

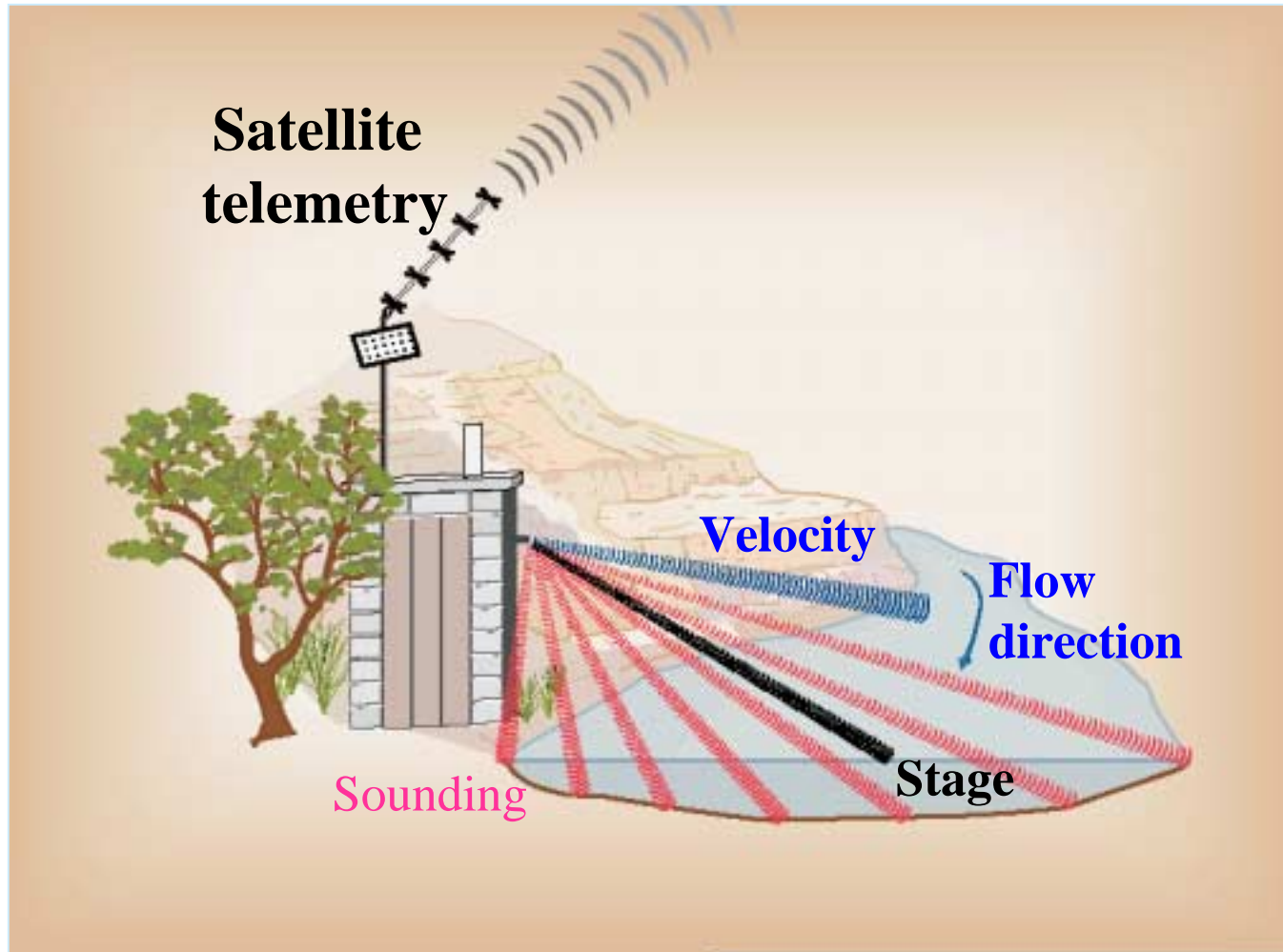
HYDRO21 UPDATE

Cowlitz River, WA
May 1, 2001



Gaging Station of the Future

Where are We ?



