United States Department of Agriculture
Natural Resources Conservation Service

W A S C O B . E X E

Water and Sediment

Control Basin Design

Version 3.00

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Introduction:

This program can be used to calculate the dimensions of a basin that is used to contain or detain, sediment and storm water runoff. The program accepts topographic information is the form of cross-section. These cross- sections are entered into the system in a standard distance / elevation (rod reading) format. As data is entered, it is graphically displayed which helps to assure the integrity of the data. When sufficient survey data has been entered, information reflecting the characteristics of the watershed and desired dimensions of the embankment or dike are added to the data set. With the above data available, the program will determine the appropriate runoff from the watershed, expected sediment yield from the watershed and storage capabilities of the site. It will then determine the dimensions of a dike or embankment necessary to temporarily store the runoff and sediment. Once a satisfactory design has been achieved, a report suitable for documentation can be easily generated.

The program is capable of saving the survey and design parameters so that subsequent modifications to the design are easily accessible.

Supporting Files:

The water and sediment control basin design program is contained in a file called ***"WASCOB.EXE"***. In order to run, it must be supported by at least seven additional files on the default drive. The recommended setup follows:

BRT71EFR.EXE	This is a runtime module that is copyrighted to Microsoft Quick BASIC ™
OH_ENG.CFG	The file containing all of the specifics about your computing system such as type of printer, type of monitor, where data is saved, etc. This file is generated and maintained by a separate program named “eng_cfg.exe”. It is accessible from the “Utility” selection of the main Ohio Engineering Menu.
CLIMATE.DAT	This file contains rainfall information arranged by county name. If this file is accessible, the program will retrieve the applicable rainfall information necessary for your design. If the file is missing, the program will still run but the necessary information will need to be supplied. This file is maintained by a separate program named “data_ed.exe”.
WASCOB.STD	This file contains the default values or any standard values that may apply to this program. The data in this file is controlled by the “modify defaults” portion of the program (see page 11).
WASCOB.ST2	Many of the values that support the program such as minimum and maximum values, formula coefficients, etc. are contained in this ASCII file. While this data can be edited using conventional text editors, it is recommended that changes be left to the experts.(See Page 15 for details related to the contents of this file.)

WASCOB.HLP A file that contains help information related to this program. The program will run without this file but there will obviously be no help information available if the file is not present. Should the program be run without this file, a "dummy" file will be created with this file name containing no data. The information in the "real" file can be modified or clarified using a supporting program named *"edithelp.exe"*.

BROWSE.COM This utility program is used so that some of the reports can be generated in a file format and then viewed on the screen in a controllable manner.

Loading WASCOB:

"WASCOB" can be loaded several ways. Make certain that you are in the subdirectory where the engineering programs reside. The main **"Ohio Engineering Menu"** can be loaded first by entering **"ENGMENU"** at the DOS prompt (C>) and then selecting the "**WASCOB**" program from the choice list. If the water and sediment control basin design program does not exist in the list of programs, use a text editor like *"notepad"* or *"edit"* and enter the following line in the file named "engmenu.dat".

"wascob.exe", "Water & Sediment Control Basin"

The second option is to simply enter **"WASCOB"** at the DOS prompt. The program can also be executed using the procedures for launching a DOS program appropriate with the version of Windows that is being used. Typically this is done by creating a "pif" file or a "short cut". Refer to your Windows manual if you are using Windows.

Special Keys:

In addition to the normal "arrow" keys, "Page Up" and "Page Down", several special purpose keys are available at various times in the program. A brief description of the function of these keys follows. Additional information on these keys can be found by using the **F1** key within the program. (It should be noted that the mouse will also simulate the arrow keys, the left button simulates the return key and the right button duplicates the escape key.)

¿ This is a very important key in that inputs are not registered to the program until the **"return"** (↵) key is pressed. Failing to press the "return" key might result in an error message or it might result in computations being made without the input you thought you had made. Remember to input the requested data and then **press return (¿)** before computing, printing or saving the data. It should be noted that the **tab key** will provide the same response as the return key.

Esc The escape key is most often used to "back up" one action or level in the program. In other words, take you back from whence you cometh. For example, if you are in the data entry screen, "*Esc*" will take you back to the main WASCOB menu. If you are in the main WASCOB menu, "*Esc*" will afford you an opportunity to exit from the program.

