Flood Risk Management and Columbia River Treaty 2014-2024 Review

Lower Columbia River Estuary Partnership
2013 Science to Policy Summit:
The Columbia River Treaty
May 10, 2013

Matt Rea – Treaty Review Program Manager
Corps of Engineers

Topics

- Columbia River Basin flood risk management overview
  - *Corps charge and authorities regarding the Treaty and flood management*
- Current flood risk management under the Columbia River Treaty
  - *Ecosystem benefits at different operating levels, i.e., 450 vs. 600*
- Changes in Treaty flood risk management after 2024
- Iteration 2 flood risk findings and results
  - *Flood, navigation and recreation impacts*

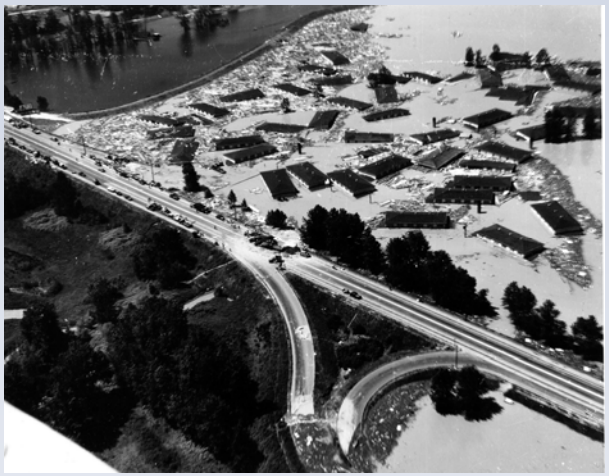
1894 Downtown Portland

History of Columbia Basin Flood Risk Management Prior to the Treaty

- Pre-Treaty System Authorizations
  - 1926 -- House Document 308 authorized cost estimates for development of navigation, hydropower, irrigation, and flood control of nations rivers
  - 1936 -- Flood Control Act established federal investigations and improvements for flood control and allied purposes shall be under the jurisdiction of the Secretary of War (precursor of the Secretary of the Army under the supervision of the Chief of Engineers.
  - 1936, 1938 and 1941 -- Flood Control Acts authorized numerous levees in the Lower Columbia Basin which were designed to local and tributary conditions
  - 1942 -- Grand Coulee Dam becomes operational
- 1948 Vanport Flood
  - Galvanized the region to seek a system-wide approach to flood control

1948 Columbia River Flood

Portland



Vanport

Bonners Ferry

House Document 531 (Flood Control Act of 1950)

- System Design
  - found it impractical due to engineering and economical considerations to achieve the desired level of flood risk reduction using only a single regulation method such as storage reservoirs or levees
  - Identified a flow of 800,000 cfs at The Dalles as a practical balance point to achieve the desired level of flood risk reduction using a combined system of reservoirs and levees
  - Envisioned a system of U.S. and Canadian storage reservoirs
- System Objectives
  - established the primary objective to regulate the 1894 runoff hydrograph to a peak flow of 800,000 cfs at The Dalles
  - recognized that maximum flood-control benefits may be attained during moderate as well as major floods by regulating floods to 600,000 cfs at The Dalles where major damages were determined to begin

The Columbia River Treaty

"Relating to International Cooperation in Water Resource Development in the Columbia River Basin"

