An aerial photograph of a fish weir structure in a canal. The weir is a large, rectangular concrete structure with a central gate and several smaller structures on either side. The canal is filled with water, and the surrounding area is a mix of sandy soil and sparse vegetation. The text is overlaid on the image in yellow and white.

EVALUATION OF HOGBACK FISH WEIR: DESIGNED TO REDUCE ENTRAINMENT OF ENDANGERED FISH IN CANALS

Mark McKinstry

US Bureau of Reclamation, Salt Lake City, UT

Chris Cheek

The Navajo Nation, Farmington, NM

Peter MacKinnon

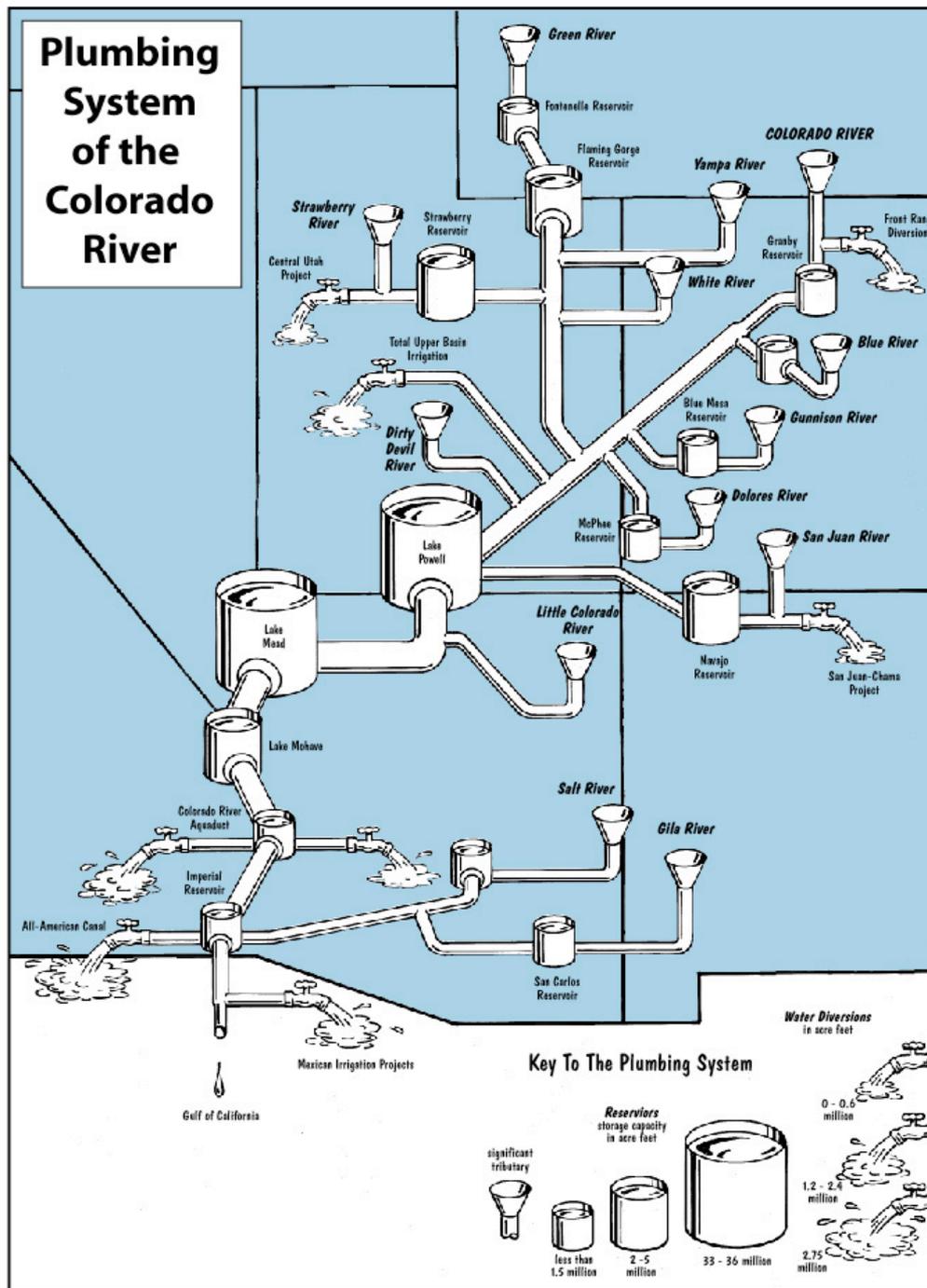
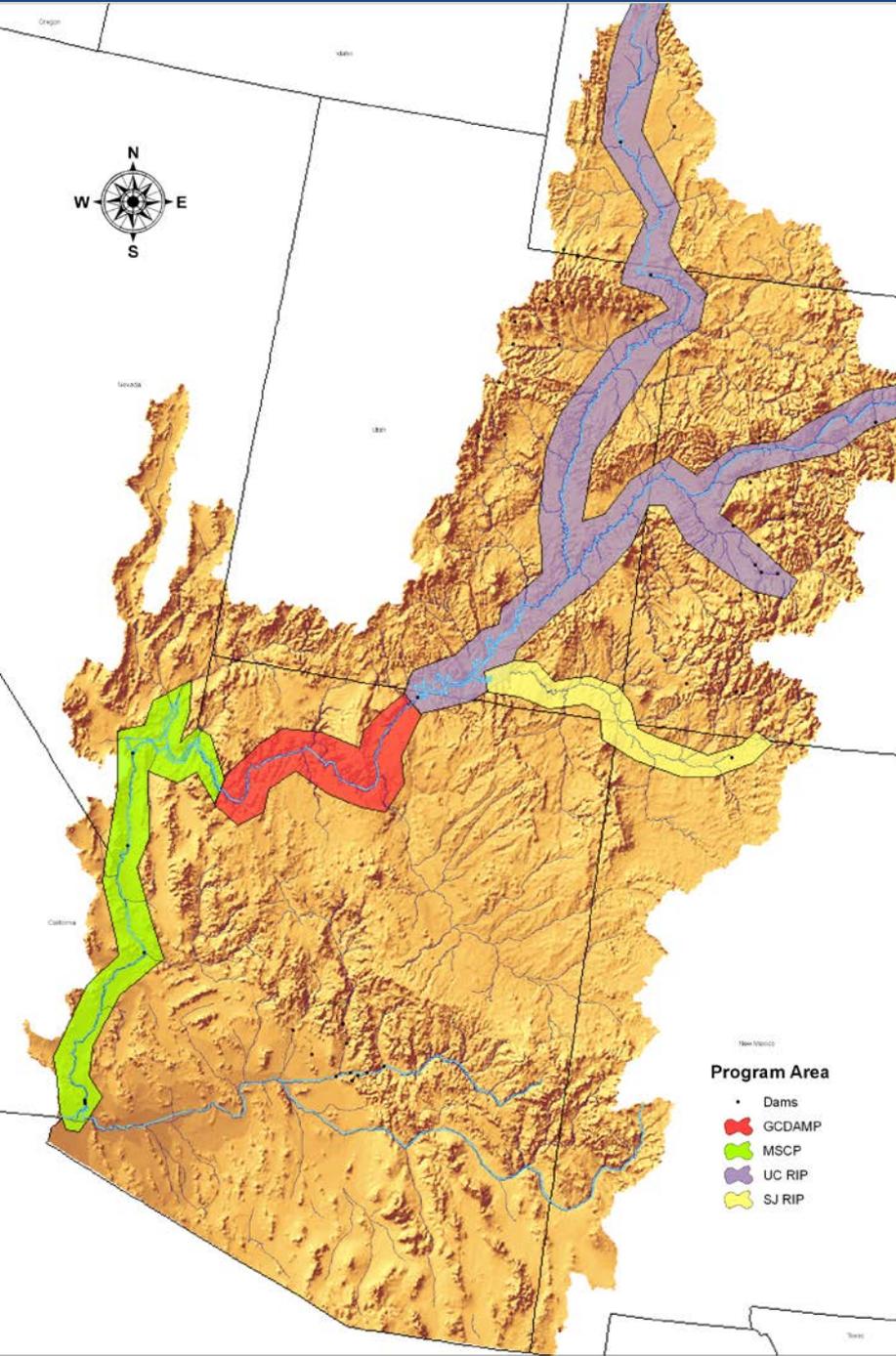
Biomark, Boise, ID

