CHAPTER 3.0

ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES

3.1 OVERVIEW OF ANALYTICAL METHODS

This section describes the general analytical approach used to evaluate potential environmental effects of the proposed NTSA. More specific information on analytical techniques and assumptions used is found in specific sections describing environmental impacts and in Appendix B.

As described in Chapter 2.0, both the existing NTSA and the proposed NTSA provide for storage in Treaty and non-Treaty space in several BC Hydro reservoirs. Of the potential storage, only the amount of active storage in Mica differs substantially between the two NTSA agreements. Non-Treaty storage in Mica also represents by far the largest volume of storage under the agreement. Because the other types of storage are available only on an intermittent basis, have not been used regularly under the existing NTSA, and are only of small volume, analysis focused on use of the potential 5.0 MAF of non-Treaty storage in Mica. Studies conducted for this EA are based on the full 5 MAF being available as active storage space. It currently appears that only 4.5 MAF will be available as active storage with 0.5 MAF that may be made available as recallable space. Thus the analysis examines the effects of using both active and recallable storage in Mica. In order to simplify discussions in this document, the term non-Treaty storage is used to refer to the 2.0 MAF of active storage in Mica in the existing agreement and the 5.0 MAF of non-Treaty space in Mica studied as active storage in the proposed agreement.

Three approaches were used to estimate the potential environmental effects of the proposed NTSA. The first approach was to evaluate operation of the 2.0 MAF of non-Treaty space utilized under the existing NTSA. The second approach was to use the System Analysis Model (SAM) to estimate expected operation of the power system over a wide variety of randomly chosen historical water conditions and loads throughout the 20-year study horizon both with and without the proposed NTSA. The third approach was to use hydro regulation studies to estimate the maximum rate of storage transactions that could occur under either the existing or proposed NTSA assuming the 50-year (1929 - 1978) historical water sequence.

3.1.1 Historical Evaluation of Non-Treaty Storage Use

Because the proposed agreement contains the same operating limitations as the existing agreement, it is expected that the 5.0 MAF of non-Treaty space made available in the proposed NTSA would be utilized similarly to the 2.0 MAF of non-Treaty space operated under the existing NTSA. Daily transaction records from April 1984 through September 1989 were analyzed to determine monthly average transactions, maximum daily storage and release rates, and patterns of use of non-Treaty space.

3.1.2 Use of the System Analysis Model

SAM was used to estimate expected operation of the power system over a wide variety of randomly chosen historical water conditions and loads throughout the 20-year study horizon both with and without the proposed NTSA. The SAM results were used to determine potential effects of the proposed NTSA on Pacific Northwest power system operations, including effects on export sales, purchases, types of generation facilities and the amount they operated throughout the PNW, and operation of the PNW hydro system.

3.1.2.1 Modeling of Alternatives in SAM

The SAM was used to project changes in power system operations resulting from the proposed agreement. Studies were run for two alternatives: the No-Action alternative and the proposed agreement. The No-Action alternative assumes operation of non-Treaty space as opportunity storage as is the current practice. The proposed NTSA was studied both as opportunity storage and as a firm resource. Studies were run assuming expected future conditions, such as medium load growth. These studies are the Base Cases for each alternative. In addition, sensitivity studies were run for selected parameters as described in Section 3.1.2.2.

No-Action Alternative. The No-Action alternative represents operation under the existing agreement until the agreement expires in 1993. This alternative assumes operation of 2 MAF of NTS (1 MAF by BC Hydro and 1 MAF by the U.S.) until 1993. After 1993, storage transactions (but no release transactions) occur until NTS is full. No other aspects of the existing NTSA (such as recallable storage space) are modeled. Although BPA is the only U.S. party with decision-making authority under the existing agreement, SAM, a regional model, makes decisions on non-Treaty use for the PNW region not just BPA. Two MAF of Mica non-Treaty storage space (active storage) is assumed to be used for opportunity storage following historical patterns. Each party (U.S. utilities or BC Hydro) determines whether to store or release water from non-Treaty space depending upon markets available for energy produced at the time. Commenters on the NTSA Discussion Paper suggested that the potential reservoir elevation increases associated with non-Treaty storage did not depict the probable use of the U.S. hydro system. Based on the comments received, study assumptions were modified. The results of those modified studies are presented in this EA.

For the purposes of studying potential effects of non-Treaty storage on the U.S. power system, it is assumed that U.S. reservoirs are drafted to produce the U.S. firm energy load carrying capability in accordance with planning guidelines, prior to use of non-Treaty storage to meet regional loads or extraregional markets. In order to study the full range of potential environmental impacts in Canada, BC Hydro used studies, consistent with those presented in the Discussion Paper, that maximize use of non-Treaty storage. The modification described above applies to the No-Action alternative and to the proposed agreement when operated for opportunity storage. It does not apply to the use of non-Treaty storage as a firm resource. A further description of the logic used to model non-Treaty storage use in SAM is provided in Appendix B.

Proposed NTSA - Opportunity Storage. In this case, operation of the non-Treaty storage is modeled the same as in the No-Action alternative, except the volume of available storage is increased from 2 MAF to 5 MAF in September 1990. As currently structured, the proposed agreement would expire in 2003; although, the final agreement may provide for some extension. In order to assess the full range of potential impacts through the planning horizon, the Base Case studies assume the proposed agreement remains in effect through 2008. Because daily limitations on the amount of water that can be stored or released are the same for both alternatives, monthly constraints are the same as for the No-Action alternative.

Proposed NTSA - Firm Resource. This case assumes that the U.S. would declare non-Treaty storage as a firm resource in Pacific Northwest Coordination Agreement (PNCA) planning and thus would be obligated to refill the storage space along with U.S reservoirs. SAM was modified to accommodate operation of the U.S. portion of non-Treaty storage space similar to operation of other U.S. reservoirs. A check was made to determine what additional increment of FELCC in SAM results from operation of the U.S. half of non-Treaty storage. In order to analyze the effects of non-Treaty operation as a firm resource, rather than the effects of additional firm surplus, the gain in FELCC was assumed to be sold under contract within the PNW. Additional studies were performed for the economic analyses, which assume non-Treaty storage is used for deferral of new resources rather than for firm sales. BC Hydro is assumed to operate its portion of the storage for firm use, such that Canadian non-Treaty storage is reserved for firm load service.

3.1.2.2 Sensitivity Studies

Several studies were conducted to determine the sensitivity of study results to assumptions used in modeling non-Treaty storage use.

PNW High Loads. This sensitivity case uses BPA's high 1988 long-term load forecast to determine the effect of load growth higher than expected on the use of non-Treaty storage space. Medium loads used in the base case increase from 17,600 megawatts (MW) in 1989 to 21,600 MW in 2008; high loads increase from 18,300 MW to 28,400 MW over the same period.

Southwest High Loads and High Gas Prices. A case was constructed to study the effects of higher Southwest load and gas price assumptions than in the medium forecasts used in the base case.

Alternative Dispatch Criteria. The base case studies use specific dispatch criteria to operate non-Treaty storage. To examine the effects of the criteria chosen on the non-Treaty storage operation in SAM, this case assumes use of non-Treaty storage to meet markets at 10 percent lower prices than assumed in the base case. This case does not apply to the use of non-Treaty storage as a firm resource.

Spill Agreement. At the time BPA began the non-Treaty storage analyses, the U.S. Army Corps of Engineers' (Corps) spill plan was in place. BPA was negotiating an agreement with fishery interests calling for varying the amounts of spill for fish at selected projects. The Spill Agreement was signed April 10, 1989. This case incorporates the negotiated Spill Agreement into the SAM operating logic and shows the effects of its interaction with non-Treaty storage.

