ORANGE COUNTY
NITROGEN AND SELENIUM MANAGEMENT PROGRAM

Summary of Data Resources

FINAL

November 1, 2005

Review of Available Data for Selenium and Nitrogen

Annotated Bibliography

This annotated bibliography was developed to serve as a source of information for work being conducted for the Nitrogen and Selenium Management Program (NSMP) in the San Diego Creek / Newport Bay Watershed (watershed). It includes pertinent sources of data identified for the watershed, including those from other locations if they were found to be relevant in relation to the sources, transport pathways, transformation process, water levels, tissue concentrations (for selenium), and mechanisms of impact for selenium and nitrogen in the watershed. The annotated bibliography describes the purpose of each study, study design, types of data collected, location of data, and applicability of each data set to the Work Plan tasks. This bibliography uses existing data compilations to the greatest extent possible. In particular, available information on foodweb and wildlife impacts in the watershed was highlighted. An attempt was made to include all relevant documents, including peer-reviewed research publications, reports submitted under contracts or grants to regulatory and management agencies, monitoring data gathered by permittees in the watershed, and any other pertinent data identified under Task 1 of the Work Plan. This data review also includes a summary of the existing standards, objectives, and guidelines used to manage selenium and assess its impacts. The bibliography will continue to grow as more documents and studies are identified or completed in the watershed. Studies with no-impact findings will be evaluated with statistical power analysis for robustness.

Data are provided in this memorandum to provide a brief overview of the information provided in the annotated bibliography, including information on the key sources / authors, subjects covered, geographical extent, and available monitoring.

Existing standards and guidelines for evaluating selenium and nitrogen

Both selenium and nitrogen are discharged with extracted groundwater. Separate TMDLs have been developed as a first step in controlling selenium and nitrogen loading in the San Diego Creek watershed and downstream to Newport Bay (note that there isn't a "stand alone" Selenium TMDL – selenium is included in a Toxics TMDL for Newport Bay adopted by the EPA in 2002). The Newport Bay Toxics TMDL (USEPA, 2002) defines loading capacities that ensure attainment of numeric water quality objectives adopted in the California Toxics Rule (CTR; USEPA, 2000). Those water quality objectives are assumed to ensure protection of beneficial uses, although that assumption may need to be re-evaluated through consideration of site-specific water quality objectives. Selenium is highly variable in speciation, bioavailability, fate, and transport among systems. It is likely that a thorough characterization of San Diego Creek and Newport Bay selenium will reveal site-specific determinants of toxicity. For example, the current USEPA draft water quality chronic criterion for selenium is based on fish tissue concentrations, with the opportunity to use site-specific bioaccumulation factors to back-calculate protective water quality values (USEPA, 2004).

In contrast, links between target concentrations and beneficial uses are lacking for nitrogen (SARWQCB, 1998). The current water column concentrations in the Basin Plan for San Diego Creek Reach 1 and Reach 2 are not based on protection of beneficial uses and should be evaluated. The TMDL load reductions are assumed to serve as interim goals prior to results of

site-specific studies. They are based on broad-target reductions of 50 percent loading as a means to attain 1970s-era conditions in Newport Bay.

Selenium

Selenium exceeds the CTR chronic objective for selenium in freshwater in much of the San Diego Creek watershed (Table 1). Farther downstream, in Newport Bay, saltwater objectives are consistently attained. It is recognized that exposure and effects of selenium in the San Diego Creek watershed occur through dissolved and particulate selenium species, uptake and transport of various organic fractions, uptake and sequestration of selenium into biota (and eventually, sediment), and remineralization from the sediment-stored fraction back to the ecosystem. Aquatic macroinvertebrate, clam, fish, and bird egg tissues have been found to exceed guidelines for selenium concentrations that may pose marginal or substantial ecological risk to birds and other wildlife in the watershed (Byron and Irvine, 2005; Byron, 2005; Santolo, 2005; Byard, 2003). It is expected that primary exposure routes to aquatic biota will be through the food chain. These issues will be refined and presented as part of the Conceptual Site Model, now under development.

The media-specific target values for selenium concentration, designed to be protective of aquatic life, were developed and summarized as part of the TMDL for toxic pollutants in San Diego Creek and Upper Newport Bay (USEPA, 2002). The protective concentrations were chosen from a combination of adopted water quality criteria and primary toxicity literature. A weight-of-evidence approach applied to local toxicity and chemical data and screening values was used in developing evidence of impairment and tiers of probable effect levels for the TMDL (Kozelka and Smith, 2002). Screening criteria were required for water, sediment, and tissue concentrations in aquatic biota. Effects to both human health and aquatic life were evaluated. However, tissue and sediment screening values are not promulgated standards (in contrast to those for water). In addition, only water quality exceedances are driving the selenium portion of the Toxics TMDL; it was adopted based on water quality exceedances for the creek and the proximity of the creek to the Bay.

Selenium screening values were adopted for the TMDL and are presented in Table 1.

Table 1. Numeric screening values adopted as part of the Newport Bay Toxics TMDL*.							
	Water, promulgated standards (µg/L)				Sediment, low-level toxicity (mg/kg, dry)	Tissue, consumption advisory levels (µg/g, wet)	
	Fresh, acute (NTR)	**Fresh, chronic (CTR)**	Salt, acute (CTR)	**Salt, chronic (CTR)**	**Marine, AET**	OEHHA	**UN, MIS** (fish/**shellfish**)
Total selenium	20	**5**	290**	**71****	**1**	20	2/**0.3**

*** As cited in Kozelka and Smith, 2002**

AET = apparent effects threshold.

CTR = California Toxics Rule (USEPA, 2000).

NTR = National Toxics Rule (USEPA, 1995).

OEHHA = California Office of Environmental Health Hazard Assessment.

UN MIS = United Nations, Median International Standards.

Bold values are targets chosen for the TMDL.

** As dissolved Se; others as total recoverable Se.

It is recognized that TMDL implementation will require both load and concentration goals to reduce selenium loads to downstream water bodies. Although chronic criteria values were chosen as water targets, the TMDL will use acute, freshwater values (20 µg/L, Table 1) as targets for high-volume storm flows that quickly move through the watershed but that constitute high loading events.

Nitrogen

Nitrogen loading targets were developed for the watershed as part of the Nutrient TMDL in an evaluation process similar to that used later for selenium. Nitrogen, like selenium, is a concern from dissolved contributions to the watershed, primarily as nitrate. Unlike selenium, however, nitrogen compounds are not a concern in tissue or sediment. Instead, the Nutrient TMDL specifies that dissolved nitrate is a potential nutrient stimulant causing excessive algal growth in the creek and bay (assuming nitrogen limitations to growth). The TMDL adopted loading targets for both total phosphorus and total nitrogen as a means of controlling excessive algal growth in Newport Bay and San Diego Creek (SARWQCB, 1998).

Total inorganic nitrogen (TIN) concentrations exceed Basin Plan numeric objectives in the upper portion (Reach 2) of San Diego Creek, and have been shown to promote excessive growth of algae in Newport Bay, although impacts on beneficial uses related to freshwater and estuarine habitats, recreation, and navigation have declined in recent years due to reductions in nitrogen loads. It should be noted that the Basin Plan numeric objectives for TIN concentrations are not based on values known to cause a degradation of beneficial uses.

The basis for Nutrient TMDL targets was to require a 50 percent reduction in watershed loading of nitrogen and phosphorus compounds as a tool for reducing downstream algal growth. The 50 percent load reduction target is based on comparing historical loading estimates as observed during better water quality conditions to loading during recent periods of impairment. No specific stream or bay concentration goals were adopted, although the TMDL called for the study of new standards as may be appropriate for nitrogen and phosphorus. The 1995 Basin Plan goals require a total inorganic nitrogen (nitrate plus ammonia) standard of 13 mg/L and 5 mg/L for Reaches 1 and 2 (below and above Jeffrey Road; respectively) for San Diego Creek (SARWQCB, 1995). These water quality concentration goals for nitrogen were not updated as part of the 1998 Nutrient TMDL (SARWQCB, 1998). There is no nitrogen concentration standard or goal for the marine waters of Newport Bay. Rather, the goal is appropriately addressed as a load reduction from watershed discharges (although the link between load and algal growth awaits future, site-specific studies).

Summary of the bibliography for selenium and nitrogen

Selenium

Studies Sources / Authors: The annotated bibliography currently contains over 58 unique references related to selenium from 12 main sources. The main study contributors include County of Orange, Irvine Ranch Water District (IRWD), Southern California Coastal Water Research Project Authority (SCCWRP), and SARWQCB. In addition, an annotated bibliography designed by Tetra Tech, Inc. for the County of Orange as well as a few bibliographic and literature review sources were identified and have been included. In addition, reference lists from applicable TMDL studies have been reviewed for additional sources and these will be incorporated as well.

Subjects covered: A wide variety of subjects are covered by the sources obtained. The key subject areas include the following:

- Monitoring data throughout the watershed and Newport Bay for particulate and dissolved waterborne selenium, sediment selenium, and bioaccumulated tissue selenium
- Seasonal patterns and site-specific concentrations and loads
- Relationships between ambient selenium concentrations and toxicity
- The influence of selenium in Newport Bay sediments on bioavailability and toxicity
- Contaminant levels in Newport Bay fish
- Effects of San Diego Creek wetlands on selenium bioavailability and toxicity
- Groundwater monitoring data

- Examples from studies and modeling of the San Francisco Bay estuary system for selenium fate, transport, bioavailability and toxicity

Geographical extent: It was the intent of the bibliography not only to include local studies and data specific to Newport Bay Watershed, but also to gather background information for developing a model of selenium transport, bioavailability, and toxicity. The list below provides a summary of the geographical extent of relevant studies.

Local: Newport Bay / San Diego Creek Watershed

State: Central California, San Francisco Bay

National: Various selenium-impacted areas throughout the country, particularly in the western U.S.

Data available: The significant water quality information that is available for the Newport Bay Watershed comes from the County of Orange through their NPDES / TMDL monitoring program. IRWD has also collected data, as has the California Department of Transportation (Caltrans) at a highway dewatering facility within the watershed. Local studies conducted by SCCWRP provide additional data. A report that summarizes water quality data collected in Upper Newport Bay by a number of public agencies prior to July 1996 is included in the bibliography.

Nitrogen

Studies Sources / Authors: The annotated bibliography currently contains over 60 unique references related to nitrogen. The main study contributors include County of Orange, USEPA Region 9, SCCWRP, and Tetra Tech, Inc. In addition, a few bibliographic and literature review sources were identified and have been included; however, the reports referenced in these sources have not yet been obtained. An effort will be made to incorporate useful references from those sources in the final bibliography. Specifically, they include an annotated bibliography designed by Tetra Tech, Inc. for the County of Orange; a recent literature review on nutrient impacts in water bodies, and a review of recently completed Nutrient TMDLs. In addition, reference lists from applicable TMDL studies and from USEPA nutrient criteria documents have been reviewed for additional sources and these will be incorporated as well.

Subjects covered: A wide variety of subjects are covered by the sources obtained. The key subject areas include the following:

- Relationships between land use, nutrients, and algae in streams
- Nitrogen cycling / transport / uptake in streams
- Eutrophication of bays and coastal areas (including local studies as well as areas other than Newport Bay)
- Extent and magnitude of algal growth
- Nutrient TMDL approach and evaluation
- Monitoring guidance
- Nutrient criteria development
- Beneficial use impairment

Geographical extent: It was the intent of the bibliography not only to include local studies and data specific to Newport Bay Watershed, but also to gather background information for developing a model of nitrogen transport and algal relations. The list below provides a summary of the geographical extent of the studies divided into local, regional, state, national, and international categories.

