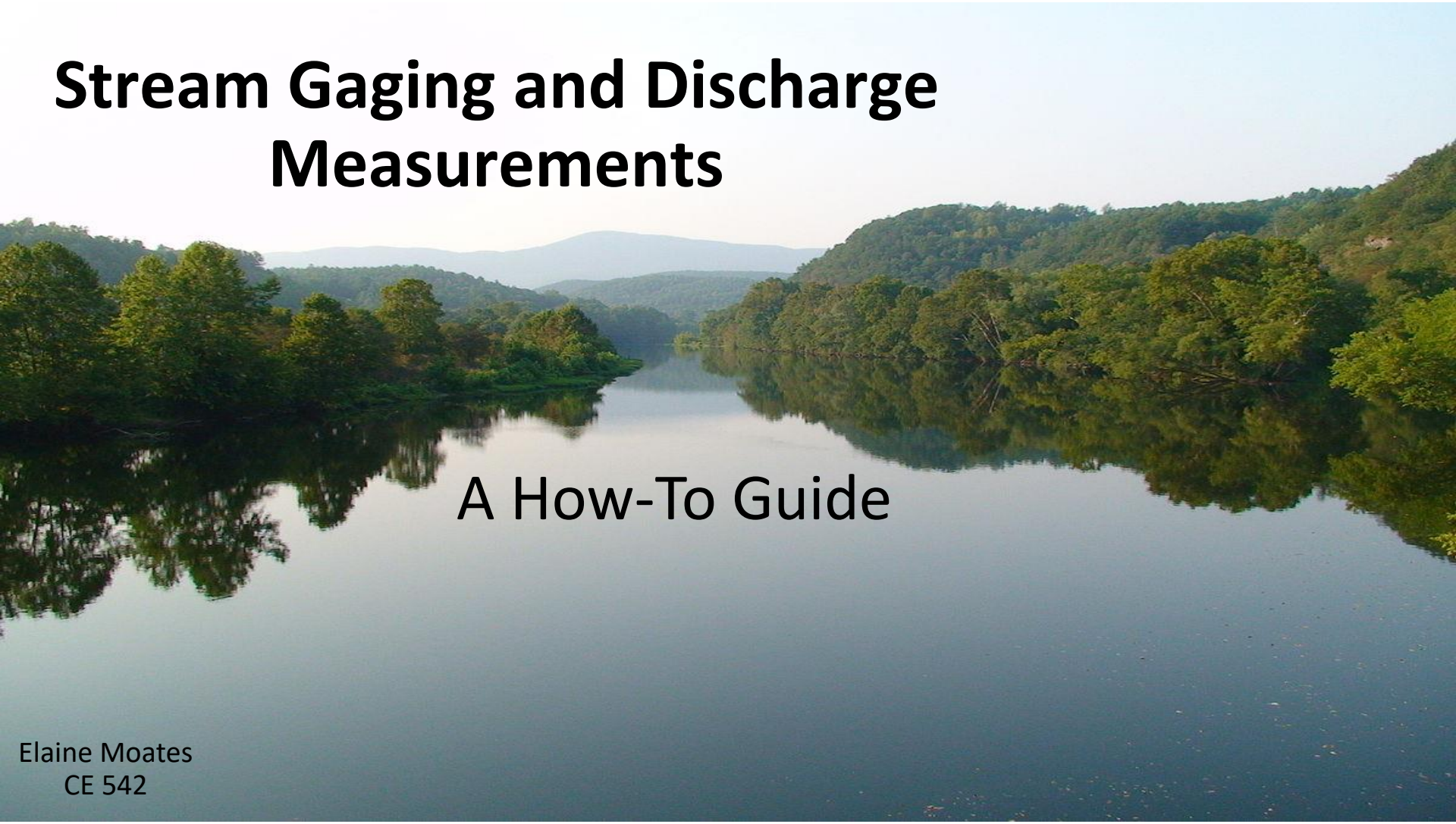
Streamflow Measurement

- Why we need it?
- How is it done?
- Where do we get streamflow data in the United States?

Stream Gaging and Discharge Measurements



A How-To Guide

Elaine Moates
CE 542

Stream Gaging:

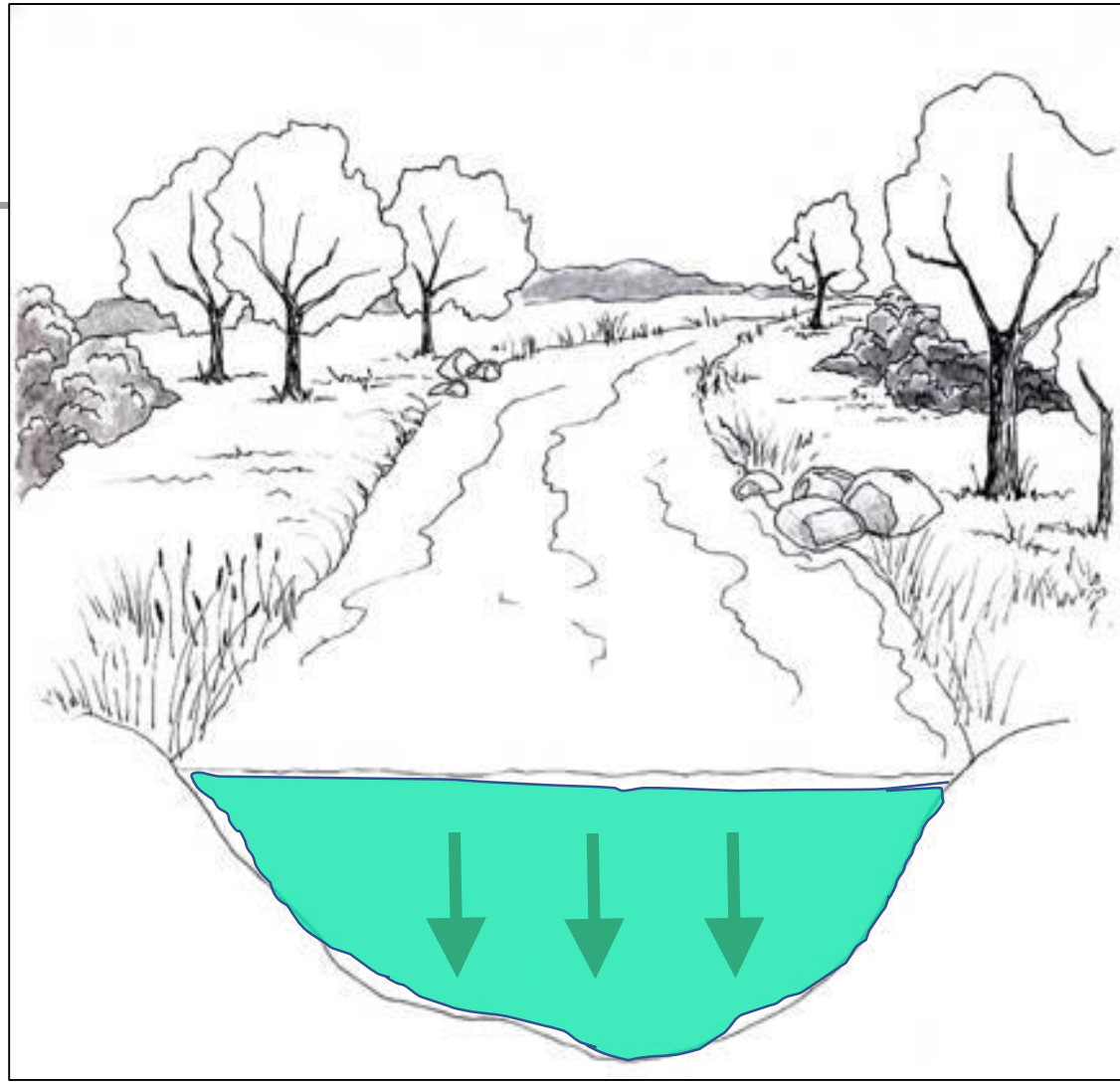
Measuring the volume of water flowing through a stream per unit time

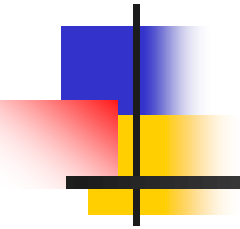
Not possible to measure directly

So how is it done?

