Grand Canyon Monitoring and Research Center

Proposed Experimental Flow Design
WY 2002-2003

Adaptive Management Work Group
April 24-25, 2002

USGS
science for a changing world

Motion Passed by AMWG, January 18, 2002

- **Motion:** ***In concert with RPA flows for native fish during 2002-2003 request that the GCMRC, in consultation with the TWG, design an experimental flow sequence that tests hypotheses for conservation of sediment. Report to AMWG in April 2002 on the proposed flow sequence.***

Response Process

- GCMRC Draft Flow Scenario 1.1 on 2/7/02
- Conference Call Hosted on 2/8/02 For Discussion
- Began Development of Frequently Asked Questions
- Respond to GCRG Memo of Inquiry 2/11/02
- AGFD & GCMRC Staff Met w/Lees Ferry Guides 2/12/02
- GCMRC Mailing to TWG members 2/15/02
    - **Draft Flow Scenarios 1.2, FAQ's, Corrected Fig. 1 (2/22/02)**
- GCMRC met with GCROA 2/21/02
- TWG Meeting 2/26-27/02

The WY 2002 – 2003 experimental flow recommendation is intended to have two primary purposes

- improve retention of sediment in the CRE
- benefit native fish populations (primarily HBC)

Specific Objectives WY 2002 – 2003 Experimental flows

- decrease downstream export of tributary input sediment from Marble Canyon
- increase short term retention of sediment stored in channel through low flows and long term retention of sediment in shorelines through BHBFs
- Reduce non-native fish abundance and thereby improve survival and recruitment of HBC by reducing competition and predation
- improve and maintain habitat for young native fish

WY 2002 – 2003 Hydrology Assumption

Recommendations are based on an 8.23 maf water year

Working Hypotheses

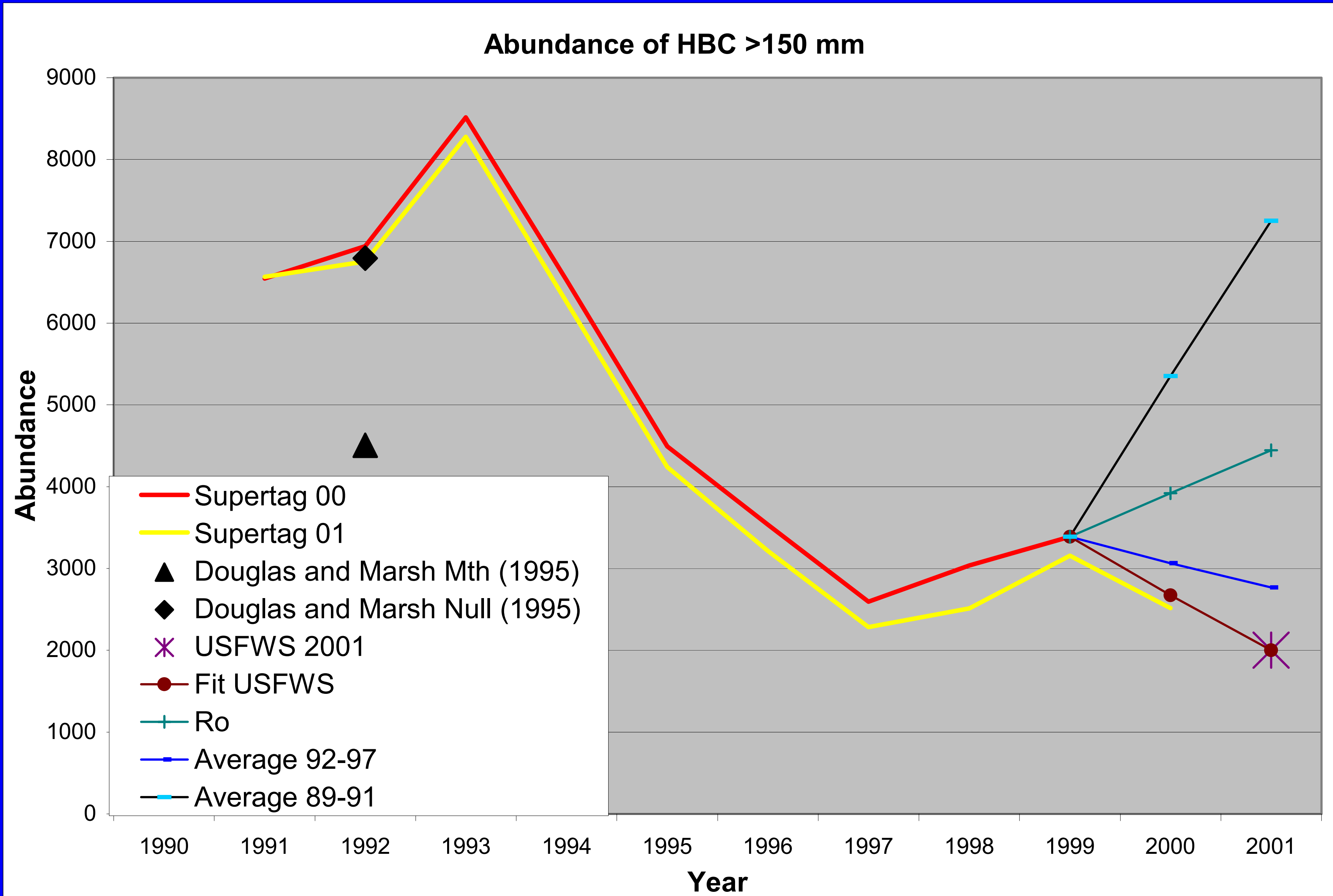
- Sediment
  - Sediment not retained under normal ROD operations
  - Tributary input retained best at flows <10,000cfs
  - Fine sediment retained best at lower flows and may contribute to increased turbidity
  - Fine sediment may reduce erosion of bars
  - Experimental flows need to be responsive to opportunities presented by tributary inputs
  - Experimental fluctuating flows combined with BHBF may increase stability of stored sediment

