MATS-TC: Automating Time of Concentration Through Multidisciplinary Collaboration

2018 IAFSM Annual Conference

Taylor Leahy, PE
Andrew C. Reicks,CFM

March 15th

CDM Smith

MATS-TC: Automating Time of Concentration Through Multidisciplinary Collaboration

- Taylor Leahy, PE
  - Water resources engineer
  - FEMA H&H studies

- Andrew C. Reicks, CFM
  - GIS Specialist
  - Tool Development

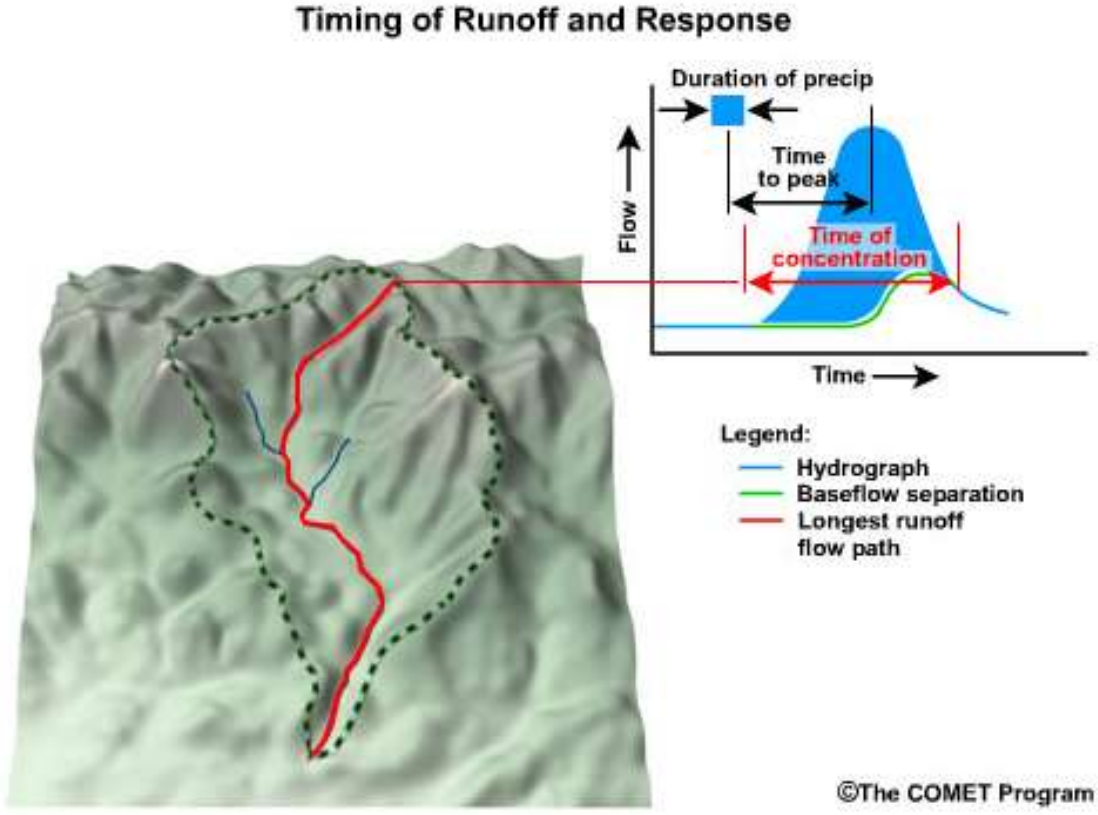
Overview

- Time of Concentration
- Previous process
- Full Automation
- Outcome
- Moving Toward the Future

Time of Concentration

Time of Concentration

- Time of concentration (Tc) is the time required for runoff to travel from the hydraulically most distant point in the watershed to the outlet.



Velocity Method

- Adds the travel time of various flow types, the sum is the watershed's TC
- Three main flow types
  - Sheet
  - Shallow Concentrated
  - Channel
- Each flow has its own formula for travel time

Travel Time Formulas

- Sheet

$$T_t = \frac{0.007(n\ell)^{0.8}}{(P_2)^{0.5} S^{0.4}} \qquad \text{(eq. 15–8)}$$

where:
T_t = travel time, h
n = Manning's roughness coefficient (table 15–1)
ℓ = sheet flow length, ft
P_2 = 2-year, 24-hour rainfall, in
S = slope of land surface, ft/ft

- Shallow Concentration
- Channel

$$V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n} \qquad \text{(eq. 15–10)}$$

