

Yellowtail Reallocation Study

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US Army Corps of Engineers
BUILDING STRONG®

Presentation Overview

- Project background
- Reservoir simulation information
- Summary of results
- Questions



Project Objective

- Evaluate the change in flood reduction benefits due to reallocation of flood control storage to joint use storage for Yellowtail Dam.



BIGHORN LAKE STORAGE ALLOCATION

Dam Crest
Elev.
3660.0

3657 (1,328,360 AF)

Surcharge - 52,829 Acre-Feet

Exclusive Flood Control - 258,331 Acre - Feet

3640 (1,070,029 Acre - Feet)

Joint Use - 240,342 Acre - Feet

3614 (829,687 Acre - Feet)

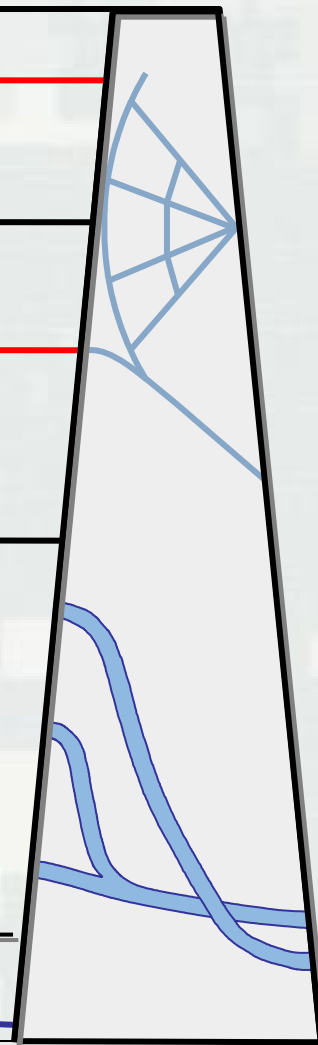
Active Conservation - 336,103 Acre - Feet

Top of Conservation Elev. 3547.00 (493,584 Acre - Feet)

Inactive Conservation - 477,576 Acre - Feet

Top of Dead Elev. 3296.50 (16,008 Acre - Feet)

Dead - 16,008 Acre - Feet



PROPOSED STORAGE ALLOCATION

Dam Crest
Elev.
3660.0

3657 (1,328,360 AF)

Surcharge - 52,829 Acre-Feet

Exclusive Flood Control - 190,846 Acre - Feet

3645 (1,137,514 Acre - Feet)

Joint Use - 307,827 Acre - Feet

3614 (897,172 Acre - Feet)

Active Conservation - 336,103 Acre - Feet

Top of Conservation Elev. 3547.00 (493,584 Acre - Feet)

Inactive Conservation - 477,576 Acre - Feet

Top of Dead Elev. 3296.50 (16,008 Acre - Feet)

Dead - 16,008 Acre - Feet



HEC-ResSim

(Reservoir Evaluation System-Simulation)

- Single or multiple reservoir systems
- Flood control
- Hydropower
- Water supply (municipal, irrigation, etc)
- Diversions
- Navigation
- Flow targets (max & min)
- Period of record or event simulation



Yellowtail ResSim Schematic



Data Requirements

- Daily stream flow 1967-2006
- Daily reservoir inflow, outflow, storage
- Daily precipitation, evaporation
- Elevation-area-capacity relationships
- Spillway & outlet rating curves
- Downstream discharge-damage functions
- Reservoir operating criteria/storage zones
- Project design floods
- Local flow calculations



ResSim Modeling Process

- Gather input data
- Construct and calibrate models
 - ▶ Period of record, inflow design flood, project design flood, 1923 event
 - ▶ Establishment of a baseline condition
- Develop reallocated condition
 - ▶ Increase top of joint use pool to 3645 ft msl
- Evaluate change in net flood benefits between the baseline and reallocated simulations.



Period of Record Model Results



Summary of Analysis

- Comparison of elevation and outflow data
- Pool and flow duration relationships
 - ▶ Annual and seasonal
- Pool probability
- Flow frequency
- Change in flood benefits
 - ▶ Yearly and period of record



Summary of Analysis

- Two period of record models created
 - ▶ Fixed guide curve
 - Drafts to elevation 3600 ft msl each spring
 - Reallocation of joint use storage to 3645 ft msl
 - Based on historical operations
 - ▶ Time series guide curve
 - Drafts to an elevation based on spring inflow conditions
 - Reallocation of joint use storage to 3643 ft msl
 - Not based on historical operations, but potential future operations

