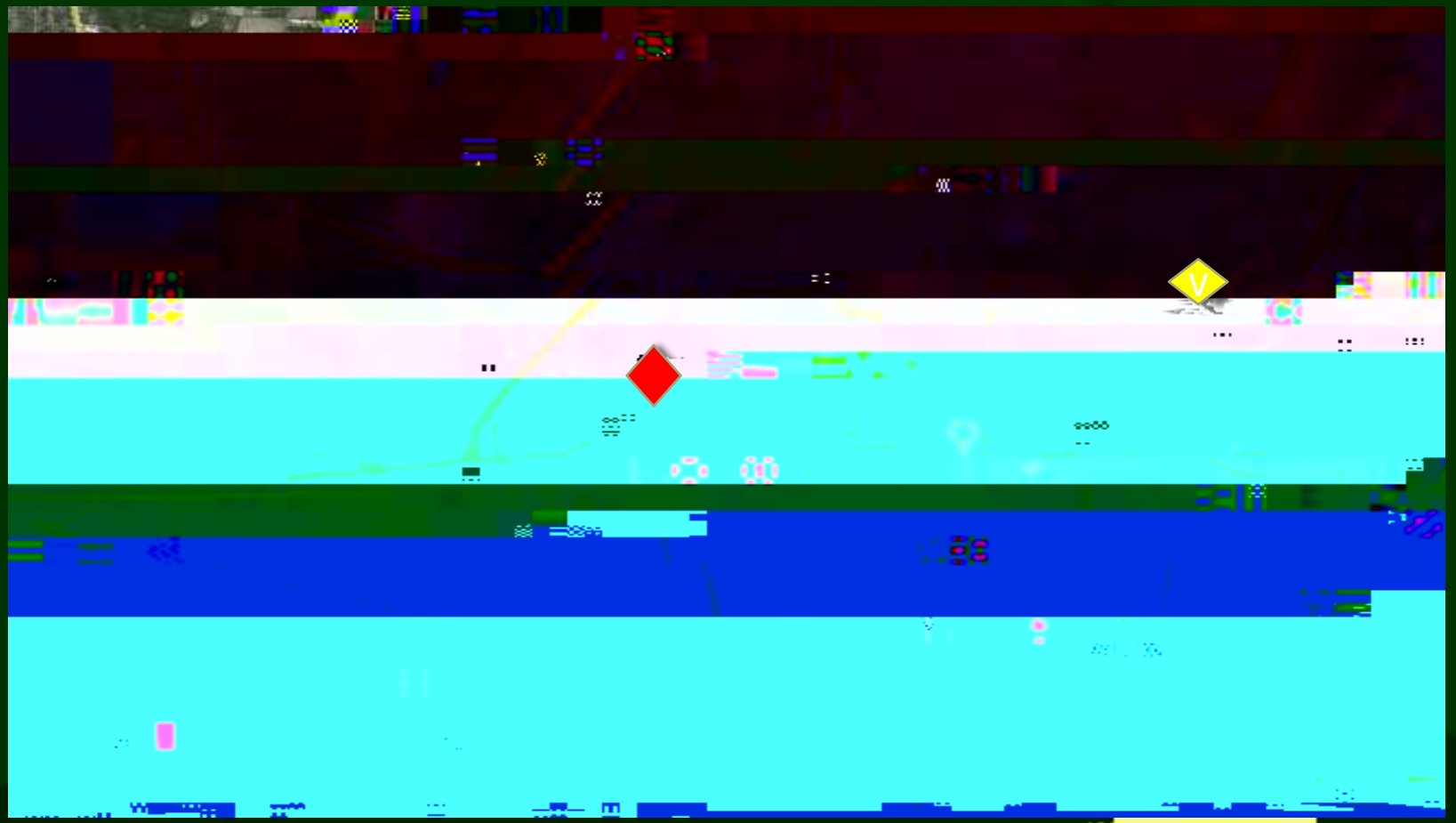
Beaver Creek Corridor Design and Analysis

By: Alex Previte

Overview

- Introduction
- Key concepts
- Model Development
- Design
- Accuracy
- Conclusion

