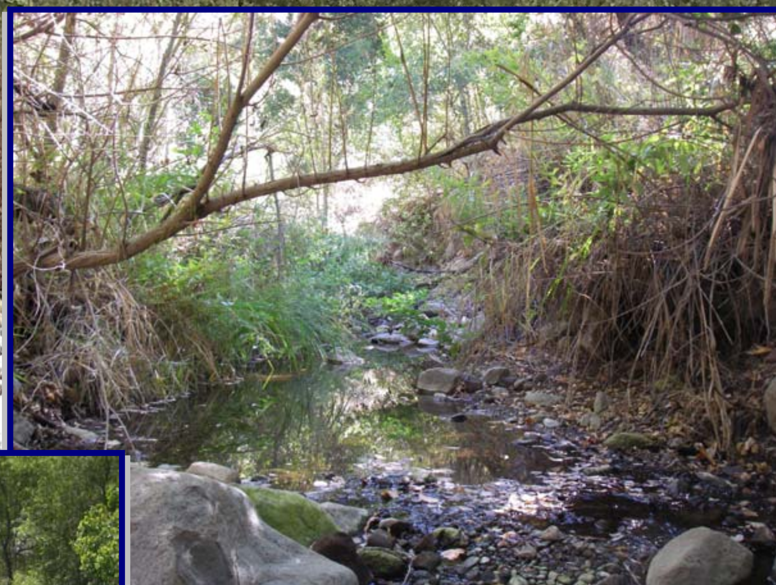
# 2007
# BIOASSESSMENT MONITORING PROGRAM IN LOS ANGELES COUNTY

## Final Report

Prepared For:

Los Angeles County Department of Public Works
Watershed Management Division
900 South Fremont Avenue
Alhambra, California 91803-1331

April 2008



PUBLIC WORKS

WESTON SOLUTIONS

# 2007 BIOASSESSMENT MONITORING PROGRAM IN LOS ANGELES COUNTY

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Prepared For:

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April 2008

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| °C | Degrees Celsius |
| °F | Degrees Fahrenheit |
| ABL | Aquatic Bioassessment Laboratory |
| ANOVA | Analysis of Variance |
| CDFG | California Department of Fish and Game |
| CF | Collector Filterer |
| CG | Collector Gatherer |
| cm | Centimeter |
| CSBP | California Stream Bioassessment Procedure |
| EPT | Ephemeroptera, Plecoptera, and Trichoptera |
| FFG | Functional Feeding Group |
| ft | Feet |
| IBI | Index of Biotic Integrity |
| LACDPW | Los Angeles County Department of Public Works |
| m | Meter |
| mg/L | Milligrams per Liter |
| MH | Macrophyte Herbivore |
| mm | Millimeter |
| mS/cm | Millisiemens per centimeter |
| NTU | Nephelometric Turbidity Unit |
| OM | Omnivore |
| PH | Piercer Herbivore |
| ppt | Parts per thousand |
| QA/QC | Quality Assurance/Quality Control |
| qt | Quart |
| SWAMP | Surface Water Ambient Monitoring Program |
| SDRWQCB | San Diego Regional Water Quality Control Board |
| TV | Tolerance Value |
| U.S. EPA | United States Environmental Protection Agency |
| XY | Xylophage (wood eater) |

# EXECUTIVE SUMMARY


***Background***
Weston Solutions, Inc. was contracted by the Los Angeles County Department of Public Works to perform biological assessments of various freshwater streams in six Los Angeles County watersheds. The goals of the program are to assess biological integrity and to detect biological trends and responses to pollution in receiving waters throughout the region. This program focuses on the sampling and analysis of freshwater stream benthic macroinvertebrates to achieve these goals. The program was initiated in October of 2003, with monitoring surveys conducted once per year since that time.

***Study area***
The study area consisted of twenty stream monitoring reaches within the six primary watersheds of Los Angeles County. The watersheds included the Santa Clara River Watershed, the Santa Monica Bay Watershed (including the Ballona Creek Watershed and the Malibu Creek Watershed), the Dominguez Watershed, the Los Angeles River Watershed, and the San Gabriel River Watershed. In 2007, seventeen of the twenty sites were sampled due to dry conditions at three of the sites. The sites were sampled in the months of July (San Gabriel River Watershed only) and October (all remaining watersheds).

Five of the monitoring reaches (Stations SGM-110, 12, 13, 14, and 19) were located in concrete lined channels, and one (Station 11) was partially lined with concrete. Two of the monitoring reaches (Stations SGUT-504 and 17) were considered reference sites that had minimal upstream urban development. Station 13 was considered a reference site for concrete lined channels, although this site does receive runoff from urbanized areas.

***Methodology***
Field sampling followed the standard protocols described in the California Stream Bioassessment Procedure (Harrington, 2003). The four sites in the San Gabriel River Watershed also incorporated the SWAMP physical habitat assessment protocol (Ode, 2007). Composite benthic macroinvertebrate samples were collected from each monitoring reach and in the laboratory 500 organisms were removed for analysis. Organisms were identified to standard taxonomic level I as specified in the Southwest Association of Freshwater Invertebrate Taxonomists List of Freshwater Invertebrate Taxa. Data analysis included the calculation of standard community-based metric values and a Southern California Index of Biotic Integrity (IBI) (Ode et al., 2005). Additional analyses included a comparison of concrete lined channels with unlined channels, cluster analysis of stations and taxa present, comparison of IBI scores with site elevations, and analysis of IBI scores and key metrics since the beginning of the program in 2003.

***Findings***
Taxonomic evaluation of the 2007 samples yielded 94 different taxa from 8,632 individual organisms. The most abundant organisms collected throughout the region were midges of the family Chironomidae, which were present at every monitoring site. The majority of organisms collected from the monitoring reaches were moderately or highly tolerant to stream impairments, and all of the sites except Station 16-Las Virgenes Creek and Station 17-Cold Creek (a reference site) were dominated by organisms in the collector-gatherer feeding guild.

The Index of Biotic Integrity score of a monitoring reach is considered the strongest analytical tool for rating overall benthic community quality. Sites rated Poor and Very Poor have an IBI score of 26 or lower and are considered “impaired”. The IBI scores for the 2007 study ranged from 0 to 52 out of a possible 70 points, and the benthic macroinvertebrate communities were rated from Very Poor to Good. Six of the monitoring reaches were located in highly modified, concrete-lined urban water courses, and these sites all had IBI ratings of Poor or Very Poor. Analysis of individual metrics, as well as total IBI scores showed that monitoring sites located in the lower elevation watershed areas had lower quality benthic communities than sites located in the mid to upper reaches of the watersheds.

**Table ES-1: Index of Biotic Integrity Scoring for 2007**

| Watershed | Monitoring Reach | Receiving Water | Total IBI Score (0-70 Point Scale) | IBI Rating |
|---|---|---|---|---|
| Malibu | 17 | Cold Creek | 52 | Good |
| Los Angeles | 6 | Arroyo Seco | 40 | Fair |
| San Gabriel | SGUT-504 | San Gabriel River | 34 | Fair |
| Santa Clara | 1 | Santa Clara River | 27 | Fair |
| San Gabriel | SGUT-505 | San Gabriel River | 25 | Poor |
| Malibu | 16 | Las Virgenes Creek | 20 | Poor |
| Malibu | 18 | Triunfo Creek | 19 | Poor |
| San Gabriel | SGM-110 | San Gabriel River | 19 | Poor |
| Los Angeles | 12 | Los Angeles River | 17 | Poor |
| San Gabriel | SGLT-506 | Walnut Creek | 17 | Poor |
| Los Angeles | 7 | Arroyo Seco | 11 | Very Poor |
| Ballona | 14 | Ballona Creek | 10 | Very Poor |
| Los Angeles | 8 | Compton Creek | 6 | Very Poor |
| Los Angeles | 13 | Los Angeles River | 4 | Very Poor |
| Malibu | 15 | Medea Creek | 2 | Very Poor |
| Los Angeles | 11 | Los Angeles River | 0 | Very Poor |
| Dominguez | 19 | Dominguez Channel | 0 | Very Poor |
| San Gabriel | 9* | Zone 1 Ditch | | |
| Los Angeles | 10* | Eaton Wash | | |
| Santa Clara | 20* | Bouquet Canyon | | |
| *Not sampled due to dry conditions | | | | |

Comparison of the IBI scores for the five survey years to date did not indicate any substantial trend towards degradation or improvement at any of the sites. Four of the sites had the highest IBI scores to date in 2007 and two sites had their lowest IBI scores in 2007.

An analysis of the benthic community quality in concrete lined versus unlined sites indicated that there was a slight yet statistically significant difference in IBI scores between sites located in the lower watershed areas. When reference sites were added to the analysis, the difference in IBI scores between lined and unlined sites was of much greater significance.

Two-way cluster analysis of taxa and stations showed fairly vague clustering by taxa but the stations did appear to cluster according to site physical conditions and total IBI scores. Lower watershed sites were populated by ubiquitous taxa common to most all sites while the upper watershed and reference sites had taxa unique to each site in addition to the ubiquitous taxa. Upper watershed sites with natural channels clustered together, lower watershed channelized sites with soft bottoms clustered together, and fully concrete lined sites clustered together.

***Conclusion***

Stream bioassessment monitoring of the watersheds of Los Angeles County has been conducted for five consecutive years beginning in October of 2003. Sampling and analysis methodology has undergone some relatively minor alterations, but overall results have been quite consistent for all of the monitoring sites. Monitoring sites located in highly urbanized areas of the watersheds have had benthic macroinvertebrate communities that were considered impaired based on the Southern California Index of Biotic Integrity. Reference monitoring site communities have been rated unimpaired for the duration of the study.

# 1.0 INTRODUCTION

Weston Solutions, Inc. (Weston) was contracted by the Los Angeles County Department of Public Works (LACDPW) to perform biological assessments of various freshwater streams in six Los Angeles County watersheds. The goals of the program are to assess biological integrity and to detect biological trends and responses to pollution in receiving waters throughout the region. Sampling and analysis followed the protocols described in the California Stream Bioassessment Procedure (CSBP) (Harrington, 2003), and also incorporated the Southern California Index of Biotic Integrity (IBI) (Ode et al., 2005). This program was initiated in October of 2003, with monitoring surveys conducted once per year since that time.

The sampling protocol of the CSBP includes the collection and identification of stream benthic macroinvertebrates, and also assesses the quality and condition of the in-stream physical habitat and adjacent riparian zone. Utilizing species-specific tolerance values and community species composition, numerical biometric indices are calculated, allowing for the determination of habitat health in streams. Over time, this information is used to identify ecological trends and aid analyses of the appropriateness of water quality management programs (Yoder and Rankin, 1998). Invertebrates reside in streams for periods ranging from a month to several years, and have varying sensitivities to physical, biological, and chemical disturbances to the stream. By assessing the invertebrate community structure of a stream, a realistic, long-term measure of stream habitat health and ecological response is obtained. This information may complement monitoring programs that test water quality parameters which provide a measure of habitat conditions only at the moment sampling occurs. The addition of bioassessment to chemical, bacterial, and toxicological approaches to watershed monitoring programs gives a comprehensive indication of water quality and the effects of ecological impacts.

