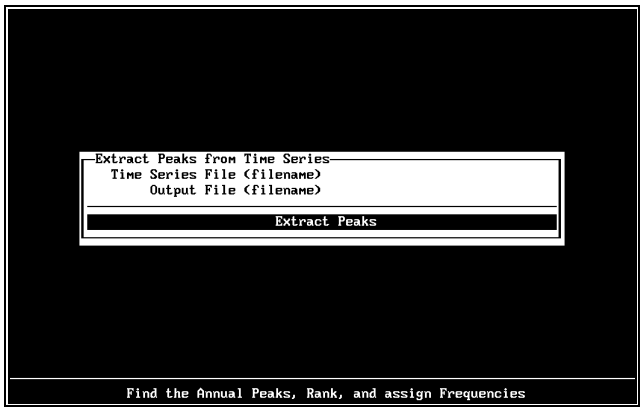
The *Analysis Tools Module* can be accessed by typing [T] while in the Main Menu. This module begins by displaying a screen of the following menu items.

8.1 COMPUTE PEAKS AND FLOW FREQUENCIES [P]

This menu item can be selected with the [P] key.

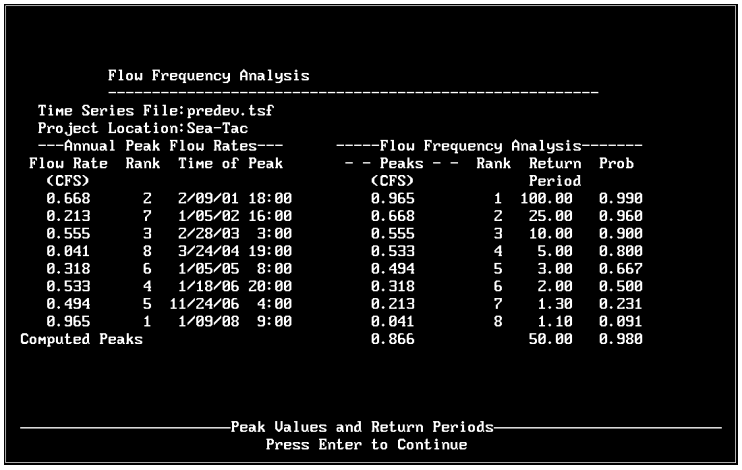
Annual Peak Flow Data are generated by identifying the yearly maximum discharge in each of the water years of data. These peak values are ranked and then assigned return periods/probabilities based on their relative ranking.



- **Time Series File** (filename). The user must enter the filename of the time series to be used in the frequency analysis. A TSF extension is assumed.
- **Output File** (filename). The user may enter a filename for the results of the frequency analysis. A PKS extension is appended to the filename. If no output filename is specified, the results will only be displayed on the screen.

Extract Peaks: Select this option to calculate the Peaks and a screen similiar to the following screen appears, presenting the ranked peaks and associated frequencies for the time series being analyzed.

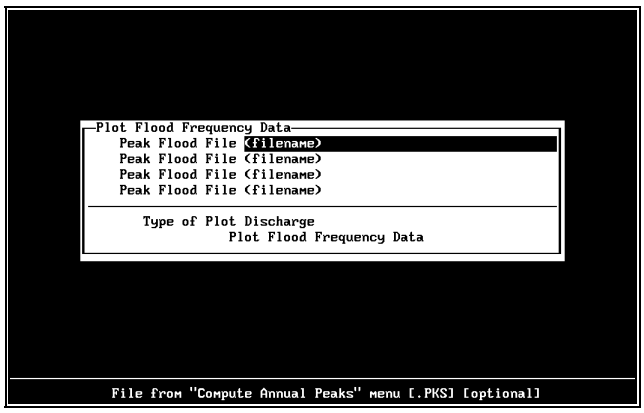
The left half of the output file contains the date and magnitude of the annual peak for each water year and the relative rank of each annual peak. The right half displays the peak flows according to their rank and assigns to each a return period/probability.



8.2 PLOT FLOW FREQUENCIES [F]

This menu item can be selected with the [F] key.

