

RECLAMATION

Managing Water in the West

Green and Gunnison River Operations: Transitioning from the Old to the New While Looking Ahead in 2013

*Drought Workshop
November 6-7, 2012*



U.S. Department of the Interior
Bureau of Reclamation

UC Operations Process

- 24-Month Study
- Mid-Term (Probabilistic) Operations Model (MTOM)
- Stakeholder Benefits
- 2013 Results

24-Month Study Official Uses

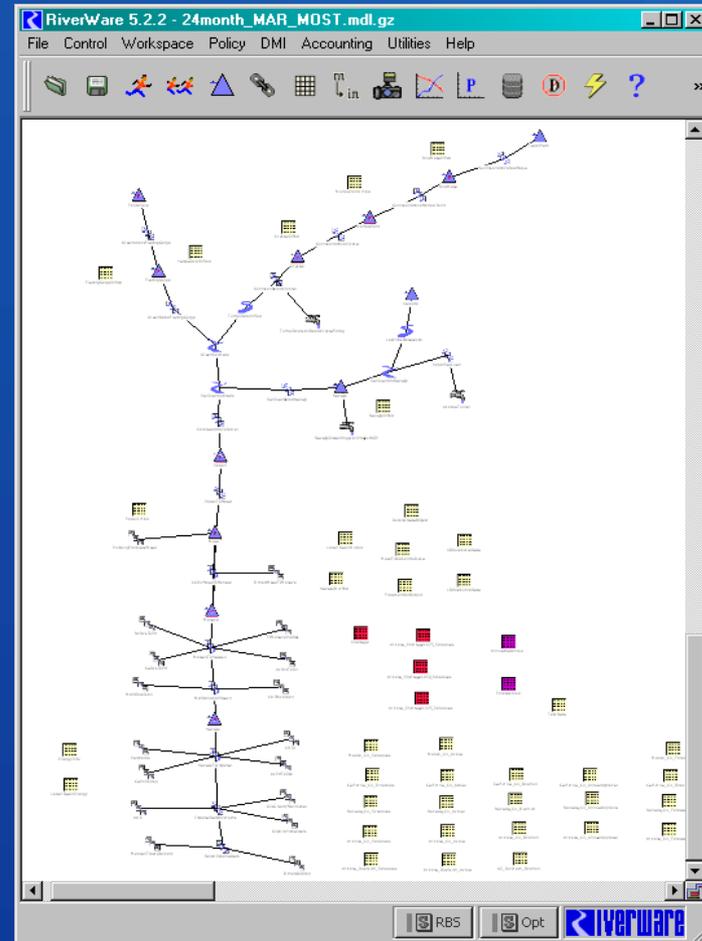
- Annual Operating Plan for all reservoirs
- Determines operating tier for Lake Powell
 - August run of the 24-Month Study (sometimes April)
- Official model projection for determining Lower Basin surpluses and shortages
 - Secretary declares surpluses or shortage



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Model Configuration

- Reservoir Operation
 - 12 major reservoirs
- Monthly time step
- 24-month projection
- Updated monthly



Model Assumptions

- Inflows
- Reservoir operations
- Demands



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Inflows

Upper Basin

- Forecasted inflows issued by Colorado Basin River Forecast Center and Natural Resources Conservation Service
- Most probable inflow (1 trace)
 - (3 traces if running minimum / maximum probable)

Lower Basin

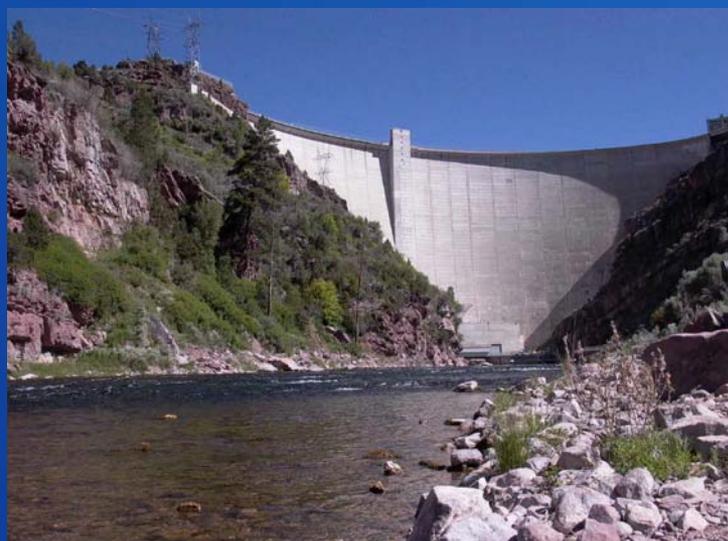
- 5-year average for side inflows



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Reservoir Operations

- Up-to-date operations input by reservoir operators each month
 - For each reservoir: evaluate inflows, set releases given operating objectives
 - Coordination between Powell and Mead



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Demands

Upper Basin

- Included in monthly reservoir inflow forecast
 - Based on assumptions in River Forecast Center models (consider historic and current use patterns)
 - Adjusts for wet/dry years

Lower Basin

- Actual approved water orders
 - Adjusted for Intentionally Created Surplus, paybacks, etc
 - Updated monthly



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Output

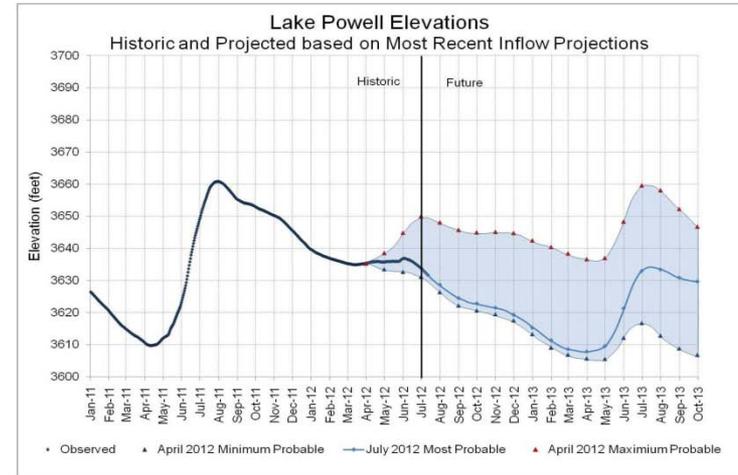
- Annual Operating Plan (written document)
- 24-Month Study Report (mostly tabular data), monthly update to the AOP

OPERATION PLAN FOR COLORADO RIVER SYSTEM RESERVOIRS
October 2012 24-Month Study
 Most Probable Inflow*
Lake Powell

