Eugene Water & Electric Board
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November 6, 2020

Filed Electronically

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory
Commission Attention: OEP/DHAC
888 First Street, NE
Washington, DC 20426

Subject: P-2242 Carmen-Smith Hydroelectric Project
License Articles 14 and 404. Water Quality Management.

Dear Secretary Bose:

On May 17, 2019, the Federal Energy Regulatory Commission (FERC) issued to the Eugene Water & Electric Board (EWEB) an Order Issuing New License (167 FERC ¶ 61,152) for the Carmen-Smith Hydroelectric Project, Project No. 2242 (Project). License Article 14 in Appendix A requires EWEB to submit a Water Quality Management Plan to the State of Oregon Department of Environmental Quality (ODEQ) for approval within one year of license issuance, which was by May 16, 2020. According to License Articles 14 and 404, upon ODEQ's approval of the WQMP and no later than November 16, 2020, EWEB is required to file the Water Quality Management Plan with FERC for the Commission's approval.

Please find attached EWEB's Water Quality Management Plan and approval letter from the Oregon Department of Environmental Quality.

If you have any questions, please contact me at 541-685-7120, or scarlett.philibosian@eweb.org.

Respectfully submitted,

Scarlett Philibosian
Regulatory
Specialist

Enclosures
Water Quality Management Plan for the Eugene Water & Electric Board Carmen-Smith Hydroelectric Project (FERC No. 2242) McKenzie Sub-basin, Linn and Lane Counties, Oregon.
Letter of ODEQ Approval of Water Quality Management Plan.

cc: Carmen-Smith Designated Representatives, Marilyn Fonseca
EWEB: Jared Rubin, Mike McCann, Andrew Janos, Andy Talabere, Chris Taylor, RR

Oregon
Kate Brown, Governor

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Western Region Eugene Office
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November 5, 2020

Jared Rubin
Environmental and Property Supervisor
Eugene Water & Electric Board
P.O. Box 10148
Eugene, OR 97440-2148

Re: Carmen-Smith Hydroelectric Project (FERC No. 2242)
DEQ Approval of Water Quality Management Plan

Dear Jared:

On October 26, 2020, the Oregon Department of Environmental Quality received from the Eugene Water and Electric Board a revised Water Quality Management Plan prepared in compliance with DEQ's section 401 water quality certification dated July 23, 2018, and proposed license article 14 of the November 2018 Amended and Restated Settlement Agreement for the Relicensing of the Carmen-Smith Hydroelectric Project.

DEQ has completed its review and finds the revised WQMP adequately addresses our comments and incorporates the revisions requested by DEQ addressed in our correspondence dated September 28, 2020. DEQ approves the revised WQMP as submitted.

DEQ looks forward to working with EWEB to implement the WQMP and the conditions of the section 401 water quality certification. If you have any questions regarding implementation of plan please contact me directly at (541) 686-7810 or via email at stine.chris@deq.state.or.us.

Sincerely,

Christopher Stine, PE
Hydroelectric Specialist

cc: Fish Working Group representatives

FINAL ◦ OCTOBER 2020

Water Quality Management Plan for the Eugene Water & Electric Board Carmen-Smith Hydroelectric Project (FERC No. 2242) McKenzie Sub-basin, Linn and Lane Counties, Oregon

PREPARED FOR

Eugene Water & Electric Board
500 E 4th Avenue
Eugene, Oregon 97401

PREPARED BY

Stillwater Sciences
850 G Street. Suite K
Arcata, California 95521

Stillwater Sciences

Suggested citation:
Stillwater Sciences. 2020. Water Quality Management Plan for the Eugene Water & Electric Board Carmen-Smith Hydroelectric Project (FERC No. 2242) McKenzie Sub-basin, Linn and Lane Counties, Oregon. Final Report. Prepared by Stillwater Sciences, Arcata, California for Eugene Water & Electric Board, Eugene, Oregon.

Cover photos: Carmen-Smith Hydroelectric Project water quality sampling, Smith Reservoir and Carmen Diversion Dam, McKenzie River, Oregon.

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Table of Acronyms

Acronym	Explanation
AMP	Aquatics Management Plan
˚C	degrees Celsius
cfs	cubic feet per second
CWA	Clean Water Act
DO	Dissolved oxygen
EWEB	Eugene Water & Electric Board
FERC	Federal Energy Regulatory Commission
FNU	Formazin Nephelometric Unit
FPA	Federal Power Act
$ft^3\ s^{-1}$	feet cubed per second
IGDO	Intergravel Dissolved Oxygen
mg/L	milligrams per liter
mi^2	mile squared
mm Hg	millimeter mercury
NIST	National Institute of Standard and Technology
NTU	Nephelometric Turbidity Unit
OAR	Oregon Administrative Rules
ODEQ	Oregon Department of Environmental Quality
pH	hydrogen ion concentration
PME	protection, mitigation, and enhancement
Project	Carmen-Smith Hydroelectric Project
QA	quality assurance
QC	quality control
RM	river mile
$uS\ cm^{-1}$	microsiemen per centimeter
SM	Standard Method
s.u.	standard unit
TDG	total dissolved gas
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USGS	United States Geological Survey
WQMP	Water Quality Management Plan
WQO	water quality objective

1 INTRODUCTION

1.1 Purpose

On May 17, 2019, the Federal Energy Regulatory Commission (FERC) issued to the Eugene Water & Electric Board (EWEB) a new license for a term of 40-years effective from May 01, 2019 for the 91.995 Megawatt (MW) Carmen-Smith Hydroelectric Project (Project) (FERC No. 2242) in the Linn and Lane Counties, Oregon. The issuance of the license followed settlement among EWEB, federal agencies, state agencies, tribes, and environmental organizations as set forth in the Amended and Restated Settlement Agreement for the Relicensing of the Carmen-Smith Hydroelectric Project, filed with FERC on December 16, 2016 ("2016 Settlement Agreement"). This superseded the 2008 Settlement Agreement for the same Project.

The FERC License is subject to: terms and conditions set forth in the Federal Power Act (FPA) and regulations pursuant to the FPA; conditions set forth in the Clean Water Act Section 401 Certification (CWA 401 Certification)[1] issued by the Oregon Department of Environmental Quality on July 23, 2018[2] (ODEQ 2018a); conditions submitted by the U.S. Department of Agriculture Forest Service (USFS)[3], U.S. Department of the Interior, and Secretary of the U.S. Department of Commerce under the FPA; terms and conditions of the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Biological Opinions[4] under Section 7 of the Endangered Species Act; and License Articles, including License Articles in the 2016 Settlement Agreement and in the FERC License itself. The above-listed CWA 401 Certification specifies water quality certification conditions for the Project. Condition 1 of the CWA 401 Certification requires that EWEB prepares and implements this Water Quality Management Plan (WQMP). Upon approval by ODEQ, EWEB must file this WQMP with FERC and implement this WQMP upon FERC approval. The CWA 401 Certification cross-references the Aquatics Management Plan (AMP) (Stillwater Sciences 2016a), which is part of the 2016 Settlement Agreement, and identifies and describes the process to be used for addressing fisheries and other aquatics resource issues at the Project.

This WQMP describes procedures that will be implemented by EWEB to satisfy requirements of the CWA 401 Certification. EWEB considers that this WQMP, in combination with information contained in EWEB's revised application for certification pursuant to Section 401 of the CWA (EWEB 2010), and conditions included in the 2016 Settlement Agreement, provides ODEQ with the following assurances: that the Project will not contribute measurably to the violation of applicable water quality standards and criteria; that the physical, chemical, and biological water quality of waters potentially affected by the Project will not be degraded from existing conditions; that future Project operations will offset any ongoing contributions to non-attainment of water quality standard numeric or narrative criteria; and that such operations will also mitigate for any ongoing adverse impacts to designated beneficial uses.

[1] The FERC License excludes activities relating to gravel augmentation in the McKenzie Wild and Scenic River corridor and the requirement for project-specific funding.

[2] Amended August 16, 2018.

[3] Regarding the USFS conditions, the FERC License excludes activities relating to gravel augmentation in the McKenzie Wild and Scenic River corridor, funding of a USFS protection officer, and the cost reimbursement schedule in the 2008 intergovernmental agreement.

[4] Regarding the NMFS Biological Opinion, the FERC License excludes activities relating to gravel augmentation in the McKenzie Wild and Scenic River corridor and funding of a Forest Service protection officer.

In the sections below, descriptions of the Project setting, existing beneficial uses, State water quality goals and standards, the application of those goals and standards to the Project, measures designed to attain compliance, monitoring strategies, and reporting of monitoring results are provided.

1.2 Project Setting

The Project is situated on the McKenzie and Smith Rivers in the McKenzie Sub-basin, Willamette Basin, and occupies 574 acres within the Willamette National Forest (Figure 1-1). The Project stores water in three Project reservoirs and bypasses of 5.7 miles of the McKenzie River and 2.5 miles of the Smith River (Table 1-1). The Project boundary encloses the lands occupied by Project features, including three project reservoirs: Carmen Diversion Reservoir (on the McKenzie River), Smith Reservoir (on the Smith River), and Trail Bridge Reservoir (at the confluence of the McKenzie and Smith Rivers, receiving water from both). Project reservoirs include the 30-acre Carmen Diversion Reservoir impounded by the 25-foot-high, 2,100-foot-long Carmen Diversion Dam on the McKenzie River at river mile (RM) 87.5; the 178-acre Smith reservoir impounded by the 235-foot-high, 1,100-foot-long Smith Dam, on the Smith River at RM 2.5; and the 71-acre Trail Bridge Reservoir impounded by the 100-foot-high, 700-foot-long Trail Bridge Dam at RM 82 on the McKenzie River. Other Project features include the Carmen Powerhouse and Trail Bridge Powerhouse, bypassed reaches, transmission line corridors, access roads, and a salmon spawning channel known as the "Carmen-Smith Spawning Channel" constructed by EWEB below the Trail Bridge Powerhouse.

The Project was operating prior to reaches of the McKenzie River being designated as a *wild and scenic river* pursuant to the Omnibus Oregon Wild and Scenic Rivers Act on October 28, 1988. The designation includes 12.7 miles of the McKenzie River, from Clear Creek to Scott Creek, which is managed for remarkable scenic, recreation, geologic, water quality, and fish values. The Project dams and reservoirs are excluded from the *wild and scenic river* designation, and the Smith River is outside of the designation corridor. The Upper and Lower Carmen Bypass reaches are within the designation corridor (FERC 2019).

