

Freshwater Inflows from Trinity River into Galveston Bay

October 7, 2015

U.S. Geological Survey
Texas Water Science Center
Gulf Coast Program Office

TRINITY RIVER

- It is believed that more than half of the average inflow into Galveston Bay comes from the Trinity River.
- Limited understanding of nutrient and sediment inputs.
- Accurate discharge measurements are needed.

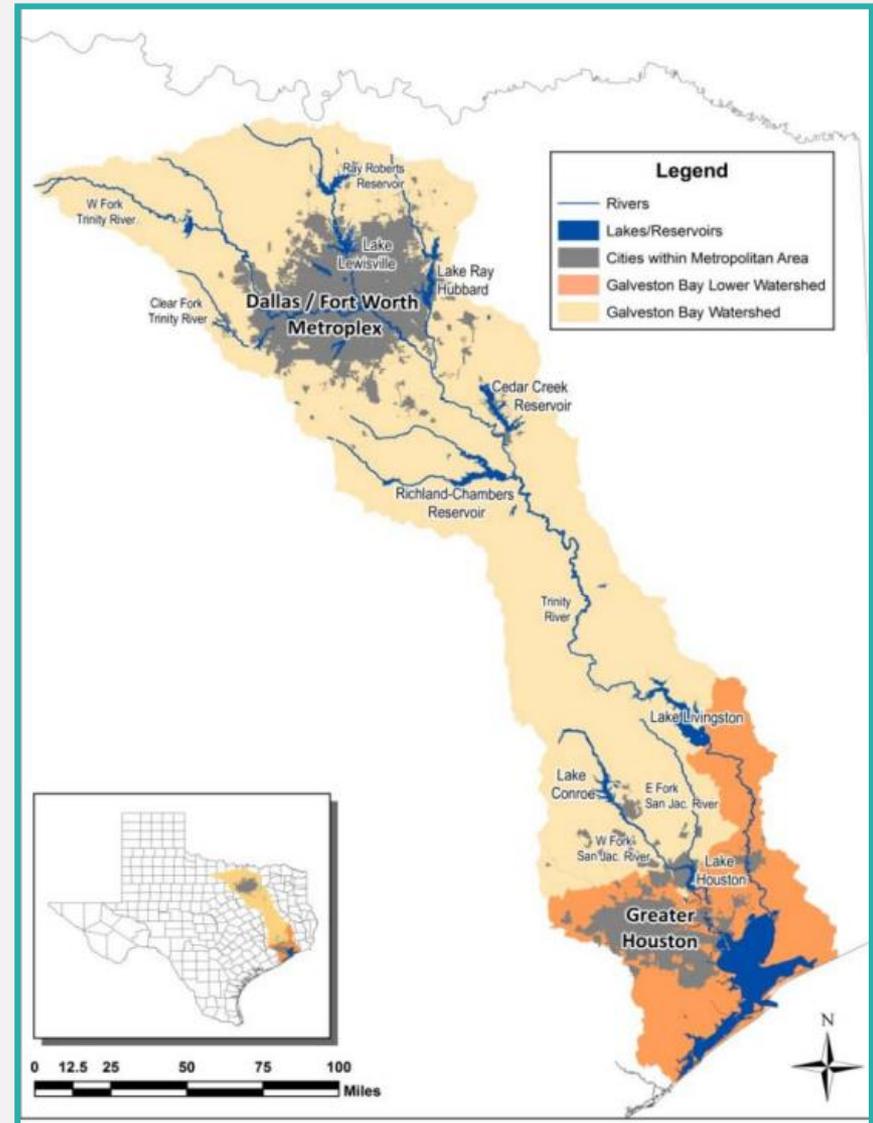
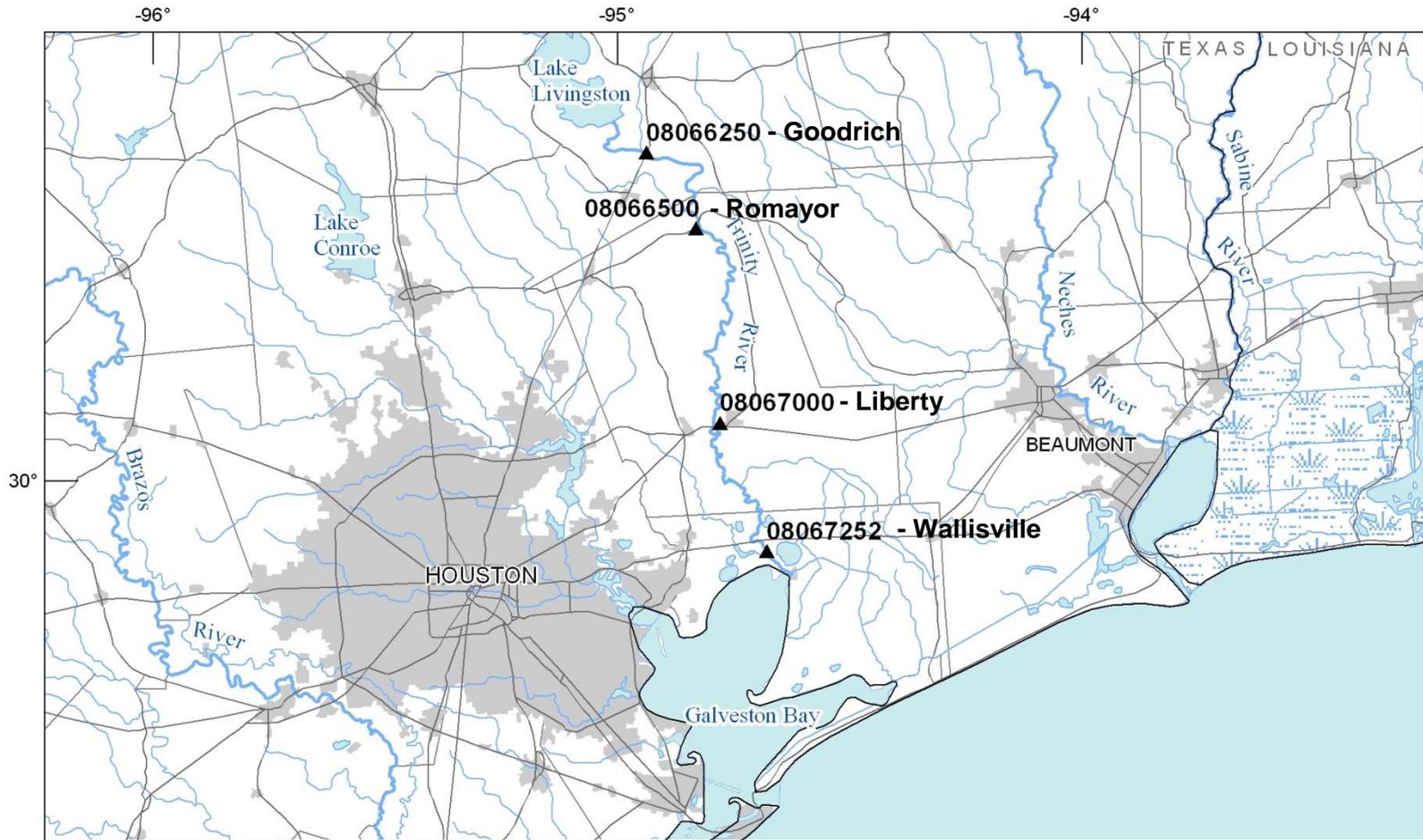
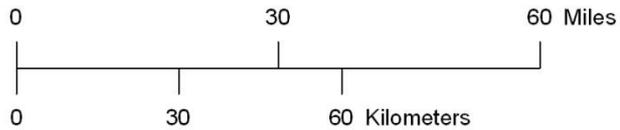