F1 This function key will display help information if it is available. On some screens, you will be offered an option of selecting help for the particular entry where the cursor is, the entire screen or special keys.

F2 This key has been designated as the **"edit"** key. Pressing this key will afford you the opportunity to edit a previous entry or default value without completely retyping it. In this mode, the system shifts into an automatic "insert" mode and the left and right cursor keys and the backspace key, all become active. Once again, the return **(¿)** key will register your final entry.

F3 In some instances, pressing this key will cause a calculator to pop up on the screen. This is handy when you need to make a quick calculation. Pressing **F1** while the calculator is on the screen will cause a "help" window to appear that explains how to use the calculator.

F5 If noted at the bottom of the screen, pressing the F5 key will cause the report appropriate for the screen that you are on to be printed.

F9 This function key causes the computation routines to be implemented. This key can be pressed any time a solution is desired. If there is not sufficient data for a successful computation, an applicable message will be displayed. New or changed values on the input screen will clear previous computations and the F9 key will again be needed when all of the changes have been made.

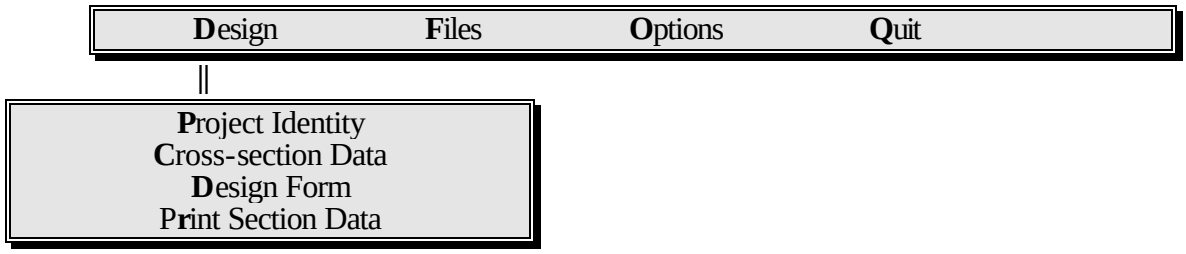
F10 Many times this is used as a “continue” key. Once the entries that are requested on a screen are filled in, this key will cause the program to continue with the function of the screen. It is important to note that this key has other functions assigned to it, so be alert to the messages on the screen.

WASCOB Main Menu -

When the program is first activated, a menu similar to that below will be displayed. The marker identifies the function that is currently active. Pressing "F1" will display a small description of the function. Pressing "Enter" (↵) or the left mouse button will activate the current function. The first letter can also be used to activate any of the specific selections. The right and left arrow keys or the mouse can be used to move the marker.

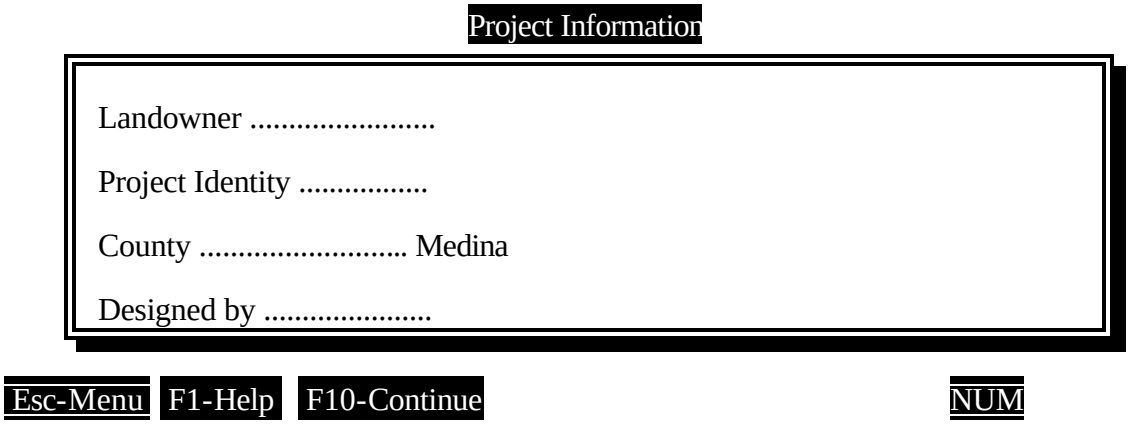
Design:

Selecting “D” for design will cause the following screen, showing the following functions that can be processed by this portion of the program, to appear.