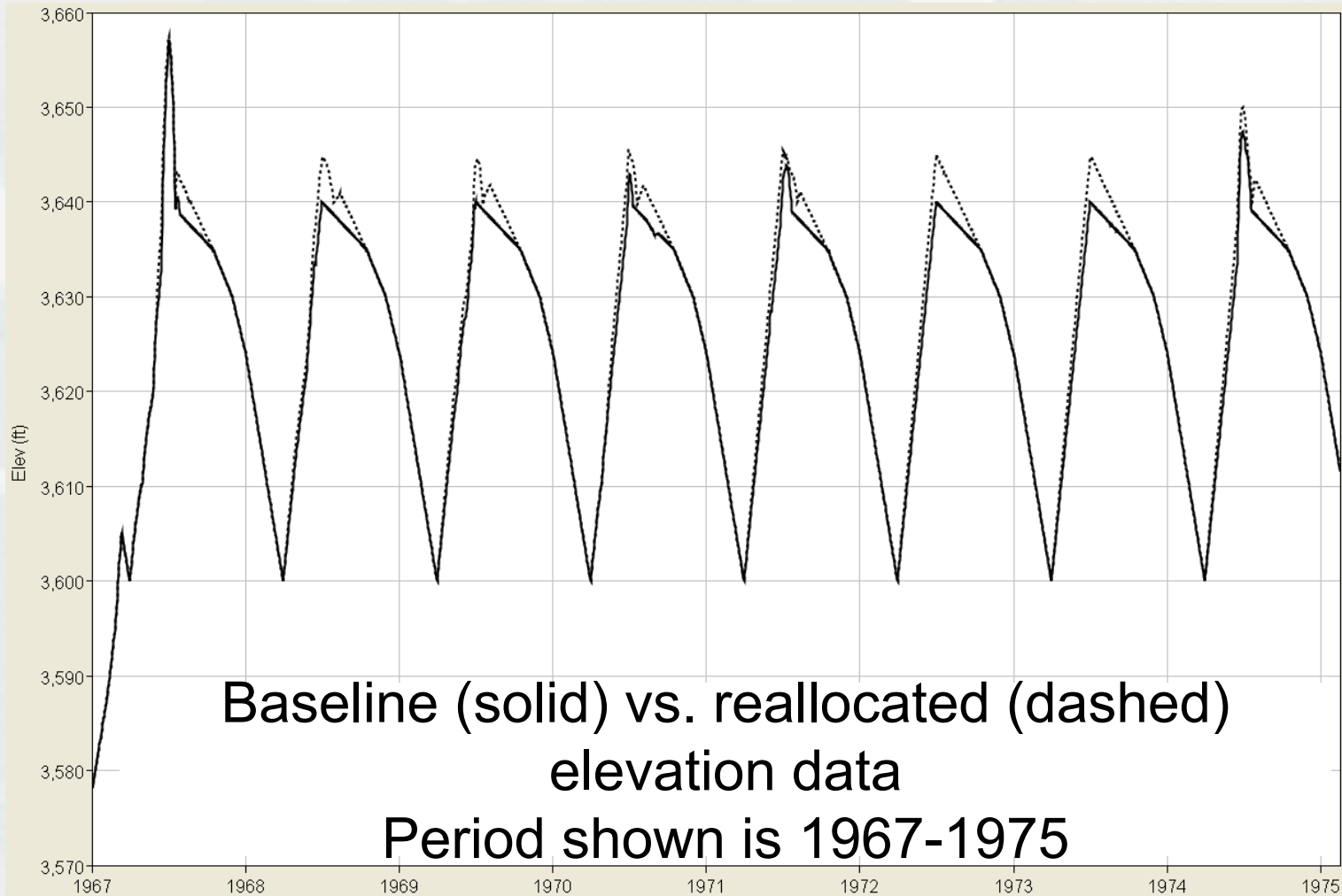


Summary of Results

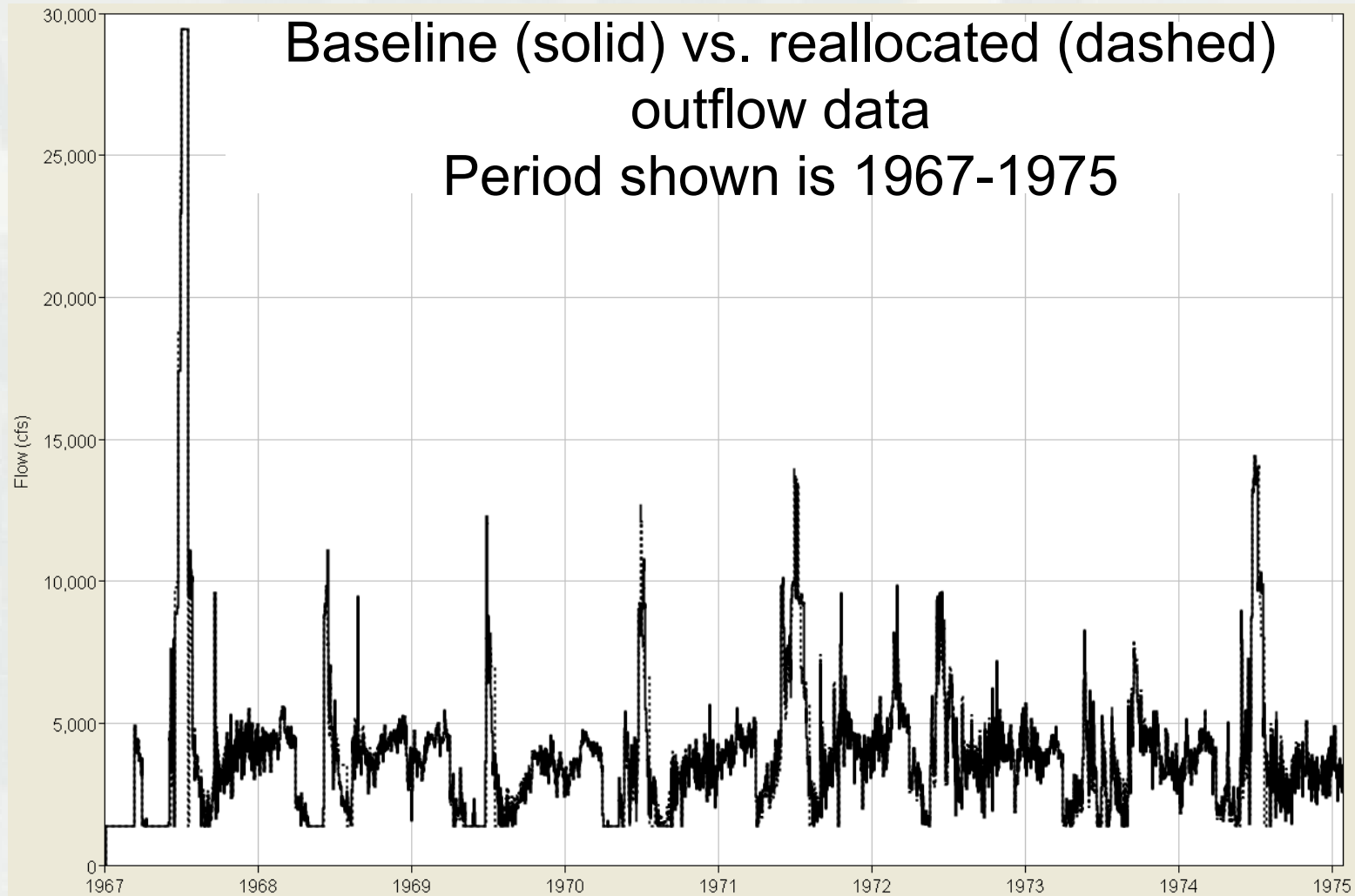
- Detailed write-up of all period of record results included in the Yellowtail Dam Reallocation Study report.
 - ▶ Information presented is only a portion of all period of record results.



