Experiment 3

Steady Flow Modelling:Modelling Water Surface Profile with a Sinusoidal Bed

Reasons of Bed Level Changing

- Because of continuous sediment movement in river beds, bed levels are changed and formed into different shapes depending on the flow states. These are known as *bed forms.*

Types of Bed Forms

1. Ripples
2. Dunes
3. Plane Bed
4. Anti Dunes
5. Chutes and Pools

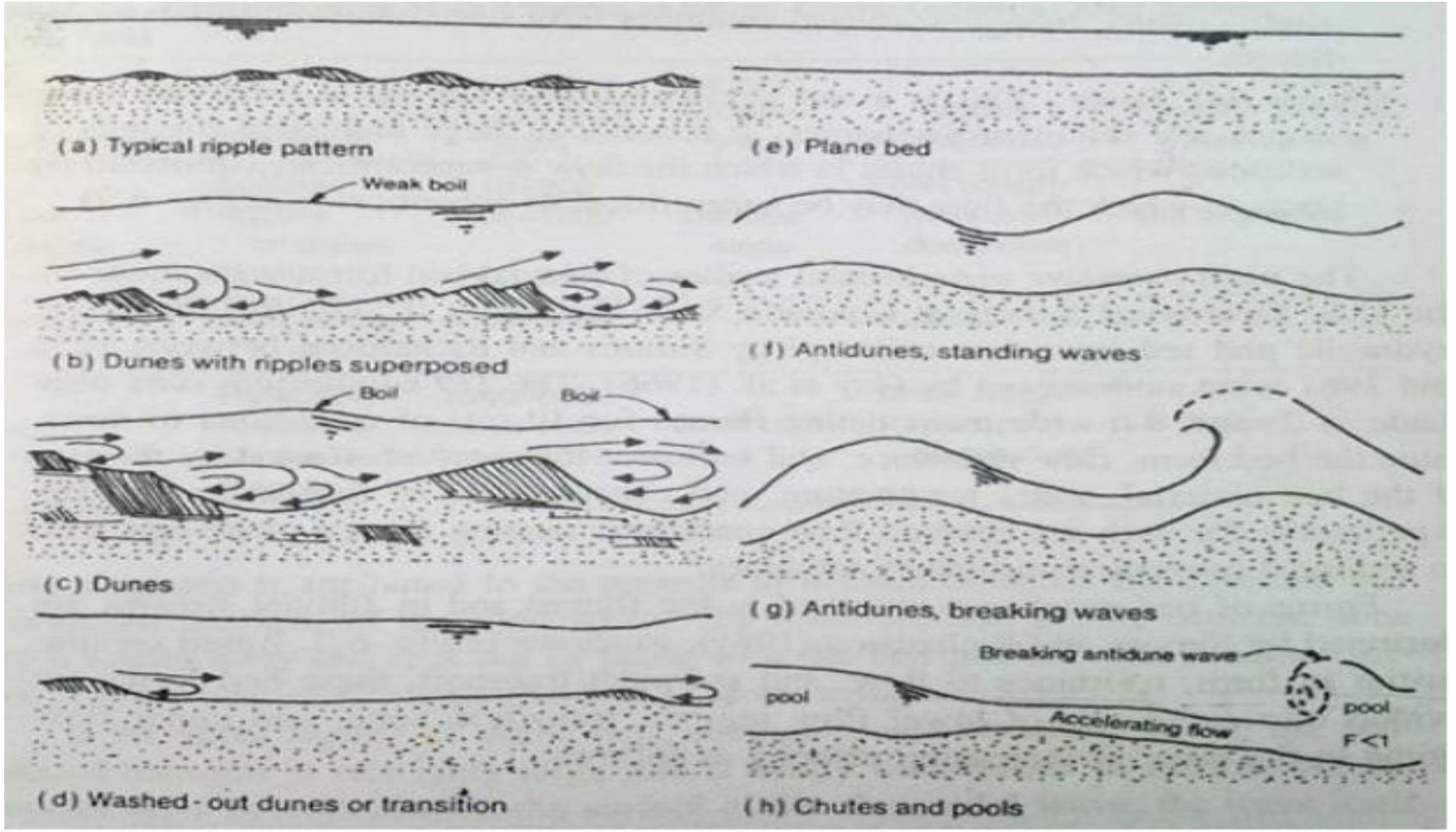


Figure: Different bed forms in alluvial channels (after Simons et al., 1966)

Ripples

- Bed forms of having small amplitudes and wavelengths
- Nearly sinusoidal and have gentle upstream slope with a relatively higher downstream slope

Dunes

- Larger than ripples but smaller than bar or island
- Water surface profile is out of phase with the bed level profile
- Ripples and dunes are developed during low flow regime, i.e, *subcritical flow*

Plane Bed

- As the flow moves towards higher flow regime, bed forms are washed out and formed plane bed

Antidunes

- As flow increases and sediment transport continues, antidune bed forms are formed
- For this bed form, water surface profile is in phase with bed elevation profile

Chutes and Pools

- For rivers with steep slope, such as mountain rivers, alternate deep pool and steep chutes are observed

