

**Tailrace Water Temperature Monitoring and  
Enhancement Plan**

*for*

**Energy Northwest's  
Packwood Lake Hydroelectric Project  
FERC No. 2244  
Lewis County, Washington**

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**June 2008**

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## **TAILRACE WATER TEMPERATURE MONITORING AND ENHANCEMENT PLAN**

### **1.0 INTRODUCTION**

Energy Northwest, Licensee of the Packwood Lake Hydroelectric Project, filed its Final Application for New License (FLA) with the Federal Energy Regulatory Commission (FERC) on February 24, 2008. FERC issued an Additional Information Request (AIR) on April 8, 2008. FERC requested that Energy Northwest provide clarification of Protection Mitigation and Enhancement (PM&E) measures and to submit several fully developed resource management plans, including a Tailrace Water Temperature Monitoring and Enhancement Plan. As stated in the AIR:

*In Section E.5.2.3 of your FLA, as one of your proposed environmental measures for water resources, you propose to develop a monitoring plan to evaluate the effectiveness of project operations under the new license in meeting the applicable temperature standard at the confluence of the tailrace with the Cowlitz River side channel. You also indicate the possible need for additional measures other than the timing of the project outage, such as the establishment of a mixing zone in the Cowlitz River below the tailrace. While we understand the overall goal of this monitoring plan, the lack of descriptions of the possible additional measures, and while we support adaptive management, the lack of a clearly defined strategy in your FLA, makes it difficult for us to complete our environmental analysis of this proposal.*

*So that we may more accurately analyze the effects of your proposed measure on water temperature, please develop and file with the Commission a detailed tailrace water temperature monitoring and enhancement plan. The plan should include (1) a thorough description of the monitoring that you propose to implement to monitor your compliance with applicable state temperature standards; and (2) a listing of any environmental measures that you may be implementing in the tailrace area over the term of a new license including and an approximate cost estimate for each of the proposed or possible measures. If applicable, the plan also should include a description of the steps that would be taken if performance goals are not achieved.*

This Tailrace Water Temperature Monitoring and Enhancement Plan is being submitted in response to the AIR.

### **1.1 Goals and Objectives**

The purpose of the Tailrace Water Temperature Monitoring and Enhancement Plan is to monitor water temperatures in the Project's lined tailrace, at the Packwood Lake outlet and the mouth of Lake Creek, to determine the effects of the tailrace water on Cowlitz

River water temperature. The monitoring to be implemented under this plan is intended to document the Project's compliance with water quality standards promulgated by the Washington Department of Ecology (Ecology). This monitoring, together with the proposed change in timing of the Project's annual maintenance outage, will be the main actions that Energy Northwest will take toward achieving and demonstrating compliance with current water quality standards.

## **1.2 Water Quality Standards**

Ecology will issue a water quality certification, pursuant to Section 401 of the Clean Water Act (CWA), for the operation of the Project under a new FERC license. The certification will require compliance with the water quality standards set forth by Ecology under the CWA. This Tailrace Water Temperature Monitoring and Enhancement Plan describes the methods Energy Northwest will employ to comply with the state standards and its Project-specific water quality certification.

Compliance with the state water quality standards requires, in part, knowing the natural water quality condition for a water body. When the 7-day average of the maximum daily temperatures (7-DAD Max)<sup>1</sup> exceeds the water quality temperature criteria (16°C for Lake Creek), and that condition is due to natural conditions, then human actions, considered cumulatively, may not cause the 7-DADMax temperature to increase more than 0.3°C (WAC 173-201A-200(1)(c)(i)).

“AKART” is an acronym for “all known, available, and reasonable methods of prevention, control, and treatment.” AKART shall represent the most current methodology that can be reasonably required for preventing, controlling, or abating the pollutants associated with a discharge. The concept of AKART applies to both point and nonpoint sources of pollution. The term “best management practices,” typically applied to nonpoint source pollution controls is considered a subset of the AKART requirement. (WAC 173-201A).