Image Source: Houston Advanced Research Center



Base from:
 U.S. Geological Survey,
 The National Atlas of the
 United States 1:2,000,000

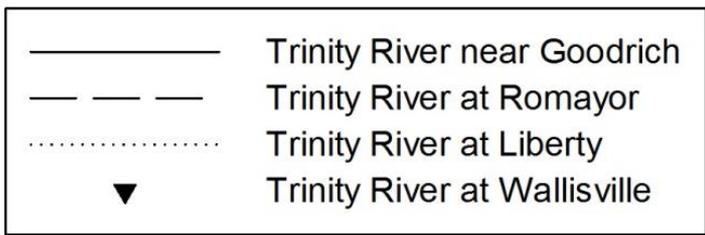
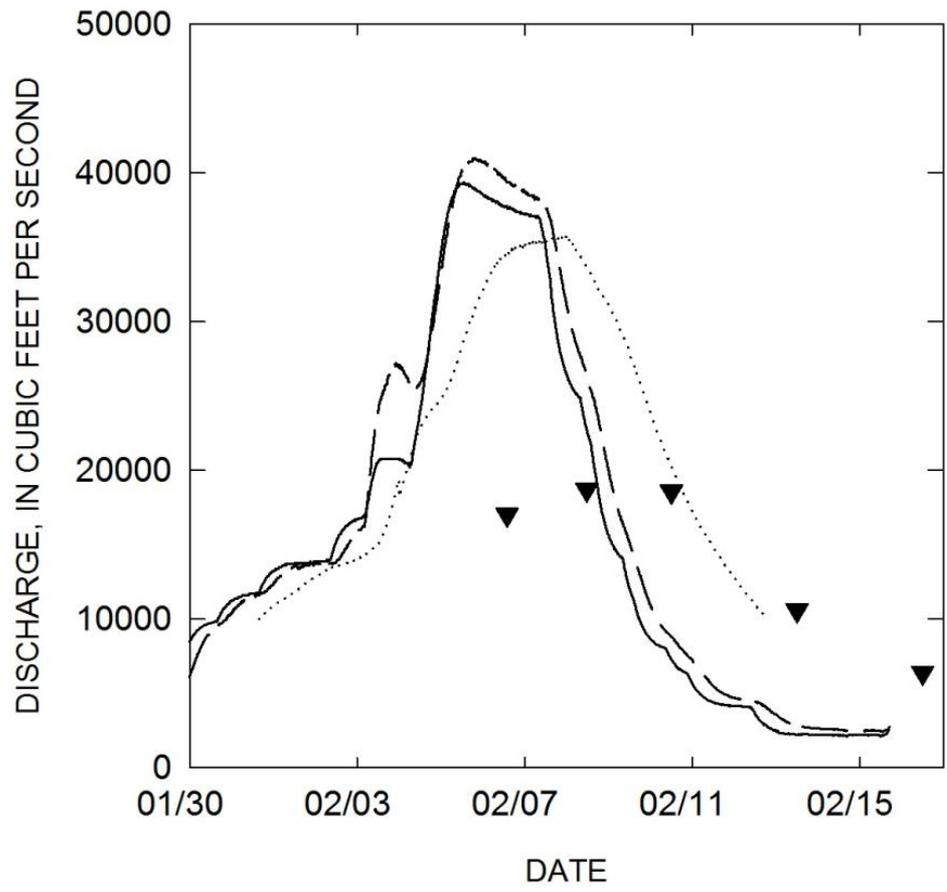
Texas Centric Mapping System
 Projection: Albers Equal Area
 Linear Unit: Meter
 Datum: North American Datum of 1983



EXPLANATION

▲ Stream gage

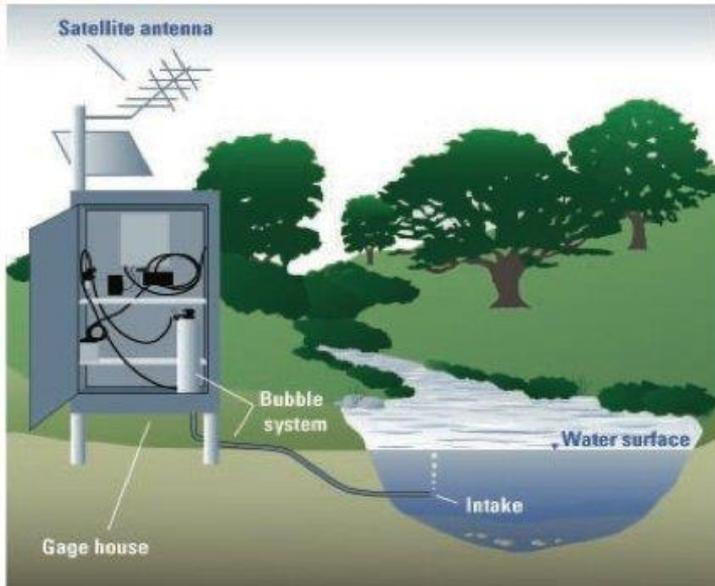




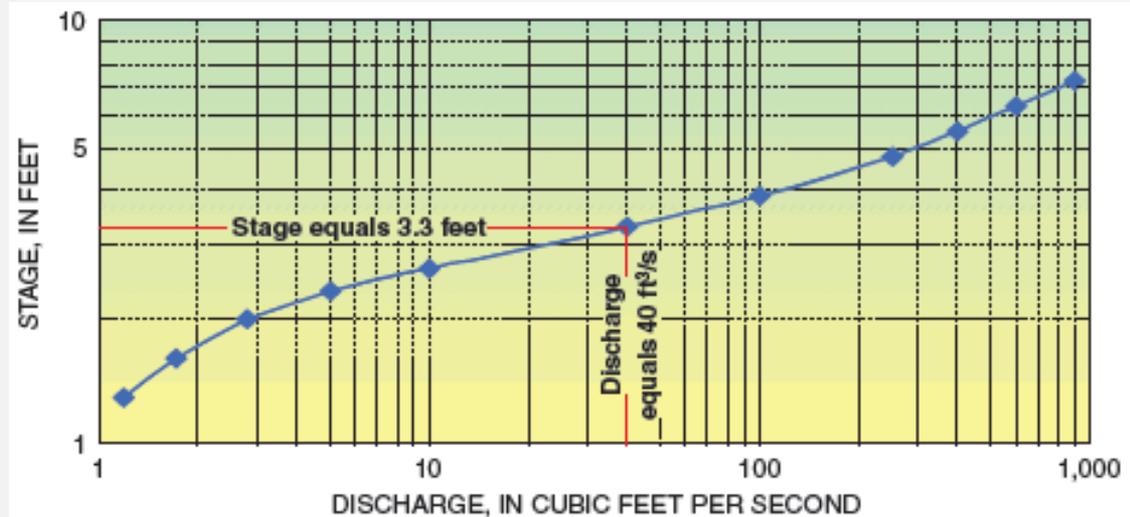
OBJECTIVES

- Define flow patterns in the lower reaches of the Trinity River.
- Evaluate the variability of nutrient and sediment concentrations and loads entering Galveston Bay over a range of hydrologic conditions.
- Investigate possible correlations between in situ field measurements of acoustic backscatter and discrete nutrient and sediment concentrations.