The user can plot up to four flow frequency data files to the screen.



- **Peak Flow File** (filename). The user must enter filename(s) of the time series to be plotted. These files are created using the Compute Peaks routine. The assumed filename extension is PKS.
- **Type of Plot.** Plots can be produced using *Discharge* data or *Stage* data. The user may use the space bar to toggle between *Discharge* and *Stage*. When plotting stage data, all PKS files specified must be from routed time series, otherwise stage data would not exist.

Plot Flood Frequency Data: Select this option and the flood frequency curves for the identified time series files are plotted on the screen.

PRINTING GRAPHIC IMAGES:

WKCRTS (Win95 version of KCRTS): To print graphs in WKCRTS using Windows printer drivers, click the WKCRTS icon in the upper left hand corner of the graph window. Select "Print" from the pull down menu to configure printer and print graphic image.

KCRTS in Win95 mode: Pressing *Print-Scrn* key while in Windows environment directs the graphics image to the clipboard, even if KCRTS is running in full screen. The graphics image may be copied from clipboard to other applications, as desired. DOS print screen utilities may be useful in sending graphic images directly to printer.

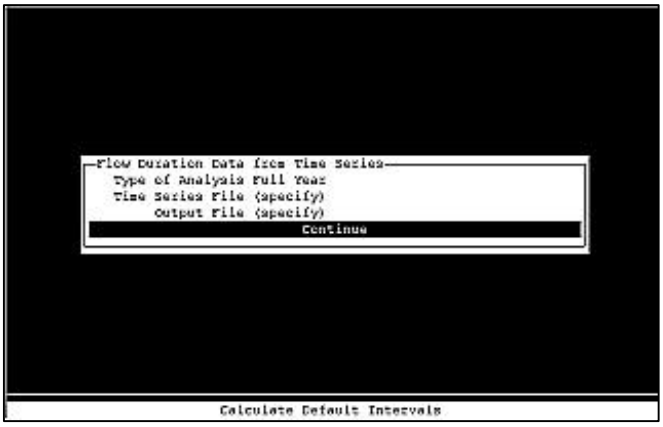
KCRTS in DOS mode: The printing of graphs can be accomplished using the DOS graphics driver, GRAPHICS.COM. The driver must be installed prior to starting KCRTS. Type HELP GRAPHICS for list of DOS-supported devices. Once installed, a graph can be printed by pressing Shift and Print-Scrn simultaneously. EXAMPLE COMMAND LINE C:\> graphics laserjetii.

8.3 COMPUTE FLOW DURATION AND EXCEEDANCE [D]

This menu item can be selected with the [D] key.

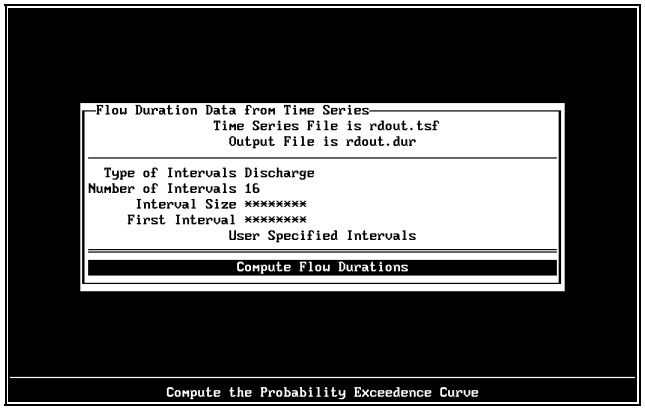
Duration and exceedance analysis simply involves counting the number of timesteps a given flow rate is exceeded and dividing that count by the total number of timesteps. This value is known as the exceedence probability or flow duration. Calculating the exceedence probability at several flowrate "cutoffs" results in a flow duration curve. Flow Duration data for reduced records are generated by analyzing the first seven years of the record. The program will determine default cutoff values, or the user may define their own. The results are saved in a text file that can be printed or imported into a spreadsheet or similar program for additional analysis.