Local: Newport Bay / San Diego Creek Watershed

Regional: Malibu Creek Watershed, Calleguas Creek Watershed, Los Angeles River and tributaries

State: Central California, San Francisco Bay

National: Chesapeake Bay, Florida, Maryland, Texas, Federal Water Quality Coalition, Ohio River Basin

International: New Zealand

Data available: The significant water quality information that is available for the Newport Bay Watershed comes from the County of Orange through their NPDES / TMDL monitoring program. IRWD has also collected data. Local studies conducted by SCCWRP provided additional data. A report that summarizes water quality data collected in Upper Newport Bay by a number of public agencies prior to July 1996 is included in the bibliography.

References

Byard, J. L. 2003. Selenium Concentrations in Waterfowl Eggs from the San Joaquin Wildlife Refuge: A Preliminary Assessment of the Potential Hazard to Aquatic Biota. Prepared for the Irvine Co. January 24, 2003.

Byron, E. R. 2005. Data Report: 2004 Sampling for Sediment and Tissue Chemistry from San Diego Creek and Upper Newport Bay. Prepared for Terri Reeder, SARWQCB. May 20, 2005.

Byron, E. R., and C. Irvine. 2005. Selenium, Heavy Metals, and Chlorinated Pesticides in Tissue and Sediment Samples of Sedimentation Basin No. 2, San Diego Creek (Orange County, California). Final Report to SARWQCB, Submitted by Martha Sutula, SCCWRP. July 28, 2005.

Fan A. M., and S. A. Book. 1986. Human Health Significance of Selenium in Scoters and Scaups in San Francisco Bay Region. California Office of Environmental Health Hazard Assessment, Dept. of Health Services, Berkeley, CA.

Kozelka, P., and D. Smith. 2002. Part H: Decision Document of Water Quality Assessment for San Diego Creek and Newport Bay. *In* "Toxic Pollutants TMDL for San Diego Creek and Newport Bay, CA." USEPA. June 14, 2002.

Santa Anna Regional Water Quality Control Board (SARWQCB). 1995. Santa Ana Region Basin Plan. April 17, 1995.

SARWQCB. 1998. Nutrient TMDL for the Newport Bay / San Diego Creek watershed.

SARWQCB. 2004. Santa Ana Region Water Management Plan. 2004. Resolution R8-2004-0001.

Santolo, G. M. 2005, Summary of Contaminant Results for Eggs Collected from the San Diego Creek Watershed, 2004. Prepared for Terri Reeder, SARWQCB. January 28, 2005.

U.S. Environmental Protection Agency (USEPA). 1995. Stay of Federal Water Quality Criteria for Metals; Water Quality Standards; Establishment of Numeric Criteria for Priority Pollutants; States' Compliance-Revision of Metals Criteria; Final Rules. Federal Register 60(86): 22228-22237.

USEPA. 2000. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Rule. Federal Register 65(97):31682-31719.

USEPA. 2002. Total Maximum Daily Loads for Toxic Pollutants. San Diego Creek and Newport Bay, California. USEPA, Region 9. June 14, 2002.

USEPA. 2004. Draft Aquatic Life Water Quality Criteria for Selenium - 2004. EPA-822-D-04-001. Office of Water. November.

1. Headers with green highlights are fields received approval from the County (Except for "Subject" and "Applicability to the Workplan" headers, which we are combining them together into one.
2. Blue text is the master record for the detailed record that follows in the subsequent rows.
3. A "Filter" Field is added. This will allow users to filter for Master Record (by "1 - " or "1 and 2 - ") or detailed records (anything that starts with a "2" or "1 and 2")
4. Subject, Secondary Subject, and Applicability to the Workplan are combined into one column called "Subject/Applicability to the Workplan"
5. Light orange in the Nitrogen reference section represents documents available in the Newport Annotated Bibliography developed by Tetra Tech
6. Light yellow in the Nitrogen reference section represents documents that have been identified but not yet obtained and reviewed

Summary of Data Resources for the Newport Bay Watershed

Orange County Nitrogen and Selenium Management Program

Filter	Short Reference Source	Reference Source (Author, Yr, Title, Source)	Reference Contact	Summary	Subject/ Applicability to the Workplan/Purpose	Study Location	Location_ 01 (State level)	Location _02 (at local-level)	Location_03 (Wateshed)	Location_04 (Tributary)	No. of Data Points	Study Year	Time of Year	Type of Study	Co-Located Study?	Constituents Monitored	Sampling Frequency	Media
1	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Orange County's long-term monitoring NPDES and STORET data on selenium from surface water (total and dissolved) and sediment collected in the Newport Bay Watershed. Average daily discharge rate for San Diego Creek and 24-hr precipitation total in Santa Ana are available.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Channels and tributaries		1973 - 2004	Wet and Dry Season	Field Study	Not Applicable	Se (total), Se (dissolved)	Varies	Surface Water and sediment
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	The only dissolved Se collected at this channel was in 2004 from this data set.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Central Irvine Channel	1	1986-2004	Dry Season	Field Study	Not Applicable	Se (Dissolved)	One-Time	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Dissolved and total Se were collected in 2002 year-round in both wet and dry months. Dissolved Se was collected twice in 2003.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	East Costa Mesa Channel	26	2002 - 2003	Dry Season	Field Study	Not Applicable	Se (Dissolved)	Monthly (but not all)	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Monitoring were conducted monthly in 2002 for Se (dissolved) and Se (total); in 2003, data were collected for 9 months (4 dry months, 5 wet months) also for Se (total) and Se (dissolved). In 2001 and 2004, data were collected one time for dissolved and total Se but only in a wet month (Dec). Campus Drive and Harvard Ave stations were combined in this summary.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	San Diego Creek	30	2002 - 2003	Dry Season	Field Study	Not Applicable	Se (Dissolved)	Monthly (but not all)	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Dissolved and total Se were each collected in May, 2003, twice.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Santa Isabella Channel	2	2003	Dry Season	Field Study	Not Applicable	Se (Dissolved)	Varies	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	The only dissolved Se collected by Orange County in the wet month was in 2003	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Central Irvine Channel	2	1986-2004	Wet Season	Field Study	Not Applicable	Se (Dissolved)	Varies	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Dissolved and Total Se were collected in 2002 year-round in both wet and dry months. Total Se was collected four times (Jan - April) in 2003. Dissolved Se was collected 6 times in December, 2001.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	East Costa Mesa Channel	51	2001 - 2003	Wet Season	Field Study	Not Applicable	Se (Dissolved)	Varies	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Only one sample was collected in 2002 and 4 samples were collected in 2003.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Lane Channel	5	2002 - 2003	Wet Season	Field Study	Not Applicable	Se (Dissolved)	Varies	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Only two samples were collected in 2002 and two more in 2003.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Peters Canyon Wash	4	2002 - 2003	Wet Season	Field Study	Not Applicable	Se (Dissolved)	Varies	Surface Water

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2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Monitoring were conducted monthly in 2002 for Se (dissolved) and Se (total); in 2003, data were collected for 9 months (4 dry months, 5 wet months) also for Se (total) and Se (dissolved). In 2001 and 2004, data were collected one time for dissolved and total Se but only in a wet month (Dec). Campus Drive and Harvard Ave stations were combined.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	San Diego Creek	46	2001 - 2004	Wet Season	Field Study	Not Applicable	Se (Dissolved)	Varies	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Sample collection started monthly in Nov, 2002 and ended in April, 2003. Up to 4 samples were collected in a month for a total of 15 samples.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Santa Isabella Channel	15	2002 - 2003	Wet Season	Field Study	Not Applicable	Se (Dissolved)	Monthly	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Sampling for total Se from 1986-2004 in dry months is more frequent than dissolved Se collected in dry and wet months combined.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Central Irvine Channel	27	1986 - 2004	Dry Season	Field Study	Not Applicable	Se (Total)	Varies	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	The only Se sampled in this channel was total Se collected in a dry month in 1987.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Hines Nursery Channel	1	1987	Dry Season	Field Study	Not Applicable	Se (Total)	One-Time	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	One sample was collected yearly from 1977-1987.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Lane Channel	12	1977 - 1987	Dry Season	Field Study	Not Applicable	Se (Total)	Yearly	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Total Se was collected from '73 - '87, except in '76. Samples were taken in all the 6 dry months in 2002 and collection was made in 4 dry months in 2003. Campus Drive and Harvard Ave stations were combined in this summary.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	San Diego Creek	47	1973 - 2003	Dry Season	Field Study	Not Applicable	Se (Total)	Varies	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Sampling was done at least once a year from '73 - '87, except '86 where no sample was collected.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Santa Ana Delhi Channel	18	1973 - 1987	Dry Season	Field Study	Not Applicable	Se (Total)	Yearly (sometime more frequent)	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Dissolved and total Se were each collected in May, 2003, twice.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Santa Isabella Channel	2	2003	Dry Season	Field Study	Not Applicable	Se (Total)	One-Time	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	The only total Se collected in wet month by Orange County is in 2004.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Central Irvine Channel	2	1986-2004	Wet Season	Field Study	Not Applicable	Se (Total)	One-Time	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Up to four samples were collected in a year between '78 through '03 for a total of 9 samples.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Lane Channel	9	1978 - 2003	Wet Season	Field Study	Not Applicable	Se (Total)	Varies	Surface Water

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2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Total Se was collected for a total of 7 years in a span of 28 years ("74 - '01). Samples were taken in all the 6 wet months in 2002 and collection was made in 5 wet months in 2003. Campus Drive and Harvard Ave stations were combined in this summary.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	San Diego Creek	54	1974 - 2004	Wet Season	Field Study	Not Applicable	Se (Total)	Varies	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Collection spanned from '74 - '03 but only sampled in 9 of the 30 yr span.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Santa Ana Delhi Channel	19	1974 - 2003	Wet Season	Field Study	Not Applicable	Se (Total)	Varies	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Sample collection started monthly in Nov, 2002 and ended in April, 2003. Up to 5 samples were collected in a month for a total of 17 samples.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Santa Isabella Channel	17	2002 - 2003	Wet Season	Field Study	Not Applicable	Se (Total)	Monthly	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	The only Se collected in a dry month at this channel in all available data.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Bonita Canyon Channel	1	1989	Dry Season	Field Study	Not Applicable	Se (Total)	One-time	Sediment
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Samples were collected annually for 3 years during dry months.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Lane Channel	3	1979 - 1981	Dry Season	Field Study	Not Applicable	Se (Total)	Yearly	Sediment
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Se was collected at least once a year for 9 years from '78-'86. Campus Drive and Harvard Ave stations were combined in this summary.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	San Diego Creek	11	1978 - 1986	Dry Season	Field Study	Not Applicable	Se (Total)	Varies	Sediment
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	The only Se collected in a wet month at this channel in all available data.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Bonita Canyon Channel	1	1983	Wet Season	Field Study	Not Applicable	Se (Total)	One-time	Sediment
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Samples were collected annually for 2 years.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Lane Channel	2	1982 - 1983	Wet Season	Field Study	Not Applicable	Se (Total)	Yearly	Sediment
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Se was collected once a year for 3 years from '82-'84 in wet months. Campus Drive and Harvard Ave stations were combined in this summary.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	San Diego Creek	3	1982 - 1984	Wet Season	Field Study	Not Applicable	Se (Total)	Yearly	Sediment
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	For 2002 and 2003, sample collection frequency was similar to that of San Diego Creek: Samples were taken in all the 6 dry months in 2002 and collection was made in 4 dry months in 2003.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	East Costa Mesa Channel	28	1976 - 2003	Dry Season	Field Study	Not Applicable	Se (Total)	Varies	Surface Water

