Appendix B

Survey Tide Correction Program
Conceptual Description

The Survey Tide Correction program developed in the University of Florida Coastal and Oceanographic Engineering Department by Bill Miller under the direction of Dr. Max Sheppard consists of three Fortran 90 programs. The basic program is survcorr.f90 which performs the linear interpolations and corrects the survey data. The other programs, baseline1.f90 and baseline2.f90, may be used to provide "SURVCORR" with its baseline files.

The basic concept is to provide a means of correcting a survey of water depth within a winding canal or river system using a limited amount of tidal data. To do this a "baseline" of correcting reference points is constructed along the survey path within the system. In an ideal case, tide gages would be located at each baseline point and the survey could be corrected using a linear interpolation to the two gages nearest to the survey point.

However, setting up so many tide gages is not practical. Therefore, a baseline tide data file is constructed using two gages at either end of the system. The data is interpolated by program "BASELINE2" based on the distance of the point from each gage. The baseline data is then used to correct the survey data. By using this "baseline method," the distance between the gages within the winding path of the system may be considered, rather than the direct distance from the survey point to the gages. This direct distance will likely cut across the system and not reflect the true distance seen by the tide as it propagates along the baseline path.

Thus, the baseline points are best located at the corners and bends in the system and the file describing the locations must list the points in sequence along the path of the system. The diagram below illustrates such a baseline.

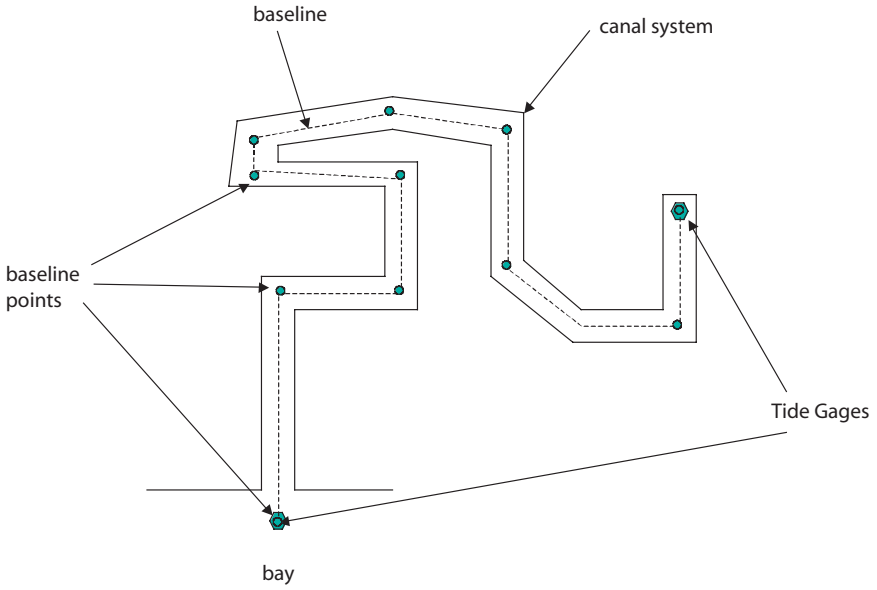

Figure 1. Canal System and Baseline Development

If a branch to the canal system exists, a branch to the main baseline may be developed using the "BASELINE1" program. The figure below illustrates this situation.

