SAN GABRIEL RIVER REGIONAL MONITORING PROGRAM

Submitted to the

Los Angeles Regional Water Quality Control Board

by

Los Angeles County Sanitation Districts

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Agency	Staff
AES Corporation	Steve Maghy
City of Downey	Gerry Greene
Facilitator	Brock Bernstein
Friends of the San Gabriel River	Xilonia Cruz-Gonzalez
	Jacqueline Lambrichts
Los Angeles County Department of Public Works	Arfan Haidary
	Frank Wu
Los Angeles County Sanitation Districts	Sharon Green
	Heather Lamberson
	Monica Gasca
	Martha Rincon
Los Angeles Department of Water and Power	Susan Damron
	Bob Krivak
Los Angeles & San Gabriel Rivers Watershed Council	Suzanne Dallman
Los Angeles Regional Water Quality Control Board	Shirley Birosik
	Rod Collins
	Michael Lyons
Orange County Stormwater Program	Karen Hauptly
	Bruce Moore
	Scott Jakubowski
Rivers and Mountains Conservancy	Belinda Faustinos
	Kelly Schmoker
San Gabriel Mountains Regional Conservancy	Ann Croissant
	Wendy Katagi
	Chris Solek
	Rick Thomas
Santa Ana Regional Water Quality Control Board	Wanda Marquis-Smith
	Dave Woelfel
SCCWRP	Ken Schiff
	Eric Stein
U.S. Army Corps of Engineers	Aaron Allen
U.S. EPA	Terry Fleming
U.S. Forest Service	Marty Dumpis

In addition to these workgroup members, invited experts provided valuable information and advice on a number of key issues.

Executive Summary

This report presents a design for an integrated regional monitoring program for the San Gabriel River watershed, the San Gabriel River Regional Monitoring Program (SGRRMP). This report satisfies an NPDES permit requirement of the Los Angeles County Sanitation Districts for the Long Beach, Los Coyotes, Whittier Narrows, San Jose Creek, and Pomona Water Reclamation Plants, and fulfills the fundamental purpose of providing a framework for monitoring at the watershed scale. It proposes to accomplish this by:

- Expanding the monitoring of ambient conditions related to key beneficial uses to the entire watershed
- Attempting to improve the coordination and cost-effectiveness of disparate monitoring efforts
- Providing a framework for periodic and comprehensive assessments of watershed condition.

The program design, which was partially implemented through a set a cooperative efforts in 2005, was developed by a multi-stakeholder workgroup and addresses five core management questions, including:

1. What is the condition of streams in the watershed?
2. Are conditions at areas of unique interest getting better or worse?
3. Are receiving waters near discharges meeting water quality objectives?
4. Is it safe to swim?
5. Are locally caught fish safe to eat?

While there is a wide range of beneficial uses defined in the Water Quality Control Plan for the Los Angeles Region (Basin Plan) that are broadly applicable to the San Gabriel River watershed and the core management questions, the recommended regional monitoring program focuses on a subset of these beneficial uses that relate primarily to habitat conditions and to recreational use of the watershed:

- Warm Freshwater Habitat (WARM)
- Cold Freshwater Habitat (COLD)
- Estuarine Habitat (EST)
- Wildlife Habitat (WILD)
- Water Contact Recreation (REC1)
- Commercial and Sport Fishing (COMM).

These captured the regulatory, management, and public interest priorities of the stakeholders represented on the workgroup, as well as reflecting the primary objectives of traditional permit monitoring in the watershed. Table Ex.1 shows which beneficial uses are addressed by each core management question.

An evaluation of the design of existing monitoring programs, and the information they currently produce, demonstrated that only Question 3 is being answered with any degree of completeness, although current compliance monitoring efforts have not recently been examined for consistency and efficiency. For example, there are insufficient monitoring sites in the upper watershed to answer Question 1 (condition of streams) for that area and there is no routine monitoring of bacterial indicators needed for answering Question 4 (swimming safety). The summary of existing monitoring (Summary of Existing Monitoring Programs in the San Gabriel River Watershed) is included as a companion document with this report.

The overall program design (Figures Ex.1 and 2) addresses each of the five core management questions in turn, providing the rationale for the recommended design approach, selection of indicators and monitoring frequency, appropriate data products, and coordination with other efforts, as well as a preliminary estimate of costs. The design recommendations are summarized briefly in Table Ex.2.

Portions of the proposed program related to Questions 1 and 2 were implemented in 2005, through a set of cooperative efforts and one-time compliance monitoring offsets. In addition, specific design recommendations were developed for Questions 3 – 5. Sections 6 (related to compliance monitoring) and 10 (related to implementation and costs) describe a proposed set of permanent compliance monitoring offsets that will be sufficient to fully fund the program on an ongoing basis.

The design of the regional monitoring program is based on clear statements of rationale and criteria for decisionmaking about design options. The implementation plan is based on experience gained during the first year's monitoring effort, as well as on standardized costs that were used for developing budgets and examining tradeoffs among monitoring options. These building blocks provide tools that can be used to adapt the SGRRMP over time in response to improved knowledge and/or shifting management information needs.

The regional monitoring program described here reflects a high degree of consensus among a broadly representative group of stakeholders in the watershed. It represents a significant advance towards regional integration of monitoring efforts and assessment of watershed condition. However, it is important to recognize that, while the program will enhance the ability to assess the status of some beneficial uses, it will not provide the means, across the entire watershed, for fully determining compliance with water quality objectives, defining impairment, or meeting the requirements of the 303d listing/delisting process (Table Ex.3). Such purposes require more spatially and temporally intensive sampling efforts that are fulfilled by only some of the components of the proposed monitoring program.

Table Ex. 1. Beneficial uses addressed by each component of the SGRRMP.

Beneficial use	Q1: Stream condition	Q2: Unique areas	Q3: Discharges	Q4: Safe to swim	Q5: Safe to eat fish
Warm freshwater habitat	X	X	X		
Cold freshwater habitat	X	X	X		
Estuarine habitat		X	X		
Wildlife habitat	X	X	X		
Water Contact recreation				X	
Commercial, sport fishing					X

Table Ex.2. Summary of the recommended SGRRMP design to address each of the five core management questions.

Question	Approach	Sites	Indicators	Frequency
Q1: Stream condition	Randomized design for streams in entire watershed, except 1st and 2nd order[1] streams	30 in Year 1 10 new in each following year	Triad: bioassessment, water chemistry, toxicity	Annually, in spring
Q2: Unique areas	Fixed stations in estuary and freshwater	12 in freshwater • 4 high[2] value • 5 confluence of tribs/mainstem • 3 background	Freshwater: • Riparian habitat • Triad: bioassessment, water chemistry, toxicity • Riparian habitat	 Annually, in spring Annually, in spring Annually, in spring
		4 in estuary	Estuary: • Full suite water quality • Sediment chemistry, toxicity, infauna	 Annually, in spring Annually, in spring
Q3: Discharges	Improve coordination Improve efficiency Reduce overlap			
Q4: Safe to swim	Focus on high-use areas Defer to health depts. for details	6 lake and river areas 5 background 1 estuary	Total coliforms, E. coli, Enterococci	Adjusted based on degree of use and proximity to source(s)
Q5: Safe to eat fish	3-yr pilot study Focus on: • Popular fishing sites • Commonly caught species • High-risk chemicals	Minimum 2 each in lakes, river, estuary	Commonly caught fish at each location Mercury, DDTs, PCBs, arsenic, selenium	Annually in late summer

[1] Stream order is defined by a tributary's position in the branching network, with 1st order streams being headwater streams, 2nd order streams those with one tributary above them, and so on.
[2] High value sites are locations of relatively isolated unique habitat

Table Ex.3. Summary of potential management uses of information produced by the proposed SGRRMP.

Core question	305b	303d	TMDL	Health advisories
Q1: Stream condition	X		X	
Q2: Unique areas	X	X	X	
Q3: Discharges	X	X	X	
Q4: Safe to swim	X	X	X	X
Q5: Safe to eat fish	X	X	X	X

Figure Ex.1. Distribution of monitoring stations for the first year of the random watershed component of the regional monitoring program, as well as current compliance monitoring sites under the major discharge permits in the watershed.

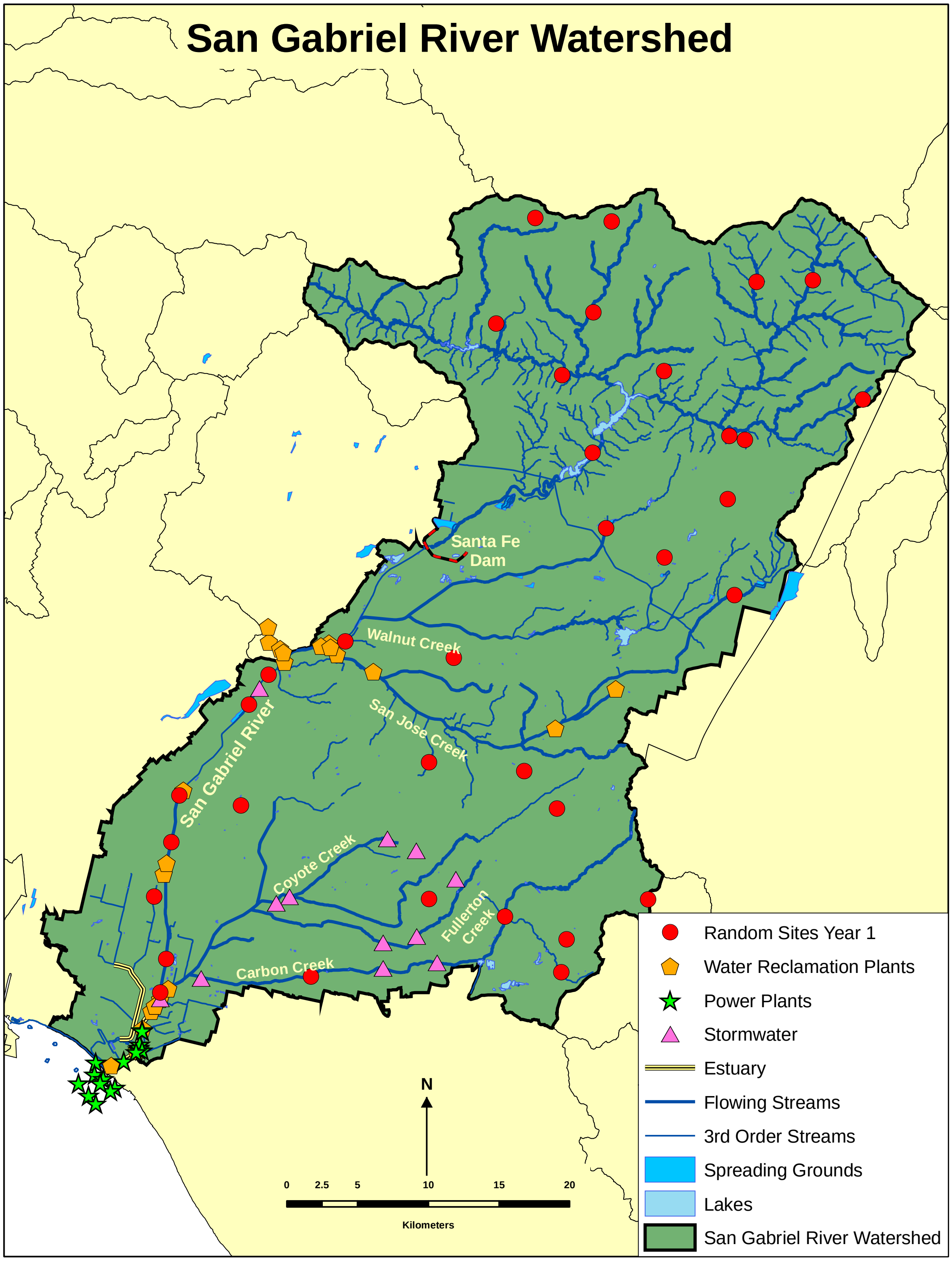
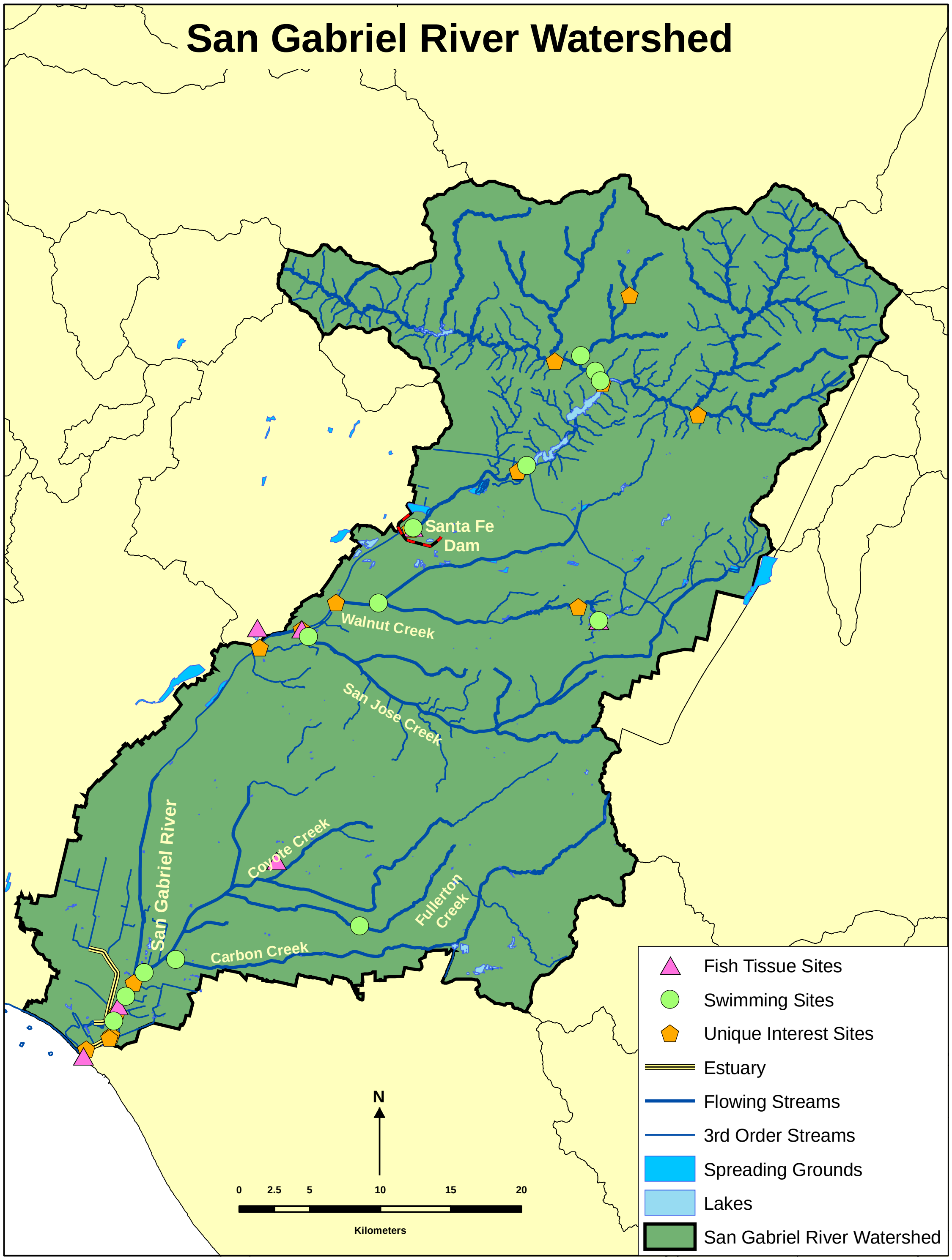


Figure Ex.2. Distribution of monitoring stations for all other components of the regional monitoring program, including fish tissue, swimming (body contact recreation), and sites of unique interest.



1.0 Introduction

1.1 Regional setting

The San Gabriel River Watershed is located in the eastern portion of Los Angeles County. It is bound by the San Gabriel Mountains to the north, the San Bernardino Mountains to the east, the watershed divide with the Los Angeles River to the west, and the Pacific Ocean to the south. The San Gabriel River's headwaters originate in the San Gabriel Mountains and the River terminates at the San Pedro Bay/Los Angeles and Long Beach Harbor complex, which is semi-enclosed by a 7.5 mile breakwater.

The 689 sq. mi. watershed consists of extensive areas of undisturbed riparian and woodland habitats in its upper reaches. Much of the watershed of the West Fork and East Fork of the river is set aside as a wilderness area; other areas (primarily lower elevation) in the upper watershed are subject to heavy recreational use. The upper watershed also contains a series of flood control and water conservation dams. Further downstream, towards the middle of the watershed, are large spreading grounds utilized for groundwater recharge. The watershed is hydraulically connected to the Los Angeles River watershed through the Whittier Narrows Reservoir via the Rio Hondo (normally only during high storm flows). The lower part of the river and its major tributaries flow primarily through concrete-lined channels in a heavily urbanized portion of the county before becoming a soft bottom channel once again near the ocean in the city of Long Beach. Approximately 26% of the land area of the watershed is developed.

Tertiary-treated effluent from five publicly-owned treatment works (POTWs) enters the river in the lower part of the watershed (which is partially channelized) while two power generating stations discharge cooling water into the river's estuary. The five POTWs have treatment capacities ranging from 15 million gallons per day (MGD) to 100 MGD. These facilities produce approximately 163 MGD (183,000 acre-feet/year) of recycled water, of which about 37% is reused through groundwater recharge, landscape irrigation, industrial processing and other applications. The rest is discharged to surface waters. The power plants together are permitted to discharge up to about 2,000 MGD. The watershed is also covered under two NPDES municipal stormwater permits (for Los Angeles and Orange Counties). Thirty-nine of the 109 permittees with separate NPDES permits (mostly industries) in the watershed discharge directly to the San Gabriel River. Twenty-one discharge to Coyote Creek and twelve discharge to San Jose Creek.

Of the 534 dischargers enrolled collectively under the general industrial storm water permit in the watershed, the largest numbers occur in the cities of Industry, Irwindale, Pomona, and Santa Fe Springs. Auto wrecking, lumber, metal plating, trucking, and die-casting are a large component of these businesses. About two-thirds of the facilities are greater than one acre in size and about 80 of them are larger than ten acres

There are 175 construction sites enrolled individually under the construction storm water permit. The sites are fairly evenly divided between residential and commercial and a similar number of sites are found in both the upper and lower watershed. About one-half of them occur on sites that are larger than ten acres.

1.2 Background

The development of a watershed-wide monitoring program for the San Gabriel River watershed is a direct response to a NPDES permit requirement established by the Los Angeles Regional Water Quality Control Board (LARWQCB) for the Los Angeles County Sanitation Districts' (LACSD) Long Beach, Los Coyotes, Whittier Narrows, San Jose Creek, and Pomona Water Reclamation Plants. For purposes of discussion, this program is termed the San Gabriel River Regional Monitoring Program (SGRRMP). This requirement stemmed, not from any specific contamination problem or discharge condition, but instead from a broader desire by LARWQCB staff for more integrated information about ambient conditions across the watershed as a whole and about patterns and trends in those conditions. This was a natural response to the growing awareness that watersheds involve habitats, physical features, and processes (both human and natural) that stretch across typical regulatory and management boundaries and are not well captured by current compliance monitoring systems. The regional monitoring design proposed here can be seen as a watershed-scale counterpart to existing larger-scale regional monitoring efforts in the southern California region (e.g., the state's Surface Water Ambient Monitoring Program (SWAMP), U.S. EPA's Western Environmental Monitoring and Assessment Program (EMAP), and the regional Bight Program) that attempt to address questions and concerns about regional condition and trends. The program presented here is unique in its intent to incorporate local and site-specific issues within a broader watershed-scale perspective.

In addition to these broader goals, this effort considered improving the overall cost effectiveness of monitoring efforts in the watershed. To this end, a number of recommendations are presented that are intended to reduce redundancies within and between programs, target constituent lists more directly on contaminants of concern, and adjust monitoring locations and sampling frequencies to better respond to management priorities.

The regional monitoring program is designed to complement and/or coordinate with the State Water Resources Control Board's SWAMP effort in the San Gabriel River watershed and with U.S. EPA's Western EMAP. This includes both the coordination of sampling effort and the use of consistent field sampling and laboratory analysis methods. In addition, the proposed program uses tools developed by the California Department of Fish and Game and the Southern California Wetlands Recovery Project for the regional assessment of biologic conditions in streams and channels, as well as monitoring design approaches developed by the Stormwater Monitoring Coalition's (SMC) model stormwater monitoring program (SCCWRP technical report #419, www.sccwrp.org/pubs/techrpt.htm).

The proposed SGRRMP does not exist in a vacuum. There are other efforts either planned or underway in the watershed intended to address similar or complementary questions about overall stream status. Primary among these are the LARWQCB's SWAMP effort and the volunteer monitoring efforts currently being planned by the Friends of the San Gabriel River and the San Gabriel Mountains Regional Conservancy. Coordination among these efforts could take several forms, including:

- Collaboration on planned monitoring efforts to defray financial and logistical costs
- Coordination and standardization of field sampling, laboratory analysis, and data management methods. Such efforts would be similar to the methodological intercalibration exercises conducted by SCCWRP as part of the periodic Bight Program
- Collaboration, either in terms of financial or in-kind support, on preparation of periodic watershed reports that integrate and synthesize monitoring data at the watershed scale.

1.3 Methods

The SGRRMP reflects the collaborative work of a workgroup impaneled by SCCWRP at the request of LACSD. The technical committee included representatives from state and federal regulatory agencies, key permittees in the watershed, other resource management agencies, and several conservation organizations active in the watershed (see Acknowledgements). This report, and its companion document (Summary of Existing Monitoring Programs in the San Gabriel River Watershed), summarizes current monitoring efforts in the watershed and makes specific recommendations about modifications needed to better answer management questions at the watershed scale. In the process of developing these recommendations, the workgroup attempted to balance the desire for consistency, standardization, and regional efficiency with reasonable requirements for program-specific differences in design needed to address program- and site-specific issues.

There are three boundary conditions that helped to structure and direct this effort. First, efforts focused on receiving water monitoring. Monitoring of the effluent from water reclamation plants and the power generating stations was not considered, reflecting LACSD's permit specification of a watershed-wide (or regional) monitoring program. Second, the proposed regional program includes the estuary in its definition of the watershed, although distinct monitoring approaches are proposed for the estuary and the freshwater portion of the watershed. Third, as described more fully in Section 1.4 Implementation, the SGRRMP does not include a detailed implementation plan, but does include general recommendations and a preliminary cost estimate.

1.4 Implementation

The integrated monitoring program described below is structured around a set of core management questions. These questions reflect specific concerns about different aspects of the San Gabriel River watershed and the impacts of human activities on these. For each question, the SGRRMP describes a monitoring design, including its overall approach and rationale, indicators to be measured, recommended monitoring sites and frequencies, and expected data products. The SGRRMP also identifies recommended modifications to some existing efforts that would bring them into line with the proposed regional program.

The proposed program clearly recognizes that any final decisions about modifications to existing monitoring efforts and/or about the initiation of new efforts will depend on detailed negotiations among the major stakeholders in the watershed. Thus, decisions about certain design details, coordination among related efforts, available resources and funding, logistics, phasing, and reporting remain to be resolved by the parties. This is a realistic acknowledgement of the diversity of core questions, the large number of stakeholders, and the range of existing monitoring efforts, some permit-based and some not. Thus, the proposed regional monitoring program described below is intended as a carefully considered starting point for detailed implementation discussions among an expanded group of stakeholders.