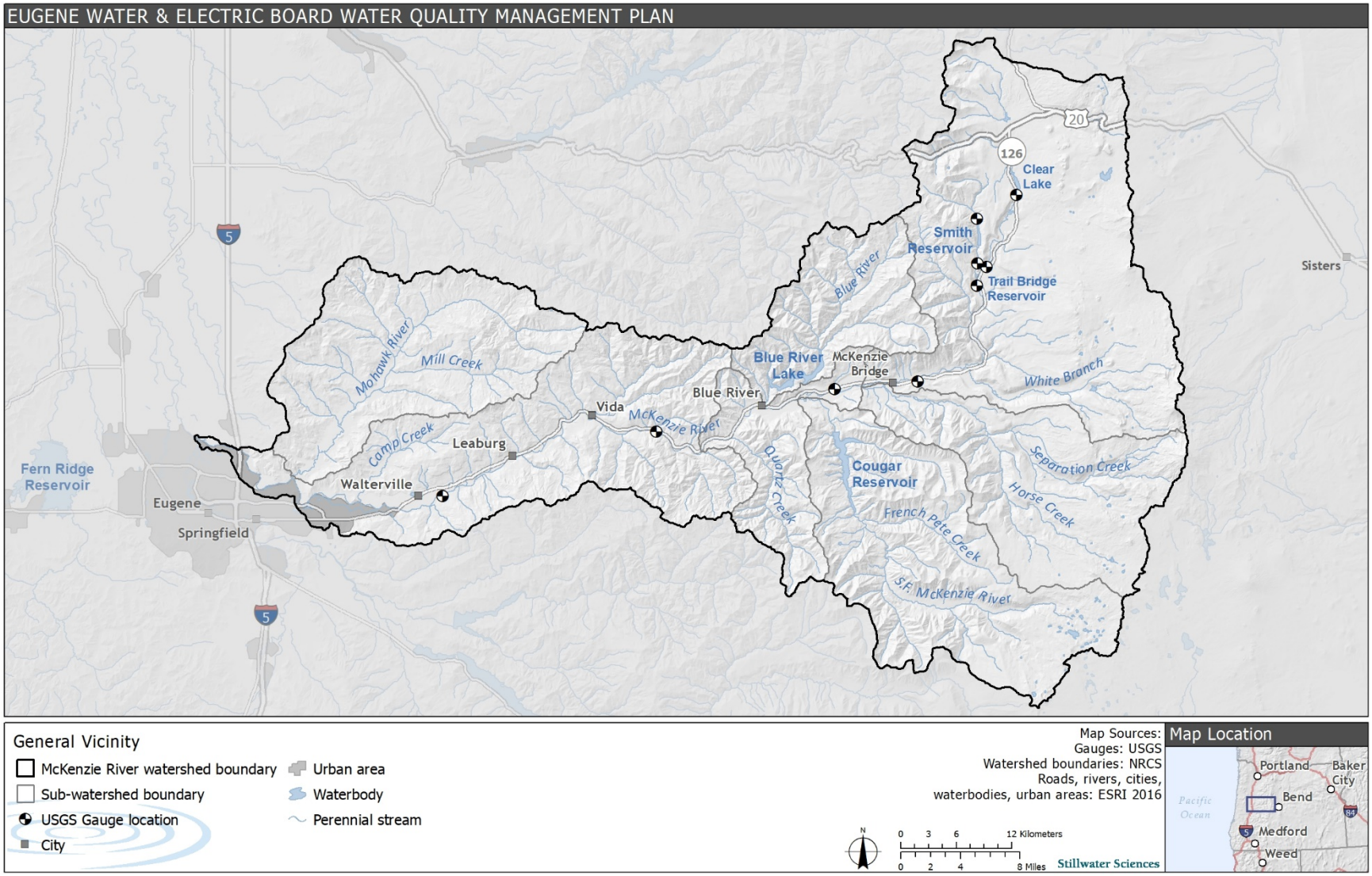

Figure 1-1. Carmen Smith Project (FERC No. 2242) vicinity, McKenzie Sub-basin, Linn and Lane Counties, Oregon.

Table 1-1. Carmen-Smith Hydroelectric Project (FERC No. 2244) features relevant to this Water Quality Monitoring Program.

Description	River	River Mile(s)
Carmen Diversion Dam	McKenzie River	RM 87.5
Upper Carmen Bypass Reach (from the Carmen Diversion Dam to Tamolitch Falls)	McKenzie River	RM 87.5 to RM 84.1
Lower Carmen Bypass Reach (from Tamolitch Falls to Trail Bridge Reservoir)	McKenzie River	RM 84.1 to RM 82.8
Carmen Powerhouse tailrace	McKenzie River	RM 82.7
Trail Bridge Dam	McKenzie River	RM 82
Smith Bypass Reach (from Smith Dam to Trail Bridge Reservoir)	Smith River	RM 2.5 to 0

Under normal Project operations, water diverted from the Carmen Diversion Reservoir flows into the 2.2-mile-long underground Carmen Diversion Tunnel that discharges water into Smith Reservoir. Spill from Carmen Diversion Dam is discharged to the Carmen Bypass Reach (Upper/ Lower), which then flows into the Trail Bridge Reservoir located downstream on the McKenzie River.

From Smith Reservoir, water enters the 1.4-mile-long underground Smith Power Tunnel and travels to a surge chamber for the Carmen Penstock. From the surge chamber, water flows through the 1,160-foot-long Carmen Penstock to the Carmen Powerhouse, located at the upstream end of Trail Bridge Reservoir. The Carmen Powerhouse contains two generating units with Francis turbines and two generators, each with an authorized capacity of 41.61 MW, for a total authorized capacity of 83.220 MW. Spill from Smith Dam is discharged to the Smith River downstream of the dam and flows downstream through the 2.5-mile-long Smith Bypass Reach into Trail Bridge Reservoir.

Trail Bridge Reservoir is used as a re-regulating development. As originally designed, water in the Trail Bridge Reservoir passes through the Trail Bridge Penstock and Trail Bridge Powerhouse or spillways before it is discharged to the McKenzie River downstream of Trail Bridge Dam. Under terms of the 2016 Settlement Agreement [Article 8] (see also AMP Section 4.3.6), EWEB committed to design, construct, operate, and maintain the Trail Bridge Dam spillway, gate and hoist system, and attraction water supply for downstream fish passage at Trail Bridge Dam, and conduct hydraulic and biological monitoring of the system. Once complete, use of Trail Bridge Powerhouse for power generation purposes will cease, allowing fish to pass through the existing spillway and avoid entrainment. Thereafter, the Trail Bridge Powerhouse will be operated only for safety, maintenance, and emergency purposes. EWEB will install a new trap-and-haul system at the Project's Trail Bridge Dam and remove the tailrace barrier downstream of Trail Bridge Dam to provide fish access (Chinook salmon, bull trout, and other native salmonids) for trap-and-haul, and will also conduct hydraulic and biological monitoring to ensure that the facility is functioning as designed.

1.3 Beneficial Uses

Oregon law and the CWA are generally structured to require water quality to be protected and maintained so that existing and potential beneficial uses of public waters are not impaired or precluded by degraded water quality. The State's designated beneficial uses to be protected in the

Willamette Basin, where the Project would be located, are listed in Oregon Administrative Rules (OAR) 340-041-0340, Table 340A. In the McKenzie River Tributary and other tributaries (i.e., the Smith River), these uses include public and private domestic water supply, industrial water supply, irrigation, livestock watering, fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, aesthetic quality, and hydropower generation. Under OAR 340-041-0004, ODEQ requires water quality to be managed to protect the recognized beneficial uses. Generally, if a water quality standard fully protects the most sensitive beneficial use, such as fisheries, aquatic life, and water supply, then all beneficial uses are fully protected.

Fish and spawning uses are designated on OAR 340-041-0340 Figures 340A and 340B. Designated fish uses within the Willamette Basin include bull trout (*Salvelinus confluentus*) spawning and juvenile rearing, core cold-water habitat, salmon and trout rearing and migration, salmon and steelhead (*Oncorhynchus mykiss)* migration corridors, and cool water species (areas of no salmonid use). The designated fish use within the segment of the McKenzie River affected by the Carmen-Smith Hydroelectric Project, which is designated as the McKenzie Sub-basin, is bull trout spawning and rearing (see OAR 340-041-0340, Figures 340A and 340B). Based on surveys conducted in 2005, portions of the Project area support populations of federally listed fish species including bull trout and spring Chinook salmon (*O. tshawytscha*), other native species such as cutthroat trout (*O. clarkii*), as well as introduced species which rely on certain habitat requirements, including the presence of cold water, during critical life stage development (Stillwater Sciences 2006). Farther downstream, at the tributary junction with the South Fork McKenzie River, the designated fish use pursuant to OAR 340-041-0340 Figures 340A and 340B changes to core cold-water habitat, which is designated for use by salmon and steelhead spawning from September 1 to June 15.

1.4 Habitat Protection, Mitigation, and Enhancement Measures

During the FERC relicensing process, EWEB conducted comprehensive water quality studies during 2004 and 2005, including seasonal synoptic surveys of analytical water chemistry and *in situ* water quality (e.g., conductivity, dissolved oxygen (DO), hydrogen ion concentration [pH], and turbidity), water temperature monitoring and modeling, diel (72-hour) monitoring of *in situ* water quality, inter-gravel dissolved oxygen (IGDO) sampling, benthic macroinvertebrate surveys, as well as operational monitoring of total dissolved gas (TDG) in the Carmen Powerhouse tailrace (Stillwater Sciences 2006). Study results and other historical water quality information were used to evaluate existing water conditions in Project-affected waters, and to assess compliance with applicable narrative and numerical water quality standards. In general, water quality in Project reservoirs and reaches met applicable water quality standards. However, water temperature in lower Deer Creek and the Smith Bypass reach exceeded temperature criteria.

As part of the 2016 Settlement Agreement among EWEB, federal agencies, state agencies, tribes, and environmental organizations, EWEB committed to a suite of protection, mitigation, and enhancement (PME) measures to be implemented under the new FERC License, along with some interim measures to be implemented after filing of the 2016 Settlement Agreement.. In the sections below, we discuss PME measures related to water use and quality, including instream flow releases to the bypassed reaches, agreements to establish and fund operations of U.S. Geological Survey (USGS) gaging stations in the Lower Carmen Bypass and Smith Bypass reaches, as well as the planned turbine runner replacement in the Carmen Powerhouse, which will be undertaken to improve generation efficiency and address exceedances of TDG standards identified during operational testing conducted in 2005 (Stillwater Sciences 2006).

1.4.1 Stage, Discharge, and Water Quality Monitoring and Reporting

In addition to long-term monitoring of McKenzie River discharges by USGS at Clear Lake (USGS 14158500) and downstream of Trail Bridge Dam (USGS 14158850), EWEB recently completed funding agreements with USGS in accordance with the CWA 401 Certification and Section 4.2 of the AMP, to install, operate, and maintain the following river gauges:

- A flow gauge in the Lower Carmen Bypass Reach (USGS 1415740) approximately 0.4 km (0.2 mi) upstream of the Trail Bridge Reservoir, as near to the location of the pressure transducer used in relicensing studies as the USGS determines is feasible. USGS gauge 1415740 has been operable since 2016.
- A flow and water temperature gauge in the Smith Bypass Reach (USGS 14158798), upstream of Trail Bridge Reservoir. USGS gauge 1415798 has been operable since 2017. Planning for relocating this gauge upstream, closer to Smith Dam, is ongoing and shall be completed in accordance with the schedule provided in Section 4.2.3.4 of the AMP.

The sensors at the gauge stations in the Lower Carmen Bypass Reach and Smith Bypass Reach are required to provide real-time and publicly accessible data reporting capability (AMP – Section 4.2). Table 1-2 includes relevant gauge data and the available period of record for stage, discharge, and monitored water quality parameters. Periods of data availability are based on "daily data" (derived from raw data with a 15-minute measurement frequency), and in most cases daily statistics, monthly statistics, and annual statistics are available for similar or shorter periods. Water quality grab sampling results at USGS gauge 14158850 between August 1977 and April 1985 are available, and included DO, pH, turbidity, dissolved solids, and several metals and minerals, in addition to water discharge, water temperature, and specific conductivity. Accessible online data is maintained by the USGS Oregon Water Science Center.

Table 1-2. Summary of available USGS hydrologic monitoring information in the vicinity of the Carmen-Smith Hydroelectric Project.

	USGS gauge 14158850[1]	**USGS gauge 14158740**	**USGS gauge 14158798**
Coordinates[2] (latitude, longitude)	44°16'4.4", -122°2'59.2"	44°17'11.0", -122°02'12.5"	44°17'23.6", -122°02'54.9"
River / Bypass Reach	McKenzie River (downstream of Trail Bridge Dam)	Lower Carmen Bypass Reach (above Trail Bridge Reservoir, below Payne Creek)	Smith River Bypass Reach (above Trail Bridge Reservoir)
Drainage Area (mi^2)	184	160	21.4
Water Discharge ($ft^3\ s^{-1}$)	10-01-1959 to present	07-21-2016 to present	08-11-2017 to present
Annual Peak Water Discharge ($ft^3\ s^{-1}$)	1960 to present	2017 to present	2018 to present
Water Temperature (°C)	11-04-1976 to present	09-02-2016 to present	08-10-2017 to present
Specific Conductivity of Water (uS cm^{-1} at 25°C)	11-04--1976 to 09-29-1985 2017-07-13 to present	2016-09-22 to present	08-10-2017 to present
Field Measurements	12-22 -1964 to present	07-27-2016 to present	08-31-2017 to present
Field/Lab Water Quality Samples[3]	08-10-1977 to 04-11-1985	NA	NA

Source: USGS 2020a–c, left to right.

[1] The local datum of the gauge from 1963 to present is 1,980.00 feet above NGVD29 (USGS 2020a).

[2] Datum: NAD83.

[3] Dissolved oxygen, pH, turbidity, dissolved solids, and several metals and minerals, in addition to water discharge, water temperature, and specific conductivity.

