2010
BIOASSESSMENT MONITORING PROGRAM IN LOS ANGELES COUNTY

FINAL REPORT

Prepared for:
Los Angeles County Flood Control District
Watershed Management Division
900 South Fremont Avenue
Alhambra, California 91803-1331

April 2011

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Los Angeles County Flood Control District
Watershed Management Division
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ACRONYMS AND ABBREVIATIONS

ABL	Aquatic Bioassessment Laboratory
bioassessment	biological assessment
Bioassessment Program	biological assessments of various freshwater streams in five Los Angeles County watersheds
BMI	benthic macroinvertebrate
CDFG	California Department of Fish and Game
County	Los Angeles County
CRAM	California Rapid Assessment Method
CSBP	California Stream Bioassessment Procedure
EPT	Ephemeroptera, Plecoptera, and Trichoptera
FFG	functional feeding group
IBI	Index of Biotic Integrity
LACFCD	Los Angeles County Flood Control District
LARWMP	Los Angeles River Watershed-wide Monitoring Program
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
Public Works	County of Los Angeles Department of Public Works
QA	quality assurance
QC	quality control
SAFIT	Southwest Association of Freshwater Invertebrate Taxonomists
SCCWRP	Southern California Coastal Water Research Project
SGRRMP	San Gabriel River Regional Monitoring Program
SMC	Stormwater Monitoring Coalition
SMC Program	Stormwater Monitoring Coalition Southern California Regional Watershed Monitoring Program
SOW	scope of work
SWAMP	Surface Water Ambient Monitoring Program
TV	tolerance value
USEPA	United States Environmental Protection Agency
WESTON®	Weston Solutions, Inc.

EXECUTIVE SUMMARY

Background

Weston Solutions, Inc. (WESTON®) was contracted by the Los Angeles County Flood Control District (LACFCD) to perform biological assessments (bioassessments) of various freshwater streams in Los Angeles County (County) (Bioassessment Program). The Bioassessment Program is required for National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit compliance, under the enforcment of the Los Angeles Regional Water Quality Control Board (RWQCB). The goals of this program are to assess biological integrity and to detect biological trends and responses to pollution in receiving waters throughout the County. To achieve these goals, the program focuses on the sampling and analysis of freshwater stream benthic macroinvertebrates (BMI). The program was initiated in October 2003, and monitoring surveys have been conducted once per year since that time, for a total of eight surveys to date. Surveys were conducted in October 2003, October 2004, October 2005, July (San Gabriel River Watershed only) and October 2006, June (San Gabriel River Watershed only) and October 2007, November 2008, June 2009, and June through July 2010.

In 2010, the Bioassessment Program incorporated three collaborative monitoring programs in addition to the basic NPDES Program. These three programs included the San Gabriel River Regional Monitoring Program (SGRRMP), the Los Angeles River Watershed-Wide Monitoring Program (LARWMP), and the Stormwater Monitoring Coalition (SMC) Regional Watershed Monitoring Program (SMC Program).

Study Area and Monitoring Sites

The study area consisted of 18 stream monitoring sites within the five primary watersheds of the County. The watersheds and number of sites sampled in each were as follows:

- San Gabriel River Watershed: four sites.
- Los Angeles River Watershed: six sites.
- Dominguez Channel Watershed: one site.
- Santa Monica Bay Watershed (SMBW), including Malibu Creek Watershed and Ballona Creek Watershed: four sites.
- Santa Clara River Watershed: three sites.

From July 6, 2010 to July 15, 2010, 17 sites were sampled. All of the sites originally identified in the Scope of Work (SOW) were acceptable for samping. One site, SMC09564 in the Santa Clara River Watershed, was within 300 meters of a targeted site, VA-RD, which is sampled annually by the Los Angeles County Sanitation District (LACSD). This site was sampled on June 1, 2010, which was within the SMC sampling period, and taxonomic data from that program was provided to LACFCD for inclusion in the Final Report. Three of the monitoring reaches (SGUT-501–San Gabriel River, SGUT-504–San Gabriel River, and 6–Arroyo Seco) were considered reference sites since they had minimal upstream urban development and runoff, and were located in un-altered channels. Five of the other sites were located in concrete-lined channels. These included sites LALT500–Rio Hondo, LALT501–Arroyo Seco, LALT503–Tujunga Wash, 19–Dominguez Channel, and SMC03944–Cheseboro Canyon Channel. Due to active channel reconstruction at the time of sampling, LALT501 was sampled approximately 0.8 miles upstream from its usual location, at a similarly characterized site. All nine remaining sites were in unlined channels.

Methodology

Field sampling followed the standard protocols described in the Surface Water Ambient Monitoring Program (SWAMP) physical habitat assessment protocol (Ode, 2007). Organisms were identified to standard taxonomic Level II effort as specified in the *Southwest Association of Freshwater Invertebrate Taxonomists* (SAFIT) *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). In addition to the SWAMP physical habitat assessment, the California Rapid Assessment Method (CRAM) for riverine wetlands was intiated in 2009. Additional analyses included a comparison of concrete-lined channels to unlined channels, comparison of IBI scores to site elevations, comparison of CRAM scores to IBI scores (2009 and some 2010 data), and Bray–Curtis-based cluster analysis of taxa and monitoring sites. With the exception of the CRAM-IBI relationship, these analyses were performed for both the 2010 data and for the 2003 to 2010 data, separately.

Findings

Taxonomic evaluation of the 2010 samples yielded 130 different taxa from 13,166 individual organisms. Ostracods (seed shrimp) were the most abundant organisms collected throughout the County. The majority of organisms collected from the monitoring sites were moderately or highly tolerant to stream impairments. Fourteen of the 18 sites were dominated by organisms in the collector feeding groups (collector–gatherers and collector–filterers), which typically become more abundant in response to water quality impairment.

The IBI score of a monitoring reach is considered the strongest analytical tool for rating overall benthic community quality. The score is in points on a 0–70 scale, where higher scores indicate higher-quality BMI communities. Sites rated Poor or Very Poor have an IBI score of 26 or lower and are considered impaired (i.e., 26 is the impairment threshold). The IBI scores for the 2010 study ranged from 0 to 56, out of the possible 70 points (Table ES-1), and the ratings for quality of BMI communities ranged from Very Poor to Very Good. The monitoring reaches located in highly modified, concrete-lined channels had Poor and Very Poor IBI ratings. Analysis of individual metrics as well as total IBI scores showed that monitoring sites located in the lower-elevation, urban watershed areas had lower-quality benthic communities than sites located in the middle to upper and natural reaches of the watersheds. A correlation analysis of elevation and IBI scores indicated a positive and significant correlation countywide. When individual watersheds were considered, the San Gabriel River Watershed and Los Angeles River Watershed had a positive and significant correlation between elevation and IBI scores, whereas the Santa Monica Bay and Santa Clara River Watersheds had a negative but insignificant correlation (i.e., IBI scores were somewhat lower in the upper watershed). Analysis of the IBI scores for the eight survey years through 2010 did not indicate any substantial trend through time toward degradation or improvement at any of the sites.

An analysis of the benthic community quality in concrete-lined sites versus unlined sites for all watersheds in 2010 indicated a statistically significant difference in IBI scores between sites located in the lower watershed areas based on channel type. When reference sites were added to the analysis, the difference in IBI scores between concrete-lined sites and unlined sites was greater. When considering all survey years, the difference between concrete-lined sites and unlined sites was also statistically significant, whether reference sites were included in the analysis or not. Linear regression analysis between CRAM scores for physical habitat quality and IBI scores for 2009 and 2010 data combined had an R^2 of 0.546, indicating a significant relationship between the two. Using 2009 data only, this analysis showed a somewhat stronger relationship, with an R^2 of 0.577.

Conclusion

Stream bioassessment monitoring of the watersheds of the County has been conducted for eight consecutive years beginning October 2003, at a total of 49 different sites. Monitoring sites located in highly urbanized areas of the watersheds have consistently had BMI communities that were considered impaired based on the Southern California IBI. Reference monitoring site BMI communities have been rated unimpaired for the duration of the study with the exception of 6–Arroyo Seco, which was rated impaired in the 2010 survey. Sampling and analysis methodology has been altered somewhat in the standard protocols, but overall results have been relatively consistent for all of the monitoring sites, and no results have shown any significant trend for increasing or decreasing biotic integrity. Correlations between IBI scores and channel type (i.e., concrete-lined versus unlined), elevation, and CRAM habitat scores indicated that all three factors are significantly related to IBI scores when all areas of a watershed are considered. These relationships were also confirmed by two-way cluster analysis of sites and their corresponding taxa.

Table ES-1. Index of Biotic Integrity Scoring for 2010

Receiving Waterbody	Site Code	IBI Score (0–70 scale)	IBI Rating
San Gabriel River Watershed			
San Gabriel River	SGUT-501	56	Very Good
San Gabriel River	SGUT-504	50	Good
San Gabriel River	SGUT-505	29	Fair
Walnut Channel	5, SGLT-506	0	Very Poor
Los Angeles River Watershed			
Arroyo Seco	6	23	Poor
Arroyo Seco	7	22	Poor
Rio Hondo	LALT500	13	Very Poor
Arroyo Seco	LALT501	19	Poor
Compton Creek	8, LALT502	6	Very Poor
Tujunga Wash	LALT503	18	Poor
Dominguez Channel Watershed			
Dominguez Channel	19	7	Very Poor
Santa Monica Bay Watershed			
Rustic Canyon Creek	SMC02548	51	Good
Cheseboro Canyon Channel	SMC03944	7	Very Poor
Malibu Creek	SMC02152	17	Poor
Medea Creek	SMC04264	14	Poor
Santa Clara River Watershed			
Santa Clara River	SMC01676	28	Fair
Santa Clara River	SMC01372, SMC01372 Dup	31/ 23	Fair/ Poor
Santa Clara River	SMC09564 (LACSD Site VA-RD)	17	Poor

SGUT = San Gabriel River Upper watershed Targeted site
SGLT = San Gabriel River Lower watershed Targeted site
SGLR = San Gabriel River Lower watershed Random site
SGMR = San Gabriel River Mid-watershed Random site
LALT = Los Angeles River Lower watershed Tributary site
SMC = SMC random site

1.0 INTRODUCTION

Weston Solutions, Inc. (WESTON®) was contracted by the Los Angeles County Flood Control District (LACFCD) to perform biological assessments (bioassessments) of various freshwater streams in five Los Angeles County (County) watersheds (Bioassessment Program). The Bioassessment Program is required for National Pollutant Discharge Elimination System (NPDES) Permit compliance as enforced by the Los Angeles RWQCB (i.e., Region 4). The goals of the program are to assess biological integrity and to detect possible biological trends and responses to pollution in receiving waters throughout the County. Sampling and analysis followed the protocols described in the Surface Water Ambient Monitoring Program (SWAMP) physical habitat assessment protocol (Ode, 2007) and also incorporated the Stormwater Monitoring Coalition (SMC) Regional Monitoring of Southern California's Coastal Watersheds workplan (SCCWRP, 2007). The County program was initiated in October 2003, and monitoring surveys have been conducted once per year since that time. In 2010, the Bioassessment Program incorporated three monitoring programs in addition to the NPDES Program. These included the San Gabriel River Regional Monitoring Program (SGRRMP), Los Angeles River Watershed-Wide Monitoring Program (LARWMP), and SMC Regional Watershed Monitoring Program (SMC Program).

The Bioassessment Program includes the collection and identification of stream benthic macroinvertebrates (BMI) and also assesses the quality and condition of the in-stream physical habitats and adjacent riparian zones. Using species-specific tolerance values (TVs) and community composition, numerical biometric indices are calculated that determine the ecological health of streams. Over time, this information may be 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 one month to several years and have varying sensitivities to physical, biological, and chemical disturbances in 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 presents the results of stream bioassessment surveys from 18 monitoring sites in the Los Angeles Basin, conducted from June 1, 2010 to July 15, 2010, as well as analyses of historical data. No significant rain events occurred during the sampling period or during the previous month. A taxonomic list of all identified BMIs, biological metric and Index of Biotic Integrity (IBI) calculations, physical habitat information, and a discussion and analysis of the results are included in this report.

2.0 STUDY AREA OVERVIEW

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

Five of the monitoring sites were located in concrete-lined channels: LALT500–Rio Hondo, LALT501–Arroyo Seco, LALT503–Tujunga Wash, 19–Dominguez Channel, and SMC03944–Cheseboro Canyon Channel. Due to active channel reconstruction at LALT501 at the time of sampling, the site was relocated approximately 0.8 miles upstream with an increase of 55 ft elevation, at a similarly characterized site. Three of the soft bottomed (unlined) monitoring sites were considered reference sites with minimal upstream urban development: SGUT-501–San Gabriel River, SGUT-504–San Gabriel River, and 6–Arroyo Seco. One unlined channel site for the SMC program, SMC09564, was located within 300 meters of an annually sampled site of LACSD (VA-RD), so data generated from VA-RD were applied to SMC09564. All nine remaining sites were in unlined channels.

Table 1. Los Angeles County Flood Control District Stream Bioassessment Monitoring Stations, 2010

Site	Targeted (T) or Random (R) SMC Site	Receiving Waterbody	Location, Date Sampled	Coordinates	Justification	Elevation (feet above sea level)
San Gabriel River Watershed: four sites						
SGUT-501	T	San Gabriel River Unlined Channel	San Gabriel River upstream of the confluence with Bear Creek, 7/7/2010	N 34.24067º W -117.88215º	Upstream reference site, targeted/fixed site for SGRRMP	1,620
SGUT-504	T	San Gabriel River Unlined Channel	Upper San Gabriel River near East Fork Road, 7/7/2010	N 34.23652º W -117.81664º	Upstream reference site, targeted/fixed site for SGRRMP	1,512
SGUT-505	T	San Gabriel River Unlined Channel	Upper San Gabriel River below Morris Reservoir, 7/8/2010	N 34.17133º W -117.88762º	Targeted/fixed site for SGRRMP	898
5, SGLT-506	T	Walnut Creek Unlined Channel	Walnut Channel upstream of San Gabriel River, 7/6/2010	N 34.06180º W -117.99314º	Targeted/fixed site for SGRRMP	298
Los Angeles River Watershed: six sites						
6	T	Arroyo Seco Unlined Channel	Upstream of Arroyo Seco Spreading Grounds, 7/8/2010	N 34.20327º W -118.16647º	Upstream reference site with minimal impact from residential land use	1,118
7	T	Arroyo Seco Unlined Channel	Arroyo Seco downstream from Interstate 134, 7/6/2010	N 34.144963º W -118.165102º	Assess impacts of residential land use	725
LALT500	T	Rio Hondo Lined Channel	Rio Hondo at Los Angeles River, 7/15/2010	N 33.93555º W -118.17200º	Offset site for the LARWMP	82
LALT501	T	Arroyo Seco Lined Channel	Arroyo Seco at Los Angeles River, 7/15/2010	N 34.08677º W -118.21076º	Offset site for the LARWMP	350
8, LALT502	T	Compton Creek Unlined Channel	Compton Creek upstream of the confluence with the Los Angeles River, 7/15/2010	N 33.84622º W -118.20922º	Offset site for the LARWMP	22
LALT503	T	Tujunga Wash Lined Channel	Tujunga Wash at Los Angeles River, 7/15/2010	N 34.14691º W -118.38932º	Offset site for the LARWMP	578
Dominguez Channel Watershed: one site						
19	T	Dominguez Channel Lined Channel	Dominguez Channel upstream of Vermont Avenue, 7/10/2010	N 33.87111º W -118.29683º	Assess impacts from upper Dominguez Channel Watershed	8
Santa Monica Bay Watershed: four sites						
SMC02548	R	Rustic Canyon Creek Unlined Channel	Rustic Canyon Creek, parallel to Rustic Canyon Road, 7/9/2010	N 34.06379º W -118.50764º	Random site for the SMC Regional Monitoring Program	415
SMC03944	R	Cheseboro Canyon Channel Lined Channel	Cheseboro Canyon Channel, northeast of the intersection of Vejar Drive and Agoura Road, 7/12/2010	N 34.14271º W -118.75016º	Random site for the SMC Regional Monitoring Program	860

Table 1. Los Angeles County Flood Control District Stream Bioassessment Monitoring Stations, 2010

Site	Targeted (T) or Random (R) SMC Site	Receiving Waterbody	Location, Date Sampled	Coordinates	Justification	Elevation (feet above sea level)
SMC02152	R	Malibu Creek Unlined Channel	Malibu Creek, in Malibu Creek State Park, just upstream of the confluence with Las Virgenes Creek 7/14/2010	N 34.09801º W -118.72171º	Random site for the SMC Regional Monitoring Program	500
SMC04264	R	Medea Creek Unlined Channel	Medea Creek, south of Kanaan Road and Silver Creek Road, 7/9/2010	N 34.13010º W -118.75365º	Random site for the SMC Regional Monitoring Program	775
Santa Clara River Watershed: three sites						
SMC01676	R	Santa Clara River Unlined Channel	Santa Clara River, 1/3 mile upstream of Long Canyon Road, 7/13/2010	N 34.41932º W -118.62961º	Random site for the SMC Regional Monitoring Program	935
SMC01372	R	Santa Clara River Unlined Channel	Santa Clara River, south of Henry Mayo Drive, between Commerce Center Drive and The Old Road, 7/13/2010	N 34.43437º W -118.61386º	Random site for the SMC Regional Monitoring Program	980
SMC09564 (LACSD Site VA-RD)	R	Santa Clara River Unlined Channel	Santa Clara River, downstream of The Old Road Bridge and the LACSD treatment plant, 7/12/2010 (sampled by LACSD, 6/1/2010)	N 34.43220º W -118.59397º (Site VA-RD: N 34.43299 º W -118.59435)	Random site for the SMC Regional Monitoring Program	1015

SGUT = San Gabriel River Upper watershed Targeted site
SGLT = San Gabriel River Lower watershed Targeted site
SGLR = San Gabriel River Lower watershed Random site
SGMR = San Gabriel River Mid-watershed Random site
LALT = Los Angeles River Lower watershed Tributary site
SMC = SMC random site

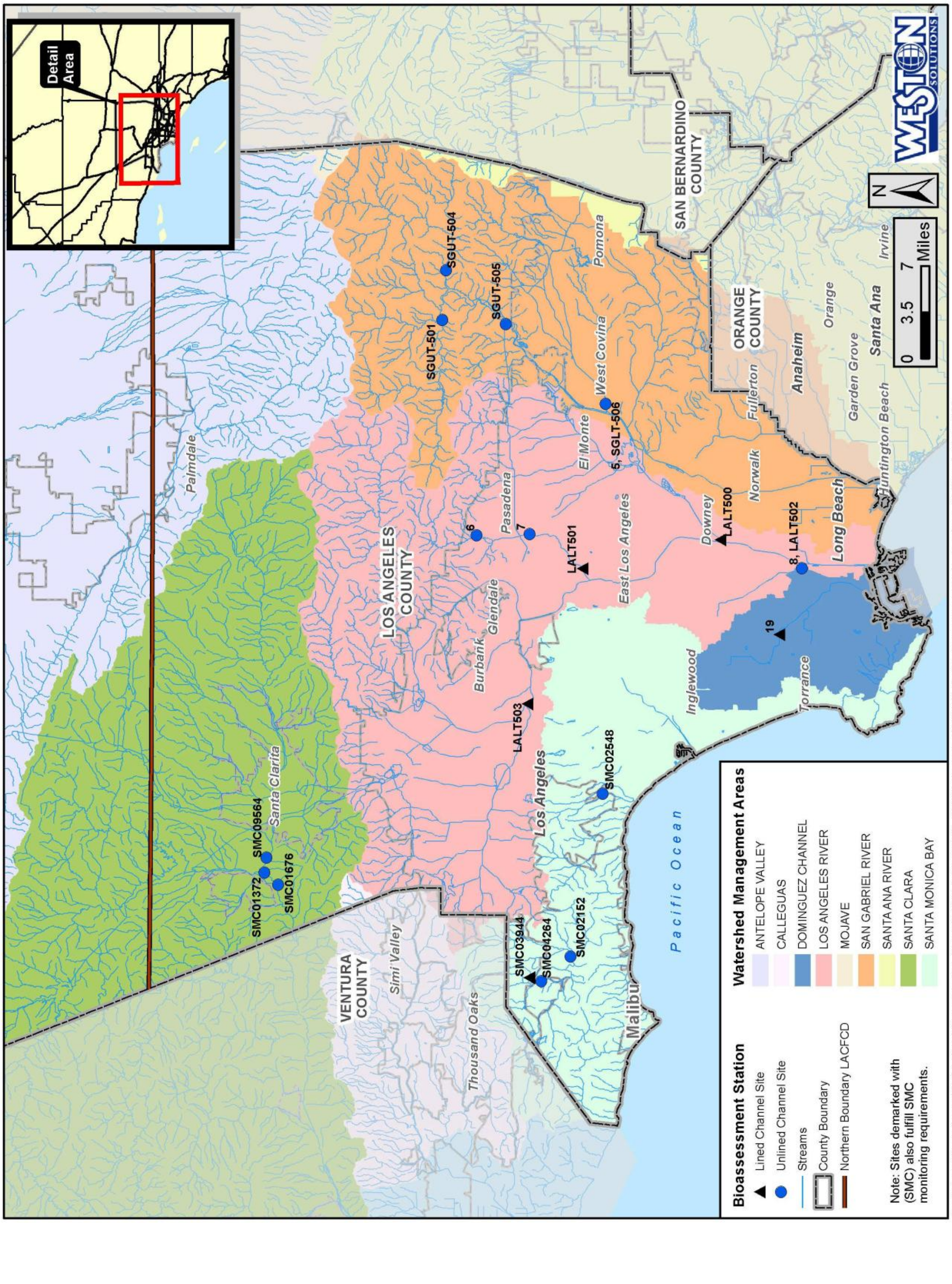


Figure 1. Stream Bioassessment Monitoring Locations for 2010

3.0 METHODS

A general description of the methods incorporated in the sampling program is presented below. WESTON personnel followed the protocols of the SWAMP physical habitat assessment procedure (Ode, 2007), the SMC regional bioassessment workplan (SCCWRP, 2007), and Quality Assurance Project Plan (QAPP) (SCCWRP, 2009). The California Rapid Assessment Method (CRAM) for riverine wetlands (Collins et al. 2008) was also performed. These documents may be referenced for more detailed procedural information.

The sampling and analysis for the 2010 survey was performed using the same protocols as in the 2009 survey. Throughout the history of the program, there have been varying levels of effort concerning the in-stream sampling area and the number of organisms processed for each site. These variances have been dictated by changes in the standard protocols and were not at the discretion of the LACFCD or its consultants. Sample area size has varied from 9 ft^2 to 18 ft^2 and was 11 ft^2 in 2009 and 2010. The sampling strategy within the sites has changed from targeted riffle sampling to a reachwide sampling technique where collections were made at evenly spaced 15-m transects. In the laboratory, the target number of organisms identified varied from 500 to 900 organisms and was 600 organisms in 2009 and 2010.

3.1 Sampling Site Selection

Historically, the Bioassessment Program consisted of 20 targeted sites. In 2003, Los Angeles County Department of Public Works (LACDPW) staff performed a field reconnaissance of the monitoring reaches prior to program initiation to determine the suitability of the 20 original proposed sites. Over the years, various sites have been “offset” to contribute to other watershed-specific monitoring programs; For example, sites 11, 12, and 13 in the Los Angeles River Watershed were offset in 2008 with sites LALT500, LALT501, and LALT503 as a contribution to the LARWMP for the Los Angeles and San Gabriel River Watershed Council (LASGRWC). Other programs that have been incorporated include the San Gabriel River Regional Monitoring Program (SGRRMP), also under the LASGRWC, and the SMC Southern California Regional Watershed Monitoring Program (SMC Program). Sites that contributed to the SGRRMP have site codes beginning with “SG” and sites that contributed to the SMC program have site codes beginning with “SMC”.

In 2010, the 18 sites sampled included 11 targeted sites that have been sampled historically and seven random sites that were sampled for the first time in 2010. In 2010, as in other years, data from eight of the targeted sites also contributed to the LASGRWC’s programs. The seven random sites were selected for inclusion in the SMC Program. One of the SMC sites, SMC09564 in the Santa Clara River Watershed, was within 300 m of Los Angeles County Santitation District (LACSD) targeted monitoring site VA-RD, so the BMI and SWAMP physical habitat data from VA-RD were applied to SMC09564.

3.2 Monitoring Reach Delineation

Historically, monitoring sites were established in stream reaches with ample current flow and riffle habitat, where available. The sampling points specified in the California Stream Bioassessment Procedure (CSBP) target riffle habitat. 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 in each stream, comparability among streams is possible. For some of the monitoring sites in this study, optimal riffle habitat was not always available; therefore, best available habitat was sampled. The best available habitat was selected based on complexity of substrates in the streambed.

Under optimal conditions, five riffles constituted a monitoring site, and three of these were randomly selected for sampling per reach. The length of the monitoring reach was variable, depending upon the frequency of riffles. Given sufficient riffle width and length, a sampling transect perpendicular to stream flow was selected randomly in the upper one-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-m reach of the stream was selected, and three separate 1-m-wide transects were randomly selected.

Beginning in 2009, all of the monitoring sites were delineated to encompass a 150-m stream reach regardless of site conditions. Historical targeted sites were established in the same or relatively same locations as in past surveys. Randomly placed sites were established such that the downstream margin was as close to the nominal coordinates as possible and never more than 300 meters away from the nominal coordinates.

3.3 Sample Collection

Historically, once a sampling transect was established, BMIs were collected using a 1-ft-wide, 0.5-mm mesh D-frame kick-net. Depending on the protocol, a 1-ft^2 or 2-ft^2 area upstream of the net was sampled by disrupting the substrate and scrubbing the cobble and boulders so that 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 one to three minutes, depending on substrate complexity. Three areas along each transect were sampled 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 the three sample points were selected to best represent the diversity of habitat types present. This procedure was repeated for the next two riffles, proceeding from downstream to upstream. Sample material was transferred from the kick-net to 1-qt jars, preserved with 95% ethanol, and returned to WESTON’s benthic laboratory for processing, excluding SMC09564 in 2010, which was processed by the LACSD.

Beginning in 2009, BMI samples were collected at evenly spaced 15-m transects for a total of 11 transects in each 150-m reach. The physical conditions at all of the 2010 sites allowed for sampling over an uninterrupted 150-m reach, although SGUT-505-San Gabriel River was too deep to traverse and sampling was limited to the left bank of the river. BMIs were collected using a standard 1-ft-wide kick-net, and each sample point consisted of a 1-ft^2 area. The samples were collected in a repeating alternating margin-center-margin pattern and were otherwise collected and preserved using similar methods as those previously used.

Every monitoring site was sampled from downstream to upstream. Every monitoring site was photographed. Representative photographs of the monitoring sites are presented in Appendix A.

3.4 Physical Habitat Quality Assessment

Historically, for each monitoring reach sampled, the physical habitat of the stream and its adjacent banks were assessed using United States Environmental Protection Agency (USEPA) Rapid Bioassessment Protocols (Barbour et al., 1999). Habitat quality parameters were assessed to provide a record of the overall condition of the reach. Parameters (e.g., 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.

Beginning in 2009, the SWAMP physical habitat assessment protocol was used. This protocol is more comprehensive and quantitative than the USEPA protocol. Detailed measures (e.g, substrate size, bank vegetation, human influences, and in-stream features) were taken at the same 11 transects where BMI collections were taken. A subset of the physical habitat measures were also assessed at intertransects 7.5 m apart. Copies of the SWAMP field data sheets are presented in Appendix C (electronic version only). In 2009, the CRAM protocol for assessing riverine wetland quality was also performed at all locations, although it was only required at SMC sites. In 2010, CRAM was only performed at the SMC random sites, as required, and at 6–Arroyo Seco due to substantial observed physical habitat alteration from the years prior. This site had severe deposition of gravel and cobble as well as scouring of vegetation, likely due to wildfires in the upper watershed.

CRAM assesses a number of wetland attributes (e.g., in-stream habitat complexity, riparian vegetation, buffer zone width and quality, adjacent land uses, and hydrologic connectivity). CRAM incorporates a broader landscape scope than the SWAMP physical habitat assessment, and yields a single score for a site. The range of possible scores is 25 to 100 points, with higher scores representing higher-quality wetlands. The method is relatively new, and the scoring system has yet to be calibrated to give ratings such as ‘Poor’ or ‘Good’.

In situ physical water quality measurements were taken at each of the monitoring sites. Measurements included water temperature, specific conductance, pH, dissolved oxygen, and turbidity. Water samples were collected and analyzed for alkalinity and hardness in the laboratory to achieve greater accuracy than the standard field methods.

3.5 Laboratory Processing and Analysis

At the laboratory, samples were relinquished under chain of custody to the laboratory sample custodian. Prior to sample processing, technicians signed out each sample in a sample tracking logbook. The sample was poured over a No. 35 standard testing sieve (i.e., 0.5-mm stainless-steel mesh), and the ethanol was retained for reuse. The sample was gently rinsed with freshwater, and large debris (e.g., wood, leaves, and rocks) was removed. The sample was transferred to a tray marked with grids approximately 25 cm^2 and was spread homogenously to a thickness of approximately 0.25 inch. One grid was randomly selected, and the sample material contained within the grid was removed and processed. In cases where the animals appeared abundant, only a fraction of the sample in the grid may have been removed. The material from the grid was examined under a stereomicroscope, and the invertebrates were removed, sorted into major taxonomic groups, and placed in vials containing 70% ethanol. This process was repeated until the specified number of organisms was removed from the sample (i.e., 300, 500, or

600, depending on the protocol). Organisms from a grid in excess of the specified number 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 was labeled "sorted," and the unprocessed material was returned to the original sample container, checked in to the sample tracking logbook, and archived. Sorted material was retained for quality assurance (QA) purposes.

Historically, all organisms were identified to standard taxonomic Level I as specified in the *Southwest Association of Freshwater Invertebrate Taxonomists* (SAFIT) *List of Freshwater Invertebrate Taxa* (SAFIT, 2006), 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 was consistent from 2003 through 2008. Beginning in 2009, the taxonomic effort level was increased to SAFIT Level II, in which insects are identified to species level when possible, and chironomidae are identified to genus level to meet SMC requirements. 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.

Quality Assurance / Quality Control—After sample processing is complete, a minimum of 20% of the BMI samples were checked to ensure a 95% or better organism removal efficiency. To comply with the SMC QA requirements, all SMC samples underwent the sorting QA. Results of the sorting QA/ quality control (QC) were entered onto the Stream Bioassessment Sorting Sheet (Appendix C). To ensure accuracy of the taxonomic identifications, at least 20% of the samples (i.e., four samples) were sent to the California Department of Fish and Game (CDFG) Aquatic Bioassessment Laboratory (ABL) for taxonomic verification. Any discrepancies between ABL identifications and the original identifications were reconciled in the taxonomic database. Taxonomic QA/QC results for one sample were also sent to the SMC to determine if minimum quality objectives (MQOs) were met. 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 were converted into a SAS® database for QA/QC and data reduction. BMI community-based metric values were calculated from the entire database. For calculation of the IBI (described below), the database was randomly reduced to a 500-organism count (Ode et al., 2005). A list of the standard CSBP metrics, a brief description of what they signify, and their predicted responses to impairment are 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." Note that for some organisms identified at the Family level or above, a single TV or FFG was not assigned, 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 IBI was calculated for each monitoring reach (Ode et al., 2005). The IBI is a quantitative scoring system for assessing the quality of

BMI assemblages and is currently the most useful tool for reducing a complex macroinvertebrate dataset to a qualitative rating for each monitoring reach. The IBI score is derived from the cumulative value of seven biological metrics (Table 2). Percent collector–filterers and percent collecter–gatherers are combined into a single IBI metric. 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 the County. Future development of a refined IBI has been suggested by SWAMP.

Using data generated from the BMI samples, additional analyses included comparisons of IBI scores from concrete-lined and unlined channels, IBI scores and monitoring site elevations, and comparative analyses of mean biological metrics and IBI scores for all years of monitoring. IBI scores and CRAM scores were also compared to assess the relationship between the biotic quality and the physical habitat quality for the years 2009 and 2010.

Table 2. Bioassessment Metrics Used to Characterize Benthic Invertebrate Communities

Metric	Description	Expected 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[1] 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 TVs 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		
TV	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 TV of 0, 1, or 2	Decrease
Percent Tolerant Organisms	Percent of organisms in sample that are highly tolerant to impairment as indicated by a TV of 8, 9, or 10	Increase
Percent Tolerant Taxa*	Percent of taxa in sample that are highly tolerant to impairment as indicated by a TV 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
FFGs		
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

Table 2. Bioassessment Metrics Used to Characterize Benthic Invertebrate Communities

Metric	Description	Expected Response to Impairment
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 pa, mh, ph, om, and xy	Variable
Abundance		
Estimated Abundance	Estimated number of organisms in entire sample	Variable

*Metrics used to calculate the IBI
[1]EPT = Ephemeroptera, Plecoptera, and Trichoptera
Source: SDRWQCB, 1999

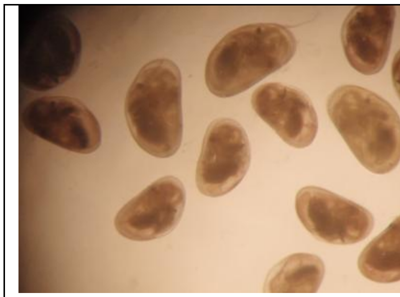
4.0 COUNTY-WIDE SURVEY RESULTS FROM 2010 AND 2003–2010

The 2010 Survey was conducted in July. A discussion of the 2010 survey results is presented below. A complete list of the benthic invertebrates identified at all sites and replicates is presented in Appendix B.1. Ranked total abundance for each species at all sampling sites combined is presented in Appendix B.2, and the calculated BMI 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 was due to fact that the metrics were calculated on a randomly selected subset of 500 organisms and also to the presence of immature or damaged specimens identified at a higher systematic level than the standard effort that were not considered to be unique taxa. It should also be noted that the increased taxonomic effort for the 2009 and 2010 surveys substantially increased the apparent taxa richness thus comparisons with past surveys need to consider this difference.

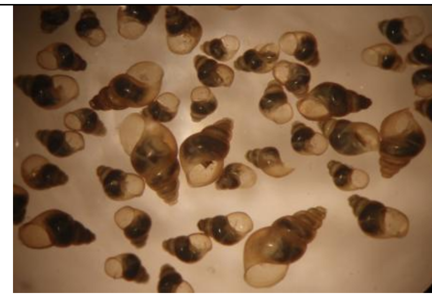
4.1 Benthic Macroinvertebrate Community – 2010 Study Area Summary

When all sites in the County study area are combined, a total of approximately 130 unique taxa were identified from 13,166 individual organisms (Appendix B.1 and Appendix B.2). The five most abundant taxa in descending order were Ostracods (seed shrimp) at 2,280 individuals; the mayfly, *Baetis adonis*, at 2,025 individuals; the mud snail Hydrobiidae at 1,350 individuals; the amphipod crustacean, *Hyalella* sp., at 673 individuals; and the mayfly, *Fallceon quilleri*, at 629 individuals (Appendix B.2) (Figure 2). All of these taxa are moderately to highly tolerant to habitat impairment and with the exception of hydrobiid snails, which are scrapers, are in the collector–gatherer feeding group. Collector–gatherers feed on organic detritus, algae, and various microorganisms (Smith, 2001; Usinger, 1956), and high abundances of these organisms are often associated with high levels of urban runoff (Lenat and Crawford, 1994).



Seed Shrimp, Ostracoda

Mayfly, *Baetis adonis*



Mud Snail, Hydrobiidae

Amphipod, *Hyalella*

Mayfly, *Fallceon quilleri*

Figure 2. The Five Most Abundant Organisms Collected in Los Angeles County for the 2010 Survey

The order Diptera (true flies) had the greatest number of unique taxa identified (55 taxa, including 34 chironomid genera and species complexes), followed by Trichoptera (caddisflies) with 14 taxa and Ephemeroptera (mayflies) and Coleoptera (beetles) with 13 taxa each (Appendix B.1). Chironomid midges were the only group of organisms that were collected at all of the monitoring sites, and Ostracods were collected at all but three sites.

4.2 2010 Benthic Macroinvertebrate Community Metrics

Benthic invertebrate community metric values for each monitoring reach are presented in Appendix B.3. Table 2 above may be referenced for a brief definition of each metric and their response to impairment. Each metric is based on a different component of the BMI community, and the combination of metric scores gives an indication of overall biotic integrity for a given site.

Taxa Richness**—**Taxa richness is the total number of unique taxa in a sample, and it is presumed that higher richness indicates higher biotic integrity. This number does not account for damaged or immature specimens identified at a higher taxonomic level than specified in the SAFIT list (also referred to as indiscriminate taxa). In 2010, taxa richness per sample ranged from ten taxa at 5, SGLT-506–Walnut Channel to 44 taxa at SGUT-504–San Gabriel River (Appendix B.3). Taxa richness values for historical surveys prior to 2009 were based on Level I taxonomic effort, which is likely why they, for the most part, were substantially lower than for the 2009 and 2010 surveys. On average, the unlined sites had approximately 47% greater taxa richness than the concrete-lined sites.

Diversity and Dominance**—**Two diversity indices were calculated for each site: Shannon diversity, which increases with evenness of distribution amongst present taxa and Margalef diversity, which increases with increasing numbers of taxa present. Shannon diversity values per site ranged from 0.2 at 5, SGLT-506–Walnut Channel to 2.9 at SGUT-505–San Gabriel River (Appendix B.3). Margalef Diversity values per site ranged from 1.4 at 5, SGLT-506–Walnut Channel to 7.7 at SGUT-504–San Gabriel River (Appendix B.3). Dominance is a metric that is presumed to decrease with increasing biotic integrity. Dominance by a single taxon ranged from 27.8% *Baetis adonis* at SGUT-504–San Gabriel River to 96.4% Ostracods at 5, SGLT-506–Walnut Channel (Appendix B.3).

***Ephemeroptera, Plecoptera, and Trichoptera Taxa*—**This metric represents the number of taxa in the orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT) that are collected at each site. These orders contain impairment-sensitive taxa, and greater diversity of these taxa indicates higher biotic integrity. Several of these taxa (e.g., mayflies in the family Baetidae and the caddisflies, *Cheumatopsyche* sp., *Hydropsyche* sp., and *Hydroptila* sp.) have moderate tolerance values and are tolerant to urban runoff that does not contain high levels of chemical pollutants. This means that percent-sensitive EPT (TV ≤3) is a much stronger metric than total-percent EPT when assessing ecological health at a site. All of the stonefly taxa are sensitive to urban runoff.

The greatest number of EPT taxa (17) was collected at SGUT-501–San Gabriel River, and the second greatest number of EPT taxa (11) was collected at SMC02548–Rustic Canyon Creek (Appendix B.3). There were no EPT taxa collected at one monitoring site, 5, SGLT-506–Walnut Channel. EPT individuals were most abundant at LALT501–Los Angeles River where baetid mayflies comprised 89.8% of the benthic community (Appendix B.3). The most abundant of the EPT taxa across the survey region included the baetid mayflies, *Baetis adonis* and *Fallceon quilleri* (Appendix B.2). Sensitive EPT taxa (TV 0–3) were collected at five of the sites and were collected in the greatest numbers at SGUT-501–San Gabriel River, where they comprised 55.6% of the benthic community. The high percentage of sensitive EPT at this site was primarily due to a high abundance of the caddisfly, *Micrasema* sp., with 277 individuals.