Robert Norman

US Bureau of Reclamation, Grand Junction, CO

Scott Durst

US Fish and Wildlife Service, Albuquerque, NM

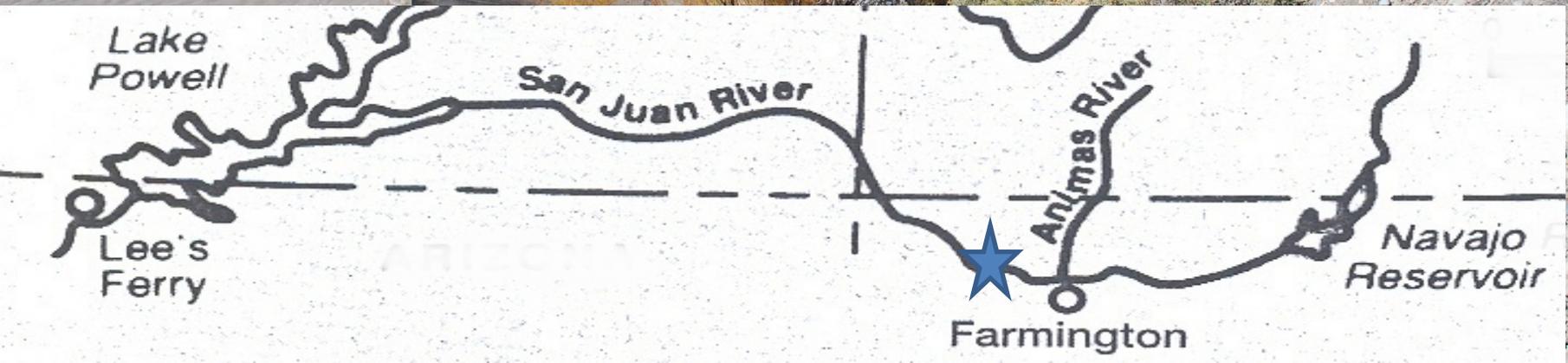
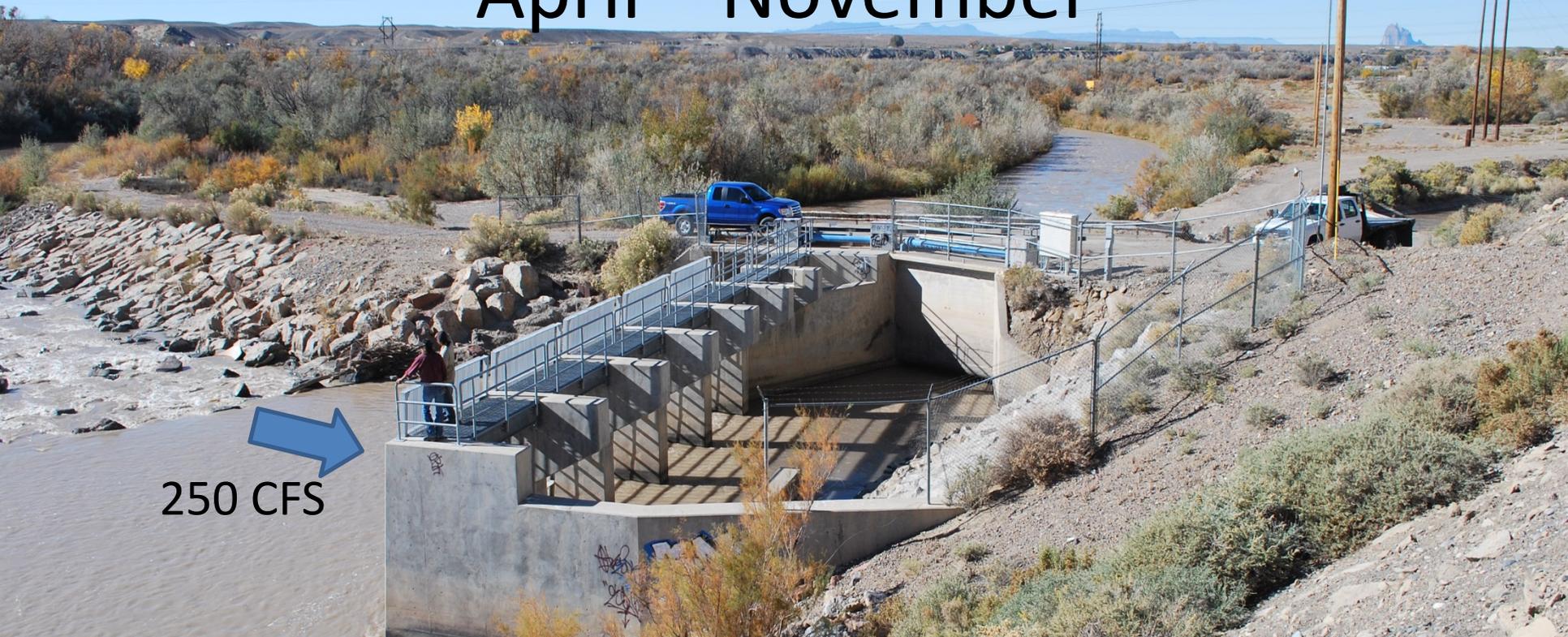


Entrainment



Hogback Canal, San Juan River, NM

April—November



Hogback Fish Entrainment Study

Renfro, Platania & Dudley (2006)

- 2004-2005 sampling in Hogback Canal
- 11,400 fish
- 201 Colorado Pikeminnow (Endangered)
- COPM were 42-315 mm
- Green River Canal, Green River, UT > 600 PIT-tagged endangered fish in 2013

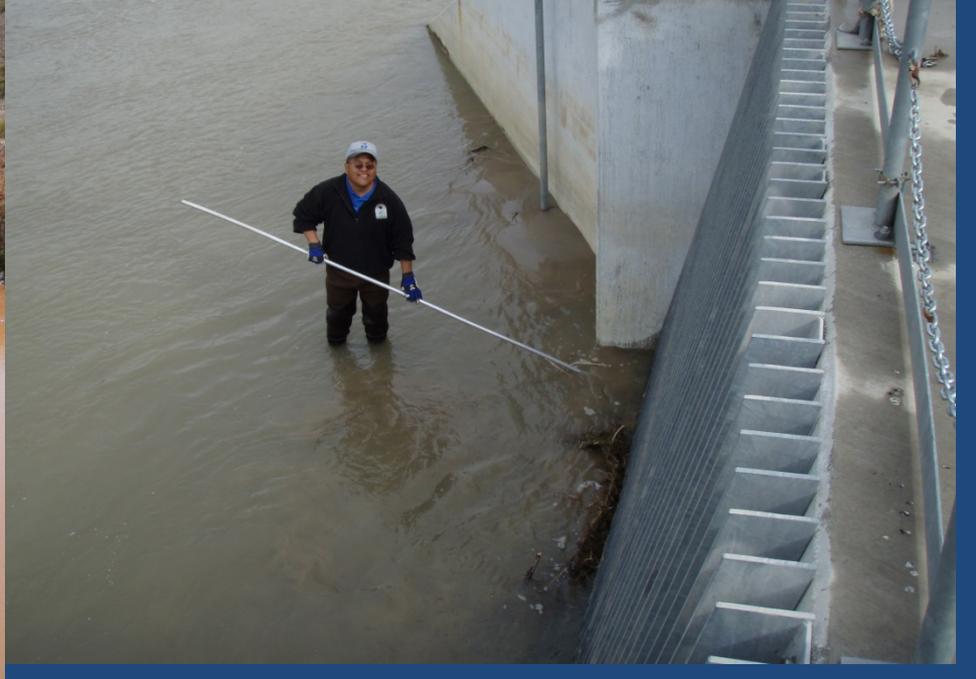


What to Do?

