

Analysis of Microcystin in Resident Fish Tissues in the Vicinity of the Klamath Hydroelectric Project: Preliminary 2008 Results

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DATE: May 26, 2009

Introduction

This memorandum provides preliminary results of the analysis of microcystin, a cyanobacteria (blue-green algae) toxin, in tissues of resident fish in the vicinity of the Klamath Hydroelectric Project (Project) facilities in northern California. The analysis of microcystin compounds was conducted on fillet tissues from edible-sized resident fish from Copco and Iron Gate reservoirs and the Klamath River upstream and downstream of these reservoirs. The resident fish species included rainbow trout (*Oncorhynchus mykiss*), yellow perch (*Perca flavescens*), and black crappie (*Pomoxis nigromaculatus*). Copco and Iron Gate reservoirs were the focus of this investigation because of the recent occurrences of summertime blooms of the cyanobacteria species *Microcystis aeruginosa* (MSAE), which is capable of producing the toxin microcystin.

Fish tissue sample collection occurred on four occasions during 2008, including once in the spring (in May 2008) before the expected cyanobacteria bloom period, twice in summer (in July and September 2008) during the bloom period, and once in late fall (November 2008) after the bloom period. This memorandum provides results of the analysis of samples collected in May, July, and September 2008. The results of the analysis of samples collected in November 2008 are still pending from the analytical laboratory and will be reported in a follow-up memorandum when results are available.

Field Sampling

Fish Collection

The field sampling effort focused on collecting fish tissue samples from the following four reservoir and river segments in the Project vicinity:

- Iron Gate reservoir (located on the Klamath River from about River Mile [RM] 190.5 to RM 196.3)
- Copco reservoir (located between RM 198.6 to RM 204)

- Klamath River downstream of the Iron Gate dam to the I-5 freeway crossing (RM 176.7 to RM 190.5)
- Klamath River upstream of the Copco reservoir to the Stateline (RM 204 to RM 209)

Yellow perch and crappie were targeted in the reservoirs to represent resident sport fish in the reservoirs that are typically captured and consumed. Ten to twenty adult yellow perch and three to ten crappie were targeted for collection from each reservoir on each sampling occasion as practicable.

Rainbow trout (or steelhead) were targeted in the river segments to represent resident sport fish in the river that are typically captured and consumed. Three to ten rainbow trout (or steelhead) specimens were targeted for collection from each of the river segments on each sampling occasion as practicable.

Fish were collected by hook and line sampling (“angling”). PacifiCorp, CH2M HILL, and fishing guide boats and personnel were used for fish collections.

Fish Tissue Sample Preparation and Handling

Upon collection, each fish specimen was placed whole into a clean zip-lock bag. The bag was labeled using a permanent marking pen with a unique identification number and immediately placed on ice in an insulated cooler. At the end of each day’s sampling activity, individual fish specimens were weighed to the nearest gram, and a total length was obtained and recorded. Each fish specimen was examined and noted for any abnormal external conditions (e.g., lesions, parasites).

Each fish specimen was dissected to obtain a skinless fillet. From a skinless fillet, a sub-sample of approximately two to ten grams was obtained and placed into a new pre-labeled 50-ml polyethylene sampling bottle. For quality assurance purposes, a second sample was obtained from a skinless fillet from the opposite side of every twentieth fish specimen processed on a given day. A sample label was placed on each bottle that provided the unique sample number assigned to the fish, the time and date of capture, the species common name, and the collector’s initials.

Each completed sample bottle containing tissue samples for analytical determination of microcystin concentrations was placed in a freezer immediately after processing and held in the freezer until shipped to the analytical lab. During shipment to the analytical laboratory, the samples were contained in an insulated cooler containing dry ice to insure all tissue samples remained frozen during shipment.

Laboratory Analyses

Analytical determination of concentrations of microcystin compounds in fish tissue samples was performed by the laboratory of Dr. Gregory Boyer, State University of New York College of Environmental Science and Forestry (SUNY-ESF), Syracuse, New York. Frozen samples were shipped under Chain-of-Custody procedures using overnight courier service to the SUNY-ESF laboratory in Syracuse, New York. Upon receipt at the Syracuse laboratory, samples were held in an ultra-cold freezer until analysis.

Method for Determination of Tissue Concentrations of Microcystin

Sample Preparation

To prepare the samples for analysis, the frozen samples were lyophilized (i.e., freeze-dried) to dryness at SUNY-ESF and the lyophilizate was vortexed (i.e., mixed by whirlpool effect) to ensure uniformity. A 100 mg (0.1 g dry weight) subsample was mixed with 1 ml of water containing 4 µg of the internal standard 7cys-S-propyl-microcystin-LR (per the methodology of Smith and Boyer 2008). Five ml of 50 percent aqueous methanol was added and the samples were sonicated (21 watts power) on ice for 1 minute. Following sonication, the samples were allowed to stand for 30 min at -20°C, centrifuged to settle debris, and the clarified supernatant decanted into a clean glass tube. The solvent was removed in vacuo and the dry material reconstituted in 1 ml of 80 percent aqueous methanol. The sample was again allowed to stand for 30 minutes at -20°C, clarified by centrifugation, and the supernatant transferred to an autosampler vial, which was sealed and stored at -20°C for subsequent analysis.

Analysis of Total Free Microcystins

Following tissue sample preparation, the total concentrations of microcystin compounds were quantified in each sample by high performance liquid chromatography with mass spectral detection (LCMS). The LCMS assay measured the molecular weight of total microcystin variants or congeners that are not bound to proteins (i.e., free microcystins). The free microcystins are considered the most important from a potential toxicity standpoint, since the mechanism of toxic action by microcystins involves covalent binding to proteins. The bound (i.e., non-free) fraction is no longer accessible or “bioavailable” for toxicity (Ibelings and Chorus 2007).

The LCMS assay was performed using a ZQ4000 single quad instrument and Ace C18 column operating with a 0.02 percent trifluoroacetic acid (TFA) acetonitrile gradient. The LCMS analysis was run in two different formats. First, samples were scanned looking at all masses between 750 and 1250 atomic mass units (amu), a range that encompasses the molecular ion of all of the 80 known microcystin congeners. The molecular ions corresponding to 12 common microcystin congeners found in North America (i.e., microcystin-RR, -dmRR, Nod, -YR, -LR, -dmLR, -AR, -FR, -WR, -LA, -LW, -LF) and the internal standard -tLR were extracted from that total ion trace. Additional mass spectra were scanned for any other peaks of interest that exhibited diagnostic microcystin ultraviolet (UV) signatures. Microcystins were identified on the basis of their UV signatures, liquid chromatography retention times relative to microcystin-RR, -LR, -tLR and -LF standards, and comparison of their molecular weights against a database of the 80 known microcystin congeners.

In addition to the LCMS spectra scan (discussed above), the LCMS also was used in selected ion monitoring (SIM) mode to enhance the selectivity and detectability of the microcystin-LR, -LA, and -RR congeners. The vast majority of reported research on microcystin toxicity is focused on the -LR congener, which is generally regarded as the most toxic microcystin congener (Funari and Testai 2008). The -LA congener was the predominant congener present in the additional LCMS analysis of algal samples from the Project reservoirs

provided to SUNY-ESF for this analysis¹. The -RR congener also was included because it is a very common congener in North American samples (G. Boyer, SUNY, pers. comm.).