An agreement between Canada and the United States of America,

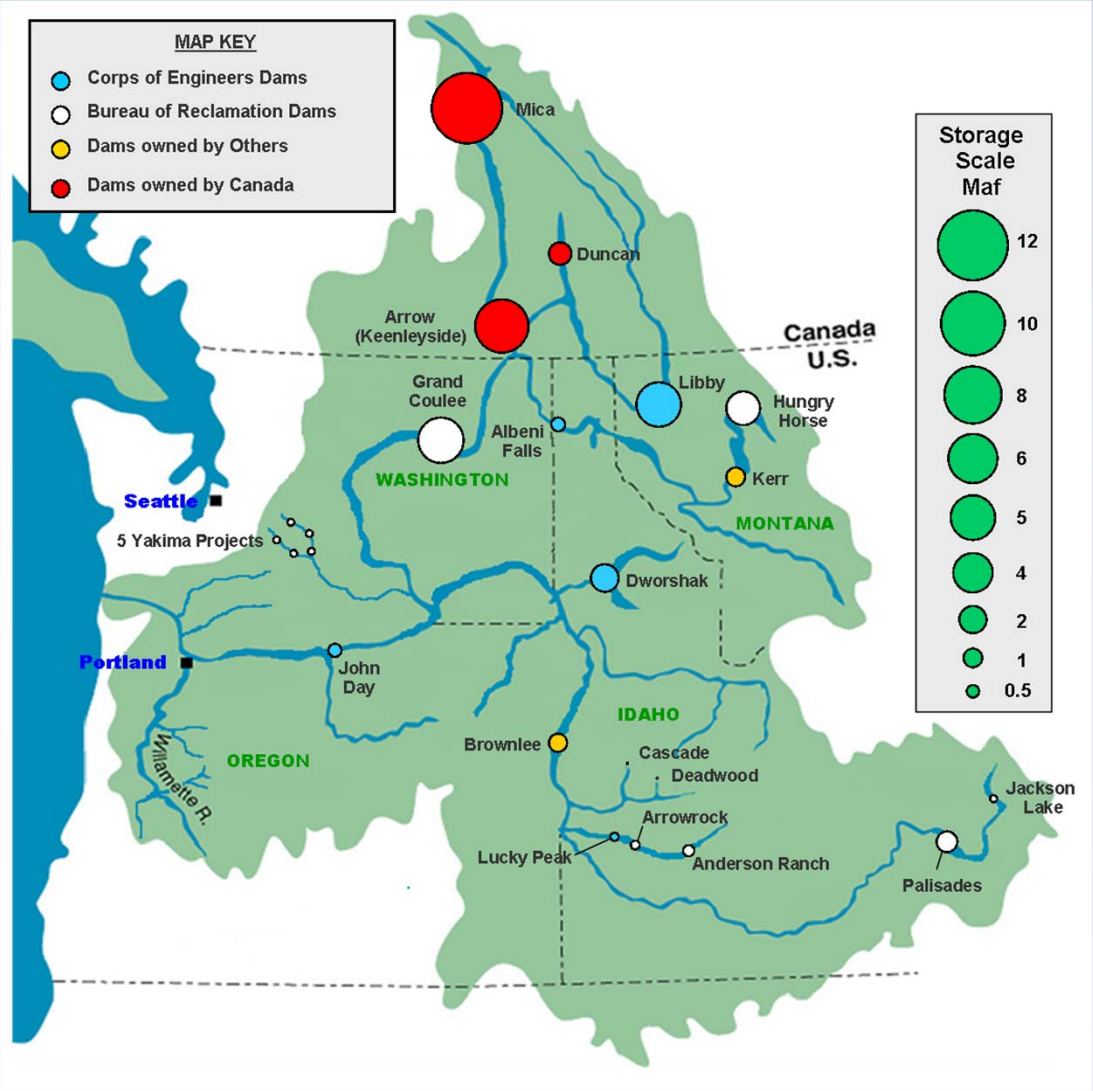
signed at Washington, D.C., January 17, 1961

Libby Dam and Lake Koocanusa, Montana and British Columbia

Current Treaty Flood Control Provisions

- Canada is obligated to operate 8.45 Maf of reservoir storage (increased to 8.95 Maf in 1995 due to reallocation of Mica/Arrow storage) under a flood control operating plan that attempts to eliminate, or if not possible then reduce, all flood damages in both Canada and the U.S.
- Canada must also operate all additional storage on an on-call basis (as requested and paid for). This has never been used to date.
- As the dams were completed, the U.S. paid Canada $64.4 million for one-half the present worth of the expected future U.S. flood damages prevented from 1968 through 2024.
- This U.S. purchase of 8.45 Maf of flood control operation expires in 2024.

Where is our storage?