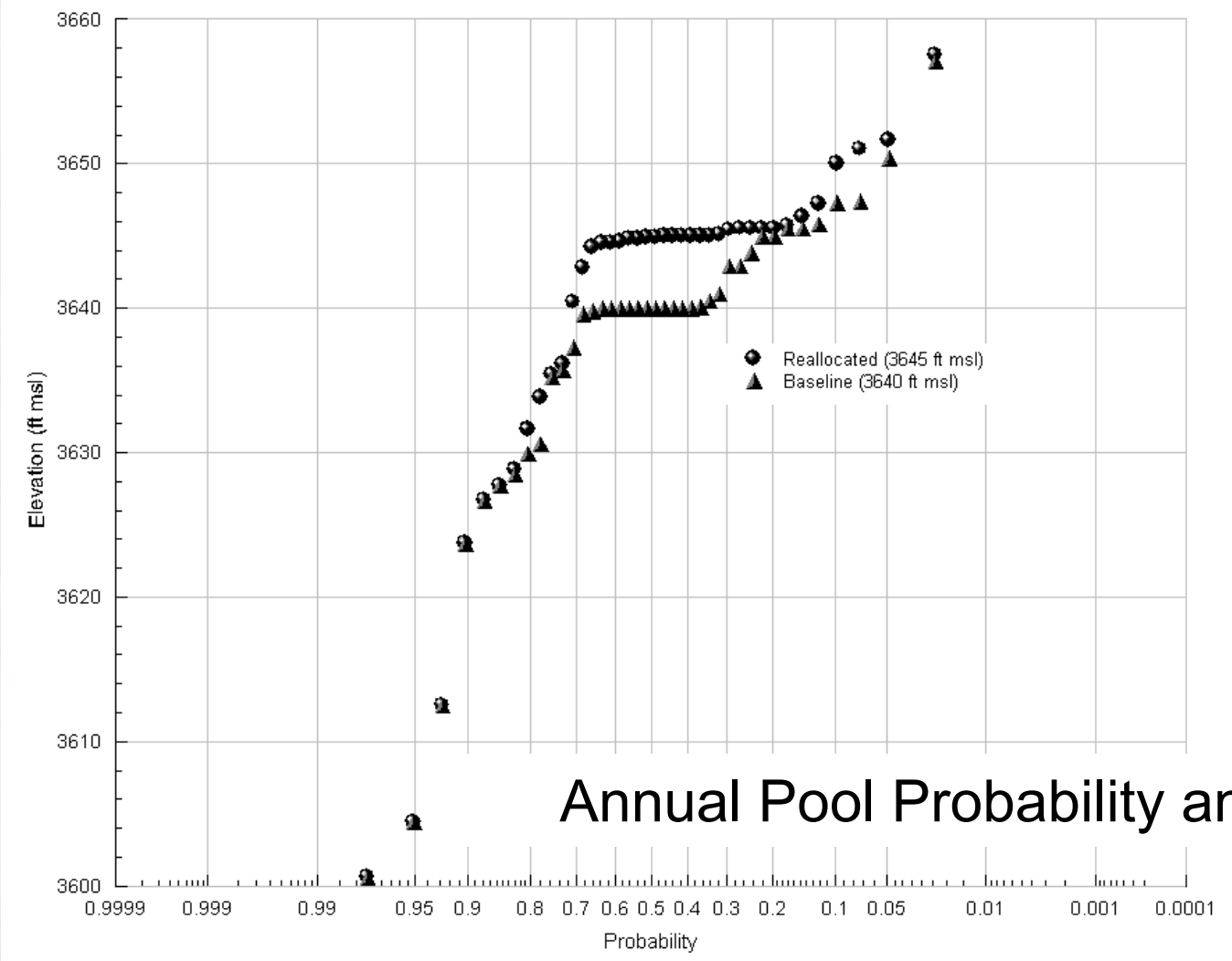
Summary of Results



Summary of Results



Summary of Results



Annual Pool Probability analysis



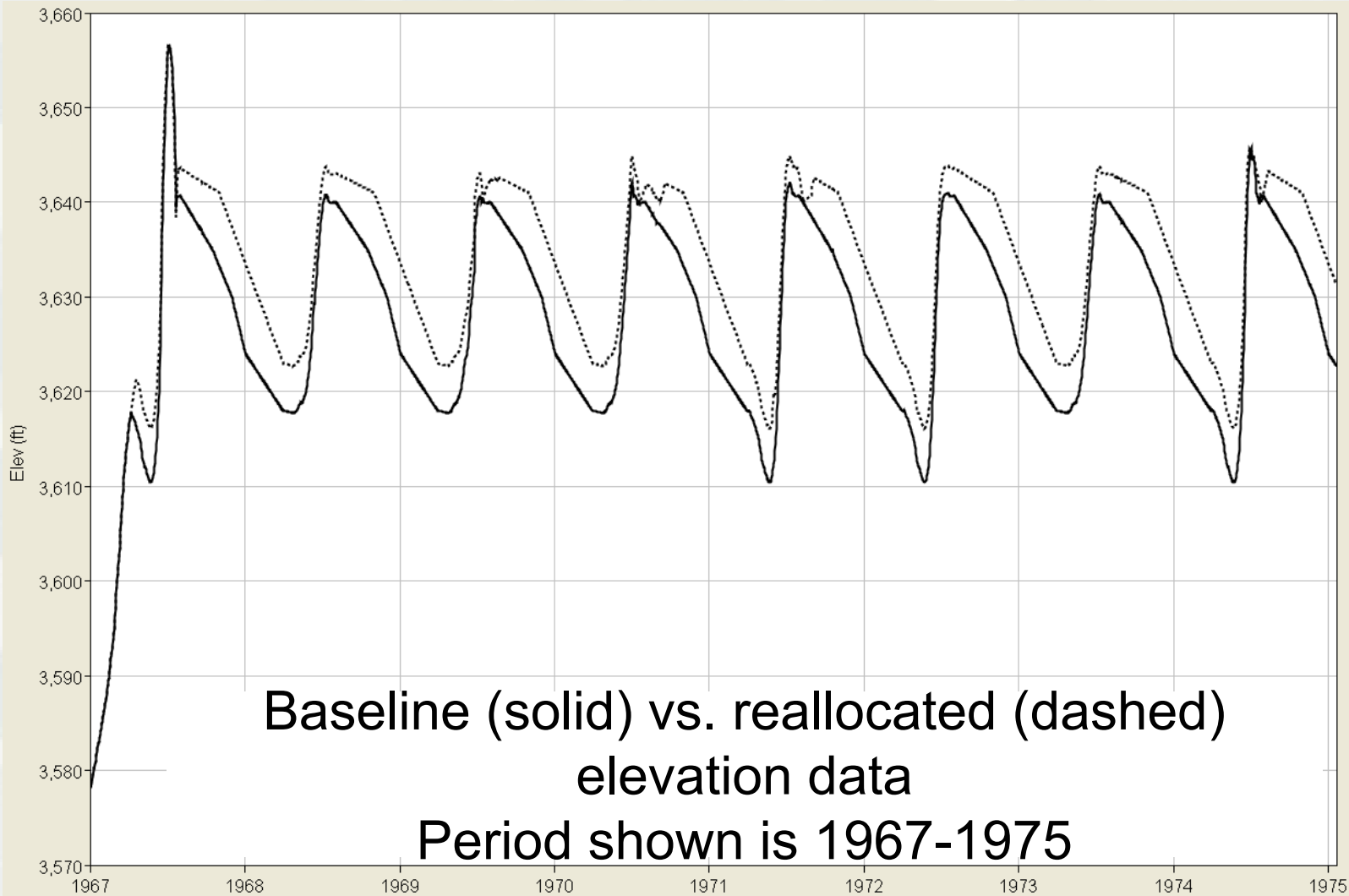
Summary of Results

Reach	Difference in Average Annual (\$1000)	% of Baseline
Reach 1 – Miles City	-1.8	1.1
Reach 2 – Miles City	-0.3	1.1
Reach 3 – Sidney	0.3	1.5
Reach 5 – Hardin	0.0	0.0
Reach 6 – Bighorn	0.0	0.0

Baseline vs. reallocated change in flood benefits (average annual). Difference is reallocated – baseline.



