Merwin Hydroelectric Project
FERC Project No. 935

FINAL LICENSE APPLICATION

Exhibit B – Project Operation and Resource Utilization

PacifiCorp
Portland, Oregon

April 2004

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B.1.0 INTRODUCTION

In compliance with the Code of Federal Regulations (18 CFR, Parts 4 and 16), PacifiCorp is applying to the Federal Energy Regulatory Commission (FERC) to relicense the Merwin Hydroelectric Project (FERC Project No. 935) on the North Fork Lewis River, in the State of Washington. The current license for the Merwin Project, which PacifiCorp currently owns and operates, was issued on October 6, 1983 and expires on May 1, 2006.

PacifiCorp is applying for a new license to continue operation of the project. This Exhibit B presents the response to information required by the FERC as described in 18 Code of Federal Regulations (CFR) Section 4**.**51(c). It is a description of the Merwin Project operations and resource utilization.

Exhibit B is organized in 5 sections that generally follow the sequence of information requested in the CFR. Following this introduction, project operations are described in Section B.2.0 Section B.3.0 discusses dependable capacity and energy production. Section B.4.0 discusses Project Power Utilization and Section B.5.0 describes proposed changes to project facilities.

B.2.0 PROJECT OPERATION

The Merwin Hydroelectric Project is 1 of 4 hydroelectric projects on the North Fork of the Lewis River, in conjunction with the Swift No. 1, Swift No. 2, and Yale projects (FERC Project Nos. 2111, 2213, and 2071, respectively). It is operated as a re-regulating facility to meet minimum streamflow and ramping requirements downstream of the project. Merwin powerhouse discharges directly into the Lewis River. Article 49 of the current Merwin license stipulates powerhouse discharge requirements.

Merwin is one of the Lewis River Hydroelectric Projects that are operated as integral components of PacifiCorp's control areas. Scheduling of power from these facilities is coordinated daily based on factors such as reservoir storage, fishery requirements, recreation requirements, flood control requirements, snow pack conditions and current and forecasted inflow conditions, system load requirements, availability of other resources, and in-streamflow requirements. Real-time adjustments to this schedule occur as load and resource conditions dictate. Water releases for generation are based on the need for the dispatch of a flexible resource, real-time load demands, and river and reservoir objectives.

The Merwin powerhouse is normally operated and monitored from the Lewis River Hydro Control Center (HCC), located near the Merwin dam and powerhouse. The plant is visited several times daily as 3 operators are on duty for the Lewis River Projects during normal work hours. At all other times, 2 operators are on duty. Operators live in housing near the Merwin and Yale projects and are available on short notice for local control. The Merwin units can be operated manually from the powerhouse or remotely from the HCC.

The HCC is staffed 24 hours a day with at least one Control Operator per shift. Preschedules for anticipated hourly generation for each plant are developed by PacifiCorp's C&T Power Scheduling Group in Portland. The prescheduled generation is dispatched in real-time by the HCC Control Operator, with any required adjustments coordinated with HCC and the C&T Real Time Generation Control Desk located in Portland. Merwin units are operated in one of 3 control modes, as follows:

Local Manual Operation: To start a unit on local manual, the Operator verifies that the lube oil pump for the turbine guide bearing is operating and the bearing oil level is normal. An Operator pushes the start button, and the unit begins to roll, coming up to speed no-load. Once up to speed no-load, the Operator turns on the synchroscope, manually synchronizes the unit to the line, closing the breaker to connect the unit to the system. The output and voltage can then be adjusted manually as required by the Operator.

Local Auto Operation: To start a unit on local auto, the Operator verifies that the lube oil pump for the turbine guide bearing is operating and the bearing oil level is normal. The operator then pushes the start button. The automated control system begins to roll the unit up to speed no-load, synchronize, and close the breaker automatically. The output and voltage can then be adjusted by the Operator.

Remote Auto Operation: To start in remote auto, a selector switch located within the powerhouse must be in the "remote auto" position, and the unit auxiliaries must be functioning normally. The HCC Control Operator can then send a start signal via the System Control and Data Acquisition (SCADA) system, and the unit will roll, come up to speed, synchronize, and close the breaker automatically. The HCC Control Operator can then adjust the load as required. Unlike the Yale and Swift Projects, Merwin can not be operated from the C&T Real Time Generation Control Desk and unit loading must be controlled from HCC.

Lake Merwin is normally operated between elevations 233.5 feet and 239.6 feet (full pool). There is no prescribed normal winter elevation. The lake is typically operated in the top 5 feet for recreational purposes during the summer. It may be drawn down as low as 165 feet msl during non-recreational periods for special operations.

