Continuous Slope Area Computation

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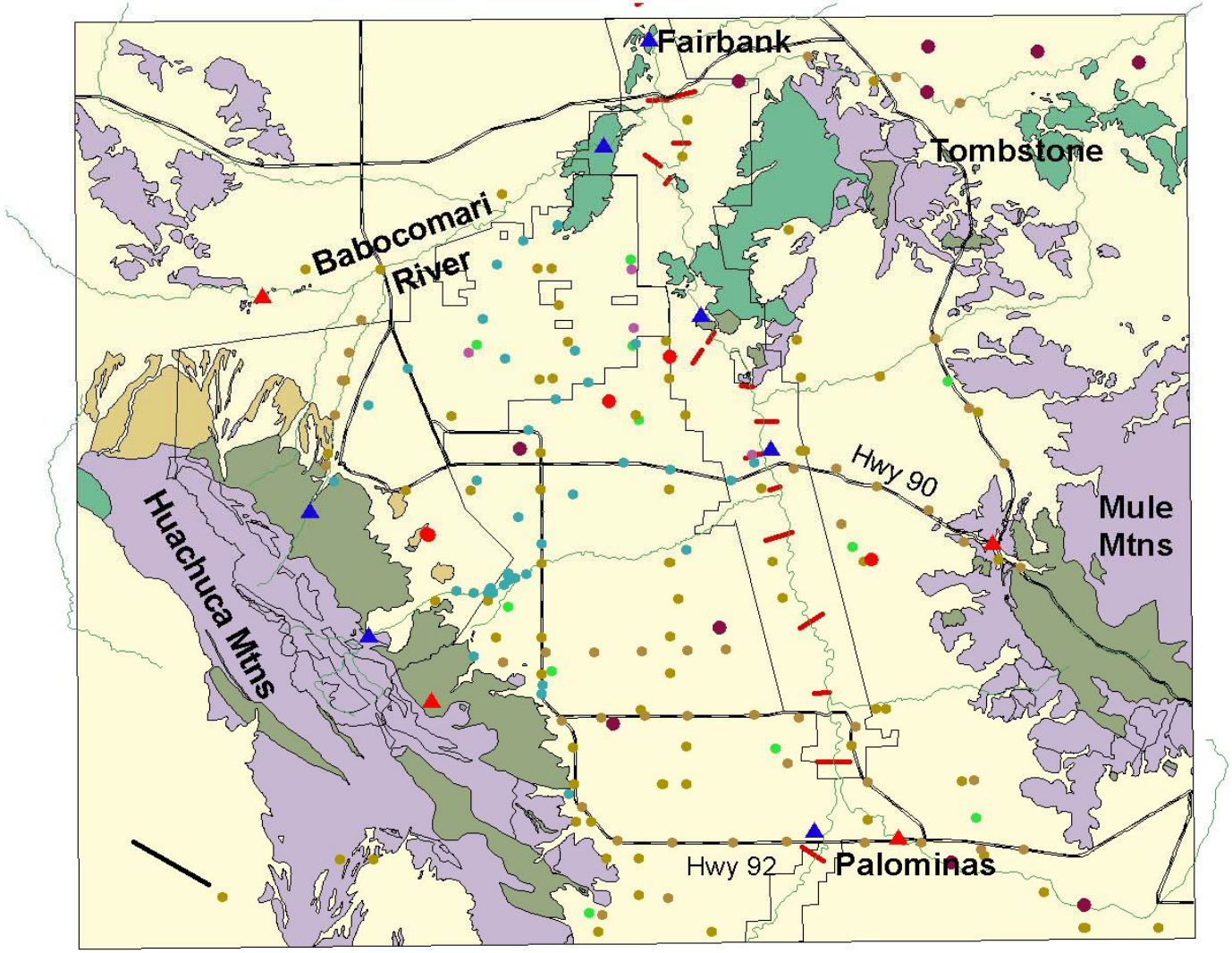
Eight crest-stage gages, instrumented with pressure transducer, are used to monitor a slope-area reach at the Babocomari River gaging station in Southern Arizona.

Continuous slope-area site at lower Babocomari River



Data Collection Sites in the Sierra Vista Subwatershed of the Upper San Pedro Valley

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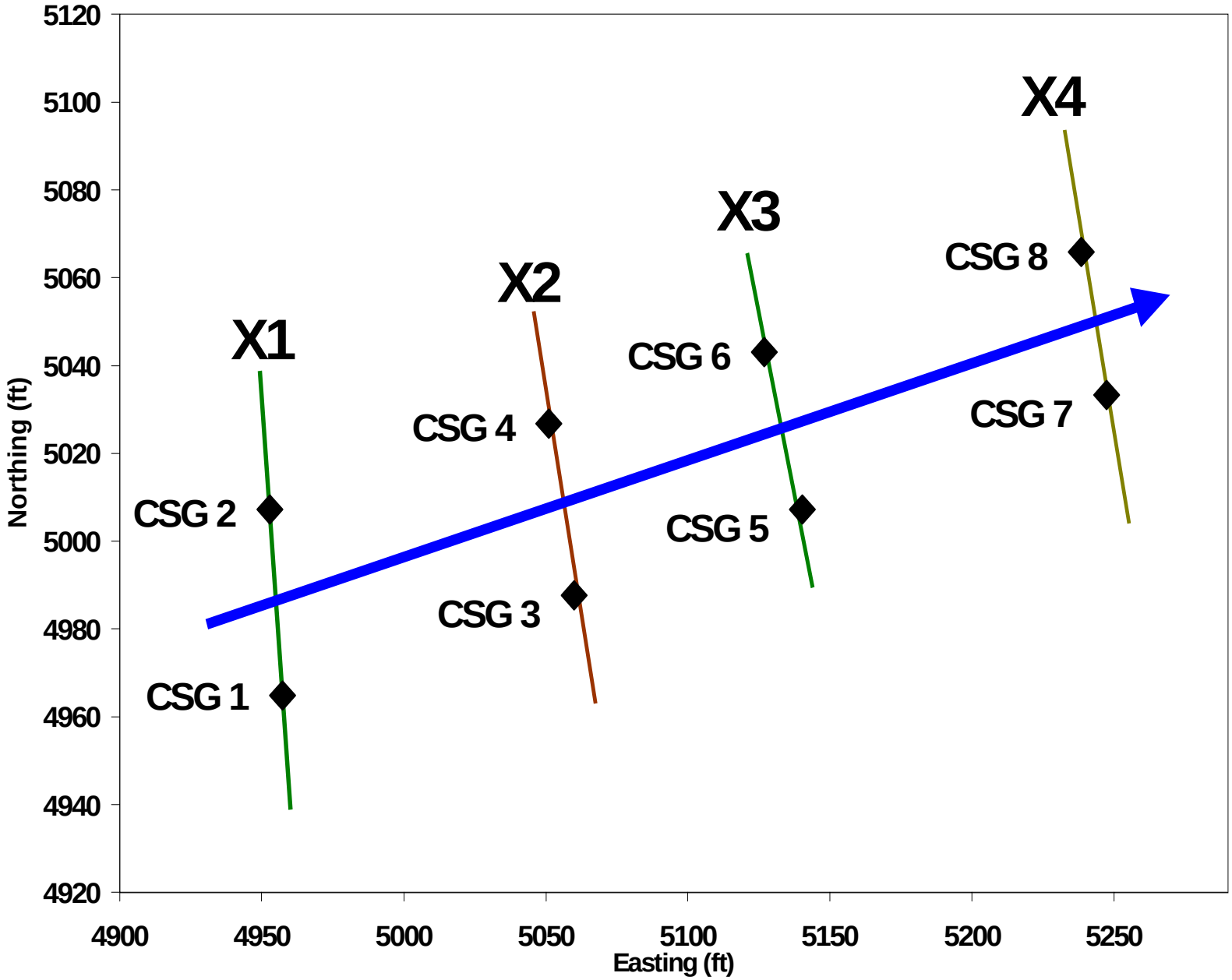
Measuring Open-Channel Flow Indirectly