Refresh

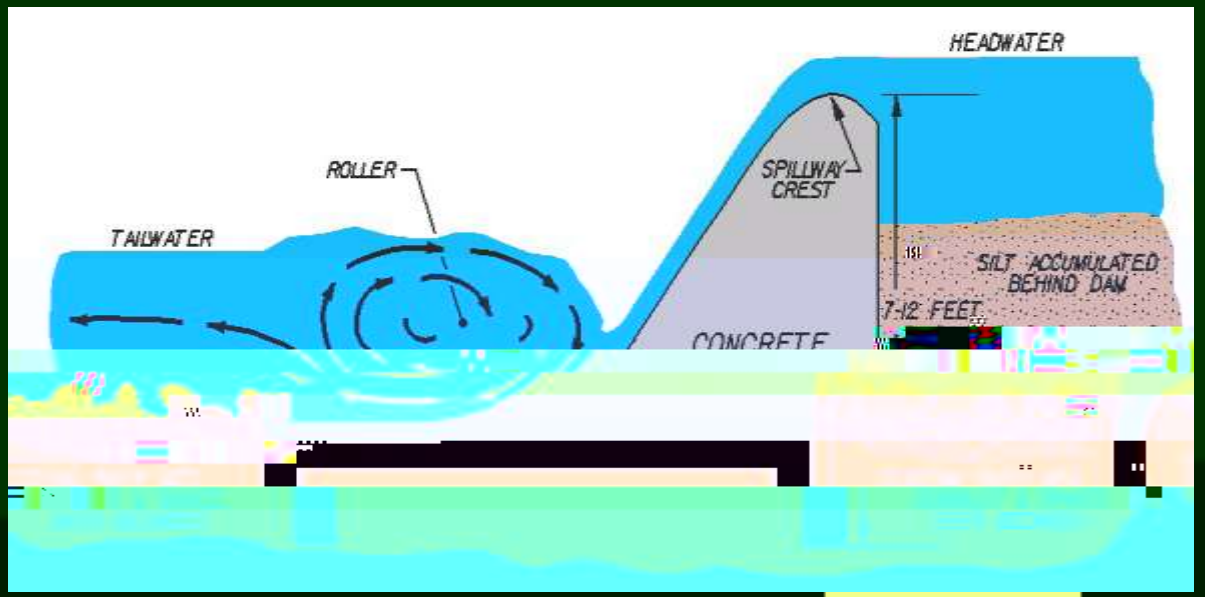


= Beaver Creek Site

= Wittenberg

Introduction

- Low head dam : small overflow dam used to alter the flow characteristics of a river or stream



- Dangers:
  - Drowning
  - Alter Ecosystem
  - User Friendly: Kayaking

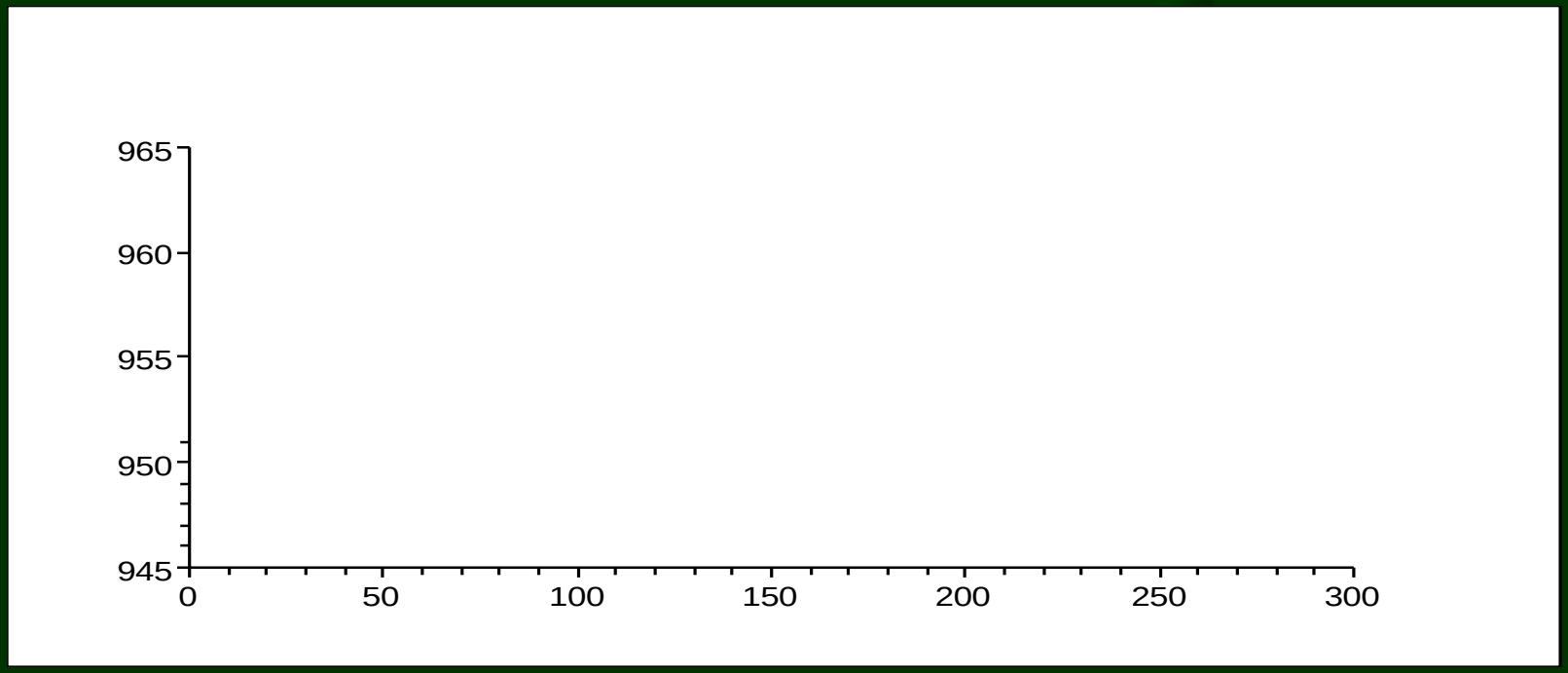
Introduction

- HEC-RAS
  - Hydrologic Engineering Centers River Analysis System
- Computer program
- Used for analyzing rivers and streams
- Able to compute flow characteristics given certain parameters

