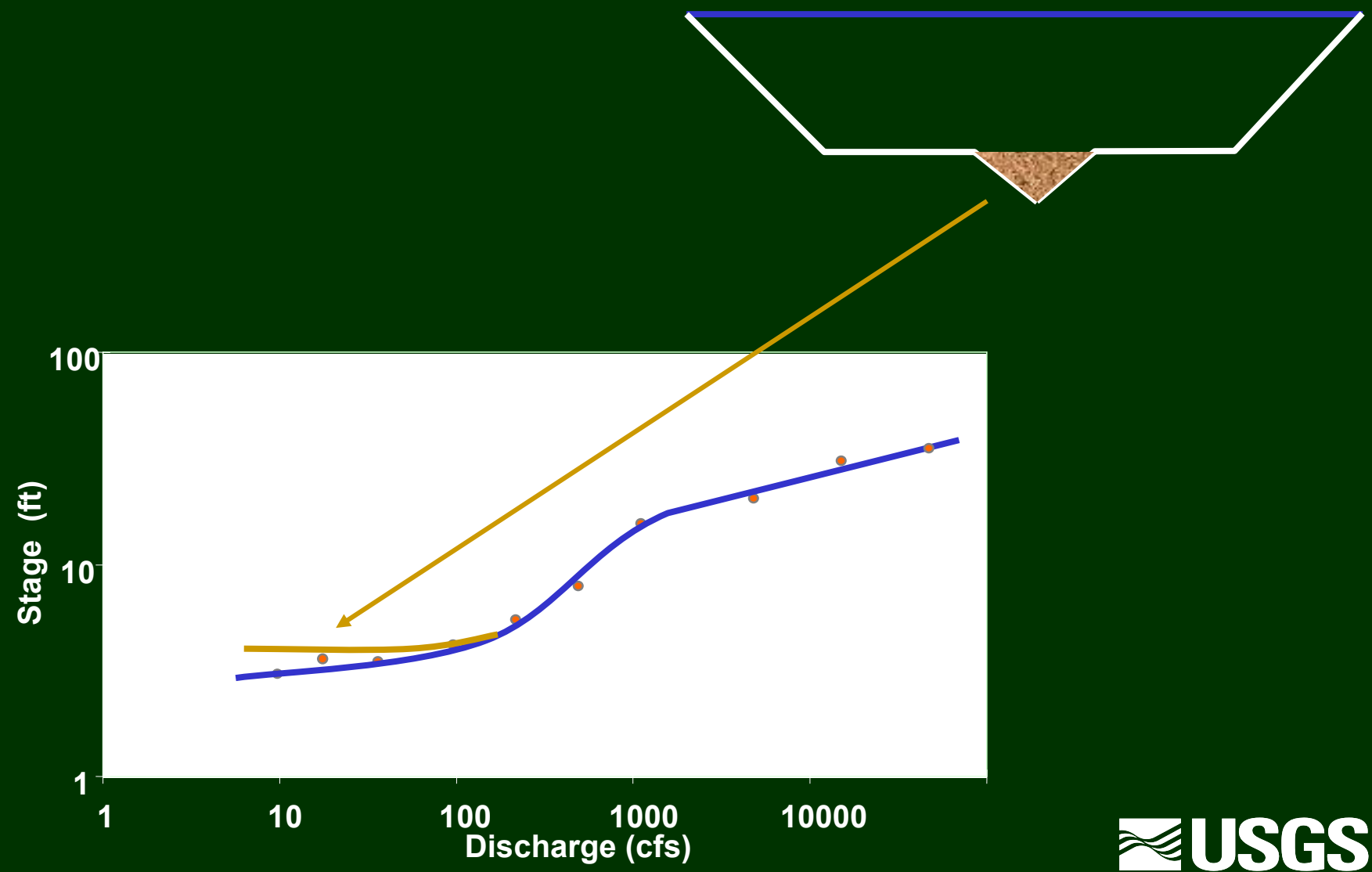
Ratings are not static—you must learn how to apply “shifts” to them



