MEMORANDUM 20-18836.100

October 30, 2000

TO: MARZIAH KIEHN, DEPARTMENT OF GENERAL ADMINISTRATION

FROM: CHRIS CLEVELAND, BROWN AND CALDWELL

SUBJECT: CAPITOL LAKE ADAPTIVE MANAGEMENT PLAN
RESULTS FOR BUDD INLET-CAPITOL LAKE SIMULATIONS
FINAL REPORT

The purpose of Budd Inlet and Capitol Lake water quality investigation is to analyze the effects of various Capitol Lake operational schemes Budd Inlet water quality. Water quality is measured in terms of dissolved oxygen (DO) levels in accordance with Department of Ecology criteria. Continuous simulations were conducted representing winter through early fall seasonal conditions. The water quality analyses were conducted using previously collected field data the GLLVHT model originally developed for Budd Inlet in 1998 and updated in 1999 *(Budd Inlet Scientific Study, Final Report, Brown and Caldwell et al., August 1998 and LOTT NPDES Permit Modifications Modeling, Revised Interim Report, Brown and Caldwell et al., November 24, 1999)*. The 1999 update was conducted to incorporate the effects of dinoflagellate algae on dissolved oxygen levels in Budd Inlet (dinoflagellates are highly mobile biota that vertically migrate in the water column.) The second report was produced to describe the results of including dinoflagellates in the water quality model routine of the GLLVHT model.

Several different Capitol Lake operating scenarios were simulated as referenced in the matrix below and detailed in the following paragraphs. The simulation period uses boundary condition/field data from the period January 25, 1997, to September 15, 1997 as presented in the 1998 report. A map showing the analysis grid of the model in is shown on Figure 1. Results are shown quantitatively in tabular presentation with several graphical representations to illustrate comparisons between scenarios.

	Capitol Lake with tide gates and annual drawdown	Capitol Lake with tide gates and no annual drawdown	Capitol Lake with no artificial control
No LOTT discharge Baseline Case	A1	B1	C1
1997 Observed LOTT discharge	A2	B2	C2

The computed dissolved oxygen concentrations for each of the six cases shown above are saved every four hours at every three-dimensional grid cell over the full simulation period for each case.

Capitol Lake Conditions

There are three Capitol Lake operating conditions included in this analysis. They are as follows:

(A) Capitol Lake with tide gates and annual drawdown

This condition represents the traditional operation of Capitol Lake through 1997. Tide gates open twice a day with the falling tide controlling flow out of Capitol Lake into Budd Inlet. Additionally, for two weeks at the end of July, the entire volume of Capitol Lake is allowed to draw down and back-flushed with saltwater.

(B) Capitol Lake with tide gates and no annual drawdown

This case is the same as case 'A' except that the annual drawdown does not occur. This scenario represents the operation condition since 1997. The Capitol Lake outflow time series during the drawdown period (July 17 to July 31) is replaced with flow data from the period August 1 – August 15.

(C) Capitol Lake with no artificial control

Capitol Lake is modified to respond as a naturally controlled extension of Budd Inlet. The existing tide gates are removed and a 500-foot section if the separating earthen berm is removed. The Deschutes River flows into Capitol Lake with a natural tidal exchange between Capitol Lake and the Budd Inlet. For modeling purposes, the surface area of Capitol Lake is simulated by increasing the dimensions of the four grid cells at the south end of West Bay in Budd Inlet (see Figure 1.)

LOTT Discharge Conditions

Since the LOTT treatment plant represents the largest permitted point discharge in Budd Inlet, several LOTT discharge scenarios have been included. Two different conditions are examined are:

(1) No LOTT Discharge

A baseline case is run without the LOTT discharge. This allows examining the effects of the different Capitol Lake operations alone.

(2) Observed 1997 LOTT Discharge

In this condition, LOTT discharge values are from observed data for 1997. This allows analyzing the effects of Capitol Lake operational changes on LOTT.

Baseline Conditions

Two different baseline conditions have been considered in this analysis. Case A, traditional operation of Capitol Lake, and Case B, operation since 1997. Comparisons of the estuarine condition, Case C, will be made against each of these alternate baseline conditions.

For the "A" baseline condition for evaluating the effects of Capitol Lake operational practices two different cases have been designated:

- Case A1 – Traditional Capitol Lake management practices and **no** LOTT discharge and;
- Case A2 – Traditional Capitol Lake management practices **with** LOTT discharge.

Many of the figures representing the model results (Figures 2 through 11) are tabular in appearance with each cell representing a grid position in the model of Budd Inlet as identified in Figure 1. The cell represents a series of layers or depths through the water column. The north

end of Budd Inlet is represented by row 23, and the southern extent as row 2. The west extent of Budd Inlet (Cooper Point area) is represented as column 2 and the east extent as column 12. Consequently West Bay/Capitol Lake is represented by cells in the area rows 2 through 4 between columns 2 and 6 inclusive.

Figure 2 and Figure 3 illustrate (a) the average DO through the water column for each cell (b) the minimum DO in the water column, and (c) the time of the minimum DO, as generated by the model, for baseline conditions A1 and A2. In figure 2b (minimum DO at every cell and over all layers for Case A1) the minimum DO in West Bay ranges from 1.7 mg/l in cell 2-6 (row 2 column 6) to 3.93 mg/l in cell 4-3. The time the minimum DO occurs (Figure 2c) is September 2 (9/2) and September 12 (9/12) respectively.

- Case A1 (Figures 2a-2c) – Traditional Capitol Lake operation *without* LOTT discharge – Figure 2a illustrates the average DO is well above the 5.0 mg/l standard for class B waters (Budd Inlet's current water quality classification by Ecology). The average DO ranges from 8.5 mg/l in cell 12-2 to 11.0 mg/l in cell 6-10. Figure 2b shows that the minimum dissolved oxygen for the historical Capitol Lake operations occurs off the outflow of Capitol Lake into West Bay of Budd Inlet. The minimum DO fails to meet the 5.0 mg/l standard in most areas of Budd Inlet. Most of these low DO values occur in the lower 3 meters of the water column. However, East and West Bay low DO is found throughout the water column. The low DO plume migrates northeast through the inlet. The minimum dissolved oxygen for this case occurs in early to mid September (Figure 2c).

- Case A2 (Figures 3a-3c) – Traditional Capital lake operation *with* LOTT discharge – Figure 3a illustrates the average DO in Budd Inlet ranges from a low of 8.54 mg/l in cell 12-2 to 11.01 mg/l in cell 2-12 (Note this is very similar to figure 2a). Figure 3b shows, in comparison to Case A1, a 1 to 5 percent lower dissolved oxygen off the entrance of Capitol Lake into the West Bay and near the location of the LOTT discharge (cells between rows 5 to 7 and columns 5 and 6). However, the dissolved oxygen reduction is less than 0.1 mg/l and less than 50 percent of the allowable reduction for discharges into Class B waters. Comparing Figures 2b and 3b you will notice the distribution low dissolved oxygen areas is similar for Case A2 and Case A1. Further, comparing Figures 2c and 3c, minimum dissolved oxygen event occurs at the same time suggesting Capitol Lake not LOTT dominates water quality. Figure 4 graphically illustrates the spatial distribution of the minimum dissolved oxygen for Case A1 (similar for Case A2.) as represented on Figure 2b.

Since the absolute values and distribution of DO were similar for Case A1 and A2, for the "B" baseline condition this memo will discuss case B1 only (Capitol Lake without drawdown and no LOTT discharge).

- Case B1 (Figures 5a-5c – Capitol Lake without annual drawdown and no LOTT discharge – Figure 5a illustrates the average DO in Budd Inlet ranges from 8.50 mg/l in cell 12-2 to 10.95 mg/l in cell 2-12 (notice the similarity to case A1). Figure 5b shows the minimum DO in West Bay ranges from 1.72 mg/l in cell 2-6 to 3.94 mg/l in cell 3-4. The timing of this event is early to mid September as shown on Figure 5c. Figure 6 graphically illustrates the minimum DO distribution as demonstrated in Figure 2b. You will notice the low DO plume originates in West Bay and proceeds north and then north-northwest.

Comparative Results

To estimate the water quality impacts between Capitol Lake operating scenarios we used the model to compare results in Budd Inlet by grid cell. These differences are measured relative to the baseline case (Case A or B) and the test case (Case B or C). The water quality impacts are

defined as differences in the dissolved oxygen. Five different representations were prepared for each comparison (the letter corresponds to the figure reference).

- (a) The maximum dissolved oxygen difference (mg/l) found over the 10-month simulation period for each horizontal cell location and any vertical layer within the water column. An improvement (or increase) in DO is represented as a positive value and a degradation as a negative value.
- (b) The date of occurrence (month and day) for the maximum dissolved oxygen difference.
- (c) The percentage of time during the 10-month simulation period an **improvement** in dissolved oxygen would occur (measured in percent).
- (d) The change in the average water column dissolved oxygen (mg/l) for the simulation period. An improvement (or increase) in DO is represented as a positive value and a degradation as a negative value.
- (e) Graphical spatial comparison of the maximum dissolved oxygen differences overlain on a bathometric map of the Budd Inlet.

The following Capitol Lake operating scenarios comparisons were conducted:

- B1 minus A1 – Examines the effects of eliminating the traditional drawdown of Capitol Lake **without** LOTT discharges.
- C1 minus A1 – Examines the effects of changing Capitol Lake outflow to a tidally driven estuary **without** LOTT discharges against the traditional management practices.
- B2 minus A2 – Examines the effects of eliminating the traditional drawdown of Capitol Lake **with** 1997 LOTT discharges.
- C2 minus A2 – Examines the effects of changing Capitol Lake outflow to a tidally driven estuary **with** 1997 LOTT discharges against the traditional management practices.
- C1 minus B1 – Examines the effects of changing Capitol Lake outflow to a tidally driven estuary **without** LOTT discharges against present management practices.

Case B1 minus Case A1 Comparison

The results of comparing case B1 and A1 are represented in Figures 7a through 7e. As illustrated on Figure 7a, a maximum difference in DO is an improvement of +2.6 mg/l occurring in the vicinity of the entrance of Capitol Lake into West Bay. This improvement in dissolved oxygen is present only in East and West Bay of Budd Inlet and net reductions are present in DO for the remainder of Budd Inlet. As illustrated on Figure 7b, the maximum DO difference/impact as a result of this change occurs between July 25 (7/25) and July 30 (7/30) toward the end of the traditional drawdown period. This suggests the elimination of the traditional drawdown resulted in a dramatic, but localized, net improvement in the DO for South Budd Inlet.

Figure 7c shows that eliminating the drawdown of Capitol Lake improves the dissolved oxygen about 10 percent of the time in the vicinity of the entrance of the Lake into West Bay, with the percentage of time gradually decreasing northward from that location. The simulation period is about 240 days long, so the percentage of time there is an improvement is confined to about two to four weeks per year. However this improvement is most pronounced during the critical summer months. Figure 7d shows that the change in the average dissolved oxygen over the simulation less than 1 percent (-0.002 ÷ 0.007 mg/l DO). Consequently the revised practice of no

drawdown has little impact to annual water quality. Figure 7e graphically illustrates the information contained on Figure 7a.

