MARICOPA COUNTY
FLOOD CONTROL DISTRICT

DRAINAGE DESIGN MANAGEMENT SYSTEM FOR WINDOWS

VERSION 6.8.0

TUTORIAL # 14

LATERAL EROSION ANALYSIS

KVL Consultants, Inc.

LATERAL EROSION ANALYSIS

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RIPRAP SIZING ANALYSIS FOR BANK PROTECTION

DATE UPDATED: MAY 7, 2024

TUTORIAL TIME: 40 MINUTES

1.0 PROBLEM STATEMENT

To estimate the lateral erosion corridor for a watercourse as a basis to protect the public from potential flood encroachments caused by unmitigated lateral bank migration.

The following data are provided for this tutorial:

- The Cross Section "*LATEROS1*"
  - Parameters for Hydraulics and Geometry:
    - **Design Flow Rate (cfs):** *3200*
    - **Channel Slope (ft/ft):** *0.015*
    - **Design Manning's n for Main Channel:** *0.035*
    - **Design Manning's n for LOB:** *0.045*
    - **Design Manning's n for ROB:** *0.050*
  - The geometric data (station and elevation) of the cross section:

Station (X)	Elevation (Y)	Notes
0	*165.0*	
200	*164.9*	
215	*164.5*	*FEMA Floodway Left Station*
275	*164.3*	
318	*164.1*	*Left Bank Station*
320	*163.9*	
321	*163.85*	
325	*163.8*	
340	*163.6*	
345	*160.0*	
350	*159.9*	
355	*159.6*	*Thalweg Station*
365	*159.7*	
370	*160.0*	

Station (X)	Elevation (Y)	Notes
375	*161.0*	
380	*163.0*	*Right Bank Station*
390	*163.2*	
420	*164.0*	*FEMA Floodway Right Station*
515	*164.3*	
600	*164.6*	
900	*165.0*	

- Data for Alternative Analyses

(a) Alternative Scenario #1: No Data Available

- **Channel Depth, D (ft):** *4.5*

(b) Alternative Scenario #2: Scour Data Available

- **Channel Depth, D (ft):** *4.5*
- **Scour Depth, Zt (ft):** *12.0*

(c) Alternative Scenario #3: Scour and Historical Data are Available

- **Channel Depth, D (ft):** *4.5*
- **Scour Depth, Zt (ft):** *12.0*
- **Left Historical Lateral Erosion Distance, Lh (ft)** *85.0*
- **Right Historical Lateral Erosion Distance, Rh (ft)** *85.0*

(d) Alternative Scenario #4: Scour, Historical Data and Cross Section Data are Available

- **Cross Section ID:** *LATEROS1*
- **Scour Depth, Zt (ft):** *12.0*
- **Left Historical Lateral Erosion Distance, Lh (ft)** *85.0*
- **Right Historical Lateral Erosion Distance, Rh (ft)** *85.0*
- **FEMA Floodway Left Station** *215.0*
- **FEMA Floodway Right Station** *420.0*
- **Thalweg Station** *355.0*

2.0 STEP-BY-STEP PROCEDURES

Step 1: Establish a New Project and Default Set-up

Step 2: Prepare the Cross Section Geometry

Step 3: Import Cross Section and Hydraulic Data

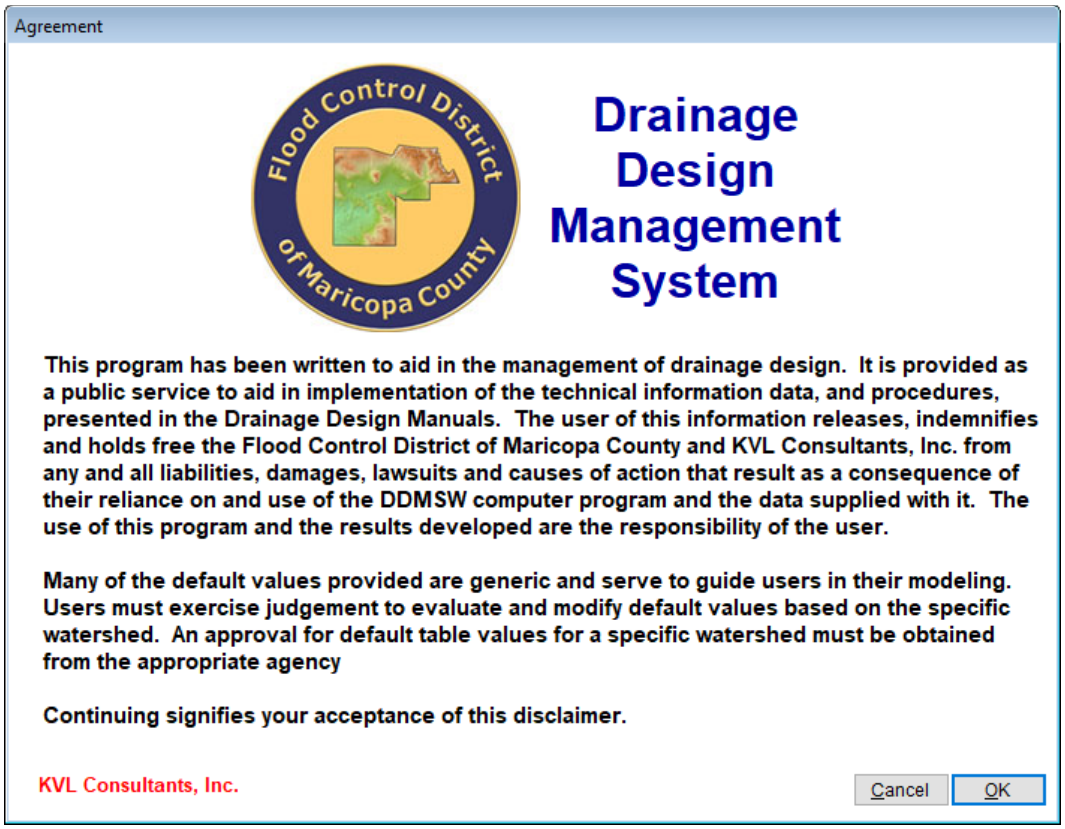
Step 4: Calculate Lateral Erosion Distance

- (a) Scenario #1 – No Data Available
- (b) Scenario #2 – Scour Data Available
- (c) Scenario #3 – Scour and Historical Data Available
- (d) Scenario #4 – Scour, Historical and Cross Section Data Available

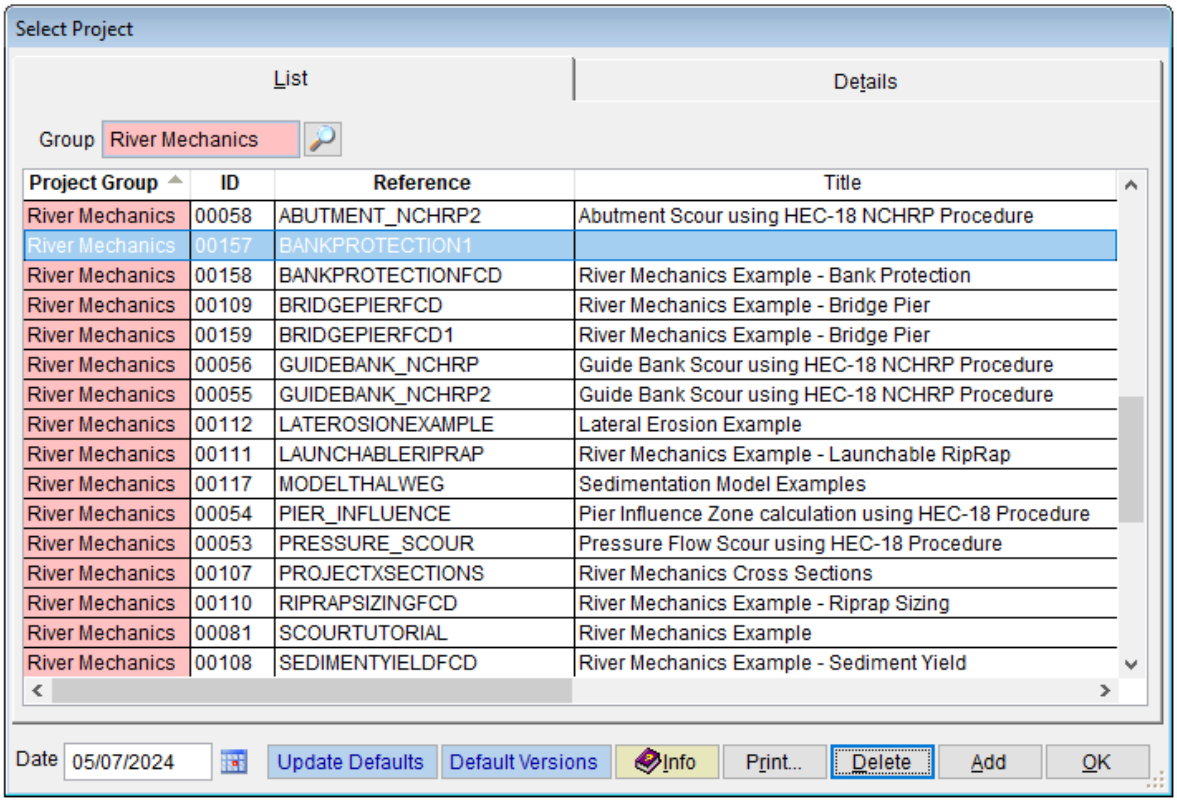
Step 5: Report and Documentation of Results

2.1 STEP 1 - ESTABLISH A NEW PROJECT AND DEFAULTS SET-UP

(a) Click the **DDMSW** icon on the Desktop or Program menu to launch the **DDMSW**. Click **OK** to accept the software disclaimer as is shown in the following figure.



After the **DDMSW** is launched, the **SELECT PROJECT** window is automatically opened as is shown in the following figure.



(b) Click the **Add** button on the **SELECT PROJECT** window to start a new project (or you can start a new project by **File ➔ New Project**).

(c) On the **NEW PROJECT OPTIONS** form, select **River Mechanics** checkbox and click the **OK** button to close the form.

(d) Type *"LATEROSION1"* into the **Reference** textbox. This is the name of this newly created project. The users can choose the name as long as it does not exist in the **DDMSW** database.