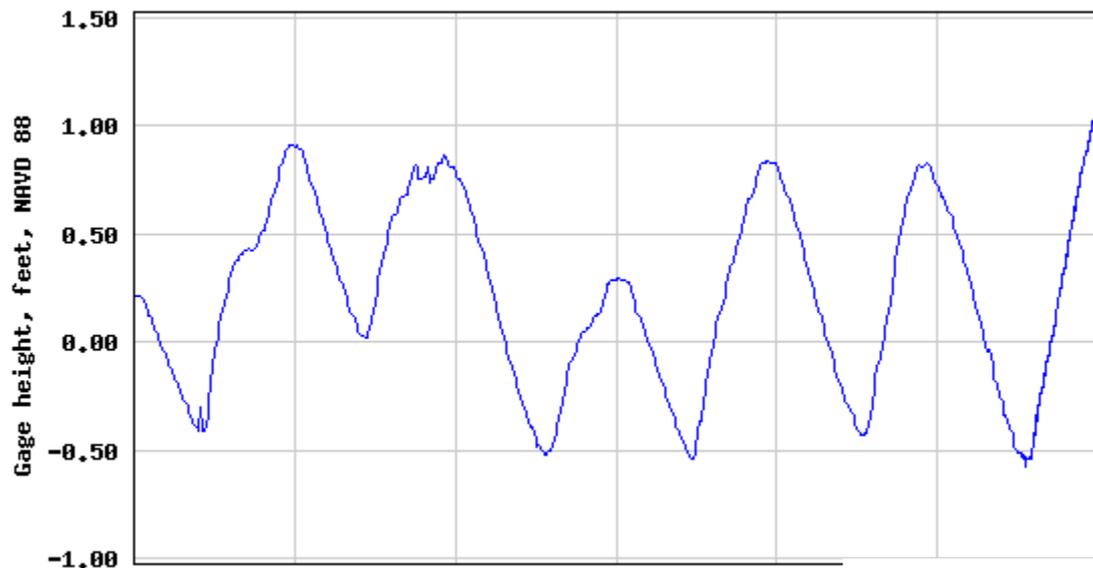
TRADITIONAL STREAMGAGING



- Stage-discharge rating curve developed from:
 - Stage
 - Discharge measurements



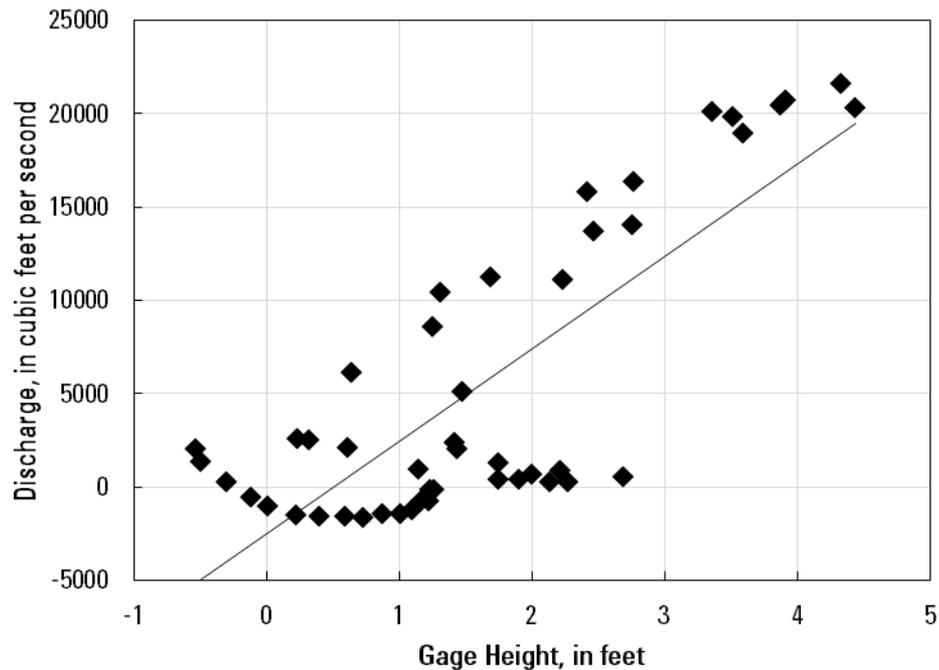
USGS 08067252 Trinity Rv at Wallisville, TX



Feb 10 2015 Feb 11 2015 Feb 12 2015 Feb 13 2015 F

----- Provisional Data Subject to Revision

- Coastal sites:
 - Multiple discharge for same stage

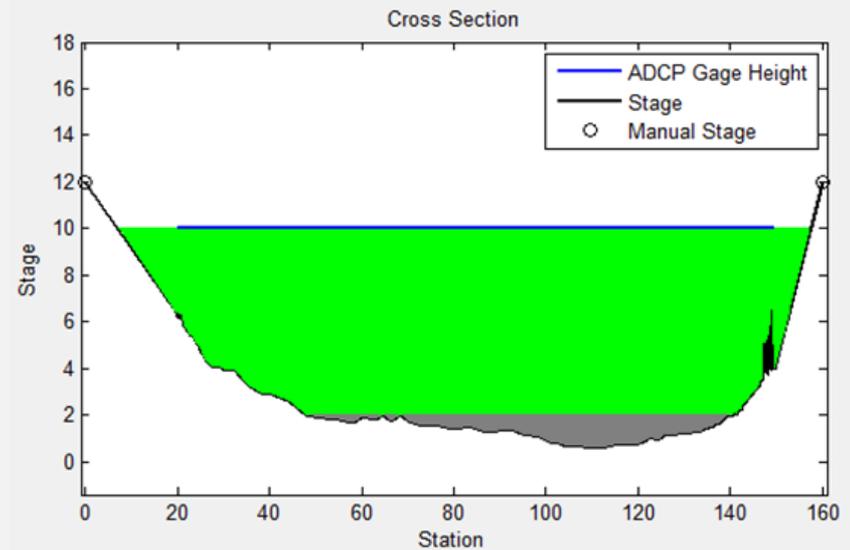
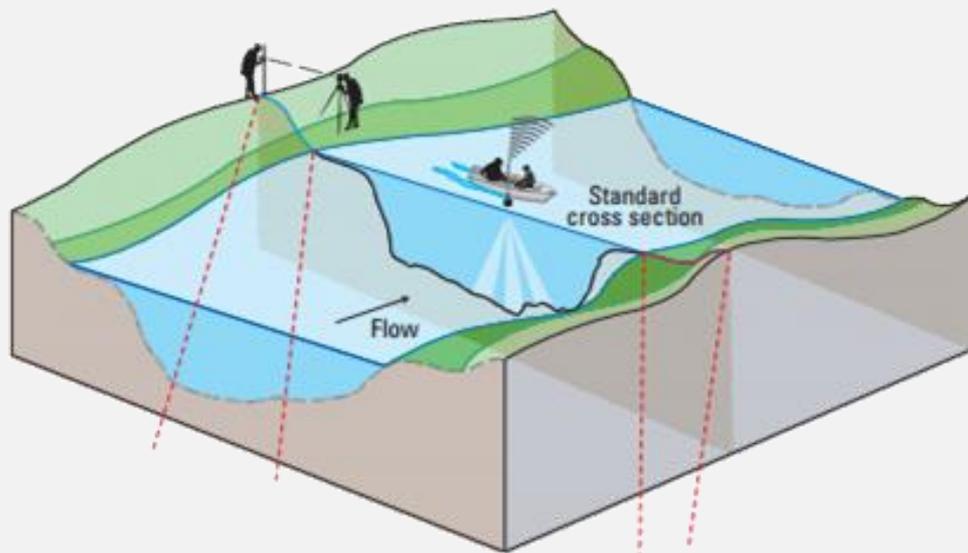