Case C1 minus Case A1 Comparison

The comparison of Cases C1 and A1 shows the effects of Capitol Lake as a natural tidal estuary compared to the traditional management practice. The results of this comparison are shown on Figures 8a through 8e. Figure 8a shows a maximum difference of up to +5.28 mg/l (cell 2-3) occurring in the vicinity of the outflow of Capitol Lake into West Bay. These improvements extend northward to include central Budd Inlet. Figure 8b shows the improvement in dissolved oxygen occurs in mid June in the East Bay and in mid September in central Budd Inlet (again critical water quality months). This suggests the tidally driven body of water minimizes the potential for creating low circulation areas when the gates are closed and alters the current circulation patterns in Budd Inlet.

Figure 8c shows operating Capitol Lake as a natural estuary would improve dissolved oxygen 45 to 72 percent of the time over most of Budd Inlet. The area most improved is in the vicinity of the entrance of Capitol Lake into the West Bay (cells between rows 2 to 8 and columns 3 to 7). The DO in central Budd Inlet (rows 8 to 16) would be improved approximately 55 percent of the time with the largest improvements in the western half (columns 2 to 5). The improvement in the average dissolved oxygen, as shown on Figure 8d, is about 0.9 mg/l near the outflow of Capitol Lake (cell 2-3) into West Bay whereas the increase is only about 0.1 mg/l in central Budd Inlet (cells between rows 8 and 16). Figure 8e graphically illustrates the results contained on Figure 8a. This is a dramatic finding since to improve the *average* DO concentration the increase must be sustained over a long period and observed at multiple depths.

Case B2 minus Case A2 Comparison and C2 minus A2 Comparison

The Case B2 minus A2 comparisons are shown on Figures 9a through Figure 9d and the Case C2 minus A2 comparisons are shown on Figures 10a through Figure 10d. Examination of B2 minus A2 and C2 minus A2 cases show nearly identical results to the B1 minus A1 and the C1 minus A1 Case results. Consequently, LOTT discharges have little direct impact on Budd Inlet water quality relative to Capitol Lake management policies. However, the water quality conditions in Budd Inlet do directly limit the acceptable water quality criteria for the LOTT discharge. Further, these results suggest the Capitol Lake management policies impact Budd Inlet water quality more than LOTT discharges.

Case C1 minus Case B1 Comparison

This comparison highlights the changes in water quality as a result of operating Capitol Lake as an estuary versus present management practice. The results of this analysis are illustrated in Figures 11a through 11e. Similar to the Case C1 minus A1 comparison, (see previous discussion and Figures 8a through 8e), the positive effects are most noticeable in West Bay with less dramatic improvements in central Bud Inlet. Since the mechanism most likely responsible for the DO improvements is the increased volume of water being exchanged in southern Budd Inlet, this is not surprising. The results indicate operating Capitol Lake as an estuary would have pronounced water quality improvements for Budd Inlet throughout the summer months versus present operating management polices.

Conclusions

Elimination of the summertime Capitol Lake drawdown does produce a dramatic, localized improvement in water quality of West Bay during select periods in the summer months. Although

the impact to the average water quality in Budd Inlet can be argued to be inconsequential, the period when the improvements are observed is critical to overall Budd Inlet water quality. Continuation of annual drawdown and saltwater backfill events are not recommended, particularly in the summer and early fall seasons.

A substantial water quality improvement (an increase of 1-5 mg/l dissolved oxygen) is realized in south and central Budd Inlet as a result of returning Capitol Lake to a tidal estuary as demonstrated in comparison of Case C1 to both Case A1 and to Case B1. Improvements are observed throughout the Budd Inlet, but particularly in the most water quality impaired areas in East Bay and West Bay. These areas were observed to have water quality improvements throughout the water column. This improvement can be largely attributed to the increase in continuous hydraulic flushing induced by the tidal action through Capitol Lake.

Neither management scheme appears to be impacted by LOTT discharges. However, Capitol Lake operations directly affect the regulatory criteria for the LOTT discharge.

References

Brown and Caldwell et al., August 1998. Budd Inlet Scientific Study Final Report. Prepared for: The Lacey, Olympia, Tumwater, Thurston County Partnership (LOTT). Prepared by Aura Nova Consultants, Brown and Caldwell, Inc., Evans-Hamilton, Inc., J.E.Edinger Associates, Inc., Washington State Department of Ecology, Dr. Alan Devol, University of Washington Department of Ecology. August 1998.

Brown and Caldwell et al., 1999. LOTT NPDES Permit Modifications Modeling Revised Interim Report. Prepared for: The Lacey, Olympia, Tumwater, Thurston County Partnership (LOTT). Prepared by Aura Nova Consultants, Inc., Brown and Caldwell, Inc., and J.E.Edinger Associates, Inc.. November 24, 1999.

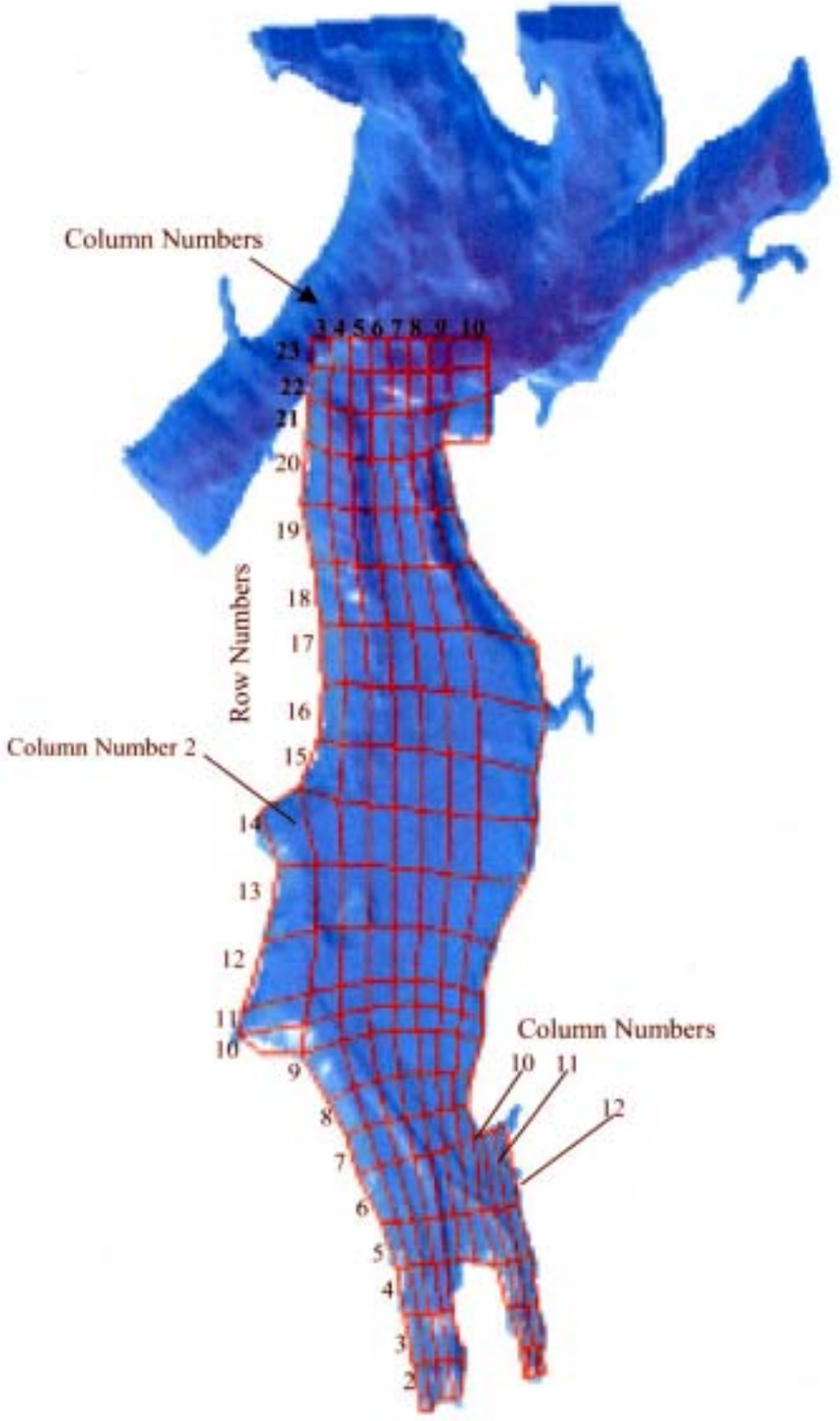


Figure 1. Water quality model grid for Budd Inlet / Capitol Lake

Average DO at every cell and over all layers

A1

ij	2	3	4	5	6	7	8	9	10	11	12
23		8.944	8.946	8.946	8.946	8.946	8.946	8.945	8.944		
22		8.904	8.862	8.863	8.86	8.853	8.836	8.831	8.854		
21		8.89	8.81	8.85	8.84	8.86	8.77	8.74	8.77		
20		8.87	8.77	8.90	8.88	8.88	8.78	8.77			
19		8.82	8.75	8.87	8.86	8.86	8.76	8.83			
18		8.89	8.74	8.85	8.84	8.93	8.78	8.86			
17		9.23	8.96	8.86	8.83	8.92	8.92	8.94			
16		9.43	8.85	8.85	8.95	8.90	8.86	8.87			
15		9.46	8.82	8.82	8.92	8.89	9.01	9.02			
14	9.259	9.12	8.81	8.95	8.92	8.88	9.02	9.24			
13	8.797	8.89	8.94	8.92	8.89	9.04	9.01	9.45			
12	8.50	9.25	8.89	9.09	9.07	9.04	9.21	9.66			
11	8.66	8.75	9.07	9.05	9.05	9.26	9.47	9.72			
10	9.27	8.96	9.03	9.27	9.27	9.25	9.47	9.93			
9		8.87	8.97	9.24	9.26	9.49	9.73	9.98			
8		8.76	8.90	9.19	9.46	9.48	9.96	10.01			
7		8.97	8.86	8.95	9.21	9.73	10.00	10.23			
6		9.22	9.09	8.93	8.96	9.48	9.78	10.08	11	10.677	10.764
5		9.38	9.22	8.84	8.88	9.44	9.49	9.50	10	10.397	10.446
4		9.59	9.02	8.63	8.64				10.34	10.17	10.73
3		9.52	9.18	8.41	8.42				10.74	10.18	10.74
2		8.66	8.51	8.21	8.23				10.62	10.89	10.95

Figure 2a. Case A1 - Average Budd Inlet Dissolved Oxygen

Minimum DO at every cell and over all layers — A1

	2	3	4	5	6	7	8	9	10	11	12
23		6	6	6	6	6	6	6	6		
22		5.9	5.79	5.74	5.68	5.63	5.6	5.6	5.74		
21		5.72	5.57	5.49	5.4	5.31	5.26	5.31	5.5		
20		5.46	5.28	5.06	4.98	4.96	4.88	4.87			
19		5.23	4.97	4.75	4.71	4.66	4.58	4.58			
18		4.98	4.74	4.5	4.41	4.35	4.37	4.33			
17		5.08	4.24	4.18	4.17	4.05	3.99	3.91			
16		4.86	3.57	3.79	3.8	3.73	3.77	3.74			
15		4.6	3.32	3.51	3.49	3.46	3.66	3.76			
14	3.85	3.41	3.12	3.3	3.28	3.31	3.4	3.97			
13	2.27	2.67	3	3.14	3.14	3.3	3.34	4.19			
12	1.44	3.93	2.94	3.39	3.31	3.3	3.78	4.64			
11	2.15	2.23	3.32	3.5	3.47	3.78	4.23	4.69			
10	3.99	2.99	3.1	3.89	3.84	3.79	4.23	5.01			
9		2.93	2.94	3.79	3.86	4.21	4.57	4.99			
8		2.86	2.85	3.5	4.01	4.18	4.79	4.99			
7		3.4	2.63	2.47	3.17	4.09	4.51	4.87			
6		3.59	3.15	2.08	2.01	3.56	3.87	4.23	5.38	5.97	6
5		3.81	3.45	1.92	1.93	3.49	3.32	3.13	3.9	4.4	4.44
4		3.93	3.28	1.85	1.85				4.27	4.47	5.3
3		3.69	3.34	1.83	1.84				5.04	4.46	5.06
2		2.68	2.57	1.72	1.7				5.21	5.77	6

