Fact Sheet for NPDES Permit WA0000892
Kaiser Aluminum Washington, LLC

Purpose of this fact sheet

This fact sheet explains and documents the decisions the Department of Ecology (Ecology) made in drafting the proposed National Pollutant Discharge Elimination System (NPDES) permit for Kaiser Aluminum Washington, LLC (Kaiser).

This fact sheet complies with Section 173-220-060 of the Washington Administrative Code (WAC), which requires Ecology to prepare a draft permit and accompanying fact sheet for public evaluation before issuing an NPDES permit.

Ecology makes the draft permit and fact sheet available for public review and comment at least 30-days before issuing the final permit. Copies of the fact sheet and draft permit for Kaiser NPDES permit WA0000892, are available for public review and comment from December 29, 2021 until February 12, 2022. For more details on preparing and filing comments about these documents, please see **Appendix A - Public Involvement**.

Kaiser reviewed the draft permit and fact sheet for factual accuracy. Ecology corrected any errors or omissions regarding the facility's location, history, discharges, or receiving water prior to publishing this draft fact sheet for public notice.

After the public comment period closes, Ecology will summarize substantive comments and provide responses to them. Ecology will include the summary and responses to comments in this fact sheet as **Appendix F** - **Response to Comments**, and publish it when issuing the final NPDES permit. Ecology generally will not revise the rest of the fact sheet. The full document will become part of the legal history contained in the facility's permit file.

Summary

Kaiser owns and operates an aluminum rolling mill and metal finishing plant at Trentwood, Spokane County, Washington. The facility discharges treated process wastewater, stormwater, and plant sanitary wastewater to the Spokane River.

The permit incorporates final water quality-based effluent limits (WQBELs) for total phosphorus, ammonia, and carbonaceous biochemical oxygen demand ($CBOD_5$). These WQBELs are necessary to meet requirements of the Spokane River Dissolved Oxygen total maximum daily load (TMDL). The proposed permit also includes a water quality-based limit for PCBs, and the preparation and implementation of a PCB Pollutant Minimization Plan (PMP).

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I. Introduction

The Federal Clean Water Act (FCWA, 1972, and later amendments in 1977, 1981, and 1987) established water quality goals for the navigable (surface) waters of the United States. One mechanism for achieving the goals of the Clean Water Act is the National Pollutant Discharge Elimination System (NPDES), administered by the federal Environmental Protection Agency (EPA). The EPA authorized the state of Washington to manage the NPDES permit program in our state. Our state legislature accepted the delegation and assigned the power and duty for conducting NPDES permitting and enforcement to Ecology. The Legislature defined Ecology's authority and obligations for the wastewater discharge permit program in 90.48 RCW (Revised Code of Washington).

The following regulations apply to industrial NPDES permits:

- Procedures Ecology follows for issuing NPDES permits (Chapter 173-220 WAC)
- Water quality criteria for surface waters (Chapter 173-201A WAC)
- Water quality criteria for ground waters (Chapter 173-200 WAC)
- Whole effluent toxicity testing and limits (Chapter 173-205 WAC)
- Sediment management standards (Chapter 173-204 WAC)
- Submission of plans and reports for construction of wastewater facilities (Chapter 173-240 WAC)

These rules require any industrial facility owner/operator to obtain an NPDES permit before discharging wastewater to state waters. They also help define the basis for limits on each discharge and for performance requirements imposed by the permit.

Under the NPDES permit program and in response to a complete and accepted permit application, Ecology must prepare a draft permit and accompanying fact sheet, and make them available for public review before final issuance. Ecology must also publish an announcement (public notice) telling people where they can read the draft permit, and where to send their comments, during a period of thirty days (WAC 173-220-050). (See **Appendix A - Public Involvement Information** for more detail about the public notice and comment procedures). After the public comment period ends, Ecology may make changes to the draft NPDES permit in response to comment(s). Ecology will summarize the responses to comments and any changes to the permit in **Appendix F**.

II. Background Information

Table 1: Facility Information

Applicant	Kaiser Aluminum Washington, LLC
Facility Name and Address	Kaiser Aluminum Washington, LLC Trentwood Works 15000 E. Euclid Ave, Spokane Valley, WA 99215
Contact at Facility	Brent Downey, Environmental Affairs Manager (509) 927-6219
Responsible Official	Scott Endres, Vice President PO Box 15108, Spokane Valley, WA 99215-5108 (509) 924-1500 FAX #: (509) 927-6095
Industry Type	Aluminum Forming
Categorical Industry	40 CFR Part 467, Aluminum Forming Point Source Category
Type of Treatment	Settling/Filtration for non-contact and contact cooling waters, and stormwater. Oil Removal/Lime Addition/Settling/Filtration for oil and metal contaminated process wastewaters. Primary Clarification, Secondary Treatment (Trickling Filter), Chemical Precipitation, Secondary Clarification, Disinfection for plant sanitary wastewater.
SIC Codes	3353 - Aluminum sheet, plate and foil
NAIC Codes	331314 - Secondary smelting and alloying of aluminum 331315 - Aluminum sheet, plate and foil
Facility Location (NAD83/WGS84 reference datum)	Latitude: 47.686048 Longitude: -117.205603
Discharge Waterbody Name and Location (NAD83/WGS84 reference datum)	Spokane River Latitude: 47.6860445517192 Longitude: -117.223793548856
Intake Structure	Latitude: 47.68345 Longitude: -117.2208

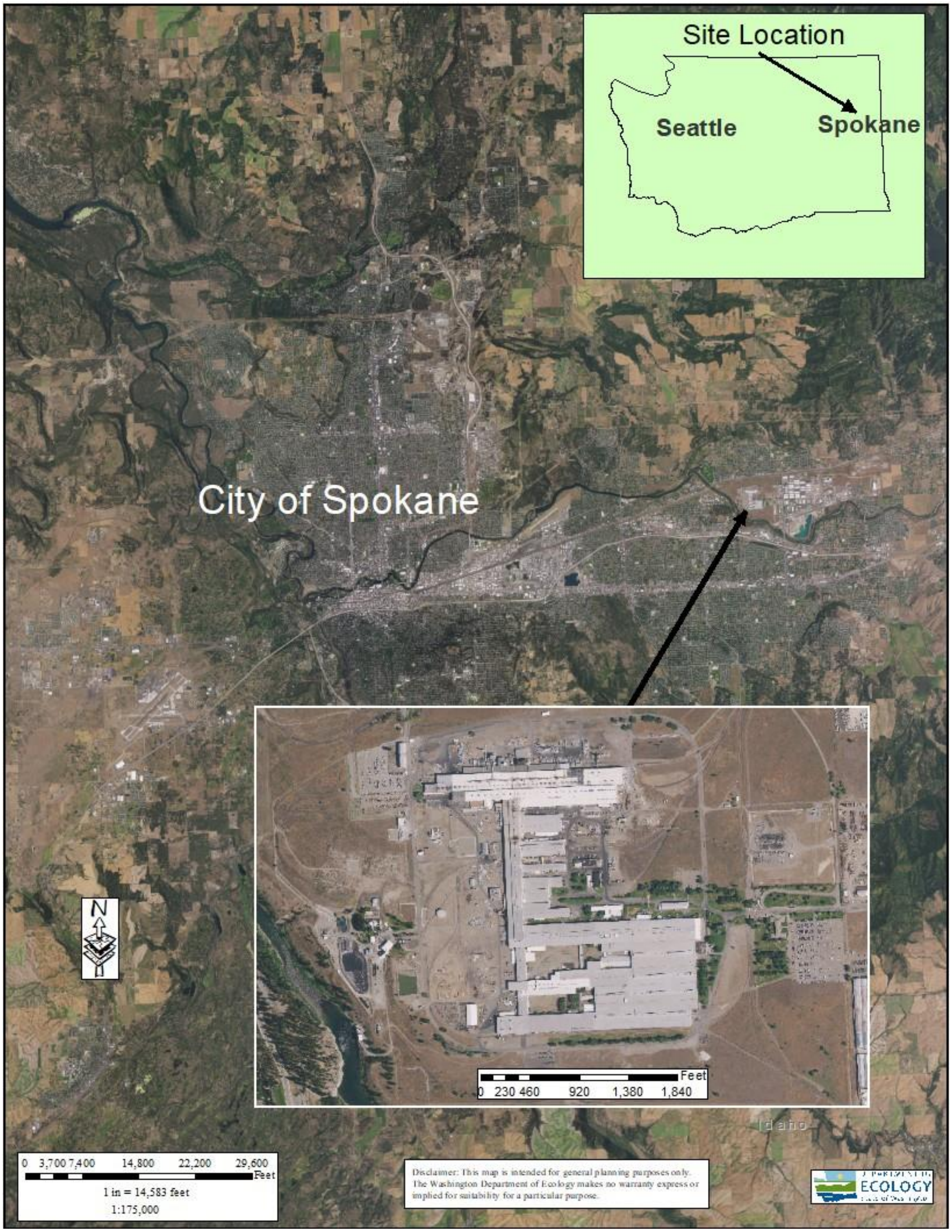
Table 2: Permit Status

Renewal Date of Previous Permit	June 22, 2011
Application for Permit Renewal Submittal Date	March 1, 2021
Date of Ecology Acceptance of Application	March 12, 2021

Table 3: Inspection Status

Date of Last Non-sampling Inspection Date	June 4, 2018

Figure 1: Facility Location Map



A. Facility description

History

Kaiser Aluminum Washington, LLC (Kaiser) owns an aluminum rolling mill and metal finishing plant at Trentwood, Spokane County, Washington (see Figure 1). The facility produces aluminum sheet, plate, and coil through the melting and alloying of aluminum, casting of ingots, and rolling with neat oils and emulsions. Ancillary operations include direct chill casting and solution heat-treating. Finished products are used mainly in the aerospace industry and for general engineering applications. The plant sits on 512 acres, with over 60 acres under one roof, and is designated an EPA major facility.

The U.S. Government Defense Plant Corporation built the Trentwood facility in 1942 to produce aluminum for World War II aircraft. In 1946 Kaiser leased, then later purchased the facility. The Permittee has operated at the site since that time.

Historic releases/cleanup activities

Materials used in past aluminum production included PCB oil, petroleum fuels, solvents, and chromium. Cleanup of contamination is ongoing under the State's Model Toxics Control Act (MTCA). Kaiser has completed many interim cleanup actions; including removing petroleum on groundwater and excavating or capping contaminated soil. PCB contamination in groundwater remains the primary issue.

Kaiser currently uses a pilot pump-and-treat system to assess the removal of PCBs from groundwater. Treated water discharges upgradient of the plume and is infiltrated. Using a walnut-shell filtration treatment system can effectively remove PCBs from groundwater and this system could be expanded into a full-scale treatment system. However, Kaiser has identified new technologies that could be more effective in removing PCBs and result in a shorter cleanup timeframe.

Current cleanup work includes the installation of a full-scale groundwater extraction network and a larger treated-water conveyance pipe(s) to the existing infiltration area, and the testing of additional technologies to remove PCBs from groundwater. Once Ecology determines the most appropriate cleanup technology for removing PCBs from groundwater at the site, a full-scale treatment system will be installed and operated to meet cleanup goals. See Ecology's site cleanup webpage for Kaiser Aluminum & Chemical Corporation Trentwood online at https://apps.ecology.wa.gov/gsp/Sitepage.aspx?csid=7093.

Agreed Order No. 16958

The Environmental Protection Agency (EPA) promulgated human health based water quality criteria for the State of Washington under 40 CFR Part 131.45 in December 2016. In August 2018, EPA announced its decision to reconsider the human health based water quality criteria it promulgated for Washington in December 2016. Due to the regulatory uncertainty surrounding the human health based water quality criteria for PCBs, Ecology delayed the renewal of NPDES Permit No. WA0000892, which expired on June 30, 2016 and administratively extended by Ecology on June 30, 2016.

In January 2020, Ecology and Kaiser finalized an Agreed Order that included actions intended to improve water quality in the Spokane River.

Kaiser agreed to:

- Prepare a report that examined all known, available, and reasonable methods of prevention, control, and treatment for PCBs
- Continue to participate in the Spokane River Regional Toxics Task Force
- Prepare a PCB Pollutant Minimization Plan (PMP)

In support of this permit renewal, Kaiser also agreed to begin monitoring of receiving water temperature upstream of its outfall and to prepare a cooling water intake structure information and compliance report.

Ecology plans to incorporate these requirements into the proposed permit. When the final permit is issued: Ecology will cancel the Agreed Order.

Industrial Processes

Manufacturing operations include re-melting, alloying, and casting of aluminum to form ingots. Three hot rolling mills, used alone or in a combination, form the ingots into aluminum sheet, plate, or coil. Cold mills further reduce thickness for coil product. Additional operations consist of annealing (heating the metal and allowing it to cool slowly to remove internal stress and harden the metal), solution heat-treating, inspection, sawing, and final product packaging. The facility operates 24-hours per day, 7-days per week, with current employment of about 650 personnel.

The Trentwood location does not have access to municipal sewers. As a result, the facility has a sanitary wastewater treatment plant to serve the facility employee population.

Wastewater Treatment processes

The wastewater discharged from the facility consists of treated stormwater, process wastewater, and treated sanitary effluent. All stormwater, process and sanitary wastewater flows through a lined four million gallon settling lagoon (equipped with oil skimming and collection equipment), and a walnut shell filtration unit prior to discharging to the Spokane River.

The following table summarizes the discharge outfalls and wastewater sources at the facility:

Table 4: Discharge Outfalls

Outfall #	Description	Wastewater Source
0001	Final Discharge to Spokane River	Internal Outfall 0006
0002	Internal Outfall to wastewater lagoon	Treated industrial process wastewater
0003	Internal Outfall to wastewater lagoon	Treated plant sanitary wastewater
0004	Internal Outfall to wastewater lagoon.	Noncontact and contact cooling water, and stormwater from south portion of plant site
0005	Internal Outfall to wastewater lagoon	Noncontact and contact cooling water, and stormwater from north portion of plant site
0006	Internal Outfall to Final Discharge	Treated (Walnut Shell Filtration System) wastewater lagoon effluent.

The process wastewater from aluminum hot and cold rolling is contaminated with oil and metals. An industrial wastewater treatment (IWT) plant removes these contaminates prior to discharge into the settling lagoon. Influent to the IWT contains approximately 5% emulsified oil. The IWT plant uses an acid and steam to break the oil emulsion and coalesce the oil from the water. The recovered oil is transferred to storage tanks for recycling off-site through a fuels program. From the oil break system, the wastewater flows to a series of oil/water separation tanks where additional oil is skimmed off the surface of the water.

From the oil/water separation tanks, the wastewater flows to a neutralization tank where the addition of lime raises the pH to about 8.5. This precipitates the aluminum and zinc ions from the water. From the neutralization tank, the wastewater discharges to a clarifier to remove solids. The solids removed from the clarifier go through a vacuum drum filter system for dewatering. Kaiser ships the dewatered solids offsite for disposal.

Kaiser discharges additional process wastewater streams to the wastewater lagoon via internal Outfalls #004 and #005 (south and north Outfalls, respectively). Both the south and north Outfalls discharge mostly non-contact cooling water to the wastewater lagoon. The wastewater lagoon also receives storm water runoff from approximately 60 acres of roof and other impervious areas.

The sanitary wastewater treatment (SWT) plant includes primary settling, trickling filter treatment, ferric chloride addition/chemical precipitation, secondary settling, and chlorination. Sludge is digested in a storage tank and shipped off-site for disposal. The SWT effluent flows through internal Outfall 0003 to the north Outfall and then mixes with the industrial process wastewater in the wastewater lagoon.

Effluent from the wastewater lagoon is routed through a walnut shell (WS) filtration system (Outfall 0006), prior to final discharge to the Spokane River via Outfall 0001. Kaiser installed the WS filtration system in 2003 to reduce PCBs discharged from the facility (see further discussion below) to the Spokane River. The backwash from the BWS filter system is pumped to oil reclaim tanks. In the tanks, Kaiser allows time for the oil to separate from the water, and then pumps the water phase back into the IWT system. The remaining oil is sent to the oil reclaim tanks.

Kaiser uses onsite groundwater wells to provide source water for the industrial operations. Kaiser has an overall goal of reducing wastewater discharged into the Spokane River. Section V, subsection B, describes these flow reduction projects and their schedule of implementation in more detail. Kaiser has implemented two of four phases of projects for the use of injection wells for disposal of groundwater sourced, once-through non-contact cooling water to groundwater. Once completed, the injection well system will have the capacity to accept up to 5 million gallons per day of groundwater sourced, once-through non-contact cooling water.

Discharge outfall 0001

Wastewater discharges to the Spokane River at River Mile 86.0 via a submerged two open port diffuser located in about the middle of the river channel. The outfall pipe extends approximately 100 feet from the high water mark to the middle of the channel.

B. Description of the receiving water

The Spokane River basin encompasses over 6,000 square miles in Washington and Idaho. The headwaters begin at the outlet of Lake Coeur d’Alene in Idaho. The river flows west 112 river miles to the Columbia River in Washington. It flows through the cities of Post Falls and Coeur d’Alene in Idaho, and through the large urban areas of Spokane Valley and Spokane in Washington.

The flow regime for the Spokane River is dictated largely by freezing temperatures in the winter followed by spring and summer snowmelt. The annual harmonic mean flow is approximately 2,154 cfs as the river crosses the Idaho border. Flow increases to 2,896 cfs downstream of Spokane as an overall net influx of groundwater through this reach.

In Idaho, other point source outfalls to the Spokane River include the City of Coeur d’Alene, Hayden Area Regional Sewer Board POTW, and the City of Post Falls POTW. In Washington, point sources include Liberty Lake Sewer & Water District (upstream from the Permittee) and Inland Empire Paper Company, Spokane County Regional Water Reclamation Facility, and the City of Spokane Advanced Wastewater Treatment Plant (downstream from the Permittee).

Significant nearby non-point sources of pollutants to the Spokane River include stormwater and combined sewer overflows from the City of Spokane, and agricultural pollution sources from Latah Creek (or Hangman Creek), Little Spokane River, and Coulee/Deep Creeks.

Section IIIE of this fact sheet describes the known receiving waterbody impairments. The ambient background data used for this permit includes data from Ecology's Environmental Information Management System (EIM) for upstream stations on the Spokane River from January 2011 to January 2021. The ambient background data also includes results from PCB surveys for the Spokane River at a station at Mirabeau Park.

Table 5: Ambient Background Data

Parameter	Units	# of Samples	Value	Description
Temperature	°C	203	22.0	90th Percentile
pH minimum pH maximum	standard units	183	7.2 8.0	10th Percentile 90th Percentile
Dissolved Oxygen	mg/L	157	8.36	10th Percentile
Total Ammonia-N	mg/L	111	0.028	90th Percentile
Turbidity	NTU	154	3.3	90th Percentile
Hardness	mg/L as CaCO3	85	19.4	10th Percentile
Total Alkalinity	mg/L as CaCO3	11	23 70	10th Percentile 90th Percentile
Aluminum, dissolved	µg/L	1	9	Maximum
Arsenic, total	µg/L	52	0.52 0.44	90th Percentile Geometric Mean
Cadmium, dissolved	µg/L	53	0.185	90th Percentile
Chromium, dissolved	µg/L	51	0.125	90th Percentile
Copper, dissolved	µg/L	53	0.576 0.527	90th Percentile Geometric Mean
Mercury, total	µg/L	52	0.00236 0.00116	90th Percentile Geometric Mean
Nickel, dissolved	µg/L	52	0.39 0.23	90th Percentile Geometric Mean
Total PCBs [a]	pg/L	22 22	59.5 41.3	90th Percentile 50th Percentile
Lead, dissolved	µg/L	52	1.05	90th Percentile
Silver, dissolved	µg/L	54	0.01	90th Percentile
Zinc, dissolved	µg/L	53	54.0	90th Percentile

[a] Results with a 3x blank censoring applied

C. Wastewater characterization

Kaiser reported the concentration of pollutants in the discharge in the permit application and in discharge monitoring reports. The tabulated data represents the quality of the wastewater effluent discharged from January 2019 through December 2020, except for flow values. The table below lists flow data summarized from January 2020 through December 31, 2020, which represents lower values due to implementation of flow reduction projects. The wastewater effluent is characterized as follows:

Table 6: Wastewater Characterization – Outfall 0001 (Final Discharge to Spokane River)

Parameter	Units	# of Samples	Average Value	95th Percentile	Maximum Value
Flow	mgd	365	6.24	6.55	7.9
Ammonia	mg/L lbs/day	417	0.043 2.25	0.093 4.9	0.4 22.6
Carbonaceous Biochemical Oxygen Demand ($CBOD_5$)	mg/L; lbs/day	415	2.9 152.8	4.8 281.0	23.4 413.8
Cadmium, Total	µg/L	208	0.030	0.05	0.08
Lead, Total	µg/L	208	0.167	0.41	0.77
Ortho P	µg/L; lbs/day	209	4.2 0.068	4.0 0.27	15.5 0.8
Total P	µg/L; lbs/day	209	18.6 0.96	27.6 1.58	44 2.3
Temperature	°F °C	1,371	71.5 22.0	78.5 25.8	81.6 27.6
Zinc	µg/L	209	17.0	26.0	37.0
Total PCBs	pg/L mg/day	53	4,217 102.4	7,240 194.0	14,145 487.3
Antimony	µg/L	2	-	-	0.73
Arsenic, Total	µg/L	2	-	-	3.3
Beryllium, Total	µg/L	2	-	-	0.34
Chromium, Total	µg/L	2	-	-	0.85
Copper, Total	µg/L	2	-	-	2.5
Mercury, Total	µg/L	2	-	-	0.00036

Parameter	Units	# of Samples	Average Value	95th Percentile	Maximum Value
Nickel, Total	µg/L	2	-	-	0.60
Silver, Total	µg/L	2	-	-	0.20
Thallium, Total	µg/L	2	-	-	0.32
Chlorobenzene [b]	µg/L	2	-	-	0.043
Chloroform	µg/L	2	-	-	0.032
Tetrachloroethylene [b]	µg/L	2	-	-	0.30
Toluene [b]	µg/L	2	-	-	0.30
Trichloroethylene [b]	µg/L	2	-	-	0.071
Acenapthene	µg/L	2	-	-	0.075
Diethyl phthalate	µg/L	2	-	-	0.23
2,6-dinitrotoluene	µg/L	2	-	-	0.27
Fluoride	mg/L	2	-	-	0.1
Nitrate-Nitrite	mg/L	2	-	-	6.93
Total Nitrogen	mg/L	2	-	-	1.9
Sulfate	mg/L	2	-	-	20

Parameter	Units	# of Samples	Minimum	Percentile Value	Maximum
pH, maximum	s.u.	731	6.9	7.7 95th %tile [c]	9.3
pH, minimum	s.u.	731	3.8	6.8 5th %tile [d]	7.7

[a] Results with no blank censoring applied

[b] Compound also detected in laboratory blank sample

[c] Daily maximum pH is 7.7 s.u. or less for 95% of the values

[d] Daily minimum pH is 6.8 s.u. or greater for 95% of the values

Table 7: Wastewater Characterization – Outfall 0006 (Walnut Shell Filtration Effluent)

Parameter	Units	# of Samples	Average Value	Maximum Value
Aluminum	mg/L lbs/day	209	0.058 2.76	0.108 5.8

Parameter	Units	# of Samples	Average Value	Maximum Value
Chromium	mg/L lbs/day	209	0.0021 0.104	0.0076 0.50
Cyanide	mg/L lbs/day	2	<0.01 0	<0.01 0
Oil & Grease	mg/L lbs/day	208	2.5 97.2	9.5 329
Total Suspended Solids (TSS)	mg/L lbs/day	209	2.1 96.7	13.6 836.8

Table 8: Wastewater Characterization – Inlet to Walnut Shell Filtration System

Parameter	Units	# of Samples	Average Value	Maximum Value
Polychlorinated Biphenyls (PCBs)	g/day	53	0.48	2.79

Table 9: Wastewater Characterization – Outfall 0003 (Sanitary Treatment Plant Effluent)

Parameter	Units	# of Samples	Average Value	Maximum Value
Biochemical Oxygen Demand (BOD_5)	mg/L lbs/day	415	7.2 5.26	19.6 26.8
Fecal Coliform	#/100 ml	107	11.2	742
Flow	gpd	731	0.09	0.96
TSS	mg/L lbs/day	209	5.2 4.14	17.8 30.4

Table 10: Wastewater Characterization – Spokane River Intake

Parameter	Units	# of Samples	Average Value	Maximum Value
Aluminum	mg/L lbs/day	209	0.0418 0.38	0.174 5.1
Chromium	mg/L lbs/day	391	0.0041 0.0038	0.045 0.0013
Flow	mgd	731	3.8	5.0
Oil & Grease	mg/L lbs/day	391	1.8 37.22	6.6 202.4

Parameter	Units	# of Samples	Average Value	Maximum Value
TSS	mg/L lbs/day	389	0.72 16.25	3.1 98.6

D. Summary of compliance with previous permit issued on June 23, 2011

The previous permit placed effluent limits on Outfall 0001 for zinc, lead, cadmium, pH, total phosphorus, ammonia, and $CBOD_5$; on Outfall 0006 for chromium, cyanide, aluminum, oil and grease, and TSS; on Outfall 0003 for BOD, TSS and fecal coliform bacteria; and a design influent loading for PCBs to the Walnut Shell Filtration System.

Kaiser has complied with the effluent limits and permit conditions throughout the duration of the permit over the past five years with the few exceptions noted below. Ecology assessed compliance based on its review of the facility's discharge monitoring reports (DMRs) and on inspections.

The following table summarizes these effluent violations.

Table 11: Summary of Compliance with Previous Permit

Date	Outfall	Parameter	Units	Value	Min/Max Limit
June 2017	0001	pH Max	Standard units.	10.9	9
June 2018	0001	pH Min	Standard units.	5.8	6
November 2020	0001	pH Min	Standard units.	3.8	6
March 2017	BWSI	PCBs	grams/day	0.97	0.78
April 2017	BWSI	PCBs	grams/day	1.09	0.78
July 2017	BWSI	PCBs	grams/day	0.865	0.78
May 2019	BWSI	PCBs	grams/day	1.54	0.78
July 2019	BWSI	PCBs	grams/day	1.41	0.78

The June 2017 pH exceedances resulted from intermittent power issues that resulted in anomalous pH readings on June 2 and 3.

On June 24-29, 2018, effluent pH levels at Outfall 0001 went outside of the permitted range. The Permittee reported that the pH dropped from 6.2 to 5.9 within a two-minute interval on June 24. The pH remained at that level until June 29 when it increased from 5.9 to 6.2 within a two-minute interval. At the time, the Permittee routinely performed daily pH checks, but used pH test strips. Because of this incidence, Kaiser purchased a hand held pH probe to perform these daily checks.

In November 2020, the Permittee reported that a broken pH probe caused erroneous readings. The Permittee promptly replaced the probe and pH readings returned to within the permitted range.

In July 2019, Kaiser had an exceedance of the influent design loading criteria for PCBs to the walnut shell filter system. In its non-compliance report, Kaiser reported a significant level of mobilization of PCB loading occurred during sludge removal and dewatering of the wastewater-settling lagoon.

During this work, the lagoon was bypassed and small auxiliary settling basins were used. Sampling indicated PCBs were being mobilized during the use of the auxiliary settling basins. Kaiser did not identify an internal source of PCBs that would have caused an exceedance of the inlet loading criteria.

In May 2019, Kaiser reported an exceedance of the design criteria for PCB inlet loading of the Walnut Shell Filtration System. However, the exceedance was likely caused by a laboratory interference that resulted in elevated detection levels.

The Permittee also exceeded the design loading criteria to the Walnut Shell Filtration System for March, April and July 2017. These exceedances triggered the sludge removal action at the exit section of the settling lagoon.

The following table summarizes other violations and permit triggers that occurred during the last five years. Permit triggers are not violations but rather when triggered require the permit holder to take an action defined in the permit.

Table 12: Violations/Permit Triggers

Date	Violation	Number of Violations	Notes
June 2017	Analysis not Conducted	2	Samples lost in laboratory after collection
July 2017	Analysis not Conducted	2	Samples lost in laboratory after collection
June 2018	Analysis not Conducted	20	Samples lost due to sampler malfunction
January 2019	Frequency of Sampling Violation	22	Missed sample collection due to operator error
April 2019	Frequency of Sampling Violation	2	Samples lost in laboratory after collection
October 2019	Late Submittal of DMRs	1	DMR submitted 1 day late
May 2020	Late Submittal of DMRs	1	DMR submitted 26 days late

E. State environmental policy act (SEPA) compliance

State law exempts the issuance, reissuance or modification of any wastewater discharge permit from the SEPA process as long as the permit contains conditions that are no less stringent than federal and state rules and regulations (RCW 43.21C.0383). The exemption applies only to existing discharges, not to new discharges.

III. Proposed Permit Limits

Federal and state regulations require that effluent limits in an NPDES permit must be either technology- or water quality-based.

- Technology-based limits are based upon the treatment methods available to treat specific pollutants. Technology-based limits are set by the EPA and published as a regulation, or Ecology develops the limit on a case-by-case basis (40 CFR 125.3, and Chapter 173-220 WAC).
- Water quality-based limits are calculated so that the effluent will comply with the Surface Water Quality Standards (Chapter 173-201A WAC), Ground Water Standards (Chapter 173-200 WAC), Sediment Quality Standards (Chapter 173-204 WAC), or the Federal Water Quality Criteria Applicable to Washington (40 CFR 131.45).
- Ecology must apply the most stringent of these limits to each parameter of concern. These limits are described below.

The limits in this permit reflect information received in the application and from supporting reports (engineering, hydrogeology, etc.). Ecology evaluated the permit application and determined the limits needed to comply with the rules adopted by the state of Washington. Ecology does not develop effluent limits for all reported pollutants. Some pollutants are not treatable at the concentrations reported, are not controllable at the source, are not listed in regulation, and do not have a reasonable potential to cause a water quality violation.

Ecology does not usually develop limits for pollutants not reported in the permit application but may be present in the discharge. The permit does not authorize discharge of the non-reported pollutants. During the five-year permit term, the facility's effluent discharge conditions may change from those conditions reported in the permit application. Under permit condition G20, the facility must notify Ecology if significant changes occur in any constituent. Until Ecology modifies the permit to reflect additional discharge of pollutants, a permitted facility could be violating its permit.

A. Design criteria

Under WAC 173-220-150 (1)(g), flows and waste loadings must not exceed approved design criteria. Ecology approved design criteria for inlet PCB loadings to the Walnut Shell Filtration System (CDM, 2002). The table below includes design criteria from the referenced report.

Table 13: Design Criteria for Walnut Shell Filtration System

Parameter	Design Quantity
Daily Maximum Flow	11.0 mgd
Influent Total PCB Loading	0.78 g/day

B. Technology-based effluent limits

Process Wastewaters

Technology-based limitations for aluminum forming are based on Best Available Technology (BAT) limits for toxic and nonconventional pollutants; and Best Conventional Technology (BCT) limits for conventional pollutants. For aluminum forming, BCT limits have not been promulgated. Therefore, Best Practical Technology (BPT) limits are assumed to equal BCT.

New Source Performance Standards (NSPS) also applies to expanded horizontal heat treat production. The Environmental Protection Agency (EPA) has developed these limits, found in the Code of Federal Regulations (CFR), current as of July 1, 2014, as follows:

Table 14: Technology-based Limits for Outfall 0006

Subcategory	Technology
Rolling with Neat Oils (40 CFR 467, Subpart A, Core without an annealing furnace scrubber)	BAT/BCT
Rolling with Emulsions (40 CFR 467, Subpart B, Core)	BAT/BCT
Rolling with Neat Oils (40 CFR 467, Subpart A, Solution Heat Treating Contact Cooling Water)	BAT/BCT
Rolling with Emulsions (40 CFR Part 467, Subpart B, Direct Chill Casting Contact Cooling Water)	BAT/BCT
Rolling with Emulsions (40 CFR Part 467, Subpart B, Solution Heat Treating Contact Cooling Water)	BAT/BCT & NSPS

The Permittee also generates non-scope wastewaters (those wastewater generated from processes not covered under the effluent guidelines). Guidance for setting discharge limits for non-scope wastewater is provided by amendments to the original publication of the Development Document for the Aluminum Forming Point Source Category. The amendments with corresponding explanation were published in the Federal Register (Vol. 53, No. 248, December 27, 1988).

For wastewater discharged from the industrial wastewater treatment plant, applicable subcategories (i.e. building blocks) included Rolling with Neat Oils (Core) and Rolling with Emulsions (Core). For wastewaters discharged directly into the wastewater lagoon (via the north and south Outfalls), building blocks include Rolling with Neat Oils (Solution Heat Treatment Contact Cooling Water) and Rolling with Emulsions (Direct Chill Casting Contact Cooling Water and Solution Heat Treatment Contact Cooling Water). Additionally, since the majority of the wastewater discharge to the wastewater lagoon is non-scope wastewater, allowance for non-scope discharge is also applicable.

The guidance for setting discharge limits for non-scope wastewater states that the discharge limits should be determined from the product of the wastewater flow rate and treatment limits as given in Section VII of the Development Document. The resulting quantity can then be added to other process wastewater building blocks to determine the total mass discharge limit.

From the 2015 permit renewal application data an estimated average non-scope wastewater flow rate is 7.40 mgd. One-day maximum and thirty-day average treatment limits for lime settling and filtration (LS&F) provided in Table VII-20, Section VII of the Development Document were used in determining the non-scope allowances. The treatment limits were then multiplied by the average flow rate to give the allowable non-scope mass allowance (non-production based mass allowance). These values were added to the process wastewater building blocks in calculating the total allowable mass discharge limits.

The resulting technology-based effluent limits for process wastewater discharged from Outfall 0006 are summarized below:

Table 15: Technology-based Limits for Outfall 0006

Pollutant	Daily Average	Daily Maximum
Chromium, lbs/day	5.2	17.6
Cyanide, lbs/day	0.8	1.9
Zinc, lbs/day	16.2	49.8
Aluminum, lbs/day	117.1	287.0
Oil and Grease, lbs/day	533.5	609.9
TSS, lbs/day	610.3	1,019.9

Parameter	Daily Minimum	Daily Maximum
pH	6.0 standard units	9.0 standard units

The Permittee has consistently met their existing permit limits at Outfall 0006. Based on best professional judgement, Ecology also considered the case-by-case technology-based effluent limitations for chromium, cyanide, aluminum, oil & grease, and TSS established on existing performance-based permit limits:

Table 16: Existing Case-by-Case Technology-based Limits for Outfall 0006

	Effluent Limitations	Effluent Limitations
Effluent Characteristic	**Daily Average**	**Daily Maximum**
Chromium, lbs/day	2.1	5.1

	Effluent Limitations	Effluent Limitations
Cyanide, lbs/day	0.53	1.27
Aluminum, lbs/day	7.5	14.4
Oil & Grease, lbs/day	374.7	565.3
TSS, lbs/day	406.1	903.9

When the discharger demonstrates certain conditions, federal rules in 40 CFR Part 122.45(g) allow the adjustment of technology based effluent limits to reflect credit for pollutants in the discharge's intake water. In this instance, the applicable provisions include 40 CFR Part 122.45(g)(1)(ii), the control system would meet the applicable technology-based limitation in the absence of pollutants in the Spokane River intake water; and 40 CFR Part 122.45(g)(2), the generic measure of TSS in the effluent is substantially similar to the generic measure of TSS in the Spokane River intake water. Kaiser demonstrated these conditions during a previous permit renewal.

The proposed permit will specify this intake water credit by allowing Kaiser to calculate discharge quantities of chromium, aluminum, oil and grease, and TSS on a net basis, by subtracting Spokane River intake water loadings from Outfall 0006 loadings.

Domestic Wastewater

Federal and state regulations define secondary treatment effluent limits for domestic wastewater treatment plants. These effluent limits are given in 40 CFR Part 133 (federal) and in chapter 173-221 WAC (state).

Domestic wastewater facilities, which receive less concentrated influent wastewater, are eligible for a lower percent removal effluent limit or a lower mass loading limit based on the lower percent removal provided the facility can demonstrate all of the elements listed below:

- The wastewater facility consistently achieves the effluent concentration limits and mass limits based upon the effluent concentrations.
- That to meet the percent removal requirements, the wastewater facility would have to achieve an effluent concentration at least 5 mg/L below the effluent concentration otherwise required.
- The less concentrated influent is not the result of excessive infiltration and/or inflow (I/I).
- The wastewater facility must have developed and implemented an Ecology-approved program for ongoing maintenance, repair, and replacement including I/I control.

Ecology may approve a request for alternative limits only if a facility meets all of the following conditions.

- The discharge must not cause water quality violations.

- The facility must identify effluent concentrations consistently achievable through proper operation and maintenance.
- The facility must demonstrate that industrial wastewater does not interfere with the domestic wastewater facility.
- The wastewater facility must be within Ecology-approved hydraulic and organic design loading capacity.
- The facility must evaluate whether seasonal alternative limits are more appropriate than year-round.
- The facility must meet all other permit requirements and conditions.

Ecology reviewed the information in the past record and will continue to not include percent removal requirements for TSS and BOD_5 because of the dilute nature of the Permittee's domestic wastewater. Instead, the proposed permit will contain effluent BOD and TSS loadings based on a limiting design flow through the secondary clarifier of 192,000 gpd (CH2M Engineers, 1970).

Table 17 identifies technology-based limits for fecal coliform, BOD_5, and TSS, as listed in chapter 173-221-040 WAC, secondary treatment standards. Section III.G of this fact sheet describes the potential for water quality-based limits.

Table 17: Technology-based Limits for Outfall 0003

Parameter	Average Monthly Limit	Average Weekly Limit
BOD_5	30 mg/L, 42 lbs/day	45 mg/L, 72 lbs/day
TSS	30 mg/L, 42 lbs/day	45 mg/L, 72 lbs/day

Parameter	Monthly Geometric Mean Limit	Weekly Geometric Mean Limit
Fecal Coliform Bacteria	200 organisms/100 mL	400 organisms/100 mL

C. Surface water quality-based effluent limits

The Washington State surface water quality standards (Chapter 173-201A WAC) are designed to protect existing water quality and preserve the beneficial uses of Washington's surface waters. Waste discharge permits must include conditions that ensure the discharge will meet the surface water quality standards (WAC 173-201A-510). Water quality-based effluent limits may be based on an individual waste load allocation or on a waste load allocation developed during a basin wide total maximum daily load study (TMDL).

Numeric criteria for the protection of aquatic life and recreation

Numeric water quality criteria are listed in the water quality standards for surface waters (Chapter 173-201A WAC). They specify the maximum levels of pollutants allowed in receiving water to protect aquatic life and recreation in and on the water. Ecology uses numeric criteria along with chemical and physical data for the wastewater and receiving water to derive the effluent limits in the discharge permit. When surface water quality-based limits are more stringent or potentially more stringent than technology-based limits, the discharge must meet the water quality-based limits.

Numeric criteria for the protection of human health

Numeric water quality criteria for the protection of human health are promulgated in Chapter 173-201A WAC and 40 CFR 131.45. These criteria are designed to protect humans from exposure to pollutants linked to cancer and other diseases, based on consuming fish and shellfish and drinking contaminated surface waters. The water quality standards also include radionuclide criteria to protect humans from the effects of radioactive substances.

Ecology submitted a standards revision for 192 new human health criteria for 97 pollutants to EPA on August 1, 2016. In accordance with requirements of CWA section 303(c) (2) (B), EPA finalized 144 new and revised Washington specific human health criteria for priority pollutants, to apply to waters under Washington’s jurisdiction. EPA approved 45 human health criteria as submitted by Washington. The EPA took no action on Ecology submitted criteria for arsenic, dioxin, and thallium. The existing criteria for these three pollutants remain in effect and were included in 40 CFR 131.45, Revision of certain Federal Water quality criteria applicable to Washington.

On May 13, 2020, EPA issued a final rule that withdrew the initial action on PCBs changing the criteria for PCBs from seven parts per quadrillion (ppq) to 170 ppq. Recently (June 30, 2021), EPA filed a motion with the federal court that provides time for EPA to propose new human health criteria for Washington.

Specifically, EPA proposes to:

- Issue a proposed rule establishing protective federal human health criteria applicable to Washington’s surface waters.
- Put that rule out for public comment.
- Finalize a rule for Washington in 18 months.

Until a new federal rule is in place, Ecology based the proposed permit on the current applicable human health the criteria, which Ecology listed in WAC 173-201A-240, Toxic Substances Criteria. For PCBs, the current applicable human health criteria for PCBs is 170 ppq.

General condition G3 of the permit allows Ecology to modify, revoke, reissue or terminate a permit under certain conditions. One of the conditions includes the promulgation of new or amended standards or regulations having a direct bearing upon permit conditions, or requiring permit revision. When EPA finalizes its new rule, Ecology will evaluate the impact to the permit resulting from any changes to the criteria. Ecology will then take appropriate actions, which could include modifying the current permit or including new requirements in the next permit issuance.

Narrative criteria

Narrative water quality criteria (e.g., WAC 173-201A-240(1); 2006) limit the toxic, radioactive, or other deleterious material concentrations that the facility may discharge to levels below those that have the potential to do the following:

- Adversely affect designated water uses.
- Cause acute or chronic toxicity to biota.
- Impair aesthetic values.
- Adversely affect human health.

