Appendix 6 – Implementing the Stage-Area and Index Ratings in National Water Information System (NWIS) Automated Data Processing System (ADAPS) Version 4.10

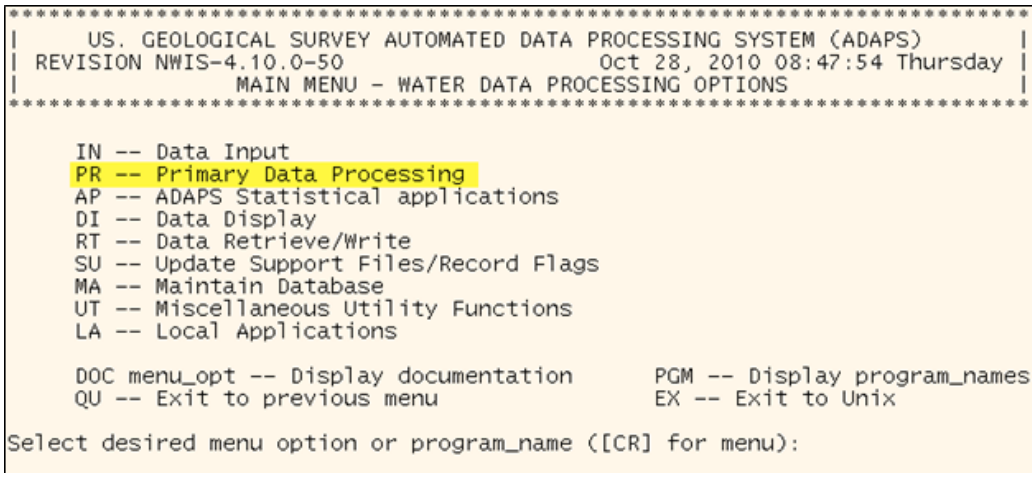
Implementing a Stage-Area Rating

All ratings associated with discharge are implemented under the discharge data descriptor (DD). In order to compute discharge using other variables (DDs), a processor must be configured under the "SU" option in ADAPS. The database administrator should be consulted to enable the discharge processor for a site. The stage-area and index ratings are entered under the DD for discharge ("STAR" and "VELO" options, respectively).

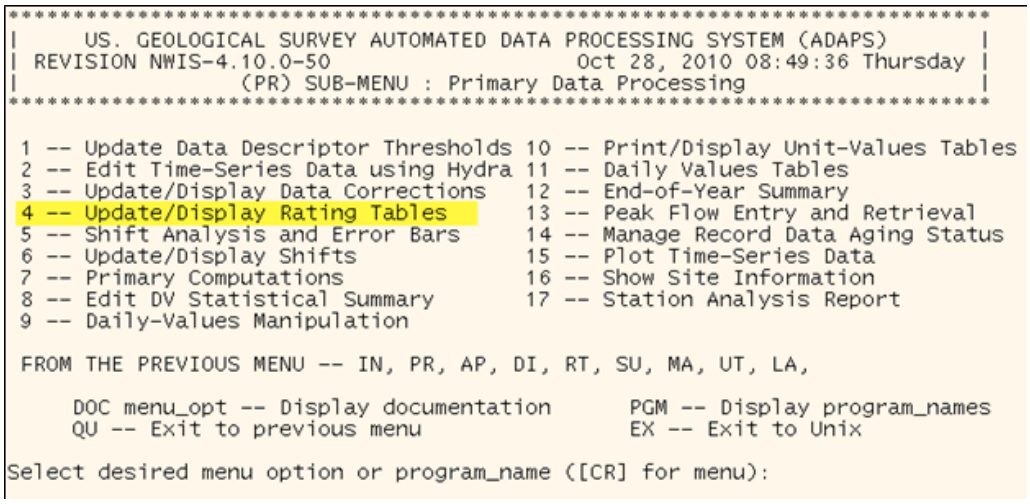
Many streams have complex cross-sectional shapes where the stage-area relation can be closely approximated using 2nd- or 3rd-order polynomial equations; however, these equations cannot be expressed in the current version of ADAPS. A close approximation of the stage-area relation also can be expressed as a series of short straight lines (linear rating in ADAPS) where the stage-area rating is a "linear" rating (look-up table) with input values of stage and corresponding output values of cross-sectional area with values in between computed using linear interpolation. The number of rows for the ADAPS rating has a maximum of 999 input-output value pairs, and the interval between each stage value of the stage-area rating should be chosen to adequately reproduce the shape of the stage-area relation.

The following steps should be followed when implementing a stage-area rating in ADAPS. Screen captures illustrating the ADAPS program input/output are shown where appropriate in order to aid in the explanation of the rating implementation process.

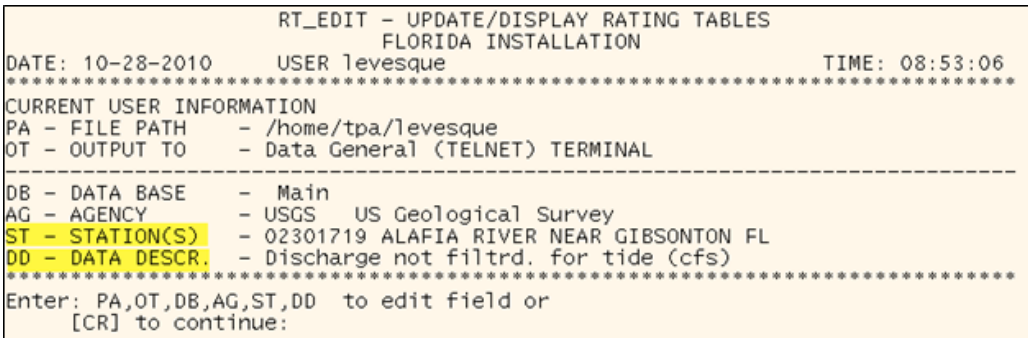
1. Start ADAPS.
2. Select the Primary Data Processing (PR) option.



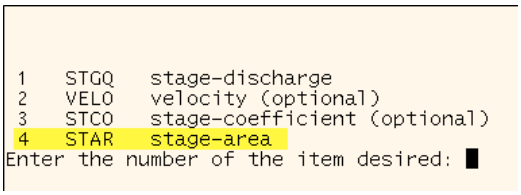
3. Select Update/Display Rating Tables (option 4).



