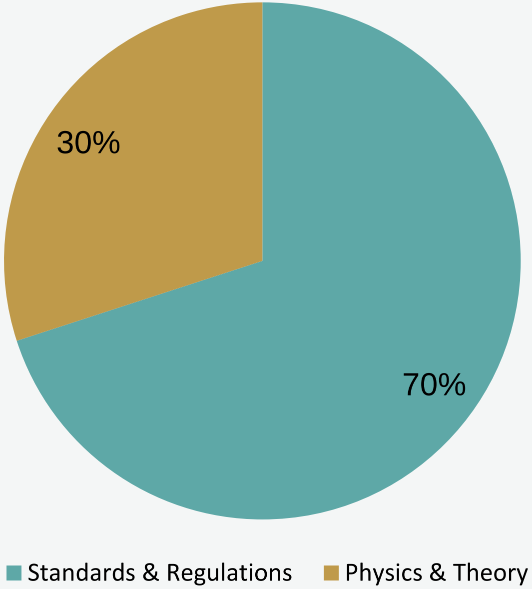
Hydrology Method Selection

A Practical Decision Tree by Watershed Size

The Reality Nobody Teaches



Hydrology is NOT purely physics-based

Engineering judgment > theoretical perfection

Choose by: scale + regulation + purpose

Step 1: Watershed Size Eliminates 80% of Confusion

Small Watersheds

< 20-50 acres - Parking lots, sites, developments

Medium Watersheds

50 acres - 5-10 mi^2 - Neighborhoods, small streams, culverts

Large Watersheds

> 5-10 mi^2 - Rivers, bridges, FEMA, floodplain studies

Small Drainage Areas

< 20-50 acres

When to Use

Typical Projects

- Parking lots
- Site developments
- Small urban drainage
- Inlet design

Characteristics

- Short Tc
- Very flashy runoff
- Simple geometry

Methods & Tools

Recommended

- ✓Rational Method
- ✓Tc + C calculations
- ✓PondPack / HydroCAD

Do NOT Use

- ✗HEC-HMS (overkill)
- ✗StreamStats (overkill)

Medium Watershed Applications

50 acres - 5-10 mi²

Project Types

Typical Applications

- Neighborhoods
- Small streams
- Culvert design
- Detention ponds
- Stormwater systems

Storage and timing matter at this scale

Recommended Methods

Use These

- ✓TR-55
- ✓CN method
- ✓Tc calculations
- ✓HEC-HMS
- ✓PondPack routing

Avoid

- ✗Rational Method (becomes inaccurate)

Large Watershed & River Systems

> 5-10 mi^2

Applications

Typical Projects

- Rivers and streams
- Bridge design
- FEMA studies
- Floodplain mapping
- Regional analysis

Regional statistics more reliable than manual CN estimation

Tools & Approach

Recommended

- ✓StreamStats
- ✓USGS regression
- ✓HEC-HMS basin model
- ✓HEC-RAS

Do NOT Use

- ✗Rational Method
- ✗Detailed CN per subcatchment

What Each Method Really Is

StreamStats / USGS Regression

What it really is: Statistics from hundreds of stream gages analyzing similar watersheds

- **Good for:** Large basins, bridge design, FEMA studies, fast screening
- **Limitations:** No hydrograph, no routing, not good for detention design
- **Output:** Peak flow only

Rational Method

What it really is: Steady-state assumption where peak occurs when storm duration = Tc

- **Good for:** Small urban sites, pipes, inlets, simple drainage
- **Limitations:** Cannot route, ignores storage, bad for natural basins
- **Output:** Peak flow only

CN + Tc + HMS / PondPack

What it really is: Simplified physics-based rainfall-runoff simulation

- **Good for:** Hydrograph shape, storage, routing, detention sizing, timing
- **Limitations:** Requires assumptions, parameter uncertainty, overkill for tiny sites
- **Output:** Full hydrograph

Method Capabilities & Limitations

Capability	StreamStats	Rational	CN/HMS
Peak flow	✓	✓	✓
Hydrograph shape	✗	✗	✓
Routing capability	✗	✗	✓
Storage consideration	✗	✗	✓
Setup complexity	Low	Low	Medium

Simple Decision Flowchart

What do you need?

Peak flow for bridge/floodplain?

Use **StreamStats**

Pipes/inlets/small site?

Use **Rational Method**

Detention pond design?

Use **CN + Tc + PondPack/HMS**

Full watershed routing?

Use **HEC-HMS**

Basin > 10-20 mi²?

Use **Regression + HMS combo**

What Professionals Actually Do

- **Small Project** → **PondPack only**
- **Medium** → **HMS only**
- **Large** → **StreamStats + HMS**
- **Very Large** → **Regression + HMS + RAS**

Note: Manual Tc/CN calculations are primarily for understanding, quick checks, or agency requirements - not necessarily because they are more accurate

Combining Methods

(It's Normal)

Example Integration

1. StreamStats for boundary flow
2. CN method for subbasins
3. Route in HMS
4. Check Rational for pipes

"Right tool for each piece" is standard practice in consulting

Key Takeaways & Recommendations

Scale determines method - Watershed size eliminates most confusion

Choose simplest tool - Never more complicated than necessary

Mix methods as needed - Use right tool for each component

Default to HEC-HMS - For medium/large projects, most transferable skill

Engineering judgment matters - 30% physics, 70% standards & regulations

Pick the simplest tool that answers the question