Appendix A: Marina Description and History

Marina Description and History

This appendix contains the responses of a marina manager survey that DPR sent out to the 23 marinas that participated in this study. The information that is presented in this section includes the marina's general description and history. Moreover, each marina owner/manager provided information on the types of vessels found in the marina, the capacity of the marina, and other potential sources of metals in the marina environment (besides the AFP sources). If available, the marina URL or web link, which could contain additional information on the marina, is also provided. Lastly, a table of GPS coordinates for the marinas in this study is presented at the end of this appendix (Table A-1).

Tahoe Keys Marina

The Tahoe Keys Marina, located near the southern shore of Lake Tahoe, was built 35 years ago on the Truckee Marsh. The Truckee River flows into the lake through the remnant of the marsh. In the 1960s the residential/resort lots (Tahoe Keys) and marina were dredged from the existing marsh, and two channels were built to give the keys and marina access to the lake. Tahoe Keys uses the west channel, and the marina uses the east channel. As a result of a lawsuit brought by the Washoe Indian Tribe, flow is maintained in the Truckee River throughout the year to promote fishing.

The Tahoe Keys Marina has 230 slips, 100 percent of which were occupied in the summer of 2006. Because the Tahoe Keyes Marina is located on a freshwater, oligotrophic lake, antifouling paints and hull cleaning have not been used extensively. The majority of the vessels in the marina are recreational boats; only three are commercial boats.

Potential sources of copper in the Tahoe Keys Marina are unknown to the owners of the marina, and the marina's wooden structures have not been treated with wood preservatives. The marina's docks are constructed of either cement or pressure-treated wood. The marina has not been dredged within the last four years.

Online information for the Tahoe Keys Marina can be found at www.tahoemarina.com.

Folsom Lake Marina

The Folsom Lake Marina is located at Browns Ravine in the Folsom Lake State Recreational Area, as a concession for the California State Park System. The marina is protected from the main body of the lake by an earth-filled breakwater. Folsom Lake is the reservoir behind Folsom Dam on the American River.

The American River was developed during the Gold Rush era. The first dam on the American River was a hydroelectric dam, the Folsom Powerhouse Dam, built in 1893 as a logging impoundment and converted in 1895 to a power generating facility. Folsom Lake was formed when Folsom Dam was built in 1955 to provide flood control works to protect Sacramento, and the Folsom Powerhouse Dam was removed. The operable lake level ranges for Folsom Lake Marina are between 360 and 465 feet.

Folsom Lake Marina has 674 wet slips and 175 dry slips. Additionally, there is a courtesy ramp. The slips accommodate boats up to a 26 feet long, and there is a three- to six-year waiting period for slip rental depending on the size of the boat. Lake businesses rent boats and recreational equipment.

Online information for the Folsom Lake Marina can be found at http://www.folsomlakemarina.com/

Sacramento Marina

The Sacramento Marina is located about two miles south of the confluence of the Sacramento and American rivers. The original portion of the marina, 261 slips, was constructed in 1959. In 1990, the soccer field to the north of the marina was abandoned and the size of the basin was enlarged. An additional 284 slips and the marina office were constructed at that time.

The original portion of the marina were replaced by new concrete docks in 2008. With the completion of the new concrete docks, the marina now has 475 slips. All of the docks at the Sacramento Marina are made of concrete. The pilings in the north basin are constructed of concrete and the new pilings in the south basin are steel There are no submerged wooden structures in the Marina.

The average occupancy at the marina in the summer of 2006 was approximately 97%, with nearly all recreational boats. The marina was last dredged in October of 2007. Annual or semi annual dredging is required at the entrance to the marina. Silts and sediments that fill the Sacramento River are derived from the northerly portion of the Sacramento watershed.

Online information for the Sacramento City Marina can be found at http://www.sacramentomarina.com/about/index.html.

Village West Marina

The Village West Marina is located in Fourteen Mile Slough, north of the Calaveras River. This marina was excavated and built in 1972 on a point of land that was left after the levee was breached. The land was likely farmed prior to the establishment of Village West Marina.

The marina started with three docks, and grew over time to its current size of about 20 docks with most of them being covered. There are currently 650 covered slips and 50 open slips. The marina was 85% occupied in the summer of 2006. The marina pilings are composed of metal. No creosote was used in any of the wood structures within the marina. The harbormaster, Mike Spence, mentioned that he discourages boaters from using metal antifouling paints because they are not necessary in freshwater and are an unnecessary expense. In the summer of 2006 all boats in the marina were recreational.

The Village West Marina is located on the San Joaquin River, which does not flow through the marina, resulting in a long residence time for marina water. It was last dredged three to four years ago (approximately 2003).

Online information for the Village West Marina can be found at http://www.villagewestmarina.com/

Antioch Marina

The Antioch Marina is located on the south side of the San Joaquin River, east of the San Francisco Bay, approximately 3 1/4 miles west of the Antioch Bridge. The depth of the marina is a natural gradient from the center of the San Joaquin River (68 feet) to the shore, with an average water depth of 10 feet within the marina.

The Antioch Marina was completed in 1988. Prior to the marina being built, the site housed a cannery. Part of the present marina site was a slough connecting to the a wetlands preserve.

The Antioch Marina has 310 slips, occupied to about 82 percent of capacity in the summer of 2006. All of the vessels docked in the Antioch Marina are recreational.

Wood in the Antioch Marina is pressure treated with chromated copper arsenate. However, no treated wood is submerged. All floats and pilings are concrete. Storm drains from the marina terminate in the Antioch Marina basin, as does a storm drain along the adjacent railroad tracks.

34,000 cubic yards of material was dredged from the Antioch Marina in April 1998. The Antioch Marina does not expect to dredge again until 2012.

Online information for the Antioch Marina can be found at www.ci.antioch.ca.us/CitySvcs/Marina/.

Pittsburg Marina

The Pittsburg Marina is located approximately five miles west of the Antioch Marina along the New York Slough on the San Joaquin River. It was built in various stages from an initial fishing village to the addition of several additional basins some 25 years ago.

The Pittsburg Marina has 600 slips with a 75% occupancy, all of which are recreational.

There are no major submerged structures; however, there are approximately 100 wooden piles, which are about 50-years old. The harbormaster is not aware of any unusual sources of copper in the marina. Sixty percent of the Pittsburg Marina was dredged in 2005.

Online information for the Pittsburg Marina can be found at www.pittsburgmarina.com/pittsburg/marina/.

Benicia Marina

The Benicia Marina was built on a garbage dump in historic Benicia, California. It is located west of the Benicia-Martinez Bridge, on the north shore of the Carquinez Strait downstream from Suisun Bay. The City of Benicia was founded in 1848, and hosted one of the first large industrial operations in California, the Pacific Mail Steamship Company, which operated from 1879 until 1930 as a repair, refueling, and cleaning facility. The permit to build the Benicia Marina was obtained in 1977; however, the marina was not occupied until 1984.

In the summer of 2006, the Benicia Marina had 300 slips, with 95 percent occupancy. All the boats in the marina are recreational. The marina has been dredged for sediment every year for the past nine years. There are two creosote-treated pilings in Benicia Marina.

Online information for the Benicia Marina can be found at http://www.beniciachamber.com/guide/marina.html.

Vallejo Municipal Marina

The Vallejo Marina is located about three miles north of the Carquinez Strait on the Napa River. The marina has two basins that were constructed in two phases. The north basin was constructed between 1960 and 1962, the south basin between 1990 and 1992.

In the north basin there are creosote-treated piles. In both basins, the breakwaters are steel piles with treated wood sheathing. The north basin breakwater was installed between 1975 and 1977 and the south basin between 1990 and 1992. The last dredging in both basins occurred in 2003. The entrance areas need to be dredged every four years.

During the sampling period, the Vallejo Marina had 800 slips with about 60 percent occupancy. Approximately five percent of the slips are used by commercial vessels.

Online information for the Vallejo Municipal Marina can be found at http://www.ci.vallejo.ca.us/GovSite/

Loch Lomond Marina

The Loch Lomond Marina is located in San Rafael, northeast of the mouth of San Rafael Creek and the western end of Richmond-San Rafael Bridge at Point San Quentin and southwest of the mouth of San Pablo Bay. The land area was extended by fill to create Loch Lomond Marina in the early 1950s. The Loch Lomond Yacht Club was established in 1962. Completely rebuilt in the 1990s, the Loch Lomond Marina is one of the largest marinas in the North Bay. The marina was last dredged in 2002, to a depth of eight feet. Most of the pilings are pressure treated, and there are no major submerged structures in the marina besides for the piling sections that are under water.

The Loch Lomond Marina has 524 slips that can accommodate vessels from 62 to 104 feet. The marina was filled to 82 percent of capacity in summer 2006. About ninety-seven percent of the vessels are recreational.

Online information for the Loch Lomond Marina can be found at www.lochlomondmarina.com.

Marina Bay Yacht Harbor

The Marina Bay Yacht Harbor is located in Richmond, on the east shore of San Francisco Bay near the Richmond-San Rafael Bridge. The marina was built between 1980 and 1985 on property that was used during World War II and after as a part of the Kaiser shipyards. The area where the marina was built had been used by the Navy for ship repairs, and the Ford Motor Company had an assembly plant nearby.

When Richmond received possession of the area, there was major contamination. Many years and much care was taken to clean up most of the soil, but some areas were simply capped or left to deal with later. Since 2006, more buried drums have been discovered on shore immediately adjacent to the water. Wood pilings, likely treated with creosote, have been found in the water off of one of the docks and in the area of the marina's launch ramp.

There are several potential sources of non-AFP copper in the marina area, particular during period of wet-weather. Some of the sources may be more significant than other. One of the marina's docks (dock D) has copper pipe running just above the waterline. Contaminated soil surrounding the harbor could be another source to the harbor. The parking lot drains empty directly into the harbor, which includes the housing units surrounding the marina. The marina enforces strict rules that prohibit any activity other than parking and the street drains are clearly marked.

The Marina Bay Yacht Harbor has 850 slips including end slips and side-ties. The marina was 85 percent occupied during the summer of 2006. Ninety-five percent of the vessels are recreational and five percent are commercial.

Online information for the Marina Bay Yacht Harbor can be found at http://www.marinabayyachtharbor.com/.

Clipper Yacht Harbor

The Clipper Yacht Harbor is located in Sausalito, California, on the west shore of Richardson Bay. It is a full-service marina built in 1947. Prior to the marina, the area was the Marinship Shipyard owned by the Bechtel Company. During World War II, the company produced 93 vessels in three and a half years, operating round the clock, employing 70,000 workers.

There are 667 slips in Clipper Yacht Harbor, with 90 percent of the slip capacity filled during the summer of 2006. Ninety-five percent of the vessels are recreational, with approximately five percent commercial or charter vessels.

There are no known sources of copper in the marina, and no submerged structures. There are southern pine structures, but they are not treated. The average marina depth is eight feet.

Online information for the Clipper Yacht Harbor can be found at http://www.clipperyacht.com/.

Berkeley Marina

The City of Berkeley holds the lands and water known as the Berkeley Marina as a tideland grant, in trust for the people of the City Of Berkeley and the general public. In 1866, a 1300-foot pier was built for business transport. In 1874, a ferry service began to transport people to and from San Francisco. In 1903, the City of Berkeley expanded the area to gain more land for buildings, proposed shopping and housing. On the north end, currently known as Cesar Chavez Park, the land was a garbage dump site. The dump was cleaned up some 30 or more years ago, and top soil was brought in to develop park land. Fifty-two acres of basin were developed: wood docks (docks A through I), in the 1960s, and concrete structures (docks J through O) in the 1970s. Docks F and G were replaced with new wood in 1997, and replacement docks H and I are nearly complete and are being made with concrete. The marina was last dredged in 1989. The Berkeley Marina recently used bathymetric surveys to determine dredging needs.

The Berkeley Marina's 52 acres of water and 975 berths can accommodate 975 boats from 16- to 85-feet long. An entrance breakwater eliminates surge and rough water. The average occupancy of the marina is about 91 percent, due somewhat to new construction of docks H and I during the last year.

The Berkeley Marine Center Boat Yard, which is located on the north end of the marina, may have other sources of copper. The original piles are creosote treated, the new piles concrete. Limited replacement piles for wood and all other wood treated at the marina are treated with copper borate azol (CBA).

Ninety percent of the vessels in the Berkeley Marina are recreational, with the remaining 10 percent being either commercial or charter vessels.

Online information for the Berkeley Marina can be found at http://www.ci.berkeley.ca.us/.

San Francisco Marina

The San Francisco Marina is located in the Marina District of San Francisco, directly east of the Golden Gate Bridge. The West Harbor of the San Francisco Marina has had boats in that location since the mid 1800s, with a boatyard (Stone) at what is now the site of the St. Francis Youth Center from sometime during the 1920s. Historically, there were also dairies, meat packing and tanneries, distillers at Chestnut & Pierce, Fulton Iron Works, Phelps Manufacturing, and the Beaver Hill Coal Co. During the San Francisco Panama Pacific Exposition in 1912, there were a number of operations that may have had a legacy effect on the geochemistry of the marina. Piers were located at Gas House Cove in the current marina for large ships, and the gas house itself used substantial amounts of coal to process gas. The Sierra and San Francisco Power Company buried a 11,000 volt circuit somewhere in that area. And the Ford Plant produced 4,338 automobiles during the Exposition. The Exposition buildings themselves were demolished after the Exposition closed in 1915, and the land was sold to the Marina Development Corporation in 1915.

Currently, there are two public utility company (PUC) discharge outfalls, one near Fort Mason and one just east of the harbor office. The current extent of use that these outfalls receive is not known at this time by the marina manager.

There is possible use of copper in treated wood for the docks, but the dates of treatment are unknown.

The San Francisco Marina has a total number of 650 slips, with approximately 95 percent usage in 2006. Most vessels in the marina are recreational, although between five and ten percent of the small craft are used for commercial fishing.

Online information for the San Francisco Marina can be found at http://www.sfmarina.org/.

South Beach Harbor

The South Beach Harbor marina is located on the west side of San Francisco Bay directly south of the San Francisco-Oakland Bay Bridge. Before the South Beach Harbor was built in 1986, the site contained three rather dilapidated piers–number 42, 44, and 46. All were removed prior to dredging of the marina basin and installation of the piles and floating docks. The last dredging was done in 2004 outside the marina basin prior to the installation of the commercial guest dock on the north side of Pier 40. No dredging has been required inside the marina since the time of its original construction in 1986. The very slow rate of sedimentation over the last 20 years would indicate that dredging will probably not be required within the marina basin for at least another ten years.

The South Beach Harbor has 700 slips and all were occupied in the summer of 2006, except for a few in the process of turnover. There are long wait lists for all of the berths, so that there is usually only a short delay between the time a vacate notice is received and the berth is occupied by the next vessel. Approximately 95 of the vessels in the harbor were recreational during 2006.

Most of the concrete docks have pressure-treated walers, which are used above the water level, but no wood preservatives are used.

Online information for the South Beach Harbor can be found at www.southbeachharbor.com.

Ballena Isle Marina

Ballena Isle Marina is located on the eastern shore of the San Francisco Bay in Alameda, California. The harbor is protected by a bow-shaped piece of land that protects the interior of Ballena Bay. The Ballena Isle Marina was built in the early 1970s on open space.

There are 504 slips, and the occupancy of the Ballena Isle Marina was around 75 percent in the summer of 2006. The marina was built with creosote piles with wood ramps, and there are several locations around the marina that drain rainwater from the streets and gutters of
the City of Alameda.

All vessels in the Ballena Isle Marina are recreational vessels. The last time the marina was dredged was about 1998, and the spoils were deposited on the marina property. The dredge material met regulatory requirements to be kept in place on the property.

Online information for the Ballena Isle Marina can be found at http://www.ballenaisle.com/.

Coyote Point Marina

The Coyote Point Marina is located approximately 10 miles south of San Francisco in San Mateo on the eastern side of Coyote Point. Coyote Point is located north of the San Mateo Bridge on the western shore of the San Francisco Bay. The marina was built in two phases. The older section of the marina was built in the 1940s, and the latter section built in the 1960s. The Coyote Point Marina has a total of 580 slips, with about 85 percent occupancy in the summer of 2006. The marina now has about 80 percent occupancy. All vessels at the Coyote Point Marina are used for recreation. The marina had been dredged three or four years prior to 2006, and was dredged again in September of 2006. In the past, dredging did not suggest copper contamination of the sediments from submerged structures.

Online information for the Coyote Point Marina can be found at http://www.co.sanmateo.ca.us/.

Santa Cruz Harbor

The Santa Cruz Harbor is located on the north shore of Monterey Bay. Prior to the harbor, the area was known as Woods Lagoon. It was a wetland/lagoon with a small stream entering and flowing to the Monterey Bay, with little tidal flush. The Santa Cruz Harbor marina complex was built by the Corps of Engineers and opened in 1964 with 360 slips. The marina is divided into two sections: a north and a south harbor. In 1973, the north harbor was expanded to include 455 more slips.

There are approximately 1,200 boats in the water in the marina. There are 960 permanent berths with the remainder berths set aside for dories, kayaks, and visitors. The Santa Cruz Harbor is always at full capacity, with long waiting lists for berths. Of the vessels docking at the marina, 90 percent are recreational vessels and 10 percent are commercial vessels.

Pilings are made of steel, plastic and some creosote-treated wood. The older docks are pressure treated and the retro-fit docks are untreated wood. There is sheet piling along the western side of the harbor. None of these structures contain copper.

The Santa Cruz Harbor is dredged annually, November through April. Up to approx 300,000 cubic yards of sand deposited by the San Lorenzo River are removed annually from the harbor entrance. All material has tested as clean sand and is pumped off-shore through a 16-inch hydraulic dredge.

Online information for the Santa Cruz Harbor can be found at www.santacruzharbor.org .

Monterey Harbor

The Monterey Harbor is located on the southern shore of Monterey Bay. The harbor has more than two hundred years of history, having first been established by Gaspar de Portola of Spain in 1770. In 1822, Mexico claimed the area, and in 1846 possession of the Monterey lands was claimed for the United States. The harbor wharf was built in 1870 by the Pacific Coast Steamship Company to serve regular passenger and freight service, and taken over by the City of Monterey in 1913 to better provide for its maintenance. Under the city's control, the commercial and freight capacity of the wharf grew, so that by 1920 there were warehouses, fish outlets and other marine service businesses. After World War II, the fishing industry declined.

The marina was constructed in 1960 and had 367 berths available. G pier, completed in 1975, added another 29 berths. Currently, there are 412 berths in the marina, 120 permanent mooring spaces in the harbor, and 25-40 seasonal moorings between April and October. During the summer of 2006, the berths and mooring spaces were occupied at 85-90 percent of capacity. Roughly 12 percent of the vessels in the Monterey Harbor are commercial.

There are few sources of copper in the marina. The little wood present in the Monterey Harbor is pressure treated. However, the ends of the pressure-treated replacement wood are usually treated with a copper green preservative. Although the painting is done out of the water, there is a possibility of some runoff into the harbor particularly during the winter. A very small dredging project, approximately 10,000 cubic yards, was conducted in 2005.

Online information for the Monterey Harbor can be found at http://www.monterey.org/harbor/

Santa Barbara Harbor

The Santa Barbara Harbor is the major marina complex in the City of Santa Barbara. The breakwater was constructed between 1927 and 1930 creating what is now the Santa Barbara Harbor. Immediately after construction of the breakwater, vessels anchored or put down moorings with most of the harbor being occupied. The first docks were installed in the mid-1950s with all four marina completed by the mid-1970s.

There are 1,133 slips in the harbor. At least 95 percent of the slips had vessels in them in the summer of 2006. Ninety percent of the vessels are recreational and the remaining ten percent are commercial fishing vessels.

There has been a drydock (where boats can be serviced while they are out of the water) in the harbor for at least 30 years. The boatyard recently installed a diversion unit whereby all of their discharges are diverted to the sewer system. There are no other obvious sources of copper in Santa Barbara Harbor. All wooden piles in the harbor are treated with creosote. Wooden walers and stringers, which are above the water line, are treated with AZCA.

The channel at the marina's entrance is dredged twice a year, once in the fall and once in the spring. The last dredging was completed April 2007. There are no unique hydrologic features to speak of in Santa Barbara Harbor. Natural circulation is moderate compared some other harbors. The harbor is probably one of the most built out marinas with very little open water and therefore a high percentage of boat bottoms compared to available water surface.

Online information for the Santa Barbara Marina can be found at http://www.santabarbaraca.gov/Government/Departments/Waterfront/Clean_Marina_Program.htm. The SWPPP has detailed information on the Santa Barbara Harbor including all of Santa Barbara Harbor's best management practices.

Marina del Rey (Front Basin and Back Basin)

The Marina del Rey marina complex is located in an unincorporated area of Los Angeles County, north of Playa del Rey and near the mouth of Ballona Creek. The Marina del Rey was developed as a small-boat harbor in 1958. Following a destructive 1962-63 winter season, wave protection facilities were initiated and construction was completed in 1965. The watershed drains 2.9 square miles of highly urbanized land area that includes the City of Los Angeles and Culver City.

The Marina del Rey has slips for approximately 6,100 pleasure craft as well as transient boat launches and 1900 feet of guest docks. The water area of the marina is 403 acres, and it has 2 miles of 1,000 feet-wide main channel. Near the breakwater, sediments are coarse sand as a result of wave action, while the inner harbor sediments are characterized by fine silts, suggesting low current velocities and long water residence times.

Online information for the Marina del Rey can be found at http://beaches.co.la.ca.us/BandH/Marina/Main.htm.

Downtown Shoreline Marina

The Downtown Shoreline Marina sits directly across from the Port of Long Beach, at the mouth of Los Angeles River. The marina opened in 1982, next to land that was created by fill. The marina was built next to an offshore drilling island, within the Long Beach breakwater wall.

The marina has 1,800 total slips. The marina was under construction (replacing pressure treated wood docks with concrete docks and some pile driving) during 2006, and the estimated occupancy was about 90 percent.

The Downtown Shoreline Marina is located near outflows the Santa Ana River and various flood control channels. So, the potential for harmful metals to flow into the area are great even during dry periods. All of Long Beach's storm drains flow into the ocean, and many outlets discharge near the beaches that are adjacent to the marina.

The wooden piles used in the past are largely gone, but the make-up of the fill from the early 1900s is unknown. Some wooden piles may still be in place underwater. All currently known wood is pressure treated, but the City of Long Beach does not use wood piles now.

There are several copper sources that originate outside the marinas that could affect the water quality including metals in the marina. The cruise ship terminal at the Queen Mary, the container terminal just south of the Queen Mary, and numerous trucks, vehicles and ships, could contribute to metals in the water from dockside runoff and atmospheric deposition.

Online information for the Downtown Shoreline Marina can be found at www.longbeach.gov/park/marine/default.asp.

Alamitos Bay Marina

The Alamitos Bay Marina is located in the southeast corner of Los Angeles County near the intersection of the Pacific Coast Highway and Second Street. Alamitos Bay was active back to 1907, when small freighters used the bay as a cargo unloading area. The marina was opened in 1957 surrounded by oil derricks, new home construction and the red line rail service.

The Alamitos Bay Marina has 1996 slips. The bay area in general is estimated to have another 1000 slips. During the summer of 2006 approximately 95 percent of the slips were occupied.

Alamitos Bay is near the outlet of several rivers and flood control channels, which carry runoff into the bay even during dry periods. Alamitos Bay has a shipyard, which could be a source of pollutants.

Alamitos Bay circulation is minimal, except when the two adjacent power plants are operating. When these are in operation at full capacity, it is estimated that the bay can be emptied up to three times per day. The flow could be good for water quality, but the movement could stir up the sediment. The plants tend to require more water during hot-weather periods, so there is generally more water circulation during the dry season.

Online information for the Alamitos Bay Marina can be found at www.longbeach.gov/park/marine/default.asp.

Table A-1. Marina GPS Coordinates

Marina	City	Latitude	Longitude
Tahoe Keys Marina	Lake Tahoe	38.93	-120.00
Folsom Lake Marina	Folsom	38.71	-121.09
Sacramento Marina	Sacramento	38.56	-121.51
Village West Marina	Stockton	38.00	-121.36
Antioch Marina	Antioch	38.01	-121.82
Pittsburg Marina	Pittsburg	38.03	-121.88
Benicia Marina	Benicia	38.03	-122.15
Vallejo Municipal Marina	Vallejo	38.10	-122.26
Loch Lomond Marina	San Rafael	37.97	-122.48
Marina Bay Yacht Harbor	Richmond	37.90	-122.34
Clipper Yacht Harbor	Sausalito	37.87	-122.49
Berkeley Marina	Berkeley	37.86	-122.32
San Francisco Marina	San Francisco	37.80	-122.44
South Beach Harbor	San Francisco	37.77	-122.38
Ballena Isle Marina	Alameda	37.76	-122.28
Coyote Point Marina	San Mateo	37.59	-122.31
Santa Cruz Harbor	Santa Cruz	36.97	-121.99
Monterey Harbor	Monterey	36.60	-121.88
Santa Barbara Harbor	Santa Barbara	34.40	-119.69
Marina del Rey (Back Basin)	Los Angeles	33.98	-118.45
Marina del Rey (Front Basin)	Los Angeles	33.97	-118.45
Downtown Shoreline Marina	Long Beach	33.76	-118.18
Alamitos Bay Marina	Long Beach	33.75	-118.11

Appendix B: Analytical Methods (ANR Analytical Laboratory)

820 - Alkalinity, Bicarbonate and Carbonate

Water Method, DANR SOP
Work Request Code: Alkalinity, HCO3, CO3
Labworks Code: ALK, HC03-W, CO3
Effective Date: DPR Project 2006-07
Version #: 02-DPR

Summary

This method measures bicarbonate (HCO3-), carbonate (CO32-) and alkalinity levels in water. Quantitation is by titration with 0.025 N H2SO4. The method has a routine detection limit of 0.1 meq/L but is capable of a method detection limit for alkalinity of 2 mg CaCO3/L if requested by client.

Sample Preparation

- Sample should be collected in a clean, plastic bottle that has been rinsed three times prior to use.
- Well-water samples should be collected after pumping for at least 30 minutes.
- Samples from distribution systems should be collected after lines have been flushed sufficiently to ensure that the sample is representative of the supply.
- Sample should be refrigerated until analysis can be completed.
- Sample should not be filtered or acidified.

Equipment and Apparatus

- Jencons Digitrate Electronic Buret
- 50 mL beaker
- Magnetic stir plate and small (2.5 cm) Teflon coated magnetic stir bars
- Barnstead E-Pure water purifier system to supply Type I water, 18 mega ohm
- Assorted volumetric flasks
- pH meter, Oakton pH 11 Series

Reagents

- Water: unless otherwise noted, water used to prepare reagents throughout this procedure is Type I, 18 megaohm water supplied by the Barnstead E-pure system listed above.
- Primary standard buffer solutions: pH 4.0, 7.0, and 10.0, Orion.
- 0.025 N H2SO4, prepare by diluting 25.0 mL 1 N H2SO4, certified, Fisher (# SA212-1) to a final volume of 1 L in a volumetric flask.
- Phenolphthalein indicator solution: weigh 0.500 g phenolphthalein, Fisher, into a 100 mL volumetric flask, add 50 mL 95% ethanol and bring to final volume with water.
- Methyl orange indicator solution: Dissolve 0.500 g methyl orange, Fisher, in water and bring to volume in a 1 L volumetric flask.

Procedure

1. Place 25.0 mL aliquot of water sample in beaker and add magnetic stirrer. Place on stir plate with magnetic stir bar and add three drops of phenolphthalein indicator solution to the sample.
2. If pink color appears, titrate with 0.025 N H2SO4 until the pink color has disappeared. Record amount of 0.025 N H2SO4 added. If pink color doesn't appear, there is no carbonate present. Then add three drops of methyl orange indicator solution. If yellow color appears, titrate until the yellow color has changed to orange. If no yellow appears, there is no bicarbonate present.
3. If the color of the water sample prevents visualization of the color change, a pH meter can be used. Calibrate the pH meter according to manufacturer's instructions using purchased buffer solutions (pH 4, 7, 10). Record acid needed to reach pH 8.3 and pH 4.6 and calculate carbonate, bicarbonate and alkalinity values as in calculation section.

Quality Control and Reference Material

- Duplicate samples should be analyzed for the first, last and every tenth sample of each set, provided there is sufficient sample available.

- A 25 mL sample of deionized water will be analyzed as a reagent blank.
- The standard reference material used for this analysis is UCD006
- An alternate standard reference material for this analysis is PW34 (PotableWatRTM Inorganics, Environmental Resource Associates).
- For acceptable ranges for standard reference materials see Labworks QC File.

Calculations

Carbonate Calculation:

CO32- meq/L = (2 x P x N x 1000) / (sample volume in mL)
P = number of mL of H2SO4 of normality N to reach CO32- inflection point (pH 8.3)
Routine reporting MDL= 0.1 meq/L CO32-

If carbonate is present, the bicarbonate titration is a continuation of the carbonate titration.

Bicarbonate Calculation:

HCO3- meq/L = ((M – P) x N x 1000) / (sample volume in mL)
M = the number of mL from P to the HCO3- inflection point (pH 4.6)
Routine reporting MDL= 0.1 meq/L HCO3-

Alkalinity Calculation:

Alkalinity to pH 4.6 in meq/L = ((mL acid used of normality N) x N x 1000)/ sample volume in mL)
Alkalinity to pH 4.6 in mg CaCO3 / L = ((mL acid used of normality N) x N x 50 x 1000)/ sample volume in mL)
Routine reporting MDL= 0.1 meq/L

Health and Safety

- Care should be taken when making dilute acid solution. To prevent excessive heat and possible burns, the acid should be added to the volumetric flask after water has been added.
- Avoid contact with or inhalation of methyl orange powder when preparing indicator solution.

Special Handling and/or Cleaning Procedures

- Beakers and magnetic stir bars should be cleaned and rinsed thoroughly prior to reuse. Drying is not necessary.

Literature and References

Clesceri, L. S., A. E. Greenberg and A. E. Eaton. 1998. Method 2320 (Alkalinity). Standard Methods for the Examination of Water and Wastewater, 20th Edition.

Rhoades, J. D. 1982. Soluble salts. p. 167-179. In: A. L. Page et al. (ed.) Methods of soil analysis: Part 2: Chemical and microbiological properties. Monograph Number 9 (Second Edition). ASA, Madison, WI.

U.S. EPA Method 310.2, Editorial Revision 1974, Alkalinity (Colorimetric, Automated, Methyl Orange).

U.S. Salinity Laboratory Staff. 1954. Carbonate and bicarbonate by titration with acid. p. 98. In: L. A. Richards (ed.) Diagnosis and improvement of saline and alkali soils. USDA Agricultural Handbook 60. U.S. Government Printing Office, Washington, D.C.

Revision Information

- Reformatted on November 7, 2001 by Sue Littlefield, Laboratory Supervisor.
- Revised on May 5, 2006 by Traci Francis, Laboratory Supervisor. Revisions included adding two references, adding alkalinity calculation, and adding preparation instructions for indicator solutions.

Method Modifications for Department of Pesticide Regulation project (2006-2007)

- The endpoint was determined by pH meter (pH of 4.5) instead of with color indicator solution.
- Additional QC samples analyzed with each set of samples:
- Lab control (18 M ohm water)

- Fresh or salt water matrix sample (received from DPR filtered)
- Duplicate lab control and matrix spikes at 50 mg/L for fresh water sets and 200 mg/L for salt water sets

835 - Soluble Elements

Water Method, DANR SOP
Work Request Code: Soluble Minerals: Al, B, Ca, Cu, Fe, K, Mg, Mn, Na, Si, Zn
Labworks Code: ag-w, al-w, as-w, b-w, ca-w, ca-wx, cd-w, cr-w, cu-w, fe-w, k-solw, mg-w, mg-wx, mn-w, mo-w, na-w, na-wx, ni-w, pb-w, p-w-icp, si-w (si-w2), zn-w
Effective Date: DPR Project 2006-07
Version #: 02-DPR

Summary

This method quantitatively determines the concentration of the listed elements in water samples by flame Atomic Absorption and Emission Spectrometry (AAS, AES) and Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES). Approximately 100 mL per sample is requested. If sample is limited, some analyses are done simultaneously so the total sample required may be reduced. The EPA recommends that water for soluble analytes be filtered and acidified at the time of collection. Lower detection limits than those listed in the table below may be possible. Contact the lab if lower detection limits are needed or if elements not listed in the table are needed.

Element	MDL (mg/L)	Instrument(s)
Ag	0.01	ICP
Al	0.05	ICP
B	0.1	ICP
Ca	0.5	ICP
Cd	0.005	ICP
Cr	0.005	ICP
Cu	0.1	ICP or AAS
Fe	0.1	ICP or AAS
K	0.05	AES
Mg	0.5	ICP
Mn	0.1	ICP or AAS
Mo	0.01	ICP
Na	0.1	AES
Ni	0.05	ICP
P	0.05	ICP
Pb	0.05	ICP
Si	0.1	ICP
Zn	0.02	ICP or AAS

Sample Preparation

- Samples should be collected in a clean, plastic bottle that has been rinsed three times prior to use.
- Well-water samples should be collected after pumping for at least 30 minutes.
- Samples from distribution systems should be collected after lines have been flushed sufficiently to ensure that the sample is representative of the supply.
- Samples should be filtered through 0.45 uM filters and acidified to pH < 2 with 1+1 HNO3 as soon after collection as possible. If other analyses such as pH, EC, nitrate, etc. are required, acidify a subsample if possible.
- Samples should be refrigerated until analysis can be completed.

Equipment and Apparatus

- 13x100 mm polypropylene autosampler tubes
- Barnstead E-Pure water purifier system to supply Type I water, 18 megaohm
- Flame Atomic Absorption Spectrophotometer, Perkin Elmer, AA800 or AA300
- Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES), Thermo Iris Advantage
- Volumetric flasks, assorted sizes

Reagents

- Water used throughout this procedure is Type I, 18 megaohm water supplied by the Barnstead E-pure system listed above.
- Nitric acid, trace metal grade, Fisher.

Procedure

1. Fill 13x100 mm autosampler tube with sample.
2. Analyze for requested elements as indicated in Instrument Set-up section.

Standards

Record indicated information in the Standard Prep Notebook. Standards are stored in volumetric flasks or plastic bottles at room temperature.

- Potassium and sodium standards, 1 mg/mL, certified AA grade, obtained from Fisher.
- Calcium, magnesium, phosphorus and boron, 2000, 1000, 500 and 50 mg/L, respectively, in a custom mix, UCD3A, obtained from Inorganic Ventures.
- Copper, zinc, manganese, iron, lead, cadmium, silver, aluminum, chromium, molybdenum, nickel and silicon standards, 1000 mg/L, obtained from SPEX Certiprep.
- Potassium: Prepare a seven point instrument calibration curve in 2% HNO3 solution using 100 mL volumetric flasks. Prepare the following standards for potassium: 0.0, 5.0, 10.0, 20.0, 50.0, 80.0 and 100.0 mg/L. Alternately, the standards prepared as in SOP 550 for extractable potassium may be used. If sample response is below the lowest curve point of 5 mg/L, use a lower curve of 0, 0.1, 0.5, 1.0, 5.0, 10.0 mg/L standards.
- Sodium: Prepare a seven point instrument calibration curve in 2% HNO3 solution using 100 mL volumetric flasks. Prepare the following standards for sodium: 0.0, 3.0, 10.0, 20.0, 50.0, 80.0 and 100.0 mg/L. If sample response is below the lowest curve point of 3 mg/L, use a lower curve of 0, 0.2, 0.5, 1.0, 3.0, 5.0, 10.0 mg/L.
- Calcium, magnesium and boron: Prepare a three point instrument calibration curve in 2% HNO3 solution using 500 mL volumetric flasks. Prepare the following standards for calcium, magnesium and boron: 0.0, 20.0, 10.0 and 0.5 mg/L respectively and 200, 100 and 5 mg/L respectively. Store standards in Teflon bottles at room temperature.
- Phosphorus: Prepare a 5 mg/L standard in 2% HNO3 solution in a 500 mL volumetric flask. Calibrate the instrument with a 2% HNO3 blank and the 5 mg/L P standard.
- Copper, zinc, manganese and iron: Prepare a seven point instrument calibration curve in 2% HNO3 solution using 1000 mL volumetric flasks. Prepare the following standards: 0.1 mg/L zinc with 0.25 mg/L copper, manganese and iron, 0.2 mg/L zinc with 0.5 mg/L copper, manganese and iron, 0.5 mg/L zinc with 1.0 mg/L copper, manganese and iron, 1.0 mg/L zinc with 2.0 mg/L copper, manganese and iron, 2.0 mg/L zinc with 3.0 mg/L copper, manganese and iron, 3.0 mg/L zinc with 5.0 mg/L copper, manganese and iron, 5.0 mg/L zinc with 10.0 mg/L copper, manganese and iron.
- Lead, cadmium, silver, aluminum, chromium, molybdenum nickel and silicon: Prepare 0.05, 1.0 and 10.0 mg/L mixture of the listed elements in 2% HNO3 in water. The ICP is calibrated with a 2% HNO3 blank and the 1.0 mg/L standard. The 0.05 mg/L standard is run as an unknown to check low level accuracy. The 10 mg/L standard can be used to verify linearity if high level samples are encountered.
- Note: Calibration curve points may be adjusted to more closely match the concentration in the samples being tested, especially for large projects.

Instrument Set-up

For all analyses, analyze the calibration curve and run a standard as a drift check periodically as needed throughout the run and at the end of the run to demonstrate that instrument drift has not exceeded 10%.

- The ICP-AES should be turned on following the instrument standard operating procedure and allowed to warm up for 45 minutes.
- Power setting: 1150 Watts
- Pump setting: 100 rpm
- Nebulizer pressure: 0.50 L/min
- Flush time: 45 sec
- # of Repeats: 3
- Wavelengths commonly used are listed below but alternate wavelengths may be used to avoid interferences in difficult matrices.

Element	Wavelength(nm)
Ag	328.0
Al	396.1
B	208.9
Ca	315.8
Cd	226.5
Cr	206.1
Cu	224.7
Fe	259.9
Mg	279.0
Mn	257.6
Mo	202.0
Ni	341.4
P	185.9
Pb	220.3
Si	251.6
Zn	206.2

- All data should be printed as well as stored in an appropriately named data file, including the work request number (i.e. W325.txt)
- Upon completion of analysis, export data for transfer to LIMS, rinse nebulizer and spray chamber with 2% HNO3 and shut down following the instrument standard operating procedure.
- The flame AA should be turned on and allowed to warm up following the instrument SOP

Element	Mode	Wavelength	Slit Setting	Lamp Current
K	Emission	766.5	0.7	N/A
Na	Emission	589.0	0.2	N/A
Cu	Absorption	324.8	0.7	15 mA
Fe	Absorption	248.3	0.2	30 mA
Mn	Absorption	279.5	0.2	20 mA
Zn	Absorption	213.9	0.7	15 mA

- The following are settings used for each element:
- Upon completion of analyses, instrument should be shut down following instrument standard operating procedures.

Quality Control and Reference Material

- Duplicate samples from each set will be included. Duplicate samples include the first and last sample of every set and every tenth sample in between.
- A water blank (18 megaohm) will be included with each sample set as a reagent blank.
- Standard reference materials will be included with each sample set. The standard reference material for B, Ca, Mg and Na is UCD 006. UCD 006 is an in-house reference material made in a 20 L carboy with 10 L campus tap water and 10 L 18 megaohm water. The thoroughly mixed sample is tested at least twenty times to determine acceptable ranges for each element when a new batch is made. The standard reference material for K is named PW34 (PotableWatRTM Inorganics from Environmental Resource Associates (ERA)). PW34 is also an alternate SRM for Na. WasteWatRTM Simple Nutrients (ERA) is the SRM for P. WasteWatRTM Hardness (ERA) is an alternate SRM for Ca and Mg. NIST 1640 Natural Water may be used for low level Cu and Zn testing. The acceptable ranges for current lot numbers of the listed SRMs can be found in the QCSTDACT file. For other elements, a standard solution is read as an unknown sample during the analysis.

Calculations

- Report results to three significant digits on a mg/L basis (include any dilutions made in the final calculation)
  mg/L analyte = mg/L found X Dilution Factor
- See Summary section for MDLs.

Health and Safety

- ICP-AES waste is considered a hazardous waste and must be disposed of according to U. C. Davis E. H. & S. policies.

Comments / Notes

- Samples having analyte concentrations exceeding the highest calibration standard will require dilution and reanalysis or the analysis of a standard to demonstrate linearity of the calibration at the higher level.

Literature and References

- Clesceri, L. S., A. E. Greenberg and A. E. Eaton. 1998. Method 3111 B. (Direct Air- Acetylene Flame Method) and Method 3120 B. (Inductively Coupled Plasma Method). Standard Methods for the Examination of Water and Wastewater, 20th Edition.
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- EPA Method 200.7, Trace Elements in Water, Solids, and Biosolids by Inductively Coupled Plasma-Atomic Emission Spectrometry
-
- EPA Method 258.1, Potassium (AA, Direct Aspiration)
-
- EPA Method 273.1, Sodium (AA, Direct Aspiration)

Revision Information

- Reformatted on April 24, 2002 by Sue Littlefield, Laboratory Supervisor.
- Revised on December 14, 2006 by Traci Francis, Laboratory Supervisor. Revisions include addition of many elements, list of specific MDLs, EPA references, and more specific instrument setup information.

Method Modifications for Department of Pesticide Regulation Project (2006-07)

- Additional QC samples analyzed with each set of samples:
- Lab control (0.2% nitric acid in 18 M ohm water)
- Fresh or salt water matrix sample (received from DPR filtered and acidified)
- Duplicate lab control and matrix spikes at 50, 20, 4.0 and 2.0 mg/L for fresh water sets and 500, 1400, 10,000, 400 mg/L for salt water sets for Ca, Mg, Na and K respectively
- For Zn analyses (fresh and salt water sets) the spike level was 10 ug/L
- An internal standard was used to correct for matrix effects on the ICP for zinc analyses on salt water. Yttrium was added to all samples and standards at the ratio of 40 uL 100 ug/mL yttrium standard to 4 mL sample or standard.
- A second source standard was analyzed as a continuing calibration verification (CCV) after the calibration of the instrument, after every ten samples and at the end of the analytical run.

837 - Copper in Water by Graphite Furnace

Water Method, DANR SOP
Work Request Code: By Special Request
Labworks Code: CU-WDPR
Effective Date: DPR Project 2006-07
Version #: 03-DPR

Summary

This method quantitatively measures the concentration of copper in water samples by Graphite Furnace Atomic Absorption Spectrometry (GFAAS). The method has a detection limit of approximately 0.1 ug/L for copper. The analysis requires approximately 2.5 mL of sample but 10 mL is requested to allow for quality control samples. Samples should be refrigerated and acidified until delivery to the lab.

Sample Preparation

- Sample should be collected in an acid cleaned, plastic bottle that has been rinsed three times prior to use.
- Well-water samples should be collected after pumping for at least 30 minutes.
- Samples from distribution systems should be collected after lines have been flushed sufficiently to ensure that the sample is representative of the supply.
- Samples should be refrigerated and acidified until analysis.
- Sample should be allowed to equilibrate to room temperature just prior to analysis.

Equipment and Apparatus

- Perkin Elmer AAnalyst 800 Atomic Absorption Spectrometer equipped with the Transverse Heated Graphite Atomizer (THGA) Graphite Furnace including the AS-800 Autosampler
- Perkin Elmer copper hollow-cathode lamp.
- THGA Graphite Tubes with End Cap, Pkg 5 (Perkin Elmer # B3000653)
- 7mL Polypropylene Round Reagent Containers for PerkinElmer AS-800 Graphite Furnace Autosampler, Pkg. 100 (Perkin Elmer # B3001567)
- 2.5mL Polypropylene Disposable Sample Cups, Pkg. 1000 (Perkin Elmer # B3001566)
- Barnstead E-Pure water purifier system to supply Type I water, 18 megaohm
- Parafilm (Fisher # 13-374-12)
- Volumetric flasks, assorted sizes
- Nalgene ® narrow-mouth, 125 mL LDPE bottles (Fisher)
- Pipettes, assorted

Reagents

- Water: water used to prepare reagents throughout this procedure is Type I, 18 megaohm water supplied by the Barnstead E-pure system listed above.
- Nitric Acid: acid used to prepare reagents throughout this procedure is optima grade supplied by Fisher.

Procedure

1. Filter and/or dilute samples as needed for analysis. Dilute all saltwater samples 1:1 in 0.15M nitric acid.
2. Analyze samples by Graphite Furnace, see instrument set-up section.

Standards

- Stock Copper standard, 1,000 mg/L, Spex (Fisher) and CPI
- Prepare 1.00 mg/L Cu working standard by diluting 0.100 mL of 1,000 mg/L Cu stock solution to 100.0 mL with 0.1% nitric acid in a 100 mL acid cleaned volumetric flask. Standard is stable for at least 6 months.
- Prepare 100 ug/L Cu working standard by diluting 10.0 mL of 1.00 mg/L Cu standard to 100.0 mL with 0.1% nitric acid in a 100 mL acid cleaned volumetric flask.
- Instrument calibration standards are 0.0, 0.5, 3.0, 5.0 and 10 ug/L. 10 ug/L and 0.5 ug/L standards are prepared in 0.1% HNO3 in 18 megaohm water. Instrument automatically prepares 3.0 and 5.0 ug/L standards using the 10 ug/L standard.

- Prepare 10 ug/L and 0.5 ug/L Cu standard.
- 10.0 ug/L standard: add 1.0 mL 1.00 mg/L Cu standard to a 100 mL volumetric flask half filled with water. Add 0.1 mL nitric acid and add water to the 100 mL mark and mix thoroughly.
- 0.5 ug/L standard: add 5 uL 1.00 mg/L Cu standard to a to a 100 mL volumetric flask half filled with water. Add 0.1 mL nitric acid and add water to the 100 mL mark and mix thoroughly.
- For saltwater samples, all standards are prepared as indicated above in 0.15M nitric acid.
- Record indicated information in Standard Prep Notebook. Store standards in plastic bottles at room temperature.

Instrument Set-up

The instrument should be turned on and the lamp allowed to warm up for 15 minutes. Align furnace before each analysis.
The instrument method is Cu 10 ppb (fresh water) and Cu 10 ppb Seawater (saltwater).

Method Description: Cu 10 ppb
Spectrometer
Element: Cu
Wavelength (nm): 324.8
Slit Width (nm): 0.7L

Signal
Type: AA –BG Measurement: Peak Area

Settings

Read Parameters
Time (sec): 3.0 Delay Time (sec): 0.0 BOC Time (sec): 2

Replicates … Same for All Samples: 2

Lamp Current
Use current (mA): 15

Furnace Program (Fresh water)

StepTemp (ºC)	Ramp Time	Hold Time	Internal Flow	Gas Type	
1	110	1	45	250	Normal
2	130	15	45	250	Normal
3	1200	15	10	250	Normal
4	2100	0	5	0	Normal
5	2450	1	5	250	Normal
6	20	1	15	250	Normal
7	2450	1	5	250	Normal

Furnace Program (Saltwater)

StepTemp (ºC)	Ramp Time	Hold Time	Internal Flow	Gas Type	
1	110	1	45	250	Normal
2	130	15	45	250	Normal
3	1150	15	10	250	Normal
4	2150	0	5	0	Normal
5	2500	1	5	250	Normal
6	20	1	15	250	Normal
7	2500	1	5	250	Normal

Read Step: 4 Injection Temperature (ºC): 20

No extra furnace cleanout

Furnace Autosampler (Fresh Water)

Sample

Volume: 30 uL Diluent Volume: 0 uL Diluent Location: 80

Furnace Autosampler (Saltwater)

Sample

Volume: 20 uL Diluent Volume: 0 uL Diluent Location: 80

Matrix Modifiers: None

Autosampler and Furnace Sequence

Step	Actions and Parameters
A	Pipet diluent + modifier1 + spike + sample/std
B	Run furnace steps 1 to end

Pipet speed … Take up: 100% Dispensing: 100%

Calibration Equation and Units

Equation: Linear Through Zero

Maximum Decimal Places: 3 Maximum Significant Figures: 4

Calibration Units: ug/L

Sample Units: ug/L

Calibration Standard Concentrations (Fresh water)

	ID	Concentration	A/S Loc	Stock (uL)	Diluent (uL)
Calib Blank	Calib Blank		1	30	0
Standard 1	Calib Std 1	0.5	3	30	0
Standard 2	Calib Std 2	3	2	9	21
Standard 3	Calib Std 3	5	2	15	15
Standard 4	Calib Std 4	10	2	30	0

Calibration Standard Concentrations (Saltwater)

	ID	Concentration	A/S Loc	Stock (uL)	Diluent (uL)
Calib Blank	Calib Blank		1	20	0
Standard 1	Calib Std 1	0.5	3	20	0
Standard 2	Calib Std 2	3	2	6	14
Standard 3	Calib Std 3	5	2	10	10
Standard 4	Calib Std 4	10	2	20	0

Calibration Check

Minimum Correlation Coefficient: 0.995000

QC Sample Definition

QC	Sample ID	A/S Loc	Count as Sample	Subtract Reagent Blank
QC1	5 ppb CCV	40	No	No

QC Sample Concentrations and Limits

QC 1: 5 ppb CCV Concentration Units: Sample

Analyte	Units	Conc	Lower Limit	Upper Limit
Cu 324.8	ug/L	5.00	4.500	5.500

Schedule for QC Analyses

QC	Sample ID	After Init Cal	After Recal	Periodic Freq	At End	
QC1	5 ppb CCV	Yes	No	Yes	10	Yes

Periodic Timing of Analyses

Frequency … Same for all QC's: 10
Count: Samples

Save the data using a file name that includes the work request number and the element.
Record indicated information in the instrument logbook.

Quality Control and Reference Material

- Duplicate subsamples will be analyzed for the first, last and every tenth sample of each set.
- 18Mohm water will be analyzed as a reagent blank, if the samples are filtered prior to analysis, the blank water sample should also be filtered.
- The standard reference material used for this analysis is NIST 1640 Trace Metals in Natural Water (National Institute of Standards and Technology). For acceptable range for current lot number of NIST1640 see Labworks QC File.
- For the last sample of each set of fresh water samples, take an additional aliquot to spike 5 ug/L if there is sufficient sample available. Add 100 uL of 100 ug/L standard to 2 mL of water sample in a 2.5 mL autosampler vial, cover with a piece of paraflim and shake vigorously to mix.
- For the last sample of each set of saltwater samples, take an additional aliquot to spike at
- 8 ug/L if there is sufficient sample available. Add 160 uL of 100 ug/L standard to 2 mL of water sample in a 2.5 mL autosampler vial, cover with a piece of paraflim and shake vigorously to mix. Dilute additional 1:1 with 0.15M nitric acid.
- Account for the dilution of the sample with the spiking solution in the final calculation. Due to variable amounts of analyte in the samples tested, the spike level may be inappropriate, in which case a passing NIST 1640 result should be considered sufficient for accuracy criteria.

Calculations

- The raw value from instrument in ug/L is multiplied by any dilution factor as needed.
- MDL = 0.1 ug/L
- The limit of detection (LOD) based on seven replicates of a 0.5 ug/L standard is 0.1ug/L.
- Percent spike recovery calculation: (((Cu concentration in spike) – (Cu concentration in sample))/(spike level))*100

Special Handling and/or Cleaning Procedures

- Autosampler vials need to be cleaned prior to use since copper contamination exists. Soak vials overnight in 2% nitric acid and shake vigorously on mechanical shaker using the high setting for approximately 4 hours. Rinse vials extremely well with 18 megaohm water and air dry in a basket covered with clean paper towels.
- Fill pipette tips while wearing clean gloves.
- To avoid contamination take special care to work in a clean area wearing gloves.
- For saltwater samples the furnace needs to be cleaned after every analysis. Remove furnace windows and clean furnace with swabs and water. Clean the dosing hole with a Kim Wipe wrapped around a dental pick. Gently clean furnace windows with a Kim Wipe before reassembly.

Comments/Notes

- Check instrument calibration for drift every 10th sample. Instrument drift should not exceed 10% from initial calibration.
- Dilutions are required on samples having copper concentrations exceeding the highest standard.
- The THGA Graphite Furnace techniques and recommended conditions literature suggests a matrix modifier of 0.005 mg Pd + 0.003 mg Mg(NO3)2 be used. However, the solution contains copper. It is better to omit the modifier in order to minimize contamination.
- Dilute saltwater samples 1:1 in 0.15M nitric acid before analyzing to minimize amount of salt introduced onto the platform.
- Graphite tubes need to be changed more frequently for saltwater analyses than for fresh water.

Literature and References

- Cabon, J.Y. and A. Le Bihan. 1995. The determination of Cr, Cu and Mn in seawater with transversely heated graphite furnace atomic absorption spectrometry. Spectrochimica Acta Part B 50 (1195) 1703-1716.

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- Perkin Elmer, The THGA Graphite Furnace Techniques and Recommended Conditions Manual.

Revision Information

- Created on August 31, 2006 by Rani Singh, Chemist.
- Revised on November 1, 2006 by Rani Singh, Chemist, to add information pertinent to conducting the method on salt water.
- Revised on March 1, 2007 by Traci Francis, Laboratory Supervisor, to correct spike information.

Method Modifications for Department of Pesticide Regulation Project (2006-07)

- Additional QC samples analyzed with each set of samples:
- Lab control (0.15 M nitric acid in 18 M ohm water for salt water sets, 0.1% nitric acid in 18 M ohm water for fresh water sets)
- Fresh or salt water matrix sample (received from DPR filtered and acidified)
- Duplicate lab control and matrix spikes at 5 ug/L for fresh water sets and 8 ug/L for salt water sets
- A second source standard was analyzed as a continuing calibration verification (CCV) after the calibration of the instrument, after every ten samples and at the end of the analytical run.

870 - Total Solids, Total Suspended Solids, and Total Dissolved Solids

Water Method, SOP
Work Request Code: TS, TSS, TDS
Labworks Code: TS, TSS, TDS
Effective Date: DPR Project 2006-07
Version #: 02-DPR

Summary

This method quantifies solids in water or wastewater samples using gravimetric analysis following oven drying. Solids refer to matter suspended or dissolved in the water or wastewater and may affect water or effluent quality in adverse ways. Waters with high dissolved solids generally are of inferior palatability and may induce unfavorable physiological reactions in transient consumers. Solids analyses are important in the control of biological and physical wastewater treatment processes and for assessing compliance with regulatory agency limitations. The method has a detection limit of approximately 4mg L-1 for TSS and 10mg L-1 for TDS and TS. The results are generally reproducible within 7%.

Sample Preparation

- Sample should be collected in a clean, plastic bottle that has been rinsed three times prior to use.
- Well-water samples should be collected after pumping for at least 30 minutes.
- Samples from distribution systems should be collected after lines have been flushed sufficiently to ensure that the sample is representative of the supply.
- Sample should be kept under refrigeration until analysis can be completed.