- Deliver irrigation water



Screening to eliminate fish



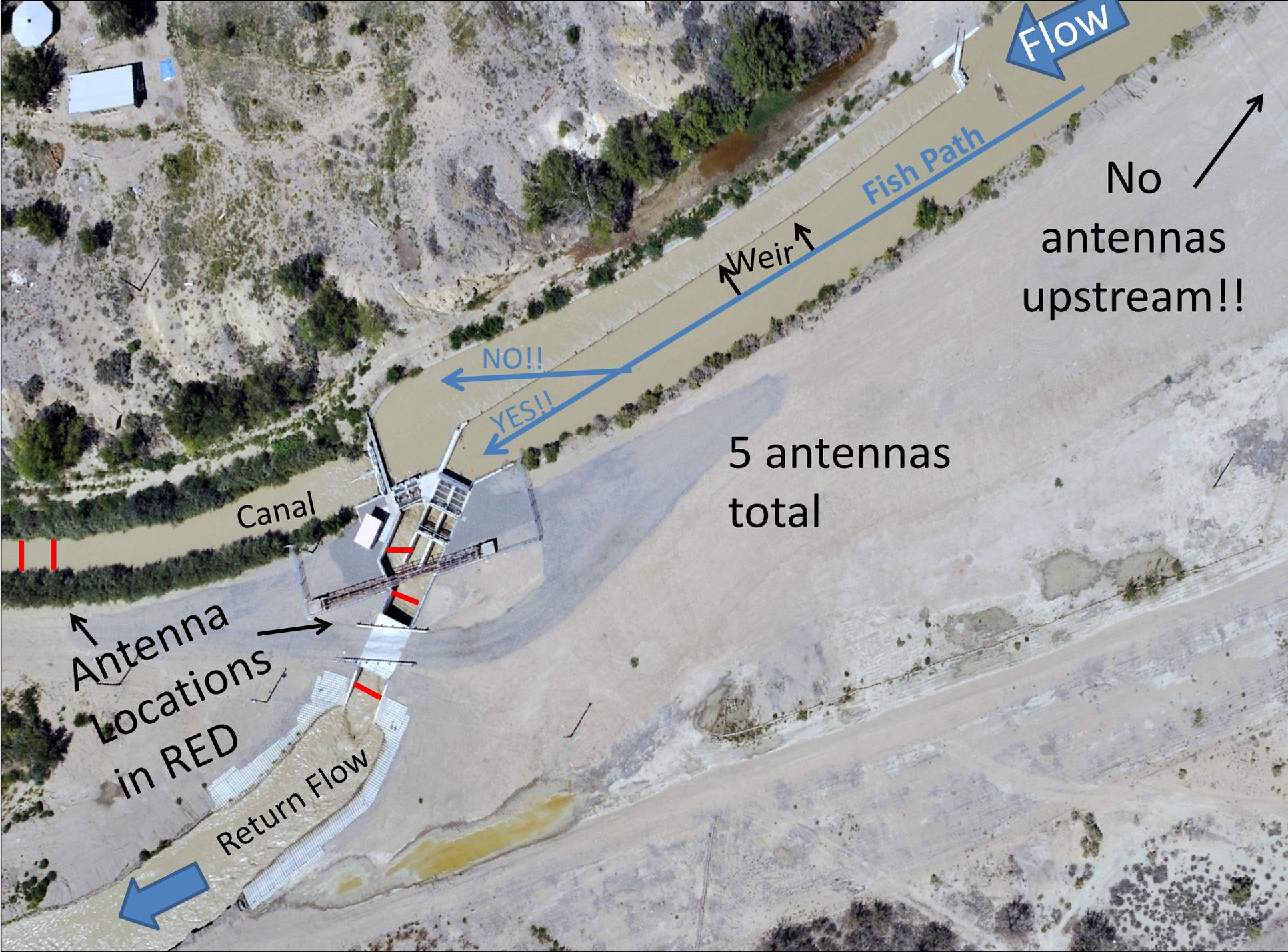
Electric Barriers



An aerial photograph of a river with a fish weir structure. The river is brown and flows from the top left towards the bottom left. The weir structure is a complex of concrete and metal components, including a central gate and side channels. The surrounding area is dry and sandy with some sparse vegetation. The text is overlaid on the top left of the image.

Value Engineering study (2007)
Try a fish weir instead of screening

Constructed and operational by March 2013
\$3.5 million



FLOW

No antennas upstream!!

Fish Path

Weir

NO!!

YES!!