The SIM mode considers only four congener ions (i.e., -LR, -tLR, -LA, and -RR), rather than all of the many ions located between 750 and 1250 amu and is therefore significantly more sensitive than scan mode. This results in an approximately 100-fold increase in sensitivity but provides less information about the sample in terms of fragment ions and isotope peaks. The instrument was standardized in SIM mode using microcystin-LR at a specific mass-to-charge ratio (m/z) = 995.5, -tLR at m/z = 1087.5, -LA at m/z = 910.5 and 932.5, and -RR at m/z = 1038.5.

All results were reported on a weight basis in units of $\mu\text{g/g}$ dry weight of tissue. The Instrument Detection Limit (IDL)² is approximately 1 ng microcystin-LR on column³ in the full scan mode and 0.01 ng on column in the SIM mode. The Method Detection Limit (MDL)⁴ relative to the LCMS spectra scan was determined for each sample from the recoveries of the internal standard (7cys-S-propyl microcystin LR) in full scan mode. Analysis in the SIM mode resulted in a second more-sensitive MDL for -LR, -LA, and -RR congeners in each sample, determined from the recoveries of the internal standard (7cys-S-propyl-microcystin-LR) in SIM mode.

Kann (2008) reported the presence of demethylated forms of the -LR and -RR congeners (-dmLR and -dmRR) in some samples following microcystin analysis of fish and freshwater mussel tissues collected in the Klamath River in 2007. To assess if these two demethylated forms would be present in 2008, water samples were provided to the SUNY-ESF laboratory that were representative of the phytoplankton flora present at the time of fish exposure. These water samples were lyophilized to dryness and extracted in 50 percent acidified methanol with ultrasound (Boyer 2007). The resulting samples were clarified by centrifugation and analyzed for microcystins by LCMS using both the full scan and SIM modes as described above.

May, July, and September 2008 Sample Results

The locations and numbers of fish tissue samples collected in May, July, and September 2008 are summarized in Table 1. Laboratory results for these samples are tabulated in Appendix A, Table A-1. Laboratory results are not yet available for November 2008 tissue samples as

¹ CH2M HILL provided samples collected on August 27, 2008 at two open-water reservoir sites in the lower ends of Iron Gate and Copco reservoirs (near the log booms) that were associated with PacifiCorp's 2008 water quality monitoring study (as described in Carlson and Raymond 2008a). These samples were taken as horizontal integrated samples (over a distance of about 50 m) at a depth of 0.5 m below the surface. These particular samples were provided to SUNY because of known levels of microcystin (of 22.2 and 23.1 $\mu\text{g/L}$, respectively, in the Iron Gate and Copco samples) that were detected in aliquots of these samples by CH2M HILL Applied Sciences Laboratory using the competitive Enzyme-Linked ImmunoSorbent Assay (ELISA) method. The ELISA method does not distinguish between the specific microcystin congeners, but yields one value as the sum of all measurable microcystin variants.

² Instrument Detection Limit (IDL) is the concentration equivalent to a signal, due to the analyte of interest, which is the smallest signal that can be distinguished from background noise by a particular instrument. The IDL is similar to the "critical level" and "criterion of detection" as defined in the literature. (Standard Methods, 18th edition).

³ On-column detection occurs when analytes are detected on the analytical column (LCMS Ace C18) over which the injected sample flows.

⁴ Method Detection Limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, and is determined from analysis of a sample in a given matrix containing the analyte. MDLs are statistically determined values that define how easily measurements of a substance by a specific analytical protocol can be distinguished from measurements of a blank (background noise).

of the date of this memorandum. The pending results of the analyses of November 2008 tissue samples will be summarized in a follow-up memorandum after results become available.

TABLE 1. Number of the Tissue Samples Collected at the PacifiCorp Klamath Project in 2008 and Analyzed for Microcystin for Three Species of Resident Fish: Rainbow Trout (*Oncorhynchus mykiss*), Yellow Perch (*Perca flavescens*), and Black Crappie (*Pomoxis nigromaculatus*)

Event	Location	Species	Number of Samples
May	Klamath River Below Iron Gate	Rainbow trout	6
	Iron Gate Reservoir	Yellow perch	23
	Iron Gate Reservoir	Black crappie	1
	Copco Reservoir	Yellow perch	18
	Copco Reservoir	Black crappie	6
	Klamath River above Copco	Rainbow trout	7
July	Klamath River Below Iron Gate	Rainbow trout	10
	Iron Gate Reservoir	Yellow perch	20
	Iron Gate Reservoir	Black crappie	1
	Copco Reservoir	Yellow perch	21
	Copco Reservoir	Black crappie	3
	Klamath River above Copco	Rainbow trout	10
September	Klamath River Below Iron Gate	Rainbow trout	12
	Iron Gate Reservoir	Yellow perch	21
	Iron Gate Reservoir	Black crappie	11
	Copco Reservoir	Yellow perch	21
	Copco Reservoir	Black crappie	2
	Klamath River above Copco	Rainbow trout	10

All of the 203 fish tissue samples collected in May, July, and September 2008 were below detection for total free microcystins. The MDL for total free microcystins varied by sample from 19.1 to 124.9 $\mu\text{g}/\text{kg}$ on a dry weight⁵ (dw) basis, with an average MDL of 74.6 $\mu\text{g}/\text{kg}$ dw. Correcting for sample moisture content, the equivalent MDL on a wet weight⁶ (ww) basis varied by sample from 2.1 to 46.5 $\mu\text{g}/\text{kg}$ ww, with an average MDL of 14.6 $\mu\text{g}/\text{kg}$ ww.

⁵ Dry weight is the weight of microcystin found in subsequent analysis divided by weight of the dried tissue which once contained it.

⁶ Wet weight is the weight of microcystin found in analysis divided by weight of the tissue before water is removed by drying.

Of the 203 fish tissue samples, 200 were below detection in the SIM mode specifically for the -LR, -LA, and -RR congeners. Of the remaining three samples, two were classified by the SUNY-ESF lab as “ambiguous” because of interfering peaks detected near the -LR mass-to-charge ratio (m/z) locus in the SIM mode. The third sample sustained a broken vial and could not be analyzed. The MDL for the SIM mode analysis of these congeners varied by sample from 0.5 to 8.0 $\mu\text{g}/\text{kg dw}$, with an average MDL of 1.8 $\mu\text{g}/\text{kg dw}$. Correcting for sample moisture content, the equivalent MDL on a wet weight basis varied by sample from 0.1 to 1.3 $\mu\text{g}/\text{kg ww}$, with an average MDL of 0.3 $\mu\text{g}/\text{kg ww}$. The SUNY-ESF laboratory also reported no specific detection of -dmLR and -dmRR forms in the LCMS scans for total free microcystins.