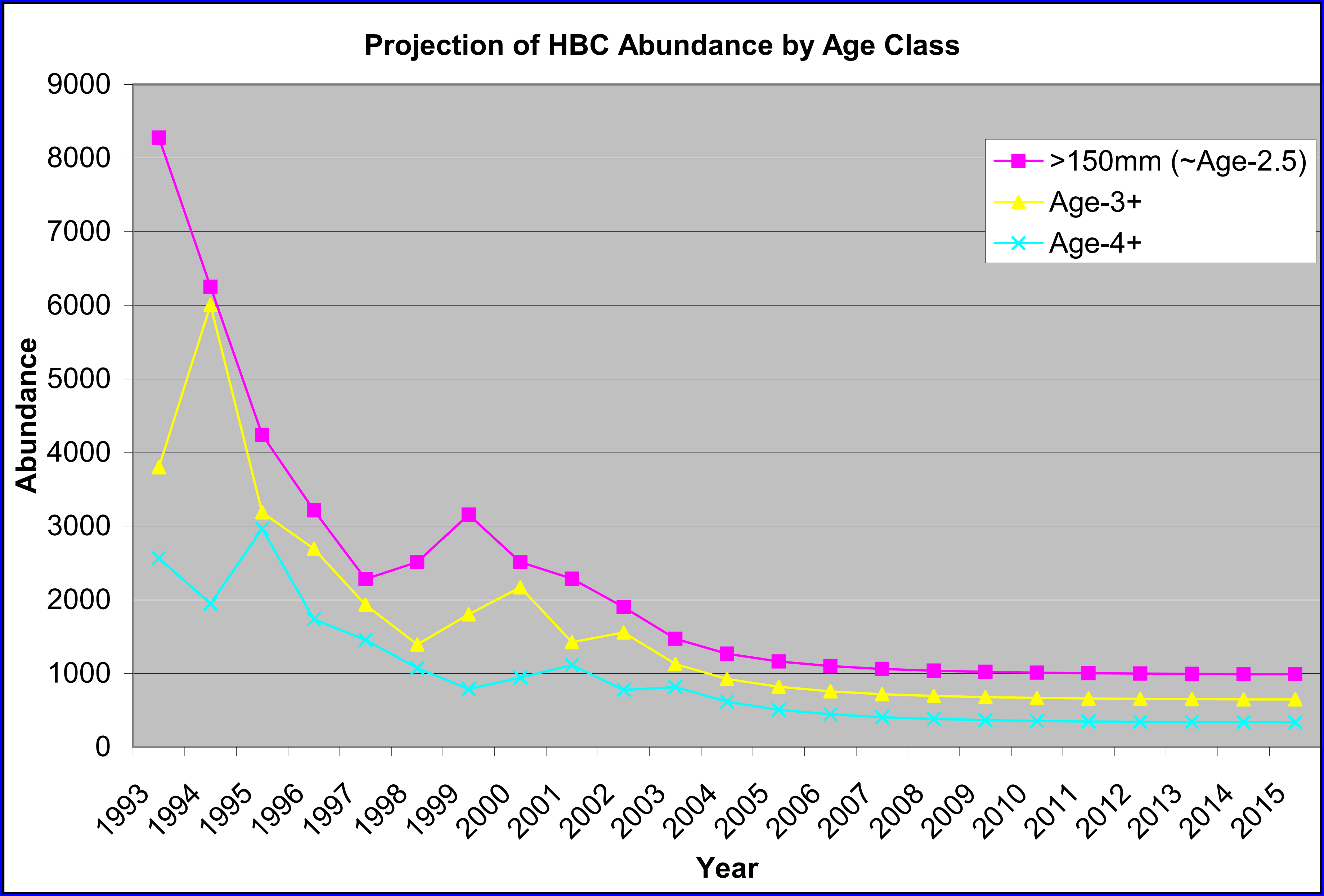
Working Hypotheses(cont.)