U.S. DEPARTMENT OF THE INTERIOR
 BUREAU OF RECLAMATION

Date	Unreg Inflow (1000 Acre-Ft)	Regulated Inflow (1000 Acre-Ft)	Evap Losses (1000 Acre-Ft)	PowerPlant Release (1000 Acre-Ft)	Bypass Release (1000 Acre-Ft)	Total Release (1000 Acre-Ft)	Reservoir Elev End of Month (ft)	Bank Storage (1000 Acre-Ft)	EQM Storage (1000 Acre-Ft)	Lees Ferry (1000 Acre-Ft)
* Oct 2011	513	930	45	958	0	956	3650.27	5434	17249	979
H Nov 2011	506	930	43	1059	0	1099	3645.87	5388	19693	1154
I Dec 2011	363	690	33	1223	0	1223	3639.75	5332	19974	1228
S Jan 2012	358	503	10	852	0	852	3636.91	5305	15641	848
T Feb 2012	342	490	11	653	0	653	3636.28	5290	15403	854
O Mar 2012	560	625	19	600	0	600	3635.33	5290	15465	607
R Apr 2012	764	688	29	608	0	608	3635.76	5294	15508	612
I May 2012	792	770	35	601	0	601	3638.83	5304	15632	906
C Jun 2012	353	386	54	709	0	709	3633.90	5277	15264	712
A Jul 2012	154	285	62	888	0	888	3628.45	5228	14860	892
L Aug 2012	101	299	80	800	0	800	3623.82	5186	14151	910
* Sep 2012	154	295	54	481	0	481	3621.66	5168	13920	478
WY 2012	4968	5964	485	9466	0	9466				9827
Oct 2012	200	278	37	464	0	464	3619.34	5149	13993	494
Nov 2012	300	307	35	600	0	600	3616.62	5126	13408	600
Dec 2012	250	310	27	800	0	800	3611.96	5088	12929	800
Jan 2013	250	307	8	800	0	800	3607.34	5051	12465	800
Feb 2013	250	286	9	675	0	675	3603.59	5021	12066	675
Mar 2013	425	358	15	600	0	600	3601.14	5002	11859	600
Apr 2013	675	533	23	600	0	600	3600.27	4986	11776	600
May 2013	1500	1214	28	600	0	600	3605.86	5039	12318	600
Jun 2013	2150	1919	45	800	0	800	3614.81	5111	13221	800
Jul 2013	875	615	55	811	0	811	3614.34	5107	13173	811
Aug 2013	400	502	55	850	0	850	3610.69	5078	12800	850
Sep 2013	325	274	50	600	0	600	3608.52	5060	12562	600
WY 2013	7966	7161	386	8299	0	8299				8299
Oct 2013	443	470	34	600	0	600	3606.99	5048	12429	600
Nov 2013	441	434	33	600	0	600	3605.13	5033	12246	600
Dec 2013	363	363	28	800	0	800	3600.90	5001	11836	800
Jan 2014	361	396	8	800	0	800	3598.68	4970	11495	800
Feb 2014	363	406	8	600	0	600	3594.87	4955	11267	600
Mar 2014	665	562	14	600	0	600	3594.36	4951	11220	600
Apr 2014	1056	684	22	600	0	600	3609.56	4968	11425	600
May 2014	2343	1929	28	600	0	600	3609.00	5064	12630	600
Jun 2014	2066	2287	47	650	0	650	3623.00	5180	14084	650
Jul 2014	1091	696	59	850	0	850	3623.14	5187	14164	850
Aug 2014	500	601	57	600	0	600	3620.66	5180	13833	600
Sep 2014	459	531	53	600	0	600	3619.30	5149	13592	600
WY 2014	18728	16118	386	8299	0	8299				8299

* Based on the Colorado River Basin Forecast Center's Most Probable Water Supply Forecast
 Model Run ID: 2139
 Processed On: 10/10/2012 2:34:27PM

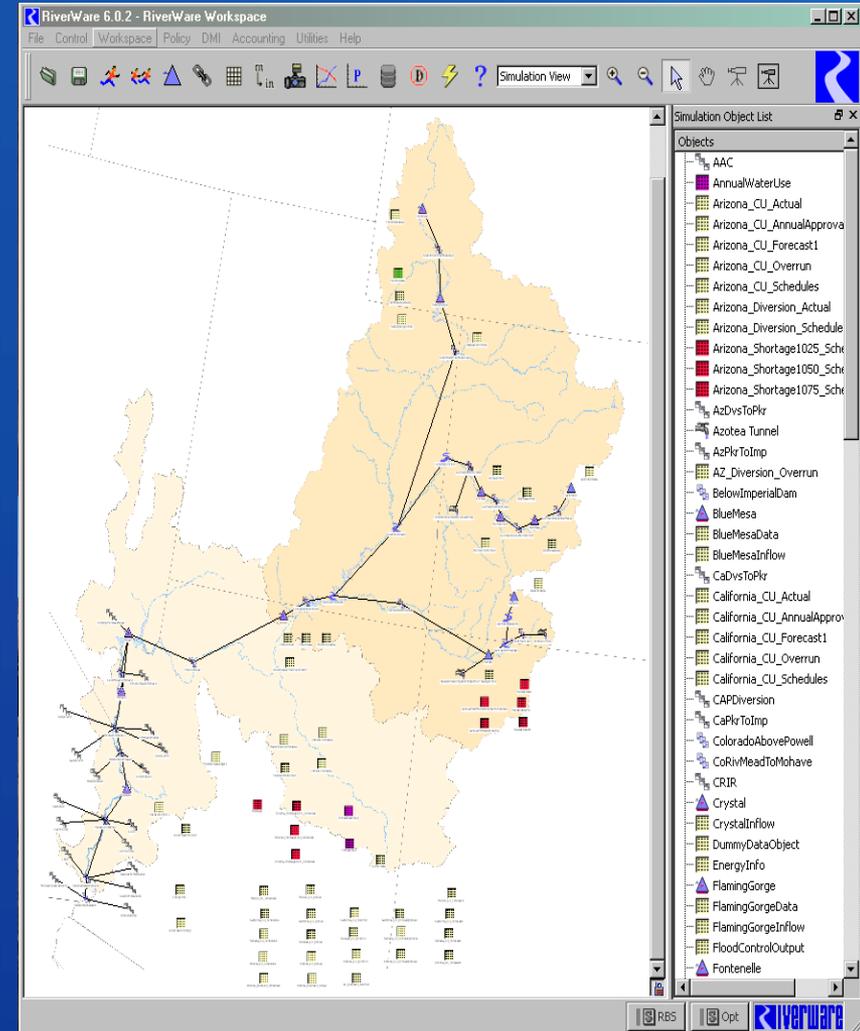


Mid-Term Operations Model (MTOM) Update

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MTOM- Overview

- Based on 24-Month Study, but able to simulate multiple traces for a probabilistic output and analysis
- MTOM is additional tool to evaluate risk and uncertainty in Colorado River Basin
- 24-Month Study is still official model for operational tier determinations



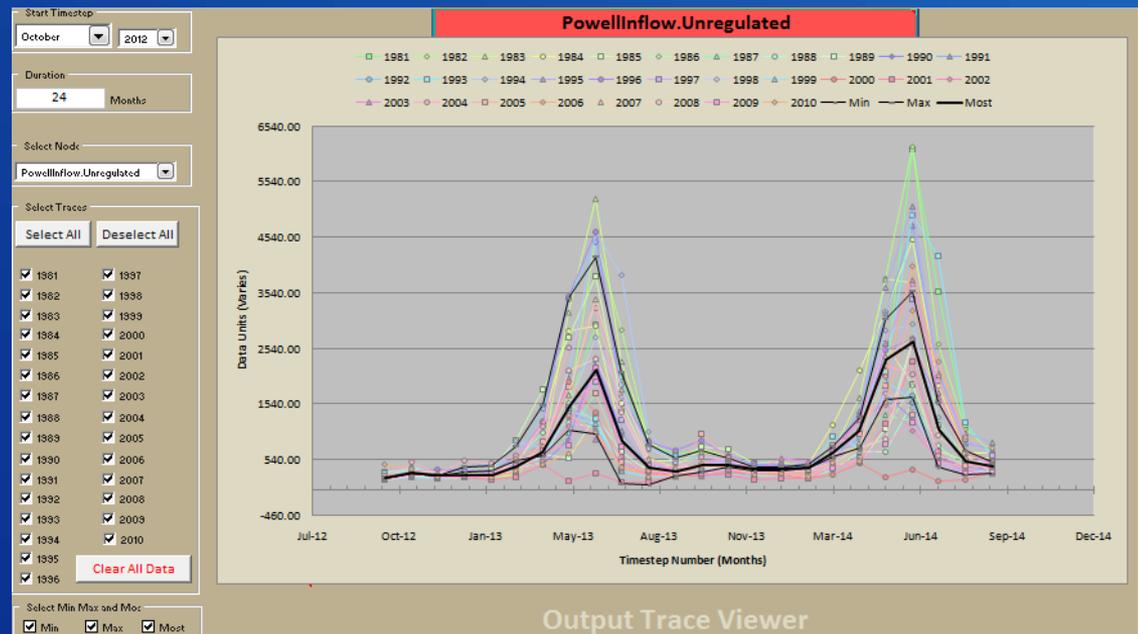
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MTOM - Current Status

- UC/LC operators validating MTOM outputs
 - Comparison against official 24–Month Study
 - Refine model inputs and rules to improve operations planning
- Expect to be ready to share *preliminary* multiple trace results with stakeholders in late 2012
 - No change since last update
- Expect to share *draft* model, ruleset and documentation with interested technical stakeholders in late 2012 or early 2013
 - Basic functionality
 - Development will continue

