DEPARTMENT OF ECOLOGY

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SUBJECT: Spokane River Preliminary CEQUALW2 Model Results

The following is a preliminary summary of the CEQUALW2 model forecast for different loading scenarios for the Spokane River and Long Lake TMDL study area. The CEQUALW2 model was calibrated to data collected in 1991 and 2000. The calibrated model was used with 2001 river flow and meteorological conditions to estimate pollutant loading effects for low river flow conditions (i.e., 2001 was a low-river flow year). Also included is a discussion of our proposed application of the dissolved oxygen criteria and critical conditions for establishing pollutant TMDL limits. Please note that a more detailed discussion of the material presented in this memorandum will be provided in the final report for the Spokane project.

As you know, the CEQUALW2 model is currently being calibrated to 2001 conditions and will not be finalized until November 2002. Therefore, the results presented are subject to change based on the 2001 model calibration results. The TDML study problem statement, study design, data collected, quality assurance, model setup, model calibration, and other related topics are discussed in the following draft documents: Spokane River and Long Lake Total Maximum Load Study Data Summary Report and the Upper Spokane River Model Boundary Conditions and Model Setup, and the Upper Spokane River Model Calibration reports. The purpose of this document is to provide you and other interested parties with preliminary water quality model forecasts with respect to the dissolved oxygen criteria.

Pollutants of Concern:

The major pollutants of concern that reduce dissolved oxygen are carbonaceous biochemical oxygen demand (CBOD) and nitrogenous BOD (e.g., ammonia). Nutrient loading is also of concern because of its indirect impact on dissolved oxygen through potential increases in primary productivity and the resultant plant respiration and decay processes (these also reduce dissolved oxygen).

The CEQUALW2 model of the Spokane River and Long Lake is a 2-dimensional dynamic model that simulates the water quality processes that affect dissolved oxygen concentrations including the interaction of phytoplankton, dissolved nutrients, and organic matter. In addition, the CEQUALW2 model simulates major physical processes that also affect dissolved oxygen concentrations such as heat transfer (i.e., water temperature changes) and hydrodynamics (i.e., river flow and velocity). The CEQUALW2 model will be used to predict whether dissolved oxygen levels violate water quality criteria during critical conditions. The model will also be used to determine the amount of pollutant loading reduction needed to meet the dissolved oxygen water quality criteria.

Water Quality Criteria:

The Spokane River classifications and dissolved oxygen criteria listed in the WAC (Ch. 173-201A-130 WAC) are:

PORTION OF STUDY AREA	CLASSIFICATION	DISSOLVED OXYGEN CRITERION
Long Lake (from Long Lake Dam to Nine Mile Bridge)	Lake Class	No measurable decrease from natural conditions
Spokane River (from Nine Mile Bridge to the Idaho border)	Class A	Dissolved oxygen shall exceed 8.0 mg/L

The dissolved oxygen criterion for Long Lake is “no measurable change from natural conditions.” The criterion for the river is “dissolved oxygen shall exceed 8.0 mg/L,” which is to apply at all times; therefore the minimum dissolved oxygen concentrations shall exceed 8.0 mg/L. However, in other TMDLs for oxygen-consuming substances, Ecology has allowed a 0.2 mg/L degradation in dissolved oxygen concentration due to human impacts. We are proposing to apply this allowable change in dissolved oxygen for the Spokane River and Long Lake TMDL study as discussed in the following paragraphs.

In general, it is not possible to precisely define natural conditions that existed before human impacts. Any analysis can only approximate natural conditions given the physical changes that may have altered the water body and its watershed (including groundwater). For example, Long Lake is a man-made reservoir that is formed by a hydroelectric dam. Physical, chemical, and biological processes in the reservoir, even without additional human impacts due to pollution, are different than what they would be if the river were free flowing, and any attempt to compare the two states would be inappropriate. However, we believe that water quality in Long Lake (and the Spokane River) does have a reference water quality condition that would exist if there were little or no pollutant effects. Once defined, this reference condition can be used to compare against current and possible future water quality conditions. For this technical memorandum we are proposing to apply the Lake Class dissolved oxygen criteria to Long Lake as follows:

> Under critical year conditions, allow no more than a 0.2 mg/L deficit in dissolved oxygen from "natural conditions" (i.e., reference conditions) at any point in the water column due to identified point and nonpoint pollutants. Reference conditions for Long Lake will be defined as the water quality conditions estimated by the calibrated CEQUALW2 model that would occur with no point source discharges and tributary pollutant (nonpoint source) concentrations set to estimated background conditions. Critical year conditions will be a hydrologic year that provides critical low flow conditions equal to approximately a 10 percent recurrence frequency (See Critical Condition section).

The Class A water quality criterion for dissolved oxygen will be applied to the Spokane River as follows:

> Under critical year conditions, the dissolved oxygen criterion will be assumed to be met: (1) when the CEQUALW2 model predicts dissolved oxygen greater than 8.0 mg/L; or (2) when the CEQUALW2 model predicts dissolved oxygen less than 8.0 mg/L and the combined impact of identified point and non point sources of oxygen-consuming substances causes less than a 0.2 mg/L deficit in dissolved oxygen.

Critical Condition:

Historically, we have used steady-state water quality models under "critical conditions" to establish pollutant allocations to protect water quality relative to a specific water quality criterion. In WAC 173-201A a critical condition is defined as:

> Critical condition is when physical, chemical, and biological characteristics of the receiving water environment interact with the effluent to produce the greatest potential adverse impact on aquatic biota and existing or characteristic water uses. For steady-state discharges to riverine systems the critical condition may be assumed to be equal to the 7Q10 flow event unless determined otherwise by the department.

Pollutant allocations are usually established by introducing different pollutant loading into the model under critical conditions (including low river flow, high temperatures, and estimated nonpoint source loading) then, by a trial-and-error procedure the model is used to find allocations that just satisfies the water quality criterion. However, the Spokane River system

CEQUALW2 model application is dynamic (i.e., simulates real-time changes in water quantity and water quality) and applying a "steady-state" modeling solution for establishing pollutant allocations would not make use of the model's capabilities to predict water quality under changing conditions. Therefore, we are proposing to define a "critical year" for establishing pollutant allocations.

The critical year should provide low river flows during periods of the year that most influence water quality in Long Lake and the Spokane River. Currently, we are proposing to use 2001 as the critical year for establishing pollutant allocations based on the following analysis of flow data from the USGS gauge near Monroe Street:

- The April-May and June-September 2001 daily average flows were estimated to be exceeded about 10% of the time or have approximate exceedence probabilities equal to 0.10.

- August daily average flows during the last two weeks of August were 611 cfs which also would have an exceedence probability approximately equal to the calculated 7Q10 low flow event of 620 cfs.

In addition, we believe that 2001 should be used as the critical year because the CEQUALW2 model will be calibrated to ambient and effluent data collected during 2001, which will reduce the uncertainty associated with projecting water quality conditions to low flow conditions.

In general, spring and summer river flows likely influence late-summer water quality of Long Lake because the magnitude of the spring snowmelt and summer base flows determine pollutant residence time in Long Lake (i.e., high spring and summer flows provide more flushing than low flows). In addition, flows in August determine the magnitude of the annual low-flow period for the river. The low river flow period is expected to be the most critical period for pollutant loading effects in the river and Long Lake (i.e., less dilution and longer residence time). By using a critical year like 2001 that has seasonal and August low flows that correspond to about a 0.10 exceedence probability to establish pollutant allocations, the water quality in Long Lake and the Spokane River should be adequately protected. These actual flow conditions would be expected to be lower only about 10 times every 100 years.

Margin of Safety:

When using a steady-state modeling approach to establish pollutant loading limits, Ecology has not historically identified an explicit margin-of-safety to meet a TMDL because the "conservative assumptions" incorporated in the critical conditions not only considered low flow but other conditions like high temperatures and point sources continuously discharging at their maximum permitted level. For the Spokane TMDL study, an explicit margin-of-safety will need to be identified because the model uses ambient conditions for 2001 that may or may not be exceeded during other low years.