The Sensitive Caddisfly, *Micrasema*

***Tolerance Values*—**For most stream macroinvertebrates, a TV has been determined for each taxon through prior research on each type of animals' life history (Hilsenhoff, 1987). TVs range from 0, for organisms highly intolerant (i.e., sensitive) to impairments, to 10, for organisms that are highly tolerant to impairments. For some taxa, the tolerance value is either unknown or is too diverse within a group to assign a single value and therefore no TV is applied. A 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 (TV 0–2) is likely the strongest indicator of good water quality.

Average community TVs for all sites ranged from 2.9 at both SGUT-501–San Gabriel River and SMC02548–Rustic Canyon Creek to 8.0 at 5, SGLT-506–Walnut Channel (Appendix B.3). Highly tolerant organisms (TV 8–10) were most abundant at 5, SGLT-506–Walnut Channel, where high numbers of ostracods contributed to a total of 98.6% tolerant organisms. Highly tolerant organisms were least abundant at LALT501–Los Angeles River, where they comprised 0.8% of the community. Highly intolerant (i.e., sensitive) organisms were collected from four sites, which were the same sites where sensitive EPT were collected; sensitive EPT with a TV of 2 or less are also counted in the highly intolerant metric. These sites included SGUT-501, SGUT-504, 6–Arroyo Seco, and SMC02548–Rustic Canyon Creek. SGUT-501 had the greatest number of intolerant organisms, where they comprised 53.6% of the community. Highly intolerant organisms collected in high numbers county-wide included the stonefly *Malenka* sp. (310 individuals) the caddisfly, *Micrasema* sp. (281 individuals), and the caddisfly, *Lepidostoma* sp. (141 individuals).

Functional Feeding Groups**—**As with TVs, FFG designations have been determined through prior life-history research or observations of each taxon. In rare instances, the feeding strategy of an organism is unknown, and for some taxonomic designations at a high level (e.g., family level) the feeding strategies are too diverse to assign a single feeding group to the taxon. The percent composition of the FFGs provides useful information regarding 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.

Fifteen of the 18 monitoring reaches were dominated by taxa in the collector feeding groups (collector-gatherers plus collector-filterers) (Appendix B.1 and Appendix B.3). Seven of the eight most abundant taxa in the study region (i.e., ostracods, *Baetis adonis*, *Hyalella*, *Fallceon quilleri*, *Simulium* sp., Oligochaetes and the midge *Crictopus* sp.) were in the collector feeding groups and generally increase in abundance in response to urban runoff in a watershed (SLSI, 2003). SGUT-501–San Gabriel River was dominated by "others" (i.e., *Micrasema* sp., a macrophyte herbivore) and SMC02152–Malibu Creek was dominated by scrapers (i.e., hydrobiid snails). SMC02548–Rustic Canyon Creek was dominated by shredder taxa, which feed on coarse particulate organic matter. 5, SGLT-506–Walnut Channel had the greatest dominance by a single feeding group, where collector–gatherers comprised 98.6% of the community.

Estimated Abundance**—**The estimated total abundance is the total number of BMI predicted to be in the sample if the entire sample had been processed (e.g., if 50% of the sample was processed and had 600 BMI, the estimated total abundance would be 1200). This value is then divided by 11 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 48 organisms per square foot of substrate at 8, LALT502–Compton Creek to 11,409 organisms per square foot at SMC03944–Cheseboro Channel (Appendix B.3). The abundance at SMC-03944 was more than twice the second highest abundance value at 5, SGLT–Walnut Channel. Both of these sites were dominated by Ostradods, a small, highly prolific organism that thrives in slow current conditions with fine particulate organic matter in the substrate. Abundance at the reference sites ranged from 95 to 514 organisms per square foot.

4.3 2010 Physical Habitat Quality Assessment

The SWAMP physical habitat procedure was performed at all sites. The procedure is much more comprehensive than the historical USEPA method in which ten parameters were assessed qualitatively on a 0 to 20 point scale to give a single habitat score. The SWAMP procedure retained three of these original USEPA parameters, including epifaunal substrate/cover, sediment deposition, and channel alteration. Additionally, many aspects of the reachwide habitat were quantitatively assessed (e.g., substrate size, algal cover, bank vegetation cover, canopy cover, in-stream habitat complexity, and human influences, flow volume, and reach gradient). Qualitative assessments were also made to characterize flow habitats and bank stability. As of the writing of this report, summary indices of the SWAMP physical habitat data have not been developed, although CRAM scores (described below) do provide a multi-attribute summary to determine relative habitat quality. Table 3 lists the more relevant physical habitat parameters and briefly describes the conditions that are most beneficial to macroinvertebrate communities. Figure 3 presents photographs of good and poor quality physical habitats. Water quality data are presented in Appendix B.4, and physical habitat measures for each monitoring reach are presented in Appendix B.5.

Water quality measurements at most of the monitoring sites did not indicate severe impairment. Values for pH were between 7.65 and 9.64 (SMC04264–Medea Creek and LALT500–Los Angeles River, respectively). Specific conductance, a general indicator of dissolved solids, was moderate to low at all sites except SMC03944–Cheseboro Channel, SMC02152–Malibu Creek, and SMC04264–Medea Creek, which had values of 3.174, 3.221, and 2.926 mg/L, respectively. These three sites also had the highest hardness values (>1,200 mg/L CaCO3, i.e., above the method detection limit) and alkalinity measures were also highest at SMC02152–Malibu Creek and SMC04264–Medea Creek. Excessive salts, metallic cations (e.g., calcium, magnesium, and ferrous iron), and limestone formations can naturally elevate water hardness (Sawyer and McCarty, 1978), which may subsequently limit the BMI community to taxa that are tolerant to these constituents. Dissolved oxygen levels were suitable for BMI at all sites and ranged from 4.99 mg/L at 8, LALT502–Compton Creek to 13.70 mg/L at SMC03944–Cheseboro Channel. Water temperatures were quite variable throughout the County, ranging from 17.0°C (58.0°F) at SGUT-504–San Gabriel River to 37.2° C (98.6° F) at LALT500–Los Angeles River. Turbidity, a measure of water clarity (clear waters have low nephelometric turbidity unit (NTU) values and the meter range is 0-1,000 NTU), was relatively low at most sites, although elevated turbidity was observed at 8, LALT502–Los Angeles River with a value of 58.9 NTU. Elevated turbidity is most commonly caused by suspended sediments in the water column.

Currently SWAMP has not developed standard metrics summarizing the overall habitat quality, but the more relevant physical habitat measures (e.g., substrate composition, channel alteration, canopy cover, and flow characteristics) are presented in Appendix B.5. For each SMC site, the CRAM for riverine wetlands was applied in 2010. Although all sites received CRAM scores in 2009, the CRAM for riverine wetlands was only conducted at SMC sites and 6–Arroyo Seco in 2010. For the remainder of the 2010 targeted sites, the 2009 CRAM scores were utilized, along with their corresponding 2009 IBI scores, when CRAM and IBI comparisons were made between sites. It is suspected that 2010 CRAM scores would have been similar to 2009 CRAM scores for the targeted sites except for 6–Arroyo Seco, which had severe stream bed and vegetation alteration as a result of wildfires and deposition of coarse rocky substrate.

The CRAM provides a single score relating to the physical habitat quality and incorporates in-stream quality, buffer zone width and quality of vegetation, and surrounding landscape attributes. The range of scores is 25 to 100. Higher scores indicate a higher-quality physical habitat, although the scores have yet to be calibrated region-wide to provide quality rating categories (e.g., "Good" or "Poor"). In 2010, the highest-quality physical habitat was at SMC02548–Rustic Canyon Creek with a CRAM score of 79. The poorest quality physical habitat was at SMC03944–Cheseboro Channel with a CRAM score of 30. The highest-quality physical habitat in 2009, on the other hand, was at 6–Arroyo Seco in the Los Angeles River Watershed and SMC01550–Trancas Creek in the Malibu Creek Watershed, both with a CRAM score of 85. The CRAM score for 6–Arroyo Seco decreased to 61 in 2010 due to impacts from wildfires that had affected the site. The poorest quality site in 2009 was at SMC01640–Las Virgenes Creek with a CRAM score of 27.

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

Parameter	Conditions Assessed	Optimal Conditions
Epifaunal substrate/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.
Flow habitats	The presence of cascades, rapids, riffles, runs, glides, and pools.	A mix of all regimes, dominated by riffles.
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 and canopy cover	The width of native riparian vegetation along both streambanks and the amount of overhanging vegetation above the streambed providing shade and coarse organic matter.	Width of riparian zone more than 18 m; human activities have not impacted zone. Canopy covers majority of streambed.

Source: CSBP, 1999
*Retained by SWAMP procedure

Figure 3. Examples of Good Physical Habitat Conditions (top row) and Poor Physical Habitat Conditions (bottom row)

4.4 2010 Index of Biotic Integrity

In 2004, a Southern California IBI 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. This IBI may be refined in the future; it has been noted that this IBI may lack strength when assessing low-gradient or low-elevation sites (due to the rarity of reference streams sampled in Southern California with these characteristics).

Ode et al. (2005) 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 was assigned a score from 0 to 10 (e.g., if there were four Coleoptera taxa in a sample, the metric score would be 7). These scores were added to provide a final IBI score; the highest possible total score was 70. This score may be normalized to a scale ranging from 0 to 100; the raw IBI scores are presented in this report. Each final score was 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.

Table 4. Index of Biotic Integrity Scoring Ranges

Metric Score	Number Coleoptera Taxa	Number EPT Taxa	Number Predator Taxa	Percent CF and 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 IBI is effective for broadly identifying impairment. Sites rated Poor or Very Poor have an IBI score of 26 or lower and are considered impaired (i.e., 26 is the impairment threshold). 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. (2005) determined that the minimum detectable difference between IBI scores is approximately 9 points (on the 0–70-point scale). This implies that at least a 9-point difference between two site scores is necessary to determine if one is of significantly higher quality than the other.

The total IBI scores for each monitoring reach are shown on Figure 4 and Figure 5. A complete list of the IBI metric values, individual IBI scores, and total IBI scores are presented in Appendix B.6.

The 18 monitoring sites in the County had IBI ratings ranging from Very Poor to Very Good with IBI scores ranging from 0 to 56, with a maximum possible IBI score of 70. Six of the sites were rated above the level of impairment (i.e., Fair, Good, or Very Good). SGUT-501–San Gabriel River was the highest-rated site and was the only one rated Very Good. Eight sites were rated Poor, and included concrete-lined and unlined sites at low to mid elevation that had substantial urban influence. One site, 6-Arroyo Seco, that was rated Poor has in the past been consistently rated unimpaired; the decrease in IBI score was likely due to severe erosion in the watershed that impacted the site. The five remaining sites were rated Very Poor. Three of these were in concrete-lined channels, and the other two were in soft-bottomed concrete channels. It is also interesting to note the difference in IBI scores between SMC01372 and the SMC01372 duplicate sample. Although the difference was less than the ‘minimum detectable difference’ of nine points described by Ode et al., 2007 (i.e., the difference could be due to natural biological variability), this difference puts the two scores on either side of the impairment threshold.

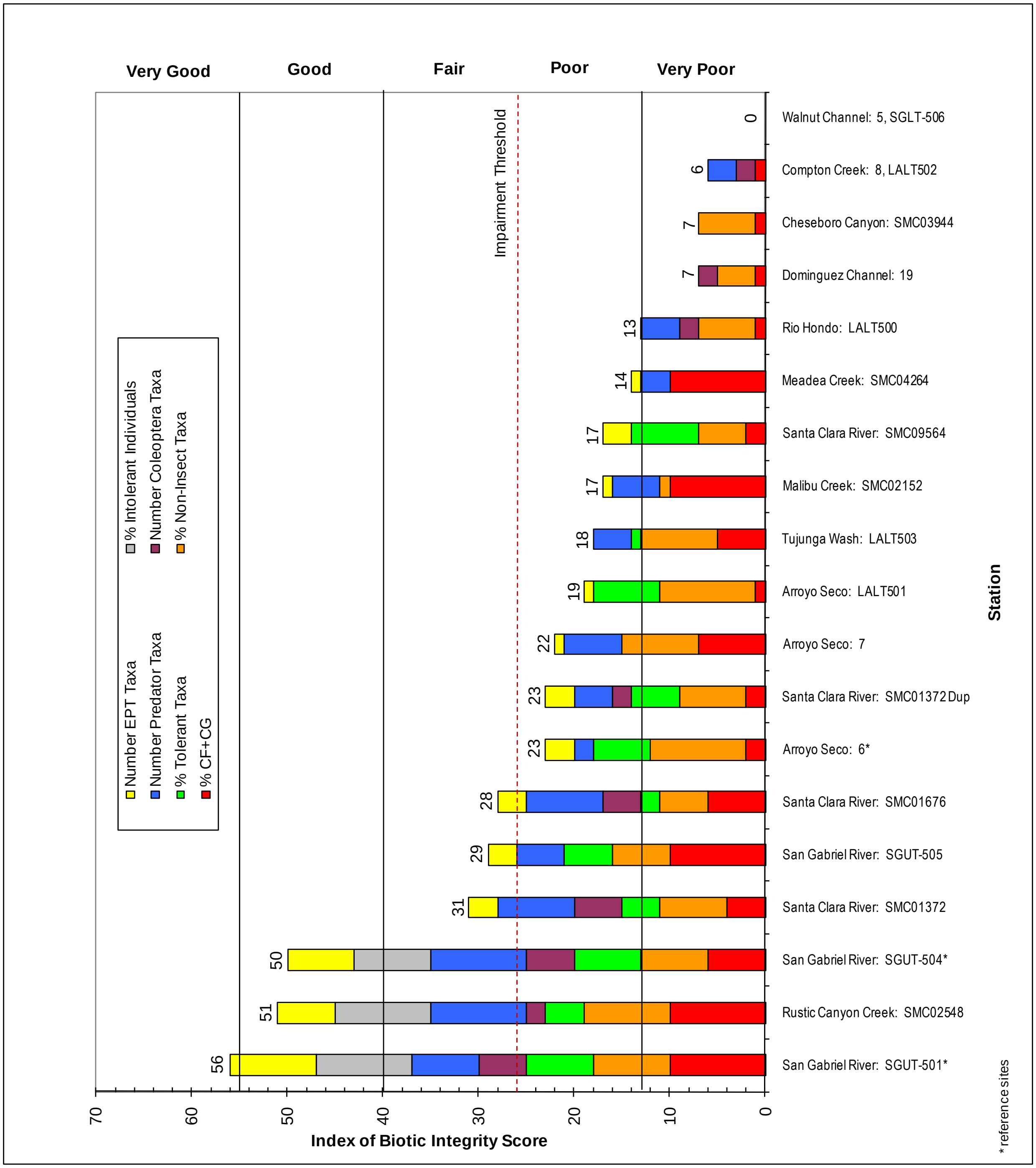


Figure 4. Index Biotic Integrity Scores for Los Angeles County Bioassessment Sites for 2010 (0–70 scale)

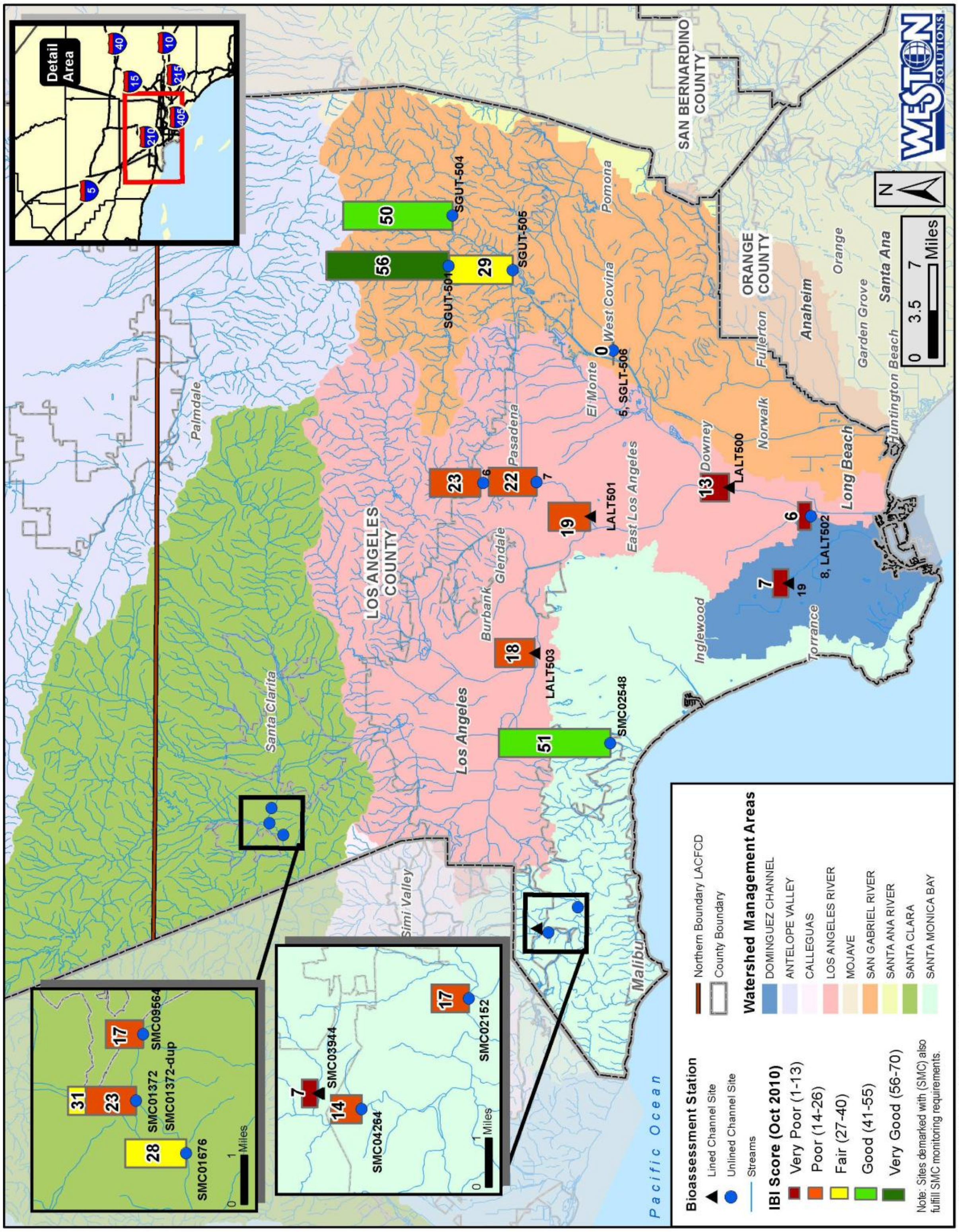


Figure 5. Stream Bioassessment Monitoring Locations with Index of Biotic Integrity Scores per Site for 2010

Comparison of Concrete-Lined Channels and Unlined Channels

In the 2010 survey, five sites were located in concrete-lined channels, including three sites in the Los Angeles River Watershed: LALT500, LALT501, and LALT503, one site in Dominguez Channel Watershed, 19, and one site in the Santa Monica Bay Watershed, SMC03944–Cheseboro Channel. A concrete substrate is considered inferior for macroinvertebrate colonization compared to a more complex natural substrate (e.g., substrates with layered cobblestone, plant stems, and wood). The concrete-lined channels generally had minimal coarse organic food sources, lacked riparian canopy, and had uniform water flow characteristics consisting of flat runs rather than true riffles. Concrete-lined channel sites typically have a relatively thick microalgae layer containing detritus and microorganisms, which provide the primary food resources for macroinvertebrates in this habitat type. In spite of this, 5, SGLT–506 had the lowest IBI score of any site in 2010. This was due to the extreme dominance of Ostracods (Appendix B.1), a highly tolerant organism that responds to high levels of fine particulate organic matter that is often associated with urban runoff. The conditions at the site were apparently favorable for this organism, likely due to the slow current and moderately complex substrate that was able to retain greater deposits of organic silt than the smooth surfaces of many of the concrete-lined sites.

In 2010, the concrete-lined channel sites had IBI scores of 19 or less and benthic quality ratings of Poor and Very Poor (Figure 6). It is reasonable to infer that the poorer-quality physical habitats of the concrete-lined channel sites had a deleterious effect on benthic community quality and the IBI scores in the lower watershed stream reaches, but since these sites were dominated by urban runoff, water quality may have had an additional impact. In 2010, two of the concrete-lined sites had relatively high IBI scores, including LALT503–Tujunga Wash and LALT501–Arroyo Seco, which had IBI scores of 18 and 19, respectively. LALT503 benefitted from having a low percentage of non-insect taxa and a moderately low percentage of collector taxa. LALT501 also benefitted from a low percentage of non-insect taxa plus a low percentage of tolerant taxa.

To determine if the IBI scores for unlined sites were statistically different from IBI scores at concrete-lined sites, the Wilcoxon Ranked Sum test was used and is presented graphically on Figure 7. 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 are presented in *Biostatistical Analysis* (Zar, 1999). The results for the two groups were compared. The hypothesis was tested at an alpha of 0.05, as follows:

> H_0 (null hypothesis): Unlined Channel IBI Scores = Concrete-Lined Channel IBI Scores
> H_a (alternate hypothesis): Unlined Channel IBI Scores ≠ Concrete-Lined Channel IBI Scores

The test was run using all sites, including the reference sites, and no exclusions were made based on location (i.e., upper or lower) in the watershed.

The null hypothesis is that IBI scores in unlined channels are equivelant to IBI scores in concrete-lined channels. The results of the analysis indicated that in both scenarios the null hypothesis was rejected, and the alternate was accepted. This means that the IBI scores at unlined sites were statistically different, overall, than IBI scores at concrete-lined sites with a p-value of 0.005. When the p-value is less than 0.05 the difference is significant; in other words, the chance of having this result is less than 5%, and we can safely (or significantly) reject the null hypothesis. In Figure 7, a visual comparison of the two groups is presented. The minimum and maximum IBI scores are indicated by the upper and lower horizontal lines (whiskers), the 25th percentile is represented by the bottom of the shaded box, the median is the line near the middle of the box, and the 75th percentile is the top side of the box. The two datasets are significantly different from one another if the mean of one set is higher or lower than the 25th or 75th percentile line of the other set. One version of the analysis does not include reference sites in the unlined group, whereas the other includes reference sites in the unlined group.

Without considering reference sites, the mean IBI scores of the urban unlined sites were higher than the 75th percentile (top of the shaded box) of the concrete-lined sites and therefore were rated slightly superior to the lined sites. This difference was slightly less than was seen in 2009 (WESTON, 2010), due to relatively high IBI scores at two of the concrete-lined sites. When reference sites were considered, this difference was even more apparent: the unlined sites were clearly statistically superior to the concrete-lined sites.

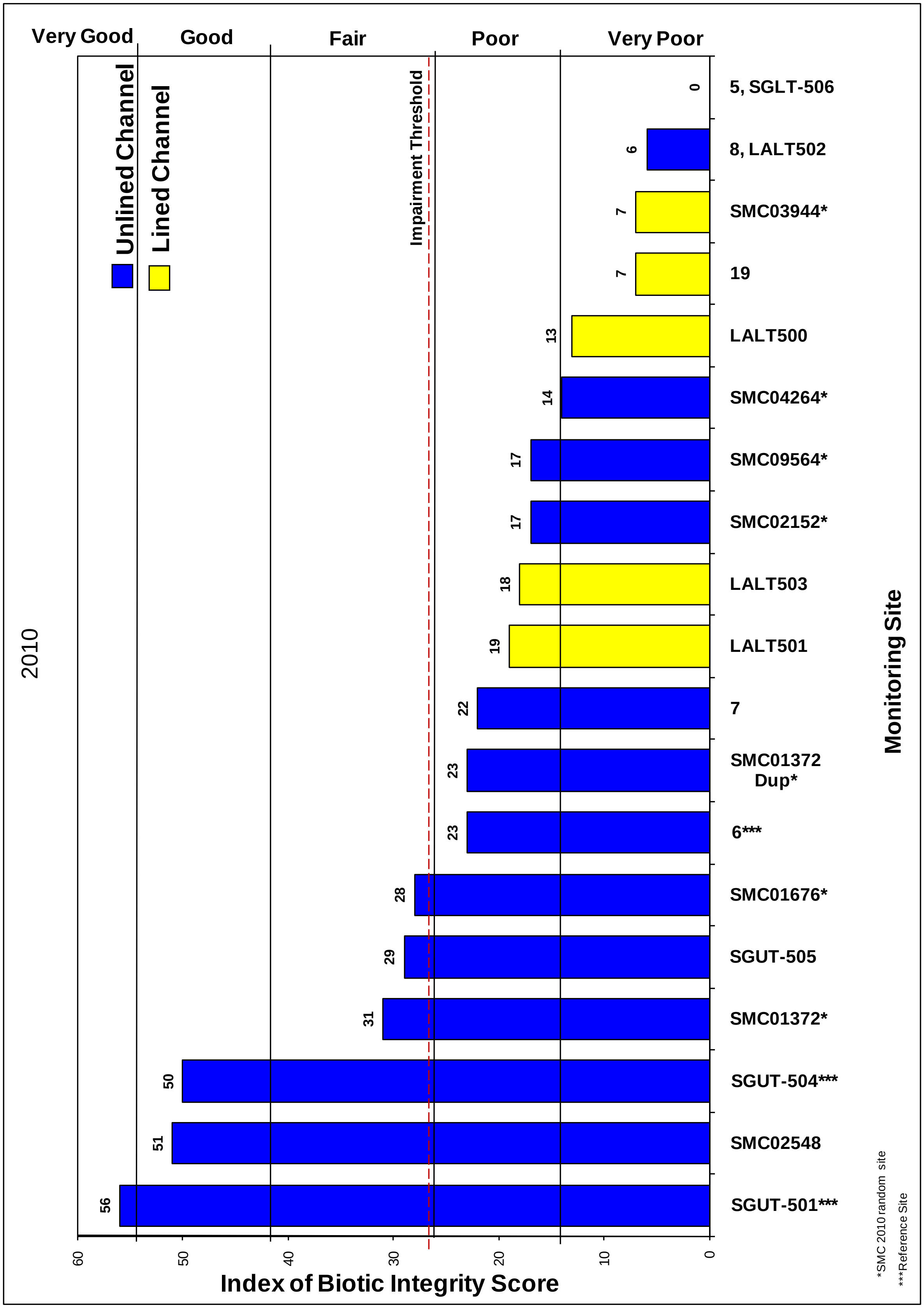


Figure 6. Index Biotic Integrity Scores for Concrete-Lined versus Unlined Channels for 2010 Survey

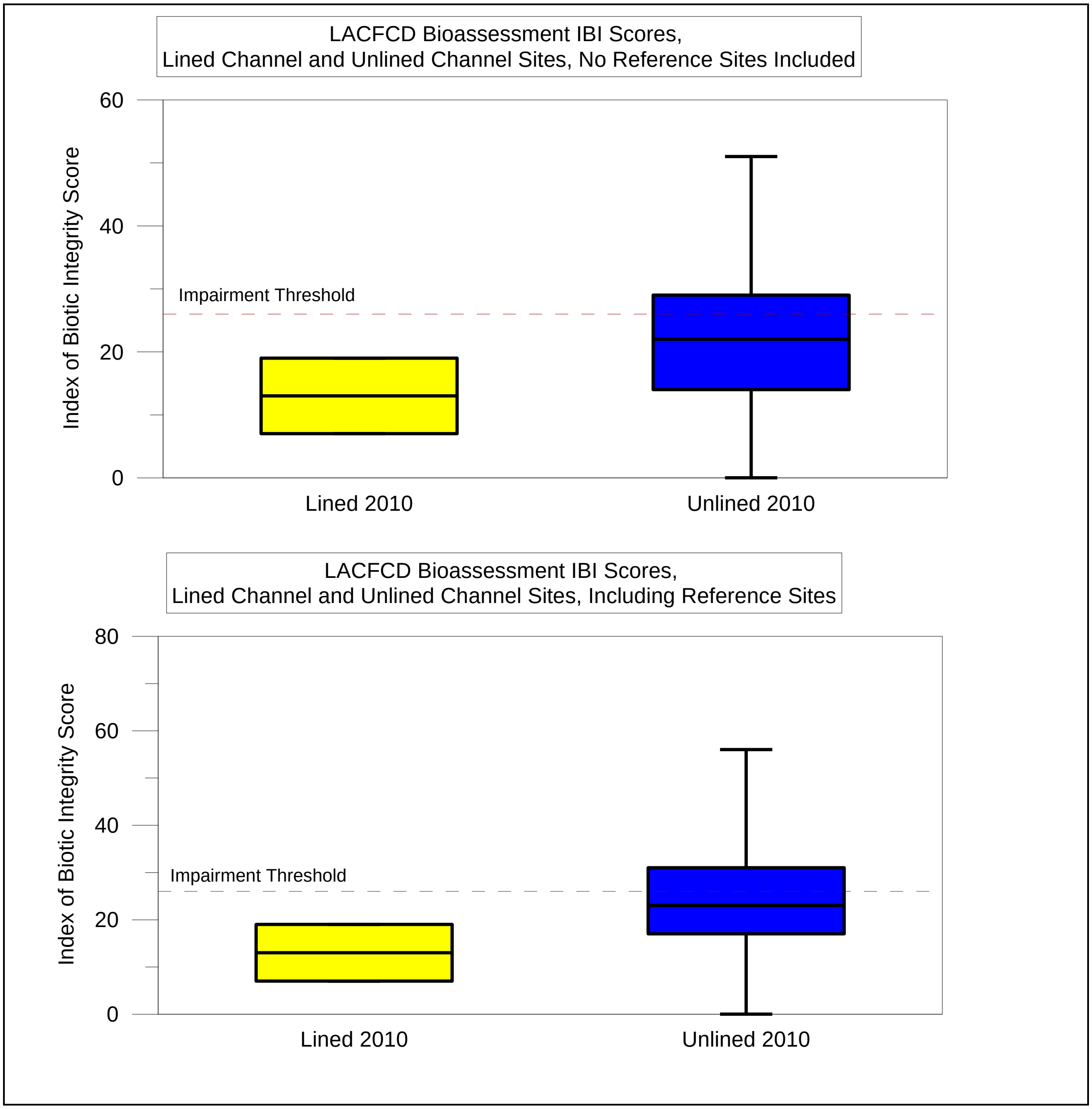


Figure 7. Comparison of Concrete-Lined and Unlined Channel Sites for 2010

Comparison of Index of Biotic Integrity Scores and the California Rapid Assessment Method Scores for all Watersheds for 2010

To test the relationship between IBI scores and physical habitat, a linear regression analysis was used to evaluate the relationship between CRAM scores and IBI scores. Table 5 summarizes the site IBI scores, CRAM scores, and elevations for the sites at which CRAM was performed in 2010. As noted in Section 4.3 above, the targeted sites did not have CRAM re-assessed in 2010 with the exception of 6–Arroyo Seco, which had undergone substantial habitat alteration.

The results of the analysis were a coefficient of determination (R^2) of 0.372 (Figure 8). This results in a correlation of 0.610. While this result shows some relationship between CRAM and

IBI scores, it does not show a linear relationship between CRAM and IBI scores, especially at the lower ranges of each score. However, above the IBI impairment threshold line, the relationship appears to improve.

Table 5. Site Index of Biotic Integrity Scores, California Rapid Assessment Method Scores, and Elevation of Stream Bioassessment Monitoring Stations for 2010

Site	IBI Score (0–70)	CRAM Score (25–100)	Elevation (feet above sea level)
Los Angeles River Watershed			
6*	23	61	1,118
Santa Monica Bay Watershed			
SMC02548	51	79	415
SMC03944	7	30	860
SMC02152	17	78	500
SMC04264	14	68	775
Santa Clara River Watershed			
SMC01676	28	69	935
SMC01372/ SMC01372 Dup	31/ 23	67	980
SMC09564	17	65	1,015
yellow highlight = concrete-lined channel site blue highlight = unlined channel site *reference site			

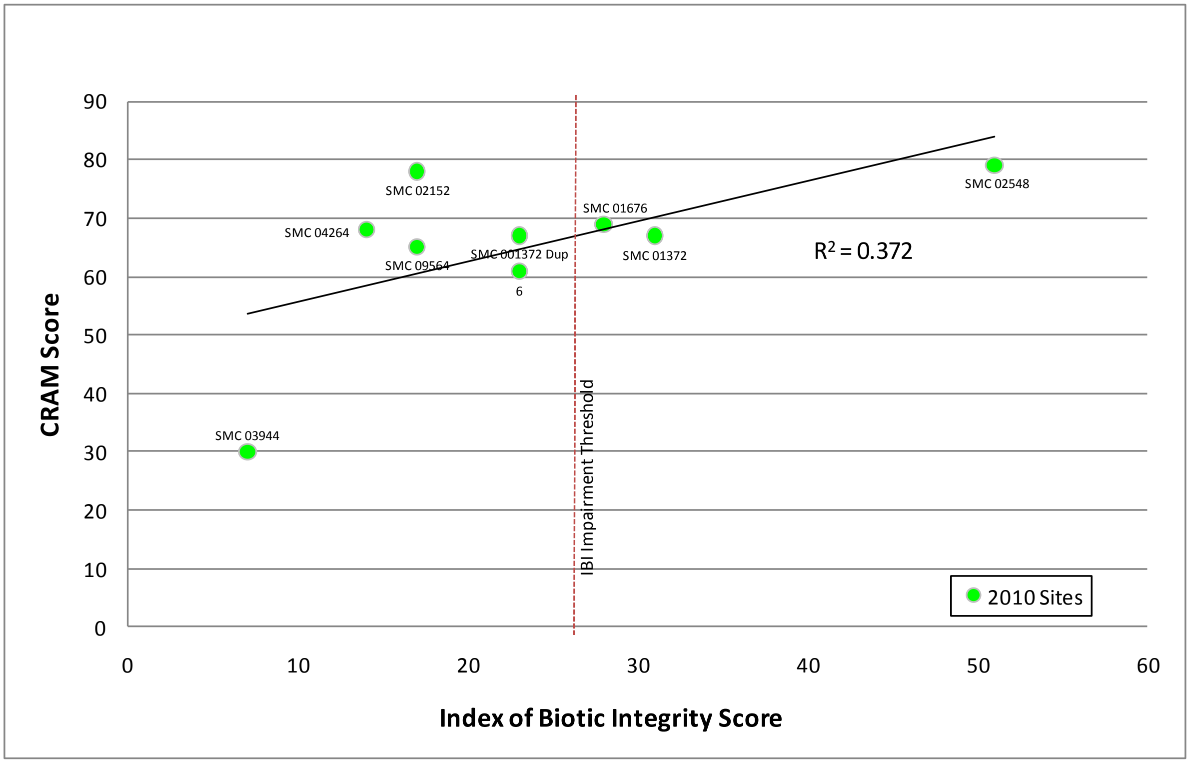


Figure 8. Correlation of California Rapid Assessment Method and Index of Biotic Integrity Scores for 2010

Comparison of Index of Biotic Integrity Scores and Elevation for 2010

To examine the relationship of IBI scores and elevation, a Spearman rank correlation was conducted for 2010 IBI scores versus elevation. The correlation coefficient for 2010 IBI versus elevation was 0.662. The correlation was significant since it was greater than the critical value of 0.460 (alpha of 0.05 (i.e., 95% confidence) and 19 samples). These results indicate that countywide, IBI scores are significantly and positively correlated to elevation per site. 2008 and 2009 results also supported this correlation (WESTON, 2009; WESTON, 2010).

To represent this relationship graphically, a linear regression analysis was performed (Figure 9).

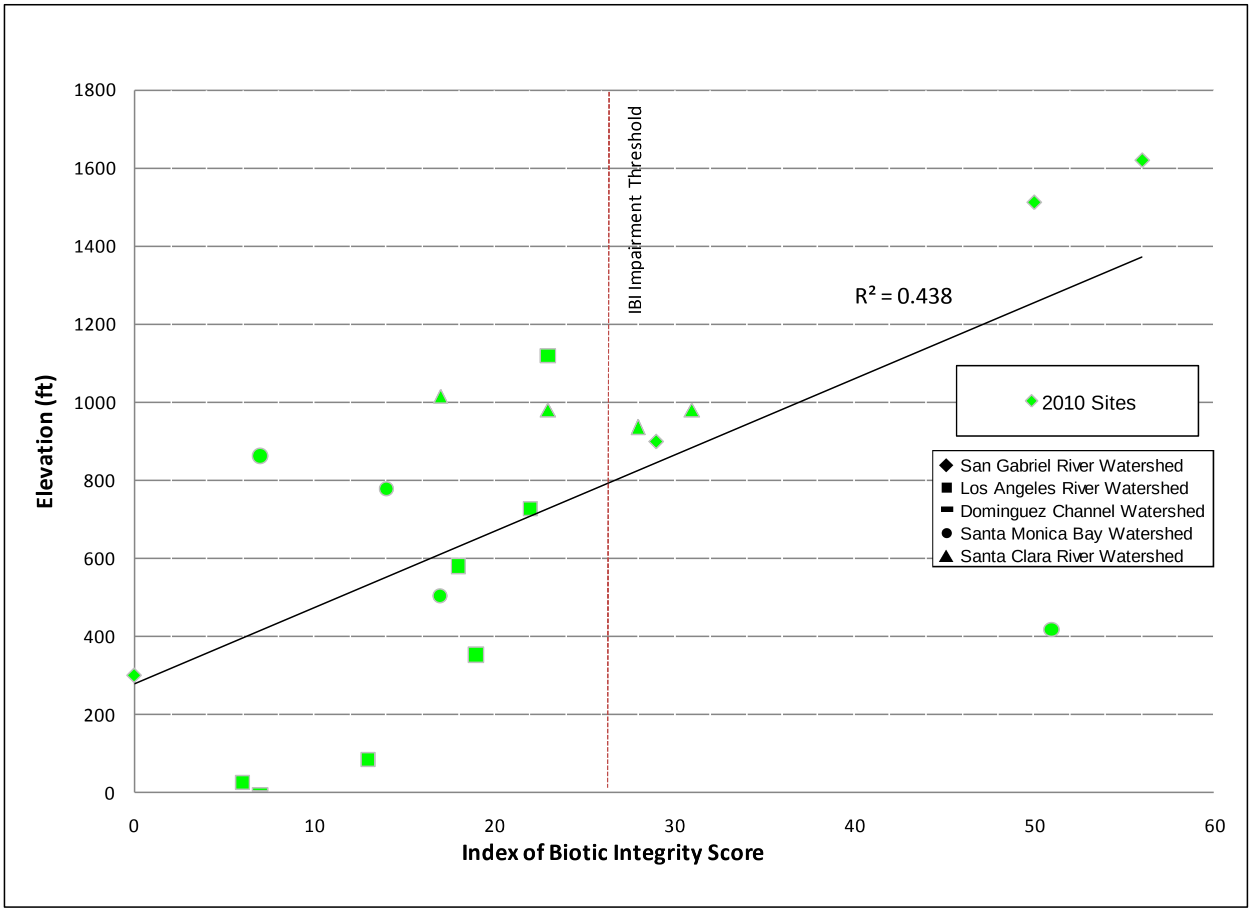


Figure 9. Correlation of Index of Biotic Integrity Scores and Elevation for 2010

Cluster Analysis

A cluster analysis was performed to test for similarities between site location and BMI community structure. The analysis is based on a two-way Bray–Curtis similarity matrix calculated on relative abundances of taxa by site. Sites with similar communities of taxa will cluster together; likewise, taxa that occur at the same sites will cluster together. The analysis only considers the taxa and sites and is independent of other factors such as channel type, elevation, or organism tolerance.

