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Subject: 2015 Lake Level Report for your Review and Comment - By February 24
Date: Monday, February 01, 2016 1:00:23 PM
Attachments: [Article 405b- PUD Submittal of Lake Chelan 2015 Annual Lake Level Report draft final 20116.docx](#)

PUBLIC UTILITY DISTRICT NO. 1 of CHELAN COUNTY
P.O. Box 1231, Wenatchee, WA 98807-1231 • 327 N. Wenatchee Ave., Wenatchee, WA 98801
(509) 663-8121 • Toll free 1-888-663-8121 • www.chelanpud.org

Re: Lake Chelan Hydroelectric Project No. 637
License Article 405 – 2015 Annual Lake Level Report

It is that time of year again! Please find the 2015 Lake Chelan Annual Lake Level Report attached for your review and comment.

We plan to finalize and submit the 2015 Lake Level Report to the Federal Energy Regulatory Commission on February 26, 2016. For your information, we've provided a summary and links to this License requirement below.

Please submit your comments to me at jeff.osborn@chelanpud.org on or before the end of the day on **February 24, 2016**. All received comments and Chelan PUD responses will be included in the final report submitted to FERC.

If you have any questions, please feel free to contact me at 509-661-4176. Thank you, very much, for taking time out of your busy schedules to review the report.

Jeff

Jeff Osborn
License Compliance Supervisor
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FERC License Order, November 6, 2006 :

<http://www.chelanpud.org/documents/9009.pdf>

(b) a provision to file with the Commission within one year of the issuance date of the license, and annually thereafter, a report comparing monthly actual and target lake levels; and runoff volume forecasts and other factors influencing achievement of targeted lake levels; and (c) an implementation schedule. The licensee shall prepare the plan after consultation with **the Washington Department of Ecology; NOAA National Marine Fisheries Service (NMFS, U.S. Geological Survey (USGS), U.S. Park Service, U.S. Forest Service, U.S. Fish and Wildlife Service, Washington State Parks and Recreation Commission, Washington Interagency Committee for Outdoor Recreation, Confederated Tribes of the Colville Reservation, the Yakama Nation, the Confederated Tribes of the Umatilla Indian Reservation, City of Chelan, Lake Chelan Sportsman's Association, Manson Parks**

and Recreation Department, Lake Chelan Recreation Association, and American Whitewater.

Order Modifying and Approving Operations Compliance and Monitoring Plan, Article 405, November 30, 2007:

http://www.chelanpud.org/departments/licensingCompliance/lc_implementation/ResourceDocuments/9494_1.pdf

(C) The licensee shall file annually with the Commission by February 28, beginning in 2009, their Annual Lake Level Report. The licensee shall allow the resource agencies, Tribes and non-governmental organizations specified under Article 405, 30 days to provide comments and/or recommendations on their report before filing with the Commission.

LAKE CHELAN ANNUAL LAKE LEVEL REPORT 2015

LICENSE ARTICLE 405

Draft Final

**LAKE CHELAN HYDROELECTRIC PROJECT
FERC Project No. 637**

February 26, 2016



**Public Utility District No. 1 of Chelan County
Wenatchee, Washington**

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SECTION 1: EXECUTIVE SUMMARY

The Public Utility District No. 1 of Chelan County, Washington (Chelan PUD) received a new license (License)¹ from the Federal Energy Regulatory Commission (FERC) on November 6, 2006, authorizing Chelan PUD to operate the Lake Chelan Project (Project) for a period of 50 years. License Article 405 requires Chelan PUD to annually file with FERC a report comparing monthly actual and target lake levels, runoff volume forecasts and other factors influencing achievement of target lake levels.

