These are the notes from the April 12, 2018 meeting of the TAC. It has been decided that minutes of these meetings are unnecessary but that some record should exist. The notes below focus on two tasks given to the TAC by the Commission: attempt to find ways to improve Tongue River forecasting and make Table 10 accurate and useful. The notes do not pretend to accurately capture all the discussion and presentations.
Mark Elison

AGENDA
Yellowstone River Compact Commission
Technical Advisory Committee Spring Meeting
April 12, 2018, Billings, MT

8:00 – 8:30 Welcome and Light Refreshments

8:30 (Items below will be sequential following Introductions)

1. **Introductions**
   Attending: Mark Elison, Chuck Dalby and Commissioner Jan Langel (Montana DNRC), Jessica Winter, Loren Smith, Dave Schroeder, Beth Callaway, and (via phone) Commissioner Pat Tyrell (Wyoming State Engineers Office), Chris Brown (Wyoming Attorney General's Office), Kirk Miller & Seth Davidson (USGS), Todd Chambers (NOAA-NWS), Clayton Jordan & Gerald Benock (US Bureau of Reclamation) and via phone, Lucas Zukiewicz)NRCS)

2. **Additions/Revisions to Agenda**
   No additions or changes were made.

3. **Hydrologic Update**
   MT & WY USGS (Kirk Miller)
   Kirk Miller presented a hydrologic update on streams of relevance. Notable points were the relatively uniform high winter flows and dramatic peak flows as ice came out. Most streams were running well above average at present and have been over the winter.

4. **2017 Runoff Forecasts**
   NRCS (Luke Zukiewicz)
   Luke Zukiewicz presented SNOTEL site data and 2018 Runoff Forecasts.
   Snowpack in the Upper Yellowstone is at or above historic peaks. The same is true for the northwest portions of Wyoming. Luke made mention of the Clarks Fork Basin where even 50 percent predictions could see record flows. The overall scenario for the Upper Yellowstone Basin is one of high snowpack and the potential was high to very high runoff.
   NOAA – NWS (Todd Chambers)
   Todd Chambers presented NWS predictions for April and April through July. The general pattern is one of lower than average temperatures and higher than average precipitation across the region. Exceptions include far NE Montana and the southern half of Wyoming. There are several locations including the Clarks Fork and Shields that have a greater than 25 percent chance of moderate flooding.

Other Federal Agencies (Bureau of Reclamation)

Clayton Jordan from the Bureau of Reclamation gave some estimates of runoff into Big Horn Lake and described current operation of Yellowtail dam. The picture was also of very high to record setting inflows to the reservoir

5. **YRCC Technical Advisory Committee Report**

Update on Tongue River forecasting efforts (Chuck Dalby, MT/Beth Callaway, WY)

Beth Callaway, Luke Zukiewicz & Chuck Dalby discussed the progress on increasing accuracy of Tongue River forecasting efforts. The NWS has a new prediction point on the Tongue River at the state line. As of December 2017, the NWS has posted the new Tongue River near Decker (State Line) forecast point online: https://water.weather.gov/ahps2/hydrograph.php?wfo=byz&gage=dslm8

The TAC agreed that the unpredictability of spring precipitation strongly limits increased accuracy in forecasting Stateline inflows to Tongue River Reservoir. Todd Chambers reported that the NWS is working to increase prediction accuracy particularly in the 60 to 90-day range and hope to achieve the accuracy they now have with 7-day forecasts. He said they don't have a good timeline for that as the progress is incremental. The group agreed to write up a memo documenting efforts to-date and next steps recommendations to present to the Yellowstone Compact Commission in December. Chuck Dalby and Beth Callaway shall take the lead on that effort. Commissioner Tyrell suggested that the TAC consider looking at contributions from weather events (i.e. late spring storms) to uncertainty in NRCS and NWS forecasts. The notes from an August 2017 Tac meeting with the NWS are attached.

Update on new NRCS forecasting methods for consideration (Luke Zukiewicz)

Lucas confirmed that the NRCS performed a precipitation Runoff Modeling System (PRMS) model run on the Tongue River Basin (a deterministic, distributed-parameter, physical process-based model). The results indicated that (PRMS) does not perform better in terms of skill than the existing headwater statistical model for streamflow volume forecasts that NRCS currently employs. As has been discussed to-date, the possibility of adding new data points such as weather stations or precipitation gages at lower elevations in the valley could be useful.

6. **Reservoir operations and storage**

Current conditions in Big Horn Reservoir (Clayton Jordan, Bureau of Reclamation), Buffalo Bill & Boysen Reservoirs (Loren Smith, WY), Lake DeSmet (Dave Schroeder, WY), Tongue River Reservoir, Cooney & Glacier Reservoirs (Mark Elison, MT) were presented. Most reservoirs are at 75 to 80% full and around averages for this time of year.

7. **Bighorn Lake operations technical review (Bureau of Reclamation)**

Gerald Benock (Bureau of Reclamation) discussed the history and ongoing discussions surrounding operations of the Big Horn reservoir. An operational criteria evaluation committee is currently examining the current operational criteria. Both Montana and Wyoming have been involved in the Bighorn River Systems Issues Group and associated technical committee meetings regularly since 2008. Representatives from both states will be attending the spring 2018 meeting in Billings on April 24th.

8. **Montana V. Wyoming update (Chris Brown, WY)**

Chris Brown (WY Attorney General's Office) gave a summary of the Montana v Wyoming case. The final decree was issued as of February 20, 2018. Both states have shared their water right lists; final updated lists will be presented at the December 2018 Commission meeting. Specific points in the final decree included conditions necessary before Montana can make a call for regulation and requirements for information sharing. It was suggested that a clearer understanding of what each state would like in terms of information and to what extent that information should be expanded should be discussed and agreed upon.

9. **State permits and adjudication**
   State permits and adjudication in Montana and Wyoming over the last year were discussed by Mark Elison (MT) and Dave Schroeder and Loren Smith (WY). In general, the adjudication and granting of permits continues as usual. Loren Smith indicated that his office has several in-stream flow applications awaiting proof inspections and data collection.

10. **Wyoming project updates (Beth Callaway, WY)**
    Beth Callaway (WY) presented selected Fiscal Year 2018 Wyoming water planning projects in the Yellowstone River Basin (attached) and gave an update on the state's MODIS-based SWE product efforts. The contract with INSTAAR is complete and recommendations on HUC 12 watersheds that may benefit from additional SNOTEL ground measurements received. Next steps could include looking at correlation between runoff prediction error and special SWE estimates from NWS or NRCS forecast products to identify opportunities to reduce errors as well as opportunities for additional instrumentation to improve data collection within sub-watersheds that have high contributions to peak SWE. Updates on Wyoming's weather modification program were discussed briefly.

11. **Table 10 discussion and proposal**
    Chuck Dalby (MT) presented a history of Table 10 of the Compact Commission Annual Report and a proposal for alterations to the table to simplify the data, focus on relevant information and reduce the number of footnotes. The proposed changes were generally accepted. A final updated recommendation on Table 10 will be presented to the Compact Commission in December. The history and recommended final table are attached.