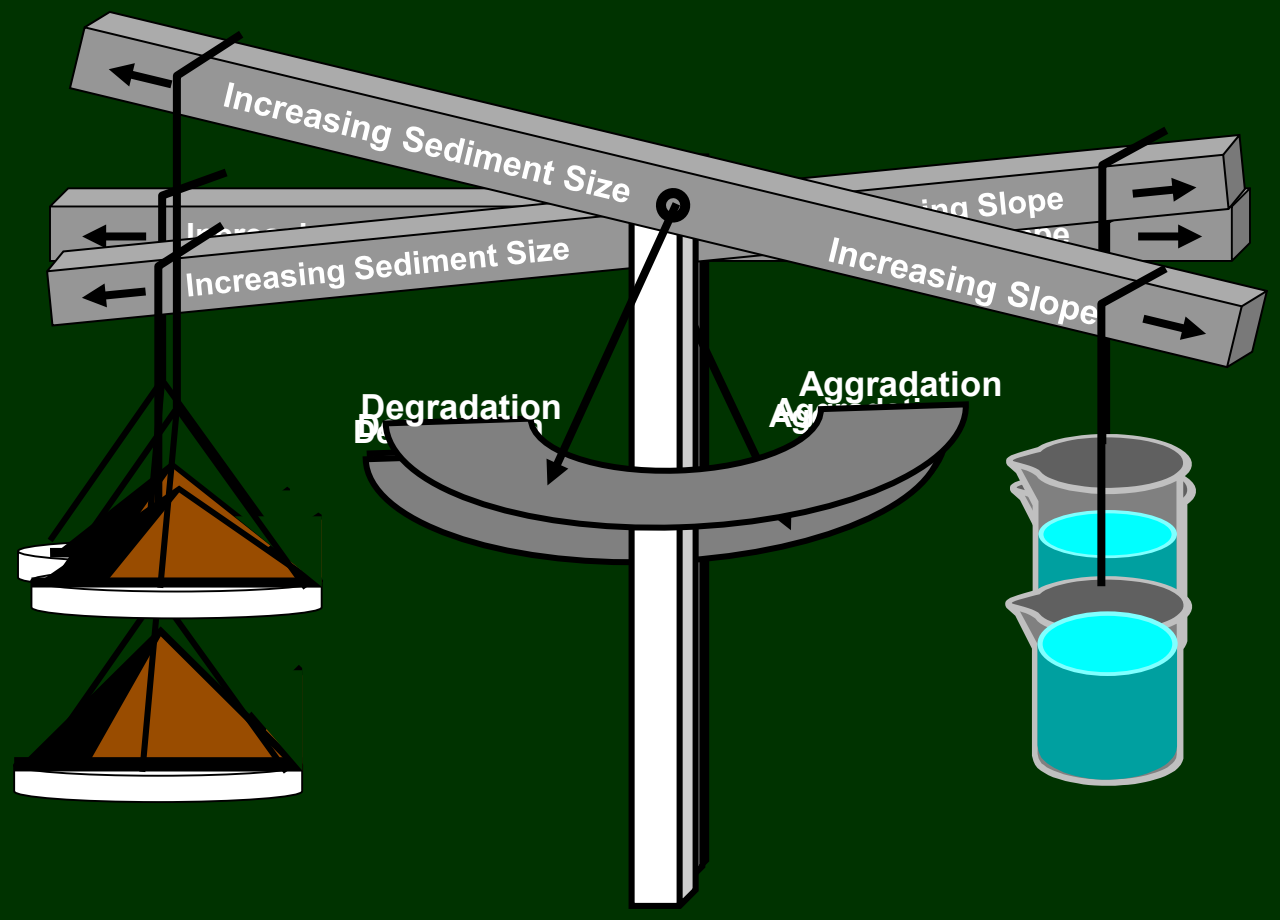
It is common for controls to change…

Photographer standing on debris jam <u>before</u> flood

Photographer in approximately same location <u>after</u> flood

USGS

Most natural channels are dynamic--channel shape changes to carry the imposed load



Modified from Lane, 1955

Shift Development Concepts

1. Shifting controls occur due to changes in the control such as scour or fill, growth/removal of vegetation, or debris accumulation.

2. Shifts are used until evidence of a permanent change in the rating is documented.

3. In this method, a correction, called a shift adjustment, is applied to the g.h. record to adjust the temporary relation between g.h. and discharge to the base rating.

USGS

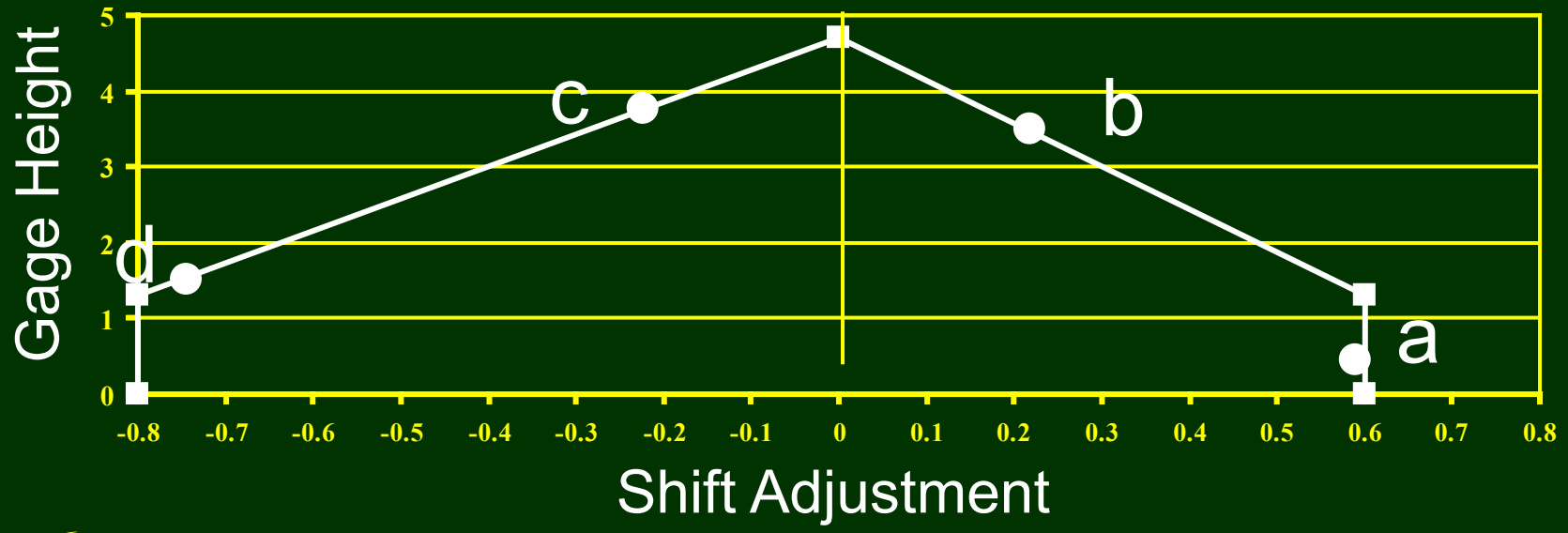
Shift Development Concepts (cont.)