1. Measure the velocity of flow at a cross-section
2. Compute the area of the cross-section
3. Calculate discharge

$$Q = V \times A$$

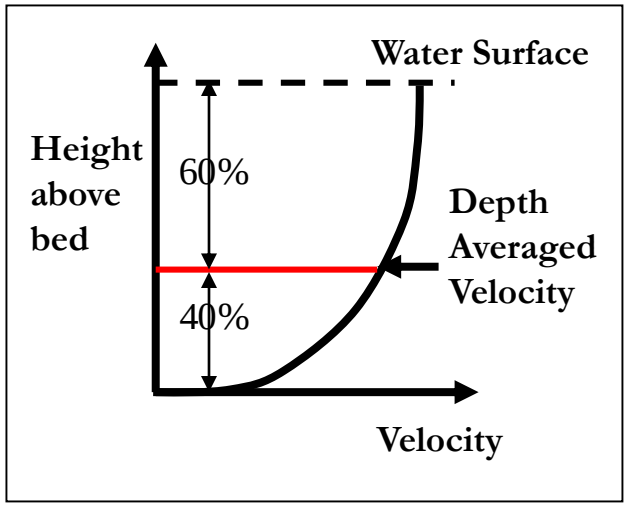




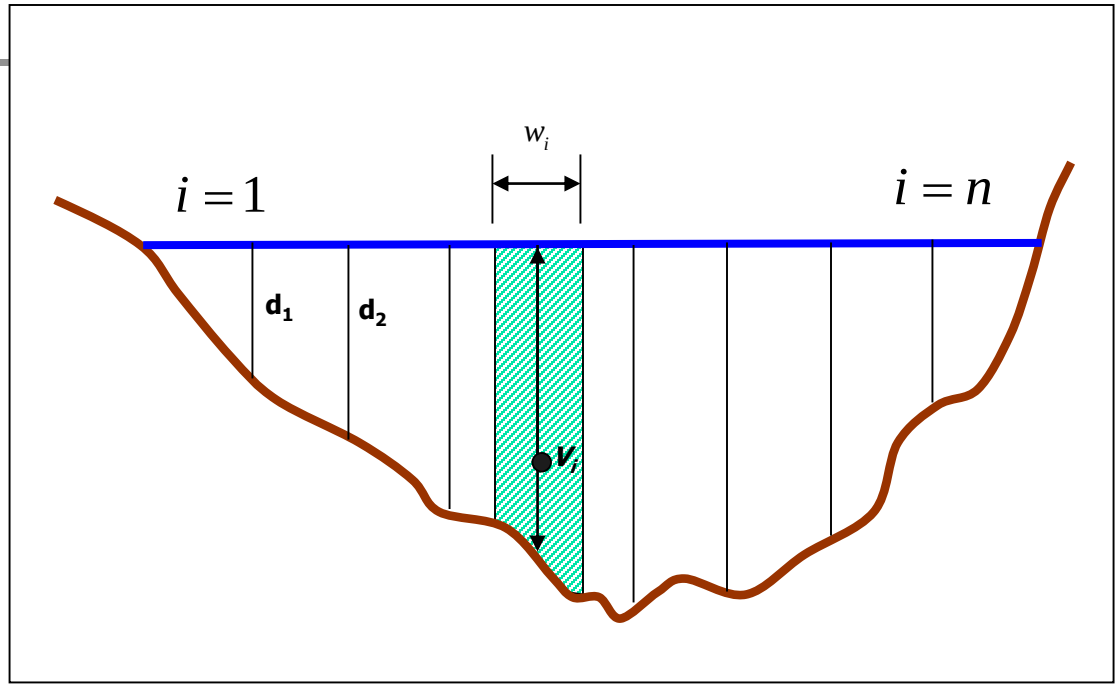