- Native Fish (HBC)
  - Humpback Chub are not responding favorably to normal ROD operations
  - LCR Humpback Chub population is dependent to some extent on the mainstem
  - Non-native fish populations may be influencing HBC recruitment through predation and/or competition
  - Disadvantaging non-natives (trout) in the mainstem through fluctuating flows may indirectly benefit HBC
  - Sediment experiments may improve habitat and increase turbidity

Adaptive Management

- Sediment elements of experiments are reasonably well understood and likely to produce predicted response
- Fish aspects of experiments are more speculative but considered low risk and represent needed management action to begin addressing decline in HBC
- Experiments are complimentary


Abundance of HBC >150 mm
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Abundance
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
Year
Supertag 00
Supertag 01
Douglas and Marsh Mth (1995)
Douglas and Marsh Null (1995)
USFWS 2001
Fit USFWS
Ro
Average 92-97
Average 89-91



Projection of HBC Abundance by Age Class
Abundance
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
>150mm (~Age-2.5)
Age-3+
Age-4+
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Year

Process (Post AMWG)

- AMWG Recommendation to Secretary
- Engage in AOP Process, May & June mtgs.
- Design Needed Additional Research & Monitoring Elements in Response to AMWG Action
- Present Research Design and $$ Needs to July AMWG?

Need for Long-term Experimental Framework

<u>Resource Conditions Since Implementation of ROD Flows</u>

- Decline of HBC
- Continued loss of sediment
- Erosion of archaeological sites
- Decline in health of Lees Ferry Trout

Long-term Experimentation

- Move from passive to active AM
- Requires individual treatments embedded in a long-term experimental design
- Each year represents a treatment, it is the individual treatments taken together that represent the experiment
- Treatments need to be strong enough to have a measurable affect