Equipment and Apparatus

- 25, 50, 100 and 200 mL graduated cylinders.
- 10mL pipette.
- Forceps.
- 100, 150 and 250mL beakers.
- Millipore 47mm Glass Fiber Filters without binders (for TDS only).
- Proweigh 47mm Preweighed Filters for Gravimetric Analysis (for TSS and TDS/TSS).
- Drying oven, for operation at 103-105oC and 178-180oC.
- Analytical balance, capable of weighing to 0.1 mg.
- Glass or aluminum drying pan.
- Dessicator.
- Filtering apparatus: GE Osmonics Gravi-Seal Analytical Funnels, 500mL flasks with side arm, Filter holder vacuum manifold.

Reagents

- Deionized water, ASTM Type I grade.

Procedure-TS

- Heat clean beaker in 105oC oven for one hour. Cool in dessicator and weigh immediately before use. Record weight to nearest 0.0001 g (W1).
- Transfer appropriate amount of well-mixed sample to beaker.
- Heat in 103-105oC oven until completely dry. Cool beaker in dessicator and weigh. Record weight to nearest 0.0001 g (W2).

Procedure-TSS

1. Since pre-prepared glass fiber filter disks are used there are no preparation steps before using filters.
2. Assemble filtering apparatus and set filter paper in it.
3. Completely filter appropriate amount of well-mixed sample.

4. Wash filter with three successive rinses of 10mL deionized water, trying to remove any particles left behind in graduated cylinder, allowing water to completely filter between washings.
5. Using forceps carefully remove filter from filtration apparatus and place in corresponding pre-labeled aluminum dish.
6. Place all aluminum dishes in a pan and dry in 103-105oC for at least 4 hours. (Samples may also be dried overnight.)
7. Immediately place samples in a dessicator to cool.
8. Quickly weigh samples by taking out samples one at a time. Replace lid to dessicator each time to minimize exposure to the air so filters don't gain moisture.
9. Record weight to the nearest 0.0001g (W2).

Procedure-TDS

1. Heat clean beakers in 180oC oven for one hour. Cool in dessicator and weigh immediately before use. Record weight to nearest 0.0001 g (W1).
2. Follow steps 1-4 for TSS using Millipore filter papers if analyzing only for TDS, otherwise follow the same steps using Proweigh pre-prepared papers if analyzing for both TDS and TSS.
3. If analyzing for TSS as well follow step 5 for TSS otherwise discard filter paper.
4. Transfer total filtrate from flask into preweighed beakers.
5. Evaporate sample in 103-105oC oven.
6. Furthermore, dry evaporated sample in oven at 178-182oC for at least 1 hour.
7. Cool beaker in dessicator and weigh. Record weight to nearest 0.0001g (W2).

Quality Control and Reference Material

- Duplicate subsamples should be analyzed for the first, last and every tenth sample of each set, provided there is sufficient sample available.
- Deionized water will be analyzed as a reagent blank.
- The standard reference material used for TSS is WasteWatR Hardness (29.7 + 2.9 mg L-1).
- The standard reference material used for TDS is WasteWatR Minerals (323 + 24 mg L-1).
- The standard reference material used for TS is WasteWatR Minerals (339 + 24 mg L-1).

Calculations

$$\text{Total Solids mg L-1} = \frac{(W2 - W1)\ X1000\ X1000}{\text{Sample volume, mL}}$$

$$\text{Total Suspended Solids mg L-1} = \frac{(W2 - W1)\ X1000\ X1000}{\text{Sample volume, mL}}$$

$$\text{Total Dissolved Solids mg L-1} = \frac{(W2 - W1)\ X1000\ X1000}{\text{Sample volume, mL}}$$

Where:

W1 = weight of dish or filter paper, mg, and
W2 = weight of dried residue + dish or filter paper, mg.

MDL = 4mg L-1 for TSS, 10mg L-1 for TDS and TS

Health and Safety

- Use gloves when placing samples into and taking samples out of the oven to prevent burns.

Comments / Notes

- Sample volumes can be adjusted between 5 and 200mL based on amount of solids present in sample.
- For samples requiring TSS and TDS, subsample filtered through pre-weighed filter paper for TSS may be saved and dried for TDS.
- When analyzing for both TDS and TSS, place beakers and filter papers in separate ovens so papers don't gain moisture from water in beakers.
- When analyzing for TDS and TS take caution to not raise temperature of oven too high to avoid samples from spurting over.

Special Handling and/or Cleaning Procedures

- Beakers should be cleaned thoroughly prior to reuse. With high solids samples, it may be necessary to soak beakers to remove dried residue.

Literature and References

Clesceri, L. S., A. E. Greenberg and A. E. Eaton. 1998. Method 2540 B. (Total Solids), Method 2540 C. (Total Dissolved Solids) and Method 2540 D. (Total Suspended Solids). Standard Methods for the Examination of Water and Wastewater, 20th Edition.

Revision Information

- Reformatted on April 29, 2002 by Sue Littlefield, Laboratory Supervisor.
- Revised in May, 2004 by Rani Singh. Filter paper changed, vacuum filtration now used, oven temperature changed for TDS.

Method Modifications for Department of Pesticide Regulation Project (2006-07)

- Salt water samples were diluted with water (1:1) and mixed thoroughly to improve filtering.
- The filter paper and sample reservoir were rinsed 3 times with 25 mL water instead of 10mL.

880 - Anions in Water

Water Method, DANR SOP
Work Request Code: SO4, Cl
Labworks Code: SO4-W-IC, CL-W-IC
Effective Date: DPR Project 2006-07
Version #: 02-DPR

Summary

This method quantitatively measures the concentration of sulfate and chloride in water samples by Ion Chromatography (IC). The method has detection limits of approximately 0.5 mg/L for sulfate and chloride. The analysis requires approximately 1 mL of sample but 5 mL is requested to allow for quality control samples. Samples should be refrigerated until delivery to the lab.

Sample Preparation

- Sample should be collected in a clean, plastic bottle that has been rinsed three times prior to use.
- Well-water samples should be collected after pumping for at least 30 minutes.
- Samples from distribution systems should be collected after lines have been flushed sufficiently to ensure that the sample is representative of the supply.
- Samples should be refrigerated until analysis.
- Sample should be allowed to equilibrate to room temperature just prior to analysis.

Equipment and Apparatus

- ICS-2000 Reagent-FreeTM Ion Chromatography (RFIC) System with EluGen EGC-KOH Cartridge
- IonPac AG18 4 x 50 mm guard column, Dionex
- IonPac AS18 4 x 250 mm analytical column, Dionex
- Barnstead E-Pure water purifier system to supply Type I water, 18 megaohm
- 0.45 micron 47 mm nylon filters, Fisher # R04SP04700, to filter water for IC system
- Polypropylene autosampler vials, 1.5 mL, (Dionex # 061696 or Fisher # NC9295186)
- 3 cc syringes
- 0.2 micron syringe filters (for filtering samples prior to IC analysis), Millipore IC Millex-LG (part number SLLG C13 NL), filtering is optional if samples have already been filtered with 0.45 micron filters
- Volumetric flasks, assorted sizes
- Nalgene ® narrow-mouth, 125 mL LDPE bottles (Fisher)
- Pipettes, assorted

Reagents

- Water: unless otherwise noted, water used to prepare reagents throughout this procedure is Type I, 18 megaohm water supplied by the Barnstead E-pure system listed above.

Procedure

1. Filter and/or dilute samples as needed for analysis.
2. Analyze samples by ion chromatography, see instrument set-up section.

Standards

- Sulfate and chloride standards, 1 mg/mL, LabChem Inc. and CPI
- Instrument calibration standards, 0.5, 1, 2, 10, 25, 100, 250 mg/L mixed standard prepared in 18 Mohm water.
- Prepare a seven-point instrument calibration curve in water using 100 mL volumetric flasks. The standards are 0.0, 0.5, 1.0, 2.0, 10.0, 25.0, 100 and 250 mg/L mixture of chloride and sulfate. Record indicated information in Standard Prep Notebook. Store standards in plastic bottles at room temperature. Standards are stable for at least one month.
- 0.5 mg/L standard: add 50 uL 1000 mg/L Chloride and Sulfate standard to a 100 mL volumetric flask half filled with water. Add water to the 100 mL mark and mix thoroughly.

- 1.0 mg/L standard: add 100 uL 1000 mg/L Chloride and Sulfate standard to a 100 mL volumetric flask half filled with water. Add water to the 100 mL mark and mix thoroughly.
- 2.0 mg/L standard: add 200 uL 1000 mg/L Chloride and Sulfate standard to a 100 mL volumetric flask half filled with water. Add water to the 100 mL mark and mix thoroughly.
- 10.0 mg/L standard: add 1.0 mL 1000 mg/L Chloride and Sulfate standard to a 100 mL volumetric flask half filled with water. Add water to the 100 mL mark and mix thoroughly.
- 25.0 mg/L standard: add 2.5 mL 1000 mg/L Chloride and Sulfate standard to a 100 mL volumetric flask half filled with water. Add water to the 100 mL mark and mix thoroughly.
- 100 mg/L standard: add 10 mL 1000 mg/L Chloride and Sulfate standard to a 100 mL volumetric flask half filled with water. Add water to the 100 mL mark and mix thoroughly.
- 250 mg/L standard: add 25 mL 1000 mg/L Chloride and Sulfate standard to a 100 mL volumetric flask half filled with water. Add water to the 100 mL mark and mix thoroughly.

Instrument Set-up

- Filter fresh water for IC system on a weekly basis or more often as needed to supply eluent generation.
- Use start-up button in IC system control window to set initial operating parameters and allow instrument to warm up until a stable baseline is achieved. (The baseline can be monitored before starting a run by using the blue button on the top tool bar.)
- The instrument can be shut down using the shut down button in the system control window or by adding a shutdown method at the end of a sequence.
- The instrument program file name is 35mM ISO.

  Cell temp: 35oC
  Column temp: 30oC
  Suppressor Current: 100 mA
  Eluent Concentration: 35.0 mM
  Flow Rate: 1.00 mL/min
  Run Time: 8.5 min. Approximate retention times: 4.3 min (chloride), 5.8 min (sulfate)

Quality Control and Reference Material

- Duplicate subsamples will be analyzed for the first, last and every tenth sample of each set.
- 18Mohm water will be analyzed as a reagent blank, if the samples are filtered prior to analysis, the blank water sample should also be filtered.
- The standard reference material used for this analysis is PW34 (PotableWatRTM Inorganics, Environmental Resource Associates). For acceptable range for current lot number of PW34 see Labworks QC File.
- For the last sample of each set, take an additional aliquot to spike at 100 mg/L if there is sufficient sample available. Add 100 uL of 1000 ug/mL for each standard to 1 mL of water sample and vortex. Filter if necessary. Account for the dilution of the sample with the spiking solution in the final calculation. Due to variable amounts of analytes in the samples tested, the spike level may be inappropriate, in which case a passing PW34 result should be considered sufficient for accuracy criteria.

Calculations

- The raw value from instrument in mg/L is multiplied by any dilution factor as needed.
- MDL = 0.5 mg/L
- The limit of detection (LOD) based on seven replicates of a 0.5 mg/L standard is less that 0.1 mg/L for both chloride and sulfate.
- Percent spike recovery calculation: (((analyte amount in spike) – (analyte amount in sample))/(spike level))*100

Special Handling and/or Cleaning Procedures

- Autosampler vials must be polypropylene, not glass, due to chloride contamination issues.
- Samples should be transferred to autosampler vials using plastic pipette tips, not glass pasteur pipettes, due to chloride contamination.

Comments / Notes

- Check instrument calibration for drift every 10th sample. Instrument drift should not exceed 10% from initial calibration.
- Dilutions are required on samples having sulfate or chloride concentrations exceeding the highest standard.

Literature and References

Dionex Application Note 154, Determination of Inorganic Anions in Environmental Waters Using a Hydroxide-Selective Column.

U.S. EPA Method 300.0, Determination of Inorganic Anions by Ion Chromatography, Revision 2.1, 1993.

Revision Information

- Created on July 13, 2006 by Traci M. Francis, Laboratory Supervisor.
- Revised on March 1, 2007 by Traci M. Francis, Laboratory Supervisor, to correct spike information.

Method Modifications for Department of Pesticide Regulation Project (2006-07)

- Additional QC samples analyzed with each set of samples:
- Lab control (18 M ohm water)
- Fresh or salt water matrix sample (received from DPR filtered)
- Duplicate lab control and matrix spikes at 2.0 and 4.0 mg/L for fresh water sets and 20,000 and 3000 mg/L for salt water sets for chloride and sulfate respectively
- A second source standard was analyzed as a continuing calibration verification (CCV) after the calibration of the instrument, after every ten samples and at the end of the analytical run.

891 - Total Copper in Water

Water Method, DANR SOP
Work Request Code: By Special Request
Labworks Code: CU-WTDPR
Effective Date: DPR Project 2006-07
Version #: 01-DPR

Summary

This method quantitatively measures the concentration of total copper in water samples by Graphite Furnace Atomic Absorption Spectrometry (GFAAS). The method has a detection limit of approximately 0.1 ug/L for copper. The analysis requires approximately 25 mL of sample but 100 mL is requested to allow for quality control samples. Samples should be acidified and refrigerated until delivery to the lab.

Sample Preparation

- Sample should be collected in an acid cleaned, plastic bottle that has been rinsed three times prior to use.
- Well-water samples should be collected after pumping for at least 30 minutes.
- Samples from distribution systems should be collected after lines have been flushed sufficiently to ensure that the sample is representative of the supply.
- Samples should be refrigerated and acidified until analysis.
- Sample should be allowed to equilibrate to room temperature just prior to analysis.

Equipment and Apparatus

- Perkin Elmer AAnalyst 800 Atomic Absorption Spectrometer equipped with the Transverse Heated Graphite Atomizer (THGA) Graphite Furnace including the AS-800 Autosampler
- Perkin Elmer copper hollow-cathode lamp
- THGA Graphite Tubes with End Cap, Pkg 5 (Perkin Elmer # B3000653)
- 7mL Polypropylene Round Reagent Containers for PerkinElmer AS-800 Graphite Furnace Autosampler, Pkg. 100 (Perkin Elmer # B3001567)
- 2.5mL Polypropylene Disposable Sample Cups, Pkg. 1000 (Perkin Elmer # B3001566)
- Barnstead E-Pure water purifier system to supply Type I water, 18 megaohm
- Parafilm (Fisher # 13-374-12)
- Volumetric flasks, assorted sizes
- Nalgene ® narrow-mouth, 125 mL LDPE bottles (Fisher)
- Pipettes, assorted
- Kimble Kimax 50 mL Digestion Tubes (Folin Wu), Pack of 6 (Fisher Scientific #11-381-5)
- Digestion Block (AIM500), 50 place, temperature operation 25-400°C, time controlled

Reagents

- Water: water used to prepare reagents throughout this procedure is Type I, 18 megaohm water supplied by the Barnstead E-pure system listed above.
- Nitric Acid: acid used to prepare reagents throughout this procedure is optima grade supplied by Fisher.
- Hydrochloric Acid: acid used to prepare reagents throughout this procedure is optima grade supplied by Fisher.

Procedure

1. Pipette 25 mL of well mixed water sample into 50 mL digestion tube.
2. Add 0.5 mL of 1:1 nitric acid:water and 0.25 mL of 1:1 hydrochloric acid:water. Mix gently.
3. Place tubes in digestion block with the following program:
4. Step to 95°C.Hold 240 minutes.
5. Allow tubes to cool. (Keep tubes covered with parafilm to avoid contamination).
6. Bring to 25 mL mark with deionized water.
7. Cover each tube with parafilm.
8. Mix thoroughly with vortex stirrer.
9. After vortexing allow particles in samples to settle.
10. Pipette samples as needed for analysis.

11. Analyze samples by Graphite Furnace, see instrument set-up section.

Standards

- Stock Copper standard, 1,000 mg/L, Spex (Fisher) and CPI
- Prepare 1.00 mg/L Cu working standard by diluting 0.100 mL of 1,000 mg/L Cu stock solution to 100.0 mL with 0.15 M nitric acid + 0.055 M hydrochloric acid in 18 megaohm water in a 100 mL acid cleaned volumetric flask. Standard is stable for at least 6 months.
- Prepare 100 ug/L Cu working standard by diluting 10.0 mL of 1.00 mg/L Cu standard to 100.0 mL with 0.15 M nitric acid + 0.055 M hydrochloric acid in 18 megaohm water in a 100 mL acid cleaned volumetric flask.
- Instrument calibration standards are 0.0, 0.5, 3.0, 5.0 and 10 ug/L. 10 ug/L and 0.5 ug/L standards are prepared in 0.15 M nitric acid + 0.055 M hydrochloric acid in 18 megaohm water. Instrument automatically prepares 3.0 and 5.0 ug/L standards using the 10 ug/L standard.
- Prepare 10 ug/L and 0.5 ug/L Cu standard.
- 10.0 ug/L standard: add 1.0 mL of 1.00 mg/L Cu standard to a 100 mL volumetric flask half filled with water. Add 0.1 mL nitric acid and add water to the 100 mL mark and mix thoroughly.
- 0.5 ug/L standard (prepared for each analysis): add 100 uL of 10 ug/L Cu standard and 1.90 mL of 0.15 M nitric acid + 0.055 M hydrochloric acid in 18 megaohm water to a 2.5 mL autosampler vial. Cover vial with a square of parafilm and shake to mix.
- Record indicated information in Standard Prep Notebook. Store standards in plastic bottles at room temperature.

Instrument Set-up

The instrument should be turned on and the lamp allowed to warm up for 15 minutes. Align furnace before each analysis.
The instrument method is Cu 10 ppb with recal.

Method Description: Cu 10 ppb with recal
Spectrometer
Element: Cu
Wavelength (nm): 324.8
Slit Width (nm): 0.7L

Signal: Type: AA –BG Measurement: Peak Area

Settings
Read Parameters: Time (sec): 3.0 Delay Time (sec): 0.0 BOC Time (sec): 2
Replicates: Same for All Samples: 2
Lamp Current: Use current (mA): 15

Furnace Program

StepTemp (ºC)		Ramp Time	Hold Time	Internal Flow	Gas Type	
1	110		1	45	250	Normal
2	130		15	45	250	Normal
3	1150		15	10	250	Normal
4	2150		0	5	0	Normal
5	2500		1	5	250	Normal
6	20		1	15	250	Normal
7	2500		1	5	250	Normal

Read Step: 4 Injection Temperature (ºC): 20

No extra furnace cleanout

Furnace Autosampler
Sample Volume: 20 uL Diluent Volume: 0 uL Diluent Location: 80

Matrix Modifiers: None

Autosampler and Furnace Sequence

Step	Actions and Parameters
A	Pipet diluent + modifier1 + spike + sample/std
B	Run furnace steps 1 to end

Pipette speed … Take up: 100% Dispensing: 100%

Calibration Equation and Units

Equation: Linear Through Zero
Maximum Decimal Places: 3 Maximum Significant Figures: 4
Calibration Units: ug/L
Sample Units: ug/L

Calibration Standard Concentrations

ID		Concentration	A/S Loc	Stock (uL)	Diluent (uL)
Calib Blank	Calib Blank		1	20	0
Standard 1	Calib Std 1	0.5	3	20	0
Standard 2	Calib Std 2	3	2	6	14
Standard 3	Calib Std 3	5	2	10	10
Standard 4	Calib Std 4	10	2	20	0

Calibration Check

Minimum Correlation Coefficient: 0.995000

QC Sample Definition

QC	Sample ID	A/S Loc	Count as Sample	Subtract Reagent Blank
QC1	5 ppb CCV	60	No	No

QC Sample Concentrations and Limits

QC 1: 5 ppb CCV Concentration Units: Sample

Analyte	Units	Conc	Lower Limit	Upper Limit
Cu 324.8	ug/L	5.00	4.500	5.500

Schedule for QC Analyses

QC	Sample ID	After Init Cal	After Recal	Periodic Freq	At End	
QC1	5 ppb CCV	Yes	No	Yes	10	Yes

Periodic Timing of Analyses

Frequency … Same for all QC's: 10
Count: Samples

Save the data using a file name that includes the work request number and the element.
Record indicated information in the instrument logbook.

Quality Control and Reference Material

- Duplicate subsamples will be analyzed for the first, last and every tenth sample of each set.
- 0.15 M nitric acid + 0.055 M hydrochloric acid in 18 mega ohm water will be analyzed as a reagent blank.
- The standard reference material used for this analysis is NIST 1640 Trace Metals in Natural Water (National Institute of Standards and Technology). For acceptable range for current lot number of NIST1640 see Labworks QC File.
- For the last sample of each set of fresh water samples, take an additional aliquot to spike at 10.0 ug/L if there is sufficient sample available. Add 0.25 mL of 1 mg/L copper standard to 25 mL of water sample in a digestion tube. Digest along with samples as described earlier.
- For the last sample of each set of saltwater samples, take an additional aliquot to spike at 20.0 ug/L if there is sufficient sample available. Add 0.50 mL of 1 mg/L copper standard to 25 mL of water sample in a digestion

tube. Digest along with samples as described earlier. Dilute additional 1:1 with 0.15 M nitric acid + 0.055 M hydrochloric acid in water before analysis.

- Adjust the spike level according to the final volume and account for the dilution of the sample with the spiking solution in the final calculation. Due to variable amounts of analyte in the samples tested, the spike level may be inappropriate, in which case a passing NIST 1640 result should be considered sufficient for accuracy criteria.

Calculations

- The raw value from instrument in ug/L is multiplied by any dilution factor as needed.
- MDL = 0.1 ug/L
- The limit of detection (LOD) based on seven replicates of a 0.5 ug/L standard is 0.1ug/L.
- Percent spike recovery calculation: (((Cu concentration in spike) – (Cu concentration in sample))/(spike level))*100

Special Handling and/or Cleaning Procedures

- Autosampler vials need to be cleaned prior to use since copper contamination exists. Soak vials overnight in 2% nitric acid and shake vigorously on mechanical shaker using the high setting for approximately 4 hours. Rinse vials extremely well with 18 megaohm water and air dry in a basket covered with clean paper towels.
- Digestion tubes must be washed in hot water, brushed thoroughly and rinsed with tap water. After rinsing digest at 150°C for 1 hour with 3 mL trace metal grade nitric acid. Cool tubes. Empty acid into a recycled acid bottle for other use. Rinse tubes three times with deionized water. Air dry in a basket covered with clean paper towels.
- Fill pipette tips while wearing clean gloves. To avoid contamination take special care to work in a clean area wearing gloves.
- For saltwater samples the furnace needs to be cleaned after every analysis. Remove furnace windows and clean furnace with swabs and water. Clean the dosing hole with a Kim Wipe wrapped around a dental pick. Gently clean furnace windows with a Kim Wipe before reassembly.

Comments / Notes

- Check instrument calibration for drift every 10th sample. Instrument drift should not exceed 10% from initial calibration.
- Dilutions are required on samples having copper concentrations exceeding the highest standard.
- The THGA Graphite Furnace techniques and recommended conditions literature suggests a matrix modifier of 0.005 mg Pd + 0.003 mg Mg(NO3)2 be used. However, the solution contains copper. It is better to omit the modifier in order to minimize contamination.
- Dilute saltwater samples 1:1 in 0.15 M nitric acid + 0.055 M hydrochloric acid in water before analyzing to minimize amount of salt introduced onto the platform.
- Graphite tubes need to be changed more frequently for saltwater analyses than for fresh water.

Literature and References

Cabon, J.Y. and A. Le Bihan. 1995. The determination of Cr, Cu and Mn in seawater with transversely heated graphite furnace atomic absorption spectrometry. Spectrochimica Acta Part B 50 (1195) 1703-1716.

Perkin Elmer, The THGA Graphite Furnace Techniques and Recommended Conditions Manual.

U.S. EPA Method 200.7, Trace Elements in Water, Solids, and Biosolids by Inductively Coupled Plasma-Atomic Emission Spectrometry.

Revision Information

- Created on February 5, 2007 by Rani Singh, Chemist.

Method Modifications for Department of Pesticide Regulation Project (2006-07)

- Additional QC samples analyzed with each set of samples:
- Lab control (0.15 M nitric acid and 0.055 M hydrochloric acid in 18 M ohm water)
- Fresh or salt water matrix sample (received from DPR acidified)
- Duplicate lab control and matrix spikes at 10 ug/L for fresh water sets and 20 ug/L for salt water sets

- A second source standard was analyzed as a continuing calibration verification (CCV) after the calibration of the instrument, after every ten samples and at the end of the analytical run.

390 - Total Elements (INCLUDES P, Zn, Mn, Fe, Cu, Mo, Cd, Cr, Pb, and Ni)

Soil Method

Work Request Code: Zn, Mn, Fe, Cu, Cd, Cr, Pb, Ni, P, Mo
Labworks Code: ZN_TOT, MN_TOT, FE_TOT, CU_TOT,
CD_TOT, CR_TOT, PB_TOT, NI_TOT,
P-ST, MO-ST
Version #: 02

Summary

This method determines the concentration of Zn, Mn, Fe, Cu, Cd, Cr, Pb, Ni, P, Mo and additional elements as requested utilizing a nitric acid/hydrogen peroxide closed vessel microwave digestion. Analysis is by Atomic Absorption Spectrometry (AAS) for Zn, Mn, Fe, Cu and Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES) for other elements. The approximate method detection limit is 1mg/kg for all elements except phosphorus (0.001%).

Sample Preparation

- Samples should be spread out and air-dried where the samples will not be contaminated. Samples may also be placed in a forced draft oven at 35 to 55oC.
- Large chunks of sample are broken up with a rubber hammer and samples are crushed in a Bico-Braun soil pulverizer to pass through a 2 mm sieve.
- A subsample is pulverized to pass through a 50 or 60 mesh sieve to ensure homogeneity, and placed in an appropriate container and labeled.

Equipment and Apparatus

- Analytical balance: 250 g capacity, resolution +/- 0.1 mg
- Microwave digestion system and Teflon PFA double wall digestion vessel equipped with 200 psi relief seals, CEM MDS-2000
- Repipette dispensers, set to 0.5 mL or 1mL for nitric acid and 2 mL hydrogen peroxide
- Polypropylene disposable, graduated 15 mL centrifuge tubes with caps, VWR
- 13x100 mm polypropylene autosampler tubes
- Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES), Thermo Iris Advantage
- Atomic Absorption Spectrophotometer, Perkin Elmer, AA800 or AA300
- Barnstead E-Pure water purifier system to supply Type I water, 18 megaohm

Reagents

- Water: unless otherwise noted water used throughout this procedure is Type I, 18 megaohm water supplied by the Barnstead E-pure system listed above.
- Hydrogen Peroxide 30% solution, certified A.C.S, Fisher
- Nitric Acid , Trace Metal Grade, Fisher

Procedure

- Weigh 0.5000 g ~ 0.0005 g dry soil into 120 mL Teflon® microwave digestion vessel.
- For Mo analysis a 0.1000 g +/- 0.0005 g sample is weighed.
- Using pipette dispenser, carefully add 1 mL nitric acid and 2 mL of hydrogen peroxide to each vessel. Ensure that the sample is completely wetted by the reagents. (Safety glasses are a must throughout the microwave digestion procedure.)
- Place digestion vessel in outer body shell on the carousel, cap tightly. Double check that the threads are tight for the pressure relief valve also. Fill all spaces on carousel and place the carousel in the microwave oven. Set microwave program for 5:00 minutes of 296 watts power (40% power) and 8:00 minutes of 565 watts power (90% power). The program name is STDMETHOD.
- At completion of program, remove samples and place in hood to cool completely.

- Remove cap, rinse cap into vessel with water. Quantitatively transfer digest to 15 mL disposable, graduated centrifuge tube. Add water to the 15 mL mark and cap tube. Dry threaded cap of any moisture with a Kimwipe to avoid deterioration of cap threads.
- Invert tube three times and shake vigorously to mix acid and water thoroughly. Allow to settle overnight or centrifuge if digests are needed the same day.
- Dilutions are often necessary for soil digests.
- For analysis of phosphorus, samples are diluted 4X before analysis on ICP. This is done to improve spike recovery and minimize the matrix effect.
- Copper, iron, zinc and manganese are analyzed by Flame AA and other elements are analyzed by ICP.
- If low levels of Pb or Cd are present in the samples and cannot be determined by ICP due to interferences, samples may be analyzed by graphite furnace AA.

Standards

- Cu, Fe, Mn, Zn, Cd, Cr, Pb, Ni, P, Mo Standards, 1000 mg/L, obtained from SPEX Certiprep.
- AA Standard 1 (calibration blank): Fresh water is used for the calibration blank
- AA Standard 2 (0.25 mg/L Cu, Fe, Mn and 0.1 mg/L Zn): add 250 uL of Cu, Fe and Mn, and 100 uL of Zn 1000 mg/L standards to a 1 L volumetric flask half filled with water. Carefully pump in 20 mL concentrated nitric acid, swirl to mix and add water to the mark. Cap and mix thoroughly.
- AA Standard 3 (0.5 mg/L Cu, Fe, Mn and 0.2 mg/L Zn): add 500 uL of Cu, Fe and Mn, and 200 uL of Zn 1000 mg/L standards to a 1 L volumetric flask half filled with water. Carefully pump in 20 mL concentrated nitric acid, swirl to mix and add water to the mark. Cap and mix thoroughly.
- AA Standard 4 (1.0 mg/L Cu, Fe, Mn and 0.5 mg/L Zn): add 1000 uL of Cu, Fe and Mn, and 500 uL of Zn 1000 mg/L standards to a 1 L volumetric flask half filled with water. Carefully pump in 20 mL concentrated nitric acid, swirl to mix and add water to the mark. Cap and mix thoroughly.
- AA Standard 5 (2.0 mg/L Cu, Fe, Mn and 1.0 mg/L Zn): add 2000 uL of Cu, Fe and Mn, and 1000 uL of Zn 1000 mg/L standards to a 1 L volumetric flask half filled with water. Carefully pump in 20 mL concentrated nitric acid, swirl to mix and add water to the mark. Cap and mix thoroughly.
- AA Standard 6 (3.0 mg/L Cu, Fe, Mn and 2.0 mg/L Zn): add 3000 uL of Cu, Fe and Mn, and 2000 uL of Zn 1000 mg/L standards to a 1 L volumetric flask half filled with water. Carefully pump in 20 mL concentrated nitric acid, swirl to mix and add water to the mark. Cap and mix thoroughly.
- AA Standard 7 (5.0 mg/L Cu, Fe, Mn and 3.0 mg/L Zn): add 5mL of Cu, Fe and Mn, and 3000 uL of Zn 1000 mg/L standards to a 1 L volumetric flask half filled with water. Carefully pump in 20 mL concentrated nitric acid, swirl to mix and add water to the mark. Cap and mix thoroughly.
- AA Standard 8 (10.0 mg/L Cu, Fe, Mn and 5.0 mg/L Zn): add 10mL of Cu, Fe and Mn, and 5 mL of Zn 1000 mg/L standards to a 1 L volumetric flask half filled with water. Carefully pump in 20 mL concentrated nitric acid, swirl to mix and add water to the mark. Cap and mix thoroughly.
- For analyses of Cd, Cr, Pb, Ni, Mo on ICP, the typical calibration scheme is to run a three-point calibration of 2% nitric acid in water as the blank and 0.5 and 10.0 mg/L standards. Depending upon the amount of analyte in the digest, the calibration standard levels may be modified.
- For analysis of P on the ICP, a 2% nitric acid in water blank and 5.0 and 50.0 mg/L standards are used for calibrating.

Instrument Set-up

ICP

- The ICP-AES should be turned on following instrument manufacturer guidelines and allowed to warm up for 45 minutes.
- The following settings should be used:
- Cd wavelength: 226.5 nm
- Cr wavelength: 206.1 nm
- Ni wavelength: 341.4 nm
- Pb wavelength: 220.3 nm
- Mo wavelength: 202.0 nm
- Power setting: 1150 Watts
- Pump setting: 100 rpm
- Nebulizer flow rate: 0.50 L/min

- Flush time: 45 sec
- # of Repeats: 3
- All data should be printed as well as stored in an appropriately named data file, including the work request number (i.e. 05S423.txt)
- Upon completion of analysis, export data for transfer to LIMS, rinse nebulizer and spray chamber with 2% HNO3 and shut down following ISOP.
- Record indicated information in the instrument logbook.

AA

- The AA should be turned on and allowed to warm up for approximately 15 minutes.
- Zn, Fe, Mn, and Cu are analyzed in absorption mode with wavelength settings of 213.9nm, 248.3nm, 279.5nm, and 324.7nm for Zn, Fe, Mn, and Cu respectively. Follow the ISOP for specific analysis instructions.
- Save the data using a file name that includes the work request number and the element.
- Record indicated information in the instrument logbook.

Quality Control and Reference Material

- Duplicate samples from each set will be included. Duplicate samples include the first and last sample of every set and every tenth sample in between.
- A reagent blank will be included with each sample set.
- A spike duplicate and blank spike will be included with each sample set.
- Standard reference materials will be included with each sample set. The standard reference materials will include UCD187, UCD107, UCD2891 for Cu, Fe, Mn, Zn. For other elements, the spiked blank will serve as the SRM.

Calculations

Report results to three significant digits on a mg/kg basis:

- Analyte mg/kg = (mg/L analyte in digest) x (DF)
- Dilution Factor (DF) = 30 (0.5g soil in 15mL final volume)
- Note phosphorus is reported in % by multiplying the mg/kg result by 0.0001.
- Spike recovery(%) = ((Csp – Cs) / C) * 100
- Csp = Concentration of spiked sample
- Cs = Concentration of sample
- C = Spike level
- MDL estimate = 1 mg/kg for all elements (except phosphorus: 0.001%) The MDL estimate is based on instrument sensitivity, dilution factor and interferences.

Health and Safety

- Personal protective equipment, including gloves, goggles and lab coat will be worn when handling acids required for microwave digestion.
- Samples will be allowed to cool to room temperature prior to transfer from digestion vessel to prevent burns.
- All vessel components must be dry and free of particulate matter. Drops of liquid or particles will absorb microwave energy, causing localized heating which may char and damage vessel components, leading to possible vessel failure.
- ICP-AES waste is considered a hazardous waste and must be disposed of according to U. C. Davis E. H. & S. policies.

Special Handling and/or Cleaning Procedures

- Upon completion of transfer of digested sample, add 5 mL of diluted Microclean soap (1:1 Microclean:water) to the PFA vessel and allow to soak for approximately 15 minutes.
- Scrub vessel with brush to loosen and remove any undigested material.
- Rinse vessel with hot tap water and place in 0.5 N HCl acid bath to soak for 30 minutes.
- Remove vessel from acid bath, rinse three times with ASTM Type I water and allow to air dry.
- When adding reagent to vessels always wear protective clothing (i.e., eye protection, lab coat, disposable gloves). Always handle reagents and opening of vessels in an acid hood capable of high air flow, 100 cfm.
- Inspect vessel rupture seal in the cap for replacement.

- Centrifuging may be necessary to clear the digest.

Literature and References

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Revision Information

- Reformatted and spiking information added on January 22, 2002 by Sue Littlefield, Laboratory Supervisor.
- Modified by adding more detailed standard preparation and instrument set-up information. Plant and water analysis information was removed. Modified in August, 2005 by Traci Francis, Laboratory Supervisor.

DPR Dissolved Organic Carbon Analytical Method (abbreviated)

EPA Method 415.3 (Revision 1 by B. B. Potter)
Determination of total organic carbon and specific UV absorbance
at 254 nm in source water and drinking water.

Note: References to total organic carbon (TOC) can be substituted by DOC since the samples that were analyzed were filtered through a 0.45 µm filter prior to analysis.

Standard and Blanks:
Assemble a sample rack for the instrument in the following order:

- Calibration Blank (CB; HPLC grade water with < 50 ppb (µg/L) TOC)
- Standard curve
- 3 x Laboratory Reagent Blank (LRB; HPLC grade water with < 50 ppb TOC)
- # 1-20 samples in duplicate

Procedure:
1. Run calibration curve (4 points between 1 ppm and 50 ppm) for each batch including a CB (stored in computer). Each batch consisted of up to 68 samples.
2. The first sample of each batch is an LRB.
3. Every 20 samples, run a 5 ppm standard followed by a LRB or CB to accommodate method 415.3 Revision 1.
4. At the end of the batch, run another 5 ppm standard followed by an LRB.
5. Averaged the sample and duplicate results. Then normalized this value with the averaged results of the 5 ppm standards.
6. If sample in the regular analysis is below 0.5 ppm (mg/L), then use the high sensitivity catalyst for analysis, which has a method detection limit as low as 60 µg/L. The method reporting limit is about 180 ppb or 0.180 ppm.

NOAA HML Irgarol and M1 Analytical Method

Materials and methods

Chemicals

Methanol, acetone, and HPLC-grade water were purchased from Burdick & Jackson (Muskegon, MI, USA). Irgarol 1051 (2-methylthio-4-tert-butylamino-6-cyclopropylamino-s-triazine, 99.0% purity), was purchased from Ciba Specialty Chemicals Inc. (Tarrytown, NY, USA). 2-methylthio-4-tert-butylamino-6-amino-s-triazine (M1 or GS26575) standard was a kind gift from Dr. P. Gardinali, Florida International University. Diuron standard (purity 99.0%) was purchased from ChemService (West Chester, PA, USA). Chlortoluron N,N-dimethyl-d6 (purity 98.0%) was obtained from Cambridge Isotope Laboratories (Andover, MA, USA). Ammonium formate and formic acid were purchased from Sigma Aldrich (St. Louis, MO).

Chemical Analysis

Sample preparation

Solid phase extraction was performed as previously described (Thomas et al., 2002) with minor modifications. Antifouling compounds of interest were extracted with C18 (1 g, 6 mL) Solid Phase Extraction (SPE) cartridges (Phenomenex, Torrance, CA) using a vacuum manifold (Fisher Scientific, Pittsburgh, PA). Prior to sample extraction, the SPE cartridges were sequentially conditioned with 10 mL each of acetone, methanol and HPLC water. Prior to the extraction, water samples (500 mL) were spiked with an internal standard (Chlortoluron N,N-dimethyl-d6), and then passed through the conditioned SPE cartridges at a flow rate of 10 mL/min. The cartridges were rinsed with HPLC water to remove salts, and dried under vacuum for 1 h. The compounds of interest (Irgarol and M1) were eluted using 15 mL methanol, and the resulting extract was evaporated to 0.5 mL using nitrogen.

Liquid Chromatography

The chromatographic separation of antifouling compounds was achieved using LC (Agilent 1100 LC, Agilent Technologies Inc., Palo Alto, CA) and a reverse phase column (Luna C18, 5 µm, 100Å, 50 x 2.0 mm ID, Phenomenex) fitted with a guard column (C18 4 x 2.0 mm, Phenomenex) at 25°C. A binary gradient of 100% methanol and ammonium formate buffer (pH 3.9) was used. Flow rate was 0.35 mL/min. The injection volume was 20 µL for all analyses.

Mass spectrometry

Mass spectrometry was performed with an API 4000 triple quadrupole mass spectrometer (Applied Biosystems, MDS Sciex, Framingham, MA) with ElectroSpray Ionization coupled to the Agilent 1100 liquid chromatograph. Operating conditions were: capillary voltage 3,000 V, fragmentor 56 V, nebulizer gas pressure 55 psi, source temperature 550°C. The most intensive precursor ion to product ion transition was selected for detection in Multiple Reaction Monitoring Mode (MRM). The transitions were: 254→198 (Irgarol); 214→159 (M1); 233→72 (diuron); 219→78 (Internal standard). A second less intensive transition was used for confirmation. The target analytes were identified on the basis of their retention times and first chosen precursor to fragment transition and quantified using constructed calibration curves which were linear within 1-1,000 ng/mL with r2 being greater than 0.99.

Appendix C: SCCWRP's Toxicity and Phase I TIE methods

Standard Operation Procedure for Mussel Embryo Development Test

Southern California Coastal Water Research Project Toxicology Laboratory

I. Overview

This method estimates the toxicity in aqueous samples by a 48 hour exposure of *Mytilus galloprovincialis* embryos. The test endpoint is normal embryo development and survival. The test is based on methods in the EPA's Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms (EPA/600/R-95/136). The purpose of this SOP is to detail the test procedure as specifically applied in our laboratory. The SOP is intended to supplement the material in the protocol, not replace it.

II. Supply Checklist

Deep trays for use as water baths (2)
Glass bread pan (2)
Seawater and DIW squirt bottles
pH, DO and conductivity meter/probes
Graduated cylinders 50-1000 ml for making gamete and solution dilutions
Automatic pipets 0.1 ml up to 10 ml
Water pump
Tubing with Y-joint
Thermometer
250 ml, 400 ml and 1 L beakers (several)
Inverted microscope
Counter, 2 unit
Sedgwick-Rafter counting chamber
Perforated plunger to fit 250 ml, 400 ml and 1 L beakers
Nitex screening 100 µm or smaller openings
Razor blades
Eppendorf Pipet tips (100 µl, 1 ml and 10 ml)
Shell vials with translucent caps, 5 dram
Formalin, 30% borax buffered (see recipe below)
Dispenser for formalin to repeatedly deliver 1 ml
Pasteur pipets and bulbs (both 5 ¾ and 9 in)
Scintillation vial racks (plastic for exposure, cardboard for storage)
Spawning and gamete calculation data sheet
Glass or Fiberglass aquaria tanks (3)
Air pump
Pairing knife.
Air stones

III. Animals Collection and Culturing

Adult Bivalves (*Mytilus galloprovincialis*) are obtained from (Carlsbad Aquafarms, John Davis ph# 760-438-2444, FAX# 760-438-3568) a commercial supplier.

Set up glass aquaria tanks in the cold room. To each tank add about six inches of seawater the day before the mussels arrive. Temperature shock may cause the animals to spawn; therefore once you have received the mussels, the animals should be acclimated to the cold room by opening the travel cooler. After acclimation, transfer the mussels equally among the tanks, and add air stones.

The seawater should be changed everyday. Mussels can remain in holding under optimal conditions up to eight weeks from receiving date. No food is given to the mussels while in holding.

Water quality measurements (pH, ammonia, DO and salinity) should be made on the system on a weekly basis.

IV. Test Design

Summary of test conditions
Type: Static non-renewal
Salinity: 32 ± 2 g/kg
Temperature: 15 ± 1 °C
Duration: 48 hours
Endpoint: normality of development and survival
Exposure volume: 10 ml
Test containers: 29.35 x 55 mm (5 dram) glass shell vial with snap cap.
Lighting: Ambient laboratory
Photoperiod: 16 hours Light and 8 hours Dark
Salinity adjustment: Hypersaline brine
Dilution water: natural seawater (activated carbon and 0.45 µm filtered)
Water Quality: DO, pH, salinity and ammonia (optional)
Reference toxicant: concurrent with each experimental batch, copper chloride

Exposures should be conducted in 5 dram glass shell vials. The vials should be vigorously rinsed with DIW and allowed to dry before use. Vials should be labeled and randomly distributed in vials racks (based on our experiment set-up randomization program).

The sample volume is 10 ml per replicate, with 5 replicates per concentration. Include an additional 5 vials of 32 ‰ seawater to determine the actual embryo density. After the samples are in the vials, the vials should be placed in the 15 ºC room for at least ½ hr before starting the exposure. The vials should kept covered with parafilm whenever possible from the time of labeling through the end of the exposure to prevent cross contamination and evaporation.

V. Sample Handling

Care should be taken during sample preparation and dilution that cross contamination of glassware used for the samples and for the gametes does not occur. The exposure vials should be covered at all times to prevent contamination.

Samples having a salinity of less than 30 ‰ should be adjusted using hypersaline brine.

To make the brine, first place a glass container (usually a 1 L beaker or 1 Gal jar) of seawater in a freezer for at least 18 hr. Remove the container from the freezer and allow the ice to thaw at room temperature. During the thawing process, occasionally pour off the thawed brine to a clean beaker. Check the salinity of the brine by taking a 6 ml sample and dilute it with 6 ml DIW. Multiply the salinity by 2 (Note: the conductivity to salinity algorithm is not accurate above 40 ‰, which necessitates making the dilution just described). When the salinity of the brine is close to the desired level, or the volume needed is achieved, final dilution of the brine to the desired level should be made using seawater. The salinity of the brine used for sample adjustment should never exceed 80 ppt, as higher levels have been known to cause toxicity. When testing samples that have no saline content (stormwater, sewage effluent, etc) it is usually desirable to make the brine at 64 ‰ so that a 50:50 mixture of sample and brine has a final salinity of 32 ‰.

We have found that brine may be stored in the refrigerator for up to a week.

Water quality measurements are made at the beginning and end of the testing time.

Separate sub-samples for water quality analysis of each test sample or dilution should be taken at the time the samples are prepared. Samples should be measured for pH, DO and salinity.

VI. Reference Toxicant

Each test of field or laboratory samples should include a concurrent reference toxicant exposure to copper. The reference toxicant exposure should include a control (0 µg/L) and five concentrations of copper.

The copper concentrations are prepared by first making a stock solution of 10,000 µg/L copper. This stock solution consists of 0.0268 g $CuCl_2 \cdot 2 \cdot H_2O$ in 1 L DIW. A working stock is prepared by diluting 10 ml of stock solution into 90 ml of seawater to produce a concentration of 1,000 µg/L. The concentrations tested should be 0, 4.5, 6.5, 9.5, 13.9,20.4, and 30.0µg/L. These concentrations are achieved by adding 0.45, 0.65, 0.95, 1.39, 2.04, and 3.00 mL of working stock to seawater to make 100 ml of each concentration. An approximately 40 ml sample of the highest concentration should be saved in a plastic container for copper concentration verification. This sample should be preserved by adding two drops of concentrated, redistilled nitric acid then storing it in the refrigerator.

VII. Test Procedure

A. Before Spawning Mussels
Fill about half full with 32‰ seawater two deep trays and heat to 20 ºC. Place both bread pans and the pump with tubing in one of the trays. With seawater, rinse about ten 250 ml beakers and fill with 75 mL of seawater at 15 ºC. Gently scrap off the barnacles and other encrusting organisms with a pairing knife from twenty mussels. Then rinse animals with 32 ‰ seawater.

B. Mussel Spawning
Place the animals into bread pans in the 20 ºC seawater bath. Turn on the water pump so that there is flow in each pan. Note initial time of mussel addition, look for spawning mussels, after 30 min. stop the pump. Wait 15 min. If no spawning occurs place the mussels in a 15 ºC, 32 ‰ seawater bath for 15 min. then start the process again. At least two animals of each sex with good gamete quantity and quality are necessary.

C. Gamete Collection
When individual animals are observed shedding gametes, remove them from the pan. Rinse each animal individually with 32 ‰ seawater and place in their own 250 mL beaker that has enough seawater to cover the animal at 15 ºC.

Early in the spawning process, using a clean Pasteur pipet mix up the eggs in the beaker from one female and transfer about 0.5 ml of egg solution to the rafter cell.

Check the eggs on the microscope at 100X power. Greater than 90% of the eggs should be round, of average size, not clumped, and not containing germinal vesicles. If the eggs appear to be of good quality, add a very small amount of sperm to the eggs in the Rafter cell. Watch for motility of the sperm and the ability to fertilize. Continue checking so that all of the males and females are tested in this manner.

D. Egg Counting
Allow the eggs of the females that were deemed to be in good condition to settle to the bottom of their collection beakers. Pour off most of the water from each beaker, then pour the remaining water with the eggs through the 100 um nitex screen into a 1 L beaker. After adding the eggs from all the "good" females, bring the water level in the beaker up to about 600 ml. Allow the eggs to resettle (about ½ hr. After the eggs have settled, again pour off most of the water, then again pour the eggs through the nitex into a clean 1 L beaker. Again bring the water up to about 600 ml.

Put 9 ml of seawater into each of two scintillation vials, labeled A and B. Using the perforated plunger mix the egg solution well and take a 1 ml sample and place it into vial A. Mix vial A well and take 1 ml sample from it and place in vial B.

Mix vial B well and place a 1 ml sample onto the Rafter cell. Count all of the eggs on the Rafter cell on a microscope a 100X. If total count is less than 30, then use vial A for counting. Record the count in the appropriate place on the egg and sperm count form. Take a second sample from vial B and count. Record the second count. If the two counts are within 20% calculate the mean. If the counts are not within 20%, count one more sample before calculating the mean.

The egg density target should be about 5000-8000 eggs/mL. This is a stock solution so if the egg density is higher or lower it is ok just use the actual value when calculating the embryo density. Density must not be less than 1500. If the density of the eggs is less than 1500, let the eggs settle and decant excess water.

E. Sperm suspension
Filter high quality sperm through a 100 um nitex screen into one beaker and make a note as to which animals were used on the mussel spawning data sheet.

F. Trial fertilization test
A trial fertilization must be performed with each spawning event. A series of sperm dilutions will be performed to achieve final sperm to egg ratio. Use a 10 mL pipet with the tip cut off and place10 mL of egg suspension into three scintillation vials. Add 0.1, 0.3, and 1.0 mL of sperm suspension using pipets.

Let these solutions sit for 1.5 –2.5 hours in the lab. Transfer about 0.5 ml of egg solution to the rafter cell. Check the eggs on the microscope at 100X power.

Fertilized eggs will have a single polar body, a very small clear circle attached to an egg, or they will have multiple cells that look like Micky Mouse ears. Use the ratio of egg to sperm that uses the lowest amount of sperm to achieve >90% fertilization.

While the eggs are being fertilized, finish the egg counts and determine the eggs/mL concentration. (See Mussel Spawning Datasheet)

To calculate the sperm suspension volume necessary to add to the egg solution, take the volume of the egg suspension prepared in section D and multiply by the sperm to egg ratio determined in the trial fertilization.

G. Test Initiation
Add sperm to eggs(embryo suspension), and use the perforated plunger to mix the suspension. Adjust the embryo suspension density to 1500 – 3000/ mL. Our target density and volume for the embryo suspension is 2500 embryos/mL in 300mL of 32 ‰ seawater. (See Mussel Spawning Datasheet) Achieve this by measuring out the needed amount of embryo stock solution and add 15 °C seawater to 300mL. Use the perforated plunger to mix the suspension. Cover the beaker with parafilm and set aside until ready to use (do not let stand for more than one hour).

On the mussel spawning record form record the time that you will add the embryo solution to the first vial. Using the perforated plunger, continually agitate the embryo solution while adding 0.1 ml to each exposure container. Be careful to insure that the embryo solution is added to the liquid in the exposure containers and does not contact the side of the vials first. Record the time that you finish the embryo addition. Recover the vials with the parafilm. Record the temperature at which the exposure is being performed.

The 5 additional vials of seawater will serve as the initial embryo density subsamples.

One mL of 30% borax buffered formalin will be added to each vial within minutes of the embryo solution addition. These will be used to determine the survival in the controls and the other treatments. Record the counts embryo count form. Calculate the actual embryo density by averaging the 5 sub-samples.

48 hours after the start of the addition of embryos, transfer the racks of exposure vials to the Biology Lab. Terminate the test by adding 1 ml of 30% borax buffered formalin to each vial. This should be done inside a fume hood. The formalin should be dispensed from the re-pipettor. Secure a snap cap on each vial and give the vial a quick swirl to ensure that the formalin is evenly distributed.

This task is made easier with two people; one adding the formalin and the other capping and swirling the vials.

VIII. Microscopic Evaluation

The samples can be evaluated whenever convenient. There is not a known maximum holding time for preserved samples. The samples are evaluated by placing the entire vial in a small petri dish and placing this over the objective port in the stage of the inverted microscope. The embryos are easily viewed at 100 X. Start at the top of the vial and move across to the opposite side, scoring all “D” shape embryos as normal and those without the “D” shape as abnormal. Move the stage down one field of view and make another complete pass of the vial, continue this process until the entire vial has been counted. Record the results on the mussel embryo development examination data sheet and put a colored dot on the cap to designate it as counted.

IX. Data Analysis

There are three endpoints that can be analyzed. One endpoint is the percent normal. In this case the number of normal embryos is divided by the total number of normal and abnormal embryo present in a vial then multiplied by 100. a second endpoint is percent normal alive data, which is the number of normal embryos present in the vial divided by the mean of the initial count of embryos in the 5 sub-samples then multiplied by 100. The third endpoint is percent alive. In figuring the percent alive one assumes that if embryos are present, no matter what condition, then they are alive. You compare the sum of both the normal and the abnormal embryos against the mean of the initial count of embryos in the 5 subsamples then multiply by 100.

Enter the endpoint data into the Excel spreadsheet by container number. The means and standard deviations are calculated automatically by the spreadsheet.

For each experiment, run an ANOVA and Dunnett's test using Toxstat. Use a point estimation program (such as Toxstat) to calculate the EC50 using the probit method.

The reference toxicant data are similarly entered in the appropriate Excel spreadsheet. Calculate the EC50 as above and plot this value on the running laboratory control chart for this bioassay.

X. Quality Assurance

Test Acceptability Criteria
Mean normal development in the controls must be at least 90%. Mean survival in the controls must be > 50%. The percent minimum significant difference (MSD) must be less than 25%.

Reference toxicant results
The reference toxicant EC50 should fall within two standard deviations of the mean on the control chart. If the EC50 falls outside this range, results of concurrent tests should be examined carefully. The investigator should include a discussion of the significance of the exceedance in any report of the data.

Deviations from test conditions
Deviations from acceptable test conditions must be recorded (i.e. temperature out of range). Best professional judgment will be applied to determine whether the deviation was significant enough to render the results of the test questionable.

The investigator should include a discussion of the significance of the deviation in any report of the data.

XI. Cleaning procedures

The exposure vials are used as shipped except that they should be vigorously rinsed with DIW and allowed to dry before use. All glassware and plasticware used in handling the gametes or samples should be processed under the normal toxicology lab cleaning procedure to remove metals and organics.

After it is decided that the embryo samples can be discarded, the vials should be emptied into the sink under a fume hood with running water. The vials should then be rinsed once with tap water and then discarded in the trash. To prevent injuries from broken glass, it best to accumulate the discarded vials in a separate trash bag and then discard directly to the dumpster.

XII. References

USEPA, 1995. "Short-term methods of estimating the chronic toxicity of effluents and receiving water to west coast marine and estuarine organisms.

National Exposure Research Laboratory, Office of Research and Development. Cincinnati, Ohio.

Standard Operation Procedure for Conducting a Phase I Toxicity Indentification Evaluation (TIE) Using the Mussel Development Test

Southern California Coastal Water Research Project Toxicology Laboratory

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OVERVIEW

A phase I TIE uses physical or chemical manipulation of an aqueous sample to selectively remove or render non-toxic substances found in the sample. Through these means, the class (i.e. metals, non-polar organics) of compound causing the toxicity in the original sample may be determined. The methods used in this SOP are based on those in Marine Toxicity Identification Evaluation (TIE): Phase I Guidance Document (EPA/600/R-96/054). The methods for the mussel development test can be found in SOP #T12.0 and EPA's Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to West Coast Marine and Estuarine Organisms (EPA/600/R-95/136).