Flow durations may be calculated over a specific range of flows, such as analyzing the predeveloped time series between 50 percent of the 2-year and the 50-year peak flows. This partial duration curve is useful as a "target" curve for meeting the Level 2 (Stream Protection) detention standard.



- **Type of Analysis.** Toggle between *Full Year* and *Partial Year* duration statistics. Most durational analyses use full year statistics. However, for some fish passage or wetland mitigation alternatives a particular portion of the water year may be of concern. When *Partial Year* is selected the program will prompt for additional date and timestep information. Partial year flow durations should only be calculated using the full historical period of record.
- **Time Series File** (filename). The user must enter the filename of the time series to be used in the frequency analysis. A TSF extension is assumed.
- **Output File** (filename). The user must enter the filename for the results of the duration analysis. The default extension DUR will be added to the filename.

Continue. Select this option to continue with computation of flow duration exceedence data.



- **Type of Intervals.** The user may use the space bar to toggle between *Discharge* and *Stage* depending on the type of analysis being performed.
- **Number of Intervals.** The user may enter the number of intervals to be used in the duration analysis. The number of intervals must be between 1 and 36. To improve resolution of duration plots, increase the number of cutoffs. A minimum of 16 cutoffs should be used for most analyses.

OPTIONAL: The first interval and interval size control the range of flows to be analyzed. These are usually left blank as KCRTS will set these values automatically to analyze the full range of flows encountered in the time series being analyzed.

- **Interval Size.** The interval size is specified by the user to control the cutoff values. As a general rule, the interval size is calculated by the following relationship.

  Interval Size = Upper end of *Discharge* (or *Stage*) range of concern minus the lower end (first interval) of the *Discharge* (or *Stage*) range of concern. That quantity is then divided by one less than the number of cutoffs.

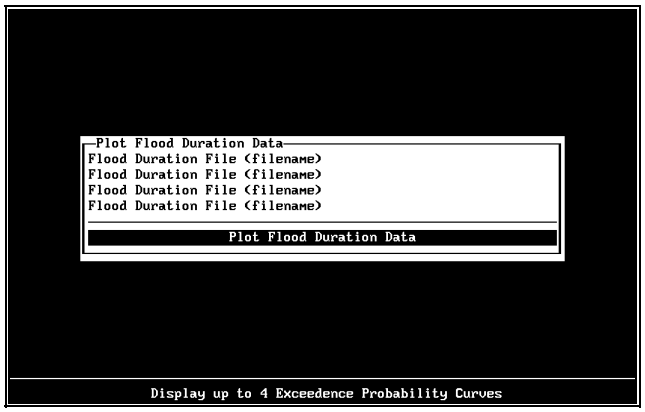
- **First Interval.** The first interval cutoff is specified by the user. This first interval identifies the low end of the *Discharge* (or *Stage*) range being used for the duration analysis.

Compute Flow Durations Select this option to perform the duration analysis. The results are printed to the screen as well as to the filename identified.

8.4 PLOT PROBABILITY EXCEEDANCE CURVES [E]

This menu item can be selected with the [E] key.

The user may plot up to four flow duration data files to the screen.



- **Flood Duration File** (filename). The user may enter up to four filenames to use in the duration plot. These data files are created in the Compute Durations routine. The assumed filename extension is DUR.

Plot Flood duration Data Select this option to plot the flood probability exceedence curves on the screen.

PRINTING GRAPHIC IMAGES:

WKCRTS (Win95 version of KCRTS): To print graphs in WKCRTS using Windows printer drivers, click the WKCRTS icon in the upper left hand corner of the graph window. Select "Print" from the pull down menu to configure printer and print graphic image.

KCRTS in Win95 mode: Pressing *Print-Scrn* key while in Windows environment directs the graphics image to the clipboard, even if KCRTS is running in full screen. The graphics image may be copied from clipboard to other applications, as desired. DOS print screen utilities may be useful in sending graphic images directly to printer.

KCRTS in DOS mode: The printing of graphs can be accomplished using the DOS graphics driver, GRAPHICS.COM. The driver must be installed prior to starting KCRTS. Type HELP GRAPHICS for list of DOS-supported devices. Once installed, a graph can be printed by pressing Shift and Print-Scrn simultaneously.