1.4.2 Instream Flow Requirements

To improve conditions for spawning and rearing of bull trout and Chinook salmon in the lower Carmen and Smith Bypass reaches, and to support reintroduction efforts of native cutthroat trout in the Upper Carmen Bypass reach, instream flow releases have been included in the AMP (Section 4.2, Table 4-4 of the AMP), as an interim measure (2016 Settlement Agreement, Section 2.8, Interim Measure 8), and/or in the CWA 401 Certification (Condition 2a). Instream flow releases are to be implemented as either a "block release" or "minimum instream" flow, defined as follows:

- **Block release**: A release from a controlled point which does not vary as flows within the reach increase or decrease, with a compliance point at the release structure.
- **Minimum instream flow**: The instream flow needed to comply with a minimum threshold value, as measured at a compliance point within the river reach. An increase above a defined block release may be necessary to meet a minimum instream flow.

The water flow requirements are for three main river reaches:

- **Upper Carmen Bypass Reach**: Beginning after EWEB constructs the flow release system described in AMP Section 4.2.1.2 and within six years of FERC License issuance (i.e., by May 17, 2025) EWEB shall release a minimum of 30 cubic feet per second (cfs) from Carmen Diversion Dam into the Upper Carmen Bypass Reach year-round. Prior to construction of the water release structure for the minimum 30 cfs, EWEB will release interim flows of at least 30 cfs when reasonably practicable *[per LA 16, Construction Management Plan, item J]*.
- **Lower Carmen Bypass Reach**: Beginning in 2016, EWEB shall make a reasonable effort to release additional water from the Carmen Diversion Dam as necessary to maintain a minimum target flow of 160 cfs in the Lower Carmen Bypass Reach at the USGS gauge to be installed upstream of the Carmen powerhouse (2016 Settlement Agreement, Section 2.8, Interim Measure 8; AMP Section 4.2.1.2).
- **Smith River Bypass Reach**: within six years of FERC license issuance, EWEB shall release water from Smith Dam into the Smith Bypass Reach as follows:
    - Minimum Block Release – 10 cfs year-round and 35 cfs from August 16 through October 31;
    - Minimum Instream Flow – 30 cfs from November 1 through April 15 and 25 cfs from April 16 through August 15.

Flow monitoring details are further specified in Section 2 of this WQMP.

WQMP Condition 2 b) requires that, beginning with the first-year scheduled water releases from Project dams are required, EWEB shall prepare and submit to ODEQ an annual report of average hourly flows for each previous water year (October 1 through September 30) at all monitored locations. The report shall include documentation of instream flow releases, per AMP Section 4.3. Recognizing that instream flows will also be reported on a calendar year basis pursuant to the AMP (see Section 4.2), available instream flow data will be included with the annual WQMP report (Section 9) to allow timely interpretation of water quality monitoring results.

1.4.3 Flow Fluctuation and Ramping

In order to improve conditions for Bull Trout and Chinook salmon in the McKenzie River, Trail Bridge Reservoir, Lower Carmen Bypass Reach, and Smith Bypass Reach, Condition 2 c) of the

CWA 401 Certification specifies flow fluctuation and "ramping" rate requirements for three locations shown in Table 1-3.

Table 1-3. Carmen-Smith (FERC No. 2242) Project flow fluctuation and ramping requirements.

Location	Fluctuation or Ramping	Numeric Criteria	Applicable Time Period
Trail Bridge Reservoir (EWEB stilling well and float)	Maximum Daily Elevation Fluctuations	7 feet daily	March 15 through October 31
		12 feet daily	November 1 through March 14
	Maximum Downramp Ramping Rate	12 inches per hour	March 15 through August 31
		14 inches per hour	September 1 through October 31
		24 inches per hour	November 1 through March 14
	Maximum Upramp Ramping Rate	38 inches per hour	Year-round
McKenzie River below Trail Bridge Dam (USGS 14158850)	Maximum Up and Downramp	0.30 feet daily	April 1 through August 31
		0.30 feet weekly	
		0.20 feet daily	September 1 through October 31
		0.20 feet weekly	
		0.60 feet daily	November 1 through March 31
		0.80 feet weekly	
	Maximum Hourly Upramp	0.20 feet per hour	Normal operations
		0.40 feet per hour	Maintenance (scheduled maintenance requires two weeks advance notice)
	Maximum Hourly Downramp	0.20 feet per hour	Year-round
Smith River Bypass Reach (USGS 14158798)	Maximum Downramp Rate	3 inches per hour	At the end of all spill events[5]

1.4.4 Other Habitat Protection, Mitigation, and Enhancement Measures

Condition 2 e) of the CWA 401 Certification requires that EWEB shall undertake activities to increase spawning and rearing habitat in Project reservoirs and bypass reaches, in accordance with Articles 4, 5, 6, 7, 8, and 9 of the 2016 Settlement Agreement and Section 4.3 of the AMP. Measures from the 2016 Settlement Agreement related to gravel augmentation in the Lower Carmen Bypass Reach are excluded from the FERC License to avoid conflicts with the Wild and Scenic Rivers Act. Measures related to "smoothing flows" for distribution of gravel that may be added pursuant to the USFS special use authorization are retained in the FERC License (see paragraph 71).

1.5 Adaptive Management Considerations

In connection with the relicensing of the Project, the FERC License and 2016 Settlement Agreement include PME measures and other actions that are expected, over time, to have a beneficial impact on water quality. If water quality monitoring indicates Project activities reduce support for designated beneficial uses, ODEQ may require EWEB to submit a report analyzing the situation, may require additional monitoring, or may require EWEB to submit a plan to ensure

5 During storm events flow releases must be conducted with priority for protection of public safety and project facilities, including the Smith and Trail Bridge dams.

compliance with applicable water quality standards (Condition 2f) of the CWA 401 Certification. Adaptive management considerations specific to each water quality parameter are described in Sections 3 to 7 of this WQMP.

2 OVERVIEW OF MONITORING APPROACH, METHODS AND SCHEDULE

In accordance with the CWA 401 Certification and AMP, EWEB shall monitor water quality to provide the ODEQ reasonable assurance that the Project achieves all applicable water quality requirements under the new FERC License. This WQMP includes routine monitoring of instream flows, DO, pH, water temperature, and turbidity, as well as event-based monitoring of total dissolved gas (TDG), at the frequencies, timing and duration shown in Table 2-1. Monitoring locations are shown in Figure 2-1. Continuous water quality monitoring in the McKenzie River downstream of Trail Bridge Dam will commence within 6-months of FERC approving this WQMP. Water quality monitoring in the three bypass reaches shall commence in the first calendar year following FERC approval of this WQMP, although EWEB may also perform monitoring in the same year as FERC approval occurs.

To allow assessment of cumulative water quality impacts due to Project operations and provide a basis for implementing future adaptive management measures, the monitoring site in the McKenzie River downstream of Trail Bridge Dam has been selected for continuous year-round water quality monitoring. At this site, a water quality station will be co-located with USGS Gauge 14158850 (Table 2-1). USGS Gauge 14158850 continuously measures stage (for instream flow) and water temperature year-round (Table 1-2), and EWEB will additionally measure temperature, pH, DO, and turbidity continuously on a year-round basis at this site. As required by the CWA 401 Certification, event based TDG monitoring will also occur at this site (Table 2-1).

This WQMP also establishes a framework for assessing the effects of Project operation on water quality in each of the three affected bypass reaches—Upper Carmen Bypass, Lower Carmen Bypass, and Smith Bypass. In the Upper Carmen Bypass Reach a new water quality site will be established, in the Lower Carmen Bypass Reach a water quality station will be co-located with USGS Gauge 14158740, and in the Smith Bypass Reach a water quality station will be established downstream of USGS Gauge 14158798[6]. Because previous monitoring studies conducted as part of Project relicensing indicate that water quality in Project bypass reaches generally met applicable water quality standards, this WQMP proposes a strategy that combines continuous year-round monitoring of instream flow (water discharge) and water temperatures, monthly spot checks of *in situ* water temperature, DO, pH, and turbidity, as well as short-term seasonal monitoring of these *in situ* water quality parameters in the three bypass reaches during the summer low flow conditions. Seasonal continuous monitoring of *in situ* water quality will be conducted at the locations and timing shown in Table 2-1. Data from monthly spot checks of *in situ* water quality will be assessed and reported in the context of both the continuous water temperature and flow data as well as the diel variability found during seasonal monitoring. As required by the CWA 401 Certification, this WQMP also includes one-time event-based monitoring of TDG (Section 7).

[6] Note that USGS Gauge 14158798 is planned to be relocated farther upstream of the existing location within three years of approval of the FERC License.

Table 2-1. Carmen-Smith Hydroelectric Project (FERC No. 2242) water quality monitoring parameters, frequency, and timing by location.

Location*	Stage/ Discharge[1]	Temperature[2]	Dissolved Oxygen[3]	pH[3]	Turbidity[3]	Total Dissolved Gas[4]
Upper Carmen Bypass[5]		**M, C**	**M, S**	**M, S**	**M, S**	**E**
Lower Carmen Bypass (1.4 km downstream of Tamolitch Falls)	**C**[6]					
USGS 14158740 (McKenzie River below Payne Creek); also part of the Lower Carmen Bypass Reach	**C**[7,8]	**C**[7]	**M, S**	**M, S**	**M, S**	
Carmen Powerhouse (tailrace, bypass valve outfall and downstream locations in Trail Bridge Reservoir)						**E**
USGS 14158798 (Smith River upstream of Trail Bridge Reservoir)	**C**[7,8]	**C**[7,8]				
Smith River Bypass (upstream of Trail Bridge Reservoir and downstream of USGS 14158798)		**M, C**	**M, S**	**M, S**	**M, S**	**E**
USGS 14158850 (McKenzie River downstream of Trail Bridge Dam)	**C**[7]	**C**[7]	**C**	**C**	**C**	**E**[9]

Frequencies: C = continuous (15- or 30-minute interval) monitoring; S = continuous seasonal monitoring during summer low-flow conditions from August 1 to August 15 in the Smith River Bypass and for a minimum of 72-hours between August 16-31 at Carmen Bypass locations; E = continuous event-based monitoring for a minimum of 72-hours (see Section 7.3 for details); M = single sample monthly spot checks (April 15–November 15).

* This table describes general location only. Exact locations are described by parameter in the sections below.

[1] Stage and discharge monitoring requirements are from AMP Sections 4.2.2.3, 4.2.2.4, and 4.2.3.4.

[2] Water temperature monitoring requirements are from AMP Section 4.2.3.4 and 401 Certification Condition 6.

[3] Dissolved oxygen, hydrogen ion concentration (pH), and turbidity monitoring requirements are from 401 Certification Conditions 4 to 7.

[4] As described in CWA 401 Certification Condition 8, event-based Total Dissolved Gas monitoring is required for a period of 72 hours at each monitoring site, except see Section 7.3 for sites downstream of the powerhouse tailraces and below the discharge outfall of the Carmen powerhouse bypass valve.

[5] Location to be determined by the downstream extent of continuously wetted habitat corresponding to 30 cfs discharge from Carmen Diversion Dam.

[6] Stage monitoring is required for a period of five years following initiation of flow releases in accordance with Section 4.2.2.4 of the AMP.

[7] Monitoring conducted by USGS.

[8] Monitoring is required for the full term of the FERC Project license in accordance with Sections 4.2.2.3 and 4.2.3.4 of the AMP.

[9] The monitoring location for event based TDG monitoring downstream of Trail Bridge dam will be developed in consultation with ODEQ once the designs of the modified spillway and trap and haul facility are complete.