Narrative criteria protect the specific designated uses of all fresh waters (WAC 173-201A-200, 2016) and of all marine waters (WAC 173-201A-210, 2016) in the state of Washington.

Antidegradation

Description – The purpose of Washington's Antidegradation Policy (WAC 173-201A-300-330; 2016) is to:

- Restore and maintain the highest possible quality of the surface waters of Washington.
- Describe situations under which water quality may be lowered from its current condition.
- Apply to human activities that are likely to have an impact on the water quality of surface water.
- Ensure that all human activities likely to contribute to a lowering of water quality, at a minimum, apply all known, available, and reasonable methods of prevention, control, and treatment (AKART).
- Apply three tiers of protection (described below) for surface waters of the state.

Tier I: ensures existing and designated uses are maintained and protected and applies to all waters and all sources of pollutions.

Tier II: ensures that waters of a higher quality than the criteria assigned are not degraded unless such lowering of water quality is necessary and in the overriding public interest. Tier II applies only to a specific list of polluting activities.

Tier III: prevents the degradation of waters formally listed as "outstanding resource waters," and applies to all sources of pollution.

A facility must prepare a Tier II analysis when all three of the following conditions are met:

- The facility is planning a new or expanded action.
- Ecology regulates or authorizes the action.
- The action has the potential to cause measurable degradation to existing water quality at the edge of a chronic mixing zone.

Facility Specific Requirements — this facility must meet Tier I requirements.

- Dischargers must maintain and protect existing and designated uses. Ecology must not allow any degradation that will interfere with, or become injurious to, existing or designated uses, except as provided for in Chapter 173-201A WAC.
- For waters that do not meet assigned criteria, or protect existing or designated uses, Ecology will take appropriate and definitive steps to bring the water quality back into compliance with the water quality standards.
- Whenever the natural conditions of a water body are of a lower quality than the assigned criteria, the natural conditions constitute the water quality criteria. Where water quality criteria are not met because of natural conditions, human actions are not allowed to further lower the water quality, except where explicitly allowed in Chapter 173-201A WAC.

Ecology's analysis described in this section of the fact sheet demonstrates that the proposed permit conditions will protect existing and designated uses of the receiving water.

Mixing zones

A mixing zone is the defined area in the receiving water surrounding the discharge port(s), where wastewater mixes with receiving water. Within mixing zones, the pollutant concentrations may exceed water quality numeric standards, so long as the discharge does not interfere with designated uses of the receiving water body (for example, recreation, water supply, and aquatic life and wildlife habitat, etc.) The pollutant concentrations outside of the mixing zones must meet water quality numeric standards.

State and federal rules allow mixing zones because the concentrations and effects of most pollutants diminish rapidly after discharge, due to dilution. Ecology defines mixing zone sizes to limit the amount of time any exposure to the end-of-pipe discharge could harm water quality, plants, or fish.

The state's water quality standards allow Ecology to authorize mixing zones for the facility's permitted wastewater discharges only if those discharges already receive all known, available, and reasonable methods of prevention, control, and treatment (AKART).

Mixing zones typically require compliance with water quality criteria within a specified distance from the point of discharge and must not use more than 25% of the available width of the water body for dilution [WAC 173-201A-400 (7)(a)(ii-iii)].

Ecology uses modeling to estimate the amount of mixing within the mixing zone. Through modeling, Ecology determines the potential for violating the water quality standards at the edge of the mixing zone and derives any necessary effluent limits. Steady-state models are the most frequently used tools for conducting mixing zone analyses.

Ecology chooses values for each effluent and for receiving water variables that correspond to the time-period when the most critical condition is likely to occur (see Ecology's Permit Writer's Manual available online at https://apps.ecology.wa.gov/publications/documents/92109.pdf). Each critical condition parameter, by itself, has a low probability of occurrence and the resulting dilution factor is conservative. The term "reasonable worst-case" applies to these values.

The mixing zone analysis produces a numerical value called a dilution factor (DF). A dilution factor represents the amount of mixing of effluent and receiving water that occurs at the boundary of the mixing zone. For example, a dilution factor of four means the effluent is 25% and the receiving water is 75% of the total volume of water at the boundary of the mixing zone. Ecology uses dilution factors with the water quality criteria to calculate reasonable potentials and effluent limits. Water quality standards include both aquatic life-based criteria and human health-based criteria. The former is applied at both the acute and chronic mixing zone boundaries; the latter are applied only at the chronic boundary. The concentration of pollutants at the boundaries of any of these mixing zones may not exceed the numerical criteria for that zone.

Each aquatic life **acute** criterion is based on the assumption that organisms are not exposed to that concentration for more than one hour and more often than one exposure in three years. Each aquatic life **chronic** criterion is based on the assumption that organisms are not exposed to that concentration for more than four consecutive days and more often than once in three years.

The two types of human health-based water quality criteria distinguish between those pollutants linked to non-cancer effects (non-carcinogenic) and those linked to cancer effects (carcinogenic). The human health-based water quality criteria incorporate several exposure and risk assumptions.

These assumptions include:

- A 70-year lifetime of daily exposures.
- An ingestion rate for fish or shellfish measured in kg/day.
- An ingestion rate of two and four tenths (2.4) liters/day for drinking water (increased from two liters/day in the 2016 Water Quality Standards update).
- A one-in-one-million cancer risk for carcinogenic chemicals.

This permit authorizes a small acute mixing zone, surrounded by a chronic mixing zone around the point of discharge (WAC 173-201A-400). The water quality standards impose certain conditions before allowing the discharger a mixing zone:

1. **Ecology must specify both the allowed size and location in a permit.**

   The proposed permit specifies the size and location of the allowed mixing zone (as specified below).

2. **The facility must fully apply "all known, available, and reasonable methods of prevention, control and treatment" (AKART) to its discharge.**

   Ecology has determined that the treatment provided at Kaiser meets the requirements of AKART (see "Technology-based Limits").

3. **Ecology must consider critical discharge conditions.**

   Surface water quality-based limits are derived for the water body's critical condition (the receiving water and waste discharge condition with the highest potential for adverse impact on the aquatic biota, human health, and existing or designated waterbody uses). The critical discharge condition is often pollutant-specific or waterbody-specific.

   Critical discharge conditions are those conditions that result in reduced dilution or increased effect of the pollutant. Factors affecting dilution include the depth of water, the density stratification in the water column, the currents, and the rate of discharge. Density stratification is determined by the salinity and temperature of the receiving water. Temperatures are warmer in the surface waters in summer. Therefore, density stratification is generally greatest during the summer months. Density stratification affects how far up in the water column a freshwater plume may rise. The rate of mixing is greatest when an effluent is rising. The effluent stops rising when the mixed effluent is the same density as the surrounding water. After the effluent stops rising, the rate of mixing is much more gradual. Water depth can affect dilution when a plume might rise to the surface when there is little or no stratification. Ecology's Permit Writer's Manual describes additional guidance on criteria/design conditions for determining dilution factors. The manual is available online at https://apps.ecology.wa.gov/publications/documents/92109.pdf.

   Ecology estimated the critical river flows at the Permittee's point of discharge based on data from the USGS gauging station for the Spokane River (at Spokane USGS 12422500). Ecology calculated critical river flows at this gauge using data from 2009 to present. In June 2009, the Federal Energy Regulatory Commission reissued a license to Avista Utilities for their operation and maintenance of five hydroelectric projects on the Spokane River. The license requires Avista Utilities to maintain a minimum discharge of 600 cfs from the Post Falls dam in Idaho from June 7 until the Tuesday following Labor Day each year, and reduce the minimum discharge to 500 cfs if the water level in Lake Coeur d'Alene falls below 2,127.75 feet during the summer full-pool period. The FERC flow requirements have resulted in increased summertime flows in the Spokane River.

The following table shows critical flows for the Spokane River at Spokane gauge (USGS 12422500):

Table 18: Critical Flows for the Spokane River at Spokane (USGS 12422500)

Critical Condition	Flow
Seven-day-average low river flow with a recurrence interval of ten years (7Q10)	749 cubic feet per second (cfs)
Thirty-day low river flow with a recurrence interval of five years (30Q5)	892 cfs
Harmonic mean river flow	2,728 cfs

Ecology then adjusted these critical flows based on measurements taken by Ecology at 11 river stations during August 2005 and 2006 (Covert, 2016). One of these stations included the Centennial Trail Bridge below Plantes Ferry Park, about 1.7 miles downstream from the Permittee's outfall. The table below compares measured flows at the Centennial Trail Bridge below Plantes Ferry Park with flows at Spokane River at Spokane:

Table 19: River Flow Measurements at the Centennial Trail Bridge and the Spokane River at Spokane (USGS 12322500)

Measured Flows (cfs)	Centennial Trail Bridge	Spokane River at Spokane (USGS 12422500)	Difference
Date			
August 2005	492	613	-121
August 2006	579	750	-171

The August 2006 flows for the Spokane River at Spokane approximated the 7Q10 value of 749 cfs. Ecology used the difference of 171 cfs to estimate the critical 7Q10 and 30Q5 river flows at the point of discharge. Ecology did not have representative flows at the harmonic mean flowrate; therefore, used the difference of 171 cfs for the adjustment.

Table 20: Critical Conditions Used to Model the Discharge at Kaiser

Critical Condition	Spokane River at Spokane (USGS 12422500)	Adjustment	Point of Discharge
Seven-day-average low river flow with a recurrence interval of ten years (7Q10), cfs	749	-171	578

Critical Condition	Spokane River at Spokane (USGS 12422500)	Adjustment	Point of Discharge
Thirty-day low river flow with a recurrence interval of five years (30Q5), cfs	892	-171	721
Harmonic mean river flow, cfs	2,728	-171	2,557

Critical Condition	Effluent
Maximum average monthly effluent flow for chronic and human health non-carcinogen	6.24 million gallons per day (mgd)
Annual average flow for human health carcinogen	5.65 mgd
Maximum daily flow for acute mixing zone	7.90 mgd

Ecology obtained critical water quality ambient data from Ecology's EIM System for water quality monitoring stations upstream of the discharge. Table 5 lists this data.

4. **Supporting information must clearly indicate the mixing zone would not:**

- Have a reasonable potential to cause the loss of sensitive or important habitat.
- Substantially interfere with the existing or characteristic uses.
- Result in damage to the ecosystem.
- Adversely affect public health.

Ecology established Washington State water quality criteria for toxic chemicals using EPA criteria. EPA developed the criteria using toxicity tests with numerous organisms and set the criteria to generally protect the species tested and to fully protect all commercially and recreationally important species.

EPA sets acute criteria for toxic chemicals assuming organisms are exposed to the pollutant at the criteria concentration for one hour. They set chronic standards assuming organisms are exposed to the pollutant at the criteria concentration for four days. Dilution modeling under critical conditions generally shows that both acute and chronic criteria concentrations are reached within minutes of discharge.

The discharge plume does not impact drifting and non-strong swimming organisms because they cannot stay in the plume close to the outfall long enough to be affected. Strong swimming fish could maintain a position within the plume, but they can also avoid the discharge by swimming away. Mixing zones generally do not affect benthic organisms (bottom dwellers) because the buoyant plume rises in the water column.

Ecology has additionally determined that the effluent will not exceed 33 degrees C for more than two seconds after discharge; and that the temperature of the water will not create lethal conditions or blockages to fish migration.

Ecology evaluates the cumulative toxicity of an effluent by testing the discharge with whole effluent toxicity (WET) testing.

Because this facility includes domestic wastewater as part of its wastestream at internal Outfall 0003, the effluent at Outfall 0001 contains fecal coliform bacteria. Ecology developed the water quality criteria for fecal coliforms (discussed below) to assure that people swimming (primary contact recreation) in water meeting the criteria would not develop gastro enteric illnesses.

Ecology has authorized a mixing zone for this discharge; the internal Outfall 0003 is subject to a technology-based effluent limit of 200-colony forming units/100mL. With dilution from process wastewater streams, the effluent meets the water quality criteria at the point of discharge and does not need dilution to meet the water quality criteria.

O January 1, 2021, the recreational water quality criteria for bacteria changed to *E.coli* for freshwater. No change to the indicator will occur during this permit cycle as a site-specific correlation between fecal coliform and *E.coli* needs developing. The next permit cycle will require Kaiser to meet the primary contact *E.coli* standard.

Ecology reviewed the above information, the specific information on the characteristics of the discharge, the receiving water characteristics and the discharge location. Based on this review, Ecology concluded that the discharge does not have a reasonable potential to cause the loss of sensitive or important habitat, substantially interfere with existing or characteristics uses, result in damage to the ecosystem, or adversely affect public health if the permit limits are met.

5. **The discharge/receiving water mixture must not exceed water quality criteria outside the boundary of a mixing zone.**

Ecology conducted a reasonable potential analysis using procedures established by the EPA and by Ecology, for each pollutant and concluded the discharge/receiving water mixture will not violate water quality criteria outside the boundary of the mixing zone if permit limits are met.

6. **The size of the mixing zone and the concentrations of the pollutants must be minimized.**

At any given time, the effluent plume uses only a portion of the acute and chronic mixing zone, which minimizes the volume of water involved in mixing. The plume mixes as it rises through the water column therefore much of the receiving water volume at lower depths in the mixing zone is not mixed with discharge.

Similarly, because the discharge may stop rising at some depth due to density stratification, waters above that depth will not mix with the discharge. Ecology determined it is impractical to specify in the permit the actual, much more limited volume in which the dilution occurs as the plume rises and moves with the current.

Ecology minimizes the size of mixing zones by requiring dischargers to install diffusers when they are appropriate to the discharge and the specific receiving waterbody. When a diffuser is installed, the discharge is more completely mixed with the receiving water in a shorter time. Ecology also minimizes the size of the mixing zone (in the form of the dilution factor) using design criteria with a low probability of occurrence. For example, Ecology uses the expected 95th percentile pollutant concentration, the 90th percentile background concentration, the centerline dilution factor, and the lowest flow occurring once in every ten years to perform the reasonable potential analysis.

Because of the above reasons, Ecology has effectively minimized the size of the mixing zone authorized in the proposed permit.

7. **Maximum size of mixing zone.**

The authorized mixing zone does not exceed the maximum size restriction.

8. **Acute mixing zone.**

- The discharge/receiving water mixture must comply with acute criteria as near to the point of discharge as practicably attainable.

Ecology determined the acute criteria would be met at 10% of the volume fraction of the chronic mixing zone at the ten-year low flow.

- The pollutant concentration, duration, and frequency of exposure to the discharge will not create a barrier to migration or translocation of indigenous organisms to a degree that has the potential to cause damage to the ecosystem.

As described above, the toxicity of any pollutant depends upon the exposure, the pollutant concentration, and the time the organism is exposed to that concentration. Authorizing a limited acute mixing zone for this discharge assures that it will not create a barrier to migration. The effluent from this discharge will rise as it enters the receiving water, assuring that the rising effluent will not cause translocation of indigenous organisms near the point of discharge (below the rising effluent).

- Comply with size restrictions.

The mixing zone authorized for this discharge complies with the size restrictions published in Chapter 173-201A WAC.

9. **Overlap of Mixing Zones.**

This mixing zone does not overlap another mixing zone.

D. Designated uses and surface water quality criteria

Applicable designated uses and surface water quality criteria are defined in Chapter 173-201A WAC. In addition, the U.S. EPA has also set human health criteria for certain toxic pollutants in 40 CFR Part 131.45. The table included below summarizes the criteria applicable to this facility’s discharge.

- Aquatic Life Uses are designated based on the presence of, or the intent to provide protection for the key uses. All indigenous fish and non-fish aquatic species must be protected in waters of the state in addition to the key species.

  The **Aquatic Life Uses** for this receiving water are identified below.

Freshwater Aquatic Life Uses and Associated Criteria

Table 21: Salmonid Spawning, Rearing, and Migration

Criteria	Value
Temperature Criteria – Highest 7-DAD MAX	17.5°C (63.5°F)
Dissolved Oxygen Criteria – Lowest 1-Day Minimum	8.0 mg/L
Turbidity Criteria	• 5 NTU over background when the background is 50 NTU or less; or • A 10 percent increase in turbidity when the background turbidity is more than 50 NTU.
Total Dissolved Gas Criteria	Total dissolved gas must not exceed 110 percent of saturation at any point of sample collection.
pH Criteria	The pH must measure within the range of 6.5 to 8.5 with a human-caused variation within the above range of less than 0.5 units.

The **recreational uses** for this receiving water are identified below.

Table 22: Recreational Uses and Associated Criteria

Recreational Use	Criteria
Primary Contact Recreation	*E.coli* organism levels must not exceed a geometric mean value of 100 CFU or MPN per 100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained within the averaging period exceeding 320 CFU or MPN per 100 mL.

- The water supply uses are domestic, agricultural, industrial, and stock watering.
- The miscellaneous freshwater uses are wildlife habitat, harvesting, commerce and navigation, boating, and aesthetics.

An additional special condition applies to the Spokane River. From Nine Mile Bridge (river mile 58.0) to the Idaho Border (river mile 96.5), temperature shall not exceed a one-day maximum (1-DMax) of 20.0°C due to human activities.

E. Water quality impairments

Ecology routinely assesses available water quality data on a statewide basis. Ecology submits these results to the Environmental Protection Agency (EPA) as an “integrated report” to satisfy Sections 303(d) and 305(b) of the federal Clean Water Act. EPA recommends the listing of water quality for a particular location in one of five categories. Categories one through four represent the 305(b) Report that assesses the overall status of water quality in the State. Category five waters represent the 303(d) list, which are known impaired waters in the State.

A total daily maximum load (TMDL) is required for each pollutant on the 303(d) list that EPA has determined is suitable for such a calculation. A TMDL is not required if other pollution control requirements result in compliance with the applicable water quality standard(s). A TMDL determines the amount of pollution a water body can receive while still meeting water quality standards. The TMDL sets maximum allowable pollution from various sources as either individual waste load allocations (WLAs) for point sources or load allocations (LAs) for nonpoint sources.

The current (2016) 303(d) list contains multiple segments in the Spokane River. River segments are listed for temperature, dissolved oxygen, PCBs in fish tissue, and dioxin in fish tissue. At the discharge location, listings include temperature, PCBs in fish tissue, and dioxin in fish tissue.

Category 4a waters of the 305(b) report represent impaired waters that have an EPA approved TMDL in place and are actively being implemented. In the Spokane River, this includes the Spokane River Metals TMDL addressing cadmium, lead, and zinc (Ecology, 1999); and the Spokane River Dissolved Oxygen TMDL for total phosphorus and dissolved oxygen (Ecology, 2010). Specific WLAs applicable to the Permittee are discussed in the next section below.

The previous permit issued on June 23, 2011, included a comprehensive approach toward addressing point and nonpoint sources of PCBs in the Spokane River. The permit required the permitted to participate in formation and funding of the Spokane River Regional Toxics Task Force (Task Force). The goal of the Task Force is to develop a comprehensive plan to bring the Spokane River into compliance with applicable water quality standards for PCBs.

The previous permit included specific tasks for the Permittee to work with the Task Force to accomplish, including completion of the comprehensive plan by December 2016.

Ecology developed a criterion by which it could assess the measurable progress of the Task Force’s efforts in meeting water quality criteria for PCBs online at http://srrttf.org/?attachment_id=6029.

Section H discusses specific Best Management Practices (BMPs) and Task Force milestones applicable to the Permittee for the discharge of PCBs.

F. Evaluation of surface water quality-based effluent limits for narrative criteria

Ecology must consider the narrative criteria described in WAC 173-201A-260 when it determines permit limits and conditions. Narrative water quality criteria limit the toxic, radioactive, or other deleterious material concentrations that the facility may discharge which have the potential to adversely affect designated uses, cause acute or chronic toxicity to biota, impair aesthetic values, or adversely affect human health.

Ecology considers narrative criteria when it evaluates the characteristics of the wastewater and when it implements all known, available, and reasonable methods of treatment and prevention (AKART) as described above in the technology-based limits section. When Ecology determines if a facility is meeting AKART it considers the pollutants in the wastewater and the adequacy of the treatment to prevent the violation of narrative criteria.

In addition, Ecology considers the toxicity of the wastewater discharge by requiring whole effluent toxicity (WET) testing when there is a reasonable potential for the discharge to contain toxics. Ecology’s analysis of the need for WET testing for this discharge is described later in the fact sheet.

G. Evaluation of surface water quality-based effluent limits for numeric criteria

Pollutants in an effluent may affect the aquatic environment near the point of discharge (near-field) or at a considerable distance from the point of discharge (far-field). Toxic pollutants, for example, are near-field pollutants; their adverse effects diminish rapidly with mixing in the receiving water. Conversely, a pollutant such as biological oxygen demand (BOD) is a far-field pollutant whose adverse effect occurs away from the discharge even after dilution has occurred. Thus, the method of calculating surface water quality-based effluent limits varies with the point at which the pollutant has its maximum effect.

With technology-based controls (AKART), predicted pollutant concentrations in the discharge exceed water quality criteria. Ecology therefore authorizes a mixing zone in accordance with the geometric configuration, flow restriction, and other restrictions imposed on mixing zones by Chapter 173-201A WAC.

The diffuser at Outfall 0001 is a submerged two-port diffuser located approximately in the middle of the river channel.

Chronic Mixing Zone — WAC 173-201A-400(7)(a) specifies that mixing zones must not extend in a downstream direction from the discharge ports for a distance greater than 300 feet plus the depth of water over the discharge ports, or extend upstream for a distance of over 100 feet, not utilize greater than 25% of the flow, and not occupy greater than 25% of the width of the water body.

The flow volume restriction resulted in a smaller chronic dilution factor than the distance downstream. The dilution factor below results from the volume restriction.

Acute Mixing Zone — WAC 173-201A-400(8)(a) specifies that in rivers and streams a zone where acute toxics criteria may be exceeded must not extend beyond 10% of the distance towards the upstream and downstream boundaries of the chronic zone, not use greater than 2.5% of the flow and not occupy greater than 25% of the width of the water body.

The flow volume restriction resulted in a smaller acute dilution factor than the distance downstream. The dilution factor below results from the volume restriction.

Ecology determined the dilution factors that occur within these zones at the critical condition using the effluent/receiving water flow volume restrictions. The dilution factors are listed below.

Table 23: Dilution Factors (DF)

Criteria	Acute	Chronic
Aquatic Life	2.5	20.4
Human Health, Non-carcinogen	---	24.1
Human Health, Carcinogen	---	74.1

Ecology determined the impacts of pH, ammonia, metals, other toxics, and temperature as described below, using the dilution factors in the above table. The derivation of surface water quality-based limits also takes into account the variability of pollutant concentrations in both the effluent and the receiving water.

Federal regulations (CFR Part 122.44(d)) require that NPDES permits contain limits to control all pollutants or pollutant parameters (either conventional, nonconventional, or toxic pollutants) which Ecology determines are, or may be, discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any State water quality standard, including State narrative criteria for water quality.

Dissolved Oxygen — **Total Phosphorus, Ammonia, and $CBOD_5$ Effects** — Natural decomposition of organic material in wastewater effluent impacts dissolved oxygen in the receiving water at distances far outside of the regulated mixing zone. The 5-day carbonaceous biochemical oxygen demand (BOD_5) of an effluent sample indicates the amount of carbon based biodegradable material in the wastewater and estimates the magnitude of oxygen consumption the wastewater will generate in the receiving water.

The amount of total phosphorus and ammonia-based nitrogen in the wastewater also provides an indication of oxygen demand in the receiving water.

Ecology has completed a dissolved oxygen TMDL, referenced above, and established effluent limits for total phosphorus, ammonia, and carbonaceous biochemical oxygen demand ($CBOD_5$).

The previous permit issued on June 23, 2011, contained a 10-year schedule of compliance for meeting final water quality based effluent limits for total phosphorus, $CBOD_5$, and ammonia derived from the waste load allocations from the TMDL.

Table 24: Final Water Quality Based Effluent Limitations

Parameter	Seasonal Average (March through October)
Ammonia, lbs/day	9.0
Total Phosphorus, lbs/day	3.21
$CBOD_5$, lbs/day	462.7

This compliance schedule required reductions in the total phosphorus, $CBOD_5$, and ammonia discharged to the Spokane River, through a combination of treatment technology and other target pursuit actions as incorporated into a delta elimination plan.

Treatment Technology: During the previous permit term, Kaiser identified that ferric sulfate addition to its sanitary treatment plant was the most effective technology for seasonally removing phosphorus from their effluent. In 2019, Kaiser completed installation of the system, which included ferric sulfate addition and pH adjustment at the headworks, and an additional ferric sulfate addition point prior to secondary clarification.

Delta Elimination Plan: A discharger's Delta is the actual pounds of phosphorus, $CBOD_5$, or ammonia discharged per day after the implementation of treatment technology minus the WLA target pounds. The Delta Elimination Plan would include a planned and scheduled group of actions aimed at eliminating a discharger's Delta.

Depending on the discharger, the Delta Elimination Plan could include a range of other phosphorus, $CBOD_5$, and ammonia removal actions such as conservation, effluent re-use, source control through support of regional phosphorus, $CBOD_5$, and ammonia reduction efforts (such as limiting use of fertilizers and dishwasher detergents), and supporting regional non-point source control efforts to be established. The plan, in combination with the pollutant reduction from technology, provides reasonable assurance of meeting the permit holder's WLAs in by the end of the ten year compliance schedule (by 2021). Kaiser was able to meet its WLAs with pollutant reduction from technology alone.

For a discharger, or group of dischargers, Delta Elimination can also consist of additional toolbox items that allow the development of alternate waste load allocations and WQBELs, as long as the resulting DO is consistent with that defined in the TMDL.

These toolbox items can include concepts such as pollutant equivalency (the exchange of one pollutant for another) and bubble limits (sum of applicable wasteload allocations for multiple points sources becomes a cap or bubble).

Kaiser and Inland Empire Paper Company have pursued a nutrient bubble limit. Under a bubble limit, an individual discharger is not considered in violation of their WQBEL, as long as the collective bubble limit is met during the same reporting period.

Bubble limits are a form of water quality offsets (under WAC 173-201A-450, https://apps.leg.wa.gov/wac/default.aspx?cite=173-201A-450). Ecology's Draft Water Quality Trading Framework also discusses bubble allocations between point source dischargers. EPA issued a draft test for "Compliance with Washington Water Quality Standards", which would allow the results of a given CE-QUAL-W2 simulation to be assessed in terms of whether its results were consistent with the TMDL. This test for compliance had three criteria, all of which must be met:

1. The alternate scenario must not increase the spatial or temporal extent of Avista responsibilities, after results are rounded to 0.1 mg/L.
2. The alternate scenario must not decrease the dissolved oxygen concentration averaged across all Avista-affected segments and times.
3. The alternate scenario must not increase Avista's responsibility in any segment or time, after results are rounded to 0.1 mg/L.

The procedure for developing a bubble limit for Kaiser and Inland Empire Paper included the following steps:

1. Verify model predictions to that ensure results match those of the model used to develop the TMDL.
2. Conduct loading sensitivity by varying pollutant loads for each discharger (e.g. 0, +/- 50%, +/- 100%)
3. Calculate linear response function. Two slopes were calculated, one for each increasing load and another for decreasing loads relative to the TMDL WLA. To match results of the TMDL, each line segment included the point with the wasteload allocation and a dissolved oxygen change of zero.
4. Calculate and incorporate safety factor. For increasing loads, the slope resulting in the largest incremental dissolved oxygen decrease was used. For decreasing loads, the slope resulting in the lowest incremental DO increase was used.
5. Ensure the results were consistent with the TMDL by procedures from EPA's draft test for "Compliance with Washington Water Quality Standards". The results met all of the three criteria described above.

Appendix E contains bubble limit calculations for $CBOD_5$ (LimnoTech 2020a). The results show a trading ratio for $CBOD_5$ of 2.9851 (a one-pound decrease in IEP $CBOD_5$ loading will allow for a 2.9851 pound increase in Kaiser $CBOD_5$ loading).

The proposed permit will specify a final water quality based effluent limit for $CBOD_5$ as:

- A seasonal average individual limit for $CBOD_5$ as 462.7 lbs/day
- A seasonal average bubble (aggregate) limit for $CBOD_5$ as:
  - 462.7 lbs/day, when the $CBOD_5$ seasonal average individual load from IEP is equal to or greater than 123.2 lbs/day

    - 462.7 + [123.2 - $CBOD_5$ seasonal average individual load from IEP (lbs/day)] x 2.9821, when the $CBOD_5$ seasonal average individual load from IEP is less than 123.2 lbs/day
- The Permittee will not be considered in violation of the seasonal average individual limit for $CBOD_5$ unless the seasonal average bubble (aggregate) limit is also exceeded.

Appendix E also contains the bubble limit calculations for total phosphorus (LimnoTech 2020b). These results show a trading ratio of 1.87 for total phosphorus (a one-pound decrease in IEP TP loading will allow for a 1.87-pound increase in Kaiser loading). Similarly, the proposed permit will specify a final water quality based effluent limit for total phosphorus as:

- A seasonal average individual limit for total phosphorus (as P) as 3.21 lbs/day
- A seasonal average bubble (aggregate) limit for total phosphorus (as P) as:
    - 3.21 lbs/day, when the total phosphorus (as P) seasonal average individual load from IEP is equal to or greater than 2.39 lbs/day
    - 3.21 + [2.39 – total phosphorus seasonal average individual load from Inland Empire Paper Company (lbs/day)] x 1.87, when the total phosphorus (as P) seasonal average individual load from IEP is less than 2.39 lbs/day
- The Permittee will not be considered in violation of the seasonal average individual limit for total phosphorus unless the seasonal average bubble (aggregate) limit is also exceeded.

pH — Ecology modeled the impact of the effluent pH on the receiving water using the calculations from EPA, 1988. These calculations require effluent and receiving water temperatures, pH, alkalinities and the chronic dilution factor tabulated above. Ecology did not have representative data for effluent alkalinity and used a range of alkalinity based on upstream receiving water data. **Appendix D** includes the model results.

Ecology predicts no violation of the pH criteria under critical conditions. Therefore, the proposed permit includes technology-based effluent limits for pH.

Bacteria — In the previous permit cycle, Ecology estimated that the discharge would not cause a violation of the fecal coliform water quality criterion based on the dilution of treated plant sanitary wastewater with other process wastewaters and the receiving water under critical conditions.

The changes to the State's surface water quality criteria for bacteria did not affect the domestic technology based limits for fecal coliform in WAC 173-221. Without a site-specific correlation between fecal coliform and *E.coli*, Ecology cannot determine whether the discharge will violate the water quality criterion for *E.coli*. Given that the characteristics of the receiving water and the discharge have not changed substantially since the analysis conducted in the previous permit cycle, the proposed permit will maintain the technology-based effluent limit for fecal coliform.

In addition, the Permittee will be required to monitor for both fecal coliform and *E.coli* for development of the site-specific correlation. Ecology will then use this data to assess the reasonable potential to exceed the applicable water quality criterion in the next iteration of this permit.

Turbidity - Ecology evaluated the impact of turbidity based on the range of turbidity in the effluent and turbidity of the receiving water. Based on visual observation of the facility's effluent, Ecology expects no violations of the turbidity criteria outside the designated mixing zone.

Cadmium, Lead, and Zinc - The Spokane River dissolved metals TMDL based-waste load allocations on the most restrictive permit limits derived by either meeting aquatic life toxicity criteria at effluent hardness at the end-of pipe, or based on maintaining existing concentrations of metals in effluent using performance based limits with an added 10 percent compliance buffer. Whichever method results in the lower limit will be selected for the permit limit and established as the wasteload allocation.

The Permittee withdraws a portion of their supply water from the Spokane River. The levels of cadmium, lead, and zinc in the intake water complicate the development of performance based limits for these parameters. For example, many times the zinc concentrations in the intake water at the facility exceeded those discharged. For this reason, the proposed permit will set limits based on the aquatic life water quality criteria and end-of-pipe hardness.

Ecology calculated criteria values based on information from the previous permit that assumed a 10^{th} percentile end-of-pipe hardness of 133 mg/L as $CaCO_3$.

The resulting limits are as follows:

Table 25: Spokane River Metals Criteria (End-of-pipe)

Metal	Monthly Average	Daily Maximum
Cadmium, µg/L	1.3	2.2
Lead, µg/L	7.0	12.1
Zinc, µg/L	75	146

Toxic Pollutants - Facilities with technology-based effluent limits must also meet the surface water quality standards.

The following toxic pollutants are present in the discharge: ammonia, heavy metals (aluminum, antimony, arsenic, chromium, copper, iron, manganese, mercury, nickel) and certain priority pollutant organics (acenapthene, chlorobenzene, diethylphthalate, dinitrotoluene, tetrachloroethylene, and trichloroethylene).

Ecology conducted a reasonable potential analysis (See **Appendix D**) on these parameters to determine whether it would require effluent limits in this permit.

Ammonia's toxicity depends on that portion which is available in the unionized form. The amount of unionized ammonia depends on the temperature and pH in the receiving freshwater. To evaluate ammonia toxicity, Ecology used the available receiving water information as listed in Table 5 and Ecology spreadsheet tools.

No valid ambient background data were available for acenapthene, antimony, chlorobenzene, tetrachloroethylene, thallium, and trichloroethylene. Ecology used zero for background. Valid ambient background data were available for other applicable pollutants (Table5). Ecology used all applicable data to evaluate reasonable potential for this discharge to cause a violation of water quality standards.

Ecology determined that these lists of pollutants pose no reasonable potential to exceed the water quality criteria at the critical condition using procedures given in EPA, 1991 (**Appendix D**) and as described above. Ecology’s determination assumes that this facility meets the other effluent limits of this permit.

Temperature - The state temperature standards (WAC 173-201A, WAC 173-201A-200, WAC 173-201A-600, and WAC 173-201A-602) include multiple elements:

- Annual summer maximum threshold criteria (June 15 to September 15)
- Supplemental spawning and rearing season criteria (September 15 to June 15)
- Incremental warming restrictions
- Protections against acute effects
- Ecology evaluates each criterion independently to determine reasonable potential and derive permit limits
- Annual summer maximum and supplementary spawning/rearing criteria

  Each water body has an annual maximum temperature criterion [WAC 173-201A-200(1)(c), WAC 173-201A-210(1)(c), and WAC 173-201A-602, Table 602]. These threshold criteria (e.g., 12, 16, 17.5, 20°C) protect specific categories of aquatic life by controlling the effect of human actions on summer temperatures.

  Some waters have an additional threshold criterion to protect the spawning and incubation of salmonids (9°C for char and 13°C for salmon and trout) [WAC 173-201A-602, Table 602]. These criteria apply during specific date-windows.

  The threshold criteria apply at the edge of the chronic mixing zone. Criteria for most fresh waters are expressed as the highest 7-Day average of daily maximum temperature (7-DADMax). The 7-DADMax temperature is the arithmetic average of seven consecutive measures of daily maximum temperatures. Criteria for marine waters and some fresh waters, including the Spokane River, are expressed as the highest 1-Day annual maximum temperature (1-DMax).

- Incremental warming criteria

  The water quality standards limit the amount of warming human sources can cause under specific situations [WAC 173-201A-200(1)(c)(i)-(ii), WAC 173-201A-210(1)(c)(i)-(ii)]. The incremental warming criteria apply at the edge of the chronic mixing zone.

At locations and times when background temperatures are cooler than the assigned threshold criterion, point sources are permitted to warm the water by only a defined increment. These increments are permitted only to the extent doing so does not cause temperatures to exceed either the annual maximum or supplemental spawning criteria.

1. Guidelines to prevent acute mortality or barriers to migration of salmonids. These site-level considerations do not override the temperature criteria listed above. Instantaneous lethality to passing fish: The upper 99th percentile daily maximum effluent temperature must not exceed 33°C, unless a dilution analysis indicates ambient temperatures will not exceed 33°C two seconds after discharge.
2. General lethality and migration blockage: Temperature at the edge of a chronic mixing zone must not exceed either a 1DMax of 23°C or a 7DADMax of 22°C.
3. Lethality to incubating fish: The temperature must not exceed 17.5°C at locations where eggs are incubating.

Reasonable Potential Analysis

Data Collection Required: Ecology does not have sufficient information on the temperature of the receiving water near the outfall to determine compliance with water quality criteria for temperature. Kaiser agreed to submit a QAPP and begin monitoring receiving water temperature upstream of the outfall as an item in Agreed Order No. 16958.

The proposed permit requires Kaiser to continue monitoring effluent and receiving water temperature and submit a data summary report to Ecology by January 1 of every year.

Ecology will evaluate the data to determine reasonable potential during the next permit cycle for annual summer maximum, incremental warming criteria, and protections for temperature acute effects.

H. Human health

Washington's water quality standards include numeric human health-based criteria for 97 priority pollutants that Ecology must consider when writing NPDES permits.

Ecology determined the effluent may contain chemicals of concern for human health based on data or information indicating the discharge contains regulated chemicals.

Ecology evaluated the discharge's potential to cause or contribute to an excursion of the water quality standards as required by 40 CFR 122.44(d) by following the procedures published in EPA Publication No. EPA/505/2-90-001, **Technical Support Document for Water Quality-Based Toxics Control** available online at https://www3.epa.gov/npdes/pubs/owm0264.pdf and Ecology Publication No. 92-109, **Water Quality Program Permit Writer's Manual** available online at https://apps.ecology.wa.gov/publications/documents/92109.pdf.

The evaluation showed that for acenapthene, antimony, chlorobenzene, chloroform, copper, diethylphthalate, mercury, nickel, tetrachloroethylene, thallium, and trichloroethylene have, there is no reasonable potential to cause or contribute to a violation of water quality standards, and an effluent limit is not needed.

Arsenic - In 1992, EPA adopted risk-based inorganic arsenic criteria for the protection of human health for the State of Washington of 0.018 µg/L, based on exposure from fish and shellfish tissue and water ingestion. In 2015, the State proposed revised human health based criteria for total arsenic of 10 µg/L based on the drinking water maximum contaminant level (MCL).

Ultimately, EPA disapproved the State's proposed arsenic criteria of 10 µg/L of total arsenic. EPA, in 40 CFR Part 131.45, has promulgated a human health criteria value of 0.018 µg/L of inorganic arsenic, unchanged from the 1992 criteria. This criterion differs from the drinking water maximum contaminant level (MCL) of 10 µg/L of total arsenic. In addition, natural background concentrations of arsenic in surface and groundwater often exceeds the human health criteria value.

NPDES-approved analytical test methods for arsenic listed in 40 CFR Part 136 measure only the total recoverable portion of metal, and not the inorganic portion. Without an approved analytical method for measuring inorganic arsenic, or an approved translator for determining inorganic-to-total recoverable arsenic ratios, Ecology is unable to determine an effluent limitation for discharges to surface waters.

In EPA's approval/disapproval of Washington's Human Health Water Quality Criteria, located online at https://www.epa.gov/sites/production/files/2017-10/documents/wawqs-letter-11152016.pdf, EPA states that the federal agency intended to conduct a toxicological review of inorganic arsenic in 2017.

However, EPA has not completed this task. The proposed permit requires routine monitoring for total arsenic in the final effluent to support future effluent limit decisions until the regulatory issues with the human health based criteria are resolved.

Total PCBs – Ecology has determined that the discharge has a reasonable potential to contribute to excursions above the water quality standards for PCBs. This determination is based on the presence of PCBs in the effluent and the 303(d) listing for PCBs in fish tissue in the Spokane River at the point of discharge.

Because of the reasonable potential determination, federal regulations in CFR Part 122.44(d) require this permit contains water quality based limitations to control PCBs. The proposed permit will include an end of pipe limit based on the human health criterion of 170 pg/L.

Federal regulations in 40 CFR Part 122.44(k)(4) also allow the use of best management practices (BMPs) to control or abate the discharge of pollutants when the practices are reasonably necessary to achieve effluent limitations and standards or to carry out the purposes and intent of the Clean Water Act.

BMPs are the actions identified to manage, prevent contamination of, and treat wastewater discharges. BMPs include schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the state. BMPs also include treatment systems, operating procedures, and practices used to control plant site runoff, spillage or leaks, sludge or waste disposal, and drainage from raw material storage.

The proposed permit will include BMPs and other measures intended to control and abate PCBs discharged to the Spokane River as a PCB pollutant minimization plan (PMP).

The proposed permit will require that the PCB PMP include the following:

- The continuation of source identification and removal actions for PCBs remaining within the Permittee's industrial wastewater sewer system.
- A design influent loading value for PCBs to the black walnut shell (BWS) treatment system. When the influent exceeds this loading value, the proposed permit requires additional analysis and investigation into the elevated PCB levels.
- Purchasing procedures that require a ranking and evaluation for elimination/substitution of products that contribute PCBs to the final discharge.
- Surveys of existing site materials and equipment (paints, caulks, building materials, capacitors, light ballasts, electrical equipment, etc.) that may contribute PCBs to the final discharge.
- BMPs used to prevent contributions of PCBs to the final discharge during site demolition and remodeling work.

The proposed permit also continues the comprehensive approach towards addressing point and nonpoint sources of PCBs in the Spokane River through the Spokane River Regional Toxics Task Force (Task Force). The goal of the Task Force is to develop and implement a comprehensive plan to bring the Spokane River into compliance with applicable water quality standards for PCBs.