Expire in 2003. In order to evaluate potential effects of the refill obligation at the end of the agreement, a study is examined in which the proposed agreement expires in 2003. This study is also used in the economic analyses to evaluate benefits of the proposed agreement.

3.1.3 Use of Hydro Regulation Studies

Hydro regulator model results from the 1996 operating year of the 1988 Pacific Northwest Loads and Resources (Whitebook) study were used to evaluate the potential that non-Treaty storage use would result in decreased Columbia River flows in the spring and summer months. The maximum storage that could occur in those months was determined for each of the 50 historical water years. Estimates of potential storage are subject to the following assumptions: (1) storage amounts are limited by the difference between Treaty discharges in the hydro regulation study and the minimum discharge requirements at Mica (0 thousand cubic feet per second (kcfs)) and Arrow (5 kcfs); (2) storage is limited to the combined amount of nonfirm energy available to the U.S. and BC Hydro; (3) non-Treaty storage space is assumed to always be available; (4) PNW high cost thermal resources are displaced and DSI first quartile served prior to storing in non-Treaty space; (5) storage into non-Treaty space takes precedence over nonfirm sales to the Southwest; and (6) transmission line limitations between BC Hydro and BPA are not considered.

3.2 USE OF NON-TREATY STORAGE

The basic concept of the proposed NTSA is the same as the existing agreement. In the proposed NTSA, when one party stores into non-Treaty space, outflow at Mica and into the U.S. is reduced by the amount of the storage, and the storing party delivers energy to nonstoring parties to make them whole. When non-Treaty storage is released, the outflow at the project containing the non-Treaty space and at the U.S.-Canadian border is increased, and the releasing party receives energy from all downstream plants. Treaty operations are essentially unaffected by the non-Treaty storage. NTSA transactions must be consistent with Treaty operations and with project operating limits and transmission constraints. A discussion of project operating requirements related to NTSA transactions is provided in Appendix F.

The NTSA, when operated for opportunity storage, provides flexibility for BPA, MCP, and BC Hydro to meet both marketing and operating objectives. In general, storage is more likely to occur when flows are high relative to loads and market conditions are poor. Similarly, releases are more likely to occur when flows are low relative to loads and market conditions are good. On a daily basis, however, non-Treaty storage may be used to enhance hydro system operations, for example, to meet fishery needs. As a general rule, energy is exchanged between U.S. utilities and BC Hydro when either party stores or releases water from non-Treaty storage.

The proposed NTSA will operate in the same manner as the existing agreement. The magnitude of daily transactions under the proposed NTSA will be the same as under the existing agreement; however, the increased volume of active storage available may take longer to fill or empty.

3.2.1 Historical Use of Non-Treaty Storage

Mica Storage. Non-Treaty storage transaction records from April 1984 through September 1989 (provided in Appendix C) were reviewed to determine patterns of Mica storage use under the existing NTSA and to evaluate model results in the context of historical non-Treaty storage use.

The average monthly transactions over the past 5 years (Table 3.2.1) and the maximum daily transactions for each month (Table 3.2.2) were examined. Although the transactions do not directly correspond to changes in flow downstream from Grand Coulee, transaction amounts reasonably approximate the potential monthly average flow changes except during periods of water budget requests. During periods of Columbia River water budget requests, discharge from Grand Coulee supports requested water budget flows at Priest Rapids, and flows are not reduced due to (but may be supplemented by) non-Treaty storage transactions. On a daily basis, non-Treaty storage transactions may not be equivalent to flow changes downstream from Grand Coulee, but transactions set a maximum limit on the flow reduction that could occur as a result of non-Treaty storage transactions.

Table 3.2.1

MICA NON-TREATY STORAGE ACTIVITY*

APRIL 1984 - SEPTEMBER 1989
(Monthly Average Values in KSFD/day)

+ = release - = storage

Month	1984	1985	1986	1987	1988	1989	AVE
January	---	0.0	0.0	+2.7	+0.1	+0.2	+0.6
February	---	0.0	-10.7	+3.7	0.0	+2.7	-0.9
March	---	+6.5	-10.7	+7.9	0.0	0.0	+0.7
April	-6.2	+1.3	-8.3	+2.0	+0.1	-3.6	-2.5
May	-7.3	-0.1	-3.6	-5.2	0.0	-10.0	-4.4
June	-8.2	-6.5	0.0	-0.9	-1.5	+0.5	-2.8
July	-2.7	+7.5	+0.4	+2.5	+2.7	+13.6	+4.0
August	-1.3	+5.2	+5.4	+5.8	-1.5	-0.6	+2.2
September	-2.1	+6.7	+3.5	-3.9	0.0	+0.8	+0.8
October	+5.9	+1.3	-4.4	-0.1	-2.4	---	+0.1
November	-2.6	-0.3	+2.1	-1.5	-2.0	---	-0.9
December	0.0	+1.9	+3.9	+7.5	-0.2	---	+2.6

Water Year (July-June)	Store/Release (KSFD)	Runoff (Jan - July at The Dalles)
1983-1984	-656.17	119.1 MAF
1984-1985	-40.17	87.7
1985-1986	-312.00	108.3
1986-1987	+640.80	76.5
1987-1988	+283.54	73.1
1988-1989	-425.00	90.6

* NTSA transactions for both BPA and BC Hydro resulting from use of 2.0 MAF of Mica Non-Treaty Storage.

TABLE 3.2.2

MICA NON-TREATY STORAGE AND RELEASE */

Maximum Daily Transactions
(KSFD)

Year	1984		1985		1986		1987		1988		1989	
Month	Stor	Rel	Stor	Rel	Stor	Rel	Stor	Rel	Stor	Rel	Stor	Rel
Jan			0.0	0.0	0.0	0.0	-6.3	10.0	0.0	3.0	-7.0	6.0
Feb			0.0	0.0	-15.0	0.0	-20.0	15.0	0.0	0.0	0.0	15.0
Mar			0.0	25.0	-12.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0
Apr	-15.0	0.0	-10.0	12.0	-15.0	0.0	-8.0	7.0	0.0	0.0	-15.0	5.0
May	-10.0	0.0	-10.0	20.0	-5.0	0.0	-10.0	0.0	0.0	0.0	-10.0	0.0
Jun	-10.0	0.0	-10.0	10.0	0.0	0.0	-10.0	10.0	-10.0	8.0	-10.0	10.0
Jul	-10.0	17.0	0.0	11.0	0.0	4.5	-5.8	10.0	0.0	10.0	0.0	22.0
Aug	-25.0	15.0	0.0	17.0	0.0	15.2	-10.0	17.0	-6.0	0.0	-10.0	0.0
Sep	-14.0	6.0	-3.0	16.0	0.0	8.6	-14.0	10.0	0.0	0.0	-10.0	7.0
Oct	-16.0	19.0	-2.0	6.0	-7.0	2.6	-7.0	9.5	-22.0	3.0		
Nov	-10.0	8.0	-12.0	16.0	-5.2	10.0	-23.0	12.0	-10.0	8.0		
Dec	0.0	0.0	0.0	10.0	-5.0	10.6	0.0	12.0	-10.0	6.0		

*/ NTSA transactions resulting from operation of 2.0 MAF of Mica non-Treaty storage.
Stor = Storage
Rel = Release

The following discussion refers to monthly average and maximum daily non-Treaty storage transactions in units of thousand second-foot-days (KSFD)/day, which are equivalent to the average flow changes in kcfs that occurred at the U.S.-Canadian border.