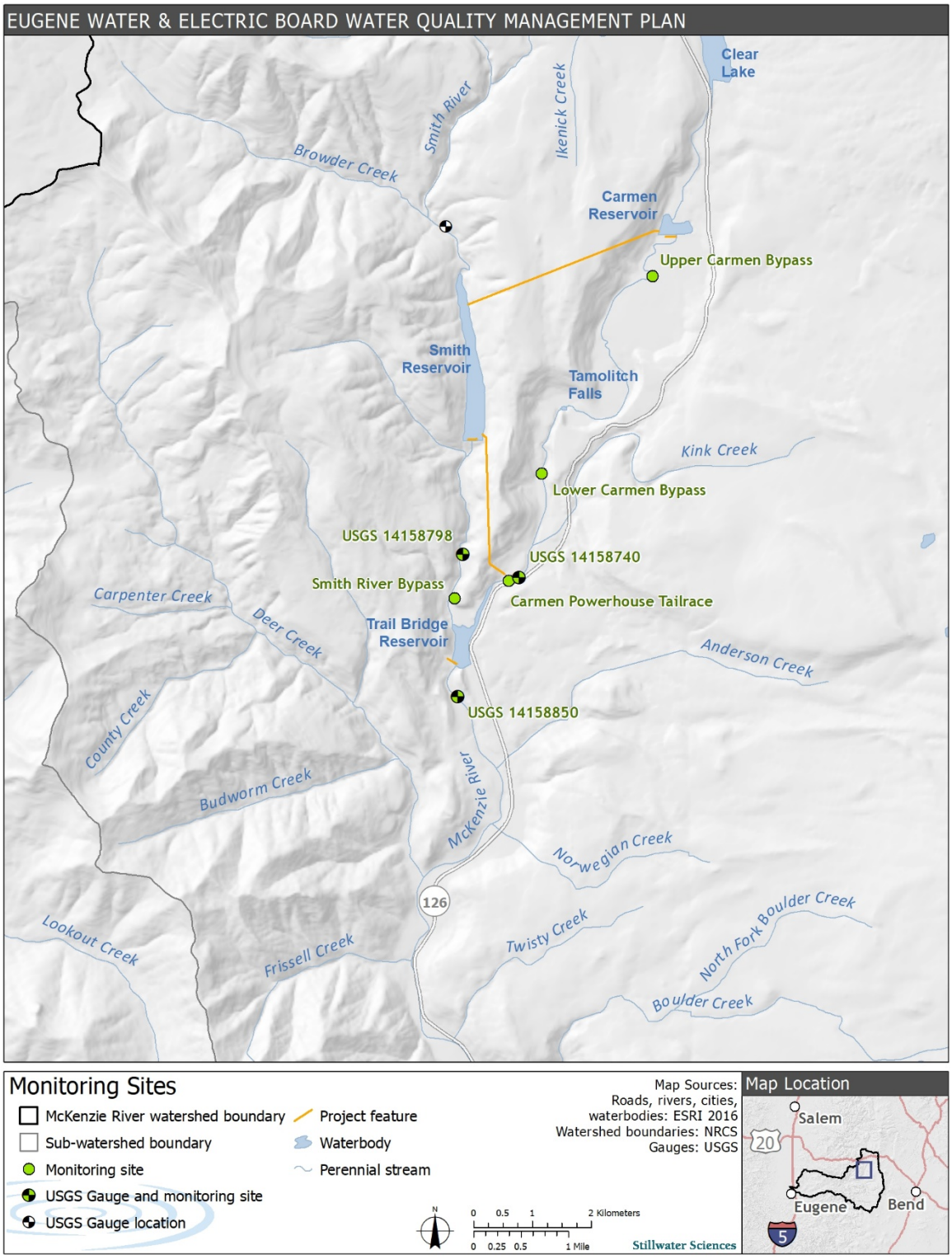

Figure 2-1. Carmen-Smith Hydroelectric Project (FERC No. 2242) water quality monitoring locations.

To allow comparisons with applicable ODEQ water quality standards, monitoring methods will conform generally with ODEQ procedures (2009) and procedures described in the USGS (*variously dated*) *National field manual for the collection of water-quality data*, or future variations of these procedures, including appropriate quality control procedures described in Section 9 of this WQMP. Field methods are summarized in Table 2-2 below, with details of the methods used for required monitoring for each parameter provided in Sections 3 to 7.

Table 2-2. Carmen-Smith Project (FERC No. 2242) *in situ* water quality methods.

Parameter	Method1	Units	Accuracy
Dissolved oxygen (Luminescent)	ASTM D888-18C	mg/L and percent saturation (%)	± 0.1 mg/L or 1% of reading (0-20 mg/L)
Dissolved Oxygen (Polarographic)	ASTM D888-18B; EPA 360.1; SM 4500-O	mg/L and percent saturation (%)	± 0.2 mg/L or 2% of reading (0-20 mg/L)
pH	EPA 150.2; SM 4500H-2011	Standard unit (s.u.)	±0.1 within ±10°C of calibration temp
Temperature	EPA 170.1; SM 2550B-2000	ºC	± 0.2 °C
Total Dissolved Gas	SM 2810B-2011	mm Hg	±1.5 mm Hg
Turbidity (Nephelometric)	EPA 180.1; ISO 7027-1:2016 SM 2130B-2011	NTU/ FNU	±2% of reading or 0.5 NTU

[1] Methods may be found in APHA (2017), ASTM (2018), ISO (2016), and USEPA (1983).

3 DISSOLVED OXYGEN

Dissolved oxygen (DO) is one of the principal parameters used to determine water quality in support of aquatic life. DO is of critical importance to gill-breathing organisms (e.g., fish and macroinvertebrates) and other aquatic life that requires oxygen to meet metabolic needs. Some aquatic species such as the salmonids are very sensitive to reduced concentrations of DO. Sensitivity to DO concentrations also varies between various life stages (e.g., egg, larvae, and adults), and between different life processes (e.g., feeding, growth, and reproduction). Because salmonids build nests ("redds") in gravels for spawning, DO concentrations within gravels (i.e., inter-gravel DO, or IGDO) directly influence the survival of developing salmonid embryos. High water column DO levels are not necessarily indicative of adequate IGDO levels, which may vary depending on several interrelated factors including water column concentrations, the percentage of fine sediment in the gravel pores, sediment oxygen demand, as well as the respiratory oxygen demand of the developing eggs. However, IGDO sampling can impact embryos, thus is only recommended where there is non-compliance with standards for water column DO. OAR 340-041-0016 allows for reduced water column DO concentrations in circumstances when IGDO criteria are met (see Section 3.1).

3.1 ODEQ Standard

The DO standard is set forth in OAR 340-041-0016 and requires that no waste discharges, or activities conducted alone or in combination, violate the relevant thresholds. For specified water

bodies, including bull trout spawning and rearing habitat in the McKenzie Sub-basin (see OAR Figure 340B), from spawning through fry emergence the following criteria apply:

> "(a) The dissolved oxygen may not be less than 11.0 milligram per liter (mg/l). However, if the minimum intergravel dissolved oxygen, measured as a spatial median, is 8.0 mg/l or greater, then the DO criterion is 9.0 mg/l;
>
> (b) Where conditions of barometric pressure, altitude, and temperature preclude attainment of the 11.0 mg/l or 9.0 mg/l criteria, dissolved oxygen levels must not be less than 95 percent of saturation;
>
> (c) The spatial median intergravel dissolved oxygen concentration must not fall below 8.0 mg/l."

3.2 Application to the Carmen Smith Project

Although monitoring conducted during 2004–2005 (Stillwater Sciences 2006) demonstrated that Project operations were not associated with exceedances of the DO criteria, Condition 4 b) of the CWA 401 Certification includes additional DO monitoring to ensure that planned instream flow releases included in Section 4.2 of the AMP (see the summarized flow requirements in Section 1.5 of this WQMP) will meet applicable water quality standards in Project bypass reaches and downstream of Trail Bridge Dam.

ODEQ applies the 11.0 mg/l criteria to protect spawning habitat from August 15 through June 15. ODEQ applies the 8.0 mg/l criteria to protect rearing and migration habitat from June 16 through August 14. Monitoring data for the locations listed below will be compared to these WQO:

- Upper Carmen Bypass Reach;
- Lower Carmen Bypass Reach;
- Smith Bypass Reach; and
- McKenzie River downstream of Trail Bridge Dam.

3.3 Monitoring Methods

In accordance with Condition 4 a) (1) of the CWA 401 Certification, EWEB shall measure DO at downstream locations in the Upper Carmen Bypass Reach, Lower Carmen Bypass Reach, and Smith River Bypass Reach. Additionally, in accordance with Condition 4 a) (2) of the CWA 401 Certification, to assess cumulative Project effects on DO in response to modifications to Project developments and/or operations, EWEB shall measure DO at USGS gauge 14158850 located approximately 0.2 miles below Trail Bridge Dam.

Equipment used for DO monitoring shall be from YSI (Yellow Springs Instruments), Hydrolab (OTT-Hydromet, Loveland, CO), In Situ Inc.(Fort Collins, CO), or other equipment meeting the requirements of ASTM 888-12 - *Standard Test Methods for Dissolved Oxygen in Water* (See Table 2-2). Methods used in this WQMP are based upon luminescence (optical sensor) methods described by USGS (Rounds et al 2013), with amperometric (Clark cell) methods used in limited circumstances allowing frequent calibration checks. Calibration and maintenance shall be in accordance with manufacturer's recommendations, with field calibration conducted in water saturated air (100% relative humidity) that has been allowed to reach stable temperatures (see Section 8.2.1.1). The manufacturer's instruction manual will be consulted for specific procedures regarding calibration, maintenance, and use. Because iodometric (Winkler) methods are labor intensive and require multiple replicates to achieve required ODEQ accuracy and precision

requirements (Table 8-1), these methods are not proposed for DO monitoring or calibration in this WQMP.

Using a calibrated DO meter or multi-parameter instrument, monthly spot measurements will be taken at downstream locations in the Upper Carmen and Smith bypass reaches (Table 2-2) from March through November of each year. Multi-parameter instruments used for continuous seasonal monitoring of DO will be deployed at wadeable depths, with continuously deployed instruments secured using short lengths of fence post or foundation stakes with secondary cable attachments. Continuous data will be recorded at 15 minutes intervals for a minimum of 72-hours. To the extent possible, DO sampling shall be conducted in areas with suitable substrate, depths, and velocities for salmonid spawning. All sampling will be conducted to avoid disturbance of actively spawning adult salmonids or existing redds. To capture critical conditions for salmonid spawning and rearing, continuous 72-hour sampling events are scheduled at these locations around the second half of August.

In addition to completion of pre- and post-sampling calibration sheets, Quality Assurance/Quality Control (QA/QC) procedures and contingencies to address inoperable or malfunctioning equipment shall be carried out as described in Section 8.

3.4 Assessment and Adaptive Management

EWEB shall monitor DO in Project bypass reaches and in the McKenzie River downstream of Trail Bridge Dam at the frequencies specified in Table 2-1 unless authorized otherwise by ODEQ. Each year data will be reviewed to ensure QA/QC procedures and data quality objectives have been met (see Section 8.1). Validated field data, as well as data downloaded from USGS gauge locations will be compared to seasonal WQOs applicable to each monitoring location (see Section 3.2), with results included in annual reports filed with ODEQ in accordance with Condition 4(c) of the CWA 401 Certification. In accordance with Condition 4 (d) of the CWA 401 Certification, if water quality monitoring demonstrates that Project operations contribute to exceedances of the applicable DO criterion, ODEQ may require EWEB to submit a report analyzing the situation, may require additional monitoring, or may require EWEB to prepare a plan in consultation with ODEQ that proposes measures to attain the DO criteria. Upon ODEQ approval, EWEB shall submit the plan to FERC for approval. Upon FERC approval, EWEB shall implement the plan.

EWEB shall begin annual water quality monitoring according to the schedule in Table 2-1 within one year following approval of this WQMP by FERC. EWEB shall continue to monitor DO in each of the three bypass reaches for a minimum of five years following the year in which minimum instream flows are implemented according to Section 4.2 of the AMP and Condition 2(a) of the CWA 401 Certification. If after this period DO monitoring data at any of these bypass reach monitoring sites indicates that Project operation is not causing a violation of Oregon's DO water quality standard or is reducing support for existing and designated beneficial uses, EWEB may request a modification to the monitoring schedule that may include a reduction or cessation of DO monitoring. EWEB shall implement any changes to the water quality monitoring schedule as approved or modified by ODEQ following such a request.

Lastly, EWEB shall continuously monitor DO at the water quality station in the McKenzie River below Trail Bridge Dam according to the schedule in Table 2-1, unless authorized otherwise by ODEQ. Continuous monitoring at this water quality station is necessary to assess the cumulative effects of project actions and provide a basis for implementing adaptive management strategies as required by the Aquatics Management Plan. EWEB may conduct a review of monitoring data to

evaluate the direct, indirect, and cumulative effects of project operation on DO. At EWEB's request, DEQ will review the monitoring data and, at the Department's discretion, may increase, decrease, or suspend future monitoring requirements as warranted by water quality monitoring data.

4 HYDROGEN ION CONCENTRATION (pH)

pH (i.e., hydrogen ion concentration) is a measure of water's acidity (pH<7) or alkalinity (pH>7) and is indicated on a log-concentration scale using "standard units" ranging from 0 to 14, based on dissolved hydrogen ion concentrations. pH affects solubility and forms of metals, minerals, as well as potential toxicity of dissolved ammonia (NH_3/NH_4^+). pH is generally controlled within suitable ranges (6.5–8.5) by carbonate equilibria such that the amounts of dissolved carbon dioxide (CO_2) consumed by photosynthesis or produced by algal and bacterial respiration does not result in unsuitably high (typically daytime) or low (typically nighttime) levels.