4. Select the station and DD that need a new or updated rating.

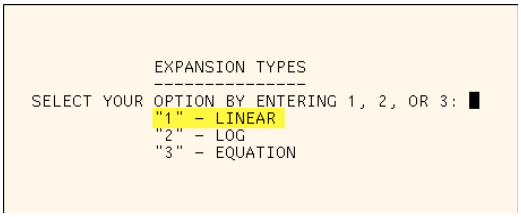


5. Select STAR (option 4).



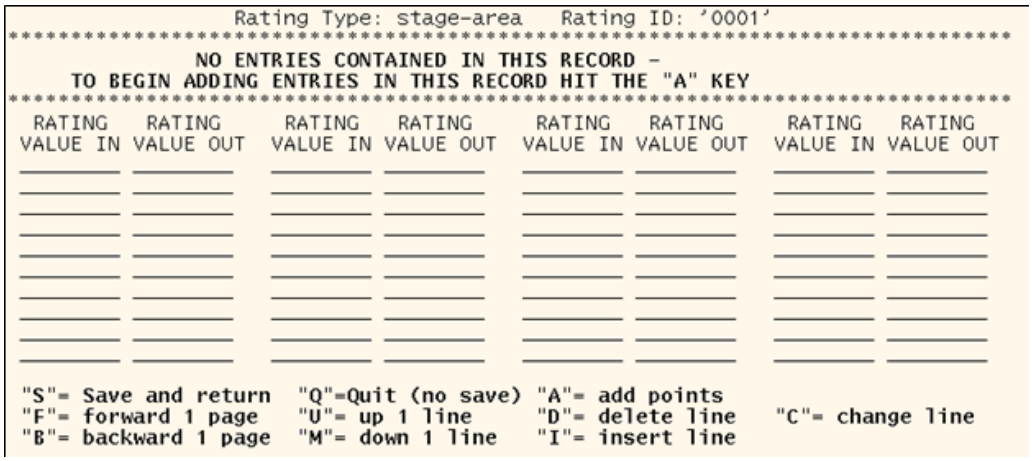
Enter the new 4-digit rating ID number. It is recommended that a rating ID convention be specified in the USGS Water Science Center (WSC) Surface-Water Quality-Assurance Plan (SW QA Plan).

6. Select Linear (option 1) under the Expansion Types menu for an input-output table rating (recommended).



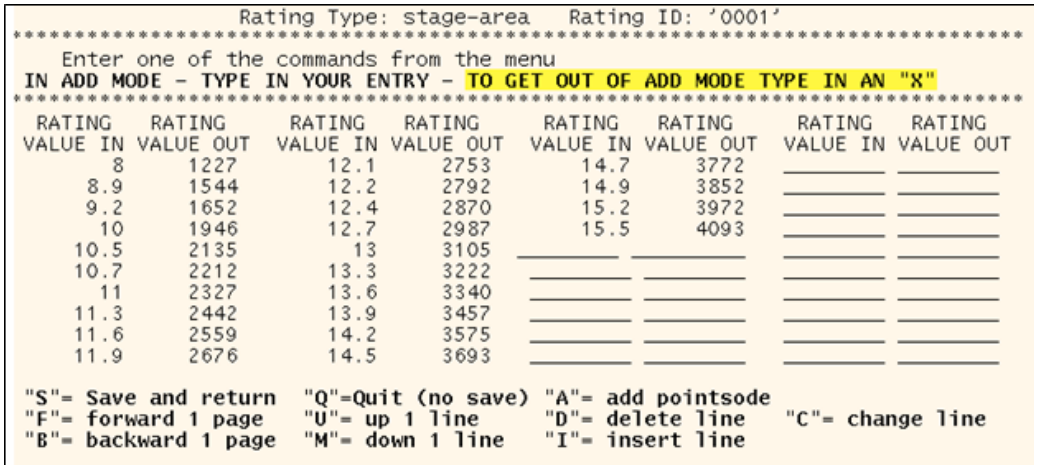
The display will provide an area for remarks. Enter text for remarks about the rating. (Example: Established rating, rating based on re-survey of cross section on March 28, 2010). More than one line of remarks can be entered for each rating. Each line is limited to 120 characters It is strongly recommended that information about the rating is provided in the remarks to assist in the quality-assurance review process and for historical documentation. Follow the on-screen directions to enter remarks.

7. After entering remarks, the linear expansion rating entry table will be displayed.

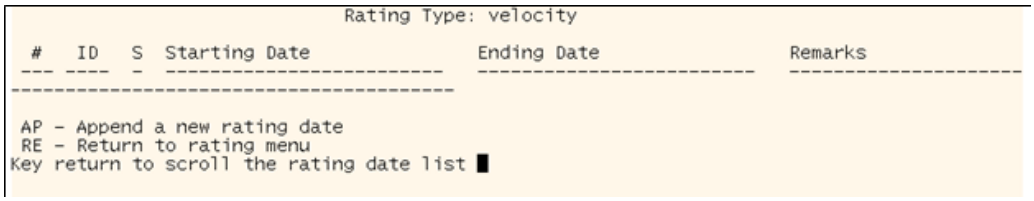


Follow the on-screen directions for entering the stage-area input and output values for the linear (table) rating. Values must be entered in ascending numerical order from lowest to highest. To add the input-output data value pairs, enter "A," then type a stage value, a space, and the corresponding area value (Example: 1 20).

8. Press the enter key and repeat the sequence for all the data value pairs required to adequately define the stage-area rating.



9. Enter "X" to exit the Add mode. After verifying that the correct data value pairs have been entered, save the rating ("S"). After saving the rating, choices for entering the starting date of the rating will be presented.



Each stage-area rating for the station requires a starting date and time for the rating to begin. The starting date and time is entered by using "Append a new rating date" (AP) for a new rating. For existing ratings the display also allows the choice of editing (ED) the starting date and time for an existing rating. Use the "Edit a rating date" (ED) option for an existing rating that requires revision of the starting or ending date. Select the appropriate option (AP or ED) and enter the date and time you want the rating to be implemented. For new stations, this date and time typically will be the date and time of the first valid data value. For a new rating, the starting date display will only allow the choice of appending a new rating.