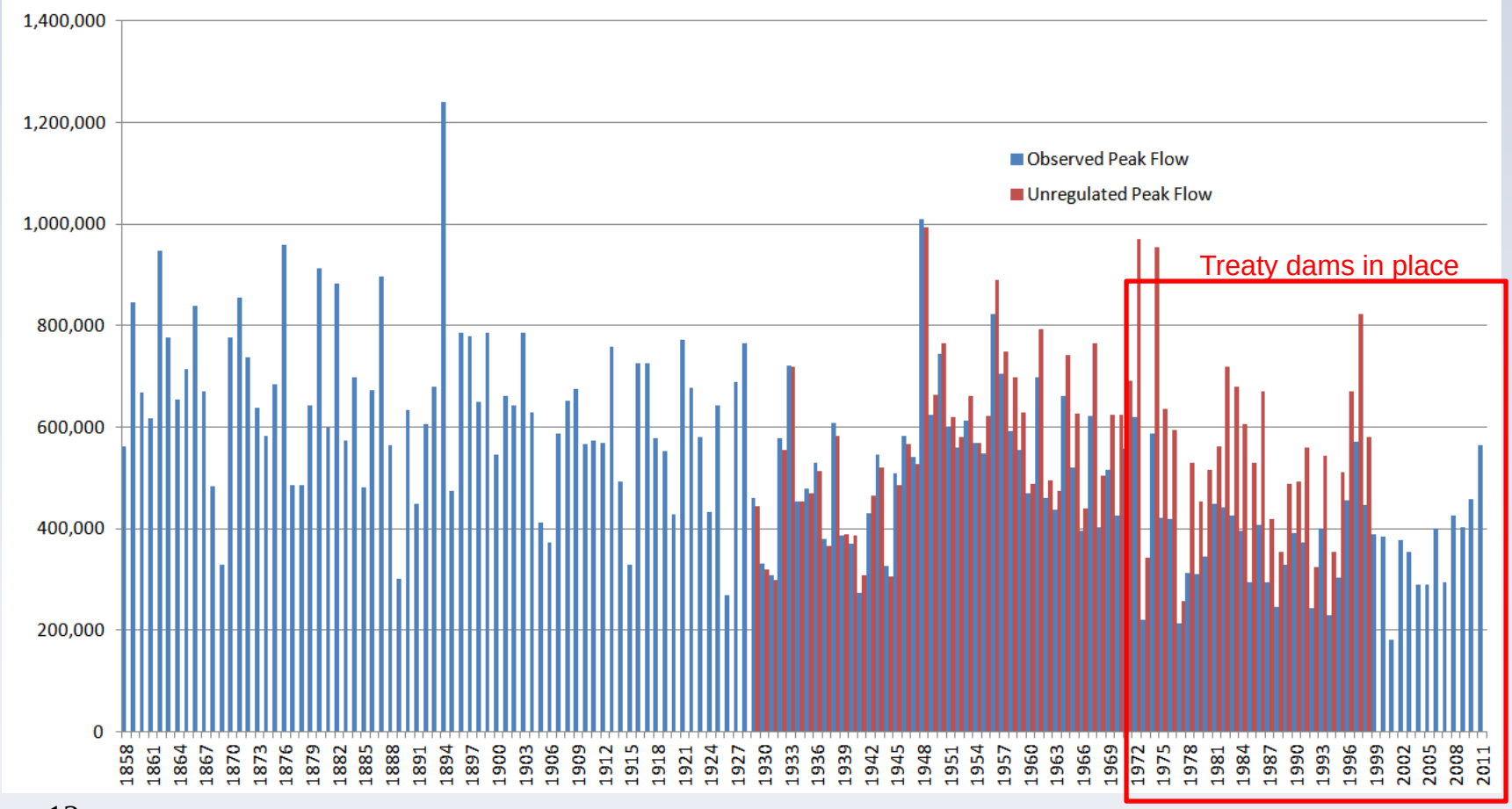
Treaty Flood Control Operating Plan (FCOP)

- Required by Columbia River Treaty, Annex A
- Began in 1965 by Task Force of Entity representatives from USACE, BPA, BOR and BC Hydro
- First draft prepared in1968
- Objectives of the FCOP
  - Regulate the 1894 runoff hydrograph to a peak flow of 800,000 cfs at The Dalles
  - Control annual peak flows up to no more than 600,000 cfs where major damage was determined to occur
  - To minimize flood damages beginning at 450,000 cfs at The Dalles

Treaty Flood Control Operating Plan (FCOP)

- Basis for 450,000 cfs Objective
  - The full bank flow associated with the 16 foot flood stage at Vancouver WA as defined by the National Weather Service
  - Damages below the Dalles were determined to begin at 450,000 cfs
  - To include sufficient flexibility to handle hydrologic and forecast uncertainties
  - To achieve the objective of minimizing flood damages to the extent possible, the FCOP anticipates hydrologic/forecast uncertainty and calculates a desired regulated flow during refill that minimizes the possibility of (or amount) exceeding 450,000 cfs at The Dalles.
  - Achieve high likelihood of refill as quickly as possible to support and optimize power operations and other operating purposes.