SUPPLY CHECKLIST

Sodium Thiosulfate, 5-hydrate (STS)
(Ethylenedinitrilo) Tetraacetic Acid, Disodium salt (EDTA)
0.1 N NaOH
500 ml polycarbonate centrifuge tubes
Centrifuge capable of 3000 X G and holding 500 ml centrifuge tubes
pH, DO and conductivity meter/probes
Automatic pipets 0.025 ml up to 10 ml
C-18 cartridges (1 gram, 2 gram and/or 10 gram)
Adapters for cartridges
Masterflex pump with at least 2 pump heads
60 ml syringe bodies for reservoirs
Cation exchange columns, 0.5 gram (optional)
50 ml, 125 ml, 250 ml, 500 ml and 1000 ml Erlenmeyer (many)
Teflon tubing
Pasteur pipets
Parafilm
Aluminum foil

PREPARATIONS

Samples

Before any further manipulation of the samples, salinity must be measured and the appropriate amount of brine added to achieve a salinity of 34 ± 2 g/kg. For details of the brining procedure, see the mussel development test SOP.

Stock Solutions

Sodium thiosulfate (STS)

STS is not stable and must be made fresh on the day it is to be used. The stock solution concentration is 15 g/L and is made by dissolving 2.35 g of Sodium Thiosulfate, 5-hydrate in 100 ml of DIW. Measure out the crystals in 100 ml beaker and add about 75 ml of DIW. Add a stir bar and mix until dissolved. Transfer to a 100 ml volumetric flask. Rinse the beaker twice with DIW and add to the flask. Bring the volume up to the line with DIW and mix by inversion. Transfer to a 125 ml Erlenmeyer flask and cover with Parafilm.

(Ethylenedinitrilo) Tetraacetic Acid, Disodium salt (EDTA)

EDTA is stable can be stored in the refrigerator for up to one month. The stock solution concentration is 25 g/L and is made by dissolving 2.78 g of EDTA in 100 ml of DIW. EDTA is difficult to dissolve, so plan on allowing about 1 hr between making and using the stock solution. Weigh out the EDTA in a 100 ml beaker, then rinse the compound with

DIW into a 100 ml volumetric flask. Bring the level up to the line and add a stir bar. Mix until completely dissolved. Transfer to a 125 ml Erlenmeyer flask and cover with Parafilm.

TEST DESIGN

Bioassay Method: Mussel embryo development
Replicates per treatment concentration: 3
Concentrations of Sample per Treatment: 2 or 3
Salinity adjustment: Hypersaline brine
Dilution water: natural seawater (activated carbon and 0.45 µm filtered)
Water quality: DO, pH and salinity on highest sample concentration of each treatment
Reference toxicant: Optional (usually not performed)

Exposures are conducted in the usual 5 dram glass shell vials with 10 ml volumes per replicate. Normally each treatment is tested at the highest concentration possible after salinity adjustment and at half of that concentration. Other concentrations or the addition of more concentrations may be appropriate depending on the goals of the experiment.

TIE MANIPULATIONS

EDTA

The concentration of EDTA within the exposures is 60 mg/l. If multiple concentrations of a sample are to be tested, each sample concentration will have 60 mg/L of EDTA. Therefore, all dilutions should be made before addition of the EDTA stock. The EDTA treatment is performed on samples that have been salinity adjusted, but not manipulated in any other manner. The stock solution is added to the sample at a rate of 24 µl of stock for every 10 ml of sample. After the addition of EDTA, the pH of the samples should be checked. If the pH is below 7.5, use NaOH (0.1 N or less) to adjust the pH to between 7.8 and 8.3. After addition of the EDTA the samples should be given at least 3 hr for interactions to occur before addition of the gametes begins. A sample of laboratory seawater must be treated with 60 mg/l EDTA and tested as a blank to verify that the treatment is not causing toxicity.

STS

The concentration of STS within the exposures is 50 mg/l. If multiple concentrations of a sample are to be tested, each sample concentration will have 50 mg/L of STS. Therefore, all dilutions should be made before addition of the STS stock. The STS treatment is performed on samples that have been salinity adjusted, but not manipulated in any other manner. The stock solution is added to the sample at a rate of 34 µl of stock for every 10 ml of sample. After addition of the STS the samples should be given at least 1 hr for interactions to occur before addition of the gametes begins. A sample of laboratory seawater must be treated with 50 mg/l STS and tested as a blank to verify that the treatment is not causing toxicity.

Particle Removal (Centrifugation)

Samples for centrifugation should be placed in 500 ml polycarbonate centrifuge tubes. Pairs of tubes should be balanced within 1 gram for placement on opposite sides of the rotor. The samples should be spun at 3000 X G for 30 minutes. The temperature in the centrifuge should be set at about 10 °C. A sample of laboratory seawater must also be centrifuged and tested as a blank to verify that the treatment is not causing toxicity.

The volume of sample to be centrifuged is dependent on the goals of the experiment. For testing of particle removal only, with 3 replicates and 2 concentrations, only 100 ml of sample are needed. However, sample that has gone through the centrifugation process is also used for application to C-18 and cation exchange columns. Samples for chemical analysis may also be centrifuged.

After the centrifuge stops, carefully remove the tubes from the rotor avoiding disruption of the pellet. Using Teflon coated tubing, siphon the supernatant into an appropriate container, again avoiding disruption of the pellet. The type

of container will depend on what the sample will be used for (i.e. plastic for a metals sample or an Erlenmeyer flask for toxicity testing).

C-18 Column Extraction

Samples must go through the particle removal process before being applied to the column. The volume of sample to be passed through the column is dependent on the goals of the experiment. For merely testing what passes through the column only about 150 ml of sample needs to be applied. However, if further study will involve elution of the column, more sample should be applied to increase the amount of the substances adhering to the column. We have 3 sizes of C-18 column available. The volume of sample that can be passed through before exceeding the capacity of the column is based on the concentration of extractable materials, which is an unknown. Therefore, to minimize the chances of exceeding column capacity we will use the 1 gram columns for samples less than 500 ml; the 2 gram for samples between 500 ml and 1 L and the 10 gram column for samples greater than 1 L. Each column size will have a different procedure for preparation and use. Before passing the sample through the column, a sample of laboratory seawater must me passed through and tested as a blank to verify that the treatment is not causing toxicity. Before using the C-18 columns, verify that all tubing in the Masterflex system is in good working order. The tubing in the pump head should be replaced after a couple of months, whether it has been used or not. Run at least 500 ml of DIW through the tubing, using the pump, before attaching to any columns. Set the flow to the desired rate.

For 1 g columns: Prepare the column by passing 10 ml of isopropanol through at 5 ml/min. Before the sorbant dries, pass 10 ml of DIW. As the last of the DIW passes through, add 100 ml of seawater, discarding the first 25 ml and collecting the remainder for the C-18 blank. The column must then be reconditioned by adding 10 ml of isopropanol. Before sorbant dries, pass 10 ml of DIW, then 20 ml of seawater. Then pass up to 500 ml of sample, discarding the first 25 ml. If the timing of the start of the fertilization test necessitates, a 100 ml subsample of what has passed through the column can be taken as soon as it is available. After all the sample has passed through the column, let the pump run dry for at least 2 minutes to get as much liquid as possible out of the sorbant. The column should then be labeled appropriately, have both ends covered with aluminum foil and stored in the refrigerator for potential elution at a later time.

For 2 g columns: Prepare the column by passing 20 ml of isopropanol through at 7 ml/min. Before the sorbant dries, pass 20 ml of DIW. As the last of the DIW passes through, add 125 ml of seawater, discarding the first 50 ml and collecting the remainder for the C-18 blank. The column must then be reconditioned by adding 20 ml of isopropanol. Before sorbant dries, pass 20 ml of DIW, then 40 ml of seawater. Then pass up to 1000 ml of sample, discarding the first 50 ml. If the timing of the start of the fertilization test necessitates, a 100 ml subsample of what has passed through the column can be taken as soon as it is available. After all the sample has passed through the column, let the pump run dry for at least 2 minutes to get as much liquid as possible out of the sorbant. The column should then be labeled appropriately, have both ends covered with aluminum foil and stored in the refrigerator for potential elution at a later time.

For 10 g columns: (***This method is based on several assumptions regarding volumes for column preparation. As yet we have not used these large cartridges***). Prepare the column by passing 50 ml of isopropanol through at 10 ml/min. Before the sorbant dries, pass 50 ml of DIW. As the last of the DIW passes through, add 150 ml of seawater, discarding the first 75 ml and collecting the remainder for the C-18 blank. The column must then be reconditioned by adding 50 ml of isopropanol. Before sorbant dries, pass 50 ml of DIW, then 50 ml of seawater. Then pass up to 3000 ml of sample, discarding the first 75 ml. If the timing of the start of the fertilization test necessitates, a 100 ml subsample of what has passed through the column can be taken as soon as it is available. After all the sample has passed through the column, let the pump run dry for at least 2 minutes to get as much liquid as possible out of the sorbant. The column should then be labeled appropriately, have both ends covered with aluminum foil and stored in the refrigerator for potential elution at a later time.

Cation Exchange Column Extraction (optional)

The cation exchange column removes cationic metals and usually provides phase I results similar to the EDTA treatment. The advantage of the cation exchange column is metals removed by the column can be eluted and verification of toxicity and chemical analysis in phase II can be performed.
Samples must go through the particle removal process before being applied to the column. The volume of sample applied to the column is dependant on the goals of the experiment. To merely test the toxicity of the sample after it

has passed through the column, only about 150 ml needs to be applied. More sample can be applied to provide a greater amount retained by the column for later elution in phase II testing. Presently, we have only 0.5 g cation exchange columns. To avoid overloading these columns, it would be best to apply no more than 500 ml of sample.

Before using the cation exchange columns verify that all tubing in the Masterflex system is in good working order. Tubing in the pump head should be replaced after a couple of months, whether it has been used or not. Run at least 500 ml of DIW through the tubing, at 7-10 ml/min before attaching to the columns. Then pass 2 ml of 10% HCl through the tubing to remove any metals. Pass at least another 25 ml of DIW through the tubing while setting the flow rate to 2.5 ml/min.

Pass 2 ml of optima grade methanol through the column at 2.5 ml/min. Before sorbant dries, pass 6 ml of DIW. Before the sorbant dries, pass another 70 ml of DIW discarding the first 15 ml and collecting the remainder as a blank. This sample will need to be brined and tested with the fertilization test to verify that the treatment is not causing toxicity. As the last of the DIW passes through the column, between 150 and 500 ml of sample can be applied, discarding the first 25 ml that passes. If the timing of the start of the fertilization test necessitates, a 100 ml subsample of what has passed through the column can be taken as soon as it is available. After all the sample has passed through the column, let the pump run dry for at least 2 minutes to get as much liquid as possible out of the sorbant. The column should then be labeled appropriately, have both ends covered with parafilm and stored in the refrigerator for potential elution at a later time.

REFERENCE TOXICANT

It is usually not necessary to perform a reference toxicant test concurrently with TIE testing. However, if initial testing and TIE testing are combined, the standard copper reference toxicant concentration series should be tested (See mussel development test SOP).

DATA ANALYSIS

Enter the percent fertilized data in the Excel spreadsheet by container number. The means and standard deviations of each treatment are calculated automatically. An ANOVA and multiple range test can be run either using the macro built into the spreadsheet or by using Toxstat. If sufficient number of concentrations of each treatment and/or the baseline sample are tested, then EC50 calculations using the probit method can be made using Toxstat.

QUALITY ASSURANCE

Test Acceptability Criteria

The acceptability criteria for TIE testing is much less stringent than for regular testing. Between replicate variability must be low enough that differences between the original sample and the treated sample are discernible. Mean fertilization in the controls should be at least 70% and sperm to egg ratio should not exceed 3000:1.

Deviations from test conditions

While great latitude is allowed in conducting TIE testing, it is very important to record any modifications that are made from the standard operating procedure. Modifications to either TIE manipulations or the fertilization testing methods should be noted.

Use of treatment blanks

Since some of the treatments used in the TIE process can be toxic themselves, it is extremely important that a blank is tested for each treatment. Lack of blanks may render a TIE uninterpretable.

CLEANING PROCEDURES

All glassware used in the TIE process should go through the normal toxicology glassware washing procedure.

The polycarbonate centrifuge tubes should be detergent scrubbed then detergent soaked for 24 hr, followed by 3X tap water rinses, 1X 10% nitric acid rinse, 3X DIW rinse, 2X methanol rinse, 1X hexane rinse. After the hexane rinse the bottles should air dry under a fume hood until all the hexane has evaporated. Then a 24 hr 10% nitric acid soak and finally a 3X Type I water rinse.

REFERENCES

USEPA. 1995. "Short-term methods of estimating the chronic toxicity of effluents and receiving water to west coast marine and estuarine organisms. National Exposure Research Laboratory, Office of Research and Development. Cincinnati, Ohio.

USEPA. 1996. "Marine Toxicity Identification Evaluation (TIE): Phase I Guidance Document". National Health and Environmental Effects Research Laboratory, Atlantic Ecology Division. Narragansett, Rhode Island.

Appendix D: Method Validation Results (ANR Laboratory) and Summary of Laboratory QA/QC Results (All Laboratories)

Summary of Study QA/QC Results

DPR required that ongoing laboratory QA/QC (in addition to typically used calibration standards, reagent blanks, etc.) for all analytical laboratory work conducted in the study. Overall, the assessment of QA/QC sample results shows the quality of laboratory analysis to be of very high quality. A brief overview of QA/QC data types and results is given in this appendix.

Method Validation - ANR Laboratory

Prior to the collection and analysis of environmental samples, DPR required ANR Laboratory to validate all of the methods used. Validation for both low level and high level spikes were completed (Tables D-1 and D-2). NOAA and SCCWRP provided supporting documentation of their methods for Irgarol/M1 (NOAA) and toxicity/TIE (SCCWRP). Therefore, study-specific validation was not required from these laboratories.

The recovery of analytes from environmental matrices and the precision of quantification in these matrices established that ANR Laboratory's performance was very good. In fact, the initial precision and accuracy ranges were so good that this resulted in an extremely tight validation-based control limits. For more practical and functional control limits, a decision was made to default to the U.S. EPA analytical method accuracy and precision limits, as established in the study QAPP (Table D-3).

Ongoing (Batch) QA/QC – ANR Laboratory

Due to the large number of samples and analysis (> 6,000) needed for this study, ANR Analytical Laboratory processed and handled approximately 170 sample batches. Each sample batch typically included the following QC samples:

- Laboratory blank
- Laboratory control sample (LCS)
- LCS duplicate
- Matrix spike sample (MS)
- MS duplicate
- Standard reference material (SRM)

Multiple analysis (e.g., Na, K, Ca, Mg) may be associated with a single batch of QA/QC samples. Thus, a batch could have as few as seven QC samples associated with it or as many as 28. Overall, ANR Laboratory conducted over 2,500 QA/QC analysis for this study.

QA/QC results were always within acceptable limits for the QC sample types listed above with the lone exception of an SRM recovery for TCu that was slightly below control limits (79.4 µg/L where acceptable range was 85.2±4.3 µg/L). Subsequent SRM recovery results were within control limits. Therefore, the results of ongoing quality control for DCu, TCu, DZn, TSS, Alkalinity, Ca, Cl, K, Mg, Na, and SO_4 were exceptional overall.

Recall that ANR Laboratory analyzed a limited number of sediment samples that were collected by DPR field crew. These samples were analyzed as three separate batches. QA/QC samples for these sediment samples are identical to those used for water samples. QA/QC results for sediment samples were all within acceptable ranges for TCu and TZn.

Ongoing (Batch) QA/QC – NOAA's HML

Although NOAA's HML only analyzed 45 samples for Irgarol and M1, batch QA/QC samples were required nonetheless. A sample batch consisted of 6 environmental samples (maximum), a reagent blank, a duplicate sample, and a matrix spike. Continuous calibration verification samples were also included in each instrumental run.

Matrix spike recoveries were 91 ± 5% for Irgarol and 102 ± 5% for M1 at the spike level of 100 ng/L. Irgarol and M1 concentrations found in replicate samples were on average within 7 and 11%, respectively. Both average accuracy and precision results are well within the acceptable ranges for the method.

Table D-1. Method Validation Results (Low Level Spikes)

	Sulfate		Chloride		Calcium		Magnesium		Potassium		Sodium	
	Fresh	Salt	Fresh	Salt	Fresh	Salt	Fresh	Salt	Fresh	Salt	Fresh	Salt
SPK Level -->	4	3000	2	20000	10	500	4	1400	2	400	4	10000
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Replicate 1	103.3%	103.1%	107.4%	101.6%	98.5%	100.1%	95.3%	94.5%	102.0%	105.8%	95.7%	104.6%
Replicate 2	100.1%	102.8%	106.0%	98.9%	99.8%	100.4%	96.2%	94.5%	102.7%	104.6%	95.5%	101.9%
Replicate 3	99.8%	103.2%	104.1%	99.0%	100.5%	99.8%	96.8%	93.6%	103.0%	104.4%	96.0%	101.7%
Replicate 4	99.7%	102.5%	105.0%	101.4%	100.9%	99.8%	96.8%	95.4%	104.2%	105.3%	96.7%	101.8%
Replicate 5	98.2%	100.4%	105.9%	98.8%	100.8%	100.9%	96.9%	95.6%	102.5%	105.0%	95.5%	97.6%
Average	100.2%	102.4%	105.7%	99.9%	100.1%	100.2%	96.4%	94.7%	102.9%	105.0%	95.9%	101.5%
1 Std Deviation	1.9%	1.2%	1.2%	1.4%	1.0%	0.5%	0.7%	0.8%	0.8%	0.6%	0.5%	2.5%
Initial Precision and Accuracy												
Warning (2s) Range	96.5%	104.7%	103.2%	102.8%	98.1%	101.1%	95.1%	96.3%	101.2%	106.1%	94.8%	106.5%
to	104.0%	105.9%	108.2%	104.2%	102.1%	101.6%	97.7%	97.0%	104.6%	106.7%	96.9%	109.0%
Failure (3s) Range	94.6%	98.9%	102.0%	95.7%	97.2%	98.8%	94.4%	92.4%	100.3%	103.3%	94.3%	94.1%
to	105.9%	105.9%	109.4%	104.2%	103.0%	101.6%	98.4%	97.0%	105.4%	106.7%	97.4%	109.0%

	Alkalinity		Dissolved Copper		Dissolved Zinc		Total Copper	
	Fresh	Salt	Fresh	Salt	Fresh	Salt	Fresh	Salt
SPK Level -->	50	200	1	3	10	10	2.00	4.00
	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Replicate 1	101.7%	99.5%	93.4%	99.2%	104.0%	96.7%	113.5%	93.9%
Replicate 2	101.7%	101.5%	94.3%	95.4%	103.6%	96.7%	102.4%	87.6%
Replicate 3	100.7%	100.8%	92.5%	94.4%	104.5%	95.7%	109.3%	97.1%
Replicate 4	98.7%	100.8%	92.8%	100.5%	105.5%	95.5%	99.9%	89.8%
Replicate 5	102.7%	99.0%	92.2%	93.7%	105.3%	95.1%	111.4%	83.8%
Average	101.1%	100.3%	93.0%	96.6%	104.6%	96.0%	107.3%	90.4%
1 Std Deviation	1.5%	1.0%	0.8%	3.0%	0.8%	0.7%	5.9%	5.2%
Initial Precision and Accuracy								
Warning (2s) Range	98.1%	102.3%	91.3%	102.7%	103.0%	97.4%	95.5%	100.9%
to	104.2%	103.4%	94.7%	105.7%	106.2%	98.1%	119.0%	106.1%
Failure (3s) Range	96.6%	97.2%	90.5%	87.5%	102.2%	93.8%	89.7%	74.8%
to	105.7%	103.4%	95.5%	105.7%	107.0%	98.1%	124.9%	106.1%

Table D-2. Method Validation Results (High Level Spikes)

	Sulfate		Chloride		Calcium		Magnesium		Potassium		Sodium	
SPK Level -->	Fresh	Salt	Fresh	Salt	Fresh	Salt	Fresh	Salt	Fresh	Salt	Fresh	Salt
	20	15000	10	90000	50	2500	20	7000	10	2000	20	50000
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Replicate 1	99.3%	100.9%	99.4%	100.9%	98.8%	105.7%	93.0%	101.2%	97.8%	100.5%	100.2%	100.0%
Replicate 2	100.3%	101.4%	100.3%	100.5%	99.4%	104.9%	92.6%	100.7%	98.4%	100.4%	97.2%	100.9%
Replicate 3	100.5%	100.8%	100.5%	100.5%	99.4%	105.3%	92.3%	101.2%	98.2%	101.0%	99.5%	100.7%
Replicate 4	100.2%	100.2%	100.4%	100.4%	100.0%	105.8%	93.1%	102.0%	97.7%	101.4%	99.3%	99.3%
Replicate 5	100.3%	99.7%	100.0%	99.4%	99.6%	106.5%	93.8%	103.0%	96.9%	100.1%	99.1%	100.4%
Average	100.1%	100.6%	100.1%	100.3%	99.4%	105.6%	93.0%	101.6%	97.8%	100.7%	99.1%	100.3%
1 Std Deviation	0.5%	0.7%	0.4%	0.6%	0.5%	0.6%	0.6%	0.9%	0.6%	0.5%	1.1%	0.6%
Initial Precision and Accuracy												
Warning (2s) Range	99.1%	101.9%	99.2%	101.5%	98.5%	106.8%	91.9%	103.4%	96.6%	101.7%	96.8%	101.6%
to	101.1%	102.6%	101.0%	102.0%	100.3%	107.4%	94.1%	104.3%	99.0%	102.3%	101.3%	102.2%
Failure (3s) Range	98.6%	98.6%	98.8%	98.6%	98.1%	103.9%	91.3%	99.0%	96.0%	99.1%	95.7%	98.4%
to	101.6%	102.6%	101.4%	102.0%	100.8%	107.4%	94.7%	104.3%	99.6%	102.3%	102.4%	102.2%

	Alkalinity		Dissolved Copper		Dissolved Zinc		Total Copper	
	Fresh	Salt	Fresh	Salt	Fresh	Salt	Fresh	Salt
SPK Level -->	250	1000	5	8	50	50	10.00	20.00
	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Replicate 1	101.0%	101.6%	90.0%	95.5%	105.7%	98.4%	95.9%	92.9%
Replicate 2	100.0%	101.2%	90.9%	95.1%	103.0%	99.5%	98.0%	93.1%
Replicate 3	100.8%	99.6%	92.4%	94.5%	104.3%	98.5%	98.3%	94.8%
Replicate 4	99.8%	97.9%	94.0%	92.7%	105.3%	98.7%	98.3%	92.3%
Replicate 5	100.0%	99.6%	92.6%	92.7%	104.4%	96.3%	98.3%	92.8%
Average	100.3%	100.0%	92.0%	94.1%	104.5%	98.3%	97.8%	93.2%
1 Std Deviation	0.5%	1.5%	1.5%	1.3%	1.0%	1.2%	1.1%	0.9%
Initial Precision and Accuracy								
Warning (2s) Range	99.2%	103.0%	88.9%	96.7%	102.5%	100.6%	95.6%	95.1%
to	101.4%	104.5%	95.1%	98.0%	106.6%	101.8%	99.9%	96.0%
Failure (3s) Range	98.7%	95.5%	87.3%	90.2%	101.5%	94.8%	94.6%	90.4%
to	101.9%	104.5%	96.6%	98.0%	107.6%	101.8%	100.9%	96.0%

Table D-3. Analyte-Specific Accuracy, Precision, and Recovery Limits (Per Study QAPP)

Parameter	Accuracy	Precision (RPD)	Recovery
DCu	75%-125%	± 25%	MS ± 25%
TCu	75%-125%	± 25%	MS ± 25%
DZn	75%-125%	± 25%	± 25%
Irgarol 1051	75%-125%	± 25%	84-112%
DOC	75%-125%	± 25%	± 25%
Salinity(Cl)	80%-120%	Lab duplicate, blind field duplicate, MS/MSD 25% RPD	Matrix spike 80% - 120% or control limit at ± 3 Standard Deviation
Sulfate			
Magnesium			
Calcium			
Sodium			
Potassium			
Alkalinity			
Toxicity, TIE	± 2 SD[1]	± 2 SD[1]	N/A
Total Suspended Solids	75% - 125%	± 25%	± 25%
TCu (sediment)	75% - 125%	MS/MSD ± 25 RPD	MS 75% - 125%
TZn (sediment)			

[1] Within 2 standard deviations of recent reference toxicant tests.
[2] Minimum significant difference.

Ongoing (Batch) QA/QC - SCCWRP

For toxicity and TIE analysis, SCCWRP evaluated completeness of data, reference toxicant data, water quality data (pH, salinity, dissolved oxygen and ammonia), and control and blank samples results. Control and blank samples included:

- Seawater controls (for Toxicity)
- Brine controls (for Toxicity)
- Ethylenediaminetetraacetic acid (EDTA) blanks (for TIE)
- Sodium thiosulfate (STS) blanks (for TIE)
- Centrifugation blanks (for TIE)
- Post C18 column blanks (for TIE)

QA/QC results for toxicity and TIE samples were very good. See SCCWRP Data Report (Appendix I) for detailed QA/QC results.

Ongoing (Batch) QA/QC – DPR

DPR performed DOC analysis per EPA 415.3 combustion/non-dispersive infrared method (U.S. EPA, 2005). There were 27 DOC batches each with its own associated QA/QC results. QA/QC for this method included the use of duplicate samples for each environmental sample and of SRMs for each batch. Note that each batch's duplicate results were averaged and then normalized to the SRM result. So, even though SRM and duplicate results showed good accuracy and precision for DOC analysis, the averaging and normalization procedures tended to minimize the impact of poorer analytical results.

Holding Times

DPR requested that all participating laboratory observe sample holding times guidelines. The majority of analysis were done well within holding time limits (Table D-4). However, a few analysis types routinely exceeded these limits, namely chloride, sulfate, and TCu. The ANR laboratory that were responsible for these analysis were operating at capacity. DPR worked with ANR Laboratory to prioritize the analysis types that needed to stay within holding time limits (e.g., DCu and DZn). At the same time, DPR's project manager allowed some of the analysis that were less crucial to the study objectives to exceed holding times to ensure that higher priority analysis were completed first.

Table D-4. Sample Holding Time Guidelines and Calculated Average Holding Times

Analyte	Maximum Holding Time	Average Holding Time	Notes
DCu and DZn in water	4 hrs. filtration and acidification, 6 months analysis	DCu = 113 days DZn = 136 days	
TCu in water	4 hrs. acidification, 6 months (180 days) analysis	TCu = 175 days	~ 25% of TCu samples were analyzed just after the 180 days limit.
Cations (Mg, Ca, Na, K), DOC	4 hrs. filtration and acidification, 6 months (180 days) analysis	Mg = 153 Ca = 153 days Na = 147 K = 143 days DOC = 9 days	< 1% of Mg, Ca, Na, and K samples exceeded the 180-day limit
Total Suspended Solids	7 days from collection; 5 days from receipt at laboratory	TSS = 5.7 days (from collection)	
Irgarol/M1	48 hrs.	Irgarol/M1 < 2 days from collection	
Alkalinity Salinity (Cl), Sulfate (SO_4)	14 days at 4°C, dark	Alkalinity = 9.9 days Salinity (Cl) = 22 days Sulfate (SO_4) = 22 days	Project leader authorized the exceedance of holding times for salinity (Cl) and sulfate (SO_4) due prioritization needs
Toxicity in water	48 hrs. preferred, 72 hrs. max	Toxicity < 2 days from collection	
Sediment TOC	12 months	N/A	No sediment samples were analyzed for TOC

Appendix E: Field Quality Assurance/Quality Control Results and Discussion

Field and Rinse Blanks

Field crew collected field and rinse blanks that were analyzed for the same constituents as environmental samples (marina and LRS water samples). Field blanks were collected from 18 of 67 sampling events. Rinse blanks were collected from 21 of 67 sampling events.

Contaminated blanks were occasionally observed. The majority of DCu field and rinse blank results were below the detection limit (< 0.1 µg/L) or contained DCu that was less than 0.5 µg/L (Table E-1). A higher level of contamination appears to exist in the study's rinse blanks as compared to the field blanks (Table E-2). The highest field blank concentration of DCu detected was 0.4 µg/L (Figure E-1), while the highest DCu concentrations in rinse blanks was 46.3 µg/L (Figure E-2). Note that two DCu values in the rinse blank graph extend beyond the designated display maximum of 5 µg/L.

Table E-1. Distribution of DCu Concentrations in Field QC Samples

Blank Types	Sample Concentrations			
	< 0.1 µg/L (below detection)	0.1–0.5 µg/L	0.5–1.0 µg/L	> 1.0 µg/L
Field Blanks	56%	44%	0%	0%
Rinse Blanks	38%	29%	14%	19%

Figure E-1. Field Blank Results Above Detection Limit

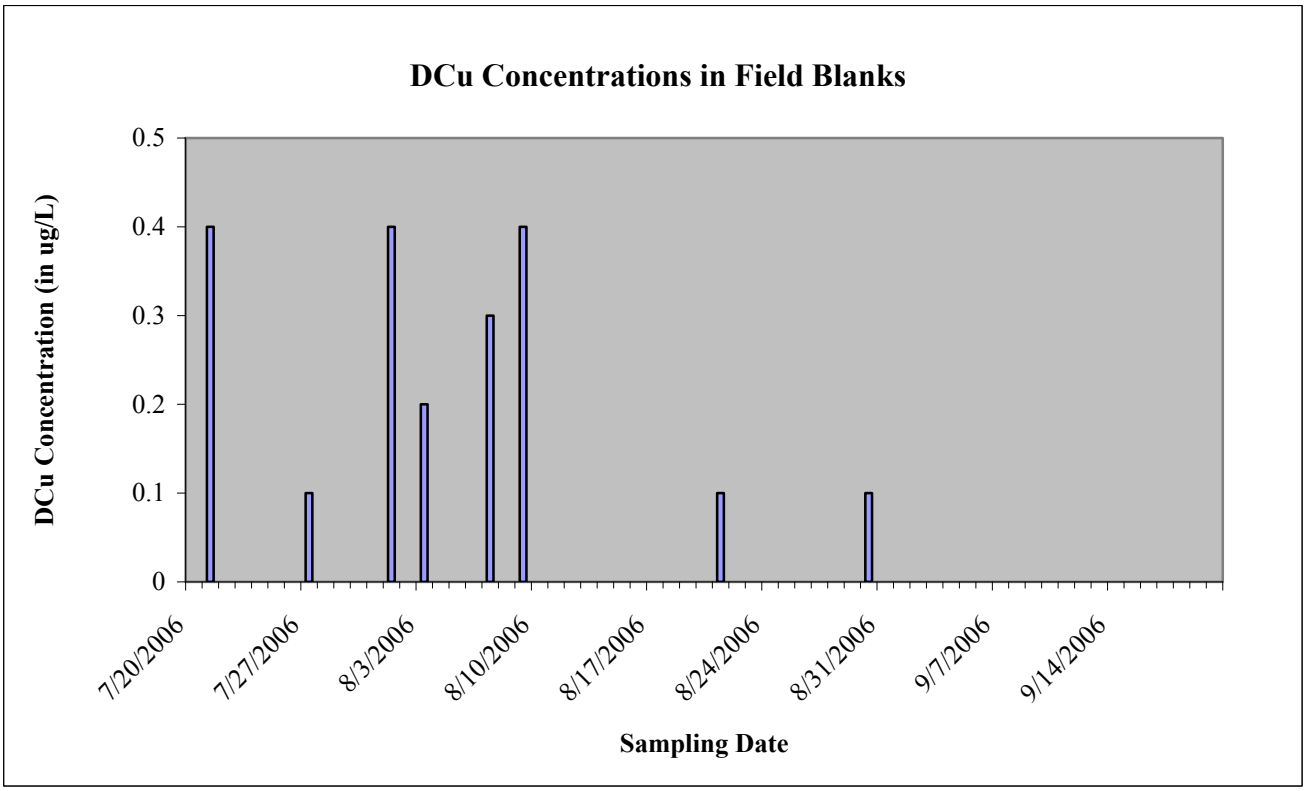
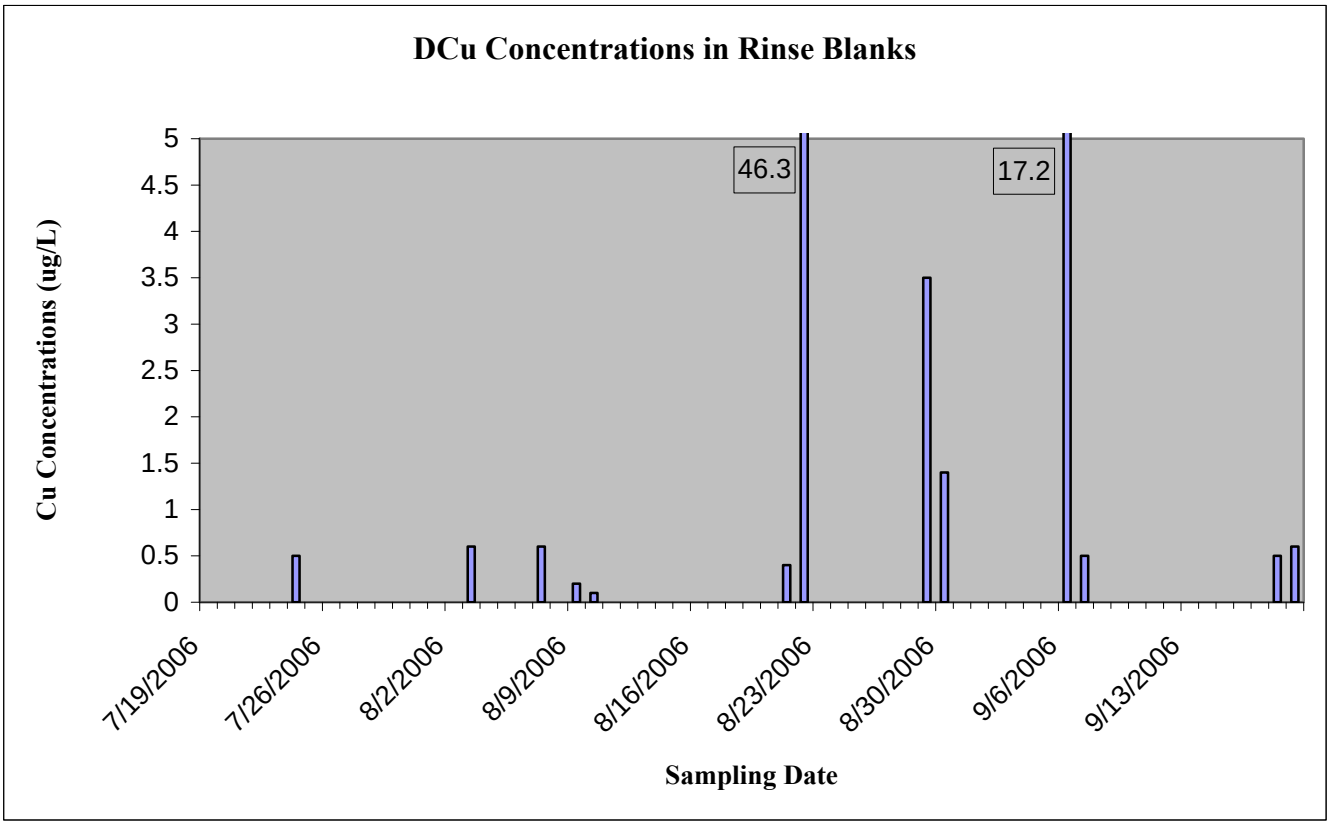


Figure E-2. Rinse Blank Results Above Detection Limit



Even though DCu concentrations in a few rinse blank samples were above 1 µg/L, environmental samples taken subsequently after these blanks were all within expected range (often below detection limits). This strongly suggests that the factors that led to high DCu (and presumably TCu and DZn) concentrations were isolated to the rinse blanks and that these factors did not appreciably impact the integrity of subsequent environmental samples. An evaluation of the rinse blank collection procedure suggests that the following sources or pathways may have contributed to elevated concentrations of metals and other analytes in the rinse blanks:

- Bucket used to draw rinse blanks samples from was contaminated or inadequately rinsed
- Batches of rinse blank water (deionized or distilled) were occasionally contaminated
- Field crew may have inadvertently introduced contaminants into the sample during handling
- Site specific contamination from boat or surroundings may have occurred (e.g., particulate deposition, ambient water introduction)
- Contamination introduced in the laboratory

In the end, it is possible to definitively determine why two of the rinse blank samples contained relatively high levels of DCu, in particular, 46.3 and 17.2 µg/L. For comparison, the highest concentration of DCu detected in the study was 18.4 µg/L. An overall examination of the DCu concentrations from all 67 sampling events did not reveal results that were distinctly outside of the expected range. Moreover, the DCu concentrations tend to stay consistently within a narrow range for each marina, water type, and sample type (marina versus LRS). Native rinses that were done prior to each and every collection on the pump and tubing setup likely served to minimize the potential effects of contamination between samples.

The majority of positive rinse and field blank samples contained DCu concentrations that were between 0.1 and 0.6 µg/L. In this range, the DCu concentrations in the blank samples are relatively low compared to what is typically detected the environmental samples in this study. This low level contamination could have also been the result of the same five factors listed above. However, other factors may have led to this type of contamination. These additional factors are:

- The use of in-line filters in the early part of the study
- Contaminated ultra pure acid or contamination that occurred during acid preservation steps
- The change in use of deionized water to distilled water as blank and rinse water as the study progressed

The last factor, in particular, likely contributed to sporadic detections of DCu in the 0.1–0.5 µg/L range. An analysis of the stock water used for blanks showed that distilled water contained 0.5 µg/L and deionized water contain < 0.1 µg/L (below detection limit). Since distilled water gradually replaced deionized water as the preferred water for use as blank water by field crew, it is probable that low level contamination from distilled water use occurred at some stage in the study. It is important to note again, however, that contamination during both the field and rinse blank collection process was likely mitigated by the intensive rinsing with native water prior to the collection of each environmental sample.

TCu and DZn were also detected in both types of blanks (Table E-2). TCu was detected at similar frequency and concentrations as DCu. DZn tended to occur at higher levels than DCu and TCu. The concentrations of DZn in environmental samples, however, tend to also be proportionately higher.

DOC was also frequently detected in both types of blanks. Two plausible reasons for this high frequency are the low detection limit for this analyte (50 µg/L) and its ubiquitous nature. Therefore, DOC appears in virtually all the blanks. However, the mean of the rinse and field blank concentrations of DOC represents only about 14% of the mean environmental concentrations of DOC. DOC is important in this study mainly from the perspective of the BLM and DOC model. If the effect of the low level contamination of DOC on the model outputs is taken into consideration, it could have caused the models to slightly over-predict the bioavailability of copper and therefore slightly under-predict toxicity.

Table E-2. Field and Rinse Blank Results

City	Marina Name	Date Sampled	Time	Blank	Sampling Event	TSS (mg/L)	TCU (ug/L)	DCU (ug/L)	DZN (ug/L)	CA (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Alk (mg/L)	Cl (mg/L)	SO4 (mg/L)	DOC (mg/L)
Stockton	Village West Marina	7/19/2006	1203	Rinse Blank	1	<4	0.4	<0.1	3.6	<0.5	<0.5	<0.5	<0.2	5	<0.5	<0.5	0.15
Sacramento	Sacramento City Marina	7/21/2006	1135	Field Blank	1	<4	<0.1	0.4	1.4	<0.5	<0.5	<0.5	0.5	5	<0.5	<0.5	
Sacramento	Sacramento City Marina	7/21/2006	1301	Rinse Blank	1	<4	0.3	<0.1	2.3	<0.5	<0.5	<0.5	0.5	5	<0.5	<0.5	0.13
Berkeley	City of Berkeley Marina	7/24/2006	1224	Rinse Blank	1	<4	0.5	0.5	8.7	<0.5	<0.5	1	<0.2	4	0.9	<0.5	0.26
Richmond	Marina Bay Yacht Harbor	7/25/2006	1134	Rinse Blank	1	<4	0.2	<0.1	<1	<0.5	<0.5	<0.5	<0.2	5	<0.5	<0.5	0.11
San Francisco	South Beach Harbor	7/26/2006	1531	Rinse Blank	1	<4	0.4	<0.1	4	<0.5	<0.5	<0.5	<0.2	5	0.6	<0.5	0.39
Alameda	Ballena Isle Marina	7/27/2006	1025	Field Blank	1	<4	0.2	0.1	7.9	<0.5	<0.5	<0.5	<0.2	4	<0.5	<0.5	0.32
San Mateo	Coyote Point Marina	7/28/2006	1040	Field Blank	1	<4	<0.1	<0.1	<1	<0.5	<0.5	<0.5	<0.2	5	<0.5	<0.5	0.10
Long Beach	Alamitos Bay Marina	8/1/2006	1030	Field Blank	1	<4	0.6	0.4	<1	<0.5	<0.5	0.7	<0.2	4	1.1	<0.5	0.16
Long Beach	Alamitos Bay Marina	8/1/2006	1025	Rinse Blank	1	<4	0.4	<0.1	10.5	<0.5	<0.5	<0.5	<0.2	4	<0.5	<0.5	0.07
Santa Barbara	Santa Barbara Harbor	8/3/2006	1120	Field Blank	1	<4	<0.1	0.2	<1	<0.5	<0.5	<0.5	<0.2	4	<0.5	<0.5	0.07
Santa Barbara	Santa Barbara Harbor	8/3/2006	1130	Rinse Blank	1	<4	0.4	0.6	5.2	<0.5	<0.5	1	<0.2	4	1.7	<0.5	0.13
Benicia	Benicia Marina	8/7/2006	1334	Field Blank	1	<4	<0.1	0.3	4.3	<0.5	<0.5	<0.5	<0.2	4	<0.5	<0.5	
Vallejo	Vallejo Municipal Marina	8/7/2006	1109	Rinse Blank	1	<4	0.5	0.6	<1	<0.5	<0.5	<0.5	<0.2	4	<0.5	<0.5	0.18
Santa Cruz	Santa Cruz Harbor	8/9/2006	1128	Field Blank	1	<4	0.4	0.4	2.5	<0.5	<0.5	<0.5	<0.2	5	<0.5	<0.5	0.10
Santa Cruz	Santa Cruz Harbor	8/9/2006	1247	Rinse Blank	1	<4	0.4	0.2	2.3	<0.5	<0.5	<0.5	<0.2	5	1	<0.5	1.08
Monterey	Monterey Harbor	8/10/2006	1111	Field Blank	1	<4	0.3	<0.1	2.1	<0.5	<0.5	<0.5	<0.2	5	<0.5	<0.5	0.06
Monterey	Monterey Harbor	8/10/2006	1127	Rinse Blank	1	<4	0.5	0.1	1.2	<0.5	<0.5	<0.5	<0.2	4	<0.5	<0.5	0.26
Sacramento	Sacramento City Marina	8/16/2006	1010	Field Blank	2	<4	0.1	<0.1	5.7	<0.5	0.5	<0.5	<0.2	3	<0.5	<0.5	0.08
Sacramento	Sacramento City Marina	8/16/2006	1045	Rinse Blank	2	<4	0.9	<0.1	2.4	<0.5	0.5	<0.5	<0.2	4	<0.5	<0.5	0.22
Lake Tahoe	Tahoe Keyes Marina	8/17/2006	1145	Field Blank	2	<4	0.1	<0.1	<1	0.5	<0.5	<0.5	<0.2	4	<0.5	<0.5	0.08
Lake Tahoe	Tahoe Keyes Marina	8/17/2006	1240	Rinse Blank	2	<4	0.6	<0.1	5.1	0.5	0.5	<0.5	<0.2				0.16
Berkeley	City of Berkeley Marina	8/21/2006	1033	Field Blank	2	<4	<0.1	0.1	<1	<0.5	<0.5	<0.5	<0.2	3	<0.5	<0.5	0.12
Berkeley	City of Berkeley Marina	8/21/2006	1155	Rinse Blank	2	<4	0.4	0.4	2.7	<0.5	<0.5	1.3	<0.2	3	2.1	<0.5	0.26
San Rafael	Loch Lomond Marina	8/22/2006	1411	Field Blank	2	<4	<0.1	<0.1	<1	<0.5	<0.5	<0.5	<0.2	5	<0.5	<0.5	0.06
San Rafael	Loch Lomond Marina	8/22/2006	1548	Rinse Blank	2	<4	48.4	46.3	18.2	<0.5	<0.5	<0.5	<0.2	5	0.6	<0.5	0.13
Long Beach	Alamitos Bay Marina	8/29/2006	938	Field Blank	2	<4	<0.1	<0.1	2.6	<0.5	<0.5	<0.5	<0.2	4	<0.5	<0.5	0.09
Long Beach	Alamitos Bay Marina	8/29/2006	1106	Rinse Blank	2	<4	4.3	3.5	5.1	<0.5	<0.5	<0.5	<0.2	3	0.8	<0.5	0.14

City	Marina Name	Date Sampled	Time	Blank	Sampling Event	TSS (mg/L)	TCU (ug/L)	DCU (ug/L)	DZN (ug/L)	CA (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Alk (mg/L)	Cl (mg/L)	SO4 (mg/L)	DOC (mg/L)
Los Angeles	Marina del Rey Back Basin	8/30/2006	1225	Field Blank	2	<4	<0.1	0.1	3.6	<0.5	<0.5	<0.5	<0.2	3	<0.5	<0.5	0.15
Los Angeles	Marina del Rey Back Basin	8/30/2006	1138	Rinse Blank	2	<4	1.7	1.4	3.4	<0.5	<0.5	0.6	<0.2	3	1	<0.5	0.13
Benicia	Benicia Marina	9/6/2006	1340	Field Blank	2	<4	<0.1	<0.1	<1	<0.5	<0.5	<0.5	<0.2	3	<0.5	<0.5	
Benicia	Benicia Marina	9/6/2006	1436	Rinse Blank	2	<4	18.3	17.2	7.6	<0.5	1.2	9.8	0.3	3	10.8	1.4	
Santa Cruz	Santa Cruz Harbor	9/7/2006	1100	Field Blank	2	<4	<0.1	<0.1	5	<0.5	<0.5	<0.5	<0.2	3	<0.5		0.26
Santa Cruz	Santa Cruz Harbor	9/7/2006	1111	Rinse Blank	2	<4	1.3	0.5	<1	<0.5	<0.5	<0.5	<0.2	3	0.6	<0.5	0.20
Stockton	Village West Marina	9/13/2006	1203	Field Blank	3	<4	0.1	<0.1	<1	<0.5	<0.5	<0.5	<0.2	3	<0.5	<0.5	0.29
Stockton	Village West Marina	9/13/2006	1335	Rinse Blank	3	<4	0.4	<0.1	2.2	<0.5	<0.5	<0.5	<0.2	2	<0.5	<0.5	0.24
Berkeley	City of Berkeley Marina	9/18/2006	1055	Rinse Blank	3	<4	0.5	0.5	3.1	<0.5	<0.5	<0.5	<0.2	3	<0.5	<0.5	0.31
Sausalito	Clipper Yacht Harbor	9/19/2006	1436	Rinse Blank	3	<4	0.7	0.6	1.9	<0.5	<0.5	<0.5	<0.2	2	0.5	<0.5	0.29
San Francisco	San Francisco Marina	9/20/2006	1055	Field Blank	3	<4	<0.1	<0.1	1.2	<0.5	<0.5	<0.5	<0.2	2	<0.5	<0.5	0.24

Appendix F: Metals, TSS, & BLM-Related Water Column Data (ANR Laboratory and DPR Laboratory)

Table F-1. Metals, TSS, & BLM-Related Data

City	Marina Name	Sample Site	Sampling Event	Sampling Date	Time	TSS (mg/L)	TCu (ug/L)	DCu (ug/L)	DZn (ug/L)	CA (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Alkalinity (mg/L)	Cl (mg/L)	SO4 (mg/L)	DOC (mg/L)
Long Beach	Alamitos Bay Marina	1	1	8/1/2006	954	16	4.4	3.4	12.4	428	1350	10254	414	115	19360	2771	0.78
Long Beach	Alamitos Bay Marina	2	1	8/1/2006	1007	24	1.6	1.3	2.9	429	1360	10404	413	114	19284	2751	0.83
Long Beach	Alamitos Bay Marina	3	1	8/1/2006	1016	18	1.7	1.6	3.2	430	1350	11068	412	115	19488	2731	0.77
Long Beach	Alamitos Bay Marina	4	1	8/1/2006	1043	<4	2.7	2.9	7.2	425	1350	10424	414	114	19388	2703	0.82
Long Beach	Alamitos Bay Marina	5	1	8/1/2006	1054	10	1	1.2	11.6	429	1360	10630	411	115	19347	2739	0.89
Long Beach	Alamitos Bay Marina	6	1	8/1/2006	1113	12	1.2	1.2	2.8	431	1360	10680	412	114	19258	2635	0.82
Long Beach	Alamitos Bay Marina	7	1	8/1/2006	1123	11	0.3	0.6	2.4	432	1350	10463	420	114	19435	2720	0.75
Long Beach	Alamitos Bay Marina	8	1	8/1/2006	1133	17	0.1	0.4	7.5	429	1350	10773	414	117	19328	2636	0.76
Long Beach	Alamitos Bay Marina	1	2	8/29/2006	911	19	2.4	2.3	8.9	434	1350	10700	429	114	19468	2562	1.10
Long Beach	Alamitos Bay Marina	2	2	8/29/2006	930	22	1.5	0.5	4.9	434	1350	10700	412	114	19515	2589	0.94
Long Beach	Alamitos Bay Marina	3	2	8/29/2006	948	9	1.2	1	9.3	441	1370	10200	399	110	19889	2564	0.89
Long Beach	Alamitos Bay Marina	4	2	8/29/2006	1000	11	1.7	1.5	8	441	1370	10600	418	113	19485	2507	0.88
Long Beach	Alamitos Bay Marina	5	2	8/29/2006	1014	18	0.7	0.4	6.8	440	1370	10800	438	112	19516	2619	0.96
Long Beach	Alamitos Bay Marina	6	2	8/29/2006	1035	19	0.8	<0.1	3	442	1370	10800	411	112	19553	2589	1.02
Long Beach	Alamitos Bay Marina	7	2	8/29/2006	1045	34	<0.1	<0.1	10.8	443	1370	10600	419	113	19366	2619	0.86
Long Beach	Alamitos Bay Marina	8	2	8/29/2006	1059	17	<0.1	<0.1	20.3	443	1380	10800	414	112	19667	2661	0.83
Long Beach	Alamitos Bay Marina	1	3	9/26/2006	925	13	3.2	3.2	22.3	433	1360	10360	404	113	20300	2800	0.97
Long Beach	Alamitos Bay Marina	2	3	9/26/2006	945	8	<0.1	0.4	5.5	428	1340	10410	409	113	19800	2720	1.01
Long Beach	Alamitos Bay Marina	3	3	9/26/2006	958	17	<0.1	0.5	3.9	425	1330	10380	408	113	19700	2710	1.03
Long Beach	Alamitos Bay Marina	4	3	9/26/2006	1013	18	1.8	0.6	6.3	444	1390	10400	401	112	20400	2810	1.01
Long Beach	Alamitos Bay Marina	5	3	9/26/2006	1024	19	0.6	0.9	8.9	449	1410	10490	399	112	20100	2780	1.02
Long Beach	Alamitos Bay Marina	6	3	9/26/2006	1047	15	<0.1	0.2	1.6	440	1370	10410	413	112	20400	2810	1.04
Long Beach	Alamitos Bay Marina	7	3	9/26/2006	1057	20	<0.1	0.3	8.8	436	1360	10400	401	114	20400	2820	1.00
Long Beach	Alamitos Bay Marina	8	3	9/26/2006	1104	21	<0.1	0.2	11.3	434	1350	10320	403	110	20300	2800	1.03
Antioch	Antioch Marina	1	1	8/8/2006	1305	9	2.5	1.8	<1	18	25	160	9	57	357	55	1.58
Antioch	Antioch Marina	2	1	8/8/2006	1312	9	3.4	2.9	3.4	20	31	201	12	58	389	59	1.74
Antioch	Antioch Marina	3	1	8/8/2006	1320	6	3.4	1.9	<1	19	27	175	10	56	334	52	1.62
Antioch	Antioch Marina	4	1	8/8/2006	1326	8	2.6	1.7	2.3	19	27	171	10	56	323	51	1.62
Antioch	Antioch Marina	5	1	8/8/2006	1335	17	2.6	1.4	<1	14	14	78	5	56	123	24	1.47

City	Marina Name	Sample Site	Sampling Event	Sampling Date	Time	TSS (mg/L)	TCu (ug/L)	DCu (ug/L)	DZn (ug/L)	CA (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Alkalinity (mg/L)	Cl (mg/L)	SO4 (mg/L)	DOC (mg/L)
Antioch	Antioch Marina	6	1	8/8/2006	1343	9	2.2	1.4	<1	14	14	75	5	58	128	25	1.41
Antioch	Antioch Marina	7	1	8/8/2006	1350	16	2.2	1.4	<1	14	13	68	5	56	129	24	1.49
Antioch	Antioch Marina	8	1	8/8/2006	1355	11	2.5	1.4	1.2	14	14	76	5	57	143	27	1.62
Antioch	Antioch Marina	1	2	9/6/2006	927	5	2.8	2.6	2.2	18	24	152	8	61	328	52	L
Antioch	Antioch Marina	2	2	9/6/2006	934	6	3.8	2.2	4.2	17	20	129	7	61	244	40	L
Antioch	Antioch Marina	3	2	9/6/2006	940	4	3.9	2.5	2.1	18	25	164	8	61	283	46	L
Antioch	Antioch Marina	4	2	9/6/2006	945	4	3.4	2.6	2.6	18	23	150	7	62	274	45	L
Antioch	Antioch Marina	5	2	9/6/2006	955	13	2.8	1.7	3.1	15	15	84	4	62	146	27	L
Antioch	Antioch Marina	6	2	9/6/2006	1006	11	2.9	1.6	2	14	15	82	4	60	147	27	L
Antioch	Antioch Marina	7	2	9/6/2006	1010	14	2.8	1.6	2.5	15	15	83	4	60	145	27	L
Antioch	Antioch Marina	8	2	9/6/2006	1016	10	2.9	1.7	2.3	15	15	85	5	60	147	27	L
Antioch	Antioch Marina	1	3	10/2/2006	1118	10	2.6	2.1	1.3	18	21	131	7	73	225	37	2.14
Antioch	Antioch Marina	2	3	10/2/2006	1135	8	2.6	2	1.9	18	22	132	7	70	217	37	2.11
Antioch	Antioch Marina	3	3	10/2/2006	1142	7	2.5	2.1	1.5	18	20	119	6	71	200	34	2.34
Antioch	Antioch Marina	4	3	10/2/2006	1150	10	2.5	2	1.1	18	22	134	7	70	244	39	2.28
Antioch	Antioch Marina	5	3	10/2/2006	1202	17	2.8	1.6	2.4	18	22	137	7	70	240	40	2.37
Antioch	Antioch Marina	6	3	10/2/2006	1207	22	2.7	1.6	1.1	18	22	135	7	69	236	39	2.17
Antioch	Antioch Marina	7	3	10/2/2006	1214	17	2.9	1.6	1.3	18	22	133	7	70	237	39	2.15
Antioch	Antioch Marina	8	3	10/2/2006	1220	13	2.5	1.6	1.9	17	18	105	5	70	192	33	2.13
Alameda	Ballena Isle Marina	1	1	7/27/2006	1000	34	4.6	4.9	8.7	357	1110	8780	333	113	16455	2333	1.35
Alameda	Ballena Isle Marina	2	1	7/27/2006	1012	28	2.6	2.3	3.4	357	1110	8900	332	109	16439	2290	1.38
Alameda	Ballena Isle Marina	3	1	7/27/2006	1028	37	4.5	4.3	5.9	360	1120	8700	337	109	16425	2321	1.33
Alameda	Ballena Isle Marina	4	1	7/27/2006	1039	36	4.9	4.9	8.3	358	1120	8720	338	108	16340	2275	1.34
Alameda	Ballena Isle Marina	5	1	7/27/2006	1052	33	1.2	1.5	1.6	356	1110	8640	339	110	16364	2289	1.42
Alameda	Ballena Isle Marina	6	1	7/27/2006	1105	14	1	1.3	2.8	357	1120	8670	338	109	16670	2335	1.30
Alameda	Ballena Isle Marina	7	1	7/27/2006	1113	18	0.9	1.2	1.7	359	1120	8740	336	107	16483	2281	1.26
Alameda	Ballena Isle Marina	8	1	7/27/2006	1123	22	0.6	1.1	2.4	360	1120	8780	339	108	16384	2267	1.43
Alameda	Ballena Isle Marina	1	2	8/24/2006	1030	14	3.9	3.5	12	372	1140	8960	350	111	16700	2150	1.57
Alameda	Ballena Isle Marina	2	2	8/24/2006	1036	19	1	1.2	3.4	372	1150	9120	348	107	18000	2350	1.36
Alameda	Ballena Isle Marina	3	2	8/24/2006	1042	19	3.8	3.7	9.2	370	1140	9050	346	111	16900	2230	1.55