Energy Northwest will use AKART in its efforts to achieve compliance with the water quality standards.

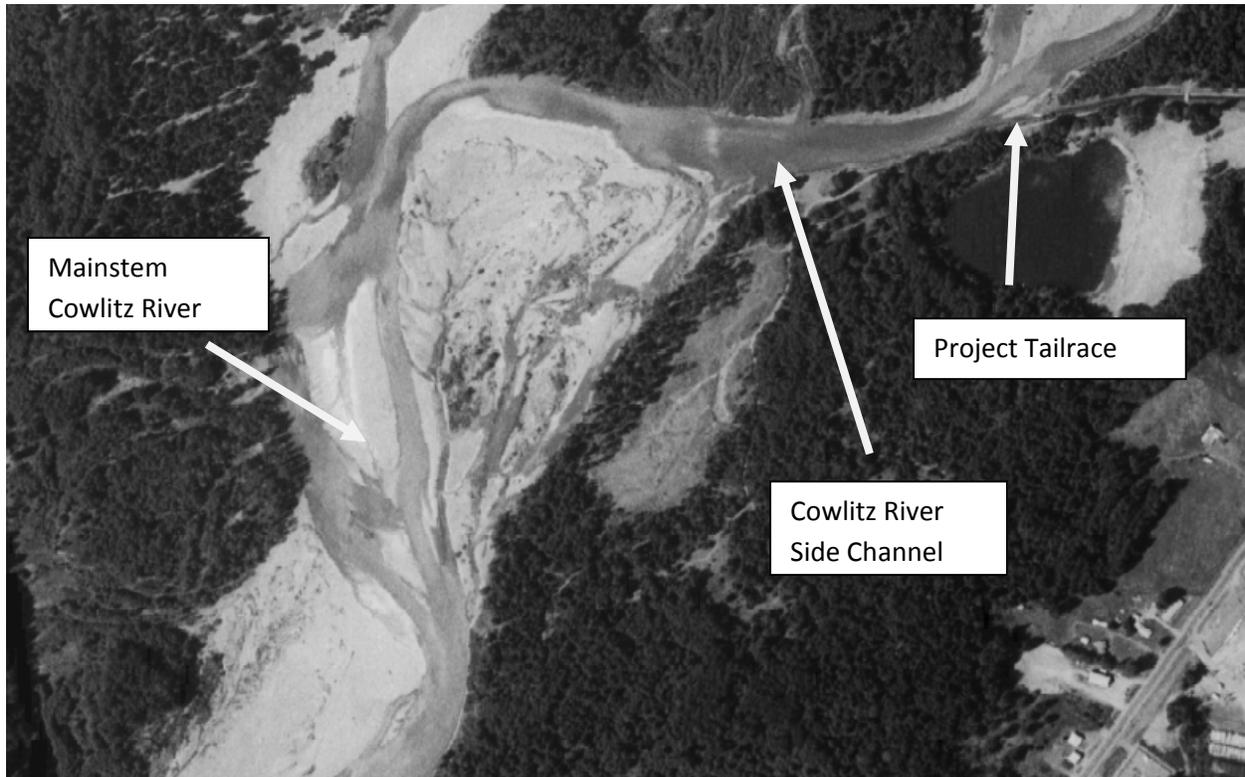
## **1.3 Background**

Water from Packwood Lake enters the Cowlitz River by one of two routes: one is the natural route via Lake Creek, and the other is via the Packwood Lake Hydroelectric Project. Naturally warmed surface water is withdrawn from Packwood Lake at the Project intake and diverted through a water conveyance to the Packwood powerhouse, a portion of which is buried. There it passes over the turbine runner, enters a stilling

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<sup>1</sup> "7-DADMax" or "7-day average of the daily maximum temperatures" is the arithmetic average of seven consecutive measures of daily maximum temperatures. The 7-DADMax for any individual day is calculated by averaging that day's daily maximum temperature with the daily maximum temperatures of the three days prior and the three days after that date. WAC 173-201A-020.

basin, and is routed back to a side channel of the Cowlitz River, via a lined tailrace canal (Figures 1 and 2, below).