Project Identity -

Upon making this selection, an input screen will appear. The information solicited on this screen will be used to generate complete documentation and to identify the project on these reports as well as in the data saving process.



- Landowner - This information will be used on the print out to identify the project.

- Project Identity - This information is used on the printed output to identify the project more specifically. For example, there might be several control basins on a farm or even in a field. This entry is used to specifically identify the site.

- County - This should be the name of the county that the waterway is in. If you have used the "ENG_CFG.EXE" program, your own county should appear and all you need to do is press the return. If you want to use a different county, simply enter the new county name or press F4 and select a county from the list presented. It is important that the county be spelled correctly because it is the "key" to selecting the proper rainfall that will eventually be used in the design.

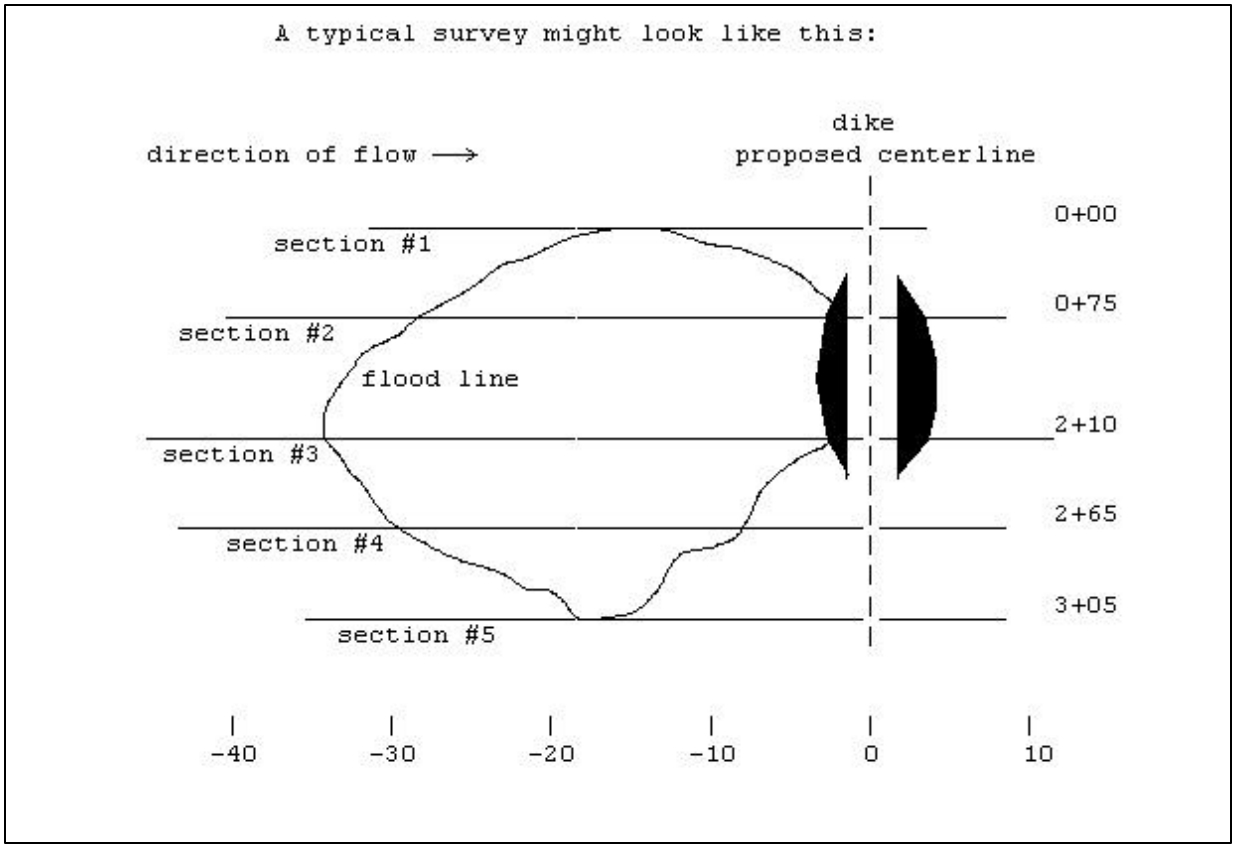
- Designed by - This information is again used on the printed output and helps the lawyers identify the person responsible if the design does not work.