Summary of Results

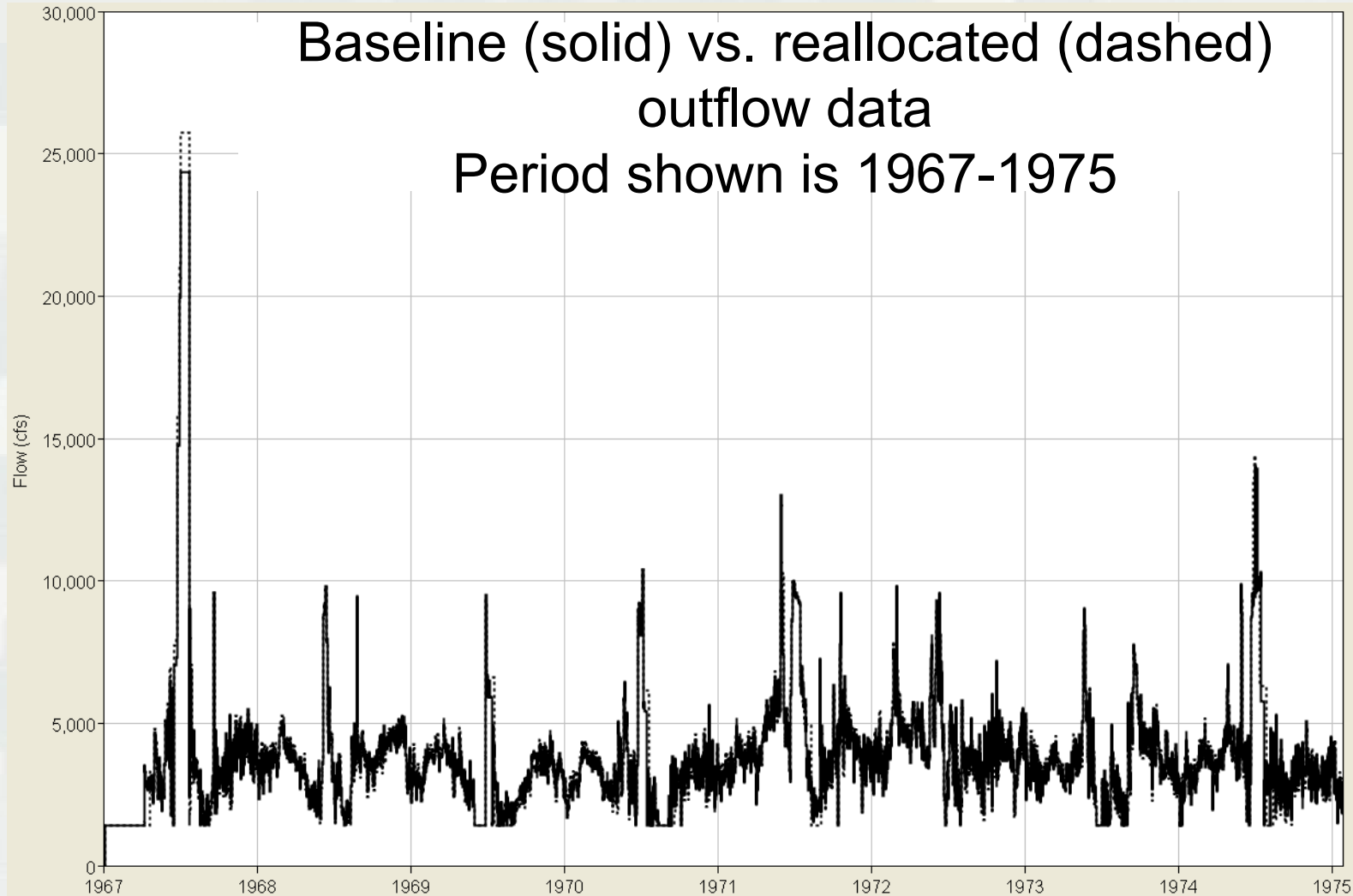


Baseline (solid) vs. reallocated (dashed)
elevation data

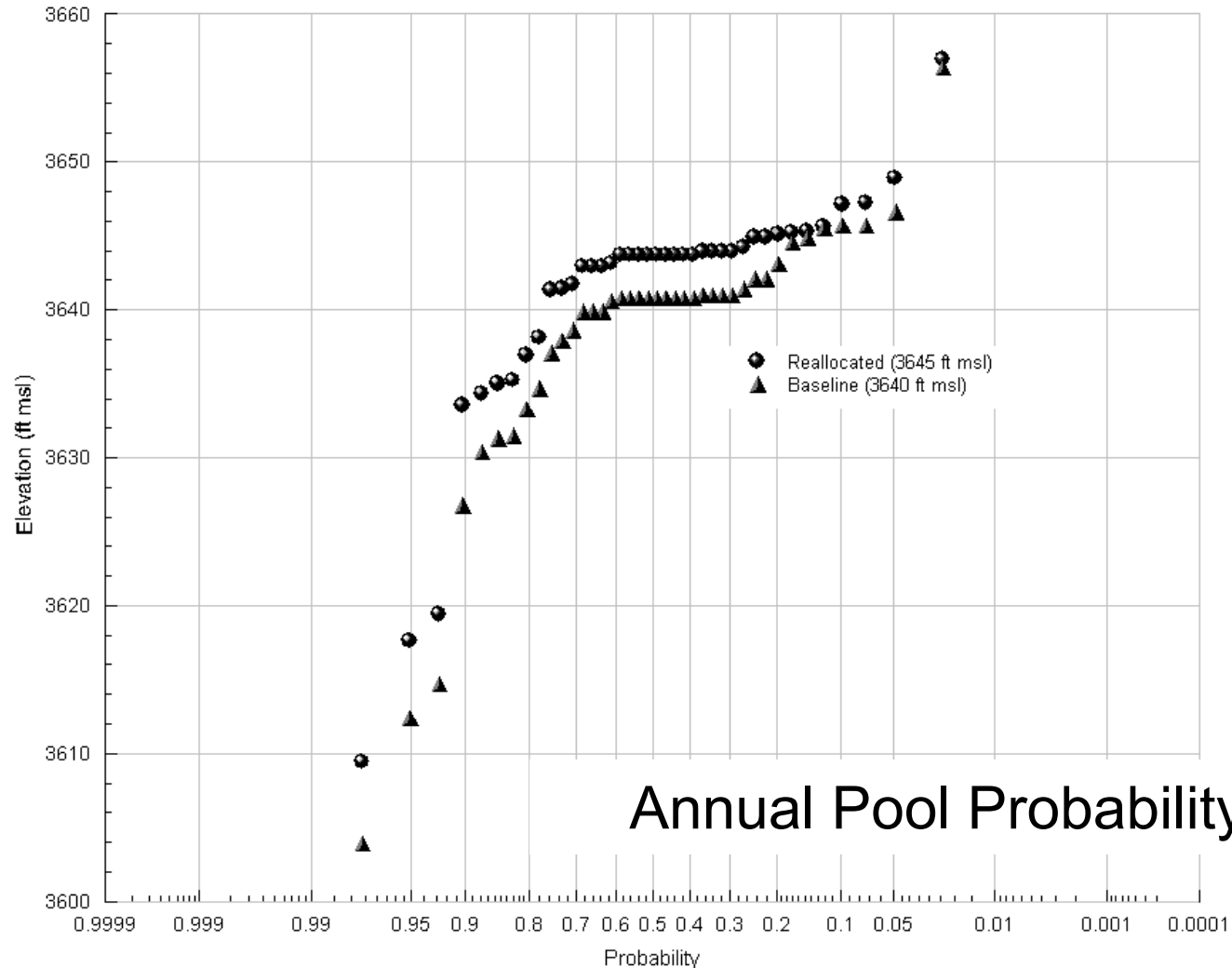
Period shown is 1967-1975



Summary of Results



Summary of Results



Annual Pool Probability analysis



Summary of Results

