Streamgage Potential at the Mississippi River at Anoka & Champlin, MN

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Photo courtesy of MNDOT http://www.dot.state.mn.us/historicbridges

Topics

- Previous meetings regarding gage need
- USGS & streamgaging
- Review streamgaging process
- Streamgage options & costs
- Discussion
  - Your needs and uses for gage data
  - Where to from here?
  - What do you get for your funds?

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Original meetings

- 2011 April: NWS announced plans to discontinue river forecasts at Anoka + 5 other
- 2011 May: Meeting in Anoka to discuss options (NWS, USGS, county & community)

- Why was NWS going to discontinue river flood forecasts?
- Current USGS gages account for almost all flow at location. Why won't those work?

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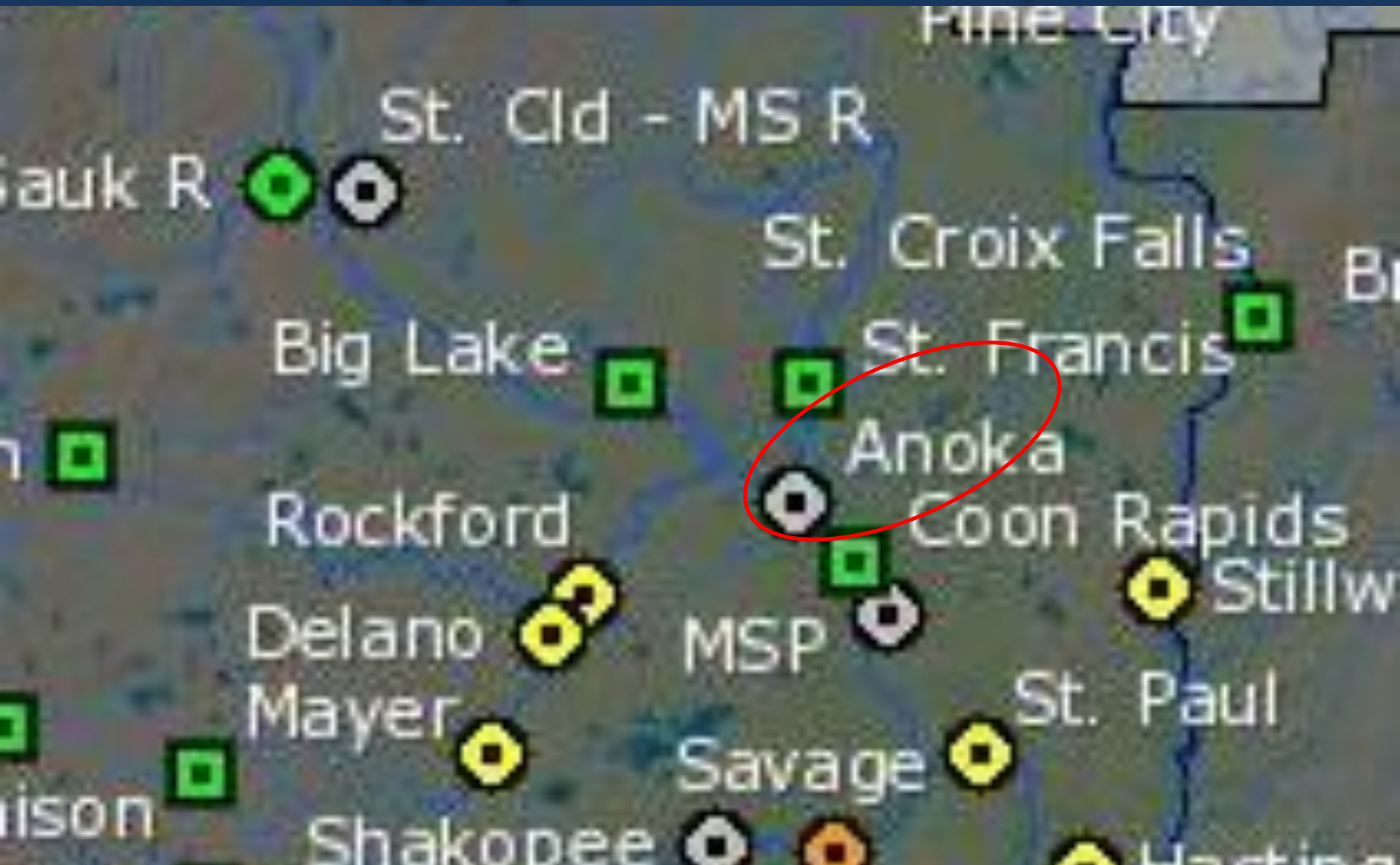
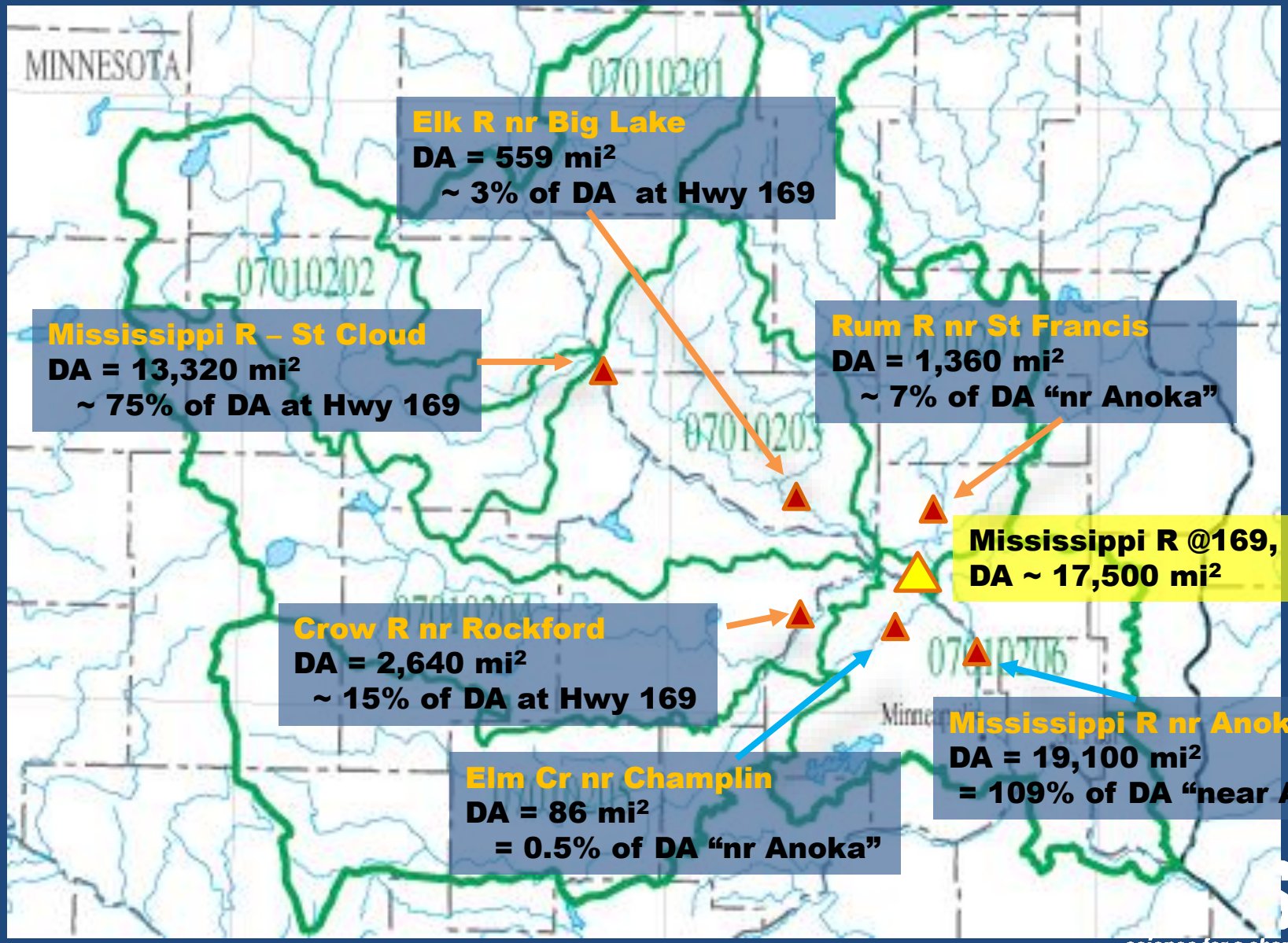
NWS Forecast Points are circles (grey=discontinued)



USGS Streamgages near Anoka



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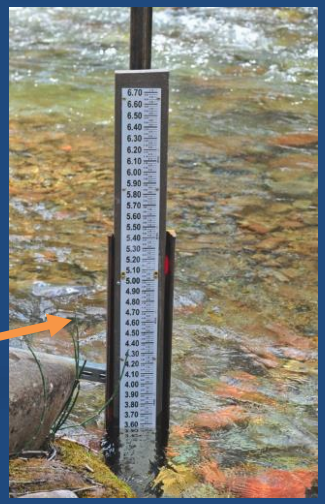
Approximate location of the old "Anoka gage" used by NWS



Forecast discontinued because gage was not continuous, & lacked maintained relation between river level and discharge

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Meeting timeline

- 2011 April: NWS announces plan to discontinue river forecasts at Anoka – no discharge
- 2011 May: Meeting in Anoka to discuss options (NWS, USGS, county & community)
- 2012 April – July: 2nd effort by NWS; webinar
- ~2012: river forecasts discontinued
- 2014 Feb: renewed interest & meeting in Champlin because of high-water & no-wake potential
- 2016 Dec: NWS & USGS meet with Scott, Champlin
- 2017 Feb: Scott, Champlin staff & I met with EMs

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U.S. Geological Survey

- The USGS serves the Nation by providing reliable scientific information to …minimize loss of life and property from natural disasters; manage water…resources; and enhance and protect our quality of life

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What the USGS does

- The USGS is an independent fact-finding agency that collects, monitors, analyzes, and provides scientific understanding about natural resource and natural hazard conditions and issues.

- The value of the USGS to the Nation rests on its ability to carry out studies on a national scale and to sustain long-term monitoring and assessment of natural resources and hazards.

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Streamgaging Is a Partnership

- Local partners & USGS fund streamgages
- USGS
  - Operates & maintains streamgages
  - Makes field measurements
  - Processes, QAs, publishes & archives data
  - Feeds data updates to NWS* in real time
  - Integrates data into other investigations
- NWS uses data for forecasting
- Local partners (& others) use data for their needs

*NWS, COE, and DNR all receive same data stream near real-time

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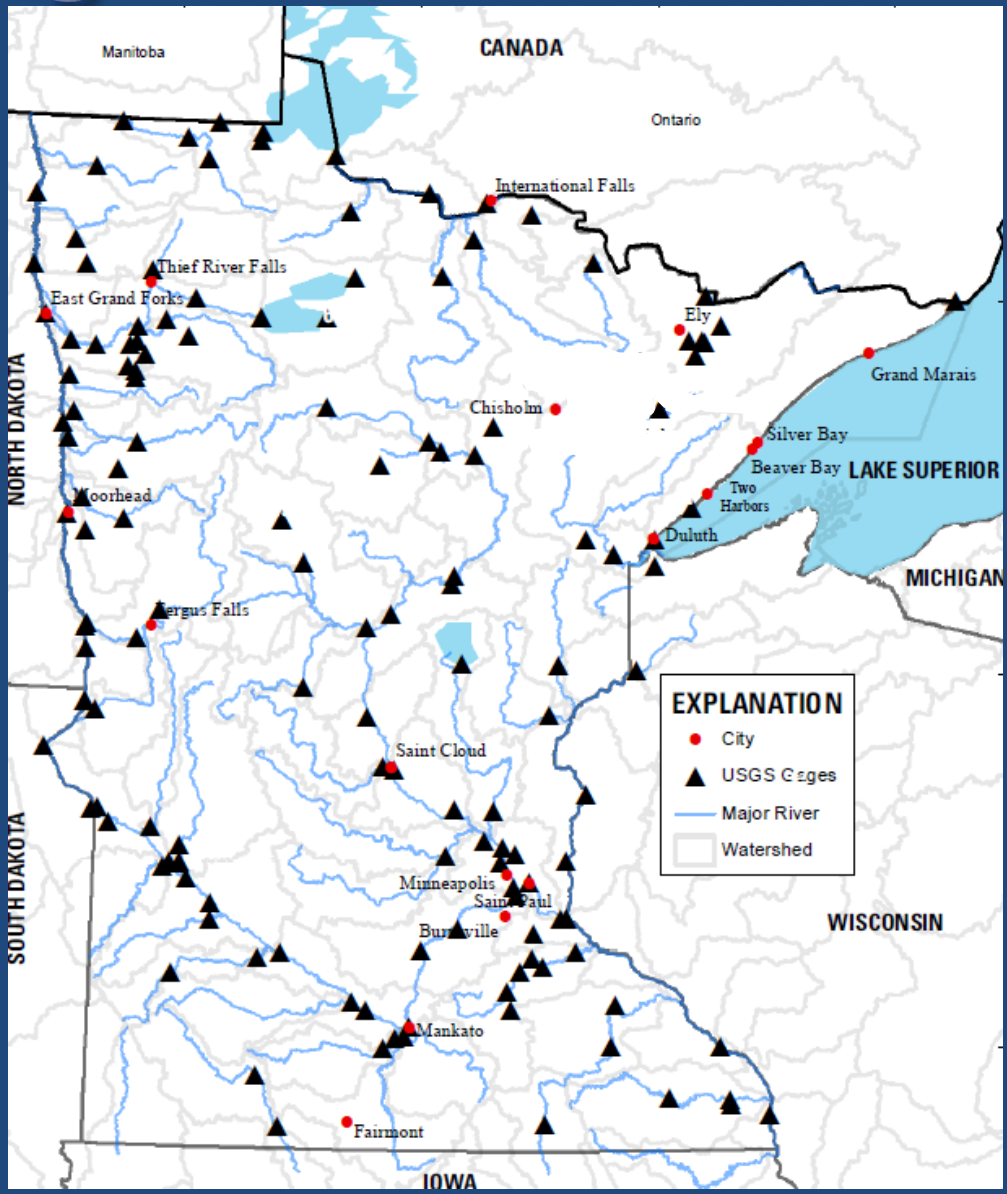
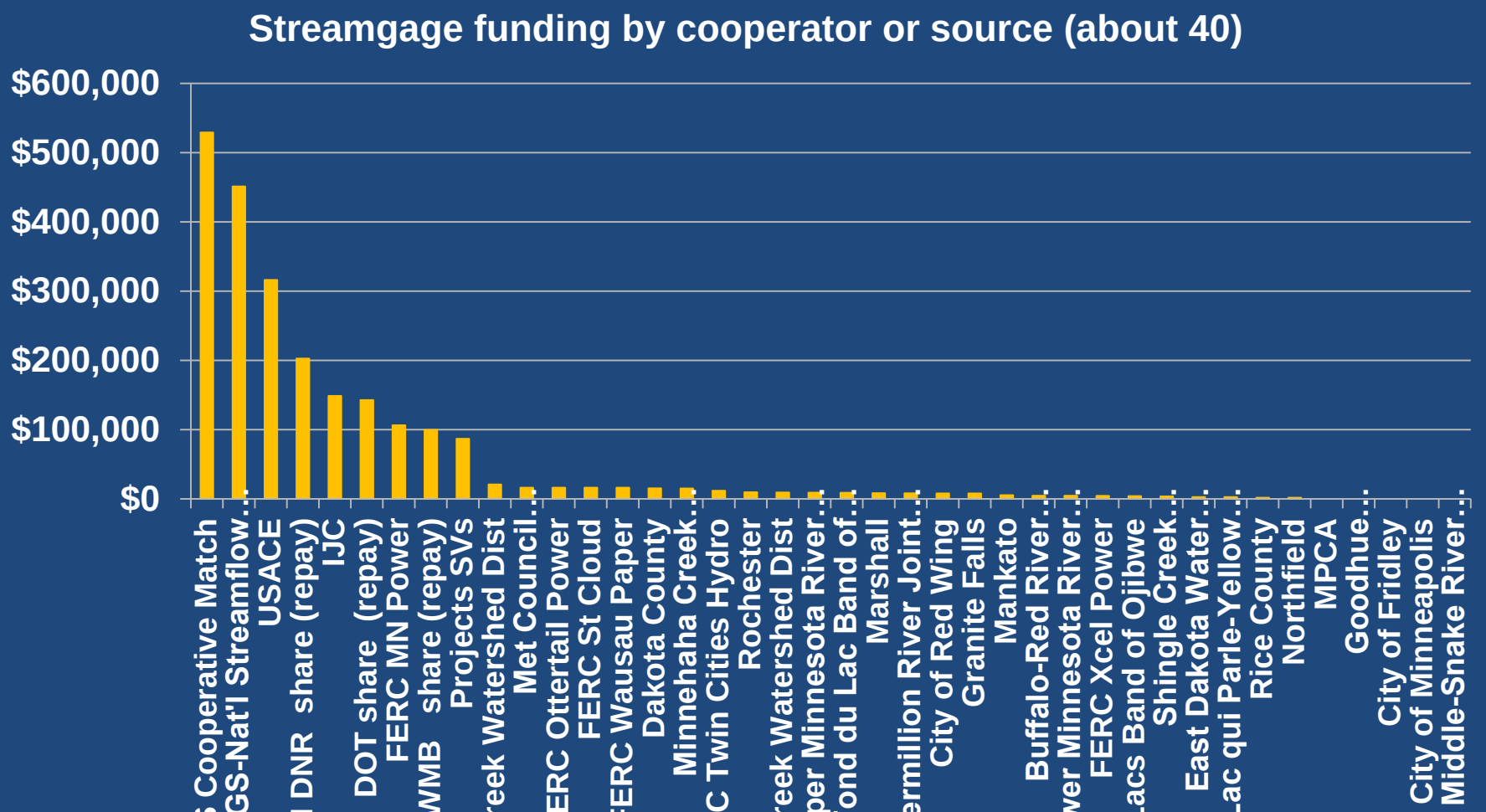
USGS Streamgage Network in MN