Cross-section Data:

One of the most critical aspects of the WASCOB program is the gathering of the survey data. It has to be collected in a specific manner and using a specific sign convention.

First the proposed centerline of the dike is located in the field. This centerline should be stationed left to right looking downstream. All cross-sections must be taken perpendicular to this centerline with the centerline being the zero distance on the cross-section. It is very important that the cross-sections be at right angles to the centerline. These cross-sections should be viewed so that the water will flow from left to right. This will create several negative distances in the data points. The data should extend far enough upstream and downstream to cover all the slope intercepts.

If there are deep eroded gullies in the area of the dike, it may cause problems if the bottom of the gully is surveyed. The program places the orifice a specified distance below the lowest upstream slope intercept. If this intercept happens to fall within a gully, the orifice might be placed lower than necessary. Unless the gully is significant to the storage volume, it is probably best that it not be part of the cross-section. If you want to survey it, make it a side shot that is not entered into the program.



Upon choosing "Cross-section Data" from the menu, a blank form will appear on the screen. The top portions is the plot area where the cross-section will be displayed as the data is entered. The lower portion of the screen is laid out to accept the data.

- Cross-section Station = The station should be entered as a distance (without the "+") and the program will convert the distance to station format. It is not important that the sections be entered in any specific order as the program will sort them from left to right (increasing stations).

If more than one cross-section has been entered into the system for this job, pressing the F4 function key will provide a list of the sections that exist. Selecting one of the stations will move you to that specific cross-section.

- Elevation or Rod Reading (E/R) = This selection signifies whether the data you are about to enter is in elevation or rod reading format. The program is capable of accepting either. It can even accept some sections as rod readings and others as rod reading. It should be noted that the form of the data (whether elevation or rod) is determined when you exit from the screen the first time. If you suddenly notice that the cross-section is plotted upside down, you have somehow confused the program and it thinks your rod readings are elevations or visa versa. If this should happen, you might have to re-enter the data, trick the system by entering a phony benchmark elevation or carefully edit the saved file using a text editor.

- HI = If you previously entered an "R" for rod reading data, a new line will be displayed on the screen requesting the elevation of the instrument (HI). This elevation will subsequently be used to calculate the elevation of the cross-section data points.

- Dist – Elevation / Rod = The remainder of the entries are the coordinates of the cross-section. Whether the data is entered as elevation or rod readings is predetermined by the choice made above. Each point of a cross-section consists of a pair of data (distance and elevation or rod reading). The significance of this is the manner in which the cursor moves around on the entry screen. The order in which you enter the coordinates is not important as the program will once again sort them. It is important however, that they be entered according to the above mentioned sign convention.

  As the coordinates are entered , the section will be drawn on the screen. This provides an opportunity to pick out obvious errors and correct them.

  Once all of the data for a cross-section had been entered, pressing "PgDn" will move the program to the next cross-section.

Design Form:

WASCOB Design for Demo

- Watershed -		- Ridge -	
County	Medina		
Drainage Area	14 ac.	Front slope	6.5:1
Runoff Curve Number	71	Back slope	7.0:1
10 yr. rainfall	3.5 in.	Top Width	10.0 ft.
Soil Loss	6 ton/ac.	Dist from baseline	ft.

