

# Altered Flood Control, Climate Change, and Rebuilding Pacific Northwest Salmon Stocks



**Kyle Dittmer**

*Hydrologist – Meteorologist*

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Columbia River Inter-Tribal Fish Commission

Portland, Oregon

# Introduction



- A Natural River reservoir operation promotes environmental conditions that are in harmony with the salmon's biological timing. (Return of the River...Independent Science Group, 2000, <http://www.nwcouncil.org/library/return/2000-12.htm>)
- Altered flood control and earlier reservoir refill can create a more natural flow regime.
- Modified operations are at Grand Coulee (WA), Dworshak (ID), Brownlee (ID), Libby & Hungry Horse (MT), Mica & Arrow (British Columbia).

# Columbia River Basin



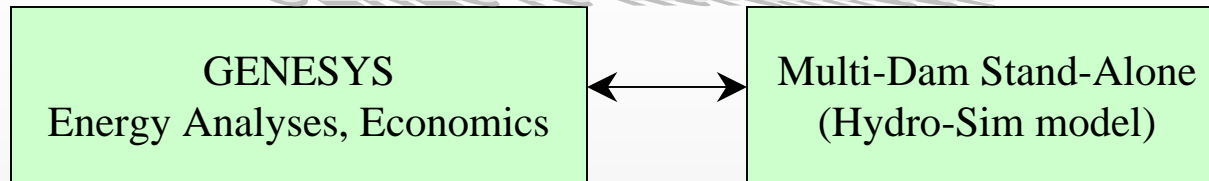
# Natural Flow regime Concept

- Natural Flow improves salmon survival with: increased turbidity & habitat, decreased travel time, higher river and estuary productivity.
- Altered Flood Control uses less reservoir drafts during winter and early spring.
- More water is shifted from winter to spring.
- Summer flow augmentation: 3.377 MaF.
- Nez Perce Tribe Summer Plan for Dworshak.
- Modified VAR-Q used for Libby & Hungry Horse.

# GENESYS Hydro-generation model

- This NPPC model uses monthly time steps.
- Operations are specified at major PNW dams.
- Model runs sequentially from dam-to-dam.
- Record spans 50 Water Years: 1929 - 1978.
- Output: flow, spill, pool elevations, generation.
- Rule Curves altered for flood control operations.
- In 2006 (?), model upgrades: 70 water years (1929-1999) and maybe half-month time steps.

# GENESYS Northwest



PLANT File:  
Physical Characteristics--  
Min/Max flow, FB vs. Storage  
Tail-Water vs. Discharge

PERIOD File:  
Rule Curves  
(temporal data)

OPERATIONS Files:  
Flow Limits, Spill, Storage Limits  
"Operation-Exception"

Program Control Files-- Pre-Processing

*50 years historical, observed data*  
*Proportional draft, PNCA specified*

**GENESYS**  
**Multi-Dam**

*Prioritized operating parameters*  
*Draft specific reservoirs, if desired*

Program Control Files-- Post-Processing

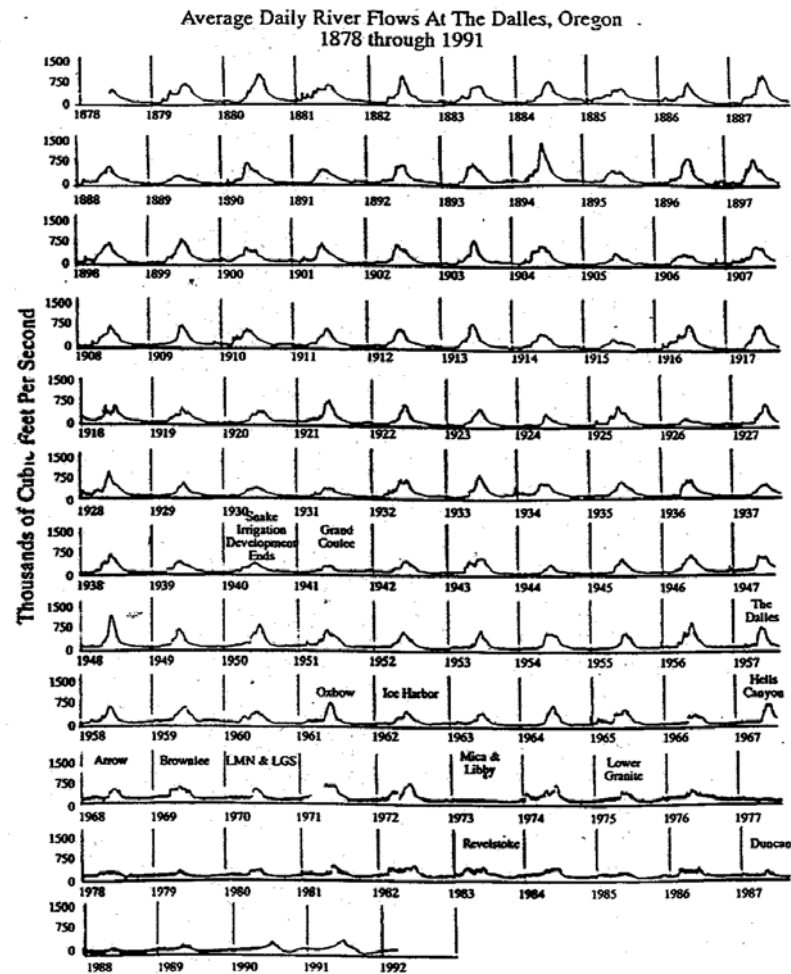
Graphical Displays:  
Outflow, Pool Elevations, Storage

Tabular Reports and Data Files

# Corps System Flood Control

- Regulate Flood of 1894 to 800 kcfs (primary) and 600 kcfs (secondary), at The Dalles.
- Flood flow, 550 kcfs; and Bank-full, 450 kcfs.
- Reservoirs systematically drawn down from January through April 30.
- Reservoir draft depends on monthly final Water Supply (Volume) Forecast. Corps does not look at trend of WSF and may overdraft reservoirs.
- Reservoirs start refilling after May 1st.
- Reservoirs fill by June 30th and pass inflow.

# Long-term Effects of Corps Flood Control



**FIGURE 2** Average daily river flows measured at The Dalles, Oregon over the historical record and construction dates of Columbia basin mainstem hydroprojects.



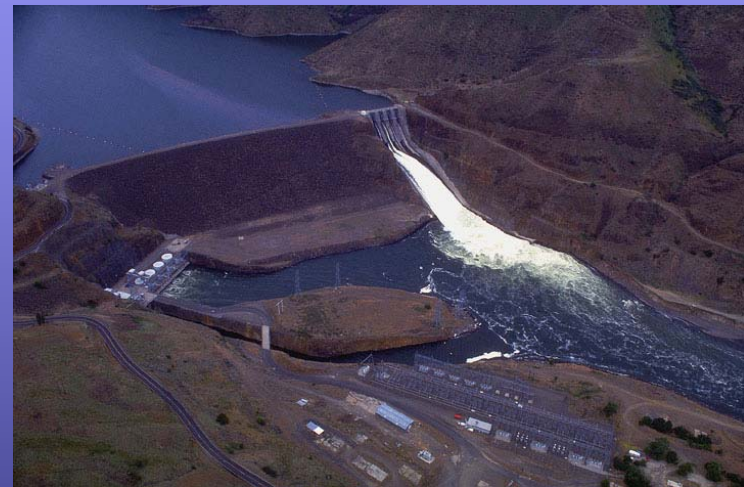
# Altered Flood Control

- Global warming will reduce winter snow packs. Spring flood control drafts can be reduced.
- New forecast tools (eg, UW, NOAA, CRITFC) can reduce premature flood control drafts.
- Fill all reservoirs by May 31st, not June 30th.
- Inflows passed in June for a higher spring peak.
- Altered Flood Control adds more storage: 508 KaF at Grand Coulee, 874 KaF at Libby, 366 KaF Hungry Horse, 420 KaF at Dworshak, 205 KaF at Brownlee, 507 KaF from Mica and Arrow. Total = 2.9 MaF.

# How Much Water is Saved?



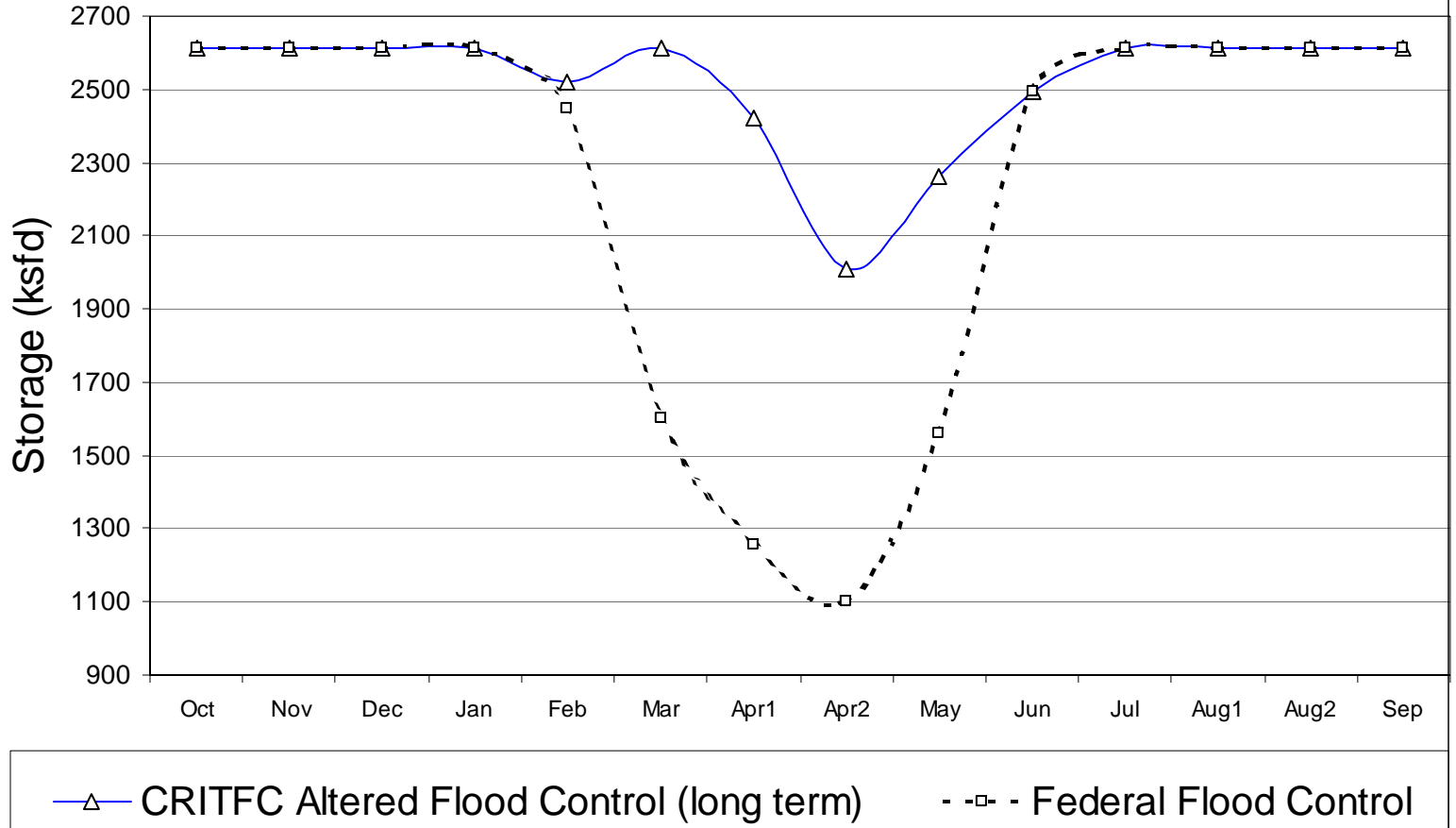
**Dworshak**



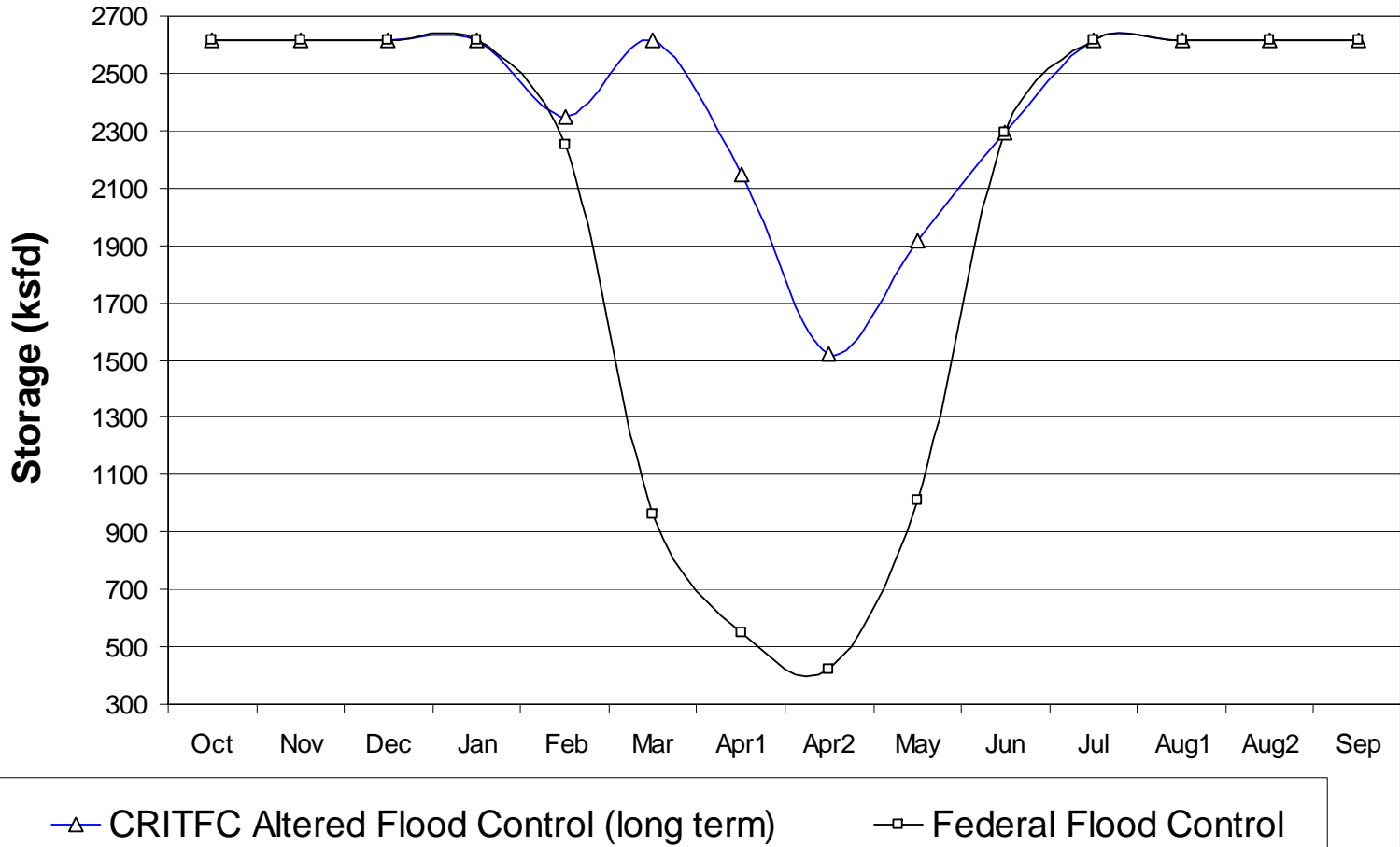
**Brownlee**

Each year on average, CRITFC's Altered Flood Control can shift the entire volume of Dworshak and Brownlee reservoirs to benefit salmon passage!!!

