The Department of Ecology's Supplemental Modeling Report.
A Critical Review.

David H. Milne PhD   July, 2018

5. ECOLOGY'S BUDD INLET MODEL: FLAWED SCIENCE.

Back in 2008, the directors of three state agencies signed a letter advocating removal of Capitol Lake and reopening its basin to tidal waters.[1] At that time the idea was new and worth exploring. Unfortunately, despite a wealth of contrary evidence compiled since then, the agencies have persisted with this objective with immovable determination. Ecology's drive to eliminate Capitol Lake, using the Budd Inlet Model as its centerpiece, has been especially resistant to redirection.

In ordinary science, if the preponderance of real-world observations and facts don't support one's hypothesis, most scientists accept that the hypothesis is not true. Not Ecology. Ecology's reaction to skepticism about its claims based on the Budd Inlet Model has always been to change ("update") the model and run it again, never to defend or better explain what they claimed to prove the first time or … unthinkable to them … admit they were mistaken.

Ecology maneuvers its model findings to enforce the view the Capitol Lake must be eliminated in the following ways:

1) by omitting running simulations likely to show a positive effect of the Lake on Budd Inlet;

2) by downplaying outcomes of simulations that show ways of improving Budd Inlet other than by removing Capitol Lake;

3) by distracting readers and reviewers with simulations of trivial unlikely scenarios and science-like meaningless graphs;

4) by resorting to "explanations" of the Lake's effects that can't be checked by analyzing any known real-world data.

To make matters worse, the modelers have made errors in key calculations and have based important claims on ecologically impossible assumptions.

All of these faults are prominent in Ecology's SM Report. These are described and analyzed in this Chapter.

[1] The directors were Jay Manning (Dept. of Ecology), Phil Anderson (Dept. of Fish and Wildlife), and Peter Goldmark (Dept. of Natural Resources).

5-1. Avoidance of Simulations Likely to Exonerate Capitol Lake.

5-1a. The Missing Simulation of Plant Harvesting … Background and Evasion.

When the TMDL Report came out in 2012, sections that focused on Capitol Lake said nothing whatsoever about the Lake's uptake of nitrogen nutrients by its lush growth of plants. The Lake was (and still is) removing the huge load of nitrogen carried into it by the Deschutes River and preventing it from reaching Budd Inlet during the growing season -- an immense benefit to the Inlet's water quality. The Lake's nitrogen uptake has been well known since 1977 when the CH2M-Hill consultants carried out the most comprehensive study of Capitol Lake ever made (CH2M-Hill, 1978).

Ecology's "TMDL Advisory Group" – some two dozen representatives of area agencies and organizations – hadn't commented on this omission at the time when I began attending meetings (2013). I questioned it and met with the Advisory Group's leaders to propose bringing it up in a presentation to the group. (Others, notably members of CLIPA,[2] also starting asking questions about this during the meetings at that time.) The TMDL meetings were abruptly canceled and by the time I was able to give a presentation (to a different group, jointly with Ecology modelers) the agency had "updated the model" and produced a Poster with a new approach.[3] That is, the nitrogen uptake by the Lake was acknowledged, but the new claim was that the uptake didn't matter because the plants that captured the nitrogen were immediately carried over the dam into the Inlet where their decay depleted oxygen there. (The key phrase used by Ecology to refer to this claim, then and now, is that "organic carbon" – "TOC" – from the Lake depletes oxygen in Budd Inlet.)

The Poster Figure (also presented as Figure 11 p. 36 in the SM Report) is shown here for reader recognition (Figure 5-1). The Estuary TOC calculation (upper graph, blue) is in error and under-calculates at least half of the proposed Estuary's organic carbon production for the simulated (Lake Basin) area. It also hides the large remainder of the missing organic carbon in Budd Inlet outside the simulated area. The Lake TOC contribution to Budd Inlet (upper graph, green) can't possibly be as high as shown in any real-world plant-filled lake. I show these errors of calculation and interpretation in Chapter 7.