(e) Type into the **Title** textbox a brief descriptive title of this project. ***(Optional)***

(f) Type into the **Location** textbox the location of this project. ***(Optional)***

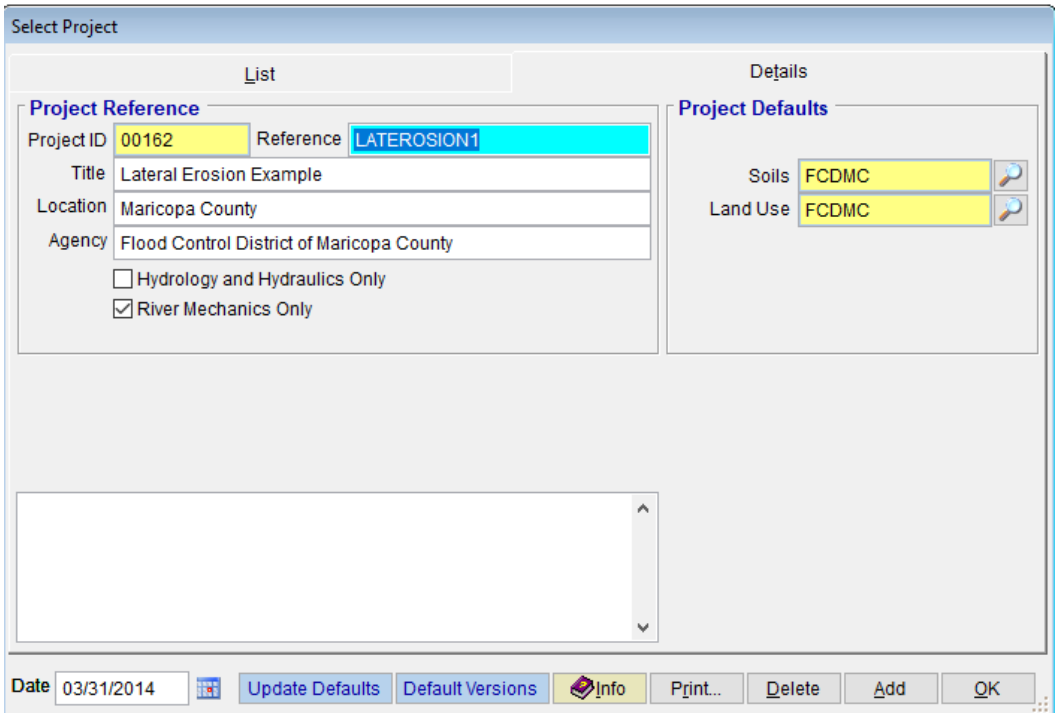
(g) Type into the **Agency** textbox the agency or company name. ***(Optional)***

(h) Check **River Mechanics** checkbox for this project.

(i) Type a detailed description of this project into the **Comment Box** under the **Project Reference** frame. ***(Optional)***

(j) Click the **Save** button to save the entered data.

(k) Click the **OK** button on the **SELECT PROJECT** window, and then click **OK** on the pop-up message box. The following figure shows what the window looks like.

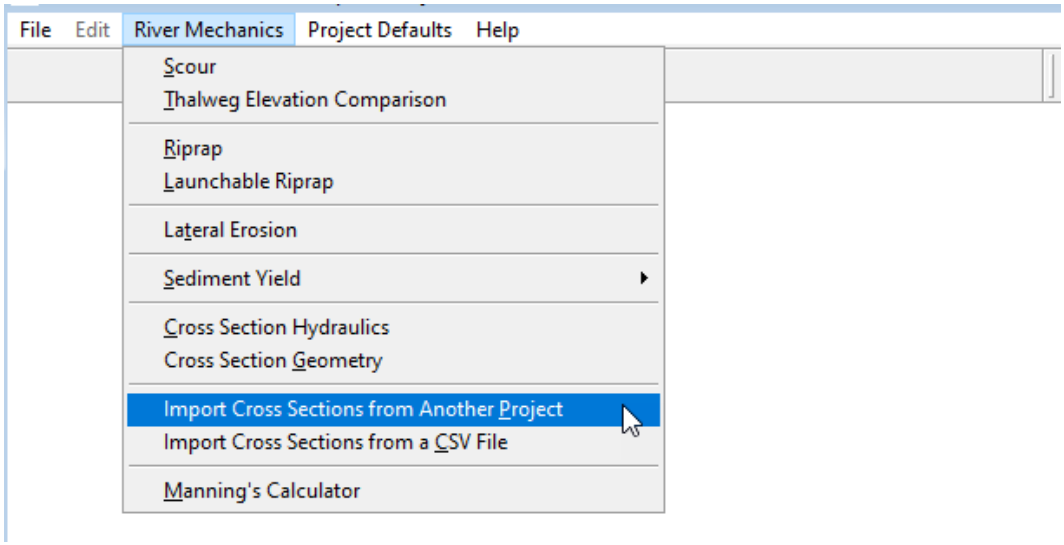


Note: The **Project ID** *00162* in the above figure is the database records unique read-only identifier of the project, which is automatically generated by the program when a new project is created. When the users create a new project, the **Project ID** of this new project will not be the same as the **Project ID** shown in the above figure.

2.2 STEP 2 – PREPARE THE CROSS SECTION AND HYDRAULICS DATA

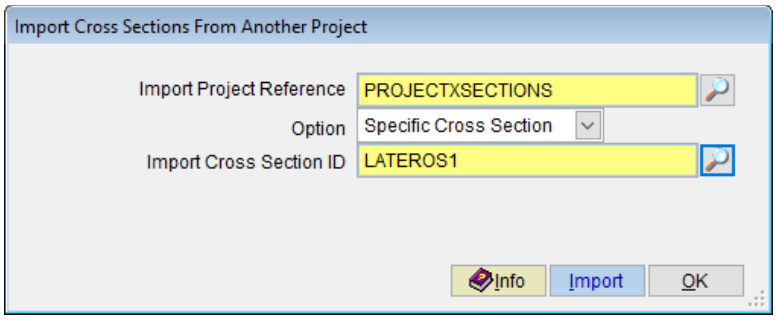
To develop the cross section and hydraulic data to be used for this project, the *"LATEROS1"* dataset will be used which will be imported from another project.

(a) From the menu bar of main application window, click **River Mechanics** ➔ **Import Cross Sections from Another Project** to open the **IMPORT CROSS SECTIONS FROM ANOTHER PROJECT** form.

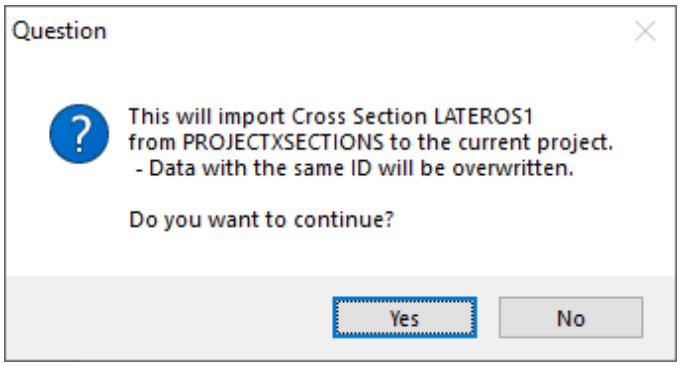


(b) On the **IMPORT CROSS SECTIONS FROM ANOTHER PROJECT** form, select the following settings:

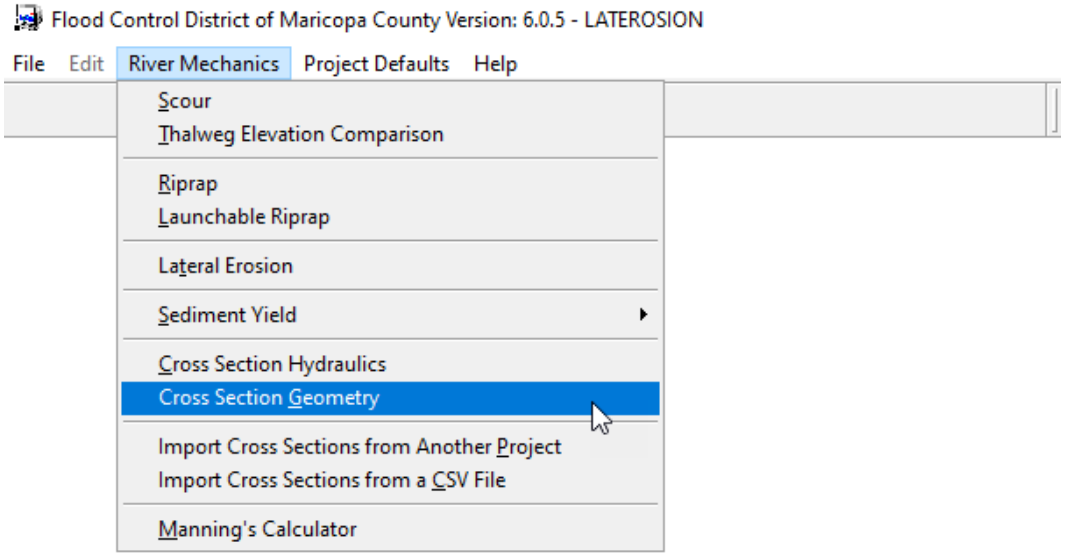
- **Import Project Reference:** *PROJECTXSECTIONS*
- **Option:** *Specific Cross Section*
- **Import Cross Section ID:** *LATEROS1*



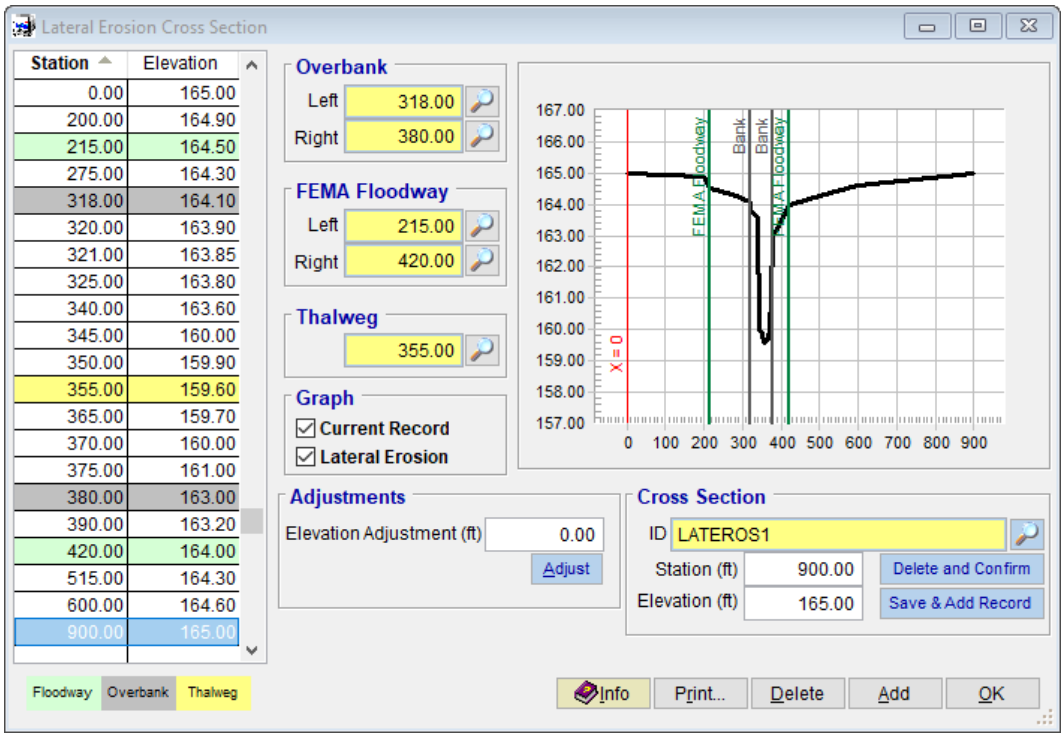
(c) Once the specified data have been selected, click the **Import** button. Select **Yes** to proceed and hit **OK** to close the **IMPORT CROSS SECTION FROM ANOTHER PROJECT** form.



