SWAMP
Surface Water Ambient Monitoring Program

Final Technical Report	2010

WADEABLE STREAMS BIOASSESSMENT
REGION 8
Sites Sampled: May – June 2008

Prepared by:

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Stream Ecology and Assessment Laboratory

June 2010

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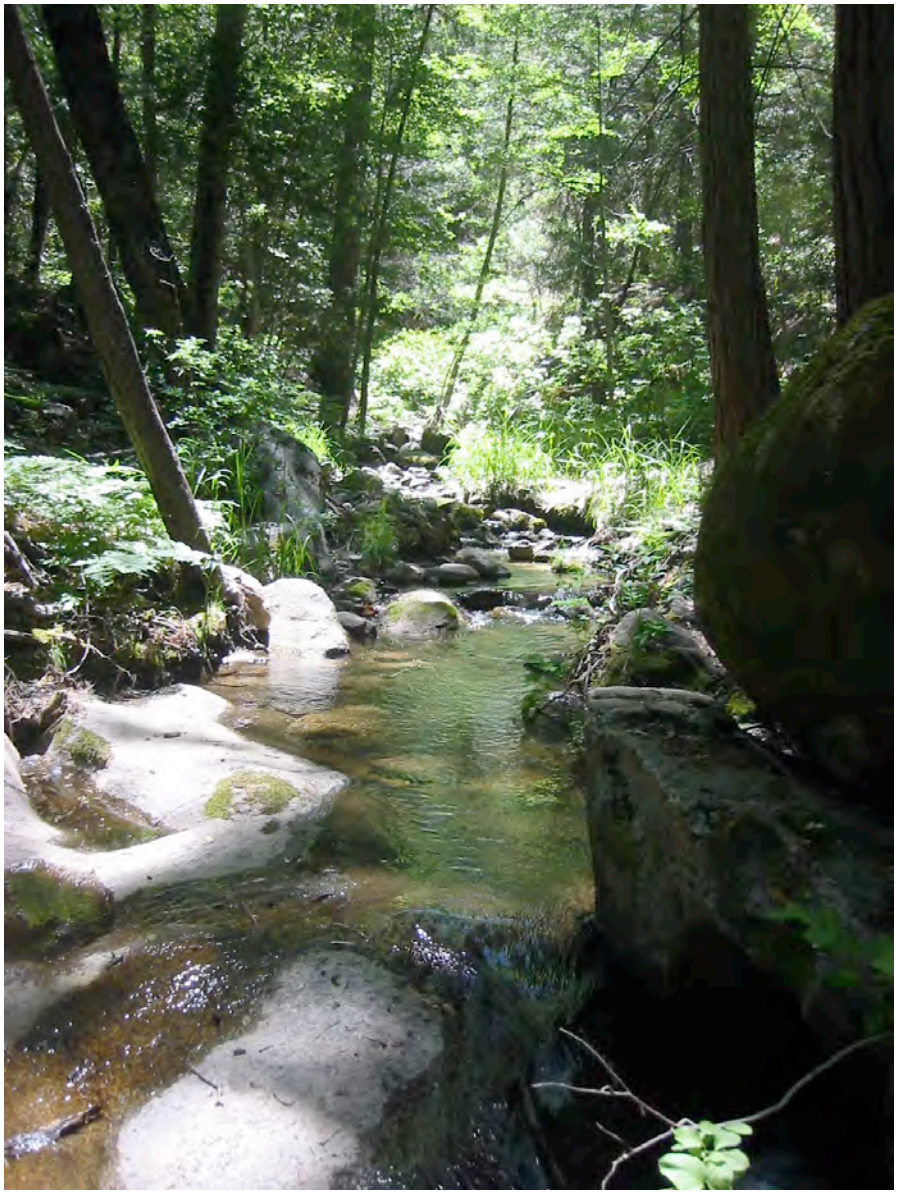

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California State University Long Beach
Stream Ecology and Assessment Laboratory

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Executive Summary

The Santa Ana Regional Water Quality Control Board contracted California State University Long Beach's Stream Ecology and Assessment Laboratory, through the Institute for Integrated Research in Materials Environments and Society, to conduct a five year study of the waterways within the Santa Ana River watershed. This study is designed to address the federal Environmental Protection Agency-mandated requirement (EPA requirement 305(b)) for an assessment of the integrity of surface waters in the watersheds of the Santa Ana and San Jacinto Rivers by sampling the biological (benthic macroinvertebrates), physical (in-stream habitat, surrounding riparian habitats), and chemical (water quality measurements and water samples for further laboratory analysis) attributes at each sampling location. At the conclusion of the five year period, the data collected will be used to estimate the number of stream kilometers that are in one of five categories of health (very good, good, fair, poor, and very poor). Annual reports during these five years will provide information on the quality of the individual sites sampled.

During the 2008 bioassessment sampling events, a total of 108 distinct benthic macroinvertebrate taxa were identified from the 34 sampled locations. Taxa were identified to standard taxonomic levels utilizing the California Aquatic Macroinvertebrate Laboratory Network's list of Californian Macroinvertebrate Taxa and Standard Taxonomic Effort. Sample locations were divided into three categories: low-elevation (0 meters to 350 meters), mid-elevation (350 meters to 700 meters), and high-elevation (700 meters and higher). Using the Southern California Coastal Index of Biotic Integrity (Ode et al. 2005) as a measure of biotic condition, stream sites were classified (very poor, poor, fair, good, and very good). Southern California Coastal Index of Biological Integrity scores (adjusted to a scale of 0 to 100) ranged from 0 to 39 (very poor to poor) for low-elevation sites, 9 to 40 (very poor to fair) for mid-elevation sites, and 7 to 57 (very poor to fair) for high-elevation sites. The Southern California Coastal Index of Biological Integrity scores were positively correlated with elevation (R-square = 0.317; P-value = 0.000351) (low-elevation mean score = 16.9 ± 11.6, mid-elevation mean score = 27.7 ± 13.2, and high-elevation mean score = 33.8 ± 15.0). IBI scores were also positively correlated with overall habitat scores and were negatively correlated with temperature, conductivity, and alkalinity. The physical habitat condition of the sampled sites ranged from poor to optimal (0 to 15 "poor," 16 to 30 "marginal," 31 to 45 "suboptimal," and 46 to 60 "optimal"). Predominantly natural high-elevation channels had the highest values (averaging 48.1 and ranging from 35 to 58), followed by mid-elevation channels (averaging 33.3 and ranging from 21 to 40), and finally the low-elevation channels had the lowest values (averaging 26.3 and ranging from 6 to 49). The water quality characteristics were relatively consistent among sites with near neutral to alkaline mean pH values (7.28 to 10.45), more than adequate levels of mean dissolved oxygen (6.32 to 19.32), and highly variable conductivity values (0.053 to 2.800 mS/cm). Natural inland waters usually contain small amounts of dissolved mineral salts.

Although the data collected during the 2008 bioassessment sampling events are only a small subset of the proposed sites to be collected within the region over the five year experimental period, the results obtained during 2008 provide baseline information to begin assessing the health of the waters within the region.

Introduction

Freshwater is an important natural resource. Understanding the health of rivers, streams, and other water resources is essential for the development of management plans that protect the nation's vital water resources. One approach that has been advocated for determining water quality is the "Aquatic Life Use Assessment" (ALUA). ALUA is one of the Environmental Protection Indicators for California (EPIC) adopted by the California Environmental Protection Agency (Cal/EPA) for determining water quality. These bioassessment tools utilize direct measurements of biological assemblages occupying various trophic levels and can include plants, macroinvertebrates, vertebrates (fish) and periphyton (diatoms and algae), as direct methods for assessing the biological health of a waterway's ecosystem. Direct measurements of biological communities, when used in conjunction to other relevant measurements of watershed health (e.g. watershed characteristics, land-use practices, in-stream habitat and water chemistry), are effective ways to monitor long-term trends of a watershed's condition (Davis and Simon 1995). Biological assessments, which integrate the effects of water quality over time, are sensitive to many aspects of both habitat and water chemistry and provide a more familiar representation of ecological health to those who are unfamiliar with interpreting the results of chemical or toxicity tests (Gibson 1996). When integrated with physical habitat assessments and chemical test results, biological assessments describe the health of a waterway and provide an *in vivo* means of evaluating the anthropogenic effects (e.g. sediments, temperature and habitat alteration) on a waterway. As defined by the 2006 EPA Wadeable Streams Assessment (WSA) document, *"biological integrity represents the capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity and functional organization comparable to that of the natural habitat of the region."* Bioassessment is a proxy for determining stream water quality and habitat quality based on the types and numbers of organisms living there.

The monitoring of water quality using BMIs is the most utilized bioassessment method when compared with similar assessments that use vertebrates or periphyton. BMIs are not only ubiquitous, but are relatively stationary and highly diverse. These traits can provide a variety of predictable responses to a number of environmental stresses (Rosenberg and Resh 1993). Depending on the length of time an individual BMI taxon resides in an aquatic environment (a few months to several years), the sensitivity to physical and chemical alterations to its environment will vary. BMIs are an excellent indicator group in assessing the health of a waterway (Resh and Jackson 1993) and function as a significant food resource for both aquatic and terrestrial organisms. In addition, herbivorous BMIs aid in the control of periphyton populations and many BMI taxa contribute to the breakdown of detritus. Furthermore, the diversity of BMI taxa also plays an important role in the overall ecology and biogeography of a region (Erman 1996).

Biological assessments are often based on multimetric techniques. These techniques use a number of biologic measurements (metrics), each representing a particular aspect of the biological community, to assign a water quality value to the location under study. Locations can then be ranked by these values and classified into qualitative categories of "very good," "good," "fair," "poor," and "very poor." This system of ranking and categorizing biological conditions is referred to as an Index of Biotic Integrity (IBI), and is currently the recommended method for the

development of biocriteria by the United States Environmental Protection Agency (USEPA; Davis and Simon 1995). This method may also be used in the development of Tiered Aquatic Life Uses (TALU). The current IBI used for southern California is the Southern Coastal California Index of Biological Integrity (SCC-IBI; Ode et al. 2005), developed by the California Department of Fish and Game's Aquatic Bioassessment Laboratory (Cal/DFG-ABL).