- About 114 gages
- Funded by:
  - USGS
  - >40 other entities
    - Federal
    - State
    - County
    - City
    - Tribal
    - FERC Licensees



Funding Sources in Minnesota



Fiscal Year 2013

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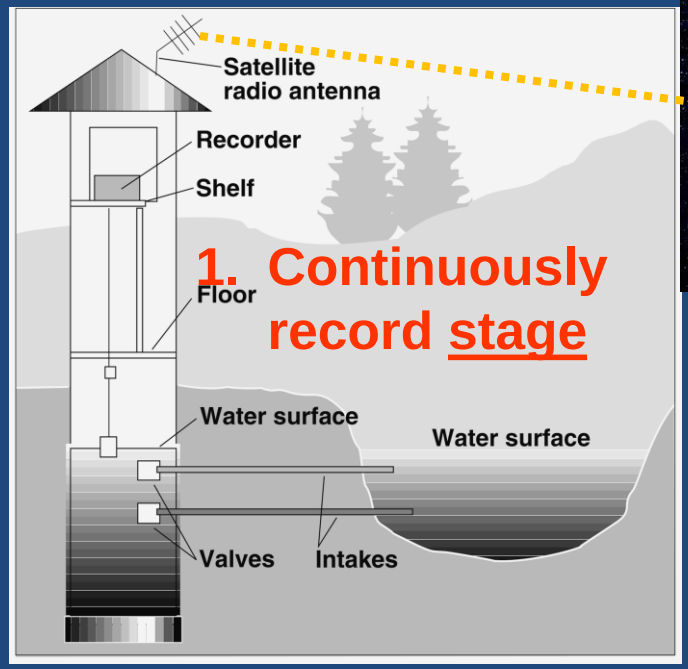
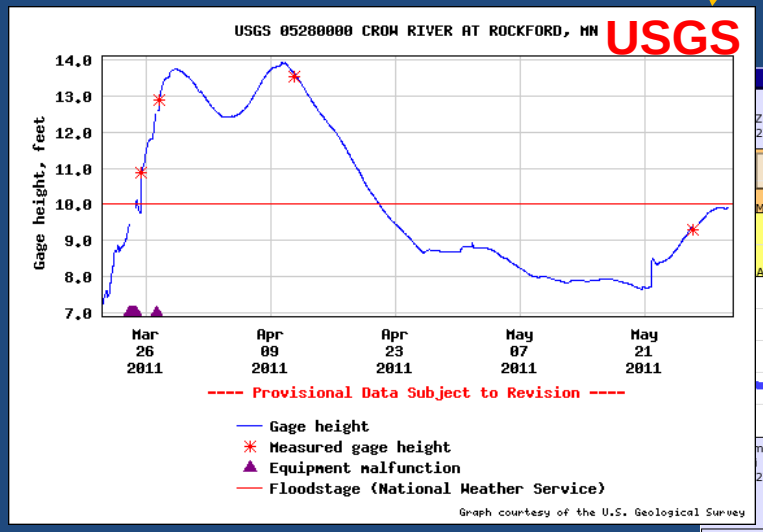
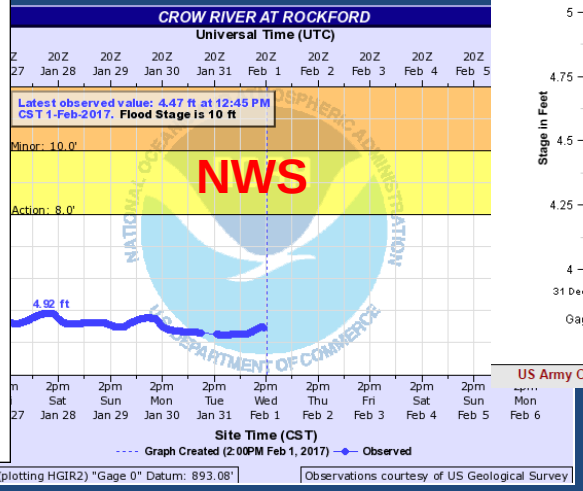
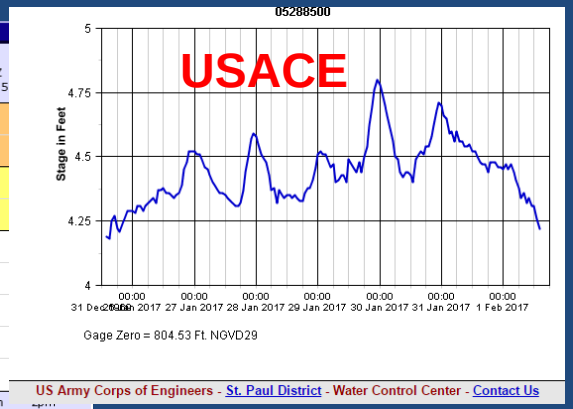
Streamgaging Process









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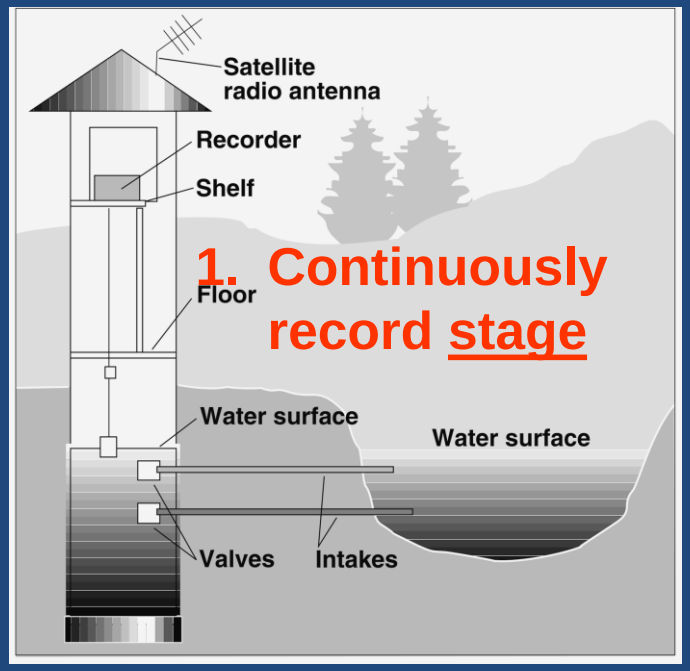
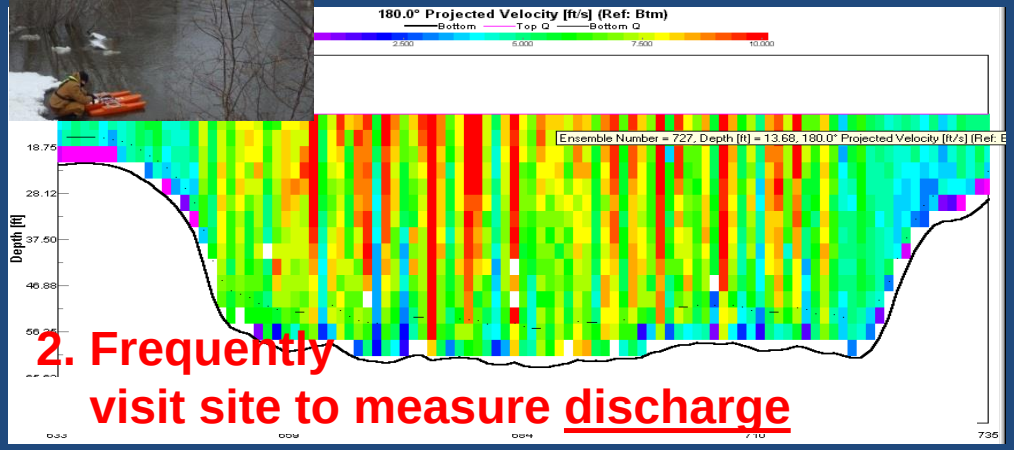
Streamgaging Process



1. Continuously record stage



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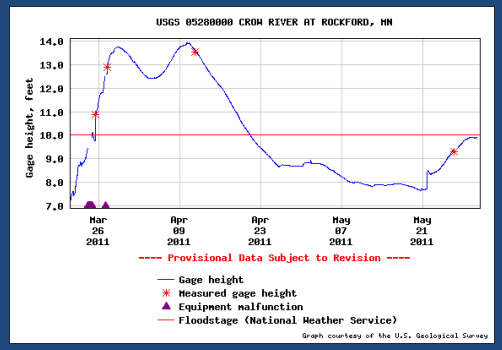

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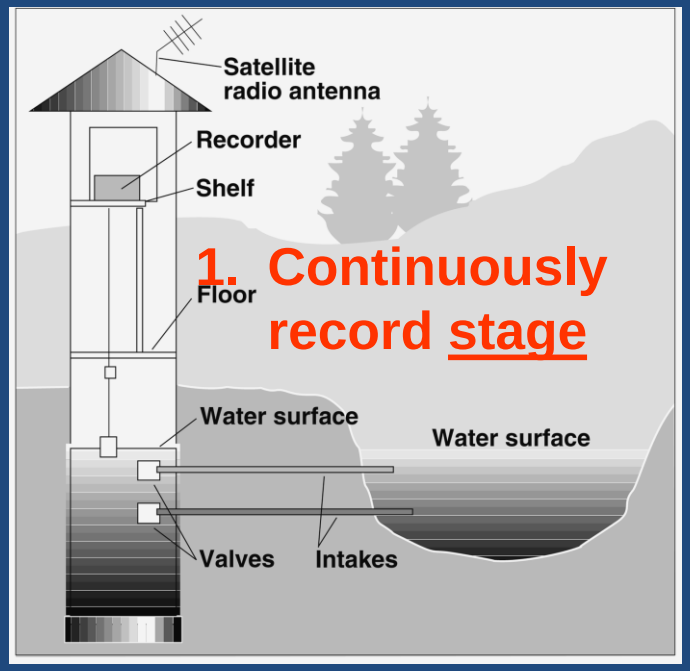
Streamgaging Process



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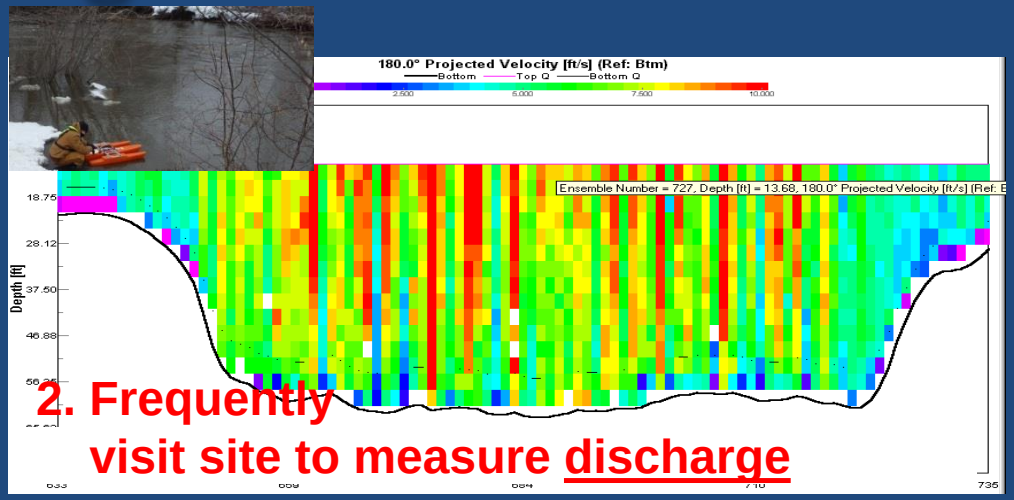