INDEX-VELOCITY 101

$$Q = \text{Area} \times \text{Velocity}$$

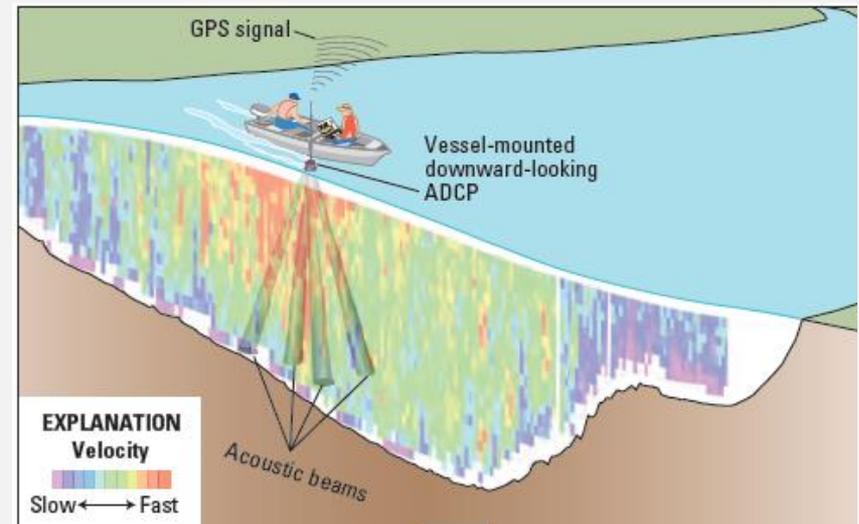
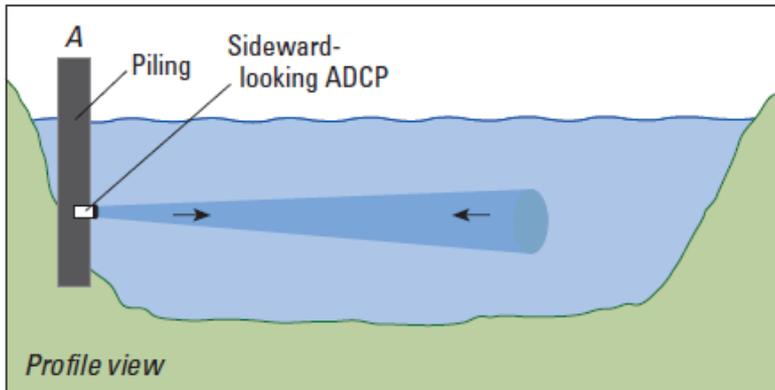
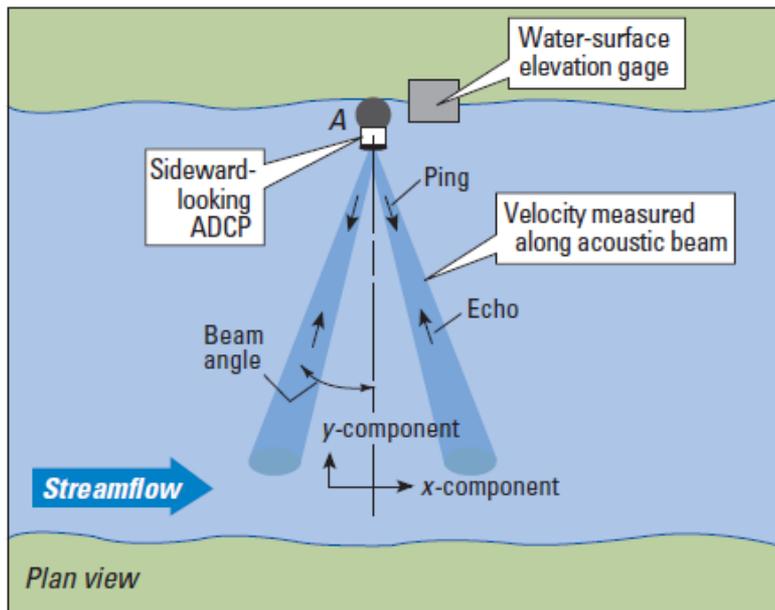
INDEX-VELOCITY METHOD