Water quality information for the streams in the Santa Ana and San Jacinto watersheds (Region 8) is currently based mostly on discharger data from NPDES permits, and volunteer monitoring efforts of selected streams. This information focuses on problem areas within the region or areas where permits have been issued. Consequently, there are a large number of streams in the region that lack water quality information. Due to lack of available funding to implement a fully comprehensive "multiple biological assemblage model" to assess the biotic integrity, a decision was made by the Santa Ana Regional Water Quality Control Board (SARWQCB) to initially focus on using a macroinvertebrate bioassessment tool to assess the biotic integrity of the wadeable streams in Region 8 of California.

The SARWQCB contracted California State University Long Beach (CSULB) Stream Ecology and Assessment Laboratory (SEAL), through the Institute for Integrated Research in Materials Environments and Society (IIRMES), to conduct a five-year study within Region 8 of California waterways utilizing a probabilistic sampling design. IIRMES, a multifaceted organization was designed to promote and enhance educational and research opportunities for faculty, graduate and undergraduate students, and the greater community at large by embracing and integrating all scientists who study historical and temporally changing phenomena from the solid earth to organisms, landscapes, and societies. By collaborating with interdisciplinary faculty, scientists within the organization are able to bring common research perspectives, techniques, and instrumentation to bear their research.

Project Objective

The overall objective of the five-year bioassessment project described within this report is to address the federal Environmental Protection Agency (EPA) mandated requirement (EPA requirement 305(b)) for an assessment of the integrity of surface waters in Region 8 of California. Specifically, this project aims to meet this objective by collecting and subsequently analyzing macroinvertebrate data collected from random sites using the SCC-IBI. This method yields a single score of the biological integrity of a site. The SCC-IBI model provides a score based on the combination of seven biological metrics. This score can then be ranked, and compared to sites that are independently designated as high-quality "reference" sites.

The data collected using this analysis may be used to identify streams that may require improvement of water quality. They also may be used to refine and compare several methods of analysis and interpretation of bioassessment data. Although not comprehensive by nature, the design of the ongoing project will also provide a basis to estimate the percentage of stream kilometers in the region that meet the aquatic life beneficial use. The region's Basin Plan related to beneficial use is as follows: *"Inland surface water communities and populations including vertebrate, invertebrate and plant species shall not be degraded as a result of the discharge of waste. Degradation is damage to an aquatic community or population with the result that a*

balanced community no longer exists. A balanced community is one that is diverse, has the ability to sustain itself through cyclic seasonal changes, includes necessary food chain species, and is not dominated by pollution tolerant species, unless that domination is caused by physical habitat limitations. A balanced community also may include historically introduced non-native species but does not include species present because best available technology has not been implemented or because site-specific objectives have been adopted or because of thermal discharges (SARWQCB 1995)."

Methods

In order to comply with standard sampling protocols, initially established by the Cal/DFG-ABL during the development of the SCC-IBI, benthic macroinvertebrate samples were collected between an index period between May and July.

Sampling Site Selection

The SARWQCB worked with statistician Tony Olsen from EPA at Corvallis to design a cost effective, randomized sampling design based upon the Environmental Monitoring and Assessment Program (EMAP; USEPA 2006) criteria that could be used to representatively sub-sample the various streams in the region. Dr. Olsen provided a list of coordinates for 750 potential locations to select for sampling. Under the original sampling design, 50 sites would be randomly selected from these locations annually for a period of five years to provide a total of 250 sites that would be considered statistically representative of the 1302 linear stream kilometers covering the Santa Ana regional stream network. This sampling density provided a level of statistical precision of +/- 12% with at a spatial coverage resolution of approximately 1.6 linear kilometers. The original sampling study also did not include any stratification elements, and was designed for perennial and non-perennial streams that were 3rd and higher Strahler order. Given the nature of the terrain and the xeric conditions in southern California, not all sites were found to be viable for the study. Consequently prior to collecting any environmental measurements or infauna samples, the sites from within the list were prescreened by first undertaking reconnaissance of each of the sampling locations to determine accessibility and suitability for benthic macroinvertebrate sampling. Elements that were deemed essential for an accessible site to be considered suitable for sampling were based upon criteria that led to the development of the SCC-IBI. Subsequently, two approved modifications were made to the design in the sampling study outlined above:

First, due to the constraints in the available funds for the project, the number of sampling sites was reduced from 50 to 34 for the 2008 sampling year. Statistical analyses show that this reduction in sampling effort increased the level of imprecision regarding the representation of the sub samples by 4% (Tony Olsen, personal communication). While not desirable, this difference was not considered to unduly compromise the objectives of the study. Furthermore it was concluded that additional sampling or an extension to the duration of the study could ultimately be undertaken to restore the original level of precision in the sampling design.

Second, the initial experimental design involved dividing Region 8 into three hydrological units (Santa Ana, San Gabriel, and the San Jacinto units). Because the portion of the San Gabriel

hydrological unit included in Region 8 contained only seven sites, those sites were combined with those in the Santa Ana hydrological unit. The two hydrologic units (Santa Ana and San Jacinto, with the former including the San Gabriel) were subsequently divided into three elevation strata: 0 meters to 350 meters, 350 meters to 700 meters, and 700 meters and up. Randomly generated GPS coordinates were used to determine the location of sites (evenly distributed throughout defined categories). The purpose of dividing the region into three elevation categories was to ensure that sampling occurred throughout the entire region each year. It was determined that not dividing the region into these biologically relevant strata might have resulted in analytical bias due to intensive sampling in a small subset of the region one year and no sampling in this subset the following year.

Sampling took place between May and July in 2008, and the samples were transported to the laboratory within two days of collection for water chemistry analyses, storage and subsequent processing. Table 1 provides site-specific information.

Sampling Reach Determination

The sampling procedures used during the 2008 bioassessment survey followed the FULL level of the *Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California* (Ode 2007), which is a modification of the California Stream Bioassessment Procedures (CSBP; DFG 2003) and Environmental Monitoring and Assessment Program (EMAP) procedures. At each sample location, a 150-meter reach was surveyed to locate all riffles (250-meters for streams with wetted-widths greater than 10 meters). A riffle is defined as a shallow area with fast flowing water that supports a complex substrate and the greatest diversity of BMIs and therefore targeted as the ideal location for BMI collection. Sample locations that were classified as a continuous riffle or lacked riffles completely followed the reach-wide benthos procedure (RWB) or multi-habitat approach. Each reach was broken into 11 equidistant transects, spaced every 15 meters (25 meters for streams with widths greater than 10 meters), with each transect designated with a number representing its location along the reach (0 meters through 150/ 250 meters, downstream to upstream).

Table 1. Sites sampled during the 2008 index period (April - July 2008).

Site Code	Stream name	County	Latitude	Longitude	Elevation (m)	Collection date
801FGC022	Frog Creek	San Bernardino	34.158421	-116.871483	2125	23-May-08
801XXX046	Unknown	Orange	33.792624	-117.716714	200	5-May-08
801PCW048	Peters Canyon Wash	Orange	33.717518	-117.785665	28	11-May-08
801HBC050	Heart Bar Creek	San Bernardino	34.156261	-116.793138	2047	23-Jun-08
801MLC057	Middle Fork Lytle Creek	San Bernardino	34.250969	-117.548075	1295	18-May-08
801SAN068	San Antonio Creek Channel	San Bernardino	34.272031	-117.646596	1575	10-Jun-08
801STC071	Santiago Creek	Orange	33.748189	-117.675376	241	5-Jun-08
801MIC074	Mill Creek	San Bernardino	34.087672	-116.883676	1862	25-May-08
801EBC080	East Fork Barton Creek	San Bernardino	34.150702	-116.883416	2078	24-Jun-08
801XXX112	Unknown	San Bernardino	34.261405	-117.468570	780	11-Jun-08
801CYC114	City Creek	San Bernardino	34.153800	-117.184222	443	7-Jul-08
801XXX118	Unknown	San Bernardino	34.283653	-117.481745	880	11-Jun-08
801EBC126	East Fork Barton Creek	San Bernardino	34.174275	-116.894223	1844	23-Jun-08
801STC142	Santiago Creek	Orange	33.773858	-117.688576	247	8-Jul-08
801STC149	Santiago Creek	Orange	33.767738	-117.679411	257	8-Jul-08
801TMW153	Temescal Wash	Riverside	33.815840	-117.498028	241	16-Jun-08
802INC155	Indian Creek	Riverside	33.810720	-116.773689	1671	30-Jun-08
801TMW162	Temescal Wash	Riverside	33.730484	-117.412416	360	16-Jun-08
801SAR165	Santa Ana River	Riverside	33.963652	-117.477504	198	6-Jul-08
801PCW171	Peters Canyon Wash	Orange	33.728098	-117.777678	37	4-Jun-08
801SDC178	San Diego Creek	Orange	33.682068	-117.813620	19	11-May-08
801XXX259	Unknown	San Bernardino	34.077117	-117.092617	622	29-Jun-08
802SWC270	Strawberry Creek	Riverside	33.728587	-116.750863	1536	30-Jun-08
801MIC272	Mill Creek	San Bernardino	34.087759	-116.913516	1662	25-Jun-08
801XXX305	Unknown	Orange	33.708200	-117.799748	13	4-Jun-08
801SAR334	Santa Ana River	San Bernardino	34.183026	-116.877150	1732	25-Jun-08
801SAR351	Santa Ana River	Riverside	33.966811	-117.521406	189	19-Jun-08
801PLC362	Lytle Creek	San Bernardino	34.238746	-117.497814	902	17-Jun-08
801PLC469	Plunge Creek	San Bernardino	34.110799	-117.145880	448	7-Jul-08
405CTC480	Coyote Creek	Orange	33.804151	-118.082589	2	8-Jul-08
802HYC496	Herkey Creek	Riverside	33.693205	-116.679533	1371	1-Jul-08
801SDC504	San Diego Creek	Orange	33.655065	-117.759562	45	8-Jul-08
801SAR528	Santa Ana River	Orange	33.874751	-117.713113	83	25-May-08
802SWC535	Strawberry Creek	Riverside	33.739028	-116.722525	1597	2-Jul-08

Sample Collection

BMI samples were collected starting with the downstream transect and then proceeding upstream. This technique was used in order to avoid habitat disruption to downstream transects during sample collection. Samples were collected at either 25% instream of the right bank (R), 50% instream of the right bank (C) or 75% instream of the right bank (L) at each transect following a R, C, L pattern starting with the right bank. This alternating pattern was followed along each 150-meter sampling reach until a single sample was collected from each reach (0 meters to 150 meters).