Storing into Mica non-Treaty space has occurred, on average over the 5-year period, in February, April, May, June, and November. Releases, on average, have occurred in all other months. Over the 5-year period, rates of storing and releasing have been modest. May has averaged the greatest rate of storing, about 4.4 KSFD/day, and July has averaged the greatest rate of releasing, about 4.0 KSFD/day. The relatively higher level of storage in May corresponds to storage of excess generation produced by requested water budget releases, but does not equate to a corresponding reduction in flow downstream of Grand Coulee.

The maximum monthly average rate of Mica non-Treaty storage for any year over the past 5 years was 10.7 KSFD/day in March 1986. The maximum monthly average release, 13.6 KSFD/day, occurred in July 1989.

Total storage volume and January through July runoff at The Dalles are presented for each year of the existing NTSA at the bottom of Table 3.2.1. As expected, on an annual basis, larger volumes are generally stored in higher runoff years and storage is generally released in lower runoff years.

In the period April 1984 through September 1989, there were NTSA transactions on about 55 percent of the days. The maximum daily Mica non-Treaty storage, about 25 KSFD, occurred on August 8, 1984. The maximum daily release, also 25 KSFD, occurred on March 28 and 29, 1985. Maximum daily transactions for each month are provided in Table 3.2.2. Most of the daily NTSA transactions were 10 KSFD or less. Amounts in excess of 10 KSFD were stored on about 4.3 percent of the total days, while daily amounts of storage in excess of 15 KSFD occurred on only 0.6 percent of the total days. Releases showed a similar pattern. Daily releases in excess of 10 and 15 KSFD occurred on 6.8 and 1.9 percent of the total days, respectively.

There is no discernable pattern to the non-Treaty storage transactions based on day of the week. The use of non-Treaty storage provides hydro system flexibility. This flexibility is derived from the ability to make daily, rather than weekly, changes in flow at the U.S.-Canadian border, the ability to obtain energy from Canadian projects by release of non-Treaty water, and the ability to obtain additional load by storing water in the non-Treaty space. Therefore, it is not unusual to see energy stored one week and released the next, producing a more efficient hydro-operation and reducing streamflow fluctuations.

Other NTSA Storage. In addition to the 2 MAF of non-Treaty storage in Mica, other aspects of the existing NTSA have been utilized over the past 5 years. These include initial filling of Revelstoke and use of recallable storage space in Mica and Arrow. The existing NTSA provides for use of Treaty space in Mica and Arrow. These provisions of the existing NTSA have not been used.

Because Revelstoke was filled under provisions in the existing agreement, and there are no other major projects proposed on BC Hydro's Columbia River system, historical evaluation of the initial filling of Revelstoke is not valuable in determining potential effects of the proposed NTSA.

Recallable space in Mica and Arrow has been made available by BC Hydro under the existing agreement. This allows energy to be stored into non-Treaty space that is not covered by other agreements, space previously utilized by short-term agreements between BPA and BC Hydro. In Arrow, this is the first 2 feet (132.1 KSFD, or 0.26 MAF) above normal full pool. When available, it is equally shared between BPA and BC Hydro. The Arrow recallable space is not generally used unless Arrow is already full. Recallable space in Arrow (0.26 MAF) was available during two periods: August 9, 1984, through March 31, 1985; and August 1, 1985, through December 3, 1985.

As with other non-Treaty storage transactions, storage in Arrow is limited by project operating limits. The maximum daily rate of storage into this space under the existing NTSA was 40 KSFD/day. This rate could not be maintained for more than 1 day because the total space available to each party is only 66.05 KSFD and the maximum daily change in flow at Arrow is 15 KSFD/day. The maximum rate occurred once, on August 11, 1984. Total storage into all space covered by the NTSA totaled 43 KSFD on that date. The daily flow at Priest Rapids, 116 kcfs, was the highest for that week, and well above the monthly average of 101.0 kcfs. This stored water was released over the following 2 weeks. Total storage into space covered by the NTSA (including storage to fill Revelstoke) totaled 74 KSFD for August 1984, an average of only 2.4 KSFD/day.

Recallable space in Mica (0.533 MAF) was made available by BC Hydro from November 14, 1984, to May 31, 1985. If Mica active storage is expanded to include 4.5 MAF of non-Treaty space in Mica, there will be only 0.5 MAF in Mica to be used for recallable storage. Historically, the recallable space in Mica has never been used by BPA and has been used by BC Hydro only in the period November 1984 through March 1985. Use of recallable space in Mica is limited by the same restrictions that apply to other non-Treaty storage space in Mica.

3.2.2 System Analysis Model Results

SAM was used to simulate power system operations, including thermal and hydro system operations in the PNW and British Columbia. Information on new resources was obtained from the Least Cost Mix Model (LCMM). Because the LCMM develops resources in small increments as required to meet load, thus remaining in load/resource balance throughout the study period, new resources were adjusted to expected capacity levels before being input to SAM. A discussion of new resources may be found in Section 3.4.8. Descriptions of the SAM and the LCMM are included in Appendix B.

The following discussion refers to non-Treaty storage transactions in terms of megawatts, to make non-Treaty storage comparable with other resource

operations. The average flow change at the U.S.-Canadian border is the energy in MW divided by 160 MW/kcfs, the total water-to-energy conversion factor from Mica through Bonneville Dam. The term "net average" is used to describe the averaging of both storing and releasing non-Treaty storage transactions, resulting in net average storing or net average releasing.

3.2.2.1 Use of Non-Treaty Storage for Opportunity Storage

Using non-Treaty storage space as opportunity storage allows parties to store water in Mica for later release when generation is more usable or more valuable. This applies to both U.S. and BC Hydro operation of non-Treaty storage space. Results discussed for non-Treaty storage are the sum of the U.S. and Canadian operations for the proposed agreement alternative, and are 20-year averages unless otherwise stated (Tables 3.2.3 and 3.2.4). Storage released for opportunity sales is used to serve the most valuable market, such as Pacific Southwest (PSW) economy sales, BPA's direct service industries (DSI) customer load, or regional firm load.

In typical water conditions, net average storing occurs mainly during the 7-month period January through July, and non-Treaty storage transactions average about 385 MW stored. Releasing usually occurs during the 4-month period August through November, and non-Treaty storage transactions average about 650 MW released. Energy is gained when spill or otherwise unusable generation is stored in available non-Treaty space and released later when it is usable for power generation. In typical water years, the amount of energy stored is about the same as the amount of energy released. Non-Treaty space varies from about 40 percent of full at the end of December up to about 65 percent of full at the end of July.

In addition to shifting generation and flows from the spring to the fall, there is a transfer of water and energy from wet years into drier years. In the driest 10 percent of water years, on a net average basis water is generally released from non-Treaty storage space in all months except May. Net average releases average 650 MW, with the largest releases occurring in the fall. Much of this energy is used to serve firm load and reduces the amount of draft required on the rest of the hydro system. In low runoff years non-Treaty space is drafted from about 50 percent full at the end of September to less than 4 percent of full by the end of the following August.

In high runoff years (the wettest 10 percent), net average storing occurs in most months other than September and October. This net storage averages about 390 MW, with the most water/energy stored in February and July, each averaging about 700 MW. In high runoff years, the storage space fills from about 50 percent full at the end of September to about 90 percent full by the end of August of the following year.

3.2.2.2 Use of Non-Treaty Storage as a Firm Resource

The proposed NTSA would allow non-Treaty storage to be used as a firm resource as well as for opportunity storage. When used as a firm resource, the U.S.