Time of Minimum DO at every cell and over all layers — A1

	2	3	4	5	6	7	8	9	10	11	12
23		1/25	1/25	1/25	1/25	1/25	1/25	1/25	1/25		
22		9/14	9/14	9/14	9/14	9/14	9/14	9/14	9/14		
21		9/14	9/14	9/2	9/2	9/2	5/2	9/1	9/1		
20		9/1	9/1	5/2	5/2	9/1	9/1	9/1			
19		9/1	9/1	5/2	9/1	9/1	9/1	9/1			
18		9/1	9/1	9/1	9/1	9/1	9/1	9/1			
17		9/2	9/1	9/1	9/1	9/1	9/1	9/1			
16		9/2	9/1	9/1	9/1	9/1	9/1	9/1			
15		9/2	9/1	9/1	9/1	9/1	9/1	9/1			
14	9/2	9/1	9/1	9/1	9/1	9/1	9/1	9/1			
13	9/1	9/1	9/1	9/1	9/1	9/1	9/1	9/2			
12	9/3	9/2	9/1	9/1	9/1	9/1	9/2	5/5			
11	9/2	9/2	9/2	9/1	9/1	5/5	5/5	5/5			
10	9/5	9/1	9/1	9/2	5/5	5/5	5/5	9/6			
9		9/1	9/1	9/1	5/5	5/5	9/6	9/13			
8		9/1	9/1	9/1	9/1	9/6	9/6	9/13			
7		9/2	9/1	9/1	9/1	9/8	9/11	9/13			
6		9/6	9/1	9/1	9/1	9/6	9/6	9/11	9/13	1/25	1/25
5		9/6	9/6	9/1	9/1	9/9	9/1	9/1	9/11	9/11	9/11
4		9/12	9/9	9/1	9/1				9/11	9/12	9/13
3		9/12	9/10	9/1	9/1				9/13	9/12	9/13
2		9/6	9/2	9/2	9/2				9/13	9/13	1/25

Figure 2b and 2c (Con't). Case A1 - Minimum Budd Inlet DO and Date of Occurrence

Average DO at every cell and over all layers — A2

	2	3	4	5	6	7	8	9	10	11	12
23		8.944	8.946	8.946	8.946	8.946	8.946	8.945	8.944		
22		8.911	8.869	8.871	8.868	8.861	8.845	8.84	8.865		
21		8.90	8.82	8.86	8.85	8.88	8.78	8.76	8.78		
20		8.88	8.78	8.92	8.90	8.90	8.80	8.80			
19		8.84	8.76	8.90	8.88	8.89	8.79	8.87			
18		8.91	8.76	8.88	8.87	8.97	8.81	8.90			
17		9.26	9.01	8.89	8.86	8.96	8.96	8.98			
16		9.47	8.88	8.89	8.98	8.94	8.90	8.91			
15		9.50	8.85	8.86	8.96	8.93	9.06	9.07			
14	9.3	9.15	8.84	8.99	8.96	8.92	9.06	9.30			
13	8.837	8.93	8.98	8.97	8.94	9.09	9.06	9.51			
12	8.54	9.29	8.93	9.14	9.12	9.09	9.26	9.72			
11	8.71	8.79	9.12	9.10	9.10	9.31	9.53	9.79			
10	9.32	9.00	9.08	9.33	9.33	9.31	9.53	10.00			
9		8.92	9.02	9.30	9.32	9.55	9.79	10.05			
8		8.81	8.95	9.25	9.52	9.54	10.02	10.07			
7		9.03	8.92	9.01	9.27	9.78	10.04	10.27			
6		9.28	9.15	8.98	9.00	9.48	9.76	10.06	11	10.725	10.832
5		9.41	9.25	8.83	8.81	9.17	9.30	9.32	10	10.297	10.362
4		9.59	9.04	8.63	8.62				10.24	10.05	10.73
3		9.53	9.19	8.43	8.43				10.72	10.05	10.73
2		8.70	8.55	8.24	8.25				10.83	10.93	11.01

Figure 3a. Case A2 - Average Dissolved Oxygen

Minimum DO at every cell and over all layers — A2

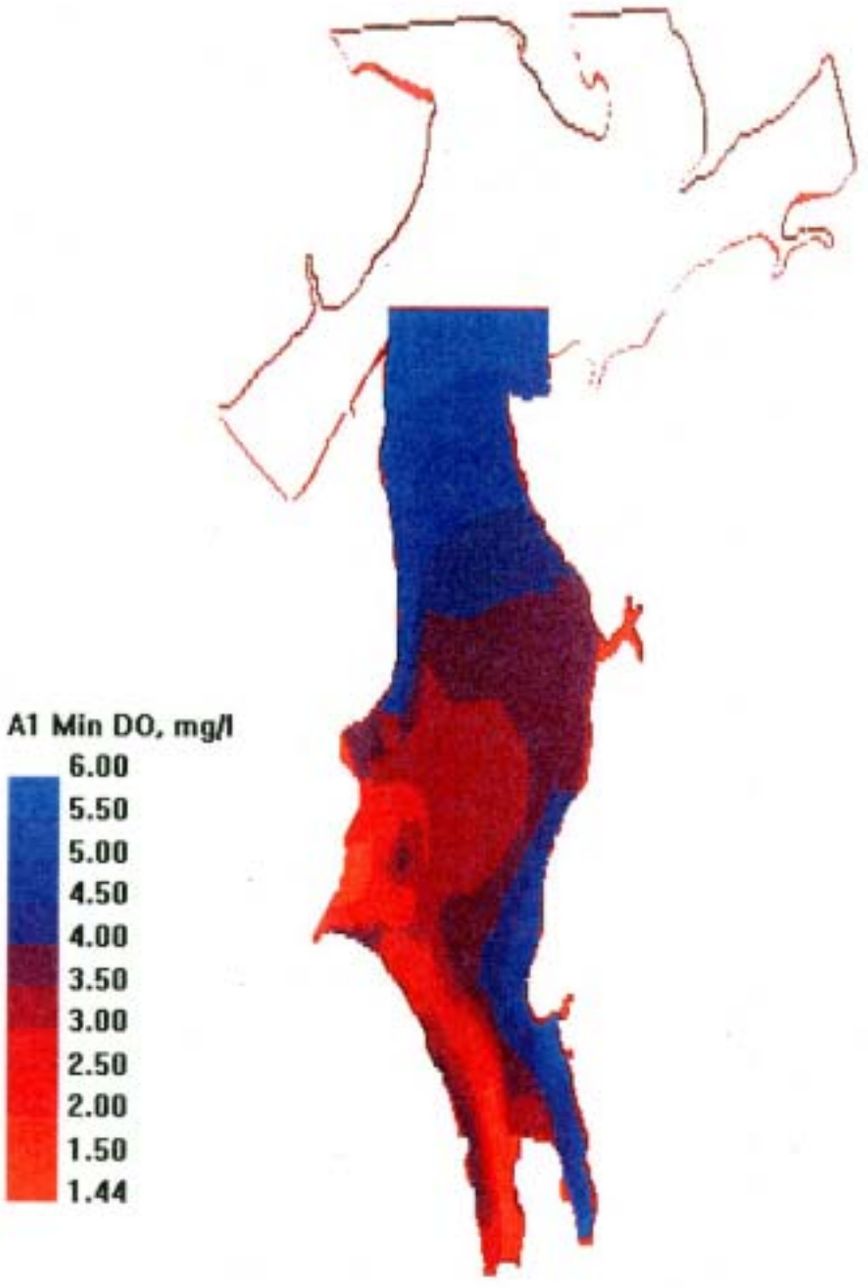
	2	3	4	5	6	7	8	9	10	11	12
23		6	6	6	6	6	6	6	6		
22		5.92	5.82	5.77	5.71	5.67	5.63	5.64	5.77		
21		5.75	5.6	5.54	5.44	5.35	5.27	5.35	5.53		
20		5.49	5.3	5.08	4.99	4.98	4.91	4.91			
19		5.26	5	4.77	4.74	4.71	4.62	4.62			
18		5.02	4.78	4.53	4.46	4.4	4.41	4.38			
17		5.14	4.29	4.23	4.22	4.1	4.04	3.96			
16		4.94	3.62	3.83	3.86	3.78	3.82	3.79			
15		4.67	3.36	3.56	3.55	3.52	3.73	3.81			
14	3.91	3.48	3.18	3.36	3.34	3.37	3.47	4.05			
13	2.36	2.75	3.07	3.2	3.21	3.37	3.41	4.26			
12	1.53	3.99	3.01	3.46	3.38	3.37	3.83	4.69			
11	2.22	2.3	3.41	3.56	3.53	3.8	4.27	4.74			
10	4.08	3.1	3.22	3.94	3.87	3.81	4.27	5.15			
9		3.05	3.06	3.91	3.89	4.25	4.67	5.08			
8		2.96	2.96	3.66	4.15	4.32	4.91	5.06			
7		3.51	2.82	2.7	3.35	4.27	4.7	4.93			
6		3.75	3.28	2.22	2.13	3.78	4.09	4.46	5.24	5.76	6
5		4.04	3.66	2	1.95	3.55	3.37	2.99	3.9	4.35	4.4
4		4.11	3.49	1.88	1.88				4.26	4.38	4.96
3		3.9	3.51	1.81	1.83				4.84	4.35	4.84
2		2.79	2.51	1.69	1.67				4.92	5.34	5.89

Time of Minimum DO at every cell and over all layers — A2

	2	3	4	5	6	7	8	9	10	11	12
23		1/25	1/25	1/25	1/25	1/25	1/25	1/25	1/25		
22		9/14	9/14	9/14	9/14	9/14	9/14	9/14	9/14		
21		9/14	9/14	9/2	9/2	9/2	5/2	9/1	9/1		
20		9/1	9/1	5/2	5/2	5/2	5/2	9/1			
19		9/1	9/1	5/2	5/2	9/1	9/1	9/1			
18		9/1	9/1	5/2	9/1	9/1	9/1	9/1			
17		9/2	9/1	9/1	9/1	9/1	9/1	9/1			
16		9/2	9/1	9/1	9/1	9/1	9/1	9/1			
15		9/2	9/1	9/1	9/1	9/1	9/1	9/1			
14	9/2	9/1	9/1	9/1	9/1	9/1	9/1	9/1			
13	9/1	9/1	9/1	9/1	9/1	9/1	9/1	9/2			
12	9/3	9/2	9/1	9/1	9/1	9/1	9/2	5/5			
11	9/2	9/2	9/2	9/2	9/1	5/5	5/5	5/5			
10	9/5	9/2	9/1	5/5	5/5	5/5	5/5	9/13			
9		9/1	9/1	9/1	5/5	5/5	5/5	9/13			
8		9/1	9/1	9/1	9/1	9/6	9/13	9/13			
7		9/2	9/1	9/1	9/1	9/1	9/12	9/13			
6		9/6	9/1	9/1	9/1	9/6	9/8	9/11	9/13	9/13	1/25
5		9/6	9/6	9/1	9/1	9/1	9/1	9/1	9/1	9/1	9/13
4		9/12	9/7	9/1	9/1				9/11	9/12	9/13
3		9/12	9/6	9/1	9/1				9/13	9/12	9/13
2		9/3	9/2	9/2	9/2				9/13	9/13	9/13