During 2015, Chelan PUD managed lake levels as runoff forecasts evolved through winter and spring. Runoff forecasts for the April 1 to July 31 time period were for 87% of average runoff on February 1, 70% of average runoff on March 1, and 64% of average runoff on April 1. Actual runoff for the April 1 – July 31 time period was almost 64% of average. Lake levels were managed, as defined in Chapter 8 of the Lake Chelan Comprehensive Plan,² to meet all operating objectives and lake level targets for the year 2015. The tributary barrier objective was not met fully because lake levels were significantly higher than average throughout the fall and winter draft period, despite near capacity generation, due to significantly higher than average October through March precipitation. No barriers to upstream fish passage at any tributary mouths were documented in 2015, even with much higher than average lake levels occurring from mid-January through mid-May.

The table below compares monthly May through October 2015 actual and target lake levels. Chelan PUD manages lake levels following an annual draft and refill cycle, generally beginning in August, that starts to release water from Lake Chelan to meet operating objectives and for power generation from September through March, then refills Lake Chelan from April through July.

Table 1: Comparison of Actual and Target Lake Levels

Date	License Target Lake Level (feet)	2015 Actual Lake Level (end of day)* (feet)	Difference between Actual and Target Lake Level (feet)
May 1, 2015	1,087.6	1,092.4	4.8
June 1, 2015	1,094.0	1,097.8	3.8
July 1, 2015	1,098.0	1,099.8	1.8
August 1, 2015	1,099.0	1,099.1	0.1
September 7, 2015	1,098.7	1,098.7	0.0
October 1, 2015	1,097.2	1,097.5	0.3

* USGS Gage #12452000 Lake Chelan at Chelan

¹ Federal Energy Regulatory Commission Order on Offer of Settlement and Issuing New License and Order on Rehearing for the Lake Chelan Hydroelectric Project No. 637 were issued November 6, 2006, and April 19, 2007, respectively, to the Public Utility District No. 1 of Chelan County.

² Final Lake Chelan Comprehensive Settlement Agreement for the Lake Chelan Project No. 637, dated October 8, 2003.

SECTION 2: INTRODUCTION

The Public Utility District No. 1 of Chelan County, Washington (Chelan PUD) received a new license (License)³ from the Federal Energy Regulatory Commission (FERC) on November 6, 2006, authorizing Chelan PUD to operate the Lake Chelan Project (Project) for a period of 50 years. The License sets a minimum lake level of 1,079 feet and a maximum lake level at 1,100 feet. Chelan PUD manages lake levels within the minimum and maximum elevations according to license operating objectives and for power generation.

The License establishes monthly target lake levels for the period from May 1 through October 1 that Chelan PUD will try to attain consistent with the license operating objectives for flood control, protection of fish resources, recreation, and preventing shoreline erosion. Chelan PUD monitors snowpack in the Lake Chelan basin and predicts snowmelt runoff volume from December through August. Chelan PUD manages power generation and spill to reach lake level targets by using runoff volume and precipitation forecasts, past experience with runoff timing and actual lake levels.

License Article 405 requires Chelan PUD to file annually a report with FERC comparing monthly actual and target lake levels, runoff volume forecasts and other factors influencing achievement of lake level targets. This Lake Level Report documents decisions and other information regarding achievement of monthly target lake levels beginning May 2015 through October 2015.

Chelan PUD uses a hydropower system simulation model (CHEOPS) developed specifically to assist with lake level management decisions. The CHEOPS computer model uses historical information, a target curve, and operational constraints to provide a predictive tool for making operational decisions. Historical information includes a data set of Lake Chelan hydrologic variables which Chelan PUD began collecting in 1952. A target curve is a collection of elevations with corresponding dates which are used to guide the computer model and subsequent operating decisions. Operational constraints include minimum and maximum generation limits and spill requirements or limitations. The use of a target curve, in conjunction with professional experience and actual hydrologic behavior of the lake environment, provides the best available basis for balancing license objectives and the likelihood of being within reasonable predictive probability of meeting monthly lake level targets.⁴ In some years, late runoff may affect the ability to meet lake level targets, and, therefore, lake level targets would be met as soon as practicable.

