228	229	231	232	233
102.1	234	235	237	238	239	240	242	243	244	245
102.2	247	248	249	250	252	253	254	255	257	258
102.3	259	260	262	263	264	265	267	268	269	270
102.4	272	273	274	275	277	278	279	281	282	283
102.5	284	286	287	288	289	291	292	293	295	296
102.6	297	298	300	301	302	304	305	306	308	309
102.7	310	311	313	314	315	317	318	319	321	322
102.8	323	324	326	327	328	330	331	332	334	335
102.9	336	338	339	340	342	343	344	346	347	348
103.0	349	351	352	353	355	356	357	359	360	362
103.1	363	364	366	367	368	370	371	372	374	375
103.2	376	378	379	380	382	383	384	386	387	389
103.3	390	391	393	394	395	397	398	399	401	402
103.4	404	405	406	408	409	410	412	413	415	416
103.5	417	419	420	422	423	424	426	427	428	430
103.6	431	433	434	435	437	438	440	441	442	444
103.7	445	447	448	450	451	452	454	455	457	458
103.8	459	461	462	464	465	467	468	469	471	472
103.9	474	475	477	478	479	481	482	484	485	487

Sample I for Large Epsilon
Capacity Table - 0.01 foot inc

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
104.0	488	489	491	492	494	495	497	498	500	501
104.1	502	504	505	507	508	510	511	513	514	516
104.2	517	518	520	521	523	524	526	527	529	530
104.3	532	533	535	536	538	539	541	542	544	545
104.4	546	548	549	551	552	554	555	557	558	560
104.5	561	563	564	566	567	569	570	572	573	575
104.6	576	578	579	581	582	584	585	587	588	590
104.7	591	593	595	596	598	599	601	602	604	605
104.8	607	608	610	611	613	614	616	617	619	621
104.9	622	624	625	627	628	630	631	633	634	636
105.0	637	639	641	642	644	645	647	648	650	651
105.1	653	655	656	658	659	661	662	664	666	667
105.2	669	670	672	673	675	677	678	680	681	683
105.3	684	686	688	689	691	692	694	696	697	699
105.4	700	702	704	705	707	708	710	712	713	715
105.5	716	718	720	721	723	724	726	728	729	731
105.6	732	734	736	737	739	741	742	744	745	747
105.7	749	750	752	754	755	757	758	760	762	763
105.8	765	767	768	770	772	773	775	777	778	780
105.9	781	783	785	786	788	790	791	793	795	796
106.0	798	800	801	803	805	806	808	810	811	813
106.1	815	816	818	820	821	823	825	826	828	830
106.2	831	833	835	836	838	840	842	843	845	847
106.3	848	850	852	853	855	857	858	860	862	864
106.4	865	867	869	870	872	874	876	877	879	881
106.5	882	884	886	888	889	891	893	894	896	898
106.6	900	901	903	905	906	908	910	912	913	915
106.7	917	919	920	922	924	926	927	929	931	933
106.8	934	936	938	940	941	943	945	947	948	950
106.9	952	954	955	957	959	961	962	964	966	968
107.0	969	971	973	975	977	978	980	982	984	985
107.1	987	989	991	993	994	996	998	1000	1002	1003
107.2	1005	1007	1009	1011	1012	1014	1016	1018	1019	1021
107.3	1023	1025	1027	1029	1030	1032	1034	1036	1038	1039
107.4	1041	1043	1045	1047	1048	1050	1052	1054	1056	1058
107.5	1059	1061	1063	1065	1067	1069	1070	1072	1074	1076
107.6	1078	1080	1081	1083	1085	1087	1089	1091	1092	1094
107.7	1096	1098	1100	1102	1103	1105	1107	1109	1111	1113
107.8	1115	1116	1118	1120	1122	1124	1126	1128	1130	1131
107.9	1133	1135	1137	1139	1141	1143	1144	1146	1148	1150

