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MEMORANDUM

TO: Rod Sando, CBFWA
Michelle Seibert

FROM: FPC Staff

DATE: April 17, 2003

RE: 1995-2002 Biological Opinion Operations

At your request the Fish Passage Center has compiled information regarding the fulfillment of Biological Opinion measures between the years of 1995 and 2002. In our analysis we have compiled information on spill for fish passage, spring and summer flow objectives, and summer draft limits. The following points outline the findings of our analyses:

SPILL

- ❖ Spill has mostly been provided in accordance with the prevailing spill program in any specific year; however, there has been a considerable variation in spill among years for a variety of reasons (excess generation spill, excess hydraulic capacity spill, maintenance issues, test schedules).

FLOW

- ❖ Fulfillment of the Biological Opinion flow objective has varied from year to year:
 - 1995: 3 of 4 Flow Objectives Met = 75%
 - 1996: 3 of 4 Flow Objectives Met = 75%
 - 1997: 4 of 4 Flow Objectives Met = 100%
 - 1998: 3 of 4 Flow Objectives Met = 75%
 - 1999: 5 of 5 Flow Objectives Met = 100%
 - 2000: 1 of 5 Flow Objectives Met = 20%
 - 2001: 0 of 5 Flow Objectives Met = 0%
 - 2002: 2 of 5 Flow Objectives Met = 40%
- ❖ Since 1995 flow objectives have been met 58% of the time; over the last three years, flow objectives have only been met 20% of the time.

SUMMER DRAFT LIMITS

- ❖ **Grand Coulee:** Were within ½-foot of the August 31st draft limit in six of the last eight years.
- ❖ **Hungry Horse:** Were within ½-foot of the August 31st draft limit in three of the last eight years.
- ❖ **Libby:** Were within ½-foot of the draft limit in zero of the last eight years (two years were drafted over four below the limit), mostly due to agreements with BC Hydro.
- ❖ **Dworshak:** Were within ½-foot of the draft limit in three of the last eight years

Spill for Fish Passage

Prior to 1993 when the first Biological Opinion was issued, spill was considered mitigation at hydroelectric projects to enhance project survival for juvenile salmonids. Historically, spill occurred operationally, when project capacity or system generation needs were exceeded. As the hydrosystem was developed it became more efficient through such actions as the construction of the DC and AC Intertie transmission lines. As a consequence, the occurrence of spill declined, accelerating the disagreements between operators and regulators and the fishery agencies regarding the provision of spill. In December of 1988, a 10-year spill program was developed for implementation of spill at projects that were not equipped with adequate bypass systems to achieve a fish passage efficiency goal. (Fish Spill Memorandum of Agreement).

As fish stocks continued to decline and were listed under the Endangered Species Act, it became clear that the negotiated contracts were not aggressive enough to recover endangered stocks. This led to the modification of spill programs under the different versions of the Biological Opinion. At the same time that spill was identified as a key element in the recovery of listed stocks, the need to meet the objectives of the Clean Water Act was also identified. Spill causes high levels of total dissolved gas that could increase mortality and eliminate the benefits associated with the implementation of an aggressive spill program. Therefore, subsequent implementation of a spill program has been within the confines of the “risk” associated with increased levels of total dissolved gas. Consequently, spill is limited by the “gas cap” approved by the State water quality agencies as a way of managing risk. The following is a yearly account of the program in place and the spill that occurred in the federal Hydrosystem.

1993 – The NMFS Biological Opinion was issued on May 26, 1993. Prior to that date spill was in accordance with the COE Annual Fish Passage Plan, which prohibited spill at the collector projects and only called for spill at the non-collector projects to achieve a 70/50 fish passage efficiency (fish passage efficiency (FPE) is a measurement of the proportion of fish that pass a project via a non turbine route). The Fish Passage Plan criteria applied to Ice Harbor and Bonneville dams. Spill according to the 1989 Fish Spill MOA was implemented at The Dalles and John Day dams. The 1993 Opinion superceded the earlier implementation scheme and prohibited planned spill at the collector projects, limited spill at Ice Harbor Dam, called for the removal of fish screens at Ice Harbor and Bonneville dams during the summer migration and

implemented spill according to the 1989 MOA at John Day and The Dalles dams. The 1989 Spill MOA called for spill at John Day during the spring for 10 hours a day at a level equal to 20% of instantaneous flow, and spill at The Dalles Dam at a level equal to 10% of the daily average flow during the spring and 5% of daily average flow during the summer.