This report will present the results of stream bioassessment surveys of twenty monitoring reaches in the Los Angeles Basin, conducted on June 11 and 12 (San Gabriel Watershed only), and from October 1 to October 31, 2007 for the remaining sites. A moderate rain event occurred during the October sampling period when roughly 0.5 inches of rain fell on October 13 throughout most of Los Angeles County. A taxonomic listing of all collected benthic macroinvertebrates, biological metric and Index of Biotic Integrity calculations, and a discussion and analysis of the results are included.

# 2.0 STUDY AREA OVERVIEW

The monitoring reaches assessed in this study were located in six watersheds throughout Los Angeles County, including the Santa Clara River Watershed, the Santa Monica Bay Watershed (including the Ballona Creek Watershed and the Malibu Creek Watershed), the Dominguez Watershed, the Los Angeles River Watershed, and the San Gabriel River Watershed. The monitoring reaches are described in Table 1, and the rationale for monitoring each site is included. A map of the monitoring locations is shown in Figure 1.

Five of the monitoring reaches (Stations SGM-110, 12, 13, 14, and 19) were located in concrete lined channels, and one (Station 11) was partially lined with concrete. Three of the monitoring reaches (Stations SGUT-504, 13, and 17) were considered reference sites that had minimal upstream urban development.

# Table 1: LACDPW Stream Bioassessment Monitoring Stations, 2007.

| Station | Receiving Water Body | Location – Date | Coordinates | Justification | Elevation (ft above sea level) |
|---|---|---|---|---|---|
| **San Gabriel River Watershed** | | | | | |
| 2 (SGUT-504) | San Gabriel River Mainstem | Upper San Gabriel River near East Fork Rd. – June 12 | N 34º 14.228' W -117º 49.129' | Offset site for the San Gabriel River Watershed Monitoring Project | 1,512 |
| 3 (SGUT-505) | San Gabriel River Mainstem | Upper San Gabriel River below Morris Reservoir – June 12 | N 34º 10.164' W -117º 53.359' | Offset site for the San Gabriel River Watershed Monitoring Project | 898 |
| 4 (SGM-110) | San Gabriel River Lined Channel Tributary | San Gabriel River at Carson Street– June 11 | N 33º 53.982' W -118º 05.571' | Offset site for the San Gabriel River Watershed Monitoring Project | 22 |
| 5 (SGLT-506) | Walnut Creek Unlined Channel | Walnut Channel upstream of San Gabriel River – June 11 | N 34º 03.704' W -117º 59.477' | Assess impacts of upstream land uses; nursery and residential area/San Gabriel River Watershed Monitoring Project site. | 298 |
| **Los Angeles River Watershed** | | | | | |
| 6 | Arroyo Seco Unlined Channel | Upstream of Arroyo Seco Spreading Grounds – Oct. 10 | N 34º 12.189' W -118º 09.968' | Assess impacts in upper to mid watershed from residential land use | 1,118 |
| 7 | Arroyo Seco Unlined Channel | Arroyo Seco downstream from I-134 – Oct. 10 | N 34º 08.676' W -118º 09.982' | Assess impacts of residential land use | 725 |
| 8 | Compton Creek Unlined Channel | Compton Creek upstream of the confluence with the Los Angeles River – Oct. 31 | N 33º 50.788' W -118º 12.535' | Assess impacts of urban pollution in Compton Creek | 22 |
| 9 | Zone 1 Ditch / Whittier Narrows Dam Unlined Channel | Zone 1 Ditch at Whittier Narrows Dam- not visited | N 34º 01.452' W -118º 04.250' | Los Angeles County Sanitation District baseline site; not sampled due to dry conditions | 200 |
| 10 | Eaton Wash Unlined Channel | Upstream of Eaton Wash Canyon Reservoir at New York Drive–Oct. 9 | N 34º 10.538' W -118º 05.707' | Assess impacts of tributary to Los Angeles River; not sampled due to dry conditions | 928 |
| 11 | Los Angeles River Partially Lined Channel | Los Angeles River at Victory Blvd –Oct. 10 | N 34º 09.362' W -118º 17.591' | Assess impacts of adjacent equestrian area | 446 |
| 12 | Los Angeles River Lined Channel | Los Angeles River near confluence with Arroyo Seco Channel – Oct. 10 | N 34º 05.112' W -118º 13.713' | Main river channel | 318 |
| 13 | Los Angeles River Lined Channel | Los Angeles River upstream of Sepulveda Dam – Oct. 30 | N 34º 10.207' W -118º 28.582' | Upstream reference site | 682 |
| **Ballona Creek Watershed** | | | | | |
| 14 | Ballona Creek Lined Channel | Ballona Creek at I-405 and S. Sepulveda Blvd – Oct. 31 | N 34º 00.445' W -118º 23.761' | Original location relocated due to tidal influence | 29 |
| **Malibu Creek Watershed** | | | | | |
| 15 | Medea Creek Unlined Channel | Medea Creek at Thousand Oaks Blvd. and Kanan Rd. – Oct. 9 | N 34º 09.043' W -118º 45.456' | Assess impacts of Medea Creek to Malibu Creek | 862 |
| 16 | Las Virgenes Creek Unlined Channel | Las Virgenes Creek near the Los Angeles County line – Oct. 9 | N 34º 10.133' W -118º 42.192' | Assess impacts from tributary to Malibu Creek | 856 |
| 17 | Cold Creek Unlined Channel | Cold Creek at Stunt Rd. at Cold Creek Preserve – Oct. 9 | N 34º 05.707' W -118º 38.918' | Upstream reference site | 385 |
| 18 | Triunfo Creek Unlined Channel | Triunfo Creek downstream of Troutdale Dr. and nursery – Oct. 9 | N 34º 06.851' W -118º 46.750' | Assess impacts of nursery | 761 |

**Table 1: LACDPW Stream Bioassessment Monitoring Stations, 2007.**

| Station | Receiving Water Body | Location – Date | Coordinates | Justification | Elevation (ft above sea level) |
|---|---|---|---|---|---|
| **Dominguez Watershed** | | | | | |
| 19 | Dominguez Channel Lined Channel | Dominguez Channel and Vermont Ave – Oct. 30 | N 33º 52.270' W -118º 17.909' | Original location relocated due to tidal influence | 3 |
| **Santa Clara Watershed** | | | | | |
| 1 | Santa Clara River Unlined Channel | Santa Clara River at The Old Road – Oct. 30 | N 34º 25.945' W -118º 35.689' | Location of DPW mass emission monitoring site | |
| 20 | Bouquet Canyon Unlined Channel | Bouquet Canyon Wash below Vasquez Canyon Road Oct. 30 | N 34º 28.422' W -118º 28.023' | Assess conditions upstream of Diazinon findings; not sampled due to dry conditions | 1,512 |

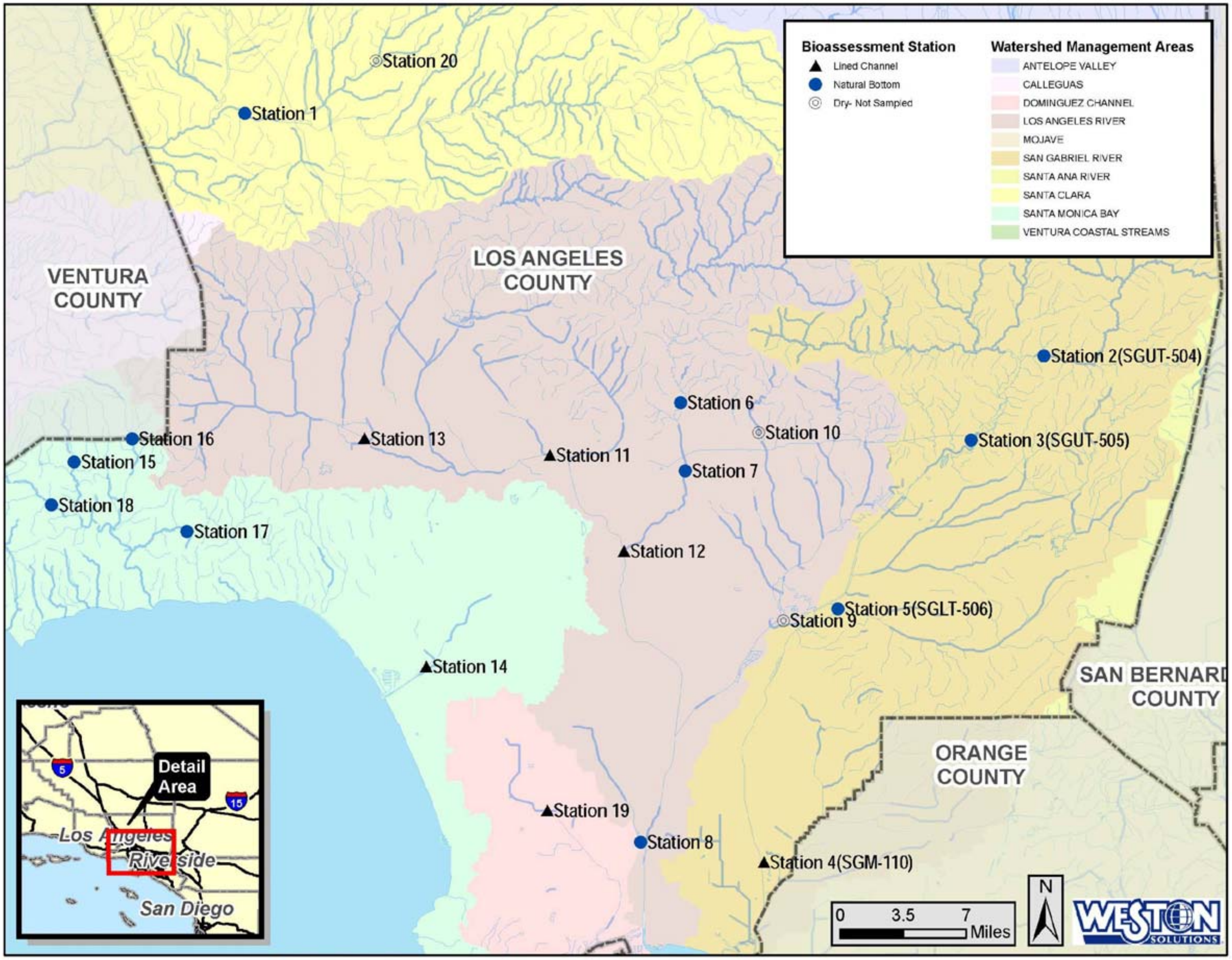


Figure 1: Stream Bioassessment Monitoring Locations, 2007.

# 3.0 METHODS

A general description of the methods incorporated in the sampling program is presented below. Weston personnel adhered to the protocols of the CSBP (Harrington, 2003) as closely as practicable, and this document may be referenced for more detailed procedural information (http://www.dfg.ca.gov/cabw/Field/csbpwforms.html). The four sites in the San Gabriel River Watershed also incorporated the SWAMP physical habitat assessment protocol (Ode, 2007).

The sampling and analysis for the 2007 survey was performed by the same protocols as the 2006 survey. The 2006 and 2007 surveys were different from previous surveys in two respects which reflected the difference between the 1999 CSBP version and the 2003 version. One difference was in the level of field sampling, where the total benthic area sampled was reduced from 18 $ft^2$ to 9 $ft^2$. The second difference was in the laboratory sample processing. Prior methods required three sample replicates to be processed separately with 300 organisms removed from each replicate (900 total organisms). In the new protocol, the three replicate samples were combined and a total of 500 organisms were removed from the sample. It did not appear that this reduction in effort affected the overall diversity of taxa, as the 2006 and 2007 surveys had similar or greater diversity than in all previous surveys (see Section 4.6), and calculation of the Index of Biotic Integrity has always used a 500-organism count.