The BMIs were collected using a one foot wide, 0.5-milimeter mesh D-frame kick-net. A one-foot by one-foot sampling plot, directly in front of the net, was sampled by first checking for heavy organisms such as clams and/or snails. These organisms were removed from the substrate by hand and placed into the net. Stones larger than a golf ball were carefully picked-up and rubbed in front of the net to collect all attached animals. The remaining underlying substrate was sampled by digging through the material to a depth of four inches (10-centimeters) and thoroughly manipulating the substrate in each quadrat with a consistent sampling effort (approximately one to three minutes). This procedure was repeated at each of the 11 transects.

The resulting 11 samples from a site were composited into one 1-liter jar and preserved in the field using 95% ethanol. Larger samples (e.g. samples that contained more than 50% sediment or 66% organic material) were split into additional jars as needed. A label containing the project, sample date, site designation, longitude and latitude, sampler's initials, and jar number was placed in each jar. A chain of custody form was completed for each sample location. As soon as the samples were returned to the lab, the ethanol, having been diluted with variable amounts of water from the samples, was replaced with fresh 75% ethanol.

Physical Habitat Quality Assessment and Water Quality Measurements

The physical habitat quality was surveyed along the entire reach of each sampling location following the Full Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California (Ode 2007). At every 15-meter intervals along the 150-meter reach (25-meter intervals along the 250-meter reach), starting at transect 0-meters, physical habitat quality was determined by observing substrate complexity, consolidation, embeddedness, sediment depth, identifying human influences, determining canopy cover, and identifying indications of trophic complexity. At each transect, a depth profile was obtained at five equidistant points starting at banks edge and ending on the opposite banks edge. Additional substrate measurements and depth profiles were measured midway between main transects throughout the entire reach. Each sampling reach was scored using the General Habitat Characterization Form. Stream velocity was measured using a 60% stream depth method at each transect using a Flowatch flow-meter that measures velocities directly (buoyant object method used when 60% depth method cannot be preformed due to obstructions or depth limitations).

Four water quality parameters were collected on site at each sample location using a YSI 556 environmental monitoring unit and these included pH, dissolved oxygen (mg/l), conductivity (mS/cm), and water temperature (°C). In addition to these on site measurements, a 1000 ml water sample was collected at each site for laboratory analysis to test for other parameters used to describe the general chemical status of the streams. These measurements were performed by CRG Marine Laboratories, Inc. and include the quantification of ammonia nitrogen, dissolved orthophosphate, nitrate-nitrogen, nitrite-nitrogen, alkalinity, and total suspended solids. Although this form of sampling only provides a snapshot of the potential water chemistry at the time of BMI collection, the water chemistry collected during BMI sampling can provide valuable insight as to potential exposure values at each site.

Taxonomic Identification of BMIs

The BMI samples were transported to and processed by CSULB-SEAL. At the laboratory, each sample was rinsed through a No. 35 standard testing sieve (0.5 mm brass mesh) and transferred into a tray marked with twenty, 25 cm^2 grids. All sample material was removed from one randomly selected grid at a time and placed into a Petri dish for inspection under a stereomicroscope. All invertebrates from the grid were separated from the surrounding detritus and transferred to vials containing 75% ethanol. This process was continued until 600 organisms were removed from each sample. The material left from the processed grids was transferred into a jar with 75% ethanol and labeled as "remnant" material. Any remaining unprocessed sample from the tray was transferred back to the original sample container with 75% ethanol and archived. BMIs were then identified to standard taxonomic levels established by the Southwestern Association of Freshwater Invertebrate Taxonomists (SAFIT) using standard taxonomic keys, typically genus level for insects and order or class for non-insects (Brown 1972, Edmunds et al. 1976, Kathman and Brinkhurst 1998, Klemm 1985, Merritt and Cummins 1995, Pennak 1989, Stewart and Stark 1993, Surdick 1985, Thorp and Covich 1991, Usinger 1963, Wiederholm 1983, 1986, Wiggins 1996, Wold 1974).

Data Analysis

A taxonomic list of all aquatic macroinvertebrates identified from the samples was entered into a Microsoft Excel® spreadsheet program. Excel® was used to generate a standalone taxonomic list, and to calculate and summarize the benthic macroinvertebrate community-based metric values.

All biological metric scores reported in this document are based on 500 organisms (fewer than 500 organisms were used only if the total number of organisms in a sample was fewer than 500). Current SWAMP protocols require a sample of 600 BMIs; however, the So Cal IBI was built using counts of 500 BMIs. To generate the seven biological metrics (Table 2) used to calculate the So Cal IBI, all samples were statistically subsampled to 500 BMIs. Each of the seven metrics are included in one of the following major categories:

Richness Measures – These metrics reflect the diversity of the aquatic assemblage where increasing diversity correlates with increasing health of the assemblage and suggests that niche space, habitat, and food sources are adequate to support survival and propagation of a variety of species.

Tolerance/Intolerance Measures – These metrics reflect the relative sensitivity of the community to aquatic perturbations. The taxa used are usually pollution tolerant or intolerant, but are generally nonspecific to the type of stressors. The metric values usually increase as the effects of pollution in the form of organics and sedimentation increase.

Functional Feeding Groups – These metrics provide information on the balance of feeding strategies in the aquatic assemblage. The functional feeding group composition is a surrogate for complex processes of trophic interactions, production, and food source availability. An imbalance of the functional feeding groups reflects unstable food dynamics and indicates a stressed condition.

Index of Biotic Integrity

An Index of Biotic Integrity (IBI) uses biological metrics to describe the biological condition of a watershed or ecoregion. These metrics vary by biogeographical area and are based on reference sites. These reference sites are locations within the biogeographical area thought to be relatively pristine and minimally impacted by anthropogenic activities. Many different metrics were measured, but only those that showed responsiveness to watershed-scale and reach-scale disturbance variables and lacked correlation with other responsive metrics were used (Ode et al. 2005). The IBI used to evaluate the 34 sampled sites was developed from 2000 to 2003 and was based on data from the Southern California Coastal region (Ode et al. 2005; Table 3). It should be noted that the reference sites assessed during the development of the SCC-IBI did not include sites with physical alterations (i.e., concrete-lined or modified channels), and low gradient reference sites were largely underrepresented.

Quality Assurance and Quality Control (QA/QC)

All QA/QC requirements were followed by sampling personnel (CSULB 2006) during the 2008 sampling events. An auditor from SLSII accompanied sampling personnel during the 2008 bioassessment to ensure that all sampling activities were completed using the approved methods. Only CSULB-SEAL personnel trained in the approved sampling methods participated in the collection of BMIs during the 2008 sampling events. All internal QA/QC procedures were followed and none of the limits described in the document were violated. Picking error also occurred in certain samples during sample processing leading to greater than 600 BMIs being picked, when this occurred 600 BMIs were randomly subsampled from the overall data set from that specific location. Four sites (165, 351, 071 dup, and 046) had fewer than 450 BMIs found in the benthic sample; although SCC-IBI scores were generated for these sites, scores generated using fewer than 450 BMIs have not been validated. All QA/QC documentation, including the chain of custody forms for each site, are on file with the appropriate contract laboratory and CSULB-SEAL.

Table 2. Bioassessment metrics used to describe characteristics of the benthic macroinvertebrate (BMI) communities at assessed sites.

BMI Metric	Description	Response to Impairment
Richness Measures		
EPT Taxa	Number of taxa in the Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) insect orders	Decrease
Number of Coleoptera Taxa	Number of taxa from the insect order Coleoptera (beetles)	Decrease
Number of Predator Taxa	Number of taxa from the predator functional feeding group	Decrease
Tolerance/Intolerance Measures		
Percent Tolerant Taxa	Percent of taxa in sample that are highly tolerant to impairment as indicated by a tolerance value 8, 9, 10	Increase
Percent Non-insect Taxa	Percent of organisms in sample that are not in the Class Insecta	Increase
Functional Feeding Groups (FFG)		
Percent Collector-Gatherers (CG)	Percent of macrobenthos that collect or gather fine particulate matter	Increase
Percent Collector-Filterers (CF)	Percent of macrobenthos that filter fine particulate matter	Increase
Percent Collector Gathererers + Collector Filterers (CF)	Percent of macrobenthos that collect or gather fine particulate matter and/or percent of macrobenthos that filter fine particulate matter	Increase

Table 3. Southern Coastal California Benthic Macroinvertebrate Index of Biotic Integrity parameters and scoring ranges (to adjust IBI scores so that they range from 0 to 100, multiply the total IBI score by 10/7; from Ode et al. 2005).

