

RECLAMATION

Managing Water in the West

Communicating Risk and Uncertainty in Water Supply Forecasts

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Bureau of Reclamation

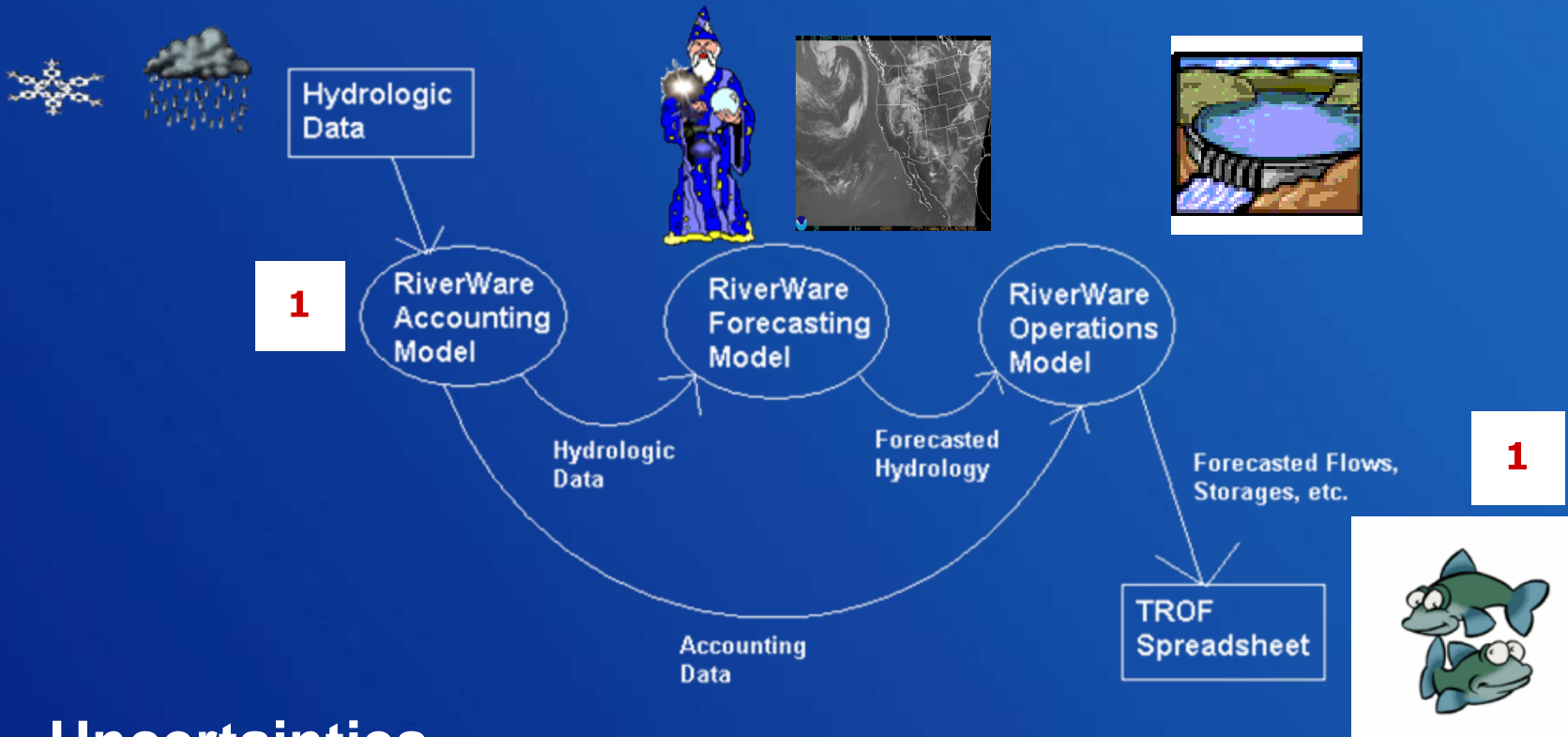
Communicating Risk and Uncertainty in Water Supply Forecasts