³ Federal Energy Regulatory Commission Order on Offer of Settlement and Issuing New License and Order on Rehearing for the Lake Chelan Hydroelectric Project No. 637 were issued November 6, 2006, and April 19, 2007, respectively, to the Public Utility District No. 1 of Chelan County.

⁴ Section 3.1 of Chapter 8, Final Lake Chelan Comprehensive Settlement Agreement for the Lake Chelan Project No. 637, dated October 8, 2003.

SECTION 3: COMPARISON OF ACTUAL AND TARGET LAKE LEVELS

The table below compares monthly actual and target lake levels from May through October 2015. Lake levels are recorded at the end of the day, 2400 hours. Chelan PUD manages lake levels following an annual draft and refill cycle, generally beginning in August, that starts to release water from Lake Chelan to meet operating objectives, lake level targets, and for power generation from September through March, then refills Lake Chelan from April through July. Lake levels were successfully managed using generation and spill as defined in Chapter 8 of the Lake Chelan Comprehensive Plan.

Table 2: Comparison of Actual and Target Lake Levels

Date	License Target Lake Level (feet)	2015 Actual Lake Level (end of day)* (feet)	Difference between Actual and Target Lake Level (feet)
May 1, 2015	1,087.6	1,092.4	4.8
June 1, 2015	1,094.0	1,097.8	3.8
July 1, 2015	1,098.0	1,099.8	1.8
August 1, 2015	1,099.0	1,099.1	.1
September 7, 2015	1,098.7	1,098.7	0.0
October 1, 2015	1,097.2	1,097.5	0.3