Preliminary CEQUALW2 Model Forecast:

To estimate the current and potential future impacts of point and nonpoint sources of oxygen-consuming substances, the CEQUALW2 model (as calibrated to 1991 and 2000 conditions) was run under the following scenarios:

1. **CURRENT**: A base case defined as 2001 river flow and meteorological conditions with point source pollutant loads, boundary constituent concentrations, and temperatures set at those included for the model calibration year 2000.

2. **NO-POINT**: The CURRENT case without point source loads.

3. **NO-SOURCE**: The NO-POINT case with tributary and upstream river boundary concentrations set at estimated background conditions. Tributaries and upstream river nutrient (nitrate, phosphorus, ammonia) concentrations were set to background conditions based on data collected by Soltero et al. (1988) at the inlet to Eloika Lake in the Little Spokane and/or data from the outlet of Lake Couer D'Alene collected as part of this study. The average Lake Couer D'Alene ultimate CBOD as measured by the dischargers in 2001,
1.4 mg/L, was used to set the maximum CBOD at the model upstream boundary and Hangman Creek. Ultimate CBOD values measured in the Little Spokane River were all less than 1.4 mg/L and were set at 1.0 for the NO-SOURCE scenario. All other constituents were the same as 2000 conditions. Tables 1-3 lists the 2000 and estimated background conditions that were changed between the CURRENT and NO-SOURCE scenarios. Coulee Creek water quality constituents were the same as those used for Hangman Creek.

4. **SOD**: The NO-SOURCE case with sediment oxygen demand set 0.25 g O_2 m^{-2} per day, which is value that has been historically used to define an oligotrophic system (Welch, 1980).

5. **PERMIT**: The CURRENT case with point source daily loads set at the average monthly BOD5 permit loading limits. Kaiser Aluminum does not have a BOD5 permit limit and daily loads were set at the same values estimated for 2000 in this case. Figure 1 shows the daily loads from 2000 and average monthly BOD5 loads for the PERMIT scenario including the 2000 Kaiser BOD5 loads added to both scenarios.

Figure 2 shows the difference between the CURRENT and NO-POINT scenarios for model segment 188 on Julian day 243 (i.e., August 31). Segement 188 represents the area associated with sample station LL0 shown in Figure 3. The average difference between the scenarios at segment 188 below a depth of 9 meters is 0.54 mg/L (i.e., the dissolved oxygen concentration profile is predicted to increase by an average of 0.54 mg/L below 9 meters from the CURRENT scenario). The maximum difference of 1.7 mg/L occurs at about 13 meters and the minimum deficit of 0.30 mg/L around 36 meters. As expected, the summer interflow zone of the lake is most affected by both internal and external BOD loading to the lake.

Figure 4 shows the same scenario results as Figure 2 but with the NO-SOURCE scenario results added. The average difference between the NO-SOURCE and CURRENT scenarios below 9 meters is 1.6 mg/L with the maximum difference occurring at about 14 meters and the minimum of 1.4 mg/L around 37 meters.

Figure 5 shows the same scenario results as Figure 4 but with the SOD scenario results added. The dissolved oxygen profile is predicted to significantly increase under oligotrophic SOD conditions. Although it is probably not possible to determine exactly what level of sediment oxygen demand would be in the system without point and nonpoint sources of pollution, the predicted profile probably represents the “best possible” dissolved oxygen profile for the lake given the time of year and location.

Although the Spokane River system would be expected to have oligotrophic water quality characteristics without human sources of nutrients and oxygen-consuming substances, the CEQUALW2 model cannot be used to forecast changes in sediment oxygen demand due to changes in pollutant loading. Therefore, the SOD scenario results can only be used as a possible best case condition for the lake and should not be used as the reference condition for establishing pollutant loading allocations. Pollutant allocations should be established using the NO-SOURCE scenario as the reference condition to determine allowable dissolved oxygen deficits, because the pollutant loads that cause dissolved oxygen deficits of 0.2 mg/L should be the same for either scenario.

Figure 6 shows the same results as Figure 5 but with the PERMIT scenario results added. The dissolved oxygen profile is predicted to decrease significantly under the average monthly BOD5 PERMIT loading conditions.

The model segments that represent the area of Long Lake extending about 9-10 miles upstream from the dam predict varying degrees of dissolved oxygen concentration changes greater than 0.20 mg/L on August 31 due to point and nonpoint sources (i.e., CURRENT versus NO-SOURCE scenarios). The red box in Figure 3 contains the area of the lake that is predicted to have the greatest changes in dissolved oxygen (13-14 model segments represent this area). Currently, we have not determined the extent of the period that the model would predict dissolved oxygen criteria violations in Long Lake. However, we have reviewed the model output for days representing the period from August 1st through September 10th, and the results suggest that dissolved oxygen concentrations would violate the criteria for some portion of the water column in some segments of Long Lake during this entire period.

Figure 7 shows the scenario results for model segment 133 which is representative of the model segments (131-135) in the upper part of Nine Mile dam pool. This area is within the red square shown on Figure 8. Segment 133 is predicted to have diurnal minimum dissolved oxygen concentrations less than 8 mg/L under the CURRENT and PERMIT loading scenarios. The NO-POINT and NO-SOURCE scenarios predicted minimum dissolved oxygen concentrations above 8 mg/L. Figure 9 shows the diurnal range of dissolved oxygen concentrations predicted at a depth of two meters under the CURRENT, NO-SOURCE, and PERMIT loading scenarios. The magnitude of the diurnal changes is due to differences in predicted periphyton growth and associated effects under the different scenarios.

Figure 10 shows the scenario results for model segment 61 which is representative of the model segments (57-64) in the Upriver Dam pool. This area is shown within the red square on Figure 11 (about a two-and-a-half mile river reach). Figure 12 shows the diurnal range of dissolved oxygen concentrations predicted at a depth of two meters under the CURRENT, NO-SOURCE, and PERMIT loading scenarios.

Conclusions:

The preliminary model results suggest that, under the proposed critical year conditions, current levels of point and nonpoint BOD and nutrient loading would violate the dissolved oxygen criteria in Long Lake and parts of the Spokane River. The major conclusions that can be drawn from the preliminary model results for the critical year scenarios are as follows:

1. The effects of BOD and nutrient loading on dissolved oxygen concentrations during the summer are estimated to be the greatest in the interflow zone of Long Lake.

2. Diurnal dissolved oxygen concentrations in the river are caused by photosynthesis and respiration of periphyton relative to nutrient and BOD loading. The diurnal minimums are predicted to violate the river water quality criterion of 8 mg/L.

3. Although a few river model segments are predicted to have diurnal minimum dissolved oxygen concentrations that violate the criterion, the results suggest that Long Lake will probably be the most critical area of the modeled river system for determining pollutant TMDL limits and associated allocations. Managing pollutant loads to allow no more than 0.2 mg/L dissolved oxygen deficit in the lake will likely also protect water quality in the river.

4. Current point and nonpoint BOD and nutrient loading to the study area are predicted to violate the water quality criteria for portions of Long Lake and the Spokane River.

5. Current average monthly permitted BOD5 loading would cause significant degradation of dissolved oxygen in Long Lake.

6. Without human sources of oxygen consuming substances it is expected that Long Lake would have oligotrophic water quality characteristics such as low algal productivity, high dissolved oxygen concentrations, and low sediment oxygen demand.

References:

Soltero, R.A., L.A. Campbell, K.R. Merrill, R.W. Plotnikoff, and L.M. Sexton, 1988. Water Quality Assessment and Restoration Feasibility for Eloika Lake, WA. Department of Biology, Eastern Washington University, Cheney, WA.

Welch, E.B., 1980. Ecological Effects of Waste Water. Cambridge University Press.