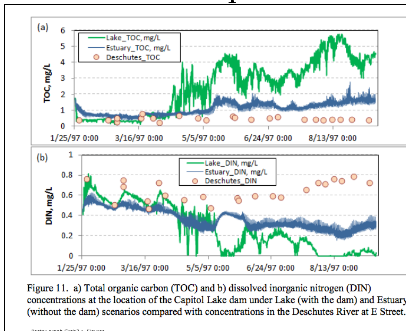


Figure 5-1. Basis of Ecology's "organic carbon" claim. See Chapter 7, this Review. Source: Figure 11, SM Report, p. 36.

---

[2] CLIPA = Capitol Lake Improvement and Protection Association, the leading local group advocating preservation of the Lake. The CLIPA webpage is cited in References, this Review.

[3] The "update" was an "adjustment" of the uptake of dissolved oxygen from the water by the sediments. This adjustment had nothing to do with real-life data; it was said to create a better match between the Budd Inlet model and features of a larger regional model for all of Puget Sound. The Poster also presented a new grid map of Budd Inlet showing very widespread negative effects of Capitol Lake – more persuasive than Ecology's first feeble attempt at this shown in the TMDL Report.

We seldom have an opportunity to physically remove nutrient nitrogen from natural waters – but the opportunity is there in Capitol Lake. That could be done by periodically harvesting the macroscopic plants, removing organic carbon and nitrogen from the Lake and clearing the way for more nitrogen and carbon removal by regrowth and follow-up harvesting of the plants. Ecology did not model this scenario. *This deliberate omission is the most irresponsible feature of the entire SM Report.*

Blithely assuming the role of harvesting experts while speaking from utter ignorance of real-life aquatic ecology, the modelers assure us that they already know that such a simulation would be unhelpful.[4] Based on their guesses about phosphorus, phytoplankton, the tonnage required and the like, they chose not to simulate plant harvesting (p. 69, SM Report). *That is the foremost example of Ecology's avoidance of conducting simulations that might show beneficial effects of Capitol Lake.*

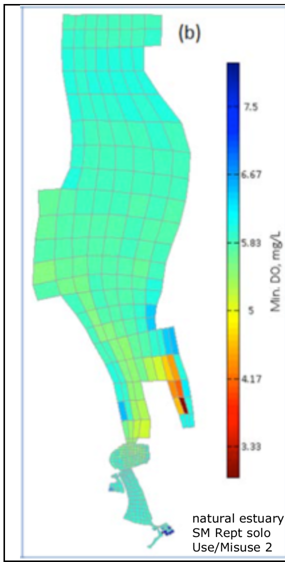


Figure 5-2. The Budd Inlet Model's "natural estuary" (pre-modern Budd Inlet) simulation result. Red shows large DO violations in East Bay. Source: Fig. 7b in the SM Report, p. 32.

<u>5-1b. The Missing Simulation of Moxlie Creek's Effect on East Bay.</u>

Another simulation avoided by Ecology is that of isolating Moxlie Creek to analyze its effect on East Bay. East Bay is the epicenter of low dissolved oxygen conditions for all of Budd Inlet. Virtually every simulation of different combinations of human-caused effects results in a map showing more-or-less low dissolved oxygen there. Even a simulation of the "natural" Budd Inlet estuary before it was affected by any human activities at all shows the East Bay low DO "hot spot" (Figure 5-2).

The East Bay DO violations there are usually the most persistent and severe in all of Budd Inlet. It is likely that these low DO's are created by Moxlie Creek (at the head of East Bay) and supported by Mission Creek (just south of Priest Point Park). Both creeks have nutrient nitrogen concentrations that are among the highest of all waters that enter South Puget Sound (SPSDOS 2011). Their small flow volumes are not enough to drive strong estuarine circulation in the constricted East Bay embayment and a curtain of rising fresh water from the LOTT outfall might be creating partial blockage of the estuarine circulation there. A breakwater restricts the size of the entrance and a flotilla of moored boats and docks restricts contact between the water and the atmosphere. Finally, an oxygen-reducing process never mentioned by the modelers (the "null zone effect," see Chapter 1) is probably at work in East Bay.

[4] To the contrary, Capitol Lake is an ideal location for physical removal of tons of vegetation. A preliminary estimate is that some 7 metric tons of nitrogen nutrients *or more* could be removed from the Lake each summer (Steelhammer, pers comm. 2018). See Steelhammer & others, 2018.

