

Preliminary Iteration #2 Results

Water Quality Work Group

*CE-QUAL-W2 Lake Roosevelt Outflow
Temperature Modeling*



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Outline

- Evaluation criteria
- Modeling overview
- Model results and analysis
- Conclusions

Evaluation Criteria

- Effects of different scenarios on Grand Coulee (GCL) outflow temperatures taking powerhouse (PH) operations into account

Modeling Overview

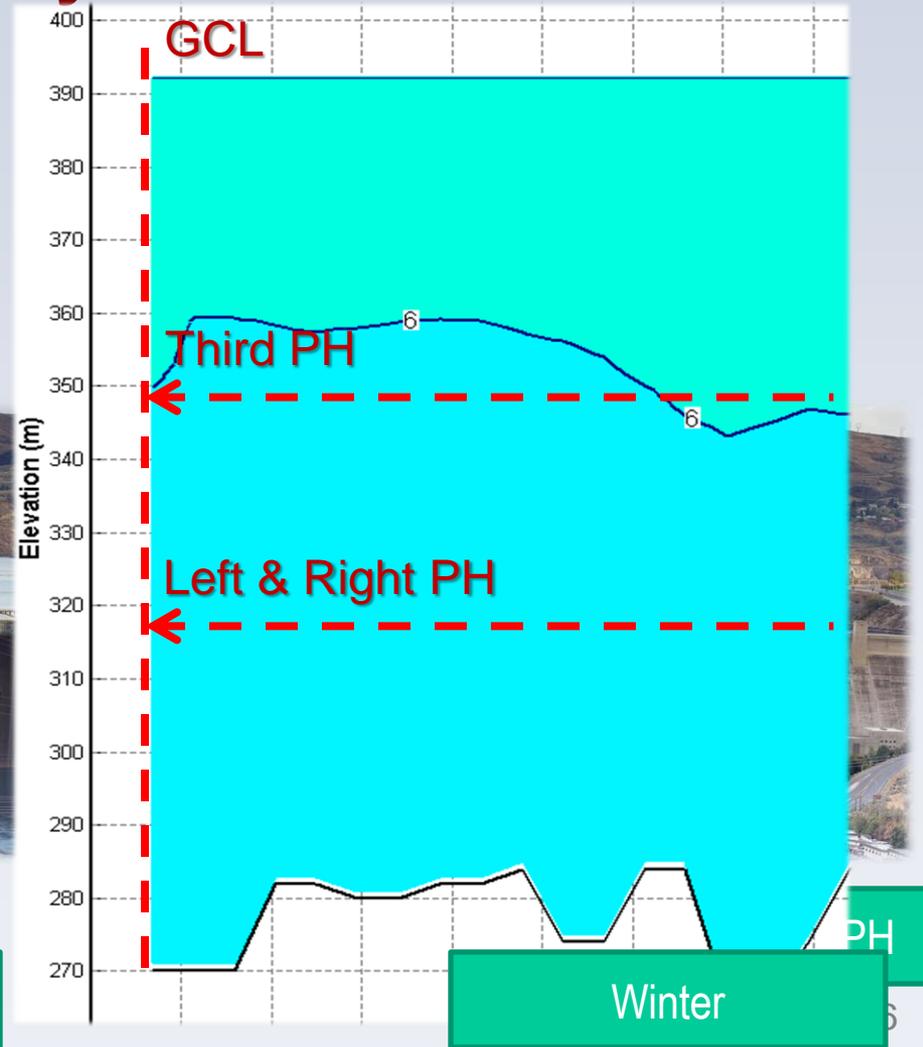
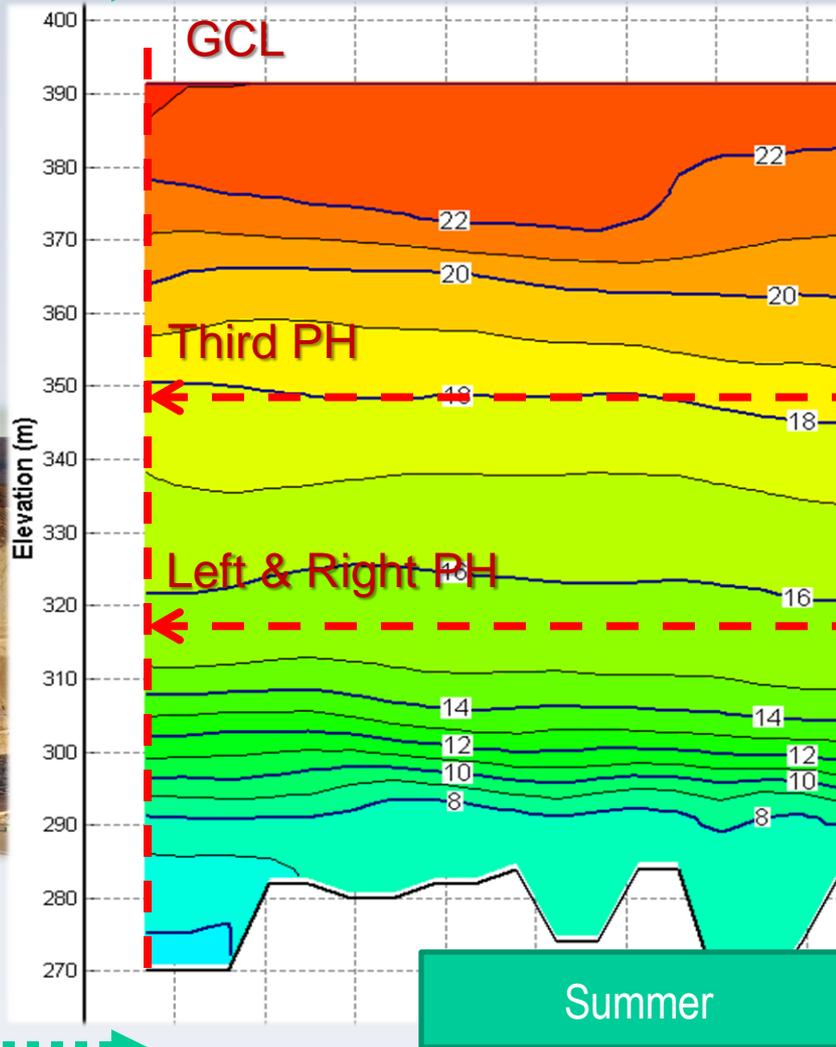
- Modeling approach
 - CE-QUAL-W2
 - A 2-D hydrodynamic and water quality model capable of predicting state variables (temperature, velocity, water surface elevation, nutrients, etc.) at longitudinal segments and vertical layers
- Model calibration