In October 2011, the Sierra Club brought a citizen suit under provisions of the Clean Water Act against EPA (Sierra Club, et al. v. McLerran, No. 11-CV-1759-BJR), claiming EPA failed to perform a nondiscretionary duty of establishing a TMDL for PCBs in the Spokane River. In an Order issued by the U.S. District Court on March 16, 2015, the Court directed EPA to consult with Ecology and file a schedule for the measuring and completion of the work of the Task Force, including quantifiable benchmarks, plans for acquiring missing scientific information, deadlines for completed scientific studies, concrete permitting recommendations for the interim, specific standards upon which to judge the Task Force's effectiveness, and a definite endpoint at which time Ecology must pursue and finalize its TMDL.

EPA submitted its plan for addressing PCBs in the Spokane River (http://srrttf.org/wp-content/uploads/2015/07/EPA-plan-for-PCBs-in-response-to-court-order.pdf) to the Court on July 14, 2015.

EPA's plan included a December 15, 2020 date for meeting an instream concentration of PCBs in the Spokane River of 200 pg/L and a December 15, 2024 date for meeting an instream concentration of PCBs of 170 pg/L. In October 2020, the Sierra Club moved to amend its complaint to challenge EPA's plan and to renew its claim that EPA had a nondiscretionary duty to develop a TMDL for PCBs in the Spokane River. Presently, EPA is now seeking public input on a proposed consent decree with the plaintiffs to settle this litigation, with an EPA obligation to issue TMDLs for PCBs by September 30, 2024 for PCB-impaired waters in the Spokane River, the Little Spokane River, and Lake Spokane (Long Lake).

EPA's plan includes BMP and monitoring recommendations for point sources discharging into the Spokane River. The proposed permit includes recommendations applicable to Kaiser with the following qualifications:

- EPA recommended that the permits require receiving water monitoring for PCB congeners upstream and downstream of the outfalls using EPA Method 1668C at a frequency adequate to assess both high and low river flow conditions. Since the Task Force has characterized PCB concentrations in the river at both high and low flow conditions, the proposed permit does not include this activity.
- Ecology analyzed available effluent TSS and PCB data and determined effluent TSS and PCB concentrations are not positively correlated. However, the proposed permit includes EPA's recommendation to establish all known, available and reasonable treatment (AKART) or performance-based effluent limits for TSS. As discussed above, the performance-based limits already established in this permit are more stringent than applicable EPA effluent guidelines and, in Ecology's best professional judgment, represent AKART.

The proposed permit includes specific tasks for the Permittee to implement from the 2016 Comprehensive Plan to Reduce Polychlorinated Biphenyls (PCBs) in the Spokane River (Comprehensive Plan):

- Screening for PCB containing materials
- Building demolition and disposal
- PCB containing electrical equipment
- Leak prevention/detection in electrical equipment

I. Sediment quality

The aquatic sediment standards (Chapter 173-204 WAC) protect aquatic biota and human health. Under these standards, Ecology may require a facility to evaluate the potential for its discharge to cause a violation of sediment standards (WAC 173-204-400). You can obtain additional information about sediments at the Aquatic Lands Cleanup Unit website available at https://ecology.wa.gov/Spills-Cleanup/Contamination-cleanup/Sediment-cleanups.

The Spokane River near the discharge is not an area of sediment deposition. However, depositional areas do occur downstream from the Permittee at Donkey Island and behind Upriver Dam. Two PCB deposits in river-bottom sediments in these depositional areas were investigated and cleaned up from 2003 to 2007 in accordance with a consent decree Ecology entered into with Avista Development, Inc. (Avista) and Kaiser.

Because sediment deposition does not occur near the outfall, Ecology believes the potential for this discharge to cause a violation of sediment quality standards is low. If in the future Ecology determines a potential for violation of the sediment quality standards, Ecology may issue an order requiring Kaiser to demonstrate either:

- The point of discharge is not an area of deposition, or
- Toxics do not accumulate in the sediments even though the point of discharge is a depositional area.

J. Whole effluent toxicity

The water quality standards for surface waters forbid discharge of effluent that has the potential to cause toxic effects in the receiving waters. Many toxic pollutants cannot be measured by commonly available detection methods. However, laboratory tests can measure toxicity directly by exposing living organisms to the wastewater and measuring their responses. These tests measure the aggregate toxicity of the whole effluent, so this approach is called whole effluent toxicity (WET) testing. Some WET tests measure acute toxicity and other WET tests measure chronic toxicity.

- **Acute toxicity tests measure mortality as the significant response to** the toxicity of the effluent. Dischargers who monitor their wastewater with acute toxicity tests find early indications of any potential lethal effect of the effluent on organisms in the receiving water.
- **Chronic toxicity tests measure various sublethal toxic responses,** such as reduced growth or reproduction. Chronic toxicity tests often involve either a complete life cycle test on an organism with an extremely short life cycle, or a partial life cycle test during a critical stage of a test organism's life. Some chronic toxicity tests also measure organism survival.

Laboratories accredited by Ecology for WET testing know how to use the proper WET testing protocols, fulfill the data requirements, and submit results in the correct reporting format. Accredited laboratory staff know about WET testing and how to calculate an NOEC, LC50, EC50, IC25, etc. Ecology gives all accredited labs the most recent version of Publication No. WQ-R-95-80, **Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria,** which is referenced in the permit and is available online at https://apps.ecology.wa.gov/publications/documents/9580.pdf. Ecology recommends that Kaiser send a copy of the acute or chronic toxicity sections(s) of its NPDES permit to the laboratory.

WET testing conducted during the previous permit term showed the facility's effluent has a reasonable potential to cause acute toxicity in the receiving water. The proposed permit will include an acute toxicity limit. **The effluent limit for acute toxicity is: No acute toxicity detected in a test sample representing the acute critical effluent concentration (ACEC).** The acute critical effluent concentration (ACEC) is the concentration of effluent at the boundary of the acute mixing zone during critical conditions. The ACEC equals 40% effluent (dilution factor of 2.5).

Compliance with an acute toxicity limit is measured by an acute toxicity test comparing test organism survival in the ACEC (using a sample of effluent diluted to equal the ACEC) to survival in nontoxic control water. Kaiser is in compliance with the acute toxicity limit if there is no statistically significant difference in test organism survival between the ACEC sample and the control sample.

All WET testing results conducted in order to monitor for compliance with a chronic WET limit assigned in a previous permit met the chronic toxicity performance standard defined in WAC 173-205-020. In addition, Ecology has determined that the Permittee has not made any changes to the facility that would trigger an additional effluent characterization pursuant to WAC 173-205-060. For these reasons, Ecology has not included the chronic WET limit in the proposed permit. Instead, the Permittee must conduct WET testing at the end of the permit term in order to verify that effluent toxicity has not increased.

K. Comparison of effluent limits with the previous permit modified on November 18, 2014

The proposed permit limits for Outfalls 0006 and 0003 have not changed from the previous permit limits.

Table 26: Comparison of Previous and Proposed Effluent Limits – Outfall 0001

		Previous Effluent Limits	Outfall #0001	Proposed Effluent Limits	Outfall #0001
Parameter	**Basis of Limit**	**Average Monthly**	**Average Weekly**	**Average Monthly**	**Average Weekly**
Total Zinc, µg/L	Water Quality	75	146	75	146
Total Lead, µg/L	Water Quality	7.0	12.1	7	12.1
Total Cadmium, µg/L	Water Quality	1.3	2.2	1.3	2.2
Total PCBs, pg/L	Water Quality	-	-	170	233

Parameter	Basis of Limit	Previous Effluent Limits: Outfall #0001	Proposed Effluent Limits: Outfall #0001
pH	Technology	6.0 to 9.0	6.0 to 9.0

		Previous Effluent Limits	Outfall #0001	Proposed Effluent Limits	Outfall #0001
Parameter	**Basis of Limit**	**Average Monthly**	**Average Weekly**	**Seasonal Average**	**March - October**
Ammonia as N, lbs/day	Water Quality	-	-	-	9
Total Phosphorus as P, lbs/day	Water Quality	3.8	-	-	footnote a
Carbonaceous Biochemical Oxygen Demand ($CBOD_5$), lbs/day	Water Quality	-	-	-	footnote a

[a] Individual plus bubble (aggregate) limit with Inland Empire Paper Company, see Section III.G for further discussion.

IV. Monitoring Requirements

Ecology requires monitoring, recording, and reporting (WAC 173-220-210 and 40 CFR 122.41) to verify that the treatment process is functioning correctly and that the discharge complies with the permit's effluent limits.

If a facility uses a contract laboratory to monitor wastewater, it must ensure that the laboratory uses the methods and meets or exceeds the method detection levels required by the permit. The permit describes when facilities may use alternative methods. It also describes what to do in certain situations when the laboratory encounters matrix effects. When a facility uses an alternative method as allowed by the permit, it must report the test method, detection level (DL), and quantitation level (QL) on the discharge monitoring report or in the required report.

A. Wastewater monitoring

The proposed permit requires Kaiser to monitor for alkalinity and hardness to further characterize the effluent. The parameters are necessary to determine the impact on the quality of the surface water for metals and pH.

The monitoring schedule is detailed in the proposed permit under Special Condition S2. Specified monitoring frequencies take into account the quantity and variability of the discharge, the treatment method, past compliance, significance of pollutants, and cost of monitoring.

Ecology has required monitoring of both fecal coliform and *E.coli* in the proposed permit. This dual monitoring will help inform both Ecology and Kaiser of the correlation between the two indicators. Dual monitoring requirements consist of fecal coliform and E.coli at Outfall 0003.

B. Lab accreditation

Ecology requires that facilities must use a laboratory registered or accredited under the provisions of Chapter 173-50 WAC, Accreditation of Environmental Laboratories, to prepare all monitoring data (with the exception of certain parameters). Ecology accredited the laboratory at this facility for the following parameters:

Table 27: Accredited Parameters

Parameter	Category	Method Name	Matrix Description
n-Hexane Extractable Material (O&G)	General Chemistry	EPA 1664A_1_1999	Non-Potable Water
Solids, Total Suspended	General Chemistry	SM 2540 D-2011	Non-Potable Water
pH	General Chemistry	SM 4500-H+ B-2011	Non-Potable Water
Ammonia	General Chemistry	SM 4500-NH3 D-2011	Non-Potable Water
Orthophosphate	General Chemistry	SM 4500-P E-2011	Non-Potable Water
Phosphorus, Total	General Chemistry	SM 4500-P E-2011	Non-Potable Water
Biochemical Oxygen Demand (BOD)	General Chemistry	SM 5210 B-2011	Non-Potable Water
Carbonaceous BOD ($CBOD_5$)	General Chemistry	SM 5210 B-2011	Non-Potable Water
Aluminum	Metals	SM 3120 B-2011	Non-Potable Water
Chromium	Metals	SM 3120 B-2011	Non-Potable Water
Zinc	Metals	SM 3120 B-2011	Non-Potable Water

Parameter	Category	Method Name	Matrix Description
Fecal coliform-count	Microbiology	SM 9222 D (mFC)-06	Non-Potable Water

C. Effluent limits which are near detection or quantitation levels

The water quality-based effluent concentration limits for lead and total PCBs are near or below the limits of current analytical methods to detect or accurately quantify. The method detection level (MDL) also known as detection level (DL) is the minimum concentration of a pollutant that a laboratory can measure and report with a 99 percent confidence that its concentration is greater than zero (as determined by a specific laboratory method). The quantitation level (QL) is the level at which a laboratory can reliably report concentrations with a specified level of error. Estimated concentrations are the values between the DL and the QL. Ecology requires permitted facilities to report estimated concentrations. When reporting maximum daily effluent concentrations, Ecology requires the facility to report “less than X” where X is the required detection level if the measured effluent concentration falls below the detection level.

D. Total PCB analytical methods

The selection of the appropriate method for a wastewater PCB analysis relates to the anticipated concentration of the toxic in the sample. Method 608.3, approved by the EPA (40 CFR Part 136) has much higher detection and quantitation limits, DL and QL, respectively, than Methods 1628 and 1668. Methods 1628 and 1668 have not been approved by the EPA for determining compliance with effluent limits set in NPDES permits.

A comparison between DLs and QLs for Methods 608.3, 1628, and 1668 are in the table below:

Table 28: EPA Method Comparison

EPA Method/Criteria	Analyte	DL (µg/L)	QL (µg/L)
608.3	Aroclors	0.065	0.195
1628	Congeners	0.00019	0.0005
1668	Congeners	0.00005	0.0001
Human Health Criteria	Sum Total	0.000170	0.000170

Ecology has specified Method 1668 to evaluate BMP effectiveness in this proposed permit to ensure the return of usable data. Method 1668 results will enable Ecology to continue making measurable progress determinations related to reduction of toxicant loading to the Spokane River. DLs and QLs for Method 1668 are much lower than Method 608.3 (see Table 28, above).

Ecology's Water Quality Program guidance regarding appropriate use of Method 1668 is summarized below. The guidance supports Ecology's decision to include this method for the purpose of BMP effectiveness monitoring in the proposed permit.

Method 1668, a sensitive analytical method, has the capability of detecting 209 different PCB congeners. Costs for this analysis are higher than Method 608.3.

Water quality standards are based on Total PCBs (the sum of all Arochlors, isomers, homologs, or congeners), and have most frequently been measured as a calculated sum of all or a select group of Aroclors found in a sample. The data generated by Method 1668 is far more complex and extensive than data generated by other Methods such as 608.3 and 8082, and more sensitive than Method 1628. The data generated by Method 1668 must be carefully managed, assessed and applied.

Data produced from this method must be used in a documented and consistent manner with procedures (e.g. blank correction, calculating total PCBs) specific to the level of certainty required in decision-making.

For example, when PCB concentrations are very low, background contamination in laboratory blanks may interfere with the calculation of total PCB. To address this, a process known as censoring or blank correction is often applied. The choice of a censoring technique is specific to data and project needs and should be spelled out in a Quality Assurance Project Plan (QAPP). The most commonly used technique is described in EPA's National Functional Guidelines for the Contract Laboratory Program and is available online at https://www.epa.gov/clp/superfund-clp-national-functional-guidelines-data-review.

Methods 1668 and 1628 are not currently approved by EPA under 40 CFR Part 136 for compliance with effluent limits set in NPDES permits. Ecology will continue to use the most sensitive methods currently approved by EPA to evaluate compliance with numeric effluent limits. This permit will require the use of method 608.3 for compliance with numeric effluent limits as follows:

1. **Required monitoring to complete a permit application** – Use only 40 CFR Part 136 methods. 40 CFR 122.21(e)(3) says the application shall not be considered complete unless 40 CFR Part 136 approved methods are used.
2. **Evaluating compliance with numeric effluent limits** – Use only 40 CFR part 136 methods. This is currently Method 608. 40 CFR 122.44(i)(1) specifically requires monitoring to assure compliance with permit limitations according to Part 136 approved methods.

However, Ecology will also use data from Method 1668 in targeted situations as follows:

1. **Evaluating reasonable potential** - Use all valid and applicable data, including data collected using methods not approved under 40 CFR Part 136 (e.g. Method 1668).

   EPA's **Technical Support Document (TSD), Section 3.2** supports the use of all available information when evaluating reasonable potential, including available data and in some cases the lack of data.

2. **Calculating numeric effluent limits** - Use all valid and applicable data, including data collected using methods not approved under 40 CFR Part 136 (e.g. Method 1668). If valid data collected using a more sensitive but non-Part 136 method make it feasible to calculate limits, those data should be used to calculate the numeric effluent limit.

   Effluent limits are required when there is reasonable potential (RP). Numeric effluent limits are required where it is feasible to calculate them.

3. **Conducting analysis for All Known Available and Reasonable Technology (AKART)** - Use methods appropriate for the facility.

   a) As a toxic pollutant, PCBs are subject to WAC 173-220-130 and RCW 90.48.520, which requires the application of all known, available, and reasonable methods to control toxicants in the applicant's wastewater (also known as AKART).

   b) Methods of control for PCBs may include, but are not limited to, treatment technology, source control, or best management practices.

   c) A general discussion about AKART and how it is applied in wastewater discharge permits is provided in Section 3 of Chapter 4 in Ecology's **Water Quality Program Permit Writer's Manual.**

   d) For the purposes of applying AKART, Method 1668 may be required where identification of sources based on congener profile is required, or where expected concentrations are below analytical levels achievable by 608, and where treatment to lower levels is found to be reasonable. Site-specific factors must be considered when choosing the appropriate test method.

4. **Evaluating effectiveness of best management practices** - Use methods appropriate for evaluating the effectiveness of the best management practice (BMP).

   PCB analytical method selection will depend on expected concentrations in the sampled media, the BMPs required or selected, and the potential sources of PCBs on and to the site.

   For example:

   - A PCB Aroclor Method (608 or 8082) would typically be used where it is sufficiently sensitive to evaluate the effectiveness of the BMP. For example, a source-tracing program aimed at finding and addressing PCB sources at individual properties based on PCB concentrations in catch basin solids that are routinely detectable using Method 8082.

   - Method 1668 would typically be used for source identification when the potential sources are likely to have different congener profiles. Where the sources of PCBs on an individual property are not known, PCB congener data may be useful in identifying sources on and to the site.

- Method 1668 would typically be used when expected concentrations are below analytical levels achievable by an Aroclor method (608 or 8082). The congener method (1668) is needed to characterize influent or effluent or ambient water quality where PCBs are expected to be below 0.016 µg/L. These data may be used to evaluate trends over time and to quantify reductions in influent, effluent and/or receiving waters.

V. Other Permit Conditions

A. Cooling water intake structures

Thousands of industrial facilities use large volumes of water from lakes, rivers, estuaries, or oceans to cool their machinery. Cooling water intake structures (CWIS) can cause adverse environmental impacts by pulling large numbers of fish and shellfish or their eggs into a power plant's or manufacturing facility's cooling system. The organisms may be killed or injured by heat, physical stress, or by chemicals used to clean the cooling system. Larger organisms may be killed or injured when they are trapped against screens at the front of an intake structure.

Section 316(b) of the Clean Water Act requires EPA to issue regulations for the design and operation of cooling water intake structures to minimize adverse environmental impacts. EPA has finalized standards that apply to existing manufacturing and industrial facilities that are designed to withdraw more than 2 million gallons of cooling water per day and use at least 25% of the water for cooling purposes.

The new requirements for existing facilities are included in the NPDES permit regulations, 40 CFR Parts 122 and 125 (Subpart J). The rule establishes best technology available to minimize impingement and entrainment of all life stages of fish and shellfish. Impingement occurs when fish or shellfish become entrapped on the outer part of intake screens and entrainment occurs when fish or shellfish pass through the screens and into the cooling water system.

The rule gives facilities seven options to reduce impingement. Entrainment standards are either site specific or a reduction of intake flow to a level commensurate with a closed cycle recirculating system.

Ecology must ensure that the location, design, construction, and capacity of Kaiser's intake water structure reflect the best technology available for minimizing adverse environmental impacts. The proposed permit requires Kaiser to properly operate and maintain existing technologies used to minimize impingement and entrainment and report any significant impingement or entrainment observed. In addition, the proposed permit requires the Permittee to submit an information and compliance report that addresses NPDES permit application requirements for cooling water intake structures found in 40 CFR 122.21(r).

Ecology will use this information to assess the potential for impingement and entrainment at the CWIS, evaluate the appropriateness of any proposed technologies or mitigation measures, and determine any additional requirements to place on the facility in the next permit cycle.

B. Schedule for flow reduction efforts and implementation of AKART for PCBs

Agreed Order No. 16958 set a schedule for implementing AKART for reduction of PCBs in the final effluent. The timing of this schedule ran concurrent with a series of flow reduction projects planned by Kaiser. Ultimately, this will allow Kaiser to design and build a treatment system after flow reduction projects have been implemented. The flow reduction project schedule is a required component of Kaiser's PMP and includes the actions listed in the table below.

Table 29: Flow Reduction Actions and Schedule

	Flow Reduction Action	Schedule
I.	Conversion of air compressors from water cooling to air cooling	Completed
II.	Conversion of certain water cooled direct current motor/generator sets to rectifying transformers that require no water for cooling	Completed
III.	Conversion of a cryogenic plant for nitrogen production from water cooling to air cooling	Completed
IV.	Implement Phase 1 of underground injection of groundwater sourced non-contact cooling water, average daily infiltration rate of 0.85 million gallons per day (mgd)	Completed
V.	Complete Conversion to Groundwater Sourced Cooling, estimated average daily reduction in effluent flow of 0.5 mgd	Completed
VI.	Underground Injection Phase 2, Non-Contact Cooling, South Production Area, average daily infiltration rate of 0.5 mgd	Completed
VII.	Contact Cooling, Heat Treat Systems and South Production Area, estimated average daily reduction in effluent flow of 1.0 mgd	4th Qtr. 2023
VIII.	Contact Cooling, South Area Facility Modernization Project	1st Qtr. 2025
IX.	Underground Injection Phase 3, Non-Contact Cooling, Casting Operations, estimated Phase 3 + Phase 4 average daily reduction in effluent flow up to 1.0 mgd	2nd Qtr. 2025
X.	Underground Injection Phase 4, Miscellaneous Cooling Systems, estimated Phase 3 + Phase 4 average daily reduction in effluent flow up to 1.0 mgd	2rd Qtr. 2026
XI.	Contact Cooling, Casting Operations	1st Qtr. 2029

Because flow reduction for contact cooling at the facility's casting operations (Item XI) is estimated to require significant planning, design, and construction, the timing of the flow reduction actions runs until the 1st quarter of 2029.

The following table contains the schedule for evaluating and installing treatment technology. The length of this compliance schedule coincides with the schedule of flow reduction actions.

Table 30: PCB AKART Actions and Schedule

	AKART Action	Schedule
I.	Identify technologies Describe process used to evaluate technologies	Completed
II.	Identify final technology evaluation process Proposed schedule & scope for bench scale testing of candidate technologies	Completed
III.	Submission of results of bench scale testing Proposed schedule for pilot scale testing of candidate technologies	1/1/2025
IV.	Submission of results of pilot scale testing Proposed schedule for submission of approvable engineering report	1/1/2029
V.	Submission of approvable engineering report and plans and specification for treatment system that provides technology all known, available, and reasonable methods of prevention, control, and treatment for PCBs	1/1/2030
VI.	Completion of construction of technology and implementation of AKART	1/1/2031

The proposed permit will incorporate the outstanding items into a schedule of compliance (Permit Condition S.11).

C. Underground injection control monitoring and reporting

Ecology regulates Kaiser's use of injection wells for disposal of groundwater sourced, once through non-contact cooling water to groundwater under the Underground Injection Control (UIC) program (Chapter 173-218 WAC). The UIC systems must not increase surface water temperatures through groundwater/surface water interactions or impact existing on-site contaminant groundwater plumes.

The proposed permit incorporates UIC reporting of groundwater data to determine:

- background temperatures in the Spokane Valley-Rathdrum Prairie (SVRP) Aquifer
- temperatures downgradient of the injection wells

- temperatures changes near existing groundwater contaminant plumes
- temperatures downgradient of the injection wells in the vicinity of the Spokane River
- PCB levels in the groundwater sourced, once-through non-contact cooling water discharged to ground.

In addition, the proposed permit requires the Permittee develop an UIC well maintenance plan that outlines procedures used to maintain existing infiltration capacities of the UIC systems.

D. Reporting and record keeping

Ecology based Special Condition S3 on its authority to specify any appropriate reporting and record keeping requirements to prevent and control waste discharges (WAC 173-220-210).

E. Non routine and unanticipated wastewater

Occasionally, this facility may generate wastewater that was not characterized in the permit application because it is not a routine discharge and was not anticipated at the time of application. These wastes typically consist of waters used to pressure-test storage tanks or fire water systems or of leaks from drinking water systems.

The permit authorizes the discharge of non-routine and unanticipated wastewater under certain conditions. The facility must characterize these wastewaters for pollutants and examine the opportunities for reuse. Depending on the nature and extent of pollutants in this wastewater and on any opportunities for reuse, Ecology may:

- Authorize the facility to discharge the wastewater.
- Require the facility to treat the wastewater.
- Require the facility to reuse the wastewater.

F. Spill plan

This facility stores a quantity of chemicals on-site that have the potential to cause water pollution if accidentally released. Ecology can require a facility to develop best management plans to prevent this accidental release [Section 402(a)(1) of the Federal Water Pollution Control Act (FWPCA) and RCW 90.48.080].

Kaiser developed a plan for preventing the accidental release of pollutants to state waters and for minimizing damages if such a spill occurs. The proposed permit requires the facility to update this plan and submit it to Ecology.

G. Solid waste control plan

Kaiser could cause pollution of the waters of the state through inappropriate disposal of solid waste or through the release of leachate from solid waste.

This proposed permit requires this facility to develop a solid waste control plan to prevent solid waste from causing pollution of waters of the state. The facility must submit the plan to Ecology for approval (RCW 90.48.080).

You can obtain an **Ecology guidance document**, which describes how to develop a Solid Waste Control Plan at https://fortress.wa.gov/ecy/publications/documents/0710024.pdf.

H. Operation and maintenance manual

Ecology requires industries to take all reasonable steps to properly operate and maintain their wastewater treatment system in accordance with state and federal regulations [40 CFR 122.41(e) and WAC 173-220-150 (1)(g)]. The facility will prepare and submit an operation and maintenance manual as required by state regulation for the construction of wastewater treatment facilities (WAC 173-240-150). Implementation of the procedures in the operation and maintenance manual ensures the facility's compliance with the terms and limits in the permit.

I. General conditions

Ecology bases the standardized General Conditions on state and federal law and regulations. They are included in all individual industrial NPDES permits issued by Ecology.

VI. Permit Issuance Procedures

A. Permit modifications

Ecology may modify this permit to impose numerical limits, if necessary to comply with water quality standards for surface waters, with sediment quality standards, or with water quality standards for groundwaters, after obtaining new information from sources such as inspections, effluent monitoring, outfall studies, and effluent mixing studies.

Ecology may also modify this permit to comply with new or amended state or federal regulations.

B. Proposed permit Issuance

This proposed permit includes all statutory requirements for Ecology to authorize a wastewater discharge. The permit includes limits and conditions to protect human health and aquatic life, and the beneficial uses of waters of the state of Washington. Ecology proposes to issue this permit for a term of five years.

VII. References for Text and Appendices

Environmental Protection Agency (EPA)

1992. National Toxics Rule. Federal Register, V. 57, No. 246, Tuesday, December 22, 1992.

1991. *Technical Support Document for Water Quality-based Toxics Control*. EPA/505/2-90-001.

1988. *Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling*. USEPA Office of Water, Washington, D.C.

1985. *Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water*. EPA/600/6-85/002a.

1983. *Water Quality Standards Handbook*. USEPA Office of Water, Washington, D.C. Tsivoglou, E.C., and J.R. Wallace.

1972. *Characterization of Stream Reaeration Capacity*. EPA-R3-72-012. (Cited in EPA 1985 op.cit.)

1979. *In-stream Deoxygenation Rate Prediction*. Journal Environmental Engineering Division, ASCE. 105(EE2). (Cited in EPA 1985 op.cit.)

Washington State Department of Ecology

July 2018. Permit Writer's Manual. Publication Number 92-109 (https://apps.ecology.wa.gov/publications/summarypages/92109.html)

September 2011. Water Quality Program Guidance Manual – Supplemental Guidance on Implementing Tier II Antidegradation. Publication Number 11-10-073 (https://apps.ecology.wa.gov/publications/SummaryPages/1110073.html)

October 2010 (revised). Water Quality Program Guidance Manual – Procedures to Implement the State's Temperature Standards through NPDES Permits. Publication Number 06-10-100 (https://apps.ecology.wa.gov/publications/documents/0610100.pdf)

February 2007. Focus Sheet on Solid Waste Control Plan, Developing a Solid Waste Control Plan for Industrial Wastewater Discharge Permittees, Publication Number 07-10-024. (https://apps.ecology.wa.gov/publications/SummaryPages/0710024.html)

Laws and Regulations (http://leg.wa.gov/LawsAndAgencyRules/Pages/default.aspx)

Permit and Wastewater Related Information (https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Water-quality-permits-guidance)

Appendix A - Public Involvement Information

Ecology proposes to reissue a permit to Kaiser Aluminum Washington, LLC. The permit includes wastewater discharge limits and other conditions. This fact sheet describes the facility and Ecology's reasons for requiring permit conditions.

Ecology placed a Public Notice of Application on May 20, 2021 and May 27, 2021 in the Spokesman Review to inform the public about the submitted application and to invite comment on the reissuance of this permit.

Ecology will place a Public Notice of Draft on December 29, 2021 in the Spokesman Review to inform the public and to invite comment on the proposed draft National Pollutant Discharge Elimination System permit and fact sheet.

The notice:

- Tells where copies of the draft Permit and Fact Sheet are available for public evaluation (a local public library, the closest Regional or Field Office, posted on our website).
- Offers to provide the documents in an alternate format to accommodate special needs.
- Urges people to submit their comments, in writing, before the end of the Comment Period
- Tells how to request a public hearing of comments about the proposed NPDES permit.
- Explains the next step(s) in the permitting process.

Ecology Publication 03-07-023, **Frequently Asked Questions about Effective Public Commenting** is available on our website at https://fortress.wa.gov/ecy/publications/SummaryPages/0307023.html

For more information, call the Department of Ecology Eastern Regional Office at (509) 329-3400 or visit Ecology's webpage at www.ecy.wa.gov.

Appendix B - Your Right to Appeal

You have a right to appeal this permit to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of the final permit. The appeal process is governed by Chapter 43.21B RCW and Chapter 371-08 WAC. “Date of receipt” is defined in RCW 43.21B.001(2) (see glossary).

To appeal you must do the following within 30 days of the date of receipt of this permit:

File your appeal and a copy of this permit with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.

Serve a copy of your appeal and this permit on Ecology in paper form - by mail or in person. (See addresses below.) E-mail is not accepted.

You must also comply with other applicable requirements in Chapter 43.21B RCW and Chapter 371-08 WAC.

Table 31: Address and Location Information

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey, WA 98503	**Department of Ecology** Attn: Appeals Processing Desk PO Box 47608 Olympia, WA 98504-7608
Pollution Control Hearings Board 1111 Israel RD SW STE 301 Tumwater, WA 98501	**Pollution Control Hearings Board** PO Box 40903 Olympia, WA 98504-0903

Appendix C - Glossary

1-DMax or 1-day maximum temperature – The highest water temperature reached on any given day. This measure can be obtained using calibrated maximum/minimum thermometers or continuous monitoring probes having sampling intervals of thirty minutes or less.

7-DADMax or 7-day average of the daily maximum temperatures – The arithmetic average of seven consecutive measures of daily maximum temperatures. The 7-DADMax for any individual day is calculated by averaging that day's daily maximum temperature with the daily maximum temperatures of the three days prior and the three days after that date.

Acute toxicity – The lethal effect of a compound on an organism that occurs in a short time period, usually 48 to 96 hours.

AKART – The acronym for "all known, available, and reasonable methods of prevention, control and treatment." AKART is a technology-based approach to limiting pollutants from wastewater discharges, which requires an engineering judgment and an economic judgment. AKART must be applied to all wastes and contaminants prior to entry into waters of the state in accordance with RCW 90.48.010 and RCW 90.48.520, WAC 173-200-030(2)(c)(ii), and WAC 173-216-110(1)(a).

Alternate point of compliance – An alternative location in the groundwater from the point of compliance where compliance with the groundwater standards is measured. It may be established in the groundwater at locations some distance from the discharge source, up to, but not exceeding the property boundary and is determined on a site-specific basis following an AKART analysis. An "early warning value" must be used when an alternate point is established. An alternate point of compliance must be determined and approved in accordance with WAC 173-200-060(2).

Ambient water quality – The existing environmental condition of the water in a receiving water body.

Ammonia – Ammonia is produced by the breakdown of nitrogenous materials in wastewater. Ammonia is toxic to aquatic organisms, exerts an oxygen demand, and contributes to eutrophication. It also increases the amount of chlorine needed to disinfect wastewater.

Annual average design flow (AADF) – average of the daily flow volumes anticipated to occur over a calendar year.

Average monthly (intermittent) discharge limit – The average of the measured values obtained over a calendar months' time taking into account zero discharge days.

Average monthly discharge limit – The average of the measured values obtained over a calendar months' time.

Background water quality – The concentrations of chemical, physical, biological or radiological constituents or other characteristics in or of groundwater at a particular point in time upgradient of an activity that has not been affected by that activity, [WAC 173-200-020(3)].

Background water quality for any parameter is statistically defined as the 95% upper tolerance interval with a 95% confidence based on at least eight hydraulically upgradient water quality samples. The eight samples are collected over a period of at least one year, with no more than one sample collected during any month in a single calendar year.

Best management practices (BMPs) – Schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the state. BMPs include treatment systems, operating procedures, and practices to control; plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. BMPs may be further categorized as operational, source control, erosion and sediment control, and treatment BMPs.

BOD5 – Determining the five-day Biochemical Oxygen Demand of an effluent is an indirect way of measuring the quantity of organic material present in an effluent that is utilized by bacteria. The BOD5 is used in modeling to measure the reduction of dissolved oxygen in receiving waters after effluent is discharged. Stress caused by reduced dissolved oxygen levels makes organisms less competitive and less able to sustain their species in the aquatic environment. Although BOD_5 is not a specific compound, it is defined as a conventional pollutant under the federal Clean Water Act.

Bypass – The intentional diversion of waste streams from any portion of a treatment facility.

Categorical pretreatment standards – National pretreatment standards specifying quantities or concentrations of pollutants or pollutant properties, which may be discharged to a POTW by existing or new industrial users in specific industrial subcategories.

Chlorine – A chemical used to disinfect wastewaters of pathogens harmful to human health. It is also extremely toxic to aquatic life.

Chronic toxicity – The effect of a compound on an organism over a relatively long time, often 1/10 of an organism's lifespan or more. Chronic toxicity can measure survival, reproduction or growth rates, or other parameters to measure the toxic effects of a compound or combination of compounds.

Clean water act (CWA) – The federal Water Pollution Control Act enacted by Public Law 92-500, as amended by Public Laws 95-217, 95-576, 96-483, 97-117; USC 1251 et seq.

Compliance inspection-without sampling – A site visit, for the purpose of determining the compliance of a facility with the terms and conditions of its permit or with applicable statutes and regulations.

Compliance inspection-with sampling – A site visit, for the purpose of determining the compliance of a facility with the terms and conditions of its permit or with applicable statutes and regulations. In addition, it includes as a minimum, sampling and analysis for all parameters with limits in the permit to ascertain compliance with those limits; and, for municipal facilities, sampling of influent to ascertain compliance with the 85 percent removal requirement. Ecology may conduct additional sampling.

Composite sample – A mixture of grab samples collected at the same sampling point at different times, formed either by continuous sampling or by mixing discrete samples. May be "time-composite" (collected at constant time intervals) or "flow-proportional" (collected either as a constant sample volume at time intervals proportional to stream flow, or collected by increasing the volume of each aliquot as the flow increased while maintaining a constant time interval between the aliquots).

Construction activity – Clearing, grading, excavation, and any other activity, which disturbs the surface of the land. Such activities may include road building; construction of residential houses, office buildings, or industrial buildings; and demolition activity.

Continuous monitoring – Uninterrupted, unless otherwise noted in the permit.

Critical condition – The time during which the combination of receiving water and waste discharge conditions have the highest potential for causing toxicity in the receiving water environment. This situation usually occurs when the flow within a water body is low, thus, its ability to dilute effluent is reduced.

Date of receipt – This is defined in RCW 43.21B.001(2) as five business days after the date of mailing; or the date of actual receipt, when the actual receipt date can be proven by a preponderance of the evidence. The recipient's sworn affidavit or declaration indicating the date of receipt, which is unchallenged by the agency, constitutes sufficient evidence of actual receipt. The date of actual receipt, however, may not exceed forty-five days from the date of mailing.

Detection limit – The minimum concentration of a substance that can be measured and reported with 99 percent confidence that the pollutant concentration is above zero and is determined from analysis of a sample in a given matrix containing the pollutant.

Dilution factor (DF) – A measure of the amount of mixing of effluent and receiving water that occurs at the boundary of the mixing zone. Expressed as the inverse of the percent effluent fraction, for example, a dilution factor of 10 means the effluent comprises 10% by volume and the receiving water 90%.

Distribution uniformity – The uniformity of infiltration (or application in the case of sprinkle or trickle irrigation) throughout the field expressed as a percent relating to the average depth infiltrated in the lowest one-quarter of the area to the average depth of water infiltrated.

Early warning value – The concentration of a pollutant set in accordance with WAC 173-200-070 that is a percentage of an enforcement limit. It may be established in the effluent, groundwater, surface water, the vadose zone or within the treatment process. This value acts as a trigger to detect and respond to increasing contaminant concentrations prior to the degradation of a beneficial use.

Enforcement limit – The concentration assigned to a contaminant in the groundwater at the point of compliance for the purpose of regulation, [WAC 173-200-020(11)]. This limit assures that a groundwater criterion will not be exceeded and that background water quality will be protected.

Engineering report – A document that thoroughly examines the engineering and administrative aspects of a particular domestic or industrial wastewater facility. The report must contain the appropriate information required in WAC 173-240-060 or WAC 173-240-130.

Enterococci – A subgroup of fecal streptococci that includes *S. faecalis, S. faecium, S. gallinarum,* and *S. avium.* The enterococci are differentiated from other streptococci by their ability to grow in 6.5% sodium chloride, at pH 9.6, and at 10°C and 45°C.

E. coli – A bacterium in the family Enterobacteriaceae named Escherichia coli and is a common inhabitant of the intestinal tract of warm-blooded animals, and its presence in water samples is an indication of fecal pollution and the possible presence of enteric pathogens.

Fecal coliform bacteria – Fecal coliform bacteria are used as indicators of pathogenic bacteria in the effluent that are harmful to humans. Pathogenic bacteria in wastewater discharges are controlled by disinfecting the wastewater. The presence of high numbers of fecal coliform bacteria in a water body can indicate the recent release of untreated wastewater and/or the presence of animal feces.

Grab sample – A single sample or measurement taken at a specific time or over as short a period of time as is feasible.

Groundwater – Water in a saturated zone or stratum beneath the surface of land or below a surface water body.

Industrial user – A discharger of wastewater to the sanitary sewer that is not sanitary wastewater or is not equivalent to sanitary wastewater in character.

Industrial wastewater – Water or liquid-carried waste from industrial or commercial processes, as distinct from domestic wastewater. These wastes may result from any process or activity of industry, manufacture, trade or business; from the development of any natural resource; or from animal operations such as feedlots, poultry houses, or dairies. The term includes contaminated stormwater and leachate from solid waste facilities.

Interference – A discharge which, alone or in conjunction with a discharge or discharges from other sources, both:

- Inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and
- Therefore is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued thereunder (or more stringent State or local regulations): Section 405 of the Clean Water Act, the Solid Waste Disposal Act (SWDA) (including title II, more commonly referred to as the Resource Conservation and Recovery Act (RCRA), and including State regulations contained in any State sludge management plan prepared pursuant to subtitle D of the SWDA), sludge regulations appearing in 40 CFR Part 507, the Clean Air Act, the Toxic Substances Control Act, and the Marine Protection, Research and Sanctuaries Act.

Local limits – Specific prohibitions or limits on pollutants or pollutant parameters developed by a POTW.

Major facility – A facility discharging to surface water with an EPA rating score of > 80 points based on such factors as flow volume, toxic pollutant potential, and public health impact.

Maximum daily discharge limit – The highest allowable daily discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. The daily discharge is calculated as the average measurement of the pollutant over the day.

Maximum day design flow (MDDF) – The largest volume of flow anticipated to occur during a one-day period, expressed as a daily average.

Maximum month design flow (MMDF) – The largest volume of flow anticipated to occur during a continuous 30-day period, expressed as a daily average.

Maximum week design flow (MWDF) – The largest volume of flow anticipated to occur during a continuous 7-day period, expressed as a daily average.

Method detection level (MDL) – See Detection Limit.

Minor facility -- A facility discharging to surface water with an EPA rating score of < 80 points based on such factors as flow volume, toxic pollutant potential, and public health impact.

Mixing zone – An area that surrounds an effluent discharge within which water quality criteria may be exceeded. The permit specifies the area of the authorized mixing zone that Ecology defines following procedures outlined in state regulations (Chapter 173-201A WAC).

National pollutant discharge elimination system (NPDES) – The NPDES (Section 402 of the Clean Water Act) is the federal wastewater permitting system for discharges to navigable waters of the United States. Many states, including the state of Washington, have been delegated the authority to issue these permits. NPDES permits issued by Washington State permit writers are joint NPDES/State permits issued under both state and federal laws.

pH – The pH of a liquid measures its acidity or alkalinity. It is the negative logarithm of the hydrogen ion concentration. A pH of 7 is defined as neutral and large variations above or below this value are considered harmful to most aquatic life.

Pass-through – A discharge which exits the POTW into waters of the State in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation), or which is a cause of a violation of State water quality standards.

Peak hour design flow (PHDF) – The largest volume of flow anticipated to occur during a one-hour period, expressed as a daily or hourly average.

