

**Presentation 13:  
Earth Spillways — State of Practice and  
Research Needs**

## Spillway Design 101

- Determine routed discharge flow
- Size channel for desired flow
  - Broad Crested Weir ( $Q = c L H^{3/2}$ )
  - Manning's equation
  - HEC-RAS (HEC-2)
- Check channel flow velocity
  - NRCS Bulk length procedure (SITES)
  - HEC-RAS
- Armor (concrete, rock) or enlarge



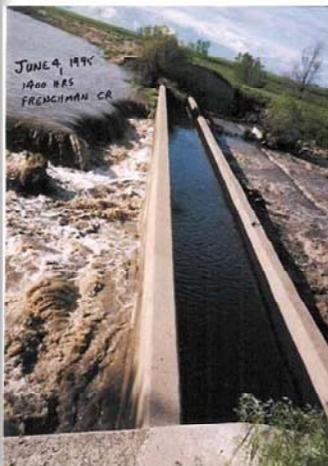


## Bulk Length / Sill Walls

- soil type
- time of flow
- depth of wall/ width



### Frenchman Creek



### Burgess #1

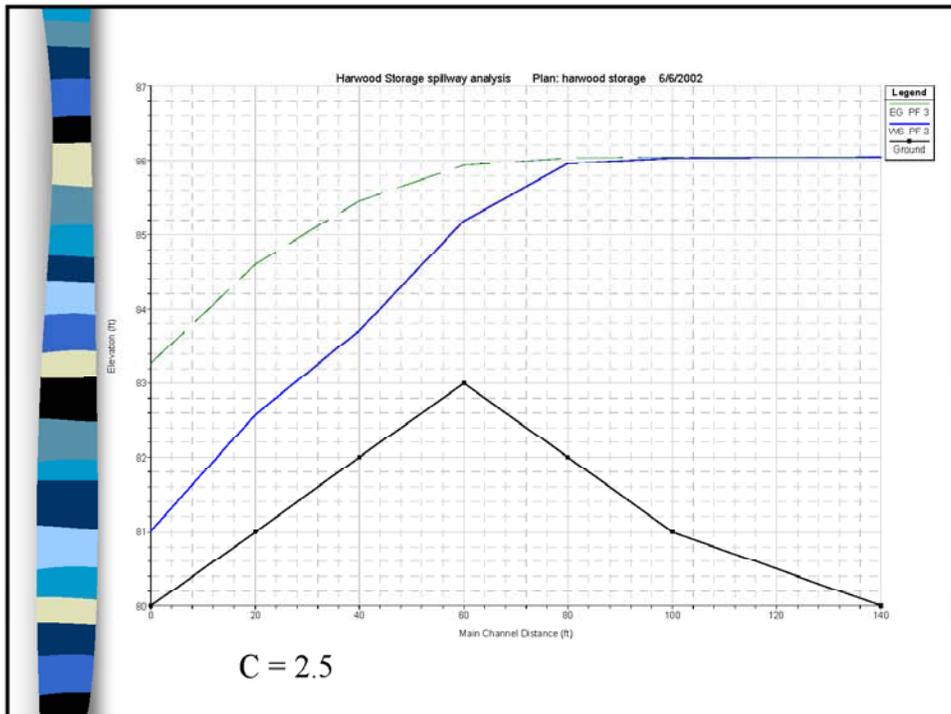


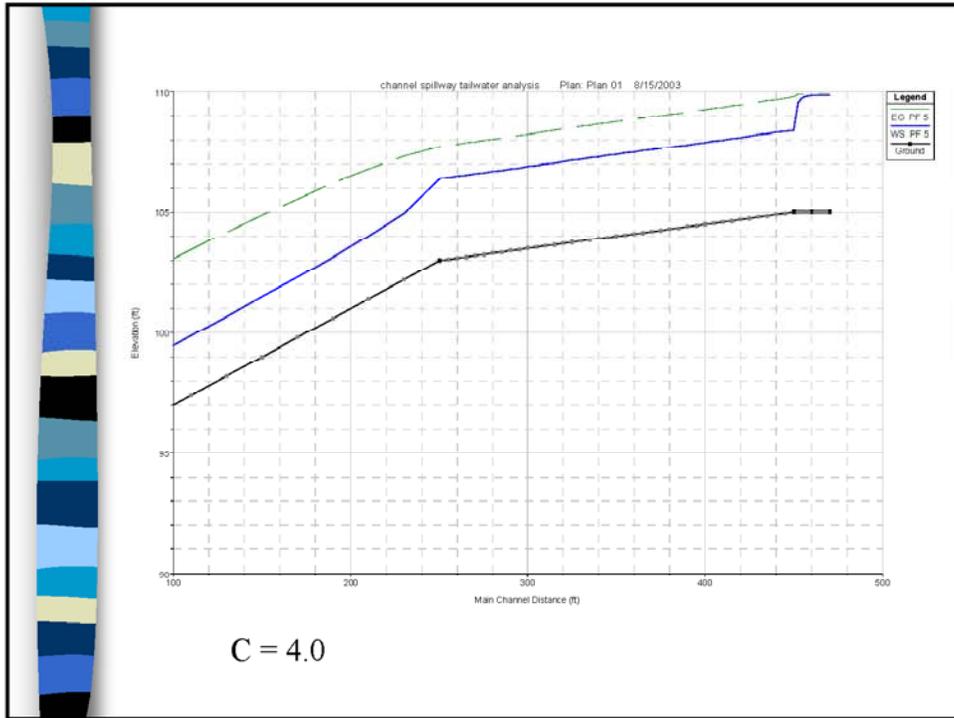
# Discharge co-efficient

$$Q = c L H^{3/2}$$

What is correct value for "c";

- broad crested weir? (approx. 2.6-3.1)
- Uniform flow using Manning's eq.?
- Tailwater analysis -> C = approx. 1.5 – 4.1 !!





## Ice/ Snow blockage

- snow depth
- melting/ clearing

Design to keep spillway open despite snow cover?







## Precipitation in High Mountain Regions

There has been some research to date suggesting that high mountains, and orographic effects do not correlate with published HMR data (Jarrett). Other research indicates “rain shadow” effects (Henz, Tomlinson).



## Research Needs:

- Design criteria for:
  - Flow capacity; C factor, bulk length
  - Sill wall; depth, spacing
  - Headcutting
- Ice/ Snow blockage, and melting
- HMR design indices for orographic effects

**Presentation 14:  
Issues and Research Needs Related to  
Hydraulics for State Regulated Dams**

*Issues and Research Needs  
Related to Hydraulics for State  
Regulated Dams*

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## *Issues and Research Needs Related to Hydraulics for State Regulated Dams*

States regulate over 90 % of the dams  
listed on the National Inventory of  
Dams.

## *State Survey*

30 states responded

- Types of spillways?
- PVC siphon spillways?
- Ice and snow effects on hydraulics?