Stage-Area Rating



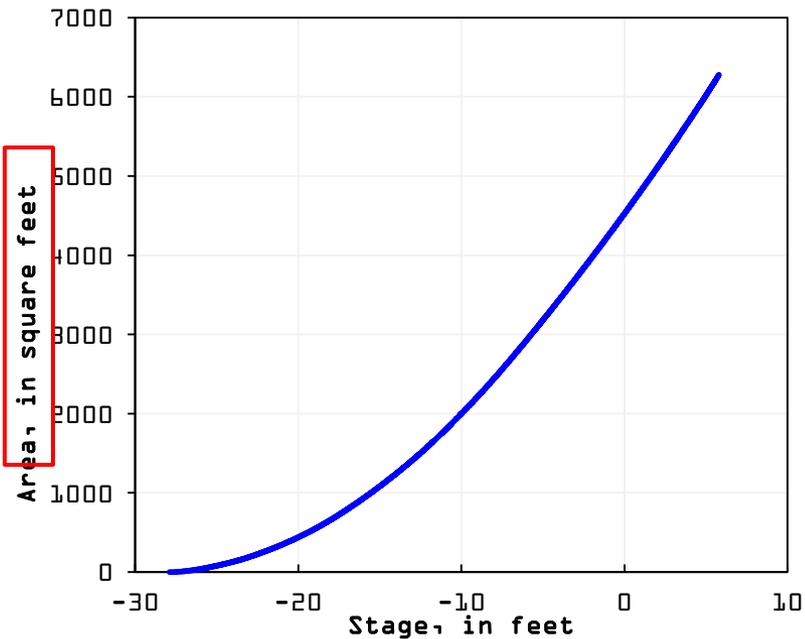
INDEX-VELOCITY METHOD

Index-Velocity Rating

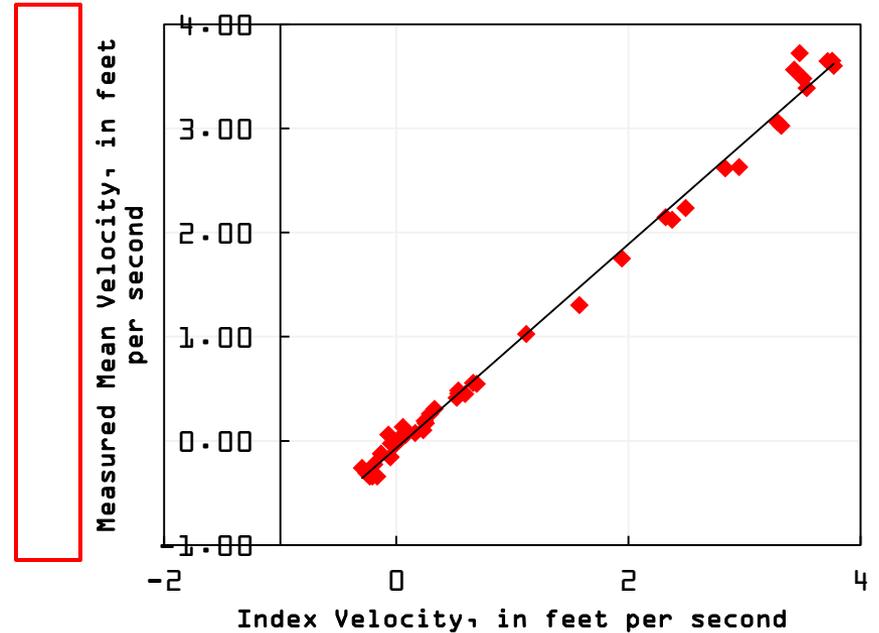


INDEX-VELOCITY METHOD

Stage-Area Rating



Index-Velocity Rating



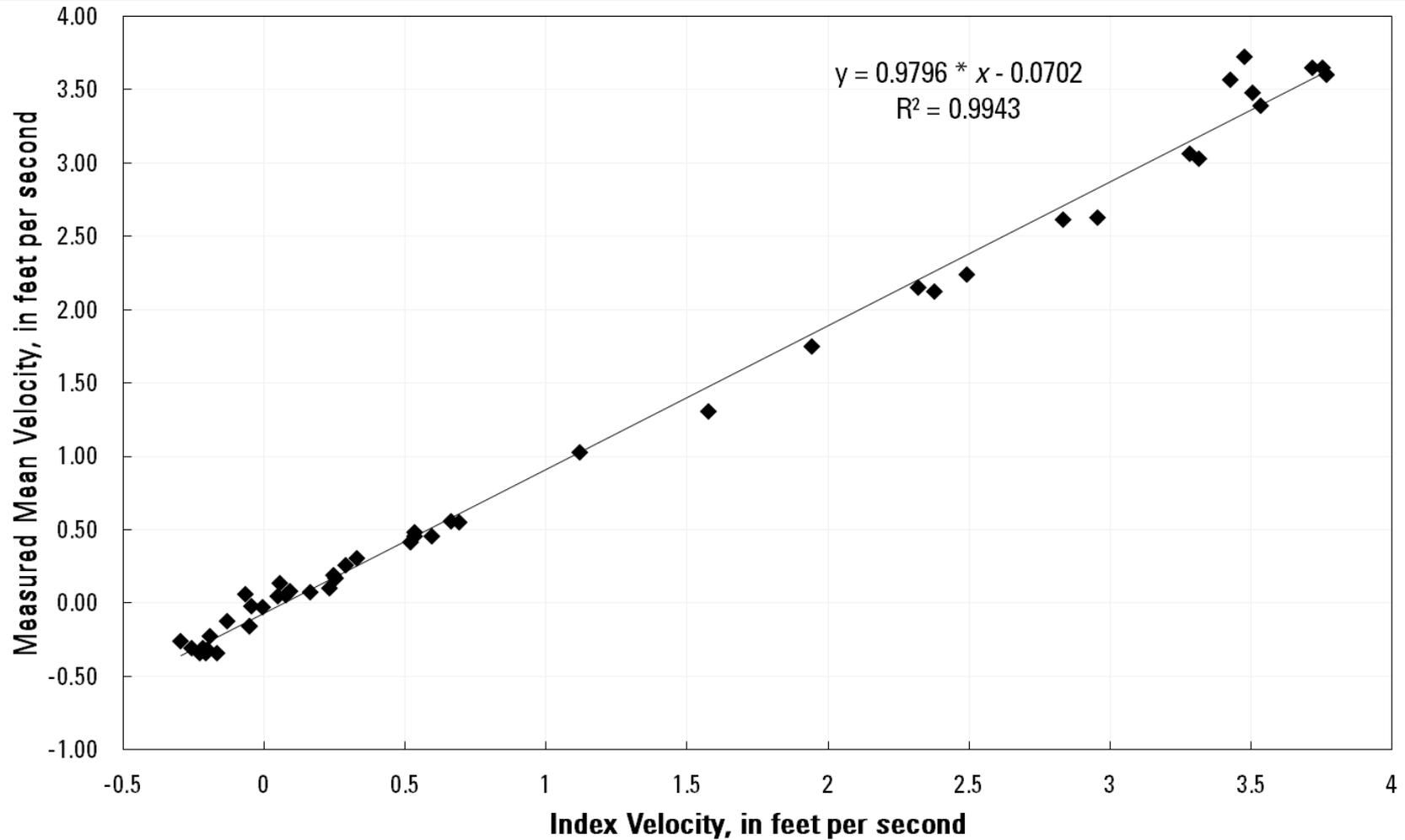
$$A \times V = Q$$

INDEX-VELOCITY GAGE

08067252

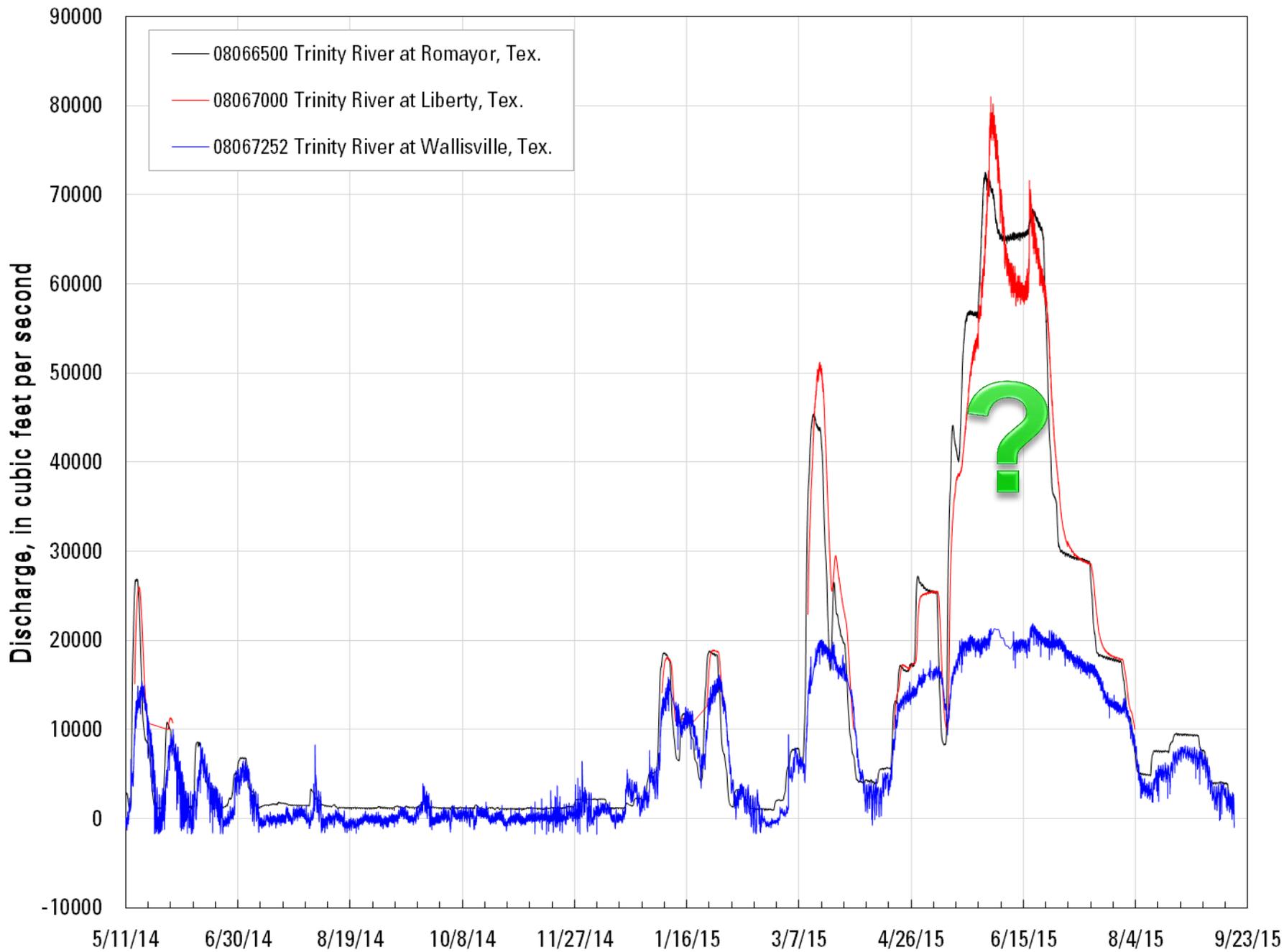


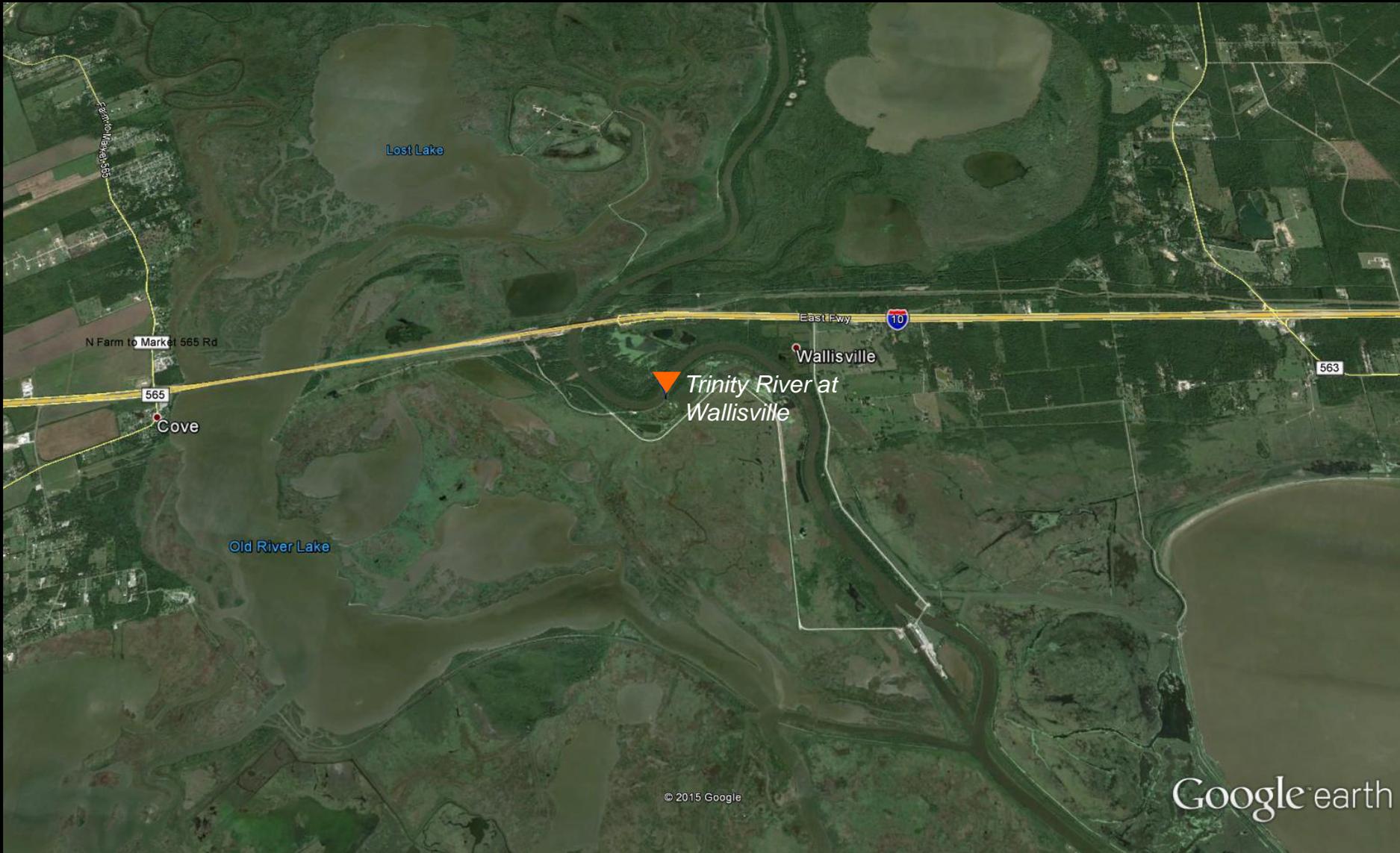
INDEX-VELOCITY RATING



n = 47

Range: -1,630 – 21,600 cfs



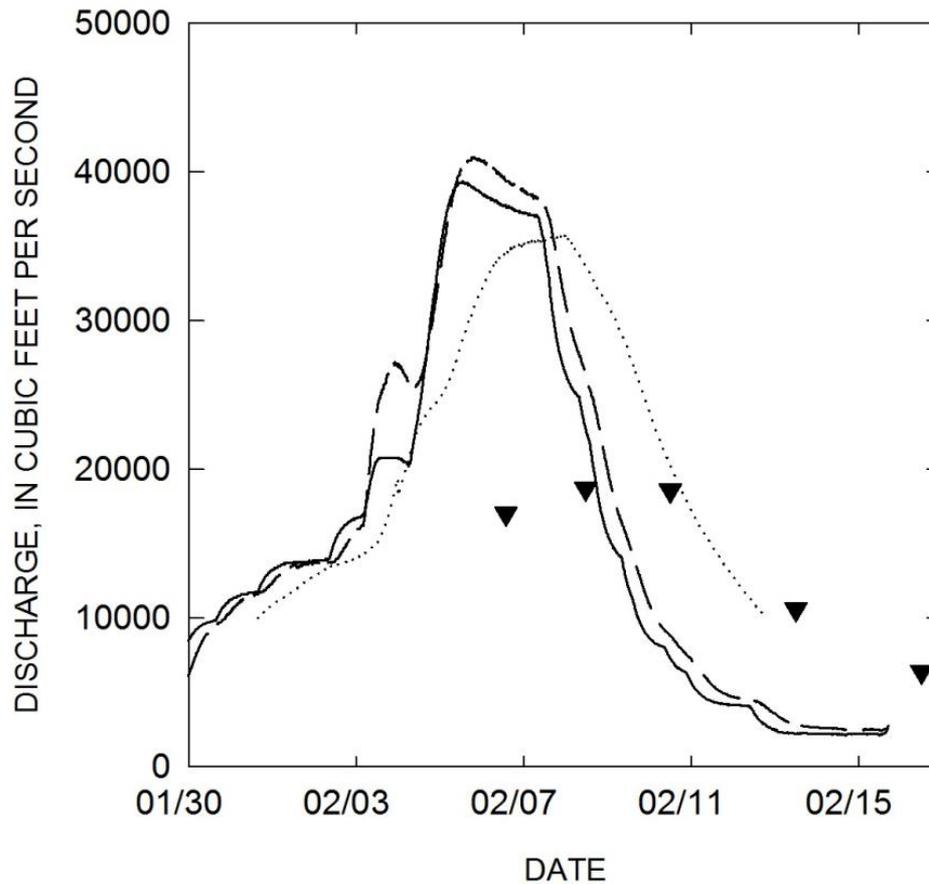


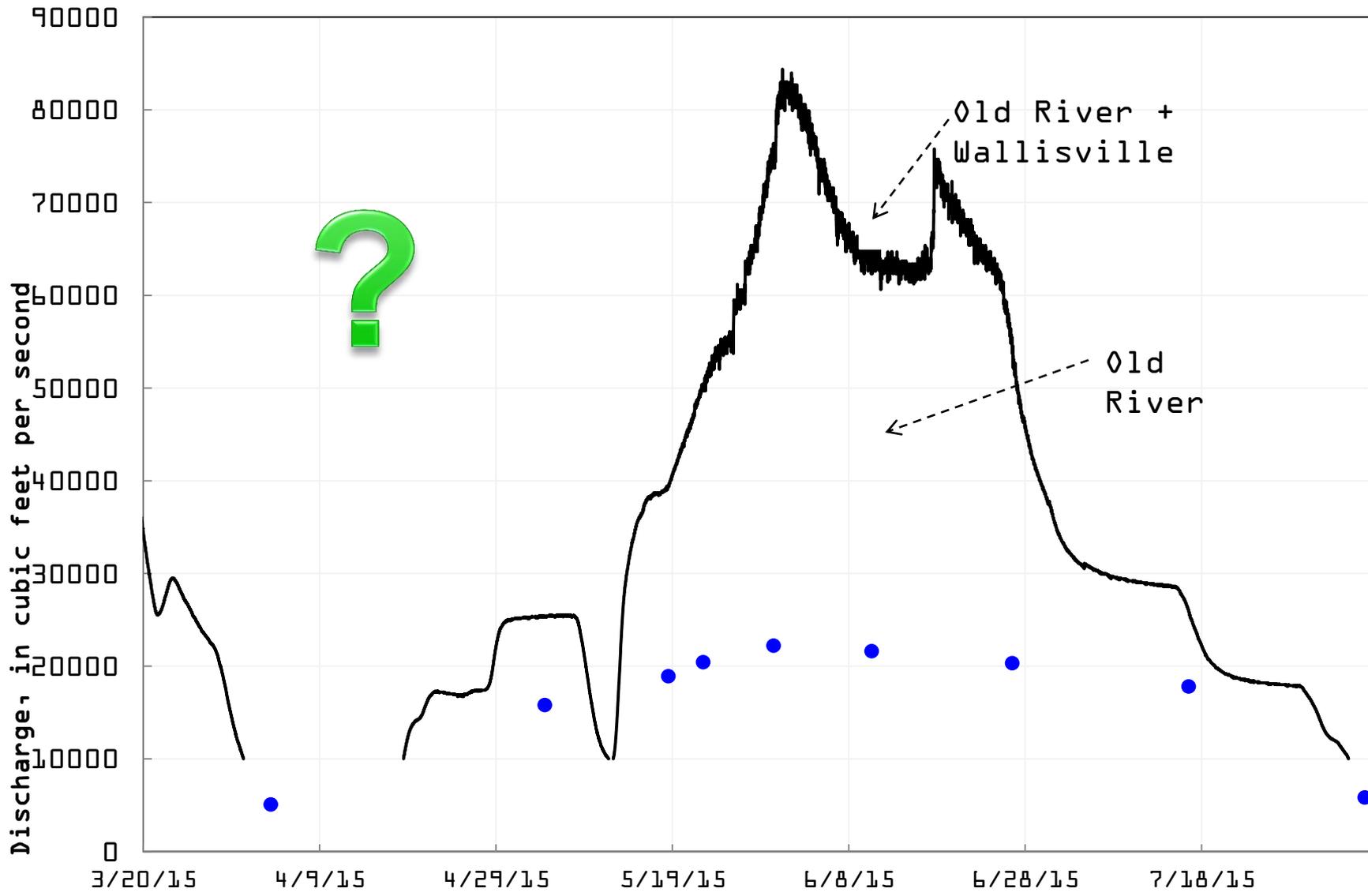


2/6/2012

35,000 cfs at Liberty







— Trinity River at Liberty, TX

● Trinity River at Wallisville, TX

http://waterdata.usgs.gov/tx/nwis/uv?site_no=08067252

Station: 08067252 Trinity River at Wallisville, TX



[Retransmission, forecasts and summary by the National Weather Service](#)

This station managed by the Houston Field Unit.

Available Parameters	Available Period	Output format	Days (7)	GO
<input type="checkbox"/> All 30 Available Parameters for this site		<input checked="" type="radio"/> Graph	<input type="text"/>	
<input type="checkbox"/> 00010 Temperature, water, Upstream of Barrier	2007-10-01 2015-10-07	<input type="radio"/> Graph w/ stats	-- or --	