Daily inflows to the Lewis River system are used by the Swift No. 1, Yale, Merwin, and Swift No. 2 Hydroelectric Projects to meet the generation system requirements while maintaining minimum flows, reservoir levels, and storage requirements. Article 49 of the Merwin license defines minimum flows, ramping rates, and other operational constraints for the Lewis River below Merwin.

When natural inflows to Lake Merwin are in excess of power production capacity and reservoir storage space nears the prescribed minimum, spill is initiated. During high run-off conditions, the projects operate under special guidelines established to manage peak storm runoff in accordance with the respective FERC licenses. When conditions require releases from Merwin Dam (the farthest downstream project) to be significantly greater than Merwin's turbine capacity, appropriate notifications are made to respective county

emergency management services, National Weather Service, and U.S. Army Corps of Engineers at predetermined discharge levels.

B.3.0 DEPENDABLE CAPACITY AND ENERGY PRODUCTION

Total licensed plant capacity of the Merwin Project is 136,000 (kW). The long-term (30 year) average annual generation at Merwin is approximately 511,534 MWh. Based on the estimated generation and the plant capacity of 136 MW, the plant factor is approximately 43 percent, and the dependable capacity is approximately 53 MW[1].

B.3.1 HYDROLOGY

The Merwin Project is located on the North Fork Lewis River in the Cascade Mountain Range in southwestern Washington. The majority of the drainage basin lies within the Gifford Pinchot National Forest. The drainage area upstream of the Merwin Project is approximately 726 square miles. Flows into Merwin Reservoir are regulated by PacifiCorp's Swift and Yale Reservoirs, also on the North Fork Lewis River.

The annual and monthly inflows to Merwin Reservoir are based on average monthly flow data for the 1928 through 1989 period of record, obtained from the development of adjusted streamflow and storage records for the Columbia River and Coastal Basins by the Bonneville Power Administration (BPA). These data were published in July 1993. The adjusted streamflows were derived from project outflow and reservoir elevation and storage records from PacifiCorp for the Lewis River projects. The nearest USGS Gage Station (No. 14220500) on the Lewis River is located at Ariel, at RM 19, immediately downstream of the Merwin powerhouse.

Mean monthly inflows for the project generally peak during December and reach their lowest levels in August and September. Mean monthly inflows for each month of the period of record are shown in Table B.3.1-1. A summary of the mean monthly inflows for the period of record is shown on Figure B.3.1-1.

Project annual and monthly flow duration curves are included in Appendix A to this Exhibit B, located in volume III of this application.

Table B.3.1-1. Mean monthly flow (cfs) at Merwin

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Mean
1928-29	2340	3960	4660	3440	1940	4970	6180	6730	4420	1720	1040	807	3527
1929-30	815	838	4500	2760	11300	4600	4720	3850	2330	1170	879	770	3156
1930-31	933	1790	2310	5270	4770	7190	8740	3580	2150	1480	896	864	3319
1931-32	2240	5390	5240	6490	5880	12300	8970	7290	5570	2550	1360	1040	5358
1932-33	1640	10600	7510	8160	3310	7110	6270	8520	10600	4420	1810	2320	6029
1933-34	5261	5300	28300	16670	4831	7247	4437	2713	1445	1170	981	919	6660
1934-35	4313	11430	8563	8684	6043	4790	4716	6156	4290	2009	1156	1089	5092
1935-36	1217	2128	3680	11130	3915	5452	5215	7105	4931	2080	1280	968	4101

[1] This number was determined using BPA data flow data and a minimum reservoir elevation of 165.0-ft. Corresponding tailwater elevations were determined using equations from PacifiCorp's model.