HYDRO 21 Progress

Non-contact Discharge
Experiment on Skagit
River, WA - April 21,
1999



Surface-velocity data-collection

Channel cross-section data
collection using GPR; checked
with ADCP



Results

Method	Time	Discharge (m ³ /s)	Discharge from rating curve (m ³ /s)
ADCP	1042	526	527
	1130	521	524
	1156	511	521
	1252	525	518
	1300	517	518
	1312	523	515
	1316	514	515
Mean		520	520
Current meter	1630	527	504
Non-contact radar	1253	518	518
	1305	517	518
	1339	520	515
Mean		518	517

(4.6 % difference)

Hydro21

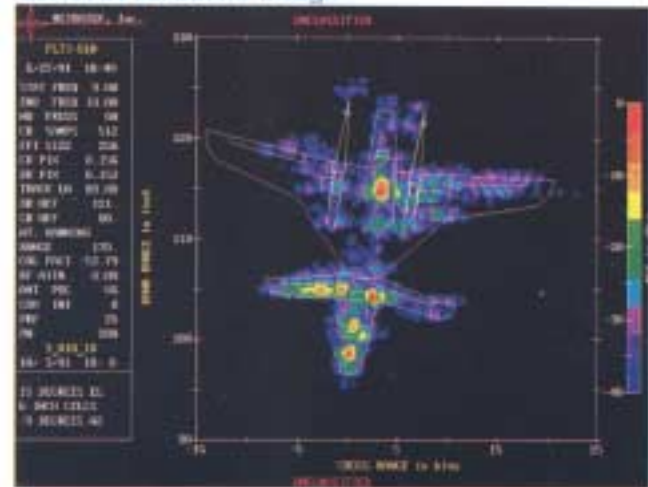
Military Contractors have done remarkable things



DOLPHIN Running on Surface

Remote-control sub to clear mines in Persian Gulf.