Figures

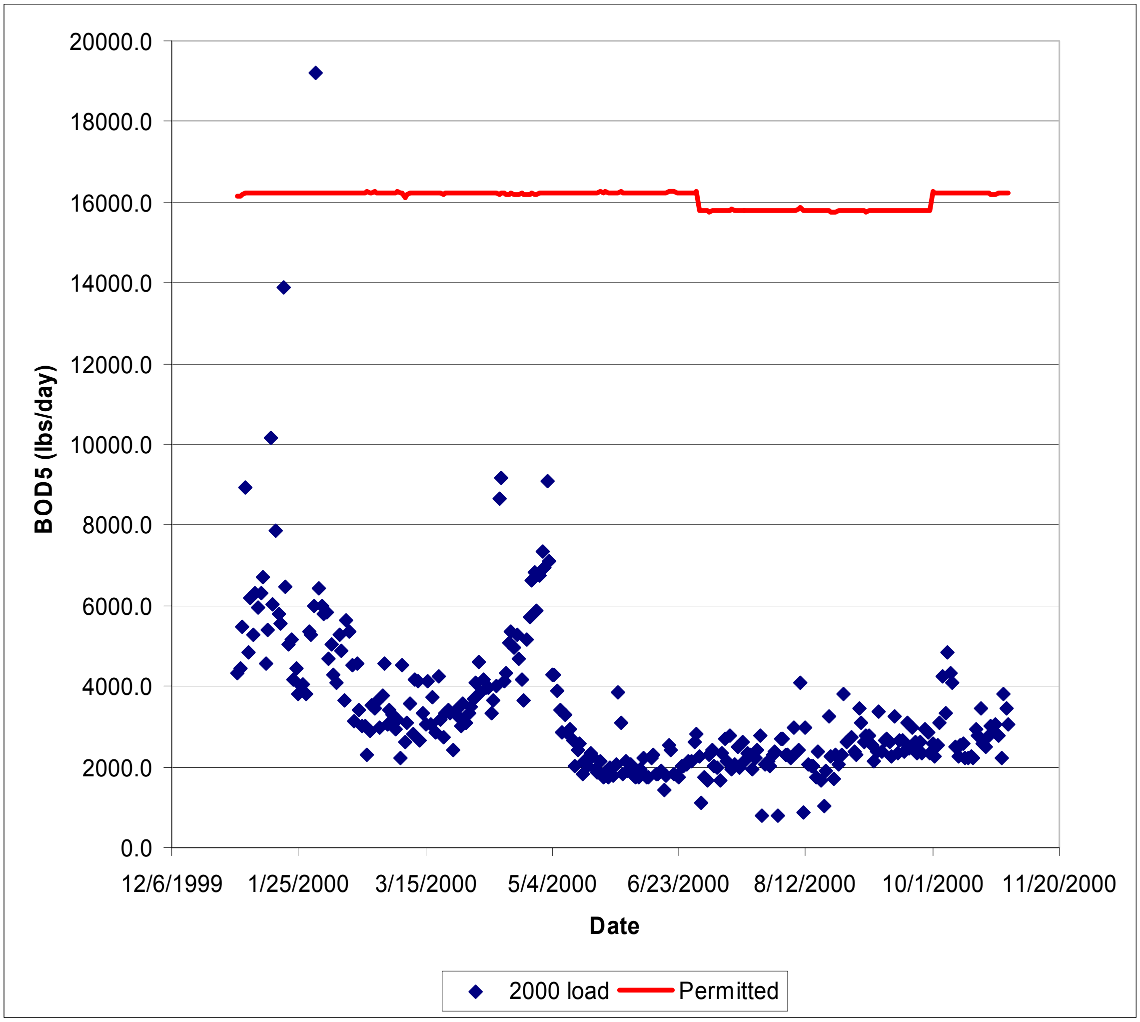

Figure 1. Permitted and estimated total daily-average year 2000 BOD5 loading from the City of Spokane WWTP, Inland Empire Paper Company, Kaiser Aluminum, and Liberty Lake WWTP.

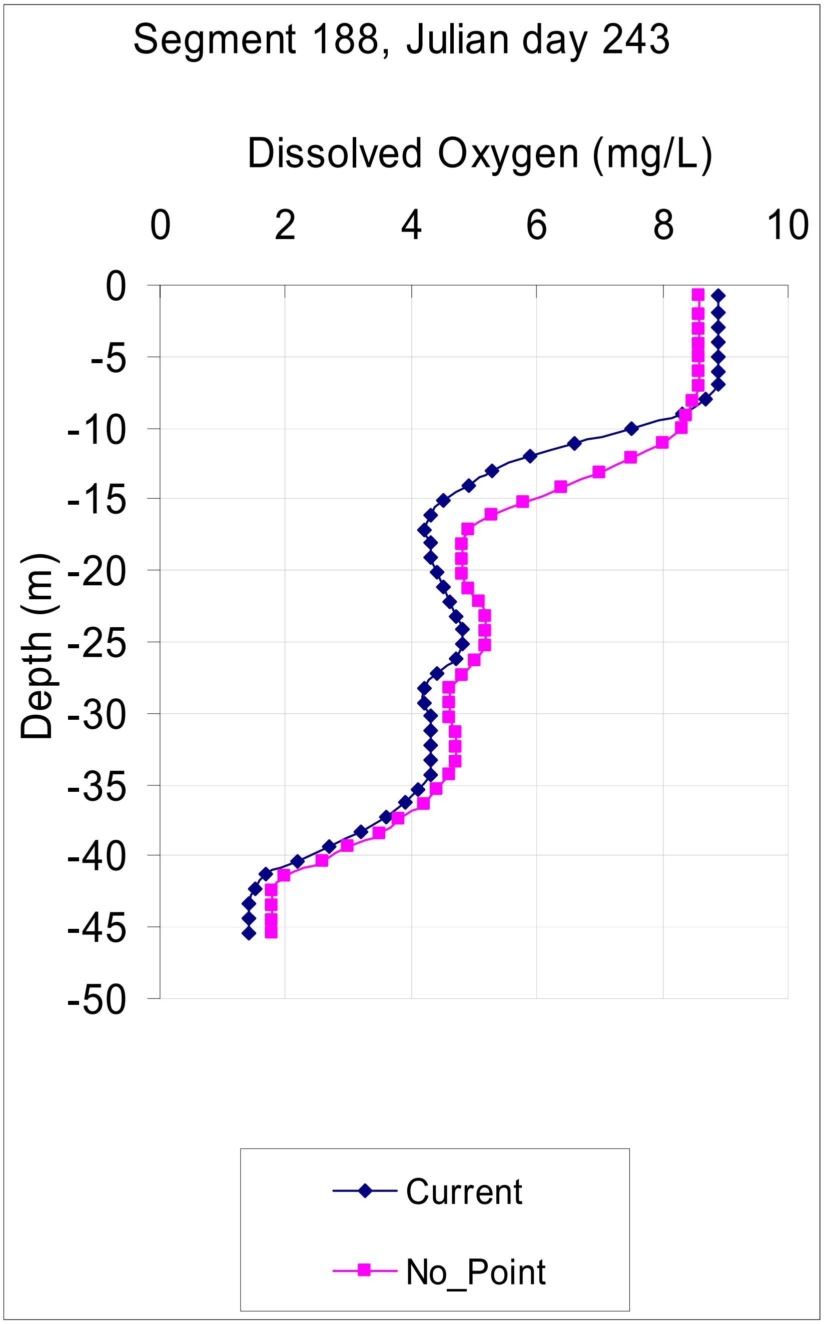

Figure 2. Model predicted dissolved oxygen profiles for Long Lake at model segment 188, CURRENT and NO-POINT scenarios.