The 2010 results are portrayed in a two-way table that shows the relative abundance of each taxon by site (Appendix B.7). Results of the cluster analysis showed three major taxa clusters and four site clusters, labeled 1 through 3 and A through D, respectively, and bounded by bold red lines. The graphic also indicates concrete-lined sites (highlighted yellow), unlined sites (highlighted blue), reference sites (with asterisked site names), and the organisms' TVs. The sites are also labeled with elevation codes indicating low (i.e., less than 500 ft above sea level), medium (i.e., 500–1,500 ft above sea level), and high (i.e., above 1,500 ft above sea level) elevations.

Overall site clustering showed that site clusters A and B had the greatest degree of separation from clusters C and D. Cluster A had four of the five concrete-lined channel sites and cluster B had soft-bottomed sites in areas with high levels of urbanization. Site cluster C contained all of the reference sites (plus one concrete-lined site, LALT501–Arroyo Seco) and cluster D was limited to the Santa Clara River Watershed sites. These clusters appeared closely associated with IBI scores for the sites; clusters A and B had the lowest IBI scores, cluster C had the highest IBI scores, and cluster D had intermediate IBI scores. The trends in IBI scores were generally consistent with CRAM scores.

The sites in cluster A were best characterized by having high numbers of taxa in taxa cluster 3. Taxa in cluster A were best represented by highly tolerant organisms such as Ostracods, and the midge genera *Cricotopus* sp., *Chironomus* sp., and *Dicrotendipes* sp.

Site cluster B contained 8, LALT502–Compton Creek and two of the urbanized Santa Monica Bay sites, SMC02152–Malibu Creek and SMC04264–Medea Creek. Cluster B was also associated with taxa cluster 3, and the taxa most abundant at all three sites included highly tolerant damselflies in the family Coenagrionidae and the amphipod, *Hyalella* sp.

Site cluster C contained all of the reference sites and all three Arroyo Seco sites. There was also a notable sub-cluster containing Site 6–Arroyo Seco and LALT501–Arroyo Seco. This sub-cluster association was likely driven by high abundances of the mayfly, *Baetis adonis* at both sites. The remaining sites of cluster C were most associated with taxa cluster 1, which contined many low tolerance organisms such as the caddisflies, *Agapetus* sp., *Micrasema* sp., and *Rhyacophila* sp.; the mayfly, *Serratella micheneri*; and the stonefly *Calineuria californica*.

Site cluster D contained the three Santa Clara River sites. Cluster D was most associated with taxa cluster 2, including the mayfly, *Tricorythodes* sp.; the damselflies, *Argia* sp. and *Hetaerina* a*mericana*; and the beetle, *Tropisternus* sp.

Comparison of the 2010 cluster analysis with previous years' cluster analysis (Appendix B.8) showed that there has been a consistent pattern of three station cluster types (i.e., reference and open sites, urban unlined sites, and urban concrete-lined sites).

4.5 All Watersheds' Survey Results for 2003–2010

Study information from 2003 through 2009 (BonTerra, 2004; WESTON, 2005; WESTON, 2006; WESTON, 2007; WESTON, 2008; WESTON, 2009; WESTON, 2010) was compared to the 2010 data to assess year-to-year variance and trends in biotic integrity of the streams. Regional macroinvertebrate community structure was relatively similar in the first seven survey years (i.e., years prior to 2010), and the ten most abundant taxa remained fairly consistent. Additionally, sites with unique, high-quality communities (e.g., 6–Arroyo Seco and 17–Cold Creek) also showed year-to-year taxonomic consistency, prior to 2010. The 2010 survey had a few notable differences: 6–Arroyo Seco was subjected to severe erosion during the wet season and the BMI community was substantially different than in past surveys; there were two intolerant organisms, the caddisfly *Micrasema* sp. and the stonefly *Malenka* sp., in the ten most abundant taxa; two of the concrete-lined sites, LALT501–Arroyo Seco and LALT503–Tujunga Wash had significantly higher IBI scores than in past surveys.

Historically, the 2008 survey collected the greatest number of unique taxa studywide (i.e., 99) compared with 94 in 2007, 96 in 2006, 81 in 2005, 73 in 2004, and 88 in 2003. Countywide taxa richness in 2009 was 146 and in 2010 was 130, but, because of increased taxonomic effort to SAFIT Level II (per SMC protocols), these values are not comparable to the historical surveys. Because of this, the 2009 and 2010 taxa richness values were converted to taxonomic Level I effort in order to calculate the mean richness values for all years. These re-calculated values are presented below in the mean metric tables for each watershed.

Comparison of Concrete-Lined Channels and Unlined Channels – 2003-2010

Since 2003, 49 sites have been monitored in the Bioassessment Program. Seventeen of these sites have been in concrete-lined channels. Figure 10 shows the IBI scores for all sites and all years of monitoring, with concrete-lined sites highlighted in yellow and unlined sites highlighted in blue. Each bar in Figure 10 represents one year's IBI results, in chronological order, from left to right for each site, with a maximum of eight bars per site.

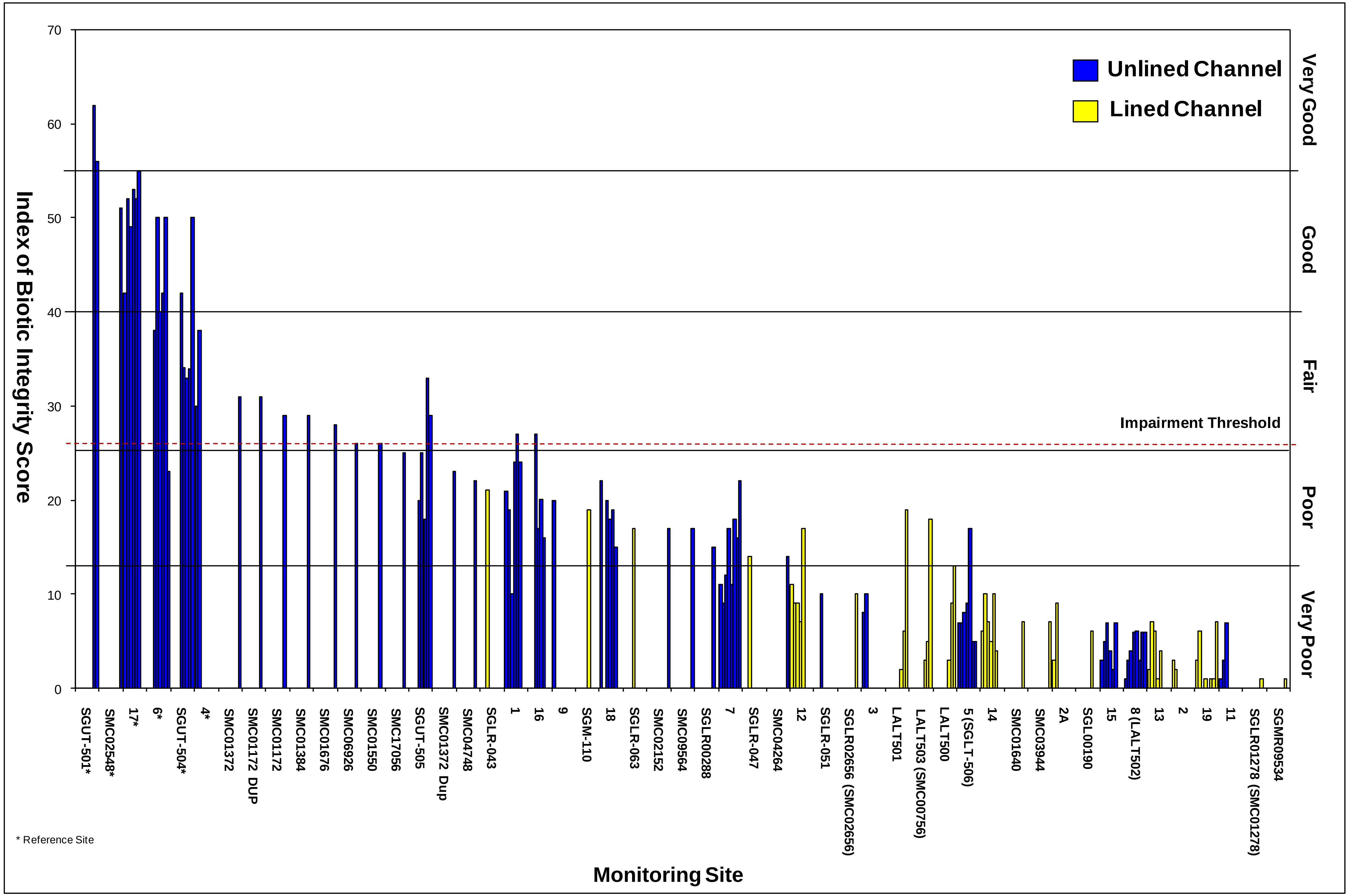


Figure 10. Index of Biotic Integrity Scores for Concrete-Lined versus Unlined Channels, All Watersheds for 2003–2010

The Wilcoxon Ranked Sum test was run with no exclusions based on location (i.e., upper or lower) in the watershed. The associated p-value was less than 0.000, indicating that the mean IBI scores of the concrete-lined sites were statistically lower than the unlined sites (p-value less than 0.05 is significant).

Using a whisker–box plot to compare the two channel types, the mean 2003–2010 IBI scores of the unlined sites were slightly superior to the concrete-lined sites in the lower watershed (Figure 11). When the reference sites were added to the analysis, a greater difference between site types resulted; mean IBI scores of unlined sites were significantly superior to those of the concrete-lined sites.

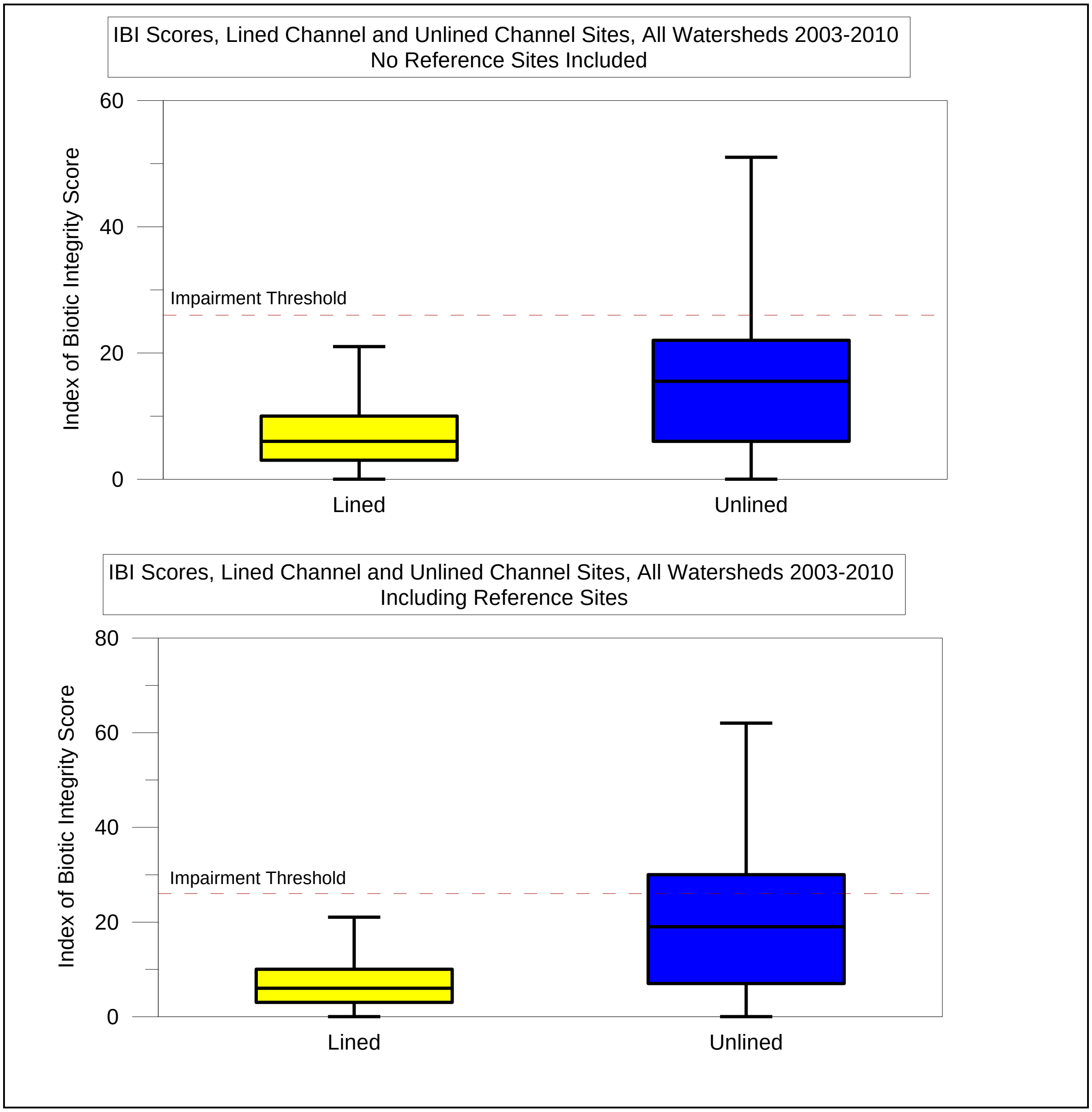


Figure 11. Comparison of Concrete-Lined and Unlined Channel Sites, All Watersheds for 2003–2010

Comparison of Index of Biotic Integrity Scores and the California Rapid Assessment Method Scores for all Watersheds for 2009 and 2010

To test the relationship between IBI scores and physical habitat, a linear regression analysis was used to evaluate the relationship between CRAM scores and IBI scores since the CRAM analysis was initiated in 2009. Table 6 summarizes the site IBI scores, CRAM scores, and elevations for the sites at which CRAM was performed in 2009 and 2010. As noted in Section 4.3 above, the targeted sites did not have CRAM re-assessed in 2010 with the exception of 6–Arroyo Seco, which had undergone substantial habitat alteration.

The results of the analysis were a coefficient of determination (R^2) of 0.546 (Figure 12). This results in a correlation of 0.739. This result shows a relationship between CRAM and IBI scores, and the relationship is more significant than when the analysis only used the 2010 data (Section 4.4, Figure 8). In Figure 12, there appears to be three groupings of sites: those with the lowest CRAM and IBI scores that includes most of the lined channel sites, those with moderate to high CRAM scores but that are still mostly below the IBI threshold, and those with both high CRAM and IBI scores that includes the reference sites and SMC02548–Rustic Canyon Creek.

Table 6. Site Index of Biotic Integrity Scores, California Rapid Assessment Method Scores, and Elevation of Stream Bioassessment Monitoring Stations for 2009 and 2010

Site	IBI Score 2009 (0–70)	CRAM Score 2009 (25–100)	IBI Score 2010 (0–70)	CRAM Score 2010 (25–100)	Elevation (feet above sea level)
San Gabriel River Watershed					
SGUT-501*	62	83			1,620
SGUT-504*	50	74			1,512
SGUT-505	33	69			898
5, SGLT-506	5	58			298
Los Angeles River Watershed					
6*	34	61	23	61	1,118
7	16	69			725
LALT500	9	37			82
LALT501	6	39			295 (2009), 350 (2010)
8, LALT502	6	47			22
LALT503	5	37			578
Dominguez Channel Watershed					
19	1	37			8
Santa Monica Bay Watershed					
SMC01172/ Dup	29/ 31	79			1,200
SMC06926	26	42			210
SMC01384	29	83			285
SMC01550	26	85			310
SMC01640	7	27			780
SMC02548			51	79	415
SMC03944			7	30	860

Table 6. Site Index of Biotic Integrity Scores, California Rapid Assessment Method Scores, and Elevation of Stream Bioassessment Monitoring Stations for 2009 and 2010

Site	IBI Score 2009 (0–70)	CRAM Score 2009 (25–100)	IBI Score 2010 (0–70)	CRAM Score 2010 (25–100)	Elevation (feet above sea level)
SMC02152			17	78	500
SMC04264			14	68	775
Santa Clara River Watershed					
SMC04748	22	79			885
SMC17056	25	69			1,060
SMC01676			28	69	935
SMC01372/ Dup			31/ 23	67	980
SMC09564			17	65	1,015

yellow highlight = concrete-lined channel site
blue highlight = unlined channel site
no highlight = not assessed
*reference site

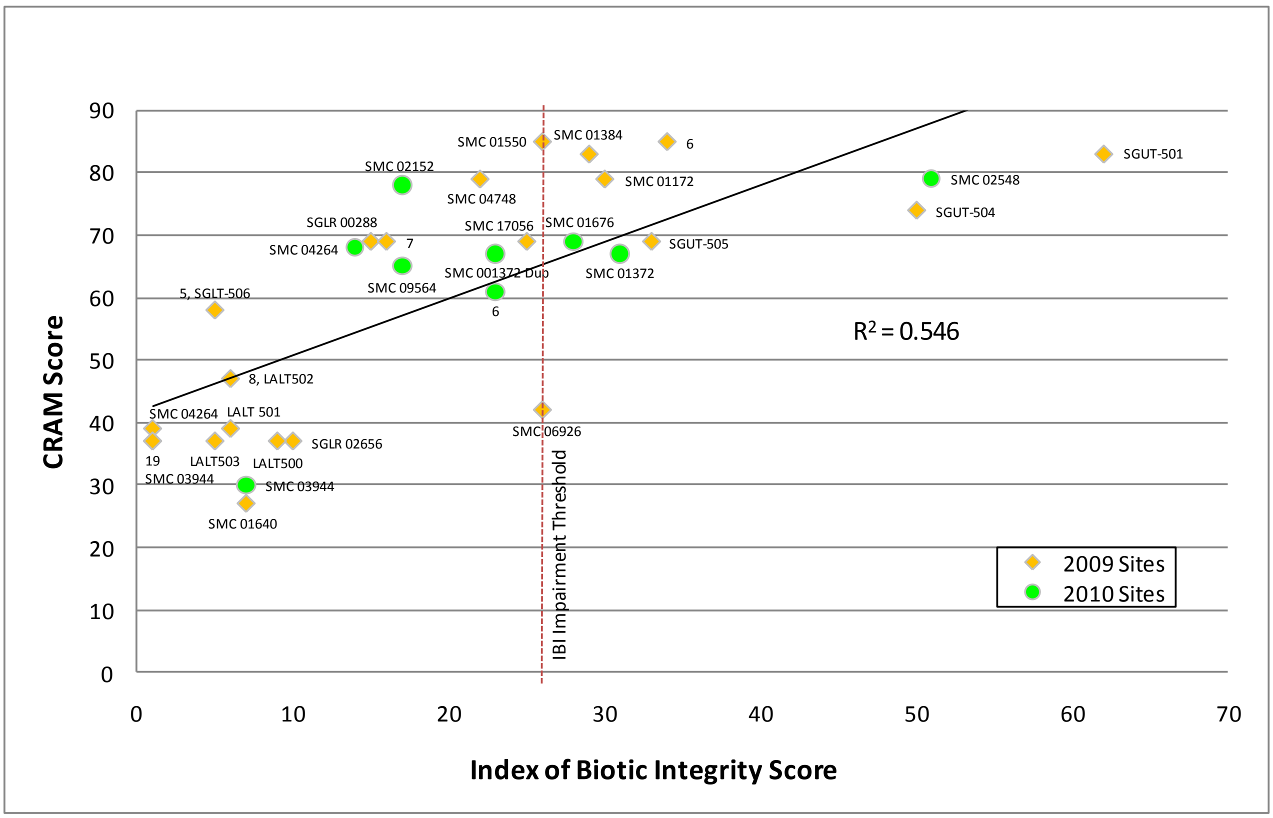


Figure 12. Correlation of California Rapid Assessment Method and Index of Biotic Integrity Scores for 2009 and 2010

Comparison of Index of Biotic Integrity Scores and Elevation for 2003–2010

To examine the relationship of IBI scores and elevation, a Spearman rank correlation was conducted for IBI score versus elevation. The correlation coefficient for IBI versus elevation was 0.499. The correlation was significant based on a critical value of 0.165 (138 samples and an alpha of 0.05). These results indicate that site IBI scores were significantly correlated to elevation on a countywide basis through time. Independently, the 2008, 2009, and 2010 results also support this correlation (WESTON, 2009; WESTON, 2010).

An illustration of these results is shown in Figure 13, a linear correlation of IBI scores and elevation. The coefficient of determination is shown on the graph as a measure of how well the data points fit a linear line. Although the relationship is statistically significant, it is apparent in Figure C that some sites at relatively low elevations have correspondingly high IBI scores, especially in the Santa Monica Bay Watershed. There are also many sites in the mid elevation range (i.e., 600-1000 ft) with IBI scores well below the impairment threshold. This, when assessed in conjunction with the CRAM and IBI correlation (Figure 12), could indicate that elevation is a secondary factor to the amount of urbanization and habitat quality (on a watershed scale) for a given monitoring site. This interpretation is strengthened by the individual watershed analyses comparing IBI and elevation data in sections 5.1 through 5.5, below, where this relationship varies depending on which watershed is considered.

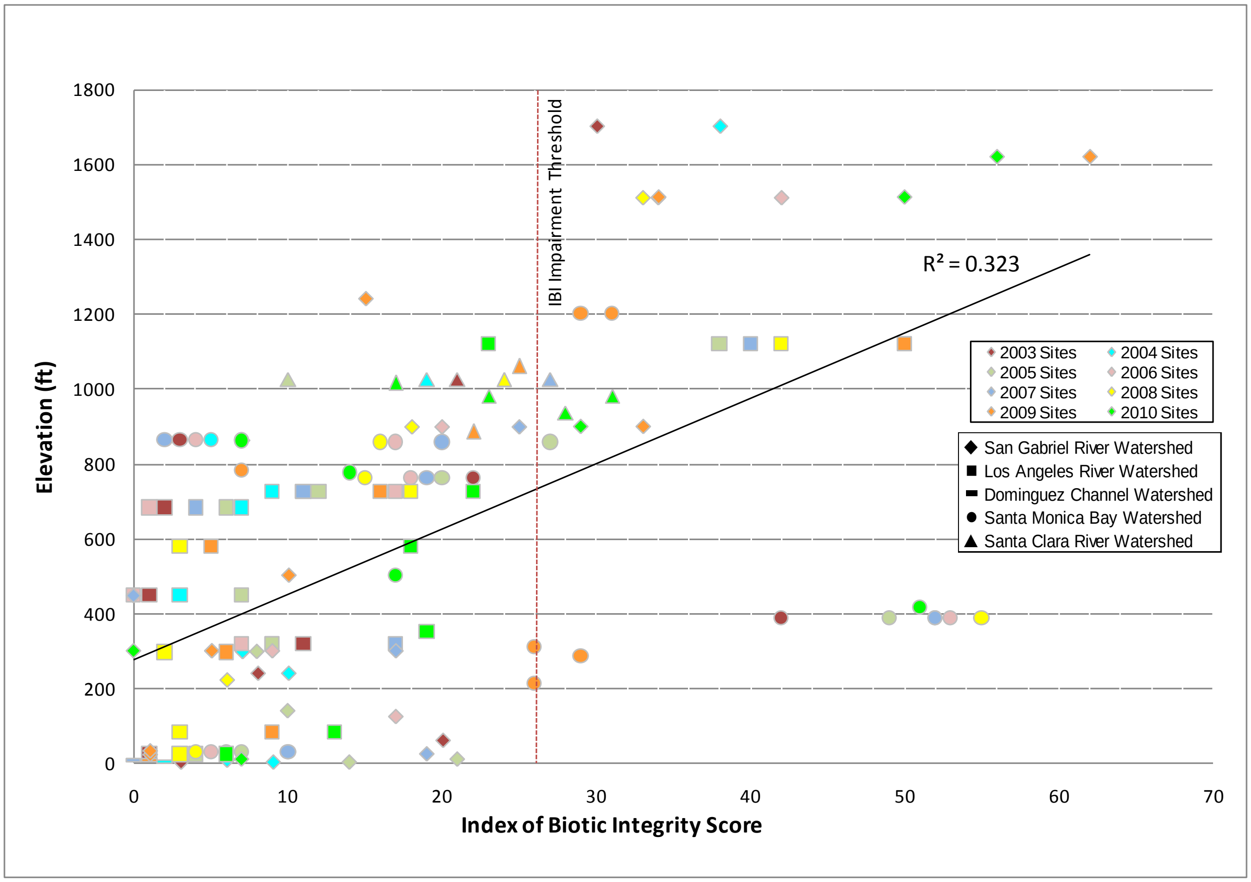


Figure 13. Correlation of Index of Biotic Integrity Scores and Elevation for 2003–2010

Cluster Analysis for 2003–2010

A cluster analysis was performed to test for similarities between site location and BMI community structure. The analysis was performed as described in Subsection 4.4 above. The similarity matrix is shown in Appendix B.8.

Overall results of the analysis of the whole time span were similar to the 2010 results with five major taxa clusters and four site clusters, labeled 1 through 5 and A through E, respectively. This analysis confirmed that the BMI communities are different based on their location in the watershed and their channel type. The site clusters fell into two general groups, with clusters A, B and D containing low to mid-elevation urban sites plus the concrete-lined channel sites, whereas clusters C and E contained the reference sites and less developed mid-elevation sites. Cluster E was also limited to sites in the Santa Clara River Watershed. The taxa clusters were also in two general groups, with clusters 1, 2, 3 and 5 containing the ubiquitous and moderately to highly tolerant taxa, whereas cluster 4 contained all of the intolerant (sensitive) taxa.

The BMI assemblages and IBI scores of the sites also confirmed that the higher elevation, less urbanized portions of the watersheds and the unlined sites (clusters C and E) were of superior quality to the low elevation sites with greater urbanization. Site cluster C contained the intolerant taxa of taxa cluster 4, best characterized by the caddisflies, *Agapetus* sp., *Micrasema* sp., *Tinodes* sp., and *Wormaldia* sp.; the mayflies, *Serratella* sp. and *Epeorus* sp.; and the stonefly, *Malenka* sp. Cluster C also had a strong correlation with taxa cluster 5, although this taxa cluster was comprised entirely of higher tolerance midge genera that were also found at some of the lower rated sites (thus the association was not likely ecologically significant). Site cluster E, with most of the Santa Clara River sites was best characterized by moderately tolerant organisms in taxa cluster 2 such as the damselfly, *Hetaerina Americana*; the beetle, *Tropisternus*; and the mayfly, *Tricorythodes*. Additionally, the sites in clusters C and E, for the most part, had higher IBI scores than clusters A, B, and D. Taxa associated with clusters A, B, and D were mostly ubiquitous with moderate to high tolerance values. The most notable taxa associated with these site clusters included Oligochaetes, Ostracods, and *Hyalella* sp., all of which increase in response to fine particulate organic matter.

5.0 2003–2010 SURVEY RESULTS BY WATERSHED

Study information from 2003 through 2009 (BonTerra, 2004; WESTON, 2005; WESTON, 2006; WESTON, 2007; WESTON, 2008; WESTON, 2009; WESTON, 2010) was compared to the 2010 data to assess the year-to-year variance and trends in biotic integrity of the streams. For these multi-year historical analyses, each watershed is considered separately. Targeted monitoring reaches were relocated very close to previous years' surveys and were historically sampled at the same time of year (mid-fall), except for the four San Gabriel River Watershed sites, sampled in June 2008, and all 2009 and 2010 sites, sampled in June and/or July. Analyses for each watershed are presented in subsections 5.1 through 5.5.

One site, 19–Dominguez Channel, was permanently moved approximately 0.5 miles upstream in 2006 due to high salinity (tidal influence) detected at the original site. In 2010, LALT501–Arroyo Seco was temporarily moved approximately 0.8 miles upstream to avoid impacts from maintenance and reconstruction activities that were occurring to the channel at the time of sampling. Since the Bioassessment Program's inception in 2003, many of the original fixed monitoring sites have also been relocated to accommodate other watershed-specific monitoring programs, including the SMC Regional Bioassessment Program. Some of these sites have switched from a fixed or targeted location to a randomly (or stratified randomly) selected site. Random sites have typically been sampled for a single year and were then relocated the following year. Therefore, multi-year assessments may not be made for a number of sites in some watersheds.

5.1 San Gabriel River Watershed Survey Results for 2003–2010

The San Gabriel River Watershed has been sampled in 18 different locations from 2003 through 2010 (Figure 14). One site, 5, SGLT-506–Walnut Channel, has been sampled in all eight surveys, but the remaining sites have been sampled a maximum of five times. Many sites have been sampled only once. Sites with "SG" in the site code prefix were offset sites for the SGRRMP study, and two of these sites, SGLR01278 (SMC01278) and SGLR02656 (SMC02656), were also designated SMC sites in 2009.

The watershed is somewhat unique in that it lacks full hydrologic connectivity between the upper and lower watershed areas, and these two areas are very different in terms of geography and land use. The upper watershed is largely in the Angeles National Forest, is sparsely populated, and has many high-gradient natural streams. The lower watershed is highly urbanized with low-gradient streams, many of which have been modified through channelization for flood control. Separating the upper and lower watershed areas are several "spreading grounds" that retain water for groundwater recharge. The bioassessment monitoring sites have signaled this difference with higher IBI scores (Figure 15) and better physical habitat rankings for the upper watershed sites: 4, SGUT-501, SGUT-504, and SGUT-505.

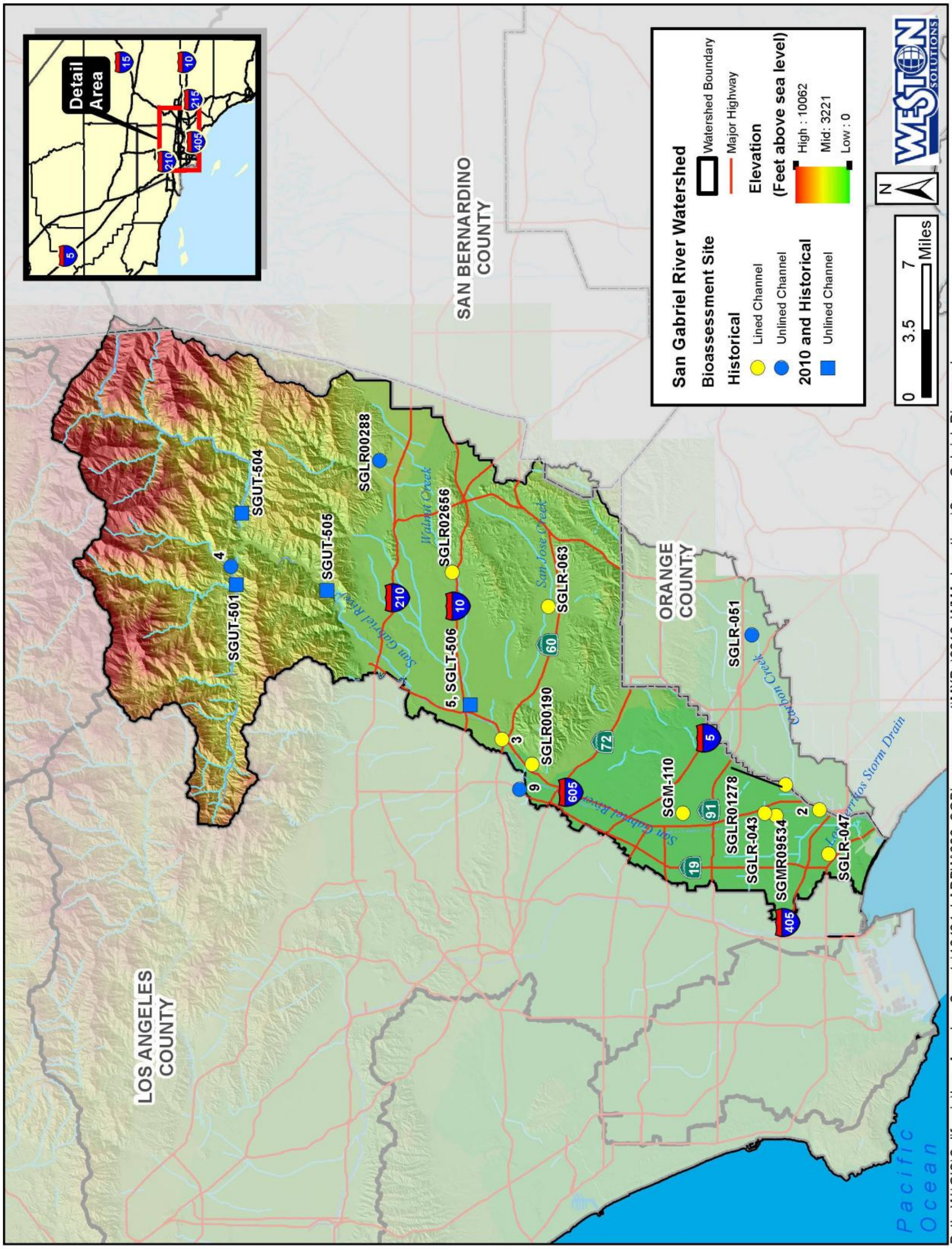


Figure 14. Bioassessment Monitoring Sites in the San Gabriel River Watershed for 2003–2010

Mean Metric Analysis for 2003–2010

Table 7 shows the mean biological metric values of four individual metrics that are considered strong indicators of ecological health. Therein, concrete-lined channel sites are highlighted in yellow and unlined channel sites are highlighted in blue. Reference sites are signified with an asterisk following their site names. For consistency with historical surveys, the 2009 and 2010 taxa richness values were adjusted to taxonomic Level I from Level II, for their comparison with previous data.

SGUT-501–San Gabriel River biological metric values indicated a substantially higher-quality benthic community than at any other site. Values for mean taxa richness and EPT taxa were over sixty-five percent higher than the next highest values at SGUT-504–San Gabriel River, and the percent intolerant taxa was over four times greater. There was also a clear difference between the lower and upper watershed sites. The lower watershed sites had a maximum mean taxa richness of 21.0, whereas taxa richness in the upper watershed sites ranged from 24.0 to 43.0. The maximum mean number of EPT taxa in the lower watershed was 5, whereas in the upper watershed the mean number EPT taxa ranged from 9.0 to 20.5. Intolerant taxa were absent from all lower watershed sites and comprised from 3.1–45.2% of the benthic community in the upper watershed. The percent collector–filterers plus collector–gatherers (i.e., collector taxa) ranged from 47.7% at SGUT-501 to 100.0% at SGM-110. The ubiquity of these organisms means that, independently, the metric is not always an accurate indicator of impairment, and based on the IBI scoring ranges, a percentage of less than 80% collector taxa is indicative of Good biotic conditions. The reference sites in the watershed ranged from 47.7–85.0% collector taxa.

Table 7. San Gabriel River Watershed Selected Metric Values, Annual Surveys for 2003–2010

Monitoring Reach	Station Number	Number Samples	Taxa Richness**	EPT Taxa	Percent Intolerant Taxa	Percent Collector-Filterers plus Collector-Gatherers
San Gabriel River	4*	2	24.0	12.0	3.1%	85.0%
San Gabriel River	SGUT-501*	2	43.0	20.5	45.2%	47.7%
San Gabriel River	SGUT-504*	5	28.0	12.2	10.8%	74.6%
San Gabriel River	SGUT-505	5	25.2	9.0	5.8%	69.1%
San Gabriel River	SGL00190	1	7.0	0.0	0.0%	73.5%
San Gabriel River	SGLR-043	1	13.0	0.0	0.0%	74.0%
San Gabriel River	SGLR-047	1	11.0	0.0	0.0%	90.0%
San Gabriel River	SGLR-063	1	14.0	3.0	0.0%	79.4%
San Gabriel River	SGM-110	1	4.0	1.0	0.0%	100.0%
San Gabriel River	SGLR01278	1	9.0	1.0	0.0%	97.2%
San Gabriel River	SGLR02656	1	11.0	3.0	0.0%	81.6%
San Gabriel River	SGLR00288	1	14.0	2.0	0.0%	50.6%
San Gabriel River	SGMR09534	1	10.0	1.0	0.0%	95.8%
Walnut Channel	5, SGLT-506	8	12.9	1.8	0.0%	87.6%
Zone 1 Ditch	9	1	21.0	5.0	0.0%	74.0%
Coyote Creek	2	2	11.0	2.3	0.0%	92.7%

Table 7. San Gabriel River Watershed Selected Metric Values, Annual Surveys for 2003–2010

Monitoring Reach	Station Number	Number Samples	Taxa Richness**	EPT Taxa	Percent Intolerant Taxa	Percent Collector-Filterers plus Collector-Gatherers
San Jose Creek	3	2	10.5	2.0	0.0%	84.0%
Carbon Creek	SGLR-051	1	15.0	3.0	0.0%	72.0%
yellow highlight = concrete-lined channel site blue highlight = unlined channel site * = reference site **2009 and 2010 taxa richness values adjusted from Level II to Level I taxonomy values						

Comparison of Index of Biotic Integrity Scores for 2003–2010

SGUT-501–San Gabriel River was the highest ranking site for IBI scores in the watershed (Table 8). It was also at the highest elevation (Table 1), had the coldest water temperature, and had the lowest specific conductivity out of all the San Gabriel River Watershed sites (Appendix B.4). Of all the sites monitored, the three designated reference sites (i.e., SGUT-501, SGUT-504, and 4) were always rated unimpaired, whereas most other sites were rated impaired in all surveys. SGUT-505 was the only site that had IBI scores on both sides of the impairment threshold of 26 points out of a possible 70; this site scored above the impairment threshold twice, with IBI scores of 33 and 29 in 2009 and 2010, respectively. None of the sites have shown any significant upward or downward trends for the sites sampled four or more times (i.e., SGUT-504, SGUT-505, and 5, SGLT-506). The total scoring ranges for these sites were up to 17 points, with no consistency among sites for better or worse years (e.g., the highest IBI scores were in 2010, 2009, and 2007, respectively, for SGUT-504, SGUT-505, and 5, SGLT-506). The causes for the relatively wide range of scores for SGUT-504 and 5, SGLT-506 is unclear, but is possibly due to natural biological variability. In 2007, when 5, SGLT-506 had its highest IBI score, there were few Ostracods compared to 2010, 69 versus 759 individuals, respectively. The 2007 assemblage also had a much greater taxa richness of predators (most notably, large dragonfly nymphs), which likely reduced the Ostracod abundance through predation. These fluctuations in population dynamics may occur naturally and are not necessarily due to any ecological stressor.