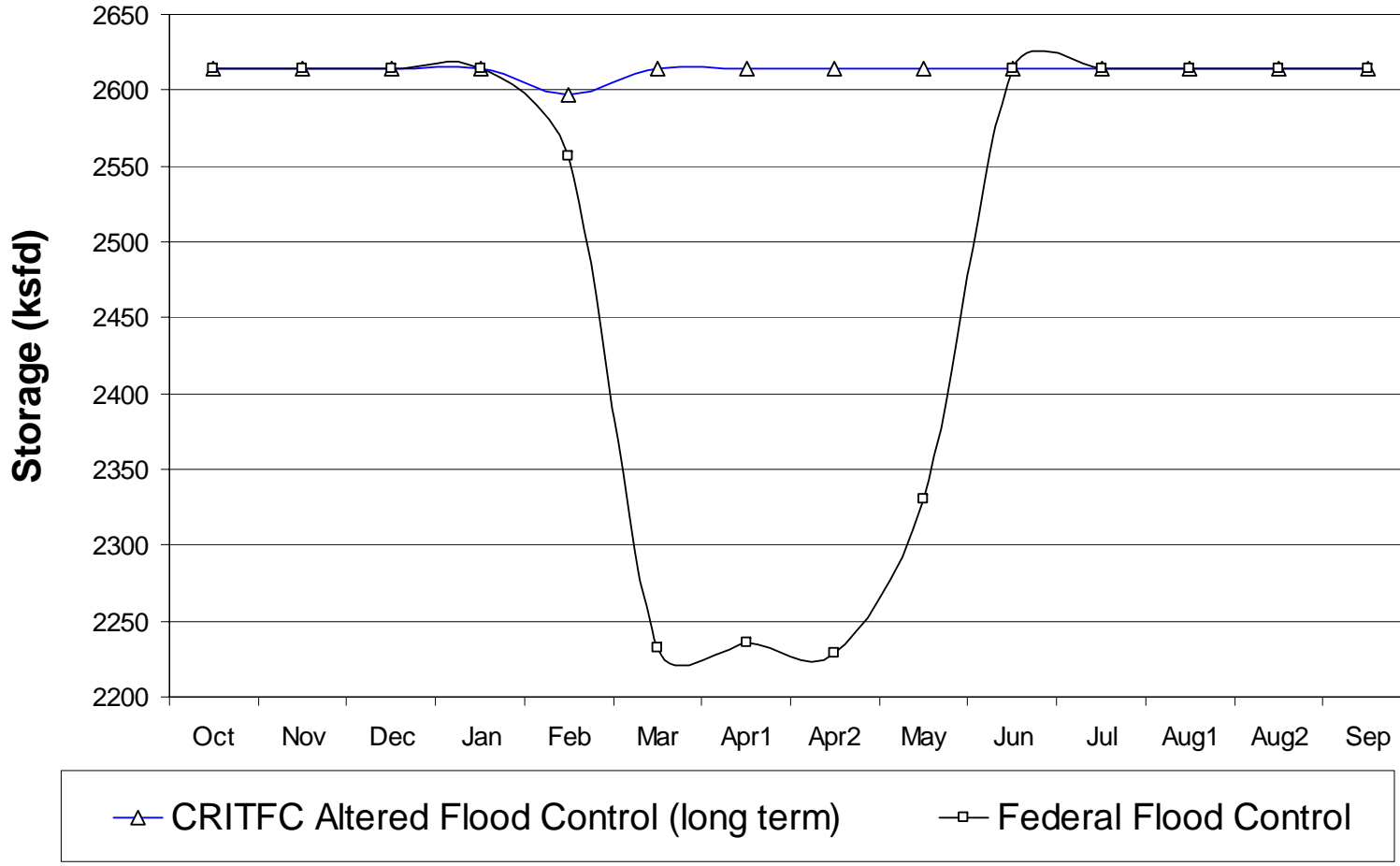
# Grand Coulee: Flood Control Rule Curve