* USGS Gage #12452000 Lake Chelan at Chelan

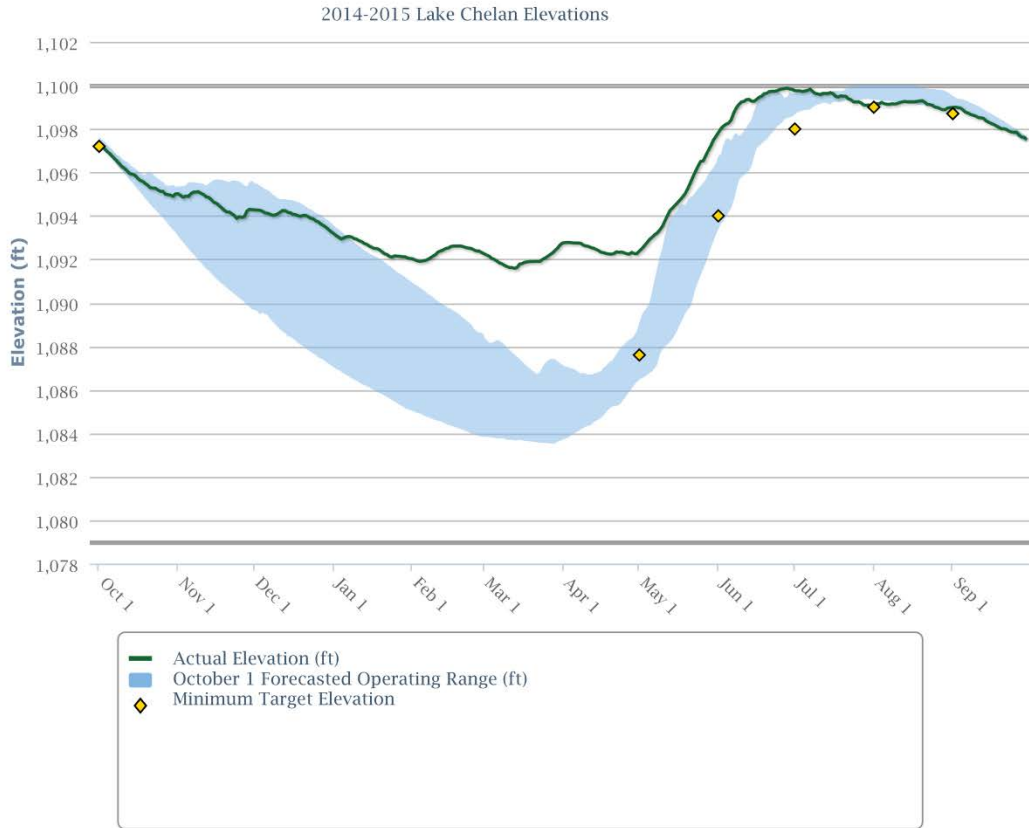


Figure 1. 2014-2015 Lake Chelan Elevations

SECTION 4: ACTUAL AND FORECASTED RUNOFF

April 1 through July 31, 2015, runoff forecasts for the Chelan Basin were produced on February 1, March 1, and April 1 of 2015. The runoff forecast on February 1 was 87% of average, the runoff forecast on March 1 decreased considerably to 70% of average, and the runoff forecast on April 1 continued to decrease, and was reaching historic lows, at 64% of average. Runoff volume forecasts and lake level are summarized below in Table 3.

Table 3: Runoff Volume Forecasts for April 1 – July 31, 2015

Date	Forecasted Percent of Average Runoff	Forecasted Runoff Volume (SFD) ⁵
February 1	87%	456,837
March 1	70%	367,570
April 1	64%	336,064

Actual runoff for April 1 through July 31 was almost 64% of average, producing 334,789 second-foot-days (SFD)⁵ of water.

⁵ The volume of water represented by a flow of 1 cubic foot per second for 24 hours.

SECTION 5: DECISIONS RELATED TO LAKE LEVEL

Chelan PUD manages Lake Chelan lake levels with the intent of meeting operating objectives, target lake levels (to the extent consistent with the objectives), and providing efficient operation of Chelan PUD generating resources. All operating objectives, with the exception of the tributary barrier objective, and monthly target lake levels were achieved in 2015. The tributary barrier objective was not met fully because lake levels were significantly higher than average throughout the fall and winter, draft period despite near capacity generation, due to significantly higher October through March precipitation. Photographs are taken annually of the mouths of major tributaries to Lake Chelan during the lowest lake elevation, usually in late March, to document presence/absence of barriers to upstream fish passage that may have formed during the previous year. Current and historic photographs have been compiled in a Tributary Barriers Photographs Report (Chelan PUD 2016). No barriers to upstream fish passage at any tributary mouths were documented in 2015, even with much higher than average lake levels occurring from mid-January through mid-May (Figure 1.)

Operations during the fall of 2014 are summarized in this paragraph, as these operations set up operations for 2015. Generation from October through December 2014 was scheduled at near maximum to provide lake draft, to create room for spring runoff, to provide flood control, and to generate electricity. Snowpack accumulation in November and December 2014 was slightly less than average. However, inflows were considerably greater than average and inflow projections showed a continuing upward trend throughout much of the fall and winter (Table 4). Considering actual lake levels and forecasts, there was the expectation of having plenty of water to meet tailrace security flows for Chinook salmon later in the winter.

Table 4: Lake Chelan Basin Percent of Average Precipitation for fall/winter 2014/2015

	October 2014	November 2014	December 2015	January 2015	February 2015	March 2015
% of 63-yr Average	158%	192%	205%	214%	278%	211%

The lake level on January 1, 2015, was 1,093.2 feet. Generation continued to be scheduled at near maximum month average capacity during January, February and March, due to near record accumulated inflows (Table 4), in order to continue drafting the lake, while still retaining enough water to maintain tailrace security flows through March.

The lake reached an unusually high low point of 1,091.6 feet on March 13, 2015, despite near maximum generation, due to the near record accumulated inflows. Although inflows remained above average throughout April, the April through July runoff forecast on April 1 was estimate to be very low, 64% of average. Due to the extreme low inflow forecast and expected early runoff, in mid-April a higher target curve was implemented to provide the highest probability that the lake would be refilled and monthly target lake levels could be achieved. Generation was reduced occasionally during the spring to follow the higher target curve. Refill timing was early, with over 89% of the April 1 to July 31 runoff occurring by July 1 (80% is considered average).