Effects of Bed Forms

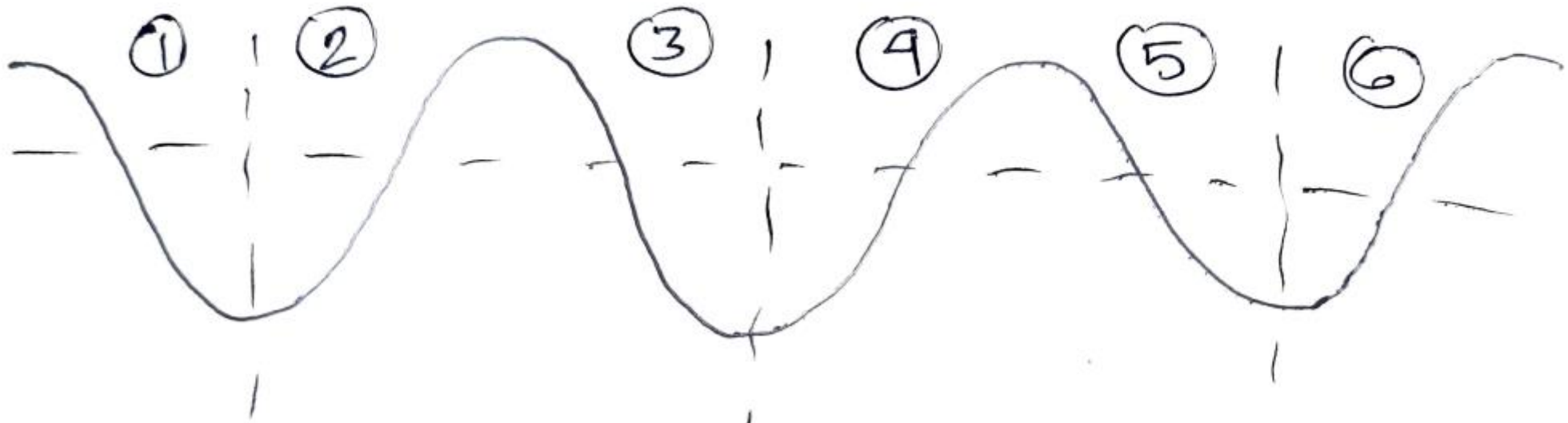
Presence of bed forms effect the flow resistance, i.e., roughness. Moreover, water surface profile is also affected by the types of bed form.

Objectives of This Experiment

1. Generate a sinusoidal bed profile using the given information.
2. Create a new project.
3. Draw a schematic of a straight river.
4. Assign cross section data.
5. Assign boundary condition data.
6. Perform the analysis
7. View and present the results