- Basin and Model
- Current Methodologies
 - Similar Years
 - Monte Carlo
- Considerations and Needs for the Future



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Truckee-Carson RiverWare Model



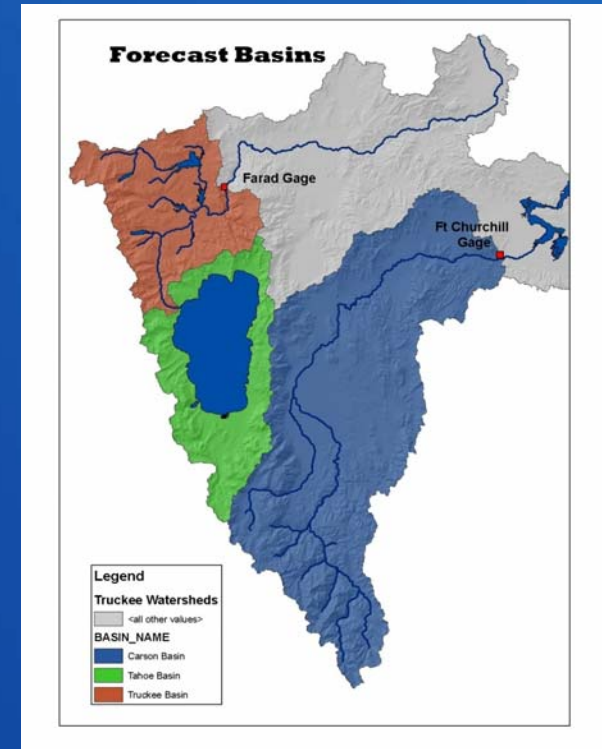
Uncertainties

- Gaging Accuracy
- Model Accuracy
- Weather Forecast
- Runoff Forecast
- Policy Decisions
- Demands
- Losses
- Return Flows