The Dalles Peak Flows



Post-2024 Changes in Treaty Flood Control

Regardless of Whether the Treaty Continues or is Terminated:

- Flood control provided by Canadian projects transitions to a "Called Upon" operation after 2024 for the life of the projects:
- U.S. requests for called upon storage limited to potential floods that cannot be adequately controlled by all related (effective) U.S. storage
- Canada must be consulted prior to a called upon action
- Called upon storage to provide no greater degree of flood control after 2024 than prior to 2024
- U.S. must pay for operating costs and any economic losses in Canada due to the called upon operation

Flood Risk Management

Iteration #2
General Summary of Results

Scope of Iteration 2 studies

- 3 alternatives from Iteration 1 for full impact assessment
  - Treaty Continues with 450 and 600 kcfs flood flow objectives (2A-TC and 2B-TC)
  - Treaty Terminates with 450 kcfs flood flow objectives (2A-TT)
- Consider 4 additional Treaty Terminates Canadian Operations scenarios
- Incorporated 2 Climate Change scenarios into select Treaty alternatives

Current Condition (RC-CC*)

- This is how the system is managed up to 2024 under current Treaty provisions and current U.S. operations
- All alternatives and components are compared to the current condition

*** RC-CC: Reference Case, Current Condition**

Iteration 2 components – Flood risk

F1 – Full use of authorized storage
Maximize use of authorized U.S. storage (full draft as needed)

F2 – No Called Upon flood storage
No use of Canadian storage for U.S. flood risk management

F3 – Modify U.S. levees to perform to authorized levels
Evaluate ability to reduce U.S. flood risk if all U.S. levees perform to authorized level

Iteration 2 Components – Ecosystem

E1 – Natural Spring Hydrograph

Store and release water from U.S. and Canadian reservoirs to meet a natural flow based on the type of water year, no system flood control, no operation specifically for power

E2 – Reservoirs as Natural Lakes

Generally hold reserves full and pass inflows through, no system flood control, no operation specifically for power

E3 – Summer Flows

Store water in Canadian projects during the fall and release to augment summer flows in U.S.

E4 – Floodplain Reconnection (not modeled)

E5 – Dry Year Strategy

Store water in Canadian projects during winter/early spring to augment spring flow in lowest 20% of water years

