

BEFORE THE UNITED STATES DEPARTMENT OF ENERGY

Federal Power Act Section 202(c))
Emergency Order: Transalta)
Centralia Generation LLC)
_____)

Order No. 202-25-11

Motion to Intervene, Motion for Clarification, and Requests for Rehearing and Stay
of Sierra Club, NW Energy Coalition, Washington Conservation Action, Climate
Solutions, Public Citizen, and Environmental Defense Fund
(collectively, “Public Interest Organizations” or “PIOs”)

Exhibit 1-131:
Southwest Clean Air Agency Basis Statement for TransAlta 2021 Title V Air
Operating Permit

**TransAlta Centralia Generation, LLC
Centralia Plant**

Title V Basis Statement

September 22, 2021

Southwest Clean Air Agency
11815 NE 99th Street, Suite 1294
Vancouver, WA 98682-2322
Telephone: (360) 574-3058

PERMIT No.: SW98-8-R5-A

PREPARED FOR: TransAlta Centralia Generation, LLC
Centralia Plant
913 Big Hanaford Road
Centralia, WA 98531

PLANT SITE: Centralia Plant
913 Big Hanaford Road
Centralia, WA 98531

PERMIT ENGINEER: Clinton H. Lamoreaux, Air Quality Engineer

REVIEWED BY: Paul T. Mairose, Chief Engineer

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I. GENERAL INFORMATION AND CERTIFICATION

1. Company Name: TransAlta Centralia Generation, LLC
2. Facility Name: Centralia Plant
3. Contact Person: Mickey Dreher, Plant Manger
4. Inspection Contact Person: David Raastad, Manager EH&S
5. Unified Business Identification Number: 601-985-591
6. SIC Number: 4911

7. Basis for Title V Applicability:

The Centralia Steam Electric Generating Plant has the potential to emit more than 100 tons per year of sulfur dioxide, nitrogen oxides, particulate matter with an aerodynamic diameter less than 10 microns, particulate matter with an aerodynamic diameter less than 2.5 microns, and carbon monoxide which are criteria air pollutants listed under section 302 of the Federal Clean Air Act, more than 100 tons per year of volatile organic compounds (VOCs), and the potential to emit more than 25 tons per year of all hazardous air pollutant (HAP) emissions combined, which are listed under Section 112 of the Clean Air Act.

Facilitywide Potential To Emit Summary (not including nonroad engines)

Pollutant	Potential Emissions (tons per year)
Nitrogen oxides	6,760
Carbon monoxide	8,044
Volatile organic compounds	87
Sulfur dioxide	5,917
Particulate Matter	1,929
PM ₁₀	1,467
PM _{2.5}	1,386
Combined HAPs	53
Individual HAP	28 (HF)
CO ₂ equivalent	8,081,792

8. Current Permitting Action:

This Title V Air Operating Permit is being re-issued to incorporate revisions to 40 CFR 63 Subpart UUUUU "National Emission Standards for Hazardous Air Pollutants: Coal and Oil-fired Electric Utility Steam Generating Units" and the latest revision to BART Order 6426. In addition, units that were removed from service with the shutdown of Unit 1 have been removed, regulatory date citations have been updated, the permit format has been modified, minor typographical errors have been corrected and the word "shall" has been removed or replaced in each instance to improve clarity.

9. Attainment Area:

The Centralia Plant is located in an area that is in attainment or unclassifiable for all criteria pollutants.

10. Facility Description:

Coal Plant

The Centralia Coal Plant generates electric energy from a steam driven turbine. Pulverized coal is combusted in a single boiler to create heat that generates pressurized steam used in the turbine. Until December 31, 2020 when "Unit 1" retired, the facility utilized two coal-fired boilers, therefore permits and historical references will frequently refer to two boilers (Unit 1 and Unit 2). Combustion of coal produces emissions of sulfur dioxide (SO₂), oxides of nitrogen (NO_x), particulate matter (PM), carbon monoxide (CO), volatile organic compounds (VOCs), and certain hazardous air pollutants (HAPs) in sufficient quantities to designate the facility as a Title V source of air pollutants.

Until May 4, 2000, PacifiCorp owned the largest share of the Centralia Plant and operated the facility on behalf of all eight utility owners. As of May 4, 2000, TransAlta Centralia Generation, LLC took over ownership of the plant. The plant consists of one 670 net MW unit identified as Unit 2 (Acid Rain Program designation BW22) which is the source of nearly all emissions released from the facility. An auxiliary boiler is used to provide steam for starting the main coal-fired boiler when it is off line. Historically, coal was supplied primarily from the adjacent TransAlta Centralia Mining, LLC (a subsidiary of TransAlta) mine and stacked and reclaimed in the Centralia Plant's coal handling yard. A smaller portion of coal from the Powder River Basin in Wyoming was blended with Centralia coal to meet Btu requirements in the boilers and, potentially, to ensure that the hourly SO₂ emission limit continued to be met. The coal mine ceased active mining operations in November 2006 and currently almost all coal is supplied from the Powder River Basin. Since 2015 a small percentage of coal is supplied coal fines recovered during the reclamation process of the fine coal refuse impoundments formed during the Centralia Mine's coal washing process. The coal mine could conceivably re-open and once again supply coal to the power plant in the future.

Particulate matter from coal combustion is controlled by dual electrostatic precipitators (ESPs) in series. Sulfur dioxide emissions are managed by coal blending and scrubbing of the flue gas. Mercury emissions are controlled by an activated carbon injection system upstream of the second set of ESPs coupled with a sorbent enhancement additive injected into the boiler. The mercury control systems were completed November 24, 2011. NO_x emissions are controlled with low-NO_x burners with coupled over-fire air systems (LNC3) and a selective non-catalytic reduction system (SNCR). The LNC3 controls were installed on Unit 2 in 2001. The SNCR systems were installed on both units in 2012. Emissions of other gaseous pollutants are minimized through good combustion practices. A portion of the fly ash captured in the ESPs is sold and shipped off site while the balance is stockpiled or trucked to the Centralia Mine landfill site. Bottom ash is also sold, stockpiled, or returned to the Centralia Mine landfill site. Additional emission points include the cooling towers, coal storage and handling yard, emergency diesel generators, mist eliminators for turbine lube oil ventilation exhaust, and maintenance activities.

The Centralia Coal Plant's two units can operate continuously 24 hours per day, 7 days per week. One or the other, and occasionally both, of the units are taken off line for maintenance purposes as conditions dictate, for economy, or reserve shut down. The auxiliary boiler operates only as needed, which is typically less than 120 hours per year.

Combustion Turbine Facility

Construction of the combustion turbine project commenced in 2001 and was completed during the summer of 2002. The project was permitted as a major modification to an existing major source. The Combustion Turbine Facility, with the exception of the Black Stop Diesel Generator Engine, was retired effective January 1, 2015. The Black Stop Diesel Generator Engine was retired at the end of 2020.

11. SWCAA Air Discharge Permits and Consent Order(s):

The following table lists each Air Discharge Permit and Consent Order(s) issued for this facility. Permits or Orders in bold contain no active requirements. The requirements may have been superseded, may have been of limited duration, or the equipment may have been removed.

<u>Order/Permit Number</u>	<u>App. No.</u>	<u>Date Issued</u>	<u>Description</u>
69-1107LET	L-1	11-7-69	Approval to construct Units 1 and 2
72-0804LET	N/A	8-4-72	Approval to restart after outage – output not to exceed 300 MW unless approved after PM compliance indicated by testing
72-0914LET	N/A	9-14-72	Approval given for operation at 400 MW
72-1006LET	N/A	10-6-72	Approval given for operation at 500 MW
72-1017LET	N/A	10-17-72	Approval to operate Unit 2 at full load for 48 hour demonstration
72-1102LET	N/A	11-2-72	Approval to operate Unit 1 at same load as Unit 2
72-1211LET2	N/A	12-11-72	Approval given for operation of each unit up to 500 MW, PM not to exceed 0.06 gr/dscf
73-0329LET	L-49	3-29-73	Approval to install SO ₃ conditioning system to aid PM removal in Koppers ESPs
73-0413LET	L-50	4-13-73	Approval to install second set of ESPs as pilot test
73-0426LET	N/A	4-26-73	Regulatory Order requiring testing to provide additional information on SO ₃ conditioning system
73-0504LET	N/A	5-4-73	Required testing and reporting for ESP pilot test program
73-0522LET	N/A	5-22-73	Modified dates and operating conditions specified in 4-4-73 letter
73-0611LET	N/A	6-11-73	Approval to operate Unit 1 at up to 700 MW w/ PM ≤ 0.06 gr/dscf
74-0702LET	L-50R	2-7-74	Approved design and installation of second set of ESPs

<u>Order/Permit Number</u>	<u>App. No.</u>	<u>Date Issued</u>	<u>Description</u>
74-0222LET	N/A	2-22-74	Revision to clarify language in 2-7-74 letter
74-38	N/A	3-25-74	Specifies testing on Unit 2
74-38A	N/A	5-2-74	Extends high load testing days to 30
87-934	N/A	8-26-87	Order of Violation – Exceedance of 1,000 ppm SO ₂ limit, inconsistent with 1969 application, penalties levied, required to sample coal, stack SO ₂ .
87-934-STAY	N/A	9-21-87	Order staying for 18 months requirements for SO ₂ sampling, coal S sampling, and withdrawing Order of Violation 87-934 if compliance with ambient SO _x limits met despite being above 1,000 ppm limits.
88-934	N/A	2-24-88	Order, Withdrawal of Stay, and Modification of Order of Violation - Required to study lime injection, blend and wash coal install continuous SO ₂ and O ₂ emissions monitors, install ambient air quality monitors at three sites near the facility.
88-934B	N/A	7-14-98	Variance and Modification of Order – Modified SO ₂ averaging period, required ambient modeling and collection of meteorological data.
88-934C	N/A	10-24-99	934C Variance Renewal and Modification of Order - extended the variance for weekly instead of hourly averaging of SO ₂ emissions until November 25, 1990, extended the collection of ambient monitoring data through September 30, 1990, and modified the ambient air monitoring provision to require two rather than three sites
90-934D	N/A	11-9-90	Variance Renewal and Modification of Order - extended the variance for weekly instead of hourly averaging of SO ₂ emissions until the earlier of November 25, 1991 or the date on which practicable means for the adequate abatement or control of SO ₂ emissions from the Centralia Plant become known, available, and implementable. The Order required that collection of ambient meteorological monitoring data extend through September 30, 1991, and that the permittee report to SWCAA the results of its dispersion modeling by December 31, 1991.

<u>Order/Permit Number</u>	<u>App. No.</u>	<u>Date Issued</u>	<u>Description</u>
90-934E	N/A	4-5-91	Withdrawal of Petition, Surrender of Variance, and Order - terminated the variance, meteorological monitoring, ambient monitoring, dispersion modeling, and modeling report provisions of SWCAA 90-934D and 88-934.
95-1787	N/A	8-25-95	RACT order limiting SO ₂ emissions to 1.1 lb/MMBtu
96-1872	N/A	3-20-96	Withdraws RACT Order 95-1787. Replaced with a Letter of Agreement between SWCAA and PacifiCorp.
97-2057	N/A	12-8-97	Determination of SO ₂ , NO _x , CO and PM RACT, SO ₂ and NO _x controls
97-2057R1	N/A	2-26-98	Revision of RACT determination
99-2187	N/A	2-1-99	Stay Order extending the date when procurement contract for Unit 1 control technology must be signed by 60 days (new date May 31, 1999).
01-2350	L-480	5-30-01	Minor source permit for combustion turbine project. Does not address PM or NO _x emissions
PSD-01-01	N/A	2-22-02	PSD permit for combustion turbine project – addresses PM and NO _x emissions
01-2403	L-490	2-27-02	Replacement of the Unit 1 and Unit 2 Turbine Lube Oil Mist Eliminators and Replacement of Two Rotary Fly Ash Unloaders With a Single Pug Mill
01-2350R1	L-496	5-6-02	Modification of 01-2350 primarily to increase SO ₂ limit to account for higher sulfur content in natural gas
PSD-01-01 Amendment 1	N/A	1-30-03	Modification of PSD-01-01 to accommodate a larger than originally permitted BHP auxiliary boiler
01-2350R2	L-505	10-15-03	Modification of 01-2350R1 to accommodate a larger than originally permitted BHP auxiliary boiler.
PSD-01-01 Amendment 2	N/A	6-11-04	Modification of PSD-01-01 Amendment 1 to allow use of 40 CFR 75 RATA schedule where 40 CFR 60 schedules had been required.
01-2350R3	L-552	5-12-05	Modification of source testing and RATA frequencies for Combustion Turbine Facility
05-2612	L-556	7-15-05	Expansion of West Coal Unloading Facility with addition of 1 hopper

<u>Order/Permit Number</u>	<u>App. No.</u>	<u>Date Issued</u>	<u>Description</u>
05-2636	L-565	11-23-05	Installation of FGD Bleed Treatment Lime Storage Silo
07-2712	L-590	2-7-07	Modification of West Coal Unloading Facility with surge capacity addition
07-2749	L-603	9-26-07	Installation of East Coal Unloading Facility and modification of requirements for West Coal Unloading Facility. After removal of the West Coal Unloading Facility in 2011, East Coal Unloading Facility simply referred to as the Coal Unloading Facility.
01-2350R4	L-608	1-18-08	Elimination of 1.5 ppmvd @ 15% O ₂ (8-hour average) CO emission limit for BHP Project combustion turbines. The 3.0 ppmvd @ 15% O ₂ (1-hour average) limit was retained.
08-2779	L-613	3-12-08	Replacement of the existing 1,800 cfm cartridge-style Torit baghouse with a larger Donaldson Torit cartridge style baghouse rated at 4,000 cfm in the Journal Shop.
09-2876	L-634	6-16-09	Installation and operation of a 251 horsepower nonroad engine that will drive a Jetstream pressure washer. The engine and pressure washer package will be mounted on a mobile trailer for use throughout the power plant and associated facilities. Because this is a non-road engine, it is not part of the facility's Title V permit.
Order No. 6426	N/A	6-18-10	BART Order from Washington Department of Ecology establishing NO _x emission limit of 0.24 lb/MMBtu for the coal fired boilers and coal quality requirements. EPA approved the SIP submission containing this BART submission in a Federal Register notice dated December 6, 2012.
11-2972	L-647	4-14-11	Installation and operation of an emergency water pump at the (East) CUF powered by a diesel engine. Superseded 07-2749.
11-2984	L-650	6-14-11	Installation of equipment associated with activated carbon injection mercury emission control system.
11-2996	L-654	11-3-11	Installation and operation of the Pump 8 Engine. This permit also addressed the grandfathered engine on Barge 5429. Note that Pump 8 was subsequently referred to as the Pump-05 engine.
First Revision of Order No. 6426	N/A	12-13-11	Revision of BART Order 6426 with new requirements for SNCR.

<u>Order/Permit Number</u>	<u>App. No.</u>	<u>Date Issued</u>	<u>Description</u>
12-3016	L-657	4-30-12	Installation of a baghouse to replace the existing baghouse on the fly ash weigh bin (operated by Lafarge North America), and the relatively new "Fly Ash Bin 11 to Weight Hopper Air Slide Filter" (operated by TransAlta). The new baghouse filters dust from air collected from the fly ash loading spout and air vented to the fly ash bin from the No. 11 Air Slide and the No. 12 Air Slide.
12-3035	L-659	10-18-12	Installation of a new fire pump engine that may also be used to supply water to other systems at the plant during a maintenance event. Superseded 11-2996.
14-3093	L-668	4-30-14	Approval of coal mine waste reprocessing activities and fine coal recovery at TransAlta Centralia Mining and delivery by conveyor to TransAlta Centralia Generation.
16-3188	L-683	6-1-16	Approval of one trailer-mounted water pump driven by a 99 horsepower diesel engine and one Caterpillar emergency generator set powered by a 480 horsepower diesel engine to replace the Unit 2 emergency generator set. Superseded 12-3035.
16-3202	N/A	12-13-16	Regulatory order to limit SO ₂ emissions to protect 1-hour SO ₂ NAAQS.
Second Revision of Order No. 6426	N/A	7-29-20	Revision of BART Order 6426 with lower NO _x limit for one unit and removal of prescriptive SNCR operating requirements.

II. EMISSIONS UNIT DESCRIPTIONS

Summary Table

EU No.	Generating Equipment	Emission Control
EU-1	Unit 1 Boiler (BW21) – 670 MW (net), coal fired (Retired)	N/A (Retired)
EU-2	Unit 2 Boiler (BW22) – 670 MW (net), coal fired	CO: Combustion controls NO _x : Combustion controls, SNCR VOC: Combustion controls PM: Dual ESPs, wet scrubber SO ₂ : Wet scrubber Hg: Sorbent enhancement additive in boiler, carbon injection between ESPs
EU-3	Auxiliary Boiler – 170 MMBtu/hr, oil-fired	Fuel consumption limit
EU-4	Material Handling (Coal Handling, Ash Handling, FGD Bleed Treatment Lime Storage Silo, Limestone Ball Mill)	<u>Coal Handling</u> – minimal emissions, no controls necessary except use of wet suppression at Coal Unloading Facility <u>Ash Handling</u> – baghouse, wet suppression, and enclosure as appropriate <u>FGD Bleed Treatment Lime Storage Silo</u> – Baghouse <u>Limestone Ball Mill</u> – Wet process, full enclosure
EU-5	Turbine Lube Oil Mist Vent 1 (Retired)	N/A (Retired)
EU-6	Turbine Lube Oil Mist Vent 2	Turbine Lube Oil Mist Eliminator 2
EU-7	Black Stop Diesel Generator Engine – 1,445 hp diesel engine (Retired)	N/A (Retired)
EU-8	Journal Shop Welding	Journal Shop Welding Filter
EU-9	Emergency Diesel Generator 1	None
EU-10	Emergency Diesel Generator 2	Ultra-low sulfur fuel, EPA Tier 3 design, operating hours limit
EU-11	Fire Pump Engine (205 hp diesel engine)	Ultra low sulfur fuel, EPA Tier 3 design, operating hours limit
EU-12	Coal Unloading Facility Emergency Diesel Sump Pump Engine (115 hp diesel engine)	Ultra low sulfur fuel, EPA Tier 2 design, operating hours limit
EU-13	SEA System 1	Cartridge-style Fabric Filter
EU-14	SEA System 2	Cartridge-style Fabric Filter
EU-15	Sorbent Silo 1	Cartridge-style Fabric Filter
EU-16	Sorbent Silo 2	Cartridge-style Fabric Filter
EU-17	Fly Ash Bin 11	Baghouse

EU No.	Generating Equipment	Emission Control
EU-18	Fly Ash Bin 12	Baghouse
EU-19	Fly Ash Bin 14	Baghouse
EU-20	Fly Ash Bin 14 Air Slide to Bin 11 Air Slide	Cartridge-style Fabric Filter
EU-21	Fly Ash Bin 14 to 6050 Air Slide	Cartridge-style Fabric Filter
EU-22	Fine Coal Handling	Wet suppression

Detailed Descriptions

EU-1 Unit 1 Boiler (Retired)

EU-1 retired at the end of 2020.

EU-2 Unit 2 Boiler

EU-2 consists of the Unit 2 boiler and its exhaust gas flow path including the 470 ft tall stacks (bypass and scrubber) through which the flue gases are discharged to the ambient air. The Unit 2 boiler is a Combustion Engineering coal-fired steam generator equipped with superheat and reheat that combusts pulverized coal in a divided furnace with tangential injection of pulverized coal and combustion air. The eight corners (four in each half of the split furnace configuration) of the boiler are supplied with fuel and air by eight levels of burners, with each level supplied by one of the eight coal pulverizers. A maximum design capacity of 490 tons per hour of coal can be combusted in the boiler. Typically, full load is attained burning 420 tons per hour of average heat content coal by operating seven of the eight pulverizers at rated capacity. Incidental quantities of on-site generated dangerous waste, used oil and grease may also be burned in the boiler. Combustion produces emissions of SO₂, NO_x, CO, PM, VOCs, and HAPs. Flue gases exit the boiler through heat exchangers and pass first through a Koppers electrostatic precipitator (ESP) with a specific collection area of 383 ft²/1,000 acfm, and then through a Lodge-Cottrell ESP with a specific collection area of 384 ft²/1,000 acfm for removal of particulate matter. The dual ESP system achieves a collection efficiency of 99.7% or better for particulate matter. Final flue gas treatment occurs in a forced oxidation limestone flue gas desulfurization system (wet scrubber) installed in 2001. The original stack has been retained for bypass operations during emergencies, startup, shutdown, and outages of the flue gas desulfurization system.

Mercury emissions are controlled by an activated carbon injection system upstream of the second set of ESPs coupled with a sorbent enhancement additive injected into the boiler. The mercury control system was completed November 24, 2011. NO_x emissions are controlled with "Low-NO_x Combustion, Level 3" (LNC3) controls consisting of Alstom concentric firing, low NO_x burners with close coupled and separated over-fire air. The LNC3 controls were installed in 2001.

The SNCR system was installed in 2012 and consists of Nalco Mobotec's Rotamix SNCR system. The system consists of concentrated urea storage, urea dilution, and three levels of diluted urea injection near the top of the boiler. Each urea injection point utilizes an air atomizing nozzle with annular air to allow the urea to be dispersed into the boiler before

reacting. Each nozzle can be angled approximately 30 degrees upward or downward. The lowest level of injectors is approximately at the 10.5 floor level. Each of the three horizontal levels consists of six injectors spread across the front of the boiler, with four more injectors slightly above the row of six, for a total of 30 injectors. A single air header with a blower supplies ambient air to all of the annular air supplies on the boiler. The air intake for these blowers is inside the top of the boiler building.

Each SNCR blower or pump has a redundant backup to minimize the possibility of a system outage. As the temperature regime changes with changing boiler load, the levels at which the urea is injected is modified accordingly to ensure the proper injection location.

The following individual pieces of equipment are associated with EU-2:

<u>Equipment</u>	<u>Facility Designation</u>
One Boiler for Unit 2	Unit 2 or BW22
Two ESP units in series	Koppers 21 & 22; Lodge-Cottrell 21A & 22A
Unit 2 wet scrubber	FGD 2

Construction of EU-2 officially commenced (for the purposes of 40 CFR 60) with signing of a construction contract on December 23, 1968. EU-2 commenced commercial operation in September 1972.

Applicable NSPS/NESHAP/MACT: 40 CFR 63 Subpart UUUUU

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
NO _x	6,744	Yes/No ¹	Yes	No. Permit requires CEMS.
CO	8,042	No	Yes	No. No emission control equipment and the permit requires CEMS.
VOC	86	No	No	No
SO ₂	5,913	Yes	Yes	No. Permit requires CEMS.
PM ₁₀	1,277	Yes	Yes	Yes. See M20 of Permit.
NH ₃	220	No	Yes	No
HF	28	Yes	No	No

¹ SNCR is available but there is no requirement to use the system and there is little likelihood the system will be used in the future.

EU-3 Auxiliary Boiler

EU-3 consists of the auxiliary boiler which is used to provide auxiliary steam throughout the plant when sufficient auxiliary steam is not available from Unit 2, such as during cold startup. The auxiliary boiler is a Babcock & Wilcox watertube steam boiler (National Board number 23173, Washington State ID number 26415-71W) with a rated capacity of 115,000 lb/hr of steam and 170 MMBtu/hr. It combusts No. 2 fuel oil, also known as distillate grade diesel fuel, to produce steam at 150 psig and 500°F and discharges flue gases through a 5 ft diameter

steel stack 250 ft in height. EU-3 emits NO_x, SO₂, CO, PM, and VOCs from combustion of No. 2 fuel oil.

Construction of EU-3 officially commenced (for the purposes of 40 CFR 60) with signing of a construction contract on December 23, 1968.

Applicable NSPS/NESHAP/MACT: 40 CFR 63 Subpart DDDDD

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
NO _x	6.00	No	No	No
CO	1.50	No	No	No
VOC	0.08	No	No	No
SO ₂	4.26	No	No	No
PM ₁₀	0.99	No	No	No

EU-4 Material Handling

EU-4 consists of all coal handling equipment and operations on the Centralia Plant site, the ash collection and load-out facilities, the FGD Bleed Treatment Lime Storage Silo, and the Limestone Ball Mill. The coal handling equipment receives and stores the coal, reclaims coal from storage piles, and distributes the coal throughout the plant. Historically, coal has been received from the adjacent coal mine and delivered from the Powder River Basin. Most of the coal combusted in the Centralia Plant has been obtained from the adjacent TransAlta Centralia Mining (TCM) mine, which processed coal at its preparation plant and transferred the coal by conveyor to the Centralia Plant. This mine is currently closed. Coal is received by rail car at the Coal Unloading Facility from which it is transferred by conveyor and mobile machinery to storage piles. Note that prior to 2011 there were two Coal Unloading facilities. One located at the West end of the plant site and one located the East end of the plant site. The West Coal Unloading Facility was removed from service in 2011. Except for descriptions in historical context all coal is unloaded at a single point: the Coal Unloading Facility formerly the known as the East Coal Unloading Facility. In 2007 the permittee received an Air Discharge Permit to construct the Coal Unloading Facility. A traveling bucket-wheel stacker-reclaimer transfers yard conveyor transported coal to or from ready storage piles. In addition, a coal blending system installed in 2001 supplies coal to the plant from the ready storage pile. Dust suppression is provided to minimize generation of fugitive dust as coal is transported to the silos and pulverizers.

Fly ash is collected in storage silos and sent off-site via one of two load-out facilities. A portion of the fly ash is sold and loaded into trucks by an off-site contractor who is contractually responsible to the permittee for operation and air quality compliance of these truck-loading facilities at the Plant. Permittee is ultimately responsible for compliance under the Clean Air Act at this facility. The other load out operated by the Plant is used to dispose of fly ash in the TCM mine. Bottom ash is dewatered in settling tanks and loaded while damp into trucks for transport to the TCM mine as backfill or sold for off site use.

The following individual pieces of equipment are associated with EU-4:

<u>Equipment</u>	<u>Facility Designation</u>
Coal Unloading Facility	CUF
Twelve coal conveyors	Conveyors 1-5, 6A, 6B, 7, 11, 12, 21, & 22
One bucket-wheel stacker-reclaimer	Stacker-reclaimer
Coal blending system	
Chemical stabilizing dust suppression systems at CUF and No. 5 reclaim	(N/A)
Four coal silos	Silos 21-28 (Unit 2)
Coal surge bin	(N/A)
Four bottom ash dewatering bins	Bins 11, 12, 21, 22
Various mobile machinery	(N/A)
Four fly ash bins	Bins 11, 12, 13, 14
Bin 11 – Unclassified ash with single UCC model 6050 pin paddle mixer/unloader – 330 tph capacity, installed in 2009	
Bin 12 – Classified ash with single UCC model 6050 pin paddle mixer/unloader – 330 tph capacity, installed in 2009	
Bin 13 – Repurposed as a boron removal clarifier in the FGD Bleed Treatment system	
Bin 14 – Replaced into service in 2011 to handle fly ash from the Lodge-Cottrell that contains carbon sorbent from the mercury control system.	
Fly Ash Weigh Bin Baghouse	Same
FGD Bleed Treatment Lime Storage Silo	Same
Limestone Ball Mill	Same

Coal Unloading Facility Details

The Coal Unloading Facility consists of two below-grade hoppers, each associated with a drag flight conveyor that transfers coal to an interim conveyor that feeds the new radial stacker or feeds directly into the coal blending system. The radial stacker transfers coal to the plant stockpiles. Coal in the coal stockpiles is dozed to the coal blending/plant feed conveyors. The following transfer points are associated with the Coal Unloading Facility:

1. Rail car to below-grade hoppers (2)
2. Below-grade hoppers to apron feeders
3. Apron feeders to Conveyor 8A
4. Conveyor 8A to Conveyor 8B (stacker)
5. Conveyor 8B (stacker) to coal stockpile or Conveyor 8C
6. Conveyor 8C to ground level reclaims 3, 3A
7. Reclaims 3, 3A to Conveyor 4 or 4A (which feed the plant)

The maximum coal unloading rate is 4,000 tons per hour with 5,000 ton per hour surge capacity. The Coal Unloading Facility began operation on February 1, 2008.

FGD Bleed Treatment Lime Storage Silo Details

The FGD Bleed Treatment Lime Storage Silo stores hydrated lime ($\text{Ca}(\text{OH})_2$). The lime is used to treat a bleed stream of scrubber liquid from the flue gas desulfurization system. The scrubber liquid treatment system is designed to reduce boron and zinc levels in the wastewater. The silo is located immediately southeast of the Unit 1 scrubber vessel. The silo is pneumatically loaded from trucks at a rate of approximately 16.7 tons per hour. Specific silo and associated dust collector information is listed below.

Silo Make/Model: USFilter Lime Silo; WHM® Bulk Chemical Storage; Model T-1
 Silo Capacity: 5,600 cubic feet
 Silo Height: 53'1" without dust collector, 58' with dust collector
 Dust Collector Make/Model: C.P. Environmental Filters, Inc. / model 36-CTBFD-009-CM-30
 Number of Bags: 9 cartridge style pleated "bags" measuring 6" in diameter by 36" l long
 Cleaning Method: Reverse Pulse-Jet
 Cloth Area: 270 ft²
 Filter Media: 8.5 oz. pleated spun bonded polyester felt with PTFE membrane laminated to the exterior surface of the fabric
 Design Exhaust Flow: 600 acfm
 Installed: 2006

The manufacturer warrants that the particulate matter concentration in the effluent gas will not exceed an average of 0.005 gr/acf based on an inlet loading of 10 gr/acf.

Limestone Ball Mill Details

The Limestone Ball Mill is located in the ground floor of the FGD Building. The Limestone Ball Mill crushes limestone transferred from the limestone storage silo with water to form a limestone slurry for use in the Flue Gas Desulfurization systems. The Limestone Ball Mill is fully enclosed and is not a potential source of particulate matter emissions (the process is fully enclosed and water is injected at the upstream end of the ball mill), however it is an "affected facility" for the purposes of Title 40 Code of Federal Regulations (CFR) Part 60 Subpart OOO "Standards of Performance for Nonmetallic Mineral Processing Plants."

Ball mill processing capacity: 41 tons per hour
 Manufacturer: Svedala Industries (now known as Metso Minerals)
 Serial number: 49663
 Manufacture date: May 2000
 Installation date: September 2001

Fly Ash Weigh Bin Baghouse Details

The Fly Ash Weigh Bin receives fly ash from the No. 11 Air Slide and the No. 12 Air Slide. The Fly Ash Weigh Bin was manufactured by Halliburton and has a capacity of up to 30,000 pounds. During normal operation, approximately 900 cfm of fluidizing air from one of the air slides is vented out of the Fly Ash Weigh Bin Baghouse. The Fly Ash Weigh Bin Baghouse draws approximately 900 cfm of air from the fly ash loading spout to control fugitive dust while loading, for a total air flow of 1,800 cfm. At times total airflow could range up to 2,700

cfm if fly ash were being loaded into the Fly Ash Weigh Bin from both air slides (i.e. more than one Fly Ash Bin) simultaneously. The Fly Ash Weigh Bin Baghouse is turned on/off by the contractor in charge of loading fly ash (currently Lafarge North America), however TransAlta will retain responsibility for maintenance of, and the emissions from, the Fly Ash Weigh Bin Baghouse. The following details of the cartridge collector were provided:

Baghouse Make / Model:	Donaldson Torit / Powercore CPV-4
Installed:	Installation completed July 30, 2012
Design Flow Rate:	2,700 cfm (rated at 1,400 cfm to 2,700 cfm)
Filter Description:	4 cartridges (7" wide x 22" long x 7.5" tall), total of 252 ft ² filter area
Filter Description:	Ultra-web nanofiber material
Cleaning Method:	Pulsed jet – collected fly ash will drop down into the fly ash weigh bin.
Stack Description:	16" inside diameter stack exhausting vertically approximately 8' above the top of the fly ash weigh bin and 49-50' above ground level. An 18" diameter shroud (stack within a stack design) may be used to prevent rain intrusion into the stack.

Applicable NSPS/NESHAP/MACT: None

CAM Applicability Review

Particulate matter is the only regulated pollutant of interest for units that comprise EU-4. Equipment that utilizes a control device and has a particulate matter emission limit is reviewed below.

Equipment	Uncontrolled PTE (tons)	Subject to CAM?
FGD Bleed Treatment Lime Storage Silo	12 ¹	No
Fly Ash Bin 11	0 ²	No. CAM plan is included in the Permit as M31 for the exhausts (treated as separated EUs from the piping, storage, and transfer equipment listed here).
Fly Ash Bin 12		
Fly Ash Bin 14		
Fly Ash Weigh Bin	68 ³	No

¹ Assumes an inlet loading of 10 gr/dscf (likely a gross overestimate) for a potential operating time of 467 hours per year based on 6 25-ton loads per week at an off-loading rate of 16.7 tons per hour. Note that the bin vent may be "inherent process equipment".

² This does not include the baghouses which are treated as separate EUs. This equipment consists only of sealed piping and transfer equipment which does not have emissions unless a pipe fails or leaks.

³ Assumes 1,800 cfm of operation for 8,760 hours per year at an "uncontrolled" rate of 1 gr/dscf. Due to the nature of fly ash, filtration of some time is required, therefore at least some level of control is "inherent process equipment". Unit operates with 900 cfm of bin fluidizing air at all times, only exceeding this rate when actual loading is occurring and when the weigh bin is receiving ash from more than one storage bin at a time.

EU-5 Turbine Lube Oil Mist Vent 1 (Retired)

Retired at the end of 2020.

EU-6 Turbine Lube Oil Mist Vent 2

The Unit 2 turbine is equipped with an oil storage tank, lube oil reservoir, and other components of the lube oil system that supplies clean oil to the turbine-generator bearings and other equipment. The turbine lube oil mist eliminator controls oil droplet emissions from the vapor extractor, which removes moisture from the oil.

Turbine Lube Oil Mist Eliminator 2 is an Advanced Environmental Systems Air-Clear™ Mist Collection System sized to handle up to 1,000 cubic feet per minute (cfm) of oil mist at a concentration of 1,500 mg/m³ and a temperature of 120°F. The mist eliminator utilizes 67 ft² (based on the inside diameter of cylindrical filters) of fiberbed diffusion coalescing filters to collect up to 99.5% of the liquid mists on a particle count basis. Manufacturer literature suggests that the collection efficiency can be as high as 99.99% on a mass basis. This unit is designed to maintain the exit opacity at 5% or below. The blower system is designed to supply an average exhaust flowrate of 5 cfm (maximum of 600 cfm for short periods). This is substantially lower than the 1,000 cfm design of the mist eliminator. The mist eliminator is designed so that the filter elements are replaced when the gas flow becomes overly restricted due to high differential pressure across the filters. The differential pressure across the filters is less important to emission control than the average flow velocity through the filters. The manufacturer estimates that a velocity of 40 feet per minute or less is required for adequate opacity control. The permittee's blower has the capacity to produce a velocity of approximately 9 feet per minute (600 cfm/67 ft²).

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
VOC	0.01	Yes	Yes	No

EU-7 Black Stop Diesel Generator Engine (Retired)

The Black Stop Diesel Generator Engine retired at the end of 2020.

EU-8 Journal Shop Welding

Coal journals used in the coal pulverizers are repaired in the Journal Shop. Repairs consist primarily of welding replacement metal onto the journals to replace metal worn off during normal use. TransAlta submitted Air Discharge Permit Application L-613 on February 4, 2008 for replacement of the existing 1,800 cfm cartridge-style Torit baghouse with a larger Donald Torit cartridge style baghouse rated at 4,000 cfm. The purpose of the replacement

was to improve worker hygiene in the Journal Shop, especially to reduce potential worker exposure to chromium welding fumes.

Journal Shop – Baghouse. Journal Shop welding electrode use is less than 12,000 pounds per year. The baghouse pickups are positioned in such a way to minimize exposure of welders to welding fumes. Most welding is expected to be shielded metal arc welding. The following baghouse details were available:

Make / Model: Donaldson Torit / DFO 2-8
 Filter Area: 1,520 square feet of cartridge style filters
 Primary Filter Media: Ultra-Web FR with a MERV rating of 13
 No. of Filters: 8
 Secondary Filters: Contains two 24" x 24" x 12" HEPA filters downstream of cartridge filters
 Design Capacity: 4,000 cubic feet per minute @ 10" w.c., 70 °F
 Installed: September 10, 2008
 Stack Description: Exhausts horizontally through two 24" x 24" x 12" ducts at ambient temperature ~12' above grade.

Applicable NSPS/NESHAP/MACT: None

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
PM ₁₀	0.49	Yes	Yes – opacity as a surrogate for PM	No

EU-9 Emergency Diesel Generator 1

Engine Rating: 440 horsepower
 Engine Make / Model: Caterpillar / D343
 Engine Serial Number: 6287637
 Stack Description: ~ 8" diameter exhausted above the 8th floor roof

Diesel fuel oil is burned by this generator to supply back-up power to critical electrical systems in Unit 1. The generator is operated for about ¼ hour each week for testing, and consumes less than 300 gallons of fuel annually producing emissions below the thresholds of WAC 173-401-530(4) for an insignificant emission unit. This unit is not an insignificant emission unit because it is subject to applicable requirements found in 40 CFR 63 Subpart ZZZZ. The applicable requirements became effective May 3, 2010 (Federal Register notice dated March 3, 2010) with a compliance date of May 3, 2013.

Applicable NSPS/NESHAP/MACT: 40 CFR 63 Subpart ZZZZ

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
NO _x	1.36	No	No	No
CO	0.29	No	No	No
VOC	0.11	No	No	No
SO ₂	0.00048	No	No	No
PM ₁₀	0.01	No	No	No

EU-10 Emergency Diesel Generator 2

Generator Set Make / Model: Caterpillar / C9
 Generator Output: 300 kW
 Engine Make / Model: Caterpillar / C9
 Engine Serial Number: CASP01214
 Fuel: Diesel, 22.7 gallons per hour at full load
 Engine Power: 480 hp
 Engine Built: 2016
 Engine Certification: EPA Tier 3 Emergency
 Stack Description: ~ 7" diameter, exhausting vertically, ~8' above the 8th floor roof, stack flow 2,460.9 acfm at 927.2°F
 Location: 46°45'19.19"N, 122°51'36.24"W
 NSPS/NESHAP/MACT: 40 CFR 60 Subpart IIII, 40 CFR 63 Subpart ZZZZ

Applicable NSPS/NESHAP/MACT: 40 CFR 60 Subpart IIII, 40 CFR 63 Subpart ZZZZ

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
NO _x	0.42	No	No	No
CO	0.02	No	No	No
VOC	0.01	No	No	No
SO ₂	0.00049	No	No	No
PM ₁₀	0.0024	No	No	No

EU-11 Fire Pump Engine

The Fire Pump Engine drives a backup fire water pump. This unit will operate for testing and maintenance of the engine, as necessary during an emergency, and for limited time periods for non-emergency operation (e.g. during maintenance events when the electrical pump system is unavailable). Total annual operation is expected to be no more than 504 hours per year (3 weeks). Engine details are provided below:

Engine Make / Model: Cummins / CFP7E-F50 Fire Pump Driver
 Engine Serial Number: 73467344
 Fuel: Diesel, 10.6 gallons per hour at full load

Engine Power: 205 hp
 Engine Built: 2012
 Engine Installed: Installation completed December 27, 2012
 Engine Certification: EPA Tier 3
 Stack Description: ~ 4" diameter, exhausting vertically ~18' above grade, 1' 10" above roof level, stack flow 1,174 acfm @ 879°F
 Location: 46°45'22.44"N, 122°51'44.23"W

Applicable NSPS/NESHAP/MACT: 40 CFR 60 Subpart IIII, 40 CFR 63 Subpart ZZZZ

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
NO _x	0.28	No	Yes	No
CO	0.14	No	Yes	No
VOC	0.01	No	No	No
SO ₂	0.0006	No	No	No
PM ₁₀	0.013	No	Yes	No

EU-12 Coal Unloading Facility Emergency Diesel Sump Pump Engine

The CUF Emergency Diesel Sump Pump consists of a Godwin water pump driven by a diesel engine. The engine is operated for testing, maintenance, and as an emergency backup to the existing electric water pump. Engine details are provided below:

Engine Make / Model: John Deere / 4045TF275
 Engine Serial Number: PE 4045TF593425
 Engine Family: 6JDXL06.8082
 Fuel: Diesel, 42.7 pounds per hour @ full load
 Horsepower Rating: 115
 Engine Built: July 9, 2006
 Engine Certification: EPA Tier 2
 Stack Description: ~ 4" diameter, exhausting vertically ~6.5' above grade, stack flow 713 acfm @ 860 °F

Applicable NSPS/NESHAP/MACT: 40 CFR 63 Subpart ZZZZ, 40 CFR 60 Subpart IIII

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
NO _x	0.25	No	Yes	No
CO	0.04	No	Yes	No
VOC	0.0077	No	No	No
SO ₂	0.00013	No	No	No
PM ₁₀	0.0055	No	Yes	No

EU-13 SEA System 1

Based on a review of the potential Sorbent Enhancement Additive (SEA) materials, no significant increase in pollutant emission rates is expected as a result of injecting SEA into the boiler. Emissions are associated with venting of SEA laden air from the SEA hopper and the hammermill crusher through the SEA System 1 Cartridge Collector. The system feed capacity is 5-100 lb/hr, therefore the hammermill crusher is not subject to 40 CFR 60 Subpart OOO. The following details of the cartridge collector were provided:

Make / Model: Grünergy Technologies / PV-2-160 AR III
 Design Flow Rate: 1,130 cfm
 Design Exhaust Concentration: 0.005 gr/dscf
 No. of Cartridges: 2
 Filter Description: 160 ft² of 8 oz/yd² thermally fused polyester with PTFE membrane
 Cleaning Method: Pulsed jet
 Stack Description: 6" diameter stack exhausting vertically on east wall of the boiler building.

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
PM ₁₀	42.42 ¹	Yes	Yes	No

¹ Assumes conservative (high) inlet concentration loading of 1.0 gr/dscf.

EU-14 SEA System 2

Based on a review of the potential SEA materials, no significant increase in pollutant emission rates is expected as a result of injecting SEA into the boiler. Emissions are associated with venting of SEA laden air from the SEA hopper and the hammermill crusher through the SEA System 2 Cartridge Collector. The system feed capacity is 5-100 lb/hr, therefore the hammermill crusher is not subject to 40 CFR 60 Subpart OOO. The following details of the cartridge collector were provided:

Make / Model: Grünergy Technologies / PV-2-160 AR III
 Design Flow Rate: 1,130 cfm
 Design Exhaust Concentration: 0.005 gr/dscf
 No. of Cartridges: 2
 Filter Description: 160 ft² of 8 oz/yd² thermally fused polyester with PTFE membrane
 Cleaning Method: Pulsed jet
 Stack Description: 6" diameter stack exhausting vertically on east wall of the boiler building.

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
PM ₁₀	42.42 ¹	Yes	Yes	No

¹ Assumes conservative (high) inlet concentration loading of 1.0 gr/dscf.

EU-15 Sorbent Silo 1

Sorbent Silo 1 is located directly north of the ductwork between the Koppers ESPs and the Lodge-Cottrell ESPs. The following details of the vent filter system were provided:

Make / Model: Torit Technologies / TBV-4 Insertable
 Design Flow Rate: 350 cfm, passively vented
 Design Exhaust Concentration: 0.005 gr/dscf
 Filter Description: 4 Ultra-Web II NL cartridges, each containing a filter area of 170 ft² of 8 oz/yd² nanofiber on cellulose material
 Cleaning Method: Reverse air jet
 Stack Description: Circular exhaust measuring approximately 12" diameter exhausting vertically on the top of the silo, approximately 95' above grade

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
PM ₁₀	13.14 ¹	Yes	Yes	No

¹ Assumes conservative (high) inlet concentration loading of 1.0 gr/dscf.

EU-16 Sorbent Silo 2

Sorbent Silo 2 is located directly south of the ductwork between the Koppers ESPs and the Lodge-Cottrell ESPs. The following equipment details were provided:

Make / Model: Torit Technologies / TBV-4 Insertable
 Design Flow Rate: 350 cfm, passively vented
 Design Exhaust Concentration: 0.005 gr/dscf
 Filter Description: 4 Ultra-Web II NL cartridges, each containing a filter area of 170 ft² of 8 oz/yd² nanofiber on cellulose material
 Cleaning Method: Reverse air jet
 Stack Description: Circular exhaust measuring approximately 12" diameter exhausting vertically on the top of the silo, approximately 95' above grade

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
PM ₁₀	13.14 ¹	Yes	Yes	No

¹ Assumes conservative (high) inlet concentration loading of 1.0 gr/dscf.

EU-17 Fly Ash Bin 11 Baghouse

The Fly Ash Bin 11 Baghouse is located on top of the fly ash bins. A baghouse leak detector has been installed. The following equipment details were provided:

Make / Model: Industrial Accessories Company (IAC) / 144TB-BVWT-256-S6

Design Flow Rate: 14,730 cfm

Design Exhaust Concentration: 0.005 gr/dscf

Filter Description: 256 bags, 114 inches long with a total filter area of 4,997 ft², top load, DuPont Type 54 or equal, polyester material.

Cleaning Method: Reverse air jet

Stack Description: Rectangular exhaust measuring approximately 18" x 50" exhausting vertically ~ 5' above the top of the baghouse, approximately 30' above the top of the fly ash bin.

Leak Detector: Tribo-Flow model 4001-1111-01-154N with 12" long probe

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
PM ₁₀	553 ¹	Yes	Yes	Yes – CAM plan is included in the Permit as M31.

¹ Assumes inlet concentration loading of 1.0 gr/dscf.

EU-18 Fly Ash Bin 12 Baghouse

The Fly Ash Bin 12 Baghouse is located on top of the fly ash bins. A baghouse leak detector has been installed. The following equipment details were provided:

Make / Model: Industrial Accessories Company (IAC) / 144TB-BVWT-256-S6

Design Flow Rate: 14,730 cfm

Design Exhaust Concentration: 0.005 gr/dscf

Filter Description: 256 bags, 114 inches long with a total filter area of 4,997 ft², top load, DuPont Type 54 or equal, polyester material.

Cleaning Method: Reverse air jet

Stack Description: Rectangular exhaust measuring approximately 18" x 50" exhausting vertically ~ 5' above the top of the baghouse, approximately 30' above the top of the fly ash bin.

Leak Detector: Tribo-Flow model 4001-111-I-154N with 12" long probe

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
PM ₁₀	553 ¹	Yes	Yes	Yes – CAM plan is included in the Permit as M31.

EU-19 Fly Ash Bin 14 Baghouse

The Fly Ash Bin 14 Baghouse is located on top of the fly ash bins. A baghouse leak detector has been installed. The following equipment details were provided:

Make / Model: Industrial Accessories Company (IAC) / 144TB-BVWT-256-S6

Design Flow Rate: 14,730 cfm

Design Exhaust Concentration: 0.005 gr/dscf

Filter Description: 256 bags, 114 inches long with a total filter area of 4,997 ft², top load, DuPont Type 54 or equal, polyester material.

Cleaning Method: Reverse air jet

Stack Description: Rectangular exhaust measuring approximately 18" x 50" exhausting vertically ~ 5' above the top of the baghouse, approximately 30' above the top of the fly ash bin.

Leak Detector: Tribo-Flow model 4001-111-I-154N with 12" long probe

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
PM ₁₀	553 ¹	Yes	Yes	Yes – CAM plan is included in the Permit as M31.

EU-20 Fly Ash Bin 14 Air Slide to Bin 11 Air Slide

The air slide utilizes approximately 900 cfm of air to help move fly ash from Fly Ash Bin 14 to the Bin 11 Air Slide which in turn moves fly ash to the weigh hopper. The air is exhausted through a cartridge-style air filter system. The blower is located downstream of the air filter. The following equipment details were provided:

Make / Model: DCL / VML185

Design Flow Rate: 900 cfm
 Design Exhaust Concentration: 0.005 gr/dscf
 Filter Description: 4 polyester cartridges, each measuring approximately 8" outside diameter by 22 inches long, combined filter area of 185 ft²
 Cleaning Method: Reverse air jet
 Stack Description: Exhausts approximately 35 feet above ground on the south side of the Bin 11 building – discharged vertically through ~ 6" diameter exhaust.

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
PM ₁₀	33.8	Yes	Yes	No

EU-21 Fly Ash Bin 14 to 6050 Air Slide

The air slide utilizes approximately 600 cfm of air to help move fly ash from Fly Ash Bin 14 to the 6050 unloader. The air is exhausted through a cartridge-style air filter system. The blower is located downstream of the air filter. The following equipment details were provided:

Make / Model: DCL / VML140
 Design Flow Rate: 600 cfm
 Design Exhaust Concentration: 0.005 gr/dscf
 Filter Description: 3 polyester cartridges, each measuring approximately 8" outside diameter by 22 inches long, combined filter area of 140 ft²
 Cleaning Method: Reverse air jet
 Stack Description: Exhausts approximately 35 feet above ground inbetween the Bin 11 and Bin 14 buildings discharged vertically through ~ 6" diameter exhaust.

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
PM ₁₀	33.8	Yes	Yes	No

EU-22 Fine Coal Handling

Coal mine waste reprocessing and fine coal recovery activities at the Centralia Mine were approved in April 2014 and production began in December 2014. The activities involve dredging waste coal fines from ponds, processing those materials to separate fine coal from waste material, transferring waste slurry to a pit in the North Hanaford area, and transferring fine coal to the coal stockpile at TransAlta Generation. Fugitive dust may be generated at unenclosed material transfer points.

The fine coal handling equipment spans both the TransAlta Centralia Generation and TransAlta Centralia Mining facilities. Each facility maintains separate Air Operating Permits. TransAlta has indicated that after construction is complete, all equipment from Transfer Point 04 (TP-04) and downstream (including the fine coal stockpile) are the responsibility of TransAlta Centralia Generation. An enclosed conveyor will transfer fine coal over Big Hanaford Road from TransAlta Centralia Mining to TransAlta Centralia Generation. TP-04 is the first transfer point north of Big Hanaford Road. Responsibility for the equipment upstream of TP-04 has been retained by TransAlta Centralia Mining.

Transfer Point (TP)	Emission Control Notes
TP-01 (screen bowl centrifuge to clean coal collection conveyor)	Fully enclosed and in the process building
TP-02 (clean coal collection conveyor to 48" conveyor)	Fully enclosed
TP-03 (48" conveyor to conveyor over Big Hanaford Road)	Fully enclosed
TP-04 (transfer either to existing conveyor to directly feed power plant or transfer to fixed stacker for periods when the power plant is not running. A flop gate will direct the flow.)	Fully enclosed
TP-05 (discharge from the stacking conveyor to clean coal stockpile – estimated to be 15% of total throughput)	High pressure suppression as necessary at stacker discharge.

Conveyor Descriptions

Conveyor from TP-01 to TP-02 (Clean Coal Collection Conveyor): This 24" conveyor passes through the process building wall and is covered, but not fully enclosed, where it exits the building.

Conveyor from TP-02 to TP-03: 48" conveyor running along the south side of Parking Lot No. 2. This conveyor is covered but not fully enclosed.

Conveyor from TP-03 to TP-04 (conveyor over Big Hanaford Road): This conveyor is fully enclosed with the exception of some portal sized openings and open sides for a short distance near the head and tail pulleys.

Conveyor from TP-04 to Power Plant: This is an existing conveyor that runs along the south side of the coal plant stockpile and feeds the power plant.

Conveyor to TP-04 to Stockpile: This is an existing stacker that has been re-located to this fixed location. This is a 250' long open conveyor.

Applicable NSPS: 40 CFR 60 Subpart Y "Standards of Performance for Coal Preparation and Processing Plants."

CAM Applicability Review

Pollutant	Uncontrolled PTE (tons)	Emission Control Device?	Emission Limit?	Subject to CAM?
PM ₁₀	0.09	Yes (water spray)	Yes	No

III. EXPLANATION OF INSIGNIFICANT EMISSIONS UNIT DETERMINATIONS

Each emission unit listed as insignificant in the permit has been reviewed by SWCAA to confirm its status. The numbering system used to identify these emission units is consistent with internal Centralia Plant designations and does not necessarily use consecutive numbers. Emission units were determined to be insignificant as follows:

IEU-55B Maintenance Shops Welding Emissions

Maintenance welding is exempt from registration according to SWCAA 400-101(10) and did not require an approval. Emissions from this discharge point are less than 0.1 ton/yr, well below the 0.75 ton PM₁₀/yr threshold of WAC 173-401-530(4)(e) so this unit is considered insignificant. Based on a conservative estimate that no more than 2,000 lb of electrode is used annually in any one shop and the highest value emission factor of 82 lb/1,000 lb from EPA AP-42 Table 12.19-1, the annual emissions are calculated to be:

$$2,000 \text{ lb} * (82 \text{ lb}/1,000 \text{ lb}) * (1 \text{ ton}/2,000 \text{ lb}) < 0.1 \text{ ton/yr}$$

IEU-57 Cooling Towers

Primary cooling of the process steam takes place at the cooling towers for the Coal Plant. The cooling towers are categorically exempt insignificant emissions units under WAC 173-401-532(121) because of processing exclusively non-contact cooling water. Furthermore, the cooling towers do not use chromium-based water treatment chemicals. Sodium hypochlorite is used to treat circulating cooling water and does not escape to the ambient air.

IEU-61 Cold Solvent Parts Washers

Eight parts washing solvent tanks are used at the Centralia Plant site for only non-chlorinated solvent, each tank ranging in size from 30 to 40 gallons. The tanks are covered by lids when parts are not actively loaded or unloaded into or out of the tanks. The parts washers emit minimal VOC emissions and are considered insignificant because only fugitive emissions are released consistent with the definition of insignificant emission units in WAC 173-401-530(1)(d) and because their emissions are below the 2.0 tons per year VOC threshold of WAC 173-401-530(4)(d). Based on solvent use of 12,000 lb/yr and a recycle rate of 92% estimated by the solvent recycle vendor, VOC emissions are calculated to be:

$$12,000 \text{ lb/yr} * (1 - 0.92) * (1 \text{ ton}/2,000 \text{ lb}) = 0.48 \text{ tons per year VOC}$$

IEU-71 Fuel Oil Storage Tank 1

This storage tank supplies fuel oil to the boiler for startups and has a capacity of 100,000 gallons. Its VOC emissions are well below the insignificant emission thresholds of WAC 173-401-530(4)(d) (2.0 tons per year of VOC) so the emission unit is considered insignificant. Based on the methodology of EPA AP-42 §7.1 Organic Liquid Storage Tanks, an effective emission factor of 0.079 lb/1,000 gal was derived for this tank. For annual throughput of 220,000 gallons, VOC emissions are calculated to be:

$$220,000 \text{ gal} * 0.079 \text{ lb/1,000 gal} * (1 \text{ ton/2,000 lb}) = 0.009 \text{ tons per year VOC}$$

IEU-72 Fuel Oil Storage Tank 2

This storage tank supplies fuel oil to the boiler for startups and has a capacity of 100,000 gallons. Its VOC emissions are well below the insignificant emission thresholds of WAC 173-401-530(4)(d) (2.0 tons per year of VOC) so the emission unit is considered insignificant. Based on the methodology of EPA AP-42 §7.1 Organic Liquid Storage Tanks, an effective emission factor of 0.079 lb/1,000 gal was derived for this tank. For an annual throughput of 220,000 gallons, VOC emissions are calculated to be:

$$220,000 \text{ gal} * 0.079 \text{ lb/1,000 gal} * (1 \text{ ton/2,000 lb}) = 0.009 \text{ tons per year VOC}$$

IEU-73 Gasoline Storage Tank

The tank is a 5,200 gallon above ground tank with a white concrete shell used to fuel vehicles and equipment on site. The tank utilizes submerged fill and is not equipped with Stage I or II vapor recovery. No pressure/vacuum valve is utilized. Annual emissions from the storage tank are reported by the permittee to be less than 0.5 ton/yr, well below the 2.0 tons VOC/yr insignificant emission threshold of WAC 173-401-530(4)(d).

Gasoline vapors are emitted primarily from the following:

1. Storage Tank Loading Losses
2. Storage Tank Breathing Losses

Storage tank loading and breathing losses were estimated using EPA's Tanks 4.09D emission estimation software.