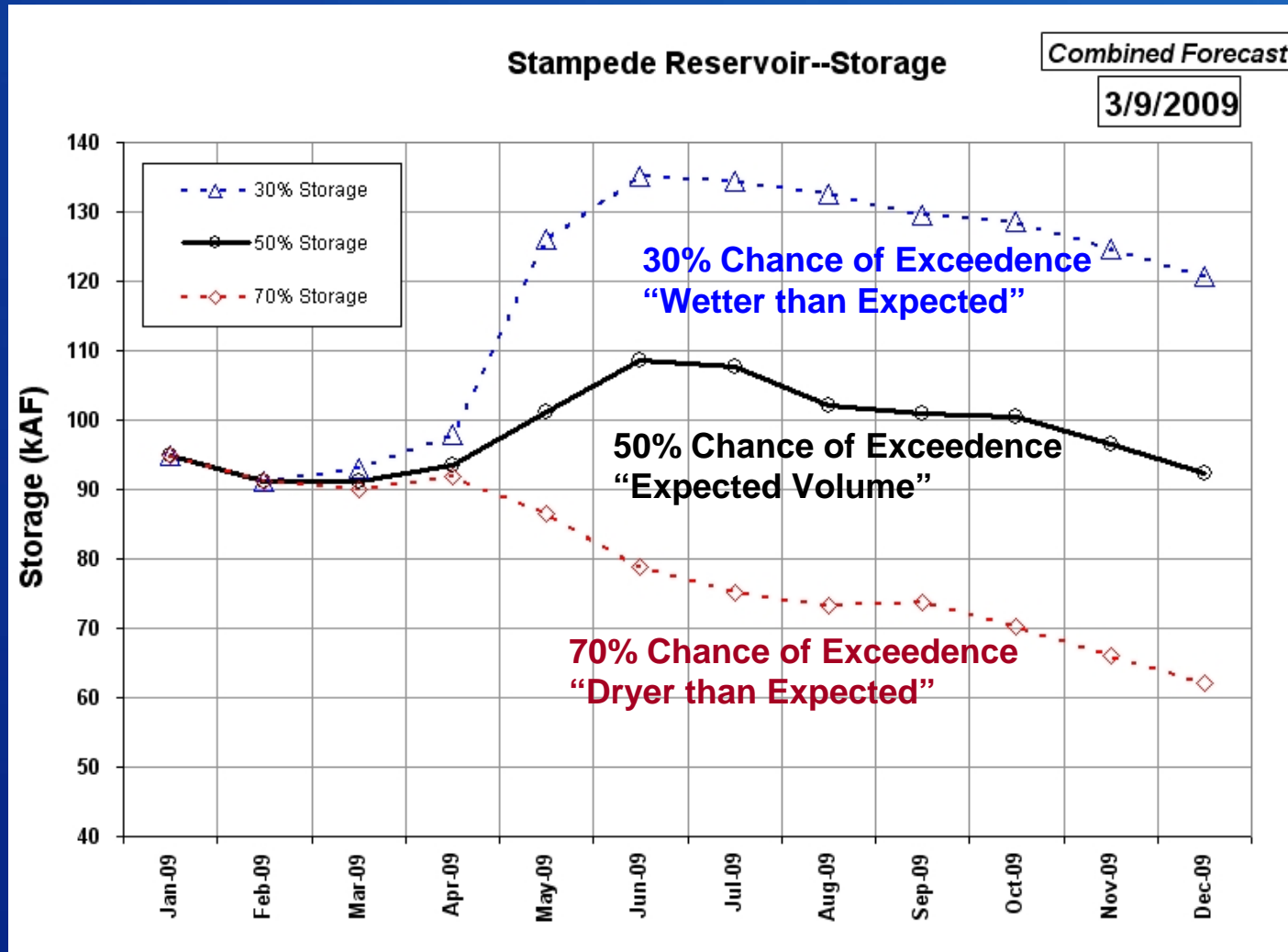
Monthly Water Supply Forecasts

Similar Years Methodology

- NRCS April-July Volume forecasts for 3 basins: Tahoe, Truckee, and Carson.
- Forecasts are given as normal distributions with values for:
 - 10%, 30%, 50%, 70%, and 90% Probability of Exceedence.
- Volumes are matched to historically similar years to obtain hydrograph patterns and daily flow values.
- Hydrographs are disaggregated to several basin locations and model is run for each exceedence value.



Monthly Presentation to Stakeholders



Monte Carlo Uncertainty Analysis Using Excel Controller

- **Used to Estimate the Likelihood of Certain Events Happening:**
 - Likelihood of reaching Boca Reservoir's security limit.
 - Likelihood of storing water on Lahontan's flashboards.
- **Randomly Select Runoff Volumes from the NRCS Forecast Distribution**
- **Run RiverWare Model Multiple Times to Develop Flow and Volume Estimates**

Excel / RiverWare Multiple Run Tool

NRCS Forecast Values (Input Distribution)

Run Parameters – Stochastically Generated Forecast Values

Each Row Has All Forecast Parameters Needed for a RW Model Run

RiverWare Slots To be Output After Each Run

Microsoft Excel - TCRA_Feb14_200_Aug15_MC.xls

File Edit View Insert Format Tools Data Window Help

Type a question for help

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Truckee Carson RiverWare Model Run Generator