- Slope Conveyance
- Step-backwater
- Slope Area

The Manning equation

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2},$$

Q = Discharge
A = Cross-sectional area
R = Hydraulic radius
S = Friction slope
n = Manning's roughness coefficient


X1
X2
X3
X4
CSG 1
CSG 2
CSG 3
CSG 4
CSG 5
CSG 6
CSG 7
CSG 8
Northing (ft)
Easting (ft)
5120
5100
5080
5060
5040
5020
5000
4980
4960
4940
4920
4900
4950
5000
5050
5100
5150
5200
5250

Continuous Slope-Area

- Combination of direct and indirect measurement
- Designed to measure periods of medium to high-flows.
- Used to develop and verify rating curves.
- Slope-area computation program SAC is used to compute peak flow.
- Used at sites where indirect measurements are primarily used to verify peaks.
- Gage a reach and not a single cross section.

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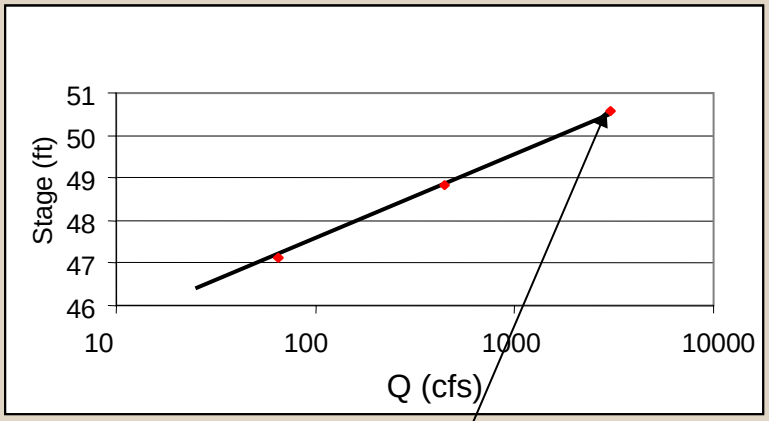
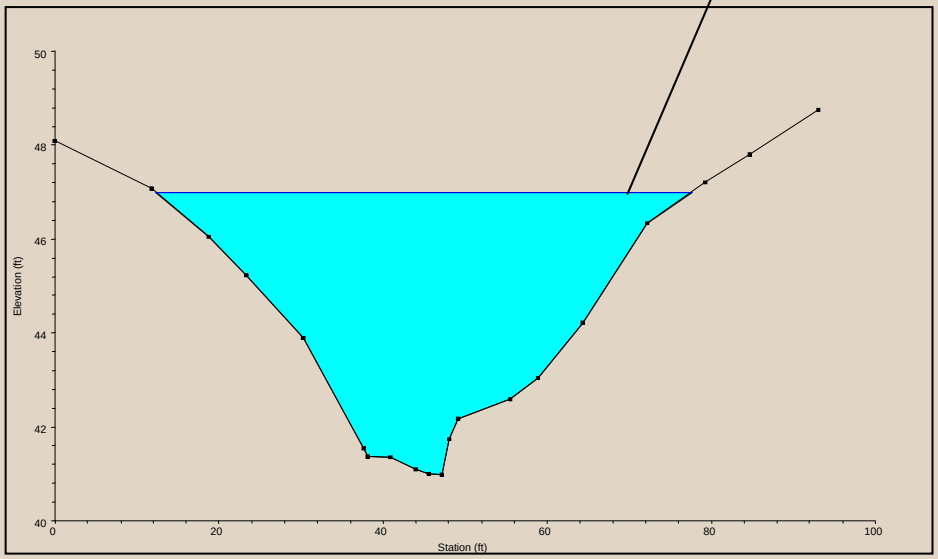
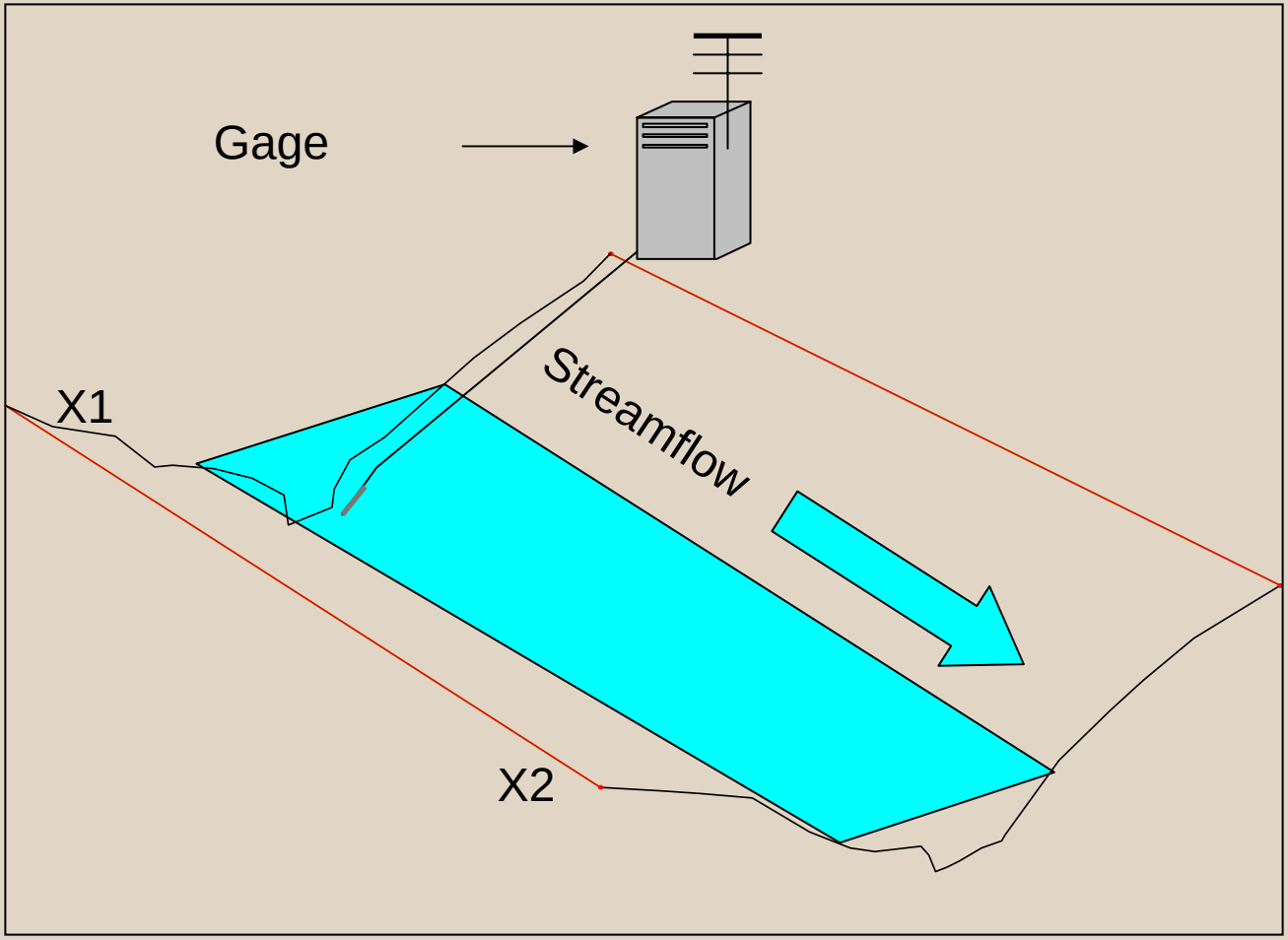
Stage Hydrograph from Gaging Station