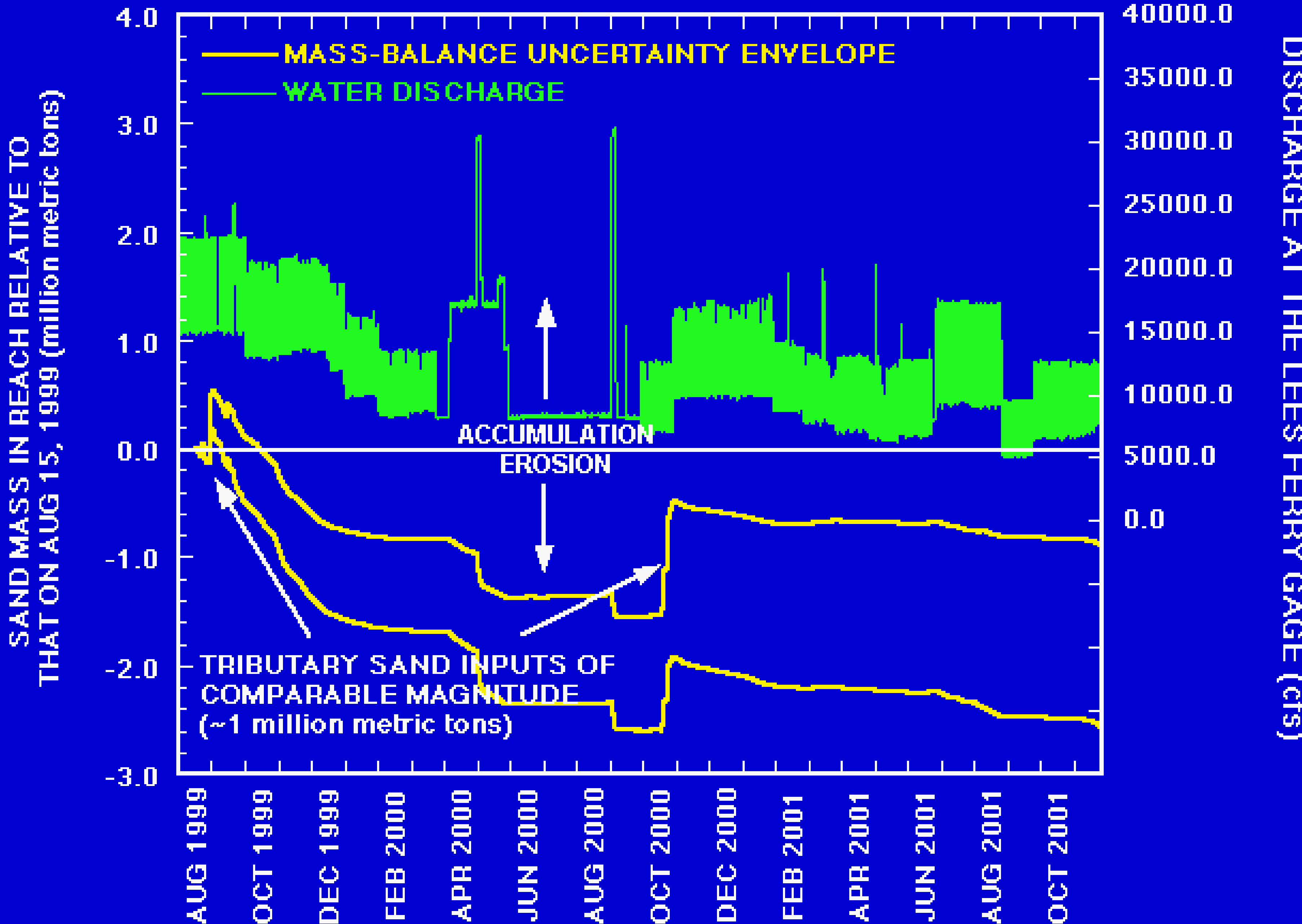
Long-term Experimentation - continued

- Do the treatment first that is most likely to have the desired effect
- Managers retain the right to truncate the experiment when they believe sufficient learning has occurred to recommend a management action