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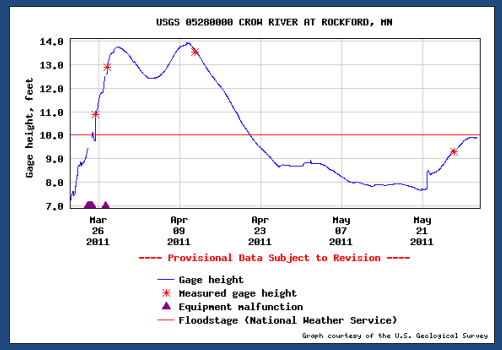

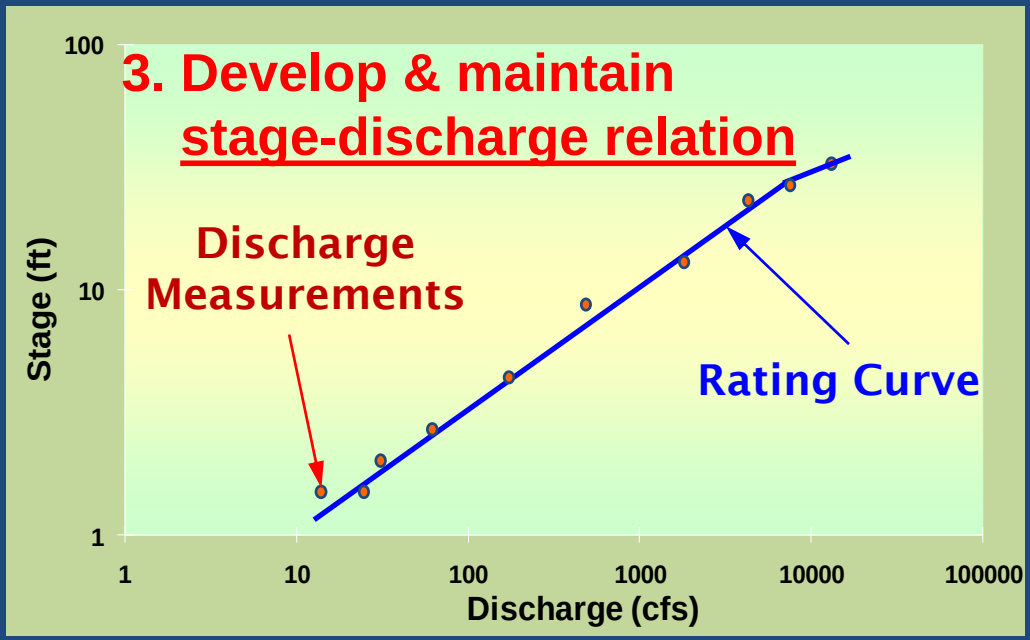

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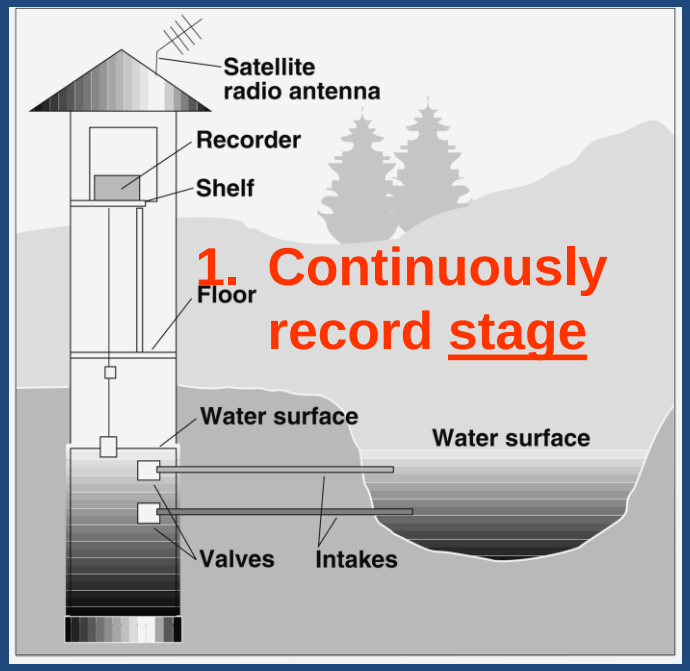
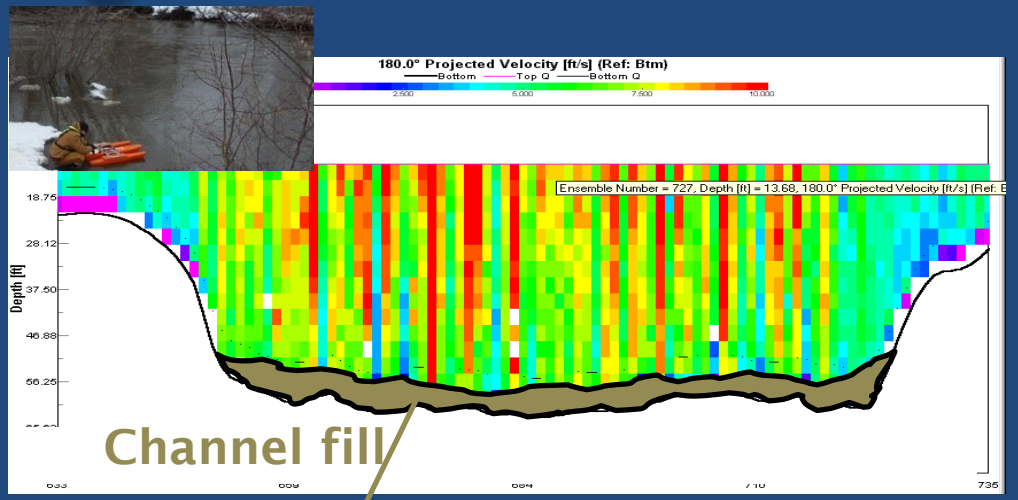
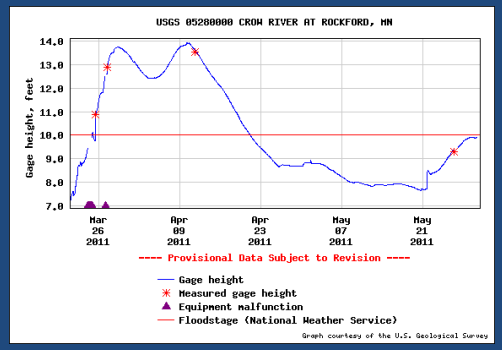
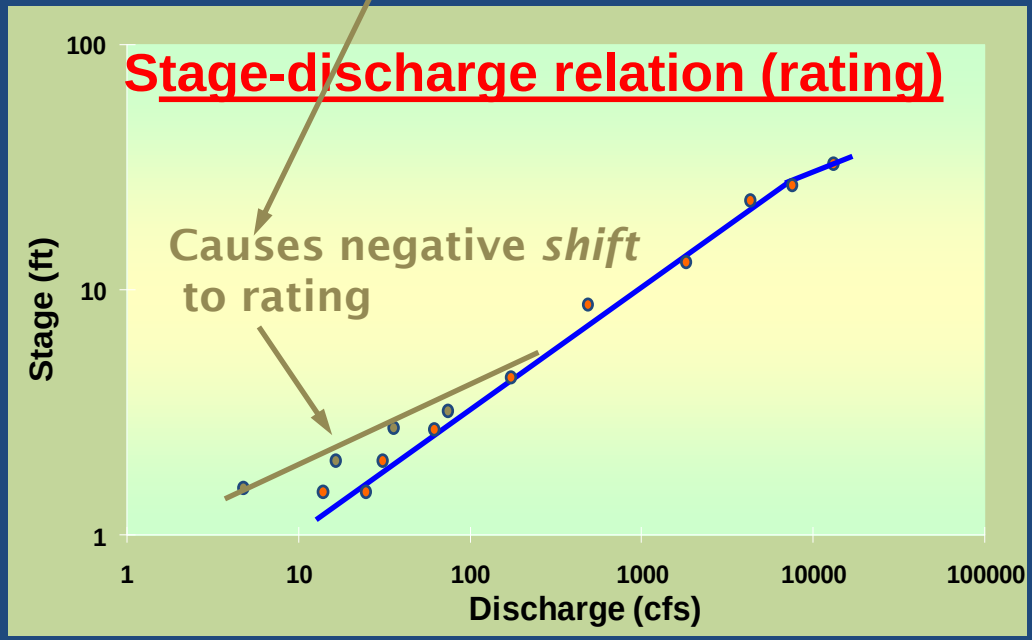
Streamgaging Process









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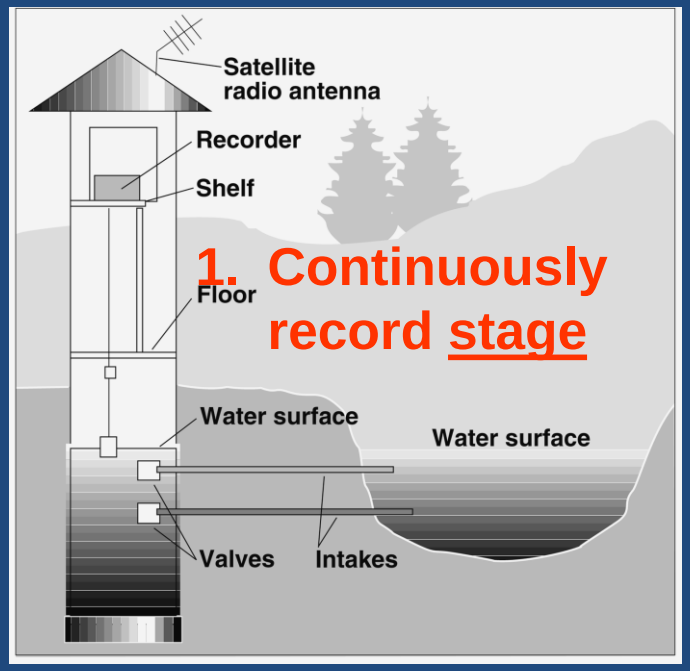

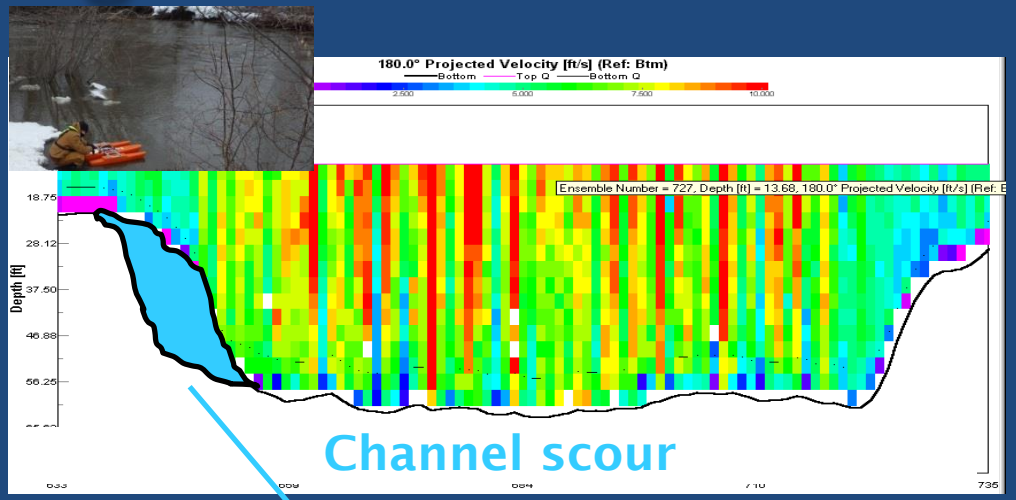

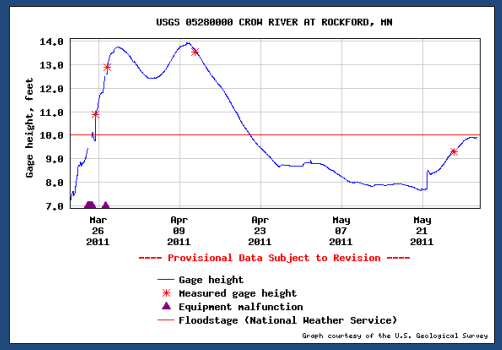

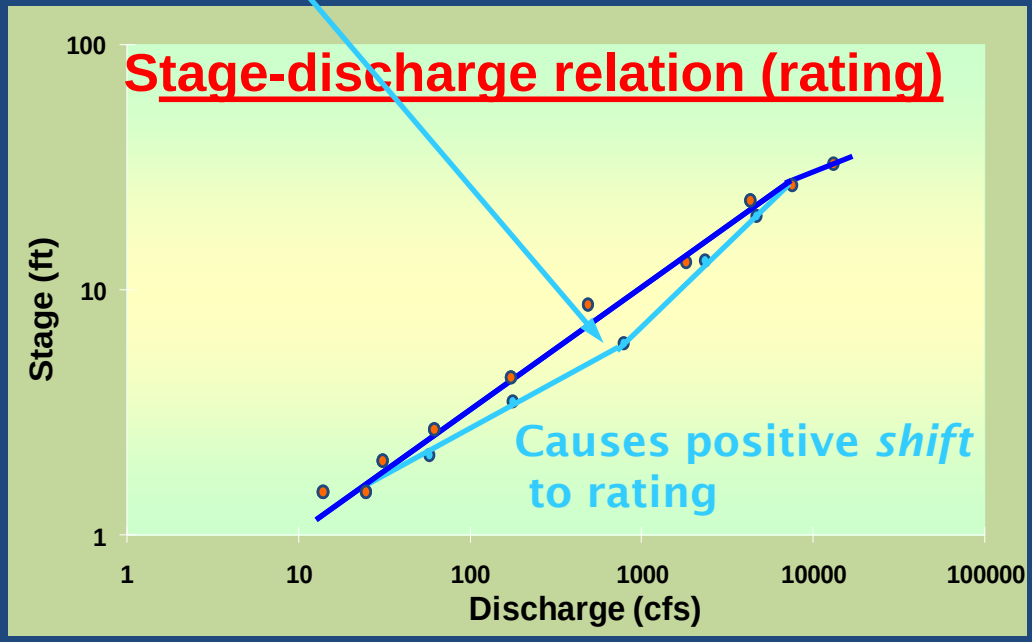

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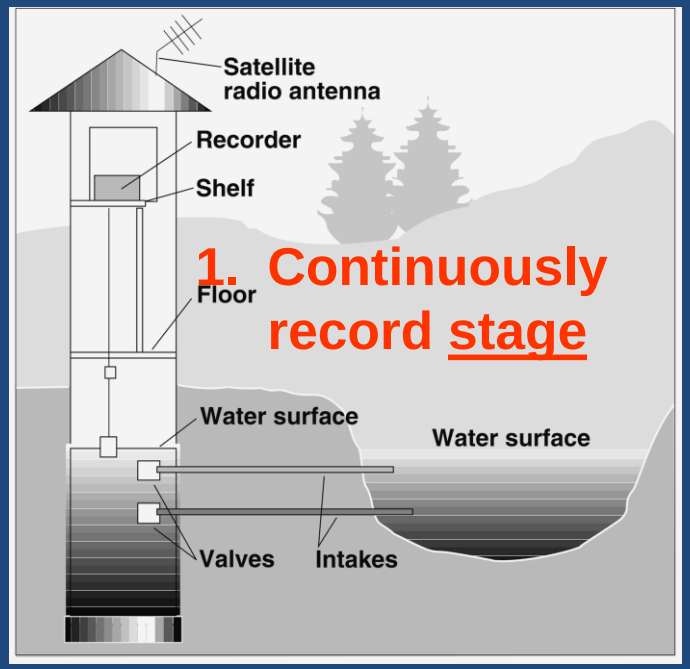

