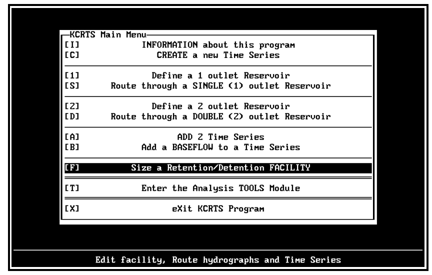
This menu item can be selected with the "F" key while in the main menu.



The following R/D facility design routines are useful tools for the preliminary sizing of various retention and detention facilities including: ponds, tanks, vaults, infiltration ponds, infiltration tanks, and gravel trench/beds.

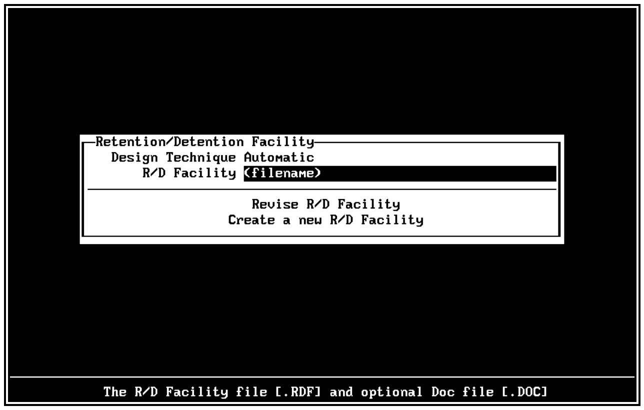
These routines substantially reduce the amount of time required to perform laborious and tedious calculations and eliminate associated mathematical errors. They allow an engineer to analyze a variety of situations and can be used to compare design options. It is important to understand that the results only reflect the data read by the program and are no more accurate than the judgment of the designer/modeler when input information is chosen. The designer/modeler should not blindly rely on these tools but should use them as supplemental aids to proper analysis and design.

7.1 WHAT THE R/D FACILITY DESIGN PROGRAM CAN DO

The routines within this program can aide the designer in developing preliminary sizing and routing characteristics for developing the layout of various detention facilities and control structures. In the automatic sizing mode, the program determines the storage volume required for a single storm event called the primary design hydrograph (PDH) and the specified maximum allowable (target) release rate for that event. The target release rate and facility depth sets the size of the upper orifice. The PDH is then iteratively routed through facilities of varying size until the full storage depth is utilized and the target discharge is met. This yields the minimum storage volume required to meet the target discharge for the storm specified as the PDH (i.e., 10-year outflow event). The routine then routes several other storm event hydrographs through the facility and displays the results. The designer can use these additional hydrographs to iteractively size additional orifices to meet other performance objectives (i.e., control 2-year discharges). Detailed examples of facility sizing procedures and strategies are included in the KCRTS User's Guide.

7.2 FACILITY SIZING

When this menu item is selected from the main menu, the following screen appears.



- **Design Technique.** The user chooses between *Automatic* and *Manual* mode.

  In *Automatic* mode, the program designs the smallest facility that will route the Primary Design Hydrograph through the facility while maintaining the Primary Target Release Rate.

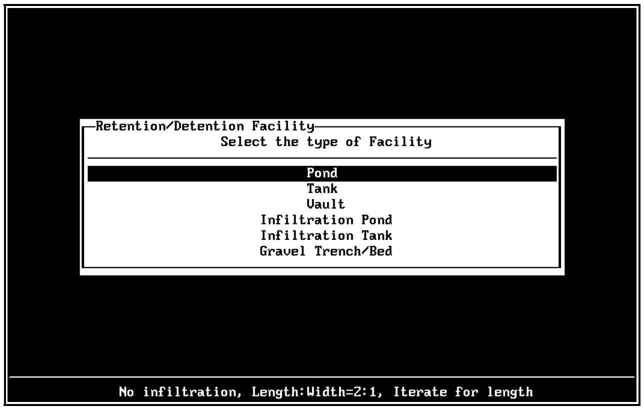
  Manual mode is similar to the automatic mode except the user controls all of the facility parameters, including the bottom area and orifice sizes. This mode is useful for fine-tuning duration matching facilities.

- **R/D Facility (filename).** The user specifies the name of the file to which the facility design information is to be stored. KCRTS assumes or will add an RDF extension if one is not given. Facility files may be used in the Route 1 Outlet routine or time series routing may be done within Size A Facility.

Create a new R/D Facility. Select this item to design a new facility. All information will be zeroed, and the user will begin entering the facility information.

Revise R/D Facility. Select this item to edit an existing facility, enter the existing filename and select. An existing facility may be edited and saved to a different filename without losing the original facility data file.

If *Create a new R/D Facility* is chosen, the following screen appears.



- Highlight the type of facility to be sized and press Enter.

The following sections describe the different facility types and the user input required for each.

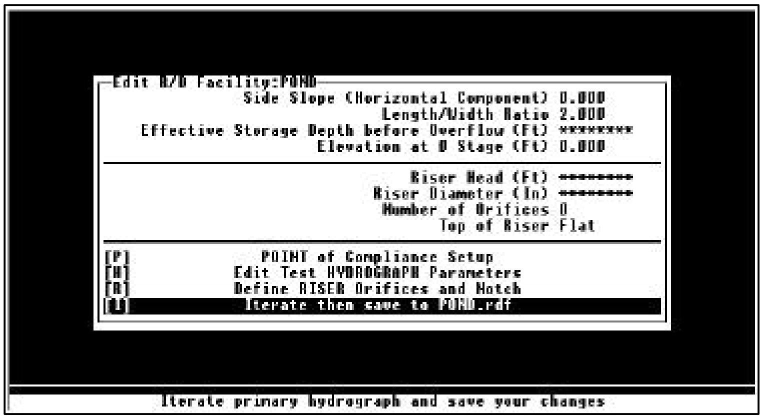
Note: The following selections appear at the bottom of the data input screens for all facility types.

Point of Compliance Setup
Edit Test Hydrograph Parameters
Define Riser Orifices and Notch
Iterate then save to (Filename)

Refer to Section 7.2.7 for a description of these options.

7.2.1 POND

This type of facility has a trapezoidal cross-section with a rectangular bottom. The default bottom area length-to-width ratio is 2:1. The side slopes are constant and identical for all sides. The following screen appears when this facility type is selected.