Assumptions Governing the GCMRC Proposal

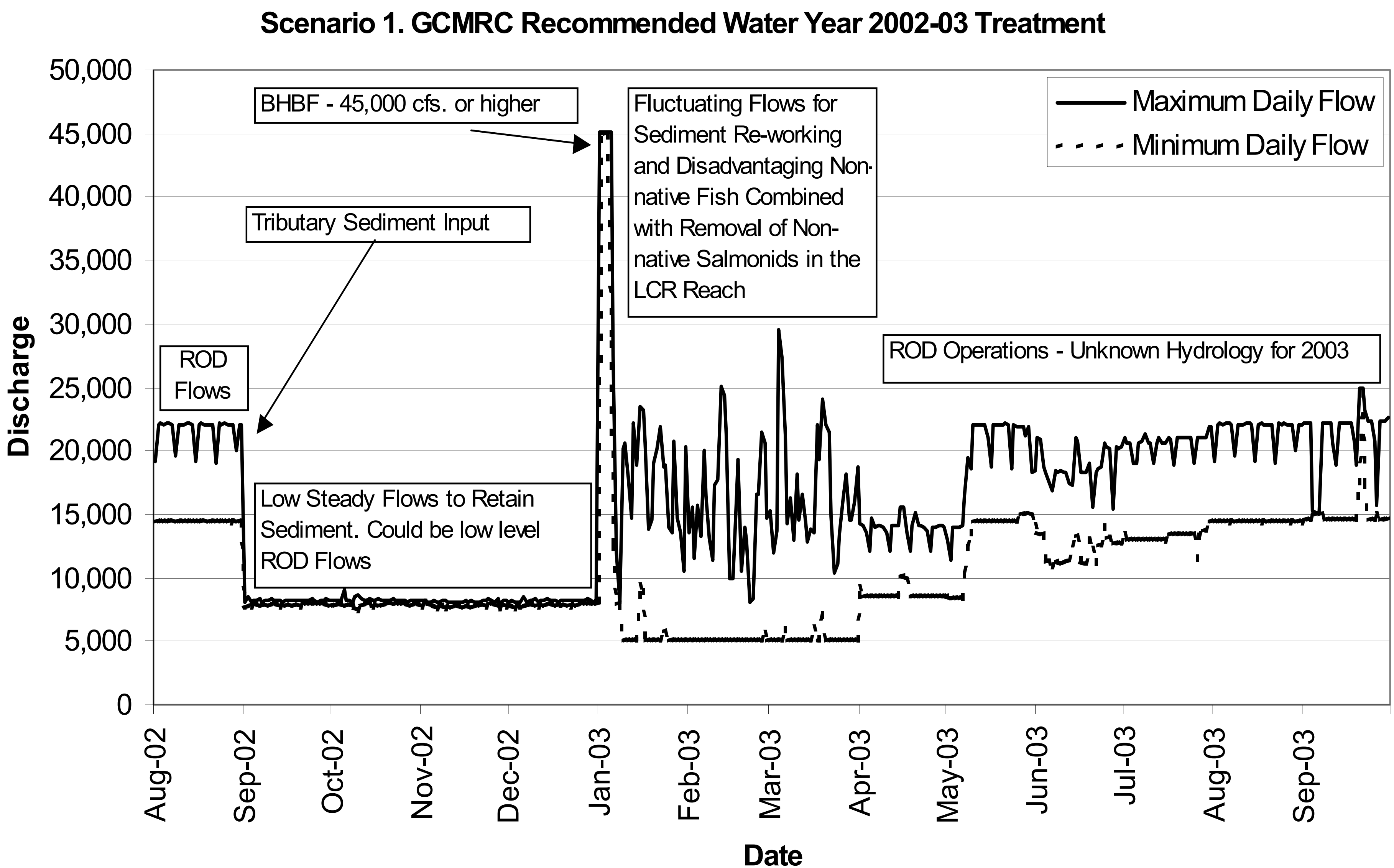
- Hydrology and reservoir elevation in WY 2002 and 2003 will allow the first two treatment years to be implemented under similar fall flow conditions
- Implement Scenario 1 in year 1
- Implement a Scenario that includes ROD flows and/or HMF flows in year 2
- Sufficient Funding to support the science plan will be available (each treatment will have different costs for monitoring and research)