12. **Schedule 2018 Yellowstone River Compact Commission Meeting** – Scheduled an *in-person* meeting in Billings on December 6th, 2018

SUMMARY
Yellowstone River Compact Commission
Technical Advisory Committee

Tongue River Flow Forecasting Discussion
Conference Call
August 24, 2017

Attendees
Beth Callaway (WY)
Dave Schroeder (WY)
Bern Hinckley (WY)
Chuck Dalby (MT)
Kevin Smith (MT)
Kevin Low (NWS-MRBFC)
Gregg Schaalk (NWS-MRBFC)
Scott Dummer (NWS-MRBFC)

1. Background

The Yellowstone River Compact Commission's (YRCC) assignment to assess forecasting tools to assist with the administration of the Tongue River continued with a discussion between the Technical Advisory Committee (TAC) and representatives from the National Weather Service Missouri River Basin Forecasting Center (NWS-MRBFC) in Kansas City. The group convened via conference call on August 24th to discuss the possibility of adding a new NWS 90-day probabilistic forecasting point for the Tongue River at the Wyoming-Montana state line (roughly the same location as USGS gage 06306300 Tongue River at State Line near Decker).

The discussion began with a refresher outlining the TAC's desire to identify forecasting tools that would assist with Tongue River administration under the terms of the Yellowstone River Compact and Special Master's findings. The assignment's "sideboards" include focusing on state line total volume streamflow forecasts for the April – June time period with particular attention to low-flow (i.e.- driest 20 percent) years.

2. NWS-MRBFC forecast tools

The NWS-MRBFC team reviewed the possibility of adding a probabilistic 90-day volumetric inflow forecast for the Tongue River at state line. The forecast would be similar to what is currently provided at existing forecast points in other parts of the Missouri River Basin (e.g.- reservoir inflow volume for Pathfinder Reservoir or Goose Creek at Sheridan). It would include 90-day distribution as well as weekly distribution exceedance probability charts. These published forecasts are updated monthly based on current conditions but actually use a weekly time step so weekly information can be shared upon request. See Appendix A for example forecasts for Goose Creek at Sheridan.

Methodology: The 90-day probabilistic forecast methodology (known as Ensemble Streamflow Prediction, or ESP) incorporates: 1) 30-years of historical observations for temperature, precipitation and snow water equivalent, 2) current and forecasted temperature (16-day forecast) and precipitation (5-day forecast), 3) and soil moisture, which is balanced against streamflow observations from the last 5-10 days. Soil moisture is a conceptual piece of the water balance model and is estimated via the Sacramento Soil Moisture Accounting (SAC-SMA) model whereby the potential ET curve is used to linearly interpolate soil moisture values. When asked if there is any remotely-sensed ET (e.g.- LANDSAT-based ET estimates) linkage to the current soil moisture model, the NWS-MRBFC responded that it might be looked at in the future but is not currently incorporated into ESP forecasts. With the exception of the short-term temperature and precipitation variables, their approach, like that of NRCS, includes no predictions (there are no larger climate teleconnections considered at this time).

NWS-MRBFC informally shares data and results with NRCS, but there is no program coordination or formal comparison of results at this time. Although they recognize that the two approaches yield different results, their experience has been that there is no consistent direction or magnitude of the differences.

Natural vs. Regulated Flows: Two types of forecasted hydrographs are produced and analyzed separately. Natural flows are represented in the current 90-day probabilistic forecasts and charts for existing NWS-MRBFC forecast points. Currently the NWS-MRBFC issues text-based June through September natural flow forecasts for Tongue River at Dayton (DAYW4), state line near Decker (DSLM8n) and Tongue River Reservoir inflows (DKRM8N). See Appendix B for sample text forecasts for these points. The link to these forecasts is located here:
https://forecast.weather.gov/product.php?site=NWS&product=ESP&issuedby=KRF.

The TAC expressed the desire to use regulated flows for the new Tongue River at state line forecast point. NWS-MRBFC confirmed they could easily modify forecasts for the new Tongue River forecast point to represent regulated flows by next fiscal year.

Forecast Verification: Probabilistic forecasting requires hindcasting and uses considerable resources to conduct. Therefore, the NWS-MRBFC cannot provide analysis for probabilistic forecasting at this time. They do, however, provide raw ensembles so that users can run their own statistics depending on their own needs (e.g.- Denver Water and the Bureau of Reclamation currently perform their own analyses based on raw ensembles).

Future enhancements: The NWS-MRBFC is operating on limited resources therefore can offer very little customization of any of their products for now. For example, there is no potential at this time for recalibration of models to optimize low-flow forecasting, and their current efforts may reflect some skew to focus on flood flows. They can assist by sharing intermediate results, however, and are developing a web-based customization tool that allows user-defined time periods for forecasts. The NWS-MRBFC anticipates that this functionality will likely be operational sometime in the 2017-18 water supply season. Although they are unable to provide customizable

error analysis (e.g.- the model cannot be re-run to optimize error for the TAC's needs such as for low-flow years), this could be a future possibility depending on resource availability.

Next Steps

NWS-MRBFC

- Notify the TAC when the new Tongue River at state line forecast point for regulated flows becomes available, sometime during the 2017-18 fiscal year.
- Provide clarification on how to obtain ESP Flow Trace "spaghetti plot" chart.

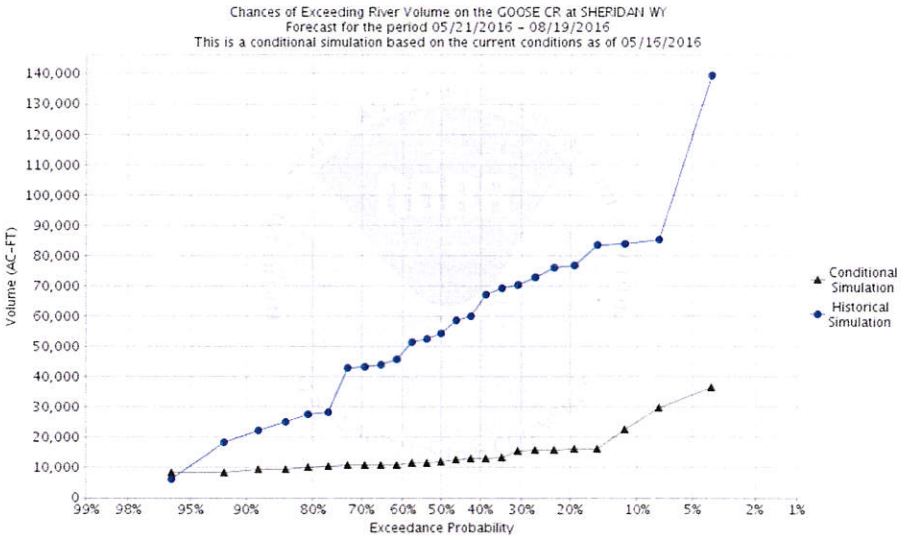
Commented [BC1]: Kevin Low did provide this to me; I'll resurrect this after our YRCC meeting.

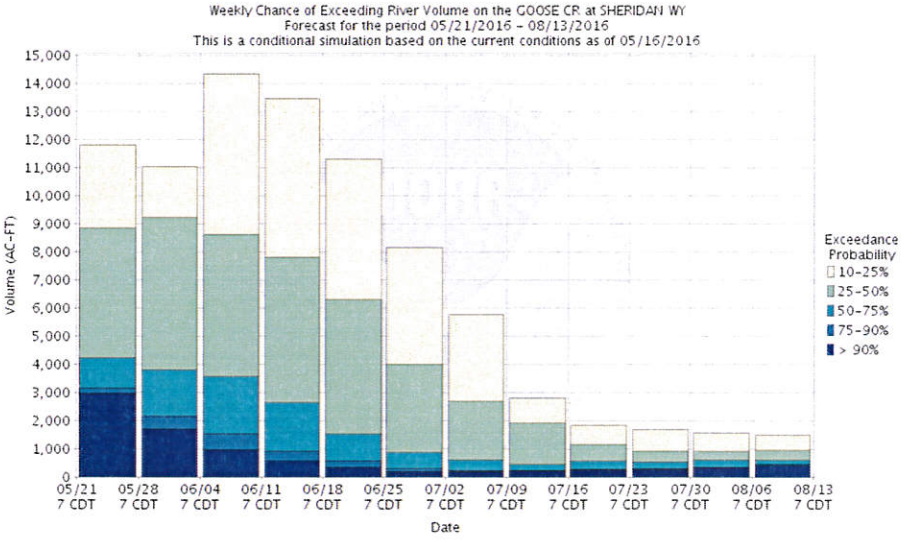
TAC

- Develop specific output requests for NWS consideration.
- Develop a comparison between NRCS and NWS past forecasts.
- Progress report during the YRCC meeting on December 7, 2017.