**Figure 1. Aerial Photo of Tailrace Terminus and Cowlitz River**

The Department of Ecology has established that waters in the tailrace are waters of the state and therefore must comply with the state water quality standards. Prior to construction and operation of the Packwood Lake Hydroelectric Project, the water that now enters the Cowlitz River through the Project tailrace entered the Cowlitz River via Lake Creek. (Figure 1-2).



Energy Northwest modeled pre-Project water temperature conditions in Lake Creek and used the findings as the basis for establishing the temperature criteria to be applied to the tailrace discharge into the Cowlitz River.

Energy Northwest utilized the QUAL2Kw model to assess pre-Project water temperatures in Lake Creek. QUAL2Kw is a river and stream water quality model that represents a modernized version of the QUAL2E model (Brown and Barnwell 1987). QUAL2Kw is similar to QUAL2E in the following respects:

- One dimensional. The channel is well mixed vertically and laterally.
- Steady state hydraulics. Non-uniform, steady flow is simulated.
- Diel heat budget. The heat budget and temperature are simulated as a function of meteorology of a diel time scale.
- Diel water-quality kinetics. All water quality variables are simulated on a diel time scale.
- Heat and mass inputs. Point and non-point loads and abstractions are simulated.

Analysis using the QUAL2Kw model determined the pre-Project 7-DADMax water temperature in Lake Creek to be 19.09°C (EES Consulting, 2007). Given this modeled, “natural” temperature, and applying the criteria for temperature in the Washington water quality standards, the maximum allowable temperature for water delivered by the Project to the Cowlitz River via the tailrace is 19.39°C. (WAC 173-201A)

Two years of water temperature monitoring and analysis were conducted in the Project tailrace (2004 and 2005). The highest seven-day period of water temperatures in the tailrace during both years of the monitoring occurred between August 15 and August 21, 2004. (EES Consulting, 2007). High temperatures ranged from 18.62 °C to 20.25 °C, with a 7-DADMax of 19.46 °C, which would exceed the maximum allowable temperature by 0.07°C.

Because the tailrace water is likely to exceed the temperature standard in August, Energy Northwest has agreed to undertake a schedule of compliance, to implement best management practices (non-construction facility operation changes), and to complete the necessary water quality studies (temperature monitoring) to verify the effectiveness of proposed changes in achieving compliance with the state water quality standards (Ten Year attainment plan, allowed under WAC 173-201A-510(5); see Appendix A).

## **2.0 ENVIRONMENTAL MEASURES**

As part of a coordinated set of PM&E measures in the Final License Application for the Project, Energy Northwest plans to address Project effects on several environmental resources by implementing the following measures proposed in the final license application in the tailrace vicinity. (Energy Northwest, 2008):

- Modifying the timing of the annual Project maintenance outage for the new license term
- Eliminating the current lake drawdown that occurs prior to the annual outage.
- Conducting a fish rescue effort in the tailrace slough below the tailrace if the project flows are the primary source of water for the tailrace slough. (See Final License Application, Exhibit E, Section E.5.3.1.3.7).

Currently, Energy Northwest shuts down the Project for annual maintenance on October 1, and the Project is off line during most or all of the month. Under the new license, Energy Northwest is proposing to shut down between August 15 and September 15. The new outage timing will coincide with the period when water temperatures are warmest at Packwood Lake. Because no water would be discharged to the Cowlitz River from the Project tailrace during the outage, there would be no elevation of temperature, or exceedence of temperature criteria caused by the Project during that time.