Streamflow Measurement

Venkatesh Merwade

Stream Flow Rate



Velocity profile in stream



Discharge at a cross-section

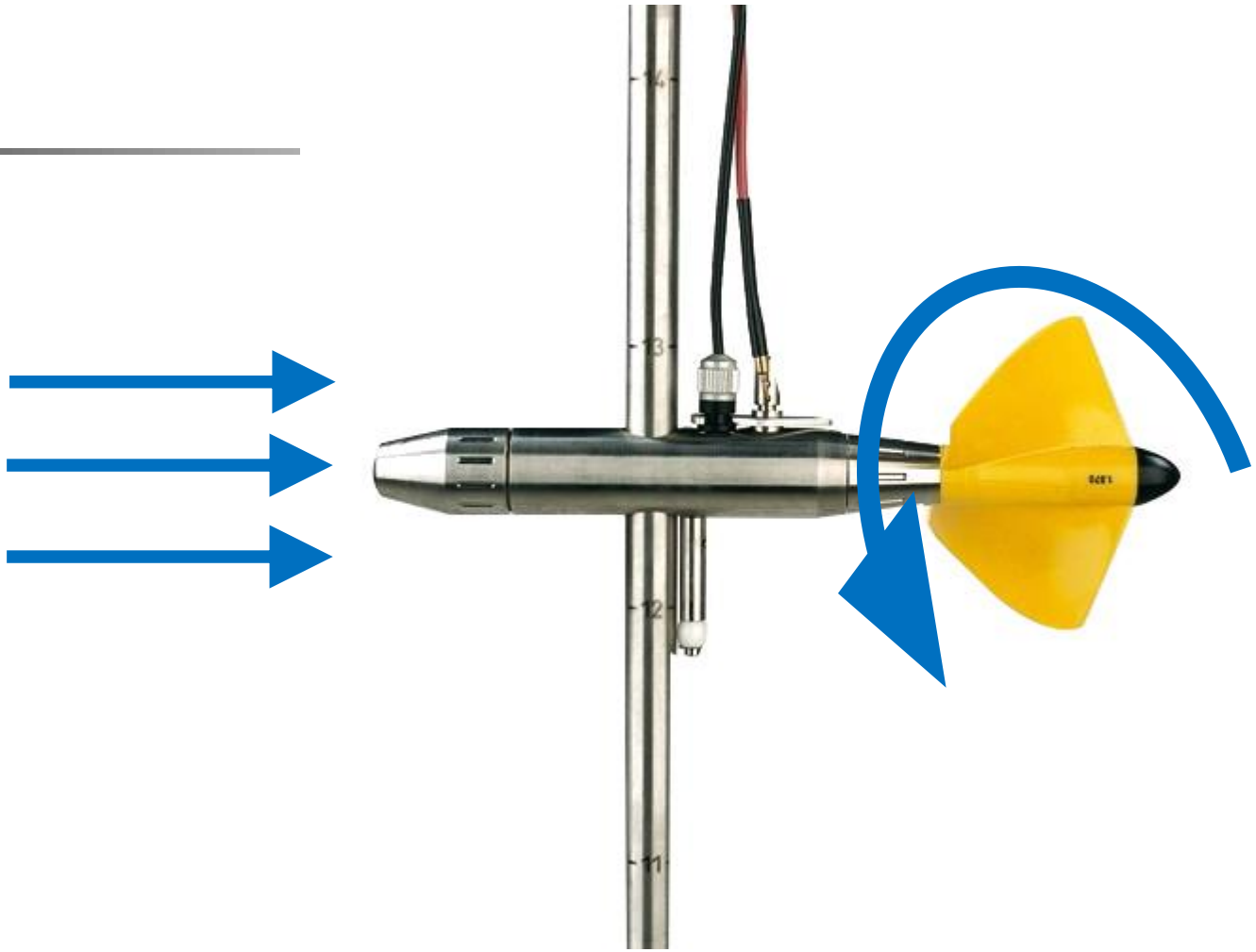
$$Q = \iint_A \vec{\mathbf{V}} \cdot d\vec{\mathbf{A}}$$