<input type="checkbox"/> 00095 Specific cond at 25C, Upstream of Barrier	2007-10-01 2015-10-07	<input type="radio"/> Graph w/o stats	<input type="text"/>	
<input type="checkbox"/> 72020 Elevation above NGVD, Upstream of Barrier	2007-10-01 2015-10-07	<input type="radio"/> Graph w/ (up to 3) parms	<input type="text"/>	
<input type="checkbox"/> 72020 Elevation above NGVD, Downstream of Barrier	2007-10-01 2015-10-07	<input type="radio"/> Table	<input type="text"/>	
<input type="checkbox"/> 70969 DCP battery voltage	2015-09-19 2015-10-07	<input type="radio"/> Tab-separated	<input type="text"/>	
<input type="checkbox"/> 00035 Wind speed	2012-10-07 2015-10-07			
<input type="checkbox"/> 00010 Temperature, water, Downstream of Barrier	2007-10-01 2015-10-07			
<input type="checkbox"/> 00095 Specific cond at 25C, Downstream of Barrier	2007-10-01 2015-10-07			
<input type="checkbox"/> 00480 Salinity, Upstream of Barrier	2012-10-07 2015-10-07			
<input type="checkbox"/> 00480 Salinity, Downstream of Barrier	2012-10-07 2015-10-07			
<input type="checkbox"/> 00036 Wind direction	2012-10-07 2015-10-07			
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<input type="checkbox"/> 00055 Stream velocity, Y-Velocity	2014-04-18 2015-10-07			
<input type="checkbox"/> 00010 Temperature, water, X-Velocity	2014-04-18 2015-10-07			