Changing the outage timing to this period, and eliminating the current pre-outage lake drawdown are expected not only to reduce the temperature impacts of the Project during the warmest time of the year, but also to provide benefits to any ESA-listed fish in the tailrace slough. Chinook spawning begins on about August 15 in the vicinity of the Project. By starting the outage on August 15th rather than the current October outage timing, the Project will avoid providing attraction water that would draw adult Chinook salmon into the tailrace slough to spawn. Because the lake will not be drawn down prior to the outage, there will be sufficient water stored for continuous flows when the Project comes back on line, thereby reducing the risk of dewatering any Chinook salmon eggs that may be present in the tailrace side channel.

It is important to note the Washington Department of Fish and Wildlife and the U.S. Fish and Wildlife Service have indicated that the outage timing will also be constrained by the spawn timing and out-migration of adfluvial rainbow trout in Packwood Lake, as well as the need to provide increased bypass flows to support spawning and rearing in the anadromous reach of lower Lake Creek.

As an additional measure, Energy Northwest will conduct a fish rescue effort in the tailrace slough from the terminus of the tailrace down to the confluence with the mainstem Cowlitz River when conditions warrant. The tailrace slough side channel of the Cowlitz River can experience frequent and dramatic changes. During some years, large volumes of river water flow through the tailrace slough and in other years the river provides very little flow. During low river flows the project tailrace provides the majority of water through the slough. Under these conditions the water flowing from the Project tailrace does not meet the river for several hundred feet or more downstream of the tailrace terminus.

This situation presents a challenge for monitoring temperature impacts to the mainstem of Cowlitz River. Energy Northwest will conduct monitoring and continue consultation

with Ecology to determine how to best obtain data and document conditions and achieve compliance.

### **3.0 TAILRACE WATER TEMPERATURE MONITORING**

It is anticipated that moving the outage will have a beneficial effect on water temperature in the Cowlitz River at the confluence with the Project tailrace, since no water at all will be released through the powerhouse during most of the hottest period of the year. Energy Northwest is proposing to monitor water temperature, as described below, after beginning the new outage schedule to determine if moving the outage brings the Project into compliance with the temperature standard.

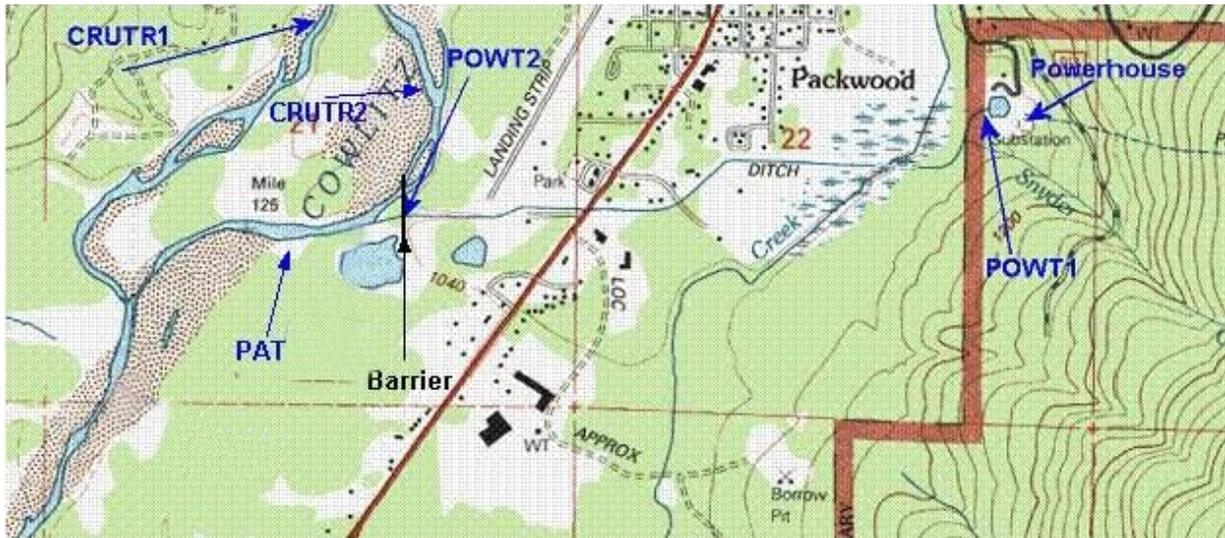
To confirm the expected beneficial effect on water temperatures of the proposed change in the annual Project outage schedule, Energy Northwest will monitor water temperatures at seven sites in four areas: 1) in the tailrace, 2) Lake Creek, 3) Packwood Lake, and 4) the Cowlitz River. Monitoring will take place on an annual basis between June 25th and October 5th for the first ten years of the new license (or until modified by the Department of Ecology).