	Metric Scoring Ranges for the Southern Coastal California B-IBI						
Metric Score	**# EPT Taxa**	**% Intolerant Individuals**	**# Predator Taxa**	**% Tolerant Taxa**	**% Non-Insect Taxa**	**% CF + CG**	**# Coleoptera Taxa**
10	> 17	25-100	> 12	0-4	0-8	0-59	> 5
9	16-17	23-24	12	5-8	9-12	60-63	
8	15	21-22	11	9-12	13-17	64-67	5
7	13-14	19-20	10	13-16	18-21	68-71	4
6	11-12	16-18	9	17-19	22-25	72-75	
5	9-10	13-15	8	20-22	26-29	76-80	3
4	7-8	10-12	7	23-25	30-34	81-84	2
3	5-6	7-9	6	26-29	35-38	85-88	
2	4	4-6	5	30-33	39-42	89-92	1
1	2-3	1-3	4	34-37	43-46	93-96	
0	0-1	0	0-3	38-100	47-100	97-100	0

Total IBI Scoring Range Adjusted Scale (0 - 100)	0-20 Very Poor	21-40 Poor	41-60 Fair	61-80 Good	81-100 Very Good

Results

BMI Community Structure

During the 2008 bioassessment sampling events, 108 distinct BMI taxa were identified from the 34 sampled locations (Appendix D). Low elevation sites were dominated by mayfly larvae *Baetis spp*. and *Tricorythodes spp*., caddisfly larvae *Hydropysche spp*. and immature Hydroptilidae, aquatic fly larvae from the family Chironomidae, aquatic crustacean *Hyalella sp*. and seed-shrimp from the order Ostracoda, aquatic worms from the class Oligochaeta, and aquatic snails *Physa sp*. Mid elevation sites were dominated by mayfly larvae *Baetis spp*., caddisfly larvae *Hydropsyche/Ceratopsyche sp*., aquatic fly larvae from the family Chironomidae, *Simulium sp*., *Caloparyphus/Euparyphus sp*., aquatic beetle larvae *Optioservus sp*., and seed-shrimp from the order Ostracoda. High elevation sites were dominated by mayfly larvae *Baetis sp*., stonefly larvae *Malenka sp*., *Yoraperla sp*., and *Zapada sp*., aquatic fly larvae from the family Chironomidae, *Simulium sp*., *Prosimulium sp*., and *Caloparyphus/Euparyphus sp*., seed shrimp from the order Ostracoda, bivalves *Pisidium sp*., and aquatic mites *Sperchon sp*.

Index of Biological Integrity – SCC-IBI scores are adjusted from a scale of 0 to 70 (seven summed metrics ranging from 0 to 10), to a scale of 0 to 100 for ease of interpretation. Adjusted SCC-IBI scores were obtained by multiplying the summed SCC-IBI score by 10 and dividing that score by 7. The adjusted SCC-IBI scores for the 2008 bioassessment sampling events ranged from 0 to 57.2 (Table 4, Figure 1). SCC-IBI scores were positively correlated with elevation (R^2 = 0.32, Figure 2) and overall habitat characterization scores (R^2 = 0.45, Figure 12), and negatively correlated with water temperature (R^2 = 0.24, Figure 3), conductivity (R^2 = 0.36, Figure 6), and alkalinity (R^2 = 0.22, Figure 7). SCC-IBI scores showed no correlation with dissolved oxygen (Figure 4), turbidity (Figure 5), dissolved orthophosphate (Figure 8), ammonia (Figure 9), nitrate (Figure 10), and nitrite (Figure 11). A qualitative analysis of the seven metrics that comprise the SCC-IBI scores for the sites sampled in 2008 (Figure 13) suggests that low elevation sites are comparable to higher elevation sites with respect to the metrics percent non-insect taxa and percent tolerant taxa, but are deficient in numbers of EPT and Coleoptera taxa.

Water Chemistry – Refer to Appendix C for water chemistry values.

Physical Habitat Quality

During the 2008 bioassessment sampling events, samples were collected from a wide array of landuse and channel types. Low elevation streams consisted of mix of streams surrounded by urban/suburb landcover with concrete-lined and natural channel types; mid elevation streams were predominantly urban/suburb landcover with man-made embankments and natural stream bottoms; and high elevation streams were all surrounded by forest landcover with natural channel types (Table 5). Overall habitat characterization scores ranged from 6 to 58 (poor to optimal; Table 5) with low elevation streams averaging 26.29 ± 12.91 (marginal), mid elevation streams averaging 33.25 ± 8.73 (suboptimal), and high elevation streams averaging 48.13 ± 8.16 (optimal).

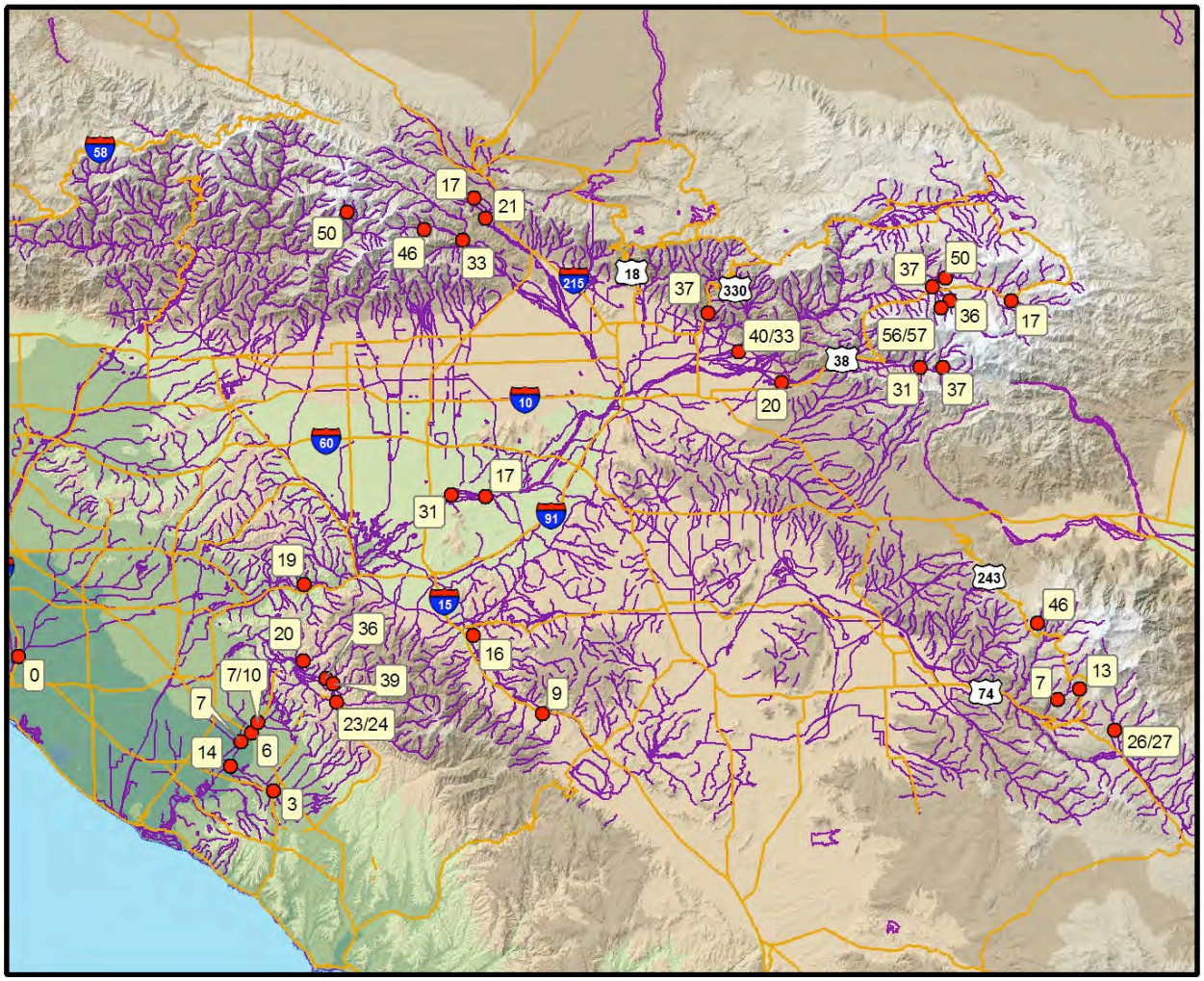

Figure 1. SCC-IBI scores for sites sampled during the 2008 bioassessment survey.

Table 4. SCC-IBI metrics and overall rating for each location sampled during the 2008 bioassessment survey. The three sites reported in italics had fewer than 500 BMIs collected.

Elevation Strata (meters)	Site	Replicates	EPT Taxa	% Intolerant Individuals	# Predator Taxa	% Tolerant Taxa	% Non-Insect Taxa	% CF + CG	# Coleoptera Taxa	Total IBI Score (Adjusted on a scale of 0 to 100)	IBI Rating
0 – 350	**405CTC480**	1	0	0	0	0	0	0	0	**0**	**Very Poor**
0 – 350	**801PCW048**	1	0	0	0	3	1	0	0	**5.72**	**Very Poor**
0 – 350	**801PCW171**	1	0	0	0	4	0	0	0	**5.72**	**Very Poor**
0 – 350	**801PCW171**	2	0	0	0	5	2	0	0	**10.01**	**Very Poor**
0 – 350	***801SAR165***	*1*	*2*	*0*	*0*	*5*	*4*	*1*	*0*	***17.16***	***Very Poor***
0 - 350	***801SAR351***	*1*	*1*	*0*	*0*	*10*	*10*	*1*	*0*	***31.46***	***Poor***
0 - 350	**801SAR528**	1	3	0	0	5	2	3	0	**18.59**	**Very Poor**
0 - 350	**801SDC178**	1	0	0	0	5	5	0	0	**14.3**	**Very Poor**
0 - 350	**801SDC504**	1	0	0	0	0	1	1	0	**2.86**	**Very Poor**
0 - 350	**801STC071**	1	1	0	0	1	8	2	4	**22.88**	**Poor**
0 - 350	**801STC071**	2	2	0	3	0	7	1	4	**24.31**	**Poor**
0 - 350	**801STC142**	1	2	0	2	0	7	10	4	**35.75**	**Poor**
0 - 350	**801STC149**	1	3	0	3	2	7	8	4	**38.61**	**Poor**
0 - 350	**801TMW153**	1	1	0	0	0	2	8	0	**15.73**	**Very Poor**
0 - 350	***801XXX046***	*1*	*1*	*0*	*2*	*2*	*5*	*4*	*0*	***20.02***	***Poor***
0 - 350	**801XXX305**	1	1	0	0	2	1	1	0	**7.15**	**Very Poor**
350 - 700	**801CYC114**	1	4	1	1	6	7	3	4	**37.18**	**Poor**
350 - 700	**801PLC469**	1	4	1	3	4	6	6	4	**40.04**	**Fair**
350 - 700	**801PLC469**	2	3	0	0	6	8	4	2	**32.89**	**Poor**
350 - 700	**801TMW162**	1	1	0	2	0	2	1	0	**8.58**	**Very Poor**
350 - 700	**801XXX259**	1	0	0	0	0	8	1	5	**20.02**	**Poor**
700 +	**801EBC080**	1	7	6	10	7	4	5	0	**55.77**	**Fair**
700 +	**801EBC080**	2	7	5	10	8	6	4	0	**57.2**	**Fair**
700 +	**801EBC126**	1	1	2	1	10	10	0	2	**37.18**	**Poor**
700 +	**801FGC022**	1	6	2	0	8	8	1	0	**35.75**	**Poor**
700 +	**801HBC050**	1	0	7	0	0	1	4	0	**17.16**	**Very Poor**
700 +	**801MIC074**	1	1	1	2	10	10	0	2	**37.18**	**Poor**
700 +	**801MIC272**	1	3	2	0	8	9	0	0	**31.46**	**Poor**
700 +	**801MLC057**	1	6	5	4	7	8	2	0	**45.76**	**Fair**
700 +	**801PLC362**	1	5	2	4	6	5	1	0	**32.89**	**Poor**
700 +	**801SAN068**	1	6	3	10	7	6	1	2	**50.05**	**Fair**
700 +	**801SAR334**	1	7	5	5	8	9	1	0	**50.05**	**Fair**
700 +	**801XXX112**	1	0	0	0	4	9	2	0	**21.45**	**Poor**
700 +	**801XXX118**	1	0	0	0	2	10	0	0	**17.16**	**Very Poor**
700 +	**802HYC496**	1	0	0	3	3	7	1	4	**25.74**	**Poor**
700 +	**802HYC496**	2	1	0	3	4	6	0	5	**27.17**	**Poor**
700 +	**802INC155**	1	2	10	3	4	5	8	0	**45.76**	**Fair**
700 +	**802SWC270**	1	0	0	1	0	2	0	2	**7.15**	**Very Poor**
700 +	**802SWC535**	1	0	1	3	2	3	0	0	**12.87**	**Very Poor**

