# USER'S MANUAL

# PROGRAM "RETARD"


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## **********THE RETARD PROGRAM**********

After evaluating the runoff from an area or basin using the Los Angeles County F0601 program, the problem is what to do with the runoff. Often, the downstream channel does not have sufficient capacity to handle increased runoff from new developments. Therefore, a retarding or detention basin must be installed.

This program is designed to assist the engineer in designing or evaluating retarding basins, and computing and displaying the resultant hydrograph after routing it through a dam or retarding basin.

This program creates an output hydrograph file that can then be used as an input hydrograph file for program F0601.

To run the program, the engineer must first have an input hydrograph. This is obtained automatically with the F0601 hydrology program by selecting the appropriate hydrograph output option.

The program has the capacity of accepting up to 4 hydrographs as contained in the input hydrograph file. For example, the day-1 through day-4 storms may be input into the program.

**********RETARDING BASIN/RESERVOIRS**********

The retarding basin option uses the Storage Indication Method of routing a hydrograph through a reservoir. This is also called the Modified Puls Method. To use this option, the user must first determine the storage capacity of the reservoir (Acre-Feet) verses the depth of water in the reservoir. Then, the user has 2 options for entering or computing the amount of outflow (CFS) of the basin versus depth.

First, several (up to 20) storage vs. depth values must be entered. Here, if the storage value is exceeded by the volume of the incoming hydrograph, you will be notified on the hydrograph printout. There-fore, the maximum possible depth of the basin should always be entered. The program displays the following:

```
DATA ENTRY FOR RETARDING BASIN:
The program requires depth, storage and discharge data
related to the input depth value.  With this data the
the program uses the modified puls / storage indication
method to calculate adjusted output flow.
For the first entry only:
bottom of basin assumed as depth (Ft) = 0
Basin outflow at depth = 0 (Ft.) assumed as 0 (QFS)

Enter total number of entry depths >
```

Second, the outflow rate (CFS) at each depth must be determined. The program offers the following options for the outflow rate:

```
DATA ENTRY FOR RETARDING BASIN:
The program allows the user the following options for
computing or entering the outflow data for the basin:
1 - User manual entry of outflow vs. depth
2 - Computation of discharge for various outlets at
different depths, including either weir(V or rect) flow;
```

Pressure/non-pressure pipe flow; Free outlet(weir)
pipe flow; or Pressure/non-pressure box channel flow;
depending on reservoir depth.

Enter desired option >

If option 2 or program computation of outflow vs. depth is selected,
the program presents the following:

DATA ENTRY FOR OUTLETS (Maximum of 10 allowed)
The program calculates the discharge of basin outlets located at different heights above the bottom of the basin.
The outlet types include weirs, either trapezoidal or flat top, pressure/non-pressure pipe(s)(at same level)under spillway, Free outlet pipe(weir type flow), or trapezoidal shaped box structures under pressure/non-pressure flow, depending on depth of water in the basin.

Enter total number of outlet structures desired >

Enter 0 if box or pipe has free outlet under pressure flow; or 1 to use outlet soffit as outlet depth. >

After selecting the number of outlet structures desired, the program requests the following data about the type of outlet structure. The outlet structures may be entered in any order.

DATA ENTRY FOR OUTLETS (Number _____ of _____)
The following types of basin outlets are available:
1 - Weir, either trapezoidal or flat crested
2 - Pressure/non-pressure pipe(s) under spillway
3 - Free outlet pipe (weir type flow)
4 - Box structure pressure/non-pressure

Enter type of outlet structure desired >

Enter height of structure inlet from basin bottom (Ft) >

Depending on the type of outlet structure selected, the program will ask the following additional questions:

PIPES, BOX STRUCTURES

CHANNEL OUTLET STRUCTURES:
For pipe(s) or box structures, the length and elevation difference along the outlet structure is required to determine the slope of the channel structure for outlet capacity at various basin depths:

Enter the length of the channel (Ft) >

Enter elevation difference (inlet-outlet) (Ft) >

Individual questions about the pipe or box/trapezoidal channels are asked by the program. The user has the option of entering multiple pipe or box structures with each entry if the pipes or boxes are parallel and have the same length and elevation difference between the inlet and outlet. Pipe, box, or retangular channels may be installed at any elevation from the bottom elevation of the basin.