Data will be collected in 30-minute intervals using Onset tidbit<sub>tm</sub> thermistors. Data will be organized on a monthly basis and a comparative analysis will be conducted. An annual report will be submitted to Ecology for a 60-day comment period, and Ecology's comments will be addressed, prior to the report being filed with FERC. The annual report will document water temperatures in the tailrace, as well as differences in the mainstem Cowlitz River upstream and downstream of the tailrace contribution. The proposed placement of thermistors at the Cowlitz River sites is preliminary until landowner permission and permits have been received for access and placement of the probes.

The temperature loggers will be downloaded monthly. The seven sites will be established as follows:

1. POWT1 – Located near where the stilling basin empties into the tailrace.
2. POWT2 – Located in the immediate vicinity of the fish barrier near the terminus of the tailrace. This site will be established in an area that ensures that no mixing with Cowlitz River water is taking place.
3. CRUTR1 – A secure location upstream of the tailrace in the mainstem of the Cowlitz River. This site will monitor water temperatures in the Cowlitz River above the point where temperature can be affected by the tailrace.
4. CRUTR2 – Located upstream of the tailrace in the side channel of the Cowlitz River.
5. LCMH – Located in Lake Creek near the mouth.
6. PLO – Located in Packwood Lake near the outlet canal leading to the intake.
7. PAT – Located along the tailrace or side channel collecting ambient air temperature.

The five monitoring sites in the vicinity of the Project tailrace are shown in Figure 3 below



**Figure 3. Thermister Locations for Monitoring Packwood Tailrace Water Temperatures**

Energy Northwest must send Ecology a temperature monitoring Quality Assurance Project Plan (QAPP) for approval 60 days prior to the start of temperature monitoring.

Energy Northwest will use best management practices in conducting temperature monitoring. If monitoring shows that shifting the annual outage to August, as proposed, does not bring the Project fully into compliance with the temperature criteria, Energy Northwest will consult with Ecology to determine whether alternative reasonable and feasible techniques exist that may be effective in achieving full compliance.

If Ecology determines that Energy Northwest has employed AKART and the temperature criteria still has not been met at the end of ten years of monitoring, Energy Northwest will consult with Ecology to determine the next appropriate steps to be taken, These may include the designating a mixing zone, determining whether the continued Project temperature excursions are economically and socially acceptable, doing temperature mitigation (such as shade tree plantings) upstream on the Cowlitz River, or ramping power usage, if all other reasonable, feasible measures have been tried or investigated.

#### **4.0 SCHEDULE AND DELIVERABLES**

Both the modification to the outage timing and water temperature monitoring will begin with Energy Northwest's receipt of the new license from FERC. The outage timing modification will be permanent and continue for the duration of the new license. Water temperature monitoring will be conducted for the first ten years of the new license, unless the temperature criteria are met for three consecutive years, at which time

Energy Northwest will petition DOE to suspend or modify the monitoring activities. As described above, an annual report will be submitted to Ecology and other agencies for a 60-day comment period, at the end of which, Energy Northwest will meet with Ecology to discuss the monitoring data and the need for continued monitoring. Ecology’s comments will be incorporated and addressed prior to filing with FERC. Table 1 displays an annual schedule of tasks related to the Packwood Tailrace Water Temperature Monitoring Plan. Each year’s data will be discussed with agency representatives at an annual resource coordination meeting intended to review all compliance work being conducted for Energy Northwest’s new license. Table 2 summarizes estimated annual costs for the environmental measures described in Section 2.0.