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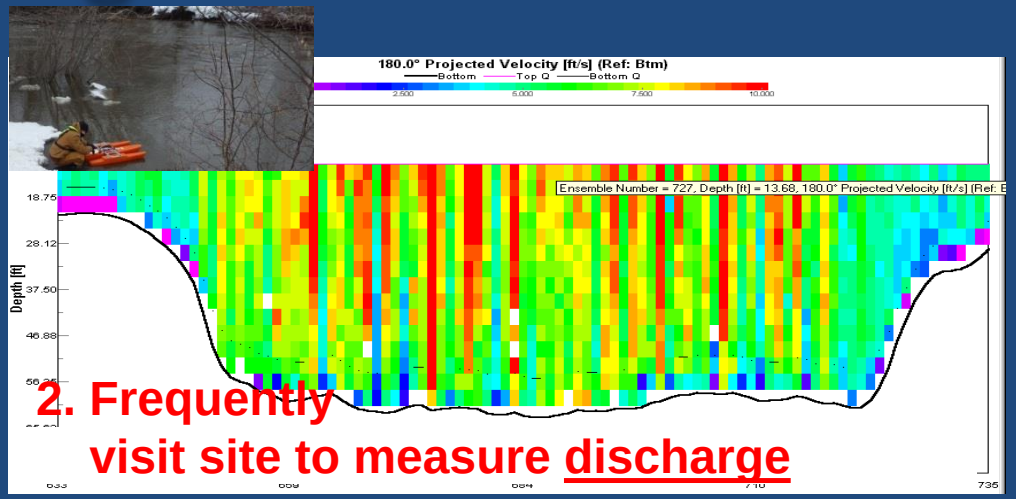

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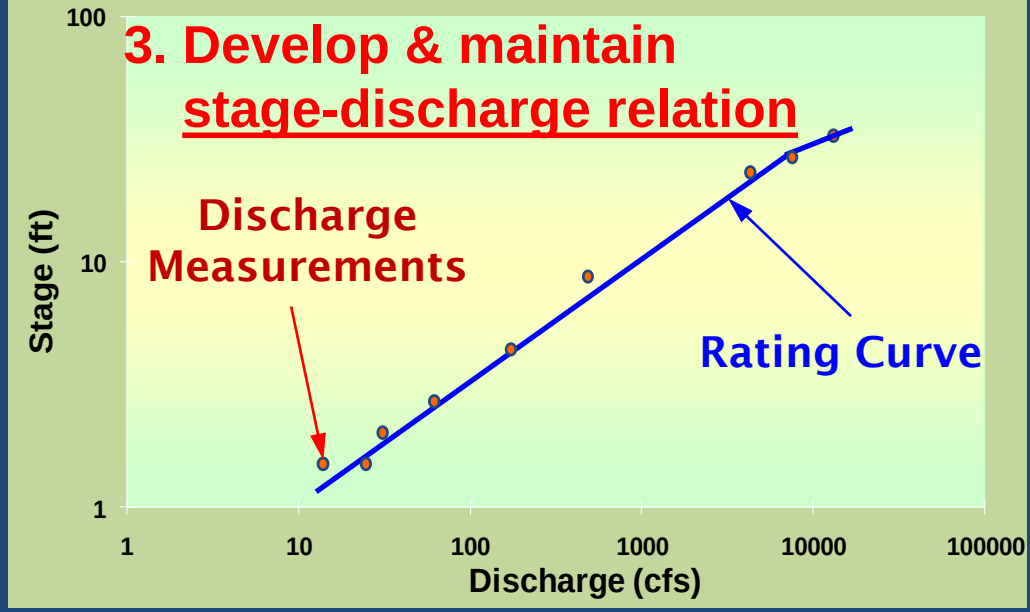
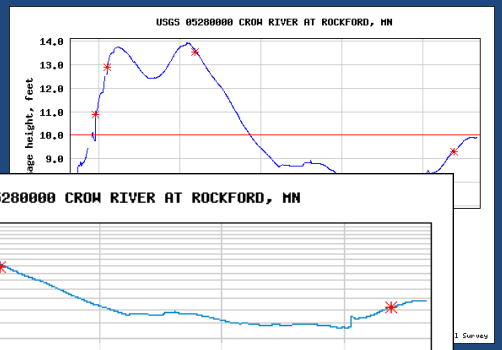
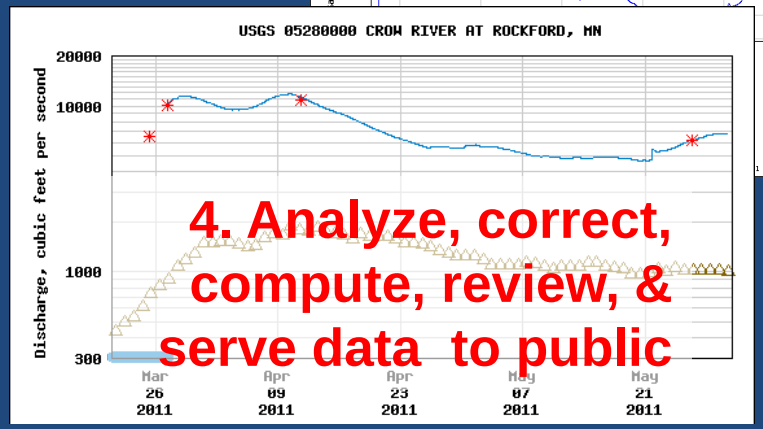


3. Develop & maintain stage-discharge relation





4. Analyze, correct, compute, review, & serve data to public

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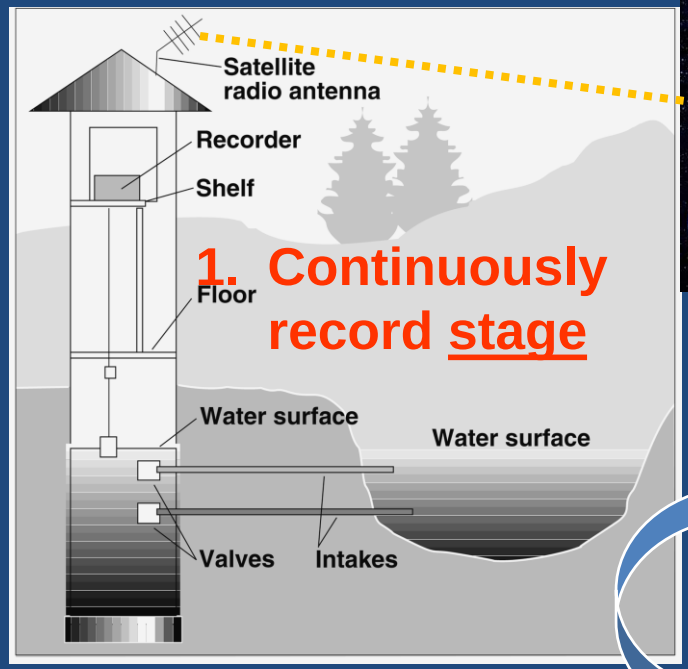
Streamgaging Process



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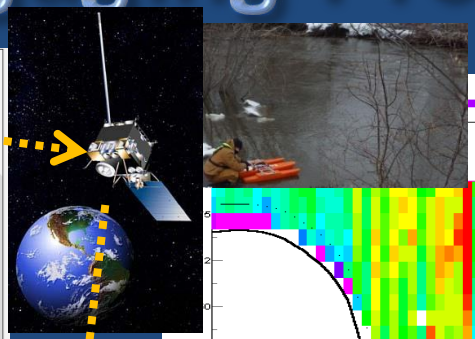

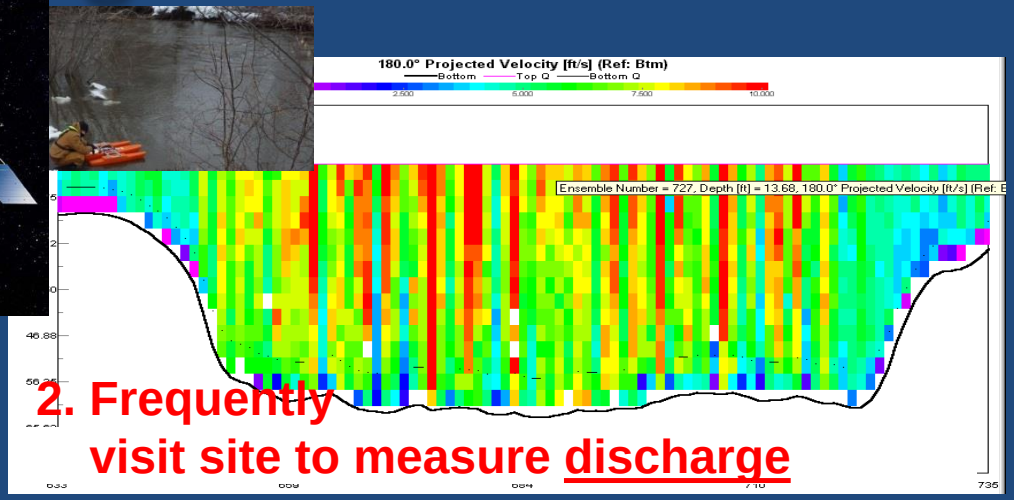

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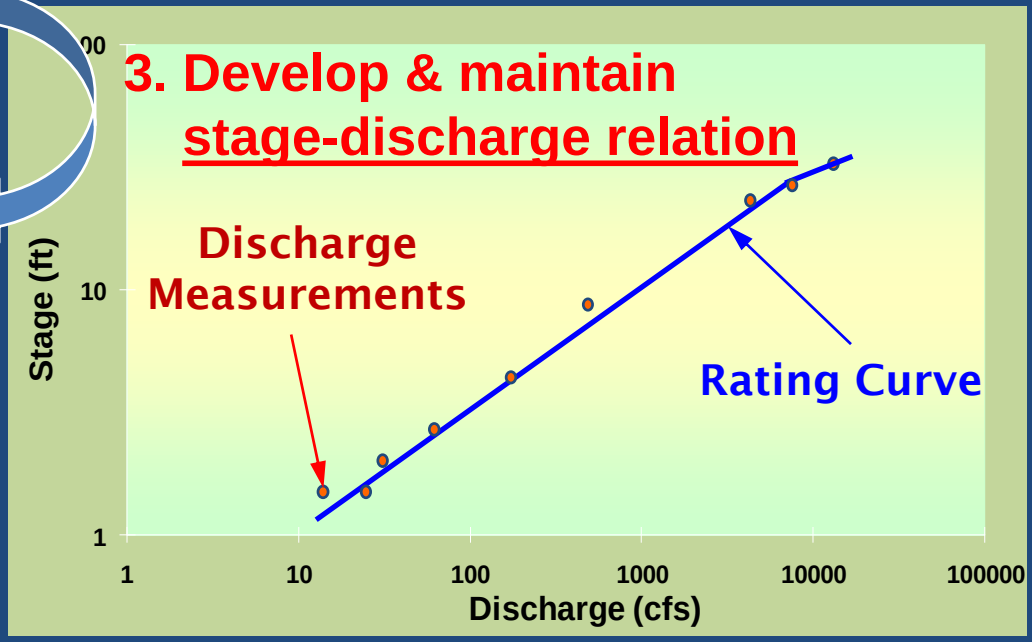