Table 8. San Gabriel River Watershed, Comparison of Index of Biotic Integrity Scores for 2003–2010

Monitoring Reach	Station Number	IBI Score 2003	IBI Score 2004	IBI Score 2005	IBI Score 2006	IBI Score 2007	IBI Score 2008	IBI Score 2009	IBI Score 2010	Mean IBI Score	IBI Range
San Gabriel River	4*	30	38							34.0	8
San Gabriel River	SGUT-501*							62	56	59.0	6
San Gabriel River	SGUT-504*				42	34	33	34	50	38.6	17
San Gabriel River	SGUT-505				20	25	18	33	29	25.0	15
San Gabriel River	SGLR00288							15		15.0	NA
San Gabriel River	SGLR02656							10		10.0	NA
San Gabriel River	SGL00190						6			6.0	NA
San Gabriel River	SGLR-043			21						21.0	NA

Table 8. San Gabriel River Watershed, Comparison of Index of Biotic Integrity Scores for 2003–2010

Monitoring Reach	Station Number	IBI Score 2003	IBI Score 2004	IBI Score 2005	IBI Score 2006	IBI Score 2007	IBI Score 2008	IBI Score 2009	IBI Score 2010	Mean IBI Score	IBI Range
San Gabriel River	SGLR-047			14						14.0	NA
San Gabriel River	SGLR-063				17					17.0	NA
San Gabriel River	SGM-110					19				19.0	NA
San Gabriel River	SGLR01278							1		1.0	NA
San Gabriel River	SGMR9534							1		1.0	NA
San Gabriel River	SGLR-051			10						10.0	NA
Walnut Channel	5, SGLT-506	7	7	8	9	17	5	5	0	7.3	17
Zone 1 Ditch	9	20								20.0	NA
Coyote Creek	2	3	9							6.0	6
San Jose Creek	3	8	10							9.0	2

yellow highlight = concrete-lined channel site
blue highlight = unlined channel site
no highlight = not sampled
* = reference site
NA = Not Applicable

Comparison of Concrete-Lined Channels and Unlined Channels for 2003–2010

All concrete-lined channel sites monitored in the San Gabriel River Watershed were in the lower watershed. A majority of these were sampled one year only and all had IBI scores under 26, indicating impaired biotic integrity (Figure 15). The Wilcoxon Ranked Sum test was run with and without the reference sites, without making any exclusions based on location (i.e., upper or lower) in the watershed. When reference sites were excluded, a p-value of 0.156 resulted, and the mean IBI scores of the concrete-lined sites were not statistically lower than the unlined sites in the lower watershed (p-value less than 0.05 is significant; i.e., the chance of having this result is less than 0.5%), and we can safely (or significantly) reject the null hypothesis. When reference sites from the upper watershed were also considered, the p-value decreased to 0.008, which signifies that the unlined sites were statistically superior to the concrete-lined sites.

Using a whisker–box plot to compare the two channel types, the mean IBI scores of the concrete-lined sites were very similar to the unlined sites in the lower watershed (Figure 16). When the reference sites were added to the analysis, a statistically significant difference between site types resulted (i.e., the median line of unlined sites was above the 75^{th} percentile line of the concrete-lined sites), and the unlined sites were superior to concrete-lined sites. This was likely due to the more natural water source and better physical habitat quality of the reference sites relative to the concrete-lined sites.

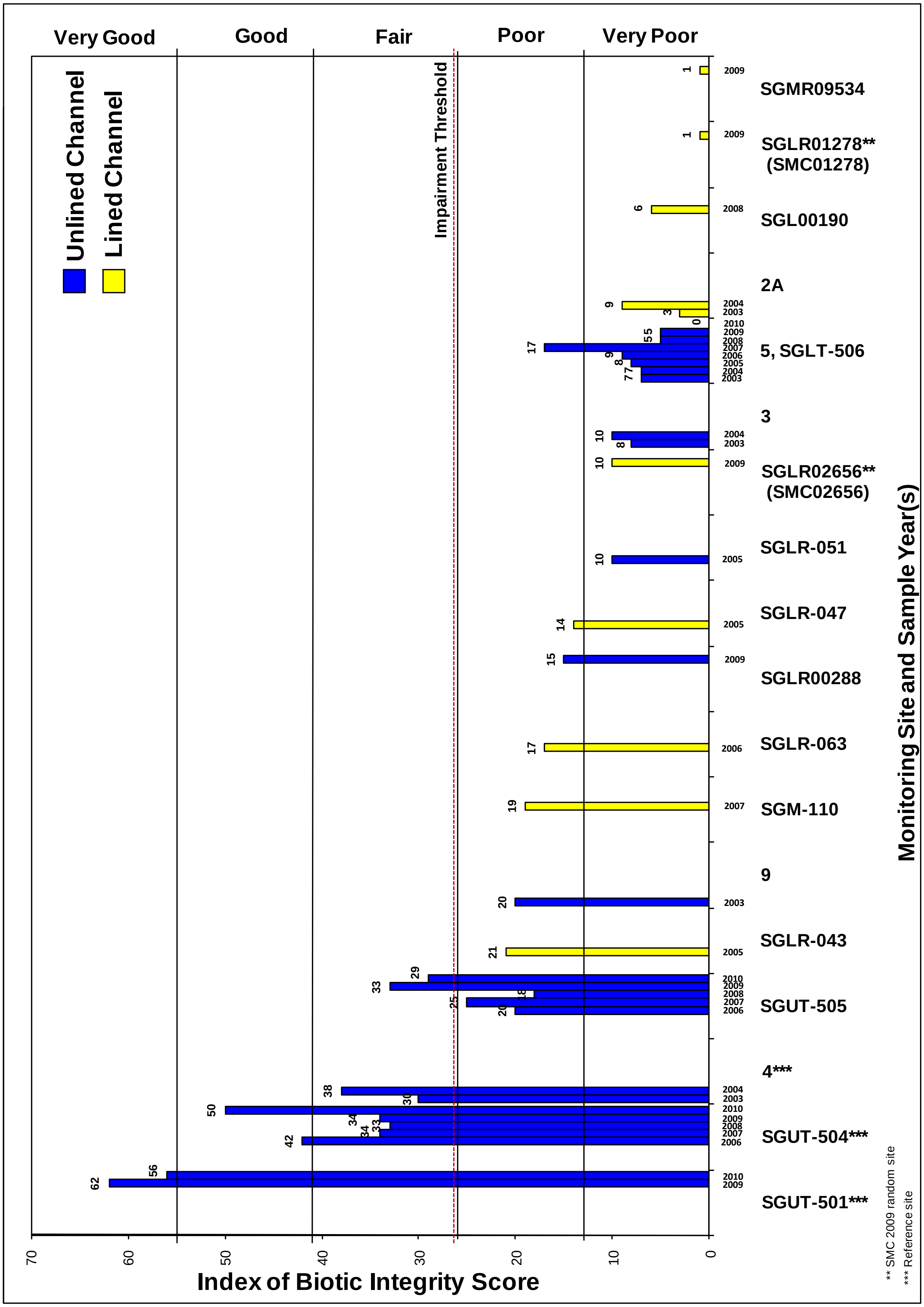


Figure 15. Index of Biotic Integrity Scores for Concrete-Lined and Unlined Channel Sites, San Gabriel River Watershed for 2003–2010

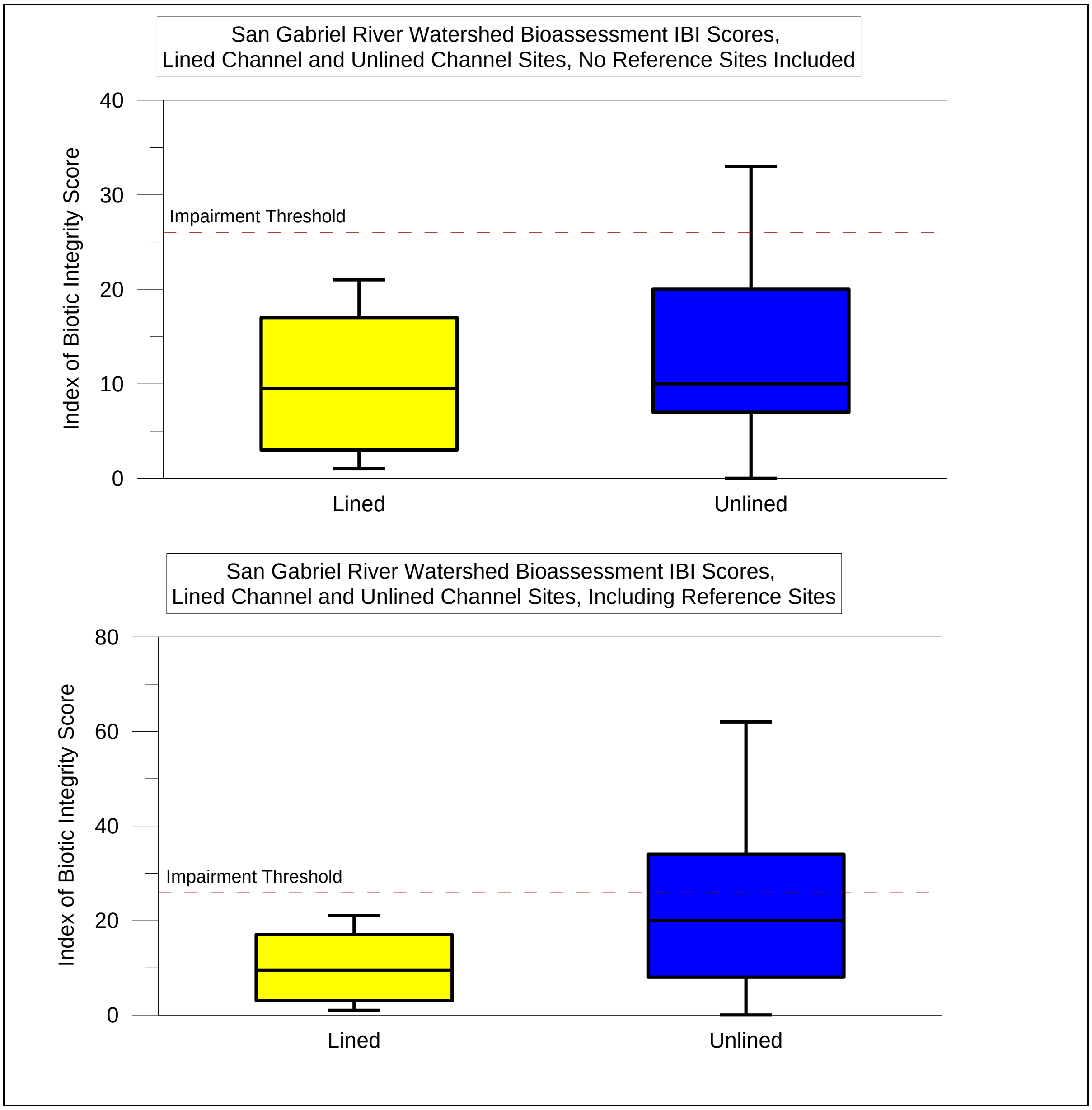


Figure 16. Comparison of Concrete-Lined and Unlined Channel Sites, San Gabriel River Watershed for 2003–2010

Comparison of Index of Biotic Integrity Scores and Elevation for 2003–2010

To examine the relationship of IBI scores and elevation, a Spearman rank correlation was conducted for IBI score versus elevation. The correlation coefficient for IBI versus elevation was 0.577. The correlation was significant, based on a critical value of 0.335 (35 samples and an alpha of 0.05). These results indicate that site IBI scores were significantly correlated to elevation.

An illustration of these results is shown in Figure 17, a linear correlation of IBI scores and elevation. The coefficient of determination is shown on the graph as a measure of how well the data points fit a linear line. It is evident that the relationship between IBI scores and elevation is significant, and the lower elevation sites had lower IBI scores.

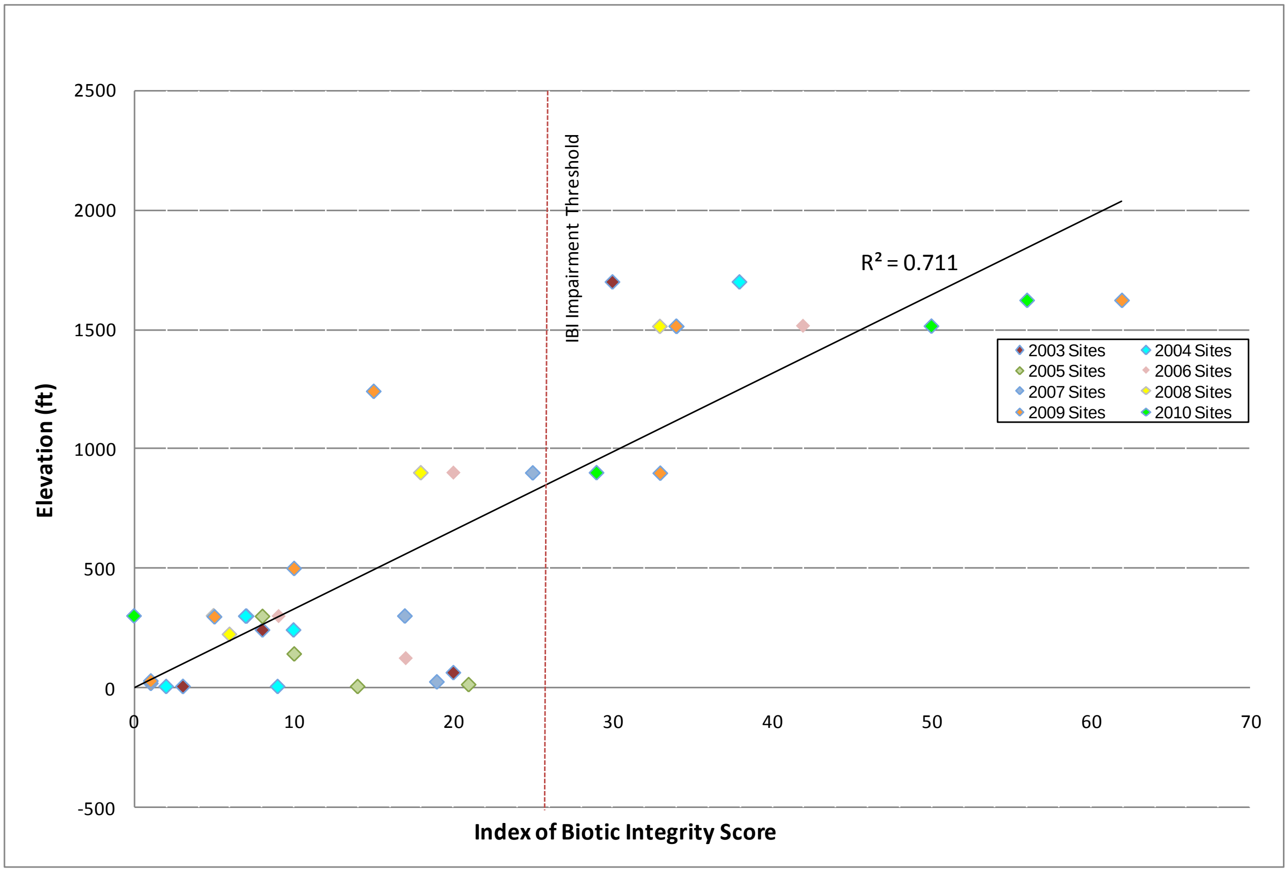


Figure 17. Correlation of Index of Biotic Integrity Scores and Elevation, San Gabriel River Watershed for 2003–2010

5.2 Los Angeles River Watershed Survey Results for 2003–2010

The Los Angeles River Watershed is similar to the San Gabriel River Watershed in that much of the upper watershed is in the Angeles National Forest, whereas the lower watershed is highly urbanized and has been modified with flood control channels, reservoirs, and spreading grounds. The Los Angeles River Watershed bioassessment monitoring sites have mostly been in the lower watershed, except 6–Arroyo Seco (Figure 18). 6–Arroyo Seco was located near the base of Millard Canyon just above the Arroyo Seco Spreading Grounds and received little or no urban runoff. The spreading grounds disrupt the hydrologic connectivity such that 7–Arroyo Seco, located approximately 4 miles downstream of 6–Arroyo Seco, was dominated by urban runoff. All other monitoring sites were in highly modified waterways in the lower watershed with either fully or partially concrete-lined channels. Because large areas of wilderness in the upper watershed exist that have not been monitored in the Bioassessment Program, the full range of reference conditions are not represented in this report.

The watershed has been sampled in nine locations from 2003 through 2010. 8, LALT-502–Compton Creek and 7–Arroyo Seco have been sampled in every survey, and all other sites have been sampled at least three times. Sites with "LALT" in the site code prefix were offset sites for the LARWMP study beginning in 2008, which have been sampled in tributaries to the Los Angeles River immediately above their confluence with the Los Angeles River.

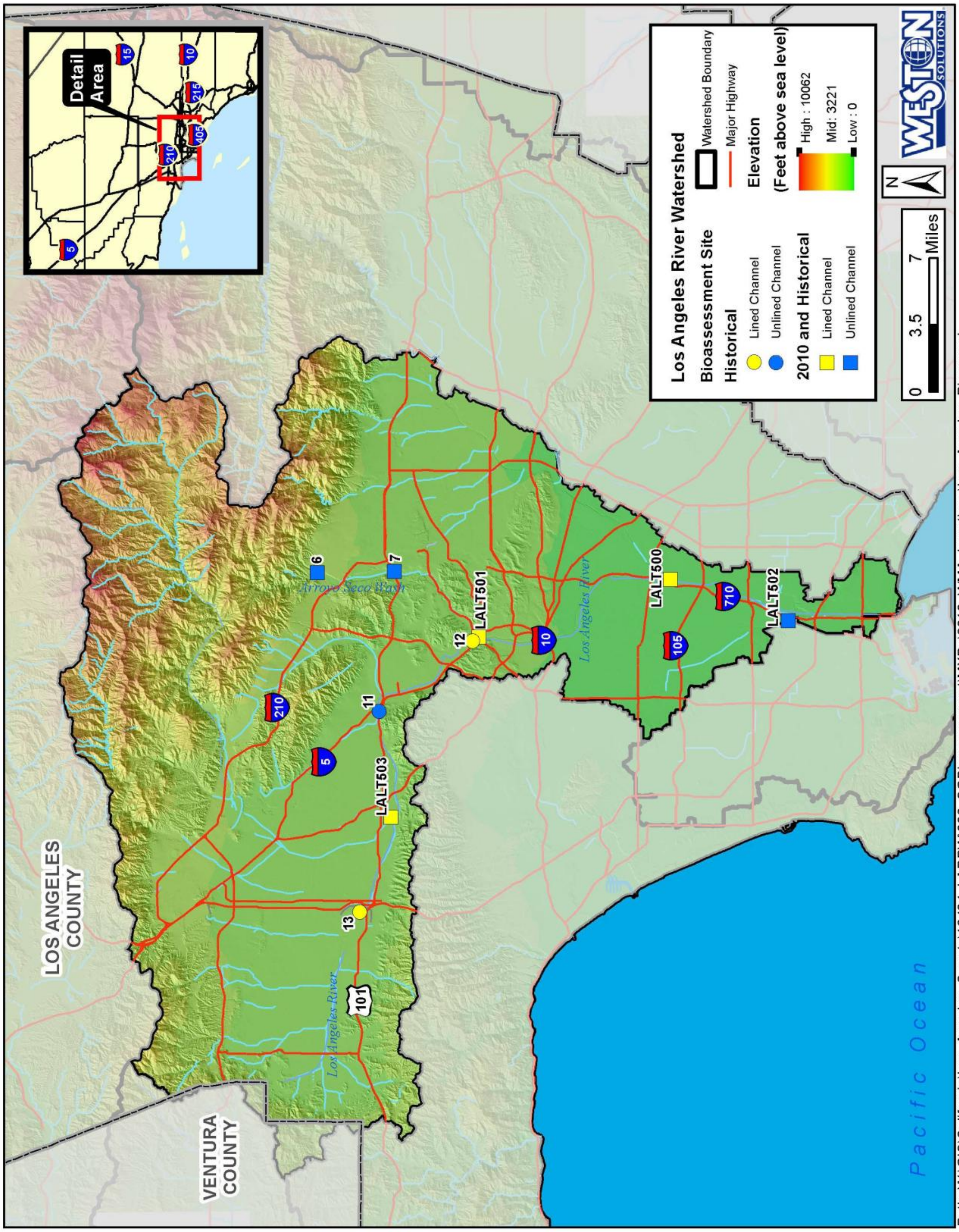


Figure 18. Bioassessment Monitoring Sites in the Los Angeles River Watershed for 2003–2010

Mean Metric Analysis for 2003–2010

Table 9 shows the mean biological metric values of four individual metrics that are considered strong indicators of ecological health. Therein, concrete-lined channel sites are highlighted in yellow, and unlined channel sites are highlighted in blue. Reference sites are signified with asterisks following their site names. 6–Arroyo Seco biological metric values indicated a higher-quality benthic community than any other site in the watershed. Values for taxa richnes and EPT taxa were substantially higher at 6–Arroyo Seco (32.0 and 10.1, respectively), and it was the only site where intolerant taxa were collected. The lower watershed sites had a maximum mean taxa richness of 15.8 and a maximum mean number of EPT taxa of 3.0. The mean percent collector–filterers plus collector–gatherers ranged from 82.7–98.2% in the lower watershed and was 56.1% at 6–Arroyo Seco. These metrics indicate Poor biotic conditions in the lower watershed, whereas 6–Arroyo Seco had Good biotic conditions.

Table 9. Los Angeles River Watershed Selected Metric Values, Annual Surveys for 2003–2010

Monitoring Reach	Station Number	Number Samples	Taxa Richness**	EPT Taxa	Percent Intolerant Taxa	Percent Collector-Filterers plus Collector-Gatherers
Arroyo Seco	6*	6	32.0	10.1	2.5%	56.1%
Arroyo Seco	7	8	15.8	2.8	0.0%	82.7%
Arroyo Seco	LALT501	3	12.7	3.0	0.0%	96.8%
Tujunga Wash	LALT503	3	12.7	1.7	0.0%	91.6%
Rio Hondo	LALT500	3	12.3	1.3	0.0%	94.3%
Compton Creek	8, LALT502	8	12.7	1.3	0.0%	92.3%
Los Angeles River	11	5	10.0	1.0	0.0%	98.2%
Los Angeles River	12	5	9.6	2.2	0.0%	90.3%
Los Angeles River	13	5	11.4	2.0	0.0%	94.7%

yellow highlight = concrete-lined channel site
blue highlight = unlined channel site
*= reference site
**2009 and 2010 taxa richness values adjusted from Level II to Level I taxonomy values

Comparison of Index of Biotic Index Scores for 2003–2010

6–Arroyo Seco was the highest-rated site in every survey since the beginning of the Bioassessment Program, with a mean IBI score of 40.5 out of 70 and a quality rating of Good (Table 10). This site also had the greatest range of IBI scores (27 points) with an IBI score of 23 in 2010 that was significantly lower than for any other survey. This was likely due to the fire and subsequent erosion in the upper watershed that deposited substantial alluvial material in the sampling reach (see photos below). All other sites had IBI scores ranging from Poor to Very Poor. 7–Arroyo Seco was the second highest-rated site with a mean IBI score of 14.5 and a quality rating of Poor, although its 2010 IBI score increased at least 4 points from any previous sample year. Additionally, this was the only site in the watershed that may have been trending upward over the eight years of samples and this is evident graphically in Figure 19. Two sites, LALT501–Arroyo Seco and LALT503–Tujunga Wash had significantly higher IBI scores in 2010 than in any previous survey, with scores of 19 and 18, respectively, and the second and third highest ranges in scores, respectively, over the years. In 2010, LALT500–Rio Hondo had an IBI score that was clearly higher than past years' scores. 8, LALT502's IBI score remained the same as in 2009 and was the same or better as all other previous years.

6–Arroyo Seco pre-fire, October 2008 (left) and post-fire, July 2010 (right)

Table 10. Los Angeles River Watershed, Comparison of Index of Biotic Integrity Scores for 2003–2010

Monitoring Reach	Station Number	IBI Score 2003	IBI Score 2004	IBI Score 2005	IBI Score 2006	IBI Score 2007	IBI Score 2008	IBI Score 2009	IBI Score 2010	Mean IBI Score	IBI Range
Los Angeles River	11	1	3	7	0	0				2.2	7
Los Angeles River	12	11	9	9	7	17				10.6	8
Los Angeles River	13	2	7	6	1	4				4.0	6
Tujunga Wash	LALT503						3	5	18	8.7	15
Arroyo Seco	6*			38	50	40	42	50	23	40.5	27
Arroyo Seco	7	11	9	12	17	11	18	16	22	14.5	13
Arroyo Seco	LALT501						2	6	19	9.0	17
Rio Hondo	LALT500						3	9	13	8.3	10
Compton Creek	8, LALT502	1	3	4	6	6	3	6	6	4.4	5

yellow highlight = concrete-lined channel site
blue highlight = unlined channel site
no highlight = not sampled
* = reference site

Comparison of Concrete-Lined Channels and Unlined Channels for 2003–2010

All of the concrete-lined channel sites monitored in the lower watershed had IBI scores indicating impaired biotic integrity (Figure 19). The Wilcoxon Ranked Sum test was run with and without the reference site. No exclusions were made based on location in the watershed. When reference sites were excluded, the p-value was 0.723, and the mean IBI scores of the concrete-lined sites were not statistically lower than the unlined sites in the lower watershed (p-value less than 0.05 is significant; i.e., the chance of having this result was greater than 5%). Therefore we can safely (or significantly) accept the null hypothesis that concrete-lined and unlined sites have similar IBI scores. When the reference site from the upper watershed was considered, the p-value decreased to 0.336, but the unlined sites were still statistically similar to the concrete-lined sites. However, had more high-quality, unlined upper watershed sites been sampled, there would likely have been a significant difference for IBI scores between the two site types.

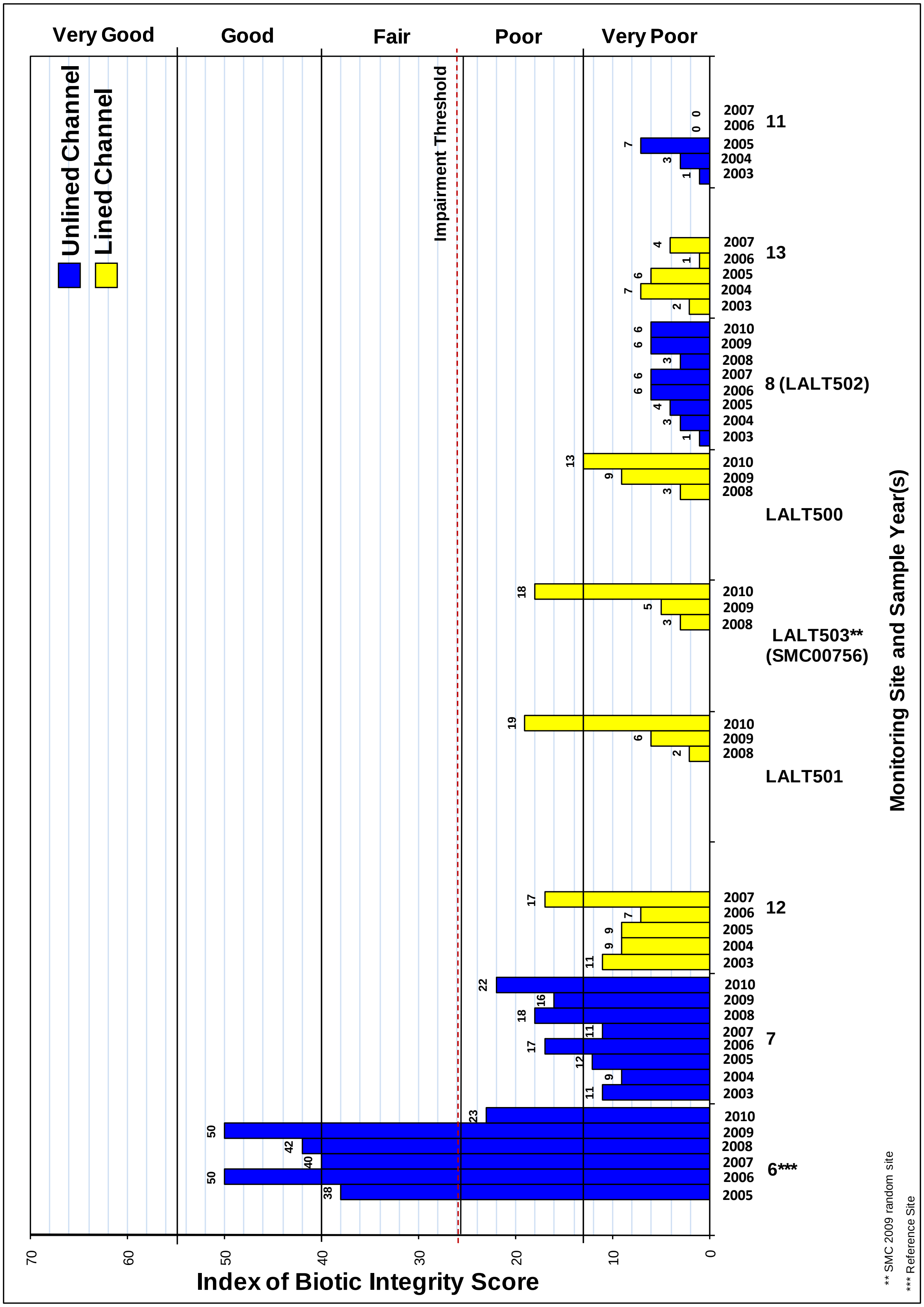


Figure 19. Index of Biotic Integrity Scores for Concrete-Lined and Unlined Channel Sites, Los Angeles River Watershed for 2003–2010

Using a whisker–box plot to compare the two channel types, the mean IBI scores of the concrete-lined sites were very similar to the unlined sites in the lower watershed (Figure 20). When the reference site was added to the analysis, a slight difference between site types resulted but not to a level of statistical significance. As with the Wilcoxon Ranked Sum test, this result is skewed by an under-representation of unlined sites in the upper watershed, as the IBI scores of 6–Arroyo Seco are clearly superior to all other sites in the watershed (Figure 19).

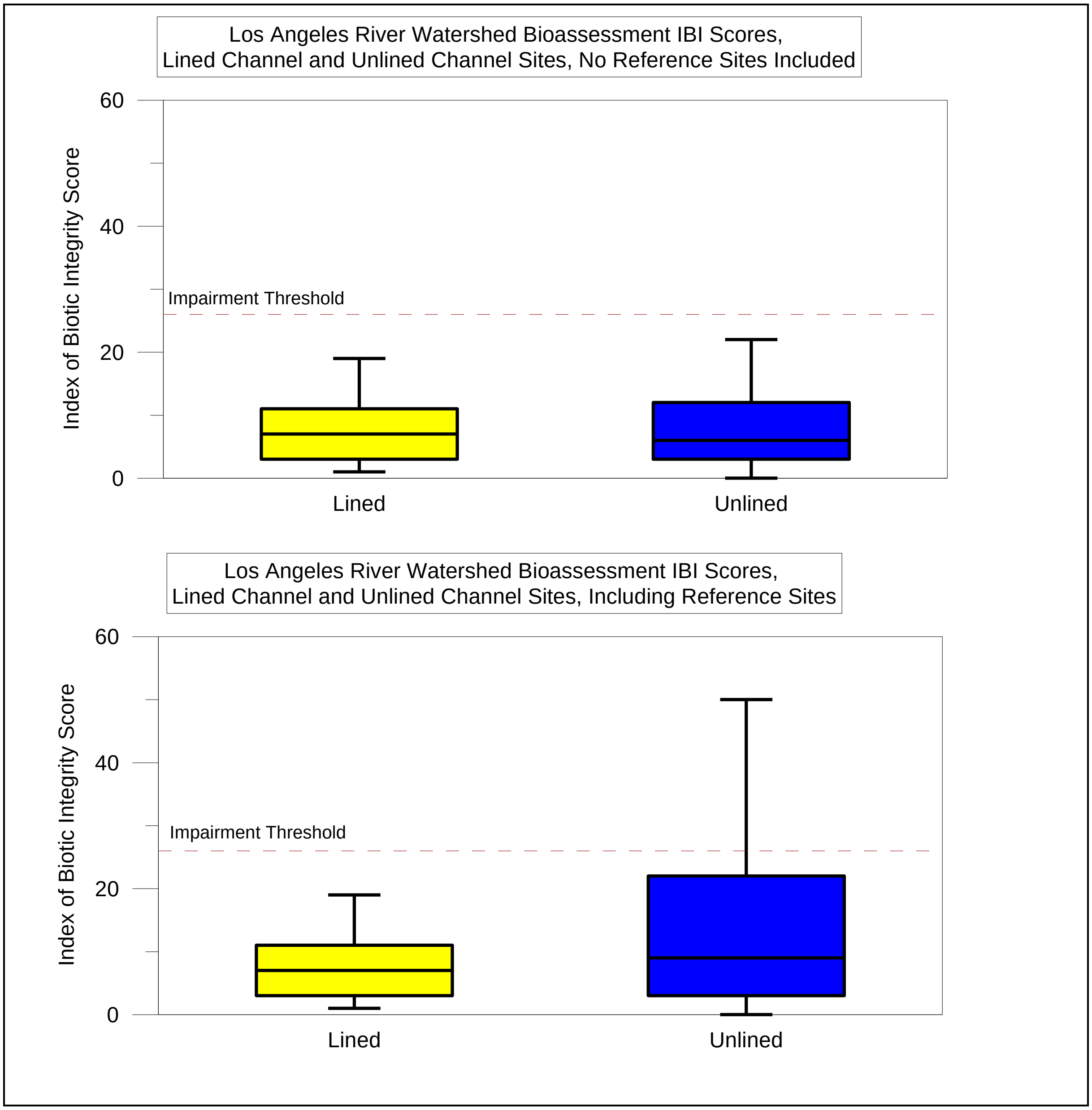


Figure 20. Comparison of Concrete-Lined and Unlined Channel Sites, Los Angeles River Watershed for 2003–2010

Comparison of Index of Biotic Integrity Scores and Elevation for 2003–2010

To examine the relationship of IBI scores and elevation, a Spearman rank correlation was conducted for IBI score versus elevation. The correlation coefficient for IBI versus elevation was 0.577. The correlation was significant based on a critical value of 0.291 (46 samples and an alpha of 0.05). This result indicates that site IBI scores were significantly and positively correlated with elevation.

An illustration of these results is shown in Figure 21, a linear correlation of IBI scores and elevation. The coefficient of determination is shown on the graph as a measure of how well the data points fit a linear line. It is evident that although the relationship is significant, there is a relatively wide range of elevation values for sites with low IBI scores.

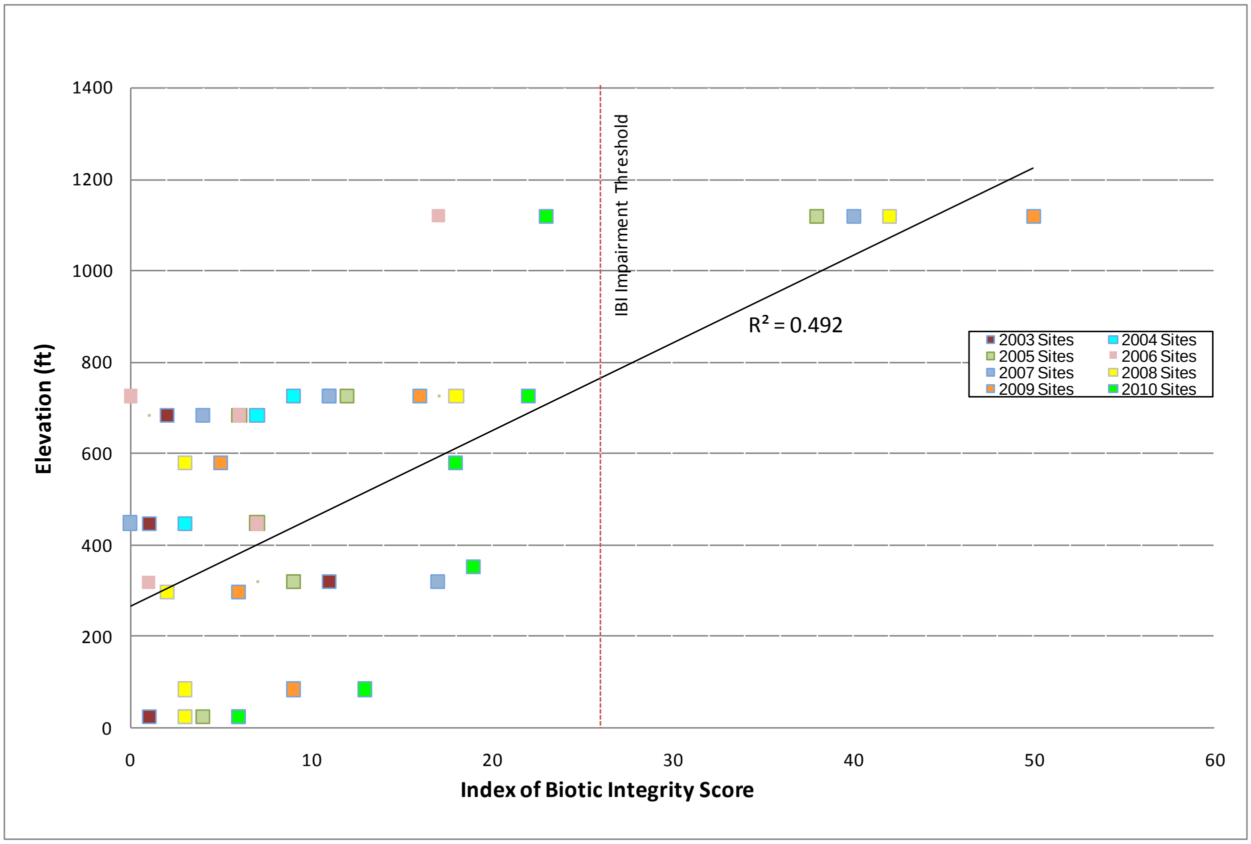


Figure 21. Correlation of Index of Biotic Integrity Scores and Elevation, Los Angeles River Watershed for 2003–2010

5.3 Dominguez Channel Watershed Survey Results for 2003–2010

The Dominguez Channel Watershed is located in the central portion of the Los Angeles Basin and is almost completely urbanized. The watershed boundary is defined not so much by topography but by a system of storm drains and flood control channels. The largest waterway is the Dominguez Channel, which discharges into the Los Angeles Harbor. A single bioassessment site, 19–Dominguez Channel, has been monitored in Dominguez Channel and has been sampled every year since 2003 (Figure 22). The site is within a fully concrete-lined channel and is just upstream of any tidal influence. Because only one site was monitored in this watershed, the comparative analyses with unlined sites and elevation performed for the other watersheds were not possible for this watershed.