**Table 1. Packwood Tailrace Water Temperature Monitoring and Enhancement Plan Schedule**

<b>Task</b>	<b>Time Frame</b>	<b>Frequency</b>
Submit to Ecology a temperature monitoring QAPP	60 days prior to the 1 <sup>st</sup> monitoring period	Once, with updates as needed
Temperature Monitoring in the Tailrace	June 25 – October 5	Annually for the first 10 years of new license*
Packwood Project Outage	August 15 – September 15	Annually for the duration of the new license
Draft Tailrace Water Temperature Monitoring Report to Agencies for review	Annually, 60 days prior to the Resource Coordination Meeting	Annually for the first 10 years of new license*
Tailrace Water Temperature Monitoring Report to FERC	After receiving comments from WDOE and other Agencies.	Annually for the first 10 years of new license*
Resource Coordination Meeting	To be determined in consultation with Agencies	Annually for the duration of the new license

\*if compliance not achieved for 3 consecutive years

**Table 2. Estimated Costs of Proposed PME Measures for the Tailrace Slough**

Environmental Measure	Estimated Annual Cost	Comments
Temperature Monitoring	\$11,600	
Modifying Outage Timing	\$16,268	Based on an increase of 3 hours of labor per week for weekly inspections and 40 hours per year for annual maintenance (196 manhours). (from Table D-2, Energy Northwest 2008)
Eliminating Drawdown Prior to Outage	\$5,722	The cost for a shutdown in August is estimated at \$5,772. (Based on a minimum shutdown duration of 12 hours X blended costs of \$48.1/Megawatt hr X 5 MW/hr X 12 hrs; each occurrence) (from Table D-2, Energy Northwest 2008)
Fish Rescue	\$12,980	2 continuous years of seining the stilling basin and tailrace fish rescue. If capture is below threshold set by the BO, seine 2 more times 3 years apart. Each occurrence requires a Fish capture permit and personnel with a fish handling experience Total is: 4 consultants trained in fish handling/snorkeling (80hrsX\$95/hr=\$7600) + Per Diem for 4 Consultants @\$90 per day for two days=\$720) + 2 Plant Staff \$83/hr X 10hrs =\$1660) + \$3,000 annual permit costs 3. If the plant must be shut down to perform the stilling basin seining and tailrace fish rescue (from Table D-2, Energy Northwest 2008).

## **5.0 REFERENCES CITED**

Brown, L. C. and T. O. Barnwell, Jr., 1987. The enhanced water quality models QUAL2E and QUAL2E-UNCAS documentation and user manual. EPA document # EPA/600/3-87/007, Cooperative Agreement # 811883, Environmental Research Laboratory, U.S. Environmental Protection Agency, Athens, GA.

EES Consulting. 2007. Final temperature model, Lake Creek, for Energy Northwest's Packwood Lake Hydroelectric Project (FERC No. 2244). Submitted to Energy Northwest. September, 2007.

Energy Northwest, 2008. Final Application for New License, Packwood Lake Hydroelectric Project, FERC No. 2244, Energy Northwest, Richland, WA. February, 2008.

**Appendix A**

**Washington Administrative Code Section 173-201A-510, Sections (4) and (5)**

**WAC 173-201A-510**

**Means of implementation.**

**(4) General allowance for compliance schedules.**

(a) Permits, orders, and directives of the department for existing discharges may include a schedule for achieving compliance with water quality criteria contained in this chapter. Such schedules of compliance shall be developed to ensure final compliance with all water quality-based effluent limits in the shortest practicable time. Decisions regarding whether to issue schedules of compliance will be made on a case-by-case basis by the department. Schedules of compliance may not be issued for new discharges. Schedules of compliance may be issued to allow for: (i) Construction of necessary treatment capability; (ii) implementation of necessary best management practices; (iii) implementation of additional storm water best management practices for discharges determined not to meet water quality criteria following implementation of an initial set of best management practices; (iv) completion of necessary water quality studies; or (v) resolution of a pending water quality standards' issue through rule-making action.