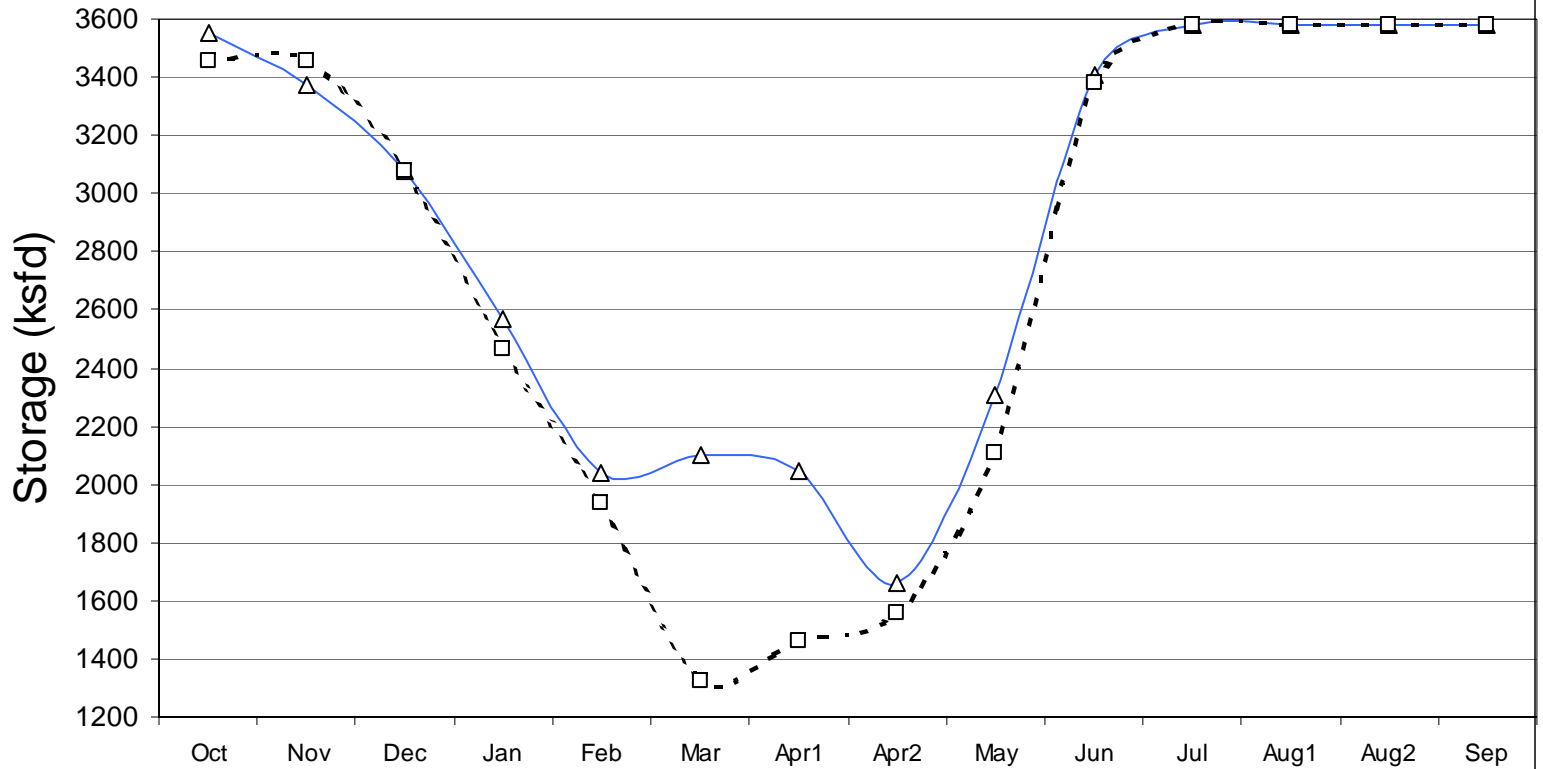
# Grand Coulee: Flood Control HIGH YRS



# Grand Coulee: Flood Control LOW YRS



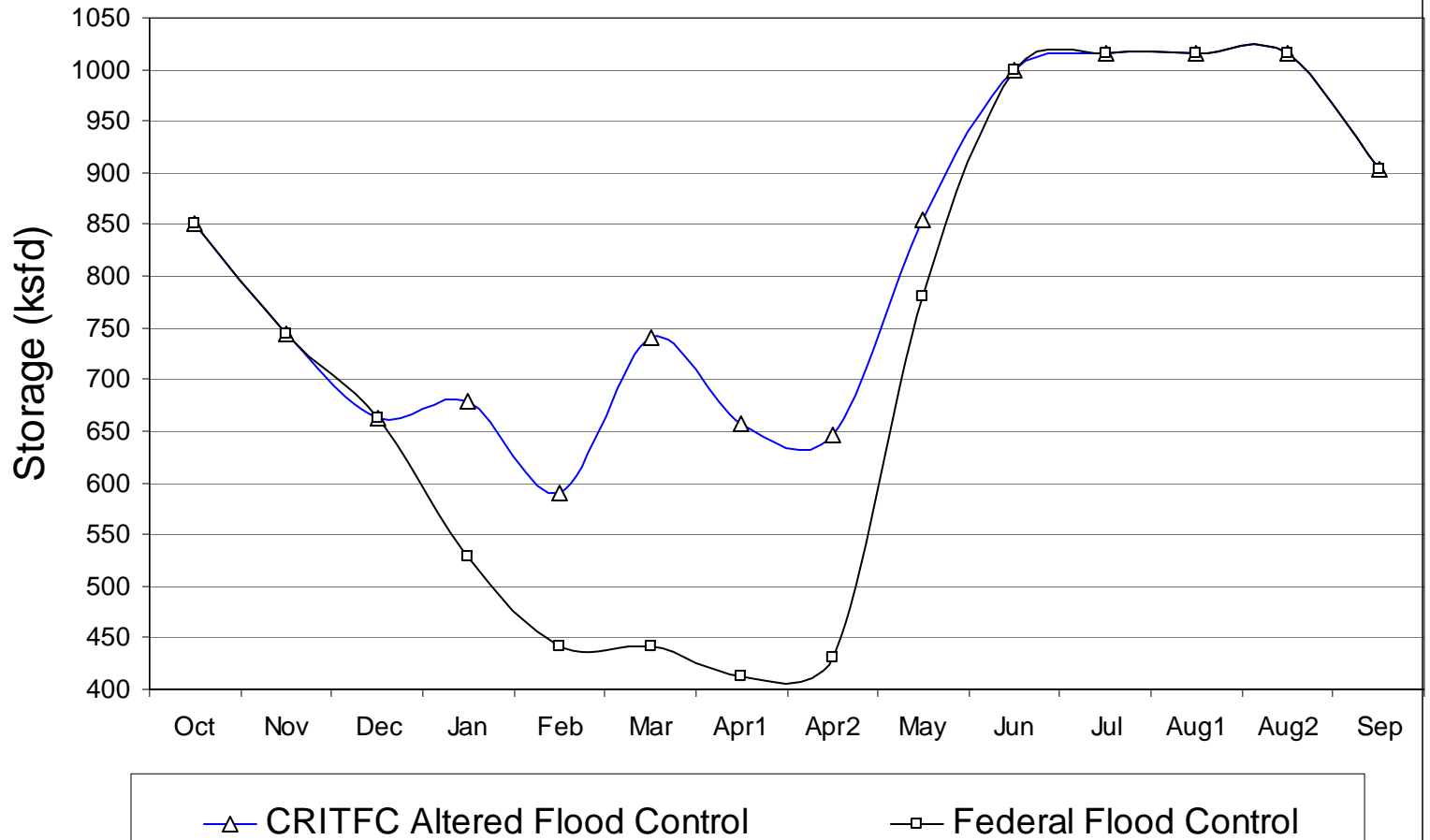
# Arrow pool: Flood Control Rule Curve



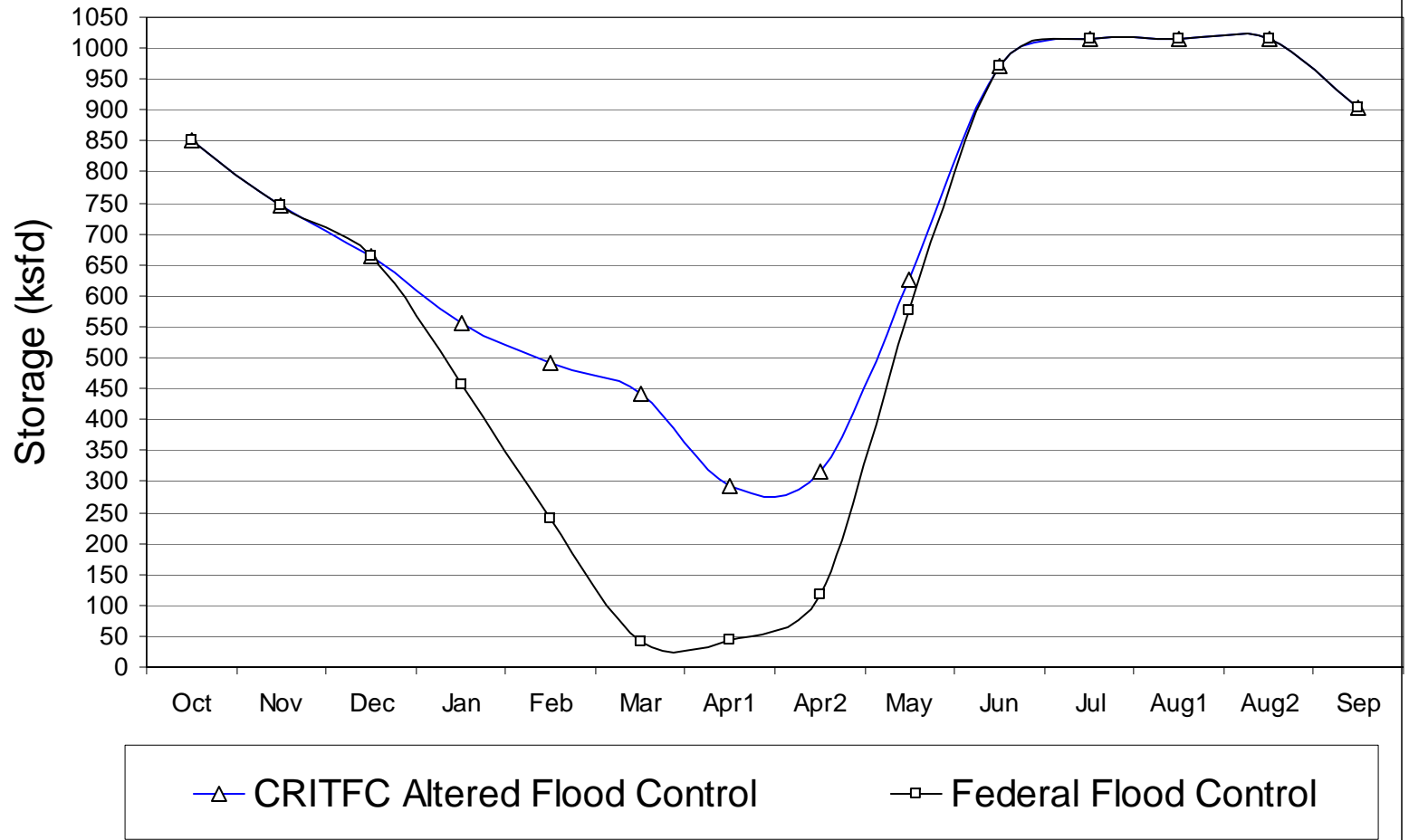
—△— CRITFC Altered Flood Control

- -□- - Federal Flood Control

# Dworshak pool: Flood Control Rule Curve

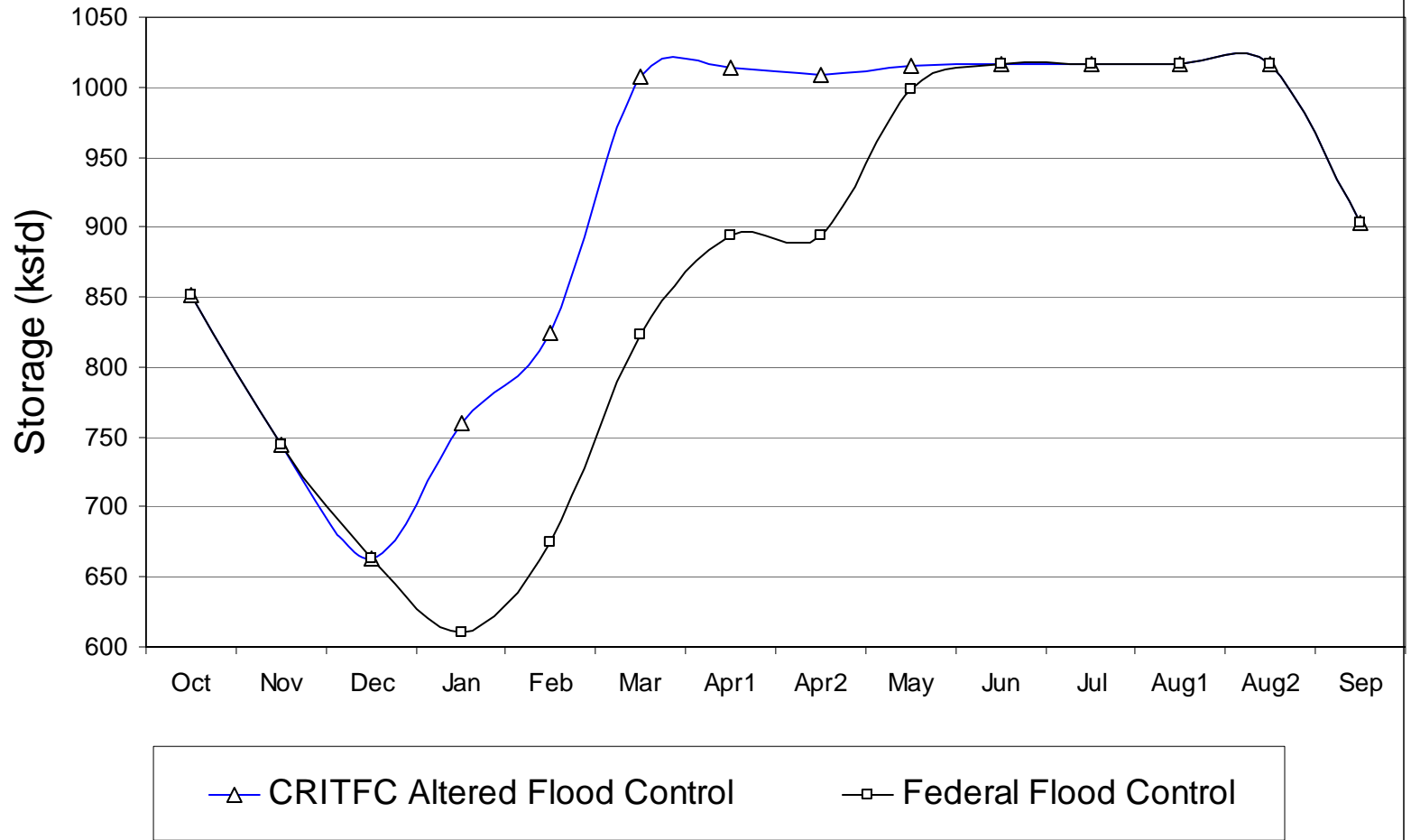


# Dworshak pool: Flood Control HIGH YRS

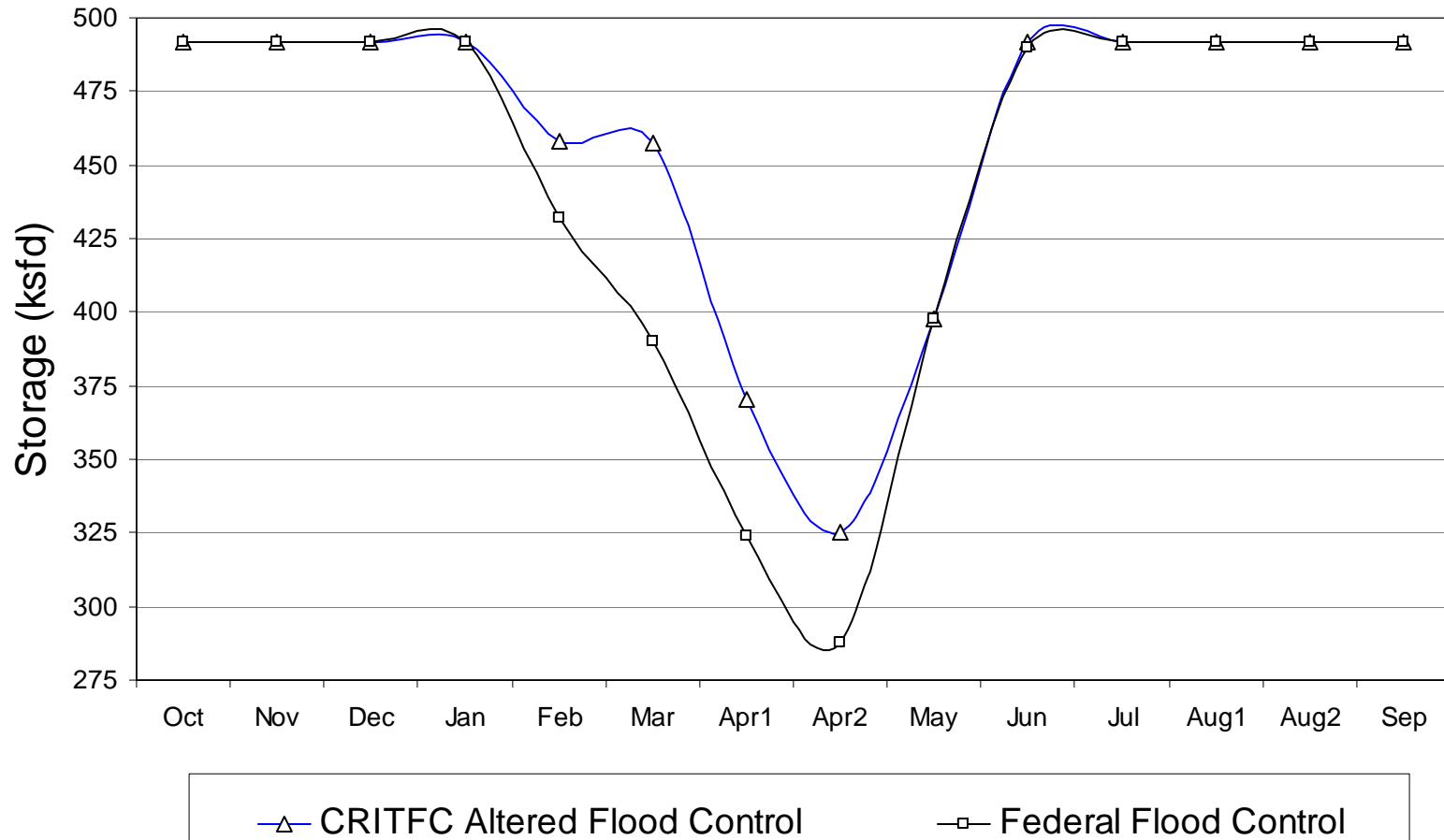




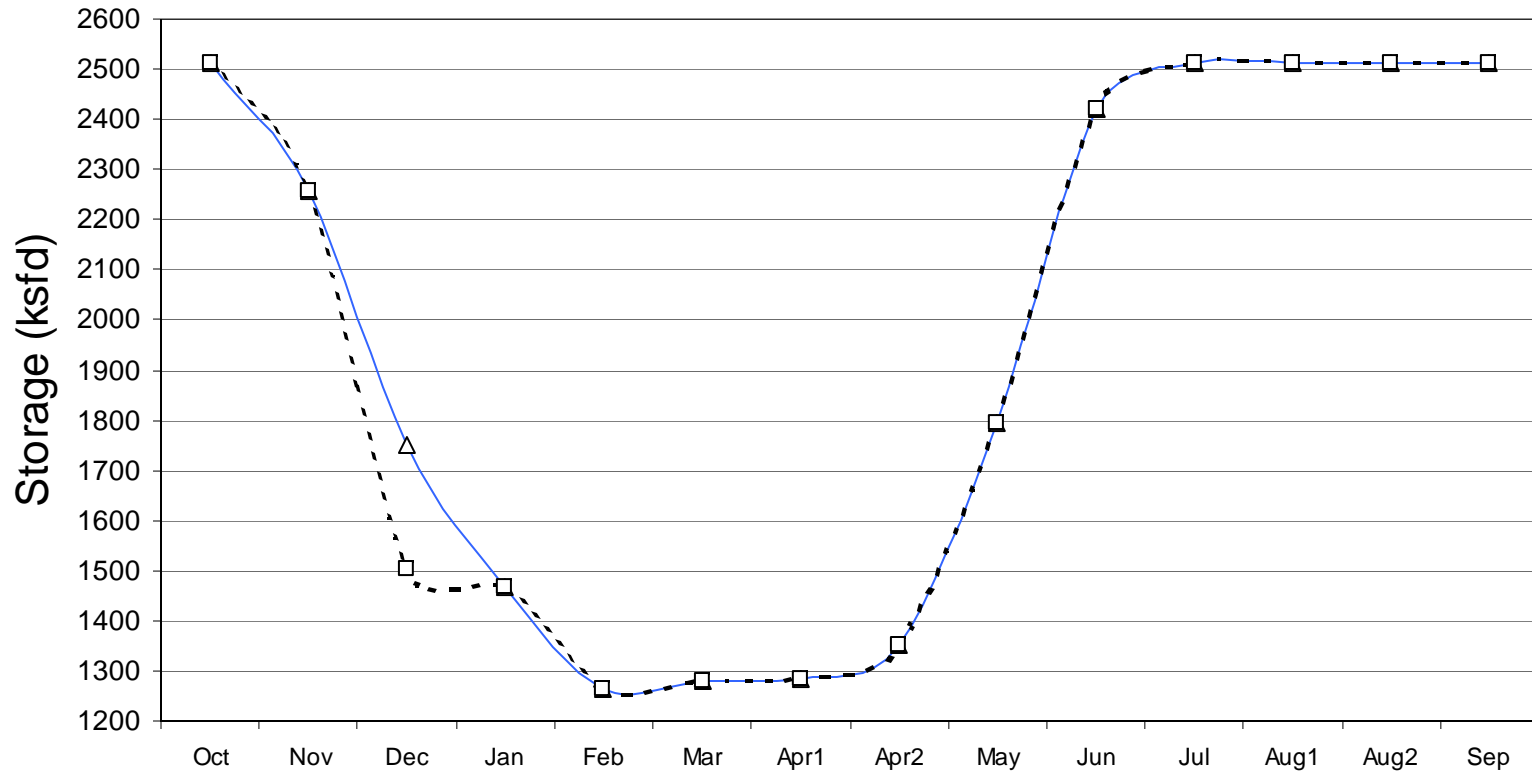
## Dworshak pool: Flood Control LOW years