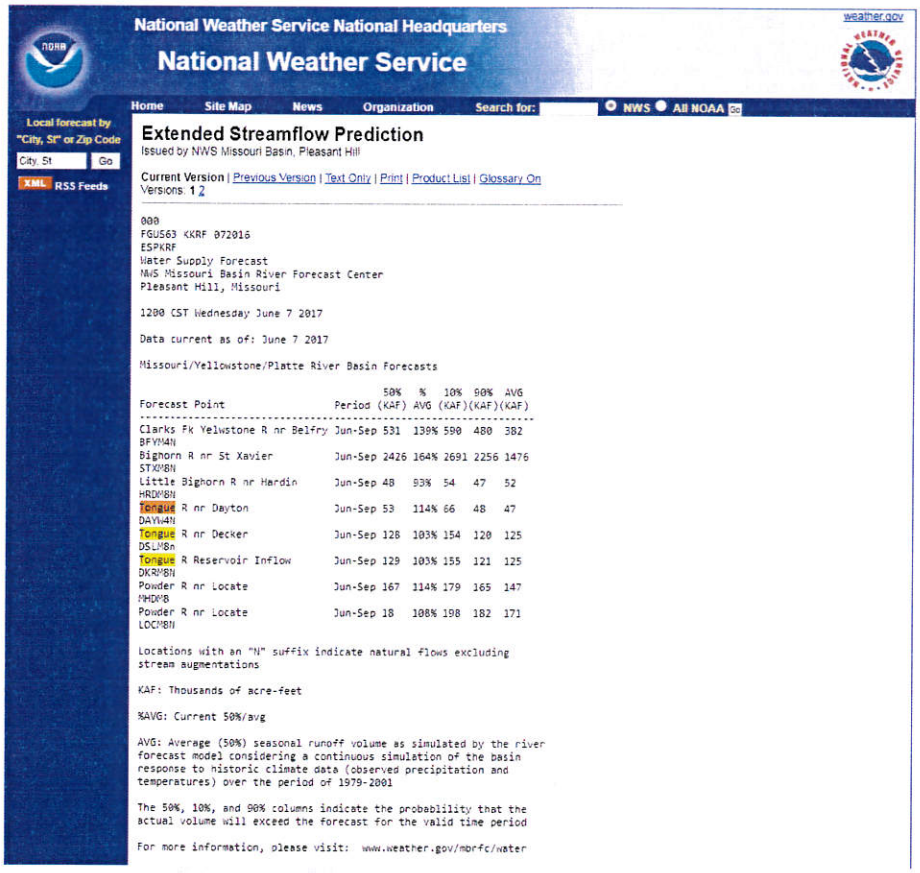
Commented [BC2]: These are what I think we loosely discussed. It may be a good idea to get back in touch with NWS to make sure.

Appendix A: Sample forecast graphs for Goose Creek at Sheridan forecast point





Appendix B: Text-based June through September natural flow forecasts



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Extended Streamflow Prediction

Issued by NWS Missouri Basin, Pleasant Hill

Current Version | Previous Version | Text Only | Print | Product List | Glossary On

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FGUS63 KKRF 072016
ESPKRF
Water Supply Forecast
NWS Missouri Basin River Forecast Center
Pleasant Hill, Missouri

1200 CST Wednesday June 7 2017

Data current as of: June 7 2017

Missouri/Yellowstone/Platte River Basin Forecasts

                                          50%   %   10%  90%  AVG
Forecast Point                  Period (KAF) AVG (KAF)(KAF)(KAF)
-------------------------------------------------------------------
Clarks Fk Yelwstone R nr Belfry Jun-Sep 531  139% 590  480  382
BFYM4N
Bighorn R nr St Xavier          Jun-Sep 2426 164% 2691 2256 1476
STXM8N
Little Bighorn R nr Hardin      Jun-Sep 48   93%  54   47   52
HRDM8N
Tongue R nr Dayton              Jun-Sep 53   114% 66   48   47
DAYW4N
Tongue R nr Decker              Jun-Sep 128  103% 154  120  125
DSLM8N
Tongue R Reservoir Inflow       Jun-Sep 129  103% 155  121  125
DKRM8N
Powder R nr Locate              Jun-Sep 167  114% 179  165  147
MHDM8
Powder R nr Locate              Jun-Sep 18   108% 198  182  171
LOCM8N

Locations with an "N" suffix indicate natural flows excluding
stream augmentations

KAF: Thousands of acre-feet

%AVG: Current 50%/avg

AVG: Average (50%) seasonal runoff volume as simulated by the river
forecast model considering a continuous simulation of the basin
response to historic climate data (observed precipitation and
temperatures) over the period of 1979-2001

The 50%, 10%, and 90% columns indicate the probability that the
actual volume will exceed the forecast for the valid time period

For more information, please visit:  www.weather.gov/mbrfc/water
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LEVEL I RECONNAISSANCE STUDIES - NEW DEVELOPMENT

Middle Big Horn River Big Horn, Hot Springs, Park Watershed Study and Washakie Counties	$300,000
Popo Agie Watershed Study, Fremont County Phase II	$235,000
River Basin Planning - GIS Statewide Data Model Implementation	$115,000
River Basin Planning – NHDPlus Statewide HR and Streamstats – Phase I and II	$240,000
River Basin Planning – Water Statewide Supply Index	$170,000
Sheridan Municipal Watershed Johnson and Sheridan Wildfire Hazard Mitigation Counties Assessment1	$165,000
Sheridan Water Master Plan Sheridan	$250,000

LEVEL II FEASIBILITY STUDIES – DAMS AND RESERVOIRS

Clear Creek Storage Johnson County (Bull Creek Reservoir = 11,300 AF)	$700,000
Nowood River Storage-Alkali Cr. Big Horn, Washakie Counties (Alkali Creek Reservoir = 7,600 AF)	$4,000,000
Shell Valley Storage-Leavitt Reservoir Big Horn County (Leavitt Reservoir Expansion = 5,961 AF)	$4,500,000

Table 10. Water-year-end contents for Yellowstone River Compact reservoirs or lakes.

