Simulating Mixed-Media Storage

January 2019 Webinar

Presenter: Jason Lillywhite

GoldSim

Purpose

Learn how you can account for changing quantities of solids and water in a storage facility over time.

- Estimate volumetric inflow of solids based on density and proportions in slurry inflow
- Simulate the reduction in water capacity as solids accumulate
- Account for entrained water in the solids
- Manage storage and overflows using a geometric relationship of depth vs. volume in the storage facility

Applications:

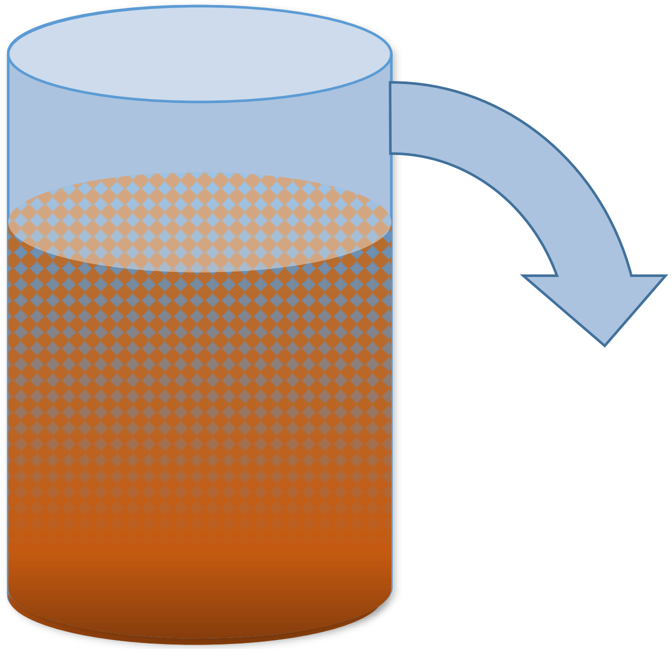
- Mine water management
- Reservoir sedimentation

Overview

Build a model in GoldSim that accounts for solids and water

Assumptions:

- Water is clean
- The geometry of the void filled by water remains unchanged
- Only water will overflow
- Solids immediately settle upon entering storage
- The volume of water entrained in the solids is constant over the vertical profile
- Solids are not being compacted over time

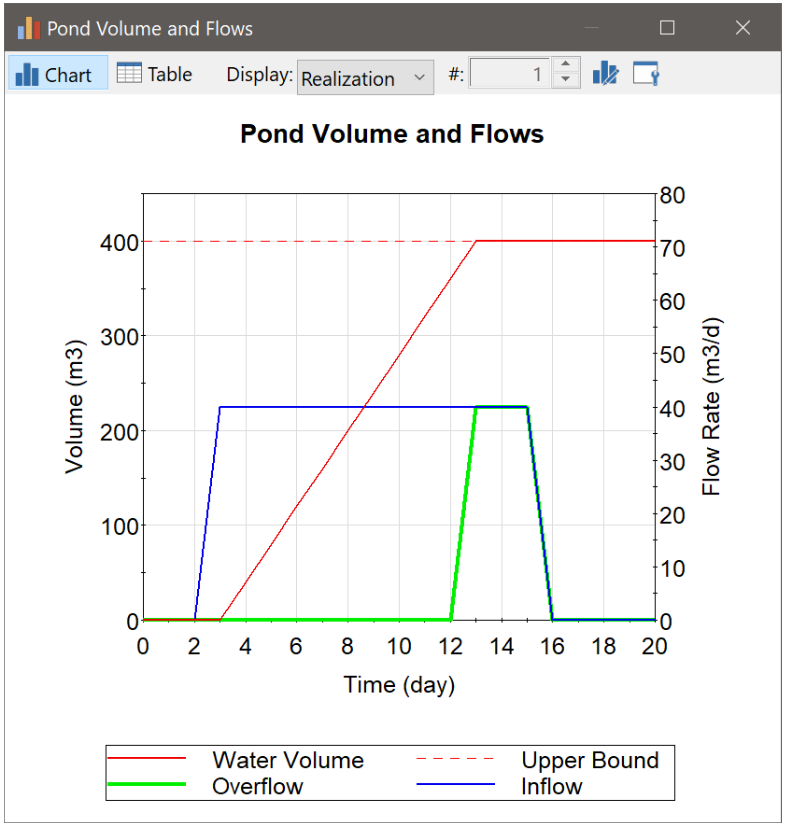


Step 1: Upper Bound

Water is the only media to overflow when upper bound is reached

Build a model that simulates just the upper bound of a water pool

Note unscheduled events that occur at the bounds. Allow unscheduled events?