Table B.3.1-1. Mean monthly flow (cfs) at Merwin

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Mean
1936-37	909	831	5487	1654	2894	6523	10180	7447	7919	2490	1284	1045	4055
1937-38	1378	11840	10920	8333	3988	6351	6170	6207	3438	1657	1172	1026	5377
1938-39	1371	3899	6042	7192	5544	5372	5371	4420	2854	1742	1142	971	3819
1939-40	1203	1408	8691	4253	10420	8434	5065	4147	1548	1104	1002	990	4006
1940-41	1600	4156	5378	5621	3382	2835	2615	3358	1886	1131	919	2558	2951
1941-42	3225	4551	10730	3184	5121	3508	3850	3880	3906	1753	1218	834	3808
1942-43	1128	9692	8693	4637	6587	6001	9739	5268	4576	2207	1199	955	5031
1943-44	2052	2870	4477	4084	4367	3454	4538	3760	2459	1140	860	945	2912
1944-45	1023	3343	3206	7732	7626	5476	5213	8260	3163	1391	978	1395	4047
1945-46	1197	6975	8986	8891	6045	6668	5986	7036	5695	3689	1435	1091	5298
1946-47	2565	8193	15020	5909	7957	5360	5937	3201	2445	1509	1062	1305	5021
1947-48	7390	8107	5861	7930	6184	4617	5806	8044	5282	1971	1210	1260	5302
1948-49	2189	6010	6606	1906	6669	6813	7050	9771	4672	2282	1177	1083	4669
1949-50	2131	7685	7268	7294	9368	11180	8720	7943	8008	3915	1786	1374	6364
1950-51	5235	10090	11960	8224	10370	4103	6319	6543	3566	1784	1190	1199	5851
1951-52	7032	5916	7787	3139	7663	4411	7146	6886	3808	2010	1183	970	4818
1952-53	700	825	3397	18750	9377	4820	4870	6886	5295	2723	1480	1386	5028
1953-54	1898	6495	12360	7631	9682	5689	7354	6372	6317	3713	1737	1370	5859
1954-55	2176	5914	5757	4617	5668	3150	5990	6287	7821	3991	1756	1644	4547
1955-56	7005	12470	12250	9700	3915	8059	8257	9039	6850	3789	1937	1420	7073
1956-57	3597	5042	9529	3100	5654	8964	7290	5717	2785	1441	1115	867	4590
1957-58	1392	4020	9168	9067	10770	4528	8149	5295	2855	1445	1004	988	4851
1958-59	1638	11390	8784	11680	4736	5438	6736	5728	4769	1859	1152	2859	5561
1959-60	6211	6937	6309	3866	8833	6074	8441	7750	4529	1742	1332	1386	5264
1960-61	2270	11940	5551	8888	15790	9535	6260	6704	3739	1584	1222	1136	6145
1961-62	2371	4501	9846	6390	5007	4437	7467	5465	3257	1502	1209	1152	4382
1962-63	3347	10900	6863	4433	7746	4220	7438	5495	2156	1481	1028	934	4637
1963-64	1813	8932	5978	10350	5631	5422	5206	5956	6331	2939	1966	1623	5173
1964-65	2082	6354	14080	9716	7080	4084	6193	4977	3010	1399	1079	847	5069
1965-66	1082	3230	4234	7288	4258	7681	7337	6722	3877	2498	1239	1010	4208
1966-67	1911	4927	11420	11070	6479	5378	4220	5845	4684	1706	988	870	4960
1967-68	4233	4699	6987	7450	14380	6753	4448	3921	4904	1584	2128	2471	5294
1968-69	5172	9093	8250	7631	3388	4514	7546	9179	4865	2089	1146	1849	5405
1969-70	3470	4389	6884	14030	7881	5598	4762	4564	2680	1208	886	1041	4774
1970-71	2101	6137	7950	12280	7861	6258	6450	8899	6899	4293	1785	1879	6059
1971-72	2564	6151	7289	11260	12720	15090	6702	8507	5272	2546	1390	2012	6779
1972-73	1327	4318	11480	7089	3074	4400	3517	3564	2454	1483	923	1307	3760
1973-74	2374	10900	13000	15090	8023	8083	8123	7579	9076	4398	1915	1252	7482
1974-75	1125	4510	9972	12280	6563	5959	3673	6512	4468	2236	1445	1288	5006
1975-76	3486	8534	16090	10370	6062	4582	5520	6992	3895	2272	1496	1063	5875
1976-77	1108	1530	1805	2006	2446	5390	4725	4315	3644	1113	1118	2184	2612
1977-78	2333	10710	17430	6754	5787	4143	5287	4985	3006	1506	1181	1732	5404
1978-79	1080	2743	4623	1998	8262	7495	4861	5539	1985	1315	236	1974	3477
1979-80	2110	2228	11070	6904	7064	5228	7541	3746	2186	1316	934	983	4272
1980-81	834	5676	13260	3580	9462	3172	6030	3392	4645	1699	1020	930	4436
1981-82	2838	5677	9868	7781	14780	6882	5955	5722	3803	1782	1235	1269	5574
1982-83	2597	5236	9909	11640	9545	9594	5436	4725	3471	3663	1681	1632	5750