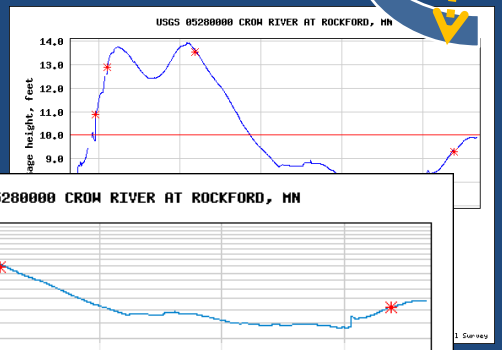

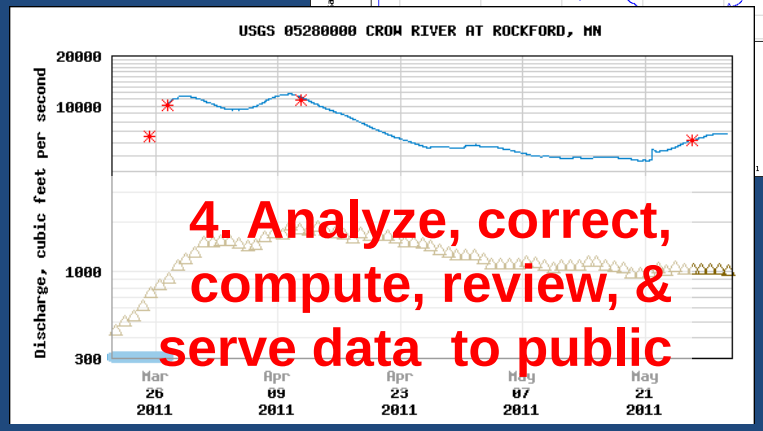

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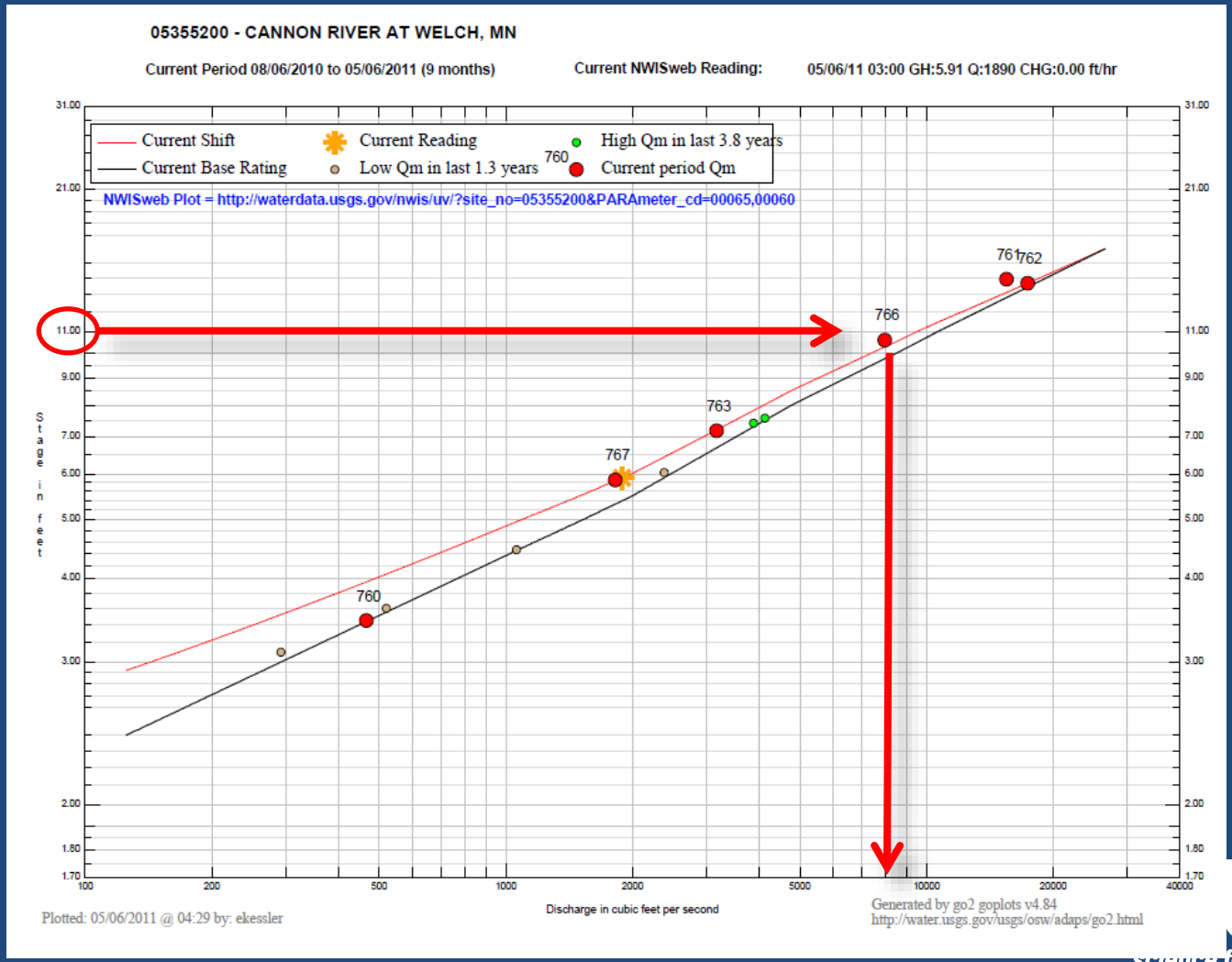
USGS and NWS use these ratings in fundamentally different ways

USGS uses recorded stage to calculate discharge that occured.



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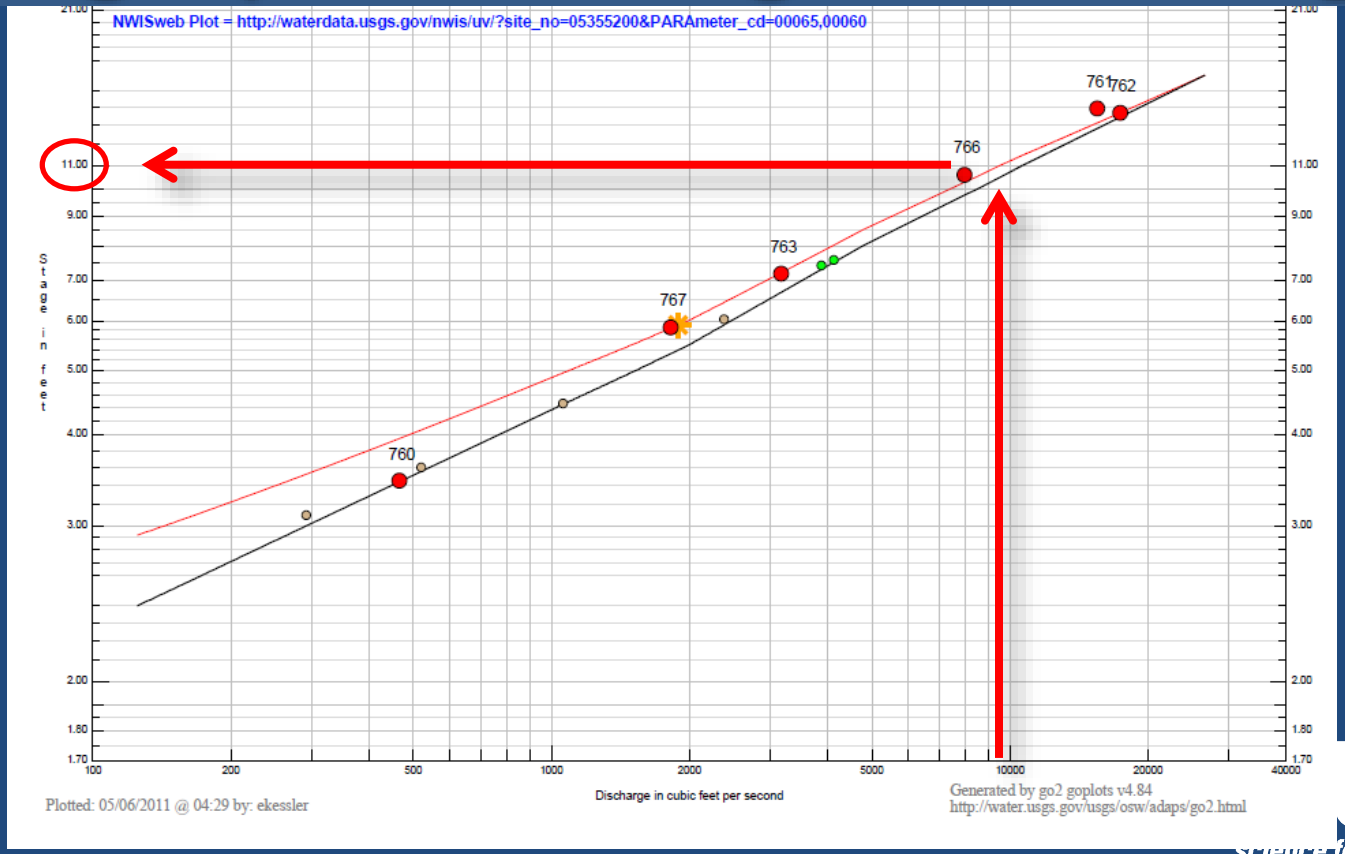
USGS and NWS use these USGS ratings in fundamentally different ways!

NWS uses rain & snowmelt runoff models to predict the discharge to pass your location, then uses rating to predict how high the river will get!



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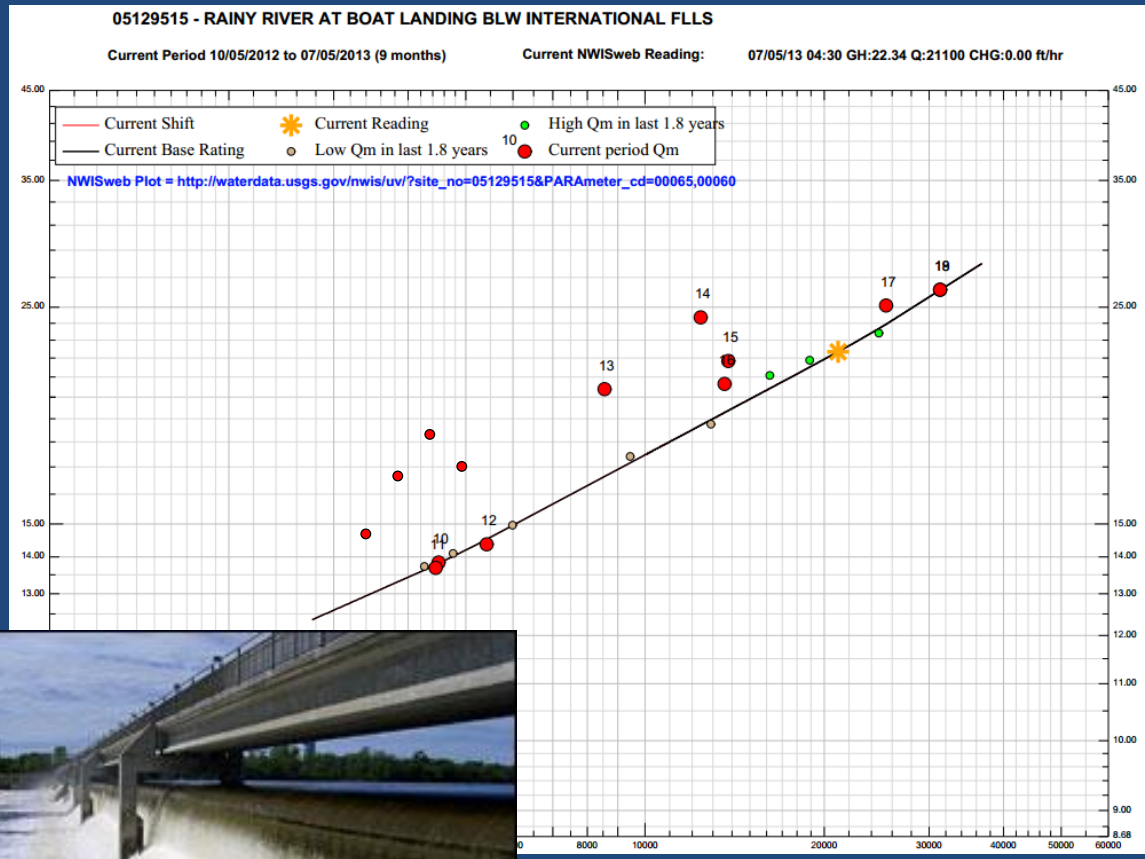
Stage-Discharge Ratings May Be Invalidated by Variable Backwater

Causes:

- Ice
- Downstream dams & gate changes
- River confluences
- Vegetation



Coon Rapids Dam & Rum River likely cause backwater at Highway 169

Solution: index-velocity & area rating…

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2 more sources of information needed to compute discharge by Index-velocity method

$$Q = AV$$

Q = Discharge (m^3/s or cfs)
A = Channel cross-section Area (m^2 or ft^2)
V = Mean channel velocity (m/s or ft/sec)

- 3. Channel area - computed at a specific, selected location using a *stage-area rating*
- 4. Mean-channel velocity - computed from the index velocity measured by an instrument using an *index-to-mean velocity rating*

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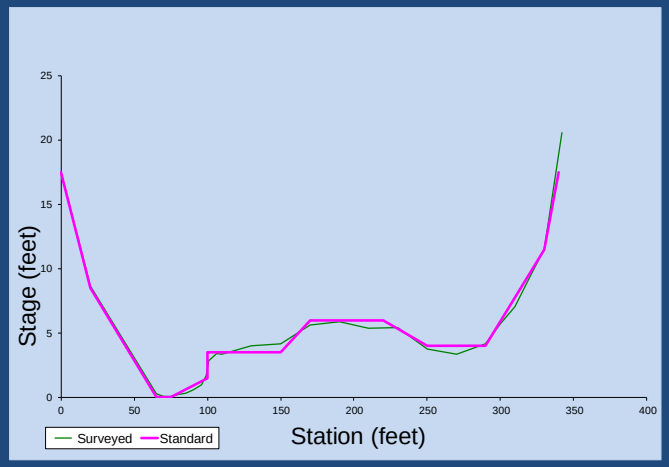
Index-Velocity Method

Channel Area

To compute channel areas for a range of stages, a *stage-area rating* must be developed

- Channel surveyed
- Stage-area rating developed from the survey data



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Index-velocity Method

Index-velocity ratings:

- ADVMs measure in a portion of the channel; mean channel velocity is not measured directly
- Thus we need to relate the ADVM measured velocity (*index velocity*) to the measured-mean channel velocity.
- *This relation varies with orientation of ADVM and spot in channel chosen for indexing*

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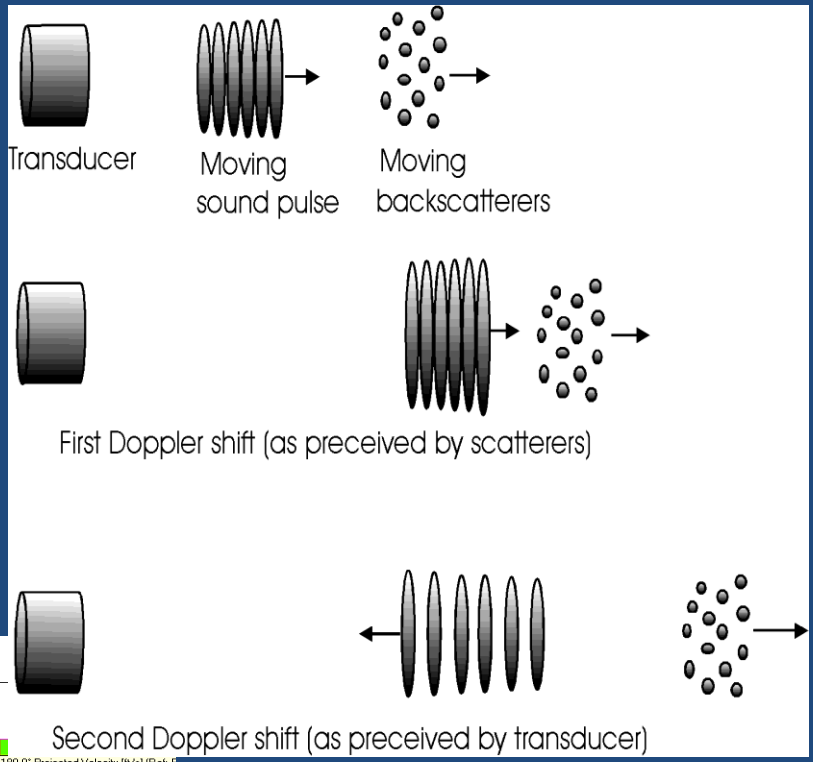
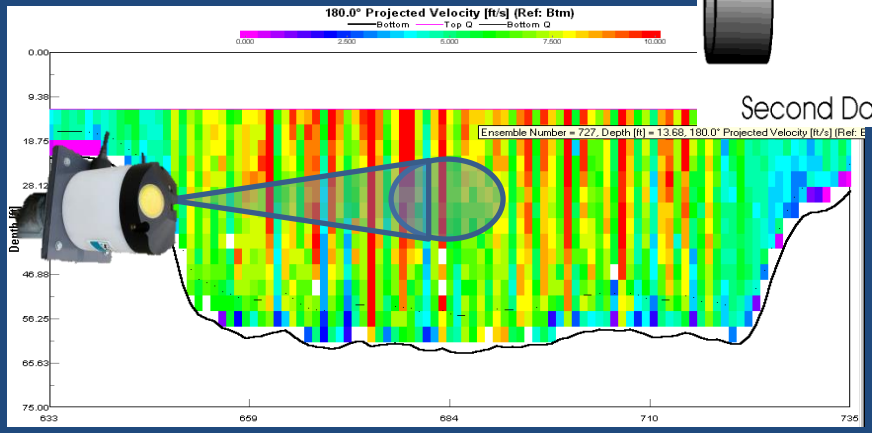
Additional site instrumentation: Index-velocity-area gage to measure stream velocity

Acoustic Doppler Velocity Meter (ADVM)





