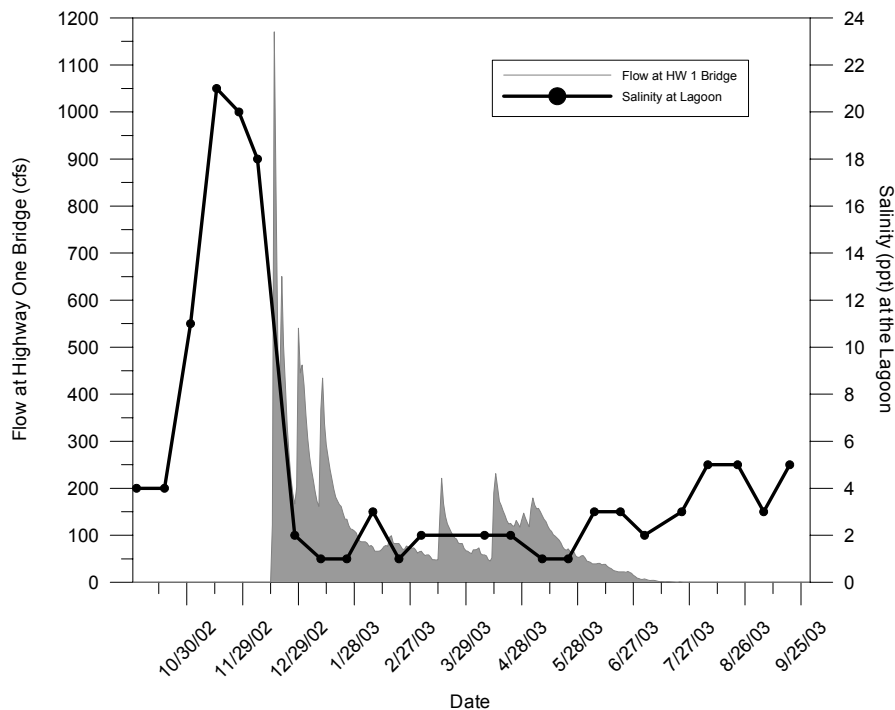


## SECTION 5.6.2 CARMEL RIVER LAGOON WATER QUALITY

Since 1991, the MPWMD has collected surface water quality data at the Carmel River Lagoon (**Appendix 5.6**). Location and description of sampling stations can be found in **Appendix 5.6**. Data were collected for the following chemical and physical parameters: temperature (°F), dissolved oxygen (mg/L), carbon dioxide (mg/L), pH, specific conductance (uS/cm), salinity (ppt), and turbidity (NTU). The emphasis for this suite of parameters is on the suitability for rearing juvenile steelhead.

Water quality in the Carmel River Lagoon is dependent on freshwater inflow from the Carmel River, tidal levels, and ocean waves over topping the sandbar from the Pacific Ocean. It is typical to observe a decline in water quality during the late summer, fall and early winter months. This is due primarily to a lack of freshwater input and inflow of seawater. For example, during Water Year 2003, there was no freshwater inflow until December 15, 2002 (**Figure 5.6.2-A**). During the time before December 15, 2002, ocean waves over topped the sandbar and added salt water and marine organic material to the lagoon. As shown below, the salinity within the lagoon increased. The marine organic material entering the lagoon causes an increase in decomposition. As shown in **Table 5.6.2-A**, November 2002, this resulted in an increase in carbon dioxide and a decrease in dissolved oxygen. This is a common scenario in the lagoon. Timing of inflows and amount of marine organic material entering the lagoon varies from year to year. The severity of water quality degradation that occurs due to these factors also varies from year to year.