10. Select append (AP) and enter the starting date and time for the rating and select the appropriate time datum (EST, CST, PST, or UTC). For a situation in which a rating has changed and another rating is required to represent the channel cross section, the date and time may be near the peak of a high-flow event, or near the date and time of a cross-section re-survey if a flow event cannot be verified.

```
                    Rating Selection List
                    =====================
 1    stage-area, Rating ID: '0001'

                     * - rating is currently active
       Enter the number of the rating desired: 1

  Specify the new rating starting date
ENTER DATE AS (MM DD YYYY): 03 28 2010
  Specify the new rating starting time
ENTER TIME AS (HHMMSS): 101300
  Specify the new rating starting time datum (<CR>="EST   ")
ENTER TIME DATUM CODE ("?" to pick from list):
```

If the rating you want to enter is not the first rating, but an updated rating (new cross-sectional area), then the preceding rating must be ended at a specified date and time. Enter the date and time that marks the beginning of the new rating, and the older rating will automatically have the ending date entered. The ending date-time of the old rating and the starting date-time of the new rating should not leave a gap between time periods when no rating is active. If the ending date and time are not correct, the values can be edited using the "ED" option.

11. After entering the starting date and time of the stage-area rating, remarks about the timing of the rating or general remarks about the rating can be entered. The remarks for how the rating was developed appear at the top of the rating. Remarks are used to describe the rating, and the remarks entered at the time of the starting date are listed with the rating start time.

```
 #   ID   S  Starting Date              Ending Date               Remarks
--- ---- -  ------------------------  ------------------------  ------------------------------------------------------
------
  1 0001     10-28-2010 @ 00:01:00 EST            -----            Rating started at time of first cross-section survey.

AP - Append a new rating date
ED - Edit a rating date
RM - Remove a rating date
RE - Return to rating menu
Key return to scroll the rating date list
```

Implementing an Index Rating

Some steps for implementing an index rating are identical to the stage-area rating implementation. ADAPS currently (2011) supports three methods for implementing an index rating; (1) single-variable equation, (2) table lookup, and (3) a multi-parameter, stage-factor rating. A fourth method requires that an external script be executed outside of ADAPS on the NWIS server and is used for the most complicated ratings. Descriptions of how to use these methods are provided below. An example simple-linear index rating is implemented using the equation method. An example compound-linear index rating is implemented using the table lookup capability. Then two example multiple-linear ratings are implemented using the multi-parameter, stage-factor rating capability and an external script.

Simple-Linear Index Ratings in ADAPS

Use the following steps for the first Equation type index rating.

1. Start ADAPS.
2. Select the Primary Data Processing (PR) option.

```
*******************************************************************************
|     US. GEOLOGICAL SURVEY AUTOMATED DATA PROCESSING SYSTEM (ADAPS)       |
| REVISION NWIS-4.10.0-50                    Oct 28, 2010 08:47:54 Thursday |
|                 MAIN MENU - WATER DATA PROCESSING OPTIONS                 |
*******************************************************************************

     IN -- Data Input
     PR -- Primary Data Processing
     AP -- ADAPS Statistical applications
     DI -- Data Display
     RT -- Data Retrieve/Write
     SU -- Update Support Files/Record Flags
     MA -- Maintain Database
     UT -- Miscellaneous Utility Functions
     LA -- Local Applications

     DOC menu_opt -- Display documentation      PGM -- Display program_names
     QU -- Exit to previous menu                EX -- Exit to Unix

Select desired menu option or program_name ([CR] for menu):
```

3. Select Update/Display Rating Tables (option 4).

```
*******************************************************************************
|     US. GEOLOGICAL SURVEY AUTOMATED DATA PROCESSING SYSTEM (ADAPS)       |
| REVISION NWIS-4.10.0-50                    Oct 28, 2010 08:49:36 Thursday |
|                 (PR) SUB-MENU : Primary Data Processing                   |
*******************************************************************************

 1 -- Update Data Descriptor Thresholds 10 -- Print/Display Unit-Values Tables
 2 -- Edit Time-Series Data using Hydra 11 -- Daily Values Tables
 3 -- Update/Display Data Corrections   12 -- End-of-Year Summary
 4 -- Update/Display Rating Tables      13 -- Peak Flow Entry and Retrieval
 5 -- Shift Analysis and Error Bars     14 -- Manage Record Data Aging Status
 6 -- Update/Display Shifts             15 -- Plot Time-Series Data
 7 -- Primary Computations              16 -- Show Site Information
 8 -- Edit DV Statistical Summary       17 -- Station Analysis Report
 9 -- Daily-Values Manipulation

 FROM THE PREVIOUS MENU -- IN, PR, AP, DI, RT, SU, MA, UT, LA,

     DOC menu_opt -- Display documentation      PGM -- Display program_names
     QU -- Exit to previous menu                EX -- Exit to Unix

Select desired menu option or program_name ([CR] for menu):
```

4. Select the station and DD that need a new or updated rating.

```
                    RT_EDIT - UPDATE/DISPLAY RATING TABLES
                              FLORIDA INSTALLATION
DATE: 10-28-2010     USER levesque                          TIME: 08:53:06
*******************************************************************************
CURRENT USER INFORMATION
PA - FILE PATH     - /home/tpa/levesque
OT - OUTPUT TO     - Data General (TELNET) TERMINAL
-------------------------------------------------------------------------------
DB - DATA BASE     -  Main
AG - AGENCY        - USGS   US Geological Survey
ST - STATION(S)    - 02301719 ALAFIA RIVER NEAR GIBSONTON FL
DD - DATA DESCR.   - Discharge not filtrd. for tide (cfs)
*******************************************************************************
Enter: PA,OT,DB,AG,ST,DD  to edit field or
     [CR] to continue:
```

5. Select VELO (option 2).

```
1   STGQ   stage-discharge
2   VELO   velocity (optional)
3   STCO   stage-coefficient (optional)
4   STAR   stage-area
Enter the number of the item desired:
```

Enter the new 4-digit rating ID number. A rating ID convention should be specified in the USGS Water Science Center (WSC) Surface-Water Quality-Assurance Plan (SW QA Plan).

The form for the Equation type of index rating is the simplest. It is a single straight line (fig. 6-1) that can be expressed using a simple-linear equation of the form

$$y = mX + b, \tag{6-1}$$

where

y = computed-mean velocity,
m = slope of the line (also named the X variable coefficient),
X = index velocity, and
b = y intercept or intercept (defined where the regression line crosses the y-axis when x = 0).