The parameters were used in Tanks 4.09D:

Nearest City:	Olympia, WA
Type of Tank:	Horizontal Tank
Shell Length:	12.5'
Shell Diameter:	9'
Tank Volume:	5,200 gallons
Shell Color:	White
Shell Condition:	Poor
Vacuum Setting:	0.0 psi
Pressure Setting:	0.0 psi
Liquid:	Gasoline (RVP=10)

Based on EPA Speciate 3.2 profile number 2455, approximately 50.85% of the total VOC emissions are toxic air pollutants (TAPs) as defined by WAC 173-460, and approximately 12.91% of the total VOC emissions are federally listed hazardous air pollutants (HAPs). For a throughput of 930,000 gallons per year, TAP and HAP emission rates are estimated to be:

IEU-73 Gasoline Storage Tank Emissions		
Throughput =	15,000 gallons per year	
Control Efficiency =	0% (Assume no vapor balance fittings)	
<u>Emission Factors</u>		
Storage Tank Working Losses =	7.099 lb/1,000 gallons	
Storage Tank Breathing Losses =	770 lbs/year	
Emissions Summary		
	lbs	tons
Volatile Organic Compounds	876	0.44
Toxic Air Pollutants	446	0.22
Hazardous Air Pollutants	113	0.06

IEU-74 Diesel Storage Tank

The storage tank has a capacity of 5,200 gallons and is used to fuel vehicles and equipment on site. VOC storage tanks not greater than 10,000 gallons capacity with appropriate closure and vapor pressure not greater than 80 mmHg are defined in WAC 173-401-533(2)(c) to be insignificant emission units. Annual emissions from the storage tank are reported by the permittee to be less than 0.001 ton/yr, below the 2.0 tons VOC/yr insignificant emission threshold of WAC 173-401-530(4)(d). Based on the methodology of EPA AP-42 §7.1 Organic Liquid Storage Tanks, an effective emission factor of 0.020 lb/1000 gal was derived for this tank. For an annual throughput of 16,000 gallons, VOC emissions are calculated to be:

$$16,000 \text{ gal} * 0.020 \text{ lb/1000 gal} * (1 \text{ ton}/2,000 \text{ lb}) = 0.0002 \text{ tons per year VOC}$$

IEU-75 U1 Emergency Diesel Generator Fuel Storage Tank

This fuel storage tank has a capacity of 350 gallons and supplies the U1 emergency diesel generator. Storage tanks not greater than 1,100 gallons capacity with maximum vapor pressure of 550 mmHg are defined in WAC 173-401-533(2)(b) to be insignificant emission units. Based on the methodology of EPA AP-42 §7.1 Organic Liquid Storage Tanks, an effective emission factor of 0.034 lb/1,000 gal was derived for this tank. For an annual throughput of 300 gallons, VOC emissions are calculated to be:

$$300 \text{ gal} * 0.034 \text{ lb/1,000 gal} * (1 \text{ ton}/2,000 \text{ lb}) = 0.00001 \text{ tons per year VOC}$$

IEU-76 U2 Emergency Diesel Generator Fuel Storage Tank

This fuel storage tank has a capacity of 350 gallons and supplies the U2 emergency diesel generator. Storage tanks not greater than 1,100 gallons capacity with maximum vapor pressure of 550 mmHg are defined in WAC 173-401-533(2)(b) to be insignificant emission units. Based on the methodology of EPA AP-42 §7.1 Organic Liquid Storage Tanks, an

effective emission factor of 0.034 lb/1,000 gal was derived for this tank. For annual throughput of 300 gallons, VOC emissions are calculated to be:

$$300 \text{ gal} * 0.034 \text{ lb/1,000 gal} * (1 \text{ ton/2,000 lb}) = 0.00001 \text{ tons per year VOC}$$

IEU-77 Emergency Diesel Fire Pump Fuel Storage Tank

This fuel storage tank has a capacity of 350 gallons and supplies the emergency diesel fire pump. Storage tanks not greater than 1,100 gallons capacity with maximum vapor pressure of 550 mmHg are defined in WAC 173-401-533(2)(b) to be insignificant emission units. Based on the methodology of EPA AP-42 §7.1 Organic Liquid Storage Tanks, an effective emission factor of 0.47 lb/1,000 gal was derived for this tank. For an annual throughput of 150 gallons, VOC emissions are calculated to be:

$$150 \text{ gal} * 0.47 \text{ lb/1,000 gal} * (1 \text{ ton/2,000 lb}) = 0.00004 \text{ tons per year VOC}$$

IEU-78 Limestone Silo

The limestone silo receives limestone shipments from trucks and feeds the ball mill for the FGD system. Particulate matter emissions are controlled by a Flex-Kleen model 30/36-PVBL-9-11 G vent filter (serial number 100770) located on top of the limestone silo. The vent filter has a rated efficiency of 99.9%. The conveyor to the silo has a capacity of 200 tons per hour and the ball mill has a capacity of 41 tons per hour, therefore the unit can operate up to $8,760 * (41/200) = 1,796$ hours per year. The vent filter fan is rated at 900 cfm. At a maximum emission concentration of 0.005 gr/dscf (typical maximum for material handling silo filters), potential emissions are:

$$\frac{1,796 \text{ hours per year}}{\text{year}} * \frac{900 \text{ cubic feet}}{\text{minute}} * \frac{60 \text{ minutes}}{\text{hour}} * \frac{0.005 \text{ grains}}{\text{standard cu ft}} * \frac{1 \text{ pound}}{7,000 \text{ grains}} = \frac{69 \text{ pounds}}{\text{year}}$$

Emissions from this discharge point are well below the 0.75 ton PM₁₀/yr threshold of WAC 173-401-530(4)(e) so this unit is considered insignificant.

IEU-79 Lime Silo

The lime silo receives lime shipments from trucks and feeds the FGD system when necessary (e.g. ball mill is inoperable). Particulate matter emissions are controlled by a Flex-Kleen model 30-PVBL-9-11 G vent filter located on top of the limestone silo. The vent filter has a rated efficiency of 99.9%. This unit can receive approximately 25 tons per hour of material from a truck (1 truckload per hour). The vent filter fan is rated at 900 cfm. At a maximum emission concentration of 0.005 gr/dscf (typical maximum for material handling silo filters), potential emissions are:

$$\frac{8,760 \text{ hours per year}}{\text{year}} * \frac{900 \text{ cubic feet}}{\text{minute}} * \frac{60 \text{ minutes}}{\text{hour}} * \frac{0.005 \text{ grains}}{\text{standard cu ft}} * \frac{1 \text{ pound}}{7,000 \text{ grains}} = \frac{338 \text{ pounds}}{\text{year}}$$

This unit typically operates one hour per day, so typical emissions are far less than 338 pounds per year. Emissions from this discharge point are well below the 0.75 ton PM₁₀/yr threshold of WAC 173-401-530(4)(e) so this unit is considered insignificant.

IV. EXPLANATION OF SELECTED PERMIT PROVISIONS AND GENERAL TERMS AND CONDITIONS

P11. Unavoidable Excess Emissions

[SWCAA 400-107]

SWCAA 400-107 establishes criteria and procedures for determining when excess emissions are considered unavoidable. Emissions that meet the requirements to be classified as unavoidable are still considered excess emissions and are reportable but are excused and not subject to penalty. Notification of excess emissions is required as soon as possible and must occur by the next business day following the excess emissions event. Excess emissions due to startup or shutdown conditions are considered unavoidable if the permittee adequately demonstrates the excess emissions could not have been prevented through careful planning and design. Upset excess emissions are considered unavoidable if the permittee adequately demonstrates the upset event was not caused by poor or inadequate design, operation, maintenance, or other reasonably preventable condition, and the permittee takes appropriate corrective action that minimizes emissions during the event, taking into account the total emissions impact of that corrective action. Additional descriptions of potential excess emissions and how the permittee is expected to respond to those events are provided in requirements M9 and M15 - Startup, Shut Down, and Outage Operation Procedures.

The Utility MACT (Subpart UUUUU) and the Boiler MACT (Subpart DDDDD) are federally standards that can be delegated to state and local agencies and contain specific, and more restrictive, affirmative defense provisions that apply only to malfunctions. For these reasons, SWCAA has concluded that the state and local excess emission provisions cannot apply to these standards.

G2. Chemical Accident Prevention

[40 CFR 68]

Part 68 requires risk management plans be developed for the substances and thresholds listed in 40 CFR 68.130. Chlorine and ammonia are listed substances. The permittee no longer uses chlorine or ammonia on site. The SNCR system utilizes urea rather than ammonia. The permittee uses no other substance listed in 40 CFR 68.130, therefore this standard currently does not apply to this facility.

G11. Portable Sources

[SWCAA 400-036, SWCAA 400-110(6)]

SWCAA 400-110(6) establishes procedures for approving the operation of portable sources of air emissions that locate temporarily at project sites. These requirements are general statewide standards and apply to all portable sources of air contaminants. Common equipment subject to these conditions include emergency generators, engine-powered pumps, rock crushers, concrete batch plants, and hot mix asphalt plants that operate for a short time period at a site to fulfill the needs of a specific contract. Portable sources exempt from registration under SWCAA 400-101 are exempt from SWCAA 400-110 and not subject to

the portable source requirements. Among those categories listed in SWCAA 400-101 that are exempt are operations with potential to emit less than 1 ton per year of all criteria pollutants other than PM_{2.5}, and less than 0.5 tons per year of PM_{2.5}.

V. EXPLANATION OF OPERATING TERMS AND CONDITIONS

Req. 1-8 General Standards for Maximum Emissions

[SWCAA 400-040, SWCAA 01-2350R4]

SWCAA 400-040 establishes maximum emission standards for various air contaminants. These requirements are general statewide standards and apply to all sources of air contaminants. Therefore, these requirements apply to all emission units at the source, both EU and IEU. Pursuant to WAC 401-530(2)(c), the permit does not contain any testing, monitoring, recordkeeping, or reporting requirements for IEUs except those specifically identified by the underlying requirements. The averaging time for the SO₂ standard of Req-6 is satisfied by 60-minute average values averaged over each clock hour consistent with the monitoring provisions of M8.

No specific monitoring was specified for Req-7 because there are no specific monitoring requirements that can be used to encompass the whole range of potential concealment and masking scenarios. The permittee is required to certify compliance with all terms and conditions of the permit, including these prohibited items, at least annually. The permittee must make a reasonable inquiry to determine if concealment or masking has occurred during the reporting period in order to certify compliance.

Req. 9, 10 Emission Standards for Combustion and Incineration Units

[SWCAA 400-050]

SWCAA 400-050 establishes maximum emission standards for selected emissions from combustion and incineration units. These requirements apply to all combustion and incineration units at the source, both EUs and IEUs. Pursuant to WAC 401-530(2)(c), the permit does not contain any testing, monitoring, recordkeeping, or reporting requirements for IEUs except those specifically identified by the requirements as applying to IEUs.

Req. 11 Emission Standards for General Process Units

[SWCAA 400-060]

SWCAA 400-060 establishes maximum particulate matter emission standards for general process units. These requirements apply to all general process units at the source, both EUs and IEUs. Pursuant to WAC 401-530(2)(c), the permit does not contain any testing, monitoring, recordkeeping, or reporting requirements for IEUs except those specifically identified by the requirements as applying to IEUs.

Req. 12 Emission Standards for Certain Source Categories - Abrasive Blasting

[SWCAA 400-070(8)]

SWCAA 400-070 establishes emission standards for seven specific source categories. The requirements of SWCAA 400-070(8) apply due to the potential for infrequent abrasive blasting operations at the plant site. Abrasive blasting is required to be conducted inside a booth or structure designed to capture the blast grit, overspray, and removed material, except for blasting of outdoor structures and items too large to be handled inside an enclosure. Outdoor blasting is to be performed with either steel shot or an abrasive material containing less than 1 percent by mass material that would pass through a No. 200 sieve. Precautions to minimize emissions, such as enclosure of the area being blasted with tarps, are to be used for outdoor blasting.

No specific monitoring was specified for this requirement because there are no specific monitoring requirements that can be used to encompass the whole range of potential blasting scenarios. The permittee is required to certify compliance with all terms and conditions of the permit, including this requirement, at least annually. The permittee must make a reasonable inquiry to determine if prohibited activities have occurred during the reporting period in order to certify compliance.

Req. 13 Opacity Monitoring, and Reporting

[SWCAA 400-105(4)(a)(i) & (4)(e)]

SWCAA 400-105(5)(a) & (5)(e) requires that fossil fuel-fired steam generators of 250 million Btu/hr or greater heat input without sulfur dioxide control equipment install a continuous monitor for opacity, and operate it in accordance with the requirements found in 40 CFR 51, Appendix P and 40 CFR 60, Appendices B - F, as appropriate. This requirement applies to emission units EU-1 and EU-2 only during a scheduled outage of the flue gas desulfurization system and anticipated startups. Anticipated startups exclude startups immediately (less than 12 hours) following a forced outage. This requirement does not establish a visible emission standard with a specified opacity value; Reqs-1 and 15 are the applicable requirements that set a visible emission standard expressed as an opacity value to be achieved. The evaluation method is presented in Appendix A of the Air Operating Permit.

Req. 6, 14, 15, 17 - 20, 23, 24, 27, 35, 39, 40 Regulatory Order to Establish RACT

[SWCAA 97-2057R1]

The Regulatory Order to Establish Reasonably Available Control Technology (RACT) superseded all previous Orders applicable to EU-1 and EU-2.

Following extensive analysis of what constitutes RACT for this source, SWCAA issued Regulatory Order to Establish RACT SWCAA 97-2057 to the Centralia Plant on December 8, 1997 to establish Reasonably Available Control Technology (RACT) emission limits for SO₂, NO_x, PM, and CO emissions from the plant. The Centralia Plant petitioned SWCAA for a modification of the NO_x emission limit, and SWCAA revised the RACT Order as SWCAA 97-2057R1 on February 26, 1998. This Order establishes RACT emission limits for SO₂, NO_x, PM, and CO emissions, restricts the annual consumption of fuel oil by the

auxiliary boiler (EU-3), and supersedes all Orders previously issued to the Centralia Plant (see VI. Explanation of Obsolete and Future Requirements).

Section 36 of SWCAA 97-2057R1 (Requirement 15) establishes opacity limitations for the boiler (EU-2). The permittee operates opacity monitors in the ductwork upstream of the bypass stack. No correlation has been developed to describe the relationship between the opacity indicated by these monitors and the opacity of the FGD exhaust; therefore these monitors cannot be used to determine compliance with this requirement for the FGD exhaust.

Requirement 18 applies during normal operation. Emissions during startups, shutdowns, and outages of the FGD system are addressed by Requirement 19.

Req. 16, 21, 26 Utility MACT Emission Limits

[40 CFR 63 Subpart UUUUU]

The Utility MACT established emission limitations for hazardous air pollutants or their surrogates from coal and oil fired electric utility steam generating units.

For non-Hg HAP metals, sources may comply with an alternative particulate matter (PM) emissions limit as a surrogate. Past source emissions testing at this facility has consistently demonstrated compliance with the Utility MACT PM emission limit by a wide margin and the Utility MACT emission limit is far less stringent than the PM emission limit in RACT Order 97-2057R1, therefore TransAlta has chosen not to utilize the "emissions averaging" provisions and therefore does not need to develop an "emissions averaging plan". The Utility MACT PM emission limit and the PM emission limit in RACT Order 97-2057R1 were listed separately for informational purposes and because of the significant monitoring and recordkeeping requirements tied directly to the Utility MACT.

For HCl and HF emissions, sources may comply with an alternative SO₂ emissions limit as a surrogate. This is the choice TransAlta has chosen for the obvious reason that TransAlta must already operate an SO₂ CEMS to comply with the Acid Rain Program, and SWCAA 97-2051R1. CEMS data for this facility indicates that this facility consistently demonstrates compliance with the Utility MACT SO₂ emission limit by a wide margin, therefore TransAlta has chosen not to utilize the "emissions averaging" provisions and therefore does not need to develop an "emissions averaging plan".

The Hg emission limit in the Utility MACT is more stringent than the Hg emission limit TransAlta complies with under an off-permit agreement with Washington State signed May 2010. To comply with this off-permit agreement, TransAlta installed a Hg CEMS system that was certified to the Clean Air Mercury Rule standards in December 2009. In 2017 TransAlta replaced the CEMS with a sorbent trap monitoring system to demonstrate compliance with the Hg emission limit. A Hg process monitor provides the real-time feedback necessary to allow TransAlta to adjust operation of the Hg control system to assure compliance with the standard. Using the sorbent trap monitoring system, a single concentration value is assigned to each hour in the operating period (40 CFR 60 Subpart UUUUU Appendix A, Section 6.1.2). Concentration data is then converted to units of the emission standard (e.g. lb/TBtu) for each hour in the monitoring period using other CEMS data (e.g. diluent).

TransAlta has chosen not to utilize the "emissions averaging" provisions and therefore does not need to develop an "emissions averaging plan". For the Hg standard, sources must meet a more stringent Hg emission limit under the emissions averaging provisions.

Req. 22 Acid Rain Compliance Plan

[WAC 173-406-400, 40 CFR 72.40(a)]

40 CFR 72.9 and WAC 173-406-106 require that the Centralia Plant hold SO₂ allowances not less than the total annual emissions in tons of SO₂ from the affected units (EU-1, EU-2) at the Centralia Plant. The Centralia Plant received an initial allocation of allowances only for BW21 (EU-1) and BW22 (EU-2). The EPA may reallocate the number of allowances assigned to individual units and between units; therefore, annual allowance allocations may change in the future. The number of allowances actually held by a source in an Acid Rain affected unit account may differ from the number initially allocated by U.S. EPA as allowances are bought and sold on the open market to cover actual emissions.

Req. 27b - 31 Washington Department of Ecology BART Order

[Second Revision of BART Order No. 6426]

The BART Order established NO_x and NH₃ emission limits and associated operating, monitoring, recordkeeping, and reporting requirements for the coal fired boiler. The BART NO_x emission limit of 0.18 lb/MMBtu (30-day rolling average) is expected to be more stringent in all aspects than the previously established RACT permit limit of 0.30 lb/MMBtu (annual average for operation >360 MW); however the RACT limit in Req-27 was retained for the extremely unlikely scenario where overall NO_x emissions are less than 0.18 lb/MMBtu but NO_x emissions at operations above 360 MW were much higher.

Req. 34 Acid Rain NO_x Reduction Early Election for Group 1, Phase II Boilers

[WAC 173-406-106, 40 CFR 76.7(a)(1)]

The Phase II emission limit of 0.40 lb/million Btu was effective January 1, 2008.

Req. 36 Acid Rain Primary Monitoring Provisions

[40 CFR 75.10(a)]

40 CFR 75.10(a)(1) through (3) requires that an Acid Rain affected unit be equipped with continuous emissions monitoring systems with an automated data acquisition and handling system for measuring and recording SO₂, NO_x, and CO₂ emissions, respectively, discharged to the atmosphere. 40 CFR 75.10(a)(4) requires such units to be equipped with a continuous opacity monitoring system with an automated data acquisition and handling system for measuring and recording the opacity of discharged emissions.

Opacity

40 CFR 75.14(b) exempts units utilizing a wet flue gas pollution control system from the opacity monitoring requirements if the owner or operator can demonstrate that condensed water vapor is present in the exhaust stream and would impede the accuracy of opacity measurements. The Centralia Plant has provided ample demonstration that condensed water vapor is present in sufficient quantities to interfere with an opacity monitor and is therefore exempt from the requirement to continuously monitor opacity from the scrubber flues.

The gas stream leaving the scrubbers is saturated with water. As the flue gas inevitably cools, water condenses out of the gas stream forming steam and water droplets. The results of testing conducted during November 2001 (6 runs during scrubber performance test) and December 2001 (9 runs during initial RATA) indicated that the flue gas was supersaturated. Condensed water vapor is clearly visible through the sample ports at the test platform. All subsequent testing has supported this determination.

Gaseous Pollutant Monitoring at Bypass Stack

SWCAA 97-2051R1 requires monitoring of SO₂ emissions from both the bypass and scrubber flues. Acid Rain rules do not require direct monitoring at the bypass stack. This policy was detailed in question "17.6 – Revised" from the Acid Rain Policy Manual (December 2000) in addition to the Acid Rain rules promulgated May 1, 2002. Note that "Question 17.6 – Revised" is also found as "Question 16.4" in the 2013 version of the Part 75 Emissions Monitoring Policy Manual. The CEMS may be located upstream. When a certified monitoring system is not maintained on the bypass stack, the maximum potential emissions must be reported for bypass hours.

Req. 37 Utility MACT Tune-up Requirements

[40 CFR 63 Subpart UUUUU]

Subpart UUUUU requires initial and periodic tune-ups of the coal-fired boiler. The tune-up requirements are detailed in 40 CFR 63.10021(e) and Table 3 of 40 CFR 63 Subpart UUUUU. At the time this permit is being issued, TransAlta does not utilize neural network combustion optimization software; therefore the tune-up must be conducted every 36 months. In accordance with 40 CFR 63.10021(e) the initial inspection of the burners may be delayed beyond the October 13, 2015 compliance date and until the next "scheduled outage" if an outage is not scheduled before the compliance date. EPA describes this "scheduled outage" as a "major outage" in comment responses during rule development where there were comment regarding the long period of time necessary to erect scaffolding in the boiler. It is SWCAA's understanding that a short-term economic outage or an outage planned with little lead-time (for example to effect repairs) is not the type of "scheduled outage" discussed by this section of the rule. For the purposes of this requirement, SWCAA believes that a "scheduled outage" is a boiler outage where the boiler will be offline for a significant amount of time (e.g. weeks or months), and would usually be associated with planned inspections, major maintenance and/or repairs of the boiler interior.

Req. 38 Utility MACT Startup and Shutdown Provisions

[40 CFR 63 Subpart UUUUU]

Subpart UUUUU requires that all startups be conducted on "clean fuels". During startup and shutdown the facility typically uses ultra-low sulfur diesel, which is included in the definition of "clean fuels". In accordance with 40 CFR 63.10011(f) the facility must determine the "cleanest fuel" available on-site or accessible nearby for use during periods of startup or shutdown. However, the facility is required to utilize a "clean fuel", but not necessarily the "cleanest fuel" identified in 40 CFR 63.10011(f). See Response to Comment 67 in EPA's November 2014 Summary of Public Comments and Responses to the startup and shutdown reconsideration of 40 CFR 63 Subpart UUUUU.

The permittee is not precluded from considering a capital project to add natural gas firing capability. However New Source Review would be required before installing natural gas firing capability.

In the interests of streamlining the permit, the portions of the cited regulations that reference recordkeeping and reporting requirements were considered informational and not included in the permit requirement. All applicable recordkeeping and reporting requirements are included elsewhere in the permit.

Table 3 of Subpart UUUUU provides compliance options for two different definitions of "startup". The permittee is not committed to use either one. In option one, the ESPs and flue gas desulfurization (FGD) system must be engaged once coal is fired.

In option two, additional records must be generated and kept, clean fuels must be fired to the maximum extent possible during the startup period, the particulate control devices must be engaged within 1 hour of firing coal, and the Subpart UUUUU emission limits apply within 4 hours of producing electricity for any purpose. The FGD systems are not designed as PM control devices and are not necessary to meet PM emission limits; therefore, only the ESPs must be engaged within 1 hour of firing coal. SWCAA understands that operation of the FGD systems too early in the startup process when oil is being fired, and when PM levels have not been sufficiently reduced, is detrimental to both the short-term and long-term performance of the FGD system and would likely cause an increase in overall acid gas emissions. The US EPA provided some clarification of the startup requirements in an e-mail message dated August 13, 2015.

For Option 2, the end of "startup" was defined as ending when the EGU generates electricity that is sold or used for any other purpose (including on site use), or 4 hours after the EGU makes useful thermal energy (such as heat or steam) for industrial, commercial, heating, or cooling purposes (16 U.S.C. 796(18)(A) and 18 CFR 292.202(c)), whichever is earlier. The end of the startup period must be known to determine when "clean fuels" (ultra-low sulfur diesel in this case) no longer need to be fired to the "maximum extent possible". Based on the intent of the section and SWCAA's conversations with EPA staff, SWCAA believes that the end of startup could be much earlier (i.e. when all of the applicable pollution control devices have been engaged). At that point there is no need to continue firing "clean fuels" for the purpose of minimizing emissions and the facility should be able to achieve compliance with all applicable emission limits.

With respect to firing clean fuel to the "maximum extent possible", SWCAA understands this requirement to impose a duty to fire as much clean fuel as necessary to enable the applicable emission control equipment to be engaged as soon as possible, but no later than 1 hour after, coal is fired.

Req. 39 Good Air Pollution Control Practices

[40 CFR 63.9991(c)(2), 63.1000(b), SWCAA 97-2057R1]

This requirement as it originates from SWCAA 97-2057R1 is meant to require reasonable practices to reduce emissions below the short-term emission limits provided in SWCAA 97-2057R1 when possible, and optimize use of the emission control equipment. The following paragraphs describe good air pollution control practices for minimization of SO₂, NO_x, and PM emissions from the coal-fired boiler for compliance with the requirements from SWCAA 97-2057R1.

Sulfur Dioxide

The SO₂ emission control equipment is the Flue Gas Desulfurization (FGD) system or scrubber. Good air pollution control practice is to utilize recycle pumps as necessary to maintain SO₂ as low as practicable without allowing the SO₂ CEMS indication to drop to or below zero (below zero indications are possible due to minor instrument drift). A small amount of SO₂ must be maintained in the flue gas to assure that the gypsum that is produced is of marketable quality for manufacturing, and to prevent degradation or damage to the desulfurization system from scaling. If all SO₂ in the flue gas is reacted, the residual limestone can, in a short time period, cause scaling in the reaction vessel leading to reduced scrubbing efficiency and mechanical failure.

The original design specifications for the scrubber specify that three of the four recycle pumps would be in operation at any one time. The fourth recycle pump would be maintained as a maintenance spare and backup. The specification was based on the use of high sulfur coal from the Centralia Mine. When the plant is using low sulfur coal from the Powder River Basin, SO₂ can be maintained at a minimum level with the use of less than three recycle pumps.

In addition to maintaining minimum SO₂ levels, at times it may not be possible to operate the design number of recycle pumps and spray levels due to operational problems including when:

1. Equipment problems require two pumps off-line for maintenance or repair activities; and
2. Equipment problems downstream of the scrubber (e.g. vacuum belt filter malfunctions, problems with reaction tank oxidation blowers) or upstream of the scrubber (e.g. reagent pump or ball mill failures) limit reagent addition or gypsum removal.

Such events should be reported as an upset condition and will be reviewed on an individual basis.

Nitrogen Oxides

The NO_x emissions control system is good boiler combustion practices, low NO_x burner modifications on the boiler, and the SNCR system. NO_x control through good combustion practices is significantly different than add-on SO₂ control. This form of NO_x control is an integral part of the combustion process. If the boiler is operated to minimize NO_x emissions, combustion efficiency decreases to the point of limiting electrical power output, increases coal combustion/megawatt which increases emissions of other pollutants (SO₂, PM, CO and VOCs) and increases slagging, sootblowing and maintenance costs from increased boiler tube repairs. Based on current information, good air pollution control practice for NO_x is balancing the varied factors and maintaining emissions below the RACT and BART limitations.

Particulate Matter

The particulate matter (PM) emissions control systems are the two tandem electrostatic precipitators in series. In addition, the FGD system removes additional PM through the scrubbing process. Maintaining good precipitator performance is important in order to maintain the quality of the gypsum by-product necessary for sale for use in wallboard.

Req. 41, 42 Boiler MACT Requirements for Auxiliary Boiler

[40 CFR 63 Subpart DDDDD]

Boilers in the "limited use" subcategory are those boilers with a federally enforceable annual average capacity factor of no more than 10 percent. The Auxiliary Boiler (EU-3) is a startup boiler; therefore, a low capacity utilization would be expected. Section 45 of SWCAA 97-2057R1 expressly limited the total amount of fuel this boiler can fire to 600,000 gallons per year. The boiler has a rated heat input capacity of 170 MMBtu/hr. Assuming a fuel oil heat input capacity of 138,000 Btu/gallon (from 40 CFR 98), the 600,000 gallon per year limitation is equivalent to a capacity factor of approximately 5.6%. Both the 600,000 gallon per year limitation and the 10 percent capacity factor threshold are on a calendar year basis. Boilers in the "limited use" subcategory are subject to the general requirement to operate consistent with good air pollution control practices and the requirement to conduct initial and periodic tune-ups rather than specific emission limits.

Req. 43 Pug Mill Opacity

[SWCAA 01-2403]

This requirement represents BACT for control of fugitive particulate matter from this source at the time of permitting (2001). The only potential point of emissions from this source is fugitive during the transfer to trucks. The pug mill mixing function is conducted through the use of the two UCC Model 6050 Pin Paddle Mixers installed in 2009.

Req. 44 Turbine Lube Oil Mist Eliminators Opacity

[SWCAA 01-2403]

This requirement represents BACT for control of visible emissions/lube oil mist from this source at the time of permitting (2001). The manufacturer literature for the Advanced Environmental Systems mist eliminator guarantees opacity levels of 5% or less. On-site observations have demonstrated that visible emissions from this source do not exceed 5%. Using the conservative assumption of a 99.5% control efficiency (provided by Advanced

Environmental Systems on a particle count basis), and 8,760 hours of operation per year, each turbine lube oil mist eliminator will emit up to 0.1 pounds of lube oil mist per year.

Req. 45 - 47 Control of Particulate Matter from Coal Unloading
[SWCAA 11-2972]

The requirements in Air Discharge Permit SWCAA 11-2972 represent BACT for control of particulate matter (coal dust) from the unloading of coal from rail cars at this facility.

Annual emissions of PM₁₀ from the Coal Unloading Facility are to be calculated using the following equation (found in Section 6 of the Technical Support Document for Air Discharge Permit 11-2972) for each transfer point:

$$E = k(0.0032) \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where: E = emission factor (lbs PM per ton coal unloaded)
k = particle size multiplier (dimensionless). k=1.0 for PM, 0.35 for PM₁₀, 0.11 for PM_{2.5}
U = mean wind speed (miles per hour)
M = coal moisture content (%)

A control factor of 90% is applied to transfer points utilizing high pressure wet suppression to control fugitive dust (some pre-existing transfer points may be uncontrolled).

Req. 48, 49 Control of Particulate Matter from FGD Bleed Treatment Lime Storage Silo
[SWCAA 05-2636]

Air Discharge Permit SWCAA 05-2636 was written in response to an Air Discharge Permit (ADP) application for installation of a new hydrated lime storage silo. This silo was installed as part of a project to remove boron and zinc from the flue gas desulfurization (FGD) system scrubbing liquor. These requirements represent BACT for control of particulate matter (hydrated lime) from the pneumatic loading of hydrated lime into the silo.

Req. 50, 51 Control of Particulate Matter from Journal Shop
[SWCAA 08-2779]

Air Discharge Permit SWCAA 08-2779 was written in response to an Air Discharge Permit (ADP) application for installation of a larger capacity cartridge filtration system to control welding fumes exhausted from the Journal Shop. The purpose of the project was to reduce worker exposure to welding fumes. The requirements in Air Discharge Permit were written to implement BACT and protect ambient air quality.

Req. 52 - 58 Engine Requirements Originating from 40 CFR 63 Subpart ZZZZ
[40 CFR 63 Subpart ZZZZ]

40 CFR 63 Subpart ZZZZ established emission limitations and operating requirements for various categories of reciprocating engines. The engines at the coal plant fall into two categories of engines regulated by Subpart ZZZZ. All of the applicable requirements for these engines have been included in the Air Operating Permit.

One requirement requires that engines be maintained "according to the manufacturer's emission-related written instructions or develop a maintenance plan which must provide to the extent practicable for the maintenance and operation of the engine in a manner consistent with good air pollution control practice for minimizing emissions." The permittee submitted a maintenance plan for their "existing" stationary diesel engines to SWCAA on August 8, 2011. The portions of the maintenance plan relevant to engine emissions are included in Appendix C and are applicable requirements as described in Req-54.

For the purposes of this requirement, emergency operation of the fire pump is any operation necessary in response to a fire.

Req. 55, 57, 58, 61, 62, 65 Engine Requirements Originating from 40 CFR 60 Subpart IIII
[40 CFR 63 Subpart IIII]

40 CFR 63 Subpart IIII established emission limitations and operating requirements for various categories of "new" reciprocating engines. Where the requirements under Subpart IIII are the same as for 40 CFR 63 Subpart ZZZZ, the terms have been streamlined and applied to groups of engines. All of the applicable requirements for these engines have been included in the Air Operating Permit.

Req. 59 - 65 Requirements for the Coal Unloading Facility Emergency Diesel Sump Pump Engine
[40 CFR 63 Subpart ZZZZ, 40 CFR 60 Subpart IIII, and SWCAA 11-2972]

The Coal Unloading Facility Emergency Diesel Sump Pump Engine was installed as a "new" engine for the purposes of 40 CFR Subpart ZZZZ, therefore the engine is required to comply with Subpart ZZZZ by meeting the requirements of 40 CFR 60 Subpart IIII. The engine underwent New Source Review, resulting in the issuance of Air Discharge Permit 11-2972. Air Discharge Permit 11-2972 contained all of the applicable requirements from 40 CFR 60 Subpart IIII and additional requirements originating from SWCAA's general regulations and the minor New Source Review process.

In a June 28, 2011 amendment to 40 CFR 60 Subpart IIII, EPA changed section 60.4211(a) to allow owners/operators of stationary engines to deviate from manufacturer's written emissions-related instructions if they complied with additional recordkeeping and conducted an initial source test to demonstrate compliance with the applicable emission standards. These alternative requirements are included in section 60.4211(g). This compliance option is not detailed in the permit because the permittee has indicated that they will follow the manufacturer's written instructions.

For the purposes of this requirement, emergency operation is any operation necessary because the electrical water pump at the Coal Unloading Facility has unexpectedly failed. If the electrical water pump fails, it must be repaired as soon as practical. Operation of the Coal Unloading Facility Diesel Sump Pump Engine because the electrical water pump was not repaired as soon as practicable, would not be considered emergency operation.

Compliance with the annual emission limits for the Engine in Condition 5 of SWCAA 11-2972 is to be determined by multiplying the hours of operation by the emission factors presented in the Technical Support Document for SWCAA 11-2972 unless new emission factors are provided by the manufacturer or developed through source testing.

Req. 66 - 71 Requirements for Fire Pump Engine and Emergency Diesel Generator 2
 [SWCAA 16-3188]

The requirements for these two engines appear together in many places because they are both subject to 40 CFR 60 Subpart IIII and are regulated by Air Discharge Permit 16-3188. Compliance with the annual emission limits for the Fire Pump Engine must be determined by multiplying the hours of operation by the emission factors presented in the Technical Support Document for SWCAA 16-3188 unless new emission factors are provided by the manufacturer or developed through source testing. These emission factors are listed in the explanation of M27.

Req. 72 – 76 Requirements for the Material Handling Systems Associated with the Mercury Control System and Fly Ash Bins
 [SWCAA 11-2984]

Air Discharge Permit 11-2984 was written to approve material handling modifications necessary to implement an activated carbon injection (ACI) mercury control system on the two coal-fired boilers (one of which retired at the end of 2020). The fly ash bin baghouse exhausts are subject to the Compliance Assurance Monitoring (CAM) requirements of 40 CFR 64, and each utilize a baghouse leak detection monitor. This monitoring (along with periodic source emissions testing) is expected to provide an adequate assurance of compliance with the permitted emission limits.

Compliance with the annual emission limits in Condition 1 of SWCAA 11-2984 is to be determined by multiplying the hours of operation by the design flow rate and an emission concentration of 0.005 gr/dscf unless new emission factors are developed through source testing.

Filter	Rated Flow
SEA System 1	1,130
SEA System 2	1,130
Sorbent Silo 1	350
Sorbent Silo 2	350
Fly Ash Bin 11	14,730
Fly Ash Bin 12	14,730
Fly Ash Bin 14	14,730
Fly Ash Bin 14 Air Slide to Bin 11 Air Slide	900

Filter	Rated Flow
Fly Ash Bin 11 to Weigh Hopper Air Slide	900
Fly Ash Bin 14 to 6050 Air Slide	600

Condition 3 of SWCAA 11-2984 requires that each emission unit be operated properly. It will be presumed that the equipment is being operated properly unless otherwise indicated by an inspection or excess emissions. In that case, equipment operating manuals and maintenance records may be reviewed to determine if the equipment is being improperly operated or maintained.

Req. 77 – 81 Requirements for the Fly Ash Weigh Bin

[SWCAA 12-3016]

Air Discharge Permit 12-3016 was written to approve a new baghouse for the Fly Ash Weigh Bin to replace the existing baghouse on the fly ash weigh bin (operated by Lafarge North America at the time of permitting), and the relatively new "Fly Ash Bin 11 to Weight Hopper Air Slide Filter" (operated by TransAlta). The replacement baghouse filters dust from air collected from the fly ash loading spout and air vented to the fly ash bin from the No. 11 Air Slide and the No. 12 Air Slide.

Compliance with the annual emission limits in Condition 1 of SWCAA 12-3016 is to be determined by multiplying the hours of operation by the design flow rate and an emission concentration of 0.002 gr/dscf until or unless new emission factors are developed through source testing.

Req. 82 – 88 Requirements for Fine Coal Handling

[SWCAA 14-3093]

Air Discharge Permit 14-3093 was written to approve coal mine waste reprocessing activities and fine coal recovery. Only fine coal handling will occur at TransAlta Centralia Generation.

Annual emissions of particulate matter from the transfer of fine coal onto the coal stockpile are to be calculated using the following equation (found in Section 6 of the Technical Support Document for Air Discharge Permit 14-3093) for each transfer point:

$$E = k(0.0032) \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where:

- E = emission factor (lbs PM per ton coal unloaded)
- k = particle size multiplier (dimensionless). k=1.0 for PM, 0.35 for PM₁₀, 0.11 for PM_{2.5}
- U = mean wind speed (miles per hour)
- M = coal moisture content (%)

Meteorological data indicates that the mean wind speed at this site is 4 miles per hour. It was assumed that wet suppression will provide for 90% control of fugitive dust emissions. There is only one transfer point that is not fully enclosed (transfer to the TransAlta Generation stockpile). The transfer to the TransAlta Generation stockpile will be equipped with high-pressure wet suppression that will be used if visible emissions are observed. It is expected that the fine coal moisture will be too high to generate significant dust.

Req. 88 – 92, 95, 96 Minor New Source Review Permit and Subpart ZZZZ Requirements for Black Stop Generator Operation

Requirements removed – the Black Stop Generator Engine was permanently retired at the end of 2020.

Req. 93, 94 PSD Permit for Combustion Turbine Facility (Black Stop Diesel Generator Engine)

Requirements removed – the Black Stop Generator Engine was permanently retired at the end of 2020.

VI. EXPLANATION OF OBSOLETE AND FUTURE REQUIREMENTS

1. Obsolete Regulatory Orders/Permits

SWCAA issued eight Orders and Air Discharge Permits to the permittee between 1972 and 1974 in response to a particulate matter control equipment testing program and Air Discharge Permit applications submitted for installation or modification of such equipment and for operations at the source. Seven Orders were issued to the permittee between 1987 and 1991 regarding the averaging period for the SWCAA SO₂ emission standard and a variance request by the source. These seven Orders are no longer applicable as described below. From 1995 through early 1998, three Regulatory Orders concerning Reasonably Available Control Technology (RACT) requirements were issued to the permittee, two of which are no longer applicable as described below.

A SWCAA Order dated December 11, 1972 required the PM emission level of 0.06 gr/dscf not to be exceeded at any time, and also established maximum operating levels during compliance testing of both units. An Order dated April 13, 1973 approved installation of additional ESP collection area and required that additional sections be designed and installed to control emissions to 0.06 gr/dscf. A SWCAA Order dated April 26, 1973 specified objectives of a particulate matter emission testing program, allowed operation at maximum output during a specified test schedule for Unit 1, and reiterated the 0.06 gr/dscf emission limit in the December 11, 1972 Order. An Order dated May 4, 1973 approved operation of Unit 2 at maximum output during a scheduled particulate matter emissions test and listed the objectives of the test program. A May 22, 1973 Order extended the test schedule for Unit 2. A SWCAA Order dated June 11, 1973 approved full output operation of Unit 1, and, not to be exceeded at any time, the particulate matter emission level of 0.06 gr/dscf.

These Orders were effectively replaced by a subsequent SWCAA Order (dated February 7, 1974 and revised on February 22, 1974) that approved installation of the Lodge-Cottrell ESPs in series following the original ESPs on both Units 1 and 2. This February 1974 Order approved continued operation at an emission level not to exceed 0.06 gr/dscf and required

demonstration of satisfactory equipment performance within three months after startup of the new ESPs. Administrative Order 74-38 established a high-load testing schedule for Unit 2 not to exceed ten days commencing May 6, 1974. Although these Orders were not explicitly superseded until SWCAA 97-2057R1 was issued, the Orders dealing only with the testing program to improve and evaluate particulate matter collection became moot with the approval and subsequent performance demonstration of the Lodge-Cottrell ESPs.

The Centralia Plant disagreed with SWCAA's authority to establish via the February 1974 Order an emission limit more stringent than the state standard for particulate matter, 0.1 gr/dscf. SWCAA established the 0.06 gr/dscf emission limit consistent with "advances in the art" (the term that predates BACT) to not allow degradation of the control equipment and ensure meaningful emission reductions as intended under the Clean Air Act. Although all previous Orders have been superseded by Section 49 of SWCAA 97-2057R1, the 0.06 gr/dscf emission limit based on "advances in the art" was effective until the RACT limit of 0.010 gr/dscf become the applicable requirement for particulate matter emissions after December 31, 2001.

Order of Violation SWCAA 87-934 was issued for violations of the 1,000 ppm SO₂ emission limit based on average daily coal sulfur analyses, and required the permittee to implement coal analysis at twenty minute intervals, perform sampling of SO₂ emissions, and correlate the sampling results with the coal analyses. The Order suspended a civil penalty provided that no additional violations of the SO₂ emission standard occurred for one year. Stay of Order of Violation SWCAA 87-934-STAY stayed for up to 18 months from September 21, 1987 the requirements in SWCAA 87-934 for coal analysis and SO₂ emission sampling, and the civil penalty.

Order, Withdrawal of Stay, and Modification of Order of Violation SWCAA 88-934 required the Centralia Plant to install continuous SO₂ and O₂ emissions monitors, install ambient air quality monitors at three sites near the facility, blend and wash the coal supplied to its boilers, conduct a feasibility study of lime injection multiple burner technology to reduce SO₂ emissions, and comply with the SO₂ emission limit of 1,000 ppm averaged over a one week period. This Order, issued on February 24, 1988, withdrew the coal analysis and SO₂ emission sampling provisions and the civil penalty assessed by SWCAA 87-934. SWCAA 88-934 was amended by Variance and Modification of Order SWCAA 88-934B which granted a variance from the 1-hour averaging period of the SO₂ emission standard and established a weekly averaging period effective May 25, 1988 through November 25, 1989. SWCAA 88-934B required measured SO₂ emissions to be corrected to a dry basis, installation of meteorological monitoring equipment to be operated from October 1, 1988 through September 30, 1989, modeling of SO₂ emissions by an EPA approved dispersion model, and other minor modifications to 88-934.

SWCAA 88-934C Variance Renewal and Modification of Order extended the variance for weekly instead of hourly averaging of SO₂ emissions until November 25, 1990, extended the collection of ambient monitoring data through September 30, 1990, and modified the ambient air monitoring provision to require two rather than three sites. SWCAA 90-934D Variance Renewal and Modification of Order extended the variance for weekly instead of hourly averaging of SO₂ emissions until the earlier of November 25, 1991 or the date on which practicable means for the adequate abatement or control of SO₂ emissions from the Centralia

Plant become known, available, and implementable. The Order required that collection of ambient meteorological monitoring data extend through September 30, 1991, and that the permittee report to SWCAA the results of its dispersion modeling by December 31, 1991. Effective on April 5, 1991, SWCAA 90-934E Withdrawal of Petition, Surrender of Variance, and Order terminated the variance, meteorological monitoring, ambient monitoring, dispersion modeling, and modeling report provisions of SWCAA 90-934D and 88-934.

SWCAA 90-934E Withdrawal of Petition, Surrender of Variance, and Order (issued on April 5, 1991) revoked an earlier Variance and restored compliance with the SO₂ standard over a 1-hour averaging period. It also established a procedure for determining compliance with the hourly SO₂ standard which defined an "excess SO₂ emission day" as 3 or more unique excess SO₂ emission hours during any continuous 24-hour period in the month, and an "SO₂ emission violation" as 3 or more unique excess SO₂ emission days occurring in a calendar month. SWCAA 97-2057R1 supersedes Order No. SWCAA 90-934E along with its SO₂ compliance procedure.

Regulatory Order to Establish RACT SWCAA 95-1787 established a plant-wide annual average emission rate limit and total tonnage limit for SO₂ and specified compliance dates for achieving these emission limits. This Order was appealed by a third party to the Pollution Control Hearings Board (PCHB). SWCAA issued Order of Withdrawal SWCAA 96-1872 to withdraw SWCAA 95-1787 while pursuing additional SO₂ emission reductions through a collaborative process. However, the PCHB ruled SWCAA 96-1872 was an amendment to the original RACT Order, and therefore the RACT Order (95-1787) was still in effect. The SWCAA Board then approved Resolution 1996-8 on September 18, 1996 which withdrew both SWCAA 95-1787 and 96-1872, a decision later upheld by the PCHB.

An EPA Order on Consent was issued on May 18, 2001 to allow the permittee to commence construction of the Combustion Turbine Facility prior to issuance of a PSD permit. This order became obsolete upon issuance of PSD permit No. PSD-01-01.

PSD-01-01 was issued on February 22, 2002 for construction of the Combustion Turbine Facility. This PSD permit dealt only with those PSD pollutants with emissions at or above the PSD significance threshold (PM and NO_x). SWCAA Air Discharge Permit 01-2350 was issued on May 30, 2001 to address emissions of all other pollutants. Air Discharge Permit 01-2350 was superseded by Air Discharge Permit SWCAA 01-2350R1, issued on May 6, 2002. Air Discharge Permit SWCAA 01-2350R1 was written in response to an Air Discharge Permit application requesting an increase in the combustion turbine facility's sulfur oxides emission limits.

The permittee became aware on July 12, 2002 that the auxiliary boiler that was ultimately installed at the Combustion Turbine Facility was not the one approved by PSD-01-01 or Air Discharge Permit SWCAA 01-2350R1. PSD-01-01 and Air Discharge Permit SWCAA 01-2350R1 approved the 4.18 MMBtu/hr Cleaver-Brooks boiler specified in the Notice of Construction (NOC) applications for those permits. The permittee notified SWCAA of this fact on the next business day (July 15, 2002).

On July 22, 2002 SWCAA issued Consent Order SWCAA 02-2422 to address the issue. The consent order was signed by Ms. Linda Chambers for TransAlta Centralia Generation,

LLC on July 24, 2002. This consent Order became obsolete with the submittal of a Notice of Construction L-505 on August 15, 2002 (submittal of this notice satisfied the last requirement in the consent order).

PSD-01-01 was superseded by PSD-01-01 Amendment 1 on January 30, 2003. The permit amendment was made to approve the existing BHP Auxiliary Boiler.

Air Discharge Permit 01-2350R1 was superseded by Air Discharge Permit 01-2350R2 on October 15, 2003. Air Discharge Permit 01-2350R2 was written in response to Air Discharge Permit application L-505 for approval of the existing BHP Auxiliary Boiler.

PSD-01-01 Amendment 1 was superseded by PSD-01-01 Amendment 2 on June 11, 2004. The permit amendment was made to clarify the RATA frequency requirements.

Air Discharge Permit 01-2350R2 was superseded by Air Discharge Permit 01-2350R3 on May 12, 2005. Air Discharge Permit 01-2350R3 was written to make the source testing and RATA frequencies in the minor source permit consistent with the RATA frequencies in PSD-01-01 and the Acid Rain Program rules.

Air Discharge Permit 05-2612 was issued on July 15, 2005 for the addition of a coal unloading hopper to the West Coal Unloading Facility. Air Discharge Permit 05-2612 was superseded by Air Discharge Permit 07-2712 on February 7, 2007. Air Discharge Permit 07-2712 was written in response to a request for installation of surge capacity to the West Coal Unloading Facility. Air Discharge Permit 07-2712 was superseded by Air Discharge Permit 07-2749 on September 26, 2007. Air Discharge Permit 07-2749 was written in response to a request for modification of the West Coal Unloading Facility operating limitations and installation of the Coal Unloading Facility. Air Discharge Permit 07-2749 was superseded by Air Discharge Permit 11-2972 on April 14, 2011. Air Discharge Permit 11-2972 was written in response to a request to install a diesel-fired emergency water pump at the Coal Unloading Facility.

Air Discharge Permit 01-2350R3 was superseded by Air Discharge Permit 01-2350R4 on January 18, 2008. Air Discharge Permit SWCAA 01-2350R4 was written in response to an ADP application submitted by the permittee to eliminate the 1.5 ppmvd @ 15% O₂ (8-hour average) CO emission limit (BACT was re-evaluated) for the combustion turbines. The 3.0 ppmvd @ 15% O₂ (1-hour average) was retained.

Best Available Retrofit Technology (BART) Order No. 6426 was issued June 18, 2010 by the Washington Department of Ecology as implementation of Washington's visibility program (WAC 173-400-151) which is implemented consistent with the federal visibility protection program (40 CFR Part 51, Subpart P). Order No. 6426 established a NO_x emission limit of 0.24 lb/MMBtu for the coal fired boilers and a minimum coal quality requirements. EPA approved the SIP submission containing this BART submission in a Federal Register notice dated December 6, 2012.

BART Order No. 6426 was superseded by the First Revision of BART Order No. 6426 issued December 13, 2011. The First Revision of BART Order No. 6426 was issued to implement new requirements from a 2011 law (Washington Engrossed Second Substitute Senate Bill 5769). Under this law the Governor is required to enter in a "memorandum of agreement" with the plant owner on behalf of Washington State to install and operate selective non-catalytic reduction (SNCR) to provide additional control of NO_x emissions no later than January 1, 2013. The Memorandum of Agreement was finalized December 23, 2011. The law also requires one boiler to comply with the greenhouse gas emission performance standard in RCW 80.80 by December 31, 2020 and the second boiler by December 31, 2025. These requirements were included in the First Revision of BART Order No. 6426. Approval of this revision into the Washington SIP was published in the Federal Register on December 6, 2012.

The First Revision of BART Order No. 6426 was superseded by the Second Revision of BART Order No. 6426 issued July 29, 2020. This revision was made to address problems with, and caused by, the SNCR system. The revision reduced the NO_x limit for the longer-lived unit from 0.21 lb/MMBtu to 0.18 lb/MMBtu while removing the prescriptive SNCR operating requirements. Approval of this revision into the Washington SIP was published in the Federal Register on May 7, 2021.

Air Discharge Permit 11-2996 was issued November 11, 2011 for installation and operation of the Pump-05 Engine. Air Discharge Permit 11-2996 was superseded on October 18, 2012 by Air Discharge Permit 12-3035. Air Discharge Permit 12-3035 was issued for installation of a new fire pump engine that may also be used to supply non-emergency water pumping during plant maintenance events. The permit conditions related to the engines addressed in Air Discharge Permit 11-2996 were carried forward in Air Discharge Permit 12-3035.

Air Discharge Permit 12-3035 was superseded by Air Discharge Permit 16-3188 on June 1, 2016. Air Discharge Permit 16-3188 was written for approval of a nonroad engine and an emergency generator engine to replace the Emergency Diesel Generator 2 engine.

2. Initial Testing Requirements for Limestone Ball Mill

The initial testing requirements of 40 CFR 60.18 for the Limestone Ball Mill (consisting of opacity observations as specified in 40 CFR 60 Subpart OOO) were completed on October 24, 2007.

3. Acid Rain Requirements

The general Acid Rain recordkeeping provisions of 40 CFR 75.50 are no longer valid as of January 1, 1996, and are replaced by the general recordkeeping provisions of 40 CFR 75.54. The Acid Rain Program provided an optional set of recordkeeping requirements with only slightly different provisions prior to January 1, 1996, but disallows their use from January 1996 onward.

4. Future NSPS/MACT/NESHAP Standards

None

5. Future Coal-Fired Boiler Shutdown Requirements

Condition 3 of the Second Revision of Bart Order No. 6426 requires that one coal-fired unit permanently cease burning coal no later than December 31, 2020, and the second permanently cease burning coal no later than December 31, 2025. These requirements would not apply if the Department of Ecology determines as a requirement of state or federal law or regulation that selective catalytic reduction (SCR) technology must be installed on either coal fired boiler. This requirement implements requirements in RCW 80.80 as amended in 2011. RCW 80.80 requires that the coal fired boilers meet a greenhouse gas performance standard that is the lower of 1,100 lbs/MW-hr or the average available greenhouse gas emissions output as determined under RCW 80.80.050. The output determined under RCW 80.80.050 is published by the Washington Department of Commerce in WAC 194-26 and was 925 lbs/MW-hr effective April 6, 2013. These standards cannot be met by these boilers without the addition of CO₂ capture equipment or shutdown.

VII. EXPLANATION OF MONITORING AND RECORDKEEPING TERMS AND CONDITIONS

M1. General Recordkeeping

This recordkeeping section is taken directly from SWCAA 97-2057R2 Sections 26 and 29, SWCAA 05-2636, SWCAA 08-2779, SWCAA 11-2072, SWCAA 14-3093, and WAC 173-401-615(2). Sections (a) through (d) were added to clarify specific requirements. Under K1(c)(i) of the permit "equipment out of service" is limited to SO₂ emission control equipment, and "upset conditions" are limited to pollution control equipment or equipment that would directly impact SO₂ emissions.

M2. Visible Emission Monitoring

This monitoring requirement is used to provide, by itself or in combination with other monitoring requirements, a reasonable assurance of compliance with the general requirements drawn from SWCAA 400 and the specific requirements drawn from SWCAA 97-2057R1, SWCAA 01-2403, and SWCAA 14-3093. The general requirements in SWCAA 400 do not directly establish any specific regime of monitoring or recordkeeping. Consequently, SWCAA has implemented monitoring and recordkeeping requirements under the "gap filling" provisions of WAC 173-401-615 where no other monitoring is required by an applicable requirement. M1 is designed to provide periodic assurance of compliance and record any necessary corrective action. This requirement pertains to the visual technique for evaluating visible emissions, not the continuous monitor method. Demonstration of compliance is required in some cases via visible emissions evaluation. An individual educated in the procedures of visible emission observation and evaluation is to perform the periodic compliance assurance monitoring. A Certified Observer, certified in accordance with EPA Method 9, is to perform the visible emission observations based on the method in Appendix A of the Air Operating Permit.

M3. Particulate Matter Emissions Monitoring

This monitoring requirement is used to provide, by itself or in combination with other monitoring requirements, a reasonable assurance of compliance with the general requirements drawn from SWCAA 400 and specific requirements drawn from SWCAA 05-2636, SWCAA 11-2972, SWCAA 12-3016, and SWCAA 14-3093. A particulate matter exhaust standard of 0.1 gr/dscf applies to both combustion and non-combustion emission units. These requirements do not directly establish any specific regime of monitoring or recordkeeping. Consequently, SWCAA has implemented monitoring and recordkeeping requirements under the "gap filling" provisions of WAC 173-401-615 where no other monitoring is required by an applicable requirement. M2 is designed to assure compliance through periodic facility inspections and prompt corrective action within 2 hours of observing particulate matter fallout or excess visible emissions whenever necessary. The permittee is required to resolve the particulate matter fallout or excess emissions problem within 24 hours of initial discovery, or notify SWCAA by the next working day of progress made towards resolution. Excess emissions are emissions above the state standard or permit limit. The site inspection and visual observation are surrogate methods for assessing the relative emissions from non-combustion emission units EU-4, EU-5, and EU-6 that have demonstrated emissions well below the general standards.

Both Coal Plant units (EU-1 and EU-2) are equipped with electrostatic precipitators that remove over 99.5% of the particulate matter from coal combustion leaving emission concentrations less than one-tenth of the standard in Req-9. Combustion of fuel oil in the auxiliary boiler (EU-3) does not produce emission concentrations near this standard either. Monitoring for the standards in Reqs-9 and 11 makes use of observations that will readily indicate if control equipment or material handling management practices are seriously deficient. The site inspection and visual observation are surrogate methods for assessing the relative emissions from emission units EU-1, EU-2, and EU-3 that have demonstrated emissions well below the general standards.

Condition 8 of Air Discharge Permit SWCAA 11-2972 requires that the water pressure of the spray/fog nozzles be maintained at 80 psig or greater during operation of the coal unloading facility, however no monitoring of the water pressure was required (although a visual inspection is required monthly). Consequently, SWCAA has implemented monitoring and recordkeeping requirements under the "gap filling" provisions of WAC 173-401-615 that require the spray pressure to be measured during the monthly inspection and recoded in accordance with Section VIII K1(a).

M4. Fugitive Emissions Monitoring

This monitoring requirement is used to provide, by itself or in combination with other monitoring requirements, a reasonable assurance of compliance with the general requirements drawn from SWCAA 400 and the specific requirement from SWCAA 01-2403 to control fugitive dust from operation of the fly ash pugmill. SWCAA 400 does not directly establish any specific regime of monitoring or recordkeeping for these standards. Consequently, SWCAA has implemented monitoring and recordkeeping requirements under the "gap filling" provisions of WAC 173-401-615 for those general requirements. M3 is designed to assure compliance through a combination of periodic facility inspections, use of

reasonable precautions and good work practices, and prompt corrective action whenever necessary.

M5. Complaint Monitoring

This monitoring requirement is used to provide, by itself or in combination with other monitoring requirements, a reasonable assurance of compliance with the general requirements drawn from SWCAA 400 and specific requirements in SWCAA 01-2350R4, SWCAA 11-2972, SWCAA 12-3016, and SWCAA 16-3188. SWCAA 400, SWCAA 01-2350R4, Condition 3 of SWCAA 12-3016, and SWCAA 16-3188 do not directly establish any specific regime of monitoring or recordkeeping for these requirements. Consequently, for these rules SWCAA has implemented monitoring and recordkeeping requirements under the "gap filling" provisions of WAC 173-401-615. M4 is designed to assure compliance through prompt complaint response and corrective action whenever necessary.