**Figure 5.6.2-A.** Freshwater inflow and salinity measurements at the Carmel River Lagoon during WY 2003.

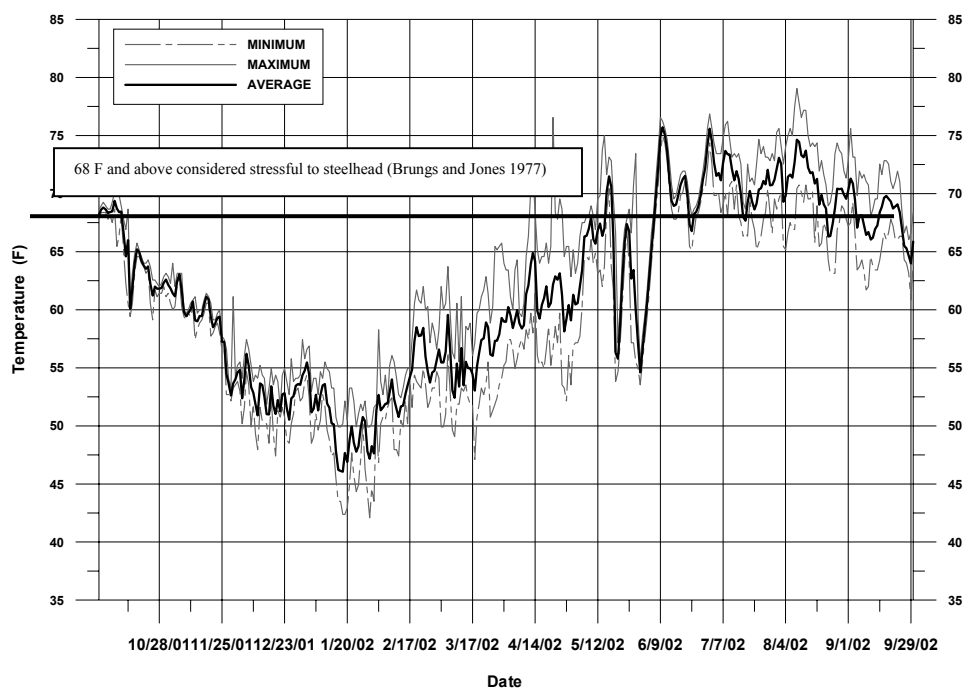


**Table 5.6.2-A.** Water quality data collected during WY2003 at Carmel River Lagoon.

Date	Time (24 hr)	Temperature (F)	Dissolved Oxygen (mg/L)	Carbon Dioxide (mg/L)	pH	Conductivity (uS/cm)	Nacl (ppt)	Turbidity (NTU)
03-Oct-02	13:13	66.0	11.0	10.0	8.0	9650	4	N/A
18-Oct-02	13:10	63.0	10.0	10.0	8.0	4780	4	N/A
01-Nov-02	12:10	55.0	10.0	10.0	8.0	15160	11	N/A
15-Nov-02	12:15	56.0	2.0	40.0	6.5	>19999	21	N/A
27-Nov-02	11:20	55.0	2.0	35.0	7.5	>19999	20	N/A
12-Dec-02	11:45	53.0	7.0	35.0	7.5	>19999	18	N/A
27-Dec-02	12:30	54.0	9.0	5.0	7.5	437	2	1.5
10-Jan-03	12:25	56.0	10.0	10.0	7.5	283	1	55.0
24-Jan-03	12:50	57.0	10.0	10.0	7.5	1447	1	1.0
07-Feb-03	13:45	52.0	11.0	10.0	7.5	788	3	0.4
21-Feb-03	12:45	58.0	11.0	10.0	8.0	601	1	0.5
05-Mar-03	13:45	60.0	11.0	5.0	8.0	1093	2	0.4
08-Apr-03	14:30	67.0	9.0	10.0	8.0	1324	2	1.2
22-Apr-03	13:35	61.0	10.0	10.0	7.5	1321	2	1.2
09-May-03	12:30	61.0	10.0	10.0	7.5	779	1	1.2
23-May-03	12:25	64.0	9.0	10.0	8.0	565	1	0.7
06-Jun-03	11:40	66.0	9.0	10.0	7.5	1628	3	2.2
20-Jun-03	12:00	69.0	8.0	10.0	8.0	3190	3	1.2
03-Jul-03	12:35	70.0	10.0	15.0	8.0	3320	2	0.7
23-Jul-03	15:10	72.0	11.0	15.0	8.0	5080	3	0.6
06-Aug-03	11:10	75.0	10.0	25.0	8.0	10940	5	1.5
22-Aug-03	13:15	72.0	11.0	25.0	8.0	7160	5	1.0
05-Sep-03	13:05	71.0	12.0	25.0	8.0	6130	3	3.0
19-Sep-03	12:45	70.0	11.0	30.0	8.0	8660	5	5.2
<b>Minimum</b>		52.0	2.0	5.0	6.5	283.0	1.0	0.4
<b>Maximum</b>		75.0	12.0	40.0	8.0	>19999.0	21.0	55.0
<b>Average</b>		62.6	9.3	16.0	7.8			

Lagoon water temperature commonly exceeds 70 degrees Fahrenheit (°F) during the late summer and early fall period. An example of lagoon water temperature in the south arm for WY 2002 is shown in **Figure 5.6.2-B**. Constant water temperature over 68°F is considered to be stressful on steelhead (Brungs and Jones 1977). Factors affecting water temperature within the lagoon are surface water elevation, air temperature, wind, and water temperature of inflow (freshwater and/or sea water). Water temperature graphs for two sampling stations within the lagoon are presented in **Appendix 5.6**.