As the Budd Inlet Model was configured in 2014, Moxlie Creek was not treated separately; it was lumped together with several other small creeks and shoreline sources around Budd Inlet (Kolosseus, pers com. 2014). I suggested that it be isolated and its effects simulated. To my knowledge, isolation of Moxlie Creek as a separate source has not been done.[5]

Several of the "other" creeks lumped together with Moxlie Creek in the simulation (Butler, Ellis, Gull Harbor) are far from East Bay. Moxlie and Mission Creeks enter East Bay (Moxlie) or are close-by in a position to influence it (Mission). Moxlie Creek's effect could still be simulated in the present model by running a simulation with no LOTT, no Deschutes River, and no External Source contributions to Budd Inlet, leaving only the small "Other Watersheds" contribution. Then deleting the Other Watersheds. To my knowledge, the modelers have not done so – or at least not shown the findings of any such simulation.

If Moxlie Creek is the source of the DO depletions in East Bay, that would kill all talk of blaming "the dam" as deleterious to Budd Inlet once and for all. This critical simulation has been avoided.

5-2. Downplaying Solutions Other Than Eliminating Capitol Lake.

Figure 5-3 shows the effects of relocating the LOTT outfall (the discharge pipe for treated wastewater) away from its present location. In all of these scenarios, all human-caused sources of oxygen depletion (the LOTT outfall, the minor contributions of three small local treatment plants, and a few tiny creeks are included. Specifically, all "dam" effects are excluded.

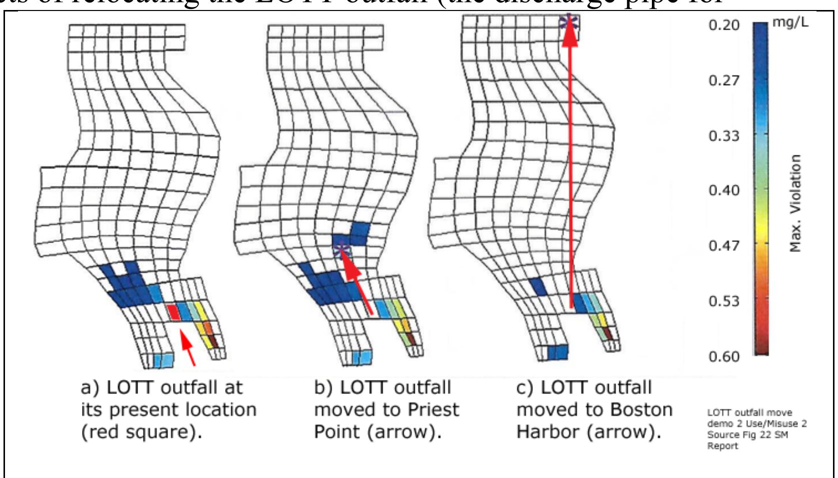


Figure 5-3. Simulated changes in Budd Inlet dissolved oxygen resulting from relocations of the LOTT treated effluent outfall. All anthropogenic nitrogen inputs are present. Outfall at (a) in its existing location, (b) at Priest Point Park, and (c) at Boston Harbor. Source: Figure 22 SM Report, p. 45, same as "no dam" baseline scenario, Figure 4-5, this Review.

Scenario (a) shows the outfall at its existing location with small oxygen

---

[5] Three simulations in the SM Report removed or reduced the "other watersheds" category that includes Moxlie Creek. In one, *all* local sources of human-introduced nitrogen nutrients (Deschutes River, "other watersheds," and LOTT) were eliminated leaving only the external source (see Figure 18 SM Report; also Table 4-1 Row D this Review). In the second, inputs from the Deschutes and other watersheds were reduced by half (Fig. 19c SM Report p. 42; Row E Table 4-1). The third reduced all watersheds' inputs by half, set LOTT at zero and kept the external source at 100% (Row H Table 4-1). The effect in all cases was to obliterate most violations – but East Bay was largely unchanged.

standards violations (as colored squares) in that scenario. Scenario (b) shows what the oxygen situation would look like if the outfall was moved to the Priest Point area, scenario (c) shows the effects of moving it to Boston Harbor.