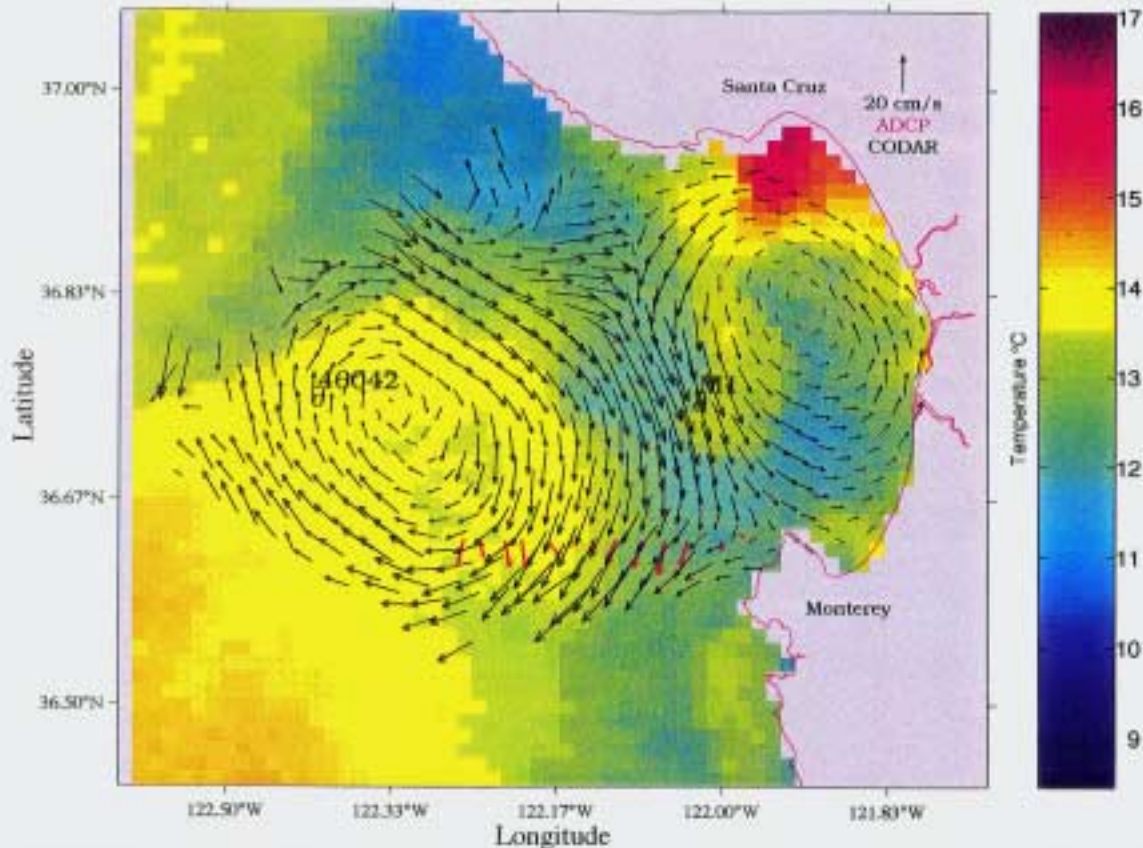
AIRSAR Airborne Image



Radar image of fighter aircraft

Radar-derived surface-current vectors, Monterey Bay, CA

From: Remotely sensed surface currents in Monterey Bay from shore-based HF radar (CODAR),
Jeffrey D. Paduan and Leslie K. Rosenfeld, *J. Geophys. Res.*, vol. 101, no. C9, pp. 20,669 - 20,686.



Average radar-derived surface-current vectors for the period 0900 UT August 6 to 0700 UT August 7, 1994 (black arrows);
average VM-ADCP vectors for the period 1016 UT August 6 to 0524 UT August 7, 1994 (red arrows), shown with uncorrected
AVHRR Channel 4 surface temperatures at 0300 UT August 6, 1994.

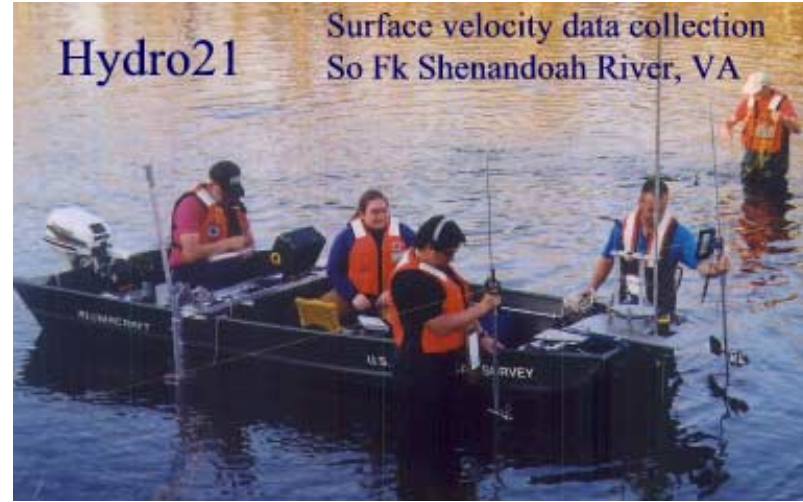
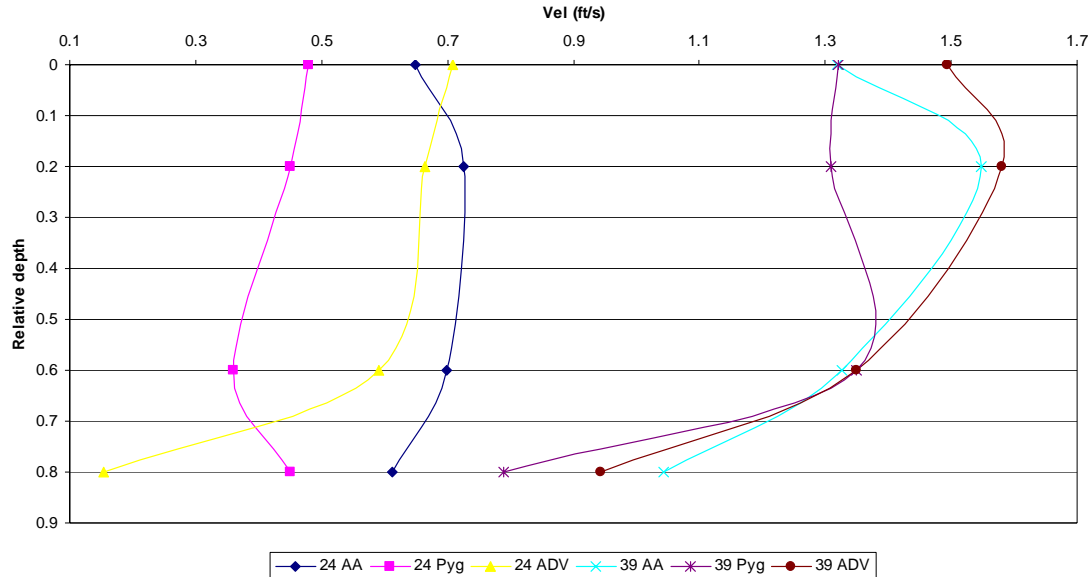
HYDRO21 Progress