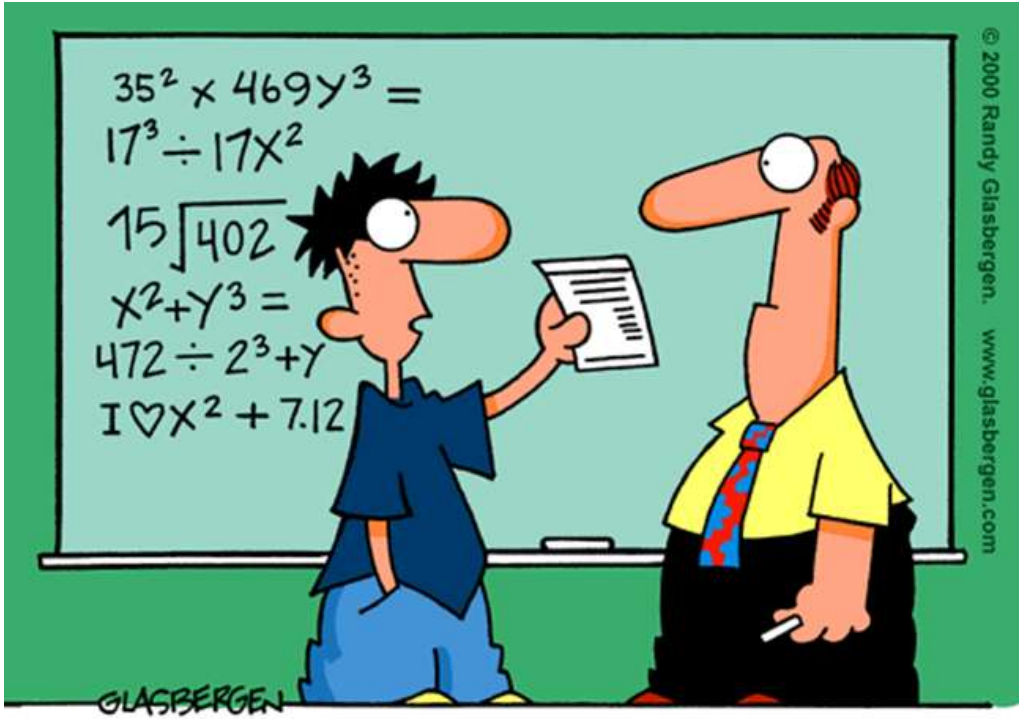
where:
V = average velocity, ft/s
r = hydraulic radius, ft
$= \frac{a}{P_w}$
a = cross-sectional flow area, ft^2
P_w = wetted perimeter, ft
s = slope of the hydraulic grade line (channel slope), ft/ft
n = Manning's n value for open channel flow

Travel time (T_t) is the ratio of flow length to flow velocity:

$$T_t = \frac{L}{3600V} \qquad \text{[eq. 3-1]}$$

where:

T_t = travel time (hr)
L = flow length (ft)
V = average velocity (ft/s)
3600 = conversion factor from seconds to hours.



"I HAD MY DOCTOR DO A D.N.A. BLOOD ANALYSIS. AS I SUSPECTED, I'M MISSING THE MATH GENE."

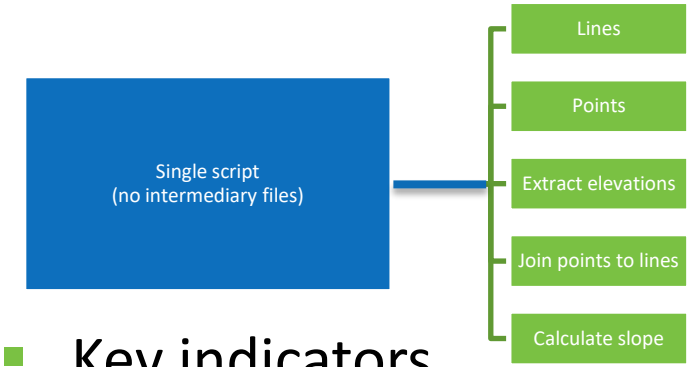
Previous Process

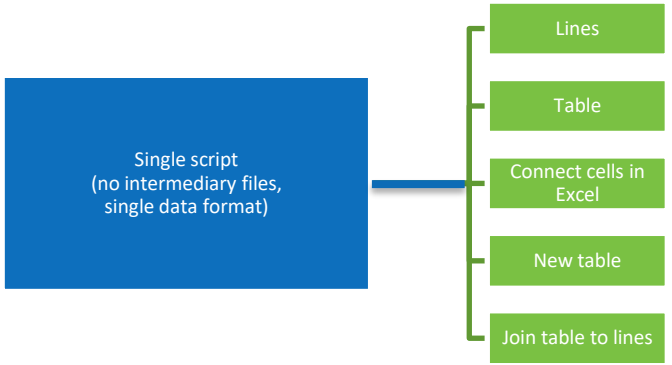
Manual Process

- Inputs created manually
  - Stream widths & depths
  - Stream segment splitting
  - Stream segment attribution
- Data Calculations
  - Data exported, processed, imported back
  - Formula components added manually
  - Large file size