Figure 3b and 3c (Con't). Case A2 - Minimum Budd Inlet DO and Time of Occurrence

**Figure 4. Distribution of Minimum Dissolved Oxygen in Budd Inlet
With Traditional Capitol Lake Operating Conditions and No LOTT Discharge – Case A1
(results similar with LOTT discharge)**



Average DO at every cell and over all layers — B1

ij	2	3	4	5	6	7	8	9	10	11	12
23		8.94	8.95	8.95	8.95	8.95	8.95	8.95	8.94		
22		8.90	8.86	8.86	8.86	8.85	8.84	8.83	8.85		
21		8.89	8.81	8.85	8.83	8.86	8.76	8.74	8.77		
20		8.87	8.77	8.89	8.88	8.87	8.78	8.77			
19		8.82	8.74	8.87	8.86	8.86	8.76	8.83			
18		8.89	8.74	8.85	8.84	8.93	8.78	8.86			
17		9.23	8.98	8.85	8.83	8.92	8.92	8.93			
16		9.43	8.85	8.85	8.94	8.90	8.86	8.87			
15		9.46	8.82	8.82	8.92	8.89	9.01	9.02			
14	9.26	9.12	8.81	8.95	8.92	8.88	9.02	9.24			
13	8.80	8.89	8.94	8.92	8.90	9.04	9.01	9.45			
12	8.50	9.25	8.89	9.09	9.07	9.04	9.21	9.66			
11	8.67	8.75	9.07	9.05	9.05	9.26	9.47	9.72			
10	9.27	8.96	9.03	9.27	9.27	9.25	9.47	9.93			
9		8.87	8.97	9.24	9.26	9.49	9.73	9.97			
8		8.76	8.90	9.19	9.46	9.48	9.96	10.01			
7		8.97	8.86	8.95	9.21	9.73	10.00	10.23			
6		9.22	9.09	8.94	8.96	9.47	9.78	10.08	10.54	10.67	10.76
5		9.38	9.23	8.84	8.88	9.44	9.49	9.50	10.10	10.40	10.45
4		9.59	9.02	8.63	8.64				10.34	10.17	10.72
3		9.52	9.19	8.41	8.43				10.74	10.18	10.74
2		8.67	8.52	8.21	8.23				10.82	10.89	10.95

Minimum DO at every cell and over all layers — B1

ij	2	3	4	5	6	7	8	9	10	11	12
23		6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00		
22		5.90	5.79	5.74	5.68	5.63	5.60	5.61	5.74		
21		5.71	5.57	5.49	5.40	5.31	5.26	5.30	5.50		
20		5.46	5.27	5.06	4.98	4.96	4.88	4.87			
19		5.23	4.96	4.75	4.71	4.66	4.58	4.57			
18		4.98	4.74	4.50	4.42	4.36	4.37	4.34			
17		5.08	4.25	4.18	4.17	4.05	3.99	3.91			
16		4.87	3.57	3.79	3.80	3.73	3.78	3.75			
15		4.61	3.32	3.52	3.49	3.46	3.67	3.77			
14	3.86	3.43	3.13	3.31	3.29	3.32	3.41	3.98			
13	2.29	2.68	3.01	3.15	3.15	3.31	3.36	4.19			
12	1.46	3.94	2.96	3.40	3.33	3.31	3.78	4.64			
11	2.17	2.24	3.33	3.51	3.48	3.78	4.23	4.69			
10	4.00	3.01	3.12	3.90	3.84	3.79	4.23	5.02			
9		2.95	2.96	3.80	3.86	4.21	4.58	5.00			
8		2.87	2.86	3.51	4.02	4.20	4.81	4.99			
7		3.42	2.64	2.47	3.19	4.10	4.52	4.87			
6		3.60	3.16	2.09	2.02	3.57	3.88	4.24	5.40	5.97	6.00
5		3.81	3.46	1.93	1.94	3.50	3.33	3.14	3.91	4.41	4.46
4		3.94	3.30	1.86	1.87				4.28	4.48	5.30
3		3.69	3.35	1.84	1.86				5.05	4.47	5.06
2		2.70	2.58	1.74	1.72				5.23	5.77	6.00

Time of Minimum DO at every cell and over all layers — B1

ij	2	3	4	5	6	7	8	9	10	11	12
23		1/25	1/25	1/25	1/25	1/25	1/25	1/25	1/25		
22		9/14	9/14	9/14	9/14	9/14	9/14	9/14	9/14		
21		9/14	9/14	9/2	9/2	9/2	5/2	9/1	9/1		
20		9/1	9/1	5/2	5/2	9/1	9/1	9/1			
19		9/1	9/1	5/2	9/1	9/1	9/1	9/1			
18		9/1	9/1	9/1	9/1	9/1	9/1	9/1			
17		9/2	9/1	9/1	9/1	9/1	9/1	9/1			
16		9/2	9/1	9/1	9/1	9/1	9/1	9/1			
15		9/2	9/1	9/1	9/1	9/1	9/1	9/1			
14	9/2	9/1	9/1	9/1	9/1	9/1	9/1	9/1			
13	9/1	9/1	9/1	9/1	9/1	9/1	9/1	9/2			
12	9/2	9/2	9/1	9/1	9/1	9/1	9/2	5/5			
11	9/2	9/2	9/2	9/1	9/1	5/5	5/5	5/5			
10	9/5	9/1	9/1	9/2	5/5	5/5	5/5	9/6			
9		9/1	9/1	9/1	5/5	5/5	9/6	9/13			
8		9/1	9/1	9/1	9/1	9/6	9/6	9/13			
7		9/2	9/1	9/1	9/1	9/8	9/11	9/13			
6		9/6	9/1	9/1	9/1	9/6	9/6	9/11	9/13	1/25	1/25
5		9/10	9/9	9/1	9/1	9/9	9/1	9/1	9/11	9/11	9/11
4		9/12	9/7	9/1	9/1				9/11	9/12	9/13
3		9/12	9/10	9/1	9/1				9/13	9/12	9/13
2		9/6	9/2	9/2	9/2				9/13	9/13	1/25

Figure 5a, 5b, and 5c Case B1: Average DO, Minimum DO, and Time of Occurrence

Figure 6 Distribution of Minimum Dissolved Oxygen in Budd Inlet with no Annual Drawdown and no LOTT Discharge Case B1 – (results similar with LOTT discharge)

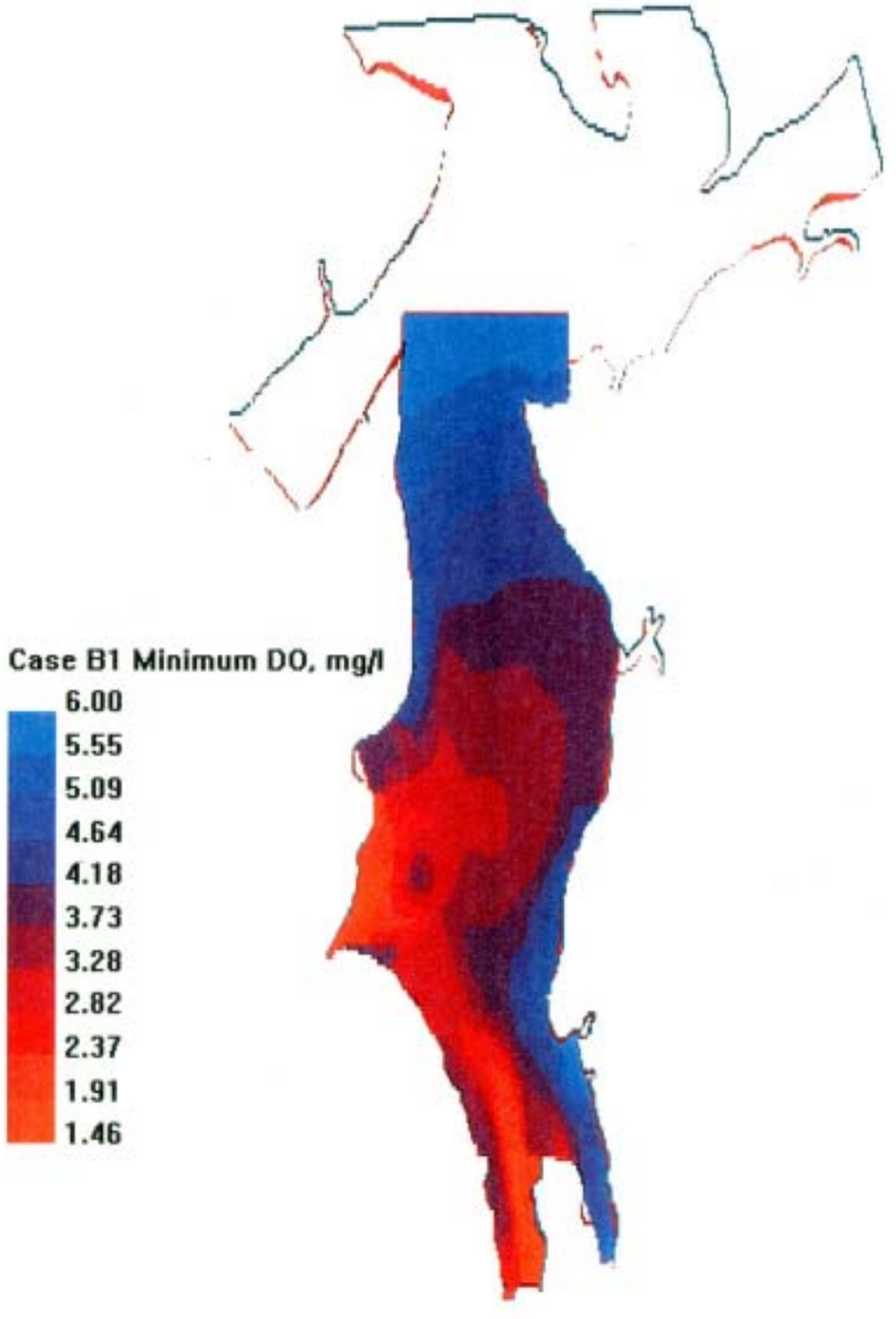


Figure 7a and 7b. Case B1 minus A1 - Maximum DO Difference and Date of Occurrence