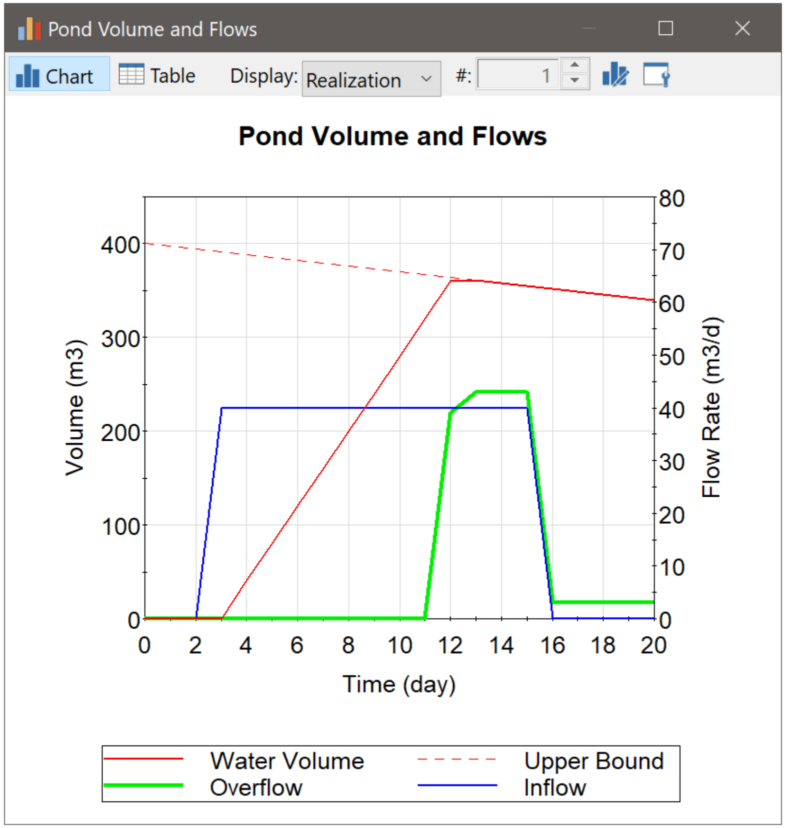


Step 2: Moving Upper Bound

Accumulating solids cause a reduction in water pool capacity

Model this by reducing the upper bound over time.

The water must overflow to maintain upper bound if at capacity



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Step 3: Model Slurry Flow

The solids mass inflow (M_s) is 10 tonne/day and its density (ρ_s) is 2.6 tonne/m3. The concentraition of solids in the slurry (C_w) is 20% by weight. Using phase relationship equations and ratios we can solve for volumetric flows of water and solids separately:

$$Solids\ volumetric\ inflow = \boldsymbol{Q_s} = \boldsymbol{M_s/\rho_s}$$

$$M_s = Mass\ flow\ rate\ of\ solids$$

$$\rho_s = Density\ of\ dry\ solids$$

$$Water\ inflow = \boldsymbol{Qw} = \boldsymbol{Q_m} \times (\boldsymbol{1} - \boldsymbol{C_v})$$