Comparison to 2007 Sample Results

Kann (2008) presented results of the microcystin analysis of fish and freshwater mussel tissues collected in the Klamath River in 2007. Included in the sample types reported by Kann (2008) are 38 yellow perch muscle (“fillet”) samples collected from Iron Gate and Copco reservoirs (19 samples from each reservoir) on September 6-7, 2007. These 38 perch muscle samples are the most directly comparable to those collected in this study in 2008 as presented above. In contrast to the results of this study, Kann (2008) reported detectable levels of two microcystin congeners (i.e., -dmLR and -YR) in many of the perch muscle samples collected in 2007. Kann (2008) reported that levels were non-detect in all perch muscle samples for the other six congeners assessed, including -LA, -LF, -LW, -LR, -RR, and -dmRR.

The specific reasons are unknown for the difference between the non-detect results of the 2008 perch muscle samples and the detectable levels of -dmLR and -YR congeners in many of the samples collected in 2007 as reported by Kann (2008). Kann (2008) reported that the dmLR congener was detected in 25 of the 38 samples (66 percent) at relatively high levels of 57 to 422 $\mu\text{g}/\text{kg ww}$, and the -YR congener was detected in 16 of the 38 samples (42 percent) at relatively low levels of 2.5 to 4.2 $\mu\text{g}/\text{kg ww}$. By contrast, as described above, microcystin, including -dmLR and -YR congeners, were not found at detectable levels in any of the 2008 fish tissue samples.

The difference between 2007 and 2008 samples may be a result of change in MSAE and microcystin between the two years. As previously mentioned, analysis by the SUNY-ESF laboratory of algal samples from the Project reservoirs collected in 2008 indicated that the -LA congener was the predominant congener with no detected presence of -dmLR or -YR. Since the fish can only accumulate toxins from their food source, this suggests there was no -dmLR or -YR in their feed to accumulate in the fish tissues. Monitoring data also suggests that the MSAE and microcystin in the Project reservoirs were at lower levels in 2008 than 2007 (Carlson and Raymond 2008b, Raymond 2008, KBGAWG 2008). Research indicates that there can be considerable temporal and spatial variation and fluctuation – even within a given water body – in MSAE strains and the production of microcystin, including demethylated forms of microcystin (Mikalsen et al. 2003, Via-Ordorika et al. 2004). Therefore, a difference in results from samples collected in two separate years is not only plausible but perhaps expected.

A second possible explanation for the difference between 2007 and 2008 samples may be due to variation in analytical methods. Kann (2008) used a more selective LCMS-MS technique to achieve a lower detection limit for a limited number of toxins. However, this possible explanation would apply only to the -YR congener and not the -dmLR congener. For the -dmLR congener, both the SIM and full scan method used in 2008 would have been able to detect -dmLR at the concentrations reported for 2007 by Kann (2008). For the -YR congener, the relatively low levels of 2.5 to 4.2 µg/kg ww reported by Kann (2008) would have been below the detection limit for the full scan method utilized in 2008 (as previously discussed, the average MDL for the full scan method was 14.6 µg/kg ww). The more sensitive SIM method was not used to look at the -YR congener at this time. Rather, SIM analysis in this study targeted the -LR, -LA, and -RR congeners for reasons as explained above.

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Appendix A:

Laboratory Results of Fish Tissue Samples Collected in May, July, and September 2008

Table A-1. Analysis Results of Microcystin in Tissue Samples Collected at the PacifiCorp Klamath Project in 2008 for Three Species of Resident Fish: Rainbow Trout (*Oncorhynchus mykiss*), Yellow Perch (*Perca flavescens*), and Black Crappie (*Pomoxis nigromaculatus*)

ESF Number	Sample ID	Date Collected	Total Free Microcystin Level	Method Detection Limit (LCMS Full Scan)		SIM for RR, LR and LA Congeners Only	Method Detection Limit (SIM Mode)		Extracted Ion Trace for Demethylated LR	Extracted Ion Trace for Demethylated RR
				µg/kg dry wt.	µg/kg wet wt.		µg/kg dry wt.	µg/kg wet wt.		
08-720	IGR-01-YP-01	29-May-08	Below detection	60.3	9.8	Non-detect	1.8	0.3	Non-detect	Non-detect
08-721	IGR-01-YP-02	29-May-08	Below detection	60.5	9.7	Non-detect	1.6	0.3	Non-detect	Non-detect
08-722	IGR-01-YP-03	29-May-08	Below detection	62.2	13.6	Non-detect	2.0	0.4	Non-detect	Non-detect
08-723	IGR-01-YP-04	29-May-08	Below detection	61.8	11.0	Non-detect	1.6	0.3	Non-detect	Non-detect
08-724	IGR-01-YP-05	29-May-08	Below detection	60.6	9.3	Non-detect	1.6	0.2	Non-detect	Non-detect
08-725	IGR-01-YP-06	29-May-08	Below detection	61.1	12.4	Non-detect	2.4	0.5	Non-detect	Non-detect
08-726	IGR-01-YP-07	29-May-08	Below detection	61.4	12.5	Non-detect	1.6	0.3	Non-detect	Non-detect
08-727	IGR-01-YP-08	29-May-08	Below detection	60.3	9.9	Non-detect	1.5	0.2	Non-detect	Non-detect
08-728	IGR-01-YP-09	29-May-08	Below detection	61.0	12.3	Non-detect	1.8	0.4	Non-detect	Non-detect
08-729	IGR-01-YP-10	29-May-08	Below detection	61.9	12.9	Non-detect	1.7	0.4	Non-detect	Non-detect
08-730	IGR-01-YP-11	29-May-08	Below detection	57.1	10.2	Non-detect	1.8	0.3	Non-detect	Non-detect
08-731	IGR-01-YP-12	29-May-08	Below detection	62.2	10.6	Non-detect	1.8	0.3	Non-detect	Non-detect
08-732	IGR-01-YP-13	29-May-08	Below detection	62.1	12.1	Non-detect	1.5	0.3	Non-detect	Non-detect
08-733	IGR-01-YP-14	29-May-08	Below detection	57.1	10.1	Non-detect	1.6	0.3	Non-detect	Non-detect
08-734	IGR-01-YP-15	29-May-08	Below detection	19.1	2.6	Non-detect	1.1	0.1	Non-detect	Non-detect
08-735	IGR-01-YP-15	29-May-08	Below detection	19.2	2.7	Non-detect	2.4	0.3	Non-detect	Non-detect
08-736	IGR-01-YP-17	29-May-08	Below detection	19.1	3.1	Non-detect	1.2	0.2	Non-detect	Non-detect
08-737	IGR-01-YP-18	29-May-08	Below detection	19.1	3.0	Ambiguous	NA	NA	Non-detect	Non-detect

Table A-1. Analysis Results of Microcystin in Tissue Samples Collected at the PacifiCorp Klamath Project in 2008 for Three Species of Resident Fish: Rainbow Trout (*Oncorhynchus mykiss*), Yellow Perch (*Perca flavescens*), and Black Crappie (*Pomoxis nigromaculatus*)