Table 3.2.3

COMPARISON OF U.S. NON-TREATY OPERATION (BASE CASE)
(aMW)

Average Over Low Water Years (Bottom 10 Percent)

ALTERNATIVE	SEP	OCT	NOV	DEC	JAN	FEB	MAR	AP1 */	AP2 */	MAY	JUN	JUL	AG1 */	AG2 */	AVG
No-Action	119	64	37	15	49	13	1	0	0	0	0	1	0	0	25
Change Resulting from Proposal															
Opportunity	701	387	498	224	542	582	190	80	80	0	263	182	55	51	308
Firm	97	88	85	175	-148	154	-51	153	50	0	851	541	706	413	204

Average Over Typical Water Years (Mid 80 Percent)

ALTERNATIVE	SEP	OCT	NOV	DEC	JAN	FEB	MAR	AP1 */	AP2 */	MAY	JUN	JUL	AG1 */	AG2 */	AVG
No-Action	119	51	23	-29	-49	-107	-32	-27	-25	-23	-37	-52	42	44	-10
Change Resulting from Proposal															
Opportunity	522	237	252	-20	-90	-99	-295	-213	-178	-129	-168	-241	224	236	0
Firm	-40	19	-269	-34	-207	14	-8	51	75	10	2	2	107	111	-28

Average Over High Water Years (Top 10 Percent)

ALTERNATIVE	SEP	OCT	NOV	DEC	JAN	FEB	MAR	AP1 */	AP2 */	MAY	JUN	JUL	AG1 */	AG2 */	AVG
No-Action	160	-40	-31	-97	-8	-97	-73	-9	-9	-19	-29	-7	0	0	-21
Change Resulting from Proposal															
Opportunity	634	65	-36	-231	101	-161	-281	-142	-141	-174	-185	-293	-99	-105	-67
Firm	-111	-348	-131	-5	-31	138	28	8	8	19	29	7	0	0	-33

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*/ AP1 = April 1-15; AP2 = April 16-30; AG1 = August 1-15; AG2 = August 16-31.

Table 3.2.4

COMPARISON OF BC HYDRO NON-TREATY OPERATION (BASE CASE) (ANNUAL aMW)

Average Over Low Water Years (Bottom 10 Percent)

ALTERNATIVE	SEP	OCT	NOV	DEC	JAN	FEB	MAR	AP1 */	AP2 */	MAY	JUN	JUL	AG1 */	AG2 */	AVG
No-Action	75	40	40	44	61	16	3	0	0	0	0	0	0	0	23
Change Resulting from Proposal															
Opportunity	588	358	316	213	468	377	119	59	59	0	326	100	33	30	246
Firm	571	304	322	241	496	428	131	55	54	0	404	147	28	27	260

Average Over Typical Water Years (Mid 80 Percent)

ALTERNATIVE	SEP	OCT	NOV	DEC	JAN	FEB	MAR	AP1 */	AP2 */	MAY	JUN	JUL	AG1 */	AG2 */	AVG
No-Action	73	29	20	1	-87	-113	1	-5	-3	-32	6	-18	12	13	-9
Change Resulting from Proposal															
Opportunity	458	225	159	69	-103	-296	-187	-95	-72	-122	-1	-108	167	175	15
Firm	456	218	165	90	-38	-265	-148	-82	-72	-194	-3	-146	171	168	19

Average Over High Water Years (Top 10 Percent)

ALTERNATIVE	SEP	OCT	NOV	DEC	JAN	FEB	MAR	AP1 */	AP2 */	MAY	JUN	JUL	AG1 */	AG2 */	AVG
No-Action	121	-5	-14	11	-108	-164	-64	0	0	-62	-7	-14	0	0	-26
Change Resulting from Proposal															
Opportunity	618	109	50	36	-124	-306	-176	-29	-20	-286	-210	-414	-143	-156	-73
Firm	617	169	57	58	-80	-280	-163	-35	-30	-427	-274	-338	-79	-75	-64

*/ AP1 = April 1-15; AP2 = April 16-30; AG1 = August 1-15; AG2 = August 16-31.

portion (only) would incur a refill obligation for the non-Treaty space under Coordination Agreement planning.

In typical water conditions, water is drafted out of non-Treaty space to serve firm loads during the August through October period. NTSA transactions during this period average 420 MW released. Winter storms often produce excess energy and result in storage into non-Treaty space beginning around November. Later, as the runoff forecast becomes available, non-Treaty storage is filled according to planning guidelines along with other reservoirs on the U.S. system. On BC Hydro's system, non-Treaty storage is used to serve firm loads and to displace use of higher-cost resources. The greatest amount of storage occurs in January and February. In those months, non-Treaty storage transactions average 420 MW stored.

Because of the refill requirement associated with the U.S. non-Treaty space, non-Treaty storage content is considerably higher when it is used as a firm resource than when it is used for opportunity storage. The lowest non-Treaty total content (U.S. and BC Hydro portions), 65 percent of full, occurs in December, prior to the runoff forecast in January. By the end of July, non-Treaty content averages 80 percent of full.

In the driest 10 percent of the runoff conditions, use of non-Treaty storage as a firm resource is similar to its use as opportunity storage. In both cases energy and water are transferred from wetter years into drier ones. Because U.S. non-Treaty storage has a refill requirement when used as a firm resource, the space is generally more full at the beginning of a low water period than when it is used as opportunity storage. This allows drafting of non-Treaty storage to serve firm load. Drafting of non-Treaty storage generally occurs in all months except May, with transactions averaging 550 MW released for this period. In low water years, non-Treaty space drafts from about 66 percent of full at the end of September to only about 26 percent of full at the end of the following August.

In the wettest runoff years, storing typically occurs in most months except September, if there is non-Treaty storage space available. September flows are often lower than those used in planning, and non-Treaty storage is drafted along with the rest of the U.S. system to meet firm loads. The magnitude of non-Treaty storage transactions is smaller on an average basis than when used for opportunity storage, because the U.S. portion is frequently full, precluding storage by U.S. utilities. Although BC Hydro's portion is not constrained in the same way, BC Hydro alone is not able to store as much energy as the U.S. and BC Hydro combined. With high runoff conditions, the non-Treaty storage space fills from about 66 percent of full at the end of September to 94 percent of full by the end of August of the following year.

3.2.2.3 Results of Sensitivity Studies

Sensitivity studies show that operation of non-Treaty storage under the proposed agreement, when compared to the No-Action alternative, is largely unaffected by assumptions used in the SAM studies that were analyzed in the

sensitivity studies. Non-Treaty storage use in the sensitivity studies closely parallels its operation in the Base Case. The "SW High Load High Gas Price" and the "Spill Agreement Signed" sensitivities produce non-Treaty operations that are essentially identical to the Base Case. Results of the "Expire 2003" case are identical to the proposed agreement Base Case through 2003, after which non-Treaty storage can no longer be released and the proposed agreement is similar to the No-Action alternative. The "PNW High Load" sensitivity case results in somewhat lower non-Treaty storage content and less energy production from use of non-Treaty storage space than the Base Case studies, but results are generally similar to those for the Base Case.

The "Alternative Dispatch Criteria" (ADC) sensitivity study results in the greatest change in non-Treaty storage use from the Base Case. Because non-Treaty storage is used to meet lower priced markets than in the other studies, non-Treaty storage is used more frequently and non-Treaty content averages about 75 percent of that in the Base Case. Likewise, energy available to serve load in the low water years is only about 75 percent of that available in the Base Case. In high runoff years, the ADC studies have the greatest rate of spring storage of any of the cases studied. This is because non-Treaty storage is seldom full and thus space is often available into June and July. This allows storing to occur when non-Treaty space had filled in other studies. Annual average non-Treaty generation is similar to other cases.