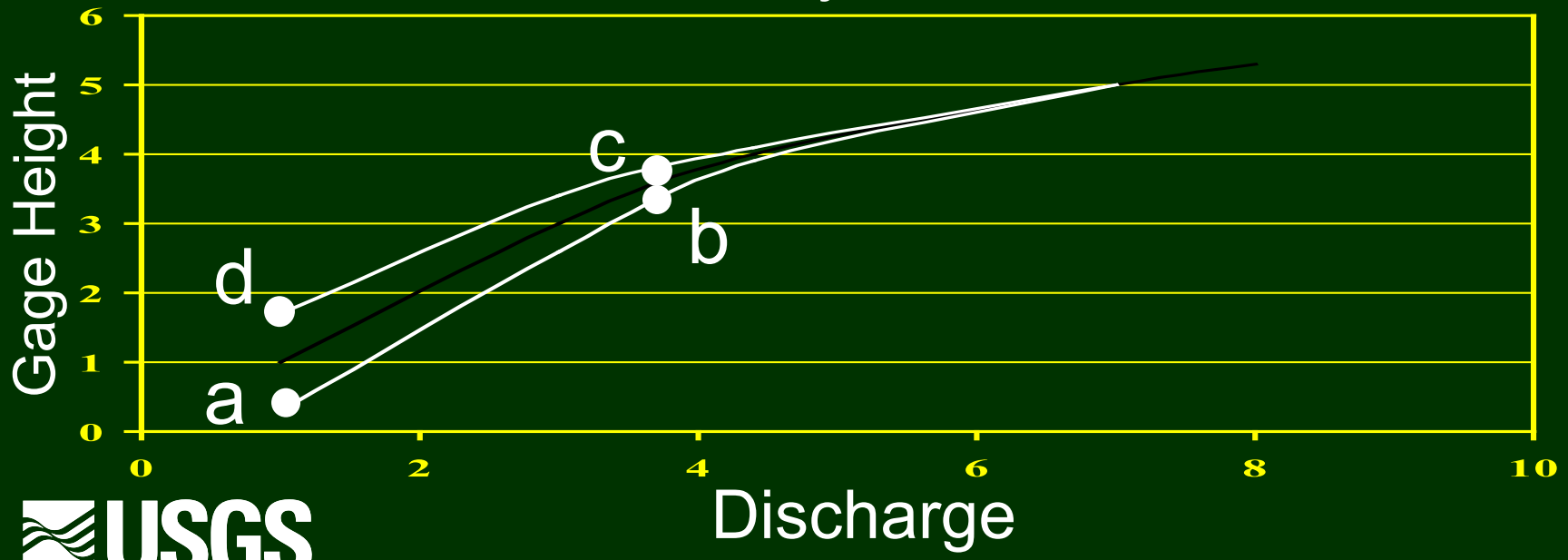
4. The shift adjustment is the difference between the measurement GH and the rating GH for a given discharge. A shift is plus if the measurement gage height is less than the rating GH, and minus if the measurement GH is more than the rating gage height.

5. All shift adjustments should be specified by means of a variable-shift diagram (V-shift diagram).

USGS

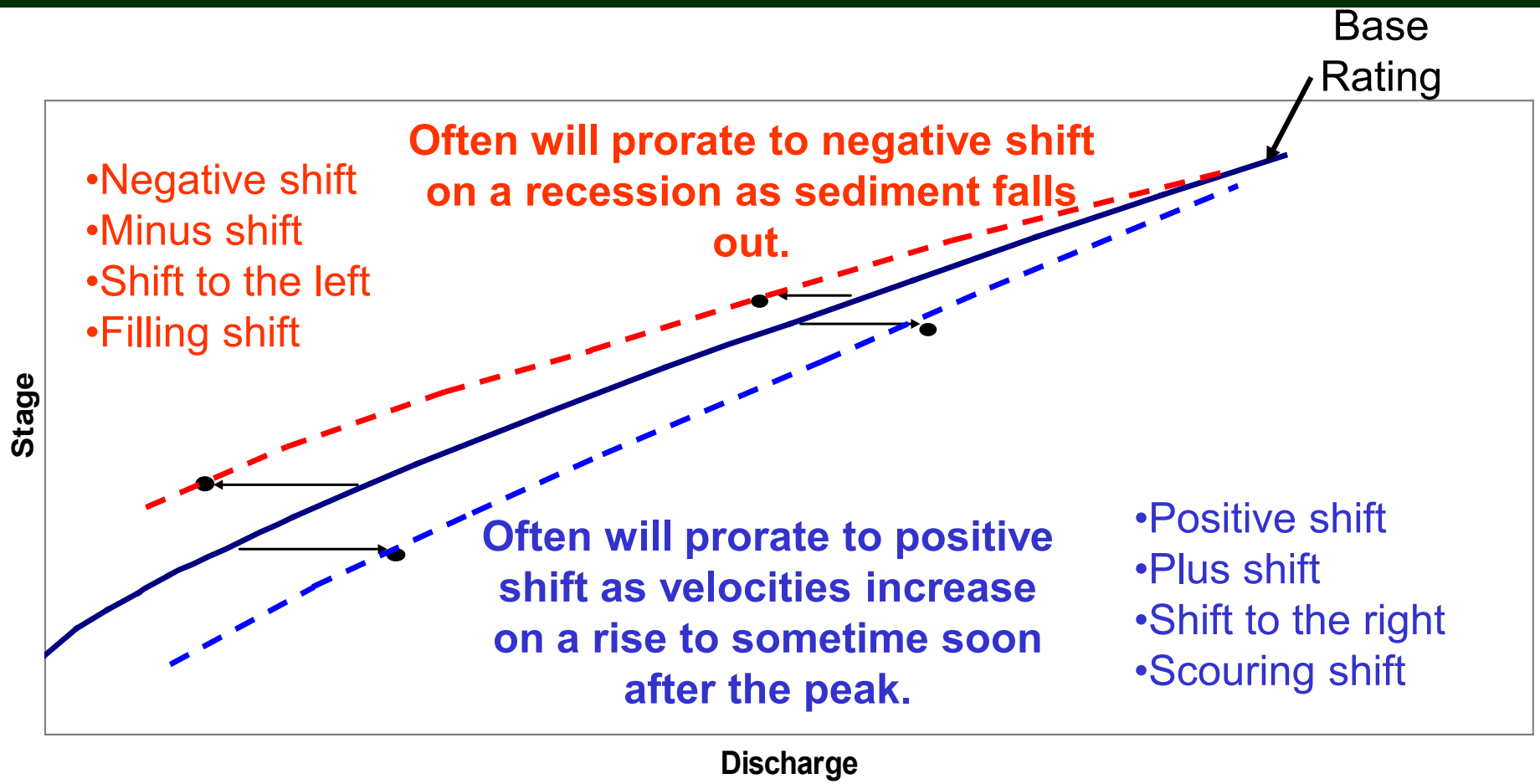
ADAPS uses V-diagrams to apply shifts to ratings