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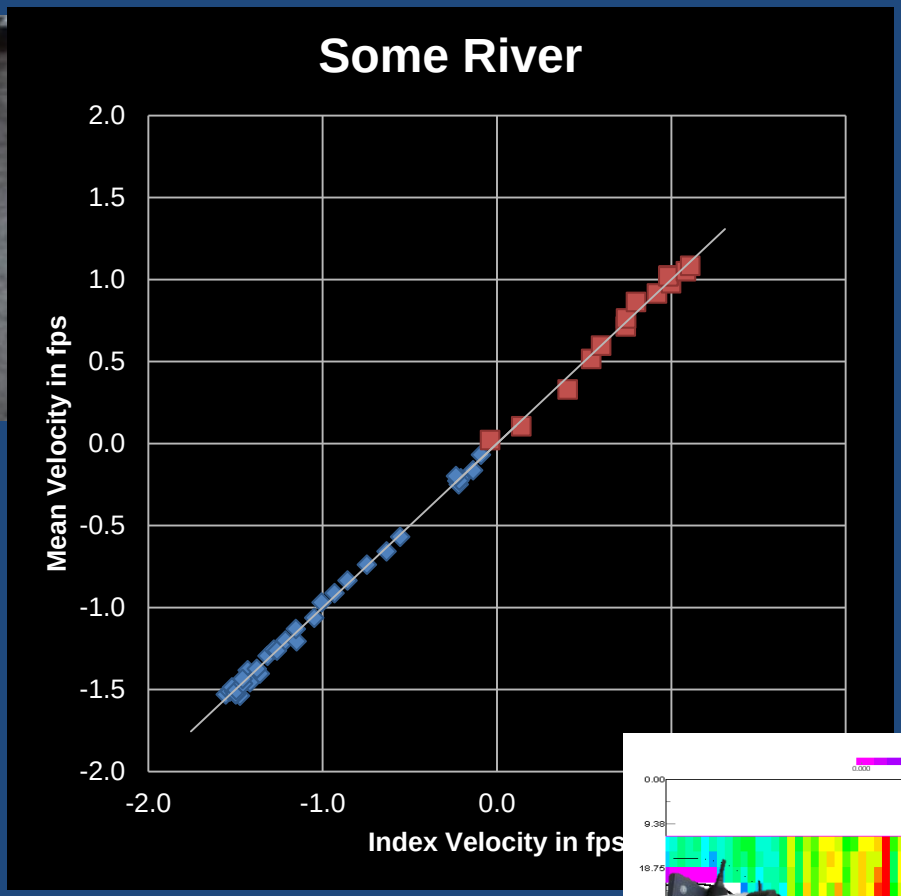
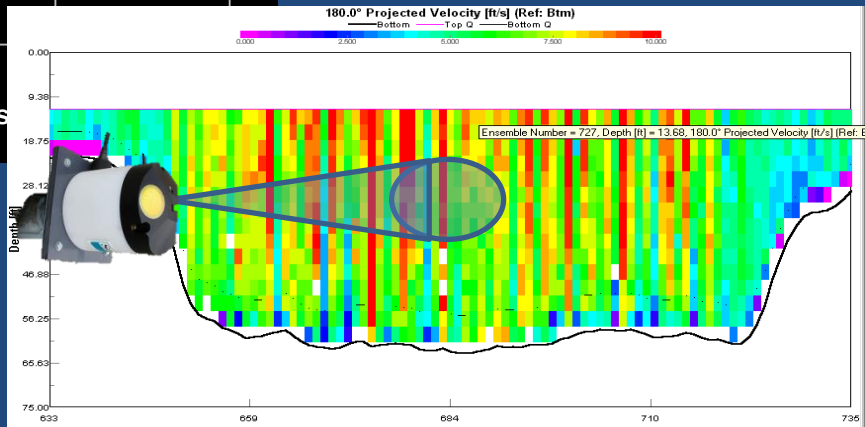
Create a relation between

Mean of channel velocity by discharge measurement





Continuously recorded Index velocity

Computing Continuous Discharge at an Index Velocity Site

- For each stage value we compute area = A
- For each velocity value we compute mean channel velocity = V
- Then Q=VA
- →Discharge record

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Newer method does uses the surface-water velocity radar to do similar

- Radar pings water-surface velocity
- Less vulnerable to flood damage & maintenance
- Method in development, less certain currently
- Plan to use here

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Types of Continuous Streamgages
By Increasing Complexity & Cost

Data Collected	Radar	Pressure Transducer /Bubbler	Velocity Meter Meter
1. Stage only			
A. 3-season (no ice-affected record)	Yes	Yes	
B. 4-season (includes winter record)	Maybe	Yes	
2. Stage & Discharge			
A. 3-season (no ice-affected discharge)	Yes	Yes	
B. 4-season (includes winter discharge)	Maybe	Yes	
3. Stage, Index-Velocity, Discharge			
A. 3-season (no ice-affected discharge)	Yes	Yes	Yes
B. 4-season (includes winter discharge)	Maybe	Maybe not	Yes

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Radar Stage Measurement

Least expensive to install & maintain

Cannot be used in winter to accurately sense stage through ice

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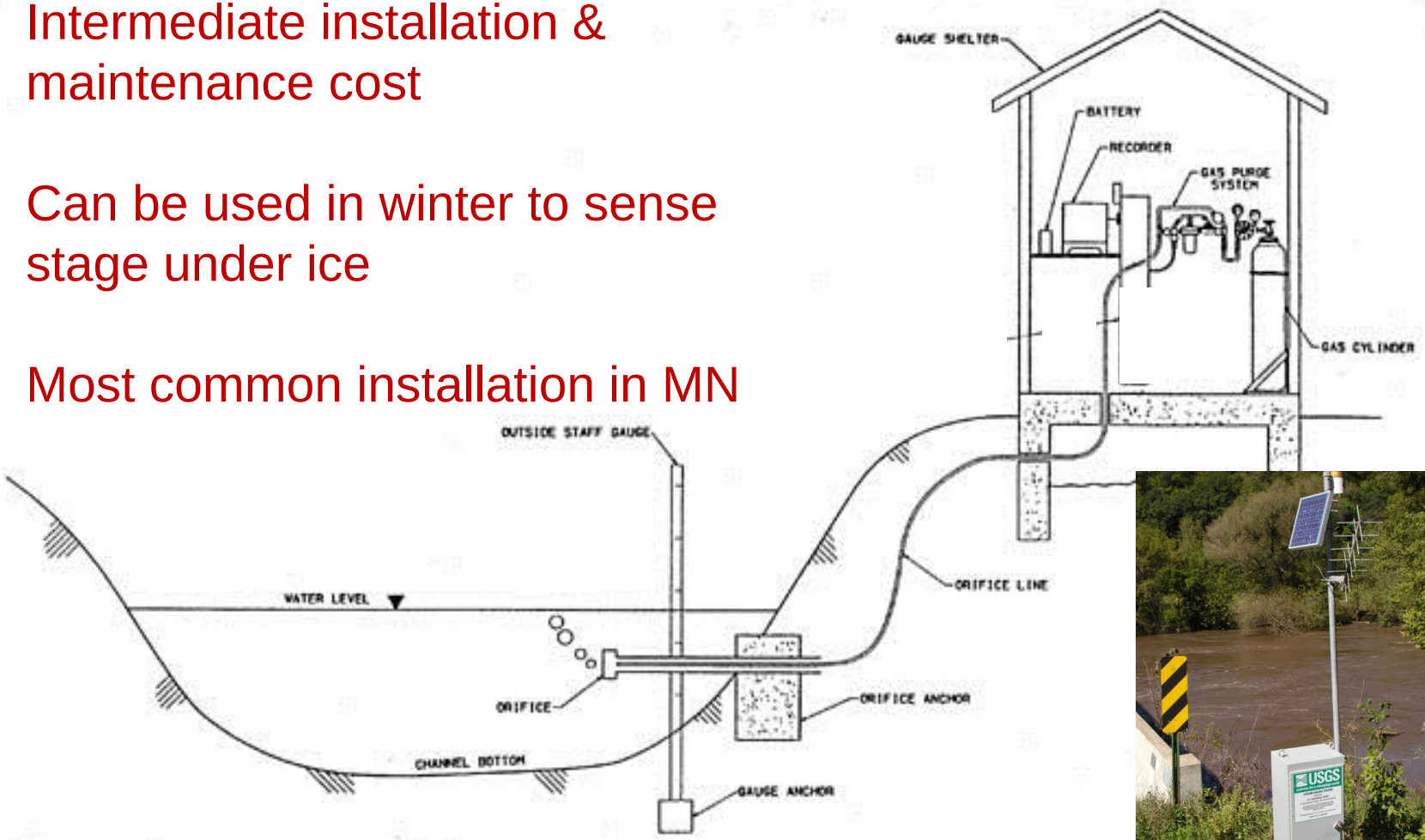
Pressure transducer & bubbler system

Intermediate installation & maintenance cost

Can be used in winter to sense stage under ice

Most common installation in MN



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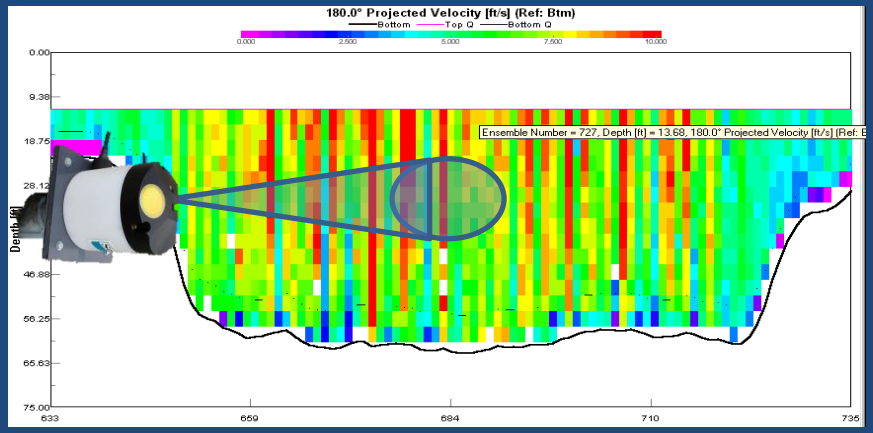
Index-velocity/area gage uses Doppler effect to compute discharge

Acoustic Doppler Velocity Meter (ADVM)



Or surface-water velocity radar

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Installation-related expenses that USGS has purchased or will cover

Item	Amount
1. Stage sensor (radar)	$4,100
2. Surface velocity sensor	$10,400
3. Gage shelter & mounting	$8,900
4. Data coll. platform, telemetry	$4,300
(5. Labor, permits, etc)	($6,200)
Total	$33,900

1. Installation will be paid by USGS-GWSIP funds
2. USGS has limited match to contribute to annual O&M costs

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Approximate[1] Gross[2] Costs of Gages

Gage type	O&M, 2017[4]	
	3-Season	4-Season
1. Stage only	$6,000	$8,000
2. Stage & Discharge	$13,000	$17,300
3. Stage, index-vel, discharge		
A. ADVM	$17,300	$20,000
B. SW Vel. Radar	$17,300	$20,000

1. Approximate because installations are site specific
2. Gross costs do not reflect split between USGS & partners
3. Much of installation may be paid by USGS-GWSIP funds
4. USGS has $1000 of match to contribute to annual O&M costs

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Form 9-1366
(Oct. 2005)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement

Customer #: 600000
Agreement #: 12EMMNNQ0002500
Project #: GC12NQ000010000/KN
TIN #: 41-6005882

Joint Funding Agreement

FOR
WATER RESOURCES INVESTIGATIONS

THIS AGREEMENT is entered into as of the 1st day of September, 2012, by the U.S. GEOLOGICAL SURVEY, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the Rice County, party of the second part.

1. The parties hereto agree that subject to availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation for the installation of a streamgage on the Cannon River at County 29 downstream of Faribault, Minnesota, herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50; and 43 USC 50b.
2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) includes In-Kind Services in the amount of $.

(a) $1,620 by the party of the first part during the period September 01, 2012 to September 30, 2012

(b) $12,480 by the party of the second part during the period September 01, 2012 to September 30, 2012

(c) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties.

(d) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.

3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.
4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.
5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.
6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.
7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.

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Topics

- Previous meetings regarding gage need
- USGS & streamgaging
- Review streamgaging process
- Streamgage options & costs
- Discussion
  - Your needs and uses for gage data?
  - Where to from here?
  - What do you get for your funds?

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What do you get for your money?

- More accurate, reliable river forecasts: NWS
- Robust, redundant near real-time data
  - Satellite data telemetered hourly to web
  - WaterAlert: user-specified SMSText/email alerts
- Partnership with USGS data collection
  - Among highest quality. Easier access to USGS professionals & technicians & hydrologic community
  - Immediate knowledge of ongoing & potential studies
- Nationally consistent data for other studies
  - Quality assurance & testing of new streamgaging tech.
- Many other applications of streamgage data
  - Link to One-StopStreamgage

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WaterAlert

- Receive automatic alerts via SMSText or email
- You set the threshold criteria for gage of interest
- Choose to be notified daily or hourly
- Unsubscribe easily (click on link in notification)