3.2.2.4 Comparison of Historical Data to SAM Results

SAM results of 200 simulations of non-Treaty operation for opportunity storage were compared with the results from 5 years of actual operations to verify that the modeling results are reasonable. The comparison matched well, considering that the historical data covered only 5 years and did not include the same mix of water conditions as did the computer simulations. The pattern of releasing in the fall and storing in winter and spring was apparent, as was a clear trend of storing more in wet years and releasing more in dry years. See Table 3.2.1 for the actual use values, and Tables 3.2.3 and 3.2.4 for the results of the computer simulations.

In addition, the frequency of monthly transactions greater than 10 kcfs was compared with historical data. In both historical data and computer simulations, releases of 10 kcfs or more on a monthly average basis occur only about 3 percent of the time. Storing of 10 kcfs or more occurs in nearly 6 percent of the months in computer simulations, while historical data show a rate of only 1.5 percent. Thus the SAM may overstate the rate of storage into non-Treaty space, which would tend to overstate potential reductions in Columbia River flow. Resulting environmental effects determined by using SAM data would be greater than actually expected to result from the proposed agreement.

3.2.3 Hydro Regulator Model Results

As a part of the analysis prepared for this EA, hydro regulation studies conducted for the 1988 Pacific Northwest Loads and Resources Study were used to evaluate the maximum potential storage transactions that could occur during the April through August period in the 5 MAF of Mica non-Treaty space to be shared by the U.S. and BC Hydro. The evaluation included potential effects of using Arrow Treaty space made accessible to BC Hydro by the existing and proposed agreements.

The hydro regulator model does not fully account for all of the operational and power marketing activities that ultimately affect flows and reservoir levels. Therefore, the model was used only to evaluate the maximum potential storage, and thus the maximum potential decrease in flow, that could occur under the NTSA on a daily or monthly basis during the spring period of anadromous fish migration. Further description of the assumptions used in these evaluations is provided in Appendix C.

The maximum potential rate of storage into Mica non-Treaty space during the mid-April through August period was calculated for 50 historical water years based on Treaty discharge requirements and minimum discharge requirements at Mica and Arrow, and combined nonfirm availability for the U.S. and BC Hydro. These results, presented in Appendix C, represent a theoretical maximum condition that applies to both the existing NTSA and the proposed agreement. Actual storage amounts would be substantially less when nonfirm marketing, displacement of medium and low-cost resources, transmission line-loading limitations, and non-Treaty space availability are considered.

The maximum amount that can be stored in Mica non-Treaty storage is 10 KSFD/day from mid-April until Mica Treaty space refills, usually the end of July or August. The maximum amount that can be stored on a daily basis is not influenced by the additional 3 MAF of non-Treaty storage studied in the proposed agreement. At any time during the year, including after Mica refills, the maximum amount that can be stored if only one party (the U.S. or BC Hydro) chooses to store is approximately 25 to 30 KSFD/day based on transmission line-loading limitations between BPA and BC Hydro.

A summary of the hydro regulation study results for Mica non-Treaty space is provided in Table 3.2.5. The maximum storage rate in the second half of April and May is 10 KSFD/day for all water years. Some storage, although not always at the maximum rate, can occur in 40 percent of the years in the second half of April and about 75 percent of the years in May. In years in which Mica refills prior to the end of June, monthly maximum non-Treaty storage rates may be higher than 10 KSFD/day. On a monthly average basis, the highest June storage rate would be about 14 KSFD/day, with lower maximum daily storage rates in the early part of the month and higher maximum storage rates at the end of the month, after Mica has refilled. Some storage is possible in June (typically around 10 KSFD/day) in about 80 percent of the years. In less than 10 percent of the years, maximum storage rates exceed 10 KSFD/day. Requested

Table 3.2.5

SUMMARY OF HYDRO REGULATION STUDY RESULTS

POTENTIAL STORAGE IN MICA NON-TREATY SPACE

	Apr. 15-30	May	June	July	Aug 1-15	Aug 16-31
Number of water years (out of 50) with potential for storage.	20	38	34	40	44	45
Max. daily storage rate (KSFD/day)	10.0	10.0	14.3	59.8	52.2	48.0
No. of years in which max. storage rate could occur.	14	32	1	1	1	1
No. of years in which storage > 10 KSFD/day could occur.	0	0	4	26	24	10

water budget releases would not be affected by non-Treaty storage, although energy produced by the releases may be stored in non-Treaty storage space rather than being sold as nonfirm energy.

In several water years, maximum storage rates are higher in July and August than in the April through June period. The reason is that Mica has refilled, so storing in non-Treaty space is not limited by a Treaty discharge of 10 kcfs. Rather, the limit is Mica inflow when inflow is greater than 10 kcfs. Maximum potential storage exceeds 10 KSFD/day in approximately 50 percent of the years in July and the first half of August (although not necessarily the same years), and 20 percent of the years in the second half of August. The years in which high storage rates occur generally have relatively high Columbia River flow levels.

3.2.3.1 Comparison of Historical Data to Hydro Regulator Results

When the hydro regulator results are compared with historical operation of non-Treaty space and with estimates of non-Treaty storage transactions in SAM, it is evident that the hydro regulator analysis represents an extreme view of potential storage transactions. In actual operation, storage amounts are substantially less than the theoretical maximum rates calculated based on the hydro regulation studies, and releasing rather than storing typically occurs during July and August. The hydro regulation study overstates the potential for storage in non-Treaty space during the mid-April through August period, and therefore can be used to describe the maximum decrease in flow during that timeframe that may result from the existing and proposed agreements.

An examination of the hydro regulator study results shows that BC Hydro's use of Arrow Treaty storage would not add to the maximum storage amounts calculated for Mica non-Treaty space.

3.3 POWER SYSTEM EFFECTS

This section describes effects of the proposed NTSA on: (1) export sales from the PNW and BC Hydro to the PSW; (2) purchases by the PNW from BC Hydro; and (3) generation levels in the PNW by resource type. The changes to the power system described in this section may have effects on the environment. The environmental effects of the proposal are discussed in Sections 3.4.2 through 3.8.

3.3.1 Analytical Methods

For each study case, SAM was run for a 20-year study horizon (1989-2008) a total of 200 times--each time with a random selection around the expected regional load, thermal plant performance, and water conditions. SAM simulates the operation of PNW and BC Hydro resources, based on economic and operating criteria. If additional energy is available to market economically to California, then PNW and BC Hydro resources are run to serve California markets in accordance with principles of the Long-Term Intertie Access Policy. If energy is available from BC Hydro to serve PNW loads more economically than operation of a PNW resource, then energy is purchased for that purpose. A description of SAM and the study assumptions is provided in Appendix B.

Information on thermal resource operations is presented as changes in generation level, by resource type, on an annual average basis. Also included are changes in the amount of energy purchased by the PNW from BC Hydro. Data on export sales to California are presented separately for the PNW and BC Hydro. Results reported in the following sections are annual averages over the 200 simulations and, where specified, are averaged over all or a portion of the 20-year study horizon. Data for each year are provided in Appendix D.