Solution

Height of riser	= 6.0 ft.	Elev of ridge	= 125.6
Size of riser	= 6.0 in.	Elev of orifice	= 120.8
Size of orifice	= 3.50 in.	Elev of low cl point	= 125.6
Discharge	= 0.62 cfs.	Elev of low abutment	= 126.0
d1	= 2.0 ft.	Volume of fill	= 42.8 yds.
d2	= 2.0 ft.	Volume water stored	= 0.79 ac.ft.
Drawdown time	= 24.0 hr.	Volume of sediment	= 0.52 ac.ft.
Delivery ratio	= 100 %	Area flooded	= 0.53 ac.
Runoff stored	= 64 %	End Stations	9+98 on centerline
			10+15 on centerline

(F10) Computation Speed - Fast

Esc-Menu F1-Help F5-Print F9-Compute AltV-View NUM

The design screen is divided into two parts. The top portion outlines the required inputs and the bottom displays the solution. Once sufficient data has been entered in th e top portion, the F9 key will initiate the computation procedure. When the computation is complete, the results will be displayed in the lower portion. Subsequent changes to the inputs will cause the design results to be cleared, necessitating a re-computation.

Details related to the inputs and outputs are as follows:

- county - this should be the county in which the site is located. The value that initially appears is controlled by the configuration that was set up using the *"eng_cfg.exe"* program that is accessed from utilities on the main engineering menu. If the county name needs to be changed, it can be re-typed or the F4 key will provide a list to select from. It is important that the county name be properly spelled so using the F4 option is the safest. If the county name you desire does not appear in the provided list, see the help or instructions associated with the *"data_ed.exe"* program.

- drainage area - this is the total uncontrolled area flowing into the site in acres. If there are wascob's in series, only the drainage area below the one directly the next one upstream would be entered.

- runoff curve number - the curve number should represent that area that drains into the site.

- design rainfall - if you spelled the county name correctly and the county is contained in the data file (*"climate.dat"*), the rainfall amount should be present. If not, you should enter the amount of rain that might be expected for the design period.

- Soil loss - this value should represent the soil loss from the drainage area and can be obtained by using the Universal Soil Loss Equation.

- Front slope - this is the planned slope ratio on the upstream side of the proposed dike. It is entered as a ratio of horizontal to one foot of vertical.

- Back slope - this is the planned slope ratio on the downstream side of the proposed dike.

- Top width - this value should be the planned top width of the proposed dike. If you select one that does not meet specifications due to the height of the dike, the program will challenge you during the design process.

- Dist from baseline - if the dike is built on the centerline that was selected in the field, this value will be zero. However, if you change your mind after you see the design, this feature will allow you to slide the dike upstream or downstream. Just remember the sign conventions, upstream is a negative direction. If you would like to move the dike upstream 5 feet, enter -5.

Computation details:

Once sufficient data has been entered and the F9 key has been pressed, the computation will begin. The program starts by determining the maximum dike elevation that is available based on your survey data. This elevation is the lowest of the abutments or end elevations. Initially it compares the volume of storage that is available at that elevation to the amount that is needed to store the runoff and the sediment. It then begins to make adjustments accordingly and proceeds to search for the elevation that will result in a favorable comparison. The program is allowed to go a specified distance above the maximum elevation in its search. If it can be satisfied in this range, it will notify you that the dike is higher than the abutments which means you will need to extend the dike to match the top elevation.

The program has a procedure built in that will allow it to extrapolate data when the original data does not extend far enough to reach the slope intercepts. Before extrapolation can take place, the user has to authorize it with an appropriate response to the question. If extrapolation is permitted, the data is locked and can not be saved. If it is desired to save the data, answer the extrapolation question with a "no", save the data and return to the design screen for the computation. The extrapolation is based on a projection of the last two points in the survey and will only proceed if those two points are sloped in the right direction. Each time this condition is encountered, the program will ask if you want the data extrapolated. The best way to avoid extrapolation is to get sufficient survey data originally.

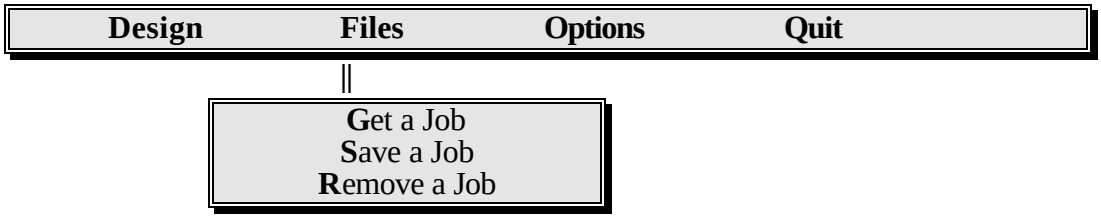
During the computation process, the elevation that is being tried will be displayed on the screen. If the trial goes astray or you can see it pursuing an undesirable route or you

want to discontinue the computation for any other reason, the F6 key will stop the computation and return you to the design input screen.