2.0 Principles and Framework for Regional Monitoring

2.1 Design principles and framework

The details of monitoring guidance that addresses the core management questions and their related objectives corresponds to a set of basic principles that provide an overall set of boundary conditions for monitoring design:

- Monitoring should be focused on decision-making; data not helpful in making a decision about clearly defined regulatory, management, or technical issues should not be collected.
- The level of monitoring effort should reflect the potential for impact, with more monitoring allocated to situations where the potential impact (in terms of both the probability of an impact's occurrence and its extent and magnitude) is higher and less monitoring to situations where such potential is lower or where monitoring is not likely to provide useful information.
- Monitoring designs should be integrated into a logically consistent whole, in which all aspects of the design support the core management question, and strive for both cost effectiveness and scientific rigor.
- Monitoring should be adaptive, in terms of its ability to both trigger follow-on studies as needed and make necessary mid-course corrections based on monitoring findings.

The proposed regional program fits within a larger context for monitoring program design being adopted throughout the southern California region. In this scheme, currently used in large ocean discharge permits and some stormwater permits, monitoring activities are organized into three categories:

Core monitoring includes long-term monitoring, intended to track compliance with specific regulatory requirements or limits, to conduct ongoing assessments, or to track trends in certain important conditions over time. Thus, core monitoring generally occurs at fixed stations that are sampled routinely over time.

Regional monitoring includes cooperative studies that provide a larger-scale view of conditions and can be used to assess the cumulative results of anthropogenic and natural effects on the environment. Regional monitoring also helps to place particular impacts in perspective by comparing local results (i.e. core monitoring) to the breadth and depth of human impacts and natural variability found throughout a larger region.

Special projects include specific targeted studies included as adaptive elements within core or regional monitoring designs. These are shorter-term efforts, with a specified beginning, middle, and end, intended to extend or provide more insight into core monitoring results, for example, by investigating the specific sources that may be contributing to a receiving water problem.

Within this overall structure, the regional program design described here focuses on both core (Questions 2, 3, 4, and 5) and regional (Question 1) monitoring, with references to special projects as needed.

2.2 Core management questions

The workgroup identified a subset of the beneficial uses in the region's Basin Plan that served as the central focus for the proposed regional monitoring design. These beneficial uses relate primarily to habitat conditions and to recreational use of the watershed and include:

- Warm Freshwater Habitat (WARM)
- Cold Freshwater Habitat (COLD)
- Estuarine Habitat (EST)
- Wildlife Habitat (WILD)
- Water Contact Recreation (REC1)
- Commercial and Sport Fishing (COMM).

These captured the regulatory, management, and public interest priorities of the stakeholders represented on the workgroup, as well as reflecting the primary objectives of traditional permit monitoring in the watershed. This short list did not, however, include other significant uses of water in the watershed, particularly Municipal and Domestic Supply (MUN), and Ground Water Recharge (GWR). While clearly important, these uses are being managed and monitored by other agencies and programs whose efforts have little if any overlap with monitoring focused on the uses listed above. As a result, these other efforts did not provide the immediate opportunity for regional coordination that was a central goal of the workgroup's efforts.

The workgroup articulated five core management questions, related to the priority beneficial uses:

- Question 1: What is the condition of streams in the watershed?
- Question 2: Are conditions at areas of unique interest getting better or worse?
- Question 3: Are receiving waters near discharges meeting water quality objectives?
- Question 4: Is it safe to swim?
- Question 5: Are locally caught fish safe to eat?

The summary of existing monitoring in the watershed (see next section) provided a basis for assessing the degree to which each core question is currently being addressed. This assessment formed the starting point for the development and description of regionalized monitoring designs targeted at each management question. In some cases, this required the development of new designs where little or no effort currently exists. In others, it involved the coordination and standardization of existing efforts that have been implemented independently and/or piecemeal over a period of years.

3.0 Existing Monitoring

The starting point for the workgroup's considerations was the set of monitoring activities now taking place in the watershed (see companion document, Summary of Existing Monitoring Programs in the San Gabriel River Watershed). That review focused on existing compliance monitoring because it represents the largest pool of available effort for meeting the goals of the regional monitoring program. Special studies, occasional characterizations, and other sporadic efforts were not included in the review. However, other broader efforts (e.g., volunteer watershed monitoring) are integrated as appropriate into the set of regional designs.

There appear to be four basic types of monitoring designs currently utilized by the agencies conducting routine monitoring in the watershed, including:

- End of watershed designs that typically measure the cumulative mass emissions from all discharges, primarily during wet weather storms
- Dispersed watershed designs that assess overall conditions and impacts in freshwater habitats, primarily in dry weather
- Site-specific watershed designs that assess conditions and trends in freshwater or estuarine habitats of particular interest, primarily in dry weather
- Dry-weather reconnaissance designs focused on identifying sources of pollution to the municipal stormwater system.

While all of these approaches can be found in the watershed, not every agency uses all four, as illustrated in Table 3.1.

The summary highlights two important features of existing monitoring efforts in the San Gabriel River watershed. First, the bulk of monitoring effort is concentrated around major discharges from water reclamation plants and power generating stations. Second, there are large inconsistencies among programs and program components in terms of the rationale for station location, the constituent list sampled, and the frequency of measurement. Many such differences reflect a logical amount of variety, given the different activities and responsibilities of each monitoring agency. In addition, however, these existing monitoring programs have to some extent accreted over time, with new elements being added as permits are renewed. Thus, programs have not all been designed from a regional perspective, with the goals of balancing efforts throughout the watershed, or of ensuring consistency among programs.

The workgroup then assessed, in qualitative terms, the degree to which the existing monitoring system, taken as a whole, addresses each of the core management questions:

Question 1: What is the condition of streams in the watershed?
Not answerable for the watershed as a whole. Not answerable for the upper watershed. Answerable only in part for the lower watershed because monitoring stations are sited to assess discharge compliance, not watershed condition

Question 2: Are conditions at areas of unique interest getting better or worse?
Not answerable because these have not been identified and therefore monitoring has not been focused on them.

Question 3: Are receiving waters near discharges meeting water quality objectives?
Answerable, although monitoring effort has not been examined for consistency and efficiency.

Question 4: Is it safe to swim?
Not answerable because there is no health-related monitoring targeted at recreational areas.

Question 5: Are locally caught fish safe to eat?
Not answerable because there is no fish tissue monitoring targeted at recreational fishing locations and catch.

Only one of the five core management questions is currently being addressed to any degree, not a surprising conclusion, given that the existing monitoring system has been designed primarily to evaluate specific permit requirements of point-source discharges in the lower watershed. This information confirmed the workgroup's initial impression that a number of key management questions remain unanswered and provides a basis for consideration, during the SGRRMP's implementation phase, of the potential reallocation of certain monitoring efforts.

Table 3.1. Generalized distribution of monitoring approaches across the separate ongoing, routine monitoring programs in the San Gabriel River watershed. Special studies and "one-time" characterizations not included.

Program	End of watershed	Dispersed watershed	Site-specific watershed	Recon-naissance
AES (power plant)			X	
LACSD			X	
LACDPW	X	X		
LA Dept. Water and Power			X	
Orange County Stormwater				X
US Forest Service			X	

4.0 Question 1: What is the Condition of Streams in the Watershed?

This question focuses on the beneficial uses:

- Warm Freshwater Habitat (WARM)
- Cold Freshwater Habitat (COLD)
- Wildlife Habitat (WILD),

and reflects concerns related to the status of streams in the watershed as a whole, rather than issues at specific or fixed sites.

Potential assessment questions that address such concerns include:

- What is the percentage of perennial streams that support their designated beneficial uses of Warm Freshwater Habitat, Cold Freshwater Habitat, and Wildlife Habitat?
- Is the percent of streams in the watershed/region which support the beneficial uses of Warm Freshwater Habitat, Cold Freshwater Habitat, and Wildlife Habitat increasing or decreasing over time?
- What is the distribution of benthic conditions (as reflected in IBI (Index of Biotic Integrity) scores) in streams of the watershed?
- What proportion of streams have an altered/degraded benthic community structure (i.e., IBI scores substantially below reference or best attainable condition)?

In overview, the monitoring design (Table 4.1) recommended to address such questions has the following elements:

- A randomized, or probabilistic, sampling scheme that includes the entire watershed, with the exception of 1^{st} and 2^{nd} order and ephemeral streams, down to the upper boundary of the estuary
- The watershed is treated as a single stratum, with sample subpopulations defined for the upper and lower watershed, and for the San Gabriel River mainstem below Whittier Narrows, to ensure a representative distribution of sampling sites
- Sampling conducted at 30 sites in the first year and then continued with ten new randomly selected sites in each subsequent year (Figure 4.1)
- Monitoring occurring in the spring and structured around the Triad approach, which includes bioassessment, aquatic toxicity, and water chemistry
- Measures of physical habitat characteristics collected coincident with bioassessment, including both the California Department of Fish and Game method and the California Rapid Assessment Method (CRAM).

The types of data products resulting from this monitoring design and appropriate for answering Question 1 may include:

- Cumulative frequency distribution plots of key individual indicators or metrics and of synthesized Triad results or condition scores
- Estimates of the stream reach miles in the watershed above/below benchmarks of interest for key indicators and for synthesized Triad results

- Maps of the areal distribution of monitoring sites in the watershed above/below benchmarks of interest for key indicators and for synthesized Triad results
- Estimates of difference in status between the upper and lower watershed, and between the mainstem and tributaries
- Trends over time in the estimates of watershed condition.

The following subsections provide details on the design approach selected, as well as on the recommended indicators and the sampling sites and frequencies. Data from the random watershed design will most probably not be ideally suited for use in the 303d listing process. This is because new sites will be sampled each year and a random, or probability based, design is not intended to support conclusions about the condition of specific locations. However, the State's current listing policy does not preclude the use of data from programs not expressly designed for listing purposes, and data from the random design could potentially apply to river reaches if enough random sites happen to fall in a specific reach over a three-year period.

4.1 Design approach

A random, probability-based design is best suited to addressing the core management question about the status of the watershed's streams as a whole. The strength of such an approach is that it will support conclusions about conditions across the entire watershed, and about any strata (or discrete subdivisions) defined within the watershed. The drawback is that it will not support conclusions about conditions at specific sites.

In probability based designs, such as used by the SWAMP, EMAP, and Bight Programs, stations are located randomly in order to provide the ability to draw statistically valid inferences about an area as a whole, rather than about just the site itself. Such designs can allocate monitoring sites randomly throughout the entire region, or can subdivide the region into a number of strata that are relatively homogeneous. For example, watershed strata could be based on relative amount of urbanization, general habitat type, or channel morphology. Whatever the stratification scheme, the basic design principle is that samples are allocated randomly among strata, with the number of samples per stratum based on a consistent weighting factor (e.g., area of the respective strata). The level of sampling effort required in probability based designs depends, as in all designs, on the specific questions being asked, the underlying levels of variability in the data, and on the level of precision needed for decision making. The primary intent of this component of the SGRRMP is to answer questions about the frequency of sampled areas above or below different benchmarks of interest. Given that the confidence limits around the cumulative frequency curve are widest at the 0.5 point on the curve, the workgroup made a subjective decision to accept a 15% confidence limit for this statistic (see Section 4.1.2).

The design effort for this component of the regional monitoring program involved developing rigorous answers to a series of subsidiary questions to define the detailed aspects of the overall management question:

- Which type of aquatic resources will be monitored?
- Where in the watershed will monitoring occur?
- How will stream quality/condition be defined?
- How will the conditions of streams be measured?
- How frequently will monitoring occur?

These questions are addressed in the following sections.

4.1.1 Target population and sampling frame

The target population is the ecological resource about which information is desired. The target population is defined as:

- The San Gabriel River watershed down to the upper end of the estuary
- Where flowing surface water exists for the large majority of the year
- Channels (both natural and modified) that fit the definition of "waters of the US" along with the adjacent riparian vegetation that would typically fall under the jurisdiction of the California Department of Fish and Game.

More detailed definitions and descriptions of these boundary conditions follow.

Questions about the condition of streams in the freshwater portion of the watershed are dealt with separately from those related to the estuary, which are addressed under Question 2. Focusing strictly on freshwater simplifies the selection of sampling sites and indicators for Question 1, because it removes the need to create a separate sampling stratum and a parallel set of indicators for brackish water. The boundary between the San Gabriel River and the estuary for purposes of this program is situated at the point where the concrete apron in the river is replaced by a soft bottom, which occurs just upstream of Atherton Drive.

The target population is also defined as those portions of the watershed's stream network where flowing water exists for the majority of the year. Major impoundments in the watershed were excluded from the target population. These impoundments include the areas behind Cogswell, San Gabriel, Morris, Santa Fe, Puddingstone, and Whittier Narrows Dams, and Legg and Peck Lakes. Flowing surface water is defined as those channels coded as perennial in the National Hydrographic Dataset (NHD) and confirmed as such by the workgroup. The NHD data layer for perennial streams was adjusted based on the workgroup's personal knowledge of the status of streams in the watershed. Segments that have no flow except during storms or during rare circumstances (e.g., controlled discharge) were recoded as non-flowing. Flowing surface water was defined to include water from all sources, including natural (local) and imported water, urban runoff, and treated effluent from water reclamation plants. This resulted in some artificially perennial stream segments in the lower watershed being recoded as flowing. Again in the lower watershed, some segments that are actually underground stormdrain channels were removed from the dataset. In the upper watershed, the NHD layer was modified based on the workgroup's best understanding of the typical condition of the streams with regard to year-round flow.

Some portions of the target population (i.e., the smaller creeks and streams in the upper reaches of the watershed) are both difficult to access (and therefore more costly to sample) and much less likely to contain flowing water. Removing hard-to-access streams from the target population, simply on the basis of their relative ease of access, would bias the watershed assessment. This is because hard-to-access streams will, by definition, be less impacted than those with easier access. The SWAMP design for the Los Angeles County portion of the Santa Clara River watershed dealt with this problem by systematically removing 1st and 2nd order streams from the target population. The SGRRMP design for Question 1 addresses these related issues by removing 1st and 2nd order and ephemeral streams from the target population, solely on the basis of their size, rather than their relative degree of access. The implication of this decision is that monitoring results will not be applicable to these smaller headwater streams.

Because the amount and location of flowing water in the watershed can shift seasonally, the definition of the sampling frame (a representation of the target population used to select the sample sites and that must have the attributes needed to implement the monitoring design) should also include a time frame. There are a number of issues related to the choice of sampling period. In general, flow is greater and more streams contain flowing water in the winter and spring. However, storms during these seasons can also scour channels and remove invertebrate communities. Streams that contain flowing water in the fall may be more likely to have more persistent, and less variable, invertebrate communities. In terms of managed flows, LACSD's Pomona and Long Beach Water Reclamation Plants discharge much less water in the summer, when demand for reclaimed water is higher, while they discharge much more in the winter. As a result, they mimic the natural flow regime and do not require special consideration when determining the timing of bioassessment sampling. In addition recharge/release of imported water and captured storm flows by the Los Angeles County Department of Public Works (LADPW) affects the amount and location of flowing water.

The choice of sampling period is also affected by the potential for coordination among existing programs and the availability of interpretive tools. The EMAP and SWAMP sampling periods are in the spring, and both of these programs use a bioassessment indicator, as will the SGRRMP (see Section 4.2 Indicators). In contrast, the two permittees that now conduct bioassessment monitoring (LACSD and LADPW) are required in their permits to do so in the fall, using the same basic protocol employed by EMAP and SWAMP.

The proposed random watershed monitoring design recommends bioassessment sampling in the spring, after an antecedent dry period long enough to ensure that a benthic invertebrate community is likely to have developed after any scouring from storm flows during the wet season. The recommendation for spring sampling is based on the value of data compatibility with the EMAP and SWAMP efforts and the fact that both permittee programs are relatively new. In addition, the California Department of Fish and Game's Index of Biotic Integrity (IBI) for evaluating bioassessment data is currently only established for the spring. However, efforts are underway to develop an IBI that is applicable to a mid-spring through mid-fall index period. Once this IBI becomes available, and/or when sufficient data are available to intercalibrate bioassessment results from spring and fall periods, then it may become possible to sample in either the spring or the fall, adding flexibility to the program.

4.1.2 Strata, subpopulations, and sampling requirements

Stratification can be used to subdivide the watershed into more homogeneous sections to better answer questions about differences between distinct portions of the watershed. However, sampling requirements in randomized designs increase linearly with the number of strata. Thus, the value of increased resolution must be balanced against the associated increase in cost and effort, because each stratum requires a full complement of sampling sites.

An alternative to stratification is to subsample specific areas of the watershed, yet still treat the watershed as a single stratum. This approach ensures representation of all subpopulations by distributing samples in desired proportions across the various sections of the watershed. The advantage of this approach is that it does not require a complete set of samples for each area of interest. The disadvantage is that it does not allow comparison between the subpopulations of the watershed.

The San Gabriel River watershed displays clear differences between its upper and lower portions in terms of channel morphology and habitat, and most probably in water quality and quantity as well (given the relative absence of urbanization in the upper watershed). In addition to these subdivisions, the workgroup identified the mainstem of the San Gabriel River as an area of particular interest.

The SGRRMP design treats the watershed as one overall stratum with three subpopulations. This decision was based primarily on the fact that the primary purpose of Question 1 is to assess the entire watershed, and not to specifically address either particular sites or comprehensively monitor all the streams in the watershed.

The number of sites sampled under the random design depends on the desired confidence level in the data. A larger sample size translates to less uncertainty associated with differences or trends in the data, and vice-versa. Data from the randomized design will be used to produce cumulative frequency distributions of the indicator measures. These distribution curves can then be used to make descriptive statements about the proportion of the stratum (i.e., the watershed) that is above or below any particular threshold level of interest, for example, an IBI score of 35. The confidence level attached to these estimates of proportion depend on the size of the error bars around the cumulative frequency distribution curve. As with all statistical estimates, the larger the error bars, the less the confidence of the estimate. The error bars around the binomial cumulative frequency distribution curve are widest at a proportion, or "p", of 0.5, that is, halfway along the curve. Thus, selecting a sampling intensity that ensures the error bars will be acceptable at p = 0.5 means that, even in the worst case, useful estimates can be produced. The error bars associated with several representative levels of sampling effort are as follows:

- 50 sites + / - 12%
- 30 sites + / - 15%
- 12 sites + / - 24%.

Thirty samples per stratum were determined to provide a reasonable level of confidence for assessment, the same level of sampling intensity selected by the Bight Program. Defining two or three distinct strata would require a total of 60 to 90 sampling sites, an unrealistic number for a program of this nature. However, the procedure for drawing the random samples includes a requirement that the three portions of the watershed will be treated as subpopulations, with samples distributed to ensure a representative number of samples in each subpopulation. For purposes of the sample draw, the boundary between the upper and lower portions of the watershed is Santa Fe Dam. The first year's sampling sites, drawn randomly from the target population, are shown in Figure 4.1.

4.1.3 Sampling frequency and intensity

The recommended sampling frequency and intensity were selected to balance the twin goals of achieving the assessment threshold of 30 sites as quickly as possible, while also keeping in mind the longer-term relevant management timeframes. Relevant management timeframes (e.g., permit renewals, 305b reports) are several years long and longer-term monitoring of the results of natural processes that affect the watershed does not necessarily require frequent monitoring on an annual timescale. Thus, a complete assessment of the entire watershed on an annual basis is not necessary.

The recommended design is frontloaded. This involves sampling 30 sites during the first year of the program and ten newly selected random sites in each subsequent year. This would enable managers to carry out a valid assessment after the first year, which would increase the immediate value of the program. Sampling ten new sites in each subsequent year would have the benefits of:

- Sampling the entire watershed over a period of time

- Producing a new set of 30 sites on a three-year schedule appropriate to management timeframes
- Spreading sampling out over a number of years, which would tend to smooth or average year-to-year variability
- Keeping the level of effort to a level that realistically could be funded.

4.2 Indicators

Monitoring of overall stream status is recommended to be based on the Triad approach, in which bioassessment (and its associated suite of physical habitat measurements), aquatic toxicity, and water column chemistry data provide a variety of perspectives on conditions at a site. It is especially suited to situations where the primary concern is the relationship between water quality and habitat or ecosystem condition, and no single or simple suite of indicators affords an unambiguous measure of status. The Triad of measurements provides an opportunity to assess whether there are apparent linkages between observed levels of chemicals of concern and impacts on test organisms and/or the instream community itself (although it is widely recognized that, in general, the instream benthic community is most dependent on physical habitat features).

4.2.1 Bioassessment

Bioassessment, a measure of the structure of one or more components of the instream biological community, provides a direct measure, from one perspective, of the ecological status of instream communities. There are alternative approaches to stream bioassessment, for example, those used by Western EMAP, the U.S. Forest Service, and the California Department of Fish and Game. While similar in their basic approach (which involves measurement of various aspects of the instream benthic invertebrate fauna), all differ somewhat in their details, with none having emerged as a clear standard. The State of California's SWAMP has established a bioassessment subcommittee with the goal of resolving which method(s) to use for its monitoring efforts. A decision about which specific method to use in the SGRRMP has therefore been deferred pending the resolution of this issue.

In addition to differences in technical approaches for assessing instream animal communities, there are two alternative approaches for collecting the physical habitat measurements that are typically part of the bioassessment method (Table 4.2). The first is associated with EMAP and the California Department of Fish and Game's IBI. Because these methods monitor stream macroinvertebrates, their physical habitat measurements focus on the physical features in streams that are useful in explaining patterns in macroinvertebrate community structure. A second approach is the California Rapid Assessment Method (CRAM), being developed and evaluated by the Southern California Wetlands Recovery Project. CRAM is a rapid assessment tool that does not measure macroinvertebrates but whose primary emphasis is on the overall biology of the system, including the geomorphology, vegetation, riparian zone, and floodplain. Because both methods of measuring physical habitat involve on-site measurements, reflect complementary aspects of the stream and riparian system, and do not involve significant time to implement, the SGRRMP design includes both the IBI and CRAM sets of physical (and biological) habitat measures (Table 4.2).

4.2.2 Aquatic toxicity

Aquatic toxicity provides another measure of potential impact, although the use of test organisms in the laboratory makes this a less direct indicator of site-specific impact than the bioassessment leg of the Triad. On the other hand, aquatic toxicity tests can help identify potential impacts from chemical contaminants.

A key design decision is whether to use a single test species or multiple species. One currently popular standard approach is to use a fish (fathead minnow (*Pimephales promelas*)), an arthropod (*Ceriodaphnia dubia*), and a plant (*Selenastrum capricornutum*), although the *Pimephales promelas* is generally regarded as not very sensitive to many toxicants. *Selenastrum capricornutum* is also problematic because ammonia retards its growth but other nutrients may cause it to grow faster, making it difficult to interpret test results. Another option would be to use two arthropod test species, for example, *Ceriodaphnia dubia* and *Hyalella azteca*. However, this approach has been criticized because such taxonomically similar test species would most likely result in a relatively narrow response range to potential toxicants. The use of a single test species is open to the same criticism.

The recommended SGRRMP design for toxicity testing under Question 1 is to use two species (*Ceriodaphnia dubia* and *Pimephales promelas*) in the upper watershed during the first year of the program and *Ceriodaphnia dubia* alone in the remainder of the watershed. If no toxicity to *Pimephales promelas* is found, then this species will be dropped and the program in subsequent years will use only *Ceriodaphnia dubia*.