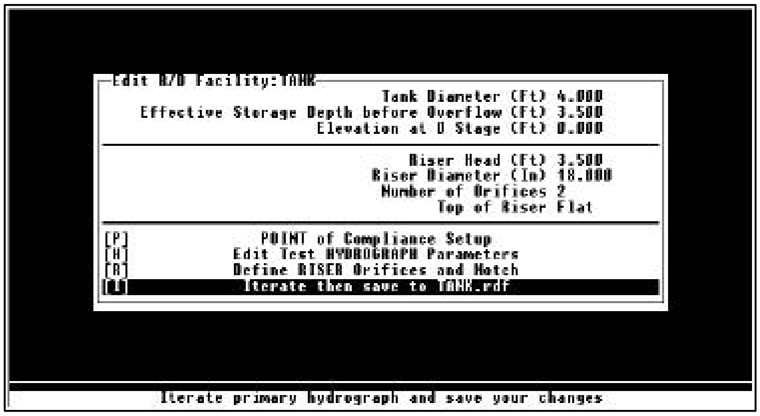


- **Side Slope (Horizontal Component).** The side slope is a ratio of the horizontal component to the vertical component. The vertical component is set at 1. For example, for a facility with a 3-to-1 side slope, the user would enter 3 for the horizontal component.
- **Length/Width Ratio.** Equal to facility length divided by facility width. The L/W ratio is measured at the bottom of the live storage. The ratio can be set between 1 and 10. The default ratio is 2.0.
- **Bottom Width/Length/Area (Sq Ft).** The bottom width/length/area only appears when using the facility design routine in Manual mode. It is adjusted to control the volume of the pond. KCRTS uses the following rules in handling these variables.
  - **Bottom Length and Width specified. Bottom Area not specified.** KCRTS saves the length and width specified. Displays showing L/W ratio or bottom area are calculated based on these values.
  - **Bottom Length, Width, and Area specified.** KCRTS will use the ratio of the length/width and then calculate a new bottom length and width based on bottom area and L/W ratio. (To specify a 20,000 square foot bottom area at 6:1 L/W ratio, set Length =6, Width=1, and Area=20000.)
  - **Bottom Length and Area specified.** KCRTS calculates the bottom width based on area and length specified. If resulting L/W ratio is less than 1.0, KCRTS will swap the Length and Width to maintain a ratio greater than 1.0.
  - **Bottom Width and Area specified.** KCRTS calculates the bottom length based on area and width specified. If resulting L/W ratio is less than 1.0, KCRTS will swap the Length and Width to maintain a ratio greater than 1.0.
  - **Bottom Area specified only.** KCRTS will use default 2:1 L/W ratio and calculates bottom length and width.
- **Effective Storage Depth before Overflow (Ft).** The effective storage depth is the depth of the active storage in the facility. It does not include "dead" storage at the bottom of the facility reservoir, nor any depth needed for head on overflow structures or "freeboard."
- **Elevation at Stage 0.0 (Ft).** The elevation at stage 0.0 is the elevation at the bottom of the effective storage depth. It may be an actual elevation tied to a common datum or it may be zero. Elevation adjustments do not affect the size of the facility.
- **Riser Head (Ft).** The riser head is the height of the riser control structure measured from the 2-year normal flow depth in the outfall pipe. Typically, the designer will equate the 2-year flow depth to the pipe invert for calculation purposes and then lower the pipe invert by a dimension equivalent to the flow depth during the detailed design stage. Riser heads greater than the effective storage depth implies the invert of the outfall pipe is lower than the bottom of the storage reservoir.

- **Riser Diameter (In).** The riser diameter is the inside diameter of the riser. This sets the overflow capacity of the facility for calculation purposes. The routine does not simulate spillway overflows. Riser diameter does not affect the size of the facility.
- **Number of Orifices.** The number of orifices can vary from 1 to 3. For most designs, 2 orifices are adequate.
- **Top of Riser.** The user may specify the top of the orifice as Flat or Notched. Refer to Section 5.3.4 of the *King County Surface Water Design Manual* for equations used. It is recommended that the Flat option be used for all iterative sizing and that if the final elevation of the uppermost orifice is unfeasible, to switch the design mode to manual before replacing the upper orifice with a notched release structure.

7.2.2 TANK

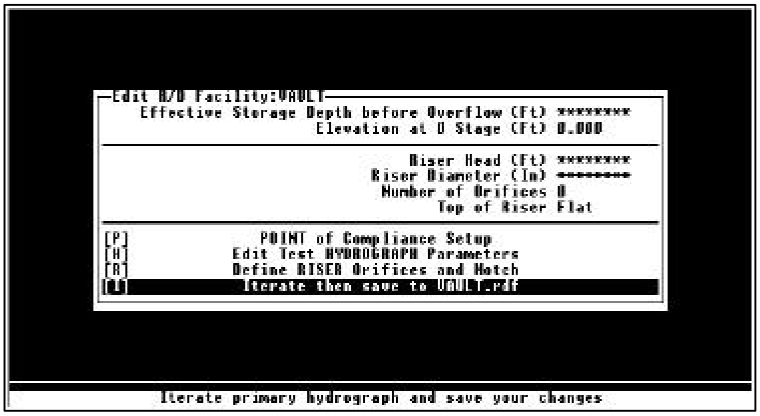
A tank is simulated in KCRTS as a horizontal cylindrical structure. The following screen appears when this facility type is selected.



- **Tank Diameter (Ft).** The tank diameter is the inside diameter of the tank.
- **Tank Length (Ft).** The tank length only appears when using the facility sizing routine in Manual mode. It is adjusted to control the volume of the tank.
- **Effective Storage Depth before Overflow (Ft).** The effective storage depth is the depth of the active storage in the facility. It does not include “dead” storage at the bottom of the facility, nor any depth needed for head on overflow structures or “freeboard.”
- **Elevation at Stage 0.0 (Ft).** The elevation at stage 0.0 is the elevation at the bottom of the effective storage depth. It may be an actual elevation tied to a common datum or it may be zero.
- **Riser Head (Ft).** The riser head is the height of the riser control structure measured from the 2-year normal flow depth in the outfall pipe. Typically, the designer will equate the 2-year flow depth to the pipe invert for calculation purposes and then lower the pipe invert by a dimension equivalent to the flow depth during the detailed design stage. Riser heads greater than the effective storage depth implies the invert of the outfall pipe is lower than the bottom of the storage reservoir.
- **Riser Diameter (In).** The riser diameter is the inside diameter of the riser. This sets the overflow capacity of the facility for calculation purposes. The routine does not simulate spillway overflows.
- **Number of Orifices.** The number of orifices can vary from 1 to 3. For most designs, 2 orifices are adequate.
- **Top of Riser.** The user may specify the top of the orifice as Flat or Notched. Refer to Section 5.3 of the *King County Surface Water Design Manual* for equations used. It is recommended that the Flat option be used for all iterative sizing and that if the final elevation of the uppermost orifice is unfeasible, to switch the design mode to manual before replacing the upper orifice with a notched release structure.

7.2.3 VAULT

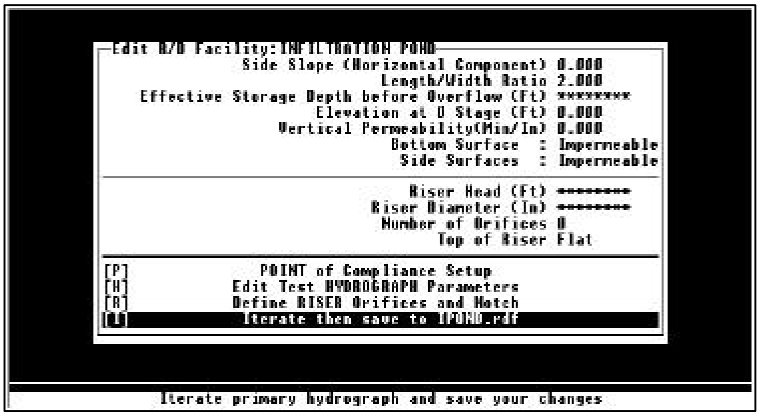
A vault is simulated as a rectangular storage structure. The following screen appears when this type of facility is selected.