Reservoir or lake name	Pre-compact 1950 water right	Post-compact 1950 water right	Total permitted water right	Contents on Sept. 30, 2016	Contents on Sept. 30, 2015	Change in contents
Clarks Fork Yellowstone River Basin						
Cooney Reservoir[3,4]	28,230	0	28,230	13,990	18,380	-4,390
Glacier Lake[3,4]	4,200	0	4,200	--	--	--
Bighorn River Basin						
(Lake) Adelaide Reservoir[5]	1,449	3,315	4,764	428	675	-247
Anchor Reservoir[2,5]	0	9,252	9,252	482	395	87
Bighorn Lake[8]	0	1,116,000	1,116,000	924,700	951,800	-27,100
Boysen Reservoir[8]	757,851	0	757,851	584,800	591,000	-6,200
Buffalo Bill Reservoir[8]	456,640	187,940	644,580	421,300	430,800	-9,500
Bull Lake[5]	151,951	0	151,951	37,570	62,960	-25,390
Christina Reservoir[5]	3,860	0	3,860	260	55	205
Corral Reservoir[5]	0	1,027	1,027	711	676	35
Diamond Creek Dike Reservoir[5]	0	18,378	18,378	237	388	-151
Enterprise Reservoir[5]	1,494	204	1,698	28	12	16
Fairview Extension Reservoir[5]	791	620	1,411	1,410	1,200	210
Greybull Valley Reservoir[5]	0	33,169	33,169	9,340	9,030	310
Harrington Reservoir[5]	315	887	1,202	1,200	800	400
Lake Cameahwait Reservoir[5]	0	6,683	6,683	6,680	6,680	0
Lake Creek Reservoir[5]	1,373	0	1,373	460	655	-195
Lodge Grass Reservoir[7]	22,900	0	22,900	13,900	15,320	-1,420
Lower Sunshine Reservoir[5]	0	58,748	58,748	35,700	36,720	-1,020
Newton Reservoir[5]	4,525	0	4,525	556	305	251
Perkins and Kinney Reservoir[5]	1,202	0	1,202	704	1,040	-336
Pilot Butte Reservoir[8,9]	34,600	0	34,600	4,750	12,740	-7,990
Sage Creek Reservoir[5]	440	2,345	2,785	2,700	2,680	20
Shell Reservoir[5]	1,949	0	1,949	269	112	157
Shoshone Lake Reservoir[5]	4,560	5,181	9,741	0	0	0
Upper Sunshine Reservoir[5]	52,988	0	52,988	29,150	38,010	-8,860
Teapot Reservoir[5]	1,578	0	1,578	0	0	0
Ten Sleep Reservoir[5]	3,509	0	3,509	3,510	3,240	270
Wiley Reservoir[5]	689	331	1,020	1,020	1,020	0
Worthen Meadow Reservoir[5]	0	1,504	1,504	1,350	1,190	160
Powder River Basin						
Cloud Peak Reservoir[5]	3,398	173	3,570	0	0	0
Dull Knife Reservoir[5]	0	4,345	4,345	546	1,430	-884
Healy Reservoir[5]	0	5,140	5,140	2,900	3,920	-1,020
Kearney Lake Reservoir[5]	1,854	4,470	6,324	0	2,120	-2,120
Lake DeSmet[5]	37,515	197,472	234,987	194,200	201,900	-7,700
Muddy Guard Reservoirs[5,11]	0	2,336	2,336	855	1,240	-385
Posy No. 1 Reservoir[5]	0	1,537	1,537	765	1,190	-425
Tie Hack Reservoir[5]	1,647	788	2,435	2,260	2,330	-70
Willow Park Reservoir[5]	4,457	0	4,457	1,810	1,670	140

Table 10. Water-year-end contents for Yellowstone River Compact reservoirs[1] or lakes (continued).

Reservoir or lake name	Pre-compact 1950 water right	Post-compact 1950 water right	Total permitted water right	Contents on Sept. 30, 2016	Contents on Sept. 30, 2015	Change in Contents[1]
Tongue River Basin						
Big Horn Reservoir[5]	2,749	1,875	4,624	210	643	-433
Dome Reservoirs[5,9]	1,843	188	2,031	649	441	208
Park Reservoir[5]	7,347	3,015	10,362	3,470	4,390	-920
Sawmill Lakes Reservoir[5]	0	1,275	1,275	749	749	0
Tongue River Reservoir[3,4]	72,500	6,571	79,071	41,680	46,910	-5,230
Twin Lakes Reservoir[5,10]	1,180	2,232	3,412	2,830	2,280	550

[1]Change in contents is derived from subtracting the previous water year's contents from the current water year's contents.

[2]Anchor Reservoir was built to have a usable content of 17,410 acre-ft., but sinkholes and constructed dikes within the area contained by the dam prevent filling the reservoir to the designed volume, and at present, only 9,252 acre-ft. has been adjudicated with the remaining capacity having been eliminated from the permit.

[3]Reservoir managed by the State of Montana.

[4]Contents by year are provided by Montana Department of Natural Resources.

[5]Reservoir managed by the State of Wyoming.

[6]Contents by year are provided by Wyoming State Engineer's Office.

[7]Lodge Grass Reservoir (Willow Creek Dam) managed and reported by Bureau of Indian Affairs

[8]Reservoirs managed by Bureau of Reclamation. Except for Pilot Butte, contents by year are provided by the Bureau.

[9]Data are combined contents of Dome Lake and Dome Lake No. 1 Reservoir.

[10]Data are combined contents of Twin Lakes No. 1 and Twin Lakes No. 2 Reservoirs.

[11]Data are combined contents of Muddy Guard No. 1 and Muddy Guard No. 2 Reservoirs

Date:

TO: **Yellowstone River Technical Advisory Committee**

RE: **Table 10. Yellowstone River Compact Commission Annual Report**

FROM: Chuck Dalby, Hydrologist, WRD, MT DNRC; Mark Elison, Billings Regional Manager, MT DNRC; Beth Callaway, Interstate Streams Division, WY SEO; Loren Smith, Superintendent Water Division III, WY-SEO, State Board of Control; Dave Schroeder, Superintendent Water Division II, WY-SEO, State Board of Control

Introduction

Table 10. in the present-day Yellowstone River Compact Commission Annual reports was established by the Commissioners at the annual meeting in 2003 (Appendix page 6). In its first appearance in the 2004 Annual Report of the Commission, Table 10 (not formally named) contained 30 reservoirs and six qualifying footnotes. In its present form (2016) the table contains 47 reservoirs and 17 footnotes. The purpose of this memo is to trace the history of Table 10., and suggest modifications to simplify its current format. These proposed modifications were developed by myself, Mark Elison, Beth Callaway, Loren Smith, and Dave Schroder.

History

In the first Annual Report of the Yellowstone River Compact Commission, Table 10. did not exist; instead the monthly contents of several reservoirs completed prior to January 1, 1950 (Pre-1950), and after January 1, 1950 (Post-1950) were reported in two separate tables (Appendix page 5.) This reporting continued through the 2003 Annual report. At the 2003 Commission meeting, the Commissioners expressed the desire to include additional reservoirs in the basin (Appendix page 6.) , and the forerunner of Table 10. was established. In 2006 the table was formally assigned a number—Table 10. (Appendix page 7.)

At the TAC meeting in 2008, Sue Lowry stated that WY was interested in a more comprehensive list of Pre-and Post-1950 reservoirs that exist in both states (Appendix page8). Keith Kerbel and Sue worked on the task of developing a list of reservoirs that were greater than 100 acre-feet in size. This comprehensive list included (my recollection—I could not find the original Excel spreadsheet) over hundred reservoirs—most were in Wyoming. At the 2009 TAC meeting (Appendix page 8), it was decided to narrow the list to include only reservoirs with volumes 1,000 acre-feet or greater. This resulted in the current list of reservoirs present in Table 10. as is shown in the YRC 2011 Annual Report (Appendix page 10.).

Justification for Simplification of Table 10.