Reach	Difference in Average Annual (\$1000)	% of Baseline
Reach 1 – Miles City	2.2	1.4
Reach 2 – Miles City	0.4	1.5
Reach 3 – Sidney	0.2	1.0
Reach 5 – Hardin	0.2	50.0
Reach 6 – Bighorn	0.6	1.9

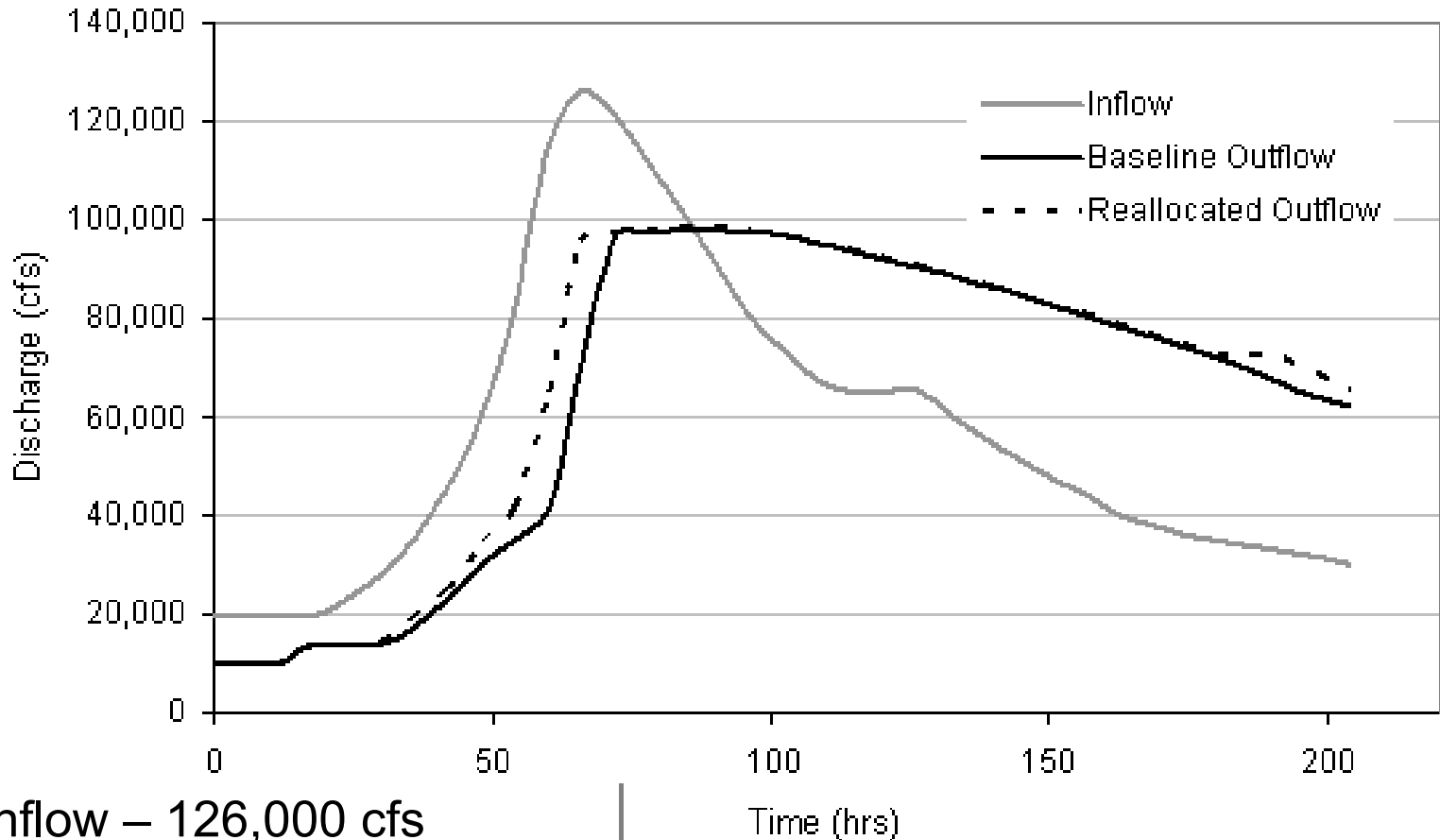
Baseline vs. reallocated change in flood benefits (average annual). Difference is reallocated – baseline.