- **Bottom Length (Ft), Bottom Width (Ft), Bottom Area (Sq Ft).** These parameters only appear when in Manual mode of Size a Facility, and are used to control the volume of the facility.
- **Effective Storage Depth before Overflow (Ft).** The effective storage depth is the depth of the active storage in the facility. It does not include “dead” storage at the bottom of the facility, nor any depth needed for head on overflow structures or “freeboard.”
- **Elevation at Stage 0.0 (Ft).** The elevation at stage 0.0 is the elevation at the bottom of the effective storage depth. It may be an actual elevation tied to a common datum or it may be zero.
- **Riser Head (Ft).** The riser head is the height of the riser control structure measured from the 2-year normal flow depth in the outfall pipe. Typically, the designer will equate the 2-year flow depth to the pipe invert for calculation purposes and then lower the pipe invert by a dimension equivalent to the flow depth during the detailed design stage. Riser heads greater than the effective storage depth implies the invert of the outfall pipe is lower than the bottom of the storage reservoir.
- **Riser Diameter (In).** The riser diameter is the inside diameter of the riser. This sets the overflow capacity of the facility for calculation purposes. The routine does not simulate spillway overflows.
- **Number of Orifices.** The number of orifices can vary from 1 to 3. For most designs, 2 orifices are adequate.
- **Top of Riser.** The user may specify the top of the orifice as Flat or Notched. Refer to Section 5.3 of the *King County Surface Water Design Manual* for equations used. It is recommended that the Flat option be used for all iterative sizing and that if the final elevation of the uppermost orifice is unfeasible, to switch the design mode to manual before replacing the upper orifice with a notched release structure.

7.2.4 INFILTRATION POND

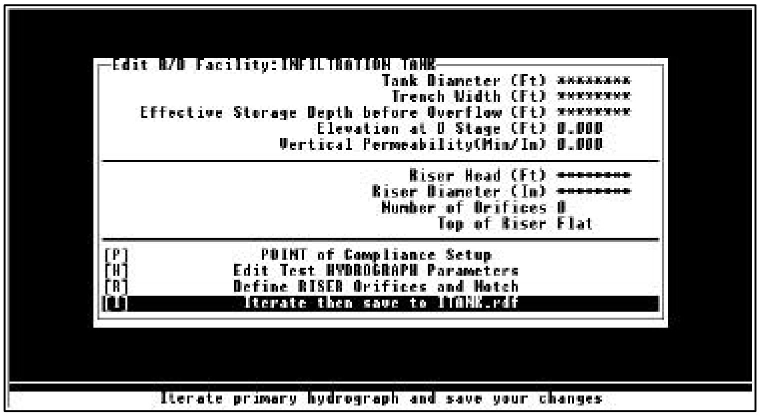
The infiltration pond is similar to the Pond described in the previous section. The infiltration pond can facilitate infiltration of water through the bottom and side walls of the facility. The following screen appears when this facility type is selected.



- **Side Slope (Horizontal Component).** The side slope is a ratio of the horizontal component to the vertical component. The vertical component is set at 1. For example, for a facility with a 3-to-1 side slope, the user would enter 3 for the horizontal component.
- **Bottom Length, Width, and Area (Sq Ft).** The bottom length/width/area only appears when using the facility design routine in Manual mode. They are adjusted to control the volume and Length/Width ratio of the pond. Infiltration Pond routine uses the same data input protocol as the Pond Routine, see Section 7.2.1.
- **Effective Storage Depth before Overflow (Ft).** The effective storage depth is the depth of the active storage in the facility. It does not include "dead" storage at the bottom of the facility, nor any depth needed for head on overflow structures or "freeboard."
- **Elevation at Stage 0.0 (Ft).** The elevation at stage 0.0 is the elevation at the bottom of the effective storage depth. It may be an actual elevation tied to a common datum or it may be zero.
- **Vertical Infiltration (Min/In):** The average vertical infiltration of the reservoir soils in minutes per inch. Vertical infiltration is the reciprocal of the design infiltration rate determined per Section 5.4 of the Surface Water Design Manual.
- **Bottom Surface/Side Surfaces (Permeability).** The user specifies which portions of the facility are permeable. The space bar can be used to toggle between permeable and impermeable.
- **Riser Head (Ft).** The riser head is the height of the riser control structure measured from the 2-year normal flow depth in the outfall pipe. Typically the designer will equate the 2-year flow depth to the pipe invert for calculation purposes and then lower the pipe invert by a dimension equivalent to the flow depth, during the detailed design stage. Riser heads greater than the effective storage depth implies the invert of the outfall pipe is lower than the bottom of the storage reservoir.
- **Riser Diameter (In).** The riser diameter is the inside diameter of the riser. This sets the overflow capacity of the facility for calculation purposes. The routine does not simulate spillway overflows.
- **Number of Orifices.** The number of orifices from 1 to 3. For most designs, 2 orifices are adequate. For infiltration facilities, the bottom orifice may be set above 0.0 or the number of orifices set to zero.
- **Top of Riser.** The user may specify the top of the orifice as Flat or Notched. Refer to Section 5.3 of the *King County Surface Water Design Manual* for equations used.

7.2.5 INFILTRATION TANK

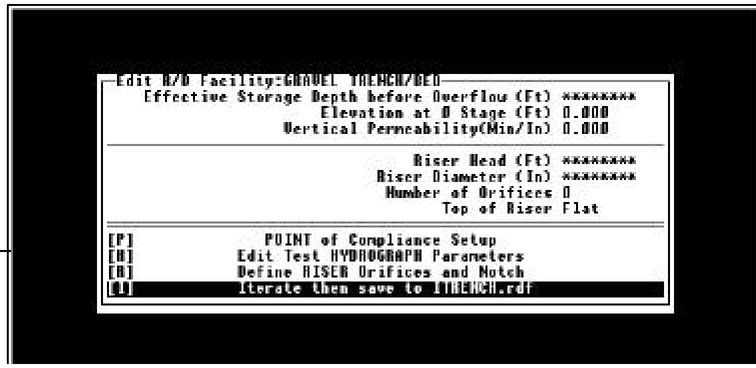
The Infiltration Tank is similar to the Tank described in a previous section. The infiltration tank allows for infiltration through the bottom half of the tank. The following screen appears when this facility type is selected.



