



**Tulsa District:
Sedimentation Projections
for Our Reservoirs**



Tulsa District Reservoirs:

- We have almost 50 reservoirs within our district boundaries.
- Most of these reservoirs were constructed between the 1940's through the 1980's, with typical design lives of 50 to 100 yrs.
- Many of our projects are approaching their design life.



Tulsa District Reservoirs:

- Local public and private sectors have seen these lakes as a source of municipal and industrial water supply for the state's population.
- These reservoirs are being used for recreational purposes, and supplemental stream flow water for water quality, aquatic life, and related activities



Tulsa District's FORCTEOS:

- Paul Bisdorf from the Tulsa District researched various methods of determining the reduction in storage capacity due to sedimentation, and wrote an algorithm to accomplish the best method.
- This program is called forcteos.



FORCTEOS:

- FORCTEOS (the software) requires the following information to predict future sedimentation:
 - Original Capacity at top of flood control pool
 - Resurveyed capacity at the top of flood control pool
 - Original capacity at top of conservation pool
 - Resurveyed capacity at top of conservation pool
 - Original capacity at the top of inactive pool
 - Resurveyed capacity at the top of inactive pool
 - Year of reservoir closure
 - Period in years from closure to date of resurvey
 - Total number of years for forecast periods.
 - Percentage of soil type from collected sediment samples
 - Average Annual Inflows from Closure to Resurvey



Computations

- Tons of sediment deposited
- Trap Efficiency
- Detention Time
- Flow Through Time
- Volume of Sediment in a 100 yr period
- Total Volume Deposited



Tons of Sediment deposited

- Determines Sediment Yield
 - The software computes a total sediment deposit of each type of soil of the material found in the sediment samples.
 - Age of the deposit in years
 - Based on one of the three (3) types of projects the software uses predefined dry density weights to compute the total yield based on the percentage of the separate soils.
- Determines Total Tons of Sediment.
 - Once the total sediment yield is calculated the software determines the tons of sediment deposited since the last survey.

Trap Efficiency

- The next step requires determining the ratio of sediment inflow to sediment outflow and refining this ratio.

$$T_e = (Q_{si} - Q_{so}) / Q_{si}$$

HEC's IHD Vol 12
Eqn (5-01)

T_e = trap efficiency expressed as a decimal

Q_{si} = inflowing sediment load

Q_{so} = outflowing sediment load.



Detention-time

- Refinement of the trap efficiency is determined by converting the trap efficiency ratio into the log of the trap efficiency ratio.



Flow through time

- The flow through time, or detention time in years, is the ratio of the capacity of the reservoir in ac-ft over the average annual water yield in volume/year.

$$T_d = S / Y_w$$

HEC's IHD Vol 12
Eqn (5-02)

T_d = Flow through time in years

S = Capacity of reservoir in ac-ft

Y_w = average annual water yield in volume/yr.

Volume of sediment in 100-year period

- The software then converts the sediment inflow from tons/year to ac. ft. in 100 year period .

$$V_d = Q_{si} * \frac{1}{\text{PercentSed}} \frac{\text{ft}^3}{\text{lb}} * 200 \text{lb} / \text{ton} * \frac{1 \text{ac. ft.}}{43560 \text{ft}^3} * 100 \text{years}$$

Final step

- Total Volume Deposit is the result of the trap efficiency multiplied by the total volume of sediment delivered during a 100 year period.

$$V_t = T_e * V_d$$

HEC's IHD Vol 12
Eqn (5-05)

V_t = Total Volume Deposited

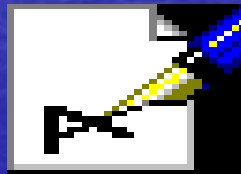
T_e = Trap Efficiency

V_d = Total Volume Deposited in 100 yr period



Tulsa District Reservoirs:

- Forcteos program is run to obtain the following output:



WordPad Document



Create the EAC curves

- So essentially the program output gives you 3 points on an elevation capacity curve:
 - Capacity at
 - top of conservation pool
 - top of flood pool
 - top of inactive pool
- Using an excel spreadsheet, I take these three points and work backwards to create a complete 1 ft EAC table.

Questions??

Sarah Harris

918-669-4354

Sarah.j.Harris@usace.army.mil