Table 5 Physical habitat characterization and overall rating for each location sampled during the 2008 bioassessment survey

Elevation Strata (meters)	Site	Dominant landuse/ landcover	Channel Type	Epifaunal Substrate/ Cover (0 to 20)	Sediment Deposition (0 to 20)	Channel Alteration (0 to 20)	Overall Habitat Characterization score (0 to 60)	Overall Habitat Characterization score Rating
0 - 350	405CTC480	Urban/ Industrial	Concrete-lined	0	20	0	20	marginal
0 - 350	801PCW048	Suburb/ Town	Concrete-lined	5	4	2	11	poor
0 - 350	801PCW171	Suburb/ Town	Concrete-lined	0	17	0	17	marginal
0 - 350	801SAR165	Suburb/ Town	Natural	7	3	15	25	marginal
0 - 350	801SAR351	Urban/ Industrial	Natural	2	2	20	24	marginal
0 - 350	801SAR528	Suburb/ Town	Natural	16	11	11	38	suboptimal
0 - 350	801SDC178	Suburb/ Town	Concrete-lined	2	4	0	6	poor
0 - 350	801SDC504	Urban/ Industrial	Natural	3	3	5	11	poor
0 - 350	801STC071	Forest	Natural	7	3	20	30	marginal
0 - 350	801STC142	Forest	Natural	14	15	20	49	optimal
0 - 350	801STC149	Rangeland	Natural	12	12	19	43	suboptimal
0 - 350	801TMW153	Urban/ Industrial	Rip-rap embankment/ Natural bottom	17	8	10	35	suboptimal
0 - 350	801XXX046	Forest	Natural	8	9	20	37	suboptimal
0 - 350	801XXX305	Suburb/ Town	Concrete-embankment/ Natural bottom	12	6	4	22	marginal
350 - 700	801CYC114	Urban/ Industrial	Concrete-embankment/ Natural bottom	15	15	10	40	suboptimal
350 - 700	801PLC469	Suburb/ Town	Natural	3	15	3	21	marginal
350 - 700	801TMW162	Rangeland	Natural	12	6	15	33	suboptimal
350 - 700	801XXX259	Agriculture	Natural	11	18	10	39	suboptimal
700 +	801EBC080	Forest	Natural	20	17	19	56	optimal
700 +	801EBC126	Forest	Natural	17	19	20	56	optimal
700 +	801FGC022	Forest	Natural	20	15	20	55	optimal
700 +	801HBC050	Forest	Natural	14	5	16	35	suboptimal
700 +	801MIC074	Forest	Natural	3	15	20	38	suboptimal
700 +	801MIC272	Forest	Natural	5	14	20	39	suboptimal
700 +	801MLC057	Forest	Natural	17	18	19	54	optimal
700 +	801PLC362	Forest	Natural	18	18	20	56	optimal
700 +	801SAN068	Forest	Natural	18	18	20	56	optimal
700 +	801SAR334	Forest	Natural	20	18	20	58	optimal
700 +	801XXX112	Forest	Natural	12	13	16	41	suboptimal
700 +	801XXX118	Forest	Natural	10	12	20	42	suboptimal
700 +	802HYC496	Forest	Natural	13	18	20	51	optimal
700 +	802INC155	Forest	Natural	17	6	20	43	suboptimal
700 +	802SWC270	Forest	Natural	15	16	20	51	optimal
700 +	802SWC535	Forest	Natural	7	13	19	39	suboptimal

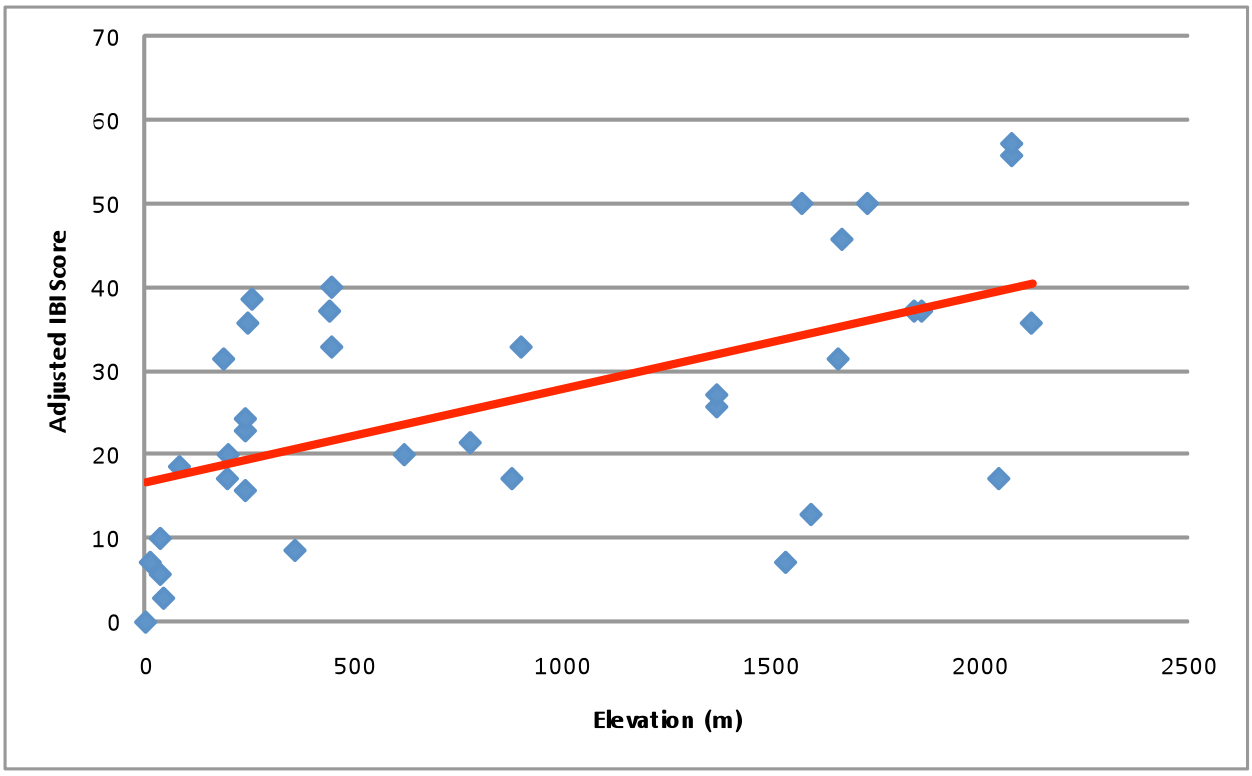

Figure 2. IBI scores as a function of elevation (IBI scores adjusted on a scale of 0 to 100).

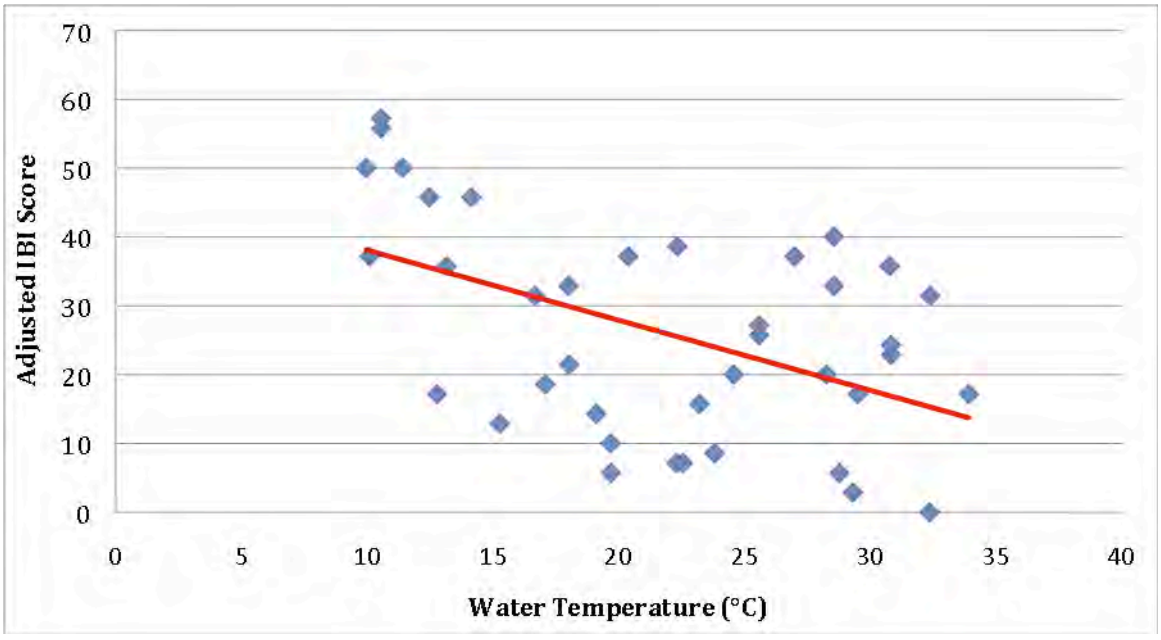

Figure 3. IBI scores as a function of water temperature (IBI scores adjusted on a scale of 0 to 100).