- **Tank Diameter (Ft).** The tank diameter is the inside diameter of the tank.
- **Tank Length (Ft).** The tank length only appears when using the facility sizing routine in Manual mode. It is adjusted to control the volume of the tank.
- **Effective Storage Depth before Overflow (Ft).** The effective storage depth is the depth of the active storage in the facility. It does not include “dead” storage at the bottom of the facility, nor any depth needed for head on overflow structures or “freeboard.”
- **Elevation at Stage 0.0 (Ft).** The elevation at stage 0.0 is the elevation at the bottom of the effective storage depth. It may be an actual elevation tied to a common datum or it may be zero.
- **Vertical Infiltration (Min/In):** The average vertical infiltration of the reservoir soils in minutes per inch. Vertical infiltration is the reciprocal of the design infiltration rate determined per Section 5.4 of the Surface Water Design Manual.
- **Riser Head (Ft).** The riser head is the height of the riser control structure measured from the 2-year normal flow depth in the outfall pipe. Typically, the designer will equate the 2-year flow depth to the pipe invert for calculation purposes and then lower the pipe invert by a dimension equivalent to the flow depth during the detailed design stage. Riser heads greater than the effective storage depth implies the invert of the outfall pipe is lower than the bottom of the storage reservoir.
- **Riser Diameter (In).** The riser diameter is the inside diameter of the riser. This sets the overflow capacity of the facility for calculation purposes. The routine does not simulate spillway overflows.
- **Number of Orifices.** The number of orifices from 1 to 3. For most designs, 2 orifices are adequate. For infiltration facilities, the bottom orifice may be set above 0.0, or the number of orifices set to zero.
- **Top of Riser.** The user may specify the top of the orifice as Flat or Notched. Refer to Section 5.3 of the *King County Surface Water Design Manual* for equations used. It is recommended that the Flat option be used for all iterative sizing and that if the final elevation of the uppermost orifice is unfeasible, to switch the design mode to manual before replacing the upper orifice with a notched release structure.

7.2.6 GRAVEL TRENCH / BED

A Gravel Trench/Bed is rectangular with vertical side walls. Infiltration occurs through the bottom of this type of facility. The following screen appears when this facility type is selected.



- **Bottom Length (Ft), Bottom Width (Ft)**. These parameters only appear in Manual mode of Size a Facility, and are used to control the volume of the facility.
- **Bottom Area (Sq Ft).** The bottom area only appears when using the facility design routine in Manual mode. It is adjusted to control the volume of the trench. KCRTS maintains a 30 percent void ratio in the gravel trench.
- **Effective Storage Depth before Overflow (Ft).** The effective storage depth is the depth of the active storage in the facility. It does not include "dead" storage at the bottom of the facility, nor any depth needed for head on overflow structures or "freeboard."
- **Elevation at Stage 0.0 (Ft).** The elevation at stage 0.0 is the elevation at the bottom of the effective storage depth. It may be an actual elevation tied to a common datum or it may be zero.
- **Vertical Infiltration (Min/In):** The average vertical infiltration of the reservoir soils in minutes per inch. Vertical infiltration is the reciprocal of the design infiltration rate determined per Section 5.4 of the Surface Water Design Manual.
- **Riser Head (Ft).** The riser head is the height of the riser control structure measured from the 2-year normal flow depth in the outfall pipe. Typically, the designer will equate the 2-year flow depth to the pipe invert for calculation purposes and then lower the pipe invert by a dimension equivalent to the flow depth during the detailed design stage. Riser heads greater than the effective storage depth implies the invert of the outfall pipe is lower than the bottom of the storage reservoir.
- **Riser Diameter (In).** The riser diameter is the inside diameter of the riser. This sets the overflow capacity of the facility for calculation purposes. The routine does not simulate spillway overflows.
- **Number of Orifices.** The number of orifices from 1 to 3. For most designs, 2 orifices are adequate. For infiltration facilities, the bottom orifice may be set above 0.0 or the number of orifices set to zero.
- **Top of Riser.** The user may specify the top of the orifice as Flat or Notched. Refer to Section 5.3 of the *King County Surface Water Design Manual* for equations used. It is recommended that the Flat option be used for all iterative sizing and that if the final elevation of the uppermost orifice is unfeasible, to switch the design mode to manual before replacing the upper orifice with a notched release structure.

7.2.7 ADDITIONAL FACILITY INFORMATION

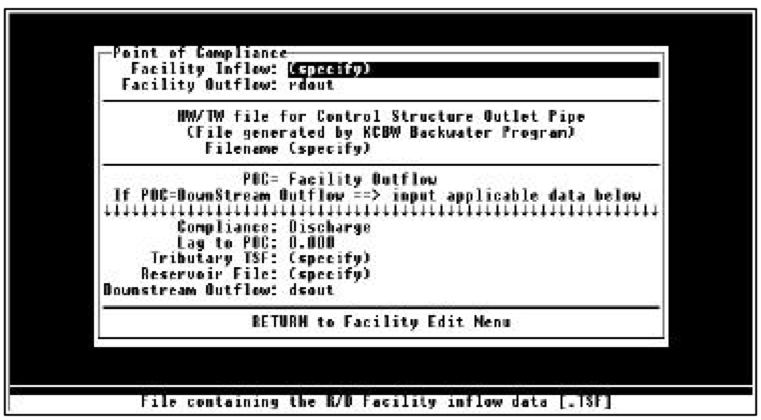
The menu items which appear at the bottom of the facility data input screens and are described in the following sections:

Point of Compliance Setup - Section 7.2.7.1
Edit Test Hydrograph Parameters - Section 7.2.7.2
Define Riser Orifices and Notch - Section 7.2.7.3
Iterate then save to (Filename) - Section 7.2.7.4

7.2.7.1 Point of Compliance Setup

The Point of Compliance setup includes the specification of all timeseries files to be used in sizing the facility as well as allowing the designer/modeler to adjust where compliance with the applicable performance standard will be achieved. Under some circumstances, the "point-of-compliance" is not measured at the outflow from the facility, but rather at some point downstream of the facility. In Automatic sizing mode, the Iteration routine can be used to directly size a facility such that a specified downstream condition is achieved. This enhanced iteration feature is only available in KCRTS Version 4.2x and later. This item can be selected by pressing the P key. When selected, the following screen appears:

- **Facility Inflow.** The user is prompted to enter the filename of the inflow time series to be routed through the facility. A TSF extension is assumed. This timeseries includes all runoff which under developed condition will flow through the facility.



- **Facility Outflow.** To change the outflow time series filename, highlight the *Facility Outflow* line. Overwrite the existing filename with the new filename (filename extensions are handled by KCRTS).

The default setup is to save the outflow time series to filename RDOUT.TSF. The downstream point-of-compliance is turned off, and no analysis will be performed. The file overwrite notification is turned off, so all previous runs using the same outflow time series name will be automatically overwritten with the most current facility performance.

- **HW/TW file for Control Structure (optional).** This option allows the designer to consider tailwater effects of the downstream drainage system on the discharge capacity of the control structure. By leaving this item blank, the designer/modeler is assuming that the outlet from the control structure is a free outfall with no tailwater effects. If designed with a free outfall assumption, a final design adjustment to the control structure outlet is recommended. The recommended adjustment is to lower the invert of the control structure outlet pipe by a distance equal to the 2-year headwater on the outlet pipe, making the actual operating head of the orifices closer to the assumption of free outfall.
- **POC =.** This defines where the point of Compliance [POC] calculations are to be performed. The default point of compliance is at the facility outflow. POC= *Facility Outflow.* If designing to a downstream point of compliance (common downstream POC situations described below), the POC should be toggled to *Downstream Outflow*.