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2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Total Se was collected in 2 dry months (1 month apart) in 2003.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Peters Canyon Wash	16	2003	Dry Season	Field Study	Not Applicable	Se (Total)	Varies	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Sampled annually from '76 - '78 and from '82 - '84.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Big Canyon Wash	6	1976 - 1984	Wet Season	Field Study	Not Applicable	Se (Total)	Yearly	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Samples were taken 3 times in '83, thereafter sampled annually from '84-'89, except '86 for which no samples were taken.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Bonita Canyon Channel	7	1983 - 1989	Wet Season	Field Study	Not Applicable	Se (Total)	Yearly (most of the time)	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	All 7 samples were collected in 2001 were done in a wet month. For 2002 and 2003, sample collection frequency was similar to that of San Diego Creek: Samples were taken in all the 6 wet months in 2002 and collection was made in 4 wet months in 2003.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	East Costa Mesa Channel	52	2001 - 2003	Wet Season	Field Study	Not Applicable	Se (Total)	Varies	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Total Se was collected in 3 times all in November, 2002, and 2 times in February, 2003.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Peters Canyon Wash	5	2002 - 2003	Wet Season	Field Study	Not Applicable	Se (Total)	Varies	Surface Water
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Samples were collected one time in '78 and '81-'82, but semi-annual collection was conducted for 2 years in '79 and '80.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Big Canyon Wash	7	1978 - 1982	Dry Season	Field Study	Not Applicable	Se (Total)	Varies	Sediment
2	County of Orange, 2005	Moore, B. 2005. Email to Tom Bonigut, RBF. RE: Merged Dataset from STORET and NPDES Stations in the Newpport Bay Watershed. Orange County, RDMD. Sept. 19, 2005.	Bruce Moore	Se was collected annually for two years during a wet month.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	Big Canyon Wash	2	1982 - 1983	Wet Season	Field Study	Not Applicable	Se (Total)	Yearly	Sediment
1	Bay et al., 2003	Bay, S., D. Greenstein, D. Vidal, D. Schlenk. 2003. Investigation of Metals Toxicity in San Diego Creek. Technical Report # 407, Southern California Coastal Water Research Project. August 29.	http://www.sccwrp.org/pubs/techrpt.htm	A two-part study was conducted to investigate the contribution of selenium and other trace metals to toxicity in San Diego Creek. The first part of the study included the analysis of dry and wet weather samples from San Diego Creek for toxicity assessment, toxicity identification, and metals concentrations. The second part of the study consisted of a laboratory study to study the effects of selenium bioaccumulation on larval rainbow trout. The objective of the bioaccumulation study was to determine the relationship between selenium exposure and impacts on endpoints of significance to fish populations. San Diego Creek water samples were found to be frequently toxic to either the water flea (Ceriodaphnia dubia) or a green alga (Selenastrum capricornutum). Trace metal concentrations were below TMDL numeric targets and are not believed to contribute to toxicity. Chlorides and unidentified organics, such a spyrethroid pesticides, may be present in the samples. Elevated selenium concentrations (>5ug/L) have been measured in San Diego Creek and the impact on larval rainbow trout Fish exposed to SeMe through their food for 90-days exhibited a red in body weight and fork length at all levels of exposure when compar control samples.	Toxicity (Se); Bioaccumulation (Se); Dietary exposure (Se); CSM (Se)	Local; not applicable for laboratory study	CA; not applicable for laboratory study	SD Creek (Reach)	Newport Bay Watershed	San Diego Creek	8; 79	2001 (laboratory study); 2002-2003 (field study)	Wet and Dry Season	Field Study; laboratory study	No	Se (total); Se (dissolved); Selenomethionine (laboratory study)	Five times; not applicable for toxcity tests	Surface Water; tissue

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2	Bay et al., 2003	Bay, S., D. Greenstein, D. Vidal, D. Schlenk. 2003. Investigation of Metals Toxicity in San Diego Creek. Technical Report # 407, Southern California Coastal Water Research Project. August 29.	http://www.sccwrp.org/pubs/techrpt.htm	A two-part study was conducted to investigate the contribution of selenium and other trace metals to toxicity in San Diego Creek. The first part of the study included the analysis of dry and wet weather samples from San Diego Creek for toxicity assessment, toxicity identification, and metals concentrations. The second part of the study consisted of a laboratory study to study the effects of selenium bioaccumulation on larval rainbow trout. The objective of the bioaccumulation study was to determine the relationship between selenium exposure and impacts on endpoints of significance to fish populations. San Diego Creek water samples were found to be frequently toxic to either the water flea (Ceriodaphnia dubia) or a green alga (Selenastrum capricornutum). Trace metal concentrations were below TMDL numeric targets and are not believed to contribute to toxicity. Chlorides and unidentified organics, such a spyrethroid pesticides, may be present in the samples. Elevated selenium concentrations (>5ug/L) have been measured in San Diego Creek and the impact on larval rainbow trout Fish exposed to SeMe through their food for 90-days exhibited a red in body weight and fork length at all levels of exposure when compar	Toxicity (Se); Bioaccumulation (Se); Dietary exposure (Se); CSM (Se)	Local	CA	SD Creek (Reach)	Newport Bay Watershed	San Diego Creek	8	2002-2003	Wet and Dry Season	Field Study	No	Se (total); Se (dissolved)	Five times	Surface Water
2	Bay et al., 2003	Bay, S., D. Greenstein, D. Vidal, D. Schlenk. 2003. Investigation of Metals Toxicity in San Diego Creek. Technical Report # 407, Southern California Coastal Water Research Project. August 29.	http://www.sccwrp.org/pubs/techrpt.htm	A two-part study was conducted to investigate the contribution of selenium and other trace metals to toxicity in San Diego Creek. The first part of the study included the analysis of dry and wet weather samples from San Diego Creek for toxicity assessment, toxicity identification, and metals concentrations. The second part of the study consisted of a laboratory study to study the effects of selenium bioaccumulation on larval rainbow trout. The objective of the bioaccumulation study was to determine the relationship between selenium exposure and impacts on endpoints of significance to fish populations. Fish exposed to SeMe through their food for 90-days exhibited a reduction in body weight and fork length at all levels of exposure when compared to control samples.	Toxicity (Se); Bioaccumulation (Se); Dietary exposure (Se); CSM (Se)	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	79	2001	NA	Laboratory Study	Not Applicable	Selenomethionine	Not Applicable	Tissue
1,2	Bay et al., 2004	Bay, S., D. Greenstein, J. Brown. 2004. Newport Bay Sediment Toxicity Studies. Technical Report # 433 Southern California Coastal Water Research Project. June 4.	http://www.sccwrp.org/pubs/techrpt.htm	Assessment of sediment toxicity in Newport Bay-Sediment samples were collected from multiple locations throughout Newport Bay. Sampling and testing was conducted during both the wet and dry seasons in order to evaluate the impact of stormwater runoff on sediment quality. The results of this task were also used to select locations for subsequent sediment toxicity identification evaluation (TIE) studies. Influence of contaminated sediment on water quality-This task measured water column toxicity at various sites in Newport Bay during dry weather, when stormwater inputs were not present. The concentration of trace organics (DDTs, PCBs, PAHs) in bay waters was determined at selected locations by the use of in-situ sampling pumps. In addition, laboratory tests were conducted to determine whether Newport Bay sediments released toxic materials into the water column. Identification of sediment and water column toxicants-Research was conducted to determine the cause of sediment-associated toxicity at several locations within Newport Bay.	Toxicity (Se); Bioaccumulation (Se); Dietary exposure (Se); CSM (Se)	Local	CA	Upper Newport Bay	Newport Bay Watershed	Upper Newport Bay	20	2000-2001	Wet and Dry Season	Field Study	NA	Se (total)	Two times	Sediment
1	Bay et al., 2002	Bay, S., D. Vidal, D. Schlenk. 2002. Effects of Selenium Accumulation on Larval Rainbow Trout (Oncorhynchus mykiss). Technical Report 373, Southern California Coastal Water Research Project. December 9.	http://www.sccwrp.org/pubs/techrpt.htm	The study consisted of a laboratory study to study the effects of selenium bioaccumulation on larval rainbow trout. The objective of the bioaccumulation study was to determine the relationship between selenium exposure and impacts on endpoints of significance to fish populations. San Diego Creek water samples were found to be frequently toxic to either the water flea (Ceriodaphnia dubia) or a green alga (Selenastrum capricornutum). Trace metal concentrations were below TMDL numeric targets and are not believed to contribute to toxicity. Chlorides and unidentified organics, such a spyrethroid pesticides, may be present in the samples. Elevated selenium concentrations (>5ug/L) have been measured in San Diego Creek and the impact on larval rainbow trout was evaluated. Fish exposed to SeMe through their food for 90-days exhibited a reduction in body weight and fork length at all levels of exposure when compared to control samples.	Toxicity (Se); Bioaccumulation (Se); Dietary exposure (Se); CSM (Se)	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	79	2001	NA	Laboratory Study	Yes	Selenomethionine	Not Applicable	Tissue

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2	Bay et al., 2002	Bay, S., D. Vidal, D. Schlenk. 2002. Effects of Selenium Accumulation on Larval Rainbow Trout (Oncorhynchus mykiss). Technical Report 373, Southern California Coastal Water Research Project. December 9.	http://www.sccwrp.org/pubs/techrpt.htm	The study consisted of a laboratory study to study the effects of selenium bioaccumulation on larval rainbow trout. The objective of the bioaccumulation study was to determine the relationship between selenium exposure and impacts on endpoints of significance to fish populations. San Diego Creek water samples were found to be frequently toxic to either the water flea (Ceriodaphnia dubia) or a green alga (Selenastrum capricornutum). Trace metal concentrations were below TMDL numeric targets and are not believed to contribute to toxicity. Chlorides and unidentified organics, such a spyrethroid pesticides, may be present in the samples. Elevated selenium concentrations (>5ug/L) have been measured in San Diego Creek and the impact on larval rainbow trout was evaluated. Fish exposed to SeMe through their food for 90 days exhibited a reduction in body weight and fork length at all levels of exposure when compared to control samples.	Toxicity (Se); Bioaccumulation (Se); Dietary exposure (Se); CSM (Se)	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	79	2001	NA	Laboratory Study	Yes	Selenomethionine	Not Applicable	Tissue
1,2	Allen et al., 2004	Allen, M. J., D. W. Diehl, E. Y. Zeng. 2004. Biaccumulation by Recreational and Forage Fish in Newport Bay, Califrornia in 2000-2002. Technical Report 436. Southern California Coastal Water Research Project. June 30.	http://www.sccwrp.org/pubs/techrpt.htm	The objectives of this study are to 1) provide recent data on the distribution and contaminant levels in Newport Bay fishes, 2) identify species that pose a potential health concern because they have contaminant concentrations above screening values (SVs) for human or wildlife consumption of fish, 3) identify what fish contaminants may warrant regulatory focus, and 4) identify species or ecological groups of fishes for possible future monitoring or experimentation. The study focused on recreational fish species during the first year, with a focus on comparing contaminant levels in fish to SVs for human fish consumption. The second year targeted forage fish species consumed by wildlife predators, and hence focused on SVs for wildlife fish consumption. Selenium was one of the fish contaminants that might warrant regulatory focus. Trace metal concentrations were below levels of concern for human fish consumption and generally for wildlife fish consumption. Topsmelt, California killifish, and arrow goby (Clevelandia ios) caught in the upper bay had selenium levels above the wildlife SV. N some ecological patterns. Fishes with levels of selenium above SVs f fish consumption tend to feed or live near the edge of the bay. Furth	Tissue Concentration (Se); Aquatic Foodweb (Se); CSM (Se)	Local	CA	Upper Newport Bay	Newport Bay Watershed	Upper Newport Bay	74	2000-2002	Wet and Dry Season	Field Study	No	Se (total)	Four times	Tissue
1	Sutula et al., 2004	Sutula, M., S. Bay, G. Santolo, and R. Zembal. 2004. Organochlorine, trace elements and metal Contaminants in the Food Web of the Light-footed Clapper Rail, Upper Newport Bay, California		The objective of this study is to: 1) determine the concentration and degree of bioaccumulation of heavy and trace metals (including selenium), and organochlorine compounds in three components of the Upper Newport Bay ecosystem: non-viable clapper rail eggs, benthic macrofauna and sediments and 2) evaluate contaminant impacts on clapper rails by examining nonviable eggs for evidence of egg shell-thinning or embryo developmental abnormalities. This study found that selenium is present and biomagnifying in the food web of the Light-footed Clapper Rail in Upper Newport Bay. Levels of Se in sediments and prey organisms are within a range of concern, but the concentrations of these contaminants in clapper rail eggs were below levels considered to impair reproduction.	Aquatic Foodweb (Se); CSM (Se)	Local	CA	Upper Newport Bay	Newport Bay Watershed	Upper Newport Bay	6; 13; 6	2003-2004	NA	Field Study	Yes	Se (total)	Two times	Sediment; Tissue (egg); Tissue (prey)
2	Sutula et al., 2004	Sutula, M., S. Bay, G. Santolo, and R. Zembal. 2004. Organochlorine, trace elements and metal Contaminants in the Food Web of the Light-footed Clapper Rail, Upper Newport Bay, California		The objective of this study is to: 1) determine the concentration and degree of bioaccumulation of heavy and trace metals (including selenium), and organochlorine compounds in three components of the Upper Newport Bay ecosystem: non-viable clapper rail eggs, benthic macrofauna and sediments and 2) evaluate contaminant impacts on clapper rails by examining nonviable eggs for evidence of egg shell-thinning or embryo developmental abnormalities. This study found that selenium is present and biomagnifying in the food web of the Light-footed Clapper Rail in Upper Newport Bay. Levels of Se in sediments and prey organisms are within a range of concern, but the concentrations of these contaminants in clapper rail eggs were below levels considered to impair reproduction.	Aquatic Foodweb (Se); CSM (Se)	Local	CA	Upper Newport Bay	Newport Bay Watershed	Upper Newport Bay	6	2003-2004	NA	Field Study	Yes	Se (total)	Two times	Tissue (egg)