M6. Operations Monitoring

The requirements cited in this monitoring section are "gap-filling" monitoring under the authority of WAC 173-401-615(1). No requirements rely solely on this monitoring condition to assure compliance. These requirements ensure sufficient monitoring where the applicable rule or permit does not provide an adequate assurance of compliance with the applicable requirement. M5 is designed to assure compliance through operation of pollution control equipment according to manufacturer specifications and/or consistent with good engineering and maintenance practices, and by taking corrective action whenever necessary. Emissions control equipment is operated to minimize overall long-term emissions. Manufacturer specifications should be followed except in instances where alternative practices are equivalent or better. The goal is to maintain performance rather than follow exact manufacturer specifications.

M7. Coal Plant SO₂ General Standard Monitoring

This monitoring requirement in combination with M8 is used to provide a reasonable assurance of compliance with the general SO₂ emission concentration limit contained in SWCAA 400. SWCAA 400-040(6) limits the emission of sulfur dioxide from combustion sources to a maximum of 1,000 ppmv corrected to a specified oxygen percentage as noted in SWCAA 400-050(3). The combustion sources at this facility combust pulverized coal and fuel oil (No. 2 distillate diesel oil). EU-3 is fueled exclusively with fuel oil, and its monitoring requirement consists only of quarterly certification of fuel sulfur content. A CEM mandated by the Acid Rain Program continuously measures the SO₂ concentrations of the flue gasses emitted by EU-1 and EU-2 and determines 60-minute averages (see M9).

SWCAA 97-2057R1 requires the use of coal sulfur content sampling to fill in missing CEM data periods, and certification of fuel oil burned in the auxiliary boiler and BW21 and BW22 but does not detail the frequency of such monitoring. This requirement provides the explanation of the minimum monitoring necessary to comply with these requirements. Monitoring of coal sulfur content by monthly composite sampling is required for comparison and potential backup purposes in the event of missing CEMS data. The conversion between fuel sulfur content and SO₂ concentration relies upon an approximate linear relationship based

on operational experience with a coal sulfur content of 1% by weight corresponding to an SO₂ bypass stack concentration of 1,000 ppm. Quarterly certification of fuel oil sulfur content is required to demonstrate compliance with the 1,000 ppm requirement, but the frequency of each sulfur content determination depends on the fuel suppliers' shipments and is not a continuous monitoring requirement. The maximum level of sulfur in the fuel oil consumed is 0.5% by weight. The following calculation demonstrates how the 1,000 ppmvd sulfur dioxide limit cannot be exceeded when burning fuel oil with a sulfur content of 0.5% or less:

$$\text{ppm SO}_2 @ 7\% \text{O}_2 = \frac{7.206 \text{ lb oil}}{\text{gallon}} \cdot \frac{1 \text{ gallon}}{0.141 \text{ MMBtu}} \cdot \frac{0.005 \text{ lb S}}{\text{lb oil}} \cdot \frac{\text{lb} \cdot \text{mole}}{32 \text{ lb S}} \cdot \frac{385 \text{ scf}}{\text{lb} \cdot \text{mole}} \cdot \frac{\text{MMBtu}}{9,190 \text{ dscf}} \cdot \frac{(20.9 - 7\% \text{O}_2)}{20.9} \cdot 10^6$$

$$\text{ppm SO}_2 @ 7\% \text{O}_2 = 22.2$$

M8. Coal Plant Stack Sampling Monitoring Requirements

This monitoring requirement is used to provide, by itself or in combination with other monitoring requirements, a reasonable assurance of compliance with the general requirements drawn from SWCAA 400, the specific emission limits contained in SWCAA 97-2057R1, Second Revision of BART Order No. 6426 and 40 CFR 63 Subpart UUUUU. SWCAA 400-052 specifies a frequency for source testing of all applicable combustion units, which are those which emit 100 tons per year or more of NO_x, CO, particulate matter, SO₂, or VOC. Emissions tests are required every two calendar years for those pollutants for which the source emits 100 tons per year or more. The use of continuous emissions monitors is an acceptable alternative to the specified sampling schedule. The permittee operates CEMS at each stack for NO_x and SO₂ that meet Acid Rain requirements. In addition, CO is continuously monitored from both scrubbed flues. Requirement M9 is designed to elaborate on the SWCAA-only regulation, integrate its requirements with those from the RACT Order, and provide periodic assurance of compliance with the particulate matter exhaust concentration standards.

Past source testing at the bypass stacks has indicated compliance with the particulate matter emission limits by a wide margin. With one exception during a scrubber upset, source tests on scrubbed flues have demonstrated compliance with the PM emission limits by an adequate margin. Because continuous methods are used to quantify emissions of SO₂, NO_x, and CO, compliance with the PM emission limits has been repeatedly demonstrated by a wide margin, and because opacity monitor data utilized as part of a CAM plan, and equipment maintenance review provides additional assurance that PM emission limits are met, periodic source testing is adequate to provide a reasonable assurance of continuous compliance with the PM emission limit.

Ammonia slip monitoring must be conducted at least annually, and as frequently as semiannually in accordance with the requirements of the Second Revision of BART Order No. 6426. Between source emission tests, urea usage is monitored in accordance with M25. Large increases in urea usage without corresponding decreases in NO_x emissions would indicate the possibility of increased ammonia slip.

M9. Coal Plant Continuous Monitoring Provisions

This monitoring requirement is used to provide, by itself or in combination with other monitoring requirements, a reasonable assurance of compliance with the general requirements drawn from SWCAA 400, the specific emission limits contained in SWCAA 97-2057R1, Second Revision of BART Order No. 6426, 40 CFR 63 Subpart UUUUU, and to provide compliance with the Acid Rain requirements.

CEMS for SO₂, NO_x, CO, CO₂, Hg, and moisture monitor exhaust concentrations and allow for the calculation of mass emission rates of these pollutants from the coal-fired boiler. A COMS for measuring the opacity of emissions has been retained at each bypass stack but will not be installed on the scrubber flues because condensed water vapor makes opacity monitoring at these flues impossible. Note that TransAlta received an official exemption from the Acid Rain Program COMS requirements for the scrubbed stacks in accordance with 40 CFR 75.14(b) [see letter from Sam Napolitano (EPA) to Lou Florence (TransAlta) dated July 28, 2011]. SWCAA 97-2057R1 requires the use of an SO₂/O₂ CEMS on the bypass stacks. NO_x and CO₂ CEMS are not required on the bypass stacks by SWCAA 97-2057R1, local, state, or federal (40 CFR 75) regulations. The CEMS and/or COMS are calibrated daily in the active stack to ensure accurate measurements. An O₂ monitor measures and records O₂ concentration in the stack gas discharged to the atmosphere consistent with the Acid Rain monitoring provisions, although the requirement for operating an O₂ monitor is based on SWCAA 97-2057R1, Sections 21 and 27a, and SWCAA 400-040(6) and 400-050(3) which specify that the 1-hour average SO₂ concentration data be on a dry basis corrected to 7% O₂. The correction method uses the as-measured SO₂ concentration for each clock hour and the corresponding actual O₂ concentration to standardize the SO₂ data to 7% O₂, as shown:

$$\text{SO}_2, \text{ dry @ 7\% O}_2 = [(20.9 - 7) / (20.9 - \text{O}_2\%, \text{ dry})] * \text{SO}_2, \text{ dry @ actual O}_2\%$$

This monitoring is to be used for demonstrating compliance with the specific pollutant emissions limits and standards in the permit. The monitors are to be installed, operated, maintained, and calibrated in accordance with the Acid Rain Program monitoring requirements and Subpart UUUUU as applicable. SWCAA 400-040 does not directly establish any specific regime of continuous monitoring or recordkeeping for the COMS. Consequently, SWCAA has used the monitoring requirements from SWCAA 97-2057R1 Section 36 and recordkeeping requirements under the "gap filling" provisions of WAC 173-401-615. Requirement M9(c) is designed to assure compliance with the state visible emissions standard using the COMS 6-minute average opacity data. Monitoring of 1-minute average opacity also meets this monitoring requirement because 6-minute averages may be calculated from 1-minute average data. This method of evaluation is deemed adequate to demonstrate compliance with the visible emissions standard of SWCAA 400-040(1), which is primarily a visual observation method. SWCAA 97-2057R1 Section 36 specifies that evaluation of the visible emission standard occur by both COMS and visual observation using Method 9 as prescribed in Appendix A to the permit.

Missing data procedures for the Acid Rain Program are specified for those hours when the CEMS does not measure or record valid data for the applicable monitors. The requirements specify methods for substituting data depending on factors such as the length of the missing data period and monitor system data availability rate. For compliance with the SO₂ concentration standard of SWCAA 400-040(6), the missing data procedures are identical to

those of 40 CFR 75.30 - 75.33 when the length of the missing data period is four hours or less. However, when monitor out-of-service periods are greater than four hours, data from an on-line coal analyzer, any as-burned coal analyses conducted by the permittee, and plant operating data is evaluated. For state and local rules and permits, the purpose of missing data substitution is to represent true and actual emissions as closely as possible. Therefore, the data or combination of data that best represents actual emissions is used to determine the SO₂ concentrations.

Missing data substitution procedures of 40 CFR 75 are not utilized to demonstrate compliance with the NO_x emission limit from the Second Revision of BART Order No. 6426 or the SO₂, PM, or Hg emission limits from 40 CFR 63 Subpart UUUUU. Reported emissions for comparison with these limits are intended to be more representative of actual emissions than the more conservative reporting required by 40 CFR 75 (Acid Rain Program Monitoring).

Electric output monitoring was added under the "gap filling" provisions of WAC 173-401-615 in order to allow the calculation of SO₂, PM, and Hg emission rates in units of lb/MWh or lb/GWh for comparison with the emission limits in 40 CFR 63 Subpart UUUUU.

Section M9(s) describes the requirements to monitor the bypass stack for SO₂, Hg, and PM in accordance with 40 CFR 63.10006(c) and 40 CFR 63.10010(a)(4). 40 CFR 63.10010(a)(4) indicates that if a relevant CEMS is not installed on the bypass stack, bypass hours are counted as deviations from the monitoring requirements. Based on a review of EPA's December 2011 Response to Public Comments, it appears that EPA intends to count a failure to monitor the bypass stack for either Hg or PM as a deviation from Subpart UUUUU requirements only if the bypass stack is used outside of startup or shutdown. Otherwise it appears that EPA would simply count unmonitored bypass hours as monitor downtime. In EPA's response to Commenter 17675, EPA writes:

"... The EPA has modified the bypass stack monitoring requirements. Under 40 CFR Part 75, the EPA allows the use of a maximum potential concentration value on a bypass stack. That approach works within the broad context of an emissions trading program but does not work when evaluating compliance with a specific emission limit over a shorter period. Thus, the final rule provides two other options for a source. One is to monitor the bypass stack consistent with the proposed rule. The other is to treat any hours of bypass stack emissions as periods of monitor downtime. In general, this is consistent with the EPA's approach to startup and shutdown periods, in that we treat those periods as subject to a work practice standard. That generally obviates the need to monitor the bypass stack as the emission limit does not apply during the periods when the source is most likely to operate a bypass stack..."

In the past many facilities, although not this facility, have operated certain pollution control equipment only seasonally, therefore the bypass stack was routinely used during normal operation. The requirement in Subpart UUUUU to monitor the bypass stack addresses this possibility.

M10. 40 CFR 63 Subpart UUUUU Recordkeeping and Startup Monitoring

This recordkeeping requirement is taken directly from 40 CFR 63 Subpart UUUUU and the general requirements of 40 CFR 63.8 and 40 CFR 63.10 that apply to Subpart UUUUU

M11. Coal Plant Startup, Shut Down, and Outage Operation Procedures for RACT Order

This monitoring requirement is used to provide, by itself or in combination with other monitoring requirements, a reasonable assurance of compliance with the specific requirements contained in SWCAA 97-2057R1. Pursuant to SWCAA 400-081 "Start-up and Shutdown," technology based emission standards and control technology determinations must take into consideration the physical and operational ability of a source to comply with the applicable standards during start-up or shutdown. Where it is determined that a source is not capable of achieving continuous compliance with an emission standard during start-up or shutdown, SWCAA must include appropriate emission limitations, operating parameters, or other criteria to regulate performance of the source during start-up or shutdown.

M9 ensures sufficient monitoring to excuse unavoidable excess emissions or demonstrate compliance with the permit. The use of terms, test methods, units, averaging periods, and other conventions will be consistent with the applicable requirements. Emissions control equipment is operated to minimize overall emissions, except to the extent equipment operation will cause degradation of its long-term performance.

Exceedances of the PM and opacity limitations are excused under SWCAA 97-2057R1 based on SWCAA 400-107 during on-line preventive maintenance and manual ESP rapping which may cause short duration emissions increases, and during startup and shutdown when the ESPs are out of service. Excess emissions due to scheduled maintenance are considered unavoidable if the permittee adequately demonstrates the excess emissions could not have been avoided through reasonable design, better scheduling for maintenance, or through better operation and maintenance practices. ESP component maintenance and manual rapping of ESP plates are among the maintenance activities that often result in short duration excess emissions, however these excess emissions are considered unavoidable and necessary to enhance long-term equipment performance and, as such, are excused from penalty.

Shutdown of one FGD system requires opening of the damper to the associated bypass stack. This operation has been known to cause excess opacity. The cause of the excess opacity is believed to be re-entrainment of ash deposited in the duct near the damper. Excess opacity due to opening of the bypass damper and re-entrainment of ash deposits is unavoidable, and therefore will be excused from penalty providing:

- (a) The permittee reports the excess emission as soon as possible but no later than 48 hours after discovery;
- (b) The permittee adequately demonstrates that the cause of the excess opacity was opening of the bypass duct (e.g. the excess opacity was contemporaneous with bypass duct opening); and
- (c) The permittee adequately demonstrates that directing flue gas to the bypass stack was unavoidable (e.g. the FGD shutdown was not reasonably preventable).

Hourly SO₂ emissions during shutdown, startup, and maintenance of the SO₂ emission control technology in excess of 250 ppm are excused under SWCAA 400-107 provided the alternative hourly SO₂ limits of Req-20 are not exceeded. Shutdown and startup periods are defined based on an ESP temperature of 220°F or below, and the startup period begins when fuel is

introduced into a boiler to raise its temperature to operating conditions. ESP operation during startup and shutdown of EU-1 or EU-2 will degrade the overall ESP performance. When ESP temperature is below about 220°F, and especially when the boiler is combusting fuel oil, continued operation can result in fouling of the precipitator plates, which decreases long-term PM collection efficiency. Operation of the SO₂ emission control technology when the ESPs are off line and not removing PM is expected to foul or possibly plug key components, so the SO₂ emission control technology is not required to be placed in operation until the upstream ESPs are functioning. The end of the startup period is defined based on identifiable operating events.

Emissions in excess of both the 250 ppm hourly SO₂ limit and the alternative shutdown, startup, and SO₂ emission control technology outage limits of Req-20 may be excused provided the permittee meets the burden of proof regarding unavoidable emissions under SWCAA 400-107, especially subsections (4), (5), and (6). For unit startups, shutdowns, and on-line maintenance when the SO₂ emission control technology is out of service, the permittee is expected to blend lower sulfur coal into the boiler fuel supply prior to a planned outage of the SO₂ control system. The permittee submitted a scrubber startup, shutdown, and maintenance procedure in correspondence dated September 19, 2002. The document outlines the procedures implemented by the permittee to maintain compliance with the emission limits and operational requirements imposed by applicable air regulations and permits.

If burning high sulfur coal, sulfur dioxide emissions in excess of the 1,000 ppm limit in Req-19 are unavoidable during the first 6 – 8 hours (the length of time required to burn through coal stored in the silos) of a forced outage of the flue gas desulfurization (FGD) system if the cause of the forced outage is itself unavoidable. Good air pollution control practice for minimizing emissions during a forced outage of the FGD system include changing the coal blend so that emissions will be reduced below the 1,000 ppm limit after the high-sulfur coal blend is burned out of the silos. The permittee has indicated that the coal blend will be changed within approximately 15 minutes of notification of a scrubber problem.

M12. Coal Plant SO₂ 12-Month Period Emission Evaluation

This monitoring requirement is used to provide, by itself or in combination with other monitoring requirements, a reasonable assurance of compliance with the specific requirements contained in SWCAA 97-2057R1. Calculation of the annual tons of SO₂ emitted for comparison with the limitations must include all hourly SO₂ emission data, including startups, shutdowns, upsets, and forced or planned emission control system outages. An exceedance of the annual limitation is defined as any consecutive 12 calendar months in which SO₂ emissions exceed the tons per year SO₂ limitations applicable at the time. Although each day in the last month of the 12-month exceedance period can be treated as a separate day of violation, an alternative day-by-day evaluation method can be used by the permittee to more specifically identify the violation period. According to the alternative evaluation method, the number of violation days is equal to the number of 365-day emission summations, ending within the last month of the exceedance period, in which the SO₂ emissions exceed the annual limitation. This alternative evaluation method is the same as a 365-day rolling total, rolled each calendar day.

M13. Coal Plant SO₂ Monitoring of Bypass Stacks

This monitoring requirement is used to provide, by itself or in combination with other monitoring requirements, a reasonable assurance of compliance with the specific requirements contained in SWCAA 97-2057R1. The owners of the Centralia Plant had sole discretion to select the SO₂ and NO_x emission control technologies provided they met the applicable emission limits. The control technology configuration could include the maintenance of the original stacks for bypass provided a CEMS was maintained to monitor SO₂ emissions from the bypass stacks.

If the bypass stacks do not contain certified functional CEMS for SO₂, any emergency bypass emissions released through these stacks will be considered an upset condition reportable to SWCAA as a deviation from permit conditions. All SO₂ emissions released from the facility, regardless of where, how, or under what operating condition, is included in the plant SO₂ total for comparison with the annual limitation.

M14. Coal Plant Fuel Oil Usage Evaluation

This monitoring requirement is used to provide, by itself or in combination with other monitoring requirements, a reasonable assurance of compliance with the specific requirements contained in SWCAA 97-2057R1 and the fuel usage monitoring requirement of 40 CFR 63.7525(k). The permittee is required to monitor fuel oil usage in all of the boilers. The permittee accepted a voluntary limit on the amount of fuel oil consumed by the auxiliary boiler (EU-3) so it would not be necessary to evaluate RACT for this unit. RACT may have otherwise been applicable because the auxiliary boiler's potential-to-emit was sufficient to qualify it as a major source on its own, even though emissions calculated from actual fuel usage resulted in emissions substantially below the major source threshold. To evaluate fuel usage compared to the consumption limit, the auxiliary boiler must be equipped with a separate fuel meter or be supplied by its own unique fuel tank to identify fuel consumed in the auxiliary boiler. If the auxiliary boiler consumes fuel oil containing the maximum allowed 0.5% sulfur by weight, the SO₂ emissions from EU-3 will be larger than emissions of other criteria pollutants from EU-3. Emissions are calculated based on emission factors from U.S. EPA AP-42 §1.3. An example of this SO₂ emission calculation using the maximum allowed annual fuel consumption is shown below:

$$\frac{600,000 \text{ gallons}}{\text{year}} \cdot \frac{7.206 \text{ lb oil}}{\text{gallon}} \cdot \frac{0.005 \text{ lb S}}{\text{lb oil}} \cdot \frac{1 \text{ lb} \cdot \text{mole S}}{32 \text{ lb S}} \cdot \frac{64 \text{ lbs SO}_2}{\text{lb} \cdot \text{mole SO}_2} \cdot \frac{1 \text{ ton}}{2,000 \text{ lbs}} = 21.6 \text{ tons per year}$$

The daily fuel monitoring requirement of 40 CFR 63.7525(k) is used to demonstrate that the boiler remains in the "limited use" subcategory and is exempt from many of the requirements of 40 CFR 63 Subpart DDDDD.

M15. Black Stop Diesel Generator Engine Source Testing Requirements

Requirements removed – the Black Stop Generator Engine was permanently retired at the end of 2020.

M16. Black Stop Diesel Generator Engine Startup and Shutdown

Requirements removed – the Black Stop Generator Engine was permanently retired at the end of 2020.

M17. Black Stop Diesel Generator Engine Fuel Certification

Requirements removed – the Black Stop Generator Engine was permanently retired at the end of 2020.

M18. Black Stop Diesel Generator Engine Hours Monitoring

Requirements removed – the Black Stop Generator Engine was permanently retired at the end of 2020.

M19. Maintenance Activities Monitoring

The data provided by this monitoring requirement, in conjunction with source testing, provides a reasonable assurance that emissions that are not monitored continuously are within permitted limits. Each occurrence of maintenance and repairs to the fly ash unloading pugmill or turbine lube oil mist eliminators that may affect emissions is recorded. This data is available to plant personnel and SWCAA upon inspection. This data can be periodically reviewed by SWCAA and plant personnel to determine if emission factors used to calculate emissions remain valid.

For example, the replacement of filters in the lube oil mist eliminators could affect emissions if a slightly different filter were installed, therefore filter replacements for the turbine lube oil mist eliminators must be documented.

This monitoring term was included in SWCAA 01-2403 because it can be a valuable inspection tool that requires minimal effort on the part of the permittee.

M20. Particulate Matter Compliance Assurance Monitoring for BW22

The permittee was required to submit a Compliance Assurance Monitoring (CAM) plan for particulate matter emissions from EU-2 in accordance with 40 CFR 64 for the permit renewal in 2004. CAM is applicable to emissions from both the bypass and FGD stacks of EU-2. The permittee's CAM plan was approved as incorporated into the Air Operating Permit. The CAM plan utilizes opacity as a surrogate indicator of particulate matter control device operation and particulate matter emissions.

The CAM plan for the bypass stacks was required because the permittee is allowed to use the bypass stack for limited periods of time outside of startup, shutdown, and extreme emergency conditions. To date, the bypass stacks have not been used except during startup, shutdown, and upsets. Because facilitywide SO₂ emissions are limited to 10,000 tons per year, use of the unscrubbed bypass stack rapidly utilizes the allowable annual emissions (at a rate of ~5 tons per hour), therefore use of these stacks outside of startup, shutdown, and extreme emergencies is unlikely. Any significant use of the bypass stack can result in

restrictions on plant operation to maintain compliance with the 10,000 ton per year SO₂ limit.

For the FGD stack, opacity in the ductwork upstream of the scrubber of less than 30% provides an adequate assurance that particulate matter emissions from the applicable FGD stack will be less than the permit limit. Source testing at this facility has demonstrated that the scrubber is highly efficient at removing particulate matter from the flue gas. Particulate matter emission levels well below the indicator range will adversely affect scrubbing liquor chemistry and gypsum quality and potentially result in damage to the scrubber, therefore the permittee is highly motivated to maintain opacity levels well below the 30% level.

When an excursion occurs, the Permittee is required to submit a report that includes the "ESP field settings" along with the fields out of service. The ESP field settings are the secondary voltage and secondary current, consistent with 40 CFR 63 Subpart UUUUU.

M21. Coal Unloading Facility

The data provided by this monitoring requirement is used to calculate annual emissions of particulate matter from the coal unloading facility.

M22. FGD Bleed Treatment Lime Storage Silo

Differential pressure across the dust collector must be recorded at least monthly to assist in evaluating whether the dust collector is operating properly. Large changes in differential pressure can indicate operational problems. The number of hours the silo is actively vented must be recorded annually to allow the calculation of emissions from the silo. In conjunction with the monthly inspections required by M3, this data will provide a reasonable assurance of ongoing compliance with the particulate matter emission limits.

M23. Journal Shop

The amount of each type of welding rod that is used in the Journal Shop must be monitored and recorded to calculate annual emissions. The Journal Shop baghouse is designed to provide a high level of control and utilizes both primary filters and secondary HEPA filters. SWCAA believes that unless there is an obvious upset condition (for which monitoring is required), the unit will comply with particulate matter emission limits.

M24. Reserved

M25. SNCR System Monitoring

In accordance with Condition 4 of the Second Revision of BART Order No. 6426, ammonia monitoring is required only when urea injection exceeding 1.5 gallons per minute is used for NO_x control. Condition 7 requires reporting of the urea concentration and injection rate within 30 days of first injecting urea in a calendar year, but does not include monitoring, or any reporting after those 30 days. Urea flow rate monitoring is necessary for SWCAA and Ecology to know when ammonia testing is required; therefore, this

provision was added under the "gap filling" monitoring provisions of WAC 173-401-615(1).

M26. Coal Plant Emergency Engine Monitoring

These requirements come directly from 40 CFR 60 Subpart IIII (for Emergency Diesel Generator 2), 40 CFR 63 Subpart ZZZZ (for Emergency Diesel Generator 1), and SWCAA 16-3188. For the purposes of Subparts IIII and ZZZZ, the engines are classified as emergency compression ignition engines with a site rating of less than 500 horsepower. For this classification of engine in each rule, the applicable requirements are all operating or maintenance requirements. The permittee must document how many hours each engine is operated, and for what purpose it was operated, to demonstrate that the engines are indeed being operated as emergency engines. Because all operating and maintenance activities must be documented, and all operating hours accounted for, these monitoring provisions provide a reasonable assurance of compliance with the applicable requirements. A review of the documentation for a specific engine will conclusively determine the compliance status of the unit with respect to the operating and maintenance requirements.

M27. Fire Pump Engine Monitoring

M27(a) comes directly from SWCAA 16-3188 and provides a reasonable assurance of compliance with the fuel sulfur limitations and allows for the calculation of annual sulfur dioxide emissions.

M27(b) comes directly from SWCAA 16-3188 and provides a reasonable assurance of compliance with the hours limitation and allows for a calculation of annual emissions.

Unless new testing is conducted after the issuance date of SWCAA 16-3188 (June 1, 2016), the following emission factors are to be used:

Pollutant	Fire Pump Engine Emission Factors (lb/hr)
NO _x	1.12
CO	0.54
PM	0.050
PM ₁₀	0.050
PM _{2.5}	0.050

M27(c) provides a reasonable assurance of compliance with the maintenance requirements of 40 CFR 63 Subpart IIII. Subpart IIII requires that certain maintenance activities be undertaken as specified frequencies (measured in the number of hours an engine has operated) but does not include any provision for monitoring how many hours an engine has operated. SWCAA has required the permittee to document the hour meter reading at each incident of maintenance and repairs under the "gap filling" provisions of WAC 173-401-615. Since maintenance activities must occur at least once per year, this means that at least once per year there will be written documentation of the number of hours of operation between maintenance events. Also, at any time after the first maintenance event, the

permittee or the inspector can compare the hour meter reading for an engine to the hour meter reading during the last maintenance event to determine whether the maintenance schedule is being met.

M28. Coal Unloading Facility Emergency Diesel Sump Pump Engine Monitoring

M28(a) comes directly from SWCAA 11-2972 and provides a reasonable assurance of compliance with the fuel sulfur limitations and allows for the calculation of annual sulfur dioxide emissions.

M28(b) comes directly from SWCAA 11-2972 and provides a reasonable assurance of compliance with the hours limitation and allows for a calculation of annual emissions.

Unless new testing is conducted after the issuance date of SWCAA 11-2972 (April 14, 2011), the following emission factors are to be used:

Pollutant	Emission Factors (lb/hr)
NO _x	2.54
CO	0.44
PM	0.055
PM ₁₀	0.055
PM _{2.5}	0.055

M28(c) provides a reasonable assurance of compliance with the maintenance requirements of 40 CFR 60 Subpart III. Subpart III requires that certain maintenance activities be undertaken as specified frequencies (measured in the number of hours an engine has operated) but does not include any provision for monitoring how many hours an engine has operated. SWCAA has required the permittee to document the hour meter reading at each incident of maintenance and repairs under the "gap filling" provisions of WAC 173-401-615. Since maintenance activities must occur at least once per year, this means that at least once per year there will be written documentation of the number of hours of operation between maintenance events. Also, at any time after the first maintenance event, the permittee or the inspector can compare the hour meter reading for an engine to the hour meter reading during the last maintenance event to determine whether the maintenance schedule is being met.

This documentation can be compared with the written maintenance instructions provided or approved by the manufacturer to determine the status of compliance with this requirement.

M29. Mercury Control System and Fly Ash Material Handling

The number of hours each unit is operated must be logged to allow for the calculation of annual emissions. Annual emissions must be calculated using the emission factors shown below unless new emission factors are developed through source testing.

Filter	(lb/hr)
SEA System 1	0.048
SEA System 2	0.048
Sorbent Silo 1	0.015
Sorbent Silo 2	0.015
Fly Ash Bin 11	0.63
Fly Ash Bin 12	0.63
Fly Ash Bin 14	0.63
Fly Ash Bin 14 Air Slide to Bin 11 Air Slide	0.039
Fly Ash Bin 11 to Weigh Hopper Air Slide	0.039
Fly Ash Bin 14 to 6050 Air Slide	0.026

The above emission rates listed in the table above are based on the design flow rate for each unit and the permitted emission concentration (0.005 gr/dscf).

M30. Fly Ash Baghouses - Source Emission Testing Requirements

Initially, periodic source emissions testing was coupled with the use of a baghouse leak detection system to provide a reasonable assurance with the permitted emission limits. This was the same approach taken by EPA in NSPS and MACT standards (e.g. NSPS Subpart Y) issued after November 15, 1990 to assure compliance with numeric particulate matter limits; therefore, this approach was presumed to be equivalent to CAM. A CAM Plan was later developed for these baghouses in accordance with 40 CFR 64 and is included as M34. The CAM Plan replaced the previous requirement to operate the baghouse leak detectors in accordance with the requirements in 40 CFR 62.256(c).

The initial alarm setpoints of 100 pA were established based on the results of source emissions testing conducted October 2011 during which the following results were obtained:

Baghouse	Bin 11	Bin 12	Bin 14
Filterable PM	0.0001 gr/dscf	0.0002 gr/dscf	0.0001 gr/dscf
Leak Detector Output	23 pA	18 pA	42 pA

The system utilizes a Tribo-Flow model 4001-1111-0I-154N detector. Manufacturer literature indicates that the equipment is designed for a detection limit on the order of 0.0005 gr/dscf; therefore, the instrument response during the initial testing appears to be a low baseline. The 100 pA alarm setpoint is significantly less than 10 times this baseline for all stacks and well below the response expected at a concentration of 0.005 gr/dscf (the permit limit).

M31. Fly Ash Bin Baghouses – Compliance Assurance Monitoring

The permittee was required to submit a Compliance Assurance Monitoring (CAM) plan for particulate matter emissions from EU-17, EU-18, and EU-19 in accordance with 40 CFR 64 for the permit renewal in 2014. CAM is applicable to these units because

uncontrolled PM emissions would be expected to exceed 100 tons per year each. The permittee's CAM plan was approved as incorporated into the Air Operating Permit. The CAM plan utilizes an electrostatic particle detection system (also known as a baghouse leak detection system) as a surrogate indicator of particulate matter control device operation and particulate matter emissions. This is the same approach taken by EPA in NSPS and MACT standards (e.g. NSPS Subpart Y) issued after November 15, 1990 to assure compliance with numeric particulate matter limits; therefore, this approach is presumed to satisfy CAM requirements.

During initial source emissions testing in October 2011, emissions from the baghouses were measured at 0.0001 – 0.0002 gr/dscf. This level is generally at the method detection limit and 25-50 times lower than the applicable emission limit of 0.005 gr/dscf. During the testing the electrostatic particle detector readings were 18 – 42 pA. Based on this testing, TransAlta's initial alarm setpoint of 100 pA was sufficiently protective of the permit limit that no additional testing was necessary to establish an appropriate upper limit to the indicator range.

Alarm setpoints for these types of detectors may need to be adjusted from time to time due to changes in stack conditions, ambient conditions, or detector replacements. Where such detectors are referenced in NSPS/MACT regulations (e.g. 40 CFR 60 Subpart Y, 40 CFR 63 Subpart SSSSSS), sources are allowed to change the alarm setpoints quarterly in accordance with their site-specific monitoring plan. TransAlta's CAM plan (analogous to a site specific monitoring plan under NSPS/MACT regulations) indicates that changes to the alarm setpoint would be based upon the results of source emissions testing. SWCAA incorporated this provision into the Permit.

M32. Reserved

M33. Coal-Fired Boiler Tune-up and Startup/Shutdown Monitoring

40 CFR 63 Subpart UUUUU requires periodic tune-ups in accordance with specific requirements. In addition, all "applicable control technologies" must be engaged when firing anything other than "clean fuels". In this case, the only other fuel is coal.

A semiannual compliance report must be submitted that includes the date of the most recent tune-up and a report if there were any deviations from the work practice standards (consisting of the tune-up and the startup and shutdown provision). 40 CFR 63.10032(a)(1) requires sources to maintain all documentation supporting each semiannual report. This requirement describes this documentation as it pertains to the work practice standards (tune-ups and startup/shutdown provisions).

Full documentation of each tune-up as required by section (a) provides all of the records necessary to determine if all the tune-up requirements are being met.

The information in section (b) is necessary to determine:

- a. That "clean fuels" are being burned during startup;
- b. When the unit is in startup or shutdown, because the emission limits from Subpart UUUUU do not apply during startup or shutdown; and

- c. That the relevant emission control equipment is being engaged when required.

M34. Auxiliary Boiler Tune-up Monitoring

40 CFR 63 Subpart DDDDD requires periodic tune-ups in accordance with specific requirements. The initial tune-up must be fully documented in to comply with 40 CFR 63.7555(a)(1), but there is no specific requirement to fully document subsequent tune-ups. Consequently, SWCAA has implemented this documentation requirement for subsequent tune-ups under the "gap filling" provisions of WAC 173-401-615.

Full documentation of each tune-up as required by this requirement provides all of the records necessary to determine if all the tune-up requirements are being met.

M35. Fine Coal Handling

The requirements listed this monitoring condition are all included in both 40 CFR 60 Subpart Y and SWCAA 14-3093. Because the permittee has not committed to a single monitoring strategy, both of the allowable strategies were included. The total amount of coal transferred is required by Subpart Y and necessary to calculate annual emissions.

M36. Acid Rain, RACT, and NSR CEMS Data Recordkeeping Requirements

This recordkeeping section is taken from 40 CFR 75.57, 75.58, and 75.59 and supplemented by specific requirements from SWCAA 97-2057R1, and the "gap filling" provisions of WAC 173-401-615(2).

The Acid Rain Program requires that pertinent records be maintained for at least three years from the date of the record. However, the recordkeeping provisions of the Air Operating Permit regulations, WAC 173-401-615(2)(c), require retention of records for a period of five years.

The basis for recordkeeping requirements for 1-hour SO₂ standard concentrations (dry @ 7% O₂) is the "gap filling" provisions of WAC 173-401-615(2). Data from the plant computer system not required by the Acid Rain Program is not saved for archiving in the same way that data consistent with 40 CFR 75.57 - 75.59 is recorded.

The Acid Rain regulation specifies the type and format of data to be recorded for flow and SO₂ emissions from Acid Rain affected units. The data recordkeeping requirements pursuant to SWCAA 97-2057R1 for 1-hour SO₂ standard concentration (dry @ 7% O₂) are parallel to those of the Acid Rain Program, but for a smaller quantity of required data. The data recordkeeping requirements for rolling 12-month SO₂ emissions (tons per year) are specified, and the additional data to be included in this summation stated for recordkeeping purposes.

The data recordkeeping requirements for hourly NO_x corresponding to unit generating load of 360 MW gross or greater are parallel to those of the Acid Rain Program, but for a smaller quantity of required data pursuant to SWCAA 97-2057R1 Section 30.

M37. 40 CFR 63 Subpart DDDDD Recordkeeping

This recordkeeping requirement is taken directly from 40 CFR 63.7555 and 40 CFR 63.7560.

M38. 40 CFR 60 Subpart Y Recordkeeping

This recordkeeping requirement is taken directly from 40 CFR 60 Subpart Y. The amount of coal processed will be the amount of coal conveyed to the permittee's facility and used to calculate annual emissions.

VIII. EXPLANATION OF SELECTED REPORTING TERMS AND CONDITIONS

R1. Deviations from Permit Conditions and CAM Excursions

The permittee is required to report all permit deviations promptly. This reporting requirement is taken directly from WAC 173-401-615(3) and is included in some form in PSD-01-01 Amendment 2 Condition 22(d)(1), Second Revision of BART Order No. 6426 Section 11, SWCAA 97-2057R1 Sections 23, 28, 29, and 37, SWCAA 01-2403 Section 11(e)(1), SWCAA 01-2350R4 Conditions 28(a & b), SWCAA 11-2984 Conditions 15 and 16, SWCAA 14-3093 Conditions 17 and 18, and SWCAA 16-3188 Conditions 12 and 13. SWCAA defines "prompt" in the permit in relation to the degree and type of deviation likely to occur and the applicable requirement. Excess emissions of SO₂, particulate matter, or opacity are to be reported to SWCAA during the current business day or next business morning. A written report may be requested by SWCAA and is required for any SO₂ emission control technology forced outage longer than 72 hours. Any emissions released through a bypass duct without a certified functioning CEMS are defined as an upset condition which must be reported to SWCAA during the current business day or by the next business morning and must be documented to SWCAA within 5 days of occurrence. All other deviations must be reported no later than 30 days following the end of the month during which the deviation was discovered. This reporting frequency is taken from WAC 173-401-615(3).

R2. Complaint Reports

The permittee is required to report all complaints to SWCAA within three business days of receipt to ensure prompt complaint response. This reporting section is based on WAC 173-401-615(3), and SWCAA's definition of "prompt" for reporting of complaints.

R3. Quarterly Reports

The permittee is required to report specific monitoring records and provide a certification of monitoring records on a quarterly basis for the Acid Rain Program. Although a semiannual report on the status of, and certification of monitoring records is required by WAC 173-401-615(3), quarterly reporting of specified monitoring records is required under 40 CFR 75.64, with compliance certification according to 40 CFR 75.64(c). Non-Acid Rain reporting requirements for the coal plant are derived from 40 CFR 63 Subpart UUUUU, the Second Revision of BART Order No. 6426, SWCAA 97-2057R1 Sections 27d, 43, and 45, and WAC 173-401-615(3). Non-Acid Rain reporting requirement for the combustion turbine facility

are specified in SWCAA 01-2350R4 and PSD-01-01 Amendment 2. Although records are reported quarterly, certification of non-Acid Rain monitoring records is only required every six months consistent with WAC 173-401-615(3).

No specific NO_x reporting requirements were included in the SWCAA 97-2057R1 to demonstrate compliance with the NO_x emission limits that apply at 360 MW or greater, therefore section R3(e) was added using the "gap-filling" provisions of WAC 173-401-615.

For Subpart UUUUU reports, no special SO₂ CEMS data reporting are listed because reporting of SO₂ data (and supporting diluent and/or moisture monitors) is covered by the Acid Rain Program reporting requirements (see the Acid Rain Permit and 40 CFR 75). EPA guidance indicates that Acid Rain Program requirements must not be detailed in Title V permits. The Acid Rain Permit incorporates the appropriate requirements by reference. The Hg CEMS reporting requirements mirror the Acid Rain Program reporting requirements for SO₂ and require utilization of the same data reporting system. SWCAA will have access to the data through EPA's system upon submission.

R4. Semiannual Reports

The permittee is required to provide a report of all monitoring records and provide a certification of all reports on a semi-annual basis. Semiannual reporting and certification of monitoring records is required by WAC 173-401-615(3). A Responsible Official must certify all reports required by the Title V permit.

In addition, specific reporting elements required by 40 CFR 63 Subpart UUUUU have been listed.

R5. Annual Reports and Compliance Certification

The permittee is required to report and certify compliance with all permit terms and conditions on an annual basis. Annual compliance certification is required by WAC 173-401-630(5) for all requirements, including Acid Rain Program requirements. Since 2005, a separate Acid Rain Program certification has not been required.

All of the items other than the compliance certification are used to calculate annual emissions from individual emission units.

R6. Emission Inventory Reports

The permittee is required to report an inventory of emissions from the source on an annual basis. Annual reporting of emissions inventory is required under SWCAA 400-105 to be submitted to SWCAA by March 15th for the previous calendar year unless an extension is approved by SWCAA. SWCAA's Executive Director may extend the submittal date to April 15th (the deadline in WAC 173-400-105).

R7. Source Test Plans and Reports

The permittee is required to notify SWCAA in advance of all required source testing so that SWCAA personnel may be present during testing. The permittee must also report test results within 45 days of test completion to allow timely review by SWCAA. Operating conditions are also to be included in all test reports to relate emissions to the method of operation. Source testing described in monitoring requirements M8 and M15 are examples of source test results subject to this reporting requirement.

R8. Acid Rain Notification of Certification and Recertification Test Dates and Applications and Other General Reporting Provisions

This reporting section is taken from 40 CFR 75.60, 75.61 and 75.63 to indicate that the reporting requirements in these Acid Rain sections apply. Advance notification within specified time periods is required for the date each unit commences commercial operation, CEMS certification and recertification tests, relative accuracy test audits, and COMS certification and recertification tests at Acid Rain affected units. An application for certification or recertification is required for Acid Rain affected units. Each certification application is to be submitted in electronic or paper format as specified by the EPA Administrator. The permittee must comply with All Acid Rain reporting requirements in 40 CFR 75.60.

R9. BART Order Milestone and Urea Injection Reports

This reporting section is taken directly from the Second Revision of BART Order No. 6426.

R10. 40 CFR 63 Subpart DDDDD Reports for Auxiliary Boiler

This reporting section is taken from 40 CFR 63.7545(e) and 40 CFR 63.9. The Notification of Compliance Status must include an identification of which category each boiler is in for the purposes of 40 CFR 63 Subpart DDDDD. The Auxiliary Boiler (EU-3) is in the "Limited Use Boiler" subcategory.

R11. 40 CFR 63 Subpart UUUUU Reports

This reporting section is taken from 40 CFR 63 Subpart UUUUU and includes all reports not required to be submitted each quarter or semiannually.

R12. 40 CFR 60 Subpart Y Performance Monitoring Reports

This reporting section is taken from 40 CFR 63 Subpart Y and applies to the periodic visible emission evaluation reports required by Subpart Y.

IX. COMPLIANCE HISTORY

The following Notices of Violation (NOV) were issued for the time period beginning 5 years before the current permit term.

NOC/ NOV No.	Violation Date	Notes
5881	7/12/2015	Bypass of the Unit 2 scrubber during normal operation. The bypass occurred because maintenance personnel accidentally locked out the pH probe signals, rather than the level probe signals, when performing a monthly preventative maintenance flush on the level probes
5882	7/23/2015	Failure to complete SNCR optimization testing by the end of calendar year 2014.
6111	6/18/2016	Partial bypass of Unit 1 scrubber and associated opacity exceedance. The Unit 1 scrubber was partially bypassed between 11:20 and 11:48 on Saturday June 18, 2016. The partial bypass occurred when the connection between a damper actuator and control motor broke during a startup of Unit 1.
6121	8/22/2017	Unit 2 selective non-catalytic reduction (SNCR) system was offline between 05:52 and 11:28 when the urea tank ran empty. TransAlta's report of the incident indicated that they were maintaining a low level in the tank after some foundation concern following an earlier subsurface water leak. Subsequently the urea need increased due to increased operations and urea deliveries were not increased to compensate.
6123	7/28/2017, 8/3/2017, 10/9/2017	Exceedances of voluntary SO ₂ emission limit established to protect NAAQS. Primary cause may have been that increasing emissions were not noticed in time by control room operators.
6125	8/5/2017 – 9/14/2017 U1 7/21/2017 – 9/13/2017 U2	Exceedances of the 30-boiler operating day rolling average mercury emission limit. Caused in part by under-feeding carbon adsorbent.
6426	2017	Improper operation of SNCR systems for Units 1 and 2 for calendar year 2017. Included under-injection of urea, use of incorrect injection devices, and use of incorrect urea concentrations.
6427	12/27/2017 – 1/23/2018	The mercury emissions from Unit 2 exceeded 1.2 lb/TBtu (30-boiler operating day rolling average) from December 27, 2017 through January 23, 2018.
10101	8/3/2018 – 8/10/2018	The mercury emissions from Unit 1 exceeded 1.2 lb/TBtu (30-boiler operating day rolling average) from August 3, 2018 through August 10, 2018.
10102	9/1/2018	Unit 1 scrubber bypass between approximately 05:25 and 06:01. The bypass was initiated by an inadvertent mouse click that resulted in one of the two ducts (duct 11) being placed in bypass mode.

NOC/ NOV No.	Violation Date	Notes
10103	11/8/2018	During the startup of Unit 1 on November 8, 2018 the selective non-catalytic reduction (SNCR) system was not engaged as early as it should have been to control NO _x emissions. During this startup a set of fans on the boiler tripped, which also tripped the SNCR system offline. The fact that the SNCR system had been tripped offline was not noticed by the operators until the shift change at 7:00 a.m. TransAlta reported that based on the steam flow the SNCR system should have been operational between 05:00 and 06:00. Operators noticed the issue and started the SNCR system between 07:00 and 08:00.
10106	1/1/2018 – 4/13/2019	Improper operation of the SNCR systems on both Units 1 and 2.

X. APPENDICES

Appendix A of the Air Operating Permit contains the methods by which visible emissions from the permittee's operations are to be evaluated when performing required monitoring. SWCAA has exercised its latitude under SWCAA 400-105(4) "Source Testing" to approve an alternative test method in advance for visible emissions. Approval has been granted via signature of SWCAA's Control Officer in this permit. The federal requirements still require that EPA Method 9 be performed. The difference between the Appendix A visible emission method and EPA Method 9 is the data reduction method used.

Appendix B of the Air Operating Permit contains the Acid Rain Permit for the Centralia Plant. The Acid Rain permit is effective beginning on the same date as this Air Operating Permit through the expiration date of this Air Operating Permit. Nearly all requirements in the Acid Rain permit are incorporated by reference to the applicable regulation; therefore changes in the applicable regulation are automatically incorporated into the permit.

Appendix C of the Air Operating Permit contains TransAlta's Small Engine Maintenance Plan used to meet the maintenance requirements of 40 CFR 60 Subpart IIII and 40 CFR 63 Subpart ZZZZ for specific engines.

XI. PERMIT ACTIONS

Air Operating Permit SW98-8 (original Title 5 permit)

1. Final Permit Issued: August 6, 1999

Air Operating Permit SW98-8-R1 (administrative permit amendment)

1. Final Permit Issued: July 12, 2000

Air Operating Permit SW98-8-R2 (first renewal)

1. Final Permit Issued: August 6, 2004

Air Operating Permit SW98-8-R2-A (modification)

1. Final Permit Issued: May 12, 2005

Air Operating Permit SW98-8-R2-B (modification)

1. Final Permit Issued: March 25, 2008

Air Operating Permit SW98-8-R3 (second renewal)

1. Renewal Permit Application Submitted: February 3, 2009
 2. Permit Application Deemed Complete: March 17, 2009
 3. Permit Application Sent to EPA: May 15, 2009
 4. Draft Permit Issued: May 15, 2009
 5. Proposed Permit Issued: July 21, 2009
 6. Final Permit Issued: September 16, 2009

Air Operating Permit SW98-8-R3-A (modification)

1. "Reopening for Cause" Letter to Permittee: July 12, 2011
 2. Draft Permit Issued: September 14, 2011
 3. Proposed Permit Issued: October 26, 2011
 4. Final Permit Issued: December 21, 2011

Air Operating Permit SW98-8-R4 (third renewal)

1. Renewal Permit Application Submitted: September 16, 2013
 2. Permit Application Deemed Complete: January 8, 2014
 3. Permit Application Sent to EPA: January 8, 2014
 4. Draft Permit Issued: June 6, 2014
 5. Proposed Permit Issued: July 16, 2014
 6. Final Permit Issued: September 16, 2014

Air Operating Permit SW98-8-R4-A (modification)

1. Reopening for Cause" Letter to Permittee: April 24, 2015
 2. Draft Permit Issued: November 20, 2015
 3. Proposed Permit Issued: January 7, 2016
 4. Final Permit Issued: March 14, 2016

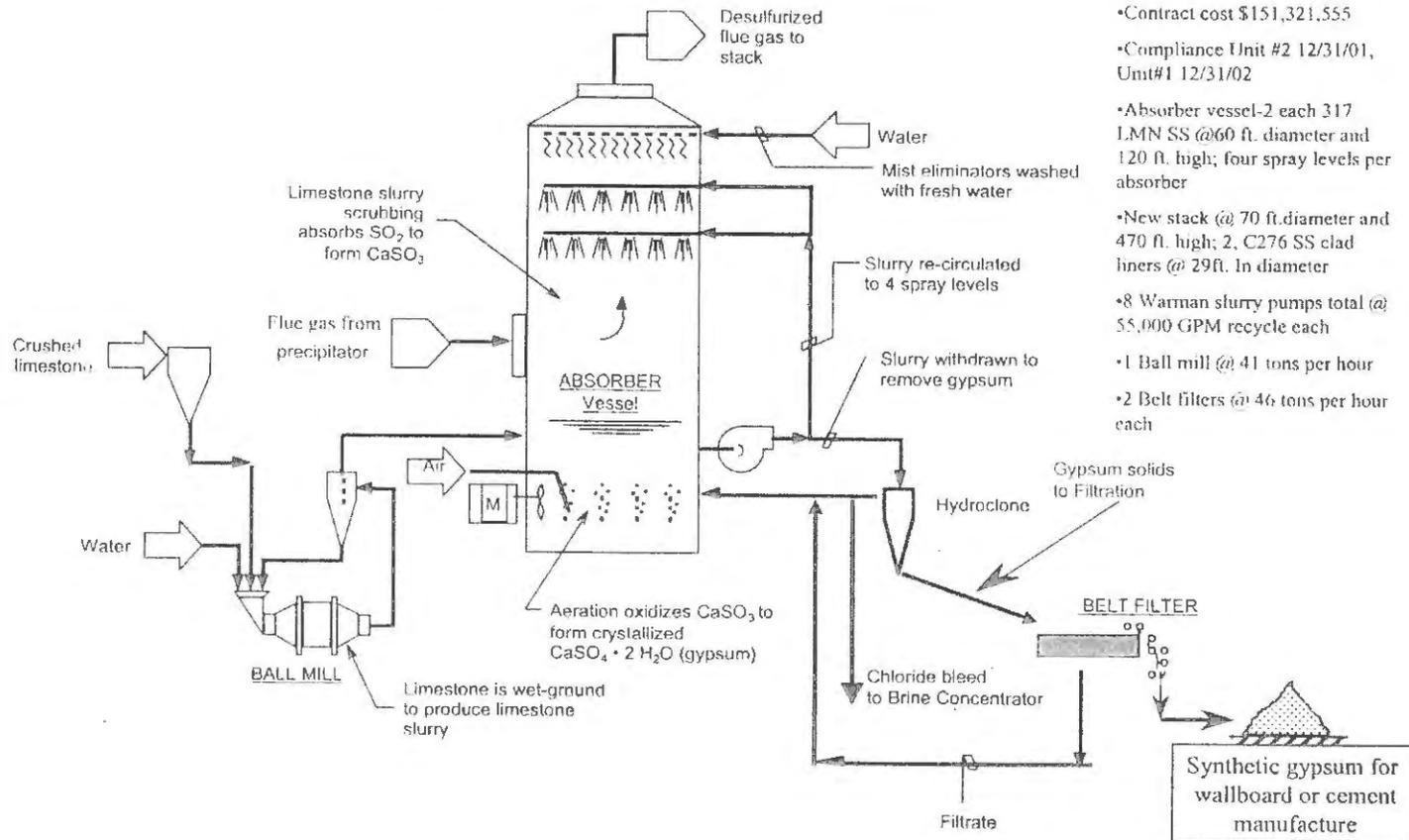
Air Operating Permit SW98-8-R5 (fourth renewal)

1. Renewal Permit Application Submitted: September 13, 2018
 2. Permit Application Deemed Complete: April 19, 2019
 3. Permit Application Sent to EPA: July 18, 2019
 4. Draft Permit Issued: July 18, 2019
 5. Proposed Permit Issued: August 27, 2019
 6. Final Permit Issued: October 14, 2019

XII. PLANT DRAWINGS

Drawing 1 – Forced Oxidized Limestone FGD System

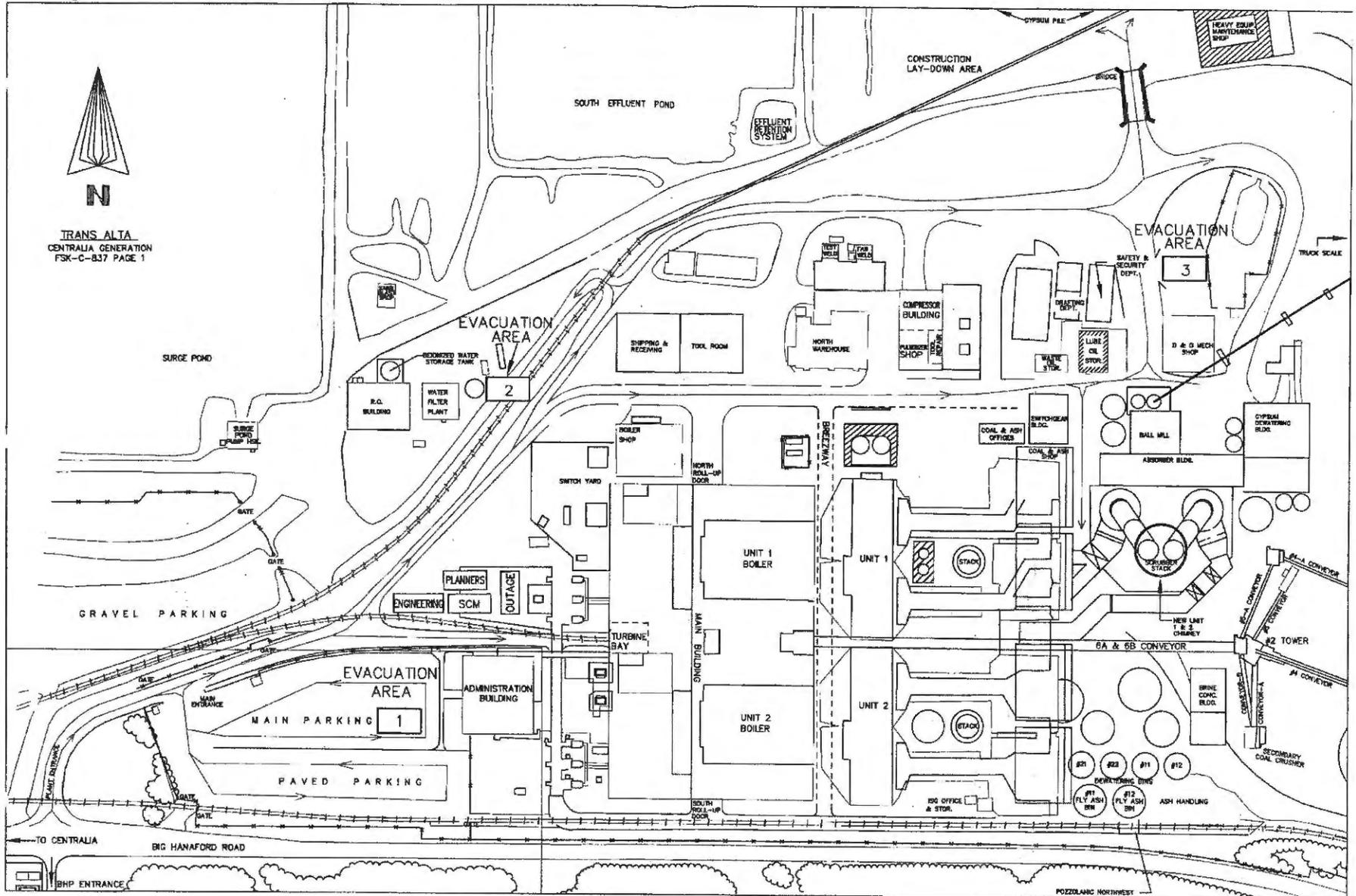
TransAlta Centralia Forced Oxidized Limestone FGD System



Centralia Power Plant FGD

- Contract cost \$151,321,555
- Compliance Unit #2 12/31/01, Unit#1 12/31/02
- Absorber vessel-2 each 317 LMN SS @60 ft. diameter and 120 ft. high; four spray levels per absorber
- New stack @ 70 ft. diameter and 470 ft. high; 2, C276 SS clad liners @ 29ft. in diameter
- 8 Warman slurry pumps total @ 55,000 GPM recycle each
- 1 Ball mill @ 41 tons per hour
- 2 Belt filters @ 46 tons per hour each

Drawing 2 - Coal Plant Schematic



Appendix A
Applicable Requirement Review

CFR 60 Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines		
Requirement	Title V Permit Location	Comments
60.4200	—	"Am I subject to this subpart?" Informational. This subpart applies to the Coal Unloading Facility Emergency Diesel Sump Pump Engine, Emergency Diesel Generator 2, and the Fire Pump Engine.
60.4201	—	"What emission standards must I meet for non-emergency engines if I am a stationary CI internal combustion engine manufacturer?"
60.4202	—	"What emission standards must I meet for emergency engines if I am a stationary CI internal combustion engine manufacturer?"
60.4203	—	"How long must my engines meet the emission standards if I am a manufacturer of stationary CI internal combustion engines?"
60.4204	—	"What emission standards must I meet for non-emergency engines if I am an owner or operator of a stationary CI internal combustion engine?" Section (b) states that 2007 model year and later non-emergency engines must comply with 40 CFR 60.4201 as applicable. This applies to the Fire Pump Engine. Compliance is met through engine certification and proper operation and maintenance. This engine is Tier 3 EPA certified which meets this requirement. No active requirement.
60.4205	—	"What emission standards must I meet for emergency engines if I am an owner or operator of a stationary CI internal combustion engine?" Section (a) states that the pre-2007 model year engines must meet the requirements in Table I. This applies to the Coal Unloading Facility Emergency Diesel Sump Pump. Compliance is met through engine certification and proper operation and maintenance. This engine is Tier 2 EPA certified which meets the Table 1 requirement. Section (b) states that 2007 model year and later emergency engines must comply with 40 CFR 60.4202 as applicable. This applies to Emergency Diesel Generator 2. Compliance is met through engine certification and proper operation and maintenance. This engine is Tier 3 EPA certified which meets this requirement. No active requirements in this section.
60.4206	—	"How long must I meet the emission standards if I am an owner or operator of a stationary CI internal combustion engine?" Informational. No exemption or modification of any other requirement in this section.
60.4207	Req-60, Req-68	"What fuel requirements must I meet if I am an owner or operator of a stationary CI internal combustion engine subject to this subpart?"
60.4208	—	"What is the deadline for importing or installing stationary CI ICE produced in previous model years?"
60.4209	—	"What are the monitoring requirements if I am an owner or operator of a stationary CI internal combustion engine?" Requires compliance with monitoring requirements of 40 CFR 60.4211.