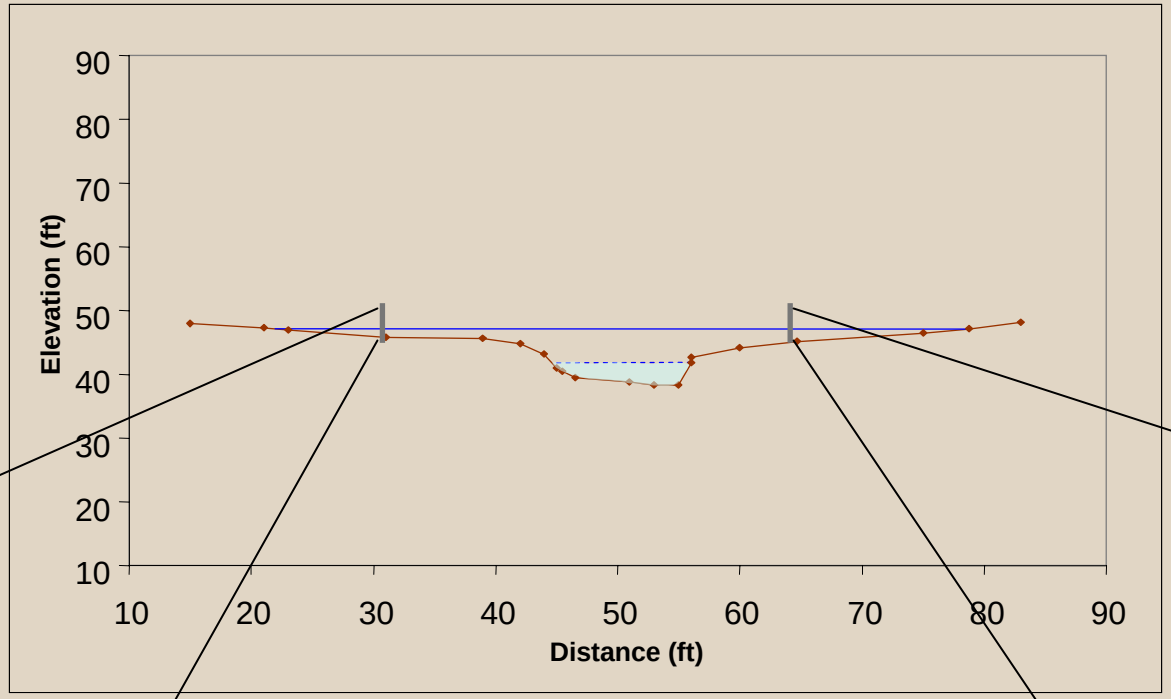
Gaging a Reach

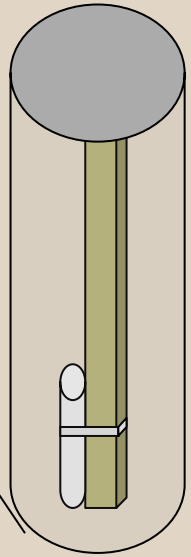


Slope-Area Reach

- Four cross-sections that have two crest-stage gages to measure stage.
- Reach is about 400 feet long.
- Reach produces uniform cross-sections.
- Reach has grass in the channel which makes the reach very stable (no scour or fill).

Lower Babocomari Continuous Slope-Area Site
Cross-Section Two





Pressure Transducer
Installed in Crest-Stage Gage

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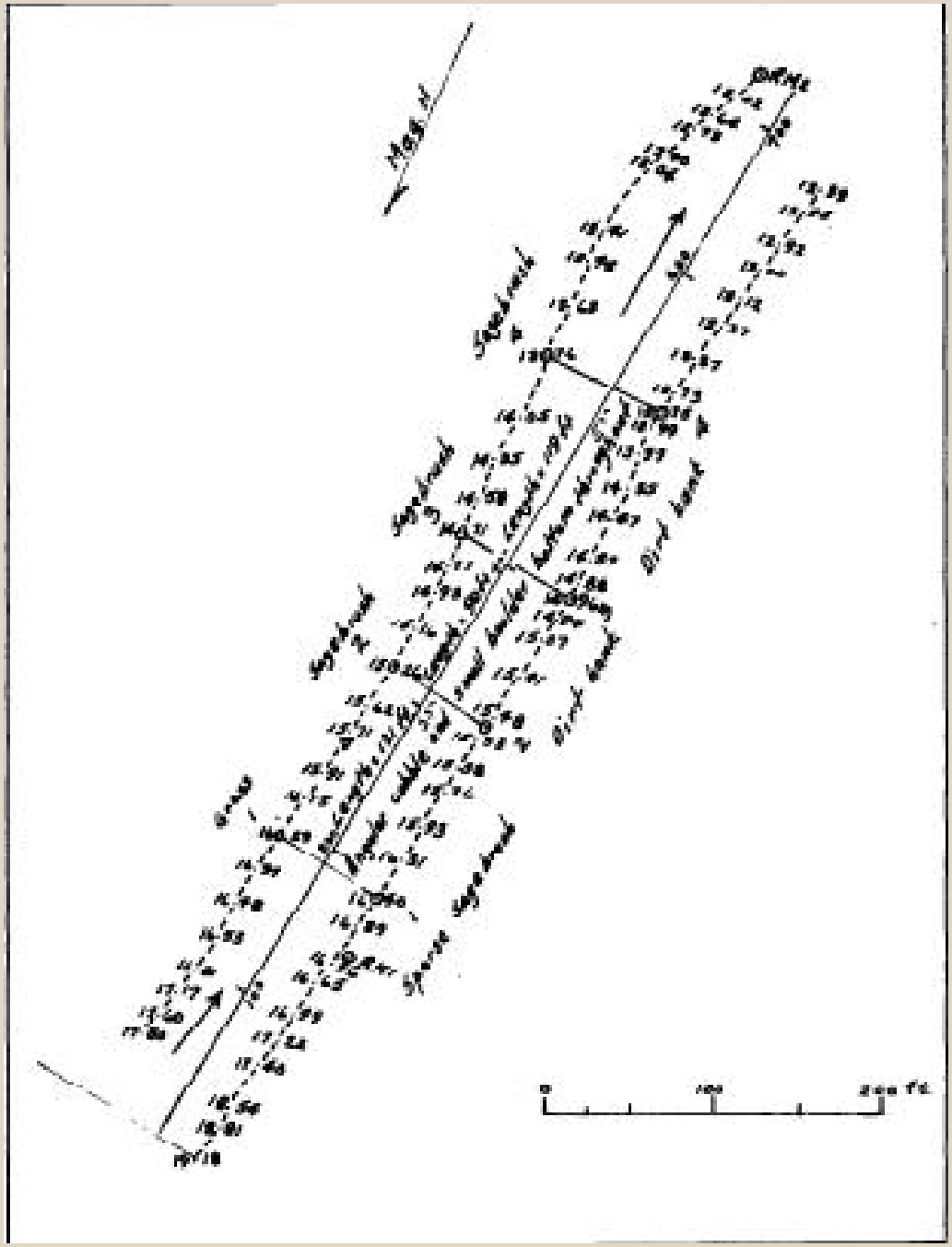