March 2000 South Fork Shenandoah River,
VA Contractor bankside non-contact
discharge experiment (Monostatic radar)

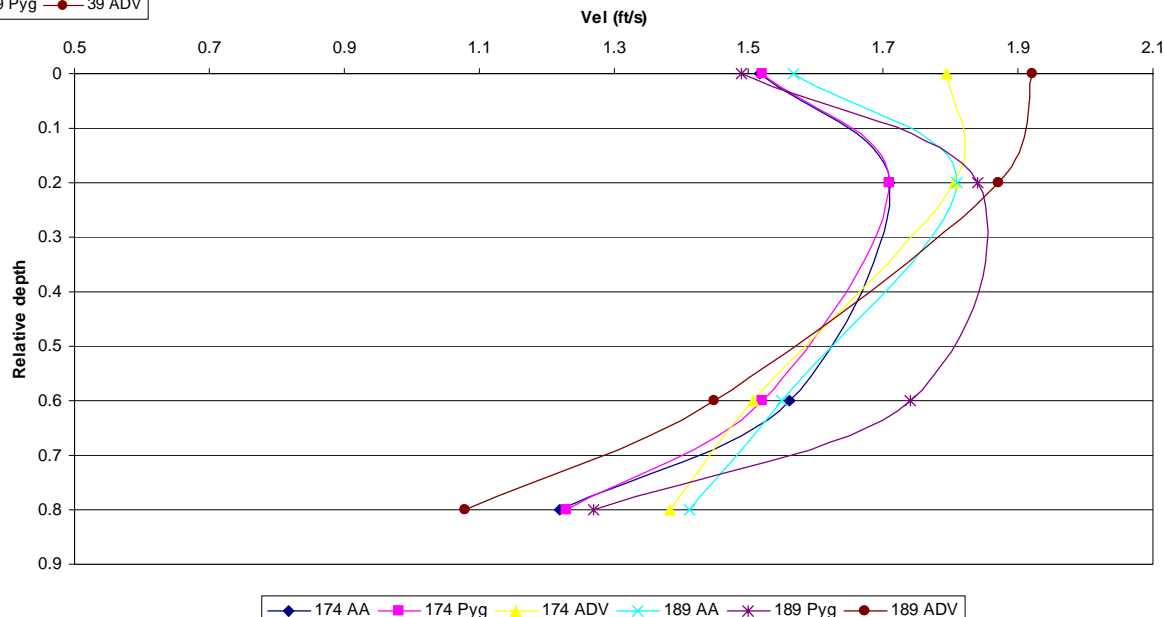


Shenandoah River Velocity Profiles

Shenandoah Vel Profiles 24 & 39 ft



Shenandoah Vel Profiles 174 & 189 ft



Channel margin data

Middle of channel data



HYDRO21 Progress

June 2000 Tracy-Mendota Canal and American River, CA (Bistatic radar)