City	Marina Name	Sample Site	Sampling Event	Sampling Date	Time	TSS (mg/L)	TCu (ug/L)	DCu (ug/L)	DZn (ug/L)	CA (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Alkalinity (mg/L)	Cl (mg/L)	SO4 (mg/L)	DOC (mg/L)
Alameda	Ballena Isle Marina	4	2	8/24/2006	1047	21	1.9	1.5	<1	373	1140	8940	338	113	16700	2210	1.64
Alameda	Ballena Isle Marina	5	2	8/24/2006	1054	13	1.3	1.3	1.4	374	1150	8850	351	110	16400	2220	1.55
Alameda	Ballena Isle Marina	6	2	8/24/2006	1109	13	1.2	1.3	2.1	377	1150	8440	346	110	16700	2260	1.44
Alameda	Ballena Isle Marina	7	2	8/24/2006	1120	10	4.3	3.7	7.8	373	1150	8740	348	110	16600	2150	1.58
Alameda	Ballena Isle Marina	8	2	8/24/2006	1130	18	2.9	3	8.6	374	1150	7630	347	110	16700	2140	1.56
Alameda	Ballena Isle Marina	1	3	9/21/2006	1008	19	3.2	3.3	5.7	364	1120	9140	347	115	16700	2270	1.46
Alameda	Ballena Isle Marina	2	3	9/21/2006	1018	11	9.3	2	5.3	362	1120	9030	345	115	16600	2240	1.49
Alameda	Ballena Isle Marina	3	3	9/21/2006	1024	11	2.7	2.8	4.6	368	1130	9040	345	116	16600	2240	1.36
Alameda	Ballena Isle Marina	4	3	9/21/2006	1029	14	2.9	2.7	5.7	368	1130	9020	346	116	16700	2260	1.44
Alameda	Ballena Isle Marina	5	3	9/21/2006	1001	25	1.1	1.2	1	367	1120	9110	341	115	16400	2220	1.43
Alameda	Ballena Isle Marina	6	3	9/21/2006	940	11	0.8	0.8	3.1	368	1120	9090	352	115	16800	2300	1.21
Alameda	Ballena Isle Marina	7	3	9/21/2006	949	15	0.6	0.8	1.1	367	1120	9190	351	112	17000	2320	1.24
Alameda	Ballena Isle Marina	8	3	9/21/2006	953	20	0.8	1	3.5	367	1130	9150	348	115	16600	2250	1.44
Benicia	Benicia Marina	1	1	8/7/2006	1257	28	3.4	1.8	1.1	157	444	3520	141	77	6959	952	1.70
Benicia	Benicia Marina	2	1	8/7/2006	1310	22	4.8	3.4	2.9	154	436	3450	140	77	7458	1020	1.86
Benicia	Benicia Marina	3	1	8/7/2006	1314	24	5.1	3.3	3.3	154	436	3470	140	75	6928	944	2.09
Benicia	Benicia Marina	4	1	8/7/2006	1327	29	4.1	2.7	2.3	155	438	3430	141	76	7233	987	1.75
Benicia	Benicia Marina	5	1	8/7/2006	1345	86	6	1.7	1.8	176	506	3960	160	78	8514	1168	1.69
Benicia	Benicia Marina	6	1	8/7/2006	1351	65	5.7	2.2	2.3	177	511	4020	162	79	8778	1206	1.70
Benicia	Benicia Marina	7	1	8/7/2006	1402	57	4.4	1.9	<1	177	511	3980	163	88	8174	1120	1.64
Benicia	Benicia Marina	8	1	8/7/2006	1413	22	2.7	2.1	<1	161	456	3590	147	78	7396	1010	2.08
Benicia	Benicia Marina	1	2	9/6/2006	1315	46	4.7	2.2	1.7	149	419	3108	138	76	6899	942	L
Benicia	Benicia Marina	2	2	9/6/2006	1320	30	4.4	2.6	1.9	145	412	3394	137	74	6928	947	L
Benicia	Benicia Marina	3	2	9/6/2006	1325	27	4.3	2.8	2.1	145	409	3214	134	76	6660	909	L
Benicia	Benicia Marina	4	2	9/6/2006	1335	23	5.4	3.7	11.7	145	406	3155	133	75	6902	942	L
Benicia	Benicia Marina	5	2	9/6/2006	1345	150	9.7	1.7	1.6	178	514	3818	166	78	7972	1086	L
Benicia	Benicia Marina	6	2	9/6/2006	1404	121	8.7	1.7	<1	185	535	4149	171	78	8346	1142	L
Benicia	Benicia Marina	7	2	9/6/2006	1415	46	4.5	1.8	<1	169	482	3646	156	78	7328	1000	L
Benicia	Benicia Marina	8	2	9/6/2006	1423	40	4.1	1.7	<1	163	465	3616	150	76	7354	1005	L
Benicia	Benicia Marina	1	3	10/2/2006	1400	18	3.4	2.4	3.6	141	388	3189	131	83	6032	773	2.22

City	Marina Name	Sample Site	Sampling Event	Sampling Date	Time	TSS (mg/L)	TCu (ug/L)	DCu (ug/L)	DZn (ug/L)	CA (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Alkalinity (mg/L)	Cl (mg/L)	SO4 (mg/L)	DOC (mg/L)
Benicia	Benicia Marina	2	3	10/2/2006	1410	17	3.6	2.9	3.4	140	385	3208	130	82	6052	791	2.19
Benicia	Benicia Marina	3	3	10/2/2006	1455	15	3.3	2.5	1.7	139	379	3087	128	92	6110	787	2.25
Benicia	Benicia Marina	4	3	10/2/2006	1504	13	3.4	2.8	3.3	140	384	3204	129	81	6220	832	2.27
Benicia	Benicia Marina	5	3	10/2/2006	1522	43	3.2	1.5	<1	201	570	4613	190	87	8700	1150	2.09
Benicia	Benicia Marina	6	3	10/2/2006	1530	39	3.2	1.6	1.9	196	553	4533	185	89	8626	1143	2.19
Benicia	Benicia Marina	7	3	10/2/2006	1556	34	2.6	1.5	1.2	202	569	4693	182	86	9161	1214	2.31
Benicia	Benicia Marina	8	3	10/2/2006	1543	54	3.6	1.6	2.6	198	556	4523	184	87	9311	1238	2.10
Berkeley	City of Berkeley Marina	1	1	7/24/2006	1150	20	7	6.8	6.7	377	1130	8768	346	103	16560	2393	1.14
Berkeley	City of Berkeley Marina	2	1	7/24/2006	1201	23	5.4	4.9	4.6	375	1130	8592	344	100	16463	2315	1.16
Berkeley	City of Berkeley Marina	3	1	7/24/2006	1212	21	4.7	4.4	4.3	375	1140	8626	344	104	16691	2335	1.14
Berkeley	City of Berkeley Marina	4	1	7/24/2006	1234	21	6.1	4.5	4.9	373	1130	8152	344	99	16614	2339	1.09
Berkeley	City of Berkeley Marina	5	1	7/24/2006	1232	17	0.8	1.2	2.7	382	1150	8606	350	105	16692	2446	1.00
Berkeley	City of Berkeley Marina	6	1	7/24/2006	1252	16	0.8	1.3	1.8	377	1140	8792	347	102	17189	2476	1.12
Berkeley	City of Berkeley Marina	7	1	7/24/2006	1302	16	0.7	1.1	2.2	384	1150	8774	353	106	17132	2468	0.91
Berkeley	City of Berkeley Marina	8	1	7/24/2006	1220	25	0.6	2	1.7	384	1170	8936	355	107	17360	2433	0.96
Berkeley	City of Berkeley Marina	1	2	8/21/2006	1024	19	4.4	3	6.9	378	1160	9199	362	106	17280	2305	0.81
Berkeley	City of Berkeley Marina	2	2	8/21/2006	1042	8	3.9	3	4.3	380	1170	9070	364	109	17807	2414	0.89
Berkeley	City of Berkeley Marina	3	2	8/21/2006	1052	25	3.7	2.9	4.3	380	1170	9022	364	108	17755	2452	0.86
Berkeley	City of Berkeley Marina	4	2	8/21/2006	1100	20	3.6	3	4.2	378	1170	9004	371	109	17833	2471	0.85
Berkeley	City of Berkeley Marina	5	2	8/21/2006	1123	14	0.5	0.3	1.3	376	1150	9187	366	108	17667	2418	0.79
Berkeley	City of Berkeley Marina	6	2	8/21/2006	1115	19	0.9	0.8	7.7	385	1180	9186	366	108	18302	2521	0.94
Berkeley	City of Berkeley Marina	7	2	8/21/2006	1135	11	0.6	0.2	2.4	379	1160	9018	363	106	18017	2452	0.74
Berkeley	City of Berkeley Marina	8	2	8/21/2006	1145	16	0.4	0.3	2.5	384	1170	8875	362	108	18080	2497	0.90
Berkeley	City of Berkeley Marina	1	3	9/18/2006	1012	10	4.3	3.8	8.8	375	1160	9080	358	106	17155	2330	0.79
Berkeley	City of Berkeley Marina	2	3	9/18/2006	1023	19	2.4	1.8	2.9	379	1170	8950	356	107	16362	2215	0.93
Berkeley	City of Berkeley Marina	3	3	9/18/2006	1046	21	2.8	2.6	4.5	377	1160	8910	358	107	17336	2332	0.98
Berkeley	City of Berkeley Marina	4	3	9/18/2006	1052	20	2.6	1.9	2.9	372	1150	8930	358	107	16973	2258	0.92
Berkeley	City of Berkeley Marina	5	3	9/18/2006	1111	16	0.7	0.6	1	367	1140	9050	362	105	16977	2305	0.88
Berkeley	City of Berkeley Marina	6	3	9/18/2006	1104	16	1.2	0.9	9.5	371	1150	8940	361	107	16543	2206	2.70
Berkeley	City of Berkeley Marina	7	3	9/18/2006	1120	8	3.2	0.7	1.2	370	1150	9140	356	105	17440	2345	0.73

City	Marina Name	Sample Site	Sampling Event	Sampling Date	Time	TSS (mg/L)	TCu (ug/L)	DCu (ug/L)	DZn (ug/L)	CA (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Alkalinity (mg/L)	Cl (mg/L)	SO4 (mg/L)	DOC (mg/L)
Berkeley	City of Berkeley Marina	8	3	9/18/2006	1130	12	1	0.5	<1	364	1130	8630	358	104	17209	2352	0.73
Sausalito	Clipper Yacht Harbor	1	1	7/27/2006	1415	29	0.8	1.3	3.4	377	1180	9140	360	111	17204	2407	0.94
Sausalito	Clipper Yacht Harbor	2	1	7/27/2006	1426	23	2	2	3	383	1190	9000	359	109	17594	2476	0.94
Sausalito	Clipper Yacht Harbor	3	1	7/27/2006	1436	23	2	2.5	4.7	382	1190	9260	358	111	17774	2473	0.97
Sausalito	Clipper Yacht Harbor	4	1	7/27/2006	1447	27	1.3	1.8	2.4	384	1200	9390	363	109	17333	2446	0.97
Sausalito	Clipper Yacht Harbor	5	1	7/27/2006	1456	26	0.6	0.9	1.1	378	1180	9270	358	109	17205	2433	0.94
Sausalito	Clipper Yacht Harbor	6	1	7/27/2006	1506	23	1	0.9	<1	378	1180	9250	359	110	17215	2440	0.92
Sausalito	Clipper Yacht Harbor	7	1	7/27/2006	1516	19	0.6	0.8	1.3	375	1170	9280	356	109	16989	2386	0.94
Sausalito	Clipper Yacht Harbor	8	1	7/27/2006	1526	31	0.7	0.9	2	380	1180	9300	361	106	17336	2458	0.96
Sausalito	Clipper Yacht Harbor	1	2	8/25/2006	1317	19	1.5	2.7	12.7	396	1230	8780	371	108	17900	2400	1.09
Sausalito	Clipper Yacht Harbor	2	2	8/25/2006	1325	20	4.7	3.6	6.6	400	1250	9790	371	109	17700	2350	0.99
Sausalito	Clipper Yacht Harbor	3	2	8/25/2006	1333	14	9	6.6	12.2	397	1240	9730	368	108	16800	2300	1.00
Sausalito	Clipper Yacht Harbor	4	2	8/25/2006	1340	9	4.4	3.2	5.4	403	1250	9740	376	108	18100	2450	0.95
Sausalito	Clipper Yacht Harbor	5	2	8/25/2006	1358	16	2.3	0.8	2.3	398	1230	9460	373	108	17700	2400	1.01
Sausalito	Clipper Yacht Harbor	6	2	8/25/2006	1352	21	1.4	0.6	3.4	399	1240	9550	375	108	18100	2480	0.94
Sausalito	Clipper Yacht Harbor	7	2	8/25/2006	1402	24	0.8	0.5	1.6	391	1220	9700	367	108	17900	2460	0.99
Sausalito	Clipper Yacht Harbor	8	2	8/25/2006	1408	21	1.8	0.3	6.3	396	1230	9370	377	107	17600	2400	0.95
Sausalito	Clipper Yacht Harbor	1	3	9/19/2006	1340	20	1.5	1.7	2.9	377	1174	9340	361	107	17213	2312	0.76
Sausalito	Clipper Yacht Harbor	2	3	9/19/2006	1350	24	3.1	3.7	5.8	383	1197	9350	371	110	17567	2379	1.06
Sausalito	Clipper Yacht Harbor	3	3	9/19/2006	1355	17	1.2	1.4	3.2	374	1166	9750	367	107	17744	2424	1.09
Sausalito	Clipper Yacht Harbor	4	3	9/19/2006	1400	14	1.1	1.6	4	383	1191	9500	364	108	17889	2434	1.44
Sausalito	Clipper Yacht Harbor	5	3	9/19/2006	1410	15	0.8	0.8	3.7	383	1194	9490	371	108	17702	2400	1.04
Sausalito	Clipper Yacht Harbor	6	3	9/19/2006	1415	16	0.6	1.2	2	380	1182	9490	368	107	17710	2385	1.46
Sausalito	Clipper Yacht Harbor	7	3	9/19/2006	1422	19	0.6	0.9	2	383	1197	9650	366	107	17669	2402	1.15
Sausalito	Clipper Yacht Harbor	8	3	9/19/2006	1430	24	0.8	1.2	5.2	384	1203	9530	376	107	17147	2322	1.54
San Mateo	Coyote Point Marina	1	1	7/28/2006	1001	23	1.7	1.8	2.2	353	1080	8170	343	111	15993	2310	1.51
San Mateo	Coyote Point Marina	2	1	7/28/2006	1011	10	2.4	2.6	6	354	1080	8220	343	111	16124	2327	1.58
San Mateo	Coyote Point Marina	3	1	7/28/2006	1020	12	2.6	2.1	3.4	353	1090	7680	335	110	16152	2333	1.51
San Mateo	Coyote Point Marina	4	1	7/28/2006	1032	13	1.8	1.7	4.1	355	1090	7820	342	112	16188	2337	1.66
San Mateo	Coyote Point Marina	5	1	7/28/2006	1053	14	0.9	1.5	<1	358	1090	7820	342	110	16256	2347	1.55

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San Mateo	Coyote Point Marina	6	1	7/28/2006	1100	7	1	1.3	3.3	358	1100	8250	343	109	16195	2339	1.55
San Mateo	Coyote Point Marina	7	1	7/28/2006	1111	10	0.8	1.3	5.7	354	1080	7980	337	112	16062	2318	1.53
San Mateo	Coyote Point Marina	8	1	7/28/2006	1122	10	1.1	1.4	1.8	359	1100	8280	342	113	16090	2326	1.52
San Mateo	Coyote Point Marina	1	2	8/25/2006	925	22	2.3	2.2	5.6	368	1150	8950	355	114	17300	2390	1.76
San Mateo	Coyote Point Marina	2	2	8/25/2006	933	24	2.4	2.2	4.1	373	1160	9170	352	114	17300	2370	1.76
San Mateo	Coyote Point Marina	3	2	8/25/2006	942	24	2.4	2.4	5.5	378	1170	8900	362	114	17200	2370	1.77
San Mateo	Coyote Point Marina	4	2	8/25/2006	950	22	2.5	2.2	8.1	375	1160	9200	349	112	17400	2410	1.80
San Mateo	Coyote Point Marina	5	2	8/25/2006	1004	15	1	1.3	16.6	377	1170	8990	356	112	17200	2370	1.82
San Mateo	Coyote Point Marina	8	2	8/25/2006	1010	20	1.2	1.1	2	380	1180	9110	363	109	17200	2360	1.75
San Mateo	Coyote Point Marina	6	2	8/25/2006	1024	17	1	1.2	2.3	379	1180	9120	363	111	17500	2420	1.64
San Mateo	Coyote Point Marina	7	2	8/25/2006	1029	15	0.7	1.1	4.1	381	1180	8920	356	109	17500	2390	1.53
Long Beach	Downtown Shoreline Marina	1	1	8/1/2006	1310	19	8.7	7.4	16.8	431	1350	10057	417	113	19085	2691	0.90
Long Beach	Downtown Shoreline Marina	2	1	8/1/2006	1321	25	6.7	6.3	15.9	428	1350	10530	415	114	19260	2706	0.86
Long Beach	Downtown Shoreline Marina	3	1	8/1/2006	1329	22	7	7.7	25.8	433	1350	10400	407	111	19323	2584	1.10
Long Beach	Downtown Shoreline Marina	4	1	8/1/2006	1337	16	2.6	2.4	9.9	425	1330	10352	414	115	19368	2692	1.00
Long Beach	Downtown Shoreline Marina	5	1	8/1/2006	1352	12	0.2	0.5	2.7	416	1300	9962	414	119	18811	2635	1.26
Long Beach	Downtown Shoreline Marina	6	1	8/1/2006	1357	15	<0.1	0.8	2.1	419	1310	10345	405	118	18771	2639	1.19
Long Beach	Downtown Shoreline Marina	7	1	8/1/2006	1404	22	0.2	0.6	5.5	418	1320	10432	407	115	18933	2670	1.09
Long Beach	Downtown Shoreline Marina	8	1	8/1/2006	1411	21	0.3	0.7	3.6	415	1300	9985	405	115	18705	2624	1.21
Long Beach	Downtown Shoreline Marina	1	2	8/29/2006	1332	16	6.3	5.3	16.7	432	1350	10500	410	113	19478	2623	1.24
Long Beach	Downtown Shoreline Marina	2	2	8/29/2006	1340	22	8.4	7.4	21.8	432	1340	10400	404	116	18971	2564	0.99
Long Beach	Downtown Shoreline Marina	3	2	8/29/2006	1348	11	5.1	8.9	26.7	426	1340	10410	417	115	19110	2621	0.97
Long Beach	Downtown Shoreline Marina	4	2	8/29/2006	1359	26	4	4.4	16.5	431	1330	10400	403	110	19131	2600	1.20
Long Beach	Downtown Shoreline Marina	5	2	8/29/2006	1416	19	0.1	0.4	6.1	420	1290	10300	391	115	18509	2526	1.33
Long Beach	Downtown Shoreline Marina	6	2	8/29/2006	1423	13	<0.1	0.5	2.7	426	1310	10400	398	109	19221	2615	1.38
Long Beach	Downtown Shoreline Marina	7	2	8/29/2006	1430	13	<0.1	0.4	2.5	426	1320	10400	401	115	19099	2570	1.47
Long Beach	Downtown Shoreline Marina	8	2	8/29/2006	1439	21	0.2	0.5	3.3	434	1340	10500	402	112	19185	2568	1.16
Long Beach	Downtown Shoreline Marina	1	3	9/26/2006	1340	22	10.1	10.9	40.1	431	1340	10240	409	112	19900	2740	1.05
Long Beach	Downtown Shoreline Marina	2	3	9/26/2006	1351	22	11.5	9.5	26.7	434	1350	10310	405	112	19500	2700	1.10
Long Beach	Downtown Shoreline Marina	3	3	9/26/2006	1358	15	9.2	8.6	24.2	427	1330	10220	403	111	19800	2730	0.96

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Long Beach	Downtown Shoreline Marina	4	3	9/26/2006	1407	13	3.9	6	16.8	426	1330	10210	402	112	19900	2750	1.12
Long Beach	Downtown Shoreline Marina	5	3	9/26/2006	1423	6	1.2	1.2	7.6	345	1010	7720	316	128	14800	2080	2.94
Long Beach	Downtown Shoreline Marina	6	3	9/26/2006	1433	15	<0.1	0.9	5.6	434	1360	10310	407	119	18500	2560	1.80
Long Beach	Downtown Shoreline Marina	7	3	9/26/2006	1440	17	<0.1	0.9	3.8	417	1290	9790	395	114	19300	2670	1.92
Long Beach	Downtown Shoreline Marina	8	3	9/26/2006	1527	19	<0.1	0.9	4.8	420	1300	10030	393	114	18400	2530	0.86
Folsom	Folsom Lake Marina	1	1	7/17/2006	1045	<4	0.6	0.3	3	5	2	2	1	L	L	L	1.38
Folsom	Folsom Lake Marina	2	1	7/17/2006	1101	<4	0.6	0.2	1.5	5	2	2	1	L	L	L	1.34
Folsom	Folsom Lake Marina	3	1	7/17/2006	1111	<4	0.8	0.7	3.3	5	2	2	1	L	L	L	1.30
Folsom	Folsom Lake Marina	4	1	7/17/2006	1120	<4	0.7	0.4	2.5	5	2	2	1	L	L	L	1.32
Folsom	Folsom Lake Marina	5	1	7/17/2006	1132	<4	0.9	0.5	3.1	5	2	2	1	L	L	L	1.10
Folsom	Folsom Lake Marina	6	1	7/17/2006	1145	<4	0.7	0.4	<1	5	2	2	1	L	L	L	1.18
Folsom	Folsom Lake Marina	7	1	7/17/2006	1152	<4	0.5	0.2	1	5	2	2	1	L	L	L	1.26
Folsom	Folsom Lake Marina	8	1	7/17/2006	1203	<4	0.7	0.3	<1	5	2	2	1	L	L	L	1.07
Folsom	Folsom Lake Marina	1	2	8/14/2006	955	<4	0.6	0.6	4.5	5	2	2	1	24	1	2	1.64
Folsom	Folsom Lake Marina	2	2	8/14/2006	1005	<4	0.6	0.6	5.5	5	2	2	1	26	1	2	1.51
Folsom	Folsom Lake Marina	3	2	8/14/2006	1015	<4	0.7	0.6	6.3	5	2	2	1	24	1	2	1.41
Folsom	Folsom Lake Marina	4	2	8/14/2006	1025	<4	0.7	0.6	8.6	5	2	2	1	22	1	2	1.35
Folsom	Folsom Lake Marina	5	2	8/14/2006	1030	<4	0.6	0.4	2.8	5	2	2	1	23	1	2	1.45
Folsom	Folsom Lake Marina	6	2	8/14/2006	1042	<4	0.6	0.2	1.6	5	2	2	1	23	1	2	1.52
Folsom	Folsom Lake Marina	7	2	8/14/2006	1050	<4	0.8	0.3	9.1	5	2	2	1	24	1	2	1.63
Folsom	Folsom Lake Marina	8	2	8/14/2006	1100	<4	0.5	0.2	8.8	5	2	2	1	24	1	2	1.61
Folsom	Folsom Lake Marina	1	3	9/14/2006	1030	<4	0.7	0.6	1.3	5	1	2	1	21	1	1	0.92
Folsom	Folsom Lake Marina	2	3	9/14/2006	1053	<4	0.6	0.5	2.6	5	2	2	1	21	1	1	0.96
Folsom	Folsom Lake Marina	3	3	9/14/2006	1120	<4	0.7	0.5	2.9	5	1	2	1	21	1	1	0.86
Folsom	Folsom Lake Marina	4	3	9/14/2006	1147	<4	0.7	0.5	1.3	5	1	2	1	21	1	1	0.95
Folsom	Folsom Lake Marina	5	3	9/14/2006	1205	<4	0.7	0.5	1.6	5	1	2	1	21	1	1	0.94
Folsom	Folsom Lake Marina	6	3	9/14/2006	1230	<4	0.6	0.5	8.4	5	1	2	1	21	1	1	1.06
Folsom	Folsom Lake Marina	7	3	9/14/2006	1302	<4	0.6	0.4	<1	5	1	2	1	21	1	1	0.96
Folsom	Folsom Lake Marina	8	3	9/14/2006	1328	<4	0.5	0.4	<1	5	1	2	1	21	1	1	1.27
San Rafael	Loch Lomond Marina	1	1	7/25/2006	1402	19	10.6	10.3	11.1	313	971	7010	304	95	14500	2090	1.28

City	Marina Name	Sample Site	Sampling Event	Sampling Date	Time	TSS (mg/L)	TCu (ug/L)	DCu (ug/L)	DZn (ug/L)	CA (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Alkalinity (mg/L)	Cl (mg/L)	SO4 (mg/L)	DOC (mg/L)
San Rafael	Loch Lomond Marina	2	1	7/25/2006	1413	20	8.3	8.4	9.9	318	981	6970	307	98	14400	2080	1.28
San Rafael	Loch Lomond Marina	3	1	7/25/2006	1422	26	9	7.2	9.2	317	979	7230	305	94	14300	2070	1.26
San Rafael	Loch Lomond Marina	4	1	7/25/2006	1430	19	9.7	8	7.9	314	969	7510	304	92	14400	2070	1.23
San Rafael	Loch Lomond Marina	5	1	7/25/2006	1445	37	1.9	1.4	1.8	321	995	7450	309	95	14900	2160	1.56
San Rafael	Loch Lomond Marina	6	1	7/25/2006	1455	40	2.2	1.8	2.2	322	999	7250	308	97	14600	2100	L
San Rafael	Loch Lomond Marina	7	1	7/25/2006	1504	43	2.5	1.8	2.4	319	991	7280	306	96	14600	2100	1.23
San Rafael	Loch Lomond Marina	8	1	7/25/2006	1512	41	2.8	2.1	2.6	319	988	7210	307	94	14700	2130	1.43
San Rafael	Loch Lomond Marina	1	2	8/22/2006	1400	11	8.8	7.7	9.2	335	1036	8220	329	103	16120	2021	1.68
San Rafael	Loch Lomond Marina	2	2	8/22/2006	1417	22	5.9	4	4.9	335	1036	8090	332	103	16049	2150	1.33
San Rafael	Loch Lomond Marina	3	2	8/22/2006	1432	21	5.1	4.8	5.6	340	1050	8210	332	100	15519	2109	1.72
San Rafael	Loch Lomond Marina	4	2	8/22/2006	1443	19	4.6	5.3	6	344	1053	8160	331	101	15624	2099	1.38
San Rafael	Loch Lomond Marina	5	2	8/22/2006	1459	21	2.7	1.8	1.2	330	1013	7950	318	99	15458	2076	1.27
San Rafael	Loch Lomond Marina	6	2	8/22/2006	1513	17	2.1	1.3	<1	324	997	7830	320	99	15083	2034	1.47
San Rafael	Loch Lomond Marina	7	2	8/22/2006	1524	21	2.3	1.3	1.3	394	1232	9560	379	101	15410	2059	1.41
San Rafael	Loch Lomond Marina	8	2	8/22/2006	1535	25	3.1	2.1	1.8	344	1065	8130	336	103	15606	2111	1.33
San Rafael	Loch Lomond Marina	1	3	9/19/2006	1008	10	7.1	6.7	13.8	322	988	7900	306	100	14597	1965	1.00
San Rafael	Loch Lomond Marina	2	3	9/19/2006	1017	17	4.5	4.3	9.6	320	979	7970	307	99	14432	1912	1.60
San Rafael	Loch Lomond Marina	3	3	9/19/2006	1025	23	5	4.4	7.8	322	986	7890	305	100	14726	1967	1.14
San Rafael	Loch Lomond Marina	4	3	9/19/2006	1032	30	2.8	3.2	4.9	320	986	7890	305	98	14657	1950	1.06
San Rafael	Loch Lomond Marina	5	3	9/19/2006	1045	26	2.5	2.1	2.8	319	982	7730	299	98	14441	1911	1.30
San Rafael	Loch Lomond Marina	6	3	9/19/2006	1052	23	2.5	1.5	3.4	312	957	7910	297	97	14417	1946	1.22
San Rafael	Loch Lomond Marina	7	3	9/19/2006	1103	19	2.1	1.6	2	315	969	7810	300	98	14541	1961	1.17
San Rafael	Loch Lomond Marina	8	3	9/19/2006	1110	26	2.9	2.2	3.7	318	976	7780	301	100	14575	1920	1.22
Richmond	Marina Bay Yacht Harbor	1	1	7/25/2006	955	11	2.3	2.7	3.4	371	1120	8320	341	99	17249	2513	1.26
Richmond	Marina Bay Yacht Harbor	2	1	7/25/2006	1010	16	2	3.1	3	374	1130	8410	349	104	17153	2468	1.18
Richmond	Marina Bay Yacht Harbor	3	1	7/25/2006	1020	16	2.5	3.6	3.8	370	1120	7700	346	101	16872	2383	6.44
Richmond	Marina Bay Yacht Harbor	4	1	7/25/2006	1028	11	2.9	3.1	3.5	369	1120	8370	344	101	16914	2400	1.19
Richmond	Marina Bay Yacht Harbor	5	1	7/25/2006	1048	18	1	1.8	3	376	1140	7860	345	104	16895	2406	0.99
Richmond	Marina Bay Yacht Harbor	6	1	7/25/2006	1058	13	2	2.5	3.5	369	1120	8960	349	99	16842	2398	1.16
Richmond	Marina Bay Yacht Harbor	1	2	8/22/2006	1007	14	2	1.7	4.1	382	1170	9026	366	106	17452	2325	0.73

City	Marina Name	Sample Site	Sampling Event	Sampling Date	Time	TSS (mg/L)	TCu (ug/L)	DCu (ug/L)	DZn (ug/L)	CA (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Alkalinity (mg/L)	Cl (mg/L)	SO4 (mg/L)	DOC (mg/L)
Richmond	Marina Bay Yacht Harbor	2	2	8/22/2006	1026	11	2.3	2.5	4.7	378	1170	9349	362	107	17234	2295	0.86
Richmond	Marina Bay Yacht Harbor	3	2	8/22/2006	1041	12	2.7	2.4	4.8	382	1170	9022	373	107	17857	2358	0.78
Richmond	Marina Bay Yacht Harbor	4	2	8/22/2006	1050	13	2.9	2.6	5.3	380	1160	9004	363	105	17536	2429	0.78
Richmond	Marina Bay Yacht Harbor	5	2	8/22/2006	1110	21	1.5	1.5	1.8	378	1160	8971	371	106	17636	2390	0.74
Richmond	Marina Bay Yacht Harbor	6	2	8/22/2006	1120	21	2.8	1.6	2.7	376	1160	9177	366	106	17494	2398	0.75
Richmond	Marina Bay Yacht Harbor	1	3	9/18/2006	1435	11	5.7	2.1	2.9	370	1150	8960	359	104	15994	2134	0.68
Richmond	Marina Bay Yacht Harbor	2	3	9/18/2006	1448	17	3.3	3.4	4.1	376	1170	9130	357	105	17372	2311	0.86
Richmond	Marina Bay Yacht Harbor	3	3	9/18/2006	1458	15	2.6	2.9	5.2	375	1160	9070	358	105	17341	2366	0.86
Richmond	Marina Bay Yacht Harbor	4	3	9/18/2006	1510	11	2.1	2.3	5	377	1160	9100	355	106	17292	2357	1.15
Richmond	Marina Bay Yacht Harbor	5	3	9/18/2006	1520	12	2.1	1.9	4	370	1150	9060	357	107	17332	2365	0.74
Richmond	Marina Bay Yacht Harbor	6	3	9/18/2006	1532	16	1.6	1.3	2.5	372	1160	9130	356	107	17390	2369	0.65
Los Angeles	Marina del Rey Back Basin	1	1	8/2/2006	1011	14	20.2	18.4	55.4	434	1360	11000	416	120	19300	2770	1.05
Los Angeles	Marina del Rey Back Basin	2	1	8/2/2006	1018	17	20.1	17.9	55	433	1360	10700	414	119	19300	2780	1.00
Los Angeles	Marina del Rey Back Basin	3	1	8/2/2006	1028	17	16.2	14.5	43.3	432	1360	10400	416	120	19400	2770	1.00
Los Angeles	Marina del Rey Back Basin	4	1	8/2/2006	1041	25	16.8	14.1	54.1	430	1360	10600	421	116	19400	2740	1.06
Los Angeles	Marina del Rey Back Basin	1	2	8/30/2006	1049	13	15.3	11.5	50.9	430	1340	10497	408	116	19729	2649	0.99
Los Angeles	Marina del Rey Back Basin	2	2	8/30/2006	1103	17	17.8	18.4	59.5	428	1340	10429	417	116	19609	2676	1.03
Los Angeles	Marina del Rey Back Basin	3	2	8/30/2006	1113	15	12.1	12.4	49.3	425	1330	10404	418	115	19942	2669	1.04
Los Angeles	Marina del Rey Back Basin	4	2	8/30/2006	1130	23	15.2	14.2	52.8	433	1350	10367	419	114	19631	2604	1.03
Los Angeles	Marina del Rey Back Basin	1	3	9/27/2006	1035	10	12.9	12.7	54.8	417	1320	10700	394	120	20400	2790	1.04
Los Angeles	Marina del Rey Back Basin	2	3	9/27/2006	1044	29	13.7	13.3	50.4	420	1340	10700	402	117	19900	2730	1.05
Los Angeles	Marina del Rey Back Basin	3	3	9/27/2006	1053	28	9	8.1	33.3	421	1330	10700	401	115	19700	2710	1.90
Los Angeles	Marina del Rey Back Basin	4	3	9/27/2006	1106	24	11.8	12	46.9	435	1380	10600	402	116	20000	2740	0.99
Los Angeles	Marina del Rey Front Basin	1	1	8/2/2006	1059	16	17	16.2	49.1	429	1360	10700	421	120	19300	2700	1.05
Los Angeles	Marina del Rey Front Basin	2	1	8/2/2006	1117	15	16.4	14.5	45.3	435	1370	10600	417	116	19500	2750	1.02
Los Angeles	Marina del Rey Front Basin	3	1	8/2/2006	1127	15	15.8	14.9	58.9	434	1370	10600	418	118	19500	2750	0.97
Los Angeles	Marina del Rey Front Basin	4	1	8/2/2006	1143	24	14.7	13.8	45.8	432	1370	10700	421	117	19500	2760	0.70
Los Angeles	Marina del Rey Front Basin	5	1	8/2/2006	1202	29	4.6	4.7	17.6	436	1370	10400	416	117	19400	2730	0.93
Los Angeles	Marina del Rey Front Basin	6	1	8/2/2006	1211	21	1	1.6	8.2	437	1370	10400	421	118	19600	2800	0.74
Los Angeles	Marina del Rey Front Basin	7	1	8/2/2006	1222	19	<0.1	0.5	8.1	438	1380	10700	423	118	19700	2800	1.57

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Los Angeles	Marina del Rey Front Basin	8	1	8/2/2006	1227	15	<0.1	0.3	1.2	436	1380	10800	420	118	19600	2730	0.69
Los Angeles	Marina del Rey Front Basin	1	2	8/30/2006	1157	17	13.2	13.1	54.6	426	1340	10570	413	113	19686	2668	1.01
Los Angeles	Marina del Rey Front Basin	2	2	8/30/2006	1205	12	13.9	12.5	66.6	426	1340	10552	413	114	20414	2734	0.93
Los Angeles	Marina del Rey Front Basin	3	2	8/30/2006	1218	24	12.8	11.8	38.7	429	1340	10393	416	115	19504	2644	1.01
Los Angeles	Marina del Rey Front Basin	4	2	8/30/2006	1246	18	13.7	11.9	54.2	421	1330	10394	427	113	19475	2635	1.11
Los Angeles	Marina del Rey Front Basin	5	2	8/30/2006	1303	23	3	3.8	22.1	420	1320	10478	413	115	18468	2454	1.58
Los Angeles	Marina del Rey Front Basin	6	2	8/30/2006	1312	15	<0.1	1.5	6.5	417	1320	10420	420	113	19575	2619	1.12
Los Angeles	Marina del Rey Front Basin	7	2	8/30/2006	1321	10	<0.1	0.9	8.9	420	1320	10582	400	113	19590	2650	1.00
Los Angeles	Marina del Rey Front Basin	8	2	8/30/2006	1330	13	<0.1	0.4	11	427	1340	10582	428	112	19669	2650	0.97
Los Angeles	Marina del Rey Front Basin	1	3	9/27/2006	1120	18	13	12.2	55.1	435	1370	10700	401	118	19900	2740	0.98
Los Angeles	Marina del Rey Front Basin	2	3	9/27/2006	1129	14	11.5	11.5	49	436	1370	10500	406	115	19900	2720	0.87
Los Angeles	Marina del Rey Front Basin	3	3	9/27/2006	1137	9	9.2	8.9	38.2	431	1360	10600	404	115	19700	2700	1.05
Los Angeles	Marina del Rey Front Basin	4	3	9/27/2006	1158	14	10.5	10	41.4	437	1390	10700	404	129	20100	2760	0.91
Los Angeles	Marina del Rey Front Basin	5	3	9/27/2006	1215	20	2.9	3.4	16.4	434	1390	10600	403	117	19900	2730	1.73
Los Angeles	Marina del Rey Front Basin	6	3	9/27/2006	1224	18	<0.1	0.4	1.2	432	1380	10800	408	115	19800	2710	0.79
Los Angeles	Marina del Rey Front Basin	7	3	9/27/2006	1233	18	<0.1	0.7	2.6	433	1360	10600	404	114	20000	2750	0.90
Los Angeles	Marina del Rey Front Basin	8	3	9/27/2006	1240	14	<0.1	0.3	<1	434	1370	10800	408	112	20100	2760	0.77
Monterey	Monterey Harbor	1	1	8/10/2006	1039	19	6.9	6.3	24.4	454	1410	10270	429	120	19464	2676	1.06
Monterey	Monterey Harbor	2	1	8/10/2006	1052	25	7.2	7.1	26	453	1400	10350	430	116	19556	2694	1.00
Monterey	Monterey Harbor	3	1	8/10/2006	1105	24	4.9	4.6	20.2	452	1410	10020	424	119	19443	2676	0.89
Monterey	Monterey Harbor	4	1	8/10/2006	1120	17	5.2	4.8	22.7	453	1420	10380	429	119	19527	2650	0.93
Monterey	Monterey Harbor	5	1	8/10/2006	1147	14	<0.1	<0.1	<1	456	1420	10060	422	115	19298	2626	0.86
Monterey	Monterey Harbor	6	1	8/10/2006	1159	21	<0.1	<0.1	2.7	453	1410	10090	418	115	19478	2663	0.79
Monterey	Monterey Harbor	7	1	8/10/2006	1208	22	0.3	<0.1	12	449	1400	9900	425	117	19434	2648	0.72
Monterey	Monterey Harbor	8	1	8/10/2006	1216	25	<0.1	<0.1	6	451	1400	10400	423	116	19385	2608	0.82
Monterey	Monterey Harbor	1	2	9/8/2006	928	20	3.3	3.7	11.9	435	1370	10100	407	111	19608	2681	0.71
Monterey	Monterey Harbor	2	2	9/8/2006	935	17	3.7	3.7	19.5	434	1370	10200	399	112	19587	2673	0.74
Monterey	Monterey Harbor	3	2	9/8/2006	945	12	2.8	3.1	9.7	439	1390	10200	401	112	20074	2742	0.76
Monterey	Monterey Harbor	4	2	9/8/2006	953	19	2.6	2.4	8.4	433	1370	10300	403	113	19840	2709	0.65
Monterey	Monterey Harbor	5	2	9/8/2006	1004	19	<0.1	0.4	<1	437	1380	10200	393	113	20047	2743	0.65

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Monterey	Monterey Harbor	6	2	9/8/2006	1010	20	<0.1	0.4	1.4	437	1380	10300	409	115	19771	2689	1.02
Monterey	Monterey Harbor	7	2	9/8/2006	1018	16	<0.1	0.3	<1	434	1360	10300	410	114	19877	2705	1.11
Monterey	Monterey Harbor	8	2	9/8/2006	1024	17	<0.1	0.2	1.9	432	1360	10400	403	111	20521	2796	0.54
Monterey	Monterey Harbor	1	3	10/19/2006	937	10	7.9	6.3	23.4	422	1300	10600	410	115	20100	2690	1.60
Monterey	Monterey Harbor	2	3	10/19/2006	948	10	8	6.7	23	424	1310	10800	406	118	19700	2700	1.59
Monterey	Monterey Harbor	3	3	10/19/2006	1000	10	9.2	7.8	25.1	423	1300	10700	410	114	19600	2670	1.53
Monterey	Monterey Harbor	4	3	10/19/2006	1010	<4	7.9	6.4	22.1	422	1310	10700	401	113	20000	2720	1.52
Monterey	Monterey Harbor	5	3	10/19/2006	1023	19	<0.1	0.5	<1	423	1310	10800	408	114	19700	2680	1.38
Monterey	Monterey Harbor	6	3	10/19/2006	1033	19	<0.1	0.4	1.2	419	1300	10700	407	113	20000	2680	1.36
Monterey	Monterey Harbor	7	3	10/19/2006	1045	6	<0.1	0.4	1.1	421	1310	10800	402	112	20000	2750	1.45
Monterey	Monterey Harbor	8	3	10/19/2006	1115	10	<0.1	0.5	<1	421	1310	10800	405	114	19900	2730	1.78
Pittsburg	Pittsburg Marina	1	1	8/8/2006	948	8	2.9	1.7	1.9	34	72	533	25	61	1025	141	1.59
Pittsburg	Pittsburg Marina	2	1	8/8/2006	1000	7	2.4	1.8	2.3	39	87	656	30	64	1331	180	1.61
Pittsburg	Pittsburg Marina	3	1	8/8/2006	1027	10	4.3	3.2	4.4	33	67	502	24	60	969	134	1.75
Pittsburg	Pittsburg Marina	4	1	8/8/2006	1033	7	4.9	3.6	7.1	32	66	451	23	61	982	133	1.66
Pittsburg	Pittsburg Marina	5	1	8/8/2006	1015	22	2.9	1.4	<1	20	32	210	12	58	391	58	1.74
Pittsburg	Pittsburg Marina	6	1	8/8/2006	1045	16	2.9	1.4	<1	20	29	182	11	L	L	L	1.57
Pittsburg	Pittsburg Marina	7	1	8/8/2006	1052	17	2.9	1.6	1.3	22	37	245	14	58	407	62	1.50
Pittsburg	Pittsburg Marina	8	1	8/8/2006	1101	20	2.9	1.4	1.5	24	42	277	16	58	552	82	1.48
Pittsburg	Pittsburg Marina	1	2	9/5/2006	1400	9	2.4	1.7	5.2	22	36	251	12	61	426	68	1.55
Pittsburg	Pittsburg Marina	2	2	9/5/2006	1415	5	2.9	2.4	3.8	25	43	308	14	61	552	86	1.53
Pittsburg	Pittsburg Marina	3	2	9/5/2006	1430	<4	2.9	2.2	5.1	23	39	274	13	62	477	77	1.52
Pittsburg	Pittsburg Marina	4	2	9/5/2006	1435	7	2.7	2	3.9	23	39	272	13	61	496	76	1.47
Pittsburg	Pittsburg Marina	5	2	9/5/2006	1508	14	2.8	1.6	6.4	32	65	480	21	61	884	135	1.50
Pittsburg	Pittsburg Marina	6	2	9/5/2006	1500	15	2.6	1.5	3.5	27	51	379	17	61	608	95	1.64
Pittsburg	Pittsburg Marina	7	2	9/5/2006	1450	13	2.5	1.5	1.5	27	50	359	16	60	628	95	1.46
Pittsburg	Pittsburg Marina	8	2	9/5/2006	1445	14	3	1.5	2.5	30	60	436	19	62	776	120	1.50
Pittsburg	Pittsburg Marina	1	3	10/3/2006	1445	8	2.6	1.7	1.5	23	37	245	12	71	465	70	2.15
Pittsburg	Pittsburg Marina	2	3	10/3/2006	1328	6	3.5	2.4	2.5	23	37	255	12	72	478	72	2.29
Pittsburg	Pittsburg Marina	3	3	10/3/2006	1423	10	2.9	1.8	1.5	23	37	248	12	72	469	70	2.18

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Pittsburg	Pittsburg Marina	4	3	10/3/2006	1430	10	2.9	2	1.2	24	37	248	12	71	453	141	2.26
Pittsburg	Pittsburg Marina	5	3	10/3/2006	1345	28	3.3	1.5	1	34	70	506	22	70	939	137	2.20
Pittsburg	Pittsburg Marina	6	3	10/3/2006	1354	21	3.2	1.4	1.3	32	64	461	20	71	835	118	2.13
Pittsburg	Pittsburg Marina	7	3	10/3/2006	1404	17	2.9	1.4	<1	35	72	524	23	71	1039	145	2.33
Pittsburg	Pittsburg Marina	8	3	10/3/2006	1412	24	2.9	1.4	2	38	80	600	26	71	1132	155	2.20
Sacramento	Sacramento City Marina	1	1	7/21/2006	1045	7	2.5	3.7	1.4	10	5	6	1	53	4	5	1.30
Sacramento	Sacramento City Marina	2	1	7/21/2006	1102	4	3.8	3.7	1.9	10	5	6	1	53	4	5	1.22
Sacramento	Sacramento City Marina	3	1	7/21/2006	1115	5	3.4	2.5	<1	10	5	6	1	52	4	5	1.22
Sacramento	Sacramento City Marina	4	1	7/21/2006	1125	<4	3.7	2.2	<1	10	5	6	1	53	4	5	1.26
Sacramento	Sacramento City Marina	5	1	7/21/2006	1201	19	2.3	0.8	1.1	10	5	6	1	50	3	5	0.24
Sacramento	Sacramento City Marina	6	1	7/21/2006	1212	19	2.4	2.3	2.8	10	5	6	1	51	3	5	1.02
Sacramento	Sacramento City Marina	7	1	7/21/2006	1223	17	2	0.5	<1	10	5	6	1	51	3	4	1.04
Sacramento	Sacramento City Marina	8	1	7/21/2006	1236	26	2.8	0.8	3.6	10	5	6	1	53	3	5	1.06
Sacramento	Sacramento City Marina	1	2	8/16/2006	923	<4	5.1	3	2.4	11	5	7	1	60	4	5	1.42
Sacramento	Sacramento City Marina	2	2	8/16/2006	933	<4	5.1	3.5	5.7	11	5	7	1	58	4	5	1.27
Sacramento	Sacramento City Marina	3	2	8/16/2006	941	<4	4.5	2.8	3.1	10	5	7	1	59	4	5	0.97
Sacramento	Sacramento City Marina	4	2	8/16/2006	952	4	4.1	2.3	4.4	10	5	7	1	58	4	5	1.33
Sacramento	Sacramento City Marina	5	2	8/16/2006	1003	17	2.2	0.6	3.7	10	5	7	1	62	4	5	1.17
Sacramento	Sacramento City Marina	6	2	8/16/2006	1014	14	2	0.5	4	10	5	7	1	56	4	5	1.32
Sacramento	Sacramento City Marina	7	2	8/16/2006	1023	16	2	0.5	2.5	10	5	7	1	57	4	5	1.23
Sacramento	Sacramento City Marina	8	2	8/16/2006	1030	22	2.6	0.6	2.1	11	6	8	1	66	4	6	0.95
Sacramento	Sacramento City Marina	1	3	9/12/2006	1046	<4	5.8	3.7	7.8	11	6	8	1	60	4	5	1.09
Sacramento	Sacramento City Marina	2	3	9/12/2006	1102	4	4.6	3.2	3.3	11	6	8	1	61	4	5	1.05
Sacramento	Sacramento City Marina	3	3	9/12/2006	1111	<4	4.5	3.1	4	11	6	8	1	60	4	5	1.07
Sacramento	Sacramento City Marina	4	3	9/12/2006	1123	<4	3.9	2.5	3.7	11	6	8	1	61	4	5	0.93
Sacramento	Sacramento City Marina	5	3	9/12/2006	1135	24	2.4	0.7	2	12	6	8	1	63	5	5	1.13
Sacramento	Sacramento City Marina	6	3	9/12/2006	1145	19	2.5	0.6	5.4	11	6	8	1	62	5	5	1.15
Sacramento	Sacramento City Marina	7	3	9/12/2006	1154	19	2.4	0.7	2.7	11	6	8	1	62	5	5	1.14
Sacramento	Sacramento City Marina	8	3	9/12/2006	1203	28	3	0.7	3	13	7	9	1	70	5	6	1.21
San Francisco	San Francisco Marina	1	1	7/26/2006	1025	26	2	2	5.4	393	1230	9500	380	112	18400	2663	0.85

City	Marina Name	Sample Site	Sampling Event	Sampling Date	Time	TSS (mg/L)	TCu (ug/L)	DCu (ug/L)	DZn (ug/L)	CA (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Alkalinity (mg/L)	Cl (mg/L)	SO4 (mg/L)	DOC (mg/L)
San Francisco	San Francisco Marina	2	1	7/26/2006	1034	20	1	1.2	2.3	384	1200	9310	367	113	17949	2589	0.89
San Francisco	San Francisco Marina	3	1	7/26/2006	1047	22	0.6	1.1	1.3	384	1200	9430	361	109	17924	2588	2.06
San Francisco	San Francisco Marina	4	1	7/26/2006	1053	32	0.6	1.1	4.1	383	1200	9390	364	110	17974	2601	0.94
San Francisco	San Francisco Marina	5	1	7/26/2006	1102	18	0.1	0.8	1.9	388	1220	9450	365	111	18077	2610	0.85
San Francisco	San Francisco Marina	6	1	7/26/2006	1110	30	0.1	0.7	2	388	1210	9490	367	113	18465	2671	0.84
San Francisco	San Francisco Marina	7	1	7/26/2006	1117	30	0.2	0.8	2	391	1230	9400	372	110	18329	2653	1.47
San Francisco	San Francisco Marina	8	1	7/26/2006	1126	32	0.2	0.8	2.2	387	1210	9480	370	110	18482	2672	0.87
San Francisco	San Francisco Marina	1	2	8/23/2006	1006	26	3.6	3.9	9	337	1030	7690	322	110	18300	2490	0.92
San Francisco	San Francisco Marina	2	2	8/23/2006	1020	17	0.9	1.2	2	393	1220	8850	377	107	18000	2380	0.68
San Francisco	San Francisco Marina	3	2	8/23/2006	1033	24	0.8	0.9	3.1	394	1220	8890	379	108	18000	2420	0.60
San Francisco	San Francisco Marina	4	2	8/23/2006	1043	26	0.9	1	1.1	390	1210	8940	375	107	18100	2410	0.61
San Francisco	San Francisco Marina	5	2	8/23/2006	1058	20	0.7	0.9	1.8	393	1220	9210	383	108	18100	2480	0.99
San Francisco	San Francisco Marina	6	2	8/23/2006	1110	13	0.6	0.7	1.4	388	1210	9330	380	107	17700	2270	1.13
San Francisco	San Francisco Marina	7	2	8/23/2006	1121	11	0.6	0.7	1.3	390	1220	9390	380	108	18000	2450	0.62
San Francisco	San Francisco Marina	8	2	8/23/2006	1134	17	0.6	1	1.5	395	1230	9270	383	108	18300	2510	0.92
San Francisco	San Francisco Marina	1	3	9/20/2006	1020	13	1.3	1.7	5	393	1200	9530	377	109	17825	2437	0.96
San Francisco	San Francisco Marina	2	3	9/20/2006	1034	16	0.4	0.9	3.3	385	1180	9510	380	108	17614	2387	0.65
San Francisco	San Francisco Marina	3	3	9/20/2006	1043	23	0.5	0.3	1.4	407	1240	9570	372	108	17907	2446	1.02
San Francisco	San Francisco Marina	4	3	9/20/2006	1050	25	0.7	0.4	1.7	405	1250	9570	383	108	17951	2441	0.78
San Francisco	San Francisco Marina	5	3	9/20/2006	1100	13	<0.1	<0.1	2.1	414	1280	9830	383	108	18378	2493	1.07
San Francisco	San Francisco Marina	6	3	9/20/2006	1110	20	<0.1	0.2	<1	413	1280	9750	382	108	18178	2454	0.95
San Francisco	San Francisco Marina	7	3	9/20/2006	1117	18	<0.1	<0.1	1.7	409	1260	9720	381	109	18096	2498	0.97
San Francisco	San Francisco Marina	8	3	9/20/2006	1125	30	<0.1	<0.1	<1	412	1270	9690	389	110	18309	2491	1.07
Santa Barbara	Santa Barbara Harbor	1	1	8/3/2006	1053	17	3.6	2.3	6.4	432	1340	10185	414	119	20492	2966	0.86
Santa Barbara	Santa Barbara Harbor	2	1	8/3/2006	1101	23	6.5	6.5	13.3	427	1330	10252	429	116	20519	2964	0.79
Santa Barbara	Santa Barbara Harbor	3	1	8/3/2006	1112	24	7	6.6	12	429	1340	10217	431	117	20625	2984	0.92
Santa Barbara	Santa Barbara Harbor	4	1	8/3/2006	1125	14	4.7	4.6	11.4	426	1340	9927	433	115	20833	3008	0.73
Santa Barbara	Santa Barbara Harbor	5	1	8/3/2006	1138	13	<0.1	<0.1	<1	424	1320	10148	437	115	20356	2937	0.87
Santa Barbara	Santa Barbara Harbor	6	1	8/3/2006	1146	18	<0.1	<0.1	2.3	425	1330	10057	432	113	21285	3081	0.57
Santa Barbara	Santa Barbara Harbor	7	1	8/3/2006	1153	22	<0.1	<0.1	<1	420	1310	10145	436	115	21099	3053	0.87