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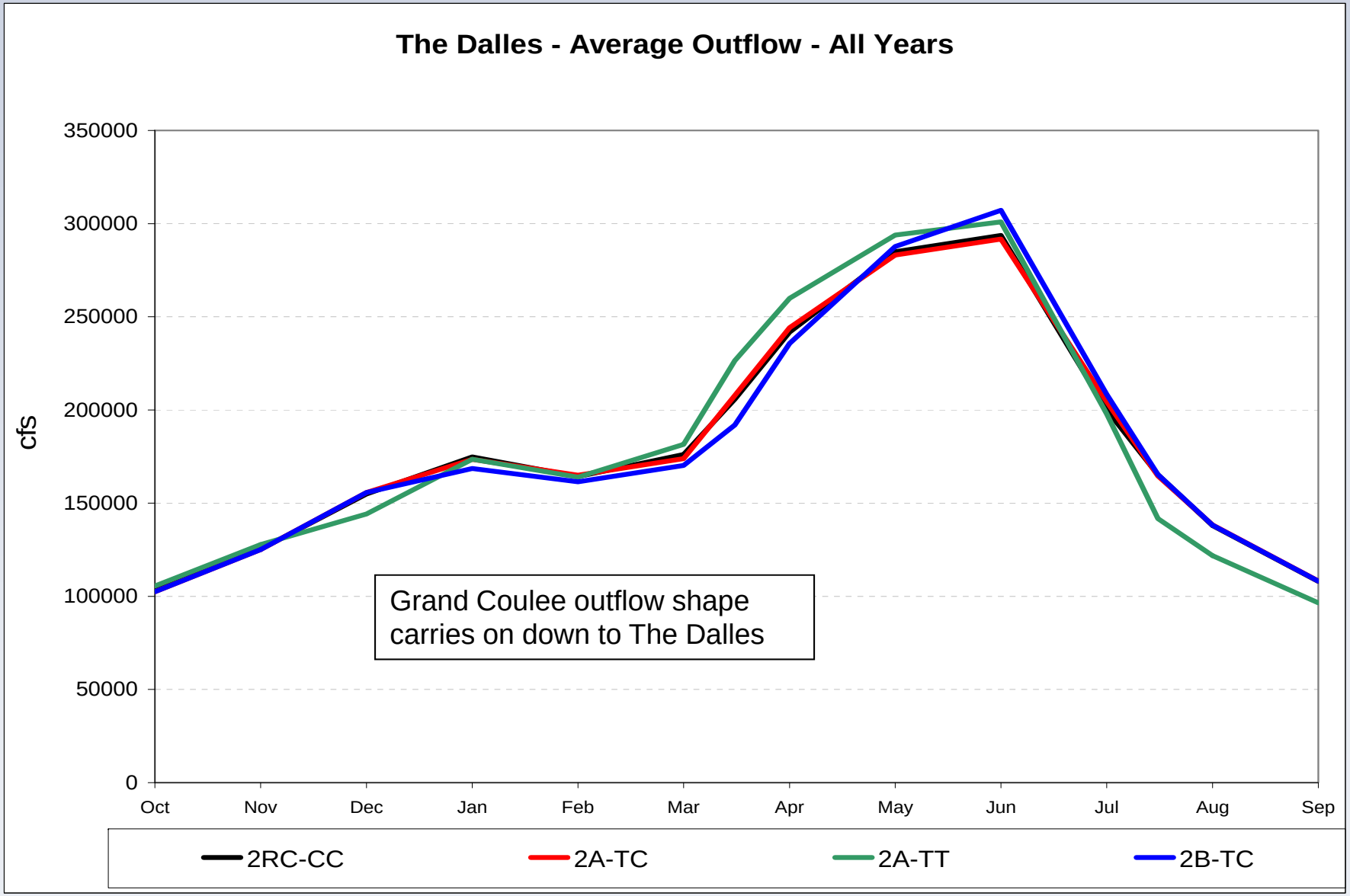
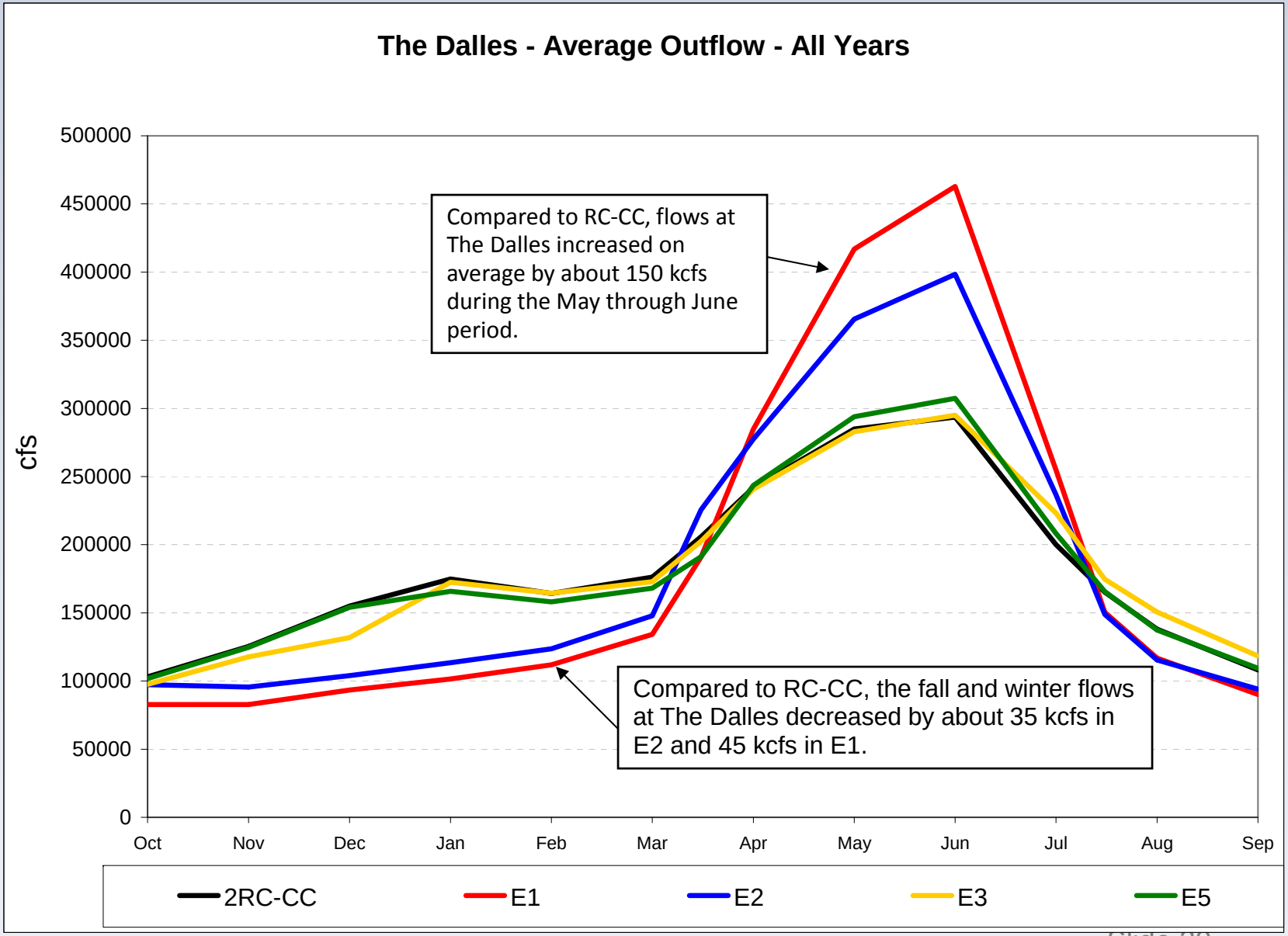
U.S. Army Corps of Engineers – Bonneville Power Administration