No planned spill occurred at the Snake River collector projects, but some excess generation spill did occur during the spring season. The spill MOA was implemented at John Day and The Dalles dams. During the period of peak runoff spill exceeded the levels of the MOA, but whenever possible they were managed down to those levels.

1994 – Spill was initially provided according to the 1994 –1998 BIOP, which required 70% spring and 50% summer FPE at non-collector projects. Operations changes on May 11 and implementation was requested to the 80% FPE. Spill was adjusted and varied up to the TDG waivers until May 27, when NMFS requested a one-third reduction in spill levels. Summer spill was limited at John Day and The Dalles Dams.

1995 – Spill was provided according the 1995 Biological Opinion. This included spring spill at the Snake and Lower River projects and summer spill at Ice Harbor, John Day, The Dalles and Bonneville dams. Spill was up to the 80% FPE objective, or as limited by the gas cap. Ice Harbor Dam's hydraulic capacity was limited to 66 Kcfs; consequently, significant excess hydraulic capacity spill occurred at this project. John Day Dam did not have spillway deflectors installed and spill was limited

1996 – Spill was provided according to the 1995 Biological Opinion. Extremely high natural runoff conditions resulted in spill levels in excess of those that would have occurred under a spill program managed for total dissolved gas levels.

1997 - Spill was provided according to the 1995 Biological Opinion. Extremely high natural runoff conditions again this year resulted in spill levels in excess of those that would have occurred under a spill program managed for total dissolved gas levels. Full use of the John Day Dam spillway was delayed until after May 5 because of delays in spillway deflector installation due to contested contracts. The Ice Harbor project operated with spillway deflectors. The addition of spillway deflectors at both Ice Harbor and John Day resulted in lower levels of total dissolved gas compared to the previous high flow year values.

1998 – The 1998 Supplemental BIOP called for additional spill to the gas caps on a system-wide basis, even if the project met the 80% FPE at lower spill amounts. The Supplemental BIOP also modified the planning dates for spill allowing earlier initiation of the program and keying the duration to fish passage movement.

1999 – Spill was provided according to the 1998 Supplemental BIOP and was primarily involuntary, resulting from flows in excess of hydraulic capacity and power needs. Spill at most projects met or exceeded the 80% fish passage efficiency objective. The notable exception was The Dalles Dam, where the conduct of a spill test, where spill alternated between 64% of average daily flow and 30% of average daily flow, resulted in less spill than called for in the BIOP.

2000 – In April of 2000 NMFS released a Spill Plan agreement that modified the 1998 Supplemental BIOP spill levels, and was to be the basis for the 2000 BIOP spill program. Spill at Lower Monumental Dam was increased from a 12-hour to a 24-hour period. At The Dalles Dam, spill was reduced from the 64% of daily average flow, to 40% of daily average flow. In addition, while spill remained the same at John Day and Bonneville dams, spill tests were called for at both the projects. In general, the BIOP was implemented up to the spill gas caps.

2001 – The low flows and the declaration of a power system emergency resulted in no spill occurring in the Snake River during either the spring or the summer migration. A limited spill program equal to 600 MW months of energy was implemented after mid-May at Bonneville and The Dalles dams, and on May 25th at McNary and John Day dams that extended to June 15th. A limited summer spill program was implemented beginning in mid July at The Dalles and Bonneville dams.

2002 – Spring and summer spill were provided according to the NMFS 2000 BIOP, as constrained by the total dissolved gas caps. The only exception occurred at Lower Monumental Dam where spill was not implemented because of repairs work that was being conducted in the stilling basin.