If the project contains developed areas which will bypass the R/D facility:

The POC is defined as the point where bypassed flows and facility ouflows recombine (usually at the project site boundary), which is downstream of the R/D facility. To verify performance, the bypass time series must be added to the facility outflow time series prior to assessing compliance with the regulatory standard. The following steps will set up the auto analysis to assess performance at the POC.

- **POC=** Using the spacebar, toggle to *Downstream*.
- **Compliance:** Set to *Discharge* for bypass area analysis to match the predeveloped discharge conditions at the point of compliance.
- **Lag to POC:** Enter the travel time for the facility outflows to travel to the POC. Travel times, or lags, can be specified in even increments of the timestep.
- **Tributary TSF:** Enter the filename of the time series file, which includes onsite areas tributary to the POC but not tributary to the R/D facility. If more than one non-detained tributary area is present, these can be summed by using the [A] Add 2 Time Series routine, of the Main Menu, before setting up the Auto Analysis.
- **Reservoir File:** Leave blank for bypass area scenario.
- **Downstream Outflow:** Specify a filename for the time series, representing developed flows at the POC. The default filename is DSOUT. For this scenario DSOUT will be the sum of RDOUT.TSF and the Tributary bypass TSF.

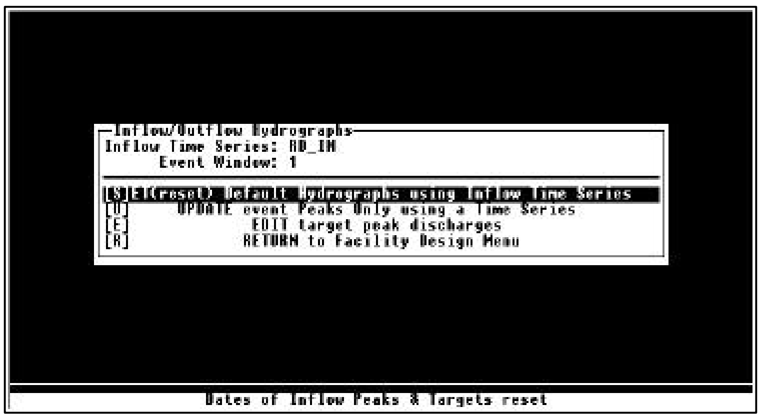
If the project discharges to a downstream volume sensitive flooding problem:

The POC is defined at the outfall of the reservoir file defining the flooding area. To verify performance, the discharges and storage volumes at different water levels in the POC must be determined and inputted into a Route 1 Outlet data file (RS1) prior to assessing compliance with the regulatory standard. The following steps will set up the auto analysis to assess performance at the POC.

- **POC=** Using the spacebar, toggle to *Downstream.*
- **Compliance:** Set to *Stage* to match existing stage elevations in the downstream reservoir. Set to *Discharge* to match existing surface discharge conditions from the downstream reservoir.
- **Lag to POC:** Enter the travel time for the facility outflows to travel to the POC. Travel times, or lags, can be specified in even increments of the timestep.
- **Tributary TSF:** Enter the filename of the time series, which is the entire runoff tributary to the POC but not tributary to the R/D facility. If the facility outflow is the sole source of runoff to the downstream system, leave the line blank. If more than one off-site or on-site bypass tributary areas are present, these can be summed and lagged by using the [A] Add 2 Time Series routine, of the Main Menu, before setting up the Auto Analysis.
- **Reservoir File:** Specify the filename of the reservoir file defining the stage-storage-discharge at the POC. This file must be in the single outlet (RS1) format. See section 3.1 for details on creating a single outlet reservoir file.
- **Downstream Outflow:** Specify a filename for the time series, representing the developed outflows from the POC reservoir. The default filename is DSOUT. The reservoir inflow is the sum of RDOUT.TSF and the Tributary TSF. The reservoir inflow is not saved. For this scenario, DSOUT will be the routed outflow from the downstream reservoir.

7.2.7.2 Edit Test Inflow Hydrograph Parameters

The Test Inflow Hydrograph List is a list of storm events which can be used in place of the entire time series for sizing of retention/detention facilities in Automatic mode. In Automatic mode, the iteration routine will update the list of events to include the annual peak DISCHARGE events at the point of compliance. The designer can use these event hydrographs to completely size a Level 1 detention facility and to initially size a Level 2 detention facility. Also, this is where the user can adjust the length of the test inflow hydrographs by changing the size of the Event Window. Select this option and the following screen appears:



- **Inflow Time Series.** The program displays the inflow timeseries file specified by the user in the Point of Compliance Setup screen. The filename of the inflow timeseries can be changed in either location. A TSF extension is assumed.
- **Event Window.** Controls the length of the test inflow hydrographs in units of months. For most designs, this can be left set to 1. The program will automatically increase the event window if the iteration routine determines that the facility is subject to prefilling before the start of the test hydrograph. By increasing the length of the hydrograph event window, the storm event(s) causing the prefilling will be included in the test hydrograph(s).

7.2.7.2.1 SET (RESET) DEFAULT HYDROGRAPHS USING INFLOW TIME SERIES

Select this option to extract the event dates from the inflow time series and to specify the Primary Design Hydrograph (PDH) and target release rates. The program will create a list of annual peak events in ranked descending order corresponding to the 8 peak annual runoff events found in the inflow time series. **WARNING:** Selection of this option resets the entire test hydrograph list including target release rates and primary design hydrograph number. The test inflow hydrographs are organized based on their relative ranking as follows.

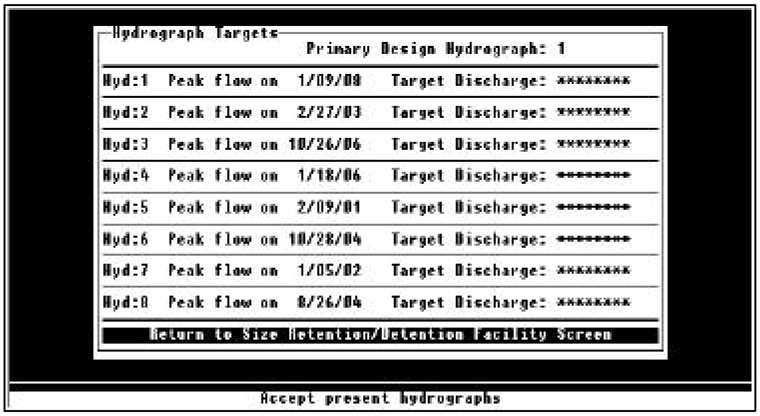
When using *Reduced* data set: All 8 annual peaks are extracted. The return frequencies of the inflow time series peaks are displayed on the help bar. **CAUTION:** These are the return frequencies of the file specified as the inflow time series. Since the facility must be sized to control the events that create the highest outflows (annual peak outflow events), modifications to the hydrograph list may be necessary. Once the initial facility is sized, it is necessary to route the full time series and to update the event dates based on the actual outflow time series rather than inflow time series. KCRTS Version 4.0 and later performs this event date verification automatically during the automatic sizing iteration routine. If KCRTS determines that the event dates corresponding to the annual peak outflows do not match the event dates in the test inflow hydrograph list, KCRTS will update the event dates in the list and re-iterate the facility size with the updated Test Hydrograph List. This process is repeated until the event date and rank of each hydrograph has been verified, such that the peak outflows from the hydrographs have the plotting positions shown below.