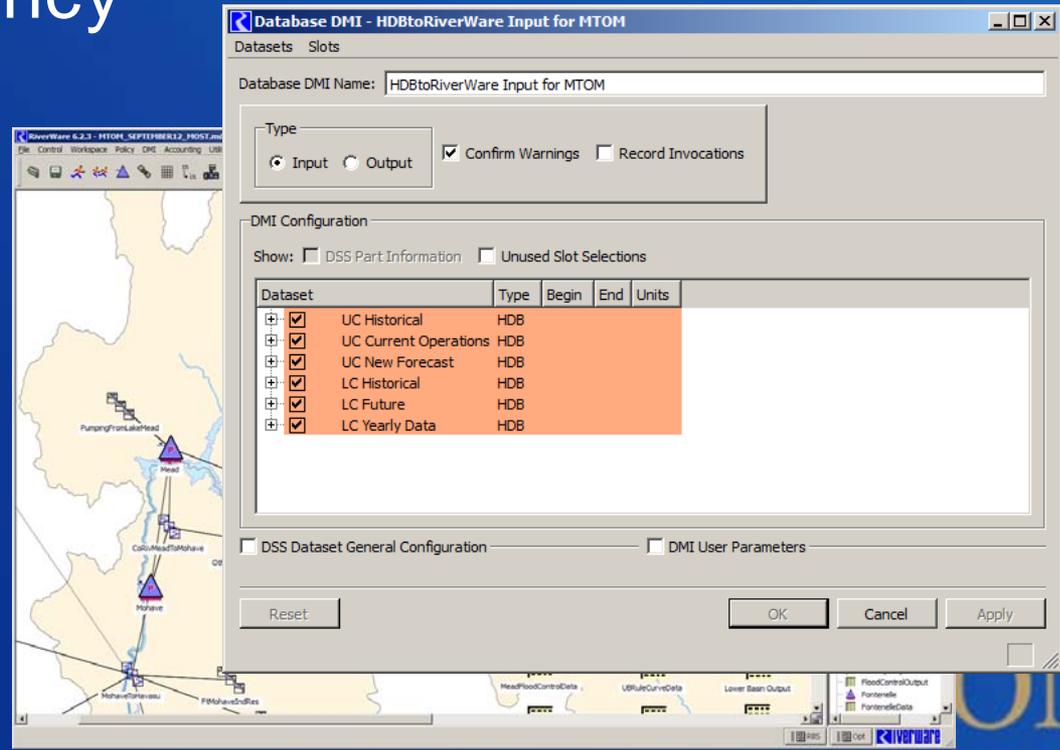
MTOM Updates - Inflows

- Bias corrected inflows
 - Previously used raw ESP output
 - Did not match official forecasts used in 24MS
 - Improved consistency of inflow assumptions



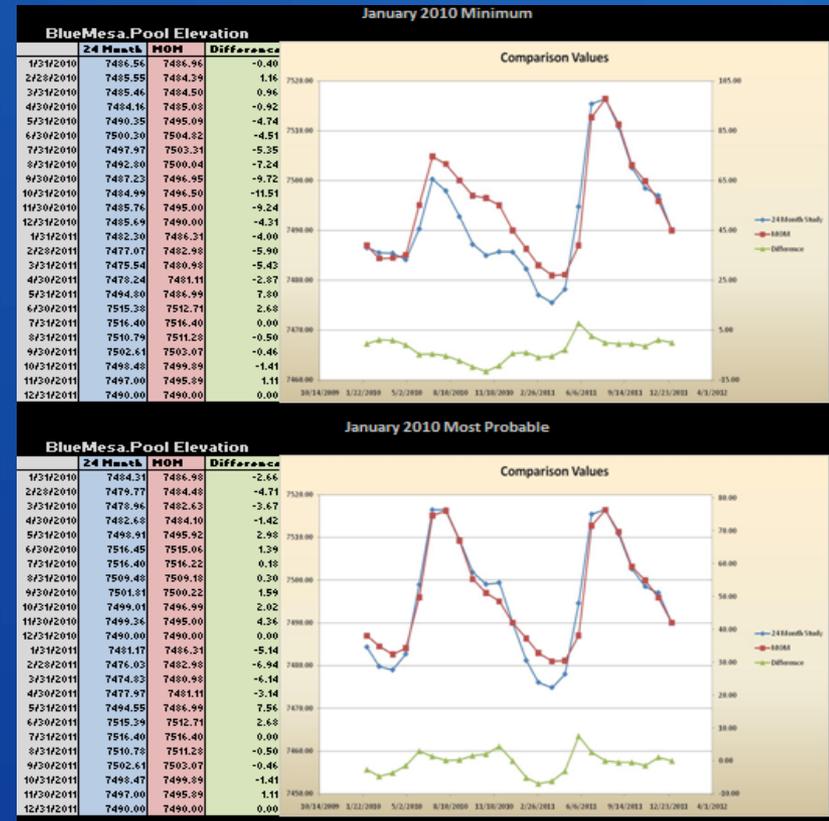
MTOM Updates – Data Management

- Improved Data Management Interface
 - Previously used Excel pass-through spreadsheets
 - Model transfers data directly from HDB
 - Improved efficiency



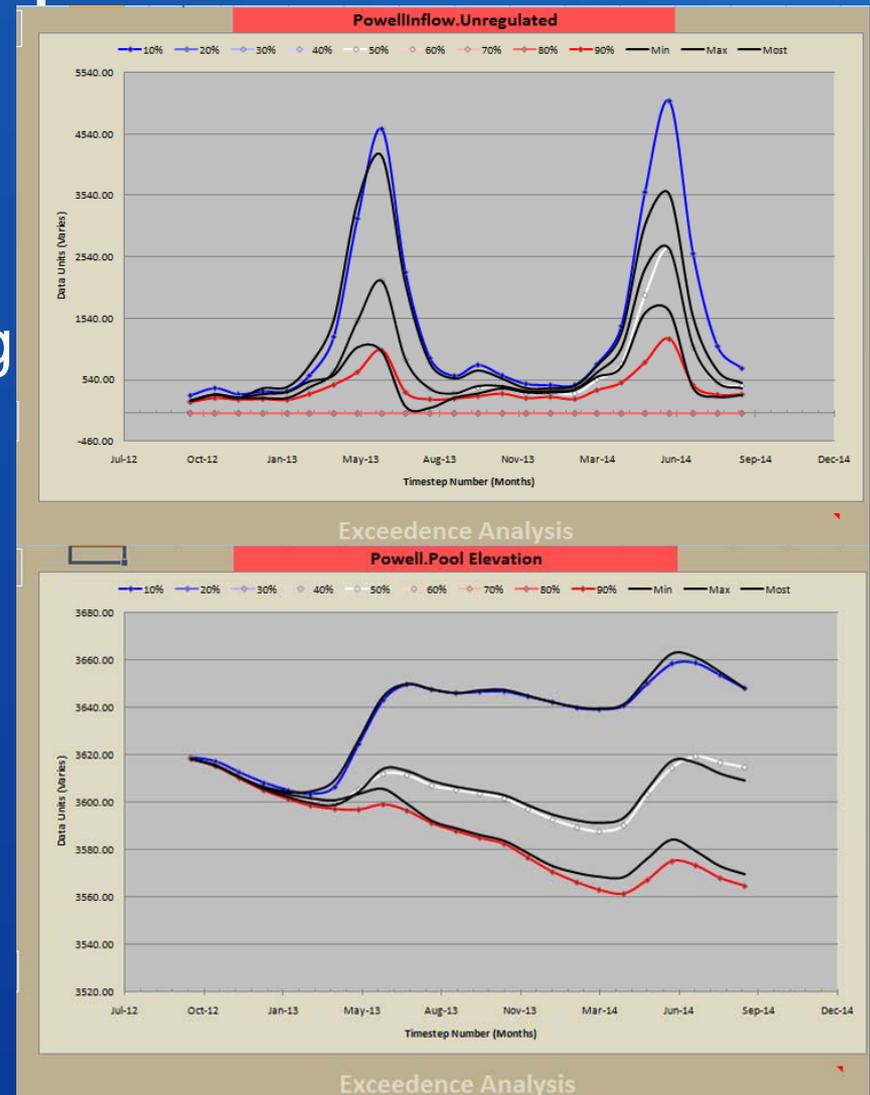
MTOM – Reservoir Ops Validation

- Parallel runs began in Jan
- Compare 24-MS official results against MTOM (using official forecast) to verify reservoir rules
- Evaluate elevations and releases
- Work still underway...