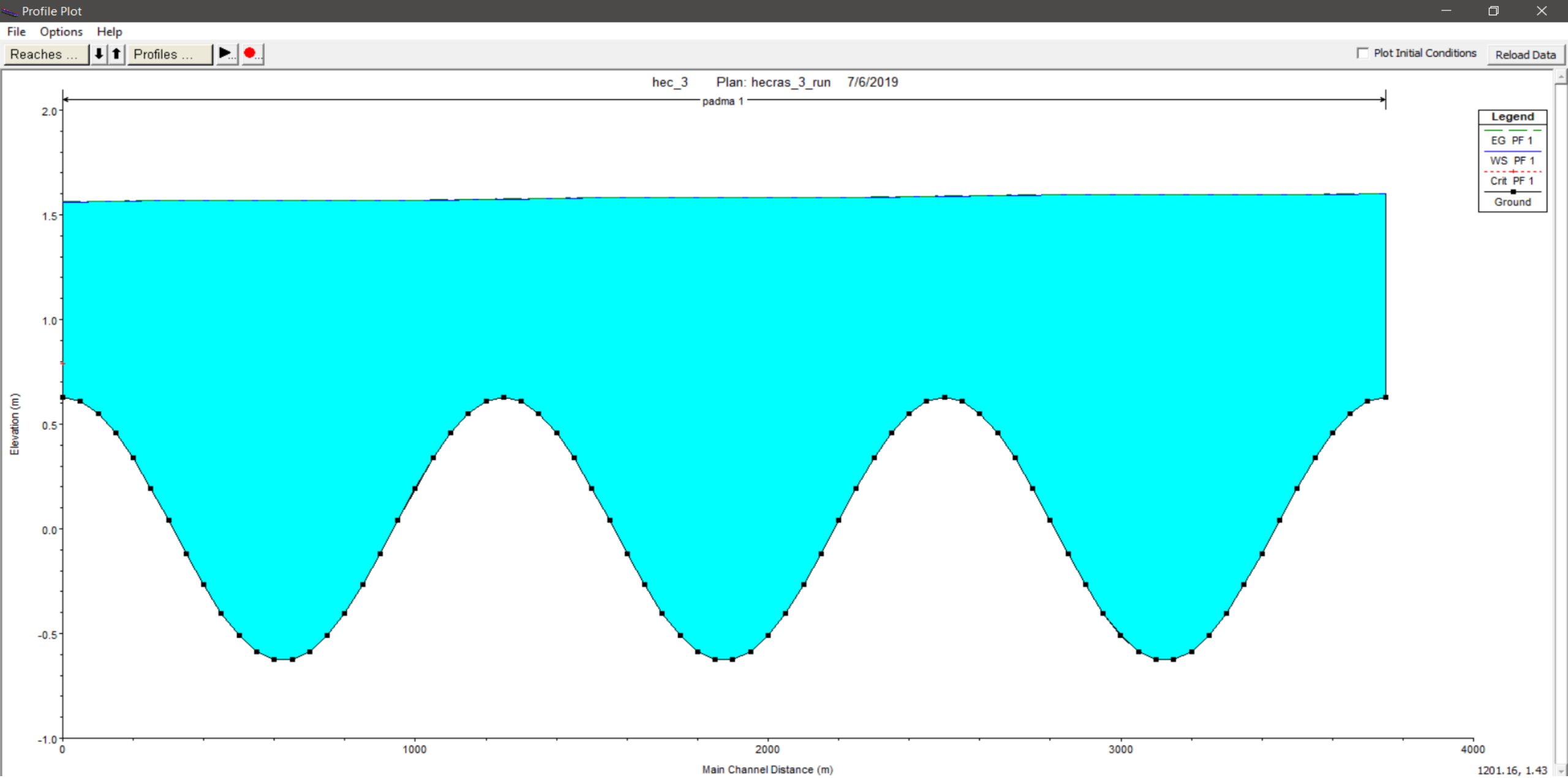
Data

1. The channel is rectangular.
2. The channel width is 100 m.
3. The channel length is 3750 m.
4. Use 50 m interval
5. Manning's n can be assumed as 0.025 *s/m1/3*.
6. The discharge in the channel is 20 cumec in the u/s.
7. Bed profile = Amplitude*Cos(PI*distance/625)
8. Amplitude is = (Last two digits of your student number + 50)/100.
9. Downstream boundary condition is = (Amplitude+0.3+river bed level height) m



$$3750 \div 6 = 625$$

$$\text{Bed profile} = \text{Amp} \times \cos\left[\frac{\text{PIX distance}}{625}\right]$$