## 3.1 Sampling Site Selection

A field reconnaissance of the monitoring reaches by LACDPW staff occurred prior to program initiation in 2003 to determine the suitability of the twenty proposed sites. Since the program inception, variability in rainfall amounts has resulted in some inconsistency in flow regimes at the monitoring sites. In 2007, Stations 9, 10 and 20 were dry and could not be sampled. Originally established Stations 2, 3, and 4 in the San Gabriel River Watershed were offset with Stations SGUT-504, SGUT-505, and SGM-110 as a contribution to the San Gabriel River Watershed Monitoring Project for the San Gabriel River Watershed Council. Data from Station 5 were also shared with the Watershed Council with an alternate station designation of SGLT-506. All other monitoring sites that were sampled in 2007 were in the same locations as in previous years of the program.

## 3.2 Monitoring Reach Delineation

The sampling points specified in the CSBP target a stream feature known as a riffle. An ideal riffle is an area of variable flow regimes with some surface disturbance and a relatively complex and stable substrate. These areas provide increased colonization potential for benthic invertebrates. Riffles typically support the greatest diversity of invertebrates in a stream, and by selecting the richest habitats available at each stream, comparability among streams is possible. For some of the monitoring reaches in this study, optimal riffle habitat was not always available; therefore "best available" habitat was sampled. Best available habitat was selected based on complexity of substrates in the stream bed.

Under optimal conditions, five riffles constituted a monitoring reach, and three of these were randomly selected for sampling using a random number table. Given sufficient riffle width and length, a sampling transect perpendicular to stream flow was selected randomly in the upper third of the riffle. In situations where the only available riffles were very short and/or narrow, the samples were taken to best represent available substrate types. For monitoring reaches in uniform concrete channels, a 150-meter reach of the stream was selected, and 3 separate 1-m wide transects were randomly selected. Every monitoring reach was sampled from downstream to upstream. Photographs were taken of every monitoring reach and most of the individual riffles sampled. Representative photos of the monitoring reaches are presented in Appendix A.

## 3.3 Sample Collection

Once a sampling transect was established, benthic invertebrates were collected using a 1-ft wide, 0.5-mm mesh D-frame kick-net. A 1-$ft^2$ area upstream of the net was sampled by disrupting the substrate and scrubbing the cobble and boulders so that the organisms were dislodged and swept into the net by the current or by hand sweeping. In areas with little or no current, the substrate was disturbed and the net was swept back and forth to capture the organisms. The duration of the sampling generally ranged from 1 to 3 minutes, depending on substrate complexity. Three 1-$ft^2$ areas were sampled along each transect and combined into one composite sample. The three sample points on the transect were usually taken near the right and left margins and in the middle of the stream, or were selected to best represent the diversity of habitat types present. This procedure was repeated for the next two riffles until a total of nine replicate 1-$ft^2$ samples were collected. Samples were transferred to 1-qt jars and preserved with 95% ethanol and returned to Weston's benthic laboratory for processing.

## 3.4 Physical Habitat Quality Assessment

For each monitoring reach sampled, the physical habitat of the stream and its adjacent banks were assessed using U.S. EPA Rapid Bioassessment Protocols. Habitat quality parameters were assessed to provide a record of the overall condition of the reach. Parameters such as channel alteration, frequency of riffles, width of riparian zones, and vegetative cover help to provide a more comprehensive understanding of the condition of the stream. Additionally, specific characteristics of the sampled riffles were recorded, including riffle length, depth, gradient, velocity, substrate complexity, and substrate composition.

Water quality measurements were taken at each of the monitoring sites. Measurements included water temperature, specific conductance, pH, dissolved oxygen, turbidity, and hardness.

## 3.5 Laboratory Processing and Analysis

At the laboratory, samples were relinquished to the laboratory sample custodian. Prior to sample processing, technicians signed out each sample in a sample tracking log book. The sample was poured over a No. 35 standard testing sieve (0.5-mm stainless steel mesh) and the ethanol retained for re-use. The sample was gently rinsed with fresh water, and large debris such as wood, leaves, or rocks were removed. The sample was transferred to a tray marked with grids approximately 25 $cm^2$ in size and spread homogenously to a thickness of approximately ¼". One grid was randomly selected and the sample material contained within the grid was removed and processed. In cases where the animals appeared extremely abundant, a fraction of the grid may have been removed. The material from the grid was examined under a stereomicroscope and all the invertebrates were removed, sorted into major taxonomic groups, and placed in vials containing 70% ethanol. This process was repeated until 500 organisms were removed from the sample. Organisms from a grid in excess of the 500 were placed in a separate vial labeled "extra animals", so that a total abundance for the sample could be estimated. All sample processing information was entered onto a Stream Bioassessment Sorting Sheet (Appendix C). Processed material from the sample was placed in a separate jar and labeled "sorted", and the unprocessed material was returned to the original sample container, checked in to the sample tracking log book, and archived. Sorted material was retained for quality assurance purposes.

All organisms were identified to standard taxonomic level I as specified in the Southwest Association of Freshwater Invertebrate Taxonomists List of Freshwater Invertebrate Taxa (available at: http://www.swrcb.ca.gov/swamp/docs/safit/ste_list.pdf); genus level for most insects, and order or class for non-insects. The taxonomic levels are fixed under this document to prevent inconsistencies in taxonomic effort between laboratories. The level of taxonomic effort has not changed since the inception of the LACDPW bioassessment monitoring program in 2003, although a few minor adjustments in taxa determinations have been made. With the exception of some beetles, nearly all of the insects identified in the program were in the larval and pupal stages of development, which metamorphose into an aerial adult form. Nearly all of the non-insect taxa are aquatic for their entire life history.

QA/QC: After sample processing is complete, at least 10% of the sample lot, or one sample processed per each technician are checked to ensure a 90% or better organism removal efficiency. Results of the sorting QA/QC were entered onto the Stream Bioassessment Sorting Sheet. To ensure accuracy of the taxonomic identifications, 10% of the samples (two samples) were sent to the CDFG Aquatic Bioassessment Laboratory (ABL) for verification. Any discrepancies between ABL identifications and the original identifications were changed in the taxonomic database. Results of the sorting and taxonomic QA/QC analyses are presented in Appendix C.

## 3.6 Data Analysis

Taxonomic data were entered into an electronic file using Microsoft Word and converted into a SAS database for QA/QC and data reduction. Benthic macroinvertebrate community-based metric values were calculated from the database. A list of the standard CSBP metrics and a brief description of what they signify is presented in Table 2. A taxonomic list of the macroinvertebrates present in each sample was created in Microsoft Excel, including the designated tolerance value (TV) and functional feeding group (FFG) of each taxon. Macrophyte herbivores (mh), piercer herbivores (ph), omnivores (om), parasites (pa) and xylophages/wood eaters (xy) were combined into a group designated "Other". Also note that for some organisms identified at the Family level or above, a single TV or FFG was not assigned. This is because the taxa within the group have a broad range of tolerances or feeding strategies and a single designation is not representative.

In addition to the individual metric values, a multi-metric Index of Biotic Integrity (IBI) was calculated for each monitoring reach (Ode et al., 2005). The IBI is a quantitative scoring system for assessing the quality of benthic macroinvertebrate assemblages, and is currently our most useful tool in reducing a complex macroinvertebrate data set to a qualitative rating for each monitoring reach. The IBI score is derived from the cumulative value of seven biological metrics (Table 2, asterisked metrics). The total scores were categorized into ratings of the benthic community, ranging from Very Poor to Very Good. It has been noted that the Southern California IBI was developed with very few sites located at low elevations in Los Angeles County, and future development of a refined IBI has been suggested.

**Table 2: Bioassessment Metrics Used to Characterize Benthic Invertebrate Communities.**
Source: modified from SDRWQCB, 1999

| BMI Metric | Description | Response to Impairment |
|---|---|---|
| **Richness Measures** | | |
| Taxa Richness | Total number of individual taxa | Decrease |
| Coleopteran Taxa* | Number of taxa in the insect order Coleoptera (beetles) | Decrease |
| EPT Taxa* | Number of taxa in the Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) insect orders | Decrease |
| Dipteran Taxa | Number of taxa in the insect order Diptera (true flies) | Increase |
| Non-Insect Taxa | Number of non-insect taxa | Increase |
| Predator Taxa* | Number of taxa in the predator feeding group | Decrease |
| **Composition Measures** | | |
| EPT Index | Percent composition of mayfly, stonefly, and caddisfly larvae | Decrease |
| Sensitive EPT Index | Percent composition of mayfly, stonefly, and caddisfly larvae with tolerance values between 0 and 3 | Decrease |
| Shannon Diversity Index | General measure of sample diversity that incorporates richness and evenness (Shannon and Weaver 1963) | Decrease |
| Margalef Diversity | Measure of sample diversity weighted for richness | Decrease |
| **Tolerance/Intolerance Measures** | | |
| Tolerance Value | Value between 0 and 10 of individuals designated as pollution tolerant (higher values) or intolerant (lower values) | Increase |
| Dominant Taxon | Percent composition of the single most abundant taxon | Increase |
| Percent Chironomidae | Percent composition of the tolerant dipteran family Chironomidae | Increase |
| Percent Intolerant Organisms* | Percent of organisms in sample that are highly intolerant to impairment as indicated by a tolerance value of 0, 1 or 2 | Decrease |
| Percent Tolerant Organisms | Percent of organisms in sample that are highly tolerant to impairment as indicated by a tolerance value of 8, 9 or 10 | Increase |
| Percent Tolerant Taxa* | Percent of taxa in sample that are highly tolerant to impairment as indicated by a tolerance value of 8, 9 or 10 | Increase |
| Percent Non-insect Organisms | Percent of organisms in sample that are not in the Class Insecta | Increase |
| Percent Non-insect Taxa* | Percent of taxa in sample that are not in the Class Insecta | Increase |
| **Functional Feeding Groups (FFG)** | | |
| Percent Collector-Gatherers* | Percent of macrobenthos that collect or gather fine particulate matter | Increase |
| Percent Collector-Filterers* | Percent of macrobenthos that filter fine particulate matter | Increase |
| Percent Scrapers | Percent of macrobenthos that graze upon periphyton | Increase |
| Percent Predators | Percent of macrobenthos that feed on other organisms | Variable |
| Percent Shredders | Percent of macrobenthos that shreds coarse particulate matter | Decrease |
| Percent Other | Percent of macrobenthos that are parasites, macrophyte herbivores, piercer herbivores, omnivores, and xylophages | Variable |
| **Abundance** | | |
| Estimated Abundance | Estimated number of organisms in entire sample | Variable |
| *indicates metrics used to calculate the Index of Biotic Integrity | | |

# 4.0 RESULTS

A discussion of the results of the survey is presented below. A complete listing of the benthic invertebrates identified at all stations and replicates are presented systematically in Appendix B.1. Ranked total abundance for each species at all sampling sites combined are presented in Appendix B.2, and the calculated metric values for each monitoring reach are presented in Appendix B.3.