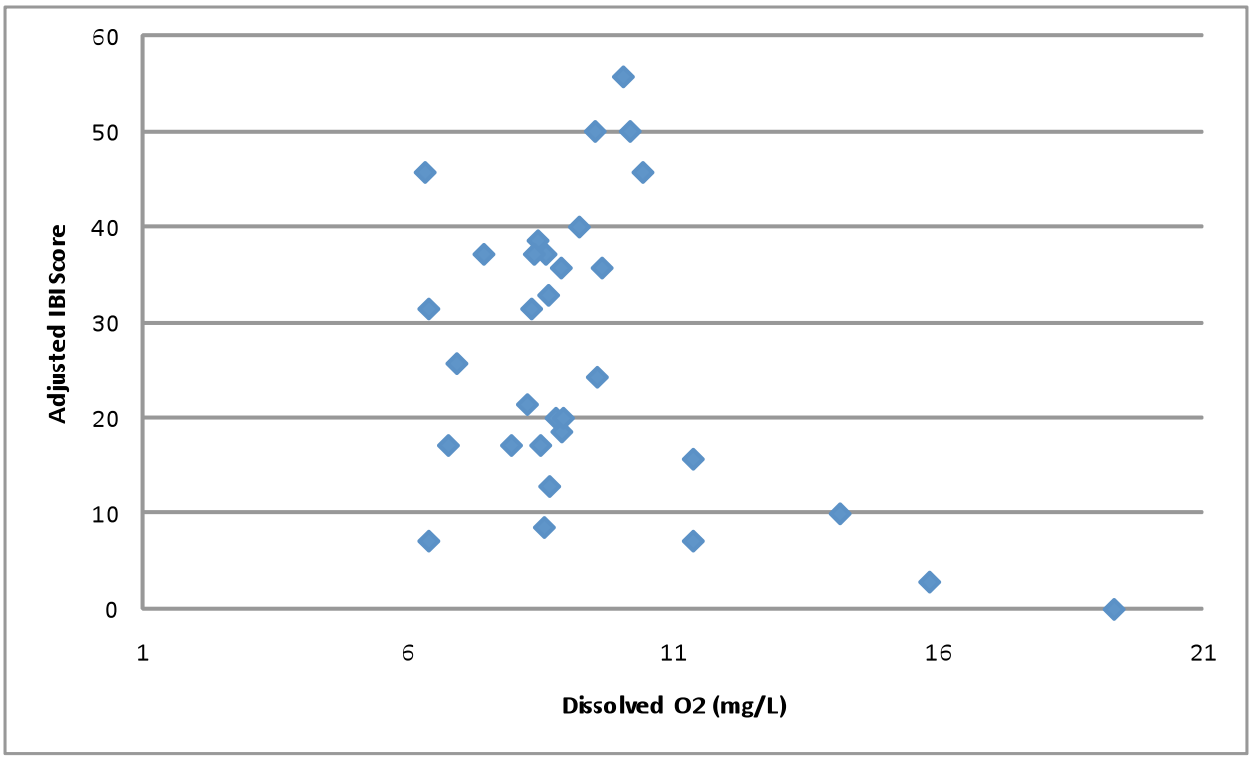

Figure 4. IBI scores as a function of dissolved oxygen (IBI scores adjusted on a scale of 0 to 100).

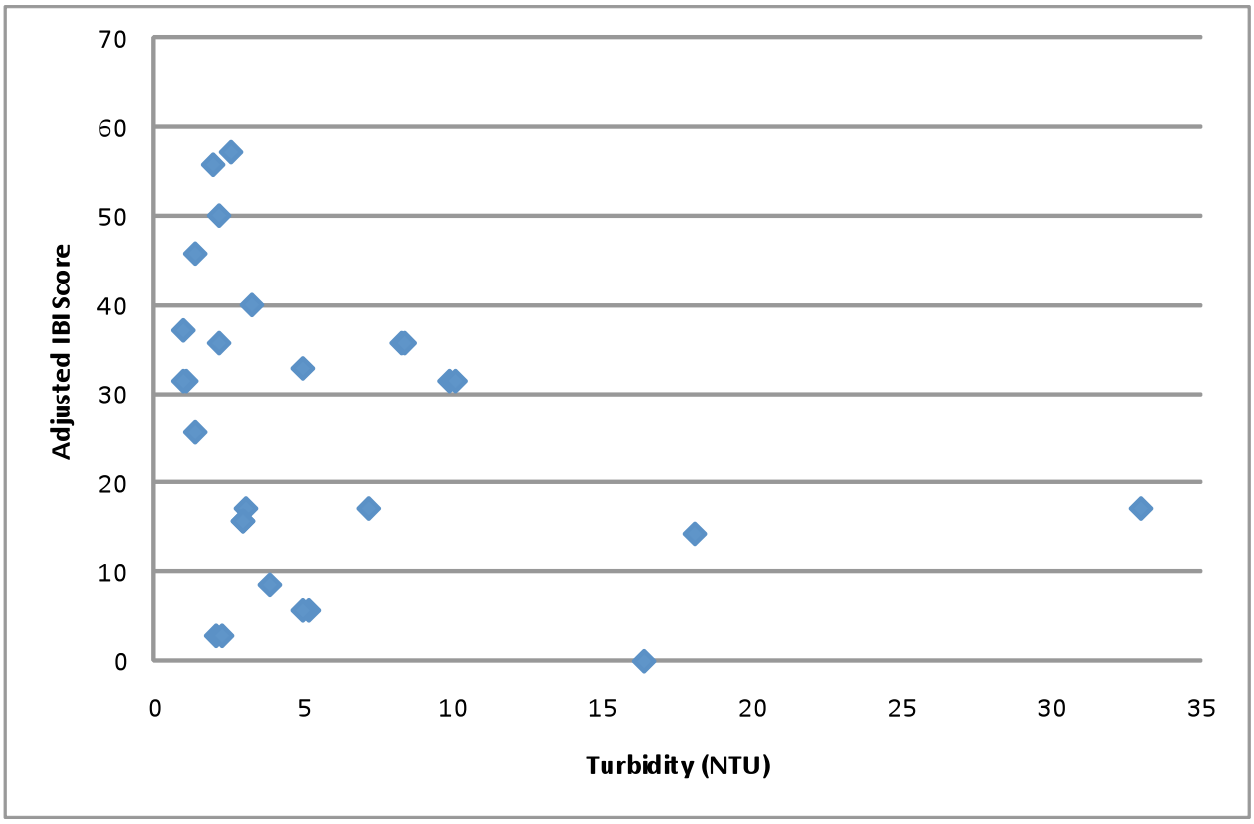

Figure 5. IBI scores as a function of turbidity (IBI scores adjusted on a scale of 0 to 100).

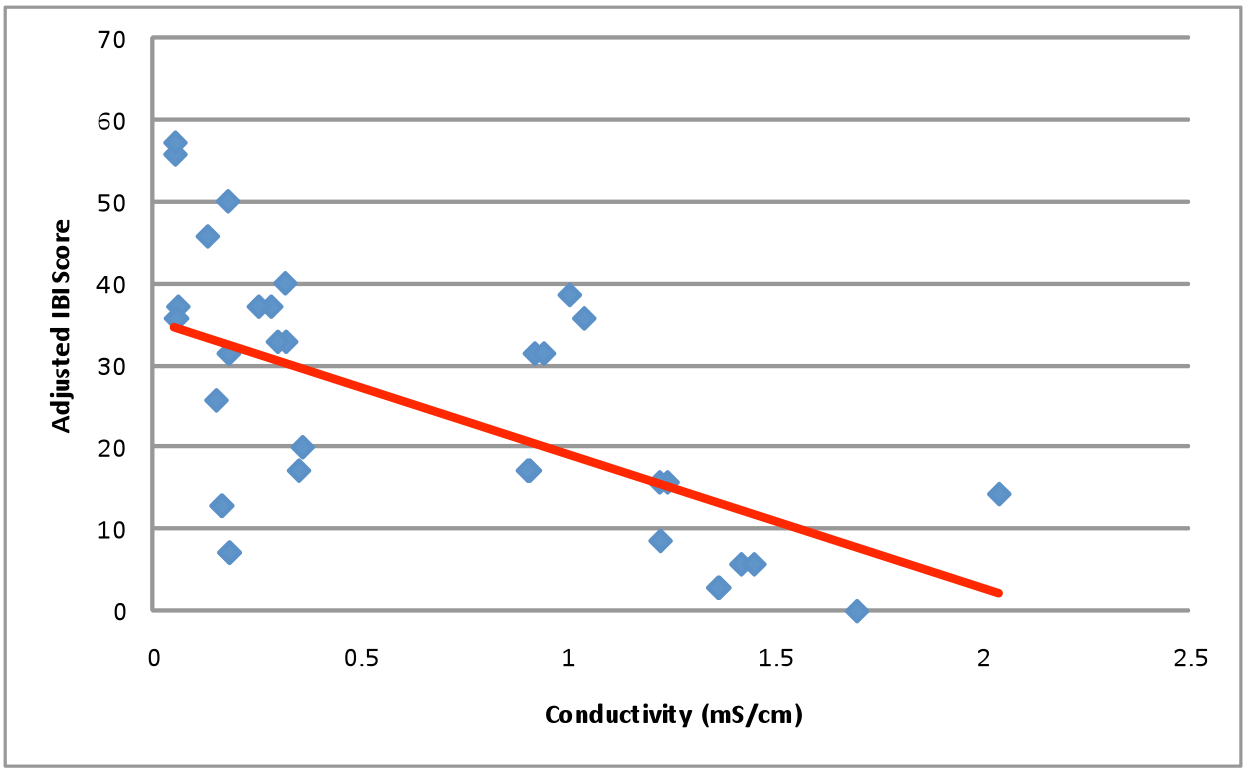

Figure 6. IBI scores as a function of conductivity (IBI scores adjusted on a scale of 0 to 100).