- Skimming flows on stepped spillways?
- Questions about hydraulics of spillways?
- Adequate training?
- What are the issues?





## *Siphons*

- Hydraulics for multiple intakes
- Hydraulics for each pipe
- Maximum height limitations
- Maximum pipe size
- Material Types
- Joint integrity



## *Ice and Snow*

- Hydraulic changes due to ice
- Cost effective designs to minimize ice jams and icing impacts
- Ice/snow removal without site visits (especially small dams)



## *Drop Structures*

- Slugging flows in deep conduits (prevention)
- Loading of pipe/drop structure due to slugging flows
- Rational approach to air demand & minimum air pressure in outlet pipes
- Deflector plates in drop structures ( are they necessary)



## *Stepped Spillways (RCC)*

- Changing hydraulics due to weathering of steps
- Skimming flows at high volume flows
- Hydraulic Jumps in stilling basins ( Have we forgotten lessons learned in concrete chute design?)
- Cracking in steps/stilling basins







## *Concrete Blocks*

- Performance during extreme floods
- Debris flows
- Long term material performance



## *Hydraulic Coefficients*

- Overstated coefficient capacities
- Better software
- Realistic and relevant evaluations



## *Irregular Spillway Shapes*

- Geometric shape evaluation
- Rock lined/rip rap lined channels
- Rock channels
- Man made rapids versus fish passages

## *Miscellaneous*

- Corrugated metal pipe life
- Overtopping of earth dams
- Rip rap / concrete drop structure design
- Flash boards that do not fail
- Application of earthquake loading forces with hydraulic and other loading conditions. When?





## *Research Results Need to be Relevant and Reliable*

The results need to be proven in the field in long term applications. Small dam owners do not have the financial capability to do the same upgrade twice.





*Issues and Research Needs  
Related to Hydraulics for State  
Regulated Dams*

Questions?