This decision was based on the fact that the goal of the random component of the watershed program is to provide an overall assessment of the general level of toxic effects in the watershed, rather than to conduct a detailed examination of site-specific toxicity impacts. In addition, past toxicity testing in the watershed has documented only minimal toxicity in certain areas, and that only for *Ceriodaphnia dubia*. Finally, *Pimephales promelas* is sensitive primarily to ammonia and ammonia levels have significantly decreased now that the LACSD treatment plants have implemented nitrification/denitrification processes. Taken together, this information strongly suggested that a single test species (*Ceriodaphnia dubia*) would be sufficient to meet the program's purposes. However, the U.S. EPA toxicity study currently underway concentrates only on the lower watershed, and there remains some residual concern about the potential for toxicity in the poorly studied upper watershed. The inclusion of *Pimephales promelas* in the upper watershed during the program's first year should address these concerns.

4.2.3 Water chemistry

Water chemistry data (Table 4.3) help to put the bioassessment and aquatic toxicity data into context, as well as provides direct measures of some potential sources of human impact. Some parameters (e.g., hardness, anions, cations) are also useful in general watershed characterization and in describing basic physical characteristics of the aquatic environment.

Water chemistry parameters selected for measurement include the range of contaminants that past monitoring data have shown to be the source of most water quality problems in the watershed and that are appropriate for broad watershed assessment and/or contribute to standards development. A longer list of contaminants is measured at the compliance monitoring sites associated with specific discharges (see Section 6.0 and companion report, Summary of Existing Monitoring Programs in the San Gabriel River Watershed). Bacterial indicators are not included among the recommended parameters because single, unreplicated samples collected once a year from a shifting set of random sites were considered to provide little useful information, especially in light of the well-known variability inherent in bacterial indicator measurements.

4.3 Coordination with other efforts.

There are other efforts either planned or underway intended to address similar or complementary questions about stream status throughout the watershed. The first of these is the LARWQCB's SWAMP effort (with its focus on assessing hydrologic units). This program plans for a total of 30 random watershed sites in the Los Angeles and San Gabriel River watershed, to be sampled once every five years, with 15 allocated to the San Gabriel River watershed. While the total of 30 sites is sufficient for probability based estimates on the combined watershed, the 15 sites planned for the San Gabriel River watershed are not adequate, by themselves, for this purpose. The LARWQCB sampled their 15 sites in the San Gabriel River watershed during 2005 in coordination with the SGRRMP, thus reducing the financial and logistical impact on the SGRRMP.

In addition to the SWAMP effort, a variety of support was provided to the SGRRMP in its first sampling season (2005) by a number of other agencies and/or programs, including:

- U.S. EPA
- California Department of Fish and Game
- Los Angeles County Sanitation Districts
- Los Angeles County Department of Public Works
- Orange County Stormwater Program
- Southern California Coastal Water Research Project
- San Gabriel Mountains Regional Conservancy.

The support included logistical coordination, field sampling, laboratory analyses, and data management. The LARWQCB authorized a set of one-time compliance monitoring offsets to permit LACSD and LADPW to shift a limited amount of monitoring effort to meet the requirements of the new program.

The SGRRMP's random watershed monitoring design already includes specific elements intended to coordinate with SWAMP, including:

- Use of the Triad approach
- Intent to use the bioassessment method(s) selected by the SWAMP bioassessment committee
- The decision to monitor in the spring
- Agreement in principle to standardize chemical measurements and methods to the greatest extent possible.

In addition, the SGRRMP workgroup envisions ongoing coordination as needed with the agencies involved in the first year's sampling effort.

Table 4.1. Design overview for the random watershed component of the regional monitoring program, which recommends a Triad approach of bioassessment, aquatic toxicity, and water chemistry.

Design element	Description	Details
Design approach	Probabilistic design	All channels with flowing water, except for 1st and 2nd order and ephemeral streams Excludes impoundments Watershed treated as one stratum with three subpopulations
Number of sites	30 in year 1 10 in subsequent years	All sites selected randomly Ensure representative distribution across upper and lower watershed, and mainstem
Sampling frequency	Yearly in spring	
Bioassessment indicator	Stream macroinvertebrates Physical habitat measurements	Macroinvertebrate sampling method not defined Both IBI/EMAP and CRAM physical habitat measurements
Aquatic toxicity indicator	Basic scan	*Ceriodaphnia dubia* and *Pimephales promelas* in 1st year *Ceriodaphnia dubia* only in subsequent years if no *Pimephales promelas* impacts found
Water chemistry indicator	ICP total trace metals (34 metals) Conventional chemistry (hardness, pH, dissolved oxygen, etc.) Nutrients Organophosphate pesticides (19)	

Table 4.2 Physical habitat parameters sampled in the EMAP and California Department of Fish and Game (CDFG) approaches compared to the California Rapid Assessment Method (CRAM) approach.

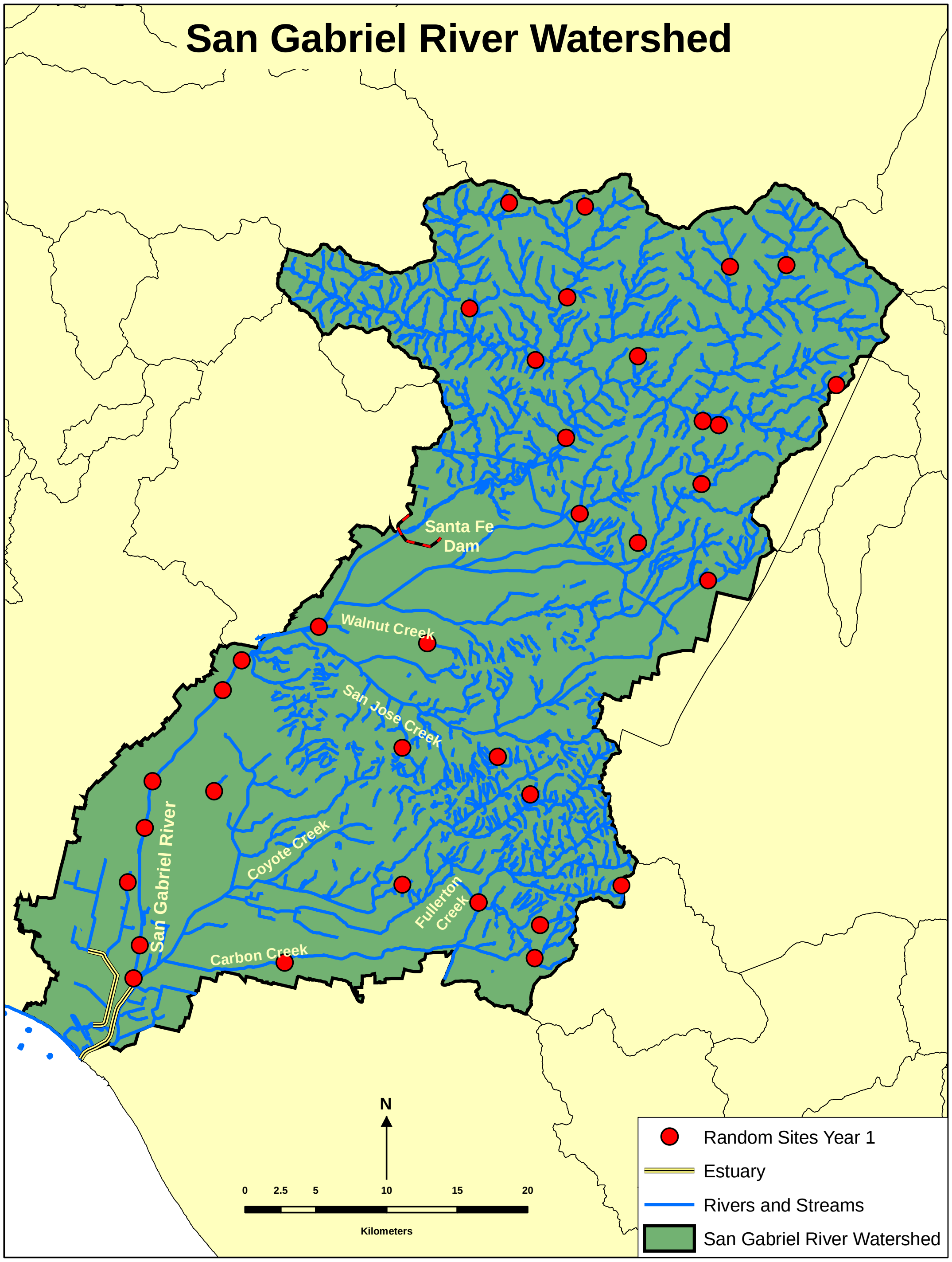
Aspect of system	EPA P-Hab and CDFG physical habitat quality	California Rapid Assessment Method
Hydrology	Channel flow status: amount of flow - coverage of entire streambed	Hydroperiod: presence of "intact" baseflow and peak flow regimes
		Water source: lack of artificial sources of dry season flow
Hydrology/physical structure	Velocity/depth regime: presence of pools, riffles and runs	Physical patch richness: presence of riffles, runs, pools, snags, mounds, bars, etc
Physical structure/substrate	Sediment deposition: deposition and bar formation	
Physical structure/substrate	Embeddedness: composition of channel bed (e.g. cobble, boulders)	
Physical structure	Channel alteration: presence of channelization or bank hardening	Hydrologic connectivity: connection between stream and adjacent floodplain
Physical structure	Bank stability: presence of erosion along banks	
Biogeochemistry		Organic matter accumulation: presence of organic matter in various stages of decay
Physical structure/habitat	Epifaunal substrate/available cover: presence of submerged habitat, such as snags, cobble beds etc	Topographic complexity: cross section of the stream contains a variety of different habitats such as bars, runs, ponds
Physical structure/habitat	Frequency of riffles, frequency and distance between riffles	
Habitat	Vegetation protection: extent and diversity of habitat along the streambanks	Biotic patch richness: Diversity of habitat types

Aspect of system	EPA P-Hab and CDFG physical habitat quality	California Rapid Assessment Method
Habitat	Riparian vegetative zone width: width of riparian zone and presence of human activities	Buffer: 3 metrics evaluating the extent, width, and condition of the buffer
Habitat		Connectivity: connectivity with upstream and downstream reaches
Habitat		Vertical biotic structure: extent of different height classes of vegetation
Habitat		Interspersion and zonation: spatial diversity and complexity of habitats - presence of habitat mosaic
Habitat		Invasive plant species: percent coverage of invasive plant species
Habitat		Native plant species richness: number of codominant native plant species

Table 4.3 Details of the water chemistry parameters recommended to be measured in the random watershed component of the program.

Category	Parameters	General assessment use	Standards development use
General physical characteristics	Hardness, alkalinity, total dissolved solids (TDS), total suspended solids (TSS)	Basic physical characteristics Useful in watershed characterization Gross measures of water quality	
DO and pH		Actual measurement can depend on time of day, but important in interpreting toxicity results related to ammonia Ancillary data for interpreting benthos and algae data	Provide basic information about pH levels throughout watershed to help evaluate applicability of existing standards
Total and dissolved organic carbon		Basic physical characteristics Gross measures of water quality Useful in assessing algae problem, supplements nutrient measures	Biotic Ligand Model development
Total suspended solids		Basic physical characteristics Gross measures of water quality Surrogate for turbidity	
Metals	Total and dissolved metals for watershed characteristics, patterns (ICP list of 34 metals)	Metals can speciate, so total metals simpler to measure Mercury not an issue in streams but is a potential problem in reservoirs	Biotic Ligand Model development
Nutrients	Nitrate, nitrite, total Kjeldahl nitrogen, ammonia, total phosphate, orthophosphate	Useful for gross description of conditions Ancillary data for interpreting benthos and algae data	Provide basic information about nutrient levels throughout watershed prior to standards development
Organophosphate pesticides	ICP list (19, incl. chlorpyrifos, diazinon, malathion)	Interest in patterns of pesticide distribution Random design may not provide spatial intensity needed	

Figure 4.1. Location of the 30 random watershed sites sampled during the first year of the program.



5.0 Question 2: Are Conditions at Areas of Unique Interest Getting Better or Worse?

This question focuses on the beneficial uses:

- Warm Freshwater Habitat (WARM)
- Cold Freshwater Habitat (COLD)
- Wildlife Habitat (WILD)
- Estuarine Habitat (EST),

and reflects concerns related to the status and trends of condition at specific, fixed locations or areas in the watershed, including the estuary at the bottom of the watershed. These locations are ones the workgroup agreed represented a type of natural habitat that is relatively scarce in the region, is at an elevated risk of impact because of intense recreational use, or has the potential to provide information about trends in key portions of the watershed.

Potential assessment questions that address such concerns include:

- Are areas of valued habitat supporting their designated beneficial uses of Warm Freshwater Habitat, Cold Freshwater Habitat, Wildlife Habitat, and/or Estuarine Habitat?
- What is the condition of specific areas of valued habitat, and is this condition getting better or worse over time?
- How do habitat and water quality conditions at valued habitat areas compare to conditions in other portions of the watershed?
- What are the patterns and trends in general water mass characteristics (e.g. temperature and salinity) in the estuary?
- What is the condition of sediment quality in the estuary?
- What is the condition of water quality and habitat at key confluence locations (where major tributaries enter the mainstem) that are likely to reflect cumulative impacts from discrete portions of the watershed?
- What are the differences in habitat or water quality between subwatersheds, as reflected by conditions at confluence sites?
- What are the trends over time in the relative differences between subwatersheds?

The component of the regional monitoring program to address these questions is intended primarily as a trend monitoring effort and has the following three recommended elements (Table 5.1):

- For high value / high risk sites in the freshwater portion of the watershed:
    - A fixed design that focuses on four specific locations and three minimally impacted sites
    - An emphasis on habitat conditions rather than water quality
    - Sampling will take place in the spring to coordinate with monitoring for Question 1
    - Monitoring will be structured around the CRAM approach (Table 4.2)
- For the estuary:
    - A fixed design including four existing stations monitored by LACSD
    - An emphasis on water quality and sediment quality
    - Sampling of conventional water quality parameters at an undetermined frequency
    - Annual sampling of a broader list of water quality parameters

  - Annual sampling of sediment chemistry, sediment toxicity, and benthic infauna
- For confluence sites where major tributaries enter the mainstem:
  - A fixed design that focuses on five specific locations
  - Monitoring based on the Triad of bioassessment, water quality, and aquatic toxicity
  - Sampling will take place in the spring to coordinate with monitoring for Question 1.

The types of data products resulting from this monitoring design and appropriate for answering Question 2 may include:

- For high value / high risk sites in the freshwater portion of the watershed:
  - Site-by-site summaries of the quantitative scoring of CRAM attributes and trends in these over time
  - Site-by-site comparisons of CRAM attributes between high value / high risk and minimally impacted sites
  - Site-by-site interpretations and conclusions of habitat status and trends
- For the estuary:
  - Graphical and map-based descriptions of spatial and temporal patterns of descriptive water mass characteristics (e.g., temperature, salinity)
  - Graphical and mapbased descriptions of spatial and temporal patterns of sediment chemistry, sediment toxicity, and benthic infaunal community structure (sediment Triad)
  - Evaluation of sediment Triad data with reference to the pending statewide Sediment Quality Objectives
- For confluence sites:
  - Descriptions of water quality conditions (e.g., conventional chemistry, total metals, organophosphate pesticides)
  - Comparisons across sites of water quality conditions
  - Trend plots and maps of changes in measures of condition over time.

Over time, information from the confluence locations may also be useful in assessing differences between subwatersheds, directing management attention to specific subareas of the watershed, improving understanding of the nature of cumulative effects, and tracking the effectiveness of management actions at a subwatershed scale.

The following subsections provide details on the design approach selected, as well as on the recommended indicators and the sampling sites and frequencies.

5.1 Design approach

This question reflects concerns related to the status of particular locations in the watershed that are of heightened interest because they meet one or more of the following criteria:

- They represent unique habitat value
- Valued habitat is at higher risk because of concentrated human use
- They are confluence points where major tributaries enter the mainstem, providing an ability to monitor cumulative impacts from major portions of the watershed
- They provide a measure of natural background or context against which to evaluate trends in other portions of the watershed.

The primary goal of this component of the program is to track trends over time and provide early warning of potential degradation so that management action can be taken. The appropriate design is therefore a set of fixed sites monitored systematically over time with consistent and readily interpretable methods.

5.1.1 Freshwater portion of the watershed

The workgroup identified specific sites (Figure 5.1) that fit into the following three categories:

- Specific areas of valued and/or at-risk habitat
  - Los Cerritos Wetland
  - Santa Fe Dam scrub habitat near the head of the lake
  - Walnut Creek County Park
  - Whittier Narrows
- Confluence points where major tributaries enter the mainstem
  - Confluence of East and West Forks of San Gabriel River
  - Mainstem of San Gabriel River below Morris Dam, at the bottom of the canyon
  - Confluence of Walnut creek and mainstem of San Gabriel River
  - Confluence of San Jose Creek and mainstem of San Gabriel River
  - Confluence of Coyote Creek and mainstem of San Gabriel River
- Minimally impacted sites that provide a measure of natural background or context
  - Three sites being used for the SCCWRP Natural Loadings Study
    - Cattle Canyon, tributary to the East Fork of San Gabriel River
    - Bear Creek, tributary to the West Fork of San Gabriel River
    - Upper North Fork of San Gabriel River.

The two stormwater mass emissions stations monitored by LADPW (San Gabriel River at Spring Street and Coyote Creek at Del Amo Boulevard) capture the large majority of loads to the system. These data provide additional context for understanding spatial patterns and temporal trends in the watershed.

The Los Cerritos Wetland represents a special case because it is not currently hydrologically connected to the San Gabriel River, and has its own distinct watershed. However, it is recommended for inclusion in the regional program because:

- Coastal wetlands are extremely valuable habitats in southern California
- The area was at one time a part of the San Gabriel River estuary and thus the larger watershed
- It is not yet developed and thus meets criteria for protection.

The development of a SGRRMP monitoring design for the Los Cerritos Wetland should be deferred until this can be coordinated with the recommendations that emerge from the Wetlands Recovery Project's effort to develop a regional wetlands monitoring program.

Monitoring for all other sites should occur during non-storm conditions in the spring, and coincide with the random watershed monitoring to the greatest extent possible.

5.1.2 Estuary

The estuary as a whole is considered an area of special interest because of the regional scarcity of estuarine habitat in southern California. Current monitoring in the estuary includes several compliance stations sampled by the power generating stations and four stations sampled by LACSD as part of its NPDES monitoring program. The power plant monitoring effort is considered as a portion of the compliance monitoring system (see Section 6.0) because it is directly associated with discharges into the estuary. However, the four LACSD stations are addressed within this component because they represent general locations of interest useful for characterizing and assessing the estuary.

Recommended monitoring focuses on both water and sediment quality. It is presumed that longer-term impacts will appear primarily in the sediment, because this is where particle-bound contaminants are expected to settle out. Annual sampling is recommended for sediment constituents and for a longer list of water quality parameters. Conventional water quality parameters are recommended for more frequent sampling, on a schedule to be defined during the subsequent detailed implementation phase.

5.2 Indicators

5.2.1 Freshwater portion of the watershed

For the minimally impacted sites and the high value / high risk sites (with the exception of the Los Cerritos Wetland), recommended monitoring should be based on the CRAM set of habitat metrics (Table 4.2). This recommendation is based on the fact that the primary questions in this aspect of the program relate to the status and trends of habitat, rather than water quality. Comparison studies have shown that the CRAM indicators are more stable, less influenced by short-term events, and thus more suitable for longer-term trend monitoring than are the standard bioassessment indicators. For the Santa Fe Dam and Whittier Narrows sites, it will be necessary to define the specific zone for which CRAM will be appropriate, since CRAM generally does not apply to upland sites.

For the confluence sites, recommended monitoring is based on the Triad approach used in Question 1 (bioassessment, water chemistry, aquatic toxicity) (Tables 4.3, 5.1).

5.2.2 Estuary

LACSD monitoring in the estuary currently focuses on a water chemistry constituent list related to their upstream discharges. These are not directly relevant to the estuary because the point discharge input from upstream is, at this location, swamped by the influence of the ocean. This judgment is supported by both historical water quality data and more recent toxicity testing, which show little if any evidence of water quality concerns in the estuary. The recommended water chemistry monitoring is therefore focused on conventional chemistry (e.g., dissolved oxygen, hardness), which will be useful in describing and tracking trends in general water mass characteristics. A longer list of constituents (yet to be defined but including contaminants such as metals and pesticides) is recommended for annual sampling.

Annual sediment sampling should include sediment chemistry, sediment toxicity, and benthic infauna in order to obtain a more complete picture of sediment quality and to be consistent with the approach being developed for the State Water Resources Control Board’s (SWRCB’s) Sediment Quality Objectives.

5.3 Coordination with other efforts

There are different opportunities available for coordination related to the freshwater and the estuary portions of this component of the SGRRMP.

For the freshwater portion, as described in Section 4.3, there are other broad monitoring efforts planned for the San Gabriel River watershed, in addition to the ongoing compliance monitoring conducted by LACSD around its water reclamation plants, and the stormwater mass emissions sites monitored by LADPW and planned by the Orange County Stormwater Program. These provide opportunities for coordination and standardization, particularly with regard to:

- The four SWAMP directed sites planned for the base of four subwatersheds (Walnut Creek, West Fork, North Fork, East Fork), which will use the Triad approach to monitor aquatic condition
- The monitoring designs being developed by the Friends of the San Gabriel River and the San Gabriel Mountains Regional Conservancy, which will focus on both water chemistry and habitat
- The existing compliance monitoring being conducted by LACSD at the confluences of both San Jose Creek and Coyote Creek with the mainstem
- Stormwater mass emissions monitoring.

For the estuary portion, there are several opportunities for coordination and standardization, including:

- Power generating station monitoring program(s) that have sites adjacent to two of the LACSD estuary stations
- The Bight Program's bays and estuaries component
- The SWAMP site planned for the bottom of the estuary, which will sample a broad range of indicators, including sediment chemistry in addition to those planned for the tributaries.

Coordination with all these programs can include efforts to standardize field sampling, laboratory analysis, and data management methods. Coordination with SWAMP, the Bight Program, and the Friends and Conservancy programs can take the form of cooperative sampling efforts to defray costs. Coordination with the power generating station(s) can take the form of cooperative sampling and/or consolidating stations.

5.4 Special projects

There are two related special projects underway to improve understanding of the hydrodynamics and water quality of the estuary. Both are modeling efforts, although each has a somewhat different focus.

The first modeling effort is being conducted by SCCWRP. Its goal is to begin to collect the data necessary to understand the physical, chemical and biological dynamics in the San Gabriel River estuary in order to develop a model that links sources of pollutants and their fate and transport throughout the year. This effort is being carried out in collaboration with efforts underway by U.S. EPA and the LARWQCB to develop watershed models for the San Gabriel River watershed. The SCCWRP model can be applied to the development of watershed TMDL targets and/or site-specific water quality objectives for the estuary.

The SCCWRP study has a number of distinct steps:

- Develop a hydrodynamic model
- Develop a watershed model
- Define the inputs to a water quality model
- Describe the transformation processes that occur in the estuary
- Collect data to calibrate and validate the water quality model.

The hydrodynamic model will use the physical description of the estuary to describe water movement. Inputs to the water quality model will be defined using discharge records and a model of stormwater runoff. Finally, water quality data will be collected to validate the model incorporating all these factors.

Both dry and wet weather conditions in the estuary will be modeled. However, the sampling and monitoring efforts to calibrate and validate the model will be focused on the dry season. Wet weather inputs will be simulated using a calibrated watershed model of the San Gabriel River and Coyote Creek watersheds. Land use and water quality monitoring data will be used to quantify wet weather inputs to the water quality model. Validation of the wet weather component of the estuary can be accomplished with additional resources, should they become available.