5 antennas total

Canal

Return Flow

Antenna Locations in RED



25-75 CFS



100-175 CFS

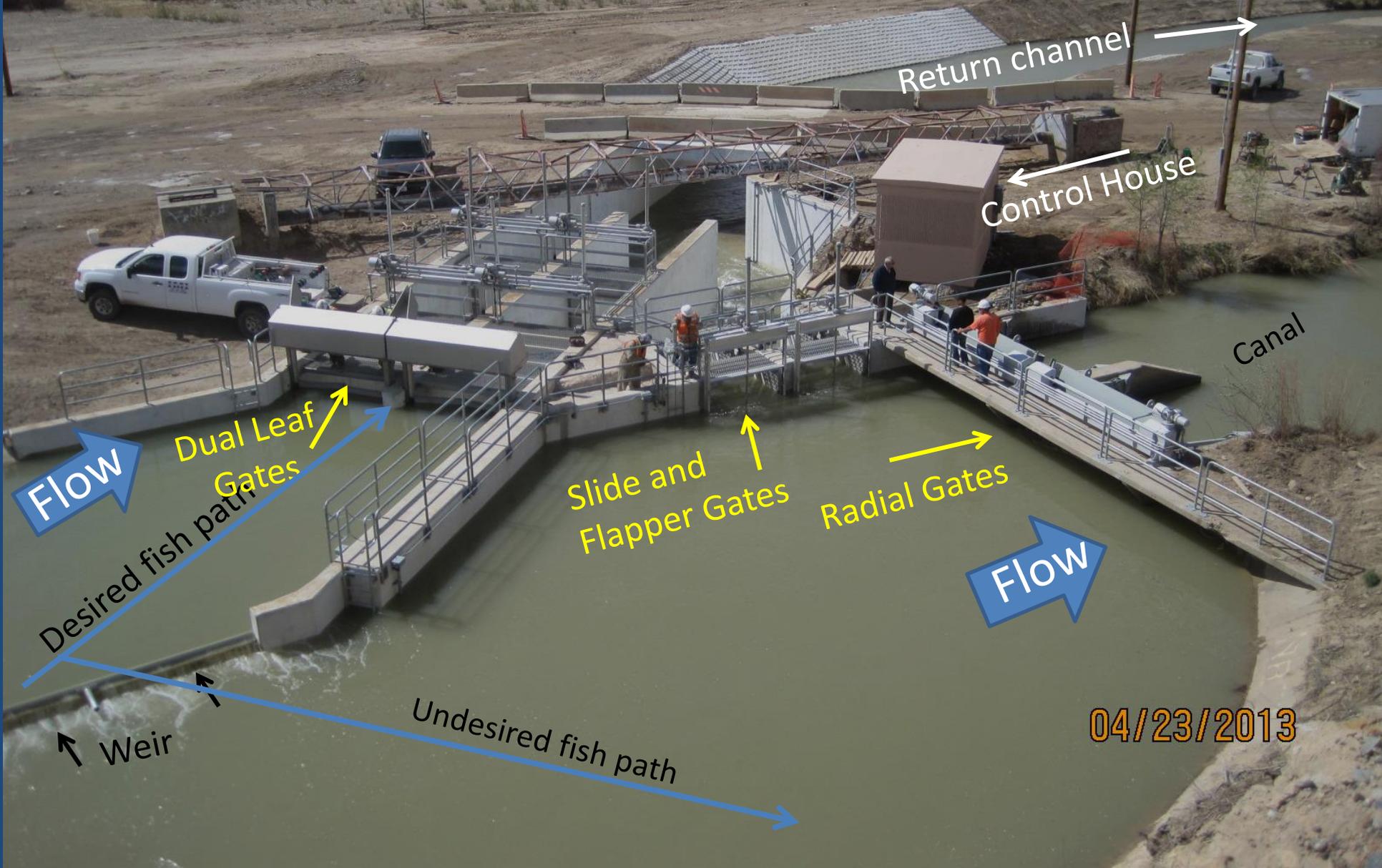


04/23/2013



Weir Wall—8'

Hogback Weir Facility



Return channel

Control House

Canal

FLOW

Dual Leaf Gates

Slide and Flapper Gates

Radial Gates

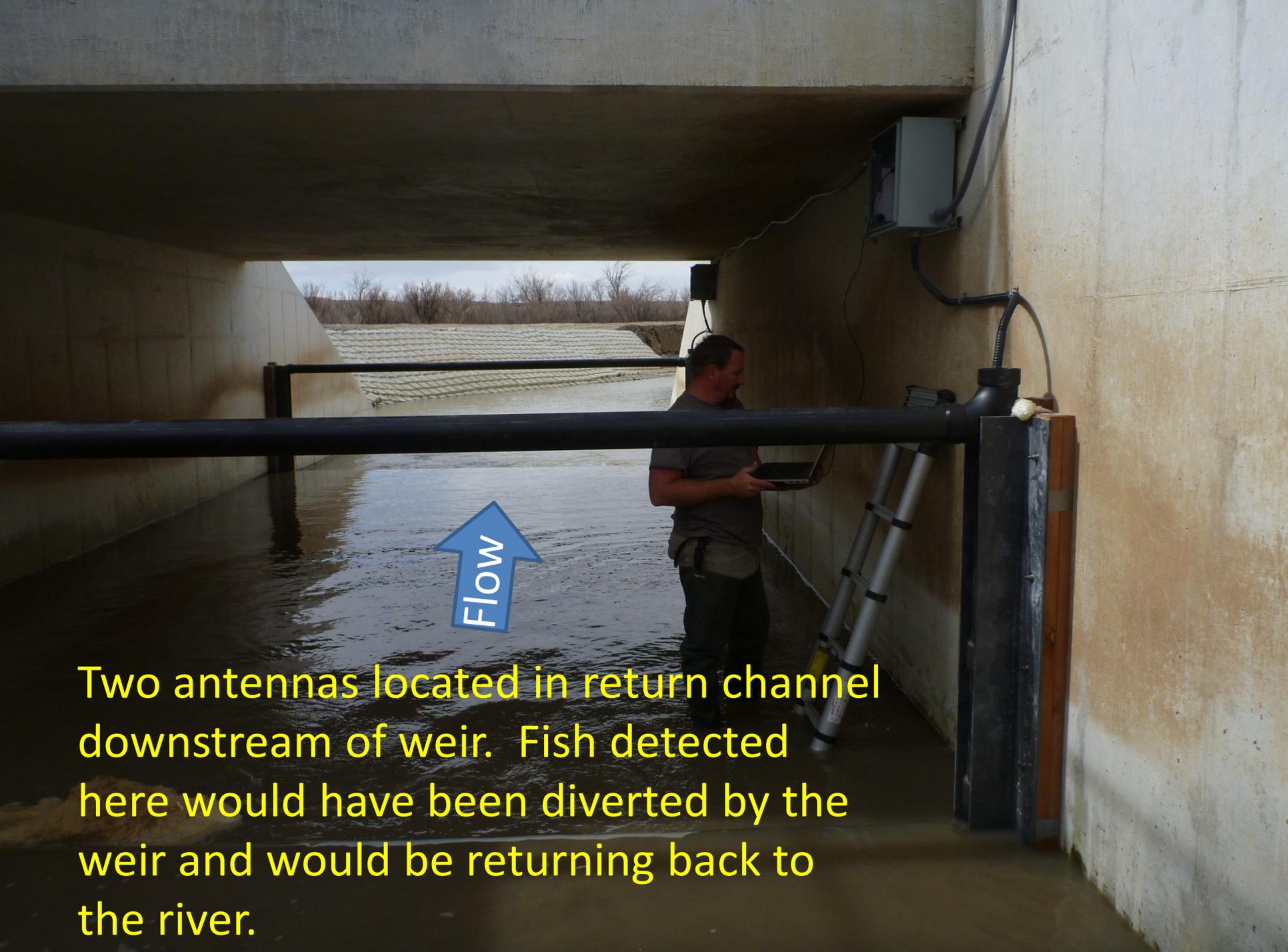
FLOW

Desired fish path

Undesired fish path

Weir

04/23/2013



Two antennas located in return channel downstream of weir. Fish detected here would have been diverted by the weir and would be returning back to the river.