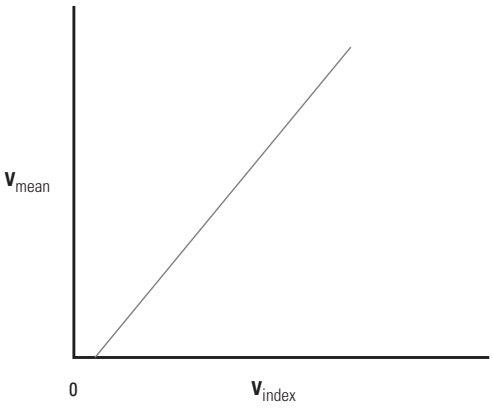


Figure 6-1. Equation type of index rating.

6. To implement this type of rating in ADAPS, the Equation expansion type is selected (option 3).

```
      Rating Type: velocity (optional)   Rating ID: '0001'



             EXPANSION TYPES
             ---------------
SELECT YOUR OPTION BY ENTERING 1, 2, OR 3:
             "1" - LINEAR
             "2" - LOG
             "3" - EQUATION
```

```
             Rating Type: velocity (optional)   Rating ID: '0001'



                                                    C
                  Equation: output = A * (B + input)   + D
                            current values:  A =            .9213
                                             B =
                                             C =
                                             D =           -.0136

Enter the equation element (A, B, C, or D) you wish to change or return to quit
```

The form of the equation in ADAPS is slightly different from the form of the simple-linear regression equation 6-1 above, and only two of the four variables (A and D) are used to implement a simple-linear index rating. “A” is the slope of the line (“m” in previous equation), and “D” is the y-intercept. Leave the variables “B” and “C” blank so they will have no effect on the computation of mean velocity.

7. After entering the equation rating in ADAPS, verify that the values entered are correct and quit the equation screen. Then, the rating “starting date” prompt will be displayed.

```
 #   ID   S  Starting Date              Ending Date               Remarks
--- ----  -  ------------------------  ------------------------  ------------------------------------------------
------

AP - Append a new rating date
 RE - Return to rating menu
Key return to scroll the rating date list
```

For a new rating, the starting date display will only allow the choice of appending a new rating. For existing ratings, the display will also allow the choice of editing the starting date and time for an existing rating (ED option). Select append (AP option), enter the starting date and time for the rating, and select the appropriate time datum (EST, CST, PST, or UTC). For a situation in which a rating has changed and another rating is required to represent changes to the index rating, the date and time of the start of the rating may be near the peak of a high-flow event, or near the date and time of a cross-section re-survey that revealed a substantial change in cross-section geometry if a flow event cannot be verified. This is all that is required for implementing an Equation type of index rating in ADAPS.

```
                     Rating Selection List
                     =====================
 1    velocity, Rating ID: '0001'

                      * - rating is currently active
       Enter the number of the rating desired: 1

  Specify the new rating starting date
ENTER DATE AS (MM DD YYYY): 06 28 2010
  Specify the new rating starting time
ENTER TIME AS (HHMMSS): 100000
  Specify the new rating starting time datum (<CR>="EST    ")
ENTER TIME DATUM CODE ("?" to pick from list):
```

Compound-Linear Index Ratings in ADAPS

The second type of index rating that can be implemented in ADAPS is referred to as a compound-linear rating. Occasionally the rating can be defined as two or more lines having differing slopes with transition regions linking the lines. An example of such a rating is for a stream where out-of-bank flows occur, and two straight lines and a transition region are required to define the index rating: (1) a linear rating for in-channel flow and (2) another linear rating for out-of-bank flow. A simplified graph of this rating is shown in figure 6-2.

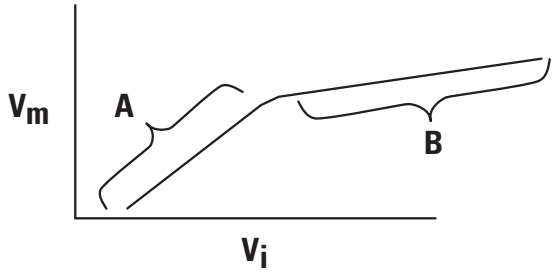


Figure 6-2. Compound-linear rating.

Segments A and B can be expressed mathematically as two straight lines with different slopes and intercepts and a region of transition that may or may not be curved that connects the two segments. If the index rating is of this form, it can be expressed using what is called a linear expansion rating in ADAPS. The linear expansion rating is a lookup table of data values with an input value (index velocity) and an output value (measured-mean velocity).

After determining the two straight line segments using linear regression analysis methods for each segment, the intercept of the two lines can be solved by setting the two equations equal to each other and solving for the index velocity value, then using that index velocity value in one of the original equations to determine the corresponding mean velocity value. The transition between the two segments likely will be curved and may require additional data points to adequately define the transition.

When implementing this rating in ADAPS, steps 1–5 (listed previously for the simple-linear index rating) are the same.

6. After computing the lowest and highest velocity values for each segment and the transition points between the two segments, the rating can be entered into ADAPS using the "linear" expansion type.

```
      Rating Type: velocity (optional)   Rating ID: '0001'



              EXPANSION TYPES
              ---------------
 SELECT YOUR OPTION BY ENTERING 1, 2, OR 3:
              "1" - LINEAR
              "2" - LOG
              "3" - EQUATION
```

