Dolores River Dialogue

HYDROLOGY REPORT
March, 2005

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DRD HYDROLOGY REPORT OUTLINE

Executive Summary
This Section should be produced after 'results' are completed and analyzed. This summary should be the 'boiled down' version of all that follows.

- Present most important and germane findings – bullets (J Porter 'findings')
- Consider 'Spill' plot - spill quantity vs year, as modeled by the DRD
- Consider 'Spill' probability plot - annual Q in AF vs likelihood of recurrence in any given year

I. A. Purpose and Need

B. Background

C. Summary Of The Plan Process

II. History of Dolores River Diversions and the Dolores Project

III. Data Analysis – Methods

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Data Availability

- Dolores River @ Dolores (USGS 09166500): 10/1/1895 – 9/30/1903; 10/1/1910 – 9/30/1912; 10/1/1921 – 9/30/2003; 92 years
- Dolores River below McPhee Reservoir (DOLBMCCO-DWR): 1/1/1986 – 9/30/2003; 17 years
- Disappointment Creek Nr Dove Ck ((USGS 09168500): 8/1/1957 – 9/30/1986; 29 years
- Dolores River at Slickrock (USGS 09168730): 5/1/97 – 6/30/2003 (scattered record); 6 years
- Dolores River Nr Bedrock (USGS 0917110): 10/1/1917 – 9/30/1922; 8/1/1971 – 6/19/2003; 37 years
- San Miguel River @ Uravan (USGS 09177000); 8/1/1954 – 9/30/1962; 10/1/1973 – 9/30/2003; 38 years
- Dolores River @ Gateway (USGS09179500): 10/1/1936 – 9/30/1954
- Dolores River nr Cisco, UT (USGS 09180000): 12/1/1950 – 9/30/2003; 53 years

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b. Peak Flow Flood Frequency

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1. Watershed Hydrology DG TO ADD VERBAGE HERE

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SEE APPENDIX A-1 THRU A-4 FOR DATA AND RESULTS

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   a. Total Annual Flow ('frequency of spill' curve)
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C. **Recreational Boating – Spill Release Patterns**

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   3. **(DPR TABLE 33????) – not found yet**

C. **DRD Constraints – "Hydro contracted.xls"**

D. **DRD Boating Hydro.xls**

D. **Contract Summary**

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I. Overview of the Dolores River Dialogue – Process and the Hydrology Report

A. Purpose and Need

The purpose of the DRD Hydrology Report as outlined in the DRD Plan to Proceed is to perform a hydrologic analysis ". . . to describe the amount of water expected to flow downstream of McPhee Reservoir through spills and baseflow releases. It also needs to describe the realistic opportunities to manage or enhance or those flows." The report is also intended to be utilized by the Core Science Team to aid in their assessment of both the existing ecological conditions downstream of McPhee, and to discern where 'opportunity flows' may be found.

This Report summarizes the historical watershed hydrologic data available from gaged stations within the watershed relative to the DRD interests, and also provides a detailed analysis of the operations of McPhee Reservoir. The results describe in probabilistic terms the likelihood of the availability of 'spill water' that may be available to meet downstream ecological needs.

B. Background

The Dolores River Dialogue ("DRD or Dialogue") is a multi-stakeholder effort aimed at improving the environment of the Dolores River downstream of McPhee Dam, while protecting or enhancing human uses of the Dolores River resource. The dialogue is considering a range of creative alternatives. The practical actions that may result from this effort fall into three categories:1) river channel work (maintenance, restoration, habitat improvement); 2) spill flow management / enhancement; 3) base flow – pool management /operation; and/or 4) some combination of these three strategies. Specific alternatives may include, but are not limited to, re-timing downstream releases, efficiency/infrastructure improvements, interruptible supplies, new storage, new supplies, stream habitat improvements, and weather modification. To evaluate the various strategies and determine the preferred alternatives, the Dialogue needs technical expertise in several disciplines. Some of this expertise can be

supplied by members of the Dialogue. Other expertise, by its nature, must be supplied by folks not involved in the Dialogue.

C. Summary Of The Plan Process

The Technical Team, with oversight and direction from the Dolores River Dialogue Group, will lead this Plan To Proceed. Two groups will be formed. The Core Hydrology Group will be responsible for the water availability analysis. The Core Science-based Group will be responsible for providing the scientific analysis of the environments downstream of McPhee Reservoir that could be impacted by potential actions under consideration by the Dialogue Group. The Technical Team is responsible for directing the work and the reports provided by the two new technical groups, and also with producing a comprehensive summary report of both the water availability, and the necessary science that describes the impacts of various actions. The Technical Team will also provide a menu of recommendations for the Dolores River Dialogue Group to consider based on these reports. The Core Hydrology Group will be led by John Porter and the Dolores Water Conservancy District, Chuck Wanner, and include other members of the DRD roundtable, including David Graf, Vern Harrell, Erik Knight and any additional hydrology, engineering, or recreational boating expertise, as needed. In addition, a member of the core science group should participate.

II. History of Dolores River Diversions and the Dolores Project

The first diversions from the Dolores River, except for domestic purposes, were in 1875. These diversions were for agricultural purposes stretching from Rico and Dunton at the high end of the basin to Paradox Valley at the lower end of the basin. The amount of water diverted was negligible – less than 10,000 acre-feet per year. In 1883 the Cortez Canal Companies No1 & No2 were privately incorporated and funded. The purpose of those two companies was to develop the infrastructure to trans-basin divert up to 1,400 cubic feet per second from the Dolores Basin to irrigable lands in the upper areas of McElmo Creek, tributary to the San Juan River. Two physical diversions were constructed. One was a 1 ½ mile long tunnel and the other was 6 mile long canal. Diversion of water first began in 1886. From that day forward, until McPhee Dam was constructed, Montezuma Valley Irrigation Company, successor to the original two Canal Companies, diverted the entire Dolores River from the conclusion of the spring runoff until the end of the irrigation season, in late October.

During the 1970s planning for the needs of the multi-purpose Dolores Project, the BOR, not only planned for the traditional uses of a project, but planned for two unique / non traditional needs. First, the Dolores Project would be the means for satisfying Ute Mountain Ute Indian Tribe's ("UMUT") Winters Doctrine claims

to the Mancos River; and second, a year around by-pass flow for a fishery below McPhee Dam.

To get the water for what was considered upuntil then, non-traditional needs, the BOR converted the design of non-Indian Full Service irrigation features of Project from an open ditch surface delivery system to an "underground pipeline / pressurized" system. Doing so saves enough water to meet the needs of the two purposes described above. One, it provided 23,200 AF of water for the UMUT to irrigate 7,500 acres of land. It also provided 25,400 AF (which has now been expanded to 29,300) of water for a fishery below McPhee Dam.

The BOR realized that without being able to develop all of the flow of the Dolores River (to do so meant flooding the town of Dolores) the downstream fishery would have to share water supply shortage commensurate with other users, specifically irrigators. The method the BOR chose to administer such a shortage was to incorporate into the Final Environmental Impact Statement ("EIS") a mechanism whereby the release below McPhee would be either 20 , 50 , or 78 cfs, depending on whether it was a dry, normal or wet year. The type of year was to be determined on March 1st of each year based on the content of the reservoir and the relative amount of snow pack. If those two criteria established a "dry" year then 20 cfs would be released for the next 365 days. If the formula determined a "normal" year then 50 cfs would be the next years release and if it was a "wet" year, then 78 cfs was the annual release.

Construction of McPhee Dam was completed in the fall of 1983. Filling began in the spring of 1984. The Division of Wildlife ("DOW") began a fish-stocking program below the dam in the fall 1983 and continued throughout the filling of the reservoir and beyond. A quality fishery was established. Filling of the reservoir was completed in 1987. Very few irrigators were on line, so there was plenty of water for the downstream fishery during filling. The release was set at 150 cfs until the drought of 1988 through 1992.

In accordance with the Project's EIS, the March 1st 1990 content of the reservoir and the snow pack dictated a "dry" year, meaning a 20 cfs downstream release. Contrary to the Environmental Impact Statement ("EIS") guidelines, the District & the BOR agreed to re-evaluate the criteria on May 1st. As a result of April precipitation, the calculation was much nearer being a "normal" year, which would have designated a 50 cfs release, but the absolute criteria still indicated "dry", so the District and the BOR abided by the EIS guidelines and set the release at 20 cfs. Had the calculation been redone on May 5th it would have clearly been a normal year.

In May, the Five Rivers Chapter of Trout Unlimited ("TU"), wrote "arbitrary selection of water use and management by DWCD is offensive and wrong". Naturally, the District responded with a defensive retort as follows: "More water for the fishery hurts all the other users". By June 10th the 20 cfs was clearly having a negative effect on the fishery. The word on the street and in the State's

newspapers was, "Dolores means river of sorrow" - "The river will die" – "lawsuit in works". On June 12th the BOR in Washington - ordered the gates below McPhee be opened - that the flow be increased back to 78 cfs. The District's response was, "the EIS is being abided by", and "By what authority do you make such a request". I gather, somewhat uniquely, the DWCD owns the projects water rights, rather than the Federal Government.

The stage was set for a confrontation. In many cases the better way to manage water is obvious. In this case it was clear that if a way could be found to manage the fishery release in such a manner that water could be saved during the winter season for higher flows during the summer (a pool concept) the fishery would benefit. However, the irrigators would suffer greater shortages during consecutive drought years.

Changing from a "flow release" to a "managed pool" was a process which took 6 years. In 1997 an Environmental Assessment was issued, with a FONSI (Finding of No Significant Impact) which officially changed the release below McPhee Dam from an "annual flow" to a "managed pool". In addition the parties agreed to work together to create a pool of 36,500 AF of water for the fishery. To date, the downstream pool includes 29,300 AF of Project water, and up to 3,900 AF of additional non-project 'senior' water, although this quantity is subject to river administration and downstream 'beneficial uses'. Recent administration (e.g., 2002) has shown that this water is not strictly additive to the managed fishery pool, so the reliable components of the pool are 25,400 AF provided for in the DPR calculations and 3,900 AF purchased from DWCD in 1997 (both subject to shortage in dry years). DWCD was paid $3.8 million for accepting greater shortages to full service irrigators.

Trout Unlimited and DWCD cooperatively provided the leadership in forming an ad hoc group, in 1997, called the Dolores River In-stream-flow Partnership (DRIP). The purpose of the group was to "work together to create a pool of 36,500 AF" for the downstream fishery. The focus of the DRIP effort was for more water. Many option were explored. A consensus could not be reached and because of the 2000 - 2004 drought the DRIP process was suspended.

In the fall of 2003, San Juan Citizen's Alliance and DWCD, guided by Chuck Wanner (SJCA staff) and DWCD, guided by Steve Arveshough, (DWCD Gen. Manager) resurrected talks. That collaborative effort resulted in the formation of the Dolores River Dialogue.

III. Data Analysis – Methods DG NEEDS TO ADD VERBAGE HERE

1. Watershed Hydrology

GAGE DATA (Full Results in Appendix A)

- Dolores River @ Dolores (USGS 09166500): 10/1/1895 – 9/30/1903; 10/1/1910 – 9/30/1912; 10/1/1921 – 9/30/2003; 90 years total
- Dolores River below McPhee Reservoir (DOLBMCCO-DWR): 1/1/1986 – 9/30/2003; 17 years
- Disappointment Creek Nr Dove Ck ((USGS 09168500): 8/1/1957 – 9/30/1986; 29 years
- Dolores River Nr Bedrock (USGS 0917110): 10/1/1917 – 9/30/1922; 8/1/1971 – 6/19/2003) – 37 years
- San Miguel River @ Uravan (USGS 09177000)
- Dolores River @ Gateway (USGS09179500): 10/1/1936 – 9/30/1954

A. Gage Data Analyses (See Also Appendix A)

i. Discharge at Dolores Gage (Appendix A-1)

a. Total Annual Flow ('frequency of spill' curve)

USGS Daily average flow data from the Dolores gage were extrapolated to generate total annual flow (in AF) for the 90-yr period record, and are the same input data used in the DRD Hydrology Model, described in Section III.2, McPhee Reservoir Operations Hydrology. These data were then plotted as a frequency curve to discern the probability of a specific quantity of annual flow to be available at the Dolores gage. It should be noted that the pre-McPhee BOR gage at the McPhee Dam site indicates that total inflows from the Dolores and its tributaries (but within the drainage area captured by McPhee) are approximately 17 percent greater than the inflow at the Dolores gage. A separate analysis compared using monthly average discharge vs the daily record; the results show little difference between the frequency plots for total production generated by the two related data sets.

The 'total annual flow' frequency curve at the Dolores gage also was plotted against spill data available from DWCD (Dolores District). This plot

illustrates the recurrence intervals of managed spill volumes relative to the total annual production at the Dolores gage.

b. Peak Flow Flood Frequency

Daily average flow data from the USGS gage at Dolores was used to generate the annual maximum series of peak flows over the period of record at the Dolores (90 years) and McPhee (18 years) gages. The Dolores peak flow data was also plotted over time, and used as input to the comparative peak flow analyses between the Bedrock and Dolores gages (Section III.1.A.ii.a.).

ii. Post-McPhee Spill Hydrology (Appendix A-2)

a. Dolores vs Bedrock Peak Flow Data – pre- and post-dam

Annual peak flow data from the Dolores and Bedrock gages were examined to discern the effects to peak flow from dam completion. The data were plotted over time for the two peak flow series (Bedrock and Dolores), and a second plot showing the correlations between annual peaks before and after closure of McPhee shows graphically the effects of McPhee on peak flows at Bedrock.

b. Dolores District Data (Total out-of-basin Diversion) (SEE "DRD Hydro 10154" and "Hydro Contracte", Section III.2. for a complete post-McPhee diversion records)

c. DWR at McPhee – Annual Peak flow flood-frequency curves and tabular data were compiled to examine peak flow frequency below McPhee Dam. These data were derived from daily records available from the Division of Water Resources (DWR) gage below the outlet of McPhee.

iii. Downstream Gage Analyses (Appendix A-3)

a. Total Flow (Dolores, Slickrock, Bedrock, Disappointment, Bedrock, San Miguel, Gateway, Cisco)

Because monthly and daily average flow data from the Dolores River gages showed very little difference in total flow calculations, both were used to examine total annual flow at these sites.

b. Comparative Gage Analyses (Dolores, Disappointment, Bedrock, San Miguel)

For a 15-year period of record (1971 – 1985) daily average flow data were available from four gage sites affecting flow on the Dolores River: Dolores, Disappointment Ck nr Dove Ck, Bedrock, and the San Miguel River at Uravan. These data were examined to compare total production from the contributing drainage to each gage, and to examine the temporal variability of peak flows from upstream to downstream. San Miguel River data from the Uravan gage were not available for the 1971 and 1972 water years (Oct 1 - Sept 30).

1. Total Flow – Daily data were compiled into annual production data to examine total contributions to flow from each drainage. Table ___ (sub-watershed sizes) presents the total watershed sizes for seven sub-watersheds contributing flow to the Dolores. Average annual contributions were also plotted against the annual total flow record from these sites.

2. Peak Flow Variability – Peak flow dates from the daily records for these gages were compiled in tabular form to discern the temporal variability of peaks from the sub-catchments on and tributary to the Dolores River. The data were sorted first relative to annual maximum at the Bedrock gage in order to discern (grossly) how peak flows were correlated in time as one went downstream. Color coding was used on the table to show the frequency of temporal correlations, and to also stratify for the timing of the peak. Peak timing was shown to be either pre-snowmelt or pre-season 'rain on snow' driven (April 1 – May 15), snowmelt driven (May 16-June 30), monsoonal driven (July and August), and post-monsoonal (October-November). A second table presents these same

data color coded to show the temporal differences between peak flows at the four gage sites between 1971 and 1985.

iv. Indicators of Hydrologic Alteration (IHA) Analyses (Appendix A-4)

Indicators of Hydrologic Alteration is a program developed (*... jointly by TNC and Colorado State University????...*) that extracts pre-and post-dam parameter comparisons for gage records spanning dam construction. Monthly flow summary data from downstream gages at Bedrock and Cisco were used as input for these analyses.

a. Bedrock
b. Cisco

2. McPhee Reservoir Operations Hydrology

The task assigned the Hydrology Group was, given contractual constraints, to analyze the amount of water expected to flow downstream of McPhee Reservoir through spills and base flow releases. The purpose is to identify realistic opportunities to manage or enhance those flows.

Three Microsoft Excel workbooks were used for Dolores River Dialogue modeling, as follows:

- "DRD hydrology 10154" (See Appendix B) – This file addresses water availability based on the historical use data; specifically, the modeling analyzed the amount of water expected to flow downstream of McPhee Reservoir through base flow (Appendix B-1) and spill (Appendix B-2) releases. The workbook has 16 sheets, each addressing, either in data or chart form, a component of the DRD modeling process.

- "Hydro contracted" (See Appendix C) – This file was created in order to analyze the constraints on water availability, and to compare DPR modeling with actual post-McPhee water allocation.

- "DRD Boating Hydro" (See Appendix D) – These analyses present graphical and tabular data for the post-McPhee spill record (13 of 18 years). In order to examine release patterns during spill years, the boating analyses plotted release records for all spill years, the six lowest spill years, and the six highest spill years. Averages for 'all', 'high', and 'low' were also plotted.

An additional document describing the contract details as the project has evolved since its inception in 1962 is included as Appendix E.

A. DRD Hydrology 10154 - Baseflow Analysis

Baseflow analyses examined the total flow (assumed ~ 33,200 AF) available for downstream release on a full-allocation year, and used patterns reminiscent of recent historical releases to model monthly flows. The individual spreadsheet entitled "Base Flow Management" calculates the benefit to the downstream release assuming a 'managed spill event' between April 15 and June 10.

The benefit to the downstream pool results from the BOR/ DWCD policy that allows for no debit to the release during managed spills. The quantity of water 'saved' then becomes available for downstream release over a shorter 'baseflow release' year, ie, the number of days available to release the fish pool allocation is reduced by the length of the managed spill, but not the amount of water available for the release. When a spill year is followed by a shortage to full storage the following year, all project users subject to the shortage (primarily Project irrigators and the managed pool) will be commensurately reduced by the prior years' 'saved' fish water.

B. DRD Hydrology 10154 - Spill Analysis

The hydrologic modeling analysis of the Upper Dolores River (headwaters to and including all releases from McPhee Dam) is based on 77 years of record, from 1928 through 2004. The analysis is also based on all contracts and recognized constraints. The base data came from several sources. The 1928 thru 1974 data comes directly from the Dolores Project Definite Plan Report (DPR). The 1975 thru 1985 data comes from USGS on-line achieves. This data is expressed in average cfs / day. at the Dolores gage. The USGS data was converted to total annual acre feet at McPhee. The BOR operated a gage at the McPhee Dam site from 1939 thru 1952. Based on that gage's data, a correlated inflow at McPhee Dam is 117% greater than at Dolores. The 1986 thru 2004 inflow data comes from DWCD's In/outflow Tabulation, which is a daily record of the actual inflows and outflows from McPhee Reservoir. The measured inflow and outflow are balanced each day with the BOR's capacity table, which caused unexplained in/outflow spikes, on a daily basis. However, over a period of several days these discrepancies balanced, perhaps because the capacity tables are not based on actual measurements, whereas in/outflow are based on actual measurements.

i. DPR and DRD Hydrologic Comparisons - DRD Model Refinements

DPR calculations were based on providing the total contracted allocation to each entity, if the water was available. During the 18 years of actual Project operation (1986 – 2004) it is clear that the Ute Farm & Ranch and the Downstream Release will annually use their total allocation. At present Municipal & Industrial (M&I) allocations are only about 30% utilized. DPR allowance for evaporation & seepage (Evap) also appeared to be less than 50% of actual loss. Montezuma Valley Irrigation Company (MVI) and non-Indian Full Service (FS) irrigators do not use their total allocation. Therefore, to obtain a more realistic picture of water spilled, an adjustment to MVIC, M&I, FS, & Evap demands needed to be modeled differently than in the DPR.

ii. 1st Model Observations and Adjustments

The "1st model" grants the Downstream Release and the Ute Farm & Ranch their full allocation each year. An adjustment was made to the M&I use assumption to account for increasing use over time. The model reduces M&I diversions backwards from the year of highest use (5,060 AF) assigned to 2004, then subtracts 1.5% for the prior years use and back to 1928. Montezuma Valley Irrigation Company's actual post-McPhee diversions averaged 133, 792 AF -- 1986 through 2001 plus 6,000 AF sold to DWCD for DWCD's WetPack project totaling 139,792 AF. That average was used each year for the entire 77-year period.

Because the irrigation project area was not fully developed until 1999, there is no reliable history of average diversions for non-Ute irrigators. However, an analysis of average per acre application rates provide a valid basis to assess demand. The total per acre allocation is 23.86 inches. The 1994 – 1999 average application rate was actually 20.08 inches per acre, which is 84.19% of the total. Therefore, based on the total allocation of 55,400 AF, the average annual diversion was 46,643 AF.

Spills were calculated if the ending content (October 31) of any given year exceeded 381,100 AF (the maximum capacity of McPhee Reservoir). Shortages were calculated

if the ending content was below 152,000 AF (McPhee Reservoir's minimum active capacity).

iii. DRD Model Refinements

Three sub-models were created to address issues not directly accounted for in the DPR Hydrologic Analysis.

- **Monthly Analysis** - First, it did not seem realistic to calculate spills, based on McPhee being full at the end of the season. During actual operation the reservoir fills and spills in the spring, by mid June, then is used during the summer and fall season and is never actually full on October 31. Therefore, a model (worksheet "monthly") was created calculating monthly ending content for the 228 months between November 1985 through October 2004,. The calculations were based on actual DWCD In/outflow Tabulation records. The calculations also recognized the pattern of diversion for the various users, again based on actual records (worksheet "AVGS"). A comparison of the medeled spills under the 'monthly' and 'yearly' accounting scenarios suggested that the difference was not significant enough to justify the effort needed to model the entire 77 years on a monthly basis ("YRLY V MO").

- **Diversion Variability** – A second analysis was performed to incorporate the effects of variable diversion rates on the annual water budget, as records indicate that less water is diverted during wetter years. Several analysis were run in an effort to correlate a diversion pattern with climatic factors, as follows: a) MVI diversions vs summer precipitation; b) MVI diversions vs summer temperature; c) MVI diversions vs annual runoff; and d) MVI diversions vs annual inflow (considered to be 117 percent of the Dolores Gage inflow as per the DPR Hydrologic Study). Correlation d), while not perfect, showed a closer correlation (worksheet "MVI div v inflow").

- **DRY – MEDIUM – WET Adjustment** - Third, since annual inflow (correlation 'd' above) was more closely correlated than other measurements, the spreadsheet separated MVI's diversions into three separate averages, HI during dry years, MED during medium years, and LOW during wet years (worksheet "mvi div pattern"), based on splitting the inflow record into thirds. Average FS diversions were separated the same way, by using the

percentage difference between MVI's HI, MED, & LOW diversions.

iv. 2nd Analysis

A second model ("2nd model") incorporating the adjustments described above was created incorporating the adjustments described above. The results present both the original DPR assumption model ("avg div") and the DRD refinements. The difference between the DPR and '2nd' models is that the calculation for MVI & FS in the 2nd model is based on a DRY = HI, MED = Medium, WET = LOW diversion rates compared to one average for all 77 years. The comparison is charted in the worksheet "spill comp".

C. DRD Hydrologic Constraints (Appendix C)

The file "hydro contracted" was used to analyze the DPR hydrologic simulation results (pre-Project development) with the actual historic data as compiled by the Dolores Water Conservancy District's daily inflow-outflow tabulations. These comparisons show the projected water budget before construction of the dam with a detailed accounting of what has actually occurred. Note that average total inflow was ~17,000 AF/yr (5%) greater during the 18 year post-dam period. A detailed set of Excel spreadsheet notes follows the tabular data in Appendix C, and details how each allocation was derived. Graphical analyses ("pies") depict both contract allocations based on the DPR, and the historic allocations over the last 18 years. The last sheet presents both graphical and tabular summary data for this anlysis.

D. Recreational Boating – Historic Spill Release Patterns (Appendix D)

The historic managed spill release periods were extracted from the data set, and analyzed separately to discern spill patterns over the post-dam period of record. The plots reflect spill releases over the record, and further stratifies the lower six releases (MAX = 106,108 AF) and the six highest releases (MIN = 207,145 AF). Averages for all three analyses were also calculated and plotted separately.

E. Contract Summary (Appendix E)

Appendix E presents a summary of the Dolores Project controlling contracts and citations. The appendix also summarizes the water

rights portfolios of both project- and non-project users that affect McPhee Reservoir operations.

IV. Results

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   b. Cisco

B. Current Hydrology (noting FS and DRD Model Assumptions – *maybe simply reference next section below*)

2. McPhee Reservoir Operations Hydrology

The following are observations from each of the models, and a brief review of the model assumptions and differences: Two models / analysis were created. The first used averages (the same) for each of the 77 years. The second did the same thing for all users except, MVIC & FS. For MVIC & FS the 2nd model uses 3 different averages – dry, med & wet years.

A. "1st model"

The reservoir spilled 44 times. The average spill was 175,400 AF. The average annual spill is 102,000 AF. There were 13 years the spill was less than 100,000 AF. 4 years was longest no-spill period (6 years if the 1962 spill of 6,000 AF is ignored). Note that modeling included 77 years (1928 - 2004).

B. "2nd model"

The difference between "1st" & "2nd" models is as follows: There were 42 yrs of spill instead of 44. Spills varied from 16,000 AF greater to 16,000 AF less. The average spill was 2,450 AF greater (42 yrs). The small spills of 1962 & 1968 disappeared. Therefore, 6 years is the greatest NO SPILL period (1959 - 1964) instead of 4. For every spill of less than 100,00 AF, the spill Q was decreased (as one would expect because of greater MVI & FS diversion during dry years).

C. General Observation

The DPR's average annual spill was 76,000 AF. The DRD model spill is 101,000 AF. The reason for the difference is twofold. Irrigators & M&I users use less than their contracted allocations and the 1986 - 2003 average inflow was greater.

The difference between the 1986 v 2000 yearly v monthly models was not significant enough to justify doing the entire 77 years on a monthly basis(see the "YRLY V MO" chart).

V. Discussion

1. Watershed Hydrology

A. Historical and Native Flow Conditions

B. Current Hydrology - Opportunity Flows for Dolores River Habitats

2. Operations Hydrology - Scientific and Management Questions

The models provoked following scientific and management questions: What threshold volume of spill is required "for geomorphology to "take care of itself"? Below that threshold, what are the geomorphology / recreational boating management options? Should a minimal spill following a large spill be managed differently than a minimal spill

following a year or more of no-spill? What forecasted threshold volume of spill determines a "managed spill" vs a "spill on need" basis?

A. "No Debit" to the fishery pool during a managed or actual spill

A table modeling the benefit to the fishery and the associated risk to Project users as a result of the "no debit to the fishery pool during a managed or actual spill" was developed. It produced the following observations: The benefit is a net increase to the annual fishery pool of 50 cfs for each day (1,370 AF each 15 day period) the duration of the "no debit". The negative impact for Project users, is that the Q created by the "no debit" event increases the amount of the shortage burden during the next shortage. What are the trade offs of using the "no-spill debit" for geomorphology purposes as opposed to fish flow purposes?

B. Downstream Inflow

A model comparing the monthly flows at Bedrock and the volume of downstream release from McPhee was made for a large spill year (1986), a modest spill year (1996), and a no-spill year (2001). The average flow for all 12 months was greater at Bedrock than at McPhee, except June, which was equal to the McPhee release. Does this fact offer any scientific opportunities for geomorphology / recreational boating management options?

C. Recreational Boating – Spill Release Patterns

Experience with management of spills for the benefit of recreational boating, demonstrates that commencing a "managed spill" prior to April 15th does not benefit the boating community because, generally the weather is not conducive to boating. Boaters say that there is greater benefit to their interest by release of higher flows during the warmer part of the season rather than a longer season with lower flows. A longer season can be created by extending the season forward, with lower flows.