While spill has mostly been provided in accordance with the prevailing spill program in any specific year, there has been a considerable variation in spill among years for a variety of reasons (excess generation spill, excess hydraulic capacity spill, maintenance issues, test schedules). To capture this variation the following tables summarize the amount of spill that occurred in two different ways. The daily average spill (in Kcfs) that occurred is summed over the spring and summer period to give an estimate of the magnitude of water spilled. For comparison sake all periods were standardized to the present planning dates for spill, that is to say, the spring period extends from April 3 to June 20 in the Snake River and April 10 to June 30 in the lower Columbia River, while the summer period extends from June 21 to August 31 in the Snake and July 1 through August 31 in the lower Columbia. The second summary statistic averages the daily proportion of water spilled (relative to total flow) over the same time periods. Spill over the ten-year period has ranged from the lows observed during the power emergency in 2001 to the highs observed during the high flow years of 1996 and 1997.

YEAR	Lower Granite				Little Goose				Lower Monumental				Ice Harbor			
	Spring		Summer		Spring		Summer		Spring		Summer		Spring		Summer	
	Total	Avg %	Total	Avg %	Total	Avg %	Total	Avg %	Total	Avg %	Total	Avg %	Total	Avg %	Total	Avg %
1993	848	0.07	0	0.00	1748	0.17	0	0.00	1382	0.12	0	0.00	2548	0.29	931	0.29
1994	736	0.15	13	0.01	1069	0.20	0	0.00	424	0.09	14	0.01	1611	0.34	342	0.13
1995	824	0.09	33	0.00	1491	0.19	96	0.01	1176	0.14	87	0.01	2787	0.33	1817	0.49
1996	4203	0.39	332	0.05	4015	0.38	407	0.07	3892	0.34	465	0.08	4506	0.41	1825	0.52
1997	4304	0.32	268	0.04	4453	0.36	186	0.02	4652	0.36	278	0.03	6924	0.53	2830	0.59
1998	2647	0.28	106	0.02	2813	0.32	14	0.00	2501	0.26	8	0.00	5151	0.58	2998	0.72
1999	3328	0.37	359	0.04	2136	0.25	84	0.01	1848	0.20	88	0.01	5567	0.62	3178	0.76
2000	1880	0.29	15	0.00	1606	0.22	29	0.01	2310	0.33	6	0.00	4855	0.70	2205	0.79
2001	0	0.00	15	0.01	0	0.00	1	0.00	0	0.00	9	0.01	10	0.00	0	0.00
2002	2432	0.37	383	0.08	2142	0.35	271	0.07	70	0.01	0	0.00	4463	0.65	2397	0.76

	McNary				John Day				The Dalles				Bonneville			
	Spring		Summer		Spring		Summer		Spring		Summer		Spring		Summer	
	Total	Avg %	Total	Avg %	Total	Avg %	Total	Avg %	Total	Avg %	Total	Avg %	Total	Avg %	Total	Avg %
1993	4574	0.18	0.38	0.00	2645	0.11	609	0.07	4450	0.02	408	0.05	8289	0.43	3783	0.41
1994	1494	0.09	159	0.02	558	0.03	418	0.06	3341	0.21	397	0.05	6410	0.40	2781	0.35
1995	7611	0.36	429	0.03	693	0.03	318	0.03	10189	0.47	6138	0.59	6888	0.33	5403	0.51
1996	11650	0.56	4094	0.28	6758	0.22	2231	0.18	16859	0.57	7253	0.57	14296	0.47	5482	0.42
1997	21698	0.59	4829	0.31	11630	0.29	2840	0.19	21923	0.58	9102	0.64	18751	0.49	6220	0.43
1998	9289	0.38	1186	0.09	7116	0.28	2939	0.28	10342	0.42	4856	0.46	8373	0.34	5456	0.51
1999	10960	0.44	4867	0.33	6403	0.25	3938	0.28	10599	0.42	7871	0.57	8274	0.32	5350	0.38
2000	7760	0.38	365	0.03	6274	0.31	3311	0.35	7627	0.38	3688	0.39	7306	0.35	5653	0.57
2001	163	0.01	0	0.00	400	0.04	0	0.00	1263	0.11	1163	0.20	1482	0.12	1281	0.20
2002	9560	0.42	2015	0.13	6952	0.30	3426	0.29	8107	0.37	4507	0.39	9919	0.44	6724	0.58