$$Q \approx \sum_{i=1}^{n} V_i * A_i$$

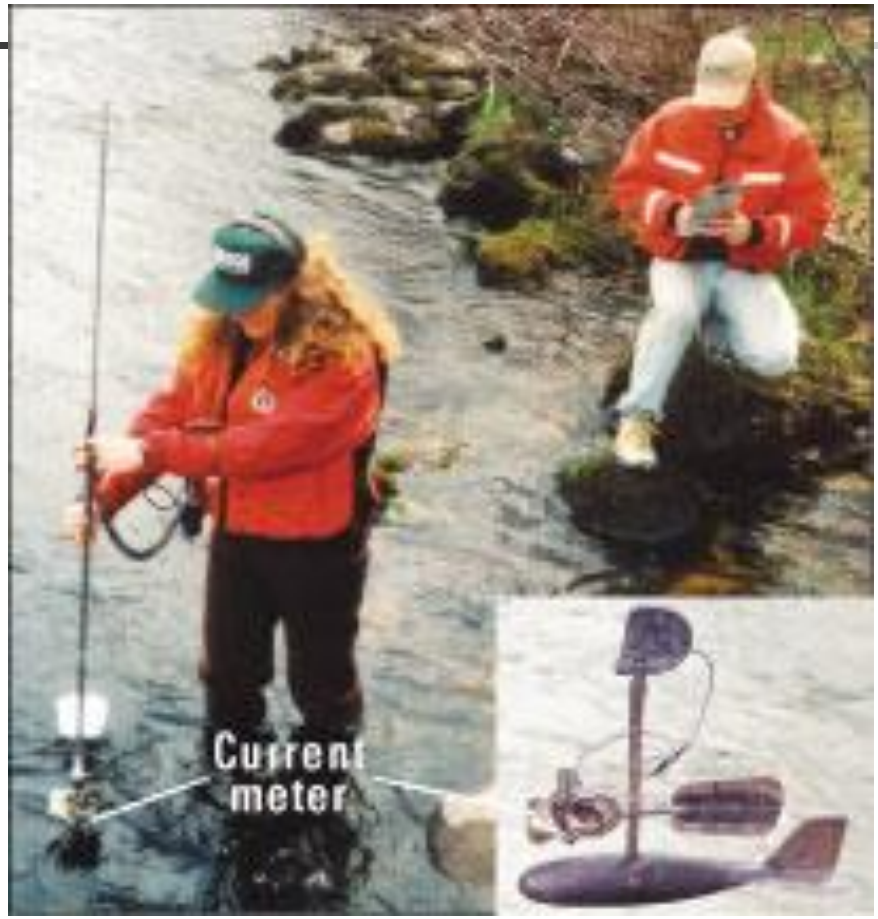
$$A_i = w * \frac{(d_i + d_{i+1})}{2}$$

Current Meter for Velocity Measurement

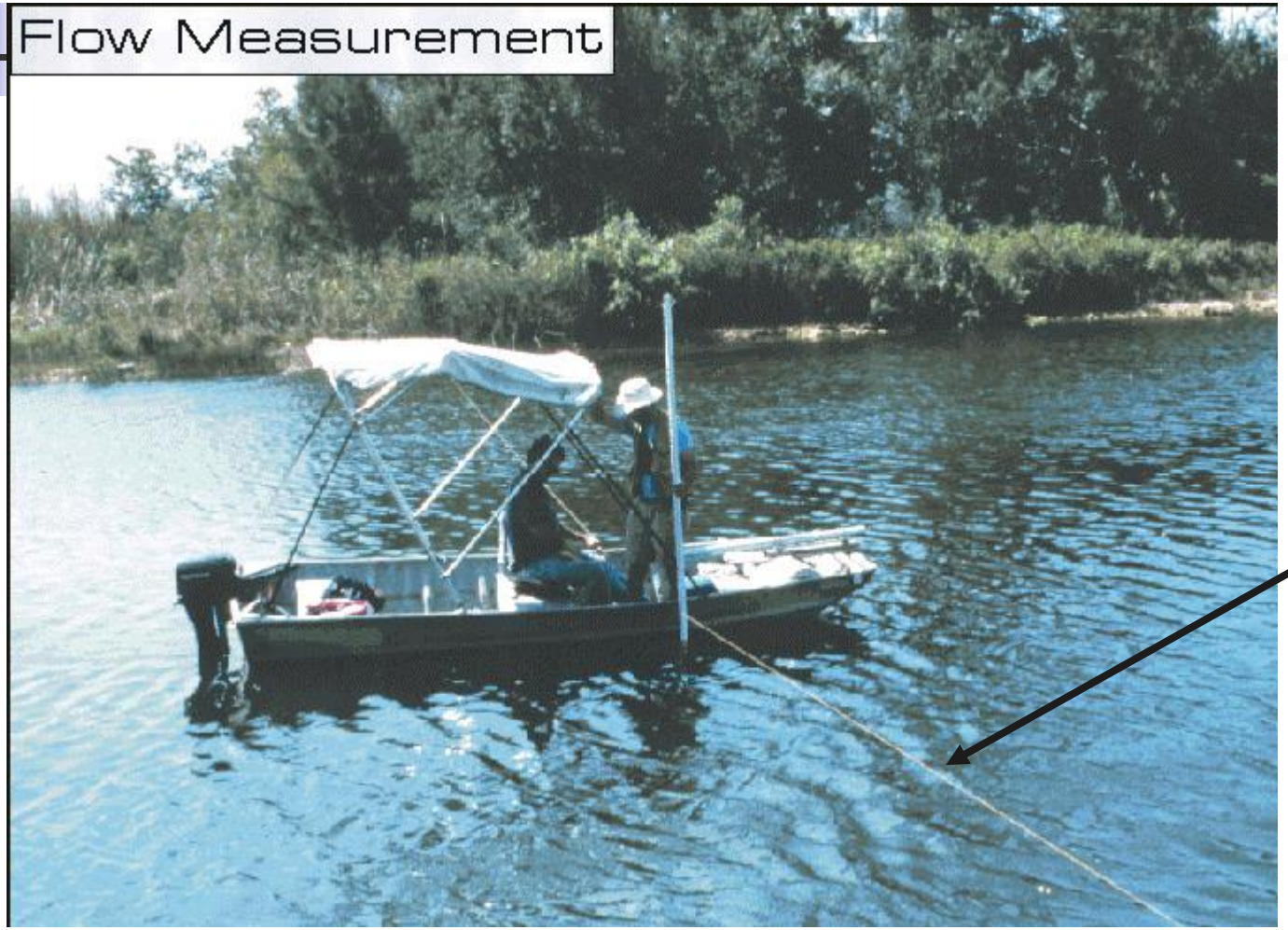
- Mechanical device that is submerged in the stream
- The tail spins as water flows past
- The number of tail revolutions is used to measure velocity