HYDRO21 Progress

Sept 2000 Helicopter Experiment on Lewis River, Cowlitz River, Toutle River, WA



GPS system failed

**Helicopter based radar system
for discharge measurement
September 13, 2000**

Micro-wave Radar



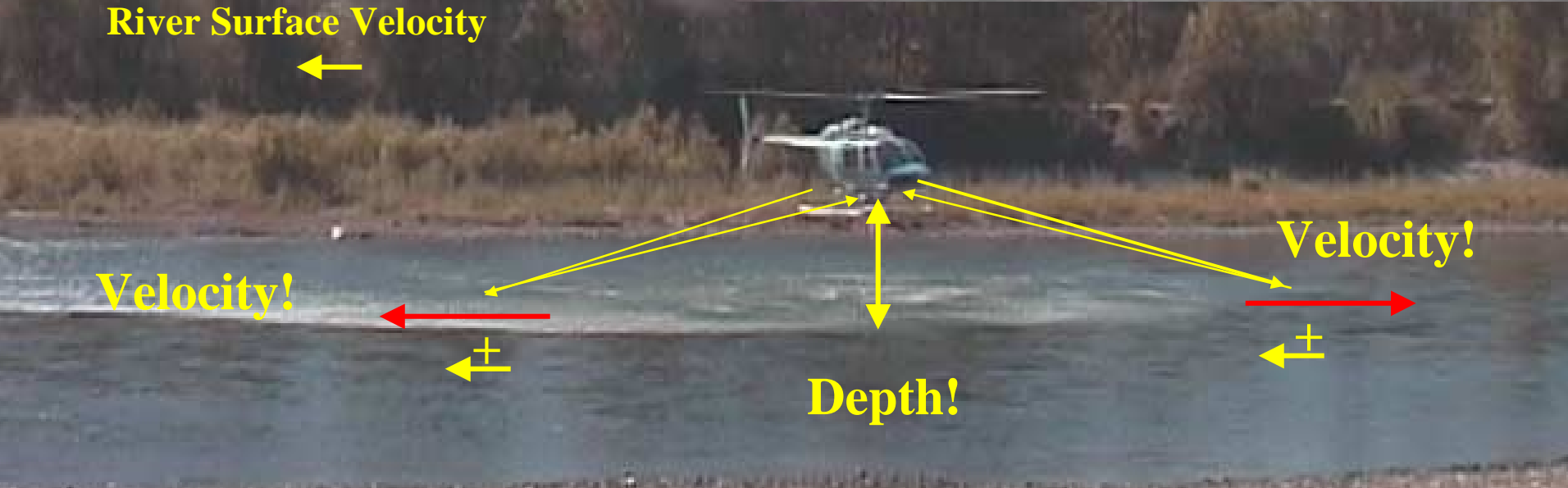
GPR



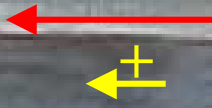
Velocity due to Down Wash



River Surface Velocity

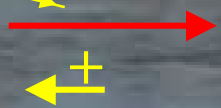


Velocity!



Depth!

Velocity!