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Green and Gunnison Results

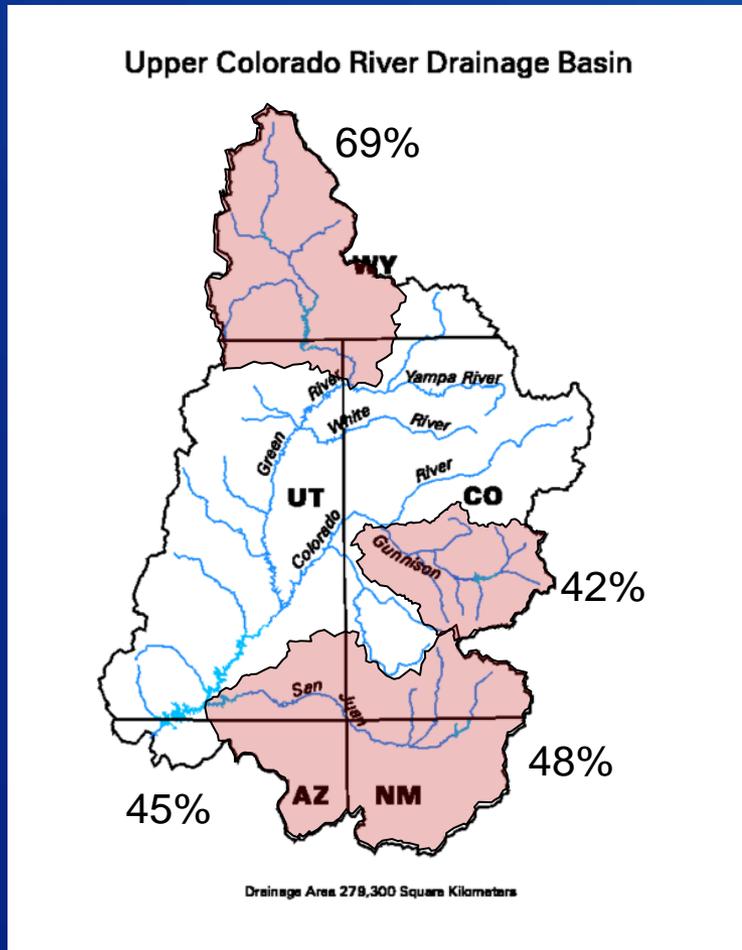
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Prescribed Management and Operational Objectives

- Records of Decision
 - Navajo Reservoir
 - Flaming Gorge
 - Aspinall Unit
 - Black Canyon Water Right
- Authorized purposes
 - Fill reservoir annually for water supply
 - Generate hydropower
- Achieve environmental flow requirements (endangered fish)
 - Adaptive management
- Regulate the flow of the river for:
 - flood control, recreation, fish and wildlife

Upper Colorado River Basin 2012 Water Year Inflow

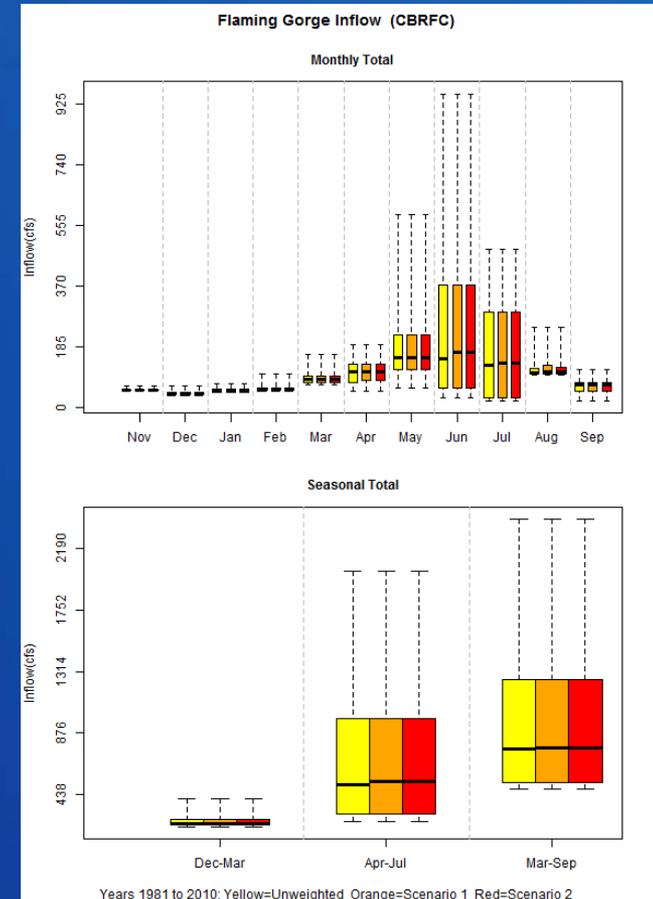
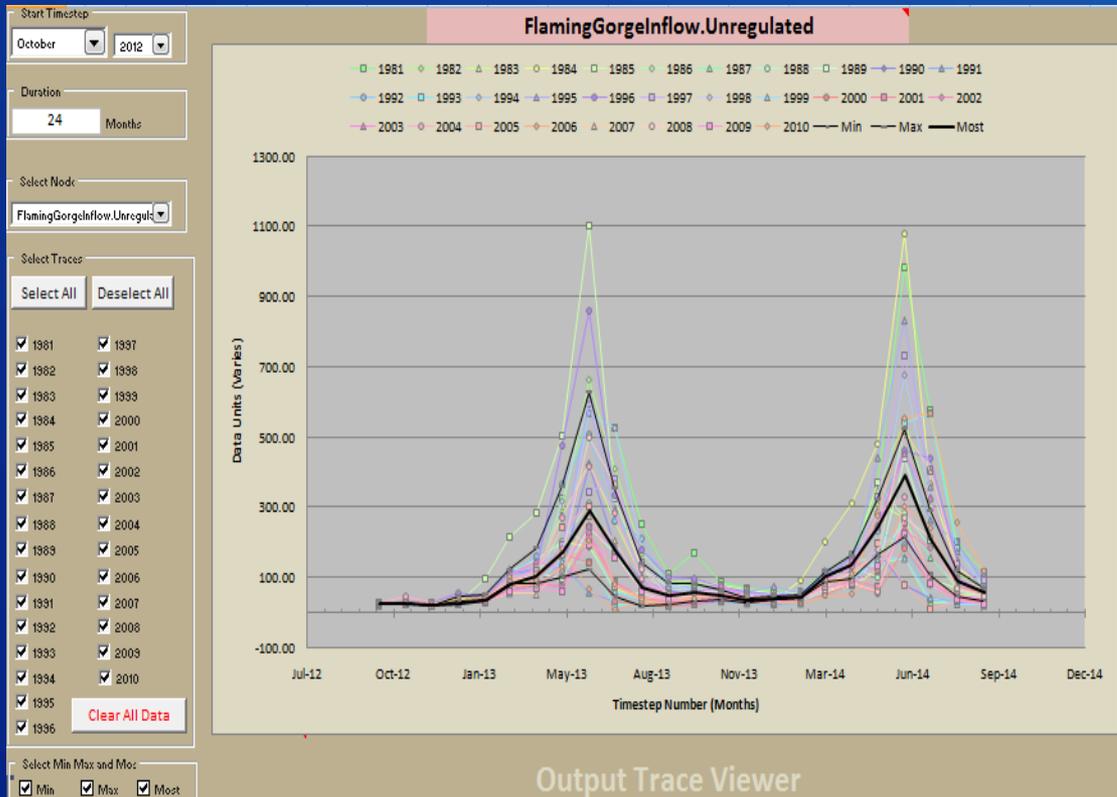
(30-year average stream gage flow, 1981-2010)