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2	Sutula et al., 2004	Sutula, M., S. Bay, G. Santolo, and R. Zembal. 2004. Organochlorine, trace elements and metal Contaminants in the Food Web of the Light-footed Clapper Rail, Upper Newport Bay, California		The objective of this study is to: 1) determine the concentration and degree of bioaccumulation of heavy and trace metals (including selenium), and organochlorine compounds in three components of the Upper Newport Bay ecosystem: non-viable clapper rail eggs, benthic macrofauna and sediments and 2) evaluate contaminant impacts on clapper rails by examining nonviable eggs for evidence of egg shell-thinning or embryo developmental abnormalities. This study found that selenium is present and biomagnifying in the food web of the Light-footed Clapper Rail in Upper Newport Bay. Levels of Se in sediments and prey organisms are within a range of concern, but the concentrations of these contaminants in clapper rail eggs were below levels considered to impair reproduction.	Aquatic Foodweb (Se); CSM (Se)	Local	CA	Upper Newport Bay	Newport Bay Watershed	Upper Newport Bay	13	2003-2004	NA	Field Study	Yes	Se (total)	Two times	Sediment
2	Sutula et al., 2004	Sutula, M., S. Bay, G. Santolo, and R. Zembal. 2004. Organochlorine, trace elements and metal Contaminants in the Food Web of the Light-footed Clapper Rail, Upper Newport Bay, California		The objective of this study is to: 1) determine the concentration and degree of bioaccumulation of heavy and trace metals (including selenium), and organochlorine compounds in three components of the Upper Newport Bay ecosystem: non-viable clapper rail eggs, benthic macrofauna and sediments and 2) evaluate contaminant impacts on clapper rails by examining nonviable eggs for evidence of egg shell-thinning or embryo developmental abnormalities. This study found that selenium is present and biomagnifying in the food web of the Light-footed Clapper Rail in Upper Newport Bay. Levels of Se in sediments and prey organisms are within a range of concern, but the concentrations of these contaminants in clapper rail eggs were below levels considered to impair reproduction.	Aquatic Foodweb (Se); CSM (Se)	Local	CA	Upper Newport Bay	Newport Bay Watershed	Upper Newport Bay	6	2003-2004	NA	Field Study	Yes	Se (total)	Two times	Tissue (prey)
1	Stewart et al., 2004	Stewart, A.R, S. N Luoma, C. E. Schlekat, M. A. Doblin, and K. A. Hieb. 2004. Food Web Pathway Determines How Selenium Affects Aquatic Ecosystems: A San Francisco Case Study. Environ. Sci. Technol. 38: 4519-4526.	Journal of Environmental Science and Technology	Chemical contaminants disrupt ecosystems, but specific effects may be under-appreciated when poorly known processes such as uptake mechanisms, uptake via diet, food preferences, and food web dynamics are influential. Here we show that a combination of food web structure and the physiology of trace element accumulation explain why some species in San Francisco Bay are threatened by a relatively low level of selenium contamination and some are not. Bivalves and crustacean zooplankton form the base of two dominant food webs in estuaries. The dominant bivalve Potamocorbula amurensis has a 10-fold slower rate constant of loss for selenium than do common crustaceans such as copepods and the mysid Neomysis mercedis (rate constant of loss, ke) 0.025, 0.155, and 0.25 d-1, respectively). The result is much higher selenium concentrations in the bivalve than in the crustaceans. Stable isotope analyses show that this difference is propagated up the respective food webs in San Francisco Bay. Several predators of bivalves have tissue concentrations of selenium that exceed thresholds thought to be associated with teratogenesis or reproductive failure (liver Se >15 íg g-1 dry wei	Aquatic Foodweb (Se); Bioaccumulation (Se); CSM (Se)	State	CA	San Francisco	Suisun Bay; San Francisco Bay			1999-2000	Dry and Wet Season	Field Study	No	Se (total)	Not Applicable	Tissue
2	Stewart et al., 2004	Stewart, A.R, S. N Luoma, C. E. Schlekat, M. A. Doblin, and K. A. Hieb. 2004. Food Web Pathway Determines How Selenium Affects Aquatic Ecosystems: A San Francisco Case Study. Environ. Sci. Technol. 38: 4519-4526.	Journal of Environmental Science and Technology	Chemical contaminants disrupt ecosystems, but specific effects may be under-appreciated when poorly known processes such as uptake mechanisms, uptake via diet, food preferences, and food web dynamics are influential. Here we show that a combination of food web structure and the physiology of trace element accumulation explain why some species in San Francisco Bay are threatened by a relatively low level of selenium contamination and some are not. Bivalves and crustacean zooplankton form the base of two dominant food webs in estuaries. The dominant bivalve Potamocorbula amurensis has a 10-fold slower rate constant of loss for selenium than do common crustaceans such as copepods and the mysid Neomysis mercedis (rate constant of loss, ke) 0.025, 0.155, and 0.25 d-1, respectively). The result is much higher selenium concentrations in the bivalve than in the crustaceans. Stable isotope analyses show that this difference is propagated up the respective food webs in San Francisco Bay. Several predators of bivalves have tissue concentrations of selenium that exceed thresholds thought to be associated with teratogenesis or reproductive failure (liver Se >15 íg g-1 dry wei	Aquatic Foodweb (Se); Bioaccumulation (Se); CSM (Se)	State	CA	San Francisco	Suisun Bay; San Francisco Bay			1999-2000	Dry and Wet Season	Field Study	No	Se (total)	Not Applicable	Tissue

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1,2	Luoma and Rainbow, 2005	Luoma, S. N. and P. S. Rainbow. 2005. Why is Metal Bioaccumulation so Variable? Biodynamics as a Unifying Concept. Environ. Sci. Technol. 39 (7):1921-1931.	Journal of Environmental Science and Technology	Ecological risks from metal contaminants are difficult to document because responses differ among species, threats differ among metals, and environmental influences are complex. Unifying concepts are needed to better tie together such complexities. Here we suggest that a biologically based conceptualization, the biodynamic model, provides the necessary unification for a key aspect in risk: metal bioaccumulation (internal exposure). The model is mechanistically based, but empirically considers geochemical influences, biological differences, and differences among metals. Forecasts from the model agree closely with observations from nature, validating its basic assumptions. The biodynamic metal bioaccumulation model combines targeted, high-quality geochemical analyses from a site of interest with parameterization of key physiological constants for a species from that site. The physiological parameters include metal influx rates from water, influx rates from food, rate constants of loss, and growth rates (when high). We compiled results from 15 publications that forecast species-specific bioaccumulation, and compare the forecast field. These data consider concentrations that cover 7 orders of magnitude. They include 7 metals and 14 species of animals from 3 phyla and 11 marine, estuarine, and freshwater environments. The coefficient of determination (R2) between forecasts and independently observed bioaccumulatio	Aquatic Foodweb (Se); Bioaccumulation (Se); CSM (Se)	NA	NA	NA	NA	NA	NA	NA	NA	Modeling	NA	NA	NA	NA
1	Horne, 2004	Horne, A. J. 2004. Technical Memo: Predicted Changes in Bioaccumulation and Toxicity of Selenium Following Construction of the Natural Treatment Systems in San Diego Creek Watershed Relative to the Current Status Quo. January 6. Appendix L In: Irvine Ranch Water District Selenium Action Plan		The NTS is a generic method to remove pollutants using sustainable methods in an environmentally friendly fashion. In particular, the NTS is a mostly sustainable system that depends on renewable resources such as sunlight rather than oil or gas. The NTS Master Plan describes how much of several pollutants will be removed and the generally expected pollutant sinks. To the extent that Se is removed from the watershed and immobilized in the sediments in the NTS, the entire watershed will have a lower Se concentration. Also, to the extent that the NTS provides bird habitat that gives a net benefit to birds, the NTS will improve the existing situation. Expected improvement can be approximated from the current NTS site San Joaquin Marsh (SJM) and other Se-contaminated wetlands. Currently in the SJM about 30% of the Se is removed (~15% of Se in SDC). The entire NTS is more than three times the area of SJM and should be much more efficient (~ 2-3 times) at removing Se from the water.	Aquatic Foodweb (Se); Transformation Process (Se); BMP Evaluation (Se)	Local	CA	SD Creek (Reach)	Newport Bay Watershed	San Diego Creek	Not applicable	Not applicable	Not applicable	Treatment Evaluation	Not applicable	Not applicable	Not applicable	Not applicable
2	Horne, 2004	Horne, A. J. 2004. Technical Memo: Predicted Changes in Bioaccumulation and Toxicity of Selenium Following Construction of the Natural Treatment Systems in San Diego Creek Watershed Relative to the Current Status Quo. January 6. Appendix L In: Irvine Ranch Water District Selenium Action Plan		The NTS is a generic method to remove pollutants using sustainable methods in an environmentally friendly fashion. In particular, the NTS is a mostly sustainable system that depends on renewable resources such as sunlight rather than oil or gas. The NTS Master Plan describes how much of several pollutants will be removed and the generally expected pollutant sinks. To the extent that Se is removed from the watershed and immobilized in the sediments in the NTS, the entire watershed will have a lower Se concentration. Also, to the extent that the NTS provides bird habitat that gives a net benefit to birds, the NTS will improve the existing situation. Expected improvement can be approximated from the current NTS site San Joaquin Marsh (SJM) and other Se-contaminated wetlands. Currently in the SJM about 30% of the Se is removed (~15% of Se in SDC). The entire NTS is more than three times the area of SJM and should be much more efficient (~ 2-3 times) at removing Se from the water.	Aquatic Foodweb (Se); Transformation Process (Se); BMP Evaluation (Se)	Local	CA	SD Creek (Reach)	Newport Bay Watershed	San Diego Creek	Not applicable	Not applicable	Not applicable	Treatment Evaluation	Not applicable	Not applicable	Not applicable	Not applicable
1	CSULA, 2005	CSULA. (California State University at Los Angeles). 2005. Progress Report on Task 8.San Joaquin Marsh Wildlife Sanctuary Monitoring.			Transformation Process (Se); Specitation (Se)	State	CA	San Joaquin Marsh		Marsh	NA	2004	Dry Season	Field Study	NA	Speciated Selenium; Se (dissolved); Se (total)	One-Time; various	Groundwater; surface water
2	CSULA, 2005	CSULA. (California State University at Los Angeles). 2005. Progress Report on Task 8.San Joaquin Marsh Wildlife Sanctuary Monitoring.			Transformation Process (Se); Specitation (Se)	State	CA	San Joaquin Marsh		Marsh	NA	2004	Dry Season	Field Study	NA	Speciated Selenium	One-Time	Groundwater