(d) To check if the lateral erosion cross section data has been successfully imported, open the **NATURAL CROSS SECTIONS** form (**River Mechanics ➔ Cross Section Geometry**).



(e) On the form, select *"LATEROS1"* for the **Cross Section ID** by clicking the Selector button at the right side of the **ID** textbox.



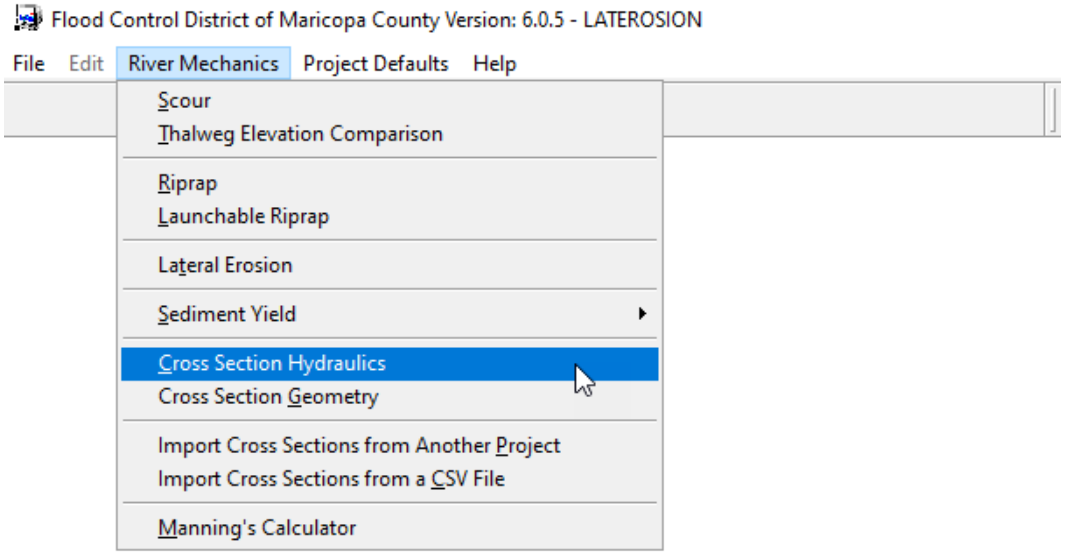
Compare the geometric data on the **NATURAL CROSS SECTIONS** form against the tabulated data listed below. Make necessary data edits or adjustments on the form, if necessary. Click **OK** to close the form.

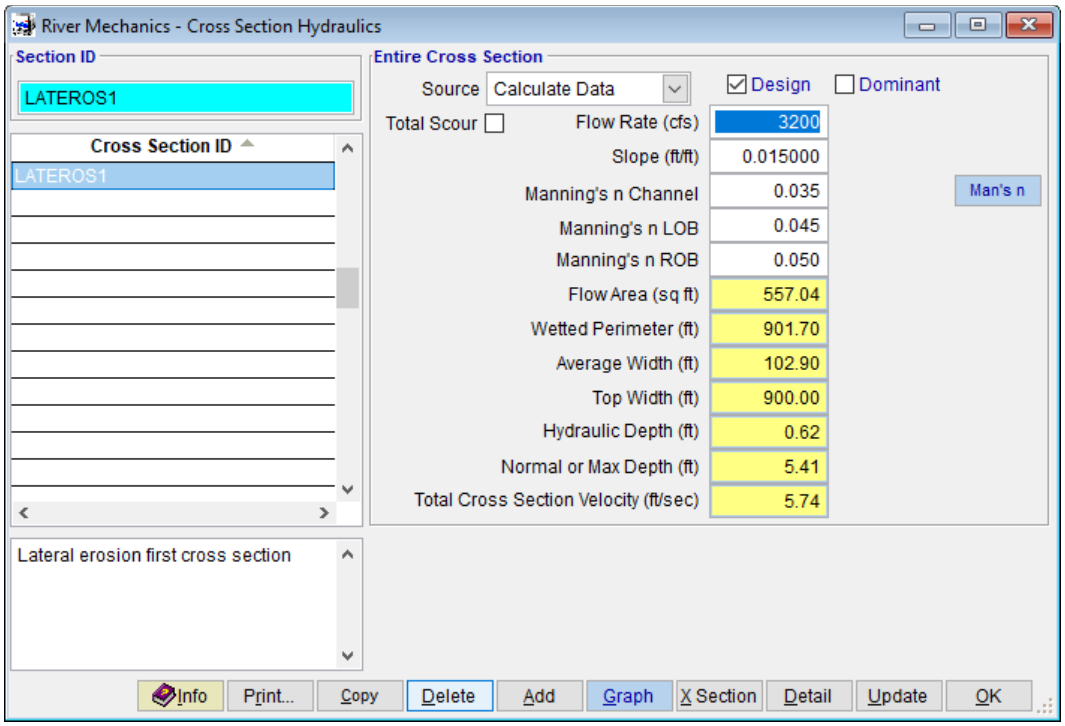
Station (X)	Elevation (Y)	Notes
0	*165.0*	
200	*164.9*	
215	*164.5*	*FEMA Floodway Left Station*
275	*164.3*	
318	*164.1*	*Left Bank Station*
320	*163.9*	
321	*163.85*	
325	*163.8*	
340	*163.6*	
345	*160.0*	
350	*159.9*	
355	*159.6*	*Thalweg Station*
365	*159.7*	
370	*160.0*	
375	*161.0*	

Station (X)	Elevation (Y)	Notes
380	*163.0*	*Right Bank Station*
390	*163.2*	
420	*164.0*	*FEMA Floodway Right Station*
515	*164.3*	
600	*164.6*	
900	*165.0*	

(f) Edit the cross section geometry, if necessary, and click ***Save*** to save all changes and revisions. Click ***OK*** to close and exit the **NATURAL CROSS SECTION** form.

(g) To view the cross-section hydraulic data for this cross-section, open the **CROSS SECTION HYDRAULICS** form (**River Mechanics ➔ Cross Section Hydraulics**) and on the form select *"LATEROS1"* from the **Cross Section ID** listing.





(h) On the **CROSS SECTION HYDRAULICS** form, ensure that the **Source** is set to "*Calculate Data*". Check to ensure that the imported data values for **Flow Rate (cfs)**, **Slope (ft/ft)**, and **Manning's n (Channel, LOB, and ROB)** are the project values specified for this project, otherwise, edit and modify them.

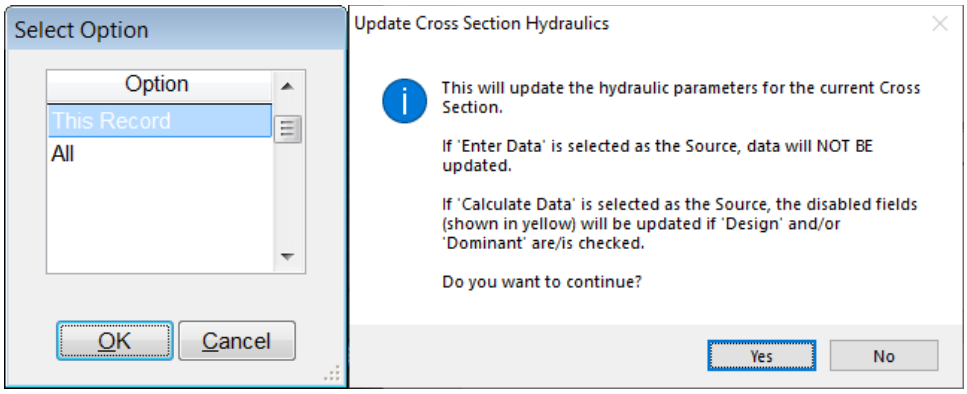
The project data are provided below:

- **Design Flow Rate (cfs):** *3200*
- **Channel Slope (ft/ft):** *0.015*
- **Design Manning's n for Main Channel:** *0.035*
- **Design Manning's n for LOB:** *0.045*
- **Design Manning's n for ROB:** *0.050*

(i) Click ***Save*** to save the edits, if you have made any.

(j) To recalculate or update the hydraulic analysis on this form, click **Update**.

(k) Select "*This Record*" from the **SELECT OPTION** form. Click ***OK*** to close the form.



(l) Click ***Yes*** on the **UPDATE CROSS SECTION HYDRAULICS** form to continue.

(m) Click **OK** to close the form.