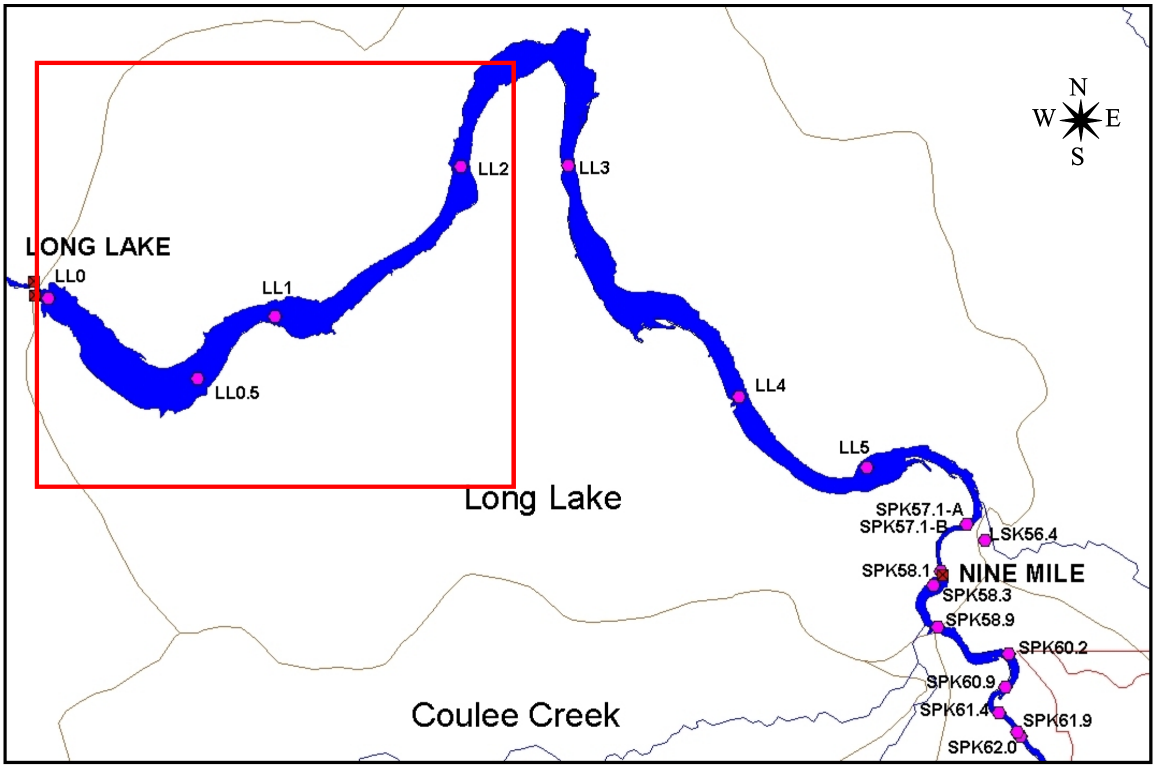

Figure 3. Area of Long Lake predicted to have dissolved oxygen deficits greater than 0.2 mg/L due to human causes.

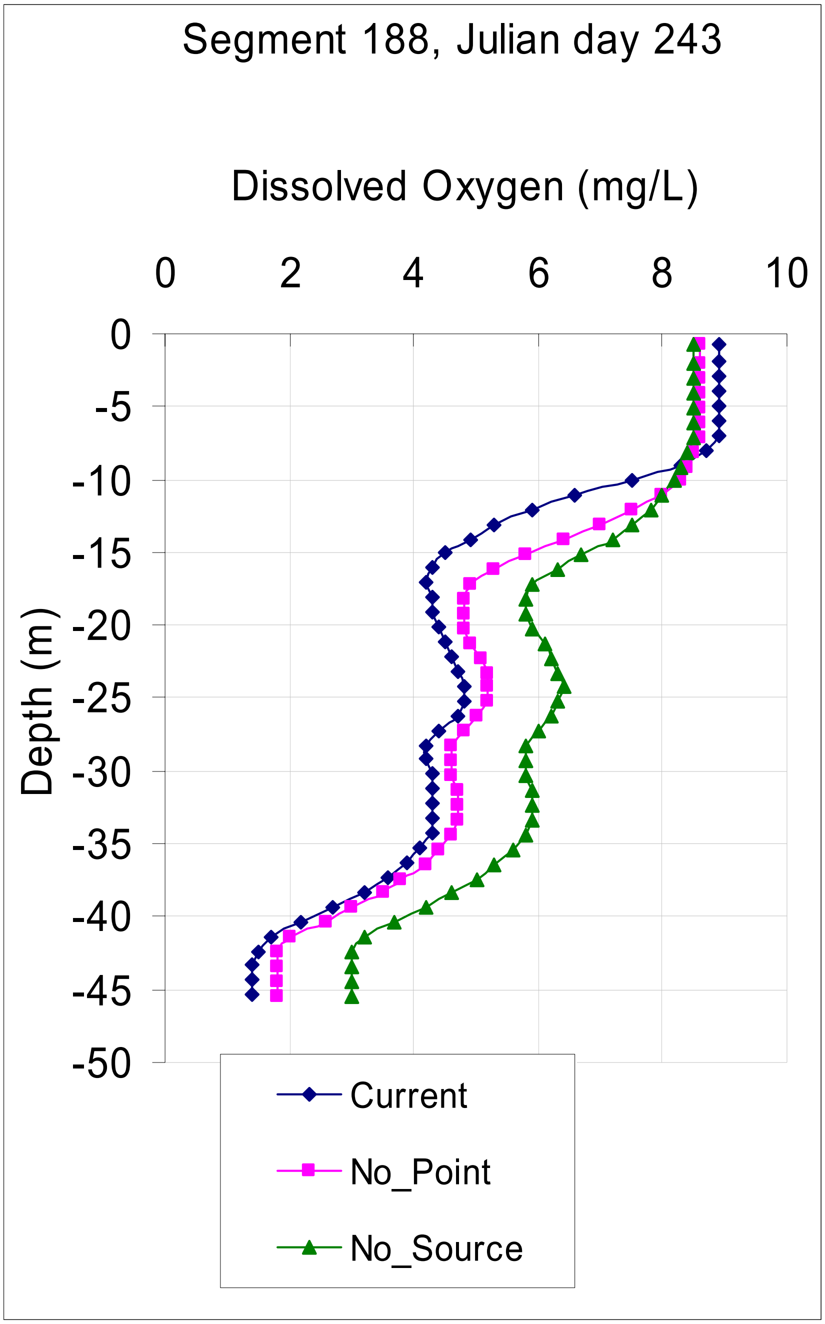

Figure 4. Model predicted dissolved oxygen profiles for Long Lake at model segment 188, including the NO-SOURCE scenario.

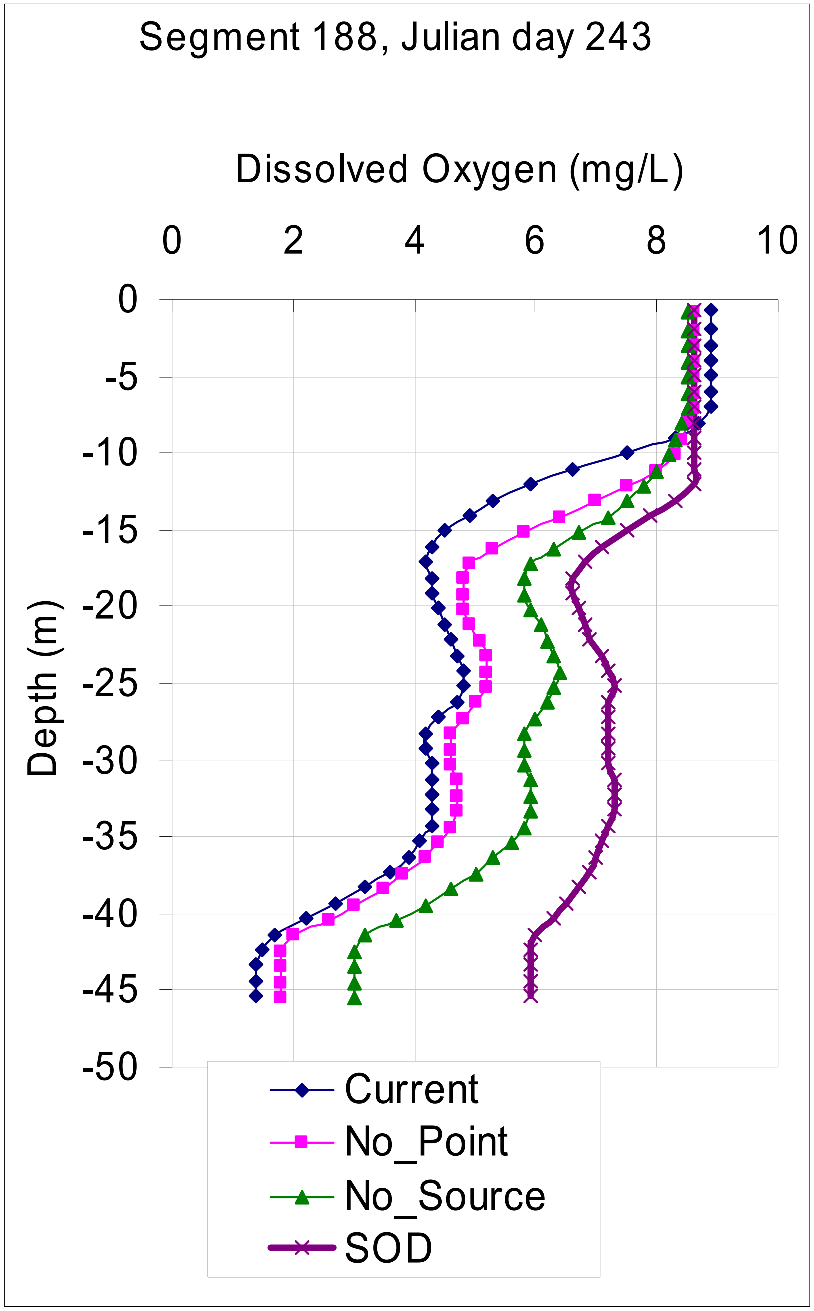

Figure 5. Model predicted dissolved oxygen profiles for Long Lake at model segment 188, including the SOD scenario.