Spring and Summer Flow Objectives

The following table summarizes the Spring and summer Biological Opinion flow objectives and actual flows for the years 1995 to 2002 at Lower Granite, Priest Rapids, and McNary. For each year, bold font would indicate that the spring or summer actual average flow was equal to or greater than the flow objective.

	1995	1996	1997	1998	1999	2000	2001	2002
Lower Granite								
Spring Objective	95.0	100.0	100	90.0	100.0	96.3	85.0	97.0
Spring Average	101.1	138.3	162.5	115.6	117.0	85.1	47.5	83.4
Summer Objective	52.0	53.5	55.0	50.6	54.0	51.3	50.0	51.0
Summer Average	55.3	52.7	66.3	53.2	56.0	39.6	25.4	41.2
Priest Rapids								
Spring Objective	<i>Na</i>	<i>Na</i>	<i>Na</i>	<i>Na</i>	135.0	135.0	135.0	135.0
Spring Average	<i>Na</i>	<i>Na</i>	<i>Na</i>	<i>Na</i>	169.6	158.1	76.7	180.6
McNary								
Spring Objective	249.0	260	260.0	228.0	260.0	260.0	220.0	246.0
Spring Average	253.0	357.1	463.5	287.8	303.6	243.4	123.9	269.3
Summer Objective	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
Summer Average	164.7	214.5	236.6	169.7	228.2	153.6	90.9	190.9

Fulfillment of the Biological Opinion flow objective has varied from year to year:

- ❖ 1995: 3 of 4 Flow Objectives Met = 75%
- ❖ 1996: 3 of 4 Flow Objectives Met = 75%
- ❖ 1997: 4 of 4 Flow Objectives Met = 100%
- ❖ 1998: 3 of 4 Flow Objectives Met = 75%
- ❖ 1999: 5 of 5 Flow Objectives Met = 100%
- ❖ 2000: 1 of 5 Flow Objectives Met = 20%
- ❖ 2001: 0 of 5 Flow Objectives Met = 0%
- ❖ 2002: 2 of 5 Flow Objectives Met = 40%

Overall, taking into account all of the projects with BiOp flow objectives (all blocks in the above table), since 1995 flow objectives have been met 58% of the time. Within the last three years, flow objectives have only been met 20% of the time.

Summer Draft Limits

The following table summarizes the actual end of August elevations of Grand Coulee, Hungry Horse, Libby, and Dworshak along with the BiOp draft limit. The end of August draft limits are fixed at Hungry Horse (3540 feet), Libby (2439 feet), and Dworshak (1520 feet); however, the draft limit ranges between 1278-1280 at Grand Coulee depending on the July final April-to-August runoff volume forecast at The Dalles Dam (for each year the draft limit is in parenthesis).

	1995	1996	1997	1998	1999	2000	2001	2002
Grand Coulee	1280.4 (1280.0)	1280.3 (1280.0)	1279.8 (1280.0)	1279.0 (1280.0)	1286.4 (1280.0)	1280.4 (1280.0)	1278.3 (1278.0)	1279.5 (1280.0)
Hungry Horse (3540)	3552.8	3543.2	3546.2	3540.0	3554.3	3539.8	3539.4	3544.9
Libby (2439)	2454.2	2452.3	2450.1	2443.9	2455.63	2434.9	2434.9	2442.2
Dworshak (1520)	1530.9	1535.6	1500.5	1520.3	1526.6	1520.1	1520.5	1534.0

Meeting the BiOp summer draft limits varies depending on the project. Since 1995:

- ❖ **Grand Coulee:** Six of the last eight years were within ½-foot of the draft limit
- ❖ **Hungry Horse:** Three of the last eight years were within ½-foot of the draft limit
- ❖ **Libby:** Zero of the last eight years were within ½-foot of the draft limit
(Two years were drafted over four below the limit)
- ❖ **Dworshak:** Three of the last eight years were within ½-foot of the draft limit
(One year was drafted below the limit)

The following paragraphs provide a year-by-year summary of why projects did not draft to their respective BiOp summer limits.