2.3 STEP 3 - CALCULATE LATERAL EROSION DISTANCE

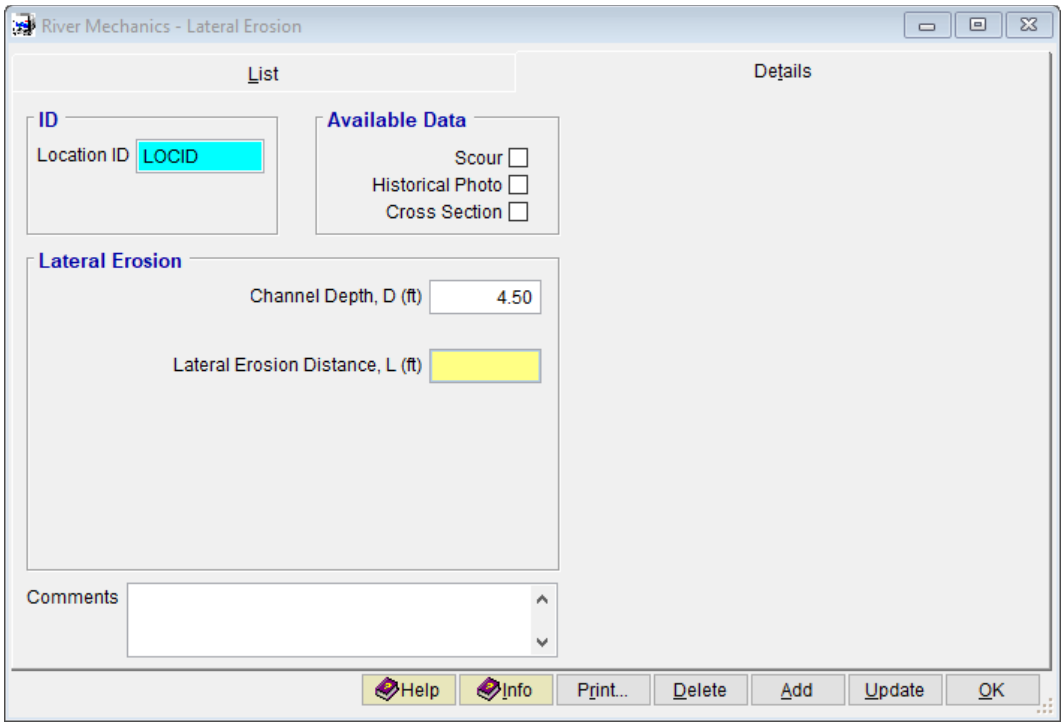
Four (4) analysis scenarios will be presented in this tutorial. These different scenarios are dependent on availability of data for analysis. These scenarios include: (a) no data; (b) with scour data; (c) with scour and historical data; and (d) with scour, historical, and cross section data.

2.3.1 Scenario #1 - No Data

(a) Click on the **River Mechanics ➔ Lateral Erosion**

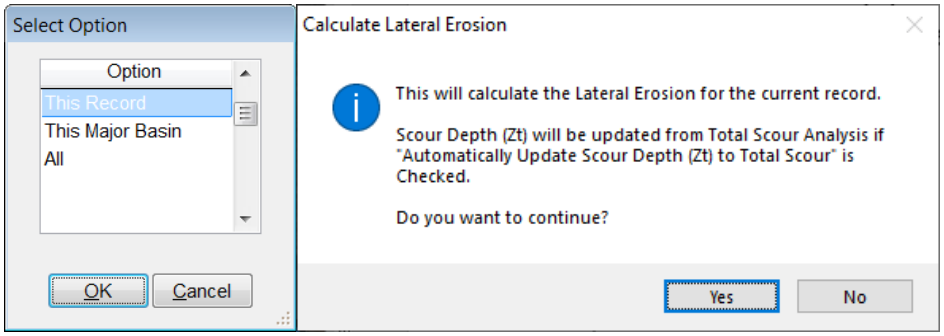
(b) Click **Add** to enter a new data and type in "*LOCID*" on the **Location ID** textbox. **M**ake sure that all the check boxes in the **Available Data** frame are unchecked.

(c) Type in "*4.5*" into the **Channel Depth, D (ft)** textbox. This information is assumed to be the field estimate made on the channel depth.



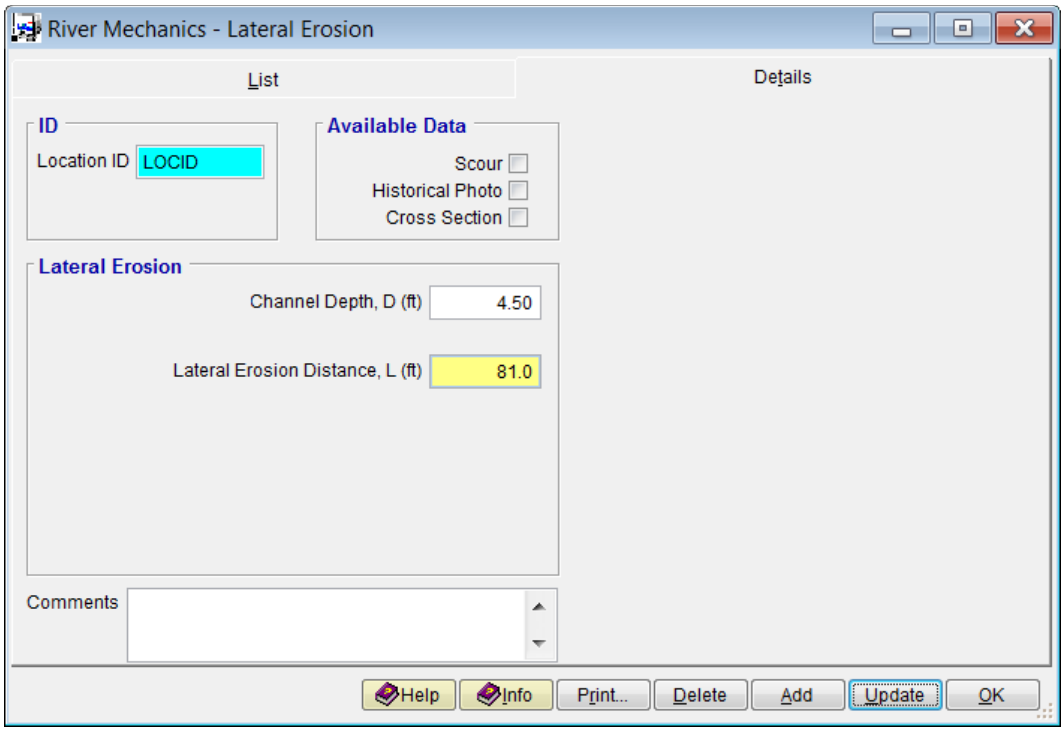
(d) Click ***Save*** to save the data entered.

(e) To calculate the **Lateral Erosion Distance, L (ft)**, click the ***Update*** button and select "*This Record*" from the **SELECT OPTION** form. Click ***OK*** to close the form.



(f) Click ***Yes*** when the **CALCULATE LATERAL EROSION** form opens.

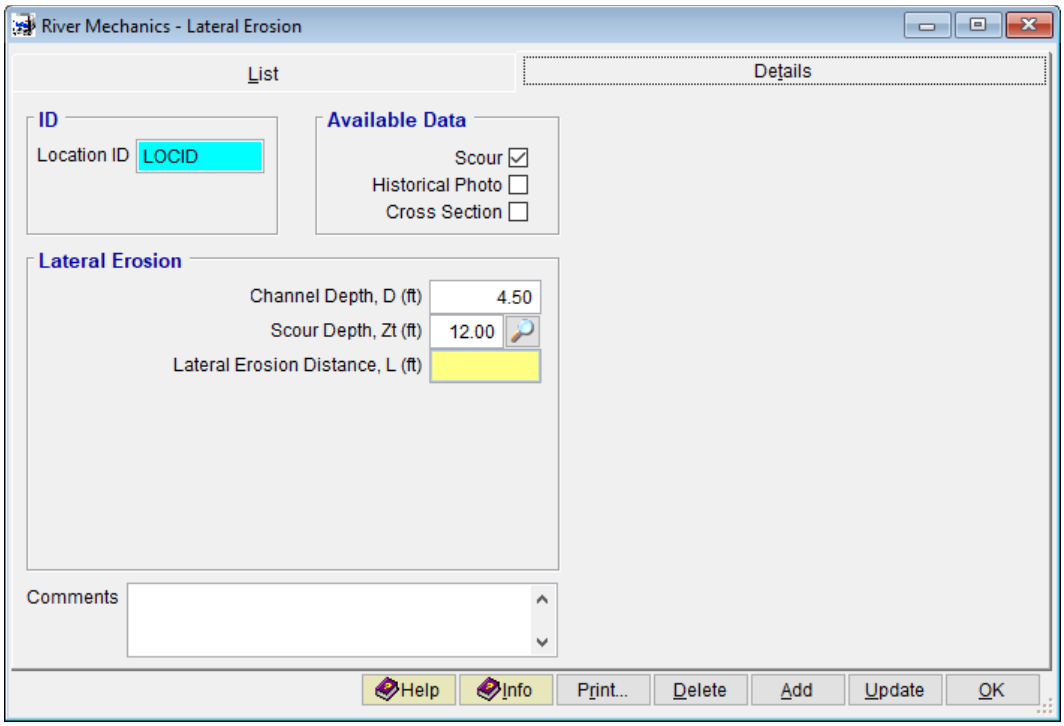
The following screen capture below shows the results of the analysis. The only data used was a field estimate of the **Channel Depth, D (ft)** at the location of interest.



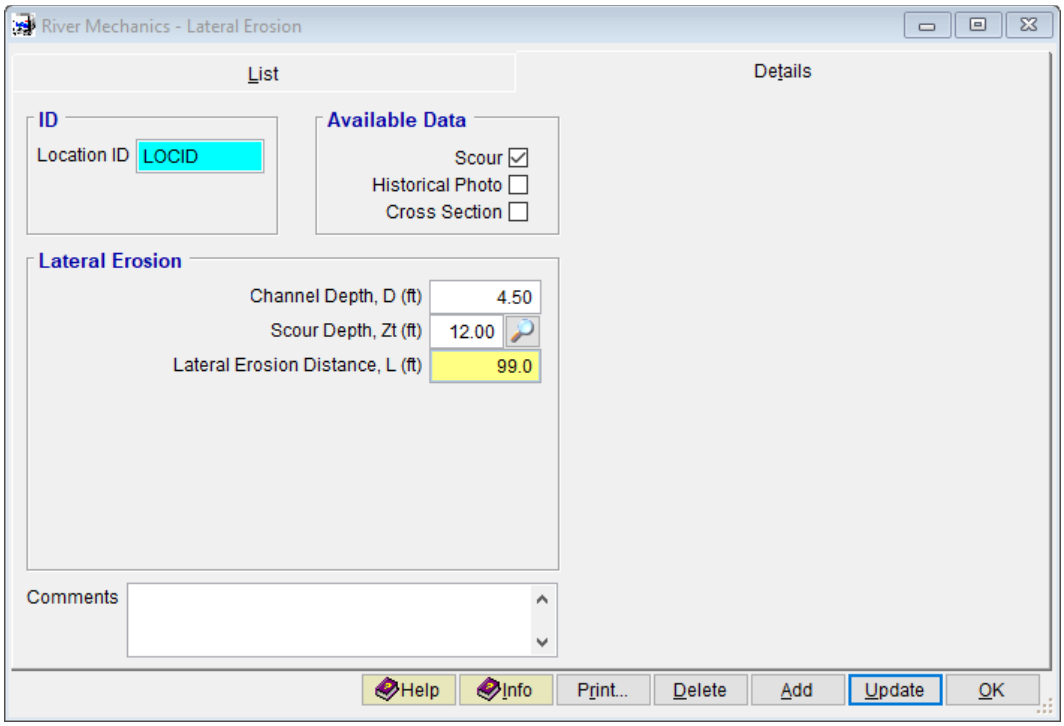
2.3.2 Scenario #2 – Scour Data Available

(a) On the **RIVER MECHANICS – LATERAL EROSION** form (**River Mechanics ➔ Lateral Erosion**), check the **Scour** checkbox and leave the other two checkboxes unchecked.