CFR 60 Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines		
Requirement	Title V Permit Location	Comments
60.4209(a)	Req-54	Requires emergency engines that do not meet the requirements for non-emergency engines to install a non-resettable hour meter. This applies to Emergency Diesel Generator 2 which is a 2016 model year certified to EPA Tier 3 for emergency use only.
60.4209(b)	—	Requirements for engines using particulate filters to comply with standards. The engines at this facility do not utilize particulate filters.
60.4210	—	"What are my compliance requirements if I am a stationary CI internal combustion engine manufacturer?"
60.4211	"What are my compliance requirements if I am an owner or operator of a stationary CI internal combustion engine?"	
60.4211(a)	Req-64, Req-67	Operation and maintenance requirements.
60.4211(b)	—	For applicable pre-2007 model year engines, requires demonstration of compliance by one of several methods. This is applicable to the Coal Unloading Facility Emergency Diesel Sump Pump Engine and compliance was demonstrated by purchasing a certified engine (option 1). There are no ongoing requirements.
60.4211(c)	—	For 2007 and later model year engines, requires compliance by purchasing an engine certified to the appropriate standards. This is applicable to the Fire Pump Engine and Emergency Diesel Generator 2. Both units were certified to the appropriate standards. There are no ongoing requirements.
60.4211(d)	—	This section applies to engines with a displacement ≥ 30 liters per cylinder. The engines at this facility are all smaller than this.
60.4211(e)	—	Requirements for modified or reconstructed engines. There are no modified or reconstructed engines at this facility.
60.4211(f)	Req-56, Req-57, Req-61	Operating limits for emergency engines.
60.4211(g)	Req-64, Req-67	Alternatives for engines not installed, configured, operated or maintained in accordance with manufacturer's instructions.
60.4211(f)	—	Requirements applicable to engines with auxiliary emission control devices. None of the engines at this facility utilize such units.
60.4212	—	"What test methods and other procedures must I use if I am an owner or operator of a stationary CI internal combustion engine with a displacement of less than 30 liters per cylinder?" Testing is not required for any of the engines at this facility.
60.4213	—	"What test methods and other procedures must I use if I am an owner or operator of a stationary CI internal combustion engine with a displacement of greater than or equal to 30 liters per cylinder?" The engines at this facility are all smaller than this.

CFR 60 Subpart III – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines		
Requirement	Title V Permit Location	Comments
60.4214	M26	"What are my notification, reporting, and recordkeeping requirements if I am an owner or operator of a stationary CI internal combustion engine?" The only remaining applicable requirement is a requirement for Emergency Diesel Generator 2 to keep records of operation in emergency and non-emergency service.
60.4215	—	"What requirements must I meet for engines used in Guam, American Samoa, or the Commonwealth of the Northern Mariana Islands?"
60.4216	—	"What requirements must I meet for engines used in Alaska?"
60.4217	—	"What emission standards must I meet if I am an owner or operator of a stationary internal combustion engine using special fuels?" This facility does not have approval to utilize special fuels.
60.4218	—	"What parts of the General Provisions apply to me?" Refers to Table 8.
60.4219	—	"What definitions apply to this subpart?" Informational.
Table 1	—	"Emission Standards for Stationary Pre-2007 Model Year Engines With a Displacement of <10 Liters per Cylinder and 2007-2010 Model Year Engines >2,237 KW (3,000 HP) and With a Displacement of <10 Liters per Cylinder" Informational listing of the emission standards. This section is applicable to the Coal Unloading Facility Emergency Diesel Sump Pump Engine. Compliance was demonstrated by purchasing a EPA Tier certified engine that exceeds the standards in Table 1.
Table 2	—	"Emission Standards for 2008 Model Year and Later Emergency Stationary CI ICE <37 KW (50 HP) With a Displacement of <10 Liters per Cylinder." No engine in this category at the facility.
Table 3	—	"Certification Requirements for Stationary Fire Pump Engines." No engine in this category at the facility. The Fire Pump Engine at this facility is used for non-emergency use as well as fire protection and therefore is not a "fire pump engine" for the purposes of this subpart.
Table 4	—	"Emission Standards for Stationary Fire Pump Engines." The Fire Pump Engine at this facility is used for non-emergency use as well as fire protection and therefore is not a "fire pump engine" for the purposes of this subpart.
Table 5	—	"Labeling and Recordkeeping Requirements for New Stationary Emergency Engines." Not a requirement for the owner/operator.
Table 6	—	"Optional 3-Mode Test Cycle for Stationary Fire Pump Engines." Not a requirement for the owner/operator.
Table 7	—	"Requirements for Performance Tests for Stationary CI ICE With a Displacement of ≥ 30 Liters per Cylinder." No engine in this category at the facility.
Table 8	—	"Applicability of General Provisions to Subpart III." Table 8 was not listed directly in the permit, rather the individual General Provisions were independently identified.

CFR 60 Subpart III – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines		
Requirement	Title V Permit Location	Comments
Applicable General Requirements Identified by Table 8		
60.1	—	General applicability of the General Provisions
60.2	—	Definitions
60.3	—	Units and abbreviations
60.4	—	Address. Informational.
60.5	—	Determination of construction or modification
60.6	—	Review of plans
60.7	—	Notification and Recordkeeping. There are no notification requirements applicable to this engine.
60.8	—	Performance tests. No performance tests are required.
60.9	—	Availability of information. Informational
60.10	—	State Authority. Informational.
60.11	P1	Compliance with standards and maintenance requirements. No active requirements, however, the credible evidence provision was included in P1.
60.12	—	Circumvention (masking or concealing emissions that would violate an applicable standard). The only applicable emission standards apply to initial certification.
60.13	—	Monitoring requirements. Only applies to stationary CI ICE with a displacement of >30 liters per cylinder.
60.14	—	Modification. Modification is subject to New Source Review.
60.15	—	Reconstruction. Reconstruction is subject to New Source Review.
60.16	—	Priority list
60.17	—	Incorporations by reference
60.18	—	General control device requirements. No control devices.
60.19	—	General notification and reporting requirements. There are no notification requirements applicable to the engines at this facility.

63 Subpart DDDDD – National Emissions Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters		
Requirement	Title V Permit Location	Comments
63.7480	—	"What is the purpose of this subpart?"
63.7485	—	"Am I subject to this subpart?"
63.7485	—	"Am I subject to this subpart?" This subpart is applicable to the Auxiliary Boiler.
63.7490	—	"What is the affected source of this subpart?"
63.7491	—	"Are any boilers or process heaters not subject to this subpart?"
63.7495	—	"When to I have to comply with this subpart?" All applicable compliance dates are past.

63 Subpart DDDDD – National Emissions Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters		
Requirement	Title V Permit Location	Comments
63.7499	—	"What are the subcategories of boilers and process heaters?" Informational. The Auxiliary Boiler is in the "limited-use" subcategory.
63.7500		"What emission limitations, work practice standards, and operating limits must I meet?"
63.7500(a)	Req-40	Requirements to comply with applicable elements in tables, and general duty clause. Only the general duty clause applies to the Auxiliary Boiler because it is in the "limited-use" subcategory (see 75.000(c)).
63.7500(c)	Req-41	Tune-up requirements and exemption from specific requirements.
63.7500(d)	—	Tune-ups for small boilers.
63.7500(e)	—	Requirements for specific subcategories
63.7500(f)	—	Statement that standards apply to all normal operation. No operating standards applicable to the Auxiliary Boiler.
63.7505	Req-41	"What are my general requirements for complying with this subpart?"
63.7510	Req-41	"What are my initial compliance requirements and by what date must I conduct them?" Applies to the initial tune-up.
63.7515	Req-41	"When must I conduct subsequent performance tests, fuel analyses, or tune-ups?" Only the tune-up requirements apply to the Auxiliary Boiler.
63.7520	—	"What stack tests and procedures must I use?" No stack test is required.
63.7521	—	"What fuel analysis, fuel specification, and procedures must I use?" No requirements for the Auxiliary Boiler.
63.7522	—	"Can I use emissions averaging to comply with this subpart?" Only 1 affected unit at this facility, and no applicable emission limits apply.
63.7525	M14	"What are my monitoring, installation, operation, and maintenance requirements?"
63.7530	—	"How do I demonstrate initial compliance with the emission limitations, fuel specifications and work practice standards?" No requirements in this section for units subject only to the work practice standards.
63.7533	—	"Can I use efficiency credits earned from implementation of energy conservation measures to comply with this subpart?" Applies to emission limits. There are no applicable emission limits for the Auxiliary Boiler.
63.7535	—	"Is there a minimum amount of monitoring data I must obtain?" No continuous monitoring requirements for the Auxiliary Boiler.
63.7540	Req-41	"How do I demonstrate continuous compliance with the emission limitations, fuel specifications and work practice standards?" Section (12) requires a tune-up every 5 years.
63.7541	—	"How do I demonstrate continuous compliance under the emissions averaging provision?" Emissions averaging does not apply.
63.7545	—	"What notifications must I submit and when?" The only applicable requirements was the initial notification of compliance status, which has been completed.
63.7550	R10	"What reports must I submit and when?" Compliance reports must be submitted every 5 years.

63 Subpart DDDDD – National Emissions Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters		
Requirement	Title V Permit Location	Comments
63.7555	M34	"What records must I keep?"
63.7560	M34, M41	"63.7560 In what form and how long must I keep my records?"
63.7565	—	"What parts of the General Provisions apply to me?" Informational
63.7570	—	"Who implements and enforces this subpart?" Informational
63.7575	—	Definitions
Table 1	—	"Emission Limits for New or Reconstructed Boilers and Process Heaters"
Table 2	—	"Emission Limits for Existing Boilers and Process Heaters"
Table 3	Req-41	"Work Practice Standards"
Table 4	—	"Operating Limits for Boilers and Process Heaters"
Table 5	—	"Performance Testing Requirements"
Table 6	—	"Fuel Analysis Requirements"
Table 7	—	"Establishing Operating Limits"
Table 8	—	"Demonstrating Continuous Compliance"
Table 9	—	"Reporting Requirements"
Table 10	—	"Applicability of General Provisions to Subpart DDDDD". Informational.
Table 11	—	"Alternative Emission Limits for New or Reconstructed Boilers and Process Heaters That Commenced Construction or Reconstruction After June 4, 2010, and Before May 20, 2011"
Table 12	—	"Table 12 to Subpart DDDDD of Part 63—Alternative Emission Limits for New or Reconstructed Boilers and Process Heaters That Commenced Construction or Reconstruction After May 20, 2011, and Before December 23, 2011"
Table 13	—	"Table 13 to Subpart DDDDD of Part 63—Alternative Emission Limits for New or Reconstructed Boilers and Process Heaters That Commenced Construction or Reconstruction After December 23, 2011, and Before April 1, 2013"

63 Subpart ZZZZ – National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines		
Requirement	Title V Permit Location	Comments
63.6580	—	"What is the purpose of subpart ZZZZ?"
63.6585	—	"Am I subject to this subpart" All of the stationary engines are subject, however no requirements from subpart ZZZZ apply to the units that are also subject to Subpart IIII.

63 Subpart ZZZZ – National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines		
Requirement	Title V Permit Location	Comments
63.6590	—	"What parts of my plant does this subpart cover?" The Black Stop Diesel Generator Engine and Emergency Diesel Generator 1 are subject to requirements from subpart ZZZZ. The Black Stop Diesel Generator Engine is an existing emergency engine > 500 bhp at a major HAP source. Emergency Diesel Generator 1 is an existing emergency engine < 500 hp at a major HAP source.
63.6595	—	"When do I have to comply with this subpart?"
63.6600	—	"What emission limitations and operating limitations must I meet if I own or operate a stationary RICE with a site rating of more than 500 brake HP located at a major source of HAP emissions?" This section exempts emergency stationary RICE from compliance with the emission limits in Tables 1a, 2a, 2c, and 2d, and the operating limits in Tables 1b and 2b. This section provides exemptions but no direct requirements.
63.6601	—	"What emission limitations must I meet if I own or operate a new or reconstructed 4SLB stationary RICE with a site rating of greater than or equal to 250 brake HP and less than or equal to 500 brake HP located at a major source of HAP emissions?" No engines in this category at the facility.
63.6602	Req-51, Req-52	"What emission limitations and other requirements must I meet if I own or operate an existing stationary RICE with a site rating of equal to or less than 500 brake HP located at a major source of HAP emissions?" References the applicable emission limits in Table 2c. The only applicable emission limit category in Table 2c is "Non-emergency, non-black start CI stationary RICE 100≤HP≤300 HP" with a CO emission limit of 230 ppmvd @ 15% O ₂ .
63.6603	—	"What emission limitations, operating limitations, and other requirements must I meet if I own or operate an existing stationary RICE located at an area source of HAP emissions?" This facility is a major source.
63.6604	—	"What fuel requirements must I meet if I own or operate a stationary CI RICE?" None of the engines at this facility fall into one of the specific categories listed in this section.
63.6605	Req-55, M42	"What are my general requirements for complying with this subpart?" This section is a general duty clause.
63.6610	—	"By what date must I conduct the initial performance tests or other initial compliance demonstrations if I own or operate a stationary RICE with a site rating of more than 500 brake HP located at a major source of HAP emissions?" There are no applicable testing requirements for engines at this facility.

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Requirement	Title V Permit Location	Comments
63.6611	—	"By what date must I conduct the initial performance tests or other initial compliance demonstrations if I own or operate a new or reconstructed 4SLB SI stationary RICE with a site rating of greater than or equal to 250 and less than or equal to 500 brake HP located at a major source of HAP emissions?" No engines in this category at the facility.
63.6612	M4	"By what date must I conduct the initial performance tests or other initial compliance demonstrations if I own or operate an existing stationary RICE with a site rating of less than or equal to 500 brake HP located at a major source of HAP emissions or an existing stationary RICE located at an area source of HAP emissions?" There are no applicable testing requirements for engines at this facility.
63.6615	—	"When must I conduct subsequent performance tests?" Requires subsequent testing as per Table 3. This facility does not have any engines subject to performance testing requirements.
63.6620	—	"What performance tests and other procedures must I use?" This facility does not have any engines subject to performance testing requirements.
63.6625	Req-52, Req-53, Req-54, Req-94	"What are my monitoring, installation, collection, operation, and maintenance requirements?" Only sections (e), (f), and (h), and optionally (i) apply to any engines at this facility. Section (e)(2) and (f) apply to Emergency Diesel Generator 1 only.
63.6630	—	"How do I demonstrate initial compliance with the emission limitations, operating limitations, and other requirements?" The engines at this facility are not subject to any of the limitations or requirements for which a compliance demonstration is required.
63.6635	—	"How do I monitor and collect data to demonstrate continuous compliance?" Continuous compliance monitoring is not required for any of the engines at this facility.
63.6640	"How do I demonstrate continuous compliance with the emission limitations, operating limitations, and other requirements?"	
63.6640(a)	Req-51, Req-53	Section (a) requires compliance with applicable requirements in Tables 1a, 1b, 2a, 2b, 2c, and 2d in accordance with Table 6.
63.6640(b)	R4	Deviation reporting requirements. Included as part of routine semiannual reporting.
63.6640(c)	—	Requirements for specific 4SLB and 4SRB. This facility does not have any engines in this category.
63.6640(d)	—	Exemptions for "engine burn-in". No engines at this facility are this new.
63.6640(e)	—	Section (e) requires reporting of deviations from Part 63 "General Provisions" for non-exempted engines. Emergency engines are exempt.
63.6640(f)	Req-56, Req-90	Operating limitations for emergency engines.

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Requirement	Title V Permit Location	Comments
63.6645	—	"What notifications must I submit and when?" In accordance with 40 CFR 63.6645(a)(5) the general notification requirements in (a) do not apply to existing emergency engines.
63.6650	R4	"What reports must I submit and when?" The general requirement to report deviations in the semiannual Title V report is found in 63.6650(f).
63.6655	M19, M26	"What records must I keep?" Maintenance and operating records must be kept.
63.6660	VII	"In what form and how long must I keep my records?" This section and 63.10(b) are included in the introductory paragraphs of Section VII.
63.6665	—	"What parts of the General Provisions apply to me?" References Table 8. This section itself is informational and not included in the permit. This section exempts existing emergency engines > 500 bhp at major HAP sources (Black Stop Diesel Generator Engine) from the general provisions. While Emergency Diesel Generator 1 is not specifically exempted, there are no active general requirements for this unit.
63.6670	—	"Who implements and enforces this subpart?" This section is informational.
63.6675	—	"What definitions apply to this subpart?" This section is a reference for other sections and does not contain any directly applicable requirements.
Table 1a	—	"Table 1a to Subpart ZZZZ of Part 63—Emission Limitations for Existing, New, and Reconstructed Spark Ignition, 4SRB Stationary RICE >500 HP Located at a Major Source of HAP Emissions" No engines in this category at this facility.
Table 1b	—	"Table 1b to Subpart ZZZZ of Part 63—Operating Limitations for Existing, New, and Reconstructed SI 4SRB Stationary RICE >500 HP Located at a Major Source of HAP Emissions" No engines in this category at this facility.
Table 2a	—	"Table 2a to Subpart ZZZZ of Part 63—Emission Limitations for New and Reconstructed 2SLB and Compression Ignition Stationary RICE >500 HP and New and Reconstructed 4SLB Stationary RICE \geq 250 HP Located at a Major Source of HAP Emissions". No engines in this category at this facility.
Table 2b	—	"Table 2b to Subpart ZZZZ of Part 63—Operating Limitations for New and Reconstructed 2SLB and CI Stationary RICE >500 HP Located at a Major Source of HAP Emissions, New and Reconstructed 4SLB Stationary RICE \geq 250 HP Located at a Major Source of HAP Emissions, Existing CI Stationary RICE >500 HP" No engines in this category at this facility.

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Requirement	Title V Permit Location	Comments
Table 2c	Req-51, Req-52, Req-94, Req-95	"Table 2c to Subpart ZZZZ of Part 63—Requirements for Existing Compression Ignition Stationary RICE Located at a Major Source of HAP Emissions and Existing Spark Ignition Stationary RICE ≤500 HP Located at a Major Source of HAP Emissions".
Table 2d	—	"Table 2d to Subpart ZZZZ of Part 63—Requirements for Existing Stationary RICE Located at Area Sources of HAP Emissions" This facility is a major source of HAP.
Table 3	—	"Table 3 to Subpart ZZZZ of Part 63—Subsequent Performance Tests" There are no engines in the categories listed in Table 3 at this facility.
Table 4	—	"Table 4 to Subpart ZZZZ of Part 63—Requirements for Performance Tests". No engines at this facility are required to conduct performance tests.
Table 5	—	"Table 5 to Subpart ZZZZ of Part 63—Initial Compliance With Emission Limitations, Operating Limitations, and Other Requirements". None of the engines at this facility are subject to initial compliance demonstrations.
Table 6	Req-53	"Table 6 to Subpart ZZZZ of Part 63—Continuous Compliance With Emission Limitations, and Other Requirements". The work practice standard requirements addressed here do not apply to engines > 500 bhp such as the Black Stop Diesel Generator Engine.
Table 7	—	"Table 7 to Subpart ZZZZ of Part 63—Requirements for Reports". The only applicable engines at this facility are existing emergency engines. There are no reporting requirements for existing emergency engines.
Table 8	—	"Table 8 to Subpart ZZZZ of Part 63—Applicability of General Provisions to Subpart ZZZZ." Table 8 was not listed directly in the permit, rather the individual General Provisions were independently identified as applicable.
Applicable General Requirements Identified by Table 8		
63.1	—	General applicability of the General Provisions
63.2	—	Definitions
63.3	—	Units and abbreviations
63.4	—	Prohibited activities and circumvention
63.5	—	Construction and reconstruction notification. Construction or reconstruction would require NSR.
63.6(a)	—	Applicability. Informational
63.6(b)(1)-(4)	—	Compliance dates for new and reconstructed sources. Informational
63.6(b)(5)	—	Notification for new or reconstructed sources. Construction or reconstruction would require NSR.
63.6(b)(7)	—	Compliance dates for new and reconstructed area sources that become major sources. Informational. This facility is already a major source.
63.6(c)(1)-(2)	—	Compliance dates for existing sources. Compliance dates have passed.

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Requirement	Title V Permit Location	Comments
63.6(c)(5)	—	Compliance dates for existing area sources that become major sources. Informational. This facility is already a major source.
63.6(f)(2)	—	Methods for determining compliance. Informational.
63.6(f)(3)	—	Finding of compliance. Informational
63.6(g)(1)-(3)	—	Use of alternate standard. Informational.
63.6(i)	—	Compliance extension procedures and criteria
63.6(j)	—	Presidential compliance exemption
63.7(a)(1)-(2)	—	Performance test dates. All initial testing has been completed.
63.7(a)(3)	—	CAA section 114 authority
63.7(b)(1)	—	Notification of performance test
63.7(b)(2)	—	Notification of rescheduling
63.7(c)	—	Quality assurance/test plan
63.7(d)	—	Testing facilities
63.7(e)(2)	—	Conduct of performance tests and reduction of data. Informational
63.7(e)(3)	—	Test run duration. Run duration already specified in rule.
63.7(e)(4)	—	Administrator may require other testing under section 114 of the CAA. Informational
63.7(f)	—	Alternative test method provisions. Informational. No reasonable reason to utilize an alternative test method.
63.7(g)	—	Performance test data analysis, recordkeeping, and reporting. Source test report requirements are detailed in R6, however Subpart ZZZZ testing requirements in the permit are primarily informational because all initial testing has been completed.
63.7(h)	—	Waiver of tests. Informational.
63.8(a)(1)	—	Applicability of monitoring requirements.
63.8(a)(2)	—	Performance specifications
63.8(b)(1)	—	Alternative Monitoring.
63.8(b)(2)-(3)	—	Multiple effluents and multiple monitoring systems
63.8(c)(1)	—	Continuous monitoring system (CMS) operation and maintenance. No CMS at this facility.
63.8(c)(1)(ii)	—	Continuous monitoring system parts
63.8(c)(2)-(3)	—	Monitoring system installation
63.8(c)(4)	—	Continuous monitoring system requirements
63.8(c)(6)-(8)	—	CMS requirements
63.8(d)	—	CMS quality control
63.8(e)	—	CMS performance evaluation. Except that §63.8(e) only applies as specified in §63.6645.
63.8(f)(1)-(5)	—	Alternative monitoring method
63.8(f)(6)	—	Alternative to relative accuracy test
63.8(g)	—	Data reduction for CMS

63 Subpart ZZZZ – National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines		
Requirement	Title V Permit Location	Comments
63.9(a)	—	Applicability and State delegation of notification requirements
63.9(b)(1)-(5)	—	Initial notifications. Except that §63.9(b) only applies as specified in §63.6645.
63.9(c)	—	Request for compliance extension
63.9(d)	—	Notification of special compliance requirements for new sources
63.9(e)	—	Notification of performance test
63.9(g)(1)	—	Notification of performance evaluation
63.9(g)(3)	—	Notification that criterion for alternative to RATA is exceeded. Except that §63.9(g) only applies as specified in §63.6645.
63.9(h)(1)-(6)	—	Notification of compliance status
63.9(i)	—	Adjustment of submittal deadlines
63.9(j)	—	Change in previous information submitted. Due to the nature of the equipment at this facility and SWCAA's review, no such notice will be necessary.
63.10(a)	—	Administrative provisions for recordkeeping/reporting
63.10(b)(1)	VII	Record retention
63.10(b)(2)(vi)-(xi)	—	Records
63.10(b)(2)(xii)	—	Record when under waiver
63.10(b)(2)(xiii)	—	Records when using alternative to RATA
63.10(b)(2)(xiv)	—	Records of supporting documentation
63.10(b)(3)	—	Records of applicability determination
63.10(c)	—	Additional records for sources using CEMS
63.10(d)(1)	—	General reporting requirements. Reporting specified as per the applicable standard.
63.10(d)(2)	—	Report of performance test results
63.10(d)(4)	—	Progress reports. No progress reports required.
63.10(e)(1) and (2)(i)	—	Additional CMS Reports
63.10(e)(3)	—	Excess emission and parameter exceedances reports (CEMS)
63.10(f)	—	Waiver for recordkeeping/reporting. Informational.
63.12	—	State authority and delegations
63.13	—	Addresses. Informational
63.14	—	Incorporation by reference
63.15	—	Availability of information

40 CFR 60 Subpart UUUUU – National Emission Standards for Hazardous Air Pollutants: Coal and Oil-Fired Electric Utility Steam Generating Units		
Requirement	Title V Permit Location	Comments
63.9980	—	"What is the purpose of this subpart"
63.9981	—	"Am I subject to this subpart" This facility is subject to this regulation.
63.9982	—	"What is the affected source for this subpart" Defines the affected source. For this facility the Unit 1 and Unit 2 EGU's are classified as "existing".
63.9983	—	"Are any EGUs not subject to this subpart?" None of the exemptions apply to this facility.
63.9984	—	"When do I have to comply with this subpart?" All of the compliance dates have passed.
63.9985	—	"What is a new EGU?" TransAlta's EGUs are not new.
63.9990	—	"What are the subcategories of EGUs?" TransAlta's coal may exceed 8,300 Btu/lb, therefore these units fall into the category of "designed for coal greater than or equal to 8,300 Btu/lb" subcategory – listed elsewhere as "Coal-fired unit not low rank virgin coal."
63.9991	Req-15, Req-20, Req-25, Req-38	"What emission limitations, work practice standards, and operating limits must I meet?" This section refers to the requirements in Tables 1 – 4. Where those requirements are cited, this section that points to those requirements is cited as well.
63.10000	"What are my general requirements for complying with this subpart?"	
63.10000(a)	Req-15, Req-20, Req-25, Req-37	States that must comply with the requirements of this subpart and includes the startup and shutdown exceptions where work-practice standards apply in lieu of emission limits.
63.10000(b)	Req-38	Requirements to operate consistent with good air pollution control practices for minimizing emissions.
63.10000(c)	—	Initial performance testing requirements. All initial performance testing has been completed; therefore, these requirements are not included in the Air Operating Permit.
63.10000(d)	M9	Requires the generation of a site-specific monitoring plan for any CMS or CEMS used to demonstrate compliance with an applicable emission limit. This requirement does not apply to affected sources with existing monitoring plans prepared in accordance with 40 CFR 60 Appendix B, or 40 CFR 75. This facility utilizes a CEMS with a monitoring plan in accordance with 40 CFR 75 for SO ₂ to demonstrate compliance with acid gas limitations and therefore this CEMS is exempt from this requirement. The plan elements are considered to be met for Hg sorbent trap monitoring systems installed, operated, and quality-assured in accordance with Appendix A of Subpart UUUUU. This facility utilizes a sorbent trap monitoring system to monitor Hg emissions in accordance with Appendix A of Subpart UUUUU, therefore the plan elements are met. The only remaining requirements are to operate the Hg monitoring system in accordance with the site-specific monitoring plan (i.e. Appendix A).

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Requirement	Title V Permit Location	Comments
63.10000(e)	Req-36	Requirement to conduct periodic tune-ups according to 40 CFR 63.10021(e).
63.10000(f)	—	Requires that EGUs remain subject to this subpart at least 6 months after the EGU met definition of a subject EGU. This section is information and does not contain additional applicable requirements.
63.10000(g)	—	States that EGUs no longer meeting the definition of an EGU subject to this part must comply with any new requirements on the date no longer subject to this subpart. This section is information and does not contain additional applicable requirements.
63.10000(h)	—	Requirements related to EGUs that become subject after April 16, 2015. The only EGUs at this facility were already subject to this subpart as of April 16, 2015 therefore this does not apply to the EGUs at this facility.
63.10000(i)	—	Requirements for EGUs that cease to operate in a manner that causes the EGU to meet the definition of an EGU subject to this subpart. This section is not currently applicable. No change in applicability is anticipated in the permit term.
63.10000(j)	—	Requirement to have operational pollution control equipment as required for the EGU classification (subject or not subject to this subpart) as of the date the relevant standard is applicable. This section is not currently applicable. No change in applicability is anticipated in the permit term.
63.10000(k)	—	Requirement to have operational pollution monitoring equipment as required for the EGU classification (subject or not subject to this subpart) as of the date the relevant standard is applicable. This section is not currently applicable. No change in applicability is anticipated in the permit term.
63.10000(l)	M33, M10	No later than the date an EGU is subject, must have all necessary monitoring in place for PM or non-Hg HAP metals during startup and shutdown. Must collect, record, report, and maintain data for startup and shutdown periods to demonstrate compliance with work practice standards.
63.10000(m)	M33, M10	If using paragraph (2) of startup definition, must have all necessary monitoring in place for PM or non-Hg HAP metals on or before applicability date. Must collect, record, report and maintain applicable data.
63.10000(n)	—	If permanently convert to natural gas or biomass firing, the EGU is no longer subject to this subpart. This section is information and does not contain additional applicable requirements.
63.10005	Req 15, Req-20, Req-25	What are my initial compliance requirements and by what date must I conduct them? Although all initial compliance requirements have been completed, the reference in 63.10005(a) that clarifies that where two emission limits are specified compliance may be demonstrated with either limit, was listed for reference where two limits were specified.

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Requirement	Title V Permit Location	Comments
63.10006		When must I conduct subsequent performance tests or tune-ups?
63.10006(a)	—	Requirements for units using PM CPMS. This facility conducts quarterly testing in lieu of PM CPMS.
63.10006(b)	—	Requirements for LEE units. The EGUs at this facility do not meet LEE requirements, therefore this section is not applicable.
63.10006(c)	M9	Requirement to conduct periodic filterable PM testing or total HAP metals in accordance with Table 5, 63.10007, 63.10000(c) except as provided in 63.10021(d)(1).
63.10006(d)	—	HCl testing requirements for units that do not use CEMS to demonstrate compliance with acid gas limitations. This facility uses a SO ₂ CEMS to demonstrate compliance therefore this section is not applicable.
63.10006(e)	—	Requirements for acid gas monitoring for liquid oil-fired EGUs.
63.10006(f)	M9	Time between performance tests. This applies to the quarterly PM testing.
63.10006(g)	—	Emissions averaging provisions. This facility does not conduct emissions averaging and starting in 2021 will only operate one unit.
63.10006(h)	—	LEE test provisions. The EGUs at this facility do not meet LEE requirements, therefore this section is not applicable.
63.10007		What methods and other procedures must I use for the performance test?
63.10007(a)	M8, M9, R7	Requirements to comply with general test requirements of 63.7 and develop a site-specific test plan. Permanent testing facilities have been installed in accordance with 63.7(d).
63.10007(b)	M8, M9	Requirement to conduct performance tests in accordance with Table 5.
63.10007(c)	—	Requirements for tests for facilities with PM CEMS. This facility utilizes quarterly PM testing option in lieu of PM CEMS, therefore this section is not applicable.
63.10007(d)	M8, M9	Requirement to conduct 3 separate runs and meet the time and volume requirements of Table 1 or 2.
63.10007(e)	M9	This section explains how to use the performance test results to determine compliance with applicable emission limits. M8 contains a general reference to conduct the testing in accordance with 63.10007.
63.10007(f)	M9	Default values for startup and shutdown period CEMS calculations. This would apply to the SO ₂ CEMS.
63.10007(f)	M8	Requirement to provide documentation of performance tests to the EPA Administrator upon request.
63.10009	—	May I use emissions averaging to comply with this subpart. This facility has not utilized the option to use emissions averaging.
63.10010		What are my monitoring, installation, operation, and maintenance requirements?
63.10010(a)	M8	Allowable locations for CEMS and sorbent trap monitoring systems based on the stack configuration. The applicable equipment at this facility are the SO ₂ CEMS and the Hg sorbent trap monitoring systems.
63.10010(b)	M9	O ₂ /CO ₂ monitoring requirements.

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Requirement	Title V Permit Location	Comments
63.10010(c)	M9	Requirement to monitor flow in accordance with 40 CFR 75. (required for Hg monitoring).
63.10010(d)	M9	Requirement to monitoring moisture in accordance with 40 CFR 75. Moisture data is necessary to correlate wet flow measurements with dry Hg measurements.
63.10010(e)	—	Requirements for sources utilizing HCl and/or HF CEMS. This facility utilizes the SO ₂ CEMS option, therefore this requirement does not apply.
63.10010(f)	M9	Requirement to monitor SO ₂ in accordance with 40 CFR 75 if utilizing the SO ₂ CEMS option for acid gas monitoring. This option is used by this facility. This additional requirements in section (2) do not apply because this facility does not utilize a span of 30 ppm or less.
63.10010(g)	M9	Hg monitoring and data reduction requirements.
63.10010(h)	—	Requirements for source utilizing PM CPMS to demonstrate compliance with an operating limit. This facility does not utilize the PM CPMS option.
63.10010(i)	M9	Requirements for PM CEMS for sources complying with filterable PM limit in lieu of metal HAP limit. This facility utilizes the alternative quarterly PM testing option; however, the PM CEMS option was included in M8 as an alternative.
63.10010(j)	—	Requirements applicable to the use of a metal HAP CEMS. This facility utilizes the alternative quarterly PM testing option.
63.10010(k)	—	Requirements applicable to quarterly HCl and HF testing of liquid oil-fired EGUs.
63.10010(l)	M33	Quality assurance and site-specific monitoring plan requirements for startup monitoring systems.
63.10011	—	Initial compliance demonstration requirements. The references to 63.10011 were removed from Air Operating Permit because all initial demonstrations have been completed.
63.10020	"How do I monitor and collect data to demonstrate compliance?"	
63.10020(a)	—	General requirement to monitor in accordance with the requirements in 63.10020 and the site-specific monitoring plan. These referenced requirements are contained in other sections.
63.10020(b)	M9	Monitoring requirements and exceptions.
63.10020(c)	M9	Lists what data must be excluded from compliance calculations.
63.10020(d)	M9	Requires monitoring at all times with specific exceptions.
63.10020(e)	M10	Startup and shutdown work practice monitoring requirements.
63.10021	"How do I demonstrate continuous compliance with the emission limitations, operating limits, and work practice standards?"	
63.10021(a)	—	General requirement to demonstrate compliance with applicable requirements. These referenced requirements are contained in other sections.
63.10021(b)	M9	Describes how to use CEMS data to demonstrate compliance.

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Requirement	Title V Permit Location	Comments
63.10021(c)	—	Requirements for use of a PM CPMS. This facility does not utilize a PM CPMS.
63.10021(d)	M9	Contains details related to performance monitoring.
63.10021(e)	Req-36, R11	Tune-up requirements.
63.10021(f)	R11	Repeats the requirements to use ECMPS Client Tool for submittal of a variety of reports, specifies implications of weekend, holiday, and ECMPS outages. Although it does contain some exceptions for holidays, ECMPS system outages, etc, this section is primarily informational in nature, the specific reporting requirements are detailed elsewhere.
63.10021(g)	R4	Requirement to report deviations from emission limits, operating limits, or failed to conduct a tune-up.
63.10021(h)	M9	Requirement to following the startup or shutdown requirements in Table 3 and conduct all required monitoring during startup and shutdown. General requirements in this section that repeat the requirement to comply with another section are not reproduced in the permit.
63.10021(i)	R4	General requirement to report activities during startup and shutdown in accordance with 63.10031.
63.10022	—	"How do I demonstrate continuous compliance under the emissions averaging provision?" This facility has not utilized the option to use emissions averaging.
63.10023	—	"How do I establish my PM CPMS operating limit and determine compliance with it?" This facility does not utilize a PM CPMS.
63.10030	What notifications must I submit and when?	
63.10030(a)	M8, M9, R11	General requirement to submit the notifications required by 40 CFR 63.7, 63.8, and 63.9 as applicable – except that only certain provision of 63.9 apply (see 40 CFR 63.10040 and Table 9). The only remaining notifications are for performance tests and RATAs (30-days prenotification required for each in accordance with Table 9).
63.10030(b)	—	Initial notification deadline for existing units. Initial notifications have been submitted.
63.10030(c)	—	Initial notification deadline for "new" units. Initial notifications have been submitted.
63.10030(d)	M8	Performance test notification.
63.10030(e)	—	Initial Notice of Compliance Status report requirements. All initial notifications have been submitted.
63.10030(f)	—	Requirement to submit the notification in 40 CFR 63.10000(h)(2) and (i)(2) that apply. This is applicable to newly applicable EGUs and EGUs that modify their operation such that they are no longer subject to this subpart. Both units at this facility are "existing" and no change in applicability is anticipated in the permit term.
63.10031	What reports must I submit and when?	

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Requirement	Title V Permit Location	Comments
63.10031(a)(1)	R11	Hg CMS reporting requirements found in Appendix A are referenced here.
63.10031(a)(2)	—	Not applicable because this facility does not elect to monitor HCl and/or HF continuously. Instead, this facility continuously monitors SO ₂ as a surrogate for HCl.
63.10031(a)(3)	—	Not applicable because this facility conducts quarterly PM stack tests instead of operating a PM CEMS.
63.10031(a)(4)	—	Not applicable because this facility conducts quarterly PM stack tests instead of operating a PM CEMS.
63.10031(a)(5)	R11	SO ₂ CEMS reporting requirements.
63.10031(b)	R11	Semiannual reporting requirements.
63.10031(c)	R11	Semiannual report contents.
63.10031(d)	R11	Excess emissions and deviation reporting. Re-states the requirement in 40 CFR 63.10031(c)(1) to include the CMS summary report from 63.10(e)(3)(vi) in the semiannual report, and re-states the requirement from 40 CFR 63.10031(g) to report the applicable data elements from Section 13 of Appendix E in the quarterly reports that replace the semiannual reports in 2024.
63.10031(e)	R4	Requirement to report deviations in the semiannual Title V report unless the deviation has been reported in the semiannual or quarterly Subpart UUUUU reports and these reports are submitted with, or as part of, the semiannual Title V report.
63.10031(f)	R4	Compliance test reporting. The only applicable test is the filterable PM testing.
63.10031(f)(1)	R4	RATA test reporting. This facility does not have, and is not likely to install, PM, HCl, or HF CEMS, therefore references to these systems were removed.
63.10031(f)(2)	—	Provisions for commons stacks. This facility does not have any common stacks.
63.10031(f)(3)	—	Reserved
63.10031(f)(4)	R4	Semiannual compliance reports. This section re-states the requirement to submit semiannual reports in accordance with 63.10031(b) – (d) and the initial Notice of Compliance Status (NCS) reports required by 63.10030(e) and adds that they must be submitted as PDF files. All applicable NCS have been submitted.

40 CFR 60 Subpart UUUUU – National Emission Standards for Hazardous Air Pollutants: Coal and Oil-Fired Electric Utility Steam Generating Units		
Requirement	Title V Permit Location	Comments
63.10031(f)(5)	—	Requires all reports not in 63.10031(f), (f)(1), (f)(2) and (f)(4) to be submitted to the Administrator at the applicable address listed in 63.13. This requirement is at odds with 63.10021(f) which states that <u>all</u> reports must be submitted electronically using the ECMPS Client Tool, and the specific reporting requirements listed in the applicable reporting sections and Table 8. Because this section appears to be at odds with the intent of the revisions meant to simply report submission published in the Federal Register September 9, 2020, and is directly at odds with other submission requirements, it was not included in the Title V permit.
63.10031(f)(6)	R11	This section contains details of how to submit reports to ECMPS. Since it appears that all reports must be submitted to ECMPS, this requirement was included in the first paragraph of R11 as applicable to all reports.
63.10031(g)	R11	Details for quarterly report submissions that begin in 2024.
63.10031(h)	—	Initial Notice of Compliance Status reports submitted on or after January 1, 2024. All initial reports have been completed.
63.10031(i)	R11	This section is applicable to this facility because this facility uses the "paragraph (2)" definition of startup.
63.10031(j)	—	Applicable if use PM CEMS. This facility does not use PM CEMS.
63.10031(k)	—	Applicable if use PM or HAP metals CEMS. This facility does not use PM or HAP metal CEMS.
63.10032	What records must I keep?	
63.10032(a)	M10, M37	Records of notifications and reports.
63.10032(b)	M10	CEMS and CPMS recordkeeping.
63.10032(c)	M10	Requires maintaining records of the information listed in Table 7.
63.10032(d)	M10	Of the 3 requirements listed, only the requirement to keep records of monthly fuel use applies to this facility.
63.10032(e)	—	Recordkeeping for emissions averaging. This facility does not utilize emissions averaging.
63.10032(f)	M10	Startup and shutdown period records.
63.10032(g)	M10	Malfunction records.
63.10032(h)	M10	Records of responses to malfunctions.
63.10032(i)	M10	Records of fuel use during startup and shutdown.
63.10032(j)	—	Recordkeeping to prove EGU qualifies as limited-use liquid oil-fired.
63.10033	M10	Record form and retention requirements.
63.10040	—	Informational. Indicates that Table 9 shows which general provisions from part 63 apply.
63.10041	—	Who implements and enforces this subpart? This section does not contain applicable requirements.
63.10042	Req-15, Req-20, Req-25, Req-37	Definitions. The definition of "startup" contains two options and is relevant to several requirements.

40 CFR 60 Subpart UUUUU – National Emission Standards for Hazardous Air Pollutants: Coal and Oil-Fired Electric Utility Steam Generating Units		
Requirement	Title V Permit Location	Comments
Table 1	—	Emission Limits for New or Reconstructed EGUs.
Table 2	Req-15, Req-20, Req-25, M9	Emission Limits for Existing EGUs
Table 3	Req-36, Req-37, Req-38, Req-41, M9	Work Practice Standards
Table 4	—	Operating Limits for EGUs – applies only to PM CPMS. This facility does not use PM CPMS.
Table 5	Req-15, Req-20, Req-25, M9	Performance Testing Requirements
Table 6	—	Establishing PM CPMS Operating Limits. This facility does not use PM CPMS.
Table 7	Req-36, M9	Demonstrating Continuous Compliance.
Table 8	R4, R11	Reporting Requirements.
Table 9	M8, M9, M10	Applicability of General Provisions to Subpart UUUUU.
Appendix A	M9	Hg Monitoring Provisions.
Appendix B	—	HCl and HF Monitoring Provisions. This facility has elected to continuously monitor SO ₂ in lieu of HCl and HF.

Second Revision of BART Order No. 6426		
Condition	Title V Permit Location	Comments
1.1	Req-27b	NO _x limits.
1.2	Req-27b	Requirement to calculate the 30-day rolling average in accordance with Condition 5.
1.3	—	Informational. Explains that the Permittee is not limited in how to achieve compliance with the NO _x limits.
2.1	Req-30	Ammonia emission limit
2.2	—	Informational. Explains that the injection of urea to meet the NO _x emissions limit is at the Permittee's discretion.
3.1	Req-31	End of coal burning by first unit.
3.2	Req-31	End of coal burning by second unit
3.3	Req-27b	References the requirement to comply with Condition 1.1.3.
3.4	Req-31	Describes when Conditions 3.1 and 3.2 would not apply.
4.1 except 4.1.4	M8	Ammonia testing requirements

Second Revision of BART Order No. 6426		
Condition	Title V Permit Location	Comments
4.1.4	Req-30	Describes how compliance with the 30-day rolling average ammonia limit is determined.
5	Req-27b, M9	Describes how NO _x emissions are monitored and averaged for compliance with the BART NO _x limit.
6	R9	Reporting the end of coal firing in each boiler.
7	R9	Urea usage letter
8	R1	BART Order malfunction emission exceedance reports
9.1.1 & 9.1.2	R3	BART Order quarterly reports
9.1.3	R7	Ammonia test reports must be submitted with 45 days of test completion.
9.2	R3	Emission monitoring report requirements.

BEFORE THE UNITED STATES DEPARTMENT OF ENERGY

Federal Power Act Section 202(c))
Emergency Order: Transalta)
Centralia Generation LLC)
_____)

Order No. 202-25-11

Motion to Intervene, Motion for Clarification, and Requests for Rehearing and Stay
of Sierra Club, NW Energy Coalition, Washington Conservation Action, Climate
Solutions, Public Citizen, and Environmental Defense Fund
(collectively, “Public Interest Organizations” or “PIOs”)

Exhibit 1-132:
Mercury in Fishes in National Parks Report

Prepared in cooperation with the National Park Service, Air Resources Division

Mercury in Fishes from 21 National Parks in the Western United States—Inter- and Intra-Park Variation in Concentrations and Ecological Risk

Open-File Report 2014–1051

U.S. Department of the Interior
U.S. Geological Survey

Cover: Reflection Lake at Mount Rainier National Park. Photograph taken by Collin A. Eagles-Smith, U.S. Geological Survey, July 31, 2012.

Mercury in Fishes from 21 National Parks in the Western United States—Inter- and Intra-Park Variation in Concentrations and Ecological Risk

By Collin A. Eagles-Smith, James J. Willacker Jr., and Colleen M. Flanagan Pritz

Prepared in cooperation with the National Park Service, Air Resources Division

Open-File Report 2014–1051

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
SALLY JEWELL, Secretary

U.S. Geological Survey
Suzette M. Kimball, Acting Director

U.S. Geological Survey, Reston, Virginia: 2014

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Conversion Factors

SI to Inch/Pound

Multiply	By	To obtain
Length		
centimeter (cm)	0.3937	inch (in.)
millimeter (mm)	0.03937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
kilometer (km)	0.6214	mile (mi)
Area		
acre (ac)	0.0015625	square mile (mi ²)
Mass		
gram (g)	0.03527	ounce, avoirdupois (oz)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$^{\circ}\text{F}=(1.8\times^{\circ}\text{C})+32$$

Abbreviations and Acronyms

dw	dry weight
ww	wet weight
Hg	mercury
THg	total mercury
MeHg	methylmercury
LSM	least-square mean
NP	national park
NPS	National Park Service
CARE	Capitol Reef National Park
CRLA	Crater Lake National Park
DENA	Denali National Park
GLBA	Glacier Bay National Park
GLAC	Glacier National Park
GRCA	Grand Canyon National Park
GRTE	Grand Teton National Park
GRBA	Great Basin National Park
GRSA	Great Sand Dunes National Park
LACL	Lake Clark National Park
LAVO	Lassen Volcanic National Park
MEVE	Mesa Verde National Park
MORA	Mount Rainer National Park
NOCA	North Cascades National Park
OLYM	Olympic National Park
ROMO	Rocky Mountain National Park
SEKI	Sequoia – Kings Canyon National Park
WRST	Wrangell – St. Elias National Park
YELL	Yellowstone National Park
YOSE	Yosemite National Park
ZION	Zion National Park

Mercury in Fishes from 21 National Parks in the Western United States—Inter- and Intra-Park Variation in Concentrations and Ecological Risk

By Collin A. Eagles-Smith¹, James J. Willacker¹, Jr., and Colleen M. Flanagan Pritz²

Abstract

Mercury (Hg) is a global contaminant and human activities have increased atmospheric Hg concentrations 3- to 5-fold during the past 150 years. This increased release into the atmosphere has resulted in elevated loadings to aquatic habitats where biogeochemical processes promote the microbial conversion of inorganic Hg to methylmercury, the bioavailable form of Hg. The physicochemical properties of Hg and its complex environmental cycle have resulted in some of the most remote and protected areas of the world becoming contaminated with Hg concentrations that threaten ecosystem and human health. The national park network in the United States is comprised of some of the most pristine and sensitive wilderness in North America. There is concern that via global distribution, Hg contamination could threaten the ecological integrity of aquatic communities in the parks and the wildlife that depends on them. In this study, we examined Hg concentrations in non-migratory freshwater fish in 86 sites across 21 national parks in the Western United States. We report Hg concentrations of more than 1,400 fish collected in waters extending over a 4,000 kilometer distance, from Alaska to the arid Southwest. Across all parks, sites, and species, fish total Hg (THg) concentrations ranged from 9.9 to 1,109 nanograms per gram wet weight (ng/g ww) with a mean of 77.7 ng/g ww. We found substantial variation in fish THg concentrations among and within parks, suggesting that patterns of Hg risk are driven by processes occurring at a combination of scales. Additionally, variation (up to 20-fold) in site-specific fish THg concentrations within individual parks suggests that more intensive sampling in some parks will be required to effectively characterize Hg contamination in western national parks.

Across all fish sampled, only 5 percent had THg concentrations exceeding a benchmark (200 ng/g ww) associated with toxic responses within the fish themselves. However, Hg concentrations in 35 percent of fish sampled were above a benchmark for risk to highly sensitive avian consumers (90 ng/g ww), and THg concentrations in 68 percent of fish sampled were above exposure levels recommended by the Great Lakes Advisory Group (50 ng/g ww) for unlimited consumption by humans. Of the fish assessed for risk to human consumers (that is, species that are large enough to be consumed by recreational or subsistence anglers), only one individual fish from Yosemite National Park had a muscle Hg concentration exceeding the benchmark (950 ng/g ww) at which no human consumption is advised. Zion, Capital Reef, Wrangell-St. Elias, and Lake Clark National Parks all contained sites in which most fish exceeded benchmarks for the protection of human and wildlife health. This finding is particularly

¹ U.S. Geological Survey

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concerning in Zion and Capitol Reef National Parks because the fish from these parks were speckled dace, a small, invertebrate-feeding species, yet their Hg concentrations were as high or higher than those in the largest, long-lived predatory species, such as lake trout. Future targeted research and monitoring across park habitats would help identify patterns of Hg distribution across the landscape and facilitate management decisions aimed at reducing the ecological risk posed by Hg contamination in sensitive ecosystems protected by the National Park Service.

Introduction

Mercury (Hg) is among the most widespread environmental contaminants, distributed at a global scale from natural sources, such as volcanic eruptions and from anthropogenic sources such as emissions followed by atmospheric deposition (Driscoll and others, 2013) and at local or regional scales from current and historic mining activities (Singer and others, 2013). When reactive forms of inorganic Hg are deposited or transported to aquatic habitats, microbial processes can convert the inorganic Hg to methylmercury (MeHg), an organic Hg form that efficiently biomagnifies through food webs (Lavoie and others, 2013) and is a potent neurotoxin (Clarkson and Magos, 2006; Bennett and others, 2009; Wiener and others, 2012). The prevalence and toxicity of Hg make it a serious threat to both wildlife and humans. More than 16 million lake acres and 1 million river miles are under fish consumption advisories due to Hg contamination in the United States, and 81 percent of all fish consumption advisories were issued because of Hg contamination (U.S. Environmental Protection Agency, 2013). Mercury affects numerous physiological processes in vertebrate wildlife and humans, particularly neurological function, but it also can have a deleterious influence on cardiovascular, renal, and endocrine systems. Although the toxicological responses are particularly damaging to developing individuals, elevated Hg exposure also can have fitness consequences in adults through impairment of reproduction (Clarkson and Magos, 2006). Symptoms can occur at exposure levels commonly observed in the environment, and can result in reduced foraging efficiency, survival, or reproductive success (Burgess and Meyer, 2008; Crump and Trudeau, 2009; Wiener and others, 2012).

The widespread transport of Hg through atmospheric and hydrologic pathways, coupled with its potential for environmentally induced “activation” to a highly bioaccumulative and toxic species, is important because it suggests that even remote and protected environments may be at risk to ecological harm from Hg (Lamborg and others, 2002; Schuster and others, 2002). In fact, increasing evidence indicates that Hg contamination of remote and protected environments is not uncommon. For example, total Hg (THg) concentrations in arctic char (*Salvelinus alpinus*) and lake trout (*S. namaycush*) from lakes in Nunavut Canada have up to 1,400 nanograms per gram wet weight (ng/g ww) (Swanson and Kidd, 2010), and THg concentrations in mean northern pike (*Esox lucius*) from remote sites in Alaska have been reported above 1,800 ng/g ww (Duffy and others, 1999). At some of these remote sites, THg concentrations are routinely above the highest benchmarks for risk to human consumers (Jewett and Duffy, 2007). Similarly, Hg concentrations in fish from several western national parks have previously been reported to exceed human and wildlife health thresholds (Landers and others, 2008). Because many remote and protected areas provide refuge from development and human disturbance, they often support high densities of rare and sensitive wildlife species. As a result, the ecological consequences of elevated Hg in these locations could be particularly harmful from a conservation perspective.

National Park Service (NPS) lands are among the most pristine natural areas in the United States, protecting more than 84 million acres of diverse aquatic and terrestrial habitats. This is particularly true for the Western United States and Alaska, which only contain about 32 percent of national park units, yet account for approximately 89 percent of the total land area managed by the NPS. Because such a large proportion of NPS land is in the West, ecological stressors that are pervasive across the region could disproportionately affect NPS resources. Mercury contamination is among those stressors, because many areas of the Western United States are subject to Hg contamination at levels of concern for both human and ecosystem health (Peterson and others, 2007). Moreover, recent work has shown that some remote, high-altitude water bodies in western national parks contain fish with Hg concentrations that exceed toxicological thresholds for both humans and wildlife (Schwindt and others, 2008). However, the extent of contamination across western parks still lacks a systematic characterization and assessment of risk. Furthermore, it remains unclear whether variation in Hg concentrations in fish from remote national parks is more related to local, site- or park-specific characteristics, or broader regional characteristics. Additionally, spatially expansive baseline information is needed in order to evaluate the response of isolated environments to the Mercury and Air Toxics Standards (MATS), implemented by the U.S. Environmental Protection Agency (EPA), which aims to reduce Hg emissions from powerplants by 90 percent. Understanding how variation in fish Hg concentrations is distributed across local and regional scales will facilitate a better understanding of potential mitigation and management options.

As the first step toward better understanding the distribution of Hg across aquatic communities in western national parks, we measured Hg concentrations in fish from 21 different national parks in the Western United States and Alaska (fig. 1). We primarily targeted fish from remote, high altitude lake habitats with limited hydrological connectivity to upstream watersheds in order to minimize watershed scale processes that may potentially confound our assessment of local fish Hg exposure and the relative influence of local versus regional and global processes. Our primary objectives were as follows:

- *Objective 1:* Compare fish Hg concentrations among western national parks, and among sites within western national parks
- *Objective 2:* Determine whether variation in fish Hg concentrations in western national parks is more evident at local site and park scales, compared to broader regional scales;
- *Objective 3:* Evaluate fish Hg concentrations in western national parks with respect to a range of wildlife and human health exposure thresholds.

Because lakes with limited upstream connectivity were preferentially sampled, estimates of variability among lakes may be reduced relative to a random sampling of water available bodies, particularly at local and park scales. Furthermore, the hierarchical spatial design of the current study, combined with the gradient in landscape types, altitudes, and fish species that occur over such an extensive study area, preclude examination of the specific drivers of Hg variation at various scales, and investigating these factors was beyond the scope of the current study.

Methods

Study Sites and Sample Collection

This study focused on remote, fish-bearing aquatic habitats in the Western United States. We sampled 86 individual sites from 21 national parks in 10 Western States (fig. 1, table 1). Our primary target habitats were remote, high-altitude lakes containing non-migratory fish populations in order to reduce the likelihood that fish Hg concentrations are reflective of exposure that occurred elsewhere. However, some parks, especially Great Basin National Park (NP) and those in the arid Southwest, lacked similar aquatic habitats; therefore, we also sampled flowing rivers and streams in a few parks where lake habitats were unable to be sampled.