ESF Number	Sample ID	Date Collected	Total Free Microcystin Level	Method Detection Limit (LCMS Full Scan)		SIM for RR, LR and LA Congeners Only	Method Detection Limit (SIM Mode)		Extracted Ion Trace for Demethylated LR	Extracted Ion Trace for Demethylated RR
				µg/kg dry wt.	µg/kg wet wt.		µg/kg dry wt.	µg/kg wet wt.		
08-738	IGR-01-YP-19	29-May-08	Below detection	19.1	2.7	Non-detect	0.5	0.1	Non-detect	Non-detect
08-739	IGR-01-YP-20a	29-May-08	Below detection	19.1	3.2	Non-detect	1.1	0.2	Non-detect	Non-detect
08-740	IGR-01-YP-20b	29-May-08	Below detection	19.2	3.5	Non-detect	0.9	0.2	Non-detect	Non-detect
08-741	IGR-01-YP-21a	29-May-08	Below detection	19.1	2.1	Non-detect	0.9	0.1	Non-detect	Non-detect
08-1094	IGR-01-YP-21b	29-May-08	Below detection	21.9	4.2	Broken	NA	NA	Non-detect	Non-detect
08-742	IGR-01-CR-01	29-May-08	Below detection	21.3	4.2	Non-detect	1.0	0.2	Non-detect	Non-detect
08-743	COP-1-YP-01	28-May-08	Below detection	21.1	3.7	Non-detect	0.8	0.1	Non-detect	Non-detect
08-744	COP-1-YP-02	28-May-08	Below detection	19.1	3.1	Non-detect	1.0	0.2	Non-detect	Non-detect
08-745	COP-1-YP-03	28-May-08	Below detection	21.0	3.6	Non-detect	1.5	0.3	Non-detect	Non-detect
08-746	COP-1-YP-04	28-May-08	Below detection	20.9	3.3	Non-detect	0.7	0.1	Non-detect	Non-detect
08-747	COP-1-YP-05	29-May-08	Below detection	21.3	4.2	Non-detect	0.7	0.1	Non-detect	Non-detect
08-748	COP-1-YP-06	29-May-08	Below detection	21.2	4.2	Non-detect	0.8	0.2	Non-detect	Non-detect
08-749	COP-1-YP-07	29-May-08	Below detection	19.1	3.2	Non-detect	1.1	0.2	Non-detect	Non-detect
08-750	COP-1-YP-08	29-May-08	Below detection	21.4	4.0	Non-detect	0.8	0.1	Non-detect	Non-detect
08-751	COP-1-YP-09	29-May-08	Below detection	21.8	4.1	Non-detect	1.0	0.2	Non-detect	Non-detect
08-752	COP-1-YP-10	29-May-08	Below detection	21.6	3.7	Non-detect	0.8	0.1	Non-detect	Non-detect
08-753	COP-1-YP-11	29-May-08	Below detection	21.9	4.3	Non-detect	1.0	0.2	Non-detect	Non-detect
08-754	COP-1-YP-12	29-May-08	Below detection	21.9	4.4	Non-detect	0.8	0.2	Non-detect	Non-detect

Table A-1. Analysis Results of Microcystin in Tissue Samples Collected at the PacifiCorp Klamath Project in 2008 for Three Species of Resident Fish: Rainbow Trout (*Oncorhynchus mykiss*), Yellow Perch (*Perca flavescens*), and Black Crappie (*Pomoxis nigromaculatus*)

ESF Number	Sample ID	Date Collected	Total Free Microcystin Level	Method Detection Limit (LCMS Full Scan)		SIM for RR, LR and LA Congeners Only	Method Detection Limit (SIM Mode)		Extracted Ion Trace for Demethylated LR	Extracted Ion Trace for Demethylated RR
				µg/kg dry wt.	µg/kg wet wt.		µg/kg dry wt.	µg/kg wet wt.		
08-755	COP-1-YP-13	29-May-08	Below detection	21.3	4.0	Non-detect	0.7	0.1	Non-detect	Non-detect
08-756	COP-1-YP-14	29-May-08	Below detection	21.2	3.6	Non-detect	0.6	0.1	Non-detect	Non-detect
08-757	COP-1-YP-15	29-May-08	Below detection	22.0	3.7	Non-detect	1.0	0.2	Non-detect	Non-detect
08-758	COP-1-YP-16	29-May-08	Below detection	21.8	3.7	Non-detect	1.1	0.2	Non-detect	Non-detect
08-759	COP-1-YP-17	29-May-08	Below detection	22.0	4.2	Non-detect	0.5	0.1	Non-detect	Non-detect
08-760	COP-1-YP-18	29-May-08	Below detection	21.2	3.6	Non-detect	0.6	0.1	Non-detect	Non-detect
08-761	LKR-1-RT-01	28-May-08	Below detection	21.9	5.3	Non-detect	1.0	0.2	Non-detect	Non-detect
08-762	LKR-1-RT-02	7-Jun-08	Below detection	21.9	4.4	Non-detect	1.1	0.2	Non-detect	Non-detect
08-763	LKR-1-RT-03	7-Jun-08	Below detection	21.8	4.6	Non-detect	1.0	0.2	Non-detect	Non-detect
08-764	LKR-1-RT-04	7-Jun-08	Below detection	21.8	5.5	Non-detect	1.2	0.3	Non-detect	Non-detect
08-765	LKR-1-RT-05a	13-Jun-08	Below detection	21.8	4.7	Non-detect	1.1	0.2	Non-detect	Non-detect
08-766	LKR-1-RT-05b	13-Jun-08	Below detection	21.8	4.6	Non-detect	1.0	0.2	Non-detect	Non-detect
08-767	COP-1-CR-01	29-May-08	Below detection	22.0	4.9	Non-detect	1.4	0.3	Non-detect	Non-detect
08-768	COP-1-CR-02	29-May-08	Below detection	21.6	3.6	Non-detect	1.4	0.2	Non-detect	Non-detect
08-769	COP-1-CR-03	29-May-08	Below detection	22.8	4.2	Non-detect	0.9	0.2	Non-detect	Non-detect
08-770	COP-1-CR-04	29-May-08	Below detection	22.2	3.8	Non-detect	1.0	0.2	Non-detect	Non-detect
08-771	COP-1-CR-05a	29-May-08	Below detection	22.0	4.2	Non-detect	1.3	0.2	Non-detect	Non-detect
08-772	COP-1-CR-05b	29-May-08	Below detection	21.3	3.8	Non-detect	1.1	0.2	Non-detect	Non-detect

Table A-1. Analysis Results of Microcystin in Tissue Samples Collected at the PacifiCorp Klamath Project in 2008 for Three Species of Resident Fish: Rainbow Trout (*Oncorhynchus mykiss*), Yellow Perch (*Perca flavescens*), and Black Crappie (*Pomoxis nigromaculatus*)