Profile Plot

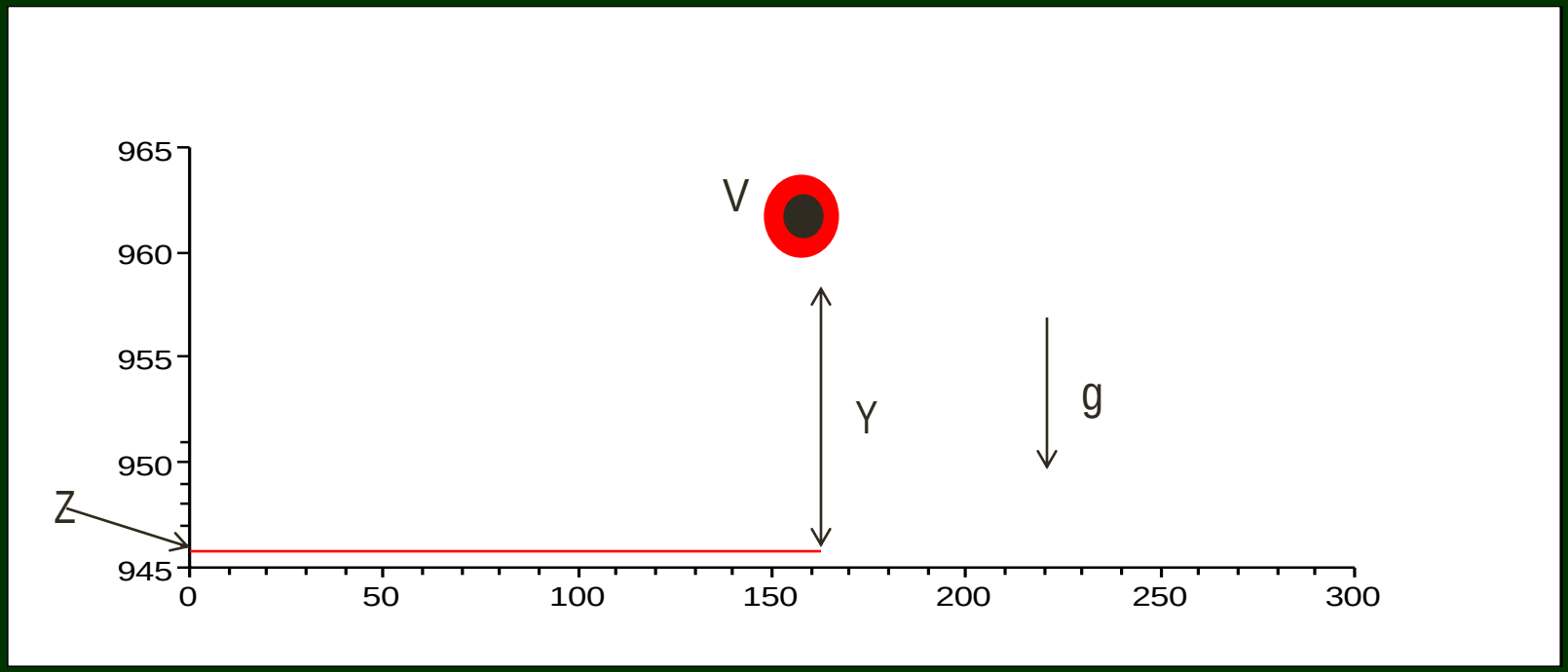
- Geometry profile
  - Data taken over 300 Ft (horizontally)
  - Conta RG[Co)ta ally)

Cross-Section



- X-axis = Horizontal width of River Station
- Y-axis = Elevation above sea level
- ● = Bank Station marker
- Contour = shape of creek bed at that station
- Stage Height (Y) = Distance from channel bottom to surface

Energy Equation



a_1, a_2 = Velocity weighting coefficients (error in average velocity)

h_e = Energy head loss

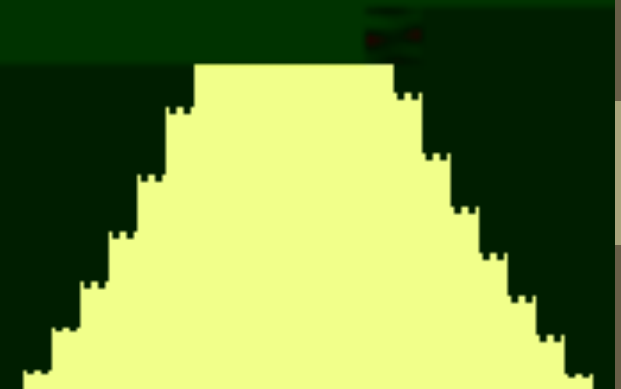
$$Z_2 + Y_2 + \frac{a_2 V_2^2}{2g} = Z_1 + Y_1 + \frac{a_1 V_1^2}{2g} + h_e$$