# Brownlee pool: Flood Control Rule Curve



# Libby pool: Flood Control Rule Curve



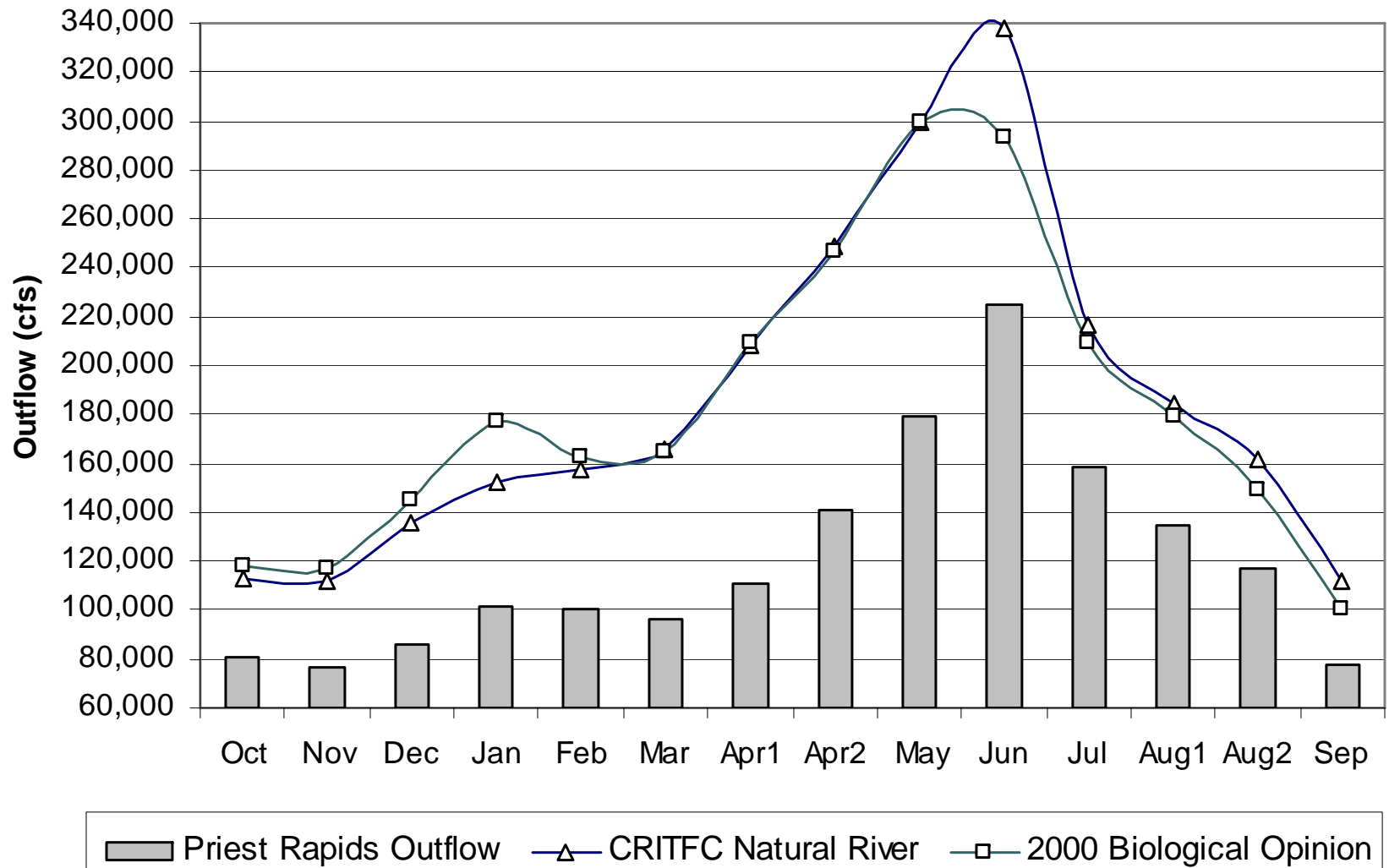
—△— CRITFC Altered Flood Control

- -□ - Federal Flood Control

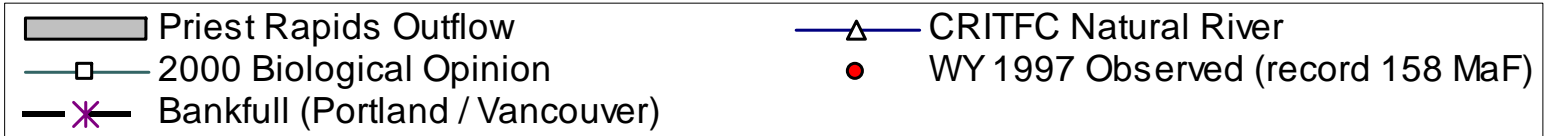
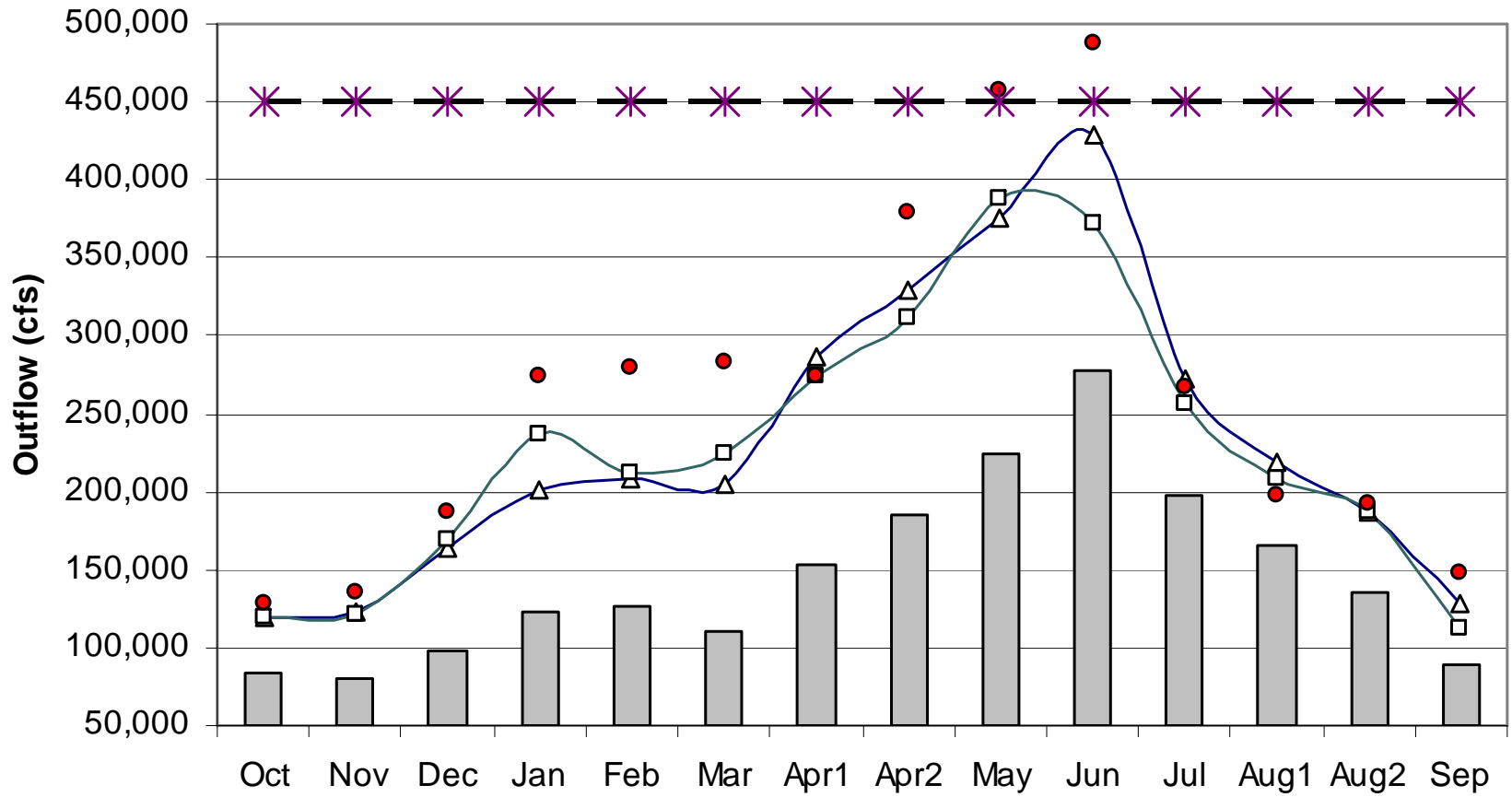
# Results of Natural Peak River plan using GENESYS model

- About 2.9 MaF more water per year is flushed. Average June peak at The Dalles is 327 kcfs. High water year peak is 417 kcfs (13 years). Low water year peak is 220 kcfs (11 years).
- McNary spring flows increase by 7% and summer flows increase by 5%.
- Residence times increase at DWR, HGH, LIB.
- Generation increases in summer, less in winter.  
Annual generation: 154,600 MW (6383 MW less than 2000 Biological Opinion)  
Tribal Energy Vision Paper: [http://www.critfc.org/legal/energy\\_fin.html](http://www.critfc.org/legal/energy_fin.html)

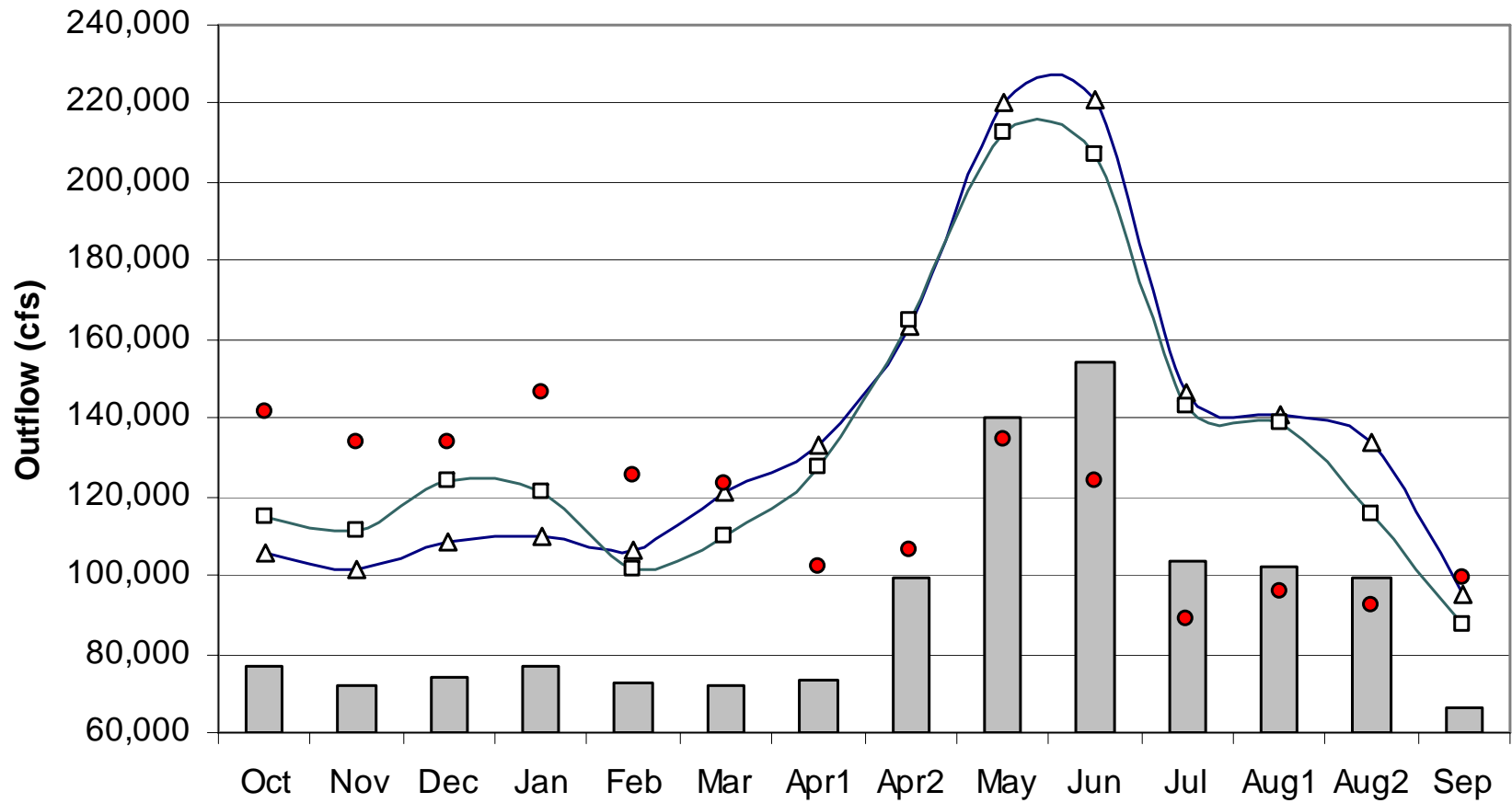
## Columbia River at The Dalles: WY 1929-1978