1995: None of the projects were drafted to the elevations specified in the BiOp by the end of August. Two agreements left water in Libby 1) BC Hydro drafted 385 Kaf out of Arrow in lieu of Libby and 2) The State of Montana left 290 Kaf in Libby. Outflows at Hungry Horse were limited by switching yard work, implementing selective withdrawal construction, and by an agreement between the federal parties and the State of Montana. Outflows at Dworshak were limited by dissolved gas.

1996: Neither the Hungry Horse or Libby reservoirs were drafted to their respective Biological Opinion levels of 3540 and 2439 feet by August 31st. The Hungry Horse reservoir drafted to an elevation of 3543 feet, three feet above the BiOp level, due to construction works at the powerhouse. The Libby reservoir drafted to an elevation of 2452, approximately 13 feet above the BiOp draft limit, due to an agreement with BC Hydro that provided a volume of 10 feet of water from Arrow reservoir instead of drafting Libby.

1997: Neither the Hungry Horse or Libby reservoirs were drafted to their respective Biological Opinion levels of 3540 and 2439 feet by August 31st. The Hungry Horse reservoir drafted to an elevation of 3546 feet, six feet above the BiOp level. The Libby reservoir drafted to an elevation of 2450, approximately 11 feet above the BiOp draft limit, due to an agreement with BC Hydro (Libby/Arrow Swap) that provided a volume of 10 feet of water from Arrow reservoir instead of drafting Libby. Dworshak was drafted to 1500 feet because of grouting work during the fall of 1997.

1998: The Hungry Horse reservoir was drafted to its Biological Opinion limit of 3540 feet by August 31st. The Libby reservoir was drafted to 2444 feet by August 31st, five feet above the BiOp level of 2439 feet, as a result of an agreement with BC Hydro (Libby/Arrow Swap) that provided a 210 Kaf of water from Arrow reservoir instead of drafting Libby.

1999: Neither the Hungry Horse or Libby reservoirs were drafted to their respective Biological Opinion levels of 3540 and 2439 feet by August 31st. The Hungry Horse reservoir drafted to an elevation of 3554 feet, 14 feet above the BiOp level, and the Libby reservoir drafted to an elevation of 2456, approximately 17 feet above the BiOp draft limit. High inflows from the Canadian portion of the Upper Columbia eliminated the necessity to draft the Libby and Hungry Horse reservoirs to the BiOp recommended levels.

2000: The Hungry Horse reservoir was drafted to its Biological Opinion limit of 3540 feet by August 31st. The Libby reservoir was drafted to 2435 feet by August 31st, four feet below the BiOp level of 2439 feet, as a result of early season drafts (including those for Bull Trout) and a lower than expected runoff volume.

2001: The Hungry Horse reservoir was drafted to 3439 feet by August 31st, just slightly below its Biological Opinion limit of 3540 feet. The Libby reservoir was drafted to 2435 feet by August 31st, four feet below the BiOp level of 2439 feet, as a result of an extremely low runoff volume.

2002: Neither the Hungry Horse or Libby reservoirs were drafted to their respective Biological Opinion levels of 3540 and 2439 feet by August 31st. The Hungry Horse reservoir drafted to an elevation of 3545 feet, five feet above the BiOp level, and the Libby reservoir drafted to an elevation of 2442, approximately three feet above the BiOp draft limit. The extra five feet of water left in Hungry Horse was released in September of 2002, and the draft limit was not reached at Libby because of a Libby/Canadian Swap. By August 31st 2002, Dworshak drafted to an elevation of 1534.0 feet, 14 feet above the BiOp draft limit. An agreement was made to release the remaining 14 feet of water in Dworshak during the month of September.