APPENDICES

A. **Gage Data Results**
   1. **Dolores FF Plots and Data.xls**
   2. **Spill Hydrology.xls**
   3. **Dol_Bedrock_Dis_SM_1971-1985.xls**
   4. **IHA Results**

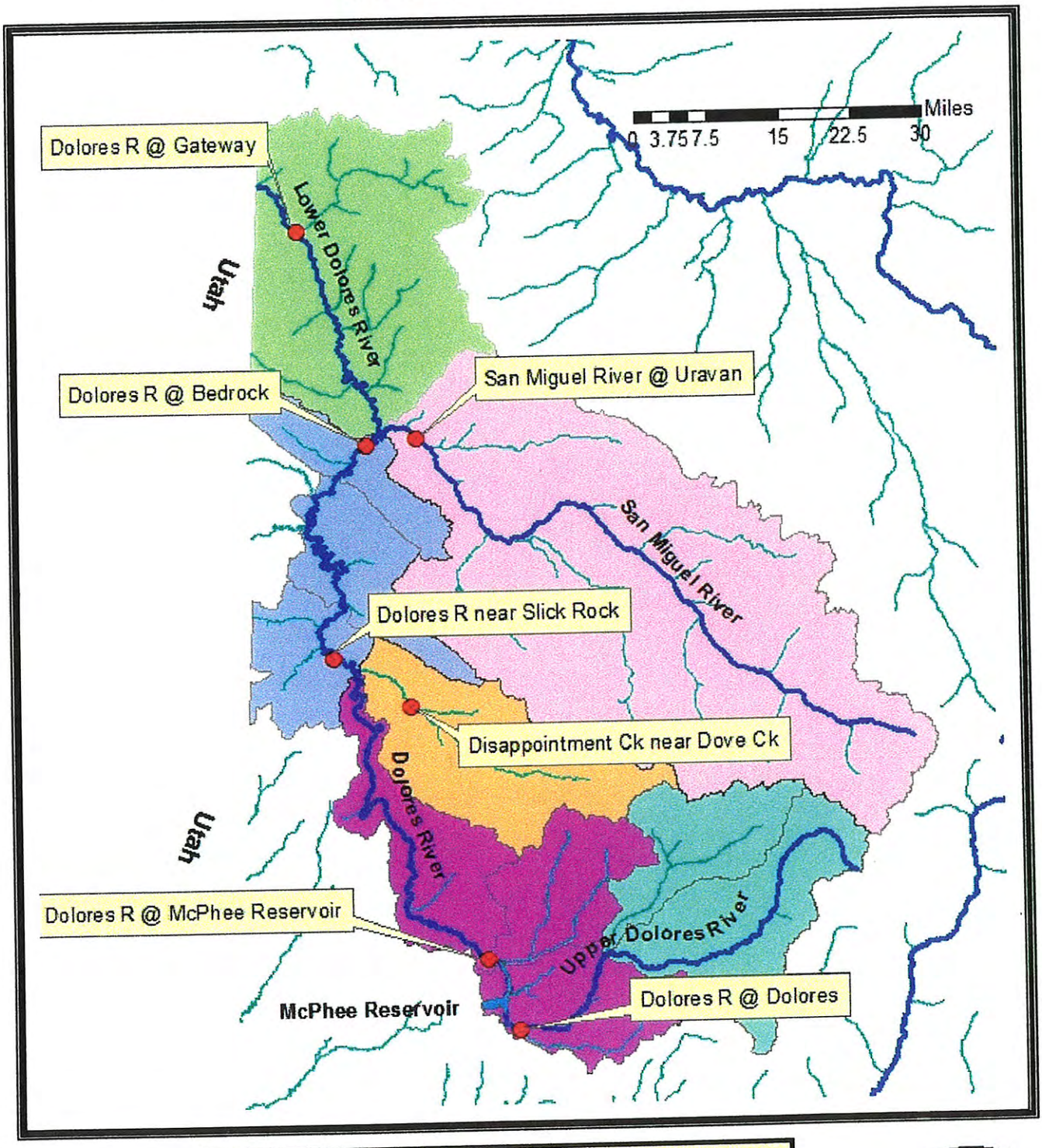
B. **DRD Operations Hydrology Results**
   1. **Baseflow - DRD Hydrology 10154**
   2. **Spill Release – DRD Hydrology 10154**
   3. **(DPR TABLE 33????) – not found yet**

C. **DRD Constraints – "Hydro contracted.xls"**

D. **DRD Boating Hydro.xls**

E. **Contract Summary – Dolores Project Contract and Water Rights Summary**

DOLORES AND SAN MIGUEL RIVER WATERSHEDS



February 25, 2005

STREAM GAGE DATA

WATERSHED NAME	USGS GAUGE #	ELEVATION (FT.)	PERIOD OF RECORD	WATERSHED SIZE (mi^2)	AVG. TOTAL ANNUAL Q (AF)
Dolores River @ Dolores	09166500	6940	10/1/1895 - 9/30/1903; 10/1/1910 - 9/30/1912; 10/01/1921 - 9/30/2003 (92 yrs)	504	339,938[1]
Dolores River @ Slickrock	09168730		5/1/1997 - 6/30/2003 (6 yrs)	1432	145397
Disappointment Creek (near Dove Creek)	09168100	6420	8/1/1957 - 9/30/1986 (29 yrs)	147	19,418[1]
Dolores River @ Bedrock	09169500	4940	10/1/1917 - 9/30/1922; 8/1/1971 - 6/19/2003; (37 yrs)	2024	464,609[1] 280,835[2] (340,526 / 227,186)
San Miguel @ Uravan	09177000	5000	8/1/1954 - 9/30/1962; 10/1/1973 - 9/30/2003; (38 yrs)	1499	262,269[1]
Dolores River @ Gateway	9179500	4548	10/1/1936 - 9/30/1954 (18 yrs)	4347	687208
Dolores River @ Cisco	0918000	4165	12/1/1950 - 9/30/2003 (53 yrs)	4580	571,493[2] (569,033 / 575,739)

1 Only overlap period 10/1971 - 9/1985 for Dolores, Bedrock , Disappointment gauges; 10/1973 - 9/30/1985 for San Miguel @ Uravan.

2 From monthly IHA data summaries (Pre-McPhee/Post-McPhee).

DOLORES RIVER WATERSHEDS

WATERSHED NAME	SIZE (mi^2)	Percent of Dolores River Watershed
WS1		
Dolores River Headwaters	279	6.1%
West Dolores River	169	3.7%
WS2		
Lost Canyon Creek	195	4.3%
Plateau Creek	174	3.8%
Dolores R-Ponderosa Gorge	224	4.9%
WS3		
Disappointment Creek	345	7.5%
WS4		
Dolores R-Summit Canyon	186	4.1%
Dolores R-Gypsum Valley	164	3.6%
Dolores R-Paradox Creeks	132	2.9%
WS5		
San Miguel River	1555	34.0%
WS6		
Lower Dolores River	725	15.8%

TOTAL - 4148

- first in Utah?

DRD HYDROLOGY REPORT
DESCRIPTION OF WORKSHEETS

This set of notes describes the files included in your .zip file. Mostly, they are the following Excel spreadsheets, but also include a map (Dolores_San Miquel Watersheds.jpg) and a table of gage information used in these analyses (Watersheds.xls).

1. "DRD FF Data and Plots.xls" – this spreadsheet contains the data and analyses related to flood-frequency analyses for the following data:
   - Annual peak daily flow at Dolores gage
   - "2nd Analysis" vs "AVE Diversions" – comparative summary of using DRD refinements that accounted for reduced diversions during wet years ('2nd Anaylsis') vs using only average annual diversion from project and non-project users ('AVE Diversions')
   - Plot showing difference in total annual flow at Dolores gage using daily vs annual average diversions
   - Flood-frequency curve for Dolores gage peak flow data (92 yr record)
   - Flood-frequency curve for McPhee gage peak flow data (18 yr record)
   - Comparison of flood-frequency curve for Dolores gage and for modeled spill record

2. "Spill Hydrology.xls" – This spreadsheet presents basic hydrologic gage data from the Dolores gage, spill data (Dolores Water Conservancy District data), and gaged data below McPhee. Overview sheet (1986-2003) and hydrographs broken down in 4-5 yr increments.

3. "Dol_Bedrock_Dis_SM_1971-1985.xls" – This spreadsheet presents summary hydrographs from the Dolores @ Dolores, Bedrock, Disappointment Ck, and San Miguel @ Uravan stream gages over a 15 year period of record coincidental to these four gaged sites. Variability of peak flow magnitude and timing (gage correlations) were examined. Other analyses of pre- and post-dam hydrologic effects at the Bedrock and Dolores gages is presented graphically. Specifically:
   - Summary Hydrographs
   - Peak flow comparisons by date of peak
   - Total annual flow by gage/ watershed
   - Bedrock and Dolores (1971-2001) – Peak Flows vs time (note dam closure in 1984)
   - Bedrock and Dolores (1971-2001) – Peak flows at Bedrock vs Dolores stratified by pre- and post-dam periods of record

4. Compiled IHA Analyses for the Bedrock and Cisco stream gages ("Compiled Bedrock IHA.xls" and Compiled Cisco IHA.xls")

5. "DRD Hydro 10154.xls" – this is the main 'model' used to examine frequency and magnitude of spills. Contained within these sheets are the comparative model analyses ('2nd Analysis' vs 'AVE Diversions'), and additional results using the DRD Hydrologic model. Specifically:

- Baseflow Management options – shows how non-debit to fish pool results in saving and flow management options for managed pool on a spill year.
- 'Spills' over time, using DRD hydrology '2nd Analysis' – modified DPR spreadsheet w/ use data compiled over 18 yrs of post-dam operation. Anaylsis uses DPR model input to analyze the same 76 years of data analyzed by the DPR study. This is the PREFERRED MODEL ANALYSIS
- Spill comparison of DRD '2nd Analysis' and 'AVE Diversion' model
- MVIC correlation plot – actual post-McPhee diversions/ project water use vs inflow at the Dolores gage, showing inverse correlation (basis for DRD model adjustments to WET-MED-DRY scenarios)
- McPhee vs Bedrock comparisons – monthly flows
- Average of wet-dry-medium years by month (MAY ADJUST THIS PLOT)

6. "Hydro contracted.xls" – This worksheet contains allocation data and an excellent abridged notation of how these allocations affect inflow and outflow in McPhee. Graphical depiction of all project and non-project allocations. Specifically:
   - DPR allocations vs DRD Hydrology (actual over 18-yr post-dam period) – data and notes
   - Allocation 1 – Pie charts based on DPR allocations
   - Allocation 2 – Pie charts based on DRD Hydrology (actual allocations over post-dam period)
   - Comparisons between DPR and 18-yr post-dam allocations

7. "DRD Boating Hydro.xls" – This data based on daily 18-year post-dam spill record, with only spill years pulled from the record. Analysis includes ALL spill years plotted, and further stratifies by both the six smallest spill years and the six largest spill years. Plots and data fairly self explanatory.

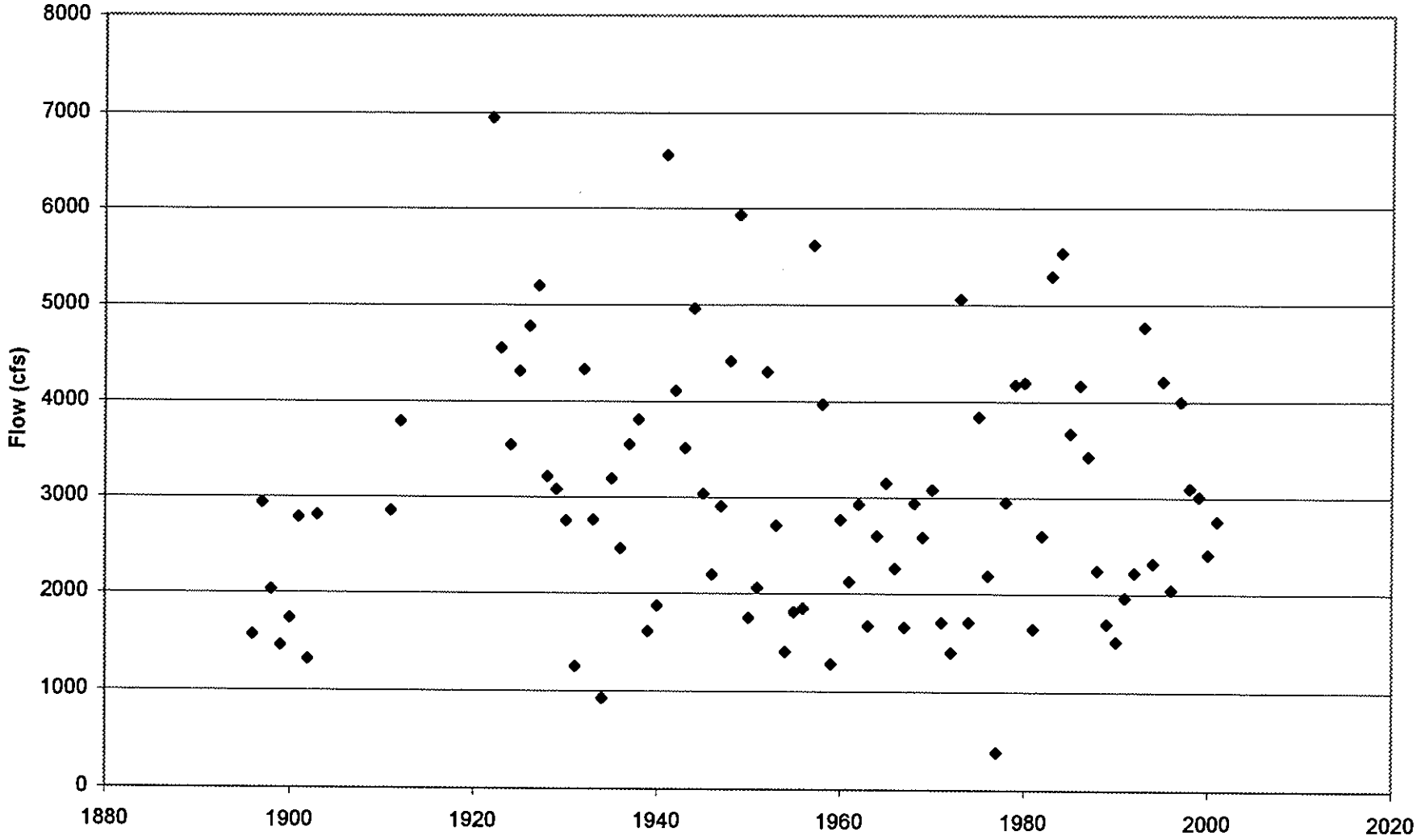
APPENDICES

APPENDIX A

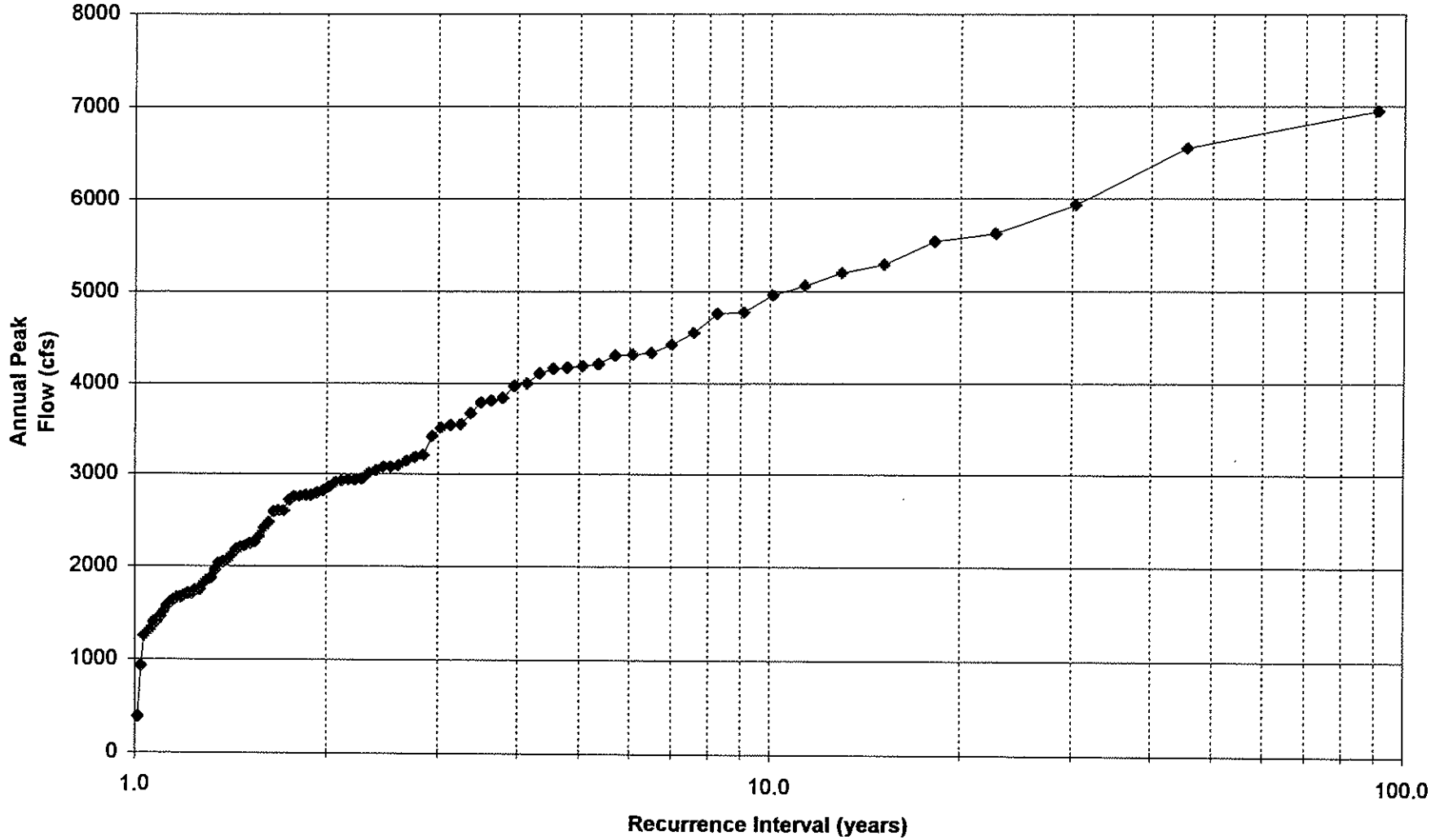
Gage Data Results

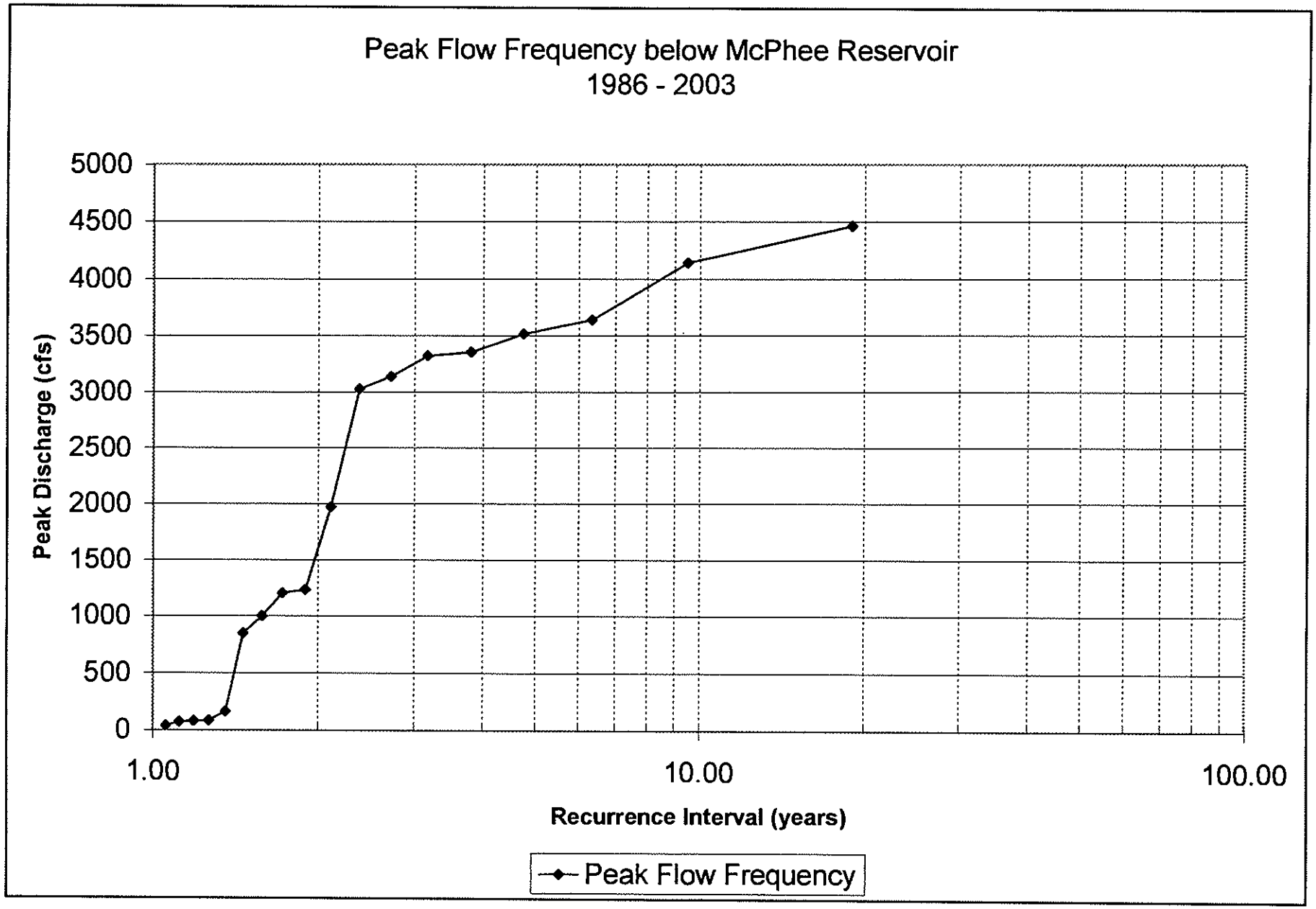
1. Dolores FF Plots and Data.xls
2. Spill Hydrology.xls
3. Dol_Bedrock_Dis_SM_1971-1985.xls
4. IHA Results

Peak Daily Maximum Flow by Water Year
Dolores River At Dolores



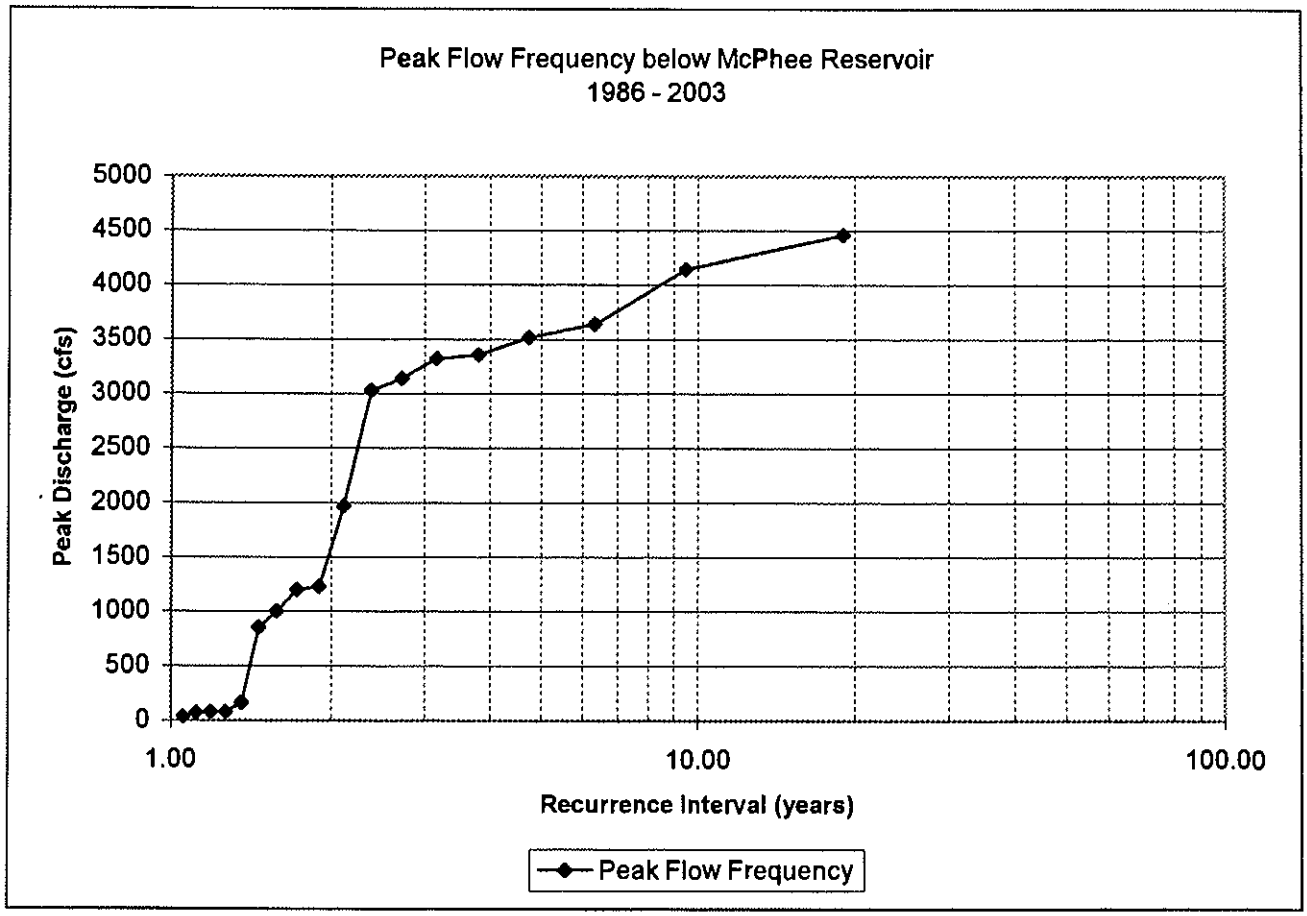
Annual Peak Frequency Plot - Dolores River at Dolores
92-year record



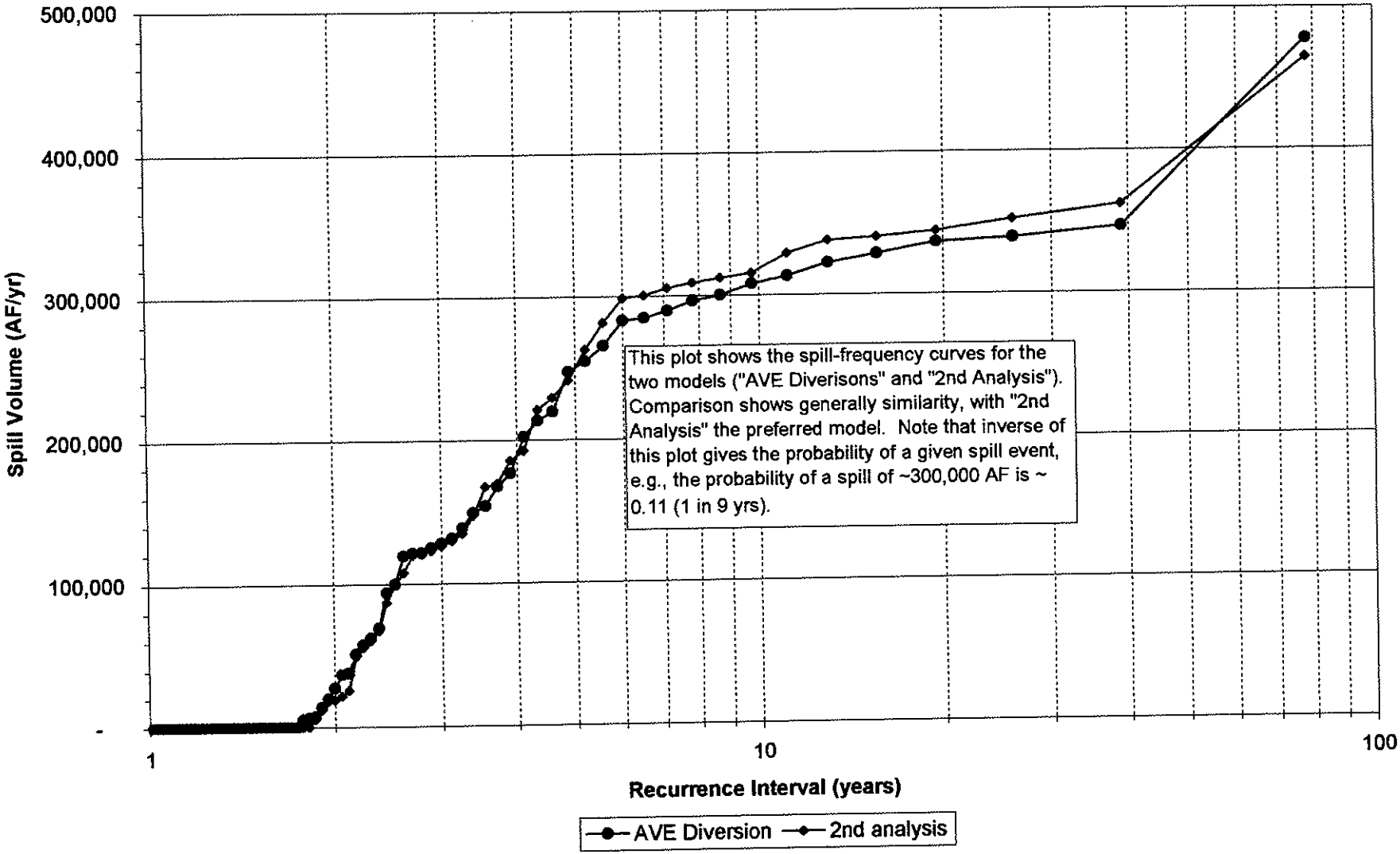

Peak Flow Frequency below McPhee Reservoir
1986 - 2003
Peak Discharge (cfs)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1.00
10.00
100.00
Recurrence Interval (years)
Peak Flow Frequency