Water releases to maintain the Chelan River minimum instream flow remained at approximately 85 cfs throughout the spring and summer, except for headwater control as discussed below, to meet fish flow objectives in Reaches 1-3 of the Chelan River. No increase in releases above 80 cfs minimum instream flow requirement is required in below average runoff years (less than an 80% water year is considered below average). Spill was increased for headwater control on June 29, and continued intermittently through July 9, to manage the refill rate of Lake Chelan in order to meet license objectives and lake level targets.

One of the priority operating objectives is to reduce high flows in the Chelan River (below 6,000 cfs)⁶ to protect fish habitat. Successful lake level management resulted in a 2015 peak hourly flow of 2,090 cfs in the Chelan River on June 29 and a maximum daily average flow of 1,408 cfs also on June 29. Successful lake level management also provided adequate flood control and resulted in meeting minimum required flows in the Chelan River, both priority operating objectives.

Once inflows dropped below turbine capacity in July, light load generation and then heavy load generation were reduced. Some lake storage was drafted during later July for generation due to an upcoming scheduled unit outage from August 4 through late September. By August 1, the lake elevation was just above the target elevation of 1,099.0. With the Lake Chelan project at just over half its generating capability and the 90 to 120 day inflow forecasts increasing, this storage draft was implemented to reduce the chance of high flows in the Chelan River and help ensure that the lake elevation could remain close to the operating curve in the fall. A maximum end-of-hour lake level of 1,099.94 feet was achieved on June 29, and a maximum daily average lake level of 1,099.87 feet was achieved also on June 29.

The lake was gradually drafted through August and early September, even with only one generating unit, and reached the September 7 lake level target on that date. After September 7, the lake was gradually drafted to just above the October 1 lake level target. Ultimately, the generation unit outage extended until October 8, with no adverse effects to storage draft. Lake draft continued through October, November and December of 2015 to provide lake draft, to create room for spring runoff, to provide flood control, and to generate electricity.

⁶ Section 3.1 of Chapter 8, Final Lake Chelan Comprehensive Settlement Agreement for the Lake Chelan Project No. 637, dated October 8, 2003.

SECTION 6: LITERATURE CITED

Chelan PUD. 2016. Tributary Barriers Photographs, 2008-2015. Public Utility District No. 1 of Chelan County, Washington.

SECTION 7: CONSULTATION

As required in Article 405, Chelan PUD distributed a draft copy of this report on February 1, 2016, requesting review and comments by February 24, 2016 to the following resource agencies, Tribes and non-governmental organizations:

Agency	Contact
Washington Department of Ecology	Mark Peterschmidt, Charlie McKinney, Jim Pacheco
U.S. Geological Survey (USGS)	Nick Elwell
NOAA National Marine Fisheries Service	Justin Yeager
U.S. National Park Service	Annelise Lesmeister, Ashley Rawhouser, Hugh Anthony
U.S. Forest Service	Kari Grover Wier, Paul Willard, Emily Johnson, Richard Vacirca
U.S. Fish and Wildlife Service	Steve Lewis
Washington Department of Fish and Wildlife	Graham Simon, Travis Maitland, Jeff Korth
Washington State Parks and Recreation Commission	Tom Ernsberger, Brian Patnode
Washington Interagency Committee for Outdoor Recreation	Nona Snell
Confederated Tribes of the Colville Reservation	Bill Towey
The Yakama Nation	Bob Rose
The Confederated Tribes of the Umatilla Indian Reservation	Carl Merkle
City of Chelan	Mike Cooney, Charles Sablan, Paul Schmidt
Lake Chelan Sportsman's Association	Phil Archibald
Manson Parks and Recreation Department	Wai Petersen
Lake Chelan Recreation Association	Richard Uhlhorn, Jim Urness
American Whitewater	Tom O'Keefe