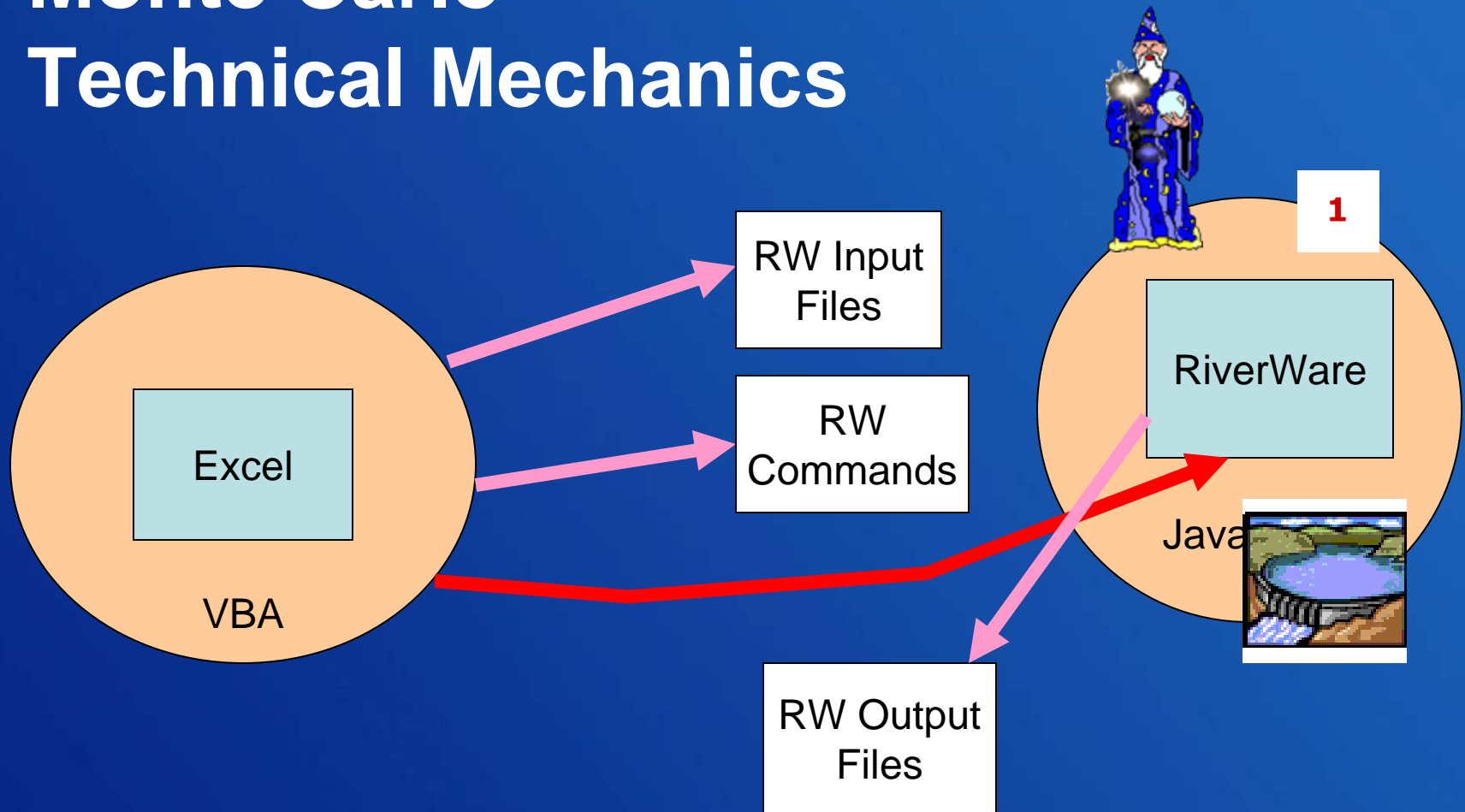
NRCS/BOR Forecast Values (1000 acre-ft)							Generate Stochastic Runs	RiverWare Models Info	
Exceedence	Tahoe Apr-High GCR (ft)	Farad JM Vol	Farad AJ Vol	Lahontan JM Vol	Lahontan AJ Vol	FaradPeakDate (days after 1/1)		IRCS Report Date:	Forecast Month
max								1/16/2008	
10	2.54	87.6	377	61.6	263.0			2	
30	1.77	75.1	307	54.4	223.0	140		1/1/2008	
50	1.4	61.3	260	49.0	195.0	133		C:/SpecialManagementP	
70	1.04	56.7	213	43.1	167.0	126		C:/SpecialManagementP	
90	0.36	45.3	143	37.5	126.0			C:/SpecialManagementP	
min possible			30			100		Date of Runs	
historic ave	1.38	55	260	100	178	133		2/13/2008	
stdev	0.63	8.76	89.52	11.24	53.33	13.33			