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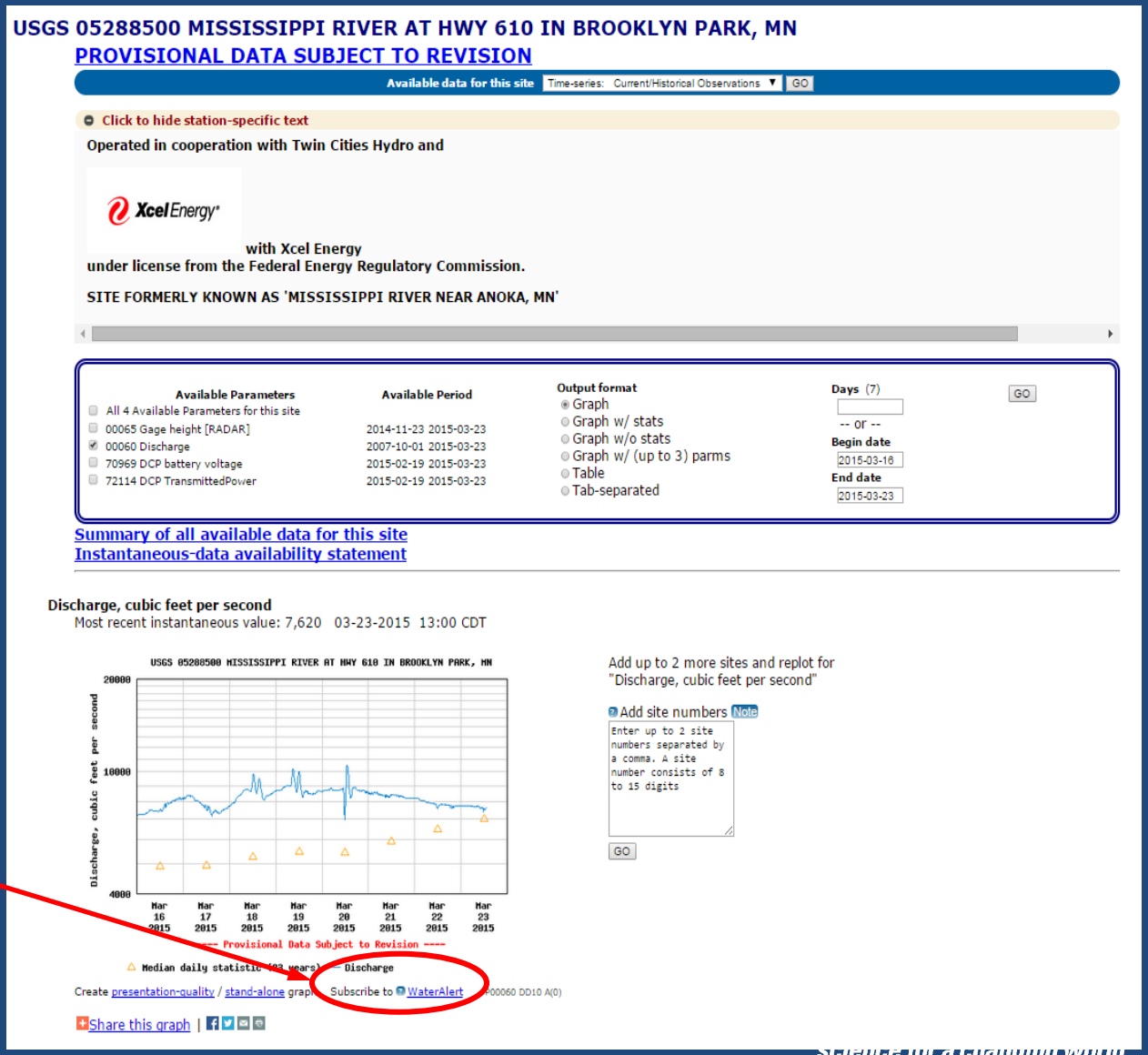
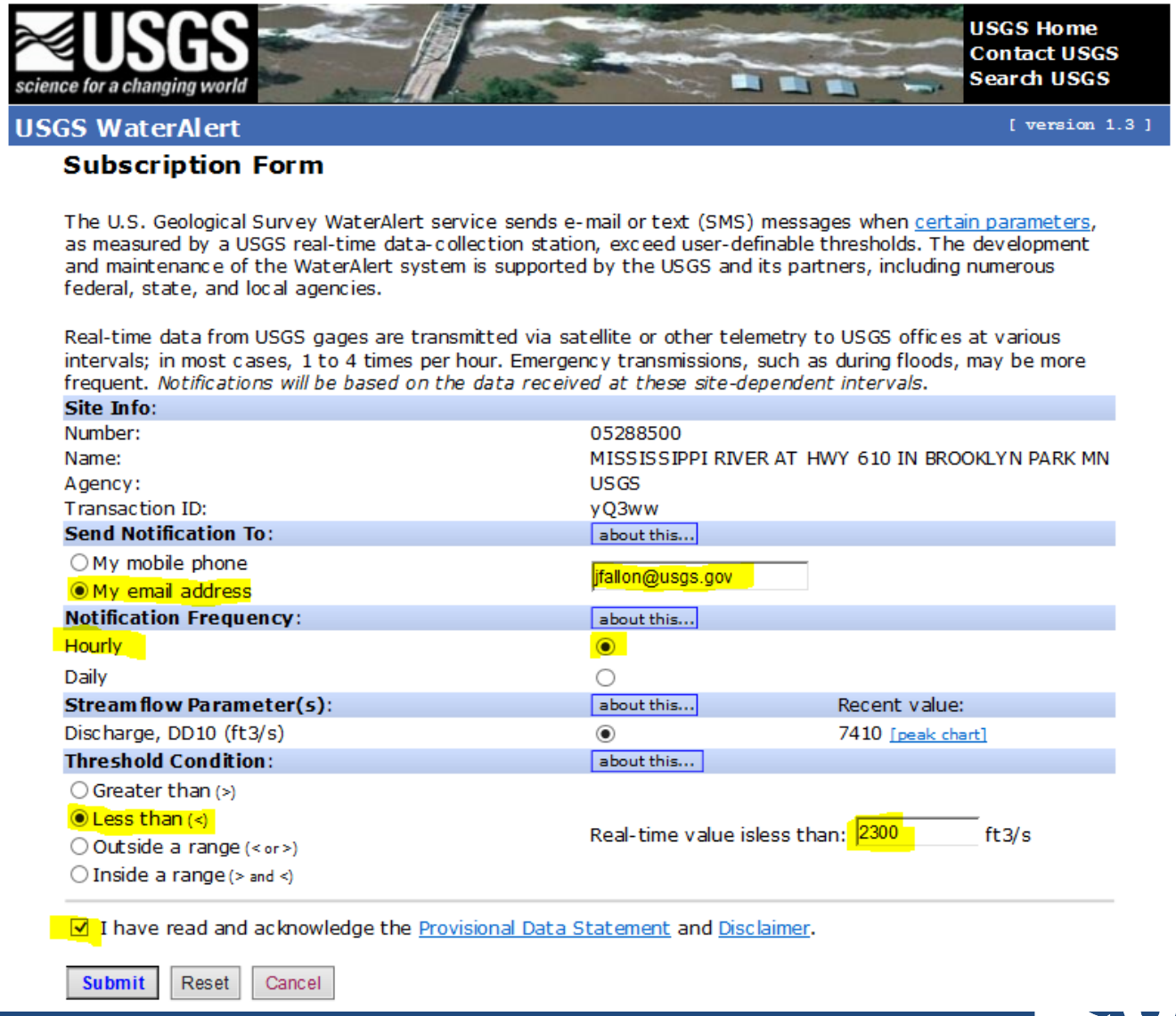
WaterAlert

- Easiest way to subscribe to the gage you already visit
- Otherwise search for "USGS WaterAlert"

Click on "WaterAlert" link under hydrograph



WaterAlert Subscription



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USGS WaterAlert [version 1.3]

Subscription Form

The U.S. Geological Survey WaterAlert service sends e-mail or text (SMS) messages when certain parameters, as measured by a USGS real-time data-collection station, exceed user-definable thresholds. The development and maintenance of the WaterAlert system is supported by the USGS and its partners, including numerous federal, state, and local agencies.

Real-time data from USGS gages are transmitted via satellite or other telemetry to USGS offices at various intervals; in most cases, 1 to 4 times per hour. Emergency transmissions, such as during floods, may be more frequent. *Notifications will be based on the data received at these site-dependent intervals.*

Site Info:

Number: 05288500
Name: MISSISSIPPI RIVER AT HWY 610 IN BROOKLYN PARK MN
Agency: USGS
Transaction ID: yQ3ww

Send Notification To: about this...

- ○ My mobile phone
- ◉ My email address — jfallon@usgs.gov

Notification Frequency: about this...

- Hourly ◉
- Daily ○

Streamflow Parameter(s): about this... Recent value:

- Discharge, DD10 (ft3/s) ◉ 7410 [peak chart]

Threshold Condition: about this...

- ○ Greater than (>)
- ◉ Less than (<)
- ○ Outside a range (< or >)
- ○ Inside a range (> and <)

Real-time value isless than: 2300 ft3/s

☑ I have read and acknowledge the Provisional Data Statement and Disclaimer.

Submit | Reset | Cancel

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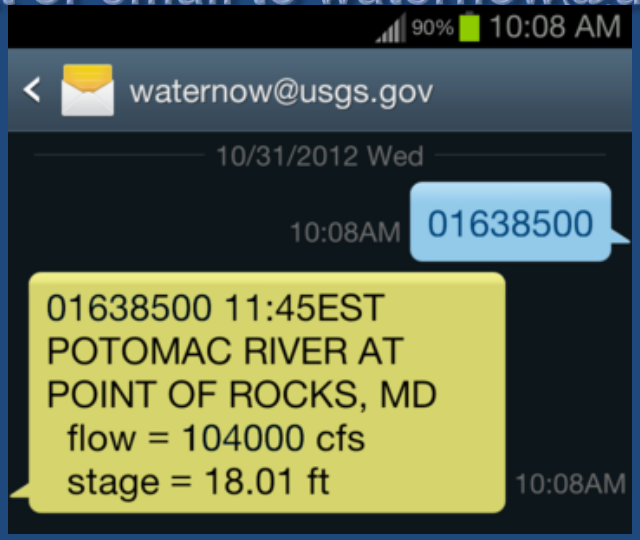
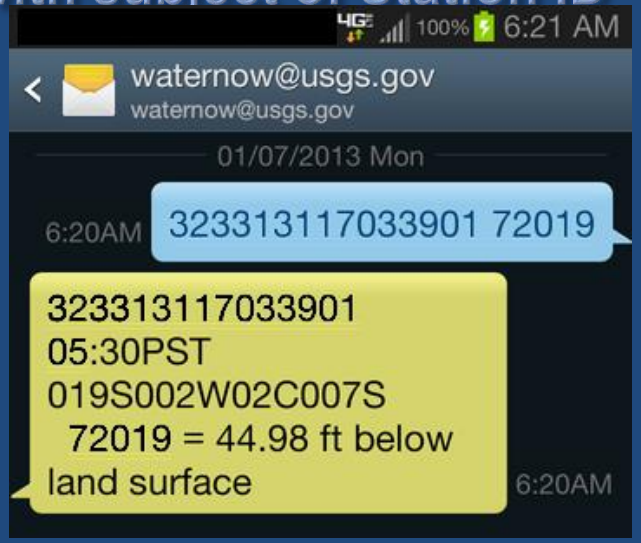
WaterNow –

Send text or email to waternow@usgs.gov , with subject of Station ID

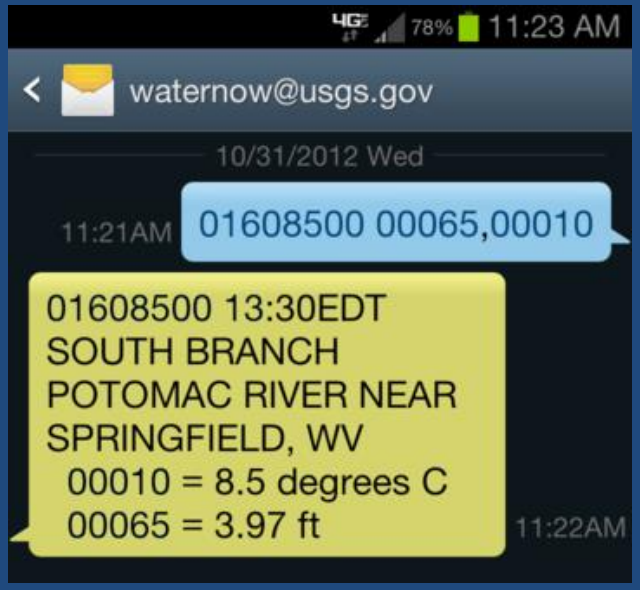
1. Simple. Recommend for stage or discharge. Enter station Identifier.



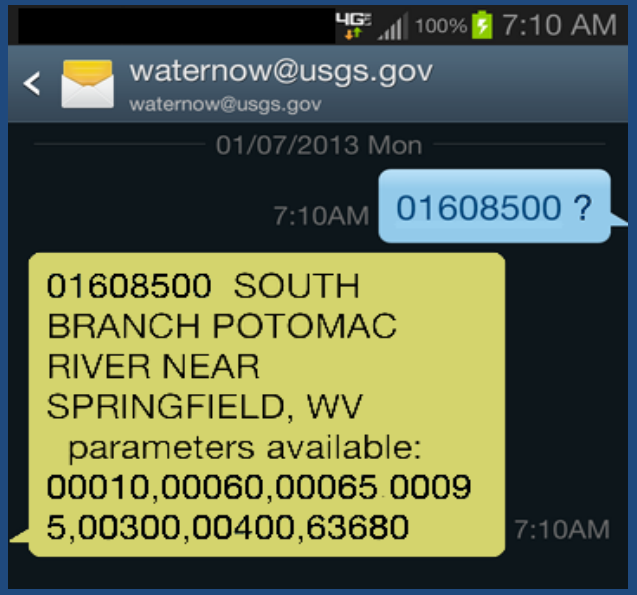
2. Enter STAID + parameter code



3. Enter STAID + many parameter codes



4. Query STAID for available parameter codes



DISCLAIMERS

It is important to note that ratings will change, and sometimes frequently. Checking the depot regularly will ensure that the currently applicable shifted rating is used for the current data, and that the current rating cannot necessarily be used on historical data. A standard disclaimer statement at the head of each rating file is included indicating this.

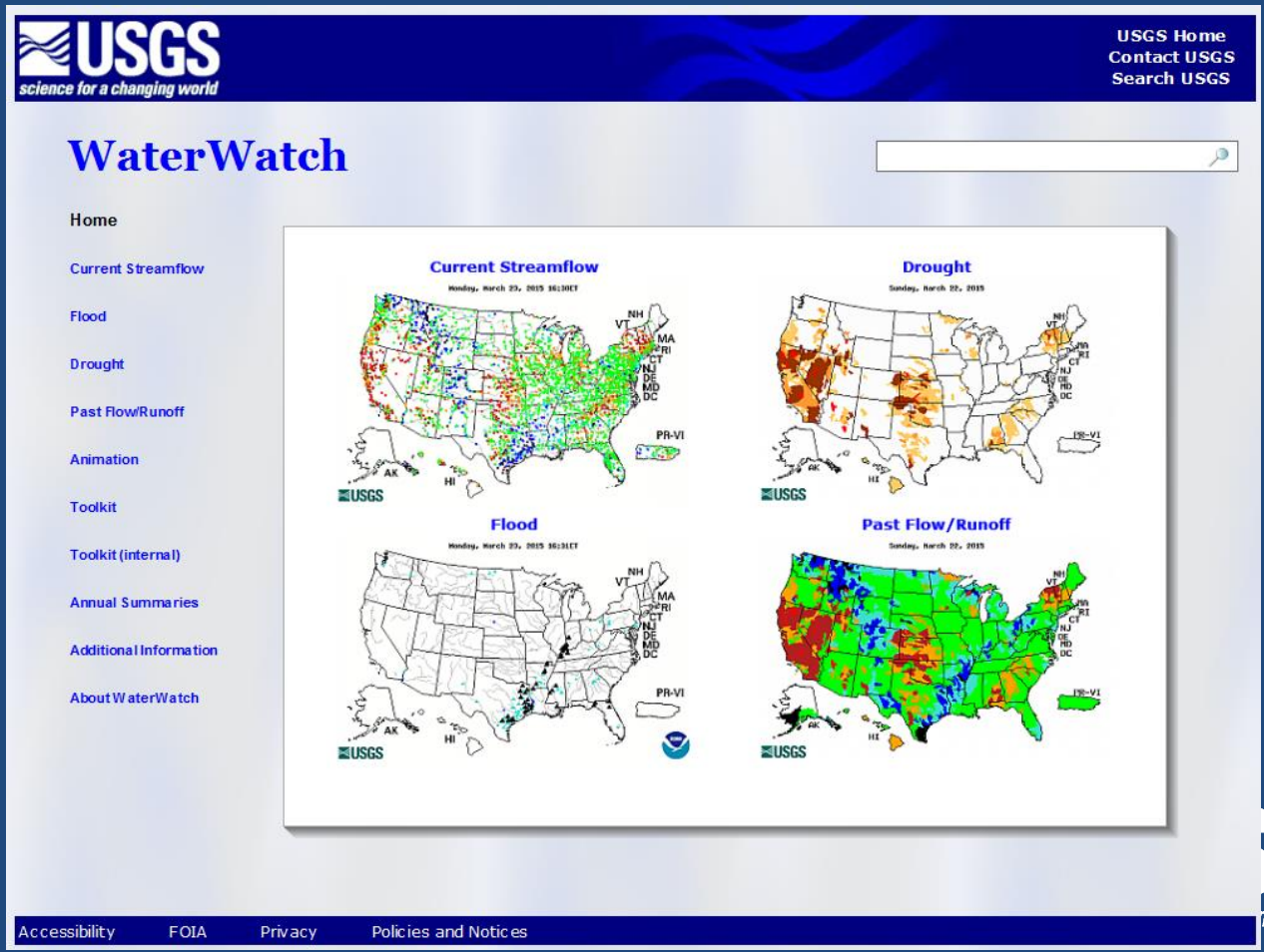
*"**Stage-discharge relations (ratings)** are usually developed from a graphical analysis of numerous discharge measurements. Measurements are made on various schedules and sometimes for different purposes. All discharge measurements are compiled and maintained in a data base. Each measurement is carefully made, and undergoes quality assurance review. Some measurements indicate a temporary change in the rating, often due to a change in the streambed (for example, erosion or deposition) or growth of riparian vegetation. Such changes are called shifts; they may indicate a short- or long-term change in the rating for the gage. In normal usage, the measured shifts (or corrections) are applied mathematically to a defined rating.*