7. After selecting the "linear" expansion type of rating, the input (index velocity) and output (mean velocity) data values are entered into a table rating. The input and output values must be entered in ascending numerical order from lowest to highest. Enter text for remarks about the rating. (Example: Established rating, rating based on measurements 1–35, velocity range 0.2 to 5 ft/s, and gage heights less than 35 ft). More than one line of remarks can be entered for each rating. Each line is limited to 120 characters. The remarks should provide information about the rating to assist in the quality-assurance review process and for historical documentation. Follow the on-screen directions to enter remarks. After entering remarks about the rating, the linear expansion rating entry table will be displayed.

```
            Rating Type: velocity (optional)   Rating ID: '0001'
**************************************************************************************
   Enter one of the commands from the menu
IN ADD MODE - TYPE IN YOUR ENTRY - TO GET OUT OF ADD MODE TYPE IN AN "X"
**************************************************************************************
 RATING   RATING     RATING   RATING     RATING   RATING     RATING   RATING
VALUE IN VALUE OUT  VALUE IN VALUE OUT  VALUE IN VALUE OUT  VALUE IN VALUE OUT
     .01        0  _______  _______    _______  _______    _______  _______
       1      .93  _______  _______    _______  _______    _______  _______
     1.2     1.12  _______  _______    _______  _______    _______  _______
     1.3     1.24  _______  _______    _______  _______    _______  _______
     1.4     1.26  _______  _______    _______  _______    _______  _______
     1.5     1.28  _______  _______    _______  _______    _______  _______
     5.4      5.1  _______  _______    _______  _______    _______  _______
_______  _______   _______  _______    _______  _______    _______  _______
_______  _______   _______  _______    _______  _______    _______  _______
_______  _______   _______  _______    _______  _______    _______  _______

"S"= Save and return  "Q"=Quit (no save) "A"= add pointsode
"F"= forward 1 page   "U"= up 1 line     "D"= delete line    "C"= change line
"B"= backward 1 page  "M"= down 1 line   "I"= insert line
```

Follow the on-screen directions for entering the index rating input and output values for the linear (table) rating. Values must be entered in ascending numerical order from lowest to highest. To add the input-output data value pairs, enter "A", then type an index velocity value, a space, and the corresponding mean velocity value (Example: 0.01 0). Press the enter key and repeat the sequence for all the data value pairs required to adequately define the index rating.

8. Enter "X" to exit the Add mode. After verifying that the correct data value pairs have been entered, save the rating (S option). After saving the rating, choices for entering the starting date of the rating will be displayed.

```
                          Rating Type: velocity

  #   ID   S  Starting Date              Ending Date               Remarks
 --- ----  -  ------------------------   ------------------------  ---------------------
-------------------------------------

 AP - Append a new rating date
 RE - Return to rating menu
Key return to scroll the rating date list
```

9. Each index rating for the station requires a start date and time for the rating to begin. The starting date and time is entered using “Append a new rating date” (AP) for a new rating. Use “Edit a rating date” (ED) for an existing rating that requires a revision for the starting or ending date. (ED is only available when ratings already exist.) Select the appropriate option (AP or ED) and enter the date and time you want the rating to be implemented and select the appropriate time datum (EST, CST, PST, or UTC). For new stations, this date and time typically will be the date and time of the first valid data value. For a new rating, the starting date display will only allow the choice of appending a new rating. For a situation in which a rating has changed and another rating is required to represent the change in relation between index and mean velocity, often the date and time are selected such that they are near to the peak of a high-flow event, or the date and time may be that of the first measurement used in the new index rating if a specific time cannot be verified.

```
                    Rating Selection List
                    =====================
1    velocity, Rating ID: '0001'

                     * - rating is currently active
       Enter the number of the rating desired: 1

  Specify the new rating starting date
ENTER DATE AS (MM DD YYYY): 06 28 2010
  Specify the new rating starting time
ENTER TIME AS (HHMMSS): 100000
  Specify the new rating starting time datum (<CR>="EST   ")
ENTER TIME DATUM CODE ("?" to pick from list):
```

If the rating you want to enter is not the first rating, but an updated rating (new cross-sectional area), then the preceding rating must be ended at a specified date and time. Enter the date and time that marks the beginning of the new rating, and the older rating will automatically have the ending date entered. The ending date-time of the old rating and the starting date-time of the new rating should not leave a gap in the time period when no rating is active. If the ending date and time are not correct, the date and time values can be edited using the “ED” option.

10. After entering the starting date and time of the index rating, additional remarks about the timing of the rating or other general remarks about the rating can be entered. The remarks for how the rating was developed appear at the top of the rating and are used to describe the rating. The remarks entered at the time of the starting date are listed with the rating start time.

```
 #   ID   S  Starting Date              Ending Date               Remarks
--- ----  -  ------------------------  ------------------------  ------------------------------------------------
------
  1 0001     03-28-2010 @ 00:01:00 EST            -----             Rating started at time of station installation.


AP - Append a new rating date
ED - Edit a rating date
RM - Remove a rating date
RE - Return to rating menu
Key return to scroll the rating date list
```

Multiple-Linear Index Velocity Rating

The third type of index rating that can be implemented in ADAPS is referred to as a multiple-linear rating. Occasionally, the index rating is not adequately defined using index velocity alone. The most common additional variable that is related to mean velocity is stage. If regression analysis indicates that index velocity and stage are significant variables and using both variables significantly improves the index rating, then this more complex rating can be implemented in ADAPS. A simplified example of a multiple-linear rating using stage and index velocity is shown in figure 6-3.

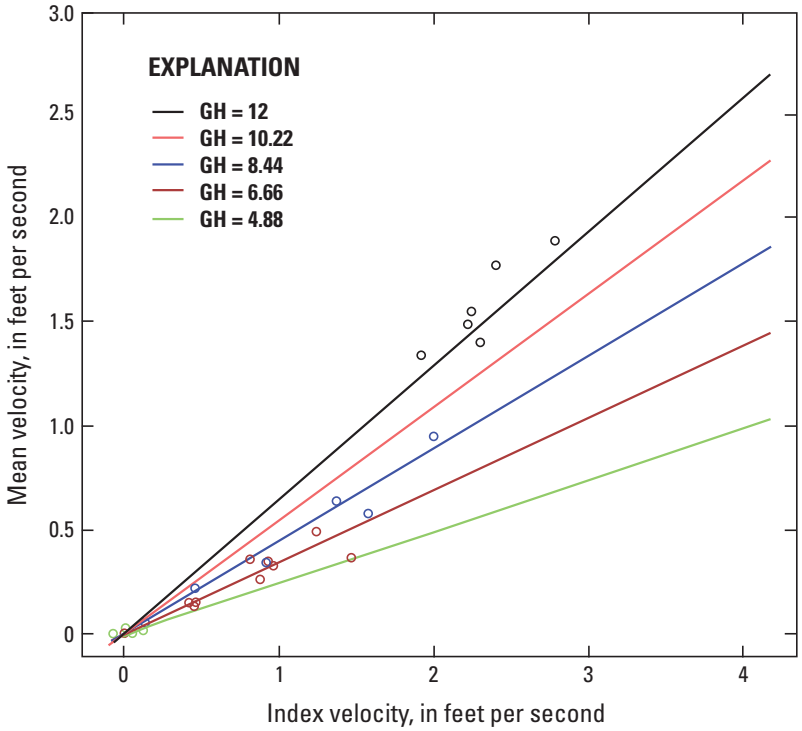


Figure 6-3. A multiple-linear index rating.