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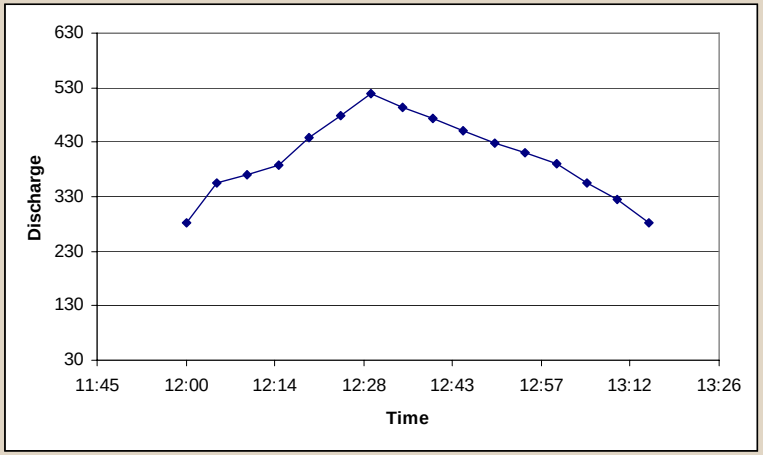
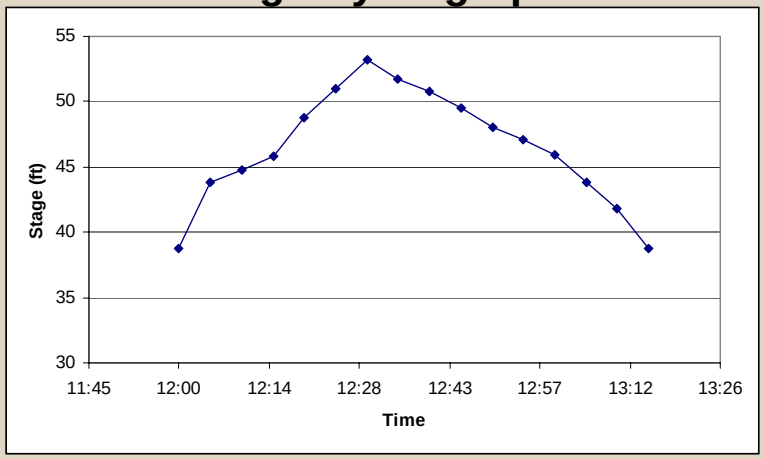
Stage and Discharge Hydrographs From Continuous Slope-Area Gage Used to Create Rating