Peak instantaneous design flow (PIDF) – The maximum anticipated instantaneous flow.

Point of compliance – The location in the groundwater where the enforcement limit must not be exceeded and a facility must comply with the Ground Water Quality Standards. Ecology determines this limit on a site-specific basis. Ecology locates the point of compliance in the groundwater as near and directly downgradient from the pollutant source as technically, hydrogeologically, and geographically feasible, unless it approves an alternative point of compliance.

Potential significant industrial user (PSIU) – A potential significant industrial user is defined as an Industrial User that does not meet the criteria for a Significant Industrial User, but which discharges wastewater meeting one or more of the following criteria:

a. Exceeds 0.5 % of treatment plant design capacity criteria and discharges <25,000 gallons per day or;
b. Is a member of a group of similar industrial users which, taken together, have the potential to cause pass through or interference at the POTW (e.g. facilities which develop photographic film or paper, and car washes).

Ecology may determine that a discharger initially classified as a potential significant industrial user should be managed as a significant industrial user.

Quantitation level (QL) – Also known as Minimum Level of Quantitation (ML) – The lowest level at which the entire analytical system must give a recognizable signal and acceptable calibration point for the analyte. It is equivalent to the concentration of the lowest calibration standard, assuming that the lab has used all method-specified sample weights, volumes, and cleanup procedures. The QL is calculated by multiplying the MDL by 3.18 and rounding the result to the number nearest to (1, 2, or 5) x 10^n, where n is an integer. (64 FR 30417).
ALSO GIVEN AS:
The smallest detectable concentration of analyte greater than the Detection Limit (DL) where the accuracy (precision & bias) achieves the objectives of the intended purpose. (Report of the Federal Advisory Committee on Detection and Quantitation Approaches and Uses in Clean Water Act Programs Submitted to the US Environmental Protection Agency December 2007).

Reasonable potential – A reasonable potential to cause a water quality violation, or loss of sensitive and/or important habitat.

Responsible corporate officer – A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or have gross annual sales or expenditures exceeding $25 million (in second quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures (40 CFR 122.22).

Sample Maximum – No sample may exceed this value.

Significant industrial user (SIU) –

1) All industrial users subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR Chapter I, Subchapter N and;

2) Any other industrial user that: discharges an average of 25,000 gallons per day or more of process wastewater to the POTW (excluding sanitary, noncontact cooling, and boiler blow-down wastewater); contributes a process wastestream that makes up 5 percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the Control Authority* on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement [in accordance with 40 CFR 403.8(f)(6)].

Upon finding that the industrial user meeting the criteria in paragraph 2, above, has no reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement, the Control Authority* may at any time, on its own initiative or in response to a petition received from an industrial user or POTW, and in accordance with 40 CFR 403.8(f)(6), determine that such industrial user is not a significant industrial user.

*The term "Control Authority" refers to the Washington State Department of Ecology in the case of non-delegated POTWs or to the POTW in the case of delegated POTWs.

Slug discharge – Any discharge of a non-routine, episodic nature, including but not limited to an accidental spill or a non-customary batch discharge to the POTW. This may include any pollutant released at a flow rate that may cause interference or pass through with the POTW or in any way violate the permit conditions or the POTW’s regulations and local limits.

Soil scientist – An individual who is registered as a Certified or Registered Professional Soil Scientist or as a Certified Professional Soil Specialist by the American Registry of Certified Professionals in Agronomy, Crops, and Soils or by the National Society of Consulting Scientists or who has the credentials for membership. Minimum requirements for eligibility are: possession of a baccalaureate, masters, or doctorate degree from a U.S. or Canadian institution with a minimum of 30 semester hours or 45 quarter-hours professional core courses in agronomy, crops or soils, and have 5, 3, or 1 years, respectively, of professional experience working in the area of agronomy, crops, or soils.

Solid waste – All putrescible and non-putrescible solid and semisolid wastes including, but not limited to, garbage, rubbish, ashes, industrial wastes, swill, sewage sludge, demolition and construction wastes, abandoned vehicles or parts thereof, contaminated soils and contaminated dredged material, and recyclable materials.

Soluble BOD_5 – Determining the soluble fraction of Biochemical Oxygen Demand of an effluent is an indirect way of measuring the quantity of soluble organic material present in an effluent that is utilized by bacteria. Although the soluble BOD_5 test is not specifically described in Standard Methods, filtering the raw sample through at least a 1.2 um filter prior to running the standard BOD_5 test is sufficient to remove the particulate organic fraction.

State waters – Lakes, rivers, ponds, streams, inland waters, underground waters, salt waters, and all other surface waters and watercourses within the jurisdiction of the state of Washington.

Stormwater – That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes, and other features of a stormwater drainage system into a defined surface water body, or a constructed infiltration facility.

Technology-based effluent limit – A permit limit based on the ability of a treatment method to reduce the pollutant.

Total coliform bacteria – A microbiological test, which detects and enumerates the total coliform group of bacteria in water samples.

Total dissolved solids – That portion of total solids in water or wastewater that passes through a specific filter.

Total maximum daily load (TMDL) – A determination of the amount of pollutant that a water body can receive and still meet water quality standards.

Total suspended solids (TSS) – Total suspended solids is the particulate material in an effluent. Large quantities of TSS discharged to a receiving water may result in solids accumulation. Apart from any toxic effects attributable to substances leached out by water, suspended solids may kill fish, shellfish, and other aquatic organisms by causing abrasive injuries and by clogging the gills and respiratory passages of various aquatic fauna. Indirectly, suspended solids can screen out light and can promote and maintain the development of noxious conditions through oxygen depletion.

Upset – An exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limits because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, lack of preventative maintenance, or careless or improper operation.

Water quality-based effluent limit – A limit imposed on the concentration of an effluent parameter to prevent the concentration of that parameter from exceeding its water quality criterion after discharge into receiving waters.

Appendix D — Technical Calculations

Several of the Excel® spreadsheet tools used to evaluate a discharger's ability to meet Washington State water quality standards are in the PermitCalc workbook on Ecology's webpage at https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Water-quality-permits-guidance.

Simple Mixing:

Ecology uses simple mixing calculations to assess the impacts of certain conservative pollutants, such as the expected increase in fecal coliform bacteria at the edge of the chronic mixing zone boundary. Simple mixing uses a mass balance approach to proportionally distribute a pollutant load from a discharge into the authorized mixing zone. The approach assumes no decay or generation of the pollutant of concern within the mixing zone. The predicted concentration at the edge of a mixing zone (C_{mz}) is based on the following calculation:

$$C_{mz} = Ca + \frac{(Ce - Ca)}{DF}$$

where: Ce = Effluent Concentration
Ca = Ambient Concentration
DF = Dilution Factor

Reasonable Potential Analysis:

The spreadsheets Input 2 – Reasonable Potential and LimitCalc in Ecology's PermitCalc Workbook determine reasonable potential (to violate the aquatic life and human health water quality standards) and calculate effluent limits. The process and formulas for determining reasonable potential and effluent limits in these spreadsheets are taken directly from EPA Publication 91-127415, the **Technical Support Document for Water Quality-based Toxics Control** available online at http://www3.epa.gov/npdes/pubs/owm0264.pdf. The adjustment for autocorrelation is from EPA (1996a), and EPA (1996b).

Calculation of Water Quality-Based Effluent Limits:

Water quality-based effluent limits are calculated by the two-value wasteload allocation process as described on page 100 of the TSD (EPA, 1991) and shown below.

Calculate the acute wasteload allocation WLA_a by multiplying the acute criteria by the acute dilution factor and subtracting the background factor. Calculate the chronic wasteload allocation (WLA_c) by multiplying the chronic criteria by the chronic dilution factor and subtracting the background factor.

$$WLA_a = (\text{acute criteria} \times DF_a) - [(\text{background conc.} \times (DF_a - 1)]$$

$$WLA_c = (\text{chronic criteria} \times DF_c) - [(\text{background conc.} \times (DF_c - 1)]$$

where: DF_a = Acute Dilution Factor
DF_c = Chronic Dilution Factor

1. Calculate the long-term averages (LTA_a and LTA_c) which will comply with the wasteload allocations WLA_a and WLA_c.

$LTA_a = WLA_a \times e^{[0.5\sigma^2 - z\sigma]}$

where: $\sigma^2 = \ln[CV^2 + 1]$

$z = 2.326$

CV = coefficient of variation = std. dev/mean

$LTA_c = WLA_c \times e^{[0.5\sigma^2 - z\sigma]}$

where: $\sigma^2 = \ln[(CV^2 \div 4) + 1]$

$z = 2.326$

2. Use the smallest LTA of the LTA_a or LTA_c to calculate the maximum daily effluent limit and the monthly average effluent limit.

MDL=Maximum Daily Limit

$MDL = LTA x e^{(Z\sigma - 0.5\sigma^2)}$

where: $\sigma^2 = \ln[CV^2 + 1]$

z = 2.326 (99th percentile occurrence)

LTA = Limiting long term average

AML = Average Monthly Limit

$AML = LTA x\ e^{(Z\sigma_n - 0.5\sigma_n^2)}$

where: $\sigma^2 = \ln[(CV^2 \div n) + 1]$

n = number of samples/month

z = 1.645 (95th % occurrence probability)

LTA = Limiting long term average

Reasonable Potential Spreadsheet; Part 1

Dilution Factor Calculations and Receiving Water Critical Conditions

Step 1: Enter Waterbody Type

Water Body Type	Freshwater

Facility Name	Kaiser
Receiving Water	Spokane River

Step 2: Enter Dilution Factors -OR- Calculate DFs by entering Facility/Receiving Water Flow Data

Do you want to enter dilution factors -or- flow data?	Flow Data

	Annual Average	Max Monthly Average	Daily Max
Facility Flow, MGD	5.65	6.24	7.9
Facility Flow, cfs (calculated)	8.74	9.65	12.22

	Condition	Receiving Water Flow, cfs	Allowable % of river flow	Max Dilution Factor Allowed	% effluent
Aquatic Life - Acute	7Q10	749	0.025	**2.53**	ACEC = 39.5
Aquatic Life - Chronic	7Q10	749	0.25	**20.4**	CCEC= 4.9
HH-Non-Carcinogen	30Q5	892	0.25	**24.1**	4.1
HH-Carcinogen	Harmonic Mean	2557	0.25	**74.1**	1.3
Whole river at 7Q10	7Q10	749	1	**78.6**	

Step 3: Enter Critical Data

	Effluent	Receiving Water
Temp, °C	25.2	22
pH, s.u.	7.7	8
Alkalinity, mg/L as CaCO3	23	23
Hardness, mg/L CaCO3	133	19.4
Salinity, psu		
Receiving water TSS, mg/L (leave blank if unknown)		
If TSS is annual data, enter 'A'; if from critical period, enter 'S'; If no TSS, leave blank		

Step 4: Specifiy if using 'Mixed' values for hardness, temperature, and pH

	Use 'Mixed Hardness' (Y/N)	Use 'Mixed Max Temp' (Y/N)	Use 'Mixed pH (Y/N)
	Y	Y	Y
Acute Zone Boundary	64.3	23.3	7.9
Chronic Zone Boundary	25.0	22.2	8.0
Whole river at 7Q10	20.8	22.0	8.0

Reasonable Potential Spreadsheet; Part 2

Reasonable Potential Calculation

Facility	Kaiser
Water Body Type	Freshwater
Rec. Water Hardness	Acute=64.3, Chronic=25 mg/L

Dilution Factors:	Acute	Chronic
Aquatic Life	2.5	20.4
Human Health Carcinogenic		74.1
Human Health Non-Carcinogenic		24.1

Pollutant, CAS No. & NPDES Application Ref. No.			AMMONIA, Criteria as Total NH3	ACENAPTHENE 83329 1B	ALUMINUM, total recoverable, pH 6.5-9.0 7429905	ANTIMONY (INORGANIC) 7440360 1M	ARSENIC (dissolved) 7440382 2M	BERYLLIUM 7440417 3M	CADMIUM - 7440439 4M Hardness dependent	CHLOROBENZENE 108907 7V	CHLOROFORM 67663 11V	CHROMIUM(TRI) -16065831 5M Hardness dependent	COPPER - 744058 6M Hardness dependent
Effluent Data	# of Samples (n)		417	2	209	2	2	2	209	2	2	2	2
	Coeff of Variation (Cv)		0.8	0.6	0.31	0.6	0.6	0.6	0.44	0.6	0.6	0.6	0.6
	Effluent Concentration, ug/L (Max. or 95th Percentile)		93	0.075	89	0.73	3.3	0.34	0.05	0.043	0.032	0.85	2.5
	Calculated 50th percentile Effluent Conc. (when n>10)												
Receiving Water Data	90th Percentile Conc., ug/L		28		9		0.52		0.12			0.125	0.576
	Geo Mean, ug/L			0		0				0	0		0.527
Water Quality Criteria	Aquatic Life Criteria, ug/L	Acute	5,615	-	630	-	360	-	2.292456	-	-	382.019	11.2182
		Chronic	795	-	320	-	190	-	0.368982	-	-	57.1357	3.46827
	WQ Criteria for Protection of Human Health, ug/L		-	110	-	12	-	-	-	380	260	-	1300
	Metal Criteria Translator, decimal	Acute	-	-	-	-	1	-	0.943	-	-	0.316	0.996
		Chronic	-	-	-	-	1	-	0.943	-	-	0.86	0.996
	Carcinogen?		N	N	N	N	Y	Y	N	N	Y	N	N

Aquatic Life Reasonable Potential

			AMMONIA	ACENAPTHENE	ALUMINUM	ANTIMONY	ARSENIC	BERYLLIUM	CADMIUM	CHLOROBENZENE	CHLOROFORM	CHROMIUM(TRI)	COPPER
Effluent percentile value			0.950		0.950		0.950		0.950			0.950	0.950
s	$s^2=\ln(CV^2+1)$		0.703		0.303		0.555		0.421			0.555	0.555
Pn	$Pn=(1\text{-confidence level})^{1/n}$		0.993		0.986		0.224		0.986			0.224	0.224
Multiplier			1.00		1.00		3.79		1.00			3.79	3.79
Max concentration (ug/L) at edge of…		Acute	54		40.594		5.260		0.091			0.478	4.080
		Chronic	31		12.922		1.108		0.116			0.255	1.011
Reasonable Potential? Limit Required?			**NO**		**NO**		**NO**		**NO**			**NO**	**NO**

Aquatic Life Limit Calculation

# of Compliance Samples Expected per month		
LTA Coeff. Var. (CV), decimal		
Permit Limit Coeff. Var. (CV), decimal		
Waste Load Allocations, ug/L	Acute	
	Chronic	
Long Term Averages, ug/L	Acute	
	Chronic	
Limiting LTA, ug/L		
Metal Translator or 1?		
Average Monthly Limit (AML), ug/L		
Maximum Daily Limit (MDL), ug/L		

Human Health Reasonable Potential

		AMMONIA	ACENAPTHENE	ALUMINUM	ANTIMONY	ARSENIC	BERYLLIUM	CADMIUM	CHLOROBENZENE	CHLOROFORM	CHROMIUM(TRI)	COPPER
s	$s^2=\ln(CV^2+1)$		0.55451		0.55451				0.55451	0.55451		0.55451
Pn	Pn=(1-confidence level)1/n		0.224		0.224				0.224	0.224		0.224
Multiplier			1.5242		1.5242				1.5242	1.5242		1.5242
Dilution Factor			24.101		24.101				24.101	74.1361		24.101
Max Conc. at edge of Chronic Zone, ug/L			0.00474		0.04617				0.00272	0.00066		0.66324
Reasonable Potential? Limit Required?			**NO**		**NO**				**NO**	**NO**		**NO**

Reasonable Potential Spreadsheet; Part 3

Reasonable Potential Calculation - Page 2

Facility	Kaiser
Water Body Type	Freshwater
Rec. Water Hardness	Acute=64.3, Chronic=25 mg/L

Dilution Factors:	Acute	Chronic
Aquatic Life	2.5	20.4
Human Health Carcinogenic		74.1
Human Health Non-Carcinogenic		24.1

Pollutant, CAS No. & NPDES Application Ref. No.			DIETHYLPHTHALATE 84662 24B	DINITROTOLUENE 2,6 606202 28B	MERCURY 7439976 8M	NICKEL - 7440020 9M - Dependent on hardness	TETRACHLOROETHYLENE 127184 24V	THALLIUM 7440280 12M	TRICHLOROETHYLENE 79016 29V				
Effluent Data	# of Samples (n)		2	2	2	2	2	2	2				
	Coeff of Variation (Cv)		0.6	0.6	0.6	0.6	0.6	0.6	0.6		0.6	0.6	0.6
	Effluent Concentration, ug/L (Max. or 95th Percentile)		0.23	0.27	0.00036	0.6	0.3	0.32	0.071				
	Calculated 50th percentile Effluent Conc. (when n>10)												
Receiving Water Data	90th Percentile Conc., ug/L				0.00236	0.39							
	Geo Mean, ug/L		0			0.34	0	0	0				
Water Quality Criteria	Aquatic Life Criteria, ug/L	Acute	-	-	2.1	973.678	-	-	-				
		Chronic	-	-	0.012	48.6001	-	-	-				
	WQ Criteria for Protection of Human Health, ug/L		4200	-	-	150	4.9	0.24	0.38				
	Metal Criteria Translator, decimal	Acute	-	-	0.85	0.998	-	-	-				
		Chronic	-	-	-	0.997	-	-	-				
	Carcinogen?		N	N	N	N	Y	N	Y				

Aquatic Life Reasonable Potential

			DIETHYLPHTHALATE	DINITROTOLUENE	MERCURY	NICKEL	TETRACHLOROETHYLENE	THALLIUM	TRICHLOROETHYLENE
Effluent percentile value					0.950	0.950			
s	$s^2=\ln(CV^2+1)$				0.555	0.555			
Pn	$Pn=(1\text{-confidence level})^{1/n}$				0.224	0.224			
Multiplier					3.79	3.79			
Max concentration (ug/L) at edge of…		Acute			0.002	1.133			
		Chronic			0.002	0.482			
Reasonable Potential? Limit Required?					**NO**	**NO**			

Aquatic Life Limit Calculation

# of Compliance Samples Expected per month		
LTA Coeff. Var. (CV), decimal		
Permit Limit Coeff. Var. (CV), decimal		
Waste Load Allocations, ug/L	Acute	
	Chronic	
Long Term Averages, ug/L	Acute	
	Chronic	
Limiting LTA, ug/L		
Metal Translator or 1?		
Average Monthly Limit (AML), ug/L		
Maximum Daily Limit (MDL), ug/L		

Human Health Reasonable Potential

		DIETHYLPHTHALATE	DINITROTOLUENE	MERCURY	NICKEL	TETRACHLOROETHYLENE	THALLIUM	TRICHLOROETHYLENE
s	$s^2=\ln(CV^2+1)$	0.55451			0.55451	0.554513	0.554513	0.554513
Pn	Pn=(1-confidence level)1/n	0.224			0.224	0.224	0.224	0.224
Multiplier		1.5242			1.5242	1.524197	1.524197	1.524197
Dilution Factor		24.101			24.101	74.13613	24.10096	74.13613
Max Conc. at edge of Chronic Zone, ug/L		0.01455			0.36384	0.006168	2.0E-02	1.5E-03
Reasonable Potential? Limit Required?		**NO**			**NO**	**NO**	**NO**	**NO**

Reasonable Potential Spreadsheet – No Mixing Zone; Part 1

Dilution Factor Calculations and Receiving Water Critical Conditions

Facility Name	Kaiser - No Mixing Zone
Receiving Water	Spokane River

Step 1: Enter Waterbody Type

Water Body Type	Freshwater

Step 2: Enter Dilution Factors -OR- Calculate DFs by entering Facility/Receiving Water Flow Data

Do you want to enter dilution factors -or- flow data?	Flow Data

	Annual Average	Max Monthly Average	Daily Max
Facility Flow, MGD	5.65	6.24	7.9
Facility Flow, cfs (calculated)	8.74	9.65	12.22

	Condition	Receiving Water Flow, cfs	Allowable % of river flow	Max Dilution Factor Allowed		% effluent
Aquatic Life - Acute	7Q10	749	0	1.00	ACEC =	100.0
Aquatic Life - Chronic	7Q10	749	0	1.0	CCEC=	100.0
HH-Non-Carcinogen	30Q5	892	0	1.0		100.0
HH-Carcinogen	Harmonic Mean	2557	0	1.0		100.0
Whole river at 7Q10	7Q10	749	0	1.0		

Step 3: Enter Critical Data

	Effluent	Receiving Water
Temp, °C	25.2	22
pH, s.u.	7.7	8
Alkalinity, mg/L as CaCO3	23	23
Hardness, mg/L CaCO3	133	19.4
Salinity, psu		
Receiving water TSS, mg/L (leave blank if unknown)		
If TSS is annual data, enter 'A'; if from critical period, enter 'S'; If no TSS, leave blank		

Step 4: Specifiy if using 'Mixed' values for hardness, temperature, and pH

	Use 'Mixed Hardness' (Y/N)	Use 'Mixed Max Temp' (Y/N)	Use 'Mixed pH (Y/N)
	Y	Y	Y
Acute Zone Boundary	133.0	25.2	7.7
Chronic Zone Boundary	133.0	25.2	7.7
Whole river at 7Q10	133.0	25.2	7.7

Reasonable Potential Spreadsheet – No Mixing Zone; Part 2

Reasonable Potential Calculation

Facility	Kaiser - No Mixing Zone
Water Body Type	Freshwater
Rec. Water Hardness	Acute=133, Chronic=133 mg/L

Dilution Factors:	Acute	Chronic
Aquatic Life	1.0	1.0
Human Health Carcinogenic		1.0
Human Health Non-Carcinogenic		1.0

Pollutant, CAS No. & NPDES Application Ref. No.		AMMONIA, Criteria as Total NH3	CADMIUM - 7440439 4M Hardness dependent	LEAD - 7439921 7M Dependent on hardness	MERCURY 7439976 8M	Polychlorinated Biphenyls (PCB's) 53469219, 11097691, 1104282, 11141165, 12672296, 11096825, 12674112 18P-24P	ZINC- 7440666 13M hardness dependent
Effluent Data	# of Samples (n)		5	5	2	53	5
	Coeff of Variation (Cv)		0.6	0.6	0.6	0.49	0.56
	Effluent Concentration, ug/L (Max. or 95th Percentile)		100	100	0.00036	0.00724	500
	Calculated 50th percentile Effluent Conc. (when n>10)					0.00347	
Receiving Water Data	90th Percentile Conc., ug/L		0.185	1.05	0.00236	0.000059	54
	Geo Mean, ug/L				0.00116	0.000041	54
Water Quality Criteria	Aquatic Life Criteria, ug/L — Acute		5.0428228	87.96996	2.1	2	145.728778
	Aquatic Life Criteria, ug/L — Chronic		1.2728777	3.428063	0.012	0.014	133.072473
	WQ Criteria for Protection of Human Health, ug/L	-	-	-	-	0.00017	2300
	Metal Criteria Translator, decimal — Acute	-	0.943	0.466	0.85	-	0.996
	Metal Criteria Translator, decimal — Chronic	-	0.943	0.466	-	-	0.996
	Carcinogen?	N	N	N	N	Y	N

Aquatic Life Reasonable Potential

		Ammonia	Cadmium	Lead	Mercury	PCB's	Zinc
Effluent percentile value			0.950	0.950	0.950	0.950	0.950
s	$s^2=\ln(CV^2+1)$		0.555	0.555	0.555	0.464	0.522
Pn	$Pn=(1\text{-confidence level})^{1/n}$		0.549	0.549	0.224	0.945	0.549
Multiplier			2.32	2.32	3.79	1.00	2.21
Max concentration (ug/L) at edge of...	Acute		219.182	108.313	0.0012	0.007	1102.115
	Chronic		219.182	108.313	0.0014	0.007	1,102.115
Reasonable Potential? Limit Required?			**YES**	**YES**	**NO**	**NO**	**YES**

Aquatic Life Limit Calculation

		Cadmium	Lead	Zinc
# of Compliance Samples Expected per month		2	2	4
LTA Coeff. Var. (CV), decimal		0.6	0.6	0.56
Permit Limit Coeff. Var. (CV), decimal		0.6	0.6	0.56
Waste Load Allocations, ug/L	Acute	5.0428228	87.96996	145.728778
	Chronic	1.2728777	3.428063	133.072473
Long Term Averages, ug/L	Acute	1.6191657	28.24568	49.5667703
	Chronic	0.6713583	1.808075	72.9375174
Limiting LTA, ug/L		0.6713583	1.808075	49.5667703
Metal Translator or 1?		0.943	0.466	1.00
Average Monthly Limit (AML), ug/L		**1.3**	**7.0**	**75.3**
Maximum Daily Limit (MDL), ug/L		**2.2**	**12.1**	**146.3**

Human Health Reasonable Potential

		PCB's	Zinc
s	$s^2=\ln(CV^2+1)$	0.463887941	0.52227527
Pn	Pn=(1-confidence level)1/n	0.945	0.549
Multiplier		0.476366291	0.93736717
Dilution Factor		1	1
Max Conc. at edge of Chronic Zone, ug/L		0.00347	4.7E+02
Reasonable Potential? Limit Required?		**YES**	**NO**

Human Health Limit Calculation

	PCB's
# of Compliance Samples Expected per month	2
Average Monthly Effluent Limit, ug/L	**0.00017**
Maximum Daily Effluent Limit, ug/L	**0.000273146**

Appendix E - Bubble (Aggregate) Limit Calculations

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Memorandum

From: Dave Dilks, Scott Hinz
Date: February 8, 2020
Project: IEP3
To: Pat Hallinan
CC: Doug Krapas, IEP; Brent Downey, Kaiser

SUBJECT: DRAFT: CBOD Bubble Permit Calculation for IEP and Kaiser

Summary

IEP and Kaiser are interested in developing a bubble permit that combines the allowable loading of their CBOD and TP discharges for purposes of determining compliance with the dissolved oxygen (DO) TMDL. LimnoTech (2018) described the planned approach and included an example application for CBOD. The approach merges the bubble permit concept as described in the Spokane DO TMDL Toolbox (http://spokaneriver.net/initiatives/spokane-river-do-tmdl-implementation/do-tmdl-toolbox/) with EPA's test for compliance to determine if the DO impacts of an alternate loading scenario are consistent with the Spokane DO TMDL.

LimnoTech (2020) formally applied the approach to develop proposed bubble permit limits for TP. This memorandum formally applies that approach to develop bubble permit limits for CBOD. CE-QUAL-W2 model results indicate that each one pound increase in IEP CBOD5 loading will require a 4.247 pound decrease in Kaiser loading, while a one pound decrease in IEP CBOD5 loading will allow for a 2.99 pound increase in Kaiser loading. The differences between these "trading ratios" is due to a factor of safety that ensures that the bubble permit will be protective of dissolved oxygen concentrations both as an average across Avista-affected segments/times, as well for individual Avista-affected segments/times for Kaiser load increases up to 25% and IEP load increases up to 30%.

CBOD Bubble Permit Calculations

This section applies the approach initially described in a preliminary manner (LimnoTech, 2018), and supplements it with additional model simulations, to demonstrate calculation of CBOD bubble permit values that are protective of dissolved oxygen when averaged across all Avista-affected segments and time periods, as well as individual Avista-affected segments and time periods. It is divided into separate discussions of:

- Results of loading sensitivity runs
- Protection of average DO
- Protection of segment/time Specific DO

Results of loading sensitivity runs

Four CBOD loads were assessed for each discharge, corresponding to a 25% and 50% reduction, and a 50% and 100% increase, of the current TMDL load. Tables B-1 and B-2 in Appendix B show incremental dissolved oxygen changes in each segment and time in response to these sensitivity runs. The change in dissolved oxygen concentrations averaged across all Avista-affected cells are displayed in Table 1 for these simulations.

Table 1. Results of Loading Sensitivity Runs for CBOD

Discharger (i)	Change from TMDL (%)	ΔL_i (lbs/day)	ΔDO_i (mg/L)
1. IEP	-50%	-61.6	+0.00911
1. IEP	-25%	-30.8	+0.00492
1. IEP	+50%	+61.6	-0.00746
1. IEP	+100%	+123.2	-0.01810
2. Kaiser	-50%	-231.5	+0.00732
2. Kaiser	-25%	-115.7	+0.00583
2. Kaiser	+50%	+231.4	-0.01285
2. Kaiser	+100%	+462.7	-0.02105

Linear regressions were developed between ΔDO_i and ΔL_i for each discharge. Regressions across all load sensitivities are shown in Figure 1 for IEP and Kaiser.

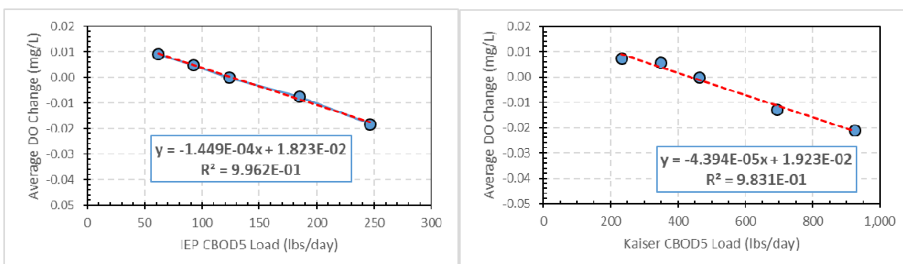

Figure 1. Linear Regressions for All CBOD Loading Sensitivity Runs

Following the same safety factor approach applied previously for the TP bubble permit calculations, separate slopes were developed for the decreased load sensitivity and increased load sensitivity runs. Consistent with the agreed-upon approach, separate regressions were derived for both the load decrease and load increase scenarios. The regressions forced a zero intercept with respect to the TDML (i.e. zero change from TMDL load results in zero effect on DO). The resulting regressions are shown in Figure 2 for load reductions and Figure 3 for load increases.

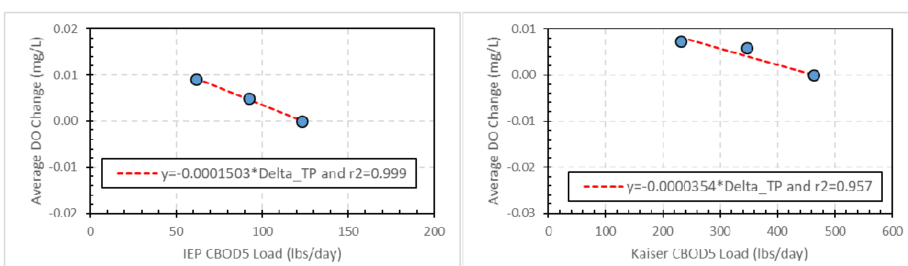

Figure 2. Linear Regressions for Decreased CBOD Loading Sensitivity Runs

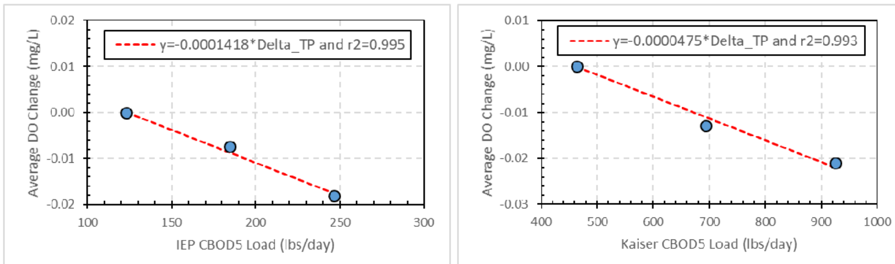

Figure 3. Linear Regression for Increased CBOD Loading Sensitivity Runs

The slopes from Figures 2 and 3 are contained in Table 2 to demonstrate how the bubble permit calculations could be applied to determine the required decrease in Kaiser CBOD5 load needed to offset a given increase in IEP load. An 10 lb/day increase in IEP CBOD5, multiplied by the most restrictive slope of -1.503E-04 (mg/l)/(lbs.day), results in an average dissolved oxygen decrease of -0.001503 mg/l. A decrease in Kaiser loading of 42.47 lb/day, multiplied by the most restrictive slope of -3.539E-05, results in an average dissolved oxygen increase 0.001503 mg/l, which offsets the IEP decrease. The ratio of 10 lb of IEP load increase being equivalent to 42.47 pounds of Kaiser load can also be expressed as 1 lb of IEP load increase being equivalent to 4.247 pounds of Kaiser load decrease.

Table 2. Example Compliance Table for the CBOD Bubble – IEP Increase

(1) Index (Discharge)	(2) Discharger	(3) Pollutant	(4) IOEF$_{i,j}$ Increase (mg/L)/(lb/day)	(5) IOEF$_{i,j}$ Decrease (mg/L)/(lb/day)	(6) Change from TMDL Load (lbs/day)	(7)* ΔDO (mg/L)
1	IEP	CBOD5	-1.418E-04	-1.503E-04	10	-0.001503
2	Kaiser	CBOD5	-4.750E-05	-3.539E-05	-42.47	0.001503
(positive number is in compliance, negative number is out of compliance)					Sum	0.0000

* If Column (6) change from TMDL Load is positive, Column (7) = Max[Column (4), Column (5)] x Column (6)
If Column (6) change from TMDL Load is negative, Column (7) = Min[Column (4), Column (5)] x Column (6)

Table 3 shows example calculations for an increase in Kaiser CBOD load. A 10 lb/day increase in Kaiser CBOD5, multiplied by the most restrictive slope of -4.750E-05, results in an average dissolved oxygen decrease of -4.750E-04. A decrease in IEP loading of 3.35 lb/day, multiplied by the most restrictive slope of -1.418E-04, results in an average dissolved oxygen increase of -4.750E-04 mg/l, which offsets the Kaiser decrease. The ratio of 10 lb of Kaiser load increase being equivalent to 3.35 pounds of IEP load decrease can also be expressed as 1 lb of IEP load decrease being equivalent to 2.99 pounds of Kaiser load increase (i.e. 10/3.35.)

Table 3. Example Compliance Table for the CBOD Bubble – Kaiser Increase

(1) Index (Discharge)	(2) Discharger	(3) Pollutant	(4) $IOEF_{i,j}$ Increase (mg/L)/(lb/day)	(5) $IOEF_{i,j}$ Decrease (mg/L)/(lb/day)	(6) Change from TMDL Load (lbs/day)	(7)* ΔDO (mg/L)
1	IEP	CBOD5	-1.418E-04	-1.503E-04	-3.35	-4.750E-04
2	Kaiser	CBOD5	-4.750E-05	-3.539E-05	10	-4.750E-04
(positive number is in compliance, negative number is out of compliance)					Sum	0.0000

* If Column (6) change from TMDL Load is positive, Column (7) = Max[Column (4), Column (5)] x Column (6)
If Column (6) change from TMDL Load is negative, Column (7) = Min[Column (4), Column (5)] x Column (6)

The results from Tables 2 and 3 show "trading ratios" (i.e. pounds of Kaiser load needed to offset a pound of IEP load) of 4.247:1 for IEP decreases and 2.99:1 for IEP increases that will be protective of Avista-averaged dissolved oxygen concentrations while considering a factor of safety. The magnitude of the safety factor inherent in these calculations can be estimated by considering the "best-fit" slopes shown previously in Figure 1. The effect of IEP loading on dissolved oxygen had a best-fit slope of -1.499E-04 (mg/L)/(lb/day), the effect of Kaiser loading on dissolved oxygen had a best-fit slope of -4.394E-05 (mg/L)/(lb/day). This indicates that a best fit trading ratio is approximately 3.41:1 (i.e. -1.499E-04 ÷ -4.394E-05), meaning that one pound of IEP load is equivalent to 3.41 pounds of Kaiser load. The proposed trading ratios of 2.99 for Kaiser increases, and 4.247:1 for IEP increases add a safety factor ranging from 14% (3.41:1 is 14% larger than 2.99:1) to 25% (4.247:1 is 25% larger than 3.41:1).

Protection of Segment/Time Specific DO

The ratios determined above were next applied to determine whether they were protective of dissolved oxygen in individual Avista-affected segments and time periods. The slopes used to calculate DO in each segment/time pair are presented in Tables B-3 and B-4 in Appendix B for IEP and Kaiser, respectively.

The metric of concern when evaluating TMDL equivalency for individual cells corresponds to whether there is a change in Avista responsibility in any cell, when rounded to nearest 0.1 mg/l. Because this metric does not behave in a directly linear fashion, a wide range of combinations of loads were tested to ensure that compliance will occur.

Table 4 shows the resulting calculations for IEP load increases. For a change in IEP load ranging from 1 to 30% of the existing TMDL (302 to 9,055 lb/season), the number of segment/time pairs with increased responsibility is always the same as the number of segment/time pairs with decreased responsibility, and the maximum DO decrease in any segment/time pair with increased responsibility is no greater than 0.0033 mg/l and within the error of the model.

Table 5 shows similar calculations for Kaiser load increases. For a change in Kaiser load ranging from 1 to 25% (1,134 to 28,341 lb/season), the number of segment/time pairs with increased responsibility is always the same as the number of segment/time pairs with decreased responsibility. The 30% Kaiser load increase resulted in there being one more segment/time pair with increased responsibility than the number of segment/time pairs with decreased responsibility The maximum DO decrease in any segment/time pair with increased responsibility is no greater than 0.0027 mg/l. These impacts are well within the error of the model.

Table 4. Demonstration of Protectiveness in Individual Segment/Time Pairs for a Range of IEP CBOD5 Load Increases

Change in IEP Load (%)	Increase in IEP Load (lbs/season)	Decrease in Kaiser Load (lbs/season)	No. of Avista Segment/time pairs		Maximum decrease in DO (mg/l)
			Increased responsibility	Decreased responsibility	
1	302	1,282	5	5	0.0001
2	604	2,564	5	5	0.0002
5	1,509	6,410	5	5	0.0006
10	3,018	12,819	5	5	0.0011
25	7,546	32,048	5	5	0.0027
30	9,055	38,457	5	5	0.0033

Table 5. Demonstration of Protectiveness in Individual Segment/Time Pairs for a Range of Kaiser CBOD5 Load Increases

Change in Kaiser Load (%)	Increase in Kaiser Load (lbs/season)	Decrease in IEP Load (lbs/season)	Responsibility Change - Number of Avista Segment/time pairs		Maximum decrease in DO (mg/l)
			Increased	Decreased	
1	1,134	380	5	5	0.0001
2	2,267	760	5	5	0.0002
5	5,668	1,899	5	5	0.0006
10	11,336	3,798	5	5	0.0012
25	28,341	9,496	5	5	0.0029
30	34,009	11,395	6	5	0.0035

These results indicate (for a range of IEP load increases up to 9,055 pounds per season, and a range of Kaiser load increases up to 28,341 pounds per season) that the safety factors used to calculate IOEF slopes protective of average DO across all Avista-affected segments and times are also protective of DO in individual Avista-affected segments and times. A bubble permit that reflects these slopes will be protective of the TMDL.

References

LimnoTech, 2020. DRAFT: TP Bubble Permit Calculation for IEP and Kaiser. January 22, 2020.