The tables being provided are shift corrected, incorporating the mathematical adjustments for ease of use by the user. The shift adjustments are applied to the individual ratings as measured data becomes available, resulting in an adjusted rating. Some ratings may change as often as weekly, others may not change for months or years.

```
# //UNITED STATES GEOLOGICAL SURVEY       http://water.usgs.gov/
# //NATIONAL WATER INFORMATION SYSTEM     http://water.usgs.gov/data.html
# //DATA ARE PROVISIONAL AND SUBJECT TO CHANGE UNTIL PUBLISHED BY USGS
# //RETRIEVED: 2014-12-19 10:15:01
# //WARNING
# //WARNING The stage-discharge rating provided in this file should be
# //WARNING considered provisional and subject to change. Stage-discharge
# //WARNING ratings change over time as the channel features that control
# //WARNING the relation between stage and discharge vary. Users are
# //WARNING cautioned to consider carefully the applicability of this
# //WARNING rating before using it for decisions that concern personal or
# //WARNING public safety or operational consequences.
# //WARNING
# //FILE TYPE="NWIS RATING"
# //DATABASE NUMBER=01 DESCRIPTION=" Standard data base for this site."
# //STATION AGENCY="USGS " NUMBER="05288500       " TIME_ZONE="CST" DST_FLAG=Y
# //STATION NAME="MISSISSIPPI RIVER AT HWY 610 IN BROOKLYN PARK, MN"
# //DD NUMBER="  10" LABEL="Discharge (ft3/s)"
# //PARAMETER CODE="00060"
# //RATING SHIFTED="20141219100000 CST"
# //RATING ID="27.0" TYPE="STGQ" NAME="stage-discharge" AGING=R
# //RATING REMARKS="Adjusted G.H. of rating points due to gage move."
# //RATING EXPANSION="logarithmic"
# //RATING OFFSET1=0.00
# //RATING_INDEP ROUNDING="2223456782" PARAMETER="Gage height (ft)"
# //RATING_DEP ROUNDING="2222233332" PARAMETER="Discharge (ft3/s)"
# //RATING_DATETIME BEGIN=20140101000000 BZONE=CST END=23821230100000 EZONE=CST AGING=W
# //SHIFT_PREV BEGIN="--------------" BZONE="---" END="--------------" EZONE="---"
# //SHIFT_PREV STAGE1="---" SHIFT1="---" STAGE2="---" SHIFT2="---" STAGE3="---" SHIFT3="---"
# //SHIFT_PREV COMMENT=" "
# //SHIFT_NEXT BEGIN="--------------" BZONE="---" END="--------------" EZONE="---"
# //SHIFT_NEXT STAGE1="---" SHIFT1="---" STAGE2="---" SHIFT2="---" STAGE3="---" SHIFT3="---"
# //SHIFT_NEXT COMMENT=" "
INDEP   SHIFT   DEP     STOR
16N     16N     16N     1S
1.00    0.00    1680    *
1.01    0.00    1700
1.02    0.00    1710
1.03    0.00    1730
1.04    0.00    1750
1.05    0.00    1770
1.06    0.00    1780
1.07    0.00    1800
1.08    0.00    1820
1.09    0.00    1840
1.10    0.00    1850
1.11    0.00    1870
1.12    0.00    1890
1.13    0.00    1910
1.14    0.00    1920
1.15    0.00    1940
1.16    0.00    1960
1.17    0.00    1980
1.18    0.00    1990
1.19    0.00    2010
1.20    0.00    2030
```

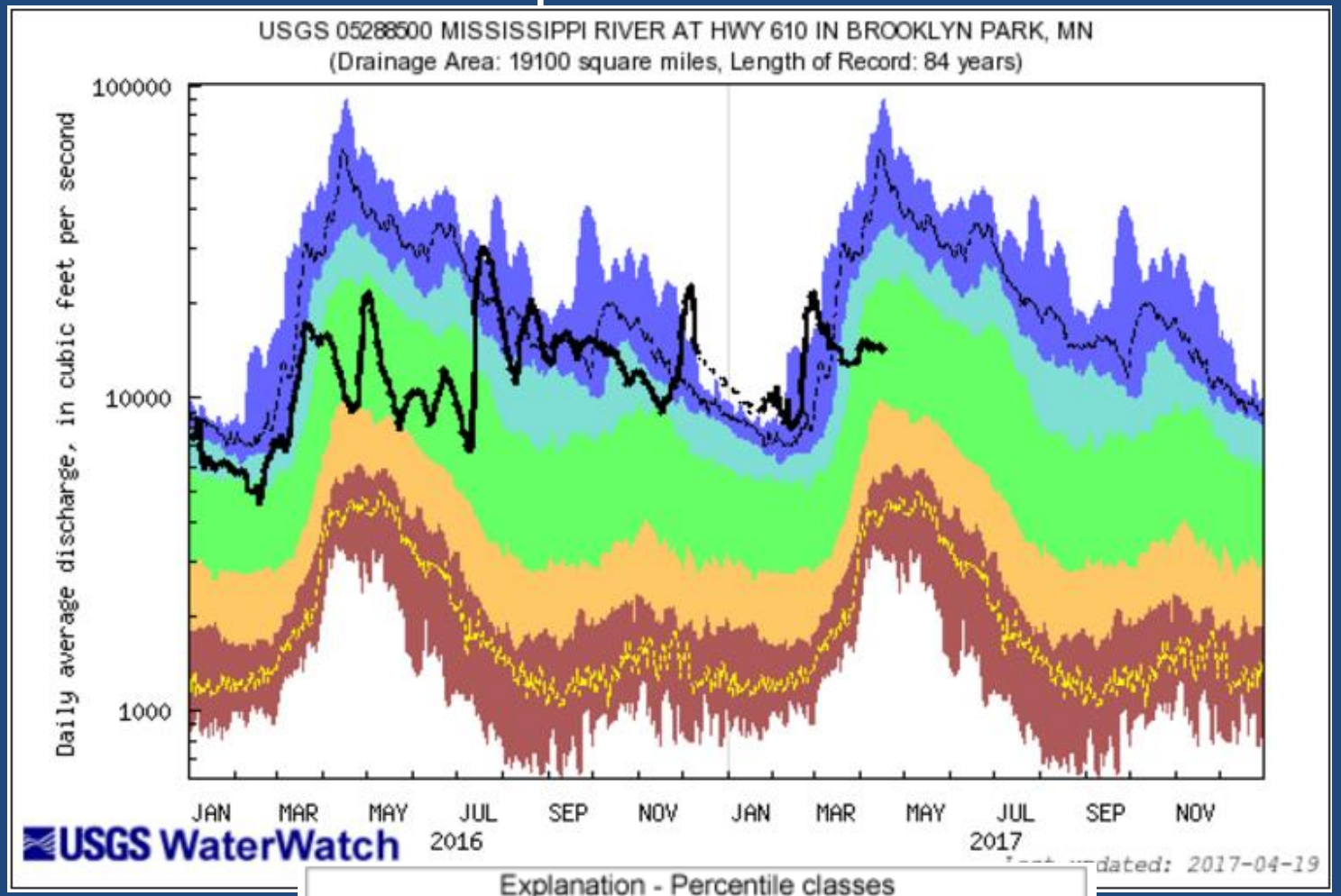
WaterWatch

- What is (or was) the streamflow?
- Compared to when?



USGS WaterWatch

- How do flows compare to historical?



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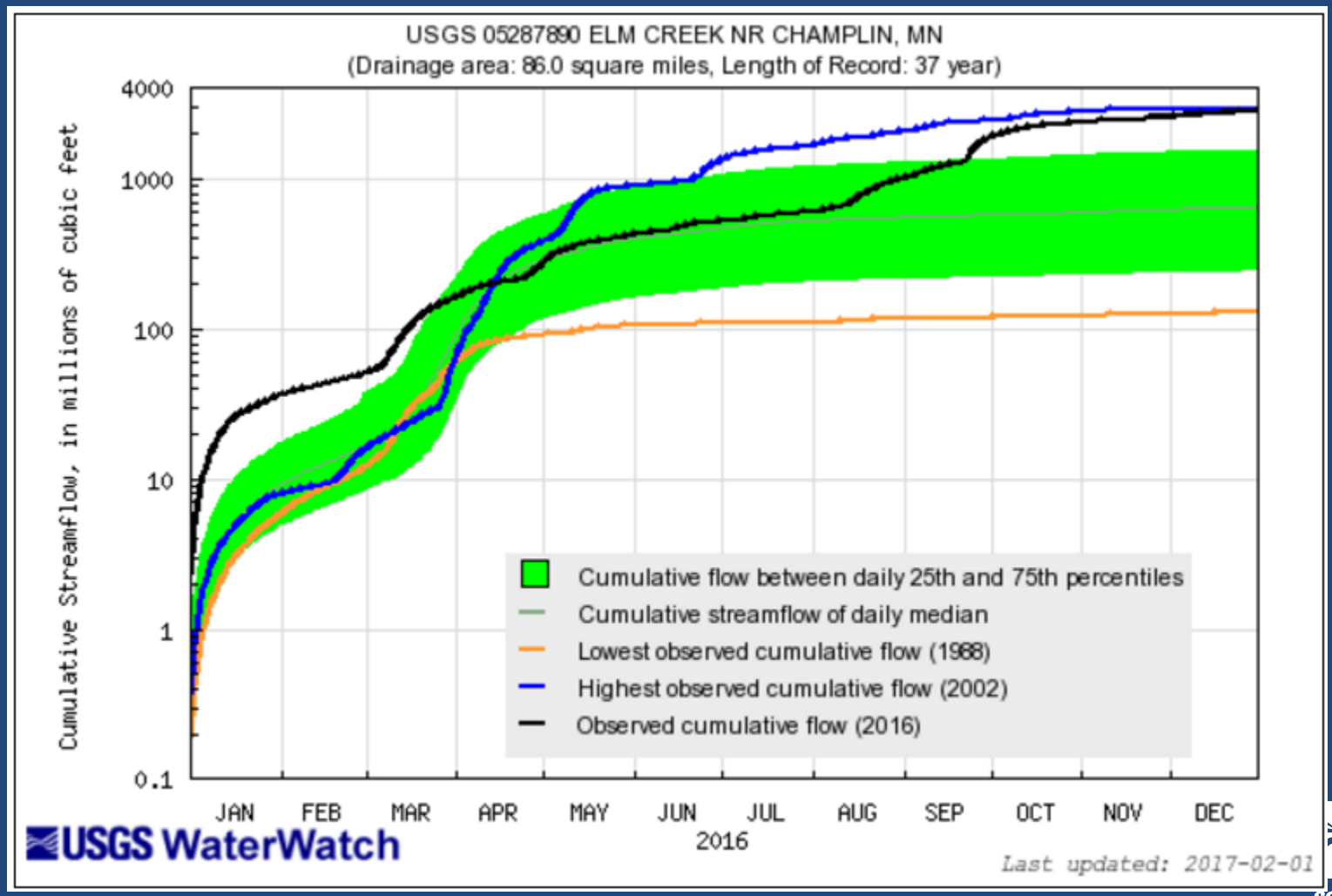
USGS WaterWatch

- Was 2016 wettest year on record for Elm Cr?



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Streamgage webcams

Click to hide station-specific text

Operated in cooperation with the elm creek Watershed Management Commission

Click on **animated image** to see the latest **full size current video** from site. Click on the **Static Image** to

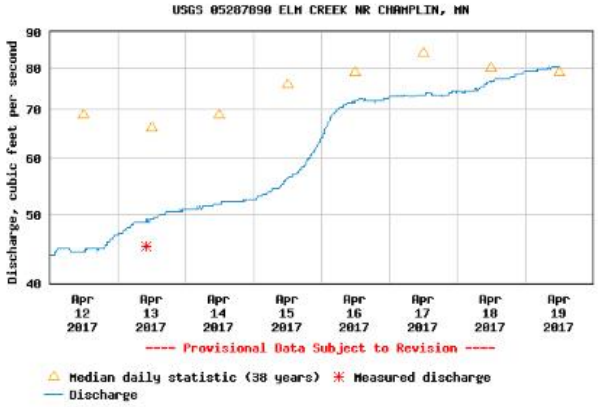
Time-lapse video products are considered a proof of concept with no guarantee regarding product up time. Tin
and Internet Explorer may be added later.

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by

Available Parameters	Available Period
All 3 Available Parameters for this site	
00060 Discharge	1991-10-01 2017-04-19
00065 Gage height	2016-12-20 2017-04-19
70969 DCP battery voltage	2016-12-28 2017-04-19

Summary of all available data for this site
Instantaneous-data availability statement

ischarge, cubic feet per second
Most recent instantaneous value: 80.3 04-19-2017 12:00 CDT



https://waterdata.usgs.gov/mn/nwis/uv/?site_no=05287890

https://waterdata.usgs.gov/mn/nwis/uv/?site_no=05289800