3.3.2 PNW Generation Mix

The PNW relies on a variety of resources to meet regional load. These include hydro, nuclear, coal, combustion turbines (CT's), and occasionally purchases from outside the region. Each resource type has specific characteristics that determine its typical operation. For example, nuclear resources tend to be run whenever they are available (base-loaded) because of their low variable costs and slow start-up times, while CT's are normally used only for peaking or drought conditions because of their high variable costs and quick start-up times. Use of additional non-Treaty storage space may affect the use of certain resource types in the PNW. Study results are summarized in Table 3.3.1 for three time periods: 1990-1993 when the use of 5 MAF of non-Treaty space is compared to use of 2 MAF; 1994-1995 a transition period when the No-Action alternative may have some residual refill obligation; and 1996-2008 when the comparison is 5 MAF of non-Treaty storage to no non-Treaty storage.

Opportunity Storage

Increased opportunity storage allows hydro generation to be reshaped into periods when it may be more usable or valuable. For example, hydro

Table 3.3.1

CHANGE IN PNW GENERATION MIX
(aMW)

1990-1993

Alternative	Hydro & NTS	Nuclear	Coal	CT	Purchases From BC Hydro
No-Action	16,458	1,546	2,796	42	98
Change Resulting from Proposal					
Opportunity	67	0	4	-9	-15
Firm	-7	0	33	9	42

1994-1995

No-Action	16,224	1,548	3,368	46	138
Change Resulting from Proposal					
Opportunity	89	0	39	-10	-8
Firm	31	0	44	1	39

1996-2008

No-Action	16,550	2,549	3,602	118	81
Change Resulting from Proposal					
Opportunity	30	0	75	-25	-19
Firm	0	0	62	3	21

generation may be shifted from the spring into the fall, or from wet years into drier years, by storing water into non-Treaty storage space for later release. In some situations, water which would otherwise be spilled can be stored and later released when it can be used for energy production. This reshaping allows high-cost resources or purchases to be displaced, and more economical sales to be made. Certain resource types are more likely to be displaced than others. In the PNW, these are CT's, outside purchases, and, in early years, higher-cost coal plants.

CT generation decreases relative to the No-Action alternative an average of 19 MW for the 20-year study horizon. The maximum annual change, a reduction of 40 MW, occurs in 1997. Changes between alternatives are more noticeable in later years, partly because the existing NTSA expires in 1993 in the No-Action alternative. Prior to that time, the study comparison is between operation of 2 MAF and 5 MAF of storage, whereas after that time, the comparison is between no non-Treaty storage and 5 MAF of storage. The usage of CT's increases in both alternatives after 1996, due to the declining regional firm surplus.

PNW purchases from BC Hydro decrease an average of 16 MW for the 20-year period relative to the No-Action alternative. The difference between the alternatives ranges from a decrease of 3 MW in 1994 to a decrease of 33 MW in 2004 with the proposed agreement.

Firm Resource

When non-Treaty storage is used as a firm resource, much of its value for providing flexibility is lost. The additional storage provided by the proposed agreement is not used to displace resources as in the opportunity storage case. Instead, it is used to meet firm load, and the storage space is required to fill and draft with the rest of the hydro system. Total system generation in the PNW increases because the 165 MW of firm energy provided by the NTSA is assumed to serve an additional 165 MW of regional firm load.

Changes in CT generation relative to the No-Action alternative are small in most years. Non-Treaty storage may be used prior to operating CT's, but CT's may also be run to refill non-Treaty storage space, resulting in little net change. In early years, CT generation is greater when non-Treaty storage is used as a firm resource under the proposed agreement than in the No-Action alternative. In these years, the No-Action alternative uses non-Treaty storage to displace high-cost resources while the firm use case is striving to fill non-Treaty storage space, which did not start out full. CT generation also increases in the firm use case in years after 2005. In these years, BC Hydro uses non-Treaty storage to defer new resources, resulting in fewer sales to the PNW to displace CT's.

3.3.3 Export Sales

If the PNW or BC Hydro has additional generation available after meeting their own obligations, sales may be made to California. Typically nonfirm energy is

sold. Because changing the amount and usage of non-Treaty storage changes the availability of nonfirm energy to both the PNW and BC Hydro, the amount of export sales made to California may be affected.

Opportunity Storage

Increased non-Treaty storage space, in addition to allowing for resource displacement, enables the PNW to make additional sales of economy energy to California. Table 3.3.2 presents summary data on export sales to California for three time periods: 1990-1993 when the use of 5 MAF of non-Treaty space is compared to use of 2 MAF; 1994-1995 a transition period when the No-Action alternative may have some residual refill obligation; and 1996-2008 when the comparison is 5 MAF of non-Treaty storage to no non-Treaty storage. In all time periods, PNW export sales to California increase by an average of 40 to 100 MW. These changes represent approximately 2 to 5 percent of the total level of sales (PNW plus BC Hydro) to California.

BC Hydro also gains flexibility in operating its power system when non-Treaty storage space is increased. Results show that BC Hydro typically uses this increased flexibility to displace its own resources, specifically the Burrard thermal plant. Because of the economic and environmental benefits involved, it is assumed that BC Hydro would displace Burrard prior to making economy energy sales to California.

Firm Resource

If non-Treaty storage is used as a firm resource and an equivalent amount of additional PNW firm load (165 MW) is served, PNW economy energy sales to California decrease by an average of 77 MW over the 20-year study horizon compared to the No-Action alternative. The decrease in exports results from the conversion of nonfirm energy to firm energy. With additional non-Treaty storage space utilized as a firm resource, water that could have produced nonfirm energy is stored and may be used later to serve firm load. Therefore, less PNW nonfirm energy is available for economy energy sales.

It is assumed that BC Hydro's use of non-Treaty storage as a firm resource is limited to serving BC Hydro and PNW firm load, not the DSI first quartile or California market. As a result, export sales from BC Hydro to California decrease if non-Treaty storage is used as a firm resource. This decrease averages 50 MW over the study horizon, with 123 MW in 2008 being the maximum decrease. The difference becomes larger in later years, as BC Hydro uses non-Treaty storage to defer resource additions.

3.3.4 Economic Analyses

SAM was used to evaluate the economic benefits of the non-Treaty storage agreement measured over the 20-year study horizon, 1989 through 2008. The economic analysis assumes that the proposed agreement expires in 2003. Changes in PNW curtailment costs, PNW production costs, PNW and BC Hydro

Table 3.3.2

CHANGE IN EXPORT SALES
(aMW)

	1990-1993		1994-1995		1996-2008	
	PNW to CA	BCH to CA	PNW to CA	BCH to CA	PNW to CA	BCH to CA
No-Action	2247	291	2337	236	2913	185
Change Resulting from Proposal						
Opportunity	44	27	103	-24	46	-55
Firm	-89	-3	-59	-34	-82	-71

economy energy revenues, PNW wheeling revenues, California displacement benefits, and PNW resource deferral benefits are measured relative to the No-Action alternative. Additional information on economic analyses may be found in Appendix E.

Opportunity Storage

The economic analysis of the proposal shows a PNW benefit of $179 million net present value for the Base Case. Additional non-Treaty storage space increases hydro energy usability from reshaping the hydro system and decreases overgeneration spill. Due to these operational changes, benefits to the PNW include decreased production costs due to additional CT displacement, decreased curtailment costs, and increased economy energy sales to California. BPA's wheeling revenues decrease because BC Hydro makes fewer sales to California.

The net benefit to California is $51 million net present value. Additional purchases from the PNW result in a gain in displacement benefits. BC Hydro sells less to California. In this study it is assumed that the benefit to BC Hydro of displacing Burrard, both economic and environmental, is greater than potential economy energy sales to California.

If PNW high loads are assumed, the economic analysis of the proposal shows a PNW benefit of $280 million net present value. The largest benefit to the PNW is a decrease in production costs due to displacement of CT's and short-term purchases. In addition, curtailment costs decrease.