4.1 ODEQ Standards

The pH standards are set forth in OAR 340-041-0021 and 340-041-0345. The former requires that pH values may not fall outside the basin-specific criteria, although the Department may determine that waters impounded by dams existing on January 1, 1996 are not in violation of the standard. The latter specifies basin-specific criteria and for Willamette Basin and specifies that pH may not fall outside the 6.5 to 8.5 pH range.

4.2 Application to the Carmen Smith Project

Although monitoring conducted during 2004-2005 (Stillwater Sciences 2006) indicated that current Project developments and operation generally exert little influence on the pH of waters in the Project area, planned instream flow releases to Bypass Reaches, as well as habitat modifications to littoral areas in Trail Bridge Reservoir associated with stranding, may both potentially affect pH. In order to provide assurances that future developments and Project operations meet applicable water quality standards in Project bypass reaches and downstream of Trail Bridge Dam, Condition 5(a) of the CWA 401 Certification includes pH monitoring (Table 2-1).

Monitoring data will be compared to a WQO within a pH range of 6.5 to 8.5 year-round in the following locations:

- Upper Carmen Bypass Reach;
- Lower Carmen Bypass Reach;
- Smith Bypass Reach; and
- McKenzie River downstream of Trail Bridge Dam.

4.3 Monitoring Methods

In accordance with Condition 5 (a)(1) of the CWA 401 Certification, EWEB shall measure pH at downstream locations in the Upper Carmen Bypass Reach, Lower Carmen Bypass Reach, and Smith River Bypass Reach. EWEB shall also measure pH at USGS gauge 14158850 located approximately 0.2 miles below Trail Bridge Dam (Table 2-1).

Equipment used for pH monitoring shall include a silica glass ion-selective electrode (ISE) or pH probe within a multi-parameter instrument that provides automatic temperature compensation from YSI (Yellow Springs Instruments), Hydrolab (OTT-Hydromet, Loveland, CO), In Situ Inc.(Fort Collins, CO), or other manufacturers meeting the requirements of U.S. Environmental Protection Agency (USEPA) Method 150.2 (Table 2-2). pH probes shall be calibrated using a two point calibration, including pH 7.0 and either pH 10.0 or pH 4.0 low ionic strength buffers (See Section 8.2.1.2). The manufacturer's instruction manual will be consulted for specific procedures regarding their calibration, maintenance, and use.

Using a calibrated pH meter or multi-parameter instrument, monthly spot measurements will be taken at downstream locations in the Upper Carmen and Smith bypass reaches (Table 2-2) from March through November of each year. Multi-parameter instruments used for continuous seasonal monitoring of pH will be deployed at wadeable depths, with continuously deployed instruments secured using short lengths of fence post or foundation stakes with secondary cable attachments. Continuous data will be collected at 15-minute intervals for a minimum of 72-hours. Post-deployment calibration checks shall be performed in the field, as described above.

In addition to completion of pre- and post-sampling calibration sheets, QA/QC procedures and contingencies to address inoperable or malfunctioning equipment shall be carried out as described in Section 8.

4.4 Assessment and Adaptive Management

pH shall be monitored in Project bypass reaches and in the McKenzie River downstream of Trail Bridge Dam at the frequencies specified in Table 2-1, unless otherwise authorized by ODEQ. Each year data will be reviewed to ensure QA/QC procedures and data quality objectives have been met (see Section 8.1). Validated field data will be compared to seasonal water quality standards applicable to each monitoring location (see Section 4.2) with results included in annual reports to ODEQ (See Section 9). The CWA 401 Certification does not include specific adaptive management conditions to address exceedances of the ODEQ pH criterion.

EWEB shall begin annual water quality monitoring according to the schedule in Table 2-1 within one year following approval of this WQMP by FERC. EWEB shall continue to monitor pH in each of the three bypass reaches for a minimum of five years following the year in which minimum instream flows are implemented according to Section 4.2 of the AMP and Condition 2(a) of the CWA 401 Certification. If after this period pH monitoring data at any of these bypass reach monitoring sites indicates that project operation is not causing a violation of Oregon's pH water quality standard or is reducing support for existing and designated beneficial uses, EWEB may request a modification to the monitoring schedule that may include a reduction or cessation of pH monitoring. EWEB shall implement any changes to the water quality monitoring schedule as approved or modified by ODEQ following such a request.

Lastly, EWEB shall continuously monitor pH at the water quality station in the McKenzie River below Trail Bridge Dam according to the schedule in Table 2-1, unless authorized otherwise by ODEQ. Continuous monitoring at this water quality station is necessary to assess the cumulative effects of project actions and provide a basis for implementing adaptive management strategies as required by the Aquatics Management Plan. EWEB may conduct a review of monitoring data to evaluate the direct, indirect, and cumulative effects of project operation on pH. At EWEB's request, DEQ will review the monitoring data and, at the Department's discretion, may increase,

decrease, or suspend future monitoring requirements as warranted by water quality monitoring data.

5 WATER TEMPERATURE

Water temperatures can affect the health, distribution, and abundance of fish, amphibians, aquatic insects, other benthic organisms, and aquatic plants. Bull trout, salmon, and steelhead are examples of native species in the Project area adapted to cool temperature regimes. Bull trout require temperatures several degrees lower than optimal for salmon and trout. Many benthic macroinvertebrates, which are important food sources for fish and as indicators of overall stream health, require cool water to thrive. Water temperature also affects DO and pH because of its influence on the relative amounts of DO and dissolved carbon dioxide (CO_2) in water, as well as more subtle effects upon pH due to the changing mobility of dissolved gases and ions with temperature.

5.1 ODEQ Standard

The standard is set forth in OAR 340-041-0028. *Biologically Based Numeric Criteria* applicable to the project are determined by the fish use and spawning designations presented on OAR Figures 340A and 340B. Figure 340A designates the entire Project as suitable habitat for bull trout. The seven-day-average maximum temperature of a stream identified as having bull trout spawning and juvenile rearing use is 12.0 degrees Celsius (53.6 degrees Fahrenheit) year-round.

5.2 Application to the Carmen Smith Project

Monitoring conducted during 2004-2005 (Stillwater Sciences 2006) indicated that all Project reservoirs, as well as tributaries and bypass reaches of the McKenzie River, meet the applicable water temperature criterion year-round. Although modeling was conducted to support a lower temperature criteria based on the natural thermal potential of the Smith Bypass Reach and Deer Creek transmission line corridor under pre-Project conditions, adjustments of the biologically based numeric criteria for natural conditions were disallowed in 2012.[7] Under Section 4.2 of the AMP (see the summarized flow requirements in Section 1.4.2 of this WQMP), EWEB will perform certain PMEs including the release of additional flows in Project reaches to enhance aquatic habitat and water quality. However, because Project operations will continue to affect the natural hydrograph and water temperatures in Project Bypass reaches and in the McKenzie River downstream of Trail Bridge Dam, Condition 6(a)(1) and 6(a)(2) require water temperature monitoring (Table 2-1).

Monitoring data will be compared to a WQO of 12.0ºC computed as the 7-day average of the daily maximum temperatures over the previous seven days, year-round, in the following locations:

- Upper Carmen Bypass Reach;
- Lower Carmen Bypass Reach;
- Smith Bypass Reach; and
- McKenzie River downstream of Trail Bridge Dam.

[7] On Feb. 28, 2012, the U.S. District Court for the District of Oregon invalidated the EPA's approval of DEQ's natural conditions criterion for water temperature in OAR 340-041- 0028(8).

In accordance with Condition 6(a)(3) of the CWA 401 Certification and Article 22 of the Settlement Agreement, and as part of the Transmission Line Management Plan (Stillwater Sciences 2019), EWEB is planning to relocate the 2,640 foot long portion of the Deer Creek valley segment of the 115-kV transmission line out of the Deer Creek riparian area towards the southwest–adjacent to Deer Creek Road, within three years of FERC License issuance. EWEB is also planning to revegetate the Deer Creek riparian area to promote shade in accordance with Section 4.5.4 of the Vegetation Management Plan (Stillwater Sciences 2016b). Water temperature monitoring is not required in Deer Creek under Condition 6(a)(3) of the CWA 401 Certification.

5.3 Monitoring Methods

In accordance with Condition 6 (a)(1) of the CWA 401 Certification, EWEB shall measure water temperature at downstream locations in the Upper Carmen Bypass Reach, Lower Carmen Bypass Reach, and Smith River Bypass Reach. EWEB shall also measure temperature at USGS gauge 14158850 located approximately 0.2 miles below Trail Bridge Dam (Table 2-1).

Temperature measurements will be conducted using thermometers, self-contained microprocessor based thermistors ("thermographs"), and temperature sensors included as part of multiparameter monitoring instruments meeting the requirements of USEPA Method 170.1 (Table 2-2). The accuracy of the field thermometers and thermographs will be verified by two-point calibration checks in ice (0ºC) and room temperature (~20ºC) water baths (See Section 8.2.1.3).

Multi-parameter instruments and standalone thermistors used for continuous water temperature monitoring shall be deployed at wadable depths at the sites shown in Table 2-1, with continuously deployed instruments secured using short lengths of fence post or foundation stakes with secondary cable attachments. Monitoring locations shall be located near the channel thalweg within well mixed (e.g., riffle) locations at least 7–10 channel widths downstream and 3–5 channel widths upstream of any tributary junction (Dunham et al., 2005). Spatial variability at each sampling site will be documented using spot measurements collected across the stream channel, longitudinally, as well as at the surface and bottom of any nearby pools. To ensure continuous data collection, two thermistors will be deployed at each site, with data downloads conducted monthly during summer, and quarterly at other times of year as river and weather conditions permit.

In addition to completion of pre- and post-deployment calibration checks, QA/QC procedures and contingencies to address inoperable or malfunctioning equipment shall be carried out as described in Section 8.

5.4 Assessment and Adaptive Management

Temperature shall be monitored in the Project bypass reaches and in the McKenzie River downstream of Trail Bridge Dam according to the schedule shown in Table 2-1.

Each year data will be reviewed to ensure QA/QC procedures and data quality objectives have been met (see Section 8.1). Validated field data will be compared to water quality standards applicable to each monitoring location (see Section 5.2) with results included in annual reports to ODEQ (see Section 9). In accordance with Condition 6 c) of the CWA 401 Certification, if water quality monitoring demonstrates that Project operations contribute to exceedances of the applicable temperature criterion, ODEQ may require EWEB to submit a report analyzing the situation, or may require additional monitoring, or may require EWEB to prepare a plan in

consultation with ODEQ which proposes measures to reduce Project-related thermal loading. The plan may consider measures to alter the timing and/or magnitude of releases to minimize temperature increases in affected reaches. Upon ODEQ approval, EWEB shall submit the plan to FERC for approval. Upon FERC approval, EWEB shall implement the plan.

EWEB shall begin annual water quality monitoring according to the schedule in Table 2-1 within one year following approval of this WQMP by FERC. EWEB shall continue to monitor temperature in each of the three bypass reaches required by Condition 6(a)(1) of the CWA 401 Certification for a minimum of five years following the year in which minimum instream flows are implemented according to Section 4.2 of the AMP and Condition 2(a) of the CWA 401 Certification. If after this period temperature monitoring data at the Upper or Lower Carmen Bypass Reach monitoring sites indicates that project operation is not causing a violation of Oregon's temperature water quality standard or is reducing support for existing and designated beneficial uses, EWEB may request a modification to the monitoring schedule that may include a reduction or cessation of temperature monitoring. EWEB shall implement any changes to the water quality monitoring schedule as approved or modified by ODEQ following such a request.

Lastly, EWEB shall continuously monitor water temperature at the water quality stations in the Smith Bypass Reach and in the McKenzie River below Trail Bridge Dam according to the schedule in Table 2-1, unless authorized otherwise by ODEQ.

6 TURBIDITY

Turbidity measures the amount of light that is scattered by suspended particulate matter relative to the light that passes directly through a water sample. Suspended materials affecting turbidity include minerals (clays, silts, non-dissolved precipitates), organic matter (algae, fine particulates from detrital plant matter), and microscopic organisms. In riverine settings, turbidity is used as an indicator of suspended sediment concentrations which can affect spawning gravels, respiration by gill-breathing organisms, as well as photosynthesis of attached (periphyton) algae in Project bypasses and suspended (phytoplankton) algae in Project reservoirs.