Development

- Determine and adjust Manning n value
- River bank adjustment
- One low-head dam replaced by a single v-notch drop structure
- Hydraulic Jump
  - Subcritical to supercritical

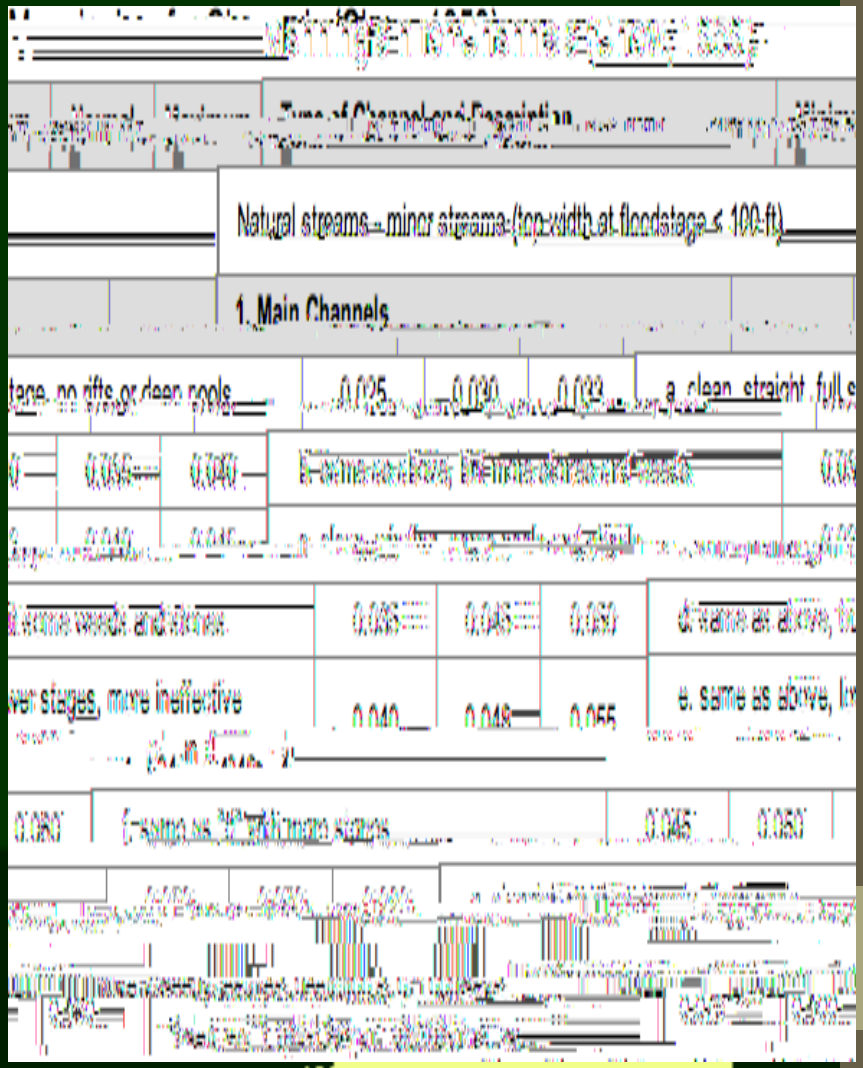
Manning Equation

- Equation:



Manning N

- Similar to coefficient of friction
- Shows the resistance to fluid flow
- Higher n means more resistant to flow



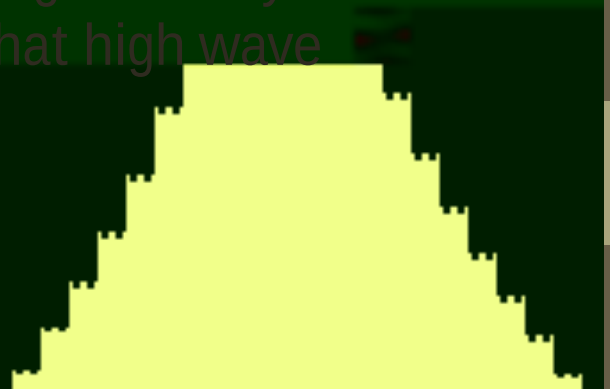
Froude Number

- Froude Number $$Fr = \frac{U}{\sqrt{gh}}$$
- U = Velocity of flow
- g = Acceleration of gravity
- h = Depth of flow relative to the channel bottom
- $\sqrt{gh}$ = Wave velocity
- Unitless