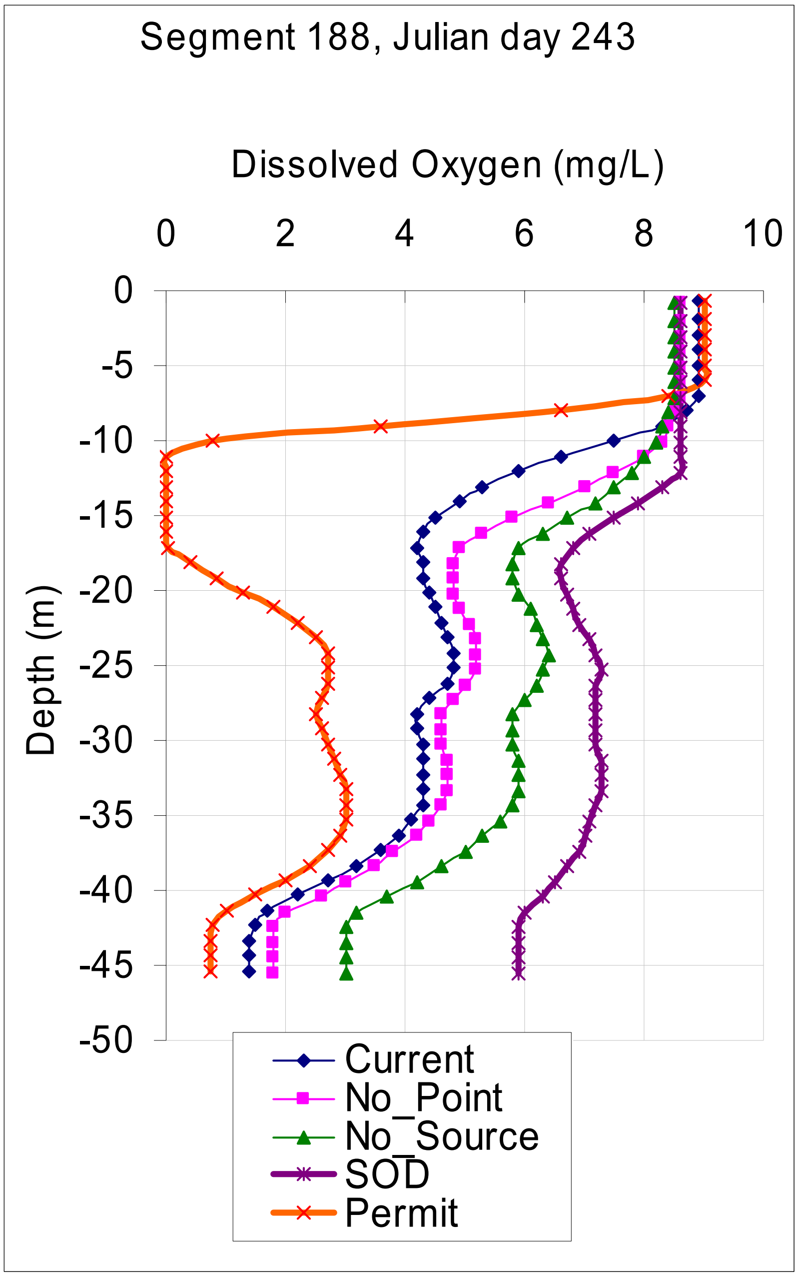

Figure 6. Model predicted dissolved oxygen profiles for Long Lake at model segment 188, including the PERMIT scenario.

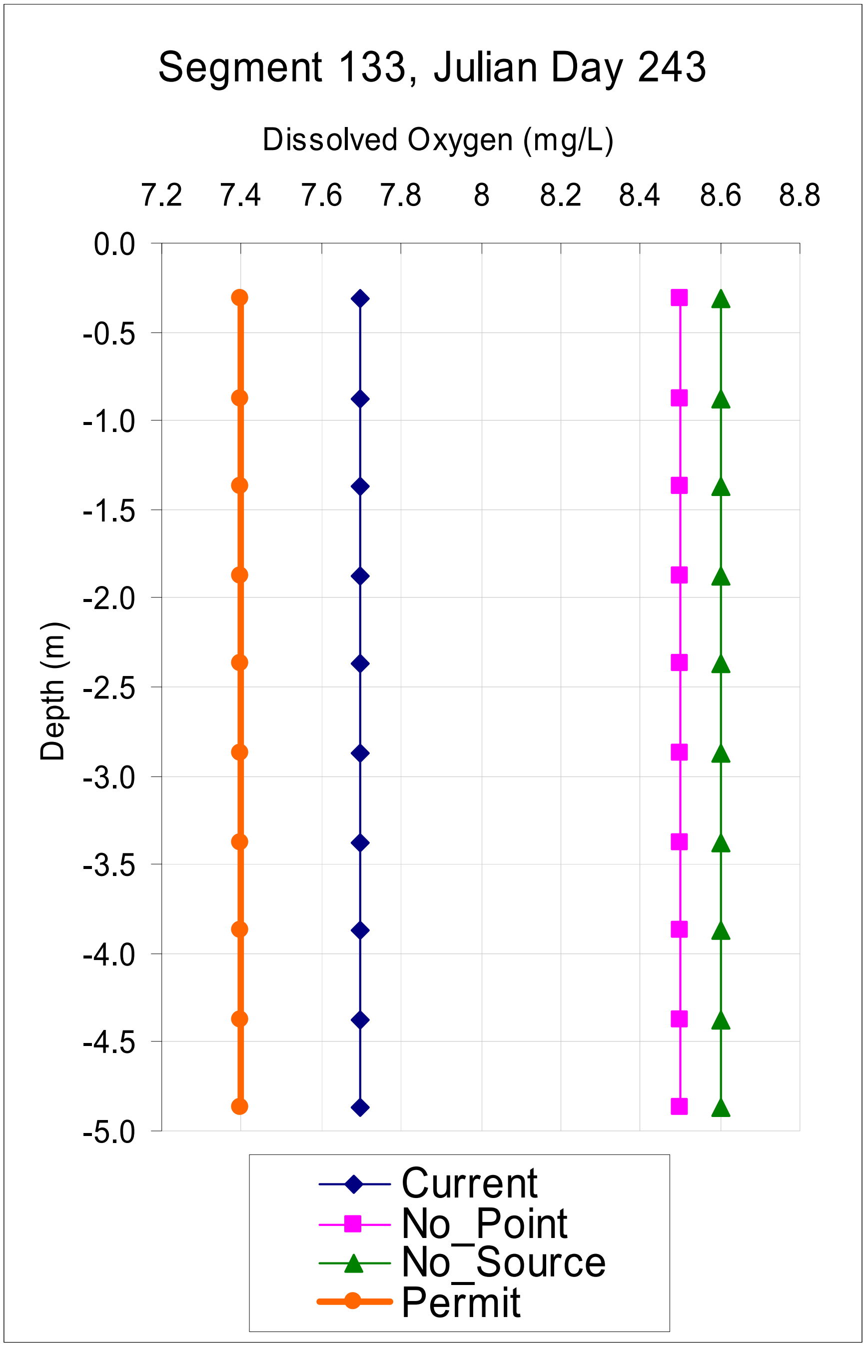

Figure 7. Model predicted dissolved oxygen concentrations at 6 am for segment 133 located in Nine Mile Dam pool.