Max DO difference based on every cell and layer — B1 minus A1

	2	3	4	5	6	7	8	9	10	11	12
23		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		
22		-0.48	-0.57	-0.63	-0.66	-0.65	-0.66	-0.65	-0.56		
21		-0.55	-0.63	-0.65	-0.65	-0.67	-0.67	-0.67	-0.63		
20		-0.60	-0.61	-0.58	-0.59	-0.59	-0.60	-0.61			
19		-0.56	-0.51	-0.47	-0.49	-0.74	-1.06	-1.19			
18		-0.59	-0.54	-0.80	-1.04	-1.13	-1.07	-1.08			
17		0.59	-0.75	-0.93	-0.93	-0.80	-0.79	-0.99			
16		0.83	-0.65	-0.65	-0.53	-0.56	-0.63	0.99			
15		0.64	0.41	-0.40	-0.41	-0.49	-0.57	-0.85			
14	0.81	0.70	0.53	-0.36	-0.36	-0.38	-0.51	-0.69			
13	0.60	0.54	0.47	0.41	0.37	-0.44	-0.42	-0.42			
12	0.79	0.53	0.45	0.44	0.40	-0.45	-0.47	-0.42			
11	0.88	0.72	0.55	-0.44	-0.51	-0.52	-0.63	0.42			
10	0.91	0.94	0.59	-0.50	-0.53	-0.54	0.54	-0.41			
9		1.01	0.87	0.66	-0.53	0.62	0.58	0.50			
8		-0.92	-0.81	-0.94	-1.19	-1.27	-1.03	-0.71			
7		-0.82	-0.82	-0.83	1.03	0.97	-1.15	-0.98			
6		0.73	0.68	0.69	-1.05	-0.92	-1.07	0.96	-0.68	-0.53	0.26
5		0.92	0.87	-0.63	-0.90	1.04	1.10	-1.53	-1.37	0.81	0.87
4		1.47	1.41	1.43	-1.52				0.98	0.80	0.58
3		2.17	2.15	2.18	2.24				0.58	0.78	0.57
2		-2.66	2.58	2.62	2.65				0.51	0.26	0.18

Time of Max DO difference based on every cell and layer — B1 minus A1

	2	3	4	5	6	7	8	9	10	11	12
23		7/18	7/18	7/18	7/18	7/18	7/18	7/18	7/18		
22		7/24	7/24	7/24	7/24	7/23	7/23	7/23	7/23		
21		7/24	7/24	7/24	7/24	7/23	7/23	7/23	7/23		
20		7/24	7/24	7/24	7/23	7/23	7/23	7/23			
19		7/24	7/24	7/23	7/24	7/24	7/24	7/24			
18		7/25	7/24	7/24	7/24	7/24	7/24	7/23			
17		7/26	7/24	7/24	7/24	7/23	7/23	7/23			
16		7/26	7/24	7/24	7/23	7/24	7/23	7/24			
15		7/26	7/26	7/23	7/23	7/23	7/24	7/24			
14	7/27	7/26	7/26	7/23	7/23	7/23	7/24	7/23			
13	7/27	7/27	7/27	7/26	7/26	7/24	7/24	7/24			
12	7/27	7/25	7/26	7/26	7/26	7/24	7/25	7/25			
11	7/27	7/27	7/24	7/24	7/24	7/24	7/26	7/23			
10	7/27	7/25	7/24	7/24	7/24	7/25	7/24	7/26			
9		7/26	7/26	7/26	7/24	7/29	7/29	7/29			
8		7/24	7/24	7/23	7/23	7/23	7/23	7/23			
7		7/22	7/24	7/24	7/26	7/26	7/23	7/23			
6		7/24	7/23	7/23	7/22	7/30	7/30	7/29	7/23	7/23	7/23
5		7/22	7/22	7/28	7/29	7/23	7/23	7/30	7/30	7/29	7/29
4		7/25	7/25	7/25	7/30				7/24	7/24	7/25
3		7/25	7/25	7/25	7/25				7/25	7/24	7/25
2		7/29	7/25	7/25	7/25				7/25	7/25	7/27

Figure 7c and 7d. Case B1 Minus A1 - Percent of Time and Average DO Difference

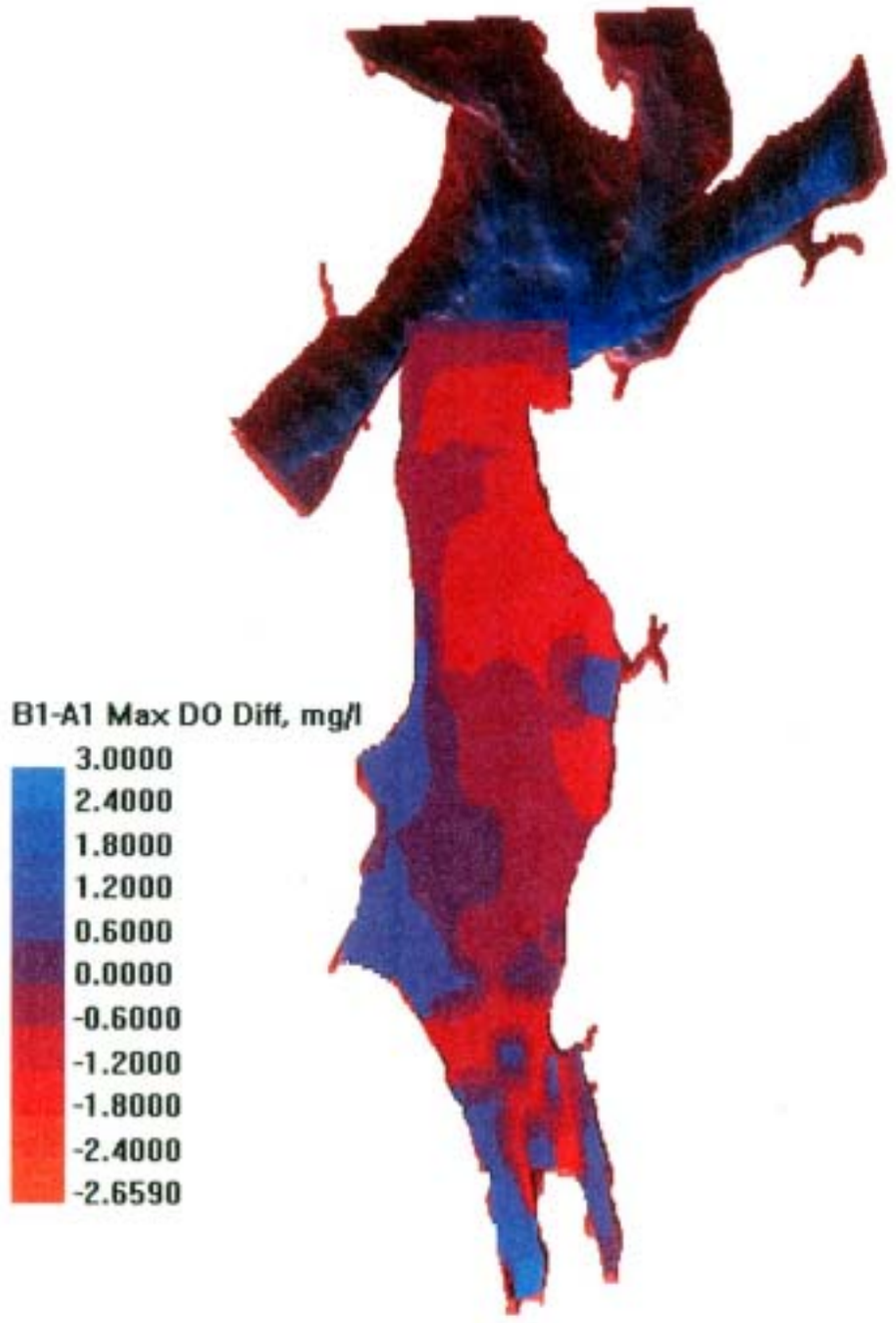
Percentage of Time DO differences occur at every cell and layer — B1 minus A1

	2	3	4	5	6	7	8	9	10	11	12
23		0.45	0.47	0.47	0.47	0.47	0.47	0.47	0.45		
22		4.93	4.68	4.51	4.45	4.77	4.83	5.31	5.57		
21		5.63	5.45	5.94	6.07	6.92	6.44	6.28	6.06		
20		6.56	5.99	6.74	6.86	6.96	6.93	6.75			
19		6.92	6.57	6.68	6.84	6.86	6.81	6.96			
18		7.23	6.62	7.07	6.66	6.82	6.70	7.06			
17		7.86	7.32	7.02	7.04	7.34	7.84	7.85			
16		8.11	7.36	7.62	7.84	8.01	8.16	8.54			
15		8.10	8.07	8.02	8.34	8.28	8.76	9.30			
14	8.91	8.89	8.61	8.44	8.86	8.70	9.19	9.45			
13	9.15	8.96	8.67	8.51	8.72	8.87	9.17	9.14			
12	9.52	8.88	9.00	8.77	8.86	8.86	9.15	9.16			
11	9.30	9.56	8.94	9.11	9.11	9.17	9.11	9.05			
10		9.82	9.73	9.17	9.22	9.33	9.29	8.79			
9		9.84	9.39	9.33	9.36	9.06	8.94	8.77			
8		9.73	9.62	9.44	9.32	9.15	8.88	9.02			
7		9.90	9.84	9.81	9.77	9.41	9.25	8.69			
6		10.00	10.14	9.96	10.00	9.61	9.55	9.17	8.72	8.29	7.55
5		9.77	10.40	10.46	10.29	9.68	9.80	9.93	9.43	9.17	9.40
4		9.89	10.42	10.53	10.51				9.64	10.00	8.70
3		9.48	10.43	10.56	10.55				9.34	9.81	9.11
2		10.19	10.44	10.54	10.63				9.13	8.98	9.07

Average DO difference at every cell and over all layers — B1 minus A1

	2	3	4	5	6	7	8	9	10	11	12
23		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
22		0.000	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001		
21		-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001		
20		-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002			
19		-0.001	-0.001	-0.001	-0.002	-0.002	-0.002	-0.002			
18		-0.001	-0.001	-0.001	-0.002	-0.002	-0.002	-0.002			
17		-0.002	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001			
16		-0.002	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001			
15		-0.001	0.000	0.000	0.000	0.000	0.000	0.000			
14	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000			
13	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000			
12	0.001	0.001	0.001	0.000	0.000	0.000	0.000	-0.001			
11	0.001	0.002	0.001	0.001	0.001	0.000	0.000	-0.001			
10	0.000	0.002	0.002	0.001	0.001	0.001	0.000	-0.001			
9		0.002	0.002	0.001	0.001	0.000	-0.001	-0.001			
8		0.001	0.001	0.000	-0.001	0.000	-0.001	-0.001			
7		0.001	0.001	0.001	0.000	-0.001	-0.001	-0.002			
6		0.002	0.002	0.002	0.001	0.000	0.000	-0.001	-0.002	-0.002	-0.003
5		0.002	0.002	0.003	0.002	0.001	0.001	0.002	0.001	0.000	0.001
4		0.004	0.004	0.004	0.004				0.002	0.003	-0.001
3		0.007	0.005	0.005	0.005				0.000	0.004	0.000
2		0.00	0.01	0.00	0.00				0.00	0.00	0.00