Fish were collected in 2008, 2009, 2011, and 2012 by NPS personnel following standardized protocols as described in this paragraph below. The intensive sampling at Mount Rainier in 2012 was conducted by U.S. Geological Survey (USGS) staff as part of a focused study in that park, examining a range of food web components. Whereas most of the sites were only sampled during 1 of the 4 years, 10 lakes within four parks (Lake Clark, Olympic, Rocky Mountain, Sequoia-Kings Canyon) were sampled in 2 separate years in order to examine temporal variation within a subset of lakes (table 1). Depending on the characteristics of a site, and its associated access logistics, fish were sampled using variable-mesh or fixed-mesh gillnets, hook and line, or beach seines. Because of ecological limits to the distribution of fish species across the entire western region of North America, identical species did not exist at all sites. Instead, we focused on targeting four primary species (brook trout [*S. fontinalis*], cutthroat trout [*Oncorhynchus clarkii*], rainbow trout [*O. mykiss*], and lake trout) that occurred across as many sites as possible. In sites where those species did not occur, we sampled the most abundant resident species that were found, trying where possible to match the ecological niche of at least one of our primary species. Once fish were collected, they were immediately wrapped in chemically cleaned aluminum foil and sealed in individually labeled polyethylene zip bags. Fish in the field were immediately placed on wet or dry ice until transport to the laboratory, where they were stored at -20°C until processing and analysis.

Sample Processing and Mercury Determination

In the laboratory, we thawed each fish to room temperature, measured standard length (SL) to the nearest millimeter, and mass to the nearest 0.1 g. From each fish with greater than 100 mm SL, we dissected 5–10 g of skinless axial muscle using nitric acid and deionized-water-rinsed scalpels, scissors, and forceps. We then rinsed each muscle sample in deionized water to remove any surface contaminants, blotted them dry with clean, lint-free wipes, and weighed them on an analytical balance to the nearest 0.0001 g. Fish with less than 100 mm SL were processed as whole-body samples. For these, we removed stomach contents and thoroughly cleaned the surface of the fish with deionized water, then blotted dry and weighed as described above for muscle tissue. We chose to process and analyze fish less than 100 mm SL as whole fish because they often lacked adequate muscle tissue for analysis. Moreover, robust conversion equations exist for translating between whole-body fish and muscle THg concentrations (Peterson and others, 2005, 2007); thus, the whole-body samples were still comparable to the muscle samples. Once muscle or whole-body samples were cleaned and weighed, we placed them in a drying oven at 50 °C until a constant mass was achieved, typically 48 h. We subsequently removed the sample from the drying oven and allowed them to cool to room temperature in a desiccator. Once cool, we measured the dry mass of each sample to the nearest 0.0001 g, and homogenized each to a fine powder with scissors and a ceramic mortar and pestle. The homogenized samples were stored in a desiccator until chemical analysis.

We determined THg concentrations of each sample following EPA method 7473 (U.S. Environmental Protection Agency, 2000) on a Milestone tri-cell DMA-80 Direct Mercury Analyzer (Milestone, Inc., Monroe, Connecticut, U.S.A.). Briefly, we used an integrated sequence of drying (250 °C for 30 s), thermal decomposition (650 °C for 90s), catalytic conversion, and then amalgamation in a gold trap, followed by cold vapor atomic absorption spectroscopy. Quality-assurance measures included analysis of two certified reference materials (either dogfish muscle tissue [DORM-4; National Research Council of Canada, Ottawa, Canada], or dogfish liver [DOLT-3; National Research Council of Canada, Ottawa, Canada]), two system and method blanks, and two duplicates-per-batch of 30 samples. Recoveries (\pm standard error) averaged 102.8 ± 0.6 percent ($n = 88$) and 97.83 ± 1.06 percent ($n = 128$) for certified reference materials and calibration checks, respectively. Absolute relative percent difference for all duplicates averaged 3.31 ± 0.40 percent.

Statistical Analyses

Unless otherwise noted, all statistical analyses were conducted on dry-weight THg concentrations to minimize inconsistencies resulting from variable moisture contents of individual fish. However, to facilitate comparisons with other work, we present wet weight THg concentrations in the text and figures. Fish length is often positively correlated with Hg concentrations, which can confound direct comparisons of fish Hg concentrations among locations with different sized fish. In order to make spatial comparisons among and within parks, we first evaluated whether size adjusting THg concentrations was necessary for each species of fish at each sampling site. To make this determination, we developed decision rules based on a combination of the strength of regression coefficients (R^2) and the small sample-size corrected Akaike's Information Criterion (AIC_c) for length versus THg concentration (dry weight, \log_{10} -transformed) regression models from each species-site combination. No size adjustment was made for models with R^2 less than 0.20. For regression models with R^2 greater than 0.20, we compared the regression model with a null model using AIC to assess whether including fish length as a variable improved the likelihood of predicting fish THg concentrations. If the difference between the regression and null AIC_c values (ΔAIC_c) was less than 2, we proceeded with size adjusting individual THg concentrations using linear regression. We also used AIC-based model assessment to determine whether sampling year (where available) influenced the relationship between size and Hg concentrations by including a year-by-size interaction. The year-by-size interaction failed to improve the plausibility of the size-Hg relationship in all cases; thus for size adjustment, we lumped all fish from a population regardless of year sampled.

The variation in sizes and species of fish collected across sites complicated direct comparisons of size-adjusted THg concentrations for all fish simultaneously. Therefore, using length-frequency histograms, we classified fish species into three different size categories (50, 200, and 400 mm SL), thus minimizing extrapolation of THg concentrations outside the range of sizes observed for each species. Mercury concentrations in smallest size category of fishes (speckled dace [*Rhinichthys osculus*], threespine stickleback [*Gasterosteus aculeatus*], and torrent sculpin [*Cottus rhotheus*]) were adjusted to the concentration predicted at 50 mm SL for each individual. Mercury concentrations in the intermediate size category of fishes (arctic grayling [*Thymallus arcticus*], brook trout, brown trout [*Salmo trutta*], cutthroat trout, Dolly Varden [*S. malma malma*], golden trout [*O. mykiss aquabonita*], kokanee [*O. nerka*], rainbow trout), were adjusted to the concentration predicted at 200 mm SL for each individual. Mercury concentrations in the largest size category of fishes (bull trout [*S. confluentus*], lake trout, lake whitefish [*Coregonus clupeaformis*], and northern pike) were adjusted to the concentration predicted at 400 mm SL for each individual. To standardize THg concentrations to the appropriate sizes, we used the linear regression equations for each site-species combination, then added the residuals from

each individual fish to its predicted concentration in order to incorporate the unexplained variation back into the estimate. For those fish sampled from sites where there was no meaningful Hg-size relationship, we used the un-adjusted Hg concentrations for each individual.

To compare Hg concentrations among parks and sites within parks, we constructed separate mixed effects, nested general linear models for each of the three size classes (50, 200, and 400 mm SL) with park and site (nested within park) included as fixed effects, and species included as a random effect in each model to statistically account for variation due to different species being collected across sites. In addition to comparing model-adjusted fish THg concentrations among parks and sites within parks, we used the model-adjusted THg concentrations at sites and parks to examine how variation in THg concentrations was partitioned across a gradient of spatial scales. To do this, we evaluated the coefficient of variation (CV) for (1) all fish within a site using individual fish THg concentrations, (2) all sites within a park using model-generated least-square mean (LSM) THg concentrations for each site, and (3) all parks using model-generated LSM Hg concentrations for each park. By comparing the CVs from each of these scales with t-tests (two-sample in comparison 1 and 2, one-sample in comparison 3), we evaluated whether within-lake processes, within-catchment processes, or within-region processes accounted for the most variation in THg concentrations.

In order to evaluate temporal variation in the subset of 10 sites that were sampled in more than 1 year, we used analysis of covariance (ANCOVA), which tested whether fish Hg concentrations were different between years for each lake, while statistically controlling for fish length. Therefore, we included standard length as a covariate in the models. The initial sampling event for each site varied between 2008, 2009, and 2011 depending on the park. The final sampling for all sites was 2012. Because of this, our goal was not to test whether there were consistent year effects, but simply to evaluate how Hg concentrations within a site might differ between two distinct years regardless of which years those were.

Risk Benchmark Values

In addition to examining spatial and temporal variation in fish THg concentrations across parks, we also evaluated the threat Hg might pose at each site to the health of fish, piscivorous wildlife, and humans by comparing measured and modeled THg concentrations to a range of established benchmarks of toxicity to different taxonomic groups.

Fish

We compared whole-body Hg concentrations in fish to a no-observed-effects-residue (NOER) of 200 ng/g ww (Beckvar and others, 2005) and a lowest-observed-effects-residue (LOER) of 300 ng/g ww (Sandheinrich and others, 2011) to assess potential risks of Hg exposure to fish themselves. The NOER threshold identifies the Hg concentration in fish tissues below which fish should not experience deleterious effects of Hg exposure on reproduction, growth, or survival. In contrast, the LOER threshold indicates the concentration above which sublethal endpoints of Hg exposure, including alterations to reproductive health, have been documented in laboratory and field studies of fish.

Birds

Birds are sensitive to the toxicological effects of MeHg exposure, and piscivorous birds are among the taxa most commonly at risk because of their high trophic position. However, robust data on the dietary Hg exposure thresholds that result in deleterious effects exist for very few bird species. Moreover, there is considerable evidence of substantial variability in the sensitivity of different bird

species to Hg exposure (Heinz and others, 2009). Therefore, accurately extrapolating risk across a range of unique species can be difficult and may result in low confidence estimates. This is particularly problematic in studies such as this one, where no single piscivorous bird species with well-documented toxicological responses to Hg exposure extends across such an expansive spatial extent, nor over such a range of habitats. Therefore, our approach was to establish a baseline of risk in a well-studied avian piscivore, then evaluate the likely range of risk for arbitrary taxa that are more and less sensitive to Hg than the baseline species. Arguably the most robust information on avian piscivore toxicological responses to Hg exposure across a range of scales of ecological organization exists for the common loon (*Gavia immer*), which has been intensively studied in field and laboratory settings for several decades (Kenow and others, 2008; Mitro and others, 2008; Scheuhammer and others, 2008; Kenow and others, 2011). This extensive research on the behavioral and reproductive impacts of Hg contamination has resulted in the development of robust dietary benchmarks for identifying ecological risk of Hg to common loons at a range of deleterious endpoints. These studies, coupled with other work on interspecific sensitivity to Hg exposure (Heinz and others, 2009), suggest that loons are moderately sensitive to Hg exposure in comparison to some other taxa. Therefore, we utilized the common loon dietary screening benchmark of 180 ng Hg/g ww in whole-body prey-fish (Depew and others, 2012b) as our baseline indicator of Hg risk to moderately sensitive avian consumers. Without solid quantitative comparisons of relative sensitivity among species, we chose a conservative approach of scaling the loon screening value down and up by 50 percent in order to estimate potential risk to bird species that are more or less sensitive to Hg exposure than the common loon. Thus, we assessed risk to avian consumers by comparing Hg concentrations in whole-body fish to 90 (high sensitivity), 180 (moderate sensitivity), and 270 ng Hg/g ww (low sensitivity) benchmarks. We recognize that this scaling is somewhat arbitrary in that it is not calibrated to specific avian species responses, but we chose this approach to better encompass the range of potential risk depending on the species that might occur at any given area. Much work is still needed to refine the scientific understanding of interspecies differences in sensitivity, but we use Heinz and others (2009) as the baseline for identifying some taxonomic groups that may fall into each classification. Based on that study of 27 bird species, piscivorous taxa that can be categorized as high sensitivity and that are found in some of the parks studied include osprey (*Pandion haliaetus*), white ibis (*Eudocimus albus*), and snowy egret (*Egretta thula*). Species that can be categorized as low sensitivity include hooded merganser (*Lophodytes cucullatus*) and double-crested cormorant (*Phalacrocorax auritus*). Besides common loon, other species with probable moderate sensitivity include common tern (*Sterna hirundo*), royal tern (*Sterna maxima*), and great egret (*Ardea alba*).

Humans

We assessed risk of Hg exposure to human consumers of fish by comparing Hg concentrations in fish muscle to the EPA's tissue residue criterion for Hg (300 ng/g ww) and two benchmarks recommended by the Great Lakes Advisory Group (GLAG) for limiting the risk of Hg exposure to anglers (Great Lakes Advisory Group, 2007). The lower benchmark (50 ng/g ww) represents the concentration of Hg in fish muscle below which unrestricted consumption of fish poses no risk to consumers. The higher benchmark (950 ng/g ww) represents the concentration of Hg in fish muscle above which GLAG recommends that no consumption occur.

Risk Estimation

We assessed risk to fish, avian consumers, and humans using two approaches. First, we compared whole-body (fish and avian risk assessments) or muscle (human risk assessment) Hg concentrations in fish to each of the reference values discussed above (two fish, three avian, and three human benchmarks) and enumerated the proportion of individuals exceeding each benchmark at each site, park, and across parks. This analysis provides an overview of Hg risk in all parks and sites sampled, but does not account for other factors that influence Hg risk. In particular, because Hg concentrations can be strongly influenced by fish size, it is important to understand how risk varies across the size spectra of the fish communities. Therefore, in the populations (that is, species-site combinations) where size was correlated with Hg concentrations, we used a second approach utilizing the size-Hg relationships to model the Hg concentration of each fish sampled from a population at 1 mm increments over the range of sizes observed in that population. We then compared these modeled fish Hg concentrations to each of the eight benchmarks at 1 mm increments to determine the proportion of individuals exceeding each benchmark at a given size. Uncertainty in these size-specific risk estimates was preserved by comparing the bounds of a 95 percent prediction interval for each fitted value to the benchmarks. The resulting size-specific risk profiles present changes in the risk of Hg across the size of individuals sampled from a population and can be used to identify the size at which a given proportion of individuals in a population likely exceed a specified threshold, or conversely, the proportion of individuals in a population that exceed a threshold at a given size. Because Hg concentrations in fish, and thus the risk of Hg to fish, wildlife, and humans, varies with fish size, these size-specific risk profiles better approximate the range of risks present in a population and provide important insights into how risks can be managed.

Results

Over a 4 year time span (2008, 2009, 2011, and 2012), we sampled 1,486 fish representing 16 different species from 86 individual sites across 21 national parks (table 1). Throughout all parks and species, fish muscle THg concentrations ranged over two orders of magnitude from 9.9 to 1,109 ng/g ww. The overall geometric mean (95-percent confidence interval in parentheses) of all fish sampled was 77.7 (73.6–80.8) ng/g ww. However, fish THg concentrations varied substantially among individual parks, with park-specific geometric mean values ranging from 32.6 (28.3–37.6) ng/g ww in Grand Teton NP to 325.6 (281.4–376.9) ng/g ww in Capitol Reef NP (table 2; fig. 2). Furthermore, within parks there was considerable variation in geometric mean fish THg concentrations among sites (table 3, figs. 2 and 3). The greatest range in site-specific geometric mean fish THg concentrations within parks occurred in Mount Rainier and Rocky Mountain NPs, where we measured approximately 11- and 8-fold differences, respectively, between the sites within each park with the lowest and highest THg concentrations (table 2, fig. 3). Importantly, the species and size distribution of fishes differed among parks and lakes, confounding direct comparisons across locations because of the influence that these factors have on THg concentrations (fig. 3). Therefore, we subsequently normalized the THg concentrations to account for the effects of size and species on fish THg concentrations, thus allowing for more meaningful spatial comparisons.

Model-Adjusted Mercury Concentrations

Inter-Park Comparisons

In order to control for the influence of size and species on fish Hg concentrations, we first assessed the relationships between fish length and THg concentrations on a site and species-specific basis as described in section, “Methods.” Size was correlated with THg concentrations in 61 of the 104 site-species combinations (table 1; Significant Size Regression). For those 61 combinations, we normalized each individual THg concentration to a standardized length (50, 200, or 400 mm SL), which was dependent on the taxonomic grouping to which it was assigned (see section, “Methods”). For the site-species combinations where there were no relationships between length and Hg concentrations, we used unadjusted Hg values for each fish as it was assigned to its respective size category (table 1).

After accounting for the effects of size and species, LSM THg concentrations of each fish size class differed among parks (50 mm SL: $F_{3,107} = 100.15$, $p < 0.001$; 200 mm SL: $F_{14,56.7} = 79.60$, $p < 0.001$; 400 mm SL: $F_{4,124} = 79.08$, $p < 0.001$; fig. 4). Fish species assigned to the 400 mm SL size class only occurred in 5 of the 21 parks, primarily the northernmost parks—Denali, Wrangell-St. Elias, Lake Clark, Glacier, and Yellowstone NPs. Among those five parks, LSM THg concentrations in fish ranged from 47.4 ± 1.6 to 278.9 ± 7.4 ng/g ww. Fish THg concentrations were highest at Wrangell-St. Elias NP followed by Glacier, Lake Clark, Yellowstone, and Denali NPs (table 2, figs. 4 and 5).

Fish assigned to the 200 mm SL size class were collected from the greatest number of parks, and representatives of this size class are absent only from Denali, Lake Clark, Glacier, Capitol Reef, Zion, and Mesa Verde NPs. Mercury concentrations in fish from the 200 mm SL size class had a much narrower range of LSMs across parks than the 400 mm SL fish with concentrations ranging from 26.6 ± 2.6 to 119.9 ± 10.2 ng/g ww. Within this size class, Yellowstone NP had the highest fish THg concentrations, followed by Olympic, Glacier Bay, Grand Canyon, Wrangell-St. Elias, North Cascades, Yosemite, Sequoia-Kings Canyon, Lassen Volcanic, Great Sand Dunes, Mount Rainier, Rocky Mountain, Great Basin, Grand Teton, and Crater Lake NPs (fig 4, table 2).

Similar to the largest size class of fishes, we only collected samples falling into our smallest size class of fishes (50 mm SL) from a limited subset of four parks, mostly in the Southwestern region. Least-square mean THg concentrations in this size class ranged from 74.9 ± 2.9 to 242.5 ± 5.4 among parks. Among the 50 mm SL size class, fish Hg concentrations were highest at Zion NP, followed by Capitol Reef, Mount Rainier, and Mesa Verde NPs. The LSM values of 50 mm SL fish from Zion and Capitol Reef NPs are comparable to those in parks with the highest 400 mm SL fish (figs. 4 and 5).

Intra-Park Comparisons

In addition to regional differences in THg concentrations across parks, we also found differences in fish THg concentrations among sites nested within parks for each of the three size classes (50 mm SL: $F_{5, 107} = 12.22$, $p < 0.001$; 200 mm SL: $F_{57, 679.9} = 41.72$, $p < 0.001$; 400 mm SL: $F_{3, 124} = 31.56$, $p < 0.001$; fig 6, table 3). The magnitude of site differences within a park varied among parks and size classes. For the 400 mm SL size class, there were only two parks with multiple sites containing fish assigned to this size class. The sites with the highest THg concentrations were 1.33- and 3.35-fold higher than the sites with the lowest THg concentrations for Wrangell-St. Elias and Lake Clark NPs, respectively. For the 200 mm SL size class, the highest site within a park averaged 4.4 times higher than the lowest site within a park. The differences between the highest and lowest sites within parks ranged

from 1.27- to 22.61-fold in Great Basin and Mount Rainier NPs, respectively. For the 50 mm SL size class, the highest site within a park was on average 1.7 times higher than the lowest site within a park, and this difference between highest and lowest sites within a park ranged from 1.05- to 2.25-fold in Zion and Mount Rainier NPs, respectively. The values above provide insight into the overall range in concentrations within and among NPs, but do not adequately address the overall variance that was measured at each scale.

Variation Across Spatial Scales

To evaluate whether variation in fish THg concentration was most prevalent at the site, park, or regional level, we examined the CV at three scales: (1) CV among fish within individual sites, (2) CV among lakes within individual parks, and (3) CV among parks across the Western United States, including Alaska. The CV among fish within individual sites ranged from 0.097 at Death Canyon Creek in Grand Teton NP to 0.819 at The Loch in Rocky Mountain NP, and averaged 0.303 across all sites (table 3). The CV among lakes within individual parks ranged from 0.121 in Great Basin NP to 0.865 on Yosemite NP (table 3). The mean CV among sites within parks (0.493) was greater than the average CV among fish within sites ($t = 3.87$, $df = 18$, $p = 0.001$). The CV among parks was 0.673 (table 3); significantly higher than the mean CV among sites within parks ($t = -3.798$, $df = 16$, $p = 0.002$). These data suggest that variation in THg concentrations increases at progressively larger landscape scales, with the greatest variation resulting from regional factors, followed by local and within-lake biological factors.

Inter-Annual Variation

There were no consistent patterns in inter-annual variability across the 10 sites sampled over separate years. Significant differences in mean Hg concentrations were observed at 5 of 10 sites. Fish THg concentrations increased from the first sampling year to the second at two sites: Sun Up Lake (Olympic NP; $F_{1,27} = 6.35$, $p = 0.018$; fig. 7) and Center Basin Lake (Sequoia-Kings Canyon NP; $F_{1,42} = 22.87$, $p < 0.0001$; fig. 7). Conversely, fish THg concentrations decreased from the first sampling event to the second in three sites—Upper Lena Lake (Olympic NP; $F_{1,24} = 7.12$, $p = 0.014$, fig. 7), Poudre Lake (Rocky Mountain NP; $F_{1,27} = 4.77$, $p = 0.038$, fig. 7), and Ypsilon Lake (Rocky Mountain NP; $F_{1,27} = 4.36$, $p = 0.046$, fig. 7). Finally, we found no differences among years at the remaining five sites—Gladys Lake (Olympic NP; $F_{1,26} = 1.13$, $p = 0.30$), Lake Nanita (Rocky Mountain NP; $F_{1,20} = 0.004$, $p = 0.89$), Mirror Lake (Rocky Mountain NP; $F_{1,27} = 0.21$, $p = 0.65$), Kern Point (Sequoia-Kings Canyon NP; $F_{1,27} = 1.47$, $p = 0.23$), and Lake Clark (Lake Clark NP; $F_{1,24} = 0.037$, $p = 0.85$). The magnitude of differences between years was 19.6 percent in Sun Up Lake (Olympic NP), 24.4 percent in Ypsilon Lake (Rocky Mountain NP), 24.8 percent in Upper Lena Lake (Olympic NP), 26.5 percent in Poudre Lake (Rocky Mountain NP), and 43.6 percent in Center Basin Lake (Sequoia-Kings Canyon NP).

Toxicological Risk

Estimating toxicological risk of Hg within ecosystems can be subjective and dependent on the endpoints selected, the uncertainty surrounding individual- and species-specific sensitivity estimates, and whether risk is based on dietary exposure or tissue-based Hg concentrations. Because of the geographic scale of this study, the wide range of species sampled, and the somewhat limited sample sizes within sites, we evaluated ecological and human health risk at a relatively coarse scale, by comparing measured, unadjusted fish THg concentrations to a gradient of pre-established benchmarks

individually for fish health, avian (piscivorous bird) health, and human health. However, in addition to simply comparing the proportion of sampled fish to these thresholds, we modeled Hg risk to each group across the range of fish sizes for each site in order to evaluate how risk to these groups varies with fish size (fig. 8; see section, “Methods”).

Fish Risk

Across all parks, species, and sizes of fish, 5 percent of individuals had whole-body THg concentrations above which Hg exposure may affect fish health (NOER; 200 ng/g ww; table 4). Fewer than 2 percent of individuals had whole-body THg concentrations above which deleterious effects are likely (LOER; 300 ng/g ww; table 4).

The distribution of risk was not evenly distributed across all parks. Thirteen of the 21 parks sampled contained no fish exceeding the 200 ng/g NOER benchmark. In the eight parks (38 percent) with fish exceeding 200 ng/g THg, the proportion of individual fish exceeding this benchmark was highest in Capitol Reef NP, where 49 percent of fish sampled had concentrations above 200 ng/g ww, followed by Lake Clark, Zion, Wrangell-St. Elias, Yosemite, Lassen Volcanic, Rocky Mountain, and Mount Rainier NPs (table 4). Of the 21 parks sampled, only 6 (Capitol Reef, Lake Clark, Wrangell-St. Elias, Zion, Yosemite, and Rocky Mountain NPs; 29 percent) contained fish with THg concentrations exceeding the 300 ng/g ww LOER benchmark (table 4), the value above which deleterious effects to fish are likely. Twenty-two percent of fish from Capitol Reef NP exceeded this concentration, whereas Lake Clark, Wrangell-St. Elias, Zion, Yosemite, and Rocky Mountain NPs had progressively lower proportions fish exceeding this benchmark (table 4).

When examined on a site-specific basis, fish THg concentrations exceeded 200 ng/g ww in 13 sites (15 percent) across the 8 parks containing fish with values above this benchmark. More than one-half of the individual fish exceeded the NOER threshold at Tanada Lake (85 percent) in Wrangell-St. Elias NP, Fremont River site 1 (67 percent) and site 7 (60 percent) in Capitol Reef NP, and Lake Clark (54 percent) in Lake Clark NP (table 4). Other sites with fish exceeding the NOER benchmark include East Fork Virgin River (Zion NP), MORA_1614 (Mount Rainier NP), Fremont River site 4 (Capitol Reef NP), Lake Kontrashibuna (Lake Clark), Mildred Lake (Yosemite NP), Fall River (Rocky Mountain NP), Mirror Lake (Rocky Mountain NP), North Fork Virgin River (Zion NP), Horseshoe Lake (Lassen Volcanic NP). The 300 ng/g LOER was exceeded in only 8 individual sites (9 percent). Two sites in Capitol Reef NP (Fremont River sites 1 and 7) had the highest proportions of individuals exceeding this benchmark, 33 and 27 percent, respectively (table 4). Other sites with fish exceeding the LOER benchmark include Tanada Lake (Wrangell-St. Elias NP), Lake Clark (Lake Clark NP), Fremont River site 4 (Capitol Reef NP), Mildred Lake (Yosemite NP), North Fork Virgin River (Zion NP), and Fall River (Rocky Mountain NP).

Size-Specific Risk

We modeled risk across the observed size range for all 61 populations with size-Hg relationships. This approach was implemented so that instead of simply calculating the proportion of fish exceeding benchmarks from the sampled size range (which is not necessarily representative of the size distribution of fish within the lake), we could estimate specific lengths at which most fish exceed each benchmark. Taking this approach, our models estimated that fish would exceed the 200 ng/g ww NOER benchmark in 21 (34 percent) of the populations modeled (fig. 9). In eight of those populations, at least one-half of all individuals are predicted to exceed the NOER at some length along their size spectra (fig. 9). Four of these populations were speckled dace from three sites in Capitol Reef NP and one site in Zion NP. In these four populations, the mean size at which 50 percent of the individuals were

modeled to exceed the benchmark was 61 mm SL, ranging from 52 mm SL in Capitol Reef's Fremont River site 1, to 67 mm SL in Fremont River sites 4 and 7 (fig. 9). For the other four populations, our models predict that 50 percent of the individuals will exceed the NOER at 264 and 302 mm in brook trout from Mildred Lake in Yosemite NP and Horseshoe Lake in Lassen Volcanic NP, respectively, 323 mm SL in suckers from Fall River in Rocky Mountain NP, and 412 mm SL in lake trout from Tanada Lake in Wrangell-St. Elias NP (fig. 9).

Model predictions estimate that fewer fish populations (12 of 61 populations modeled; 20 percent) are expected to contain individuals exceeding the 300 ng/g LOER over the range of fish sizes sampled in each population than estimated for the NOER (fig. 9). At least 50 percent of the individuals in five of the populations were predicted to exceed this benchmark at some point within their measured size spectra. Four of those populations were specked dace from Capitol Reef and Zion NPs, where the estimated size at which 50 percent exceeded the benchmark was 71 mm SL (fig. 9). Additionally, at least one-half of the lake trout population greater than 526 mm SL from Tanada Lake in Wrangell-St. Elias NP are projected to exceed the LOER (fig. 9).

Avian Risk

When examining the unadjusted whole-body THg concentrations, 35 percent of all fishes sampled had THg concentrations above our benchmark for risk to birds with high sensitivity to Hg exposure (90 ng/g ww; table 4). Tissue concentrations in 12 percent of individual fish exceeded the 180 ng/g ww benchmark for reproductive impairment in species with moderate sensitivity, and 5 percent of individual fish exceeded 270 ng/g ww, our benchmark for risk to birds with low sensitivity to Hg exposure (table 4).

Among the 21 parks, the potential risk to piscivorous birds varied substantially. In 7 parks (33 percent), none of the fish analyzed exceeded the 90 ng/g ww benchmark for highly sensitive bird species. In the remaining 14 parks (67 percent), more than one-half of sampled fish were above this concentration, and more than three-quarters of sampled fish exceeded this value in Lake Clark, Zion, Capitol Reef, and Glacier NPs (76, 90, 98, and 100 percent, respectively). The benchmark for reproductive impairment in moderately sensitive avian species was exceeded in nine (43 percent) parks. The proportion of fish within these nine parks that exceeded this benchmark, ranged from 1 percent of individual fish at Yellowstone NP to 56 percent of individual fish at Capitol Reef NP, which was the only park from which more than one-half of the fish sampled exceeded the moderate sensitivity benchmark (table 4). Fourteen of the 21 parks had no fish with THg concentrations above the benchmark for birds with low Hg sensitivity (table 4), and the proportion of fish exceeding this threshold was less than 10 percent in all remaining seven parks (33 percent) except Capitol Reef, where 33 percent of fish sampled exceeded the threshold (table 4).

On a site-specific level, 41 of the 86 sites sampled had no fish with THg concentrations above the benchmark for the most sensitive avian species (table 4). However, at the remaining 45 sites (52 percent), 63 percent of fish exceeded this benchmark, and at 7 sites, 100 percent of fish sampled were above the high sensitivity avian benchmark. At an additional seven sites, between 50 and 93 percent of fish had THg concentrations greater than the high sensitivity avian threshold (table 4). The loon reproductive impairment threshold was exceeded at 18 sites (21 percent), with more than one-half of the fish surpassing this benchmark at four sites (table 4). Nine individual sites (representing seven parks) contained fish with THg concentrations above the benchmark for birds with low sensitivity to Hg (table 4).

Size-Specific Risk

Size-specific Hg risk to piscivorous birds was modeled for 61 populations. Of these, whole-body Hg concentrations in fish from 14 populations (23 percent) did not exceed the 90 ng/g ww benchmark for risk to the most sensitive avian species, while the remaining 47 populations (77 percent) were modeled to exceed this threshold at some size (fig. 10). However, 100 percent of lake trout from Tanada and Copper Lakes in Wrangell-St. Elias NP and lake whitefish from Lake McDonald in Glacier NP were predicted to exceed this benchmark over the entire range of fish sizes (fig. 10). The size at which 50 percent of the fish in a population were predicted to exceed the benchmark for risk to highly sensitive piscivorous birds ranged from less than 40 mm SL in speckled dace from Fremont River site 1 in Capitol Reef NP to 414 mm SL in brown trout from the Colorado River in Rocky Mountain NP. Among the smaller “forage fish” (that is, speckled dace, torrent sculpin, and threespine stickleback), the mean size at which 50 percent of the individuals within a population exceeded the threshold was 59 mm SL (n = 6 populations). For brook trout, cutthroat trout, and rainbow trout, the mean size at which 50 percent of the individuals within a population exceeded the threshold was 223 mm SL (n = 15 populations).

The majority of individual populations modeled (36 of 61 populations, 59 percent) were predicted to have no individual fish with THg concentrations exceeding the benchmark for reproductive impairment in moderately sensitive avian consumers across the range of fish lengths, whereas in 25 parks (41 percent), some fish were modeled to exceed this benchmark (fig. 10). However, in 10 populations, more than one-half of the individual fish in each population were predicted to have THg concentrations above the common loon reproductive impairment benchmark, and lake trout from Tanada Lake in Wrangell-St. Elias NP were modeled to exceed this threshold over the entire range of sizes sampled (fig. 10). Four of the 10 populations with greater than 50 percent of fish predicted to exceed the loon risk concentration at some length within the population were speckled dace. The mean size at which 50 percent of these speckled dace populations was predicted to exceed the loon risk benchmark is 58 mm SL. The mean size at which 50 percent of the individuals in a population was modeled to exceed the loon risk threshold was 261 mm SL for three brook trout populations (Horseshoe Lake in Lassen Volcanic NP, Mirror Lake in Rocky Mountain NP, and Mildred Lake in Yosemite NP).

Our models predicted that fish from 12 populations sampled (20 percent) would exceed the 270 ng/g ww threshold for birds with the lowest Hg sensitivity at some point along their size spectrum (fig. 10). In six of the populations, 50 percent or more of the individuals were modeled to exceed this threshold at some size. Four of these six populations were speckled dace from Capitol Reef and Zion NPs, and the mean length at which 50 percent of the population was predicted to exceed the threshold was 68 mm SL, only 10 mm greater than the same exceedance level for loon risk. The other two populations were suckers from the Fall River in Rocky Mountain NP and lake trout from Tanada Lake in Wrangell-St. Elias NP. In those populations, the model-predicted size at which 50 percent of the population exceeded the threshold was 353 and 496 mm SL, respectively.

Human Consumption Risk

As mentioned in section, “Methods,” human health risk was assessed using fish muscle THg concentrations, not whole-body concentrations as was done for wildlife risk. In the unadjusted data across all parks, species and sizes of fish, 32 percent of fish sampled had THg concentrations in their muscle below the 50 ng/g ww threshold established by the GLAG for unlimited consumption of fish, indicating that some human consumption guidance would apply to 68 percent of the individuals measured in this study (table 4). However, only 4 percent of fish had muscle THg concentrations exceeding the EPA human health criterion of 300 ng/g ww, and less than 1 percent had concentrations above the level at which GLAG recommends that no fish be consumed (950 ng/g ww).

As with the other benchmarks, the proportion of fish exceeding human risk thresholds varied greatly among parks. Grand Teton and Great Basin NPs had the lowest proportion of fish exceeding the GLAG unlimited consumption threshold (18 percent), whereas 100 percent of fish analyzed from Glacier NP exceeded this threshold (table 4). In 17 parks (81 percent), more than one-half of sampled fish had concentrations above the GLAG threshold. In 11 (61 percent) of the 18 parks from which species consumed by humans (that is, excluding speckled dace, threespine stickleback, and torrent sculpin) were analyzed, no fish had muscle THg concentrations exceeding the EPA human health criterion. In the remaining 7 of 18 parks (39 percent) with fish exceeding the EPA human health criterion, the proportion of fish with concentrations above 300 ng/g ww was typically only 1–3 percent of individuals, with the exception of Lake Clark, Wrangell-St. Elias, and Yosemite NPs, where 40.7, 18.3, and 6.7 percent of fish exceeded the guideline, respectively (table 4). Yosemite was the only park in which any fish exceeded the GLAG no consumption guideline, with 3 percent of the analyzed fish having muscle concentrations over the guideline (table 4).

When examined at the finer site scale, 6 (8 percent) of the 79 sites from which fish species consumed by humans were sampled had no fish exceeding the GLAG unlimited consumption guideline, whereas at 23 of these sites (30 percent) all fish analyzed exceeded this guideline. At 56 sites (71 percent) at least 50 percent of the fish analyzed exceeded the unlimited consumption guideline. Thirteen sites (17 percent) had fish exceeding the EPA human health criterion, with more than 50 percent of individual fish from Lake Clark (80 percent) in Lake Clark NP and Tanada Lake (85 percent) in Wrangell-St. Elias NP exceeding the guideline. Mildred Lake in Yosemite NP was the only lake from which fish (7 percent) exceeded the GLAG no consumption guideline.

Size-Specific Risk

We used the same approach presented for fish and birds to model risk to humans across the size spectra of 54 populations with size-THg relationships. These models predicted that muscle THg concentrations in fish from every population would exceed the GLAG unlimited consumption guideline at some length over the observed range of sizes (fig. 11). The sole exception was cutthroat trout from Death Canyon Creek in Grand Teton NP, where even the largest fish sampled (260 mm SL) were predicted to have muscle concentrations below this level. In 40 of the 54 populations (74 percent) modeled, the unlimited consumption threshold was predicted to be exceeded by some fish across the entire range of observed sizes (fig. 11). In 8 populations (15 percent), all fish were expected to exceed this threshold across the entire range of sizes sampled. In the remaining populations, the average size at which 50 percent of the fish in a population were expected to exceed the threshold varied substantially, ranging from 40 mm SL in brook trout from Golden Lake in Mount Rainier NP to nearly 400 mm SL in northern pike from Lake Chilchukabena in Denali NP. When limited to brook, rainbow, and cutthroat trout, which comprise nearly 65 percent of the fish analyzed, the average size at which 50 percent of the fish in a population were modeled to exceed the unlimited consumption guideline was 179 mm SL (n = 36 populations).

Eighteen populations were modeled to exceed the EPA criterion for human consumption at some point across the measured size spectra (fig. 11). In six of these populations, models estimated that 50 percent or more of the individual fish at a certain size threshold within a population were predicted to exceed the EPA human health criterion, and all lake trout down to the smallest size (410 mm SL) from

Tanada Lake in Wrangell-St. Elias NP were predicted to exceed the EPA human health criterion (fig. 11). For the three brook trout populations where at least one-half of the fish at a given size were predicted to exceed the EPA criterion (Horseshoe Lake in Lassen Volcanic, Golden Lake in Mount Rainier, and Mildred Lake in Yosemite), the average size at which 50 percent of the individuals exceeded it was 258 mm SL.

After modeling risk across the entire sampled fish size range, nine populations (17 percent of all populations) are predicted to include some fish that exceed the GLAG no consumption guideline (fig. 11). Of these nine populations, the models predicted that only two populations (suckers from the Fall River in Rocky Mountain NP and brook trout from Mildred Lake in Yosemite NP) were expected to have more than 50 percent of individuals in the population exceeding the threshold at some length along the size spectra for each population. The sizes at which 50 percent of individuals exceeded this threshold were 353 and 250 mm SL in suckers from the Fall River and Mildred Lake, respectively (fig. 11).

Discussion

Our results indicate that Hg bioaccumulation and risk to aquatic ecosystems of national parks in the Western United States is widespread, yet highly variable. Total Hg concentrations in individual fish ranged over two orders of magnitude across more than 1,400 individuals analyzed, with the lowest concentrations near 10 ng/g ww and the highest concentrations exceeding 1,100 ng/g ww. Importantly, this variation in Hg concentrations not only occurred across parks, but also among different sites within parks, even in light of site selection criteria that included restricting sites to mostly oligotrophic, headwater systems. These results highlight the significance of both local and regional-scale processes in determining Hg risk. As a result of this variability, many of the parks contained fish that were all below even the most conservative benchmarks of risk to fish (13 of 21 parks) and piscivorous birds (7 of 21 parks). Moreover, although all parks contained one or more fish that exceeded the GLAG unlimited consumption benchmark, most parks (14 of 21) did not have any fish in exceedance of the 300 ng/g ww EPA fish tissue criterion. Conversely, for those parks with fish that did exceed ecological and human health benchmarks, a substantial proportion of the fish had concentrations that were above those thresholds of concern. This was particularly true in the case of avian risk, where more than one-half of the fish sampled in several locations exceeded thresholds for risk to reproductive impairment in highly sensitive and moderately sensitive bird species. Although we did not directly assess risk to mammalian wildlife, the benchmarks chosen for avian consumers correspond closely with the no-observed-affect-level (NOAEL) benchmark for dietary Hg in mammalian wildlife (110 ng/g ww; Basu and Head 2010). Thus, our data suggest that mammalian wildlife also are likely to be at risk across these parks. Finally, although the geographic distributions in species occurrence impeded direct comparisons across all parks simultaneously, our data identify two regions of particular concern—(1) some parks in Alaska, as well as Glacier NP, had THg concentrations in large top predator fish species that approached or exceeded human consumption guidelines, and (2) some of the smallest “forage fish” sampled in the arid Southwest region had among the highest THg concentrations of the entire study, greatly exceeding wildlife risk thresholds for reproductive impairment. Although many plausible explanations exist for these patterns, investigating the potential mechanisms was beyond the scope of this study. Thus, more work is needed to better understand the landscape drivers of THg concentrations in these fish, as well as any deleterious effects these Hg concentrations might be having on resident biota in these parks. Additionally, information regarding the species composition, size ranges, and consumption rates of fish consumed by subsistence fishers in Alaskan parks is important for better characterizing human health risk in those parks.

THg concentrations in fish from this study generally are consistent with those of other studies in freshwater habitats of protected lands in the Western United States. For example, the Western Airborne Contaminants Assessment Project (WACAP) measured fish THg concentrations in 14 lakes from eight western national parks, six of which also were included in this study (Landers and others, 2008). Mean whole-body concentrations ranged from less than 40 ng/g ww in Glacier NP to slightly more than 200 ng/g ww in Noatak NP, Alaska (Landers and others, 2008). However, because the WACAP study was designed specifically as a screening study, there was limited replication within parks for evaluating site-specific variability in relation to regional variability. The need for such replication is indicated by a comparison of Hg concentrations reported from Glacier NP by Landers and others (2008) and the current study. Landers and others (2008) found Hg concentrations in cutthroat trout from two lakes in Glacier NP to be among the lowest measured in their study, whereas in the current study, concentrations from a third lake in Glacier were among the highest observed.

We specifically addressed this issue by sampling two parks (Mount Rainier and Rocky Mountain) intensively, with 17 and 19 different sites in each park, respectively. This higher resolution sampling revealed up to 20-fold variation in size-normalized fish THg concentrations among lakes within an individual park. This level of variation within a park is important to demonstrate and incorporate into park-level assessments, but is not unexpected given the well-established linkages between site-level characteristics and both methylation and bioaccumulation processes (Hall and others, 2008; Mitchell and Gilmour, 2008; Gabriel and others, 2009; Rolfhus and others, 2011; Hsu-Kim and others, 2013). Regardless, relatively little information exists about this variability in remote and high-altitude habitats that were the focus of this study. Recent studies do suggest that Hg bioaccumulation in osprey nesting in alpine habitats is regulated by a combination of local processes and atmospheric deposition (Guigueno and others, 2012). Similarly, Hg loadings to western Canadian alpine lakes was most strongly related to site-specific processes such as organic matter supply and catchment weathering (Phillips and others, 2011). Moreover, a recent study of THg concentrations in fish from sub-alpine lakes in the Wallowa-Whitman National Forest in northeastern Oregon and western Idaho focused on among-lake variation in fish THg concentrations within a relatively localized (Eagles-Smith and others, 2013). Consistent with the current study, mean fish THg concentrations among lakes varied by more than an order of magnitude (25–443 ng/g ww), even though all lakes were within 100 km of one another. Conifer density (basal area) within the catchment of each lake was the strongest predictor of fish THg concentrations among lakes (Eagles-Smith and others, 2013), highlighting the importance of watershed characteristics on downstream Hg cycling processes. At an even broader scale, the percentage of land covered by coniferous forests (coupled with wet Hg deposition) across six States in the south-central U.S. was an important factor influencing fish THg concentrations (Drenner and others, 2013). The hierarchical spatial design of the current study, combined with the gradient in landscape types, altitudes, and fish species that occur over the approximately 4,000 km distance, complicate a similar landscape scale analysis without even greater data density and replication among sites. However, our results support the notion that Hg risk is driven by a dynamic balance of local, regional, and global processes. What is unclear, is how the relative importance of these processes changes across locations, which should be addressed in focused future research in order to facilitate more informed management of Hg risk.

Although we do not formally address risk to the unique ecological communities across the parks studied, the model-adjusted fish THg concentrations provide a valuable index of relative risk to fish, wildlife, and human health. Our results suggest that although risk is low in many locations, there are substantial concerns about the impact of Hg on ecological health in other locations. In particular, THg concentrations in speckled dace, a small invertebrate-foraging minnow from Zion and Capitol Reef NPs,

commonly exceeded some of the highest values in top predators, such as lake trout, from other parks. Size-normalized (50 mm) mean THg concentrations in these fish exceeded 200 ng/g ww in both parks, and mean concentrations in one site exceeded 300 ng/g ww. Moreover, across the range of fish sampled in these parks (approximately 70–100 mm SL), most fish exceeded these values. Because speckled dace occupy intermediate trophic positions, they serve as potential prey items for predatory fish and piscivorous birds, and dietary Hg concentrations at these levels are associated with biochemical and reproductive effects in fish (Depew and others, 2012a), as well as reproductive impairment in birds (Depew and others, 2012b). Moreover, it suggests that other invertebrate-feeding organisms in the park could be at risk. Amphibians and riparian- or aquatic invertebrate-feeding birds are two groups in particular that are both sensitive to Hg, and likely to be exposed due to their foraging ecology (Bergeron and others, 2011a, 2011b; Jackson and others, 2011; Metts and others, 2012; Willson and Hopkins, 2013).

THg concentrations in fish from Wrangell-St. Elias, Lake Clark, and Glacier NPs approached or exceeded all three benchmarks associated with reproductive impairment in piscivorous birds (90, 180, and 270 ng/g ww), and the EPA criterion for protection of human health. It is unclear whether these elevated concentrations are the result of enhanced MeHg production in these systems, or simply the fact that these were large fish (400–650 mm SL) that were likely many years old and had reached a growth asymptote in systems with only moderate Hg availability. This information gap is an important component to address with future work because it will help better gauge risk to park visitors and wildlife. Both Wrangell-St. Elias and Lake Clark support subsistence hunting and fishing activities for native and non-native rural Alaskans. If toxicological risk is mostly restricted to large, older fish, then guidelines can be better established to inform subsistence users of how to minimize exposure risk. Moreover, relatively few wildlife species are capable of consuming these large individuals, suggesting fewer species would be at risk from fish consumption and the species that are would likely be more easily monitored. Thus, understanding the relative risk posed across the size spectra of a population provides important insights into how that risk can be monitored and managed. Conversely, if certain habitats or locations within these parks are particularly sensitive to Hg methylation, the food web contamination may be more widespread, potentially necessitating a broader communication and monitoring strategy that might incorporate a more comprehensive array of subsistence foods and other wildlife taxa. Progress is already being made to address this potential concern, and USGS and Wrangell-St. Elias NP are currently completing a study to assess THg concentrations in several additional locations and species, as well as to evaluate the age structure of the fish being sampled. Although subsistence harvest is not a concern in Glacier NP, one of the species we measured, the bull trout, is listed as federally threatened under the endangered species act. Hg concentrations that we measured in bull trout from Lake McDonald in Glacier NP approached levels of concern for tissue-based fish toxicity. Because we only sampled fish from a single lake in Glacier NP, it is unclear if this is a widespread concern for toxicity to bull trout or their predators, but our data suggest that a follow-up study is warranted.

The unprecedented spatial breadth of this study facilitates the most thorough understanding of Hg bioaccumulation patterns in fish of western national parks to date. Our analysis and data compilation provide novel insight into the broad-scale distribution of Hg in fish communities of remote, protected habitats. Of note, many locations show limited Hg risk, and our data confirm that even with continued

increases in global Hg releases (Sunderland and Selin, 2013), many protected NPS lands in the United States still exhibit relatively low Hg risk. However, our results also raise new questions and can be used to guide the development of future research to help manage the unexpected number of locations in this study where Hg contamination could be an ongoing or emerging threat to ecosystem health. The high degree of variation within parks and that the parks with the most intensive sampling had the greatest range in THg concentrations. These findings strongly suggest that more intensive research and monitoring efforts within parks will undoubtedly reveal both low and high risk environments. Thus, monitoring programs should not focus on a small number of “indicator” sites and we recommend that where feasible, newly established monitoring or investigation efforts focus on sampling at the largest spatial scale possible within a park to better understand this variability.

Additionally, our focus on high-altitude habitats provided little insight regarding the magnitude of risk in lower altitude lakes and wetlands. Recent work in Mount Rainier NP suggests that Hg bioaccumulation in wetlands and lakes is substantially higher in the lowest-altitude habitats (C.A. Eagles-Smith, U.S. Geological Survey, unpub. data, 2013). Additional monitoring in low-altitude habitats that integrate a broader range of watershed processes is warranted.

Beyond monitoring, a more quantitative understanding of the biogeochemical and food web factors that regulate within-park variability will facilitate greater certainty in predicting areas across these parks with the greatest risk likelihood. Future interdisciplinary research across a range of replicated aquatic habitat types that couples key biogeochemical process-level measurements with detailed food web processes and quantification of bioaccumulation pathways would provide valuable insight for developing these predictive models. A new collaborative, citizen-science effort between USGS, NPS, and University of Maine will make initial progress in this area by evaluating Hg bioaccumulation in biosentinel dragonfly larvae in relation to a range of biogeochemical and landscape drivers. One benefit of this upcoming effort is that the use of dragonflies as biosentinels will inform the parks about risk to aquatic habitats that are not fish-bearing. Another impending contribution in this realm will be provided by an empirical model being developed by the USGS Mercury Research Laboratory that will predict aqueous MeHg concentrations in surface water based on water chemistry and watershed structure. Coupling this model with biological assessments may provide more predictive power to assess ecological risk.

Although these suggestions will greatly increase the understanding of the drivers of Hg cycling in national parks, estimates of risk will continue to be speculative and of limited confidence without empirical research on toxicological responses in resident park biota. This lack of robust toxicological benchmarks for many taxa was a particular concern in the current study because few taxa extended across the large spatial extent and ecologically diverse habitats sampled. Although our choice of toxicological benchmarks were appropriate given the constraints of the current study, generalized benchmarks, such as our bird risk thresholds, do not provide definitive estimates of risk to specific park resources. Specifically, the data presented here suggest that toxicological assessments of key ecological endpoints in Capitol Reef, Zion, Lassen Volcanic, Yosemite, Wrangell-St. Elias, Lake Clark, and Glacier NPs are warranted. Direct assessments of the physiological, behavioral, and reproductive responses of wildlife and fish in these parks will be tremendously valuable for calibrating risk estimates that have been derived on different taxa in unrelated habitats, and provide a baseline from which meaningful benchmarks for evaluating the integrative risk of Hg toxicity to whole parks or ecosystems could be developed.

National Park Summaries

Capitol Reef National Park

All fish sampled from Capitol Reef NP were speckled dace, a small insectivorous “forage fish.” Despite their intermediate position in the food web, these fish contained some of the highest Hg concentrations measured in this study, exceeding those measured in many of the largest predatory fish. As smaller fish, speckled dace serve as potential prey items for predatory fishes and piscivorous birds, and dietary Hg concentrations at these levels are associated with biochemical and reproductive effects in fish (Depew and others, 2012a), as well as reproductive impairment in birds (Depew and others, 2012b). Moreover, such high Hg concentrations suggest that other invertebrate-feeding organisms in the park could be at risk. Amphibians and riparian- or aquatic invertebrate-feeding birds are two groups in particular that are both sensitive to Hg, and likely to be exposed due to their foraging ecology (Bergeron and others, 2011a, 2011b; Jackson and others, 2011; Metts and others, 2012; Willson and Hopkins, 2013). However, we only sampled a single species at three sites in Capitol Reef NP, all of which were along the Freemont River. Therefore, we are unable to speculate whether the fish communities throughout the park contain similarly high concentrations, or whether these values were the result of a localized process. Future sampling of additional sites and species within the park is necessary to fill this important knowledge gap.

Crater Lake National Park

Kokanee and rainbow trout were sampled from two sites in Crater Lake NP. The two species had similar Hg concentrations and were among the lowest measured in this study, ranging from 16.8 to 76.0 ng/g ww. Overall our results indicate that Hg concentrations in fish from Crater Lake are unlikely to put fish or avian consumers at risk.

Denali National Park

We sampled northern pike from a single lake in Denali NP. Despite their large size and position as top predators, northern pike from Denali NP had the lowest size-normalized Hg concentrations in the 400 mm SL size class (47.4 ng/g ww at 400 mm SL) and some of the lowest observed in the entire study. In fact, the THg concentrations in northern pike from Denali were similar or less than THg concentrations in smaller fish species from the other parks in Alaska (Wrangell-St. Elias, Lake Clark, Glacier Bay). Moreover, past work in Denali found similarly low THg concentrations in burbot (*Lota lota*) and whitefish (Landers and others, 2008). Such low Hg concentrations may be the result of this site’s isolated nature. However, at other similarly isolated sites in Alaska, northern pike have been found to have consistently higher Hg concentrations (110–1,500 ng/g ww on average; Jewett and Duffy, 2007). Any additional sampling from Denali NP should aim to assess whether these data are representative of other water bodies and species in the park.

Glacier Bay National Park

We sampled Dolly Varden from two lakes and one stream in Glacier Bay NP. Mean THg concentrations across these three sites (90.2 ng/g ww) were slightly above the global mean concentration in fish across all sites and parks in this study (77.7 ng/g ww). When modeled at 200 mm, the mean Hg concentration in fish from Glacier Bay NP (102.3 ng/g ww) was among the highest in the size class. However, we also observed a 3-fold variation in the mean concentrations among the three lakes indicating that local processes are likely important drivers of Hg bioaccumulation in fish within this park. The THg concentrations measured in Dolly Varden from Glacier Bay NP were similar to concentrations (40–230 ng/g ww) found in Dolly Varden from other sites in Alaska (Jewett and Duffy, 2007).

Glacier National Park

Lake whitefish and bull trout were sampled from Lake McDonald in Glacier NP. Both species had high Hg concentrations relative to the mean across all fish in the study, and after accounting for the effects of size and species, fish from Glacier NP were some of the highest in the large (400 mm SL) size class. Mercury concentrations in Glacier NP fish approached or exceeded the EPA criterion for protection of human health and the level at which reproductive impairment to piscivorous birds could occur. Additionally, Hg concentrations in many individuals exceeded the level at which tissue-based toxicity to fish is a concern. This is particularly important considering bull trout is federally listed as threatened under the endangered species act. Because we only sampled fish from a single lake, we cannot assess whether these data are representative of other lakes in the park. However, Landers and others (2008) found that fish from two other lakes within Glacier NP had the lowest Hg concentrations among the 14 lakes measured across national parks in the West. These contrasting results suggest that substantial variation in Hg concentrations exists among water bodies within Glacier NP and more detailed analysis of local processes may be necessary to effectively manage risk.

Grand Canyon National Park

At the three sites we sampled in Grand Canyon NP, unadjusted mean THg concentrations (76 ng/g ww) were similar to the average across all fish in the study. However, size adjusted (200 mm SL) THg concentrations were among the highest in the size class (101.2 ng/g ww) across all parks. Moreover, size-adjusted THg concentrations in Shinumo Creek (178.8 ng/g ww) were more than 2-fold higher than those in the other two sites (71.5 and 81.0 ng/g ww), suggesting that Hg exposure within the park is variable.

Grand Teton National Park

Mercury concentrations in fish from the two lakes and one stream sampled in Grand Teton NP were consistently among the lowest measured in this study. It is unclear whether these low concentrations are the result of low local inputs of Hg, the Hg methylation potential of the water bodies measured, or some biological characteristic of the fish.

Great Basin National Park

We sampled brook trout from two creeks and a lake in Great Basin NP. Among these three sites Hg concentrations were uniformly among the lowest measured in the current study suggesting that at the time of sampling the ecological risk posed by Hg in these systems is likely low. Atmospheric dry deposition in Great Basin NP was among the highest measured in six western national parks (Wright and others, 2014).

Great Sand Dunes National Park

Mercury concentrations in fish from one of the two sites (Medano Lake; 70.1 ng/g ww) sampled in Great Sand Dunes NP were similar to the average across parks, whereas fish from the second site (Sand Creek; 52.7 ng/g ww) were considerably lower. Based on these data, the risk of Hg exposure to wildlife is likely low at these sites; however, data from these two sites may not adequately characterize risk at other locations within the park.

Lake Clark National Park

Lake trout from three lakes in Lake Clark NP were included in this study. Two of these sites (Lake Clark and Lake Kontrashibuna) were sampled in both 2011 and 2012, although Hg concentrations were not significantly different between the 2 years. Although THg concentrations across all sites within the park were among the highest observed in the 400 mm SL size class, there was considerable variation among lakes within the park. The mean THg concentration in Lake Clark (365.2 ng/g ww) was more than 3-fold higher than that in Telaquana Lake (109.0 ng/g ww) and 1.8 than that in Lake Kontrashibuna (204.0 ng/g ww). At the lower end of this range, THg concentrations pose limited risk to park wildlife and human users. However, the concentrations observed in Lake Kontrashibuna exceeded the benchmark for reproductive impairment to piscivorous birds, and the tissue-based criterion for fish toxicity. Moreover, fish from Lake Clark exceeded these benchmarks and the EPA criterion for protection of human health.

Lassen Volcanic National Park

There was greater than 4-fold variation in mean fish THg concentrations among the three lakes that brook trout were sampled from in Lassen Volcanic NP. Mercury concentrations were lowest in Summit Lake (43.7 ng/g ww), whereas Ridge Lake (111.3 ng/g w) and Horseshoe Lake (180.7 ng/g ww) had concentrations above the mean concentration for all fish in this study. Some of this variation in Hg concentrations among lakes in the park was due to the size of fish. After adjusting fish THg concentrations to a 200 mm SL fish size, the variation among lakes was substantially reduced. Size-based risk assessments were conducted for Horseshoe and Summit Lakes, and the resulting risk profiles contrast sharply. Our modeled risk estimates suggest that there is limited toxicological risk to fish, wildlife or humans across the fish size range in Summit Lake. Conversely, brook trout from Horseshoe Lake were modeled to reach concentrations of concern for tissue-based fish toxicity and risk to even the least sensitive species of avian consumers within the range of sizes sampled. Furthermore, a high proportion of fish from Horseshoe Lake were modeled to exceed the EPA criterion for protection of human health at sizes exceeding 280 mm SL.

Mesa Verde National Park

Speckled dace were sampled from a single location, the Mancos River, in Mesa Verde NP. Despite the small size of these fish (43–69 mm SL), their THg mean concentration (74.9 ng/g ww) was to the study-wide mean value. However, the THg concentrations from speckled dace from the lone site in Mesa Verde NP were much lower than those measured in dace from nearby Capitol Reef and Zion NPs. This difference suggests that the high concentrations observed in dace from these other parks is not solely due to some aspect of this species biology, but may reflect environmental processes occurring at the site or watershed scale.