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
108.0	1152	1154	1156	1158	1160	1161	1163	1165	1167	1169
108.1	1171	1173	1175	1177	1178	1180	1182	1184	1186	1188
108.2	1190	1192	1194	1196	1197	1199	1201	1203	1205	1207
108.3	1209	1211	1213	1215	1217	1218	1220	1222	1224	1226
108.4	1228	1230	1232	1234	1236	1238	1240	1242	1244	1245
108.5	1247	1249	1251	1253	1255	1257	1259	1261	1263	1265
108.6	1267	1269	1271	1273	1275	1277	1278	1280	1282	1284
108.7	1286	1288	1290	1292	1294	1296	1298	1300	1302	1304
108.8	1306	1308	1310	1312	1314	1316	1318	1320	1322	1324
108.9	1326	1328	1330	1332	1334	1336	1338	1340	1342	1344
109.0	1345	1347	1349	1351	1353	1355	1357	1359	1361	1363
109.1	1365	1367	1369	1371	1373	1375	1377	1379	1381	1384
109.2	1386	1388	1390	1392	1394	1396	1398	1400	1402	1404
109.3	1406	1408	1410	1412	1414	1416	1418	1420	1422	1424
109.4	1426	1428	1430	1432	1434	1436	1438	1440	1442	1444
109.5	1446	1448	1450	1453	1455	1457	1459	1461	1463	1465
109.6	1467	1469	1471	1473	1475	1477	1479	1481	1483	1485
109.7	1487	1490	1492	1494	1496	1498	1500	1502	1504	1506
109.8	1508	1510	1512	1514	1517	1519	1521	1523	1525	1527
109.9	1529	1531	1533	1535	1537	1540	1542	1544	1546	1548
110.0	1550	1552	1554	1556	1558	1561	1563	1565	1567	1569
110.1	1571	1573	1575	1577	1579	1582	1584	1586	1588	1590
110.2	1592	1594	1596	1599	1601	1603	1605	1607	1609	1611
110.3	1613	1616	1618	1620	1622	1624	1626	1628	1630	1633
110.4	1635	1637	1639	1641	1643	1645	1648	1650	1652	1654
110.5	1656	1658	1660	1663	1665	1667	1669	1671	1673	1675
110.6	1678	1680	1682	1684	1686	1688	1691	1693	1695	1697
110.7	1699	1701	1704	1706	1708	1710	1712	1714	1717	1719
110.8	1721	1723	1725	1727	1730	1732	1734	1736	1738	1740
110.9	1743	1745	1747	1749	1751	1754	1756	1758	1760	1762
111.0	1764	1767	1769	1771	1773	1775	1778	1780	1782	1784
111.1	1786	1789	1791	1793	1795	1797	1800	1802	1804	1806
111.2	1808	1811	1813	1815	1817	1820	1822	1824	1826	1828
111.3	1831	1833	1835	1837	1839	1842	1844	1846	1848	1851
111.4	1853	1855	1857	1860	1862	1864	1866	1868	1871	1873
111.5	1875	1877	1880	1882	1884	1886	1889	1891	1893	1895
111.6	1898	1900	1902	1904	1907	1909	1911	1913	1916	1918
111.7	1920	1922	1925	1927	1929	1931	1934	1936	1938	1940
111.8	1943	1945	1947	1949	1952	1954	1956	1958	1961	1963
111.9	1965	1968	1970	1972	1974	1977	1979	1981	1983	1986

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
112.0	1988	1990	1993	1995	1997	1999	2002	2004	2006	2009
112.1	2011	2013	2015	2018	2020	2022	2025	2027	2029	2031
112.2	2034	2036	2038	2041	2043	2045	2048	2050	2052	2054
112.3	2057	2059	2061	2064	2066	2068	2071	2073	2075	2078
112.4	2080	2082	2085	2087	2089	2092	2094	2096	2098	2101
112.5	2103	2105	2108	2110	2112	2115	2117	2119	2122	2124
112.6	2126	2129	2131	2133	2136	2138	2140	2143	2145	2147
112.7	2150	2152	2154	2157	2159	2162	2164	2166	2169	2171
112.8	2173	2176	2178	2180	2183	2185	2187	2190	2192	2194
112.9	2197	2199	2202	2204	2206	2209	2211	2213	2216	2218
113.0	2220	2223	2225	2228	2230	2232	2235	2237	2239	2242
113.1	2244	2247	2249	2251	2254	2256	2259	2261	2263	2266
113.2	2268	2270	2273	2275	2278	2280	2282	2285	2287	2290
113.3	2292	2294	2297	2299	2302	2304	2306	2309	2311	2314
113.4	2316	2318	2321	2323	2326	2328	2330	2333	2335	2338
113.5	2340	2343	2345	2347	2350	2352	2355	2357	2359	2362
113.6	2364	2367	2369	2372	2374	2376	2379	2381	2384	2386
113.7	2389	2391	2393	2396	2398	2401	2403	2406	2408	2411
113.8	2413	2415	2418	2420	2423	2425	2428	2430	2433	2435
113.9	2437	2440	2442	2445	2447	2450	2452	2455	2457	2460
114.0	2462	2464	2467	2469	2472	2474	2477	2479	2482	2484
114.1	2487	2489	2492	2494	2497	2499	2501	2504	2506	2509
114.2	2511	2514	2516	2519	2521	2524	2526	2529	2531	2534
114.3	2536	2539	2541	2544	2546	2549	2551	2554	2556	2559
114.4	2561	2564	2566	2569	2571	2574	2576	2579	2581	2584
114.5	2586	2589	2591	2594	2596	2599	2601	2604	2606	2609
114.6	2611	2614	2616	2619	2621	2624	2626	2629	2631	2634
114.7	2636	2639	2641	2644	2647	2649	2652	2654	2657	2659
114.8	2662	2664	2667	2669	2672	2674	2677	2679	2682	2685
114.9	2687	2690	2692	2695	2697	2700	2702	2705	2707	2710
115.0	2712	2715	2718	2720	2723	2725	2728	2730	2733	2735
115.1	2738	2741	2743	2746	2748	2751	2753	2756	2759	2761
115.2	2764	2766	2769	2771	2774	2777	2779	2782	2784	2787
115.3	2789	2792	2795	2797	2800	2802	2805	2807	2810	2813
115.4	2815	2818	2820	2823	2826	2828	2831	2833	2836	2839
115.5	2841	2844	2846	2849	2852	2854	2857	2859	2862	2865
115.6	2867	2870	2872	2875	2878	2880	2883	2885	2888	2891
115.7	2893	2896	2898	2901	2904	2906	2909	2912	2914	2917
115.8	2919	2922	2925	2927	2930	2933	2935	2938	2940	2943
115.9	2946	2948	2951	2954	2956	2959	2961	2964	2967	2969