The equation that defines figure 6-3 is of the form

$$y = aX_1 + b(X_1X_2) + c. \tag{6-2}$$

where,

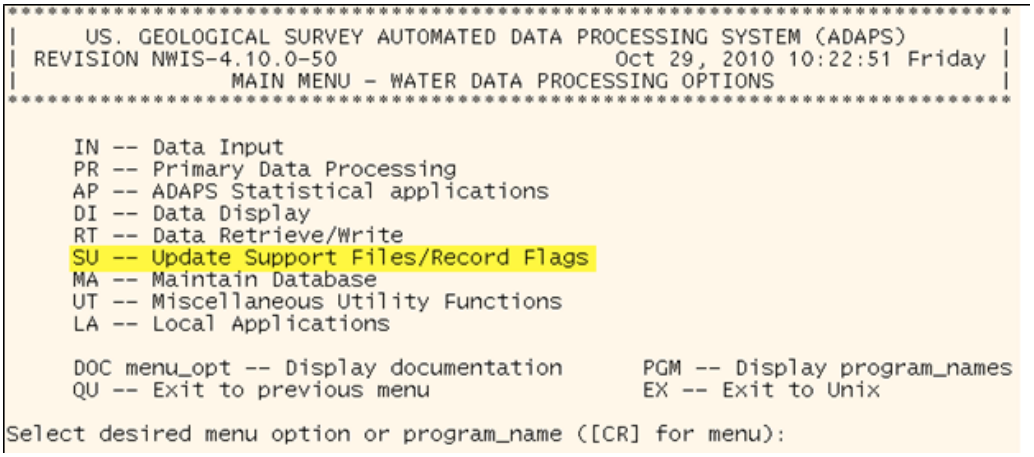
a = slope coefficient for X_1,
b = slope coefficient for X_2,
c = y intercept,
X_1 = index velocity, and
X_2 = stage.

The determination of the coefficients a, b, and c is made using regression analysis with index velocity (X_1) and index velocity × stage ($X_1 \times X_2$) as the two independent variables, as described previously in the "Multiple-Linear Regression Rating" section of the report. Equation 6-3 is modified by factoring out the common term X_1 (index velocity) to rearrange the equation to yield

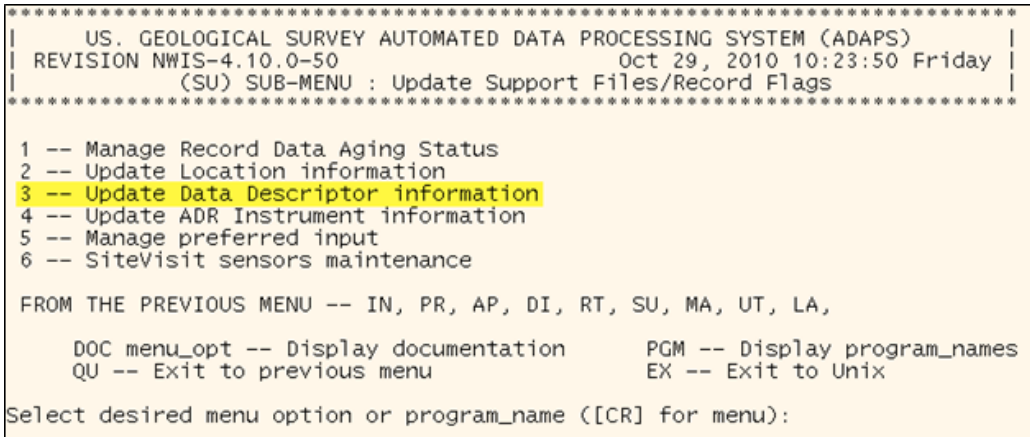
$$y = X_1(a + bX_2) + c. \tag{6-3}$$

This form of the equation is used to input the rating into ADAPS. However, the rating must be defined by using the Update Support Files/Record Flags (SU option) that typically has restricted access, rather than the Update/Display Rating Tables option. The SU option in ADAPS is only accessible by someone with ADAPS administrator rights. The following steps should be used.

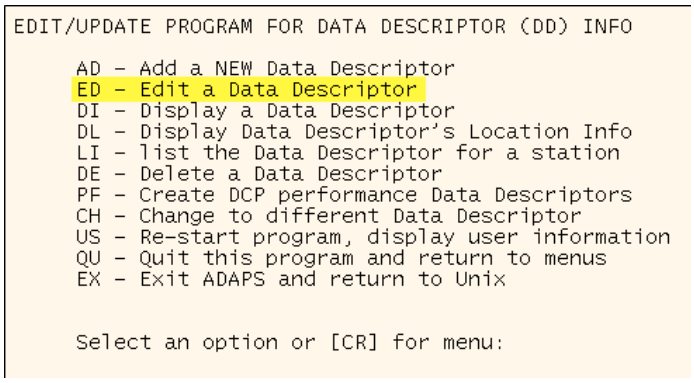
1. Select the SU option.



2. Select Update Data Descriptor information (option 3).



3. Select the station that requires the rating, then choose Edit a Data Descriptor (option ED).



4. A list of data descriptors (DDs) will be displayed. Select the correct discharge DD, then select Display/Update DD Processing Information (option 2).

```
                DD DISPLAY AND UPDATE OPTIONS

     1. DISPLAY/UPDATE DD INFORMATION
     2. DISPLAY/UPDATE DD PROCESSING INFORMATION
     3. DISPLAY/UPDATE DD SCREENING THRESHOLDS
 ENTER OPTION NUMBER INDICATING WHICH DATA TO DISPLAY/UPDATE
                     OR KEY [CR] TO CONTINUE:
```