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2	CSULA, 2005	CSULA. (California State University at Los Angeles). 2005. Progress Report on Task 8.San Joaquin Marsh Wildlife Sanctuary Monitoring.			Transformation Process (Se); Specitation (Se)	State	CA	San Joaquin Marsh		Marsh	NA	2004	Dry Season	Field Study	NA	Speciated Selenium	One-Time	Surface Water
2	CSULA, 2005	CSULA. (California State University at Los Angeles). 2005. Progress Report on Task 8.San Joaquin Marsh Wildlife Sanctuary Monitoring.			Monitoring (Se); CSM (Se)	State	CA	San Joaquin Marsh		Marsh	NA	2004	Dry Season	Field Study	NA	Se (dissolved)	various	Surface Water
2	CSULA, 2005	CSULA. (California State University at Los Angeles). 2005. Progress Report on Task 8.San Joaquin Marsh Wildlife Sanctuary Monitoring.			Monitoring (Se); CSM (Se)	State	CA	San Joaquin Marsh		Marsh	NA	2004	Dry Season	Field Study	NA	Se (total)	various	Surface Water
1,2	CDM, 2001	CMD Federal Programs Corporation (CDM). 2001. Final Groundwater Monitoring Program Report June 2000 Monitoring Round 12. June 26		Groundwater monitoring results from sites at Marine Corps Air Station El Toro, El Toro, California	Groundwater Monitoring (Se); CSM (Se)	State	CA	El Toro, CA			27	1992-2000		Field Study	NA	Se (dissolved)	On-going	Groundwater
1	Horne, 2003	Horne, A. J. 2003. Draft Selenium Concentrations in Biota Fromt eh Selenium-contaminated Section of San Diego Creek in Fall 2002. Prepared for Satna Ana Regional Water Qualtiy Control Board, Riverside, California. May 25.			Aquatic Foodweb (Se); Tissue Conentration (Se); CSM (Se)	State	CA	SD Creek (Reach)	Newport Bay Watershed	The Santa Fe Channel; Peters Canyon Wash; San Diego Creek		1998; 2002	Wet Season	Field Study		Se (total)	One-Time	Tissue; surface water
2	Horne, 2003	Horne, A. J. 2003. Draft Selenium Concentrations in Biota Fromt eh Selenium-contaminated Section of San Diego Creek in Fall 2002. Prepared for Satna Ana Regional Water Qualtiy Control Board, Riverside, California. May 25.			Aquatic Foodweb (Se); Tissue Conentration (Se); CSM (Se)	State	CA	SD Creek (Reach)	Newport Bay Watershed	The Santa Fe Channel		2002	Wet Season	Field Study		Se (total)	One-Time	Tissue
2 - Horne, 2003	Horne, 2003	Horne, A. J. 2003. Draft Selenium Concentrations in Biota Fromt eh Selenium-contaminated Section of San Diego Creek in Fall 2002. Prepared for Satna Ana Regional Water Qualtiy Control Board, Riverside, California. May 25.			Aquatic Foodweb (Se); Tissue Conentration (Se); CSM (Se)	State	CA	SD Creek (Reach)	Newport Bay Watershed	Peters Canyon Wash		2002	Wet Season	Field Study		Se (total)	One-Time	Tissue
2 - Horne, 2003	Horne, 2003	Horne, A. J. 2003. Draft Selenium Concentrations in Biota Fromt eh Selenium-contaminated Section of San Diego Creek in Fall 2002. Prepared for Satna Ana Regional Water Qualtiy Control Board, Riverside, California. May 25.			Aquatic Foodweb (Se); Tissue Conentration (Se); CSM (Se)	State	CA	SD Creek (Reach)	Newport Bay Watershed	San Diego Creek		1998	Wet Season	Field Study		Se (total)	One-Time	Tissue
2	Horne, 2003	Horne, A. J. 2003. Draft Selenium Concentrations in Biota Fromt eh Selenium-contaminated Section of San Diego Creek in Fall 2002. Prepared for Satna Ana Regional Water Qualtiy Control Board, Riverside, California. May 25.			Foodweb (Se); Aquatic Foodweb (Se); CSM (Se)	State	CA	SD Creek (Reach)	Newport Bay Watershed	The Santa Fe Channel		2002	Wet Season	Field Study		Se (total)	One-Time	Surface Water

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2	Horne, 2003	Horne, A. J. 2003. Draft Selenium Concentrations in Biota Fromt eh Selenium-contaminated Section of San Diego Creek in Fall 2002. Prepared for Satna Ana Regional Water Qualtiy Control Board, Riverside, California. May 25.			Foodweb (Se); Aquatic Foodweb (Se); CSM (Se)	State	CA	SD Creek (Reach)	Newport Bay Watershed	Peters Canyon Wash		2002	Wet Season	Field Study		Se (total)	One-Time	Surface Water
1,2	Greenstein et al., n.d.	Greenstein, D.J., S.M. Bay, and J.S. Brown. n.d. Characterization of sediment toxicity in Newport Bay. Accessed on October 3, 2005. ftp://ftp. sccwrp.org/pub /download/ PDFs /2003_04ANNUALREPORT/ ar13-greenstein_139-148.pdf	http://www.sccwrp.org/pubs/annrpt/03-04/2003-2004_table_contents.html	Used various toxicity identification evaluation (TIE) to characterize the cause of sediment toxicity to amphipod. Three Upper Newport Bay sediment samples were collected and compared against lower bay samples. Authors concluded that metals, including selenium, from the Upper Newport Bay samples were not a principle cause of the observed toxicity to amphipods. TIEs suggest that nonpolar organic constituents were the dominant toxicants.	Toxicity (Se)	Local	CA	Orange County	Upper Newport Bay	NA	3	2001 and 2002	Wet Season	Field Study	Not Applicable	Se (total)	NA	Sediment
1,2	Loving, M. 2005a	Letter from Mike Loving, City of Irvine, Dept of Public Works, to Terri Reeder, CRWQCB. Dated 9/19/2005. RE: City of Irvine Dewatering Activities for the Month of August, 2005.		Analytical report of Se from dewatering discharge at Culver and Jamboree Pump Stations. Concentration of Se ranged from 9 - 35 mg/L. Concentration of total nitrogen ranged from 14.1 - 25.9 mg/L.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	NA	10	2005	Dry Season	Field Study	Not Applicable	Se (total)	Weekly	Ground water
1,2	Loving, M. 2005b	Letter from Mike Loving, City of Irvine, Dept of Public Works, to Karen Hauptly, CRWQCB. Dated 9/14/2005. RE: Request for Information [Chemical Analysis of Groundwater Discharge].		Analytical report of Se from dewatering discharge at Culver and Jamboree Pump Stations. At Culver Pump Station, Se concentration jumped from 10 ug/L to 20,000 ug/L measured on 6/18/2004, and went back down to 12 ug/L the following week. Jamboree Station varied in the same week to 10,000 ug/L and then went back down to 7 ug/L the following week. May need to double check with the reporting agency. Concentration of total nitrogen is also included in the weekly monitoring analysis.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	NA	NA	2003 - 2005	Dry and Wet Season	Field Study	Not Applicable	Se (total)	Weekly	Ground water
1,2	Dept. of Transportation D-12, 2005	Copies of Ground Water Monitoring Data conducted at the Walnut Avenue Groundwater Treatment Facility with the addition of Selenium to the Constituent testing requirements. Reports from January 2003 to September 2004 by Environ Strategy for Silverado Constructors (TCA); Reports from October 2004 to present by Brown and Caldwell for the Department.		Certified laboratory reports of analytical results of influent and effluent water samples with Selenium constituent added from January 2003 through April 2003. Reports submitted to SARWQCB and OCSD as required by NPDES permit. Sewering of all ground water commenced in May 2003 with weekly testing of influent for only Selenium constituent in January 2004.	Monitoring (Se)	Local	CA	Orange County	Newport Bay Watershed	GWTF	15	2003 - present	Dry and Wet Season	Field Study	Yes, with flow rates	Se (total)	Weekly until 4/2005, Monthly thereafter	Ground water

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NUTRIENT REFERENCES BELOW THIS ROW																		
1	County of Orange, 2004	County of Orange. 2004. Report of the Regional Monitoring Program for the Newport/San Diego Creek Watershed Nutrient TMDL. November.		The RMP is a coordinated program among the stakeholders to assess the attainment of the goals of the nutrient TMDL. The stated objectives of the monitoring program are to quantify the three endpoints of the nutrient TMDL: 1) the seasonal and annual nutrient loading from the watershed; 2) the nutrient concentration in San Diego Creek, Reaches 1 and 2; and 3) the extent, magnitude, and duration of algal blooms in San Diego Creek and Newport Bay. Monitoring is conducted at nine sites in the Newport Bay watershed and five sites in the Newport Bay. All watershed sampling data in Appendix B, Bay storm sample data in Appendix E, algal surveys Appendix F.	Nutrient TMDL evaluation	Local	CA	Newport Bay, San Diego Creek	Newport Bay Watershed	Newport Bay, San Diego Creek						Temp, DO, pH, conductivity, nutrients, ortho PO4, flow, hardness, algae biomass	On-going	Surface water, dry season water column (surface, mid, bottom)
1	County of Orange, 2003	County of Orange. 2003. Report of the Regional Monitoring Program for the Newport/San Diego Creek Watershed Nutrient TMDL. November.		The RMP is a coordinated program among the stakeholders to assess the attainment of the goals of the nutrient TMDL. The stated objectives of the monitoring program are to quantify the three endpoints of the nutrient TMDL: 1) the seasonal and annual nutrient loading from the watershed; 2) the nutrient concentration in San Diego Creek, Reaches 1 and 2; and 3) the extent, magnitude, and duration of algal blooms in San Diego Creek and Newport Bay. Monitoring is conducted at nine sites in the Newport Bay watershed and five sites in the Newport Bay. All watershed sampling data in Appendix B, Bay storm sample data in Appendix E, algal surveys Appendix F.	Nutrient TMDL evaluation	Local	CA	Newport Bay, San Diego Creek	Newport Bay Watershed	Newport Bay, San Diego Creek		July 02 - June 03	Year Round	Field Study	Not Applic	Temp, DO, pH, conductivity, nutrients, ortho PO4, flow, hardness, algae biomass	On-going	Surface water, dry season water column (surface, mid, bottom)
	County of Orange, 2002	County of Orange. 2002. Report of the Regional Monitoring Program for the Newport/San Diego Creek Watershed Nutrient TMDL. November.		The RMP is a coordinated program among the stakeholders to assess the attainment of the goals of the nutrient TMDL. The stated objectives of the monitoring program are to quantify the three endpoints of the nutrient TMDL: 1) the seasonal and annual nutrient loading from the watershed; 2) the nutrient concentration in San Diego Creek, Reaches 1 and 2; and 3) the extent, magnitude, and duration of algal blooms in San Diego Creek and Newport Bay. Monitoring is conducted at nine sites in the Newport Bay watershed and five sites in the Newport Bay. All watershed sampling data in Appendix B, Bay storm sample data in Appendix E, algal surveys Appendix F.	Nutrient TMDL evaluation	Local	CA	Newport Bay, San Diego Creek	Newport Bay Watershed	Newport Bay, San Diego Creek		July 01- June 02	Year Round	Field Study	Not Applic	Temp, DO, pH, conductivity, nutrients, ortho PO4, flow, hardness, algae biomass	On-going	Surface water, dry season water column (surface, mid, bottom)
1	County of Orange, 2001	County of Orange. 2001. Report of the Regional Monitoring Program for the Newport/San Diego Creek Watershed Nutrient TMDL. November.		The RMP is a coordinated program among the stakeholders to assess the attainment of the goals of the nutrient TMDL. The stated objectives of the monitoring program are to quantify the three endpoints of the nutrient TMDL: 1) the seasonal and annual nutrient loading from the watershed; 2) the nutrient concentration in San Diego Creek, Reaches 1 and 2; and 3) the extent, magnitude, and duration of algal blooms in San Diego Creek and Newport Bay. Monitoring is conducted at nine sites in the Newport Bay watershed and five sites in the Newport Bay. All watershed sampling data in Appendix B, Bay storm sample data in Appendix E, algal surveys Appendix F.	Nutrient TMDL evaluation	Local	CA	Newport Bay, San Diego Creek	Newport Bay Watershed	Newport Bay, San Diego Creek		July 00- June 01	Year Round	Field Study	Not Applic	Temp, DO, pH, conductivity, nutrients, ortho PO4, flow, hardness, algae biomass	On-going	Surface water, dry season water column (surface, mid, bottom)