In this case, California incurs a cost of $26 million net present value due to the reduction in available economy energy from the PNW and BC Hydro.

Firm Resource Use

Firm resource use under the proposal assumes BPA would declare non-Treaty storage as a firm resource in PNCA planning. It is assumed BC Hydro would restrict NTSA use to service of BC Hydro and PNW firm loads and would defer some resource acquisitions. With non-Treaty storage as a firm resource, BPA would have an obligation to refill non-Treaty storage along with the U.S. reservoirs. This declaration increases FELCC, as measured in SAM, by 165 average megawatts (aMW).

Under the PNW high load forecast, the most economically advantageous case for firm use of non-Treaty storage, expensive short-term purchases and coal plants are the marginal resources and could be deferred until 2004 with substantial savings.

The economic analysis of firm resource use assuming high PNW loads and PNW resource deferral shows a PNW benefit of $305 million net present value. Production and curtailment costs for the PNW increase, and economy energy revenues drop due to the assumed increased regional load of 165 MW. Because nonfirm energy is stored and converted into firm energy, there is

less nonfirm to displace thermal resources or sell to secondary markets. The LCMM predicts a savings of $375 million by deferring short-term purchases and coal plant additions. BPA's wheeling revenues decrease because BC Hydro has converted nonfirm to firm energy and, therefore, has less nonfirm available to export.

Because of the reduction in available economy energy from the PNW and BC Hydro, California incurs a cost of $72 million. The incremental decrease in California benefits is due to the assumption that the additional firm energy remains in the PNW and BC Hydro regions.

3.3.5 Results of Sensitivity Studies

Sensitivity studies show that generation levels of PNW resources under the proposed agreement, when compared to the No-Action alternative, are largely unaffected by assumptions analyzed in the sensitivity studies. Description of the studies conducted to determine the sensitivity of study results to assumptions used in modeling non-Treaty storage use are included in Section 3.1.2.2. Section 3.3.2 describes the PNW generation mix for the Base Case No-Action and proposed alternatives.

The "PSW High Load High Gas" and the "Spill Agreement" sensitivity studies result in no major effects on generation levels. Results of the "Expire 2003" case are similar to the proposal Base Case through 2003, after which non-Treaty storage can no longer be released and the proposed agreement is similar to the No-Action alternative Base Case.

The "PNW High Load" sensitivity results in more significant changes in generation levels. Table 3.3.3 reflects the changes in generation level, by resource type, as annual averages over the 200 simulations of SAM.

When operated for Opportunity Storage, the "PNW High Load" sensitivity reflects an increase in non-Treaty storage use in the PNW which allows for reshaping of hydro generation, displacement of coal plants and CT's, and a decrease in purchases from BC Hydro. When the existing agreement expires in 1993, non-Treaty storage is used to displace CT's and reserved purchases. In later years, PNW purchases from BC Hydro decrease due to BC Hydro's use of its portion of the non-Treaty storage to displace their own resources.

When used as a firm resource, the "PNW High Load" sensitivity reflects an increase in coal, CT's, and purchases from BC Hydro, and a decrease in non-Treaty storage usage in the early years. The No-Action alternative uses non-Treaty storage to displace CT's, short-term purchases, and purchases from BC Hydro by the PNW. Purchases from BC Hydro by the PNW increase in the middle years when the non-Treaty storage is used to displace short-term purchases. (Increases in coal generation are due to resource additions to meet high PNW loads.)

Table 3.3.3

CHANGE IN PNW GENERATION MIX
PNW HIGH LOAD SENSITIVITY
(aMW)

Alternative	Hydro & NTS	Nuclear	Coal	CT	Purchases From BC Hydro
1990-1993					
No-Action	16,544	1,546	3,162	127	221
Change Resulting from Proposal					
Opportunity	77	0	-4	-16	-7
Firm	-30	0	25	27	59
1994-1995					
No-Action	16,250	1,548	3,656	236	281
Change Resulting from Proposal					
Opportunity	99	0	29	-40	23
Firm	38	0	32	-5	89
1996-2008					
No-Action	16,560	3,050	7,034	153	128
Change Resulting from Proposal					
Opportunity	17	0	82	-31	-7
Firm	1	0	67	5	35

NOTE: No-action shows total value.
Opportunity and Firm show incremental value to No-Action.

3.4 PACIFIC NORTHWEST

3.4.1 Hydroelectric System Operations

The Federal Columbia River Power System (FCRPS) projects are operated to provide for multiple uses that include power production, irrigation, navigation, flood control, recreation, fisheries, and wildlife. These sometimes competing interests are considered by the project owners and operators who develop operating constraints, annual planning criteria, and shorter-term constraints for the projects. BPA acquires and markets the power from FCRPS projects pursuant to the Bonneville Project Act and other Federal legislation and orders.

BPA's decision on whether to enter into an expanded non-Treaty storage agreement with BC Hydro does not affect the PNCA planning process or the guidelines for system operations established by it. See Appendix F for a summary of hydro system planning and operation.

Changes in several parameters were assessed to determine the potential effects of non-Treaty storage operations on the hydro system. These include the probability of system refill, total system energy content, reservoir elevations at four major Federal storage reservoirs (Libby, Hungry Horse, Grand Coulee, and Dworshak), Columbia and Snake River flows, and system overgeneration.

The Intertie Development and Use Final Environmental Impact Statement (IDU Final EIS) also evaluated elevation changes at Albeni Falls. Because reservoir elevations at this project are tightly controlled by the Corps and show little change when modeled, reservoir elevation data for Albeni Falls are not presented in this EA.

3.4.1.1 Analytical Methods

Results are based on study data obtained using the SAM. For each study case, SAM was run for a 20-year study horizon (1989-2008) a total of 200 times--each time with a random selection of regional load, thermal plant performance, and water conditions. For most hydro system parameters, monthly average data for the 20-year study horizon are presented as changes between the No-Action alternative and the proposed NTSA operated for opportunity storage or as a firm resource.

In order to better understand the effects of using non-Treaty storage over a variety of operating conditions, hydro system data are grouped according to water condition whenever possible. Low water conditions (approximately the lowest 10 percent of the 102-year record) are considered to be those years with a January-July runoff forecast at The Dalles of less than 70 MAF. In the historical flow information used by SAM, this group includes the 1929, 1930, 1931, 1937, 1941, and 1944 water years. The high water group (approximately the highest 10 percent of the 102-year record) is typical of water years 1948

and 1956, in which the January through July runoff at The Dalles exceeded 125 MAF. All other water years are grouped together and are termed "typical" or "average" water conditions in the following discussion.

3.4.1.2 System Refill

The amount of water stored in the hydro system at the end of each refill season (usually the end of July) represents water available for power production and nonpower uses during the remainder of the year or the following year. Hydro system operation after mid-January is based on the runoff forecast in order to enhance the probability of refill while meeting firm loads. To the extent that additional use of non-Treaty storage would affect hydro system refill, reservoir uses such as recreation and resident fisheries may be affected, as well as service to BPA's customers' loads.

System refill data for 20 years from the SAM studies were used to assess the potential for changes in coordinated system refill. System refill data do not include non-Treaty space. The system is considered to have refilled if, at the end of July, system content is 94 percent of the total possible system content. The 94 percent figure is essentially the same for both SAM and for adoption of first year FELCC in PNCA planning and is used to determine the next years' rule curves.