Mount Rainer National Park

Mount Rainer NP is one of two parks in which we sampled a large number of sites in order to characterize intra-park variation. Although the average fish THg concentration across the 17 sites from which fish were sampled (71.5 ng/g ww) was similar to the study-wide mean across all fish, we found a 12-fold range in mean concentrations among sites before accounting for the effects of size. Size-normalized Hg concentrations in the 200 mm SL size class were even more variable among sites. The highest mean concentration at a site (193.2 ng/g ww) was nearly 23-fold higher than the lowest site mean concentration (8.5 ng/g ww). Such extreme variation among sites in Mount Rainer NP suggests that local-scale factors play an important role in determining the ecological risk of Hg and emphasizes the need to sample from multiple locations in order to accurately characterize Hg risk to park resources as a whole.

North Cascades National Park

All three of the sites sampled in North Cascades NP had mean Hg concentrations below the average of all fish sampled in this study. After standardizing the fish to 200 mm SL, the mean Hg concentration in fish from North Cascades NP (73.3 ng/g ww) was similar to the mean of 200 mm fish across all parks. These data suggest that the ecological risk of Hg at the three sites sampled in North Cascades NP is low relative to many of the other parks. However, given the variation demonstrated among sites in this study, the limited sampling it is difficult to generalize across other sites in the park without more extensive sampling.

Olympic National Park

Mercury concentrations in fish across the five lakes sampled in Olympic NP (85.0 ng/g ww) were slightly higher than the mean concentration across the entire study. However, we found substantial variability in fish THg concentrations among lakes. In particular, size-adjusted THg concentrations in fish from Hoh Lake (253.0 ng/g ww) were more than 3.5-fold higher than those in Gladys Lake (71.5 ng/g ww), which had the lowest site-specific THg concentrations in the park. Our models of Hg risk to consumers reflects these higher concentrations and suggest that fish in Hoh Lake are likely to approach or exceed the EPA criterion for protection of human health and the avian benchmark for reproductive impairment above 180 mm. These results are similar to those reported by Landers and others (2008), who found Hg concentrations in fish from Hoh Lake were among the highest measured during their screening of national parks.

Rocky Mountain National Park

We sampled 19 sites in Rocky Mountain NP, allowing us to more rigorously examine within park variability in Hg concentrations among sites. Overall, the mean Hg concentration in fish from Rocky Mountain NP (ng/g ww) was slightly lower than the study-wide mean across all parks. Across sites within Rocky Mountain NP, concentrations varied by more than 6.5-fold between the sites with the lowest (Lake Haiyaha; 19.8 ng/g ww) and highest (Mirror Lake; 121.2 ng/g ww) concentrations. Our models of Hg risk suggest that most of the sites we sampled from Rocky Mountain NP had fish THg concentrations below the benchmarks of risk that we selected. However, brook trout from Mirror Lake and suckers from the Colorado and Fall Rivers are likely to exceed both the EPA human health criterion level and the avian reproductive impairment benchmark when the fish exceed 250 mm SL. In addition, we examined inter-annual variation at four sites in Rocky Mountain NP. At two of these sites (Nanita Lake and Mirror Lake), we found that there was no significant difference between the years sampled, whereas fish THg concentrations at Poudre Lake and Ypsilon Lake were significantly lower in 2012 compared to 2009. Additionally, two of the lakes sampled in this study (Mills Lake and Lone Pine Lake) also were sampled for another study in 2003 (Landers and others, 2008). Rainbow trout THg concentrations in Mills Lake were higher (87.5 ng/g) than in 2003 (less than 60 ng/g ww). Whereas THg concentrations in brook trout from Lone Pine Lake were lower (57.8 ng/g ww) than in 2003 (approximately 70 ng/g ww). Consistent with the results from Mount Rainer NP, our more intensive sampling at Rocky Mountain NP indicates substantial variation among sites, highlighting the importance of sampling multiple sites when characterizing the risk of Hg exposure within a national park.

Sequoia–Kings Canyon National Park

Four high-altitude lakes were sampled from Sequoia–Kings Canyon NPs. The mean fish THg concentration across all these sites (43.8 ng/g ww) was below the study-wide average across all fish analyzed in this study. Size-adjusted (200 mm SL) THg concentrations remained similarly low in all but Center Basin Lake, where the mean THg concentrations in golden trout increased to 207.3 ng/g ww. However, based on the size distribution of our sample of 30 individuals, 200 mm fish are likely rare in this population. Furthermore, two of the lakes from Sequoia–Kings Canyon NPs were sampled in 2008 (Center Basin Lake) or 2009 (Kern Point Lake) and again in 2012. Comparisons between sampling years indicate that Hg concentrations in fish from Kern Point Lake were remained similar between years, whereas Hg concentrations in Center Basin Lake fish were higher in 2012 than in 2008. Landers and others (2008) reported Hg concentrations higher than those observed in the current study from two additional high-altitude lakes in Sequoia–Kings Canyon NPs (Pear and Emerald Lakes), demonstrating that even among high-altitude lakes with potentially limited Hg inputs, fish THg concentrations can be quite variable.

Wrangell-St. Elias National Park

Lake-specific mean fish THg concentrations from the three lakes sampled at Wrangell-St. Elias NP spanned nearly 8-fold between rainbow trout from Summit Lake (53.3 ng/g ww) and Lake Trout from Tanada Lake (416.6 ng/g ww), which had the highest mean Hg concentration of any site from all of the parks examined in this study. After size-adjusting fish THg concentrations, we found that concentrations in 200 mm SL fish from Copper Lake (147.4 ng/g ww) were substantially higher than those from Summit Lake (65.4 ng/g ww). The mean size-adjusted THg concentration for 400 mm SL fish from Copper Lake (242.0 ng/g ww) and Tanada Lake (321.2 ng/g ww) approached or exceeded the

EPA fish tissue criterion, the avian reproductive impairment benchmark, and the tissue-based criterion for fish toxicity. Tanada Lake was one of the few lakes in the present study in which a relatively high proportion of fish were expected to exceed upper benchmarks for fish toxicity, reproductive impairment in low sensitivity birds, and at the largest sizes sampled, the no-consumption guideline proposed by the GLAG. The cause of such high concentrations in some fish from Wrangell-St. Elias NP is unclear and may reflect some combination of local biogeochemical processes that stimulate methylmercury production, the ecological structure of the lake's food web, or physiological characteristics of the fish themselves. For example, fish with high Hg concentrations may be exceptionally old and thus may have accumulated large quantities of Hg over their extended lives. Alternatively, fish in such northern lakes may grow slowly compared to fish in warmer, more productive systems resulting in little biodilution of ingested Hg through somatic growth.

Yellowstone National Park

Across all lakes, mean fish THg concentrations in Yellowstone NP (101.2 ng/g ww) were above the study-wide mean value from all parks. Size adjusted THg concentrations for 200 mm SL fish (119.8 ng/g ww) were among the highest measured in this study. Importantly, natural geothermal Hg sources occur throughout Yellowstone, though it is unclear if those sources play a role in fish bioaccumulation.

Yosemite National Park

The two sites sampled at Yosemite NP display starkly contrasting patterns of Hg concentrations. At one site, Spillway Lake, fish THg concentrations were uniformly low; the site mean (38.7 ng/g ww) was one-half of the study-wide mean across all parks. In contrast, THg concentrations in fish from Mildred Lake (174.4 ng/g ww) were more than twice the study-wide mean. Moreover, individual fish concentrations had a 15-fold range within the lake. Importantly, the highest individual fish THg concentration in the entire study (1,109 ng/g ww) was measured in a brook trout from Mildred Lake. This was the only fish that exceeded the no-consumption guideline proposed by the GLAG, and was 1.6-times greater than the next highest concentration measured in this study. The source of such variation within a lake is unclear, but future efforts should aim to identify the factors regulating accumulation in individuals and determining whether this variability is representative of other lakes in the park.

Zion National Park

As in Capitol Reef NP, all fish sampled from Zion NP were speckled dace and displayed high Hg concentrations (241.5 ng/g ww) for a small, low trophic level fish. At both sites along the Virgin River, mean Hg concentrations were more than 3-fold higher than the study-wide mean concentration. Furthermore, variation within and between these isolated sites was very low. As in Capitol Reef, the potential for dace to serve as prey for higher trophic position consumers, and indicators of Hg exposure in other invertebrate-feeding taxa, suggest that more research should examine factors regulating Hg accumulation in the lower trophic levels of these systems.

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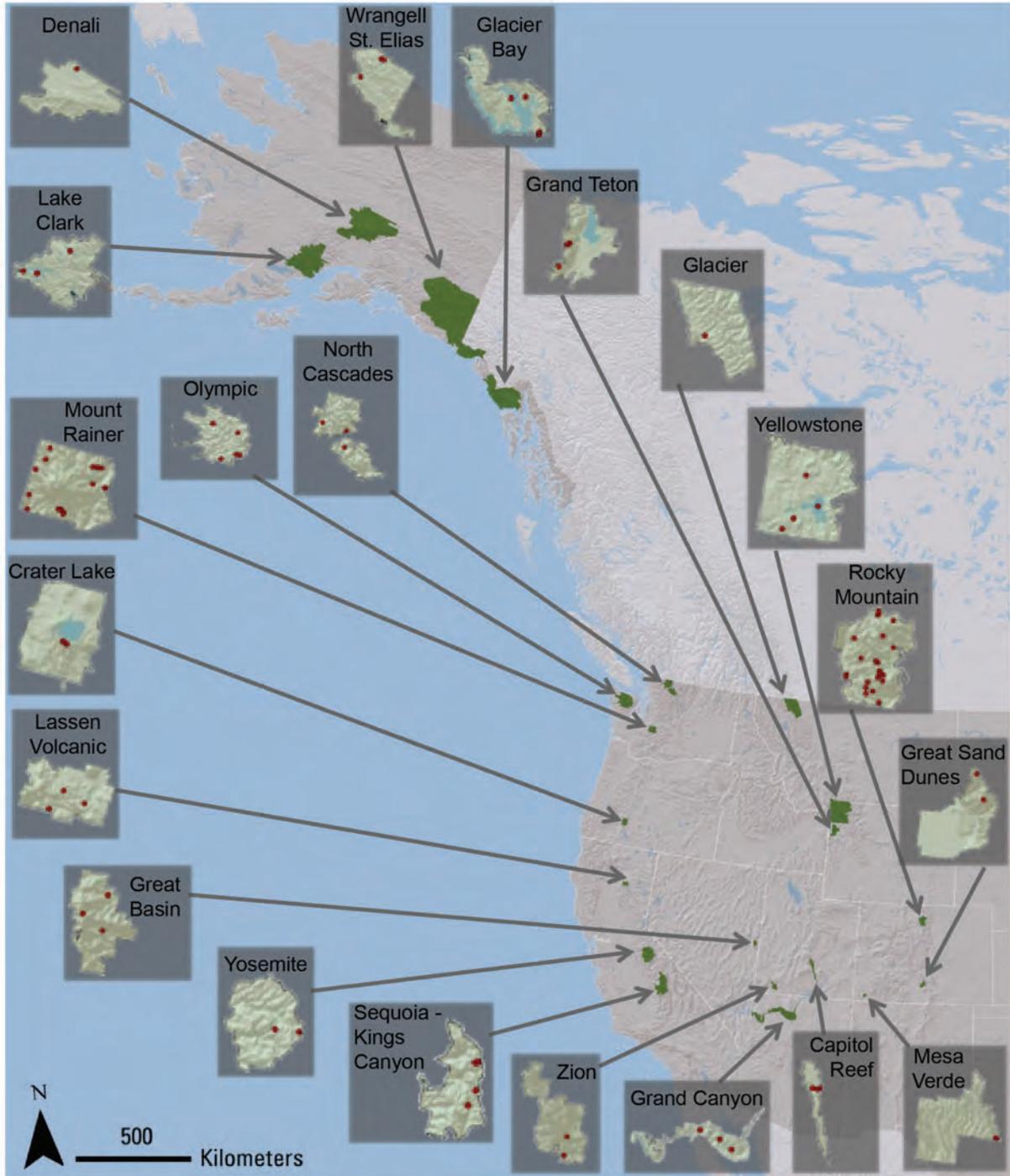


Figure 1. Spatial distribution of the 21 national parks in the Western United States sampled in this study between 2008 and 2012. Shaded polygons on base map indicate park boundaries. Red circles within each inset park boundary indicate specific sampling locations for each park.

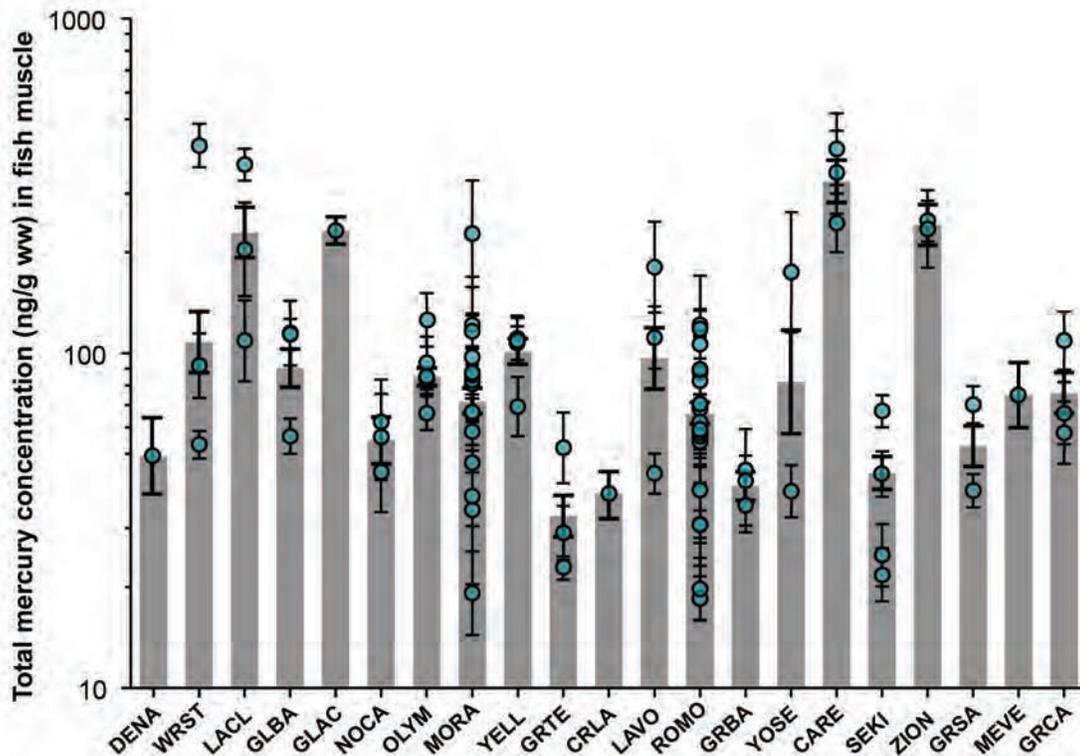


Figure 2. Total mercury (THg) concentrations (ng/g ww) in fish muscle from 21 national parks in the Western United States. Bar height and bolded error bars represent the park-wide geometric mean THg concentration and 95-percent confidence interval, respectively. Colored circles and thin error bars represent site-specific geometric mean THg concentration and 95-percent confidence interval, respectively. Parks are ordered by decreasing latitude, and park abbreviations can be referenced to park names in table 1.

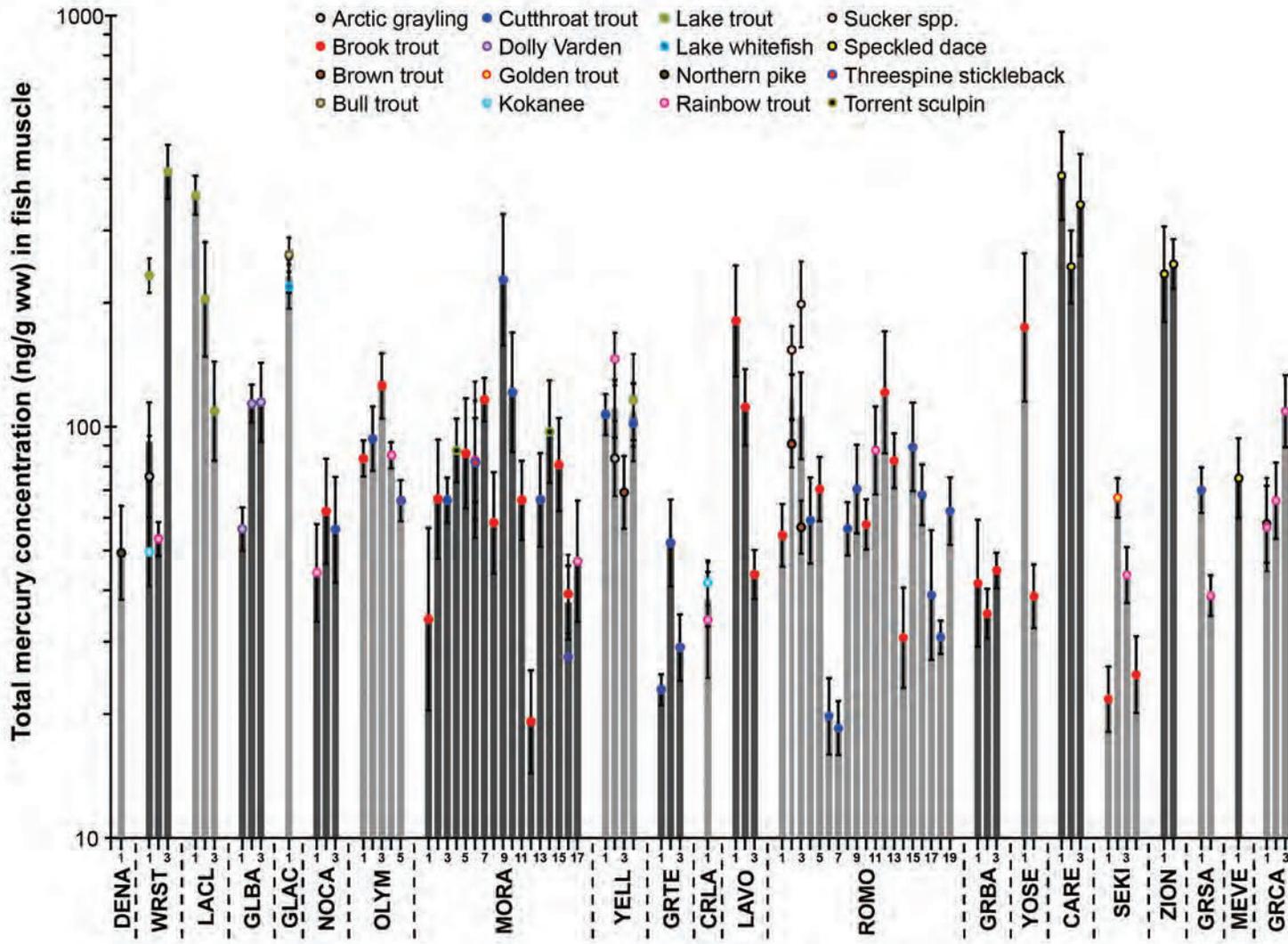


Figure 3. Total mercury (THg) concentrations (ng/g ww) in fish muscle from individual sites within 21 national parks in the Western United States. Bar height and bolded error bars represent site-specific geometric means and 95-percent confidence intervals. Circles represent species-specific geometric means in 95-percent confidence intervals within each site. Parks are ordered by decreasing latitude, and park abbreviations and site numbers can be referenced to park name in table 1.

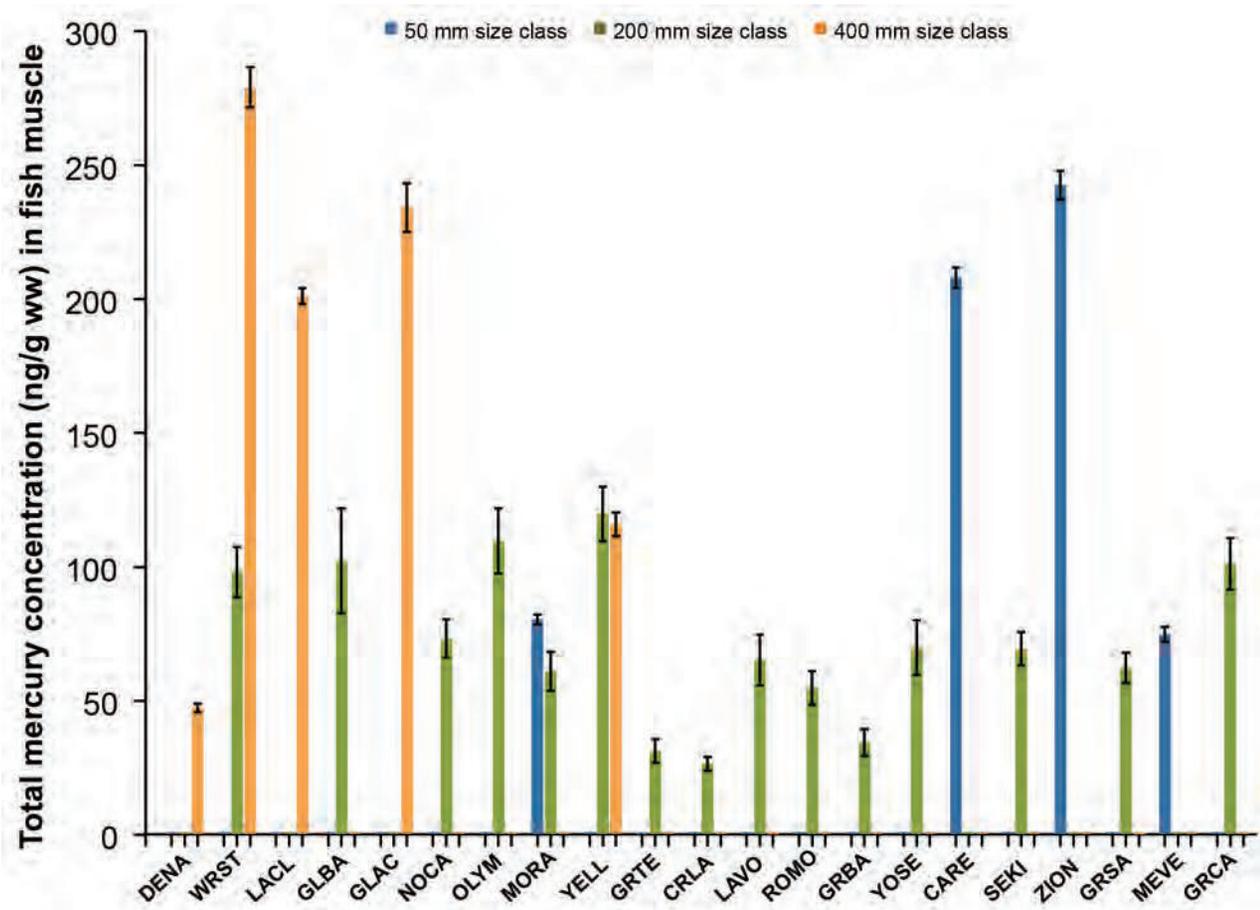


Figure 4. Size-normalized least-square (LS) total mercury (THg) concentrations in fish from 21 national parks in the Western United States. LS mean concentrations control for the influence of fish species and site within each park. Blue bars are LS means for fish species normalized to 50 mm size, green bars are LS means for fish species normalized to 200 mm size, orange bars are LS means for fish species normalized to 400 mm size. Parks are ordered by decreasing latitude, and park abbreviations can be referenced to park name in table 1. Species comprising each size category is discussed in section, "Methods."

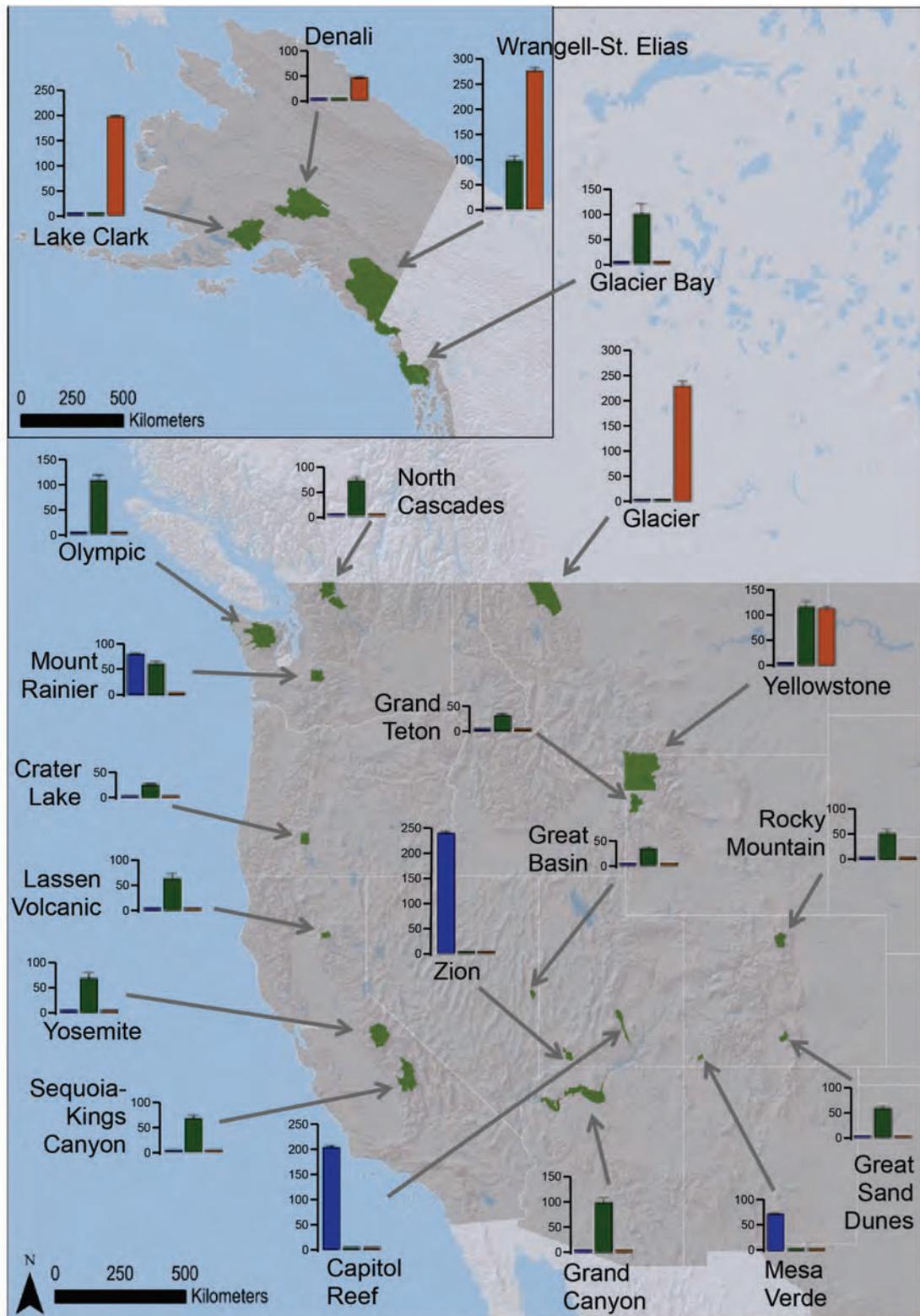


Figure 5. Least-square mean fish muscle total Hg concentrations (ng/g ww) in three size-normalized classes (blue/left = 50 mm, green/middle = 200 mm, orange/right = 400 mm) from 21 national parks in the Western United States.

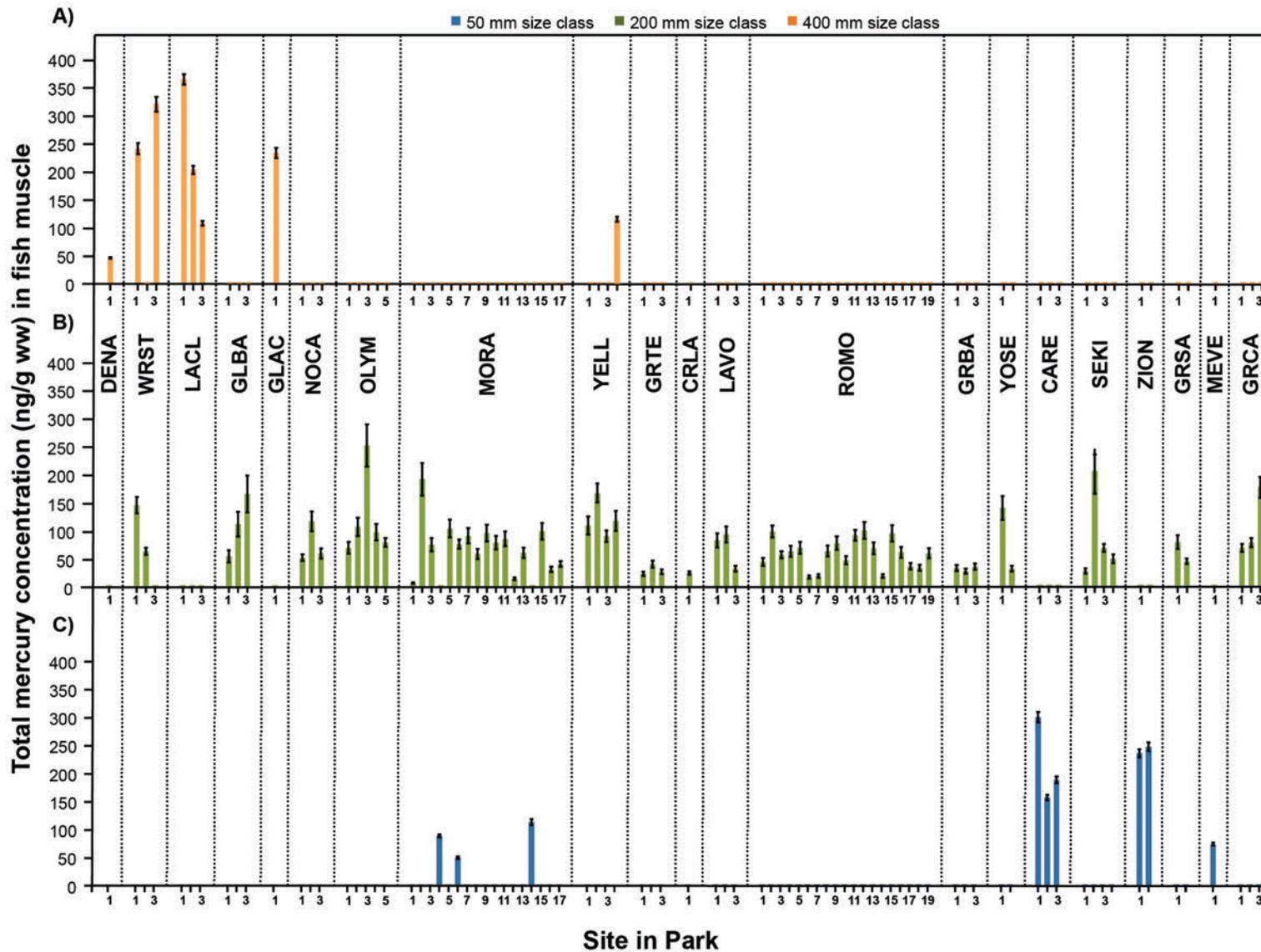


Figure 6. Least-square mean (whiskers = standard error) total mercury (THg) concentrations in fish muscle from individual sites in 21 national parks in the Western United States. Concentrations are size normalized for (A) 400 mm SL, (B) 200 mm SL, (C) 50 mm SL fish. Park abbreviations and site numbers can be referenced to park name in table 1.

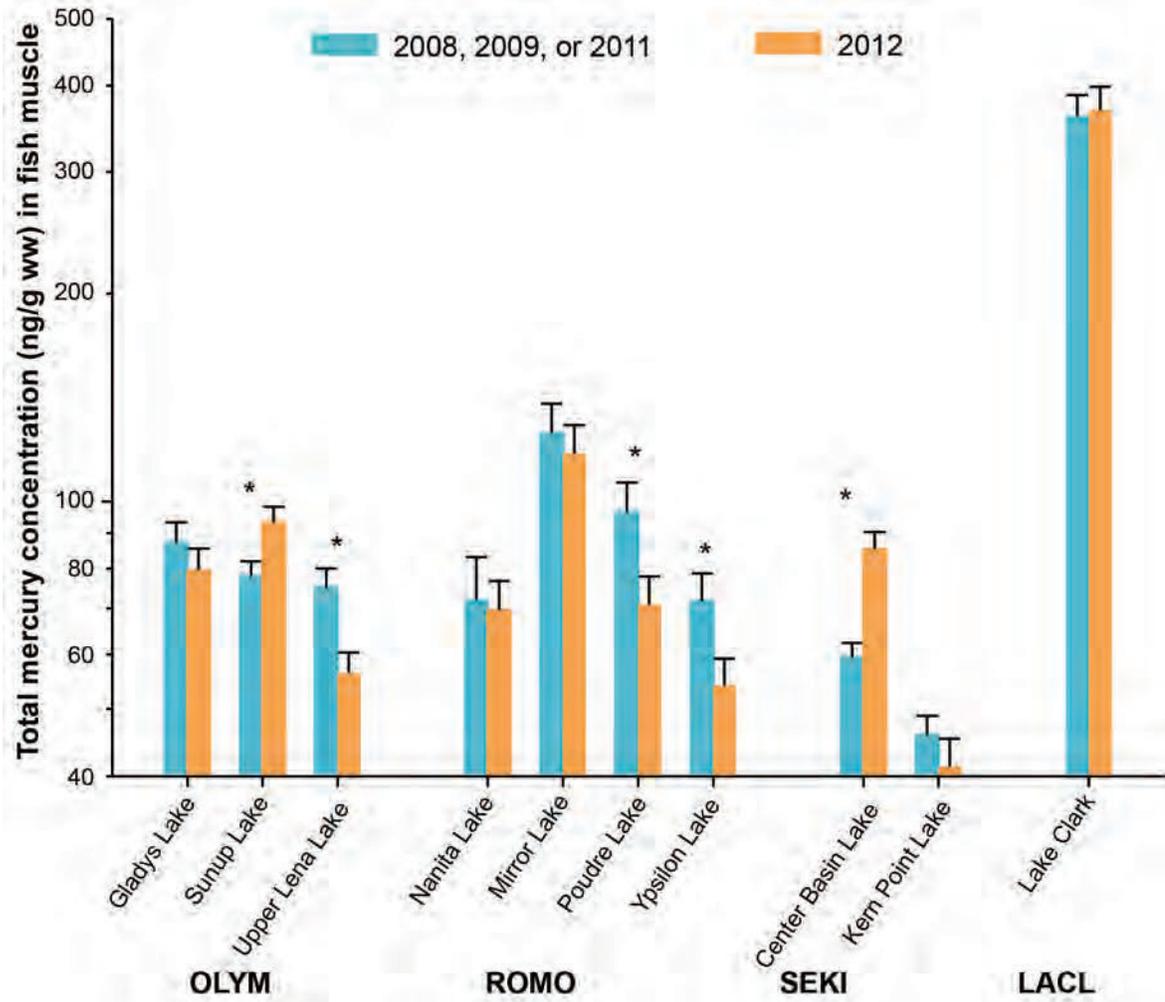


Figure 7. Inter-annual comparisons of fish total mercury concentrations (ng/g ww) in muscle tissue from 10 sites in four national parks in the Western United States. Error bars represent standard error. Asterisks indicate significant differences ($p < 0.05$) between years within a site. OLYM, Olympic NP, ROMO, Rocky Mountain NP; SEKI, Sequoia-Kings Canyon NP; and LACL, Lake Clark NP.

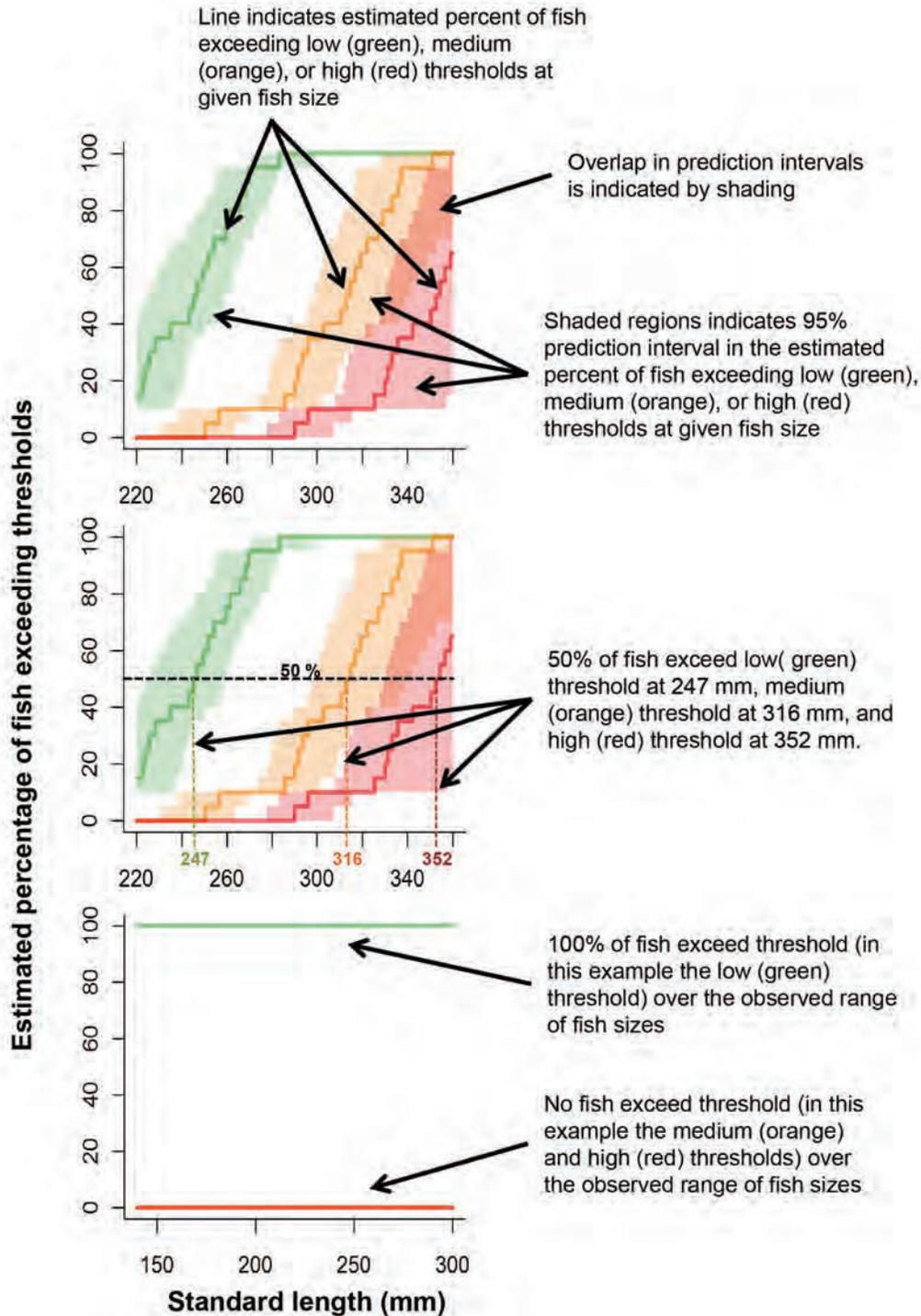


Figure 8. Example size-risk profile to evaluate proportion of fish exceeding defined toxicological benchmarks. Each color represents a defined risk benchmark. Solid lines indicated the estimated proportion of fish exceeding benchmarks across the size spectrum. Shaded regions represent the 95-percent prediction interval around the benchmark. A solid line at 0 or 100 percent indicates that all no fish or all fish, respectively, exceed the specified benchmark across the size spectra.

Risk to fishes (tissue based)

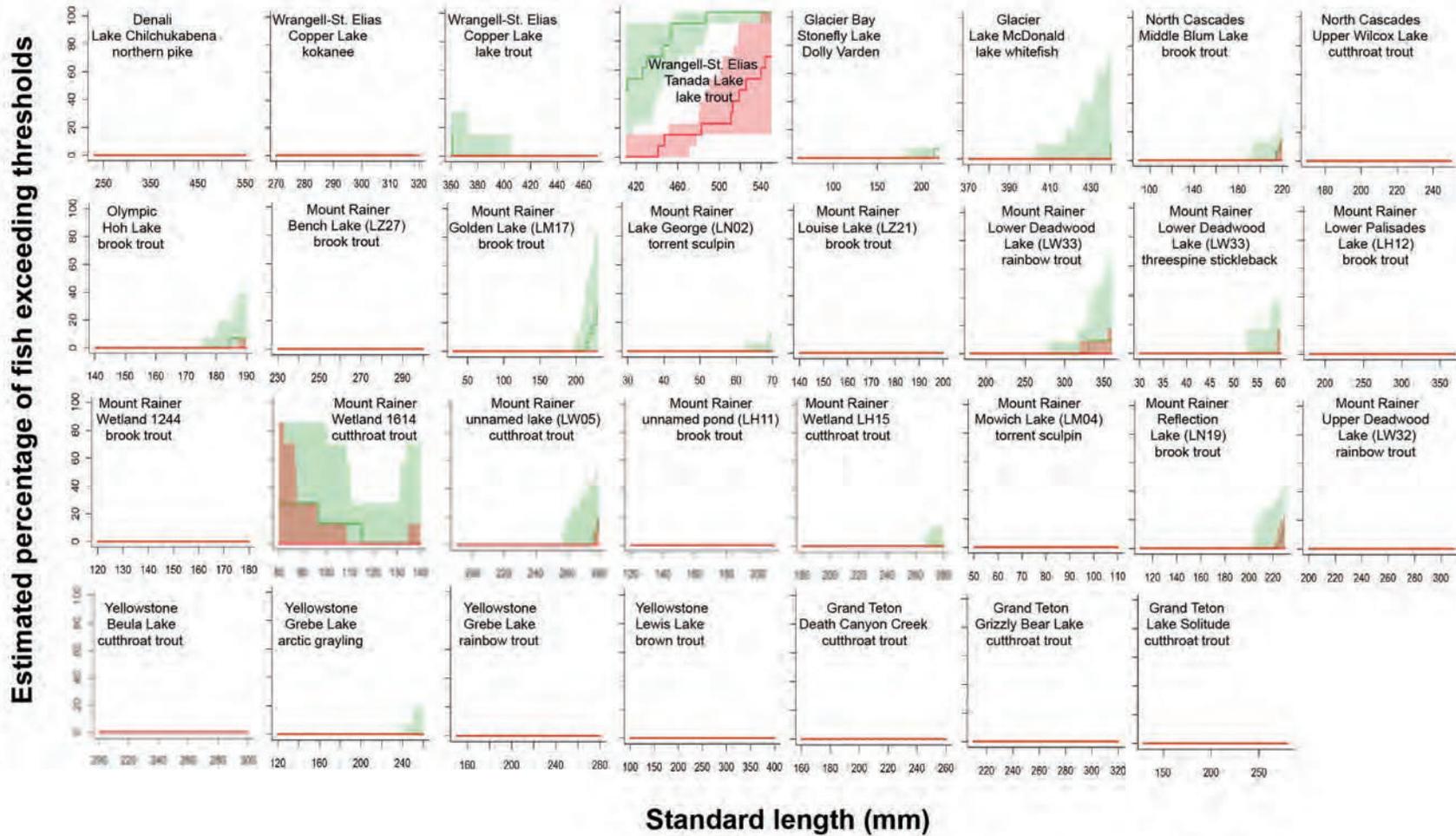


Figure 9. Modeled percentage of fish across the size range sampled in each population with whole-body total mercury concentrations that exceed benchmarks at a given size for a generic no-observed-effects residue (green; 200 ng/g ww), and lowest-observed-effects-residue (red; 300 ng/g ww) for fish health at 21 national parks in the Western United States. Parks are ordered by decreasing latitude. Figure continues on next page.

Risk to fishes (tissue based)

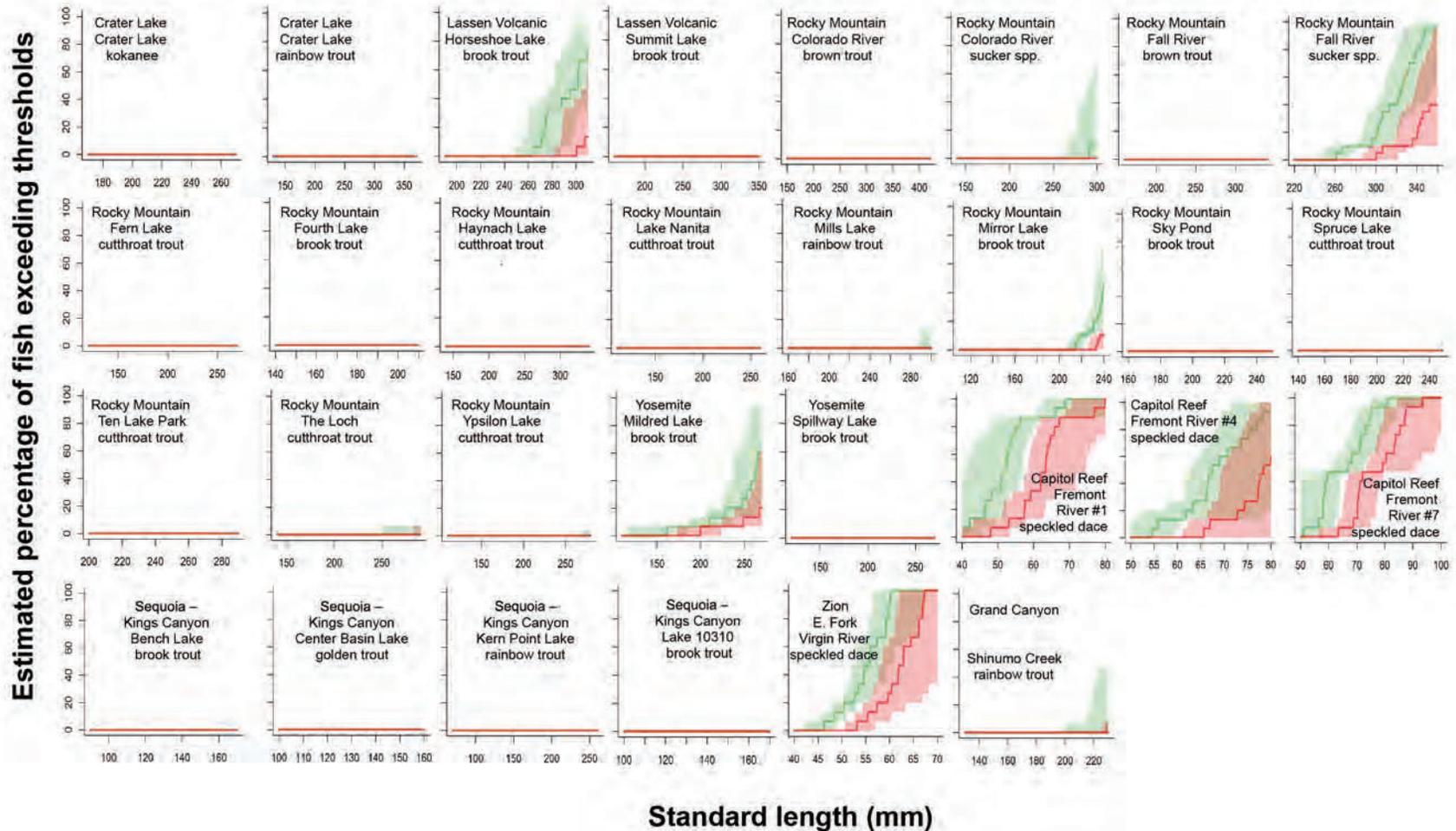


Figure 9.—Continued. Modeled percentage of fish across the size range sampled in each population with whole-body total mercury concentrations that exceed benchmarks for a generic no-observed-effects residue (green; 200 ng/g ww), and lowest-observed-effects-residue (red; 300 ng/g ww) for fish health in 21 national parks in the Western United States. Parks are ordered by decreasing latitude.

Risk to birds (diet based)

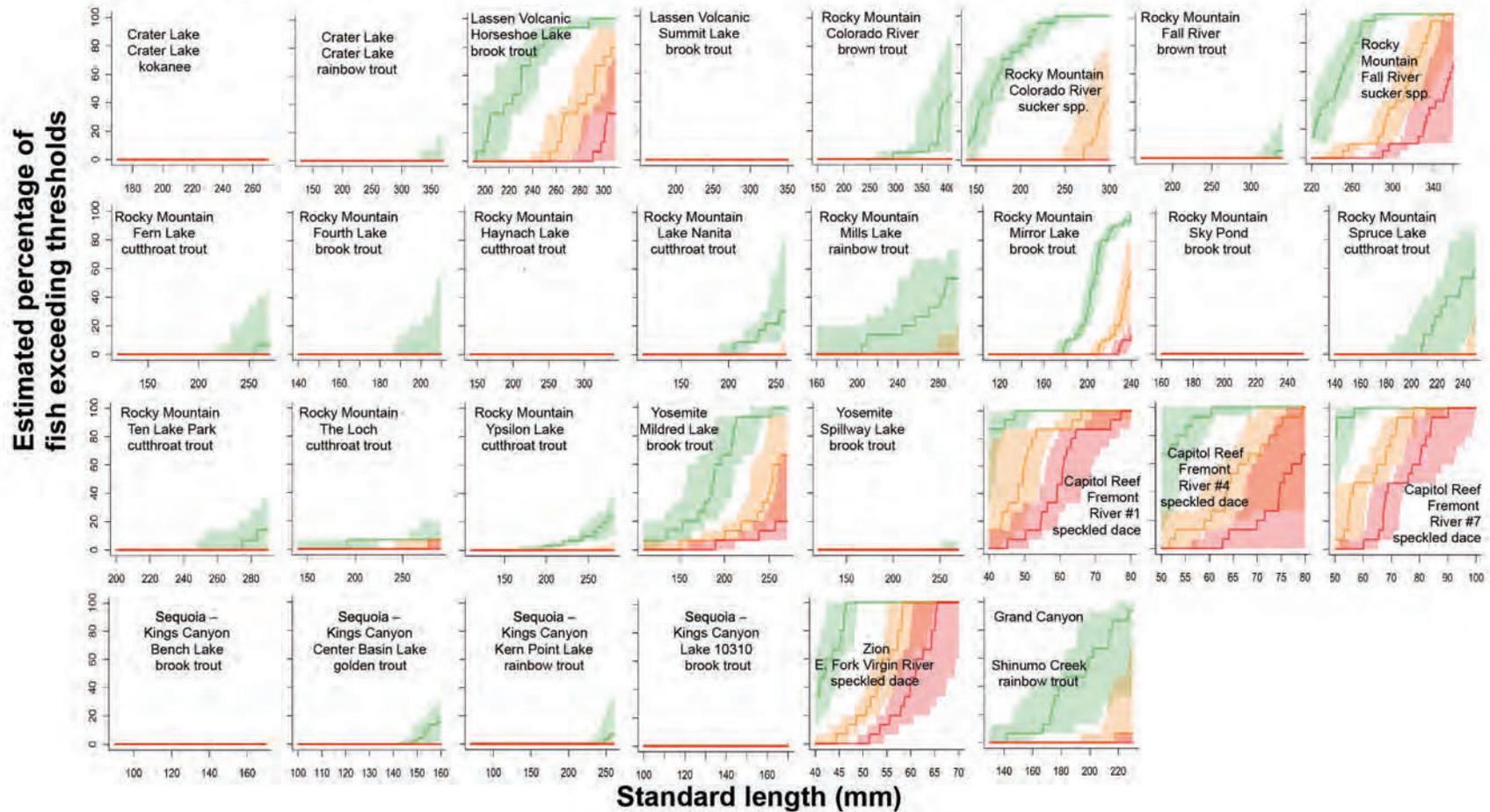


Figure 10. Modeled percentage of fish across the size range sampled in each population with whole-body total mercury concentrations that exceed dietary toxicity benchmarks for piscivorous birds that can be classified as high (green; 90 ng/g ww), medium (orange; 180 ng/g ww; common loon reproductive impairment), or low (red; 270 ng/g ww) sensitivity in 21 national parks in the Western United States. Parks are ordered by decreasing latitude. Figure continues on next page.

Risk to birds (diet based)

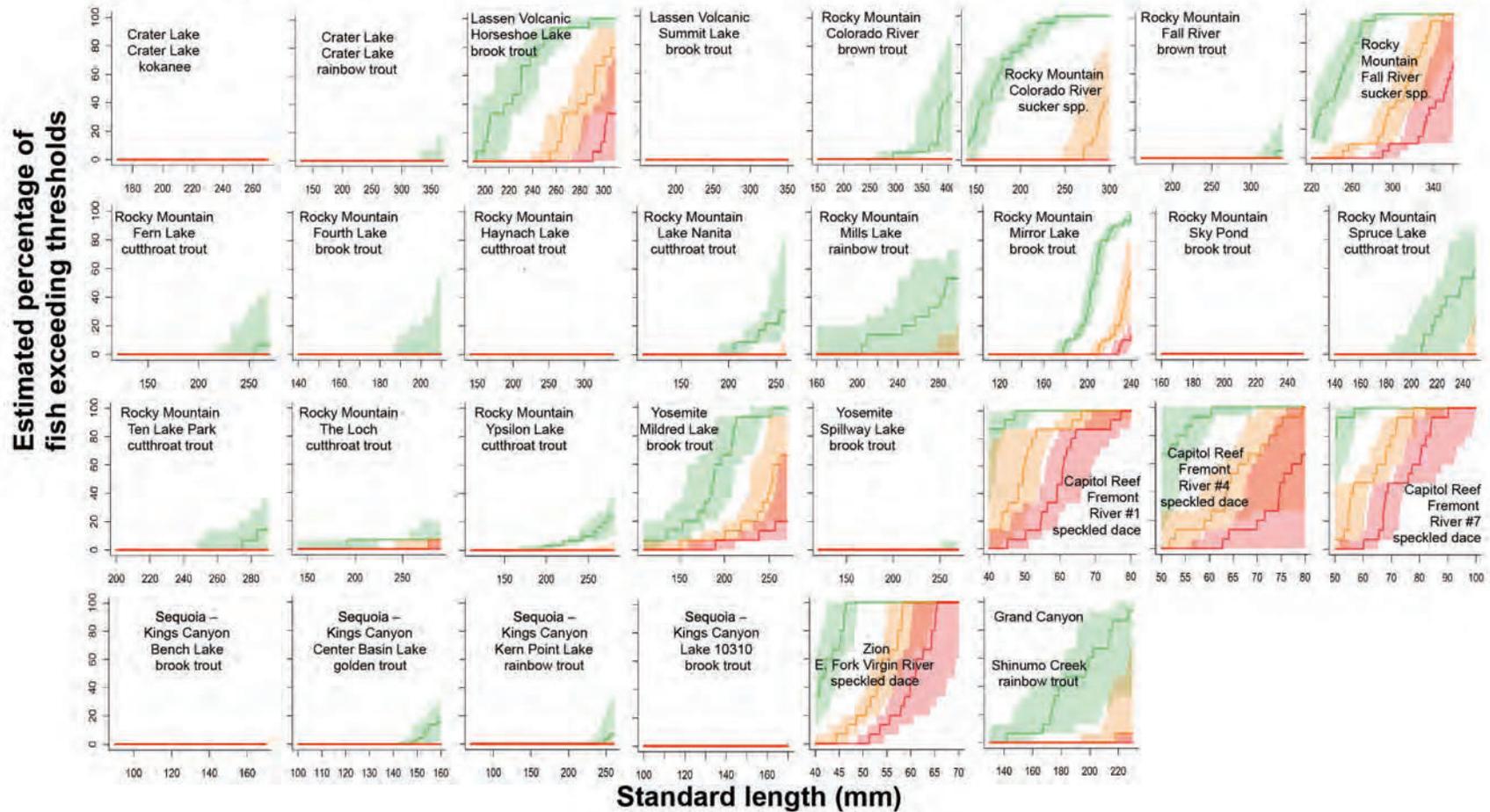


Figure 10.—Continued. Modeled percentage of fish across the sampled size range in each population with whole-body total mercury concentrations that exceed dietary toxicity benchmarks for piscivorous birds that can be classified as high (green; 90 ng/g ww), medium (orange; 180 ng/g ww; common loon reproductive impairment), or low (red; 270 ng/g ww) sensitivity in 21 national parks in the Western United States. Parks are ordered by decreasing latitude.