Scenario (c) suggests that moving the outfall to Boston Harbor would eliminate more than half of the minor DO violations occurring in southern Budd Inlet while leaving the larger ones in East Bay untouched. The overall effect is positive, though small, and policy makers – not Ecology – would have to decide whether the cost of moving the outfall would be worth the benefit. The modelers acknowledge nothing positive, dismissing this simulation with the words "Shifting the outfall location would not improve oxygen significantly."

That is an example of the strategy of downplaying all other feasible actions except for "elimination of the dam," leaving the perception that the latter is the only possible way of improving Budd Inlet water quality.

5-3. Trivial Simulations, Meaningless Graphs.

The SM Report presents a barrage of Figures aimed at showing that "the dam" causes widespread DO depletion throughout Budd Inlet. These Figures raise more questions than they answer.

Regarding nitrogen, the modelers present three Figures using data from other sources, reproduced here. They show nothing that supports Ecology's claims. One is from a source (Evans-Hamilton, not cited in the SM Report's References) that I have not seen.

Figure 5-4 shows nitrogen concentrations in the Deschutes River and at an unidentified site in Capitol Lake ("CL-6") said to be near the dam. It shows, as expected, that the Lake doesn't remove nitrogen from the water during the winter. Nitrogen concentrations near the dam appear to begin to drop by early June, as expected – but there the data abruptly end.

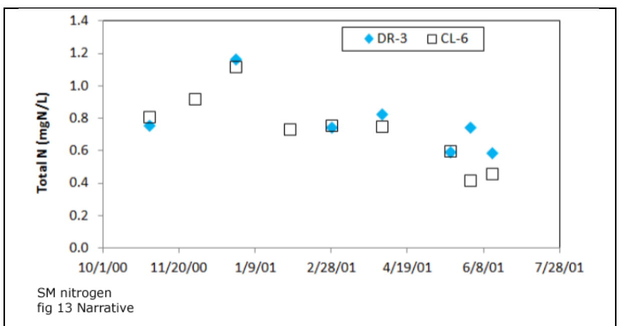
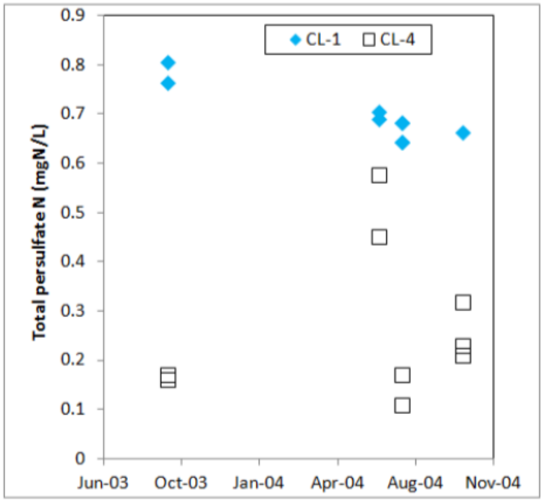


Figure 5-4. Modelers' portrayal of "total nitrogen" in the Deschutes River and at location CL-6 ("near the dam") vs. dates in 2000/2001. (Site CL-6 is not shown on an accompanying map of Capitol Lake.) Attributed to CH2M-Hill 2001 by the SM Report. This Figure is Fig. 13, SM Report, p. 37.

Figure 5-5 shows additional data included in the SM Report, equally devoid of anything that supports the modelers' claims. It shows the concentrations of "persulfate nitrogen" (obtained via a technique that measures nitrogen in drifting bits of organic matter as well as the dissolved organic nitrogen – DIN -- in the water) at two sites in Capitol Lake, one at the extreme south end of the Middle Basin (CL-1) and the other near the dam (CL-4). This Figure shows dramatic drops in persulfate nitrogen in summers 2003 and 2004. That is exactly what we already know about the Lake, namely that it removes nitrogen from the water as the water flows toward the dam.



pers nitrogen
SM fig 14 Narrative

Figure 5-5. Removal of persulfate nitrogen from Lake water as the water moves toward the dam. Sites in Capitol Lake are CL-1 (near the entry of the Deschutes River to the Lake) and CL-4 (in the North Basin near the outlet at the dam). Attributed to Roberts, Bos and Albertson, 2008. Source: Fig. 14 (in part), SM Report p. 37.