## WEIR SUTUCTURES, FREE OUTLET PIPE

Weir structures may be flat crested or V-notched. You have the option to determine which equation is used by the program to calculate outflow vs. depth.

Free outlet pipes also use a weir flow equation. The user should use caution with this type of pipe and understand that the program considers the pipe inlet or lip to be in a horizontal position, and that weir flow is occurring over the top of the lip. The pipe must also have a free, unrestricted outlet with no backwater restricting outflow.

For weir structures, the program presents the following questions:

```
CHANNEL OUTLET STRUCTURES:
For weir flow, the following information is needed
for the equation outflow=CL*(H^exp)
L = length of the spillway crest; C = discharge coeficient
C = 3.0 for a perfect weir flow
C = 2.63 for a rectangular weir with L>15 Ft.
Exp = exponent value, 1.5 for flat crested, 2.5 for v-notch
Caution: For V-notch weirs use L=1, C=2.57*tan(open angle/2)

Enter the length of the weir spillway, L (Ft) >

Enter the desired 'C' value >

Enter the exponent value, exp (1.5 flat crested, 2.5 v-notch) >
```

If a free outlet pipe is selected, the program asks the following question:

```
CHANNEL OUTLET STRUCTURES:
For free outlet discharge pipe the following infor-
mation is used in the equation Outflow = 8*A*(H^0.5)
area of the pipe, A=PI*(D^2)/4

Enter the pipe diameter (Ft.) >
```

Next, the program needs the basin storage data. Here, the user must input the basin depth and basin storage volume for the respective depth. The program considers the volume of the basin is zero at zero depth. If the user selected option 1 of basin outflow data, the basin outflow vs. depth must also be entered here. If option 2 was selected and the program is calculating the outflow rates, the calculated data is shown with each depth entry for the structures entered by the user.

The program presents the following questions:

```
  CHANNEL OUTLET STRUCTURES:
  Depth vs. Storage and Depth vs. Discharge data entry
  Depth ____  of ____
  Last: Depth(Ft)=____ Storage(AcFt)=____  Q(out)(CFS)=____


  Enter basin depth (Ft) >

  Enter basin storage (AcFt) >
```

If option 1 (manual entry of outflow) used:

```
  Enter basin outflow (CFS) >
```

Following entry of the above data, the last question the program asks is for the initial depth in the basin. The user should note that if an initial depth is input, the program considers the basin also has an initial volume set to the storage quantity for this initial depth.

The following question is displayed:

```
  DATA ENTRY FOR RETARDING BASIN:
  Initial basin depth entry:

  Enter assumed initial depth (Ft) of water in basin
  at beginning of inflow hydrograph into basin >
```

# PROGRAM NOTES

## PROGRAM FILES:

The program asks for a study NAME of up to 6 characters. With this NAME, the program applies a file extension of ".HDR" and uses this as the input data file for recording the file name of the F0601 hydrograph file and the retarding basin data as input by the user.

The final output file is named with the study NAME and a file extension of ".OUT". This report file has detailed information and graphs of the retarding basin data and inflow, outflow hydrographs along with the depth and storage of the basin.

Another final output file is named with the study NAME and a file extension of ".RTD". This file is the code 007 and code 008 data lines for re-input to the F0601 program as an input hydrograph. The hydrograph represented here is the same as the output from the retarding basin.

## REVISING THE STUDY FILE:

You may make changes to, insert options, or delete options that were used in the program. When menu item # 3 is selected from the main menu, the name of the input hydrograph file will be displayed and may be revised. Then a listing of the data as previously input for the retarding basin will be displayed. You can revise an option by entering new data in place of the old data that is

displayed.

NOTE: When reviewing the data file, if the old data is O.K., simply press ENTER. Make sure you edit the entire data input to the end of the file; otherwise, some data may be lost.