MASS-BALANCE SAND BUDGET
BETWEEN LEES FERRY AND THE GRAND CANYON GAGE



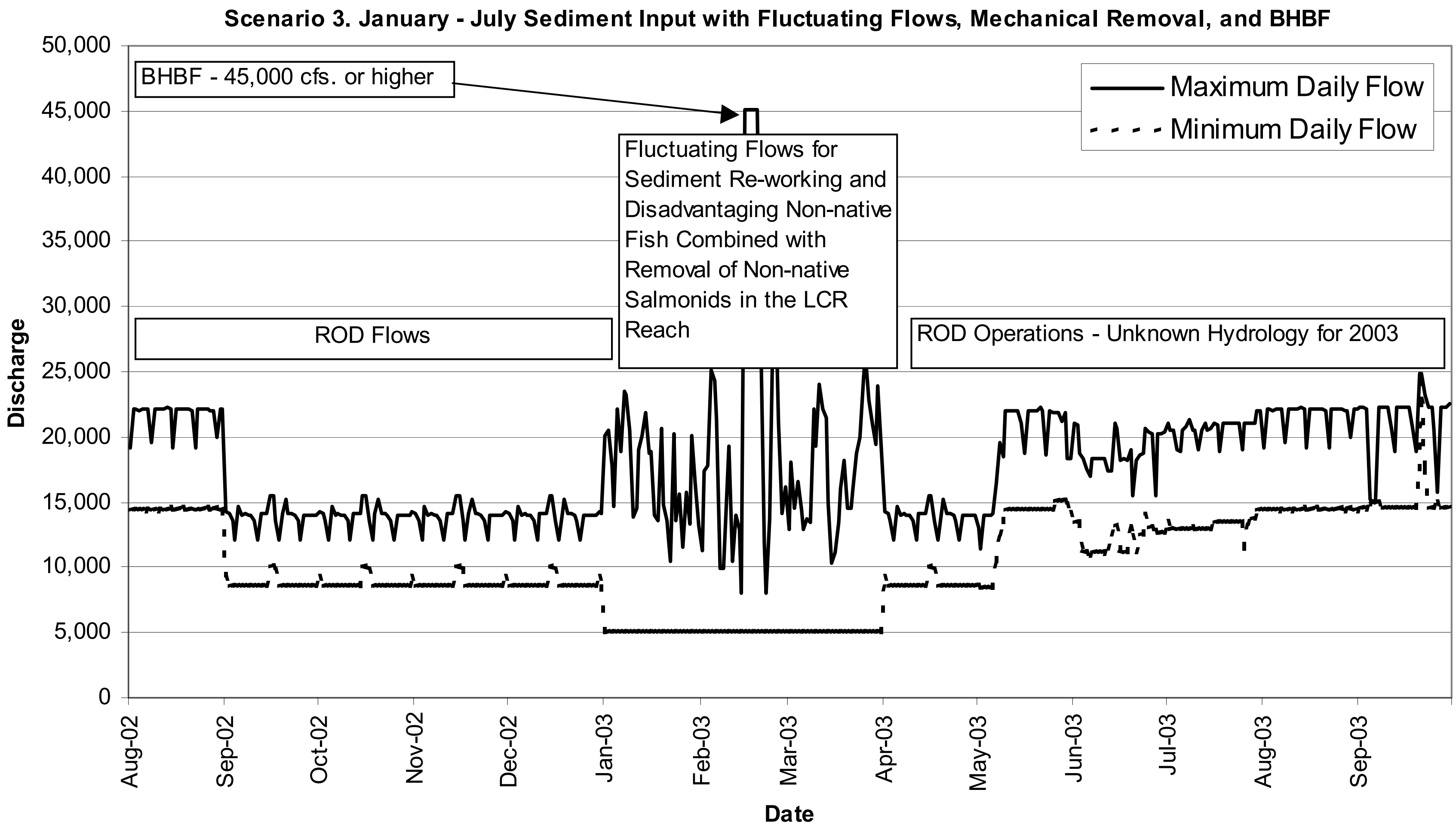
Overview of Year 1 Treatment

- Aug – Sept: Implement mechanical removal of trout at confluence of LCR
- Aug – Drop to low flows (< 10,000 cfs) if significant sediment inputs occur
- Sept – Dec: Continue low flows (< 10,000 cfs)
- Jan – Implement BHBF if sufficient sediment storage has occurred (45,000 cfs)
- Jan – Mar – Implement high fluctuating flows
- Mar – July: ROD flows and mechanical removal of trout at confluence of LCR


Scenario 1. GCMRC Recommended Water Year 2002-03 Treatment
Discharge
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Aug-02
Sep-02
Oct-02
Nov-02
Dec-02
Jan-03
Feb-03
Mar-03
Apr-03
May-03
Jun-03
Jul-03
Aug-03
Sep-03
Date
Maximum Daily Flow
Minimum Daily Flow
ROD Flows
BHBF - 45,000 cfs. or higher
Tributary Sediment Input
Low Steady Flows to Retain Sediment. Could be low level ROD Flows
Fluctuating Flows for Sediment Re-working and Disadvantaging Non-native Fish Combined with Removal of Non-native Salmonids in the LCR Reach
ROD Operations - Unknown Hydrology for 2003