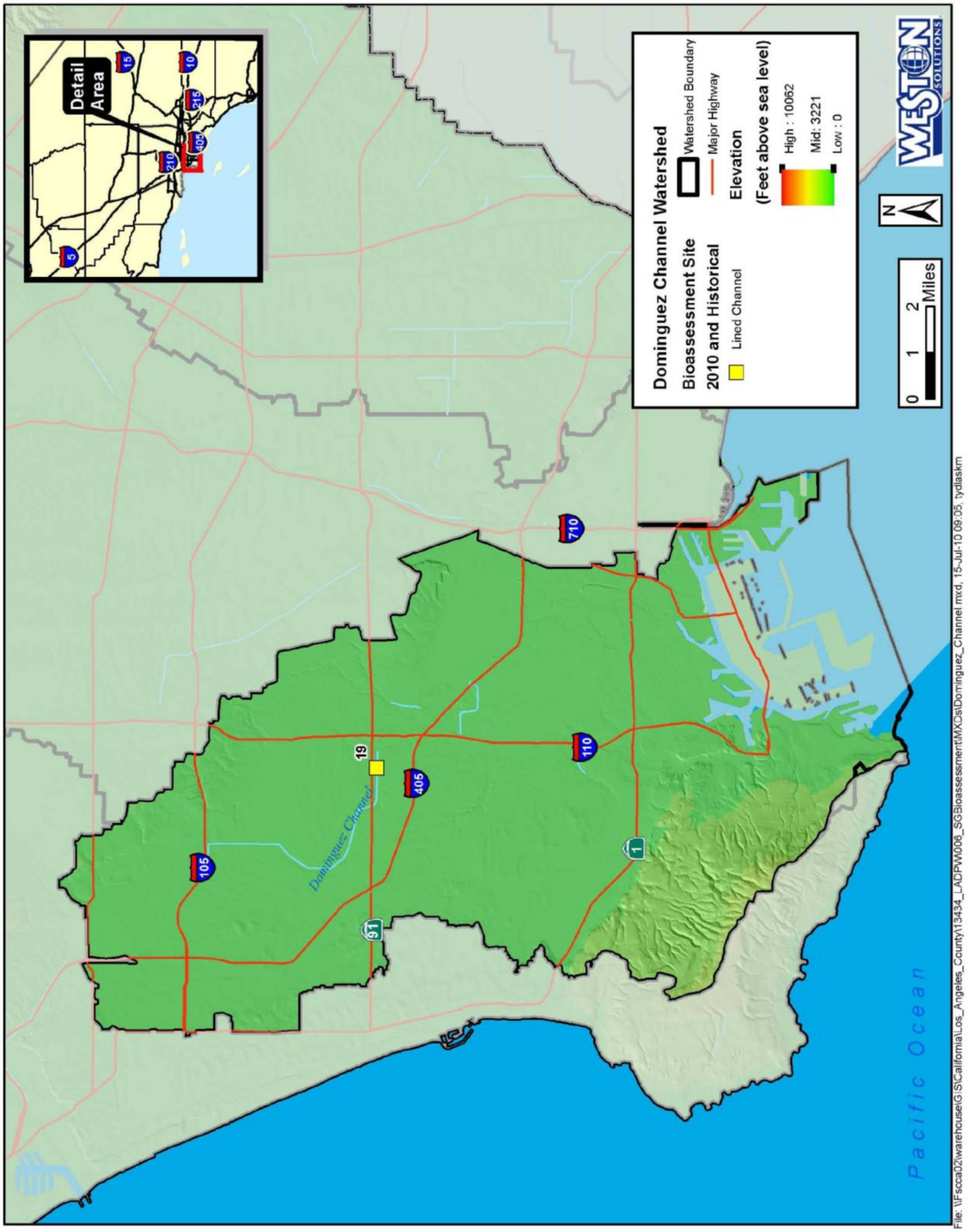


Figure 22. Bioassessment Monitoring Site in the Dominguez Channel Watershed for 2003–2010

Mean Metric Analysis for 2003–2010

Table 11 shows the mean biological metric values for 19–Dominguez Channel, which was sampled in a concrete-lined channel. All of the metrics indicated a low-quality benthic community at the site (i.e., taxa richness and EPT taxa were low, intolerant taxa were absent, and the percent collector taxa was high).

Table 11. Dominguez Channel Watershed Selected Metric Values, Mean of Annual Surveys for 2003–2010

Monitoring Reach	Station Number	Number Samples	Taxa Richness**	EPT Taxa	Percent Intolerant Taxa	Percent Collector-Filterers plus Collector-Gatherers
Dominguez Channel	19	8	9.1	0.13	0.0%	94.7%

yellow highlight = concrete-lined channel site

**2009 and 2010 taxa richness values adjusted from Level II to Level I taxonomy values

The IBI scores for 19–Dominguez Channel have been consistently in the Very Poor range, with a mean IBI score of 2.4 (Table 12 and Figure 23). The scores were consistent for the survey years of 2005-2009, with scores of 0 or 1. The 2010 IBI score was the highest to date with a score of 7, but was still statistically similar to all previous surveys. Figure 24 also shows the IBI score ranges in a box plot, which indicates the slight improvement of the mean and upper range since 2009 (WESTON, 2010).

Table 12. Dominguez Channel Watershed, Comparison of Index of Biotic Integrity Scores for 2003–2010

Monitoring Reach	Station Number	IBI Score 2003	IBI Score 2004	IBI Score 2005	IBI Score 2006	IBI Score 2007	IBI Score 2008	IBI Score 2009	IBI Score 2010	Mean IBI Score	Range
Dominguez Channel	19	3	6	0	1	0	1	1	7	2.4	7

yellow highlight = concrete-lined channel site

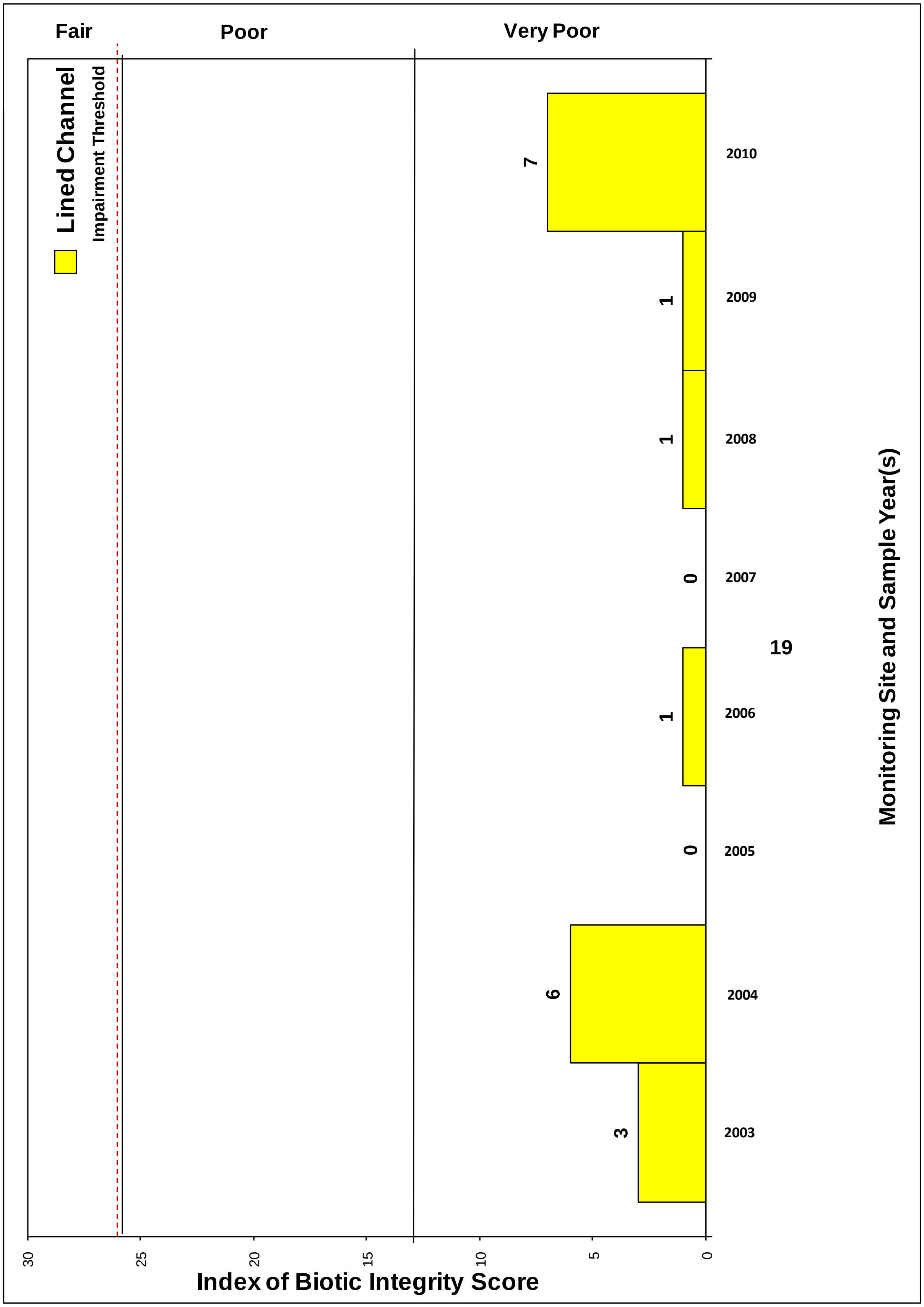


Figure 23. Index of Biotic Integrity Scores for Concrete-Lined Channel Sites, Dominguez Channel Watershed for 2003–2010

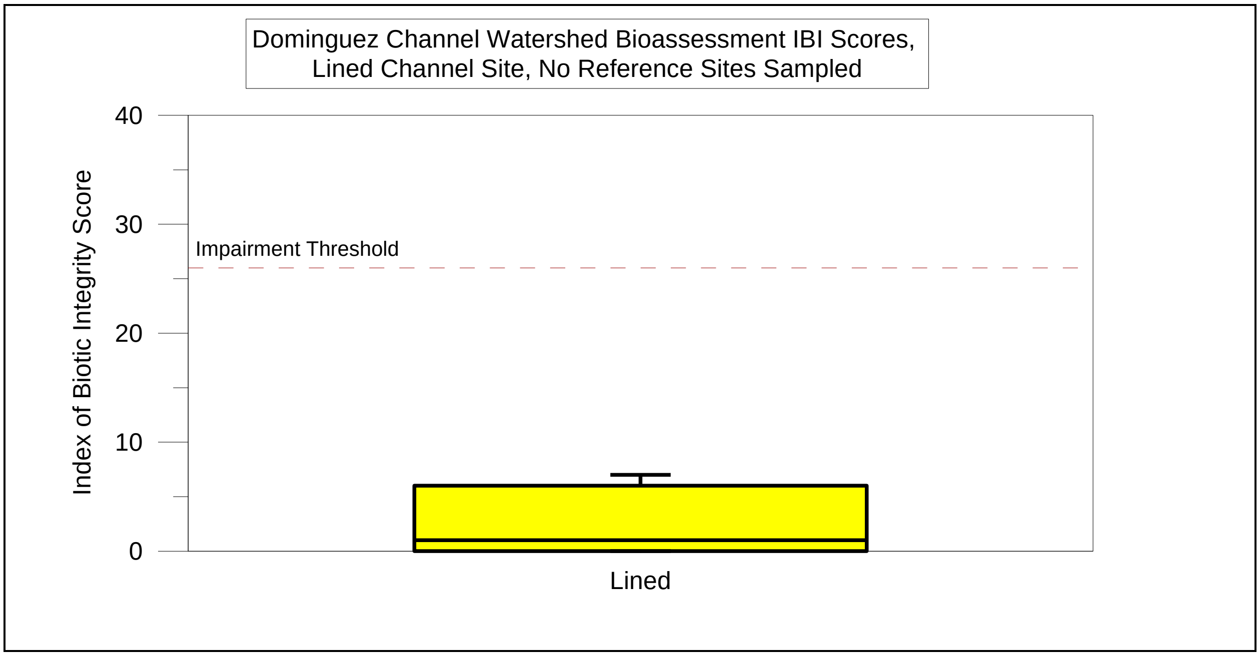


Figure 24. Comparison of Concrete-Lined and Unlined Channel Sites, Dominguez Channel Watershed for 2003–2010

5.4 Santa Monica Bay Watershed Survey Results for 2003–2010

The Santa Monica Bay Watershed encompasses the Ballona Creek Watershed, the Malibu Creek Watershed, and several other small coastal drainages (e.g., Topanga Canyon, Trancas Canyon, and Rustic Canyon) (Figure 25). The Malibu Watershed and the adjacent watersheds contain large undisturbed areas of park land and natural preserves in the Santa Monica Mountains. In contrast to the other Los Angeles County watersheds, most of the urban runoff and related impacts occur in the upper reaches of the watersheds from urban centers along the Highway 101 corridor. The Ballona Creek Watershed is in a highly urbanized portion of the County.

The watershed has been sampled in fourteen different locations from 2003 through 2010. Historically, four targeted monitoring sites were located in the upper Malibu Creek Watershed area, including one reference site, 17–Cold Creek. All of these were in unlined channels. A historical Ballona Creek monitoring site, 14–Ballona Creek, was also sampled, within a fully concrete-lined channel. In 2009, all five historical sites were replaced with randomly placed SMC sites. These were in turn replaced by four new randomly placed SMC sites in 2010, one of which, SMC03944–Cheseboro Channel, was located in a concrete-lined channel. One notable organism that was collected in SMC02152–Malibu Creek was an extremely abundant snail in the family Hydrobiidae (Appendix B.1). While none of the specimens were able to be identified to genus level, the sexually mature specimens did not have the taxonomic characters of the invasive New Zealand mud snail (*Potamopyrgus antipodarum*).

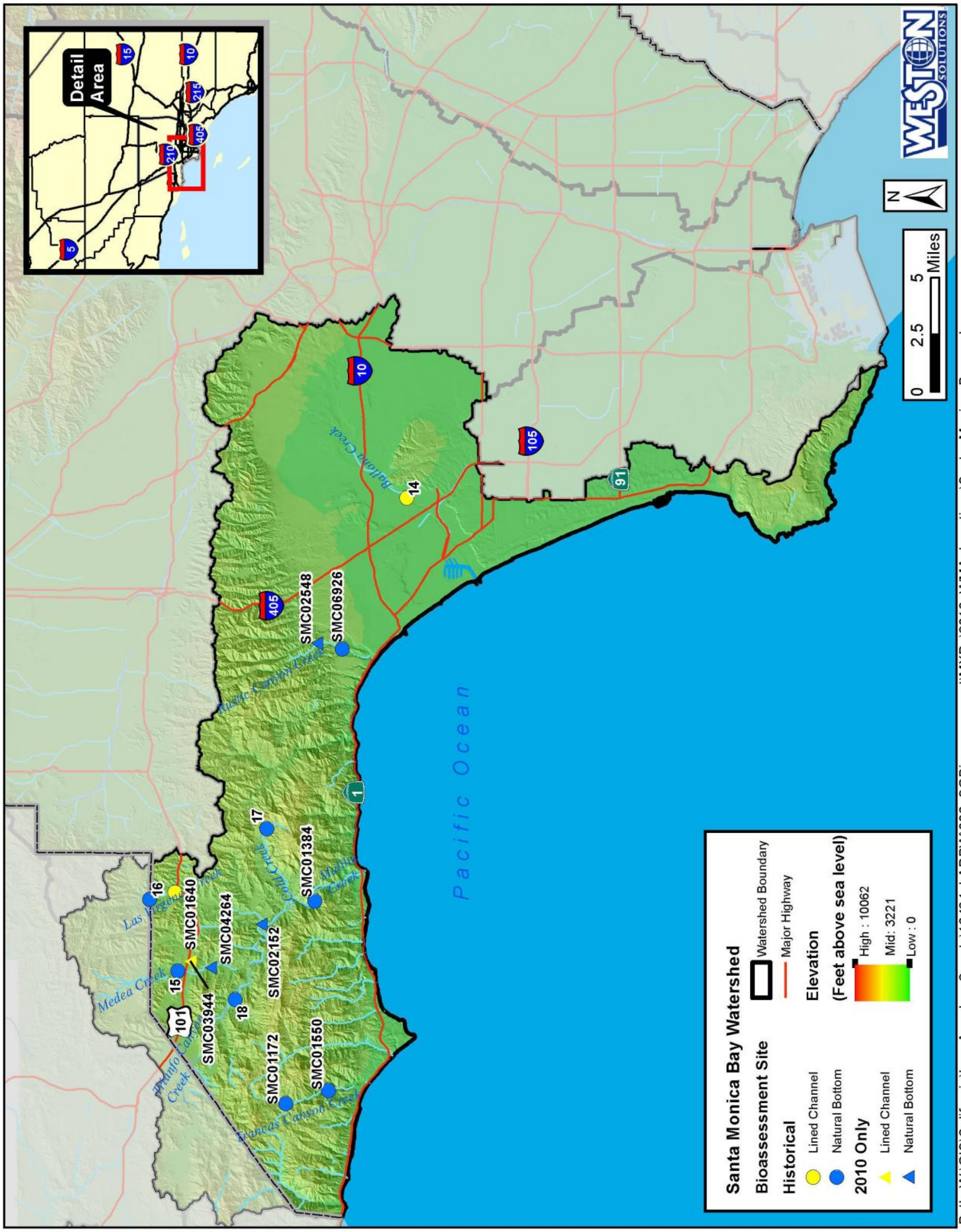


Figure 25. Bioassessment Monitoring Sites in the Santa Monica Bay Watershed for 2003–2010

Mean Metric Analysis for 2003–2010

Table 13 shows the mean biological metric values of four individual metrics that are considered strong indicators of ecological health. Therein, concrete-lined channel sites are highlighted in yellow, and unlined channel sites are highlighted in blue. Reference sites are signified with an asterisk following their site names. Mean metric values for reference 17–Cold Creek and SMC02548–Rustic Canyon Creek indicated a higher-quality benthic community than all other sites in this watershed. These two sites had very high percentages of intolerant (sensitive) taxa and moderately high diversity of EPT taxa. Four of the sites were of substantially poorer quality than the majority, including 14–Ballona Creek, 15–Medea Creek, and SMC01640–Las Virgenes Creek and SMC03944–Cheseboro Channel. These four sites had mean taxa richness of less than 12, less than two EPT taxa, no intolerant taxa, and greater than 82% collector taxa. All other sites had moderate taxa richness, low to moderate EPT taxa, and most had intolerant taxa present.

Table 13. Santa Monica Bay Watershed Selected Metric Values, Annual Surveys for 2003–2010

Monitoring Reach	Station Number	Number Samples	Taxa Richness**	EPT Taxa	Percent Intolerant Taxa	Percent Collector-Filterers plus Collector-Gatherers
Ballona Creek	14	6	10.5	1.8	0.0%	94.8%
Rustic Canyon Creek	SMC06926	1	21.0	5.0	1.0%	40.2%
Rustic Canyon Creek	SMC02548	1	22.0	11.0	70.0%	16.6%
Trancas Canyon Creek	SMC01550	1	21.0	4.0	13.8%	68.0%
Trancas Canyon Creek	SMC01172, SMC01172Dup	2	24.5	4.0	3.5%	64.7%
Las Virgenes Creek	16	4	16.8	1.9	1.3%	89.8%
Las Virgenes Creek	SMC01640	1	4.0	0.0	0.0%	96.0%
Cold Creek	17*	6	31.5	11.0	34.5%	22.3%
Triunfo Creek	18	5	26.8	2.8	0.4%	64.4%
Malibu Creek	SMC01384	1	22.0	7.0	3.0%	33.8%
Malibu Creek	SMC02152	1	20.0	3.0	0.0%	24.2%
Cheseboro Canyon Channel	SMC03944	1	6.0	1.0	0.0%	95.8%
Medea Creek	15	6	11.7	1.0	0.0%	82.4%
Medea Creek	SMC04264	1	13.0	2.0	0.0%	51.0%

yellow highlight = concrete-lined channel site
blue highlight = unlined channel site
* = reference site
**2009 and 2010 taxa richness values adjusted from Level II to Level I taxonomy values

Comparison of Index of Biotic Integrity Scores for 2003–2010

Except 17–Cold Creek, the IBI scores in the Santa Monica Bay Watershed have historically shown impaired biotic conditions in the middle to upper watershed areas (Table 14). 17–Cold Creek was consistently the highest-rated site in the Bioassessment Program. Four of the five SMC sites sampled in the Santa Monica Bay Watershed in 2009 had IBI scores near the impairment threshold of 26 points, with two of those sites rated unimpaired and three others rated impaired. In 2010, SMC02548–Rustic Canyon Creek was the only SMC site in this watershed that was rated unimpaired with an IBI score of 51, which was very similar to the mean

IBI of Cold Creek. There have been two sites sampled in Rustic Canyon, one in 2009 and one in 2010. The sites were relatively close together, approximately one mile apart and with a 200 ft elevation difference, yet the quality of the BMI communities was significantly higher at the upstream site (Table 13, Table 14, and WESTON, 2010). This was likely due to the fact that the higher quality site, SMC02548, was above the influence of urban runoff while the lower site, SMC06926, was within the urban landscape. The proximity of these two sites provides an excellent example of the presumed limitations that urban runoff may have on BMI assemblages.

Table 14. Santa Monica Bay Watershed, Comparison of Index of Biotic Integrity Scores for 2003–2010

Monitoring Reach	Station Number	IBI Score 2003	IBI Score 2004	IBI Score 2005	IBI Score 2006	IBI Score 2007	IBI Score 2008	IBI Score 2009	IBI Score 2010	Mean IBI Score	Range
Ballona Creek	14	6	10	7	5	10	4			7.0	6
Rustic Canyon Creek	SMC02548								51	51.0	NA
Rustic Canyon Creek	SMC06926							26		26.0	NA
Trancas Canyon Creek	SMC01172 DUP							31		31.0	NA
Trancas Canyon Creek	SMC01172							29		29.0	NA
Trancas Canyon Creek	SMC01550							26		26.0	NA
Las Virgenes	16			27	17	20	16			20.0	11
Las Virgenes	SMC01640							7		7.0	NA
Cold Creek	17*	42	52	49	53	52	55			50.5	13
Triunfo Creek	18	22		20	18	19	15			18.8	7
Malibu Creek	SMC01384							29		29.0	NA
Malibu Creek	SMC02152								17	17.0	NA
Cheseboro Channel	SMC03944								7	7.0	NA
Medea Creek	15	3	5	7	4	2	7			4.7	5
Medea Creek	SMC04264								14	14.0	NA

yellow highlight = concrete-lined channel site
blue highlight = unlined channel site
no highlight = not sampled
* = reference site
NA = Not Applicable

Comparison of Concrete-Lined Channels and Unlined Channels for 2003–2010

Three of the fourteen sites monitored in the Santa Monica Bay Watershed were in fully concrete-lined channels (Figure 26). All of these concrete-lined sites had mean IBI scores rated Very Poor in all surveys, and five of the unlined sites were rated Fair and Good. The Wilcoxon Ranked Sum test was run with and without the reference site. No exclusions were made based on location in the watershed. When reference sites were excluded, a p-value of 0.014 resulted, and the mean IBI scores of the concrete-lined sites were statistically lower than the unlined sites in the lower watershed (p-value less than 0.05 is significant; i.e., the chance of having this result is less than 5%), and we can safely (or significantly) reject the null hypothesis that concrete-lined channels are equal to unlined channel sites. When the reference site from the upper watershed was considered, the p-value decreased to 0.004, and the statistical difference between the concrete-lined and unlined sites was greater.

Using a whisker–box plot to compare the two channel types, the mean IBI scores of the unlined sites were statistically superior to the concrete-lined sites (i.e., the mean line of the unlined sites is above the 75^{th} percentile of the concrete-lined sites) regardless of whether the reference sites were included (Figure 27). This contrasts slightly with the Los Angeles River and San Gabriel River Watersheds because there were a number of sites in the relatively pristine coastal watershed areas (e.g., Rustic Canyon and Trancas Canyon) that were not designated reference sites but had high quality BMI communities. The results of this analysis indicated a slightly greater difference between the channel types over 2009 (WESTON, 2010) due to the high IBI score at SMC02548–Rustic Canyon Creek, which has not been sampled in the past.

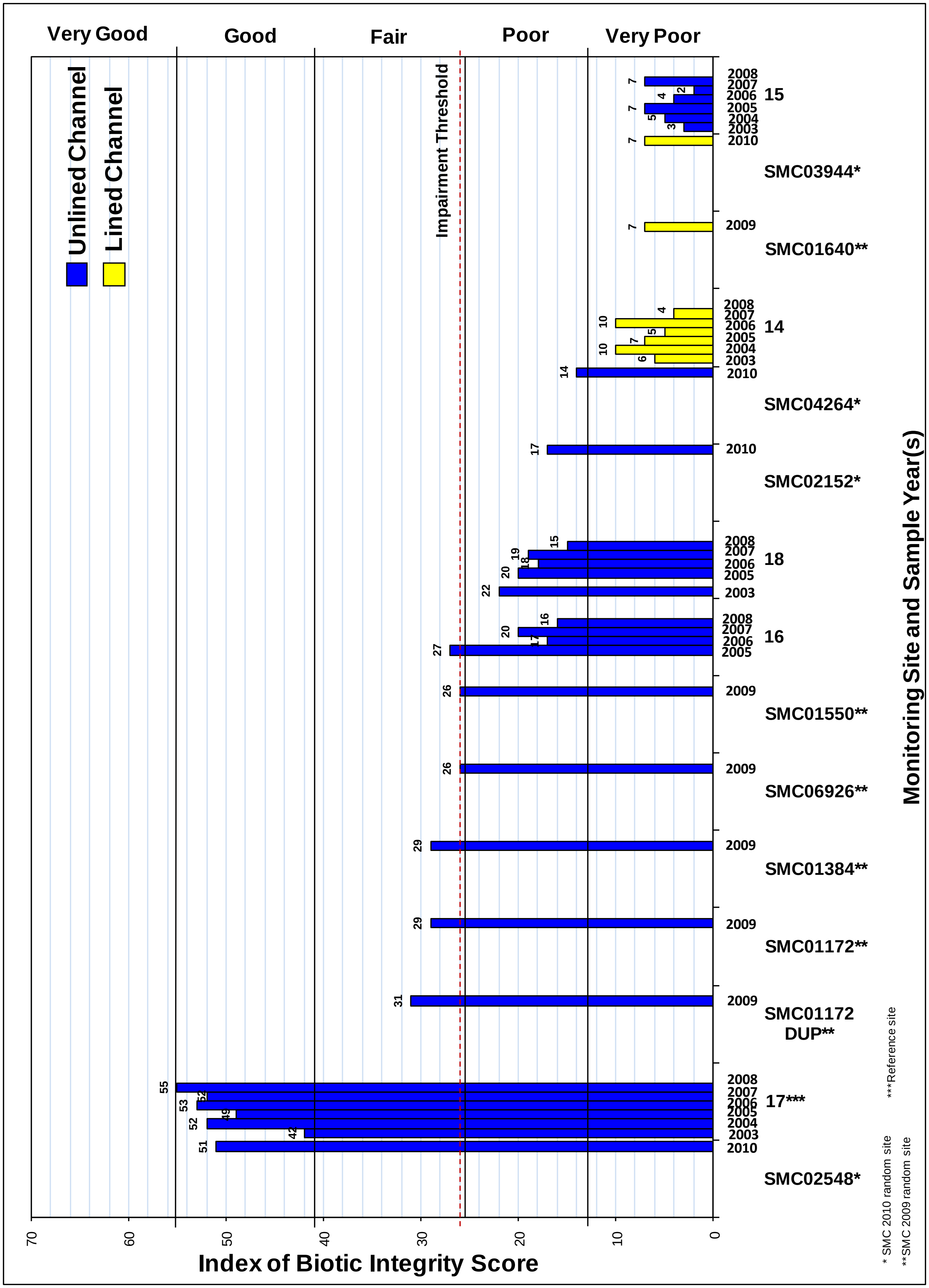


Figure 26. Index of Biotic Integrity Scores for Concrete-Lined and Unlined Channel Sites, Santa Monica Bay Watershed for 2003–2010

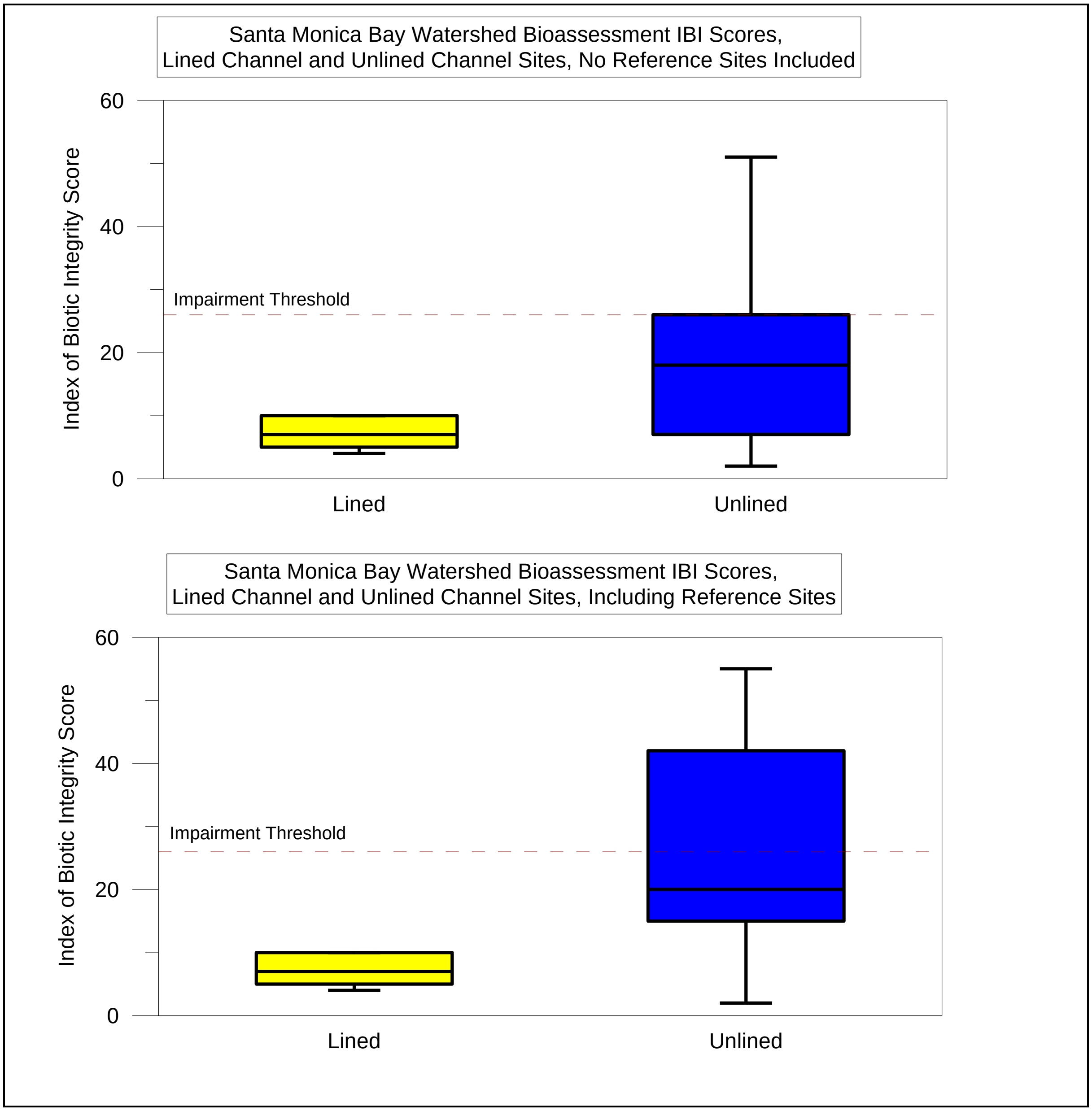


Figure 27. Comparison of Concrete-Lined and Unlined Channel Sites, Santa Monica Bay Watershed for 2003–2010

Comparison of Index of Biotic Integrity Scores and Elevation for 2003–2010

To examine the relationship of IBI scores and elevation, a Spearman rank correlation was conducted for IBI scores versus elevation. The correlation coefficient for IBI versus elevation was -0.181. The correlation was negative and not significant based on a critical value of 0.325 (37 samples and an alpha of 0.05). This result indicates that site IBI scores were not significantly related to elevation in this watershed, and the negative correlation indicated that IBI scores increased somewhat with decreasing elevation. This is likely due to a greater amount of urban development in the upper watershed and extensive forest land in the lower coastal watersheds in the Malibu area.

An illustration of these results is shown in Figure 28, a linear correlation of IBI and elevation. The coefficient of determination is shown on the graph as a measure of how well the data points fit a linear line. It is evident from this graphic that the relationship between IBI scores and elevation in this watershed was weak, slightly negative, and statistically insignificant.

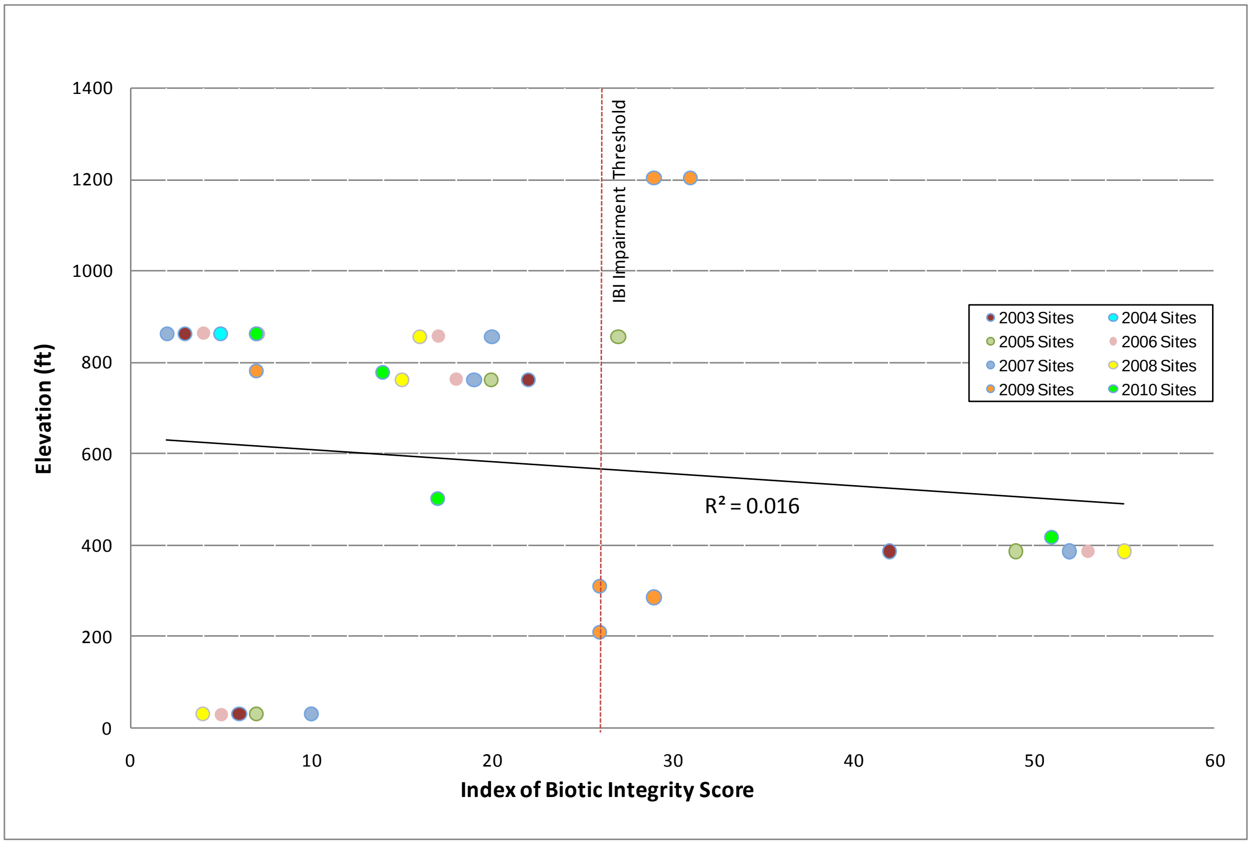


Figure 28. Correlation of Index of Biotic Integrity Scores and Elevation, Santa Monica Bay Watershed for 2003–2010

5.5 Santa Clara River Watershed Survey Results for 2003–2010

The upper portion of the Santa Clara River Watershed is in the County, with headwaters on the north slope of the San Gabriel Mountains (Figure 29). The lower watershed and outlet to the Pacific Ocean are in Ventura County. The mainstem of the Santa Clara River is unchannelized for its entire length, and a majority of the upper tributaries are non-perennial. Most of the urbanization in the upper watershed is associated with activities of the City of Santa Clarita.

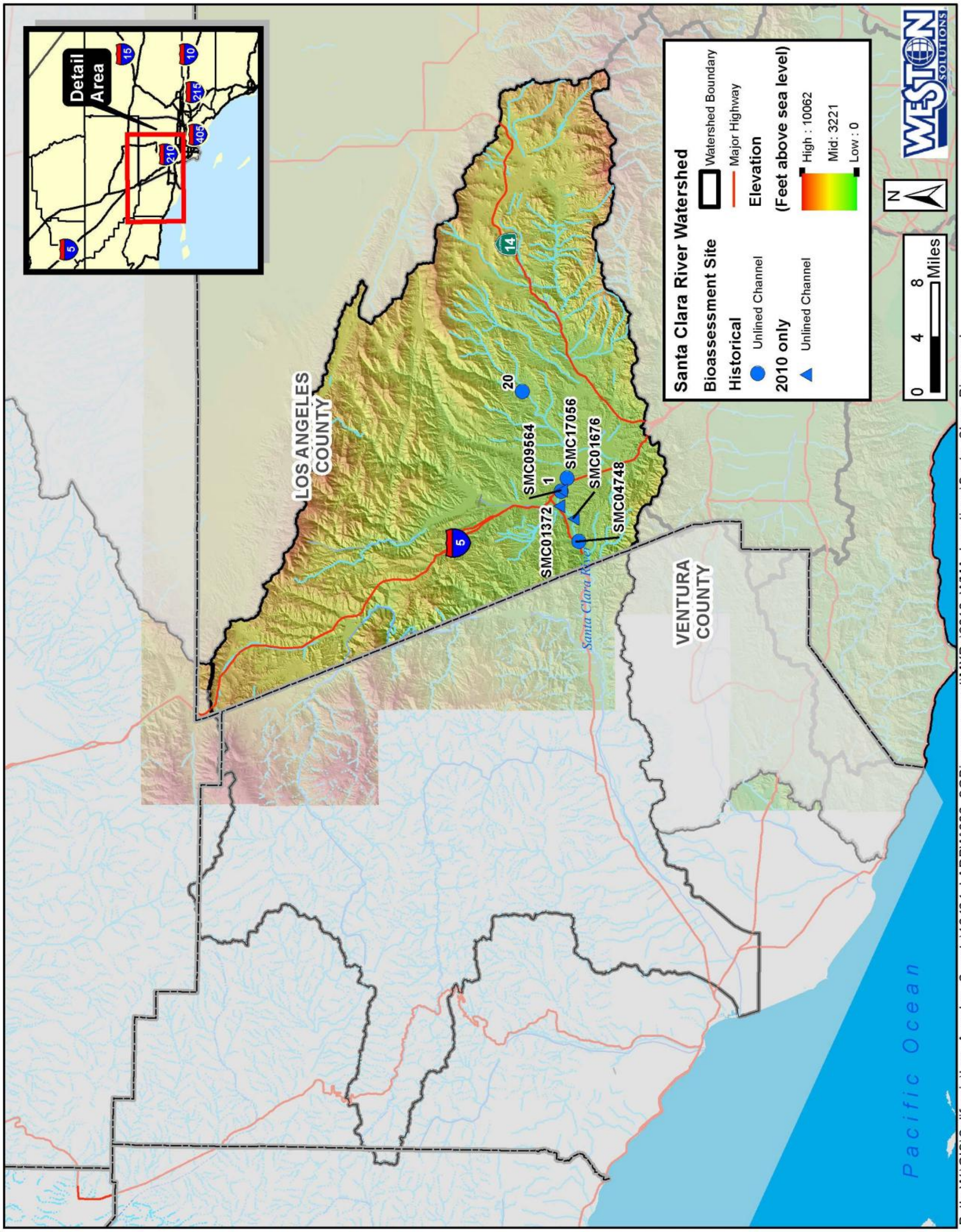


Figure 29. Bioassessment Monitoring Sites in the Santa Clara River Watershed for 2003–2010

Historically, one targeted site in the Santa Clara River mainstem, 1–Santa Clara River, was monitored every year from 2003 to 2008. An additional targeted site, 20–Bouquet Canyon, never had flowing water during the sampling period from 2003 through 2008. In 2009, these two targeted historical sites were replaced with two randomly placed SMC sites and in 2010 there were three new randomly placed SMC sites in the watershed. One of the 2010 sites, SMC09564, was also redundant with the targeted site 1 (<300 meters away). All of the sites were in unlined channels of the Santa Clara River mainstem, which have been perennialized by urban runoff. None of these were considered reference sites.