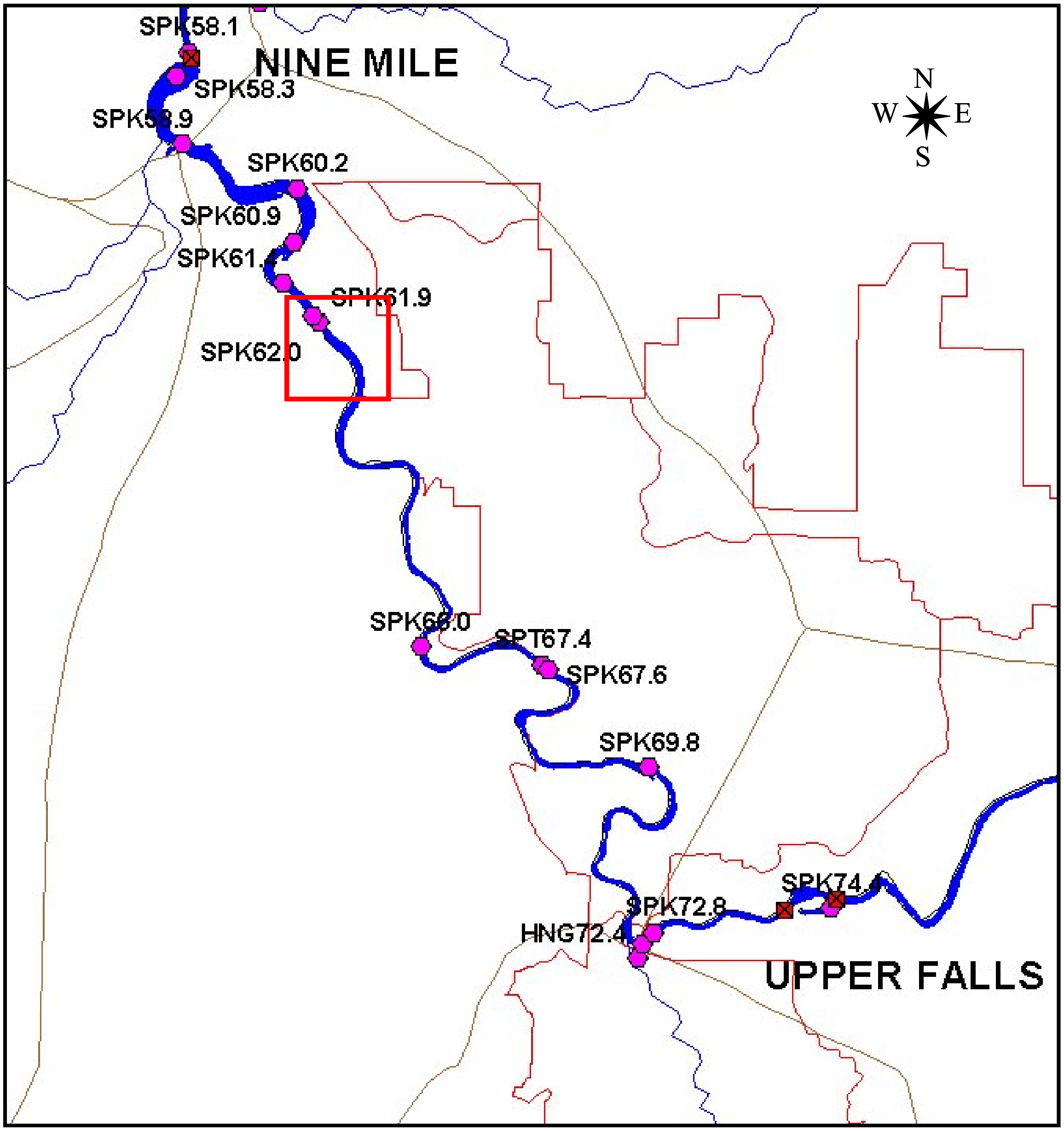

Figure 8. Area of the Spokane River near Nine Mile Dam predicted to have dissolved oxygen concentrations less than 8.0 mg/L due to human causes.

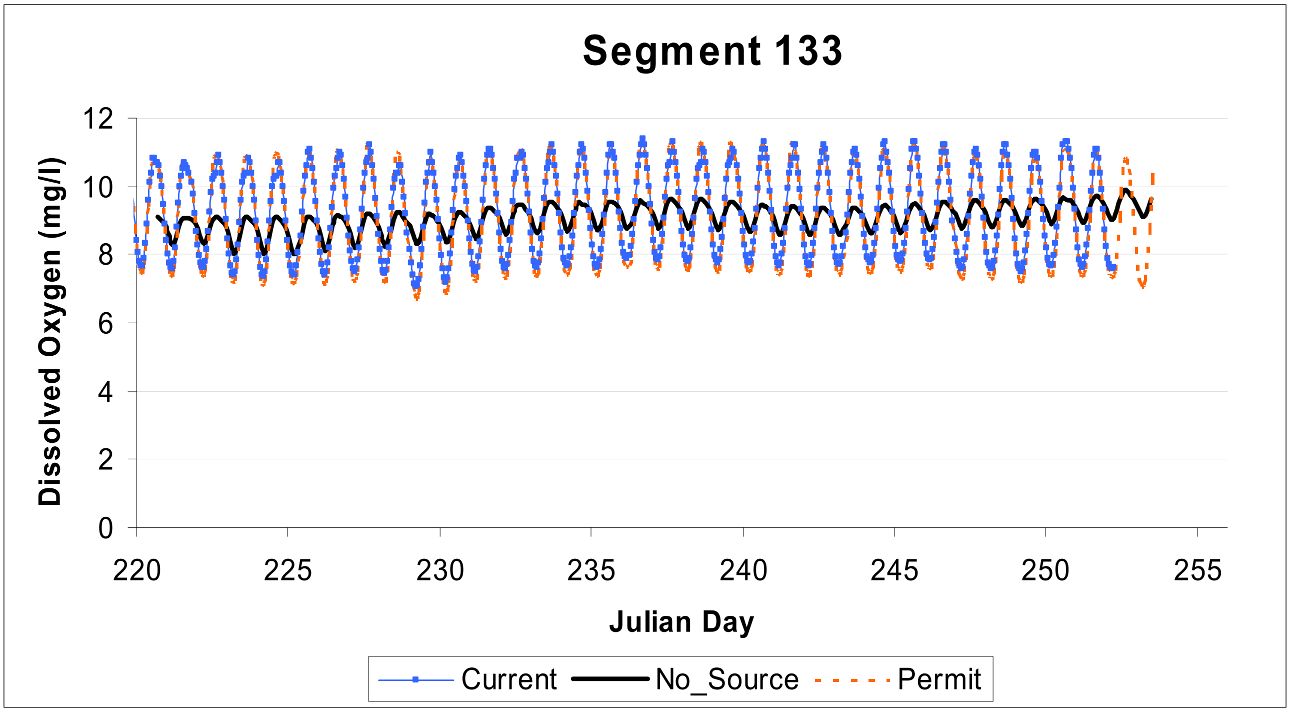

Figure 9. Model predicted diurnal dissolved oxygen concentrations at segment 133.