Calibration Year	Outflow Temperatures		Dam Temperature Profile	
	Mean Error (°C)	RMS Error (°C)	Mean Error (°C)	RMS Error (°C)
2000	-0.22	0.64	-0.03	1.01
2006	-0.19	0.54	0.22	0.89
2011	-0.30	0.77	-0.13	1.05

Modeled Years

Modeled Year	Meteorological Year	Characteristics (Modeled Year / Meteorological Year)
1941	1998	Low Flow/Low Flow Conditions
1962	2011	Average Flow/Average Flow Conditions
1997	2008	High Flow/High Flow Conditions

PH Layout

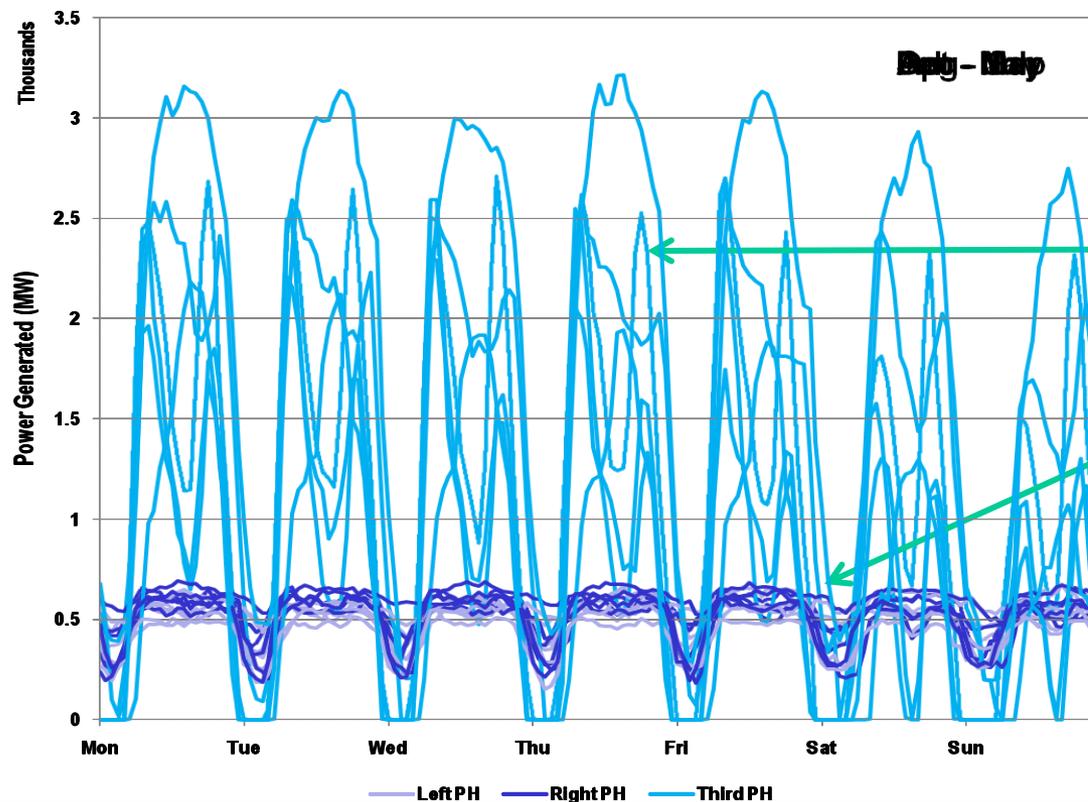


PH

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PH Operations

- PH operations are simulated using historical PH generation data and HYDSIM flows



Graph shows historical generation data

Third PH used for peaking operations

Left and Right PH used for base-loads

Model Results

Alternative Results

Modeled Year	Exceeded Temp (°C)	Number of days exceeded by Alternative				Modeled Condition
		RCCC	2ATC	2BTC	2ATT	
1941	17	91	90	90	76	Low Flow / Warm Meteorology
	18	62	61	61	54	
	19	21	21	21	17	
	20	0	0	0	0	
1962	17	Table Interpretation: 1. For the 1941 modeled year, a mean daily outflow temperature of 17°C was exceeded by the RCCC alternative for 91 days. 2. Similar values for RCCC, 2ATC, and 2BTC show that there no differences in terms of warm outflow temperatures between these Alternatives. 3. Lower values for the 2ATT Alternative shows that 2ATT produces cooler outflow temperatures than RCCC.				
	18					
	19					
	20					
1997	17	0	0	0	0	
	18					
	19					
	20					