Mean Metric Analysis for 2003–2010

Table 15 shows the mean values of four individual metrics that are considered strong indicators of ecological health. The six sites monitored in the Santa Clara River were all soft-bottomed and had similar mean metric values. Mean taxa richness ranged from 14 to 25, there were four to six EPT taxa at each site, and no intolerant taxa were collected. Collector taxa were present in moderate percentages. The similarity of these results is not surprising as the sites were relatively close to one another, and the physical conditions of the riverbed were similar at each site (i.e., all sites had substrates that were dominated by unconsolidated course sand in low gradient reaches).

Table 15. Santa Clara River Watershed Selected Metric Values, Annual Surveys for 2003–2010

Monitoring Reach	Station Number	Number Samples	Taxa Richness**	EPT Taxa	Percent Intolerant Taxa	Percent Collector-Filterers plus Collector-Gatherers
Santa Clara River	1	6	20.0	4.0	0.0%	69.4%
Santa Clara River	SMC04748	1	19.0	4.0	0.0%	81.4%
Santa Clara River	SMC17056	1	21.0	4.0	0.0%	69.6%
Santa Clara River	SMC01676	1	25.0	6.0	0.0%	73.6%
Santa Clara River	SMC01372/ SMC01372 Dup	2	21.0	5.0	0.0%	85.8%
Santa Clara River	SMC09564	1	14.0	5.0	0.0%	90.6%

blue highlight = unlined channel site

**2009 and 2010 taxa richness values adjusted from Level II to Level I taxonomy values

Comparison of Index of Biotic Integrity Scores for 2003–2010

The six sites in the Santa Clara River Watershed had IBI scores in the Poor to low Fair range (Table 16, Figure 30, and Figure 31). 1–Santa Clara River has shown significant variability, with a total range of 17 points, and was the only site in the watershed to vary across three of the IBI rating categories. This was likely due to the heavy rains of 2005 that substantially altered the streambed and flushed out most of the emergent vegetation, resulting in a low IBI score for that year. In 2010, two sites that have not been sampled in the past, SMC01372 and SMC01676, scored above the impairment threshold; these were the highest IBI scores arrived at to date amongst all sites sampled in the Santa Clara River watershed. Because of this, the median and upper range of IBI scores was slightly elevated relative to the 2009 results (WESTON, 2010).

Table 16. Santa Clara River Watershed, Comparison of Index of Biotic Integrity Scores for 2003–2010

Monitoring Reach	Station Number	IBI Score 2003	IBI Score 2004	IBI Score 2005	IBI Score 2006	IBI Score 2007	IBI Score 2008	IBI Score 2009	IBI Score 2010	Mean IBI Score	Range
Santa Clara River	1	21	19	10	24	27	24			20.8	17
Santa Clara River	SMC04748							22		22.0	NA
Santa Clara River	SMC17056							25		25.0	NA
Santa Clara River	SMC01676								28	28.0	NA
Santa Clara River	SMC01372								31	31.0	NA
Santa Clara River	SMC01372 Dup								23	23.0	NA
Santa Clara River	SMC09564								17	17.0	NA

blue highlight = unlined channel site
no highlight = not sampled
NA = Not Applicable

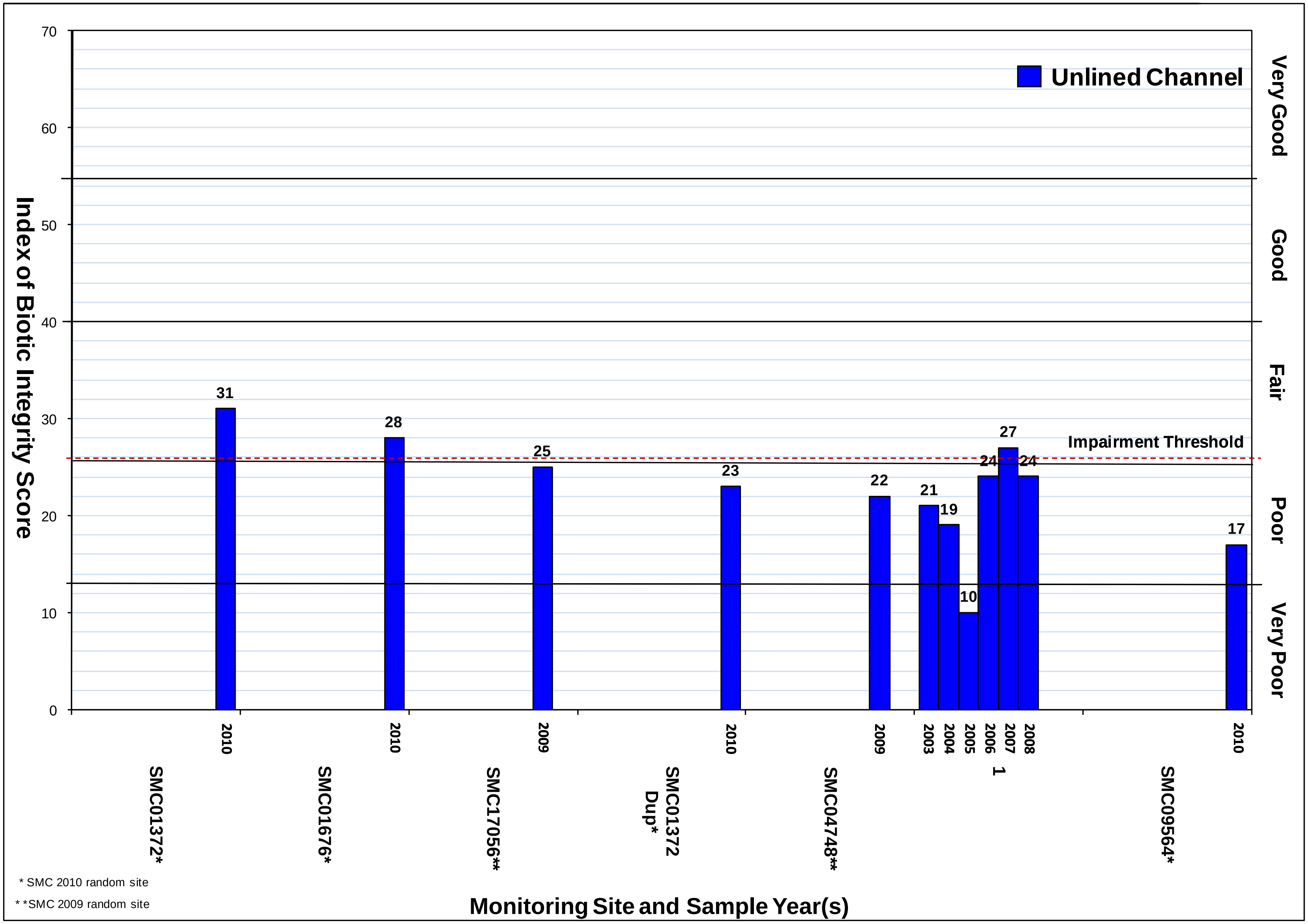


Figure 30. Index of Biotic Integrity Scores for Unlined Channel Sites, Santa Clara River Watershed for 2003–2010 (no concrete-lined sites)

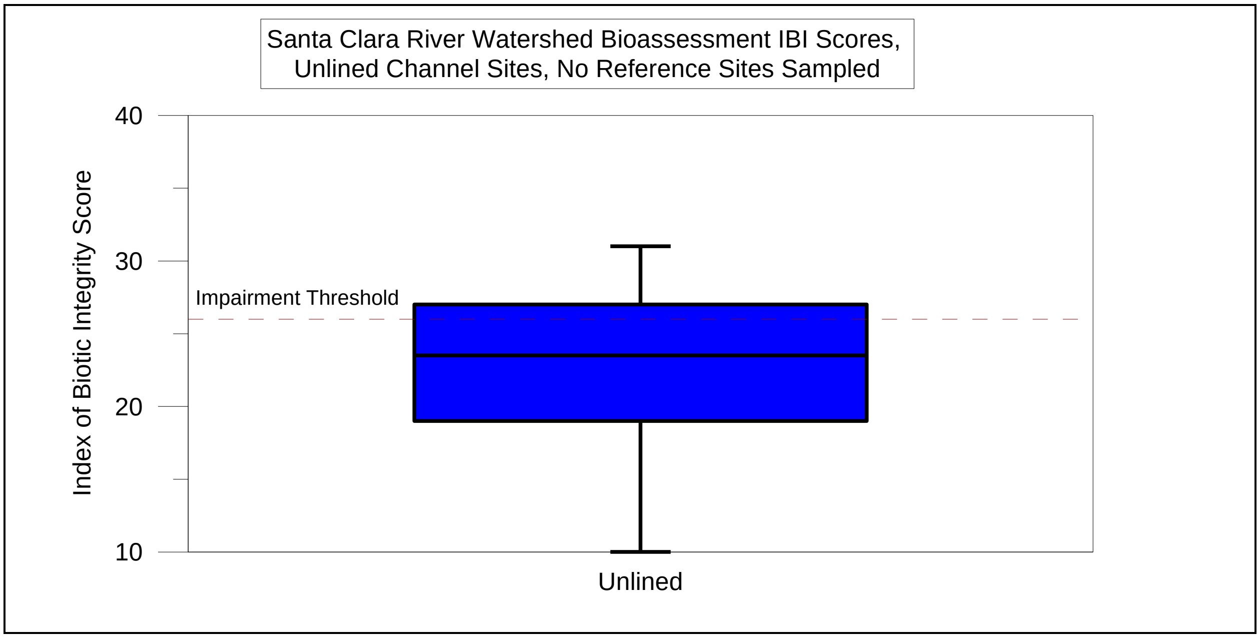


Figure 31. Unlined Channel Sites, Santa Clara River Watershed for 2003–2010 (no concrete-lined sites)

Comparison of Index of Biotic Integrity Scores and Elevation for 2003–2010

To examine the relationship of IBI scores and elevation, a Spearman rank correlation was conducted for IBI scores versus elevation. The correlation coefficient for IBI versus elevation was -0.225. The correlation was insignificant based on a critical value of 0.587 (12 samples and an alpha of 0.05). These results indicate that site IBI scores were not significantly correlated to elevation and that they increased slightly with decreasing elevation. This was not unexpected because the elevations of the three sites were within approximately 200 ft of one another, and the majority of the IBI scores were relatively similar.

An illustration of the results is shown in Figure 32, a linear correlation of IBI and elevation. The coefficient of determination is shown on the graph as a measure of how well the data points fit a linear line. It is evident from this graphic that the relationship between IBI and elevation in this area of the watershed was weak and slightly negative.

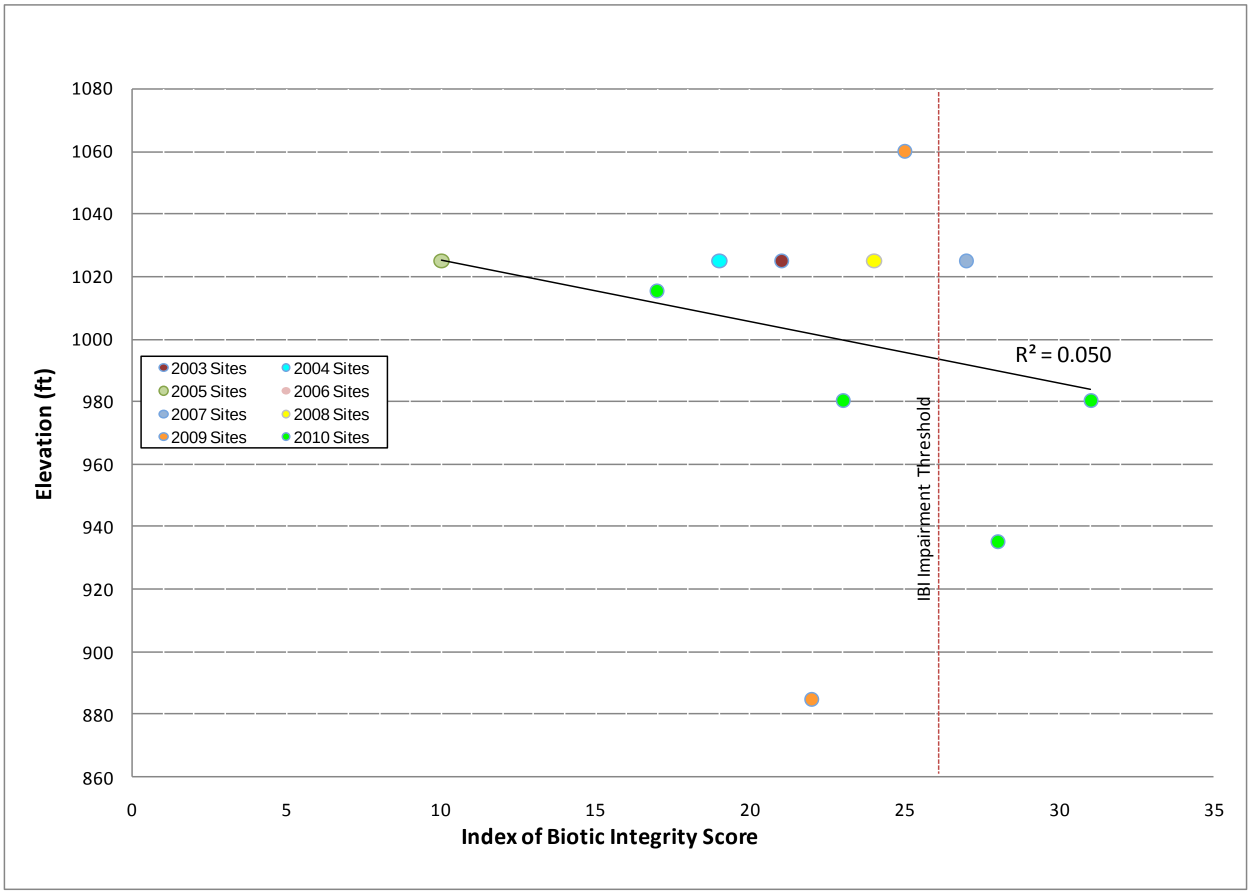


Figure 32. Correlation of Index of Biotic Integrity Scores and Elevation, Santa Clara River Watershed for 2003–2010

6.0 SUMMARY

Eighteen receiving water monitoring reaches representing five watersheds in the County were sampled for BMI and were assessed for physical habitat quality between June and July 2010. 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 BMI communities of the County. Since program inception in 2003, a total of 49 different sites have been sampled, and four of the sites were sampled in every survey.

Taxonomic evaluation of the 2010 samples yielded approximately 130 different taxa from 13,166 individual organisms by SAFIT Level II taxonomic effort, which was at a higher level of effort than in the sampling years 2003-2008, but at the same level as in 2009. In 2010, the most abundant organisms collected throughout the County were Ostracods (seed shrimp), which were present at all but three of the monitoring sites. The majority of organisms collected from the urban monitoring reaches were moderately or highly tolerant to stream impairments, and most of the sites were dominated by organisms in the collector–gatherer feeding group. In 2010, all but one site, SGUT-501–San Gabriel River, was dominated by organisms in this FFG.

The 2010 IBI scores of the monitoring reaches ranged from 0 (poorest score) to 56 (best score) out of a maximum of 70 points, and the BMI communities were rated from Very Poor to Very Good. SGUT-501–San Gabriel River was the highest-rated site, and SMC02548–Rustic Canyon Creek and SGUT-504–San Gabriel River were the second and third highest-rated sites, with IBI scores of 56, 51, and 50, respectively. Five of the other monitoring reaches were located in highly modified, concrete-lined urban water courses. Two of these sites had IBI ratings of Poor and the other three had IBI ratings of Very Poor. The site with the lowest IBI score, 0, was 5, SGLT-506–Walnut Channel.

Analysis of individual metrics as well as total IBI scores showed that in the San Gabriel and Los Angeles River watersheds, monitoring sites located in the lower watershed had lower-quality benthic communities than sites located in the middle to upper reaches of the watersheds. In these two watersheds, there was a positive and significant correlation between site elevation and IBI scores. In the Santa Monica Bay and Santa Clara Watersheds, however, this correlation was negative, and IBI scores decreased with increased elevation, although the correlation was not statistically significant.

Comparison of the IBI scores for eight survey years (i.e., 2003–2010) did not indicate any substantial trend toward degradation or improvement at any of the sites, and there were very few cases where a site varied between an impaired rating and an unimpaired rating. Trend analysis was not possible for sites that have been sampled for less than four years, which included 33 of the 49 monitoring sites.

An analysis of the difference between concrete-lined sites and unlined sites often indicated no statistically significant difference in IBI scores when the analysis was limited to sites located in the lower watershed areas. When reference and mid to upper watershed sites were added to the analysis, the difference in IBI scores between concrete-lined sites and unlined sites was generally of greater significance. The difference between concrete-lined and unlined sites was greater for the 2008 and 2009 data than for data from 2003 to 2007 and 2010. This was due to several lower Los Angeles River sites that were in concrete-lined channels yet had IBI scores similar to other unlined lower watershed sites. When this analysis was performed by watershed, the lower Los Angeles River Watershed sites did not show a difference between concrete-lined and unlined sites, whereas in the San Gabriel River Watershed and Santa Monica Bay Watershed, the difference between concrete-lined and unlined sites was much greater. Correlation analysis between CRAM physical habitat scores and IBI scores indicated a significant relationship between physical habitat and biotic integrity. The analysis also indicated that there were three groups of sites that corresponded with (1) the concrete-lined and altered channel sites, (2) the natural channel sites withinin the urban landscape, and (3) the natural channel open space sites.

The two-way cluster analysis of 2010 taxa and sites indicated some clustering by taxa, with all of the sensitive taxa contained within one cluster. But overall, the sites appeared to cluster more readily according to site physical conditions and total IBI score, and generally confirmed the correlation between CRAM and IBI scores. The open space watershed sites with natural channels and complex substrates had the strongest clustering, the Santa Clara River Watershed sites with unconsolidated sandy substrates clustered together and most of the fully concrete-lined sites clustered together. The lower watershed sites were populated primarily with abundant, ubiquitous, and opportunistic organisms common to most sites, whereas the open space sites had fairly distinctive benthic communities, with a number of unique and/or sensitive taxa present at each site. Cluster analysis of all taxonomic data from 2003 to 2010 had results similar to the 2010 data, with an overall strong association between BMI assemblages, site IBI scores and site physical characteristics.

7.0 FUTURE PROJECTIONS FOR BIOASSESSMENT

As the science of bioassessment monitoring continues to evolve, further changes in monitoring protocols and methods and in the regulatory climate are likely. Regulatory issues are likely to emerge as well, including the implementation of biological objectives or "biocriteria". This may require NPDES MS4 Permit holders to evaluate and implement ways to increase the biotic integrity of receiving waters (e.g., elevate a stream site's IBI score or another prescribed metric). Preliminary meetings regarding these potential requirements have indicated that not all waterbodies will be considered equally and that biological objectives will consider existing limitations on BMI colonization. These limitations may include attributes such as physical habitat constraints, natural perturbations, and cost-prohibitive mitigations, although these have yet to be defined.

Currently, the methodology for stream physical habitat assessment incorporates two separate protocols (i.e., SWAMP and CRAM). In 2009, CRAM was first performed, and was done at all sites, although it was only required to be performed at SMC sites. In 2010, CRAM was conducted only at SMC sites and 6-Arroyo Seco (due to major habitat disruption at that site). Both protocols assess unique attributes of the physical habitat, but there is also some redundancy between them. Streamlining of protocols by a state agency (e.g., SWAMP or CDFG) would increase efficiency of the assessment but may require approval by the State Water Resources Control Boards (SWRCBs) and RWQCBs and subsequent incorporation into the NPDES MS4 Permit. Re-calibrating the IBI for low-gradient, depositional stream reaches is another potential improvement of current stream bioassessment methodologies. Reference conditions for this habitat type were not adequately incorporated in the development of the IBI, and these types of sites may be designated as impaired when water quality is good and sensitive organisms are present but in very low numbers.

There is also research in progress to develop algal biological metrics and an algae-specific IBI for southern California. These are anticipated to be available by the end of 2011 and may be very useful tools in ambient surface water monitoring. Algae respond more quickly and to different ecological stressors than BMI, and there is a general consensus that these two monitoring tools are complementary and that the addition of algae will provide a more comprehensive understanding of anthropogenic impacts to the stream biota. Algae sample collection is currently part of the SMC program scope of work, and has the potential to become a requirement for NPDES permit compliance monitoring.

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APPENDIX A

Photos of Monitoring Reaches

Appendix A: Site Photos

SGUT-501–San Gabriel River

SGUT-504–San Gabriel River

SGUT-505–San Gabriel River

5, SGLT-506–Walnut Creek

Appendix A: Site Photos

6–Arroyo Seco

7–Arroyo Seco

LALT500–Rio Hondo

LALT501–Arroyo Seco

Appendix A: Site Photos

8, LALT502–Compton Creek

LALT503–Tunjunga Wash

19–Dominguez Channel

SMC02548-Rustic Canyon Creek

Appendix A: Site Photos

SMC03944-Cheseboro Channel

SMC02152-Malibu Creek

SMC04264-Medea Creek

SMC01676-Santa Clara River

Appendix A: Site Photos

SMC01372-Santa Clara River

SMC09564-Santa Clara River

APPENDIX B

Survey Results Data

Appendix B.1: Taxonomic Listing of Benthic Macroinvertebrates Collected from LACFCD Bioassessment Monitoring Sites for 2010

TV=Tolerance Value: range is 0-10; 0 is intolerant to impairment. FFG=Functional Feeding Group; cg=collector gatherer, cf=collector filterer, sc=scraper, p=predator, pa=parasite, mh=macrophyte herbivore, ph=piercer herbivore, om=omnivore.

	TV	FFG	San Gabriel River Watershed				Los Angeles River Watershed						Dominguez Channel	Santa Monica Bay Watershed				Santa Clara River Watershed			
			SGUT-501*	SGUT-504*	SGUT-505	5,SGLT-506	6*	7	LALT500	LALT501	8, LALT502	LALT503	19	SMC02548	SMC03944	SMC02152	SMC04264	SMC01676	SMC01372	SMC01372 Dup	SMC09564
PHYLUM ARTHROPODA																					
Insecta																					
Ephemeroptera (mayflies)																					
Baetidae																					
Baetis sp	5	cg	9	13	28		62			18				2				6	7	7	157
Baetis adonis	5	cg	69	173	198		464	41		514				40		2	2	85	201	197	39
Baetis flavistriga	4	cg		7																	
Callibaetis sp	9	cg					1	4				1	1		4	1		2			
Centroptilum/Procleon spp	3	cg	10																		
Diphetor hageni	5	cg	14	1																	
Fallceon quilleri	4	cg		5			7	68	1	58	1	1						194	133	158	3
Caenidae																					
Caenis sp	7	cg	2																		
Ephemerellidae	1	cg		30																	
Drunella sp	0	cg		1																	
Serratella sp	2	cg	15	18																	
Serratella micheneri	1	cg	14	52																	
Heptageniidae	4	sc	4																		
Epeorus sp	0	sc		25																	
Leucrocuta/Nixe sp	3	sc	2																		
Leptohyphidae																					
Tricorythodes sp	4	cg	3	10														79	69	45	18
Leptophlebidae																					
Paraleptophlebia sp	4	cg	1											6							
Odonata (dragonflies, damselflies)																					
Calopterygidae																					
Hetaerina americana	6	p																2	5	9	
Coenagrionidae	9	p									6					3	2				
Argia sp	7	p		2				2						6		10		4	10	5	3
Enallagma sp	9	p							2												
Gomphidae																					
Progomphus borealis	4	p																1			
Lestidate																					
Archilestes sp	9	p						3													
Libellulidae																					
Libellula sp	9	p				1															
Paltothemis lineatipes	9	p	1							1											
Sympetrum sp	9	p							2												
Plecoptera (stoneflies)																					
Nemouridae																					
Malenka sp	2	sh												310							
Perlidae																					
Calineuria californica	2	p	3	2																	
Perlodidae																					
Isoperla sp	2	p												2							
Hemiptera (true bugs)																					
Belostomatidae	8	p			3									1							
Abedus sp	8	p												1							
Corixidae	8	p										33								1	
Corisella sp	8	p																2			
Corisella decolor	8	p										1									
Corisella edulis	8	p							1				1								
Trichocorixa calva	8	p										1									
Trichoptera (caddisflies)																					
Brachycentridae																					
Micrasema sp	1	mh	277	4																	
Glossosomatidae																					
Agapetus sp	0	sc	2				1							15							
Helicopsychidae	3	sc																			
Helicopsyche borealis	3	sc		4																	
Hydropsychidae	4	cf																	1		

Yellow highlight = lined channel site
Bue highlight = unlined channel site
*Reference site
"sp" denotes taxa identified to genus level

Appendix B.1: Taxonomic Listing of Benthic Macroinvertebrates Collected from LACFCD Bioassessment Monitoring Sites for 2010

TV=Tolerance Value: range is 0-10; 0 is intolerant to impairment. FFG=Functional Feeding Group; cg=collector gatherer, cf=collector filterer, sc=scraper, p=predator, pa=parasite, mh=macrophyte herbivore, ph=piercer herbivore, om=omnivore.

	TV	FFG	San Gabriel River Watershed				Los Angeles River Watershed						Dominguez Channel	Santa Monica Bay Watershed				Santa Clara River Watershed			
			SGUT-501*	SGUT-504*	SGUT-505	5,SGLT-506	6*	7	LALT500	LALT501	8, LALT502	LALT503	19	SMC02548	SMC03944	SMC02152	SMC04264	SMC01676	SMC01372	SMC01372 Dup	SMC09564
Cheumatopsyche sp	5	cf	1	7																	
Hydropsyche sp	4	cf	48	91	18									18		9		37	19	14	
Hydroptilidae	4	ph			2					3				1		2	1		14	13	
Hydroptila sp	6	ph	1	1	20		8		1	4						7	8	94	49	20	18
Ochrotrichia sp	4	ph			5									4							
Oxyethira sp	3	ph			103																
Lepidostomatidae																					
Lepidostoma sp	1	sh	3											138							
Leptoceridae	4	om	4																		
Philopotamidae																					
Wormaldia sp	3	cf	4																		
Polycentropodidae																					
Polycentropus sp	6	p			1									2							
Psychomyiidae																					
Tinodes sp	2	sc	1																		
Rhyacophilidae																					
Rhyacophila sp	0	p	2											3							
Lepidoptera (moths)					1																
Coleoptera (beetles)																					
Dytiscidae																					
Colymbetinae	5	p									1			1							
Agabinus sp	5	p											1								
Hygrotus sp	5	p							1												
Ilybius sp	5	p												1							
Stictotarsus sp	5	p																1			
Elmidae																					
Narpus sp	4	cg		1																	
Optioservus sp	4	sc	4	2														1			
Ordobrevia nubifera	4	sc		1																	
Zaitzevia sp	4	sc	9																		
Haliplidae																					
Peltodytes sp	5	mh																		1	
Hydrophilidae																					
Enochrus sp	5	cg																	1		
Tropisternus sp	5	p																2	2	1	
Tropisternus ellipticus	5	p																	2		
Psephenidae																					
Psephenus falli	4	sc	1																		
Diptera (true flies)																					
Ceratopogonidae	6	p						1				5							1		
Atrichopogon	6	cg		3				1													
Bezzia/Palpomyia spp	6	p	2																		
Dasyhelea sp	6	cg							4			3				1			2		
Chironomidae	6	cg	1				1					14									99
Ablabesmyia sp	8	cg			1			3								4					
Alotanypus sp	7	p						2					1	2			1				
Apedilum sp	6	cg	1						65		4				28	3					
Brillia sp	5	sh						1						2							
Cardiocladius sp	5	p		3																	
Chironomus sp	10	cg				7		1	11		9	29	10								
Corynoneura sp	7	cg	2	1				5						3		2					
Cricotopus sp	7	cg		22	5	1			120	2	13	276	56	2	9			3			
Cricotopus/Bicinctus Grp.	7	cg						11													
Cricotopus/Trifascia Grp.	7	cg		2	1																
Dicrotendipes sp	8	cg				7		12	104			70	23		1						
Eukiefferiella sp	8	om	4	3	1		20	12						4	1			2			
Krenosmittia sp	1	cg					1														
Labrundinea	6	p														4					
Limnophyes sp	8	cg										2	3								
Micropsectra sp	7	cg	9		7		3	20	4					20		1					
Microtendipes	6	cf		9										4							

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Bue highlight = unlined channel site
*Reference site
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Appendix B.1: Taxonomic Listing of Benthic Macroinvertebrates Collected from LACFCD Bioassessment Monitoring Sites for 2010

TV=Tolerance Value: range is 0-10; 0 is intolerant to impairment. FFG=Functional Feeding Group; cg=collector gatherer, cf=collector filterer, sc=scraper, p=predator, pa=parasite, mh=macrophyte herbivore, ph=piercer herbivore, om=omnivore.

	TV	FFG	San Gabriel River Watershed				Los Angeles River Watershed						Dominguez Channel	Santa Monica Bay Watershed				Santa Clara River Watershed			
			SGUT-501*	SGUT-504*	SGUT-505	5,SGLT-506	6*	7	LALT500	LALT501	8, LALT502	LALT503	19	SMC02548	SMC03944	SMC02152	SMC04264	SMC01676	SMC01372	SMC01372 Dup	SMC09564
Nanocladius sp	3	cg																1			
Orthocladius Cmplx	6	cg		1																	
Paracladopelma sp	7						1														
Parametriocnemus sp	5	cg					2	11	1							1					
Paraphaenocladius sp	4	cg			1																
Paratanytarus sp	6											1									
Pentaneura sp	6	p		3			4	25	3	10		1		4	5	5	1	5	3	2	
Polypedilum sp	6	om	3	5			7						1	4	24						
Procladius sp	9	p						4	10		8										
Pseudochironomus sp	5	cg				1				6		2			4			3	14	10	
Rheocricotopus sp	6	om						5													
Rheotanytarsus	6	om	32	31	50		7	99	1	9				37			2				
Synorthocladius sp	2	cg	4		1																
Tanytarsus limneticus		cf							8												
Tanytarsus sp	6	cf	4	2	5		1	7	18		2	31	1		2	1					
Thienemanniella sp	6	cg		1																	
Thienemannimyia Grp	6	p	1	2			4	2		2				5	1	7	1				
Culicidae																					
Culex sp	8	cg							12												
Dixidae																					
Dixa sp	2	cg	1																		
Dolichopodidae	4	p					1			1		6									
Empididae	6	p	1	2	4		1	16		1									1	1	
Chelifera/Metachela spp	6	p		3																	
Clinocera sp	6	p			6																
Hemerodromia sp	6	p		4			1	12		1		1						3	4	2	20
Neoplasta sp	6	p												4							
Ephydridae	6				3		1					72									1
Muscidae	6	p			9		1	1			2	2									
Psychodidae		cg								4		13									
Maruina lanceolata	2	sc	1																		
Pericoma/Telmatoscopus spp	4	cg			1		1														
Psychoda sp	10	cg										5									
Simuliidae																					
Simulium sp	6	cf	4	14	10		44	309		8		1		6			1	20	81	111	4
Stratiomyidae																					
Caloparyphus/Euparyphus spp	8	cg		1			2			6				2	18	3	2	7	6	5	
Euparyphus sp	8	cg						3							3				1	2	
Nemotelus sp	8	cg					1														
Tipulidae																					
Dicranota sp	3	p	1																		
Limonia sp	6	sh				2						1							1	3	
Tipula sp	4	om			1				1							5		1	3		
PHYLUM CHELICERATA																					
Arachnida																					
Acari (mites)	5	p		13																	
Hydryphantidae																					
Protzia sp	8	p		4																	
Hygrobatidae																					
Atractides sp	8	p	2	2										5							
Lebertiidae																					
Lebertia sp	8	p		5	10																
Limnesiidae																					
Limnesia sp	5	p		1																	
Mideopsidae																					
Mideopsis sp	5	p														2					
Sperchontidae																					
Sperchon sp	8	p	4	17				17			2			1		1		4	3		
Torrenticolidae																					
Torrenticola sp	5	p	11	16																	
PHYLUM ARTHROPODA																					

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Appendix B.1: Taxonomic Listing of Benthic Macroinvertebrates Collected from LACFCD Bioassessment Monitoring Sites for 2010

TV=Tolerance Value: range is 0-10; 0 is intolerant to impairment. FFG=Functional Feeding Group; cg=collector gatherer, cf=collector filterer, sc=scraper, p=predator, pa=parasite, mh=macrophyte herbivore, ph=piercer herbivore, om=omnivore.

	TV	FFG	San Gabriel River Watershed				Los Angeles River Watershed						Dominguez Channel	Santa Monica Bay Watershed				Santa Clara River Watershed			
			SGUT-501*	SGUT-504*	SGUT-505	5,SGLT-506	6*	7	LALT500	LALT501	8, LALT502	LALT503	19	SMC02548	SMC03944	SMC02152	SMC04264	SMC01676	SMC01372	SMC01372 Dup	SMC09564
Malacostraca																					
Amphipoda (scuds)																					
Hyalellidae																					
Hyalella sp	8	cg						1	4	1	39	2	8		3	321	294				
Decapoda (crayfish)																					
Cambaridae	8	sh									1					3					
Procambarus clarki	8	sh														1					
Ostracoda	8	cg	5		33	749		4	207		26	5	499	6	649	31	32	17	10	6	1
PHYLUM PLATYHELMINTHES																					
Turbelleria (flatworms)	4	p		5	1	5			2						1		20	14	13	8	5
PHYLUM CNIDARIA																					
Hydrozoa																					
Hydroida																					
Hydridae																					
Hydra sp	5	p			2												3				
PHYLUM NEMERTEA																					
Enopla (tongueworms)																					
Hoplonemertea																					
Tetrastemmatidae																					
Prostoma sp	8	p		1	1											5	1	16	5	6	
PHYLUM ANNELIDIA																					
Hirudinea (leeches)	10	pa														1					
Arynchobdellida																					
Erpobdellidae																					
Mooreobdella sp	8	p				1					5								1		
Oligochaeta (earthworms)	5	cg	6	3	32	2		7	57		392	29	60			1	4	1		1	210
PHYLUM MOLLUSCA																					
Gastropoda (snails)																					
Pulmonata																					
Ancylidae																					
Ferrissia sp	6	sc									10							1			1
Hypsogastropoda																					
Hydrobiidae																					
Hydrobiidae	8	sc														1059	291				
Pulmonata																					
Lymnaeidae																					
Lymnea sp	6	sc			15				1												
Physidae																					
Physa sp	8	sc	3		23	2		10	2				18			9		8			7
Planorbidae																					
Menetus sp	6	sc									2										

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Appendix B.2: Ranked Abundance of Benthic Macroinvertebrates Collected from LACFCD Monitoring Sites for 2010.

Taxon	TV	FFG	San Gabriel River Watershed				Los Angeles River Watershed						Dominguez Channel	Santa Monica Bay Watershed				Santa Clara River Watershed				Grand Total
			SGUT-501*	SGUT-504*	SGUT-505	5, SGLT-506	6*	7	LALT500	LALT501	8, LALT502	LALT503	19	SMC02548	SMC03944	SMC02152	SMC04264	SMC01676	SMC01372	SMC01372 Dup	SMC09564	
Ostracoda	8	cg	5		33	749		4	207		26	5	499	6	649	31	32	17	10	6	1	2280
Baetis adonis	5	cg	69	173	198		464	41		514				40		2	2	85	201	197	39	2025
Hydrobiidae	8	sc														1059	291					1350
Hyalella sp	8	cg						1	4	1	39	2	8		3	321	294					673
Fallceon quilleri	4	cg		5			7	68	1	58	1	1						194	133	158	3	629
Simulium sp	6	cf	4	14	10		44	309		8		1		6			1	20	81	111	4	613
Oligochaeta	5	cg	6	3	32	2		7	57		392	29	60			1	4	1		1	210	805
Cricotopus sp	7	cg		22	5	1			120	2	13	276	56	2	9			3				509
Malenka sp	2	sh												310								310
Micrasema sp	1	mh	277	4																		281
Rheotanytarsus	6	om	32	31	50		7	99	1	9				37			2					268
Hydropsyche sp	4	cf	48	91	18									18		9		37	19	14		254
Dicrotendipes sp	8	cg				7		12	104			70	23		1							217
Hydroptila sp	6	ph	1	1	20		8		1	4						7	8	94	49	20	18	231
Tricorythodes sp	4	cg	3	10														79	69	45	18	224
Baetis sp	5	cg	9	13	28		62			18				2				6	7	7	157	309
Lepidostoma sp	1	sh	3											138								141
Oxyethira sp	3	ph			103																	103
Apedilum sp	6	cg	1						65		4				28	3						101
Ephydridae	6				3		1					72									1	77
Physa sp	8	sc	3		23	2		10	2				18			9		8			7	82
Tanytarsus sp	6	cf	4	2	5		1	7	18		2	31	1		2	1						74
Pentaneura sp	6	p		3			4	25	3	10		1		4	5	5	1	5	3	2		71
Turbellaria	4	p		5	1	5			2						1		20	14	13	8	5	74
Chironomus sp	10	cg				7		1	11		9	29	10									67
Serratella micheneri	1	cg	14	52																		66
Micropsectra sp	7	cg	9		7		3	20	4					20		1						64
Caloparyphus/Euparyphus spp	8	cg		1			2			6				2	18	3	2	7	6	5		52
Sperchon sp	8	p	4	17				17			2			1		1		4	3			49
Eukiefferiella sp	8	om	4	3	1		20	12						4	1			2				47
Polypedilum sp	6	om	3	5			7						1	4	24							44
Pseudochironomus sp	5	cg				1				6		2			4			3	14	10		40
Argia sp	7	p		2				2						6		10		4	10	5	3	42
Hydroptilidae	4	ph			2					3				1		2	1		14	13		36
Prostoma sp	8	p		1	1											5	1	16	5	6		35
Corixidae	8	p										33								1		34
Serratella sp	2	cg	15	18																		33
Ephemerellidae	1	cg		30																		30
Hemerodromia sp	6	p		4			1	12		1		1						3	4	2	20	48
Empididae	6	p	1	2	4		1	16		1									1	1		27
Torrenticola sp	5	p	11	16																		27
Epeorus sp	0	sc		25																		25
Thienemannimyia Grp	6	p	1	2			4	2		2				5	1	7	1					25
Procladius sp	9	p						4	10		8											22
Agapetus sp	0	sc	2				1							15								18
Psychodidae		cg								4		13										17
Chironomidae	6	cg	1				1					14									99	115
Hetaerina americana	6	p																2	5	9		16
Lymnea sp	6	sc			15				1													16
Diphetor hageni	5	cg	14	1																		15
Lebertia sp	8	p		5	10																	15
Muscidae	6	p			9		1	1			2	2										15
Parametriocnemus sp	5	cg					2	11	1							1						15
Callibaetis sp	9	cg					1	4				1	1		4	1		2				14
Acari	5	p		13																		13
Corynoneura sp	7	cg	2	1				5						3		2						13

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Appendix B.2: Ranked Abundance of Benthic Macroinvertebrates Collected from LACFCD Monitoring Sites for 2010.