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1	Kamer, K., et al., 2003	Kamer, K., E. Stein, L. Busse, J. Simpson, S. Cooper. 2003. A survey of algae and nutrients in the Malibu Creek Watershed. Southern California Coastal Water Research Project. Technical Report. October.	http://www.sccwrp.org /pubs/techrpt.htm	Biomass, percent cover, and species composition of benthic and floating algae were surveyed and nutrient (nitrogen and phosphorus) levels and physical parameters in streams in the Malibu Creek watershed were measured. Stream sites included different surrounding land use patterns representing different degrees of human influence. A nutrient diffuser experiment at a subset of these sites was also conducted to determine the existence of nutrient limitation (or lack thereof) and the identity of the limiting nutrient for algal growth limitation of algal growth in the watershed. Algal biomass and macroalgal cover data are summarized for each site and the data were also compared with literature thresholds for algal biomass. Results show that algal biomass and macroalgal cover increased with increasing human influence. The data also strongly suggest that benthic and floating algae respond to different physical and chemical variables.	Extent and magnitude of algal growth; Loads and algal growth relationship	Local			Malibu Creek Watershed		24 (2001) 76 (2002)	2001 & 2002	Dry Season	Field Study		NO3, NH4, SPR, Total N, Total P, DO, pH, conductivity, algae, % cover	Twice per year	Surface Water
1	Biggs, Barry J.F., Cathy Kilroy, 2000	Biggs, Barry J. F., Cathy Kilroy. 2000. Stream Periphyton Monitoring Manual. Prepared for The New Zealand Ministry for the Environment.		This document reviews periphyton in the context of their importance to water resources management. A background overview is given of factors controlling periphyton growth in streams, communities normally found in different habitats, the use of periphyton as environmental indicators, and guidelines to prevent their proliferation. The objective of the document is to prescribe a set of protocols that will be applicable to most of the common stream habitats in New Zealand	Monitoring guidance	International					NA			Guidance document			Not Applicable	Surface Water
	Biggs, Barry J.F., 2000	Biggs, Barry J.F. 2000. New Zealand Periphyton Guideline. Detecting, Monitoring and Manageing Enrichment of Streams. Prepared for Ministry for the Environment.		This document gives a background review of the structure and value of periphyton communities in streams, factors controlling growth and composition of periphyton, and the effects of human activities on the community. A set of guidelines is then developed to help prevent degradation of aesthetic/recreational, biodiversity and angling values by excessive enrichment of streams (and resultant proliferations of periphyton).	Monitoring guidance	International					NA			Guidance document			Not Applicable	Surface Water
1	Schiff, Kenneth C., Krista Kamer, 2000	Schiff, Kenneth C., Krista Kamer. 2000. Comparison of Nutrient Inputs, Water Column Concentrations, and Macroalgal Biomass in Upper Newport Bay, California. Southern California Coastal Water Research Project. December.	http://www.sccwrp.org /pubs/techrpt.htm	Results of a literature search focusing on synoptic nutrient water quality and macroalgal biomass data in estuaries to determine whether water quality objectives for total inorganic nitrogen (TIN) in San Diego Creek, which discharges to Upper Newport Bay (UNB), were similar to concentrations that induced macroalgal blooms in other estuaries. A wide range of concentrations, loads, and algal biomass was found in the 14 studies that met the survey criteria.	Extent and magnitude of algal growth; Loads and algal growth relationship	Local	CA	Upper Newport Bay	Newport Bay Watershed	San Diego Creek	NA	NA		Literature Review	Not Applic		Not Applicable	Surface Water
1	Kamer, Krista et al., 2002	Kamer, Krista, Kenneth Schiff, Rachel L. Kennison, Peggy Fong. 2002. Macroalgal Nutrient Dynamics in Upper Newport Bay. Southern California Coastal Water Research Project. July.	http://www.sccwrp.org /pubs/techrpt.htm	Study looked at some of the important mechanisms that may enable macroalgae to bloom under enriched conditions of southern California estuaries, including: 1) investigate the contribution of nutrients from estuarine sediments to macroalgal growth and tissue nutrient content; 2) determine if N or P is the nutrient most limiting to macroalgae; 3) measure rates of N and P uptake by *Enteromorpha intestinalis* and *Ulva expansa* , the dominant, green, bloom-forming macroalgal species; and 4) investigate the effects of varia tion in the frequency and concentration of nutrient pulses on macroalgal growth and tissue nutrient content	Extent and magnitude of algal growth; Loads and algal growth relationship	Local	CA	Upper Newport Bay	Newport Bay Watershed									
1	California Regional Water Quality Control Board Los Angeles Region, 2003	California Regional Water Quality Control Board Los Angeles Region. 2003. Total Maximum Daily Loads for Nitrogen Compounds and Related Effects Los Angeles River and Tributaries. July 10, 2003.		The Implementation Plan of this TMDL is designed to attain water quality objectives for oxidized nitrogen, and ammonia (collectively the nitrogen compound objectives) in the Los Angeles River. The implementation plan includes a provision to revise nitrogen compound targets and wasteload allocations to address the nutrient, algae, foam, scum/odor and pH impairments, if required. Special studies to assess both wet-weather and dry-weather runoff loads in the watershed, including residential, commercial, and industrial land uses and other sources are also included.	TMDL evaluation	Regional	CA			LA River and tribs				TMDL				

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1	USEPA Region 9	USEPA Region 9. Total Maximum Daily Loads for Nutrients Malibu Creek Watershed.		Includes Malibu Lagoon, Malibu Creek and its tributaries, and four urban lakes. The nutrient compounds addressed are N and P. It is recommended that a watershed-scale monitoring program be established at key compliance points along the river and samples be collected at the upstream and downstream ends of the listed tributaries. Samples to be analyzed for dissolved oxygen, ammonia, nitrate, total nitrogen, percent algal cover and Chlorophyll *a* . Much of this data is already being collected as part of the Tapia WRP monitoring program.	TMDL evaluation					Malibu Creek				TMDL				
1	Robinson, Timothy H, et al., 2005	Robinson, Timothy H., Al Leydecker, Arturo A. Keller, John M. Melack. 2005. Steps toward modeling nutrient export in coastal Californian streams with a Mediterranean climate. Agricultural Water Management. Pp. 144-158.		Measurement of nutrient export from specific land uses and development of relationships to predict nutrient export at a watershed scale was conducted along the southern California coast, near Santa Barbara. Land uses include chaparral, avocado orchards, greenhouse agriculture, open-field nurseries, and residential and commercial development. Intensive stream sampling at all sites was done in water-year 2002 (October 2001 through September 2002, WY2002) and WY2003. Manual samples (grab samples) of creek or storm drain water were collected below the surface in the thalweg.	Modeling; Loads & algal growth relationship	Regional	CA			Carpinteria, Franklin and Santa Monica creeks		2002 - 2003	Year Round	Field Study	Not Applic	nitrogen (nitrate and ammonium), phosphate (soluble reactive phosphorus: SRP)	every 2 wks dry season (May-Oct), 1 a wk during rainy season, & every 1-4 hrs during storms	Surface Water
1	Kamer, Krista et al., 2004	Kamer, Krista, P. Fong, R. Kennison and K. Schiff. 2004. Nutrient limitation of macroalga *Enteromorpha intestinalis* collected along a resource gradient in a highly eutrophic estuary. Estuaries 27:201-208.		Experiment to quantify nutrient (N and P) limitation of macroalgae collected along a gradient in water column nutrient availability in Upper Newport Bay estuary, water samples collected from five sites. Nutrient limitation of *E. intestinalis* from UNB varied spatially throughout the bay. The degree of nitrogen limitation increased with distance from the head of the estuary.	Extent and magnitude of algal growth	Local	CA	Upper Newport Bay	Newport Bay Watershed	Upper Newport Bay		2001	Dry Season	Laboratory study	Not Applic	algal tissue N & P, algal growth, water column NO3 and TKN	One-Time	Surface Water, algae (*E. intestinalis*)
1	Dauer, Daniel M. et al., 2000	Dauer, Daniel M., S.B. Weisberg and J.A. Ranasinghe. 2000. Relationships between benthic community condition, water quality, sediment quality, nutrient loads, and land use patterns in Chesapeake Bay. Estuaries 23:80-96.		Associations between macrobenthic communities, measures of water column and sediment exposure, and measures of anthropogenic activities throughout the watershed were examined for the Chesapeake Bay. Benthic condition was negatively correlated with measures of urbanization (i.e., population density, point source loadings, and total N loadings) and positively correlated with watershed forestation. Significant correlations were observed with population density and N loading below the fall line, but not above it, suggesting near-field activities have a greater effect on benthic condition than activities in the upper watershed. Chlorophyll *a* concentrations were positively correlated with N and P concens. in the water column & w/ ag land use but not correlated with N loads.	Loads and algal growth relationship	National (Chesapeake Bay)	Entire Bay (6 states)				Used data from existing studies		Year Round	Laboratory study	Not Applic	Total N, Total P, chlorophyll a, benthic community	Used data from existing studies	Water column, benthic
1	Kamer, K. and P. Fong, 2001	Kamer, K. and P. Fong. 2001. Nitrogen enrichment ameliorates the negative effects of reduced salinity on the green macroalga *Enteromorpha intestinalis* . Marine Ecology Progress Series.		The effects of simultaneous variation in N and salinity on the growth, biomass accumulation and tissue nutrient dynamics of *E. intestinalis* were investigated. A fully crossed 2-factor experiment in which N enrichment was varied (low, medium and high) and salinity was varied (15, 25 and 35 psu). Overall, addition of N enhanced algal growth while salinity reduction decreased growth. Largely, *E. intestinalis* abundance was governed by N availability rather than salinity.	Loads and algal growth relationship	Regional	CA		Calleguas Creek	Mugu Lagoon		1997	Wet Season	Field Study	Not Applic	Algae biomass, total N in algal tissue	One-Time	Algae (*E. intestinalis*)
1	Boyle, Karleen A. et al. 2004	Boyle, Karleen A., Krista Kamer, and Peggy Fong. 2004. Spatial and Temporal Patterns in Sediment and Water Column Nutrients in a Eutrophic Southern California Estuary. Estuaries Vol. 27, No. 3, p. 378–388. June.		Water column and sediment nutrient measures demonstrated that Upper Newport Bay (UNB) is a highly enriched estuary. High nitrate (NO3-) loads from the river entered the estuary at all sampling times. P-loading was high year round with no seasonal pattern. Sediment and water nutrients, as well as percent cover of three dominant macroalgae, varied between the main channel and tidal creeks. The data suggest a shift in primary nutrient sources for macroalgae in UNB from riverine input during winter and spring to recycling from sediments during summer and fall.	Loads and algal growth relationship; seasonal patterns	Local	CA	Upper Newport Bay	Newport Bay Watershed	Upper Newport Bay		1996-1997	Year Round	Field Study	Yes	Nutrients	Quarterly	Water column, sediment