Figure 7e. Case B1 minus A1 - Plot of Maximum Difference in DO



Max DO difference based on every cell and layer — C1 minus A1

	2	3	4	5	6	7	8	9	10	11	12
23		0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02		
22		-0.64	-0.79	-1	-1.12	-1.16	-1.08	-0.99	-0.79		
21		-0.96	-1.29	-1.27	-1.14	-1.1	-1	-1.04	-0.86		
20		-1.38	-0.95	-0.99	-0.95	-0.93	-1.03	-1.11			
19		-1.22	-0.94	-0.77	-0.91	-1.27	-1.19	-1.31			
18		-1.22	-0.86	-1.02	-1.14	-1.24	-1.31	-1.43			
17		-0.75	-0.89	-1.08	-1.27	-1.44	-1.6	-1.75			
16		0.99	-0.87	-0.83	-0.9	-1.03	1.14	1.61			
15		-0.84	0.83	0.88	0.91	0.91	-0.94	1.3			
14	0.83	-0.91	0.92	1.01	1.06	1.07	-1.25	-1.76			
13	0.69	0.96	1.12	1.21	1.22	1.2	1.14	-1.53			
12	1.38	1.1	1.29	1.35	1.32	1.27	1.3	1.4			
11	1.14	1.39	1.46	1.44	1.34	1.37	1.52	1.64			
10	1.08	1.9	1.55	1.45	1.37	1.42	1.6	1.74			
9		2.23	1.78	1.61	1.5	1.71	1.66	1.82			
8		2.51	2.38	1.98	1.62	1.76	1.85	1.97			
7		3.09	3.05	2.78	2.48	2.12	2.27	2.27			
6		3.46	3.48	3.32	2.94	2.67	2.96	3.2	2.15	1.85	1.89
5		3.72	3.7	3.57	3.26	2.7	2.88	3.42	3.14	2.44	2.19
4		4.28	4.26	4.12	4.11				2.05	1.9	1.89
3		4.76	4.77	4.68	5.2				1.84	1.79	1.9
2		5.28	5.26	5.19	5.1				1.9	1.91	1.92

Time of Max DO difference based on every cell and layer — C1 minus A1

	2	3	4	5	6	7	8	9	10	11	12
23		8/17	8/17	8/17	8/17	8/17	8/17	8/17	8/17		
22		6/6	6/4	6/4	6/22	6/22	6/22	6/22	6/22		
21		6/4	6/4	6/4	6/22	6/22	6/22	6/26	6/26		
20		6/4	6/4	6/22	6/22	6/26	6/21	4/22			
19		6/2	6/2	6/26	4/22	4/22	4/22	6/22			
18		6/2	6/26	6/26	6/26	6/26	7/24	5/25			
17		5/25	6/26	6/26	6/26	6/26	6/26	6/26			
16		7/26	6/3	6/3	6/26	6/26	6/26	7/24			
15		5/25	9/14	9/14	9/14	9/14	6/21	7/24			
14	9/12	5/25	9/14	9/14	9/14	9/14	6/21	6/21			
13	6/4	9/14	9/14	9/14	9/14	9/14	9/14	6/20			
12	3/2	9/14	9/14	9/14	9/14	9/14	9/12	9/12			
11	6/4	6/16	9/14	9/14	9/14	9/12	9/12	9/12			
10	6/4	6/16	9/14	9/14	6/3	9/12	9/12	9/12			
9		6/16	9/10	9/10	6/3	6/3	9/12	9/12			
8		6/16	6/16	6/16	5/5	6/2	9/12	9/12			
7		6/16	6/16	6/16	6/4	6/2	9/12	9/12			
6		6/16	6/16	6/16	6/16	6/4	4/21	9/10	9/12	9/12	9/13
5		6/15	6/16	6/16	6/16	6/16	6/4	6/4	6/17	6/16	9/11
4		6/15	6/15	6/15	6/18				6/18	6/18	9/14
3		6/15	6/15	6/15	6/18				9/14	9/14	9/14
2		6/3	6/3	6/3	6/3				9/14	9/14	9/14

Figure 8a and 8b. Case C1 minus A1 - Maximum Difference and Time of Occurrence

Percentage of Time DO differences occur at every cell and layer — C1 minus A1

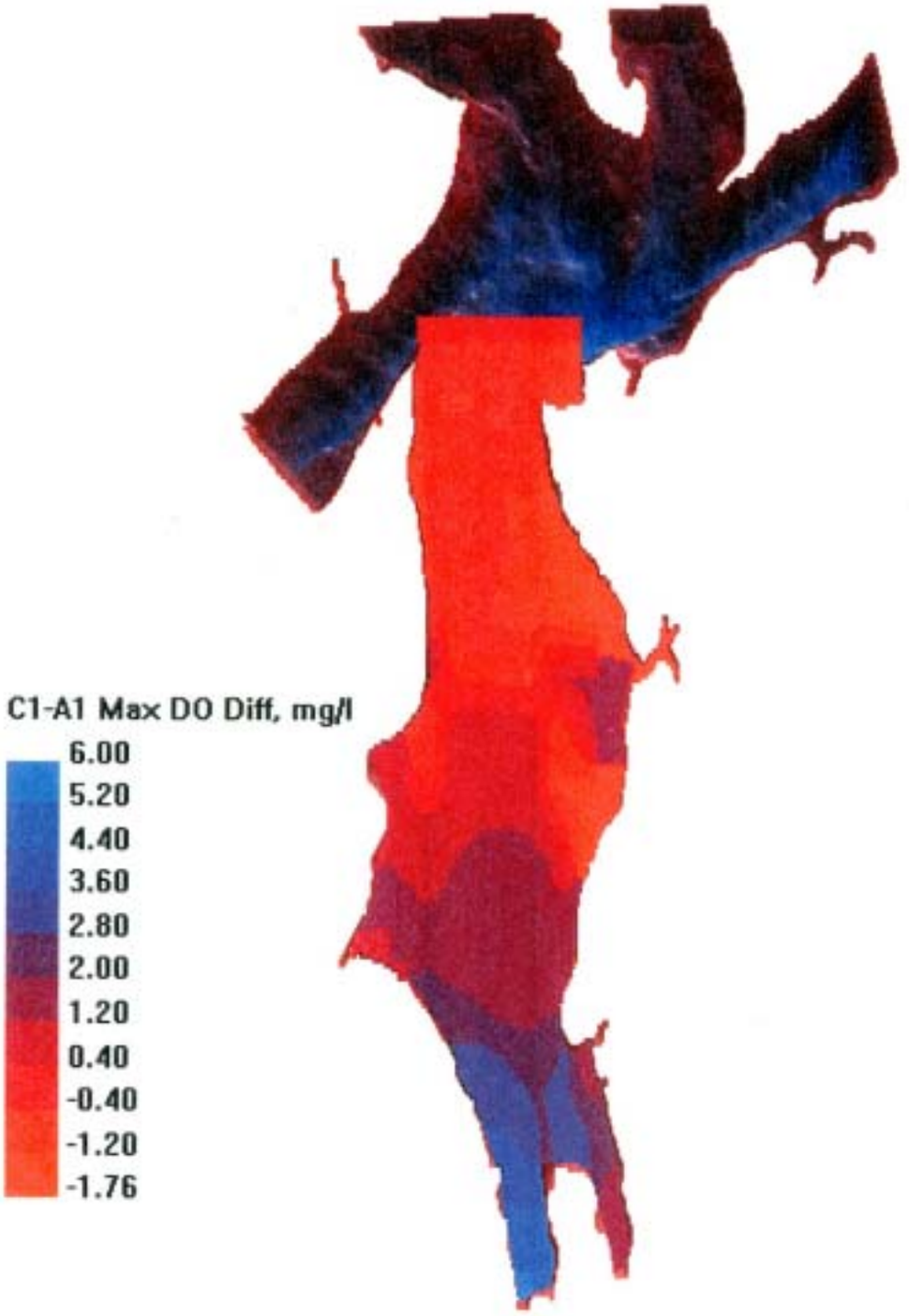
	2	3	4	5	6	7	8	9	10	11	12
23		1.78	1.75	1.75	1.75	1.75	1.75	1.76	1.78		
22		35.77	36.54	34.03	33.12	34.61	35.85	35.80	35.15		
21		46.66	49.31	46.55	45.80	46.14	48.23	47.29	42.19		
20		51.78	54.51	49.36	49.51	50.39	54.04	53.64			
19		53.93	55.63	50.44	50.24	50.44	55.00	53.98			
18		50.39	54.48	49.68	49.69	48.65	53.90	52.11			
17		42.18	47.28	49.55	50.41	50.03	51.43	51.72			
16		41.93	51.56	52.05	50.63	51.82	52.46	52.52			
15		44.92	54.80	54.97	53.69	53.86	51.64	52.36			
14	52.11	54.08	57.66	55.47	55.65	54.91	53.23	51.43			
13	60.18	60.63	59.41	57.76	56.57	54.70	54.12	50.49			
12	66.58	58.39	61.31	58.01	56.89	55.91	53.67	49.67			
11	65.66	65.19	61.33	59.23	57.80	55.85	53.53	51.23			
10	59.02	64.39	62.76	58.83	57.83	56.63	54.63	47.76			
9		64.48	63.71	60.89	60.17	56.72	52.67	49.15			
8		64.21	65.35	63.19	60.15	59.25	51.05	51.25			
7		65.56	67.23	67.70	64.92	57.58	52.24	47.09			
6		68.09	69.47	70.67	69.56	64.19	58.71	52.86	42.14	37.41	35.53
5		70.43	72.79	74.96	75.44	71.78	68.20	65.54	59.13	53.70	52.26
4		72.89	76.16	76.65	76.87				56.33	60.52	48.45
3		74.57	76.03	76.34	76.92				46.84	58.88	47.77
2		72.27	71.25	69.65	70.04				44.50	41.70	40.26

Average DO difference at every cell and over all layers — C1 minus A1

	2	3	4	5	6	7	8	9	10	11	12
23		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
22		0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01		
21		0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00		
20		0.00	0.00	0.00	0.00	0.00	0.00	0.00			
19		0.00	0.00	0.00	0.00	0.00	0.00	0.00			
18		0.00	0.00	0.00	0.00	0.00	0.01	0.01			
17		-0.01	0.00	0.00	0.01	0.01	0.01	0.02			
16		0.00	0.02	0.02	0.02	0.02	0.02	0.03			
15		0.01	0.03	0.03	0.03	0.03	0.03	0.04			
14	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04			
13	0.07	0.07	0.06	0.05	0.05	0.05	0.05	0.04			
12	0.10	0.07	0.08	0.07	0.06	0.06	0.05	0.04			
11	0.10	0.11	0.09	0.08	0.07	0.07	0.06	0.05			
10	0.07	0.12	0.11	0.09	0.08	0.08	0.07	0.04			
9		0.13	0.12	0.11	0.10	0.08	0.07	0.05			
8		0.14	0.14	0.13	0.11	0.10	0.07	0.07			
7		0.17	0.17	0.17	0.15	0.12	0.09	0.06			
6		0.23	0.22	0.22	0.22	0.19	0.16	0.12	0.03	0.01	0.01
5		0.34	0.33	0.32	0.31	0.27	0.25	0.24	0.17	0.11	0.10
4		0.58	0.51	0.47	0.47				0.14	0.17	0.06
3		0.83	0.77	0.62	0.62				0.07	0.17	0.07
2		0.91	0.83	0.69	0.69				0.06	0.04	0.04

Figure 8c and 8d. Case C1 minus A1 – Percent Time and Average DO Difference

Figure 8e. Distribution of Maximum Differences in DO for Case C1 minus A1 over Budd Inlet