<input type="checkbox"/> 99237 ADVN S/N ratio, X-Velocity	2014-04-18 2015-10-07			
<input type="checkbox"/> 99238 Loctn ADVN cell end, X-Velocity	2014-04-18 2015-10-07			
<input type="checkbox"/> 00055 Stream velocity, Cell 1 - X-Vel	2014-04-18 2015-10-07			
<input type="checkbox"/> 99237 ADVN S/N ratio, Cell 1 - X-Vel	2014-04-18 2015-10-07			
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<input type="checkbox"/> 00055 Stream velocity, Cell 5 - X-Vel	2014-04-18 2015-10-07			
<input type="checkbox"/> 99237 ADVN S/N ratio, Cell 5 - X-Vel	2014-04-19 2015-10-07			
<input type="checkbox"/> 00065 Gage height, NAVD 88	2014-04-22 2015-10-07			

+ Discharge

[Summary of all available data for this site](#)
[Instantaneous-data availability statement](#)



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WATER QUALITY MONITORING

- **Physical Water Properties**
 - Temperature
 - pH
 - Specific Conductance
 - Dissolved Oxygen
 - Turbidity



WATER QUALITY MONITORING

- **Suspended Sediment Concentration**
- **Bed material**
- **Nutrients**
 - **Total N and P**
 - **Ammonia**
 - **Nitrate + Nitrite**
 - **Orthophosphate**



WATER QUALITY MONITORING

- May 2014 – August 2015
 - 17 baseflow samples
 - 16 event samples
- Flow range
 - 238 – 22,200 cfs