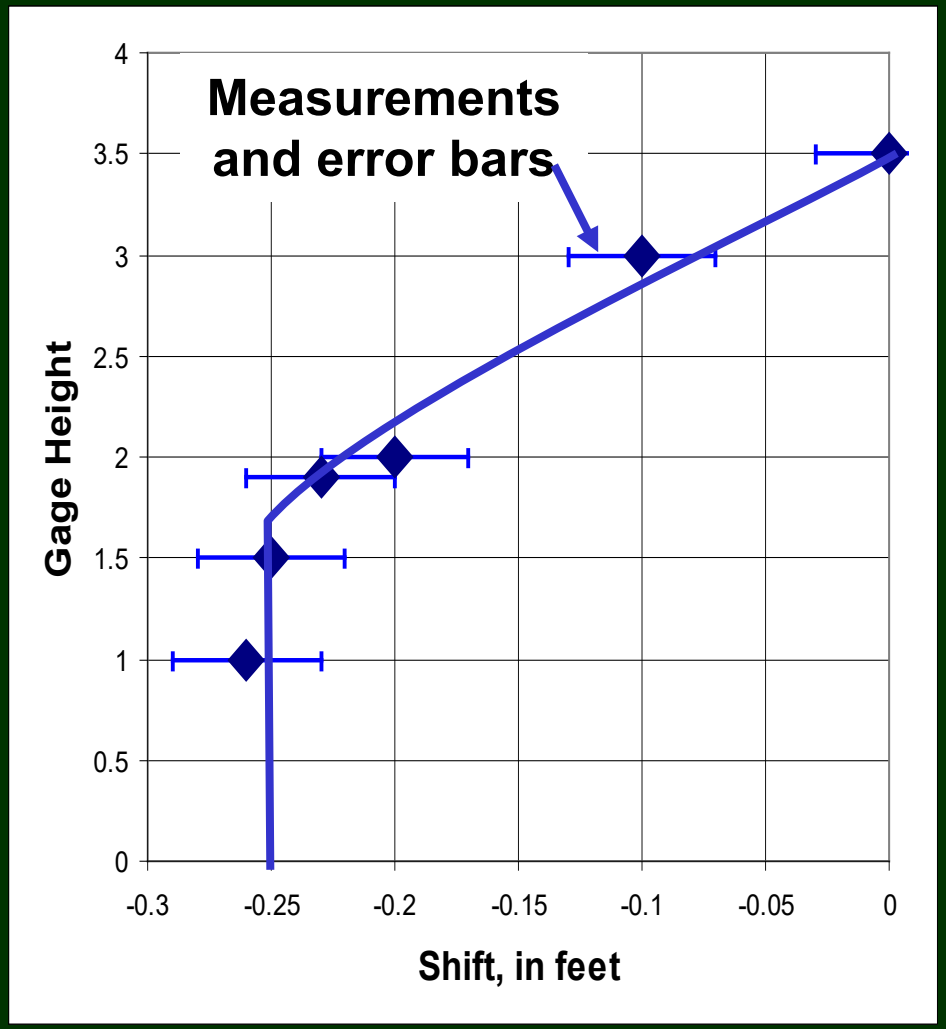
USGS

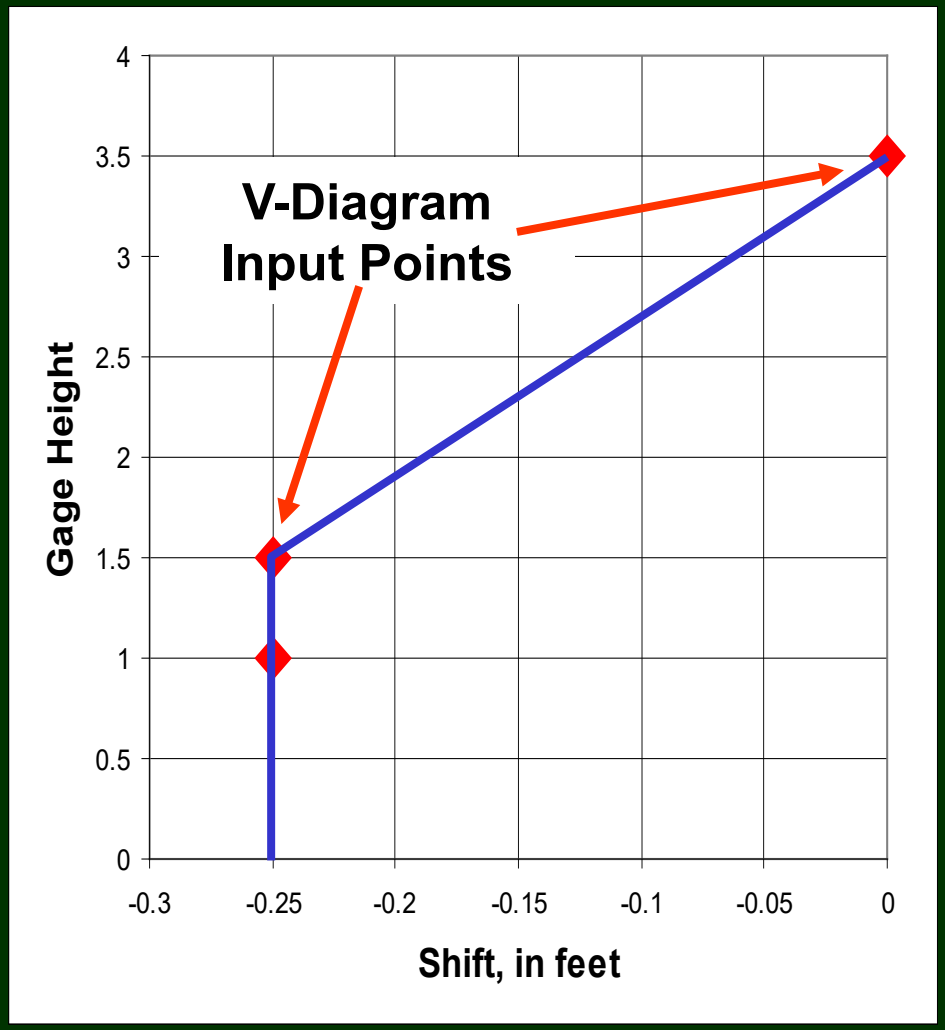
Shifts are referred to in many ways:



USGS

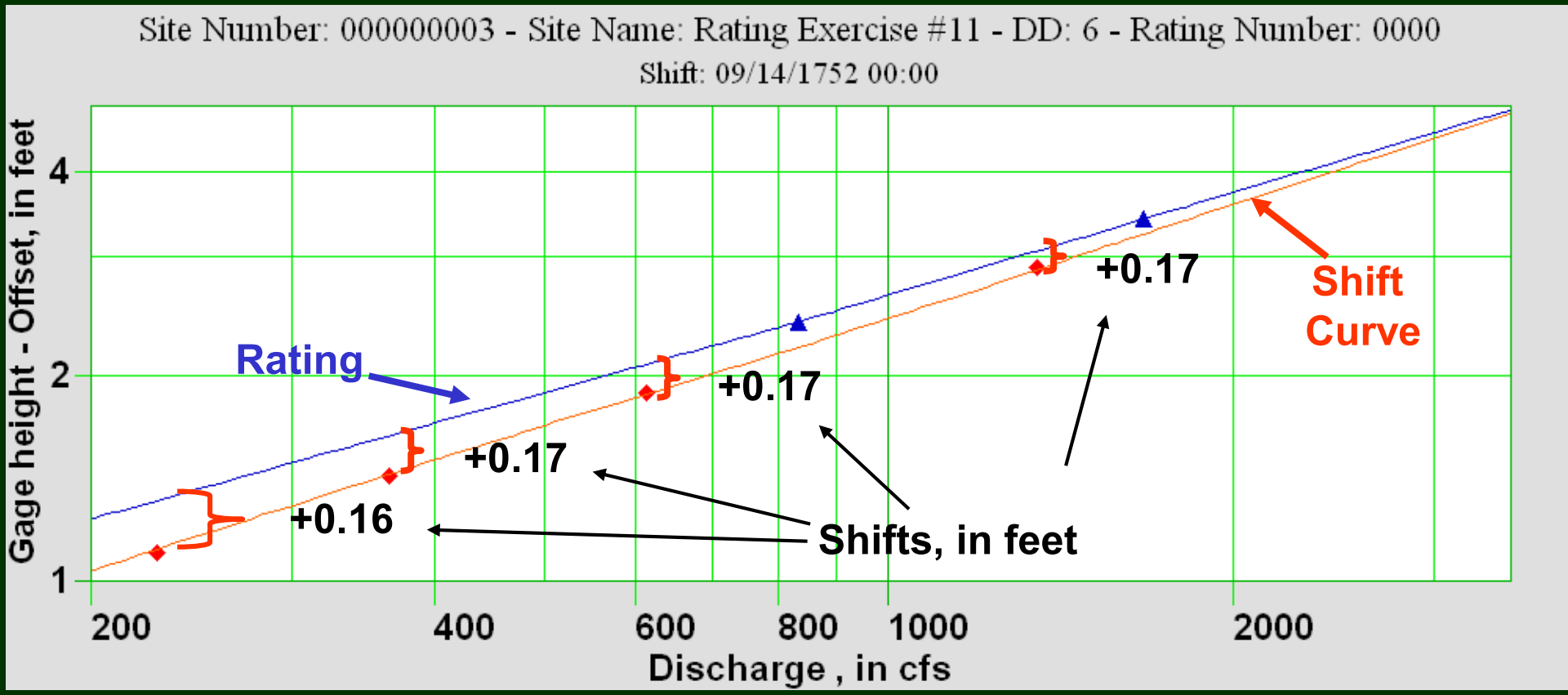
The three points used to represent variable-shift diagrams must be carefully chosen





USGS

- When working with rating shifts you must understand how shifts associated with measurements are computed
- You must be able to compute shifts in the field so you know if a check measurement is needed



USGS

Here are the steps used to compute shifts

- Determine percent difference that a measurement plots from the rating as:

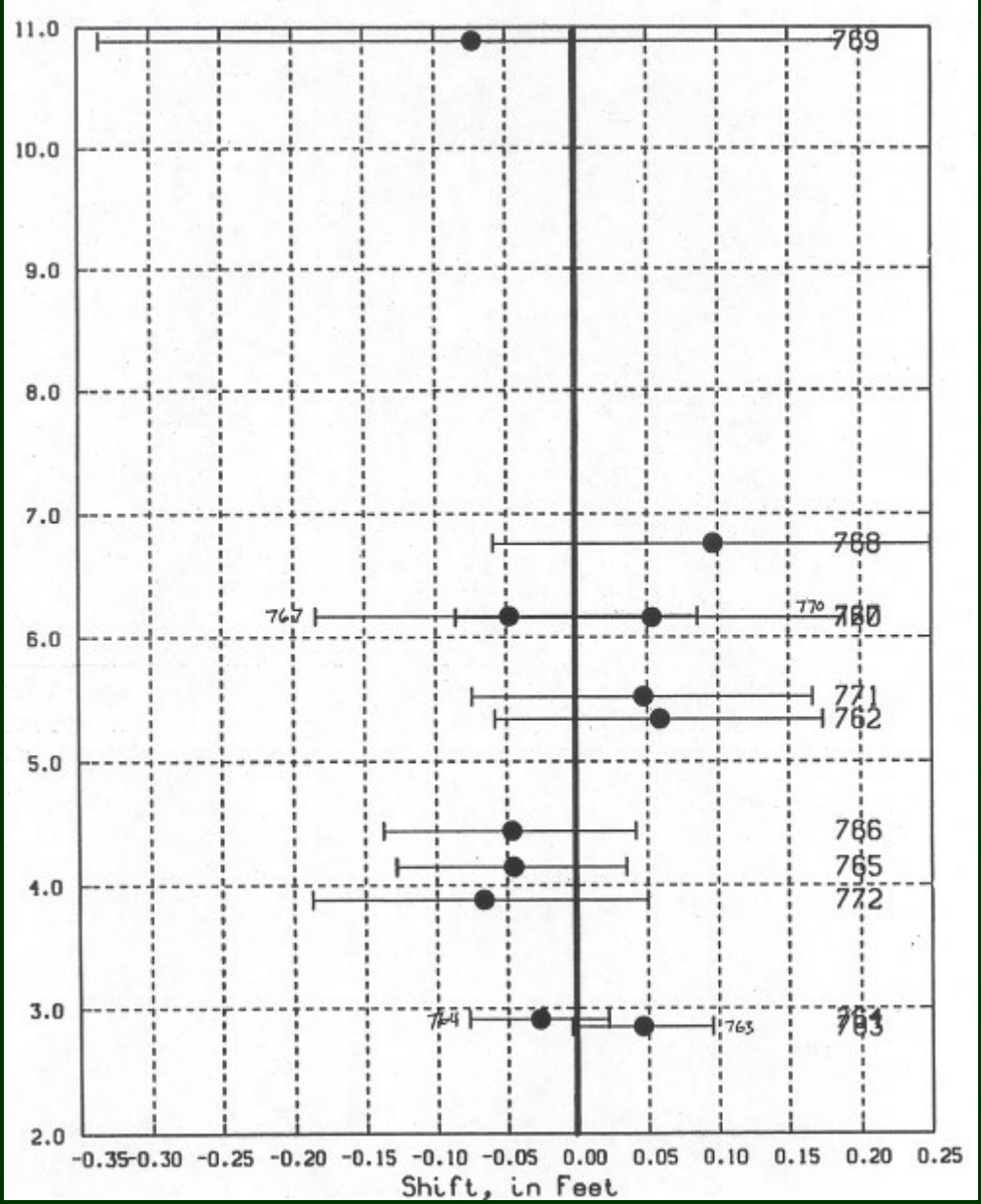
  % diff. = ((MeasQ – RatingQ) / RatingQ) x 100