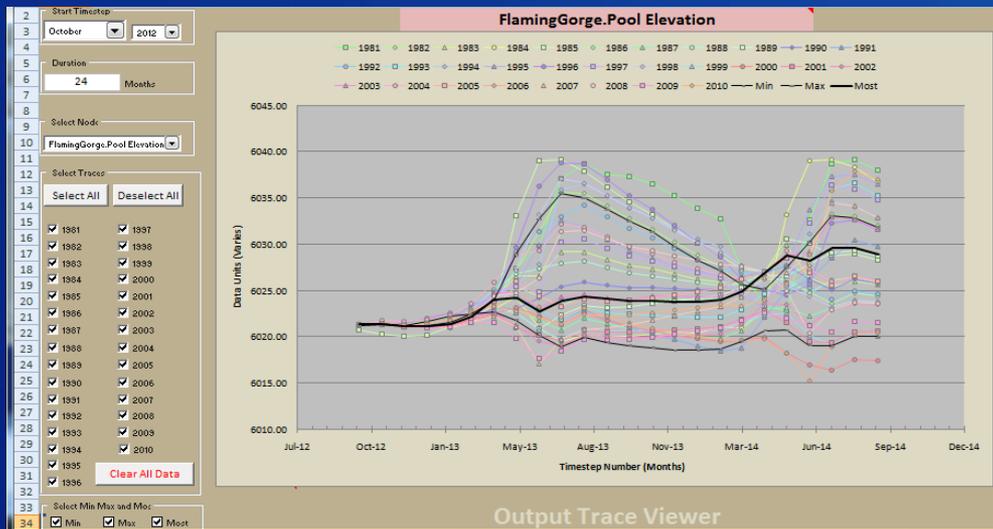
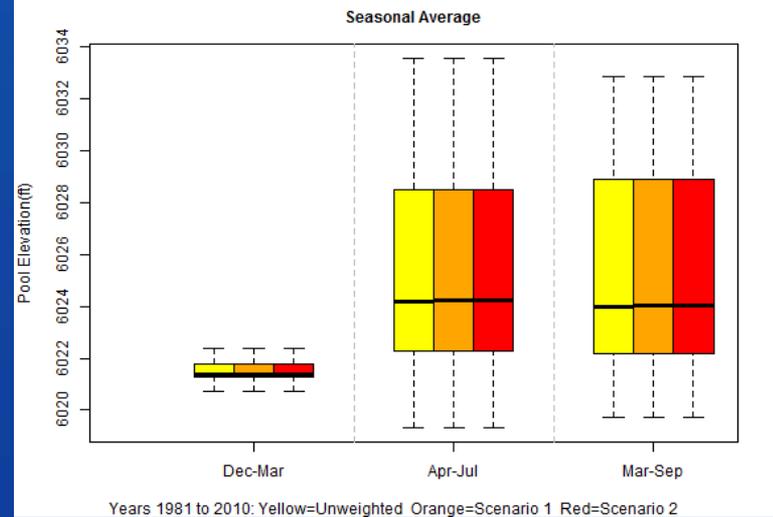
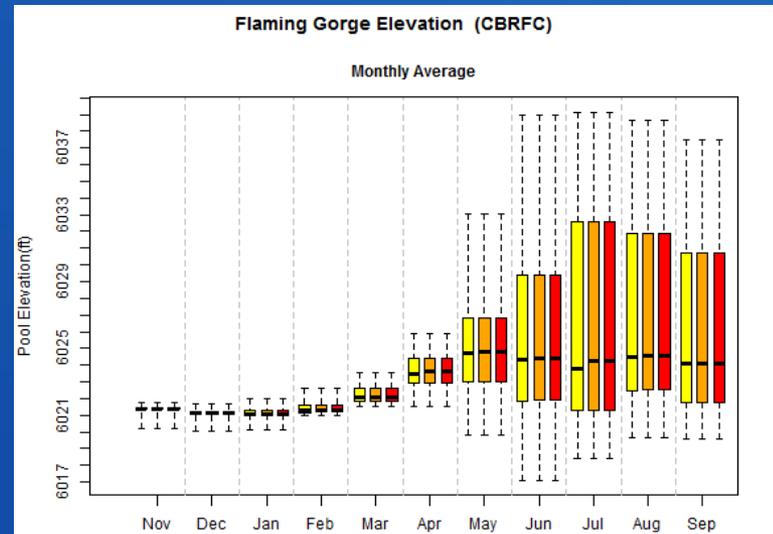
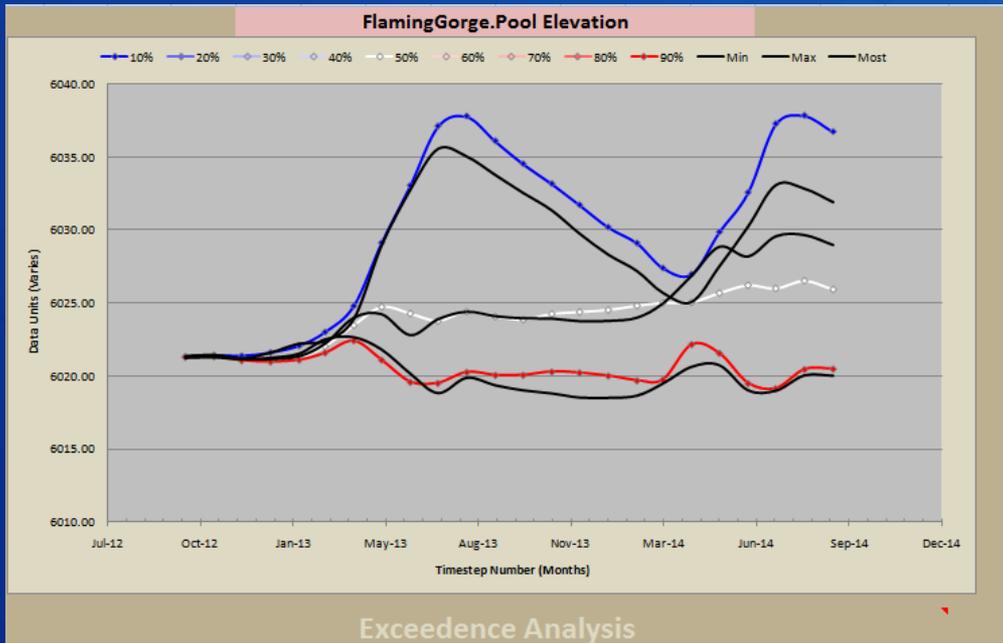


Basin	2012 Annual Flow MAF
Green River <i>above Flaming Gorge</i>	1.0 (69%)
Gunnison River <i>above Crystal</i>	0.50 (42%)
San Juan River <i>above Navajo</i>	0.52 (48%)
Upper Colorado River <i>above Lake Powell</i>	4.91 (45%)

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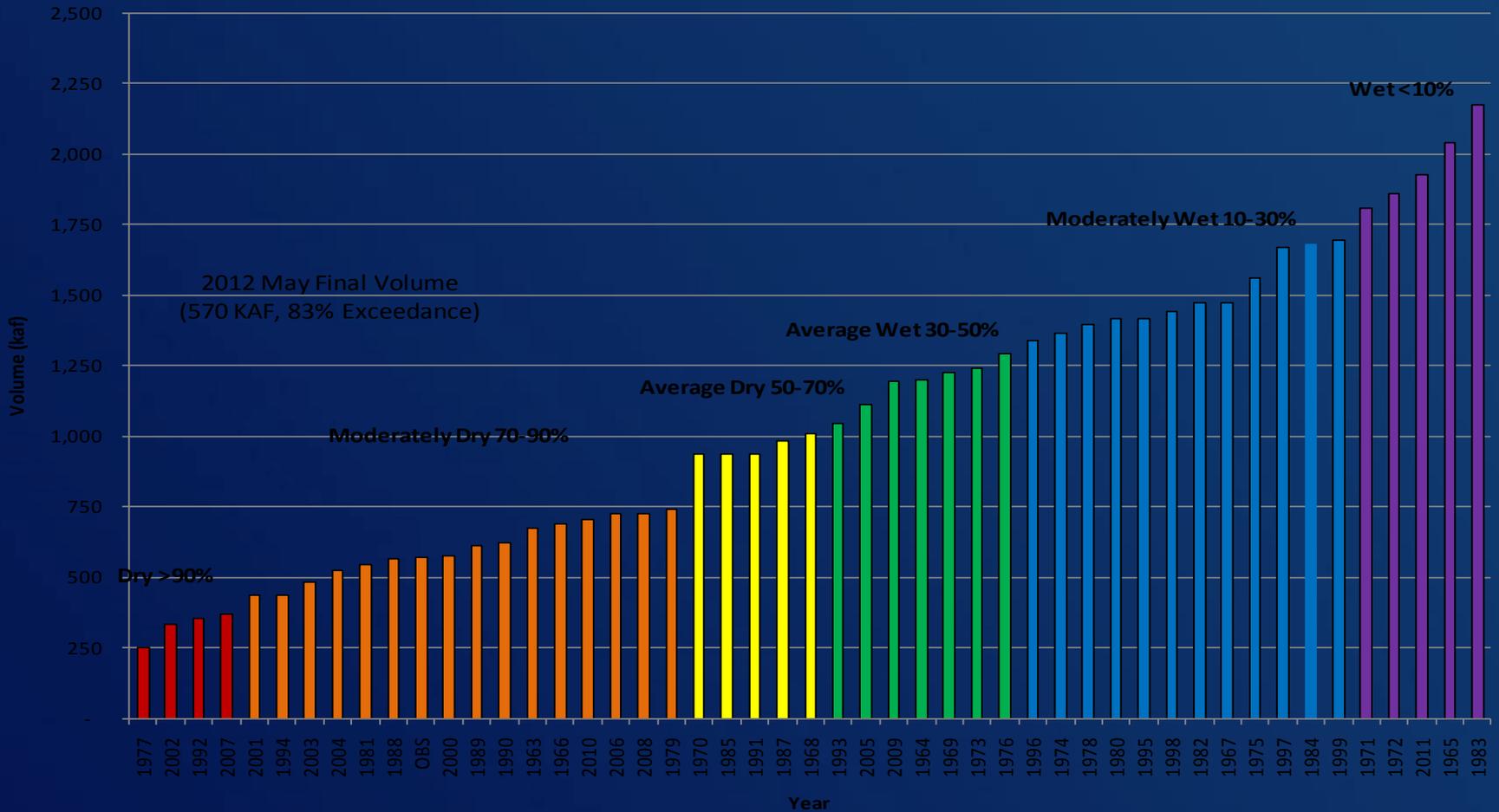
Green River Inflow