The second effort is being conducted by LADWP and AES Corporation (operator of one of the electric generating stations in the estuary) to provide additional input to decision making about the formal hydrological classification of the estuary as either an estuary or ocean/bay. LADWP and AES, respectively, operate the Haynes and Alamitos Generating Stations, which discharge into the estuary. These discharges had been classified as ocean discharges and the LARWQCB's recent classification of these discharges as estuarine discharges has important implications for the operation of the generating stations, since different thermal standards apply in the ocean and in estuaries.

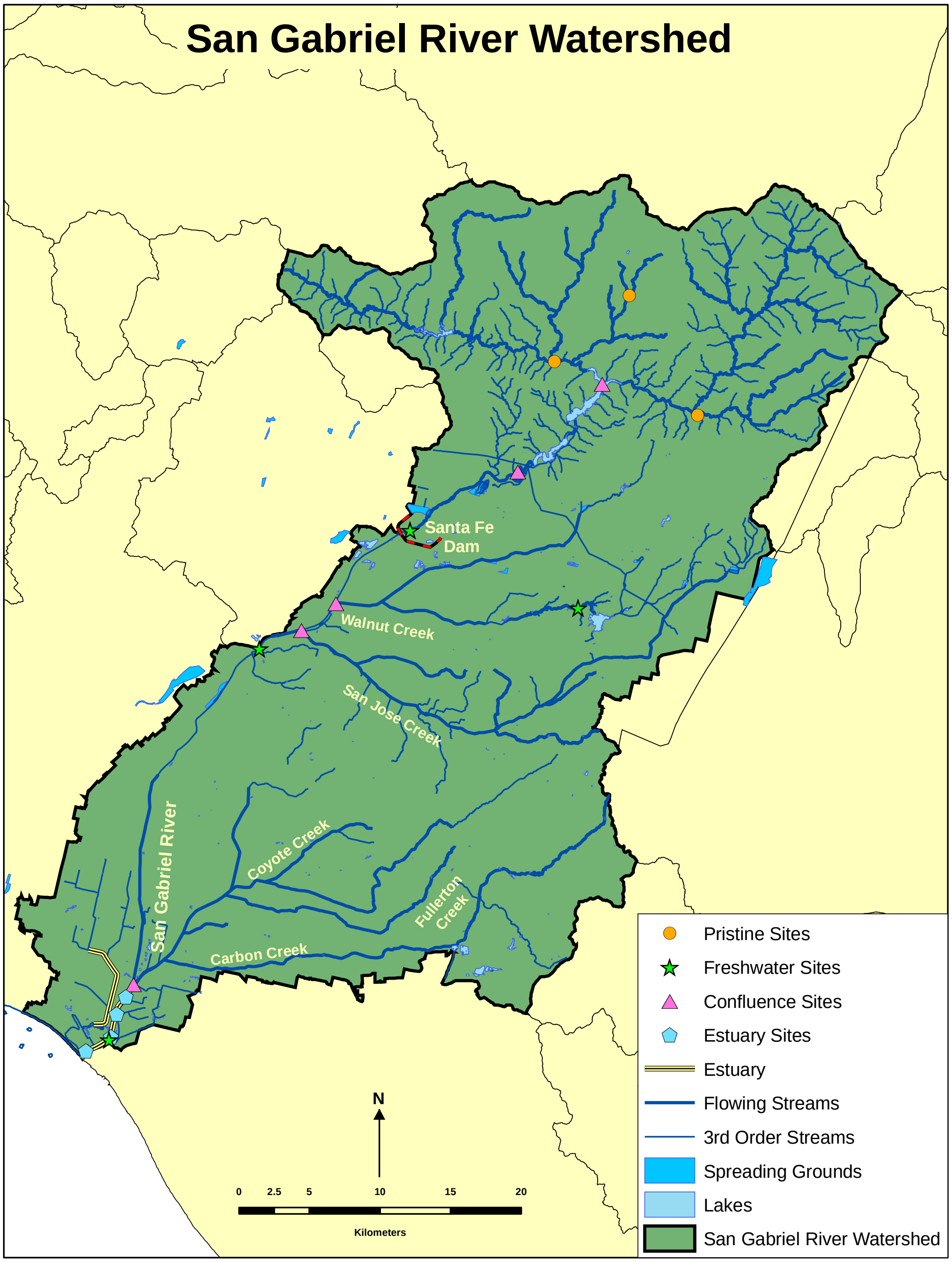
The LADWP and AES modeling project has been developed to evaluate the hypothesis that the lower San Gabriel River, from a location somewhere downstream of the 7th Street Bridge to the mouth of the river, is an embayment created by saline power plant discharges, which meet the saline waters of the San Pedro Bay. The hypothesis further assumes that, since both power plants draw intake water from Alamitos Bay/San Pedro Bay and discharge that bay water to the lower San Gabriel River, and since the salinity of the water in the vicinity of the discharges is consistent with the salinity of bay/ocean water, the lower San Gabriel River in the vicinity of the power plant discharges is best understood as an extension of the San Pedro Bay. If this hypothesis is substantiated, then, from a location somewhere upstream of the 7th Street Bridge to the upstream extent of saltwater in the river channel, the lower San Gabriel River could be understood as a saltwater and fresh water mixing zone of variable salinity that could be considered the estuary.

The modeling effort will characterize the salinity, temperature, and mixing characteristics of the lower San Gabriel River. Field sampling under a variety of tidal, flow, and plant operation regimes will provide data for a three-dimensional model of the mixing area. This model will be used to define the mixing area between the base flow and the power plant discharge, thus providing additional insight into the functional upstream and downstream boundaries of the estuarine mixing zone.

Table 5.1. Design overview for the locations of unique interest component of the regional monitoring program, which will use different indicators for the freshwater and estuary portions of the watershed.

Design element	Description	Details
Design approach	Fixed sites	Treat freshwater and estuary portions separately
Number of sites	12 in freshwater 4 in estuary	Freshwater: • High value/risk areas (4) • Major confluences (5) • Minimally impacted sites (3) Estuary: • Existing LACSD sites (4)
Sampling frequency	Freshwater: • Yearly in spring Estuary: • Yearly sediment • Yearly expanded water chemistry	
Freshwater indicators	Riparian zone habitat	CRAM metrics and attributes
	Water chemistry at confluences	General physical characteristics DO and pH Dissolved organic carbon Total suspended solids Metals Nutrients Organophosphate pesticides
	Bioassessment at confluences	Macroinvertebrate sampling method not defined Both IBI/EMAP and CRAM physical habitat measurements
	Aquatic toxicity at confluences	Ceriodaphnia dubia and Pimephales promelas in 1st year Ceriodaphnia dubia only in subsequent years if no Pimephales promelas impacts found
Estuary indicators	Water chemistry and sediment	Water chemistry: • Yearly expanded list, including metals, bacteria, OP pesticides • More frequent conventional (e.g., salinity, hardness) Sediment: • Yearly sediment chemistry (metals, pesticides, DDT/PCB, sediment toxicity, infauna

Figure 5.1. Monitoring sites to address questions related to unique freshwater and estuarine sites.



6.0 Question 3: Are Receiving Waters Near Discharges Meeting Water Quality Objectives?

This question focuses on the beneficial uses:

- Warm Freshwater Habitat (WARM)
- Wildlife Habitat (WILD)
- Estuarine Habitat (EST),

and reflects concerns related to potential impacts from point source discharges into the San Gabriel River and its tributaries, as well as into the estuary. (Note: the Cold Freshwater Habitat beneficial use designation only occurs in the upper watershed, above the LACSD discharges and the LADPW mass emissions stations and is therefore not included under this question.)

Potential assessment questions that address such concerns include:

- Do sites influenced by point sources support their designated beneficial uses of Warm Freshwater Habitat, Wildlife Habitat, and Estuarine Habitat?
- At sites influenced by point discharges, what is the concentration of chemical contaminants and the status of biological indicators?
- Is the concentration of chemical contaminants downstream of point source discharges above water quality objectives?
- Is the value of biological indicators outside the range of control, reference, or background levels?
- What is the frequency of exceedances of water quality objectives?
- Is the frequency of exceedances of water quality objectives getting better or worse over time?

In overview, the monitoring design recommended to address such questions has the following elements:

- Water chemistry monitoring at a regular frequency above and below each LACSD discharge point
- Toxicity testing on a regular frequency above and below each LACSD discharge point
- Bioassessment monitoring on a regular frequency below each LACSD discharge point
- Expanded bioassessment monitoring above each LACSD discharge point if the downstream bioassessment results are below the range expected for that habitat type
- Water, sediment, and biological community monitoring around the power plant discharges in the estuary.

The types of data products resulting from this monitoring design and appropriate for answering Question 6 may include:

- Site-by-site summaries of each sampled data type (tables of individual measurements and relevant averages)
- Site-by-site interpretations and conclusions based on synthesized results (narrative conclusions, decision trees specifying adaptive responses to monitoring results)
- Comparisons across sites for each sampled data type (tables highlighting differences, maps)
- Comparisons across sites for synthesized results (narrative conclusions, decision trees, maps)
- Trend plots over time of increases / decreases in parameters of interest.

Finalizing the specific details of constituent lists and monitoring frequencies, and of station locations in the estuary, will require additional evaluation of historical data and consideration of scientific and cost tradeoffs that were beyond the scope of this design effort. This follow-on work is envisioned to take place during the implementation phase of the SGRRMP. The existing network of compliance monitoring stations (Figure 6.1) will provide a starting point for this process.

The following subsections summarize the overall design recommendations and provide a set of criteria for guiding a subsequent more detailed design effort.

6.1 Design approach

The approach for compliance monitoring is constrained to some extent by explicit regulatory requirements that specify the manner in which comparison to water quality objectives should occur. Any adjustments intended to improve the coordination and efficiency of current compliance monitoring must therefore be carefully evaluated to ensure they are consistent with these requirements. The workgroup's evaluation was based on examination of historical monitoring and other data from the watershed and addressed the following design criteria:

1. Does the relative cost of monitoring at the existing frequencies match their respective information content and decision-making value?
2. Are monitoring sites located to provide independent measures of conditions, or are they so close together that they are duplicative?
3. Are there constituents that are currently monitored that rarely or never occur, or do not provide useful information, and that are therefore candidates for a reduced sampling frequency?
4. Does the list of monitored constituents reflect current knowledge about the nature of known and potential contamination problems in the watershed?
5. Are detection limits appropriate?
6. Do upstream – downstream station pairs have the ability to identify discharge impacts?
7. Has the monitoring design been coordinated to the greatest extent possible with other regional monitoring efforts (e.g., other SGRRMP components, SWAMP, Bight Program)?

Each of these questions is addressed in turn in the following subsections. A consideration of questions 1 – 3 led to recommendations for adjustments to LACSD's compliance monitoring program sufficient to fund the regional monitoring program on an ongoing basis. The mechanism for this monitoring offset and an analysis of the costs involved is contained in Section 10.

6.1.1 Monitoring frequency

The workgroup recommended a reduction in monitoring frequency from weekly to monthly at LACSD's compliance monitoring stations. LACSD currently measure a wide range of water quality parameters weekly at monitoring stations upstream and downstream of each water reclamation plant (WRP) discharge (21 stations) and in the estuary (four stations). The monitored parameters are shown in Table 6.1. Note that the parameter list for the inland WRP stations and the estuary stations is the same with one exception. Coliforms are measured weekly at the WRP stations and only monthly at the estuary stations.

An analysis of representative indicators (pH, DO, ammonia) from four monitoring stations examines the implications of moving to monthly monitoring. Values for many other monitored parameters were below detection limits often enough that their plots were not as informative with regards to the potential differences between the information value of weekly versus monthly monitoring schedules. Figure 6.2 shows plots of weekly data and various subsets and averages of the weekly data for comparison, including:

1. Weekly data (the current monitoring design)
2. Date from Week 1 of each month, meant to mimic a monthly monitoring frequency
3. The average of the first and second weeks of each month
4. The average of the third and fourth weeks of each month
5. The average of all the data from each month.

Items # 3 – 5 are intended to reveal whether a single monthly sample would be likely to miss patterns (e.g., peaks, trends) that only become more visible when more frequent data points are averaged or smoothed. After inspecting these plots, the workgroup agreed unanimously that monthly data provided just as much insight into patterns in receiving water chemistry as did weekly monitoring data.

6.1.2 Monitoring sites

The workgroup recommended that LACSD receiving water station R9E be removed and monitoring terminated at this station. Station R9E, at the bottom end of Coyote Creek, is intended to provide a measure of cumulative conditions in this tributary just before it joins the mainstem of the San Gabriel River. However, R9E is sometimes influenced by cross-channel sheet flow coming down the San Gabriel River past station R9W, and R9E can often be sampled only at low tide because the tidal influence can extend up to this point. When this happens, sampling at R9W can readily be moved upstream a few hundred yards. However, this is not productive at R9E because station RA is less than 100 yards upstream of R9E and this would essentially involve duplicative sampling of station RA. Because there are no additional inputs to the Coyote Creek channel between RA and R9E, the workgroup unanimously agreed that continued monitoring at R9E does not provide any additional information not already provided by RA.

6.1.3 Monitoring parameters: Useful information

The workgroup recommended that water column chlorophyll a be removed from the list of parameters monitored at the LACSD monitoring stations. Water column chlorophyll a had been added to the list of routine aquatic chemistry parameters in an attempt to better track algal growth that occurs in response to nutrient enrichment. However, it is benthic algae that are of concern and water column chlorophyll a has no functional relationship to benthic algal growth. Thus, this parameter provides no useful management or scientific information and the workgroup agreed unanimously that chlorophyll a should be removed from the list of aquatic chemistry parameters.

6.1.4 Monitoring frequency: Bioassessment Index Period

LACSD is currently required by their NPDES permits to conduct annual bioassessment monitoring in the fall. However, SWAMP calls for bioassessment monitoring in spring. Therefore, to achieve desired consistency with SWAMP and other bioassessment programs, the workgroup recommended that LACSD conduct annual permit-required bioassessment monitoring in spring instead of fall. It was also recommended that LACSD conduct annual bioassessment monitoring according to the current version of the California Stream Bioassessment Procedure that is employed by the California Department of Fish and Game (CDFG), but which may be somewhat modified from the method required by LACSD's current NPDES permits. These two adjustments to LACSD's bioassessment monitoring program would ensure that all bioassessment data collected (i.e., by SWAMP, CDFG, SGRRMP, and LACSD) in the watershed is comparable.

6.1.5 Monitoring parameters: Watershed problems

The workgroup agreed that the current list of monitoring parameters addressed concerns about the most pressing water quality problems facing the watershed. While there is some concern about newer contaminants, the workgroup also agreed that periodic priority pollutant scans and careful evaluations of the sources of elevated toxicity would provide information that could be used to adjust the scope of routine compliance monitoring as needed.

6.1.6 Detection limits

The issue of detection limits is being addressed by individual permittees in their permit negotiations with their respective Regional Boards. In general, the workgroup recommended that ideally detection limits be adequate to assess compliance with relevant water quality objectives and support related TMDL development.

6.1.7 Upstream – Downstream station pairs

The workgroup considered this issue primarily with regard to the value of paired bioassessment samples. Within the watershed, physical habitat sometimes differs between upstream and downstream monitoring sites and bioassessment monitoring results from throughout California show that habitat can have a dominant effect on the biological community. In addition, the IBI is not yet considered to be refined enough to provide the basis for the rigorous site-by-site comparisons needed for compliance monitoring and numeric biological criteria have not been developed. The workgroup considered recommending that only stations downstream of discharges be monitored for bioassessment. However, the permittees believe that it is important to maintain this paired monitoring for at least a few more years, until the relationships between the upstream and downstream stations are better characterized. The workgroup did recommend that bioassessment results at the downstream stations be evaluated by comparison to the regional background established by the random watershed sites. This would provide a more representative and stable basis of evaluation than would the comparison to individual upstream stations.

Table 6.1. Aquatic chemistry parameters sampled on a weekly and/or monthly basis at the Districts' receiving water monitoring stations (Generalized list; constituents and frequencies vary by receiving water station).

Parameter	Frequency
Temperature	weekly
pH	weekly
Dissolved Oxygen	weekly
Chlorine	weekly
Total Coliform *	monthly
Fecal Coliform *	monthly
Turbidity	monthly
BOD	monthly
Settleable Solids	monthly
TSS	monthly
Oil & Grease	monthly
TDS	monthly
Conductivity	monthly
Chloride	monthly
Sulfate	monthly
Boron	monthly
Fluoride	monthly
Ammonia-N	weekly
Nitrate-N	weekly
Nitrite-N	weekly
TKN	weekly
Total Phosphorus	weekly
Ortho Phosphorus	weekly
MBAS	monthly
NID	monthly
Total Hardness	weekly
Arsenic	monthly
Silver	monthly
PAHs	monthly

* Coliforms are sampled weekly at the inland WRP stations.

Figure 6.1. Existing network of compliance monitoring stations.

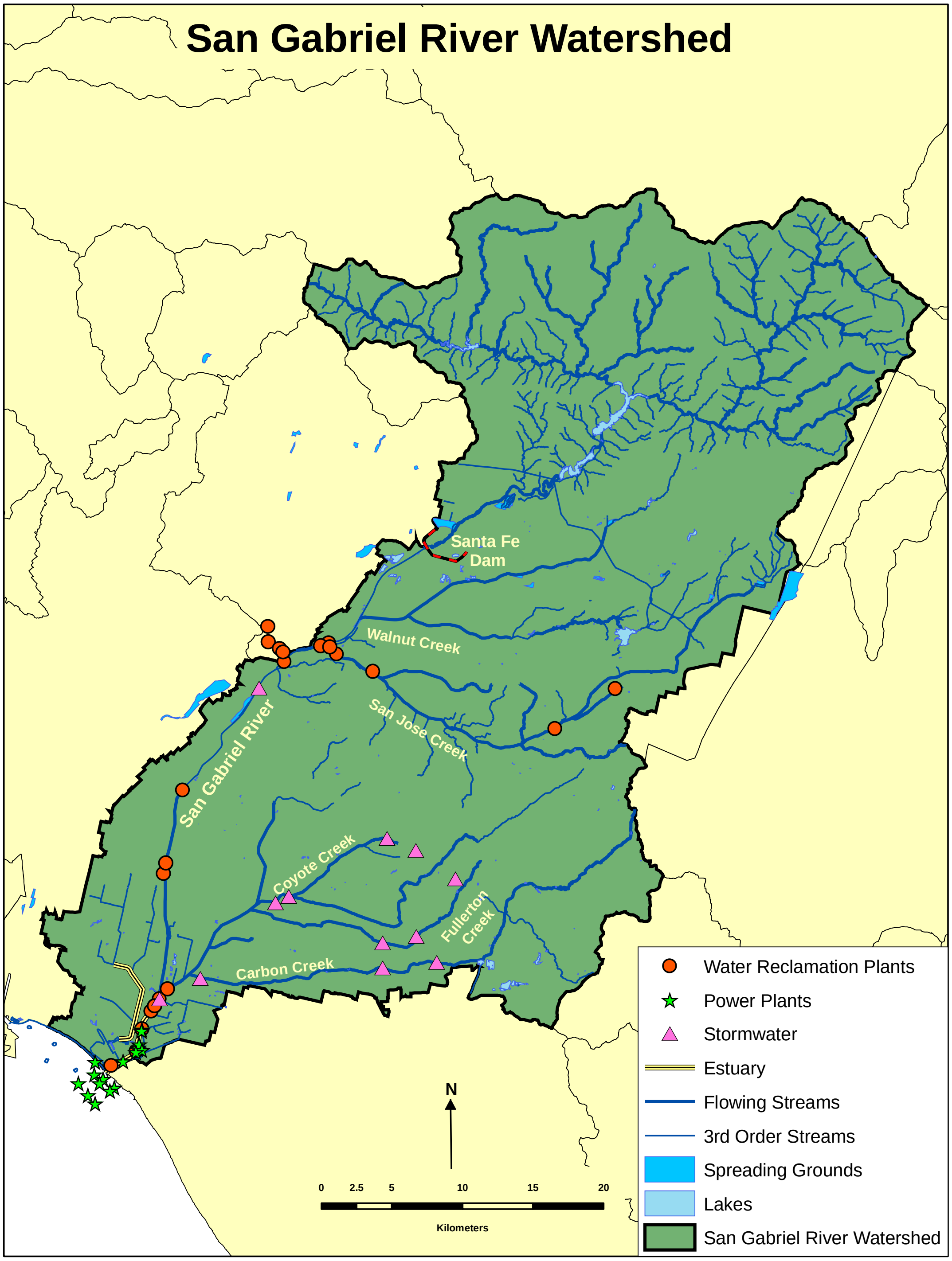


Figure 6.2.a. Time series plot of pH at station RA2.

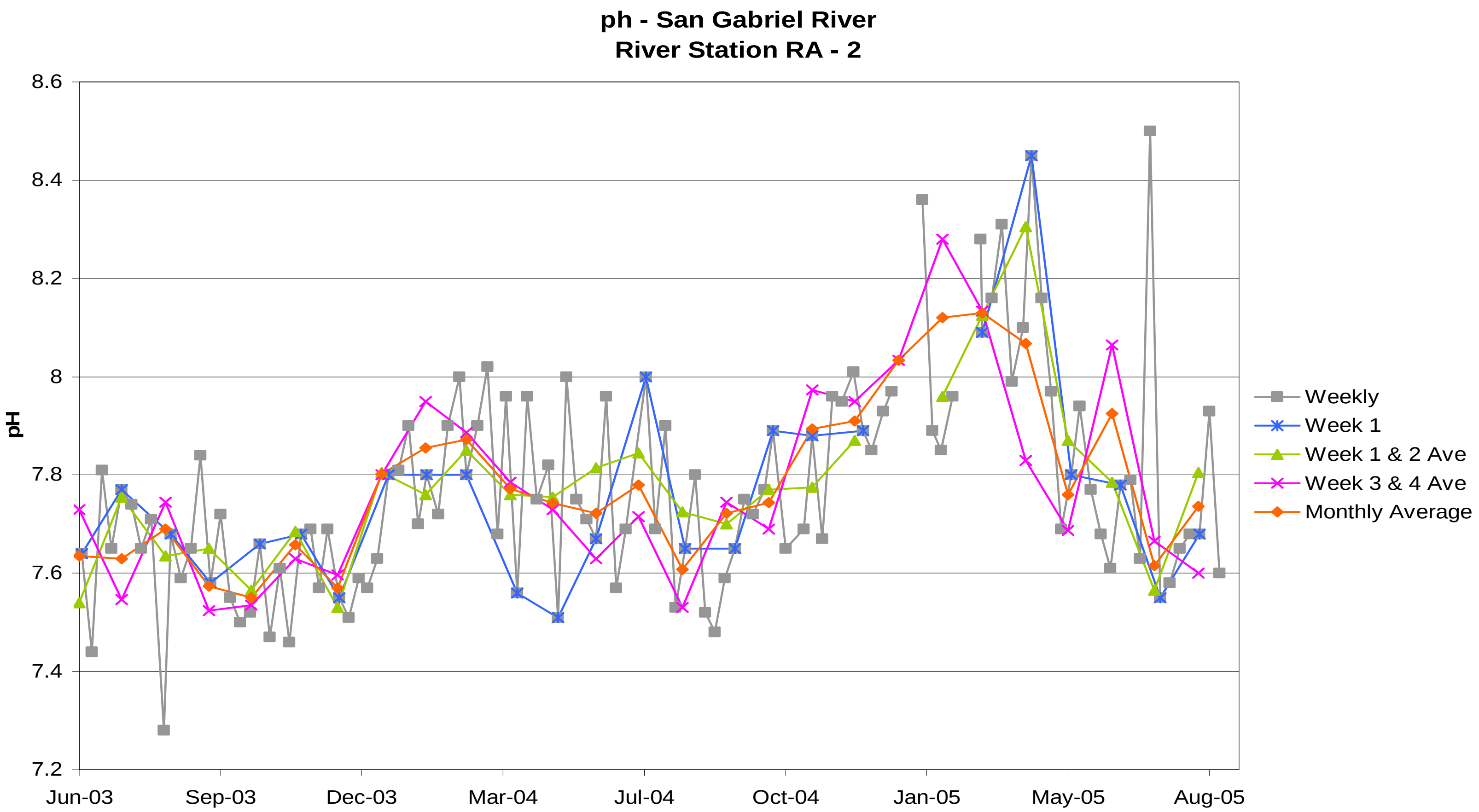


Figure 6.2.b. Time series plot of DO at station RA2.