Table B.3.1-1. Mean monthly flow (cfs) at Merwin

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Mean
1983-84	1353	12220	5709	8827	6428	7677	5456	6644	4573	2029	1143	1305	5288
1984-85	2071	8715	4665	2363	2793	4057	7665	5723	5195	1353	997	1443	3909
1985-86	2999	5936	3308	7696	9834	6785	3959	4288	1976	1178	801	1195	4126
1986-87	1371	8118	4487	5648	8090	9463	4848	3635	1990	1127	877	734	4170
1987-88	586	1236	7043	4652	5264	6515	7860	6183	3164	1398	875	915	3721
1988-89	1038	8506	4703	7031	3665	7953	7412	4428	2614	1307	1060	865	4213
Mean	2427	6197	8249	7402	6888	6194	6228	5875	4197	2046	1223	1283	4841
Median	2082	5914	7289	7288	6428	5598	6030	5728	3877	1742	1164	1114	4960
Max	7390	12470	28300	18750	15790	15090	10180	9771	10600	4420	2128	2859	7482

Maximum and minimum mean monthly flows for the Lewis River at the Merwin powerhouse for the period 1928-1989 are as follows:

	Flow (cfs)			Flow (cfs)	
Month	**Max**	**Min**	**Month**	**Max**	**Min**
January	18,750	1,654	***July***	4,420	1,104
February	15,790	1,940	***August***	2,128	236
March	15,090	2,835	***September***	2,859	734
April	10,180	2,615	***October***	7,390	586
May	9,771	2,713	***November***	7,078	825
June	10,600	1,445	***December***	28,300	1,805

B.3.2 AREA CAPACITY CURVE AND TYPICAL OPERATIONAL CURVE

The reservoir formed by Merwin Dam (Lake Merwin) is approximately 14.5 miles long and has a surface area of 4,000 acres at the operating level of 239.6 (ft. msl), which is the normal maximum elevation. The reservoir's gross and usable storage capacities at this elevation are 422,000 acre-feet and 263,700 acre-feet, respectively. Figure B.3.2-1 shows the Lake Merwin area capacity curve and an operational rule curve is presented in Figure B.3.2-2.

B.3.3 HYDRAULIC CAPACITY

The Merwin Project has a total estimated hydraulic capacity of 11,250 cfs composed of 3,750 cfs at a rated head of 188 feet from each of 3 identical vertical Francis turbines.