Overview of Year 2 Treatment

- Aug – Sept: Low ROD flows, Implement mechanical removal of trout at confluence of LCR
- Sept – Dec: ROD flows
- Jan – Implement BHBF if sufficient sediment storage has occurred
- Jan – Mar – Implement high fluctuating flows
- Mar – July: ROD flows and mechanical removal of trout at confluence of LCR


Scenario 3. January - July Sediment Input with Fluctuating Flows, Mechanical Removal, and BHBF
Discharge
Date
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
BHBF - 45,000 cfs. or higher
Fluctuating Flows for Sediment Re-working and Disadvantaging Non-native Fish Combined with Removal of Non-native Salmonids in the LCR Reach
ROD Flows
ROD Operations - Unknown Hydrology for 2003
Maximum Daily Flow
Minimum Daily Flow
Aug-02
Sep-02
Oct-02
Nov-02
Dec-02
Jan-03
Feb-03
Mar-03
Apr-03
May-03
Jun-03
Jul-03
Aug-03
Sep-03

Overview of Alternative Year 2 Treatment

- Aug – Sept: Low ROD flows, Implement mechanical removal of trout at confluence of LCR
- Aug – Dec: ROD flows with HMFs during substantial sediment inputs
- Jan – Implement BHBF if sufficient sediment storage has occurred
- Jan – Mar – Implement high fluctuating flows
- Mar – July: ROD flows and mechanical removal of trout at confluence of LCR

COMPARISON OF YEAR 1 & 2 TREATMENT OPTIONS

	YEAR 1 TREATMENT -steady, low flows followed by BHBF (Rubin et al., option 2)	YEAR 2 TREATMENT -low ROD operations followed by BHBF	ALTERNATIVE YEAR 2 TREATMENT - low ROD operations (with peak power plant releases during Paria R. floods) followed by BHBF	Summer-Fall BHBF (Rubin et al., option 1)
Amount of 1 million metric ton sand and 1 million metric ton silt & clay input from the Paria River retained for redistribution during BHBF	Almost all sand and a large amount of silt & clay retained	~75 % of sand and moderate amounts of silt & clay retained	<50 % of sand and almost no silt & clay retained	100% of sand and silt & clay available for BHBF
Time to export first half of 1 million metric ton sand input from the Paria River	~700 days @ 8,000 cfs ~200-300 days @ 10,000 cfs	~200 days @ fluctuations around 10,000 cfs	~1-2 days @ 31,000 cfs	NEED DATA
Environment where retained sediment would be stored prior to the BHBF	Below ~8,000 cfs stage in eddy bars and in channel	Below ~12,000 cfs stage in eddy bars and in channel (if ROD peaks are ~12,000 cfs)	Below ~31,000 cfs stage in eddy bars and channel	N/A
D_{50} of eddy bars deposited during BHBF	FINE TO MODERATE	MODERATE	COARSE	FINE TO MODERATE