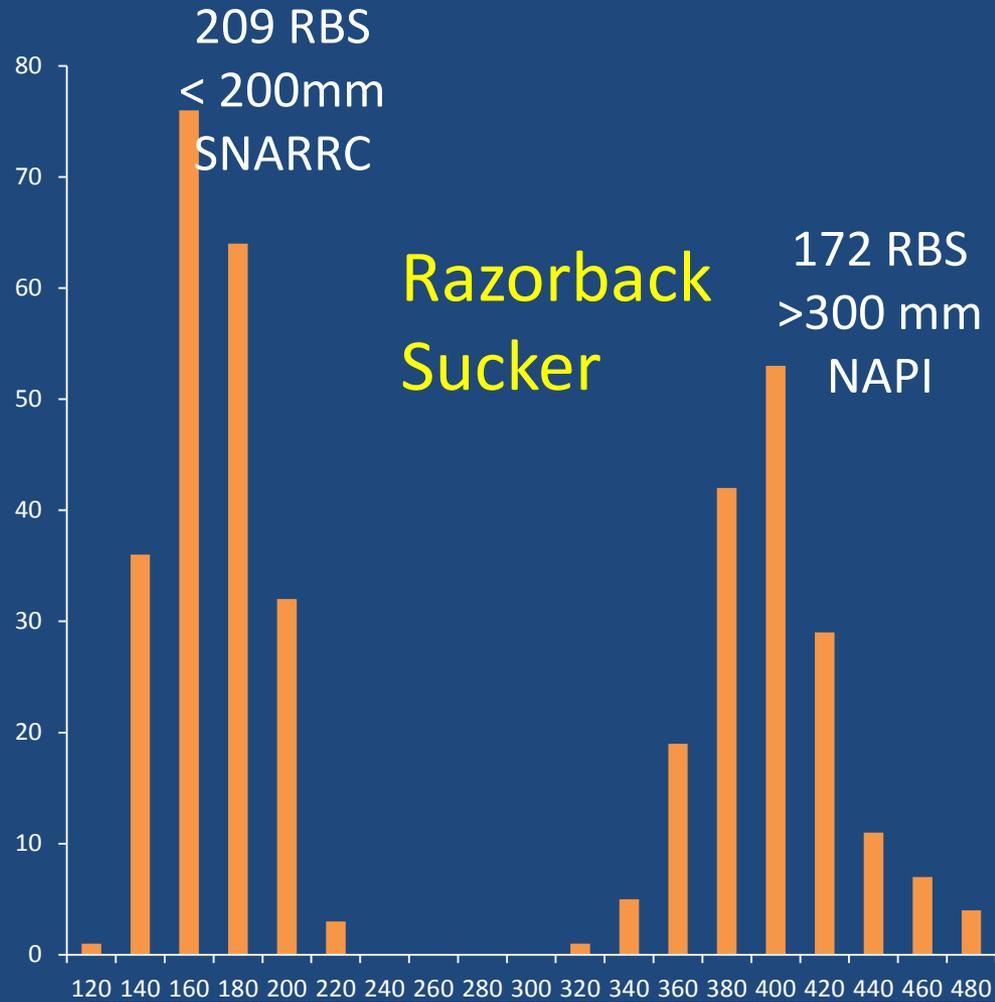
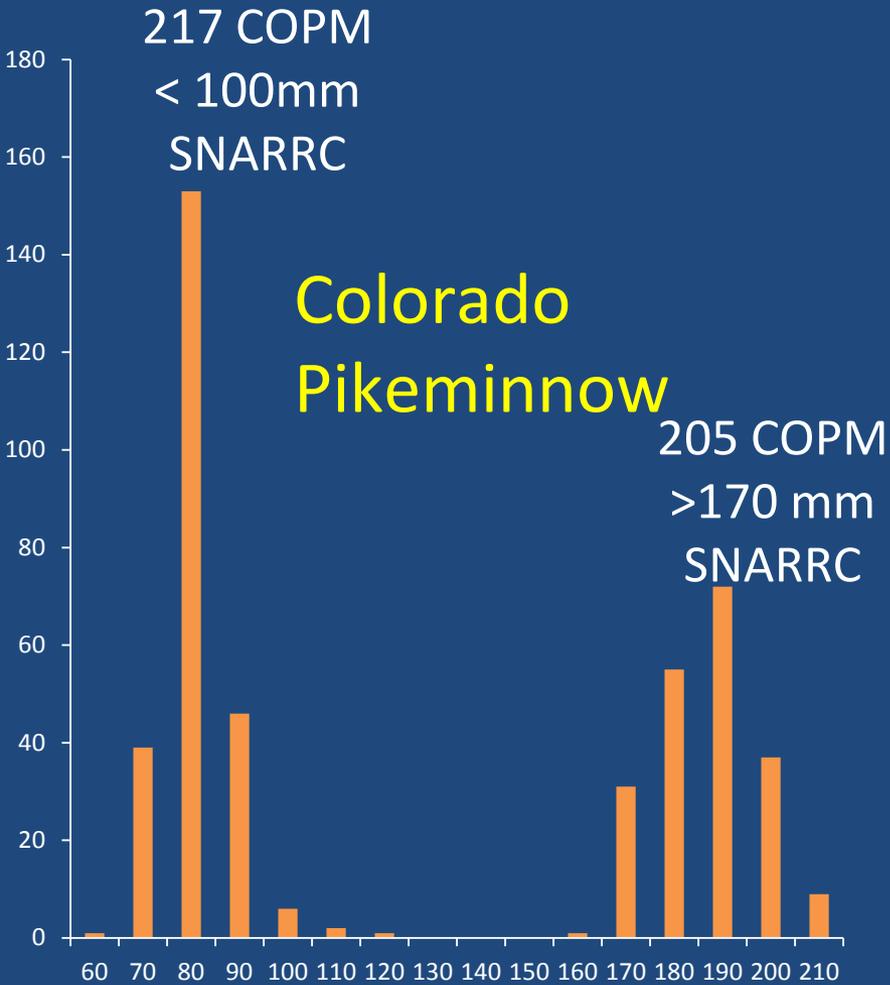


Two antennas located at flume in canal downstream of weir. Fish detected here would be entrained.

Hogback Fish Weir Test

- 1) Facility run according to specifications entire time of test—normal operations can have problems
- 2) Test was 5 days--stocking started at 1pm on Wednesday 11/5, ended Monday 11/10 8am with headgates closing and dewatering the canal
- 3) All fish, except >300mm RBS, were conditioned to flow
- 4) Stocked small numbers (~20) of fish ~ every hour—avoid tag collision