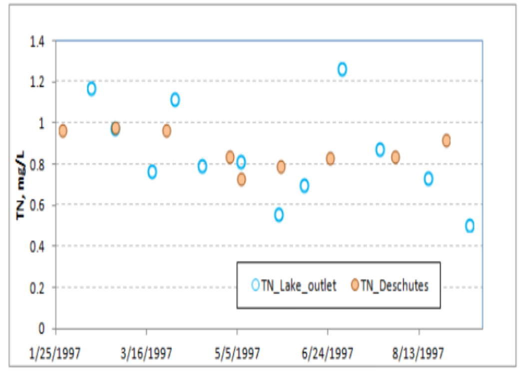


Figure 12. Total nitrogen concentration in the Deschutes River and at the location of the Capitol Lake outlet near dam during 1997.

Source: Evans Hamilton Capitol Lake data used in the 1997 Budd Inlet Scientific Study and Ecology continuous monitoring data for Deschutes River at E Street. Evans Hamilton data graph

Figure 5-6. "Total Nitrogen" concentrations in Deschutes River (orange dots) and Capitol Lake near the dam (blue circles), January 1 to about late August, 1997. SM Report Figure 12 p. 36, including caption. Modelers' sources "Evans-Hamilton" and "Budd Inlet Scientific Study" are not cited in their References.

Figure 5-6 from an Evans-Hamilton source (not seen by me) shows no significant change in the "Total Nitrogen" between the Lake Outlet and the Deschutes River between January and August, 1997, then a drop in TN by August's – and the data set's – end. This, as do the other two, shows the Lake's nitrogen removal function in action – none in winter, some in spring and summer – not what Ecology wants us to think.

To someone casually flipping through the pages of the SM Report, the graphs give an "appearance of science". Internal contradictions like these would never escape a peer reviewer if the SM Report had been submitted for real-world publication.

In the "trivial simulation" category, one scenario in the SM Report addresses nitrogen inputs to Budd Inlet from "boater wastes" and "marina wastes" (SM Report Tables 4 and 5, p. 51). While these subjects merit attention, including them while omitting studies of the effects of Moxlie Creek and harvest removals of plants from Capitol Lake shows Ecology's focus on topics not likely to be significant while avoiding those likely to exonerate Capitol Lake.

5-4. "The Dam" (Not Capitol Lake) is the Problem … or is it?

The SM Report emphasizes "the dam" as the cause of oxygen degradation in Budd Inlet, rather than some water quality property such as nutrient levels. By this semantic strategy Ecology directs public focus toward hydrodynamics and away from water quality as the reason for the alleged negative effect of Capitol Lake on Budd Inlet. Blaming it on water quality makes it possible for skeptical reviewers to question their claim; hydrodynamics is a near-impossible subject for skeptical reviewers to assess. However, it is also difficult for Ecology to make that case. The following shows that they haven't done so.

Page 34 of the SM Report presents three claims that describe how the modelers think the Lake exerts its negative effect. The first is a classic example of a hydrodynamic effect that is impossible for readers to question. That is:

1) "The dam creates a pulsed flow that alters circulation in southern Budd Inlet."[6]

The modelers never define "pulsed flow" for readers nor do they say how "pulsed flow" changes circulation in Budd Inlet, let alone East Bay. They may mean the changes in flow that result from opening and closing the gates in the 5th Avenue dam. Those gates are adjusted near-daily with the intent of maintaining the water level of Capitol Lake as near as possible to a "Set Point." In winter the Set Point is 5.8 feet above Mean Sea Level, during the summer the Set Point is 6.4 feet > MSL. (The latter is roughly at the +15 foot local tide level.)[7] The high Deschutes River flows during winter necessitate opening the gates three or four times every day at that time to maintain the lake level. Only about one adjustment per day is needed in summer to maintain the Set Point water level.