## Columbia River at The Dalles: HIGH Years



## Columbia River at The Dalles: LOW Years



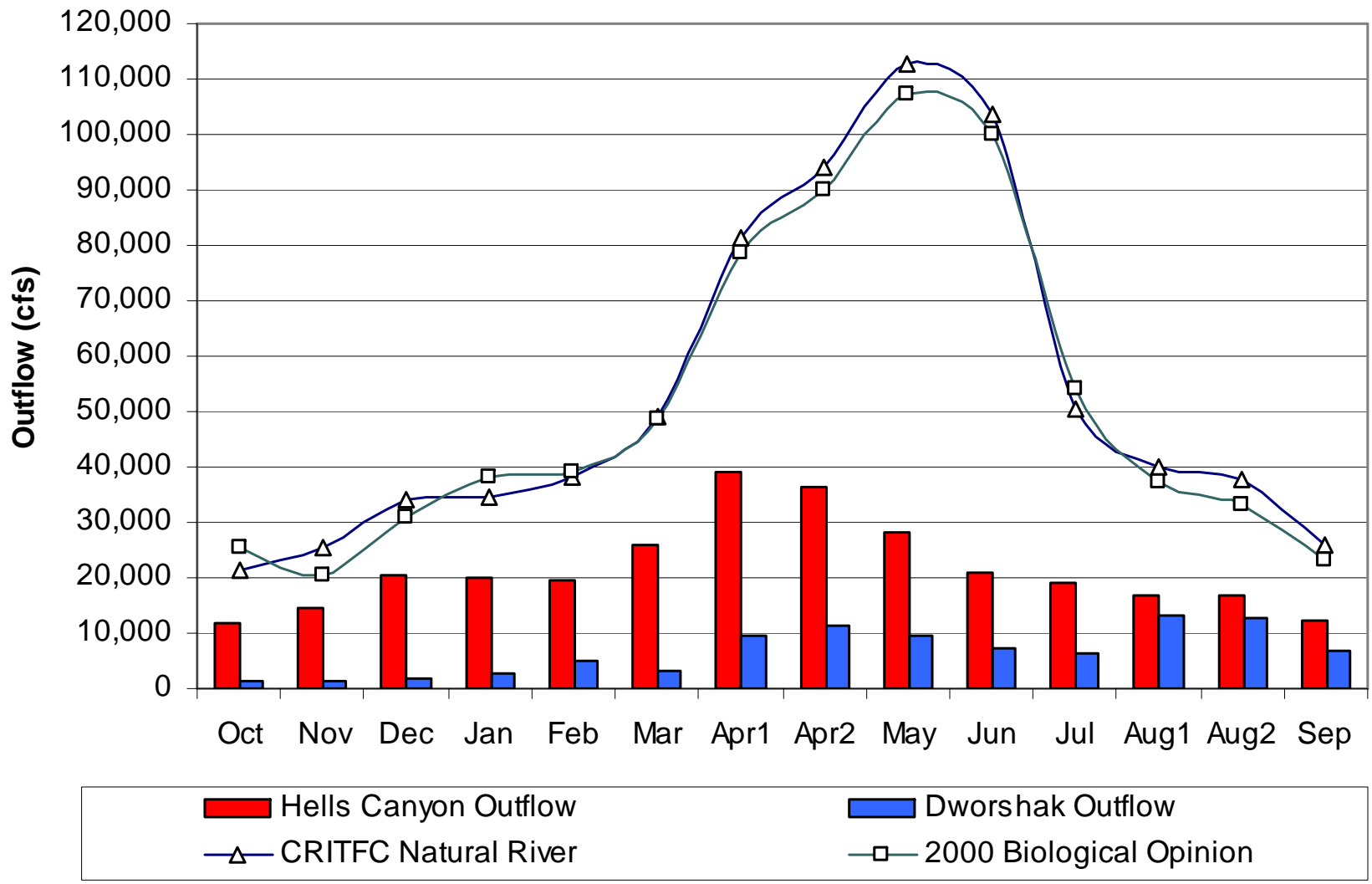
■ Priest Rapids Outflow

—△— CRITFC Natural River

—□— 2000 Biological Opinion

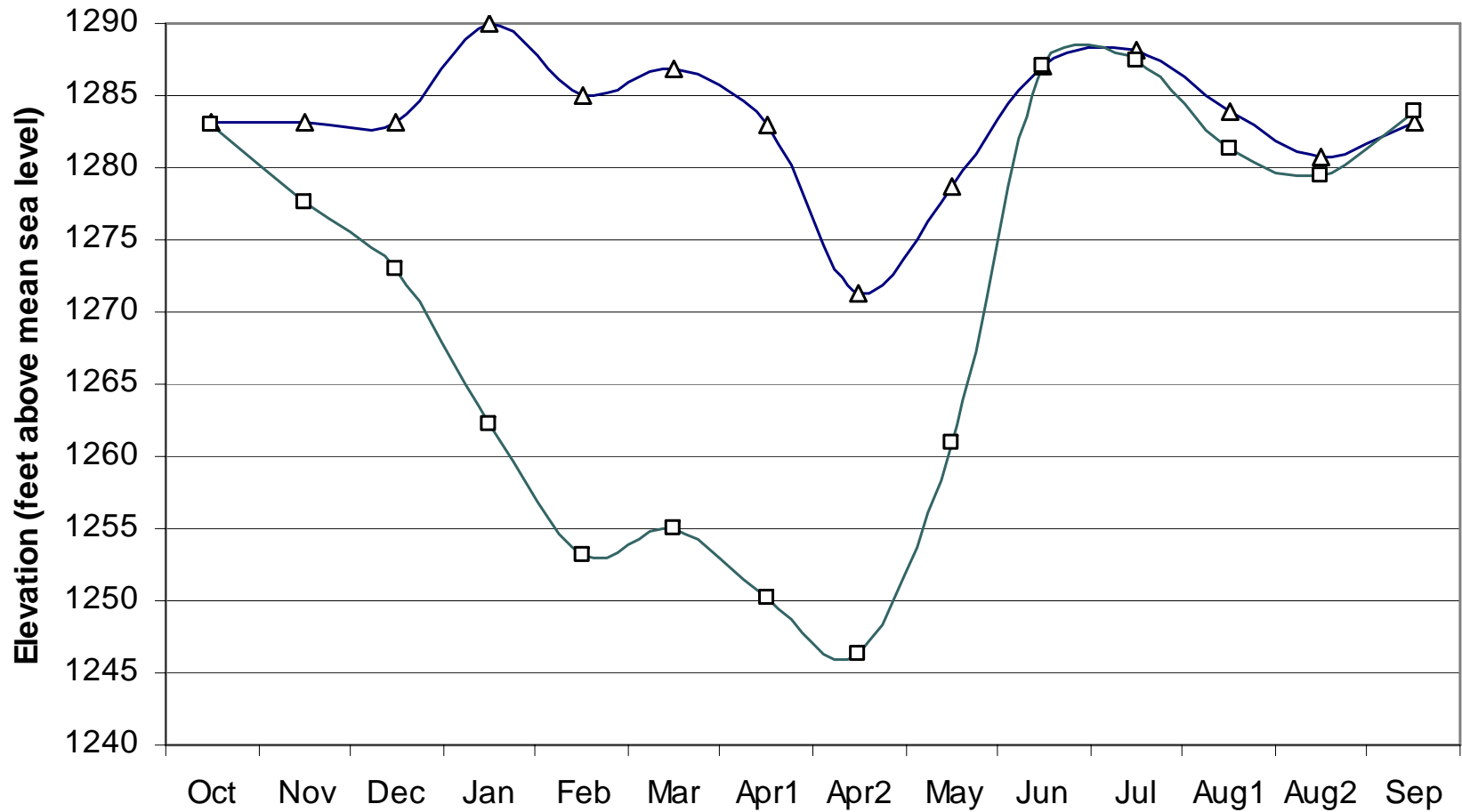
● WY 1977 Observed (record low 53 MaF)

# Snake River at Lower Granite



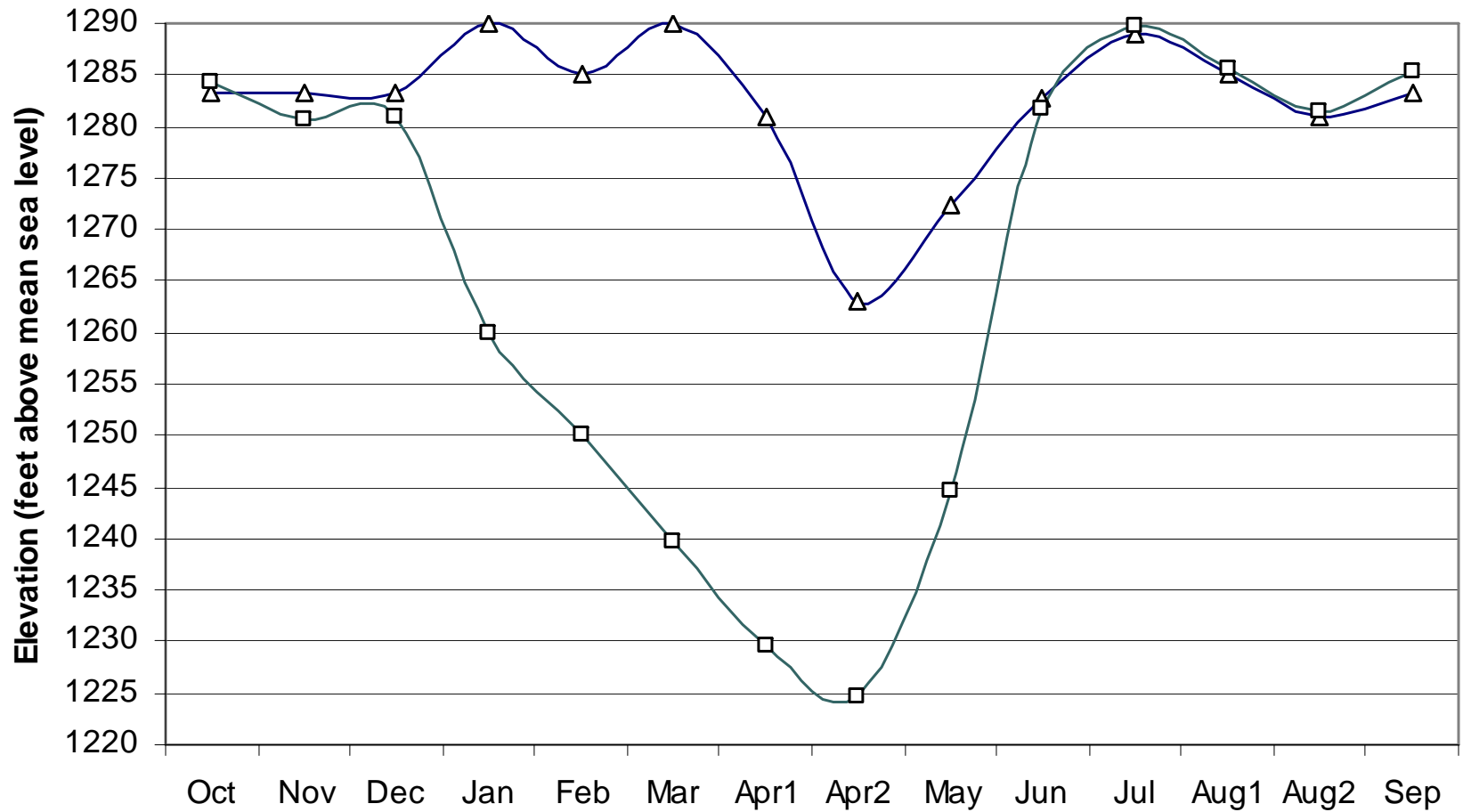


## Columbia River at Grand Coulee: WY 1929-1978



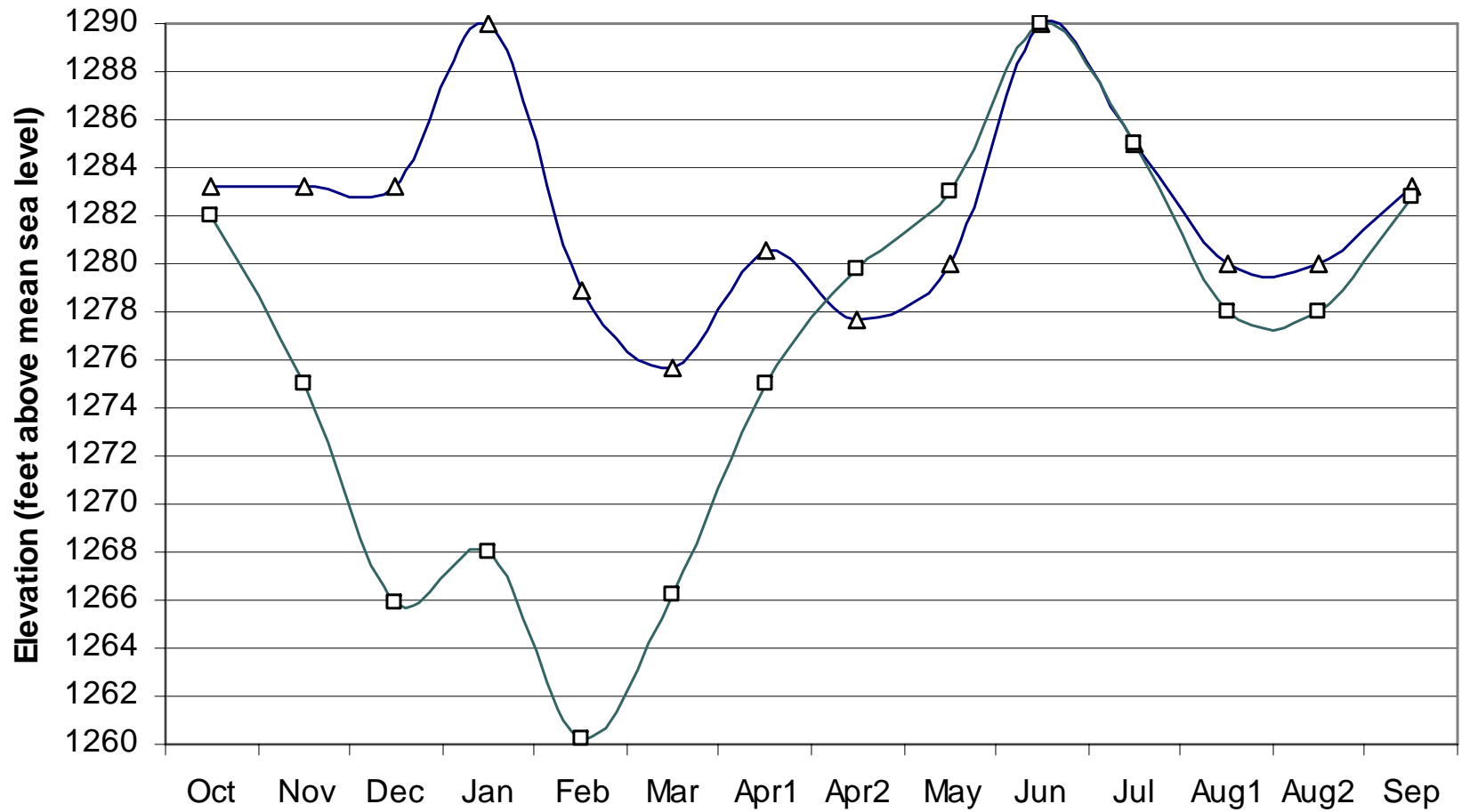
—△— CRITFC Natural River    —□— Federal Operations (2000 Biological Opinion)

## Columbia River at Grand Coulee: HIGH Years



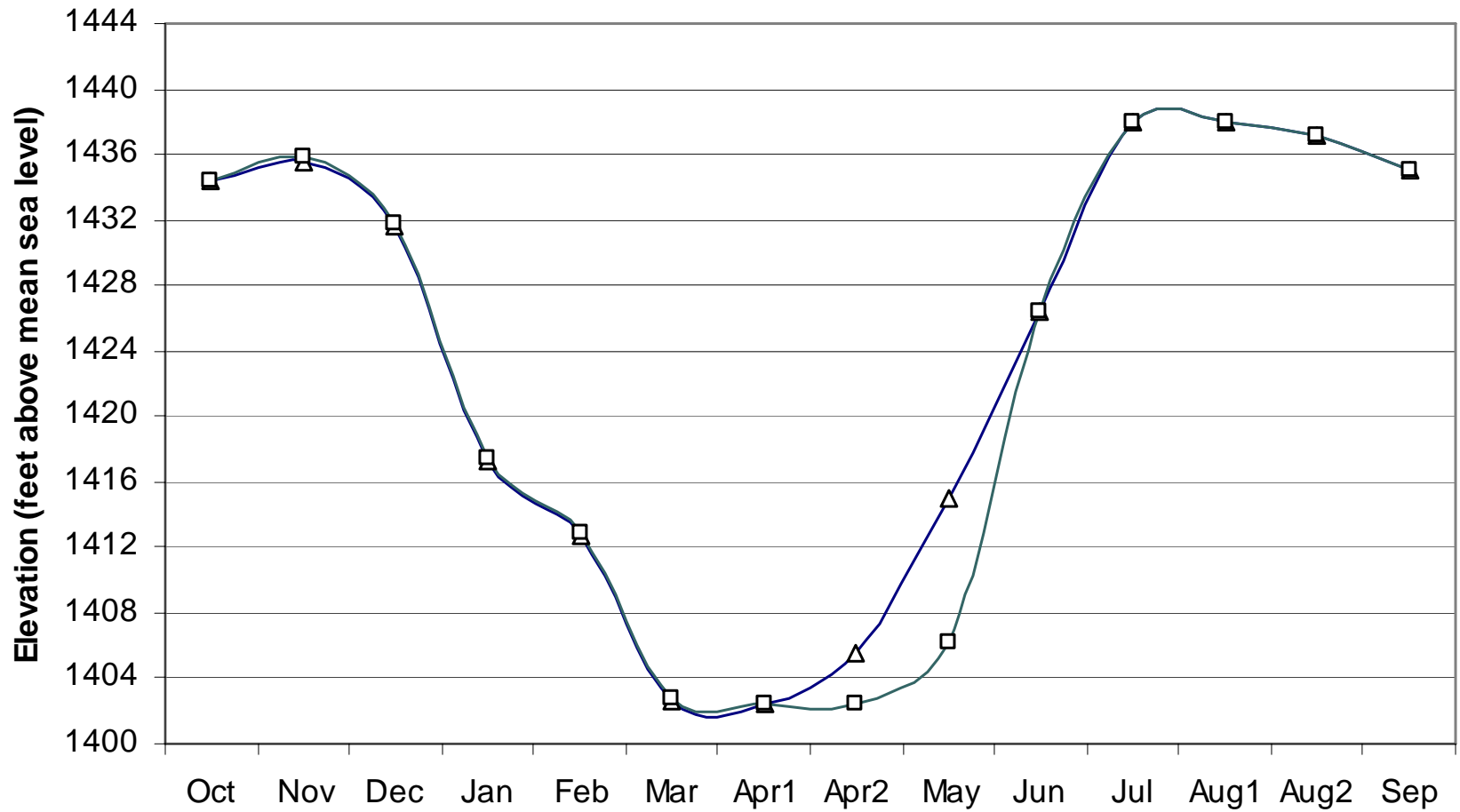
—△— CRITFC Natural River    —□— Federal Operations (2000 Biological Opinion)