The reader may notice seeming discrepancies between the number of unique taxa listed in the metrics tables and the apparent number of taxa in the taxa list. This is due to the presence of immature or damaged specimens that were identified at a higher systematic level than the standard effort, but were not thought to be unique taxa.

## 4.1 Benthic Invertebrate Community: Study Area Summary

Summing all stations in the Los Angeles County study area, a total of 94 unique taxa were identified from 8,632 individual organisms (Appendix B.1, Appendix B.2). The five most abundant taxa in descending order were chironomid midges (3,238 individuals), the Amphipod crustacean, *Hyalella* (742 individuals), the black fly, *Simulium* (592 individuals), turbellarian flatworms (571 individuals), and Oligochaetes (earthworms, 458 individuals) (Appendix B.2). All of these taxa are moderately to highly tolerant to habitat impairment, and with the exception of flatworms are in the collector-gatherer feeding group. Collector-gatherers feed on organic detritus, algae, and various micro-organisms (Pennak, 2001; Usinger, 1956) and high abundances of these organisms are often associated with high levels of urban runoff.

The order Diptera (true flies) had the greatest number of unique taxa identified (22 taxa), followed by Trichoptera (caddisflies) and Coleoptera (beetles) with 14 and 12 taxa, respectively (Appendix B.1). Chironomid midges were present at all of the monitoring sites and were the dominant organism at ten of the seventeen sites.

## 4.2 Benthic Invertebrate Community Metrics

Benthic invertebrate community metric values for each monitoring reach are presented in Appendix B.3. A listing of the five most dominant (abundant) taxa for each monitoring reach is in Appendix B.4.

***Taxa Richness:*** Taxa richness is the total number of unique taxa in a sample. This number does not account for damaged or immature specimens that were identified at a higher taxonomic level than specified in the SAFIT list (also referred to as “indiscriminate” taxa). Taxa richness per sample ranged from 2 taxa at Station 14-Ballona Creek to 38 taxa at Station 17-Cold Creek (Appendix B.3). Station 4 (SGM-110)-San Gabriel River also had very low taxa richness with 4 different taxa.

***Diversity and Dominance:*** Two diversity indices were calculated for each site: Shannon diversity, which weights for evenness of the distribution of the different taxa, and Margalef diversity, which weights for total number of different taxa. Shannon diversity values per station ranged from 0.0 at Station 14-Ballona Creek to 2.7 at Station 6-Arroyo Seco (Appendix B.3). Margalef Diversity values per station ranged from 0.2 at Station 14-Ballona Creek to 5.9 at Station 17-Cold Creek (Appendix B.3). Dominance by a single taxon ranged from 21.9% turbellarian flatworms at Station 6–Arroyo Seco to 99.8% Chironomidae at Station 14-Ballona Creek (Appendix B.4). Station 19-Dominguez Channel also had a very high dominance value with 85.9% of the community comprised of Chironomidae.

***EPT Taxa:*** This metric represents the number of taxa in the orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) that are collected at each station. These orders contain many taxa that are sensitive to impairment. Several of these taxa however, are tolerant to urban runoff that does not contain high levels of chemical pollutants, including mayflies in the family Baetidae and the caddisflies, *Cheumatopsyche*, *Hydropsyche*, and *Hydroptila*. This means that % sensitive EPT is a much stronger metric than total % EPT for assessing ecological health at a site. All of the stonefly taxa are quite sensitive to urban runoff.

The greatest number of EPT taxa were collected at Station 2 (SGUT-54)-San Gabriel River, with 12 different EPT taxa (Appendix B.3). There were no EPT taxa collected at two of the monitoring sites including Station 14-Ballona Creek and Station 19-Dominguez Channel. EPT individuals were most abundant at Station 7-Arroyo Seco, where they comprised 65.8% of the benthic community (Appendix B.3). The most abundant of the EPT taxa across the survey region included the baetid mayflies, *Baetis* and *Fallceon quilleri* (Appendix B.2). Sensitive EPT taxa (tolerance value 0-3) were collected at five of the sites but were collected in substantial numbers only at Station 2 (SGUT-54)-San Gabriel River and Station 17-Cold Creek, where they comprised 22.4% and 17.7% of the benthic community, respectively. Also notable is that 85% of the total EPT taxa at Cold Creek were sensitive EPT taxa. The other sites with sensitive EPT taxa included Station 3 (SGUT-505)-San Gabriel River, Station 6-Arroyo Seco, and Station 18-Triunfo Creek. Stoneflies were collected at Station 17-Cold Creek only.

***Tolerance Values:*** For most stream macroinvertebrates, a tolerance value has been determined for each taxon through prior research on the animals' life history (Hilsenhof, 1987) and is listed in the CAMLNet 2003 document. Tolerance values range from 0 for organisms highly sensitive to impairments, to 10 for organisms that are highly tolerant to impairments. Low to moderate abundance of impairment tolerant organisms does not necessarily imply impairment (SDRWQCB, 2001), but more importantly, the presence of sensitive organisms is unlikely when a stream is impaired. The presence of highly intolerant organisms (tolerance value 0-2) is likely the strongest indicator of good water quality.

Average community tolerance values for all sites ranged from 4.8 at Station 2 (SGUT-504)-San Gabriel River and Station 17-Cold Creek to 7.6 at Station 15-Medea Creek (Appendix B.3). Highly tolerant organisms (tolerance value 8-10) were most abundant at Station 15-Medea Creek, where a high number of the amphipod, *Hyalella* contributed to a total of 87.0% tolerant organisms. Highly tolerant organisms were least abundant at Station 4 (SGM-110)-San Gabriel River, where none were collected. Highly intolerant organisms (tolerance value 0-2), were collected from four sites: Station 2 (SGUT-504)-San Gabriel River, Station 3 (SGUT-505)-San Gabriel River, Station 6-Arroyo Seco, and Station 17-Cold Creek. Highly intolerant organisms were much more abundant at Station 2 (SGUT-504)-San Gabriel River and Station 17-Cold Creek than at any of the other sites.

***Functional Feeding Groups:*** As with tolerance values, functional feeding group designations have been determined through prior life-history research or observations of each taxon. The percent composition of the functional feeding groups provides useful information about benthic community function, and some feeding groups contain greater numbers of intolerant organisms (Table 2). In general, a more even distribution of the feeding groups indicates a higher quality benthic community. The information from feeding group composition may be particularly useful in detecting physical habitat degradation and impacts from urbanization.

All of the monitoring reaches except for Station 16-Las Virgenes Creek and Station 17-Cold Creek were dominated by taxa in the collector-gatherer feeding group (Appendix B.1, Appendix B.3). Las Virgenes Creek and Cold Creek were dominated by collector-filterers and predators, respectively. Three of the top five dominant taxa in the study region (chironomid midges, *Hyalella*, and Oligochaetes) were in the collector-gatherer feeding group, and are general indicators of urbanization of a watershed. Station 14-Ballona Creek had the greatest dominance by a single feeding group, where collector-gatherers comprised 100% of the community. Station 3 (SGUT-505)-San Gabriel River and Station 17-Cold Creek had the greatest evenness of distribution of the various feeding strategies, indicating a more dynamically functioning benthic community than the more urban influenced sites.

***Estimated Total Abundance:*** The estimated total abundance is the total number of animals predicted to be in the sample if the entire sample had been processed (all of the samples collected in 2007 had greater than 500 organisms). This value was then used to calculate the estimated number of animals living in one square foot of benthic habitat. Response to moderate habitat impairment is often indicated by an increase in total abundance by highly tolerant organisms, with a corresponding decrease in taxa richness and diversity; however, severe impairment can result in a catastrophic decrease in total abundance.

Estimated abundance ranged from 93 organisms per square foot of substrate at Station 18-Triunfo Creek to 4,329 organisms per square foot at Station 3 (SGUT-505)-San Gabriel River (Appendix B.3). Abundance at the reference sites was 436 and 577 organisms per square foot (Station 2 (SGUT-504)-San Gabriel River and Station 17-Cold Creek, respectively).

## 4.3 Physical Habitat Quality Assessment

The 10 parameters of the physical habitat of the monitoring reaches were scored on a 0 to 20 scale, thus 200 is the highest possible score. The parameters for assessment and their scoring ranges were established by the EPA and adapted for use in California for the CSBP. Table 3 lists the parameters and gives a brief description of the conditions that are most beneficial to macroinvertebrate communities. Most of the physical habitat quality parameters are scored in a qualitative manner, and they provide a good comparative tool for sites within a sampling program. Physical habitat quality scores for each monitoring reach are presented in Appendix B.5, and water quality data are presented in Appendix B.6.

**Table 3: Parameters Used to Characterize the Physical Habitat of a Stream Reach.**

| Parameter | Conditions Assessed | Optimal Conditions |
|---|---|---|
| Instream Cover | The percentage of substrate favorable for epifaunal colonization. Most favorable is a mix of snags, submerged logs, undercut banks, cobble and other stable habitats. | Complex mix of stable substrates occupying a high percentage of the stream bottom. |
| Embeddedness | The percentage of fine sediment surrounding gravel, cobble, and boulder particles. | Very little embeddedness, with layered substrate. |
| Velocity/Depth Regimes | The four velocity/depth regimes are: Slow-deep, slow-shallow, fast-deep, and fast-shallow. | A mix of all four regimes, dominated by fast-shallow. |
| Sediment Deposition | The percentage of bottom affected by the deposition of new gravel, sand or fine sediment. | Little or no new deposition, less than 5% of the bottom affected. |
| Channel Flow | The percentage of the stream channel filled by flowing water and the amount of substrate covered. | Water reaches base of both lower banks and minimal amount of substrate is exposed. |
| Channel Alteration | The amount of channelization, dredging, embankments, or shoring structures present. | Channelization or dredging absent or minimal; stream with normal pattern. |
| Riffle Frequency | The frequency of occurrence of riffle habitat. | Occurrence of riffles frequent, with variety of habitat. |
| Bank Stability | Evidence of erosion or bank failure. | Evidence of erosion and bank failure absent or minimal. |
| Vegetative Protection | The percent cover by undisturbed, native vegetation on the streambank surfaces and immediate riparian zones. | More than 90% of the streambank surfaces covered by native vegetation. |
| Riparian Vegetative Zone Width | The width of native riparian vegetation along both streambanks. | Width of riparian zone >18 meters; human activities have not impacted zone. |
| Source: Physical Habitat Form for the CSBP, revision date May 1999 | | |

Total physical habitat quality scores ranged from 83 at Station 19-Dominguez Channel to 172 at Station 6-Arroyo Seco. Other sites with high quality physical habitats included Station 2 (SGUT-504)-San Gabriel River, Station 3 (SGUT-505)-San Gabriel River, and Station 17-Cold Creek. Under the current scoring protocol, concrete lined channels are somewhat over-scored due to high ratings in categories such as Embeddedness, Sediment Deposition, and Bank Stability. The scores generally rank the sites in the proper order based on overall quality, however.