Run Analysis

Model Run Parameters							Run Status	Summarization Slots	
Run ID	Tahoe Apr-High GCR (ft)	Farad JM Vol	Farad AJ Vol	Lahontan JM Vol	Lahontan AJ Vol	FaradPeakDate (days after 1/1)		Object	Slot
1	1.50	63.1	281.2	52.4	204.5	135	complete	Lahontan	Outflow
2	0.76	51.7	173.0	38.4	147.2	120	complete	LahontanData	PrectnryRelFlow
3	1.99	65.5	324.4	57.4	232.7	144	complete	Lahontan	Storage
4	2.27	70.5	364.3	65.0	259.8	146	complete	TCanalAtWadsworth	Gage Outflow
5	1.13	57.2	227.0	44.1	171.6	127	complete	CarsonAtFChurchill	Gage Outflow
6	1.07	57.5	214.7	43.8	166.0	121	complete	TCanalAtHazen	Gage Outflow
7	0.47	48.0	135.3	33.0	122.6	111	complete	Boca	Storage
8	1.98	70.4	341.7	59.8	240.0	145	complete	Stampede	Storage
9	1.47	61.9	256.9	48.4	196.5	137	complete	Tahoe	Pool Elevation
10	0.75	51.8	172.0	37.3	139.9	118	complete	FaradGage	Gage Outflow
11	0.84	54.9	183.8	38.6	148.7	122	complete	Tahoe	Outflow
12	2.40	73.7	380.6	60.1	274.5	154	complete	Prosser	Storage
13	3.55	87.5	525.2	80.2	358.1		complete	Boca	Outflow
14	0.63	50.6	160.7	36.9	135.2	117	complete		
15	1.74	66.3	295.5	54.2	214.1	142	complete		
16	1.37	62.1	254.5	47.8	191.8	131	complete		
17	2.66	76.0	465.0	66.6	281.4	156	complete		
18	3.23	89.3	502.9	78.9	355.1	165	complete		
19	1.06	56.4	208.2	40.6	159.9	121	complete		
20	0.84	55.4	188.8	40.9	153.2	123	complete		
21	1.24	58.5	244.5	47.2	183.0	130	complete		
22	1.65	63.4	281.4	52.9	206.9	132	complete		
23	1.35	61.6	244.7	45.5	186.5	132	complete		
24	1.22	58.2	237.2	46.7	180.6	127	complete		
25	1.82	67.0	313.3	55.7	224.4	144	complete		