Table 10. has devolved into a confusing amalgamation of poorly understood columns and footnotes and will benefit from simplification. The purpose of the table is essentially to report on the change in storage of the larger reservoirs in the Yellowstone Basin; Table 10. is loosely related to Article V.C. which apportions the unused and unappropriated Post-1950 water in the Compact tributaries:

> C. The quantity of water subject to the percentage allocations, in Paragraph B 1, 2, 3 and 4 of this Article V, shall be determined on an annual water year basis measured from October 1st of any year through September 30th of the succeeding year. The quantity to which the percentage factors shall be applied through a given date in any water year shall be, in acre-feet, equal to the algebraic sum of:
>
> 1. The total diversions, in acre-feet, above the point of measurement, for irrigation, municipal, and industrial uses in Wyoming and Montana developed after January 1, 1950, during the period from October lst to that given date;
>
> *2. The net change in storage, in acre-feet, in all reservoirs in Wyoming and Montana above the point of measurement completed subsequent to January 1, 1950, during the period from October lst to that given date;*
>
> *3. The net change in storage, in acre-feet, in existing reservoirs in Wyoming and Montana above the point of measurement, which is used for irrigation, municipal, and industrial purposes developed after January 1, 1950, during the period October lst to that given date;*
>
> 4. The quantity of water, in acre-feet, that passed the point of measurement in the stream during the period from October lst to that given date;

It is likely that at some future point, when Post-1950 water is apportioned, additional reporting (e.g. monthly change in contents) beyond what is provided in Table 10. will be required.

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Now for the confusing aspects of Table 10 (page 3). The fourth column in the Table (Total Capacity) is redundant and is essentially equivalent to the third column—Total Permitted Water Right. The difference is, as explained in the current footnote 3:

> [3]Excludes dead storage, except for contents provided by Wyoming State Engineer's Office which are permitted water rights and may include dead storage.

Dead storage, the amount of water below the dam's outlet works and not subject to release, is poorly known for many or the projects and may or may not be included for some reservoirs. Many of the projects were constructed over 50 years ago and reservoir sedimentation has modified the amount of dead storage that existed at that time. Short of contemporary sedimentation surveys for all but the newest reservoirs in Table 10. there is no way to fix this. Hence the recommendation to simply eliminate column 4 and report the Total Permitted Water Right (current column 3).

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It follows from the above recommendation, that the term "Useable" in columns 5, 6, and 7 (e.g. Useable contents), should also be removed. In additional to reporting information on reservoir size and permitted water rights, the key column in Table 10. is the change in reservoir contents over the water year.

The revised Table 10. With suggested edits of columns and footnotes is given on page 3.

Table 10. Water-year-end contents for Yellowstone River Compact reservoirs[1] or lakes.

Reservoir or lake name	Pre-compact 1950 water right	Post-compact 1950 water right	Total permitted water right		contents[3] on Sept. 30, 2016	contents[3] on Sept. 30, 2015	Change in contents[4]
Clarks Fork Yellowstone River Basin							
Cooney Reservoir[5,6]	28,230	0	28,230	28,230	13,990	18,380	-4,390
Glacier Lake[5,6]	4,200	0	4,200	4,200	--	--	--
Bighorn River Basin							
(Lake) Adelaide Reservoir[7,9]	1,449	3,315	4,764	4,760	428	675	-247
Anchor Reservoir[1,8,9,10]	0	9,252	9,252	[11]17,160	482	395	87
Bighorn Lake[8,9,10]	0	1,116,000	1,116,000	[12]1,021,000	924,700	951,800	-27,100
Boysen Reservoir[8,9,10]	757,851	0	757,851	[11]741,600	584,800	591,000	-6,200
Buffalo Bill Reservoir[8,9,10]	456,640	187,940	644,580	[11]646,600	421,300	430,800	-9,500
Bull Lake[8,9,10]	151,951	0	151,951	[11]152,500	37,570	62,960	-25,390
Christina Reservoir[9,13]	3,860	0	3,860	3,860	260	55	205
Corral Reservoir[9,13]	0	1,027	1,027	1,030	711	676	35
Diamond Creek Dike Reservoir[9,13]	0	18,378	18,378	18,380	237	388	-151
Enterprise Reservoir[9,13]	1,494	204	1,698	1,700	28	12	16
Fairview Extension Reservoir[9,13]	791	620	1,411	1,410	1,410	1,200	210
Greybull Valley Reservoir[9,13]	0	33,169	33,169	33,170	9,340	9,030	310
Harrington Reservoir[9,13]	315	887	1,202	1,200	1,200	800	400
Lake Cameahwait Reservoir[9,13]	0	6,683	6,683	6,680	6,680	6,680	0
Lake Creek Reservoir[9,13]	1,373	0	1,373	1,370	460	655	-195
Lodge Grass Reservoir[14]	22,900	0	22,900	22,900	13,900	15,320	-1,420
Lower Sunshine Reservoir[9,13]	0	58,748	58,748	58,750	35,700	36,720	-1,020
Newton Reservoir[9,13]	4,525	0	4,525	4,520	556	305	251
Perkins and Kinney Reservoir[9,13]	1,202	0	1,202	1,200	704	1,040	-336
Pilot Butte Reservoir[8,9]	34,600	0	34,600	[11]33,720	4,750	12,740	-7,990
Sage Creek Reservoir[9,13]	440	2,345	2,785	2,780	2,700	2,680	20
Shell Reservoir[9,13]	1,949	0	1,949	1,950	269	112	157
Shoshone Lake Reservoir[9,13]	4,560	5,181	9,741	9,740	0	0	0
Upper Sunshine Reservoir[9,13]	52,988	0	52,988	52,990	29,150	38,010	-8,860
Teapot Reservoir[9,13]	1,578	0	1,578	1,580	0	0	0
Ten Sleep Reservoir[9,13]	3,509	0	3,509	3,510	3,510	3,240	270
Wiley Reservoir[9,13]	689	331	1,020	1,020	1,020	1,020	0
Worthen Meadow Reservoir[9,13]	0	1,504	1,504	1,500	1,350	1,190	160
Powder River Basin							
Cloud Peak Reservoir[13,15]	3,398	173	3,570	4,620	0	0	0
Dull Knife Reservoir[13,15]	0	4,345	4,345	5,000	546	1,430	-884
Healy Reservoir[13,15]	0	5,140	5,140	6,500	2,900	3,920	-1,020
Kearney Lake Reservoir[13,15]	1,854	4,470	6,324	7,500	0	2,120	-2,120
Lake DeSmet[13,15]	37,515	197,472	234,987	235,000	194,200	201,900	-7,700
Muddy Guard Reservoirs[13,15,18]	0	2,336	2,336	2,340	855	1,240	-385
Posy No. 1 Reservoir[13,15]	0	1,537	1,537	1,540	765	1,190	-425
Tie Hack Reservoir[13,15]	1,647	788	2,435	2,440	2,260	2,330	-70
Willow Park Reservoir[13,15]	4,457	0	4,457	6,470	1,810	1,670	140

Table 10. Water-year-end contents for Yellowstone River Compact reservoirs[1] or lakes (continued).

Commented [DC3]: Eliminate entire Total Capacity Column

Commented [DC4]: Strike the term "Useable" which is ambiguous (see explanation in document

Commented [DC1]: Do not round the values of Pre and Post Compact water rights—report the factual values right from the water right permit or certificate

Commented [BC2]: At the December meeting we talked about matching exactly what is in the permit records (although there is some variability as to how many significant figures there are, depending on the record).

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Reservoir or lake name	Pre-compact 1950 water right	Post-compact 1950 water right	Total permitted water right		contents[3] on Sept. 30, 2016	contents[3] on Sept. 30, 2015	in usable contents[4]
Tongue River Basin							
Big Horn Reservoir[13,15]	2,749	1,875	4,624	5,760	210	643	-433
Dome Reservoirs[6,15,16]	1,843	188	2,031	2,030	649	441	208
Park Reservoir[13]	7,347	3,015	10,362	10,360	3,470	4,390	-920
Sawmill Lakes Reservoir[13,15]	0	1,275	1,275	1,830	749	749	0
Tongue River Reservoir[5,6]	72,~~510~~500	6,~~561~~571	79,071	79,070	41,680	46,910	-5,230
Twin Lakes Reservoir[13,17]	1,180	2,232	3,412	4,040	2,830	2,280	550

New Footnote for Anchor Reservoir:

[1]Anchor Reservoir was built to have a usable contents of 17,410 acre-ft., but sinkholes and constructed dikes within the area contained by the dam prevent filling the reservoir to the designed volume, and at present, only 9,252 acre-ft. has been adjudicated with the remaining capacity having been eliminated from the permit.