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
116.0	2972	2975	2977	2980	2983	2985	2988	2991	2993	2996
116.1	2998	3001	3004	3006	3009	3012	3014	3017	3020	3022
116.2	3025	3028	3030	3033	3036	3038	3041	3044	3046	3049
116.3	3052	3054	3057	3060	3062	3065	3068	3070	3073	3076
116.4	3078	3081	3084	3086	3089	3092	3094	3097	3100	3102
116.5	3105	3108	3110	3113	3116	3119	3121	3124	3127	3129
116.6	3132	3135	3137	3140	3143	3146	3148	3151	3154	3156
116.7	3159	3162	3164	3167	3170	3173	3175	3178	3181	3183
116.8	3186	3189	3192	3194	3197	3200	3202	3205	3208	3211
116.9	3213	3216	3219	3221	3224	3227	3230	3232	3235	3238
117.0	3240	3243	3246	3249	3251	3254	3257	3260	3262	3265
117.1	3268	3271	3273	3276	3279	3282	3284	3287	3290	3293
117.2	3295	3298	3301	3304	3306	3309	3312	3315	3317	3320
117.3	3323	3326	3328	3331	3334	3337	3339	3342	3345	3348
117.4	3350	3353	3356	3359	3361	3364	3367	3370	3373	3375
117.5	3378	3381	3384	3386	3389	3392	3395	3398	3400	3403
117.6	3406	3409	3411	3414	3417	3420	3423	3425	3428	3431
117.7	3434	3437	3439	3442	3445	3448	3451	3453	3456	3459
117.8	3462	3465	3467	3470	3473	3476	3479	3481	3484	3487
117.9	3490	3493	3495	3498	3501	3504	3507	3510	3512	3515
118.0	3518	3521	3524	3526	3529	3532	3535	3538	3541	3543
118.1	3546	3549	3552	3555	3558	3560	3563	3566	3569	3572
118.2	3575	3577	3580	3583	3586	3589	3592	3594	3597	3600
118.3	3603	3606	3609	3612	3614	3617	3620	3623	3626	3629
118.4	3632	3634	3637	3640	3643	3646	3649	3652	3654	3657
118.5	3660	3663	3666	3669	3672	3674	3677	3680	3683	3686
118.6	3689	3692	3695	3697	3700	3703	3706	3709	3712	3715
118.7	3718	3720	3723	3726	3729	3732	3735	3738	3741	3744
118.8	3746	3749	3752	3755	3758	3761	3764	3767	3770	3773
118.9	3775	3778	3781	3784	3787	3790	3793	3796	3799	3802
119.0	3804	3807	3810	3813	3816	3819	3822	3825	3828	3831
119.1	3834	3837	3839	3842	3845	3848	3851	3854	3857	3860
119.2	3863	3866	3869	3872	3875	3878	3880	3883	3886	3889
119.3	3892	3895	3898	3901	3904	3907	3910	3913	3916	3919
119.4	3922	3925	3928	3930	3933	3936	3939	3942	3945	3948
119.5	3951	3954	3957	3960	3963	3966	3969	3972	3975	3978
119.6	3981	3984	3987	3990	3993	3996	3999	4001	4004	4007
119.7	4010	4013	4016	4019	4022	4025	4028	4031	4034	4037
119.8	4040	4043	4046	4049	4052	4055	4058	4061	4064	4067
119.9	4070	4073	4076	4079	4082	4085	4088	4091	4094	4097