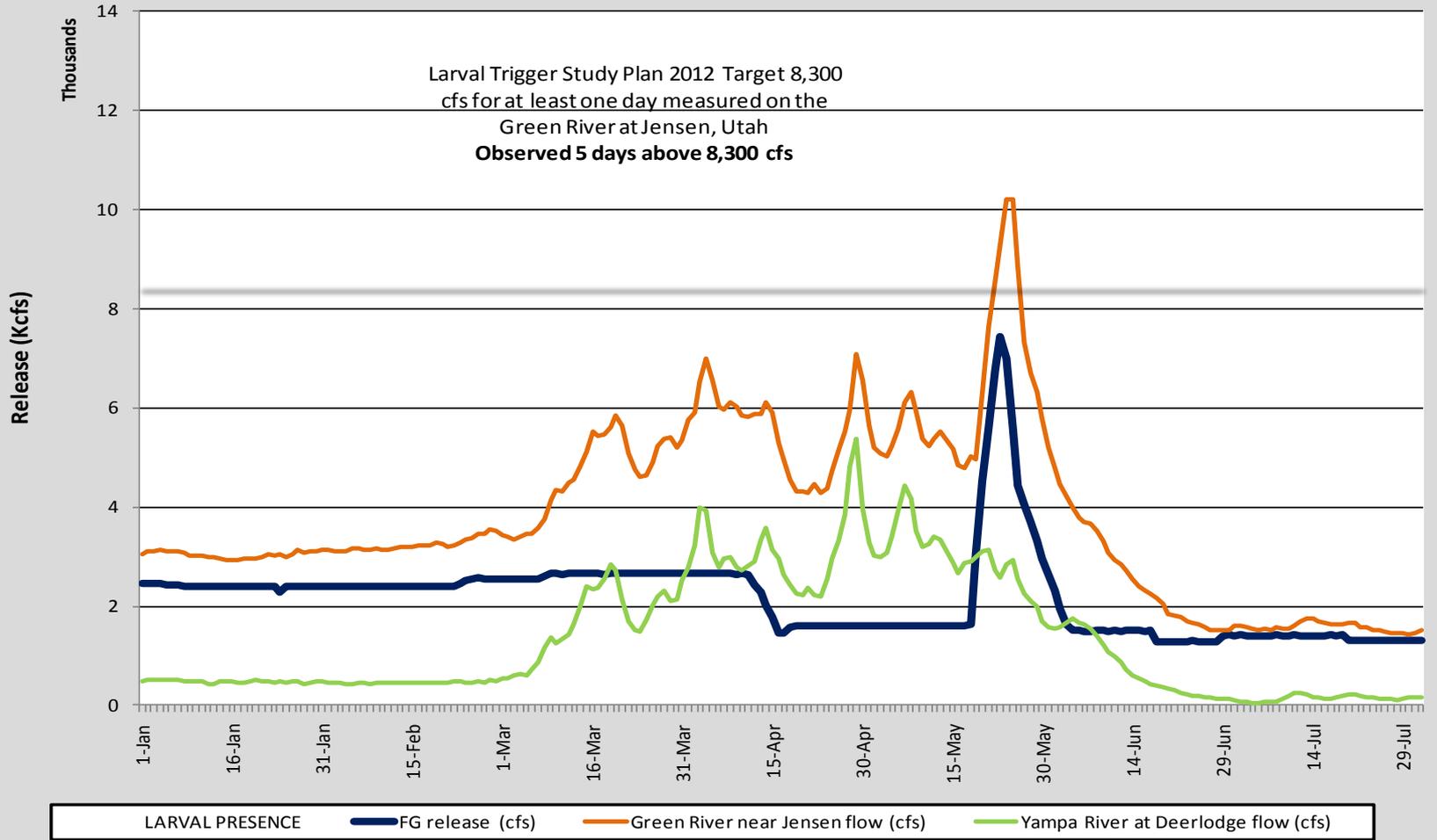
Upper Green 2012 Operations

Flaming Gorge Reservoir Historic April-July Unregulated Inflow Volume Ranking (1963-2012)

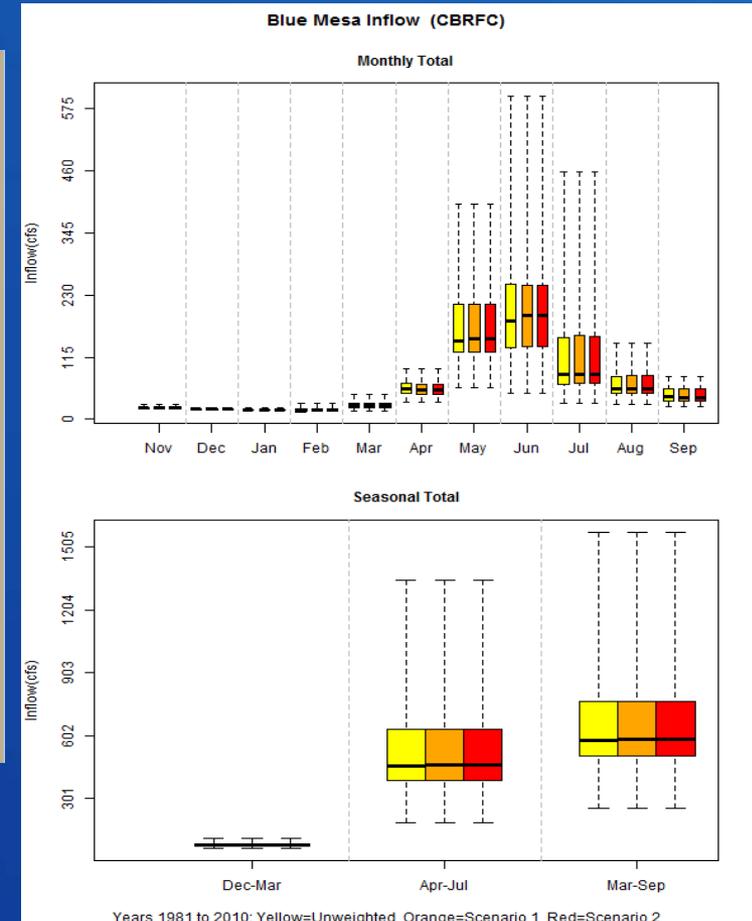
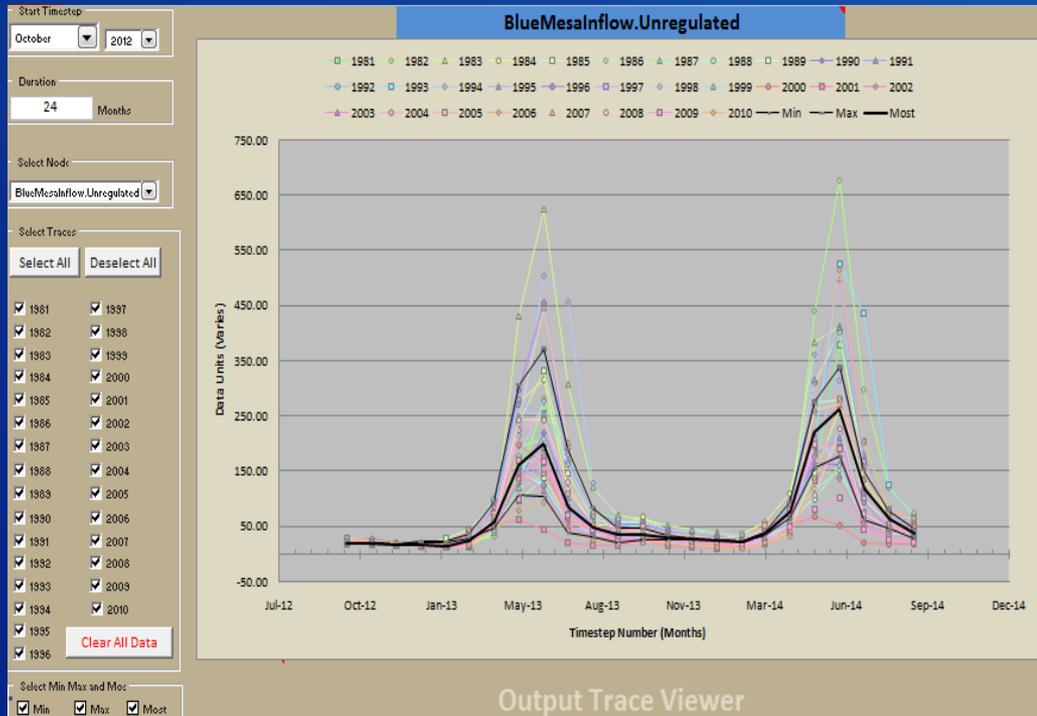