Test Hydrograph Number	Relative Rank of Hydrographs (Annual Peak Outflows)	Outflow Time Series Plotting Position (Return Period) Sea-Tac/Landsburg
1	1	100-yr
2	2	50
3	3	10
4	4	5
5	5	3
6	6	2
7	7	1.3
8	8	1.1

When using *Historical* data set: Eight annual peaks are extracted based on their gringorten plotting positions to be closest to common return periods of interest. Below are the plotting positions selected based on a 50-year historical record. For other lengths of record the rank and return period will vary.

Test Hydrograph Number	Inflow Hydrograph Rank and Assumed Outflow Time Series Plotting Position (Return Period) Sea-Tac/Landsburg	
1	1	89.5-yr
2	2	32.1
3	3	19.6
4	6	9.0
5	7	7.6
6	10	5.2
7	26	2.0
8	39	1.3

The dates of test hydrographs 1 through 8 appear on this screen.



- **Primary Design Hydrograph.** This appears near the top of the screen. The user must identify the primary design hydrograph. The primary design hydrograph is the largest event which the facility is being sized to contain. For example, if the facility is being sized to match the 2-year and the 10-year developed flows with their respective predeveloped levels, the 10-year outflow event is chosen as the Primary Design Hydrograph. For the reduced record, the 10-year event is the third ranked annual peak, which corresponds to Test Hydrograph 3. Therefore, the PDH number would be set to 3.
- **Target Discharge.** The target discharge may be set for any of the design hydrographs identified but it **must be set for the Primary Design Hydrograph**. If the facility is being sized to match the 2- and 10-year developed peak flows with the respective predeveloped peak flows, the Target Discharge for the third event in the list is set at the 10-year predeveloped peak flow and the Target Discharge for the sixth hydrograph in the list is set at the 2-year predeveloped peak flow.

Return to Size Retention/Detention Facility Screen: Select this option to return to the facility data input screen.

7.2.7.2.2 UPDATE EVENT DATES ONLY USING A TIME SERIES

This option allows the user to retain the primary design hydrograph and target release settings of the current list. The routine only extracts the event dates from the specified time series. To extract event dates from a time series other than the inflow time series (e.g., outflow time series of current facility), select this option and then at the file confirmation screen, change the time series filename to the time series desired (i.e., RDOUT.TSF).

Finding the event dates which create the outflow peak annual flows, and thus the outflow flow frequency curve, is an iterative process. Changes in storage or orifice configuration affects which events in the continuous record create the peak annual outflow events. Refer to Section 7.2.7.4.10 for details on the Event Date Notification routine which notifies the user of changes in the outflow time series affecting the assumed return frequencies of the test inflow hydrograph list.

- **Dates Time Series:** Enter the filename of time series to be used in updating the dates of the test inflow time series.

Set Dates: Select this option to perform update.

7.2.7.2.3 EDIT EVENT DATES AND TARGET PEAK DISCHARGES

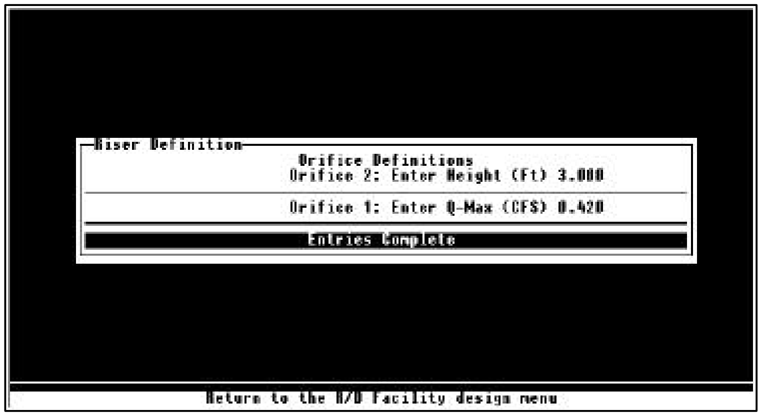
Select this option for direct access to the existing test hydrograph list for manual editing.

7.2.7.2.4 RETURN TO FACILITY DESIGN MENU

Select this option to return to the facility data input screen.

7.2.7.3 Define Riser Orifices and Notch

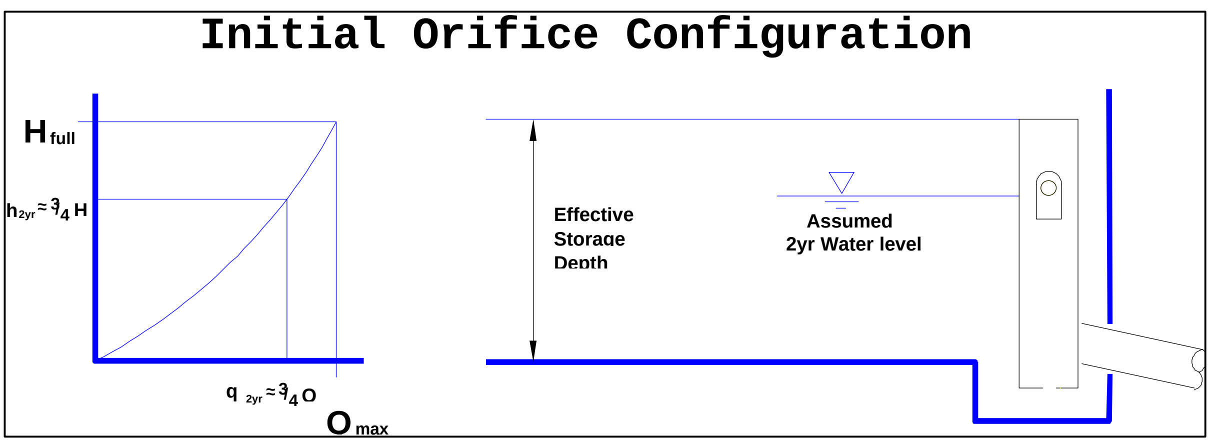
Select this option to specify the outlet orifice configuration and one of the following screens appears.



This screen appears when sizing a facility in *Automatic* mode. The user may specify the orifice data for up to three orifices. The number of orifices is specified in the main Edit Facility screen. A two-orifice design is recommended for most applications. When in *Automatic* mode the user is required to specify the orifice release rate for all but the uppermost orifice. The release rate, Q-max, is the discharge for the orifice under “pond-full” conditions. When in *Manual* mode, the user specifies the actual orifice diameter. In most cases, the user is advised to use the *Automatic* mode for the first iteration of sizing a facility. Subsequent iterations for refining the facility size can be performed in *Manual* mode.

The following rules of thumb apply for the first iteration when sizing a facility with two orifices in *Automatic* mode:

- Set the release rate for the lower orifice so that the lower target release rate is 75 percent of full stage discharge at the lower orifice (i.e., multiply the lower target release rate by 4/3 to calculate the lower orifice Q-max)
- Set the height of the second orifice at 75 percent of the effective storage depth.