Water quality measurements at most of the monitoring sites did not indicate severe impairment. Values for pH at most of the sites were between 7.5 and 8.7, while Station 19-Dominguez Channel was quite high with a value of 9.46. Specific conductance, a general indicator of dissolved solids, was moderate to low at all sites except Station 15-Medea Creek and Station 16-Las Virgenes Creek, which had values of 3.052 mg/L and 4.483 mg/L, respectively. Hardness measures ranged from 28 mg/L $CaCO_3$ at Station 16-Las Virgenes Creek to >1200 mg/L $CaCO_3$ at Station 15-Medea Creek. These two sites were extreme outliers and the remaining sites had hardness values from 112 to 716 mg/L. Excessive salts, metallic cations (e.g., calcium, magnesium, ferrous iron), and limestone formations can naturally elevate water hardness (Sawyer and McCarty, 1978). Dissolved oxygen levels were generally moderate throughout the region ranging from 5.28 mg/L at Station 16-Las Virgenes Creek to 11.84 mg/L at Station 11-Los Angeles River; Station 19-Dominguez Channel, however, was substantially higher than all other sites with dissolved oxygen of 22.28 mg/L. Water temperatures were quite variable throughout the region, ranging from 14.4°C (57.9 °F) at Station 6-Arroyo Seco to 28.8 degrees C (83.8°F) at Station 5 (SGLT-506)-Walnut Channel. Turbidity, a measure of water clarity (clear waters have low ntu values), was relatively low at most sites and the most turbid water was at Station 8-Triunfo Creek with a value of 4.1 ntu.

## 4.4 Index of Biotic Integrity

In 2004, a Southern California Index of Biotic Integrity was developed to cover the region extending from southern Monterey County to the Mexican border (Ode et al., 2005). The IBI gives a single quantified score to a site based on a multi-metric evaluation technique, and the scores may be compared across seasons and years of a monitoring program to give an indication of trends over time. The CDFG developed the IBI based on a multi-year comprehensive assessment of reference and non-reference conditions in southern California to establish an expected range of benthic invertebrate community structure in the region.

Ode et al selected seven metrics that showed a strong and predictable response to ecological impacts and stressors to calculate the IBI (Table 4). The seven metrics include Number Coleoptera Taxa, Number EPT Taxa, Number Predator Taxa, Percent Collector-Filterers plus Collector-Gatherers, Percent Intolerant Individuals, Percent Non-insect Taxa, and Percent Tolerant Taxa. Each metric value is given a score from 0 to 10, and the scores added to give a final IBI score; the highest possible total score is 70 (this score is often normalized to a 0-100 scale). Each final score is then classified into rating categories ranging from Very Poor to Very Good. Table 4 shows the metric scoring ranges and rating categories for the Southern California IBI.

The IBI is quite effective for broadly identifying impairment, and the boundary between Fair and Poor (IBI score of 26) is considered to be the threshold for impairment. It must be noted that small differences in IBI scores are not significant and may be due to natural biological variability within a stream reach. Ode et al. determined that the "minimum detectable difference" between IBI scores is about 9 points (on a 0-70 point scale), thus two site scores must be at least 9 points apart from one another to determine one is of significantly higher quality than the other.

**Table 4: Index of Biotic Integrity Scoring Ranges.**

| Metric Score | Number Coleoptera Taxa | Number EPT Taxa | Number Predator Taxa | Percent CF+CG Individuals | Percent Intolerant Individuals | Percent Non-Insect Taxa | Percent Tolerant Taxa |
|---|---|---|---|---|---|---|---|
| 10 | >5 | >17 | >12 | 0-59 | 25-100 | 0-8 | 0-4 |
| 9 | | 16-17 | 12 | 60-63 | 23-24 | 9-12 | 5-8 |
| 8 | 5 | 15 | 11 | 64-67 | 21-22 | 13-17 | 9-12 |
| 7 | 4 | 13-14 | 10 | 68-71 | 19-20 | 18-21 | 13-16 |
| 6 | | 11-12 | 9 | 72-75 | 16-18 | 22-25 | 17-19 |
| 5 | 3 | 9-10 | 8 | 76-80 | 13-15 | 26-29 | 20-22 |
| 4 | 2 | 7-8 | 7 | 81-84 | 10-12 | 30-34 | 23-25 |
| 3 | | 5-6 | 6 | 85-88 | 7-9 | 35-38 | 26-29 |
| 2 | 1 | 4 | 5 | 89-92 | 4-6 | 39-42 | 30-33 |
| 1 | | 2-3 | 4 | 93-96 | 1-3 | 43-46 | 34-37 |
| 0 | 0 | 0-1 | 0-3 | 97-100 | 0 | 47-100 | 38-100 |
| **Cumulative Ratings: Very Poor: 0-13 Poor: 14-26 Fair: 27-40 Good: 41-55 Very Good: 56-70** | | | | | | | |

Source: Ode et al., 2005

The total IBI scores for each monitoring reach are shown in Figure 2 and Figure 3. A complete list of the mean metric values, individual IBI scores, and the total IBI scores, are presented in Appendix B.7.

The 17 monitoring reaches in Los Angeles County had IBI ratings ranging from Good to Very Poor. Four of the sites were rated above the level of impairment (Fair and above) including Station 1-Santa Clara River, Station 2 (SGUT-504)-San Gabriel River, Station 6-Arroyo Seco, and Station 17-Cold Creek. Station 3 (SGUT-505)-San Gabriel River was very close to the impairment threshold. Stations 2 and 17 were designated reference sites. Station 13-Los Angeles River was also a designated reference site, and the IBI score for this monitoring reach was 4, with a rating of Very Poor. The reference monitoring reach of Station 13-Los Angeles River was located within a concrete lined channel upstream of the Sepulveda Dam and this does not represent true reference conditions (Ode et al., 2005). Station 11-Los Angeles River and Station 19-Dominguez Channel were the lowest rated sites with total IBI scores of 0.