City	Marina Name	Sample Site	Sampling Event	Sampling Date	Time	TSS (mg/L)	TCu (ug/L)	DCu (ug/L)	DZn (ug/L)	CA (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Alkalinity (mg/L)	Cl (mg/L)	SO4 (mg/L)	DOC (mg/L)
Santa Barbara	Santa Barbara Harbor	8	1	8/3/2006	1200	22	<0.1	<0.1	2.1	413	1300	10347	430	114	20162	2909	0.59
Santa Barbara	Santa Barbara Harbor	1	2	8/31/2006	1044	11	4.7	5.6	17.8	428	1340	10400	390	114	20000	2570	0.76
Santa Barbara	Santa Barbara Harbor	2	2	8/31/2006	1050	25	6.6	6.9	22.8	427	1330	10300	389	113	20000	2550	0.69
Santa Barbara	Santa Barbara Harbor	3	2	8/31/2006	1103	31	8.6	8.2	21.8	427	1340	10400	392	112	19500	2600	0.76
Santa Barbara	Santa Barbara Harbor	4	2	8/31/2006	1110	25	7.9	7.4	18.9	427	1330	10300	390	112	19500	2600	0.73
Santa Barbara	Santa Barbara Harbor	5	2	8/31/2006	1124	25	<0.1	0.5	2.3	434	1360	10400	394	112	20300	2600	0.85
Santa Barbara	Santa Barbara Harbor	6	2	8/31/2006	1132	21	<0.1	0.3	4.8	436	1360	10500	394	113	20100	2610	0.64
Santa Barbara	Santa Barbara Harbor	7	2	8/31/2006	1140	13	<0.1	0.2	2.2	437	1360	10400	395	111	20100	2600	0.76
Santa Barbara	Santa Barbara Harbor	8	2	8/31/2006	1148	18	<0.1	0.2	4.7	436	1360	10400	391	111	20300	2640	0.83
Santa Barbara	Santa Barbara Harbor	1	3	9/28/2006	1010	20	4.6	4.5	10.7	439	1380	10700	404	116	19800	2720	0.96
Santa Barbara	Santa Barbara Harbor	2	3	9/28/2006	1015	10	6.3	7.1	13.3	438	1380	10600	400	114	19900	2730	0.93
Santa Barbara	Santa Barbara Harbor	3	3	9/28/2006	1026	18	5.7	6	13.2	436	1380	10800	404	115	20000	2740	0.89
Santa Barbara	Santa Barbara Harbor	4	3	9/28/2006	1034	13	5.2	5.4	14.2	436	1380	11000	407	113	20300	2790	1.03
Santa Barbara	Santa Barbara Harbor	5	3	9/28/2006	1046	19	<0.1	<0.1	3.4	435	1380	10700	402	114	19400	2650	0.73
Santa Barbara	Santa Barbara Harbor	6	3	9/28/2006	1056	11	<0.1	0.2	<1	431	1370	10800	404	112	19600	2680	0.80
Santa Barbara	Santa Barbara Harbor	7	3	9/28/2006	1106	17	<0.1	<0.1	<1	434	1390	10800	403	114	21200	2900	0.78
Santa Barbara	Santa Barbara Harbor	8	3	9/28/2006	1118	24	<0.1	0.1	<1	439	1390	10700	400	112	19900	2730	0.78
Santa Cruz	Santa Cruz Harbor	1	1	8/9/2006	1117	29	6	3.1	18.3	436	1340	10200	418	127	19379	2684	0.94
Santa Cruz	Santa Cruz Harbor	2	1	8/9/2006	1145	30	5.1	3.2	15.5	442	1370	10100	427	124	19403	2695	0.85
Santa Cruz	Santa Cruz Harbor	3	1	8/9/2006	1154	27	6.2	4.3	13.1	445	1380	10500	432	119	19470	2702	0.78
Santa Cruz	Santa Cruz Harbor	4	1	8/9/2006	1203	21	4.4	3	8.8	447	1380	10200	431	118	19447	2696	0.77
Santa Cruz	Santa Cruz Harbor	5	1	8/9/2006	1213	16	<0.1	<0.1	2.2	448	1380	10300	427	118	19485	2705	0.80
Santa Cruz	Santa Cruz Harbor	6	1	8/9/2006	1223	15	<0.1	0.2	2.2	449	1390	10300	419	118	19480	2702	0.77
Santa Cruz	Santa Cruz Harbor	7	1	8/9/2006	1229	23	<0.1	<0.1	3.8	451	1400	10300	432	116	19432	2697	0.73
Santa Cruz	Santa Cruz Harbor	8	1	8/9/2006	1237	26	<0.1	<0.1	2.8	455	1400	10200	424	118	19508	2706	0.76
Santa Cruz	Santa Cruz Harbor	1	2	9/7/2006	1035	21	6.3	5.1	10.7	431	1360	10300	399	114	20010	2741	0.62
Santa Cruz	Santa Cruz Harbor	2	2	9/7/2006	1043	23	7.8	5.8	10.4	433	1360	10100	405	113	20017	2741	0.69
Santa Cruz	Santa Cruz Harbor	3	2	9/7/2006	1052	31	6.3	4.4	22.3	431	1350	10200	402	114	19846	2717	0.69
Santa Cruz	Santa Cruz Harbor	4	2	9/7/2006	1105	28	6.5	4.5	13.4	431	1360	10700	399	114	20059	2743	0.64
Santa Cruz	Santa Cruz Harbor	5	2	9/7/2006	1120	14	<0.1	0.5	6.9	438	1370	10800	405	111	20170	2734	0.71

City	Marina Name	Sample Site	Sampling Event	Sampling Date	Time	TSS (mg/L)	TCu (ug/L)	DCu (ug/L)	DZn (ug/L)	CA (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Alkalinity (mg/L)	Cl (mg/L)	SO4 (mg/L)	DOC (mg/L)
Santa Cruz	Santa Cruz Harbor	6	2	9/7/2006	1128	17	<0.1	0.4	2	435	1360	9900	407	111	19972	2718	1.15
Santa Cruz	Santa Cruz Harbor	7	2	9/7/2006	1136	24	<0.1	0.3	<1	436	1370	10300	404	112	19894	2717	0.77
Santa Cruz	Santa Cruz Harbor	8	2	9/7/2006	1143	25	<0.1	0.5	<1	438	1370	10700	408	115	20171	2748	0.68
Santa Cruz	Santa Cruz Harbor	1	3	10/19/2006	1510	24	7	4.5	21.6	413	1280	10600	393	115	19700	2650	1.62
Santa Cruz	Santa Cruz Harbor	2	3	10/19/2006	1517	21	6.7	4.7	20.9	415	1290	10600	408	118	19700	2670	1.65
Santa Cruz	Santa Cruz Harbor	3	3	10/19/2006	1533	19	5	4.9	15	414	1290	10700	408	120	19800	2670	1.58
Santa Cruz	Santa Cruz Harbor	4	3	10/19/2006	1543	12	6.2	5.2	10	417	1300	10600	401	118	19800	2680	1.55
Santa Cruz	Santa Cruz Harbor	5	3	10/19/2006	1554	10	<0.1	0.6	<1	409	1280	10600	405	115	19300	2600	1.46
Santa Cruz	Santa Cruz Harbor	6	3	10/19/2006	1558	22	<0.1	0.6	3.2	413	1280	10700	414	117	19400	2630	1.49
Santa Cruz	Santa Cruz Harbor	7	3	10/19/2006	1605	20	<0.1	0.6	<1	415	1300	10700	415	115	20000	2710	1.53
Santa Cruz	Santa Cruz Harbor	8	3	10/19/2006	1615	20	<0.1	0.9	2.4	414	1310	10400	415	115	19800	2670	1.89
San Francisco	South Beach Harbor	1	1	7/26/2006	1400	8	1.7	2.5	3.8	371	1160	8960	351	110	17115	2473	1.01
San Francisco	South Beach Harbor	2	1	7/26/2006	1409	15	2.1	2.3	5.5	374	1150	8970	354	109	17236	2493	0.98
San Francisco	South Beach Harbor	3	1	7/26/2006	1418	17	1.3	2	6	374	1160	9050	354	109	17365	2505	1.04
San Francisco	South Beach Harbor	4	1	7/26/2006	1426	25	1.7	2.2	4.3	371	1150	9110	350	109	17551	2531	1.43
San Francisco	South Beach Harbor	5	1	7/26/2006	1437	22	0.3	1	2.2	376	1170	9270	359	109	18534	2680	0.95
San Francisco	South Beach Harbor	6	1	7/26/2006	1443	29	0.3	0.8	1.3	387	1200	9410	370	110	18111	2620	0.83
San Francisco	South Beach Harbor	7	1	7/26/2006	1449	26	0.2	0.8	2.2	387	1210	9460	374	110	18529	2682	0.93
San Francisco	South Beach Harbor	8	1	7/26/2006	1457	20	1.2	1	1.7	387	1210	9400	370	110	18194	2629	0.89
San Francisco	South Beach Harbor	1	2	8/23/2006	1417	18	2.2	2.1	4.6	380	1180	8720	367	107	17200	2290	0.90
San Francisco	South Beach Harbor	2	2	8/23/2006	1428	22	3	2.3	6.2	383	1190	9070	370	107	17200	2280	0.73
San Francisco	South Beach Harbor	3	2	8/23/2006	1442	17	1.7	1.9	3.3	380	1180	9310	368	107	17400	2210	0.72
San Francisco	South Beach Harbor	4	2	8/23/2006	1453	11	1.8	2.1	4.3	384	1180	8960	370	109	17500	2300	0.68
San Francisco	South Beach Harbor	5	2	8/23/2006	1505	8	0.8	0.6	1.1	391	1210	9100	377	107	17900	2410	1.05
San Francisco	South Beach Harbor	6	2	8/23/2006	1516	13	1	0.7	1.4	383	1190	9020	372	107	17500	2320	0.61
San Francisco	South Beach Harbor	7	2	8/23/2006	1527	19	0.6	0.5	<1	386	1210	9040	377	107	17700	2370	1.04
San Francisco	South Beach Harbor	8	2	8/23/2006	1538	19	1.1	0.8	1.1	389	1210	9060	377	106	17600	2300	1.02
San Francisco	South Beach Harbor	1	3	9/20/2006	1336	17	2.2	2.3	4.2	384	1180	9310	360	107	17882	2462	0.68
San Francisco	South Beach Harbor	2	3	9/20/2006	1346	19	1.1	1.9	3.3	383	1180	9260	364	107	17582	2424	0.72
San Francisco	South Beach Harbor	3	3	9/20/2006	1350	20	3.2	3	4.3	387	1190	9120	366	108	17370	2391	1.11

City	Marina Name	Sample Site	Sampling Event	Sampling Date	Time	TSS (mg/L)	TCu (ug/L)	DCu (ug/L)	DZn (ug/L)	CA (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Alkalinity (mg/L)	Cl (mg/L)	SO4 (mg/L)	DOC (mg/L)
San Francisco	South Beach Harbor	4	3	9/20/2006	1405	13	2.3	2.5	4.5	392	1210	9200	368	108	17491	2408	1.45
San Francisco	South Beach Harbor	5	3	9/20/2006	1419	22	<0.1	0.5	<1	395	1210	9400	373	107	17540	2381	1.48
San Francisco	South Beach Harbor	6	3	9/20/2006	1424	18	0.2	0.4	1.7	397	1220	9300	365	109	17619	2411	1.29
San Francisco	South Beach Harbor	7	3	9/20/2006	1432	12	1.5	0.7	1.1	391	1210	9280	364	107	17702	2436	1.36
San Francisco	South Beach Harbor	8	3	9/20/2006	1435	12	<0.1	0.4	<1	384	1190	9340	365	106	17468	2358	0.98
Lake Tahoe	Tahoe Keyes Marina	1	1	7/20/2006	1140	<4	1.1	0.9	1.1	9	2	6	1	43	2	1	0.94
Lake Tahoe	Tahoe Keyes Marina	2	1	7/20/2006	1153	<4	1.1	0.9	3	9	2	6	1	42	2	1	1.15
Lake Tahoe	Tahoe Keyes Marina	3	1	7/20/2006	1205	<4	1.2	0.8	<1	9	2	6	1	44	2	1	0.95
Lake Tahoe	Tahoe Keyes Marina	4	1	7/20/2006	1220	<4	1.1	0.7	3.1	9	2	6	1	45	2	1	1.00
Lake Tahoe	Tahoe Keyes Marina	5	1	7/20/2006	1240	<4	0.2	0.2	2	8	2	5	2	42	2	2	0.63
Lake Tahoe	Tahoe Keyes Marina	6	1	7/20/2006	1252	<4	0.1	0.2	1	8	2	5	2	41	2	2	0.64
Lake Tahoe	Tahoe Keyes Marina	7	1	7/20/2006	1303	<4	0.2	0.7	<1	8	2	5	2	41	2	2	0.67
Lake Tahoe	Tahoe Keyes Marina	8	1	7/20/2006	1308	<4	0.3	<0.1	4.2	8	2	5	2	39	2	1	0.70
Lake Tahoe	Tahoe Keyes Marina	1	2	8/17/2006	1110	<4	1.3	0.8	7	9	2	6	1	47	2	2	0.95
Lake Tahoe	Tahoe Keyes Marina	2	2	8/17/2006	1117	<4	1.3	0.6	4.4	9	2	6	1	46	2	2	0.66
Lake Tahoe	Tahoe Keyes Marina	3	2	8/17/2006	1125	<4	1.3	0.7	1.9	9	2	6	1	49	2	2	0.72
Lake Tahoe	Tahoe Keyes Marina	4	2	8/17/2006	1145	<4	1.4	0.7	2.7	9	2	6	1	46	2	2	0.98
Lake Tahoe	Tahoe Keyes Marina	5	2	8/17/2006	1200	<4	0.2	<0.1	5	9	2	6	2	46	2	2	0.57
Lake Tahoe	Tahoe Keyes Marina	6	2	8/17/2006	1212	<4	0.2	<0.1	<1	9	2	6	2	46	2	2	0.54
Lake Tahoe	Tahoe Keyes Marina	7	2	8/17/2006	1222	<4	0.2	<0.1	4	9	2	6	2	46	2	2	0.60
Lake Tahoe	Tahoe Keyes Marina	8	2	8/17/2006	1242	<4	0.3	<0.1	2.9	9	2	6	2	46	2	2	0.53
Vallejo	Vallejo Marina	1	1	8/7/2006	952	15	4.4	3.9	3.8	209	605	4720	189	86	9697	1338	2.33
Vallejo	Vallejo Marina	2	1	8/7/2006	1043	10	5.6	4.6	6.4	212	609	4680	187	87	9807	1352	2.15
Vallejo	Vallejo Marina	3	1	8/7/2006	1055	11	4.9	3.3	5	208	598	4670	186	88	9591	1322	2.27
Vallejo	Vallejo Marina	4	1	8/7/2006	1101	18	3.6	4.7	4.4	208	603	4700	186	88	10369	1430	2.34
Vallejo	Vallejo Marina	5	1	8/7/2006	1005	41	3.8	1.6	1.6	214	607	4710	188	92	9682	1337	3.61
Vallejo	Vallejo Marina	6	1	8/7/2006	1015	53	4.1	1.5	1.8	214	611	4640	185	91	10231	1414	2.91
Vallejo	Vallejo Marina	7	1	8/7/2006	1024	90	7.9	1.4	2.1	216	614	4730	186	89	9956	1375	2.78
Vallejo	Vallejo Marina	8	1	8/7/2006	1029	56	3.8	1.4	<1	215	614	4700	189	87	10334	1431	2.43
Vallejo	Vallejo Marina	1	2	9/5/2006	1055	18	3.7	3	3.3	222	633	4750	200	87	9238	1231	2.11

City	Marina Name	Sample Site	Sampling Event	Sampling Date	Time	TSS (mg/L)	TCu (ug/L)	DCu (ug/L)	DZn (ug/L)	CA (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Alkalinity (mg/L)	Cl (mg/L)	SO4 (mg/L)	DOC (mg/L)
Vallejo	Vallejo Marina	2	2	9/5/2006	1102	16	4.1	2.5	4.2	214	614	4678	195	86	9387	1250	2.03
Vallejo	Vallejo Marina	3	2	9/5/2006	1113	17	5.1	4.3	9.9	216	619	4676	196	84	9552	1242	2.19
Vallejo	Vallejo Marina	4	2	9/5/2006	1155	35	3.9	2.3	2.1	200	579	4511	188	81	8739	1162	1.79
Vallejo	Vallejo Marina	5	2	9/5/2006	1125	53	4.2	1.7	1.4	192	555	4345	181	80	8412	1117	1.74
Vallejo	Vallejo Marina	6	2	9/5/2006	1133	50	4.1	1.7	3.8	189	547	4254	179	80	8132	1075	1.62
Vallejo	Vallejo Marina	7	2	9/5/2006	1140	28	3	1.7	1.6	181	523	3996	172	78	8091	1071	1.56
Vallejo	Vallejo Marina	8	2	9/5/2006	1147	38	3.4	1.6	<1	182	528	4091	174	78	8048	1065	1.74
Vallejo	Vallejo Marina	1	3	10/3/2006	943	17	3.2	2.6	3.3	214	596	4896	194	94	9188	1233	2.48
Vallejo	Vallejo Marina	2	3	10/3/2006	1033	12	3.1	2.7	3.4	209	587	4920	194	91	9102	1257	2.54
Vallejo	Vallejo Marina	3	3	10/3/2006	1045	L	4.3	4	6.2	206	576	4685	188	88	9065	1236	2.43
Vallejo	Vallejo Marina	4	3	10/3/2006	1052	17	3.8	3.5	3.8	205	578	4830	189	90	8932	1199	2.32
Vallejo	Vallejo Marina	5	3	10/3/2006	954	112	3.9	1.3	1.2	194	548	4533	180	87	8529	1164	2.26
Vallejo	Vallejo Marina	6	3	10/3/2006	1004	104	3.5	1.3	<1	191	541	4460	179	87	8459	1151	2.18
Vallejo	Vallejo Marina	7	3	10/3/2006	1015	53	3.4	1.3	1	190	539	4455	175	89	8516	1164	2.26
Vallejo	Vallejo Marina	8	3	10/3/2006	1022	40	3.7	1.3	1.5	191	542	4474	177	L	L	L	2.23
Stockton	Village West Marina	1	1	7/19/2006	1012	<4	5.2	3.3	4	16	7	24	2	61	26	26	3.42
Stockton	Village West Marina	2	1	7/19/2006	1025	9	5.1	3.5	5.7	16	7	25	2	59	26	26	3.61
Stockton	Village West Marina	3	1	7/19/2006	1036	6	5.2	2.9	2.7	16	7	25	2	62	27	26	3.42
Stockton	Village West Marina	4	1	7/19/2006	1051	7	4.8	3.3	2.6	16	7	25	2	61	27	26	3.33
Stockton	Village West Marina	5	1	7/19/2006	1100	27	4.2	1.9	1.7	17	8	26	2	62	27	26	3.64
Stockton	Village West Marina	6	1	7/19/2006	1115	24	4.7	2	1.8	16	7	25	2	66	26	26	3.59
Stockton	Village West Marina	7	1	7/19/2006	1130	23	4	1.8	1.7	16	7	25	2	64	27	26	3.84
Stockton	Village West Marina	1	2	8/15/2006	1004	16	6.4	4	4.9	19	9	30	3	73	36	31	4.04
Stockton	Village West Marina	2	2	8/15/2006	1011	21	6.3	3.2	4.6	19	9	30	3	75	36	32	3.79
Stockton	Village West Marina	3	2	8/15/2006	1019	22	5.8	2.9	16.7	19	9	30	3	73	37	32	3.83
Stockton	Village West Marina	4	2	8/15/2006	1025	23	6.4	3.5	5.1	19	9	30	3	74	37	32	3.91
Stockton	Village West Marina	5	2	8/15/2006	1035	23	4.3	2.2	5.5	19	9	30	3	73	36	32	3.83
Stockton	Village West Marina	6	2	8/15/2006	1043	23	3.9	2	2.5	19	9	31	3	72	36	31	3.74
Stockton	Village West Marina	7	2	8/15/2006	1051	24	3.9	1.8	1.4	19	9	31	3	73	35	31	3.77
Stockton	Village West Marina	8	2	8/15/2006	1057	25	3.8	1.8	3.8	19	9	29	3	76	35	31	3.56

City	Marina Name	Sample Site	Sampling Event	Sampling Date	Time	TSS (mg/L)	TCu (ug/L)	DCu (ug/L)	DZn (ug/L)	CA (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Alkalinity (mg/L)	Cl (mg/L)	SO4 (mg/L)	DOC (mg/L)
Stockton	Village West Marina	1	3	9/13/2006	1106	17	5.8	3.5	4.3	20	10	32	3	78	36	31	3.84
Stockton	Village West Marina	2	3	9/13/2006	1128	18	5.4	3.7	12	20	10	32	3	76	36	31	3.42
Stockton	Village West Marina	3	3	9/13/2006	1145	15	5.3	3.4	6.2	20	10	32	3	76	36	31	4.40
Stockton	Village West Marina	4	3	9/13/2006	1217	12	5.2	3.9	2.8	20	10	32	3	76	36	32	3.32
Stockton	Village West Marina	5	3	9/13/2006	1241	15	3	1.9	4.6	20	10	32	3	75	36	32	3.22
Stockton	Village West Marina	6	3	9/13/2006	1318	12	3.1	1.9	5.9	20	10	32	3	76	36	32	3.31
Stockton	Village West Marina	7	3	9/13/2006	1252	14	2.6	1.5	6.4	19	10	32	3	74	36	32	3.37
Stockton	Village West Marina	8	3	9/13/2006	1306	12	2.9	1.6	6.3	20	10	32	3	75	36	32	3.30

Appendix G: Water Quality Data (ANR Laboratory and DPR), Irgarol/M1 (NOAA HML), & Toxicity Results (SCCWRP)

Table G-1. Water Quality Data (ANR Laboratory and DPR), Irgarol/M1 (NOAA HML), & Toxicity (SCCWRP) Results

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
Long Beach	Alamitos Bay Marina	1	1	8/1/2006	954	22.3	7.74	4.31	51.5	6	43.7	13.7	
Long Beach	Alamitos Bay Marina	2	1	8/1/2006	1007	22	7.75	4.39	51.7	7	24.1	9.5	
Long Beach	Alamitos Bay Marina	3	1	8/1/2006	1016	21.9	7.79	5.25	51.6	7			
Long Beach	Alamitos Bay Marina	4	1	8/1/2006	1043	22.4	7.77	4.81	51.8	5			
Long Beach	Alamitos Bay Marina	5	1	8/1/2006	1054	23.4	7.81	5.04	51.6	4			
Long Beach	Alamitos Bay Marina	6	1	8/1/2006	1113	22.6	7.86	5.68	51.7	3			
Long Beach	Alamitos Bay Marina	7	1	8/1/2006	1123	21.6	7.87	6.22	51.6	5			
Long Beach	Alamitos Bay Marina	8	1	8/1/2006	1133	20.5	7.89	7.04	51.5	5			
Long Beach	Alamitos Bay Marina	1	2	8/29/2006	911	19.8	7.97	6.28	51.8	21			N (84/99)
Long Beach	Alamitos Bay Marina	2	2	8/29/2006	930	19.4	8.04	4.43	51.7	21			N (81/95)
Long Beach	Alamitos Bay Marina	3	2	8/29/2006	948	19.1	8.06	5.24	51.8	10			N (77/91)
Long Beach	Alamitos Bay Marina	4	2	8/29/2006	1000	18.9	7.88	5.69	52	9			N (83/98)
Long Beach	Alamitos Bay Marina	5	2	8/29/2006	1014	20.7	8.02	5.52	51.8	8			
Long Beach	Alamitos Bay Marina	6	2	8/29/2006	1035	19.7	8.02	6.25	51.8	21			
Long Beach	Alamitos Bay Marina	7	2	8/29/2006	1045	18.4	8.01	6.36	51.8	19			
Long Beach	Alamitos Bay Marina	8	2	8/29/2006	1059	18.2	8.04	7.01	51.9	23			
Long Beach	Alamitos Bay Marina	1	3	9/26/2006	925	20.8	7.98	5.36	47.91	16	29.8	5.6	
Long Beach	Alamitos Bay Marina	2	3	9/26/2006	945	20.06	7.96	5.72	47.9	15	12.3	0.6	
Long Beach	Alamitos Bay Marina	3	3	9/26/2006	958	20.6	8.03	4.45	48.02	15			
Long Beach	Alamitos Bay Marina	4	3	9/26/2006	1013	20.5	7.93	5.73	48.05	18			
Long Beach	Alamitos Bay Marina	5	3	9/26/2006	1024	20.8	7.9	5.44	48	18			
Long Beach	Alamitos Bay Marina	6	3	9/26/2006	1047	20.7	7.98	6.06	48.03	18			
Long Beach	Alamitos Bay Marina	7	3	9/26/2006	1057	20.3	8.01	6.43	48.05	18			
Long Beach	Alamitos Bay Marina	8	3	9/26/2006	1104	20.2	8	7.4	47.72	19			
Antioch	Antioch Marina	1	1	8/8/2006	1305	21.8	7.98	7.54	1.372	21			
Antioch	Antioch Marina	2	1	8/8/2006	1312	22.1	8	7.64	1.380	17			
Antioch	Antioch Marina	3	1	8/8/2006	1320	21.9	7.91	6.48	1.430	19			
Antioch	Antioch Marina	4	1	8/8/2006	1326	21.7	7.85	7.27	1.238	19			

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
Antioch	Antioch Marina	5	1	8/8/2006	1335	21.5	7.85	7.75	0.670	19			
Antioch	Antioch Marina	6	1	8/8/2006	1343	21.6	7.89	7.87	0.603	18			
Antioch	Antioch Marina	7	1	8/8/2006	1350	21.8	7.87	7.82	0.605	19			
Antioch	Antioch Marina	8	1	8/8/2006	1355	21.6	7.85	7.4	0.636	21			
Antioch	Antioch Marina	1	2	9/6/2006	927	20.4	8.29	8.36	1.016	8			
Antioch	Antioch Marina	2	2	9/6/2006	934	20.5	8.14	7.45	1.002	17			
Antioch	Antioch Marina	3	2	9/6/2006	940	20.6	7.95	7.35	1.176	13			
Antioch	Antioch Marina	4	2	9/6/2006	945	20.7	7.96	6.98	1.102	16			
Antioch	Antioch Marina	5	2	9/6/2006	955	20.5	7.45	7.9	0.672	20			
Antioch	Antioch Marina	6	2	9/6/2006	1006	20.5	7.31	8.17	0.680	22			
Antioch	Antioch Marina	7	2	9/6/2006	1010	20.5	7.3	7.94	0.670	19			
Antioch	Antioch Marina	8	2	9/6/2006	1016	20.5	7.18	8	0.671	17			
Antioch	Antioch Marina	1	3	10/2/2006	1118	17.9	7.82	8.34	0.864	22			
Antioch	Antioch Marina	2	3	10/2/2006	1135	17.9	8.01	7.71	0.843	23			
Antioch	Antioch Marina	3	3	10/2/2006	1142	17.8	8.08	7.45	0.845	25			
Antioch	Antioch Marina	4	3	10/2/2006	1150	18.1	8.1	7.86	0.797	25			
Antioch	Antioch Marina	5	3	10/2/2006	1202	17.6	8.2	8.46	1.065	34			
Antioch	Antioch Marina	6	3	10/2/2006	1207	17.5	8.06	8.5	1.094	33			
Antioch	Antioch Marina	7	3	10/2/2006	1214	17.6	8.12	8.32	0.945	27			
Antioch	Antioch Marina	8	3	10/2/2006	1220	17.7	8.06	8.2	0.807	25			
Alameda	Ballena Isle Marina	1	1	7/27/2006	1000	21.2	7.64	5.33	43.86	14	149.5	50.0	
Alameda	Ballena Isle Marina	2	1	7/27/2006	1012	21.3	7.59	4.77	43.87	9	66.2	25.1	
Alameda	Ballena Isle Marina	3	1	7/27/2006	1028	21.3	7.59	5.39	43.98	8			
Alameda	Ballena Isle Marina	4	1	7/27/2006	1039	21.4	7.55	4.65	43.97	8			
Alameda	Ballena Isle Marina	5	1	7/27/2006	1052	21.3	7.65	6.09	43.77	12			
Alameda	Ballena Isle Marina	6	1	7/27/2006	1105	20.9	7.61	6.08	44.07	11			
Alameda	Ballena Isle Marina	7	1	7/27/2006	1113	21	7.6	6.29	44.08	14			
Alameda	Ballena Isle Marina	8	1	7/27/2006	1123	21.1	7.62	6.26	43.84	14			
Alameda	Ballena Isle Marina	1	2	8/24/2006	1030	20	8	7.08	45.33	21			
Alameda	Ballena Isle Marina	2	2	8/24/2006	1036	20	8.2	6.84	45.43	23			

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
Alameda	Ballena Isle Marina	3	2	8/24/2006	1042	20.1	8.2	7.13	41.16	22			
Alameda	Ballena Isle Marina	4	2	8/24/2006	1047	20	8.3	6.7	45.38	25			
Alameda	Ballena Isle Marina	5	2	8/24/2006	1054	19.9	8.3	8.43	45.09	25			
Alameda	Ballena Isle Marina	6	2	8/24/2006	1109	19.5	8.2	7.85	45.74	24			
Alameda	Ballena Isle Marina	7	2	8/24/2006	1120	19.7	8.1	8.38	45.58	23			
Alameda	Ballena Isle Marina	8	2	8/24/2006	1130	20	8.2	8.42	45.28	20			
Alameda	Ballena Isle Marina	1	3	9/21/2006	1008	19.1	8.08	5.29	41.96	13	80.4	13.3	
Alameda	Ballena Isle Marina	2	3	9/21/2006	1018	19.2	8.08	6.36	41.93	18	117.4	16.2	
Alameda	Ballena Isle Marina	3	3	9/21/2006	1024	19.2	8.07	5.35	41.97	13			
Alameda	Ballena Isle Marina	4	3	9/21/2006	1029	19.2	8.02	6.3	41.94	16			
Alameda	Ballena Isle Marina	5	3	9/21/2006	1001	19.2	8.04	6.21	41.81	16			
Alameda	Ballena Isle Marina	6	3	9/21/2006	940	18.7	7.9	6.65	42.38	15			
Alameda	Ballena Isle Marina	7	3	9/21/2006	949	18.7	8.02	6.41	42.34	16			
Alameda	Ballena Isle Marina	8	3	9/21/2006	953	18.8	8.02	6.64	42.24	19			
Benicia	Benicia Marina	1	1	8/7/2006	1257	20.2	7.63	7.25	19.83	27	16.5	14.0	
Benicia	Benicia Marina	2	1	8/7/2006	1310	20.1	7.65	7.37	19.65	28	43.5	13.4	
Benicia	Benicia Marina	3	1	8/7/2006	1314	20.3	7.65	7.18	19.67	32			
Benicia	Benicia Marina	4	1	8/7/2006	1327	20.3	7.64	7.21	19.69	33			
Benicia	Benicia Marina	5	1	8/7/2006	1345	20.3	7.59	7.04	L	57			
Benicia	Benicia Marina	6	1	8/7/2006	1351	20.3	7.59	7.01	22.55	48			
Benicia	Benicia Marina	7	1	8/7/2006	1402	20.4	7.63	7.28	22.2	42			
Benicia	Benicia Marina	8	1	8/7/2006	1413	20.3	7.6	7.89	20.35	29			
Benicia	Benicia Marina	1	2	9/6/2006	1315	19.3	7.21	7.4	18.91	45			N (79/98)
Benicia	Benicia Marina	2	2	9/6/2006	1320	20	7.16	7.72	18.8	34			N (82/102)
Benicia	Benicia Marina	3	2	9/6/2006	1325	19	7.23	7.31	18.13	46			N (73/92)
Benicia	Benicia Marina	4	2	9/6/2006	1335	19.4	7.21	7.34	19.02	35			N (75/94)
Benicia	Benicia Marina	5	2	9/6/2006	1345	19.4	6.38	7.56	21.31	80			
Benicia	Benicia Marina	6	2	9/6/2006	1404	19.2	6.25	7.34	23.71	74			
Benicia	Benicia Marina	7	2	9/6/2006	1415	19.4	6.17	7.38	22.23	46			
Benicia	Benicia Marina	8	2	9/6/2006	1423	19.5	6.15	7.58	19.37	40			

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
Benicia	Benicia Marina	1	3	10/2/2006	1400	17.3	7.92	7.53	16.54	22	48.6	5.0	
Benicia	Benicia Marina	2	3	10/2/2006	1410	17.3	7.93	8.22	16.53	22	42.0	4.7	
Benicia	Benicia Marina	3	3	10/2/2006	1455	17.5	8.09	8.91	16.61	18			
Benicia	Benicia Marina	4	3	10/2/2006	1504	17.3	7.85	8.13	16.73	17			
Benicia	Benicia Marina	5	3	10/2/2006	1522	7.7	7.78	7.98	22.23	32			
Benicia	Benicia Marina	6	3	10/2/2006	1530	17.6	7.96	8.03	21.37	29			
Benicia	Benicia Marina	7	3	10/2/2006	1556	17.8	7.94	8.05	23.5	23			
Benicia	Benicia Marina	8	3	10/2/2006	1543	17.8	7.66	8.03	22.63	32			
Berkeley	Berkeley Marina	1	1	7/24/2006	1150	20.9	7.48	7.5	43.46	2	277.1	102.9	
Berkeley	Berkeley Marina	2	1	7/24/2006	1201	21.1	7.5	7.35	43.85	2	118.1	48.5	
Berkeley	Berkeley Marina	3	1	7/24/2006	1212	21	7.5	6.97	44.01	2			
Berkeley	Berkeley Marina	4	1	7/24/2006	1234	21	7.54	7.38	43.9	0			
Berkeley	Berkeley Marina	5	1	7/24/2006	1232	19.9	7.51	7.41	44.62	4			
Berkeley	Berkeley Marina	6	1	7/24/2006	1252	20.4	7.58	7.77	44.38	3			
Berkeley	Berkeley Marina	7	1	7/24/2006	1302	18.7	7.48	7.52	45.06	4			
Berkeley	Berkeley Marina	8	1	7/24/2006	1220	18.5	7.49	7.7	45.27	2			
Berkeley	Berkeley Marina	1	2	8/21/2006	1024	18.5	7.82	7.3	46.27	L			N (83/101)
Berkeley	Berkeley Marina	2	2	8/21/2006	1042	18.4	7.97	7.42	46.35	11			N (75/91)
Berkeley	Berkeley Marina	3	2	8/21/2006	1052	18.3	7.93	8.05	46.36	10			N (78/95)
Berkeley	Berkeley Marina	4	2	8/21/2006	1100	18.5	7.97	7.01	46.37	12			N (86/105)
Berkeley	Berkeley Marina	5	2	8/21/2006	1123	17.6	8.1	9.43	43.35	12			
Berkeley	Berkeley Marina	6	2	8/21/2006	1115	17.8	8.06	9.24	44.81	16			
Berkeley	Berkeley Marina	7	2	8/21/2006	1135	17.6	7.94	9.5	46.19	16			
Berkeley	Berkeley Marina	8	2	8/21/2006	1145	17.7	7.95	8.95	46.14	10			
Berkeley	Berkeley Marina	1	3	9/18/2006	1012	17.7	8.28	7.28	33.48	12	134.0	13.2	
Berkeley	Berkeley Marina	2	3	9/18/2006	1023	17.6	8.14	6	42.54	15	30.4	4.1	
Berkeley	Berkeley Marina	3	3	9/18/2006	1046	17.7	8.11	6.48	42.69	12			
Berkeley	Berkeley Marina	4	3	9/18/2006	1052	17.7	7.93	6.7	42.55	14			
Berkeley	Berkeley Marina	5	3	9/18/2006	1111	17.4	7.95	6.89	42.33	19			
Berkeley	Berkeley Marina	6	3	9/18/2006	1104	17.5	8.01	7.01	42.31	14			

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
Berkeley	Berkeley Marina	7	3	9/18/2006	1120	17.2	7.91	6.75	42.54	9			
Berkeley	Berkeley Marina	8	3	9/18/2006	1130	17.2	7.9	6.81	42.68	7			
San Mateo	Coyote Point Marina	1	1	7/28/2006	1001	23.2	7.75	3.89	43.25	1			
San Mateo	Coyote Point Marina	2	1	7/28/2006	1011	23.2	7.78	3.7	43.25	6			
San Mateo	Coyote Point Marina	3	1	7/28/2006	1020	23.2	7.76	4.5	43.24	10			
San Mateo	Coyote Point Marina	4	1	7/28/2006	1032	23.1	7.76	L	43.25	11			
San Mateo	Coyote Point Marina	5	1	7/28/2006	1053	22.7	7.83	5.63	43.3	12			
San Mateo	Coyote Point Marina	6	1	7/28/2006	1100	22.7	7.83	5.45	43.28	4			
San Mateo	Coyote Point Marina	7	1	7/28/2006	1111	23	7.81	5.3	43.25	0			
San Mateo	Coyote Point Marina	8	1	7/28/2006	1122	22.9	7.77	5.03	43.3	5			
San Mateo	Coyote Point Marina	1	2	8/25/2006	925	19.5	7.7	5.9	46.1	22			
San Mateo	Coyote Point Marina	2	2	8/25/2006	933	19.6	7.9	6.22	46.16	22			
San Mateo	Coyote Point Marina	3	2	8/25/2006	942	19.6	7.8	6.15	46.17	25			
San Mateo	Coyote Point Marina	4	2	8/25/2006	950	19.6	7.9	4.73	46.16	24			
San Mateo	Coyote Point Marina	5	2	8/25/2006	1004	19.1	8	6.89	46.34	25			
San Mateo	Coyote Point Marina	6	2	8/25/2006	1024	19.1	7.9	7.23	46.3	26			
San Mateo	Coyote Point Marina	7	2	8/25/2006	1029	19	7.7	7.57	46.3	24			
San Mateo	Coyote Point Marina	8	2	8/25/2006	1010	19.1	7.09	7.04	46.29	27			
Sausalito	Clipper Yacht Harbor	1	1	7/27/2006	1415	17.9	7.43	5.54	46.21	6			
Sausalito	Clipper Yacht Harbor	2	1	7/27/2006	1426	18.3	7.4	5.97	47.01	14			
Sausalito	Clipper Yacht Harbor	3	1	7/27/2006	1436	18.2	7.39	5.88	47.02	14			
Sausalito	Clipper Yacht Harbor	4	1	7/27/2006	1447	17.9	7.37	5.44	46.76	7			
Sausalito	Clipper Yacht Harbor	5	1	7/27/2006	1456	18.2	7.4	6.05	46.16	14			
Sausalito	Clipper Yacht Harbor	6	1	7/27/2006	1506	18.2	7.36	5.55	46.41	19			
Sausalito	Clipper Yacht Harbor	7	1	7/27/2006	1516	18.1	7.41	5.91	46.23	15			
Sausalito	Clipper Yacht Harbor	8	1	7/27/2006	1526	18.2	7.4	5.9	46.27	15			
Sausalito	Clipper Yacht Harbor	1	2	8/25/2006	1317	17.4	6.8	6.45	48.47	20			
Sausalito	Clipper Yacht Harbor	2	2	8/25/2006	1325	17.7	7.1	5.65	48.41	20			
Sausalito	Clipper Yacht Harbor	3	2	8/25/2006	1333	17.8	7	5.61	48.43	23			
Sausalito	Clipper Yacht Harbor	4	2	8/25/2006	1340	17.5	7.1	5.75	48.52	24			

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
Sausalito	Clipper Yacht Harbor	5	2	8/25/2006	1358	17.6	7	6.66	48.27	27			
Sausalito	Clipper Yacht Harbor	6	2	8/25/2006	1352	17.6	7.1	6.31	48.4	27			
Sausalito	Clipper Yacht Harbor	7	2	8/25/2006	1402	17.6	7	6.4	48.19	27			
Sausalito	Clipper Yacht Harbor	8	2	8/25/2006	1408	17.6	7	6.57	48.09	25			
Sausalito	Clipper Yacht Harbor	1	3	9/19/2006	1340	17.3	6.68	6.93	43.35	9			
Sausalito	Clipper Yacht Harbor	2	3	9/19/2006	1350	17.8	6.78	6.9	44.04	14			
Sausalito	Clipper Yacht Harbor	3	3	9/19/2006	1355	17.8	6.82	6.7	43.9	11			
Sausalito	Clipper Yacht Harbor	4	3	9/19/2006	1400	17.9	6.83	7.01	44.01	11			
Sausalito	Clipper Yacht Harbor	5	3	9/19/2006	1410	17.5	6.9	8.49	44	10			
Sausalito	Clipper Yacht Harbor	6	3	9/19/2006	1415	17.6	6.88	8.05	44	10			
Sausalito	Clipper Yacht Harbor	7	3	9/19/2006	1422	17.7	6.85	7.91	43.99	12			
Sausalito	Clipper Yacht Harbor	8	3	9/19/2006	1430	17.8	6.87	7.15	43.79	6			
Long Beach	Downtown Shoreline Marina	1	1	8/1/2006	1310	22.6	7.72	5.57	51.7	9			
Long Beach	Downtown Shoreline Marina	2	1	8/1/2006	1321	23.1	7.66	4.87	51.6	3			
Long Beach	Downtown Shoreline Marina	3	1	8/1/2006	1329	21.3	7.75	5.54	51.6	22			
Long Beach	Downtown Shoreline Marina	4	1	8/1/2006	1337	22.9	7.78	5.87	51.2	4			
Long Beach	Downtown Shoreline Marina	5	1	8/1/2006	1352	23.4	7.83	6.47	49.8	6			
Long Beach	Downtown Shoreline Marina	6	1	8/1/2006	1357	22.9	7.87	6.56	49.5	7			
Long Beach	Downtown Shoreline Marina	7	1	8/1/2006	1404	23	7.92	7.17	50.5	8			
Long Beach	Downtown Shoreline Marina	8	1	8/1/2006	1411	23.4	7.84	6.38	50	5			
Long Beach	Downtown Shoreline Marina	1	2	8/29/2006	1332	21.3	7.96	8.1	51.4	19			N (82/96)
Long Beach	Downtown Shoreline Marina	2	2	8/29/2006	1340	20.4	7.93	7.36	51.3	19			N (84/99)
Long Beach	Downtown Shoreline Marina	3	2	8/29/2006	1348	23.1	7.64	4.57	51.2	4			N (88/104)
Long Beach	Downtown Shoreline Marina	4	2	8/29/2006	1359	20.7	7.53	5.54	51.1	22			N (83/98)
Long Beach	Downtown Shoreline Marina	5	2	8/29/2006	1416	21.2	7.54	6.82	49.5	22			
Long Beach	Downtown Shoreline Marina	6	2	8/29/2006	1423	21.2	7.55	7.4	50.4	16			
Long Beach	Downtown Shoreline Marina	7	2	8/29/2006	1430	21.1	7.49	7.04	50.7	16			
Long Beach	Downtown Shoreline Marina	8	2	8/29/2006	1439	20.4	7.42	7.75	51.3	19			
Long Beach	Downtown Shoreline Marina	1	3	9/26/2006	1340	21	8.02	6.01	47.5	7	216.0	21.0	
Long Beach	Downtown Shoreline Marina	2	3	9/26/2006	1351	20.6	7.89	6.37	47.42	8	98.0	23.2	

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
Long Beach	Downtown Shoreline Marina	3	3	9/26/2006	1358	20.4	7.85	6.32	47.56	11			
Long Beach	Downtown Shoreline Marina	4	3	9/26/2006	1407	20.7	7.88	6.14	47.44	10			
Long Beach	Downtown Shoreline Marina	5	3	9/26/2006	1423	21.5	8.09	7.28	46.32	11			
Long Beach	Downtown Shoreline Marina	6	3	9/26/2006	1433	20.5	8.06	7.22	47.03	9			
Long Beach	Downtown Shoreline Marina	7	3	9/26/2006	1440	21.1	8.01	7.77	44.07	9			
Long Beach	Downtown Shoreline Marina	8	3	9/26/2006	1527	20	7.87	7.32	46.05	16			
Folsom	Folsom Lake Marina	1	1	7/17/2006	1045	26.5	7.4	7.7	0.0486	0			
Folsom	Folsom Lake Marina	2	1	7/17/2006	1101	26.5	7.94	7.58	0.0493	L			
Folsom	Folsom Lake Marina	3	1	7/17/2006	1111	26.5	7.92	7.7	0.0494	L			
Folsom	Folsom Lake Marina	4	1	7/17/2006	1120	26.5	7.77	7.9	0.0495	L			
Folsom	Folsom Lake Marina	5	1	7/17/2006	1132	26.5	7.97	7.85	0.0493	L			
Folsom	Folsom Lake Marina	6	1	7/17/2006	1145	26.7	8.09	8.04	0.0492	L			
Folsom	Folsom Lake Marina	7	1	7/17/2006	1152	26.8	8.07	8	0.0492	L			
Folsom	Folsom Lake Marina	8	1	7/17/2006	1203	27.1	8.04	7.8	0.0493	L			
Folsom	Folsom Lake Marina	1	2	8/14/2006	955	25.2	8.08	7.1	0.0492	9			
Folsom	Folsom Lake Marina	2	2	8/14/2006	1005	25.3	8.02	6.92	0.0492	9			
Folsom	Folsom Lake Marina	3	2	8/14/2006	1015	25.3	7.94	6.7	0.0492	6			
Folsom	Folsom Lake Marina	4	2	8/14/2006	1025	25.3	7.97	6.88	0.0492	5			
Folsom	Folsom Lake Marina	5	2	8/14/2006	1030	25.4	8.07	6.83	0.0495	8			
Folsom	Folsom Lake Marina	6	2	8/14/2006	1042	25.3	8.12	7.27	0.0492	6			
Folsom	Folsom Lake Marina	7	2	8/14/2006	1050	25.3	8.13	7.26	0.0491	9			
Folsom	Folsom Lake Marina	8	2	8/14/2006	1100	25.4	8.15	7.55	0.0492	6			
Folsom	Folsom Lake Marina	1	3	9/14/2006	1030	23.7	7.88	8.82	0.0464	16			
Folsom	Folsom Lake Marina	2	3	9/14/2006	1053	23.8	7.92	8.37	0.0462	19			
Folsom	Folsom Lake Marina	3	3	9/14/2006	1120	23.8	7.92	7.91	0.0463	16			
Folsom	Folsom Lake Marina	4	3	9/14/2006	1147	23.8	7.92	8.97	0.0463	14			
Folsom	Folsom Lake Marina	5	3	9/14/2006	1205	23.8	7.91	8.69	0.0464	14			
Folsom	Folsom Lake Marina	6	3	9/14/2006	1230	23.8	7.92	9.32	0.0460	15			
Folsom	Folsom Lake Marina	7	3	9/14/2006	1302	23.6	8.08	8.51	0.0461	15			
Folsom	Folsom Lake Marina	8	3	9/14/2006	1328	23.7	7.93	9.03	0.0460	10			

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
San Rafael	Loch Lomond Marina	1	1	7/25/2006	1402	25.7	7.42	6.71	38.62	L	365.7	161.0	
San Rafael	Loch Lomond Marina	2	1	7/25/2006	1413	24.8	7.39	6.34	38.83	0	712.4	217.1	
San Rafael	Loch Lomond Marina	3	1	7/25/2006	1422	24.9	7.38	6.14	38.66	1			
San Rafael	Loch Lomond Marina	4	1	7/25/2006	1430	25.3	7.38	6.43	38.75	4			
San Rafael	Loch Lomond Marina	5	1	7/25/2006	1445	23.7	7.37	6.62	39.17	1			
San Rafael	Loch Lomond Marina	6	1	7/25/2006	1455	24	7.44	6.98	39.13	18			
San Rafael	Loch Lomond Marina	7	1	7/25/2006	1504	25.5	7.38	6.63	39.27	2			
San Rafael	Loch Lomond Marina	8	1	7/25/2006	1512	26	7.35	6.57	39.2	2			
San Rafael	Loch Lomond Marina	1	2	8/22/2006	1400	21.7	7.65	7.92	42.48	0			N (81/99)
San Rafael	Loch Lomond Marina	2	2	8/22/2006	1417	20.8	7.8	8.98	42.29	4			N (80/98)
San Rafael	Loch Lomond Marina	3	2	8/22/2006	1432	20.9	7.75	9.23	42.25	0			N (80/97)
San Rafael	Loch Lomond Marina	4	2	8/22/2006	1443	21.2	7.78	9.11	42.25	1			N (82/100)
San Rafael	Loch Lomond Marina	5	2	8/22/2006	1459	21.1	7.82	9.59	41.66	11			
San Rafael	Loch Lomond Marina	6	2	8/22/2006	1513	21.1	7.72	9.27	40.91	6			
San Rafael	Loch Lomond Marina	7	2	8/22/2006	1524	21.5	7.77	9.51	41.88	4			
San Rafael	Loch Lomond Marina	8	2	8/22/2006	1535	22	7.73	9.38	42.3	0			
San Rafael	Loch Lomond Marina	1	3	9/19/2006	1008	19.2	7.28	7.58	37.64	24	178.8	39.0	
San Rafael	Loch Lomond Marina	2	3	9/19/2006	1017	18.6	7.23	7.46	37.37	31	117.4	23.8	
San Rafael	Loch Lomond Marina	3	3	9/19/2006	1025	18.7	7.18	7.25	37.4	29			
San Rafael	Loch Lomond Marina	4	3	9/19/2006	1032	18.7	7	6.83	37.35	33			
San Rafael	Loch Lomond Marina	5	3	9/19/2006	1045	18.7	7.11	7.84	37.28	32			
San Rafael	Loch Lomond Marina	6	3	9/19/2006	1052	18.9	7.12	8.69	37.03	30			
San Rafael	Loch Lomond Marina	7	3	9/19/2006	1103	18.8	6.91	8.71	37.15	26			
San Rafael	Loch Lomond Marina	8	3	9/19/2006	1110	19	6.77	8.02	37.44	29			
Richmond	Marina Bay Yacht Harbor	1	1	7/25/2006	955	21.3	7.69	7.43	44.03	7	103.7	50.7	
Richmond	Marina Bay Yacht Harbor	2	1	7/25/2006	1010	21.3	7.77	8.64	44.21	7	106.3	48.3	
Richmond	Marina Bay Yacht Harbor	3	1	7/25/2006	1020	21.3	7.72	7.62	44.18	5			
Richmond	Marina Bay Yacht Harbor	4	1	7/25/2006	1028	21.3	7.77	7.88	44.2	6			
Richmond	Marina Bay Yacht Harbor	5	1	7/25/2006	1048	20.4	6.88	7.2	45.32	7			
Richmond	Marina Bay Yacht Harbor	6	1	7/25/2006	1058	21.3	7.75	8.9	44.3	7			

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
Richmond	Marina Bay Yacht Harbor	1	2	8/22/2006	1007	18.8	7.66	8.43	46.22	17			N (84/102)
Richmond	Marina Bay Yacht Harbor	2	2	8/22/2006	1026	18.8	7.77	7.84	46.28	L			**Y (72/88)**
Richmond	Marina Bay Yacht Harbor	3	2	8/22/2006	1041	18.9	7.73	8.19	46.29	L			N (83/101)
Richmond	Marina Bay Yacht Harbor	4	2	8/22/2006	1050	18.9	7.72	7.48	46.28	L			N (77/94)
Richmond	Marina Bay Yacht Harbor	5	2	8/22/2006	1110	18.5	7.81	9.11	46.18	L			
Richmond	Marina Bay Yacht Harbor	6	2	8/22/2006	1120	18.8	7.81	8.53	46.3	L			
Richmond	Marina Bay Yacht Harbor	1	3	9/18/2006	1435	18.7	7.55	6.4	42.88	15	80.4	9.7	
Richmond	Marina Bay Yacht Harbor	2	3	9/18/2006	1448	19	7.42	6.52	43.03	8	143.4	21.6	
Richmond	Marina Bay Yacht Harbor	3	3	9/18/2006	1458	18.8	7.18	7.15	42.97	8			
Richmond	Marina Bay Yacht Harbor	4	3	9/18/2006	1510	18.8	7.16	7.51	42.86	9			
Richmond	Marina Bay Yacht Harbor	5	3	9/18/2006	1532	18.1	7.11	7.95	42.89	7			
Richmond	Marina Bay Yacht Harbor	6	3	9/18/2006	1520	18.3	7.18	7.79	42.9	7			
Monterey	Monterey Harbor	1	1	8/10/2006	1039	18.4	7.9	6.49	51.9	9			
Monterey	Monterey Harbor	2	1	8/10/2006	1052	18.4	7.96	6.32	51.9	11			
Monterey	Monterey Harbor	3	1	8/10/2006	1105	18.3	7.96	6.27	51.8	10			
Monterey	Monterey Harbor	4	1	8/10/2006	1120	18.2	7.98	7.31	51.9	11			
Monterey	Monterey Harbor	5	1	8/10/2006	1147	17.1	8	7.97	51.9	10			
Monterey	Monterey Harbor	6	1	8/10/2006	1159	17.1	8.01	8.54	51.8	5			
Monterey	Monterey Harbor	7	1	8/10/2006	1208	17.7	8.03	8.94	51.8	4			
Monterey	Monterey Harbor	8	1	8/10/2006	1216	17.9	8.07	9.38	51.9	40.7			
Monterey	Monterey Harbor	1	2	9/8/2006	928	15.4	8.16	5.1	52	1			
Monterey	Monterey Harbor	2	2	9/8/2006	935	15.4	8.13	5.63	51.9	14			
Monterey	Monterey Harbor	3	2	9/8/2006	945	15.3	8.21	5.94	52	14			
Monterey	Monterey Harbor	4	2	9/8/2006	953	15.3	8.13	7.1	52	14			
Monterey	Monterey Harbor	5	2	9/8/2006	1004	L	8.17	L	L	12			
Monterey	Monterey Harbor	6	2	9/8/2006	1010	L	L	L	L	L			
Monterey	Monterey Harbor	7	2	9/8/2006	1018	L	L	L	L	L			
Monterey	Monterey Harbor	8	2	9/8/2006	1024	14.8	8.33	8.46	52	7			
Monterey	Monterey Harbor	1	3	10/19/2006	937	15	7.88	5.25	48.4	8			
Monterey	Monterey Harbor	2	3	10/19/2006	948	15	7.85	5.34	48.43	9			