**Figure 5.6.2-B.** Water temperature for the South Arm Lagoon during WY 2002.



Favorable water quality conditions for rainbow trout/steelhead culture are listed in **Table 5.6.2-B** (Piper et al., 1982). Also listed below is the Central Coast Basin Plan water quality objectives set by the California Regional Water Quality Control Board. This criteria states that the minimum dissolved oxygen be 7.0 mg/L and the pH range between 7-8.5 at any given time (SWRCB, 1994).

**Table 5.6.2-B.** Suggested chemical criteria for trout hatchery water supply and Central Coast Basin Plan water quality criteria for cold-water estuaries.

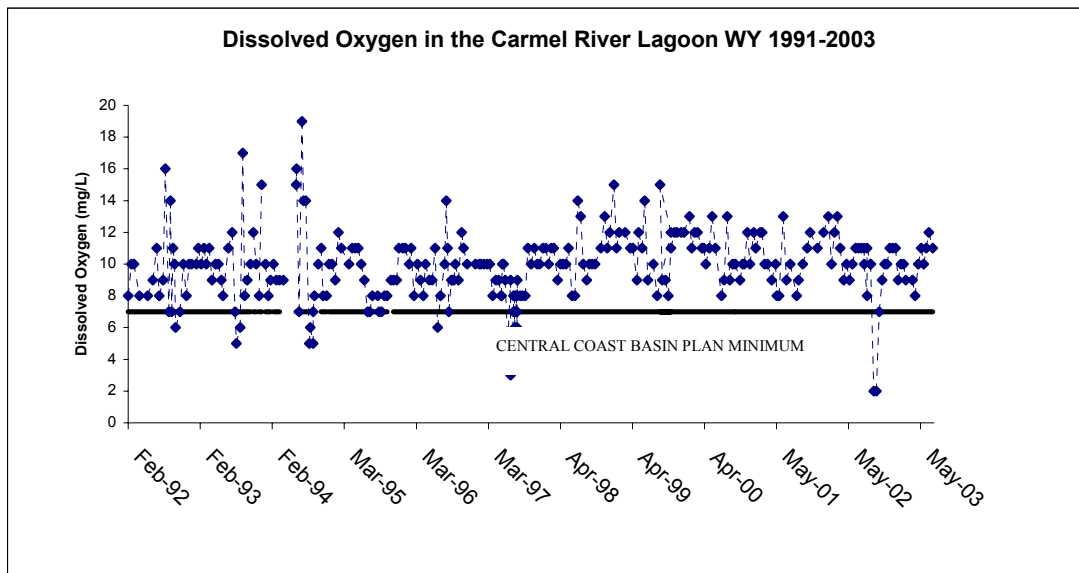
<i>Parameter</i>	<i>Hatchery water supply*</i>	<i>Central coast basin plan **</i>
Temperature range	33-78°F	never 5°F above natural receiving water temp.
Optimum temperature range	50-60°F	N/A
Dissolved oxygen	5 mg/l -saturation	not less than 7.0 mg/L
pH	6.5-8.0	7.0-8.5
Carbon dioxide	0-10 mg/l	N/A

\* Piper et al. 1982

\*\* SWRCB, 1994

Dissolved oxygen in the Carmel River Lagoon periodically violates Central Coast Basin Plan water quality guidelines. For example, in six of the last twelve years, dissolved oxygen measurements have been recorded below 7.0 mg/L (**Figure 5.6.2-C**). This is usually observed in the late summer and fall months and is primarily due to increasing water temperature and/or an inflow of large amounts of marine organic material.

**Figure 5.6.2-C.** Dissolved Oxygen measurements recorded from the Carmel River Lagoon during WY 1991-2003.



References:

Brungs, W. and B. Jones, 1977. *Temperature Criteria for Freshwater Fish: Protocol and Procedures*. Environmental Research Lab-Duluth, Minn. EPA/600/3-77/061.

Piper, R et al, 1982. *Fish Hatchery Management*. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C.

SWRCB, 1994. *Central Coast Basin Plan-Ch.3 Water Quality Objectives*. Central Coast Region, San Luis Obispo, CA.