PRELIMINARY RESULTS

NUTRIENTS AND SEDIMENT

	N	Median	Min	Max
Ammonia (mg/L as N)	33	0.02	<0.01	0.11
Nitrate + Nitrite (mg/L as N)	32	0.263	<0.040	0.779
Orthophosphate (mg/L as P)	33	0.034	0.006	0.100
Total Phosphorus (mg/L as P)	32	0.115	0.067	0.274
Total Nitrogen (mg/L)	32	0.92	0.56	1.64
Suspended Sediment (mg/L)	30	116	5	453

http://nwis.waterdata.usgs.gov/nwis/qwdata?site_no=08067252



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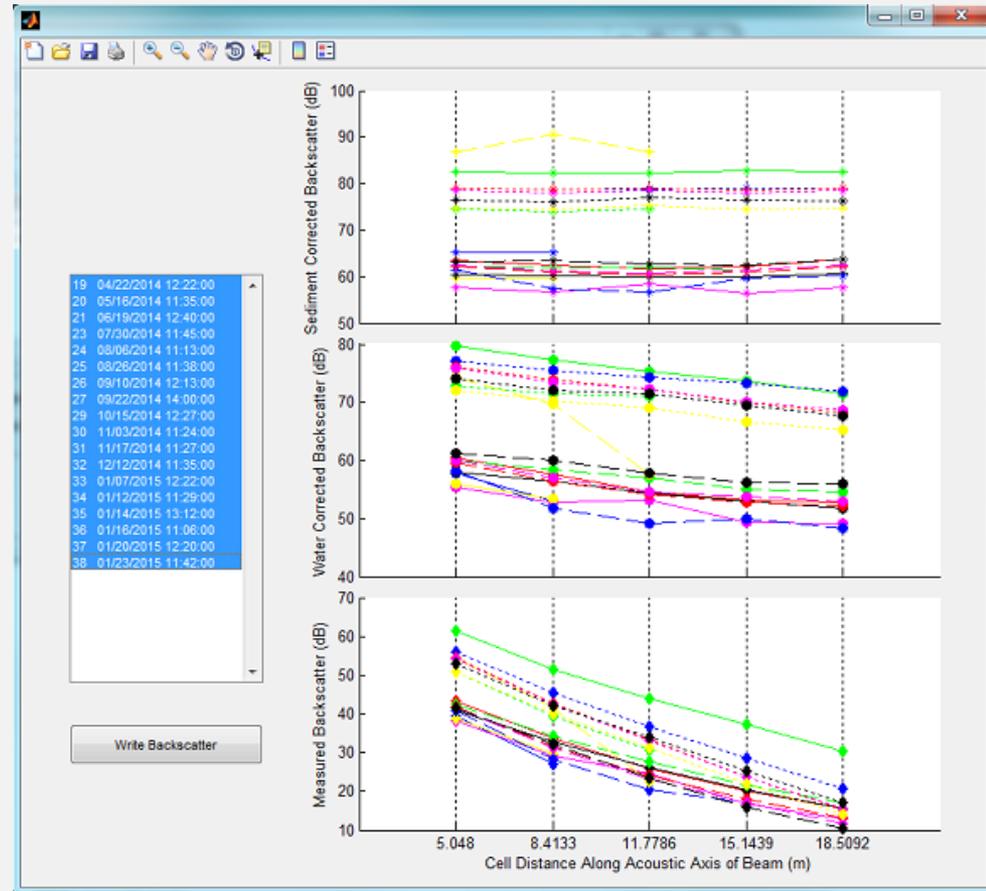
ACOUSTIC BACKSCATTER

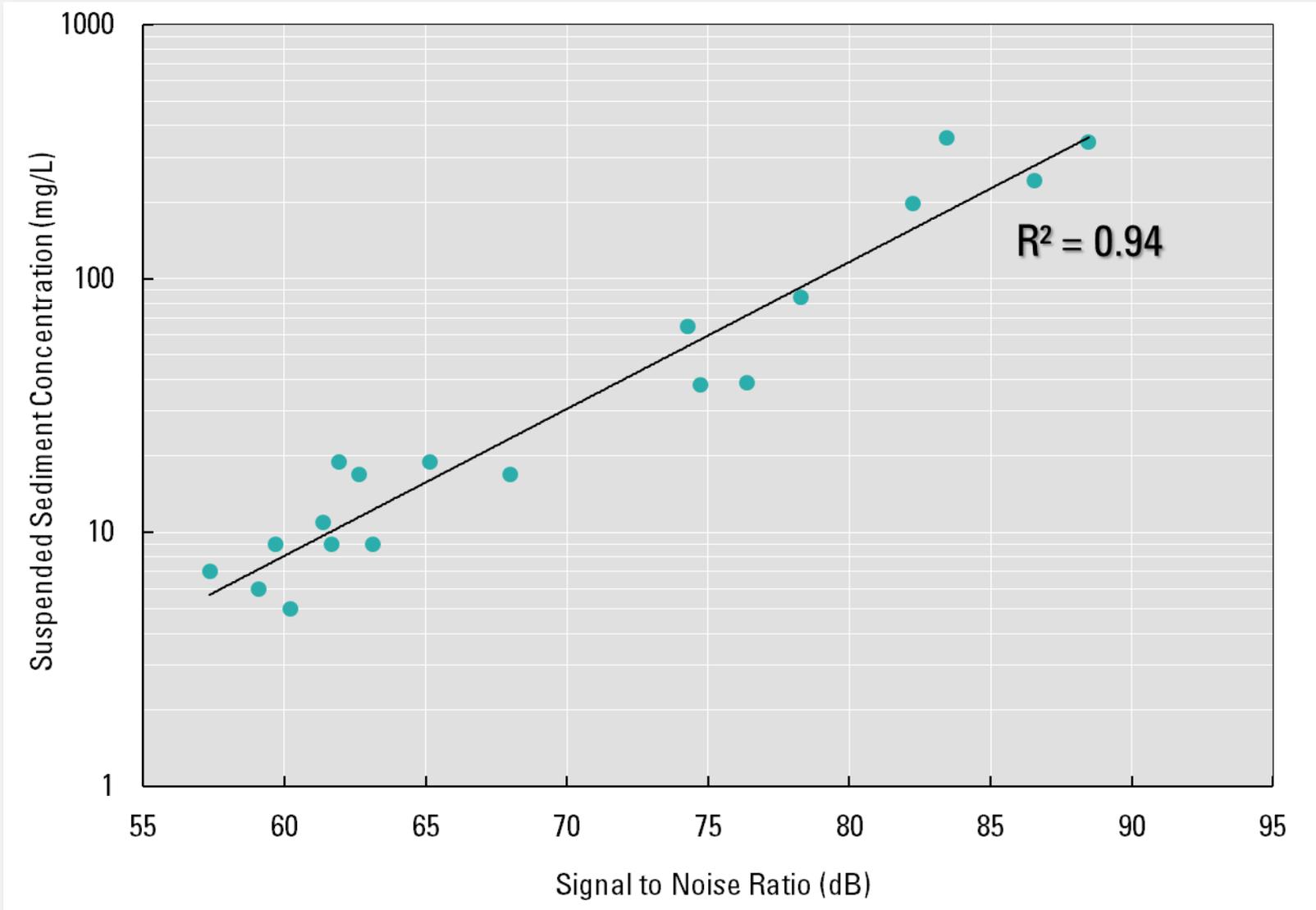


Image Source: SonTek

DATA PROCESSING

- USGS developed tools to process backscatter data.
- Measured backscatter needs to be corrected for:
 - Beam spreading and adsorption by water
 - Attenuation by sediment





Discharge range: 9 -
20,100 cfs

KEY FINDINGS

- Acoustic Doppler velocity meter holds promise for estimating suspended sediment concentration in the Trinity River.
- Flow at the lower reaches of the Trinity River follow a similar trend to the upstream stations until it attains a discharge of approximately 20,000 cfs.
- Improving our understanding of the hydrology of the Trinity River delta will require accounting for discharge not measured at Wallisville.

WHAT'S NEXT?

- Mass balance to account for missing flow
- Continue surrogate development for suspended sediment and nutrients
- Continue operating streamgage at Wallisville



Zulimar Lucena
zluca@usgs.gov

Michael T. Lee
mtlee@usgs.gov