## Columbia River at Grand Coulee: LOW Years



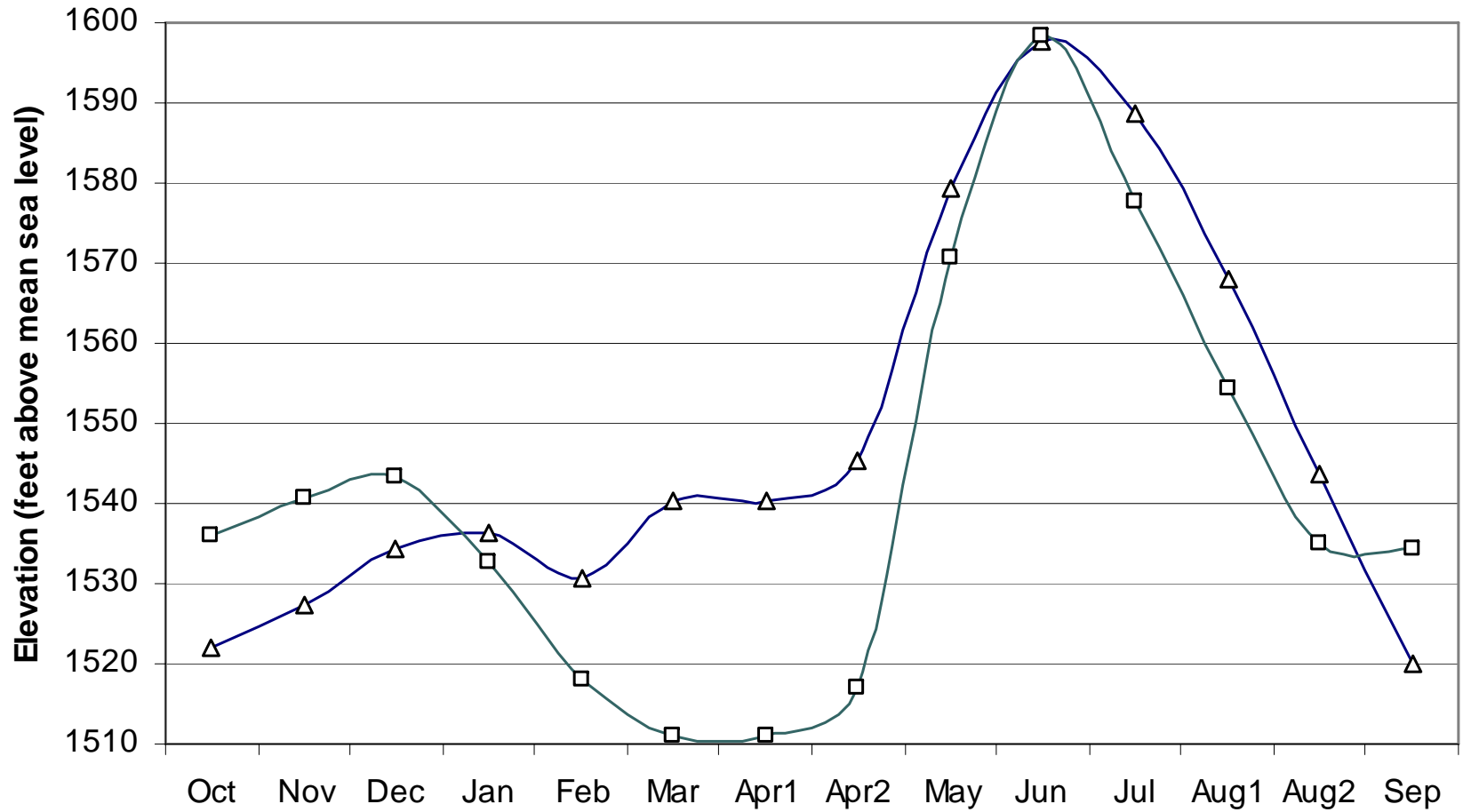
—△— CRITFC Natural River    —□— Federal Operations (2000 Biological Opinion)

## Columbia River at Arrow Lakes (BC)



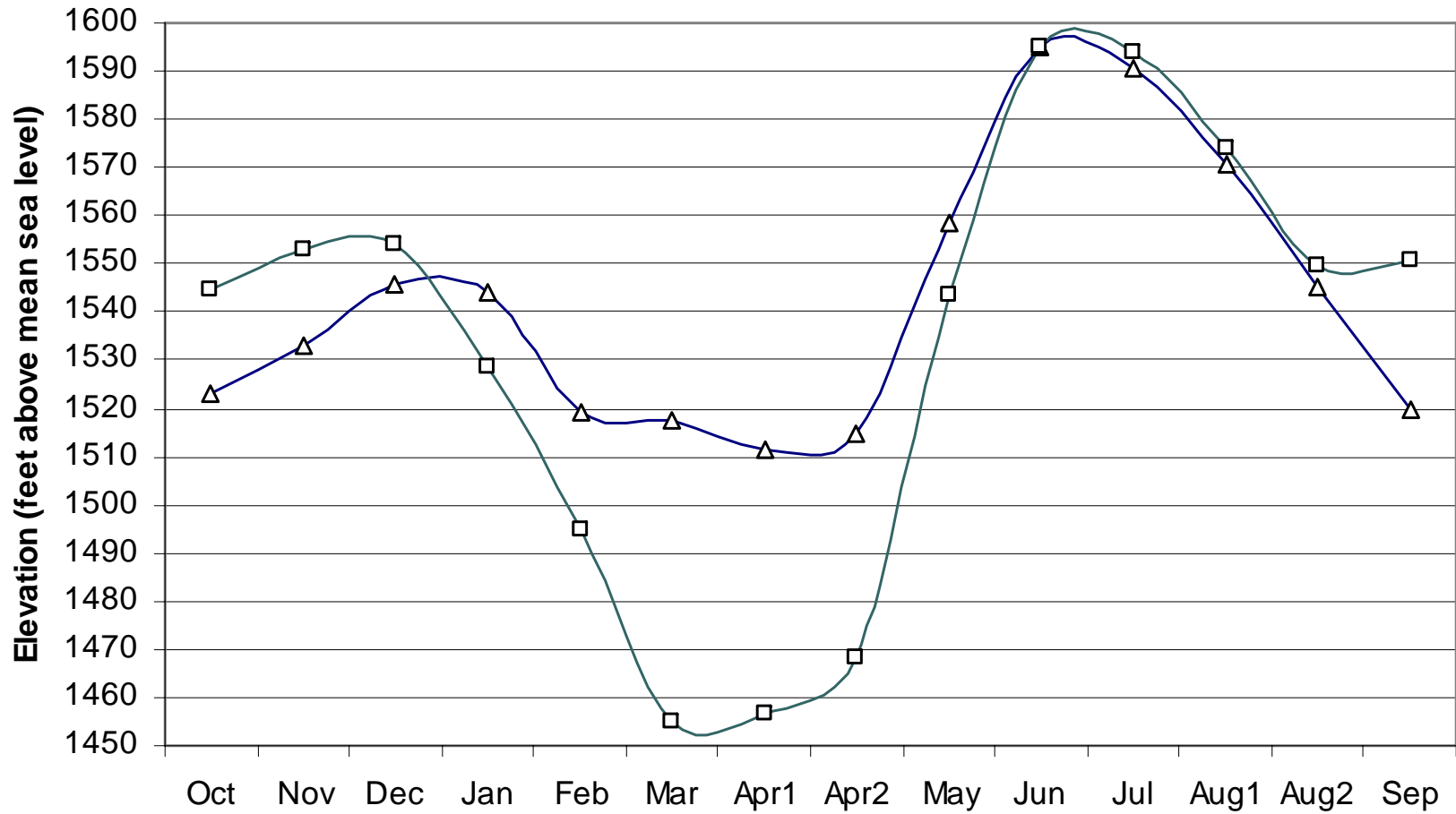
—△— CRITFC Natural River    —□— Federal Operations (2000 Biological Opinion)

## NF Clearwater River at Dworshak: WY 1928-1978



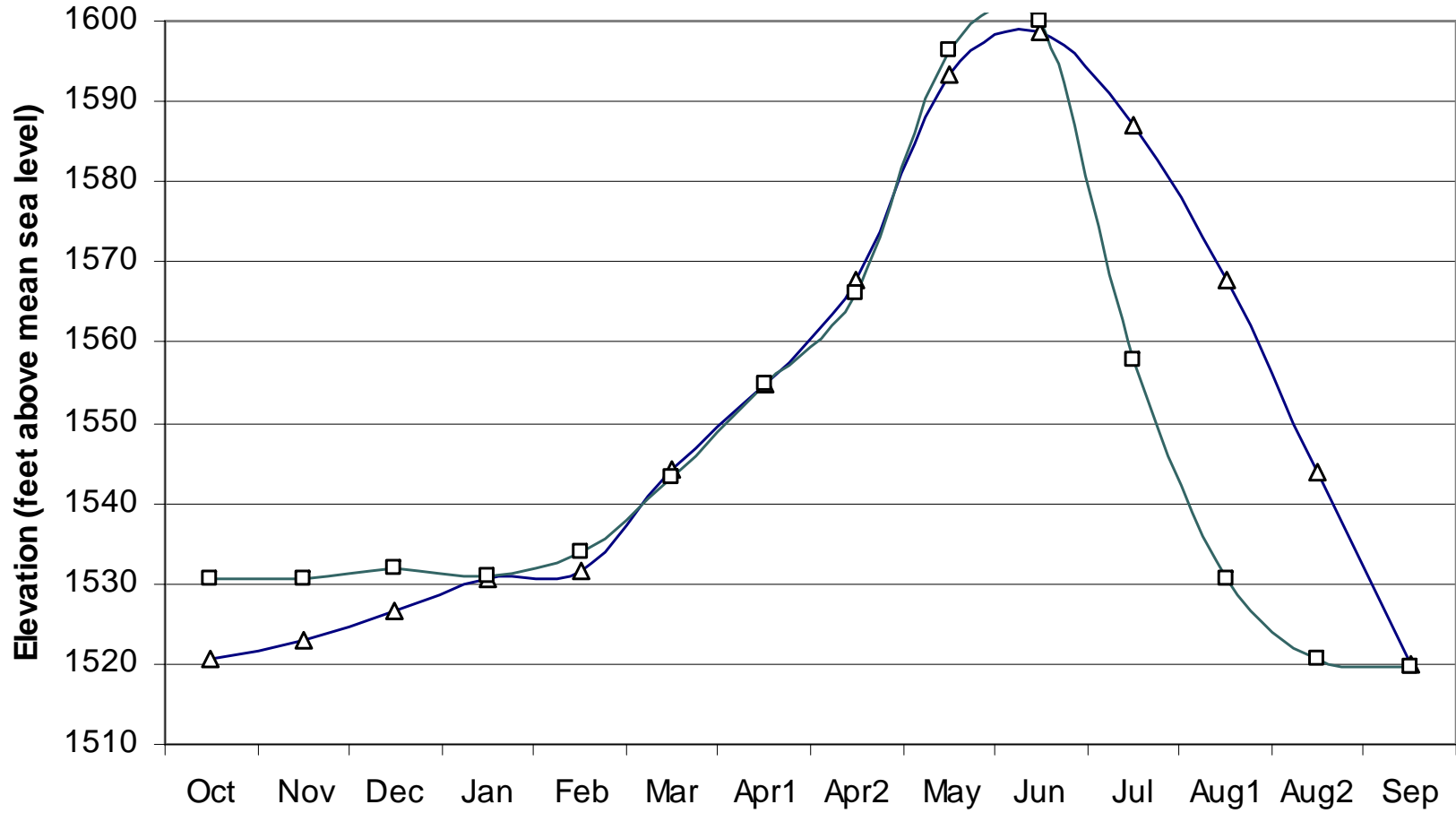
—△— CRITFC Natural River    —□— Federal Operations (2000 Biological Opinion)

## NF Clearwater River at Dworshak: HIGH Years



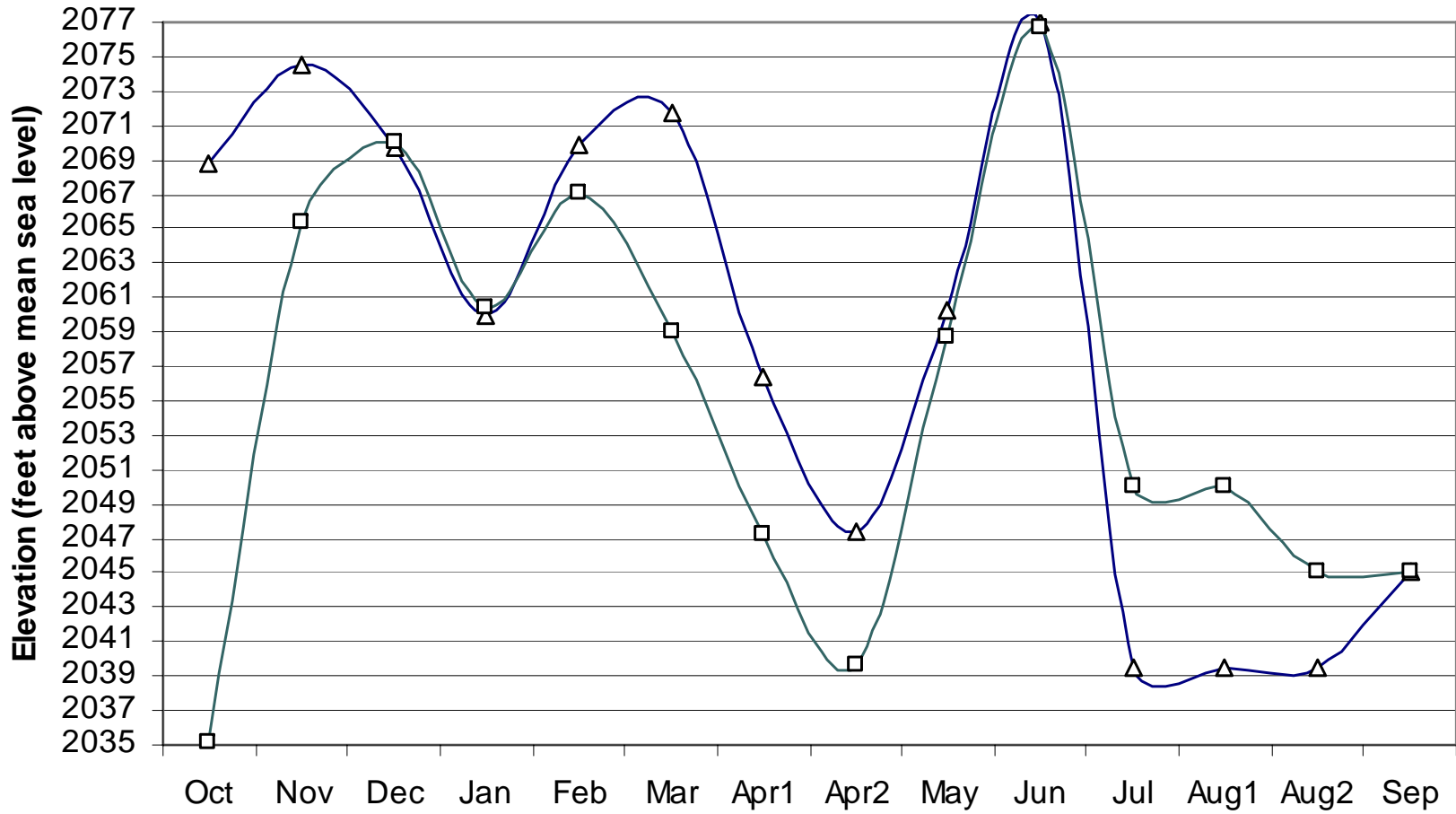
—△— CRITFC Natural River    —□— Federal Operations (2000 Biological Opinion)