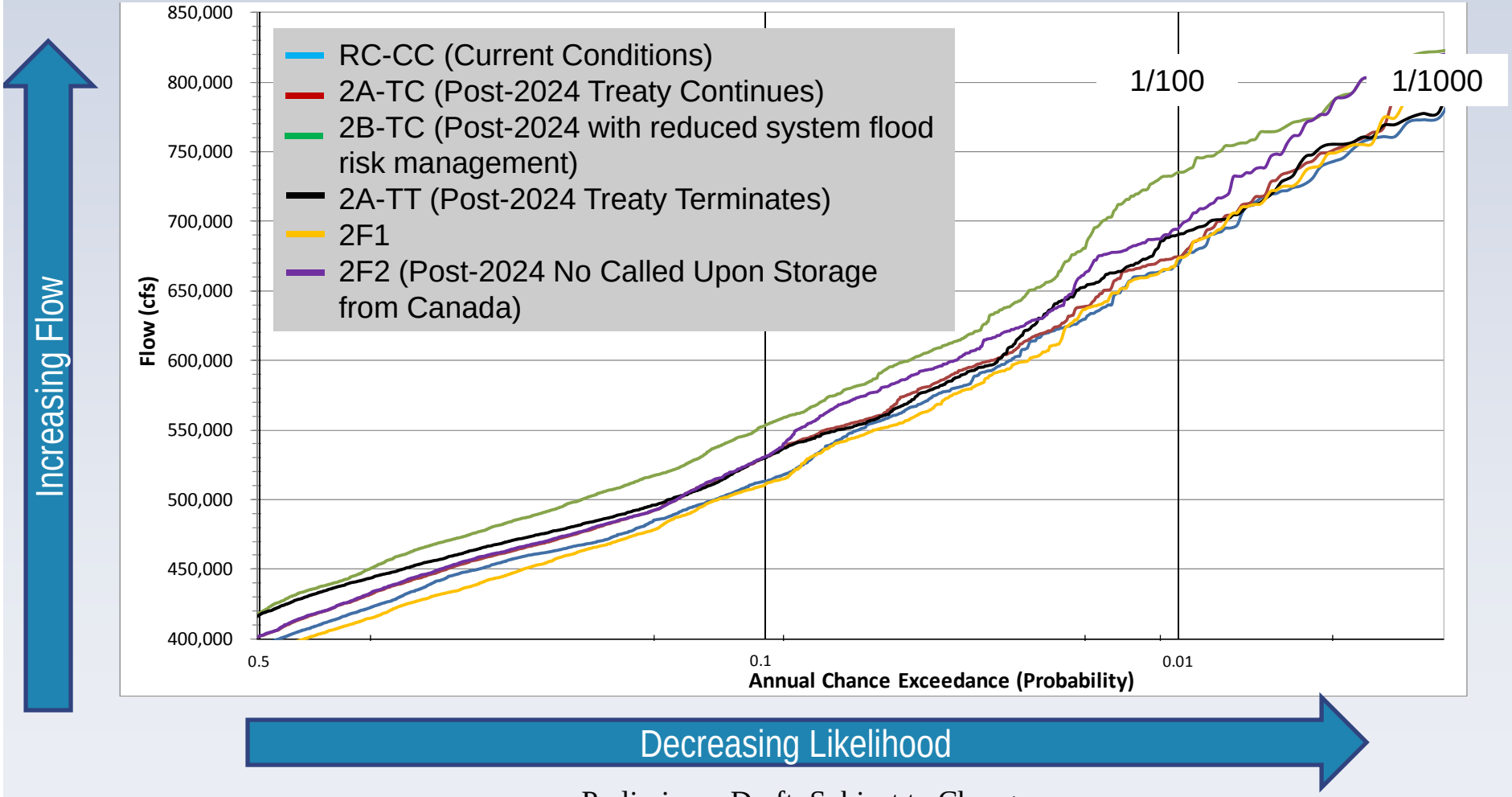



The Dalles - Average Outflow - All Years
cfs
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Compared to RC-CC, flows at The Dalles increased on average by about 150 kcfs during the May through June period.
Compared to RC-CC, the fall and winter flows at The Dalles decreased by about 35 kcfs in E2 and 45 kcfs in E1.
2RC-CC
E1
E2
E3
E5

Iteration 2 Flood Risk Metrics

- Flow Frequency Curves (Hydrologic factors)
  - The probability that any given flow will occur in any given year
  - Compares the relative frequency of flood events between alternatives (defines 1%, 0.2%, etc. flood events)
- Preliminary Expected Annual Damage (EAD)
  - A metric used to compare relative economic consequences of the alternatives
  - Average monetary value of physical losses (structure and content) related to how each alternative manages an event.