Sinusoidal Bed Profile

X-Y-Z Perspective Plot

File Options

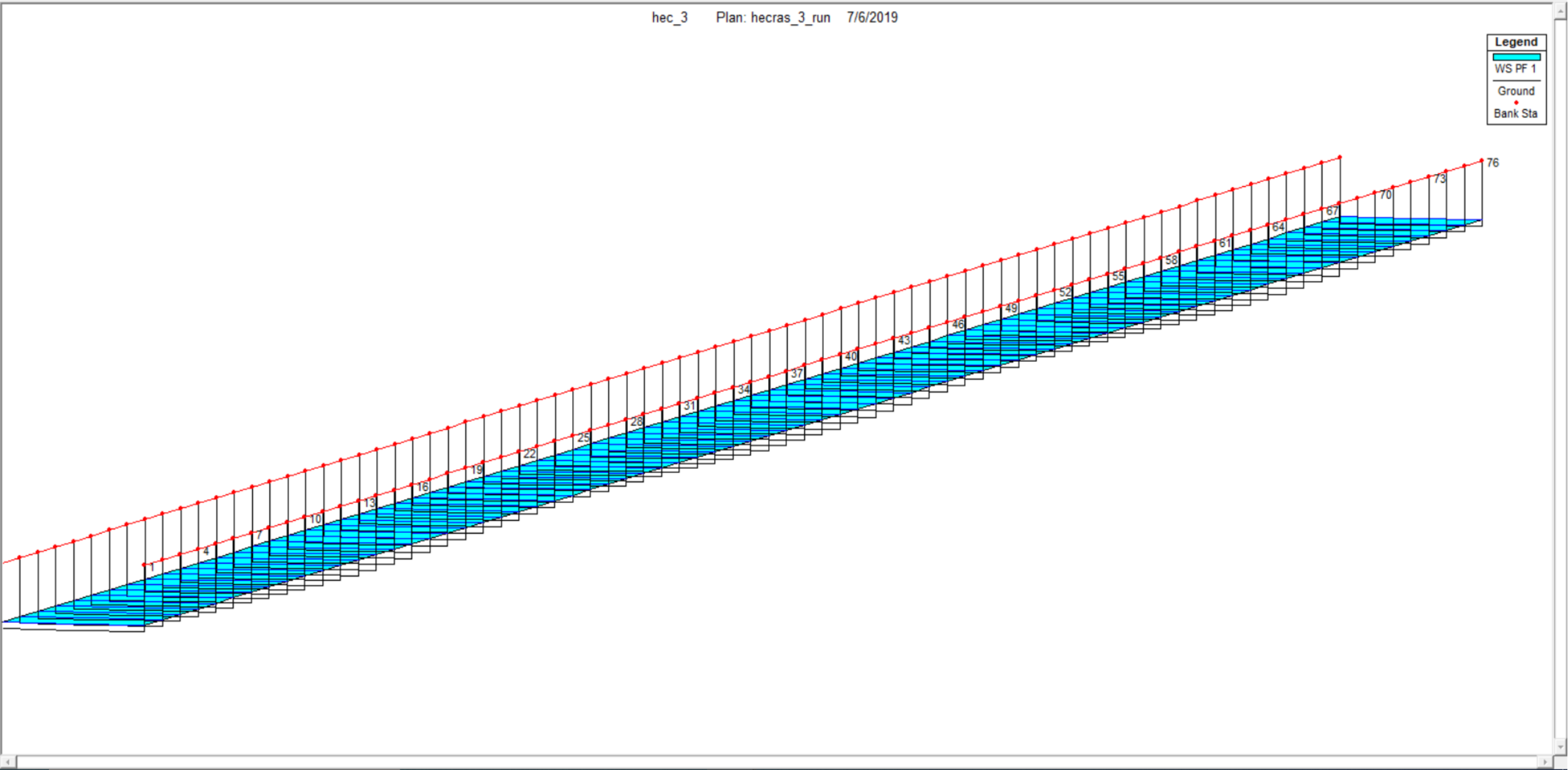
Upstream RS: 76

Downstream RS: 1

Rotation Angle -79

Azimuth Angle 9