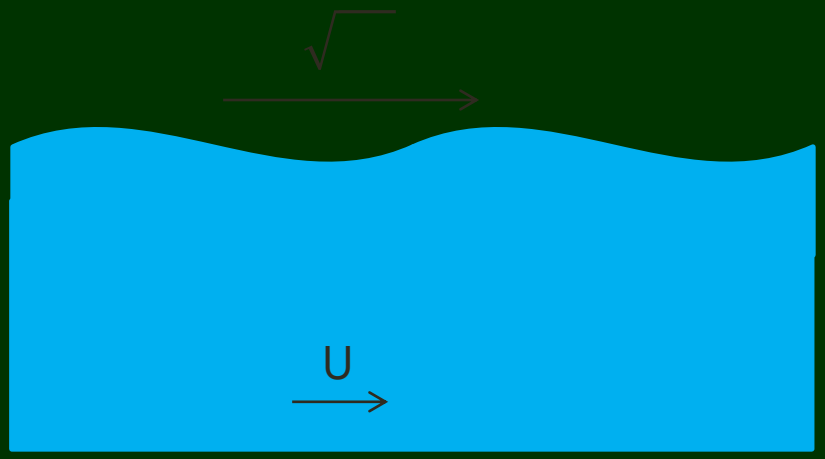
Supercritical and Subcritical Flow

- Is the Froude number > or < than 1?
  - Fr>1 = Supercritical
  - Fr<1 = Subcritical

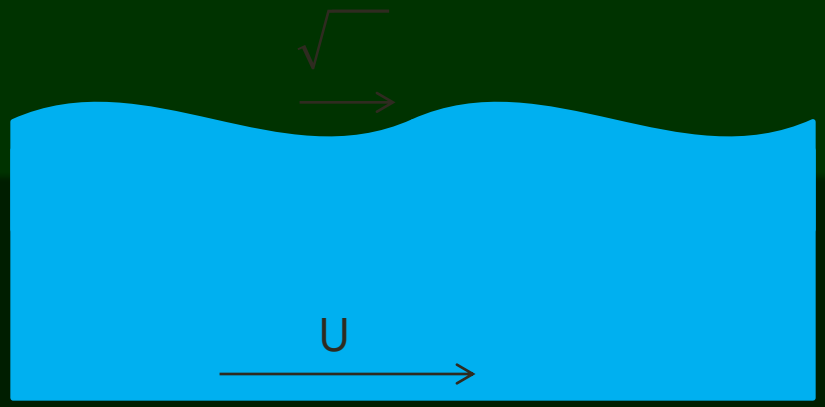
- Supercritical When flow velocity is greater than wave velocity
- Subcritical When flow velocity is less than wave velocity
- Hydraulic Jump Occurs when a flow at high velocity discharges into a zone that can't sustain that high wave velocity.