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
Monterey	Monterey Harbor	3	3	10/19/2006	1000	15.1	7.85	4.93	48.5	5			
Monterey	Monterey Harbor	4	3	10/19/2006	1010	15.2	7.81	6.46	48.46	6			
Monterey	Monterey Harbor	5	3	10/19/2006	1023	14.9	7.99	9.57	48.56	7			
Monterey	Monterey Harbor	6	3	10/19/2006	1033	14.8	7.99	9.51	48.61	10			
Monterey	Monterey Harbor	7	3	10/19/2006	1045	15.2	7.95	11.48	48.62	9			
Monterey	Monterey Harbor	8	3	10/19/2006	1115	15.4	7.81	11.85	48.64	6			
Los Angeles	Marina del Rey Back Basin	1	1	8/2/2006	1011	24.7	7.39	3.28	51.1	23	158.1	75.8	
Los Angeles	Marina del Rey Back Basin	2	1	8/2/2006	1018	24.6	7.47	3.69	51.5	13	155.2	75.1	
Los Angeles	Marina del Rey Back Basin	3	1	8/2/2006	1028	24.8	7.57	4.5	51.4	10	417.3	150.7	
Los Angeles	Marina del Rey Back Basin	4	1	8/2/2006	1041	24.7	7.58	4.32	51.7	8	137.9	57.7	
Los Angeles	Marina del Rey Back Basin	1	2	8/30/2006	1049	23.7	7.54	3.56	51.6	24			**Y (37/44)**
Los Angeles	Marina del Rey Back Basin	2	2	8/30/2006	1103	23.8	7.62	3.75	51.6	24			**Y (4/4)**
Los Angeles	Marina del Rey Back Basin	3	2	8/30/2006	1218	24.3	7.57	5	51.5	20			N (79/93)
Los Angeles	Marina del Rey Back Basin	4	2	8/30/2006	1130	24.2	7.76	4.85	51.3	26			**Y (66/78)**
Los Angeles	Marina del Rey Back Basin	1	3	9/27/2006	1035	21.6	7.9	4.08	48	10	82.6	24.0	
Los Angeles	Marina del Rey Back Basin	2	3	9/27/2006	1044	21.4	7.89	4.89	48.01	12	68.4	20.0	
Los Angeles	Marina del Rey Back Basin	3	3	9/27/2006	1053	21.8	7.91	5.43	48.02	10			
Los Angeles	Marina del Rey Back Basin	4	3	9/27/2006	1106	21.4	7.92	4.69	48.07	15			
Los Angeles	Marina del Rey Front Basin	1	1	8/2/2006	1059	24.9	7.66	5.14	51.6	12			
Los Angeles	Marina del Rey Front Basin	2	1	8/2/2006	1117	24.7	7.45	3	51.8	17			
Los Angeles	Marina del Rey Front Basin	3	1	8/2/2006	1127	25	7.68	5.38	51.9	10			
Los Angeles	Marina del Rey Front Basin	4	1	8/2/2006	1143	24.5	7.65	5.03	51.8	9			
Los Angeles	Marina del Rey Front Basin	5	1	8/2/2006	1202	24.1	7.87	6.87	51.5	10			
Los Angeles	Marina del Rey Front Basin	6	1	8/2/2006	1211	23.2	7.88	6.61	51.5	7			
Los Angeles	Marina del Rey Front Basin	7	1	8/2/2006	1222	23.1	7.95	7.06	51.8	6			
Los Angeles	Marina del Rey Front Basin	8	1	8/2/2006	1227	22.9	7.95	7.34	51.9	6			
Los Angeles	Marina del Rey Front Basin	1	2	8/30/2006	1157	24	7.77	5.38	50.9	20			**Y (67/79)**
Los Angeles	Marina del Rey Front Basin	2	2	8/30/2006	1205	24	7.79	6.01	51.8	18			**Y (55/64)**
Los Angeles	Marina del Rey Front Basin	3	2	8/30/2006	1113	23.9	7.69	5.01	51.6	24			**Y (61/72)**
Los Angeles	Marina del Rey Front Basin	4	2	8/30/2006	1246	24	7.6	4.62	51.7	23			**Y (49/57)**

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
Los Angeles	Marina del Rey Front Basin	5	2	8/30/2006	1303	23.5	7.75	6.8	50.6	23			
Los Angeles	Marina del Rey Front Basin	6	2	8/30/2006	1312	21.9	7.74	6.92	51.7	20			
Los Angeles	Marina del Rey Front Basin	7	2	8/30/2006	1321	21.4	7.72	7.16	51.6	20			
Los Angeles	Marina del Rey Front Basin	8	2	8/30/2006	1330	21.8	7.68	7.5	51.9	22			
Los Angeles	Marina del Rey Front Basin	1	3	9/27/2006	1120	21.7	7.72	4.32	48.12	13			
Los Angeles	Marina del Rey Front Basin	2	3	9/27/2006	1129	21.3	7.88	5.12	48.12	13			
Los Angeles	Marina del Rey Front Basin	3	3	9/27/2006	1137	21.5	7.83	4.96	47.81	17			
Los Angeles	Marina del Rey Front Basin	4	3	9/27/2006	1158	21.3	7.78	4.46	48.13	16			
Los Angeles	Marina del Rey Front Basin	5	3	9/27/2006	1215	21.1	7.94	7.46	48.02	8			
Los Angeles	Marina del Rey Front Basin	6	3	9/27/2006	1224	20.4	8.08	7.33	48.35	4			
Los Angeles	Marina del Rey Front Basin	7	3	9/27/2006	1233	20.3	7.93	7.57	48.08	7			
Los Angeles	Marina del Rey Front Basin	8	3	9/27/2006	1240	20.4	7.96	7.75	48.28	5			
Pittsburg	Pittsburg Marina	1	1	8/8/2006	948	21.2	7.81	7.13	3.805	19	22.5	8.9	
Pittsburg	Pittsburg Marina	2	1	8/8/2006	1000	21.2	7.8	7.52	3.718	17	91.0	12.0	
Pittsburg	Pittsburg Marina	3	1	8/8/2006	1027	21.1	7.73	7.25	3.657	18			
Pittsburg	Pittsburg Marina	4	1	8/8/2006	1033	21.2	7.81	7.32	1.585	27			
Pittsburg	Pittsburg Marina	5	1	8/8/2006	1015	21.2	7.79	7.41	3.292	15			
Pittsburg	Pittsburg Marina	6	1	8/8/2006	1045	21.2	7.78	7.84	1.381	23			
Pittsburg	Pittsburg Marina	7	1	8/8/2006	1052	21.3	7.78	7.84	1.792	23			
Pittsburg	Pittsburg Marina	8	1	8/8/2006	1101	21.2	7.76	7.63	2.015	25			
Pittsburg	Pittsburg Marina	1	2	9/5/2006	1400	20.5	6.68	7.86	1.894	34			N (78/98)
Pittsburg	Pittsburg Marina	2	2	9/5/2006	1415	20.5	5.87	8.4	2.123	31			N (79/99)
Pittsburg	Pittsburg Marina	3	2	9/5/2006	1430	20.9	6.02	8.08	2.027	34			N (76/94)
Pittsburg	Pittsburg Marina	4	2	9/5/2006	1435	20.6	5.68	8	1.900	34			Not Tested
Pittsburg	Pittsburg Marina	5	2	9/5/2006	1508	20	4.83	8.12	3.176	39			
Pittsburg	Pittsburg Marina	6	2	9/5/2006	1500	20	4.83	8.03	2.471	39			
Pittsburg	Pittsburg Marina	7	2	9/5/2006	1450	20	5.25	7.99	2.565	36			
Pittsburg	Pittsburg Marina	8	2	9/5/2006	1445	20.2	5.52	7.95	3.011	35			
Pittsburg	Pittsburg Marina	1	3	10/3/2006	1445	18	8.53	8.62	1.502	18	20.2	1.6	
Pittsburg	Pittsburg Marina	2	3	10/3/2006	1328	17.7	8.21	8.21	1.680	26	40.2	5.3	

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
Pittsburg	Pittsburg Marina	3	3	10/3/2006	1423	17.7	8.42	8.26	1.669	18			
Pittsburg	Pittsburg Marina	4	3	10/3/2006	1430	17.9	8.44	8.45	1.642	12			
Pittsburg	Pittsburg Marina	5	3	10/3/2006	1345	17.3	8.34	8.47	3.066	26			
Pittsburg	Pittsburg Marina	6	3	10/3/2006	1354	17.5	8.4	8.42	2.597	26			
Pittsburg	Pittsburg Marina	7	3	10/3/2006	1404	17.6	7.76	9.23	2.800	23			
Pittsburg	Pittsburg Marina	8	3	10/3/2006	1412	17.6	8.41	8.46	3.207	19			
Santa Barbara	Santa Barbara Harbor	1	1	8/3/2006	1053	18.4	7.61	4.41	51.3	14			
Santa Barbara	Santa Barbara Harbor	2	1	8/3/2006	1101	18.5	7.62	4	51.7	5			
Santa Barbara	Santa Barbara Harbor	3	1	8/3/2006	1112	18.5	7.65	4.51	51.7	13			
Santa Barbara	Santa Barbara Harbor	4	1	8/3/2006	1125	18.5	7.63	4.93	51.8	9			
Santa Barbara	Santa Barbara Harbor	5	1	8/3/2006	1138	18.7	7.91	7.36	51.9	12			
Santa Barbara	Santa Barbara Harbor	6	1	8/3/2006	1146	18.8	7.92	7.55	51.8	13			
Santa Barbara	Santa Barbara Harbor	7	1	8/3/2006	1153	18.6	7.91	7.81	51.8	13			
Santa Barbara	Santa Barbara Harbor	8	1	8/3/2006	1200	18.6	7.91	7.62	51.7	15			
Santa Barbara	Santa Barbara Harbor	1	2	8/31/2006	1044	17.4	7.65	5.72	52	24			
Santa Barbara	Santa Barbara Harbor	2	2	8/31/2006	1050	17.3	7.71	5.31	52	22			
Santa Barbara	Santa Barbara Harbor	3	2	8/31/2006	1103	17.4	7.87	5.29	52	23			
Santa Barbara	Santa Barbara Harbor	4	2	8/31/2006	1110	17.3	7.82	5.41	52.1	23			
Santa Barbara	Santa Barbara Harbor	5	2	8/31/2006	1124	17.7	7.98	7.54	52.1	23			
Santa Barbara	Santa Barbara Harbor	6	2	8/31/2006	1132	17.7	7.95	7.53	52.1	21			
Santa Barbara	Santa Barbara Harbor	7	2	8/31/2006	1140	17.7	7.91	7.22	52	22			
Santa Barbara	Santa Barbara Harbor	8	2	8/31/2006	1148	L	7.85	L	L	23			
Santa Barbara	Santa Barbara Harbor	1	3	9/28/2006	1010	18.4	7.79	5.36	48.39	9			
Santa Barbara	Santa Barbara Harbor	2	3	9/28/2006	1015	18.4	7.83	5.21	48.39	10			
Santa Barbara	Santa Barbara Harbor	3	3	9/28/2006	1026	18.5	7.82	5.57	48.42	10			
Santa Barbara	Santa Barbara Harbor	4	3	9/28/2006	1034	18.4	7.79	5.1	48.39	10			
Santa Barbara	Santa Barbara Harbor	5	3	9/28/2006	1046	18.2	8.14	8	48.35	13			
Santa Barbara	Santa Barbara Harbor	6	3	9/28/2006	1056	18.2	7.88	8.07	48.41	13			
Santa Barbara	Santa Barbara Harbor	7	3	9/28/2006	1106	18.2	8.01	8.14	48.37	11			
Santa Barbara	Santa Barbara Harbor	8	3	9/28/2006	1118	18.2	8	8.02	48.42	14			

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
Santa Cruz	Santa Cruz Harbor	1	1	8/9/2006	1117	18.2	7.67	5.03	50.6	16			
Santa Cruz	Santa Cruz Harbor	2	1	8/9/2006	1145	17.8	7.7	4.41	51.5	14			
Santa Cruz	Santa Cruz Harbor	3	1	8/9/2006	1154	17.4	7.74	5.26	51.9	15			
Santa Cruz	Santa Cruz Harbor	4	1	8/9/2006	1203	17.5	7.76	5.06	52	13			
Santa Cruz	Santa Cruz Harbor	5	1	8/9/2006	1213	17.8	8.11	8.73	51.6	6			
Santa Cruz	Santa Cruz Harbor	6	1	8/9/2006	1223	17.8	8.12	8.34	51.8	5			
Santa Cruz	Santa Cruz Harbor	7	1	8/9/2006	1229	17.6	8.11	8.68	52	3			
Santa Cruz	Santa Cruz Harbor	8	1	8/9/2006	1237	17.8	8.11	8.74	52	1			
Santa Cruz	Santa Cruz Harbor	1	2	9/7/2006	1035	15.9	8.08	3.79	51.4	22			
Santa Cruz	Santa Cruz Harbor	2	2	9/7/2006	1043	15.9	8.08	4.12	51.7	25			
Santa Cruz	Santa Cruz Harbor	3	2	9/7/2006	1052	16.2	7.96	4.18	51.4	24			
Santa Cruz	Santa Cruz Harbor	4	2	9/7/2006	1105	16.4	7.84	3.84	51.2	25			
Santa Cruz	Santa Cruz Harbor	5	2	9/7/2006	1120	15.6	8.42	10.2	51.8	23			
Santa Cruz	Santa Cruz Harbor	6	2	9/7/2006	1128	15.5	8.19	8.55	51.8	21			
Santa Cruz	Santa Cruz Harbor	7	2	9/7/2006	1136	15.5	8.27	10.15	51.8	21			
Santa Cruz	Santa Cruz Harbor	8	2	9/7/2006	1143	15.4	8.06	8.4	51.9	20			
Santa Cruz	Santa Cruz Harbor	1	3	10/19/2006	1510	15.8	7.43	3.68	47.82	5			
Santa Cruz	Santa Cruz Harbor	2	3	10/19/2006	1517	15.5	7.79	3.72	48.09	8			
Santa Cruz	Santa Cruz Harbor	3	3	10/19/2006	1533	15.4	7.96	3.66	48.38	5			
Santa Cruz	Santa Cruz Harbor	4	3	10/19/2006	1543	15.5	7.83	3.57	48.54	5			
Santa Cruz	Santa Cruz Harbor	5	3	10/19/2006	1554	15.8	8.39	8.86	47.3	2			
Santa Cruz	Santa Cruz Harbor	6	3	10/19/2006	1558	15.9	8.4	9.24	47.75	2			
Santa Cruz	Santa Cruz Harbor	7	3	10/19/2006	1605	15.8	8.42	9.41	48.39	2			
Santa Cruz	Santa Cruz Harbor	8	3	10/19/2006	1615	15.5	8.49	10.5	48.61	4			
Sacramento	Sacramento Marina	1	1	7/21/2006	1045	23.8	7.3	8.44	0.1277	2			
Sacramento	Sacramento Marina	2	1	7/21/2006	1102	25.1	7.7	9.1	0.1282	6			
Sacramento	Sacramento Marina	3	1	7/21/2006	1115	23.4	7.55	8.29	0.126	2			
Sacramento	Sacramento Marina	4	1	7/21/2006	1125	23	7.46	7.1	0.1272	2			
Sacramento	Sacramento Marina	5	1	7/21/2006	1201	22.6	7.41	9.44	0.1205	3			
Sacramento	Sacramento Marina	6	1	7/21/2006	1212	22.4	7.38	9.37	0.1207	3			

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
Sacramento	Sacramento Marina	7	1	7/21/2006	1223	22.4	7.37	9.45	0.1209	3			
Sacramento	Sacramento Marina	8	1	7/21/2006	1236	23	7.46	9.12	0.1303	3			
Sacramento	Sacramento Marina	1	2	8/16/2006	923	22.2	6	7.35	0.1327	20			
Sacramento	Sacramento Marina	2	2	8/16/2006	933	22.2	6	8.2	0.1322	L			
Sacramento	Sacramento Marina	3	2	8/16/2006	941	22.3	6	6.5	0.1327	14			
Sacramento	Sacramento Marina	4	2	8/16/2006	952	21.8	6	8	0.1324	15			
Sacramento	Sacramento Marina	5	2	8/16/2006	1003	20.4	6	8.45	0.1361	21			
Sacramento	Sacramento Marina	6	2	8/16/2006	1014	20.3	6.5	8.3	0.1316	15			
Sacramento	Sacramento Marina	7	2	8/16/2006	1023	20.3	6.5	8.2	0.1311	16			
Sacramento	Sacramento Marina	8	2	8/16/2006	1030	20.8	6.5	8.29	0.151	18			
Sacramento	Sacramento Marina	1	3	9/12/2006	1046	21.4	8.35	10.22	0.1463	18			
Sacramento	Sacramento Marina	2	3	9/12/2006	1102	21.3	7.98	8.71	0.143	22			
Sacramento	Sacramento Marina	3	3	9/12/2006	1111	21.2	8.02	10.06	0.1424	26			
Sacramento	Sacramento Marina	4	3	9/12/2006	1123	21.2	7.56	8.61	0.1429	27			
Sacramento	Sacramento Marina	5	3	9/12/2006	1135	19.9	6.8	9.52	0.1571	19			
Sacramento	Sacramento Marina	6	3	9/12/2006	1145	19.8	6.75	9.31	0.1461	21			
Sacramento	Sacramento Marina	7	3	9/12/2006	1154	19.8	6.43	9.27	0.1458	19			
Sacramento	Sacramento Marina	8	3	9/12/2006	1203	20	6.32	9.27	0.1688	26			
San Francisco	San Francisco Marina	1	1	7/26/2006	1025	16	7.44	5.91	48.12	3	46.4	13.6	
San Francisco	San Francisco Marina	2	1	7/26/2006	1034	17.1	7.44	5.95	46.86	0	15.1	7.4	
San Francisco	San Francisco Marina	3	1	7/26/2006	1047	17.2	7.45	5.96	46.8	0			
San Francisco	San Francisco Marina	4	1	7/26/2006	1053	17.4	7.44	6.17	46.67	0			
San Francisco	San Francisco Marina	5	1	7/26/2006	1102	17	7.47	6.56	47.13	0			
San Francisco	San Francisco Marina	6	1	7/26/2006	1110	17	7.46	6.3	47.1	0			
San Francisco	San Francisco Marina	7	1	7/26/2006	1117	16.9	7.46	6.4	47.21	0			
San Francisco	San Francisco Marina	8	1	7/26/2006	1126	16.9	7.46	6.44	47.25	0			
San Francisco	San Francisco Marina	1	2	8/23/2006	1006	16.8	7.73	8.09	48.46	11			N (80/95)
San Francisco	San Francisco Marina	2	2	8/23/2006	1020	17.6	7.77	7.5	47.9	13			N (86/102)
San Francisco	San Francisco Marina	3	2	8/23/2006	1043	17.6	7.71	8.08	47.93	10			N (81/96)
San Francisco	San Francisco Marina	4	2	8/23/2006	1033	17.5	7.71	8.15	48.05	14			N (87/104)

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
San Francisco	San Francisco Marina	5	2	8/23/2006	1058	17.3	7.81	8.9	48.55	12			
San Francisco	San Francisco Marina	6	2	8/23/2006	1110	17.3	7.92	8.58	48.5	10			
San Francisco	San Francisco Marina	7	2	8/23/2006	1121	17.1	8	9.08	48.58	12			
San Francisco	San Francisco Marina	8	2	8/23/2006	1134	17.1	7.87	9.59	48.94	12			
San Francisco	San Francisco Marina	1	3	9/20/2006	1020	15.8	7.74	6.05	44.78	14	39.4	5.1	
San Francisco	San Francisco Marina	2	3	9/20/2006	1034	16	7.66	5.75	44.73	14	18.1	1.5	
San Francisco	San Francisco Marina	3	3	9/20/2006	1043	16	7.47	5.77	44.34	13			
San Francisco	San Francisco Marina	4	3	9/20/2006	1050	15.9	7.32	6.22	44.84	8			
San Francisco	San Francisco Marina	5	3	9/20/2006	1100	15.3	7.28	6.73	45.44	8			
San Francisco	San Francisco Marina	6	3	9/20/2006	1110	15.4	7.09	6.33	44.44	12			
San Francisco	San Francisco Marina	7	3	9/20/2006	1117	15.1	6.81	6.52	45.63	11			
San Francisco	San Francisco Marina	8	3	9/20/2006	1125	15.7	7.04	6.33	45.2	12			
San Francisco	South Beach Harbor	1	1	7/26/2006	1400	19.4	7.46	5.6	45.3	0	45.2	15.8	
San Francisco	South Beach Harbor	2	1	7/26/2006	1409	19.8	7.45	5.98	45.23	1	87.6	27.2	
San Francisco	South Beach Harbor	3	1	7/26/2006	1418	19.6	7.47	6.02	45.16	6			
San Francisco	South Beach Harbor	4	1	7/26/2006	1426	19.7	7.45	6	45.45	8			
San Francisco	South Beach Harbor	5	1	7/26/2006	1437	18.8	7.48	6.26	45.78	0			
San Francisco	South Beach Harbor	6	1	7/26/2006	1443	17.8	7.47	6.06	46.6	0			
San Francisco	South Beach Harbor	7	1	7/26/2006	1449	17.4	7.49	6.38	47.05	0			
San Francisco	South Beach Harbor	8	1	7/26/2006	1457	17.4	7.45	6.42	46.75	0			
San Francisco	South Beach Harbor	1	2	8/23/2006	1417	18.8	7.82	7.93	47.17	10			N (80/95)
San Francisco	South Beach Harbor	2	2	8/23/2006	1428	19.2	7.775	7.6	47.25	13			N (85/101)
San Francisco	South Beach Harbor	3	2	8/23/2006	1442	19	7.785	8.14	47.17	27			N (78/93)
San Francisco	South Beach Harbor	4	2	8/23/2006	1453	18.8	7.835	8.88	47.21	25			N (80/96)
San Francisco	South Beach Harbor	5	2	8/23/2006	1505	17.7	7.87	8.69	48.11	26			
San Francisco	South Beach Harbor	6	2	8/23/2006	1516	18.2	7.995	9	47.68	20			
San Francisco	South Beach Harbor	7	2	8/23/2006	1527	18.1	7.925	8.6	47.81	L			
San Francisco	South Beach Harbor	8	2	8/23/2006	1538	17.8	7.97	9.07	48.06	23			
San Francisco	South Beach Harbor	1	3	9/20/2006	1336	17.3	6.99	5.71	43.87	19	149.4	8.5	
San Francisco	South Beach Harbor	2	3	9/20/2006	1346	17.1	6.78	5.46	43.78	20	36.6	4.5	

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
San Francisco	South Beach Harbor	3	3	9/20/2006	1350	17.2	6.71	5.85	43.91	13			
San Francisco	South Beach Harbor	4	3	9/20/2006	1405	17.2	6.62	6.32	43.78	16			
San Francisco	South Beach Harbor	5	3	9/20/2006	1419	16.9	6.61	6.63	44.05	21			
San Francisco	South Beach Harbor	6	3	9/20/2006	1424	16.8	6.43	6.53	44.03	18			
San Francisco	South Beach Harbor	7	3	9/20/2006	1432	16.7	6.36	7.75	43.86	17			
San Francisco	South Beach Harbor	8	3	9/20/2006	1435	16.6	6.3	6.64	43.94	23			
Lake Tahoe	Tahoe Keyes Marina	1	1	7/20/2006	1140	23.2	9.15	8.72	0.0958	8			
Lake Tahoe	Tahoe Keyes Marina	2	1	7/20/2006	1153	23.2	9.34	8.25	0.0952	3			
Lake Tahoe	Tahoe Keyes Marina	3	1	7/20/2006	1205	23.2	9.24	7.19	0.095	5			
Lake Tahoe	Tahoe Keyes Marina	4	1	7/20/2006	1220	23.3	9.11	6.56	0.0949	3			
Lake Tahoe	Tahoe Keyes Marina	5	1	7/20/2006	1240	22.4	8.31	6.82	0.0901	9			
Lake Tahoe	Tahoe Keyes Marina	6	1	7/20/2006	1252	22.4	8.07	6.47	0.0906	2			
Lake Tahoe	Tahoe Keyes Marina	7	1	7/20/2006	1303	22.6	7.99	6.37	0.0891	3			
Lake Tahoe	Tahoe Keyes Marina	8	1	7/20/2006	1308	22.6	7.9	6.47	0.085	2			
Lake Tahoe	Tahoe Keyes Marina	1	2	8/17/2006	1110	20.6	9.08	7.8	0.097	15			
Lake Tahoe	Tahoe Keyes Marina	2	2	8/17/2006	1117	20.7	9.25	7.6	0.097	12			
Lake Tahoe	Tahoe Keyes Marina	3	2	8/17/2006	1125	20.4	9.5	7.11	0.0973	12			
Lake Tahoe	Tahoe Keyes Marina	4	2	8/17/2006	1145	20.6	L	7.2	0.0973	11			
Lake Tahoe	Tahoe Keyes Marina	5	2	8/17/2006	1200	19.1	8.4	8.11	0.0944	8			
Lake Tahoe	Tahoe Keyes Marina	6	2	8/17/2006	1212	19.2	8.49	7.8	0.0948	6			
Lake Tahoe	Tahoe Keyes Marina	7	2	8/17/2006	1222	19.3	8.5	7.85	0.0947	10			
Lake Tahoe	Tahoe Keyes Marina	8	2	8/17/2006	1242	19.4	8.38	8.03	0.094	9			
Vallejo	Vallejo Municipal Marina	1	1	8/7/2006	952	20	7.57	6.16	26.08	10	26.9	8.8	
Vallejo	Vallejo Municipal Marina	2	1	8/7/2006	1043	19.7	7.56	5.9	25.94	18	36.3	24.3	
Vallejo	Vallejo Municipal Marina	3	1	8/7/2006	1055	19.8	7.55	6.64	25.83	19			
Vallejo	Vallejo Municipal Marina	4	1	8/7/2006	1101	19.9	7.53	L	26.46	24			
Vallejo	Vallejo Municipal Marina	5	1	8/7/2006	1005	20	7.51	6.33	25.95	33			
Vallejo	Vallejo Municipal Marina	6	1	8/7/2006	1015	20	7.51	6.15	25.98	44			
Vallejo	Vallejo Municipal Marina	7	1	8/7/2006	1024	20	7.51	6	26.06	82			
Vallejo	Vallejo Municipal Marina	8	1	8/7/2006	1029	20	7.51	6.12	26.07	42			

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
Vallejo	Vallejo Municipal Marina	1	2	9/5/2006	1055	19.8	7.87	6.65	26.63	30			N (82/103)
Vallejo	Vallejo Municipal Marina	2	2	9/5/2006	1102	19.4	7.62	7.07	26.34	28			N (76/95)
Vallejo	Vallejo Municipal Marina	3	2	9/5/2006	1113	19.3	7.72	7.61	26.21	26			N (81/101)
Vallejo	Vallejo Municipal Marina	4	2	9/5/2006	1155	19.4	6.22	6.84	25.34	45			N (79/99)
Vallejo	Vallejo Municipal Marina	5	2	9/5/2006	1125	19.1	6.75	7.35	24.23	45			
Vallejo	Vallejo Municipal Marina	6	2	9/5/2006	1133	19.1	6.76	7.1	23.93	50			
Vallejo	Vallejo Municipal Marina	7	2	9/5/2006	1140	19.2	6.69	7.79	22.84	44			
Vallejo	Vallejo Municipal Marina	8	2	9/5/2006	1147	19.1	6.46	7.46	23.41	45			
Vallejo	Vallejo Municipal Marina	1	3	10/3/2006	943	17	7.69	7.28	23.84	23	25.2	2.7	
Vallejo	Vallejo Municipal Marina	2	3	10/3/2006	1033	17.3	7.76	6.61	23.93	24	30.2	4.1	
Vallejo	Vallejo Municipal Marina	3	3	10/3/2006	1045	16.9	7.75	6.81	23.66	25			
Vallejo	Vallejo Municipal Marina	4	3	10/3/2006	1052	17.2	7.81	6.53	23.81	27			
Vallejo	Vallejo Municipal Marina	5	3	10/3/2006	954	17.2	7.8	7.72	22.74	38			
Vallejo	Vallejo Municipal Marina	6	3	10/3/2006	1004	17.2	7.8	7.84	22.57	38			
Vallejo	Vallejo Municipal Marina	7	3	10/3/2006	1015	17.3	7.82	7.88	22.58	41			
Vallejo	Vallejo Municipal Marina	8	3	10/3/2006	1022	17.3	7.78	7.88	22.55	43			
Stockton	Village West Marina	1	1	7/19/2006	1012	28.5	7.28	4.75	0.2737	18			
Stockton	Village West Marina	2	1	7/19/2006	1025	28.5	7.39	5.19	0.2771	16			
Stockton	Village West Marina	3	1	7/19/2006	1036	28.6	7.41	5.13	L	18			
Stockton	Village West Marina	4	1	7/19/2006	1051	28.5	7.45	4.79	0.2776	17			
Stockton	Village West Marina	5	1	7/19/2006	1100	28	7.28	5	0.2837	33			
Stockton	Village West Marina	6	1	7/19/2006	1115	28.1	7.29	5.01	0.2813	27			
Stockton	Village West Marina	7	1	7/19/2006	1130	28.1	7.25	4.82	0.2815	29			
Stockton	Village West Marina	1	2	8/15/2006	1004	25.4	7.85	3.55	0.3455	50			
Stockton	Village West Marina	2	2	8/15/2006	1011	25.6	7.32	3.68	0.3454	57			
Stockton	Village West Marina	3	2	8/15/2006	1019	25.6	7.29	3.77	0.3495	58			
Stockton	Village West Marina	4	2	8/15/2006	1025	25.6	7.26	3.62	0.3473	57			
Stockton	Village West Marina	5	2	8/15/2006	1035	25	7.29	4.43	0.3469	64			
Stockton	Village West Marina	6	2	8/15/2006	1043	24.9	7.27	4.48	0.3455	57			
Stockton	Village West Marina	7	2	8/15/2006	1051	24.8	7.29	4.41	0.3385	58			

City	Marina	Sampling Site	Sampling Event	Sampling Date	Time	Temp °C	pH	DO mg/L	EC mS/cm	Turbidity FTU	Irgarol (ng/L)	M1 (ng/L)	Toxicity (% mean survival/% of control)
Stockton	Village West Marina	8	2	8/15/2006	1057	25	7.3	4.35	0.3376	61			
Stockton	Village West Marina	1	3	9/13/2006	1106	24.8	8.05	7.67	0.3473	39			
Stockton	Village West Marina	2	3	9/13/2006	1128	24.9	8.33	8.73	0.3468	38			
Stockton	Village West Marina	3	3	9/13/2006	1145	24.8	7.95	7.67	0.3437	34			
Stockton	Village West Marina	4	3	9/13/2006	1217	24.8	7.75	6.46	0.3436	33			
Stockton	Village West Marina	5	3	9/13/2006	1241	25	7.6	7.33	0.3431	37			
Stockton	Village West Marina	6	3	9/13/2006	1318	25.5	7.58	7.17	0.244	42			
Stockton	Village West Marina	7	3	9/13/2006	1252	25.5	7.56	7.92	0.3412	36			
Stockton	Village West Marina	8	3	9/13/2006	1306	25.2	7.57	6.74	0.346	37			

Appendix H: Sediment Metals Data (ANR Analytical Laboratory)

Table H-1. Sediment Data – TCu and TZn Concentrations

Station Name	Site	Event	Date	TCu (mg/kg dry weight)	TZn (mg/kg dry weight)
Sacramento Marina	1	3	9/12/2006	169	197
Sacramento Marina	2	3	9/12/2006	134	199
Sacramento Marina	3	3	9/12/2006	135	197
Sacramento Marina	4	3	9/12/2006	93	161
Sacramento Marina	5	3	9/12/2006	43	111
Sacramento Marina	6	3	9/12/2006	57	140
Sacramento Marina	7	3	9/12/2006	44	109
Sacramento Marina	8	3	9/12/2006	17	78
Village West Marina	1	3	9/13/2006	123	234
Village West Marina	2	3	9/13/2006	123	231
Village West Marina	3	3	9/13/2006	140	273
Village West Marina	4	3	9/13/2006	142	262
Village West Marina	5	3	9/13/2006	80	141
Village West Marina	6	3	9/13/2006	72	122
Village West Marina	7	3	9/13/2006	47	93
Village West Marina	8	3	9/13/2006	80	147
Folsom Lake Marina	1	3	9/14/2006	127	117
Folsom Lake Marina	2	3	9/14/2006	155	115
Folsom Lake Marina	3	3	9/14/2006	153	147
Folsom Lake Marina	4	3	9/14/2006	104	144
Folsom Lake Marina	5	3	9/14/2006	48	28
Folsom Lake Marina	6	3	9/14/2006	49	34
Folsom Lake Marina	7	3	9/14/2006	37	23

Appendix I: SCCWRP Toxicity/TIE Data Report

Data Report for
DPR Antifouling Paint Monitoring Study

Toxicity Methodology

Toxicity testing

The mussel embryo development test (EPA 1995[1]) using *Mytilus galloprovincialis* (Carlsbad Aquafarms, Carlsbad, CA) evaluated toxicity to 48 samples collected from marinas throughout California. This test measures the reduction in the mussel's ability to normally develop from fertilized eggs after a 48 h exposure to marina water samples. Samples with salinity concentrations of less than 30 g/kg were adjusted using hypersaline brine created by freezing seawater. The tests were conducted in glass shell vials containing 10 mL of solution at a temperature of 15°C. Four replicates were tested for each sample. A seawater blank was included as negative control. A copper reference toxicant test was included as positive control.

After 48 h, the embryos were preserved and examined with a microscope to assess normal development. The data are presented as percent normal-alive, which was calculated as the number of normal embryos after exposure relative to the number of fertilized eggs added at the beginning of the exposure. Toxic effects are expressed as percent reduction in normal development relative to controls.

Phase I TIE

Two samples (Marina Del Rey #121 and #179) were selected for further investigation with Phase I Toxicity Identification Evaluation (TIE) procedures (EPA 1996[2]). These procedures were used to help identify the class of the contaminant(s) that were the likely cause(s) of toxicity (e.g., metal, non-polar organic). Each sample was subjected to treatments designed to selectively remove or neutralize classes of compounds. Treated samples were then retested to determine the change in toxicity.

Four treatments were used for each sample: centrifugation (particle removal), C18 column extraction (non-polar organics removal), addition of ethylenediaminetetraacetic acid (EDTA) (metals chelation), and addition of sodium thiosulfate (STS) (reduces oxidants and decreases the toxicity of some metals, including copper). A control sample using laboratory seawater was included with each type of treatment to verify that the manipulation itself was not causing toxicity. Samples for each TIE manipulation were tested at 100% sample strength.

EDTA was added to a concentration of 5 mg/L to each test sample. STS was added to a concentration of 50 mg/L to each test sample. The EDTA and sodium thiosulfate treatments were given at least one hour to interact with the sample prior to the start of toxicity testing. The samples were centrifuged for 30 min at 3000 X *g* to remove particle-borne contaminants before being passed through the preconditioned C18 (Varian Mega Bond Elut solid phase extraction) column.

Quality Assurance

Completeness

Completeness data quality objectives were met. Ninety eight percent (47/48 samples) were successfully tested. The single untested sample from Pittsburg Marina (#195) was not tested due to low salinity.

Test Acceptability Criteria

Test acceptability criteria were met for all test batches. Two reference toxicant tests had lower control percentage normal-alive than is acceptable. This finding should not have any effect on the quality of data for the marina samples since no toxicity was observed in the samples from these batches. Brine control data for all batches showed no sign of toxicity caused by brine.

Reference Toxicant Data

The effective concentration (EC50) values for all reference toxicant exposure that passed test acceptability criteria were within normal control chart parameters (with two standard deviations of the mean).

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[1] EPA/600/R-95/136
[2] EPA/600/R-96/054

Water Quality Analysis

All samples tested were within normal ranges for the measured water quality parameters (pH, salinity, dissolved oxygen and ammonia) during the course of the exposures. Twenty-eight samples required salinity adjustment prior to testing. The relative percentage of sample tested after addition of the brine is provided in the data tables.

Results

Data for all marina samples tested and the TIEs can be found in the tables below (Tables 1 thru 5). Only 8 of the 47 samples tested exhibited statisitically significant toxicity. Seven of the 8 samples were located in Marina del Rey. Two samples (samples #121, 179) were tested using the Phase I TIE. The decrease in toxicity observed after the EDTA treatment indicated that a cationic metal was a likely source of toxicity. The decrease in toxicity that was also observed with the STS treatment indicated that oxidants and some metals, including copper may also be a likely source of toxicity. The C-18 column had little effect on mean normal development.

Table 1. Marina water samples tested 8/23/06 in batch MG28 using mussel embryo development test.

			%Normal-Alive				
DPR Code	Sample	%Sample Tested	Mean	%of Control	Standard Deviation	Number Replicates	Significantly Different
	Seawater		82	100	7.4	4	N
	Brine Control		84	102	5.0	4	N
106	Berkeley1	92	83	101	8.5	4	N
107	Berkeley2	92	75	91	3.3	4	N
108	Berkeley3	92	78	95	11.5	4	N
109	Berkeley4	91	86	105	2.5	4	N
110	Richmond1	92	84	102	4.6	4	N
111	Richmond2	92	72	88	5.1	4	Y
112	Richmond3	92	83	101	4.6	4	N
113	Richmond4	92	77	94	2.4	4	N
114	San Rafael1	87	81	99	4.8	4	N
115	San Rafael2	87	80	98	5.2	4	N
116	San Rafael3	86	80	97	5.5	4	N
117	San Rafael4	87	82	100	4.5	4	N

Table 2. Marina water samples tested 8/24/06 in batch MG30 using mussel embryo development test.

			%Normal-Alive				
DPR Code	Sample	%Sample Tested	Mean	%of Control	Standard Deviation	Number Replicates	Significantly Different
	Seawater		84	100	3.1	4	N
	Brine Control		88	105	7.7	4	N
100	San Francisco1	100	80	95	9.7	4	N
104	San Francisco2	100	86	102	6.3	4	N
124	San Francisco3	100	81	96	9.9	4	N
130	San Francisco4	100	87	104	2.5	4	N
101	South Beach1	93	80	95	2.4	4	N
102	South Beach2	93	85	101	9.5	4	N
103	South Beach3	93	78	93	6.3	4	N
105	South Beach4	93	80	96	7.3	4	N

Table 3. Marina water samples tested 8/31/06 in batch MG32 using mussel embryo development test.

DPR Code	Sample	%Sample Tested	%Normal-Alive Mean	%of Control	Standard Deviation	Number Replicates	Significantly Different
	Seawater		85	100	9.9	4	N
	Brine Control		77	90	10.5	4	N
183	DowntownLB1	100	82	96	4.7	4	N
180	DowntownLB2	100	84	99	9.1	4	N
181	DowntownLB3	100	88	104	6.0	4	N
182	DowntownLB4	100	83	98	5.2	4	N
127	LosAlamitos1	100	84	99	5.2	4	N
125	LosAlamitos2	100	81	95	3.5	4	N
126	LosAlamitos3	100	77	91	9.0	4	N
128	LosAlamitos4	100	83	98	7.2	4	N
178	MarinaDelReyA1	100	37	44	7.6	4	Y
121	MarinaDelReyA2	100	4	4	1.9	4	Y
119	MarinaDelReyA3	100	61	72	6.9	4	Y
123	MarinaDelReyA4	100	66	78	10.8	4	Y
120	MarinaDelReyB1	100	67	79	11.8	4	Y
118	MarinaDelReyB2	100	55	64	11.1	4	Y
122	MarinaDelReyB3	100	79	93	7.4	4	N
179	MarinaDelReyB4	100	49	57	7.1	4	Y

Table 4. Marina water samples tested 9/7/06 in batch MG23 using mussel embryo development test.

DPR Code	Sample	%Sample Tested	%Normal-Alive Mean	%of Control	Standard Deviation	Number Replicates	Significantly Different
	Seawater		80	100	5.8	4	N
	Brine Control	41	80	100	4.9	4	N
192	Vallejo1	73	82	103	3.5	4	N
190	Vallejo2	73	76	95	7.2	4	N
129	Vallejo3	72	81	101	6.3	4	N
191	Vallejo4	72	79	99	5.0	4	N
185	Benicia1	68	79	98	6.1	4	N
186	Benicia2	67	82	102	8.1	4	N
188	Benicia3	67	73	92	5.1	4	N
187	Benicia4	67	75	94	3.1	4	N
194	Pittsburg1	59	78	98	7.8	4	N
193	Pittsburg2	59	79	99	6.1	4	N
184	Pittsburg3	59	76	94	3.4	4	N
195	Pittsburg4	-	-	-	-	-	-

Table 5. Marina water samples TIE tested 9/05/06 in batch MG34 using mussel embryo development test.

			%Normal-Alive			
DPR Code	Sample	%Sample Tested	Mean	%of Control	Standard Deviation	Number Replicates
	Seawater		98	100	2.6	4
121	Marina del Rey #121	100	1	1	1.1	4
179	Marina del Rey #179	100	14	14	4.1	4
	STS Blank 50 mg/L	100	95	97	6.1	3
121	STS #121 50 mg/L	100	55	57	1.3	3
179	STS #179 50 mg/L	100	82	83	1.7	3
	EDTA Blank 5 mg/L	100	41	42	9.6	3
121	EDTA #121 5 mg/L	100	91	93	6.8	3
179	EDTA #179 5 mg/L	100	92	94	10.4	3
	Centrifuge Blank	100	98	100	3.6	3
121	Centrifuge #121	100	6	6	1.5	3
179	Centrifuge #179	100	37	38	8.3	3
121	Post C-18 Blank #121	100	98	100	10.8	3
179	Post C-18 Blank #179	100	64	66	56.5	3
121	Post C-18 #121	100	80	82	3.6	3
179	Post C-18 #179	100	62	63	54.0	3

Appendix J: Comparison of Freshwater Dissolved Copper Results to CTR Hardness-Based Freshwater Acute (CMC) and Chronic (CCC) Standards

Table J-1. Comparison of Freshwater DCu Results to CTR Hardness-Based Freshwater Acute (CMC) and Chronic (CCC) Standards

Marina Name	Date	Site	Event	EC (µS/cm)	Hardness (mg/L CaCO3)	CCC Conversion Factor	CMC Conversion Factor	CCC (µg/L)	CMC (µg/L)	Result Code	Observed DCu (µg/L)
Antioch Marina	8/8/2006	1	1	658.2	149.18	0.96	0.96	12.6	19.6		1.8
Antioch Marina	8/8/2006	2	1	746.8	178.35	0.96	0.96	14.7	23.2		2.9
Antioch Marina	8/8/2006	3	1	650.6	160.31	0.96	0.96	13.4	21.0		1.9
Antioch Marina	8/8/2006	4	1	634.6	156.84	0.96	0.96	13.2	20.5		1.7
Antioch Marina	8/8/2006	5	1	291.6	93.32	0.96	0.96	8.4	12.6		1.4
Antioch Marina	8/8/2006	6	1	295.8	91.84	0.96	0.96	8.3	12.4		1.4
Antioch Marina	8/8/2006	7	1	286.6	87.96	0.96	0.96	8.0	11.9		1.4
Antioch Marina	8/8/2006	8	1	313.2	93.32	0.96	0.96	8.4	12.6		1.4
Antioch Marina	9/6/2006	1	2	618.6	142.35	0.96	0.96	12.1	18.7		2.6
Antioch Marina	9/6/2006	2	2	493.6	125.04	0.96	0.96	10.8	16.6		2.2
Antioch Marina	9/6/2006	3	2	580.6	149.84	0.96	0.96	12.7	19.7		2.5
Antioch Marina	9/6/2006	4	2	554.2	139.05	0.96	0.96	11.9	18.3		2.6
Antioch Marina	9/6/2006	5	2	328.2	97.45	0.96	0.96	8.8	13.1		1.7
Antioch Marina	9/6/2006	6	2	325	96.78	0.96	0.96	8.7	13.0		1.6
Antioch Marina	9/6/2006	7	2	325	97.45	0.96	0.96	8.8	13.1		1.6
Antioch Marina	9/6/2006	8	2	330	98.11	0.96	0.96	8.8	13.2		1.7
Antioch Marina	10/2/2006	1	3	482.8	132.90	0.96	0.96	11.4	17.6		2.1
Antioch Marina	10/2/2006	2	3	475	133.72	0.96	0.96	11.5	17.7		2
Antioch Marina	10/2/2006	3	3	439.6	127.13	0.96	0.96	11.0	16.9		2.1
Antioch Marina	10/2/2006	4	3	506	136.78	0.96	0.96	11.7	18.1		2
Antioch Marina	10/2/2006	5	3	506	137.51	0.96	0.96	11.8	18.1		1.6
Antioch Marina	10/2/2006	6	3	498.4	137.76	0.96	0.96	11.8	18.2		1.6
Antioch Marina	10/2/2006	7	3	498	134.04	0.96	0.96	11.5	17.7		1.6
Antioch Marina	10/2/2006	8	3	412	116.66	0.96	0.96	10.2	15.5		1.6
Folsom Lake Marina	7/17/2006	1	1	10	18.00	0.96	0.96	2.7	3.6		0.3
Folsom Lake Marina	7/17/2006	2	1	10	18.00	0.96	0.96	2.7	3.6		0.2
Folsom Lake Marina	7/17/2006	3	1	10	18.00	0.96	0.96	2.7	3.6		0.7
Folsom Lake Marina	7/17/2006	4	1	10	18.00	0.96	0.96	2.7	3.6		0.4
Folsom Lake Marina	7/17/2006	5	1	10	18.00	0.96	0.96	2.7	3.6		0.5
Folsom Lake Marina	7/17/2006	6	1	10	18.00	0.96	0.96	2.7	3.6		0.4
Folsom Lake Marina	7/17/2006	7	1	10	18.00	0.96	0.96	2.7	3.6		0.2
Folsom Lake Marina	7/17/2006	8	1	10	18.00	0.96	0.96	2.7	3.6		0.3
Folsom Lake Marina	8/14/2006	1	2	27.4	18.40	0.96	0.96	2.7	3.6		0.6
Folsom Lake Marina	8/14/2006	2	2	28.6	18.40	0.96	0.96	2.7	3.6		0.6
Folsom Lake Marina	8/14/2006	3	2	27.4	18.40	0.96	0.96	2.7	3.6		0.6

Marina Name	Date	Site	Event	EC (µS/cm)	Hardness (mg/L CaCO3)	CCC Conversion Factor	CMC Conversion Factor	CCC (µg/L)	CMC (µg/L)	Result Code	Observed DCu (µg/L)
Folsom Lake Marina	8/14/2006	4	2	26.2	18.15	0.96	0.96	2.7	3.6		0.6
Folsom Lake Marina	8/14/2006	5	2	26.8	18.40	0.96	0.96	2.7	3.6		0.4
Folsom Lake Marina	8/14/2006	6	2	26.8	18.40	0.96	0.96	2.7	3.6		0.2
Folsom Lake Marina	8/14/2006	7	2	27.4	18.40	0.96	0.96	2.7	3.6		0.3
Folsom Lake Marina	8/14/2006	8	2	27.4	18.40	0.96	0.96	2.7	3.6		0.2
Folsom Lake Marina	9/14/2006	1	3	23.6	16.99	0.96	0.96	2.7	3.6		1.8
Folsom Lake Marina	9/14/2006	2	3	24.6	17.40	0.96	0.96	2.7	3.6		0.5
Folsom Lake Marina	9/14/2006	3	3	23.6	16.99	0.96	0.96	2.7	3.6		0.6
Folsom Lake Marina	9/14/2006	4	3	23.6	16.99	0.96	0.96	2.7	3.6	<	0.1
Folsom Lake Marina	9/14/2006	5	3	23.6	16.99	0.96	0.96	2.7	3.6	<	0.1
Folsom Lake Marina	9/14/2006	6	3	23.6	16.99	0.96	0.96	2.7	3.6		1.5
Folsom Lake Marina	9/14/2006	7	3	23.6	16.99	0.96	0.96	2.7	3.6		1.7
Folsom Lake Marina	9/14/2006	8	3	23.6	16.99	0.96	0.96	2.7	3.6		1.6
Pittsburg Marina	8/8/2006	1	1	1866.6	381.80	0.83	0.83	41.1	24.3		3.2
Pittsburg Marina	8/8/2006	2	1	2361.4	450.00	0.83	0.83	47.9	28.0		1.8
Pittsburg Marina	8/8/2006	3	1	1765	358.92	0.83	0.83	38.7	23.1		3.6
Pittsburg Marina	8/8/2006	4	1	1723.6	350.43	0.83	0.83	37.9	22.6		1.4
Pittsburg Marina	8/8/2006	5	1	757.8	180.81	0.96	0.96	23.5	14.9		1.4
Pittsburg Marina	8/8/2006	6	1	1001	200.00	0.83	0.83	22.3	14.0		1.4
Pittsburg Marina	8/8/2006	7	1	821.8	207.91	0.96	0.96	26.8	16.7		1.6
Pittsburg Marina	8/8/2006	8	1	1027.8	231.64	0.83	0.83	25.6	15.9		1.4
Pittsburg Marina	9/5/2006	1	2	851.6	200.75	0.96	0.96	25.9	16.2		1.7
Pittsburg Marina	9/5/2006	2	2	1064.6	238.73	0.83	0.83	26.4	16.3		2.4
Pittsburg Marina	9/5/2006	3	2	940.2	218.54	0.96	0.96	28.1	17.5		2.2
Pittsburg Marina	9/5/2006	4	2	955.6	214.92	0.96	0.96	27.6	17.2		2
Pittsburg Marina	9/5/2006	5	2	1653.6	270.00	0.83	0.83	29.6	18.1		1.6
Pittsburg Marina	9/5/2006	6	2	1213.6	277.85	0.83	0.83	30.4	18.5		1.5
Pittsburg Marina	9/5/2006	7	2	1211	272.58	0.83	0.83	29.9	18.2		1.5
Pittsburg Marina	9/5/2006	8	2	1478.2	318.71	0.83	0.83	34.6	20.8		1.5
Pittsburg Marina	10/3/2006	1	3	894.6	207.70	0.96	0.96	26.8	16.7		1.7
Pittsburg Marina	10/3/2006	2	3	920.2	211.07	0.96	0.96	27.2	17.0		2.4
Pittsburg Marina	10/3/2006	3	3	902.2	209.27	0.96	0.96	26.9	16.8		1.8
Pittsburg Marina	10/3/2006	4	3	957.6	211.57	0.96	0.96	27.2	17.0		2
Pittsburg Marina	10/3/2006	5	3	1750	370.79	0.83	0.83	39.9	23.7		1.5
Pittsburg Marina	10/3/2006	6	3	1572.6	343.44	0.83	0.83	37.2	22.2		1.4
Pittsburg Marina	10/3/2006	7	3	1880.6	381.99	0.83	0.83	41.1	24.3		1.4
Pittsburg Marina	10/3/2006	8	3	2073.6	424.58	0.83	0.83	45.4	26.6		1.4

Marina Name	Date	Site	Event	EC (µS/cm)	Hardness (mg/L CaCO3)	CCC Conversion Factor	CMC Conversion Factor	CCC (µg/L)	CMC (µg/L)	Result Code	Observed DCu (µg/L)
Sacramento Marina	7/21/2006	1	1	62.8	46.93	0.96	0.96	4.7	6.6		3.7
Sacramento Marina	7/21/2006	2	1	62.8	46.93	0.96	0.96	4.7	6.6		3.7
Sacramento Marina	7/21/2006	3	1	62.2	46.93	0.96	0.96	4.7	6.6		2.5
Sacramento Marina	7/21/2006	4	1	62.8	46.02	0.96	0.96	4.6	6.5		2.2
Sacramento Marina	7/21/2006	5	1	60	43.95	0.96	0.96	4.4	6.2		0.8
Sacramento Marina	7/21/2006	6	1	60.6	44.20	0.96	0.96	4.5	6.2		2.3
Sacramento Marina	7/21/2006	7	1	59.6	45.77	0.96	0.96	4.6	6.4		0.5
Sacramento Marina	7/21/2006	8	1	61.8	46.43	0.96	0.96	4.7	6.5		0.8
Sacramento Marina	8/16/2006	1	2	69	48.41	0.96	0.96	4.8	6.8		3
Sacramento Marina	8/16/2006	2	2	67.8	47.59	0.96	0.96	4.8	6.7		3.5
Sacramento Marina	8/16/2006	3	2	67.4	47.34	0.96	0.96	4.7	6.6		2.8
Sacramento Marina	8/16/2006	4	2	66.8	47.09	0.96	0.96	4.7	6.6		2.3
Sacramento Marina	8/16/2006	5	2	69.2	46.68	0.96	0.96	4.7	6.6		0.6
Sacramento Marina	8/16/2006	6	2	65.6	45.27	0.96	0.96	4.6	6.4		0.5
Sacramento Marina	8/16/2006	7	2	66.2	45.93	0.96	0.96	4.6	6.5		0.5
Sacramento Marina	8/16/2006	8	2	75.6	52.22	0.96	0.96	5.1	7.3		0.6
Sacramento Marina	9/12/2006	1	3	71	51.80	0.96	0.96	5.1	7.2		3.7
Sacramento Marina	9/12/2006	2	3	71.6	52.22	0.96	0.96	5.1	7.3		3.2
Sacramento Marina	9/12/2006	3	3	71	51.80	0.96	0.96	5.1	7.2		3.1
Sacramento Marina	9/12/2006	4	3	71.6	51.55	0.96	0.96	5.1	7.2		2.5
Sacramento Marina	9/12/2006	5	3	74.8	54.61	0.96	0.96	5.3	7.6		0.7
Sacramento Marina	9/12/2006	6	3	73.2	52.63	0.96	0.96	5.2	7.3		0.6
Sacramento Marina	9/12/2006	7	3	73.2	53.29	0.96	0.96	5.2	7.4		0.7
Sacramento Marina	9/12/2006	8	3	83	62.30	0.96	0.96	6.0	8.6		0.7
Tahoe Keys Marina	7/20/2006	1	1	46.8	31.93	0.96	0.96	3.4	4.6		0.9
Tahoe Keys Marina	7/20/2006	2	1	46.2	31.68	0.96	0.96	3.4	4.6		0.9
Tahoe Keys Marina	7/20/2006	3	1	47.4	31.68	0.96	0.96	3.4	4.6		0.8
Tahoe Keys Marina	7/20/2006	4	1	48	31.68	0.96	0.96	3.4	4.6		0.7
Tahoe Keys Marina	7/20/2006	5	1	46.2	29.77	0.96	0.96	3.2	4.3		0.2
Tahoe Keys Marina	7/20/2006	6	1	45.6	29.77	0.96	0.96	3.2	4.3		0.2
Tahoe Keys Marina	7/20/2006	7	1	45.6	29.77	0.96	0.96	3.2	4.3		0.7
Tahoe Keys Marina	7/20/2006	8	1	43.4	27.70	0.96	0.96	3.0	4.0		0.1
Tahoe Keys Marina	8/17/2006	1	2	50.2	31.00	0.96	0.96	3.3	4.5		0.8
Tahoe Keys Marina	8/17/2006	2	2	49.6	31.68	0.96	0.96	3.4	4.6		0.6
Tahoe Keys Marina	8/17/2006	3	2	51.4	31.68	0.96	0.96	3.4	4.6		0.7
Tahoe Keys Marina	8/17/2006	4	2	49.6	31.68	0.96	0.96	3.4	4.6		0.7
Tahoe Keys Marina	8/17/2006	5	2	50.6	30.52	0.96	0.96	3.3	4.4		0.1