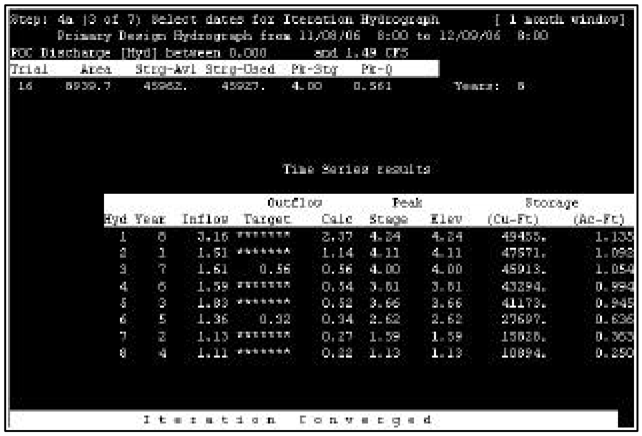


7.2.7.4 Iterate Then Save To (filename).

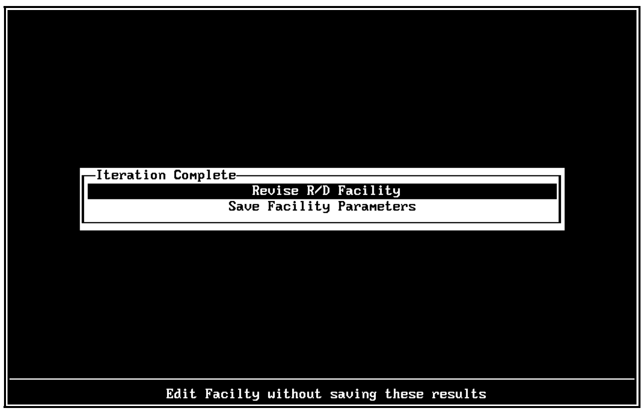
Select this option when all of the facility parameters have been entered. The following screen will appear.

- **Use Storm Event Window.** This option uses the latest Test Inflow Hydrograph List as a starting point. The event dates will be verified and updated once the initial PDH iteration occurs. If event dates do not match annual peak events at the point of compliance, the event dates of the Test Inflow Hydrograph List will be updated and the PDH iteration will be done using the new event dates. This process will be repeated until the event dates used in the iteration match the annual peaks at the point of compliance.
- **Reset Hydrograph Dates.** This option starts with the Test Inflow Hydrographs dates reset to the annual peak INFLOW events. The iteration procedure is identical to that described above for Use Storm Event Window.
- **Use Full Period of Record.** This option should be used if the Storm Event Window iteration option is not converging. This option ignores the Storm Event Window and performs the facility iteration using the full timeseries file. Each internal try at a facility size, requires the routine to route the entire timeseries file. This is therefore a much slower process than using the Storm Event Window.
- **Single Step through the Process.** This option uses the same PDH iteration routine as described above for the Use Storm Event Window option. When selected this option will perform the iteration in steps, prompting the user to continue after each step of the process. Pressing the F10 key displays a dialogue for each step of the PDH iteration process.

The program will now iterate the Primary Design Hydrograph (PDH), or full period of record, to determine the minimum size facility that meets the specified target discharge/stage for the PDH. The routine will next route, through the sized facility, the eight test hydrographs and display a summary table. The user may view the results by pressing the F10 key. The first check should be to verify that the “iteration converged.” This will be displayed on the bottom line of the F10 screen. Note that the calculated outflows are decreasing in magnitude as you move down the hydrograph summary list. If in ranked order, the assumed ranking vs. flow frequency plotting positions are the same as indicated in Section 7.2.7.2.1. The following is an example of the screen that appears when pressing F-10.



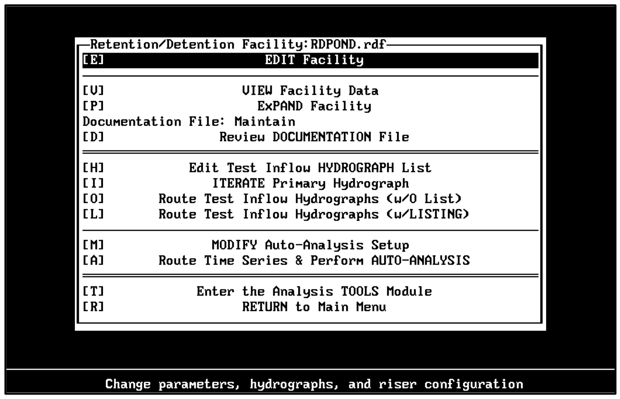
Press any key to continue.



Revise R/D Facility. Select this option if the results viewed when hitting the F-10 key indicate the need to modify the facility data. Important: If the outflow peaks are not ranked from highest to lowest, save the facility, route the full time series, and update the event dates only of the Test Hydrograph List. If calculated outflows are aligned properly, make adjustments to the orifice configuration until desired performance is achieved.

Save Facility Parameters. Select this option to save the facility parameters. For Level 2 or 3 performance standard, this option is typically selected after the first iteration. For Level 1 performance standard this option is typically selected once final orifice adjustments have been made. After saving the facility, the entire time series should be routed through the facility to check outflow performance.

7.2.8 RETENTION / DETENTION FACILITY MENU



7.2.8.1 EDIT Facility [E]

Select this option to return to the Edit Facility data input screen.

7.2.8.2 VIEW Facility Data [V]

Select this option to view the existing facility data.

7.2.8.3 ExPAND Facility [P]

Select this option to increase the storage volume at a particular stage. The program will increase the volume at this particular stage by the given percentage and then adjust the facility's bottom dimensions accordingly by using the same side slope and stage discharge relationship. The stage height entered must be greater than zero and less than or equal to the effective storage depth of the facility. The user is presented with the option of overwriting the facility data or changing the file name.

7.2.8.4 Documentation File

This option allows the user to document the facility specifications and performance in a text file. The documentation file is saved with the same filename as the facility, but with a DOC filename extension. When maintained the documentation file records summaries of actions performed by the user. This includes time series routing and analytical tools when performed within Size a Facility. If the facility is resaved and the previous facility file overwritten, the documentation file is also overwritten. If the modified facility is saved to a new filename, the previous documentation file (and facility file) will be retained. Documentation files are stored in ASCII text files and may be viewed and printed from a text editor. The documentation file is controlled from the Retention/Detention Facility Menu. The user may toggle between *NONE* and *Maintain* using the space bar.

7.2.8.5 Review DOCUMENTATION File [D]

This option allows the user to view the documentation file for the last saved facility.

7.2.8.6 Edit Test Inflow HYDROGRAPH List [H]

This option allows the user to access the same routines as when the Select Test Inflow Hydrograph option is chosen from the Edit Facility data input menu. Refer to Section 7.2.7.1 for more information.

7.2.8.7 ITERATE Primary Hydrograph [I]

This option allows the user access to the same routine described under the Edit Facility data input menu. The Primary Design Hydrograph will be iterated, the facility re-sized, and the eight test hydrographs routed through the revised facility. The designer may view the results of the iteration and routing by hitting the F-10 key.