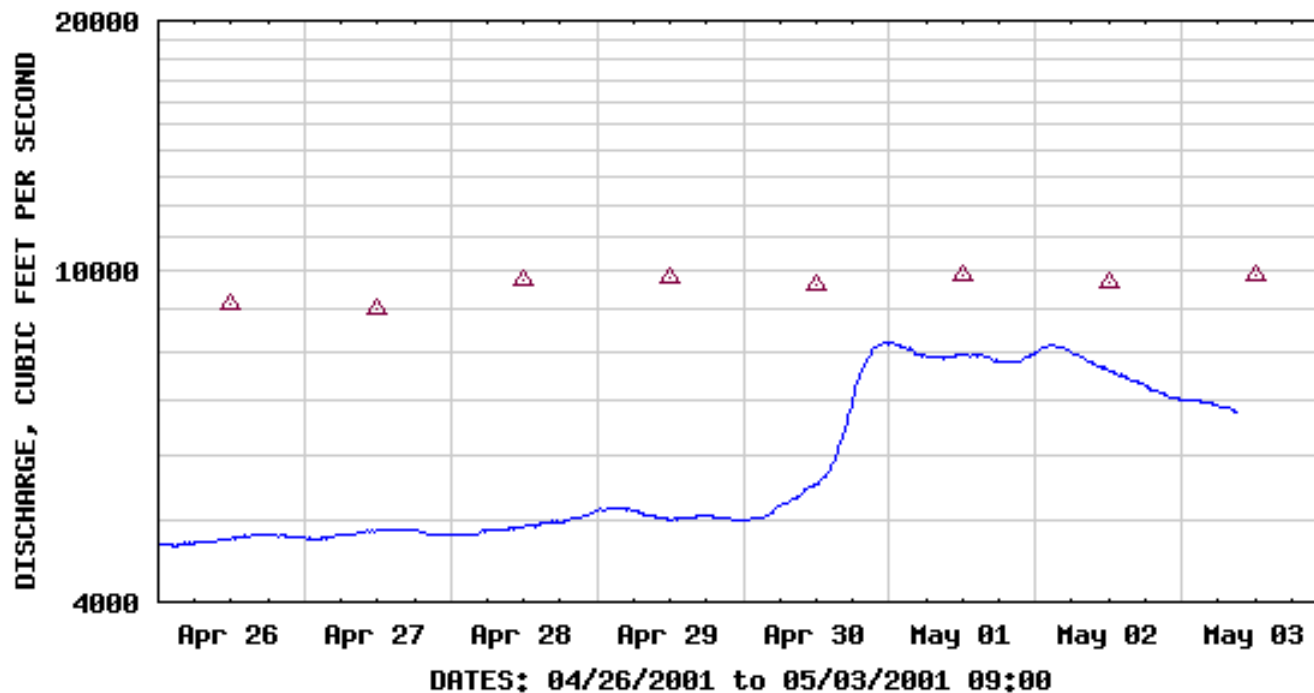
HYDRO21 Progress

May, 2001 Cowlitz River, WA second
helicopter discharge experiment



We Learned: Unshielded antenna 100 MHz
6-7 m (20 ft) height 3-6 knots

USGS 14249000 COWLITZ RIVER AT CASTLE ROCK, WASH.