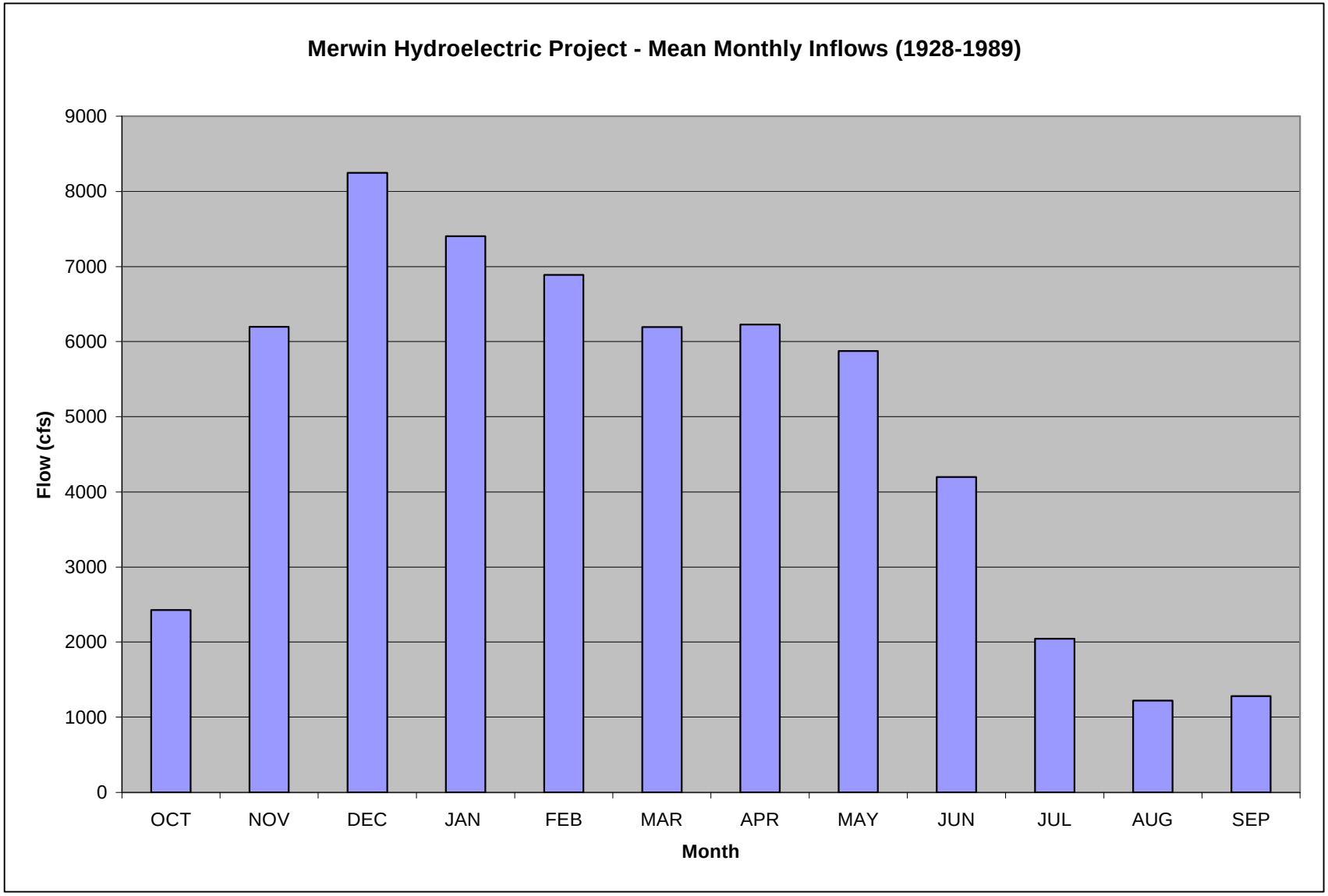

Figure B.3.1-1. Mean monthly flows for the Lewis River at Merwin powerhouse.

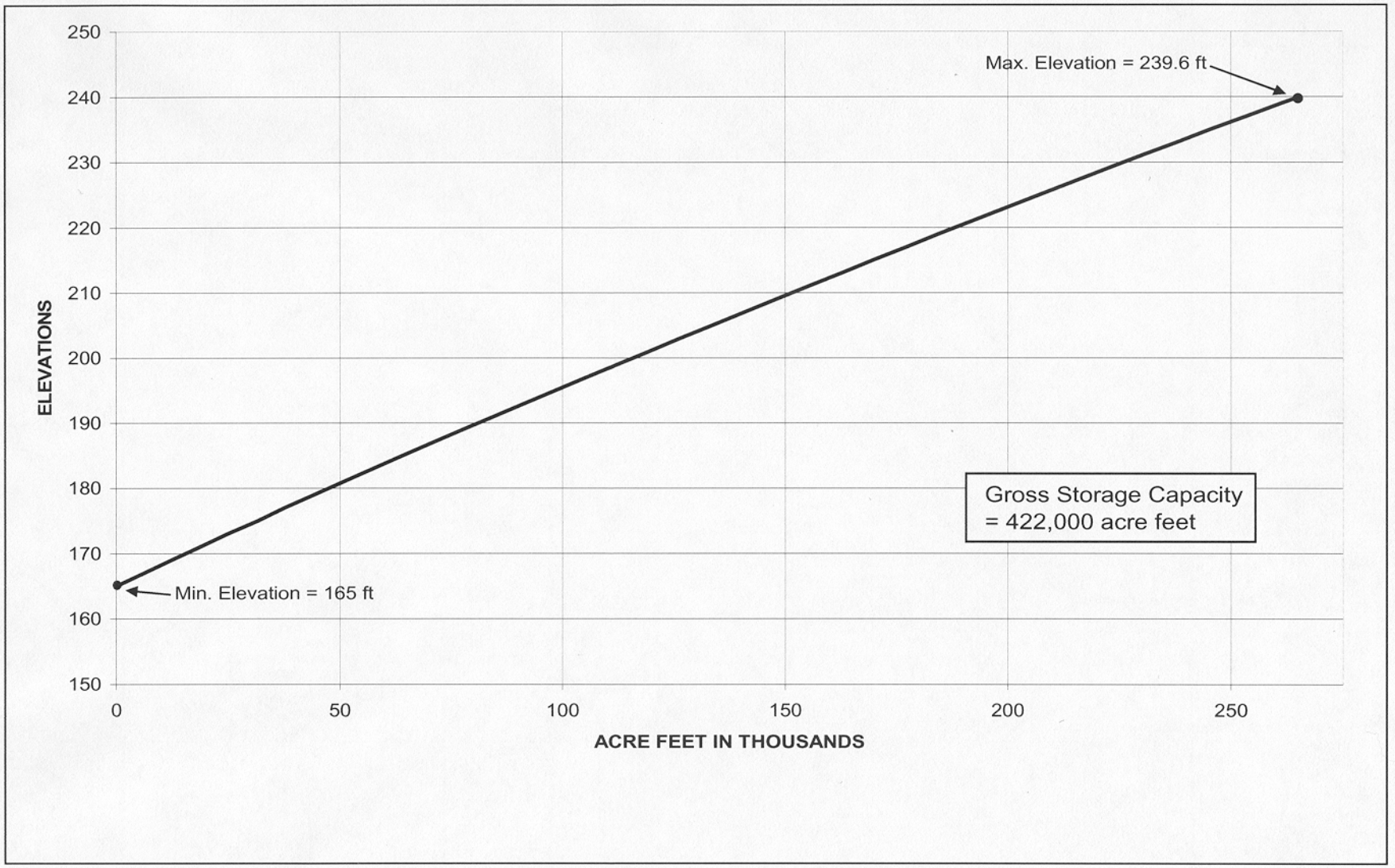

Figure B.3.2-1. Lake Merwin area capacity chart.