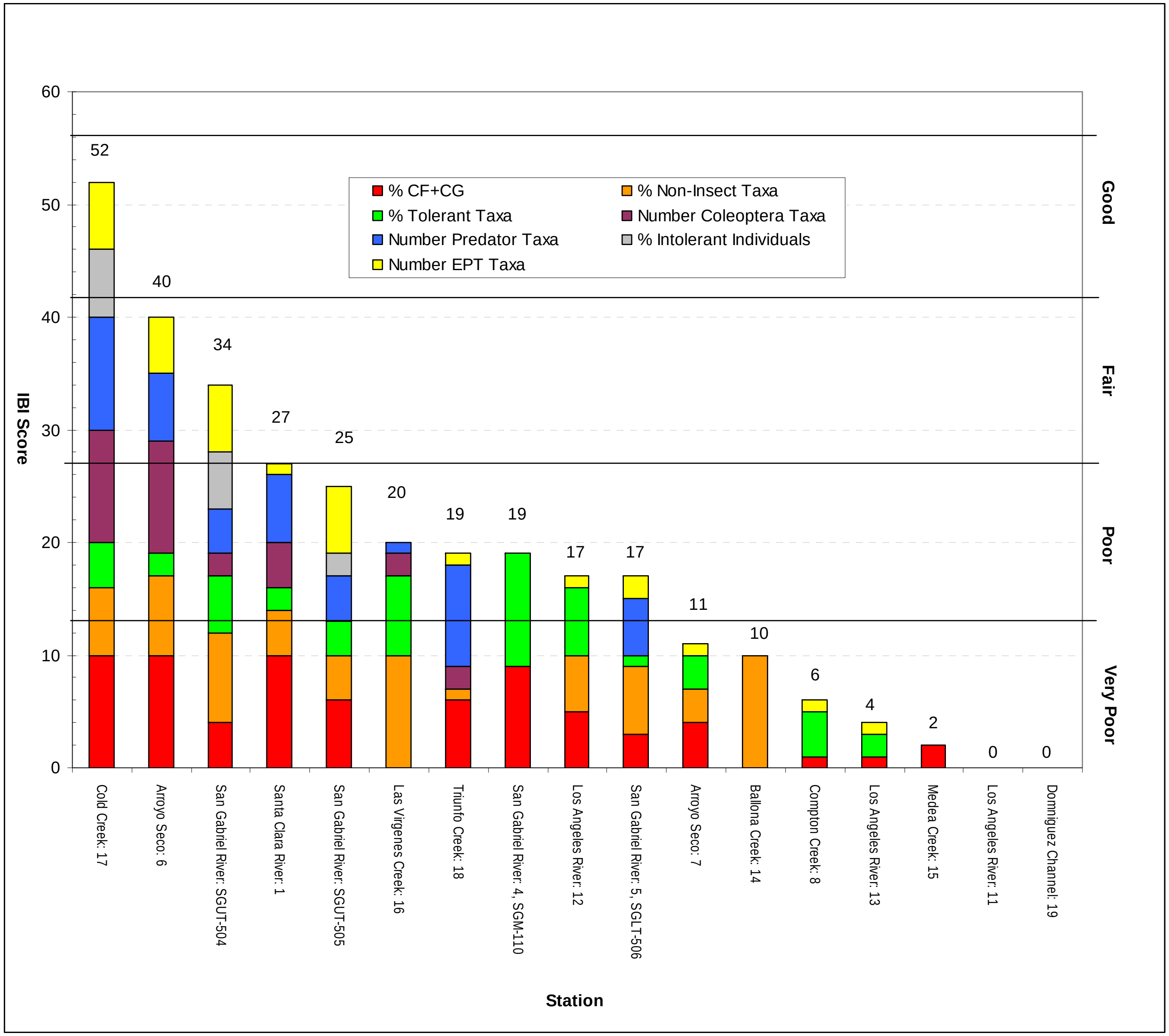


**Figure 2: Index Biotic Integrity Scores for LADPW Bioassessment Sites, 2007 (0-70 scale).**

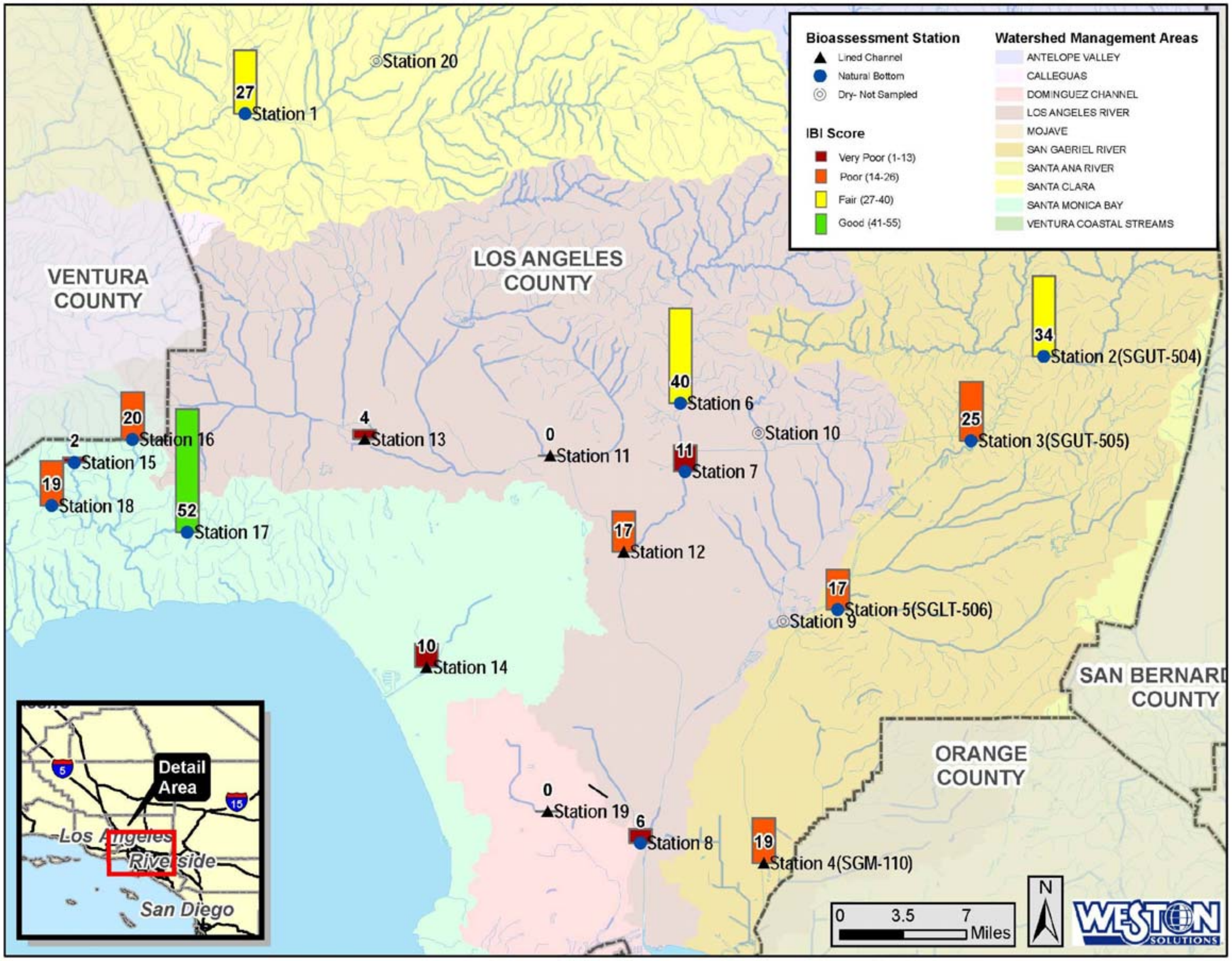


Figure 3. Stream Bioassessment Monitoring Locations, 2007, with IBI Scores

### Concrete Lined Channels versus Unlined Channels

Since the beginning of the program, eight of the monitoring reaches have been sampled in concrete lined channels (Stations SGLR-043, SGLR-047, SGLR-063, SGM-110, 2/2A, 12, 13, 14, and 19), and one (Station 11) was partially lined with concrete. This type of substrate is considered to be inferior for macroinvertebrate colonization than a more complex natural substrate (e.g., with layered cobblestone, plant stems, and wood). The lined channels were mostly devoid of coarse organic food sources and riparian canopy, and had uniform water flow characteristics consisting of flat “runs” rather than true riffles. Physical habitat scores for these sites are somewhat elevated due to very stable bank conditions and they typically have ample flow volume due to persistent urban runoff (see Appendix D, Physical Habitat Quality data sheets). It may be noted that regression analysis of the relationship between physical habitat quality and IBI scores in streams where the flow is *dominated by urban runoff* has shown almost no correlation between the two (MEC, 2003).

All of the lined channel sites had mean IBI scores that were rated Poor and Very Poor (Figure 4). The lined sites in the lower San Gabriel River (Stations SGLR-043, SGLR-047, and SGLR-063, SGM-110) received ratings of Poor, except for Station 2 which was Very Poor. The lined sites in Los Angeles River, Ballona Creek, and Dominguez Channel (Stations 12, 13, 14, and 19, respectively) had IBI scores in the Very Poor range. The IBI scores of the lined channel sites were quite evenly distributed among the other lower-watershed urban sites (Stations 4, 6, 17, SGUT-504, and SGUT-505 are upper watershed sites). An analysis of variance (ANOVA) of IBI scores for lined versus all unlined sites indicated significant difference ($p=0.043$) of IBI scores between the two types of habitat. Thus, it is possible that the poorer quality physical habitats of the lined channel sites had a significant effect on overall IBI scores in the lower watershed stream reaches, although these were dominated by urban runoff and water quality may have also been a significant factor (when the ANOVA was run comparing only the lower watershed sites, the p-value=0.22).

The Mann-Whitney test was used to determine if the IBI scores for unlined sites are statistically different from IBI scores at concrete lined sites. This test is a non-parametric alternative to the two-sample t-test. Instead of using the actual values of the dataset, ranks of the data are used. More detailed methods may be found in Zar, 1999. Sites SGLR-063, SGLR-047, SGLR-043, SGM-110, 11, 12, 13, 14, and 19 were used for the concrete lined channel dataset. All other sites were included as unlined. There was no differentiation between how many samples were collected at each site. All results for the two groups were pooled together, and the two groups compared.

The hypothesis was tested at an alpha of 0.05:

$$H_0\text{: Unlined} = \text{Lined}$$
$$H_a\text{: Unlined} \neq \text{Lined}$$

The test was run using two scenarios, both with and without the reference sites, and no exclusions were made based on location (i.e. upper or lower) in the watershed.

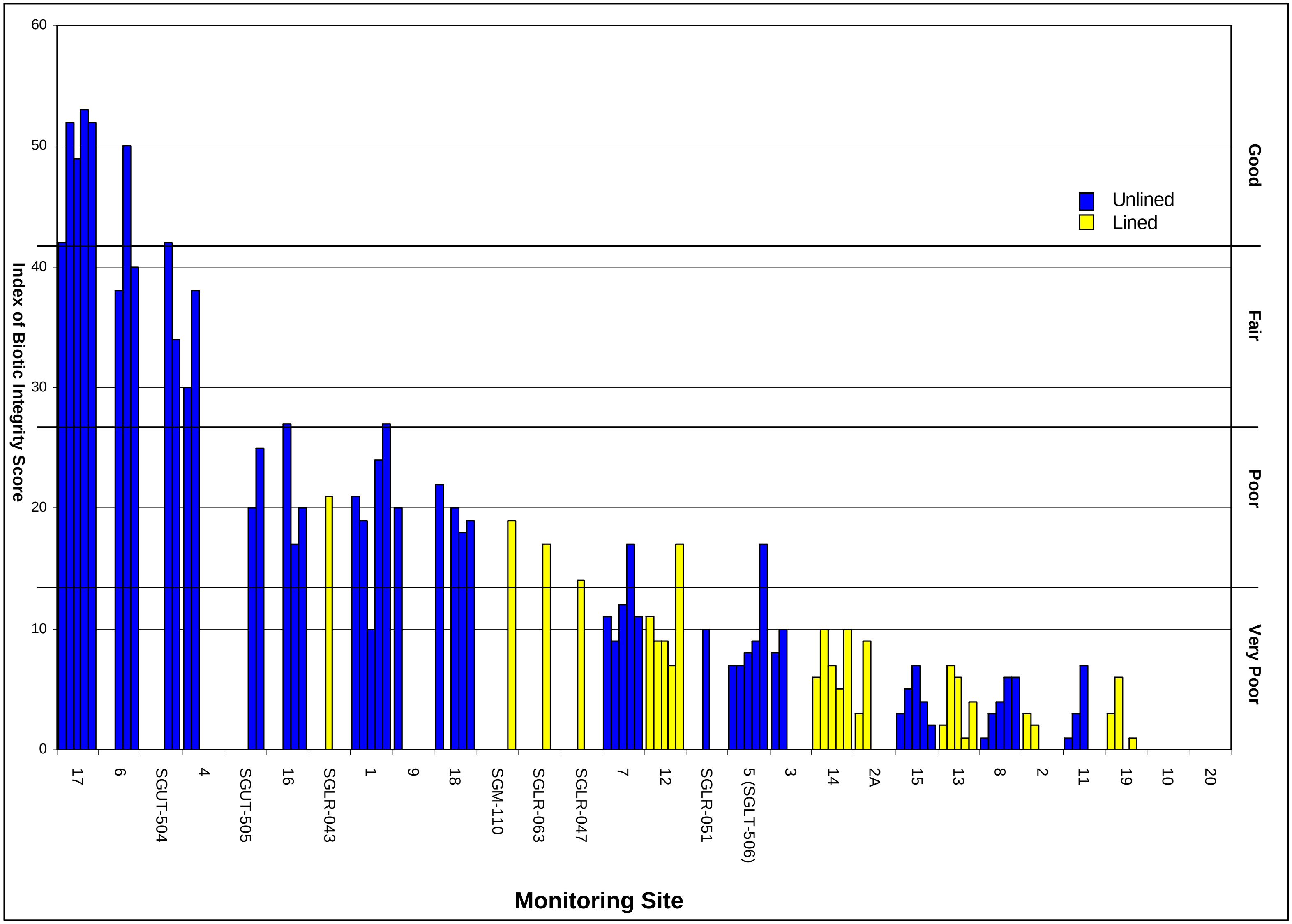


**Figure 4: Comparison of IBI Scores of Concrete Lined and Unlined Channels (0-70 scale). Each bar represents one survey year per station, beginning with 2003 at left.**

The results of the analysis indicate that in both scenarios the null hypothesis is rejected and the alternate accepted. This means that the IBI scores at unlined sites are statistically different, overall, than the IBI scores at lined sites. In Figure 5, below, a visual comparison of the two groups is presented. One version does not include reference sites in the unlined group, while the other does include reference sites in the unlined group. Without considering reference sites, the mean IBI scores of the unlined sites are slightly higher than the 75th percentile of the lined sites. When reference sites are considered, this difference is increased and the unlined sites are clearly statistically superior to the lined sites.