6.1 ODEQ Standard

The relevant standard is set forth in OAR 340-041-0036 and requires no more than a ten percent cumulative increase in natural stream turbidities (measured in Nephelometric Turbidity Units [NTU] or Formazin Nephelometric Units [FNU]), as measured relative to a control point immediately upstream of the turbidity causing activity.

6.2 Application to the Carmen Smith Project

Although monitoring conducted during 2004-2005 (Stillwater Sciences 2006) demonstrated that normal Project operations were not associated with exceedances of turbidity criteria, Condition 7 a) of the CWA 401 Certification includes additional turbidity monitoring to ensure that planned instream flow releases included in Section 4.2 and 4.4 of the AMP will meet applicable water quality standards in Project bypass reaches and downstream of Trail Bridge Dam. Monitoring data will be compared to a WQO limiting turbidity increases to no more than 10% above background at the following locations shown in Table 2-1:

- Upper Carmen Bypass Reach;
- Lower Carmen Bypass Reach;

- Smith Bypass Reach; and
- McKenzie River downstream of Trail Bridge Dam.

Because elevated turbidity concentrations can result from a range of anthropogenic and natural processes, Condition 3 of the CWA 401 Certification also specifies conditions for limiting potential construction-related sedimentation and turbidity. Conditions include limitations on flow fluctuations and ramping (Condition 3a) as documented by newly constructed gauging stations (Condition 3e), and limitations on spills to the Smith Bypass Reach (Condition 3b). In addition to turbidity monitoring associated with these operational requirements for limiting sedimentation and turbidity, sediment reduction measures are required for ground-disturbing activities, instream work, and transmission line management.

6.3 Monitoring Methods

In accordance with Condition 7 a) of the CWA 401 Certification, EWEB shall measure turbidity at downstream locations in the Upper Carmen Bypass Reach, Lower Carmen Bypass Reach, and Smith River Bypass Reach. EWEB shall also measure turbidity at USGS gauge 14158850 located approximately 0.2 miles below Trail Bridge Dam (Table 2-1).

Turbidity measurements will be conducted using a cuvette style nephelometric turbidimeter (e.g., Hach 2100Q, Hach Company, Loveland CO), as well as through use of continuously reading side scatter optical turbidimeters meeting the requirements of USEPA Method 180.1 or equivalent standard (Table 2-2). Two-point turbidity calibrations shall be conducted for cuvette style turbidimeters and multi-parameter sondes before and after monitoring (See Section 8.2.1.4). The manufacturer's instruction manual will be consulted for specific procedures regarding their calibration, maintenance, and use.

Using a calibrated turbidimeter, turbidity will be monitored according to the schedule shown in Table 2-1. In the event that spot or continuous measurements of turbidity indicate potential increases due to Project operations, additional samples will be collected upstream of the outfall/release structure for comparison to turbidity WQOs.

In addition to completion of pre- and post-sampling calibration sheets, QA/QC procedures and contingencies to address inoperable or malfunctioning equipment shall be carried out as described in Section 8.

6.4 Assessment and Adaptive Management

Turbidity shall be monitored in Project bypass reaches and in the McKenzie River downstream of Trail Bridge Dam at the frequencies specified in Table 2-1, unless authorized otherwise by ODEQ. Each year data will be reviewed to ensure QA/QC procedures and data quality objectives have been met (see Section 8.1). Validated field data will be compared to water quality standards applicable to each monitoring location (see Section 6.2) and results included in annual reports to ODEQ (see Section 9). The CWA 401 Certification does not include adaptive management conditions to address exceedances of the ODEQ turbidity criterion.

EWEB shall begin annual water quality monitoring according to the schedule in Table 2-1 within one year following approval of this WQMP by FERC. EWEB shall continue to monitor turbidity in each of the three bypass reaches for a minimum of five years following the year in which minimum instream flows are implemented according to Section 4.2 of the AMP and Condition

2(a) of the CWA 401 Certification. If after this period turbidity monitoring data at any of the bypass reach monitoring sites indicates that project operation is not causing a violation of Oregon's turbidity water quality standard or is reducing support for existing and designated beneficial uses, EWEB may request a modification to the monitoring schedule that may include a reduction or cessation of turbidity monitoring. EWEB shall implement any changes to the water quality monitoring schedule as approved or modified by ODEQ following such a request.

Lastly, EWEB shall continuously monitor turbidity at the water quality station in the McKenzie River below Trail Bridge Dam according to the schedule in Table 2-1, unless authorized otherwise by ODEQ. Continuous monitoring at this water quality station is necessary to assess the cumulative effects of project actions and provide a basis for implementing adaptive management strategies as required by the Aquatics Management Plan. EWEB may conduct a review of monitoring data to evaluate the direct, indirect, and cumulative effects of project operation on turbidity. At EWEB's request, DEQ will review the monitoring data and, at the Department's discretion, may increase, decrease, or suspend future monitoring requirements as warranted by water quality monitoring data.

7 TOTAL DISSOLVED GAS

Because of its linkage to fish bubble trauma, the amounts of total dissolved gas (TDG) in water discharges from hydropower facilities is of critical importance to the survival and health of fish and other aquatic organisms. As described by Henry's Law, the solubility of gases within water such as nitrogen, oxygen, carbon dioxide and other trace gases is increased in proportion to their partial pressures in air. As a result, the entrainment of air in power tunnels and from the plunging of highly aerated spills can trap air in water, forming bubbles, which facilitates the dissolution of these gases into water and tissues of exposed organisms. Later changes in hydrostatic pressure or temperature may result in reduced gas solubility and spontaneous bubble formation within soft tissues of fish and other aquatic organisms.

7.1 ODEQ Standard

The relevant standard is set forth in OAR 340-041-0031 and requires that waters shall be free from dissolved gases, such as carbon dioxide or hydrogen sulfide, in quantities that cause objectionable odors, are deleterious to aquatic life, navigation, recreation, or other reasonable uses. This criterion also requires that except when stream flow exceeds the ten-year, seven-day average flood, the concentration of total dissolved gas relative to atmospheric pressure at the point of sample collection may not exceed 110 percent of saturation (i.e., $100+\Delta P/BP < 110\%$). In hatchery-receiving waters and other waters of less than two feet in depth, the concentration of total dissolved gas relative to atmospheric pressure at the point of sample collection may not exceed 105 percent of saturation.

7.2 Application to the Carmen Smith Project

Because monitoring conducted during 2004-2005 (Stillwater Sciences 2006) indicated operation of the Carmen power plant contributes to elevated TDG over a broad range of generation levels, Conditions 8(a)(1) through 8(a)(3) of the CWA 401 Certification includes operational tests to be conducted within three months of startup following planned replacement of the turbine runners, with TDG monitoring conducted in the Carmen Powerhouse tailrace, and supplemental locations in Trail Bridge Reservoir (Table 2-1). Although the Trail Bridge powerhouse will not be operated

under the new FERC license, because no TDG data has been previously collected during operation of the trap and haul facility and modified Trail Bridge Dam spillway or downstream of the Upper Carmen or Smith Bypass release structures, TDG monitoring is also required at these locations in accordance with Condition 8(a)(2) and 8(a)(4) of the CWA 401 Certification, respectively.

Monitoring results will be used to demonstrate that Project operations will meet applicable water quality standards in the Carmen Powerhouse Tailrace, downstream of Carmen and Trail Bridge powerhouses, and downstream of release structures in the Upper Carmen and Smith Bypass reaches.

The Project is required to achieve TDG < 110 percent of saturation at baseflow in the following locations:

- Upper Carmen Bypass Reach;
- Carmen Powerhouse Tailrace;
- Smith Bypass Reach; and
- McKenzie River downstream of Trail Bridge Dam.

7.3 Monitoring Methods

In accordance with Condition 8) of the CWA 401 Certification and after consulting ODEQ, EWEB shall conduct event based TDG monitoring in the Carmen Powerhouse tailrace (Condition 8(a)(1)); below the Carmen and Trail Bridge powerhouse tailraces (Condition 8(a)(2)); below the discharge outfall of the Carmen powerhouse bypass valve (Condition 8(a)(3)); below each outfall of flow release structures in Project bypass reaches (Condition 8(a)(4)); and downstream of Trail Bridge Dam (Condition 8(a)(5)). EWEB shall consult with ODEQ and communicate planned field procedures at least two weeks prior to conducting event based TDG monitoring. Monitoring shall be conducted using continuously logging instruments using differential gas pressure sensors (e.g., Common Sensing, Inc., Hydrolab OTT Hydromet Corp., In Situ Inc.) based upon the direct-sensing membrane diffusion method described in Standard Method 2810B (Table 2-2).

Sensors will be calibrated in air prior to use with post-calibration pressures checked against National Institute of Standards and Technology (NIST) traceable barometer before and after field deployment (See Section 8.2.1.5). The manufacturer's instruction manual will be consulted for specific procedures regarding their calibration, maintenance, and use.

In accordance with Condition 8(a)(1) through 8(a)(3) of the CWA 401 Certification, operational tests of the Carmen Powerhouse shall be conducted within three months of startup following replacement of the turbine runners. TDG shall be monitored continuously for a minimum of 72 hours and shall be of sufficient duration to allow monitoring over three complete generation cycles at each Carmen unit over a range of power generation levels. EWEB shall also record flow and power generation at each Carmen unit, including a maximum of at least 90 percent of the rated name plate capacity of the operating unit. EWEB shall also reserve a portion of each generation level tested to measure the influence of the air admission system on TDG in the powerhouse tailrace.

In accordance with Condition 8(a)(4) of the CWA 401 Certification, EWEB shall conduct event-based monitoring of TDG downstream of the discharge outfall of the Carmen powerhouse bypass valve during pre-operational tests. TDG measurements shall be initiated one hour prior to

commencing the test and continue for six hours after opening the valve or completing the test, whichever comes first.

In accordance with Condition 8(a)(4) of the CWA 401 Certification, EWEB shall conduct event-based monitoring of TDG in the vicinity of newly constructed release structures in the Project bypass reaches. Within three months of establishing block releases to the Smith and Upper Carmen Bypass Reaches, EWEB shall measure total dissolved gas below each outfall as follows:

- Upper Carmen Bypass: measure total dissolved gas and water flow for 72 hours.
- Smith Bypass: measure total dissolved gas and water flow for 72 hours between August 16 and October 31, and between November 1 and August 15.

Lastly, in accordance with Condition 8(a)(5) of the CWA 401 Certification, EWEB shall conduct event-based monitoring of TDG at locations immediately downstream of Trail Bridge Dam within three months of beginning operation of the trap and haul facility and modified spillway. Monitoring shall be conducted in the vicinity of the trap and haul facility inlet for a minimum of 72 hours. As stated above, because designs have not yet been completed for these facilities, final monitoring locations shall be determined in consultation with ODEQ.

In addition to completion of pre- and post-sampling calibration sheets, QA/QC procedures and contingencies to address inoperable or malfunctioning equipment shall be carried out as described in Section 8.

7.4 Assessment and Adaptive Management

Depending upon the timing of the planned turbine runner replacement and other changes at the Carmen Powerhouse, construction of release structures in Project Bypass reaches, as well as construction of the modified spillway and trap and haul facility downstream of Trail Bridge Dam, EWEB shall conduct event based TDG monitoring in one or more years. Following completion of testing, field data will be reviewed to ensure QA/QC procedures and data quality objectives have been met (see Section 8.1). Validated field data will be compared to ODEQ criteria (Section 7.1) with data transmitted to ODEQ within three months of completing the required monitoring and results included in annual reports to ODEQ (See Section 9).

In accordance with Condition 8 c) of the CWA 401 Certification, if monitoring identifies TDG measurements in excess of the numeric criterion, ODEQ may require EWEB to submit a report analyzing the situation, or may require additional monitoring, or may require EWEB to prepare and submit to ODEQ an operations plan which shall propose corrective measures to attain the total dissolved gas criteria in affected areas. Upon ODEQ approval, EWEB shall submit the plan to FERC for approval. Upon FERC approval, EWEB shall implement the plan.

8 QUALITY ASSURANCE AND QUALITY CONTROL

Although the CWA 401 Certification did not require submission and ODEQ approval of a separate Quality Assurance Project Plan (QAPP), this section has been developed to describe the quality assurance methodology and data validation procedures required under Condition 1(f) of the CWA 401 Certification.