8.5 COMPARE FLOW DURATIONS [C]

This menu item can be selected with the [C] key.

Compliance with the Level 2 or 3 flow control standard requires the comparison of the duration characteristics of two timeseries files (typically, predeveloped and facility outflow), to determine if the facility performace is within allowable tolerances. In general, the following three criteria apply to duration matching flow control standards.

- The facility outflow must be strictly below the predeveloped flow durations at the bottom end of the range of control (typically, 50% of existing 2-year).

- The facility outflow may have brief excursions above the predeveloped (target) flow duration curve, provided the excusions are not more than 10%, measured vertically.
- The facility outflow duration curve may not exceed the predeveloped flow frequency curve for more than ½ of the range of control.

To size a Level 2 or 3 flow control facility, the designer compares these curves graphically and adjusts facility parameters accordingly. Howeve, to check the facility for compliance, this routine provides a more accurate numerical comparison of the two curves being compared.

- **Base Time Series** (filename). The user must enter the filename of the time series to be compared against. This is the existing condition Time Series, from which your "target" duration curve was generated. A TSF extension is assumed.
- **New Time Series** (filename). The user must enter the filename of the time series file which represent the developed condition runoff to be compared to the Base Time Series. This is either the facility outflow or downstream point of compliance time series file. A TSF extension is assumed.
- **Output File Name** (filename). The user may enter a filename for the results of the duration comparison. A PRN extension is appended to the filename. If no output filename is specified, the results will only be displayed on the screen.
- **Analysis Type.** Two way toggle between *Discharge* and *Stage.*

  Discharge. Select discharge to compare the flow duration statistics of two timeseries files (e.g., predeveloped and R/D outflow).

  Stage. Select stage to compare stage durations of two outflow timeseries from a reservoir. Typically, it will be a comparison of the reservoir outflows generated from two different inflow timeseries (e.g., existing and proposed), routed through the same reservoir file.
- **Bottom Cutoff.** Set the bottom cutoff at the lowest flow/stage value of the range of conditions being controlled. When Analysis Type = Discharge, the bottom cutoff is usually set at 50% of the existing 2-year flow rate, which is the lowest flow value controlled by the Level 2 or 3 standard.
- **Top Cutoff.** Set the top cutoff equal to the largest flow/stage value of the range of conditions being controlled. The utility below *Set Top Cutoff* can be used to automatically set the top cutoff at the largest flow/stage condition found in the base timeseries.
- **Number of Cutoffs.** This controls the number of rows displayed in the output screen and output data file. The program will automatically break up the range of flows/stages into even increments using this number. This number does not control the maximum positive and negative excursions displayed at the end of the table.

Set Top Cutoff using Base Time Series. Select this to have the program analyze the base timeseries and set the top cutoff equal to the largest event of the period of record. The period of record is first 7 years for the reduced runoff files, and the full record for the historical runoff files.

Compare Durations. Select this when input is complete to execute the routine.