ESF Number	Sample ID	Date Collected	Total Free Microcystin Level	Method Detection Limit (LCMS Full Scan)		SIM for RR, LR and LA Congeners Only	Method Detection Limit (SIM Mode)		Extracted Ion Trace for Demethylated LR	Extracted Ion Trace for Demethylated RR
				µg/kg dry wt.	µg/kg wet wt.		µg/kg dry wt.	µg/kg wet wt.		
08-773	UKRC-1-RT-01	19-Jun-08	Below detection	21.1	4.1	Non-detect	0.8	0.2	Non-detect	Non-detect
08-774	UKRC-1-RT-02	19-Jun-08	Below detection	22.2	4.0	Ambiguous	NA	NA	Non-detect	Non-detect
08-775	UKRC-1-RT-03	19-Jun-08	Below detection	21.2	6.1	Non-detect	0.7	0.2	Non-detect	Non-detect
08-776	UKRC-1-RT-04	19-Jun-08	Below detection	19.1	3.7	Non-detect	1.1	0.2	Non-detect	Non-detect
08-777	UKRC-1-RT-05	19-Jun-08	Below detection	21.8	4.4	Non-detect	0.7	0.1	Non-detect	Non-detect
08-778	UKRC-1-RT-06	19-Jun-08	Below detection	21.8	4.3	Non-detect	1.0	0.2	Non-detect	Non-detect
08-779	UKRC-1-RT-07	19-Jun-08	Below detection	22.0	5.3	Non-detect	1.1	0.3	Non-detect	Non-detect
08-882	IGR-2-YP-01	15-Jul-08	Below detection	84.9	13.4	Non-detect	1.0	0.2	Non-detect	Non-detect
08-883	IGR-2-YP-02	15-Jul-08	Below detection	84.8	14.9	Non-detect	1.0	0.2	Non-detect	Non-detect
08-884	IGR-2-YP-03	15-Jul-08	Below detection	84.8	13.4	Non-detect	1.0	0.2	Non-detect	Non-detect
08-885	IGR-2-YP-04	15-Jul-08	Below detection	84.7	13.8	Non-detect	0.9	0.1	Non-detect	Non-detect
08-886	IGR-2-YP-05	15-Jul-08	Below detection	85.3	14.7	Non-detect	1.1	0.2	Non-detect	Non-detect
08-887	IGR-2-YP-06	15-Jul-08	Below detection	85.2	13.6	Non-detect	1.2	0.2	Non-detect	Non-detect
08-888	IGR-2-YP-07	15-Jul-08	Below detection	84.7	14.4	Non-detect	1.3	0.2	Non-detect	Non-detect
08-889	IGR-2-YP-08	15-Jul-08	Below detection	84.5	14.4	Non-detect	1.9	0.3	Non-detect	Non-detect
08-890	IGR-2-YP-09	15-Jul-08	Below detection	84.5	15.9	Non-detect	1.1	0.2	Non-detect	Non-detect
08-891	IGR-2-YP-10	15-Jul-08	Below detection	84.5	15.8	Non-detect	1.0	0.2	Non-detect	Non-detect
08-892	IGR-2-YP-11	15-Jul-08	Below detection	85.1	16.4	Non-detect	1.1	0.2	Non-detect	Non-detect

Table A-1. Analysis Results of Microcystin in Tissue Samples Collected at the PacifiCorp Klamath Project in 2008 for Three Species of Resident Fish: Rainbow Trout (*Oncorhynchus mykiss*), Yellow Perch (*Perca flavescens*), and Black Crappie (*Pomoxis nigromaculatus*)

ESF Number	Sample ID	Date Collected	Total Free Microcystin Level	Method Detection Limit (LCMS Full Scan)		SIM for RR, LR and LA Congeners Only	Method Detection Limit (SIM Mode)		Extracted Ion Trace for Demethylated LR	Extracted Ion Trace for Demethylated RR
				µg/kg dry wt.	µg/kg wet wt.		µg/kg dry wt.	µg/kg wet wt.		
08-893	LKR-2-RT-01	15-Jul-08	Below detection	85.2	21.1	Non-detect	1.0	0.2	Non-detect	Non-detect
08-894	LKR-2-RT-02	15-Jul-08	Below detection	84.7	21.5	Non-detect	1.0	0.3	Non-detect	Non-detect
08-895	LKR-2-RT-03	15-Jul-08	Below detection	85.1	22.9	Non-detect	1.0	0.3	Non-detect	Non-detect
08-896	LKR-2-RT-04	15-Jul-08	Below detection	85.2	20.9	Non-detect	1.0	0.2	Non-detect	Non-detect
08-897	LKR-2-RT-05	15-Jul-08	Below detection	85.1	21.3	Non-detect	1.0	0.2	Non-detect	Non-detect
08-898	LKR-2-RT-06	15-Jul-08	Below detection	84.7	21.0	Non-detect	0.9	0.2	Non-detect	Non-detect
08-899	LKR-2-RT-07	15-Jul-08	Below detection	84.8	18.1	Non-detect	1.0	0.2	Non-detect	Non-detect
08-900	LKR-2-RT-08	15-Jul-08	Below detection	82.7	18.9	Non-detect	1.0	0.2	Non-detect	Non-detect
08-901	LKR-2-RT-09	15-Jul-08	Below detection	82.1	19.1	Non-detect	1.0	0.2	Non-detect	Non-detect
08-902	LKR-2-RT-10	15-Jul-08	Below detection	82.6	19.8	Non-detect	1.0	0.2	Non-detect	Non-detect
08-903	IGR-2-YP-12	15-Jul-08	Below detection	82.5	14.2	Non-detect	1.0	0.2	Non-detect	Non-detect
08-904	IGR-2-YP-13	15-Jul-08	Below detection	82.8	14.4	Non-detect	1.0	0.2	Non-detect	Non-detect
08-905	IGR-2-YP-14	15-Jul-08	Below detection	82.4	16.0	Non-detect	1.3	0.3	Non-detect	Non-detect
08-906	IGR-2-YP-15	15-Jul-08	Below detection	82.7	14.7	Non-detect	1.8	0.3	Non-detect	Non-detect
08-907	IGR-2-YP-16	15-Jul-08	Below detection	82.2	12.9	Non-detect	1.8	0.3	Non-detect	Non-detect
08-908	IGR-2-YP-17	15-Jul-08	Below detection	82.7	15.0	Non-detect	1.7	0.3	Non-detect	Non-detect
08-909	IGR-2-YP-18	15-Jul-08	Below detection	82.7	15.4	Non-detect	1.1	0.2	Non-detect	Non-detect
08-910	IGR-2-YP-19	15-Jul-08	Below detection	82.3	15.6	Non-detect	1.2	0.2	Non-detect	Non-detect

Table A-1. Analysis Results of Microcystin in Tissue Samples Collected at the PacifiCorp Klamath Project in 2008 for Three Species of Resident Fish: Rainbow Trout (*Oncorhynchus mykiss*), Yellow Perch (*Perca flavescens*), and Black Crappie (*Pomoxis nigromaculatus*)