There are times with the faster computers that the computation takes place so quickly that the adjustments can not be seen. The intermediate results might be important so that proper adjustments can be made by the user. The F10 function key will toggle the computation speed so that the adjusted values can be monitored. Each time you return to the screen, the computation speed will be reset to "fast".

Print Section Data:

From time to time it is necessary or desired to print the survey data points in order to validate the entries. That is the purpose of this section and the only way that data can be printed in "rod reading" format.



Data File Management:

Get a job:

This feature allows data that has been stored or saved on previous occasions, to be retrieved. A list of the data files that are available on the designated drive will be displayed. If your data is on a different drive or in a different subdirectory than the default, pressing **Alt C** will afford an opportunity to select an alternative drive and a new list of available files will appear. Cursor to the job that is desired and press return (↵) or the left mouse button to retrieve the data.

Save a job:

This selection will solicit the information required to save the data for the job that is currently in computer memory. It is wise to visit this area frequently while a large job is being entered so that portions of your work are not lost. You never can tell when the lights might go out or someone might accidentally hit the reset button.

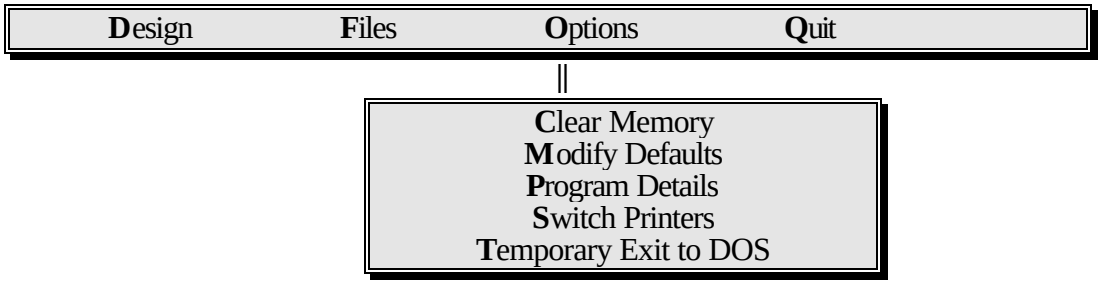
A screen will appear that identifies the data that is to be saved. Refer to the main guide for the Ohio Engineering programs for discussion related to the file naming procedures and assistance related to the information that is requested on this screen. The code used to identify WASCOB data in the file naming scenario is ***"WSB"***.

Remove a job:

Many of us do not like to throw anything away but occasionally reality sets in and we concede to the need. It is also important to remember that only 100 “wascob” jobs can be saved in one subdirectory. There might be test jobs, old jobs or jobs that you don't want the boss to see, that should be removed from the system. This selection works in a similar manner to retrieving data files. Once the desired file has been selected, you will be asked to confirm your request.

It is desirable to remove data files using this procedure rather than simply erasing them with DOS commands. This procedure will also properly manage other related files and do some minor housecleaning that the DOS procedures do not know about.

Options:



The options selection from the main menu serves two basic functions. It is an information center and it contains several features or functions that help make this program easier to use.

Clear memory:

If you get to the point that you have things so messed up that you would like to start over, this is the routine to use. It will give you a fresh start. Everything previously in memory will be gone after this operation. If there is a chance that you may change your mind, it might be wise to save the data before proceeding with this option.

Modify Parameters:

The "modify parameters" portion of the program is designed to add versatility and to allow the program to be as user friendly as possible. The choices presented control the manner in which the program responds as data is entered. The choices made will determine the default values or values that you normally use, to automatically appear when specific screens appear. If you have questions about the information required to answer the following situations, discuss them with your engineering staff.

- Standard riser height - this is the amount of riser or pipe that will stick above the ground.

- Distance from low point along the front toe of dike to orifice plate (d2) - this is the distance that the orifice is below ground and is referred to in the National Engineering Field Handbook as d2. (see figure 8-65 of the NEFH)

- Normal drawdown time (time allowed to drain flooded area) - this is the amount of time that will be allowed for all of the water to be removed from the site.