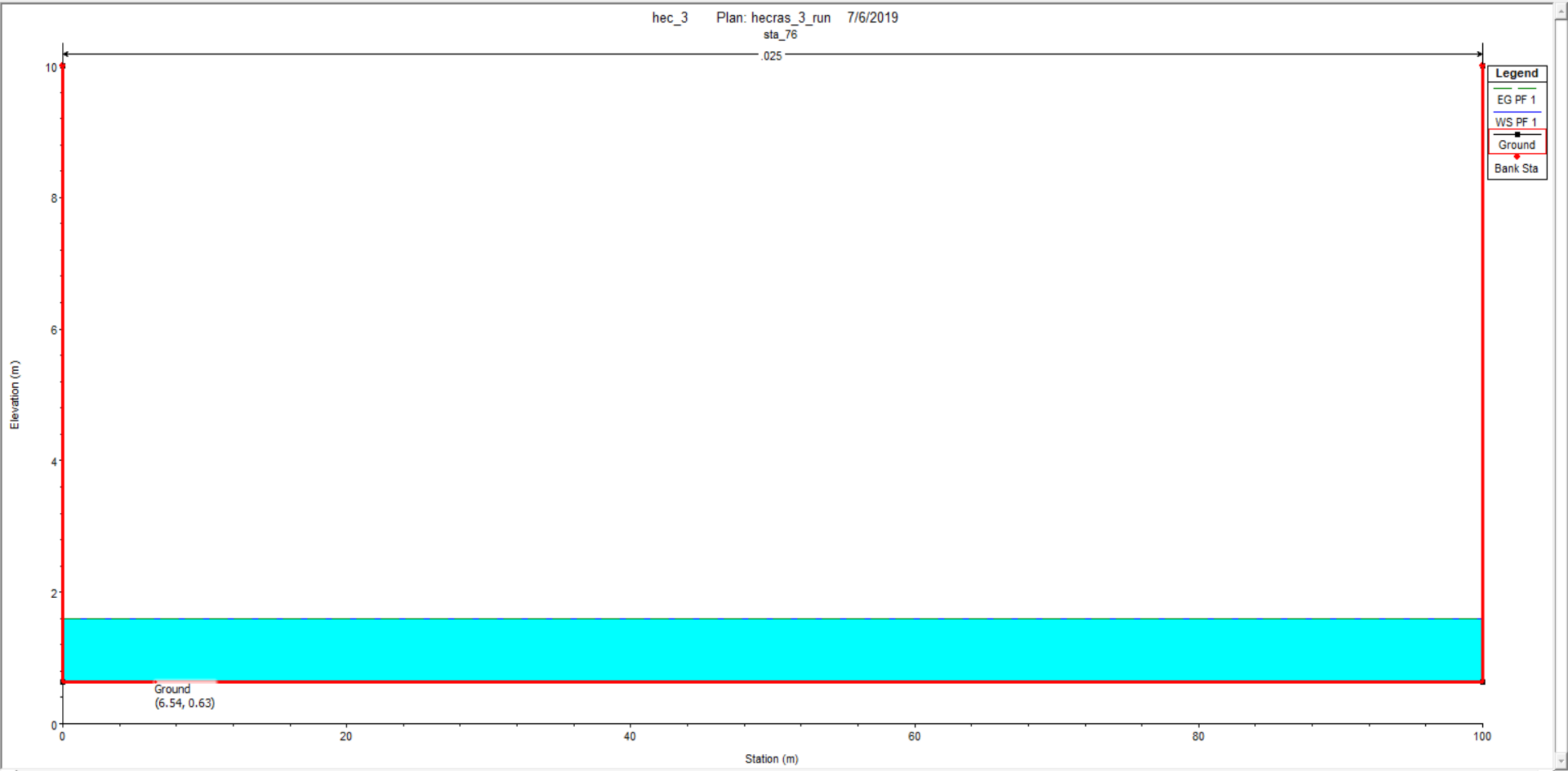
Reload Data



Cross Section

File Options Help

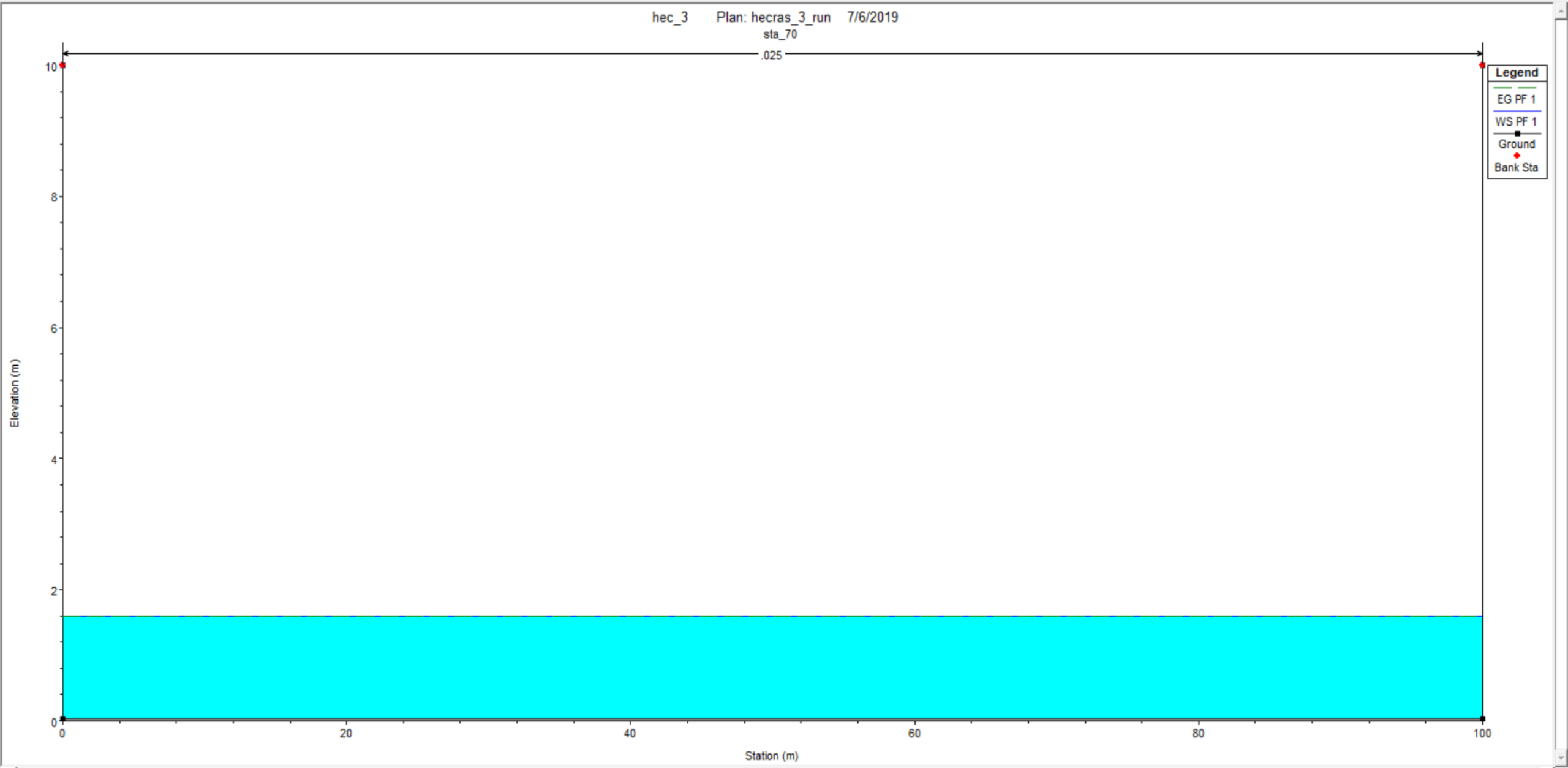
River: padma Reach: 1 River Sta.: 76 Reload Data