DWR gage (DOLBLMCCO-DWR) Peak Annual McPhee Releases

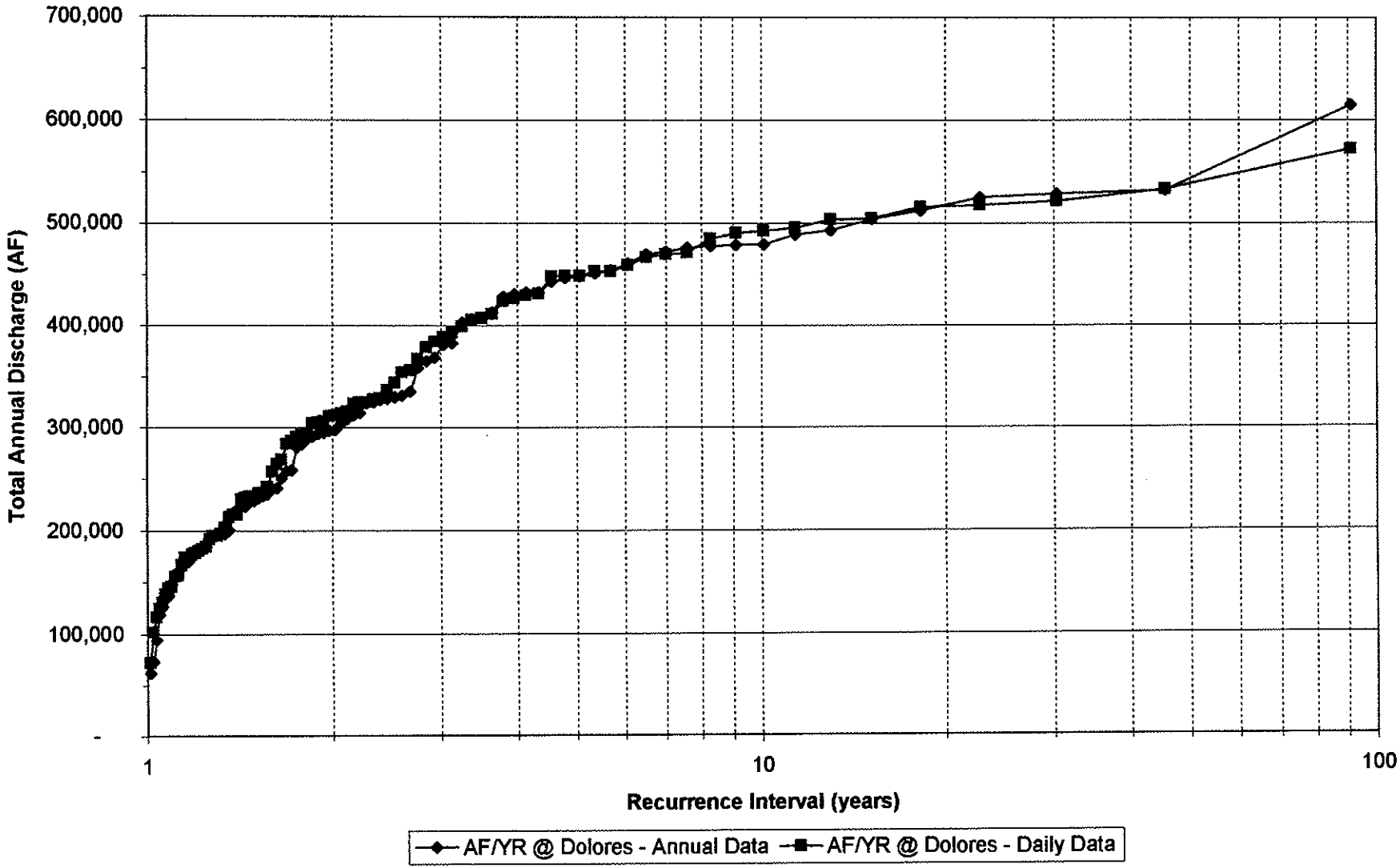
Annual Max (cfs)	Rank	Prob Val	RI (years)	Water Year (10/1 - 9/30)
4461	1	0.05	19.00	1986
4140	2	0.11	9.50	1993
3640	3	0.16	6.33	1997
3520	4	0.21	4.75	1999
3360	5	0.26	3.80	1998
3324	6	0.32	3.17	1987
3140	7	0.37	2.71	1995
3030	8	0.42	2.38	1992
1970	9	0.47	2.11	1994
1230	10	0.53	1.90	2000
1201	11	0.58	1.73	1988
1001	12	0.63	1.58	1989
851	13	0.68	1.46	1991
165	14	0.74	1.36	2002
85	15	0.79	1.27	1996
81	16	0.84	1.19	1990
75	17	0.89	1.12	2001
41	18	0.95	1.06	2003



Spill Recurrence - AVE diversions and 2nd Analysis

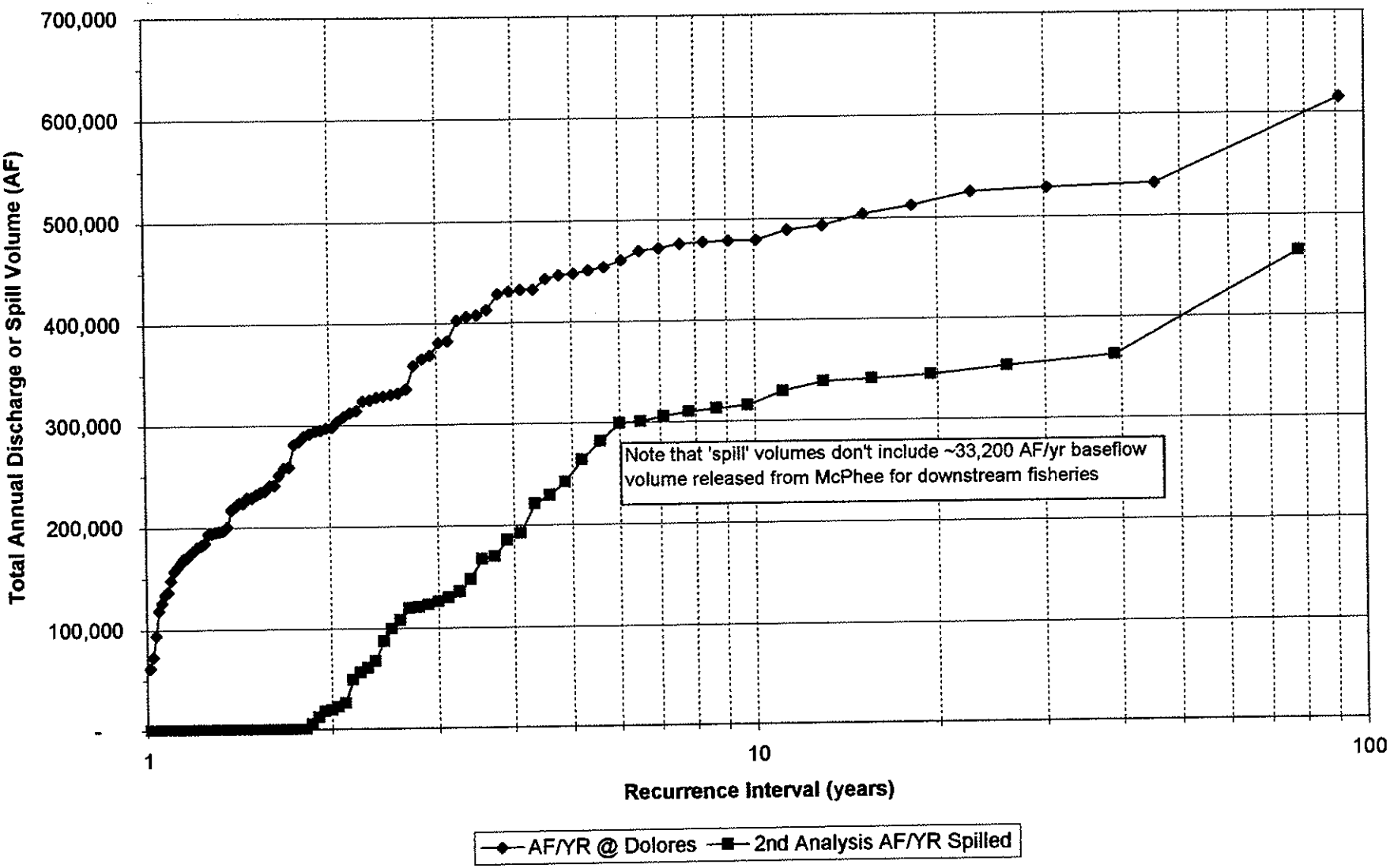


Recurrence Intervals for Annual vs Daily Discharge at the Dolores Gage

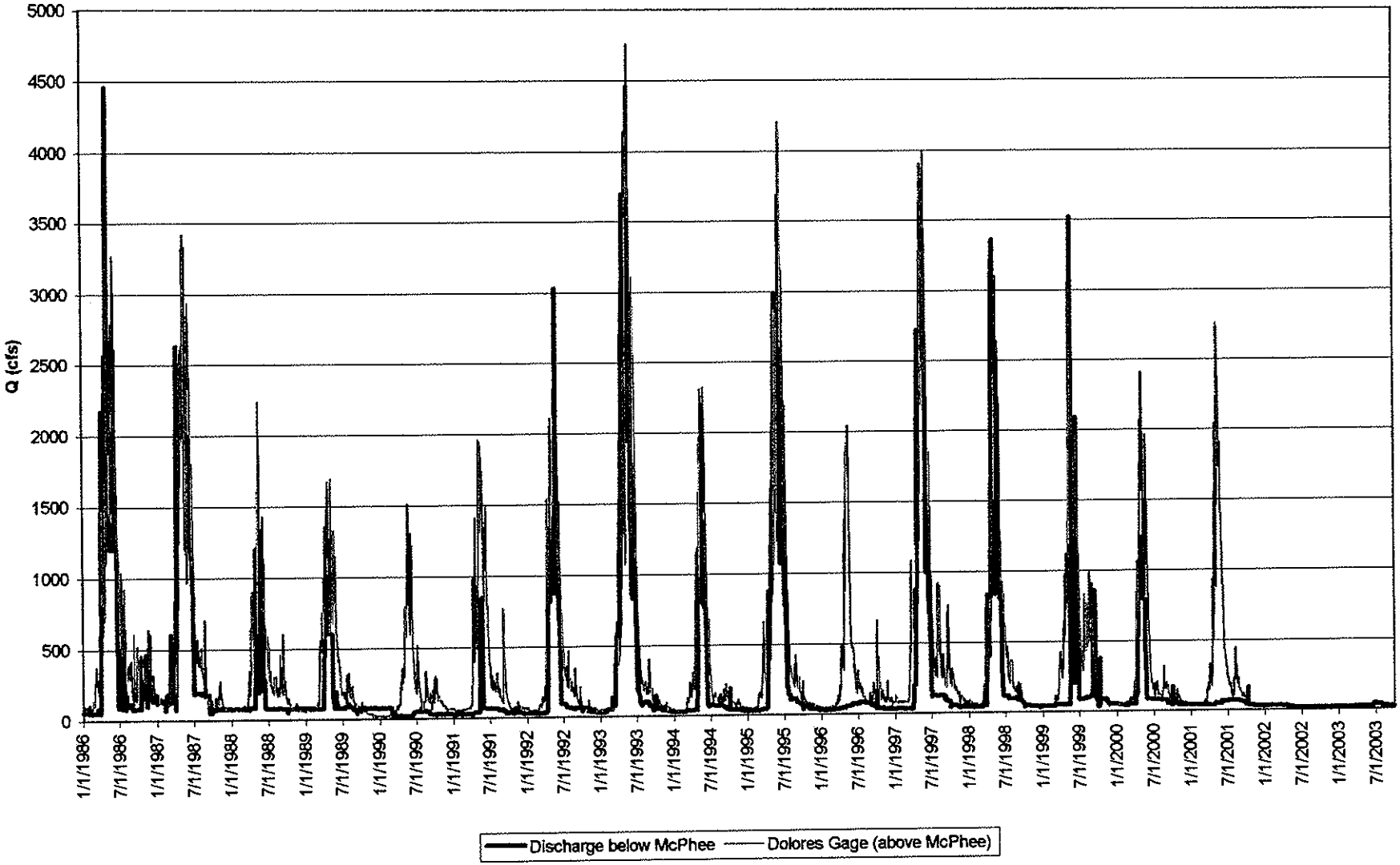


Dolores FF Data and Plots.xls

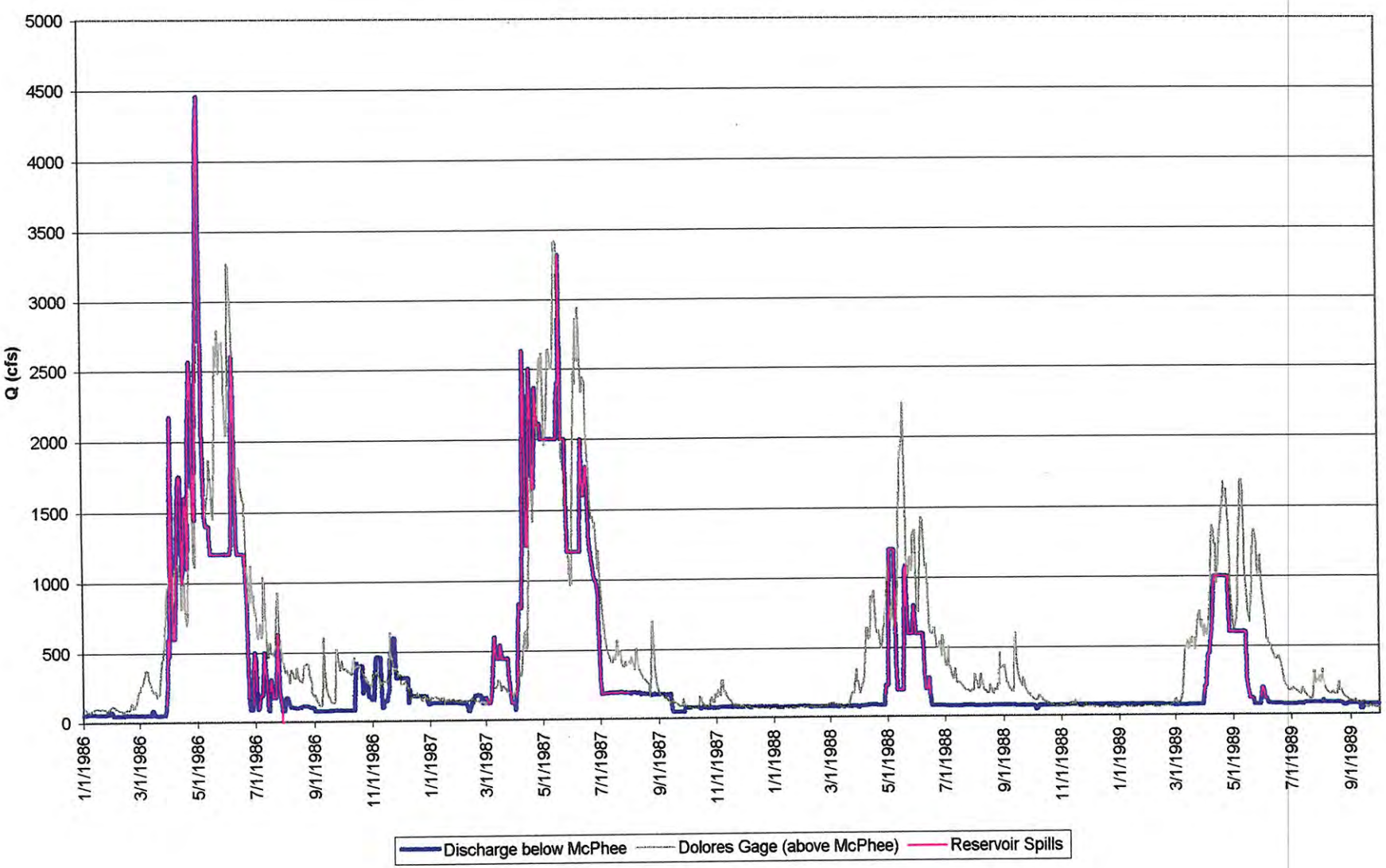
Recurrence Intervals for Annual Discharge at Dolores Gage and for Modeled Spill



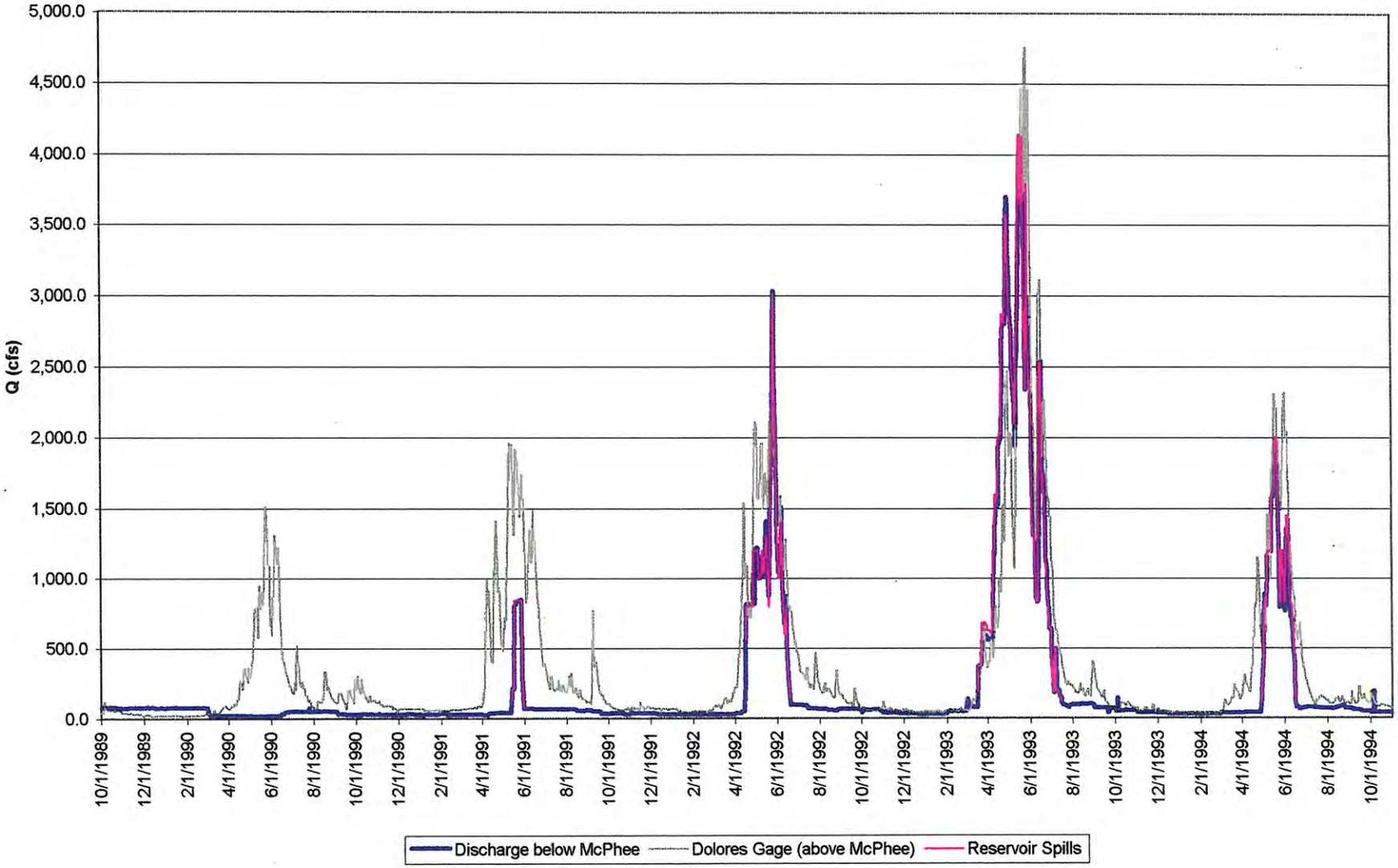
Mean Daily McPhee Release
DWR - DoI District Data



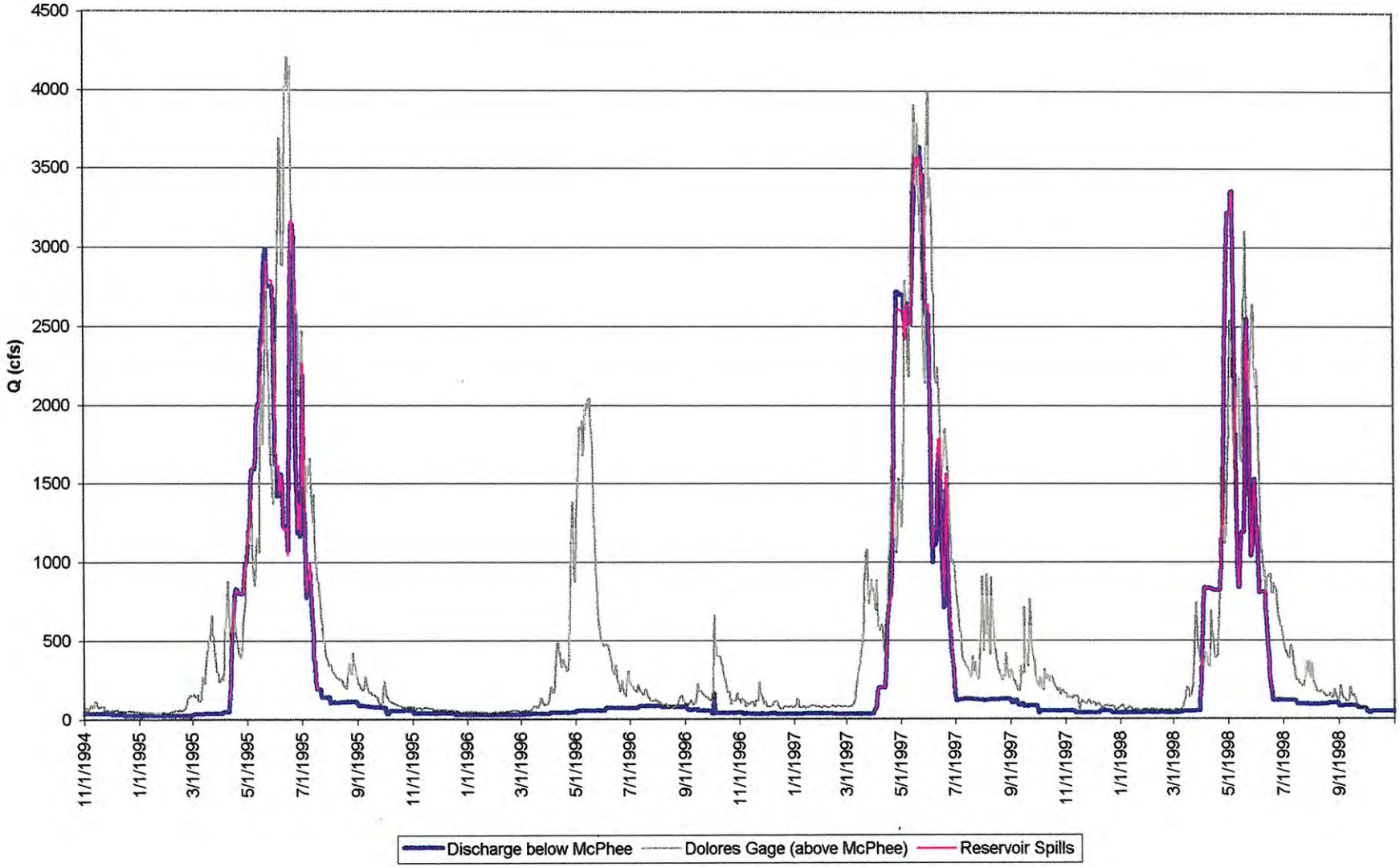
Mean Daily McPhee Release
DWR - DoI District Data



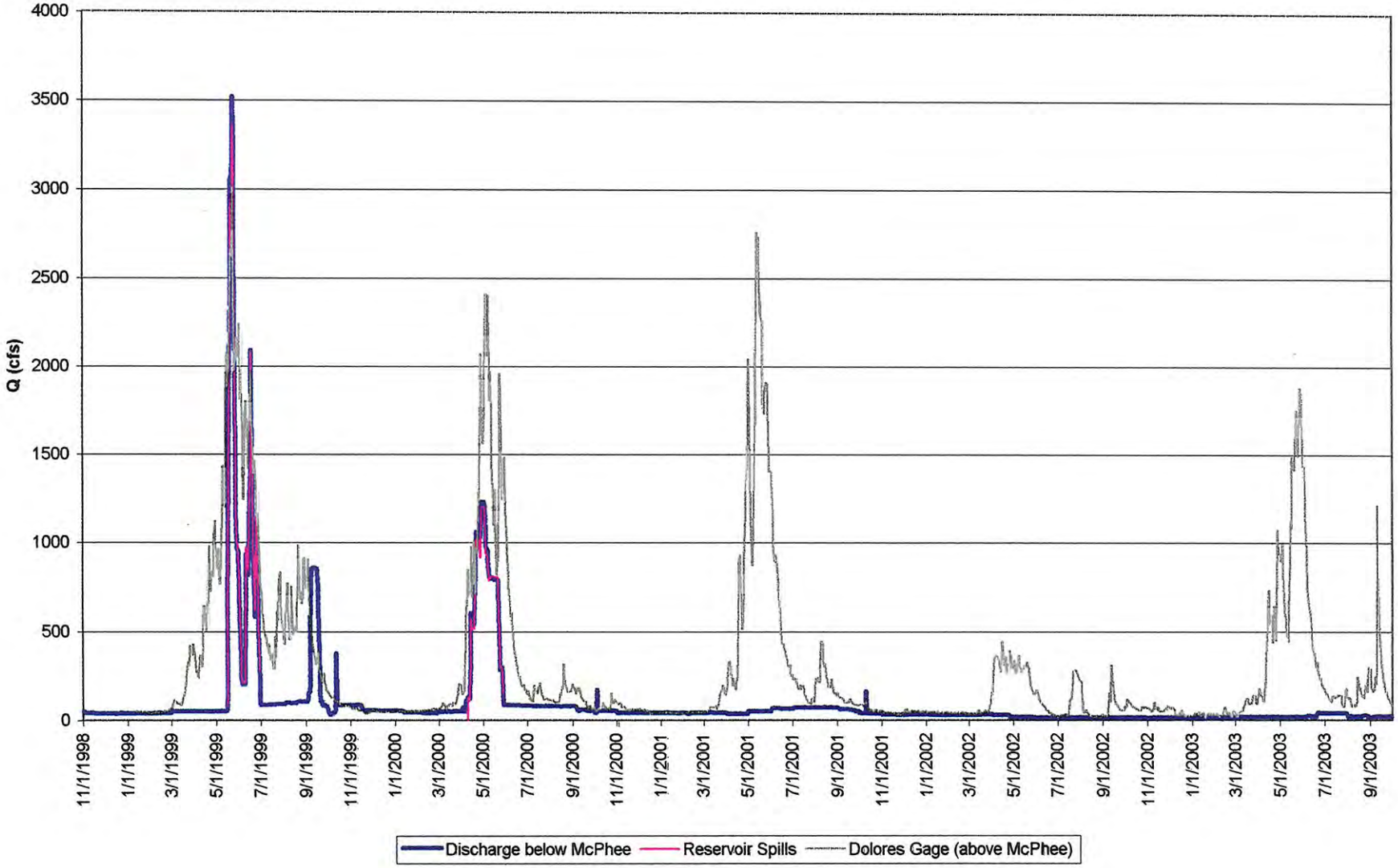
Mean Daily McPhee Release
DWR - DoI District Data