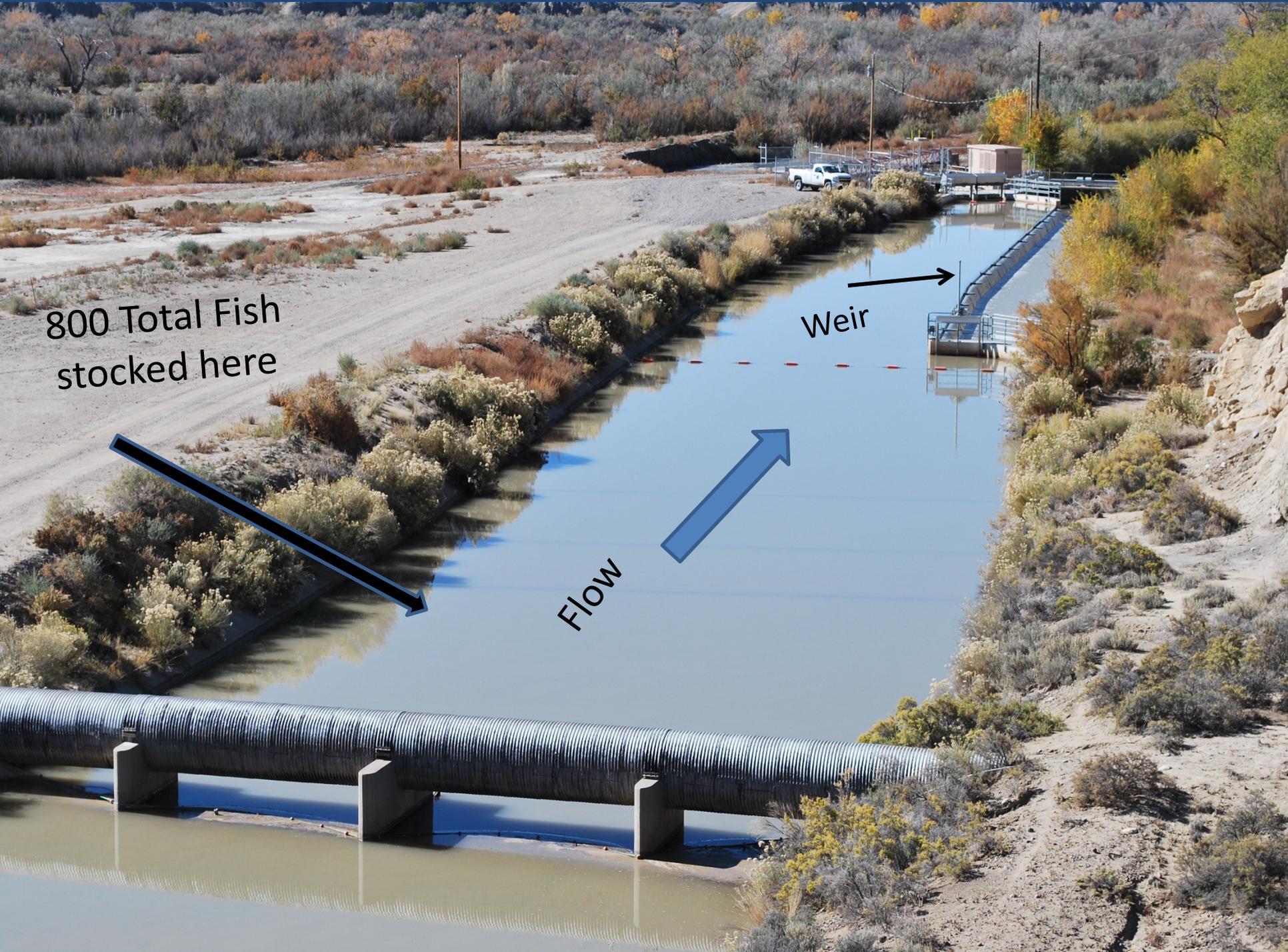
Size Classes of Stocked Fish



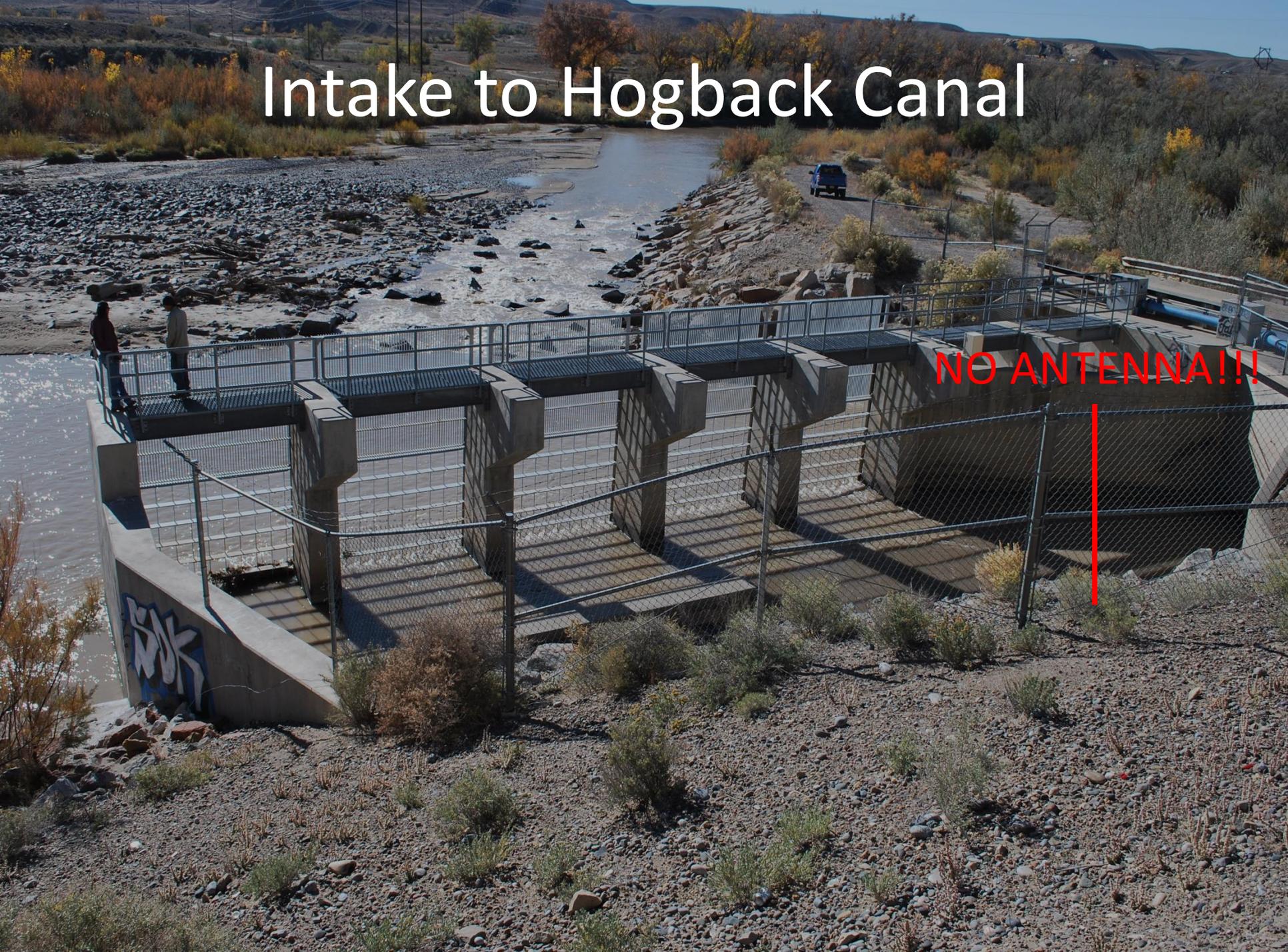
800 Total Fish stocked here

Weir

FLOW



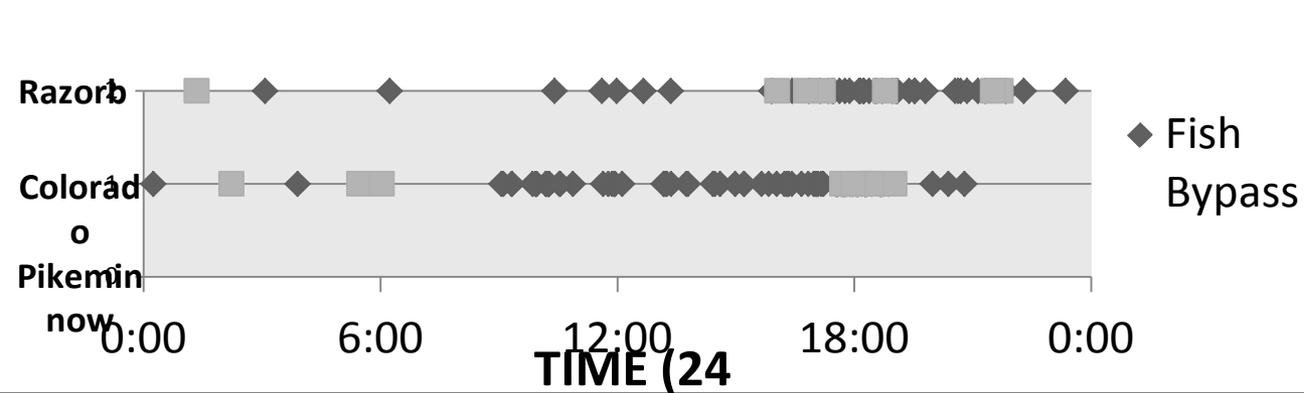
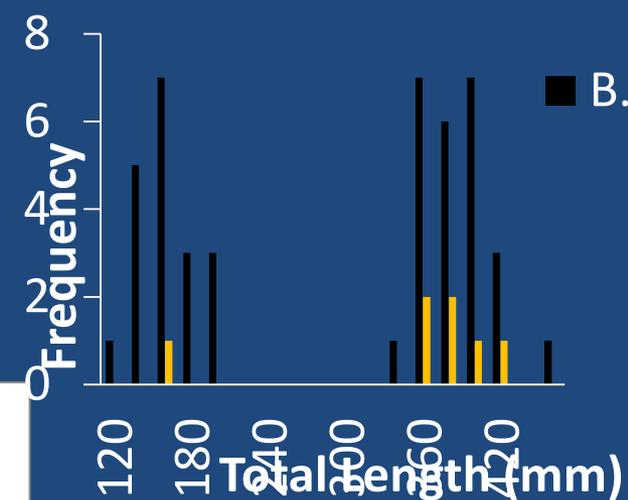
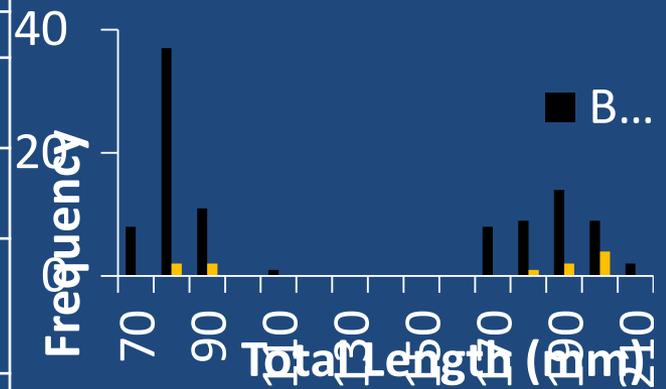
Intake to Hogback Canal