RCCC: Current Conditions

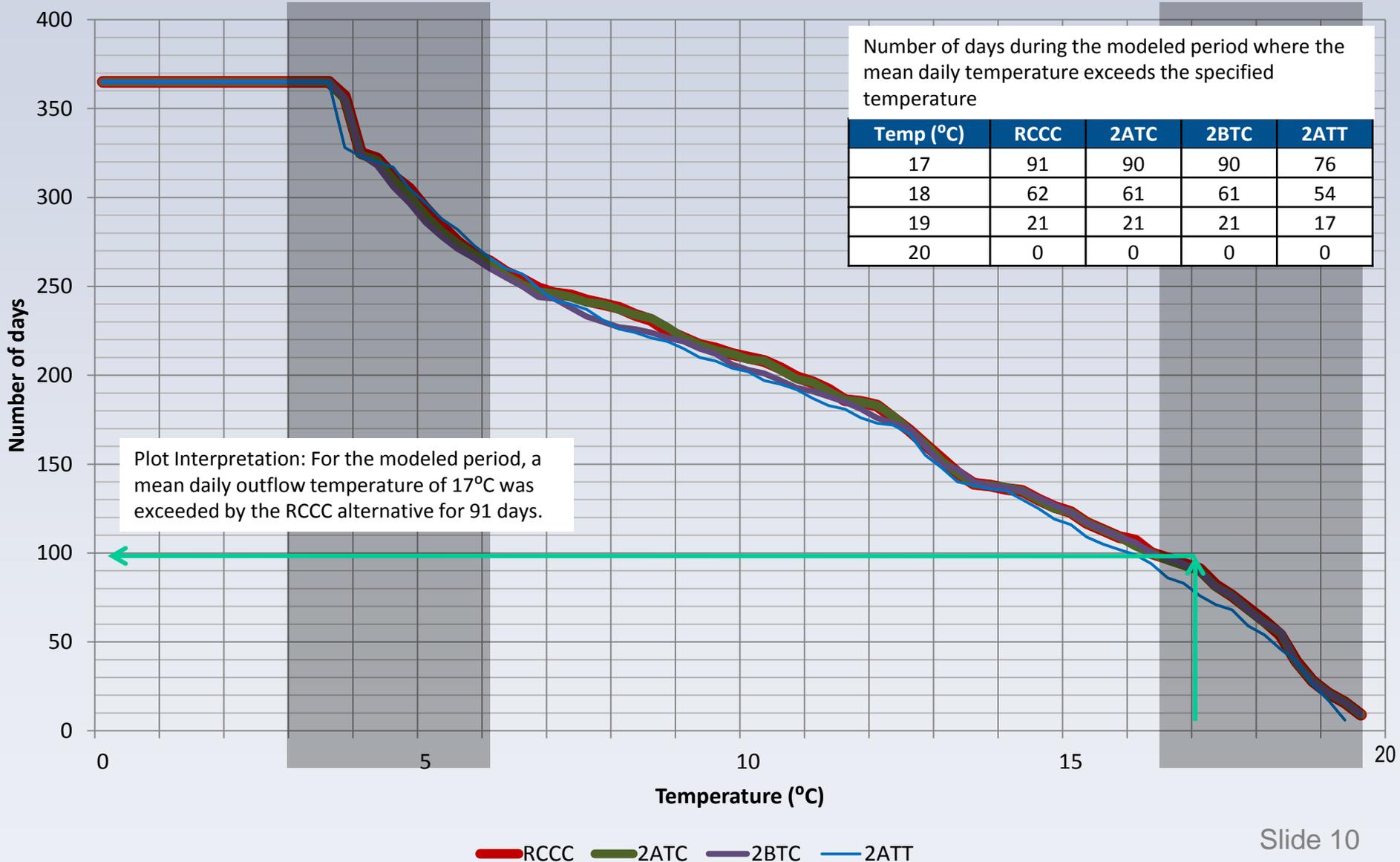
2ATC: Treaty Continues, manage flows to 450kcfs below the Dalles

2BTC: Treaty Continues , manage flows to 600kcfs below the Dalles

2ATT: Treaty Terminates , manage flows to 450kcfs below the Dalles

Columbia River Treaty 2014/2024 Review

1941 Alternative Results (Low Flow, Warm Conditions)



Columbia River Treaty 2014/2024 Review

Component Results

Modeled Year	Exceeded Temp (°C)	Number of days exceeded by Component					Modeled Condition
		RCCC	E1	E2	E3	E5	
1941	17	91	-	89	89	90	Low Flow / Warm Meteorology
	18	62	-	61	61	61	
	19	21	-	15	24	21	
	20	0	-	0	0	0	
1962	17	65	84	75	69	66	Average Flow / Cool Meteorology
	18	45	52	47	47	46	
	19	13	6	0	12	13	
	20	0	0	0	0	0	
1997	17	63	56	52	60	62	High Flow / Average Meteorology
	18	33	30	28	34	32	
	19	0	0	0	0	0	
	20	0	0	0	0	0	

E1: Normative Hydrograph

E2: Normative Reservoir Levels and River Flows

E3: Improve Summer Fish Migration

E5: Dry Year Strategy

Key Results

- Discharge – Temperature relationship
 - Lower summer outflows typically resulted in colder outflow temperatures due to less use of the third PH.
 - Lower winter outflows typically resulted in warmer spring outflow temperatures due to lingering effects of the previous summer stratification.

Key Results

- Pool Elevation –Temperature relationship
 - Lower spring pool elevations typically resulted in warmer spring outflow temperatures due to the proximity of the water surface to the outlets.