# NF Clearwater River at Dworshak: LOW Years



—△— CRITFC Natural River    —□— Federal Operations (2000 Biological Opinion)

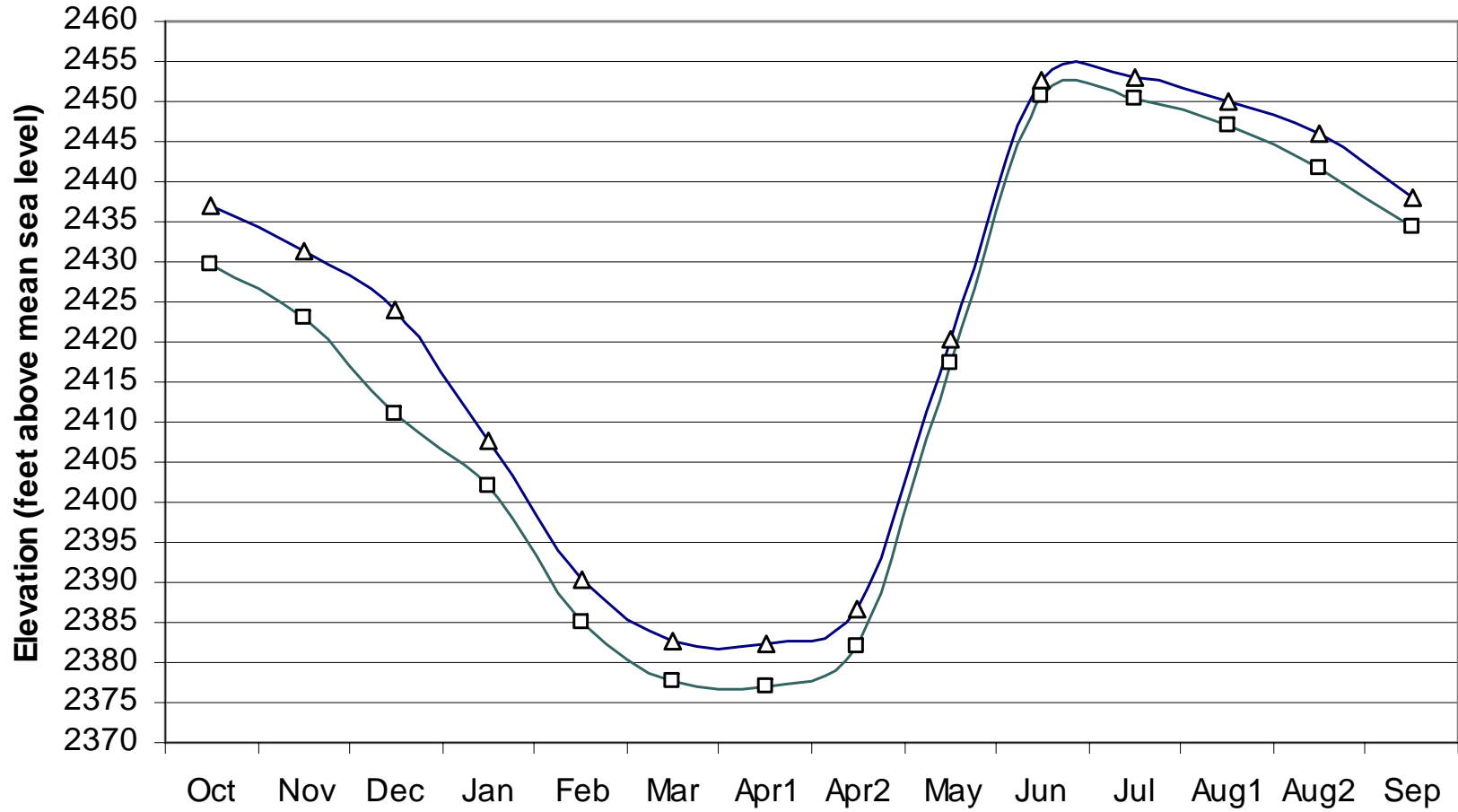
# Snake River at Brownlee: WY 1929 - 1978



—△— CRITFC Natural River    —□— Federal Operations (2000 Biological Opinion)

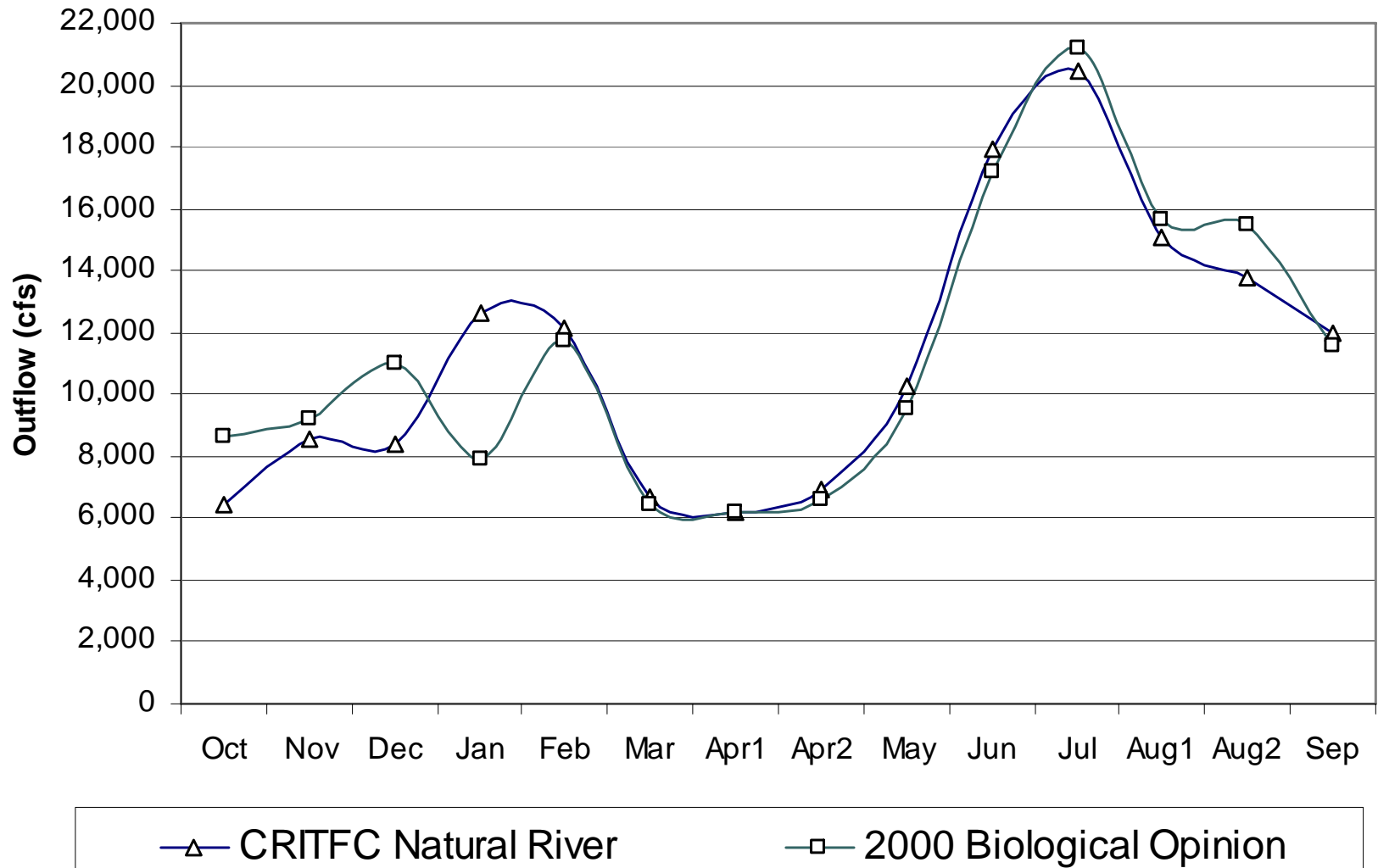


# Kootenay River at Libby

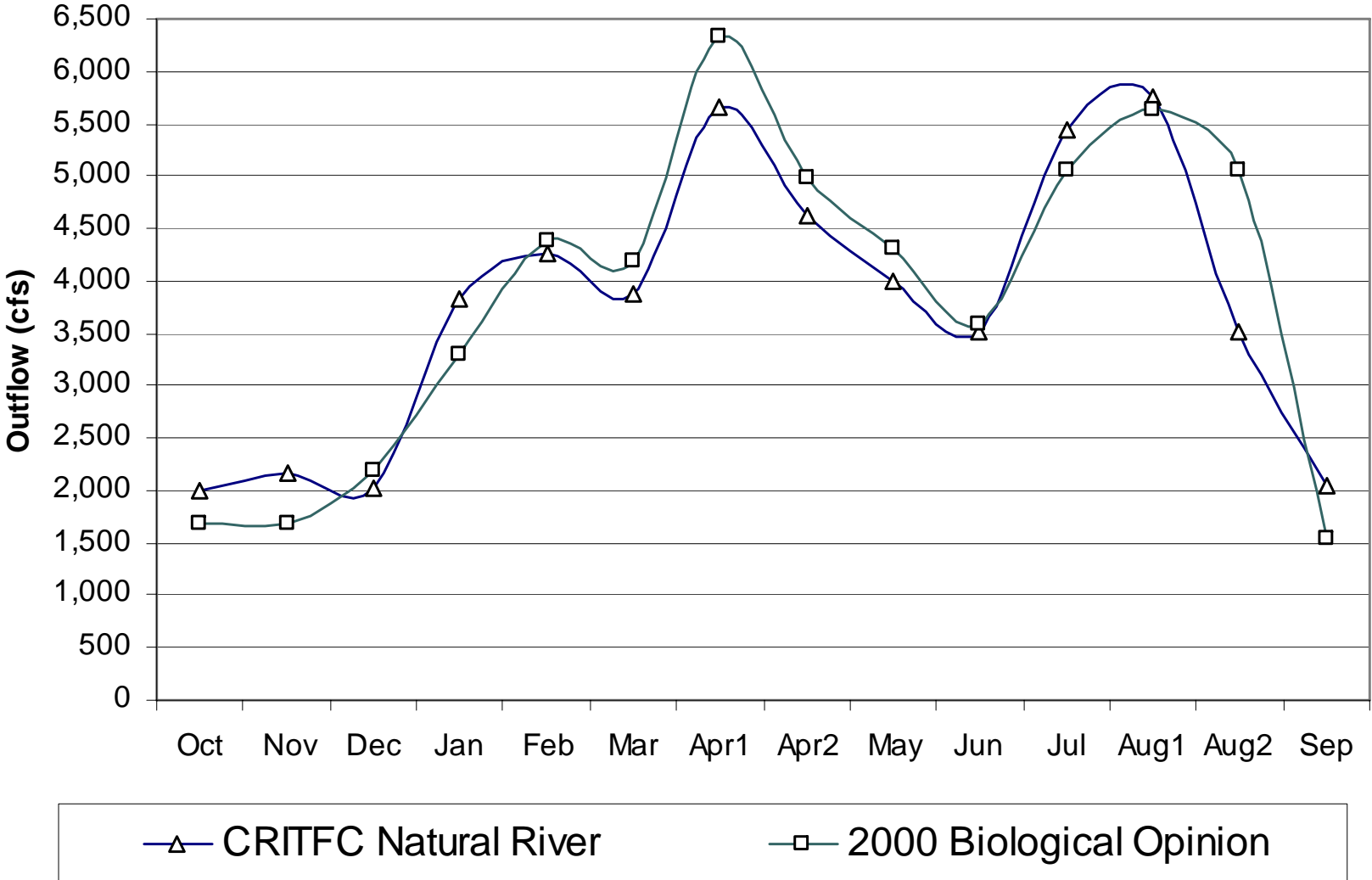


—△— CRITFC Natural River    —□— Federal Operations (2000 Biological Opinion)

# Kootenay River at Libby



# SF Flathead River at Hungry Horse



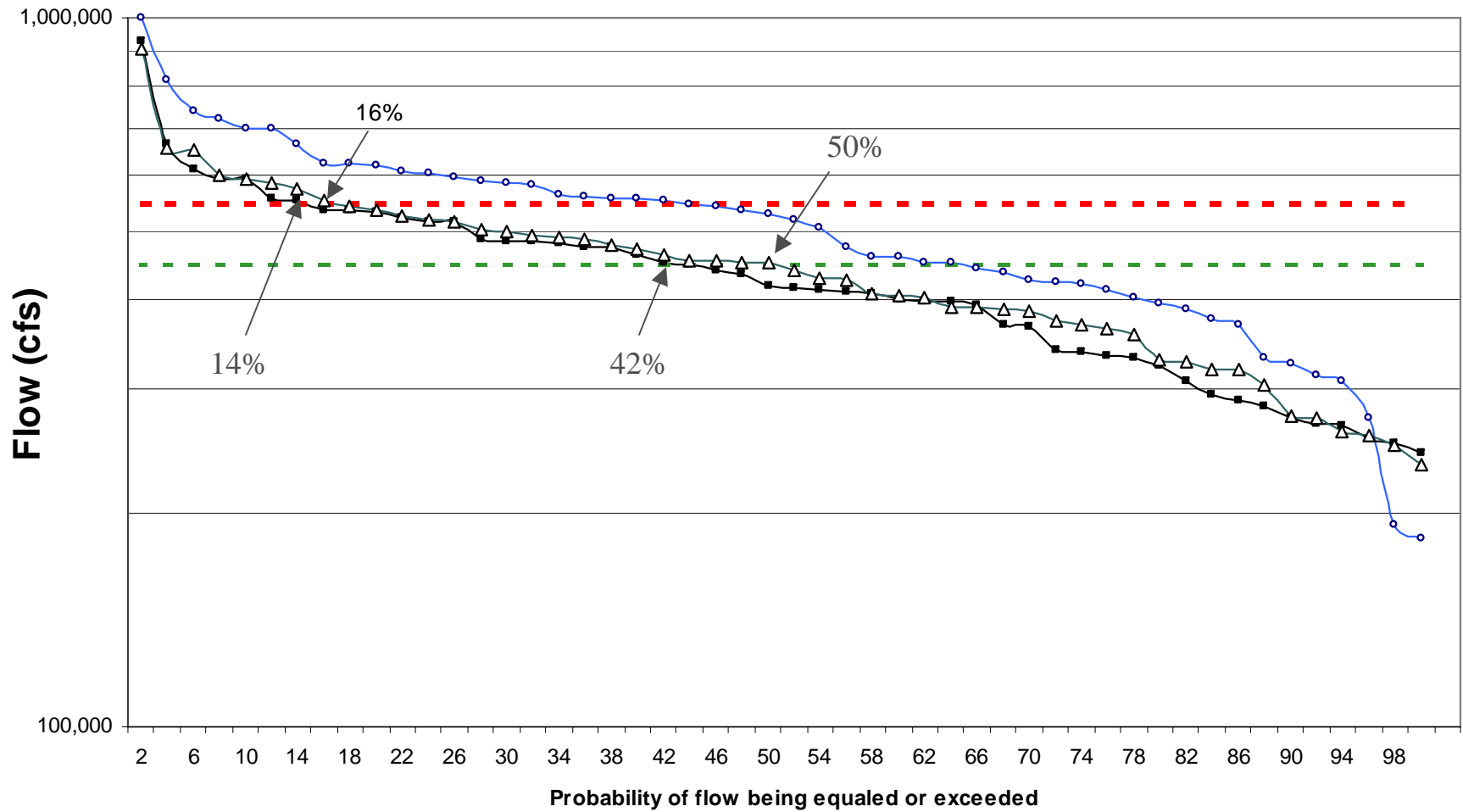
# Benefits to Northwest Salmon

- Enhanced ecosystem health and diversity. Resident fish populations enjoy more habitat.
- Speed juvenile migrants to the estuary.
- Transport more woody and organic debris.
- Less predation. Cooler passage water.
- Increase estuary plume--critical habitat.
- Provide adequate flow for returning adults.
- Re-connect and reactivate flood-plain habitats.