Inflow Design Flood Results



Comparison of Outflow Data



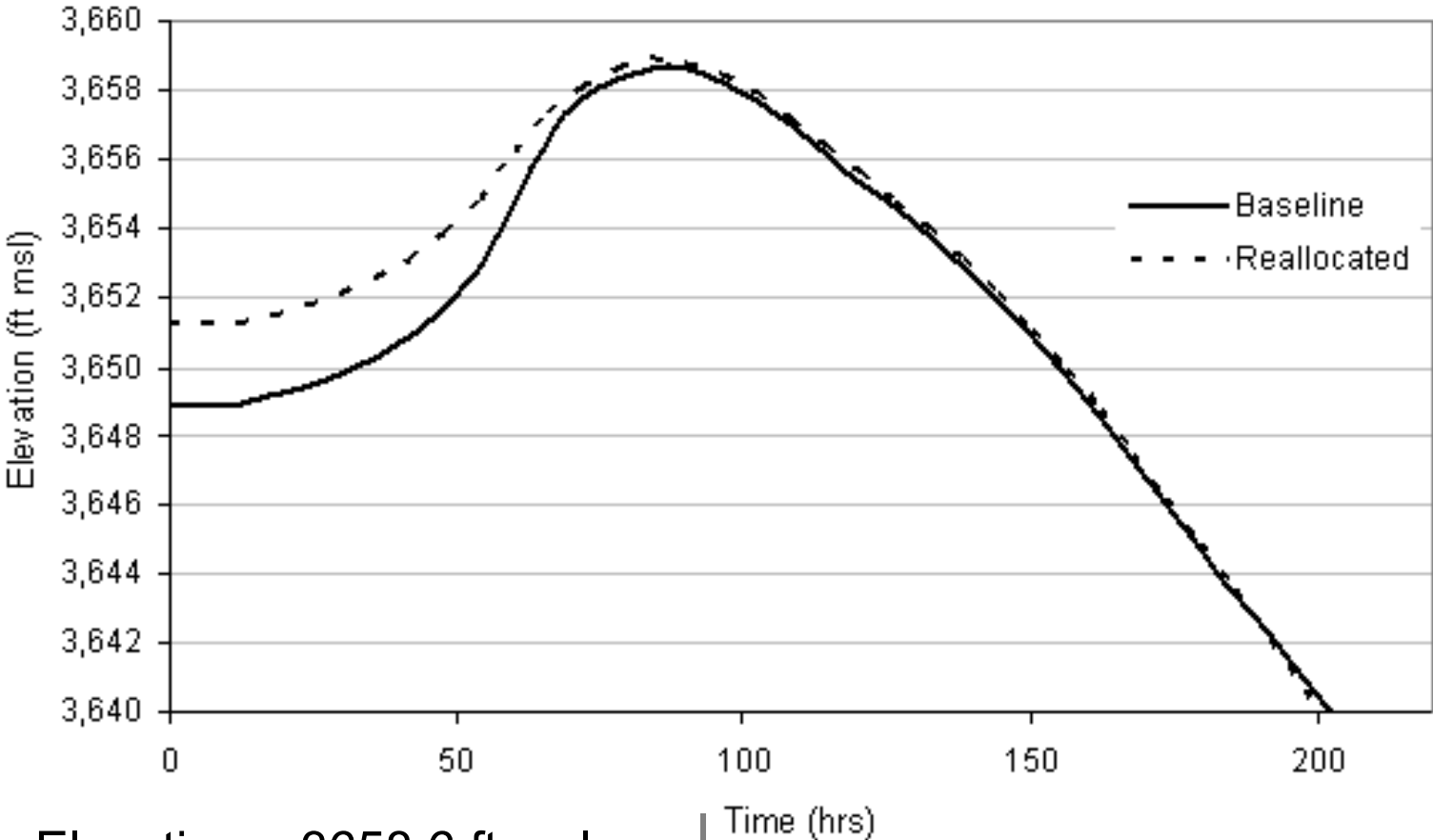
Peak inflow – 126,000 cfs

Baseline Outflow – 98,020 cfs

Reallocated Outflow – 98,350 cfs



Comparison of Elevation Data



Baseline Elevation – 3658.6 ft msl

Reallocated Elevation – 3658.9 ft msl



Results Summary

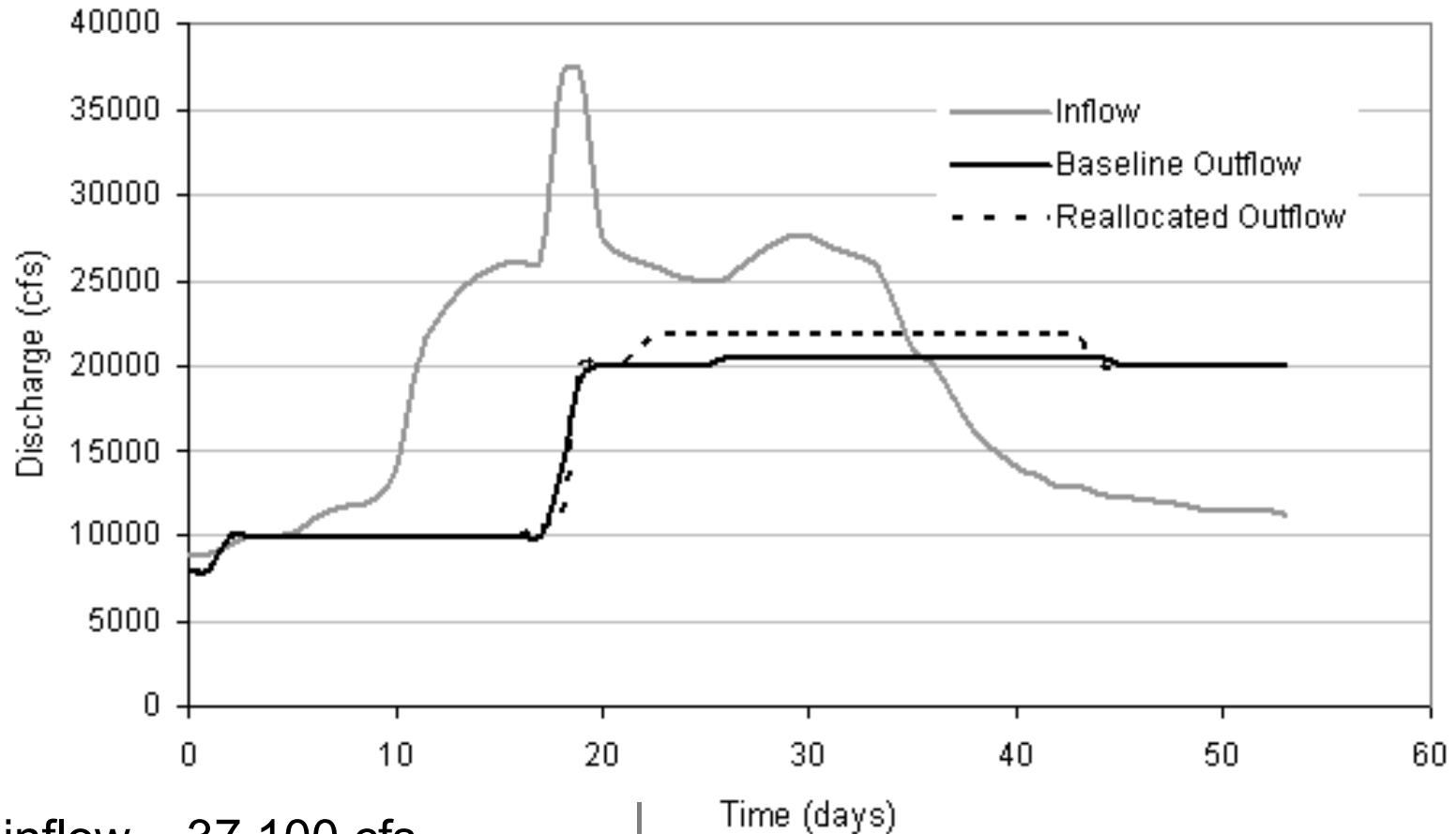
- When comparing the baseline and reallocated simulations, increased pool elevation could be categorized as a dam safety issue.
 - ▶ Pool elevation in the reallocated scenario is only 1.1 ft from the top of the dam.
 - Changes in operations could create additional dam safety concerns.