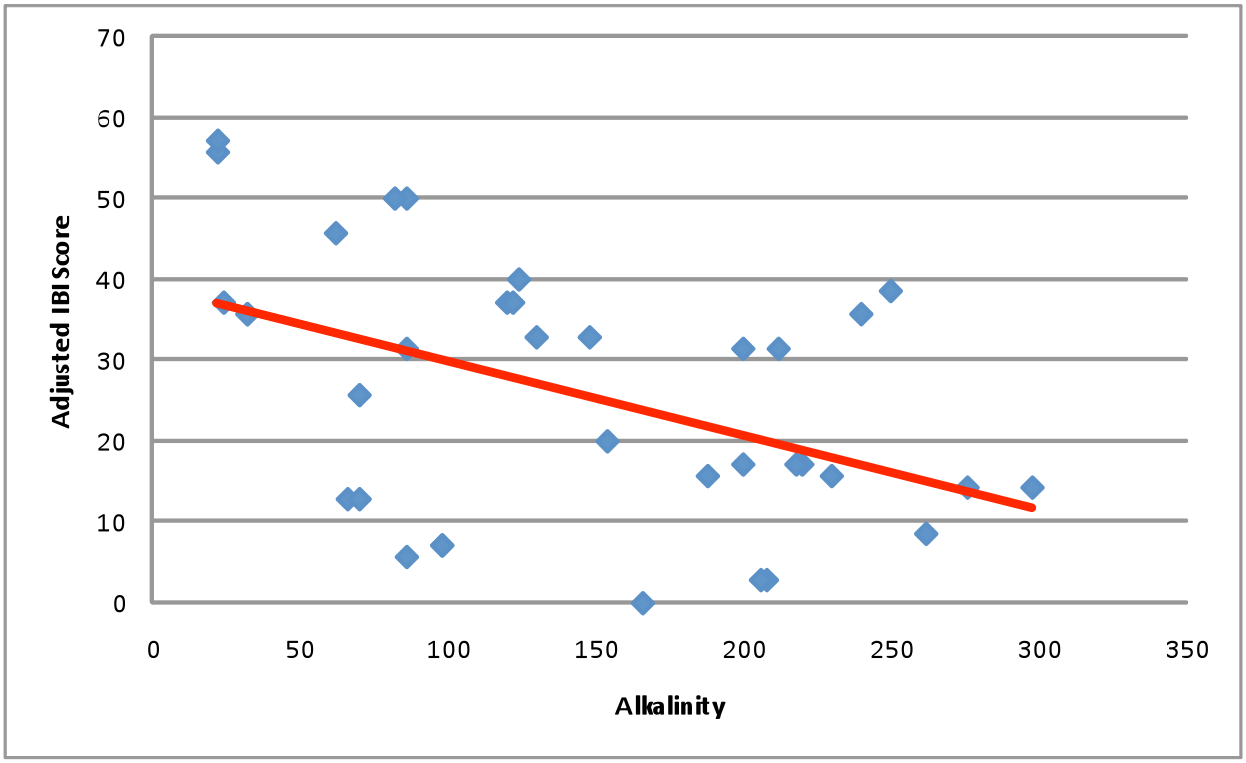

Figure 7. IBI scores as a function of alkalinity (IBI scores adjusted on a scale of 0 to 100).

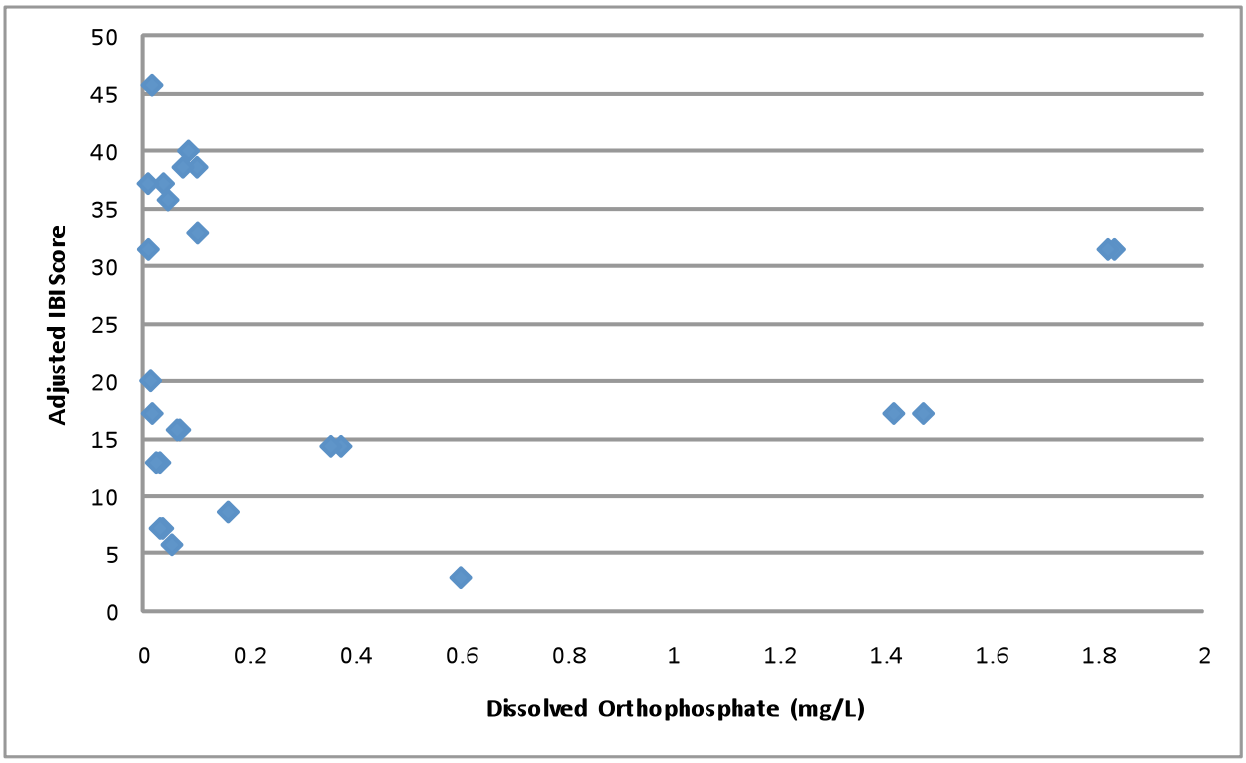

Figure 8. IBI scores as a function of dissolved orthophosphate (IBI scores adjusted on a scale of 0 to 100).

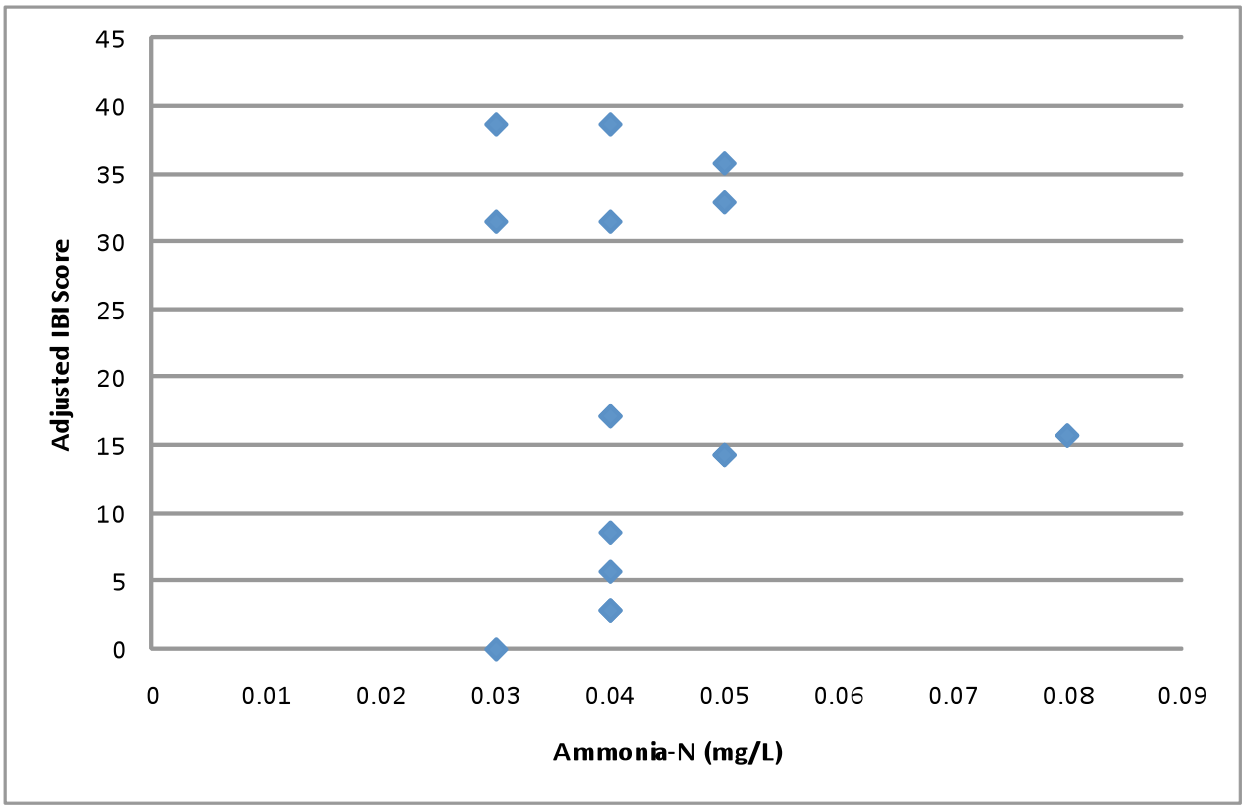

Figure 9. IBI scores as a function of ammonia (IBI scores adjusted on a scale of 0 to 100).