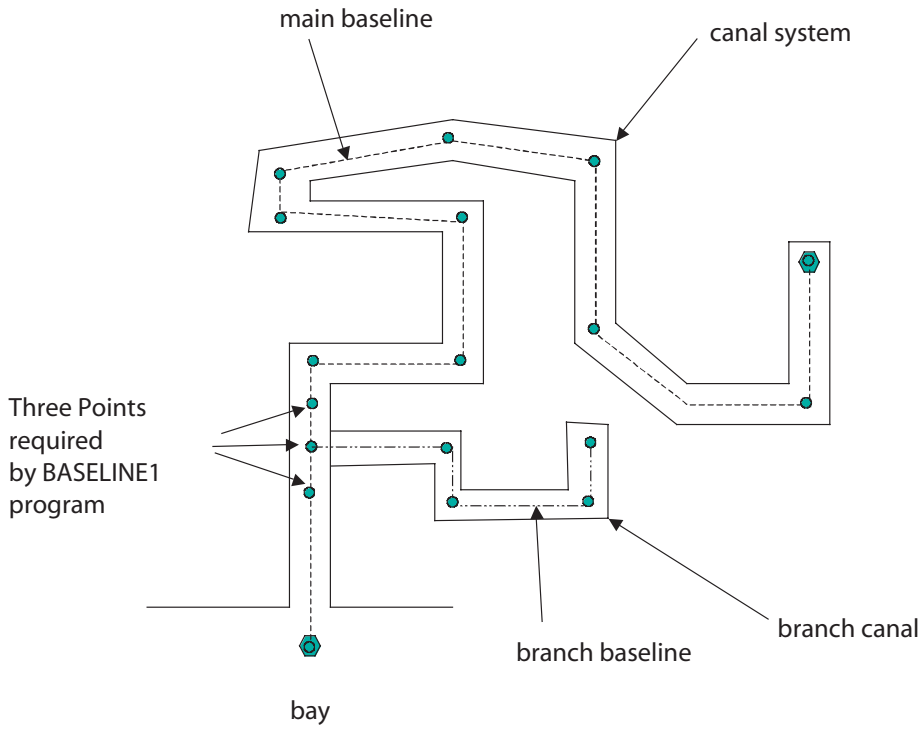

Figure 2. Branch Canal Case

The three baseline points are used to determine a water surface slope (time dependent). This slope is then applied along the branch baseline to determine the appropriate tidal correction with distance.

If the tide is the same throughout the system, using a single baseline point in "SURVCORR" will result in a direct interpolation of the survey to this one point. In other words, only the time will be considered and interpolated and not the distance from the point.

Instructions for Correcting a Survey

A. Correction between two tide gages

1. Divide the survey data into appropriate paths and format in an ASCII file described under the "SURVCORR" Program section of these instructions.

Per Fig. 1, plot a baseline on a chart of the survey area and record the locations of each point. The first and final points of the baseline should be tide gages. Each bend and corner in the canal system should be marked by A BASELINE POINT. RECORD these points in an ASCII data file described under the "SURVCORR" Program section of these instructions.

Use the "BASELINE2" program to interpolate the tide data from the two tide gages and develop the "Baseline Tide Data" file used by the "SURVCORR" program.

Use these files as the inputs to the "SURVCORR" program described under the "SURVCORR" Program section of these instructions.

The output file of the "SURVCORR" program should be examined to verify reasonableness of the corrections made to the survey data.

B. Corrections to a canal branch

Per Fig. 2, determine the three main baseline points to be used in the "BASELINE1" program and build their location and data files. These files must have the form described under the "BASELINE1" Program section of these instructions and be saved in ASCII format.

Plot a branch baseline on a chart of the survey area and record the locations of each point. The first point must be the middle point of the three points chosen above. Each bend and corner in the canal system should be marked by a baseline point. Record these points in an ASCII data file described under the "BASELINE1" Program section of these instructions.

Use these files as inputs to the "BASELINE1" program. The output of this program will be the "Baseline Tide Data" file used by the "SURVCORR" program.

Use the "Baseline Tide Data" from (3), the Baseline location file from (2) and the survey data file as the inputs to the "SURVCORR" program described under the "SURVCORR" Program section of these instructions.

The output file of the "SURVCORR" program should be examined to verify reasonableness of the corrections made to the survey data.

C. Corrections to a system with one tide gage

If only one tide gage is used, no reference exists for how the tide varies with distance. In this case, the survey cannot be corrected for distance. Use the tide gage location and tide data as the only baseline point and repeat steps 4 and 5 of section A above.

"SURVCORR" Program

Input Files. This program requires 3 input files.