The gates are never opened during the one or two daily intervals when the tide level is higher than the lake level. That is, under modern ordinary circumstances, saltwater is never deliberately admitted to the Lake through the tide gates. The gates are opened only when the Lake level is about six inches (or more) higher than the salt water level outside; the flow is mostly fresh water outward with slight mixing by salt water "leaking" inward during those openings (see BISS 1998 for a description of gates and the opening regime).

Salt water does enter the Lake daily, however, via another route during late summer and fall. A fish ladder (width 9.5 feet) for migrating salmon is positioned at the east end of the dam alongside the tide gates. In 1997 it was closed during the winter but left open from August through December to enable entry of salmon to the Lake. Recently it appears to be open throughout the entire year. Most of the flow through this opening is fresh water going outward. However when the tide rises higher than the lake level, salt water enters the lake. When that happens, a torrent of brackish water pouring through the

---

[6] For completeness, the other two are: 2) "The dam and lake alter the concentrations and loads of carbon." 3) "The dam and lake alter the concentrations and loads of nitrogen. The assimilation of inorganic nitrogen by freshwater plants (e.g., *phytoplankton*) with corresponding production of organic carbon alters discharges into Budd Inlet." Items 2 and 3 are analyzed (and shown to be beneficial to Budd Inlet) elsewhere, in Chapters 7 and 8.

[7] I am not certain of the local position of mean sea level. A tide calculating routine available at http://tbone.biol.sc.edu/tide shows a line corresponding to MSL on a 1997 Budd Inlet tide graph that is at about +9 feet above MLLW.

ladder opening into the Lake can be seen by onlookers (Figure 5-7). At present it appears that there is never a time when ordinary tidal and river flow are completely blocked by gate closure.

Figure 5-7. Saltwater with jellyfish pouring over the fish ladder, entering Capitol Lake. (Flow into the Lake is toward the top of the figure.)[8] *November 21, 2015.*

The designers of the original Budd Inlet Model considered the pattern of flow from the tide gates to be so irregular (and unimportant) that they didn't try to simulate it exactly in the Model (BISS, 1998). Instead, they devised an averaging subroutine. Presumably that subroutine is still in the Model. Exactly what "pulsed flow" looks like in the real world, how it creates water quality problems (or *improves* water quality-- ?), or whether it is a spurious feature of the model output caused by the averaging subroutine all need to be explained by the modelers.

If "pulsed flow" really causes problems, those could easily be eliminated without removing the dam simply by changing its operation. In fact a pattern of "pulsed flow" might even be discovered that could improve Budd Inlet water quality. These possibilities could be explored using the Budd Inlet Model:

a) manage the dam to pulse the flow in synchrony with the tides;

b) manage the dam to pulse the flow out of synchrony with the tides;

c) manage the dam to pulse the flow at randomly chosen times;

d) eliminate pulsed flow altogether by simply leaving the gates unadjusted.

But first, the modelers need to explain exactly what "pulsing" they are talking about, how they discovered this "problem" by using simulations, and how it affects DO levels in faraway East Bay. *They must show readers a simulation that compares Budd Inlet with and without "pulsed flow."*

5-5. "Increased Residence Time" – So What? – and a Botched Calculation.

The modelers present Figure 5-8 (their Figure 10 in the SM Report, also shown in the Poster) as evidence that "the dam" has a negative effect on Budd Inlet. The Figure shows

---

[8] The transport of jellyfish (and other marine organic matter of all sorts) into the Lake provides a small oxygen-preservation service for Budd Inlet not acknowledged by Ecology. The organic material decays there, consuming oxygen in the O2-rich Lake, thus sparing Budd Inlet's sparse O2 supply.

the modelers' claim that the "residence time" of water in East Bay (that is, the average amount of time that water resides there before it moves out) is longer with the dam in place than if the dam were absent. The calculation is flawed, so is their explanation, and in any case, even if it were true … why would that cause oxygen depletion?