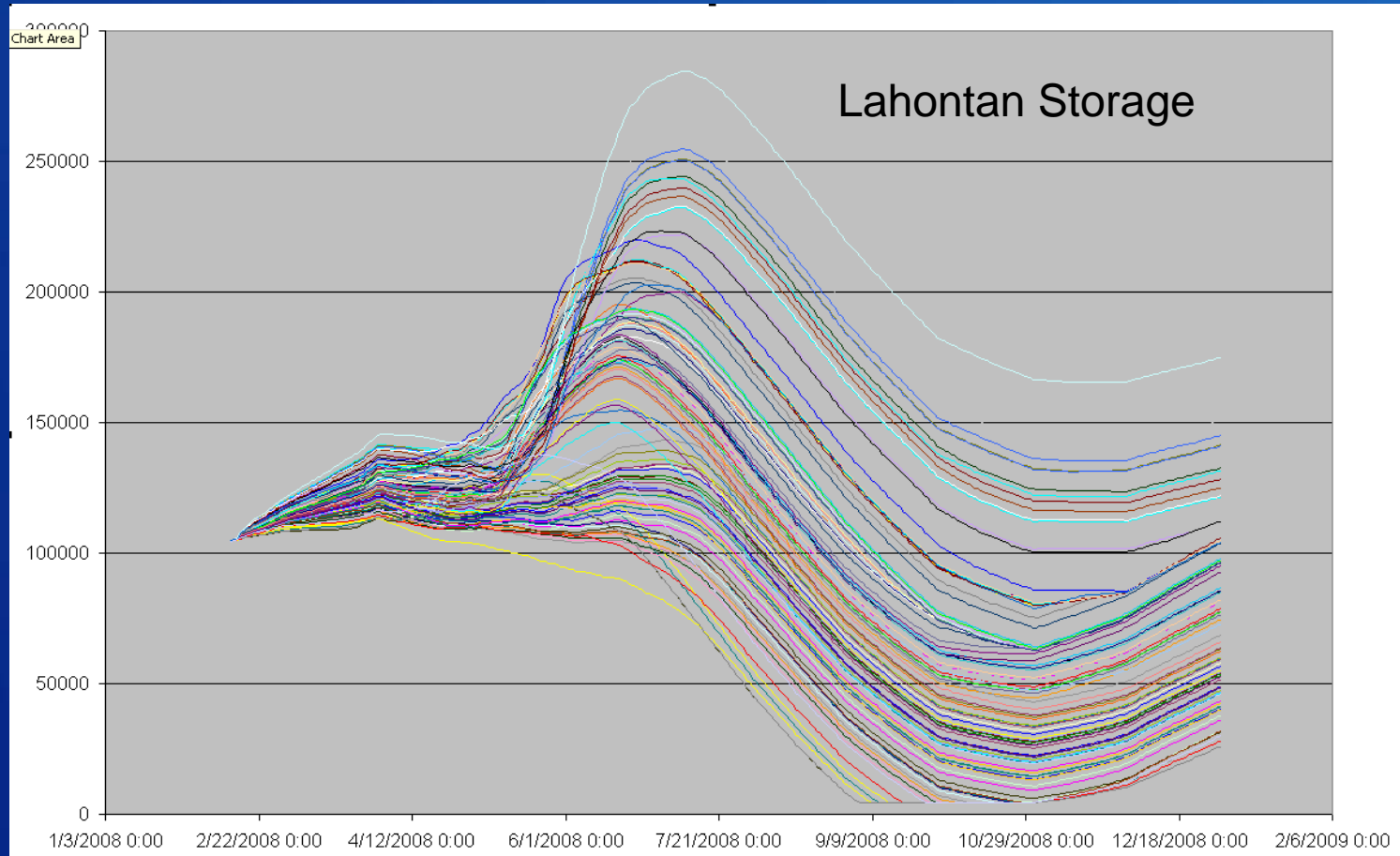
TCanalAtWadsworthGage Outflow / LahontanStorage / LahontanDataPrectnryRelFlow / LahontanOutflow / forecastInput