Marina Name	Date	Site	Event	EC (µS/cm)	Hardness (mg/L CaCO3)	CCC Conversion Factor	CMC Conversion Factor	CCC (µg/L)	CMC (µg/L)	Result Code	Observed DCu (µg/L)
Tahoe Keys Marina	8/17/2006	6	2	50.6	31.18	0.96	0.96	3.3	4.5		0.1
Tahoe Keys Marina	8/17/2006	7	2	50.6	30.52	0.96	0.96	3.3	4.4		0.1
Tahoe Keys Marina	8/17/2006	8	2	50.6	30.52	0.96	0.96	3.3	4.4		0.1
Village West Marina	7/19/2006	1	1	137.6	69.29	0.96	0.96	6.6	9.5		3.3
Village West Marina	7/19/2006	2	1	137.4	69.04	0.96	0.96	6.5	9.5		3.5
Village West Marina	7/19/2006	3	1	140.2	69.46	0.96	0.96	6.6	9.5		2.9
Village West Marina	7/19/2006	4	1	139.6	69.71	0.96	0.96	6.6	9.6		3.3
Village West Marina	7/19/2006	5	1	143.2	72.03	0.96	0.96	6.8	9.9		1.9
Village West Marina	7/19/2006	6	1	141.6	70.87	0.96	0.96	6.7	9.7		2
Village West Marina	7/19/2006	7	1	141.4	70.20	0.96	0.96	6.6	9.6		1.8
Village West Marina	8/15/2006	1	2	171.8	85.92	0.96	0.96	7.9	11.7		4
Village West Marina	8/15/2006	2	2	174	83.68	0.96	0.96	7.7	11.4		3.2
Village West Marina	8/15/2006	3	2	173.8	85.75	0.96	0.96	7.9	11.6		2.9
Village West Marina	8/15/2006	4	2	174.4	85.75	0.96	0.96	7.9	11.6		3.5
Village West Marina	8/15/2006	5	2	172.8	85.50	0.96	0.96	7.8	11.6		2.2
Village West Marina	8/15/2006	6	2	172.2	86.42	0.96	0.96	7.9	11.7		2
Village West Marina	8/15/2006	7	2	171.8	83.85	0.96	0.96	7.7	11.4		1.8
Village West Marina	8/15/2006	8	2	171.6	83.18	0.96	0.96	7.7	11.3		1.8
Village West Marina	9/13/2006	1	3	178.8	90.22	0.96	0.96	8.2	12.2		3.5
Village West Marina	9/13/2006	2	3	177.6	89.81	0.96	0.96	8.2	12.1		3.7
Village West Marina	9/13/2006	3	3	177.6	89.06	0.96	0.96	8.1	12.1		3.4
Village West Marina	9/13/2006	4	3	178.6	89.72	0.96	0.96	8.2	12.1		3.9
Village West Marina	9/13/2006	5	3	178	88.81	0.96	0.96	8.1	12.0		1.9
Village West Marina	9/13/2006	6	3	178.6	90.13	0.96	0.96	8.2	12.2		1.9
Village West Marina	9/13/2006	7	3	176.4	87.65	0.96	0.96	8.0	11.9		1.5
Village West Marina	9/13/2006	8	3	178	89.22	0.96	0.96	8.1	12.1		1.6

Appendix K: Comparison of Freshwater Dissolved Zinc Results to California Toxics Rule Hardness-Based Freshwater Acute (CMC) and Chronic (CCC) Standards

Table K-1. Comparison of Freshwater DZn Results to CTR Hardness-Based Freshwater Acute (CMC) and Chronic (CCC) Standards

Marina Name	Sampling Date	Site	Event	EC (µS/cm)	Hardness (mg/L CaCO3)	DZn CMC Conversion factor	DZn CCC Conversion factor	CCC (µg/L)	CMC (µg/L)	Result Code	Observed DZn (µg/L)
Antioch Marina	8/8/2006	1	1	658.2	149.18	0.978	0.986	165.8	164.5	<	1.0
Antioch Marina	8/8/2006	2	1	746.8	178.35	0.978	0.986	192.9	191.3		3.4
Antioch Marina	8/8/2006	3	1	650.6	160.31	0.978	0.986	176.2	174.8	<	1.0
Antioch Marina	8/8/2006	4	1	634.6	156.84	0.978	0.986	173.0	171.6		2.3
Antioch Marina	8/8/2006	5	1	291.6	93.32	0.978	0.986	111.4	110.5	<	1.0
Antioch Marina	8/8/2006	6	1	295.8	91.84	0.978	0.986	109.9	109.0	<	1.0
Antioch Marina	8/8/2006	7	1	286.6	87.96	0.978	0.986	106.0	105.1	<	1.0
Antioch Marina	8/8/2006	8	1	313.2	93.32	0.978	0.986	111.4	110.5		1.2
Antioch Marina	9/6/2006	1	2	618.6	142.35	0.978	0.986	159.3	158.1		2.2
Antioch Marina	9/6/2006	2	2	493.6	125.04	0.978	0.986	142.8	141.6		4.2
Antioch Marina	9/6/2006	3	2	580.6	149.84	0.978	0.986	166.4	165.1		2.1
Antioch Marina	9/6/2006	4	2	554.2	139.05	0.978	0.986	156.2	154.9		2.6
Antioch Marina	9/6/2006	5	2	328.2	97.45	0.978	0.986	115.6	114.6		3.1
Antioch Marina	9/6/2006	6	2	325	96.78	0.978	0.986	114.9	114.0		2.0
Antioch Marina	9/6/2006	7	2	325	97.45	0.978	0.986	115.6	114.6		2.5
Antioch Marina	9/6/2006	8	2	330	98.11	0.978	0.986	116.2	115.3		2.3
Antioch Marina	10/2/2006	1	3	482.8	132.90	0.978	0.986	150.3	149.1		1.3
Antioch Marina	10/2/2006	2	3	475	133.72	0.978	0.986	151.1	149.9		1.9
Antioch Marina	10/2/2006	3	3	439.6	127.13	0.978	0.986	144.8	143.6		1.5
Antioch Marina	10/2/2006	4	3	506	136.78	0.978	0.986	154.0	152.8		1.1
Antioch Marina	10/2/2006	5	3	506	137.51	0.978	0.986	154.7	153.5		2.4
Antioch Marina	10/2/2006	6	3	498.4	137.76	0.978	0.986	155.0	153.7		1.1
Antioch Marina	10/2/2006	7	3	498	134.04	0.978	0.986	151.4	150.2		1.3
Antioch Marina	10/2/2006	8	3	412	116.66	0.978	0.986	134.6	133.5		1.9
Folsom Lake Marina	7/17/2006	1	1	10	18.00	0.978	0.986	36.5	36.2		3.0
Folsom Lake Marina	7/17/2006	2	1	10	18.00	0.978	0.986	36.5	36.2		1.5
Folsom Lake Marina	7/17/2006	3	1	10	18.00	0.978	0.986	36.5	36.2		3.3
Folsom Lake Marina	7/17/2006	4	1	10	18.00	0.978	0.986	36.5	36.2		2.5
Folsom Lake Marina	7/17/2006	5	1	10	18.00	0.978	0.986	36.5	36.2		3.1
Folsom Lake Marina	7/17/2006	6	1	10	18.00	0.978	0.986	36.5	36.2	<	1.0
Folsom Lake Marina	7/17/2006	7	1	10	18.00	0.978	0.986	36.5	36.2		1.0
Folsom Lake Marina	7/17/2006	8	1	10	18.00	0.978	0.986	36.5	36.2	<	1.0
Folsom Lake Marina	8/14/2006	1	2	27.4	18.40	0.978	0.986	36.5	36.2		4.5
Folsom Lake Marina	8/14/2006	2	2	28.6	18.40	0.978	0.986	36.5	36.2		5.5
Folsom Lake Marina	8/14/2006	3	2	27.4	18.40	0.978	0.986	36.5	36.2		6.3
Folsom Lake Marina	8/14/2006	4	2	26.2	18.15	0.978	0.986	36.5	36.2		8.6
Folsom Lake Marina	8/14/2006	5	2	26.8	18.40	0.978	0.986	36.5	36.2		2.8
Folsom Lake Marina	8/14/2006	6	2	26.8	18.40	0.978	0.986	36.5	36.2		1.6
Folsom Lake Marina	8/14/2006	7	2	27.4	18.40	0.978	0.986	36.5	36.2		9.1

Marina Name	Sampling Date	Site	Event	EC (µS/cm)	Hardness (mg/L CaCO3)	DZn CMC Conversion factor	DZn CCC Conversion factor	CCC (µg/L)	CMC (µg/L)	Result Code	Observed DZn (µg/L)
Folsom Lake Marina	8/14/2006	8	2	27.4	18.40	0.978	0.986	36.5	36.2		8.8
Folsom Lake Marina	9/14/2006	1	3	23.6	16.99	0.978	0.986	36.5	36.2		1.3
Folsom Lake Marina	9/14/2006	2	3	24.6	17.40	0.978	0.986	36.5	36.2		2.6
Folsom Lake Marina	9/14/2006	3	3	23.6	16.99	0.978	0.986	36.5	36.2		2.9
Folsom Lake Marina	9/14/2006	4	3	23.6	16.99	0.978	0.986	36.5	36.2	<	1.3
Folsom Lake Marina	9/14/2006	5	3	23.6	16.99	0.978	0.986	36.5	36.2	<	1.6
Folsom Lake Marina	9/14/2006	6	3	23.6	16.99	0.978	0.986	36.5	36.2		8.4
Folsom Lake Marina	9/14/2006	7	3	23.6	16.99	0.978	0.986	36.5	36.2		<1
Folsom Lake Marina	9/14/2006	8	3	23.6	16.99	0.978	0.986	36.5	36.2		<1
Pittsburg Marina	8/8/2006	1	1	1866.6	381.80	0.946	0.946	352.7	352.7		1.9
Pittsburg Marina	8/8/2006	2	1	2361.4	450.00	0.946	0.946	405.4	405.4		2.3
Pittsburg Marina	8/8/2006	3	1	1765	358.92	0.946	0.946	334.7	334.7	<	1.0
Pittsburg Marina	8/8/2006	4	1	1723.6	350.43	0.946	0.946	328.0	328.0		4.4
Pittsburg Marina	8/8/2006	5	1	757.8	180.81	0.978	0.986	195.1	193.6		7.1
Pittsburg Marina	8/8/2006	6	1	1001	200.00	0.946	0.946	203.9	203.9	<	1.0
Pittsburg Marina	8/8/2006	7	1	821.8	207.91	0.978	0.986	219.7	217.9		1.3
Pittsburg Marina	8/8/2006	8	1	1027.8	231.64	0.946	0.946	230.9	230.9		1.5
Pittsburg Marina	9/5/2006	1	2	851.6	200.75	0.978	0.986	213.2	211.5		5.2
Pittsburg Marina	9/5/2006	2	2	1064.6	238.73	0.946	0.946	236.9	236.9		3.8
Pittsburg Marina	9/5/2006	3	2	940.2	218.54	0.978	0.986	229.1	227.3		5.1
Pittsburg Marina	9/5/2006	4	2	955.6	214.92	0.978	0.986	225.9	224.1		3.9
Pittsburg Marina	9/5/2006	5	2	1653.6	270.00	0.946	0.946	263.0	263.0		2.5
Pittsburg Marina	9/5/2006	6	2	1213.6	277.85	0.946	0.946	269.4	269.4		1.5
Pittsburg Marina	9/5/2006	7	2	1211	272.58	0.946	0.946	265.1	265.1		3.5
Pittsburg Marina	9/5/2006	8	2	1478.2	318.71	0.946	0.946	302.6	302.6		6.4
Pittsburg Marina	10/3/2006	1	3	894.6	207.70	0.978	0.986	219.5	217.7		2.5
Pittsburg Marina	10/3/2006	2	3	920.2	211.07	0.978	0.986	222.5	220.7		1.0
Pittsburg Marina	10/3/2006	3	3	902.2	209.27	0.978	0.986	220.9	219.1		1.3
Pittsburg Marina	10/3/2006	4	3	957.6	211.57	0.978	0.986	222.9	221.1	<	1.0
Pittsburg Marina	10/3/2006	5	3	1750	370.79	0.946	0.946	344.1	344.1		2.0
Pittsburg Marina	10/3/2006	6	3	1572.6	343.44	0.946	0.946	322.4	322.4		1.5
Pittsburg Marina	10/3/2006	7	3	1880.6	381.99	0.946	0.946	352.8	352.8		1.2
Pittsburg Marina	10/3/2006	8	3	2073.6	424.58	0.946	0.946	385.9	385.9		1.5
Sacramento Marina	7/21/2006	1	1	62.8	46.93	0.978	0.986	62.2	61.7		1.4
Sacramento Marina	7/21/2006	2	1	62.8	46.93	0.978	0.986	62.2	61.7		1.9
Sacramento Marina	7/21/2006	3	1	62.2	46.93	0.978	0.986	62.2	61.7	<	1.0
Sacramento Marina	7/21/2006	4	1	62.8	46.02	0.978	0.986	61.2	60.7	<	1.0
Sacramento Marina	7/21/2006	5	1	60	43.95	0.978	0.986	58.9	58.4		1.1
Sacramento Marina	7/21/2006	6	1	60.6	44.20	0.978	0.986	59.1	58.7		2.8
Sacramento Marina	7/21/2006	7	1	59.6	45.77	0.978	0.986	60.9	60.4	<	1.0
Sacramento Marina	7/21/2006	8	1	61.8	46.43	0.978	0.986	61.7	61.2		3.6

Marina Name	Sampling Date	Site	Event	EC (µS/cm)	Hardness (mg/L CaCO3)	DZn CMC Conversion factor	DZn CCC Conversion factor	CCC (µg/L)	CMC (µg/L)	Result Code	Observed DZn (µg/L)
Sacramento Marina	8/16/2006	1	2	69	48.41	0.978	0.986	63.9	63.4		2.4
Sacramento Marina	8/16/2006	2	2	67.8	47.59	0.978	0.986	63.0	62.5		5.7
Sacramento Marina	8/16/2006	3	2	67.4	47.34	0.978	0.986	62.7	62.2		3.1
Sacramento Marina	8/16/2006	4	2	66.8	47.09	0.978	0.986	62.4	61.9		4.4
Sacramento Marina	8/16/2006	5	2	69.2	46.68	0.978	0.986	62.0	61.4		3.7
Sacramento Marina	8/16/2006	6	2	65.6	45.27	0.978	0.986	60.4	59.9		4.0
Sacramento Marina	8/16/2006	7	2	66.2	45.93	0.978	0.986	61.1	60.6		2.5
Sacramento Marina	8/16/2006	8	2	75.6	52.22	0.978	0.986	68.1	67.6		2.1
Sacramento Marina	9/12/2006	1	3	71	51.80	0.978	0.986	67.7	67.1		7.8
Sacramento Marina	9/12/2006	2	3	71.6	52.22	0.978	0.986	68.1	67.6		3.3
Sacramento Marina	9/12/2006	3	3	71	51.80	0.978	0.986	67.7	67.1		4.0
Sacramento Marina	9/12/2006	4	3	71.6	51.55	0.978	0.986	67.4	66.8		3.7
Sacramento Marina	9/12/2006	5	3	74.8	54.61	0.978	0.986	70.8	70.2		2.0
Sacramento Marina	9/12/2006	6	3	73.2	52.63	0.978	0.986	68.6	68.0		5.4
Sacramento Marina	9/12/2006	7	3	73.2	53.29	0.978	0.986	69.3	68.7		2.7
Sacramento Marina	9/12/2006	8	3	83	62.30	0.978	0.986	79.1	78.5		3.0
Tahoe Keys Marina	7/20/2006	1	1	46.8	31.93	0.978	0.986	44.9	44.5		1.1
Tahoe Keys Marina	7/20/2006	2	1	46.2	31.68	0.978	0.986	44.6	44.2		3.0
Tahoe Keys Marina	7/20/2006	3	1	47.4	31.68	0.978	0.986	44.6	44.2	<	1.0
Tahoe Keys Marina	7/20/2006	4	1	48	31.68	0.978	0.986	44.6	44.2		3.1
Tahoe Keys Marina	7/20/2006	5	1	46.2	29.77	0.978	0.986	42.3	42.0		2.0
Tahoe Keys Marina	7/20/2006	6	1	45.6	29.77	0.978	0.986	42.3	42.0		1.0
Tahoe Keys Marina	7/20/2006	7	1	45.6	29.77	0.978	0.986	42.3	42.0	<	1.0
Tahoe Keys Marina	7/20/2006	8	1	43.4	27.70	0.978	0.986	39.8	39.5		4.2
Tahoe Keys Marina	8/17/2006	1	2	50.2	31.00	0.978	0.986	43.8	43.4		7.0
Tahoe Keys Marina	8/17/2006	2	2	49.6	31.68	0.978	0.986	44.6	44.2		4.4
Tahoe Keys Marina	8/17/2006	3	2	51.4	31.68	0.978	0.986	44.6	44.2		1.9
Tahoe Keys Marina	8/17/2006	4	2	49.6	31.68	0.978	0.986	44.6	44.2		2.7
Tahoe Keys Marina	8/17/2006	5	2	50.6	30.52	0.978	0.986	43.2	42.9		5.0
Tahoe Keys Marina	8/17/2006	6	2	50.6	31.18	0.978	0.986	44.0	43.6	<	1.0
Tahoe Keys Marina	8/17/2006	7	2	50.6	30.52	0.978	0.986	43.2	42.9		4.0
Tahoe Keys Marina	8/17/2006	8	2	50.6	30.52	0.978	0.986	43.2	42.9		2.9
Village West Marina	7/19/2006	1	1	137.6	69.29	0.978	0.986	86.6	85.9		4.0
Village West Marina	7/19/2006	2	1	137.4	69.04	0.978	0.986	86.3	85.6		5.7
Village West Marina	7/19/2006	3	1	140.2	69.46	0.978	0.986	86.8	86.0		2.7
Village West Marina	7/19/2006	4	1	139.6	69.71	0.978	0.986	87.0	86.3		2.6
Village West Marina	7/19/2006	5	1	143.2	72.03	0.978	0.986	89.5	88.7		1.7
Village West Marina	7/19/2006	6	1	141.6	70.87	0.978	0.986	88.2	87.5		1.8
Village West Marina	7/19/2006	7	1	141.4	70.20	0.978	0.986	87.5	86.8		1.7
Village West Marina	8/15/2006	1	2	171.8	85.92	0.978	0.986	103.9	103.0		4.9
Village West Marina	8/15/2006	2	2	174	83.68	0.978	0.986	101.6	100.8		4.6

Marina Name	Sampling Date	Site	Event	EC (µS/cm)	Hardness (mg/L CaCO3)	DZn CMC Conversion factor	DZn CCC Conversion factor	CCC (µg/L)	CMC (µg/L)	Result Code	Observed DZn (µg/L)
Village West Marina	8/15/2006	3	2	173.8	85.75	0.978	0.986	103.7	102.9		16.7
Village West Marina	8/15/2006	4	2	174.4	85.75	0.978	0.986	103.7	102.9		5.1
Village West Marina	8/15/2006	5	2	172.8	85.50	0.978	0.986	103.5	102.6		5.5
Village West Marina	8/15/2006	6	2	172.2	86.42	0.978	0.986	104.4	103.5		2.5
Village West Marina	8/15/2006	7	2	171.8	83.85	0.978	0.986	101.8	100.9		1.4
Village West Marina	8/15/2006	8	2	171.6	83.18	0.978	0.986	101.1	100.3		3.8
Village West Marina	9/13/2006	1	3	178.8	90.22	0.978	0.986	108.3	107.4		4.3
Village West Marina	9/13/2006	2	3	177.6	89.81	0.978	0.986	107.9	107.0		12.0
Village West Marina	9/13/2006	3	3	177.6	89.06	0.978	0.986	107.1	106.2		6.2
Village West Marina	9/13/2006	4	3	178.6	89.72	0.978	0.986	107.8	106.9		2.8
Village West Marina	9/13/2006	5	3	178	88.81	0.978	0.986	106.8	106.0		4.6
Village West Marina	9/13/2006	6	3	178.6	90.13	0.978	0.986	108.2	107.3		6.4
Village West Marina	9/13/2006	7	3	176.4	87.65	0.978	0.986	105.7	104.8		6.3
Village West Marina	9/13/2006	8	3	178	89.22	0.978	0.986	107.3	106.4		5.9

Appendix L: Freshwater Biotic Ligand Model Output

Red cells indicate locations where BLM predicts freshwater acute toxicity. Yellow cells indicate sites with toxic units within 20% of 1. Note that salinity-related factors and missing inputs limited the number of possible samples that could be analyzed with this model.

Table L-1. Freshwater BLM Output and Predicted Toxicity Results

Marina Name	Sampling Date	Site	Event	FAV	CMC	Observed DCu (µg/L)	Toxic Units
Tahoe Keys Marina	7/20/2006	1	1	35.8	17.9	0.9	0.05
Tahoe Keys Marina	7/20/2006	4	1	37.3	18.7	0.7	0.04
Tahoe Keys Marina	7/20/2006	5	1	12.5	6.3	0.2	0.03
Tahoe Keys Marina	7/20/2006	6	1	10.1	5.0	0.2	0.04
Tahoe Keys Marina	7/20/2006	7	1	9.6	4.8	0.7	0.15
Sacramento Marina	7/21/2006	1	1	7.3	3.7	3.7	1.00
Sacramento Marina	7/21/2006	3	1	9.7	4.9	2.5	0.51
Sacramento Marina	7/21/2006	4	1	95.0	47.5	2.2	0.05
Sacramento Marina	7/21/2006	5	1	1.7	0.8	0.8	1.00
Sacramento Marina	7/21/2006	6	1	6.4	3.2	2.3	0.72
Sacramento Marina	7/21/2006	7	1	6.4	3.2	0.5	0.16
Sacramento Marina	7/21/2006	8	1	7.5	3.7	0.8	0.22
Antioch Marina	8/8/2006	5	1	24.1	12.1	1.4	0.12
Antioch Marina	8/8/2006	6	1	24.0	12.0	1.4	0.12
Antioch Marina	8/8/2006	7	1	24.0	12.0	1.4	0.12
Antioch Marina	8/8/2006	8	1	26.2	13.1	1.4	0.11
Village West Marina	8/15/2006	6	2	24.7	12.4	2	0.16
Village West Marina	8/15/2006	7	2	25.6	12.8	1.8	0.14
Sacramento Marina	8/16/2006	1	2	0.8	0.4	3	7.50
Sacramento Marina	8/16/2006	2	2	0.7	0.4	3.5	8.75
Sacramento Marina	8/16/2006	3	2	0.6	0.3	2.8	9.33
Sacramento Marina	8/16/2006	4	2	0.8	0.4	2.3	5.75
Sacramento Marina	8/16/2006	5	2	0.7	0.3	0.6	2.00
Sacramento Marina	8/16/2006	6	2	2.1	1.0	0.5	0.50
Sacramento Marina	8/16/2006	7	2	1.9	1.0	0.5	0.50
Sacramento Marina	8/16/2006	8	2	1.6	0.8	0.6	0.75

Marina Name	Sampling Date	Site	Event	FAV	CMC	Observed DCu (µg/L)	Toxic Units
Sacramento Marina	9/12/2006	1	3	21.4	10.7	3.7	0.35
Sacramento Marina	9/12/2006	2	3	14.1	7.0	3.2	0.46
Sacramento Marina	9/12/2006	3	3	14.9	7.5	3.1	0.41
Sacramento Marina	9/12/2006	4	3	7.5	3.8	2.5	0.66
Sacramento Marina	9/12/2006	5	3	3.1	1.5	0.7	0.47
Sacramento Marina	9/12/2006	6	3	2.8	1.4	0.6	0.43
Sacramento Marina	9/12/2006	7	3	1.6	0.8	0.7	0.88
Sacramento Marina	9/12/2006	8	3	1.4	0.7	0.7	1.00
Village West Marina	9/13/2006	1	3	69.5	34.8	3.5	0.10
Village West Marina	9/13/2006	2	3	83.4	41.7	3.7	0.09
Village West Marina	9/13/2006	3	3	71.1	35.6	3.4	0.10
Village West Marina	9/13/2006	4	3	41.8	20.9	3.9	0.19
Folsom Lake Marina	9/14/2006	1	3	11.7	5.8	0.6	0.10
Folsom Lake Marina	9/14/2006	3	3	12.8	6.4	0.5	0.08
Folsom Lake Marina	9/14/2006	4	3	11.4	5.7	0.5	0.09
Folsom Lake Marina	9/14/2006	5	3	12.5	6.3	0.5	0.08
Folsom Lake Marina	9/14/2006	6	3	12.5	6.3	0.5	0.08
Folsom Lake Marina	9/14/2006	7	3	16.8	8.4	0.4	0.05
Folsom Lake Marina	9/14/2006	8	3	12.9	6.5	0.4	0.06
Antioch Marina	10/2/2006	1	3	37.1	18.5	2.1	0.11
Antioch Marina	10/2/2006	2	3	44.3	22.1	2	0.09
Antioch Marina	10/2/2006	3	3	50.9	25.5	2.1	0.08
Antioch Marina	10/2/2006	4	3	52.1	26.1	2	0.08
Antioch Marina	10/2/2006	5	3	59.3	29.7	1.6	0.05
Antioch Marina	10/2/2006	6	3	47.4	23.7	1.6	0.07
Antioch Marina	10/2/2006	7	3	49.8	24.9	1.6	0.06
Antioch Marina	10/2/2006	8	3	44.0	22.0	1.6	0.07

Appendix M: Dissolved Organic Carbon Model Output

Red cells indicate samples that the DOC model predicts acute toxicity to M. galloprovincialis. Yellow cells are where the model predicts chronic toxicity.

Final Chronic Criteria (FCC) = $3.59DOC^{0.60}$
Final Acute Criteria (FAC) = $5.61DOC^{0.60}$

Table M-1. DOC Model Output - Predicted Toxicity Results

Marina Name	Sampling Date	Site	Event	Time	DOC (mg/L)	Water Type	FCC	FAC	Result Code	Observed DCu (µg/L)
Alamitos Bay Marina	8/1/2006	1	1	954	0.78	Saltwater	3.1	4.8		3.4
Alamitos Bay Marina	8/1/2006	2	1	1007	0.83	Saltwater	3.2	5.0		1.3
Alamitos Bay Marina	8/1/2006	3	1	1016	0.77	Saltwater	3.1	4.8		1.6
Alamitos Bay Marina	8/1/2006	4	1	1043	0.82	Saltwater	3.2	5.0		2.9
Alamitos Bay Marina	8/1/2006	5	1	1054	0.89	Saltwater	3.3	5.2		1.2
Alamitos Bay Marina	8/1/2006	6	1	1113	0.82	Saltwater	3.2	5.0		1.2
Alamitos Bay Marina	8/1/2006	7	1	1123	0.75	Saltwater	3.0	4.7		0.6
Alamitos Bay Marina	8/1/2006	8	1	1133	0.76	Saltwater	3.1	4.8		0.4
Alamitos Bay Marina	8/29/2006	1	2	911	1.10	Saltwater	3.8	5.9		2.3
Alamitos Bay Marina	8/29/2006	2	2	930	0.94	Saltwater	3.5	5.4		0.5
Alamitos Bay Marina	8/29/2006	3	2	948	0.89	Saltwater	3.4	5.2		1
Alamitos Bay Marina	8/29/2006	4	2	1000	0.88	Saltwater	3.3	5.2		1.5
Alamitos Bay Marina	8/29/2006	5	2	1014	0.96	Saltwater	3.5	5.5		0.4
Alamitos Bay Marina	8/29/2006	6	2	1035	1.02	Saltwater	3.6	5.7	<	0.1
Alamitos Bay Marina	8/29/2006	7	2	1045	0.86	Saltwater	3.3	5.1	<	0.1
Alamitos Bay Marina	8/29/2006	8	2	1059	0.83	Saltwater	3.2	5.0	<	0.1
Alamitos Bay Marina	9/26/2006	1	3	925	0.97	Saltwater	3.5	5.5		3.2
Alamitos Bay Marina	9/26/2006	2	3	945	1.01	Saltwater	3.6	5.7		0.4
Alamitos Bay Marina	9/26/2006	3	3	958	1.03	Saltwater	3.7	5.7		0.5
Alamitos Bay Marina	9/26/2006	4	3	1013	1.01	Saltwater	3.6	5.7		0.6
Alamitos Bay Marina	9/26/2006	5	3	1024	1.02	Saltwater	3.6	5.7		0.9
Alamitos Bay Marina	9/26/2006	6	3	1047	1.04	Saltwater	3.7	5.7		0.2
Alamitos Bay Marina	9/26/2006	7	3	1057	1.00	Saltwater	3.6	5.6		0.3
Alamitos Bay Marina	9/26/2006	8	3	1104	1.03	Saltwater	3.7	5.7		0.2
Antioch Marina	8/8/2006	1	1	1305	1.58	Brackish	4.7	7.4		1.8
Antioch Marina	8/8/2006	2	1	1312	1.74	Brackish	5.0	7.8		2.9
Antioch Marina	8/8/2006	3	1	1320	1.62	Brackish	4.8	7.5		1.9
Antioch Marina	8/8/2006	4	1	1326	1.62	Brackish	4.8	7.5		1.7
Antioch Marina	8/8/2006	5	1	1335	1.47	Brackish	4.5	7.1		1.4
Antioch Marina	8/8/2006	6	1	1343	1.41	Brackish	4.4	6.9		1.4
Antioch Marina	8/8/2006	7	1	1350	1.49	Brackish	4.6	7.1		1.4
Antioch Marina	8/8/2006	8	1	1355	1.62	Brackish	4.8	7.5		1.4
Antioch Marina	10/2/2006	1	3	1118	2.14	Brackish	5.7	8.9		2.1

Marina Name	Sampling Date	Site	Event	Time	DOC (mg/L)	Water Type	FCC	FAC	Result Code	Observed DCu (µg/L)
Antioch Marina	10/2/2006	2	3	1135	2.11	Brackish	5.6	8.8		2
Antioch Marina	10/2/2006	3	3	1142	2.34	Brackish	6.0	9.4		2.1
Antioch Marina	10/2/2006	4	3	1150	2.28	Brackish	5.9	9.2		2
Antioch Marina	10/2/2006	5	3	1202	2.37	Brackish	6.0	9.4		1.6
Antioch Marina	10/2/2006	6	3	1207	2.17	Brackish	5.7	8.9		1.6
Antioch Marina	10/2/2006	7	3	1214	2.15	Brackish	5.7	8.9		1.6
Antioch Marina	10/2/2006	8	3	1220	2.13	Brackish	5.7	8.8		1.6
Ballena Isle Marina	7/27/2006	1	1	1000	1.35	Saltwater	4.3	6.7		4.9
Ballena Isle Marina	7/27/2006	2	1	1012	1.38	Saltwater	4.4	6.8		2.3
Ballena Isle Marina	7/27/2006	3	1	1028	1.33	Saltwater	4.3	6.6		4.3
Ballena Isle Marina	7/27/2006	4	1	1039	1.34	Saltwater	4.3	6.7		4.9
Ballena Isle Marina	7/27/2006	5	1	1052	1.42	Saltwater	4.4	6.9		1.5
Ballena Isle Marina	7/27/2006	6	1	1105	1.30	Saltwater	4.2	6.6		1.3
Ballena Isle Marina	7/27/2006	7	1	1113	1.26	Saltwater	4.1	6.4		1.2
Ballena Isle Marina	7/27/2006	8	1	1123	1.43	Saltwater	4.5	7.0		1.1
Ballena Isle Marina	8/24/2006	1	2	1030	1.57	Saltwater	4.7	7.4		3.5
Ballena Isle Marina	8/24/2006	2	2	1036	1.36	Saltwater	4.3	6.8		1.2
Ballena Isle Marina	8/24/2006	3	2	1042	1.55	Saltwater	4.7	7.3		3.7
Ballena Isle Marina	8/24/2006	4	2	1047	1.64	Saltwater	4.8	7.5		1.5
Ballena Isle Marina	8/24/2006	5	2	1054	1.55	Saltwater	4.7	7.3		1.3
Ballena Isle Marina	8/24/2006	6	2	1109	1.44	Saltwater	4.5	7.0		1.3
Ballena Isle Marina	8/24/2006	7	2	1120	1.58	Saltwater	4.7	7.4		3.7
Ballena Isle Marina	8/24/2006	8	2	1130	1.56	Saltwater	4.7	7.3		3
Ballena Isle Marina	9/21/2006	1	3	1008	1.46	Saltwater	4.5	7.0		3.3
Ballena Isle Marina	9/21/2006	2	3	1018	1.49	Saltwater	4.6	7.1		2
Ballena Isle Marina	9/21/2006	3	3	1024	1.36	Saltwater	4.3	6.7		2.8
Ballena Isle Marina	9/21/2006	4	3	1029	1.44	Saltwater	4.5	7.0		2.7
Ballena Isle Marina	9/21/2006	5	3	1001	1.43	Saltwater	4.4	6.9		1.2
Ballena Isle Marina	9/21/2006	6	3	940	1.21	Saltwater	4.0	6.3		0.8
Ballena Isle Marina	9/21/2006	7	3	949	1.24	Saltwater	4.1	6.4		0.8
Ballena Isle Marina	9/21/2006	8	3	953	1.44	Saltwater	4.5	7.0		1
Benicia Marina	8/7/2006	1	1	1257	1.70	Brackish	4.9	7.7		1.8
Benicia Marina	8/7/2006	2	1	1310	1.86	Brackish	5.2	8.1		3.4
Benicia Marina	8/7/2006	3	1	1314	2.09	Brackish	5.6	8.7		3.3
Benicia Marina	8/7/2006	4	1	1327	1.75	Brackish	5.0	7.8		2.7
Benicia Marina	8/7/2006	5	1	1345	1.69	Brackish	4.9	7.7		1.7
Benicia Marina	8/7/2006	6	1	1351	1.70	Brackish	4.9	7.7		2.2
Benicia Marina	8/7/2006	7	1	1402	1.64	Brackish	4.8	7.5		1.9
Benicia Marina	8/7/2006	8	1	1413	2.08	Brackish	5.6	8.7		2.1

Marina Name	Sampling Date	Site	Event	Time	DOC (mg/L)	Water Type	FCC	FAC	Result Code	Observed DCu (µg/L)
Benicia Marina	10/2/2006	1	3	1400	2.22	Brackish	5.8	9.1		2.4
Benicia Marina	10/2/2006	2	3	1410	2.19	Brackish	5.7	9.0		2.9
Benicia Marina	10/2/2006	3	3	1455	2.25	Brackish	5.8	9.1		2.5
Benicia Marina	10/2/2006	4	3	1504	2.27	Brackish	5.9	9.2		2.8
Benicia Marina	10/2/2006	5	3	1522	2.09	Brackish	5.6	8.7		1.5
Benicia Marina	10/2/2006	6	3	1530	2.19	Brackish	5.7	9.0		1.6
Benicia Marina	10/2/2006	7	3	1556	2.31	Brackish	5.9	9.3		1.5
Benicia Marina	10/2/2006	8	3	1543	2.10	Brackish	5.6	8.8		1.6
Berkeley Marina	7/24/2006	1	1	1150	1.14	Saltwater	3.9	6.1		6.8
Berkeley Marina	7/24/2006	2	1	1201	1.16	Saltwater	3.9	6.1		4.9
Berkeley Marina	7/24/2006	3	1	1212	1.14	Saltwater	3.9	6.1		4.4
Berkeley Marina	7/24/2006	4	1	1234	1.09	Saltwater	3.8	5.9		4.5
Berkeley Marina	7/24/2006	5	1	1232	1.00	Saltwater	3.6	5.6		1.2
Berkeley Marina	7/24/2006	6	1	1252	1.12	Saltwater	3.8	6.0		1.3
Berkeley Marina	7/24/2006	7	1	1302	0.91	Saltwater	3.4	5.3		1.1
Berkeley Marina	7/24/2006	8	1	1220	0.96	Saltwater	3.5	5.5		2
Berkeley Marina	8/21/2006	1	2	1024	0.81	Saltwater	3.2	4.9		3
Berkeley Marina	8/21/2006	2	2	1042	0.89	Saltwater	3.3	5.2		3
Berkeley Marina	8/21/2006	3	2	1052	0.86	Saltwater	3.3	5.1		2.9
Berkeley Marina	8/21/2006	4	2	1100	0.85	Saltwater	3.3	5.1		3
Berkeley Marina	8/21/2006	5	2	1123	0.79	Saltwater	3.1	4.9		0.3
Berkeley Marina	8/21/2006	6	2	1115	0.94	Saltwater	3.5	5.4		0.8
Berkeley Marina	8/21/2006	7	2	1135	0.74	Saltwater	3.0	4.7		0.2
Berkeley Marina	8/21/2006	8	2	1145	0.90	Saltwater	3.4	5.3		0.3
Berkeley Marina	9/18/2006	1	3	1012	0.79	Saltwater	3.1	4.9		3.8
Berkeley Marina	9/18/2006	2	3	1023	0.93	Saltwater	3.4	5.4		1.8
Berkeley Marina	9/18/2006	3	3	1046	0.98	Saltwater	3.6	5.5		2.6
Berkeley Marina	9/18/2006	4	3	1052	0.92	Saltwater	3.4	5.3		1.9
Berkeley Marina	9/18/2006	5	3	1111	0.88	Saltwater	3.3	5.2		0.6
Berkeley Marina	9/18/2006	6	3	1104	2.70	Saltwater	6.5	10.2		0.9
Berkeley Marina	9/18/2006	7	3	1120	0.73	Saltwater	3.0	4.6		0.7
Berkeley Marina	9/18/2006	8	3	1130	0.73	Saltwater	3.0	4.6		0.5
Clipper Yacht Harbor	7/27/2006	1	1	1415	0.94	Saltwater	3.5	5.4		1.3
Clipper Yacht Harbor	7/27/2006	2	1	1426	0.94	Saltwater	3.5	5.4		2
Clipper Yacht Harbor	7/27/2006	3	1	1436	0.97	Saltwater	3.5	5.5		2.5
Clipper Yacht Harbor	7/27/2006	4	1	1447	0.97	Saltwater	3.5	5.5		1.8
Clipper Yacht Harbor	7/27/2006	5	1	1456	0.94	Saltwater	3.5	5.4		0.9
Clipper Yacht Harbor	7/27/2006	6	1	1506	0.92	Saltwater	3.4	5.3		0.9
Clipper Yacht Harbor	7/27/2006	7	1	1516	0.94	Saltwater	3.5	5.4		0.8

Marina Name	Sampling Date	Site	Event	Time	DOC (mg/L)	Water Type	FCC	FAC	Result Code	Observed DCu (µg/L)
Clipper Yacht Harbor	7/27/2006	8	1	1526	0.96	Saltwater	3.5	5.5		0.9
Clipper Yacht Harbor	8/25/2006	1	2	1317	1.09	Saltwater	3.8	5.9		2.7
Clipper Yacht Harbor	8/25/2006	2	2	1325	0.99	Saltwater	3.6	5.6		3.6
Clipper Yacht Harbor	8/25/2006	3	2	1333	1.00	Saltwater	3.6	5.6		6.6
Clipper Yacht Harbor	8/25/2006	4	2	1340	0.95	Saltwater	3.5	5.4		3.2
Clipper Yacht Harbor	8/25/2006	5	2	1358	1.01	Saltwater	3.6	5.7		0.8
Clipper Yacht Harbor	8/25/2006	6	2	1352	0.94	Saltwater	3.5	5.4		0.6
Clipper Yacht Harbor	8/25/2006	7	2	1402	0.99	Saltwater	3.6	5.6		0.5
Clipper Yacht Harbor	8/25/2006	8	2	1408	0.95	Saltwater	3.5	5.4		0.3
Clipper Yacht Harbor	9/19/2006	1	3	1340	0.76	Saltwater	3.1	4.8		1.7
Clipper Yacht Harbor	9/19/2006	2	3	1350	1.06	Saltwater	3.7	5.8		3.7
Clipper Yacht Harbor	9/19/2006	3	3	1355	1.09	Saltwater	3.8	5.9		1.4
Clipper Yacht Harbor	9/19/2006	4	3	1400	1.44	Saltwater	4.5	7.0		1.6
Clipper Yacht Harbor	9/19/2006	5	3	1410	1.04	Saltwater	3.7	5.7		0.8
Clipper Yacht Harbor	9/19/2006	6	3	1415	1.46	Saltwater	4.5	7.0		1.2
Clipper Yacht Harbor	9/19/2006	7	3	1422	1.15	Saltwater	3.9	6.1		0.9
Clipper Yacht Harbor	9/19/2006	8	3	1430	1.54	Saltwater	4.7	7.3		1.2
Coyote Point Marina	7/28/2006	1	1	1001	1.51	Saltwater	4.6	7.2		1.8
Coyote Point Marina	7/28/2006	2	1	1011	1.58	Saltwater	4.7	7.4		2.6
Coyote Point Marina	7/28/2006	3	1	1020	1.51	Saltwater	4.6	7.2		2.1
Coyote Point Marina	7/28/2006	4	1	1032	1.66	Saltwater	4.9	7.6		1.7
Coyote Point Marina	7/28/2006	5	1	1053	1.55	Saltwater	4.7	7.3		1.5
Coyote Point Marina	7/28/2006	6	1	1100	1.55	Saltwater	4.7	7.3		1.3
Coyote Point Marina	7/28/2006	7	1	1111	1.53	Saltwater	4.6	7.3		1.3
Coyote Point Marina	7/28/2006	8	1	1122	1.52	Saltwater	4.6	7.2		1.4
Coyote Point Marina	8/25/2006	1	2	925	1.76	Saltwater	5.0	7.9		2.2
Coyote Point Marina	8/25/2006	2	2	933	1.76	Saltwater	5.0	7.9		2.2
Coyote Point Marina	8/25/2006	3	2	942	1.77	Saltwater	5.1	7.9		2.4
Coyote Point Marina	8/25/2006	4	2	950	1.80	Saltwater	5.1	8.0		2.2
Coyote Point Marina	8/25/2006	5	2	1004	1.82	Saltwater	5.2	8.0		1.3
Coyote Point Marina	8/25/2006	6	2	1024	1.64	Saltwater	4.8	7.6		1.2
Coyote Point Marina	8/25/2006	7	2	1029	1.53	Saltwater	4.6	7.2		1.1
Coyote Point Marina	8/25/2006	8	2	1010	1.75	Saltwater	5.0	7.8		1.1
Downtown Shoreline Marina	8/1/2006	1	1	1310	0.90	Saltwater	3.4	5.3		7.4
Downtown Shoreline Marina	8/1/2006	2	1	1321	0.86	Saltwater	3.3	5.1		6.3
Downtown Shoreline Marina	8/1/2006	3	1	1329	1.10	Saltwater	3.8	5.9		8.9
Downtown Shoreline Marina	8/1/2006	4	1	1337	1.00	Saltwater	3.6	5.6		2.4
Downtown Shoreline Marina	8/1/2006	5	1	1352	1.26	Saltwater	4.1	6.5		0.5
Downtown Shoreline Marina	8/1/2006	6	1	1357	1.19	Saltwater	4.0	6.2		0.8

Marina Name	Sampling Date	Site	Event	Time	DOC (mg/L)	Water Type	FCC	FAC	Result Code	Observed DCu (µg/L)
Downtown Shoreline Marina	8/1/2006	7	1	1404	1.09	Saltwater	3.8	5.9		0.6
Downtown Shoreline Marina	8/1/2006	8	1	1411	1.21	Saltwater	4.0	6.3		0.7
Downtown Shoreline Marina	8/29/2006	1	2	1332	1.24	Saltwater	4.1	6.4		5.3
Downtown Shoreline Marina	8/29/2006	2	2	1340	0.99	Saltwater	3.6	5.6		7.4
Downtown Shoreline Marina	8/29/2006	3	2	1348	0.97	Saltwater	3.5	5.5		7.7
Downtown Shoreline Marina	8/29/2006	4	2	1359	1.20	Saltwater	4.0	6.3		4.4
Downtown Shoreline Marina	8/29/2006	5	2	1416	1.33	Saltwater	4.3	6.7		0.4
Downtown Shoreline Marina	8/29/2006	6	2	1423	1.38	Saltwater	4.4	6.8		0.5
Downtown Shoreline Marina	8/29/2006	7	2	1430	1.47	Saltwater	4.5	7.1		0.4
Downtown Shoreline Marina	8/29/2006	8	2	1439	1.16	Saltwater	3.9	6.1		0.5
Downtown Shoreline Marina	9/26/2006	1	3	1340	1.05	Saltwater	3.7	5.8		10.9
Downtown Shoreline Marina	9/26/2006	2	3	1351	1.10	Saltwater	3.8	5.9		9.5
Downtown Shoreline Marina	9/26/2006	3	3	1358	0.96	Saltwater	3.5	5.5		8.6
Downtown Shoreline Marina	9/26/2006	4	3	1407	1.12	Saltwater	3.8	6.0		6.0
Downtown Shoreline Marina	9/26/2006	5	3	1423	2.94	Saltwater	6.9	10.7		1.2
Downtown Shoreline Marina	9/26/2006	6	3	1433	1.80	Saltwater	5.1	8.0		0.9
Downtown Shoreline Marina	9/26/2006	7	3	1440	1.92	Saltwater	5.3	8.3		0.9
Downtown Shoreline Marina	9/26/2006	8	3	1527	0.86	Saltwater	3.3	5.1		0.9
Loch Lomond Marina	7/25/2006	1	1	1402	1.28	Saltwater	4.2	6.5		10.3
Loch Lomond Marina	7/25/2006	2	1	1413	1.28	Saltwater	4.2	6.5		8.4
Loch Lomond Marina	7/25/2006	3	1	1422	1.26	Saltwater	4.1	6.4		7.2
Loch Lomond Marina	7/25/2006	4	1	1430	1.23	Saltwater	4.1	6.4		8
Loch Lomond Marina	7/25/2006	5	1	1445	1.56	Saltwater	4.7	7.3		1.4
Loch Lomond Marina	7/25/2006	7	1	1504	1.23	Saltwater	4.1	6.3		1.8
Loch Lomond Marina	7/25/2006	8	1	1512	1.43	Saltwater	4.5	7.0		2.1
Loch Lomond Marina	8/22/2006	1	2	1400	1.68	Saltwater	4.9	7.7		7.7
Loch Lomond Marina	8/22/2006	2	2	1417	1.33	Saltwater	4.3	6.7		4
Loch Lomond Marina	8/22/2006	3	2	1432	1.72	Saltwater	5.0	7.8		4.8
Loch Lomond Marina	8/22/2006	4	2	1443	1.38	Saltwater	4.4	6.8		5.3
Loch Lomond Marina	8/22/2006	5	2	1459	1.27	Saltwater	4.1	6.5		1.8
Loch Lomond Marina	8/22/2006	6	2	1513	1.47	Saltwater	4.5	7.1		1.3
Loch Lomond Marina	8/22/2006	7	2	1524	1.41	Saltwater	4.4	6.9		1.3
Loch Lomond Marina	8/22/2006	8	2	1535	1.33	Saltwater	4.3	6.7		2.1
Loch Lomond Marina	9/19/2006	1	3	1008	1.00	Saltwater	3.6	5.6		6.7
Loch Lomond Marina	9/19/2006	2	3	1017	1.60	Saltwater	4.8	7.4		4.3
Loch Lomond Marina	9/19/2006	3	3	1025	1.14	Saltwater	3.9	6.1		4.4
Loch Lomond Marina	9/19/2006	4	3	1032	1.06	Saltwater	3.7	5.8		3.2
Loch Lomond Marina	9/19/2006	5	3	1045	1.30	Saltwater	4.2	6.6		2.1
Loch Lomond Marina	9/19/2006	6	3	1052	1.22	Saltwater	4.0	6.3		1.5

Marina Name	Sampling Date	Site	Event	Time	DOC (mg/L)	Water Type	FCC	FAC	Result Code	Observed DCu (µg/L)
Loch Lomond Marina	9/19/2006	7	3	1103	1.17	Saltwater	3.9	6.2		1.6
Loch Lomond Marina	9/19/2006	8	3	1110	1.22	Saltwater	4.0	6.3		2.2
Marina Bay Yacht Harbor	7/25/2006	1	1	955	1.26	Saltwater	4.1	6.4		2.7
Marina Bay Yacht Harbor	7/25/2006	2	1	1010	1.18	Saltwater	4.0	6.2		3.1
Marina Bay Yacht Harbor	7/25/2006	3	1	1020	6.44	Saltwater	11.0	17.1		3.6
Marina Bay Yacht Harbor	7/25/2006	4	1	1028	1.19	Saltwater	4.0	6.2		3.1
Marina Bay Yacht Harbor	7/25/2006	5	1	1048	0.99	Saltwater	3.6	5.6		1.8
Marina Bay Yacht Harbor	7/25/2006	6	1	1058	1.16	Saltwater	3.9	6.1		2.5
Marina Bay Yacht Harbor	8/22/2006	1	2	1007	0.73	Saltwater	3.0	4.7		1.7
Marina Bay Yacht Harbor	8/22/2006	2	2	1026	0.86	Saltwater	3.3	5.1		2.5
Marina Bay Yacht Harbor	8/22/2006	3	2	1041	0.78	Saltwater	3.1	4.9		2.4
Marina Bay Yacht Harbor	8/22/2006	4	2	1050	0.78	Saltwater	3.1	4.8		2.6
Marina Bay Yacht Harbor	8/22/2006	5	2	1110	0.74	Saltwater	3.0	4.7		1.5
Marina Bay Yacht Harbor	8/22/2006	6	2	1120	0.75	Saltwater	3.0	4.7		1.6
Marina Bay Yacht Harbor	9/18/2006	1	3	1435	0.68	Saltwater	2.9	4.5		2.1
Marina Bay Yacht Harbor	9/18/2006	2	3	1448	0.86	Saltwater	3.3	5.1		3.4
Marina Bay Yacht Harbor	9/18/2006	3	3	1458	0.86	Saltwater	3.3	5.1		2.9
Marina Bay Yacht Harbor	9/18/2006	4	3	1510	1.15	Saltwater	3.9	6.1		2.3
Marina Bay Yacht Harbor	9/18/2006	5	3	1532	0.65	Saltwater	2.8	4.3		1.3
Marina Bay Yacht Harbor	9/18/2006	6	3	1520	0.74	Saltwater	3.0	4.7		1.9
Marina del Rey Back Basin	8/2/2006	1	1	1011	1.05	Saltwater	3.7	5.8		18.4
Marina del Rey Back Basin	8/30/2006	1	2	1049	0.99	Saltwater	3.6	5.6		11.5
Marina del Rey Back Basin	9/27/2006	1	3	1035	1.04	Saltwater	3.7	5.7		12.7
Marina del Rey Back Basin	8/2/2006	2	1	1018	1.00	Saltwater	3.6	5.6		17.9
Marina del Rey Back Basin	8/30/2006	2	2	1103	1.03	Saltwater	3.6	5.7		18.4
Marina del Rey Back Basin	9/27/2006	2	3	1044	1.05	Saltwater	3.7	5.8		13.3
Marina del Rey Back Basin	8/2/2006	3	1	1028	1.00	Saltwater	3.6	5.6		14.5
Marina del Rey Back Basin	8/30/2006	3	2	1218	1.04	Saltwater	3.7	5.8		12.4
Marina del Rey Back Basin	9/27/2006	3	3	1053	1.90	Saltwater	5.3	8.2		8.1
Marina del Rey Back Basin	8/2/2006	4	1	1041	1.06	Saltwater	3.7	5.8		14.1
Marina del Rey Back Basin	8/30/2006	4	2	1130	1.03	Saltwater	3.7	5.7		14.2
Marina del Rey Back Basin	9/27/2006	4	3	1106	0.99	Saltwater	3.6	5.6		12
Marina del Rey Front Basin	8/2/2006	1	1	1059	1.05	Saltwater	3.7	5.8		16.2
Marina del Rey Front Basin	8/2/2006	2	1	1117	1.02	Saltwater	3.6	5.7		14.5
Marina del Rey Front Basin	8/2/2006	3	1	1127	0.97	Saltwater	3.5	5.5		14.9
Marina del Rey Front Basin	8/2/2006	4	1	1143	0.70	Saltwater	2.9	4.5		13.8
Marina del Rey Front Basin	8/2/2006	5	1	1202	0.93	Saltwater	3.4	5.4		4.7
Marina del Rey Front Basin	8/2/2006	6	1	1211	0.74	Saltwater	3.0	4.7		1.6
Marina del Rey Front Basin	8/2/2006	7	1	1222	1.57	Saltwater	4.7	7.4		0.5

Marina Name	Sampling Date	Site	Event	Time	DOC (mg/L)	Water Type	FCC	FAC	Result Code	Observed DCu (µg/L)
Marina del Rey Front Basin	8/2/2006	8	1	1227	0.69	Saltwater	2.9	4.5		0.3
Marina del Rey Front Basin	8/30/2006	1	2	1157	1.01	Saltwater	3.6	5.7		13.1
Marina del Rey Front Basin	8/30/2006	2	2	1205	0.93	Saltwater	3.4	5.4		12.5
Marina del Rey Front Basin	8/30/2006	3	2	1113	1.01	Saltwater	3.6	5.6		11.8
Marina del Rey Front Basin	8/30/2006	4	2	1246	1.11	Saltwater	3.8	6.0		11.9
Marina del Rey Front Basin	8/30/2006	5	2	1303	1.58	Saltwater	4.7	7.4		3.8
Marina del Rey Front Basin	8/30/2006	6	2	1312	1.12	Saltwater	3.9	6.0		1.5
Marina del Rey Front Basin	8/30/2006	7	2	1321	1.00	Saltwater	3.6	5.6		0.9
Marina del Rey Front Basin	8/30/2006	8	2	1330	0.97	Saltwater	3.5	5.5		0.4
Marina del Rey Front Basin	9/27/2006	1	3	1120	0.98	Saltwater	3.6	5.6		12.2
Marina del Rey Front Basin	9/27/2006	2	3	1129	0.87	Saltwater	3.3	5.2		11.5
Marina del Rey Front Basin	9/27/2006	3	3	1137	1.05	Saltwater	3.7	5.8		8.9
Marina del Rey Front Basin	9/27/2006	4	3	1158	0.91	Saltwater	3.4	5.3		10
Marina del Rey Front Basin	9/27/2006	5	3	1215	1.73	Saltwater	5.0	7.8		3.4
Marina del Rey Front Basin	9/27/2006	6	3	1224	0.79	Saltwater	3.1	4.9		0.4
Marina del Rey Front Basin	9/27/2006	7	3	1233	0.90	Saltwater	3.4	5.3		0.7
Marina del Rey Front Basin	9/27/2006	8	3	1240	0.77	Saltwater	3.1	4.8		0.3
Monterey Harbor	8/10/2006	1	1	1039	1.06	Saltwater	3.7	5.8		6.3
Monterey Harbor	8/10/2006	2	1	1052	1.00	Saltwater	3.6	5.6		7.1
Monterey Harbor	8/10/2006	3	1	1105	0.89	Saltwater	3.4	5.2		4.6
Monterey Harbor	8/10/2006	4	1	1120	0.93	Saltwater	3.4	5.4		4.8
Monterey Harbor	8/10/2006	5	1	1147	0.86	Saltwater	3.3	5.1	<	0.1
Monterey Harbor	8/10/2006	6	1	1159	0.79	Saltwater	3.1	4.9	<	0.1
Monterey Harbor	8/10/2006	7	1	1208	0.72	Saltwater	3.0	4.6	<	0.1
Monterey Harbor	8/10/2006	8	1	1216	0.82	Saltwater	3.2	5.0	<	0.1
Monterey Harbor	9/8/2006	1	2	928	0.71	Saltwater	2.9	4.6		3.7
Monterey Harbor	9/8/2006	2	2	935	0.74	Saltwater	3.0	4.7		3.7
Monterey Harbor	9/8/2006	3	2	945	0.76	Saltwater	3.1	4.8		3.1
Monterey Harbor	9/8/2006	4	2	953	0.65	Saltwater	2.8	4.3		2.4
Monterey Harbor	9/8/2006	5	2	1004	0.65	Saltwater	2.8	4.3		0.4
Monterey Harbor	9/8/2006	6	2	1010	1.02	Saltwater	3.6	5.7		0.4
Monterey Harbor	9/8/2006	7	2	1018	1.11	Saltwater	3.8	6.0		0.3
Monterey Harbor	9/8/2006	8	2	1024	0.54	Saltwater	2.5	3.9		0.2
Monterey Harbor	10/19/2006	1	3	937	1.60	Saltwater	4.8	7.4		6.3
Monterey Harbor	10/19/2006	2	3	948	1.59	Saltwater	4.7	7.4		6.7
Monterey Harbor	10/19/2006	3	3	1000	1.53	Saltwater	4.6	7.3		7.8
Monterey Harbor	10/19/2006	4	3	1010	1.52	Saltwater	4.6	7.2		6.4
Monterey Harbor	10/19/2006	5	3	1023	1.38	Saltwater	4.4	6.8		0.5
Monterey Harbor	10/19/2006	6	3	1033	1.36	Saltwater	4.3	6.8		0.4