Cross Section

File Options Help

River: padma Reach: 1 River Sta.: 70 Reload Data



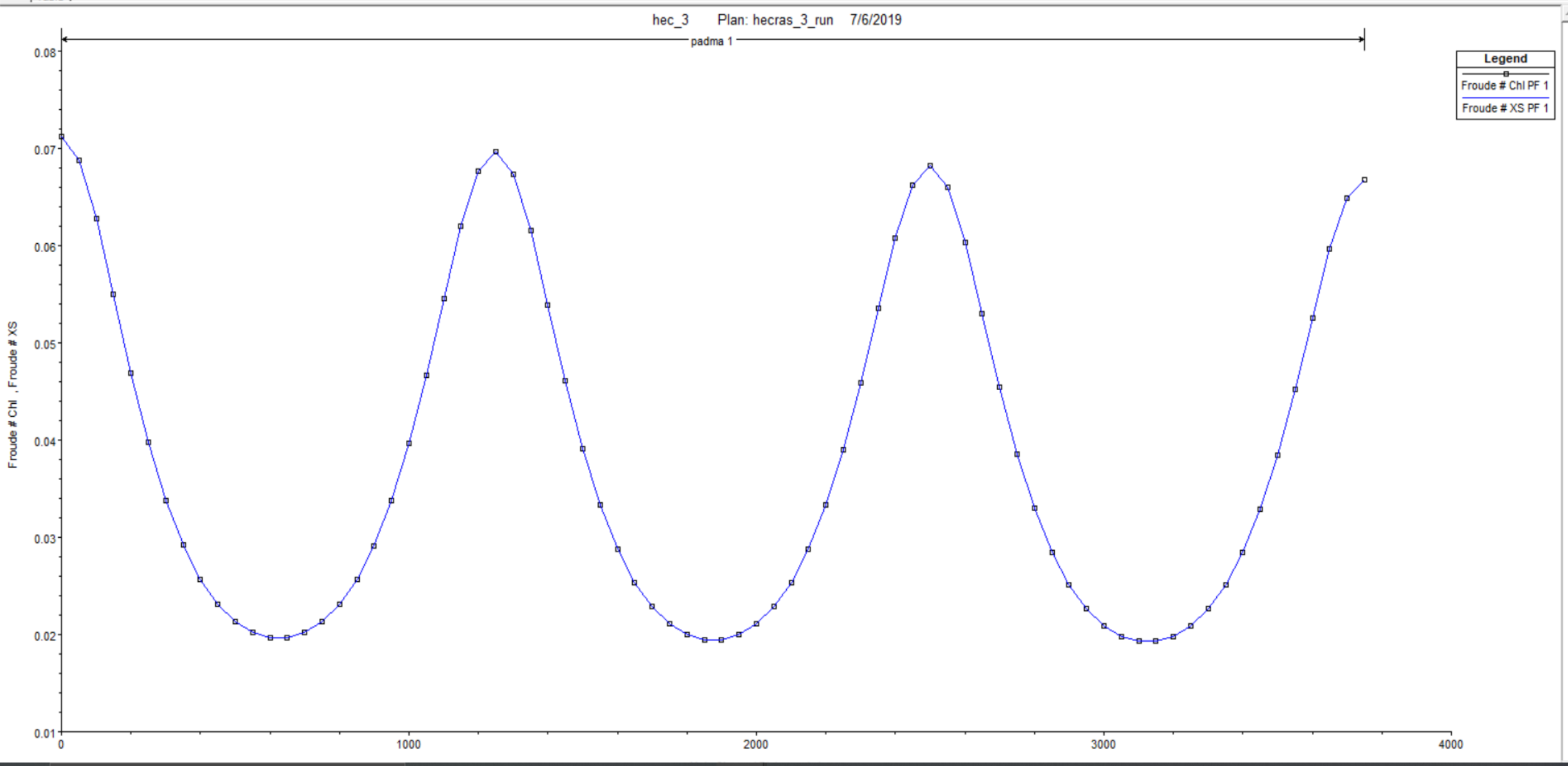
Profile Plot

General Profile Plot - Froude #

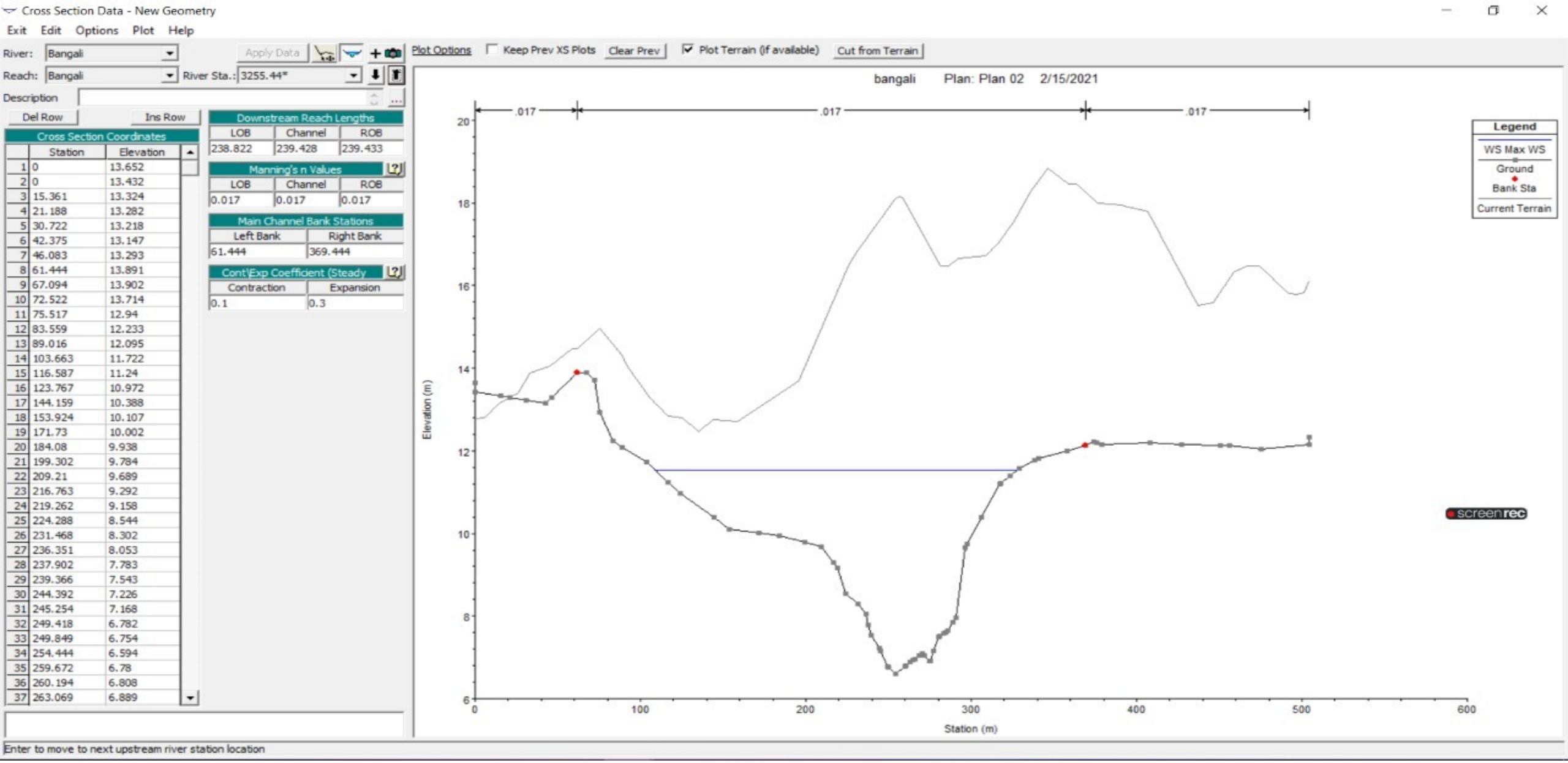
File Options Standard Plots User Plots Help