Risk to humans (diet based)

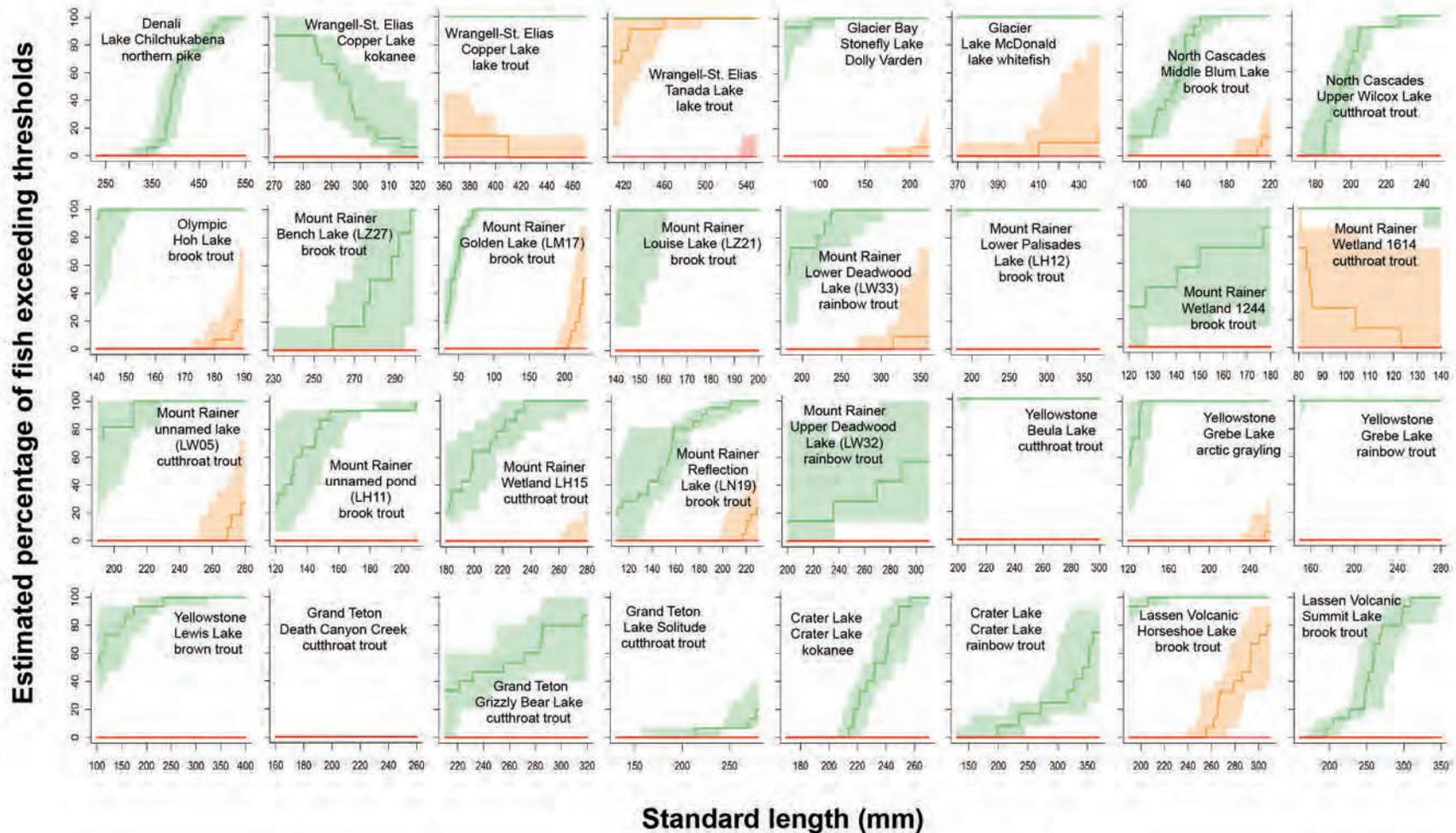


Figure 11. Modeled percentages of fish across the sampled size range in each population with muscle total mercury concentrations exceeding the Great Lakes Advisory Group's (GLAG) unlimited consumption threshold (green; 50 ng/g ww), the Environmental Protection Agency's fish consumption criterion (orange; 300 ng/g ww), and the GLAG's no-consumption threshold (red; 950 ng/g ww) in 21 national parks in the Western United States. Parks are ordered by decreasing latitude.

Risk to humans (diet based)

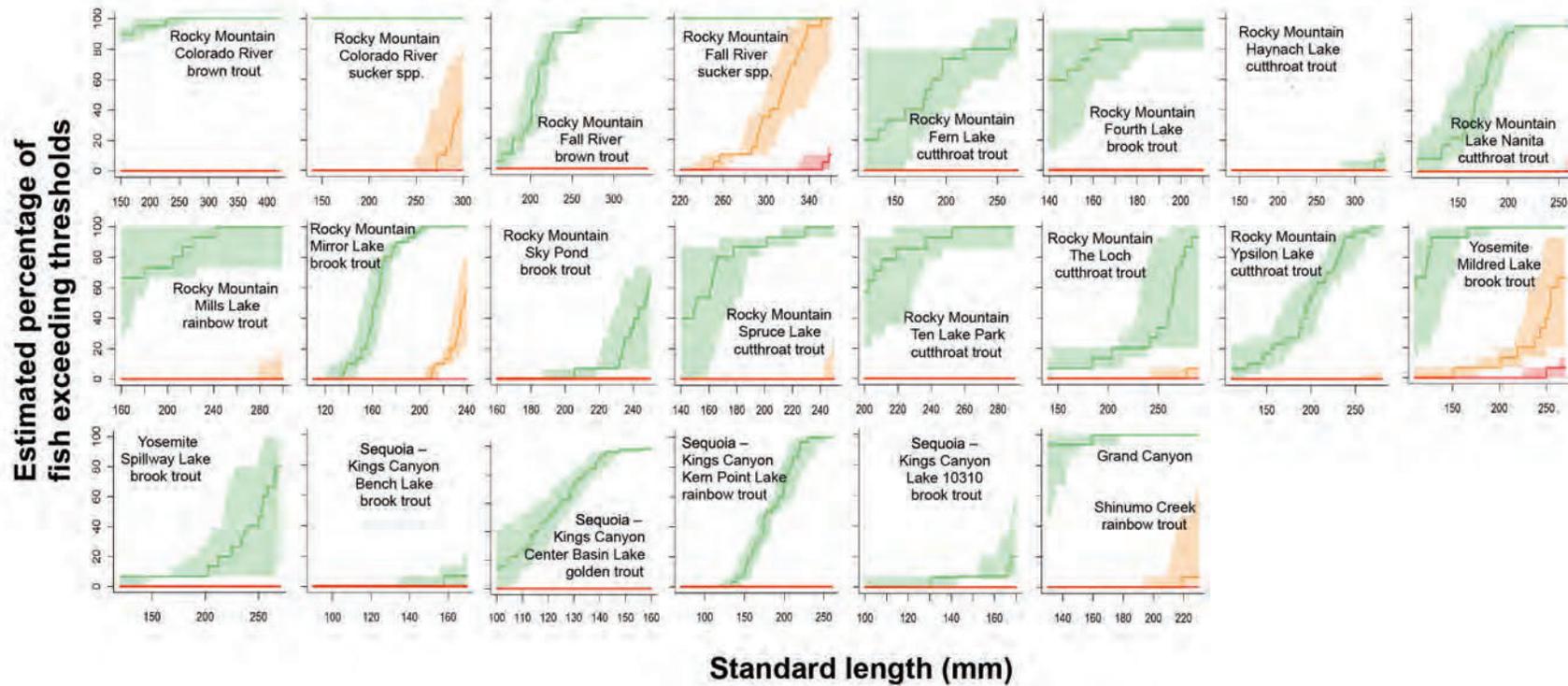


Figure 11.—Continued. Modeled percentages of fish across the sampled size range in each population with muscle total mercury concentrations exceeding the Great Lakes Advisory Group’s (GLAG) unlimited consumption threshold (green; 50 ng/g ww), the Environmental Protection Agency’s fish consumption criterion (orange; 300 ng/g ww), and the GLAG’s no consumption threshold (red; 950 ng/g ww) in 21 national parks in the Western United States. Parks are ordered by decreasing latitude.

Table 1. Site locations and sampling information for 21 national parks in the Western United States sampled between 2008 and 2012.

Park Site	Site ID	Latitude	Longitude	Altitude (m)	Habitat	Species	Year Sampled	n	Standard Length (mm)		SR ^a
									Mean	Range	
Capitol Reef											
Fremont River #1	1	38.2827	-111.1157	1502	river	speckled dace	2012	15	58	46-74	Y
Fremont River #4	2	38.2815	-111.1794	1577	river	speckled dace	2012	15	61	55-71	Y
Fremont River #7	3	38.2856	-111.2416	1649	river	speckled dace	2012	15	67	53-99	Y
Crater Lake											
Crater Lake	1	42.9057	-122.1017	1884	lake	kokanee	2011	15	207	172-265	Y
						rainbow trout	2011	12	254	137-370	Y
Denali											
Lake Chilchukabena	1	63.9153	-151.5083	191	lake	northern pike	2012	17	407	232-546	Y
Glacier											
Lake McDonald	1	48.5691	-113.9362	963	lake	bull trout	2008	5	434	386-494	N
Glacier Bay											
Falls Creek	1	58.4443	-135.5988	226	creek	Dolly Varden	2012	15	96	73-127	N
North Skidmore Lake	2	58.8451	-136.6839	98	lake	Dolly Varden	2012	15	161	128-203	N
Stonefly Lake	3	58.9674	-136.3379	38	lake	Dolly Varden	2012	15	141	61-219	Y
						lake whitefish	2008	10	396	371-431	Y
Grand Canyon											
Bright Angel Creek	1	36.1228	-112.0800	887	lake	brown trout	2012	2	139	104-174	N
						rainbow trout	2012	10	131	96-263	N
Havasu Creek	2	36.2980	-112.7402	621	creek	rainbow trout	2012	15	200	140-268	N
Shinumo Creek	3	36.2515	-112.33186	794	creek	rainbow trout	2012	15	171	131-222	Y
Grand Teton											
Death Canyon	1	43.6702	-110.87452	2564	creek	cutthroat trout	2012	15	214	162-253	Y
Grizzly Bear Lake	2	43.8027	-110.8107	2814	lake	cutthroat trout	2012	15	254	219-315	Y
Lake Solitude	3	43.7926	-110.8448	2758	lake	cutthroat trout	2012	15	227	137-278	Y
Great Basin											
Baker Lake	1	38.9577	-114.3100	3243	lake	brook trout	2011	9	230	200-252	N
Lehman Creek	2	38.9246	-114.2381	2404	creek	brook trout	2011	15	150	127-167	N
Snake Creek	3	39.01468	-114.2428	2281	creek	brook trout	2011	15	154	122-204	N
Great Sand Dunes											
Medano Lake	1	37.8564	-105.4847	3513	lake	cutthroat trout	2009	15	165	110-212	N
Sand Creek	2	37.9350	-105.5230	3365	creek	rainbow trout	2009	14	190	153-258	N

Park Site	Site ID	Latitude	Longitude	Altitude (m)	Habitat	Species	Year Sampled	n	Standard Length (mm)		SR ^a
									Mean	Range	
Lake Clark											
Lake Clark ^b	1	60.0187	-154.7574	77	lake	lake trout	2011	16	476	364-648	N
						lake trout	2012	12	478	428-580	N
Lake Kontrashibuna	2	60.1795	-154.2223	140	lake	lake trout	2011	14	358	315-398	N
						lake trout	2012	2	383	378-387	N
Telaquana Lake	3	60.9520	-153.7625	372	lake	lake trout	2011	15	483	412-586	N
Lassen Volcanic											
Horseshoe Lake	1	40.4724	-121.3358	1996	lake	brook trout	2009	15	249	197-305	Y
Ridge Lake	2	40.4138	-121.4630	1984	lake	brook trout	2009	17	187	143-210	N
Summit Lake	3	40.4929	-121.4233	2038	lake	brook trout	2009	15	221	165-346	Y
Mesa Verde											
Mancos River	1	37.2204	-108.3410	1886	river	speckled dace	2012	10	56	43-69	N
Mount Rainier											
Bench Lake (LZ27)	1	46.7622	-121.6986	1386	lake	brook trout	2012	6	262	237-298	Y
Golden Lake (LM17)	2	46.8887	-121.9002	1372	lake	brook trout	2012	16	73	36-229	Y
Green Lake (LC07)	3	46.9769	-121.8590	974	lake	cutthroat trout	2012	6	257	214-285	N
Lake George (LN02)	4	46.7917	-121.9040	1308	lake	torrent sculpin	2012	16	49	37-62	Y
Louise Lake (LZ21)	5	46.7704	-121.7157	1405	lake	brook trout	2012	6	171	145-192	Y
Lower Deadwood Lake (LW33)	6	46.8871	-121.5227	1602	lake	rainbow trout	2012	11	239	185-353	Y
						stickleback ^c	2012	6	42	34-59	Y
Lower Palisades Lake (LH12)	7	46.9533	-121.5903	1682	lake	brook trout	2012	19	277	180-365	Y
Wetland 1244	8	46.7704	-121.7259	1487	lake	brook trout	2012	7	158	122-179	Y
Wetland 1614	9	46.7401	-121.8836	669	lake	cutthroat trout	2012	7	108	89-135	Y
Unnamed Lake (LW05)	10	46.9561	-121.5719	1649	lake	cutthroat trout	2012	11	238	195-278	Y
Unnamed Pond (LH11)	11	46.9554	-121.5932	1666	lake	brook trout	2012	15	159	122-201	Y
Wetland 583	12	46.8918	-121.5948	1125	lake	brook trout	2012	9	164	131-188	N
Unnamed wetland (LH15)	13	46.9517	-121.6178	1679	lake	cutthroat trout	2008	14	218	187-276	Y
Mowich Lake (LM04)	14	46.9339	-121.864	1506	lake	torrent sculpin	2008	7	99	92-105	Y
						torrent sculpin	2012	2	56	53-59	Y
Reflection Lake (LN19)	15	46.7693	-121.7294	1483	lake	brook trout	2012	21	175	114-227	Y
Snow Lake	16	46.7570	-121.6992	1432	lake	brook trout	2012	13	210	179-239	N
						cutthroat trout	2012	2	217	193-241	N
Upper Deadwood Lake (LW32)	17	46.8890	-121.5248	1599	lake	rainbow trout	2008	7	261	203-305	Y
North Cascades											
George Lake	1	48.7061	-121.1722	268	lake	rainbow trout	2011	10	189	171-226	N
Middle Blum Lake	2	48.7500	-121.4956	1529	lake	brook trout	2008	15	142	91-220	Y
Upper Wilcox Lake	3	48.6011	-121.1717	1569	lake	cutthroat trout	2008	12	204	170-248	Y

Park Site	Site ID	Latitude	Longitude	Elevation (m)	Habitat	Species	Year Sampled	n	SL (mm) ^a		SR ^b
									Mean	Range	
Olympic											
Gladys Lake ^b	1	47.8767	-123.3578	1646	lake	brook trout	2011	15	166	159-180	N
						brook trout	2012	15	167	150-182	N
Hagen Lake	2	47.6192	-123.2680	1446	lake	cutthroat trout	2012	15	212	175-238	N
Hoh Lake	3	47.8988	-123.7863	1387	lake	brook trout	2012	15	165	142-185	Y
Sun Up Lake ^b	4	47.5314	-123.4862	1227	lake	cutthroat trout	2011	15	242	232-257	N
						cutthroat trout	2012	15	250	219-269	N
Upper Lena Lake ^b	5	47.6331	-123.2080	1389	lake	rainbow trout	2011	15	171	149-187	N
Rocky Mountain											
Black Lake	1	40.2653	-105.6410	3242	lake	brook trout	2012	15	188	126-226	N
Colorado River	2	40.2773	-105.8504	2647	river	brown trout	2012	20	272	152-413	Y
						sucker spp	2012	20	193	145-292	Y
Fall River	3	40.4014	-105.6063	2590	river	brown trout	2012	20	229	166-338	Y
						sucker spp	2012	20	273	220-359	Y
Fern Lake	4	40.3368	-105.6763	2913	lake	cutthroat trout	2012	15	209	126-270	Y
Fourth Lake	5	40.2217	-105.6861	3167	lake	brook trout	2012	15	178	146-206	Y
Haynach Lake	6	40.3467	-105.7646	3378	lake	cutthroat trout	2012	15	237	141-340	Y
Lake Haiyaha	7	40.3047	-105.6622	3120	lake	cutthroat trout	2012	15	255	182-309	N
Lake Louise	8	40.5083	-105.6206	3369	lake	cutthroat trout	2012	14	271	222-314	N
Lake Nanita ^b	9	40.2560	-105.7165	3291	lake	cutthroat trout	2008	8	231	187-258	Y
						cutthroat trout	2012	15	188	111-260	Y
Lone Pine Lake	10	40.2327	-105.7232	3134	lake	brook trout	2012	14	141	91-178	N
Mills Lake	11	40.2895	-105.6417	3033	lake	rainbow trout	2012	15	226	167-295	Y
Mirror Lake ^b	12	40.5380	-105.6984	3364	lake	brook trout	2009	15	211	153-237	Y
						brook trout	2012	15	190	115-238	Y
Poudre Lake ^b	13	40.4222	-105.8089	3282	lake	brook trout	2009	15	202	129-242	N
						brook trout	2012	15	203	108-264	N
Sky Pond	14	40.2782	-105.6688	3315	lake	brook trout	2012	15	215	162-246	Y
Spruce Lake	15	40.3423	-105.6871	2950	lake	cutthroat trout	2012	15	206	148-242	Y
Ten Lake Park	16	40.2104	-105.7194	3415	lake	cutthroat trout	2012	14	239	206-288	Y
The Loch	17	40.2925	-105.6570	3109	lake	cutthroat trout	2012	15	218	148-285	Y
Upper Hutcheson Lake	18	40.1736	-105.6470	3417	lake	cutthroat trout	2012	15	208	183-250	N
Ypsilon Lake ^b	19	40.4436	-105.6633	3218	lake	cutthroat trout	2009	15	215	156-275	Y
Sequoia-Kings Canyon											
Bench Lake	1	36.9488	-118.4651	3224	lake	brook trout	2009	15	131	92-165	Y
Center Basin Lake ^b	2	36.7305	-118.3960	3517	lake	golden trout	2008	30	136	103-156	Y
						golden trout	2012	15	138	100-157	Y
Kern Point Lake ^b	3	36.6013	-118.4319	3281	lake	rainbow trout	2009	15	166	108-224	Y
Lake 10310	4	36.9591	-118.4354	3297	lake	brook trout	2012	15	143	101-168	Y

Park Site	Site ID	Latitude	Longitude	Elevation (m)	Habitat	Species	Year Sampled	n	SL (mm) ^a		SR ^b
									Mean	Range	
Wrangell-St. Elias											
Copper Lake	1	62.4256	-143.5550	886	lake	arctic grayling	2008	15	326	274-374	N
						kokanee	2008	15	295	278-311	Y
						lake trout	2008	13	417	365-470	Y
Summit Lake	2	61.3156	-144.1919		lake	rainbow trout	2009	15	250	123-405	N
Tanada Lake	3	62.4258	-143.3717	880	lake	lake trout	2009	13	466	418-542	Y
						rainbow trout	2012	12	180	151-198	N
Yellowstone											
Beula Lake	1	44.1598	-110.7670	2261	lake	cutthroat trout	2012	15	239	204-300	Y
Grebe Lake	2	44.7516	-110.5578	2450	lake	arctic grayling	2012	15	166	128-255	Y
						rainbow trout	2012	15	234	152-273	Y
Lewis Lake	3	44.3068	-110.6305	2375	lake	brown trout	2012	15	187	109-394	Y
Yellowstone Lake	4	44.4659	-110.3330	2361	lake	cutthroat trout	2012	15	266	243-294	N
						lake trout	2012	15	273	240-325	N
						cutthroat trout	2012	15	221	115-262	Y
Yosemite											
Mildred Lake	1	37.8202	-119.4407	2916	lake	brook trout	2009	15	204	117-269	Y
Spillway Lake	2	37.8408	-119.2321	3189	lake	brook trout	2009	15	192	124-263	Y
						rainbow trout	2012	15	170	73-252	Y
Zion											
E. Fork Virgin River	1	37.1594	-112.9686	1192	river	speckled dace	2012	15	50	40-61	Y
N. Fork Virgin River	2	37.2413	-112.9588	1294	river	speckled dace	2012	15	39	34-44	N

^a Size regression used: Y=yes, N=no.

^b Lakes used in inter-annual comparison. Lake Kontrashibuna was excluded from intra-annual comparisons because only two fish were collected in 2012.

^c Threespine stickleback.

Table 2. Total mercury concentrations (THg; ng/g ww) in muscle of fish from 21 national parks in the Western United States.

[Values are reported as geometric means, 95percent confidence intervals (CI), and range, and least-square mean (LSM) concentrations controlling for the effects of size, species, and site at 50, 200, and 400 mm standardized lengths]

Park	Park Abbreviation	Total n	Geometric Mean	95percent CI	Range	50 mm			200 mm			400 mm		
						n	LSM	SE	n	LSM	SE	n	LSM	SE
Capitol Reef	CARE	45	325.6	281.4 - 376.9	136.7 - 805.4	45	207.9	3.7	-	-	-	-	-	-
Crater Lake	CRLA	27	38.0	32 - 44.3	16.8 - 76.0	-	-	-	27	26.6	2.6	-	-	-
Denali	DENA	17	49.3	37.9 - 64.1	23.7 - 88.8	-	-	-	-	-	-	17	47.4	1.6
Glacier	GLAC	15	232.4	211.6 - 255.3	167.3 - 297.9	-	-	-	-	-	-	15	234.1	9.1
Glacier Bay	GLBA	45	90.2	79.1 - 102.9	41.0 - 203.1	-	-	-	45	102.3	19.6	-	-	-
Grand Canyon	GRCA	42	76.0	66.1 - 87.5	31.8 - 241.2	-	-	-	42	101.2	9.6	-	-	-
Grand Teton	GRTE	45	32.6	28.3 - 37.6	16.2 - 99.0	-	-	-	45	31.3	4.5	-	-	-
Great Basin	GRBA	39	40.0	36.3 - 44.2	19.0 - 85.5	-	-	-	39	34.5	5.0	-	-	-
Great Sand Dunes	GRSA	29	52.7	45.8 - 60.6	29.1 - 136.6	-	-	-	29	62.4	5.6	-	-	-
Lake Clark	LACL	59	229.3	192.8 - 272.8	35.8 - 691.0	-	-	-	-	-	-	59	201.0	2.9
Lassen Volcanic	LAVO	47	96.4	78.1 - 119	28.6 - 493.4	-	-	-	47	65.3	9.5	-	-	-
Mesa Verde	MEVE	10	74.9	59.9 - 93.7	45.7 - 115.4	10	74.9	2.9	-	-	-	-	-	-
Mount Rainier	MORA	207	71.5	65.8 - 78.5	12.5 - 384.5	35	80.4	1.9	172	61.0	7.3	-	-	-
North Cascades	NOCA	37	54.9	46.7 - 64.4	22.4 - 209.3	-	-	-	37	73.3	7.2	-	-	-
Olympic	OLYM	117	85.0	80 - 90.3	34.9 - 208.8	-	-	-	337	109.7	12.1	-	-	-
Rocky Mountain	ROMO	385	66.1	61.4 - 71.1	9.9 - 528.3	-	-	-	385	54.8	6.3	-	-	-
Sequoia - Kings Canyon	SEKI	105	43.8	39.1 - 49	13.3 - 124.5	-	-	-	105	69.5	6.3	-	-	-
Wrangell-St. Elias	WRST	71	107.9	87.4 - 133.1	27.8 - 632.3	-	-	-	45	98.15	9.41	26	278.8	7.4
Yellowstone	YELL	90	101.2	92.7 - 110.5	44.6 - 312.2	-	-	-	75	119.8	10.2	15	116.0	4.3
Yosemite	YOSE	30	82.1	57.5 - 117.2	24.9 - 1108.6	-	-	-	30	70.0	10.2	-	-	-
Zion	ZION	30	241.5	209.7 - 278.2	95.9 - 532.6	30	242.5	5.4	-	-	-	-	-	-

Table 3. Total mercury concentrations (THg; ng/g ww) and coefficients of variation (CV) in fish muscle from 86 sites in 21 national parks in the Western United States.

[Values are reported as geometric means and 95 percent confidence intervals (95% CI), and least-square mean (LSM) concentrations controlling for the effects of size, species, and site at 50 mm, 200 mm, and 400 mm standardized lengths]

Park Site	Geometric Mean	95% CI	50 mm ^b		200 mm ^b		400 mm ^b		CV
			LSM	SE	LSM	SE	LSM	SE	
All Parks	77.7	73.6 - 80.8							0.67
Capitol Reef	325.6	281.4 - 376.9	207.9	3.7					0.88
Fremont River #1	407.3	318.3 - 521.1	301.0	9.4					0.31
Fremont River #4	244.7	199.8 - 299.7	157.8	4.9					0.31
Fremont River #7	346.5	260.4 - 461.1	189.4	5.9					0.30
Crater Lake	38.0	32 - 44.3			26.6	2.6			NA
Crater Lake	38.0	32.7 - 44.3			26.6	2.6			0.28
Denali	49.3	37.9 - 64.1					47.4	1.6	NA
Lake Chilchukabena	49.3	37.9 - 64.1					47.4	1.6	0.23
Glacier	232.4	211.6 - 255.3					234.1	9.1	NA
Lake McDonald	232.4	211.6 - 255.3					234.1	9.1	0.15
Glacier Bay	90.2	79.1 - 102.9			102.3	19.6			0.49
Falls Creek	56.4	50 - 63.6			56.4	10.9			0.22
North Skidmore Lake	113.7	102.3 - 126.4			113.7	22.1			0.18
Stonefly Lake	114.7	91.9 - 143.1			167.0	32.4			0.27
Grand Canyon	76.0	66.1 - 87.5			101.2	9.6			0.54
Bright Angel Creek	57.8	46.7 - 71.7			71.5	7.0			0.35
Havasu Creek	66.0	53.3 - 81.8			81.0	8.2			0.50
Shinumo Creek	108.9	89.1 - 133.2			178.8	18.0			0.28
Grand Teton	32.6	28.3 - 37.6			31.3	4.5			0.28
Death Canyon	22.9	21 - 25			25.1	3.7			0.10
Grizzly Bear Lake	52.1	40.9 - 66.4			42.4	6.3			0.40
Lake Solitude	29.0	24.1 - 34.9			28.8	4.3			0.29
Great Basin	40.0	36.3 - 44.2			34.5	5.0			0.12
Baker Lake	41.6	29.2 - 59.3			35.6	5.4			0.52
Lehman Creek	35.1	30.5 - 40.3			30.0	4.4			0.24
Snake Creek	44.7	40.4 - 49.4			38.3	5.6			0.16
Great Sand Dunes	52.7	45.8 - 60.6			62.4	5.6			0.37
Medano Lake	70.1	61.6 - 79.7			81.8	12.1			0.28
Sand Creek	38.8	34.6 - 43.5			47.6	4.8			0.21
Lake Clark	229.3	192.8 - 272.8					201.0	2.9	0.57
Lake Clark	365.2	327.4 - 407.4					365.2	9.2	0.31
Lake Kontrashibuna	204.0	147.9 - 281.4					204.0	7.3	0.41
Telaquana Lake	109.0	82.5 - 144					109.0	4.1	0.56

Park Site	Geometric Mean	95% CI ^a	50 mm ^b		200 mm ^b		400 mm ^b		CV
			LSM	SE	LSM	SE	LSM	SE	
Lassen Volcanic	96.4	78.1 - 119			65.3	9.5			0.45
Horseshoe Lake	180.7	132.3 - 246.9			84.8	12.5			0.29
Ridge Lake	111.3	89.9 - 137.9			95.4	14.0			0.39
Summit Lake	43.7	38.1 - 50.1			34.5	5.1			0.12
Mesa Verde	74.9	59.9 - 93.7	74.9	2.9					NA
Mancos River	74.9	59.9 - 93.7	74.9	2.9					0.30
Mount Rainier	71.5	65.8 - 78.5	80.4	1.9	61.0	7.3			0.55
Bench Lake	34.0	20.4 - 56.7			8.5	1.3			0.29
Golden Lake	66.6	47.7 - 93			193.2	28.5			0.14
Green Lake	66.2	58.3 - 75.2			77.3	11.9			0.12
Lake George	87.5	73.2 - 104.5	89.8	2.7					0.27
Louise Lake	86.1	63.2 - 117.3			105.9	16.2			0.19
Lower Deadwood Lake	82.9	65.5 - 104.8	50.6	2.0	77.9	8.0			
Lower Palisades Lake	116.3	103 - 131.4			92.9	13.6			0.21
MORA_1244	58.4	44 - 77.4			60.6	9.2			0.34
MORA_1614	227.4	157.5 - 328.2			97.8	14.9			0.30
MORA_230	121.2	86.7 - 169.4			80.7	12.0			0.32
MORA_234	66.2	53.1 - 82.5			87.4	12.9			0.29
MORA_583	19.2	14.4 - 25.5			16.4	2.5			0.46
MORA_LH15	66.4	51.1 - 86.2			62.5	9.2			0.36
Mowich Lake	97.2	72.9 - 129.6	114.1	5.6					0.17
Reflection Lake	80.8	62.3 - 104.9			101.0	14.8			0.44
Snow Lake	37.3	30.4 - 45.9			33.3	4.8			0.37
Upper Deadwood Lake	47.0	33.5 - 66.1			42.9	4.6			0.36
North Cascades	54.9	46.7 - 64.4			73.3	7.2			0.45
George Lake	44.1	33.5 - 58			54.1	5.6			0.34
Middle Blum Lake	62.2	46.3 - 83.5			118.5	17.5			0.36
Upper Wilcox Lake	56.2	41.8 - 75.5			61.5	9.1			0.18
Olympic	85.0	80 - 90.3			109.7	12.1			0.60
Gladys Lake	83.5	75.5 - 92.4			71.5	10.4			0.28
Hagen Lake	93.5	78.1 - 111.9			109.1	16.1			0.30
Hoh Lake	125.7	104.7 - 150.9			253.0	37.3			0.26
Sun Up Lake	85.2	79.1 - 91.7			99.4	14.5			0.19
Upper Lena Lake	66.1	58.9 - 74.1			81.1	8.0			0.27
Rocky Mountain	66.1	61.4 - 71.1			54.8	6.3			0.43
Black Lake	54.4	45.7 - 64.8			46.6	6.9			0.31
Colorado River	118.0	104.3 - 133.6			100.4	10.6			0.40
Fall River	106.2	83.3 - 135.5			59.3	6.3			0.43
Fern Lake	59.1	46.4 - 75.3			65.3	9.6			0.35
Fourth Lake.	70.4	58.8 - 84.3			71.6	10.6			0.27
Haynach Lake	19.8	15.9 - 24.5			19.4	2.9			0.26
Lake Haiyaha	18.5	15.9 - 21.5			21.6	3.2			0.26
Lake Louise	56.5	48.7 - 65.5			65.9	9.7			0.25
Lake Nanita	70.5	55 - 90.4			80.0	11.7			0.34
Lone Pine Lake	57.8	50.2 - 66.5			49.5	7.3			0.26
Mills Lake	87.5	68.5 - 111.9			94.0	9.5			0.37
Mirror Lake	121.2	86.2 - 170.5			102.4	14.9			0.36

Park Site	Geometric Mean	95% CI	50 mm ^b		200 mm ^b		400 mm ^b		CV
			LSM	SE	LSM	SE	LSM	SE	
Rocky Mountain cont.									
Poudre Lake	82.6	70.9 - 96.2			70.8	10.3			0.50
Sky Pond	30.7	23.2 - 40.6			21.4	3.2			0.30
Spruce Lake	89.3	69.7 - 114.4			97.5	14.4			0.30
Ten Lake Park	68.3	57.5 - 81			63.2	9.4			0.28
The Loch	38.9	27.1 - 56			38.6	5.7			0.82
Upper Hutcheson Lake	30.8	28 - 33.8			35.9	5.3			0.16
Ypsilon Lake	62.3	51.6 - 75.3			61.7	9.0			0.45
Sequoia - Kings Canyon	43.8	39.1 - 49			69.5	6.3			0.38
Bench Lake.	21.7	18.1 - 26.1			30.3	4.5			0.32
Center Basin Lake	67.0	60 - 74.9			207.3	39.8			0.28
Kern Point Lake	43.5	37.2 - 50.9			71.4	7.0			0.24
Lake 10310	24.9	20.1 - 30.9			52.1	7.7			0.41
Wrangell-St. Elias	107.9	87.4 - 133.1			98.2	9.4	278.8	7.4	0.57
Copper Lake	91.7	73.4 - 114.5			147.4	14.5	242.0	9.8	0.24
Summit Lake	53.3	48.5 - 58.5			65.4	6.6			0.18
Tanada Lake	416.6	358.4 - 484.2					321.2	13.0	0.19
Yellowstone	101.2	92.7 - 110.5			119.8	10.2	116.0	4.3	0.23
Beula Lake	107.1	95.5 - 120.1			111.1	16.4			0.18
Grebe Lake	110.5	94.2 - 129.7			168.8	16.4			0.19
Lewis Lake	69.2	56.5 - 84.9			92.3	10.1			0.25
Yellowstone Lake	108.9	92.8 - 127.7			119.3	17.6	116.0	4.3	
Yosemite	82.1	57.5 - 117.2			70.0	10.2			0.86
Mildred Lake	174.4	115.1 - 264.1			142.4	21.0			0.58
Spillway Lake	38.7	32.3 - 46.2			34.4	5.1			0.31
Zion	241.5	209.7 - 278.2	242.5	5.4					0.57
E. Fork Virgin River	234.9	180 - 306.5	236.8	7.4					0.29
N. Fork Virgin River	248.3	215.8 - 285.7	248.3	7.7					0.32

Table 4. Proportion of fish with wet weight mercury concentrations exceeding toxicity benchmarks from 86 sites in 21 western national parks in the Western United States.

[Comparisons to fish (no observed effects residue [NOER] = 200 ng/g, lowest observed effects residue [LOER] = 300 ng/g) and bird (high sensitivity = 90 ng/g, moderate sensitivity = 180 ng/g, low sensitivity = 270 ng/g) benchmarks were made using whole-body concentrations whereas comparisons to human consumption (unlimited consumption = 50 ng/g, EPA criterion = 300 ng/g, no consumption = 950 ng/g) benchmarks used concentrations in axial muscle tissue]

Park Site	Fish Toxicity		Bird Toxicity			Human Consumption		
	NOER	LOER	High Sens.	Moderate Sens.	Low Sens.	Unlimited Consumption	EPA Criterion	No Consumption
Among all parks	5	2	35	12	5	68	4	1
Capitol Reef	49	22	98	56	33	NA	NA	NA
Fremont River #1	67	33	100	80	60	NA	NA	NA
Fremont River #4	20	7	93	27	7	NA	NA	NA
Fremont River #7	60	27	100	60	33	NA	NA	NA
Crater Lake	--	--	--	--	--	19	--	--
Crater Lake	--	--	--	--	--	19	--	--
Denali	--	--	--	--	--	59	--	--
Lake Chilchukabena	--	--	--	--	--	59	--	--
Glacier	--	--	100	--	--	100	--	--
Lake McDonald	--	--	100	--	--	100	--	--
Glacier Bay	--	--	18	--	--	87	--	--
Falls Creek	--	--	--	--	--	60	--	--
North Skidmore Lake	--	--	20	--	--	100	--	--
Stonefly Lake	--	--	33	--	--	100	--	--
Grand Canyon	--	--	10	--	--	79	--	--
Bright Angel Creek	--	--	--	--	--	58	--	--
Havasus Creek	--	--	7	--	--	73	--	--
Shinumo Creek	--	--	20	--	--	100	--	--
Grand Teton	--	--	--	--	--	18	--	--
Death Canyon	--	--	--	--	--	--	--	--
Grizzly Bear Lake	--	--	--	--	--	47	--	--
Lake Solitude	--	--	--	--	--	7	--	--
Great Basin	--	--	--	--	--	18	--	--
Baker Lake	--	--	--	--	--	33	--	--
Lehman Creek	--	--	--	--	--	7	--	--
Snake Creek	--	--	--	--	--	20	--	--

Park Site	Fish Toxicity		Bird Toxicity			Human Consumption		
	NOER	LOER	High Sens.	Moderate Sens.	Low Sens.	Unlimited Consumption	EPA Criterion	No Consumption
Great Sand Dunes	--	--	--	--	--	59	--	--
Medano Lake	--	--	--	--	--	100	--	--
Sand Creek	--	--	--	--	--	14	--	--
Lake Clark	31	7	76	42	10	98	41	--
Lake Clark	54	14	100	79	21	100	75	--
Lake Kontrashibuna	19	--	81	19	--	94	19	--
Telaquana Lake	--	--	27	--	--	100	--	--
Lassen Volcanic	2	--	40	2	2	72	2	--
Horseshoe Lake	7	--	87	7	7	93	7	--
Ridge Lake	--	--	35	--	--	100	--	--
Summit Lake	--	--	--	--	--	20	--	--
Mesa Verde	--	--	--	--	--	NA	NA	NA
Mancos River	--	--	--	--	--	NA	NA	NA
Mount Rainier	1	--	15	2	--	72	2	--
Bench Lake	--	--	--	--	--	17	--	--
Golden Lake	--	--	19	--	--	56	6	--
Green Lake	--	--	--	--	--	100	--	--
Lake George	--	--	6	--	--	NA	NA	NA
Louise Lake	--	--	--	--	--	100	--	--
Lower Deadwood Lake	--	--	18	--	--	94	--	--
Lower Palisades Lake	--	--	21	--	--	100	--	--
MORA_1244	--	--	--	--	--	57	--	--
MORA_1614	29	--	100	29	--	100	29	--
MORA_230	--	--	55	--	--	100	--	--
MORA_234	--	--	7	--	--	73	--	--
MORA_583	--	--	--	--	--	--	--	--
MORA_LH15	--	--	7	--	--	64	--	--
Mowich Lake	--	--	11	--	--	NA	NA	NA
Reflection Lake	--	--	19	5	--	71	5	--
Snow Lake	--	--	--	--	--	27	--	--
Upper Deadwood Lake	--	--	--	--	--	29	--	--
North Cascades	--	--	5			51	--	--
George Lake	--	--	--	--	--	40	--	--
Middle Blum Lake	--	--	7	--	--	53	--	--
Upper Wilcox Lake	--	--	8	--	--	58	--	--

Park Site	Fish Toxicity		Bird Toxicity			Human Consumption		
	NOER	LOER	High Sens.	Moderate Sens.	Low Sens.	Unlimited Consumption	EPA Criterion	No Consumption
Olympic	--	--	6			94	--	--
Gladys Lake	--	--	3	--	--	100	--	--
Hagen Lake	--	--	7	--	--	100	--	--
Hoh Lake	--	--	33	--	--	100	--	--
Sun Up Lake	--	--	--	--	--	100	--	--
Upper Lena Lake	--	--	--	--	--	74	--	--
		--				--		
Rocky Mountain	2	--	15	3	1	66	3	--
Black Lake	--	--	--	--	--	60	--	--
Colorado River	--	--	28	3	--	100	3	--
Fall River	10	3	33	10	5	80	10	--
Fern Lake	--	--	--	--	--	80	--	--
Fourth Lake	--	--	--	--	--	87	--	--
Haynach Lake	--	--	--	--	--	--	--	--
Lake Haiyaha	--	--	--	--	--	--	--	--
Lake Louise	--	--	--	--	--	57	--	--
Lake Nanita	--	--	17	--	--	70	--	--
Lone Pine Lake	--	--	--	--	--	71	--	--
Mills Lake	--	--	13	--	--	80	--	--
Mirror Lake	10	--	57	17	--	77	17	--
Poudre Lake	--	--	17	--	--	100	--	--
Sky Pond	--	--	--	--	--	13	--	--
Spruce Lake	--	--	20	--	--	87	--	--
Ten Lake Park	--	--	--	--	--	93	--	--
The Loch	--	--	--	--	--	27	--	--
Upper Hutcheson Lake	--	--	--	--	--	--	--	--
Ypsilon Lake	--	--	10	--	--	60	--	--
Sequoia - Kings Canyon	--	--	--	--	--	46	--	--
Bench Lake	--	--	--	--	--	--	--	--
Center Basin Lake	--	--	--	--	--	73	--	--
Kern Point Lake	--	--	--	--	--	43	--	--
Lake 10310	--	--	--	--	--	13	--	--
Wrangell-St. Elias	16	4	39	18	7	76	18	--
Copper Lake	--	--	35	5	--	74	5	--
Summit Lake	--	--	--	--	--	60	--	--
Tanada Lake	85	23	100	85	38	100	85	--
Yellowstone	--	--	20	1	--	94	1	--
Beula Lake	--	--	7	--	--	100	--	--
Grebe Lake	--	--	30	--	--	97	--	--
Lewis Lake	--	--	7	--	--	80	--	--
Yellowstone Lake	--	--	23	3	--	97	3	--

Park Site	Fish Toxicity		Bird Toxicity			Human Consumption		
	NOER	LOER	High Sens.	Moderate Sens.	Low Sens.	Unlimited Consumption	EPA Criterion	No Consumption
Yosemite	7	3	27	7	3	60	7	3
Mildred Lake	13	7	53	13	7	100	13	7
Spillway Lake	--	--	--	--	--	20	--	--
Zion	20	3	90	27	3	NA	NA	NA
E. Fork Virgin River	30	--	80	40	--	NA	NA	NA
N. Fork Virgin River	7	7	100	13	7	NA	NA	NA

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For more information concerning the research in this report, contact the
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Corvallis, Oregon 97330
<http://fresc.usgs.gov/>

BEFORE THE UNITED STATES DEPARTMENT OF ENERGY

Federal Power Act Section 202(c))
Emergency Order: Transalta)
Centralia Generation LLC)
_____)

Order No. 202-25-11

Motion to Intervene, Motion for Clarification, and Requests for Rehearing and Stay
of Sierra Club, NW Energy Coalition, Washington Conservation Action, Climate
Solutions, Public Citizen, and Environmental Defense Fund
(collectively, “Public Interest Organizations” or “PIOs”)

Exhibit 1-133:
High Levels of Mercury in Fish at Hoh Lake Article



Glacier-fed Hoh Lake

High levels of mercury found in fish at Olympic National Park's Hoh Lake

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Tuesday, May 27, 2014 7:11pm | [NEWS](#)

Peninsula Daily News and news services

PORT ANGELES — High levels of mercury have been found in fish from a lake in Olympic National Park and in remote areas of other Western national parks, proving that even the most isolated lakes and streams in the U.S. aren't immune to mercury pollution.

The finding was included in a recently published study by the U.S. Geological Survey and National Park Service.

But overall, the report had fairly good news for sport anglers.

Researchers said that most fish they caught had "acceptable" mercury concentrations below the U.S. Environmental Protection Agency's fish  criterion for safe human consumption.

But 4 percent exceeded healthy levels — including those from one of five lakes sampled in Olympic where mercury, a cumulative neurotoxin that can cause brain damage, approached levels unsafe for humans and fish-eating birds.

Hoh Lake was the only spot sampled in Washington’s three national parks — Olympic, Mount Rainier and North Cascades — where the study found fish “are likely to approach or exceed the Environmental Protection Agency criterion for protection of human health” and for “reproductive impairment” of fish-eating birds.

The Geological Survey and National Park Service don’t regulate health guidelines, but they are working with officials in Washington and the nine other states studied on possible fish consumption advisories.

Western parks were selected because of the significant role atmospheric mercury plays in remote places, and the lack of broad-scale assessments on mercury in fish in remote areas of the West, said Colleen Flanagan Pritz, a Park Service ecologist in Denver and coauthor of the study.

While previous studies documented mercury at the Olympic and Mount Rainier parks and other places in the West, this latest study “is a wake-up call,” Flanagan Pritz said.

“We need to see fewer contaminants in park ecosystems, especially contaminants like mercury where concentrations in fish challenge the very mission of the national parks to leave wild life unimpaired for future generations.”

Olympic National Park fish were sampled from five lakes — Gladys, Hagen, Hoh, Sun Up and Upper Lena lakes.

Researchers took samples from rainbow, cutthroat and brook trout.

Samples from the five lakes showed mercury concentrations averaging 85 nanograms per gram wet weight, slightly higher than the mean for the study.

Size-adjusted concentrations at Hoh Lake were 253 ng/g ww. The EPA’s human risk threshold is 300 ng/g ww.

At the low end of the spectrum was Gladys Lake, with a concentration of 71.5 ng/g ww.

Hagen was 109.1 ng/g ww; Sun Up, 99.4 ng/g ww; Upper Lena, 81.1 ng/g ww.

The National Park Service has blamed the Centralia Big Hanaford power plant in Lewis County, 55 miles from the southern borders of Olympic National Park, for mercury emissions as well as causing serious haze in the park.

 major coal-fired power plant supplemented with newer natural-gas-fired units.



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Concerned about emissions of nitrogen oxide, particulate matter, mercury and sulfur dioxide, state and federal regulators in early 2011 struck a deal with the plant's owners that will result in both coal boilers being shut down by 2025.

Mercury is also believed to arrive in Washington state from pollution blown across the Pacific Ocean from coal-fired industries in China.

In two Alaskan parks, the average level of mercury in fish found bypassed the federal standard for human consumption.

In addition to Hoh Lake, the amounts of mercury also exceeded healthy levels at parks in California, Colorado and Wyoming, the study found.

Generally, the older and larger the fish, the more mercury they contain.

The fish study was the first of its kind to incorporate information from remote places at 21 national parks in 10 western states.

From 2008-2012, researchers sampled 1,486 fish from 16 species from 86 individual sites in the parks.

High mercury concentrations in birds, mammals and fish can result in reduced foraging efficiency, survival, and reproductive success.

Mercury concentrations in fish exceeded the most conservative fish toxicity benchmark at 15 percent of all sites, and levels exceeded the most sensitive health benchmark for fish-eating birds at 52 percent of all sites.

There were three sites in sampled in North Cascades National Park.

Results showed the mean mercury concentration below the average of all fish sampled in the study.

After standardizing the fish to 200 mm in length, the mean mercury concentration was 73.3 nanograms per gram wet weight.

At Mount Rainier, fish were sampled at 17 sites.

The average mercury concentration was 71.5 ng/g ww, similar to the studywide mean for all the fish in the study.

When adjusted to the 200 mm standardized size, concentrations ranged from 8.5-193.2 ng/g ww.

That large variation "emphasizes the need to sample from multiple locations in order to accurately characterize mercury risk to park resources as a whole," the report said.

Among the most widespread contaminants in the world, mercury is distributed globally from natural sources such as volcanic eruptions and from human sources such as burning fossil fuels in power plants.



Mercury is distributed at local or regional scales as a result of current and historic mining activities, the report said. These human activities have increased levels of atmospheric mercury at least threefold during the past 150 years, the researchers wrote.

Mercury, whether naturally occurring or in pollution, easily enters the food chain.

According to the Centers for Disease Control and Prevention, exposure to high levels of mercury in humans can damage the brain, kidneys and a developing fetus. Pregnant women and young children are particularly sensitive to mercury.

In birds that eat fish, the effects of mercury can range from reduced nest success rates – a bird might not return to a nest to incubate its eggs – and reduced ability to forage.

In fish, there are levels where changes in behavior are noticed, while higher levels could be lethal.

The full U.S. Geological Survey and National Park Service report is available at <http://tinyurl.com/natparkfish>.

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BEFORE THE UNITED STATES DEPARTMENT OF ENERGY

Federal Power Act Section 202(c))
Emergency Order: Transalta)
Centralia Generation LLC)
_____)

Order No. 202-25-11

Motion to Intervene, Motion for Clarification, and Requests for Rehearing and Stay
of Sierra Club, NW Energy Coalition, Washington Conservation Action, Climate
Solutions, Public Citizen, and Environmental Defense Fund
(collectively, “Public Interest Organizations” or “PIOs”)

Exhibit 1-134:
Southwest Clean Air Agency Notice of Violation No. 10642

EXHIBIT 11-14



5101 NE 82nd Avenue, Suite 102, Vancouver WA 98662 | 360-574-3058 / 800-633-0709 | www.swcleanair.gov

DATE OF VIOLATION: October 23, 2025		TIME OF VIOLATION: <i>(if applicable)</i> 09:25
LOCATION OF VIOLATION: Flyash Unloading Baghouse - 913 Big Hanaford Road, Centralia, WA 98531		
RESPONSIBLE PARTY / PROPERTY OWNER / FACILITY NAME: TransAlta Centralia Generation, LLC		
MAILING ADDRESS: 913 Big Hanaford Road, Centralia, WA 98531		
PHONE NUMBER: 360-330-2306	EMAIL ADDRESS: Sam Bocook@transalta.com	SWCAA ID: 754

Description of Violation(s)

IN VIOLATION OF (REGULATION/PERMIT/ORDER): Condition 2 of ADP 12-3016, Req.-79 of AOP SW98-8-R5-A SWCAA 400-040(1), Req.-1 of AOP SW98-8-R5-A SWCAA 400-116(2)	DID CAUSE OR ALLOW: Failure to maintain the Fly Ash Weigh Bin Baghouse properly, resulting in excess visible emissions.
---	--

DETAILS / EVIDENCE:
On October 23, 2025 Abraham Apfel and I visited TransAlta Centralia Generation for an unannounced inspection. Before entering the plant we drove past on Big Hanaford Road and observed a dense plume of ash from the Fly Ash Weigh Bin Baghouse and took a photograph and video. No trucks were being loading at the time. When I returned for a follow-up visit on November 4, 2025 the issue had been resolved and I spoke to maintenance personell who indicated the filters had been "plugged". This does not explain the excess emissions, but no further explanation was available. During an inspection on September 28, 2024 visible emissions could be seen from the fly ash weigh bin baghouse when viewed from the elevator to the west, but not from a legal Method 9 observation point. Fly ash loading was not occurring at the time. TransAlta reportedly replaced the filter cartridges in the unit later the same day to correct the problem.

Notice of Violation issued by

SWCAA REPRESENTATIVE: Clint Lamoreaux	DATE ISSUED: December 2, 2025
PHONE NUMBER: 360-574-3058 ext. 131	EMAIL ADDRESS: clint@swcleanair.gov

Delivery Method

<input type="checkbox"/> IN PERSON <input checked="" type="checkbox"/> USPS CERTIFIED MAIL <input type="checkbox"/> ELECTRONIC MAIL	IF DELIVERED IN PERSON NAME / TITLE OF RECIPIENT:
	(SIGNING NOTICE DOES NOT CONSTITUTE AN ADMISSION OF GUILT)

Important Information – Please Read

You may provide additional information for the Southwest Clean Air Agency (SWCAA) to consider when addressing the above referenced alleged violation(s). You are also welcome to provide evidence of any corrective actions you have taken, or will take, as evidence of prompt and effective corrective actions may reduce your penalty if a penalty is assessed. If you wish to provide additional information, or schedule a meeting with the Agency, please do so within thirty (30) days of receiving this notice. Depending on the circumstances, you typically will receive one of the following: (1) Notice of Corrective Order (NCO), a (2) Notice of Civil Penalty (NCP) or (3) a Notice of Civil Penalty and Corrective Order (NCPCO), unless the information you submit to SWCAA indicates that a violation did not occur. An NCO orders prescribed corrective actions but assesses no civil penalty. An NCP assesses a penalty not to exceed \$17,000 for each day of non-compliance. An NCPCO orders both corrective actions and a civil penalty. A civil penalty may be issued no sooner than thirty (30) days after your receipt of this Notice of Violation. For any of these actions you will receive further notification from the Southwest Clean Air Agency. Civil penalties and corrective orders may be appealed to the Pollution Control Hearings Board (PCHB) within thirty (30) days of the date of receipt of an NCO, NCP or NCPCO issued by SWCAA. For more information about appeals see RCW 43.21B, RCW 70A.15, and WAC 371-08 or visit <https://eluh0.wa.gov/boards/pollution-control-hearings-board>.

SWCAA NOTICE OF VIOLATION ENFORCEMENT PROCESS

Step 1	Step 2	Step 3	Step 4	Step 5
Notice of Violation (NOV) issued by SWCAA for permit and/or regulation-based violations recorded by the Agency.	Within thirty (30) days of receipt of the NOV, provide SWCAA with information to show that the violation did not occur, or that you were not responsible for the violation recorded by the Agency.	Unless you have shown that a violation did not occur, or that you were not responsible for the violation, and after at least thirty (30) days have passed from the date the NOV was received, SWCAA will typically issue a Notice of Corrective Order (NCO) ¹ , a Notice of Civil Penalty (NCP) ² or a Notice of Civil Penalty and Corrective Order (NCPCO) ³ .	Within thirty (30) days of receipt of an NCO, NCP or NCPCO issued to you by SWCAA, you may request remission or mitigation, or appeal the civil penalties and/or corrective orders to the Pollution Control Hearings Board (PCHB).	Unless you have been provided with relief by PCHB, remit any penalties to SWCAA and/or complete the prescribed corrective actions within the timelines provided in the NCO, NCP or NCPCO letter.

¹ Notice of Corrective Order (NCO) - order prescribes corrective actions but no civil penalty.

² Notice of Civil Penalty (NCP) - assesses a penalty not to exceed \$17,000 for each day of non-compliance.

³ Notice of Civil Penalty and Corrective Order (NCPCO) - assesses both a penalty, not to exceed \$17,000 for each day of non-compliance, as well as an order prescribing corrective actions.

BEFORE THE UNITED STATES DEPARTMENT OF ENERGY

Federal Power Act Section 202(c))
Emergency Order: Transalta)
Centralia Generation LLC)
_____)

Order No. 202-25-11

Motion to Intervene, Motion for Clarification, and Requests for Rehearing and Stay
of Sierra Club, NW Energy Coalition, Washington Conservation Action, Climate
Solutions, Public Citizen, and Environmental Defense Fund
(collectively, “Public Interest Organizations” or “PIOs”)

Exhibit 1-135:
Southwest Clean Air Agency Notice of Violation No. 10643

EXHIBIT 11-15



5101 NE 82nd Avenue, Suite 102, Vancouver WA 98662 | 360-574-3058 / 800-633-0709 | www.swcleanair.gov

DATE OF VIOLATION: 1/11/25, 3/4/25, 6/6/25, 6/11/25, 8/26/2025		TIME OF VIOLATION: <i>(if applicable)</i> Various
LOCATION OF VIOLATION: Unit #2 - 913 Big Hanaford Road, Centralia, WA 98531		
RESPONSIBLE PARTY / PROPERTY OWNER / FACILITY NAME: TransAlta Centralia Generation, LLC		
MAILING ADDRESS: 913 Big Hanaford Road, Centralia, WA 98531		
PHONE NUMBER: 360-330-2306	EMAIL ADDRESS: Sam Bocook@transalta.com	SWCAA ID: 754

Description of Violation(s)

IN VIOLATION OF (REGULATION/PERMIT/ORDER): 40 CFR 63.10042 definition of "Startup" and Table 3, Section 3 of 40 CFR 63 Subpart UUUUU SWCAA 400-075	DID CAUSE OR ALLOW: Firing of coal during startup before fully engaging the wet scrubber.
---	--

DETAILS / EVIDENCE:

Individual startup reports and quarterly reports submitted in accordance with 40 CFR 63 Subpart UUUUU detail when the flue gas desulfurization (FGD) system (scrubber) was online and when coal firing began.

Effective July 8, 2024 EPA set a deadline (January 2, 2025) by which facilities could no longer use the second definition of "startup" in 40 CFR 63.10042. The effect of this change was that the scrubber must be online before coal is fired during startup.

Notice of Violation issued by

SWCAA REPRESENTATIVE: Clint Lamoreaux	DATE ISSUED: December 16, 2025
PHONE NUMBER: 360-574-3058 ext. 131	EMAIL ADDRESS: clint@swcleanair.gov

Delivery Method

<input type="checkbox"/> IN PERSON <input checked="" type="checkbox"/> USPS CERTIFIED MAIL <input type="checkbox"/> ELECTRONIC MAIL	<i>IF DELIVERED IN PERSON</i> NAME / TITLE OF RECIPIENT: <hr/> (SIGNING NOTICE DOES NOT CONSTITUTE AN ADMISSION OF GUILT)
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Important Information – Please Read

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Step 1	Step 2	Step 3	Step 4	Step 5
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¹ Notice of Corrective Order (NCO) - order prescribes corrective actions but no civil penalty.

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BEFORE THE UNITED STATES DEPARTMENT OF ENERGY

Federal Power Act Section 202(c))
Emergency Order: Transalta)
Centralia Generation LLC)
_____)

Order No. 202-25-11

Motion to Intervene, Motion for Clarification, and Requests for Rehearing and Stay
of Sierra Club, NW Energy Coalition, Washington Conservation Action, Climate
Solutions, Public Citizen, and Environmental Defense Fund
(collectively, “Public Interest Organizations” or “PIOs”)

Exhibit 1-136:
Consent Decree

THE HONORABLE JOHN C. COUGHENOUR

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UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON
AT SEATTLE

SIERRA CLUB, *et al.*,

Plaintiffs,

v.

BNSF RAILWAY COMPANY,

Defendant.