Monte Carlo Technical Mechanics

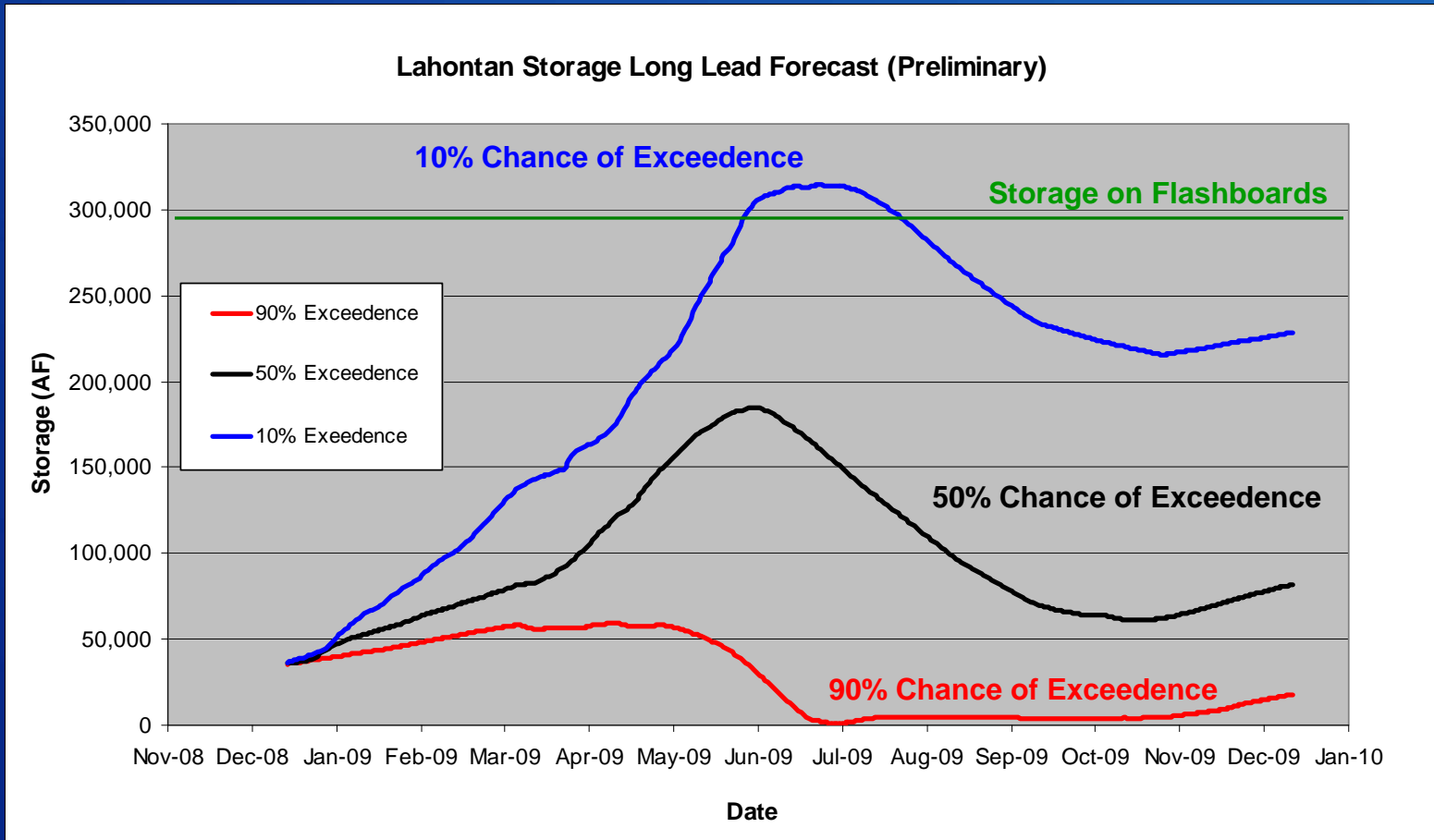


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Scenario Output from RiverWare



Presentation Graph



Future Considerations

- **Future Implementation of the Truckee River Operating Agreement (TROA)**
 - **Will Allow Water Trading and Exchanges**
 - Improve Water Security and Accessibility
 - Improve In-stream Flows
 - **Additional Stakeholder Risk due to:**
 - Potential Reservoir Spilling
 - Increased Cost of Storage
 - Potential Stranded Water (e.g. Tahoe drops below rim)
 - Additional Evaporation/Transport Losses

Future Considerations

- **Climate Change**
 - **Affects Quantity and Timing of Runoff**

Future Needs

- **Long Term RiverWare Planning Model**
 - **Address Climate Change**
 - **Long Term Impact due to Changing Operating Policy and Decisions**

Questions?

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