The following is an example output screen.

```
Duration Comparison Anaylsis
   Base File: pre.tsf
    New File: rdout.tsf
Cutoff Units: Discharge in CFS

           -----Fraction of Time----- ---------Check of Tolerance-------
  Cutoff    Base      New      %Change Probability   Base     New %Change
   0.160 |  0.89E-02  0.82E-02   -7.7 |  0.89E-02   0.160   0.158    -1.4
   0.199 |  0.62E-02  0.51E-02  -18.6 |  0.62E-02   0.199   0.180    -9.5
   0.238 |  0.49E-02  0.40E-02  -19.3 |  0.49E-02   0.238   0.200   -15.9
   0.277 |  0.37E-02  0.35E-02   -3.6 |  0.37E-02   0.277   0.266    -4.0
   0.316 |  0.28E-02  0.32E-02   12.1 |  0.28E-02   0.316   0.335     6.1
   0.355 |  0.22E-02  0.26E-02   18.0 |  0.22E-02   0.355   0.378     6.4
   0.394 |  0.15E-02  0.19E-02   25.0 |  0.15E-02   0.394   0.405     2.8
   0.433 |  0.10E-02  0.95E-03   -9.4 |  0.10E-02   0.433   0.425    -2.0
   0.472 |  0.64E-03  0.59E-03   -7.7 |  0.64E-03   0.472   0.469    -0.7
   0.512 |  0.38E-03  0.28E-03  -26.1 |  0.38E-03   0.512   0.498    -2.6
   0.551 |  0.21E-03  0.82E-04  -61.5 |  0.21E-03   0.551   0.529    -4.0
   0.590 |  0.15E-03  0.33E-04  -77.8 |  0.15E-03   0.590   0.540    -8.5
   0.629 |  0.98E-04  0.16E-04  -83.3 |  0.98E-04   0.629   0.548   -12.8
   0.668 |  0.16E-04  0.00E+00 -100.0 |  0.16E-04   0.668   0.636    -4.8

Maximum positive excursion = 0.026 cfs (  7.5%)
occuring at 0.342 cfs on the Base Data:predev.tsf
and at 0.367 cfs on the  New Data:rdout.tsf

Maximum negative excursion = 0.038 cfs (-15.9%)
occuring at 0.242 cfs on the Base Data:predev.tsf
and at 0.203 cfs on the  New Data:rdout.tsf
```

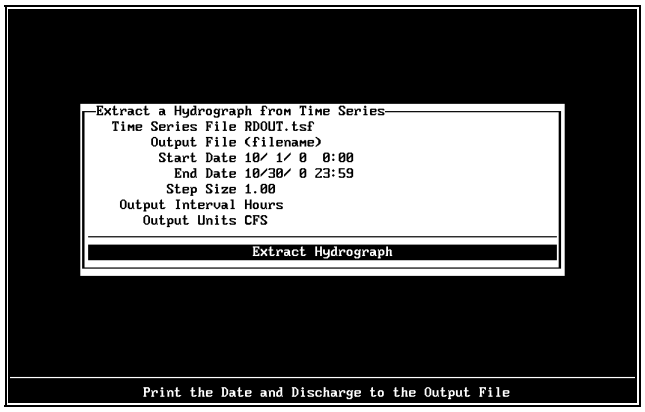
This table contains the summary of the duration comparison of the two time series specified by the user. The left half of the table compares flow durations horizontally in the direction of percent of time exceeded (exceedence probability). The right half of the table compares the flow duration curves vertically, in the direction that the allowable tolerance is measured. Typically, if the below three conditions are met, the facility is meeting the flow duration matching portion of the flow control standards.

- The duration matching standard (Level 2 or 3 Flow Control Standard) typically requires that the outflow timeseries be strictly at or below existing conditions at the lower range of control. Therefore, the % change value for the first flow cutoff must be zero or negative.
- Above the lowest cutoff the % change may not exceed positive 10 percent. Therefore, the remaining values in the % change column must be less than positive 10. Likewise, the *Maximum positive excursion* must be less than positive 10 percent.
- The duration matching standards typically require that the existing condition duration curve not be exceeded for more than 50% of the flows within the range of control. This means, that the *% change* column may not contain more positive entries than negative ones.

8.6 EXTRACT A HYDROGRAPH [H]

This menu item can be selected by the [H] key.

This menu item allows the user to extract a hydrograph from a time series to be saved as a text file. There is no limit to the length of hydrograph to be extracted. Once extracted, the hydrograph can be read into a spreadsheet or similar program for plotting or additional analysis. The output includes the date and time from the timeseries, the average discharge rate, or total discharge volume over the time interval. Output can be extracted in units of cfs or cubic feet and with a variable timestep. To extract stage data, the units must be cfs, and the step size and interval must be set equal to one time step of the time series being analyzed, hourly or 15-minutes (0.25 hours = 15 minutes).