[4]Change in contents is derived from subtracting the previous water year's contents from the current water year's ~~usable~~ contents.
[5]Reservoir managed by the State of Montana.
[6]Contents by year are provided by Montana Department of Natural Resources.
[7]Contents by year are provided by Wyoming State Engineer's Office.
[8]Reservoirs managed by Bureau of Reclamation. Except for Pilot Butte, contents by year are provided by the Bureau.
[9]Permitted capacity from http://waterplan.state.wy.us/plan/bighorn/2010/techmemos/Task3F.pdf.

~~[10]Contents by year are provided by Bureau of Reclamation.~~
[11]Top of active conservation pool.

[12]Top of joint use pool.
[13]Private reservoirs permitted and accounted by the State of Wyoming.
[14]Lodge Grass Reservoir (Willow Creek Dam) ~~M~~managed and reported by Bureau of Indian Affairs
[15]Permitted capacity from http://waterplan.state.wy.us/plan/powder/2002/techmemos/storage.
[16]Data are combined contents of Dome Lake and Dome Lake No. 1 Reservoir.
[17]Data are combined contents of Twin Lakes ~~Number~~ No. 1 and Twin Lakes ~~Number~~ No. 2 Reservoirs.
[18]Data are combined contents of Muddy Guard No. 1 and Muddy Guard No. 2 Reservoirs

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Commented [BC5]: Footnote #s to be updated pending table finalization.

Commented [BC6]: Remove per discussion on the term "usable."

Commented [BC7]: Consolidated with #10.

Commented [DC8]: Leave in ?

Commented [SoW9]: Irrelevant therefore we should remove this from footnotes. We can discuss in further detail at the meeting.

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Commented [DC10]: There may be a place for these—but they are not used in the current table.

Commented [SoW11]: Remove; irrelevant.

Commented [BC12]: Remove; irrelevant.

Appendix—Evolution of Table. 10—Excerpts from Yellowstone River Compact Annual Reports 1952-2011

1952 Report

Appendix D

RESERVOIRS IN EXISTENCE ON JANUARY 1, 1950

The extent, if any, of the use of reservoirs in this category which may be subject to Compact allocations was not determined. As a matter of hydrologic interest, the monthend contents in acre-feet of four reservoirs are given. The first three reservoirs are in the Bighorn River basin, Wyoming and data on contents were furnished by the U.S. Bureau of Reclamation. Tongue River Reservoir in Montana is operated under the supervision of the Montana Water Resources Board, which agency furnished operating data.

Contents in acre-feet

Month	a/Bull Lake	b/Pilot Butte Reservoir	c/Buffalo Bill Reservoir	d/Tongue River Reservoir
September 30, 1969	65,010	16,130	251,600	21,200
October 31	59,280	13,560	221,200	27,400
November 30	60,750	15,930	215,200	32,800
December 31	60,340	16,400	208,200	30,000
January 31, 1970	58,940	18,500	200,800	27,400
February 28	58,600	20,230	188,500	32,800
March 31	59,320	28,340	172,800	37,350
April 30	89,610	29,660	148,400	35,400
May 31	81,740	28,260	268,700	44,400
June 30	145,000	29,390	447,100	53,160
July 31	145,400	25,800	417,600	48,500
August 31	113,300	13,430	336,300	32,800
September 30, 1970	105,400	10,840	291,000	27,400
Change in Contents during water year	+ 40,390	- 5,290	+ 39,400	+ 6,200

a/ Total contents, from revised capacity table effective Oct. 1, 1965.

b/ Usable contents. Dead storage is 5,360 acre-feet.

c/ Total contents, from revised capacity table based on survey of 1959. Contents prior to October 1960 based on survey of 1941.

d/ Usable contents. Dead storage is 1,400 acre-feet. Contents based upon sedimentation surveys of October 1948.

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1970 Report

Appendix C

RESERVOIRS COMPLETED AFTER JANUARY 1, 1950

BOYSEN RESERVOIR

Water-stage recorder at dam on Wind River, 13 miles north of Shoshoni, Wyoming. Reservoir formed by earth-fill dam, construction of which began in 1947. Storage began Oct. 11, 1951. Dead storage, 59,880 acre-ft at elevation 4,657.0 ft. Usable contents, 742,100 acre-ft at elevation 4,725.0 ft (top of gates). Crest of dam at elevation, 4,758 ft.

Records given herein represent usable contents. Water is used for irrigation and power development. Allocation for flood control provided. Data furnished by U. S. Bureau of Reclamation.

EXTREMES.--Current year: Maximum usable contents, 674,100 acre-ft Oct. 1 (elevation, 4,721.41 ft); minimum, 359,400 acre-ft May 6 (elevation, 4,700.88 ft).

Period of record: Maximum usable contents, 862,700 acre-ft July 7, 1967; minimum, 189,800 acre-ft Mar. 18, 19, 1956 (elevation, 4,684.18 ft).

Month	Water-surface elevation in feet	Contents in acre-feet*	Change in contents during month in acre-feet
September 30, 1969	4,721.41	674,100	--
October 31	4,720.46	656,800	- 17,300
November 30	4,718.35	619,300	- 37,500
December 31	4,716.65	590,100	- 29,200
January 31, 1970	4,714.53	555,100	- 35,000
February 28	4,710.28	489,100	- 66,000
March 31	4,704.94	412,600	- 76,500
April 30	4,701.36	365,500	- 47,100
May 31	4,705.73	423,400	+ 57,900
June 30	4,718.39	618,400	+ 195,000
July 31	4,719.55	640,500	+ 22,100
August 31	4,718.22	617,000	- 23,500
September 30, 1970	4,717.42	603,200	- 13,800
Water year 1969-70			- 70,900

* Does not include dead storage of 59,880 acre-ft.

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1980, 1990, 2000, 2001, 2002, 2003 Reports—Same as 1970

Excerpt from 2003 report

Reservoir storage increased during water year 2003 in Bighorn Lake, Boysen Reservoir, Anchor Reservoir, Bull Lake, Pilot Butte Reservoir, Buffalo Bill Reservoir, and Tongue River Reservoir. The contents and amounts of increase are listed in the report. Total usable contents of these reservoirs at the end of water year 2003 was 1,651,800 acre-feet, which is an increase of 405,500 acre-feet from the end of water year 2002. Mr. Whitaker reported that storage in mountain reservoirs in the Tongue River drainage was 8,947 acre-feet, or a carryover of about 38 percent of capacity. Mr. Aycock asked if the reservoir storage due to the enlargements of Buffalo Bill and Tongue River Reservoirs should also be included. Although the split of original and post-Compact storage amounts was not readily available, the Commissioners decided that such information, along with storage information for other reservoirs to be specified, should be made available for water year 2004. The other reservoirs may include Upper and Lower Sunshine, Greybull Valley, Twin Lakes, and Tie Hack Reservoirs. Mr. Whitaker and Mr. Smith agreed to provide the information for next year's report for the additional reservoirs.