Max DO difference based on every cell and layer — B2 minus A2

	2	3	4	5	6	7	8	9	10	11	12
23		-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01		
22		-0.49	-0.54	-0.57	-0.59	-0.62	-0.62	-0.62	-0.56		
21		-0.54	-0.56	-0.56	-0.61	-0.63	-0.62	-0.61	-0.60		
20		-0.56	-0.52	-0.52	-0.54	-0.54	-0.53	-0.60			
19		-0.52	-0.43	-0.42	-0.51	-0.86	-1.10	-1.04			
18		-0.55	-0.58	-0.86	-1.01	-0.98	-0.99	-1.03			
17		0.62	-0.77	-0.86	-0.76	-0.71	-0.72	-0.93			
16		0.76	-0.61	-0.56	-0.43	-0.53	-0.61	1.02			
15		0.62	0.40	-0.33	-0.41	-0.46	-0.50	-0.73			
14	0.85	0.69	0.51	-0.32	-0.35	-0.36	0.45	0.61			
13	0.60	0.54	0.48	0.39	0.34	-0.40	-0.38	-0.36			
12	0.76	0.52	0.44	0.43	0.41	-0.41	-0.45	-0.41			
11	0.84	0.70	0.53	0.42	-0.47	-0.49	-0.61	0.45			
10	0.88	1.05	0.57	-0.45	-0.49	-0.49	0.56	0.43			
9		0.95	0.85	0.68	-0.53	0.65	0.60	0.51			
8		-0.83	-0.75	-0.87	-1.16	-1.28	-1.06	-0.73			
7		-0.78	-0.77	-0.79	0.96	-0.90	-1.13	-1.02			
6		0.72	0.65	0.62	-1.02	-0.91	-1.00	0.99	-0.71	0.60	0.37
5		0.92	0.90	-0.83	-0.67	1.13	1.01	-1.89	-1.86	1.31	1.32
4		1.45	-1.51	-1.56	-1.86				1.12	1.08	0.67
3		2.16	2.13	2.17	2.22				0.68	0.92	0.68
2		2.61	2.58	2.61	2.63				0.59	0.31	-0.22

Time of Max DO difference based on every cell and layer — B2 minus A2

	2	3	4	5	6	7	8	9	10	11	12
23		7/24	7/24	7/24	7/24	7/24	7/24	7/24	7/24		
22		7/24	7/24	7/24	7/23	7/23	7/23	7/23	7/23		
21		7/24	7/24	7/23	7/23	7/23	7/23	7/23	7/23		
20		7/24	7/24	7/23	7/23	7/23	7/23	7/24			
19		7/24	7/24	7/23	7/24	7/24	7/24	7/24			
18		7/25	7/24	7/24	7/24	7/24	7/23	7/23			
17		7/26	7/24	7/24	7/24	7/23	7/24	7/23			
16		7/26	7/24	7/24	7/24	7/24	7/23	7/24			
15		7/26	7/27	7/23	7/23	7/23	7/24	7/23			
14	7/27	7/26	7/26	7/23	7/23	7/23	7/23	7/23			
13	7/27	7/27	7/27	7/26	7/26	7/24	7/24	7/24			
12	7/27	7/27	7/26	7/26	7/26	7/24	7/25	7/25			
11	7/27	7/27	7/24	7/27	7/24	7/24	7/26	7/23			
10	7/27	7/25	7/24	7/24	7/24	7/24	7/24	7/23			
9		7/26	7/26	7/26	7/23	7/29	7/29	7/29			
8		7/24	7/24	7/23	7/23	7/23	7/23	7/23			
7		7/22	7/22	7/30	7/26	7/23	7/23	7/23			
6		7/24	7/23	7/23	7/22	7/30	7/30	7/29	7/22	7/23	7/23
5		7/22	7/22	7/29	7/30	7/29	7/29	7/30	7/30	7/29	7/29
4		7/25	7/30	7/30	7/30				7/29	7/29	7/25
3		7/25	7/25	7/25	7/25				7/25	7/24	7/25
2		7/25	7/25	7/25	7/25				7/25	7/25	7/29

Figure 9a and 9b. Case B2 minus A2 - Maximum DO Difference and Time of Occurrence

Percentage of Time DO differences occur at every cell and layer — B2 minus A2

	2	3	4	5	6	7	8	9	10	11	12
23		0.65	0.61	0.61	0.61	0.61	0.61	0.63	0.65		
22		4.46	4.17	4.11	4.02	4.09	4.18	4.61	4.99		
21		5.20	5.25	5.37	5.75	6.39	6.03	5.77	5.75		
20		5.73	5.58	6.41	6.70	7.06	7.04	7.03			
19		6.55	6.41	7.16	7.45	7.65	7.43	7.82			
18		7.44	6.94	7.74	7.79	8.17	7.70	8.74			
17		8.14	7.78	7.82	8.24	8.72	8.87	9.42			
16		8.55	8.46	8.45	8.93	9.28	9.17	9.70			
15		9.01	9.02	9.12	9.78	9.60	10.07	10.17			
14	10.27	9.85	9.63	9.97	10.01	10.13	10.60	10.24			
13	10.54	10.39	10.01	10.13	10.51	10.56	10.60	10.50			
12	10.97	10.57	10.52	10.77	10.99	10.94	10.86	10.71			
11	10.90	11.26	11.13	11.10	11.23	11.36	11.30	11.07			
10	11.09	11.41	11.33	11.39	11.17	11.41	11.41	10.91			
9		11.81	11.49	11.71	11.37	11.22	10.89	10.93			
8		11.86	11.66	11.52	11.26	11.42	11.29	10.97			
7		12.02	11.86	12.01	11.55	11.00	11.19	11.08			
6		12.32	12.12	11.78	11.62	11.46	11.11	11.33	10.96	10.92	10.73
5		12.15	11.97	12.05	11.64	11.50	11.48	11.71	11.69	11.62	11.67
4		12.47	12.46	12.35	12.13				11.48	11.54	11.58
3		12.86	12.32	12.34	12.44				11.48	11.76	11.42
2		12.73	12.66	12.51	12.54				11.77	11.76	11.73

Average DO difference at every cell and over all layers — B2 minus A2

	2	3	4	5	6	7	8	9	10	11	12
23		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
22		0.000	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001		
21		-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001		
20		-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001			
19		-0.001	-0.001	-0.001	-0.002	-0.002	-0.002	-0.002			
18		-0.001	-0.001	-0.001	-0.001	-0.002	-0.001	-0.002			
17		-0.002	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001			
16		-0.002	-0.001	-0.001	-0.001	-0.001	-0.001	0.000			
15		-0.001	0.000	0.000	0.000	0.000	0.000	-0.001			
14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
13	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000			
12	0.001	0.001	0.001	0.001	0.000	0.000	0.000	-0.001			
11	0.001	0.002	0.001	0.001	0.001	0.001	0.000	-0.001			
10	0.000	0.002	0.002	0.001	0.001	0.001	0.000	-0.001			
9		0.002	0.002	0.001	0.001	0.000	-0.001	-0.001			
8		0.001	0.001	0.000	-0.001	0.000	-0.001	-0.001			
7		0.001	0.001	0.001	0.000	-0.001	-0.001	-0.002			
6		0.002	0.002	0.002	0.001	0.000	-0.001	-0.001	-0.002	-0.002	-0.003
5		0.002	0.002	0.002	0.001	0.000	0.001	0.001	0.001	0.001	0.001
4		0.004	0.004	0.003	0.003				0.001	0.002	-0.001
3		0.008	0.005	0.004	0.004				0.000	0.003	-0.001
2		0.005	0.005	0.004	0.004				0.000	-0.001	-0.001

Figure 9c and 9d. Case B2 minus A2 - Percent Time and Average DO Difference

Max DO difference based on every cell and layer — C2 minus A2

	2	3	4	5	6	7	8	9	10	11	12
23		-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01		
22		-0.74	-0.93	-1.1	-1.17	-1.14	-1	-0.91	-0.82		
21		-0.9	-1.19	-1.18	-1.08	-0.99	-0.96	-0.99	-0.87		
20		-1.3	-0.96	-0.92	-0.85	-0.86	-0.95	-1.17			
19		-1.18	-0.9	-0.88	-1	-1.31	-1.18	-1.38			
18		-1.08	-0.93	-1.09	-1.22	-1.32	-1.4	-1.43			
17		0.77	-0.9	-1.07	-1.2	-1.35	-1.48	-1.59			
16		0.94	-0.89	0.89	0.91	0.91	1.04	1.41			
15		0.88	0.93	1.01	1.05	1.08	-1.23	-1.41			
14	0.86	0.93	1.02	1.13	1.21	1.26	1.25	-1.63			
13	0.91	1.05	1.23	1.33	1.39	1.41	1.43	-1.45			
12	1.52	1.2	1.4	1.48	1.5	1.52	1.56	1.6			
11	1.13	1.41	1.57	1.58	1.56	1.58	1.65	1.73			
10	1.05	1.93	1.66	1.62	1.57	1.6	1.69	1.81			
9		2.3	1.87	1.74	1.57	1.85	1.76	1.88			
8		2.59	2.39	2.11	1.76	1.83	1.86	2.01			
7		2.99	3.05	2.94	2.6	2.17	2.2	2.18			
6		3.35	3.47	3.47	3.27	2.66	2.89	2.94	2.2	2.08	2.06
5		3.84	3.81	3.7	3.53	2.99	2.81	3.73	3.72	2.39	2.39
4		4.36	4.35	4.2	4.62				2.07	1.87	1.89
3		4.86	4.86	4.77	5.37				1.72	1.67	1.79
2		5.62	5.59	5.53	5.47				1.75	1.75	1.75

Time of Max DO difference based on every cell and layer — C2 minus A2

	2	3	4	5	6	7	8	9	10	11	12
23		1/26	1/26	1/26	1/26	1/26	1/26	1/26	1/26		
22		6/22	6/22	6/22	6/22	6/22	6/22	6/22	6/22		
21		6/4	6/4	6/4	6/22	6/22	6/26	6/26	6/26		
20		6/4	6/22	6/22	6/6	6/21	6/21	4/22			
19		6/2	6/2	6/26	6/26	4/22	4/22	6/22			
18		6/2	6/26	6/26	6/26	6/26	6/26	6/26			
17		7/26	6/26	7/24	6/26	6/26	6/26	6/26			
16		7/26	6/3	9/14	9/14	6/26	6/26	7/24			
15		9/14	9/14	9/14	9/14	9/14	6/21	6/21			
14	9/12	9/14	9/14	9/14	9/14	9/14	9/14	6/21			
13	6/4	9/14	9/14	9/14	9/14	9/14	9/14	6/20			
12	5/26	9/14	9/14	9/14	9/14	9/14	9/14	9/14			
11	6/4	4/22	9/14	9/14	9/14	9/14	9/14	9/14			
10	6/4	6/16	9/14	9/14	9/14	9/14	9/12	9/12			
9		6/16	9/10	9/10	6/3	6/3	9/12	9/12			
8		6/16	6/16	6/16	9/10	6/2	9/12	9/12			
7		6/16	6/16	6/16	6/16	6/2	9/12	9/12			
6		6/16	6/16	6/16	6/16	6/4	6/2	6/2	9/11	9/11	9/14
5		6/15	6/15	6/16	6/16	6/16	6/4	6/4	4/21	6/3	6/16
4		6/15	6/15	6/15	6/18				7/1	9/14	9/14
3		6/15	6/15	6/18	6/18				9/14	9/14	9/14
2		6/3	6/3	6/3	6/3				9/14	9/14	9/14

Figure 10a and 10b.Case C2 minus A2- Maximum DO Difference and Time of Occurrence