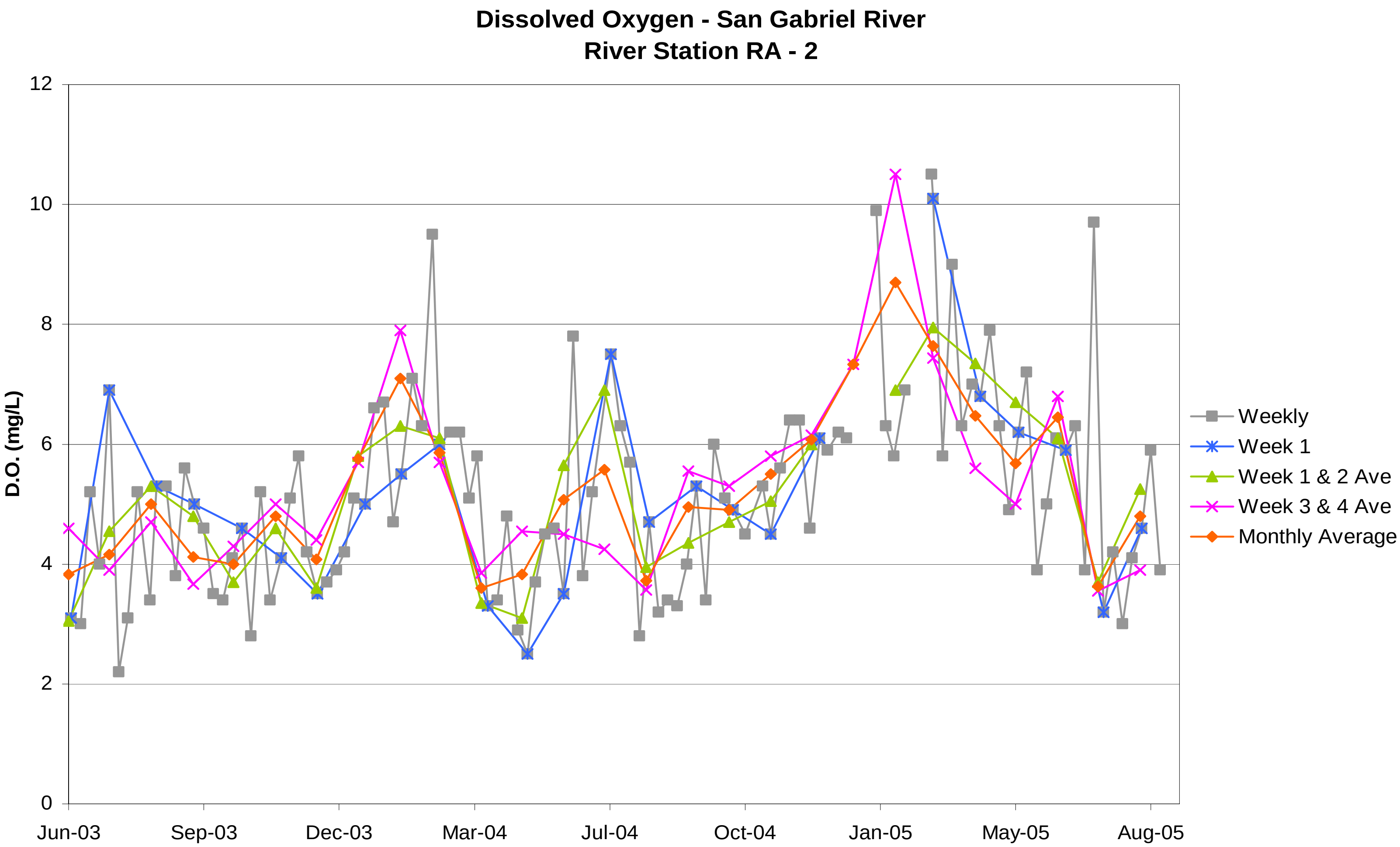


Figure 6.2.c. Time series plot of ammonia at station RA2.

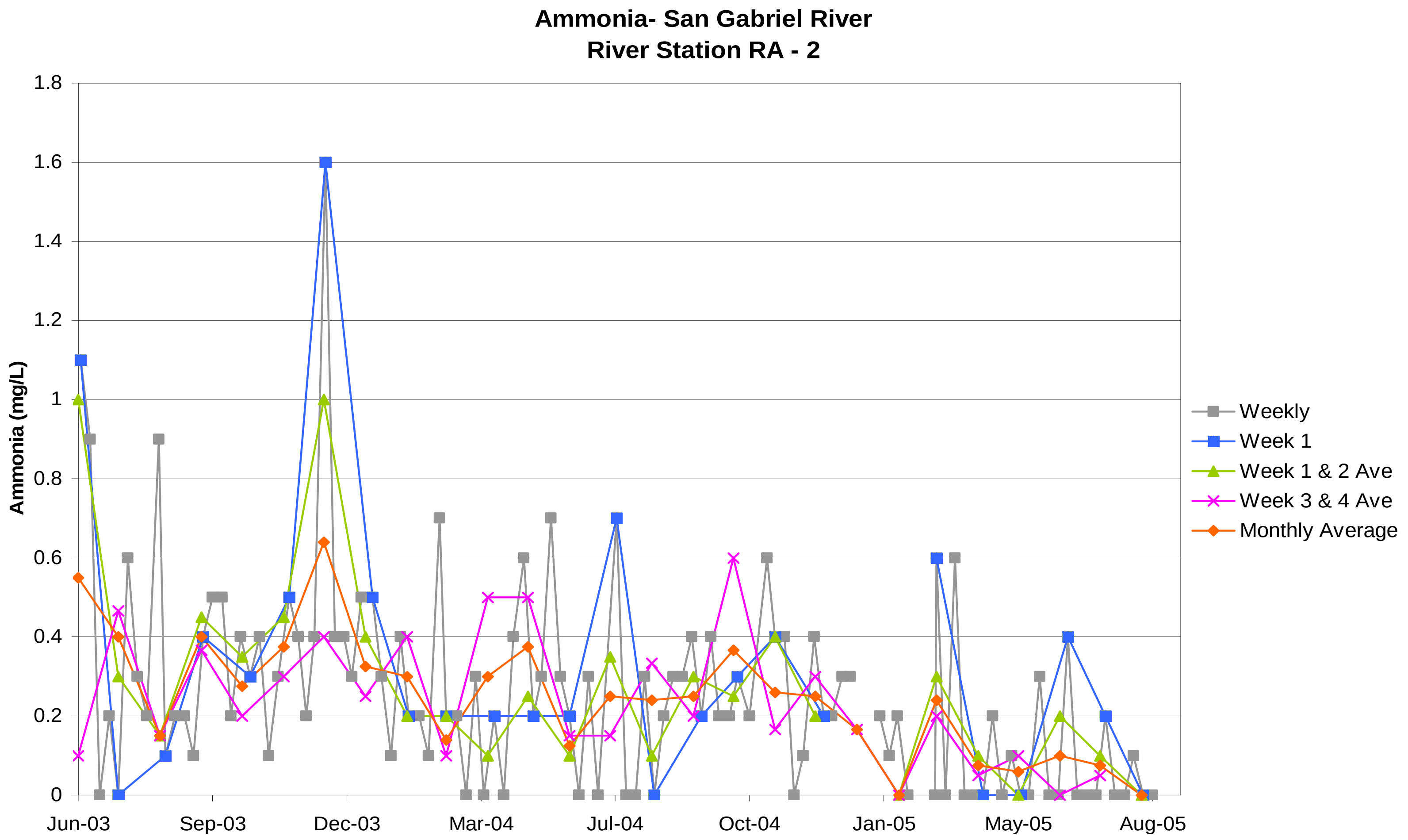


Figure 6.2.d. Time series plot of pH at station R11.

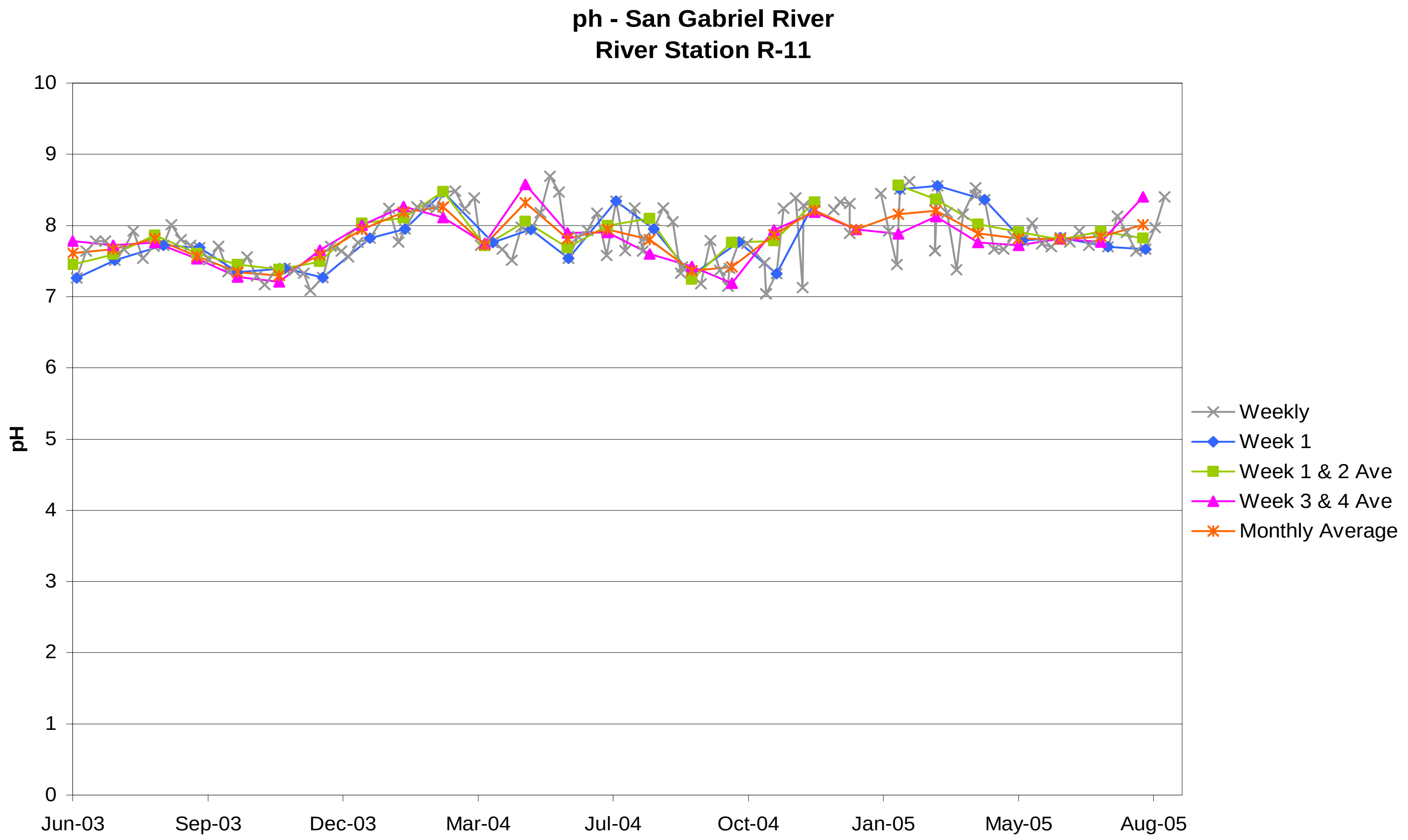


Figure 6.2.e. Time series plot of DO at station R11.

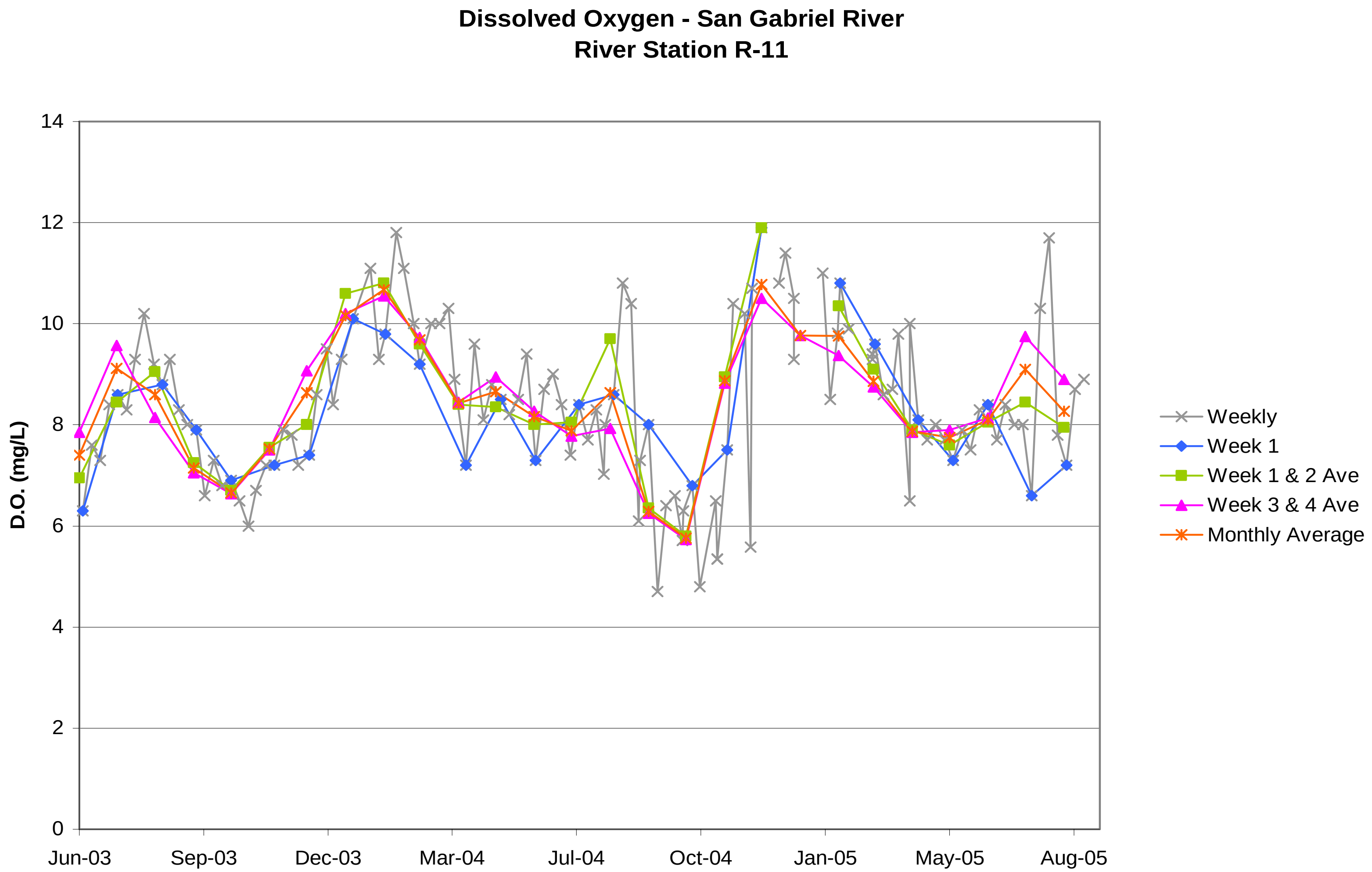


Figure 6.2.f. Time series plot of ammonia at station R11.

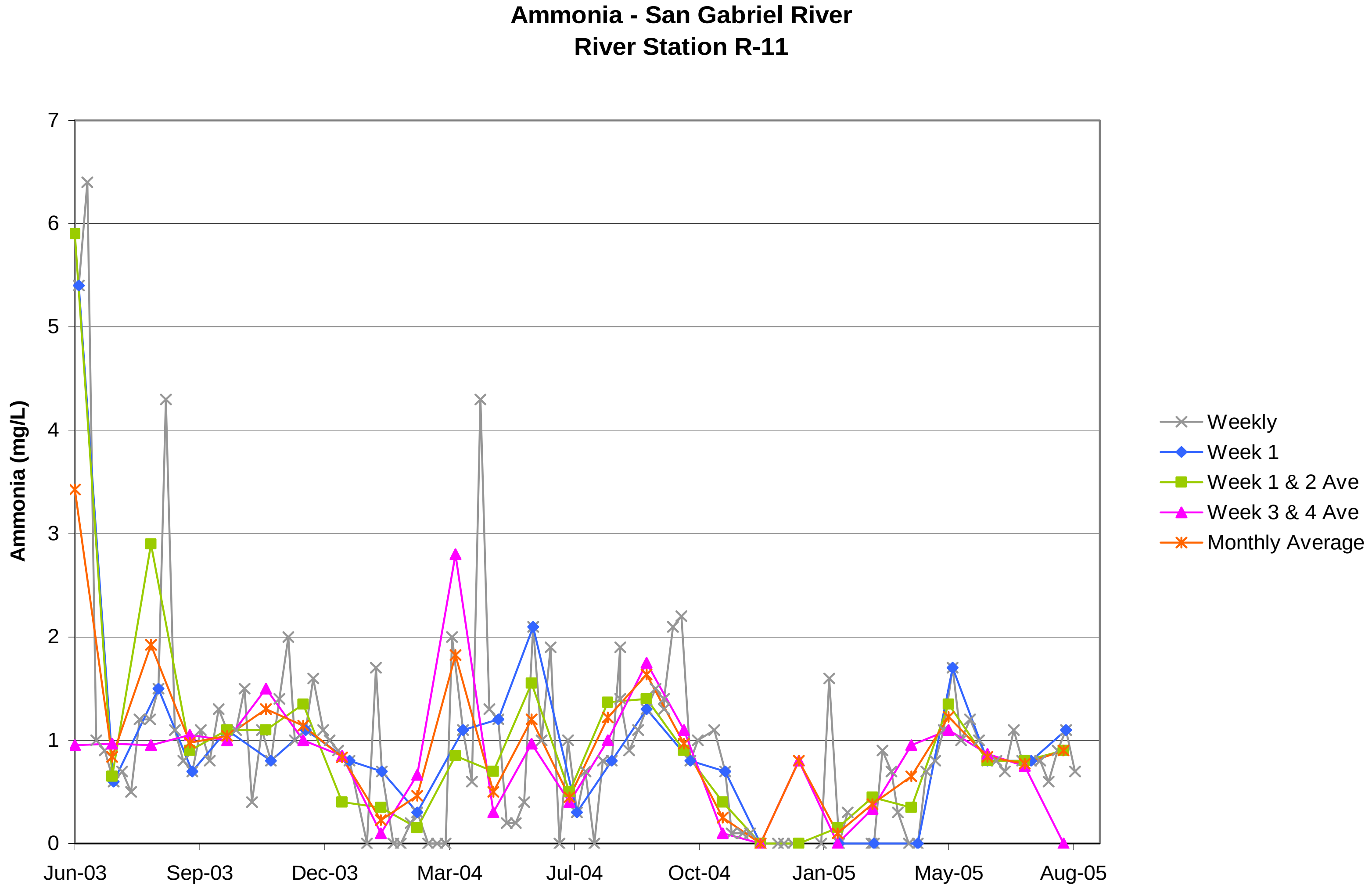


Figure 6.2.g. Time series plot of pH at station R7.

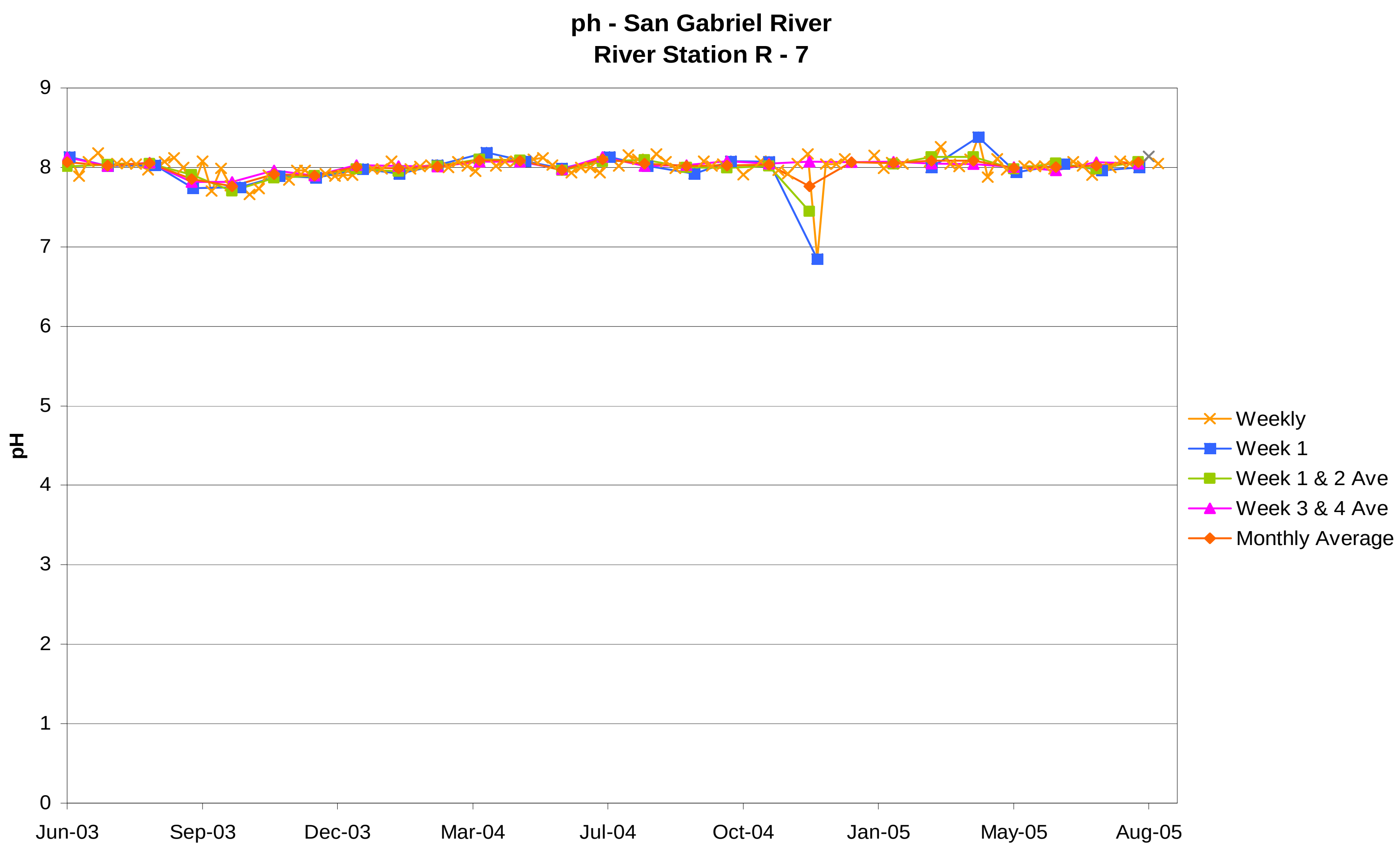


Figure 6.2.h. Time series plot of DO at station R7.