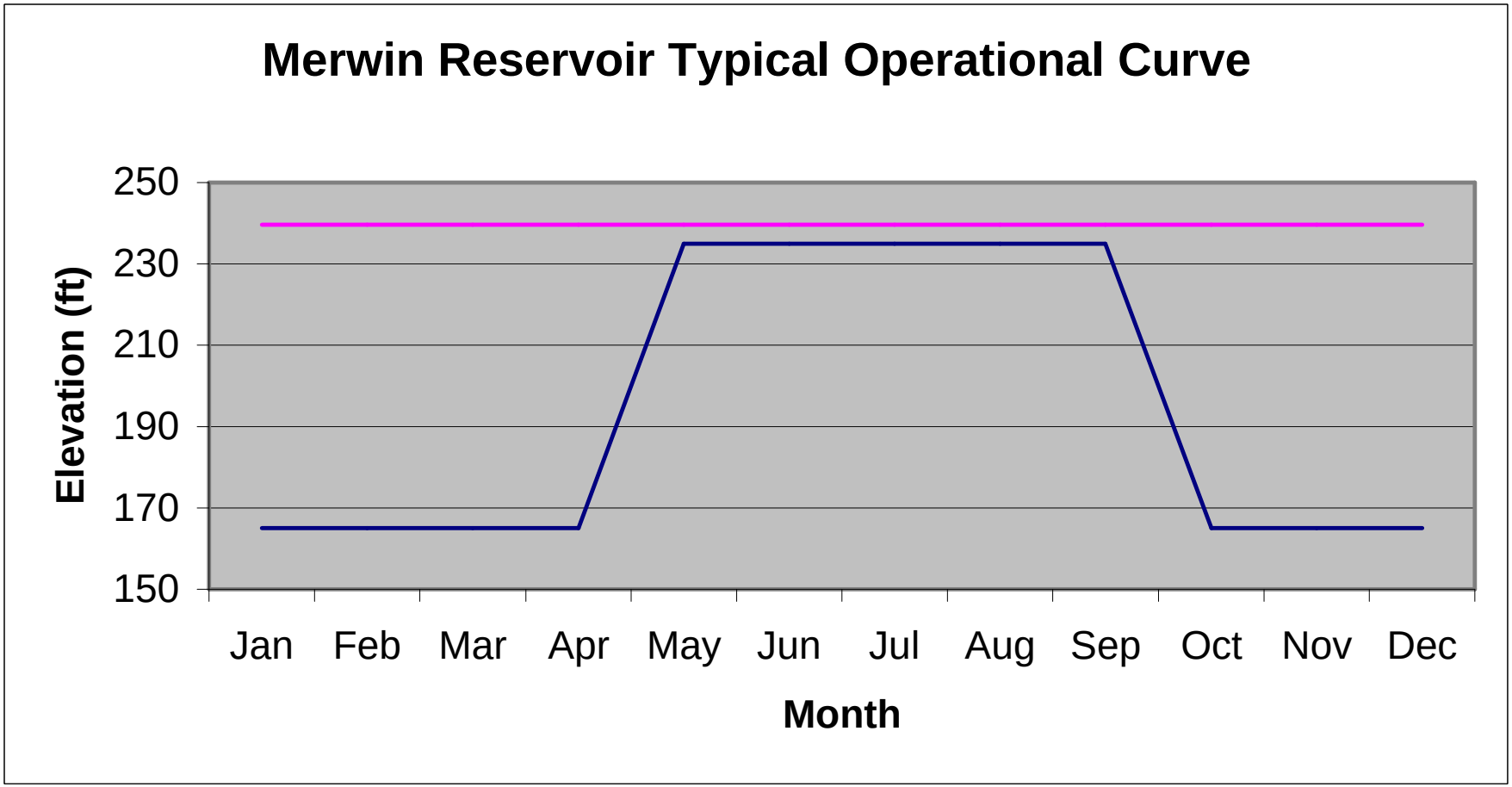

Figure B.3.2-2. Lake Merwin typical operational curve.