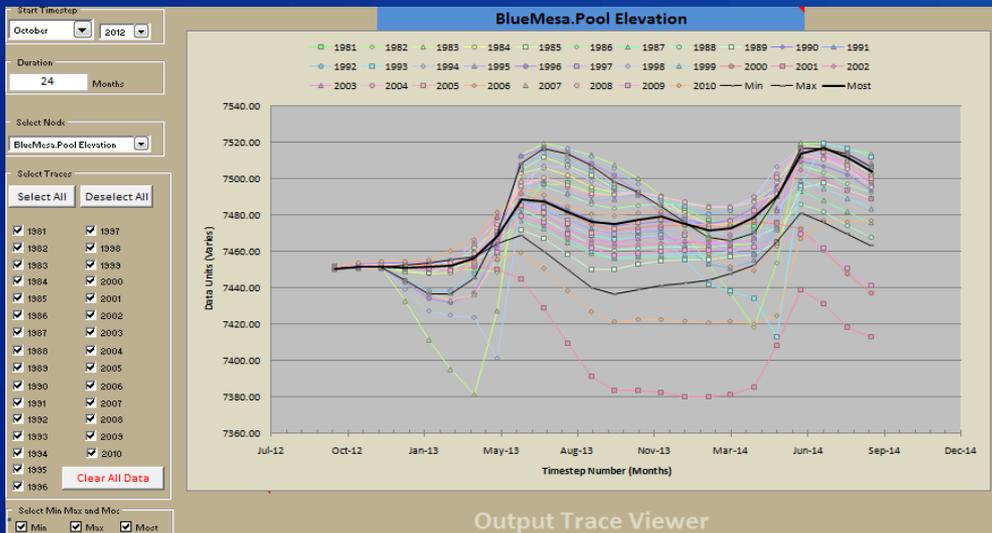
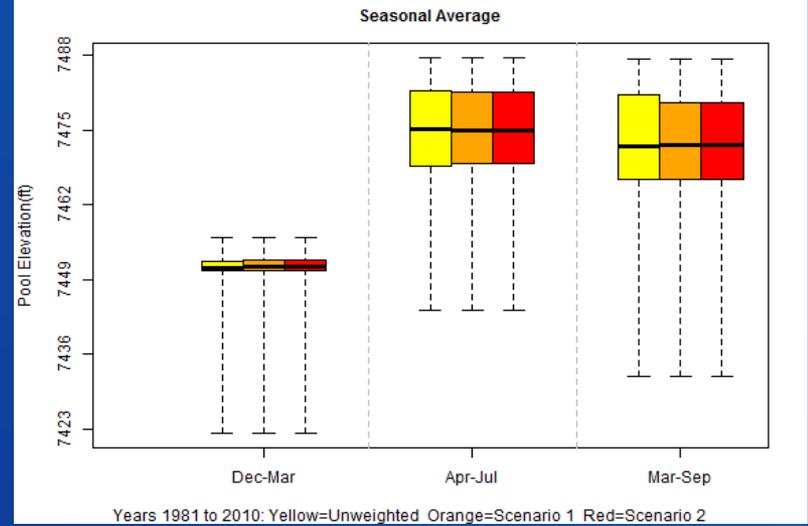
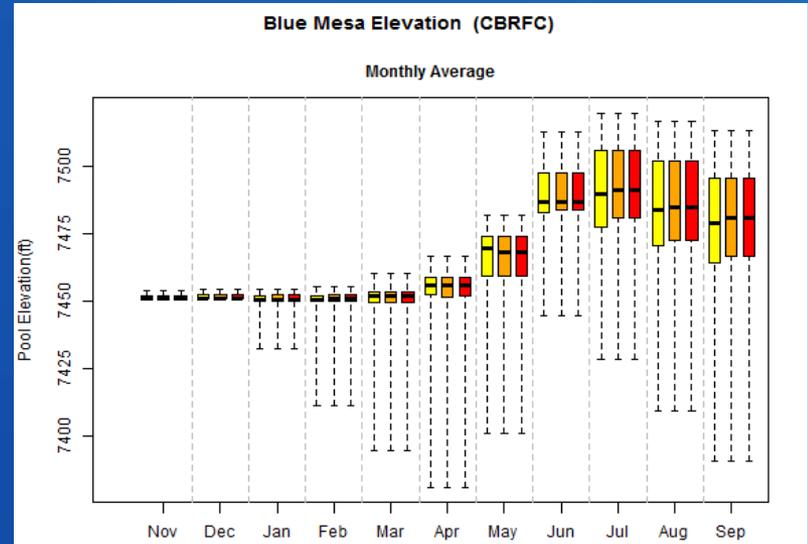
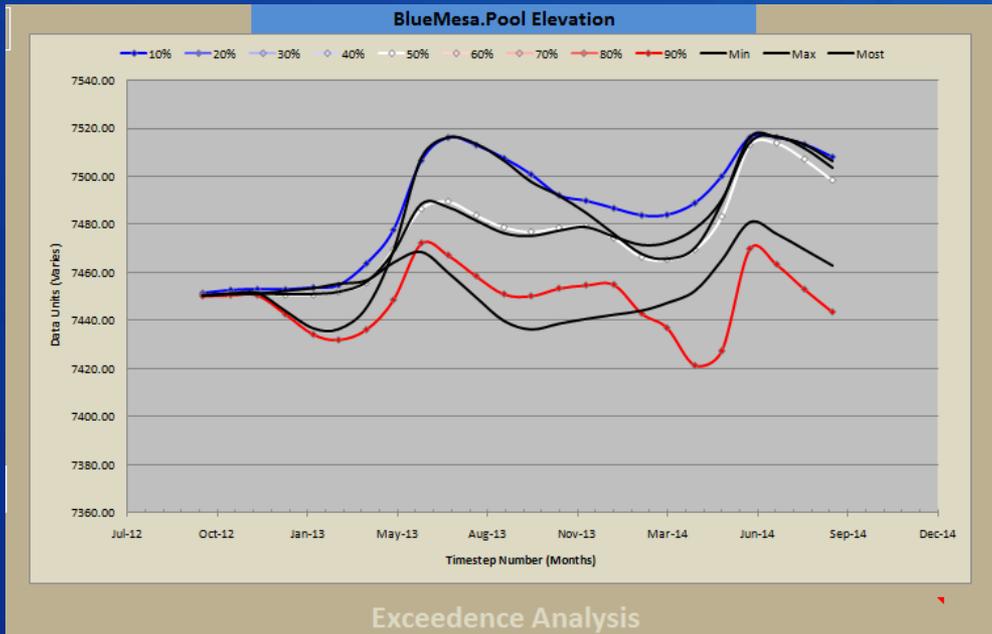
Upper Green 2012 Operations