Taxon	TV	FFG	San Gabriel River Watershed				Los Angeles River Watershed						Dominguez Channel	Santa Monica Bay Watershed				Santa Clara River Watershed				Grand Total
			SGUT-501*	SGUT-504*	SGUT-505	5, SGLT-506	6*	7	LALT500	LALT501	8, LALT502	LALT503	19	SMC02548	SMC03944	SMC02152	SMC04264	SMC01676	SMC01372	SMC01372 Dup	SMC09564	
Microtendipes	6	cf		9										4								13
Culex sp	8	cg							12													12
Coenagrionidae	9	p									6					3	2					11
Cricotopus/Bicinctus Grp.	7	cg						11														11
Ferrissia sp	6	sc									10							1			1	12
Tipula sp	4	om			1				1							5		1	3			11
Centroptilum/Procleon sp	3	cg	10																			10
Dasyhelea sp	6	cg							4			3				1			2			10
Atractides sp	8	p	2	2										5								9
Euparyphus sp	8	cg						3							3				1	2		9
Ochrotrichia sp	4	ph			5									4								9
Zaitzevia sp	4	sc	9																			9
Ablabesmyia sp	8	cg			1			3								4						8
Cheumatopsyche sp	5	cf	1	7																		8
Dolichopodidae	4	p					1			1		6										8
Tanytarsus limneticus		cf							8													8
Ceratopogonidae	6	p						1				5							1			7
Limonia sp	6	sh				2						1							1	3		7
Mooreobdella sp	8	p				1					5								1			7
Optioservus sp	4	sc	4	2														1				7
Paraleptophlebia sp	4	cg	1											6								7
Baetis flavistriga	4	cg		7																		7
Alotanypus sp	7	p						2					1	2			1					6
Clinocera sp	6	p			6																	6
Calineuria californica	2	p	3	2																		5
Hydra sp	5	p			2												3					5
Limnophyes sp	8	cg										2	3									5
Psychoda sp	10	cg										5										5
Rheocricotopus sp	6	om						5														5
Rhyacophila sp	0	p	2											3								5
Synorthocladius sp	2	cg	4		1																	5
Tropisternus sp	5	p																2	2	1		5
Atrichopogon	6	cg		3				1														4
Belostomatidae	8	p			3									1								4
Cambaridae	8	sh									1					3						4
Helicopsyche borealis	3	sc		4																		4
Heptageniidae	4	sc	4																			4
Labrundinea	6	p														4						4
Leptoceridae	4	om	4																			4
Neoplasta sp	6	p												4								4
Protzia sp	8	p		4																		4
Wormaldia sp	3	cf	4																			4
Archilestes sp	9	p						3														3
Brillia sp	5	sh						1						2								3
Cardiocladius sp	5	p		3																		3
Chelifera/Metachela spp	6	p		3																		3
Cricotopus/Trifascia Grp.	7	cg		2	1																	3
Polycentropus sp	6	p			1									2								3
Bezzia/Palpomyia	6	p	2																			2
Caenis sp	7	cg	2																			2
Colymbetinae	5	p									1			1								2
Corisella edullis	8	p							1				1									2
Corisella sp	8	p																2				2
Enallagma sp	9	p							2													2
Isoperla sp	2	p												2								2
Leucrocuta/Nixe spp	3	sc	2																			2

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Taxon	TV	FFG	San Gabriel River Watershed				Los Angeles River Watershed						Dominguez Channel	Santa Monica Bay Watershed				Santa Clara River Watershed				Grand Total
			SGUT-501*	SGUT-504*	SGUT-505	5, SGLT-506	6*	7	LALT500	LALT501	8, LALT502	LALT503	19	SMC02548	SMC03944	SMC02152	SMC04264	SMC01676	SMC01372	SMC01372 Dup	SMC09564	
Menetus sp	6	sc									2											2
Mideopsis sp	5	p														2						2
Paltothemis lineatipes	9	p	1							1												2
Pericoma/Telmatoscopus spp	4	cg			1		1															2
Sympetrum	9	p							2													2
Tropisternus ellipticus	5	p																	2			2
Abedus sp	8	p												1								1
Agabinus sp	5	p											1									1
Corisella decolor	8	p										1										1
Dicranota sp	3	p	1																			1
Dixa sp	2	cg	1																			1
Drunella sp	0	cg		1																		1
Enochrus sp	5	cg																	1			1
Hirudinea	10	pa														1						1
Hydropsychidae	4	cf																	1			1
Hygrotus sp	5	p							1													1
Ilybius sp	5	p												1								1
Krenosmittia sp	1	cg					1															1
Lepidoptera					1																	1
Libellula sp	9	p				1																1
Limnesia sp	5	p		1																		1
Maruina lanceolata	2	sc	1																			1
Nanocladius sp	3	cg																1				1
Narpus sp	4	cg		1																		1
Nemotelus sp	8	cg					1															1
Ordobrevia nubifera	4	sc		1																		1
Orthocladius Cmplx	6	cg		1																		1
Paracladopelma sp	7						1															1
Paraphaenocladius sp	4	cg			1																	1
Paratanytarsus sp	6											1										1
Peltodytes sp	5	mh																		1		1
Procambarus clarki	8	sh														1						1
Progomphus borealis	4	p																1				1
Psephenus falli	4	sc	1																			1
Stictotarsus sp	5	p																1				1
Thienemanniella sp	6	cg		1																		1
Tinodes sp	2	sc	1																			1
Trichocorixa calva	8	p										1										1
Grand Total			**606**	**629**	**602**	**778**	**647**	**720**	**643**	**649**	**523**	**608**	**683**	**662**	**753**	**1505**	**666**	**616**	**662**	**628**	**586**	13166

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Appendix B.3: Calculated BMI Metric Values for Benthic Macroinvertebrates Collected from LACFCD Monitoring Sites for 2010.

	San Gabriel River Watershed				Los Angeles River Watershed						Dominguez Channel	Santa Monica Bay Watershed				Santa Clara River Watershed			
Metric	**SGUT-501***	**SGUT-504***	**SGUT-505**	**5, SGLT-506**	**6***	**7**	**LALT500**	**LALT501**	**8, LALT502**	**LALT503**	**19**	**SMC02548**	**SMC03944**	**SMC02152**	**SMC04264**	**SMC01676**	**SMC01372**	**SMC01372 Dup**	**SMC09564**
Taxa Richness	42	44	30	10	22	31	24	13	17	22	13	31	13	21	14	27	25	20	14
Ephemeropteran Taxa	8	8	1	0	3	3	1	2	1	1	1	2	1	1	1	4	3	3	4
Plecopteran Taxa	1	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Trichopteran Taxa	8	4	5	0	2	0	0	1	0	0	0	7	0	2	1	2	2	2	1
EPT Taxa (Ephemeroptera, Plecoptera, Trichoptera)	17	13	6	0	5	3	1	3	1	1	1	11	1	3	2	6	5	5	5
% EPT Individuals	77.8%	61.6%	57.0%	0.0%	74.6%	16.6%	0.2%	89.8%	0.2%	0.2%	0.2%	81.8%	0.6%	1.4%	1.6%	80.4%	70.4%	69.0%	41.0%
% Sensitive EPT Individuals	55.6%	22.0%	17.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	70.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Dipteran Taxa	15	18	15	4	17	22	13	9	6	16	6	13	9	7	4	8	10	8	4
Non Insect Taxa	6	9	7	5	0	5	6	1	8	3	4	3	3	9	7	7	5	4	4
% Chironomidae Individuals	9.8%	13.4%	12.2%	1.8%	8.0%	32.4%	54.6%	3.6%	6.8%	68.6%	14.8%	13.0%	10.6%	1.8%	0.6%	2.0%	2.6%	1.4%	16.4%
Shannon Diversity	2.3	2.9	2.4	0.2	1.2	2.2	2.1	0.9	1.1	2.0	1.1	2.0	0.7	1.0	1.2	2.2	2.2	2.0	1.8
Margalef Diversity	7.1	7.7	5.0	1.4	3.7	4.8	3.7	2.3	2.6	3.9	1.9	5.0	2.1	3.4	2.3	4.3	4.5	3.4	2.1
Average Tolerance Value	2.9	4.3	5.2	8.0	5.2	6.0	7.3	5.0	5.7	6.9	7.7	2.9	7.8	7.9	7.8	5.0	5.0	5.0	5.3
% Dominant Taxon	47.2%	27.8%	32.4%	96.4%	71.4%	41.8%	31.6%	80.4%	75.0%	45.0%	71.2%	46.8%	85.8%	70.6%	45.0%	31.6%	30.6%	31.8%	35.8%
% Intolerant Individuals	53.6%	21.2%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	70.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Tolerant Individuals	3.2%	5.2%	11.2%	98.6%	3.8%	10.2%	56.8%	0.8%	18.2%	24.0%	81.8%	3.0%	89.4%	95.0%	93.2%	9.2%	3.8%	3.0%	1.6%
% Collector-gatherer	25.8%	55.2%	51.4%	98.6%	83.8%	27.4%	91.8%	94.4%	93.2%	73.4%	96.2%	12.4%	95.4%	23.6%	51.0%	63.8%	66.4%	68.4%	89.8%
% Collector-filterer	10.4%	19.4%	5.8%	0.0%	6.8%	42.8%	4.2%	1.4%	0.4%	4.6%	0.0%	4.2%	0.4%	0.6%	0.0%	9.8%	15.8%	21.0%	0.8%
% Predator	5.0%	13.4%	5.4%	0.8%	2.0%	10.8%	3.2%	1.6%	4.0%	9.0%	0.6%	5.4%	1.0%	3.6%	4.6%	8.6%	8.4%	4.2%	4.2%
% Shredder	0.2%	0.0%	0.0%	0.4%	0.0%	0.2%	0.0%	0.0%	0.2%	0.2%	0.0%	68.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.6%	0.0%
% Scraper	4.4%	5.6%	6.4%	0.2%	0.2%	1.0%	0.6%	0.0%	2.2%	0.0%	3.0%	2.0%	0.0%	71.0%	42.8%	1.4%	0.0%	0.0%	1.4%
% Others	54.2%	6.4%	30.2%	0.0%	6.8%	17.8%	0.2%	2.6%	0.0%	0.0%	0.2%	8.0%	3.2%	1.2%	1.6%	16.4%	9.2%	5.8%	3.6%
Estimated abundance of BMI /ft^2	918	95	304	5,894	514	546	487	971	48	1,316	2,587	2,257	11,409	2,280	2,018	933	669	1,586	666

Yellow highlight = lined channel site
Blue highlight = unlined channel site
*Reference site

Appendix B.4: Physical Water Quality Data for LACFCD Bioassessment Sites for 2010

Watershed	Receiving Water Body	Site Code	Water Temperature (°C)	pH	Specific Conductance (mS/cm)	Dissolved Oxygen (mg/l)	Turbidity (ntu)	Alkalinity (mg/L $CaCO_3$)	Hardness (mg/L $CaCO_3$)
San Gabriel River Watershed	San Gabriel River	SGUT-501*	18.5	8.12	0.328	8.20	2.3	160	144
	San Gabriel River	SGUT-504*	17.0	8.26	0.324	9.16	0.8	172	160
	San Gabriel River	SGUT-505	17.3	8.08	0.309	9.11	11.3	140	152
	Walnut Channel	5, SGLT-506	22.3	8.59	1.122	12.02	7.4	200	380
Los Angeles River Watershed	Arroyo Seco	6*	24.3	8.19	0.452	7.83	1.5	280	216
	Arroyo Seco	7	17.6	7.96	0.952	8.85	2.9	248	360
	Rio Hondo	LALT500	37.2	9.64	0.981	12.20	2.4	72	192
	Arroyo Seco	LALT501	24.1	8.26	0.993	9.86	2.9	208	360
	Compton Creek	8, LALT502	26.3	7.66	1.159	4.99	3.0	200	244
	Tujunga Wash	LALT503	23.4	8.07	2.131	5.99	58.9	300	400
Dominguez Channel	Dominguez Channel	19	21.3	8.03	0.742	9.53	0.4	200	180
Santa Monica Bay Watershed	Rustic Canyon Creek	SMC02548	17.7	7.98	1.376	8.75	0.1	320	620
	Cheseboro Canyon Channel	SMC03944	28.0	8.34	3.174	13.70	2.7	204	>1200
	Malibu Creek	SMC02152	18.8	7.90	3.221	8.14	0.9	360	>1200
	Medea Creek	SMC04264	17.4	7.65	2.926	5.33	0.2	404	>1200
Santa Clara River Watershed	Santa Clara River	SMC01676	20.8	7.90	1.239	7.59	0..0	208	380
	Santa Clara River	SMC01372	25.0	7.78	1.224	8.04	-0.7	252	748
	Santa Clara River	SMC09564	78.4	7.67	1.200	6.80	NS	212	NS

Yellow highlight = lined channel site
Blue highlight = unlined channel site
*Reference site
NS = Not Sampled

Appendix B.5: Physical Habitat Measures of LACFCD Bioassessment Monitoring Reaches for 2010.

	San Gabriel River Watershed				Los Angeles River Watershed						Dominguez Channel	Santa Monica Bay Watershed				Santa Clara River Watershed		
Physical Habitat Measure	**SGUT-501***	**SGUT-504***	**SGUT-505**	**5, SGLT-506**	**6***	**7**	**LALT500**	**LALT501**	**8, LALT502**	**LALT503**	**19**	**SMC 02548**	**SMC 03944**	**SMC 02152**	**SMC 04264**	**SMC 01676**	**SMC 01372**	**SMC 09564**
CRAM physical habitat score (25-100 point scale)	not assessed	not assessed	not assessed	NA	61	NA	NA	NA	NA	NA	NA	79	30	78	68	69	67	65
Elevation (feet above sea level)	1,620	1,512	898	298	1,118	725	82	295	22	578	3	415	210	385	310	780	1,060	885
SWAMP physical habitat attributes																		
Substrate complexity (0-20 scale)	18	15	15	9	10	15	2	3	7	2	4	18	2	17	15	14	14	14
Sediment deposition (0-20 scale)	19	16	15	14	5	11	18	18	9	20	15	19	19	12	17	15	11	13
Channel alteration (0-20 scale)	19	19	17	6	16	13	2	3	9	1	1	20	1	14	16	19	19	14
Attached macroalgae (% of reach)	17.1%	8.6%	2.9%	58.1%	0.0%	1.0%	0.0%	8.6%	31.4%	0.0%	38.1%	1.9%	4.8%	40.0%	51.4%	41.0%	50.5%	31.7%
Bank stability-left bank	stable	stable	stable	stable	stable	stable	stable	stable	stable	stable	stable	stable	stable	stable	stable	stable	stable	vulnerable
Bank stability-right bank	stable	stable	stable	stable	stable	stable	stable	stable	stable	stable	stable	stabe	stabe	stabe	stabe	stabe	stabe	stable
Gradient (% of slope)	3.4%	1.9%	2.2%	0.7%	3.7%	2.2%	0.2%	0.1%	1.1%	0.5%	0.1%	3.0%	0.7%	0.9%	0.9%	0.6%	0.5%	0.5%
Flow Volume (cfs, ft^3/second)	30.7	43.9	NR	0.3	0.6	1.3	0.0	5.8	0.9	2.8	5.5	0.2	NA	0.6	1.9	28.3	36.8	NA
Average canopy cover (% of reach)	43%	21%	4%	11%	28%	87%	50%	0%	3%	4%	0%	95%	8%	79%	65%	19%	18%	32%
Riffle/rapid habitat (% of reach)	33%	69%	25%	5%	57%	48%	1%	0%	100%	50%	0%	19%	0%	27%	17%	80%	71%	74%
Run/glide habitat (% of reach)	67%	31%	76%	96%	43%	43%	48%	100%	0%	50%	100%	82%	100%	53%	65%	20%	30%	11%
Pool habitat (% of reach)	1%	0%	0%	0%	1%	10%	52%	0%	0%	0%	0%	0%	0%	20%	19%	0%	0%	0%
Substrate composition																		
Fines (% of reach)	0%	0%	3%	9%	0%	26%	22%	1%	3%	1%	0%	0%	0%	2%	1%	2%	0%	13%
Sand (% of reach)	14%	18%	6%	36%	33%	4%	41%	0%	3%	0%	4%	11%	0%	14%	28%	30%	34%	51%
Gravel (% of reach)	8%	26%	1%	40%	38%	9%	11%	0%	0%	0%	1%	69%	0%	18%	9%	43%	44%	34%
Cobble (% of reach)	27%	34%	13%	15%	13%	26%	17%	0%	0%	0%	0%	6%	0%	21%	17%	16%	11%	0%
Boulder (% of reach)	35%	13%	55%	0%	7%	10%	2%	0%	0%	0%	0%	0%	0%	5%	6%	1%	1%	0%
Roots (% of reach)	8%	7%	7%	0%	0%	10%	0%	0%	0%	0%	0%	3%	0%	40%	35%	7%	6%	2%
Wood (% of reach)	0%	1%	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%
Consolidated Sediment (% of reach)	0%	0%	0%	0%	0%	6%	7%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Bedrock (% of reach)	9%	0%	13%	0%	8%	0%	0%	0%	0%	0%	0%	11%	0%	0%	5%	1%	3%	0%
Concrete (% of reach)	0%	1%	1%	0%	0%	10%	0%	99%	94%	99%	95%	0%	100%	0%	0%	0%	0%	0%

Yellow highlight = lined channel site
Blue highlight = unlined channel site
*Reference site
NA = Not Assessed

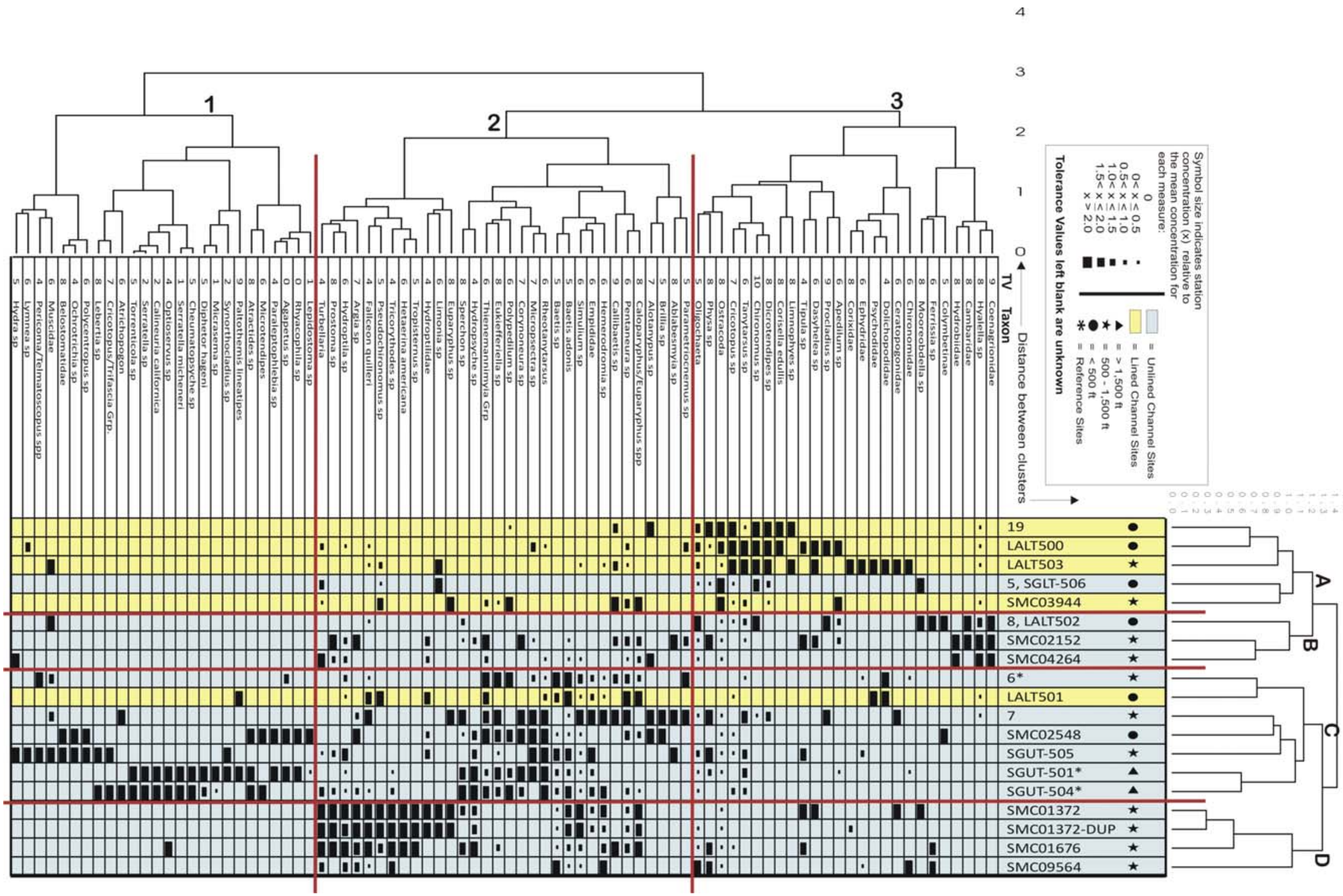
Appendix B.6: Index of Biotic Integrity Scores for LACFCD Bioassessment Sites for 2010.

Watershed	Receiving Water Body	Site Code	Total IBI Score	IBI Rating	% CF+CG		% Non-Insect Taxa		% Tolerant Taxa		Number Coleoptera Taxa		Number Predator Taxa		% Intolerant Individuals		Number EPT Taxa	
					Metric Value	IBI score	Metric Value	IBI score	Metric Value	IBI score	Metric Value	IBI score	Metric Value	IBI score	Metric Value	IBI score	Metric Value	IBI score
San Gabriel River	San Gabriel River	SGUT-501*	56	Very Good	36%	10	14%	8	14%	7	3	5	10	7	54%	10	17	9
Santa Monica Bay	Rustic Canyon Creek	SMC02548	51	Good	17%	10	10%	9	23%	4	1	2	13	10	70%	10	11	6
San Gabriel River	San Gabriel River	SGUT-504*	50	Good	75%	6	20%	7	16%	7	3	5	15	10	21%	8	13	7
Santa Clara River	Santa Clara River	SMC01372	31	Fair	82%	4	20%	7	24%	4	3	5	11	8	0%	0	5	3
San Gabriel River	San Gabriel River	SGUT-505	29	Fair	57%	10	23%	6	20%	5	0	0	8	5	0%	0	6	3
Santa Clara River	Santa Clara River	SMC01676	28	Fair	74%	6	26%	5	30%	2	2	4	11	8	0%	0	6	3
Los Angeles River	Arroyo Seco	6*	23	Poor	91%	2	0%	10	18%	6	0	0	5	2	0%	0	5	3
Santa Clara River	Santa Clara River	SMC01372 Dup	23	Poor	89%	2	20%	7	20%	5	1	2	7	4	0%	0	5	3
Los Angeles River	Arroyo Seco	7	22	Poor	70%	7	16%	8	39%	0	0	0	9	6	0%	0	3	1
Los Angeles River	Arroyo Seco	LALT501	19	Poor	96%	1	8%	10	15%	7	0	0	3	0	0%	0	3	1
Los Angeles River	Tujunga Wash	LALT503	18	Poor	78%	5	14%	8	36%	1	0	0	7	4	0%	0	1	0
Santa Monica Bay	Malibu Creek	SMC02152	17	Poor	24%	10	43%	1	43%	0	0	0	8	5	0%	0	3	1
Santa Clara River	Santa Clara River	SMC09564	17	Poor	91%	2	29%	5	14%	7	0	0	3	0	0%	0	5	3
Santa Monica Bay	Medea Creek	SMC04264	14	Poor	51%	10	50%	0	43%	0	0	0	6	3	0%	0	2	1
Los Angeles River	Rio Hondo	LALT500	13	Very Poor	96%	1	25%	6	42%	0	1	2	7	4	0%	0	1	0
Dominguez Channel	Dominguez Channel	19	7	Very Poor	96%	1	31%	4	62%	0	1	2	3	0	0%	0	1	0
Santa Monica Bay	Cheseboro Canyon Channel	SMC03944	7	Very Poor	96%	1	23%	6	38%	0	0	0	3	0	0%	0	1	0
Los Angeles River	Compton Creek	8, LALT502	6	Very Poor	94%	1	47%	0	47%	0	1	2	6	3	0%	0	1	0
San Gabriel River	Walnut Channel	SGLT-506	0	Very Poor	99%	0	50%	0	60%	0	0	0	3	0	0%	0	0	0

Yellow highlight = lined channel site
Blue highlight = unlined channel site
*Reference site

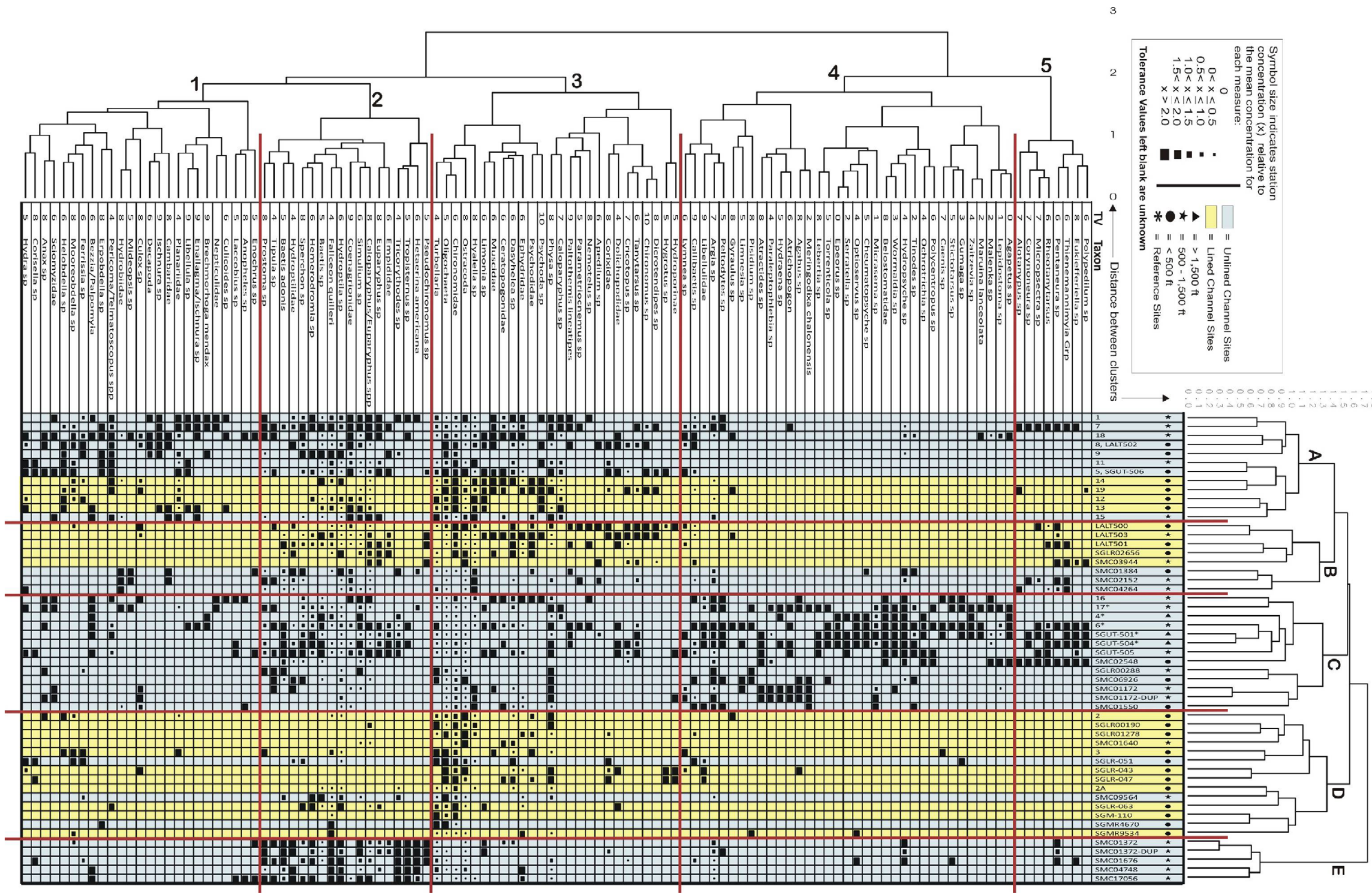
Appendix B.7. Cluster Analysis of Stations and Taxa for Los Angeles County Bioassessment Monitoring Sites for 2010.

(TV values are not applied to some family or order level taxa due to high variability within those levels)



Appendix B.8. Cluster Analysis of Stations and Taxa for Los Angeles County Bioassessment Monitoring Sites for 2003-2010.

(TV values are not applied to some family or order level taxa due to high variability within those levels)



APPENDIX C

Field Data Sheets

(ON CD ONLY)

(Chain of Custodies and Field Data Sheets are available upon request.)

Project: LACFCD Bioassessment 2010

STREAM BIOASSESSMENT LAB SAMPLE TRACKING SHEET

Survey	Station	Rep	# Jars	Vol (ml)	Sorter Out	Sorter In	QA/QC Out	QA/QC In	Taxonomy E	Taxonomy T	Taxonomy D	Taxonomy OI	Taxonomy C	M	OP	Curation Box #
2010	6	1	1	300	TVG	✓			BI	BI	BI	BI	TVG	SH	BI	NA
	7	1	1	300	TVG	✓				x	BI	BI		SH		
	19	1	1	600	TVG	✓				x	x					
	SGUT501	1	1	400	TVG	✓				BI	BI		↓	↓		
	SGUT504	1	1	150	TVG	✓							x	x		
	SGUT505	1	1	500	TVG	✓			↓	↓			TVG	SH		
	SGLT506	1	~~4~~ 3	3,000	TVG	✓			x	x						
	LALT500	1	1	100	TVG	✓			BI	BI				↓		
	LALT501	1	1	450	TVG	✓				BI				x		
	LALT502	1	1	150	TVG	✓				x				SH		
	LALT503	1	1	400	TVG	✓				x				SH		
	SMC02548	1	~~x~~ 1	400	TVG	✓	BI	✓		BI		↓		x		
	SMC03944	1	1	450	TVG	✓	BI	✓		x		x		x		
	SMC02152	1	2	1200	TVG	✓	BI	✓		BI		BI		SH		
	SMC04264	1	1	600	TVG	✓	BI	✓								
	SMC01372	1	2	1000	TVG	✓	BI	✓								
	SMC01372 DUP.	2	2	1400	TVG	✓	BI	✓								
	SMC01676	1	2	1000	TVG	✓	BI	✓	↓	↓	↓	↓	↓	↓	↓	

WESTON SOLUTIONS

Approved by:________________
Date:________________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title: **LACFCD Bioassessment 2010** Survey: **Jul-10**
Station: Site - 6 Replicate: 1
Date Collected: 8 July 2010
Sample Sed. Vol. (mL): 300 ml No./Type Contr.: **1 Qt** Sampler: **Kick Net**

II. Sorting (600 animals)

Sort Fraction: 3/25 Sorted By: NG Date(s) Sorted: 7-31-10
Total Sort Time: 3 h. # Animals Sorted: 600 Animals Remaining: 31
Animals/Grid (optional):
Comments: 1/25 - 228, 1/25 - 191, 1/25 - 181 647

Distribution of Sorted Material Est. total abundance: 5650 ÷ 11 = 514/ft²

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera	1		
Chironomidae	1		
Diptera	1		
Other Insects	1		
Mollusca			
Crustacea			
Other phyla			
Extra Animals			

III. Sorting QA/QC

Sort Criteria ______ %
QA/QC By ______ Pass/Fail ______ Date ______
QA/QC Time ______ Re-Sort Time ______ Re-Sort Date ______
No. of Animals QA/QC ______ Removal rate ______
No. of Animals Re-Sort ______

IV. Sample Qualification Comments (Circle One)

1. Preservation: (GOOD) FAIR POOR

2. Single Major Component:

Shellhash Tubes Wood Algae Seeds Animals
Fibers Coarse Sand [Fine Sand] Pea Gravel [Organic Material]
Sewage Debris Macrodetritus Other:______

WESTON SOLUTIONS

Approved by: ____________
Date: ____________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title: LACFCD Bioassessment 2010
Survey: Jul-10
Station: Site - 7
Replicate: 1
Date Collected: 7 July 2010
Sample Sed. Vol. (mL): 300 ml
No./Type Contr.: 1 Qt
Sampler: Kick Net

II. Sorting (600 animals)

Sort Fraction: 3/25
Sorted By: TVG
Date(s) Sorted: 8-3-10
Total Sort Time: 4h
Animals Sorted: 600
Animals Remaining: 16
Animals/Grid (optional): ____________
Comments: 1/25 - 183, 1/25 - 219, 1/25 - 198 720

Distribution of Sorted Material
Est. total abundance: 6000 ÷ 11 = 546/ft²

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera			
Chironomidae	1		
Diptera	1		
Other Insects	1		
Mollusca	1		
Crustacea	1		
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria ____________ %
QA/QC By ____________
Pass/Fail ____________
Date ____________
QA/QC Time ____________
Re-Sort Time ____________
Re-Sort Date ____________
No. of Animals QA/QC ____________
Removal rate ____________
No. of Animals Re-Sort ____________

IV. Sample Qualification Comments (Circle One)

1. Preservation: (GOOD) FAIR POOR
2. Single Major Component:

Shellhash, Tubes, Wood, Algae, Seeds, Animals
Fibers, Coarse Sand, [Fine Sand], Pea Gravel, [Organic Material]
Sewage Debris, Macrodetritus, Other: ____________

WESTON SOLUTIONS

Approved by:____________________
Date:____________________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title **LACFCD Bioassessment 2010** Survey **Jul-10**
Station SITe 19 Replicate 1
Date Collected 10 July 2010
Sample Sed. Vol. (mL) 600ml No./Type Contr. **1 Qt** Sampler **Kick Net**

II. Sorting (600 animals)

Sort Fraction .6/25 Sorted By TG Date(s) Sorted 7-27-10
Total Sort Time 4h. # Animals Sorted 600 Animals Remaining 72
Animals/Grid (optional)
Comments .2/25 - 211, .2/25 - 233, .2/25 - 156 683

Distribution of Sorted Material Est. total abundance 28,458 ÷ 11 = 2,587

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera			
Chironomidae	1		
Diptera			
Other Insects	1		
Mollusca	1		
Crustacea	1		
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria ____________ %
QA/QC By ____________ Pass/Fail ____________ Date ____________
QA/QC Time ____________ Re-Sort Time ____________ Re-Sort Date ____________
No. of Animals QA/QC ____________ Removal rate ____________
No. of Animals Re-Sort ____________

IV. Sample Qualification Comments (Circle One)

1. Preservation: (GOOD) FAIR POOR

2. Single Major Component:

Shellhash Tubes Wood Algae Seeds Animals
Fibers Coarse Sand [Fine Sand] Pea Gravel [Organic Material]
Sewage Debris Macrodetritus Other:____________

WESTON SOLUTIONS

Approved by:__________________
Date:__________________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title LACFCD Bioassessment 2010 — Survey Jul-10
Station SGUT-501 — Replicate 1
Date Collected 7 July 2010
Sample Sed. Vol. (mL) 400ml — No./Type Contr. 1 Qt — Sampler Kick Net

II. Sorting (600 animals)

Sort Fraction 1.5/25 — Sorted By JVG — Date(s) Sorted 7-26-10
Total Sort Time 4hr. — # Animals Sorted 600 — Animals Remaining 19
Animals/Grid (optional)
Comments .5/25 - 198, .5/25 - 216, .5/25 - 186 606

Distribution of Sorted Material — Est. total abundance 10,100 ÷ 11 = 918/ft²

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera	1		
Chironomidae	1		
Diptera	1		
Other Insects	1		
Mollusca	1		
Crustacea	1		
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria ______ %
QA/QC By ______ — Pass/Fail ______ — Date ______
QA/QC Time ______ — Re-Sort Time ______ — Re-Sort Date ______
No. of Animals QA/QC ______ — Removal rate ______
No. of Animals Re-Sort ______

IV. Sample Qualification Comments (Circle One)

1. Preservation: (GOOD — circled) FAIR POOR
2. Single Major Component:

Shellhash — Tubes — Wood — Algae — Seeds — Animals
Fibers — Coarse Sand — [Fine Sand] (boxed) — Pea Gravel — [Organic Material] (boxed)
Sewage Debris — Macrodetritus — Other:______

WESTON SOLUTIONS

Approved by:____________
Date:____________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title: LACFCD Bioassessment 2010   Survey: Jul-10
Station: SGUT-504   Replicate: 1
Date Collected: 7 July 2010
Sample Sed. Vol. (mL): 150 ml   No./Type Contr.: 1 Qt   Sampler: Kick Net

II. Sorting (600 animals)

Sort Fraction: 15/25   Sorted By: DG   Date(s) Sorted: 8-3-10
Total Sort Time: 4 hr   # Animals Sorted: 600   Animals Remaining: 30
Animals/Grid (optional)
Comments: 5/25 - 206, 5/25 - 216, 5/25 - 178   (100 ml sand)   629