- Sediment delivery ratio in percent - this is the percentage of dislodged sediment that you would expect to be carried to the site. You may need to consult your geologist or soil scientist to get a handle of this number.

- Routing procedure - this is an attempt to deal with the fact that water is flowing out of the site all of the time that water is flowing in. By pressing the F4 key, a list of routing procedures will be presented to select from.

    - No adjustment - this choice would indicate that you do not want to account for routing. In this case all of the runoff and sediment will be stored before any discharge is considered.

    - Larry Caldwell procedure - this choice would result in the storage requirements being adjusted according to the procedure proposed by Larry Caldwell. In this procedure the storage requirements are related to the drawdown times. They are represented in the following equation from his ASAE paper.

$$S = 100*(0.1225 + 0.1616*\log(Dt))$$

Where:
S = Amount stored in percent.
Dt = Drawdown time in hours.

    - Use a standard adjustment – This selection allows the user to determine or select the percentage of the total generated volume that will be stored during the computation process.

    - Can the dike turn upstream on the low end (Y/N)? – with this selection you have the potential to allow the program to turn the lowest end of the dike upstream, ninety degrees to the centerline.

    - Embankment upstream sideslope – select the default sideslope for the upstream side of the dike or embankment.

    - Embankment downstream sideslope – select the default downstream sideslope.

    - Embankment top width – Enter the preferred top width of the dike. This value might be challenged during the design process if the height gets high enough that the width is controlled by standards.

Prefer E(lev) or R(od) – This entry reflects whether you prefer to enter survey data as rod readings or elevations.

Program Details:

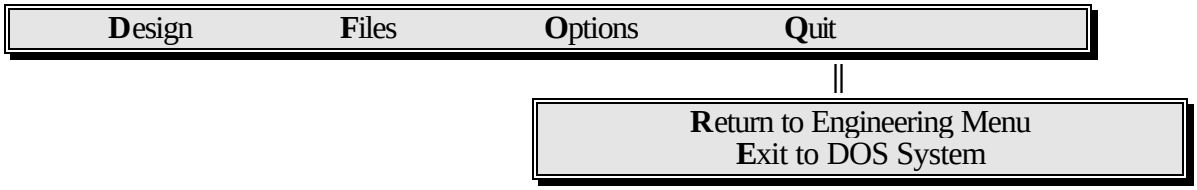
This selection will display some specifics related to the program including the date of the last revision or change. Many times there are subtle changes made to the program that do not merit changing the version number for the program. The date of these changes is normally available using this feature and matching this data is the best way to insure that the most recent version of the program is being used.

Switch Printers:

If two different printers are available on your computer system, this option will allow you to change the identity of the printer that the program uses. Basically, this action changes the value of the codes that control the manner in which the printer behaves. For example, the codes that cause the printer to print in compressed code, etc.

Temporary Exit to DOS:

Many times it would be nice or even necessary to execute a DOS command while in the program. As an example, you can't remember the subdirectory where your data is so you need to check several subdirectories or even diskettes. This option will quickly return to the system prompt and still keep your program and data in memory. When you are ready to return to the program, simply enter "exit". There is one important point to remember! **Be certain that you have returned to the subdirectory that contains the engineering program before entering "exit".**



Quit:

The response to "quit" can generate several responses depending upon how your particular system is set up. If the main *"engmenu.exe"* file is available, you might be offered an option of returning to the Engineering Menu, exiting to the operating system (which could be the DOS prompt, windows, or the batch file that originally called the animal waste program) or going directly to one of several other engineering programs. If this *"engmenu.exe"* file does not exist, you will simply be asked to confirm that you really do want to quit.

In any case, you will be warned if unsaved data has been entered so that you will have at least two chances to accidentally lose your data.