(b) Type in "*12.00"* into the **Scour Depth, Zt (ft)** textbox, while keeping the value of the **Channel Depth, D (ft)** at *"4.50".* Click **Save.**



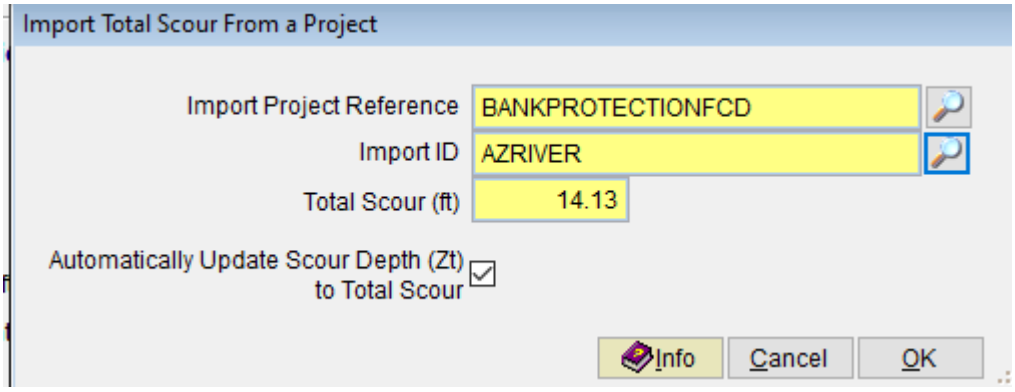
(c) To calculate the **Lateral Erosion Distance, L (ft)** for the manually entered data, click the ***Update*** button and select "*This Record"* from the **SELECT OPTION** form. Click **Yes** to continue. Note that the estimated **Lateral Erosion Distance, L (ft)** is ***99 ft***.



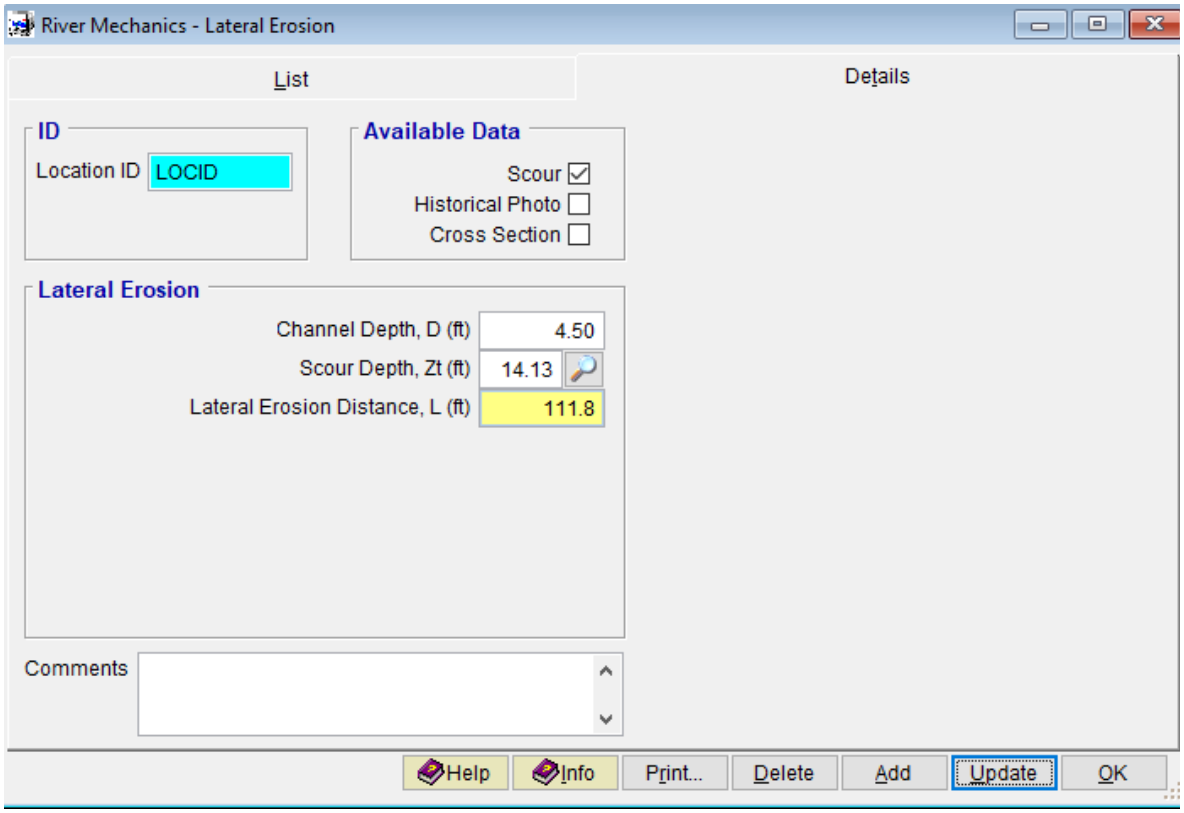
(d) As an alternative to the manual entries made, **DDMSW** has the capability to import the value from a scour analysis project. To use this import feature, click the magnifying glass across the **Scour Depth, Zt (ft)** textbox.

(e)On the **IMPORT TOTAL SCOUR FROM A PROJECT** form, use the following data:

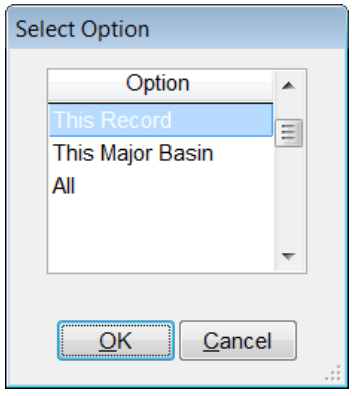
- **Import Project Reference**: *BANKPROTECTIONFCD*
- **Import ID:** *AZRIVER*
- **Automatically Update Scour Depth (Zt) to Total scour Checkbox** *Check*



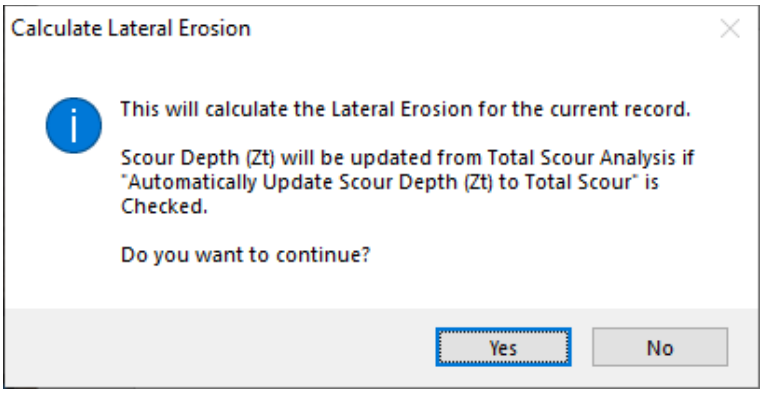
Click ***OK*** to close the form. [Note that the **Scour Depth, Zt (ft)** value has changed from *"12.00"* to *"14.13"*].



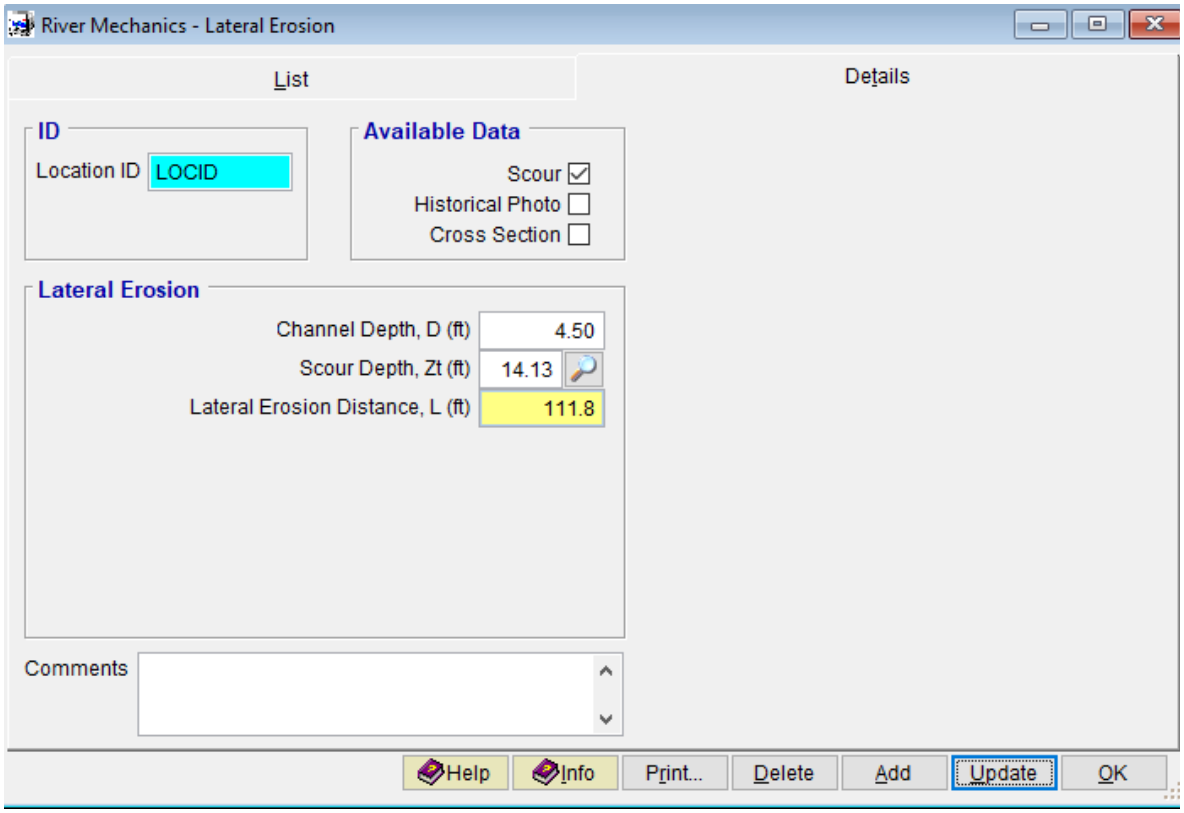
(f) To calculate the **Lateral Erosion Distance, L (ft)**, click the ***Update*** button and select "*This Record*" from the **SELECT OPTION** form. Click ***OK*** to close the form.