1. Survey Data File. This is the actual survey data file to be corrected. The file must be in 4 columns with two column headers.

$$\begin{bmatrix} time1 & id1 & x1 & y1 & depth1 \\ time2 & id2 & x2 & y2 & depth2 \\ time3 & id3 & x3 & y3 & depth3 \\ time4 & id4 & x4 & y4 & depth4 \\ \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}$$

The time should be in a continuous sequential format (i.e. seconds, minutes or hours) from a common reference time. Depth must be measured from the water's surface, positive downward.

2. Baseline Location File. This file locates (in x, y coordinates) the baseline points used to interpolate and correct the survey data. The file must be in three columns with two column headers.

$$\begin{bmatrix} point\ number1 & x1 & y1 \\ point\ number2 & x2 & y2 \\ point\ number3 & x3 & y3 \\ point\ number4 & x4 & y4 \\ \vdots & \vdots & \vdots \end{bmatrix}$$

The "point number" must be an integer value, but will not be used in the calculations. The x and y coordinates must have the same reference as the survey data. The rows of this file correspond to the location of the tide data in the columns of the "Tide Data File" described below.

3. Baseline Tide Data File. This file contains the tide information used in the correction calculation. Either the BASELINE1 or BASELINE2 programs described later may generate the file. If the baseline points consist only of known tide gages, the data developed from these gages may be used. Only one time column may be used, therefore actual tide gage data should be interpolated to this common time series. The file has the following format, again with two column headers.

$$\begin{bmatrix} time1 & \eta 11 & \eta 21 & \cdots \\ time2 & \eta 12 & \eta 22 & \cdots \\ time3 & \eta 13 & \eta 23 & \cdots \\ time4 & \eta 14 & \eta 24 & \cdots \\ \vdots & \vdots & \vdots & \ddots \end{bmatrix}$$

The time must have the same form and reference as the time in the survey file. The time series must also precede the minimum survey time and exceed the maximum survey time. The value corresponds to the tide level at each baseline point (by column) and should be referenced to the desired vertical datum (i.e. NGVD, MTL, etc.). The interpolation will subtract the appropriate tide level from the survey. In other words, at a high tide level (h > datum, i.e. h positive), the program will subtract the tide level from the survey depth. At a low tide level (h < datum, i.e. η negative), the program will add the absolute value of the tide level to the survey depth.

Output File. The program output file will have the following form.

The left five columns will be identical to the survey file described in (1) above. The sixth column will contain the corresponding survey depth corrected for the tide.

$$\begin{bmatrix} time1 & id1 & x1 & y1 & original-depth1 & corrected-depth1 \\ time2 & id2 & x2 & y2 & original-depth2 & corrected-depth2 \\ time3 & id3 & x3 & y3 & original-depth3 & corrected-depth3 \\ time4 & id4 & x4 & y4 & original-depth4 & corrected-depth4 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}$$

Single Point Baseline Construction Program ("BASELINE1")

This program will interpolate the tide data, based on distance, for a baseline which branches off of a main baseline. If only one baseline point is used, distance will not be used in the interpolation, only time. In this case, the entire system will be assumed to have the same tide.

Input Files. This program requires 3 input files.

1. Three Point Tide Data File. The three points used here will typically be chosen from a baseline file previously constructed from the BASELINE2 program. The file has the following format with no column headers.

$$\begin{bmatrix} time1 & \eta 11 & \eta 21 & \eta 31 \\ time2 & \eta 12 & \eta 22 & \eta 32 \\ time3 & \eta 13 & \eta 23 & \eta 33 \\ time4 & \eta 14 & \eta 24 & \eta 34 \\ \vdots & \vdots & \vdots & \vdots \end{bmatrix}$$

   The time must have the same form and reference as the time in the survey file. The time series must also precede the minimum survey time and exceed the maximum survey time. The η value corresponds to the tide level at each baseline point (by column) and should be referenced to the desired vertical datum (i.e. NGVD, MTL, etc.).