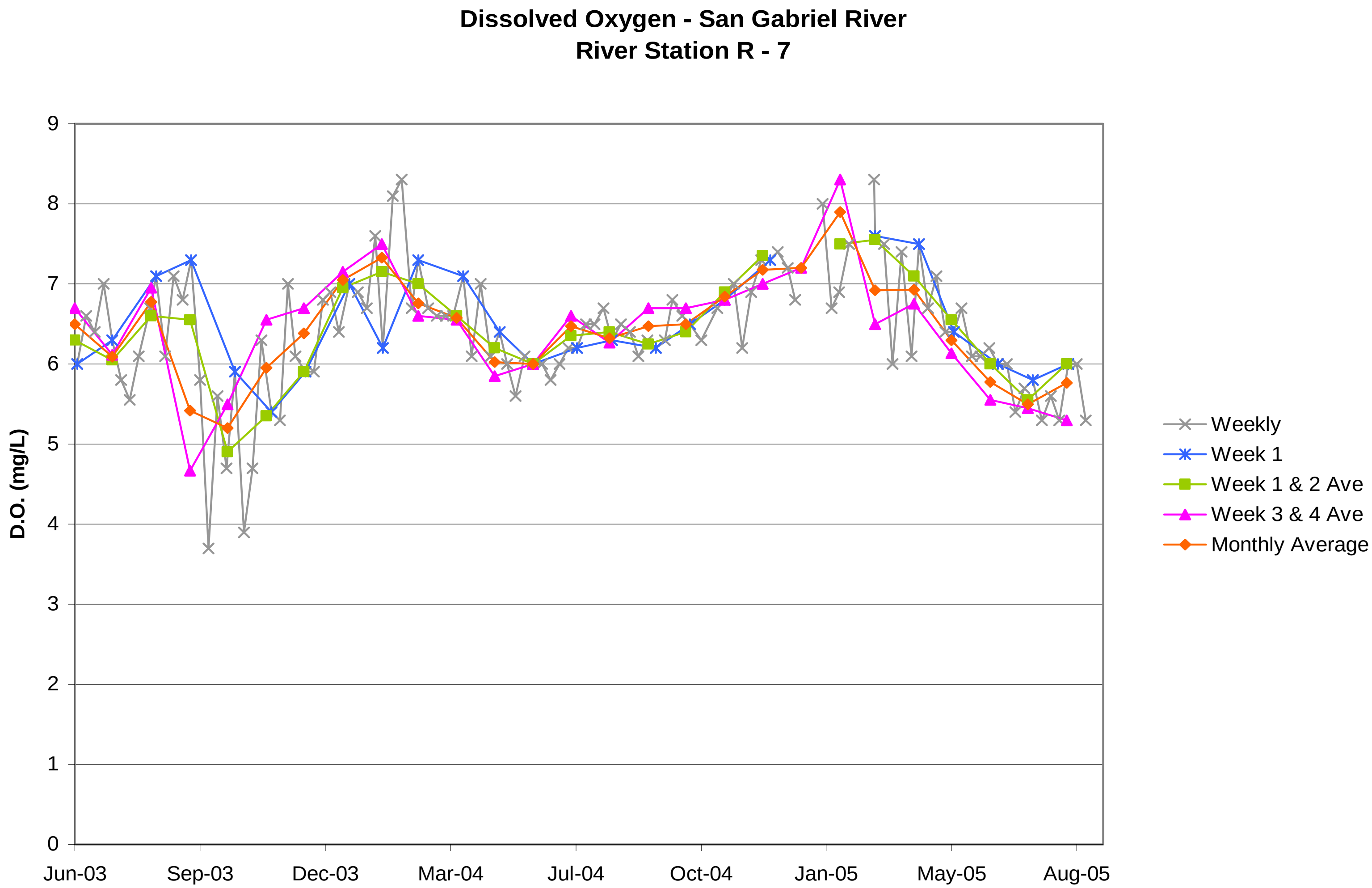


Figure 6.2.i. Time series plot of ammonia at station R7

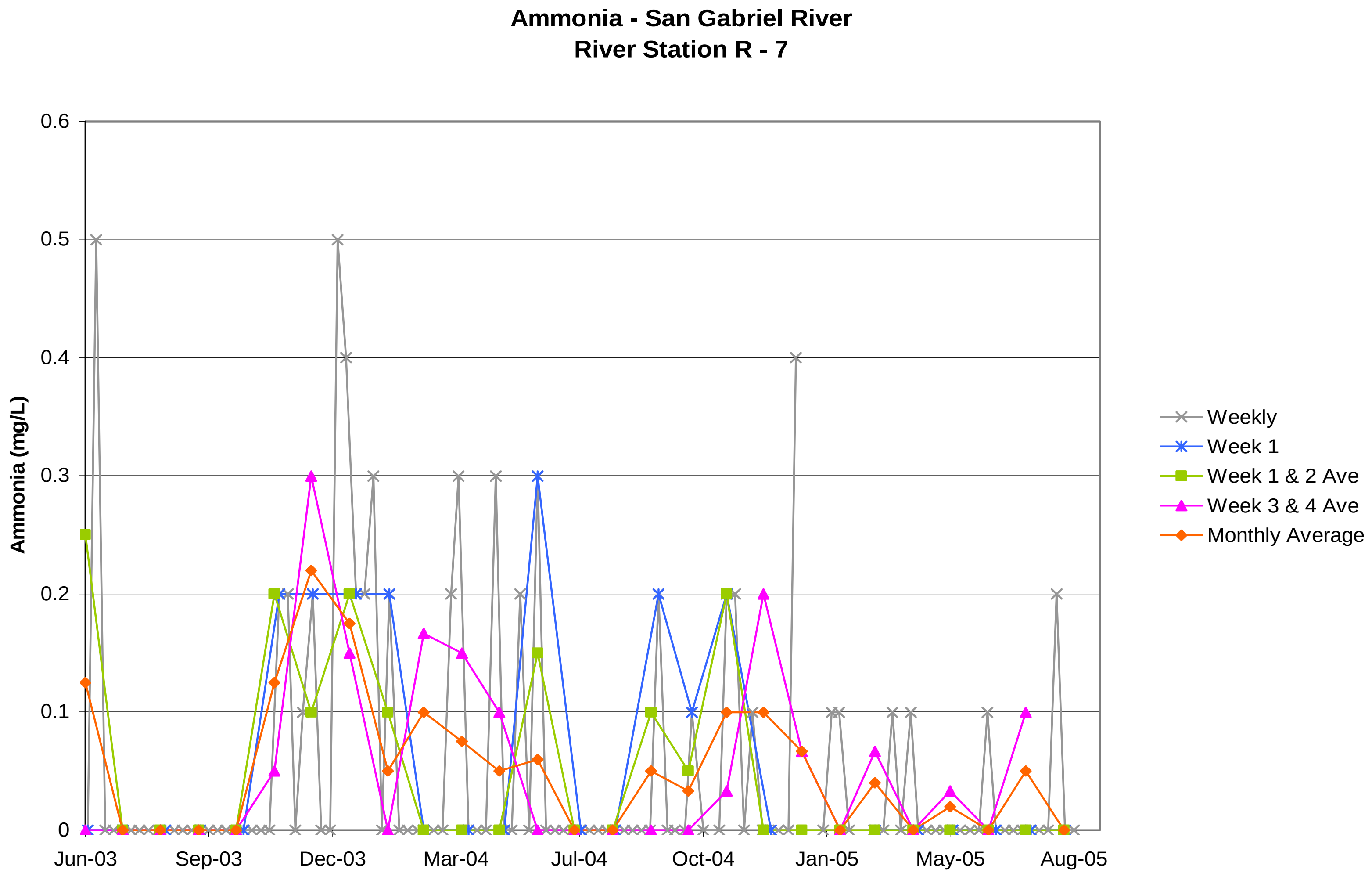


Figure 6.2.j. Time series plot of pH at station R4.

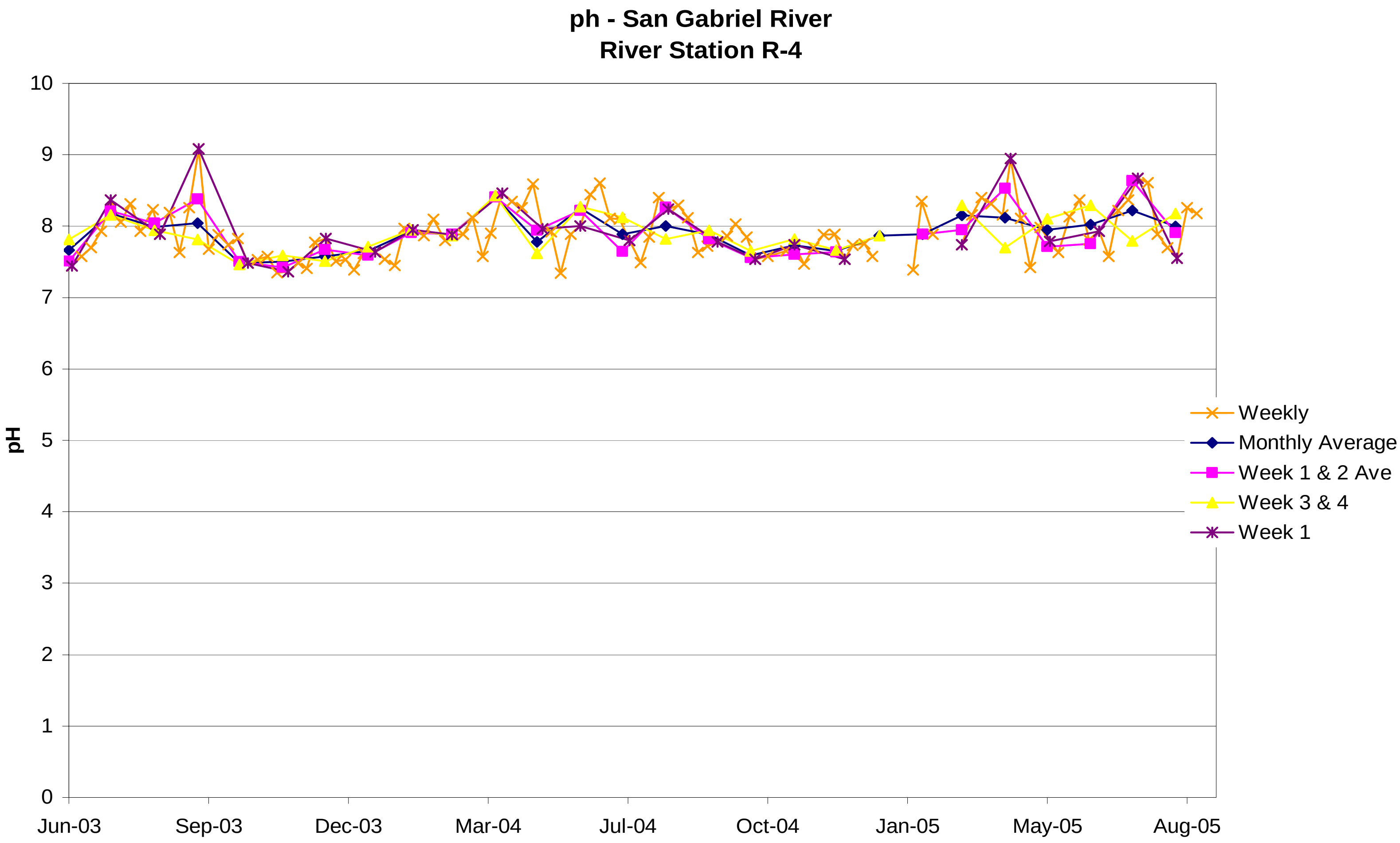


Figure 6.2.k. Time series plot of DO at station R4.

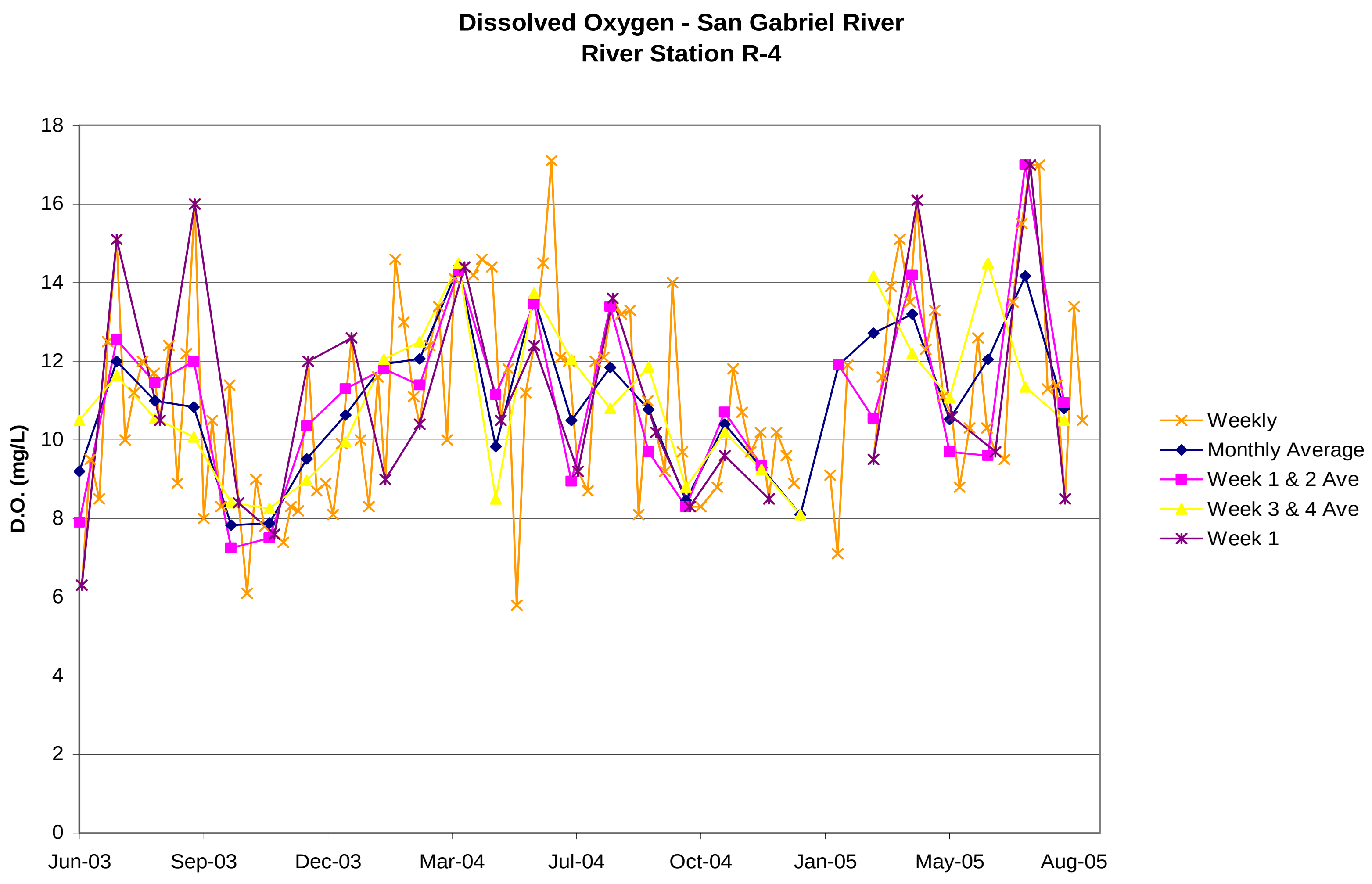
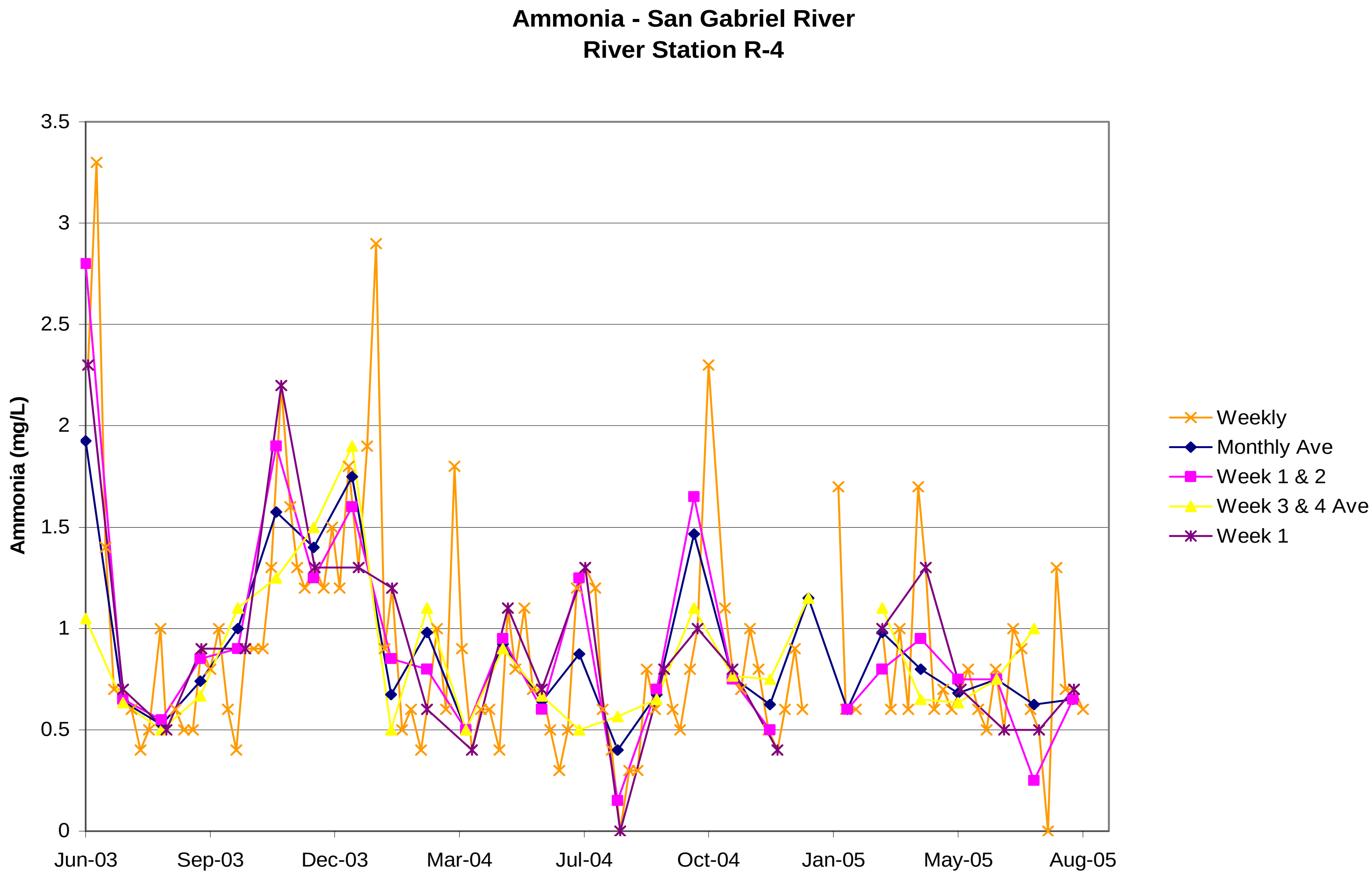


Figure 6.2.l. Time series plot of ammonia at station R4.



7.0 Question 4: Is It Safe to Swim?

This question focuses on the beneficial use:

- Water Contact Recreation (REC1),

and reflects concerns about the risk posed to recreational users of the San Gabriel River and the recreational lakes in the watershed by pathogen contamination.

Potential assessment questions that address such concerns are:

- Are bacterial indicator levels at body contact recreation areas above health standards, or adopted water quality objectives?
- What is the relative risk of body contact recreation at locations in the watershed with high concentrations of recreational use?
- What is the average level of bacterial indicators at sentinel sites in the watershed?

This information could be used by Los Angeles and Orange County public health agencies to help manage health risk. There is currently only limited monitoring at recreational sites. Monitoring at sentinel sites will be conducted by the regional monitoring program. Monitoring at recreation areas could be conducted in cooperation with volunteer agencies and/or with the respective County health departments.

In overview, the monitoring design recommended to address such questions has the following elements:

- A focus on sites with heavy recreational use
- Monitoring frequency at these sites adjusted in terms of degree of use and proximity to source(s)
- Weekly monitoring at sentinel sites to assess average levels of indicator bacteria throughout the watershed, with weekly monitoring at the head of the estuary
- Use of *E. coli* and perhaps fecal coliforms as indicators.

The types of data products resulting from this monitoring design and appropriate for answering Question 4 may include:

- Frequent (weekly, monthly depending on the circumstance) and site-by-site measures of bacterial indicator values
- Comparisons of bacterial indicator values with relevant standards or objectives on spatial and temporal scales that match sampling scales as closely as possible (e.g., data tables that highlight exceedances)
- Site-by-site and regional trends over time in the numbers of exceedances
- Periodic ratings of the relative risk of swimming at each site
- Ability to adopt new indicators as they are approved.

The following subsections provide details on the recommended design approach, as well as on the recommended indicators and the sampling sites and frequencies. The workgroup recommended that the detailed design and implementation of this program component be developed in collaboration with health departments.

7.1 Design approach

While there are Basin Plan standards for inland waters designated for REC1 use, there is currently only limited monitoring focused on such use conducted by the Los Angeles County Department of Health Services (LACDHS). LACSD does monitor bacterial indicators at its receiving water stations associated with discharges, but many of these are in concrete lined channels and none of them are known swimming locations.

The recommended monitoring approach (Table 7.1) includes three separate components, one that focuses on high-priority recreational use areas, another that targets representative sentinel sites throughout the lower watershed, and a third that monitors at a high frequency at the bottom of the watershed.

7.1.1 Recreation areas

For those locations where people commonly swim, the monitoring approach prioritizes monitoring effort using a framework developed by the Beach Water Quality Workgroup for ocean beaches. In this framework (illustrated in the following Figure 7.1), monitoring intensity is scaled according to the intensity of use and the proximity to potential sources of pathogen contamination, which can change seasonally.

Figure 7.1 Prioritization framework developed by the Beach Water Quality Workgroup for allocating monitoring effort to swimming areas.

Degree of Use	Proximity to Source(s)	
	Close →	Far
High use ↓	Daily monitoring	Weekly – monthly monitoring
Low use	Weekly – monthly monitoring	No monitoring

Based on the collective knowledge of the workgroup, the most popular swimming locations in the watershed (Figure 7.2), ranked in terms of intensity of use, are:

- Puddingstone Lake, managed by the Los Angeles Department of Parks and Recreation
- Santa Fe Dam, managed by the Los Angeles Department of Parks and Recreation
- East Fork of the San Gabriel River
- Canyon area of the mainstem San Gabriel River below the confluence of the West and East Forks
- West Fork of the San Gabriel River below Cogswell Dam, predominantly the first ½ mile of the West Fork
- North Fork of the San Gabriel River just upstream of its confluence with the West Fork.

For planning purposes, it was agreed that monitoring would be conducted weekly during the swimming season (May 1 through September 30) at these sites. For planning purposes, three locations per site will be sampled. However, the numbers and locations of sites, and their monitoring frequencies, may change after further consultation with LACDHS.

Sources of pathogen contamination include human contact recreation, wildlife, communities along the East Fork, and two large private campgrounds (Follows Camp and Camp Williams). There are no United States Forest Service public campgrounds along the East Fork and only one day-use area. This is occasionally (and illegally) used as an overnight campground. If there are no communities or campgrounds in an area, then the matrix would collapse to the one axis of degree of use. In general, use is highest in the summer, with little if any swimming occurring during the winter.