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Appendix A: Table 7 from TMDL

Table 7. TMDL Scenario #1 dissolved oxygen concentrations (*italics*) *are compared with No Source scenario concentrations (bold) for June 1 through September 15. Avista's responsibility (mg/L DO) for each segment is quantified in the shaded cells.*

Segment	June 1-15			June 15-30			July 1-15			July 16-31			Aug 1-15			Aug 16-31			Sept 1-15		
157	9.23	9.40	_	9.44	9.66	_	8.94	9.46	_	8.93	9.43	_	9.06	9.55	_	9.22	9.93	_	9.40	9.96	_
158	9.42	9.66	_	9.42	9.79	_	9.06	9.49	_	9.11	9.60	_	9.14	9.65	_	9.31	9.84	_	9.46	9.99	_
159	9.54	9.84	_	9.46	9.86	_	9.13	9.53	_	9.19	9.62	_	9.19	9.63	_	9.32	9.78	_	9.47	9.93	_
160	9.57	9.88	_	9.45	9.85	_	9.12	9.47	_	9.19	9.58	_	9.18	9.56	_	9.30	9.70	_	9.44	9.87	_
161	9.56	9.87	_	9.51	9.94	_	9.16	9.52	_	9.19	9.57	_	9.19	9.55	_	9.30	9.68	_	9.45	9.84	_
162	9.56	9.89	_	9.55	10.01	_	9.16	9.53	_	9.18	9.59	_	9.18	9.53	_	9.26	9.61	_	9.41	9.79	_
163	9.58	9.96	_	9.59	10.06	_	9.18	9.56	_	9.17	9.63	_	9.17	9.53	_	9.18	9.52	_	9.31	9.73	_
164	9.61	10.03	_	9.58	10.08	_	9.15	9.52	_	9.14	9.62	_	9.13	9.47	_	9.10	9.37	_	9.20	9.62	_
165	9.62	10.05	_	9.57	10.10	_	9.06	9.38	_	9.09	9.53	_	9.07	9.36	_	8.96	9.12	_	9.11	9.50	_
166	9.59	10.03	_	9.51	10.03	_	8.87	9.07	_	8.98	9.30	_	8.97	9.15	_	8.82	8.85	_	9.07	9.38	_
167	9.59	10.03	_	9.48	9.98	_	8.73	8.87	_	8.84	9.07	_	8.87	8.97	_	8.69	8.63	_	9.01	9.27	_
168	9.61	10.10	_	9.43	9.91	_	8.52	8.58	_	8.55	8.63	_	8.66	8.57	_	8.44	8.20	0.0	8.95	9.11	_
169	9.62	10.16	_	9.37	9.82	_	8.41	8.41	_	8.36	8.37	_	8.47	8.31	_	8.25	7.92	0.1	8.85	8.91	_
170	9.60	10.18	_	9.28	9.72	_	8.37	8.36	_	8.27	8.23	_	8.37	8.17	_	8.13	7.71	0.2	8.69	8.66	_
171	9.58	10.17	_	9.23	9.66	_	8.40	8.39	_	8.23	8.17	_	8.31	8.07	0.0	8.04	7.55	0.3	8.57	8.43	_
172	9.50	10.08	_	9.08	9.46	_	8.23	8.17	_	7.96	7.80	_	7.98	7.63	0.2	7.70	7.07	0.4	8.35	8.06	0.1
173	9.40	9.96	_	8.96	9.31	_	8.12	8.00	_	7.80	7.55	0.0	7.80	7.36	0.2	7.51	6.78	0.5	8.15	7.75	0.2
174	9.29	9.80	_	8.81	9.12	_	7.96	7.79	_	7.59	7.27	0.1	7.56	7.05	0.3	7.26	6.42	0.6	7.85	7.34	0.3
175	9.20	9.68	_	8.69	8.99	_	7.86	7.66	_	7.46	7.09	0.2	7.40	6.84	0.4	7.09	6.21	0.7	7.62	7.04	0.4
176	9.12	9.59	_	8.63	8.91	_	7.83	7.60	0.0	7.41	6.99	0.2	7.39	6.79	0.4	7.06	6.13	0.7	7.55	6.91	0.4
177	8.93	9.31	_	8.35	8.54	_	7.50	7.19	0.1	6.99	6.46	0.3	6.92	6.22	0.5	6.56	5.54	0.8	7.01	6.24	0.6
178	8.85	9.21	_	8.27	8.42	_	7.44	7.10	0.1	6.92	6.34	0.4	6.88	6.15	0.5	6.51	5.47	0.8	6.89	6.06	0.6
179	8.79	9.14	_	8.24	8.37	_	7.42	7.07	0.1	6.88	6.27	0.4	6.86	6.11	0.6	6.51	5.44	0.9	6.81	5.92	0.7
180	8.73	9.05	_	8.19	8.30	_	7.38	7.02	0.2	6.83	6.19	0.4	6.81	6.03	0.6	6.49	5.42	0.9	6.67	5.75	0.7
181	8.66	8.95	_	8.15	8.21	_	7.36	6.97	0.2	6.78	6.08	0.5	6.74	5.89	0.6	6.47	5.36	0.9	6.52	5.53	0.8
182	8.67	8.95	_	8.16	8.21	_	7.41	7.01	0.2	6.84	6.13	0.5	6.78	5.92	0.7	6.56	5.46	0.9	6.53	5.52	0.8
183	8.55	8.78	_	8.00	7.98	_	7.26	6.85	0.2	6.70	5.97	0.5	6.58	5.69	0.7	6.37	5.29	0.9	6.29	5.27	0.8
184	8.54	8.75	_	7.98	7.94	_	7.30	6.88	0.2	6.77	6.01	0.6	6.63	5.71	0.7	6.43	5.33	0.9	6.30	5.34	0.8
185	8.47	8.63	_	7.94	7.87	_	7.29	6.88	0.2	6.78	6.00	0.6	6.58	5.64	0.7	6.42	5.29	0.9	6.23	5.27	0.8
186	8.34	8.44	_	7.84	7.74	_	7.18	6.76	0.2	6.63	5.84	0.6	6.37	5.41	0.8	6.24	5.08	1.0	5.96	4.93	0.8
187	8.31	8.40	_	7.85	7.75	_	7.23	6.79	0.2	6.66	5.83	0.6	6.36	5.35	0.8	6.27	5.05	1.0	5.96	4.90	0.9
188	8.20	8.25	_	7.67	7.56	_	7.10	6.65	0.2	6.53	5.71	0.6	6.15	5.17	0.8	6.07	4.88	1.0	5.73	4.68	0.8

Table 7 (continued). TMDL Scenario #1 dissolved oxygen concentrations (*italics*) *are compared with No Source scenario concentrations (bold) for September 16 through December 31. Avista's responsibility (mg/L DO) for each segment is quantified in the shaded cells.*

Segment	Sept 16-30			Oct 1-15			Oct 16-31			Nov 1-15			Nov 16-30			Dec 1-15			Dec 16-31		
157	9.58	9.90	_	9.81	10.07	_	10.40	10.49	_	10.59	10.83	_	10.82	10.79	_	11.41	11.50	_			_
158	9.63	9.91	_	9.99	10.08	_	10.49	10.55	_	10.67	10.85	_	10.80	10.80	_	11.43	11.49	_	11.50	11.54	_
159	9.62	9.85	_	10.01	10.09	_	10.51	10.56	_	10.70	10.89	_	10.83	10.81	_	11.43	11.49	_	11.51	11.58	_
160	9.60	9.79	_	10.01	10.10	_	10.52	10.56	_	10.69	10.90	_	10.82	10.78	_	11.43	11.48	_	11.50	11.59	_
161	9.60	9.77	_	10.02	10.10	_	10.52	10.54	_	10.69	10.88	_	10.83	10.77	_	11.43	11.48	_	11.49	11.57	_
162	9.58	9.74	_	10.04	10.12	_	10.55	10.57	_	10.67	10.83	_	10.82	10.73	_	11.43	11.46	_	11.49	11.57	_
163	9.52	9.72	_	10.01	10.12	_	10.57	10.60	_	10.66	10.80	_	10.81	10.70	_	11.42	11.45	_	11.49	11.56	_
164	9.41	9.66	_	9.91	10.06	_	10.55	10.60	_	10.65	10.79	_	10.80	10.66	_	11.40	11.41	_	11.48	11.54	_
165	9.30	9.59	_	9.77	10.00	_	10.47	10.54	_	10.65	10.79	_	10.81	10.64	_	11.39	11.38	_	11.47	11.53	_
166	9.26	9.47	_	9.70	9.91	_	10.42	10.48	_	10.60	10.70	_	10.78	10.59	_	11.37	11.33	_	11.45	11.49	_
167	9.20	9.36	_	9.63	9.85	_	10.37	10.42	_	10.59	10.67	_	10.79	10.58		11.36	11.30	_	11.43	11.48	_
168	9.15	9.23	_	9.56	9.78	_	10.28	10.36	_	10.59	10.64	_	10.80	10.57		11.34	11.27	_	11.43	11.47	_
169	9.10	9.13	_	9.49	9.70	_	10.17	10.28	_	10.61	10.66	_	10.79	10.55		11.27	11.11	_	11.41	11.43	_
170	9.03	9.01	_	9.40	9.60	_	10.04	10.17	_	10.56	10.63	_	10.79	10.51		11.20	10.92		11.38	11.37	_
171	8.96	8.86	_	9.31	9.48	_	9.91	10.06	_	10.48	10.54	_	10.75	10.44		11.20	10.92		11.36	11.31	_
172	8.86	8.65	0.0	9.26	9.40	_	9.82	9.99	_	10.37	10.41	_	10.72	10.40		11.29	11.06		11.43	11.39	_
173	8.75	8.46	0.1	9.21	9.31	_	9.77	9.91	_	10.29	10.29	_	10.68	10.35		11.29	11.03		11.46	11.41	_
174	8.56	8.16	0.2	9.17	9.18	_	9.75	9.85	_	10.27	10.24	_	10.66	10.33		11.27	10.97		11.45	11.38	_
175	8.37	7.92	0.3	9.09	9.06	_	9.73	9.80	_	10.24	10.19	_	10.64	10.32		11.26	10.95		11.46	11.37	_
176	8.27	7.77	0.3	8.95	8.87	_	9.67	9.72	_	10.16	10.08	_	10.60	10.30		11.24	10.90		11.50	11.39	_
177	7.79	7.15	0.4	8.66	8.46	0.0	9.69	9.70	_	10.15	10.05	_	10.58	10.29		11.21	10.86		11.50	11.37	_
178	7.60	6.88	0.5	8.50	8.23	0.1	9.68	9.67	_	10.12	10.00	_	10.55	10.27		11.19	10.83		11.52	11.37	_
179	7.53	6.75	0.6	8.44	8.13	0.1	9.65	9.63	_	10.08	9.93	_	10.52	10.25		11.18	10.80		11.58	11.40	_
180	7.36	6.51	0.7	8.30	7.92	0.2	9.62	9.57	_	10.06	9.88	_	10.50	10.23		11.17	10.78		11.61	11.40	
181	7.18	6.24	0.7	8.12	7.64	0.3	9.54	9.43	_	10.04	9.84	_	10.48	10.20		11.16	10.76		11.59	11.35	
182	7.03	6.04	0.8	7.97	7.47	0.3	9.41	9.25	_	10.04	9.83		10.48	10.19		11.15	10.74		11.56	11.31	
183	6.66	5.63	0.8	7.59	7.01	0.4	9.28	9.09	_	10.02	9.79		10.47	10.17		11.15	10.74		11.59	11.30	
184	6.50	5.50	0.8	7.29	6.69	0.4	9.14	8.88	0.1	10.01	9.76		10.46	10.16		11.14	10.73		11.59	11.29	
185	6.31	5.29	0.8	7.02	6.35	0.5	8.90	8.56	0.1	10.00	9.74		10.46	10.16		11.13	10.71		11.59	11.26	
186	5.94	4.89	0.8	6.66	5.82	0.6	8.64	8.26	0.2	9.96	9.68		10.46	10.15		11.11	10.67		11.55	11.21	
187	5.88	4.81	0.9	6.39	5.52	0.7	8.51	8.14	0.2	9.94	9.63		10.44	10.12		11.09	10.64		11.52	11.18	
188	5.57	4.52	0.8	5.88	5.12	0.6	7.96	7.52	0.2	9.91	9.52		10.40	10.08		11.07	10.61		11.55	11.19	

Appendix B: Model Results for CBOD Calculations

Table B-1 Incremental Dissolved Oxygen Changes in Response to Changes in IEP CBOD Load

	July 1 - 15					July 16 - 31				
	0.5x	0.75x	1x	1.5x	2x	0.5x	0.75x	1x	1.5x	2x
IEP CBODu (mg/L)	18.75	28.125	37.5	56.25	75	18.75	28.125	37.5	56.25	75
Segment										
158	0.000	0.002	0.000	-0.002	-0.003	0.000	-0.004	0.000	-0.002	-0.005
159	0.001	0.001	0.000	-0.002	-0.003	0.001	-0.003	0.000	-0.002	-0.004
160	0.000	0.001	0.000	-0.003	-0.004	-0.001	0.000	0.000	-0.001	-0.005
161	0.000	0.001	0.000	-0.002	-0.003	-0.001	0.000	0.000	-0.001	-0.004
162	0.001	0.002	0.000	-0.002	-0.003	0.000	0.000	0.000	-0.001	-0.004
163	0.002	0.004	0.000	-0.001	-0.001	0.001	0.002	0.000	-0.001	-0.002
164	0.002	0.005	0.000	0.000	0.000	0.003	0.004	0.000	0.000	0.000
165	0.004	0.009	0.000	0.003	0.003	0.002	0.005	0.000	0.000	0.000
166	0.005	0.009	0.000	0.004	0.004	0.001	0.003	0.000	0.001	-0.001
167	0.004	0.007	0.000	0.002	0.002	-0.001	-0.001	0.000	-0.003	-0.006
168	0.003	0.005	0.000	0.000	0.003	-0.002	-0.002	0.000	-0.006	-0.009
169	0.002	0.005	0.000	0.000	0.004	-0.003	-0.004	0.000	-0.008	-0.011
170	0.003	0.006	0.000	0.001	0.003	-0.002	-0.003	0.000	-0.007	-0.010
171	0.005	0.007	0.000	0.002	0.004	0.002	-0.001	0.000	-0.005	-0.009
172	0.004	0.007	0.000	0.002	0.004	0.005	0.001	0.000	-0.004	-0.008
173	0.004	0.007	0.000	0.003	0.002	0.005	0.002	0.000	-0.003	-0.008
174	0.002	0.004	0.000	0.002	-0.003	0.006	0.005	0.000	-0.002	-0.008
175	0.001	0.003	0.000	0.002	-0.005	0.007	0.005	0.000	-0.002	-0.009
176	0.003	0.004	0.000	0.002	-0.005	0.008	0.005	0.000	-0.002	-0.009
177	0.005	0.003	0.000	0.001	-0.006	0.011	0.007	0.000	-0.002	-0.010
178	0.008	0.005	0.000	0.001	-0.006	0.012	0.007	0.000	-0.002	-0.011
179	0.008	0.004	0.000	-0.001	-0.006	0.012	0.006	0.000	-0.002	-0.012
180	0.010	0.005	0.000	-0.003	-0.006	0.013	0.007	0.000	-0.002	-0.013
181	0.012	0.006	0.000	-0.004	-0.005	0.013	0.008	0.000	-0.002	-0.014
182	0.011	0.006	0.000	-0.006	-0.005	0.014	0.009	0.000	-0.002	-0.014
183	0.012	0.006	0.000	-0.006	-0.007	0.015	0.009	0.000	-0.003	-0.015
184	0.009	0.005	0.000	-0.008	-0.008	0.012	0.008	0.000	-0.003	-0.016
185	0.006	0.004	0.000	-0.008	-0.010	0.008	0.006	0.000	-0.004	-0.017
186	0.008	0.006	0.000	-0.006	-0.009	0.010	0.007	0.000	-0.004	-0.017
187	0.009	0.007	0.000	-0.006	-0.008	0.011	0.007	0.000	-0.005	-0.018
188	0.003	0.005	0.000	-0.005	-0.010	0.003	0.003	0.000	-0.005	-0.019

	August 1 - 15					August 15 - 31				
	0.5x	0.75x	1x	1.5x	2x	0.5x	0.75x	1x	1.5x	2x
IEP CBODu (mg/L)	18.75	28.125	37.5	56.25	75	18.75	28.125	37.5	56.25	75
Segment										
158	0.000	-0.001	0.000	-0.003	-0.004	0.005	0.003	0.000	0.001	-0.001
159	0.001	-0.001	0.000	-0.003	-0.004	0.004	0.002	0.000	0.000	-0.002
160	0.001	-0.001	0.000	-0.002	-0.006	0.004	0.002	0.000	0.000	-0.003
161	0.001	-0.001	0.000	-0.002	-0.005	0.003	0.002	0.000	-0.001	-0.003
162	0.001	0.000	0.000	-0.002	-0.005	0.003	0.002	0.000	-0.001	-0.003
163	0.002	0.001	0.000	-0.002	-0.004	0.003	0.002	0.000	-0.002	-0.003
164	0.002	0.001	0.000	-0.003	-0.004	0.003	0.002	0.000	-0.002	-0.005
165	0.002	0.000	0.000	-0.005	-0.005	0.002	0.000	0.000	-0.004	-0.007
166	0.001	0.000	0.000	-0.006	-0.007	0.001	-0.001	0.000	-0.006	-0.010
167	0.000	0.000	0.000	-0.005	-0.009	0.001	-0.001	0.000	-0.007	-0.012
168	-0.004	0.002	0.000	-0.001	-0.015	-0.001	-0.003	0.000	-0.009	-0.016
169	-0.003	0.005	0.000	-0.001	-0.017	0.001	-0.001	0.000	-0.008	-0.016
170	-0.001	0.006	0.000	-0.001	-0.016	0.002	0.000	0.000	-0.009	-0.017
171	0.001	0.007	0.000	-0.002	-0.016	0.004	0.001	0.000	-0.008	-0.018
172	0.002	0.009	0.000	-0.001	-0.016	0.005	0.002	0.000	-0.008	-0.020
173	0.003	0.010	0.000	-0.001	-0.015	0.004	0.001	0.000	-0.010	-0.023
174	0.006	0.010	0.000	-0.003	-0.015	0.006	0.003	0.000	-0.011	-0.025
175	0.007	0.010	0.000	-0.003	-0.015	0.007	0.004	0.000	-0.010	-0.025
176	0.008	0.010	0.000	-0.003	-0.015	0.008	0.004	0.000	-0.010	-0.025
177	0.012	0.011	0.000	-0.004	-0.015	0.011	0.006	0.000	-0.010	-0.026
178	0.012	0.011	0.000	-0.004	-0.015	0.012	0.007	0.000	-0.009	-0.026
179	0.011	0.009	0.000	-0.006	-0.017	0.013	0.007	0.000	-0.009	-0.026
180	0.012	0.008	0.000	-0.007	-0.018	0.013	0.008	0.000	-0.009	-0.025
181	0.012	0.007	0.000	-0.008	-0.020	0.014	0.009	0.000	-0.008	-0.025
182	0.013	0.006	0.000	-0.008	-0.021	0.014	0.009	0.000	-0.008	-0.026
183	0.014	0.007	0.000	-0.008	-0.021	0.016	0.010	0.000	-0.008	-0.026
184	0.012	0.005	0.000	-0.008	-0.022	0.013	0.009	0.000	-0.008	-0.025
185	0.009	0.004	0.000	-0.007	-0.023	0.011	0.007	0.000	-0.008	-0.026
186	0.011	0.006	0.000	-0.006	-0.023	0.014	0.009	0.000	-0.009	-0.026
187	0.012	0.006	0.000	-0.006	-0.023	0.017	0.011	0.000	-0.010	-0.025
188	0.004	0.002	0.000	-0.006	-0.025	0.007	0.005	0.000	-0.009	-0.029

	September 1 - 15					September 16 - 30				
	0.5x	0.75x	1x	1.5x	2x	0.5x	0.75x	1x	1.5x	2x
IEP CBODu (mg/L)	18.75	28.125	37.5	56.25	75	18.75	28.125	37.5	56.25	75
Segment										
158	0.005	0.004	0.000	-0.002	-0.003	0.002	0.002	0.000	-0.002	-0.003
159	0.003	0.002	0.000	-0.004	-0.005	0.002	0.004	0.000	-0.003	-0.005
160	0.003	0.002	0.000	-0.004	-0.005	0.004	0.002	0.000	-0.002	-0.004
161	0.003	0.002	0.000	-0.003	-0.005	0.003	0.003	0.000	-0.002	-0.005
162	0.003	0.003	0.000	-0.003	-0.005	0.003	0.003	0.000	-0.003	-0.006
163	0.004	0.003	0.000	-0.002	-0.004	0.002	0.002	0.000	-0.003	-0.006
164	0.003	0.002	0.000	-0.002	-0.004	0.002	0.003	0.000	-0.003	-0.006
165	0.004	0.004	0.000	-0.002	-0.003	0.002	0.003	0.000	-0.003	-0.006
166	0.004	0.003	0.000	-0.002	-0.004	0.003	0.002	0.000	-0.004	-0.007
167	0.004	0.002	0.000	-0.003	-0.006	0.003	0.002	0.000	-0.004	-0.009
168	0.003	0.002	0.000	-0.003	-0.006	0.003	0.003	0.000	-0.004	-0.010
169	0.002	0.001	0.000	-0.003	-0.007	0.002	0.003	0.000	-0.004	-0.010
170	0.005	0.004	0.000	-0.001	-0.005	0.002	0.002	0.000	-0.004	-0.011
171	0.003	0.007	0.000	0.002	-0.002	0.002	0.001	0.000	-0.004	-0.012
172	0.009	0.007	0.000	0.003	-0.002	-0.003	-0.004	0.000	-0.008	-0.015
173	0.008	0.006	0.000	0.000	-0.005	-0.005	-0.003	0.000	-0.012	-0.018
174	0.007	0.004	0.000	-0.004	-0.010	-0.010	-0.011	0.000	-0.015	-0.022
175	0.010	0.007	0.000	-0.004	-0.010	-0.011	-0.011	0.000	-0.017	-0.023
176	0.010	0.006	0.000	-0.006	-0.012	-0.007	-0.008	0.000	-0.014	-0.021
177	0.011	0.006	0.000	-0.010	-0.017	-0.009	-0.009	0.000	-0.017	-0.024
178	0.011	0.005	0.000	-0.012	-0.020	-0.002	-0.004	0.000	-0.015	-0.022
179	0.011	0.006	0.000	-0.013	-0.023	-0.001	-0.003	0.000	-0.014	-0.023
180	0.012	0.006	0.000	-0.013	-0.024	0.002	-0.001	0.000	-0.015	-0.024
181	0.012	0.007	0.000	-0.013	-0.027	0.005	0.001	0.000	-0.015	-0.026
182	0.013	0.006	0.000	-0.014	-0.029	0.009	0.004	0.000	-0.014	-0.026
183	0.013	0.007	0.000	-0.014	-0.030	0.015	0.009	0.000	-0.012	-0.024
184	0.012	0.007	0.000	-0.013	-0.029	0.020	0.014	0.000	-0.008	-0.020
185	0.013	0.008	0.000	-0.013	-0.028	0.025	0.017	0.000	-0.007	-0.019
186	0.018	0.011	0.000	-0.012	-0.029	0.031	0.020	0.000	-0.008	-0.021
187	0.022	0.012	0.000	-0.012	-0.029	0.034	0.019	0.000	-0.009	-0.023
188	0.019	0.011	0.000	-0.011	-0.028	0.036	0.019	0.000	-0.009	-0.023

	October 1 - 15					October 16 - 31				
	0.5x	0.75x	1x	1.5x	2x	0.5x	0.75x	1x	1.5x	2x
IEP CBODu (mg/L)	18.75	28.125	37.5	56.25	75	18.75	28.125	37.5	56.25	75
Segment										
158	0.000	-0.002	0.000	-0.002	-0.004	-0.001	-0.001	0.000	-0.002	-0.003
159	0.000	-0.002	0.000	-0.002	-0.004	0.000	0.000	0.000	-0.002	-0.003
160	0.000	-0.002	0.000	-0.003	-0.005	0.000	0.000	0.000	-0.002	-0.003
161	0.000	-0.002	0.000	-0.003	-0.006	0.000	0.000	0.000	-0.002	-0.004
162	0.000	-0.001	0.000	-0.003	-0.006	0.000	0.000	0.000	-0.003	-0.005
163	0.000	-0.001	0.000	-0.003	-0.006	0.000	0.000	0.000	-0.003	-0.006
164	0.001	0.000	0.000	-0.002	-0.006	0.001	0.000	0.000	-0.003	-0.006
165	0.002	0.001	0.000	-0.002	-0.005	0.001	0.000	0.000	-0.003	-0.006
166	0.001	0.000	0.000	-0.003	-0.006	0.001	0.000	0.000	-0.003	-0.007
167	0.001	0.000	0.000	-0.003	-0.006	0.002	0.001	0.000	-0.003	-0.007
168	0.001	0.001	0.000	-0.003	-0.006	0.003	0.001	0.000	-0.002	-0.007
169	0.001	0.001	0.000	-0.004	-0.007	0.002	0.001	0.000	-0.003	-0.007
170	0.002	0.001	0.000	-0.004	-0.007	0.003	0.002	0.000	-0.002	-0.007
171	0.002	0.001	0.000	-0.004	-0.007	0.003	0.002	0.000	-0.003	-0.007
172	0.002	0.001	0.000	-0.004	-0.008	0.004	0.002	0.000	-0.002	-0.007
173	0.002	0.001	0.000	-0.004	-0.008	0.004	0.002	0.000	-0.002	-0.007
174	0.000	-0.001	0.000	-0.005	-0.010	0.004	0.002	0.000	-0.003	-0.007
175	-0.003	-0.003	0.000	-0.005	-0.011	0.004	0.002	0.000	-0.003	-0.007
176	-0.002	-0.002	0.000	-0.005	-0.011	0.005	0.003	0.000	-0.003	-0.007
177	-0.005	-0.005	0.000	-0.007	-0.015	0.005	0.002	0.000	-0.003	-0.008
178	-0.004	-0.004	0.000	-0.008	-0.016	0.005	0.002	0.000	-0.003	-0.008
179	-0.004	-0.005	0.000	-0.008	-0.017	0.005	0.002	0.000	-0.003	-0.008
180	-0.004	-0.004	0.000	-0.009	-0.018	0.003	0.002	0.000	-0.004	-0.009
181	-0.005	-0.005	0.000	-0.010	-0.020	0.007	0.003	0.000	-0.004	-0.009
182	-0.003	-0.004	0.000	-0.010	-0.020	0.009	0.004	0.000	-0.004	-0.010
183	-0.003	-0.004	0.000	-0.011	-0.022	0.006	0.002	0.000	-0.005	-0.011
184	0.002	0.000	0.000	-0.011	-0.022	0.008	0.002	0.000	-0.005	-0.011
185	0.011	0.004	0.000	-0.011	-0.021	0.015	0.004	0.000	-0.005	-0.011
186	0.017	0.005	0.000	-0.013	-0.024	0.011	0.001	0.000	-0.005	-0.013
187	0.019	0.005	0.000	-0.012	-0.026	0.012	0.001	0.000	-0.005	-0.013
188	0.032	0.009	0.000	-0.011	-0.024	0.030	0.005	0.000	-0.005	-0.012

Table B-2. Incremental Dissolved Oxygen Changes in Response to Changes in Kaiser CBOD Load

	July 1 - 15					July 16 - 31				
	0.5x	0.75x	1x	1.5x	2x	0.5x	0.75x	1x	1.5x	2x
Kaiser CBODu (mg/L)	18.75	28.125	37.5	56.25	75	18.75	28.125	37.5	56.25	75
Segment										
158	0.004	0.004	0.000	-0.005	-0.006	0.000	-0.003	0.000	-0.010	-0.010
159	0.004	0.004	0.000	-0.007	-0.008	0.002	0.000	0.000	-0.010	-0.010
160	0.005	0.004	0.000	-0.008	-0.010	0.003	0.000	0.000	-0.008	-0.011
161	0.005	0.004	0.000	-0.007	-0.010	0.003	0.000	0.000	-0.008	-0.011
162	0.006	0.005	0.000	-0.007	-0.010	0.003	0.001	0.000	-0.007	-0.011
163	0.008	0.006	0.000	-0.006	-0.009	0.004	0.003	0.000	-0.005	-0.009
164	0.009	0.006	0.000	-0.005	-0.007	0.007	0.006	0.000	-0.004	-0.007
165	0.013	0.007	0.000	-0.003	-0.005	0.007	0.007	0.000	-0.002	-0.008
166	0.014	0.008	0.000	-0.003	-0.004	0.005	0.007	0.000	-0.005	-0.010
167	0.012	0.008	0.000	-0.005	-0.005	0.003	0.002	0.000	-0.009	-0.011
168	0.011	0.007	0.000	-0.006	-0.004	0.003	0.002	0.000	-0.012	-0.012
169	0.010	0.007	0.000	-0.006	-0.002	0.003	0.002	0.000	-0.014	-0.013
170	0.011	0.006	0.000	-0.006	-0.005	0.005	0.003	0.000	-0.013	-0.012
171	0.012	0.005	0.000	-0.005	-0.007	0.007	0.005	0.000	-0.013	-0.012
172	0.012	0.007	0.000	-0.005	-0.003	0.008	0.008	0.000	-0.012	-0.011
173	0.012	0.007	0.000	-0.007	-0.006	0.009	0.008	0.000	-0.012	-0.012
174	0.010	0.005	0.000	-0.011	-0.008	0.010	0.009	0.000	-0.011	-0.013
175	0.008	0.004	0.000	-0.012	-0.011	0.010	0.009	0.000	-0.012	-0.013
176	0.009	0.002	0.000	-0.012	-0.015	0.011	0.009	0.000	-0.012	-0.015
177	0.008	0.003	0.000	-0.012	-0.016	0.012	0.011	0.000	-0.012	-0.015
178	0.009	0.003	0.000	-0.011	-0.019	0.012	0.011	0.000	-0.012	-0.017
179	0.009	0.001	0.000	-0.011	-0.022	0.012	0.010	0.000	-0.012	-0.019
180	0.009	0.002	0.000	-0.010	-0.023	0.012	0.009	0.000	-0.012	-0.021
181	0.010	0.003	0.000	-0.008	-0.022	0.012	0.008	0.000	-0.012	-0.024
182	0.010	0.004	0.000	-0.008	-0.022	0.012	0.007	0.000	-0.012	-0.026
183	0.010	0.004	0.000	-0.009	-0.021	0.012	0.008	0.000	-0.012	-0.025
184	0.009	0.002	0.000	-0.010	-0.021	0.011	0.005	0.000	-0.013	-0.026
185	0.008	0.000	0.000	-0.010	-0.022	0.009	0.002	0.000	-0.014	-0.028
186	0.010	0.003	0.000	-0.008	-0.020	0.010	0.003	0.000	-0.013	-0.027
187	0.011	0.004	0.000	-0.007	-0.019	0.010	0.003	0.000	-0.013	-0.028
188	0.010	-0.001	0.000	-0.008	-0.019	0.008	-0.004	0.000	-0.015	-0.028

	August 1 - 15					August 15 - 31				
	0.5x	0.75x	1x	1.5x	2x	0.5x	0.75x	1x	1.5x	2x
Kaiser CBODu (mg/L)	18.75	28.125	37.5	56.25	75	18.75	28.125	37.5	56.25	75
Segment										
158	0.001	0.000	0.000	-0.006	-0.010	0.006	0.001	0.000	-0.002	-0.005
159	0.002	0.001	0.000	-0.005	-0.011	0.005	0.001	0.000	-0.003	-0.006
160	0.002	0.001	0.000	-0.008	-0.012	0.005	0.001	0.000	-0.003	-0.007
161	0.002	0.001	0.000	-0.008	-0.012	0.004	0.002	0.000	-0.002	-0.006
162	0.002	0.001	0.000	-0.007	-0.011	0.004	0.002	0.000	-0.002	-0.006
163	0.004	0.002	0.000	-0.005	-0.010	0.004	0.002	0.000	-0.002	-0.005
164	0.005	0.003	0.000	-0.004	-0.010	0.003	0.002	0.000	-0.002	-0.006
165	0.006	0.002	0.000	-0.006	-0.012	0.002	0.000	0.000	-0.005	-0.008
166	0.006	0.002	0.000	-0.008	-0.014	0.001	-0.001	0.000	-0.008	-0.010
167	0.004	0.002	0.000	-0.010	-0.015	0.000	-0.001	0.000	-0.010	-0.011
168	-0.013	0.004	0.000	-0.023	-0.017	-0.004	-0.003	0.000	-0.016	-0.013
169	-0.016	0.006	0.000	-0.027	-0.017	-0.002	-0.002	0.000	-0.018	-0.014
170	-0.014	0.008	0.000	-0.025	-0.018	-0.001	-0.002	0.000	-0.019	-0.016
171	-0.008	0.009	0.000	-0.023	-0.018	-0.001	0.000	0.000	-0.018	-0.016
172	-0.006	0.012	0.000	-0.021	-0.018	-0.001	0.002	0.000	-0.020	-0.017
173	-0.002	0.013	0.000	-0.017	-0.019	-0.002	0.003	0.000	-0.021	-0.018
174	0.003	0.013	0.000	-0.015	-0.020	-0.001	0.005	0.000	-0.021	-0.019
175	0.006	0.014	0.000	-0.013	-0.020	0.000	0.007	0.000	-0.020	-0.019
176	0.008	0.013	0.000	-0.011	-0.021	0.002	0.007	0.000	-0.020	-0.021
177	0.011	0.015	0.000	-0.010	-0.020	0.004	0.010	0.000	-0.020	-0.020
178	0.012	0.014	0.000	-0.009	-0.022	0.006	0.011	0.000	-0.019	-0.022
179	0.012	0.011	0.000	-0.010	-0.023	0.007	0.011	0.000	-0.018	-0.023
180	0.013	0.010	0.000	-0.011	-0.026	0.009	0.011	0.000	-0.016	-0.024
181	0.013	0.008	0.000	-0.012	-0.026	0.011	0.011	0.000	-0.014	-0.027
182	0.012	0.006	0.000	-0.013	-0.027	0.011	0.010	0.000	-0.013	-0.028
183	0.012	0.006	0.000	-0.013	-0.027	0.012	0.011	0.000	-0.012	-0.027
184	0.011	0.004	0.000	-0.014	-0.027	0.010	0.008	0.000	-0.013	-0.028
185	0.010	0.001	0.000	-0.015	-0.028	0.009	0.004	0.000	-0.013	-0.029
186	0.011	0.003	0.000	-0.014	-0.028	0.011	0.006	0.000	-0.012	-0.028
187	0.011	0.003	0.000	-0.014	-0.028	0.013	0.007	0.000	-0.011	-0.027
188	0.008	-0.004	0.000	-0.017	-0.029	0.009	-0.002	0.000	-0.016	-0.030

	September 1 - 15					September 16 - 30				
	0.5x	0.75x	1x	1.5x	2x	0.5x	0.75x	1x	1.5x	2x
Kaiser CBODu (mg/L)	18.75	28.125	37.5	56.25	75	18.75	28.125	37.5	56.25	75
Segment										
158	0.007	0.004	0.000	-0.002	-0.009	0.005	0.003	0.000	-0.008	-0.014
159	0.005	0.003	0.000	-0.004	-0.008	0.006	0.004	0.000	-0.008	-0.016
160	0.005	0.003	0.000	-0.004	-0.008	0.008	0.005	0.000	-0.009	-0.018
161	0.005	0.003	0.000	-0.004	-0.009	0.007	0.004	0.000	-0.010	-0.018
162	0.005	0.003	0.000	-0.003	-0.008	0.007	0.004	0.000	-0.010	-0.018
163	0.005	0.004	0.000	-0.002	-0.006	0.006	0.003	0.000	-0.009	-0.017
164	0.004	0.003	0.000	-0.002	-0.006	0.006	0.003	0.000	-0.009	-0.016
165	0.005	0.004	0.000	0.000	-0.005	0.006	0.004	0.000	-0.008	-0.015
166	0.005	0.004	0.000	-0.001	-0.006	0.006	0.004	0.000	-0.009	-0.016
167	0.004	0.003	0.000	-0.003	-0.008	0.006	0.003	0.000	-0.009	-0.017
168	0.004	0.001	0.000	-0.004	-0.009	0.007	0.003	0.000	-0.009	-0.019
169	0.004	-0.003	0.000	-0.007	-0.010	0.007	0.003	0.000	-0.010	-0.020
170	0.007	-0.002	0.000	-0.006	-0.008	0.007	0.003	0.000	-0.011	-0.021
171	0.011	0.000	0.000	-0.004	-0.007	0.007	0.002	0.000	-0.011	-0.022
172	0.013	-0.002	0.000	-0.005	-0.007	0.003	-0.002	0.000	-0.015	-0.027
173	0.012	-0.002	0.000	-0.006	-0.009	0.001	-0.004	0.000	-0.017	-0.031
174	0.010	-0.002	0.000	-0.009	-0.011	-0.002	-0.007	0.000	-0.020	-0.034
175	0.012	0.000	0.000	-0.008	-0.011	-0.003	-0.007	0.000	-0.020	-0.033
176	0.010	0.000	0.000	-0.009	-0.013	-0.001	-0.005	0.000	-0.018	-0.029
177	0.009	0.002	0.000	-0.012	-0.014	-0.002	-0.006	0.000	-0.019	-0.029
178	0.008	0.003	0.000	-0.014	-0.016	0.002	-0.001	0.000	-0.016	-0.025
179	0.007	0.004	0.000	-0.014	-0.017	0.004	0.000	0.000	-0.015	-0.023
180	0.006	0.007	0.000	-0.013	-0.018	0.005	0.001	0.000	-0.015	-0.022
181	0.006	0.008	0.000	-0.014	-0.019	0.006	0.002	0.000	-0.013	-0.019
182	0.005	0.008	0.000	-0.014	-0.020	0.007	0.003	0.000	-0.013	-0.018
183	0.006	0.009	0.000	-0.014	-0.021	0.011	0.006	0.000	-0.011	-0.017
184	0.006	0.009	0.000	-0.013	-0.021	0.014	0.010	0.000	-0.007	-0.015
185	0.008	0.010	0.000	-0.011	-0.020	0.016	0.015	0.000	-0.005	-0.014
186	0.010	0.013	0.000	-0.011	-0.022	0.017	0.020	0.000	-0.006	-0.014
187	0.012	0.015	0.000	-0.011	-0.022	0.016	0.023	0.000	-0.007	-0.015
188	0.011	0.013	0.000	-0.011	-0.023	0.015	0.028	0.000	-0.007	-0.014

	October 1 - 15					October 16 - 31				
	0.5x	0.75x	1x	1.5x	2x	0.5x	0.75x	1x	1.5x	2x
Kaiser CBODu (mg/L)	18.75	28.125	37.5	56.25	75	18.75	28.125	37.5	56.25	75
Segment										
158	0.004	0.000	0.000	-0.009	-0.014	0.002	0.000	0.000	-0.006	-0.010
159	0.004	0.001	0.000	-0.009	-0.014	0.003	0.001	0.000	-0.007	-0.011
160	0.004	0.001	0.000	-0.010	-0.017	0.004	0.002	0.000	-0.007	-0.012
161	0.005	0.001	0.000	-0.011	-0.019	0.004	0.002	0.000	-0.008	-0.014
162	0.006	0.002	0.000	-0.012	-0.019	0.005	0.003	0.000	-0.010	-0.016
163	0.005	0.001	0.000	-0.011	-0.018	0.005	0.002	0.000	-0.010	-0.017
164	0.006	0.002	0.000	-0.010	-0.017	0.006	0.003	0.000	-0.010	-0.017
165	0.006	0.002	0.000	-0.008	-0.014	0.005	0.003	0.000	-0.010	-0.016
166	0.006	0.002	0.000	-0.009	-0.015	0.005	0.003	0.000	-0.010	-0.016
167	0.006	0.002	0.000	-0.008	-0.015	0.006	0.003	0.000	-0.009	-0.016
168	0.006	0.002	0.000	-0.008	-0.015	0.006	0.004	0.000	-0.008	-0.014
169	0.006	0.002	0.000	-0.008	-0.015	0.005	0.003	0.000	-0.008	-0.014
170	0.006	0.002	0.000	-0.008	-0.014	0.005	0.003	0.000	-0.006	-0.011
171	0.006	0.002	0.000	-0.008	-0.014	0.004	0.003	0.000	-0.005	-0.010
172	0.006	0.002	0.000	-0.008	-0.015	0.004	0.003	0.000	-0.004	-0.008
173	0.006	0.002	0.000	-0.009	-0.016	0.004	0.003	0.000	-0.004	-0.008
174	0.005	0.001	0.000	-0.011	-0.018	0.004	0.003	0.000	-0.005	-0.009
175	0.004	-0.002	0.000	-0.011	-0.019	0.004	0.003	0.000	-0.004	-0.008
176	0.003	-0.002	0.000	-0.011	-0.020	0.004	0.003	0.000	-0.004	-0.007
177	0.002	-0.004	0.000	-0.013	-0.024	0.004	0.003	0.000	-0.005	-0.009
178	0.002	-0.003	0.000	-0.013	-0.024	0.004	0.003	0.000	-0.005	-0.010
179	0.002	-0.004	0.000	-0.014	-0.025	0.004	0.003	0.000	-0.005	-0.010
180	0.002	-0.002	0.000	-0.014	-0.025	0.004	0.002	0.000	-0.006	-0.011
181	0.002	-0.005	0.000	-0.015	-0.027	0.006	0.006	0.000	-0.006	-0.012
182	0.003	-0.003	0.000	-0.014	-0.027	0.006	0.008	0.000	-0.006	-0.012
183	0.002	-0.003	0.000	-0.014	-0.027	0.005	0.005	0.000	-0.007	-0.014
184	0.006	0.001	0.000	-0.013	-0.026	0.005	0.007	0.000	-0.007	-0.013
185	0.008	0.010	0.000	-0.011	-0.022	0.005	0.016	0.000	-0.006	-0.012
186	0.010	0.014	0.000	-0.012	-0.026	0.003	0.012	0.000	-0.008	-0.015
187	0.009	0.015	0.000	-0.011	-0.023	0.003	0.012	0.000	-0.008	-0.015
188	0.010	0.027	0.000	-0.009	-0.016	0.006	0.031	0.000	-0.007	-0.012