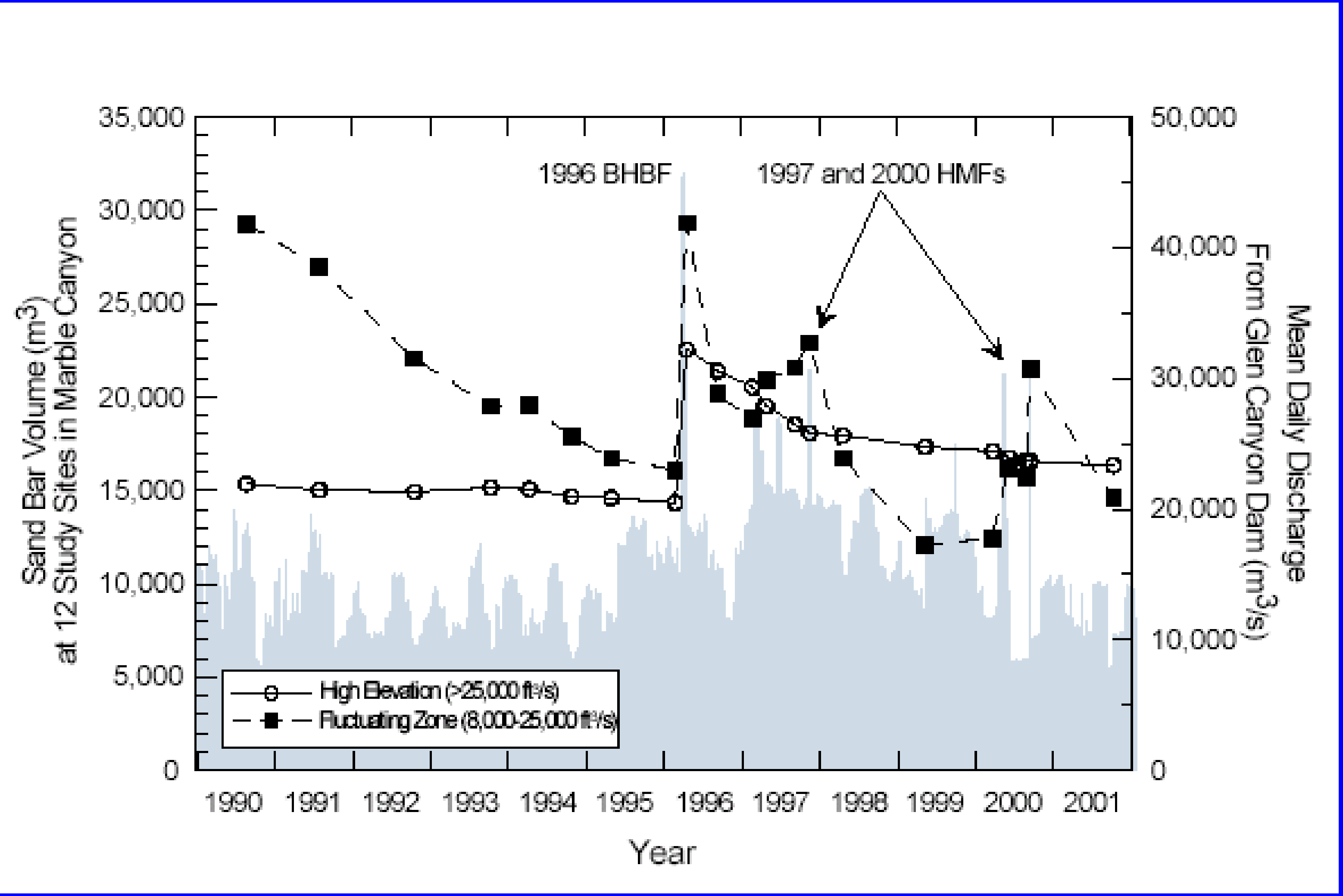
Adaptive Management Treatment Options to be determined by Ad Hoc Flow & TWG

Table: Experimental Design, long-term sequence of treatments

Water Year	Fluctuating Flows (Jan – Mar)	Mechanical Removal (Aug – Dec)	Stable Fall Flows (Aug – Dec)	TCD (Future)	BHBF (Jan – Jul)
WY2002-03	Yes	Yes	Yes	No	?
WY2003-04	Yes	Yes	No	No	?
WY2004-05	No	Yes	Yes	No	?
WY2005-06	No	Yes	No	No	?
WY2006-07					?
WY2007-08					?
WY2008-09					?
WY2009-10					?
WY2010-11					?
WY2011-12					?
WY2012-13					?
WY2013-14					?
WY2014-15					?
WY2015-16					?
WY2016-17					?
WY2017-18					?

Desired AMWG Recommendation

- Recommend the adoption of a long-term experimental framework
- Recommend implementation of Scenario 1 in year 1 and a subsequent treatment in year 2
- Recommend that GCMRC in consultation with the TWG and with advice from the Science Advisors develop a detailed long-term plan for implementation of year 3 and beyond treatments



35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Sand Bar Volume (m3) at 12 Study Sites in Marble Canyon
50,000
40,000
30,000
20,000
10,000
0
Mean Daily Discharge From Glen Canyon Dam (m3/s)
1996 BHBF
1997 and 2000 HMFs
High Elevation (>25,000 ft3/s)
Fluctuating Zone (8,000-25,000 ft3/s)
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
Year

Sand Bar Areas and Volumes in Active Zone (8,000 to 25,000 ft³/s)