Examining Alternative TMDL Loading Scenarios with CE-QUAL-W2

Spokane DO TMDL Advisory Meeting
Dave Dilks
December 6, 2016

Disclaimer

- Work discussed in this presentation was conducted on behalf of discharger community through 2011

- Since 2012, my role as technical consultant for the Spokane River Regional Toxics Task Force has prohibited my work as an advocate on DO TMDL issues

Summary

- DO TMDL required most NPDES dischargers to meet monthly average TP of 50 ug/l

- TMDL allowed alternate limits, as long as they resulted in *equivalent DO impacts* in Long Lake

- Alternate limits were assessed and approved for several permits, by:
  - extending period of more rigorous TP treatment
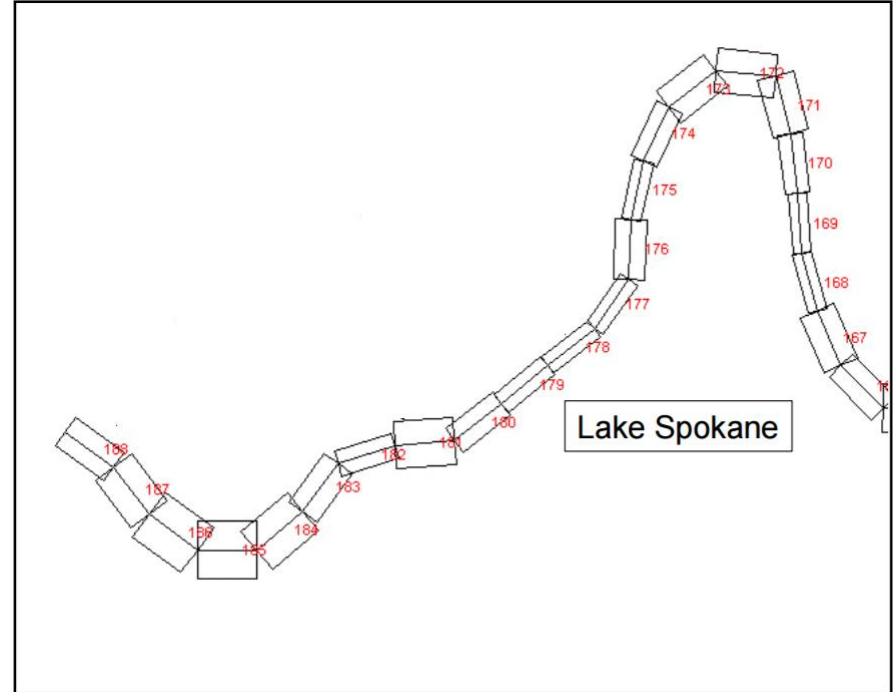 - offsetting higher TP with lower CBOD, ammonia

Defining Equivalent DO Impact

- Spokane DO TMDL was unique
  - Even with point sources at extremely stringent treatment, DO standard (<0.2 mg/l anthropogenic impact) would not be met
  - Responsibility was assigned to Avista to address remaining anthropogenic impacts above 0.2 mg/l
- "Equivalent DO impact" defined as "no increase in Avista responsibility"

Avista Responsibility

- CE-QUAL-W2 divides the system into segments
- Avista responsibility was determined by comparing model results for DO over the course of a year for two scenarios
  - No Sources
  - TMDL Scenario

Lake Spokane

Avista Responsibility

- Avista has responsibility for segments/times when the difference between runs was greater than 0.2 mg/l

Bold:

TMDL DO

Italics:

No Source DO

Yellow shade:

Avista responsibility, i.e. difference between two scenarios – 0.2

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

Equivalence with Avista Responsibility

- EPA/Ecology defined three rules to determine whether the results of a modeled scenario were "equivalent" with the TMDL

    1. Must not increase the spatial or temporal extent of Avista responsibilities*

    2. Must not decrease the DO concentration averaged across all Avista-affected segments and times.

    3. Must not increase Avista's responsibility in any segment or time*

    *After results are averaged to the nearest 0.1 mg/l

Avista Responsibility

- Avista has responsibility for segments/times when the difference between runs was greater than 0.2 mg/l

Bold:

TMDL DO

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No Source DO

Yellow shade:

Avista responsibility, i.e. difference between two scenarios – 0.2

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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
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Alternate Limits Evaluated

- Post Falls, HARSB, and Inland Empire Paper
  - Extend rigorous TP removal into February

- Coeur d'Alene
  - Extend rigorous TP removal into February
  - More stringent CBOD removal, extended into February

- Spokane County
  - Extend rigorous CBOD removal into February
  - Seasonally varying ammonia limits

Results of Evaluation

- Combined scenario:
  1. Did not increase the spatial or temporal extent of Avista responsibilities
  2. Improved the dissolved oxygen when averaged over all segments/times of Avista responsibility
  3. *With 3 exceptions,* did not increase Avista's responsibility in any segment or time, after results are rounded to 0.1 mg/l.

Exceptions Deemed Insignificant

- Three cases where Avista responsibility increased:
  - Outweighed by five cases of decreased responsibility

Segment	Time Period	Change in Avista Responsibility
188	July 1-15	Increase
188	September 1-15	Increase
186	September 16-30	Increase
172	August 1-15	Decrease
177	September 1-15	Decrease
185	September 1-15	Decrease
175	September 16-30	Decrease
180	September 16-30	Decrease

  - Magnitude of increased responsibility is smaller than known model error

Closing Comments

- Existing model has been used to support alternate effluent limits
- Nature of the TMDL and water quality standards poses some unique challenges
  - Determination of "equivalence" with the TMDL is not necessarily straightforward
  - Compliance with lake standards cannot be assessed solely by monitoring – requires a model