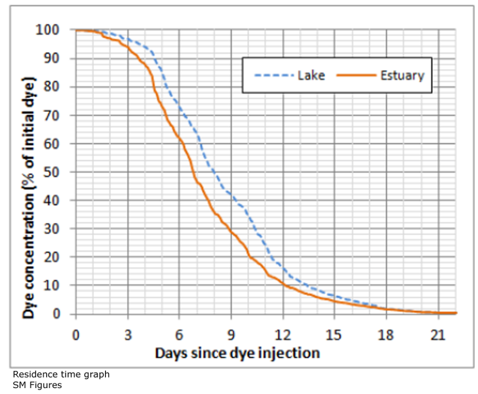


Figure 5-8. Simulated decline of a tracer dye released in bottom water, East Bay, with time. Source: SM Report's Figure 10 p. 35 and Poster (2014). (Calculated using the "e-folding time, mentioned in the Poster.)

The graph in Figure 5-8 shows the decreasing concentration of dye "added" (by the model that is) to the bottom water in a grid cell in East Bay as time goes by. The graph shows the amount of dye that remains in that cell at various times after its release. For example, a week after the "addition" of the simulated dye (7^{th} day, x axis) some 60% of it would still be there if the Lake is in place, but only 46% of it would still be there if an Estuary were present in place of the Lake (y axis).

The modelers don't tell us the time of year when the simulated dye release was made, or the depth, or the location of the grid cell release point. Nothing is said about how or why the flow trajectory of water from Capitol Lake would increase the residence time of East Bay water. No mention is made of how a longer residence time might be caused by "pulsed flow" or any other feature of "the dam."

The modelers used a calculation technique that is wrong for East Bay – namely, the "e-folding time." This statistic is used for basins in which the water is "well mixed" – blended from top to bottom by wind stirring, surface cooling or (less often) some other factor. (This situation is commonly seen in lakes during winter and spring, and Budd Inlet in late fall.) East Bay in September is not a "well mixed" system – it is a "two-layer flow-through" system with a net outgoing surface current nudged along by Moxlie Creek and a small compensating incoming bottom flow, ultimately from the Pacific Ocean, linked by an ongoing rise of incoming bottom water to the surface (that is, the "estuarine circulation"). For such systems, the residence time is calculated from the volume of the basin and the rates of inflow and outflow (see BISS Report Table 2-1 p. 2-3, 1998) – not the e-folding time.

The e-folding technique usually gives a longer residence time than does the flow-through calculation. In another report that models all of South Puget Sound, the same modelers (with two other authors) calculate the e-folding time for Budd Inlet at 18 days (SPSDOS Draft, Figure 55 p. 104). The residence time for Budd Inlet as calculated for a flow-through system by the BISS team is 8 - 12 days (BISS 1998).

But even if "the dam" really does increase the residence time of water in East Bay, so what? The negative effect of an increased residence time as described by the modelers is that it … "creates more stagnant conditions and allows for greater consumption of DO by heterotrophic bacteria as they decompose organic matter in the water column and the sediments." That is only half of the story. Not mentioned is the fact that increased residence time also creates more time for phytoplankton, algae, and the algal mat on the mud bottom – especially in a well-lit, shallow intertidal embayment like East Bay – to create more oxygen via photosynthesis – a compensating factor. The Budd Inlet Model failed in spectacular "crash and burn" style to predict exactly this – something the modelers don't mention.

Figures 5-9 and -10 show that phenomenon in East Bay (station BI-1, also at BI-2) on September 10, 1997, as observed by the BISS team. The oxygen level at the bottom (rightmost bar of each group) was actually higher than at the surface (leftmost bar) on that day (Figure 5-9); the percent DO super-saturation of the water indicating large-scale photosynthesis was likewise highest at the bottom (Figure 5-10). The DO levels are the net result of both photosynthesis (positive) and consumption by sediments and bacteria (negative), with photosynthesis far overwhelming consumption. On that day, this was the exact opposite of what the modelers are telling us.