- Determine shift associated with a measurement as:

  Shift = Rating GH – Q_{meas} GH

USGS

Shifts are often not needed if measurements plot within indicated accuracy limits with respect to the rating



Output from ADAPS "Shift Bar" program

USGS

You should use measurement ratings to help you to decided whether or not to shift

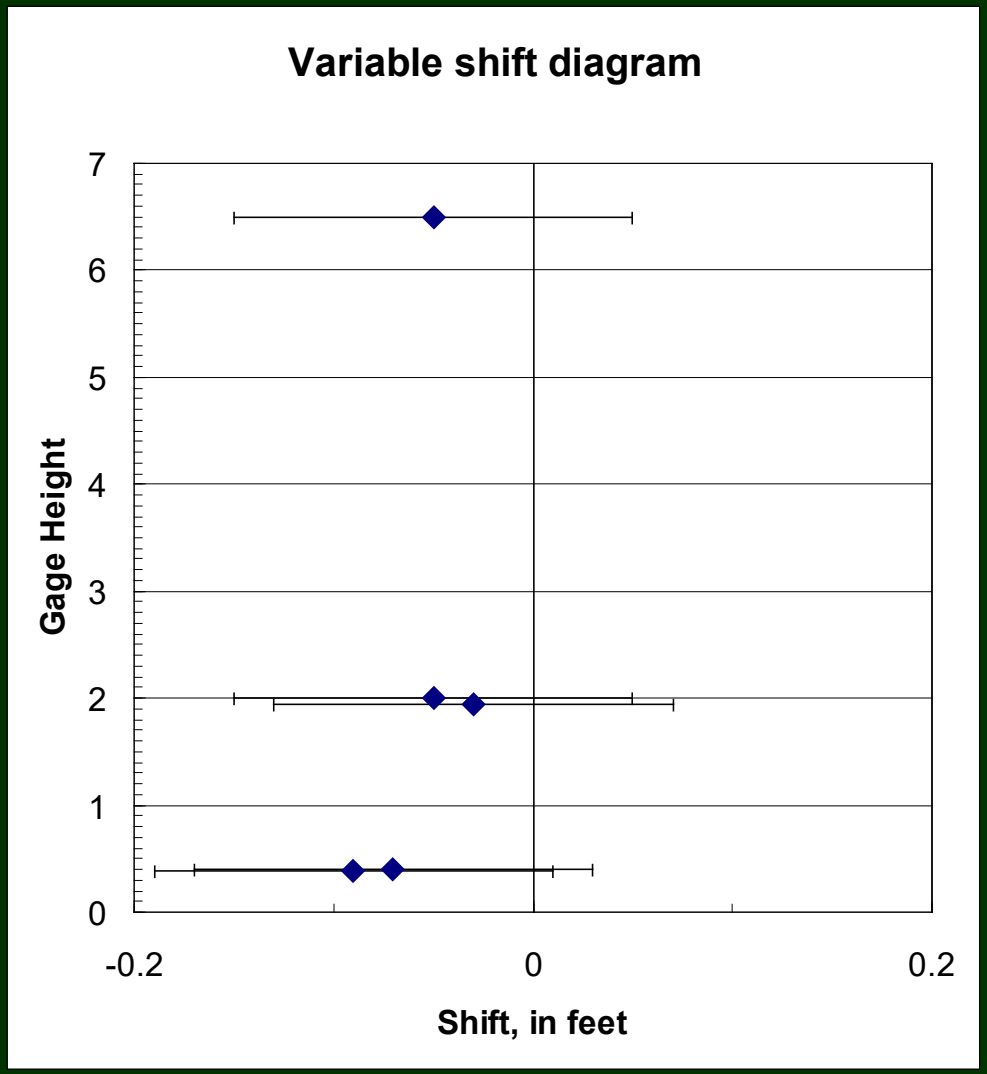
Uncertainty amounts used by ADAPS

- Excellent = 2%
- Good = 5%
- Fair = 8%
- Poor = >8%

Error bars on measurement in V-diagram plot show uncertainty

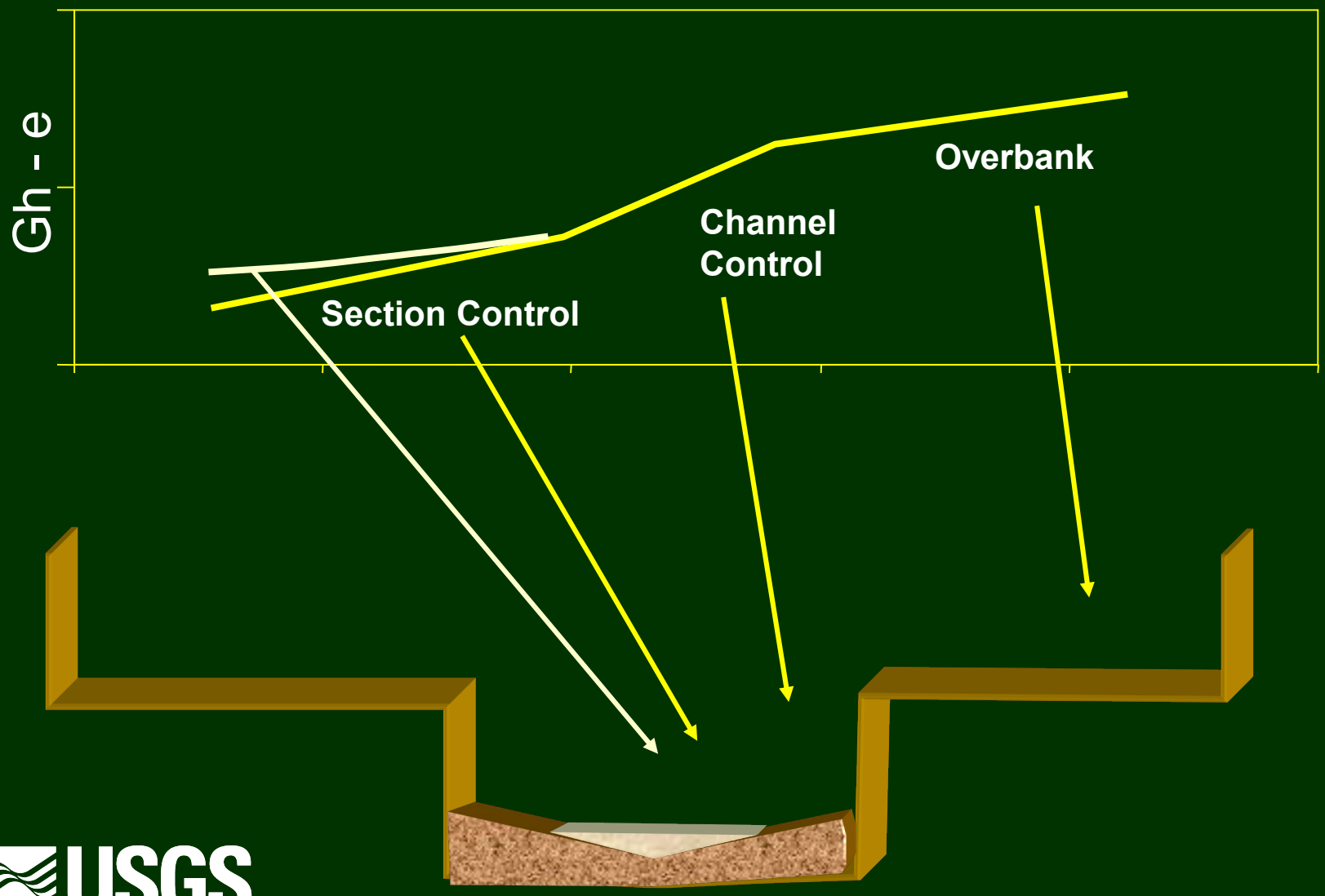