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1	Kamer, Krista et al., 2001	Kamer, Krista, Karleen A. Boyle, and Peggy Fong. 2001. Macroalgal Bloom Dynamics in a Highly Eutrophic Southern California Estuary. Estuaries Vol. 24, No. 4, p. 623-635. August.		A 16-mo long study to quantify the macroalgal community of UNB. At each station, two strata (one at high and one at low elevation) were surveyed. Macroalgal species abundance (% cover and biomass) and algal tissue N & P were measured. The algal community changed from sparse macroalgal cover during winter 1996 to larger patches dominated by *E. intestinalis* in spring 1997. UNB returned to sparse macroalgal cover by spring 1998. A field experiment was conducted in which *E. intestinalis* was used as a bioassay of N and P availability. Tissue N of algae from these bags showed a nominal increase in N with proximity to the primary nutrient input to the system, San Diego Creek. Quarterly sampling began December 1996 at 8 stations along the main channel and tidal creeks ranging from the head to the lower end of UNB	Extent and magnitude of algal growth	Local	CA	Upper Newport Bay	Newport Bay Watershed	Upper Newport Bay		Winter 1996-Spring 1998	Year Round	Field Study		dissolved N & P in algal tissue; algal survey	Quarterly	Tissue
1	Tetra Tech, Inc., 2000	Tetra Tech, Inc. 2000. Newport Bay Watershed urban Nutrient TMDL Compliance Evaluation. Final Report. Prepared for County of Orange Public Facilities and Resources Department. PCA-PFRD-001. July.		An evaluation of nutrient loading in the San Diego Creek Watershed with respect to the Regional Board's nutrient TMDL targets for the years 2002, 2007, and 2012 is provided. Historical data from 3 representative monitoring stations (San Diego Creek at Culver, San Diego Creek at Campus, and Peters Canyon Channel at Barranca) was used. Results indicate that the 1998-99 estimated urban runoff nutrient loads at the 3 stations meet the 2002 TMDL limits established for the Newport Bay Watershed/San Diego Creek (Reach 1), except for the dry season nitrogen load in Peters Canyon Channel at Barranca which is slightly (< 3%) above the TMDL limit. The 1998-99 phosphorous loads were found to be below the phased TMDL limits.	TMDL evaluation	Local	CA	Newport Bay; SD Creek (Reach)	Newport Bay Watershed	San Diego Creek; Peters Canyon Channel								
1	Larry Walker Associates, 2001	Larry Walker Associates. 2001. Calleguas Creek Nutrient TMDLs. Prepared for Calleguas Creek Watershed Management Plan Water Resources/Water Quality Subcommittee under an EPA Section 205(j) Grant awarded by the State Water Resources Control Board Agreement No. 7-120-250-0. April.		This document presents the TMDLs that address ammonia, nitrate-N+nitrite-N, nitrogen, algae, and low dissolved oxygen/organic enrichment in the Calleguas Creek Watershed. The numeric targets for the oxidized nitrogen TMDL were set equal to the Basin Plan objectives. For ammonia, values presented in the 1999 updated EPA criteria document for ammonia, adjusted to reflect site-specific conditions, were determined to be the appropriate targets. Targets for algae/dissolved oxygen were determined to be a "nuisance" algae biomass target for rivers and streams selected from literature and the Basin Plan dissolved oxygen objective for protection of aquatic life.	TMDL evaluation	Regional	CA		Calleguas Creek			2001		TMDL			NA	NA
1	California Regional Water Quality Control Board Los Angeles Region, 2003	California Regional Water Quality Control Board Los Angeles Region. 2003. Santa Clara River Total Maximum Daily Loads for Nitrogen Compounds. Staff Report. June 16, 2003.		Santa Clara River and its tributaries are impaired by ammonia, nitrate and nitrite. The "Technical Support Document" (Appendix A) contains: The SCR TMDL Nutrient Analysis, Source Analysis and Linkage Analysis: Hydrology and Water Quality by Systech Engineering Inc. and Determination of the Critical Water Quality Conditions for the Impaired Reaches of the SCR Watershed, Analysis of Potential Nutrient Load Allocation of the Reaches of the SCR Considered in the 1998 303(d) List, and Analysis of pH variation in the Impaired Reaches of the SCR.	TMDL evaluation	Regional	CA			Santa Clara River and tributaries	?		TMDL				
1	California Regional Water Quality Control Board Santa Ana Region, 1997	Staff Report on the Nutrient Total Maximum Daily Load for Newport Bay/ San Diego Creek, August 29, 1997.			TMDL evaluation	Regional	CA	Newport Bay and San Diego Creek	Newport Bay Watershed	Newport Bay, San Diego Creek		1997		TMDL				
1	USEPA Region 9	USEPA Region 9. 1998. Total Maximum Daily Loads for Nutrients San Diego Creek and Newport Bay, California.		The TMDL was adopted to promote management efforts to restore and protect these beneficial uses in the Bay. It establishes targets for reducing the annual loading of nitrogen and phosphorus to Newport Bay by 50% and meeting the numeric and narrative water quality objectives by 2012.	TMDL	Local	CA	Newport Bay and San Diego Creek	Newport Bay Watershed	Newport Bay, San Diego Creek				TMDL		NA	NA	NA

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1	USEPA Region 9	Resolution Amending the Water Quality Control Plan for the Santa Ana River Basin to Incorporate a Nutrient TMDL for the Newport Bay/San Diego Creek Watershed		The Santa Ana Regional Board adopted an amendment to the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan) to establish a Total Maximum Daily Load (TMDL) for nutrients in the Newport Bay/San Diego Creek Watershed (Resolution No. 98-9, as amended by Resolution No. 98-100).	TMDL	Local	CA	Newport Bay and San Diego Creek	Newport Bay Watershed	Newport Bay, San Diego Creek				TMDL	Not Applic	NA	NA	NA
1	BonTerra Consulting, 2004	BonTerra Consulting. 2004. San Diego Creek Watershed Natural Treatment System Plan Draft Biological Resources Technical Study. Submitted to Irvine Ranch Water District. January 19, 2004.		This study presents analysis for 31 NTS project sites, 12 of which are at the specific project level and the remaining 19 are evaluated at the program-level. Project-level analysis has been prepared to provide support for CEQA documentation for the 12 sites first phase NTS project sites. Wildlife and vegetation surveys only; no direct algal data	Beneficial use impairment; BMPs	Local	CA	SD Creek	San Diego Creek Watershed	Serrano Creek Lower; Santa Ana/Santa Fe Channel; Peters Canyon Wash; San Joaquin Marsh; Rattlesnake Reservoir; Sand Canyon Reservoir		1999-2003						
2	BonTerra Consulting, 2004	BonTerra Consulting. 2004. San Diego Creek Watershed Natural Treatment System Revised Environmental Impact Report. Volume 1. Submitted to Irvine Ranch Water District. January 19, 2004.		The NTS Plan consists of proposed improvements to assist in managing the quality of surface runoff within the San Diego Creek Watershed. A detailed discussion of the nutrient TMDL is provided in Section 3.2, Hydrology and Water Quality. The full water quality analysis, including the modeling to establish the thresholds, is provided in the NTS Plan, Chapter 4, and Appendices D and E to the NTS Plan. The models and modeling results are also included in Appendix D to this Revised Draft EIR, Volume III.	Beneficial use impairment; BMPs; modeling	Local	CA	SD Creek	San Diego Creek Watershed					Field Study (EIR)				
1	Wazniak, Catherine et al., 2004	Wazniak, Catherine, Brian Sturgis, Matthew Hall, and William Romano. 2004. Nutrient Status and Trends in the Maryland Coastal Bays. Maryland Department of Natural Resources, Tidewater Ecosystem Assessment, Annapolis, MD and United States Department of the Interior, National Park Service, Assateague Island National Seashore, Berlin, MD. Chapter 4.1 of Maryland's Coastal Bays: Ecosystem Health Assessment.		As part of the Eutrophication Monitoring Plan, which was designed to specifically track the implementation of management actions and monitor changes in nutrient/ sediment loading and subsequent responses to the ecosystem, TN and TP concentration data from the 2001 through 2003 Coastal Bays water quality monitoring program were analyzed for status. One of the long-term goals of the Maryland Coastal Bays Program (MCBP) is to help identify and track a set of regional environmental indicators and related threshold levels.	Loads and algal growth relationship; ecological impacts	National	MD		MD Coastal Bays estuary			2001-2003	Year Roun	Field Study		Total nitrogen; total phosphorus; chlor. a; DO	Monthly	Surface Water
1	Texas Water Conservation Association, 2004	Texas Water Conservation Association. 2004. Investigation to support the development of nutrient criteria based on recreational uses of reservoirs. Preliminary Report. Presented to Texas Commission on Environmental Quality Nutrient Criteria Development Advisory Workgroup. January.		The objective of this study is to compare the user responses to the chlorophyll-a measurements in order to determine the algal concentrations at which uses are considered to be impacted and the extent of the impact. It is hoped that the target, or criteria, for chlorophyll can be established as a mean summer concentration in order to facilitate determinations of whether a waterbody is compliant with water quality standards. This report presents the first, preliminary evaluation of study results. Interpretation of the data is still in progress. Each reservoir is sampled at two locations (a mainbody site and a cove or headwaters site)	Beneficial use impairment	State	TX			Lake Bridgeport; Canyon Lake; Cedar Creek Reservoir; Lake Fork Reservoir; Lake Georgetown, Lake Granger; Lake Livingston; Lake Travis		2003-2004	Dry Seaso	Field Study		nitrogen, phosphorus, chlorophyll-a, pheophytin, turbidity, TSS, temp, DO, pH, secchi disc, specific conductivity	2 times per month	Surface Water
1	Parkhurst, Benjamin R. et al., 2005	Parkhurst, Benjamin R., William Warren-Hicks, Miles (Bud) Smart. 2005. Guidance on Developing Nutrient Standards for Protecting Designated Uses of Water Bodies. Prepared for Federal Water Quality Coalition. March 28, 2005.		Technical report on how States can develop scientifically sound nutrient criteria	Beneficial use impairment	National					NA	NA		Technical	Not Applic	NA	NA	NA