Table B-3. Individual Segment/Time-Specific Slopes for IEP

	July 1 - 15			July 16 - 31			August 1 - 15			August 15 - 31			September 1 - 15			September 16 - 30			October 1 - 15			October 16 - 31		
	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc
IEP CBOD5 Change (mg/L)	0.00	-1.80	3.60	0.00	-1.80	3.60	0.00	-1.80	3.60	0.00	-1.80	3.60	0.00	-1.80	3.60	0.00	-1.80	3.60	0.00	-1.80	3.60	0.00	-1.80	3.60
Segment																								
158	-7.19E-5	-2.13E-5	-7.47E-5	-7.14E-5	-1.07E-5	-1.39E-4	-8.28E-5	-2.67E-5	-1.09E-4	-8.58E-5	-2.45E-4	-2.40E-5	-1.47E-4	-2.51E-4	-8.53E-5	-9.66E-5	-1.12E-4	-7.47E-5	-6.07E-5	0.00E+0	-1.07E-4	-4.05E-5	0.00E+0	-8.00E-5
159	-6.43E-5	0.00E+0	-2.92E-5	-6.54E-5	-2.21E-5	-3.84E-5	-9.31E-5	-3.31E-6	-4.91E-5	-9.87E-5	0.00E+0	-1.75E-5	-1.55E-4	0.00E+0	-5.46E-5	-1.52E-4	0.00E+0	-5.55E-5	-6.07E-5	-2.21E-5	-4.05E-5	-5.98E-5	0.00E+0	-3.31E-5
160	-8.66E-5	0.00E+0	-4.52E-5	-6.79E-5	-1.07E-5	-4.01E-5	-1.05E-4	-4.78E-6	-5.50E-5	-1.08E-4	0.00E+0	-2.13E-5	-1.57E-4	0.00E+0	-5.83E-5	-1.43E-4	0.00E+0	-3.90E-5	-8.28E-5	-2.21E-5	-5.33E-5	-5.98E-5	0.00E+0	-3.31E-5
161	-7.37E-5	0.00E+0	-3.29E-5	-6.16E-5	-8.09E-6	-3.57E-5	-1.08E-4	-3.68E-7	-5.37E-5	-1.08E-4	0.00E+0	-2.94E-5	-1.57E-4	0.00E+0	-5.61E-5	-1.49E-4	0.00E+0	-4.80E-5	-9.84E-5	-2.21E-5	-6.07E-5	-7.54E-5	0.00E+0	-4.05E-5
162	-7.78E-5	0.00E+0	-3.16E-5	-6.47E-5	0.00E+0	-3.16E-5	-1.07E-4	0.00E+0	-5.09E-5	-1.11E-4	0.00E+0	-3.13E-5	-1.49E-4	0.00E+0	-4.76E-5	-1.61E-4	0.00E+0	-5.68E-5	-1.06E-4	-1.10E-5	-6.07E-5	-9.75E-5	0.00E+0	-5.33E-5
163	-7.37E-5	0.00E+0	-9.20E-6	-6.80E-5	0.00E+0	-2.15E-5	-1.05E-4	0.00E+0	-4.23E-5	-1.18E-4	0.00E+0	-3.49E-5	-1.38E-4	0.00E+0	-3.95E-5	-1.53E-4	0.00E+0	-6.33E-5	-1.06E-4	-1.10E-5	-6.07E-5	-1.13E-4	0.00E+0	-6.07E-5
164	-7.23E-5	0.00E+0	-4.41E-6	-6.57E-5	0.00E+0	-5.52E-7	-1.21E-4	0.00E+0	-4.67E-5	-1.34E-4	0.00E+0	-4.25E-5	-1.39E-4	0.00E+0	-4.43E-5	-1.66E-4	0.00E+0	-6.58E-5	-1.19E-4	0.00E+0	-5.52E-5	-1.25E-4	0.00E+0	-6.07E-5
165	-4.63E-5	0.00E+0	0.00E+0	-5.42E-5	0.00E+0	0.00E+0	-1.37E-4	0.00E+0	-6.68E-5	-1.60E-4	0.00E+0	-7.65E-5	-1.44E-4	0.00E+0	-3.38E-5	-1.72E-4	0.00E+0	-6.49E-5	-1.25E-4	0.00E+0	-4.93E-5	-1.25E-4	0.00E+0	-6.07E-5
166	-3.94E-5	0.00E+0	0.00E+0	-4.21E-5	0.00E+0	-1.29E-6	-1.55E-4	0.00E+0	-8.42E-5	-2.06E-4	-7.36E-7	-1.08E-4	-1.56E-4	0.00E+0	-4.29E-5	-1.87E-4	0.00E+0	-7.21E-5	-1.28E-4	0.00E+0	-6.00E-5	-1.41E-4	0.00E+0	-6.80E-5
167	-5.51E-5	0.00E+0	0.00E+0	-9.02E-5	-1.69E-5	-5.74E-5	-1.62E-4	-1.47E-6	-8.74E-5	-2.31E-4	-5.15E-6	-1.24E-4	-1.69E-4	0.00E+0	-5.72E-5	-2.10E-4	0.00E+0	-8.59E-5	-1.33E-4	0.00E+0	-6.12E-5	-1.60E-4	0.00E+0	-6.80E-5
168	-2.00E-5	0.00E+0	0.00E+0	-1.41E-4	-4.12E-5	-1.01E-4	-2.12E-4	-2.21E-6	-1.14E-4	-2.76E-4	-4.45E-5	-1.71E-4	-1.75E-4	0.00E+0	-6.42E-5	-2.30E-4	0.00E+0	-9.27E-5	-1.41E-4	0.00E+0	-6.51E-5	-1.66E-4	0.00E+0	-6.25E-5
169	-2.76E-7	0.00E+0	0.00E+0	-1.59E-4	-6.18E-5	-1.23E-4	-2.59E-4	0.00E+0	-1.26E-4	-3.08E-4	-4.78E-6	-1.64E-4	-1.55E-4	0.00E+0	-7.04E-5	-2.37E-4	0.00E+0	-1.00E-4	-1.49E-4	0.00E+0	-6.91E-5	-1.60E-4	0.00E+0	-6.80E-5
170	-2.33E-5	0.00E+0	0.00E+0	-1.70E-4	-4.08E-5	-1.16E-4	-2.89E-4	0.00E+0	-1.25E-4	-3.45E-4	0.00E+0	-1.71E-4	-1.63E-4	0.00E+0	-4.10E-5	-2.34E-4	0.00E+0	-1.05E-4	-1.55E-4	0.00E+0	-7.04E-5	-1.73E-4	0.00E+0	-6.25E-5
171	-2.90E-5	0.00E+0	0.00E+0	-1.89E-4	0.00E+0	-9.32E-5	-3.21E-4	0.00E+0	-1.29E-4	-3.79E-4	0.00E+0	-1.76E-4	-1.75E-4	0.00E+0	-7.36E-6	-2.45E-4	0.00E+0	-1.10E-4	-1.67E-4	0.00E+0	-7.45E-5	-1.79E-4	0.00E+0	-6.80E-5
172	-1.60E-5	0.00E+0	0.00E+0	-2.03E-4	0.00E+0	-7.61E-5	-3.50E-4	0.00E+0	-1.24E-4	-4.39E-4	0.00E+0	-1.94E-4	-1.78E-4	0.00E+0	-3.68E-7	-2.29E-4	-6.03E-5	-1.56E-4	-1.73E-4	0.00E+0	-7.72E-5	-1.78E-4	0.00E+0	-6.23E-5
173	-4.94E-5	0.00E+0	0.00E+0	-2.28E-4	0.00E+0	-7.67E-5	-3.49E-4	0.00E+0	-1.16E-4	-4.86E-4	0.00E+0	-2.25E-4	-2.22E-4	0.00E+0	-4.27E-5	-2.31E-4	-1.22E-4	-1.93E-4	-1.86E-4	0.00E+0	-8.40E-5	-1.88E-4	0.00E+0	-6.38E-5
174	-8.85E-5	0.00E+0	-1.34E-5	-2.54E-4	0.00E+0	-7.49E-5	-3.96E-4	0.00E+0	-1.27E-4	-5.42E-4	0.00E+0	-2.40E-4	-2.91E-4	0.00E+0	-8.99E-5	-2.35E-4	-1.99E-4	-2.45E-4	-1.75E-4	-7.72E-6	-9.66E-5	-1.95E-4	0.00E+0	-6.79E-5
175	-1.06E-4	0.00E+0	-2.92E-5	-2.68E-4	0.00E+0	-7.80E-5	-4.11E-4	0.00E+0	-1.24E-4	-5.62E-4	0.00E+0	-2.38E-4	-3.44E-4	0.00E+0	-9.27E-5	-2.45E-4	-2.07E-4	-2.58E-4	-1.45E-4	-4.93E-5	-1.04E-4	-2.01E-4	0.00E+0	-6.91E-5
176	-1.31E-4	0.00E+0	-2.72E-5	-2.87E-4	0.00E+0	-7.96E-5	-4.19E-4	0.00E+0	-1.24E-4	-5.74E-4	0.00E+0	-2.38E-4	-3.91E-4	0.00E+0	-1.23E-4	-2.88E-4	-1.38E-4	-2.36E-4	-1.68E-4	-4.34E-5	-1.14E-4	-2.08E-4	0.00E+0	-6.97E-5
177	-1.81E-4	0.00E+0	-4.17E-5	-3.53E-4	0.00E+0	-8.64E-5	-4.81E-4	0.00E+0	-1.32E-4	-6.53E-4	0.00E+0	-2.46E-4	-5.07E-4	0.00E+0	-1.81E-4	-3.05E-4	-1.66E-4	-2.67E-4	-1.70E-4	-9.53E-5	-1.44E-4	-2.17E-4	0.00E+0	-7.60E-5
178	-2.17E-4	0.00E+0	-4.14E-5	-3.87E-4	0.00E+0	-9.20E-5	-4.82E-4	0.00E+0	-1.35E-4	-6.67E-4	0.00E+0	-2.44E-4	-5.61E-4	0.00E+0	-2.14E-4	-3.76E-4	-5.89E-5	-2.39E-4	-2.09E-4	-7.87E-5	-1.55E-4	-2.24E-4	0.00E+0	-7.93E-5
179	-2.31E-4	0.00E+0	-4.95E-5	-3.94E-4	0.00E+0	-1.02E-4	-5.02E-4	0.00E+0	-1.54E-4	-6.73E-4	0.00E+0	-2.43E-4	-6.18E-4	0.00E+0	-2.40E-4	-4.17E-4	-3.38E-5	-2.45E-4	-2.33E-4	-8.28E-5	-1.70E-4	-2.27E-4	0.00E+0	-8.13E-5
180	-2.58E-4	0.00E+0	-5.87E-5	-4.20E-4	0.00E+0	-1.10E-4	-5.22E-4	0.00E+0	-1.69E-4	-6.71E-4	0.00E+0	-2.34E-4	-6.48E-4	0.00E+0	-2.50E-4	-4.86E-4	0.00E+0	-2.60E-4	-2.54E-4	-7.61E-5	-1.79E-4	-2.22E-4	0.00E+0	-8.75E-5
181	-2.80E-4	0.00E+0	-5.43E-5	-4.47E-4	0.00E+0	-1.14E-4	-5.57E-4	0.00E+0	-1.88E-4	-6.78E-4	0.00E+0	-2.27E-4	-7.08E-4	0.00E+0	-2.73E-4	-5.67E-4	0.00E+0	-2.74E-4	-2.75E-4	-1.00E-4	-2.05E-4	-2.79E-4	0.00E+0	-8.96E-5
182	-2.99E-4	0.00E+0	-6.91E-5	-4.59E-4	0.00E+0	-1.15E-4	-5.72E-4	0.00E+0	-1.97E-4	-6.69E-4	0.00E+0	-2.22E-4	-7.30E-4	0.00E+0	-2.84E-4	-6.37E-4	0.00E+0	-2.69E-4	-3.16E-4	-6.80E-5	-2.07E-4	-3.14E-4	0.00E+0	-9.62E-5
183	-3.27E-4	0.00E+0	-8.22E-5	-4.86E-4	0.00E+0	-1.23E-4	-6.06E-4	0.00E+0	-2.02E-4	-6.94E-4	0.00E+0	-2.22E-4	-7.62E-4	0.00E+0	-2.93E-4	-6.95E-4	0.00E+0	-2.46E-4	-3.42E-4	-6.88E-5	-2.21E-4	-2.87E-4	0.00E+0	-1.06E-4
184	-3.23E-4	0.00E+0	-1.03E-4	-4.67E-4	0.00E+0	-1.32E-4	-5.83E-4	0.00E+0	-2.08E-4	-6.72E-4	0.00E+0	-2.30E-4	-7.34E-4	0.00E+0	-2.84E-4	-7.06E-4	0.00E+0	-1.89E-4	-4.32E-4	0.00E+0	-2.21E-4	-3.13E-4	0.00E+0	-1.08E-4
185	-3.02E-4	0.00E+0	-1.16E-4	-4.38E-4	0.00E+0	-1.46E-4	-5.47E-4	0.00E+0	-2.09E-4	-6.47E-4	0.00E+0	-2.37E-4	-7.32E-4	0.00E+0	-2.73E-4	-7.67E-4	0.00E+0	-1.76E-4	-5.65E-4	0.00E+0	-2.16E-4	-4.11E-4	0.00E+0	-1.05E-4
186	-3.20E-4	0.00E+0	-9.99E-5	-4.74E-4	0.00E+0	-1.52E-4	-5.74E-4	0.00E+0	-2.02E-4	-7.04E-4	0.00E+0	-2.42E-4	-8.23E-4	0.00E+0	-2.79E-4	-8.93E-4	0.00E+0	-1.98E-4	-6.96E-4	0.00E+0	-2.49E-4	-3.71E-4	0.00E+0	-1.21E-4
187	-3.26E-4	0.00E+0	-9.10E-5	-4.89E-4	0.00E+0	-1.57E-4	-5.93E-4	0.00E+0	-2.03E-4	-7.42E-4	0.00E+0	-2.39E-4	-8.76E-4	0.00E+0	-2.77E-4	-9.70E-4	0.00E+0	-2.21E-4	-7.45E-4	0.00E+0	-2.58E-4	-3.84E-4	0.00E+0	-1.23E-4
188	-2.52E-4	0.00E+0	-9.84E-5	-3.95E-4	0.00E+0	-1.68E-4	-4.94E-4	0.00E+0	-2.16E-4	-6.23E-4	0.00E+0	-2.61E-4	-8.17E-4	0.00E+0	-2.65E-4	-9.88E-4	0.00E+0	-2.16E-4	-8.84E-4	0.00E+0	-2.33E-4	-6.22E-4	0.00E+0	-1.17E-4

Table B-4. Individual Segment/Time-Specific Slopes for Kaiser

	July 1 - 15			July 16 - 31			August 1 - 15		
	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc
Kaiser CBOD5 Change (mg/L)	0.00	-1.80	3.60	0.00	-1.80	3.60	0.00	-1.80	3.60
Segment									
158	-1.08E-3	-1.17E-3	-8.67E-4	-1.04E-3	0.00E+0	-1.39E-3	-1.02E-3	-3.20E-4	-1.29E-3
159	-1.20E-3	0.00E+0	-4.58E-4	-1.16E-3	0.00E+0	-6.34E-4	-1.19E-3	0.00E+0	-5.54E-4
160	-1.42E-3	0.00E+0	-5.68E-4	-1.26E-3	0.00E+0	-6.07E-4	-1.30E-3	0.00E+0	-6.47E-4
161	-1.44E-3	0.00E+0	-5.54E-4	-1.31E-3	0.00E+0	-6.45E-4	-1.29E-3	0.00E+0	-6.40E-4
162	-1.51E-3	0.00E+0	-5.60E-4	-1.31E-3	0.00E+0	-6.03E-4	-1.31E-3	0.00E+0	-6.10E-4
163	-1.53E-3	0.00E+0	-4.71E-4	-1.26E-3	0.00E+0	-4.74E-4	-1.26E-3	0.00E+0	-5.06E-4
164	-1.50E-3	0.00E+0	-4.13E-4	-1.29E-3	0.00E+0	-3.46E-4	-1.36E-3	0.00E+0	-4.89E-4
165	-1.53E-3	0.00E+0	-2.71E-4	-1.36E-3	0.00E+0	-3.68E-4	-1.55E-3	0.00E+0	-5.91E-4
166	-1.55E-3	0.00E+0	-2.46E-4	-1.49E-3	0.00E+0	-4.99E-4	-1.75E-3	0.00E+0	-7.20E-4
167	-1.60E-3	0.00E+0	-3.32E-4	-1.45E-3	0.00E+0	-6.66E-4	-1.85E-3	0.00E+0	-8.43E-4
168	-1.38E-3	0.00E+0	-2.89E-4	-1.51E-3	0.00E+0	-7.52E-4	-1.46E-3	-2.45E-4	-1.26E-3
169	-1.25E-3	0.00E+0	-2.51E-4	-1.64E-3	0.00E+0	-8.32E-4	-1.44E-3	-2.76E-4	-1.37E-3
170	-1.45E-3	0.00E+0	-3.37E-4	-1.79E-3	0.00E+0	-8.18E-4	-1.67E-3	-7.54E-5	-1.35E-3
171	-1.62E-3	0.00E+0	-3.90E-4	-1.98E-3	0.00E+0	-8.09E-4	-1.95E-3	0.00E+0	-1.29E-3
172	-1.42E-3	0.00E+0	-2.75E-4	-2.05E-3	0.00E+0	-7.48E-4	-2.11E-3	0.00E+0	-1.23E-3
173	-1.57E-3	0.00E+0	-3.69E-4	-2.15E-3	0.00E+0	-7.81E-4	-2.44E-3	0.00E+0	-1.20E-3
174	-1.73E-3	0.00E+0	-5.98E-4	-2.28E-3	0.00E+0	-7.88E-4	-2.70E-3	0.00E+0	-1.15E-3
175	-1.87E-3	0.00E+0	-7.26E-4	-2.33E-3	0.00E+0	-8.02E-4	-2.81E-3	0.00E+0	-1.09E-3
176	-2.17E-3	0.00E+0	-8.61E-4	-2.56E-3	0.00E+0	-8.87E-4	-3.01E-3	0.00E+0	-1.10E-3
177	-2.31E-3	0.00E+0	-9.38E-4	-2.70E-3	0.00E+0	-8.84E-4	-3.10E-3	0.00E+0	-1.02E-3
178	-2.57E-3	0.00E+0	-1.03E-3	-2.87E-3	0.00E+0	-9.53E-4	-3.19E-3	0.00E+0	-1.05E-3
179	-2.70E-3	0.00E+0	-1.13E-3	-2.99E-3	0.00E+0	-1.06E-3	-3.28E-3	0.00E+0	-1.13E-3
180	-2.75E-3	0.00E+0	-1.13E-3	-3.12E-3	0.00E+0	-1.13E-3	-3.36E-3	0.00E+0	-1.19E-3
181	-2.73E-3	0.00E+0	-1.04E-3	-3.30E-3	0.00E+0	-1.23E-3	-3.44E-3	0.00E+0	-1.28E-3
182	-2.70E-3	0.00E+0	-1.03E-3	-3.36E-3	0.00E+0	-1.27E-3	-3.45E-3	0.00E+0	-1.34E-3
183	-2.65E-3	0.00E+0	-1.01E-3	-3.34E-3	0.00E+0	-1.25E-3	-3.45E-3	0.00E+0	-1.34E-3
184	-2.58E-3	0.00E+0	-1.05E-3	-3.30E-3	0.00E+0	-1.33E-3	-3.37E-3	0.00E+0	-1.40E-3
185	-2.53E-3	0.00E+0	-1.08E-3	-3.22E-3	0.00E+0	-1.39E-3	-3.29E-3	0.00E+0	-1.44E-3
186	-2.52E-3	0.00E+0	-9.54E-4	-3.23E-3	0.00E+0	-1.36E-3	-3.37E-3	0.00E+0	-1.41E-3
187	-2.50E-3	0.00E+0	-8.76E-4	-3.26E-3	0.00E+0	-1.39E-3	-3.45E-3	0.00E+0	-1.43E-3
188	-2.28E-3	0.00E+0	-9.13E-4	-2.94E-3	0.00E+0	-1.46E-3	-3.17E-3	0.00E+0	-1.55E-3

	August 15 - 31			September 1 - 15			September 16 - 30			October 1 - 15			October 16 - 31		
	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc
Kaiser CBOD5 Change (mg/L)	0.00	-1.80	3.60	0.00	-1.80	3.60	0.00	-1.80	3.60	0.00	-1.80	3.60	0.00	-1.80	3.60
Segment															
158	-7.87E-4	-1.49E-3	-6.00E-4	-1.29E-3	-1.79E-3	-1.16E-3	-1.70E-3	-1.31E-3	-1.81E-3	-1.62E-3	-1.07E-3	-1.87E-3	-1.09E-3	-5.33E-4	-1.33E-3
159	-8.70E-4	0.00E+0	-2.85E-4	-1.18E-3	0.00E+0	-4.02E-4	-1.99E-3	0.00E+0	-8.18E-4	-1.66E-3	0.00E+0	-7.63E-4	-1.30E-3	0.00E+0	-5.98E-4
160	-9.59E-4	0.00E+0	-3.20E-4	-1.16E-3	0.00E+0	-4.06E-4	-2.40E-3	0.00E+0	-9.19E-4	-1.93E-3	0.00E+0	-9.01E-4	-1.48E-3	0.00E+0	-6.34E-4
161	-9.10E-4	0.00E+0	-3.08E-4	-1.18E-3	0.00E+0	-4.17E-4	-2.37E-3	0.00E+0	-9.61E-4	-2.17E-3	0.00E+0	-1.00E-3	-1.66E-3	0.00E+0	-7.36E-4
162	-8.89E-4	0.00E+0	-2.98E-4	-1.12E-3	0.00E+0	-3.66E-4	-2.33E-3	0.00E+0	-9.58E-4	-2.30E-3	0.00E+0	-1.03E-3	-1.98E-3	0.00E+0	-8.64E-4
163	-7.66E-4	0.00E+0	-2.39E-4	-9.56E-4	0.00E+0	-2.69E-4	-2.09E-3	0.00E+0	-8.74E-4	-2.10E-3	0.00E+0	-9.66E-4	-2.02E-3	0.00E+0	-9.01E-4
164	-8.51E-4	0.00E+0	-3.02E-4	-8.46E-4	0.00E+0	-2.52E-4	-1.97E-3	0.00E+0	-8.17E-4	-2.08E-3	0.00E+0	-9.01E-4	-2.12E-3	0.00E+0	-9.01E-4
165	-8.97E-4	0.00E+0	-4.24E-4	-8.13E-4	0.00E+0	-1.85E-4	-1.92E-3	0.00E+0	-7.66E-4	-1.82E-3	0.00E+0	-7.53E-4	-1.98E-3	0.00E+0	-8.64E-4
166	-1.06E-3	-3.27E-17	-5.87E-4	-9.47E-4	0.00E+0	-2.70E-4	-2.09E-3	0.00E+0	-8.40E-4	-1.86E-3	0.00E+0	-7.89E-4	-1.98E-3	0.00E+0	-8.64E-4
167	-1.15E-3	-6.07E-5	-6.95E-4	-1.02E-3	0.00E+0	-3.50E-4	-2.14E-3	0.00E+0	-8.82E-4	-1.82E-3	0.00E+0	-7.62E-4	-2.01E-3	0.00E+0	-8.37E-4
168	-1.21E-3	-2.85E-4	-9.12E-4	-1.15E-3	0.00E+0	-4.62E-4	-2.33E-3	0.00E+0	-9.54E-4	-1.83E-3	0.00E+0	-7.75E-4	-1.86E-3	0.00E+0	-7.36E-4
169	-1.43E-3	-1.86E-4	-9.89E-4	-1.10E-3	-2.39E-5	-5.50E-4	-2.46E-3	0.00E+0	-1.02E-3	-1.84E-3	0.00E+0	-7.79E-4	-1.76E-3	0.00E+0	-7.36E-4
170	-1.68E-3	-1.31E-4	-1.08E-3	-1.19E-3	0.00E+0	-4.60E-4	-2.51E-3	0.00E+0	-1.08E-3	-1.79E-3	0.00E+0	-7.49E-4	-1.46E-3	0.00E+0	-5.70E-4
171	-1.82E-3	-1.29E-5	-1.10E-3	-1.34E-3	0.00E+0	-3.71E-4	-2.54E-3	0.00E+0	-1.12E-3	-1.79E-3	0.00E+0	-7.45E-4	-1.29E-3	0.00E+0	-5.06E-4
172	-1.98E-3	0.00E+0	-1.17E-3	-1.44E-3	0.00E+0	-4.05E-4	-2.68E-3	0.00E+0	-1.39E-3	-1.83E-3	0.00E+0	-7.69E-4	-1.11E-3	0.00E+0	-4.14E-4
173	-2.13E-3	0.00E+0	-1.24E-3	-1.52E-3	0.00E+0	-5.04E-4	-2.87E-3	-1.56E-4	-1.60E-3	-1.98E-3	0.00E+0	-8.33E-4	-1.06E-3	0.00E+0	-3.87E-4
174	-2.31E-3	0.00E+0	-1.26E-3	-1.66E-3	0.00E+0	-6.39E-4	-2.88E-3	-4.52E-4	-1.78E-3	-2.11E-3	0.00E+0	-9.66E-4	-1.17E-3	0.00E+0	-4.40E-4
175	-2.42E-3	0.00E+0	-1.26E-3	-1.83E-3	0.00E+0	-6.33E-4	-2.75E-3	-5.20E-4	-1.76E-3	-2.02E-3	0.00E+0	-1.01E-3	-1.15E-3	0.00E+0	-4.28E-4
176	-2.61E-3	0.00E+0	-1.31E-3	-1.94E-3	0.00E+0	-7.30E-4	-2.63E-3	-3.26E-4	-1.58E-3	-2.05E-3	0.00E+0	-1.03E-3	-1.03E-3	0.00E+0	-3.68E-4
177	-2.84E-3	0.00E+0	-1.30E-3	-2.11E-3	0.00E+0	-8.53E-4	-2.54E-3	-3.79E-4	-1.58E-3	-2.21E-3	-1.66E-4	-1.22E-3	-1.23E-3	0.00E+0	-4.67E-4
178	-3.03E-3	0.00E+0	-1.31E-3	-2.20E-3	0.00E+0	-9.45E-4	-2.54E-3	0.00E+0	-1.34E-3	-2.32E-3	-9.20E-5	-1.24E-3	-1.30E-3	0.00E+0	-4.91E-4
179	-3.20E-3	0.00E+0	-1.34E-3	-2.37E-3	0.00E+0	-1.03E-3	-2.53E-3	0.00E+0	-1.26E-3	-2.40E-3	-1.14E-4	-1.30E-3	-1.29E-3	0.00E+0	-4.97E-4
180	-3.38E-3	0.00E+0	-1.33E-3	-2.44E-3	0.00E+0	-1.03E-3	-2.48E-3	0.00E+0	-1.20E-3	-2.40E-3	-5.89E-5	-1.28E-3	-1.37E-3	0.00E+0	-5.65E-4
181	-3.58E-3	0.00E+0	-1.36E-3	-2.59E-3	0.00E+0	-1.09E-3	-2.37E-3	0.00E+0	-1.07E-3	-2.56E-3	-1.86E-4	-1.42E-3	-1.71E-3	0.00E+0	-6.16E-4
182	-3.61E-3	0.00E+0	-1.37E-3	-2.66E-3	0.00E+0	-1.13E-3	-2.37E-3	0.00E+0	-1.01E-3	-2.60E-3	-7.17E-5	-1.38E-3	-1.83E-3	0.00E+0	-6.39E-4
183	-3.61E-3	0.00E+0	-1.33E-3	-2.80E-3	0.00E+0	-1.16E-3	-2.55E-3	0.00E+0	-9.34E-4	-2.56E-3	-8.83E-5	-1.38E-3	-1.80E-3	0.00E+0	-7.06E-4
184	-3.52E-3	0.00E+0	-1.40E-3	-2.79E-3	0.00E+0	-1.15E-3	-2.61E-3	0.00E+0	-7.53E-4	-2.68E-3	0.00E+0	-1.26E-3	-1.77E-3	0.00E+0	-6.62E-4
185	-3.43E-3	0.00E+0	-1.44E-3	-2.77E-3	0.00E+0	-1.06E-3	-2.70E-3	0.00E+0	-6.46E-4	-2.88E-3	0.00E+0	-1.10E-3	-2.01E-3	0.00E+0	-5.90E-4
186	-3.50E-3	0.00E+0	-1.38E-3	-3.14E-3	0.00E+0	-1.11E-3	-3.03E-3	0.00E+0	-6.80E-4	-3.34E-3	0.00E+0	-1.21E-3	-2.05E-3	0.00E+0	-7.73E-4
187	-3.49E-3	0.00E+0	-1.30E-3	-3.36E-3	0.00E+0	-1.12E-3	-3.24E-3	0.00E+0	-7.62E-4	-3.15E-3	0.00E+0	-1.13E-3	-2.06E-3	0.00E+0	-7.68E-4
188	-3.25E-3	0.00E+0	-1.52E-3	-3.27E-3	0.00E+0	-1.14E-3	-3.28E-3	0.00E+0	-7.20E-4	-3.13E-3	0.00E+0	-8.49E-4	-2.64E-3	0.00E+0	-6.25E-4

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Memorandum

From: Dave Dilks, Scott Hinz
Date: January 22, 2020
Project: IEP3
To: Pat Hallinan
CC: Doug Krapas, IEP; Brent Downey, Kaiser

SUBJECT: DRAFT: TP Bubble Permit Calculation for IEP and Kaiser

Summary

IEP and Kaiser are interested in developing a bubble permit that combines the allowable loading of their CBOD and TP discharges for purposes of determining compliance with the dissolved oxygen (DO) TMDL. LimnoTech (2018) described the planned approach and included an example application for CBOD. The approach merges the bubble permit concept as described in the Spokane DO TMDL Toolbox (http://spokaneriver.net/initiatives/spokane-river-do-tmdl-implementation/do-tmdl-toolbox/) with EPA's test for compliance to determine if the DO impacts of an alternate loading scenario are consistent with the Spokane DO TMDL.

This memorandum applies that same approach previously developed for CBOD to develop bubble permit limits for TP. CE-QUAL-W2 model results indicate that each one pound increase in IEP TP loading will require a 3.4 pound decrease in Kaiser loading, while a one pound decrease in IEP TP loading will allow for a 1.1[1] pound increase in Kaiser loading. The differences between these "trading ratios" is due to a factor of safety that ensures that the bubble permit will be protective of dissolved oxygen concentrations both as an average across Avista-affected segments/times, as well for individual Avista-affected segments/times.

TP Bubble Permit Calculations

This section applies the approach described previously to CBOD (LimnoTech, 2018) to demonstrate calculation of TP bubble permit values that are protective of dissolved oxygen when averaged across all Avista-affected segments and time periods, as well as individual Avista-affected segments and time periods. It is divided into separate discussions of:

- Results of loading sensitivity runs
- Protection of Average DO
- Protection of Segment/Time Specific DO

Results of loading sensitivity runs

Four TP loads were initially assessed for each discharge, corresponding to a 25% and 50% reduction, and a 50% and 100% increase for both dischargers, of the current TMDL load. Additional 12.5% and 37.5% Kaiser TP load reduction simulations were subsequently conducted because of the relatively poor regression (r^2 = 0.49) observed between DO deficit and TP load for

[1] 1.87, if the results of one potentially anomalous simulation are excluded from the analysis

the 0%, 25% and 50% reduction simulations. Tables B-1 and B-2 in Appendix B show incremental dissolved oxygen changes in each segment and time in response to these sensitivity runs. The change in dissolved oxygen concentrations averaged across all Avista-affected cells are displayed in Table 1 for these simulations, to serve as an example of how the approach will be applied.

Table 1. Results of Loading Sensitivity Runs for TP

Discharger (i)	Change from TMDL (%)	ΔL_i (lbs/day)	ΔDO_i (mg/L)
1. IEP	-50%	-1.196	0.0023
1. IEP	-25%	-0.598	0.0015
1. IEP	+50%	1.196	-0.0014
1. IEP	+100%	2.392	-0.0077
2. Kaiser	-50%	-1.6	0.0017
2. Kaiser	-37.5%	-1.2	0.0012
2. Kaiser	-25%	-0.8	0.0053
2. Kaiser	-12.5%	-0.4	0.0012
2. Kaiser	+50%	1.6	-0.0001
2. Kaiser	+100%	3.2	-0.0034

Linear regressions were developed between ΔDO_i and ΔL_i for each discharge. Regressions across all load sensitivities are shown in Figure 1 for IEP and Kaiser.

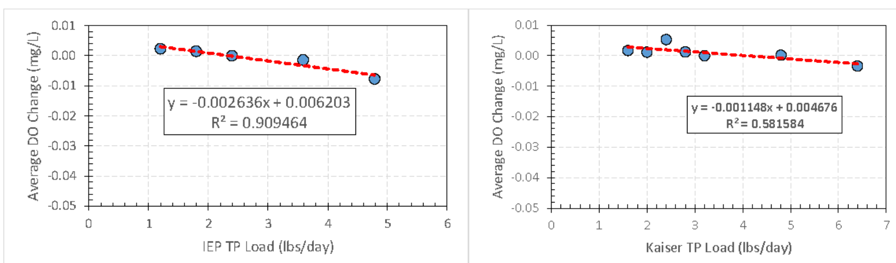

Figure 1. Linear Regressions for All TP Loading Sensitivity Runs

Following the same safety factor approach applied previously for the CBOD bubble permit calculations, separate slopes were developed for the decreased load sensitivity and increased load sensitivity runs. Consistent with the approach described for CBOD, regressions were derived to force a zero intercept with respect to the TDML (i.e. zero change from TMDL load results in zero effect on DO). The resulting regressions are shown in Figure 2 for load reductions and Figure 3 for load increases.

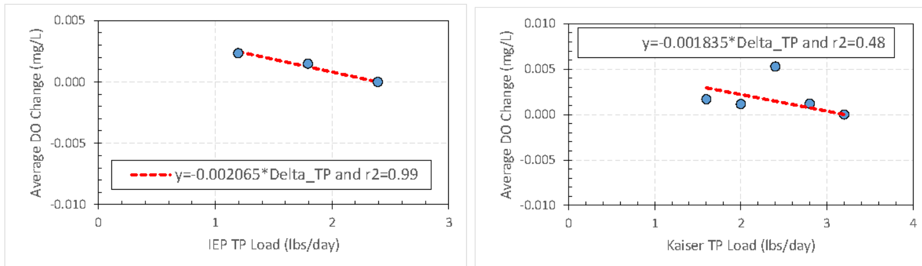

Figure 2. Linear Regressions for Decreased TP Loading Sensitivity Runs

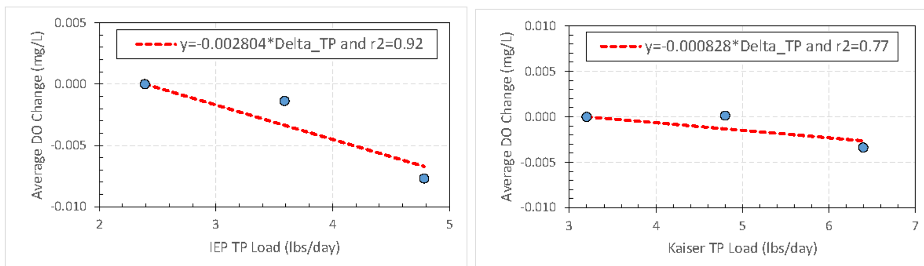

Figure 3. Linear Regression for Increased TP Loading Sensitivity Runs

Results for the 25% Kaiser reduction run (i.e. TP load = 2.4 pounds per day) appear somewhat anomalous relative to the remaining simulations as shown in Table 1 and Figures 1 and 2. This simulation results in a greater predicted average DO impact than do the 37.5% and 50% load reductions, and significantly weakens the correlation between load reduction and resulting DO impact. For this reason, bubble permit calculations provided subsequently were also conducted with the results from this simulation excluded from analysis.

The slopes from Figures 2 and 3 are contained in Table 2 to demonstrate how the bubble permit calculations could be applied to determine the required decrease in Kaiser TP load needed to offset a given increase in IEP load. An 0.1 lb/day increase in IEP TP, multiplied by the most restrictive slope of -0.002804 (mg/l)/(lbs.day), results in an average dissolved oxygen decrease of -0.00028 mg/l. A decrease in Kaiser loading of 0.34 lb/day, multiplied by the most restrictive slope of -0.000828, results in an average dissolved oxygen increase 0.00028 mg/l, which offsets the IEP decrease. The ratio of 0.1 lb of IEP load increase being equivalent to 0.34 pounds of Kaiser load can also be expressed as 1 lb of IEP load increase being equivalent to 3.4 pounds of Kaiser load decrease.

Table 2. Example Compliance Table for the TP Bubble– IEP Increase

(1) Index (Discharge)	(2) Discharger	(3) Pollutant	(4) $IOEF_{i,j}$ Increase (mg/L)/(lb/day)	(5) $IOEF_{i,j}$ Decrease (mg/L)/(lb/day)	(6) Change from TMDL Load (lbs/day)	(7)* ΔDO (mg/L)
1	IEP	TP	-0.002804	-0.002065	0.10	-0.00028
2	Kaiser	TP	-0.000828	-0.001835	-0.34	0.00028
(positive number is in compliance, negative number is out of compliance)					Sum	0.0000

* If Column (6) change from TMDL Load is positive, Column (7) = Max[Column (4), Column (5)] x Column (6)
If Column (6) change from TMDL Load is negative, Column (7) = Min[Column (4), Column (5)] x Column (6)

Table 3 shows example calculations for an increase in Kaiser TP load. A 0.1 lb/day increase in Kaiser TP, multiplied by the most restrictive slope of -0.001835, results in an average dissolved oxygen decrease of 0.0001835. A decrease in IEP loading of 0.0889 lb/day, multiplied by the most restrictive slope of -0.002065, results in an average dissolved oxygen increase of 0.0001835 mg/l, which offsets the Kaiser decrease. The ratio of 0.1 lb of Kaiser load increase being equivalent to 0.0889 pounds of IEP load decrease can also be expressed as 1 lb of IEP load decrease being equivalent to 1.1 pounds of Kaiser load increase (i.e. 0.1/0.0889.)

Table 3. Example Compliance Table for the TP Bubble – Kaiser Increase

(1) Index (Discharge)	(2) Discharger	(3) Pollutant	(4) $IOEF_{i,j}$ Increase (mg/L)/(lb/day)	(5) $IOEF_{i,j}$ Decrease (mg/L)/(lb/day)	(6) Change from TMDL Load (lbs/day)	(7)* ΔDO (mg/L)
1	IEP	TP	-0.002804	-0.002065	-.0889	0.0001835
2	Kaiser	TP	-0.000828	-0.001835	0.10	-0.0001835
(positive number is in compliance, negative number is out of compliance)					Sum	0.0000

* If Column (6) change from TMDL Load is positive, Column (7) = Max[Column (4), Column (5)] x Column (6)
If Column (6) change from TMDL Load is negative, Column (7) = Min[Column (4), Column (5)] x Column (6)

The results from Tables 2 and 3 show "trading ratios" (i.e. pounds of Kaiser load needed to offset a pound of IEP load) of 1.1:1 for IEP decreases and 3.4:1 for IEP increases that will be protective of Avista-averaged dissolved oxygen concentrations while considering a factor of safety. The magnitude of the safety factor inherent in these calculations can be estimated by considering the "best-fit" slopes shown previously in Figure 1. The effect of IEP loading on dissolved oxygen had a best-fit slope of -0.002636 (mg/L)/(lb/day), the effect of Kaiser loading on dissolved oxygen had a best-fit slope of -0.001148 (mg/L)/(lb/day). This indicates that a best fit trading ratio is approximately 2.3:1 (i.e. -0.002636/-0.001148), meaning that one pound of IEP load is equivalent to 2.3 pounds of Kaiser load. The proposed trading ratios of 1.1 for Kaiser increases, and 3.4:1 for IEP increases add a safety factor ranging from 48% (3.4:1 is 48% larger than 2.3:1) to 109% (2.3:1 is 109% larger than 1.1:1).

Analysis Excluding Kaiser 25% TP Load Reduction Results

An analysis similar to the one above was conducted excluding the potentially anomalous Kaiser 25% reduction simulation. Linear regressions TP load reduction results were developed between ΔDO_i and ΔL_i for each discharge. Regressions across all load sensitivities are shown in Figure 4 for IEP and Kaiser. Note that the IEP results are not impacted by this change.

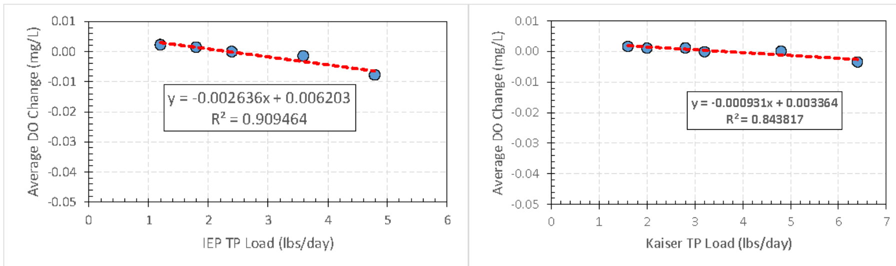

Figure 4. Linear Regressions for All TP Loading Sensitivity Runs (Potentially Anomalous Run Excluded)

Following the same safety factor approach, separate slopes were developed for the decreased load sensitivity and increased load sensitivity runs. Regressions were derived to force a zero intercept with respect to the TDML (i.e. zero change from TMDL load results in zero effect on DO). The resulting regressions are shown in Figure 5 for load reductions and Figure 6 for load increases. Note that the correlation coefficient for Kaiser reduction runs increases from 0.48 to 0.89 by excluding the potentially anomalous result.