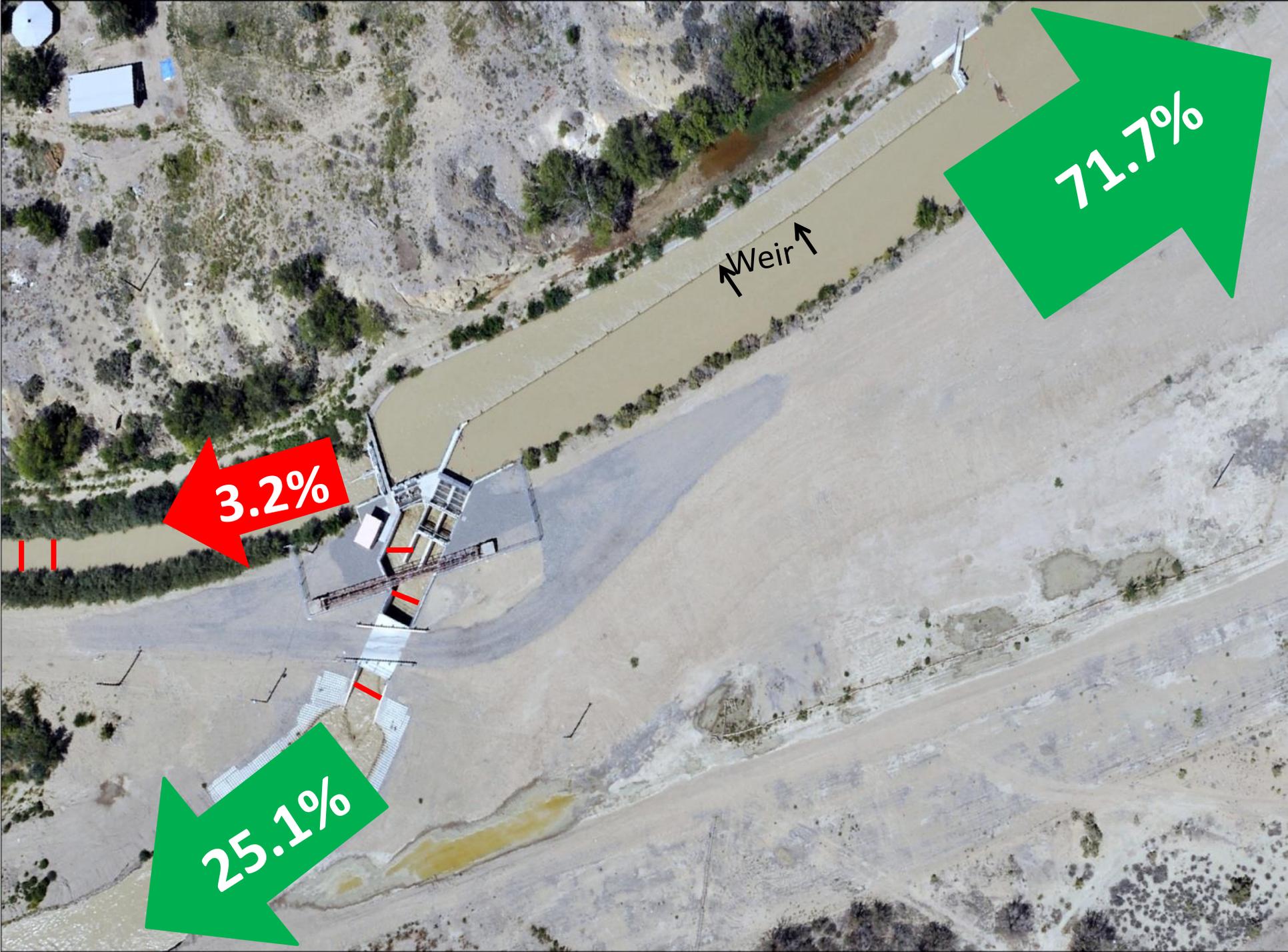
NO ANTENNA!!!

RESULTS

	CPM <100mm	CPM >150mm	RBS <200mm	RBS >300mm	Total
Number Stocked	217	205	209	172	803
1- Fish Bypassed during test	57	42	19	5	143
2- Fish Entrained during test	4	7	1	6	18
3- Undetected (upstream?)	127	135	68	78	408
	58.5% (127/217)	65.8% (135/205)	32.5% (68/209)	45.3% (78/172)	50.8% (408/803)
% bypassed 1+2	93.4% (57/61)	85.7% (42/49)	95.0% (19/20)	80.6% (25/31)	88.8% (143/161)
% bypassed of total exiting facility 1+2+3	30.3% (57/188)	22.8% (42/184)	21.6% (19/88)	22.9% (25/109)	25.1% (143/569)
% entrained 1+2	6.6% (4/61)	14.3% (7/49)	5.0% (1/20)	19.4% (6/31)	11.2% (18/161)
% entrained of total exiting facility 1+2+3	2.1% (4/188)	3.8% (7/184)	1.1% (1/88)	5.5% (6/109)	3.2% (18/569)
Post Test Fish Remaining in Intake Canal (not	29	21	121	63	234
	13.4%	10.2%	57.9%	36.6%	29.1%







3.2%

25.1%

71.7%

Weir

Future Directions

- Installed antennas at headgate 3-2015 (upstream movement)
- Larval Test (May & June 2015)
 - 1.5 + million beads
 - 100,000 larval razorback and pikeminnow
- Electrify weir wall??
- Full test of weir during entire irrigation season
 - Remove Variable Frequency Drive Motors
 - Detections during actual operations
 - Antenna efficiencies (stocked > 400 PNM fish @ various locations)