ESF Number	Sample ID	Date Collected	Total Free Microcystin Level	Method Detection Limit (LCMS Full Scan)		SIM for RR, LR and LA Congeners Only	Method Detection Limit (SIM Mode)		Extracted Ion Trace for Demethylated LR	Extracted Ion Trace for Demethylated RR
				µg/kg dry wt.	µg/kg wet wt.		µg/kg dry wt.	µg/kg wet wt.		
08-911	IGR-2-YP-19b	15-Jul-08	Below detection	82.8	13.0	Non-detect	1.7	0.3	Non-detect	Non-detect
08-912	IGR-2-CR-01	15-Jul-08	Below detection	82.6	16.7	Non-detect	1.0	0.2	Non-detect	Non-detect
08-913	COP-2-YP-01	15-Jul-08	Below detection	82.4	12.8	Non-detect	1.6	0.2	Non-detect	Non-detect
08-914	COP-2-YP-02	16-Jul-08	Below detection	82.9	14.9	Non-detect	2.2	0.4	Non-detect	Non-detect
08-915	COP-2-YP-03	16-Jul-08	Below detection	82.2	9.6	Non-detect	1.7	0.2	Non-detect	Non-detect
08-916	COP-2-YP-04	16-Jul-08	Below detection	82.1	6.9	Non-detect	1.5	0.1	Non-detect	Non-detect
08-917	COP-2-YP-05	16-Jul-08	Below detection	82.7	16.1	Non-detect	1.5	0.3	Non-detect	Non-detect
08-918	COP-2-YP-06	16-Jul-08	Below detection	82.8	15.7	Non-detect	1.0	0.2	Non-detect	Non-detect
08-919	COP-2-YP-07	16-Jul-08	Below detection	82.7	15.9	Non-detect	1.0	0.2	Non-detect	Non-detect
08-920	COP-2-YP-08	16-Jul-08	Below detection	82.4	16.1	Non-detect	1.1	0.2	Non-detect	Non-detect
08-921	COP-2-YP-09	16-Jul-08	Below detection	82.5	14.4	Non-detect	0.9	0.2	Non-detect	Non-detect
08-922	COP-2-YP-10	16-Jul-08	Below detection	82.4	17.1	Non-detect	0.9	0.2	Non-detect	Non-detect
08-923	COP-2-YP-11	16-Jul-08	Below detection	82.5	16.0	Non-detect	0.5	0.1	Non-detect	Non-detect
08-924	COP-2-YP-12	16-Jul-08	Below detection	82.1	15.0	Non-detect	0.8	0.1	Non-detect	Non-detect
08-925	COP-2-YP-13	16-Jul-08	Below detection	82.3	16.4	Non-detect	1.0	0.2	Non-detect	Non-detect
08-926	COP-2-YP-14	16-Jul-08	Below detection	82.7	16.7	Non-detect	1.2	0.2	Non-detect	Non-detect
08-927	COP-2-YP-15	16-Jul-08	Below detection	82.3	15.8	Non-detect	1.1	0.2	Non-detect	Non-detect
08-928	COP-2-YP-16	16-Jul-08	Below detection	82.2	15.8	Non-detect	1.2	0.2	Non-detect	Non-detect

Table A-1. Analysis Results of Microcystin in Tissue Samples Collected at the PacifiCorp Klamath Project in 2008 for Three Species of Resident Fish: Rainbow Trout (*Oncorhynchus mykiss*), Yellow Perch (*Perca flavescens*), and Black Crappie (*Pomoxis nigromaculatus*)

ESF Number	Sample ID	Date Collected	Total Free Microcystin Level	Method Detection Limit (LCMS Full Scan)		SIM for RR, LR and LA Congeners Only	Method Detection Limit (SIM Mode)		Extracted Ion Trace for Demethylated LR	Extracted Ion Trace for Demethylated RR
				µg/kg dry wt.	µg/kg wet wt.		µg/kg dry wt.	µg/kg wet wt.		
08-929	COP-2-YP-17	16-Jul-08	Below detection	82.8	17.3	Non-detect	1.2	0.3	Non-detect	Non-detect
08-930	COP-2-YP-18	16-Jul-08	Below detection	82.9	16.7	Non-detect	1.3	0.3	Non-detect	Non-detect
08-931	COP-2-YP-19	16-Jul-08	Below detection	82.4	15.0	Non-detect	1.5	0.3	Non-detect	Non-detect
08-932	COP-2-YP-20	16-Jul-08	Below detection	82.4	16.9	Non-detect	1.4	0.3	Non-detect	Non-detect
08-933	COP-2-YP-20b	16-Jul-08	Below detection	82.1	12.9	Non-detect	1.3	0.2	Non-detect	Non-detect
08-934	COP-2-CR-01	16-Jul-08	Below detection	82.6	15.2	Non-detect	1.7	0.3	Non-detect	Non-detect
08-935	COP-2-CR-02	16-Jul-08	Below detection	82.1	14.5	Non-detect	1.5	0.3	Non-detect	Non-detect
08-936	COP-2-CR-03	16-Jul-08	Below detection	82.4	13.3	Non-detect	1.3	0.2	Non-detect	Non-detect
08-937	UKRC-2-RT-01	16-Jul-08	Below detection	82.4	20.5	Non-detect	1.7	0.4	Non-detect	Non-detect
08-938	UKRC-2-RT-02	16-Jul-08	Below detection	82.5	21.6	Non-detect	1.6	0.4	Non-detect	Non-detect
08-939	UKRC-2-RT-03	16-Jul-08	Below detection	82.1	23.2	Non-detect	1.6	0.5	Non-detect	Non-detect
08-940	UKRC-2-RT-04	16-Jul-08	Below detection	82.2	27.0	Non-detect	1.6	0.5	Non-detect	Non-detect
08-941	UKRC-2-RT-05	16-Jul-08	Below detection	82.4	19.9	Non-detect	1.8	0.4	Non-detect	Non-detect
08-942	UKRC-2-RT-06	16-Jul-08	Below detection	82.8	21.6	Non-detect	1.4	0.4	Non-detect	Non-detect
08-943	UKRC-2-RT-07	16-Jul-08	Below detection	82.3	20.7	Non-detect	1.4	0.4	Non-detect	Non-detect
08-944	UKRC-2-RT-08	16-Jul-08	Below detection	82.4	18.8	Non-detect	1.2	0.3	Non-detect	Non-detect
08-945	UKRC-2-RT-09	16-Jul-08	Below detection	82.3	19.6	Non-detect	1.5	0.4	Non-detect	Non-detect
08-946	UKRC-2-RT-9b	16-Jul-08	Below detection	82.1	21.4	Non-detect	1.2	0.3	Non-detect	Non-detect

Table A-1. Analysis Results of Microcystin in Tissue Samples Collected at the PacifiCorp Klamath Project in 2008 for Three Species of Resident Fish: Rainbow Trout (*Oncorhynchus mykiss*), Yellow Perch (*Perca flavescens*), and Black Crappie (*Pomoxis nigromaculatus*)