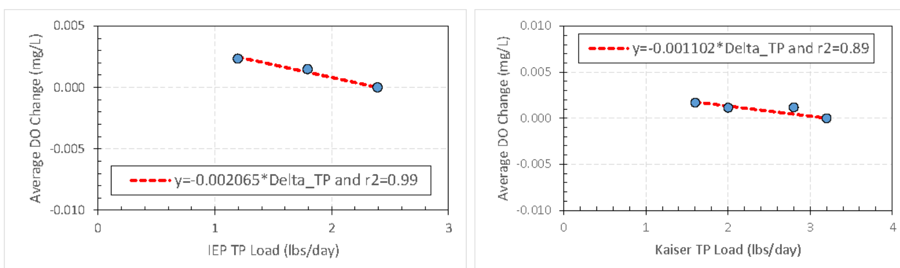

Figure 5. Linear Regressions for Decreased TP Loading Sensitivity Runs (Potentially Anomalous Run Excluded)

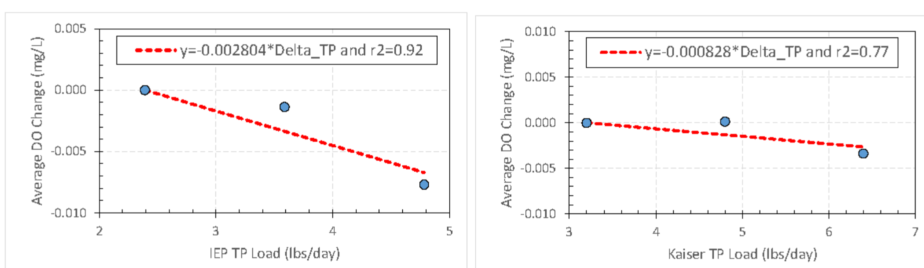

Figure 6. Linear Regression for Increased TP Loading Sensitivity Runs

The slopes from Figures 5 and 6 are contained in Table 4 to demonstrate bubble permit calculations. An 0.10 lb/day increase in IEP TP, multiplied by the most restrictive slope of -0.002804 (mg/l)/(lbs.day), results in an average dissolved oxygen decrease of -0.00028 mg/l. A decrease in Kaiser loading of 0.34 lb/day, multiplied by the most restrictive slope of -0.000828 results in an average dissolved oxygen increase 0.00028 mg/l, which offsets the IEP decrease.

The ratio of 0.1 lb of IEP load increase being equivalent to 0.34 pounds of Kaiser load can also be expressed as 1 lb of IEP load increase being equivalent to 3.4 pounds of Kaiser load.

Table 4. Example Compliance Table for the TP Bubble– IEP Increase

(1) Index (Discharge)	(2) Discharger	(3) Pollutant	(4) IOEF$_{i,j}$ Increase (mg/L)/(lb/day)	(5) IOEF$_{i,j}$ Decrease (mg/L)/(lb/day)	(6) Change from TMDL Load (lbs/day)	(7)* ΔDO (mg/L)
1	IEP	TP	-0.002804	-0.002065	0.10	-0.00028
2	Kaiser	TP	-0.000828	-0.001102	-0.34	0.00028
(positive number is in compliance, negative number is out of compliance)					Sum	0.0000

* If Column (6) change from TMDL Load is positive, Column (7) = Max[Column (4), Column (5)] x Column (6)
If Column (6) change from TMDL Load is negative, Column (7) = Min[Column (4), Column (5)] x Column (6)

Table 5 shows example calculations for an increase in Kaiser TP load. A 0.1 lb/day increase in Kaiser TP, multiplied by the most restrictive slope of -0.001102, results in an average dissolved oxygen decrease of 0.0001102. A decrease in IEP loading of 0.053 lb/day, multiplied by the most restrictive slope of -0.002065, results in an average dissolved oxygen increase of 0.0001102 mg/l, which offsets the Kaiser decrease. The ratio of 0.1 lb of Kaiser load increase being equivalent to 0.06 pounds of IEP load decrease can also be expressed as 1 lb of IEP load decrease being equivalent to 1.87 pounds of Kaiser load increase (i.e. 0.1/0.053.)

Table 5. Example Compliance Table for the TP Bubble – Kaiser Increase

(1) Index (Discharge)	(2) Discharger	(3) Pollutant	(4) IOEF$_{i,j}$ Increase (mg/L)/(lb/day)	(5) IOEF$_{i,j}$ Decrease (mg/L)/(lb/day)	(6) Change from TMDL Load (lbs/day)	(7)* ΔDO (mg/L)
1	IEP	TP	-0.002804	-0.002065	-0.053	0.0001102
2	Kaiser	TP	-0.000828	-0.001102	0.10	-0.0001102
(positive number is in compliance, negative number is out of compliance)					Sum	0.0000

* If Column (6) change from TMDL Load is positive, Column (7) = Max[Column (4), Column (5)] x Column (6)
If Column (6) change from TMDL Load is negative, Column (7) = Min[Column (4), Column (5)] x Column (6)

The results from Tables 4 and 5 show "trading ratios" (i.e. pounds of Kaiser load needed to offset a pound of IEP load) of 1.87:1 for IEP decreases and 3.4:1 for IEP increases that will be protective of Avista-averaged dissolved oxygen concentrations while considering a factor of safety. The magnitude of the safety factor inherent in these calculations can be estimated by considering the "best-fit" slopes shown previously in Figure 1. The effect of IEP loading on dissolved oxygen had a best-fit slope of -0.002636 (mg/L)/(lb/day), the effect of Kaiser loading on dissolved oxygen had a best-fit slope of -0.000931 (mg/L)/(lb/day). This indicates that a best fit trading ratio is approximately 2.8:1 (i.e. -0.002636 / -0.000931), meaning that one pound of IEP load is equivalent to 2.8 pounds of Kaiser load. The proposed trading ratios of 1.87:1 for Kaiser increases, and 3.4:1 for IEP increases add a safety factor ranging from 21% (3.4:1 is 21% larger than 2.8:1) to 50% (2.8:1 is 50% larger than 1.87:1).

Protection of Segment/Time Specific DO

The ratios determined above were next applied to determine whether they were protective of dissolved oxygen in individual Avista-affected segments and time periods. The slopes used to calculate DO in each segment/time pair are presented in Tables B-3 and B-4 in Appendix B for IEP and Kaiser, respectively.

The metric of concern when evaluating TMDL equivalency for individual cells corresponds to whether there is a change in Avista responsibility in any cell, when rounded to nearest 0.1 mg/l. Because this metric does not behave in a directly linear fashion, a wide range of combinations of loads were tested to ensure that compliance will occur.

Table 6 shows the resulting calculations for IEP load increases. For a change in IEP load ranging from 1 to 30% of the existing TMDL (6 to 176lb/season), the number of segment/time pairs with increased responsibility is always less than the number of segment/time pairs with decreased responsibility, and the maximum DO decrease in any segment/time pair with increased responsibility is no greater than 0.008 mg/l and within the error of the model.

Table 6. Demonstration of Protectiveness in Individual Segment/Time Pairs for a Range of IEP Load Increases

Change in IEP Load (%)	Increase in IEP Load (lbs/season)	Decrease in Kaiser Load (lbs/season)	No. of Avista Segment/time pairs		Maximum decrease in DO (mg/l)
			Increased responsibility	Decreased responsibility	
1	5.9	19.8	3	5	0.000
2	11.7	39.7	3	5	0.001
5	29.3	99.2	3	4	0.001
10	58.6	198.5	3	4	0.003
25	146.5	496.2	3	4	0.007
30	175.8	595.4	3	4	0.008

Table 7 shows similar calculations for Kaiser load increases with all runs considered, while Table 8 shows results when excluding the potentially anomalous run (using slopes to calculate DO in each segment/time pair in Table B-5 for and Kaiser. For a change in Kaiser load ranging from 1 to 30% (8 to 235 lb/season), the number of segment/time pairs with increased responsibility is always less than the number of segment/time pairs with decreased responsibility, and the maximum DO decrease in any segment/time pair with increased responsibility is no greater than 0.01 mg/l (0.008 mg/l if the potentially anomalous result is excluded). These impacts are well within the error of the model.

Table 7. Demonstration of Protectiveness in Individual Segment/Time Pairs for a Range of Kaiser Load (Increases All Runs Included)

Change in Kaiser Load (%)	Increase in Kaiser Load (lbs/season)	Decrease in IEP Load (lbs/season)	Responsibility Change - Number of Avista Segment/time pairs		Maximum decrease in DO (mg/l)
			Increased	Decreased	
1	7.8	7.0	3	5	0.000
2	15.7	14.0	3	5	0.001
5	39.2	35.1	3	5	0.002
10	78.4	70.2	3	5	0.003
25	196.0	175.5	3	4	0.009
30	235.2	210.6	3	4	0.010

Table 8. Demonstration of Protectiveness in Individual Segment/Time Pairs for a Range of Kaiser Load Increases (Potentially Anomalous Run Excluded)

Change in Kaiser Load (%)	Increase in Kaiser Load (lbs/season)	Decrease in IEP Load (lbs/season)	Responsibility Change - Number of Avista Segment/time pairs		Maximum decrease in DO (mg/l)
			Increased	Decreased	
1	7.8	4.2	3	5	0.000
2	15.7	8.4	3	5	0.001
5	39.2	20.9	3	5	0.001
10	78.4	41.9	3	4	0.003
25	196.0	104.7	3	4	0.007
30	235.2	125.6	3	4	0.008

These results indicate (for a range of IEP load increases up to 176 pounds per season, and a range of Kaiser load increases up to 235 pounds per season) that the safety factors used to calculate IOEF slopes protective of average DO across all Avista-affected segments and times are also protective of DO in individual Avista-affected segments and times. A bubble permit that reflects these slopes will be protective of the TMDL.

References

LimnoTech, 2018. DRAFT: Technical Methodology for Developing a Bubble Permit for IEP and Kaiser – CBOD Example. October, 7, 2018.

Washington Department of Ecology, 2010. Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load, Water Quality Improvement Report. Publication No. 07-10-073. Revised February 2010.

Washington Department of Ecology and U.S. EPA, 2011. Evaluation of Alternative Effluent Limits for Consistency with the Spokane River TMDL and Compliance with Washington Water Quality Standards. http://www.spokaneriver.net/wp-content/uploads/2012/04/Final_EPA_Ecology_Basis_for_Equivalence_2011_v3.pdf

Appendix A: Table 7 from TMDL

Table 7. TMDL Scenario #1 dissolved oxygen concentrations (*italics*) *are compared with No Source scenario concentrations (bold) for June 1 through September 15. Avista's responsibility (mg/L DO) for each segment is quantified in the shaded cells.*

Segment	June 1-15			June 15-30			July 1-15			July 16-31			Aug 1-15			Aug 16-31			Sept 1-15		
157	9.23	9.40	_	9.44	9.66	_	8.94	9.46	_	8.93	9.43	_	9.06	9.55	_	9.22	9.93	_	9.40	9.96	_
158	9.42	9.66	_	9.42	9.79	_	9.06	9.49	_	9.11	9.60	_	9.14	9.65	_	9.31	9.84	_	9.46	9.99	_
159	9.54	9.84	_	9.46	9.86	_	9.13	9.53	_	9.19	9.62	_	9.19	9.63	_	9.32	9.78	_	9.47	9.93	_
160	9.57	9.88	_	9.45	9.85	_	9.12	9.47	_	9.19	9.58	_	9.18	9.56	_	9.30	9.70	_	9.44	9.87	_
161	9.56	9.87	_	9.51	9.94	_	9.16	9.52	_	9.19	9.57	_	9.19	9.55	_	9.30	9.68	_	9.45	9.84	_
162	9.56	9.89	_	9.55	10.01	_	9.16	9.53	_	9.18	9.59	_	9.18	9.53	_	9.26	9.61	_	9.41	9.79	_
163	9.58	9.96	_	9.59	10.06	_	9.18	9.56	_	9.17	9.63	_	9.17	9.53	_	9.18	9.52	_	9.31	9.73	_
164	9.61	10.03	_	9.58	10.08	_	9.15	9.52	_	9.14	9.62	_	9.13	9.47	_	9.10	9.37	_	9.20	9.62	_
165	9.62	10.05	_	9.57	10.10	_	9.06	9.38	_	9.09	9.53	_	9.07	9.36	_	8.96	9.12	_	9.11	9.50	_
166	9.59	10.03	_	9.51	10.03	_	8.87	9.07	_	8.98	9.30	_	8.97	9.15	_	8.82	8.85	_	9.07	9.38	_
167	9.59	10.03	_	9.48	9.98	_	8.73	8.87	_	8.84	9.07	_	8.87	8.97	_	8.69	8.63	_	9.01	9.27	_
168	9.61	10.10	_	9.43	9.91	_	8.52	8.58	_	8.55	8.63	_	8.66	8.57	_	8.44	8.20	0.0	8.95	9.11	_
169	9.62	10.16	_	9.37	9.82	_	8.41	8.41	_	8.36	8.37	_	8.47	8.31	_	8.25	7.92	0.1	8.85	8.91	_
170	9.60	10.18	_	9.28	9.72	_	8.37	8.36	_	8.27	8.23	_	8.37	8.17	_	8.13	7.71	0.2	8.69	8.66	_
171	9.58	10.17	_	9.23	9.66	_	8.40	8.39	_	8.23	8.17	_	8.31	8.07	0.0	8.04	7.55	0.3	8.57	8.43	_
172	9.50	10.08	_	9.08	9.46	_	8.23	8.17	_	7.96	7.80	_	7.98	7.63	0.2	7.70	7.07	0.4	8.35	8.06	0.1
173	9.40	9.96	_	8.96	9.31	_	8.12	8.00	_	7.80	7.55	0.0	7.80	7.36	0.2	7.51	6.78	0.5	8.15	7.75	0.2
174	9.29	9.80	_	8.81	9.12	_	7.96	7.79	_	7.59	7.27	0.1	7.56	7.05	0.3	7.26	6.42	0.6	7.85	7.34	0.3
175	9.20	9.68	_	8.69	8.99	_	7.86	7.66	_	7.46	7.09	0.2	7.40	6.84	0.4	7.09	6.21	0.7	7.62	7.04	0.4
176	9.12	9.59	_	8.63	8.91	_	7.83	7.60	0.0	7.41	6.99	0.2	7.39	6.79	0.4	7.06	6.13	0.7	7.55	6.91	0.4
177	8.93	9.31	_	8.35	8.54	_	7.50	7.19	0.1	6.99	6.46	0.3	6.92	6.22	0.5	6.56	5.54	0.8	7.01	6.24	0.6
178	8.85	9.21	_	8.27	8.42	_	7.44	7.10	0.1	6.92	6.34	0.4	6.88	6.15	0.5	6.51	5.47	0.8	6.89	6.06	0.6
179	8.79	9.14	_	8.24	8.37	_	7.42	7.07	0.1	6.88	6.27	0.4	6.86	6.11	0.6	6.51	5.44	0.9	6.81	5.92	0.7
180	8.73	9.05	_	8.19	8.30	_	7.38	7.02	0.2	6.83	6.19	0.4	6.81	6.03	0.6	6.49	5.42	0.9	6.67	5.75	0.7
181	8.66	8.95	_	8.15	8.21	_	7.36	6.97	0.2	6.78	6.08	0.5	6.74	5.89	0.6	6.47	5.36	0.9	6.52	5.53	0.8
182	8.67	8.95	_	8.16	8.21	_	7.41	7.01	0.2	6.84	6.13	0.5	6.78	5.92	0.7	6.56	5.46	0.9	6.53	5.52	0.8
183	8.55	8.78	_	8.00	7.98	_	7.26	6.85	0.2	6.70	5.97	0.5	6.58	5.69	0.7	6.37	5.29	0.9	6.29	5.27	0.8
184	8.54	8.75	_	7.98	7.94	_	7.30	6.88	0.2	6.77	6.01	0.6	6.63	5.71	0.7	6.43	5.33	0.9	6.30	5.34	0.8
185	8.47	8.63	_	7.94	7.87	_	7.29	6.88	0.2	6.78	6.00	0.6	6.58	5.64	0.7	6.42	5.29	0.9	6.23	5.27	0.8
186	8.34	8.44	_	7.84	7.74	_	7.18	6.76	0.2	6.63	5.84	0.6	6.37	5.41	0.8	6.24	5.08	1.0	5.96	4.93	0.8
187	8.31	8.40	_	7.85	7.75	_	7.23	6.79	0.2	6.66	5.83	0.6	6.36	5.35	0.8	6.27	5.05	1.0	5.96	4.90	0.9
188	8.20	8.25	_	7.67	7.56	_	7.10	6.65	0.2	6.53	5.71	0.6	6.15	5.17	0.8	6.07	4.88	1.0	5.73	4.68	0.8

Table 7 (continued). TMDL Scenario #1 dissolved oxygen concentrations *(italics) are compared with No Source scenario concentrations (bold) for September 16 through December 31. Avista's responsibility (mg/L DO) for each segment is quantified in the shaded cells.*

Segment	Sept 16-30			Oct 1-15			Oct 16-31			Nov 1-15			Nov 16-30			Dec 1-15			Dec 16-31		
157	9.58	9.90	_	9.81	10.07	_	10.40	10.49	_	10.59	10.83	_	10.82	10.79	_	11.41	11.50	_			_
158	9.63	9.91	_	9.99	10.08	_	10.49	10.55	_	10.67	10.85	_	10.80	10.80	_	11.43	11.49	_	11.50	11.54	_
159	9.62	9.85	_	10.01	10.09	_	10.51	10.56	_	10.70	10.89	_	10.83	10.81	_	11.43	11.49	_	11.51	11.58	_
160	9.60	9.79	_	10.01	10.10	_	10.52	10.56	_	10.69	10.90	_	10.82	10.78	_	11.43	11.48	_	11.50	11.59	_
161	9.60	9.77	_	10.02	10.10	_	10.52	10.54	_	10.69	10.88	_	10.83	10.77	_	11.43	11.48	_	11.49	11.57	_
162	9.58	9.74	_	10.04	10.12	_	10.55	10.57	_	10.67	10.83	_	10.82	10.73	_	11.43	11.46	_	11.49	11.57	_
163	9.52	9.72	_	10.01	10.12	_	10.57	10.60	_	10.66	10.80	_	10.81	10.70	_	11.42	11.45	_	11.49	11.56	_
164	9.41	9.66	_	9.91	10.06	_	10.55	10.60	_	10.65	10.79	_	10.80	10.66	_	11.40	11.41	_	11.48	11.54	_
165	9.30	9.59	_	9.77	10.00	_	10.47	10.54	_	10.65	10.79	_	10.81	10.64	_	11.39	11.38	_	11.47	11.53	_
166	9.26	9.47	_	9.70	9.91	_	10.42	10.48	_	10.60	10.70	_	10.78	10.59	_	11.37	11.33	_	11.45	11.49	_
167	9.20	9.36	_	9.63	9.85	_	10.37	10.42	_	10.59	10.67	_	10.79	10.58		11.36	11.30	_	11.43	11.48	_
168	9.15	9.23	_	9.56	9.78	_	10.28	10.36	_	10.59	10.64	_	10.80	10.57		11.34	11.27	_	11.43	11.47	_
169	9.10	9.13	_	9.49	9.70	_	10.17	10.28	_	10.61	10.66	_	10.79	10.55		11.27	11.11	_	11.41	11.43	_
170	9.03	9.01	_	9.40	9.60	_	10.04	10.17	_	10.56	10.63	_	10.79	10.51		11.20	10.92		11.38	11.37	_
171	8.96	8.86	_	9.31	9.48	_	9.91	10.06	_	10.48	10.54	_	10.75	10.44		11.20	10.92		11.36	11.31	_
172	8.86	8.65	0.0	9.26	9.40	_	9.82	9.99	_	10.37	10.41	_	10.72	10.40		11.29	11.06		11.43	11.39	_
173	8.75	8.46	0.1	9.21	9.31	_	9.77	9.91	_	10.29	10.29	_	10.68	10.35		11.29	11.03		11.46	11.41	_
174	8.56	8.16	0.2	9.17	9.18	_	9.75	9.85	_	10.27	10.24	_	10.66	10.33		11.27	10.97		11.45	11.38	_
175	8.37	7.92	0.3	9.09	9.06	_	9.73	9.80	_	10.24	10.19	_	10.64	10.32		11.26	10.95		11.46	11.37	_
176	8.27	7.77	0.3	8.95	8.87	_	9.67	9.72	_	10.16	10.08	_	10.60	10.30		11.24	10.90		11.50	11.39	_
177	7.79	7.15	0.4	8.66	8.46	0.0	9.69	9.70	_	10.15	10.05	_	10.58	10.29		11.21	10.86		11.50	11.37	_
178	7.60	6.88	0.5	8.50	8.23	0.1	9.68	9.67	_	10.12	10.00	_	10.55	10.27		11.19	10.83		11.52	11.37	_
179	7.53	6.75	0.6	8.44	8.13	0.1	9.65	9.63	_	10.08	9.93	_	10.52	10.25		11.18	10.80		11.58	11.40	_
180	7.36	6.51	0.7	8.30	7.92	0.2	9.62	9.57	_	10.06	9.88	_	10.50	10.23		11.17	10.78		11.61	11.40	
181	7.18	6.24	0.7	8.12	7.64	0.3	9.54	9.43	_	10.04	9.84	_	10.48	10.20		11.16	10.76		11.59	11.35	
182	7.03	6.04	0.8	7.97	7.47	0.3	9.41	9.25	_	10.04	9.83		10.48	10.19		11.15	10.74		11.56	11.31	
183	6.66	5.63	0.8	7.59	7.01	0.4	9.28	9.09	_	10.02	9.79		10.47	10.17		11.15	10.74		11.59	11.30	
184	6.50	5.50	0.8	7.29	6.69	0.4	9.14	8.88	0.1	10.01	9.76		10.46	10.16		11.14	10.73		11.59	11.29	
185	6.31	5.29	0.8	7.02	6.35	0.5	8.90	8.56	0.1	10.00	9.74		10.46	10.16		11.13	10.71		11.59	11.26	
186	5.94	4.89	0.8	6.66	5.82	0.6	8.64	8.26	0.2	9.96	9.68		10.46	10.15		11.11	10.67		11.55	11.21	
187	5.88	4.81	0.9	6.39	5.52	0.7	8.51	8.14	0.2	9.94	9.63		10.44	10.12		11.09	10.64		11.52	11.18	
188	5.57	4.52	0.8	5.88	5.12	0.6	7.96	7.52	0.2	9.91	9.52		10.40	10.08		11.07	10.61		11.55	11.19	

Appendix B: Model Results for TP Calculations

Table B-1 Incremental Dissolved Oxygen Changes in Response to Changes in IEP TP Load

	July 1 - 15					July 16 - 31					August 1 - 15				
	0.5x	0.75x	1x	1.5x	2x	0.5x	0.75x	1x	1.5x	2x	0.5x	0.75x	1x	1.5x	2x
IEP TP Change (mg/L)	-0.035	-0.018	0	0.035	0.07	-0.035	-0.018	0	0.035	0.07	-0.035	-0.018	0	0.035	0.07
Segment															
158	0.008	0.002	0.000	0.018	0.003	-0.004	-0.004	0.000	-0.001	-0.004	-0.002	-0.002	0.000	0.000	0.003
159	0.016	0.001	0.000	0.016	-0.001	-0.002	-0.003	0.000	0.000	-0.004	-0.001	-0.002	0.000	0.000	-0.002
160	0.020	0.001	0.000	0.020	-0.005	-0.002	-0.002	0.000	-0.001	-0.002	-0.002	-0.002	0.000	0.000	-0.002
161	0.022	0.002	0.000	0.022	-0.004	-0.001	-0.001	0.000	-0.001	-0.002	-0.002	-0.001	0.000	0.000	-0.002
162	0.024	0.002	0.000	0.018	-0.002	-0.001	0.000	0.000	-0.001	-0.002	-0.002	-0.001	0.000	0.000	-0.002
163	0.011	0.004	0.000	0.013	-0.003	0.000	0.003	0.000	0.000	0.000	-0.001	0.000	0.000	0.001	-0.001
164	0.007	0.007	0.000	0.014	-0.006	0.002	0.004	0.000	0.002	0.001	0.000	0.000	0.000	0.001	-0.001
165	0.011	0.011	0.000	0.014	-0.010	0.001	0.005	0.000	0.003	0.004	0.001	-0.001	0.000	-0.001	-0.002
166	0.015	0.014	0.000	0.006	-0.012	0.002	0.006	0.000	0.001	0.001	0.000	0.000	0.000	-0.001	-0.004
167	0.024	0.014	0.000	0.012	-0.011	0.002	0.005	0.000	-0.004	-0.009	0.000	0.000	0.000	0.000	-0.005
168	0.031	0.018	0.000	0.008	-0.010	0.006	0.006	0.000	-0.007	-0.014	-0.005	0.005	0.000	0.000	-0.005
169	0.043	0.021	0.000	0.018	-0.005	0.009	0.006	0.000	-0.008	-0.016	-0.006	0.007	0.000	0.001	-0.005
170	0.040	0.019	0.000	0.020	-0.008	0.011	0.006	0.000	-0.007	-0.014	-0.005	0.008	0.000	0.001	-0.004
171	0.024	0.017	0.000	0.016	-0.016	0.012	0.006	0.000	-0.004	-0.011	-0.004	0.008	0.000	0.000	-0.003
172	0.025	0.021	0.000	0.015	-0.016	0.015	0.008	0.000	-0.002	-0.009	-0.002	0.010	0.000	0.001	-0.004
173	0.023	0.021	0.000	0.015	-0.009	0.016	0.009	0.000	-0.002	-0.007	0.002	0.011	0.000	0.001	-0.005
174	0.018	0.018	0.000	-0.003	-0.010	0.016	0.010	0.000	-0.002	-0.005	0.004	0.010	0.000	0.000	-0.006
175	0.011	0.015	0.000	-0.006	-0.011	0.015	0.010	0.000	-0.002	-0.005	0.005	0.010	0.000	0.000	-0.006
176	0.003	0.011	0.000	-0.008	-0.010	0.013	0.008	0.000	-0.001	-0.005	0.006	0.010	0.000	0.000	-0.006
177	0.015	0.009	0.000	0.009	0.006	0.013	0.008	0.000	0.000	-0.004	0.008	0.010	0.000	0.001	-0.007
178	0.013	0.005	0.000	0.009	0.005	0.010	0.006	0.000	0.001	-0.004	0.007	0.008	0.000	0.000	-0.007
179	0.007	0.008	0.000	0.008	0.002	0.007	0.004	0.000	0.001	-0.003	0.007	0.007	0.000	-0.001	-0.009
180	0.001	0.002	0.000	0.006	0.001	0.005	0.003	0.000	0.002	-0.003	0.007	0.005	0.000	-0.001	-0.010
181	-0.002	0.008	0.000	0.008	-0.001	0.002	0.002	0.000	0.003	-0.002	0.007	0.003	0.000	-0.002	-0.011
182	-0.003	0.008	0.000	0.006	-0.008	0.001	0.002	0.000	0.004	-0.002	0.006	0.002	0.000	-0.002	-0.012
183	-0.008	0.008	0.000	0.000	-0.011	0.001	0.001	0.000	0.004	-0.002	0.006	0.001	0.000	-0.002	-0.011
184	-0.004	0.002	0.000	0.000	-0.010	0.001	0.000	0.000	0.005	-0.003	0.006	-0.001	0.000	-0.002	-0.012
185	-0.008	0.000	0.000	-0.002	-0.012	0.001	-0.001	0.000	0.006	-0.005	0.006	-0.003	0.000	0.000	-0.012
186	-0.009	0.001	0.000	-0.002	-0.014	0.002	-0.001	0.000	0.007	-0.005	0.006	-0.002	0.000	0.002	-0.010
187	-0.007	0.002	0.000	0.001	-0.017	0.001	0.000	0.000	0.007	-0.005	0.005	-0.003	0.000	0.003	-0.010
188	-0.002	0.001	0.000	0.002	-0.012	0.000	-0.003	0.000	0.006	-0.008	0.004	-0.005	0.000	0.003	-0.011

	August 15 - 31					September 1 - 15					September 16 - 30					October 1 - 15					October 16 - 31				
	0.5x	0.75x	1x	1.5x	2x	0.5x	0.75x	1x	1.5x	2x	0.5x	0.75x	1x	1.5x	2x	0.5x	0.75x	1x	1.5x	2x	0.5x	0.75x	1x	1.5x	2x
IEP TP Change (mg/L)	-0.035	-0.018	0	0.035	0.07	-0.035	-0.018	0	0.035	0.07	-0.035	-0.018	0	0.035	0.07	-0.035	-0.018	0	0.035	0.07	-0.035	-0.018	0	0.035	0.07
Segment																									
158	0.003	0.001	0.000	0.003	0.001	0.001	0.001	0.000	0.003	0.004	-0.004	-0.002	0.000	0.000	0.003	-0.004	-0.002	0.000	0.000	0.001	-0.003	-0.001	0.000	-0.001	-0.001
159	0.002	0.000	0.000	0.002	0.000	0.002	0.001	0.000	0.001	0.002	-0.004	-0.002	0.000	0.000	0.003	-0.004	-0.001	0.000	0.000	0.001	-0.003	0.000	0.000	-0.001	0.000
160	0.002	0.000	0.000	0.002	0.000	0.002	0.000	0.000	0.000	0.001	-0.003	-0.001	0.000	0.001	0.004	-0.004	-0.002	0.000	0.000	0.001	-0.003	0.000	0.000	-0.001	0.000
161	0.002	0.000	0.000	0.001	0.000	0.002	0.000	0.000	0.001	0.001	-0.003	-0.002	0.000	0.000	0.003	-0.005	-0.003	0.000	0.000	0.001	-0.003	0.000	0.000	-0.001	0.000
162	0.002	0.000	0.000	0.002	0.000	0.002	0.001	0.000	0.001	0.001	-0.002	-0.001	0.000	0.000	0.002	-0.004	-0.002	0.000	0.001	0.002	-0.004	0.000	0.000	-0.001	0.000
163	0.002	0.000	0.000	0.002	0.001	0.002	0.001	0.000	0.001	0.002	-0.002	-0.001	0.000	0.000	0.002	-0.004	-0.002	0.000	0.000	0.001	-0.004	0.000	0.000	-0.002	0.000
164	0.002	0.000	0.000	0.002	-0.001	0.002	0.002	0.000	0.001	0.001	-0.002	-0.001	0.000	0.000	0.002	-0.003	-0.001	0.000	0.001	0.003	-0.004	0.001	0.000	-0.001	0.001
165	0.002	-0.001	0.000	0.000	-0.004	0.003	0.002	0.000	0.002	0.002	-0.001	0.000	0.000	0.000	0.003	-0.002	0.000	0.000	0.002	0.003	-0.004	0.000	0.000	-0.001	0.000
166	0.001	-0.002	0.000	-0.002	-0.006	0.003	0.002	0.000	0.002	0.001	-0.001	0.000	0.000	0.000	0.002	-0.003	-0.001	0.000	0.001	0.003	-0.004	0.000	0.000	-0.001	0.000
167	0.001	-0.002	0.000	-0.002	-0.007	0.003	0.000	0.000	0.001	0.000	-0.002	-0.001	0.000	-0.001	0.002	-0.002	-0.001	0.000	0.001	0.003	-0.004	0.001	0.000	-0.001	0.001
168	-0.001	-0.002	0.000	-0.005	-0.011	0.003	0.000	0.000	0.000	-0.002	-0.002	0.000	0.000	-0.001	0.001	-0.002	-0.001	0.000	0.001	0.003	-0.003	0.001	0.000	0.000	0.001
169	0.002	0.000	0.000	-0.005	-0.011	0.003	0.002	0.000	-0.001	-0.005	-0.001	0.000	0.000	-0.001	0.000	-0.002	-0.001	0.000	0.001	0.003	-0.003	0.000	0.000	0.000	0.001
170	0.002	0.001	0.000	-0.006	-0.012	0.006	0.004	0.000	0.001	-0.005	-0.001	-0.001	0.000	-0.001	-0.001	-0.002	-0.001	0.000	0.001	0.003	-0.003	0.001	0.000	0.000	0.002
171	0.002	0.000	0.000	-0.005	-0.011	0.008	0.006	0.000	0.005	-0.004	-0.001	-0.001	0.000	-0.002	-0.002	-0.001	-0.001	0.000	0.000	0.002	-0.002	0.001	0.000	0.001	0.002
172	0.003	0.001	0.000	-0.005	-0.012	0.009	0.010	0.000	0.004	-0.007	-0.004	-0.003	0.000	-0.005	-0.006	-0.002	-0.001	0.000	0.000	0.002	-0.002	0.001	0.000	0.001	0.002
173	0.002	0.000	0.000	-0.005	-0.013	0.007	0.009	0.000	0.001	-0.009	-0.005	-0.005	0.000	-0.008	-0.009	-0.002	-0.001	0.000	0.000	0.001	-0.002	0.001	0.000	0.001	0.002
174	0.002	0.000	0.000	-0.004	-0.013	0.006	0.010	0.000	-0.004	-0.012	-0.008	-0.008	0.000	-0.011	-0.012	-0.003	-0.002	0.000	-0.001	0.000	-0.002	0.001	0.000	0.000	0.002
175	0.003	0.001	0.000	-0.003	-0.012	0.007	0.009	0.000	-0.003	-0.011	-0.009	-0.007	0.000	-0.012	-0.014	-0.005	-0.003	0.000	-0.002	-0.001	-0.002	0.001	0.000	0.001	0.002
176	0.003	0.001	0.000	-0.003	-0.012	0.006	0.007	0.000	-0.004	-0.012	-0.006	-0.005	0.000	-0.011	-0.012	-0.005	-0.003	0.000	-0.002	-0.002	-0.002	0.001	0.000	0.001	0.002
177	0.005	0.001	0.000	-0.002	-0.012	0.006	0.005	0.000	-0.006	-0.013	-0.008	-0.006	0.000	-0.012	-0.015	-0.007	-0.004	0.000	-0.004	-0.004	-0.002	0.001	0.000	0.000	0.001
178	0.005	0.001	0.000	-0.002	-0.011	0.006	0.003	0.000	-0.007	-0.014	-0.005	-0.003	0.000	-0.009	-0.012	-0.007	-0.004	0.000	-0.004	-0.004	-0.002	0.001	0.000	0.000	0.001
179	0.005	0.001	0.000	-0.001	-0.011	0.006	0.001	0.000	-0.007	-0.012	-0.004	-0.001	0.000	-0.008	-0.012	-0.007	-0.004	0.000	-0.005	-0.005	-0.002	0.001	0.000	0.000	0.001
180	0.005	0.002	0.000	-0.001	-0.011	0.005	-0.001	0.000	-0.005	-0.011	-0.003	-0.001	0.000	-0.008	-0.013	-0.007	-0.004	0.000	-0.005	-0.005	-0.002	0.001	0.000	0.000	0.000
181	0.005	0.002	0.000	0.000	-0.011	0.004	-0.003	0.000	-0.003	-0.010	-0.001	0.001	0.000	-0.007	-0.013	-0.008	-0.005	0.000	-0.006	-0.007	-0.003	0.002	0.000	0.000	0.001
182	0.005	0.003	0.000	0.000	-0.010	0.004	-0.003	0.000	-0.003	-0.010	0.002	0.001	0.000	-0.006	-0.013	-0.006	-0.004	0.000	-0.005	-0.007	-0.003	0.002	0.000	-0.001	0.001
183	0.005	0.002	0.000	0.000	-0.010	0.003	-0.004	0.000	-0.002	-0.010	0.006	0.002	0.000	-0.003	-0.011	-0.007	-0.005	0.000	-0.006	-0.007	-0.003	0.001	0.000	-0.001	0.000
184	0.005	0.001	0.000	0.000	-0.010	0.003	-0.004	0.000	-0.001	-0.009	0.010	0.002	0.000	0.001	-0.006	-0.003	-0.003	0.000	-0.003	-0.006	-0.004	0.002	0.000	-0.002	0.000
185	0.004	0.000	0.000	-0.001	-0.011	0.003	-0.003	0.000	-0.001	-0.007	0.011	0.003	0.000	0.003	-0.003	-0.001	-0.002	0.000	-0.002	-0.004	-0.005	0.003	0.000	-0.002	0.002
186	0.005	0.001	0.000	-0.001	-0.009	0.004	-0.002	0.000	0.000	-0.006	0.011	0.002	0.000	0.004	-0.002	-0.001	-0.002	0.000	-0.003	-0.006	-0.006	0.001	0.000	-0.003	-0.001
187	0.005	0.002	0.000	-0.002	-0.008	0.004	0.000	0.000	0.000	-0.006	0.011	0.002	0.000	0.003	-0.002	-0.002	-0.004	0.000	-0.002	-0.006	-0.006	0.001	0.000	-0.003	-0.001
188	0.004	-0.002	0.000	-0.002	-0.012	0.004	-0.001	0.000	0.000	-0.006	0.009	0.002	0.000	0.003	0.000	0.000	0.000	0.000	0.000	-0.003	-0.004	0.002	0.000	-0.002	0.002

Table B-2. Incremental Dissolved Oxygen Changes in Response to Changes in Kaiser TP Load

	July 1 - 15							July 16 - 31							August 1 - 15						
	0.5x	0.625x	0.75x	0.875x	1x	1.5x	2x	0.5x	0.625x	0.75x	0.875x	1x	1.5x	2x	0.5x	0.625x	0.75x	0.875x	1x	1.5x	2x
Kaiser TP Change (mg/L)	-0.013	-0.009	-0.006	-0.003	0	0.0125	0.025	-0.013	-0.009	-0.006	-0.003	0	0.0125	0.025	-0.013	-0.009	-0.006	-0.003	0	0.0125	0.025
Segment																					
158	-0.003	-0.002	0.009	0.000	0.000	0.002	0.004	-0.007	-0.004	-0.006	-0.004	0.000	0.001	0.002	-0.006	-0.004	-0.002	-0.004	0.000	-0.001	0.005
159	-0.002	-0.002	0.017	-0.001	0.000	0.001	0.003	-0.007	-0.005	-0.004	-0.005	0.000	0.002	0.002	-0.004	-0.004	-0.002	-0.004	0.000	0.001	0.004
160	-0.003	-0.002	0.022	-0.002	0.000	0.001	0.000	-0.005	-0.002	-0.002	-0.003	0.000	0.001	0.004	-0.005	-0.003	-0.003	-0.005	0.000	0.001	0.004
161	-0.002	0.000	0.024	-0.001	0.000	0.003	0.001	-0.005	-0.002	-0.001	-0.003	0.000	0.001	0.005	-0.005	-0.003	-0.002	-0.004	0.000	0.001	0.004
162	-0.002	-0.001	0.025	-0.001	0.000	0.003	0.003	-0.004	-0.002	0.000	-0.002	0.000	0.001	0.004	-0.004	-0.002	-0.002	-0.004	0.000	0.002	0.004
163	0.000	0.001	0.013	0.002	0.000	0.005	0.001	-0.001	0.000	0.002	0.000	0.000	0.002	0.006	-0.002	-0.001	0.000	-0.002	0.000	0.002	0.005
164	0.002	0.003	0.009	0.003	0.000	0.006	-0.004	-0.001	0.003	0.003	0.001	0.000	0.003	0.006	-0.001	0.000	0.000	-0.001	0.000	0.003	0.005
165	0.005	0.006	0.014	0.006	0.000	0.012	-0.008	0.000	0.004	0.005	0.001	0.000	0.003	0.008	0.000	0.002	0.000	0.000	0.000	0.003	0.003
166	0.007	0.008	0.018	0.007	0.000	0.014	-0.007	-0.002	0.004	0.005	0.000	0.000	0.002	0.007	0.000	0.002	-0.001	-0.002	0.000	0.005	0.003
167	0.005	0.009	0.027	0.007	0.000	0.012	0.000	-0.002	0.002	0.003	-0.002	0.000	0.001	-0.002	-0.005	-0.002	-0.001	-0.003	0.000	0.002	0.003
168	0.004	0.012	0.034	0.008	0.000	0.011	0.000	-0.003	0.004	0.007	-0.002	0.000	0.001	-0.006	-0.026	-0.036	-0.002	-0.011	0.000	-0.016	0.005
169	0.004	0.015	0.047	0.009	0.000	0.011	0.000	-0.002	0.004	0.010	-0.001	0.000	0.000	-0.007	-0.030	-0.041	0.000	-0.012	0.000	-0.020	0.006
170	0.005	0.013	0.043	0.009	0.000	0.012	0.000	-0.002	0.005	0.012	-0.001	0.000	0.001	-0.006	-0.026	-0.039	0.000	-0.012	0.000	-0.020	0.006
171	0.006	0.012	0.028	0.010	0.000	0.012	-0.009	0.000	0.005	0.013	0.001	0.000	0.002	-0.004	-0.020	-0.030	0.001	-0.010	0.000	-0.019	0.006
172	0.006	0.015	0.031	0.011	0.000	0.012	-0.011	0.001	0.009	0.017	0.003	0.000	0.002	-0.002	-0.017	-0.026	0.005	-0.009	0.000	-0.019	0.006
173	0.006	0.015	0.030	0.010	0.000	0.011	-0.010	0.002	0.009	0.018	0.004	0.000	0.003	-0.001	-0.012	-0.015	0.009	-0.005	0.000	-0.014	0.004
174	0.003	0.012	0.027	0.006	0.000	0.010	-0.015	0.003	0.010	0.020	0.005	0.000	0.003	0.000	-0.007	-0.007	0.011	-0.003	0.000	-0.011	0.002
175	0.002	0.009	0.021	0.005	0.000	0.010	-0.012	0.003	0.009	0.019	0.005	0.000	0.004	0.000	-0.004	-0.002	0.014	-0.001	0.000	-0.009	0.002
176	0.002	0.006	0.013	0.005	0.000	0.010	-0.013	0.003	0.008	0.017	0.005	0.000	0.005	-0.001	0.000	0.005	0.015	0.001	0.000	-0.006	0.000
177	0.001	0.004	0.028	0.006	0.000	0.010	0.004	0.004	0.008	0.019	0.007	0.000	0.005	0.000	0.003	0.010	0.018	0.004	0.000	-0.004	0.000
178	0.002	0.001	0.025	0.007	0.000	0.011	0.004	0.005	0.007	0.017	0.008	0.000	0.005	0.000	0.005	0.013	0.017	0.005	0.000	-0.002	-0.001
179	0.002	-0.001	0.018	0.006	0.000	0.011	0.003	0.004	0.005	0.013	0.006	0.000	0.005	-0.001	0.007	0.014	0.015	0.005	0.000	0.000	-0.004
180	0.003	-0.001	0.011	0.006	0.000	0.011	0.003	0.004	0.003	0.011	0.006	0.000	0.006	-0.001	0.008	0.015	0.013	0.005	0.000	0.002	-0.006
181	0.005	0.001	0.008	0.007	0.000	0.012	0.002	0.005	0.002	0.008	0.006	0.000	0.007	-0.002	0.009	0.015	0.012	0.005	0.000	0.004	-0.008
182	0.004	0.001	0.006	0.006	0.000	0.010	0.003	0.005	0.001	0.006	0.006	0.000	0.007	-0.002	0.009	0.014	0.010	0.005	0.000	0.005	-0.009
183	0.004	0.002	0.002	0.006	0.000	0.009	0.003	0.005	0.001	0.007	0.006	0.000	0.007	-0.001	0.008	0.012	0.010	0.006	0.000	0.004	-0.009
184	0.002	0.001	0.003	0.003	0.000	0.007	0.003	0.003	0.000	0.004	0.003	0.000	0.006	-0.003	0.006	0.008	0.005	0.003	0.000	0.004	-0.010
185	0.000	0.000	-0.005	-0.002	0.000	0.005	0.002	0.002	-0.001	0.000	-0.001	0.000	0.006	-0.005	0.004	0.005	0.001	-0.001	0.000	0.004	-0.011
186	0.001	0.001	-0.005	0.000	0.000	0.006	-0.001	0.002	0.000	0.001	0.000	0.000	0.006	-0.004	0.004	0.004	0.002	0.000	0.000	0.005	-0.009
187	0.002	0.002	-0.003	0.001	0.000	0.006	0.000	0.002	0.000	0.001	0.000	0.000	0.007	-0.003	0.004	0.004	0.002	0.000	0.000	0.006	-0.009
188	-0.001	0.001	-0.006	-0.006	0.000	0.007	-0.002	-0.002	-0.002	-0.007	-0.008	0.000	0.006	-0.007	0.000	0.000	-0.008	-0.008	0.000	0.006	-0.012