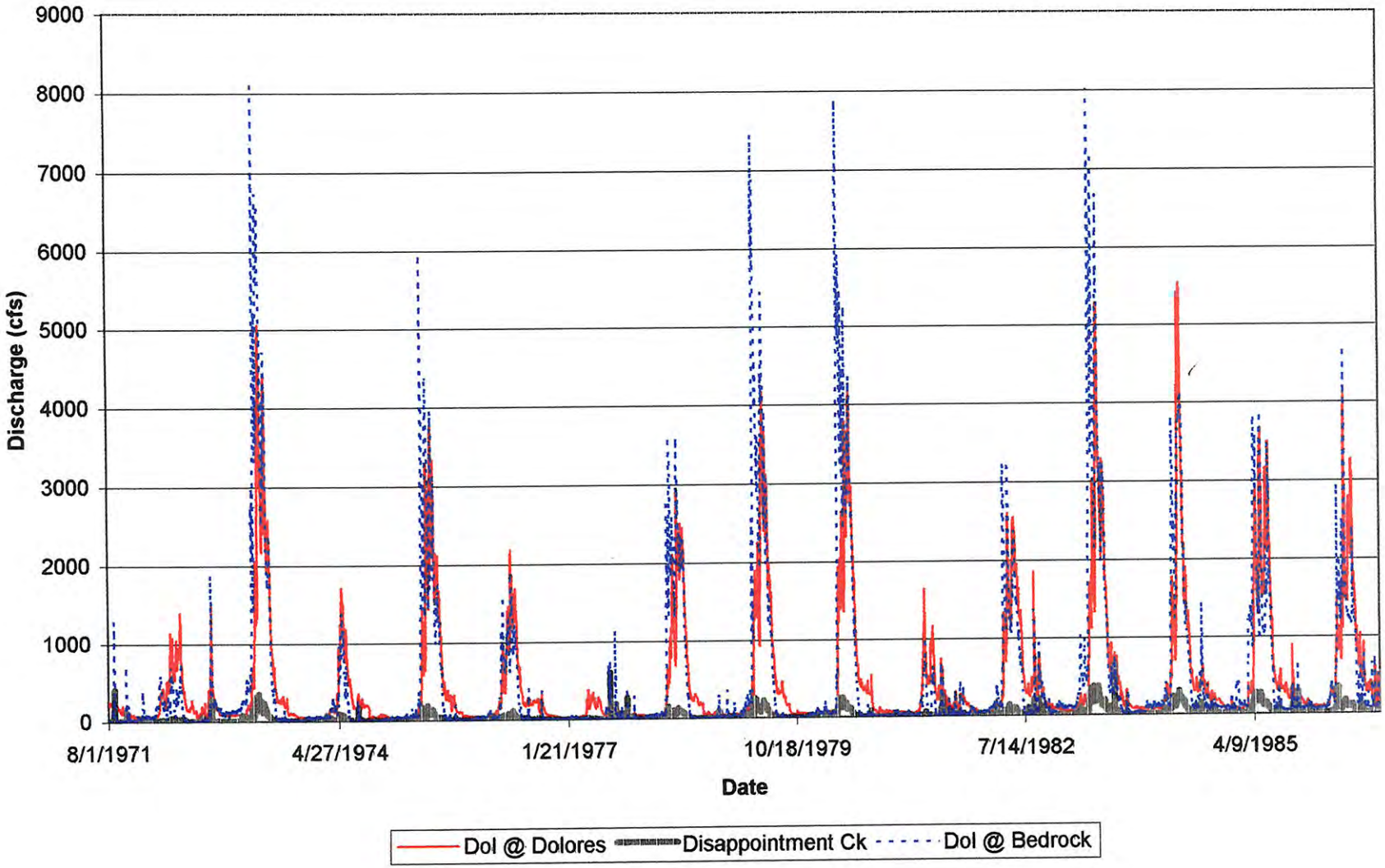
Mean Daily McPhee Release
DWR - DoI District Data



Mean Daily McPhee Release
DWR - DoI District Data



Flow Comparisons - Dolores River at Bedrock and Dolores; Disappointment Ck
8-1-1971 thru 9-30-1986

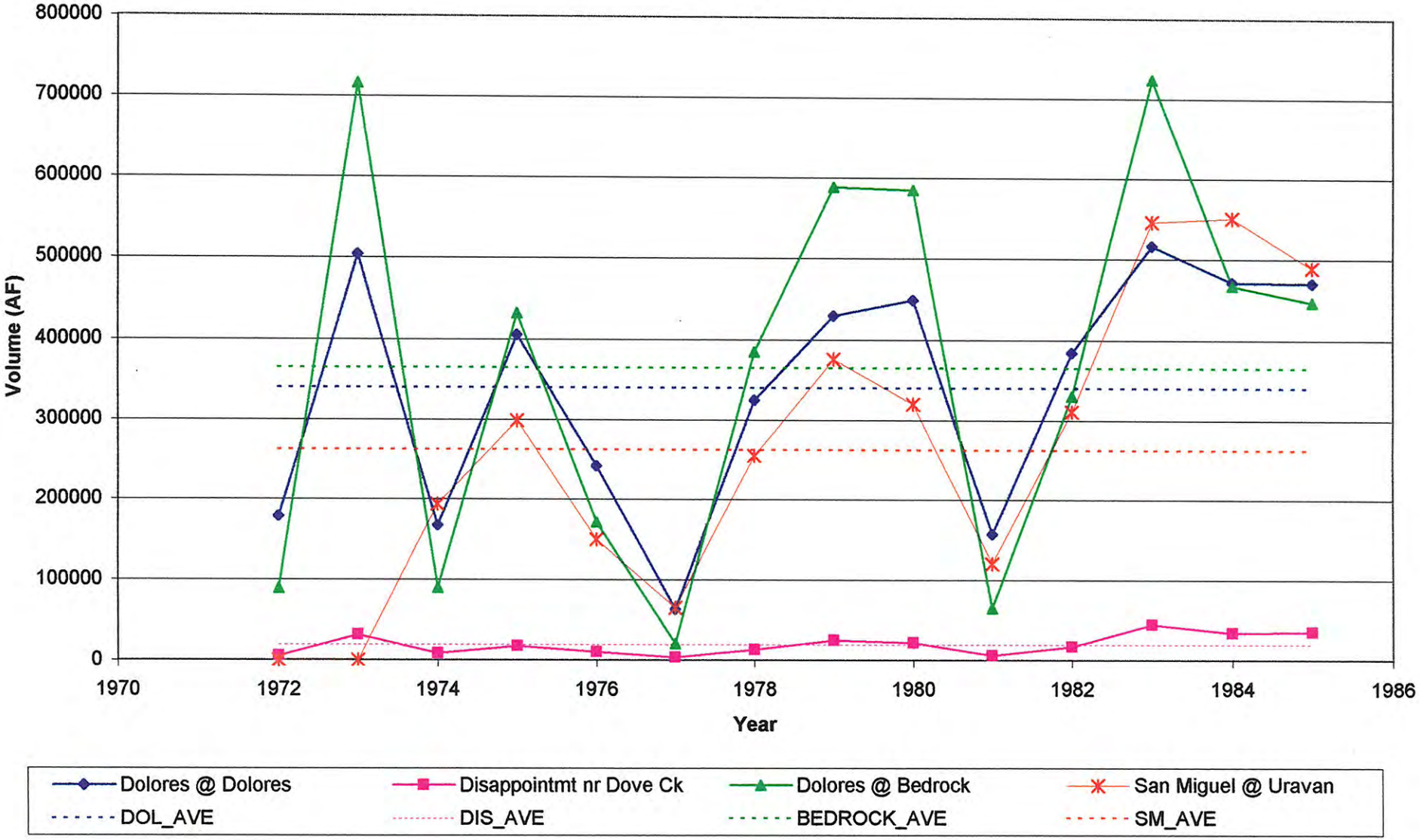


ANNUAL MAXIMUMS (cfs) YEAR	DOL @ Dolores	Disappointment	DOL @ Bedrock	SM @ Uravan
1972	1400	125	763	0? NO DATA
1973	5060	348	8150	0
1974	1710	161	1380	2630
1975	3840	186	5950	2380
1976	2180	115	1870	880
1977	385	601	1130	1140
1978	2950	277	3590	1850
1979	4170	258	7440	3790
1980	4190	250	7880	2410
1981	1640	247	990	805
1982	2600	225	3250	1960
1983	5290	663	8000	4980
1984	5540	312	4110	5440
1985	3670	275	3860	3320
1986	4160	342	4690	2060
AVE PEAK Q (cfs)	3188	289	4169	2256
STDEV/(AF/YR)	1596	160	2821	1685
STDEV/(AF/YR)	50%	56%	68%	75%

TOTAL PRODUCTION (AF/yr) YEAR	DOL @ Dolores	AVE	Disappointment	AVE	DOL @ Bedrock	AVE	SM @ Uravan	AVE
1972	178640	339938	5635	19418	89142	364609	0	262269
1973	503676	339938	31266	19418	715856	364609	0	262269
1974	166719	339938	8324	19418	89194	364609	193544	262269
1975	405273	339938	17304	19418	431619	364609	298515	262269
1976	242171	339938	10266	19418	171066	364609	149607	262269
1977	62970	339938	3720	19418	20706	364609	64657	262269
1978	324673	339938	13089	19418	384321	364609	255255	262269
1979	429138	339938	24652	19418	587808	364609	375528	262269
1980	448699	339938	21736	19418	583921	364609	319903	262269
1981	156718	339938	6302	19418	63870	364609	120018	262269
1982	383779	339938	16863	19418	330210	364609	310521	262269
1983	515738	339938	43971	19418	723690	364609	545334	262269
1984	471222	339938	33656	19418	466670	364609	550261	262269
1985	469709	339938	35063	19418	446454	364609	488623	262269
1986	452908	---	24476	---	369066	---	375570	---
AF Totals	4759127		271849		5104529		3671765	
Ave AF/YR	339938		19418		364609		262269	
STDEV	150349		12679		243581		185724	
STDEV/(AF/YR)	44%		65%		67%		71%	

McPhee filled and spilled

Drainage Contributions - Dolores, Disappointment, San Miguel Rivers
1972 - 1985



CORRELATION OF ANNUAL MAXIMUMS AT DOWNSTREAM GAGE LOCATIONS. 1972-1986

Water Year (10/1 - 9/30) (Data sorted by Peaks at Bedrock)	Dolores @ Dolores		Disappointment Ck		Dolores @ Bedrock		San Miguel at Uravan	
	Discharge	Date	Discharge (cfs)	Date	Discharge (cfs)	Date	Discharge (cfs)	Date
1973	5060	5/20/1973	348	5/11/1973	8150	4/30/1973		
1983	5290	5/31/1983	663	8/8/1983	8000	4/26/1983	4980	5/10/1983
1980	4190	6/11/1980	250	5/7/1980	7880	4/23/1980	2410	4/23/1980
1979	4170	5/29/1979	258	4/18/1979	7440	4/19/1979	3790	4/19/1979
1975	3840	6/6/1975	186	5/15-17/75	5950	4/26/1975	2380	5/12/1975
1986	4160	5/4/1986	342	4/2/1986	4690	5/5/1986	2060	6/7/1986
1984	5540	5/25/1984	312	5/16/1984	4110	5/28/1984	5440	5/16/1984
1985	3670	5/8/1985	275	5/4/1985	3860	5/7/1985	3320	4/15/1985
1978	2950	5/16/1978	277	10/7/1977	3590	4/14/1978	1850	4/27/1978
1982	2600	5/5/1982	225	9/11/1982	3250	5/4/1982	1960	5/5/1982
1976	2180	5/18/1976	115	5/21-22/76	1870	5/18-19/76	880	5/22/1976
1974	1710	5/11/1974	161	7/18/1974	1380	5/12/1974	2630	4/26/1974
1977	385	4/19/1977	601	7/24/1977	1130	8/16/1972	1140	8/16/1977
1981	1640	5/3/1981	247	7/17/1981	990	5/5/1981	805	6/10/1981
1972	1400	6/8/1972	125	10/17/1971	763	6/10/1972		

Regressions on Annual Max

Bedrock on Dolores	Bedrock on Disappointm	Bedrock on San Miguel
0.72	0.10	0.36

Regressions on Daily Data

Bedrock on Dolores	Bedrock on Disappointm	Bedrock on San Miguel
0.70	0.73	0.76

Peak Regression Data: BR on SM

Bedrock	San Miguel @UV
8000	4980
7880	2410
7440	3790
5950	2380
4690	2060
4110	5440
3860	3320
3590	1850
3250	1960
1870	880
1380	2630
1130	1140
990	805

Correlated early peaks (Apr 1 - May 15)
Correlated snow-melt peaks (May 16 - June 30)
Correlated Monsoonal Peaks (July - August)

ADD ELEV DRAINAGE Size Data

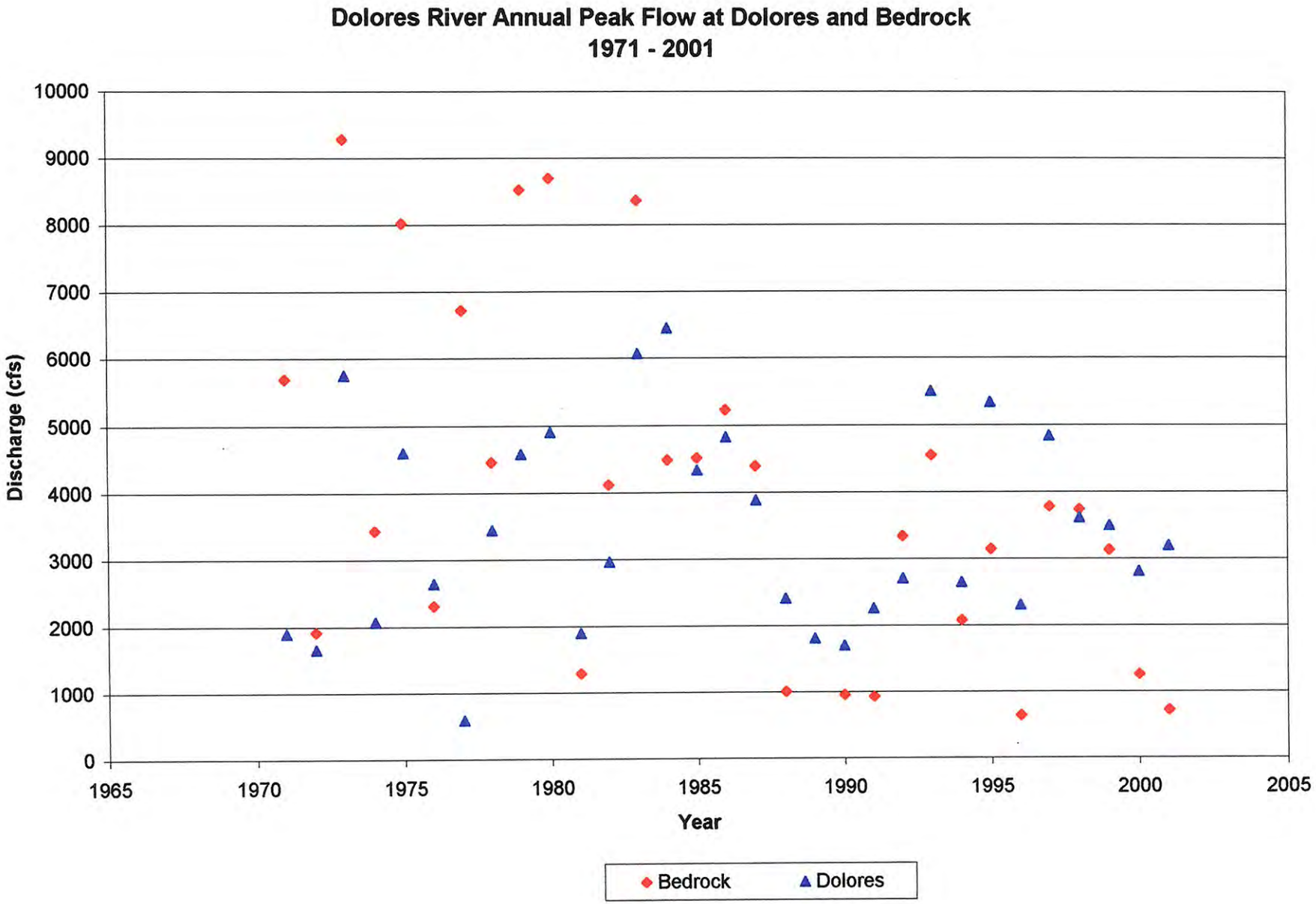
Seasonal Distribution of Annual Peak Flows

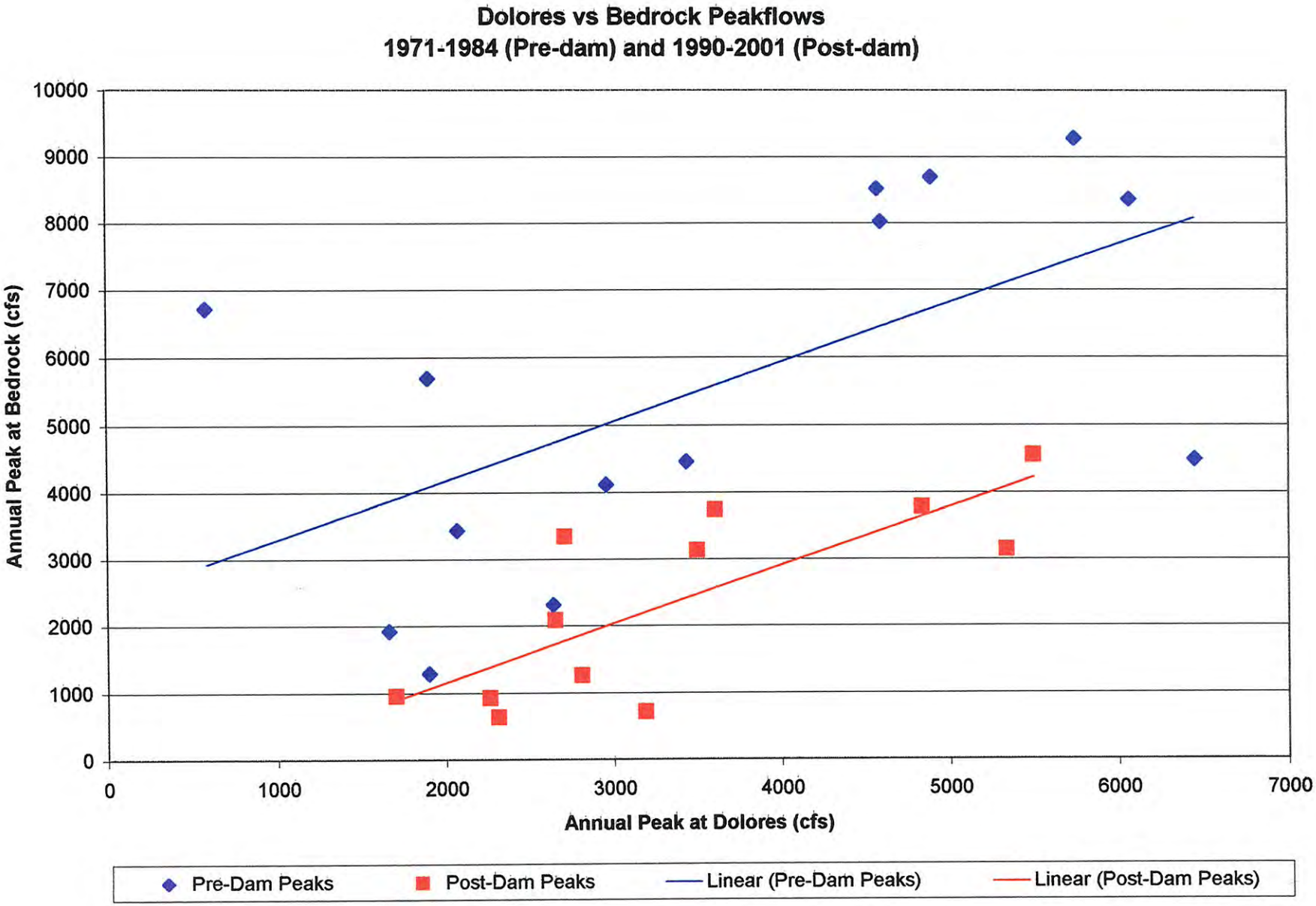
BLD – Data sorted by magnitude for each gage

Dolores @ Dolores		Disappointment Ck		Dolores @ Bedrock		San Miguel at Uravan	
Discharge (cfs)	Date	Discharge (cfs)	Date	Discharge (cfs)	Date	Discharge (cfs)	Date
5540	5/25/1984	663	8/8/1983	8150	4/30/1973		
5290	5/31/1983	601	7/24/1977	8000	4/26/1983	5440	5/16/1984
5060	5/20/1973	348	5/11/1973	7880	4/23/1980	4980	5/10/1983
4190	6/11/1980	342	4/2/1986	7440	4/19/1979	3790	4/19/1979
4170	5/29/1979	312	5/16/1984	5950	4/26/1975	3320	4/15/1985
4160	5/4/1986	277	10/7/1977	4690	5/5/1986	2630	4/26/1974
3840	6/6/1975	275	5/4/1985	4110	5/28/1984	2410	4/23/1980
3670	5/8/1985	258	4/18/1979	3860	5/7/1985	2380	5/12/1975
2950	5/16/1978	250	5/7/1980	3590	4/14/1978	2060	6/7/1986
2600	5/5/1982	247	7/17/1981	3250	5/4/1982	1960	5/5/1982
2180	5/18/1976	225	9/11/1982	1870	5/18-19/76	1850	4/27/1978
1710	5/11/1974	186	5/15-17/75	1380	5/12/1974	1140	8/16/1977
1640	5/3/1981	161	7/18/1974	1130	8/16/1972	880	5/22/1976
1400	6/8/1972	125	10/17/1971	990	5/5/1981	805	6/10/1981
385	4/19/1977	115	5/21-22/76	763	6/10/1972		

Early Peaks (Apr. 1 - May 15) - early snowmelt or rain on snow?
Snowmelt peaks (May 16 - June 30)
Monsoonal Peaks (July - Aug)
Post- monsoon fall peaks (Sept - Oct)

Annual Peaks at Bedrock			Annual Peaks at Dolores	
8/28/1971	5690	1971	6/18/1971	1900
10/17/1971	1920	1972	6/8/1972	1660
4/30/1973	9280	1973	5/20/1973	5750
7/16/1974	3430	1974	5/11/1974	2070
4/26/1975	8020	1975	6/6/1975	4600
5/19/1976	2310	1976	5/18/1976	2640
7/19/1977	6720	1977	4/18/1977	585
5/20/1978	4450	1978	5/17/1978	3440
4/19/1979	8520	1979	5/30/1979	4580
4/22/1980	8700	1980	6/11/1980	4900
5/4/1981	1290	1981	5/3/1981	1900
4/13/1982	4110	1982	5/5/1982	2960
4/26/1983	8360	1983	5/31/1983	6070
4/18/1984	4480	1984	5/25/1984	6450
4/9/1985	4510	1985	6/9/1985	4330
5/5/1986	5230	1986	5/4/1986	4820
5/21/1987	4390	1987	5/18/1987	3880
4/22/1988	1010	1988	5/18/1988	2410
		1989	5/9/1989	1810
9/6/1990	956	1990	5/25/1990	1700
5/22/1991	927	1991	5/14/1991	2260
5/26/1992	3340	1992	5/27/1992	2710
4/27/1993	4550	1993	5/28/1993	5500
5/21/1994	2080	1994	5/18/1994	2650
6/22/1995	3140	1995	6/17/1995	5340
9/14/1996	636	1996	5/17/1996	2310
5/22/1997	3780	1997	6/2/1997	4840
5/7/1998	3740	1998	5/22/1998	3610
5/26/1999	3130	1999	5/24/1999	3500
5/1/2000	1260	2000	5/5/2000	2810
4/17/2001	720	2001	5/16/2001	3190


Dolores River Annual Peak Flow at Dolores and Bedrock
1971 - 2001
Discharge (cfs)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
Bedrock
Dolores


Dolores vs Bedrock Peakflows
1971-1984 (Pre-dam) and 1990-2001 (Post-dam)
Annual Peak at Bedrock (cfs)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
1000
2000
3000
4000
5000
6000
7000
Annual Peak at Dolores (cfs)
Pre-Dam Peaks
Post-Dam Peaks
Linear (Pre-Dam Peaks)
Linear (Post-Dam Peaks)

IHA Parametric Scorecard

USGS 09169500 Dolores River at Bedrock, CO

Pre-Impact Period: 1918-1983 (18 years) **Post-Impact Period: 1984-2003 (20 years)**

Parameter	Pre Group #	Post 1	Pre	Post	Magnitude	%	Magnitude	%		Total Annual Q (AF) Pre-	Post-
October	61	83.2	1.32	0.6	22.2	36.4	-0.73	-55		3751	5116
November	47.9	78.3	1	1.03	30.3	63.3	0.02	2.2		2660	4349
December	50.2	65.5	0.68	0.75	15.3	30.5	0.06	9.3		3087	4027
January	55.1	67.4	0.53	0.6	12.3	22.3	0.07	14.1		3388	4144
February	68.2	76.4	0.54	0.47	8.2	12	-0.07	-12.5		4058	4546
March	152.2	219.5	0.78	0.96	67.2	44.1	0.18	22.4		9359	13497
April	1214.8	866.6	0.82	0.96	-348.2	-28.7	0.14	17.6		72287	51567
May	2136.1	1288.5	0.74	0.87	-847.5	-39.7	0.12	16.3		131346	79228
June	1443.8	669.5	0.8	0.98	-774.3	-53.6	0.18	22.8		65913	39839
July	264.7	137.3	0.96	1.02	-127.4	-48.1	0.07	7		16276	8442
August	92.9	108.2	1.4	0.76	15.3	16.4	-0.63	-45.4		5712	6653
September	45.2	97.1	1.54	0.67	51.9	114.9	-0.87	-56.3		2690	5778
									Total Q	340526	227186
Parameter	**Group #**	**2**									
1-day minimum	4.4	30.1	1.04	0.51	25.7	589.6	-0.52	-50.6			
3-day minimum	4.7	32.1	1.05	0.5	27.4	576.6	-0.55	-52.3			
7-day minimum	5.2	34.8	1.02	0.47	29.6	570.8	-0.55	-53.6			
30-day minimum	12.4	40.9	1.14	0.47	28.6	230.4	-0.67	-58.7			
90-day minimum	20	51.3	1.04	0.47	31.3	156.2	-0.57	-54.8			
1-day maximum	3810.7	2296.3	0.7	0.67	-1514.4	-39.7	-0.04	-5.4			
3-day maximum	3541.2	2180.4	0.71	0.69	-1360.8	-38.4	-0.02	-2.8			
7-day maximum	3150.5	2015.8	0.71	0.7	-1134.8	-36	-0.01	-1.9			
30-day maximum	2389.9	1463.5	0.73	0.8	-926.4	-38.8	0.07	9.6			
90-day maximum	1666.5	980.6	0.72	0.85	-685.9	-41.2	0.13	18.1			
Number of zero days	0.28	0	3.45	0	-0.28	-100	-3.45	-100			
Base flow-index	0.01	0.18	1.18	0.85	0.17	1264.87	-0.33	-28.02			
Parameter	**Group #**	**3**									
Date of minimum	244.2	302.9	0.08	0.18	58.6	32	0.1	114.9	**Oct 1 = Day 1**		
Date of maximum	138.2	158.8	0.1	0.14	20.6	11.2	0.04	36			
Parameter	**Group #**	**4**									
Low pulse count	5.3	0.6	0.75	2.7	-4.6	-87.7	1.95	262	**lo < 5%**		
Low pulse duration	13.1	2.5	1.18	3.32	-10.6	-80.6	2.13	180.5			
High pulse count	1.9	1.6	0.92	1.12	-0.3	-15.1	0.19	20.8	**Hi > 95%**		
High pulse duration	18.2	7.3	1.27	1.15	-11	-60.1	-0.11	-9			