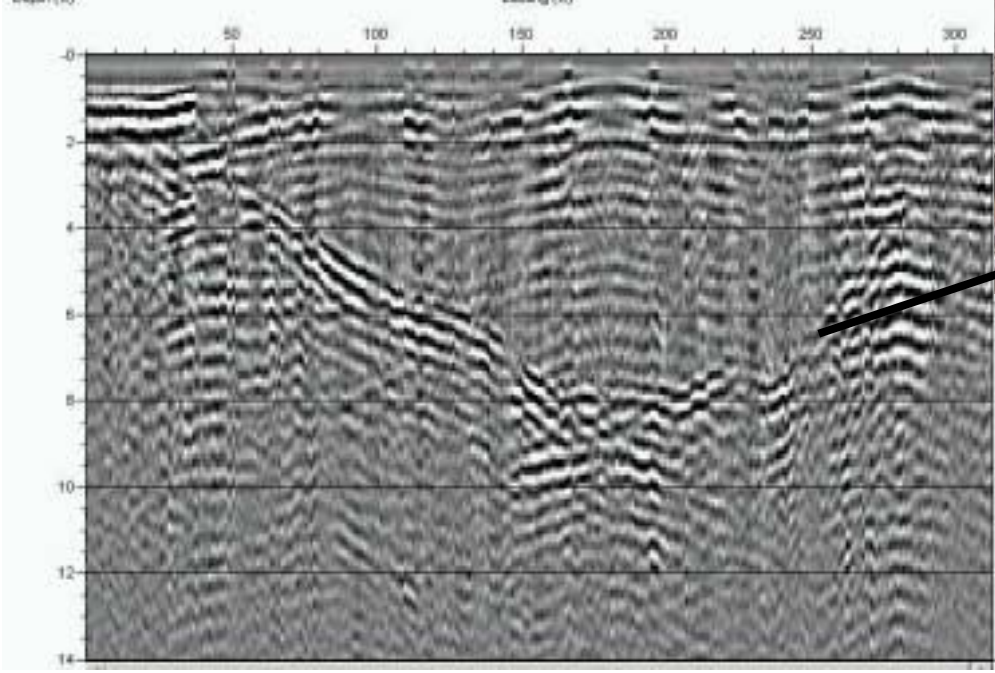
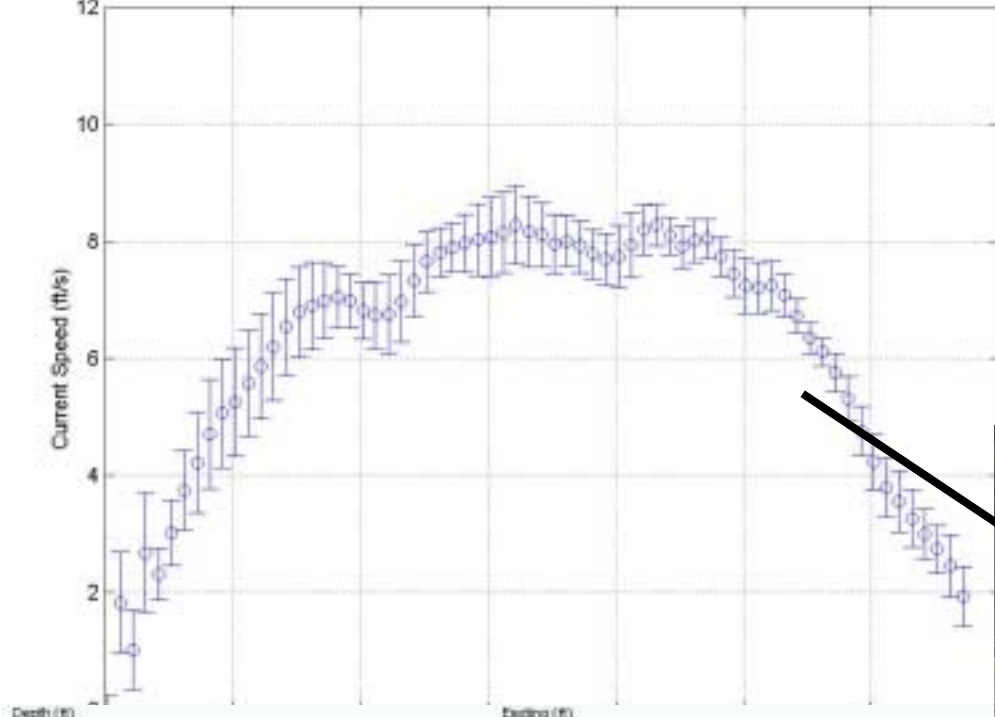
EXPLANATION

— DISCHARGE

△ MEDIAN DAILY STREAMFLOW BASED ON 59 YEARS OF RECORD

Provisional Data Subject to Revision

USGS Helicopter Flights on the Cowlitz River - May 1, 2001



Q boat = 8,000 cfs
Q helicopter = 8,500 cfs
(preliminary)