$$Q_m = Q_s/C_v$$

$$C_v = Concentration\ of\ solids\ by\ volume = C_w \times (SG_m/SG_s)$$

$$SG_m = SG_s \times SG_w/\left(SG_s + C_w \times (SG_w - SG_s)\right)$$

$$SG_s = \rho_s/SG_w$$

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Step 4: Solids Accumulation

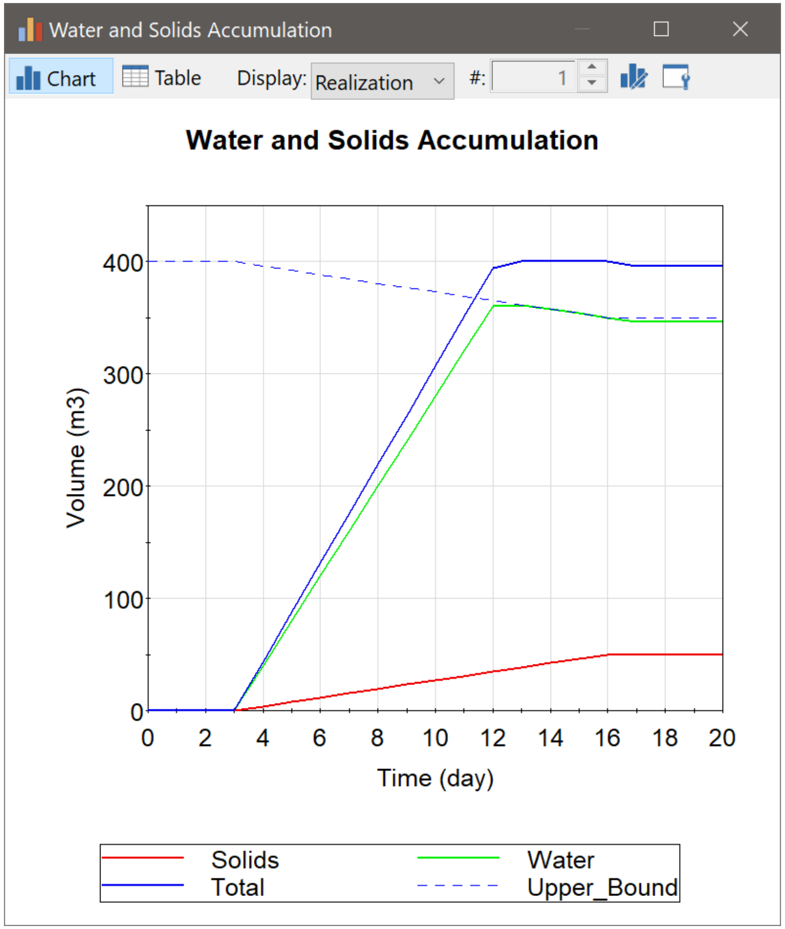
Add another Pool element

- Inflow is the volumetric flow of solids
- No upper bound for this pool

Upper bound starts at an initial value then subtract the Solids Volume over time

This upper bound controls the water pool

*Note: GoldSim must predict next upper bound when changing. Overshooting can occur (see final total volume)



Step 5: Entrained Water

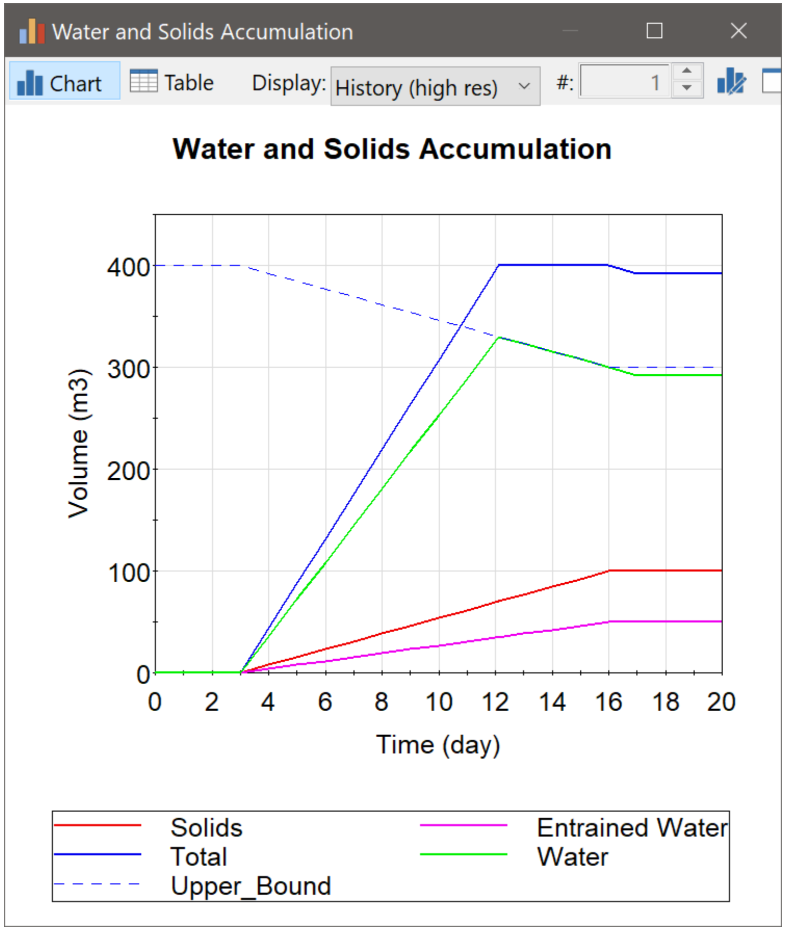
Assume a constant void ratio (e) of 1.0 in the solids after they settle in the pond.