8.1 Data Quality

The Quality Assurance/Quality Control objectives for data collected under this WQMP is to produce data that represent, as closely as possible, *in situ* conditions of the McKenzie and Smith Rivers within the Carmen Smith Project (FERC No. 2242) boundary and to provide reasonable assurance to ODEQ that Project operations will not cause or contribute to a violation of water quality standards. Procedures for sampling, chain of custody, instrument calibration, and corrective action are described in other sections of this document. Specific quality objectives for this study are described in the sections below.

8.1.1 Data quality objectives

Data quality objectives are qualitative and quantitative statements that specify the quality of data required to support a specific environmental decision or action. To achieve the objectives of this study, the following data quality objectives have been defined:

- Ensure that all samples are representative of water quality in the study area at the time of the study.
- Ensure that samples collected are of sufficient detail (i.e. spatial and temporal variability) to characterize the water quality in the study area.
- Ensure that *in situ* water quality measurements are accurate (based on measurement performance criteria) and are performed using standard methods.
- Ensure that water quality data produced are accurate (based on measurement performance criteria) and based on proven and accepted sampling and analytical methods.

8.1.2 Measurement performance criteria

To meet data quality objectives for the CWA 401 Certification, accepted sampling and analysis procedures will be used to provide data of known quality in terms of precision, accuracy, and bias. In order to meet the quality objectives, the data must be (1) of known quantitative statistical significance in terms of precision and accuracy; (2) representative of the actual site in terms of physical and chemical conditions; (3) complete to the extent that necessary conclusions may be reached; and (4) comparable to previous and subsequent data collected under this WQMP.

8.1.2.1 Precision and Accuracy

Sampling QA/QC and data reporting will follow ODEQ requirements for minimum data acceptance and Data Quality Level A for precision and accuracy as defined by the ODEQ field Data Quality Matrix Version 5.0, unless noted otherwise. Table 8-1 includes accuracy and precision targets for parameters in this WQMP. Accuracy is an expression of the degree to which a measured or computed value represents the true value. Accuracy is controlled by adherence to sample collection procedures (i.e., approved sampling methodology) as well as instrument calibrations at standard conditions (e.g., DO in saturated air) or with standard solutions (e.g., pH, turbidity). Precision measures the reproducibility of measurements under a given set of conditions.

Table 8-1. Accuracy and precision objectives.

Parameter	Equipment and Measurement Range	Calibration	Accuracy	Precision
Dissolved Oxygen (DO)	Luminescent sensor: ≤ 0.1 to 20 mg/l	Accuracy checked to saturated (100% RH) air	≤ + 0.4 mg/L > - 0.3 mg/L	≤ ± 0.3 mg/l
pH	pH electrode: 0 to 14 s.u.	Accuracy checked to standard solutions	≤ ± 0.2 s.u.	≤ ± 0.3 s.u.
Temperature	Thermistor/ Thermometer: -5 to 35 °C	Accuracy checked with NIST standards	≤ ± 0.5 °C	≤ ± 0.5 °C
Turbidity[1]	Nephelometric sensor: ≤ 1 to 1,000 NTU	Accuracy checked to standard solutions	≤ ± 10% of Std. Value	± 20% relative percent difference (± 3 NTU if NTU < 20 NTU)
Total Dissolved Gas (TDG)[2]	Membrane diffusion pressure sensor: Approx. 400 to 1,400 mm Hg	Calibrated pressure sensor/probe	≤ ± 5 mm Hg	≤ ± 5 mm Hg
Barometric Pressure[2]	Digital Barometer	Accuracy checked with NIST standards	≤ ± 1 mm Hg	≤ ± 1 mm Hg

[1] Accuracy and Precision objectives apply to Turbidity measurements in both Nephelometric Turbidity Units (NTU) as well as Formazin Nephelometric Units (FNU).

[2] Parameter not included in the ODEQ field Data Quality Matrix Version 5.0

Accuracy of thermistors and thermometers will be verified against a NIST traceable thermometer. For *in situ* water quality monitoring, including DO, pH, and turbidity, accuracy of the field multi-parameter instrument will be verified by pre-deployment or pre-field calibrations, as well as at the end of each monitoring day. Accuracy of unattended equipment will be verified using post-deployment calibration checks conducted at the end of each sampling day or upon retrieval of unattended deployments.

Although data precision from multi-parameter instruments is controlled by the sensor and conditioning circuitry used by each manufacturer, duplicate field measurements will be collected for all parameters in the lab or using a grab sample (bucket) collected at one site during monthly spot checks and field audits. Prior to continuous deployments of multi-parameter instruments, duplicate measurements will be collected continuously for a period of 8–24 hours to ensure that precision objectives (Table 8-1) are met. Precision will be estimated as the absolute value of the difference of the primary and duplicate measurement ($|x - y|$), with relative percent difference calculated as this difference divided by the average of the same two results. Precision of TDG instruments shall also be indicated by agreement among the simultaneous results from two or more instruments, either in a laboratory or field setting.

Accuracy and precision estimates falling outside of the objectives in Table 8-1 will be rectified by recalibrating instrumentation and by repeating measurements if necessary. All data associated with accuracy and precision estimates remaining outside the objectives will be flagged and reported to ODEQ with the appropriate data quality flag as described in the ODEQ field Data Quality Matrix (Section 8.3.2).

8.1.2.2 Representativeness

Representativeness expresses the degree to which data represent the true environmental condition. For this WQMP, representativeness is dependent upon monitoring design developed to provide data that are representative of the Project area and ensuring that sampling protocols are followed, as discussed in other sections of this document.

8.1.2.3 Comparability

Comparability expresses the confidence with which one data set can be evaluated in relation to another data set. Comparability is established through the sampling of parameters of concern relevant to state water quality standards, using standard methods (Table 2-2), as well as through use of common NIST or other traceable calibration and reference materials.

8.1.2.4 Completeness

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. Events that may result in a reduction in measurement completeness include inaccessibility to a sampling location, sampling equipment breakage or malfunction, as well as errors by sampling personnel.

The completeness criterion for all field measurements under this WQMP is 95 percent. That is, 95 percent of the planned data collection is accomplished, and the resulting data is accepted for analysis. Re-sampling may be required if the completeness criteria is not met for a specific field activity.

8.1.3 Project team organization

Upon approval by ODEQ and FERC, EWEB will implement this WQMP in compliance with the CWA 401 Certification. As the responsible agency, EWEB will oversee implementation of this WQMP in compliance with the CWA 401 Certification. Project personnel and their responsibilities are described in Table 8-2 below:

Table 8-2. WQMP Project Team Organization and areas of responsibility.

Name	Project Role	Responsibility
Jared Rubin or future Manager	Project Manager	Overall management of the WQMP to meet conditions within the CWA 401 Certification. As needed support, including, quality control, analysis, and reporting.
Andrew Janos or future Coordinator	Water Quality Coordinator	Coordination and as needed field sampling collection; quality control data review, analysis, and reporting.
Contract Staff	Water Quality Specialist	As needed field sampling; equipment calibration; data review, analysis, and evaluation; quality control; preparation of reports.

8.1.4 Training and certification

Proper training is critical to ensure representative data is collected, potential contamination is minimized, and conformance to all QA/QC procedures is documented. All personnel performing work will have sufficient academic training, field skills, and experience to complete the WQMP tasks to ensure that data collected meets the QA/QC requirements described in this WQMP. Field training shall include familiarization of monitoring methods and equipment. Field staff will be accompanied by experienced staff until they gain familiarity with sampling procedures. All

EWEB field staff and contractors will receive CPR/First Aid and other specialized training to ensure occupational health and safety in riverine settings where sampling will take place. A field safety plan shall be maintained that includes operations and emergency contact information, access and evacuation routes, as well as directions and contacts for the nearest emergency medical care facility.

8.2 Data Generation and Acquisition

In accordance with monitoring and reporting requirements listed in Conditions 2 through 8 of the CWA 401 Certification, EWEB shall monitor stream discharge, DO, pH, water temperature, turbidity, and total dissolved gas at the timing and frequencies shown in for locations in the Project Bypass reaches as well as downstream of powerhouse discharges. Using the standardized methods and data quality objectives listed in Table 2-2 and Table 8-1, respectively, field monitoring will be based upon the USGS National Field Manual, current ODEQ (2009) Mode of Operation Manual, as well as monitoring equipment manufacturer procedures.

8.2.1 Equipment calibration, deployment, maintenance, and data collection methods

To ensure all monitoring data collected is representative of *in situ* conditions in the Project area, all equipment shall be maintained, calibrated, deployed, and operated in a manner consistent with manufacturer recommendations and standard methods described in this WQMP. The following sections summarize the equipment calibration and maintenance methods employed, by parameter.

8.2.1.1 Dissolved oxygen

DO monitoring shall be conducted at the locations shown in Table 2-1 using the methods described in Section 3.3. The manufacturer's instruction manual will be consulted for specific procedures regarding their calibration, maintenance, and use. In addition to regular maintenance of sensor caps/membranes, because oxygen solubility is affected by temperature and pressure, the accuracy of the temperature and pressure sensors shall be checked against NIST traceable barometers and thermometer/ thermistor in a laboratory setting, no less than annually.

DO calibrations shall be as described by USGS (Rounds et al 2013). In general, calibrations will be performed in the field to ensure operating temperatures and pressures are as close as possible to those of the sample media. Primary field calibrations shall be by the water-saturated air method, with the probes placed in a 100% relative humidity environment and the temperature and DO readings allowed to equilibrate. Calibration shall be checked against standard solubility charts for the pressure and temperature readings observed, with the calibration repeated if the accuracy requirements in Table 8-1 are not met. Post-deployment calibration checks shall be performed in the field as described above. All calibration results shall be recorded on standard forms for inclusion in annual reports.

8.2.1.2 Hydrogen ion concentration (pH)

pH monitoring shall be conducted at the locations shown in Table 2-1 using the methods described in Section 4.3. The manufacturer's instruction manual will be consulted for specific procedures regarding their calibration, maintenance, and use. In addition to periodic replacement of pH sensors–because pH is affected by temperature, the accuracy of the temperature sensors shall be checked against a NIST traceable thermometer/ thermistor in a laboratory setting no less than annually.

pH calibrations shall use a two-point method (pH 7.0 and 10.0), as described by USGS (Ritz and Collins. 2008), using low ionic strength buffers. If pH values are expected to be less than 7 based upon past field measurements, then the standard pH 7.0 and pH 4.0 buffers will be used. Calibrations shall be conducted in the field observing extended times for equilibration in low ionic strength waters. Calibration shall be checked against the buffer certificate and repeated as necessary if the accuracy requirements in Table 8-1 are not met. Post-deployment calibration checks shall be performed in the field as described above. All calibration results shall be recorded on standard forms for inclusion in annual reports.

8.2.1.3 Temperature

Water temperature monitoring shall be conducted at the locations shown in Table 2-1 using the methods described in Section 5.3. The manufacturer's instruction manual will be consulted for specific procedures regarding their calibration, maintenance, and use.

Although thermometers/thermistors are not able to be calibrated outside of a factory setting, the accuracy of the field thermometers and thermographs will be verified by two-point calibration checks in ice (0ºC) and room temperature (~20ºC) water baths as described by USGS (Wilde 2006). The accuracy of the field thermometers and thermographs will be verified by comparison of the equipment readings and a NIST certified reference thermometer/thermograph. This comparison will be made prior to and after logger deployment, and at a minimum of annually for continuously deployed equipment. If a thermograph's reading varies by more than ±0.5°C from the NIST traceable thermometer, it will be replaced with an equivalent unit meeting the accuracy and precision standards in this WQMP (Table 8-1). The accuracy of the temperature sensors included in multi-parameter instruments shall be checked against a NIST traceable thermometer/ thermistor in a laboratory setting, no less than annually. EWEB shall perform field audits of all temperature recording devices no less than annually during the monitoring period.

8.2.1.4 Turbidity

Turbidity monitoring shall be conducted at the locations shown in Table 2-1 using the methods described in Section 6.3. The manufacturer's instruction manual will be consulted for specific procedures regarding their calibration, maintenance, and use.

Although portable turbidimeters are factory calibrated with formazin primary standards, two-point turbidity calibrations shall be conducted for turbidimeter and multi-parameter sondes as described by USGS (Andersen 2008) using stabilized formazin standards or equivalent secondary standards (e.g., gel or polymer based) in a laboratory setting. If turbidity readings do not meet the accuracy requirements in Table 8-1 the calibration will be repeated. Post-deployment calibration checks shall be performed in the laboratory as described above. All calibration results shall be recorded on standard forms for inclusion in annual reports.