FG Release and Green River Flows Calendar Year 2012



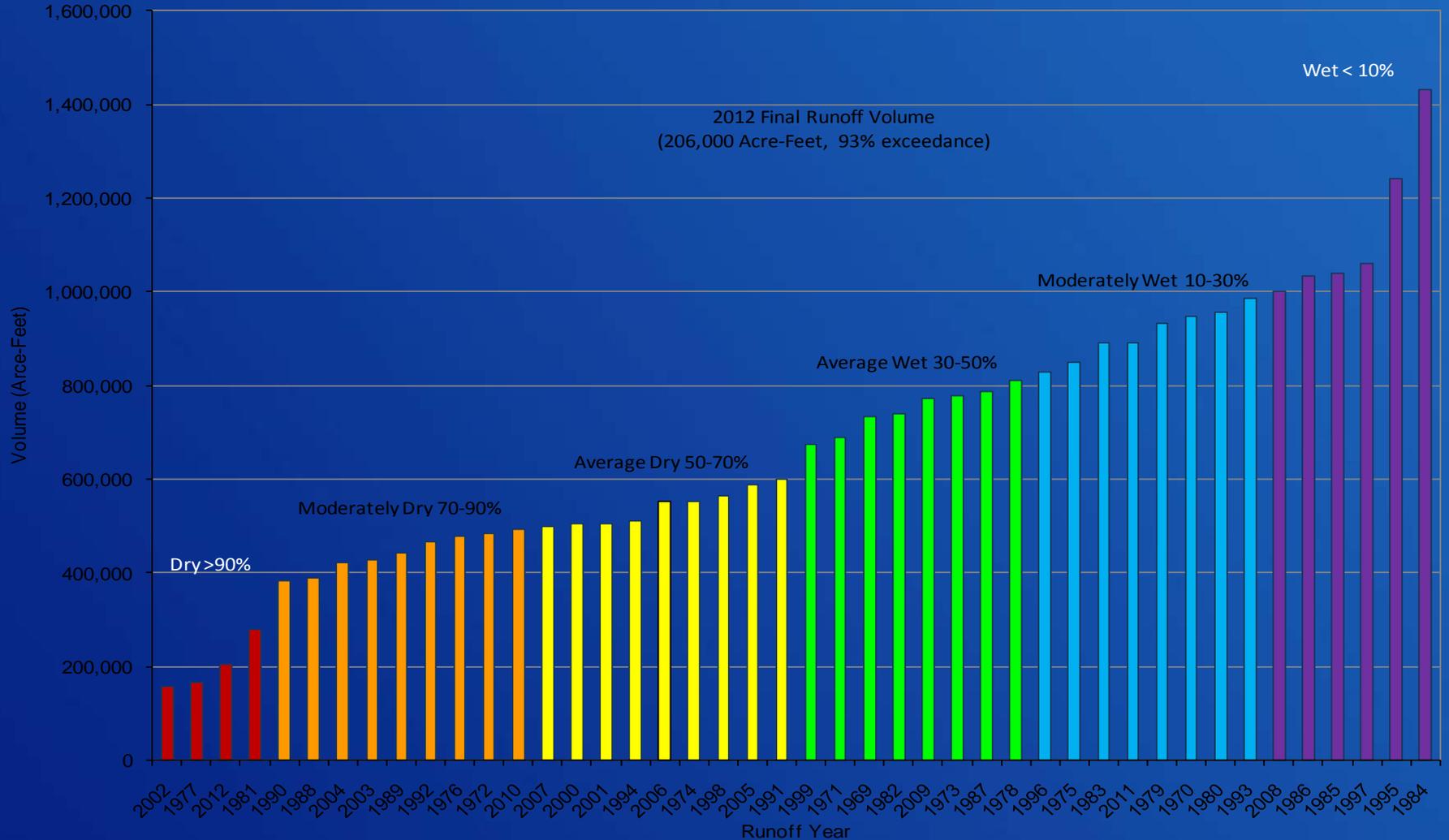
Gunnison River Inflow





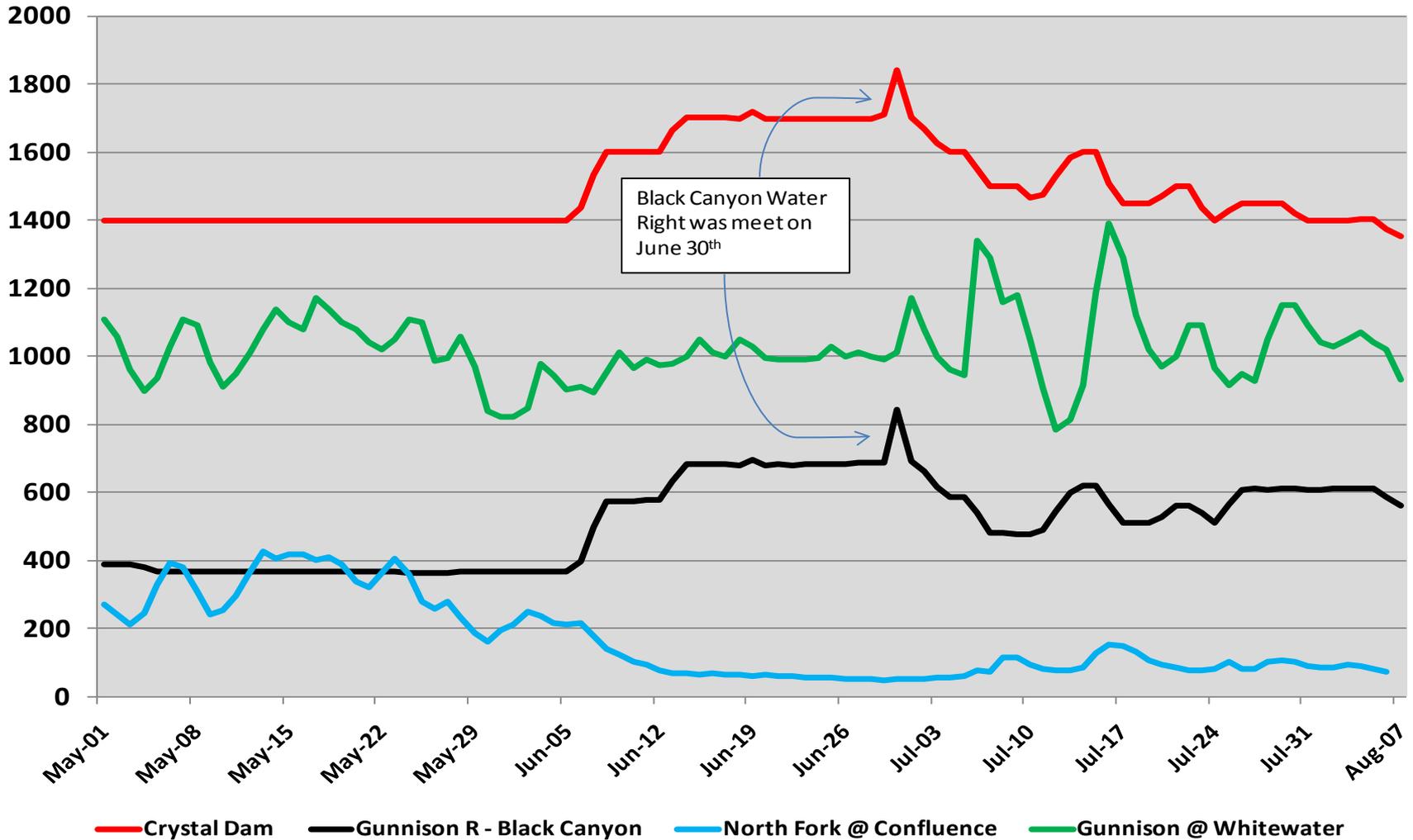
Gunnison River 2012 Operations

Blue Mesa Reservoir, Colorado
 Historic April-July Unregulated Inflow Volume Ranking (1969-2012)



Gunnison River 2012 Operations

Gunnison River Flows



Questions?

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