Project Design Flood Results



Comparison of Outflow Data



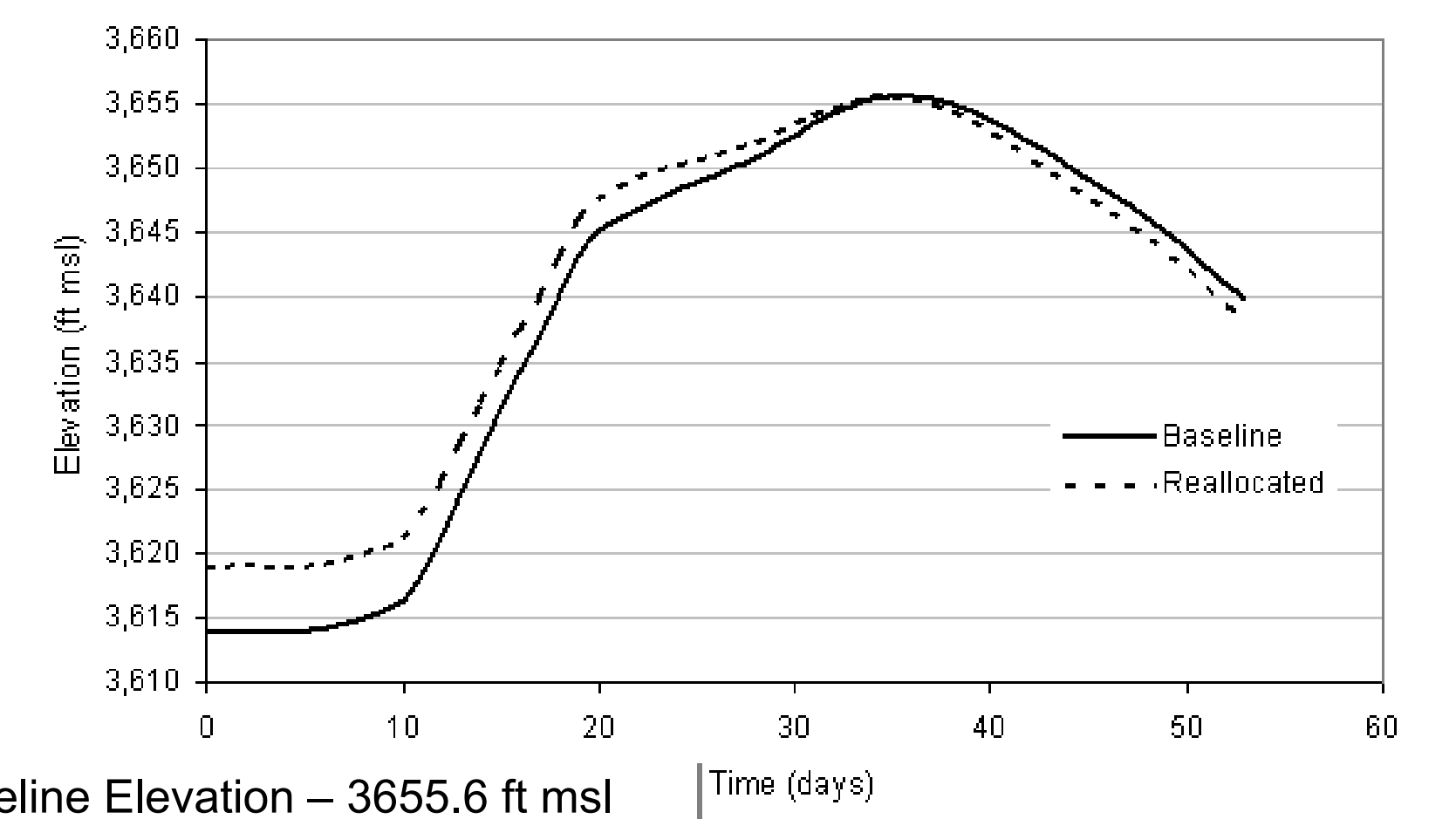
Peak inflow – 37,100 cfs

Baseline Outflow – 20,500 cfs

Reallocated Outflow – 21,900 cfs



Comparison of Elevation Data



Baseline Elevation – 3655.6 ft msl

Reallocated Elevation – 3655.5 ft msl



Results Summary

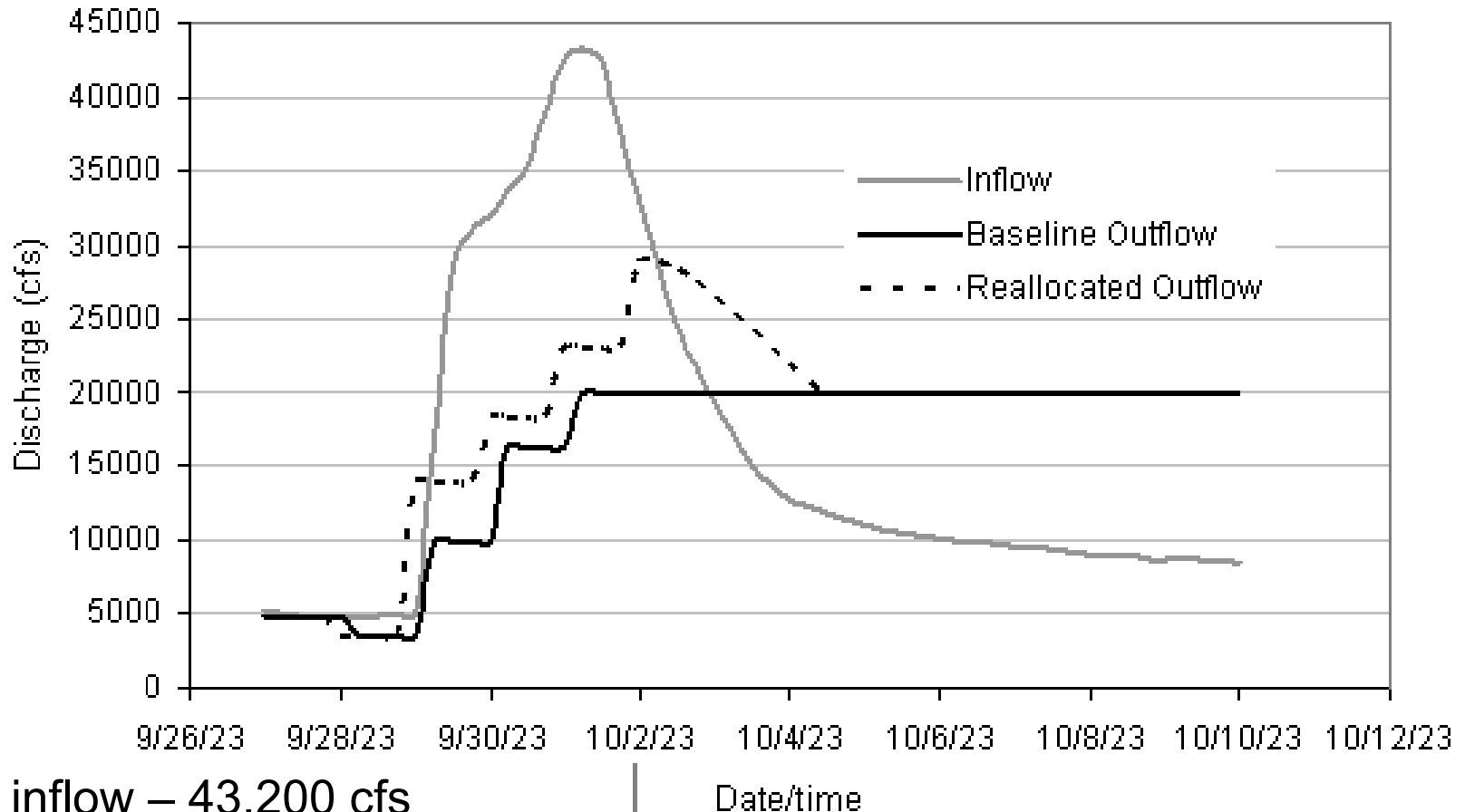
- When comparing the baseline and reallocated simulations, increased outflow could be categorized as a dam safety concern.
 - ▶ Outflow is 1,150 cfs above the listed Yellowtail Afterbay capacity.
 - Changes in operations could create additional dam safety concerns.