The Dalles Flow Frequency



Preliminary Draft: Subject to Change

Flow Probability @ The Dalles

		RC-CC	2A-TC	2B-TC
Iteration 2	450 kcfs*	28.9 %	31.8 %	39.1 %
	600 kcfs**	2.8 %	3.2 %	5.0 %
	800 kcfs	Possible but unlikely (0.07 %)	Twice as likely as CC (0.15 %)	Four times as likely as CC (0.27 %)

* 450 kcfs at The Dalles = Start of minor flooding
** 600 kcfs at The Dalles = Start of Major flooding

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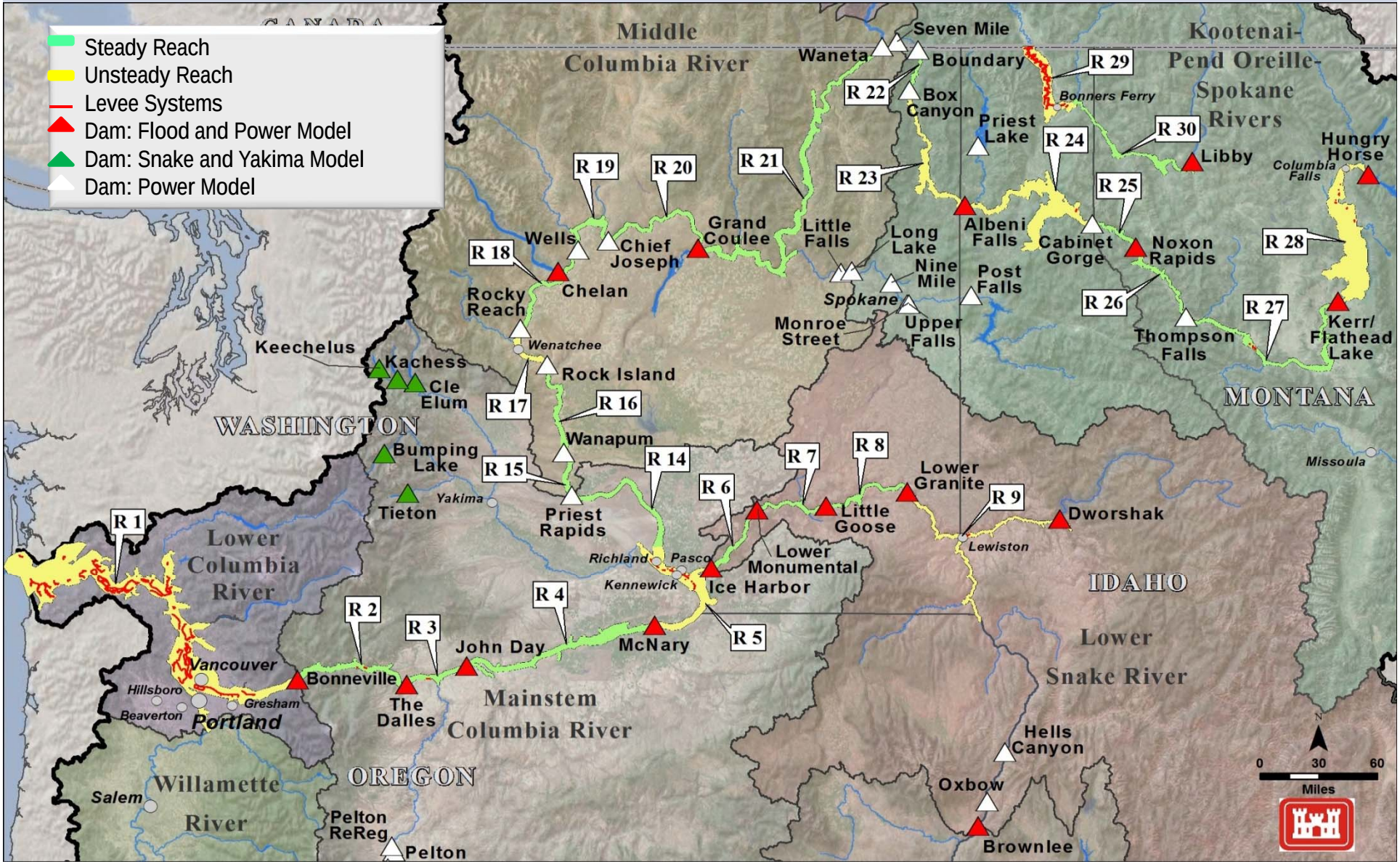
Flood Risk Consequence Area