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
120.0	4100	4103	4106	4109	4112	4115	4118	4121	4124	4127
120.1	4130	4133	4136	4139	4142	4145	4148	4151	4154	4157
120.2	4160	4163	4166	4169	4172	4175	4178	4181	4184	4187
120.3	4190	4193	4197	4200	4203	4206	4209	4212	4215	4218
120.4	4221	4224	4227	4230	4233	4236	4239	4242	4245	4248
120.5	4251	4254	4257	4260	4263	4267	4270	4273	4276	4279
120.6	4282	4285	4288	4291	4294	4297	4300	4303	4306	4309
120.7	4312	4316	4319	4322	4325	4328	4331	4334	4337	4340
120.8	4343	4346	4349	4352	4356	4359	4362	4365	4368	4371
120.9	4374	4377	4380	4383	4386	4390	4393	4396	4399	4402
121.0	4405	4408	4411	4414	4417	4421	4424	4427	4430	4433
121.1	4436	4439	4442	4445	4448	4452	4455	4458	4461	4464
121.2	4467	4470	4473	4477	4480	4483	4486	4489	4492	4495
121.3	4498	4502	4505	4508	4511	4514	4517	4520	4524	4527
121.4	4530	4533	4536	4539	4542	4546	4549	4552	4555	4558
121.5	4561	4564	4568	4571	4574	4577	4580	4583	4586	4590
121.6	4593	4596	4599	4602	4605	4609	4612	4615	4618	4621
121.7	4624	4628	4631	4634	4637	4640	4643	4647	4650	4653
121.8	4656	4659	4663	4666	4669	4672	4675	4678	4682	4685
121.9	4688	4691	4694	4698	4701	4704	4707	4710	4714	4717
122.0	4720	4723	4726	4730	4733	4736	4739	4742	4746	4749
122.1	4752	4755	4758	4762	4765	4768	4771	4775	4778	4781
122.2	4784	4787	4791	4794	4797	4800	4804	4807	4810	4813
122.3	4816	4820	4823	4826	4829	4833	4836	4839	4842	4846
122.4	4849	4852	4855	4859	4862	4865	4868	4872	4875	4878
122.5	4881	4885	4888	4891	4894	4898	4901	4904	4907	4911
122.6	4914	4917	4920	4924	4927	4930	4933	4937	4940	4943
122.7	4946	4950	4953	4956	4960	4963	4966	4969	4973	4976
122.8	4979	4982	4986	4989	4992	4996	4999	5002	5005	5009
122.9	5012	5015	5019	5022	5025	5029	5032	5035	5038	5042
123.0	5045	5048	5052	5055	5058	5062	5065	5068	5071	5075
123.1	5078	5081	5085	5088	5091	5095	5098	5101	5105	5108
123.2	5111	5115	5118	5121	5124	5128	5131	5134	5138	5141
123.3	5144	5148	5151	5154	5158	5161	5164	5168	5171	5174
123.4	5178	5181	5184	5188	5191	5195	5198	5201	5205	5208
123.5	5211	5215	5218	5221	5225	5228	5231	5235	5238	5241
123.6	5245	5248	5252	5255	5258	5262	5265	5268	5272	5275
123.7	5278	5282	5285	5289	5292	5295	5299	5302	5305	5309
123.8	5312	5316	5319	5322	5326	5329	5332	5336	5339	5343
123.9	5346	5349	5353	5356	5360	5363	5366	5370	5373	5377

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
124.0	5380	5383	5387	5390	5394	5397	5400	5404	5407	5411
124.1	5414	5417	5421	5424	5428	5431	5435	5438	5441	5445
124.2	5448	5452	5455	5458	5462	5465	5469	5472	5476	5479
124.3	5482	5486	5489	5493	5496	5500	5503	5506	5510	5513
124.4	5517	5520	5524	5527	5531	5534	5537	5541	5544	5548
124.5	5551	5555	5558	5562	5565	5569	5572	5575	5579	5582
124.6	5586	5589	5593	5596	5600	5603	5607	5610	5614	5617
124.7	5620	5624	5627	5631	5634	5638	5641	5645	5648	5652
124.8	5655	5659	5662	5666	5669	5673	5676	5680	5683	5687
124.9	5690	5694	5697	5701	5704	5708	5711	5715	5718	5722
125.0	5725	5729	5732	5736	5739	5743	5746	5750	5753	5757
125.1	5760	5764	5767	5771	5774	5778	5781	5785	5788	5792
125.2	5795	5799	5802	5806	5809	5813	5816	5820	5823	5827
125.3	5830	5834	5838	5841	5845	5848	5852	5855	5859	5862
125.4	5866	5869	5873	5876	5880	5884	5887	5891	5894	5898
125.5	5901	5905	5908	5912	5915	5919	5923	5926	5930	5933
125.6	5937	5940	5944	5947	5951	5955	5958	5962	5965	5969
125.7	5972	5976	5980	5983	5987	5990	5994	5997	6001	6005
125.8	6008	6012	6015	6019	6023	6026	6030	6033	6037	6040
125.9	6044	6048	6051	6055	6058	6062	6066	6069	6073	6076
126.0	6080	6084	6087	6091	6094	6098	6102	6105	6109	6112
126.1	6116	6120	6123	6127	6130	6134	6138	6141	6145	6149
126.2	6152	6156	6159	6163	6167	6170	6174	6178	6181	6185
126.3	6188	6192	6196	6199	6203	6207	6210	6214	6218	6221
126.4	6225	6228	6232	6236	6239	6243	6247	6250	6254	6258
126.5	6261	6265	6269	6272	6276	6280	6283	6287	6290	6294
126.6	6298	6301	6305	6309	6312	6316	6320	6323	6327	6331
126.7	6334	6338	6342	6345	6349	6353	6356	6360	6364	6368
126.8	6371	6375	6379	6382	6386	6390	6393	6397	6401	6404
126.9	6408	6412	6415	6419	6423	6427	6430	6434	6438	6441
127.0	6445	6449	6452	6456	6460	6464	6467	6471	6475	6478
127.1	6482	6486	6489	6493	6497	6501	6504	6508	6512	6515
127.2	6519	6523	6527	6530	6534	6538	6542	6545	6549	6553
127.3	6556	6560	6564	6568	6571	6575	6579	6583	6586	6590
127.4	6594	6598	6601	6605	6609	6613	6616	6620	6624	6628
127.5	6631	6635	6639	6643	6646	6650	6654	6658	6661	6665
127.6	6669	6673	6676	6680	6684	6688	6691	6695	6699	6703
127.7	6706	6710	6714	6718	6722	6725	6729	6733	6737	6740
127.8	6744	6748	6752	6756	6759	6763	6767	6771	6774	6778
127.9	6782	6786	6790	6793	6797	6801	6805	6809	6812	6816