(g) Click ***Yes*** when the **CALCULATE LATERAL EROSION** form opens.



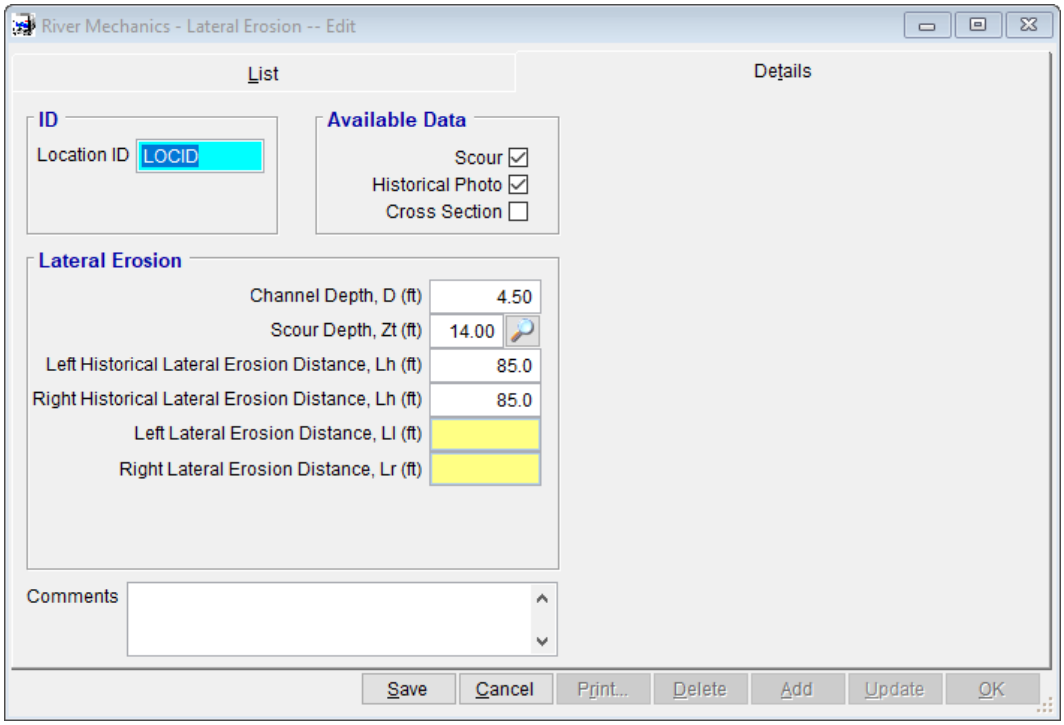
The screen capture below shows the results of the lateral erosion analysis where scour data is available, in addition to the field estimate of **Channel Depth, D (ft)** at *"4.50"* ft.



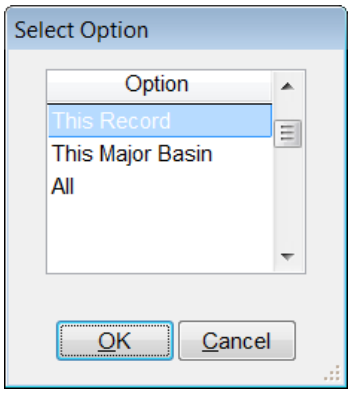
2.3.3 Scenario #3 – Scour and Historical Data Available

(a) On the **RIVER MECHANICS – LATERAL EROSION** form (**River Mechanics ➔ Lateral Erosion**), make sure that the **Scour** and **Historical Photo** checkboxes are checked. Leave the **Cross Section** checkbox unchecked.

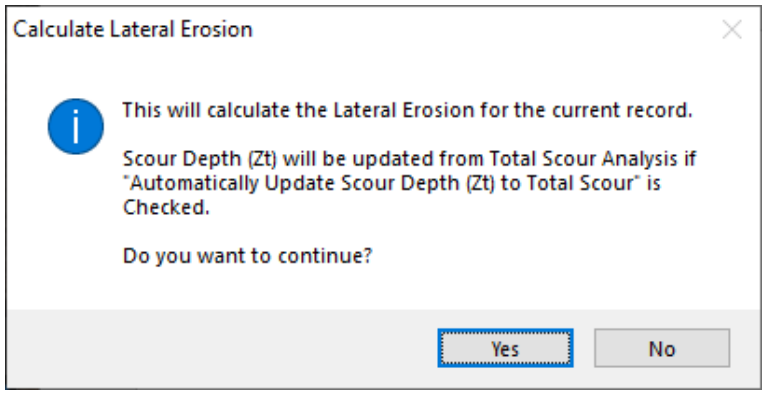
(b) Type in "*85.0*" into the **Left Historical Lateral Erosion Distance, Lh (ft)** and the **Right Historical Lateral Erosion distance, Lh (ft)** textboxes. Leave the **Channel Depth, D (ft)** value at *"4.50"* and the **Scour Depth, Zt (ft)** at "14.00" unchanged. Click ***Save*** to save the data.



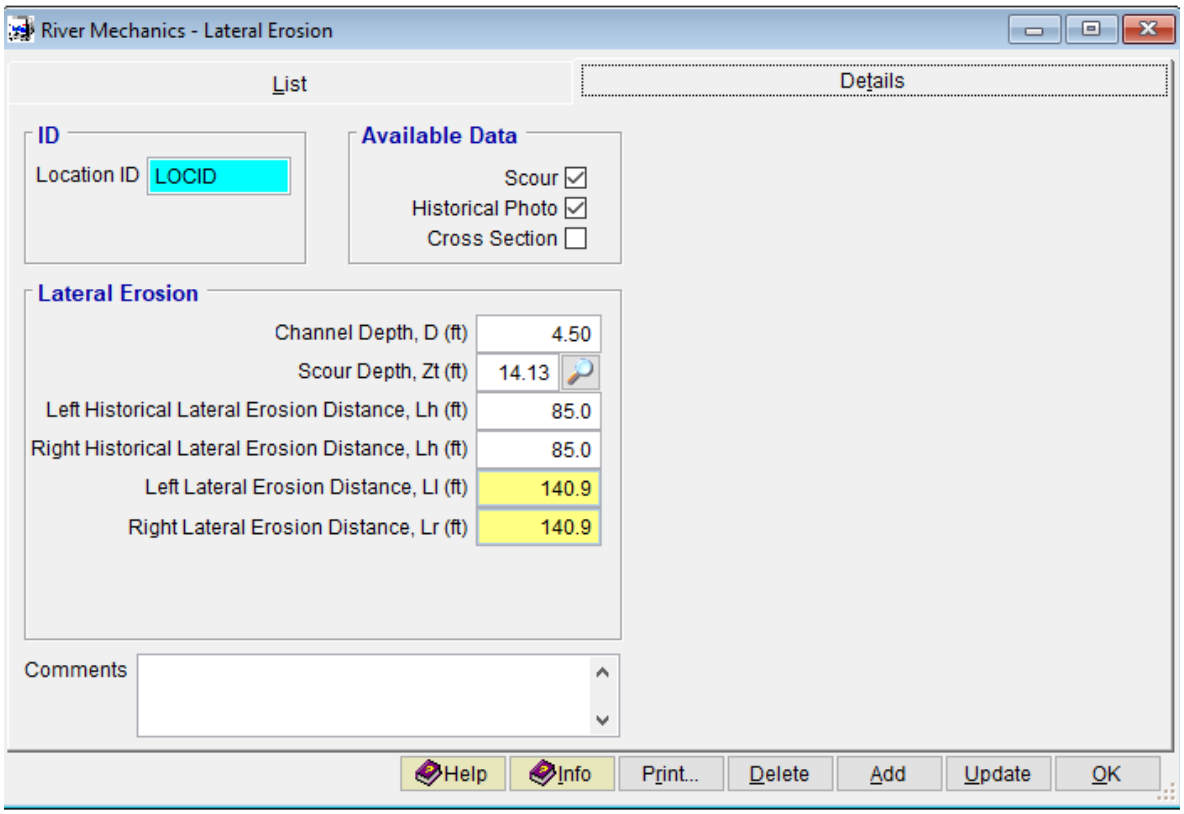
(c) To calculate the **Lateral Erosion Distance, L (ft)**, click the ***Update*** button and select "*This Record*" from the **SELECT OPTION** form. Click ***OK*** to close the form.



(d) Click ***Yes*** when the **CALCULATE LATERAL EROSION** form opens.