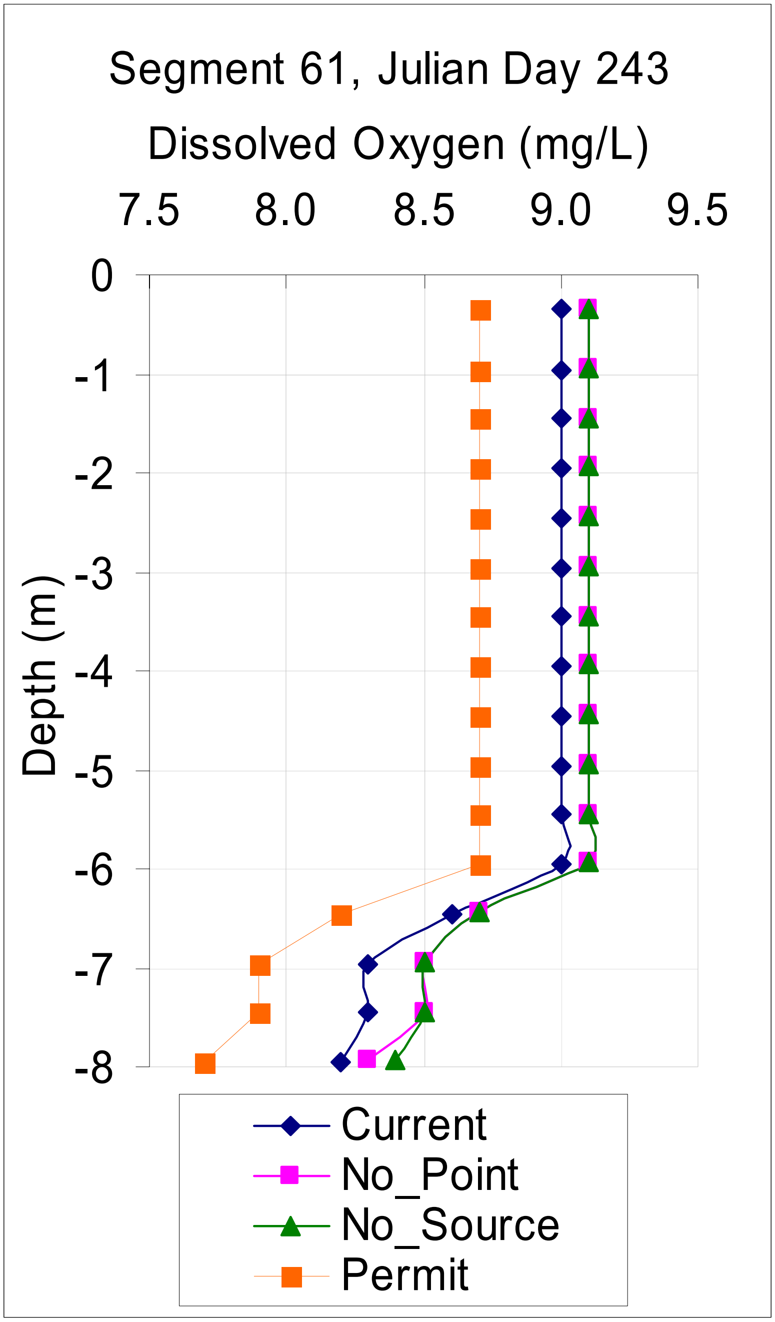

Figure 10. Model predicted dissolved oxygen concentrations for segment 61 located in Upriver Dam pool.

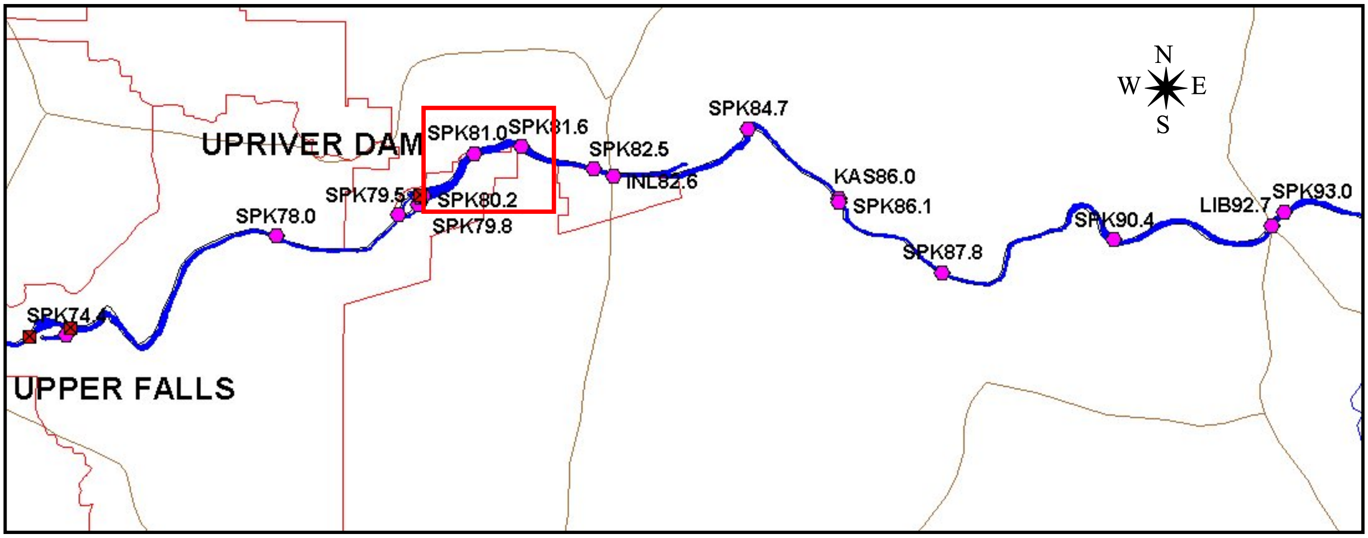

Figure 11. Area of the Spokane River near Upriver Dam predicted to have dissolved oxygen concentrations less than 8.0 mg/L due to human causes.

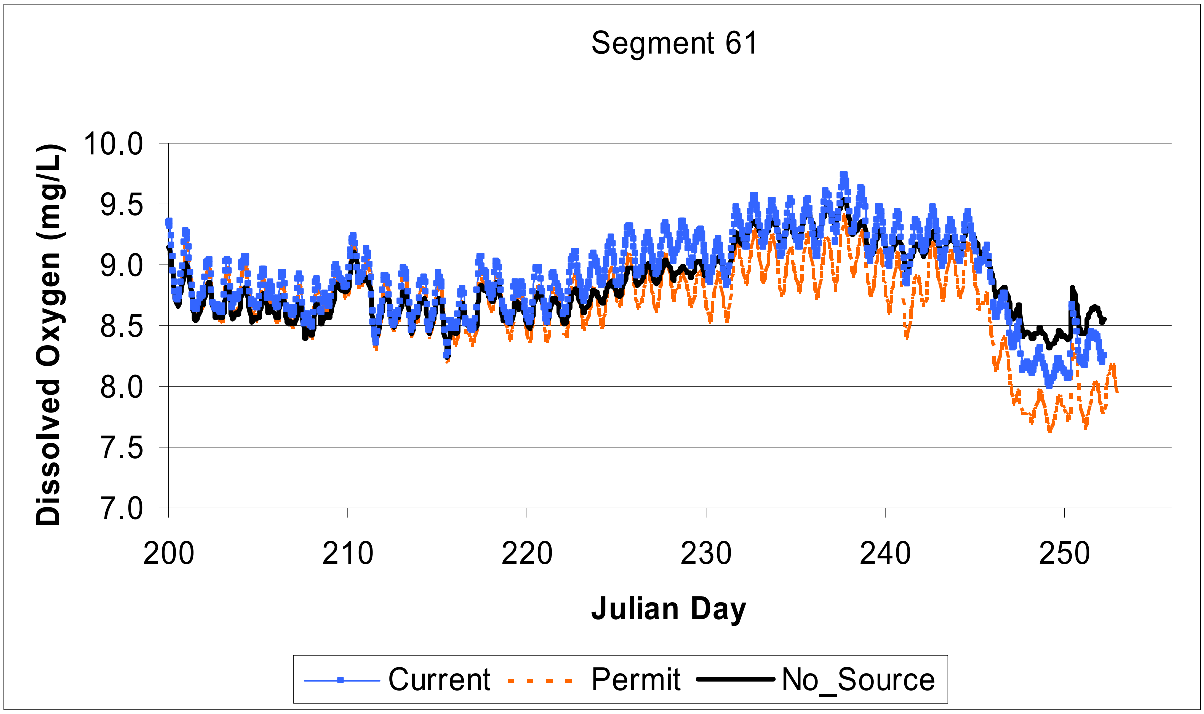

Figure 12. Model predicted diurnal dissolved oxygen concentrations at segment 61.

Tables

Table 1. State Line (upstream boundary) constituents concentrations (mg/L) used for the CURRENT and NO-SOURCE scenarios.