5. The following table will be displayed.

```
     Processor Status:                    working
     Created by:                          levesque  on: 10-26-2010 @ 15:03:11 EST
     Modified by:                         levesque  on: 10-27-2010 @ 14:26:10 EST
SD - Starts on:                           10-01-2010
ED - Ends on:                             12-31-2382
RP - Default primary report type:         Standard
GP - Unit values missing gap time:        60 (MINUTES)
DV - Compute DVs:                         MEAN
IS - Stage gage:                          DD #02 Gage height (ft)
IV - Velocity gage:                       DD #31 Stream velocity x-component
UL - Upper gage height limit:             Not specified
LL - Lower gage height limit:             Not specified
EQ - Use mean-velocity equation:          No
XC - Equation X coefficient:              Not specified
YC - Equation Y coefficient:              Not specified
EC - Equation constant:                   Not specified
HB - Base for extreme events:             Not used
HP - Interval for extreme events:         Not used
SV - Site Visit Computation Flag (Y/N):   Y

Enter code to edit field, IR to set to In-review, DE to delete processor,
 NW to create new version, or key [CR] to continue:
```

6. The highlighted entries (SD, IS, IV, EQ, XC, YC, and EC) must be correctly input in order for the rating to work. An example of a correctly entered index velocity-stage-discharge rating is shown below and represents the equation:

$$\text{mean velocity} = 0.462X_1 + 0.033(X_1X_2) + 0.099. \tag{6-4}$$

```
     Processor Status:                    working
     Created by:                          levesque  on: 10-26-2010 @ 15:03:11 EST
     Modified by:                         levesque  on: 10-27-2010 @ 14:26:10 EST
SD - Starts on:                           03-28-2010
ED - Ends on:                             12-31-2382
RP - Default primary report type:         Standard
GP - Unit values missing gap time:        60 (MINUTES)
DV - Compute DVs:                         MEAN
IS - Stage gage:                          DD #02 Gage height (ft)
IV - Velocity gage:                       DD #31 Stream velocity x-component
UL - Upper gage height limit:             35.000 ft
LL - Lower gage height limit:             3.440 ft
EQ - Use mean-velocity equation:          Yes
XC - Equation X coefficient:              0.462
YC - Equation Y coefficient:              0.033
EC - Equation constant:                   0.099
HB - Base for extreme events:             Not used
HP - Interval for extreme events:         Not used
SV - Site Visit Computation Flag (Y/N):   Y

Enter code to edit field, IR to set to In-review, DE to delete processor,
 NW to create new version, or key [CR] to continue:
```

Before any values for the equation can be entered, "Use mean-velocity equation" must be set to "Yes" (option EQ), and the processor status must be set to "working." Ensure that the correct DDs (IS and IV) have been selected for the rating. Also ensure that any old velocity ratings configured under the PR 4 option have been ended prior to the "Starts On" date in the discharge processor. A limitation of this method is that the rating history is not retained in ADAPS as is done with the stage-area rating (STAR) and index velocity rating (VELO) previously described. An electronic file of the discharge processor stage-coefficient index rating should be created and archived according to the WSC SW QA Plan. This could be a text file with a copy of the discharge processor input display and associated dates and notes that can be appended if changes to the rating are required over time.

Implementing a Complex Index Velocity Rating Outside of ADAPS

The fourth rating method requires the automatic execution of a script file outside of (independently from) ADAPS using a time-based job scheduler such as the Unix cron service. The purpose of this script is to use data from specified variables such as stage, index velocity, combinations of stage and index velocity, and other parameters to compute a mean velocity. In general, such scripts would perform the following tasks.

1. The scripts retrieve data for all variables necessary for computing a mean velocity (variables that have been found to be significantly related to measured-mean velocity).

2. After the data have been retrieved, the script computes mean velocity using equations that relate mean velocity to any number of variables. Logical operators (if, then, else) can also be used. For example, some equations may apply only if a certain stage (or any other parameter) criteria is met.

3. The script automatically writes the results to a file for import into NWIS.

The external implementation of an index rating requires that a special DD be created in ADAPS for "Computed-mean velocity." As with the stage-coefficient index rating, historical documentation is not automatically retained in ADAPS when using a script file to compute mean velocity. An electronic text file should be created, providing documentation of the equations used to compute mean velocity. An example of a Perl script used for a station in Florida is included below and can be modified for any station and any number of DDs (input variables).

Perl-Script Rating

The following are some notes about implementing the script rating example below.

1. Header has information about the file and its workings and has documentation throughout the text.

2. Documentation information has a "#" at the start of the line.

3. Variable names in the script were originally chosen for a specific site. They can be changed if so desired. If variable names are changed, all instances of that variable name must be changed throughout the script, otherwise the script will not work.

4. The script can be run automatically by the job scheduler at whatever frequency desired. In one implementation of this script, a Unix cron job (job scheduler for Unix) executes the Perl script which creates an output file that is stored in the satin/rtin (realtime in) folder.

5. After the job is run and the output file created, the data in the output file are decoded and entered into NWIS using the DECODES process. The location of the output file will be office specific and will need to be changed accordingly.