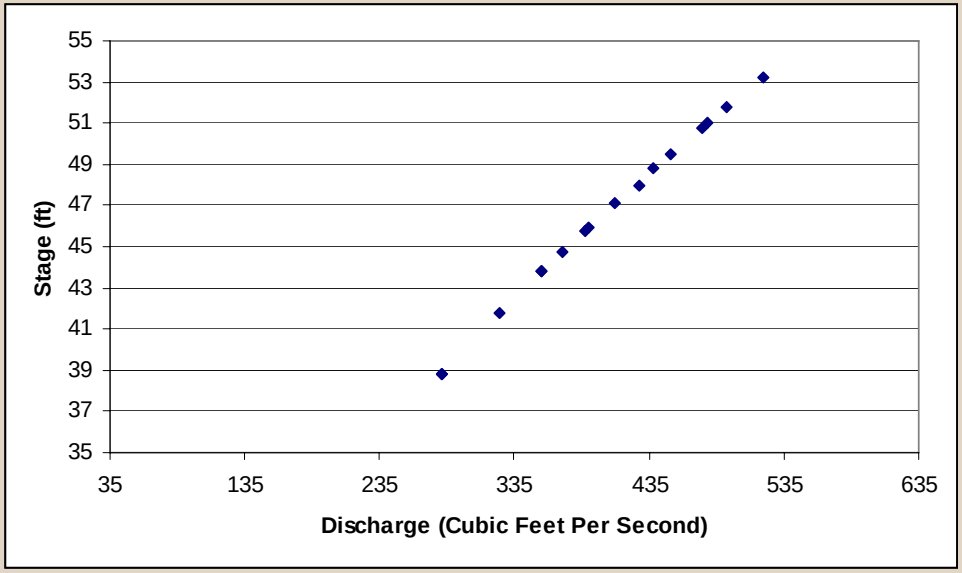
Discharge Hydrograph

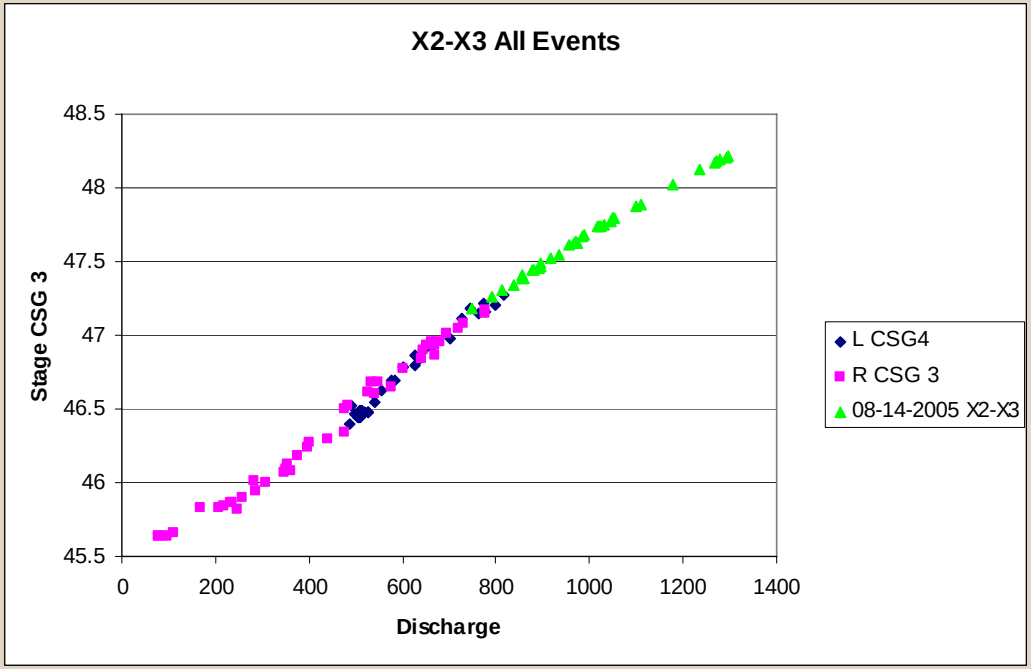


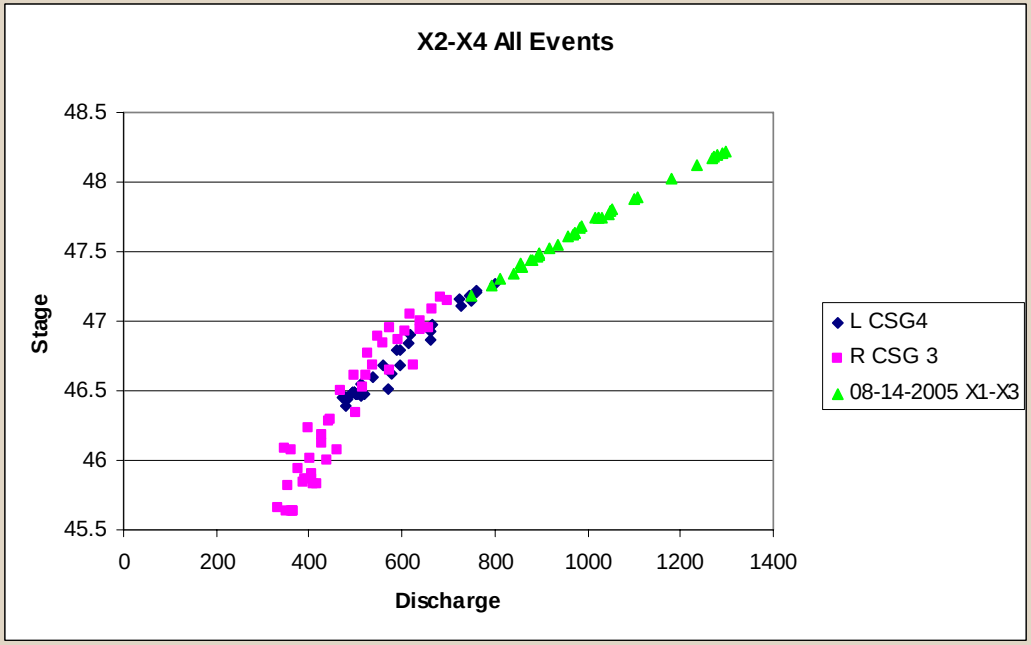
Stage Hydrograph



Rating Curve




X2-X3 All Events
Stage CSG 3
48.5
48
47.5
47
46.5
46
45.5
0
200
400
600
800
1000
1200
1400
Discharge
L CSG4
R CSG 3
08-14-2005 X2-X3


X2-X4 All Events
Stage
48.5
48
47.5
47
46.5
46
45.5
0
200
400
600
800
1000
1200
1400
Discharge
L CSG4
R CSG 3
08-14-2005 X1-X3