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
128.0	6820	6824	6828	6831	6835	6839	6843	6847	6850	6854
128.1	6858	6862	6866	6869	6873	6877	6881	6885	6889	6892
128.2	6896	6900	6904	6908	6911	6915	6919	6923	6927	6931
128.3	6934	6938	6942	6946	6950	6954	6957	6961	6965	6969
128.4	6973	6977	6980	6984	6988	6992	6996	7000	7004	7007
128.5	7011	7015	7019	7023	7027	7031	7034	7038	7042	7046
128.6	7050	7054	7058	7061	7065	7069	7073	7077	7081	7085
128.7	7088	7092	7096	7100	7104	7108	7112	7116	7119	7123
128.8	7127	7131	7135	7139	7143	7147	7150	7154	7158	7162
128.9	7166	7170	7174	7178	7182	7186	7189	7193	7197	7201
129.0	7205	7209	7213	7217	7221	7225	7228	7232	7236	7240
129.1	7244	7248	7252	7256	7260	7264	7268	7271	7275	7279
129.2	7283	7287	7291	7295	7299	7303	7307	7311	7315	7319
129.3	7322	7326	7330	7334	7338	7342	7346	7350	7354	7358
129.4	7362	7366	7370	7374	7378	7382	7385	7389	7393	7397
129.5	7401	7405	7409	7413	7417	7421	7425	7429	7433	7437
129.6	7441	7445	7449	7453	7457	7461	7465	7469	7473	7476
129.7	7480	7484	7488	7492	7496	7500	7504	7508	7512	7516
129.8	7520	7524	7528	7532	7536	7540	7544	7548	7552	7556
129.9	7560	7564	7568	7572	7576	7580	7584	7588	7592	7596
130.0	7600	7604	7608	7612	7616	7620	7624	7628	7632	7636
130.1	7640	7644	7648	7652	7656	7660	7664	7668	7672	7676
130.2	7680	7684	7688	7692	7696	7700	7704	7708	7712	7716
130.3	7720	7724	7728	7732	7737	7741	7745	7749	7753	7757
130.4	7761	7765	7769	7773	7777	7781	7785	7789	7793	7797
130.5	7801	7805	7809	7813	7817	7821	7825	7829	7834	7838
130.6	7842	7846	7850	7854	7858	7862	7866	7870	7874	7878
130.7	7882	7886	7890	7894	7898	7903	7907	7911	7915	7919
130.8	7923	7927	7931	7935	7939	7943	7947	7951	7955	7960
130.9	7964	7968	7972	7976	7980	7984	7988	7992	7996	8000
131.0	8004	8009	8013	8017	8021	8025	8029	8033	8037	8041
131.1	8045	8050	8054	8058	8062	8066	8070	8074	8078	8082
131.2	8086	8091	8095	8099	8103	8107	8111	8115	8119	8123
131.3	8128	8132	8136	8140	8144	8148	8152	8156	8161	8165
131.4	8169	8173	8177	8181	8185	8189	8194	8198	8202	8206
131.5	8210	8214	8218	8223	8227	8231	8235	8239	8243	8247
131.6	8252	8256	8260	8264	8268	8272	8276	8281	8285	8289
131.7	8293	8297	8301	8305	8310	8314	8318	8322	8326	8330
131.8	8335	8339	8343	8347	8351	8355	8360	8364	8368	8372
131.9	8376	8380	8385	8389	8393	8397	8401	8405	8410	8414