At this point, and given LACDHS' primary responsibility for human health issues, it would be premature to specify in detail the numbers and locations of monitoring locations at each site without substantive input from and coordination with LACDHS. However, it is most likely that a random approach to site selection would not be useful for public health management because swimming occurs at specific sites and is not distributed throughout the watershed.

7.1.2 Sentinel sites

A number of sentinel sites spread throughout the lower watershed will provide an overall picture of the degree to which water quality objectives are being met (or exceeded). The sites identified by the workgroup include the following:

- At the bottom of Coyote Creek above the POTW outfall (LACSD station RA1)
- At the bottom of San Gabriel River (possibly at LACSD station R9W)
- San Jose Creek above the LACSD outfall
- Walnut Creek below Big Dalton Wash
- Somewhere on Fullerton, Carbon, or Brea Creeks, with the exact location to be determined following consultation with the Orange County Stormwater Program.

Where possible, these stations should be located just above confluences, but they do not necessarily need to be located at existing monitoring sites. Monitoring will be conducted weekly during the swimming season in order to ensure the ability to assess compliance with bacterial water quality objectives.

Twice weekly monitoring year round will also be conducted at a single site in the estuary at the 7th Street bridge. The purpose of this station is to make a link between estuary conditions and beach conditions, where monitoring is frequent.

7.2 Indicators

Monitoring is recommended to focus on *E. coli*, since that is the major public health criterion, but could also include fecal coliforms, since there is a Basin Plan objective for this indicator.

7.3 Coordination with other efforts

The development of this program component must be coordinated with the LACDHS. Further coordination with the Orange County Health Care Agency may be required if popular swimming locations in the Orange County portion of the watershed are identified.

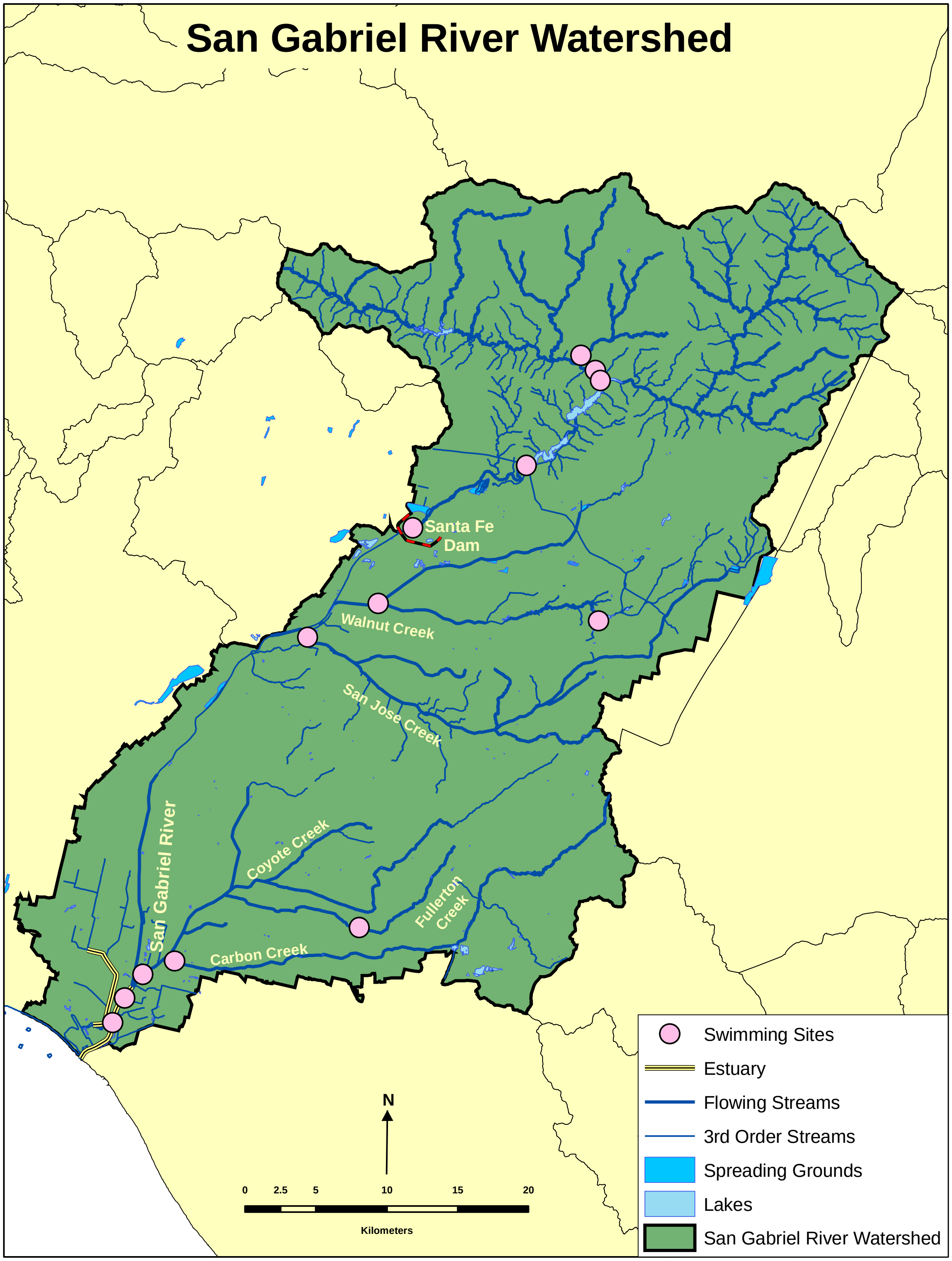
There are likely to be only limited opportunities for coordination of this program component with others components of the SGRRMP. Only the compliance monitoring component (Question 3) includes bacteria indicators in its list of monitored constituents, and monitoring sites for assessing human health risk that are selected in terms of the prioritization scheme described above will most likely not correspond to sites chosen to address water quality and/or habitat concerns. In addition, bacteria monitoring for human health typically occurs on a schedule that is much more frequent than the yearly sampling envisioned for much of the rest of the regional monitoring program.

In addition to the health departments, the regional monitoring program is investigating the possibility of collaborative monitoring efforts with volunteer groups.

Table 7.1. Design overview for the recreational swimming component of the regional monitoring program.

Design element	Description	Details
Design approach	Fixed sites	Treat swimming, sentinel, and estuary sties separately
Number of sites	6 swimming • 3 locations / site 5 sentinel 1 head of estuary	Popular swimming locations Just above major confluences 7th Street bridge
Sampling frequency	Swimming: • Weekly in swim season Sentinel: • Weekly in swim season Estuary: • Twice weekly year round	 May 1 through September 30 May 1 through September 30
Indicators	Swimming & sentinel Estuary	E. coli Fecal coliform, total coliform, Enterococcus

Figure 7.2. Recommended monitoring locations to address potential human health risks from body contact recreation.



8.0 Question 5: Are Locally Caught Fish Safe to Eat?

This question focuses on the beneficial use:

- Commercial and Sport Fishing (COMM),

and reflects concerns related to the safety of eating locally caught fish.

Potential assessment questions that address such concerns include:

- At frequently fished sites, estimate the concentration of or verify previous estimates of chemical contaminants in commonly consumed fish target species. Compare these levels to advisory levels and critical thresholds of potential human health risk
- At frequently fished sites, track the trends in tissue concentrations of chemical contaminants in commonly consumed fish target species.

In overview, the monitoring design (Table 8.1) recommended to address such questions has the following elements:

- Initial three-year pilot program to provide the basis for a long-term monitoring design
- Sample annually in summer
- Focus on six locations (two each in lakes, river, and estuary) where fishing is most frequent
- Focus on fish species most commonly caught and consumed at each site
- Focus on the five chemicals (mercury, DDTs, PCBs, arsenic, and selenium) that contribute most to human health risk in California's coastal and estuarine fishes.

The types of data products resulting from this monitoring design and appropriate for answering Question 5 may include:

- Site-by-site measures of tissue concentrations of key chemical contaminants in commonly consumed fish species
- Site-by-site measures of the frequency with which such tissue concentrations exceed advisory levels and/or critical thresholds of potential human health risk
- Trends over time in both tissue concentrations and the frequency of exceedances of advisory levels and critical thresholds.

The following subsections provide details on the design approach selected, as well as on the recommended indicators and the sampling sites and frequencies.

8.1 Design approach

The fish tissue monitoring design is based on the principles that sampling should focus on:

- Locations where recreational fishing is occurring and has traditionally occurred
- Species of fish that are most commonly caught and eaten
- Chemical constituents that contribute the most to human health risk.

While these main features of the design have been determined, a three-year pilot program is recommended to be implemented to resolve specifics of the design (e.g., sites, target species, composite size, tissue(s) sampled, monitoring frequency) for the long term. Some of this information may result from the pilot program itself and some from an angler survey and fish consumption study currently being conducted by SCCWRP for the SWRCB, the LARWQCB, and LACSD. The goal of this study is to describe level of angling effort and fish consumption patterns in six watersheds (Ventura River, Santa Clara River, Calleguas, Malibu, Los Angeles River, and San Gabriel River) to support TMDL development and other management initiatives.

Table 8.2 summarizes current knowledge about recreational fishing activities in the estuary and freshwater portions of the watershed. Of these sites, seven (Figure 8.1), thought to be the focus of the most frequent and consistent fishing effort, were selected for the pilot program:

- Puddingstone Reservoir
- Legg Lake
- Salt water end of estuary at River's End Café
- At 7th Street Bridge, near freshwater end of estuary
- San Gabriel River near the confluence with San Jose Creek
- Santa Fe Dam or headlands
- Mirada Lake.

These sites represent three lake, two estuary, and two river locations.

Sampling is recommended to occur annually in August. There are a number of potential sources of temporal variability, including seasonal changes in:

- Fish populations and assemblages
- Tissue concentrations due to spawning cycles
- Angling effort
- Angling populations (e.g., children vs. adults)
- Tissue types (e.g., more roe at some seasons)
- Stocking schedule
- Water flow due to variable storm magnitudes.

However, attempting to control for all these potential sources of variability would require a complex design with substantially higher levels of sampling and tissue analysis. In addition, annual tissue sampling during the summer would make SGRRMP data consistent with other large regional monitoring efforts (e.g., EMAP, SWAMP, Bight Program) that use the spring or summer as their index sampling period.

While the pilot program recommends sampling annually for three years, the long-term program may have different sampling frequency, depending on the specific information needed for decision-making. For example, if tissue levels of target chemicals are far above accepted screening values or action levels, and 303d delisting and/or removal of consumption advisories is unlikely, then infrequent sampling, perhaps once every ten years, may be appropriate for long-term trend tracking. Conversely, if tissue levels or target chemicals are far below screening values or action levels, and there is no information to suggest they will rise rapidly, then infrequent sampling may also be called for. However, if tissue levels are near values at which key management decisions would be made, then annual (or more frequent) sampling would be needed. This framework is summarized in Table 8.3.

Table 8.3. Conceptual framework for determining sampling frequency for fish tissue monitoring.

Tissue level relative to decision threshold	Sampling frequency
Far above	Infrequent, every 10 years
Near	Frequent, annual or greater
Far below	Infrequent, every 10 years

8.2 Indicators

Indicators fall into two major categories, the species of fish to be sampled and the chemical constituents to measure in their tissue.

The species of fish to be sampled depend on the sampling site, since different species are most common in the salt and freshwater portions of the estuary, in the various lakes, and in the river itself. These differences reflect both ecological conditions, the history of introduced species, and stocking practices. Table 8.1 summarizes current knowledge about the fish most commonly caught at each of the pilot program sites and this information should be checked against the results of the SCCWRP angler survey and fish consumption study and updated as needed. In addition, an initial reconnaissance survey may be required to finalize the list of target species at each site. This survey could be based on field collections, interviews with anglers, or a combination of both. It is recommended that stocked fish **not** be sampled. Available information indicates that stocked fish are generally caught very quickly after their release into the watershed. As a result, their tissue levels are most likely representative of their feedstock. There is no routine monitoring of tissue chemistry in the hatcheries managed by California Department of Fish and Game.

Muscle tissue from fish collected at each location would be composited into a single sample for analysis. Based on the results of SCCWRP's angler survey and fish consumption study, additional tissue types may be sampled. The number of fish to be collected at each location will follow U.S. EPA's recommendation of 3-10 fish per composite sample. Statistical power analyses using the pilot program data may help to refine this guideline, although there may be practical limits on the fish that can be caught with reasonable amounts of sampling effort.

Chemical analyses will focus on mercury, DDT, PCBs, arsenic, and selenium. These are chemicals known to occur in the watershed and that have been documented in risk analyses as potentially important sources of elevated human health risk. Dioxin was not included because there are no known sources in the watershed. Organophosphate pesticides were not included because they are not overly bioaccumulative. Furthermore, these pesticides were not found in fish tissue in a study of Newport Bay (SCCWRP technical report #436, www.sccwrp.org/pubs/techrpt.htm), which is at the bottom of a watershed with much higher pesticide use than the San Gabriel River watershed.

8.3 Coordination with other efforts

There are a number of other monitoring efforts and special studies that this program component could potentially coordinate with. These include the ongoing regional monitoring programs that include fish tissue monitoring (EMAP, SWAMP, Bight Program), as well as individual NPDES permit programs that currently include fish tissue monitoring, or may do so in the near future. These include the ocean POTW monitoring programs, the planned Regional Harbors Monitoring Program requested by the San Diego Regional Water Quality Control Board, and the developing

Toxics TMDL for Newport Bay. In addition to the angler survey and fish consumption study described above, which will provide data needed for refining the design of this program component, an ongoing SCCWRP study of contaminants in Newport Bay food webs may provide useful insight into the processes influencing patterns of fish tissue contamination.

Coordination with these other efforts can take two forms:

- Standardization of sampling protocols, target analytes, and laboratory analysis methods
- Integration and synthesis of monitoring data to improve understanding of regional patterns of human health risk, fish contamination patterns, and the processes that affect these.

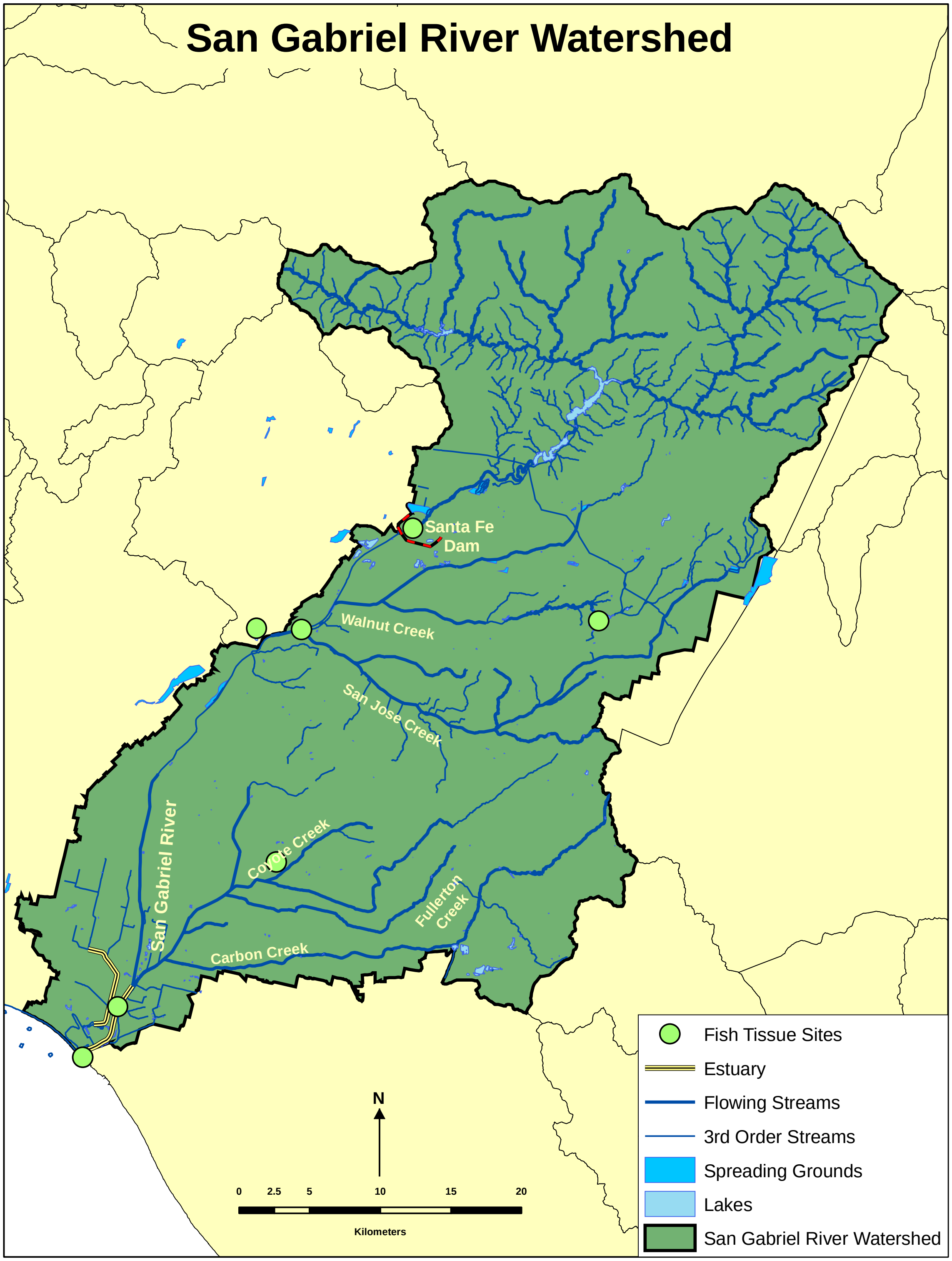
Table 8.1 Design overview for the pilot study for the fish tissue component of the regional monitoring program, which will focus on species commonly caught and consumed at popular recreational fishing locations.

Design element	Description	Details
Design approach	3-yr pilot study Focus on: • Popular fishing sites • Commonly caught species • High-risk chemicals	Pilot study to resolve details of site selection, target species, sampling frequency, composite size for long-term
Number of sites	7 for pilot	3 sites in lakes, 2 each in river, estuary
Sampling frequency	Annually in late summer for pilot	
Target species	Appropriate to each site	Lakes: carp, rainbow trout, catfish, bass, sunfish River: carp, catfish, sunfish, bluegill Estuary: tilapia, mullet, smelt, halibut, croakers
Tissue chemistry indicators	High human health risk	Mercury, DDT, PCBs, arsenic, selenium

Table 8.2 Locations in the San Gabriel River watershed where fishing has been known to occur. Pilot program sites shown in italics. Where information exists, the fish species most commonly caught at each location are also shown. Data gaps would be filled as part of the three-year pilot study.

Fishing location	Detail	Fish caught
Estuary		
Saltwater / brackish portion	Bridges over the river at: • Marina Drive • Haynes intake channel • *River's End Café / breakwater (salt water end of estuary)* • College Drive (west side) • Below 7th Street / end of Lampson (freshwater end of estuary)	Tilapia Mullet (near mouth) Smelt Halibut Croakers Look also at Haynes impingement data
Freshwater end (inland of I-405)	Above tidal prism, where concrete changes to earthen channel	Carp or tilapia
River / streams		
Above Whittier Narrows	Soft bottom, lake-like area Confluence of San Jose Creek and San Gabriel River	Sunfish, bluegill, carp, catfish?
Santa Fe Dam Reservoir		Not known in detail
Santa Fe Dam to Morris Reservoir	About 4-6 miles Natural channel, sometimes dry	Not known in detail
West Fork to Cogswell to San Gabriel Reservoir (Hwy 39)		Trout (stocked), others?
Other upstream areas		Not known in detail
Lakes & reservoirs		
Puddingstone Reservoir		Carp, rainbow trout (stocked), catfish, bass
Legg Lake		Rainbow trout (stocked), catfish, bass, sunfish
Laguna Lake (Fullerton)	Stocked with unknown fish	?
El Dorado Lakes	Mercury listing Stocked with unknown fish	Rainbow trout stocked in upper lakes
Santa Fe Dam Park Lake (same as Santa Fe Dam Reservoir)		Rainbow trout (stocked)
San Gabriel Reservoir		Rainbow trout (stocked)
Crystal Lake	Turning into a meadow	

Figure 8.1. Recommended sites for fish tissue monitoring, based on knowledge of popular recreational fishing locations.



9.0 Assessment, Data Management, and Program Stewardship

Several aspects of the regional monitoring program management and long-term stewardship were addressed by the workgroup and implemented to some degree during the program's first year of operation. These include:

- Reporting
- Data management and integration
- Program management and stewardship.

9.1 Reporting

The SGRRMP will yield its full value only to the extent that the data it produces are consistently organized, synthesized, compared to relevant data from other sources, and reported in a manner accessible to its various audiences in the public and the management, scientific, and advocacy communities.

The workgroup strongly recommended that a periodic (perhaps every five years) and thorough report on the state of the watershed be conducted. This would furnish the motivation for the technical and organizational steps needed to synthesize monitoring information on a watershed scale, including:

- Developing and implementing data management protocols and standardized data transfer formats
- Framing agreements with other regional and watershed-specific programs to share data
- Fostering effective collaboration in the synthesis and interpretation of data from the watershed
- Articulating useful questions that can serve as focal points for data analysis and interpretation
- Devising data presentation and reporting formats suited to each of several potential audiences
- Identifying potential modifications to the monitoring plan
- Identifying potential special studies to address specific questions on watershed condition or the processes that affect them.

All of these activities require focused and consistent effort, because they involve a wide variety of data types from several sources, as well as the thoughtful input of scientists and other staff from many organizations. They will occur only if they are motivated by a clear goal, such as production of a watershed report, and are led by a single entity with responsibility for managing and coordinating the effort involved.

The SGRRMP is preparing a report on the results of the 2005 monitoring effort, which focused on Questions 1 and 2 and included both random and targeted watershed sites. In addition to straightforward data summaries, the workgroup has begun to define a number of higher-level analyses that would integrate different data types to present more comprehensive assessments of watershed condition and trends. This report will be produced during the first half of 2006, with the goal of providing a template for future annual reports, which would then build toward the more comprehensive periodic (e.g., once every five years) state of the watershed report.

9.2 Data management and integration

The success and efficiency of the data analysis and reporting effort will depend on the program's ability to readily acquire, transfer, and integrate data from a number of sources. There are two reasons for this. First, some elements of the program's monitoring design will necessarily be implemented by different agencies and/or contractors. Second, analyzing and interpreting the program's data, and placing it in a relevant context, will sometimes require integrating the program's data with research and/or monitoring results from other sources.

Building blocks and/or models for data acquisition, transfer, and integration already exist, and will be further developed in the future. As a result, it will not be necessary for the program to develop its own unique data management procedures and database system. For data acquisition and transfer, the Stormwater Monitoring Coalition (SMC) and the SWAMP have developed standard data transfer and reporting formats that are readily applicable to most of the data types the program will use. Participants in the program's first year's monitoring effort successfully used one or the other of these formats to report data to SCCWRP, which has agreed to manage the 2005 data. In addition, SCCWRP is actively working with SWAMP's data managers to complete a set of data entry templates that will automatically convert a wide range of data types to SWAMP format. This will not only make it easy for contractors and program participants to transfer and share data for the reporting activities, but it will also lay the groundwork for the program to submit its data to SWAMP for inclusion in the statewide database.

In addition, SCCWRP has agreed to provide to the Los Angeles and San Gabriel Rivers Watershed Council (Watershed Council) and its contractors (see next subsection) the database tables it has created to manage the program's data. This will enable the Watershed Council to manage and work with SGRRMP monitoring data while the details of the statewide database are being completed. Ideally, the statewide database would serve as the permanent home for the program's data.