Probability of coordinated system refill for each study year ranges from about 80.5 to 88.5 percent both with and without use of additional non-Treaty storage space. For the 20-year study period, system refill is essentially unaffected by additional non-Treaty storage space, averaging an 84.8 percent probability of refill under the proposed agreement (both opportunity storage and firm use) as compared with 84.6 percent for the No-Action alternative (Table 3.4.1).

3.4.1.3 System Draft and Reservoir Elevations

System Draft

System draft is a measure of how far below full (in megawatt-months (MW-mo)) the total system content is. Total available PNW coordinated system draft is approximately 65,000 MW-mo, not including non-Treaty storage. The smaller the system draft, the greater the amount of water remaining in the system. These data are representative of the total hydro system, whereas reservoir elevation data are project-specific.

As can be seen in Figure 3, the greatest system draft occurs during the spring months in high runoff years due to flood control requirements. In low runoff years, spring draft occurs primarily to serve load and provide water for the Water Budget. In this Figure, the system in low water conditions does not draft as deeply as in higher water conditions; however, the ability to refill is limited due to the low runoff available for refill.

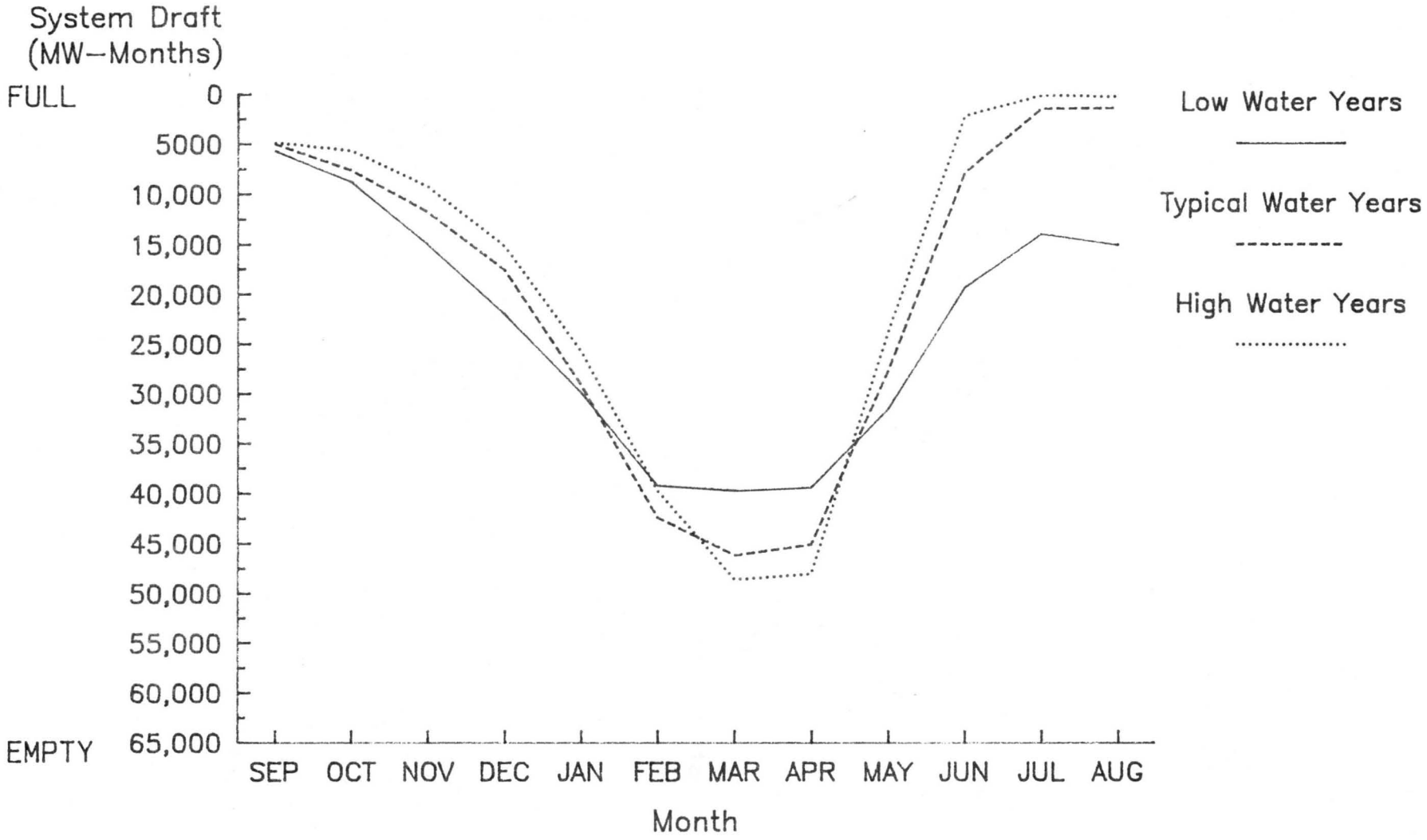
Table 3.4.1

REFILL PROBABILITY (percent)
20-YEAR AVERAGES

	No Action	Opportunity	Firm Use
Base	84.6	84.8	84.8
PNW High Loads	85.3	85.4	85.7
PSW High Loads	84.4	84.7	84.7
Spill Agreement	84.5	84.7	84.7
Alternative Dispatch Criteria	84.6	84.7	--
Expire in 2003	84.6	84.7	84.7

FIGURE 3

US HYDRO SYSTEM DRAFT
No-Action Alternative



10/16/89:CM
PKingsbury-GR/FLANCE-1 (SYSDR-2.CMP/DRW)

Opportunity Storage Use

When utilized for opportunity storage, additional non-Treaty storage space results in generally lower system draft levels (higher system content), particularly in low water conditions. Non-Treaty storage is available to serve firm load during low water conditions, rather than drafting U.S. reservoirs to serve that load. During low runoff conditions, the PNW hydro system contains approximately 600 MW-mo of additional energy with expanded non-Treaty storage. In typical runoff conditions, this difference is approximately 200 MW-mo, and in high runoff conditions the difference is small, averaging 80 MW-mo. In all water conditions studied, additional non-Treaty storage slightly increased the volume of water stored in the U.S. hydro system.

Firm Resource Use

When non-Treaty storage is used as a firm resource, expanded non-Treaty storage results in decreased system draft (increased system content) in low water conditions. Results are similar to those for opportunity storage use, with the PNW hydro system containing approximately 600 MW-mo of additional energy with expanded non-Treaty storage. In typical and high runoff conditions, changes in system draft are minimal.

Reservoir Elevations

Use of additional non-Treaty storage space may influence reservoir elevations and affect reservoir uses. However, flood control and PNCA planning requirements would not be affected, as these operating constraints are not violated. Changes in reservoir elevations may affect resident fish, wildlife, recreation, irrigation, and cultural resources. These environmental effects of the proposal are discussed in Sections 3.4.2 through 3.8.

Throughout the year, reservoir elevations tend to be shaped similar to Figure 3 for system draft, where zero represents a full reservoir. Reservoir levels are generally slightly higher with the additional non-Treaty storage space. Tables 3.4.2 through 3.4.5 present Libby, Hungry Horse, Grand Coulee, and Dworshak reservoir elevation data for the No-Action alternative and predicted elevation changes resulting from use of additional non-Treaty storage under the proposed NTSA. These elevation changes do not alter the probability of system refill (Section 3.4.1.2) because most of the changes occur in low water conditions that represent only 10 percent of the water years. Also, both the No-Action alternative and the proposal fail to refill in many low water years. Data are presented as 20-year monthly averages for low, typical, and high runoff conditions. Additional reservoir elevation data are contained in Appendix G.