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1	Strecker, Peter et al., 2005	Strecker, Peter et al. (engineers with GeoSyntec Consultants) & Norris Brandt, Irvine Ranch Water District. 2005. San Diego's Natural Treatment Stormwater Management System San Diego Creek Master Plan. The Water Report. Issue #18. Envirotech Publications.		Summary of San Diego's NTS. Presents information and data on nitrogen removal, loads, sediment factors, and phosphorus issues.	Loads; TMDL evaluation; BMPs; modeling	Local	CA	Newport Bay					Year Round					
1,2	Dept. of Transportation D-12, 2005	Copies of Ground Water Monitoring Data conducted at the Walnut Avenue Groundwater Treatment Facility testing BOD, TSS, Total Nitrogen and Phosphorus, Arsenic, Sulfate, DO and Selenium (begin 1/2003). Reports from February 1999 to September 2004 by Environ Strategy for Silverado Constructors (TCA); Reports from October 2004 to present by Brown and Caldwell for the Department.		Certified laboratory reports of analytical results of influent and effluent water samples from February 1999 through April 2003. Reports submitted to SARWQCB and OCSD as required by NPDES permit. Sewering of all ground water commenced in May 2003 as required by new NPDES permit, eliminating requirement for BOD, TSS, Total Nitrogen and Phosphorus, Arsenic, Sulfate and DO testing.	Monitoring (Total Nitrogen, Total Phosphorus, Sulfate, Dissolved Oxygen (DO), Total Suspended Solids (TSS), Arsenic, Biochemical Oxygen Demand (BOD), Nitrate, Nitrite.	Local	CA	Orange County	Newport Bay Watershed	GWTF	24	1999 - present	Dry and Wet Season	Field Study	Yes, with flow rates	Total nitrogen (TN)	Weekly until 4/2005, Monthly thereafter	Ground water
1	Santa Ana Regional Water Quality Control Board, 1990	Santa Ana Regional Water Quality Control Board. 1990. San Diego Creek Watershed Nitrogen Study. November.		This paper discusses nitrogen/nutrient issues within the San Diego Creek watershed pertaining to nurseries. It discusses implementation of BMPs, a monitoring program and offers recommendations. The study quantifies mass loads for nitrogen from several of the nurseries in the north-central part of Orange County.														
1	Santa Ana Regional Water Quality Control Board, 1997	Santa Ana Regional Water Quality Control Board. 1997. Orange County NPDES Stormwater Program Annual Progress Report 1996-1997. November.		The County's Public Facilities and Resources Department produces an annual compliance report documenting NPDES stormwater monitoring on behalf of the County, the Flood Control District and all 31 cities. Monitoring points include San Diego Creek and its tributaries and the Upper and Lower Newport Bays. Data include aqueous nutrient and trace metal concentrations and levels of trace metals, organochlorine pesticides and polychlorinated biphenyls in sediments.														
1	Alex Horne Associates, 1997	Alex Horne Associates. 1997. Macroalgae (Seaweed) and Phytoplankton in Newport-Bay Estuary: Summar-Fall 1996. Prepared for the Irvine Ranch Water District. February.		The primary purpose of this report was to provide a baseline assessment of the abundance of macroalgae and phytoplankton so that any future changes can be related to a proposed alteration in nutrient inputs.														
1	Taylor, Scott (RBF) and G. Fred Lee & Associates, 1998	Taylor, Scott (RBF) and G. Fred Lee & Associates. 1998. Review of Existing Water Quality Characteristics of Upper Newport Bay, Orange County CA. August.		This research paper reviews water quality data collected by a number of public agencies prior to July 1996. Areas of examination include toxics in water; bioaccumulation of toxics in wildlife (fish and mussels only); accumulation of toxics in sediment; pathogens; and excessive algal growth. No new biological research was performed except in biotoxicity. The work focused on Newport Bay and lower San Diego Creek.														
1	Irvine Ranch Water District, 1996	Irvine Ranch Water District. 1996. Irvine Ranch Wetlands Demonstration Project - Order 96-2 Compliance Report. Submitted to Santa Ana Regional Water Quality Control Board. January 1, 1996.		IRWD data from monitoring of their wetlands denitrification ponds, San Diego Creek and the Upper Newport Bay. Water quality monitoring in the bay consists of collecting samples for nutrient analyses and utilizing datalogging probes to continuously monitor temperature, salinity, pH and dissolved oxygen. Depressed dissolved oxygen levels found in the uppermost areas of the Upper Bay seem to be the product of excessive macroalgae growth and decay.														

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1	US Army Corps of Engineers, 1997	US Army Corps of Engineers. 1997. Feasibility Report - Upper Newport Bay, Orange County California. 3 volumes. June.		The feasibility study focuses on developing a model to predict siltation impacts on habitats. This file contains the June 1997 "Available Information Report" which lists 210 relevant documents; the November 1997 "Biological Resources of Upper Newport Bay, California" with surveys for fish, birds, insects, reptiles, mammals and vegetation; and the December 1997 "Upper Newport Bay, California Draft Baseline Conditions Report" which includes histories of the watershed, bay dredging, water quality and sedimentation. The loss of eelgrass and the shallow marine habitat in the Upper Bay was noted. Extensive references are provided. Also see an additional three volumes in the same location dealing with developing a numerical hydrodynamic model.													
1	Kleppel, G.S, 1980	Kleppel, G.S. 1980. Nutrients and phytoplankton community composition in southern California coastal waters. *California Cooperative Oceanic Fisheries Investigations Reports* 21:191-196.	http://www.sccwrp.org/pubs/techrpt.htm															
1	Alex Horne Associates, 1998a	Alex Horne Associates, 1998a. Effect of Macroalgae (Seaweeds) on Impairment of Beneficial Uses of Newport Bay and Quantification of Nutrient Control Levels Needed in San Diego Creek to Remove Beneficial Use Impairment.																
2	Alex Horne Associates, 1998b	Alex Horne Associates, 1998b. Macroalgae (Seaweed) in Newport Bay-Estuary: Spring Summer 1997, Winter 1997-98 and a comparison with 1996.																
1	USEPA Region 9, 2000	USEPA Region 9. 2000. Nutrient Criteria Technical Guidance Manual: Rivers and Streams. EPA-822-B-00-002. Office of Water. July.		This manual provides technical guidance to States, Tribes, and other authorized jurisdictions to establish water quality criteria and standards under the Clean Water Act (CWA), in order to protect aquatic life from acute and chronic effects of nutrient overenrichment.	Nutrient criteria	National												
1	USEPA Region 9, 2001	USEPA Region 9. 2001. Nutrient Criteria Technical Guidance Manual: Estuarine and Coastal Marine Waters. EPA-822-B-01-003. Office of Water. October.		This manual provides technical guidance to States, Tribes, and other authorized jurisdictions to establish water quality criteria and standards under the Clean Water Act (CWA), in order to protect aquatic life from acute and chronic effects of nutrient overenrichment.	Nutrient criteria	National												
1	Tetra Tech, Inc., 2004	Tetra Tech, Inc. 2004. Progress Report White Papers in Support of the Development of Nutrient Criteria in California. April 30, 2004. http://rd.tetratech.com/epa/		White Paper (a) A Risk-based Approach to Development of Nutrient Criteria and TMDLs; White Paper (b) Recent Literature on Nutrient Impacts in Water Bodies; White Paper (f) Use of SWAT to Simulate Nutrient Loads and Concentrations in California; White Paper (g) Review of Recently Completed Nutrient TMDLs; White Paper (j) Non-Modeling Methods for Estimating Nutrient Loads from Various Sources; White Paper (k) HSPF Nutrient TMDL Development Capabilities; White Paper (l) Advantages and Disadvantages of Using Load Duration Curves to Estimate Existing and Allowable Loads for the Development of Nutrient TMDLs. Developed under the California and EPA Region IX Regional Technical Advisory Group (RTAG) for nutrients.	Nutrient criteria; TMDL evaluation; loads; sources	All					NA	NA		Literature Rev	Not Applic	NA	NA	NA

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1	Tetra Tech, Inc.	Tetra Tech, Inc. White Paper: The Development of Nutrient Criteria, For EcoRegions Within: California, Arizona, and Nevada. Prepared for USEPA Region IX Regional Technical Advisory Group and CA SWRCB State Regional Board Advisory Board.		RTAG /STRTAG is a diverse stakeholder group that has undertaken the task of developing nutrient criteria that protect designated uses using scientifically defensible methods and appropriate water quality data. This white paper is an important milestone and tool in that process. The white paper was specifically proposed as a pre-draft work plan that would allow the RTAG and STRTAG stakeholders to develop a common understanding of the language, concepts, options, procedures needed to develop nutrient criteria.	Nutrient criteria	State	CA											
1	Tetra Tech, Inc., 2004	Tetra Tech, Inc. 2004. Progress Report: Development of Nutrient Criteria in California: 2003-2004. Prepared for USEPA Region IX. October.		This document describes the proposed California approach for development of nutrient criteria, as well as practical suggestions for its implementation. Specifically, the development of nutrient criteria and nutrient TMDLs is evaluated in terms of the *risk* of impairment of designated uses.	Nutrient criteria; beneficial use impairment	State	CA										
1	Tetra Tech, Inc., 2003	Tetra Tech, Inc. 2003. Progress Report: Ecoregion 6 (Southern and Central Californria Oak and Chaparral Woodlands) Pilot Study for the Development of Nutrient Criteria. Prepared for USEPA Region IX Regional Technical Advisory Group and CA SWRCB State Regional Board Advisory Board. September.		The purpose of the Southern and Central California Oak and Chaparral Woodlands Pilot Study for the Development of Nutrient Criteria is to test the methods and assumptions for development of nutrient criteria that have been selected for use by the EPA Region IX Regional Technical Advisory Group (RTAG) and the State Technical Regional Technical Advisory Group (STRTAG). The results of the pilot project will be used to evaluate the feasibility of the alternate Work Plan developed in collaboration with the RTAG.	Nutrient criteria	State	CA										
1	Olszowka, Deborah M., et al. 1999?	Olszowka, Deborah M., Jason P. Heath, Peter A. Tennant, Ohio River Valley Water Sanitation Commission. Evaluation of Nutrient Loads and Sources in the Ohio River Basin.		In the fall of 1997, the Ohio River Basin Water Sanitation Commission (ORSANCO) began conducting a study to evaluate nutrient loads and sources in the Ohio River Basin. The objectives of this project are to document present water quality conditions concerning nutrients in the Ohio River and its major tributaries, to quantify nutrient loads from major sub-basins to the Ohio River through water quality monitoring activities, and to assess the relative magnitude of nutrient sources (i.e., agriculture, POTWs, industrial discharges, urban runoff, etc.). In addition, the identification of priority watersheds within the Ohio River Basin will provide a basis for implementing and measuring the effectiveness of control programs to reduce stream nutrient loads in the Ohio River Basin and, ultimately, to the Gulf of Mexico. Surface Water.	Loads and algal growth relationship; sources; BMP evaluation.	National	OH		Ohio River Basin			1998-?	Wet Seasc	Field Study		Total P, ammonia, nitrate, nitrite, TKN	Biweekly	Surface Water
1	Ohio EPA, 1999	Ohio EPA. 1999. Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams. Ohio EPA Technical Bulletin MAS/1999-1-1. Aquatic Biota, Nutrients, & Habitat in Ohio Rivers & Streams, January 7,1999.		Nutrient chemistry, biological community performance, and habitat data from least impacted regional reference sites (REF) and a broader data set including sites (ALL) impacted by a variety of causes and sources were analyzed to determine the near-field (*i.e.,* localized) low-flow effects of nutrients and sediment on the aquatic assemblages of Ohio streams and rivers. Data were segregated by ecoregion and further stratified by four ranges of stream and river size. Surface waer, biological, summer-fall period.	Ecological impacts; loads and algal growth relationship	National	OH						Field Study		Ammonia, Nitrite, TKN, NO3-N, TP, TSS		Surface Water