ESF Number	Sample ID	Date Collected	Total Free Microcystin Level	Method Detection Limit (LCMS Full Scan)		SIM for RR, LR and LA Congeners Only	Method Detection Limit (SIM Mode)		Extracted Ion Trace for Demethylated LR	Extracted Ion Trace for Demethylated RR
				µg/kg dry wt.	µg/kg wet wt.		µg/kg dry wt.	µg/kg wet wt.		
08-1141	LKR-3-RT-01	9-Sep-08	Below detection	85.4	24.7	Non-detect	4.6	1.3	Non-detect	Non-detect
08-1142	LKR-3-RT-02	9-Sep-08	Below detection	85.9	22.5	Non-detect	4.2	1.1	Non-detect	Non-detect
08-1143	LKR-3-RT-03	9-Sep-08	Below detection	85.5	21.5	Non-detect	4.7	1.2	Non-detect	Non-detect
08-1144	LKR-3-RT-04	9-Sep-08	Below detection	85.2	22.6	Non-detect	2.0	0.5	Non-detect	Non-detect
08-1145	LKR-3-RT-05	9-Sep-08	Below detection	85.2	23.3	Non-detect	3.8	1.0	Non-detect	Non-detect
08-1146	LKR-3-RT-06	9-Sep-08	Below detection	85.7	21.2	Non-detect	3.9	1.0	Non-detect	Non-detect
08-1147	LKR-3-RT-07	9-Sep-08	Below detection	85.1	19.0	Non-detect	3.7	0.8	Non-detect	Non-detect
08-1148	LKR-3-RT-08	9-Sep-08	Below detection	85.4	11.3	Non-detect	4.3	0.6	Non-detect	Non-detect
08-1149	LKR-3-RT-09	9-Sep-08	Below detection	85.6	3.8	Non-detect	3.8	0.2	Non-detect	Non-detect
08-1150	LKR-3-RT-10	9-Sep-08	Below detection	85.3	20.7	Non-detect	4.0	1.0	Non-detect	Non-detect
08-1151	LKR-3-RT-11	9-Sep-08	Below detection	85.2	12.5	Non-detect	3.7	0.5	Non-detect	Non-detect
08-1152	LKR-3-RT-11a	9-Sep-08	Below detection	85.1	19.8	Non-detect	3.3	0.8	Non-detect	Non-detect
08-1153	UKRC-3-RT-01	10-Sep-08	Below detection	85.2	19.7	Non-detect	3.7	0.9	Non-detect	Non-detect
08-1154	UKRC-3-RT-02	10-Sep-08	Below detection	85.4	18.5	Non-detect	4.1	0.9	Non-detect	Non-detect
08-1155	UKRC-3-RT-03	10-Sep-08	Below detection	85.6	22.4	Non-detect	4.3	1.1	Non-detect	Non-detect
08-1156	UKRC-3-RT-04	10-Sep-08	Below detection	85.8	18.6	Non-detect	3.9	0.8	Non-detect	Non-detect
08-1157	UKRC-3-RT-05	10-Sep-08	Below detection	85.2	15.2	Non-detect	4.1	0.7	Non-detect	Non-detect
08-1158	UKRC-3-RT-06	10-Sep-08	Below detection	85.6	18.5	Non-detect	4.2	0.9	Non-detect	Non-detect

Table A-1. Analysis Results of Microcystin in Tissue Samples Collected at the PacifiCorp Klamath Project in 2008 for Three Species of Resident Fish: Rainbow Trout (*Oncorhynchus mykiss*), Yellow Perch (*Perca flavescens*), and Black Crappie (*Pomoxis nigromaculatus*)

ESF Number	Sample ID	Date Collected	Total Free Microcystin Level	Method Detection Limit (LCMS Full Scan)		SIM for RR, LR and LA Congeners Only	Method Detection Limit (SIM Mode)		Extracted Ion Trace for Demethylated LR	Extracted Ion Trace for Demethylated RR
				µg/kg dry wt.	µg/kg wet wt.		µg/kg dry wt.	µg/kg wet wt.		
08-1159	UKRC-3-RT-07	10-Sep-08	Below detection	85.1	17.5	Non-detect	3.9	0.8	Non-detect	Non-detect
08-1160	UKRC-3-RT-08	10-Sep-08	Below detection	85.3	19.3	Non-detect	4.0	0.9	Non-detect	Non-detect
08-1161	UKRC-3-RT-09	10-Sep-08	Below detection	85.3	18.8	Non-detect	5.2	1.1	Non-detect	Non-detect
08-1162	UKRC-3-RT-9a	10-Sep-08	Below detection	85.7	19.4	Non-detect	1.3	0.3	Non-detect	Non-detect
08-1163	IGR-3-YP-01	9-Sep-08	Below detection	85.1	15.2	Non-detect	3.6	0.6	Non-detect	Non-detect
08-1164	IGR-3-YP-02	9-Sep-08	Below detection	85.3	15.4	Non-detect	4.6	0.8	Non-detect	Non-detect
08-1165	IGR-3-YP-03	9-Sep-08	Below detection	72.4	12.1	Non-detect	1.4	0.2	Non-detect	Non-detect
08-1166	IGR-3-YP-04	9-Sep-08	Below detection	85.2	17.0	Non-detect	4.1	0.8	Non-detect	Non-detect
08-1167	IGR-3-YP-05	9-Sep-08	Below detection	85.1	15.2	Non-detect	5.8	1.0	Non-detect	Non-detect
08-1168	IGR-3-YP-06	9-Sep-08	Below detection	85.1	14.7	Non-detect	1.8	0.3	Non-detect	Non-detect
08-1169	IGR-3-YP-07	9-Sep-08	Below detection	85.7	16.7	Non-detect	4.4	0.9	Non-detect	Non-detect
08-1170	IGR-3-YP-08	9-Sep-08	Below detection	85.7	16.6	Non-detect	4.4	0.9	Non-detect	Non-detect
08-1171	IGR-3-YP-09	9-Sep-08	Below detection	85.6	15.0	Non-detect	3.0	0.5	Non-detect	Non-detect
08-1172	IGR-3-YP-10	9-Sep-08	Below detection	85.2	15.3	Non-detect	3.4	0.6	Non-detect	Non-detect
08-1173	IGR-3-YP-11	9-Sep-08	Below detection	85.3	14.2	Non-detect	3.2	0.5	Non-detect	Non-detect
08-1174	IGR-3-YP-12	9-Sep-08	Below detection	85.4	16.4	Non-detect	3.8	0.7	Non-detect	Non-detect
08-1175	IGR-3-YP-13	9-Sep-08	Below detection	85.8	16.7	Non-detect	2.8	0.5	Non-detect	Non-detect
08-1176	IGR-3-YP-14	9-Sep-08	Below detection	85.4	14.6	Non-detect	3.1	0.5	Non-detect	Non-detect

Table A-1. Analysis Results of Microcystin in Tissue Samples Collected at the PacifiCorp Klamath Project in 2008 for Three Species of Resident Fish: Rainbow Trout (*Oncorhynchus mykiss*), Yellow Perch (*Perca flavescens*), and Black Crappie (*Pomoxis nigromaculatus*)