Entrained water (V_e) per unit of solids (m3/kg):

$$V_e = \left(\frac{e}{SG_s}\right)/SG_w$$

Water must be removed from the water pool and added to the solids pool to include entrained water. Entrained inflow is:

$$Q_e = M_s \times V_e$$



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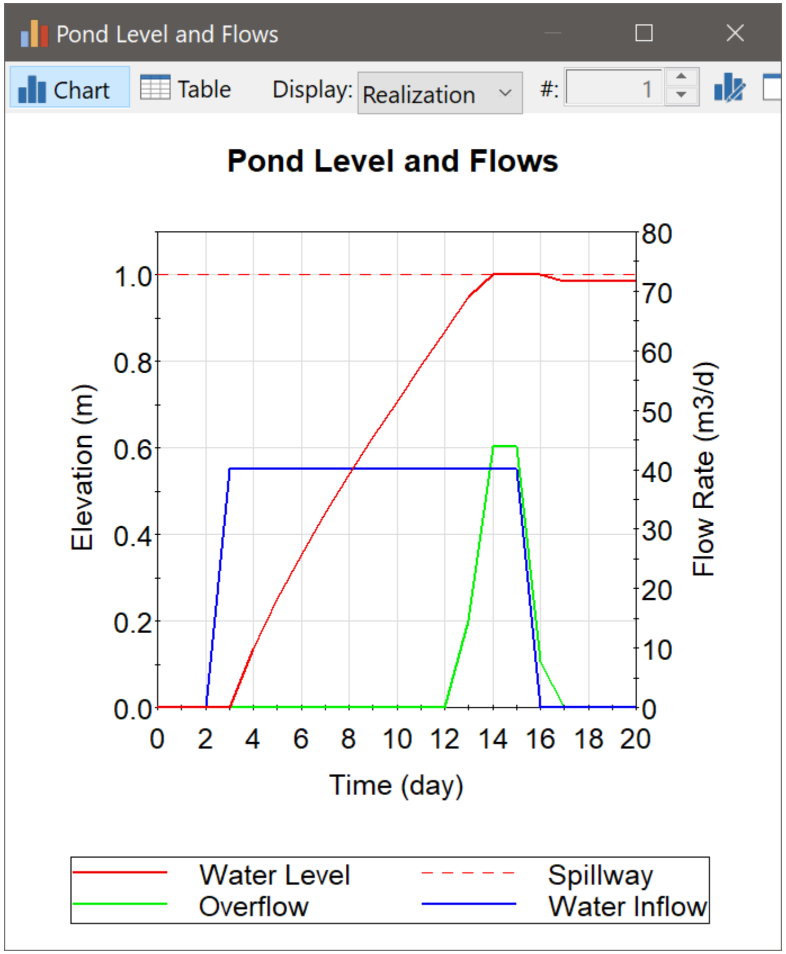
Step 6: Calculate Water Depth

Use a geometric relationship (elevation-area-volume) to account for changing elevation of the pool surface to trigger overflows.



Conclusion

The model is complete!

If you have any questions, please visit us in the forum to ask questions!

support.goldsim.com