Sub or Supercritical Flow



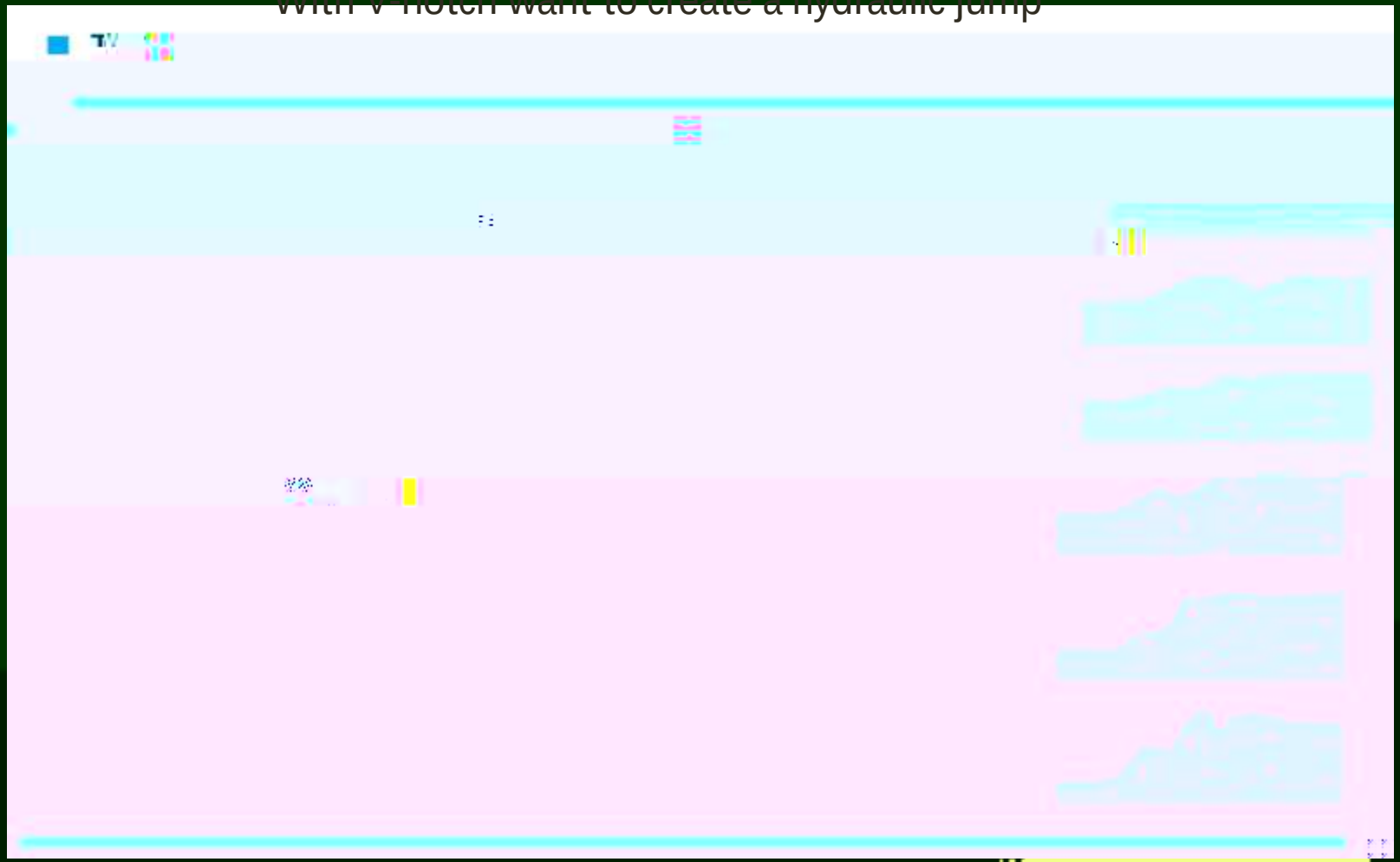
- Subcritical Flow



- Supercritical Flow

Hydraulic Jumps

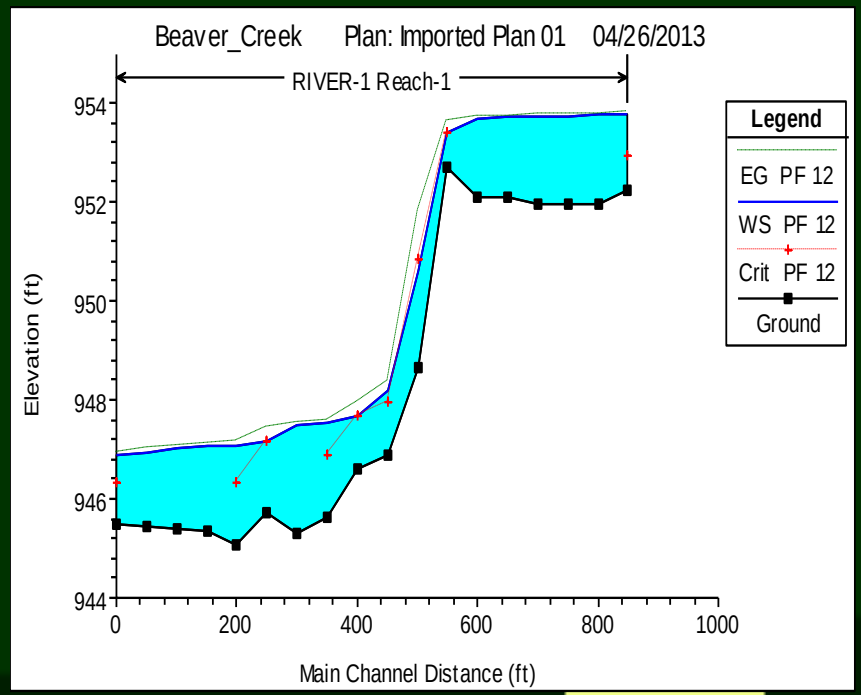
With V-notch want to create a hydraulic jump



Designing V-

Designing V-notch

- Flow Prior to dam is subcritical
- Fr<1
- Supercritical flow over the dam
- Fr>1
- Not safely passable by kayak or canoe