Marina Name	Sampling Date	Site	Event	Time	DOC (mg/L)	Water Type	FCC	FAC	Result Code	Observed DCu (µg/L)
Monterey Harbor	10/19/2006	7	3	1045	1.45	Saltwater	4.5	7.0		0.4
Monterey Harbor	10/19/2006	8	3	1115	1.78	Saltwater	5.1	7.9		0.5
Pittsburg Marina	8/8/2006	1	1	948	1.59	Brackish	4.7	7.4		1.7
Pittsburg Marina	8/8/2006	2	1	1000	1.61	Brackish	4.8	7.5		1.8
Pittsburg Marina	8/8/2006	3	1	1027	1.75	Brackish	5.0	7.8		3.2
Pittsburg Marina	8/8/2006	4	1	1033	1.66	Brackish	4.9	7.6		3.6
Pittsburg Marina	8/8/2006	5	1	1015	1.74	Brackish	5.0	7.8		1.4
Pittsburg Marina	8/8/2006	6	1	1045	1.57	Brackish	4.7	7.3		1.4
Pittsburg Marina	8/8/2006	7	1	1052	1.50	Brackish	4.6	7.2		1.6
Pittsburg Marina	8/8/2006	8	1	1101	1.48	Brackish	4.5	7.1		1.4
Pittsburg Marina	9/5/2006	1	2	1400	1.55	Brackish	4.7	7.3		1.7
Pittsburg Marina	9/5/2006	2	2	1415	1.53	Brackish	4.6	7.2		2.4
Pittsburg Marina	9/5/2006	3	2	1430	1.52	Brackish	4.6	7.2		2.2
Pittsburg Marina	9/5/2006	4	2	1435	1.47	Brackish	4.5	7.1		2
Pittsburg Marina	9/5/2006	5	2	1508	1.50	Brackish	4.6	7.2		1.6
Pittsburg Marina	9/5/2006	6	2	1500	1.64	Brackish	4.8	7.5		1.5
Pittsburg Marina	9/5/2006	7	2	1450	1.46	Brackish	4.5	7.1		1.5
Pittsburg Marina	9/5/2006	8	2	1445	1.50	Brackish	4.6	7.2		1.5
Pittsburg Marina	10/3/2006	1	3	1445	2.15	Brackish	5.7	8.9		1.7
Pittsburg Marina	10/3/2006	2	3	1328	2.29	Brackish	5.9	9.2		2.4
Pittsburg Marina	10/3/2006	3	3	1423	2.18	Brackish	5.7	9.0		1.8
Pittsburg Marina	10/3/2006	4	3	1430	2.26	Brackish	5.9	9.2		2
Pittsburg Marina	10/3/2006	5	3	1345	2.20	Brackish	5.8	9.0		1.5
Pittsburg Marina	10/3/2006	6	3	1354	2.13	Brackish	5.7	8.8		1.4
Pittsburg Marina	10/3/2006	7	3	1404	2.33	Brackish	6.0	9.3		1.4
Pittsburg Marina	10/3/2006	8	3	1412	2.20	Brackish	5.8	9.0		1.4
San Francisco Marina	7/26/2006	1	1	1025	0.85	Saltwater	3.3	5.1		2
San Francisco Marina	7/26/2006	2	1	1034	0.89	Saltwater	3.3	5.2		1.2
San Francisco Marina	7/26/2006	3	1	1047	2.06	Saltwater	5.5	8.7		1.1
San Francisco Marina	7/26/2006	4	1	1053	0.94	Saltwater	3.5	5.4		1.1
San Francisco Marina	7/26/2006	5	1	1102	0.85	Saltwater	3.3	5.1		0.8
San Francisco Marina	7/26/2006	6	1	1110	0.84	Saltwater	3.2	5.1		0.7
San Francisco Marina	7/26/2006	7	1	1117	1.47	Saltwater	4.5	7.1		0.8
San Francisco Marina	7/26/2006	8	1	1126	0.87	Saltwater	3.3	5.2		0.8
San Francisco Marina	8/23/2006	1	2	1006	0.92	Saltwater	3.4	5.4		3.9
San Francisco Marina	8/23/2006	2	2	1020	0.68	Saltwater	2.8	4.4		1.2
San Francisco Marina	8/23/2006	3	2	1043	0.61	Saltwater	2.7	4.2		1
San Francisco Marina	8/23/2006	4	2	1033	0.60	Saltwater	2.6	4.1		0.9
San Francisco Marina	8/23/2006	5	2	1058	0.99	Saltwater	3.6	5.6		0.9

Marina Name	Sampling Date	Site	Event	Time	DOC (mg/L)	Water Type	FCC	FAC	Result Code	Observed DCu (µg/L)
San Francisco Marina	8/23/2006	6	2	1110	1.13	Saltwater	3.9	6.0		0.7
San Francisco Marina	8/23/2006	7	2	1121	0.62	Saltwater	2.7	4.2		0.7
San Francisco Marina	8/23/2006	8	2	1134	0.92	Saltwater	3.4	5.3		1
San Francisco Marina	9/20/2006	1	3	1020	0.96	Saltwater	3.5	5.5		1.7
San Francisco Marina	9/20/2006	2	3	1034	0.65	Saltwater	2.8	4.3		0.9
San Francisco Marina	9/20/2006	3	3	1043	1.02	Saltwater	3.6	5.7		0.3
San Francisco Marina	9/20/2006	4	3	1050	0.78	Saltwater	3.1	4.9		0.4
San Francisco Marina	9/20/2006	5	3	1100	1.07	Saltwater	3.7	5.8	<	0.1
San Francisco Marina	9/20/2006	6	3	1110	0.95	Saltwater	3.5	5.4		0.2
San Francisco Marina	9/20/2006	7	3	1117	0.97	Saltwater	3.5	5.5	<	0.1
San Francisco Marina	9/20/2006	8	3	1125	1.07	Saltwater	3.7	5.8	<	0.1
Santa Barbara Harbor	8/3/2006	1	1	1053	0.86	Saltwater	3.3	5.1		2.3
Santa Barbara Harbor	8/3/2006	2	1	1101	0.79	Saltwater	3.1	4.9		6.5
Santa Barbara Harbor	8/3/2006	3	1	1112	0.92	Saltwater	3.4	5.3		6.6
Santa Barbara Harbor	8/3/2006	4	1	1125	0.73	Saltwater	3.0	4.7		4.6
Santa Barbara Harbor	8/3/2006	5	1	1138	0.87	Saltwater	3.3	5.2	<	0.1
Santa Barbara Harbor	8/3/2006	6	1	1146	0.57	Saltwater	2.6	4.0	<	0.1
Santa Barbara Harbor	8/3/2006	7	1	1153	0.87	Saltwater	3.3	5.2	<	0.1
Santa Barbara Harbor	8/3/2006	8	1	1200	0.59	Saltwater	2.6	4.1	<	0.1
Santa Barbara Harbor	8/31/2006	1	2	1044	0.76	Saltwater	3.0	4.8		5.6
Santa Barbara Harbor	8/31/2006	2	2	1050	0.69	Saltwater	2.9	4.5		6.9
Santa Barbara Harbor	8/31/2006	3	2	1103	0.76	Saltwater	3.1	4.8		8.2
Santa Barbara Harbor	8/31/2006	4	2	1110	0.73	Saltwater	3.0	4.7		7.4
Santa Barbara Harbor	8/31/2006	5	2	1124	0.85	Saltwater	3.3	5.1		0.5
Santa Barbara Harbor	8/31/2006	6	2	1132	0.64	Saltwater	2.8	4.3		0.3
Santa Barbara Harbor	8/31/2006	7	2	1140	0.76	Saltwater	3.0	4.7		0.2
Santa Barbara Harbor	8/31/2006	8	2	1148	0.83	Saltwater	3.2	5.0		0.2
Santa Barbara Harbor	9/28/2006	1	3	1010	0.96	Saltwater	3.5	5.5		4.5
Santa Barbara Harbor	9/28/2006	2	3	1015	0.93	Saltwater	3.4	5.4		7.1
Santa Barbara Harbor	9/28/2006	3	3	1026	0.89	Saltwater	3.4	5.2		6
Santa Barbara Harbor	9/28/2006	4	3	1034	1.03	Saltwater	3.7	5.7		5.4
Santa Barbara Harbor	9/28/2006	5	3	1046	0.73	Saltwater	3.0	4.6	<	0.1
Santa Barbara Harbor	9/28/2006	6	3	1056	0.80	Saltwater	3.1	4.9		0.2
Santa Barbara Harbor	9/28/2006	7	3	1106	0.78	Saltwater	3.1	4.8	<	0.1
Santa Barbara Harbor	9/28/2006	8	3	1118	0.78	Saltwater	3.1	4.8		0.1
Santa Cruz Harbor	8/9/2006	1	1	1117	0.94	Saltwater	3.5	5.4		3.1
Santa Cruz Harbor	8/9/2006	2	1	1145	0.85	Saltwater	3.3	5.1		3.2
Santa Cruz Harbor	8/9/2006	3	1	1154	0.78	Saltwater	3.1	4.8		4.3
Santa Cruz Harbor	8/9/2006	4	1	1203	0.77	Saltwater	3.1	4.8		3

Marina Name	Sampling Date	Site	Event	Time	DOC (mg/L)	Water Type	FCC	FAC	Result Code	Observed DCu (µg/L)
Santa Cruz Harbor	8/9/2006	5	1	1213	0.80	Saltwater	3.1	4.9	<	0.1
Santa Cruz Harbor	8/9/2006	6	1	1223	0.77	Saltwater	3.1	4.8		0.2
Santa Cruz Harbor	8/9/2006	7	1	1229	0.73	Saltwater	3.0	4.7	<	0.1
Santa Cruz Harbor	8/9/2006	8	1	1237	0.76	Saltwater	3.1	4.8	<	0.1
Santa Cruz Harbor	9/7/2006	1	2	1035	0.62	Saltwater	2.7	4.2		5.1
Santa Cruz Harbor	9/7/2006	2	2	1043	0.69	Saltwater	2.9	4.5		5.8
Santa Cruz Harbor	9/7/2006	3	2	1052	0.69	Saltwater	2.9	4.5		4.4
Santa Cruz Harbor	9/7/2006	4	2	1105	0.64	Saltwater	2.7	4.3		4.5
Santa Cruz Harbor	9/7/2006	5	2	1120	0.71	Saltwater	2.9	4.6		0.5
Santa Cruz Harbor	9/7/2006	6	2	1128	1.15	Saltwater	3.9	6.1		0.4
Santa Cruz Harbor	9/7/2006	7	2	1136	0.77	Saltwater	3.1	4.8		0.3
Santa Cruz Harbor	9/7/2006	8	2	1143	0.68	Saltwater	2.8	4.4		0.5
Santa Cruz Harbor	10/19/2006	1	3	1510	1.62	Saltwater	4.8	7.5		4.5
Santa Cruz Harbor	10/19/2006	2	3	1517	1.65	Saltwater	4.9	7.6		4.7
Santa Cruz Harbor	10/19/2006	3	3	1533	1.58	Saltwater	4.7	7.4		4.9
Santa Cruz Harbor	10/19/2006	4	3	1543	1.55	Saltwater	4.7	7.3		5.2
Santa Cruz Harbor	10/19/2006	5	3	1554	1.46	Saltwater	4.5	7.0		0.6
Santa Cruz Harbor	10/19/2006	6	3	1558	1.49	Saltwater	4.6	7.1		0.6
Santa Cruz Harbor	10/19/2006	7	3	1605	1.53	Saltwater	4.6	7.2		0.6
South Beach Harbor	7/26/2006	1	1	1400	1.01	Saltwater	3.6	5.7		2.5
South Beach Harbor	7/26/2006	2	1	1409	0.98	Saltwater	3.6	5.6		2.3
South Beach Harbor	7/26/2006	3	1	1418	1.04	Saltwater	3.7	5.8		2
South Beach Harbor	7/26/2006	4	1	1426	1.43	Saltwater	4.4	6.9		2.2
South Beach Harbor	7/26/2006	5	1	1437	0.95	Saltwater	3.5	5.5		1
South Beach Harbor	7/26/2006	6	1	1443	0.83	Saltwater	3.2	5.0		0.8
South Beach Harbor	7/26/2006	7	1	1449	0.93	Saltwater	3.4	5.4		0.8
South Beach Harbor	7/26/2006	8	1	1457	0.89	Saltwater	3.4	5.2		1
South Beach Harbor	8/23/2006	1	2	1417	0.90	Saltwater	3.4	5.3		2.1
South Beach Harbor	8/23/2006	2	2	1428	0.73	Saltwater	3.0	4.7		2.3
South Beach Harbor	8/23/2006	3	2	1442	0.72	Saltwater	2.9	4.6		1.9
South Beach Harbor	8/23/2006	4	2	1453	0.68	Saltwater	2.9	4.5		2.1
South Beach Harbor	8/23/2006	5	2	1505	1.05	Saltwater	3.7	5.8		0.6
South Beach Harbor	8/23/2006	6	2	1516	0.61	Saltwater	2.7	4.2		0.7
South Beach Harbor	8/23/2006	7	2	1527	1.04	Saltwater	3.7	5.8		0.5
South Beach Harbor	8/23/2006	8	2	1538	1.02	Saltwater	3.6	5.7		0.8
South Beach Harbor	9/20/2006	1	3	1336	0.68	Saltwater	2.9	4.5		2.3
South Beach Harbor	9/20/2006	2	3	1346	0.72	Saltwater	3.0	4.6		1.9
South Beach Harbor	9/20/2006	3	3	1350	1.11	Saltwater	3.8	6.0		3
South Beach Harbor	9/20/2006	4	3	1405	1.45	Saltwater	4.5	7.0		2.5

Marina Name	Sampling Date	Site	Event	Time	DOC (mg/L)	Water Type	FCC	FAC	Result Code	Observed DCu (µg/L)
South Beach Harbor	9/20/2006	5	3	1419	1.48	Saltwater	4.6	7.1		0.5
South Beach Harbor	9/20/2006	6	3	1424	1.29	Saltwater	4.2	6.5		0.4
South Beach Harbor	9/20/2006	7	3	1432	1.36	Saltwater	4.3	6.8		0.7
South Beach Harbor	9/20/2006	8	3	1435	0.98	Saltwater	3.5	5.5		0.4
Vallejo Municipal Marina	8/7/2006	1	1	952	2.33	Brackish	6.0	9.3		3.9
Vallejo Municipal Marina	8/7/2006	2	1	1043	2.15	Brackish	5.7	8.9		4.6
Vallejo Municipal Marina	8/7/2006	3	1	1055	2.27	Brackish	5.9	9.2		3.3
Vallejo Municipal Marina	8/7/2006	4	1	1101	2.34	Brackish	6.0	9.3		4.7
Vallejo Municipal Marina	8/7/2006	5	1	1005	3.61	Brackish	7.8	12.1		1.6
Vallejo Municipal Marina	8/7/2006	6	1	1015	2.91	Brackish	6.8	10.7		1.5
Vallejo Municipal Marina	8/7/2006	7	1	1024	2.78	Brackish	6.6	10.4		1.4
Vallejo Municipal Marina	8/7/2006	8	1	1029	2.43	Brackish	6.1	9.6		1.4
Vallejo Municipal Marina	9/5/2006	1	2	1055	2.11	Brackish	5.6	8.8		3
Vallejo Municipal Marina	9/5/2006	2	2	1102	2.03	Brackish	5.5	8.6		2.5
Vallejo Municipal Marina	9/5/2006	3	2	1113	2.19	Brackish	5.8	9.0		4.3
Vallejo Municipal Marina	9/5/2006	4	2	1155	1.79	Brackish	5.1	8.0		2.3
Vallejo Municipal Marina	9/5/2006	5	2	1125	1.74	Brackish	5.0	7.8		1.7
Vallejo Municipal Marina	9/5/2006	6	2	1133	1.62	Brackish	4.8	7.5		1.7
Vallejo Municipal Marina	9/5/2006	7	2	1140	1.56	Brackish	4.7	7.3		1.7
Vallejo Municipal Marina	9/5/2006	8	2	1147	1.74	Brackish	5.0	7.8		1.6
Vallejo Municipal Marina	10/3/2006	1	3	943	2.48	Brackish	6.2	9.7		2.6
Vallejo Municipal Marina	10/3/2006	2	3	1033	2.54	Brackish	6.3	9.8		2.7
Vallejo Municipal Marina	10/3/2006	3	3	1045	2.43	Brackish	6.1	9.6		4
Vallejo Municipal Marina	10/3/2006	4	3	1052	2.32	Brackish	6.0	9.3		3.5
Vallejo Municipal Marina	10/3/2006	5	3	954	2.26	Brackish	5.9	9.2		1.3
Vallejo Municipal Marina	10/3/2006	6	3	1004	2.18	Brackish	5.7	9.0		1.3
Vallejo Municipal Marina	10/3/2006	7	3	1015	2.26	Brackish	5.9	9.1		1.3
Vallejo Municipal Marina	10/3/2006	8	3	1022	2.23	Brackish	5.8	9.1		1.3

Appendix N: Saltwater Biotic Ligand Model Output

Red cells indicate locations where BLM predicts salt water acute toxicity to *M. galloprovincialis*. Yellow cells indicate sites with toxic units within 20% of 1. Note that salinity cutoff for this model is approximately 4 mS/cm. Antioch and Pittsburg marinas are not included here.

Table N-1. Salt Water BLM Output - Predicted Toxicity to *M. galloprovincialis*

Marina Name	Sampling Date	Site	Event	Water Type	Observed DCu (µg/L)	Predicted EC_{50} M. galloprovincialis (µg/L)	Toxic Units
Ballena Isle Marina	7/27/2006	1	1	Salt	4.9	6.0	0.81
Ballena Isle Marina	7/27/2006	2	1	Salt	2.3	6.2	0.37
Ballena Isle Marina	7/27/2006	3	1	Salt	4.3	6.0	0.72
Ballena Isle Marina	7/27/2006	4	1	Salt	4.9	6.0	0.81
Ballena Isle Marina	7/27/2006	5	1	Salt	1.5	6.3	0.24
Ballena Isle Marina	7/27/2006	6	1	Salt	1.3	5.8	0.22
Ballena Isle Marina	7/27/2006	7	1	Salt	1.2	5.7	0.21
Ballena Isle Marina	7/27/2006	8	1	Salt	1.1	6.4	0.17
Ballena Isle Marina	8/24/2006	1	2	Salt	3.5	6.7	0.52
Ballena Isle Marina	8/24/2006	2	2	Salt	1.2	5.6	0.22
Ballena Isle Marina	8/24/2006	3	2	Salt	3.7	6.3	0.59
Ballena Isle Marina	8/24/2006	4	2	Salt	1.5	6.5	0.23
Ballena Isle Marina	8/24/2006	5	2	Salt	1.3	6.1	0.21
Ballena Isle Marina	8/24/2006	6	2	Salt	1.3	5.9	0.22
Ballena Isle Marina	8/24/2006	7	2	Salt	3.7	6.6	0.56
Ballena Isle Marina	8/24/2006	8	2	Salt	3.0	6.4	0.47
Ballena Isle Marina	9/21/2006	1	3	Salt	3.3	6.1	0.54
Ballena Isle Marina	9/21/2006	2	3	Salt	2.0	6.3	0.32
Ballena Isle Marina	9/21/2006	3	3	Salt	2.8	5.7	0.49
Ballena Isle Marina	9/21/2006	4	3	Salt	2.7	6.1	0.44
Ballena Isle Marina	9/21/2006	5	3	Salt	1.2	6.1	0.20
Ballena Isle Marina	9/21/2006	6	3	Salt	0.8	5.3	0.15
Ballena Isle Marina	9/21/2006	7	3	Salt	0.8	5.3	0.15
Ballena Isle Marina	9/21/2006	8	3	Salt	1.0	6.1	0.16
Benicia Marina	8/7/2006	1	1	Brackish	1.8	7.6	0.24
Benicia Marina	8/7/2006	2	1	Brackish	3.4	8.3	0.41
Benicia Marina	8/7/2006	3	1	Brackish	3.3	9.3	0.36
Benicia Marina	8/7/2006	4	1	Brackish	2.7	7.8	0.35
Benicia Marina	8/7/2006	5	1	Brackish	1.7	7.5	0.23
Benicia Marina	8/7/2006	6	1	Brackish	2.2	7.6	0.29
Benicia Marina	8/7/2006	7	1	Brackish	1.9	7.3	0.26
Benicia Marina	8/7/2006	8	1	Brackish	2.1	9.2	0.23
Benicia Marina	10/2/2006	1	3	Brackish	2.4	9.6	0.25
Benicia Marina	10/2/2006	2	3	Brackish	2.9	9.4	0.31
Benicia Marina	10/2/2006	3	3	Brackish	2.5	9.4	0.27
Benicia Marina	10/2/2006	4	3	Brackish	2.8	9.9	0.28
Benicia Marina	10/2/2006	5	3	Brackish	1.5	9.2	0.16
Benicia Marina	10/2/2006	6	3	Brackish	1.6	9.4	0.17

Marina Name	Sampling Date	Site	Event	Water Type	Observed DCu (µg/L)	Predicted EC_{50} M. galloprovincialis (µg/L)	Toxic Units
Benicia Marina	10/2/2006	7	3	Brackish	1.5	9.9	0.15
Benicia Marina	10/2/2006	8	3	Brackish	1.6	9.3	0.17
Berkeley Marina	7/24/2006	1	1	Salt	6.8	5.2	1.32
Berkeley Marina	7/24/2006	2	1	Salt	4.9	5.2	0.94
Berkeley Marina	7/24/2006	3	1	Salt	4.4	5.2	0.85
Berkeley Marina	7/24/2006	4	1	Salt	4.5	4.9	0.91
Berkeley Marina	7/24/2006	5	1	Salt	1.2	4.5	0.26
Berkeley Marina	7/24/2006	6	1	Salt	1.3	5.1	0.26
Berkeley Marina	7/24/2006	7	1	Salt	1.1	4.1	0.27
Berkeley Marina	7/24/2006	8	1	Salt	2.0	4.4	0.46
Berkeley Marina	8/21/2006	1	2	Salt	3.0	3.6	0.83
Berkeley Marina	8/21/2006	2	2	Salt	3.0	3.9	0.77
Berkeley Marina	8/21/2006	3	2	Salt	2.9	3.8	0.77
Berkeley Marina	8/21/2006	4	2	Salt	3.0	3.7	0.81
Berkeley Marina	8/21/2006	5	2	Salt	0.3	3.4	0.09
Berkeley Marina	8/21/2006	6	2	Salt	0.8	4.0	0.20
Berkeley Marina	8/21/2006	7	2	Salt	0.2	3.3	0.06
Berkeley Marina	8/21/2006	8	2	Salt	0.3	3.9	0.08
Berkeley Marina	9/18/2006	1	3	Salt	3.8	3.2	1.17
Berkeley Marina	9/18/2006	2	3	Salt	1.8	3.9	0.46
Berkeley Marina	9/18/2006	3	3	Salt	2.6	4.2	0.63
Berkeley Marina	9/18/2006	4	3	Salt	1.9	4.0	0.47
Berkeley Marina	9/18/2006	5	3	Salt	0.6	3.9	0.16
Berkeley Marina	9/18/2006	6	3	Salt	0.9	11.4	0.08
Berkeley Marina	9/18/2006	7	3	Salt	0.7	3.3	0.22
Berkeley Marina	9/18/2006	8	3	Salt	0.5	3.3	0.15
Alamitos Bay Marina	8/1/2006	1	1	Salt	3.4	3.5	0.96
Alamitos Bay Marina	8/1/2006	2	1	Salt	1.3	3.8	0.35
Alamitos Bay Marina	8/1/2006	3	1	Salt	1.6	3.5	0.46
Alamitos Bay Marina	8/1/2006	4	1	Salt	2.9	3.7	0.78
Alamitos Bay Marina	8/1/2006	5	1	Salt	1.2	4.0	0.30
Alamitos Bay Marina	8/1/2006	6	1	Salt	1.2	3.7	0.32
Alamitos Bay Marina	8/1/2006	7	1	Salt	0.6	3.4	0.18
Alamitos Bay Marina	8/1/2006	8	1	Salt	0.4	3.4	0.12
Alamitos Bay Marina	8/29/2006	1	2	Salt	2.3	4.9	0.47
Alamitos Bay Marina	8/29/2006	2	2	Salt	0.5	4.2	0.12
Alamitos Bay Marina	8/29/2006	3	2	Salt	1.0	4.0	0.25
Alamitos Bay Marina	8/29/2006	4	2	Salt	1.5	3.9	0.38
Alamitos Bay Marina	8/29/2006	5	2	Salt	0.4	4.2	0.09
Alamitos Bay Marina	8/29/2006	6	2	Salt	0.1	4.5	0.02
Alamitos Bay Marina	8/29/2006	7	2	Salt	0.1	3.8	0.03
Alamitos Bay Marina	8/29/2006	8	2	Salt	0.1	3.7	0.03

Marina Name	Sampling Date	Site	Event	Water Type	Observed DCu (µg/L)	Predicted EC_{50} M. galloprovincialis (µg/L)	Toxic Units
Alamitos Bay Marina	9/26/2006	1	3	Salt	3.2	4.2	0.76
Alamitos Bay Marina	9/26/2006	2	3	Salt	0.4	4.4	0.09
Alamitos Bay Marina	9/26/2006	3	3	Salt	0.5	4.4	0.11
Alamitos Bay Marina	9/26/2006	4	3	Salt	0.6	4.4	0.14
Alamitos Bay Marina	9/26/2006	5	3	Salt	0.9	4.4	0.21
Alamitos Bay Marina	9/26/2006	6	3	Salt	0.2	4.7	0.04
Alamitos Bay Marina	9/26/2006	7	3	Salt	0.3	4.4	0.07
Alamitos Bay Marina	9/26/2006	8	3	Salt	0.2	4.7	0.04
Downtown Shoreline Marina	8/1/2006	1	1	Salt	7.4	3.9	1.90
Downtown Shoreline Marina	8/1/2006	2	1	Salt	6.3	3.9	1.61
Downtown Shoreline Marina	8/1/2006	3	1	Salt	7.7	4.7	1.63
Downtown Shoreline Marina	8/1/2006	4	1	Salt	2.4	4.5	0.53
Downtown Shoreline Marina	8/1/2006	5	1	Salt	0.5	5.4	0.09
Downtown Shoreline Marina	8/1/2006	6	1	Salt	0.8	5.4	0.15
Downtown Shoreline Marina	8/1/2006	7	1	Salt	0.6	4.7	0.13
Downtown Shoreline Marina	8/1/2006	8	1	Salt	0.7	5.5	0.13
Downtown Shoreline Marina	8/29/2006	1	2	Salt	5.3	5.3	1.00
Downtown Shoreline Marina	8/29/2006	2	2	Salt	7.4	4.3	1.73
Downtown Shoreline Marina	8/29/2006	3	2	Salt	8.9	4.2	2.10
Downtown Shoreline Marina	8/29/2006	4	2	Salt	4.4	5.3	0.84
Downtown Shoreline Marina	8/29/2006	5	2	Salt	0.4	5.7	0.07
Downtown Shoreline Marina	8/29/2006	6	2	Salt	0.5	6.1	0.08
Downtown Shoreline Marina	8/29/2006	7	2	Salt	0.4	6.4	0.06
Downtown Shoreline Marina	8/29/2006	8	2	Salt	0.5	5.1	0.10
Downtown Shoreline Marina	9/26/2006	1	3	Salt	10.9	4.6	2.36
Downtown Shoreline Marina	9/26/2006	2	3	Salt	9.5	4.7	2.04
Downtown Shoreline Marina	9/26/2006	3	3	Salt	8.6	4.2	2.06
Downtown Shoreline Marina	9/26/2006	4	3	Salt	6.0	4.8	1.26
Downtown Shoreline Marina	9/26/2006	5	3	Salt	1.2	12.4	0.10
Downtown Shoreline Marina	9/26/2006	6	3	Salt	0.9	7.6	0.12
Downtown Shoreline Marina	9/26/2006	7	3	Salt	0.9	8.2	0.11
Downtown Shoreline Marina	9/26/2006	8	3	Salt	0.9	3.8	0.24
Marina del Rey Back Basin	8/2/2006	1	1	Salt	18.4	4.8	3.87
Marina del Rey Back Basin	8/2/2006	2	1	Salt	17.9	4.5	3.97
Marina del Rey Back Basin	8/2/2006	3	1	Salt	14.5	4.5	3.19
Marina del Rey Back Basin	8/2/2006	4	1	Salt	14.1	4.8	2.94
Marina del Rey Back Basin	8/30/2006	1	2	Salt	11.5	4.5	2.57
Marina del Rey Back Basin	8/30/2006	2	2	Salt	18.4	4.6	3.97
Marina del Rey Back Basin	8/30/2006	3	2	Salt	12.4	4.7	2.64
Marina del Rey Back Basin	8/30/2006	4	2	Salt	14.2	4.6	3.06
Marina del Rey Back Basin	9/27/2006	1	3	Salt	12.7	4.6	2.77
Marina del Rey Back Basin	9/27/2006	2	3	Salt	13.3	4.6	2.88

Marina Name	Sampling Date	Site	Event	Water Type	Observed DCu (µg/L)	Predicted EC_{50} M. galloprovincialis (µg/L)	Toxic Units
Marina del Rey Back Basin	9/27/2006	3	3	Salt	8.1	8.1	1.00
Marina del Rey Back Basin	9/27/2006	4	3	Salt	12.0	4.3	2.78
Marina del Rey Front Basin	8/2/2006	1	1	Salt	16.2	4.8	3.41
Marina del Rey Front Basin	8/2/2006	2	1	Salt	14.5	4.6	3.19
Marina del Rey Front Basin	8/2/2006	3	1	Salt	14.9	4.4	3.39
Marina del Rey Front Basin	8/2/2006	4	1	Salt	13.8	3.2	4.35
Marina del Rey Front Basin	8/2/2006	5	1	Salt	4.7	4.2	1.11
Marina del Rey Front Basin	8/2/2006	6	1	Salt	1.6	3.4	0.47
Marina del Rey Front Basin	8/2/2006	7	1	Salt	0.5	6.9	0.07
Marina del Rey Front Basin	8/2/2006	8	1	Salt	0.3	3.2	0.09
Marina del Rey Front Basin	8/30/2006	1	2	Salt	13.1	4.5	2.90
Marina del Rey Front Basin	8/30/2006	2	2	Salt	12.5	4.2	2.99
Marina del Rey Front Basin	8/30/2006	3	2	Salt	11.8	4.5	2.60
Marina del Rey Front Basin	8/30/2006	4	2	Salt	11.9	5.0	2.39
Marina del Rey Front Basin	8/30/2006	5	2	Salt	3.8	6.9	0.55
Marina del Rey Front Basin	8/30/2006	6	2	Salt	1.5	5.0	0.30
Marina del Rey Front Basin	8/30/2006	7	2	Salt	0.9	4.4	0.20
Marina del Rey Front Basin	8/30/2006	8	2	Salt	0.4	4.3	0.09
Marina del Rey Front Basin	9/27/2006	1	3	Salt	12.2	4.3	2.83
Marina del Rey Front Basin	9/27/2006	2	3	Salt	11.5	3.9	2.96
Marina del Rey Front Basin	9/27/2006	3	3	Salt	8.9	4.6	1.94
Marina del Rey Front Basin	9/27/2006	4	3	Salt	10.0	4.1	2.46
Marina del Rey Front Basin	9/27/2006	5	3	Salt	3.4	7.4	0.46
Marina del Rey Front Basin	9/27/2006	6	3	Salt	0.4	3.4	0.12
Marina del Rey Front Basin	9/27/2006	7	3	Salt	0.7	4.0	0.18
Marina del Rey Front Basin	9/27/2006	8	3	Salt	0.3	3.4	0.09
Monterey Harbor	8/10/2006	1	1	Salt	6.3	4.7	1.35
Monterey Harbor	8/10/2006	2	1	Salt	7.1	4.4	1.63
Monterey Harbor	8/10/2006	3	1	Salt	4.6	3.9	1.18
Monterey Harbor	8/10/2006	4	1	Salt	4.8	4.1	1.19
Monterey Harbor	8/10/2006	5	1	Salt	0.1	3.7	0.03
Monterey Harbor	8/10/2006	6	1	Salt	0.1	3.4	0.03
Monterey Harbor	8/10/2006	7	1	Salt	0.1	3.1	0.03
Monterey Harbor	8/10/2006	8	1	Salt	0.1	3.5	0.03
Monterey Harbor	9/8/2006	1	2	Salt	3.7	3.0	1.23
Monterey Harbor	9/8/2006	2	2	Salt	3.7	3.2	1.17
Monterey Harbor	9/8/2006	3	2	Salt	3.1	3.2	0.97
Monterey Harbor	9/8/2006	4	2	Salt	2.4	2.8	0.86
Monterey Harbor	9/8/2006	5	2	Salt	0.4	2.8	0.14
Monterey Harbor	9/8/2006	6	2	Salt	0.4	4.3	0.09
Monterey Harbor	9/8/2006	7	2	Salt	0.3	4.6	0.06
Monterey Harbor	9/8/2006	8	2	Salt	0.2	2.2	0.09

Marina Name	Sampling Date	Site	Event	Water Type	Observed DCu (µg/L)	Predicted EC_{50} M. galloprovincialis (µg/L)	Toxic Units
Monterey Harbor	10/19/2006	1	3	Salt	6.3	7.0	0.91
Monterey Harbor	10/19/2006	2	3	Salt	6.7	6.9	0.97
Monterey Harbor	10/19/2006	3	3	Salt	7.8	6.7	1.17
Monterey Harbor	10/19/2006	4	3	Salt	6.4	6.7	0.96
Monterey Harbor	10/19/2006	5	3	Salt	0.5	5.9	0.08
Monterey Harbor	10/19/2006	6	3	Salt	0.4	5.8	0.07
Monterey Harbor	10/19/2006	7	3	Salt	0.4	6.3	0.06
Monterey Harbor	10/19/2006	8	3	Salt	0.5	7.8	0.06
Marina Bay Yacht Harbor	7/25/2006	1	1	Salt	2.7	5.6	0.48
Marina Bay Yacht Harbor	7/25/2006	2	1	Salt	3.1	5.2	0.59
Marina Bay Yacht Harbor	7/25/2006	3	1	Salt	3.6	28.0	0.13
Marina Bay Yacht Harbor	7/25/2006	4	1	Salt	3.1	5.3	0.59
Marina Bay Yacht Harbor	7/25/2006	5	1	Salt	1.8	4.3	0.42
Marina Bay Yacht Harbor	7/25/2006	6	1	Salt	2.5	5.2	0.48
Marina Bay Yacht Harbor	8/22/2006	1	2	Salt	1.7	3.3	0.51
Marina Bay Yacht Harbor	8/22/2006	2	2	Salt	2.5	3.9	0.65
Marina Bay Yacht Harbor	8/22/2006	3	2	Salt	2.4	3.5	0.68
Marina Bay Yacht Harbor	8/22/2006	4	2	Salt	2.6	3.5	0.74
Marina Bay Yacht Harbor	8/22/2006	5	2	Salt	1.5	3.3	0.45
Marina Bay Yacht Harbor	8/22/2006	6	2	Salt	1.6	3.4	0.47
Marina Bay Yacht Harbor	9/18/2006	1	3	Salt	2.1	3.1	0.67
Marina Bay Yacht Harbor	9/18/2006	2	3	Salt	3.4	3.9	0.87
Marina Bay Yacht Harbor	9/18/2006	3	3	Salt	2.9	3.9	0.75
Marina Bay Yacht Harbor	9/18/2006	4	3	Salt	2.3	5.1	0.45
Marina Bay Yacht Harbor	9/18/2006	5	3	Salt	1.3	3.0	0.44
Marina Bay Yacht Harbor	9/18/2006	6	3	Salt	1.9	3.4	0.57
San Francisco Marina	7/26/2006	1	1	Salt	2.0	3.9	0.52
San Francisco Marina	7/26/2006	2	1	Salt	1.2	4.1	0.30
San Francisco Marina	7/26/2006	3	1	Salt	1.1	9.2	0.12
San Francisco Marina	7/26/2006	4	1	Salt	1.1	4.3	0.26
San Francisco Marina	7/26/2006	5	1	Salt	0.8	3.9	0.21
San Francisco Marina	7/26/2006	6	1	Salt	0.7	3.8	0.18
San Francisco Marina	7/26/2006	7	1	Salt	0.8	6.6	0.12
San Francisco Marina	7/26/2006	8	1	Salt	0.8	4.0	0.20
San Francisco Marina	8/23/2006	1	2	Salt	3.9	4.2	0.93
San Francisco Marina	8/23/2006	2	2	Salt	1.2	3.1	0.38
San Francisco Marina	8/23/2006	3	2	Salt	1.0	2.8	0.35
San Francisco Marina	8/23/2006	4	2	Salt	0.9	2.8	0.32
San Francisco Marina	8/23/2006	5	2	Salt	0.9	4.5	0.20
San Francisco Marina	8/23/2006	6	2	Salt	0.7	5.1	0.14
San Francisco Marina	8/23/2006	7	2	Salt	0.7	2.9	0.24
San Francisco Marina	8/23/2006	8	2	Salt	1.0	4.2	0.24

Marina Name	Sampling Date	Site	Event	Water Type	Observed DCu (µg/L)	Predicted EC_{50} M. galloprovincialis (µg/L)	Toxic Units
San Francisco Marina	9/20/2006	1	3	Salt	1.7	4.3	0.39
San Francisco Marina	9/20/2006	2	3	Salt	0.9	2.9	0.31
San Francisco Marina	9/20/2006	3	3	Salt	0.3	4.6	0.07
San Francisco Marina	9/20/2006	4	3	Salt	0.4	3.5	0.11
San Francisco Marina	9/20/2006	5	3	Salt	0.1	4.8	0.02
San Francisco Marina	9/20/2006	6	3	Salt	0.2	4.2	0.05
San Francisco Marina	9/20/2006	7	3	Salt	0.1	4.4	0.02
San Francisco Marina	9/20/2006	8	3	Salt	0.1	4.7	0.02
South Beach Harbor	7/26/2006	1	1	Salt	2.5	4.5	0.56
South Beach Harbor	7/26/2006	2	1	Salt	2.3	4.3	0.53
South Beach Harbor	7/26/2006	3	1	Salt	2.0	4.6	0.44
South Beach Harbor	7/26/2006	4	1	Salt	2.2	6.1	0.36
South Beach Harbor	7/26/2006	5	1	Salt	1.0	4.1	0.24
South Beach Harbor	7/26/2006	6	1	Salt	0.8	3.7	0.22
South Beach Harbor	7/26/2006	7	1	Salt	0.8	4.1	0.19
South Beach Harbor	7/26/2006	8	1	Salt	1.0	3.9	0.26
South Beach Harbor	8/23/2006	1	2	Salt	2.1	4.1	0.52
South Beach Harbor	8/23/2006	2	2	Salt	2.3	3.3	0.71
South Beach Harbor	8/23/2006	3	2	Salt	1.9	3.3	0.58
South Beach Harbor	8/23/2006	4	2	Salt	2.1	2.9	0.72
South Beach Harbor	8/23/2006	5	2	Salt	0.6	4.8	0.13
South Beach Harbor	8/23/2006	6	2	Salt	0.7	2.6	0.27
South Beach Harbor	8/23/2006	7	2	Salt	0.5	4.7	0.11
South Beach Harbor	8/23/2006	8	2	Salt	0.8	4.1	0.19
South Beach Harbor	9/20/2006	1	3	Salt	2.3	3.1	0.74
South Beach Harbor	9/20/2006	2	3	Salt	1.9	3.0	0.64
South Beach Harbor	9/20/2006	3	3	Salt	3.0	4.9	0.61
South Beach Harbor	9/20/2006	4	3	Salt	2.5	5.4	0.46
South Beach Harbor	9/20/2006	5	3	Salt	0.5	6.2	0.08
South Beach Harbor	9/20/2006	6	3	Salt	0.4	4.7	0.09
South Beach Harbor	9/20/2006	7	3	Salt	0.7	6.0	0.12
South Beach Harbor	9/20/2006	8	3	Salt	0.4	3.5	0.11
Coyote Point Marina	7/28/2006	1	1	Salt	1.8	6.7	0.27
Coyote Point Marina	7/28/2006	2	1	Salt	2.6	7.0	0.37
Coyote Point Marina	7/28/2006	3	1	Salt	2.1	6.7	0.31
Coyote Point Marina	7/28/2006	4	1	Salt	1.7	7.3	0.23
Coyote Point Marina	7/28/2006	5	1	Salt	1.5	6.8	0.22
Coyote Point Marina	7/28/2006	6	1	Salt	1.3	6.8	0.19
Coyote Point Marina	7/28/2006	7	1	Salt	1.3	6.7	0.19
Coyote Point Marina	7/28/2006	8	1	Salt	1.4	6.7	0.21
Coyote Point Marina	8/25/2006	1	2	Salt	2.2	7.8	0.28
Coyote Point Marina	8/25/2006	2	2	Salt	2.2	7.6	0.29

Marina Name	Sampling Date	Site	Event	Water Type	Observed DCu (µg/L)	Predicted EC_{50} M. galloprovincialis (µg/L)	Toxic Units
Coyote Point Marina	8/25/2006	3	2	Salt	2.4	7.8	0.31
Coyote Point Marina	8/25/2006	4	2	Salt	2.2	7.8	0.28
Coyote Point Marina	8/25/2006	5	2	Salt	1.3	7.7	0.17
Coyote Point Marina	8/25/2006	6	2	Salt	1.2	7.1	0.17
Coyote Point Marina	8/25/2006	7	2	Salt	1.1	6.8	0.16
Coyote Point Marina	8/25/2006	8	2	Salt	1.1	7.7	0.14
Loch Lomond Marina	7/25/2006	1	1	Salt	10.3	5.8	1.79
Loch Lomond Marina	7/25/2006	2	1	Salt	8.4	5.8	1.46
Loch Lomond Marina	7/25/2006	3	1	Salt	7.2	5.7	1.27
Loch Lomond Marina	7/25/2006	4	1	Salt	8.0	5.5	1.44
Loch Lomond Marina	7/25/2006	5	1	Salt	1.4	7.0	0.20
Loch Lomond Marina	7/25/2006	7	1	Salt	1.8	5.5	0.32
Loch Lomond Marina	7/25/2006	8	1	Salt	2.1	6.4	0.33
Loch Lomond Marina	8/22/2006	1	2	Salt	7.7	7.5	1.03
Loch Lomond Marina	8/22/2006	2	2	Salt	4.0	5.9	0.68
Loch Lomond Marina	8/22/2006	3	2	Salt	4.8	7.6	0.63
Loch Lomond Marina	8/22/2006	4	2	Salt	5.3	6.1	0.87
Loch Lomond Marina	8/22/2006	5	2	Salt	1.8	5.6	0.32
Loch Lomond Marina	8/22/2006	6	2	Salt	1.3	6.5	0.20
Loch Lomond Marina	8/22/2006	7	2	Salt	1.3	6.2	0.21
Loch Lomond Marina	8/22/2006	8	2	Salt	2.1	5.9	0.36
Loch Lomond Marina	9/19/2006	1	3	Salt	6.7	4.5	1.48
Loch Lomond Marina	9/19/2006	2	3	Salt	4.3	7.1	0.60
Loch Lomond Marina	9/19/2006	3	3	Salt	4.4	5.1	0.86
Loch Lomond Marina	9/19/2006	4	3	Salt	3.2	4.7	0.69
Loch Lomond Marina	9/19/2006	5	3	Salt	2.1	5.8	0.37
Loch Lomond Marina	9/19/2006	6	3	Salt	1.5	5.4	0.28
Loch Lomond Marina	9/19/2006	7	3	Salt	1.6	5.1	0.32
Loch Lomond Marina	9/19/2006	8	3	Salt	2.2	5.1	0.43
Santa Barbara Harbor	8/3/2006	1	1	Salt	2.3	3.9	0.59
Santa Barbara Harbor	8/3/2006	2	1	Salt	6.5	3.6	1.81
Santa Barbara Harbor	8/3/2006	3	1	Salt	6.6	4.2	1.59
Santa Barbara Harbor	8/3/2006	4	1	Salt	4.6	3.3	1.38
Santa Barbara Harbor	8/3/2006	5	1	Salt	0.1	3.8	0.03
Santa Barbara Harbor	8/3/2006	6	1	Salt	0.1	2.6	0.04
Santa Barbara Harbor	8/3/2006	7	1	Salt	0.1	3.8	0.03
Santa Barbara Harbor	8/3/2006	8	1	Salt	0.1	2.7	0.04
Santa Barbara Harbor	8/31/2006	1	2	Salt	5.6	3.5	1.61
Santa Barbara Harbor	8/31/2006	2	2	Salt	6.9	3.2	2.19
Santa Barbara Harbor	8/31/2006	3	2	Salt	8.2	3.4	2.42
Santa Barbara Harbor	8/31/2006	4	2	Salt	7.4	3.3	2.26
Santa Barbara Harbor	8/31/2006	5	2	Salt	0.5	3.7	0.13

Marina Name	Sampling Date	Site	Event	Water Type	Observed DCu (µg/L)	Predicted EC_{50} M. galloprovincialis (µg/L)	Toxic Units
Santa Barbara Harbor	8/31/2006	6	2	Salt	0.3	2.9	0.11
Santa Barbara Harbor	8/31/2006	7	2	Salt	0.2	3.4	0.06
Santa Barbara Harbor	8/31/2006	8	2	Salt	0.2	3.7	0.05
Santa Barbara Harbor	9/28/2006	1	3	Salt	4.5	4.3	1.05
Santa Barbara Harbor	9/28/2006	2	3	Salt	7.1	4.1	1.71
Santa Barbara Harbor	9/28/2006	3	3	Salt	6.0	4.0	1.51
Santa Barbara Harbor	9/28/2006	4	3	Salt	5.4	4.6	1.18
Santa Barbara Harbor	9/28/2006	5	3	Salt	0.1	3.1	0.03
Santa Barbara Harbor	9/28/2006	6	3	Salt	0.2	3.6	0.06
Santa Barbara Harbor	9/28/2006	7	3	Salt	0.1	3.4	0.03
Santa Barbara Harbor	9/28/2006	8	3	Salt	0.1	3.4	0.03
Santa Cruz Harbor	8/9/2006	1	1	Salt	3.1	4.2	0.73
Santa Cruz Harbor	8/9/2006	2	1	Salt	3.2	3.8	0.83
Santa Cruz Harbor	8/9/2006	3	1	Salt	4.3	3.5	1.22
Santa Cruz Harbor	8/9/2006	4	1	Salt	3.0	3.5	0.86
Santa Cruz Harbor	8/9/2006	5	1	Salt	0.1	3.4	0.03
Santa Cruz Harbor	8/9/2006	6	1	Salt	0.2	3.3	0.06
Santa Cruz Harbor	8/9/2006	7	1	Salt	0.1	3.1	0.03
Santa Cruz Harbor	8/9/2006	8	1	Salt	0.1	3.3	0.03
Santa Cruz Harbor	9/7/2006	1	2	Salt	5.1	2.7	1.89
Santa Cruz Harbor	9/7/2006	2	2	Salt	5.8	3.0	1.94
Santa Cruz Harbor	9/7/2006	3	2	Salt	4.4	3.1	1.44
Santa Cruz Harbor	9/7/2006	4	2	Salt	4.5	2.9	1.56
Santa Cruz Harbor	9/7/2006	5	2	Salt	0.5	2.8	0.18
Santa Cruz Harbor	9/7/2006	6	2	Salt	0.4	4.8	0.08
Santa Cruz Harbor	9/7/2006	7	2	Salt	0.3	3.2	0.09
Santa Cruz Harbor	9/7/2006	8	2	Salt	0.5	3.0	0.17
Santa Cruz Harbor	10/19/2006	1	3	Salt	4.5	7.3	0.62
Santa Cruz Harbor	10/19/2006	2	3	Salt	4.7	7.3	0.65
Santa Cruz Harbor	10/19/2006	3	3	Salt	4.9	6.8	0.72
Santa Cruz Harbor	10/19/2006	4	3	Salt	5.2	6.8	0.77
Santa Cruz Harbor	10/19/2006	5	3	Salt	0.6	5.6	0.11
Santa Cruz Harbor	10/19/2006	6	3	Salt	0.6	5.7	0.10
Santa Cruz Harbor	10/19/2006	7	3	Salt	0.6	5.8	0.10
Santa Cruz Harbor	10/19/2006	8	3	Salt	0.9	7.0	0.13
Clipper Yacht Harbor	7/27/2006	1	1	Salt	1.3	4.3	0.30
Clipper Yacht Harbor	7/27/2006	2	1	Salt	2.0	4.3	0.47
Clipper Yacht Harbor	7/27/2006	3	1	Salt	2.5	4.4	0.57
Clipper Yacht Harbor	7/27/2006	4	1	Salt	1.8	4.4	0.41
Clipper Yacht Harbor	7/27/2006	5	1	Salt	0.9	4.3	0.21
Clipper Yacht Harbor	7/27/2006	6	1	Salt	0.9	4.2	0.22
Clipper Yacht Harbor	7/27/2006	7	1	Salt	0.8	4.3	0.19

Marina Name	Sampling Date	Site	Event	Water Type	Observed DCu (µg/L)	Predicted EC_{50} M. galloprovincialis (µg/L)	Toxic Units
Clipper Yacht Harbor	7/27/2006	8	1	Salt	0.9	4.4	0.21
Clipper Yacht Harbor	8/25/2006	1	2	Salt	2.7	4.6	0.59
Clipper Yacht Harbor	8/25/2006	2	2	Salt	3.6	4.4	0.82
Clipper Yacht Harbor	8/25/2006	3	2	Salt	6.6	4.4	1.50
Clipper Yacht Harbor	8/25/2006	4	2	Salt	3.2	4.2	0.75
Clipper Yacht Harbor	8/25/2006	5	2	Salt	0.8	4.5	0.18
Clipper Yacht Harbor	8/25/2006	6	2	Salt	0.6	4.2	0.14
Clipper Yacht Harbor	8/25/2006	7	2	Salt	0.5	4.4	0.11
Clipper Yacht Harbor	8/25/2006	8	2	Salt	0.3	4.2	0.07
Clipper Yacht Harbor	9/19/2006	1	3	Salt	1.7	3.2	0.54
Clipper Yacht Harbor	9/19/2006	2	3	Salt	3.7	4.5	0.83
Clipper Yacht Harbor	9/19/2006	3	3	Salt	1.4	4.6	0.30
Clipper Yacht Harbor	9/19/2006	4	3	Salt	1.6	6.1	0.26
Clipper Yacht Harbor	9/19/2006	5	3	Salt	0.8	4.5	0.18
Clipper Yacht Harbor	9/19/2006	6	3	Salt	1.2	6.2	0.19
Clipper Yacht Harbor	9/19/2006	7	3	Salt	0.9	4.9	0.18
Clipper Yacht Harbor	9/19/2006	8	3	Salt	1.2	6.6	0.18
Vallejo Marina	8/7/2006	1	1	Brackish	3.9	10.3	0.38
Vallejo Marina	8/7/2006	2	1	Brackish	4.6	9.6	0.48
Vallejo Marina	8/7/2006	3	1	Brackish	3.3	10.1	0.33
Vallejo Marina	8/7/2006	4	1	Brackish	4.7	10.4	0.45
Vallejo Marina	8/7/2006	5	1	Brackish	1.6	16.0	0.10
Vallejo Marina	8/7/2006	6	1	Brackish	1.5	12.9	0.12
Vallejo Marina	8/7/2006	7	1	Brackish	1.4	12.3	0.11
Vallejo Marina	8/7/2006	8	1	Brackish	1.4	10.8	0.13
Vallejo Marina	9/5/2006	1	2	Brackish	3.0	9.1	0.33
Vallejo Marina	9/5/2006	2	2	Brackish	2.5	9.0	0.28
Vallejo Marina	9/5/2006	3	2	Brackish	4.3	9.6	0.45
Vallejo Marina	9/5/2006	4	2	Brackish	2.3	6.0	0.38
Vallejo Marina	9/5/2006	5	2	Brackish	1.7	7.2	0.24
Vallejo Marina	9/5/2006	6	2	Brackish	1.7	6.7	0.25
Vallejo Marina	9/5/2006	7	2	Brackish	1.7	6.3	0.27
Vallejo Marina	9/5/2006	8	2	Brackish	1.6	6.5	0.25
Vallejo Marina	10/3/2006	1	3	Brackish	2.6	10.9	0.24
Vallejo Marina	10/3/2006	2	3	Brackish	2.7	11.1	0.24
Vallejo Marina	10/3/2006	3	3	Brackish	4.0	10.7	0.38
Vallejo Marina	10/3/2006	4	3	Brackish	3.5	10.1	0.35
Vallejo Marina	10/3/2006	5	3	Brackish	1.3	9.9	0.13
Vallejo Marina	10/3/2006	6	3	Brackish	1.3	9.5	0.14
Vallejo Marina	10/3/2006	7	3	Brackish	1.3	9.9	0.13
Vallejo Marina	10/3/2006	8	3	Brackish	1.3	9.8	0.13