9.3 Program stewardship

The workgroup recommended that a single entity take on the primary role of coordinating the annual monitoring and producing the periodic SGRRMP watershed assessment, and suggested the Watershed Council as a candidate for this role. The Watershed Council agreed to take on this role and has begun to actively coordinate the logistics for the 2006 monitoring effort. The detailed scope of the Watershed Council's role will be finalized as part of the proposed funding mechanism (see Section 10) that is anticipated to be implemented in 2006. The workgroup envisions that the Watershed Council will retain one or more consultants to perform some or all aspects of the field work, laboratory analysis, data management, and data analysis/reporting. The Watershed Council would oversee all activities of the consultants.

10.0 Implementation: Offsets, Costs, and Funding Mechanism

The SGRRMP was partially implemented in its first year, 2005, with the random and targeted watershed components that address Questions 1 and 2 completed. The random watershed component in 2005 involved sampling at 30 stations, while monitoring in subsequent years will involve only 10 stations per year. The 2005 effort was implemented and funded through a wide variety of one-time compliance monitoring offsets, in-kind support, and cooperative efforts with other programs.

It is anticipated that the program will be operated on a more sustainable basis beginning in 2006. The Watershed Council will provide overall management and coordination (see Section 9 for more detail). It is proposed that the program be funded through a set of approved permanent compliance monitoring reductions or offsets for LACSD (see subsections 10.3.1 – 10.3.4), with the savings redirected to the Watershed Council under the terms of a cooperative agreement between the Watershed Council and LACSD, subject to approval by the Board of Directors for both agencies. The Watershed Council would administer these funds, contracting as needed with specific entities to perform field sampling, laboratory analyses, data management and analysis, and reporting. Any surplus funds from the annual offset would be accumulated to fund the more intensive periodic watershed assessment effort and to conduct more in-depth monitoring and laboratory analyses. Substantive changes to the regional monitoring program's structure or goals would be subject to agreement by the LARWQB Executive Officer, the Watershed Council, and LACSD, in consultation with the SGRRMP technical workgroup. Adaptive or routine adjustments to monitoring locations, constituent lists, and laboratory procedures, as well as the design and implementation of special studies intended to follow up on monitoring results, would be agreed on by LARWQCB staff, the Watershed Council, and LACSD, in consultation with the SGRRMP technical workgroup.

10.1 In-kind Support

In addition to the proposed LACSD offsets (see Section 10.3) that will provide a more permanent funding basis for the program, a number of other specific forms of in-kind support are planned on an ongoing basis. Any adjustments to sampling locations or times by LACSD and LADPW will require approval of the LARWQCB. In-kind support includes:

- LACSD will conduct triad sampling (bioassessment, aquatic chemistry, toxicity testing) at its compliance stations R11 and RA as part of the targeted watershed component
- LACSD will request that all of its bioassessment sampling be moved from fall to spring
- LADPW will perform four bioassessment sites in the lower watershed (three targeted sites, one random site) and will make needed adjustments in sampling locations and timing to accomplish this.
- LADPW will shift its bioassessment sampling at Walnut Creek from the fall to the spring as part of the targeted watershed component
- Orange County Stormwater Program will sample one random site in those years when a random site falls within Orange County.

10.2 Implementation costs

The estimated costs to conduct the monitoring recommended for the overall SGRRMP are contained in Table 10.1. These costs were derived using a standardized set of costs for each category of sample collection and laboratory analysis to accommodate the fact that it is not yet known which specific agencies and/or contractors will be conducting field sampling and laboratory analyses. Where multiple costs were available from workgroup members, these were averaged to obtain a single figure. Some costs, however, were available from only one source. The overall estimated annual cost of the SGRRMP is $1,667,501 for ongoing monitoring, analysis, and reporting. This is somewhat of a moving target because the compliance monitoring requirements under Question 3 are routinely revised in response to permit and other regulatory actions.

The portion of the total program costs that are related to compliance monitoring under Question 3 is $1,318,336. The cost estimate suggested to the workgroup that the new components of the SGRRMP (i.e., Questions 1, 2, 4, and 5), which total $349,165 (for sample collection and laboratory analysis only) from the second year onward, could be funded with only moderate readjustments to compliance monitoring programs (Question 3) and/or additional funds or in-kind support from other agencies, citizen monitoring groups, grants, etc. (see next subsection for details on the funds available from compliance monitoring offsets).

The purpose of using standardized costs is to provide a common benchmark for planning and implementation. The organizations monitoring in the San Gabriel River watershed not only use different consulting companies and laboratories to conduct field sampling and laboratory analyses, but also present costs in a variety of ways (e.g., some include facility overhead and staff benefits, or QA/QC costs, while others do not), all of which make it extremely difficult to directly compare costs and evaluate potential tradeoffs in the monitoring design. Thus, the standardized costs presented in Table 10.1 will, in some cases, diverge from actual current expenses incurred by individual monitoring programs. More importantly, the costs in Table 10.1 will almost certainly differ somewhat from the costs the Watershed Council will incur as it implements the program.

Some assumptions were required in developing the standardized cost estimate. This is because certain details of the watershed design cannot be finalized until sampling actually begins and because some aggregation and averaging of costs was required in order to show all costs on the same basis. These assumptions include:

- All site visit costs (except for some for Question 3) are from the SWAMP costing template and are the same for all sample types and locations. This may be somewhat unrealistic. For example, site visits to collect bacteria samples under Question 4 may be less expensive than sites visits for collection of water chemistry samples under Questions 1 and 2, and collection of sediment samples in the estuary under Question 2 may be more expensive than collection of CRAM measurements at freshwater stations under Question 2.
- QA/QC costs are assumed to be embedded in the unit costs for each type of analysis. This assumption is not universally true for all cost estimates used, since some laboratories include such costs in the baseline analysis charge as a matter of course and others do not. Information to take the cost estimates to this next level of detail was not available, nor was it considered necessary for this stage of the costing process.
- In addition, 5% is added to sampling and analysis costs for field QA/QC duplicates.
- Unit costs for bioassessment samples (including set up, sampling, taxonomy) were obtained and were adjusted to reflect the site visit costs applied to all samples.
- Question 2: Conventional water quality sampling at the four estuary stations four times per year.
- Question 3: 25 LACSD receiving water stations, two LADPW stormwater mass emissions stations, and three shared LADWP/AES receiving water stations. LADWP and AES share

nine additional receiving water stations in San Pedro Bay, but these are not included in this cost estimate, which focuses on the San Gabriel River and its estuary.

- Question 3: For site visits at LACSD discharge sites with extremely easy access and well-established routines, a site visit cost of $250 was applied to weekly sampling at each of 25 receiving water stations.
- Question 3: LACSD costs reflect the current monitoring program, before applying the offsets described in Section 10.3.
- Question 3: Only the NPDES receiving water monitoring by LADWP/AES is included. The Reasonable Potential Analysis (RPA) monitoring conducted by these agencies is not included.
- Question 3: Includes two storm and two dry weather samples at each of two mass emissions stations monitored by LADPW.
- Question 3: The Orange County Stormwater Program's three mass emissions stations are not included because monitoring has not yet begun. Once monitoring does begin, it will include three storm and three dry weather samples per year at each station, sampled for water chemistry and toxicity.
- Question 4: Six swimming sites, three locations per site, sampled weekly for the five month swimming period (May through September), with three sites sampled during a single field trip.
- Question 4: Five watershed sentinel sites, sampled weekly for the five month swimming period (May through September), with all five locations sampled during a single field trip. This field trip will include one estuary site during the swimming season.
- Question 4: One estuary (bottom of watershed) site, sampled twice weekly throughout the year. This will require two separate field trips per week during the October through April period and one trip per week during the swimming season.
- Question 5: Seven sites have been recommended for the pilot program, but it is not known at this time how many different species, and therefore composite samples, will be collected at each site. The estimate assumes three composite samples per site per visit.
- For all DO, pH, and conductivity samples, the estimate assumes that data from a multi-parameter probe will suffice. This is included in the site visit cost. If actual lab analyses are required, then the individual costs in the spreadsheet will need to be applied.

10.3 Funding mechanism

Section 6.1 described three specific adjustments to LACSD's compliance monitoring that would improve efficiency and free up funds to support the regional monitoring program. These included:

- Shifting from weekly to monthly monitoring at 21 inland and four estuary receiving water stations
- Removing station R9E from the monitoring program
- Removing chlorophyll a from the list of monitored constituents
- Switching permit-required bioassessment monitoring to the spring season instead of fall, and conducting bioassessments according to the method that is currently employed by the California Department of Fish and Game (CDFG)

The following subsections detail the projected cost savings from each of these actions. Despite the presence of some unavoidable costing assumptions, LACSD, LARWQCB, and the other members of the workgroup all agreed that they would form the basis for calculating the resource exchange to the Watershed Council.

The actual transfer of funds from LACSD to the Watershed Council would be accomplished under the terms of a cooperative agreement between the Watershed Council and LACSD, subject to approval by the Board of Directors for both agencies.

10.3.1 Moving to monthly sampling

The following table summarizes the cost savings for moving to monthly monitoring at the 25 LACSD receiving water stations. Costs for receiving water stations at Pomona and San Jose Creek water reclamation plants (WRPs) and estuary stations are calculated separately from other inland receiving water stations because some constituents are monitored at different frequencies. The following table shows that moving to monthly monitoring at the 25 receiving water stations will save $31,577 per month for the inland and estuary stations, for a yearly cost savings of $378,924.

Station Type	Monthly Analysis Cost		Monthly Staging Cost		Monthly Station Total		Monthly Savings
	Weekly	Monthly	Weekly	Monthly	Weekly	Monthly	
WRP (11)	3053	1726	613	141	3666	1867	19789
Estuary/R9E (5)	2245	1209	613	141	2858	1350	7540
POM (3)	2135	2135	613	141	2748	2276	1416
SJC (6)	1153	1153	613	141	1766	1294	2832
Total (25)							31577

10.3.2 Removing chlorophyll a

Chlorophyll a costs $54.68 per sample. Cost savings from removing chlorophyll a from all the stations can be estimated as follows, assuming a monthly monitoring frequency:

$54.68 x 19 stations* x 12 months = $12,467

*Chlorophyll a analysis is not required for the 6 San Jose Creek WRP receiving water stations.

10.3.3 Deleting a redundant station

The cost savings from removing station R9E, assuming a monthly sampling frequency and that chlorophyll a has been removed from the parameter list are:

[$1,154 (analysis cost) + $141 (staging cost)] x 12 = $15,540

10.3.4 Total annual cost savings

The total annual cost savings from implementing these three adjustments thus are:

$378,924 + $12,467 + $15,540 = $406,931

This amount is more than adequate to cover the estimated costs (about $349,165) of the four aspects of the watershed program that are not directly related to discharge compliance monitoring. These include the random and targeted watershed monitoring, along with bacteria monitoring at key swimming and sentinel sites, and the pilot program for fish tissue monitoring.

Given that the actual scope and cost of these four program elements may change as they are implemented on a routine basis, the original cost estimate may increase. In addition, the budget in Table 10.1 contains routine administrative and other program costs, and some funds should be set aside to support the periodic and more intensive watershed assessment.

Table 10.1. Estimated costs for the San Gabriel River Regional Monitoring Program. Estimates are based on standardized costs that reflect an average of costs across programs to facilitate regional cost comparisons and planning.

SGRRMP Planning Costs		SGRRMP Program Elements ------>	Q1: Random Watershed Out Years	Item Cost (Random Watershed Out Years)	Q2: Unique Areas - Freshwater	Item Cost (Unique Areas - Freshwater)	Q2: Unique Areas - Estuary	Item Cost (Unique Areas - Estuary)	Q3: Discharges	Item Cost (Discharges)	Q4: Safe to Swim	Item Cost (Safe to Swim)	Q5: Safe to Eat Fish (Pilot Program)	Item Costs (Safe to Eat Fish)	Total units	Total Cost (Total Units x cost/unit)
Analysis or Service to be Performed	Description	Unit Cost (per sample)														
Sediment and/or Water Sample Collection	Collect sed and/or water samples; conduct multiparameter probe reading as possible; includes all sample shipping. For close access, drive-up/walk-in sites only. Sample collection costs not only include field time/costs, but also field data entry, pre-trip preparation, and post-trip	$931	10	$9,310	12	$11,172	16	$14,896	30	$27,930					38	$35,378
	For LACSD sites at water reclamation plants with extremely easy access.	$250							1352	$338,000					0	$0
	Bacteria-only collection in which 3 or 6 sites per day are sampled	$500									66	$33,000			64	$33,000
	Weekly Bacteriological Collection (head of estuary, non-swim season)	$250									82	$20,500			82	$20,500
	Fish collected w/ non-marine (TSM style)	$2,107											5	$10,535	5	$10,535
	Fish collected within marine/estuarine (CFC style)	$1,689											2	$3,378	2	$3,378
Trace Organic Chemistry	Full Scan (pesticides and pcb congeners; no PAH's) - sediment	$1,030													0	$0
	Full Scan (chlorinated pesticides and pcb congeners; no PAH's) - tissue	$195											21	$4,095	21	$4,095
	Full Scan (chlorinated pesticides and pcb congeners; no PAH's) - water	$195							316	$61,620					0	$0
															0	

SGRRMP Planning Costs		SGRRMP Program Elements ------>	Q1: Random Watershed Out Years	Item Cost (Random Watershed Out Years)	Q2: Unique Areas - Freshwater	Item Cost (Unique Areas - Freshwater)	Q2: Unique Areas - Estuary	Item Cost (Unique Areas - Estuary)	Q3: Discharges	Item Cost (Discharges)	Q4: Safe to Swim	Item Cost (Safe to Swim)	Q5: Safe to Eat Fish (Pilot Program)	Item Costs (Safe to Eat Fish)	Total units	Total Cost (Total Units x cost/unit)
	Full Scan (pesticides and pcb congeners) + PAH's - sediment	$1,764													0	$0
	Semi-volatile organics	$250							108	$27,000					0	$0
	Base neutral extractables - water	$260							4	$1,040					0	$0
															0	
	Triazine herbicides - water	$311							4	$1,244					0	$0
															0	
	VOCs (full list including MTBE+BTEX) - water	$187							104	$19,448					0	$0
															0	
	ICP OP Pesticide scan - water	$151	10	$1,510	5	$755			108	$16,308					15	$2,265
	Chlorpyrifos & Diazinon only- sed	$492													0	$0
Trace Metal Chemistry	**Sediment ICP-MS metals suite** (Includes Al, Cr, Mn, Ni, Cu, Zn, Ag, Cd, Pb, As--all costs): Se not included--see below	$195					4	$780	3	$585					4	$780
	Tissue ICP-MS metals suite (Includes Al, Cr, Mn, Ni, Cu, Zn, Ag, Cd, Pb, As, Se--all costs)	$402													0	$0
	Water ICP-MS metals suite--unfiltered "total" (Includes Al, Cr, Mn, Ni, Cu, Zn, Ag, Cd, Pb, As, Se--all costs)	$247	10	$2,470	5	$1,235	4	$988	316	$78,052					19	$4,693
	Water ICP-MS metals suite--filtered "dissolved" (Includes Al, Cr, Mn, Ni, Cu, Zn, Ag, Cd, Pb, As, Se--all costs)	$272					4	$1,088	4	$1,088					4	$1,088
															0	
	Surcharge for salinity >3 ppt water trace metals analyses	$112					4	$448							4	$448
	(using high resolution ICP-MS, to get highest reporting limits)														0	
															0	

SGRRMP Planning Costs		SGRRMP Program Elements ------>	Q1: Random Watershed Out Years	Item Cost (Random Watershed Out Years)	Q2: Unique Areas - Freshwater	Item Cost (Unique Areas - Freshwater)	Q2: Unique Areas - Estuary	Item Cost (Unique Areas - Estuary)	Q3: Discharges	Item Cost (Discharges)	Q4: Safe to Swim	Item Cost (Safe to Swim)	Q5: Safe to Eat Fish (Pilot Program)	Item Costs (Safe to Eat Fish)	Total units	Total Cost (Total Units x cost/unit)
	Mercury in tissue	$113											21	$2,373	21	$2,373
															0	
	Arsenic and selenium in tissue	$225											21	$4,725	21	$4,725
Conventional Water Chemistry	Major anions scan: ortho-phosphate, nitrate, nitrite, chloride, sulfate	$177	10	$1,770	5	$885	16	$2,832	1356	$240,012					31	$5,487
	Total Phosphate	$33	10	$330	5	$165	16	$528	1356	$44,748					31	$1,023
	Boron	$37			5	$185	16	$592							21	$777
	Cyanide	$40							316	$12,640					0	$0
	TKN	$53	10	$530	5	$265	16	$848	1356	$71,868					31	$1,643
	TDS	$35							312	$10,920					0	$0
	TSS	$22	10	$220	5	$110	16	$352	316	$6,952					31	$682
	Volatile suspended solids	$22							4	$88					0	$0
	Total phenols	$58							4	$232					0	$0
	Ammonia	$35	10	$350	5	$175	16	$560	1356	$47,460					31	$1,085
	Chlorophyll-a (syringe-filtered)	$71													0	$0
	Alkalinity	$22	10	$220	5	$110	16	$352	4	$88					31	$682
	Hardness (should do if doing metals in freshwater)	$36	10	$360	5	$180	16	$576	1356	$48,816					31	$1,116
	Suspended Sediment Concentration (SSC)	$65													0	$0
	DO	$22													0	$0
	pH	$10													0	$0
	Conductivity	$14													0	$0
	DO, pH, EC: multiparameter probe, no additional cost		10		5		16		1356						31	
	TOC	$71							4	$284					0	$0

SGRRMP Planning Costs		SGRRMP Program Elements ------>	Q1: Random Watershed Out Years	Item Cost (Random Watershed Out Years)	Q2: Unique Areas - Freshwater	Item Cost (Unique Areas - Freshwater)	Q2: Unique Areas - Estuary	Item Cost (Unique Areas - Estuary)	Q3: Discharges	Item Cost (Discharges)	Q4: Safe to Swim	Item Cost (Safe to Swim)	Q5: Safe to Eat Fish (Pilot Program)	Item Costs (Safe to Eat Fish)	Total units	Total Cost (Total Units x cost/unit)
	DOC	$71	10	$710	5	$355	16	$1,136							31	$2,201
	Turbidity	$18							316	$5,688					0	$0
	O&G	$85							316	$26,860					0	$0
	COD	$27							5	$135					0	$0
	BOD	$55							316	$17,380					0	$0
	Surfactants (MBAS)	$40							316	$12,640					0	$0
	Temp (multiparameter probe, no additional cost)								1352						0	
Sediment Physical Characteristics	Sediment Total Organic Carbon (TOC)	$60					4	$240							4	$240
	Sediment grain size (%silt/clay = fines only)	$60													0	$0
	Sediment grain size - full analysis (phi scale)	$130					4	$520							4	$520
Bacteriology and Pathology	Total & fecal coliform, Enterococcus	$45							1356	$61,020	104	$4,680			104	$4,680
	E.coli	$40									506	$20,240			506	$20,240
Biological Assessment	Bioassessment site collection, sorting, taxonomy, QA, report	$1,600	10	$16,000					26	$41,600					10	$16,000
	CRAM measurements in conjunction with bioassessment	$600	10	$6,000											10	$6,000
	CRAM measurements only	$300			12	$3,600									12	$3,600
	Benthic infauna sample sorting, taxonomy, QA, (no sample collection)	$650					4	$2,600	3	$1,950					4	$2,600
Toxicity Testing - Salt Water Origin	Water (salt water)														0	
	Larval Development (sea urchin, abalone, bivalve)	$662													0	$0
	Larval Development at Sediment Water Interface	$689													0	$0
	Sea Urchin Fertilization	$662													0	$0
	Mysid Juvenile 96-h Survival	$551													0	$0

SGRRMP Planning Costs		SGRRMP Program Elements ------>	Q1: Random Watershed Out Years	Item Cost (Random Watershed Out Years)	Q2: Unique Areas - Freshwater	Item Cost (Unique Areas - Freshwater)	Q2: Unique Areas - Estuary	Item Cost (Unique Areas - Estuary)	Q3: Discharges	Item Cost (Discharges)	Q4: Safe to Swim	Item Cost (Safe to Swim)	Q5: Safe to Eat Fish (Pilot Program)	Item Costs (Safe to Eat Fish)	Total units	Total Cost (Total Units x cost/unit)
	Additional Sample Dilutions	$441													0	$0
	Sediment														0	
	Amphipod 10-d Survival (*Rhepoxynius* or *Eohaustorius*)	$855					4	$3,420							4	$3,420
	Amphipod 10-d Survival (*Ampelisca*)	$965													0	$0
	Polychaete 20-d Growth & Survival (*Neanthes*)	$1,048													0	$0
Toxicity Testing - Fresh Water Origin	Water (fresh water)														0	
	Mysid Juvenile 96-hr Survival	$551													0	$0
	Ceriodaphnia 96-hr Survival	$386	10	$3,860					52	$20,072					10	$3,860
	Additional sample dilutions (after 100%) for *Ceriodaphnia* 96-hr test	$221													0	$0
	Ceriodaphnia 96-hr Survival in-situ	$607													0	$0
	Ceriodaphnia 7-day Survival & Reproduction (one of EPA 3-spp)	$717							104	$74,568					0	$0
	Additional Sample Dilutions for *Ceriodaphnia* 7-day test	$525													0	$0
	Pimephales (fathead minnow) 7-day test (one of EPA 3-spp)	$717													0	$0
	Selenastrum (algae) test (one of EPA 3-spp)	$717													0	$0
	Sediment														0	
	Amphipod 10-d Survival (*Hyalella*)--acute	$882													0	$0
	Amphipod 28-d Survival (*Hyalella*)--chonic (recommended)	$1,103					4	$4,412							4	$4,412
	Additional species 10-d acute (estimate)	$882													0	$0
	Sediment / Water Interface (consult as to species)	$689													0	$0
5% Field Duplicate QA/QC Sample Cost	5% of laboratory analysis costs	$8,639													0	$8,639

SGRRMP Planning Costs		SGRRMP Program Elements ------>	Q1: Random Watershed Out Years	Item Cost (Random Watershed Out Years)	Q2: Unique Areas - Freshwater	Item Cost (Unique Areas - Freshwater)	Q2: Unique Areas - Estuary	Item Cost (Unique Areas - Estuary)	Q3: Discharges	Item Cost (Discharges)	Q4: Safe to Swim	Item Cost (Safe to Swim)	Q5: Safe to Eat Fish (Pilot Program)	Item Costs (Safe to Eat Fish)	Total units	Total Cost (Total Units x cost/unit)
DFG Miscellaneous	Regional proportional share of statewide cost of DFG pass-thru subcontract ovrhd, coordination/logistics/management cost (*will calculate after know total $ each region in each subcontract)	*different for each region													0	$0
	Sampling/Cruise Reports - $525 per sampling seasonal event	$679													0	$0
	Regional Annual Interpretive Report / Publication	Negotiate													0	
SUBTOTAL COST FOR EACH PROGRAM COMPONENT:				$43,640		$19,192		$37,168		$1,318,336		$78,420		$25,106		
Programmatic sampling-related costs (QAPP, CRAM training, site recon)																$10,000
Programmatic reporting-related costs (Data management, data analysis, reporting)																$25,000
Programmatic management costs (Workgroup, project management, Watershed Council)																$42,000
Provision for special studies																$20,000
Provision for periodic State of the Watershed Report																$20,000
Technical assistance and support																$20,000
TOTAL COST EXCLUDING DISCHARGE (Q3):																$349,165