Measuring streamflow



Streamflow using a boat



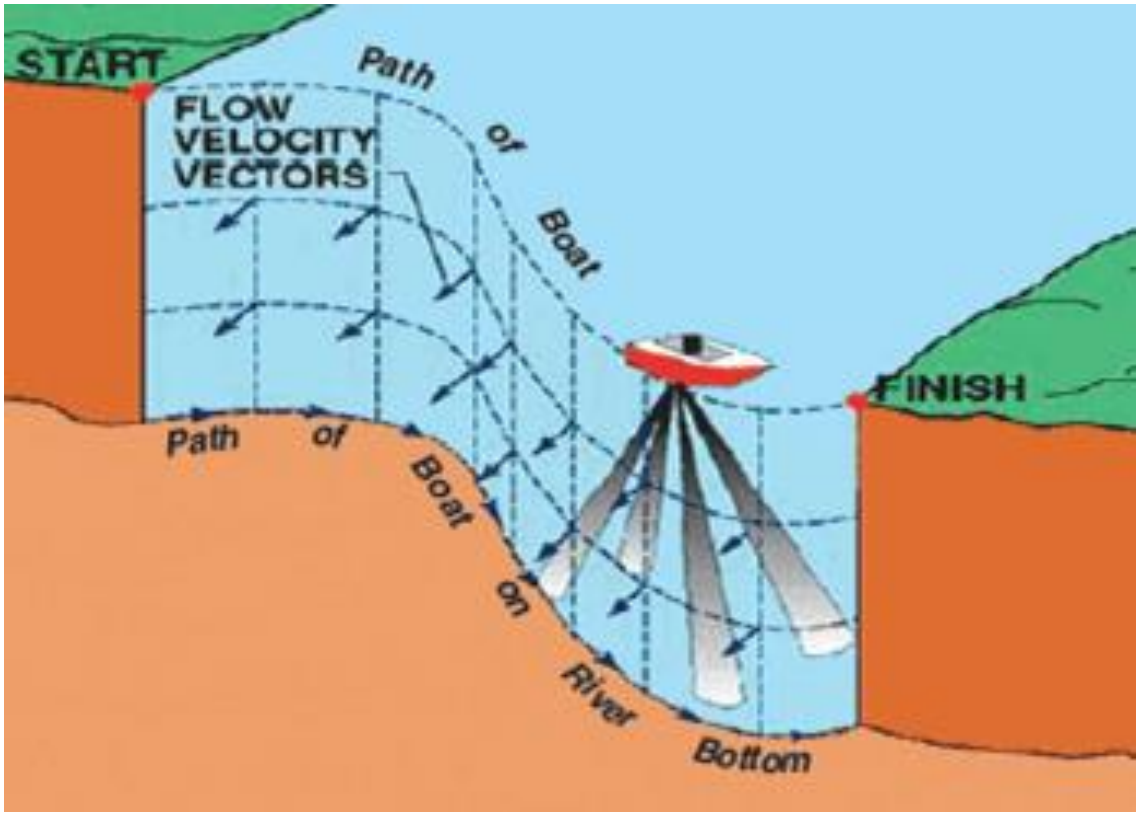
Measurement at high flows

Using stream gaging cable car

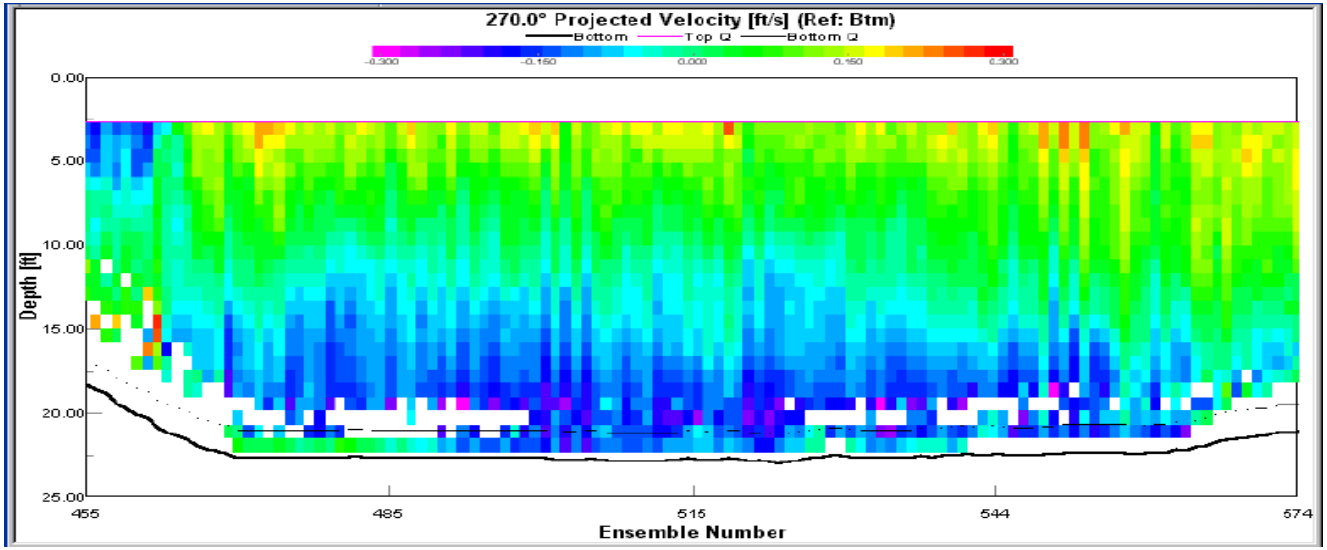
From bridge

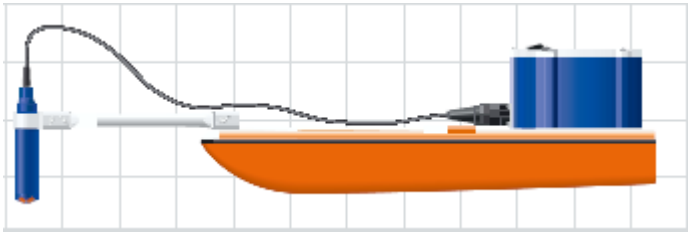
Acoustic Doppler Current Profiler:

- Uses the physics of sound and waves to create a continuous velocity profile



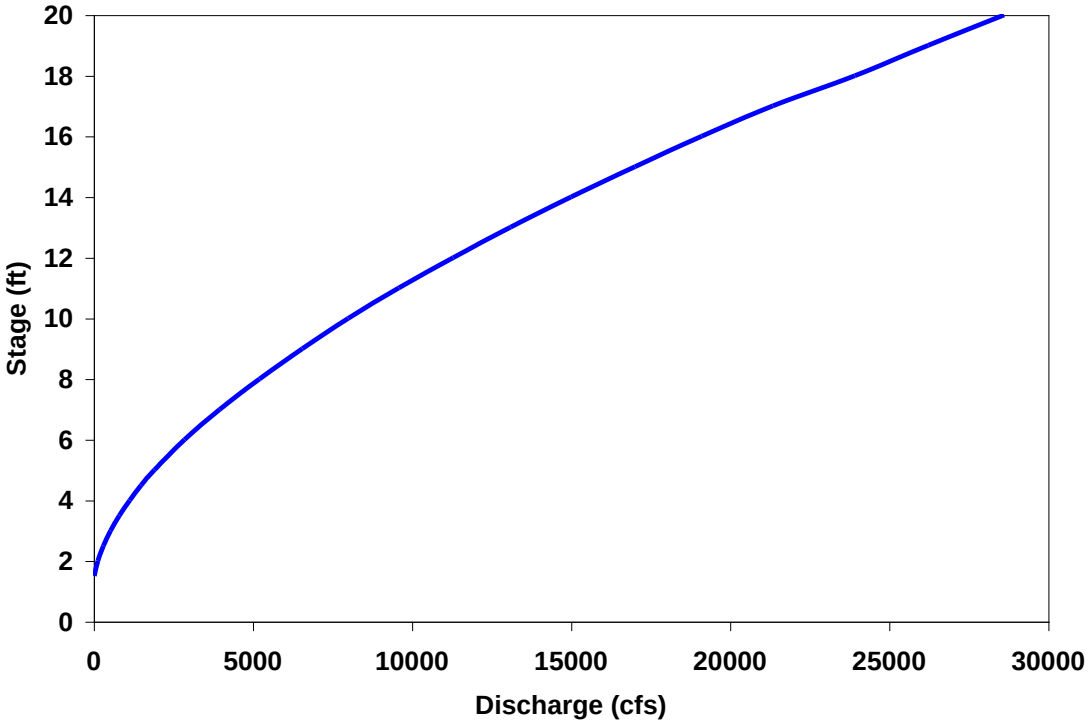
Acoustic Doppler Current Profiler





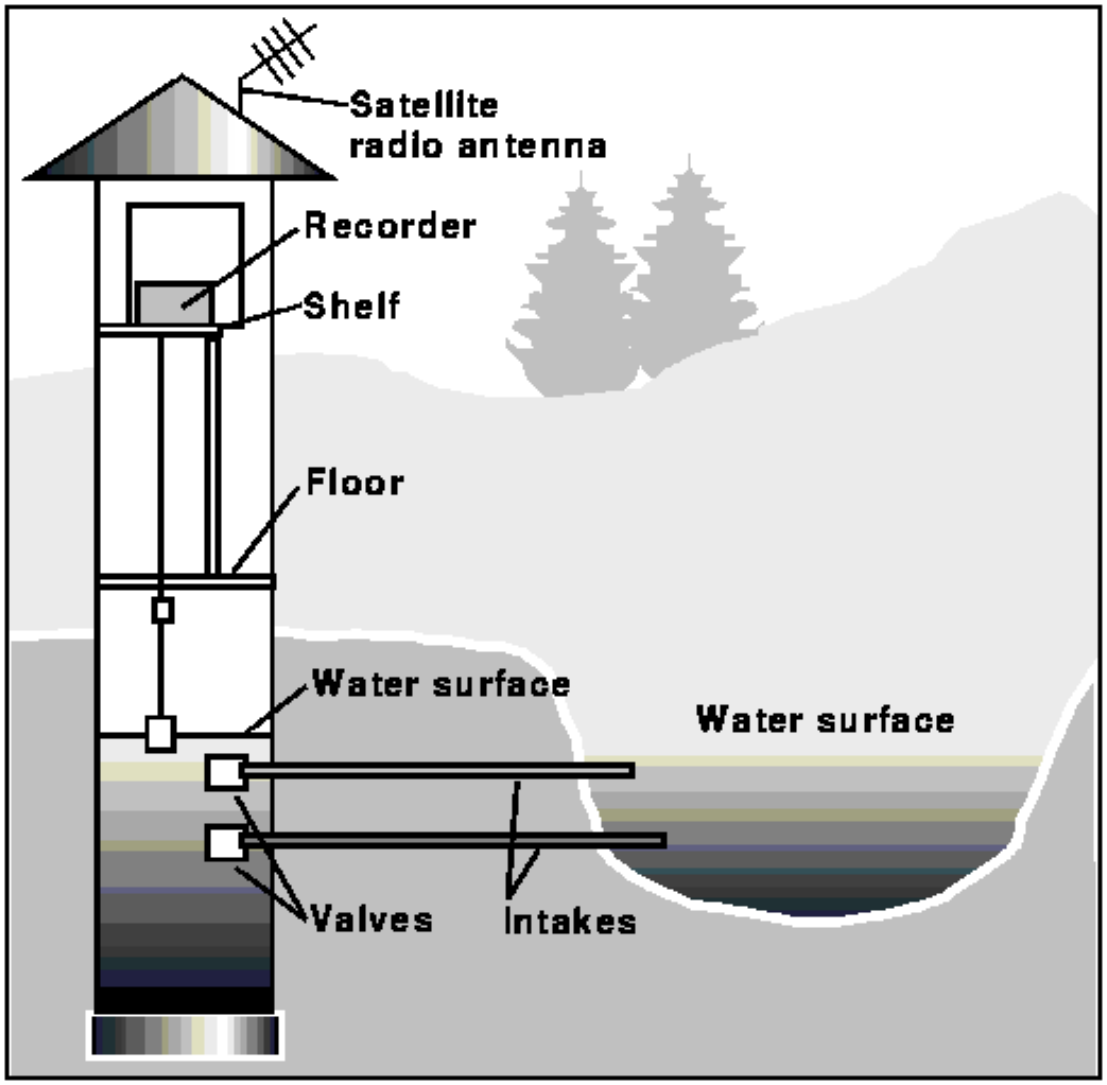
Rating Curve

- It is not feasible to measure flow daily.
- Rating curves are used to estimate flow from stage data
- Rating curve defines stage/streamflow relationship