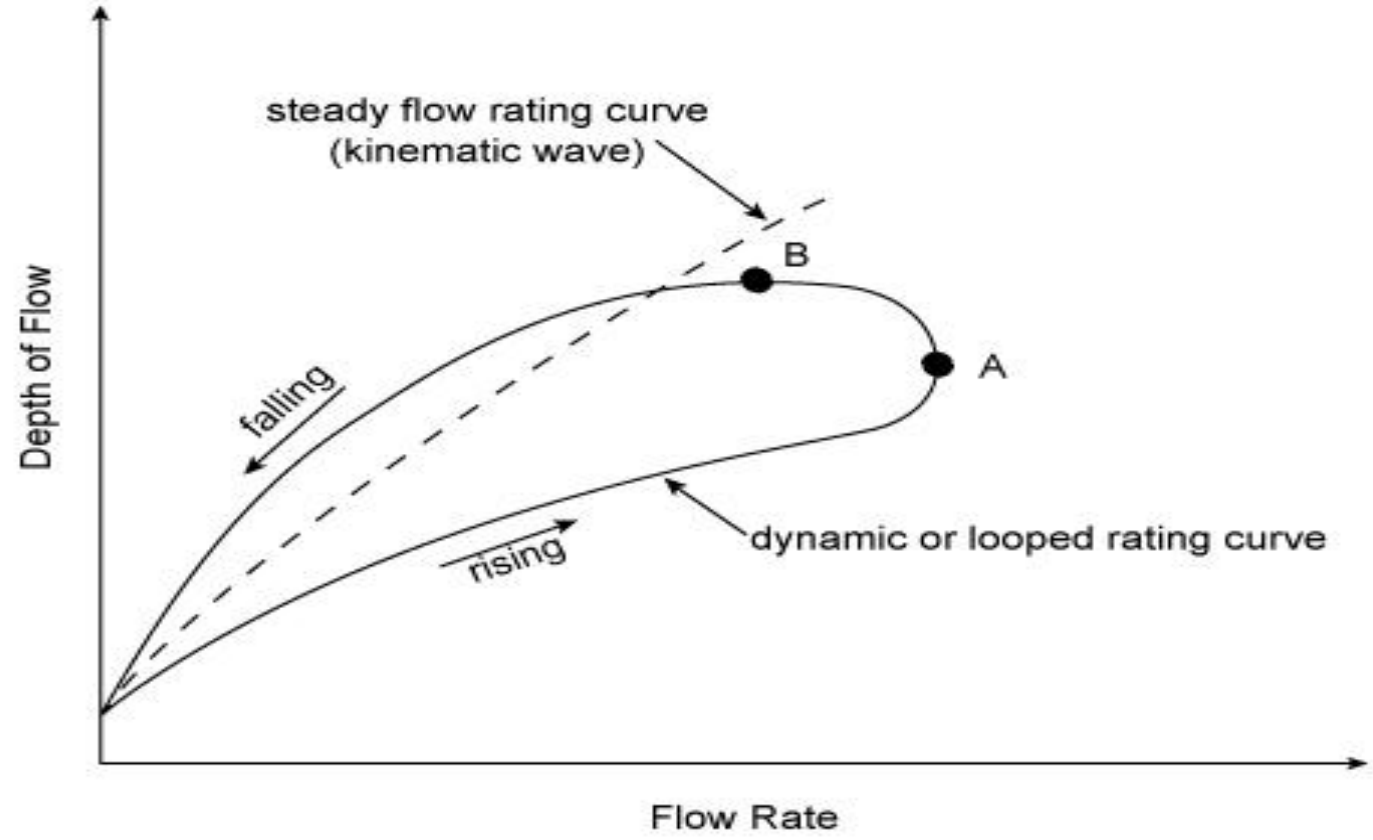
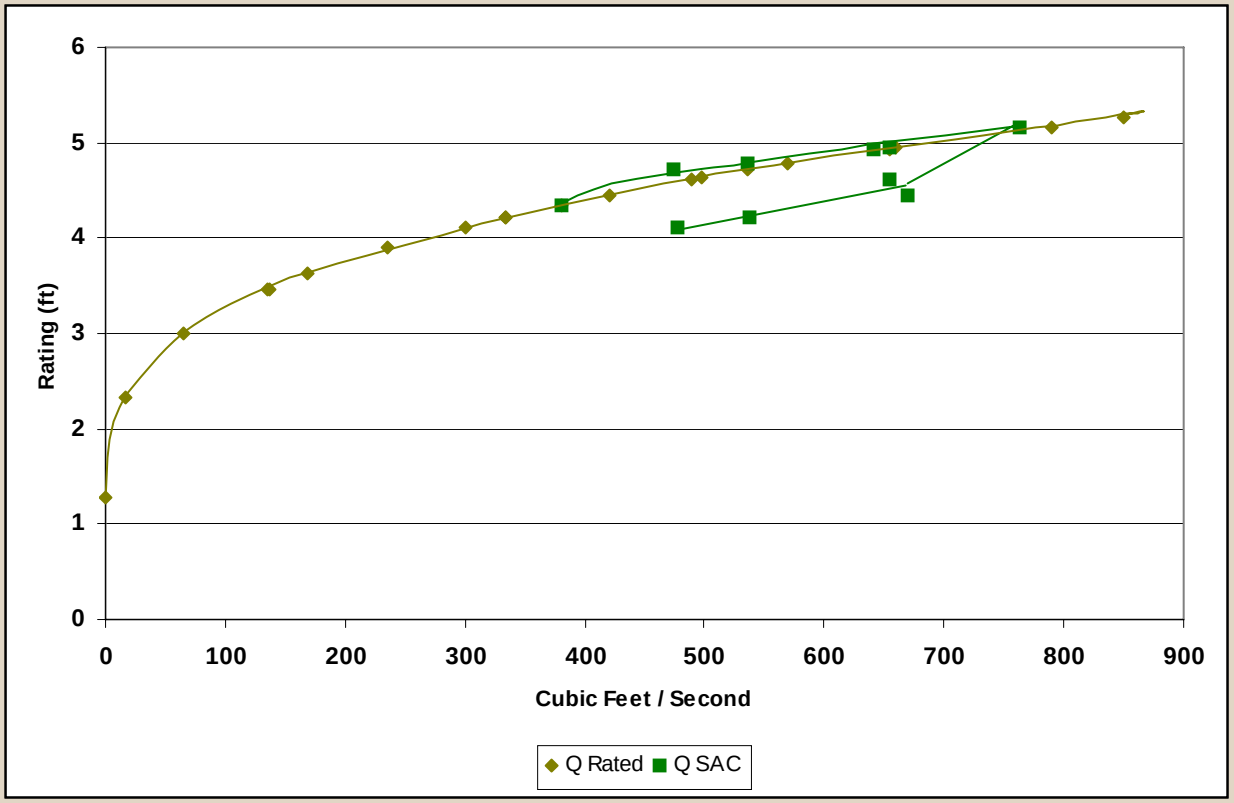
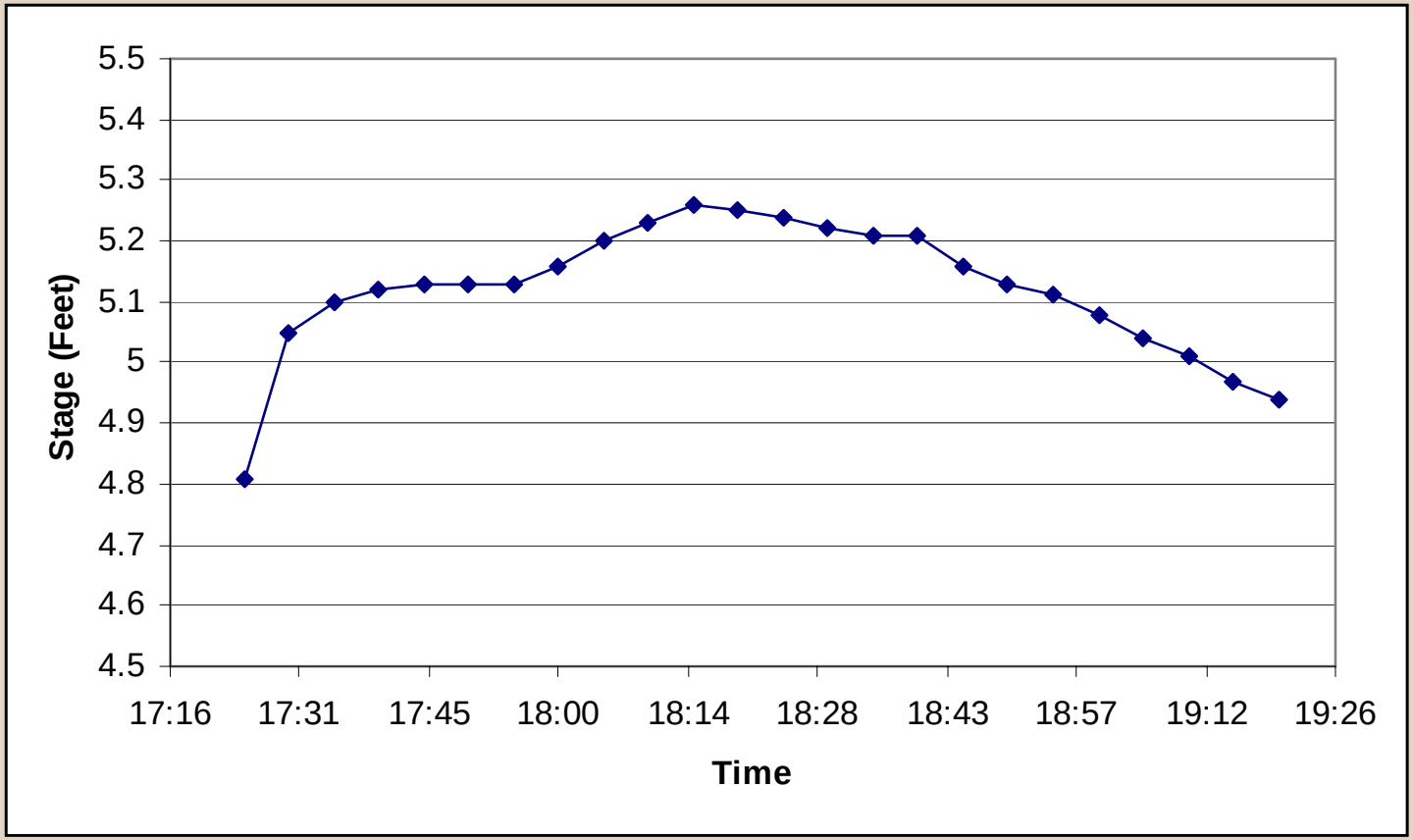


Figure 8.1. Looped rating curve.

Shift?