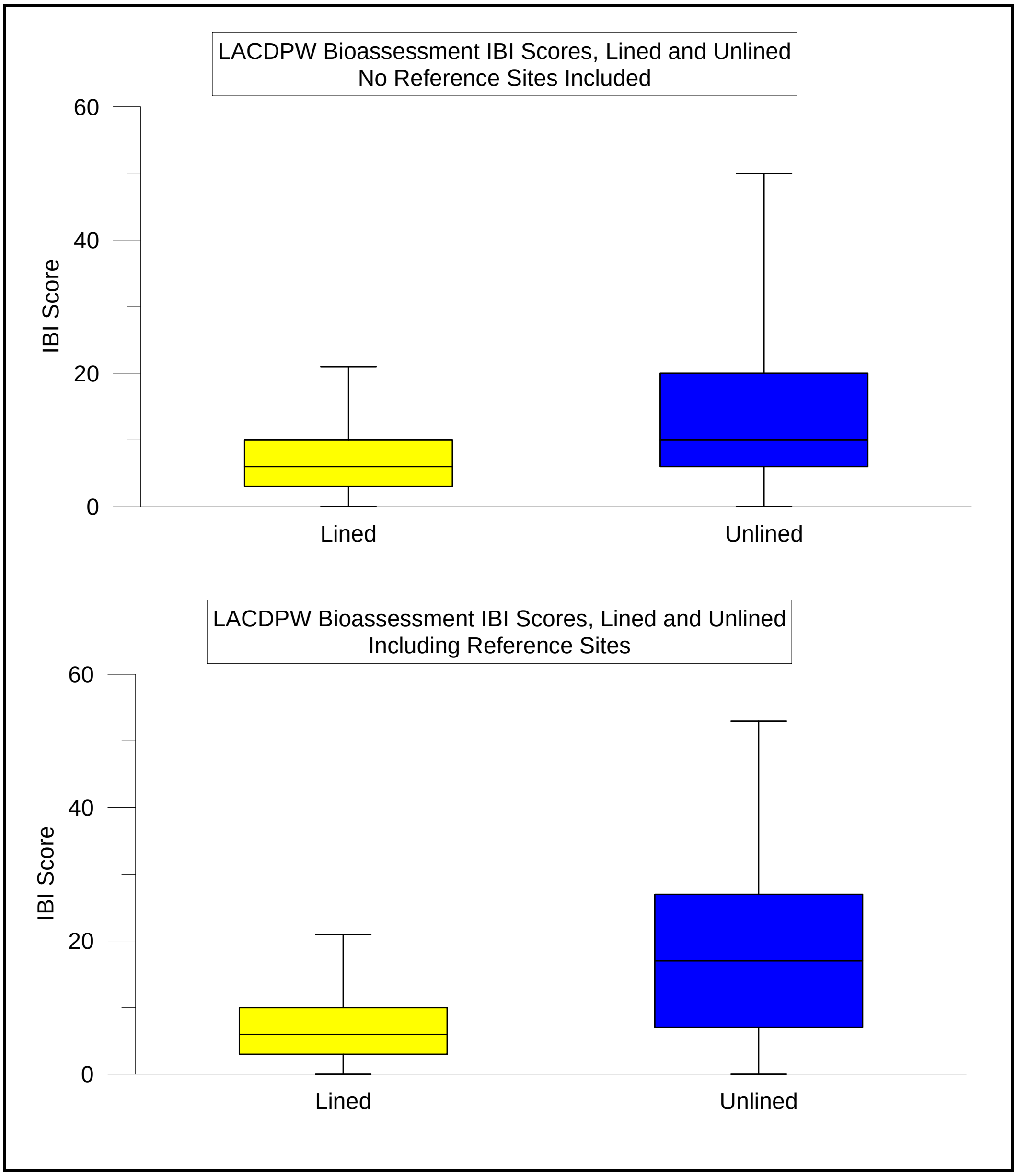


**Figure 5: Comparison of lined and unlined channel sites, 2003-2007 (0-70 scale).**

Further examination of the relationship of IBI scores to elevation was completed by conducting a Spearman rank correlation for IBI score versus elevation. The analysis was completed for the dataset as a whole, as well as by lined and unlined groups. The results indicate that the overall correlation of IBI score to elevation is 0.74. When the data are split between lined and unlined sites the correlation is 0.87 for unlined sites, and -0.17 for lined sites. Additionally, the results indicate that unlined site IBI scores are significantly correlated to elevation.

To determine if the lined channel sites supported unique benthic communities, a cluster analysis was performed to look for similarities between location and community structure (Figure 6). The analysis is based on a two-way Bray-Curtis similarity index calculated on relative abundances of taxa by station. Stations with similar communities of taxa will cluster together; likewise taxa that occur at the same locations will cluster together. The results are portrayed in a two-way table that shows the relative abundance of each taxon by location.

Results of the cluster analysis show five major station clusters and four species clusters, labeled A through E and one through four, respectively (Figure 6). The shaded blocks highlight the major clusters. In the 2007 survey, the concrete lined channels did not cluster together as much as in previous surveys, and were spread over Station clusters A, C, and D. Overall, the species clusters were not very strong, as many taxa are either ubiquitous or were collected at only one site and thus are dropped from this analysis.

Overall clustering showed that clusters A + B had the greatest degree of separation with clusters C + D + E, and that cluster E had the second greatest separation from clusters C + D. The clusters seemed strongly correlated with physical stream characteristics and IBI ratings, rather than individual taxa present.

Station cluster A contained all five of the sites located in upper watershed areas. All of these sites had natural streambeds and were the top five rated sites according to the IBI.

Station cluster B included Station 16-Las Virgenes Creek and Station 18-Triunfo Creek. Both of these sites were in mid-watershed areas with natural streambeds and were the next highest rated sites after the sites in cluster A according to the IBI. Interestingly, both of these sites had abnormal flow characteristics, with Las Virgenes Creek receiving water solely from an unknown underground runoff source while Triunfo Creek was not flowing at all and consisted of ponded areas.

Station cluster C was characterized by sites in the lower to mid watershed zone that were channelized but had soft bottom streambeds.

Station cluster D primarily consisted of the concrete lined channel sites in the lower watershed areas with the exception of Station 8-Compton Creek, which was channelized with a soft bottom.

Station Cluster E included Station 14-Ballona Creek and Station 19-Dominguez Channel. These two channelized sites were in the very lower watershed zone and both had a very high dominance by chironomid midges.

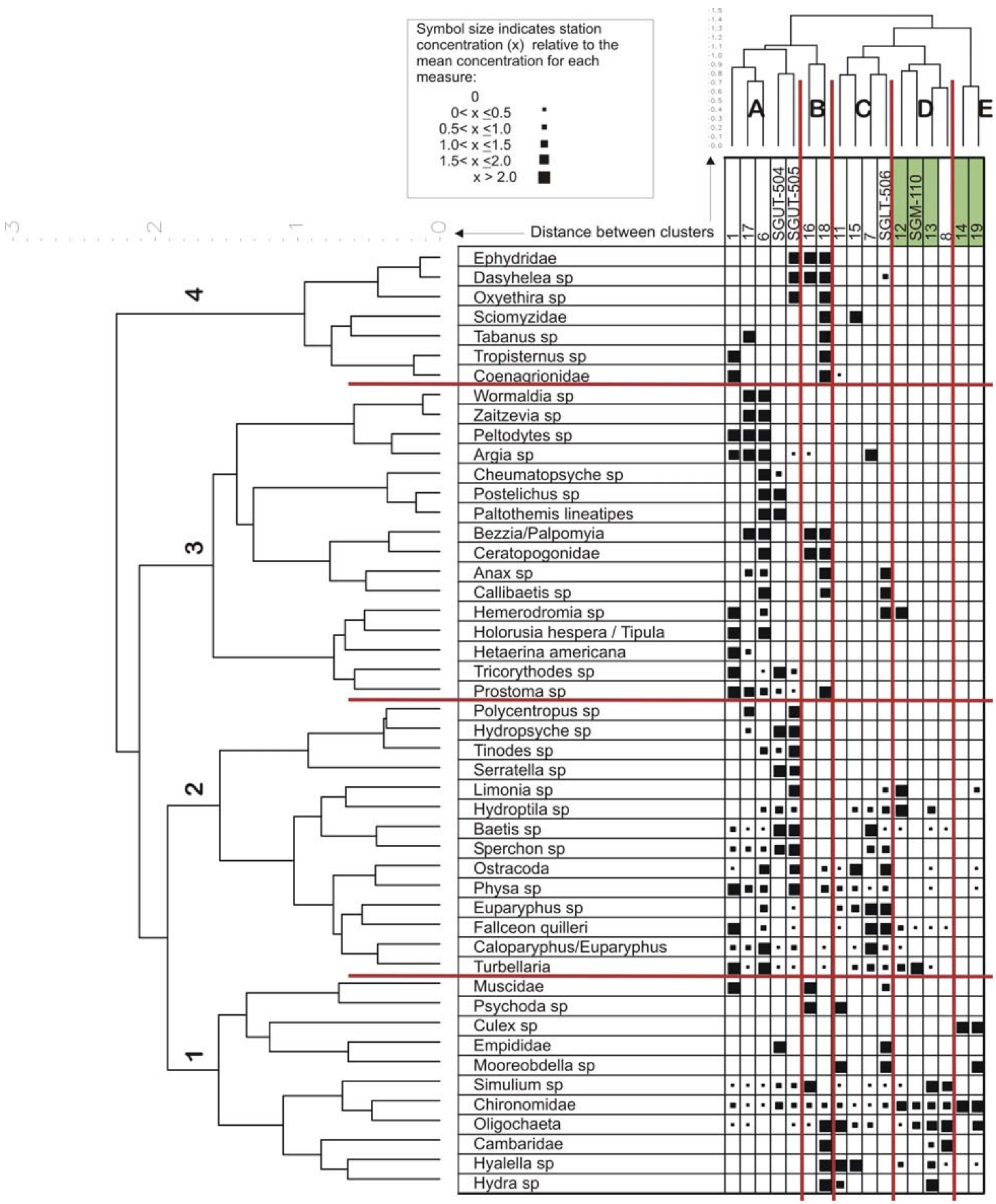


**Figure 6: Cluster Analysis of Stations and Taxa For LACDPW Bioassessment Monitoring Sites, 2007. Concrete lined sites are highlighted in green.**

## 4.5 Comparison of 2003 through 2007 Survey Results

Information from the 2003-2006 studies (Bonterra, 2004; Weston, 2005; Weston, 2006; Weston 2007) was compared to the 2007 data to assess the year-to-year variance and trends in biotic integrity of the streams. Monitoring reaches were re-located in very close proximity to previous years' surveys and were sampled at the same time of year (mid fall) except for the four San Gabriel River Watershed sites, which were sampled in June. One other site, Station 19-Dominguez Channel was moved approximately ½ mile upstream starting in 2006 due to high salinity detected at the previous site. The laboratory and data reduction procedures remained unchanged for the first three survey years. The 2006 and 2007 surveys differed in the level of laboratory processing of benthic samples, with a total of 500 organisms processed vs. 900 for previous surveys. This likely did not affect the IBI scores, as the 900 count samples of the old method were randomly reduced to 500 organisms for IBI calculation. Also note that the 2006 and 2007 surveys with the reduced level of effort had greater cumulative diversity of taxa across the region than previous surveys.

Regional macroinvertebrate community structure was relatively similar in all five survey years. The ten most abundant taxa at all sites combined were nearly the same for all four surveys. The 2006 survey collected the greatest number of unique taxa, 96, compared to 94 in 2007, 88 in 2003, 73 in 2004 and 81 in 2005.

***Mean Metric Analysis***

Table 5 below shows the mean biological metric values of four individual metrics that are considered strong indicators of ecological health. Lined channel sites are shaded in gray and the top three metrics are highlighted in green. Note that a low value for percent collector-filterers plus collector-gatherers is an indication of good habitat conditions.