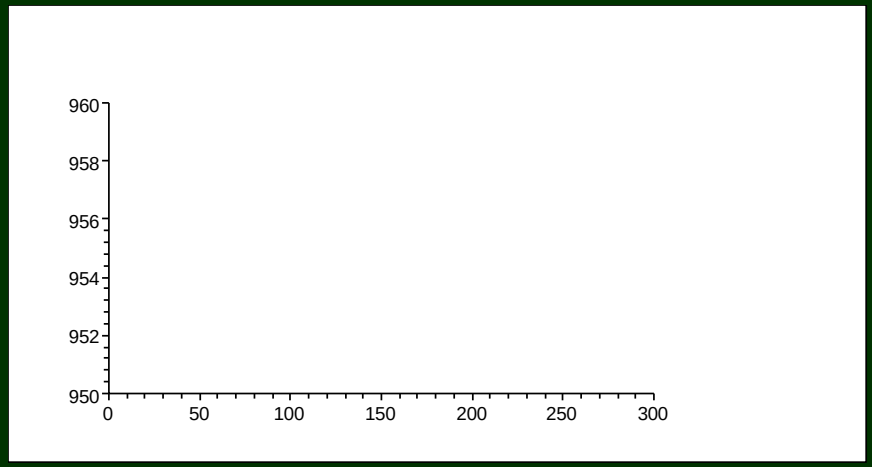


Designing V-notch

- O

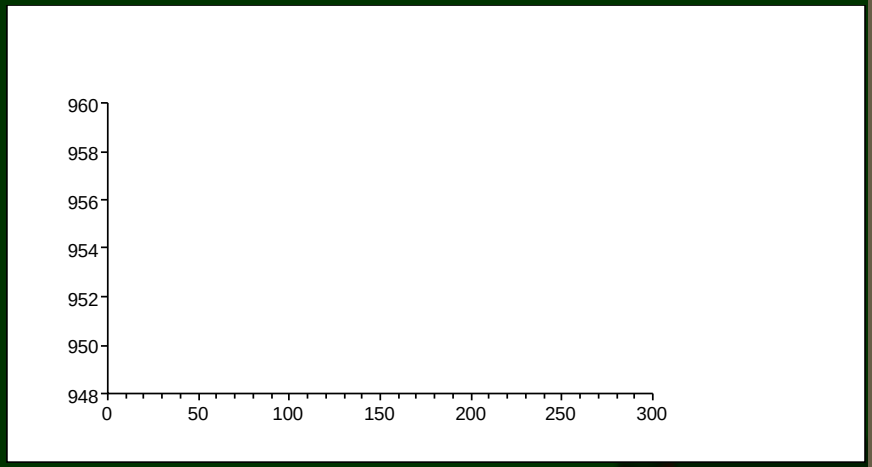
Hydraulic Jump

- Constant Q (93 cfs)



- Stage height at V-notch is 1.43 ft.

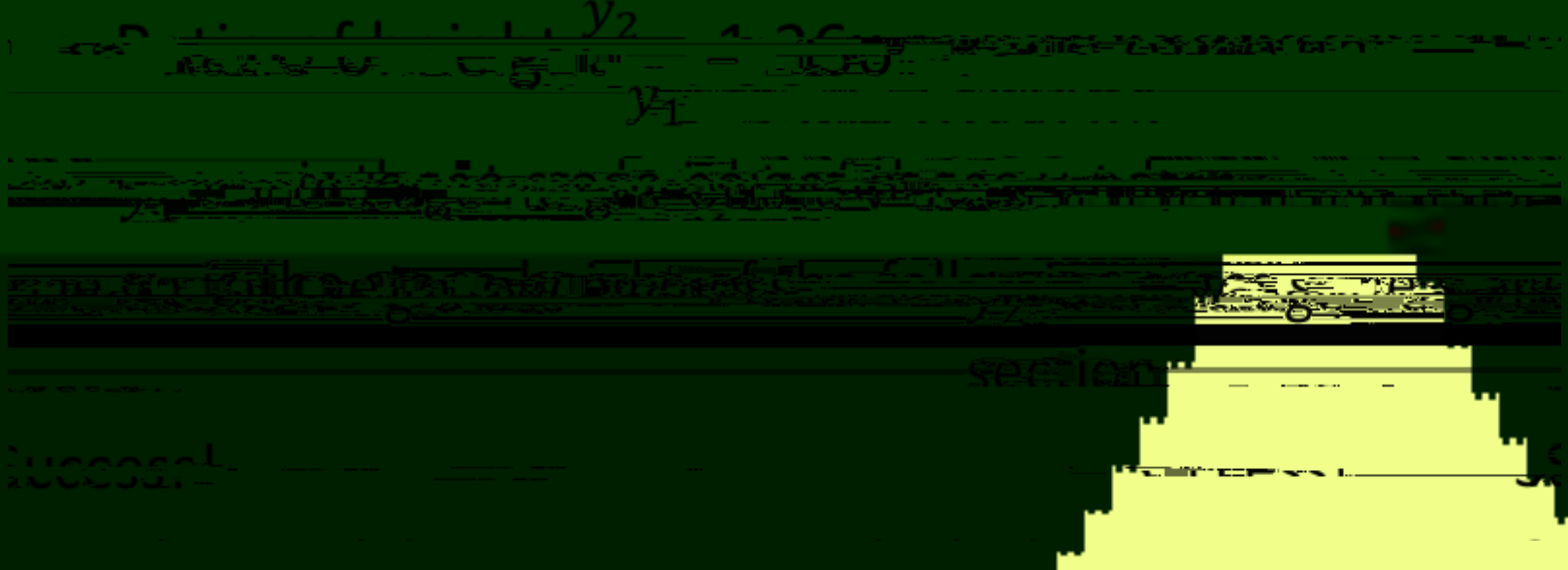
- Stage height of cross-section following V-notch is 1.94 ft.



- Hydraulic Jump?