The low pulse threshold is 14 cfs (mean of pre-period 5th percentile flow)
The high pulse level is 1508 cfs (mean of pre-period 95th percentile flow)

Parameter	Group #	5							
Rise rate	118.4	51.7	0.52	0.68	-66.7	-56.3	0.16	31	
Fall rate	-79.3	-37.9	-0.55	-0.67	41.4	-52.2	-0.12	22.2	
Number of reversals	91.3	95.8	0.35	0.13	4.5	5	-0.22	-63.3	**# times 'up and down'**

IHA Parametric Scorecard

USGS 09180000 - Dolores River nr Cisco, UT

Pre-impact period - 1951 - 1983 (33 years) **Post-impact period - 1984 - 2003 (20 years)**

	Pre	Post	Pre	Post	Magnitude	%	Magnitude	%	Total Annual Q (AF)	
Parameter	**Group #**	**1**							Pre-	Post-
October	195	269.6	0.77	0.5	74.6	38.2	-0.27	-34.7	11990	16577
November	168.6	249.7	0.52	0.67	81.2	48.1	0.15	29.3	9364	13868
December	162.8	209	0.46	0.53	46.2	28.4	0.07	14.6	10010	12851
January	165	181.6	0.4	0.39	16.5	10	-0.01	-1.4	10146	11166
February	213.3	224.7	0.45	0.4	11.4	5.3	-0.05	-11.6	12692	13371
March	344.8	492.6	0.68	0.71	147.8	42.9	0.03	3.8	21201	30289
April	1960.2	2010.8	0.8	0.87	50.6	2.6	0.07	8.3	116642	119653
May	2971	3016.4	0.79	0.85	45.4	1.5	0.06	7.9	182682	185474
June	2078.1	1704.5	0.84	0.77	-373.5	-18	-0.08	-9.3	123657	101426
July	648.7	578.9	1.02	0.82	-69.9	-10.8	-0.2	-19.9	39888	35596
August	301.1	313.7	0.91	0.8	12.6	4.2	-0.12	-12.8	18514	19289
September	205.8	271.9	1.18	0.65	66.1	32.1	-0.53	-44.7	12246	16179
									Total Q 569033	575739

Parameter	**Group #**	**2**						
1-day minimum	47	96.6	0.87	0.53	49.6	105.7	-0.34	-38.7
3-day minimum	49.8	101.8	0.87	0.54	52.1	104.6	-0.33	-38
7-day minimum	54.2	107.7	0.84	0.53	53.5	98.8	-0.31	-36.5
30-day minimum	77.5	128.4	0.62	0.47	50.9	65.7	-0.15	-24.6
90-day minimum	111	166.4	0.42	0.42	55.3	49.9	0.01	1.5
1-day maximum	5729.7	4977.9	0.72	0.76	-751.8	-13.1	0.04	5.9
3-day maximum	5432.7	4746.3	0.73	0.79	-686.4	-12.6	0.06	8.2
7-day maximum	4885.5	4468.7	0.74	0.82	-416.8	-8.5	0.08	10.6
30-day maximum	3573.8	3344.5	0.75	0.82	-229.3	-6.4	0.07	9.7
90-day maximum	2451	2308.4	0.75	0.79	-142.6	-5.8	0.03	4.3
Number of zero days	0	0	0	0	999999	999999	999999	999999
Base flow	0.09	0.15	0.7	0.45	0.07	75.53	-0.26	-36.42

Parameter	**Group #**	**3**						
Date of minimum	233	181.6	0.22	0.3	51.4	28.1	0.08	37.3
Date of maximum	140.1	146.4	0.13	0.11	6.3	3.4	-0.02	-13.3
Mean |%| change					15.8		25.3	

Parameter	**Group #**	**4**						
Low pulse count	7.4	5.1	0.59	1.03	-2.3	-30.7	0.44	73.4
Low pulse duration	11.6	6	0.69	1.04	-5.6	-48.3	0.35	51
High pulse count	2.2	1.5	0.87	0.99	-0.6	-28	0.12	14
High pulse duration	14.9	19.6	1.27	1.39	4.6	31.1	0.12	9.4

The low pulse threshold is 125 cfs (mean of pre-period 5th percentile flow)
The high pulse level is 2320 cfs (mean of pre-period 95th percentile flow)

Parameter	**Group #**	**5**						
Rise rate	136	93.7	0.6	0.64	-42.2	-31.1	0.05	7.6
Fall rate	-97.4	-67.5	-0.64	-0.64	29.9	-30.7	0	-0.3
Number of reversals	97	115.7	0.14	0.1	18.7	19.3	-0.04	-28.5

APPENDIX B

DRD Operations Hydrology Results

1. Baseflow - DRD Hydrology 10154
2. Spill Release – DRD Hydrology 10154
3. (DPR TABLE 33????) – not found yet

Impact of "no pool debit during spill"

	A	B	C	D	E	F	G
1	BASE FLOW / MANAGEMENT OPTIONS						
2							
3			16,789	45.9959			
4	Cumulative AF	Table 1	cfs days / mo	days per mo	releas volume		
5		Apr	1,500	30	50		
6		May	1,550	31	50		
7		Jun	2,250	30	75		
8		Jul	2,325	31	75		
9		Aug	2,325	31	75		
10		Sep	1,500	30	50		
11		Oct	1,550	31	50		
12		Nov	750	30	25		
13		Dec	775	31	25		
14		Jan	775	31	25		
15		Feb	700	28	25		
16		Mar	775	31	25		
17			16,775		45.8333		
18	Table 2						
19	1,368	1,368	17,465	690	Apr 15-30		
20	2,737	1,368	18,155	690	May 1-15		
21	4,197	1,460	18,891	736	May 15 -31		
22	5,565	1,368	19,581	690	Jun 1 - 10		
23	101.19				55	tot days	
24					5,565.21		
25							
26							

All extrapolate to near 33,200 AF

cfs 45.83 → 33182

16,775 cfs → 33327

Impact of "no pool debit during spill"

Cell: A1
Comment: The purpose of these two tables is to analyze the benefit that "no debit to the fish pool during managed spill" provides to the volume of the pool downstream release
This additional debit to the pool is a risk of future shortage that users inherit by allowing this practice.

Cell: C3
Comment: This is total annual AF converted to cfs days

Cell: D3
Comment: This is the average cfs / day / 365 days

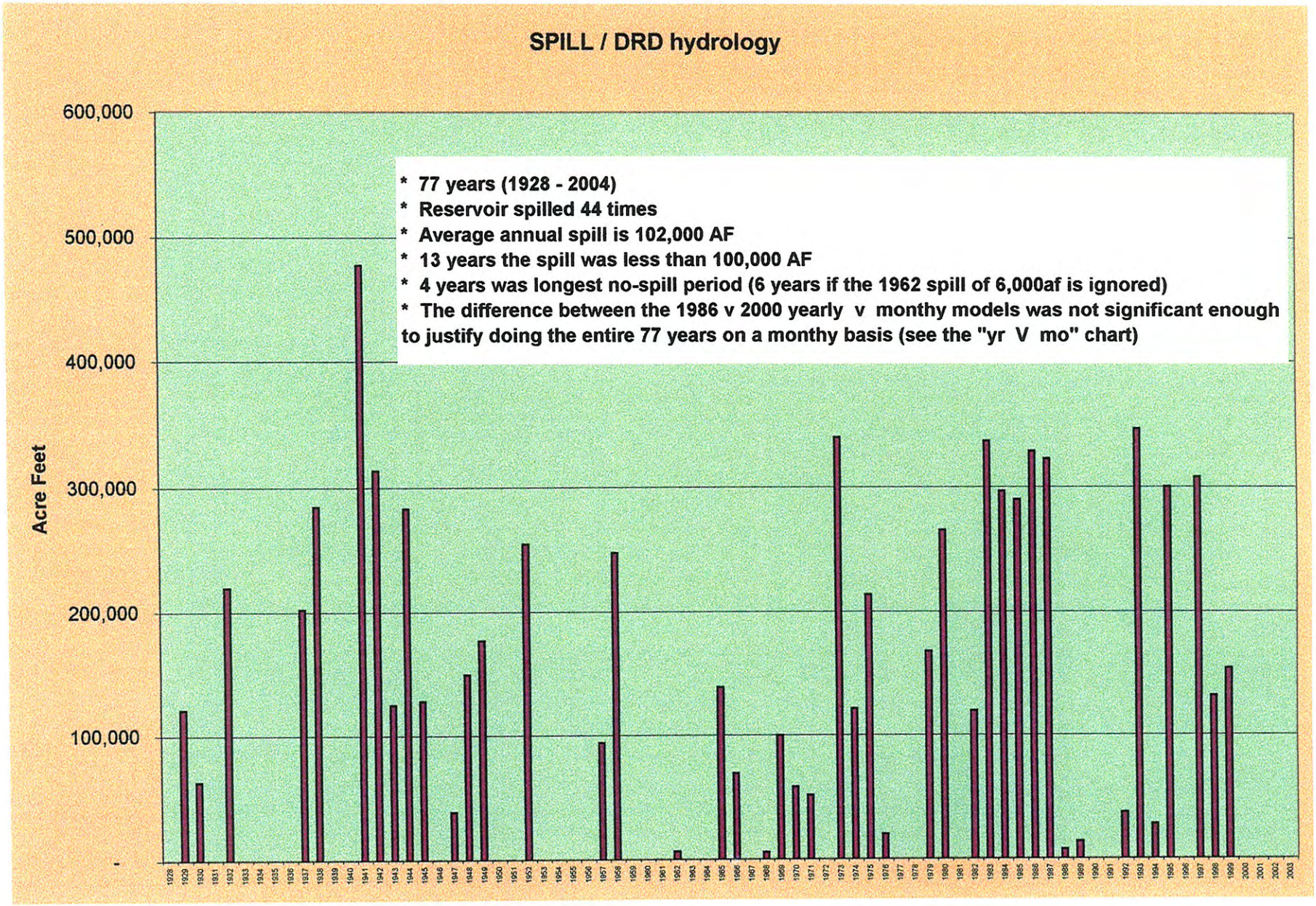
Cell: B4
Comment: Table 1 apportions 16,780 cfs days through out the year

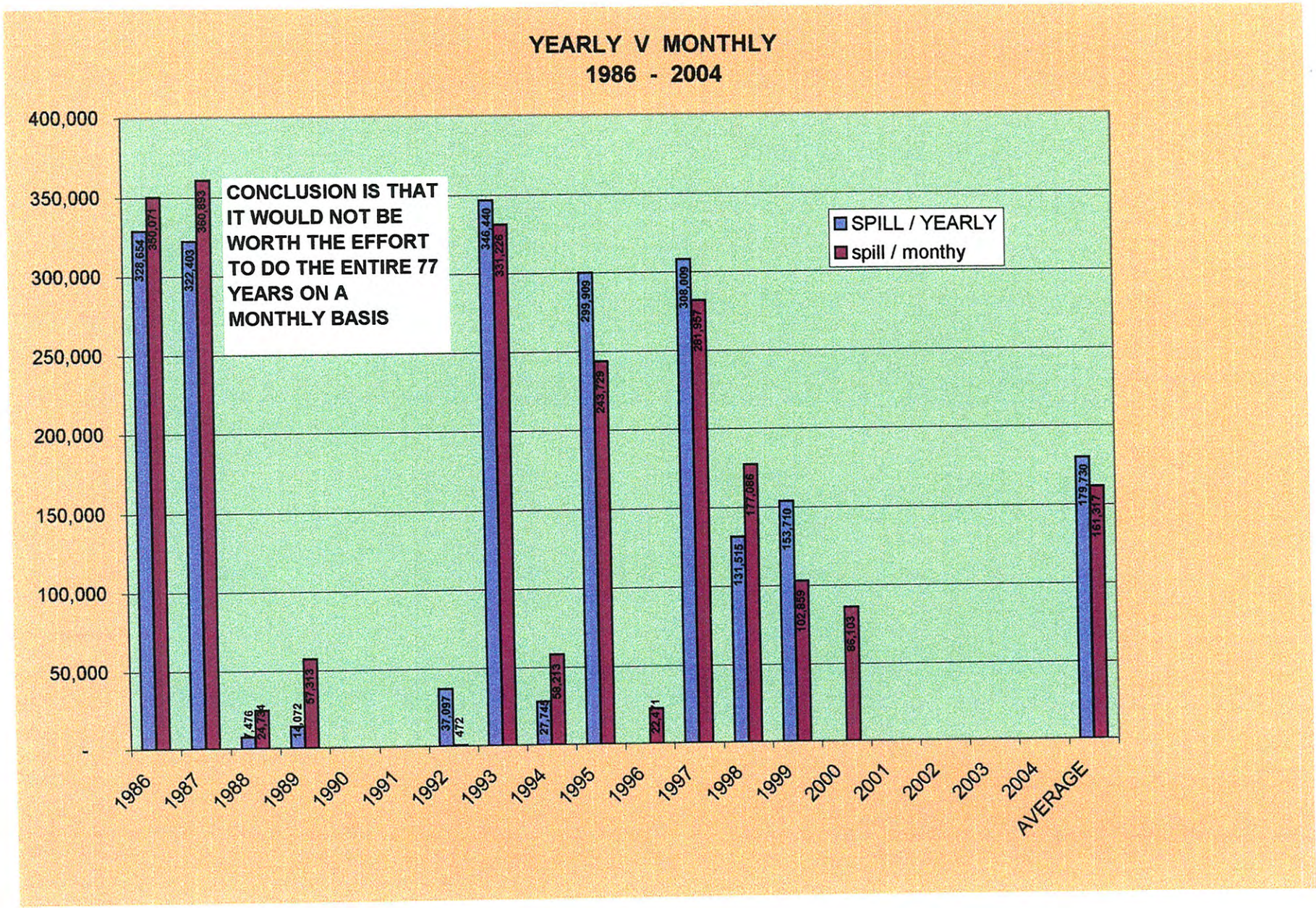
Cell: C17
Comment: The two blue cells should nearly equal each other. By adjusting the release volumn, #s in Col C and consequently #s in Cell C18 change.

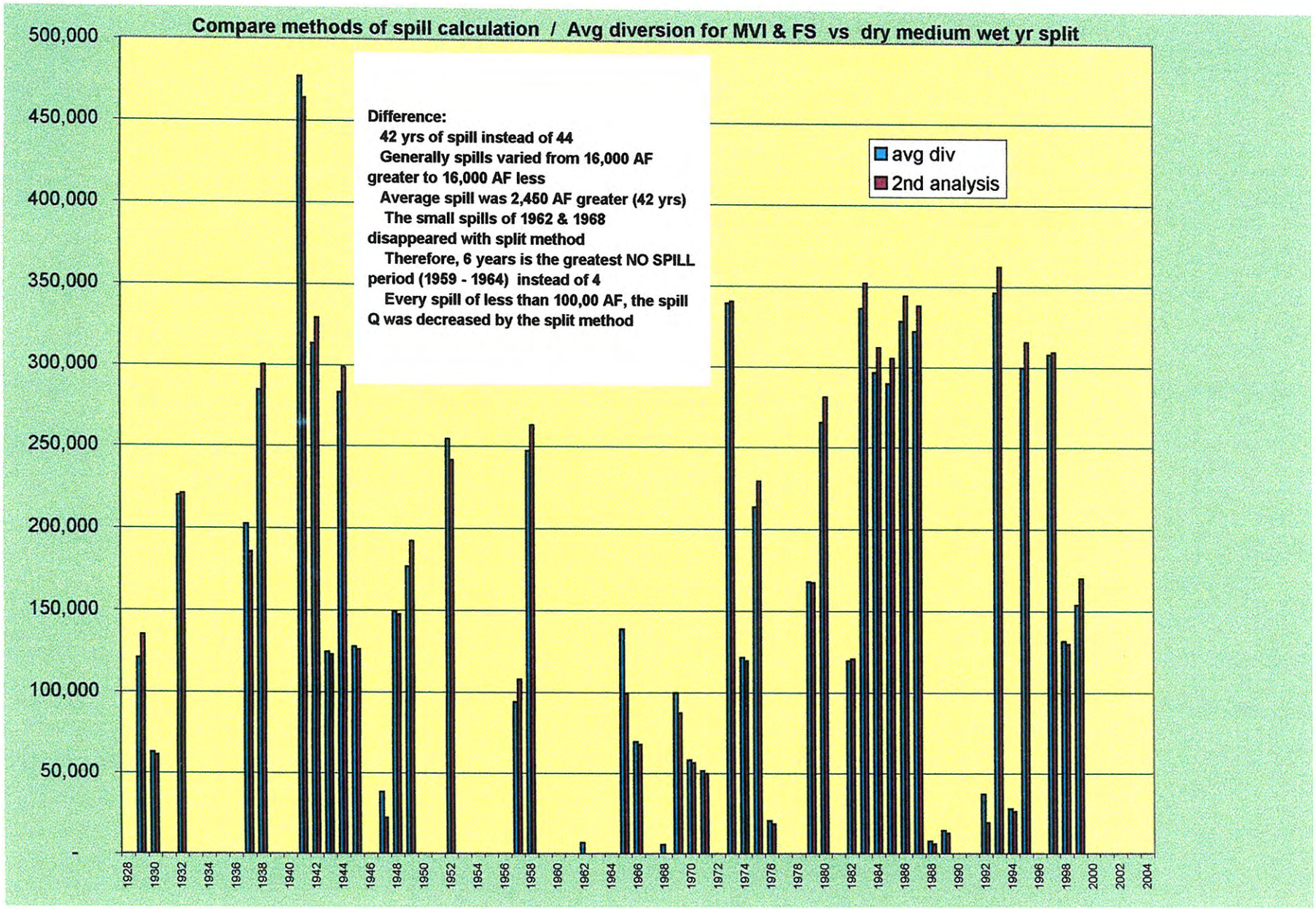
Cell: A18
Comment: Table 2 calculates the number of AF a period of "no debit to the fish pool during a managed spill" accumulates

Cell: A23
Comment: Assume a Apr 15 - Jun 10 managed spill. This is the average daily af added to the total fish pool.
What is the best use for this water?? daily flow or sediment movement??

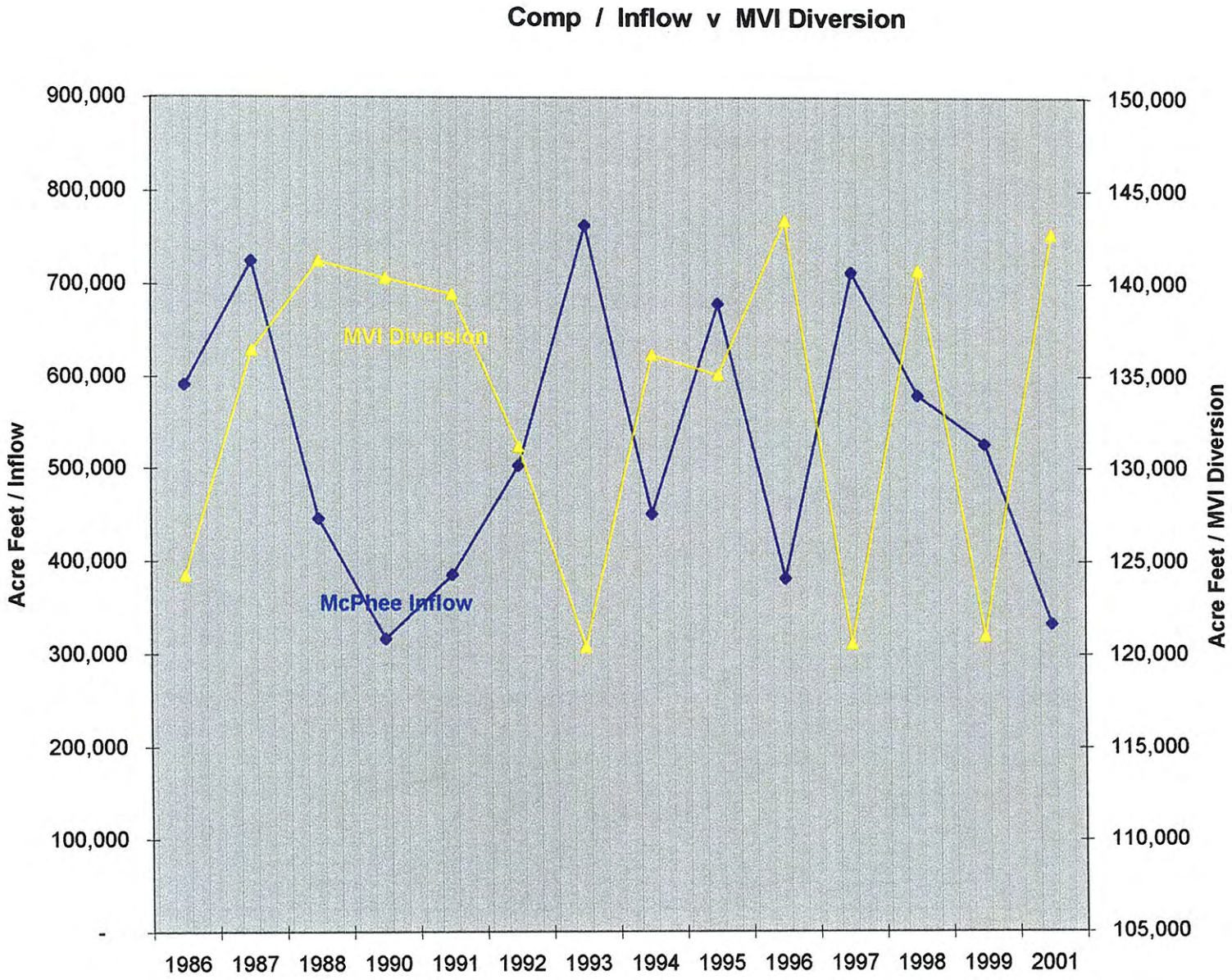
Cell: E24
Comment: Assume a managed spill from Apr 15 to Jun 10, the fishery pool would gain 5,565 af of water.


SPILL / DRD hydrology
* 77 years (1928 - 2004)
* Reservoir spilled 44 times
* Average annual spill is 102,000 AF
* 13 years the spill was less than 100,000 AF
* 4 years was longest no-spill period (6 years if the 1962 spill of 6,000af is ignored)
* The difference between the 1986 v 2000 yearly v monthy models was not significant enough to justify doing the entire 77 years on a monthy basis (see the "yr V mo" chart)
Acre Feet
600,000
500,000
400,000
300,000
200,000
100,000
-


YEARLY V MONTHLY
1986 - 2004
CONCLUSION IS THAT IT WOULD NOT BE WORTH THE EFFORT TO DO THE ENTIRE 77 YEARS ON A MONTHLY BASIS
SPILL / YEARLY
spill / monthy
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
328,654
350,071
322,403
360,893
7,476
24,734
14,072
57,313
37,097
472
346,440
331,226
27,744
58,213
299,909
243,729
22,431
308,009
281,957
131,515
177,086
153,710
102,859
86,103
179,730
161,317
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
AVERAGE


Compare methods of spill calculation / Avg diversion for MVI & FS vs dry medium wet yr split
Difference:
42 yrs of spill instead of 44
Generally spills varied from 16,000 AF greater to 16,000 AF less
Average spill was 2,450 AF greater (42 yrs)
The small spills of 1962 & 1968 disappeared with split method
Therefore, 6 years is the greatest NO SPILL period (1959 - 1964) instead of 4
Every spill of less than 100,00 AF, the spill Q was decreased by the split method
avg div
2nd analysis
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
1928
1930
1932
1934
1936
1938
1940
1942
1944
1946
1948
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004

"Spill comp"

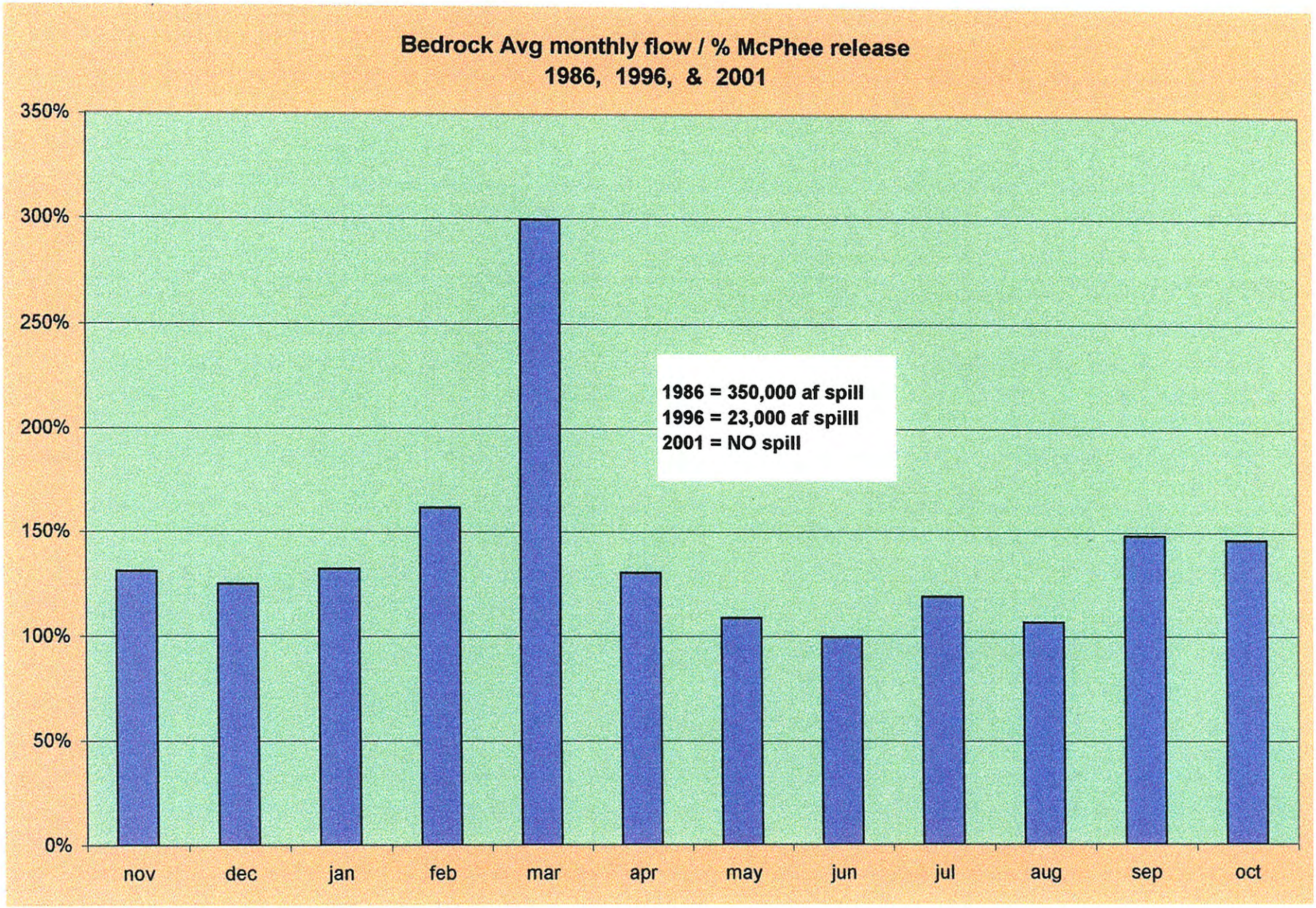

Comp / Inflow v MVI Diversion
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
-
Acre Feet / Inflow
150,000
145,000
140,000
135,000
130,000
125,000
120,000
115,000
110,000
105,000
Acre Feet / MVI Diversion
MVI Diversion
McPhee Inflow
1986
1987
1988
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2001

McPhee release v Bedrock flow comparison

	F	G	H	I	J	K	L	M	N	O
2	Table 2									
3		McPhee					Bedrock			
4		1986	1995	2001	avg	avg %	avg	1986	1995	2001
5	nov	3019	2377	2454	2617	131%	3431	5058	2975	2,261
6	dec	4249	2154	2547	2983	125%	3732	5841	2856	2,499
7	jan	3163	1821	2547	2510	132%	3320	4243	2583	3,136
8	feb	2786	1707	2275	2256	162%	3647	5554	2610	2,777
9	mar	4901	2089	2533	3174	300%	9510	21275	2951	4,304
10	apr	88044	2615	2103	30921	130%	40344	103479	3273	14,281
11	may	108257	3362	3065	38228	109%	41546	114061	4366	6,210
12	jun	63391	4047	3836	23758	100%	23723	64622	3332	3,213
13	jul	14380	4748	4318	7815	119%	9305	20722	3935	3,259
14	aug	7073	4925	4372	5457	107%	5821	7625	3689	6,149
15	sep	4721	3675	3517	3971	148%	5891	10175	4522	2,975
16	oct	12744	2961	2616	6107	146%	8936	15803	8424	2,583
17										

McPhee release v Bedrock flow comparison

Cell: F2
Comment: Col K of this table is the basis for the "bedrock %" chart


Bedrock Avg monthly flow / % McPhee release
1986, 1996, & 2001
350%
300%
250%
200%
150%
100%
50%
0%
1986 = 350,000 af spill
1996 = 23,000 af spilll
2001 = NO spill
nov
dec
jan
feb
mar
apr
may
jun
jul
aug
sep
oct

APPENDIX C

DRD Constraints – "Hydro contracted.xls"

WATER ALLOCATION OF DOLORES RIVER

	A	B	C	D
1			**Per DPR**	**Per 1986-04 Avg**
2				
3	**Total Inflow**		**353,500**	**370,393**
4				
5	**Extent of McPhee's Influence**			
6		Influenced by McPhee	139,900	137,878
7		Not Influenced by McPhee	213,600	232,515
8		Total	353,500	370,393
9	**Location of McPhee Influence**			
10		Inbasin	38,600	46,779
11		Transbasin	101,300	91,099
12		Total	139,900	137,878
13	**Inbasin Influence**			
14		Evaporation	5,400	13,579
15		Instream release / flow scenario	25,400	25,400
16		Instream / the "mistake water"	3,900	3,900
17		Sr pass through water rights	3,900	3,900
18		Total	38,600	46,779
19	**Transbasin Influence**			
20		F&W / San Juan Basin	1,600	1,600
21		Full Service ag	54,200	46,643
22		Ute ag	22,900	23,300
23		MVIC ag	13,700	13,700
24		M&I	8,700	5,656
25		M&I Evap	200	200
26		Total	101,300	91,099
27	**Not Influenced by McPhee**			
28		Cortez	4,600	1,956
29		MWC	2,100	1,100
30		MVIC	130,600	124,472
31		MVIC stock water	1,800	1,800
32		Upstream Cons Use	2,300	1,200
33		Total	141,400	130,528
34				
35		Allocated Use	281,300	268,406
36				
37		Un Allocated / Spill	72,200	101,987
38				
39				
40	**GRAND TOTAL**		353,500	370,393

Actual? or is this Ave. Model. or 2nd Accept?