# How a Natural River plan may Impact the Pacific Northwest

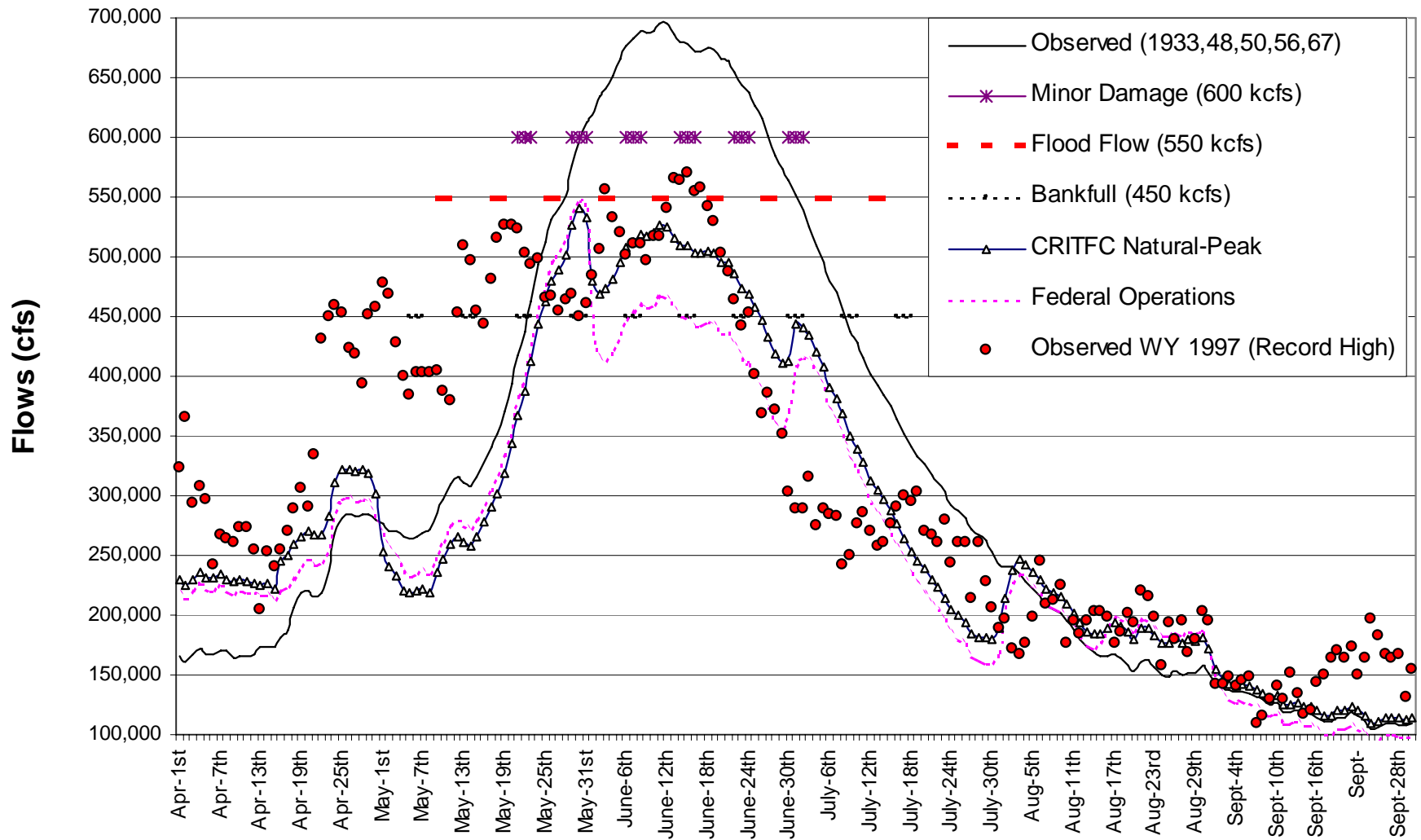
- More salmon return to spawn while Columbia Tribal treaties are honored.
- Flood risk to Portland: 16% vs. 14% (Federal) vs. 42% (historic). Bank-full flow: 50% risk versus 42% (Federal) vs. 64% (historic).
- Spring flood risk is offset by global warming.
- Less winter time wind erosion on the banks of Lake Roosevelt (WA).
- Less sediment sloughing in affected reservoirs.

### Spring Flood-Frequency (WY 1929-78): Columbia River at The Dalles



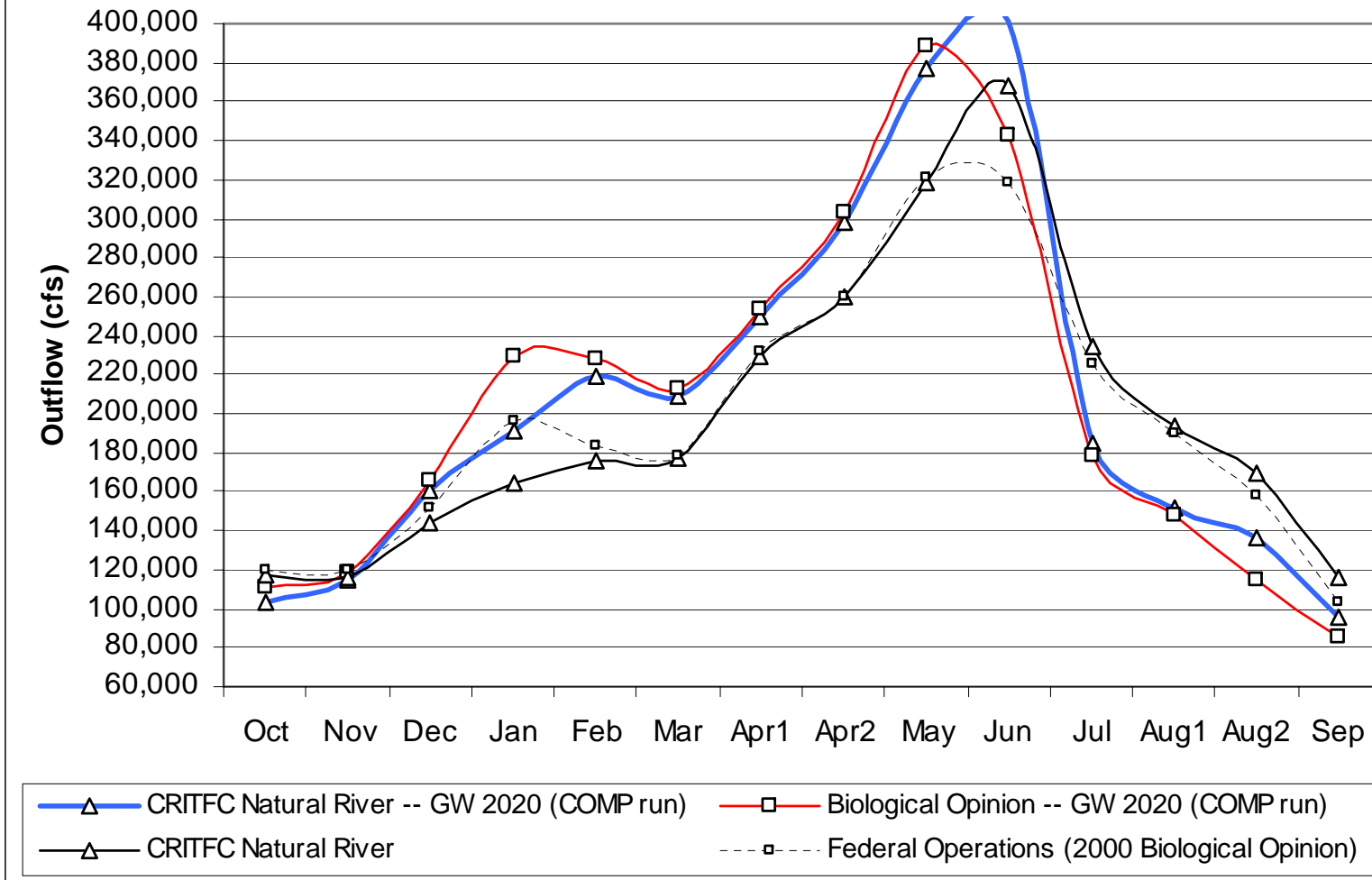
- Historical Observed peak
- Federal Operation peak
- △— CRITFC Natural Peak
- Bank Full
- Flood Flow

# The Dalles Daily Modeled Flows (High yrs)



# IMPACT OF GLOBAL WARMING BY THE YEAR 2020

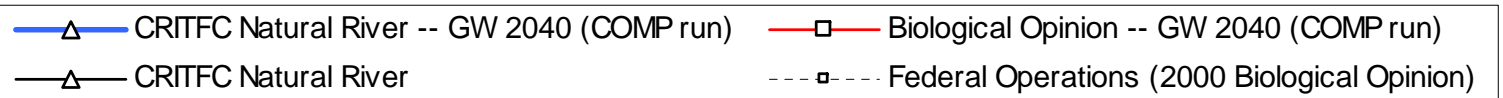
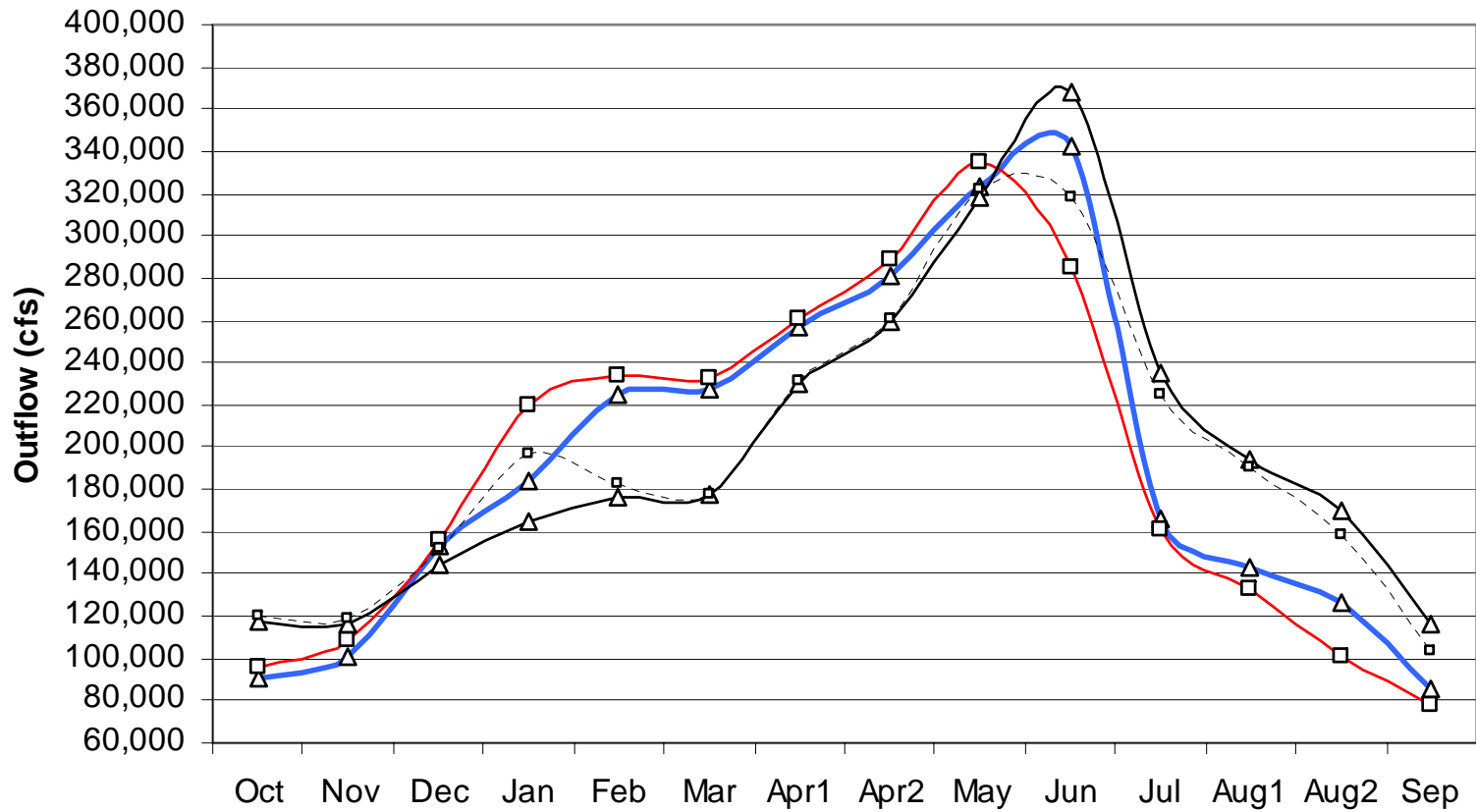
## Columbia River at The Dalles: 2020 (WY 1951-1978)





# IMPACT OF GLOBAL WARMING BY THE YEAR 2040

## Columbia River at The Dalles: 2040 (WY 1951-1978)



# Flow Summary



Seasonal Flow (McNary):			Seasonal Flow (Lower Granite):			Seasonal Flow (Priest Rapids):					
	2000BiOp	RivOps	Nat. River		2000BiOp	RivOps	Nat. River		2000BiOp	RivOps	Nat. River
Target	220-260k			Target	85-100k			Target	135,000		
<b>Spring</b>	269,837	285,533	288,440	<b>Spring</b>	97,370	100,369	101,755	<b>Spring</b>	169,298	182,067	183,746
Target	200,000			Target	50-55k						
<b>Summer</b>	180,970	184,381	189,898	<b>Summer</b>	52,217	52,103	52,779				

FLOW AUGMENTATION-- Columbia (KaF)	2000BiOp	RivOps	Nat. River
Non-Treaty Storage (Mica Dam, BC)	0	500	1,000
Banks Lake (WA)	0	250	500
FLOW AUGMENTATION-- Snake (KaF)	2000BiOp	RivOps	Nat. River
Upper-and-Middle Snake	427	427	1,427
Brownlee Dam	0	450	450

# Summary



- Altered flood control can offer 2.9 MaF of extra flow to benefit salmon stocks while move the Columbia and Snake Rivers back to a natural flow pattern, have reasonable flood protection, and take advantage of global warming.
- Natural River plan shifts winter flow into spring, refills dams by May 31, and pass inflow in June. Flood risk increases from 14% to 16% but will decrease as global climate warming continues.
- Next step: Daily flood risk & life-cycle studies.