B.3.4 TAILWATER RATING CURVE

The Merwin Project is the farthest downstream project on the North Fork of the Lewis River. The powerhouse discharges directly into the river. The tailwater level is a function of the powerhouse discharge and any spillway discharge. The tailwater-rating curve is shown in Figure B.3.4-1 and the tailwater levels are as follows:

Merwin Operating Condition	**Tailwater Elevation (feet msl)**
1 unit maximum output	49.8
2 units maximum output	51.9
3 units maximum output	53.3
3 units maximum output + 10,000 cfs spill	56.0
3 units maximum output + 20,000 cfs spill	57.9

B.3.5 PLANT CAPACITY

The plant capacity for the Merwin Project is shown in Figure B.3.5-1.

B.4.0 PROJECT POWER UTILIZATION

The estimated average annual net generation at the Merwin Project is approximately 511,534 MWh. Approximately 2,020MWh are used annually for station service. The Merwin Project does not have a specific service territory. Electricity generated at the project goes into the regional transmission grid and serves PacifiCorp's customers throughout the Northwest. Approximately half of the company's sales are to industrial customers, about one-fourth to commercial, and one-fourth to residential customers.

B.5.0 FUTURE PROJECT DEVELOPMENT

As part of this license application, PacifiCorp is not proposing any major modifications or upgrades. However, the Company will continue to evaluate the potential for project upgrades and modifications as future market and other conditions change, to ensure the most cost-effective, efficient and environmentally balanced use of the water resources available.