- **Time Series File** (filename). The user must enter the name of the time series from which the hydrograph is to be extracted. A TSF extension is assumed.
- **Output File** (filename). The user must specify the name of the file to which the extracted hydrograph is to be written. The default extension of PRN is added to the filename.
- **Start Date.** The user must specify the starting date for the extracted hydrograph.
- **End Date**. The user must specify the ending date for the extracted hydrograph.
- **Step Size**. The user must specify the step size to be used in the extracted hydrograph. The step size relates to the number of time increments within the original time series file to be combined in producing the extracted hydrograph.
- **Output Interval.** The user may use the space bar to toggle between *Hours* and *Days* for the output interval.
- **Output Units.** The user may use the space bar to toggle between *CFS* and *CuFt.*

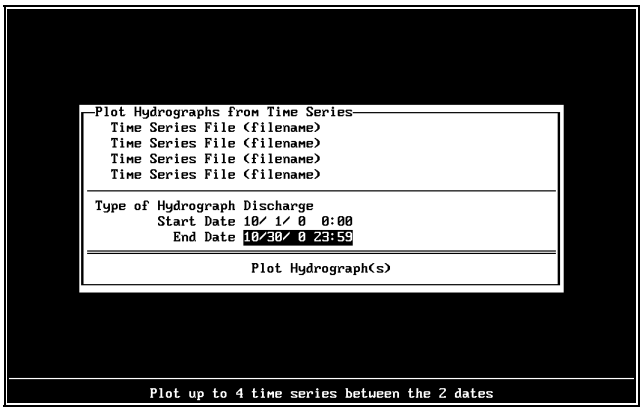
Extract Hydrograph select this option to perform hydrograph extraction.

8.7 PLOT A HYDROGRAPH [G]

This menu item can be selected by the [G] key.

In this menu item, a hydrograph is limited to a maximum of 31 days of discharge values. Hydrographs from up to four different time series can be displayed on the screen at one time. To print a graph, the DOS graphics driver must be enabled prior to running KCRTS. The graph can then be printed by simultaneously pressing the Shift and PrintScreen keys.

- **Time Series File** (filename). The user may specify up to four time series files to plot. A TSF extension is assumed.



- **Type of Hydrograph.** The user may use the space to toggle between *Discharge* and *Stage*.
- **Start Date**. The user must specify the starting date of the hydrograph(s) to be plotted.
- **End Date.** The user must specify the ending date of the hydrograph(s) to be plotted.

Plot Hydrograph(s) Select this option to plot the hydrograph(s).

PRINTING GRAPHIC IMAGES:

WKCRTS (Win95 version of KCRTS): To print graphs in WKCRTS using Windows printer drivers, click the WKCRTS icon in the upper left hand corner of the graph window. Select "Print" from the pull down menu to configure printer and print graphic image.

KCRTS in Win95 mode: Pressing *Print-Scrn* key while in Windows environment directs the graphics image to the clipboard, even if KCRTS is running in full screen. The graphics image may be copied from clipboard to other applications, as desired. DOS print screen utilities may be useful in sending graphic images directly to printer.

KCRTS in DOS mode: The printing of graphs can be accomplished using the DOS graphics driver, GRAPHICS.COM. The driver must be installed prior to starting KCRTS. Type HELP GRAPHICS for list of DOS-supported devices. Once installed, a graph can be printed by pressing Shift and Print-Scrn simultaneously.

8.8 COMPUTE VOLUME DISCHARGE [V]

This menu item can be selected by the [V] key.

This menu item calculates the total volume discharge in Cubic Feet between two dates in a time series.

An optional file name can be provided if you wish to save the data to disk. If not, the results of the analysis are only displayed on the screen.

8.9 EXPAND TOOLS MENU [T]

This option can be selected with the [T] key while in the *Analysis Tools Menu.*

Upon selecting this option, the user is presented with an expanded *Analysis Tools Menu.* These additional tools routines were developed to assess water level fluctuations in reservoirs, such as open-water wetlands. There are no analysis procedures in the Design Manual which require the use of these routines. This expanding menu option may not be present on your version of the program.

8.10 RETURN TO MAIN MENU [R]

Select this item to exit the TOOLS module. This menu item can be selected by the [R] key.