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
132.0	8418	8422	8426	8431	8435	8439	8443	8447	8451	8456
132.1	8460	8464	8468	8472	8477	8481	8485	8489	8493	8498
132.2	8502	8506	8510	8514	8519	8523	8527	8531	8535	8540
132.3	8544	8548	8552	8556	8561	8565	8569	8573	8577	8582
132.4	8586	8590	8594	8599	8603	8607	8611	8615	8620	8624
132.5	8628	8632	8637	8641	8645	8649	8653	8658	8662	8666
132.6	8670	8675	8679	8683	8687	8692	8696	8700	8704	8709
132.7	8713	8717	8721	8726	8730	8734	8738	8743	8747	8751
132.8	8755	8760	8764	8768	8772	8777	8781	8785	8789	8794
132.9	8798	8802	8806	8811	8815	8819	8823	8828	8832	8836
133.0	8840	8845	8849	8853	8858	8862	8866	8870	8875	8879
133.1	8883	8888	8892	8896	8900	8905	8909	8913	8918	8922
133.2	8926	8930	8935	8939	8943	8948	8952	8956	8960	8965
133.3	8969	8973	8978	8982	8986	8991	8995	8999	9003	9008
133.4	9012	9016	9021	9025	9029	9034	9038	9042	9046	9051
133.5	9055	9059	9064	9068	9072	9077	9081	9085	9090	9094
133.6	9098	9103	9107	9111	9116	9120	9124	9129	9133	9137
133.7	9142	9146	9150	9155	9159	9163	9168	9172	9176	9181
133.8	9185	9189	9194	9198	9202	9207	9211	9215	9220	9224
133.9	9228	9233	9237	9242	9246	9250	9255	9259	9263	9268
134.0	9272	9276	9281	9285	9289	9294	9298	9303	9307	9311
134.1	9316	9320	9324	9329	9333	9338	9342	9346	9351	9355
134.2	9359	9364	9368	9373	9377	9381	9386	9390	9394	9399
134.3	9403	9408	9412	9416	9421	9425	9430	9434	9438	9443
134.4	9447	9452	9456	9460	9465	9469	9474	9478	9482	9487
134.5	9491	9496	9500	9504	9509	9513	9518	9522	9526	9531
134.6	9535	9540	9544	9548	9553	9557	9562	9566	9571	9575
134.7	9579	9584	9588	9593	9597	9602	9606	9610	9615	9619
134.8	9624	9628	9633	9637	9641	9646	9650	9655	9659	9664
134.9	9668	9672	9677	9681	9686	9690	9695	9699	9704	9708
135.0	9712	9717	9721	9726	9730	9735	9739	9744	9748	9753
135.1	9757	9762	9766	9770	9775	9779	9784	9788	9793	9797
135.2	9802	9806	9811	9815	9820	9824	9829	9833	9837	9842
135.3	9846	9851	9855	9860	9864	9869	9873	9878	9882	9887
135.4	9891	9896	9900	9905	9909	9914	9918	9923	9927	9932
135.5	9936	9941	9945	9950	9954	9959	9963	9968	9972	9977
135.6	9981	9986	9990	9995	9999	10004	10008	10013	10017	10022
135.7	10026	10031	10035	10040	10044	10049	10053	10058	10062	10067
135.8	10071	10076	10080	10085	10089	10094	10099	10103	10108	10112
135.9	10117	10121	10126	10130	10135	10139	10144	10148	10153	10157

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
136.0	10162	10167	10171	10176	10180	10185	10189	10194	10198	10203
136.1	10207	10212	10217	10221	10226	10230	10235	10239	10244	10248
136.2	10253	10258	10262	10267	10271	10276	10280	10285	10289	10294
136.3	10299	10303	10308	10312	10317	10321	10326	10331	10335	10340
136.4	10344	10349	10353	10358	10363	10367	10372	10376	10381	10386
136.5	10390	10395	10399	10404	10408	10413	10418	10422	10427	10431
136.6	10436	10441	10445	10450	10454	10459	10464	10468	10473	10477
136.7	10482	10487	10491	10496	10500	10505	10510	10514	10519	10523
136.8	10528	10533	10537	10542	10547	10551	10556	10560	10565	10570
136.9	10574	10579	10583	10588	10593	10597	10602	10607	10611	10616
137.0	10620	10625	10630	10634	10639	10644	10648	10653	10658	10662
137.1	10667	10671	10676	10681	10685	10690	10695	10699	10704	10709
137.2	10713	10718	10723	10727	10732	10737	10741	10746	10750	10755
137.3	10760	10764	10769	10774	10778	10783	10788	10792	10797	10802
137.4	10806	10811	10816	10820	10825	10830	10834	10839	10844	10848
137.5	10853	10858	10862	10867	10872	10877	10881	10886	10891	10895
137.6	10900	10905	10909	10914	10919	10923	10928	10933	10937	10942
137.7	10947	10951	10956	10961	10966	10970	10975	10980	10984	10989
137.8	10994	10998	11003	11008	11013	11017	11022	11027	11031	11036
137.9	11041	11046	11050	11055	11060	11064	11069	11074	11079	11083
138.0	11088	11093	11097	11102	11107	11112	11116	11121	11126	11131
138.1	11135	11140	11145	11149	11154	11159	11164	11168	11173	11178
138.2	11183	11187	11192	11197	11202	11206	11211	11216	11221	11225
138.3	11230	11235	11240	11244	11249	11254	11259	11263	11268	11273
138.4	11278	11282	11287	11292	11297	11301	11306	11311	11316	11320
138.5	11325	11330	11335	11339	11344	11349	11354	11359	11363	11368
138.6	11373	11378	11382	11387	11392	11397	11401	11406	11411	11416
138.7	11421	11425	11430	11435	11440	11445	11449	11454	11459	11464
138.8	11468	11473	11478	11483	11488	11492	11497	11502	11507	11512
138.9	11516	11521	11526	11531	11536	11540	11545	11550	11555	11560
139.0	11564	11569	11574	11579	11584	11589	11593	11598	11603	11608
139.1	11613	11617	11622	11627	11632	11637	11642	11646	11651	11656
139.2	11661	11666	11671	11675	11680	11685	11690	11695	11700	11704
139.3	11709	11714	11719	11724	11729	11733	11738	11743	11748	11753
139.4	11758	11762	11767	11772	11777	11782	11787	11792	11796	11801
139.5	11806	11811	11816	11821	11826	11830	11835	11840	11845	11850
139.6	11855	11860	11864	11869	11874	11879	11884	11889	11894	11899
139.7	11903	11908	11913	11918	11923	11928	11933	11938	11942	11947
139.8	11952	11957	11962	11967	11972	11977	11981	11986	11991	11996
139.9	12001	12006	12011	12016	12021	12026	12030	12035	12040	12045