The Beginning

- Simple question
  - Split line segments 0 – 100 feet | 100 feet – end
- Questions of increasing complexity
  - Add slope to each segment
  - Time of concentration calculations





- Key indicators
  - Repetitive; Multiple steps/outputs; Multiple data formats

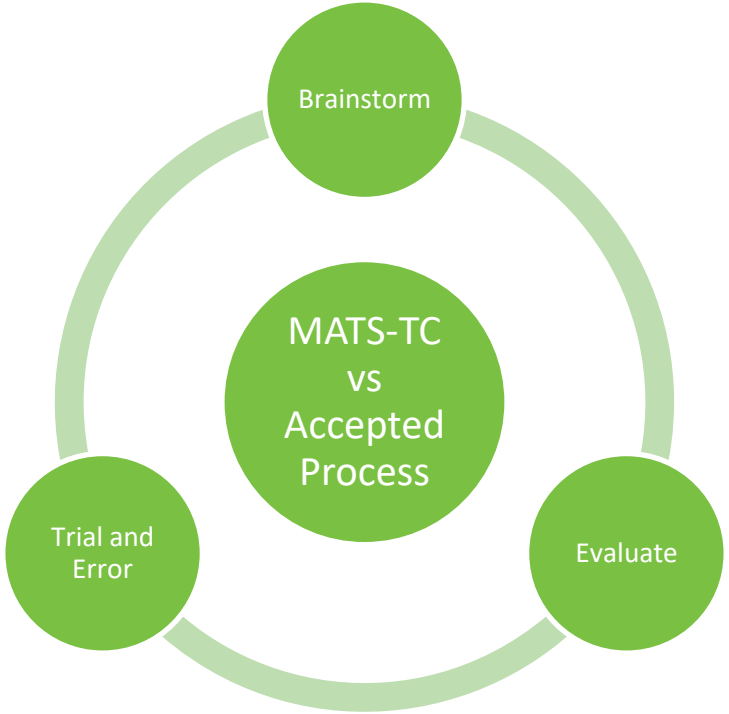
Full Automation

Jumping Off Point

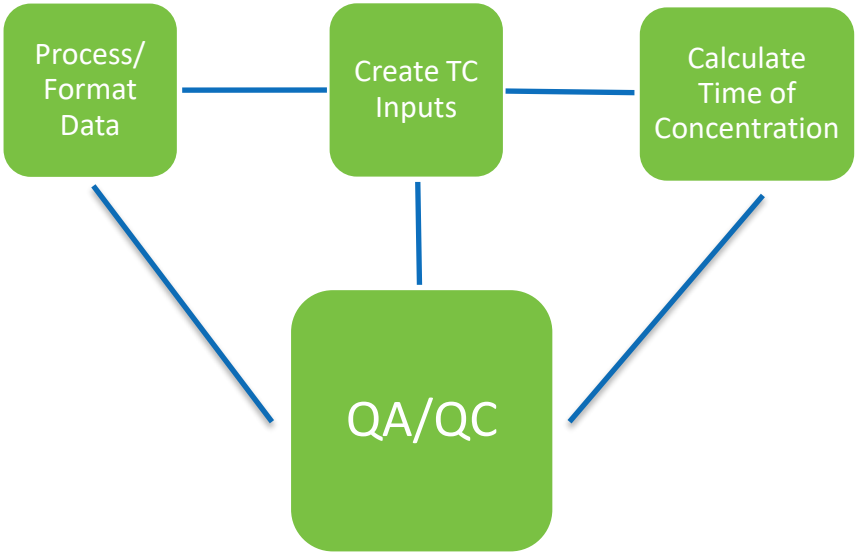
- Automating engineering decisions
  - Feasibility
  - Time
  - Level of effort
  - Accuracy
  - Quality

MATS Process

- Multi-disciplinary Automated Technical Solution
  - Collaborative approach
  - Finding commonalities
  - What's needed/what's possible/what's available
  - Identify critical elements



MATS-TC


Process/ Format Data
Create TC Inputs
Calculate Time of Concentration
QA/QC

Outcome

Results and Benefits

- TC
  - ↑ Accuracy
  - ↑ Speed
  - ↑ Repeatability
  - ↑ Data Integrity
  - ↓ Project Time
  - ↓ Manual Processing
  - ↓ Subjective Decision Making
  - ↓ Human Error
- MATS
  - ↑ Collaboration
  - ↑ Communication
  - ↑ Innovation
  - ↑ Interdisciplinary Understanding

Moving Toward the Future

Next Steps

- TC
  - Refine as more areas are studied
  - Improve error handling and documentation
  - Test and update for a variety of different areas and situations
- MATS
  - Make collaboration contagious
  - Increase interdisciplinary understanding
  - Apply method to other workflows

MATS

TC

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Thank you!

- Questions? Please email us:
  - Taylor: LeahyT@cdmsmith.com
  - Andrew: ReicksA@cdmsmith.com