(b) For the period of time during which compliance with water quality criteria is deferred, interim effluent limitations shall be formally established, based on the best professional judgment of the department. Interim effluent limitations may be numeric or nonnumeric (e.g., construction of necessary facilities by a specified date as contained in an ecology order or permit).

(c) Prior to establishing a schedule of compliance, the department shall require the discharger to evaluate the possibility of achieving water quality criteria via nonconstruction changes (e.g., facility operation, pollution prevention). Schedules of compliance may in no case exceed ten years, and shall generally not exceed the term of any permit.

**(5) Compliance schedules for dams:**

(a) All dams in the state of Washington must comply with the provisions of this chapter.

(b) For dams that cause or contribute to a violation of the water quality standards, the dam owner must develop a water quality attainment plan that provides a detailed strategy for achieving compliance. The plan must include:

(i) A compliance schedule that does not exceed ten years;

(ii) Identification of all reasonable and feasible improvements that could be used to meet standards, or if meeting the standards is not attainable, then to achieve the highest attainable level of improvement;

(iii) Any department-approved gas abatement plan as described in WAC [173-201A-200](#) (1)(f)(ii);

(iv) Analytical methods that will be used to evaluate all reasonable and feasible improvements;

(v) Water quality monitoring, which will be used by the department to track the progress in achieving compliance with the state water quality standards; and

(vi) Benchmarks and reporting sufficient for the department to track the applicant's progress toward implementing the plan within the designated time period.

(c) The plan must ensure compliance with all applicable water quality criteria, as well as any other requirements established by the department (such as through a total maximum daily load, or TMDL, analysis).

(d) If the department is acting on an application for a water quality certification, the approved water quality attainment plan may be used by the department in its determination that there is reasonable assurance that the dam will not cause or contribute to a violation of the water quality standards.

(e) When evaluating compliance with the plan, the department will allow the use of models and engineering estimates to approximate design success in meeting the standards.

(f) If reasonable progress toward implementing the plan is not occurring in accordance with the designated time frame, the department may declare the project in violation of the water quality standards and any associated water quality certification.

(g) If an applicable water quality standard is not met by the end of the time provided in the attainment plan, or after completion of all reasonable and feasible improvements, the owner must take the following steps:

(i) Evaluate any new reasonable and feasible technologies that have been developed (such as new operational or structural modifications) to achieve compliance with the standards, and develop a new compliance schedule to evaluate and incorporate the new technology;

(ii) After this evaluation, if no new reasonable and feasible improvements have been identified, then propose an alternative to achieve compliance with the standards, such as site specific criteria (WAC [173-201A-430](#)), a use attainability analysis (WAC [173-201A-440](#)), or a water quality offset (WAC [173-201A-450](#)).

(h) New dams, and any modifications to existing facilities that do not comply with a gas abatement or other pollution control plan established to meet criteria for the water body, must comply with the water quality standards at the time of project completion.

(i) Structural changes made as a part of a department approved gas abatement plan to aid fish passage, described in WAC [173-201A-200](#) (1)(f)(ii), may result in system performance limitations in meeting water quality criteria for that parameter at other times of the year.

[Statutory Authority: Chapters [90.48](#) and [90.54](#) RCW. 03-14-129 (Order 02-14), amended and recodified as § 173-201A-510, filed 7/1/03, effective 8/1/03. Statutory Authority: Chapter [90.48](#) RCW and 40 CFR 131. 97-23-064 (Order 94-19), § 173-201A-160, filed 11/18/97, effective 12/19/97. Statutory Authority: Chapter [90.48](#) RCW. 92-24-037 (Order 92-29), § 173-201A-160, filed 11/25/92, effective 12/26/92.]