ANNUAL SUMMARY OF CONTENTS FOR YELLOWSTONE RIVER COMPACT RESERVOIRS OR LAKES

[Contents are in acre feet. Reservoirs or lakes are listed in alphabetical order by drainage basin. Symbol: --, data not applicable or not available]

Reservoir or lake name	Pre-Compact 1950 water right	Post-Compact 1950 water right	Usable capacity	Usable contents on Sept. 30, 2004	Usable contents on Sept. 30, 2003	Change in contents
Bighorn River basin						
(Lake) Adelaide Reservoir[1]	1,450	4,760	6,210	800	--	---
Anchor Reservoir[2]	17,410	0	17,410	429	345	84
Bighorn Lake[2]	--	1,312,000	1,312,000	694,300	769,900	-75,600
Boysen Reservoir[2]	701,500	0	701,500	475,100	311,900	163,200
Buffalo Bill Reservoir[2]	456,600	190,000	646,600	438,800	465,700	-26,900
Bull Lake[2]	152,000	0	152,000	88,940	55,620	33,320
Greybull Valley Reservoir[1]	0	33,170	33,170	1,100	1,480	-380
Pilot Butte Reservoir[2]	34,600	0	34,600	15,630	9,290	6,340
Sunshine Reservoir[1]	52,990	0	52,990	6,600	1,800	4,800
Lower Sunshine Reservoir[1]	42,640	42,300	84,940	1,010	1,490	-480
Powder River basin						
Cloud Peak Reservoir[1]	3,400	172	3,570	0	0	0
Dull Knife Reservoir[1]	--	4,320	4,320	504	987	-483
Healy Reservoir[1]	--	5,140	5,140	2,620	3,080	-460
Kearney Reservoir[1]	1,850	4,470	6,320	2,500	2,710	-210
Lake DeSmet[1]	37,520	197,500	235,000	185,600	197,600	-12,000
Muddy Guard Reservoir[1]	--	2,340	2,340	0	492	-492
Tie Hack Reservoir[1]	1,650	2,440	2,440	2,440	2,440	0
Willow Park Reservoir[1]	4,460	--	4,460	2,230	1,320	910
Tongue River basin						
Bighorn Reservoir[1]	2,750	1,880	4,630	794	1,030	-236
Cross Creek Reservoir[1]	--	798	798	0	324	-324
Dome Reservoir[1,3]	1,840	188	2,030	1,180	1,480	-300
Granger Reservoir[1]	146	--	146	0	0	0
Last Chance Reservoir[1]	90	--	90	0	0	0
Martin Reservoir[1]	561	--	561	0	0	0
Park Reservoir[1]	7,350	3,020	10,360	4,160	4,150	10
Sawmill Lakes Reservoir[1]	--	1,280	1,280	703	0	703
Tongue River Reservoir[4]	68,000	11,070	79,070	26,620	39,050	-12,430
Twin Lakes Reservoir[1,5]	1,180	2,220	3,400	3,100	2,820	280
Weston Reservoir[1]	370	--	370	0	0	0
Willits Reservoir[1]	79	--	79	0	0	0

[1]Reservoirs managed by the State of Wyoming
[2]Reservoirs managed by Bureau of Reclamation.
[3]Data are combined contents of Dome Lake and Dome Lake Reservoir.
[4]Reservoir managed by the State of Montana.
[5]Data are combined contents of Twin Lakes Number 1 and Twin Lakes Number 2.

2006 Report Establishes Table 10.

Water-Year-End Contents for Yellowstone River Compact Reservoirs[1] or Lakes

Table 10. Water-year-end contents for Yellowstone River Compact reservoirs[1] or lakes.

[Contents are in acre-feet. Reservoirs or lakes are listed in alphabetical order by drainage basin. Symbol: --, no data or not available]

Reservoir or lake name	Pre-compact 1950 water right	Post-compact 1950 water right	Usable capacity	Usable contents on Sept. 30, 2006	Usable contents on Sept. 30, 2005	Change in usable contents
Bighorn River basin						
(Lake) Adelaide Reservoir[2]	1,450	4,760	6,210	450	2,000	-1,550
Anchor Reservoir[3]	17,410	0	17,410	233	269	-36
Bighorn Lake[3]	--	1,116,000	1,312,000	745,800	984,500	238,700
Boysen Reservoir[3]	701,500	0	701,500	407,700	591,900	-184,200
Buffalo Bill Reservoir[2]	456,600	190,000	646,600	441,100	450,300	-9,200
Bull Lake[3]	152,000	0	152,000	50,540	66,100	-15,560
Greybull Valley Reservoir[2]	0	33,170	33,170	322	8,000	-7,678
Pilot Butte Reservoir[2]	34,600	0	34,600	1,020	12,300	-11,280
Sunshine Reservoir[2]	52,990	0	52,990	5,960	24,000	-18,040
Lower Sunshine Reservoir[2]	42,640	42,300	84,940	720	21,000	-20,280
Powder River basin						
Cloud Peak Reservoir[2]	3,400	172	3,570	0	3,570	-3,570
Dull Knife Reservoir[2]	--	4,320	4,320	63	1,314	-1,251
Healy Reservoir[2]	--	5,140	5,140	1,336	4,652	-3,316
Kearney Reservoir[2]	1,850	4,470	6,320	1,085	2,641	-1,556
Lake DeSmet[2]	37,520	197,500	235,000	187,278	206,672	-19,394
Muddy Guard Reservoir[2]	--	2,340	2,340	500	492	8
Tie Hack Reservoir[2]	1,650	2,440	2,440	1,921	2,440	-519
Willow Park Reservoir[2]	4,460	--	4,460	451	2,896	-2,445
Tongue River basin						
Bighorn Reservoir[2]	2,750	1,880	4,630	584	670	-86
Cross Creek Reservoir[4]	--	798	798	309	474	-165
Dome Reservoir[2,4]	1,840	188	2,030	1,209	1,177	32
Granger Reservoir[2]	146	--	146	0	0	0
Last Chance Reservoir[2]	90	--	90	0	0	0
Martin Reservoir[2]	561	--	561	0	0	0
Park Reservoir[2]	7,350	3,020	10,360	3,088	4,684	-1,596
Sawmill Lakes Reservoir[2]	--	1,280	1,280	746	825	-79
Tongue River Reservoir[5]	79,070	--	79,070	42,720	43,760	-1,040
Twin Lakes Reservoir[2,6]	1,180	2,220	3,400	2,842	3,013	-171
Weston Reservoir[2]	370	--	370	0	0	0
Willits Reservoir[2]	79	--	79	0	0	0

[1]Wyoming disagrees with the term "Compact reservoirs" as used throughout this annual report. Wyoming's acceptance of this annual report should not be construed as Wyoming's acceptance of the use of that term.2 Reservoirs managed by the State of Wyoming.

[2]Reservoirs managed by the State of Wyoming.

[3]Reservoirs managed by Bureau of Reclamation.

[4]Data are combined contents of Dome Lake and Dome Lake Reservoir.

[5]Reservoir managed by State of Montana.

[6]Data are combined contents of Twin Lakes Number 1 and Twin Lakes Number 2.

TAC meeting minutes April 16, 2008

Keith also reported that there is a privately owned reservoir on Ash Creek that services Wyoming water users. He stated that the privately owned reservoirs in Montana are not obligated to report end of year carry-over contents to the state of Montana. Montana has a database that lists privately owned reservoirs over 50 af. A question arose on whether or not these reservoirs should be reported to the Commission. Keith further stated that some of these reservoirs have multiple fills and that information doesn't show up on database. Wyoming is reporting to the Commission selected irrigation and municipal reservoirs. Sue Lowry stated that Wyoming would be interested in seeing a list of reservoirs, both pre-50 and post- 50, that exist in Montana. It was decided that only those reservoirs that have a capacity of 100 af or greater with a use of irrigation and/or municipal need to be reported. Keith Kerbel will work on this task.