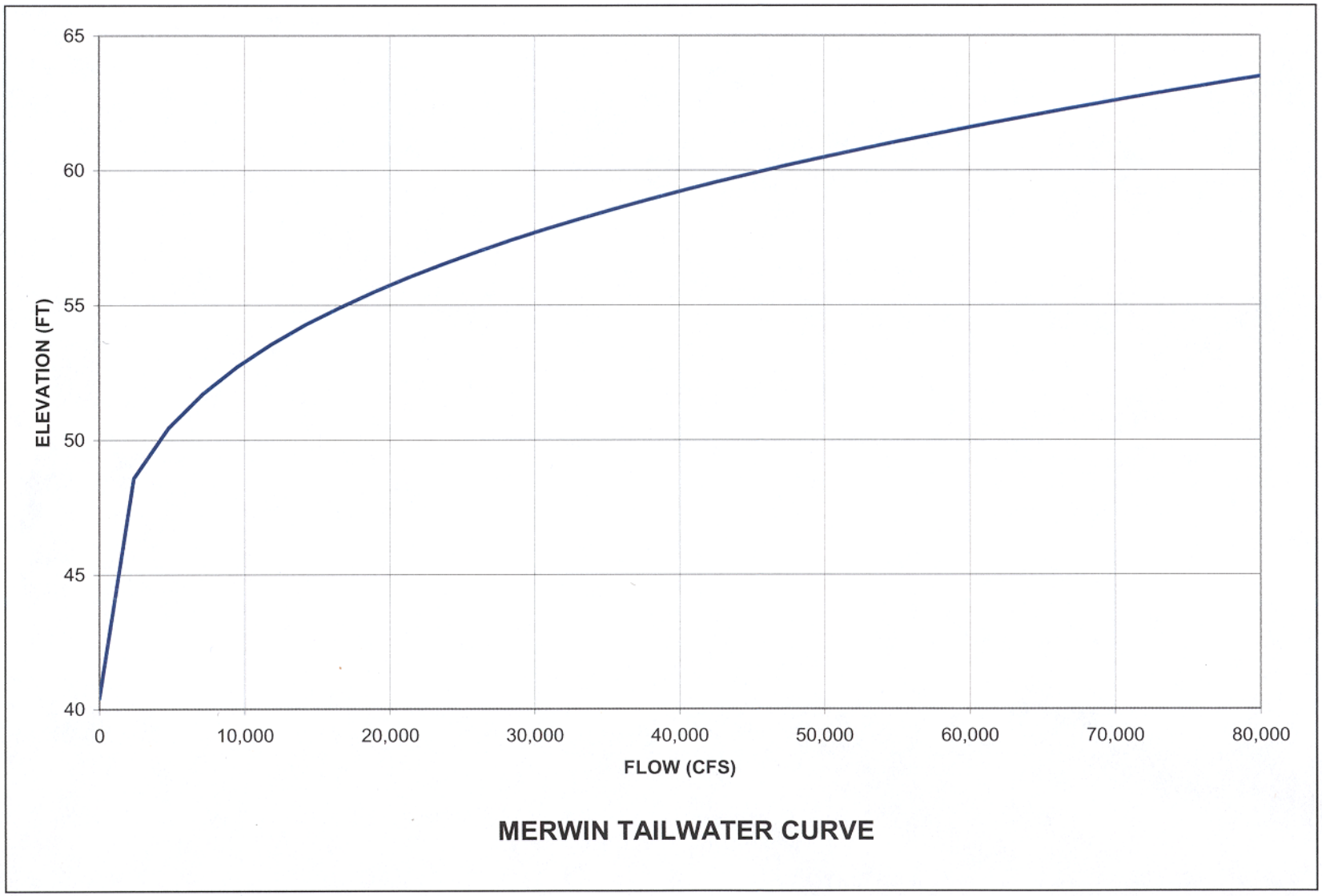

Figure B.3.4-1. Merwin tailwater rating curve.

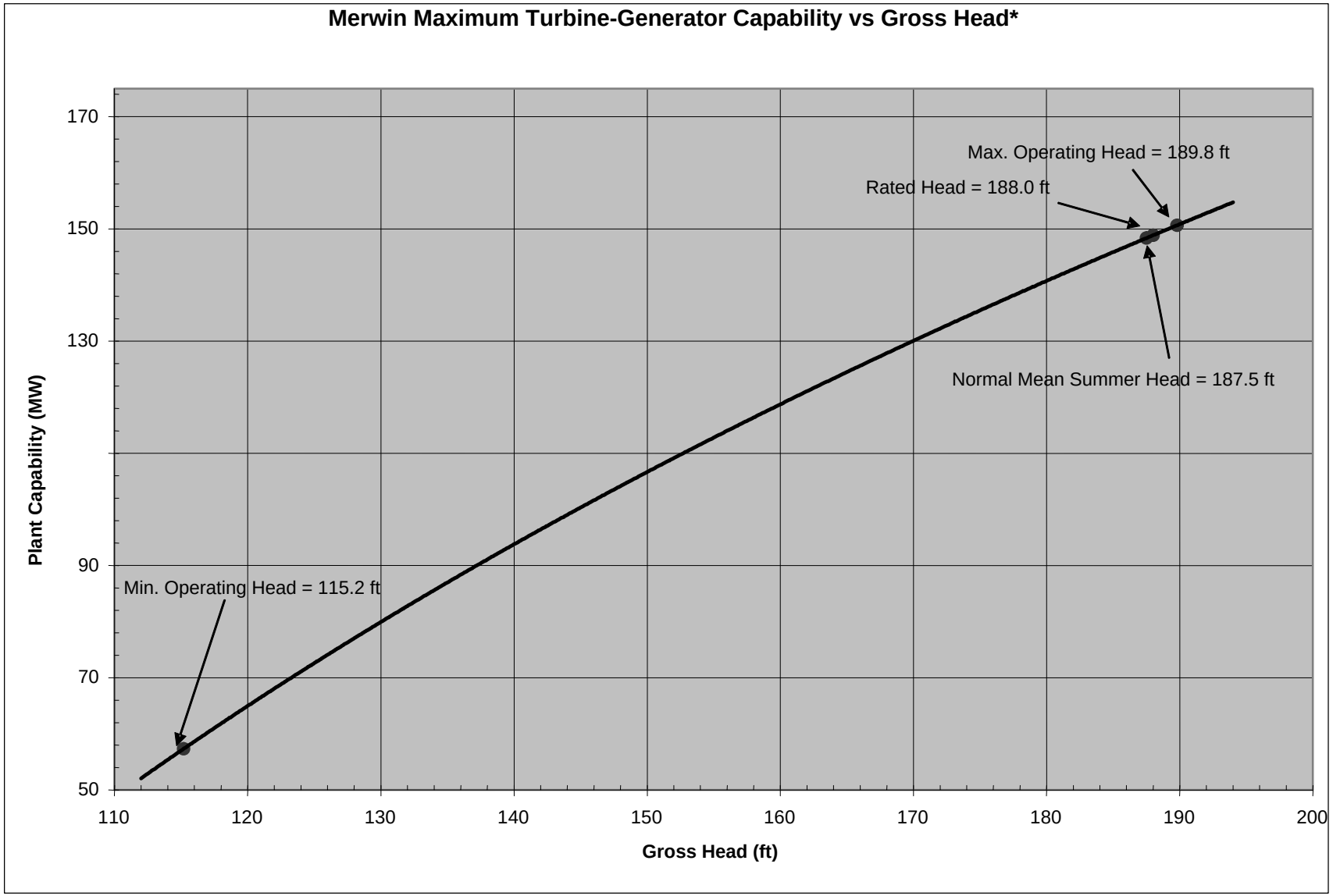

Figure B.3.5-1. Plant capacity curve

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