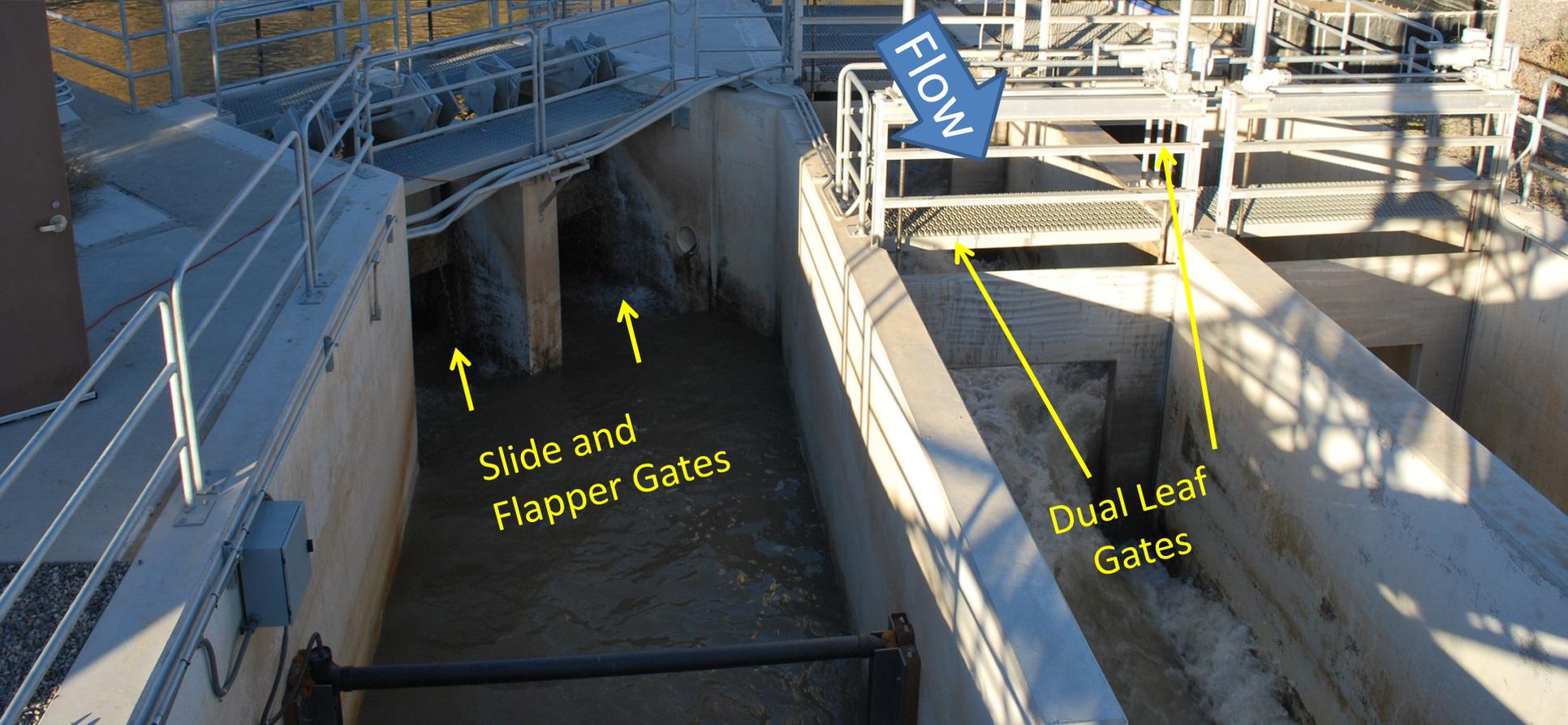
Thanks

- Peter MacKinnon, Chris Cheek, Scott Durst, & Robert Norman
- Mike Zobott (Biomark)
- Ernest Teller (USFWS)
- Manuel Ulibarri and staff @ SNARRC
- Marlin Saggboy (The Navajo Nation—Shiprock Irrigation)
- Ian Johnson, ACES Engineering

	Total
Number Stocked	803
1- Fish Bypassed during test	143
2-Fish Entrained during test	18
3- Undetected (upstream?)	408 50.8% (408/803)
% bypassed 1+2	88.8% (143/161)
% bypassed of total exiting facility 1+2+3	25.1% (143/569)
% entrained 1+2	11.2% (18/161)
% entrained of total exiting facility 1+2+3	3.2% (18/569)
Post Test Fish Remaining in Intake Canal (not entrained or bypassed)	234 29.1% (234/803)



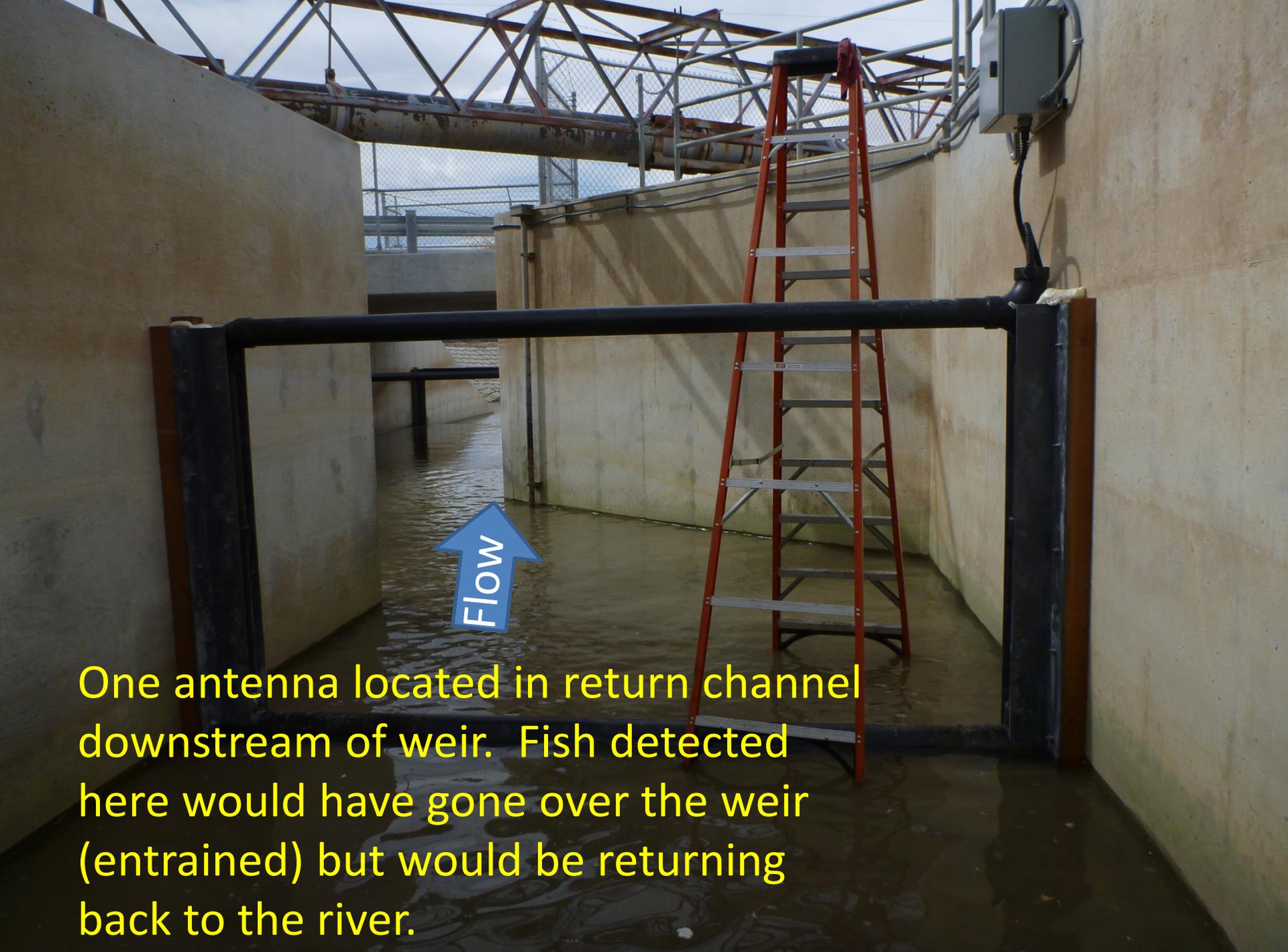
Dual Leaf Gates



FLOW

Slide and
Flapper Gates

Dual Leaf
Gates



One antenna located in return channel downstream of weir. Fish detected here would have gone over the weir (entrained) but would be returning back to the river.