JDAY	CURRENT PO4	NO-SOURCE PO4	CURRENT NH4	NO-SOURCE NH4	CURRENT NO3	NO-SOURCE NO3	CURRENT CBOD	NO-SOURCE CBOD
1.00	0.010	0.004	0.026	0.011	0.09	0.005	1.16	1.4
9.63	0.010	0.004	0.026	0.011	0.09	0.005	1.16	1.4
37.71	0.005	0.004	0.005	0.005	0.06	0.005	1.32	1.4
72.83	0.006	0.007	0.005	0.005	0.06	0.005	1.52	1.4
100.61	0.0025	0.005	0.005	0.005	0.10	0.005	1.68	1.4
128.72	0.0025	0.0025	0.005	0.005	0.03	0.005	1.96	1.4
163.90	0.0025	0.0025	0.005	0.005	0.01	0.005	2.32	1.4
187.48	0.0025	0.0025	0.005	0.005	0.04	0.005	2.56	1.4
191.67	0.0025	0.0025	0.005	0.005	0.05	0.005	2.60	1.4
208.35	0.0025	0.0025	0.005	0.005	0.06	0.005	2.77	1.4
215.40	0.0025	0.0025	0.005	0.005	0.08	0.005	2.84	1.4
219.90	0.0025	0.0025	0.014	0.005	0.09	0.005	2.88	1.4
228.36	0.0025	0.0025	0.005	0.005	0.11	0.005	2.97	1.4
228.55	0.0025	0.0025	0.005	0.005	0.07	0.005	2.55	1.4
229.38	0.0025	0.0025	0.005	0.005	0.11	0.005	2.52	1.4
229.52	0.0025	0.0025	0.005	0.005	0.08	0.005	2.52	1.4
251.39	0.0025	0.0025	0.005	0.005	0.16	0.005	1.85	1.4
254.83	0.0025	0.0025	0.005	0.005	0.12	0.005	1.75	1.4
270.38	0.0025	0.0025	0.005	0.005	0.04	0.005	1.27	1.4
270.50	0.0025	0.0025	0.005	0.005	0.05	0.005	2.47	1.4
271.37	0.0025	0.0025	0.005	0.005	0.04	0.005	2.47	1.4
271.50	0.0025	0.0025	0.005	0.005	0.05	0.005	2.47	1.4
284.41	0.0025	0.0025	0.005	0.005	0.04	0.005	2.47	1.4
319.41	0.011	0.004	0.005	0.005	0.04	0.005	2.47	1.4
347.42	0.016	0.004	0.005	0.005	0.12	0.005	2.47	1.4
365.99	0.016	0.007	0.005	0.005	0.12	0.005	2.47	1.4

PO4 = Soluble Reactive Phosphorus
NH4 = Ammonia
NO3 = Nitrate
CBOD = Carbonaceous Biochemical Oxygen Demand

Table 2. Hangman Creek constituents concentrations (mg/L) used for the CURRENT and NO-SOURCE model scenarios.

JDAY	CURRENT PO4	NO-SOURCE PO4	CURRENT NH4	NO-SOURCE NH4	CURRENT NO3	NO-SOURCE NO3	CURRENT CBOD	NO-SOURCE CBOD
1.00	0.063	0.004	0.023	0.011	3.07	0.005	1.47	1.4
9.67	0.063	0.004	0.023	0.011	3.07	0.005	1.47	1.4
37.60	0.092	0.004	0.031	0.023	6.93	0.005	3.08	1.4
72.73	0.076	0.007	0.018	0.005	4.51	0.005	3.14	1.4
100.51	0.031	0.005	0.005	0.005	1.99	0.005	3.19	1.4
128.61	0.023	0.0015	0.015	0.005	1.39	0.005	3.20	1.4
163.71	0.020	0.0015	0.012	0.005	0.73	0.005	3.15	1.4
191.55	0.015	0.0015	0.005	0.005	0.58	0.005	3.11	1.4
219.73	0.026	0.0015	0.023	0.005	0.85	0.005	3.06	1.4
228.33	0.029	0.0015	0.016	0.005	1.21	0.005	3.05	1.4
228.56	0.028	0.0015	0.005	0.005	1.15	0.005	3.05	1.4
229.32	0.026	0.0015	0.019	0.005	1.21	0.005	3.05	1.4
229.54	0.026	0.0015	0.014	0.005	1.17	0.005	3.05	1.4
254.62	0.036	0.003	0.005	0.005	0.98	0.005	3.00	1.4
270.33	0.020	0.003	0.005	0.005	0.90	0.005	2.97	1.4
270.53	0.019	0.003	0.005	0.005	0.88	0.005	2.97	1.4
271.33	0.018	0.003	0.013	0.005	0.93	0.005	2.97	1.4
271.52	0.021	0.003	0.025	0.005	0.90	0.005	2.97	1.4
283.69	0.019	0.004	0.005	0.005	0.82	0.005	2.97	1.4
318.69	0.020	0.004	0.005	0.005	1.18	0.005	2.97	1.4
365.99	0.020	0.007	0.005	0.004	1.18	0.005	2.97	1.4

PO4 = Soluble Reactive Phosphorus
NH4 = Ammonia
NO3 = Nitrate
CBOD = Carbonaceous Biochemical Oxygen Demand

Table 3. Little Spokane River constituents concentrations (mg/L) used for the CURRENT and NO-SOURCE model scenarios.

JDAY	CURRENT PO4	NO-SOURCE PO4	CURRENT NH4	NO-SOURCE NH4	CURRENT NO3	NO-SOURCE NO3	CURRENT CBOD	NO-SOURCE CBOD
1.00	0.017	0.004	0.011	0.011	1.25	0.001	1.10	1.0
9.73	0.017	0.004	0.011	0.011	1.25	0.001	1.10	1.0
37.66	0.020	0.004	0.023	0.023	1.13	0.001	1.10	1.0
72.78	0.032	0.007	0.005	0.005	0.69	0.001	1.10	1.0
100.56	0.016	0.005	0.005	0.005	0.61	0.001	1.10	1.0
128.67	0.023	0.023	0.012	0.005	0.70	0.001	1.10	1.0
159.42	0.015	0.0015	0.005	0.005	0.89	0.001	1.10	1.0
163.81	0.014	0.0015	0.005	0.005	0.94	0.001	1.10	1.0
179.55	0.009	0.0015	0.005	0.005	0.96	0.001	1.10	1.0
187.57	0.009	0.0015	0.005	0.005	1.08	0.001	1.10	1.0
191.60	0.008	0.0015	0.005	0.005	1.06	0.001	1.10	1.0
200.54	0.007	0.0015	0.005	0.005	1.12	0.001	1.10	1.0
208.44	0.011	0.0015	0.005	0.005	1.16	0.001	1.10	1.0
215.47	0.014	0.0015	0.005	0.005	1.20	0.001	1.10	1.0
219.84	0.012	0.0015	0.005	0.005	1.22	0.001	1.10	1.0
228.44	0.012	0.0015	0.005	0.005	1.36	0.001	1.10	1.0
228.66	0.012	0.0015	0.005	0.005	1.36	0.001	1.10	1.0
229.42	0.011	0.0015	0.005	0.005	1.35	0.001	1.11	1.0
229.65	0.011	0.0015	0.005	0.005	1.36	0.001	1.11	1.0
242.55	0.009	0.0015	0.005	0.005	1.27	0.001	1.18	1.0
251.45	0.012	0.0015	0.005	0.005	1.30	0.001	1.23	1.0
254.77	0.013	0.003	0.005	0.005	1.28	0.001	1.25	1.0
270.43	0.009	0.003	0.005	0.005	1.27	0.001	1.34	1.0
270.65	0.010	0.003	0.005	0.005	1.27	0.001	1.34	1.0
271.41	0.009	0.003	0.005	0.005	1.28	0.001	1.34	1.0
271.62	0.009	0.003	0.005	0.005	1.28	0.001	1.34	1.0
284.31	0.012	0.004	0.005	0.005	1.33	0.001	1.34	1.0
319.33	0.012	0.004	0.005	0.005	1.31	0.001	1.34	1.0
347.32	0.012	0.004	0.005	0.005	1.36	0.001	1.34	1.0
365.99	0.012	0.004	0.005	0.005	1.36	0.001	1.34	1.0

PO4 = Soluble Reactive Phosphorus
NH4 = Ammonia
NO3 = Nitrate
CBOD = Carbonaceous Biochemical Oxygen Demand