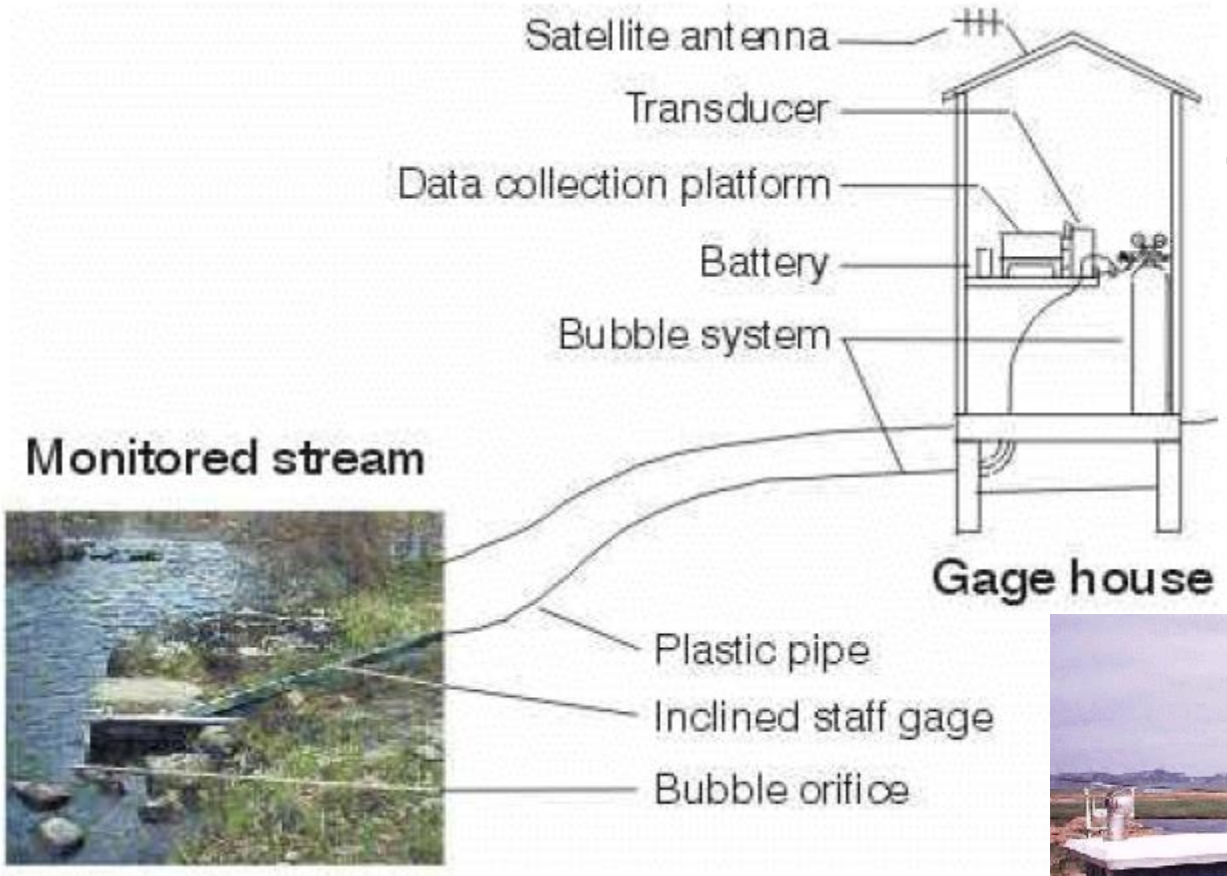


Discharge (ft3/s)	Gage Height (ft)
20	1.5
131	2.0
307	2.5
530	3.0
808	3.5
1130	4.0
1498	4.5
1912	5.0
2856	6.0
3961	7.0
5212	8.0
6561	9.0
8000	10.0
9588	11.0
11300	12.0
13100	13.0
15000	14.0
17010	15.0
19110	16.0
21340	17.0
23920	18.0
26230	19.0
28610	20.0

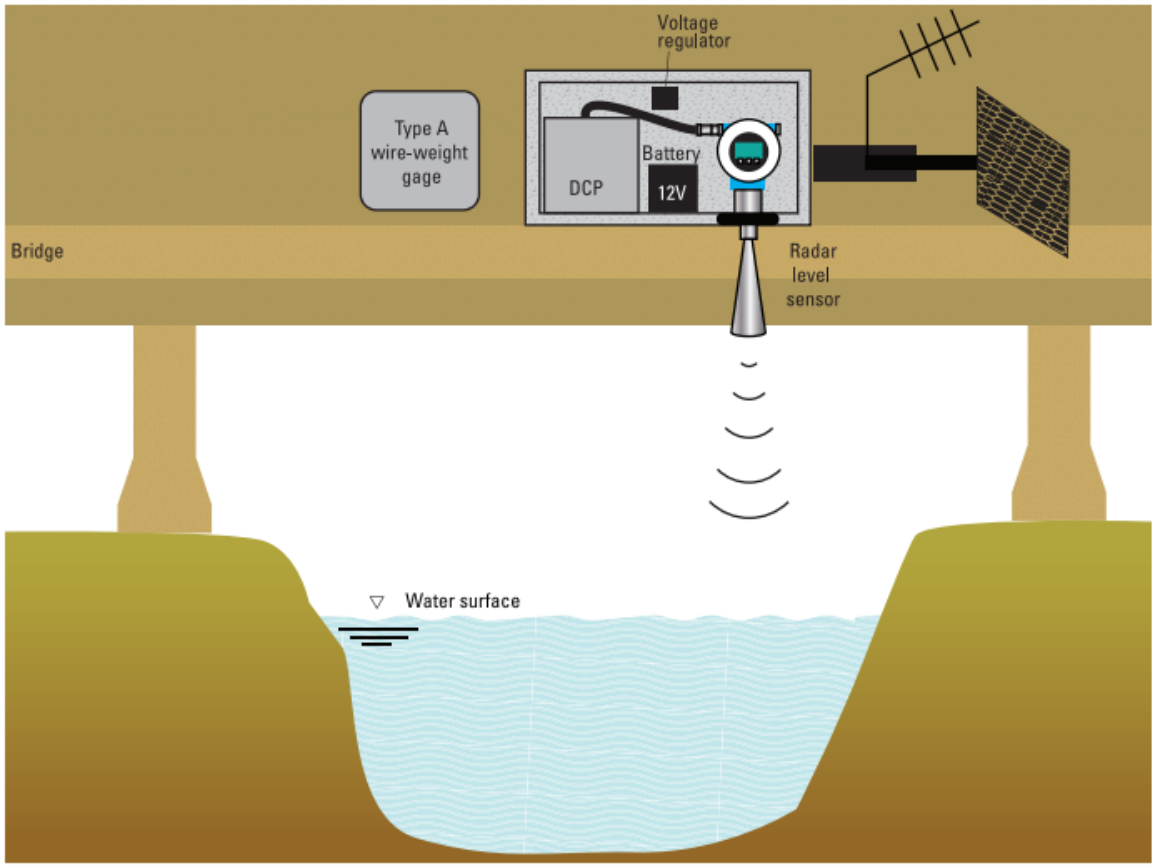
Schematic of a stilling well gaging station



Pressure transducer gaging station



Radar Streamflow Gaging



Source: USGS

Useful links

- USGS report on Stage Measurements:

  https://pubs.usgs.gov/tm/tm3-a7/tm3a7.pdf

- USGS stage and streamflow measurements

  http://waterdata.usgs.gov

Streamflow Measurement

- Why we need it?
- How is it done?
- Where do we get streamflow data in the United States?