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
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CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
140.0	12050	12055	12060	12065	12070	12075	12079	12084	12089	12094
140.1	12099	12104	12109	12114	12119	12124	12129	12133	12138	12143
140.2	12148	12153	12158	12163	12168	12173	12178	12183	12188	12193
140.3	12197	12202	12207	12212	12217	12222	12227	12232	12237	12242
140.4	12247	12252	12257	12262	12267	12272	12277	12282	12286	12291
140.5	12296	12301	12306	12311	12316	12321	12326	12331	12336	12341
140.6	12346	12351	12356	12361	12366	12371	12376	12381	12386	12391
140.7	12396	12401	12406	12411	12416	12421	12426	12431	12436	12441
140.8	12446	12451	12455	12460	12465	12470	12475	12480	12485	12490
140.9	12495	12500	12505	12510	12515	12520	12525	12530	12535	12540
141.0	12545	12551	12556	12561	12566	12571	12576	12581	12586	12591
141.1	12596	12601	12606	12611	12616	12621	12626	12631	12636	12641
141.2	12646	12651	12656	12661	12666	12671	12676	12681	12686	12691
141.3	12696	12701	12706	12711	12716	12722	12727	12732	12737	12742
141.4	12747	12752	12757	12762	12767	12772	12777	12782	12787	12792
141.5	12797	12802	12808	12813	12818	12823	12828	12833	12838	12843
141.6	12848	12853	12858	12863	12868	12873	12879	12884	12889	12894
141.7	12899	12904	12909	12914	12919	12924	12929	12935	12940	12945
141.8	12950	12955	12960	12965	12970	12975	12980	12986	12991	12996
141.9	13001	13006	13011	13016	13021	13026	13032	13037	13042	13047
142.0	13052	13057	13062	13067	13072	13078	13083	13088	13093	13098
142.1	13103	13108	13114	13119	13124	13129	13134	13139	13144	13149
142.2	13155	13160	13165	13170	13175	13180	13185	13191	13196	13201
142.3	13206	13211	13216	13222	13227	13232	13237	13242	13247	13253
142.4	13258	13263	13268	13273	13278	13284	13289	13294	13299	13304
142.5	13309	13315	13320	13325	13330	13335	13340	13346	13351	13356
142.6	13361	13366	13372	13377	13382	13387	13392	13398	13403	13408
142.7	13413	13418	13423	13429	13434	13439	13444	13450	13455	13460
142.8	13465	13470	13476	13481	13486	13491	13496	13502	13507	13512
142.9	13517	13522	13528	13533	13538	13543	13549	13554	13559	13564
143.0	13569	13575	13580	13585	13590	13596	13601	13606	13611	13617
143.1	13622	13627	13632	13638	13643	13648	13653	13659	13664	13669
143.2	13674	13680	13685	13690	13695	13701	13706	13711	13716	13722
143.3	13727	13732	13737	13743	13748	13753	13758	13764	13769	13774
143.4	13780	13785	13790	13795	13801	13806	13811	13817	13822	13827
143.5	13832	13838	13843	13848	13854	13859	13864	13869	13875	13880
143.6	13885	13891	13896	13901	13906	13912	13917	13922	13928	13933
143.7	13938	13944	13949	13954	13960	13965	13970	13975	13981	13986
143.8	13991	13997	14002	14007	14013	14018	14023	14029	14034	14039
143.9	14045	14050	14055	14061	14066	14071	14077	14082	14087	14093