USGS

Even if the Qm's plot within the error limits, you may want to shift to measurements if they show a trend



USGS

Shifts should be tied back to the rating at an appropriate point



USGS

Shifting patterns associated with artificial controls <u>MAY</u> differ from those associated with natural controls.

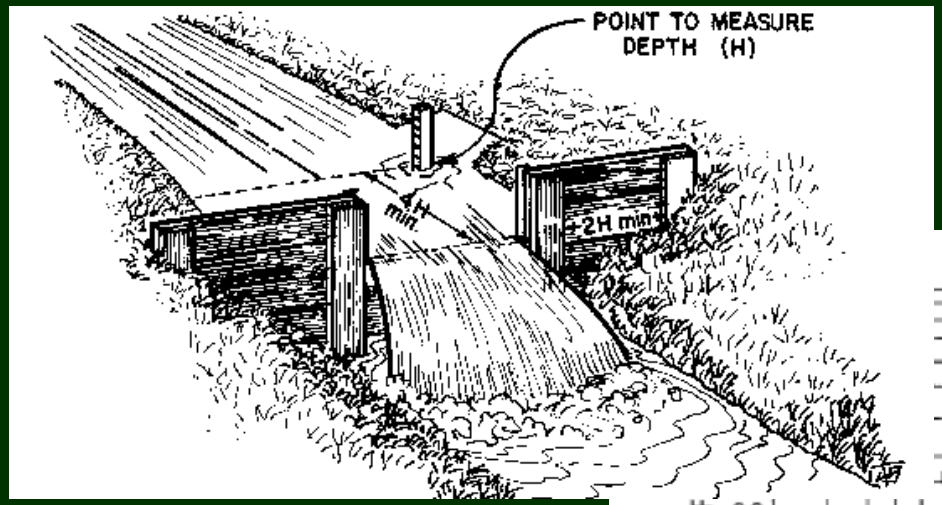
- Proper installation/maintenance of weir or flume extremely important for rating-curve validity
- Proper analysis depends on detailed observations and notes during field visits!