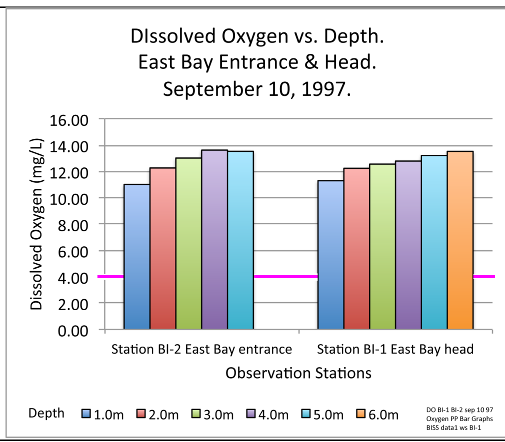


Figure 5-9. Dissolved oxygen concentrations vs. depth, BISS stations BI-2 and BI-1 (East Bay). September 10, 1997. Red line shows 4.0 mg/L ecological stress threshold. The water quality standard here is 5.0 mg/L. Data Source: BISS spreadsheet.

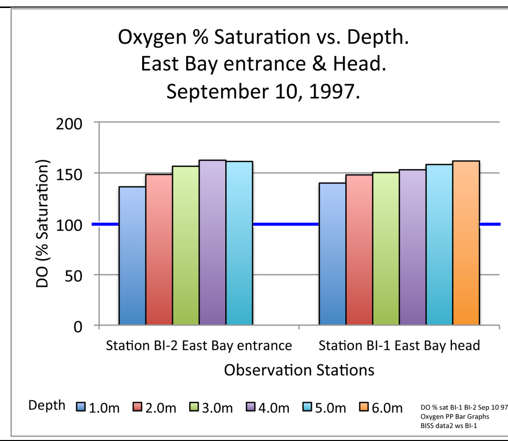


Figure 5-10. Dissolved oxygen saturation levels vs. depth, BISS stations BI-2 and BI-1 (East Bay). September 10, 1997. Blue line shows 100% saturation. Percent saturations calculated via USGS DO TABLES tool from observed water salinity and temperature data from BISS spreadsheet.

Figure 5-9 shows the per-cent saturation level of dissolved oxygen at those same two stations on that date. Water standing in contact with the atmosphere with no other processes (photosynthesis or consumption) operating will arrive at 100% saturation and stay there by exchanging oxygen with the air. Both stations show supersaturation at the surface (indicating intense photosynthesis by phytoplankton there) and even greater supersaturation at the bottom (indicating intense photosynthesis by benthic algae there).[9]

[9] All of these details were also the same at station BI-6 immediately in front of "the dam" on that same date.

The model predicted its lowest bottom water DO levels of the simulated year in both locations on that date, when in reality the bottom water DO levels were then at their highest of the year. *This implies that the Budd Inlet Model lacks a way of accurately simulating photosynthesis by benthic algae in shallow sunlit subtidal situations*. That is precisely the situation in East Bay.

Oxygen created by benthic photosynthesis is a key contributor to shallow estuarine systems. The computer's failure to calculate it in this conspicuous case implies that the model may not be correctly calculating it in *any* case, most of them more typical than this one. That is, the model calculates oxygen depletion in shallow bottom water but doesn't simulate a process that causes oxygen replenishment. *This calls into question all of Ecology's DO predictions for East Bay, even on dates where the more usual condition – low DO at the bottom, high DO at the surface – prevails.* It also implies that failed shallow water benthic oxygen calculation over all of Budd Inlet – not just East Bay – may have compromised DO predictions along all shores.

5-6. Summary.

The SM Report omits critical simulations that could show a beneficial effect of Capitol Lake on Budd Inlet and identify Moxlie Creek with other factors endemic to East Bay as the sources of oxygen depletions now blamed on the Lake. It flashes many irrelevant graphs (that show the opposite of what Ecology claims) before the reader's eyes.

A claim that "pulsed flow" from the dam causes longer residence time of the water in East Bay is unsupported by any description of how that occurs, or any description of the frequency, velocities and volumes of the pulses, or how the size of the effect varies with the frequency of the pulses, or how the effect from "the dam" manifests itself in East Bay and (seemingly nowhere else), all things that a scientific reader would need to know. The claim is made simply because "the modelers said so."

The model made wildly inaccurate predictions of DO levels in East Bay in a way that suggests it can't simulate benthic photosynthesis. This worrisome failure would seem to cast doubt on *all* of Ecology's predictions of dissolved oxygen levels in that shallow critical area and in all other shallow waters.