ESF Number	Sample ID	Date Collected	Total Free Microcystin Level	Method Detection Limit (LCMS Full Scan)		SIM for RR, LR and LA Congeners Only	Method Detection Limit (SIM Mode)		Extracted Ion Trace for Demethylated LR	Extracted Ion Trace for Demethylated RR
				µg/kg dry wt.	µg/kg wet wt.		µg/kg dry wt.	µg/kg wet wt.		
08-1177	IGR-3-YP-15	9-Sep-08	Below detection	85.6	14.8	Non-detect	2.7	0.5	Non-detect	Non-detect
08-1178	IGR-3-YP-16	9-Sep-08	Below detection	85.2	16.8	Non-detect	3.6	0.7	Non-detect	Non-detect
08-1179	IGR-3-YP-17	9-Sep-08	Below detection	85.9	15.9	Non-detect	3.0	0.6	Non-detect	Non-detect
08-1180	IGR-3-YP-18	9-Sep-08	Below detection	85.2	14.9	Non-detect	3.9	0.7	Non-detect	Non-detect
08-1181	IGR-3-YP-19	9-Sep-08	Below detection	124.9	21.9	Non-detect	1.0	0.2	Non-detect	Non-detect
08-1182	IGR-3-YP-20	9-Sep-08	Below detection	124.1	23.7	Non-detect	1.0	0.2	Non-detect	Non-detect
08-1183	IGR-3-YP-20a	9-Sep-08	Below detection	123.8	24.2	Non-detect	1.0	0.2	Non-detect	Non-detect
08-1184	IGR-3-CR-01	9-Sep-08	Below detection	124.3	20.6	Non-detect	1.1	0.2	Non-detect	Non-detect
08-1185	IGR-3-CR-02	9-Sep-08	Below detection	72.8	9.2	Non-detect	2.6	0.3	Non-detect	Non-detect
08-1186	IGR-3-CR-03	9-Sep-08	Below detection	124.9	22.2	Non-detect	1.3	0.2	Non-detect	Non-detect
08-1187	IGR-3-CR-04	9-Sep-08	Below detection	123.7	23.4	Non-detect	1.3	0.2	Non-detect	Non-detect
08-1188	IGR-3-CR-05	9-Sep-08	Below detection	124.2	22.6	Non-detect	1.3	0.2	Non-detect	Non-detect
08-1189	IGR-3-CR-06	9-Sep-08	Below detection	124.1	20.8	Non-detect	1.3	0.2	Non-detect	Non-detect
08-1190	IGR-3-CR-07	9-Sep-08	Below detection	124.6	24.5	Non-detect	1.4	0.3	Non-detect	Non-detect
08-1191	IGR-3-CR-08	9-Sep-08	Below detection	124.4	23.8	Non-detect	1.4	0.3	Non-detect	Non-detect
08-1192	IGR-3-CR-09	9-Sep-08	Below detection	124.6	21.2	Non-detect	1.4	0.2	Non-detect	Non-detect
08-1193	IGR-3-CR-10	9-Sep-08	Below detection	124.2	21.6	Non-detect	1.3	0.2	Non-detect	Non-detect
08-1194	IGR-3-CR-10a	9-Sep-08	Below detection	124.9	20.2	Non-detect	1.5	0.2	Non-detect	Non-detect

Table A-1. Analysis Results of Microcystin in Tissue Samples Collected at the PacifiCorp Klamath Project in 2008 for Three Species of Resident Fish: Rainbow Trout (*Oncorhynchus mykiss*), Yellow Perch (*Perca flavescens*), and Black Crappie (*Pomoxis nigromaculatus*)

ESF Number	Sample ID	Date Collected	Total Free Microcystin Level	Method Detection Limit (LCMS Full Scan)		SIM for RR, LR and LA Congeners Only	Method Detection Limit (SIM Mode)		Extracted Ion Trace for Demethylated LR	Extracted Ion Trace for Demethylated RR
				µg/kg dry wt.	µg/kg wet wt.		µg/kg dry wt.	µg/kg wet wt.		
08-1195	COP-3-YP-01	9-Sep-08	Below detection	124.7	26.2	Non-detect	1.3	0.3	Non-detect	Non-detect
08-1196	COP-3-YP-02	9-Sep-08	Below detection	123.8	21.8	Non-detect	1.3	0.2	Non-detect	Non-detect
08-1197	COP-3-YP-03	9-Sep-08	Below detection	124.3	25.2	Non-detect	8.0	1.6	Non-detect	Non-detect
08-1198	COP-3-YP-04	9-Sep-08	Below detection	123.7	18.7	Non-detect	1.2	0.2	Non-detect	Non-detect
08-1199	COP-3-YP-05	9-Sep-08	Below detection	124.7	23.9	Non-detect	1.0	0.2	Non-detect	Non-detect
08-1200	COP-3-YP-06	9-Sep-08	Below detection	124.3	22.8	Non-detect	1.1	0.2	Non-detect	Non-detect
08-1201	COP-3-YP-07	9-Sep-08	Below detection	124.2	22.8	Non-detect	1.1	0.2	Non-detect	Non-detect
08-1202	COP-3-YP-08	9-Sep-08	Below detection	124.4	46.5	Non-detect	1.0	0.4	Non-detect	Non-detect
08-1203	COP-3-YP-09	9-Sep-08	Below detection	123.7	22.6	Non-detect	1.0	0.2	Non-detect	Non-detect
08-1204	COP-3-YP-10	9-Sep-08	Below detection	123.7	43.8	Non-detect	1.3	0.5	Non-detect	Non-detect
08-1205	COP-3-YP-11	9-Sep-08	Below detection	123.7	21.5	Non-detect	1.3	0.2	Non-detect	Non-detect
08-1206	COP-3-YP-12	9-Sep-08	Below detection	124.2	23.8	Non-detect	1.3	0.2	Non-detect	Non-detect
08-1207	COP-3-YP-13	9-Sep-08	Below detection	124.9	19.0	Non-detect	1.2	0.2	Non-detect	Non-detect
08-1208	COP-3-YP-14	9-Sep-08	Below detection	123.8	23.1	Non-detect	1.2	0.2	Non-detect	Non-detect
08-1209	COP-3-YP-15	9-Sep-08	Below detection	124.4	22.6	Non-detect	0.6	0.1	Non-detect	Non-detect
08-1210	COP-3-YP-16	9-Sep-08	Below detection	124.6	24.4	Non-detect	1.1	0.2	Non-detect	Non-detect
08-1211	COP-3-YP-17	9-Sep-08	Below detection	124.1	24.1	Non-detect	1.3	0.3	Non-detect	Non-detect
08-1212	COP-3-YP-18	9-Sep-08	Below detection	124.7	22.6	Non-detect	1.1	0.2	Non-detect	Non-detect

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ESF Number	Sample ID	Date Collected	Total Free Microcystin Level	Method Detection Limit (LCMS Full Scan)		SIM for RR, LR and LA Congeners Only	Method Detection Limit (SIM Mode)		Extracted Ion Trace for Demethylated LR	Extracted Ion Trace for Demethylated RR
				µg/kg dry wt.	µg/kg wet wt.		µg/kg dry wt.	µg/kg wet wt.		
08-1213	COP-3-YP-19	9-Sep-08	Below detection	123.8	21.5	Non-detect	1.1	0.2	Non-detect	Non-detect
08-1214	COP-3-YP-20	9-Sep-08	Below detection	123.7	21.9	Non-detect	1.1	0.2	Non-detect	Non-detect
08-1215	COP-3-YP-20a	9-Sep-08	Below detection	124.8	23.8	Non-detect	1.3	0.2	Non-detect	Non-detect
08-1216	COP-3-CR-01	10-Sep-08	Below detection	124.6	12.2	Non-detect	1.9	0.2	Non-detect	Non-detect
08-1217	COP-3-CR-02	10-Sep-08	Below detection	72.8	13.8	Non-detect	2.8	0.5	Non-detect	Non-detect