Flood Risk Analysis Iteration 2 Conclusions

- Compared to Current Conditions (RC-CC):
  - Post 2024 Called Upon flood operations with a 450 kcfs flood flow objective at The Dalles (2A-TC)
    - flood risk increases over CC due to how Called Upon and Effective Use was implemented;
    - the increase in Reach 1 (Bonneville to the mouth) EAD is significant
  - Post 2024 Called Upon flood operations with 600 kcfs flood flow objective at The Dalles (2B-TC)
    - results in a significant flood risk increase compared to CC;
    - 97% of the increase in EAD is within Reach 1 (Bonneville to the Mouth)
  - Treaty Terminates (2A-TT)
    - impacts are similar (slightly higher) based on assumptions about operation of Canadian reservoirs if the Treaty is terminated
    - those assumptions need to be more thoroughly tested in Iteration 3

Flood Risk Analysis Iteration 2 Conclusions

- We did not calculate flood risk metrics for the Ecosystem Components in Iteration 2
  - E1 and E2 are “bookend” scenarios designed to evaluate ecosystem benefits with major changes in system and local flood risk management operations
  - Either of them would lead to substantial increase in flood risk for the Columbia River basin in the U.S.

Flood Risk Analysis Iteration 2 Conclusions

- EAD under all alternatives is driven by infrequent/high damage events and more frequent / low damage events.
  - The difference between system-wide EAD for each alternative evaluated to date is in Reach 1. This is due primarily to adhering to local flood operations under all alternatives & mainstem development and infrastructure.
- For all Iteration 2 Alternatives, the vast majority of EAD comes from non-leveed areas;
  - The levees in our system are currently “robust”; improving existing levees is not likely to be an economically viable alternative to reducing flood risk in the future
  - Reducing EAD by constructing levees or other local flood risk management measures would have to be studied on a case-by-case basis to determine feasibility

Effects of Flood Risk Management on U.S. and Canadian Reservoirs

- "Called Upon" refers to requests to Canada to provide storage for flood risk management in the U.S. after 2024
  - Does not apply to RC-CC; post 2024 operation only
  - Most frequent under 2A-TT; driven by uncertainty of Canadian reservoir operations if the Treaty is terminated
  - Least frequent under 2B-TC due to less conservative "trigger"
- "Effective Use" refers to the making additional use of U.S. reservoir storage before calling on Canada
  - Most frequent under 2A-TT; driven by uncertainty of Canadian reservoir operations if the Treaty is terminated
  - Least frequent under 2B-TC due to less conservative "trigger"; but when needed, the volumes of storage space required are much greater than any of the other alternatives.

Flood Risk Management Policy Discussions

- Corps of Engineers Treaty objective: achieve a similar level of flood risk after 2024 as we have under current conditions
- Given a level of risk, how can we manage for increases in ecosystem function?
- Description of Effective Use of US projects
- Description of Called Upon procedure
  - Annual call of Canadian storage?
  - Fixed volume with annual call?
- Understand flood risk under Treaty Terminates
- Climate change – procedures resilient or adaptive management?

Impact Assessments: Navigation

Iteration #2
General Summary of Results

Iteration 2 Navigation Metrics

- High Flow Impacts
  - Flow levels at which navigation through the inland waterway becomes more difficult and less safe; thresholds at which tow boat operators reduce the number of barges towed through navigation locks
  - Lower Columbia River: 450 kcfs at Bonneville Dam
  - Lower Snake River: 100 kcfs at Ice Harbor Dam
- Low Flow Impacts
  - Flow levels below 120 kcfs at Bonneville Dam
  - Low flows impact channel depth and port facility access on the lower Columbia River; deep draft navigation adversely affected due to draft restrictions on ships.

Navigation: Results

- For high flow and low flow thresholds compared to RC-CC:
  - Very little difference in the alternatives and components for navigation on the lower Snake River.
  - E-1 and E-2 Components result in substantial increase in the average number of days that lower Columbia River high flow thresholds are exceeded.
  - Alternative 2A-TT and the E1 / E2 components all lead to substantial increase in the average number of days that lower Columbia River flows fall below the low flow threshold.
- Analysis of alternatives effects on sedimentation in the lower Columbia River deep draft is on-going.

Questions?