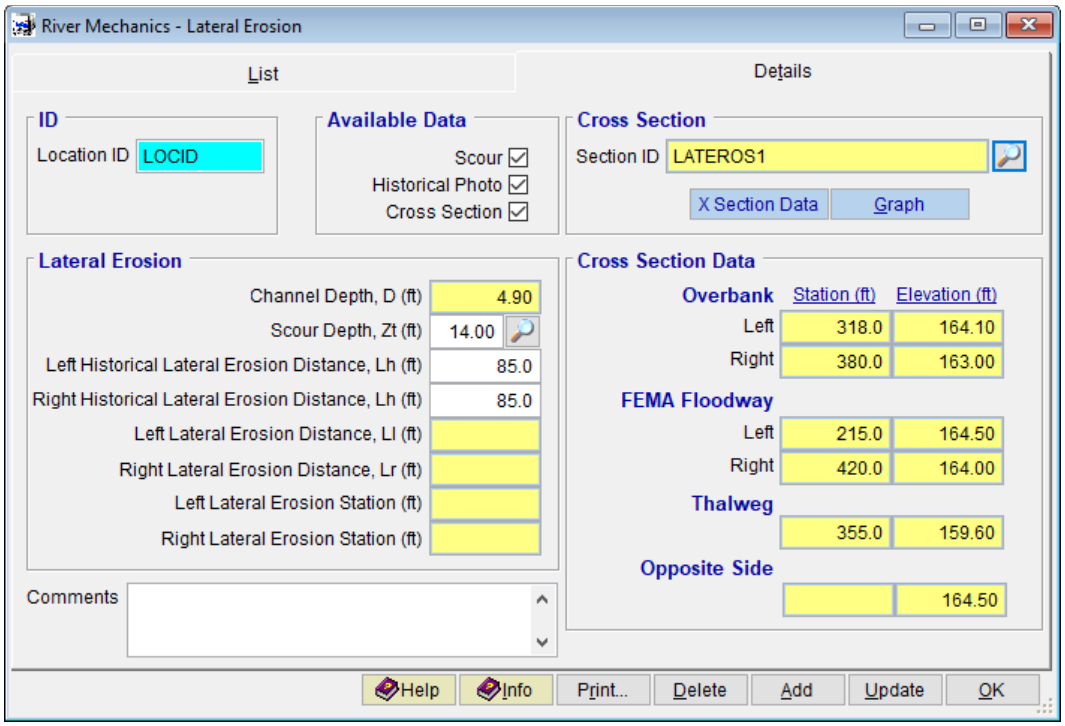


The screen capture below shows the results of the lateral erosion analysis where scour and historical data are available, in addition to the field estimate of **Channel Depth, D (ft)** at *"4.50"* ft.



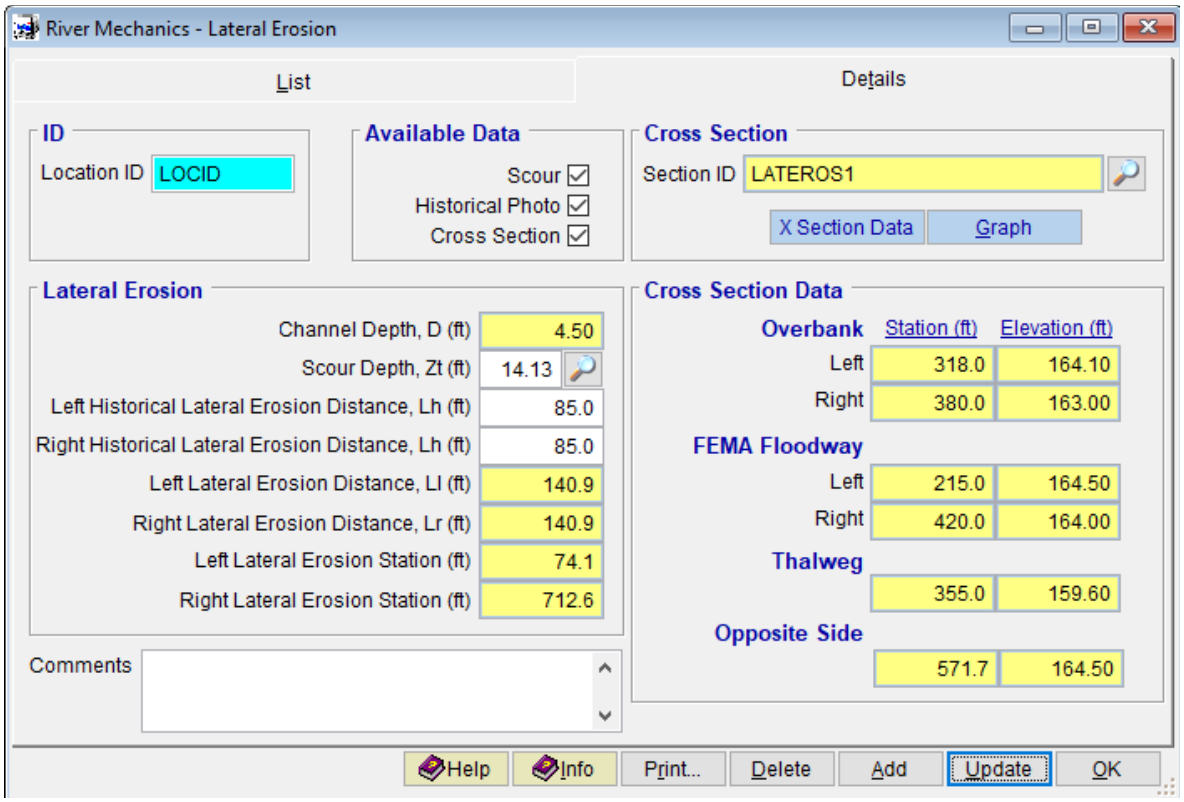
2.3.4 Scenario #4 – Scour, Historical and Cross Section Data Available

(a) On the **RIVER MECHANICS – LATERAL EROSION** form (**River Mechanics ➔ Lateral Erosion**), make sure that all the checkboxes (i.e., **Scour, Historical Photo,** and **Cross Section)** are checked.



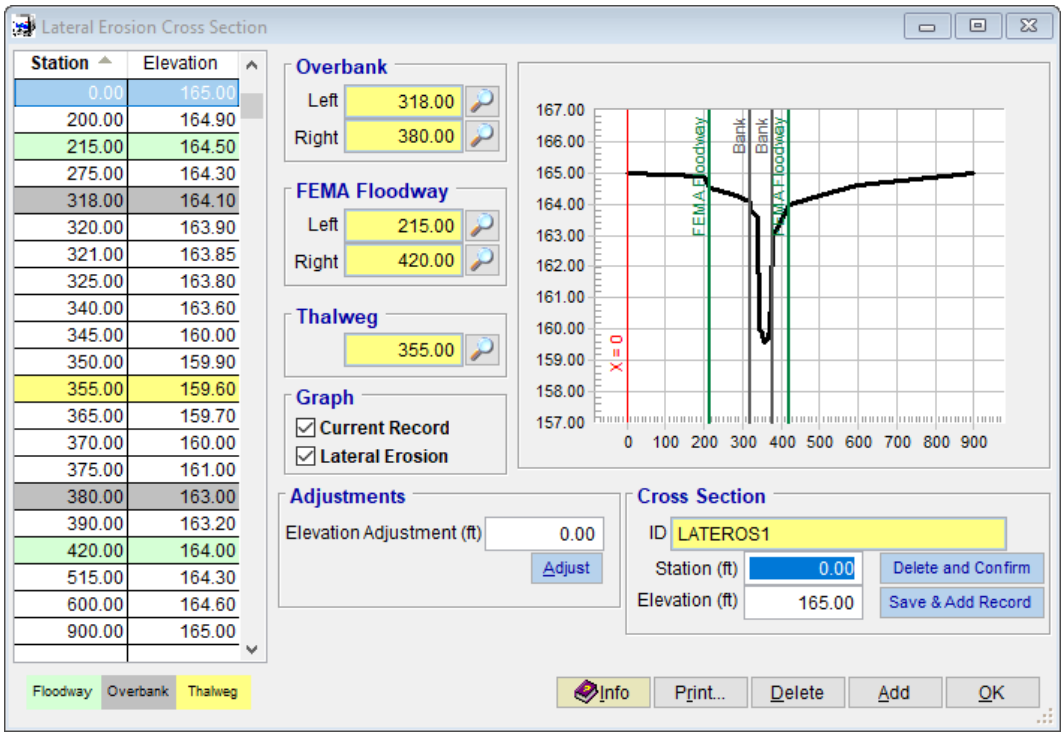
(b) To access the Cross Section Data for this project, click the **Selector** button (Magnifying glass) to the right of the **Section ID** textbox. On the **SELECT CROSS SECTION ID** form, select the *"LATEROS1"* from the list.

(c) Click ***OK*** to close the **SELECT CROSS SECTION ID** form.



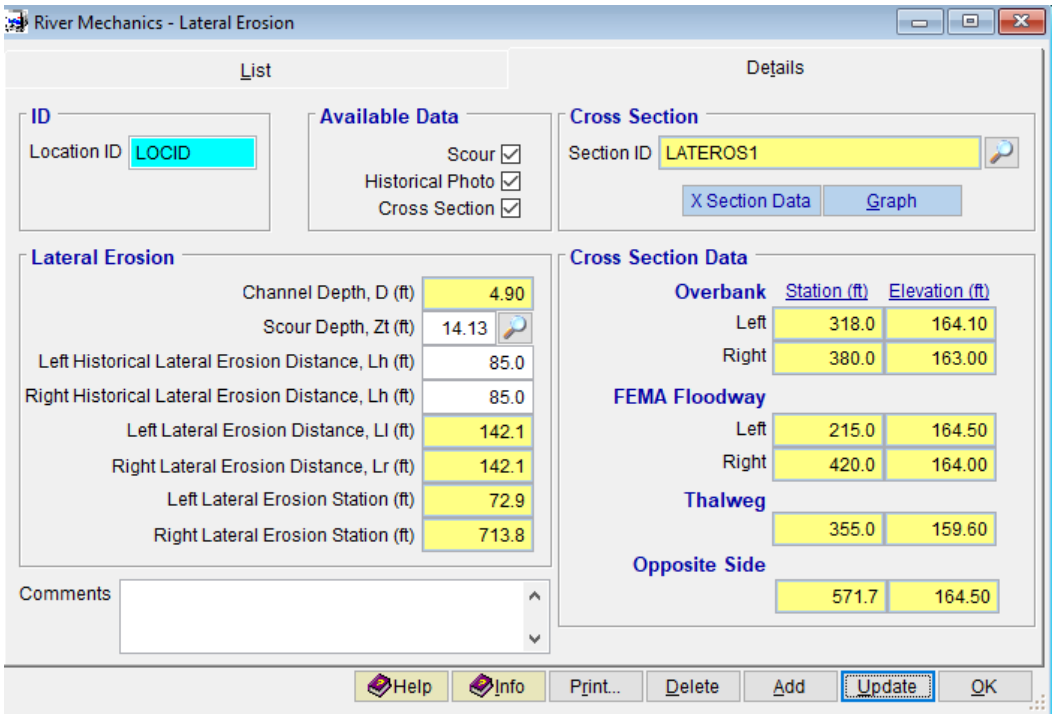
Note that by using the Cross Section Data, the **"Channel Depth, D (ft)"** textbox becomes "inactive" and a new value of the Channel Depth had replaced the manual data entered. This new value of the Channel Depth is the difference between the **FEMA Floodway Elevation** and the **Thalweg Elevation** (i.e., *164.50 -159.60 = 4.90 ft*).