Distribution of Sorted Material   Est. total abundance: 1,048 ÷ 11 = 95/ft²

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera	1		
Chironomidae	1		
Diptera	1		
Other Insects	1		
Mollusca			
Crustacea			
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria ______ %
QA/QC By ______   Pass/Fail ______   Date ______
QA/QC Time ______   Re-Sort Time ______   Re-Sort Date ______
No. of Animals QA/QC ______   Removal rate ______
No. of Animals Re-Sort ______

IV. Sample Qualification Comments (Circle One)

1. Preservation: (GOOD) FAIR POOR
2. Single Major Component:

Shellhash   Tubes   Wood   Algae   Seeds   Animals
Fibers   Coarse Sand   [Fine Sand]   Pea Gravel   [Organic Material]
Sewage Debris   Macrodetritus   Other:______

WESTON SOLUTIONS

Approved by:____________
Date:____________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title: LACFCD Bioassessment 2010 — Survey: Jul-10
Station: SGUT-505 — Replicate: 1
Date Collected: 8 July 2010
Sample Sed. Vol. (mL): 500ml — No./Type Contr.: 1 Qt — Sampler: Kick Net

II. Sorting (600 animals)

Sort Fraction: 4.5/25 — Sorted By: TNG — Date(s) Sorted: 8-2-10
Total Sort Time: 5hr. — # Animals Sorted: 600 — Animals Remaining: 13
Animals/Grid (optional):
Comments: 1.5/25 - 207, 1.5/25 - 196, 1.5/25 - 197 602

Distribution of Sorted Material — Est. total abundance: 3,344 ÷ 11 = 304/ft²

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera	1		
Chironomidae	1		
Diptera	1		
Other Insects	1		
Mollusca	1		
Crustacea	1		
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria ______ %
QA/QC By ______ Pass/Fail ______ Date ______
QA/QC Time ______ Re-Sort Time ______ Re-Sort Date ______
No. of Animals QA/QC ______ Removal rate ______
No. of Animals Re-Sort ______

IV. Sample Qualification Comments (Circle One)

1. Preservation: **GOOD** (circled) FAIR POOR
2. Single Major Component:
   Shellhash, Tubes, Wood, Algae, Seeds, Animals
   Fibers, Coarse Sand, **Fine Sand** (boxed), Pea Gravel, **Organic Material** (boxed)
   Sewage Debris, Macrodetritus, Other:______

WESTON SOLUTIONS

Approved by:____________________
Date:____________________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title LACFCD Bioassessment 2010 | Survey Jul-10
Station SGLT-506 | Replicate 1
Date Collected 6 July 2010
Sample Sed. Vol. (mL) 3L | No./Type Contr. 1 Qt | Sampler Kick Net

II. Sorting (600 animals)

Sort Fraction 3/25 | Sorted By TVG | Date(s) Sorted 7.29.10
Total Sort Time 4hr. | # Animals Sorted 600 | Animals Remaining 180
Animals/Grid (optional)
Comments 1/25 - 248, 1/25 - 260, 1/25 - 92 778

Distribution of Sorted Material | Est. total abundance 64,833 ÷ 11 = 5,894

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera			
Trichoptera			
Chironomidae	1		
Diptera	1		
Other Insects	1		
Mollusca	1		
Crustacea	1		
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria ________ %
QA/QC By ________ | Pass/Fail ________ | Date ________
QA/QC Time ________ | Re-Sort Time ________ | Re-Sort Date ________
No. of Animals QA/QC ________ | Removal rate ________
No. of Animals Re-Sort ________

IV. Sample Qualification Comments (Circle One)

1. Preservation: (GOOD) FAIR POOR

2. Single Major Component:
   Shellhash, Tubes, Wood, (Algae), Seeds, Animals, Fibers, Coarse Sand, [Fine Sand], Pea Gravel, [Organic Material], Sewage Debris, Macrodetritus, Other:________

WESTON SOLUTIONS

Approved by:__________
Date:__________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title LACFCD Bioassessment 2010 — Survey Jul-10
Station LALT500 — Replicate 1
Date Collected 15 July 2010
Sample Sed. Vol. (mL) 100ml — No./Type Contr. 1 Qt — Sampler Kick Net

II. Sorting (600 animals)

Sort Fraction 3/25 — Sorted By TVT — Date(s) Sorted 8-12-10
Total Sort Time 4hr — # Animals Sorted 600 — Animals Remaining 51
Animals/Grid (optional)
Comments 1/25-219, 1/25-207, 1/25-174 643

Distribution of Sorted Material — Est. total abundance 5358 ÷ 11 = 487/ft²

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera	1		
Chironomidae	1		
Diptera	1		
Other Insects	1		
Mollusca	1		
Crustacea	1		
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria ______ %
QA/QC By ______ — Pass/Fail ______ — Date ______
QA/QC Time ______ — Re-Sort Time ______ — Re-Sort Date ______
No. of Animals QA/QC ______ — Removal rate ______
No. of Animals Re-Sort ______

IV. Sample Qualification Comments (Circle One)

1. Preservation: (GOOD) FAIR POOR
2. Single Major Component:

Shellhash Tubes Wood Algae Seeds Animals
Fibers Coarse Sand [Fine Sand] Pea Gravel [Organic Material]
Sewage Debris Macrodetritus Other:______

WESTON SOLUTIONS

Approved by:

Date:

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title LACFCD Bioassessment 2010 | Survey Jul-10
Station LALT 501 | Replicate 1
Date Collected 15 July 2010
Sample Sed. Vol. (mL) 450ml | No./Type Contr. 1 Qt | Sampler Kick Net

II. Sorting (600 animals)

Sort Fraction 1.5/25 | Sorted By TVG | Date(s) Sorted 8-16-10
Total Sort Time 3hr. | # Animals Sorted 600 | Animals Remaining 41
Animals/Grid (optional)
Comments .5/25 - 198, .5/25 - 221, .5/25 - 181 649

Distribution of Sorted Material | Est. total abundance 10,683 ÷ 11 = 971/ft²

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera	1		
Chironomidae	1		
Diptera	1		
Other Insects	1		
Mollusca			
Crustacea	1		
Other phyla			
Extra Animals			

III. Sorting QA/QC

Sort Criteria ______ %
QA/QC By ______ | Pass/Fail ______ | Date ______
QA/QC Time ______ | Re-Sort Time ______ | Re-Sort Date ______
No. of Animals QA/QC ______ | Removal rate ______
No. of Animals Re-Sort ______

IV. Sample Qualification Comments (Circle One)

1. Preservation: GOOD FAIR POOR

2. Single Major Component:
Shellhash Tubes Wood Algae Seeds Animals
Fibers Coarse Sand Fine Sand Pea Gravel Organic Material
Sewage Debris Macrodetritus Other:

WESTON SOLUTIONS

Approved by:__________
Date:__________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title: LACFCD Bioassessment 2010 — Survey: Jul-10
Station: LACT 502 — Replicate: 1
Date Collected: 15 Jul 2010
Sample Sed. Vol. (mL): 150 ml — No./Type Contr.: 1 Qt — Sampler: Kick Net

II. Sorting (600 animals)

Sort Fraction: 100% — Sorted By: TKG — Date(s) Sorted: 8-17/18-10
Total Sort Time: 6 hr. — # Animals Sorted: 524 — Animals Remaining: -0-
Animals/Grid (optional):
Comments:

Distribution of Sorted Material — Est. total abundance: 523 ÷ 11 = 48/ft²

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera			
Chironomidae	1		
Diptera	1		
Other Insects	1		
Mollusca	1		
Crustacea	1		
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria _____ %
QA/QC By _____ Pass/Fail _____ Date _____
QA/QC Time _____ Re-Sort Time _____ Re-Sort Date _____
No. of Animals QA/QC _____ Removal rate _____
No. of Animals Re-Sort _____

IV. Sample Qualification Comments (Circle One)

1. Preservation: **(GOOD)** FAIR POOR
2. Single Major Component:
   Shellhash, Tubes, Wood, Algae, Seeds, Animals,
   Fibers, Coarse Sand, **[Fine Sand]**, Pea Gravel, **[Organic Material]**,
   Sewage Debris, Macrodetritus, Other:_____

WESTON SOLUTIONS

Approved by:__________
Date:__________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title: LACFCD Bioassessment 2010
Survey: Jul-10
Station: LALT 503
Replicate: 1
Date Collected: 15 July 2010
Sample Sed. Vol. (mL): 400ml
No./Type Contr.: 1 Qt
Sampler: Kick Net

II. Sorting (600 animals)

Sort Fraction: 1.05/25
Sorted By: TVG
Date(s) Sorted: 8-14-10
Total Sort Time: 4 hr.
Animals Sorted: 600
Animals Remaining: 9
Animals/Grid (optional):
Comments: .35/25 - 204, .35/25 - 200, .35/25 - 196 608

Distribution of Sorted Material
Est. total abundance: 14,476 ÷ 11 = 1,316/ft²

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera			
Chironomidae	1		
Diptera	1		
Other Insects	1		
Mollusca			
Crustacea	1		
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria ______ %
QA/QC By: ______ Pass/Fail: ______ Date: ______
QA/QC Time: ______ Re-Sort Time: ______ Re-Sort Date: ______
No. of Animals QA/QC: ______ Removal rate: ______
No. of Animals Re-Sort: ______

IV. Sample Qualification Comments (Circle One)

1. Preservation: GOOD (circled) FAIR POOR
2. Single Major Component:

Shellhash Tubes Wood Algae Seeds Animals
Fibers Coarse Sand [Fine Sand] Pea Gravel [Organic Material]
Sewage Debris Macrodetritus Other: ______

WESTON SOLUTIONS

Approved by:
Date:

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title: LACFCD Bioassessment 2010
Survey: Jul-10
Station: SMC 03944
Replicate: 1
Date Collected: 12 July 2010
Sample Sed. Vol. (mL): 450ml
No./Type Contr.: 1 Qt
Sampler: Kick Net

II. Sorting (600 animals)

Sort Fraction: .15/.25
Sorted By: [illegible]
Date(s) Sorted: 8-18-10
Total Sort Time: 3.5h
Animals Sorted: 600
Animals Remaining: 139
Animals/Grid (optional):
Comments: .05/.25 - 274, .05/.25 - 259, .05/.25 - 67 753

Distribution of Sorted Material
Est. total abundance: 125,500 ÷ 11 = 11,409/ft²

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera			
Chironomidae	1		
Diptera	1		
Other Insects			
Mollusca			
Crustacea	1		
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria: 100 %
QA/QC By: [illegible]
Pass/Fail: Pass
Date: 30 Aug 10
QA/QC Time: 1/2 hr
Re-Sort Time:
Re-Sort Date:
No. of Animals QA/QC: 11 all ostracods
Removal rate: 98.5%
No. of Animals Re-Sort:

IV. Sample Qualification Comments (Circle One)

1. Preservation: (GOOD) FAIR POOR

2. Single Major Component:
   Shellhash, Tubes, Wood, Algae, Seeds, Animals
   Fibers, Coarse Sand, [Fine Sand], Pea Gravel, [Organic Material]
   Sewage Debris, Macrodetritus, Other: Calcareous algae

WESTON SOLUTIONS

Approved by:__________
Date:__________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title LACFCD Bioassessment 2010 — Survey Jul-10
Station SMC02548 — Replicate 1
Date Collected 7 July 2010
Sample Sed. Vol. (mL) 400ml — No./Type Contr. 1 Qt — Sampler Kick Net

II. Sorting (600 animals)

Sort Fraction 1.5/25 — Sorted By TVG — Date(s) Sorted 7-25-10
Total Sort Time 4 hr. — # Animals Sorted 600 — Animals Remaining 39
Animals/Grid (optional)
Comments .5/25 - 209, .5/25 - 222, .5/25 - 169 662

Distribution of Sorted Material — Est. total abundance 24,825 ÷ 11 = 2,257

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera	1		
Chironomidae	1		
Diptera	1		
Other Insects	1	1	
Mollusca			
Crustacea	1		
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria 100 %
QA/QC By BIShar — Pass/Fail Pass — Date 30 Aug 10
QA/QC Time 1 hr — Re-Sort Time — Re-Sort Date
No. of Animals QA/QC 21 Small — Removal rate 96.8%
No. of Animals Re-Sort

IV. Sample Qualification Comments (Circle One)

1. Preservation: GOOD (circled) FAIR POOR

2. Single Major Component:

Shellhash, Tubes, Wood, Algae, Seeds, Animals, Fibers, Coarse Sand, Fine Sand (boxed), Pea Gravel, Organic Material (boxed), Sewage Debris, Macrodetritus, Other:

WESTON SOLUTIONS

Approved by:__________
Date:__________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title LACFCD Bioassessment 2010 Survey Jul-10
Station SMC 02152 Replicate 1
Date Collected 14 July 2010
Sample Sed. Vol. (mL) 1200 No./Type Contr. 1 Qt Sampler Kick Net

II. Sorting (600 animals)

Sort Fraction 1.5/25 Sorted By TVT Date(s) Sorted 8-10-10
Total Sort Time 5h # Animals Sorted 600 Animals Remaining 895
Animals/Grid (optional)
Comments .5/25 - 202, .5/25 - 194, .5/25 - 204 1505

Distribution of Sorted Material Est. total abundance 25,083÷11 = 2,280/ft²

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera	1		
Chironomidae	1		
Diptera	1		
Other Insects	1		
Mollusca	1		
Crustacea	1	1	
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria 100 %
QA/QC By BEsher Pass/Fail Pass Date 17 Aug 10
QA/QC Time 2 hr Re-Sort Time Re-Sort Date
No. of Animals QA/QC 11 Hyalella Removal rate 99.3%
No. of Animals Re-Sort

IV. Sample Qualification Comments (Circle One)

1. Preservation: (GOOD) FAIR POOR
2. Single Major Component:
   Shellhash Tubes Wood (Algae) Seeds Animals
   Fibers Coarse Sand [Fine Sand] Pea Gravel [Organic Material]
   Sewage Debris Macrodetritus Other:

WESTON SOLUTIONS

Approved by: ____________
Date: ____________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title: LACFCD Bioassessment 2010
Survey: Jul-10
Station: SMC 04264 TG
Replicate: 1
Date Collected: 9 Jul / 10
Sample Sed. Vol. (mL): 600 mL
No./Type Contr.: 1 Qt
Sampler: Kick Net

II. Sorting (600 animals)

Sort Fraction: .75/25
Sorted By: TVT
Date(s) Sorted: 7-24-10
Total Sort Time: 3.5 hr
Animals Sorted: 600
Animals Remaining: 66
Animals/Grid (optional): ____________
Comments: .25/25 - 224, .25/25 - 208, .25/25 - 168 666

Distribution of Sorted Material
Est. total abundance: 22,200 ÷ 11 = 2,018/ft²

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera	1		
Chironomidae	1		
Diptera	1		
Other Insects	1		
Mollusca	1		
Crustacea	1		
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria: 100% %
QA/QC By: B Isham
Pass/Fail: Fail
Date: 30 Aug 10
QA/QC Time: 3/4 hr
Re-Sort Time: ____________
Re-Sort Date: ____________
No. of Animals QA/QC: 56 (3 Hyalella + Molluscs Hydrobiids)
Removal rate: 92.2%
No. of Animals Re-Sort: ____________

IV. Sample Qualification Comments (Circle One)

1. Preservation: (GOOD, circled) FAIR POOR

2. Single Major Component:

Shellhash	Tubes	Wood	Algae	Seeds	Animals
Fibers	Coarse Sand	[Fine Sand] (boxed)		Pea Gravel	[Organic Material] (boxed)
Sewage Debris	Macrodetritus		Other: ____________		

WESTON SOLUTIONS

Approved by:__________
Date:__________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title LACFCD Bioassessment 2010 — Survey Jul-10

Station SMC 01372 — Replicate 1

Date Collected 13 July 2010

Sample Sed. Vol. (mL) 1000ml — No./Type Contr. 2 (1 Qt) — Sampler Kick Net

II. Sorting (600 animals)

Sort Fraction 2.25/25 — Sorted By TVG — Date(s) Sorted 8-21-10

Total Sort Time 4h. — # Animals Sorted 600 — Animals Remaining 33

Animals/Grid (optional)

Comments .75/25 - 227, .75/25 - 199, .75/25 - 174 662

Distribution of Sorted Material — Est. total abundance 7,356 ÷ 11 = 669/ft²

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera	1		
Chironomidae	1		
Diptera	1		
Other Insects	1		
Mollusca			
Crustacea	1		
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria 100 %

QA/QC By BIsham — Pass/Fail Pass — Date 17Aug10

QA/QC Time 1.5 hr — Re-Sort Time — Re-Sort Date

No. of Animals QA/QC 14 — Removal rate 97.8%

No. of Animals Re-Sort

IV. Sample Qualification Comments (Circle One)

1. Preservation: (GOOD) FAIR POOR

2. Single Major Component:

Shellhash, Tubes, Wood, (Algae), Seeds, Animals, Fibers, Coarse Sand, [Fine Sand], Pea Gravel, [Organic Material], Sewage Debris, Macrodetritus, Other:

WESTON SOLUTIONS

Approved by:____________________
Date:____________________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title LACFCD Bioassessment 2010 Survey Jul-10
Station SMC 01372 Replicate Dup *
Date Collected 13 July 2010
Sample Sed. Vol. (mL) 1400ml No./Type Contr. 2 Qt Sampler Kick Net

II. Sorting (600 animals)

Sort Fraction .9/25 Sorted By TVG Date(s) Sorted 8.22.10
Total Sort Time 4h. # Animals Sorted 600 Animals Remaining 24
Animals/Grid (optional)
Comments .3/25 - 223, .3/25 - 199, .3/25 - 178 628

Distribution of Sorted Material Est. total abundance 17,444 ÷ 11 = 1,586/ft²

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera	1		
Chironomidae	1		
Diptera	1		
Other Insects	1		
Mollusca			
Crustacea	1		
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria 100 %
QA/QC By BTchan Pass/Fail Pass Date 16 Aug 10
QA/QC Time 1.5 hr Re-Sort Time Re-Sort Date
No. of Animals QA/QC 14 various small Removal rate 97.8%
No. of Animals Re-Sort

IV. Sample Qualification Comments (Circle One)

1. Preservation: (GOOD) FAIR POOR

2. Single Major Component:
Shellhash Tubes Wood (Algae) Seeds Animals
Fibers Coarse Sand [Fine Sand] Pea Gravel [Organic Material]
Sewage Debris Macrodetritus Other:

WESTON SOLUTIONS

Approved by:__________
Date:__________

Stream Bioassessment Sorting Sheet

I. Sample Identification

Project Title LACFCD Bioassessment 2010 — Survey Jul-10
Station SMC 01676 — Replicate 1
Date Collected 15 July 2010
Sample Sed. Vol. (mL) 1000 ml — No./Type Contr. 1 Qt — Sampler Kick Net

II. Sorting (600 animals)

Sort Fraction 1.5/25 — Sorted By TG — Date(s) Sorted 8-24-10
Total Sort Time 4 h. — # Animals Sorted 600 — Animals Remaining 16
Animals/Grid (optional)
Comments 1.5/25 - 212, 1.5/25 - 199, 1.5/25 - 189   616

Distribution of Sorted Material — Est. total abundance 10,267 ÷ 11 = 933/ft²

	# of Vials	# of Jars	Contents of Jars
Ephemeroptera	1		
Trichoptera	1		
Chironomidae	1		
Diptera	1		
Other Insects	1		
Mollusca	1		
Crustacea	1		
Other phyla	1		
Extra Animals			

III. Sorting QA/QC

Sort Criteria 100 %
QA/QC By B Ishan — Pass/Fail Pass — Date 16 Aug 10
QA/QC Time 1 hr — Re-Sort Time — Re-Sort Date
No. of Animals QA/QC 11 small ephem — Removal rate 98.2%
No. of Animals Re-Sort

IV. Sample Qualification Comments (Circle One)

1. Preservation: (GOOD) FAIR POOR
2. Single Major Component:
   Shellhash, Tubes, Wood, (Algae), Seeds, Animals, Fibers, Coarse Sand, [Fine Sand], Pea Gravel, [Organic Material], Sewage Debris, Macrodetritus, Other:

DEPARTMENT OF FISH AND GAME
AQUATIC BIOASSESSMENT LABORATORY-CHICO
CALIFORNIA STATE UNIVERSITY, CHICO
CHICO, CA 95929-0555
530-898-4792

October 29, 2010

Bill Isham
Weston Solutions
2433 Impala Drive
Carlsbad, CA 92008

Dear Bill,

Attached are the results of my QC analysis of 1 sample submitted from the SMC 2010 project. The results are presented in five summary tables. This QC analysis was performed in accordance to the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT)'s Standard Taxonomic Effort Document (STE) 28 November 2006 version (Richards and Rogers, 2006).

Only one taxonomic discrepancy was found in this sample. An immature *Enochrus* larva was misidentified as *Tropisternus*. Since another *Enochrus* larva was identified correctly, I consider this a minor taxonomic error or possibly a sorting error.

Ostracoda was left off the original datalist.

I welcome any questions or comments you may have concerning this report.

Sincerely,

Austin Brady Richards
Aquatic Bioassessment Laboratory–Chico
California State University, Chico
Chico, CA 95929-0555
arichards@csuchico.edu
(530) 898-4792

Literature Cited

Richards, A. B. and D. C. Rogers. (2006). "Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) List of Freshwater Macroinvertebrate Taxa from California and Adjacent States including Standard Taxonomic Effort Levels. Version: 28 November 2006." Retrieved 11 May 2007, from http://www.waterboards.ca.gov/swamp/safit.html

Comparative Taxonomic Listing of all Submitted Samples

Samples submitted by Weston Solutions for Project: SMC 2010

Report prepared by Brady Richards, CDFG ABL-Chico, 10/29/2010

Taxonomist	Sample no.	Vial no.	Original ID	Original Count	Stage	ABL Count	ABL ID
	SMC01372						
		1	Baetis adonis	201		201	Baetis adonis
		2	Baetis	7		7	Baetis
		3	Hetaerina americana	5		5	Hetaerina americana
		4	Argia	10		10	Argia
		5	Hydropsyche	19	L	19	Hydropsyche
		6	Hydropsychidae	1	P	1	Hydropsychidae
		7	Hydroptila	49	L	49	Hydroptila
		8	Hydroptilidae	14	P	14	Hydroptilidae
		9	Caloparyphus/Euparyphus	6	L	6	Caloparyphus/Euparyphus
		10	Dasyhelea	2	L	2	Dasyhelea
		11	Limonia	1	L	1	Limonia
		12	Hemerodromia	4	L	4	Hemerodromia
		13	Simulium	81	L&P	81	Simulium
		14	Tipula	3	L	3	Tipula
		15	Euparyphus	1	L	1	Euparyphus
		16	Ceratopogonidae	1	P	1	Ceratopogonidae
		17	Sperchon	3		3	Sperchon
		18	Mooreobdella	1		1	Mooreobdella
		19	Turbellaria	13		13	Turbellaria
		20	Prostoma	5		5	Prostoma
		21	Fallceon quilleri	133		133	Fallceon quilleri
		22	Tricorythodes	69		71	Tricorythodes
		23	Empididae	1	P	1	Empididae
		24	Tropisternus	2	L	1	Tropisternus
		24	Tropisternus	2	L	1	Enochrus
		25	Enochrus	1	L	1	Enochrus

Taxonomist	Sample no.	Vial no.	Original ID	Original Count	Stage	ABL Count	ABL ID
	SMC01372						
		26	Tropisternus ellipticus	2	A	2	Tropisternus ellipticus
		27	Pentaneura	3	L	3	Pentaneura
		28	Pseudochironomus	14	L	14	Pseudochironomus
		29	Ostracoda	6		9	Ostracoda

Listing of Enumeration Discrepancies

Samples submitted by Weston Solutions for Project: SMC 2010

Report prepared by Brady Richards, CDFG ABL-Chico, 10/29/2010

	Sample #	Vial #	Original ID	# Counted Original	# Counted QC	Difference (Original - QC)
Minor Counting Discrepancies						
	SMC01372	22	Tricorythodes	69	71	-2
		29	Ostracoda	6	9	-3

Listing of Taxonomic Discrepancies

Samples submitted by Weston Solutions for Project: SMC 2010

Report prepared by Brady Richards, CDFG ABL-Chico, 10/29/2010

Sample #	Vial #	Final ID Original ID	QC Final ID	Taxonomic level of dispute	# Organis
SMC01372					
Disputed ID					
	24	Tropisternus	Enochrus	Genus	1

Summary of Taxonomic and Enumeration Discrepancies

Samples submitted by Weston Solutions for Project: SMC 2010

Report prepared by Brady Richards, CDFG ABL-Chico, 10/29/2010

		Taxonomic Discrepancies						Counting Discrepancies			
				Taxonomic Precision Relative to QC							
Sample #	**Total Taxa**	**Disputed ID**		**More precise**		**Less Precise**		Major		Minor	
		*f**	*n***	*f*	*n*	*f*	*n*	*f*	*d****	*f*	*d*
SMC01372	29	1	1	-	-	-	-	-	-	2	5

* = the frequency of occurence of the discrepancy, in number of samples *f*
** = the number of organisms affected (by QC Lab counts) *n*
*** = the sum total of (absolute value of) differences in counts *d*

QC Report - Disputed ID's only

Samples submitted by Weston Solutions for Project: SMC 2010

Report prepared by Brady Richards, CDFG ABL-Chico, 10/29/2010

Sample #	***Vial #.***	***Original ID***	***QC ID***	***comments***
SMC01372	24	Tropisternus	Enochrus	

STATE OF CALIFORNIA - THE RESOURCES AGENCY Arnold Schwarzenegger

DEPARTMENT OF FISH AND GAME
AQUATIC BIOASSESSMENT LABORATORY-CHICO
CALIFORNIA STATE UNIVERSITY, CHICO
CHICO, CA 95929-0555
530-898-4792

October 29, 2010

Bill Isham
Weston Solutions
2433 Impala Drive
Carlsbad, CA 92008

Dear Bill,

Attached are the results of my QC analysis of 3 samples submitted from the LACFCD 2010 project. The results are presented in five summary tables. This QC analysis was performed in accordance to the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT)'s Standard Taxonomic Effort Document (STE) 28 November 2006 version (Richards and Rogers, 2006).

There were three instances of "tagalong" organisms, including one terrestrial organism found in the Corixidae vial. Tagalongs are defined as specimens accidentally included in a vial of organisms of another taxon and are marked as "Probable sorting error" in the attached Listing of Taxonomic Discrepancies file.

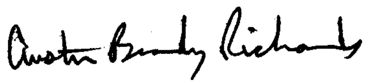
A female *Trichocorixa calva* (Say) specimen was misidentified as *T. uhleri* Sailer. The primary character used to separate the two species is the relative position of the indentation of the embolium. The indentation is about one third the distance between the embolium base and the nodal furrow for *T. calva* and about half the distance for *T. uhleri* (Lauck, 1979).

A vial of Muscidae larvae was found to contain both Muscidae and Ephydridae. The posterior spiracles of the Ephydridae larvae were on sharply pointed spines (Courtney and Merritt, 2008).

Two large count discrepancies were encountered during the QC analysis. In the submitted data lists, the counts for *Oxyethira* and *Physa* were 7 and 32 respectively, but the QC counts were 103 and 23. Since both labels had correct counts and per our email conversion this week both counts were correct in your original data, I suspect these represent transcription errors.

I welcome any questions or comments you may have concerning this report.

Sincerely,



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Literature Cited

Courtney, G. W., and R. W. Merritt. 2008. Chapter 22: Aquatic Diptera. Part One. Larvae of Aquatic Diptera. [pp. 687-722]. In: R. W. Merritt, K. W. Cummins and M. B. Berg (editors), An introduction to the aquatic insects of North America, fourth edition, xvi + 1158 pp. + 39 color plates. Kendall/Hunt Publishing Company, Dubuque, Iowa. 687-722 pp.

Lauck, David R. 1979. Family Corixidae/water boatmen. In: Menke, Arnold S. (ed.) The semiaquatic and aquatic Hemiptera of California (Heteroptera: Hemiptera)

Richards, A. B. and D. C. Rogers. (2006). "Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) List of Freshwater Macroinvertebrate Taxa from California and Adjacent States including Standard Taxonomic Effort Levels. Version: 28 November 2006." Retrieved 11 May 2007, from http://www.waterboards.ca.gov/swamp/safit.html

Comparative Taxonomic Listing of all Submitted Samples

Samples submitted by Weston Solutions for Project: LACFCD 2010

Report prepared by Brady Richards CDFG ABL-Chico, 10/29/2010

Taxonomist	Sample no.	Vial no.	Original ID	Original Count	Stage	ABL Count	ABL ID
	LALT 503						
		1	Callibaetis	1		1	Callibaetis
		2	Fallceon quilleri	1		1	Fallceon quilleri
		3	Dolichopodidae	5	L	5	Dolichopodidae
		4	Dasyhelea	3	L	3	Dasyhelea
		5	Ceratopogonidae	15	P	15	Ceratopogonidae
		5	Ceratopogonidae	15		1	Sphaeriidae
		6	Hemerodromia	1	L	1	Hemerodromia
		7	Psychoda	5	L	5	Psychoda
		8	Limonia	1	L	1	Limonia
		9	Muscidae	2	L	2	Muscidae
		10	Simulium	1	L	1	Simulium
		11	Psychodidae	3	P	3	Psychodidae
		12	Libellulidae	1		1	Libellulidae
		13	Trichocorixa uhleri	1	A	1	Trichocorixa calva
		14	Corisella decolor	1	A	1	Corisella decolor
		15	Corixidae	33	L	1	Neuroptera
		15	Corixidae	33		32	Corixidae
		16	Ephydridae	72		72	Ephydridae
		17	Hyalella	2		2	Hyalella
		18	Ostracoda	5		5	Ostracoda
		19	Oligochaeta	29		29	Oligochaeta
		20	Chironomidae	14	P	14	Chironomidae
		21	Chironomus	29		29	Chironomus
		22	Cricotopus	209		209	Cricotopus
		23	Cricotopus	67	P	67	Cricotopus
		24	Dicrotendipes	63		63	Dicrotendipes
		25	Dicrotendipes	7	P	7	Dicrotendipes

Taxonomist	Sample no.	Vial no.	Original ID	Original Count	Stage	ABL Count	ABL ID
	LALT 503						
		26	Limnophyes	2		2	Limnophyes
		27	Paratanytarsus	1		1	Paratanytarsus
		28	Pentaneura	1		1	Pentaneura
		29	Pseudochironomus	2		2	Pseudochironomus
		30	Tanytarsus	16		16	Tanytarsus
		31	Tanytarsus	15	P	15	Tanytarsus
		32	Ceratopogonidae	1	L	1	Ceratopogonidae

Taxonomist	Sample no.	Vial no.	Original ID	Original Count	Stage	ABL Count	ABL ID
	SGUT-505						
		1	Baetis adonis	198		198	Baetis adonis
		2	Baetis	28		28	Baetis
		3	Tricorythodes	3		3	Tricorythodes
		4	Hydroptila	20	L	20	Hydroptila
		5	Hydroptilidae	2	P	2	Hydroptilidae
		6	Oxyethira	7	L&P	103	Oxyethira
		7	Hydropsyche	18	L	18	Hydropsyche
		8	Polycentropus	1	L	1	Polycentropus
		9	Ochrotrichia	5	L	5	Ochrotrichia
		9	Belostomatidae	3		3	Belostomatidae
		10	Lepidoptera	1	L	1	Lepidoptera
		11	Tipula	1	L	1	Tipula
		12	Muscidae	9	L	3	Muscidae
		12	Muscidae	9	P	7	Ephydridae
		13	Ephydridae	3	L&P	3	Ephydridae
		14	Empididae	4	P	4	Empididae
		15	Clinocera	6	L	6	Clinocera
		16	Simulium	10	L&P	10	Simulium
		17	Pericoma/Telmatoscopus	1	L	1	Pericoma/Telmatoscopus
		18	Turbellaria	1		1	Turbellaria
		19	Oligochaeta	32		32	Oligochaeta
		20	Hydra	2		2	Hydra
		21	Prostoma	1		1	Prostoma
		22	Lymnaea	15		15	Lymnaea
		23	Physa	32		23	Physa
		24	Lebertia	10		10	Lebertia
		25	Ostracoda	33		33	Ostracoda
		26	Chironomidae	1	P	1	Chironomidae
		27	Ablabesmyia	2		2	Ablabesmyia
		28	Cricotopus	4		4	Cricotopus
		29	Cricotopus	1	P	1	Cricotopus

Taxonomist	Sample no.	Vial no.	Original ID	Original Count	Stage	ABL Count	ABL ID
	SGUT-505						
		30	Cricotopus trifascia group	1		1	Cricotopus trifascia group
		31	Eukiefferiella	1		1	Eukiefferiella
		32	Micropsectra	7		7	Micropsectra
		33	Paraphaenocladius	1		1	Paraphaenocladius
		34	Rheotanytarsus	44		44	Rheotanytarsus
		35	Rheotanytarsus	6	P	6	Rheotanytarsus
		36	Synorthocladius	1		1	Synorthocladius
		37	Tanytarsus	5		5	Tanytarsus

Taxonomist	Sample no.	Vial no.	Original ID	Original Count	Stage	ABL Count	ABL ID
	Station 6						
		1	Baetis adonis	462		462	Baetis adonis
		1	Baetis adonis	462	L	1	Caloparyphus/Euparyphus
		2	Baetis	62		62	Baetis
		3	Fallceon quilleri	7		7	Fallceon quilleri
		4	Hydroptila	8	L	8	Hydroptila
		5	Agapetus	1	L	1	Agapetus
		6	Caloparyphus/Euparyphus	2	L	2	Caloparyphus/Euparyphus
		7	Dolichopodidae	1	L	1	Dolichopodidae
		8	Ephydridae	1	L	1	Ephydridae
		9	Empididae	1	P	1	Empididae
		10	Hemerodromia	1	L	1	Hemerodromia
		11	Pericoma/Telmatoscopus	1	L	1	Pericoma/Telmatoscopus
		12	Libellulidae	1		1	Libellulidae
		13	Muscidae	1	L	1	Muscidae
		14	Nemotelus	1	L	1	Nemotelus
		15	Simulium	44	L&P	44	Simulium
		16	Chironomidae	1	P	1	Chironomidae
		17	Eukiefferiella	20		20	Eukiefferiella
		18	Krenosmittia	1		1	Krenosmittia
		19	Micropsectra	3		3	Micropsectra
		20	Paracladopelma	1		1	Paracladopelma
		21	Parametriocnemus	2		2	Parametriocnemus
		22	Pentaneura	2		2	Pentaneura
		23	Pentaneura	2	P	2	Pentaneura
		24	Polypedilum	7		7	Polypedilum
		25	Rheotanytarsus	5		5	Rheotanytarsus
		26	Rheotanytarsus	2	P	2	Rheotanytarsus
		27	Tanytarsus	1		1	Tanytarsus
		28	Thienemannimyia group	4		4	Thienemannimyia group

Listing of Enumeration Discrepancies

Samples submitted by Weston Solutions for Project: LACFCD 2010

Report prepared by Brady Richards, CDFG ABL-Chico, 10/29/2010

	Sample #	Vial #	Original ID	# Counted Original	QC	Difference (Original - QC)
Major Counting Discrepancies						
	SGUT-505	6	Oxyethira	7	103	-96
		23	Physa	32	23	9
Minor Counting Discrepancies						
	LALT 503	5	Ceratopogonidae	15	16	-1
	SGUT-505	9	Ochrotrichia	5	8	-3
		12	Muscidae	9	10	-1
	Station 6	1	Baetis adonis	462	463	-1

Listing of Taxonomic Discrepancies

Samples submitted by Weston Solutions for Project: LACFCD 2010

Report prepared by Brady Richards, CDFG ABL-Chico, 10/29/2010

Sample #	Vial #	Original ID	Final ID QC Final ID	Taxonomic level of dispute	# Organis
LALT 503					
Disputed ID					
	13	Trichocorixa uhleri	Trichocorixa calva	Species	1
Probable sorting error					
	5	Ceratopogonidae	Sphaeriidae	Phylum	1
	15	Corixidae	Neuroptera	Order	1
SGUT-505					
Disputed ID					
	12	Muscidae	Ephydridae	Family	7
Station 6					
Probable sorting error					
	1	Baetis adonis	Caloparyphus/Eupar		1

Summary of Taxonomic and Enumeration Discrepancies

Samples submitted by Weston Solutions for Project: LACFCD 2010

Report prepared by Brady Richards, CDFG ABL-Chico, 10/29/2010

		Taxonomic Discrepancies						Counting Discrepancies			
				Taxonomic Precision Relative to QC							
Sample #	**Total Taxa**	**Disputed ID**		**More precise**		**Less Precise**		Major		Minor	
		*f**	*n***	*f*	*n*	*f*	*n*	*f*	*d****	*f*	*d*
LALT 503	30	2	2	-	-	-	-	-	-	1	1
SGUT-505	36	1	7	-	-	-	-	2	105	2	4
Station 6	26	-	-	-	-	-	-	-	-	1	1

* = the frequency of occurence of the discrepancy, in number of samples *f*
** = the number of organisms affected (by QC Lab counts) *n*
*** = the sum total of (absolute value of) differences in counts *d*

QC Report - Disputed ID's only

Samples submitted by Weston Solutions for Project: LACFCD 2010

Report prepared by Brady Richards, CDFG ABL-Chico, 10/29/2010

Sample #	***Vial #.***	***Original ID***	***QC ID***	***comments***
LALT 503	13	Trichocorixa uhleri	Trichocorixa calva	
SGUT-505	12	Muscidae	Ephydridae	

Isham, William

From: Raphael Mazor [raphaelm@sccwrp.org]
Sent: Monday, March 21, 2011 2:36 PM
To: Couch, Christine; Isham, William
Subject: QA on Weston's SMC 2010 taxonomy data
Attachments: Summary of 2010 SMC Bug QA.xlsx

Dear Christine,

I have looked at the QA reports on Weston's taxonomy data for 2010 SMC sampling, and can assert that they passed all MQOs required in the SMC QAPP.

Weston submitted two samples for QA, one from San Diego and another from LA county. Both samples passed all sample-wise MQOs, and the batch passed all batch-wise MQOs.

Refer to the reports from the reference lab for details on the errors encountered.

Thank you.

--
Raphael D. Mazor
Freshwater Biologist
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3535 Harbor Blv Suite 110
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Tel. (714) 755-3235
Fax. (714) 755-3299

Lab	Batch#	# Samples	Original Rich	Ref Rich	Original Common	Ref Common	Orign Indiv	Ref Indiv	Random Errors	Random Error Rate	Systemic Errors	Systemic Error Rate
Weston	1	2	53	53	30	30	1506	1510	0	0	0	0

Lab	Batch	Sample	Recount accuracy	Taxa Count error rate	Taxa ID Error Rate	Individual ID error rate	High taxonomic resolution errors	Low Taxonomic resolution errors	Overall taxonomic resolution errors
Weston	1	SMC01372	0.99245852	1.00	0.03	0.001508296	0	0	0
Weston	1	SMC00693	0.99882075	1.00	0.00	0	0	0	0