8.2.1.5 Total dissolved gas

Total dissolved gas (TDG) monitoring shall be conducted at the locations shown in Table 2-1 using the methods described in Section 7.3. The manufacturer's instruction manual will be consulted for specific procedures regarding their calibration, maintenance, and use.

Sensors will be calibrated in air prior to use with post-calibration pressures checked against NIST traceable barometer before and after field deployment. If the pressure sensor reading varies by more than ±5.0 mm Hg from the NIST traceable barometer, the sensor will be replaced with an equivalent unit meeting the accuracy and precision standards in this WQMP (Table 8-1).

To allow comparison to measurement performance criteria (8.1.2) and ensure data collection is completed as planned (Section 8.2.2), a second monitoring instrument will be calibrated for QA/QC comparisons as well as for any spot checks that may be required. Post-deployment calibration checks shall be performed in the laboratory, as described above. All calibration results shall be recorded on standard forms for inclusion in annual reports.

8.2.1.6 Stream discharge and water temperature data from USGS gauges

Stream discharge and other data recorded at local USGS gauge sites will be collected using methods described in the National Field Manual (USGS, *various*) and maintained by USGS staff. For the purposes of this WQMP, and unless noted otherwise, all data retrieved from USGS will be assumed to be of sufficient quality to use when analyzing compliance with requirements of the CWA 401 Certification.

8.2.2 Contingency plan for inoperable or malfunctioning equipment

To ensure data collected as part of this WQMP consistently meets measurement performance criteria (Section 8.1.2), equipment maintenance and diagnostic procedures will be observed at the frequencies recommended by the manufacturer. To address unexpected equipment or sensor failure contingencies, operational and pre-sampling calibration checks will be conducted prior to sampling, with a second instrument to be used if the primary instrument fails these checks. Consumable supplies such as pH and turbidity standards, as well as critical spare parts, will be kept on hand to avoid delays and reduce downtime. Post-sampling calibration checks will be reviewed in the field, with field data collection repeated using recalibrated or alternate equipment if the primary sampling equipment does not pass post-calibration checks. The following contingencies are anticipated, by parameter.

Dissolved Oxygen – DO will be monitored using optical sensors included with multi-parameter sondes used during monthly spot checks, as well as during continuous seasonal water quality monitoring events. To ensure data collection achieves the completeness objectives included in this WQMP, a second (redundant) multi-parameter sonde will be available for deployment in the event of failure of the primary instrument.

pH – pH will be monitored using a standard ion selective electrode (ISE) or pH probe included with multi-parameter sondes used during monthly spot checks, as well as during continuous seasonal water quality monitoring events. To ensure data collection achieves the completeness objectives included in this WQMP, a second (redundant) multi-parameter sonde will be available for deployment in the event of failure of the primary instrument.

Temperature – Temperature will be monitored continuously using self-contained thermographs, as well as using temperature probes included as part of multi-parameter monitoring equipment used during monthly spot checks and during continuous seasonal water quality monitoring events. To ensure a continuous data record is collected meeting the completeness objectives in this WQMP, a second, redundant, thermograph will be deployed at all locations. In addition, routine queries of real time temperature data collected at USGS locations will be made to ensure data is being collected as expected. In the event of equipment failure, EWEB shall notify USGS of the problem and conduct a field visit to ensure that redundant thermograph data collection is being conducted.

Turbidity – Turbidity will be monitored using a cuvette style nephelometric turbidimeter, as well as using a side scatter optical sensor included with multi-parameter sondes used during monthly

spot checks and during continuous seasonal water quality monitoring events. To ensure data collection achieves the completeness objectives included in this WQMP, a second (redundant) turbidimeter or sonde sensor will be available for use in the event of failure of the primary instrument. In the event of multiple failures, a grab sample will be collected for laboratory determination of turbidity.

Total Dissolved Gas – TDG will be monitored using field deployed differential gas pressure sensors within standalone instruments as well as with multi-parameter monitoring equipment used during continuous seasonal water quality monitoring events. To ensure data collection achieves the completeness objectives included in this WQMP, a second (redundant) sensor and multi-parameter sonde will be available for deployment in the event of failure of the primary instrument.

8.2.3 Field Audit Schedule and Actions

For the first two years of monitoring under this WQMP, EWEB will perform a field audit using an independent observer to monitor and audit all field activities, including equipment set up, calibrations, deployment, retrieval, data downloads, as well as safety procedures. The auditor will focus on ensuring that all procedures in this WQMP are followed and any corrective actions are documented. The auditor will provide a brief written statement of their observations for inclusion in annual reports, including any deviations from the WQMP and whether the WQMP and/or field procedure should be changed.

The project manager will be responsible for ensuring that if needed, any corrective actions will meet ODEQ approval, and that each corrective action is implemented. A subsequent audit may be required beyond the initial two years proposed to ensure that the change has been successfully implemented.

8.3 Data Validation and Management

The following sections describes validation procedures, documentation, and tracking of monitoring data collected as part of this WQMP.

8.3.1 Quality assurance Project plan distribution and control

Although no formal QAPP is required by the CWA 401 Certification, the Water Quality Specialist shall be responsible for WQMP distribution to sampling staff, including a sign-off sheet to verify that all staff performing work have reviewed monitoring methods and QA procedures. Corrective actions necessitating changes to monitoring methods and QA procedures shall be documented in annual reports. A complete copy of the approved WQMP and any revisions will be maintained in the project file.

8.3.2 Data Management, validation, and reporting

All data collected as part of this WQMP shall be entered into a spreadsheet or database format by the Water Quality Specialist. Data will include continuously logged and recorded discharge and water temperature data, continuously logged water temperature data, continuously logged data from seasonal and event-based monitoring, as well as any water quality data from monthly spot checks at monitoring sites (Table 2-1). Other water temperature data will be downloaded monthly between March 15 and November 15 either by replacement of the in-service unit with a unit passing pre-calibration checks (Section 8.2.1.3) and later download, or by downloading in the

field using a handheld data storage device. Data from continuously recording multi-parameter instruments will be downloaded in the field to verify data file integrity and for later transfer into spreadsheet format. To ensure no data loss, field data from monthly spot checks will also be transcribed onto data sheets in the field for later data entry if any data loss from handheld data storage devices occurs. Any discrepancies between logged data and hand-entered data shall be noted on the field data sheets or field notebook, if used.

In addition to ensuring all calibration and field data collection activities are documented, data validation includes data review, as well as comparisons to completeness, accuracy and precision criteria for this WQMP (Table 8-1). Data reviews will be conducted to identify any data gaps in continuous data, visual inspection to ensure reasonable data values or ranges were recorded, as well as identification of results that were unexpectedly higher or lower than spot check samples. All data will be provided with appropriate qualifiers corresponding to the ODEQ Data Quality Matrix Version 5.0 (i.e., Data quality "A" through "F"). Data not meeting ODEQ data quality "A" or "B" criteria shall not be counted towards completeness goals or used for assessment of compliance with applicable water quality criteria. If necessary, additional monitoring may be conducted outside of planned schedule or in additional locations to replace missing or lower quality data not meeting minimum ODEQ acceptance criteria.

Data reporting will be completed after the data entry, data review, and data validation steps described above have been completed. Data reports shall include dates and periods sampled by parameter, as well as ODEQ data quality qualifiers described above.

8.3.3 Project documentation and records

The water quality specialist will be responsible for project documentation of monitoring and QA activities, as well as maintenance of project data in electronic (e.g., spreadsheet, database, scans of data sheets) and written form. Sample collection records include maintenance and calibration sheets, field data sheets, and supplemental QC checks (audits). Field data will include time, date, individual present, field conditions, activities performed, locations and identification numbers of equipment used, descriptions of any field access or safety issues, and documentation of equipment failures. Corrections to erroneous data on data sheets or any field notebooks will be made by crossing a line through the entry, entry of the correct information with initials, as well as notes describing the reason for the change.

9 REPORTING

As required by the CWA 401 Certification, annual reports shall be prepared throughout the period of the FERC license for the Project, and shall include records of instream flows and water temperatures (see Conditions 2a and 6b; AMP Section 4.2) and the results of water quality monitoring at all locations (Table 2-1) during each water year (October 1 to September 30). To allow timely interpretation of water quality monitoring results, provisional instream flow and water temperature data from USGS gage sites shall be downloaded and provided with the annual WQMP reports, in addition to separate reporting pursuant to the AMP (see AMP Section 4.2). The WQMP may present graphical summaries of instream flows. Results of monthly spot checks, continuous water quality data from seasonal (DO, pH, temperature, turbidity) monitoring, as well as event-based monitoring for TDG[8] shall also be included in the annual report, which will be

[8] Note EWEB shall also submit total dissolved gas monitoring data to ODEQ within three months of completing monitoring requirements described in Section 7 of this WQMP, unless expressly authorized otherwise by ODEQ.

submitted to ODEQ by December 31 for the preceding water year unless expressly authorized otherwise by ODEQ.

The annual report generally will include the results of all monitoring activities and QA/QC procedures, as well as any recommendation for follow-up actions to be discussed with ODEQ. At a minimum, annual reports shall include:

a) Narrative summary of monitoring activities and QA/QC procedures including dates and periods sampled by parameter, results of field audits and measurement performance criteria, as well as rationale for any data qualifiers in the reported data.
b) Validation information including percent data capture from continuous recording instruments and documentation of adaptive measures undertaken.
c) Summaries of validated monitoring data by parameter (instream flow, DO, pH, water temperature, turbidity, and total dissolved gas) in tabular and/or graphical form.
d) Narrative interpretation of results, including comparisons with applicable water quality standards, and a discussion of the results in the context of historical trends, seasonal conditions, and Project actions.
e) Electronic scans of instrument maintenance logs, calibration sheets, field data sheets, and any field notebook(s), if used.
f) Electronic data deliverables of all continuously recorded data provided in spreadsheet or database format.

The annual report shall present and interpret all data from the preceding water year. Data may be presented graphically, in tabular form, or using other means to illustrate monitoring objectives and compliance. Monthly spot samples will be assessed and reported in the context of both the continuous water temperature and flow data and seasonal diel survey results. The annual report shall compare data from the preceding water year with applicable criteria and present the results in the context of recent historical results and longer-term trends. The report shall include a discussion of actions implemented by EWEB pursuant to license requirements and any adaptive management action taken for attainment of State water quality standards. The annual report may recommend changes to the monitoring schedule based on an interpretation of current and historical monitoring data, subject to ODEQ's authorization.

Unless addressed in a separate report requested by ODEQ, the Annual Monitoring Report may include a request for ODEQ to consider approval of alternative or additional measures to address any identified violations of water quality standards. Following ODEQ review, EWEB shall incorporate any alternative or additional measures that will provide reasonable assurance that the proposed action will not cause or contribute to a violation of water quality standards. Additionally, following implementation of minimum instream flows and five years of monitoring (Section 4.2 of the AMP and Condition 2(a) of the CWA 401 Certification), the Annual Monitoring Report may include a request to reduce or cease monitoring of one or more water quality parameters. Such a request shall be considered if monitoring data demonstrates that the Project is not causing a violation of Oregon's relevant water quality standard and is not reducing support for existing and designated beneficial uses (see Sections 3 to 8 of this WQMP).

10 OTHER CWA 401 CERTIFICATION REQUIREMENTS

In addition to the water quality monitoring conditions set forth in Sections 1 through 7 above, the CWA 401 Certification includes a number of conditions to ensure protection of beneficial uses, such as conditions for Bacteria and Bacteria Pollution (Condition 9) and measures addressing Toxic Substances; Solid Waste Management; and Spill Response (Condition 10). Additionally,

Condition 11 includes requirements for obtaining agency approvals prior to implementation of measures under the CWA 401 Certification (Conditions 11a), conditions requiring potential changes to the CWA 401 Certification (Conditions 11b and 11c), required notifications and approvals required for Project modifications, maintenance and repair activities not previously authorized by the new FERC License (Conditions 11d and 11e), as well as conditions allowing ODEQ access as necessary to monitor compliance with the CWA 401 Certification (Condition 11f). Lastly, to allow agency oversight of the implementation of the CWA 401 Certification and unless extended administratively under ORS 543.080, Condition 12 includes annual payments with prorations to be made to ODEQ and Oregon Department of Fish and Wildlife (ODFW) for periods of 11 years and 15 years, respectively, from July 1, 2019 (i.e., year 1 of the new FERC License issued May 1, 2019). Annual fees may be terminated earlier by either ODEQ or ODFW if completed measures or Project monitoring demonstrates that oversight is no longer necessary.

11 LITERATURE CITED

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