7.2.8.8 Route Test Inflow Hydrographs (w/O List) [O]

The test inflow hydrograph list is a set of storm events extracted from the inflow time series. See Section 7.2.7.1 for details on setting up the Test Inflow Hydrograph List. This option routes the test inflow hydrographs through the current facility in memory (does not iterate PDH or resize the facility) and displays results to screen and to the Facility Documentation file. The output is a summary table including peak flows, stage, and storage for each test hydrograph.

7.2.8.9 Route Test Inflow Hydrographs (w/LISTING) [L]

To execute this option a Documentation File must be currently maintained (see below). This option performs the same hydrograph routing described above, except that the documentation file output is a complete hydrograph listing of flow, stage, and storage at each timestep for all test hydrographs.

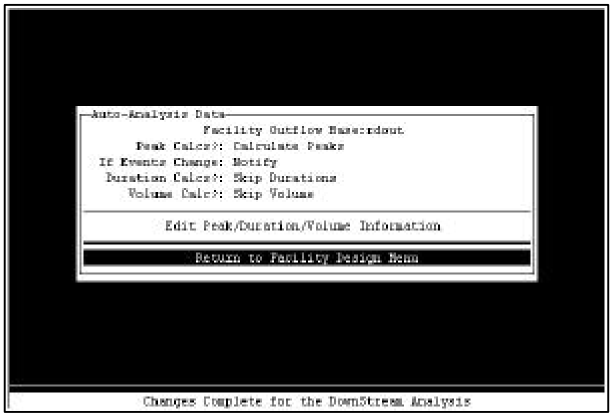
7.2.8.10 MODIFY Auto-Analysis Setup [M]

This routine allows the user to setup the facility analysis once and then each time the time series is routed all the same Analysis Tools routines are run and displays are echoed to the screen. This routine is useful to the designer for two reasons:

1. Facility sizing is an iterative process, requiring repetitive steps to assess performance and make adjustments.
2. Facility performance cannot be verified solely with the test inflow hydrographs. Performance is verified by analyzing the full outflow time series against the regulatory standard. Routing the time series may identify the need to update the test inflow hydrograph list to include the storm events (annual peaks) which compose the flow frequency curve of the OUTFLOW time series.

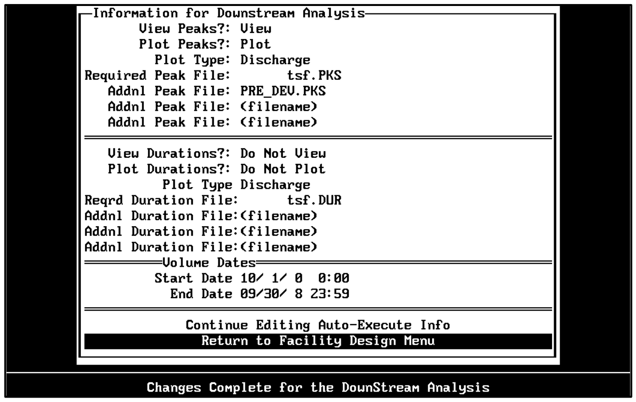
Note: The storm event dates which compose the inflow flow frequency curve will be different than the storm event dates comprising the outflow flow frequency curve. The inflow annual peak flow events typically will include more high intensity short duration events. The outflow annual peak events will typically be events with large runoff volumes, irrespective of inflow peaks.

When the *MODIFY Auto-Analysis Setup* option is selected, the following screen appears.



- **Peak Calcs?:** Toggle to *Calculate Peaks* and the program will create a PKS file for the POC outflow time series. The POC time series is the R/D *Facility Outflow* or the *Downstream Outflow* depending how the POC was defined. When selected, the *Edit Peak/Duration/Volume Information* screen allows you to set up the viewing and plotting of the peaks data.
- **If Events Change:** With the enhanced iteration routine of KCRTS Version 4.2 and later, this routine should not find any event date changes if the designer had used the PDH iteration routine in Automatic mode. This routine was retained so the user could keep the Test Inflow Hydrograph List updated while adjusting the facility in Manual mode. Toggle to *Notify* to check the event dates and assumed return frequencies of the eight test inflow hydrographs against the POC outflow time series. If, for a given return frequency the event dates of the test inflow hydrograph do not correspond to the event dates of the POC outflow time series, the program notifies the user that the test hydrograph list needs to be updated and prompts the user whether to update events or continue without updating. If sizing in Automatic mode, the Primary Design Hydrograph should be re-iterated and the orifice configuration adjusted as needed before rechecking with the time series routing and Auto-Analysis.
- **Duration Calcs?:** Toggle to *Calculate Durations* and the program will create a DUR file for the POC outflow time series. The POC time series is the R/D *Facility Outflow* or the *Downstream Outflow* depending how the POC was defined. When selected, the *Edit Peak/Duration/Volume Information* screen allows you to set up the viewing and plotting of the duration data.
- **Volume Calcs?:** Toggle to *Calculate Volume* and the program will create a PRN file for the POC outflow time series. The POC time series is the R/D *Facility Outflow* or the *Downstream Outflow* depending how the POC was defined. When selected, the *Edit Peak/Duration/Volume Information* screen allows you to set up the start and end dates for the volume calculation. Viewing of the volume summary is automatic.

Edit Peak/Duration/Volume Information: This option allows the user to control the viewing of the data files to be created, as well as the plotting of the POC data files. The plotting of data can include up to three additional data files (e.g., predeveloped target files). This option also controls the start and end date of the volume calculation option. The following screen appears when this option is selected (if **Calculated Peaks**, **Calculate Durations**, and **Calculate Volumes** are all used).



- **View Peaks**?: Use the space bar to toggle between View and Do Not View.
- **Plot Peaks**?: Use the space bar to toggle between Plot and Do Not Plot.
- **Plot Type**: Use the space bar to toggle between Discharge and Stage.
- **Additional Peak File**: Enter the filenames of up to three additional peak files (PKS) to be viewed or plotted.
- **View Durations**?: Use the space bar to toggle between View and Do Not View.
- **Plot Durations**?: Use the space bar to toggle between Plot and Do Not Plot.
- **Plot Type**: Use the space bar to toggle between Discharge and Stage.
- **Additional Duration File**: Enter the filenames of up to three additional duration files (DUR) to be viewed or plotted.

Volume Dates

- **Start Date**: Identify the beginning date to be used in the volume calculation.
- **End Date**: Identify the ending date to be used in the volume calculation.

Continue Editing Auto-Execute Info: Select this option to return to the previous screen.

Return to Facility Design Menu: Select this option when all data have been entered correctly.

7.2.8.11 Route Time Series and Perform AUTO-ANALYSIS: [A]

This option initiates the routing of the full inflow time series through the facility currently in memory. In addition to routing, all of the Auto-Analysis routines that have been setup will execute (from top to bottom as shown in the setup menu). Summary tables are echoed to the screen and the Facility Documentation file, if maintained.

7.2.8.12 Enter the Analysis TOOLS Module: [T]

Select this option to enter the analysis tools module. See Section 8 for detailed descriptions of Tools routines. This set of routines are repeated in Size a Facility to allow the designer direct access to the Analysis Tools without having to re-start the Facility Design routine.