(d) On the **RIVER MECHANICS – LATERAL EROSION** form, click on the **X Section Data** button to view the **LATERAL EROSION CROSS SECTION** form that shows the cross section data and plot identifying the location of the banks and the FEMA Floodway limits.

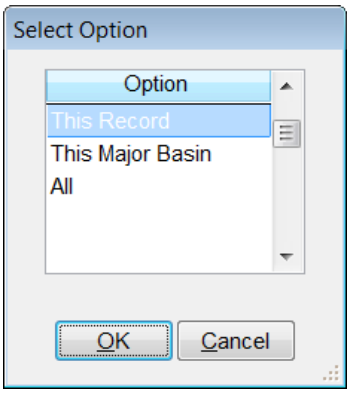


(e) Click ***OK*** to close the **LATERAL EROSION CROSS SECTION** form.

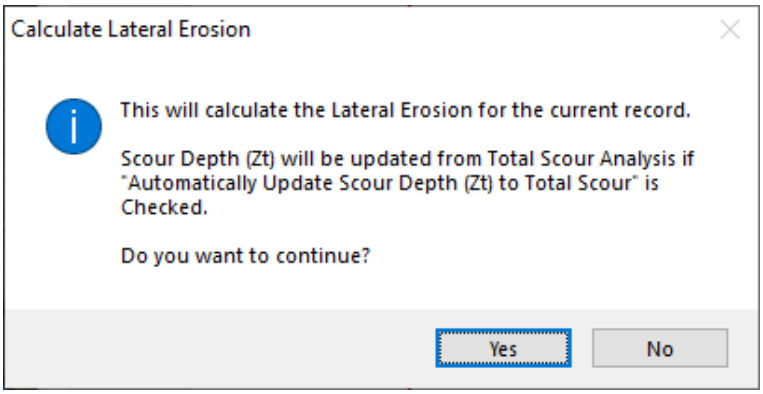
To calculate the **Left Lateral Erosion Distance Ll (ft)**, and the **Right Lateral Erosion Distance, Lr (ft)**, click the ***Update*** button.



(f) When the **SELECT OPTION** form appears, highlight "*This Record*" and click ***OK*** to close the form.

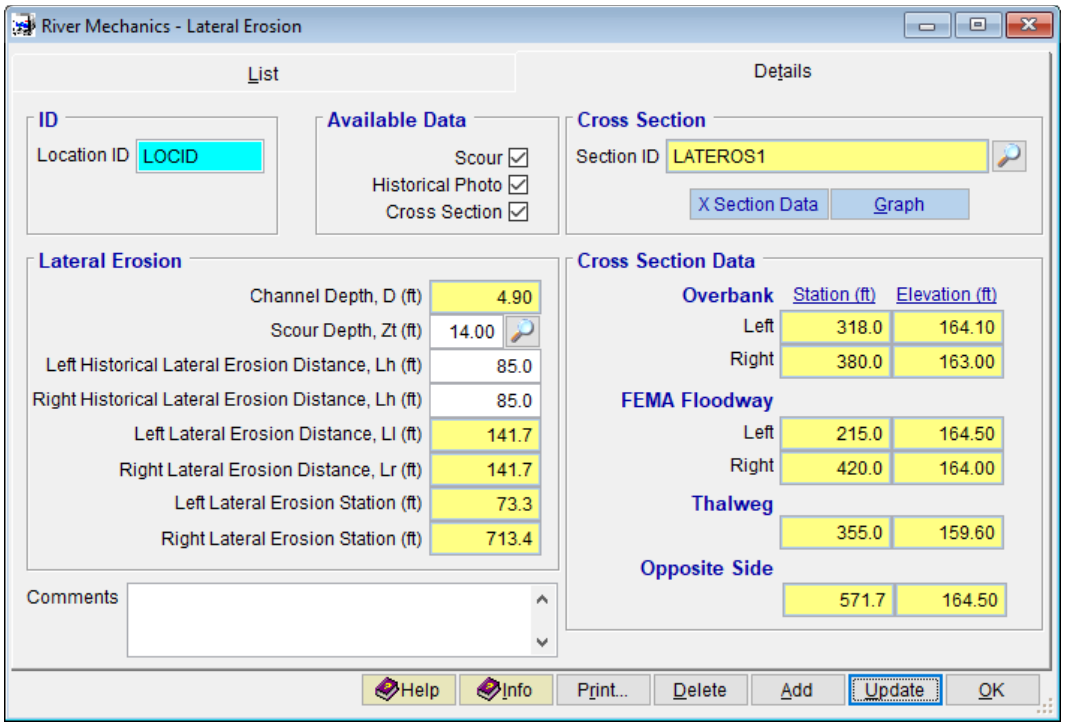


(g) Click ***Yes*** when the **CALCULATE LATERAL EROSION** form opens.

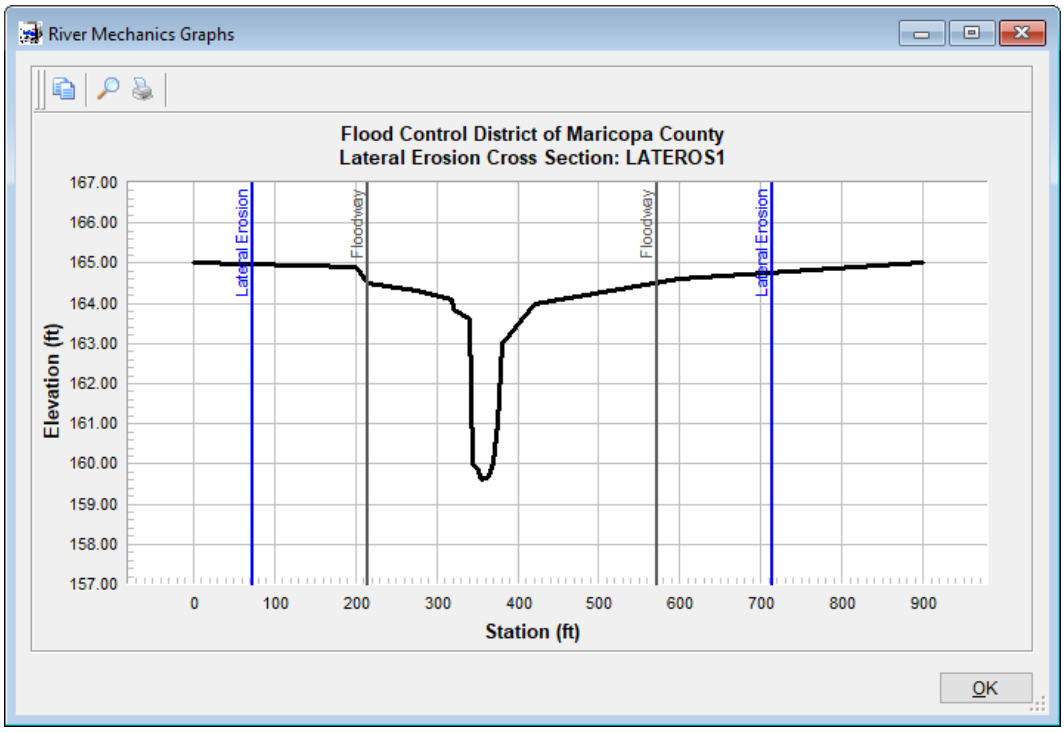


The screen capture provided below shows the results of the lateral erosion analysis where scour depth, historical data, and cross-section data are available. The summary of the results are:

- **Left Lateral Erosion Distance, Ll (ft): 142.1**
- **Right Lateral Erosion Distance, Lr (ft): 142.1**
- **Left lateral Erosion Station (ft): 72.9**
- **Right Lateral Erosion Station (ft): 713.8**



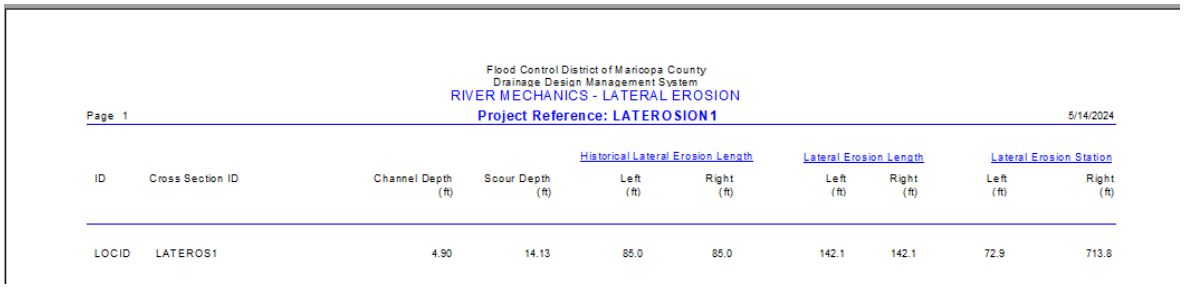
(h) To view the plot of the Lateral Erosion analysis results, click the **Graph** button. As shown on the results plot, the extent of lateral erosion on the left bank is at Station 72.9 ft and the lateral erosion on the right bank is at Station 713.8 ft. To exit the **RIVER MECHANICS GRAPHS** form, click the OK button.



2.4 STEP 4 - REPORT AND DOCUMENTATION OF RESULTS

In this step, the instruction will be given on how to view, print, and export the calculation results of the lateral erosion analysis.

(a) To view the Lateral Erosion report, click the **Print…** button on the **RIVER MECHANICS – LATERAL EROSION** form.



Flood Control District of Maricopa County
Drainage Design Management System
RIVER MECHANICS - LATERAL EROSION
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ID	Cross Section ID	Channel Depth (ft)	Scour Depth (ft)	Historical Lateral Erosion Length Left (ft)	Historical Lateral Erosion Length Right (ft)	Lateral Erosion Length Left (ft)	Lateral Erosion Length Right (ft)	Lateral Erosion Station Left (ft)	Lateral Erosion Station Right (ft)
LOCID	LATEROS1	4.90	14.13	85.0	85.0	142.1	142.1	72.9	713.8

(b) To print the report, click the printer symbol ( ) at the top of the form.

(c) To export the report to a PDF file or other file formats, click the export symbol ( ) at the top of the form.

This concludes the tutorial for the Lateral Erosion Analysis.