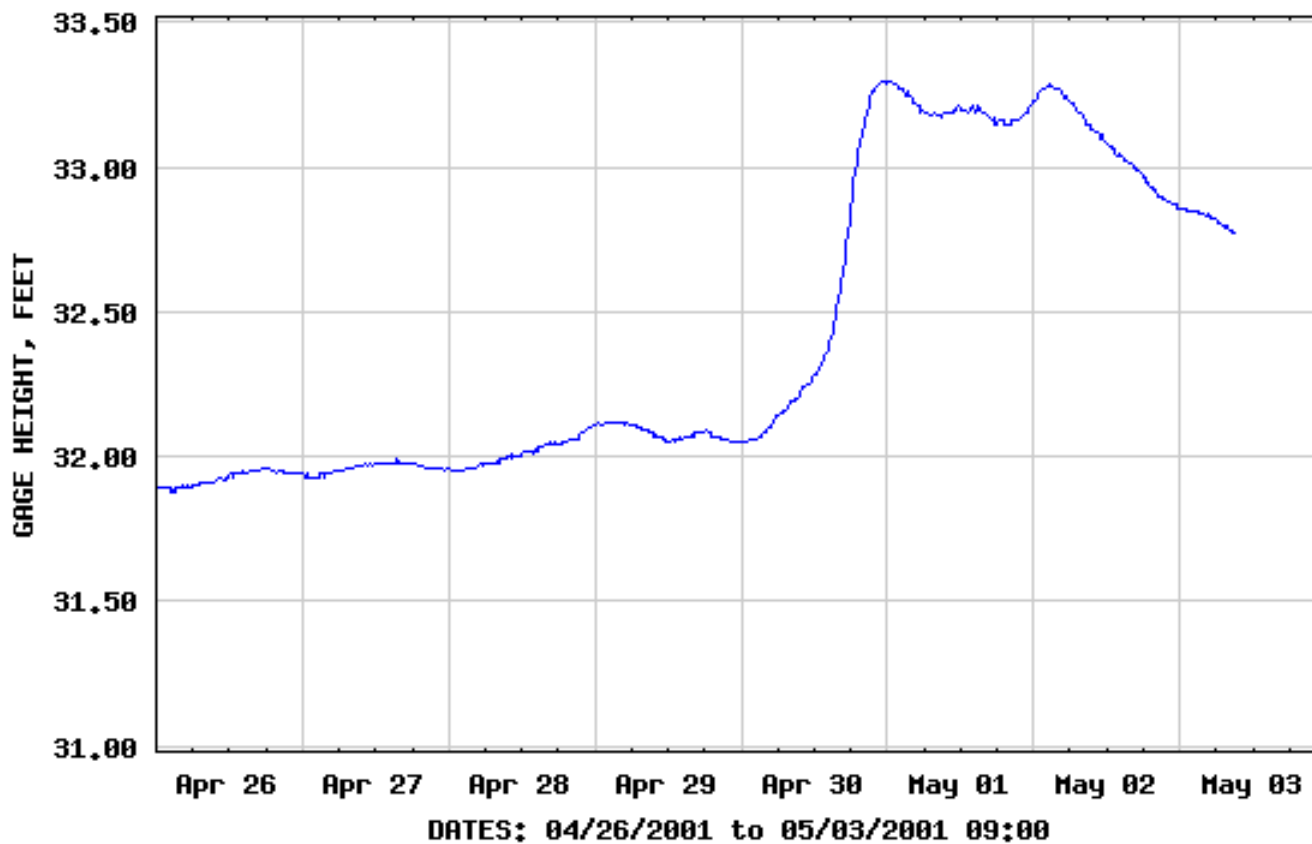


The Next Step: San Joaquin River nr Vernalis, CA

- Install 'lite' cableway for GPR transects
- Install bankside 10 GHz pulsed Doppler radar for surface velocity
- Install continuous wave radar antennas on bridge to test prototype system
- Operate continuously for extended period (ca 3 months)
- Will require human operator (ca 1/week)



USGS 14249000 COWLITZ RIVER AT CASTLE ROCK, WASH.



Provisional Data Subject to Revision