6
5
4
3
2
1
0
Rating (ft)
0
100
200
300
400
500
600
700
800
900
Cubic Feet / Second
Q Rated
Q SAC

Stage Hydrograph Generated from Sept. 19, 2004 Flow Event
09513860 Skunk Creek, Near Phoenix



Discharge Hydrograph Generated from Sept. 19, 2004 Flow Event
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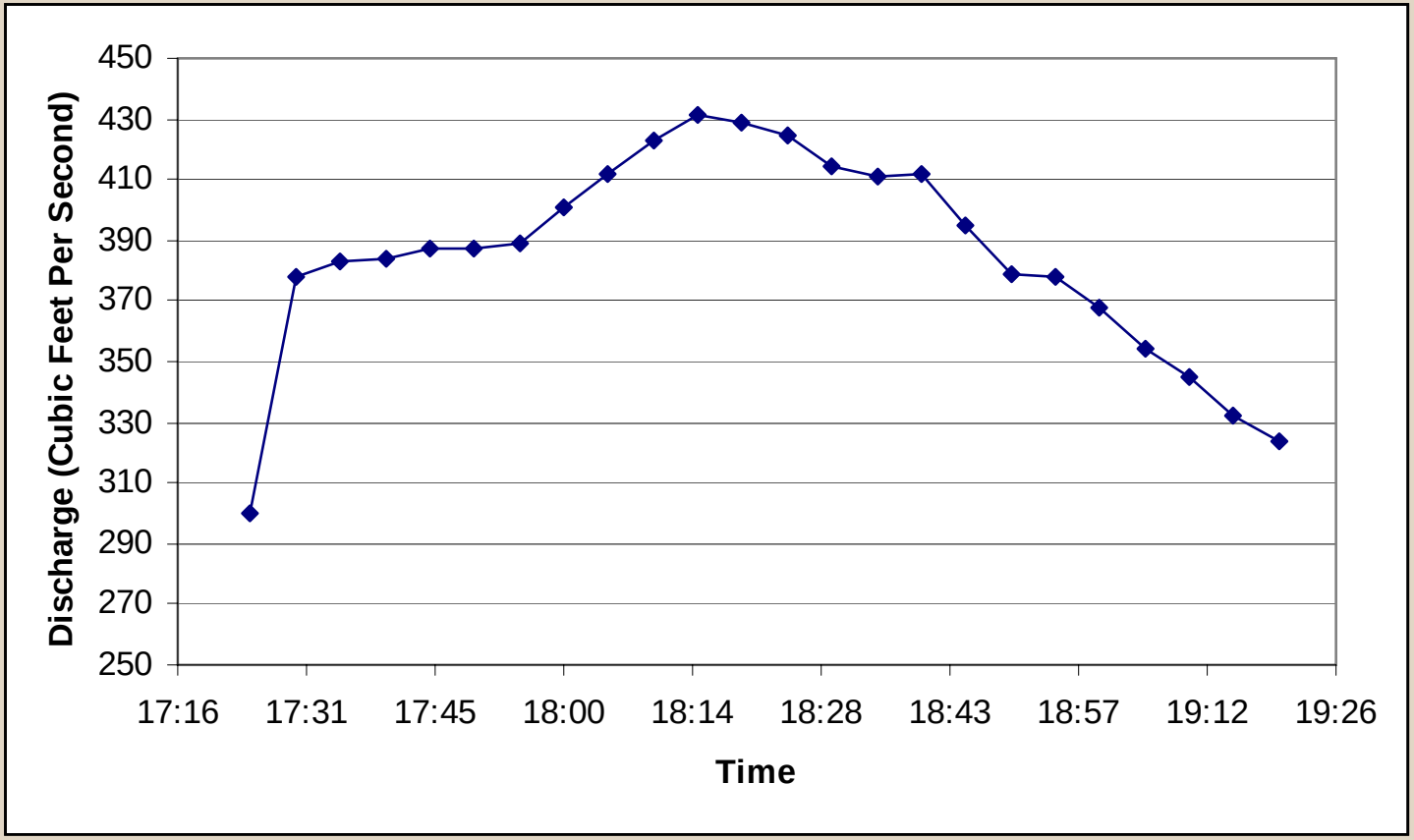
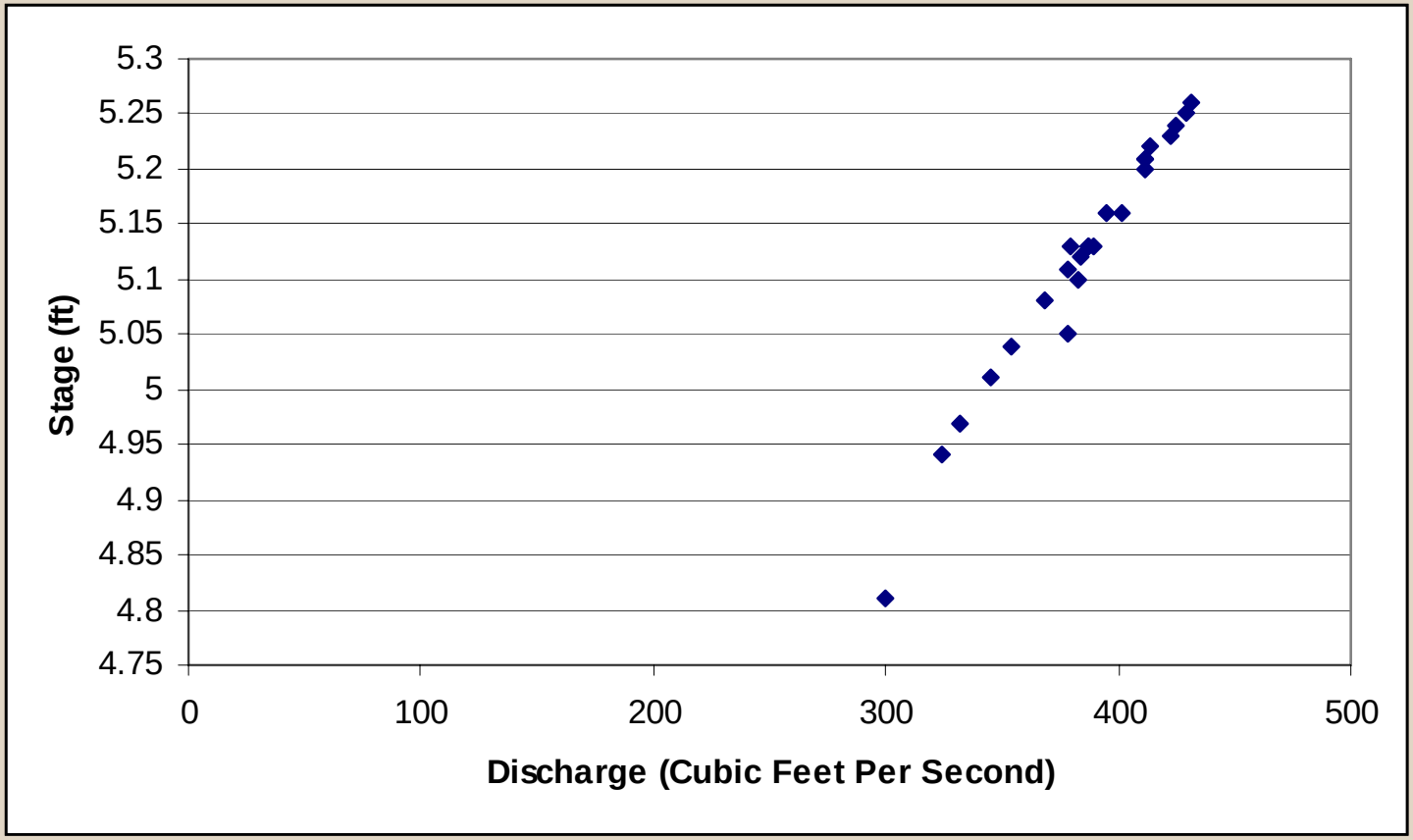
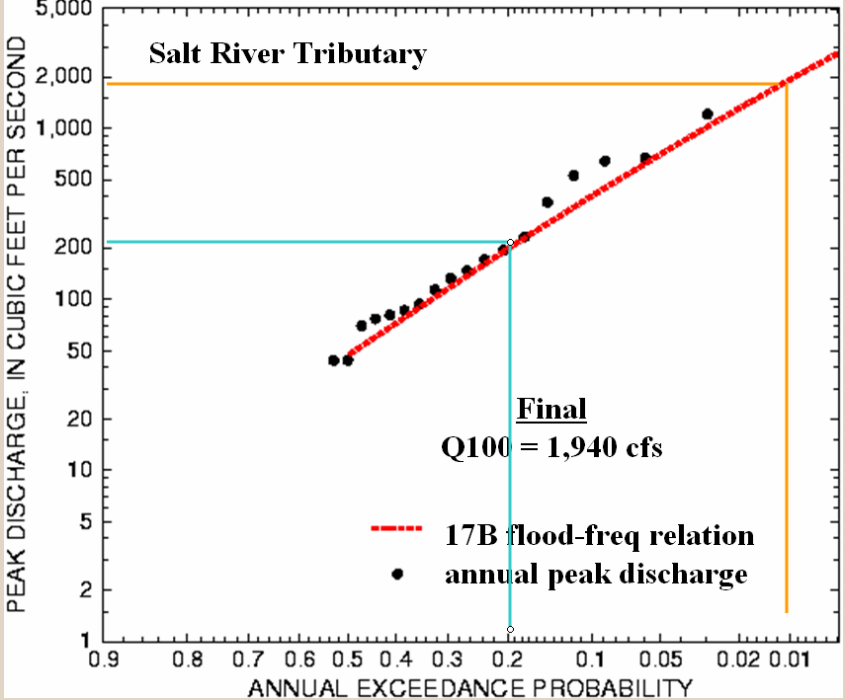