In/Out Basin - not a DS use.

Lo.

⇒ FS on-line ~1999

Hi.

NOTE BALANCE: "McPhee Enfl" + "Not Enf. by McPhee" + Spill

In Basin (Fish, Seniors) + Evap

Out-Basin

M&I DPS MVIC

Cell: C1
Comment: The #s in this column are from the BOR's Appendix B of the Definite Plan Report. They were developed by a study of the flow of the Dolores River from 1928 to 1974.

Cell: D1
Comment: The #s in this column were developed from summarizing DWCD's In/outflow daily records from 1986 thru 2004.

Cell: D3
Comment: Note the average inflow is almost 17,000 af greater than during the 46 yr DPR average

Cell: B6
Comment: The following is the water rights that are the basis for all Dolores Project allocations. All allocations are provisions in DWCD's Repayment Contract No. 7-07-40-W0470 with the United States.
The following is the water right. Montezuma County District Court, Water District Number 34, Civil Action Number 967, July 19, 1962 – Adjudication of Priorities of Water Rights for the Dolores Project by the Southwestern Water Conservation District (SWCD):
There is an exercise Dolores Project users go through each year, especially if a shortage is anticipated. The exercise is guided by a spreadsheet call the Allocation Template. This spreadsheet is very helpful in understanding the contracural constraints that is imposed on users of the Dolores River.

Cell: B7
Comment: This portion of the yield of the Dolores River is senior and separate from the Dolores Project / McPhee Reservoir. Those amount of water are listed in lines 28 - 32.

Cell: B10
Comment: This category of water use is listed in lines 14 - 17.

Cell: B11
Comment: This category of water is used in the San Juan basin. It is listed in lines 20 - 25.

Cell: B14
Comment: This is what it is. Note the difference between the DPR estimate and actual post McPhee measurement, via an evaporation pan, located at Great Cut, monitored daily by DWCD

Cell: B15
Comment: Article 9(d)(iii)(c) of DWCD's Repayment Contract No. 7-07-40-W0470 "reserves to Reclamation the average annual use of 25,400 Af of the active capacity of McPhee Reservoir for release from McPhee Reservoir for downstream fish and wildlife purposes".

The separate Operating Agreement, Contract No. 99-WC-40-R6100, carries out the purpose of the Repayment Contract's Article 9(d)(iii)(c) , Heading No. 3. Downstream Fish & Wildlife Release says "Subject to other terms and conditions herein, the following amounts of water are available annually as a managed pool to be released from McPhee Reservoir into the Dolores River for fish and wildlife purposes": 3. a) says, "Up to 3,900 AF of non-Project water to satisfy senior water rights downstream of McPhee Reservoir, based on the DPR estimate of the average annual historic usage of these senior water rights. If, pursuant to the laws of the State fo Colorado, the full decreed amount

of these downstream senior water rights is not beneficially used, or the entitlement of these senior rights is reduced , the managed pool will be reduced accordingly". This amount is added to the downstream pool at Cell N50; 3. b) says, "25,400 AF of the active capacity of McPhee Reservoir, identified in Article 9(d)(iii)(c), subject to shortages". The 25,400 AF is calculated in Appendix "B" Table 34, Column 17, pg 107; 3. c) says, "3,900 AF of Project water acquired by Reclamation from the District pursuant to Grant Agreement No. 6-FG-40-18960 dated April 10, 1996, subject to any shortages".

Cell: B16
Comment: As a result of the 1990 low flow water year, and during the next 5 years of negotiation the downstream release was changed from a "flow" (20, 50, 72 cfs - dry, normal, wet year flow) to a pooled release (25,400 af annually). Making that change identified 3,900 af of additional water that would have to come from storage, thereafter referred to as "mistake" water. The 3,900 af of Project water was acquired by Reclamation from the District pursuant to Grant Agreement No. 6-FG-40-18960 dated April 10, 1996, subject to any shortages.

Cell: B17
Comment: The note @ Cell B15 explaines item.

Cell: B20
Comment: DWCD's Repaymnet Contract No. 7-07-40-W0470 reserves unto the United states, in addition to water at Cell B21 & Cell E20, 800AF for F&W enhancement in the San Juan Basin. It is calculated in Table 34, Column 17a of Appendix "B", pg 107.

Cell: B21
Comment: The diversion requirement for the various Project areas is developed in Appendix "B", Chapter IV. The allocation of AF is found in Table 33, Column 49, Pg 107.

Cell: B22
Comment: The Colorado Ute Indian Water Rights Settlement Agreement, dated December 10, 1986,was passed into law by Public Law 100-585 in 1988. Article 3, Section A, Subsection 1, Pg 6, as follows: a). "The tribe shall receive a project reserved water right to store water from the Dolores Project. This project reserved water right shall have a 1868 priority date, shall for all time be subordinated to all water rights decreed and senior to the Dolores Project, and shall share for all time on a pro rata basis the priority of the Dolores Project, which has an adjuducation date of March 22, 1963 and appropriation date of September 10, 1940, C.A. 967, District Court, Montezuma County". b). stipulates, "The project reserved water right shall entitle the Tribe to receive and beneficially use, on that part of the Ute Mountain Ute Indian Reservation within the State or within the boundaries of the Dolores Water Conservancy District, the following allocations of water from the Project, as measured at McPhee Dam and Reservoir: (i) a maximum of 1,000 AF per annum of municipal and industrial water; (ii) a maximum of 23,300 AF per annum of agricultural irrigation water; and (iii) a maximum of 800 AF per annum for fish and wildlife development. The project reserved water right shall not exceed the total of the above allocations. c). During periods of water shortage, deliveries of project water, or deliveries of the supply of water available under the project priority, to the Tribe and to all others shall be as follows: (i) municipal and industrial water allocations as quantified in the DPR shall first be fully satisfied; (ii) agriculture irrigation water allocations and other allocations as quantified in the DPR, exclusive of the stream fishery releases, shall share shortages on a pro rata basis even if changed to other beneficial uses; (iii) stream fishery releases to the Dolores River set

forth in the DPR (later changed from a 'flow' to a 'pool') shall be made in accordance with the operating agreement between DWCD and the United States. The sharing of shortages in the project's water supply shall govern the actual amount of agricultural irrigation water and water for fish and wildlife development delivered to the Tribe whether or not the average supply of 22,900 acre-feet per annum of agricultural water and 800 acre-feet of fish and wildlife development water , as contemplated by the DPR, is actually achieved".

The Ute Mountain Ute Repayment Contract No. 9-07-40-R072- @ Article 8, pg 9, Titled "Tribes share of Project Water" quotes the same concepts and stipulations quoted from the Settlement Agreement. Article 17, pg 19 titled "Water Shortages, Waste, Seepage and Return Flows" refers directly to the language already quoted from the Water Rights Settlement Agreement.

The 23,300 AF of maximum annual agricultural irrigation water delivery and the 22,900 AF average annual delivery are calculated in Appendix, "B", Table 33, Column 40 & 41 pg 107

Cell: B23
Comment: MVIC's allocation of Dolores Project water is based on a Contract Between the Dolores Water Conservancy District and the Montezuma Valley Irrigation Company for Adjustment of Water Rights and Sale of the Use of Irrigation Water, September 23, 1977:

Cell: B24
Comment: M&I entitlements to Project water are as follows: DWCD = 5,220 AF. At this point less than 500 af of this has been sold. Cortez = 2,300 AF. UTMUT = 1,000 AF which is diverted through the Cortez system. Dove Creek = 280 AF. Both Cortez & MWC's non-Project water is accounted for at Cells M18 & 18. The calculation in this Cell is the Project water diverted during the prior season.

Cell: B27
Comment: All of the #s itemized in lines 28 - 31 are covered by water senior to McPhee. For instance, regarding seniority, MVIC water right is an 1892 right.
Many water rights upstream of McPhee are actually junior to McPhee. The administration of those rights were addressed by the following agreement:
Agreement Among the Dolores Water Conservancy District and the Montezuma Valley Irrigation Company, and Landowners in the Upper Dolores River Drainage for Water Operations on the Upper Dolores River, dated (1986??):

Cell: B35
Comment: This cell adds all of the identified allocations of Dolores River water used either in or out of the Dolores River basin. Cells 18 + 26 + 33

Cell: B37
Comment: Beginning with the average annual inflow @ line 3 and subtracting the total allocated use, the result is the the average annual spill / un-allocated water.

Cell: D37
Comment: There are three reasons this # is nearly 30,000 af greater than the DPR # is because neither MVIC nor non-Indian Full Service irrigators use all of their allocations each year. See lines 21 & 30. The

3rd reason is because the average inflow was 17,000 af greater during the 1986-04 avg than during the 46 year 1928-74 DPR avg.

DOLORES RIVER BASIN
ALLOCATION OF THE HYDROGRAPH

TOTAL INFLOW INTO McPHEE / PURSUANT TO CONTRACTS BASED ON THE DPR

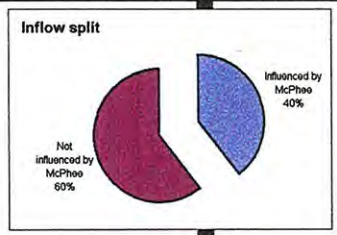
AF 353,500

Influenced by McPhee
AF 139,900
% 40%

Not influenced by McPhee
213,600 AF
60% %

In this chart the 3900 mistake water was subtracted from the spill. In actual practice it will come from a combination of four allocations: full service, ute ag, mvic project, and the spill.

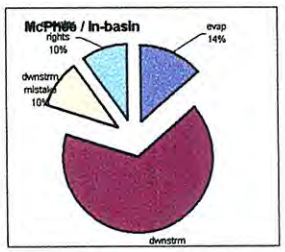
Sr Water	
Owner	AF
DOW	2011
I rogers	804
t Roso	804
gp moore	281
total	3900

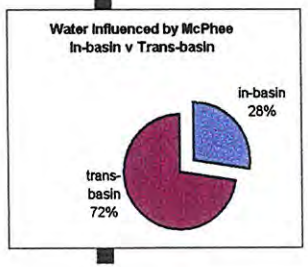


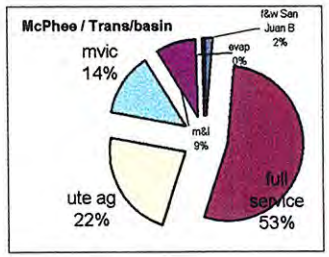
In-basin 38,600

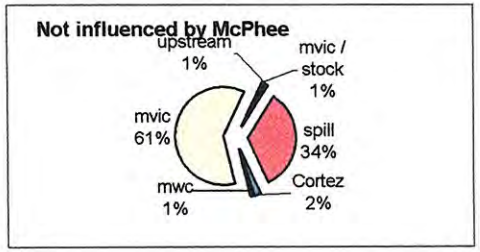
Trans-basin 101,300

evaporation	dwnstrm	dwnstrem mistake	sr water rights	f&w San Juan B	full service	ute ag	mvic	m&I	m&I evap	Cortez	mwc	mvic	mvic / stock	upstream	spill	GRAND TOTAL
5,400	25,400	3,900	3,900	1,600	54,200	22,800	13,700	8700	200	4600	2100	130600	1800	2300	72200	353,500
1.5%	7%	1.1%	1.1%	0.5%	15%	6%	4%	2.5%	0.06%	1.3%	0.6%	37%	0.5%	0.7%	20%	









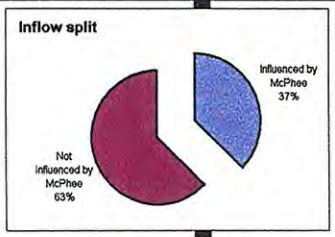
DOLORES RIVER BASIN
ALLOCATION OF THE HYDROGRAPH

TOTAL INFLOW INTO McPHEE / BASED ON 18 YEARS OF PROJECT OPERATION / AVERAGE USE

370393 **AF** **370,393**

Influenced by McPhee
AF = 137,878
% = 37%

Not influenced by McPhee
AF = 232,515
% = 63%



Sr Water	
Owner	AF
DOW	2011
I rogers	804
t Rose	804
gp moore	281
total	3900

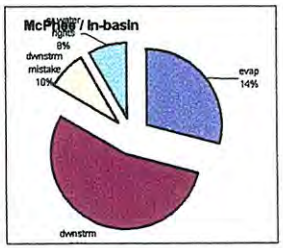
In this chart the 3900 mistake water was subtracted from the spill. In actual practice it will come from a combination of four allocations: full service, ute ag, mvic project, and the spill.

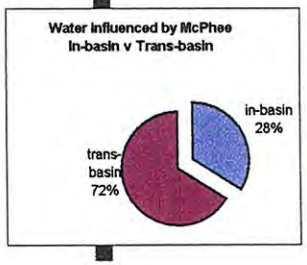
In-basin
46,779

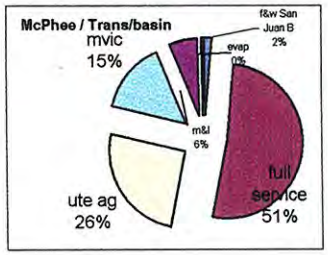
Trans-basin
91,099

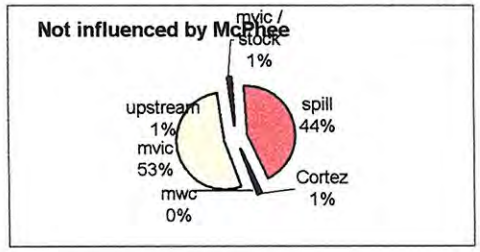
1956

evaporation	dwnstrm	dwnstrem mistake	sr water rights	f&w San Juan B	full service	ute ag	mvic	m&I	m&I evap	Cortez	mwc	mvic	mvic / stock	upstream	spill	370,393
13,579	25,400	3,800	3,800	1,600	46,643	23,300	13,700	5656	200	1956	1100	124472	1800	1200	101987	
4%	7%	1.1%	1.1%	0.4%	13%	6%	4%	1.5%	0.1%	0.5%	0.3%	34%	0.5%	0.3%	28%	





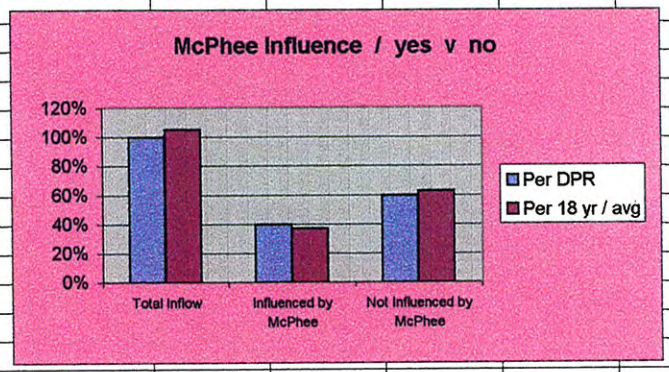


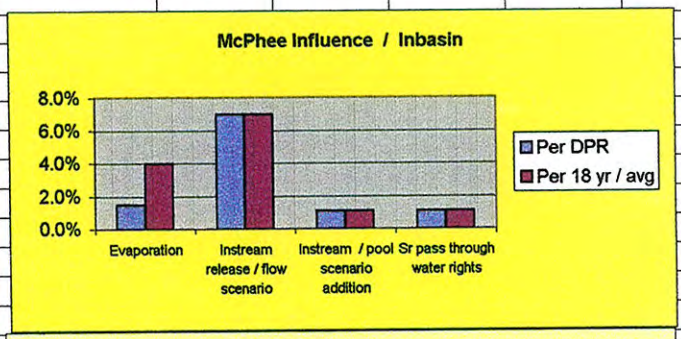


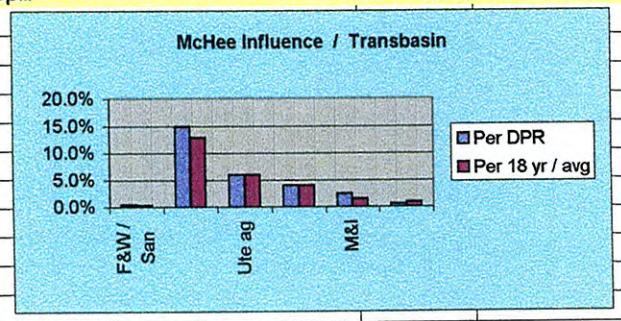
Comparison / D. R v 18yr avg model

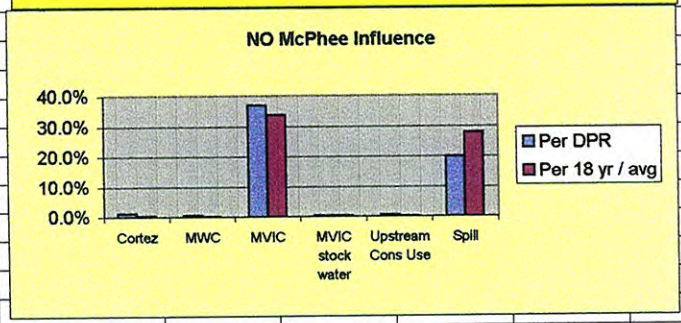
	A	B	C
1		Per DPR	Per 18 yr / avg
2	Total Inflow	100%	106%
3	Influenced by McPhee	40%	37%
4	Not Influenced by McPhee	60%	63%
5	Influenced by McPhee		
6	Inbasin	28%	28%
7	Transbasin	72%	72%
8	Inbasin		
9	Evaporation	1.5%	4%
10	Instream release / flow scenario	7%	7%
11	Instream / pool scenario addition	1.1%	1.1%
12	Sr pass through water rights	1.1%	1.1%
13	Transbasin		
14	F&W / San Juan Basin	0.5%	0.4%
15	Full Service ag	15%	13%
16	Ute ag	6%	6%
17	MVIC ag	4%	4%
18	M&I	2.5%	1.5%
19	M&I Evap	0.6%	1.0%
20	Not Influenced by McPhee		
21	Cortez	1.3%	0.5%
22	MWC	0.6%	0.3%
23	MVIC	37%	34%
24	MVIC stock water	0.5%	0.5%
25	Upstream Cons Use	0.7%	0.3%
26	Spill	20%	28%

E	F
353500	373165









Comparison / DPR v 18yr avg model

Cell: A1
Comment: The purpose of this sheet is to chart the 4 different areas of McPhee's influence.

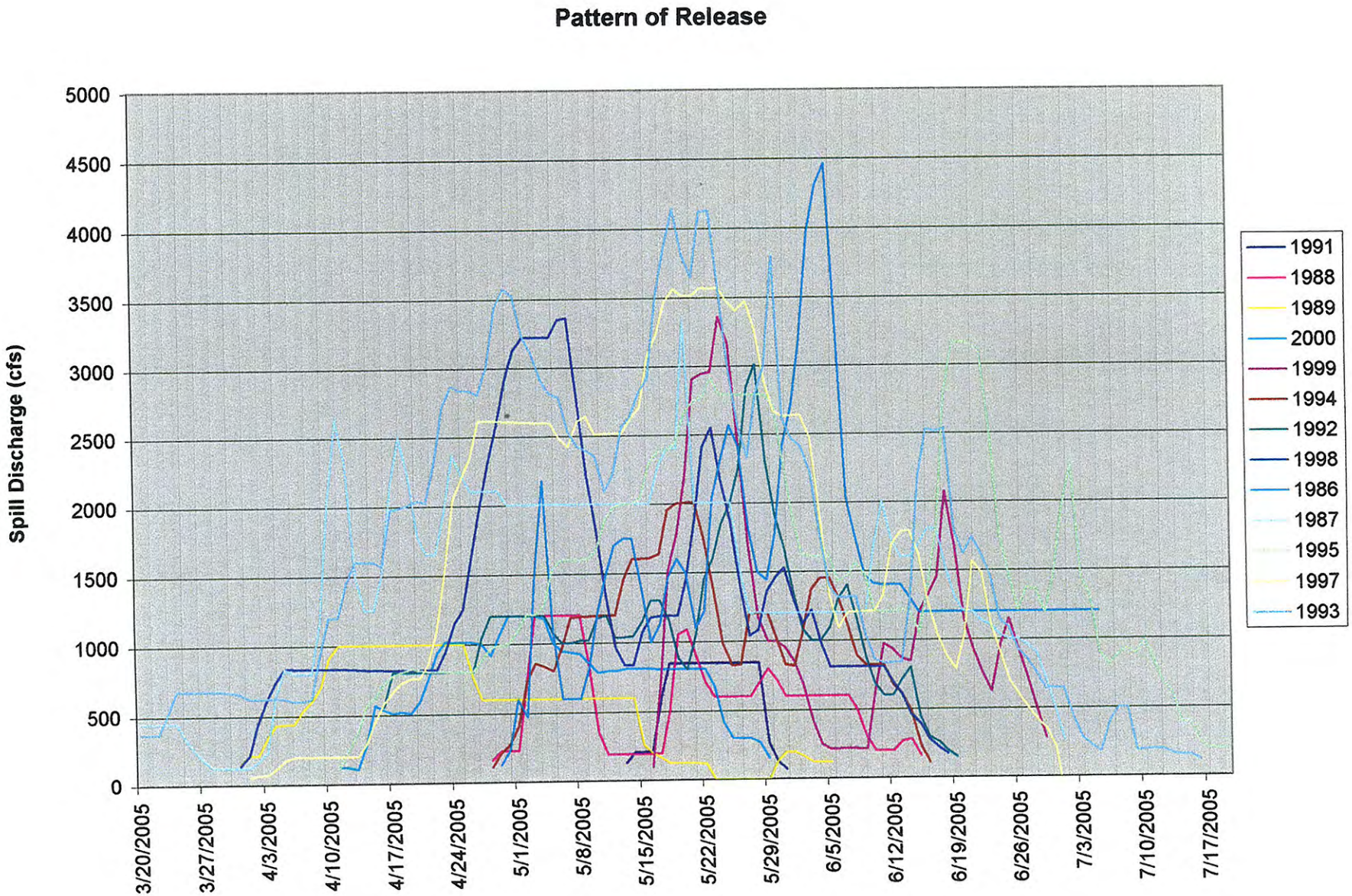
Cell: E1
Comment: DPR average inflow

Cell: F1
Comment: 18 yr avg inflow

Cell: A2
Comment: The chart color corresponds to the portion of the data from which the chart is rerived

APPENDIX D

DRD Boating Hydro.xls


Pattern of Release
Spill Discharge (cfs)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
3/20/2005
3/27/2005
4/3/2005
4/10/2005
4/17/2005
4/24/2005
5/1/2005
5/8/2005
5/15/2005
5/22/2005
5/29/2005
6/5/2005
6/12/2005
6/19/2005
6/26/2005
7/3/2005
7/10/2005
7/17/2005
1991
1988
1989
2000
1999
1994
1992
1998
1986
1987
1995
1997
1993

SPILLS / 1986-2000
Pattern of Release / cfs by day

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		13 yrs spill 1986 - 2000 / sorted least spill to most spill												
2	Day	1991	1988	1989	2000	1999	1994	1992	1998	1986	1987	1995	1997	1993
3	3/20										445			370
4	3/21										445			371
5	3/22										445			376
6	3/23										446			521
7	3/24										446			680
8	3/25										324			680
9	3/26										248			680
10	3/27										176			680
11	3/28										124			680
12	3/29										124			680
13	3/30										124			671
14	3/31			148					140		125			665
15	4/1			213					218		125		56	624
16	4/2			214					447		172		67	622
17	4/3			340					616		238		75	626
18	4/4			432					739		639		121	627
19	4/5			439					836		835		180	621
20	4/6			441					836		801		200	605
21	4/7			539					832		801		200	605
22	4/8			600					833		801		200	622
23	4/9			702					831		1172		200	946
24	4/10			911	130				831		2018		200	1200
25	4/11			1001	124				833		2631	119	200	1200
26	4/12			1001	111				833		2319	248	200	1446
27	4/13			1001	281				830		1500	372	200	1600
28	4/14			1001	570				826		1251	563	293	1600
29	4/15			1001	535				820		1251	624	458	1602
30	4/16			1001	512			556	820		1521	717	580	1571
31	4/17			1001	522			800	819		2147	778	663	1976
32	4/18			1001	512			800	817		2502	805	730	1989
33	4/19			1001	592			800	817		2221	828	756	2010
34	4/20			1001	749			800	818		1784	816	757	2040
35	4/21			1001	941			800	819		1652	808	857	2028
36	4/22			1001	1021			800	820		1652	803	1104	2322
37	4/23			1001	1014			800	951		1950	802	1514	2720
38	4/24			1001	1014			800	1150		2367	799	2046	2870
39	4/25			1001	1014			800	1250		2225	799	2198	2840
40	4/26			758	1002			800	1620		2102	802	2348	2838
41	4/27			600	916			1042	1980		2102	885	2617	2812
42	4/28		159	600	1065		109	1200	2310		2102	972	2613	3013
43	4/29		230	600	1200		216	1200	2580	124	2112	993	2613	3442
44	4/30		229	600	1200		276	1200	2910	235	2002	1001	2609	3579
45	5/1		228	600	1200		404	1200	3130	597	2002	1082	2608	3526
46	5/2		736	600	1200		730	1200	3220	474	2002	1208	2601	3231
47	5/3		1201	600	1183		859	1200	3220	1473	2002	1207	2601	3110
48	5/4		1201	600	1001		831	1200	3220	2175	2002	1273	2596	2910
49	5/5		1201	600	942		801	1075	3220	1081	2002	1533	2596	2810
50	5/6		1201	600	933		975	1000	3350	600	2002	1601	2482	2787
51	5/7		1201	600	921		1182	1000	3360	600	2002	1600	2421	2536
52	5/8		1201	600	856		1190	1019	2780	600	2002	1603	2604	2425
53	5/9		835	600	787		1194	1023	2210	812	2002	1603	2644	2394
54	5/10		354	600	797		1197	1177	1830	1201	2002	1669	2511	2354
55	5/11		193	600	795		1199	1197	1340	1486	2002	1888	2514	2095
56	5/12		194	600	809		1195	1037	963	1699	2002	1982	2517	2218