	August 15 - 31							September 1 - 15						
	0.5x	0.625x	0.75x	0.875x	1x	1.5x	2x	0.5x	0.625x	0.75x	0.875x	1x	1.5x	2x
Kaiser TP Change (mg/L)	-0.013	-0.009	-0.006	-0.003	0	0.0125	0.025	-0.013	-0.009	-0.006	-0.003	0	0.0125	0.025
Segment														
158	0.000	0.002	0.001	0.002	0.000	0.002	0.003	-0.001	0.000	0.000	0.002	0.000	0.004	0.006
159	0.000	0.002	0.000	0.001	0.000	0.002	0.002	-0.001	0.001	-0.002	0.001	0.000	0.001	0.004
160	0.001	0.002	0.000	0.001	0.000	0.002	0.002	-0.001	0.000	-0.001	0.001	0.000	0.001	0.003
161	0.000	0.001	0.000	0.001	0.000	0.002	0.003	-0.001	0.000	-0.001	0.001	0.000	0.002	[illegible]
162	0.001	0.002	0.000	0.001	0.000	0.003	0.002	0.000	0.001	0.000	0.001	0.000	0.002	[illegible]
163	0.001	0.002	0.001	0.001	0.000	0.003	0.003	0.000	0.002	0.002	0.001	0.000	0.003	[illegible]
164	0.002	0.002	0.001	0.001	0.000	0.003	0.002	0.000	0.002	0.002	0.002	0.000	0.002	[illegible]
165	0.002	0.001	-0.001	0.000	0.000	0.003	0.000	0.002	0.003	0.003	0.002	0.000	0.003	[illegible]
166	-0.001	-0.002	-0.002	-0.001	0.000	0.001	-0.002	0.002	0.003	0.003	0.002	0.000	0.002	[illegible]
167	-0.003	-0.005	-0.002	-0.002	0.000	-0.001	-0.003	0.001	0.002	0.002	0.001	0.000	0.001	[illegible]
168	-0.013	-0.011	-0.003	-0.004	0.000	-0.010	-0.005	0.002	0.003	0.001	0.000	0.000	0.001	[illegible]
169	-0.011	-0.011	-0.002	-0.002	0.000	-0.011	-0.005	0.005	0.004	-0.001	0.000	0.000	0.001	[illegible]
170	-0.008	-0.010	-0.001	-0.003	0.000	-0.008	-0.006	0.008	0.009	0.002	0.003	0.000	0.002	[illegible]
171	-0.005	-0.010	0.000	-0.003	0.000	-0.005	-0.005	0.011	0.013	0.005	0.005	0.000	0.004	[illegible]
172	-0.006	-0.012	0.001	-0.003	0.000	-0.007	-0.005	0.015	0.016	0.006	0.006	0.000	0.005	[illegible]
173	-0.009	-0.014	0.001	-0.004	0.000	-0.010	-0.006	0.015	0.015	0.005	0.005	0.000	0.004	[illegible]
174	-0.010	-0.014	0.003	-0.003	0.000	-0.012	-0.006	0.015	0.014	0.003	0.005	0.000	0.003	[illegible]
175	-0.008	-0.013	0.004	-0.003	0.000	-0.011	-0.006	0.015	0.015	0.006	0.006	0.000	0.002	[illegible]
176	-0.006	-0.012	0.005	-0.003	0.000	-0.010	-0.006	0.013	0.013	0.005	0.006	0.000	0.000	[illegible]
177	-0.006	-0.011	0.008	-0.001	0.000	-0.010	-0.005	0.010	0.010	0.006	0.007	0.000	-0.004	[illegible]
178	-0.004	-0.009	0.008	0.000	0.000	-0.009	-0.005	0.007	0.007	0.005	0.007	0.000	-0.006	[illegible]
179	-0.002	-0.007	0.008	0.000	0.000	-0.008	-0.006	0.005	0.005	0.006	0.005	0.000	-0.007	[illegible]
180	0.001	-0.002	0.008	0.000	0.000	-0.006	-0.006	0.002	0.001	0.006	0.003	0.000	-0.007	[illegible]
181	0.005	0.005	0.009	0.001	0.000	-0.004	-0.007	-0.001	-0.003	0.006	0.001	0.000	-0.007	[illegible]
182	0.007	0.008	0.009	0.002	0.000	-0.003	-0.007	-0.001	-0.005	0.006	0.000	0.000	-0.007	[illegible]
183	0.007	0.009	0.010	0.003	0.000	-0.002	-0.007	-0.002	-0.005	0.006	-0.001	0.000	-0.007	[illegible]
184	0.006	0.008	0.007	0.001	0.000	-0.001	-0.009	-0.001	-0.004	0.004	-0.002	0.000	-0.005	[illegible]
185	0.006	0.009	0.003	-0.002	0.000	-0.001	-0.011	0.000	-0.002	0.003	-0.002	0.000	-0.004	[illegible]
186	0.008	0.011	0.005	0.001	0.000	0.000	-0.010	0.002	0.000	0.008	0.002	0.000	-0.004	[illegible]
187	0.011	0.012	0.007	0.004	0.000	0.001	-0.009	0.004	0.004	0.011	0.006	0.000	-0.003	[illegible]
188	0.004	0.007	-0.004	-0.007	0.000	0.001	-0.015	0.004	0.005	0.008	0.003	0.000	-0.001	[illegible]

	September 16 - 30							October 1 - 15							October 16 - 31						
	0.5x	0.625x	0.75x	0.875x	1x	1.5x	2x	0.5x	0.625x	0.75x	0.875x	1x	1.5x	2x	0.5x	0.625x	0.75x	0.875x	1x	1.5x	2x
Kaiser TP Change (mg/L)	-0.013	-0.009	-0.006	-0.003	0	0.0125	0.025	-0.013	-0.009	-0.006	-0.003	0	0.0125	0.025	-0.013	-0.009	-0.006	-0.003	0	0.0125	0.025
Segment																					
158	-0.003	-0.004	-0.003	-0.002	0.000	0.007	0.009	-0.006	-0.005	-0.002	-0.003	0.000	0.004	0.006	-0.004	-0.004	-0.001	-0.002	0.000	0.001	0.003
159	-0.002	-0.004	-0.002	-0.002	0.000	0.008	0.010	-0.006	-0.005	-0.002	-0.003	0.000	0.004	0.007	-0.004	-0.004	-0.001	-0.003	0.000	0.003	0.005
160	-0.004	-0.003	-0.001	-0.002	0.000	0.007	0.012	-0.007	-0.006	-0.002	-0.004	0.000	0.004	0.008	-0.004	-0.004	0.000	-0.002	0.000	0.003	0.006
161	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
162	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
163	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
164	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
165	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
166	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
167	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
168	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
169	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
170	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
171	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
172	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
173	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
174	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
175	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
176	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
177	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
178	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
179	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
180	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
181	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
182	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
183	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
184	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
185	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
186	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
187	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
188	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table B-3. Individual Segment/Time-Specific Slopes for IEP

	July 1 - 15			July 16 - 31			August 1 - 15			August 15 - 31		
	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc
IEP TP Change (mg/L)	-0.035	0	0.07	-0.035	0	0.07	-0.035	0	0.07	-0.035	0	0.07
Segment												
158	0.00E+0	-2.26E-1	0.00E+0	-3.35E-3	0.00E+0	-6.14E-2	0.00E+0	0.00E+0	0.00E+0	-9.70E-3	-8.57E-2	0.00E+0
159	-1.49E-2	-3.71E-1	0.00E+0	-2.40E-2	0.00E+0	-4.91E-2	-2.74E-3	0.00E+0	-1.60E-2	0.00E+0	-5.37E-2	0.00E+0
160	-5.10E-2	-4.81E-1	0.00E+0	-1.03E-2	0.00E+0	-2.57E-2	-9.14E-4	0.00E+0	-2.00E-2	-3.20E-3	-5.71E-2	0.00E+0
161	-4.23E-2	-5.27E-1	0.00E+0	-1.14E-2	0.00E+0	-2.34E-2	-2.74E-3	0.00E+0	-2.06E-2	0.00E+0	-4.00E-2	0.00E+0
162	-4.96E-2	-5.79E-1	0.00E+0	-1.60E-2	0.00E+0	-2.46E-2	-3.20E-3	0.00E+0	-1.71E-2	0.00E+0	-4.34E-2	0.00E+0
163	-2.83E-2	-3.02E-1	0.00E+0	-5.26E-3	-3.09E-2	0.00E+0	-2.97E-3	0.00E+0	-6.86E-3	0.00E+0	-5.37E-2	0.00E+0
164	-4.43E-2	-2.47E-1	0.00E+0	0.00E+0	-9.60E-2	0.00E+0	-1.19E-2	-1.14E-2	-1.20E-2	-1.28E-2	-4.80E-2	-4.00E-3
165	-1.04E-1	-3.79E-1	-3.49E-2	0.00E+0	-9.14E-2	0.00E+0	-2.58E-2	-8.00E-3	-3.03E-2	-4.07E-2	-2.29E-2	-4.51E-2
166	-1.82E-1	-5.07E-1	-1.01E-1	-1.19E-2	-1.17E-1	0.00E+0	-3.61E-2	0.00E+0	-4.63E-2	-6.29E-2	0.00E+0	-7.89E-2
167	-1.90E-1	-6.99E-1	-6.29E-2	-1.21E-1	-1.04E-1	-1.25E-1	-4.37E-2	0.00E+0	-5.54E-2	-7.38E-2	0.00E+0	-9.43E-2
168	-2.39E-1	-9.14E-1	-7.03E-2	-2.03E-1	-2.10E-1	-2.02E-1	-3.34E-2	0.00E+0	-6.00E-2	-1.11E-1	0.00E+0	-1.50E-1
169	-2.14E-1	-1.23E+0	0.00E+0	-2.32E-1	-2.63E-1	-2.25E-1	-2.47E-2	0.00E+0	-4.57E-2	-1.32E-1	-3.43E-2	-1.56E-1
170	-2.07E-1	-1.13E+0	0.00E+0	-2.23E-1	-3.22E-1	-1.98E-1	-2.51E-2	0.00E+0	-3.83E-2	-1.49E-1	-5.49E-2	-1.73E-1
171	-2.20E-1	-7.47E-1	-8.80E-2	-1.91E-1	-3.51E-1	-1.51E-1	-3.34E-2	-2.29E-3	-4.11E-2	-1.38E-1	-6.06E-2	-1.58E-1
172	-2.42E-1	-8.18E-1	-9.83E-2	-1.80E-1	-4.46E-1	-1.13E-1	-4.71E-2	-7.54E-2	-4.00E-2	-1.43E-1	-7.54E-2	-1.60E-1
173	-1.64E-1	-7.62E-1	-1.43E-2	-1.67E-1	-4.66E-1	-9.20E-2	-7.29E-2	-1.61E-1	-5.09E-2	-1.46E-1	-4.11E-2	-1.72E-1
174	-2.22E-1	-6.07E-1	-1.26E-1	-1.50E-1	-4.77E-1	-6.86E-2	-9.74E-2	-2.03E-1	-7.09E-2	-1.46E-1	-5.60E-2	-1.69E-1
175	-2.15E-1	-4.24E-1	-1.63E-1	-1.46E-1	-4.54E-1	-6.91E-2	-1.03E-1	-2.40E-1	-6.91E-2	-1.42E-1	-7.77E-2	-1.58E-1
176	-1.71E-1	-2.00E-1	-1.63E-1	-1.33E-1	-3.94E-1	-6.80E-2	-1.09E-1	-2.50E-1	-7.43E-2	-1.46E-1	-8.69E-2	-1.61E-1
177	0.00E+0	-4.50E-1	0.00E+0	-1.15E-1	-3.82E-1	-4.86E-2	-1.17E-1	-2.95E-1	-7.26E-2	-1.46E-1	-1.33E-1	-1.50E-1
178	0.00E+0	-3.51E-1	0.00E+0	-9.12E-2	-3.01E-1	-3.89E-2	-1.18E-1	-2.69E-1	-8.06E-2	-1.39E-1	-1.26E-1	-1.42E-1
179	0.00E+0	-1.93E-1	0.00E+0	-6.97E-2	-2.07E-1	-3.54E-2	-1.28E-1	-2.42E-1	-1.00E-1	-1.37E-1	-1.26E-1	-1.39E-1
180	0.00E+0	-4.11E-2	0.00E+0	-4.75E-2	-1.39E-1	-2.46E-2	-1.36E-1	-2.16E-1	-1.16E-1	-1.31E-1	-1.31E-1	-1.30E-1
181	0.00E+0	-3.43E-3	0.00E+0	-1.74E-2	-6.63E-2	-5.14E-3	-1.50E-1	-1.98E-1	-1.38E-1	-1.26E-1	-1.47E-1	-1.21E-1
182	-3.73E-2	0.00E+0	-5.43E-2	-9.14E-3	-4.80E-2	0.00E+0	-1.50E-1	-1.67E-1	-1.46E-1	-1.24E-1	-1.39E-1	-1.21E-1
183	-7.34E-2	0.00E+0	-1.27E-1	-5.49E-3	-3.66E-2	0.00E+0	-1.36E-1	-1.51E-1	-1.33E-1	-1.15E-1	-1.47E-1	-1.06E-1
184	-7.66E-2	0.00E+0	-1.11E-1	-1.19E-2	-2.74E-2	-8.00E-3	-1.39E-1	-1.19E-1	-1.45E-1	-1.21E-1	-1.23E-1	-1.20E-1
185	-8.18E-2	0.00E+0	-1.46E-1	-2.13E-2	-2.17E-2	-2.11E-2	-1.33E-1	-9.60E-2	-1.42E-1	-1.24E-1	-1.02E-1	-1.30E-1
186	-9.51E-2	0.00E+0	-1.68E-1	-2.03E-2	-3.09E-2	-1.77E-2	-1.01E-1	-9.71E-2	-1.02E-1	-1.15E-1	-1.17E-1	-1.15E-1
187	-1.23E-1	0.00E+0	-1.86E-1	-1.67E-2	-1.94E-2	-1.60E-2	-9.39E-2	-9.03E-2	-9.49E-2	-1.08E-1	-1.28E-1	-1.03E-1
188	-9.17E-2	0.00E+0	-1.22E-1	-3.66E-2	0.00E+0	-5.03E-2	-9.49E-2	-2.86E-2	-1.11E-1	-1.30E-1	-6.74E-2	-1.46E-1

	September 1 - 15			September 16 - 30			October 1 - 15			October 16 - 31		
	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc
IEP TP Change (mg/L)	-0.035	0	0.07	-0.035	0	0.07	-0.035	0	0.07	-0.035	0	0.07
Segment												
158	0.00E+0	-3.71E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.43E-2
159	0.00E+0	-5.14E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-5.71E-3
160	0.00E+0	-4.00E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-5.71E-3
161	0.00E+0	-4.11E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-5.71E-3
162	0.00E+0	-4.69E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-5.71E-3
163	0.00E+0	-5.14E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.14E-2
164	0.00E+0	-5.94E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
165	0.00E+0	-8.69E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-5.71E-3
166	-2.29E-4	-8.11E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-5.71E-3
167	-1.26E-2	-6.51E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
168	-2.70E-2	-6.17E-2	-1.83E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
169	-6.47E-2	-8.80E-2	-5.89E-2	-2.48E-18	0.00E+0	-7.43E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
170	-7.36E-2	-1.83E-1	-4.63E-2	-1.03E-2	0.00E+0	-2.23E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
171	-6.81E-2	-2.56E-1	-2.11E-2	-2.38E-2	0.00E+0	-3.71E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
172	-1.09E-1	-3.11E-1	-5.89E-2	-5.53E-2	0.00E+0	-9.89E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
173	-1.38E-1	-2.71E-1	-1.05E-1	-7.86E-2	0.00E+0	-1.43E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
174	-1.75E-1	-2.41E-1	-1.59E-1	-1.11E-1	0.00E+0	-2.05E-1	0.00E+0	0.00E+0	-1.71E-3	0.00E+0	0.00E+0	0.00E+0
175	-1.66E-1	-2.61E-1	-1.42E-1	-1.24E-1	0.00E+0	-2.25E-1	0.00E+0	0.00E+0	-1.54E-2	0.00E+0	0.00E+0	0.00E+0
176	-1.73E-1	-2.27E-1	-1.59E-1	-1.19E-1	0.00E+0	-2.01E-1	0.00E+0	0.00E+0	-2.97E-2	0.00E+0	0.00E+0	0.00E+0
177	-1.92E-1	-1.99E-1	-1.90E-1	-1.39E-1	0.00E+0	-2.37E-1	-8.69E-3	0.00E+0	-6.34E-2	0.00E+0	0.00E+0	0.00E+0
178	-1.92E-1	-1.61E-1	-2.00E-1	-1.24E-1	0.00E+0	-1.89E-1	-1.58E-2	0.00E+0	-6.97E-2	0.00E+0	0.00E+0	0.00E+0
179	-1.73E-1	-1.44E-1	-1.81E-1	-1.26E-1	0.00E+0	-1.85E-1	-2.81E-2	0.00E+0	-8.51E-2	0.00E+0	0.00E+0	0.00E+0
180	-1.42E-1	-1.09E-1	-1.50E-1	-1.37E-1	0.00E+0	-1.89E-1	-3.02E-2	0.00E+0	-9.03E-2	0.00E+0	0.00E+0	0.00E+0
181	-1.23E-1	-7.09E-2	-1.35E-1	-1.48E-1	0.00E+0	-1.89E-1	-4.73E-2	0.00E+0	-1.16E-1	0.00E+0	0.00E+0	0.00E+0
182	-1.14E-1	-4.46E-2	-1.31E-1	-1.57E-1	-5.60E-2	-1.83E-1	-4.78E-2	0.00E+0	-1.07E-1	0.00E+0	0.00E+0	0.00E+0
183	-1.05E-1	-3.54E-2	-1.22E-1	-1.45E-1	-1.55E-1	-1.43E-1	-4.69E-2	0.00E+0	-1.14E-1	0.00E+0	0.00E+0	-8.57E-3
184	-9.55E-2	-3.20E-2	-1.11E-1	-1.04E-1	-2.59E-1	-6.51E-2	-4.73E-2	0.00E+0	-8.86E-2	0.00E+0	0.00E+0	-7.43E-3
185	-7.38E-2	-3.54E-2	-8.34E-2	-6.97E-2	-2.78E-1	-1.77E-2	-3.68E-2	0.00E+0	-5.89E-2	0.00E+0	0.00E+0	0.00E+0
186	-6.90E-2	-6.40E-2	-7.03E-2	-5.71E-2	-2.88E-1	0.00E+0	-5.81E-2	0.00E+0	-8.23E-2	0.00E+0	0.00E+0	-2.80E-2
187	-7.02E-2	-9.26E-2	-6.46E-2	-6.01E-2	-2.75E-1	-6.29E-3	-4.46E-2	0.00E+0	-7.60E-2	0.00E+0	0.00E+0	-2.69E-2
188	-6.54E-2	-7.54E-2	-6.29E-2	-3.15E-2	-2.17E-1	0.00E+0	-2.58E-2	-1.03E-2	-2.97E-2	0.00E+0	0.00E+0	0.00E+0

Table B-4A. Individual Segment/Time-Specific Slopes for Kaiser (Includes Potentially Anomalous 25% TP load reduction results)

	July 1 - 15			July 16 - 31			August 1 - 15			August 15 - 31			September 1 - 15			September 16 - 30			October 1 - 15			October 16 - 31		
	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc
Kaiser TP Change (mg/L)	-0.013	0	0.025	-0.013	0	0.025	-0.013	0	0.025	-0.013	0	0.025	-0.013	0	0.025	-0.013	0	0.025	-0.013	0	0.025	-0.013	0	0.025
Segment																								
158	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.92E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
159	0.00E+0	-1.92E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-9.39E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
160	-5.59E-2	-2.77E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.07E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
161	-6.52E-2	-4.05E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-4.80E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
162	-1.86E-2	-4.44E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-9.60E-2	0.00E+0	0.00E+0	-4.59E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
163	-3.78E-3	-3.21E-1	0.00E+0	0.00E+0	-7.47E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.11E-1	0.00E+0	0.00E+0	-1.14E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
164	-1.17E-1	-3.86E-1	-1.60E-2	0.00E+0	-1.27E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.82E-1	0.00E+0	0.00E+0	-1.17E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
165	-2.53E-1	-7.88E-1	-5.28E-2	0.00E+0	-2.23E-1	0.00E+0	0.00E+0	-2.40E-2	0.00E+0	0.00E+0	-7.36E-2	0.00E+0	0.00E+0	-2.73E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
166	-2.78E-1	-1.02E+0	0.00E+0	0.00E+0	-1.28E-1	0.00E+0	0.00E+0	-8.00E-3	0.00E+0	0.00E+0	0.00E+0	-4.96E-2	0.00E+0	-2.47E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
167	-1.61E-1	-1.14E+0	0.00E+0	-3.29E-2	-1.39E-2	-4.00E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.09E-1	0.00E+0	-1.81E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
168	-2.51E-1	-1.38E+0	0.00E+0	-1.68E-1	-1.51E-1	-1.74E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-3.20E-1	-5.15E-2	-2.02E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
169	-3.34E-1	-1.74E+0	0.00E+0	-2.44E-1	-2.51E-1	-2.42E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-3.28E-1	-1.76E-1	-3.05E-1	-1.28E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
170	-3.20E-1	-1.66E+0	0.00E+0	-2.16E-1	-3.30E-1	-1.73E-1	0.00E+0	0.00E+0	0.00E+0	-3.64E-2	0.00E+0	-3.01E-1	-2.57E-1	-7.13E-1	-8.64E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
171	-4.33E-1	-1.34E+0	-9.28E-2	-1.82E-1	-4.39E-1	-8.48E-2	0.00E+0	0.00E+0	0.00E+0	-3.32E-2	0.00E+0	-2.59E-1	-2.99E-1	-1.07E+0	-1.12E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
172	-5.28E-1	-1.52E+0	-1.55E-1	-2.01E-1	-6.94E-1	-1.60E-2	0.00E+0	0.00E+0	0.00E+0	-3.75E-2	0.00E+0	-2.91E-1	-4.39E-1	-1.37E+0	-9.12E-2	0.00E+0	0.00E+0	-6.24E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
173	-5.11E-1	-1.47E+0	-1.52E-1	-2.14E-1	-8.06E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-2.65E-2	0.00E+0	-3.58E-1	-4.60E-1	-1.28E+0	-1.52E-1	0.00E+0	0.00E+0	-1.06E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
174	-4.56E-1	-1.13E+0	-2.03E-1	-2.20E-1	-9.26E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-5.03E-2	0.00E+0	-3.84E-1	-5.19E-1	-1.24E+0	-2.50E-1	0.00E+0	0.00E+0	-2.16E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
175	-3.94E-1	-8.59E-1	-2.19E-1	-1.98E-1	-8.71E-1	0.00E+0	-7.59E-2	0.00E+0	0.00E+0	-7.01E-2	0.00E+0	-3.65E-1	-4.98E-1	-1.31E+0	-1.92E-1	0.00E+0	0.00E+0	-2.14E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
176	-3.31E-1	-5.92E-1	-2.34E-1	-1.80E-1	-7.94E-1	0.00E+0	-1.90E-1	0.00E+0	0.00E+0	-1.02E-1	0.00E+0	-3.63E-1	-4.90E-1	-1.12E+0	-2.53E-1	0.00E+0	0.00E+0	-2.21E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
177	-2.36E-2	-8.37E-1	0.00E+0	-1.81E-1	-8.99E-1	0.00E+0	-2.82E-1	-2.40E-1	0.00E+0	-1.19E-1	0.00E+0	-3.23E-1	-5.01E-1	-9.53E-1	-3.31E-1	0.00E+0	0.00E+0	-2.32E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
178	0.00E+0	-7.31E-1	0.00E+0	-1.66E-1	-8.51E-1	0.00E+0	-3.36E-1	-4.00E-1	-4.80E-2	-1.42E-1	0.00E+0	-3.01E-1	-4.63E-1	-7.25E-1	-3.65E-1	-8.35E-2	0.00E+0	-1.95E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
179	0.00E+0	-5.19E-1	0.00E+0	-1.33E-1	-6.66E-1	0.00E+0	-3.89E-1	-5.28E-1	-1.48E-1	-1.84E-1	0.00E+0	-3.02E-1	-4.14E-1	-5.25E-1	-3.73E-1	-1.69E-1	0.00E+0	-2.58E-1	0.00E+0	0.00E+0	-3.36E-2	0.00E+0	0.00E+0	0.00E+0
180	0.00E+0	-3.83E-1	0.00E+0	-1.07E-1	-5.71E-1	0.00E+0	-4.24E-1	-6.56E-1	-2.20E-1	-2.55E-1	-1.75E-1	-2.85E-1	-3.10E-1	-2.77E-1	-3.22E-1	-2.72E-1	-8.85E-2	-3.41E-1	0.00E+0	0.00E+0	-4.00E-2	0.00E+0	0.00E+0	0.00E+0
181	0.00E+0	-4.68E-1	0.00E+0	-9.22E-2	-4.92E-1	0.00E+0	-4.65E-1	-7.36E-1	-3.24E-1	-3.59E-1	-5.71E-1	-2.80E-1	-2.28E-1	-1.60E-2	-3.07E-1	-4.29E-1	-3.84E-1	-4.46E-1	0.00E+0	0.00E+0	-1.28E-1	0.00E+0	-4.16E-2	0.00E+0
182	0.00E+0	-4.18E-1	0.00E+0	-7.97E-2	-4.59E-1	0.00E+0	-4.60E-1	-7.28E-1	-3.72E-1	-4.07E-1	-7.37E-1	-2.83E-1	-1.99E-1	0.00E+0	-3.06E-1	-5.28E-1	-6.01E-1	-5.01E-1	0.00E+0	0.00E+0	-1.26E-1	0.00E+0	-1.46E-1	0.00E+0
183	0.00E+0	-3.07E-1	0.00E+0	-7.74E-2	-4.50E-1	0.00E+0	-4.32E-1	-6.64E-1	-3.60E-1	-4.04E-1	-8.23E-1	-2.46E-1	-1.66E-1	0.00E+0	-2.75E-1	-5.59E-1	-9.03E-1	-4.30E-1	0.00E+0	0.00E+0	-1.57E-1	0.00E+0	0.00E+0	0.00E+0
184	0.00E+0	-2.08E-1	0.00E+0	-6.46E-2	-2.75E-1	0.00E+0	-3.73E-1	-5.20E-1	-4.08E-1	-4.13E-1	-6.97E-1	-3.07E-1	-1.57E-1	0.00E+0	-2.59E-1	-4.78E-1	-1.11E+0	-2.40E-1	0.00E+0	0.00E+0	-1.10E-1	0.00E+0	-1.15E-1	0.00E+0
185	0.00E+0	0.00E+0	0.00E+0	-4.77E-2	-3.84E-2	-5.12E-2	-2.99E-1	-3.52E-1	-4.36E-1	-4.22E-1	-5.66E-1	-3.68E-1	-1.11E-1	0.00E+0	-1.60E-1	-3.81E-1	-1.24E+0	-5.76E-2	0.00E+0	-1.70E-1	0.00E+0	0.00E+0	-5.23E-1	0.00E+0
186	0.00E+0	0.00E+0	0.00E+0	-3.29E-2	-8.64E-2	-1.28E-2	-2.42E-1	-3.36E-1	-3.56E-1	-4.58E-1	-8.04E-1	-3.28E-1	-1.49E-1	-2.83E-1	-9.92E-2	-3.44E-1	-1.37E+0	0.00E+0	-1.01E-1	-4.07E-1	0.00E+0	0.00E+0	-1.94E-1	0.00E+0
187	0.00E+0	-9.39E-2	0.00E+0	-1.98E-2	-9.39E-2	0.00E+0	-2.28E-1	-3.44E-1	-3.52E-1	-4.88E-1	-1.03E+0	-2.83E-1	-1.98E-1	-6.02E-1	-4.64E-2	-3.10E-1	-1.33E+0	0.00E+0	-1.40E-1	-4.16E-1	-3.68E-2	0.00E+0	-1.65E-1	0.00E+0
188	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.07E-1	-1.54E-1	-1.60E-2	-4.92E-1	-3.89E-1	-2.36E-1	-4.46E-1	-1.49E-1	-5.28E-1	-6.40E-3	-1.06E-1	-1.26E+0	0.00E+0	-1.88E-1	-9.59E-1	0.00E+0	0.00E+0	-1.04E+0	0.00E+0

Table B-5. Individual Segment/Time-Specific Slopes for Kaiser (Option B - excluding anomalous 25% TP load reduction results)

	July 1 - 15			July 16 - 31			August 1 - 15			August 15 - 31			September 1 - 15			September 16 - 30			October 1 - 15			October 16 - 31		
	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc	Overall	Dec	Inc
Kaiser TP Change (mg/L)	-0.013	0	0.025	-0.013	0	0.025	-0.013	0	0.025	-0.013	0	0.025	-0.013	0	0.025	-0.013	0	0.025	-0.013	0	0.025	-0.013	0	0.025
Segment																								
158	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.92E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
159	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.08E-1	0.00E+0	0.00E+0	##########	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
160	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.18E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
161	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-5.29E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
162	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.03E-1	0.00E+0	0.00E+0	-4.55E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
163	0.00E+0	-6.28E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.08E-1	0.00E+0	0.00E+0	-9.48E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
164	-6.58E-2	-2.19E-1	-1.60E-2	0.00E+0	-8.00E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.93E-1	0.00E+0	0.00E+0	-9.35E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
165	-1.80E-1	-5.72E-1	-5.28E-2	0.00E+0	-1.39E-1	0.00E+0	0.00E+0	-2.40E-2	0.00E+0	0.00E+0	-9.97E-2	0.00E+0	0.00E+0	-2.34E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
166	-1.79E-1	-7.31E-1	0.00E+0	0.00E+0	-2.71E-2	0.00E+0	0.00E+0	-8.00E-3	0.00E+0	-5.13E-3	0.00E+0	-4.96E-2	0.00E+0	-2.17E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
167	-6.64E-3	-6.67E-1	0.00E+0	-1.66E-2	0.00E+0	-4.00E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.09E-1	0.00E+0	-1.65E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
168	-5.55E-2	-7.58E-1	0.00E+0	-1.30E-1	0.00E+0	-1.74E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-3.20E-1	-4.86E-2	-2.13E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
169	-6.49E-2	-8.60E-1	0.00E+0	-1.90E-1	-3.08E-2	-2.42E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-3.28E-1	-1.91E-1	-3.86E-1	-1.28E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
170	-7.03E-2	-8.43E-1	0.00E+0	-1.52E-1	-8.98E-2	-1.73E-1	0.00E+0	0.00E+0	0.00E+0	-4.14E-2	0.00E+0	-3.01E-1	-2.57E-1	-7.80E-1	-8.64E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
171	-2.81E-1	-8.62E-1	-9.28E-2	-1.12E-1	-1.94E-1	-8.48E-2	0.00E+0	0.00E+0	0.00E+0	-3.50E-2	0.00E+0	-2.59E-1	-2.78E-1	-1.10E+0	-1.12E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
172	-3.63E-1	-1.00E+0	-1.55E-1	-1.05E-1	-3.78E-1	-1.60E-2	0.00E+0	0.00E+0	0.00E+0	-3.17E-2	0.00E+0	-2.91E-1	-4.20E-1	-1.43E+0	-9.12E-2	0.00E+0	0.00E+0	-6.24E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
173	-3.47E-1	-9.49E-1	-1.52E-1	-1.11E-1	-4.78E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-2.32E-2	0.00E+0	-3.58E-1	-4.50E-1	-1.37E+0	-1.52E-1	0.00E+0	0.00E+0	-1.06E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
174	-3.10E-1	-6.40E-1	-2.03E-1	-1.10E-1	-5.88E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-3.47E-2	0.00E+0	-3.84E-1	-5.17E-1	-1.34E+0	-2.50E-1	0.00E+0	0.00E+0	-2.16E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
175	-2.80E-1	-4.66E-1	-2.19E-1	-9.21E-2	-5.43E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-4.68E-2	0.00E+0	-3.65E-1	-4.81E-1	-1.37E+0	-1.92E-1	0.00E+0	0.00E+0	-2.14E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
176	-2.65E-1	-3.61E-1	-2.34E-1	-8.51E-2	-5.00E-1	0.00E+0	-1.10E-1	0.00E+0	0.00E+0	-7.85E-2	0.00E+0	-3.63E-1	-4.76E-1	-1.16E+0	-2.53E-1	-4.44E-2	0.00E+0	-2.21E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
177	0.00E+0	-2.79E-1	0.00E+0	-7.46E-2	-5.75E-1	0.00E+0	-1.83E-1	-2.40E-1	0.00E+0	-7.43E-2	0.00E+0	-3.23E-1	-4.85E-1	-9.56E-1	-3.31E-1	-6.07E-2	0.00E+0	-2.32E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
178	0.00E+0	-2.25E-1	0.00E+0	-7.00E-2	-5.66E-1	0.00E+0	-2.45E-1	-4.00E-1	-4.80E-2	-9.81E-2	0.00E+0	-3.01E-1	-4.49E-1	-7.06E-1	-3.65E-1	-1.29E-1	0.00E+0	-1.95E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
179	0.00E+0	-1.44E-1	0.00E+0	-5.98E-2	-4.50E-1	0.00E+0	-3.12E-1	-5.28E-1	-1.48E-1	-1.42E-1	0.00E+0	-3.02E-1	-3.97E-1	-4.70E-1	-3.73E-1	-2.12E-1	-7.14E-2	-2.58E-1	0.00E+0	0.00E+0	-3.36E-2	0.00E+0	0.00E+0	0.00E+0
180	0.00E+0	-1.71E-1	0.00E+0	-4.74E-2	-4.00E-1	0.00E+0	-3.60E-1	-6.56E-1	-2.20E-1	-2.14E-1	0.00E+0	-2.85E-1	-2.87E-1	-1.80E-1	-3.22E-1	-3.09E-1	-2.10E-1	-3.41E-1	0.00E+0	0.00E+0	-4.00E-2	0.00E+0	0.00E+0	0.00E+0
181	0.00E+0	-3.34E-1	0.00E+0	-4.80E-2	-3.73E-1	0.00E+0	-4.11E-1	-7.36E-1	-3.24E-1	-3.17E-1	-4.30E-1	-2.80E-1	-1.99E-1	0.00E+0	-3.07E-1	-4.57E-1	-4.90E-1	-4.46E-1	0.00E+0	0.00E+0	-1.28E-1	0.00E+0	0.00E+0	0.00E+0
182	0.00E+0	-3.30E-1	0.00E+0	-4.35E-2	-3.69E-1	0.00E+0	-4.18E-1	-7.28E-1	-3.72E-1	-3.69E-1	-6.31E-1	-2.83E-1	-1.72E-1	0.00E+0	-3.06E-1	-5.39E-1	-6.56E-1	-5.01E-1	0.00E+0	0.00E+0	-1.26E-1	0.00E+0	-1.35E-2	0.00E+0
183	0.00E+0	-3.08E-1	0.00E+0	-3.92E-2	-3.52E-1	0.00E+0	-3.90E-1	-6.64E-1	-3.60E-1	-3.60E-1	-7.11E-1	-2.46E-1	-1.37E-1	0.00E+0	-2.75E-1	-5.46E-1	-9.00E-1	-4.30E-1	-1.21E-2	0.00E+0	-1.57E-1	0.00E+0	0.00E+0	0.00E+0
184	0.00E+0	-1.69E-1	0.00E+0	-4.47E-2	-2.26E-1	0.00E+0	-3.55E-1	-5.20E-1	-4.08E-1	-3.89E-1	-6.41E-1	-3.07E-1	-1.39E-1	0.00E+0	-2.59E-1	-4.33E-1	-1.03E+0	-2.40E-1	-3.11E-2	0.00E+0	-1.10E-1	0.00E+0	-2.2E-14	0.00E+0
185	0.00E+0	0.00E+0	0.00E+0	-5.19E-2	-5.42E-2	-5.12E-2	-3.07E-1	-3.52E-1	-4.36E-1	-4.21E-1	-5.85E-1	-3.68E-1	-9.42E-2	0.00E+0	-1.60E-1	-3.09E-1	-1.08E+0	-5.76E-2	0.00E+0	-1.49E-1	0.00E+0	0.00E+0	-2.51E-1	0.00E+0
186	0.00E+0	-1.07E-1	0.00E+0	-2.69E-2	-7.02E-2	-1.28E-2	-2.41E-1	-3.36E-1	-3.56E-1	-4.45E-1	-8.05E-1	-3.28E-1	-1.09E-1	-1.39E-1	-9.92E-2	-2.40E-1	-1.10E+0	0.00E+0	-7.00E-2	-3.30E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0
187	0.00E+0	-1.94E-1	0.00E+0	-1.33E-2	-7.88E-2	0.00E+0	-2.27E-1	-3.44E-1	-3.52E-1	-4.64E-1	-1.02E+0	-2.83E-1	-1.38E-1	-4.21E-1	-4.64E-2	-1.88E-1	-9.87E-1	0.00E+0	-1.01E-1	-3.00E-1	-3.68E-2	0.00E+0	0.00E+0	0.00E+0
188	0.00E+0	0.00E+0	0.00E+0	-1.69E-2	0.00E+0	-1.07E-1	-2.06E-1	-1.60E-2	-4.92E-1	-4.30E-1	-3.78E-1	-4.46E-1	-1.07E-1	-4.17E-1	-6.40E-3	0.00E+0	-8.65E-1	0.00E+0	-7.58E-2	-6.19E-1	0.00E+0	0.00E+0	-4.69E-1	0.00E+0

Appendix F - Response to Comments

Ecology received comments on the draft documents following the 60-day public comment period. A summary of the comments and Ecology's responses are located at the end of this fact sheet as Appendix F-1.