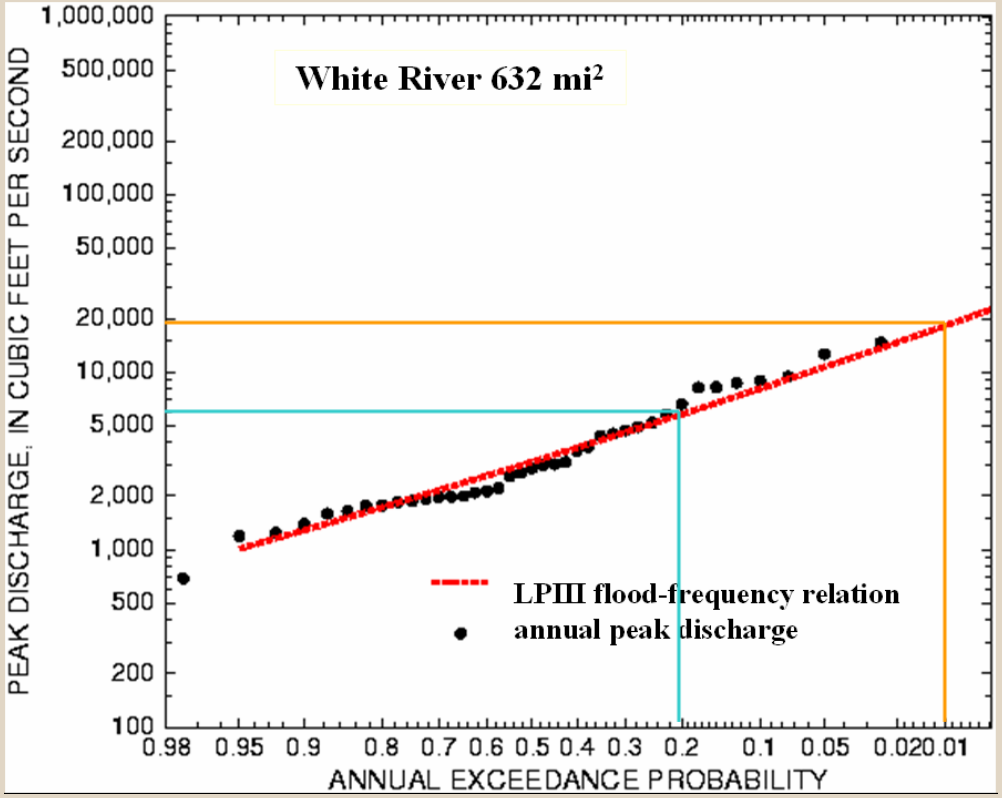
Discharge Rating Generated from Sept. 19, 2004 Flow Event
09513860 Skunk Creek, Near Phoenix

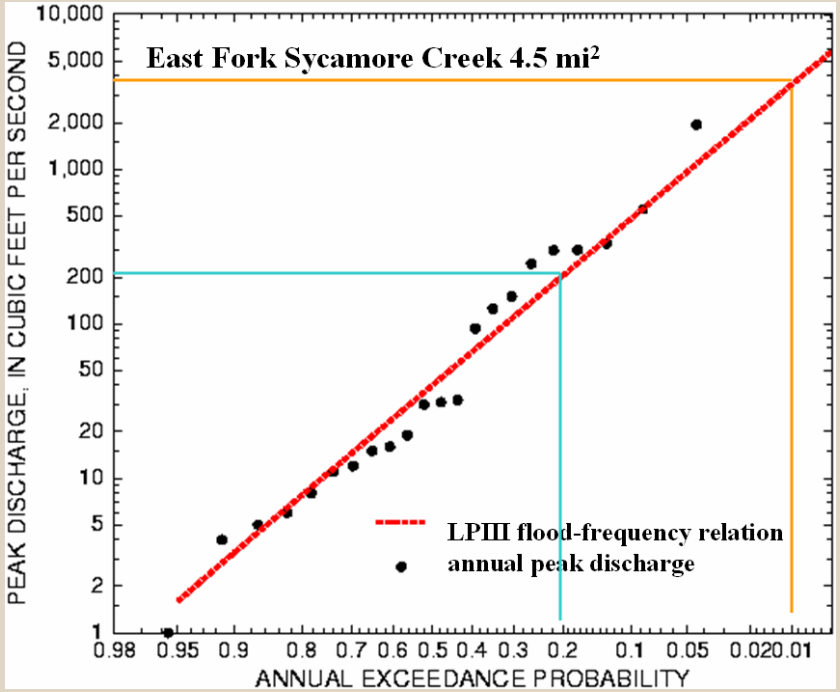


Crest-Stage Program

- Record annual peak flows that can used to determine flood magnitude and frequency for the watershed.
- The flood frequency analysis will allow you to place a return interval on a flood event. This will allow you to know how often to expect that magnitude of flood.







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CSA does not replace a gaging station

- *n* verification
- Telemetry
- Base flow

Uses of the Continuous Slope Area

- Develop rating curves
- Verify peaks
- Areas that do not require base flow comps
- Flood warning
- Remote sites