SPILLS / 1986-2000
Pattern of Release / cfs by day

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
2	**Day**	**1991**	**1988**	**1989**	**2000**	**1999**	**1994**	**1992**	**1998**	**1986**	**1987**	**1995**	**1997**	**1993**
3	3/20										445			370
57	5/13	127	194	600	811		1458	1040	837	1751	2002	2003	2513	2561
58	5/14	208	194	600	810		1602	1045	839	1751	2002	1998	2623	2641
59	5/15	211	194	262	811		1603	1150	1070	1384	2002	2049	2702	2821
60	5/16	209	196	203	805	95	1607	1300	1180	1001	2002	2295	3070	2909
61	5/17	595	196	165	803	725	1637	1300	1190	1133	2275	2383	3232	3510
62	5/18	842	511	126	803	1508	1953	1163	1190	1467	2402	2389	3471	3860
63	5/19	842	1054	126	803	1775	2001	881	1190	1601	2402	2445	3566	4140
64	5/20	842	1087	126	803	2194	2006	800	1450	1493	3324	2658	3516	3810
65	5/21	842	889	126	803	2902	2009	1053	1870	1101	2002	2743	3513	3650
66	5/22	842	704	117	675	2943	1755	1450	2410	1222	2002	2773	3573	4120
67	5/23	842	600	0	419	2956	1381	1600	2550	2033	2002	2913	3565	4130
68	5/24	842	600	0	299	3357	984	1850	2170	2302	2002	2796	3571	3578
69	5/25	842	600	0	299	3163	825	2000	1870	2567	2002	2794	3465	2988
70	5/26	842	600	0	299	2429	831	2251	1420	2416	1534	2790	3402	2559
71	5/27	842	600	0	272	1679	1201	2844	1040	1825	1201	2790	3470	2337
72	5/28	842	698	0	154	1173	1200	3009	1080	1501	1206	2790	3272	2789
73	5/29	264	801	0		1001	1202	2303	1360	1443	1201	2789	2892	3005
74	5/30	130	716	131		998	1014	1909	1460	1775	1201	2701	2669	3795
75	5/31	71	600	199		951	829	1683	1530	2421	1201	2299	2632	2614
76	6/1		600	197		847	819	1345	1300	2702	1201	1888	2636	2463
77	6/2		600	164		679	1065	1081	1120	3183	1201	1623	2641	2409
78	6/3		600	120		423	1373	1000	1220	3972	1201	1606	2479	2230
79	6/4		600	120		249	1451	1000	985	4307	1201	1609	1938	1790
80	6/5		600	120		213	1452	1092	806	4461	1201	1613	1321	1395
81	6/6		600			217	1312	1301	806	3371	1201	1427	1091	1312
82	6/7		600			217	1107	1400	808	2037	1201	1469	1201	1316
83	6/8		497			217	891	1167	808	1750	1201	1553	1209	1319
84	6/9		301			215	817	879	807	1463	1201	1477	1209	1036
85	6/10		200			624	817	683	807	1409	1679	1215	1209	860
86	6/11		200			972	820	600	807	1401	2002	1204	1322	831
87	6/12		201			931	679	600	693	1401	1721	1206	1686	837
88	6/13		267			865	607	716	606	1401	1601	1213	1783	841
89	6/14		281			842	485	800	461	1304	1601	1205	1789	1287
90	6/15		161			1198	236	446	395	1201	1689	1045	1616	2176
91	6/16					1316	110	301	279	1201	1802	1398	1272	2529
92	6/17					1454		262	220	1201	1802	1810	1034	2509
93	6/18					2072		200	175	1201	1529	2784	884	2535
94	6/19					1680		151		1201	1300	3162	786	1784
95	6/20					1147				1201	1201	3160	1030	1620
96	6/21					930				1201	1201	3155	1563	1738
97	6/22					755				1201	1132	3089	1483	1612
98	6/23					621				1201	1101	2553	1112	1460
99	6/24					958				1201	1033	1764	899	1138
100	6/25					1145				1201	1001	1478	696	1085
101	6/26					927				1201	1001	1207	598	922
102	6/27					724				1201	961	1374	508	853
103	6/28					495				1201	901	1364	417	752
104	6/29					281				1201	714	1191	358	642
105	6/30									1201	500	1482	219	643
106	7/1									1201	269	1964	-179	643
107	7/2									1201		2267		431
108	7/3									1201		1457		281
109	7/4									1201		1307		227
110	7/5									1201		896		184

SPILLS / 1986-2000
Pattern of Release / cfs by day

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
2	**Day**	**1991**	**1988**	**1989**	**2000**	**1999**	**1994**	**1992**	**1998**	**1986**	**1987**	**1995**	**1997**	**1993**
3	3/20										445			370
111	7/6											813		402
112	7/7											878		500
113	7/8											926		499
114	7/9											891		189
115	7/10											989		198
116	7/11											828		199
117	7/12											677		195
118	7/13											601		165
119	7/14											395		155
120	7/15											383		152
121	7/16											250		117
122	7/17											199		
123	7/18											200		
124	7/19											200		
125	1.9835	21,971	54,955	67,149	71,633	105,250	106,108	143,171	207,145	207,726	295,553	296,784	309,575	401,310

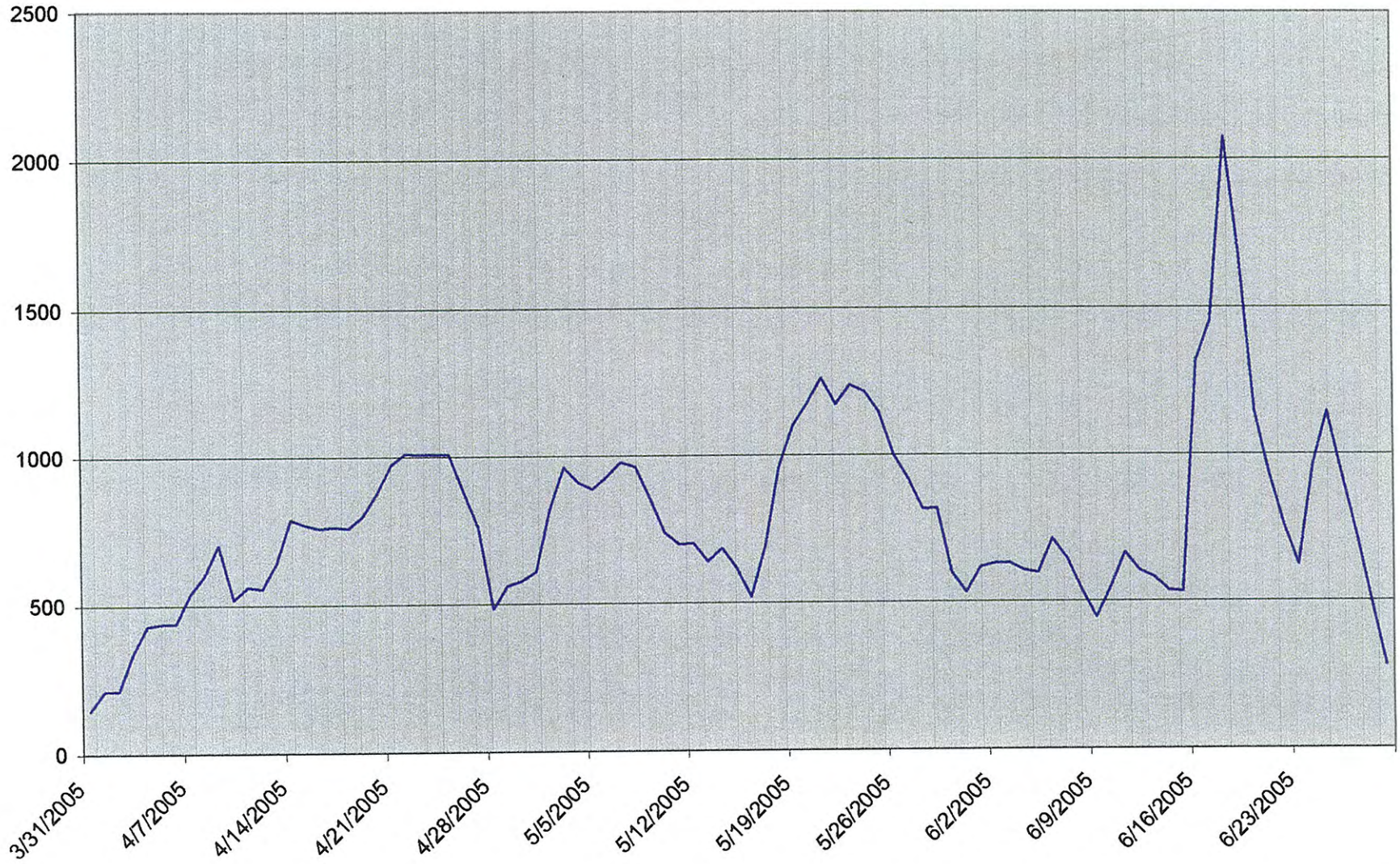
SPILLS / 1986-2000
Pattern of Release / cfs by day

Cell: B2
omment: The numbers in the columns are cfs released. The basis is DWCD's In/outflow tabulation.

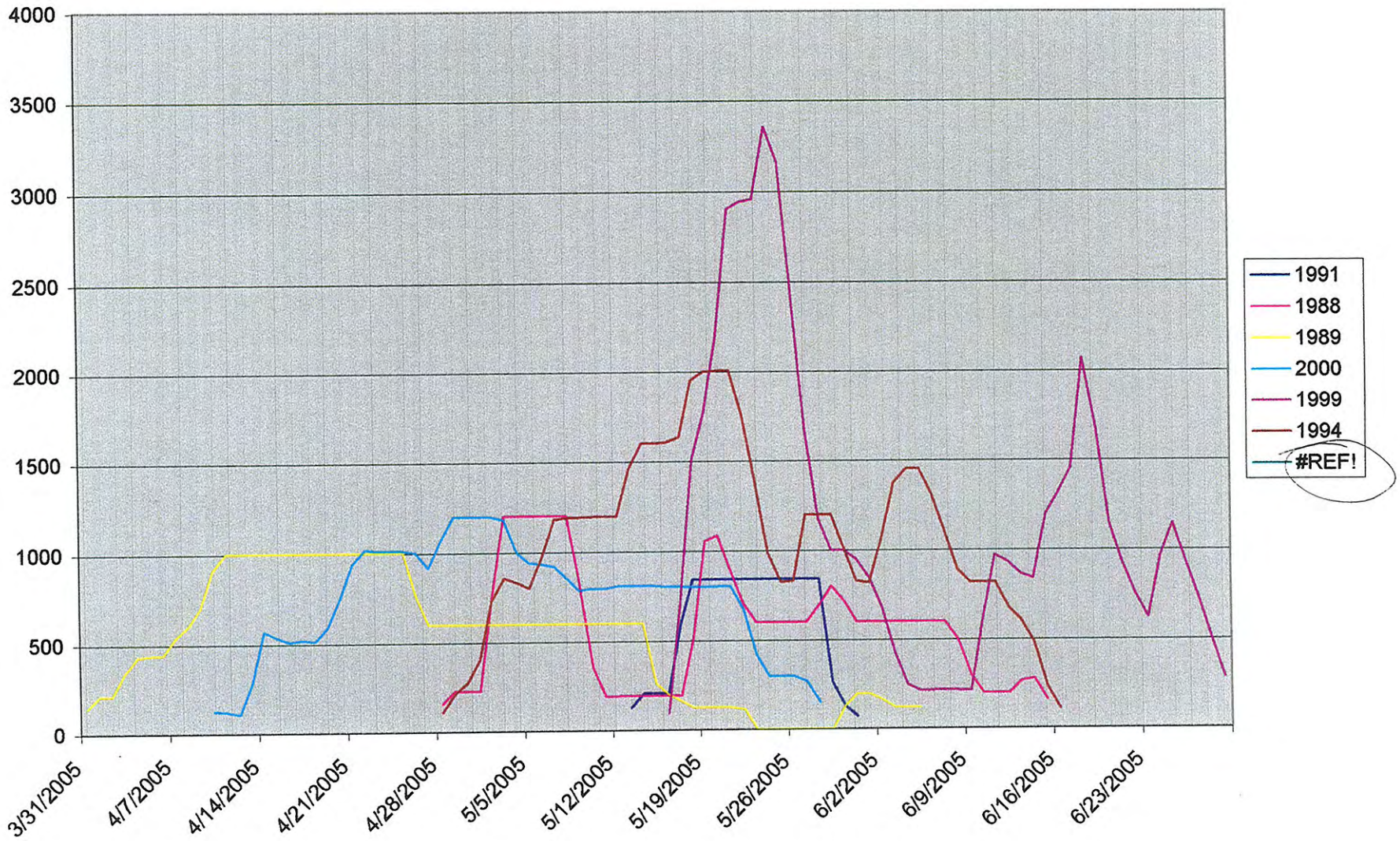
Cell: A125
Comment: Converts cfs to af

Cell: B125
Comment: The numbers in line 125 are total acre feet spilled

Average release pattern for 6 low flow years



Release pattern for 6 low spill years



Average release pattern for 6 low spill years

	A	B	C	D	E	F	G	H
1		6 lowest spill years						
2	Day	6yr avg	1991	1988	1989	2000	1999	1994
3	3/31	148			148			
4	4/1	213			213			
5	4/2	214			214			
6	4/3	340			340			
7	4/4	432			432			
8	4/5	439			439			
9	4/6	441			441			
10	4/7	539			539			
11	4/8	600			600			
12	4/9	702			702			
13	4/10	521			911	130		
14	4/11	563			1001	124		
15	4/12	556			1001	111		
16	4/13	641			1001	281		
17	4/14	786			1001	570		
18	4/15	768			1001	535		
19	4/16	756			1001	512		
20	4/17	762			1001	522		
21	4/18	757			1001	512		
22	4/19	796			1001	592		
23	4/20	875			1001	749		
24	4/21	971			1001	941		
25	4/22	1011			1001	1021		
26	4/23	1007			1001	1014		
27	4/24	1007			1001	1014		
28	4/25	1007			1001	1014		
29	4/26	880			758	1002		
30	4/27	758			600	916		
31	4/28	483		159	600	1065		109
32	4/29	561		230	600	1200		216
33	4/30	576		229	600	1200		276
34	5/1	608		228	600	1200		404
35	5/2	817		736	600	1200		730
36	5/3	961		1201	600	1183		859
37	5/4	908		1201	600	1001		831
38	5/5	886		1201	600	942		801
39	5/6	927		1201	600	933		975
40	5/7	976		1201	600	921		1182
41	5/8	962		1201	600	856		1190
42	5/9	854		835	600	787		1194
43	5/10	737		354	600	797		1197
44	5/11	697		193	600	795		1199
45	5/12	700		194	600	809		1195
46	5/13	638	127	194	600	811		1458
47	5/14	683	208	194	600	810		1602
48	5/15	616	211	194	262	811		1603
49	5/16	519	209	196	203	805	95	1607
50	5/17	687	595	196	165	803	725	1637

Average release pattern for 6 low spill years

	A	B	C	D	E	F	G	H
2	**Day**	**6yr avg**	**1991**	**1988**	**1989**	**2000**	**1999**	**1994**
3	3/31	148			148			
51	5/18	957	842	511	126	803	1508	1953
52	5/19	1100	842	1054	126	803	1775	2001
53	5/20	1176	842	1087	126	803	2194	2006
54	5/21	1262	842	889	126	803	2902	2009
55	5/22	1173	842	704	117	675	2943	1755
56	5/23	1240	842	600	0	419	2956	1381
57	5/24	1216	842	600	0	299	3357	984
58	5/25	1146	842	600	0	299	3163	825
59	5/26	1000	842	600	0	299	2429	831
60	5/27	919	842	600	0	272	1679	1201
61	5/28	813	842	698	0	154	1173	1200
62	5/29	817	264	801	0		1001	1202
63	5/30	598	130	716	131		998	1014
64	5/31	530	71	600	199		951	829
65	6/1	616		600	197		847	819
66	6/2	627		600	164		679	1065
67	6/3	629		600	120		423	1373
68	6/4	605		600	120		249	1451
69	6/5	596		600	120		213	1452
70	6/6	710		600			217	1312
71	6/7	642		600			217	1107
72	6/8	535		497			217	891
73	6/9	444		301			215	817
74	6/10	547		200			624	817
75	6/11	664		200			972	820
76	6/12	603		201			931	679
77	6/13	580		267			865	607
78	6/14	536		281			842	485
79	6/15	532		161			1198	236
80	6/16	1316					1316	110
81	6/17	1454					1454	
82	6/18	2072					20	
83	6/19	1680					16	
84	6/20	1147					1147	
85	6/21	930					930	
86	6/22	755					755	
87	6/23	621					621	
88	6/24	958					958	
89	6/25	1145					1145	
90	6/26	927					927	
91	6/27	724					724	
92	6/28	495					495	
93	6/29	281					281	
94	6/30							
95	1.9835	776	25,920	58,898	71,095	75,600	109,215	110,063
96								

Average release pattern for 6 low spill years

Cell: B2
omment: This column is the basis for creating the "low yr chart", which shows the 6 yr average spill release pattern

Cell: B3
Comment: To take an average of all of the 6 years when there was only one year of release on Mar 31 - Apr 9 would have grossly distorted this column averages. Therefore, only the years there was a release on any given day was averaged.

Cell: B13
Comment: Note the formula. Only 1989 and 2000 were averaged until Mar 28 - line 31

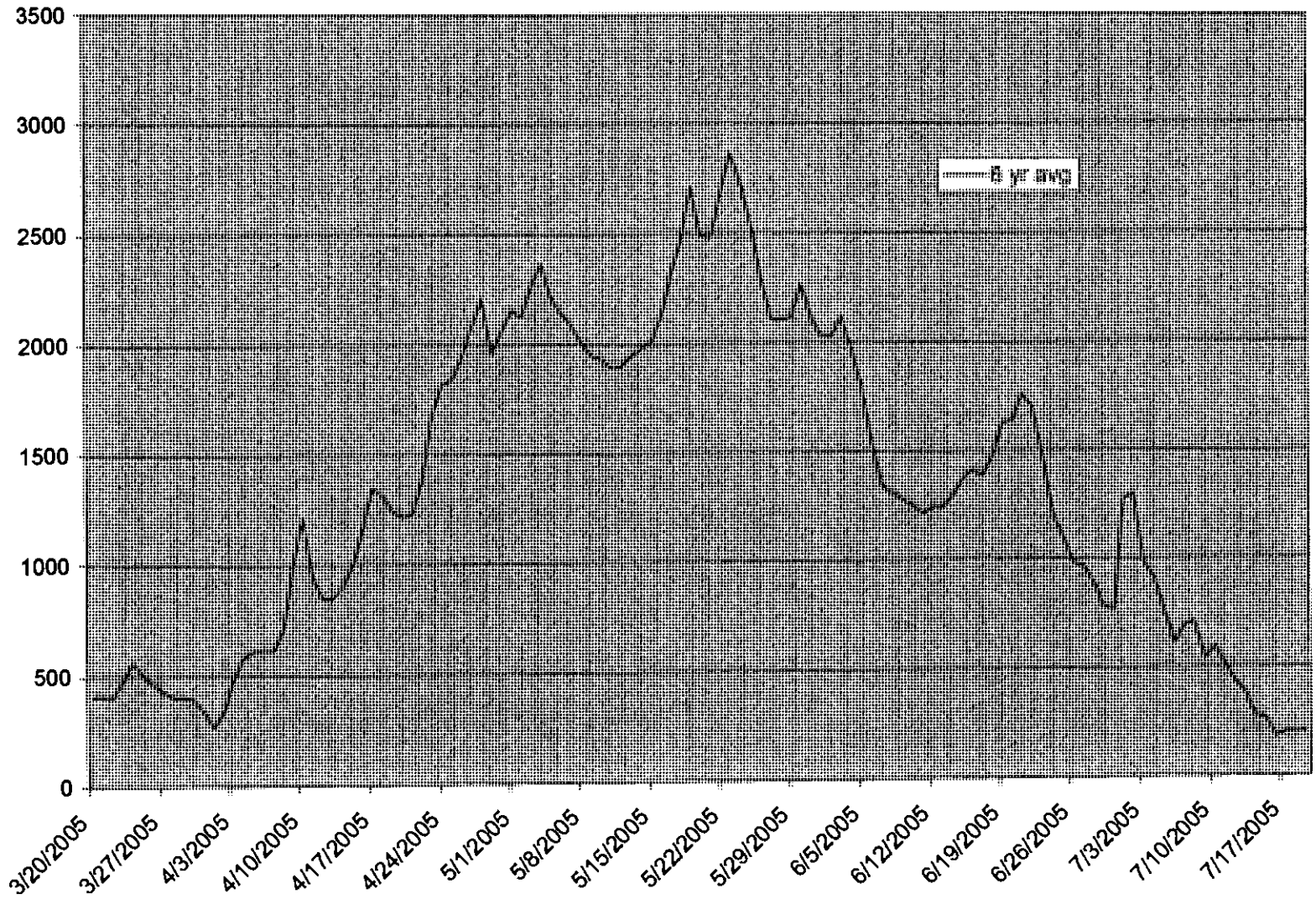
Cell: B31
Comment: Note the formula here averages Cols D, E, F, & H

Cell: A95
Comment: This is the conversion factor: cfs to af

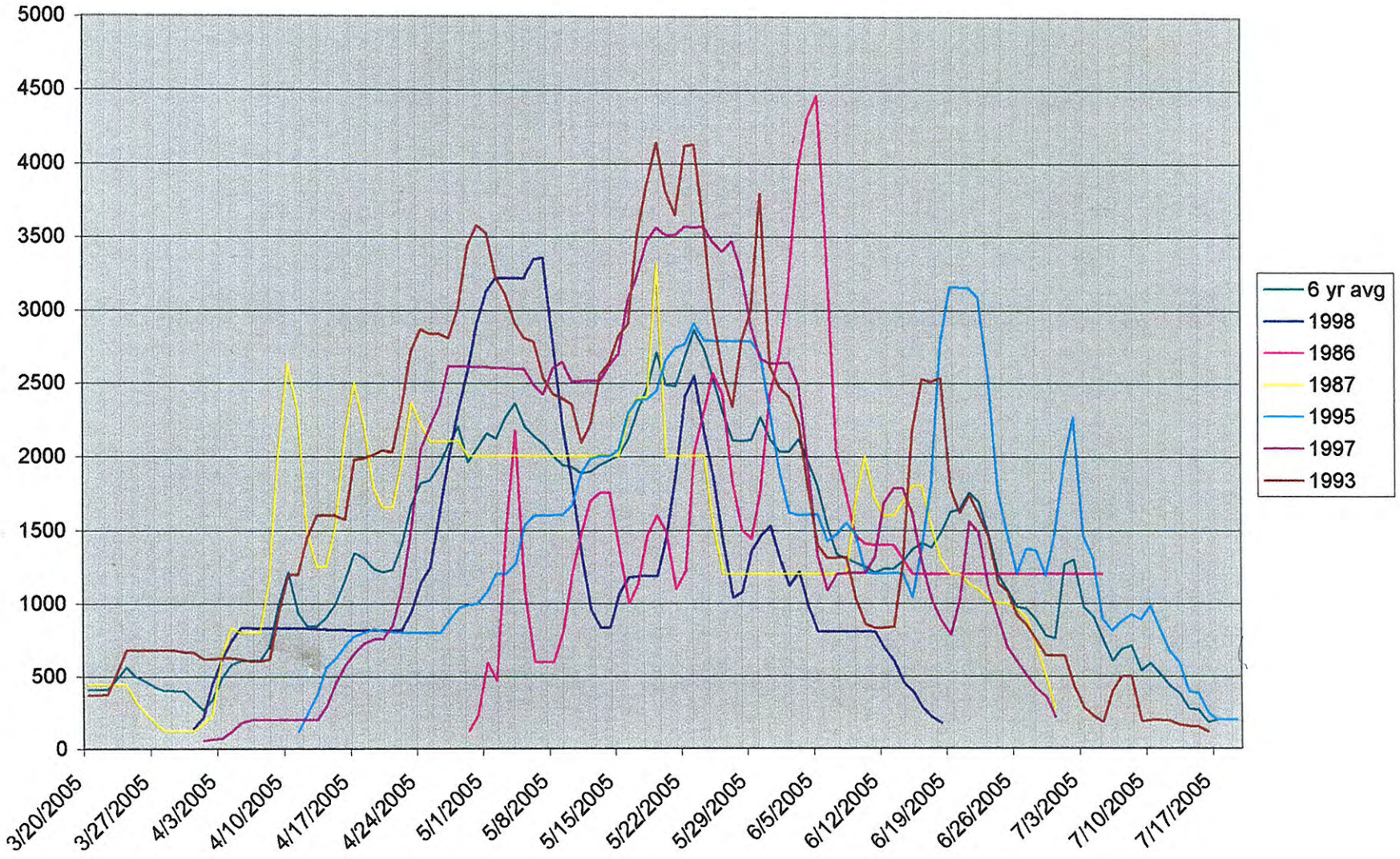
Cell: B95
Comment: Not that this calculation is relevant, but this is the average daily release during low spill years

Cell: C95
Comment: Numbers in line 95 have totaled the cfs and converted to acre feet

6 year average HI release pattern



Release pattern for 6 Hi spill years



Average release pattern 6 HI spill years

	A	B	C	D	E	F	G	H
1			6 highest spill years					
2	Day	6 yr avg	1998	1986	1987	1995	1997	1993
3	3/20	408			445			370
4	3/21	408			445			371
5	3/22	411			445			376
6	3/23	484			446			521
7	3/24	563			446			680
8	3/25	502			324			680
9	3/26	464			248			680
10	3/27	428			176			680
11	3/28	402			124			680
12	3/29	402			124			680
13	3/30	398			124			671
14	3/31	336	140		125			665
15	4/1	267	218		172		56	624
16	4/2	344	447		238		67	622
17	4/3	489	616		639		75	626
18	4/4	581	739		835		121	627
19	4/5	609	836		801		180	621
20	4/6	611	836		801		200	605
21	4/7	610	832		801		200	605
22	4/8	707	833		1172		200	622
23	4/9	999	831		2018		200	946
24	4/10	1215	831		2631		200	1200
25	4/11	934	833		2319	119	200	1200
26	4/12	845	833		1500	248	200	1446
27	4/13	851	830		1251	372	200	1600
28	4/14	906	826		1251	563	293	1600
29	4/15	1005	820		1521	624	458	1602
30	4/16	1167	820		2147	717	580	1571
31	4/17	1348	819		2502	778	663	1976
32	4/18	1312	817		2221	805	730	1989
33	4/19	1239	817		1784	828	756	2010
34	4/20	1217	818		1652	816	757	2040
35	4/21	1233	819		1652	808	857	2028
36	4/22	1400	820		1950	803	1104	2322
37	4/23	1671	951		2367	802	1514	2720
38	4/24	1818	1150		2225	799	2046	2870
39	4/25	1838	1250		2102	799	2198	2840
40	4/26	1942	1620		2102	802	2348	2838
41	4/27	2079	1980		2102	885	2617	2812
42	4/28	2204	2310		2112	972	2613	3013
43	4/29	1959	2580	124	2002	993	2613	3442
44	4/30	2056	2910	235	2002	1001	2609	3579
45	5/1	2157	3130	597	2002	1082	2608	3526
46	5/2	2123	3220	474	2002	1208	2601	3231
47	5/3	2269	3220	1473	2002	1207	2601	3110
48	5/4	2363	3220	2175	2002	1273	2596	2910
49	5/5	2207	3220	1081	2002	1533	2596	2810
50	5/6	2137	3350	600	2002	1601	2482	2787