Format of Data Files:

The following information is provided for those of you who like to dig into the program files and figure out how they work or possibly make some sneaky edits to the data. The list below is a typical saved data file. Each line is followed by a line(s) contained in brackets ([]) that explain the line above. These "bracketed" lines will not be found in an actual data file. Some spaces have been added below to make it easier to read. **Keep in mind** that the quote and comma symbols are **very important** to the program.

```
"Data Version ........ ","Ver-3.00"  [used to anticipate the format of
                                      the data]
"Centerline Station .. ",980          [distance at section centerline]
"Baseline Distance ... ",0
"Original Data (E/R).. ","E"         [survey originated as elevation]
"Current Data (E/R) .. ","E"         [survey currently elevation]
"Elevation of HI ..... ",0
   -20.00,  126.20
     0.00,  126.00                    [section distance / elevation]
    20.00,  125.80
999999
"Section Id .......... ",""
"Centerline Station .. ",1000
"Baseline Distance ... ",0
"Original Data (E/R).. ","E"
"Current Data (E/R) .. ","E"
"Elevation of HI ..... ",0
   -12.00,  126.00
     0.00,  125.60
     4.50,  125.60
   124.10,  118.00
999999
"NoMoreSections"
"Landowner ................... ","Demonstration"
"County ...................... ","Medina"
"Designer .................... ","cwl"
"Job/Project Identity ........ ","Demo for User Guide"
"Drainage Area (ac.) ......... ",14
"Runoff Curve Number ......... ",71
"Soil Loss (Ton/Ac) .......... ",0
"Upstream sideslope .......... ",6.5
"Downstream sideslope ........ ",7
"Dike topwidth ............... ",10
"Baseline to CL dist. ........ ",0
"10 year rainfall ............ ",3.5
"Riser height ................ ",6
"Depth of riser in ground (d2) ",2
"Draw down time (hrs) ........ ",24
"Delivery ratio .............. ",100
"Routing procedure ........... ","Larry Caldwell procedure"
"% or runoff stored .......... ",63.60735
"Wings are allowed (N/Y) ..... ","N"
```

Supporting Files:

WASCOB.STD

The following is an example of the data that is contained in the file named *"WASCOB.std"*. This data is maintained using the "Modify Defaults" option and any changes that are made will be saved in this file.

```
"*Standard riser height in feet*"          , 6
"*Depth of orifice below ground*"          , 2
"*Normal drawdown time in hours*"          , 24
"*Sediment delivery ratio in percent*"     , 100
"*Routing procedure (1, 2, or 3)*"         , 1
"*Percent reduction if 3 above*"           , 20
"*Allow a wing on the low end (0 or 1)*"   , 0
"*Default upstream sideslope*"             , 3
"*Default downstream sideslope*"           , 3
"*Default top width*"                      , 4
"*Preference for rod readings or elev*"    , 1
```

WASCOB.ST2

The following is an example of the data that is contained in the file named *"WASCOB.st2"*. This data basically drives the WASCOB program. The purpose of maintaining the data in such a file is that it can be modified when and if a need arises. This can be accomplished using a text editor. It is **very important** that the format and integrity of the file be maintained (commas, quotes, sometimes even spaces). It is strongly recommended that an original copy of the file be maintained prior to attempting any changes. If the program behaves strangely following modifications to this file, you can always fall back on the original version.

```
"*Program Identifier or Version *"         , "OH-Ver 3.0"
"*Date of last minor program fix*"         , "9/14/99"
"*Sediment density in lb/cu.yd.*"          , 2000
"*Maximum fill height in feet*"            , 15
"*Height at first interval*"               , 10
"*Top width at first interval*"            , 8
"*Height at second interval*"              , 5
"*Top width at second interval*"           , 6
"*Maximum height above abutment*"          , 4
"*Max orifice diam @ first interval*"      , 3.5
"*Diam above orifice @ first interval*"    , 6
"*Max orifice diam @ second interval*"     , 5.5
"*Diam above orifice @ second interval*"   , 8
"*Max orifice diam @ third interval*"      , 6.5
"*Diam above orifice @ third interval*"    , 10
"*Incremental increase above orifice*"     , 4
```

```
"*Iteration tolerance in percent*"         , 2
"*Design frequency*"                       , "10"
"*Minimum sideslope*" ,0
"*Maximum sideslope*" ,30
"*Minimum top width*", 3
"*Maximum top width*", 100
"*Minimum soil loss*", 0
"*Maximum soil loss*", 500
"*Maximum drainage area*",30
"*Minimum drawtime time*",6
"*Maximum drawdown time*", 48
```