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
144.0	14098	14103	14109	14114	14119	14125	14130	14135	14141	14146
144.1	14151	14157	14162	14168	14173	14178	14184	14189	14194	14200
144.2	14205	14210	14216	14221	14226	14232	14237	14243	14248	14253
144.3	14259	14264	14269	14275	14280	14286	14291	14296	14302	14307
144.4	14312	14318	14323	14329	14334	14339	14345	14350	14356	14361
144.5	14366	14372	14377	14383	14388	14393	14399	14404	14410	14415
144.6	14420	14426	14431	14437	14442	14447	14453	14458	14464	14469
144.7	14474	14480	14485	14491	14496	14502	14507	14512	14518	14523
144.8	14529	14534	14540	14545	14550	14556	14561	14567	14572	14578
144.9	14583	14588	14594	14599	14605	14610	14616	14621	14627	14632
145.0	14637	14643	14648	14654	14659	14665	14670	14676	14681	14687
145.1	14692	14698	14703	14708	14714	14719	14725	14730	14736	14741
145.2	14747	14752	14758	14763	14769	14774	14780	14785	14791	14796
145.3	14801	14807	14812	14818	14823	14829	14834	14840	14845	14851
145.4	14856	14862	14867	14873	14878	14884	14889	14895	14900	14906
145.5	14911	14917	14922	14928	14933	14939	14944	14950	14955	14961
145.6	14966	14972	14978	14983	14989	14994	15000	15005	15011	15016
145.7	15022	15027	15033	15038	15044	15049	15055	15060	15066	15071
145.8	15077	15083	15088	15094	15099	15105	15110	15116	15121	15127
145.9	15132	15138	15144	15149	15155	15160	15166	15171	15177	15182
146.0	15188	15194	15199	15205	15210	15216	15221	15227	15233	15238
146.1	15244	15249	15255	15260	15266	15272	15277	15283	15288	15294
146.2	15299	15305	15311	15316	15322	15327	15333	15339	15344	15350
146.3	15355	15361	15366	15372	15378	15383	15389	15394	15400	15406
146.4	15411	15417	15422	15428	15434	15439	15445	15451	15456	15462
146.5	15467	15473	15479	15484	15490	15495	15501	15507	15512	15518
146.6	15524	15529	15535	15540	15546	15552	15557	15563	15569	15574
146.7	15580	15586	15591	15597	15602	15608	15614	15619	15625	15631
146.8	15636	15642	15648	15653	15659	15665	15670	15676	15682	15687
146.9	15693	15699	15704	15710	15715	15721	15727	15732	15738	15744
147.0	15749	15755	15761	15767	15772	15778	15784	15789	15795	15801
147.1	15806	15812	15818	15823	15829	15835	15840	15846	15852	15857
147.2	15863	15869	15875	15880	15886	15892	15897	15903	15909	15914
147.3	15920	15926	15932	15937	15943	15949	15954	15960	15966	15971
147.4	15977	15983	15989	15994	16000	16006	16011	16017	16023	16029
147.5	16034	16040	16046	16052	16057	16063	16069	16074	16080	16086
147.6	16092	16097	16103	16109	16115	16120	16126	16132	16138	16143
147.7	16149	16155	16161	16166	16172	16178	16184	16189	16195	16201
147.8	16207	16212	16218	16224	16230	16235	16241	16247	16253	16258
147.9	16264	16270	16276	16282	16287	16293	16299	16305	16310	16316

TEST PROBLEM SHOWING THE EFFECTS OF A LARGE EPSILON VALUE (0.05)

(ACAP85) COMPUTED
05/01/85
15.58.49.

CAPACITY TABLE IN ACRE FEET

ELEVATION INCREMENT IS ONE HUNDREDTH FOOT

ELEV. FEET	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
148.0	16322	16328	16334	16339	16345	16351	16357	16362	16368	16374
148.1	16380	16386	16391	16397	16403	16409	16415	16420	16426	16432
148.2	16438	16444	16449	16455	16461	16467	16473	16478	16484	16490
148.3	16496	16502	16508	16513	16519	16525	16531	16537	16542	16548
148.4	16554	16560	16566	16572	16577	16583	16589	16595	16601	16607
148.5	16612	16618	16624	16630	16636	16642	16647	16653	16659	16665
148.6	16671	16677	16682	16688	16694	16700	16706	16712	16718	16723
148.7	16729	16735	16741	16747	16753	16759	16764	16770	16776	16782
148.8	16788	16794	16800	16806	16811	16817	16823	16829	16835	16841
148.9	16847	16853	16858	16864	16870	16876	16882	16888	16894	16900
149.0	16905	16911	16917	16923	16929	16935	16941	16947	16953	16959
149.1	16964	16970	16976	16982	16988	16994	17000	17006	17012	17018
149.2	17024	17029	17035	17041	17047	17053	17059	17065	17071	17077
149.3	17083	17089	17095	17100	17106	17112	17118	17124	17130	17136
149.4	17142	17148	17154	17160	17166	17172	17178	17184	17189	17195
149.5	17201	17207	17213	17219	17225	17231	17237	17243	17249	17255
149.6	17261	17267	17273	17279	17285	17291	17297	17303	17309	17315
149.7	17320	17326	17332	17338	17344	17350	17356	17362	17368	17374
149.8	17380	17386	17392	17398	17404	17410	17416	17422	17428	17434
149.9	17440	17446	17452	17458	17464	17470	17476	17482	17488	17494
150.0	17500									

Appendix D

Metric Relationships

$1\ km^2 = 1{,}000{,}000\ m^2 \quad (10^6 m^2)$

$1\ \text{Hectare} = 100{,}000\ m^2 \quad (10^4 m^2)$

$1\ km^2 = 100\ \text{Hectares}$

Multiply Hectares by meters results in units of 10,000 m^3 thus, they would have to be multiplied by 10 to get them into units of 1000 m^3.

Elevations in meters
areas in Hectares
Volumes in 1000 m^3

Elevations in ft
Areas in acres
Volume in acre-ft

1 Acre foot x 1.23348 = 1000 m^3
1 acre x 0.404686 Hectare
1 ft = x 0.3048 meters

1000 m^3 x 0.81071 = acre-ft
1 Hectare x 2.471051 = acres
1 meter x 3.28084 = ft

Appendix E

References

1. Wylie, C. R., Advanced Engineering Mathematics 3rd edition, 813 pages, McGraw-Hill Book Company, 1966.