Conclusions

- In terms of outflow temperatures:
 - No difference between the RCCC, and the 2ATC and 2BTC alternatives.
 - Slight difference between the RCCC and 2ATT alternatives with 2ATT producing cooler summer outflows.
- Lake Roosevelt is slightly stratified in the summer and isothermal in the winter
- Minimal outflow temperature control

RCCC: Current Conditions

2ATC: Treaty Continues, manage flows to 450kcfs below the Dalles

2BTC: Treaty Continues , manage flows to 600kcfs below the Dalles

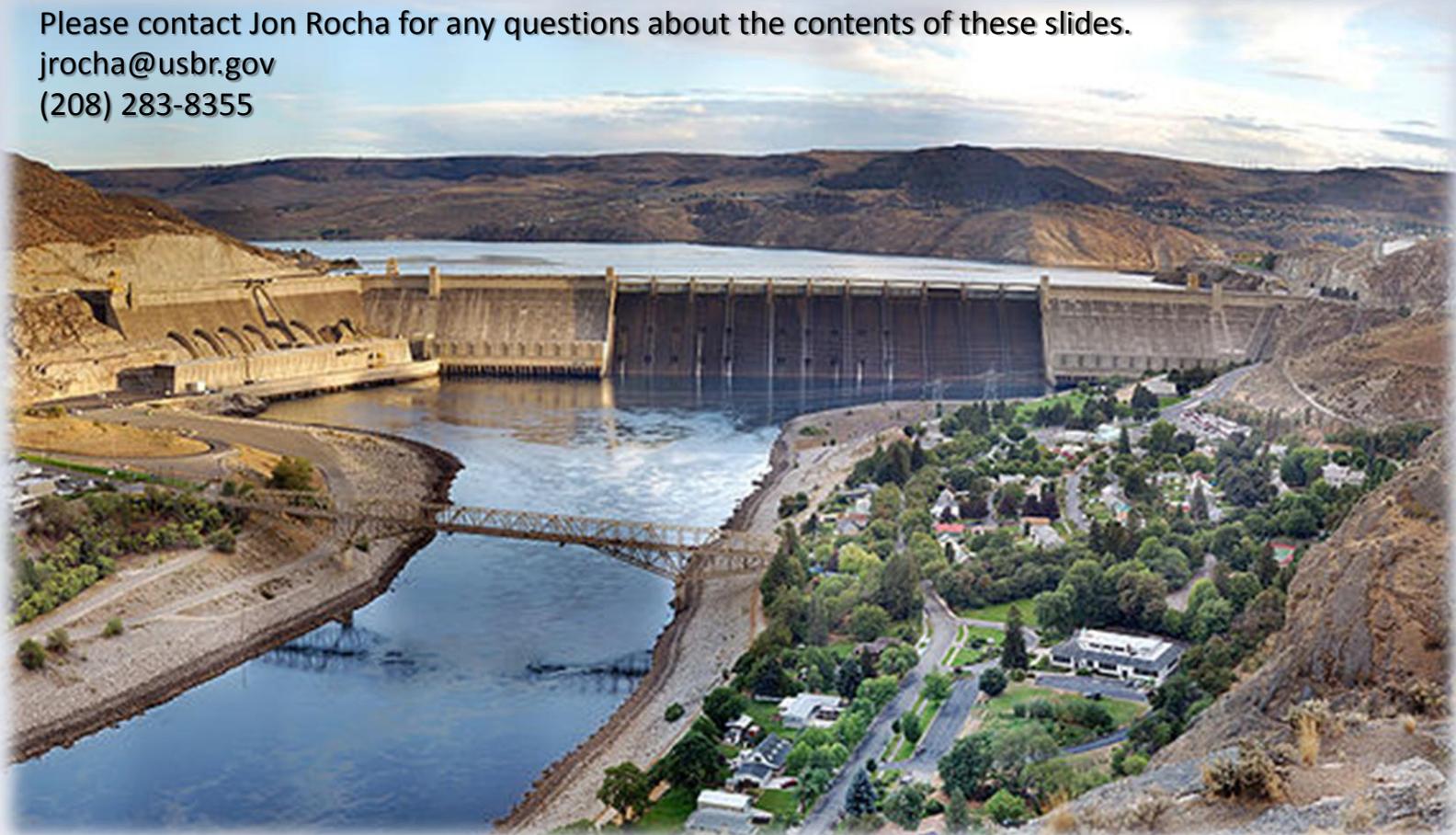
2ATT: Treaty Terminates , manage flows to 450kcfs below the Dalles

Questions

Please contact Jon Rocha for any questions about the contents of these slides.

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