Station 1-Santa Clara River
November 2004


Station 1-Santa Clara River
November 2005

Station 1-Santa Clara River
October 2006

**Table 5: Selected Metric Values, Mean of 2003-2007 Surveys.**
**(concrete lined channels are highlighted in gray, top three metric values are highlighted in green)**

| Monitoring Reach/Station Number | | Taxa Richness | EPT Taxa | Percent Intolerant Taxa | Percent Collector Filterers plus Collector Gatherers |
|---|---|---|---|---|---|
| Santa Clara River | 1 | 20.2 | 4.2 | 0% | 77.3% |
| Coyote Creek** | 2 | 11.5 | 1.5 | 0% | 89.5% |
| Coyote Creek* | 2A | 10.0 | 4.0 | 0% | 99.0% |
| San Jose Creek** | 3 | 10.5 | 2.0 | 0% | 84.0% |
| San Gabriel River** | 4 | 24.0 | 12.0 | 3.1% | 85.0% |
| Walnut Channel (SGLT-506) | 5 | 14.4 | 1.8 | 0% | 87.4% |
| Arroyo Seco*** | 6 | 33.6 | 10.7 | 1.9% | 57.6% |
| Arroyo Seco | 7 | 16.2 | 2.8 | 0% | 83.0% |
| Compton Creek | 8 | 12.0 | 1.6 | 0% | 92.0% |
| Zone 1 Ditch* | 9 | 21.0 | 5.0 | 0% | 74.0% |
| Eaton Wash | 10 | -- | -- | -- | -- |
| Los Angeles River | 11 | 10.0 | 1.0 | 0% | 98.2% |
| Los Angeles River | 12 | 9.6 | 2.2 | 0% | 90.3% |
| Los Angeles River | 13 | 11.4 | 2.0 | 0% | 94.7% |
| Ballona Creek | 14 | 10.0 | 1.6 | 0% | 96.2% |
| Medea Creek | 15 | 11.0 | 0.8 | 0% | 84.3% |
| Las Virgenes*** | 16 | 19.0 | 2.3 | 1.7% | 84.7% |
| Cold Creek | 17 | 29.2 | 11.2 | 33.3% | 24.2% |
| Triunfo Creek**** | 18 | 26.5 | 2.2 | 0.2% | 57.9% |
| Dominguez Channel | 19 | 9.4 | 0 | 0% | 94.5% |
| Bouquet Canyon | 20 | -- | -- | -- | -- |
| SGUT-504** | 2 | 25.0 | 12.0 | 10.1% | 81.0% |
| SGUT-505** | 3 | 25.0 | 9.5 | 2.9% | 73.6% |
| SGLR-043* | 4 | 13.0 | 0.0 | 0% | 74.0% |
| SGLR-047* | 3 | 11.0 | 0.0 | 0% | 90.0% |
| SGLR-051* | 4 | 15.0 | 3.0 | 0% | 72.0% |
| SGLR-063* | 4 | 14.0 | 3.0 | 0% | 79.4% |
| SGM-110* | 4 | 4.0 | 1.0 | 0% | 100.0% |
| *Sampled one year<br>**Sampled two years<br>***Sampled three years<br>****Sampled four years | | | | | |

Overall, most of the concrete lined channels had lower taxa richness, EPT taxa diversity, no intolerant taxa present, and higher percentages of collector-filterers plus collector-gatherers than the unlined sites.

Mean taxa richness ranged from 33.6 taxa at Station 6-Arroyo Seco to 4.0 taxa at Station 4 (SGM-110)-San Gabriel River (Table 5). Most of the lower watershed sites had mean taxa richness values in the range of 9 to 15 taxa per survey. The mid- to upper-watershed sites had mean taxa richness in the range of about 17-34 taxa with the exception of Station 15-Medea Creek, which had a mean of 11.0 taxa per survey. The number of EPT taxa was quite variable, and five sites had considerably greater EPT diversity than all of the other sites. Station 4-San Gabriel River, Station 2 (SGUT-504)-San Gabriel River, Station 3 (SGUT-505)-San Gabriel River, Station 6-Arroyo Seco, and Station 17-Cold Creek had mean EPT taxa richness ranging from 9.5 to 12.0, while all the other sites averaged 5.0 or less EPT taxa. The lower watershed sites typically had three or fewer EPT taxa, most frequently consisting of the mayflies, *Baetis* and *Fallceon quilleri*, and the caddisfly *Hydroptila* (Appendix B.1).

The metric percent intolerant taxa is perhaps the strongest indicator of good water quality conditions, but the metric lacks gradation for moderately to highly impaired water bodies as these intolerant taxa are typically absent. Station 17-Cold Creek had an average of 33.3 percent intolerant taxa per survey, and the next highest site, Station SGUT-504 had 10.1 percent. Nineteen of the twenty-six sites had no intolerant taxa collected over the five years of surveys, and all but one of these (Station 15-Medea Creek) were located in the lower reaches of the watersheds.

Mean percent collector-filterers plus collector-gatherers (CF+CG) ranged from 24.2 percent at Station 17-Cold Creek to 100.0 percent at Station 4 (SGM-110)-San Gabriel River. Most of the lower watershed sites had greater than 80 percent of the benthic community utilizing these two feeding strategies. This metric must be interpreted with care, for in some situations a high abundance of an impairment tolerant organism can occur that is not in these two feeding groups, thus reducing the Percent CF+CG. A notable example of this occurred in 2006 at Station 18-Triunfo Creek, where a high abundance of snails (Scrapers) were present; this site also had one of the highest percent tolerant taxa in the region. Conversely, a high number of organisms in the CF+CG feeding group may be present, while the overall community may have many low tolerance organisms.

***Mean Index of Biotic Integrity Scores***

Overall IBI ratings at most of the sites in the study were fairly consistent from 2003 thru 2007 and none of the sites showed any significant trends toward improvement or degradation (Table 6). Most sites have varied by about four to eight IBI points over the five surveys, and none of the sites varied across more than two quality categories (e.g., rated Very Poor in one survey and Fair in another). Station 1-Santa Clara River had the greatest variability in IBI scores, with a 17-point range between the high and low score. This result was likely due to the substrate conditions at the site, which were severely eroded by the heavy storm flows over the winter of 2004/2005 (see photos above). By the 2006 and 2007 surveys the site had recovered significantly and in 2007 the IBI score rated the site unimpaired.

Station 17-Cold Creek was the highest rated site for all five surveys. The highest rated non-reference sites per survey year were Station 18-Triunfo Creek (2003), Station 1-Santa Clara River (2004) and Station 6-Arroyo Seco (2005, 2006, and 2007).

**Table 6: Comparison of IBI scores 2003-2007.**

| Monitoring Reach/Station Number | | IBI Score 2003 | IBI Score 2004 | IBI Score 2005 | IBI Score 2006 | IBI Score 2007 | Mean IBI Score |
|---|---|---|---|---|---|---|---|
| Cold Creek | 17 | **42** | **52** | **49** | **53** | **52** | **49.6** |
| Arroyo Seco | 6 | Dry | Dry | **38** | **50** | **40** | **42.7** |
| San Gabriel River (SGUT-504) | 2 | Not Sampled | Not Sampled | Not Sampled | **42** | **34** | **38.0** |
| San Gabriel River | 4 | **30** | **38** | Not Sampled | Not Sampled | Not Sampled | **34.0** |
| San Gabriel River (SGUT-505) | 3 | Not Sampled | Not Sampled | Not Sampled | **20** | **25** | **22.5** |
| Las Virgenes | 16 | Dry | Dry | **27** | **17** | **20** | **21.3** |
| Triunfo Creek | 18 | **22** | Dry | **20** | **18** | **19** | **19.8** |
| Santa Clara River | 1 | **21** | **19** | **10** | **24** | **27** | **20.2** |
| Arroyo Seco | 7 | **11** | **9** | **12** | **17** | **11** | **12.0** |
| Los Angeles River | 12 | **11** | **9** | **9** | **7** | **17** | **10.6** |
| San Gabriel River (SGLT-506) | 5 | **7** | **7** | **8** | **9** | **17** | **9.6** |
| San Jose Creek | 3 | **8** | **10** | Not Sampled | Not Sampled | Not Sampled | **9.0** |
| Ballona Creek | 14 | **6** | **10** | **7** | **5** | **10** | **7.6** |
| Coyote Creek | 2A | **3** | **9** | Not Sampled | Not Sampled | Not Sampled | **6.0** |
| Medea Creek | 15 | **3** | **5** | **7** | **4** | **2** | **4.2** |
| Los Angeles River | 13 | **2** | **7** | **6** | **1** | **4** | **4.0** |
| Compton Creek | 8 | **1** | **3** | **4** | **6** | **6** | **4.0** |
| Dominguez Channel | 19 | **3** | **6** | **0** | **1** | **0** | **2.0** |
| Los Angeles River | 11 | **1** | **3** | **7** | **0** | **0** | **2.2** |
| Coyote Creek | 2 | **3** | **2** | Not Sampled | Not Sampled | Not Sampled | **2.5** |
| **Sites Sampled One or Fewer Times** | | | | | | | |
| San Gabriel River SGLR-043 | 2 | Not Sampled | Not Sampled | **21** | Not Sampled | Not Sampled | **21.0** |
| Zone 1 Ditch | 9 | **20** | Dry | Dry | Dry | Dry | **20.0** |
| San Gabriel River (SGLR-063) | 4 | Not Sampled | Not Sampled | Not Sampled | **17** | Not Sampled | **17.0** |
| San Gabriel River (SGLR-047) | 3 | Not Sampled | Not Sampled | **14** | Not Sampled | Not Sampled | **14.0** |
| Carbon Creek (SGLR-051) | 4 | Not Sampled | Not Sampled | **10** | Not Sampled | Not Sampled | **10.0** |
| San Gabriel River (SGM-110) | 4 | Not Sampled | Not Sampled | Not Sampled | Not Sampled | **19.0** | **19.0** |
| Eaton Wash | 10 | Dry | Dry | Dry | Dry | Dry | |
| Bouquet Canyon | 20 | Dry | Dry | Dry | Dry | Dry | |

# 5.0 SUMMARY

Seventeen receiving water monitoring reaches representing six watersheds in Los Angeles County were sampled for benthic macroinvertebrates and assessed for physical habitat quality on June 11 and 12, and from October 1 to 31, 2006. The monitoring reaches were located to provide an assessment of possible impacts associated with urban runoff and to evaluate the biological conditions for trend analysis of the benthic macroinvertebrate communities of the region.

Taxonomic evaluation of the samples yielded 94 different taxa from 8,632 individual organisms by SAFIT level I taxonomic effort. The most abundant organisms collected throughout the region were midges of the family Chironomidae, which were present at every monitoring site. The majority of organisms collected from the monitoring reaches were moderately or highly tolerant to stream impairments, and all of the sites except Station 16-Las Virgenes Creek and Station 17-Cold Creek (a reference site) were dominated by organisms in the collector-gatherer feeding guild.

The Index of Biotic Integrity scores of the monitoring reaches ranged from 0 to 52 out of a possible 70 points, and the benthic macroinvertebrate communities were rated from Very Poor to Good. Station 17-Cold Creek was the highest rated site and Station 6-Arroyo Seco was the second highest rated site with IBI scores of 53 and 40, respectively. Six of the monitoring reaches were located in highly modified, concrete-lined urban water courses, and these sites all had IBI ratings of Poor or Very Poor. Analysis of individual metrics, as well as total IBI scores showed that monitoring sites located in the lower watershed areas had lower quality benthic communities than sites located in the mid to upper reaches of the watersheds.

Comparison of the IBI scores for the five survey years to date did not indicate any substantial trend towards degradation or improvement at any of the sites. Four of the sites had the highest IBI scores to date in 2007, including Station 1-Santa Clara River, Station 3 (SGUT-505)-San Gabriel River, Station 5 (SGLT-506)-Walnut Channel, and Station 12-Los Angeles River. Two sites had their lowest IBI scores in 2007, including Station 15-Medea Creek and Station 2 (SGUT-504)-San Gabriel River.

An analysis of the difference between concrete lined versus unlined sites indicated that there was a slight yet statistically significant difference in IBI scores at sites located in the lower watershed areas. When reference sites were added to the analysis, the difference in IBI scores between lined and unlined sites was of much greater significance.

Two-way cluster analysis of taxa and stations showed fairly vague clustering by taxa while the stations appeared to cluster according to site physical conditions and total IBI score. Upper watershed sites with natural channels clustered together, lower watershed channelized sites with soft bottoms clustered together, and fully concrete lined sites clustered together. The lower watershed sites were populated primarily with ubiquitous, opportunistic organisms that were common to most sites, while the upper watershed sites each had fairly distinctive benthic communities with a number of unique taxa present.

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