1923 Flood Results



Comparison of Outflow Data



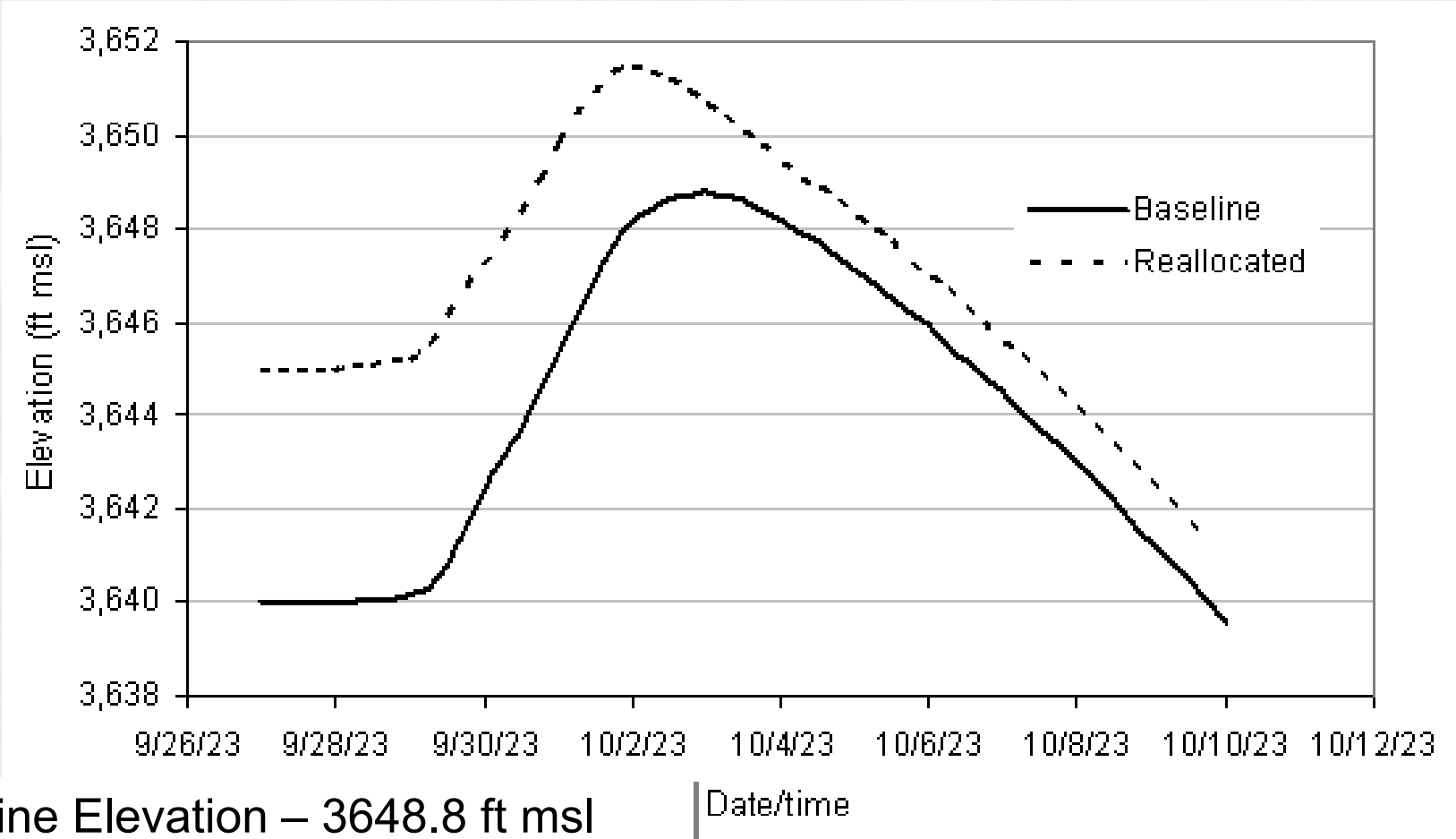
Peak inflow – 43,200 cfs

Baseline Outflow – 20,000 cfs

Reallocated Outflow – 28,800 cfs



Comparison of Elevation Data



Baseline Elevation – 3648.8 ft msl
Reallocated Elevation – 3651.5 ft msl



Results Summary

- When comparing the baseline and reallocated simulations, increased outflow could be categorized as a dam safety concern.
 - ▶ Outflow is 8,050 cfs above the listed Yellowtail Afterbay capacity.
 - Changes to operations could create additional dam safety concerns.



Next Steps

- Detailed study addressing the impacts presented
 - ▶ Identify appropriate mitigation measures
 - ▶ Update and sensitivity analysis of downstream flood damage curves
 - ▶ Analysis of downstream river capacity
- Is environmental assessment needed?
- Update flood control manual/Field Working Agreement
 - ▶ Approved by both the Bureau of Reclamation and U.S. Army Corps of Engineers