CASE NO. C13-0967-JCC

CONSENT DECREE

This matter comes before the Court on the parties' motion to enter their proposed consent decree (Dkt. No. 374). The United States has no objection to entry of the proposed consent decree. (Dkt. No. 383.) Having thoroughly considered the motion and the relevant record, the Court hereby GRANTS the motion and ENTERS the following consent decree:

WHEREAS, Plaintiffs Sierra Club, Puget Soundkeeper Alliance, RE Sources for Sustainable Communities, Columbia Riverkeeper, Friends of the Columbia Gorge, Spokane Riverkeeper, and Natural Resources Defense Council (collectively, Plaintiffs) filed a complaint in this Court seeking civil penalties, as well as declaratory and injunctive relief, against Defendant BNSF Railway Company (BNSF and collectively with Plaintiffs, the Parties) and others on June 4, 2013, alleging violations of the Clean Water Act, 33 U.S.C. § 1251, *et seq.*, (the CWA or the Act);

1 **WHEREAS**, Plaintiffs filed a separate complaint in the United States District Court for
2 the Eastern District of Washington similarly alleging that BNSF and others had violated the
3 CWA (assigned Civil No. 2:13-cv-00272 (E.D. Wash.) and hereafter referred to as the Eastern
4 District Action);

5 **WHEREAS**, the Eastern District Action was transferred to this Court and assigned Civil
6 No. 2:14-cv-00660, after which it was consolidated with the above-captioned civil action (Dkt.
7 No. 84) (the Litigation);

8 **WHEREAS**, subsequent to consolidation, on May 6, 2015, Plaintiffs filed their third
9 amended complaint (Dkt. No. 113) naming only BNSF as a Defendant;

10 **WHEREAS**, prior to filing their initial complaint, Plaintiffs sent to BNSF and others
11 Notices of Intent to Sue dated April 2, 2013, and May 9, 2013, in which they stated their intent to
12 assert claims for alleged violations of CWA sections 301 and 404, 33 U.S.C. §§ 1311, 1344, and
13 the Rivers and Harbors Act of 1899, 33 U.S.C. § 403, *et seq.*, and further asserted that “[t]he
14 pollutants that the Dischargers have discharged, are discharging, and will continue to discharge
15 include, but are not limited to, coal, coal chunks, coal dust, metabolites or related byproducts of
16 coal, surfactants applied to the coal, coal chunks and coal dust, petcoke, petcoke chunks, petcoke
17 dust, and suppressants”;

18 **WHEREAS**, CWA Section 301(a), 33 U.S.C. § 1311(a), prohibits the unpermitted
19 discharge of any pollutant to waters of the United States;

20 **WHEREAS**, Plaintiffs brought their action against BNSF for alleged CWA violations
21 pursuant to Section 505 of the Act, 33 U.S.C. § 1365;

22 **WHEREAS**, BNSF is a Class I railroad operating in 28 states. BNSF transports freight,
23 including a number of commodities, for a wide range of customers. As a Class I railroad, BNSF
24 operates as a common carrier subject to the jurisdiction of the Surface Transportation Board
25 (STB). BNSF’s status as a common carrier requires the railroad to provide transportation of
26 goods on reasonable request;

1 **WHEREAS**, coal and petroleum coke (petcoke) are among the commodities that BNSF
2 transports for its customers. BNSF transports coal, petcoke, and other commodities in open-top
3 railcars in the State of Washington and several other states;

4 **WHEREAS**, Paragraph 48 of Plaintiffs’ third amended complaint alleges that “[e]ach
5 and every coal train and each and every rail car carrying coal discharges coal pollutants to waters
6 of the United States when traveling adjacent to, over, and in proximity to waters of the United
7 States.” Paragraph 3 of the third amended complaint defines “coal pollutants” to include “coal,
8 coal chunks, coal dust, metabolites or related byproducts of coal, and other substances or
9 materials added to the coal including, but not limited to, surfactants and suppressants, and
10 petroleum coke.” The third amended complaint further alleges that BNSF did not obtain any
11 permit to discharge any pollutants from its railcars;

12 **WHEREAS**, BNSF asserted defenses to the allegations contained in the third amended
13 complaint, expressly denies Plaintiffs’ allegations in their entirety, and admits no liability by
14 entering this Consent Decree;

15 **WHEREAS**, the Parties recognize that this Consent Decree is a settlement of a contested
16 matter;

17 **WHEREAS**, the objective of the Parties in entering this Consent Decree is to resolve the
18 Litigation; and

19 **WHEREAS**, the Parties acknowledge that this Consent Decree has been negotiated by
20 the Parties in good faith and will avoid further litigation, and the Court, in entering this Consent
21 Decree, finds that this Decree is fair, reasonable, and in the public interest.

22 **NOW, THEREFORE**, without the admission of any issue of fact or law except as
23 provided in Section I, and with the consent of the Parties,

24 **IT IS HEREBY ADJUDGED, ORDERED, AND DECREED** as follows:

25 **I. GENERAL PROVISIONS**

26 1. Jurisdiction and Venue. This Court has jurisdiction over the subject matter of this action

1 and the Parties pursuant to 28 U.S.C. § 1331 and 33 U.S.C. § 1365(a). Venue is proper in this
2 judicial district pursuant to section 505(c) of the Act, 33 U.S.C. § 1365(c), because the complaint
3 alleges that discharges in violation of the Act occurred in this judicial district. BNSF does not
4 challenge the terms of this Consent Decree or this Court's jurisdiction to enter and enforce this
5 Consent Decree.

6 2. Retention of Jurisdiction. This Court shall retain jurisdiction for the purposes of issuing
7 such further orders and directions as may be necessary and appropriate for the implementation or
8 modification of this Consent Decree, enforcing compliance with, or resolving disputes regarding
9 the provisions of this Consent Decree.

10 3. Reservation of Rights. The Parties reserve the right to enforce the terms of this Consent
11 Decree and take any action authorized by federal or state law not inconsistent with this Consent
12 Decree.

13 4. Parties Bound. This Consent Decree shall be binding upon Plaintiffs, BNSF, and their
14 respective officers, agents, servants, employees, successors, and assigns.

15 5. Counterparts. This Consent Decree may be signed in counterparts, and such counterpart
16 signature pages shall be given full force and effect.

17 6. DOJ and EPA Review. The Parties recognize that, under 33. U.S.C. § 1365(c)(3), this
18 Consent Decree can be entered only forty-five (45) days after the Attorney General of the United
19 States and the Administrator of the Environmental Protection Agency receive a copy of this
20 proposed Consent Decree. Plaintiffs shall serve copies of the executed Consent Decree upon the
21 Administrator of the United States Environmental Protection Agency, the Attorney General, and
22 the Regional Administrator for EPA Region 10, and Plaintiffs shall provide notice to the Court of
23 the foregoing requirements, as required pursuant to 40 C.F.R. § 135.5.

24 7. Final Judgment. Upon approval and entry of this Consent Decree by the Court, this
25 Consent Decree shall constitute a final, non-appealable judgment of the Court under Rules 54
26

1 and 58 of the Federal Rules of Civil Procedure.

2 **II. CAR COVER STUDY**

3 8. BNSF shall conduct a study to assess the commercial and operational feasibility of car
4 covers for use on open-top coal and petcoke railcars (the Car Cover Study). In its sole
5 discretion, BNSF may conduct this study in cooperation with various interested stakeholders,
6 including without limitation, the Association of American Railroads, its customers, mine
7 operators located in the Powder River Basin, or others invited by BNSF, to the extent they may
8 agree to participate. It is anticipated that the Car Cover Study will occur over a period of
9 approximately two years following entry of this Consent Decree.

10 9. BNSF's obligation to conduct the Car Cover Study under Paragraph 8 shall require BNSF
11 to assess only car cover designs for which a functioning prototype is reasonably available to
12 BNSF within six months of the date of entry of this Consent Decree. As part of the first phase of
13 the Car Cover Study, BNSF shall conduct outreach and solicit participation from car cover
14 manufacturers.

15 10. This Consent Decree shall not be construed to require BNSF to assess any conceptual car
16 cover design or develop any car cover design. As between the Parties, BNSF is exclusively
17 responsible for conducting and overseeing the Car Cover Study, as well as arranging for
18 equipment and personnel.

19 11. Once during each six-month period (January–June and July–December of each year) until
20 the conclusion of the Car Cover Study, BNSF shall provide to Plaintiffs electronic copies of final
21 versions of all reports, technical specifications of car cover designs, testing results, testing
22 procedures, and testing data created for the Car Cover Study. Prior to receiving any such
23 information pursuant to this Paragraph, each Plaintiff organization shall execute a confidentiality
24 agreement acceptable to all study participants, including without limitation any companies whose
25 covers will be assessed. Plaintiffs acknowledge that BNSF reserves the right to redact cover
26 manufacturer-, customer-, mine- and utility-specific information in any document provided

1 pursuant to this Paragraph, and Plaintiffs agree that the redaction of such information shall not be
2 a basis for challenging the adequacy of BNSF's compliance with this Paragraph. In the event
3 that Plaintiffs contend that any information redacted by BNSF prevents Plaintiffs from assessing
4 compliance with this Consent Decree, Plaintiffs may invoke the Dispute Resolution provisions in
5 Section VIII to contest the necessity for such redactions.

6 12. If, in its sole discretion, BNSF determines that any car cover design assessed under
7 Paragraph 8 is commercially and operationally feasible, then BNSF shall undertake good faith
8 efforts to amend the safe harbor provision of BNSF Price List 6041-B (the Coal Loading Rule) to
9 add such car cover design(s) within 90 days of the conclusion of the car cover study. A decision
10 by the STB concluding that any amendment to the Coal Loading Rule proposed pursuant to this
11 Paragraph is unreasonable or otherwise invalid shall not constitute the basis for any allegation
12 that BNSF has not complied with its obligations under this Consent Decree.

13 13. For the purpose of Section II, commercial and operational feasibility of a car cover
14 design shall mean that a particular car cover (a) when used during loading and unloading
15 operations, and in transit, poses no unreasonable risk of property damage or of bodily harm to
16 BNSF employees, employees of any shipper for which BNSF transports coal and/or petcoke,
17 employees of any mine, or to the general public; (b) can be physically attached to existing open-
18 top railcars transported by BNSF without unreasonable modification to such railcars, (c) will
19 function properly and as intended throughout all operational conditions encountered by BNSF
20 trains while in-transit, (d) complies with all applicable regulatory requirements and industry
21 equipment and interchange rules, (e) conforms to all applicable BNSF clearance and operational
22 requirements, (f) requires no unreasonable modifications to equipment or processes used in
23 loading or unloading coal and petcoke into or out of railcars, (g) would not be unreasonably
24 expensive to procure, install, operate, replace, repair, or maintain; and (h) otherwise meets the
25 requirements of the Coal Loading Rule. Notwithstanding any such determination of commercial
26 and operational feasibility by BNSF, mines, shippers, or any other entity providing rail cars

1 cannot be required by BNSF to adopt or accept any specific railcar covers or associated
2 modifications to equipment or loading or unloading processes.

3 14. In the event that BNSF determines in its sole discretion that there exists one or more car
4 cover design that is commercially and operationally feasible under Section II, BNSF shall
5 present the results of the Car Cover Study at the following rail transportation and coal industry
6 meetings or conferences during the two-year period following the conclusion of the Car Cover
7 Study: American Railway Engineering and Maintenance of Way Association meetings, the
8 National Coal Transportation Association meetings, and the Railroad Environmental Conference.
9 BNSF shall provide Plaintiffs with copies of any materials that BNSF uses to present the results
10 of the Car Cover Study at those events.

11 **III. REMOVAL**

12 15. BNSF shall remove significant accumulations of coal and/or petcoke materials in areas
13 on or adjacent to BNSF's right-of-way at each of the locations identified in Appendix A to this
14 Consent Decree, as identified at trial and in designated deposition testimony. BNSF shall
15 complete this initial removal of accumulations of coal and/or petcoke materials from each of
16 these locations no later than one (1) year from entry of this Consent Decree.

17 16. Within thirty (30) business days of completion of the removal of coal and/or petcoke
18 material at each site required by Paragraph 15, BNSF shall notify Plaintiffs that the removal is
19 complete. The notification shall include before and after photographs and other documentation
20 reasonably necessary to demonstrate that BNSF has removed materials consistent with Paragraph
21 15.

22 17. BNSF shall conduct follow-up inspections of each area identified in Appendix A two
23 times during the period of this Consent Decree. BNSF will use good faith efforts to conduct the
24 first inspection between 9–12 months after service of the notification required by Paragraph 16,
25 and the second 9–12 months after the preceding inspection, subject to the availability of
26 sufficient track windows, and taking into consideration weather, safety, and other factors that

1 could restrict the time available to conduct an inspection. Within thirty (30) days of each
2 inspection, BNSF shall provide Plaintiffs with a statement as to whether any significant
3 accumulations of coal and/or petcoke materials require removal consistent with Paragraph 16.

4 18. In the event that BNSF identifies significant accumulations of coal and/or petcoke
5 materials in areas on or adjacent to BNSF's property during either of the two subsequent
6 inspections required by Paragraph 17, BNSF shall remove such materials in the same manner as
7 in Paragraph 15. Within thirty (30) days of completion of any additional removal required by
8 this Paragraph, BNSF shall notify Plaintiffs in writing that this additional removal is complete.
9 The notification shall include photographs or other documentation reasonably necessary to
10 demonstrate that BNSF has complied with its obligations under this Paragraph.

11 19. BNSF's obligation to remove significant accumulations of coal and/or petcoke material
12 under Paragraphs 15 and 18 shall be limited to material on land. BNSF is only required to use
13 non-invasive methods or techniques (e.g., vacuuming) to conduct the removal, and the means
14 and methods to conduct the removal required under Section III are within BNSF's sole
15 discretion. In no event shall BNSF be required under this Consent Decree to conduct any
16 removal activities in any waterway, including any water of the United States, or conduct any
17 ballast or track maintenance activities to remove materials from BNSF track, nor shall BNSF be
18 obligated to remove non-significant accumulations or scattered, individual pieces or fragments of
19 coal and/or petcoke material. BNSF shall not be required through this Consent Decree to remove
20 coal and/or petcoke materials under Paragraphs 15 or 18 from any property in the event that any
21 property owner declines to allow BNSF or its contractors access to their property under
22 reasonable conditions.

23 20. In the event that Plaintiffs disagree with any determination that (a) BNSF has completed
24 removal of significant accumulations of coal and/or petcoke material at any location under
25 Paragraphs 15 and 18, (b) any subsequent inspection pursuant to Paragraph 17 identified no new
26 and significant accumulations of coal and/or petcoke material that require removal, or (c) BNSF

1 has completed any subsequent removal of significant accumulations of coal and/or petcoke
2 material required under Paragraph 18, Plaintiffs may invoke the Dispute Resolution procedures
3 in Section VIII.

4 **IV. SUPPLEMENTAL ENVIRONMENTAL PROJECTS**

5 21. Within 30 days of the date this Consent Decree is approved by the Court, BNSF shall pay
6 \$1,000,000 to The Rose Foundation for Communities and the Environment for projects to
7 improve water quality or habitat in the State of Washington (and, to the extent they may improve
8 habitat or water quality of the Columbia River, in the State of Oregon). (*See* Dkt. No. 374-1.)
9 Such payment shall be made by check payable and mailed to The Rose Foundation for
10 Communities and the Environment, Attention: Tim Little, 1970 Broadway, Suite 600, Oakland,
11 California 94612, and shall bear the notation “Sierra Club, et al. v. BNSF Railway Co., Clean
12 Water Act Settlement,” with a copy provided to Plaintiffs at the time payment is made.

13 **V. RELEASE AND COVENANT NOT TO SUE**

14 22. Plaintiffs release BNSF for all claims that were or could have been brought in this
15 litigation.

16 23. Plaintiffs covenant not to sue BNSF system-wide under the Clean Water Act or
17 analogous state law or any common law theory on the theory of material leaving open-top rail
18 cars and entering waters of the United States or waters of any state for any events or occurrences
19 arising over the next five (5) years.

20 24. Any information provided by BNSF to Plaintiffs pursuant to this Consent Decree shall
21 not be admissible in any proceeding against BNSF or any entity that meaningfully participates in
22 the Car Cover Study (as that term is defined in Section II). Notwithstanding the previous
23 sentence, information provided by BNSF to Plaintiffs pursuant to this Consent Decree may be
24 used in proceedings to enforce the terms of this Consent Decree.

25 25. If the Consent Decree is terminated prior to five (5) years from the date of entry of the
26 Consent Decree, the provisions of Paragraphs 23 and 24 shall survive for the remainder of the

1 five (5) year term of the covenant not to sue.

2 26. The Parties agree that, as of the date of the entry of this Consent Decree, litigation is not
3 “reasonably foreseeable” concerning the matters described in the third amended complaint. To
4 the extent that any Party previously implemented a litigation hold to preserve documents or
5 electronically stored information related to the Litigation, the Party is no longer required to
6 maintain such litigation hold. Nothing in this paragraph relieves any Party of any other
7 obligations imposed by this Consent Decree or of the obligation to implement a litigation hold
8 concerning the rights, obligations, and duties set forth in this Consent Decree.

9 **VI. ATTORNEY FEES AND COSTS**

10 27. By entering into this Consent Decree, BNSF in no way acknowledges or concedes that
11 Plaintiffs are entitled to recover any costs of litigation (including attorney fees or expert witness
12 fees).

13 28. Notwithstanding Local Civil Rule 54, within sixty (60) days of entry of this Consent
14 Decree, Plaintiffs may file with the Court a petition under 33 U.S.C. § 1365(d) seeking an award
15 of attorney fees and litigation costs (including but not limited to expert witnesses’ fees and
16 costs). BNSF reserves the right to contest such a petition.

17 **VII. FORCE MAJEURE AND EXCUSABLE DELAYS**

18 29. BNSF shall perform all requirements under this Consent Decree in the manner and within
19 the time limits established herein, unless performance is delayed or prevented by Force Majeure
20 or Excusable Delay, which are defined for purposes of this Consent Decree as events or
21 circumstances arising from causes not reasonably foreseeable and beyond the control of BNSF,
22 or any entity controlled by BNSF or BNSF’s contractors, which delay or prevent performance of
23 any obligation under this Consent Decree despite due diligence and best efforts to fulfill the
24 obligation. Events and circumstances beyond the control of BNSF may include, without
25 limitation, earthquake, flood, hurricane, severe weather or other acts of God, war, riot, fire,
26 injunction, labor stoppage, freight embargo, material shortages, and compliance with any law,

1 rule, or decree of any governmental body, either now existing or hereafter created, that conflicts
2 with the requirements or obligations of this Consent Decree. Such events and circumstances do
3 not include normal inclement weather, financial inability to complete the work, increased cost of
4 performance, changes in BNSF's business or economic circumstances, or the failure to obtain
5 federal, state, or local permits, authorizations and approvals, unless BNSF has made timely and
6 complete application for such permits, authorizations, and approvals.

7 30. BNSF shall notify the Plaintiffs in writing within ten (10) business days after becoming
8 aware of an event or circumstance that BNSF believes constitutes Force Majeure or Excusable
9 Delay that may prevent or delay performance of an obligation under this Consent Decree.
10 BNSF's notification shall describe in detail the anticipated length of the delay, the precise cause
11 or causes of the delay, the measures taken and to be taken by BNSF to prevent or minimize the
12 delay, and a timetable by which those measures will be implemented. BNSF shall adopt all
13 reasonable measures to avoid or minimize any such delay. BNSF shall include in the notification
14 a proposed extension of the deadline associated with any obligation under this Consent Decree
15 whose performance may be prevented or delayed by unforeseeable events or circumstances
16 beyond BNSF's reasonable control.

17 31. Unless BNSF's notice contains no reasonable basis to conclude that the circumstance,
18 event, or anticipated event identified in the notice has caused or will cause a delay that
19 constitutes a Force Majeure or Excusable Delay, the time for performance shall be extended by
20 an appropriate period substantially equal to the necessary delay.

21 **VIII. DISPUTE RESOLUTION**

22 32. The Dispute Resolution procedures of this Section shall be the exclusive mechanism for
23 the parties to raise and resolve disputes arising under or with respect to this Consent Decree
24 (Covered Dispute).

25 33. A Covered Dispute shall be considered to have arisen when one Party sends the other
26 Part(ies) a written Notice of Dispute.

34. Any Covered Dispute shall, in the first instance, be the subject of informal negotiations between the Parties in an attempt to resolve the dispute in good faith and in an expeditious manner. The Parties shall have thirty (30) days following receipt of a Notice of Dispute to reach agreement.

35. If the Parties cannot reach agreement on the dispute during the 30-day period provided under Paragraph 33, Plaintiffs and BNSF shall jointly file a motion with the Court requesting resolution of the Covered Dispute. Plaintiffs and BNSF shall append to that motion written statements not to exceed five (5) single-spaced pages (excluding attachments or exhibits) setting forth their respective proposed resolutions of the dispute.

36. The Parties shall comply with any written agreement reached as a result of informal negotiations conducted during the 30-day period provided for by Paragraph 33, including any extension of time to comply with a schedule or deadline required by this Consent Decree, so long as the agreement does not constitute a material change to any terms of this Consent Decree. Section X of this Consent Decree shall govern the process for any proposed material changes to the terms of this Consent Decree.

IX. NOTICES

37. Unless otherwise specified herein, any notification, submission, statement of position, or communication required by this Consent Decree shall be made electronically, unless otherwise requested, and addressed as follows:

As to Plaintiffs: Charles M. Tebbutt, charlie@tebbuttlaw.com
Daniel C. Snyder, dan@tebbuttlaw.com
David Pettit, dpettit@nrdc.org
Jessica Yarnall Loarie,
jessica.yarnall@sierraclub.org

As to BNSF: Timothy M. Sullivan, tsullivan@bdlaw.com
Dava Kaitala, Dava.Kaitala@BNSF.com
Brooke Gaede, Brooke.Gaede@BNSF.com

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1 38. Any Party may, by written notice to all other Parties, change its designated notice
2 recipient or notice address provided above.

3 39. Notices submitted pursuant to this Section shall be deemed submitted upon electronic
4 transmission, unless otherwise provided in this Consent Decree or by mutual agreement of the
5 Parties in writing.

6 **X. MODIFICATION**

7 40. This Consent Decree contains the entire agreement of the Parties and shall not be
8 modified by any prior oral or written agreement, representation, or understanding. Any non-
9 material modification of this Consent Decree after entry may be made without approval of the
10 Court but must be in writing and approved by the Parties.

11 41. Any material modification to any term of this Consent Decree shall be effective only
12 upon approval by the Court.

13 42. A Party shall not petition the Court for modification without having first made a good
14 faith effort to reach agreement with the other Part(ies) on such modification. Notwithstanding
15 the above, any Party may, after having made such effort, petition the Court for a modification of
16 this Consent Decree and the Court shall rule on any such petition pursuant to law in effect at
17 such time. Any ruling by the Court on a petition for modification may be appealed by a Party in
18 accordance with law.

19 **XI. TERMINATION**

20 43. Upon completion of all of the work required by this Consent Decree, BNSF shall notify
21 Plaintiffs in writing that it has fully satisfied all Consent Decree requirements. This notification
22 shall indicate the case name and civil action number.

23 44. Should Plaintiffs disagree with BNSF's notification under Paragraph 43, Plaintiffs may
24 invoke Dispute Resolution pursuant to Section VIII within ten (10) days of receipt of the
25
26

1 certification.

2 45. Following the notification that BNSF has completed all work required under the Consent
3 Decree, either Party, or the Parties jointly, may move this Court to terminate this Consent
4 Decree.

5 IT IS SO ORDERED.

6 DATED this 2nd day of May 2017.

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A handwritten signature in black ink, reading "John C. Coughenour", is written over a horizontal line. The signature is cursive and includes a checkmark at the end.

John C. Coughenour
UNITED STATES DISTRICT JUDGE

APPENDIX A
Removal Sites

Description	Segment of BNSF Right Of Way	
	Start	End
Rail Bridge at Drano Lake and Drano Lake Parking Area	45.710015 N, 121.639022 W	45°42'41.21"N 121°38'58.01"W
Confluence of White Salmon and Columbia Rivers	45°43'42.30"N 121°31'15.54"W	45.729216 N 121.524720 W
Confluence of Rock Creek and Columbia River	45°41'23.24"N 121°53'15.21"W	45°41'20.77"N 121°53'19.90"W
Horsethief Lake Site – Area in vicinity of public access to boat ramp and along the top of the causeway	45.646089 N 121.096466 W	45.639152 N 121.104766 W
Causeway near Murdock	45.658225 N 121.198597 W	45.658771 N 121.198875 W

BEFORE THE UNITED STATES DEPARTMENT OF ENERGY

Federal Power Act Section 202(c))
Emergency Order: Transalta)
Centralia Generation LLC)
_____)

Order No. 202-25-11

Motion to Intervene, Motion for Clarification, and Requests for Rehearing and Stay
of Sierra Club, NW Energy Coalition, Washington Conservation Action, Climate
Solutions, Public Citizen, and Environmental Defense Fund
(collectively, “Public Interest Organizations” or “PIOs”)

Exhibit 1-137-1:
WECC 2024 Western Assessment of Resource Adequacy



WESTERN ASSESSMENT OF RESOURCE ADEQUACY 2024



The pace of change is increasing the risks to reliability across North America. The supply of electricity is not growing fast enough to keep up with demand growth. What was once a simple problem of supply and demand has become complicated by rapid change and increasing variability. Unless we prioritize reliability as the resource mix evolves and becomes more variable, we are at risk for serious and more frequent disruptions. The West must move quickly and more decisively to ensure resource adequacy over the next decade.

WECC's annual Western Assessment of Resource Adequacy (Western Assessment) examines resource-adequacy-related risks concerning the reliability of the Western Interconnection over the next 10 years. Through an energy-based probabilistic approach, WECC looks at the risks throughout the interconnection and five subregions. This work is meant to help stakeholders target specific areas and topics for deeper evaluation and mitigation.

The forecast rate of demand growth over the next decade is double what was forecast just two years ago.

Current resource plans overcast staggering demand growth over the next decade. For the Western interconnection, annual demand is forecast to grow 20.4%, from 942 TWh in 2025, to 1,134 TWh in 2034. That growth rate is more than double the 9.6% growth forecast in resource plans filed in 2022, and over our times the historical growth rate of 4.5% between 2013 and 2022.

New large loads create reliability challenges that must be addressed immediately.

A major driver of the increase in demand over the next 10 years is the expansion of large loads like data centers, manufacturing facilities, and cryptocurrency mining operations. These loads consume immense amounts of energy, can be constructed quickly, have different consumption patterns, and require changes or additions to infrastructure. In some cases, large loads require a steady supply of power at all times, while in other cases, their demand can fluctuate, creating a need for large ramping capability. There can be challenges with the way large loads behave during grid disturbances, including their ride-through capability. According to current plans, the expected large-load growth are greater in the next three to five years; however, more large loads will likely be added to our forecasts.

To meet growing demand, entities plan to build unprecedented amounts of new resources over the next decade. Never has generation been built in the West at the rate called for in current resource plans. These plans could be unattainable given past struggles to build planned resources on time.

Current resource plans include 172 GW of new generation resources to be built in the next decade. This is more than double the generation capacity added in the last 10 years and will require an exceptional effort to carry out. Between 2014 and 2023, entities added 74 GW of new generation. Demand growth and resource requirements are driving up the number of new resources needed in the next 10 years.

If demand grows as expected and industry experiences delays and cancellations in building new resources over the next decade, the West will face potentially severe resource adequacy challenges.

Over the last six years, only 76% of planned resource additions came online in the year scheduled, and in 2023, that number was 53%. Resource margins are shrinking, leaving less buffer for cancelled and delayed projects. The resource build-out over the next 10 years mimics the last five years, by 2034, the West will have hundreds of hours each year when demand is at risk.

Variability will continue to increase, exacerbating the risk of having inadequate dispatchable energy.

Over 85% of the 172 GW of planned resource additions in the next decade are variable resources (wind and solar), battery storage, or a hybrid. The addition of so many energy-limited resources, along with decreases in baseload resources and changes in load patterns, is creating more variability in the system. This increases uncertainty as to when and how much energy is needed and available. As uncertainty increases, risk increases.

Is the current resource planning structure adequate?

Entity resource plans seem overly optimistic. While planning entities provide specific information about the resources they plan to add in the next one to five years, in many cases, they provide generic, non-specific "placeholder" resources in long-term planning five to ten years out. Traditional resource planning and review practices do not have a mechanism to ensure that resources will actually be built.

Load Growth

Over at least the last decade, the Western Interconnection has experienced fairly steady and predictable load growth. This has changed. Large loads like data centers, manufacturing facilities, and cryptocurrency mining operations, as well as large-scale electrification, add substantial demand to the system in a very short time.



Load Changes

Annual Demand

Demand for electricity across the Western interconnection is expected to grow 20.4% over the next 10 years. That is more than double the 9.6% growth projected in resource plans filed in 2022. Much of this increase is attributed to plans for large load facilities across many areas in the West.

i The greatest area of load growth is the Desert Southwest (DSW), which is projecting almost 35% load growth over the next decade.

The issue is not confined to the 10-year future. Large-load growth occurs every year over the next decade, with greater effect in the next few years. For example, in 2023, the load projections for the NW-Central subregion showed a change from 128 TWh in 2025 to 139 TWh in 2034. This year's projections show an alarming increase in both the near and long-term: from 167 TWh in 2025 to 190 TWh in 2034. Data centers, manufacturing facilities, and to a lesser extent electrification, are driving this increase.

Peak Demand

Peak demand in the Western interconnection occurs in the summer. Based on plans submitted by the BAs, the expected peak demand for the Western interconnection will grow from 164 GW in 2025 to 193 GW in 2034, an increase of 17.2%. This represents a slight increase from 2023 resource plans.

According to 2024 resource plans, the projected peak **i** is slightly lower for NW-Central than it was in 2023 plans, while it is slightly higher for the DSW subregion. For the California-Mexico (CAMX) subregion, the peak reflected in 2024 plans is also slightly lower each year until 2034, when the projected peak demand is identical (66 GW) to the projections made in 2023. The projections for NW-Northern have not changed much between 2023 and 2024 resource plans, while the 2024 projections are slightly lower for the NW-Northern subregion.

In addition, although the peak demand in the Western interconnection overall occurs in the summer, many entities see their peak demand in the winter. As the climate changes, some of these entities are becoming dual-peaking. This introduces challenges to resource planning for entities that have historically seen one predominant peak.

See [the appendix](#) for more information about the drivers of load growth.

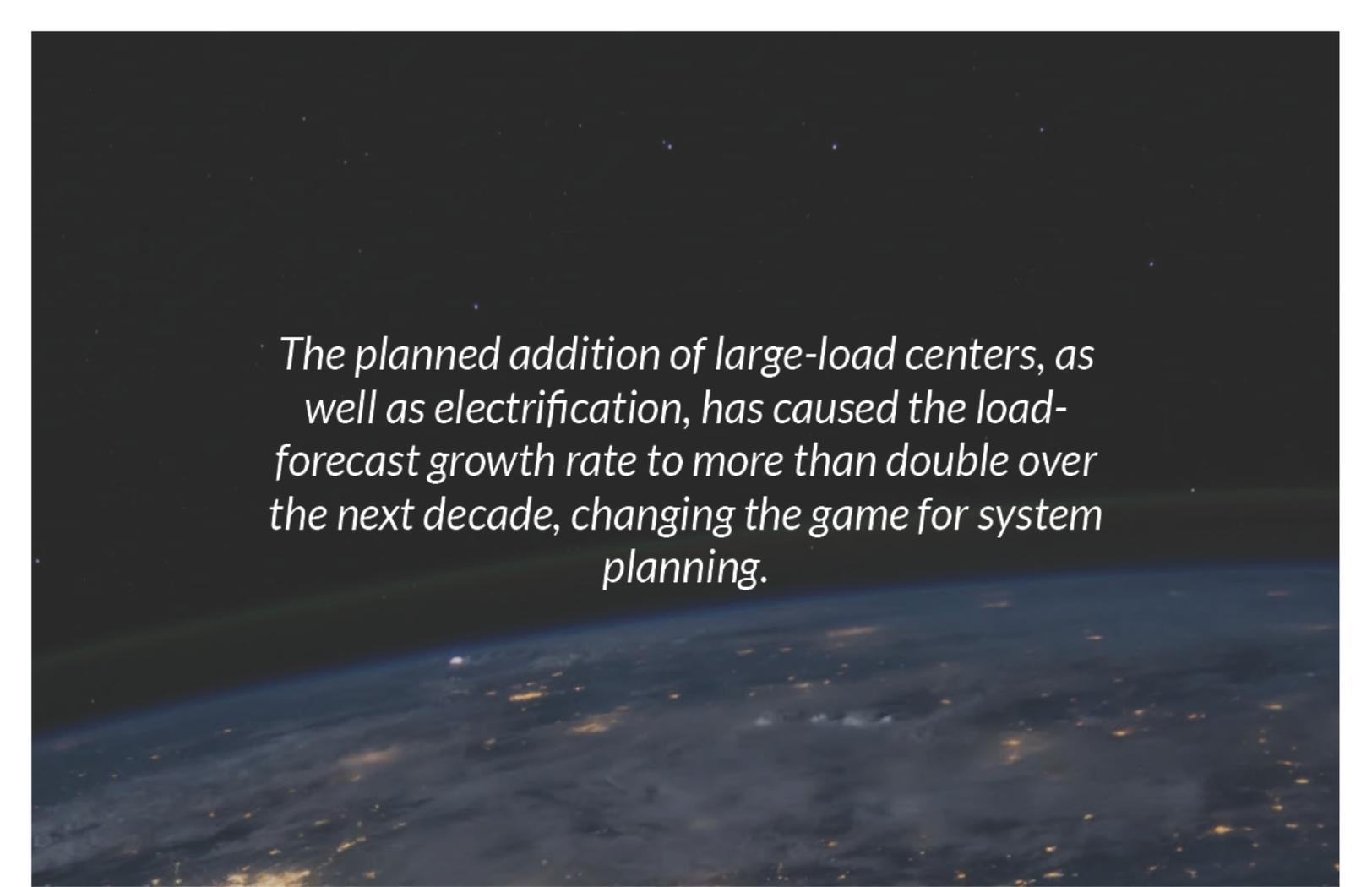
BEFORE THE UNITED STATES DEPARTMENT OF ENERGY

Federal Power Act Section 202(c))
Emergency Order: Transalta)
Centralia Generation LLC)
_____)

Order No. 202-25-11

Motion to Intervene, Motion for Clarification, and Requests for Rehearing and Stay
of Sierra Club, NW Energy Coalition, Washington Conservation Action, Climate
Solutions, Public Citizen, and Environmental Defense Fund
(collectively, “Public Interest Organizations” or “PIOs”)

Exhibit 1-137-2:
WECC 2024 Western Assessment of Resource Adequacy



The planned addition of large-load centers, as well as electrification, has caused the load-forecast growth rate to more than double over the next decade, changing the game for system planning.

Impact of Large Loads

Large loads like data centers, manufacturing facilities, and cryptocurrency mining operations add a large amount of concentrated load to the system. In some cases, new large loads inundate a service area, overwhelming existing infrastructure. Some new large-load consumption patterns are different than traditional load patterns, requiring around-the-clock energy. Others have a significant amount of variability.

Integrating large loads often requires changes or additions to power systems infrastructure. Large-load facilities can be built relatively quickly, as fast as 18 months, while building new generation resources and transmission infrastructure can take years. In addition, the question of cost allocation can complicate the construction of new infrastructure.

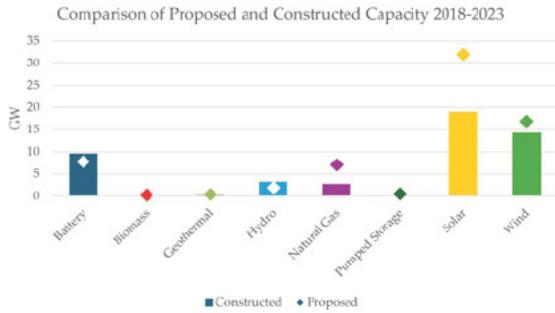
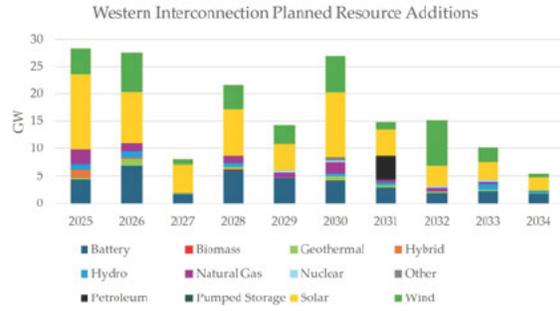
Resource Changes

Resource plans for the next 10 years include large numbers of new generation resource projects. Never has generation been built in the West at the rate called for in many current resource plans. Delays or cancellation of these projects can put resource adequacy and reliability at risk.

Planned Additions

Planned Resource Additions

Over the next decade, entities in the Western interconnection plan to add more than 172 GW of new generation capacity—almost 145 GW in battery storage, solar, and wind, according to resource plans filed in 2024. That is up from 121 GW of resources in 2023 10-year plans and is more than double the amount of generating capacity added in the last 10 years (73.7 GW). The existing generating capacity in the Western interconnection as of 2023 was 299.5 GW.



Historical Resource Additions

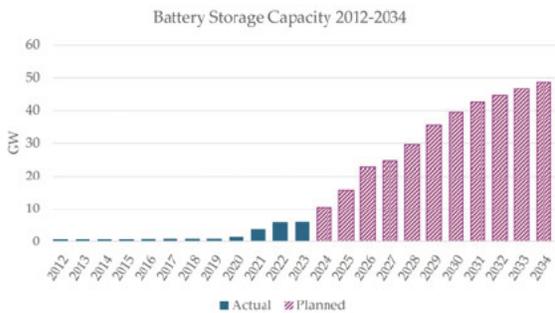
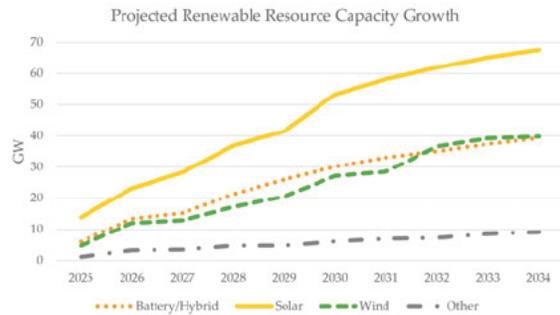
Between 2018 and 2023, approximately 76% of the proposed resource additions came online in the year scheduled. In 2023, only 53% of the new generation resources scheduled to come online that year actually came online; the rest were delayed or cancelled.

Solar

Entities plan to add nearly 68 GW of solar capacity over the next decade, more than any other resource. This will almost triple the amount of solar capacity that was in operation in 2023 (35 GW).

Wind

Wind capacity is projected to grow by nearly 40 GW from now until 2034. This increase will more than double the 37 GW in operation in 2023.



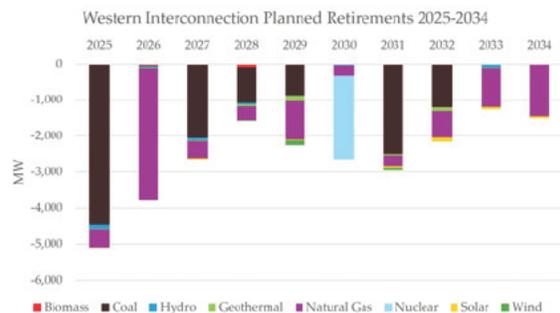
Battery Storage

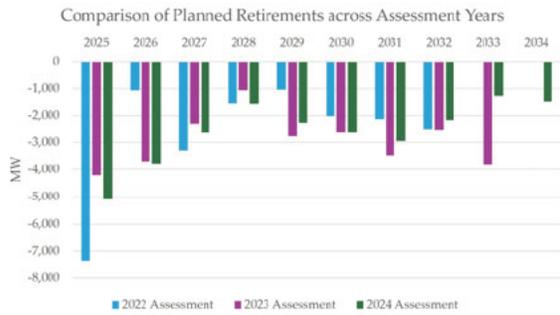
According to 2024 resource plans, battery storage will grow by more than 37 GW by 2034. In 2022, resource plans projected a total of 23 GW of storage by 2032, and that was 14 times more than what was operational in 2021 (1.6 GW). As of 2023, there was more than 10 GW of energy storage (battery and other forms of storage) installed in the Western interconnection, primarily batteries but also pumped hydro. One major driver of new storage is the expansion of the investment tax credit (ITC) for storage-solar projects and creation of a 30% TC for standalone storage.

Retirements

Planned Retirements

Entities plan to retire 25.85 GW of generation over the next 10 years. This is down slightly from resource plans filed in 2023, in which entities planned to retire 27 GW over the next decade, but is up considerably over the last 10 years. Retirements over the coming decade varied slightly compared to resource plans filed a year ago, but did not vary as much compared to the retirement delays we saw in 2023 resource plans. In 2025, for example, current resource plans call for 5.1 GW to be retired, up from 4.2 GW in 2023 resource plans (but still down considerably from 2022 plans, when 7.4 GW were slated for retirement in 2025). Current plans also show a significant change in retirements in 2033. A year ago, 3.8 GW was set to be retired in 2033; in 2024, that has dropped to 1.3 GW.





Changes in Planned Retirements

Most of these planned retirements (more than 24 GW) are baseload generation, such as coal, natural gas, and nuclear. In 2025, more than 4.4 GW of coal is set for retirement, and more than 3.6 GW of gas is slated for retirement in 2026.

In December 2023, California regulators voted to allow Diablo Canyon nuclear plant to remain open an additional five years—until 2030; it had been set to close in 2025. Diablo Canyon's two reactors have a combined generating capacity of more than 2.2 GW and accounted for 7% of California's in-state electricity generation in 2023.

Scenario Analysis

Challenges like supply chain issues, geopolitical turbulence, a shortage of skilled workers, siting issues, and the increasing interconnection queue can disrupt planned resources, which puts the interconnection at risk for resource shortfalls.

Scenario Analysis

Historically, the number of new resources that were built according to plan and on time has varied. In 2023, only 53% of planned resources were successfully built and brought online as scheduled. In other years, the success rate was better. Between 2018 and 2023, only 76% of planned resource additions came online as scheduled.

The pass is a model for building planned resources over the next 10 years, resource adequacy will be at risk. To examine this, WECC evaluated our resource build-out scenarios:

- All planned resources are built on time
- 95% of planned resources are built on time
- 85% of planned resources are built on time
- 55% of planned resources are built on time

All Additions Scenario

If all planned additions are completed and operational on time, there are 89 demand-at-risk hours over the next decade.

95% Scenario

In this scenario, there is demand at risk in every year except 2024 and 2026. In 2025, there are three hours of demand at risk, all in the NW-Northern subregion. By 2034, that number increases to 91 demand-at-risk hours across the NW-Northern and NW-Northern subregions.

- NW-Northern: Most of the demand at risk is in this subregion, including all three hours in 2025 and 82 hours in 2034.
- NW-Northern: A total of 46 hours of demand at risk over the next 10 years.

85% Scenario

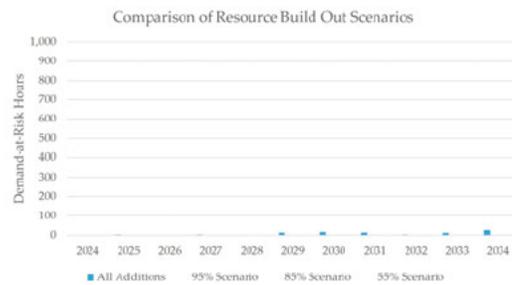
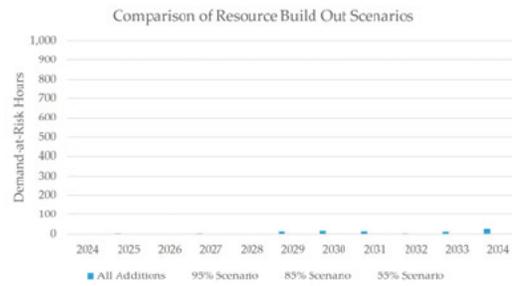
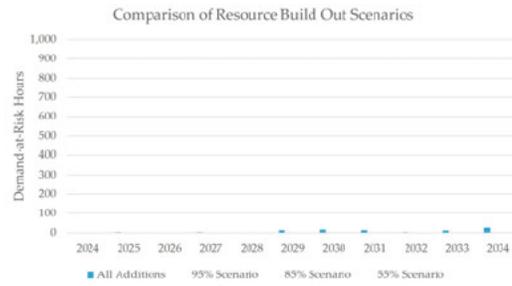
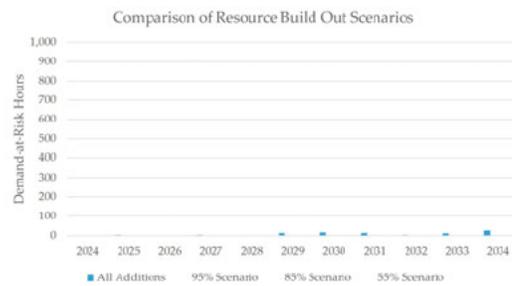
If only 85% of resources are built on time, demand at risk begins to increase significantly in 2029, when 36 hours are at risk. This increases nearly every year until 2034, when 129 hours of demand at risk. The vast majority of the demand at risk is in the NW-Northern subregion.

- NW-Northern: There is minimal impact in the short-term—a total of 16 hours of demand at risk through 2028. That increases nearly every year through the end of the 10-year period, peaking at 87 demand-at-risk hours in 2034.
- NW-Central: Demand-at-risk hours appear in 2031, with a total of 16 hours, and increase to 41 hours in 2034.

55% Scenario

In this scenario, there are a total of eight demand-at-risk hours in 2025 growing to 952 hours by 2034.

- CAMX: CAMX relies heavily on imports, resulting in no demand-at-risk hours in this scenario.
- DSW: Demand at risk starting in 2028 (one hour) and increases to 69 hours in 2034.
- NW-Northern: Demand at risk every year over the 10-year period, starting with 8 hours in 2025 and climbing to 787 hours in 2034.
- NW-Northern: Demand at risk every year starting in 2029 with two hours and increasing to 31 hours in 2034.
- NW-Central: Demand at risk after 2031, with a maximum of 65 hours in 2034.



See [the appendix](#) for information on how demand risk was calculated.

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Exhibit 1-137-3:
WECC 2024 Western Assessment of Resource Adequacy

If significant numbers of new resources are delayed or cancelled, much of the Western Interconnection may not be resource adequate over the next decade.

Risks to Planned Resource Additions



Supply Chain Disruptions

[Supply chain issues](#) have surfaced during the pandemic in 2020 and continue to affect the industry, particularly the construction of new projects and the interconnection of new generating resources. A recent [survey](#) found that supply chain issues remain a significant problem in 2024.



Interconnection Queue

The interconnection queue nationwide grew more than 30% in 2023 and has increased eightfold in the [last decade](#). The planned additions over the next 10 years will exacerbate this issue, although [FERC Order 2023](#) calls for reforms to reduce the backlog and address uncertainty in the interconnection process.



Siting Delays

There has been increasing resistance to building new energy facilities, particularly wind, solar, and battery projects. These projects have encountered opposition in at least 45 states, according to a recent [report](#), which found that local opposition to new energy facilities is widespread and growing.



Increased Costs

[Increased costs](#) of materials for new wind and solar construction, transmission expansion, and replacement of plant equipment have caused project delays and maintenance errors. The [rise](#) in interest rates in recent years has also substantially increased the cost of capital for all energy projects.

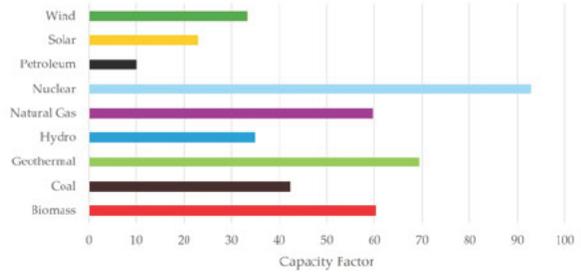
Variability

The addition of 107 GW of variable resources and retirement of 26 GW of generation, most of which is coal and natural gas, will increase system variability in the next 10 years. These changes increase risk and create challenges in system planning and operation.

Replacing Generation Resources

Over the next decade, the addition of 107 GW of wind, solar, and battery hybrid generation must cover load increases and replace 26 GW of retired resources, of which almost 25 GW are coal, natural gas, and nuclear resources. The capacity factor of variable resources is lower than baseload resources like coal, natural gas, and nuclear. Replacing the 25 GW of retired baseload resources will require much more installed capacity of wind, solar, and storage resources.

2023 Capacity Factors by Fuel Type (Source: EIA)



Increases in variable resources, decreases in baseload resources, and changes in load patterns are driving an increase in variability across the system. Variability creates uncertainty, and uncertainty creates risk.

Traditionally, resource planning has been based on capacity and focused on ensuring there is enough capacity to meet peak demand. This has been based on the assumption that resources are available as expected (accounting for forced outages). However, with increasing variability, looking only at resource capacity is no longer enough. An examination of energy availability is crucial to ensuring the West has enough energy to meet demand all hours of the year.

WECC receives nameplate capacity and historical generation information from Balancing Authorities. From this, WECC calculates the expected energy output of each resource and aggregates the number of the expected energy of the entire resource fleet. The expected energy is lower than the nameplate capacity because resources do not produce at full capacity all the time. An increase in energy-limited resources widens the gap.

As the variability of the resource mix increases, so does the range of possible generation output at any given time. Depending on system and resource fleet conditions, more or less than the expected energy may be available. Instances when less energy is available can create risk, particularly when load is high. This can be the case during extreme weather events that cause simultaneous load increases and reductions in wind and solar output.

To address this, WECC calculates the probability distributions for each resource in the fleet. These distributions show the probability that a resource will generate at a level other than the expected level. The probabilities form a band of variability where the most likely output is in the middle and the least likely outputs are at the edge. The wider the band, the higher the variability on the system and the more possibilities planners and operators need to account for.

The size of the variability band increases over the next decade, indicating that while the West is building large amounts of new resources, the overall variability of the resource fleet is increasing.

Resource Planning

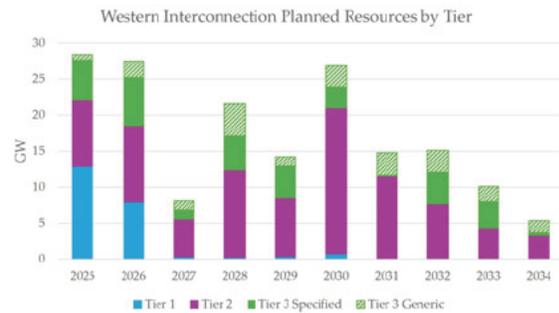
Existing resource planning practices allow a lack of specificity about the resources entities need to meet demand, particularly in the long term. The resulting uncertainty about future resource additions puts the resource adequacy of the interconnection at risk.

Planning Resource Additions

Planning entities provide WECC with information about new resources they will need to meet demand over the next 10 years. In their near-term, this information includes specific resource additions over the next one to five years. Typically, entities have a higher level of certainty about these resources because they are in some stage of development. (Tier 1 or Tier 2 resources) Entities also include resources that are not yet under development (Tier 3 resources). When Tier 3 resources are included in near-term plans, they often reflect specific resources that entities can add relatively quickly (Tier 3 Specified). When they are included in later years of a resource plan, they are usually generic placeholder resources (Tier 3 Generic). In these cases, there is less certainty about whether the resource will be built. These resources often lack unique characteristics and may be grouped together instead of listed as individual plans or units.

In the past, when there was steady, predictable load growth and a generation surplus, entities could grossly estimate the resources needed 5 to 10 years in the future and hone those plans later. There was enough surplus generation in the interconnection to cover situations where new resources were built late, cancelled, undersized, or when demand increased unexpectedly. However, given the level of change in the West, the large amount of new generation needed over the next decade, and obstacles to building it, delaying long-term resource decisions may put the resource adequacy of the interconnection at risk. This leaves the industry in a difficult position, because it needs more clarity about the future in a world that is becoming increasingly hard to predict. Resource plans that include large amounts of Tier 3 resources likely overestimate the ability to build generation.

Recently, there have been efforts to conduct longer-term planning on a 20-year horizon to meet needs identified by industry and the Federal Energy Regulatory Commission (FERC). In its [Order 1920](#), FERC requires 20-year transmission planning to ensure the industry is preparing for the long-term future of the electric grid. While planning further out may allow the industry to see potential risks sooner, that work is only as good as the information on which it relies. Planning entities struggle to specify new resources in their 10-year resource plans; hypothesizing a resource mix in the 20-year future to study transmission may be incredibly challenging. To be successful, requirements for 20-year—and longer—planning horizons will spur advances in long-term resource planning.



Resource Adequacy Programs

Resource adequacy programs can help manage resource adequacy by making advance operating efficiencies and diversity across the entities in their portfolios. The California SO's reliability requirements program sets resource adequacy requirements for load-serving entities in the SO. The CA SO program has functioned for years and is integrated with its other functions.

The Western Resource Adequacy Program (WRAP) is a developing program with the goal of providing a region-wide, collaborative approach to resource adequacy. The WRAP is administered through a FERC-approved arrangement that allows participants to phase into full, binding participation, including being subject to non-compliance charges for failing to meet the requirements of the program. Entities launching the binding program have encountered several obstacles. In April 2024, WRAP participants indicated they lacked critical mass to be able to move to the binding phase by Summer 2026. Participants cited challenges that include procuring sufficient firm capacity to meet program requirements and avoid charges. In an effort to move toward a binding program by Summer 2027, WRAP will file arrangement changes with FERC that include a temporary reduction of non-compliance charges so participants can fully participate in the program and have access to WRAP capacity reserves on the worst operating days.

To commit to a resource adequacy program, entities must know what resources they will have over. Resource plans that contain large numbers of Tier 2 and Tier 3 resources provide little certainty about future resource capacity, meaning entities cannot be confident in what resources they will have over. This may create reluctance and, ultimately, delays on the part of entities in joining these programs.

Additional Considerations

Resource adequacy is interwoven with other issues such as transmission planning, policy making, and shifts associated with a changing climate. Each introduces significant risks to reliability.

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Exhibit 1-137-4:
WECC 2024 Western Assessment of Resource Adequacy

Transmission Considerations

The modeling tool WECC uses for the Western Assessment considers electric reliability between entities when one has a short fall and the other has sufficient available energy to meet the shortfall.

The analysis in his report differs from that in the [Western Regional Transfer Capability Study \(TRACS\)](#), an assessment on which WECC collaborated with NERC and the other Regional Entities to gauge the ability of transfers between regions in the U.S. and Canada, and to determine prudent additions of transfer capability to support reliability. Congress mandated the TRACS in the Fiscal Responsibility Act of 2023. The ability of transfers between regions could be a key to maintaining reliability amid the changing resource mix and as climate change brings more extreme weather.



Imports

WECC's analysis includes imports, or the ability or entities to transfer electricity between subregions. Studying the ability to import electricity is important because the Western interconnection was designed to take advantage of its geographic and resource diversity. Imports are critical to reliability, particularly as the variability of the system increases. However, under some extreme conditions, either the resources or the transmission capacity may be reduced or eliminated altogether. Looking at different import scenarios helps WECC better understand and help in play between resource adequacy and transmission availability.

The analysis shows that every subregion relies on the ability to import or transfer electricity, although the impact is much less significant in the DSW and CAMX subregions. The NW-Northern and NW-Northern subregions were the most affected in terms of demand risk, with more than 1,900 hours of demand risk every year.

For more information about how transfer capability was handled in this assessment, see [the appendix](#).

Energy Policy

Federal and state policies are driving changes in the electric system. Several states in the West have ambitious clean energy goals, for example, and federal legislation has spurred unprecedented amounts of funding of the energy sector.

Together with the Bipartisan Infrastructure Law (BIL), the Inflation Reduction Act (IRA) has accelerated the transformation of the electric grid by making funding available for the development and deployment of clean energy manufacturing facilities and research in the form of tax credits, loans, investments, and other programs.

Batteries and electric vehicles have drawn the most investments—since the IRA's passage, \$114 billion in new projects in those industries have been announced, a [recent analysis](#) indicates. Also, according to the [White House](#), the U.S. was projected to build more new electric generation capacity in 2024 than has been built in the last two decades, with 96% of that being renewable energy.

At the state level, Washington's [Clean Energy Transformation Act](#) requires utilities to supply the state's customers with electricity that is 100% renewable or free of greenhouse gas emissions by 2045. California also has a goal of 100% of its electricity coming from renewable energy and zero-carbon resources by 2045. And Oregon's [Clean Energy Targets](#) bill requires the state's electricity providers to significantly reduce the greenhouse gas emissions levels of the electricity sold in the state: 80% below baseline emissions levels by 2030, 90% below baseline emissions levels by 2035, and emissions-free by 2040.



Weather

Extreme weather events are increasing in frequency and intensity, in some cases becoming more extreme, unpredictable, widespread, and longer-lasting. These events affect generation, particularly as the resource mix and the demand for electricity becomes more variable. As

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Exhibit 1-137-5:
WECC 2024 Western Assessment of Resource Adequacy

weather becomes more extreme, what used to be considered extreme is becoming more normal. This is changing how we manage the system.

FERC has approved several new weather-related standards in recent years, to help close reliability gaps, and utilities and planning entities continue to adapt their projections to account for climate change.

Through its 10-year and 20-year assessments, WECC examines the impact of severe weather on resource adequacy by assessing how the subregions in the Western interconnection rely on imports to remain resource adequate during even the highest high demand or electricity. As the climate changes and events become more widespread, it is important to understand how to use the diversity of the interconnection and its evolving resource mix to ensure resource adequacy.