Hydraulic Jump

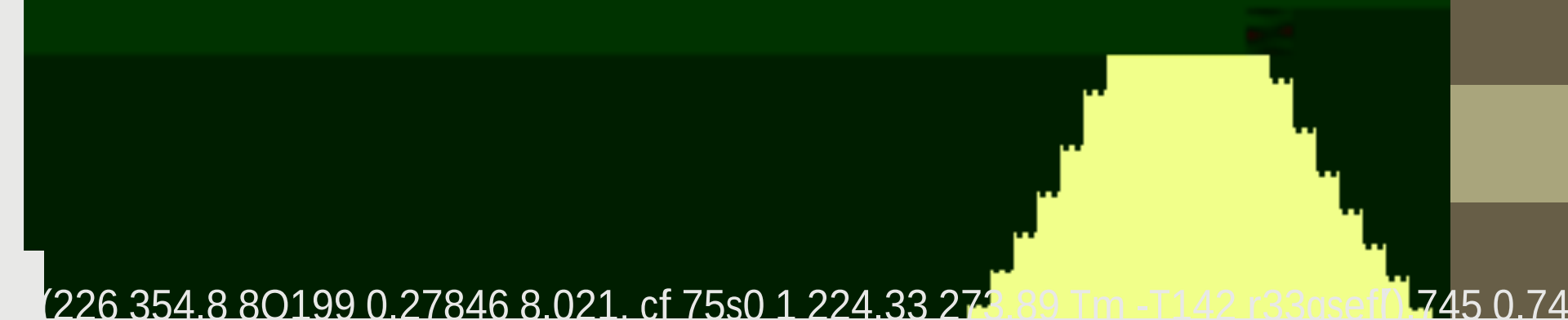
- Ratio of height — = 1.36
  - is the stage height of the v-notch
  - is the stage height of the following cross-section
  - Success!
  - Created an undulant jump or rapid which is passable by both canoe and kayak



Hydraulic Jump

- Is the model consistent?

  - > 1, < 1
  - Supercritical to subcritical flow
  - Indeed our structure has a Hydraulic jump

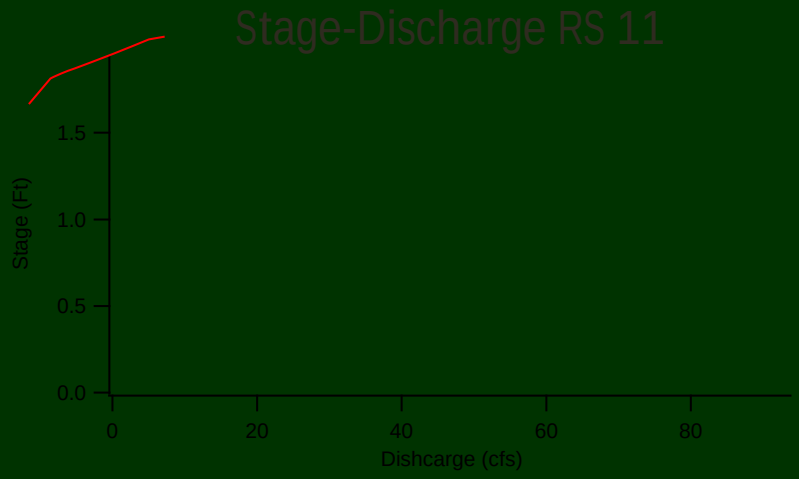


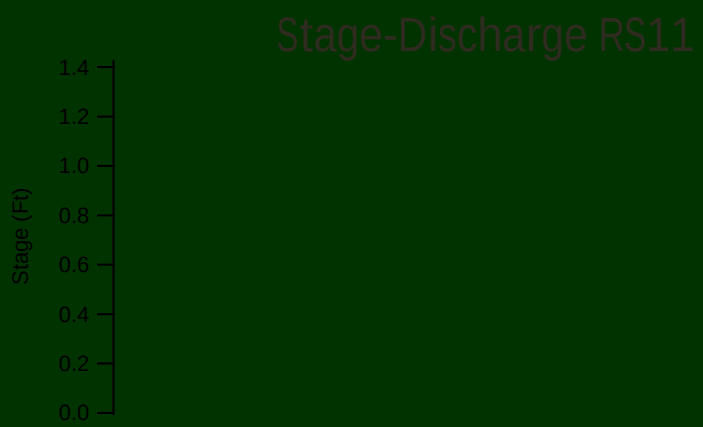
Model Accuracy

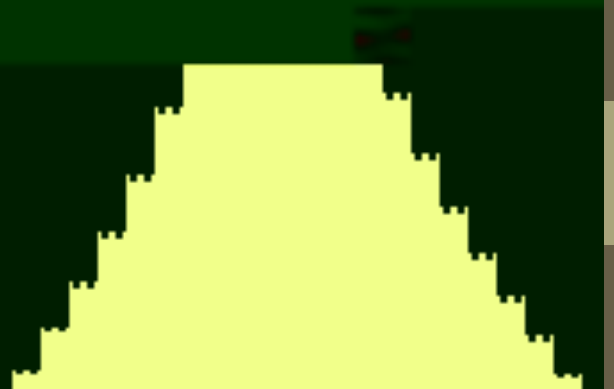
- Is stage height unreasonably high?
  - Uncharacteristic flow can damage downstream structure of bed
  - Must be consistent with the stage discharge of previous structure
  - Offset rating curves for comparison

Stage-Discharge Curve

- Pre Modification
- Post Modification







Conclusion

- HEC-RAS modeling to create modification to creek
- Model was consistent
- Dam modifications are possible

Acknowledgements

- Dr. George
- Dr. Williams

Questions?