6. The script may also be executed manually using the last number of days or a start time and end time (GMT).

```
#!/usr/bin/perl5
# crystal_ind.pl
# 02310747 Crystal River at Bagley Cove nr Crystal River, FL.
# June 15, 2005  began for WY2004  MRD   Rating # 1.0 Computes mean velocity
# This program pulls the index velocity and gage heights from NWIS and computes a mean velocity
# Need to create a DD for computed-mean velocity so the computed-mean velocity can be stored in NWIS
# The Discharge processor will have to use the computed-mean velocity DD and the Equation rating will only need a “1” value
# for the A coefficient, effectively multiplying the computed mean velocity by one (1).
# Rating # 1.0 is a bimodal rating using 88 measurements.
# INPUT: None
# INPUT: (OR) $num_days (one ARG input from command line in days)
# INPUT: (OR) beginning date ending date (2 inputs last 2 in nwis2rdb date/time format)
# OUPUT: date and computed mean velocity corresponding to gh and index velocity at Crystal River.
#xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
# $num_days is the default time period that the program will go back to start a data retrieval and Q calculation. (INPUT: None)
#$num_days = .25;
$num_days = 5;
$site_cnt = 0; # Number of sites to be processed
$i = 0; #Counter for time comparison loop
$gh_dt = 0;
$path = “/usr/opt/www/httpd/htdocs/ttpage/springs”;
# set $path_out to springs to print in this directory or rtin to send to satin.
#$path_out = “/usr/opt/www/httpd/htdocs/ttpage/springs”;
$path_out = “/usr/opt/decodes/satin/rtin”;
use Fcntl;
use Time::localtime;
use Time::Local;
$time=time;

#-------------------------------------------------------------------------------------------
#------------------------------ Allow 0, 1 or 2 command line arguments
# This is where the program uses the time period selected.

if ($cnt = @ARGV == 1) {
            $num_days = $ARGV[0];
            # print “I’m in the on loop\n”;
}
elsif ($cnt = @ARGV == 2) {
$beg = $ARGV[0];
$end = $ARGV[1];
# print “I’m in the three loop\n”;
}
else { $tm = localtime($time); $timeout = sprintf (“%04d/%02d/%02d
%2d:%02d”,$tm->year+1900,$tm->mon+1,$tm->mday+1,$tm->hour,$tm->min);
#else { $tm = localtime($time); $timeout = sprintf (“%04d/%02d/%02d
%2d:%02d”,$tm->year+1900,$tm->mon+1,$tm-#>mday,$tm->hour,$tm->min);
}
#use this to test arguments input to program
#print “The infile is $filein\n”;
#if($num_days) {print “The number of days before the present = $num_days\n”;}
if($beg && $end){print “$beg $end\n”;}
#-------------------------------------------------------------------------------------------
#---------------------------Do time stuff if interval bp is required
unless($beg && $end){ $time_int = $time - (60 * 60 * 24 * $num_days);
                        $tm = localtime($time);
                        $tm2 = localtime($time_int);
```

```
                    $end = sprintf (“%04d%02d%02d”,
                    $tm->year+1900,$tm->mon+1,$tm->mday+1);
                    #$tm->year+1900,$tm->mon+1,$tm->mday);
                    $beg = sprintf (“%04d%02d%02d”,
                    $tm2->year+1900,$tm2->mon+1,$tm2->mday);

#test the output of the user specified interval before present calculation
#print “Calculated begin time = $beg\n”;
#print “Calculated end time = $end\n”;
}
#-------------------------------------------------------------------------------
#-------------------------BEGIN PROCESSING OF EACH STATION

#------------------------- Extract the Gage Height and Index Velocity Data from ADAPS
@crystal_gh = ();
#
# variable name     stationID “unit vales” “computed” “DDID” “begin time” “end time”
#
#  -n02310747 is the station ID and -d1 indicates DDID#1 - gage height
push(@crystal_gh, `nwts2rdb -n02310747 -tuv -sC -d1 -b$beg -e$end -lGMT`);
@crystal_ivel = ();
#-d4 indicates DDID#4 - index velocity
push(@crystal_ivel, `nwts2rdb -n02310747 -tuv -sC -d4 -b$beg -e$end -lGMT`);
# You can add more statements that will retrieve other variables from NWIS. You will also have to add routines/statements
# below for each variable you want to retrieve in order to separate the variables from the date-time values.
# If you don’t like the existing variable names you can change them, just make sure you change them for all instances.

#------------------------- Write UV analysis----------------------------
# take the Gage Height RDB data and separate the time and the gage height data into different arrays.
foreach $crystal_gh (@crystal_gh){
            chomp($crystal_gh);
            if($crystal_gh =~ /^[12]/){
            ($date,$HMS,undef,$crystal_gh_data,undef)=split /\t/,$crystal_gh, 4;
            ($y,$m,$d) = unpack(‘a4a2a2’,$date);
            ($H,$M,$S) = unpack(‘a2a2a2’,$HMS);
            if($H == 24) { $H = 23; $M = 59; $S = 58;}
   $crystal_gh_et1=timelocal($S, $M, $H, $d, $m -1, $y - 1900);
#            print “$crystal_gh_data”;
 push @GH, join(‘ ‘, $crystal_gh_et1,$crystal_gh_data);
}
}
#---------------------------------------------------------------
#
# This is the same as above except it is for the index velocity data
# note the variable names...ex: crystal_ivel_data and crystal_ivel_et1 (time data)
foreach $crystal_ivel (@crystal_ivel){
 chomp($crystal_ivel);
 if($crystal_ivel =~ /^[12]/){
  ($date,$HMS,undef,$crystal_ivel_data,undef)=split /\t/,$crystal_ivel, 4;
  ($y,$m,$d) = unpack(‘a4a2a2’,$date);
  ($H,$M,$S) = unpack(‘a2a2a2’,$HMS);
if($H == 24) { $H = 23; $M = 59; $S = 58;}
   $crystal_ivel_et1=timelocal($S, $M, $H, $d, $m -1, $y - 1900);
   push @IVEL, join(‘ ‘,$crystal_ivel_et1,$crystal_ivel_data);
}
}
```

```
sysopen(FILEOUT,"$path_out/crystal_q.dat", O_WRONLY|O_TRUNC|O_CREAT) or die
"Can't create the output file $path_out/crystal_q.dat $!\n";
print FILEOUT "//SOURCE edltpa EDL\n";
print FILEOUT "//STATION 02310747\n";
print FILEOUT "//DEVICE FILE\n";

foreach $ivel (@IVEL){
        ($ivel_dt,$ivel_dat)=split / /,$ivel, 3;

          while($gh_dt < $ivel_dt & $i <= $#GH){
                                        ($gh_dt,$gh_dat)=split / /,$GH[$i],3;

#########################################################################
# Multiple linear regression # 1.0
# inputs gage height and index velocity
#########################################################################

#-----------------------------------------------

# Next calculate the mean velocity using multiple linear regression on gh and index vel
# The index-to-mean velocity calculations start here.
#
#########################################################################

if($ivel_dat >= 0) {$mvel = 1.37*$ivel_dat+0.13*$gh_dat-1.32};
if($ivel_dat < 0) {$mvel = 1.71*$ivel_dat+0.48*$ivel_dat*$ivel_dat+0.09};
#(this equation has index velocity squared as the second term)

#-----------------------------------------------


$tmx = localtime($gh_dt);
$tm_out = sprintf("%02d/%02d/%02d %02d:%02d",
$tmx->mon+1,$tmx->mday,$tmx->year-100,$tmx->hour,$tmx->min);
print FILEOUT "$tm_out $q\n";

# print FILEOUT "$tm_out $gh_dat $ivel_dat $mvel \n";
$i++;
}
}
close FILEOUT or die "COULD NOT CLOSE THE OUTPUT FILE!$!";
```