TAC meeting minutes May 19, 2009

5. Reservoir discussion (reservoir inventory assignment given to Tech Committee)

Sue Lowry briefly described what brought the Committee to this discussion of reservoirs. Historically, the Technical Committee members reported on Tongue River Reservoir and other significant reservoirs. The Commission asked if any other relatively good sized reservoir were being missed and hadn't been discussed with the technical group. Montana and Wyoming agreed to produce a list of reservoirs greater than 1000 acre-feet. Wyoming has compiled that list and is prepared to distribute it at this meeting. Jen Wilson has worked with Keith Kerbel and the Montana GIS folks to develop a listing of reservoirs in MT. Keith suggested that the Technical Committee wait until the full Commission meeting in December to discuss these reservoirs so that Mary Sexton could be present for the discussion. Montana and Wyoming will develop a GIS map showing the location of the reservoirs on each of their spreadsheets. Montana will add Tongue River Reservoir to their list and expand the uses column to include all uses.

7. Reservoir assignment for Technical Committee
   - The group discussed Footnote 1 on Table 10 which states, "Wyoming disagrees with the term "Compact Reservoirs" as used throughout this annual report. Wyoming's acceptance of this annual report should not be construed as Wyoming's acceptance of the use of that term." Wayne Berkas reviewed the 2003 discussion on whether the reservoirs listed in this table should be called "Compact Reservoirs". The group decided that, pending a decision from the Supreme Court, the term "Compact Reservoirs" will remain in the title along with the footnote. Reservoirs less than 1000 acre-feet in capacity will be removed from Table 10 for the 2011 report. At the December Commission meeting, Mr. Berkas will have an updated Table 10.

2011 Report

Water-Year-End Contents for Yellowstone River Compact Reservoirs[1] or Lakes

Month-end usable contents for additional reservoirs of interest to the Yellowstone River Compact are listed in table 10. Anchor Reservoir was built to hold 17,410 acre-ft, but sinkholes within the area contained by the dam prevent filling the reservoir to the designed volume, and at present only 9,250 acre-ft has been adjudicated with an extension to December 31, 2013 for the remaining 8,160 acre-ft.

Table 10. Water-year-end contents for Yellowstone River Compact reservoirs[1] or lakes.

[Contents are in acre-feet. Reservoirs or lakes are listed in alphabetical order by drainage basin. Abbreviation: e, estimated. Symbol: --, no data or not available]

Reservoir or lake name	Pre-compact 1950 water right	Post-compact 1950 water right	Usable capacity	Usable contents on Sept. 30, 2011	Usable contents on Sept. 30, 2010	Change in usable contents[2]
Clarks Fork Yellowstone River Basin						
Cooney Reservoir[3]	28,230	0	28,230	18,080	17,900	180
Glacier Lake[3]	4,200	0	4,200	--	--	
Bighorn River Basin						
(Lake) Adelaide Reservoir[4]	1,450	3,320	4,770	2,280	980	1,300
Anchor Reservoir[3]	--	9,250	17,410	396	350e	46
Bighorn Lake[5]	--	1,312,000	1,312,000	1,009,000	944,900	64,100
Boysen Reservoir[5]	757,900	--	757,900	651,500	599,100	52,400
Buffalo Bill Reservoir[5]	456,600	187,900	644,500	482,700	485,500	-2,800
Bull Lake[5]	77,040	--	77,040	92,240	65,120	27,120
Greybull Valley Reservoir[4]	--	33,170	33,170	9,390	4,160	5,230
Pilot Butte Reservoir[3]	34,600	--	34,600	20,400	14,300	6,100
Sunshine Reservoir[4]	52,990	--	52,990	51,180	52,340	-1,160
Lower Sunshine Reservoir[4]	--	58,750	58,750	28,570	25,060	3,230
Christina Reservoir[3]	3,860	--	3,860	3,800	3,500	300
Corral Reservoir[4]	--	1,030	1,030	640	576	64
Diamond Creek Dike Reservoir[4]	--	18,380	18,380	473	445	26
Enterprise Reservoir[4]	1,490	204	1,700	40	42	-2
Fairview Extension Reservoir[4]	791	620	1,410	1,400	1,400	0
Harrington Reservoir[4]	315	887	1,200	800	600	200
Lake Cameahwait Reservoir[3]	--	6,680	6,680	6,680	6,680	0
Lake Creek Reservoir[4]	1,370	--	1,370	1,370	1,370	0
Newton Lakes[4]	4,520	--	4,520	250	2,000	-1,750
Perkins and Kinney Reservoir[3]	1,200	--	1,200	1,040	1,150	-110
Sage Creek Reservoir[3]	440	2,240	2,780	2,680	2,680	-100
Shell Reservoir[4]	1,950	--	1,950	75	75	0
Shoshone Lake Reservoir[3]	9,740	--	9,740	70	140	-70
Texpot Reservoir[4]	1,580	--	1,580	0	0	0
Tensleep Reservoir[4]	3,510	--	3,510	1,720	3,220	-1,500
Wiley Reservoir[4]	689	331	1,020	632	1,020	-388
Worthen Meadow Reservoir[4]	--	1,500	1,500	1,500	398	1,102
Powder River Basin						
Cloud Peak Reservoir[4]	3,400	172	3,570	3,570	3,570	0
Dull Knife Reservoir[4]	--	4,320	4,350	1,330	1,170	150
Healy Reservoir[4]	--	5,140	5,140	3,460	3,970	-510
Kearney Reservoir[4]	1,850	4,470	6,320	2,000	2,190	-190
Lake DeSmet[4]	37,520	197,500	235,000	204,100	203,600	500
Muddy Guard Reservoir[4]	--	2,340	2,340	1,010	840	170
Tie Hack Reservoir[4]	1,650	788	2,440	2,440	2,440	0
Willow Park Reservoir[3]	4,460	--	4,460	386	337	45
Posy No. 1 Reservoir[4]	--	1,540	1,540	1,540	1,540	0

[1] Wyoming disagrees with the term "Compact Reservoirs" as used throughout this annual report. Wyoming's acceptance of this annual report should not be construed as Wyoming's acceptance of the use of that term.

Table 10. Water-year-end contents for Yellowstone River Compact reservoirs[1] or lakes.—Continued

[Contents are in acre-feet. Reservoirs or lakes are listed in alphabetical order by drainage basin. Symbol: --, no data or not available]

Reservoir or lake name	Pre-compact 1950 water right	Post-compact 1950 water right	Usable capacity	Usable contents on Sept. 30, 2011	Usable contents on Sept. 30, 2010	Change in usable contents[2]
Tongue River Basin						
Bighorn Reservoir[4]	2,750	1,880	4,630	1,170	357	813
Doone Reservoir[4,6]	1,840	188	2,030	1,020	993	27
Park Reservoir[4]	7,350	3,020	10,360	4,350	3,790	560
Sawmill Lakes Reservoir[3]	--	1,280	1,280	866	690	176
Tongue River Reservoir[5]	79,070	--	79,070	46,650	51,100	-4,450
Twin Lakes Reservoir[4,7]	1,180	2,220	3,400	2,130	2,200	-70
Willow Creek Reservoir[3]	--	22,900	22,900	7,400	7,220	180

[1] Wyoming disagrees with the term "Compact Reservoirs" as used throughout this annual report. Wyoming's acceptance of this annual report should not be construed as Wyoming's acceptance of the use of that term.

[2] Change in usable contents is derived from subtracting the 2011 usable contents from the 2010 usable contents.

[3] Reservoir managed by the State of Montana.

[4] Private reservoirs permitted and accounted by the State of Wyoming.

[5] Reservoirs managed by Bureau of Reclamation.

[6] Data are combined contents of Doone Lake and Doone Lake Reservoir.

[7] Data are combined contents of Twin Lakes Number 1 and Twin Lakes Number 2.