Reaches ... Profiles ... Plot Initial Conditions Reload Data

Plot Table



Unsteady Flow Simulation



River Cross Sectional Real Data

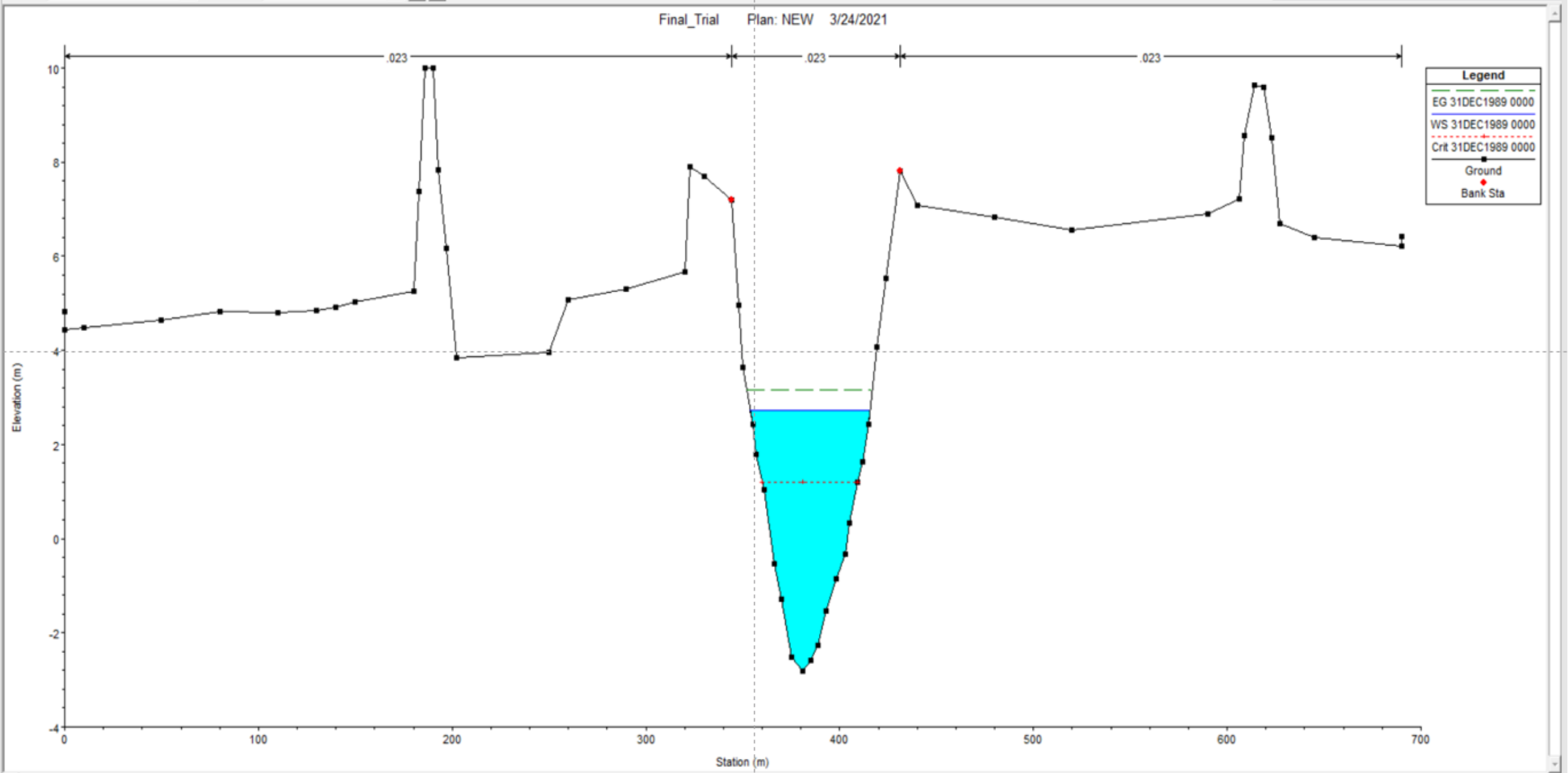
Cross Section

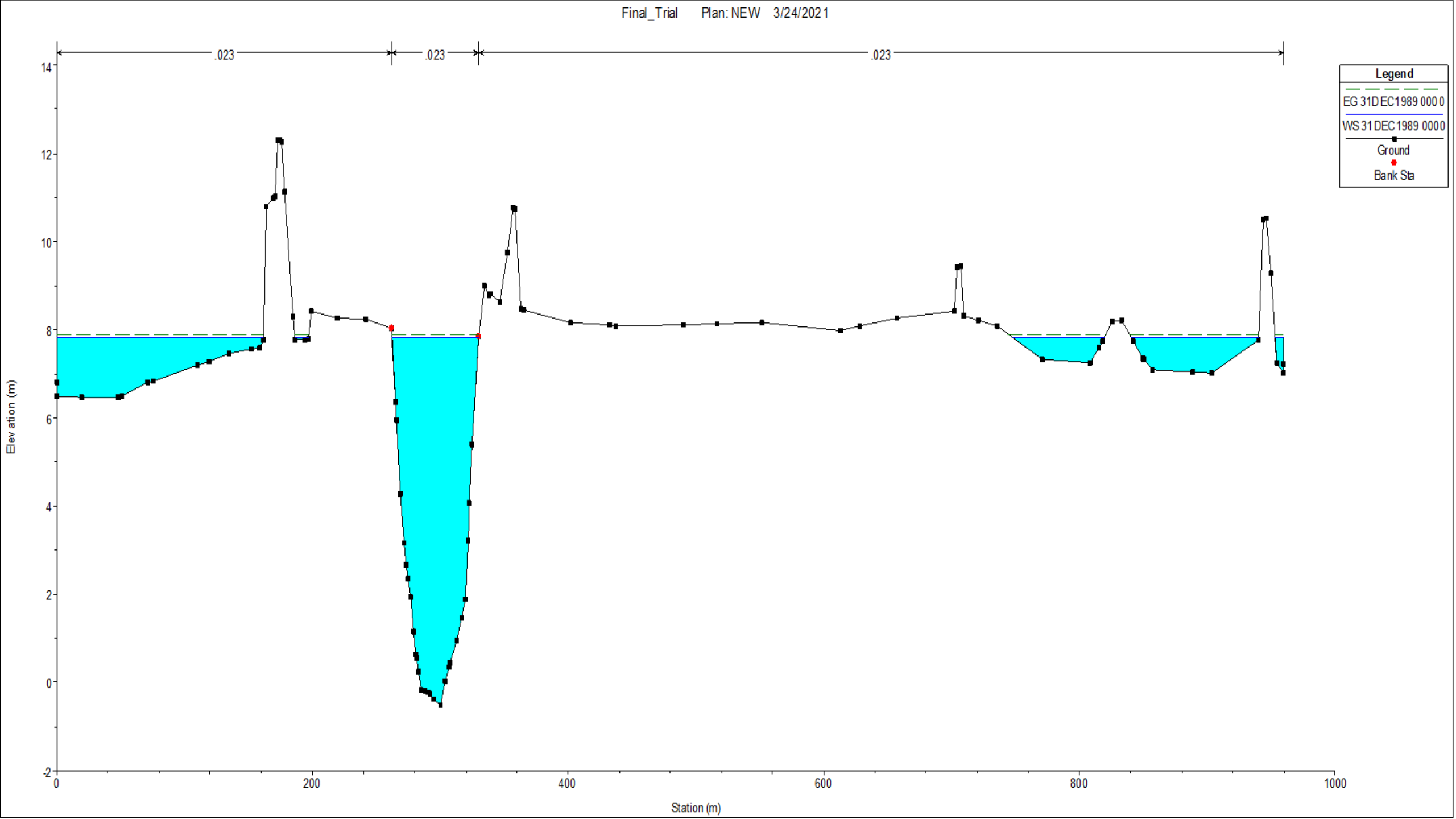
File Options Help

River: River 1 Reach: Reach 1 River Sta.: 11040

Reload Data

English




Final_Trial Plan: NEW 3/24/2021
.023
.023
.023
Legend
EG 31DEC1989 0000
WS 31DEC1989 0000
Ground
Bank Sta
Elevation (m)
Station (m)
14
12
10
8
6
4
2
0
-2
0
200
400
600
800
1000

Class Work:

1. Simulate a model using the cross sectional, discharge and water level data of Dhaleswari river.

Given Data for Class Work

1. River reach length
2. Cross sectional data
3. Discharge, water level

Submissions(Home Work)
Experiment: Unsteady Flow Simulation

1. The model simulation folder.
2. Longitudinal profile of water surface elevation.
3. Cross Sectional view of station 1,4 and 8.
4. What do you mean by steady and unsteady flow?
5. When should you use unsteady flow simulation? Describe.