Average release pattern 6 HI spill years

	A	B	C	D	E	F	G	H
2	**Day**	**6 yr avg**	**1998**	**1986**	**1987**	**1995**	**1997**	**1993**
51	5/7	2087	3360	600	2002	1600	2421	2536
52	5/8	2002	2780	600	2002	1603	2604	2425
53	5/9	1944	2210	812	2002	1603	2644	2394
54	5/10	1928	1830	1201	2002	1669	2511	2354
55	5/11	1887	1340	1486	2002	1888	2514	2095
56	5/12	1897	963	1699	2002	1982	2517	2218
57	5/13	1944	837	1751	2002	2003	2513	2561
58	5/14	1976	839	1751	2002	1998	2623	2641
59	5/15	2005	1070	1384	2002	2049	2702	2821
60	5/16	2122	1180	1001	2275	2295	3070	2909
61	5/17	2308	1190	1133	2402	2383	3232	3510
62	5/18	2463	1190	1467	2402	2389	3471	3860
63	5/19	2711	1190	1601	3324	2445	3566	4140
64	5/20	2488	1450	1493	2002	2658	3516	3810
65	5/21	2480	1870	1101	2002	2743	3513	3650
66	5/22	2683	2410	1222	2002	2773	3573	4120
67	5/23	2865	2550	2033	2002	2913	3565	4130
68	5/24	2736	2170	2302	2002	2796	3571	3578
69	5/25	2536	1870	2567	1534	2794	3465	2988
70	5/26	2298	1420	2416	1201	2790	3402	2559
71	5/27	2111	1040	1825	1206	2790	3470	2337
72	5/28	2105	1080	1501	1201	2790	3272	2789
73	5/29	2115	1360	1443	1201	2789	2892	3005
74	5/30	2267	1460	1775	1201	2701	2669	3795
75	5/31	2116	1530	2421	1201	2299	2632	2614
76	6/1	2032	1300	2702	1201	1888	2636	2463
77	6/2	2030	1120	3183	1201	1623	2641	2409
78	6/3	2118	1220	3972	1201	1606	2479	2230
79	6/4	1972	985	4307	1201	1609	1938	1790
80	6/5	1799	806	4461	1201	1613	1321	1395
81	6/6	1535	806	3371	1201	1427	1091	1312
82	6/7	1339	808	2037	1201	1469	1201	1316
83	6/8	1307	808	1750	1201	1553	1209	1319
84	6/9	1279	807	1463	1679	1477	1209	1036
85	6/10	1250	807	1409	2002	1215	1209	860
86	6/11	1214	807	1401	1721	1204	1322	831
87	6/12	1237	693	1401	1601	1206	1686	837
88	6/13	1241	606	1401	1601	1213	1783	841
89	6/14	1289	461	1304	1689	1205	1789	1287
90	6/15	1373	395	1201	1802	1045	1616	2176
91	6/16	1413	279	1201	1802	1398	1272	2529
92	6/17	1384	220	1201	1529	1810	1034	2509
93	6/18	1480	175	1201	1300	2784	884	2535
94	6/19	1627		1201	1201	3162	786	1784
95	6/20	1642		1201	1201	3160	1030	1620
96	6/21	1758		1201	1132	3155	1563	1738
97	6/22	1697		1201	1101	3089	1483	1612
98	6/23	1472		1201	1033	2553	1112	1460
99	6/24	1200		1201	1001	1764	899	1138

Average release pattern 6 HI spill years

	A	B	C	D	E	F	G	H
2	**Day**	**6 yr avg**	**1998**	**1986**	**1987**	**1995**	**1997**	**1993**
100	6/25	1092		1201	1001	1478	696	1085
101	6/26	978		1201	961	1207	598	922
102	6/27	967		1201	901	1374	508	853
103	6/28	890		1201	714	1364	417	752
104	6/29	778		1201	500	1191	358	642
105	6/30	763		1201	269	1482	219	643
106	7/1	1269		1201		1964		643
107	7/2	1300		1201		2267		431
108	7/3	980		1201		1457		281
109	7/4	912		1201		1307		227
110	7/5	760		1201		896		184
111	7/6	608				813		402
112	7/7	689				878		500
113	7/8	713				926		499
114	7/9	540				891		189
115	7/10	593				989		198
116	7/11	514				828		199
117	7/12	436				677		195
118	7/13	383				601		165
119	7/14	275				395		155
120	7/15	268				383		152
121	7/16	183				250		117
122	7/17	199				199		
123	7/18	200				200		
124	7/19	200				200		
125	1.9835	1337	207,145	207,726	295,305	296,784	309,930	401,310

Average release pattern 6 HI spill years

Cell: B2
Comment: This column is the basis for creating the "avg hi yr chart", which shows the 6 yr average spill release pattern

Cell: B3
Comment: To take an average of all of the 6 years when there was only two years of release on Mar 20 - Mar 30 would have grossly distorted this column's averages. Therefore, only the years there was a release on any given day was averaged.

Cell: B15
Comment: Note the formula only averages Col C, E, G, & H

Cell: A125
Comment: This is the conversion factor: cfs to af

Cell: B125
Comment: Not that this calculation is relevant, but this is the average daily release during hi spill years

Cell: C125
Comment: Numbers in line 95 have totaled the cfs and converted to acre feet

APPENDIX E

Dolores Project – Outline of Controlling Contracts

APP. E HYDRO

Original Water Rights

The District was awarded its original water rights by the Montezuma County District Court, Water District 34, Division 7, Civil Action #967 on July 19, 1962, as summarized in Section 1.3.

Transferred Water Rights

MVIC transferred to the District water rights as a component of the District/MVIC Contract and Contract #9-07-40-R0730, as summarized in Section 1.3.

Section 1.3

Montezuma County District Court, Water District Number 34, Civil Action Number 967, July 19, 1962 – Adjudication of Priorities of Water Rights for the Dolores Project by the Southwestern Water Conservation District (SWCD):

- The project water rights were filed on by the SWCD before the District was organized as a legal district, and later officially transferred to the District.
- Diversion and Storage Structure claims included:
- McPhee Reservoir
- Dove Creek Canal
- South Canal, and
- Other structures were claimed, but never built.
- The Appropriation Date was recorded as September 10, 1940, which was the date survey work commenced on the Dolores Project.
- Amount of Water Claimed:
  - Direct water rights claimed, using McPhee Reservoir and other project works as conduits for direct use, are 585 cfs
  - Storage rights of 400,000 AF with annual use of 250,000 AF and 100,000 AF, to refill the reservoir if capacity and water are available, claimed with the source of water being the Dolores River and pertinent tributaries, and
  - Other storage rights were claimed, but the storage structures were not built.
- Acres to be Irrigated:
  - 35,000 acres of land to be brought under cultivation to receive a full supply, and
  - 29,000 acres of land now under cultivation to receive a supplemental supply.
- Character of Use:
  - Irrigation
  - Domestic
  - Municipal
  - Industrial
  - Recreation

- Fish and wildlife
- Flood control, and
- Other beneficial purposes.

Contract Between the Dolores Water Conservancy District and the Montezuma Valley Irrigation Company for Adjustment of Water Rights and Sale of the Use of Irrigation Water, September 23, 1977:

- Preamble:
  - MVIC Dolores River Water Rights:
    - Main Canal 1 & 2:
      - 707.7 cfs, absolute ranked 17, adjudicated 2/1/1892 and appropriated 11/25/1885 for irrigation
      - 592.3 cfs, conditional ranked 17, adjudicated 2/1/1892 and appropriated 11/25/1885 for irrigation and domestic, (refer to Contract #9-07-40-R0730, Article 10, for full amount transferred)
      - 100.0 cfs, absolute ranked 101, adjudicated 3/22/1963 and appropriated 11/25/1885 for domestic, industrial, stock water and other.
    - Narraguinnep Reservoir:
      - 5,969 AF, absolute ranked 44, adjudicated 12/18/1933 and appropriated 3/15/1888 for irrigation and domestic
      - 3,306 AF, absolute ranked 74, adjudicated 12/18/1933 and appropriated 10/28/1907 for irrigation
      - 9,782 AF, absolute ranked 86, adjudicated 12/18/1933 and appropriated 8/17/1922 for irrigation
      - 1,653 AF, absolute ranked 131, adjudicated 3/22/1963 and appropriated 5/1/1956 for irrigation, domestic and stock water
      - Total 20,710 AF.
    - Groundhog Reservoir:
      - 10,623 AF, absolute ranked 69, adjudicated 12/18/1933 and appropriated 8/1/1905 for irrigation
      - 11,086 AF, absolute ranked 90, adjudicated 12/18/1933 and appropriated 10/24/1929 for irrigation
      - Total 21,709 AF, and
    - Totten Lake: Now owned by DWCD
      - 400 AF, absolute ranked 72, adjudicated 12/18/1933 and appropriated 4/25/1907 for irrigation
      - 3,000 AF, absolute ranked 129, adjudicated 3/22/1963 and appropriated 2/1/1951 for multiple use
      - Total 3,400 AF.
- General Definitions (Article 1, pg. 3):
  - Project water made available to MVIC under the terms hereof is limited to irrigation use in the production of agricultural crops and livestock, and for irrigation of small tracts of irrigable land

- Non-Project water is water historically diverted by MVIC by virtue of existing pre-project irrigation water rights as stated herein to which project benefits and repayment capability have not been assigned. MVIC will receive non-project water pursuant to the terms of this contract, and
- Irrigation Season is the period of time from April 1 to October 15 of each year.
- Adjustment of Water Rights (Article 2, pg. 3-6):
  - As per the above listed rights provided to Main Canal 1 & 2, MVIC claims a right to 1,400 cfs natural flow of the Dolores River at USGS Gauging Station No. 9-1665 near Dolores, Colorado together with the releases from Groundhog Reservoir less storage releases
  - MVIC agrees with respect to its water rights as follows:
  - MVIC will not exceed 3,000 AF during the calendar year for domestic purposes of filling cisterns, stock watering ponds and all other beneficial uses except irrigation within the limits of its water rights
  - MVIC will not exceed an annual demand of 150,400 AF of irrigation water within the limits of its water rights in the Dolores River and tributaries during any one irrigation season
  - MVIC will limit diversion of direct flow rights to a maximum of 72,000 AF during the months of April, May and June of each year; however, only the amount actually diverted shall be applied towards the limit of the annual MVIC diversion of 150,400 AF, and
  - MVIC may fill its present storage facilities, if needed, during the months of April, May and June and that this water will be over and above the direct flow irrigation deliveries to MVIC lands from its own water rights during the months of April, May and June. However, MVIC still may not exceed an annual diversion of 150,400 AF of irrigation water by direct flow and water released from MVIC storage facilities.
    - The water provided for above is herein called non-project water
    - MVIC agrees to transfer to the District its right to all water in excess of this non-project water and further agrees to execute any appropriate conveyance or assignment to the District of its water decrees representing such excess water
    - The District agrees to sell to MVIC the amount of project water necessary to fulfill the irrigation requirement of the 26,300 acres of irrigable land under the MVIC system within the District boundary, an average ranging from 13,700 AF up to 60,000 AF, depending upon river flow
    - MVIC project water will be subject to shortages in the same proportion as shortages incurred by other irrigation water users in any year
    - MVIC will make application to the District Court in Water Division No. 7 for a change in point of diversion, and

- The District and MVIC, after completion of Project facilities, will advise the Colorado State Engineer of all actions taken and furnish him operating criteria to be followed in satisfying MVIC's rights.

- Points of Delivery, Measurement, and Use of Project Water (Article 3, pg. 6-7):
  - The District will supply, install, operate, maintain and replace all appropriate measuring devices in order to accurately measure the water and encourage its economical and beneficial use, and
  - No project water will be delivered to any excess or non-irrigable lands.
- Terms of Payment (Article 4, pg. 7-8):
  - The District shall deliver MVIC's project water and MVIC will receive non-project water pursuant to operating criteria promulgated by the USBR and such criteria may be modified under conditions satisfactory to the District and MVIC
  - MVIC's repayment obligations are separated into two parts:
  - $3,160,000 to be paid in successive annual payments of $63,200 for a period of 50 years
  - An account charge of $10 times the number of separate ownership accounts receiving supplemental project water, with a minimum of $5,000 annually
  - The MVIC repayment obligation is based upon that part of the District's obligation to the United States to be paid by irrigation water users and will be paid directly to the District, and
    - Any Project water purchased hereunder remaining in storage at the end of the irrigation season will become project water available for the next following irrigation season, and MVIC will not be entitled to holdover storage rights in Project reservoirs.

- Payment of Operation, Maintenance and Replacement Costs (Article 6, pg. 9-10):
  - MVIC will pay to the District its proportionate share of the OM&R expenses necessary to provide project water to MVIC including: McPhee Dam and Reservoir, Great Cut Outlet Works, the Dolores Tunnel, the Dolores Canal and other project works in which MVIC project water is stored or carried, and
  - MVIC's payment obligation will not exceed the amount it would have normally incurred for operation and maintenance of pre-project facilities.
- Operation and Maintenance of Company Facilities (Article 11, pg. 12):
  - MVIC will operate and maintain, without cost to the District or the USBR, all of its canals and other facilities necessary to take and utilize its water, including the water purchased under this contract.
- Beneficial Use of Water (Article 12, pg. 12):

- The basis, the measure, and the limit of the right of MVIC to the use of project water shall rest perpetually in the beneficial application thereof, and MVIC agrees to put such water to beneficial irrigation use in accordance with law.

- Water Shortages, Waste, Seepage, and Return Flows (Article 14, pg. 12-13):
  - In no event shall any liability accrue against the District or the USBR for any damage, direct or indirect, arising out of a shortage on account of drought or other causes
  - MVIC project deliveries will share in equal percentage such shortages as may occur, and
  - Municipal users shall have first priority to the available project water supply.
- Allotment of Project Water (Article 15, pg. 13-14):
  - MVIC project water shall vary annually and is estimated to be an average annual supply of 13,700 AF
  - Priority of use of project water shall be:
    - Municipal and domestic commitments are to be delivered in full
    - Irrigation and other uses, exclusive of downstream fish and wildlife releases, are to share in equal percentage such shortages as may occur, and
    - Storage releases for in-stream fish maintenance flows and other wildlife purposes will be made from McPhee Reservoir. These releases will average 27,000 AF (1,600 reserved for use in the San Juan drainage) annually and will be made in accordance with operating criteria established by the USBR in consultation with the District (entitled the Operating Agreement – Contract #99-WC-40-R-6100).
- Water Conservancy Act of Colorado (Article 22, pg. 16):
  - This contract and any amendments thereto, shall be subject to the Water Conservancy Act of Colorado, CRS, the Rules and Regulations of the District Board of Directors, and the repayment contracts heretofore and hereinafter executed between the District and the USBR.

<u>Contract Number 9-07-40-R0730, Between the United States of America Bureau of Reclamation, the Dolores Water Conservancy District, the Montezuma Valley Irrigation Company and the Ute Mountain Ute Tribe, April 21, 1989, Providing for the Adjustment of Water Rights and for the Rehabilitation, Operation, Maintenance and Replacement of Facilities to Reduce Salinity Inflow to the Colorado River</u>:

- Preamble:
  - It is necessary to identify MVIC "excess" water rights for transfer to the District in accordance with the District-MVIC Contract

- The Colorado River Basin Salinity Control Act authorized salinity control as a Project purpose to reduce the salinity contribution from the Montezuma Valley by the seepage of irrigation water from the irrigated lands of the valley into the ground water and thence into the Colorado River, and
  - The USBR shall reimburse costs incurred by the District and MVIC for OM&R of the facilities listed below in order to keep the facilities in a condition that will assure maximum reduction of salinity inflow into the Colorado River.

- General Definitions (Article 1, pg. 3-4):
  - District Salinity Project Works and Towaoc-Highline Canal
    - The Towaoc-Highline Canal originating from the outfall of the Towaoc Power Plant to the terminus of said canal on the Ute Mountain Ute Reservation.
      - MVIC Salinity Works
    - Towaoc-Highline Canal farm turnout structures
    - Rocky Ford Pipe Lateral
    - Lone Pine and Upper Hermana Lateral sections, and
    - Totten Reservoir.
- Soil and Water Conservation and Salinity Control (Article 9, pg. 23):
  - The District, the Company and the USBR agree to adopt proper soil and water conservation and salinity control practices to maximize reductions in the return flow salinity, to permit the economic use of water and to sustain optimum crop yields.
- Water Rights Exchange and Credits (Article 10, pg. 24-26):
  - Pursuant to the District-MVIC contract, the following MVIC water rights are defined as excess water rights and MVIC agrees to transfer them to the District, pursuant to the laws of the State of Colorado
    - Main Canal 1 & 2, 505.0 cfs of the original 592.3 cfs.
- At the petitioning into the District of water users on the Dolores River and its tributaries upstream of McPhee Reservoir, the District will change up to 124.6 cfs of transferred Main Canal 1 & 2 right to non-project water rights at changed points of diversion and MVIC will grant the District up to 2,300 AF of storage in Groundhog Reservoir. In exchange, the USBR and the District agree to allow MVIC to store up to 2,300 AF in McPhee Reservoir, as part of the non-project water stored in McPhee Reservoir. MVIC agrees to release water from Groundhog as needed by the District. The water stored in McPhee will be classified as non-project water and will be subject to the diversion limitations of the District-MVIC contract.
- MVIC shall retain the remaining 87.3 cfs of the original, conditional 592.3 cfs. MVIC shall make these rights absolute, thus bringing MVIC's total diversion right to 795.0 cfs, which is the Dolores Project's designed diversion capacity for MVIC. The Main Canal 1 & 2 water right of 592.3 cfs will be prioritized and administered as follows:
  - 87.3 cfs will have priority 17a

- 380.4 cfs of the District's 505.0 cfs will have priority 17b, and
- 124.6 cfs of the District's 505.0 cfs will have priority 17c.

- MVIC may store in McPhee Reservoir non-project adjudicated water, which will be the daily difference between MVIC's 795 cfs diversion right and its actual diversion through project facilities.
  - The actual diversion plus storage will not exceed the diversion limitations of the District-MVIC contract
  - The 2,300 AF stored water will be the first water spilled during wet years or will be released to prevent a reservoir spill
  - The 2,300 AF stored water will be released to MVIC prior to the release of MVIC project water deliveries, as river flows decrease during the summer and fall months, and
  - There will be no carryover from year to year and on October 15th, any stored water under this contract will become project water.

<u>Agreement Among the Dolores Water Conservancy District and the Montezuma Valley Irrigation Company, and Landowners in the Upper Dolores River Drainage for Water Operations on the Upper Dolores River:</u>

- Recitals:
  - Owner means owner of real property in the Upper Dolores River drainage
  - MVIC has certain water rights on the Upper Dolores River drainage, including but not limited to, an absolute storage right in Groundhog Reservoir in the amount of 21,709 AF, adjudicated December 12, 1933, as well as the Dolores River flow rights described above
  - The District contracted Tipton & Kalmbach Engineering to conduct a comprehensive study of the historic consumptive use of junior water rights on the Upper Dolores River, called the T&K Study
  - The T&K Study identified the Historic Consumptive Use (HCU) of Owner's water rights
  - The District has available non-potable domestic, municipal and industrial water for sale from McPhee Reservoir, and
  - The parties to this Agreement desire to maintain the pre-Dolores Project status quo on the Dolores River by providing and operating an exchange plan between the District's Groundhog Storage and McPhee Reservoir in such a manner as to reduce the likelihood of an MVIC call of its Priority Number 17 water right.
- Transfer of Water Rights (Article 2, pg. 3):
- Upon MVIC's transfer of the 505.0 cfs to the District, the District will commence a change of use and point of diversion action in Water Court, Water Division Number 7, to convert the Priority 17c and Priority 17b from conditional to absolute rights and from direct flow to storage rights, and

- Any filing, by the District, for an appropriate right of exchange shall provide MVIC with water exchanged from Groundhog Reservoir with water from McPhee Reservoir on a one-to-one basis.
- Curtailment of MVIC Call and District Obligation to Supply Water to Owner (Article 3, pg. 4):
  - MVIC will not call its Priority Number 17a water right
  - MVIC will not call its Priority Number 17 water right to the extent that the District can physically and legally provide MVIC with the water to which it is entitled from McPhee Reservoir pursuant to the District-MVIC Contract, and
  - The District shall use its best efforts to maintain the status quo on the Dolores River by conducting its water management plans to satisfy USBR and to avoid an MVIC call of its Priority Number 17 water right by providing MVIC with water physically and legally available to MVIC from McPhee Reservoir and/or from the Groundhog Exchange.
- The T&K Study (Article 4, pg. 4):
  - As long as Owner continues to use land as it was used for the Historic Consumptive Use (HCU) calculations in the T&K Study, the District agrees to accept Owner's HCU as the historic consumptive use for Owner's land in any change of water right application or plan of augmentation filed by Owner.
- Groundhog Reservoir (Article 5, pg. 5):
  - MVIC shall be responsible for the operation of Groundhog Reservoir. The District shall be responsible for notifying MVIC of releases to be made from Groundhog Reservoir pursuant to this Agreement. When the Dolores River falls below 300 cfs, at the Dolores gauging station, at the conclusion of spring runoff, then the District shall order said releases and MVIC shall make said releases when the District's Groundhog Storage is physically and legally available.
  - The irrigation season is to be shortened, during years in which the District's Groundhog Storage is less than 2,300 AF. The shortage shall not be prorated among Owners
  - The District is not entitled to carryover storage in Groundhog Reservoir, and
  - MVIC holds priority storage in Groundhog Reservoir. The second priority in Groundhog Reservoir shall be the District's Groundhog Storage or a portion thereof equal to the amount of water up to 2,300 AF legally and physically available to MVIC from McPhee Reservoir.
- Owner to Join District (Article 6, pg. 5-6):
  - This Agreement constitutes a petition for inclusion of Owner's land within the District pursuant to CRS 37-45-136(2).
- Sale of Water by the District (Article 7, pg. 6):
  - The District agrees not to sell any MI&D Water upstream of the Dolores Gauging Station for less than the actual cost of that water to

the District. Such actual cost shall not be less than $100 per AF of diversion.

CASE Number 95CW104, District Court, Water Division 7, Colorado, Finding of Facts, Conclusions of Law, and Decree for Exchange and Plan of Augmentation for Authorized Diversions, Concerning the Application for Water Rights of the Dolores Water Conservancy District, in Montezuma and Dolores Counties

- Water Rights, Which Are Elements of the Plan (Article 3, pg. 2-5):
  - The District proposes to augment the depletions as approved hereunder from the production of wells, which divert tributary ground water, from surface water diversions and from evaporation within the boundaries of the District as the District now exists and may be expanded from time to time, pursuant to Colorado law. The service area within which wells and other water uses must be located in order to come within this E/A Plan is the area of property within the drainage of the Dolores River, the East and West Forks of the Dolores River and their tributaries, including the drainage into McPhee Reservoir.
- Background for E/A Plan (Article 4, pg. 5):
  - The District has a right to the use of 400 AF in Groundhog Reservoir pursuant to a District/MVIC Contract for additional water in Groundhog Reservoir dated October 28, 1998.
- Plan for Augmentation (Article 5, pg. 6):
  - Amount of Exchange: 400 AF annually
  - Rate of Delivery: 20 cfs
  - Priority Date: 25 AF Absolute, August 1985
  - 75 AF Conditional, August 1985
  - 300 AF, April 1991
  - Source: Dolores River System, and
  - MVIC will furnish the District with this water from Groundhog Reservoir pursuant to the provisions included in the District/MVIC Contract.
- General Operation of the E/A Plan (Article 7, pg. 7-9):
  - Releases from Groundhog Reservoir of up to 400 AF will provide for the replacement of the consumptive use of Authorized Diversions under this Plan
  - MVIC shall receive up to 400 AF of MI&D water from McPhee Reservoir to fulfill the Project's commitment to deliver an average, annual 13,700 AF of Project irrigation water to MVIC
  - The E/A Plan may augment water utilization for:
    - Stock watering
    - Irrigation
    - Domestic use
    - Municipal use
    - Industrial use

- Commercial use
- Evaporation
- Firefighting
- Recreational use, and
- Piscatorial use.
  - Upper Dolores Basin water users, covered by the E/A Plan, must purchase District MI&D Water, and
  - The E/A Plan does not protect the beneficiaries of the Plan from the valid call of water rights senior to/or MVIC's Numbers 17 and 17a.

- Implementation of the Plan and Inclusion of Additional Authorized Diversions Under this E/a Plan (Article 8, pg. 9):
  - Colorado Water Conservation Board (CWCB) Review
    - CWCB holds in-stream flow water rights on the Dolores River System. Depletions from certain streams under this E/A Plan could impact these in-stream flow rights, if the depletions are not replaced by releases from Groundhog Reservoir or otherwise
    - Un-replaced depletions from proposed authorized diversions impacting CWCB in-stream flow water rights shall be allowed, subject to the limitations as defined under the "De Minimis Rule"
    - The District shall calculate the cumulative total of out-of-priority un-replaced depletions that may impact an in-stream flow water right
    - After the cumulative total of depletions for a reach of a CWCB in-stream flow right, as calculated by the District, equals or exceeds 80% of the Allowed De Minimis Depletion, the CWCB shall review all pending and future Authorized Depletion Applications that may impact a CWCB in-stream flow water right, and
    - Nothing herein; however, shall preclude the AD applicant or the District from applying to Water Court for approval of a water right or an independent plan for augmentation with respect to the proposed diversion.
- It is Therefore Ordered, Adjudged and Decreed
  - The District shall submit a report to the DWR Engineer containing pertinent information on the timing of the impact of Authorized Diversions

Contract Number 02-WC-40-7060, Between The U.S. Bureau of Reclamation and the Dolores Water Conservancy District, October 19, 2001, Providing for the Carriage of Water Through Project Facilities:

- Explanatory Recitals:
  - The District has or will acquire 6,000 to 8,000 AF of Non-Project Water from MVIC,
  - The District desires to carry, divert and deliver this water in the same manner as Project Water is through the Dove Creek and South Canal Systems, including the pumping plants and laterals,

- The USBR has determined that there is at least 8,000 AF of capacity available in the System in excess of Project requirements, therefore,
- It is compatible to the purposes of the Project for the District to carry up to 8,000 AF of Non-Project water through the System.

- Carriage, Diversion and Delivery (Article 1, pg. 2-3):
  - Starting in 2003, the District may convey the Non-Project water through the System on a capacity-available basis,
  - Project water deliveries have priority, in the event of a decrease in conveyance capacity,
  - The users of the Non-Project water shall bear a proportionate share of all conveyance and evaporation losses,
  - Any change in the amount of Non-Project water the District wishes to convey must first be approved by the USBR and shall not preclude the USBR from utilizing the additional System capacity or contracting for any of the available capacity, after notification to the District of its intents, and
  - USBR reserves the right to deny the conveyance of any Non-Project water from sources other than MVIC senior water rights.
- Repayment of Construction Cost Component (Article 2, pg. 3-4):
  - The cost for the conveyance of the Non-Project Water will be determined by the actual distance conveyed and the Project facilities used, and
  - The payment will be applied pursuant to Section 5 of the CRSPA.
- Operation, Maintenance and Replacement Charges (Article 4, pg. 4):
  - The District will collect OM&R charges from users of the Non-Project Water so as not to increase the OM&R costs to Project water users or the USBR.
- Measurement and Responsibility for Distribution (Article 7, pg. 5-6):
  - The District is responsible for any measurement devices necessary to account for the inflow of Non-Project Water, and
  - The District will comply with applicable federal, state, or local laws and regulations and will notify the USBR 30 prior to any earth disturbing activities or construction needed to divert the Non-Project Water.
- Conditions affective carriage of Non-Project Irrigation Water (Article 8, pg. 6):
  - Cessations of the conveyance of Non-Project Water will be treated in the same manner as the cessations of the conveyance of Project Water, and
  - The District will receive notice five days in advance of any inspection, maintenance and operating requirements that cause such cessation in delivery.
- Quality of Water (Article 9, pg. 7):
  - The District is responsible for any remedial actions required to meet the highest quality level reasonably attainable as determined by the USBR.

- Reclamation Reform Act Compliance (Article 11, pg. 7):
  - All lands to be irrigated with the Non-Project Water will be classified according to the USBR land class standards, to assure their suitability for irrigation and must be classified as irrigable.