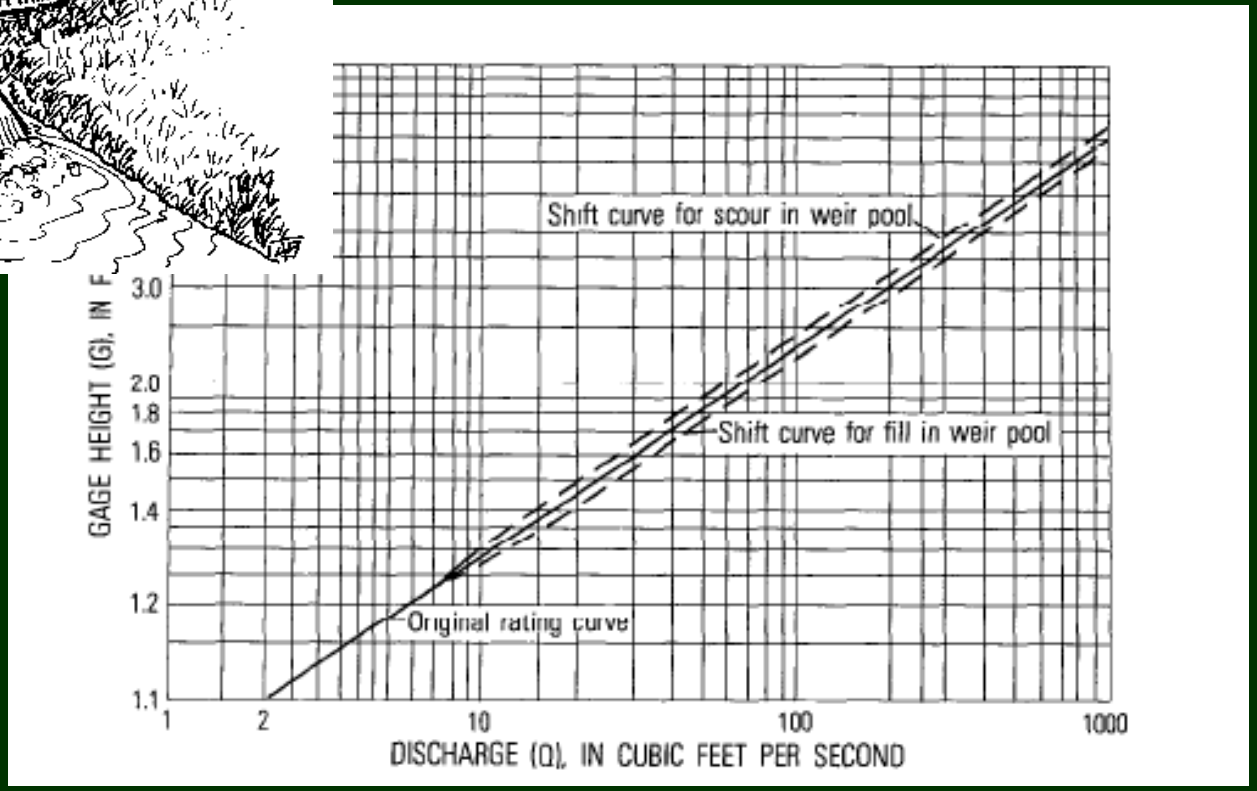
USGS

Weirs

USGS

Scour/fill of weir pool will create a shift curve that parallels a section rating except at very low flows





USGS

Fill in the weir pool causes:

- Shallower pool, higher velocities
- More discharge for given stage
- Shift to the right [plus shift] (usually FILL is associated with a shift to the left, but that is a fill on the control versus behind it as shown here)

USGS

Scour in the weir pool causes:

- Deepened pool, slower velocity
- Smaller discharge for given stage
- Shift to the left [minus shift] (usually SCOUR is associated with a shift to the right, but that is scour on/at the control versus behind it as shown here)

USGS

Vegetation growth in weir pool causes:

- Slower velocities, but gradual over time
- Seasonal shifting patterns, parallel and **to the left of rating**

USGS

Moss or algal growth **<u>on</u> weir crest results in**:

- Reduced head on the weir (increases scale offset -‘e’)
- Shift to the left (minus shift), concave up and asymptotic to rating at higher stages
- So keep the weir crest cleaned!

USGS

Flumes

USGS

At sites with flumes shifts are most commonly caused by changes in the approach section or in contracting section of flume.

USGS

Deposition of debris upstream from flume may:

- Divert flow to gage-side of flume; build-up of water at the gage results in shift to the left (neg shift req'd)
- Divert flow to opposite side of flume; build-up of water opposite the gage results in shift to the right (pos shift req'd)
- Draw shift parallel to section rating (as for weir)

USGS

Deposition of debris (or algae growth) at entrance to flume throat causes a shift to the left:

- Stage at the gage will be raised higher than normal for any given discharge
- Deposition or algae increases the scale offset ‘e’; the result is:
  - A shift to the left that is concave up and runs asymptotic to rating at higher stages (similar to the effect of algae growth on a weir crest)

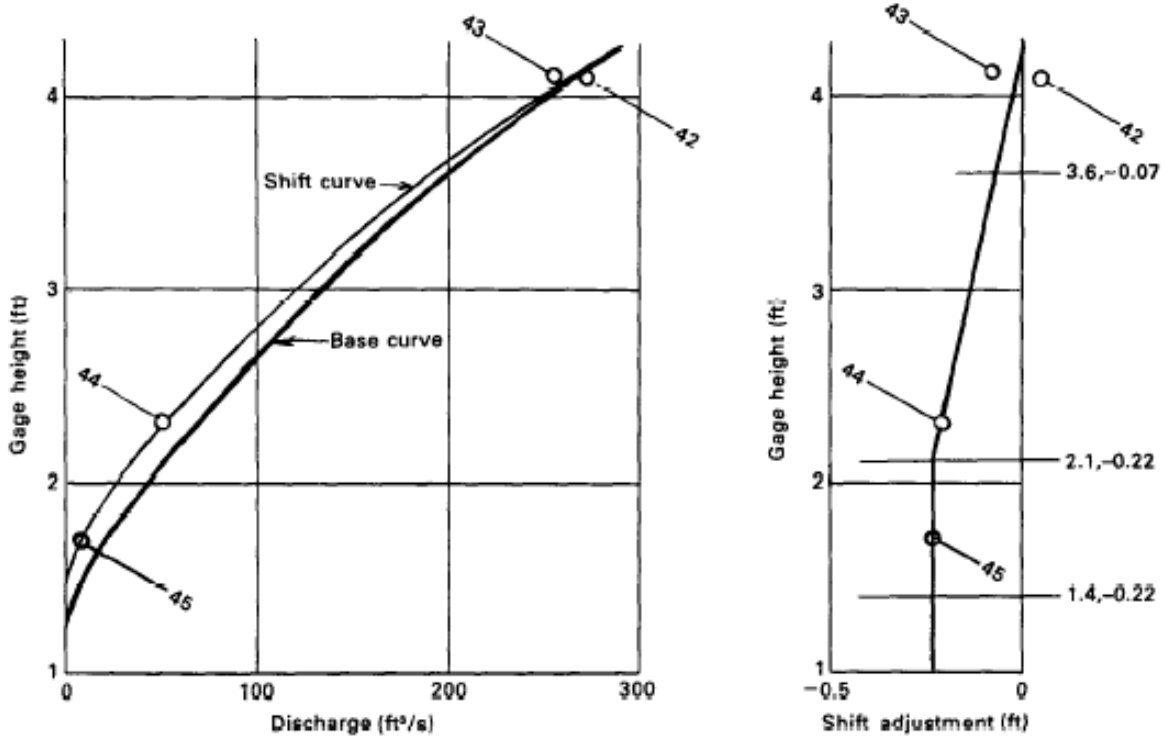
See: WSP 2175, pp. 348-352 (Rantz, 1982) for more details on shifts and artificial controls

USGS

How many shifts do you see?

USGS

Additional resources are available to help you understand how to compute and apply shifts



COMPUTATIONS

No.	Date	Gage height	Discharge	Shift adjustment computed from		% diff.
				Meas.	V-diag.	
42	May 7	4.09	273	+0.05	−0.02	+4.2
43	May 8	4.10	257	− .07	− .02	−3.8
44	June 10	2.30	53.2	− .20	− .20	−−
45	July 7	1.70	9.7	− .22	− .22	−

See additional notes

See also: TWRI on computation of continuous records of streamflow

USGS