Percentage of Time DO differences occur at every cell and layer — C2 minus A2

	2	3	4	5	6	7	8	9	10	11	12
23		2.23	2.24	2.24	2.24	2.24	2.24	2.24	2.23		
22		35.05	35.78	33.30	32.00	32.92	34.01	34.58	33.30		
21		45.97	48.43	45.19	44.37	43.86	45.90	45.23	40.05		
20		51.21	53.61	47.63	47.37	48.23	52.00	52.00			
19		53.34	54.84	49.42	48.89	49.08	53.59	52.85			
18		49.88	53.70	48.68	48.38	46.74	52.52	50.91			
17		41.37	46.07	48.21	48.94	48.31	49.83	50.29			
16		40.51	50.63	50.78	48.86	49.91	50.37	50.77			
15		43.94	53.84	53.53	52.02	52.51	49.79	50.37			
14	50.89	53.00	56.53	54.21	53.79	53.15	50.89	49.22			
13	59.02	59.24	58.14	56.56	55.06	52.29	51.70	47.84			
12	65.56	57.07	60.24	56.57	54.94	53.71	51.38	46.97			
11	64.30	64.13	59.72	57.50	55.92	53.59	50.81	48.50			
10	57.34	62.86	61.11	56.91	55.90	54.50	52.05	45.84			
9		63.05	61.89	58.91	57.88	54.20	50.28	47.21			
8		62.46	63.46	61.12	57.85	57.11	49.27	49.70			
7		63.37	65.42	65.51	62.83	55.85	51.23	46.06			
6		65.94	67.71	69.13	68.24	63.44	58.42	52.79	42.35	37.27	35.64
5		69.22	71.41	73.80	74.36	71.71	69.31	65.45	59.26	54.23	52.64
4		71.97	75.18	75.35	75.55				57.09	60.81	48.55
3		73.96	74.90	75.08	75.66				47.85	60.26	47.95
2		71.55	70.52	68.75	69.03				45.33	42.34	39.39

Average DO difference at every cell and over all layers — C2 minus A2

	2	3	4	5	6	7	8	9	10	11	12
23		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
22		-0.01	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01		
21		0.00	0.00	0.00	0.00	-0.01	0.00	0.00	-0.01		
20		0.00	0.00	0.00	-0.01	-0.01	0.00	0.00			
19		0.00	0.00	0.00	0.00	0.00	0.00	0.00			
18		0.00	0.00	0.00	0.00	0.00	0.00	0.00			
17		-0.01	0.00	0.00	0.00	0.00	0.01	0.01			
16		-0.01	0.01	0.01	0.01	0.01	0.02	0.02			
15		0.01	0.03	0.03	0.03	0.03	0.03	0.03			
14	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03			
13	0.06	0.06	0.06	0.05	0.05	0.04	0.04	0.03			
12	0.10	0.07	0.07	0.06	0.06	0.05	0.05	0.03			
11	0.09	0.10	0.09	0.07	0.07	0.06	0.05	0.05			
10	0.07	0.12	0.10	0.08	0.07	0.07	0.06	0.04			
9		0.13	0.12	0.10	0.09	0.08	0.06	0.05			
8		0.13	0.13	0.12	0.10	0.10	0.07	0.07			
7		0.17	0.16	0.16	0.15	0.12	0.10	0.06			
6		0.23	0.22	0.22	0.21	0.19	0.17	0.13	0.05	0.02	0.02
5		0.35	0.34	0.33	0.33	0.31	0.30	0.28	0.21	0.14	0.13
4		0.61	0.53	0.48	0.49				0.17	0.21	0.09
3		0.86	0.79	0.62	0.62				0.09	0.21	0.09
2		0.92	0.84	0.69	0.70				0.08	0.06	0.05

Figure 10c and 10d. Case C2 minus A2 - Percent Time and Average DO Difference

Max DO difference based on every cell and layer — C1 minus B1

ij	2	3	4	5	6	7	8	9	10	11	12
23		0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02		
22		-0.64	-0.79	-1	-1.12	-1.16	-1.08	-0.99	-0.79		
21		-0.96	-1.29	-1.27	-1.14	-1.1	-1	-1.04	-0.86		
20		-1.38	-0.95	-0.99	-0.95	-0.93	-1.03	-1.11			
19		-1.22	-0.94	-0.77	-0.91	-1.27	-1.19	-1.31			
18		-1.22	-0.86	-1.02	-1.14	-1.24	-1.29	-1.43			
17		-0.75	-0.89	-1.08	-1.27	-1.44	-1.6	-1.75			
16		-0.91	-0.87	-0.83	-0.9	-1.03	1.14	-1.19			
15		-0.84	0.83	0.88	0.92	0.91	-0.94	-1.29			
14	0.83	-0.91	0.93	1.01	1.06	1.07	-1.25	-1.76			
13	0.89	0.96	1.11	1.2	1.22	1.19	1.13	-1.53			
12	1.38	1.07	1.25	1.32	1.32	1.26	1.29	1.39			
11	1.14	1.39	1.38	1.4	1.33	1.37	1.51	1.63			
10	1.08	1.9	1.51	1.43	1.37	1.41	1.59	1.72			
9		2.23	1.78	1.61	1.5	1.71	1.65	1.8			
8		2.51	2.38	1.98	1.62	1.76	1.86	1.96			
7		3.09	3.05	2.78	2.48	2.12	2.28	2.26			
6		3.46	3.48	3.32	2.94	2.67	2.96	3.18	2.11	1.87	1.87
5		3.72	3.7	3.57	3.26	2.7	2.88	3.42	3.14	2.44	2.15
4		4.28	4.26	4.12	4.11				2.05	1.9	1.89
3		4.76	4.77	4.68	5.2				1.84	1.79	1.9
2		5.28	5.26	5.19	5.1				1.89	1.91	1.92

Time of Max DO difference based on every cell and layer — C1 minus B1

ij	2	3	4	5	6	7	8	9	10	11	12
23		8/17	8/17	8/17	8/17	8/17	8/17	8/17	8/17		
22		6/6	6/4	6/4	6/22	6/22	6/22	6/22	6/22		
21		6/4	6/4	6/4	6/22	6/22	6/22	6/26	6/26		
20		6/4	6/4	6/22	6/22	6/26	6/21	4/22			
19		6/2	6/2	6/26	4/22	4/22	4/22	6/22			
18		6/2	6/26	6/26	6/26	6/26	6/26	5/25			
17		5/25	6/26	6/26	6/26	6/26	6/26	6/26			
16		6/3	6/3	6/3	6/26	6/26	6/26	6/26			
15		5/25	9/14	9/14	9/14	9/14	6/21	6/20			
14	9/12	5/25	9/14	9/14	9/14	9/14	6/21	6/21			
13	6/4	9/14	9/14	9/14	9/14	9/14	9/14	6/20			
12	3/2	9/14	9/14	9/14	9/14	9/14	9/12	9/12			
11	6/4	6/16	9/14	9/14	9/14	9/12	9/12	9/12			
10	6/4	6/16	9/10	9/14	6/3	9/12	9/12	9/12			
9		6/16	9/10	9/10	6/3	6/3	9/12	9/12			
8		6/16	6/16	6/16	5/5	6/2	9/12	9/12			
7		6/16	6/16	6/16	6/4	6/2	9/12	9/12			
6		6/16	6/16	6/16	6/16	6/4	4/21	9/10	9/12	9/12	9/13
5		6/15	6/16	6/16	6/16	6/16	6/4	6/4	6/17	6/16	9/11
4		6/15	6/15	6/15	6/18				6/18	6/18	9/14
3		6/15	6/15	6/15	6/18				9/14	9/14	9/14
2		6/3	6/3	6/3	6/3				9/14	9/14	9/14

Figure 11a and 11b Case C1 - B1: Maximum DO Difference and Date of Occurrence

Percentage of Time DO differences occur at every cell and layer — C1 minus B1

ij	2	3	4	5	6	7	8	9	10	11	12
23		1.79	1.74	1.74	1.74	1.74	1.74	1.75	1.79		
22		35.89	36.37	34.01	33.35	34.70	36.07	36.03	35.52		
21		47.05	49.76	47.08	46.30	46.43	48.69	47.79	42.79		
20		52.23	55.15	50.17	50.22	51.01	54.45	54.03			
19		54.53	56.37	51.25	51.04	51.27	55.68	54.52			
18		51.32	55.17	50.61	50.46	49.26	54.42	52.92			
17		43.14	48.01	50.27	50.93	50.58	52.07	52.48			
16		42.84	52.30	52.59	51.05	52.23	52.91	52.97			
15		45.70	55.36	55.56	54.08	54.25	52.25	52.82			
14	52.96	54.77	58.21	56.16	56.18	55.40	53.78	52.15			
13	60.83	61.34	60.19	58.51	57.23	55.39	54.73	51.41			
12	67.23	59.20	62.17	58.92	57.63	56.55	54.52	50.59			
11	66.32	65.76	62.00	59.99	58.60	56.72	54.34	52.41			
10	59.87	64.89	63.21	59.47	58.58	57.62	55.66	49.06			
9		65.21	64.38	61.59	60.99	57.73	53.71	50.51			
8		65.08	66.01	63.91	61.05	60.34	52.30	52.39			
7		66.05	67.62	68.21	65.58	58.65	53.40	48.17			
6		68.31	69.79	71.03	70.22	65.14	59.87	54.06	43.50	39.45	37.22
5		70.51	72.88	75.18	75.67	72.44	69.00	66.13	60.26	54.72	53.11
4		72.99	76.28	76.69	76.91				57.36	61.47	49.74
3		74.58	76.05	76.30	76.91				47.40	59.57	48.77
2		72.34	71.29	69.69	70.10				44.74	42.03	40.97

Average DO difference at every cell and over all layers — C1 minus B1

ij	2	3	4	5	6	7	8	9	10	11	12
23		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
22		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
21		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
20		0.00	0.00	0.00	0.00	0.00	0.00	0.00			
19		0.00	0.00	0.00	0.00	0.00	0.01	0.01			
18		0.00	0.00	0.00	0.00	0.00	0.01	0.01			
17		-0.01	0.00	0.01	0.01	0.01	0.01	0.02			
16		0.00	0.02	0.02	0.02	0.02	0.02	0.03			
15		0.01	0.03	0.03	0.03	0.03	0.03	0.04			
14	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04			
13	0.07	0.07	0.06	0.05	0.05	0.05	0.05	0.04			
12	0.10	0.07	0.07	0.07	0.06	0.06	0.05	0.04			
11	0.09	0.11	0.09	0.08	0.07	0.07	0.06	0.05			
10	0.07	0.12	0.11	0.09	0.08	0.08	0.07	0.04			
9		0.13	0.12	0.11	0.10	0.08	0.07	0.06			
8		0.13	0.14	0.13	0.11	0.10	0.07	0.07			
7		0.17	0.16	0.16	0.15	0.12	0.09	0.06			
6		0.23	0.22	0.22	0.21	0.18	0.16	0.12	0.03	0.01	0.01
5		0.33	0.32	0.31	0.31	0.27	0.25	0.24	0.16	0.11	0.10
4		0.58	0.51	0.47	0.47				0.14	0.17	0.06
3		0.82	0.77	0.61	0.62				0.07	0.16	0.07
2		0.90	0.82	0.69	0.69				0.06	0.04	0.04

Figure 11c and 11d Case C1 minus B1: Percent Time and Average DO Difference

Figure 11e Case C1 minus B1 - Maximum DO Difference, mg/l