2. Three Point Baseline Location File. This file locates (in x, y coordinates) the three baseline points whose tide data was input in (1) above. The file must be in three columns without column headers.

$$\begin{bmatrix} point\ number1 & x1 & y1 \\ point\ number2 & x2 & y2 \\ point\ number3 & x3 & y3 \end{bmatrix}$$

   The "point number" must be an integer value, but will not be used in the calculations. The x and y coordinates must have the same reference as the survey data. The rows of this file correspond to the location of the tide data in the columns of the "Tide Data File" of (1) above.

3. Baseline Location File. This file locates (in x, y coordinates) the new baseline points. These new baseline points must begin with the middle (number 2) point in the three-point list above (i.e. "*point number1*" of this file is "*point number2*" of the above file).

$$\begin{bmatrix} point\ number1 & x1 & y1 \\ point\ number2 & x2 & y2 \\ point\ number3 & x3 & y3 \\ point\ number4 & x4 & y4 \\ \vdots & \vdots & \vdots \end{bmatrix}$$

Output File. The program output file will have the following form.

$$\begin{bmatrix} time1 & \eta 11 & \eta 21 & \cdots \\ time2 & \eta 12 & \eta 22 & \cdots \\ time3 & \eta 13 & \eta 23 & \cdots \\ time4 & \eta 14 & \eta 24 & \cdots \\ \vdots & \vdots & \vdots & \ddots \end{bmatrix}$$

This file corresponds to the Baseline Tide Data File described in the "SURVCORR" program and may be used directly in this program.

Two Tide Gage Baseline Construction Program ("BASELINE2")

This program will interpolate the tide data for a set of baseline points located between two tide gages. The interpolation will be a weighted linear interpolation based on the distance between the two gages.

Input Files. This program requires 2 input files.

1. Tide Gage Data File. This file contains the actual tide information used in the interpolation calculation. Only one time column may be used, therefore the time for each tide gage data should be interpolated to this common time series. The file has the following format, again with two rows of column headers.

$$\begin{bmatrix} time1 & \eta 11 & \eta 21 \\ time2 & \eta 12 & \eta 22 \\ time3 & \eta 13 & \eta 23 \\ time4 & \eta 14 & \eta 24 \\ \vdots & \vdots & \vdots \end{bmatrix}$$

The time must have the same form and reference as the time in the survey file. The time series must also precede the minimum survey time and exceed the maximum survey time. The η value corresponds to the tide level at each tide gage (by column) and should be referenced to the desired vertical datum (i.e. NGVD, MTL, etc.). The "SURVCORR" program will subtract the appropriate tide level from the survey. In other words, at a high tide level (η > datum, i.e. η positive), the program will subtract the tide level from the survey depth. At a low tide level (η < datum, i.e. η negative), the program will add the absolute value of the tide level to the survey depth.

2. Baseline Location File. This file locates (in x, y coordinates) the baseline points used to interpolate and correct the survey data. The file must be in three columns with two rows of column headers.

$$\begin{bmatrix} point\ number1 & x1 \\ point\ number2 & x2 \\ point\ number3 & x3 \\ point\ number4 & x4 \\ \vdots & \vdots \end{bmatrix}$$

The "point number" must be an integer value, but will not be used in the calculations. The x and y coordinates must have the same reference as the survey data. The first and last point in this file should be the two tide gages from the Tide Gage Data File of (1). The first point corresponds to the

first data column (i.e. not the time column) of the Tide Gage Data File and the last point corresponds to the second data column.

Output File. The program output file will have the following form.

$$\begin{bmatrix} time1 & \eta 11 & \eta 21 & \cdots \\ time2 & \eta 12 & \eta 22 & \cdots \\ time3 & \eta 13 & \eta 23 & \cdots \\ time4 & \eta 14 & \eta 24 & \cdots \\ \vdots & \vdots & \vdots & \ddots \end{bmatrix}$$

This file corresponds to the Baseline Tide Data File described in the “SURVCORR” program and may be used directly in this program.