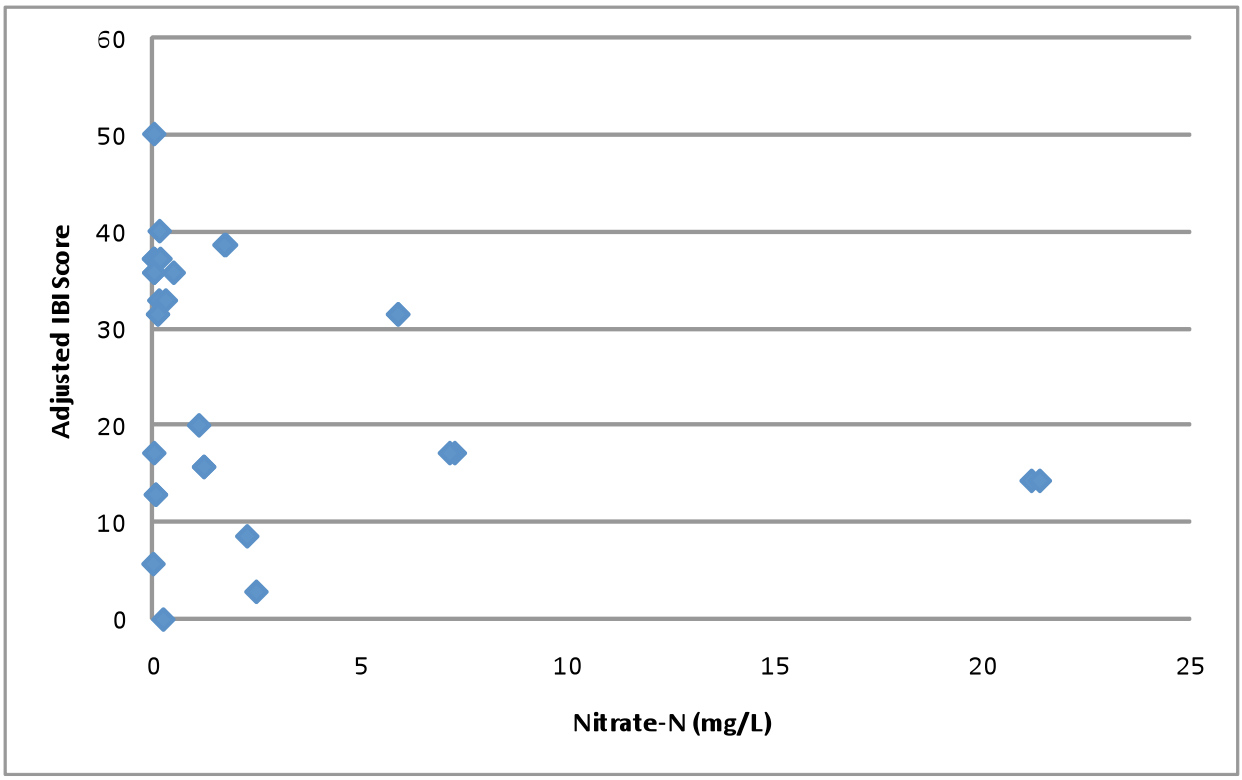

Figure 10. IBI scores as a function of nitrate (IBI scores adjusted on a scale of 0 to 100).

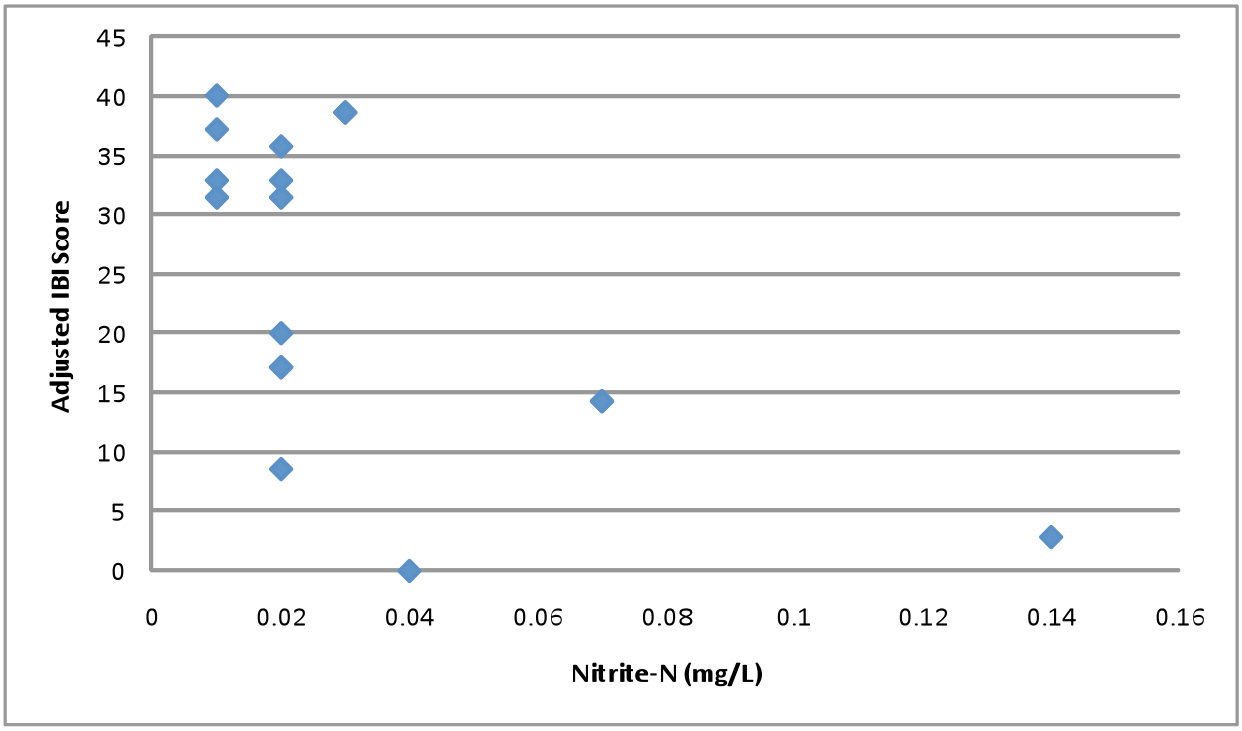

Figure 11. IBI scores as a function of nitrite (IBI scores adjusted on a scale of 0 to 100).

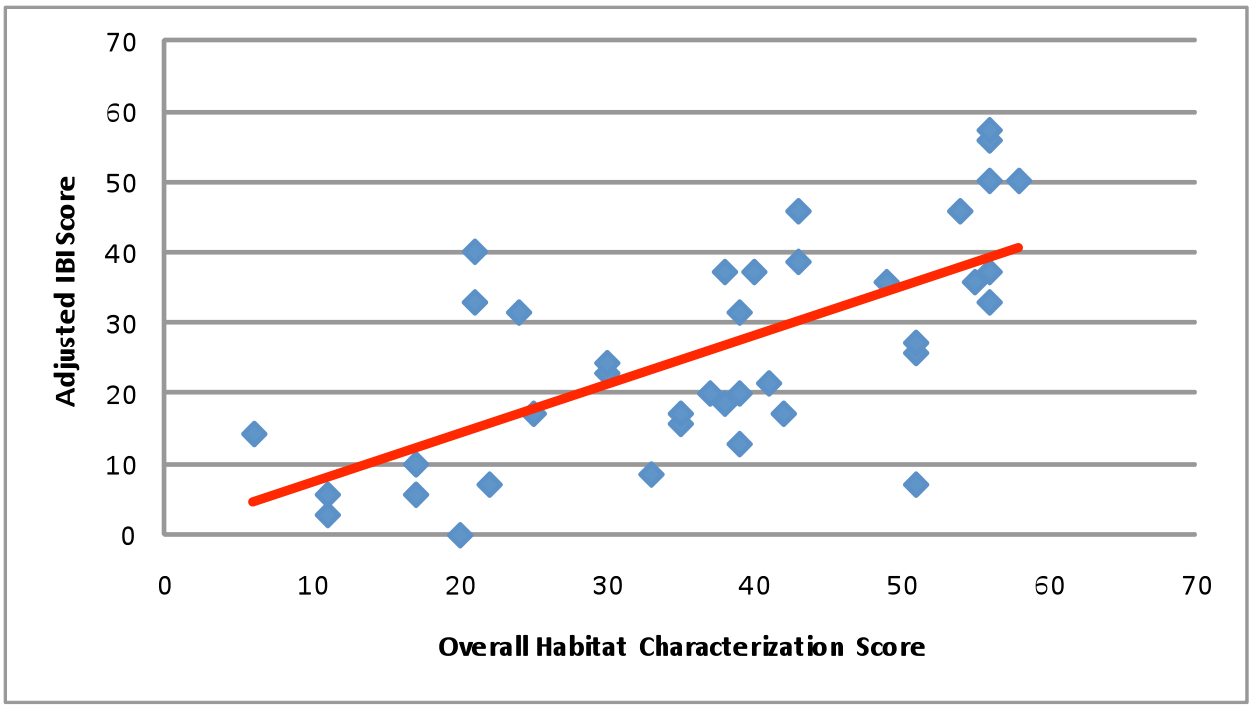

Figure 12. IBI scores as a function of overall habitat characterization (IBI scores adjusted on a scale of 0 to 100).

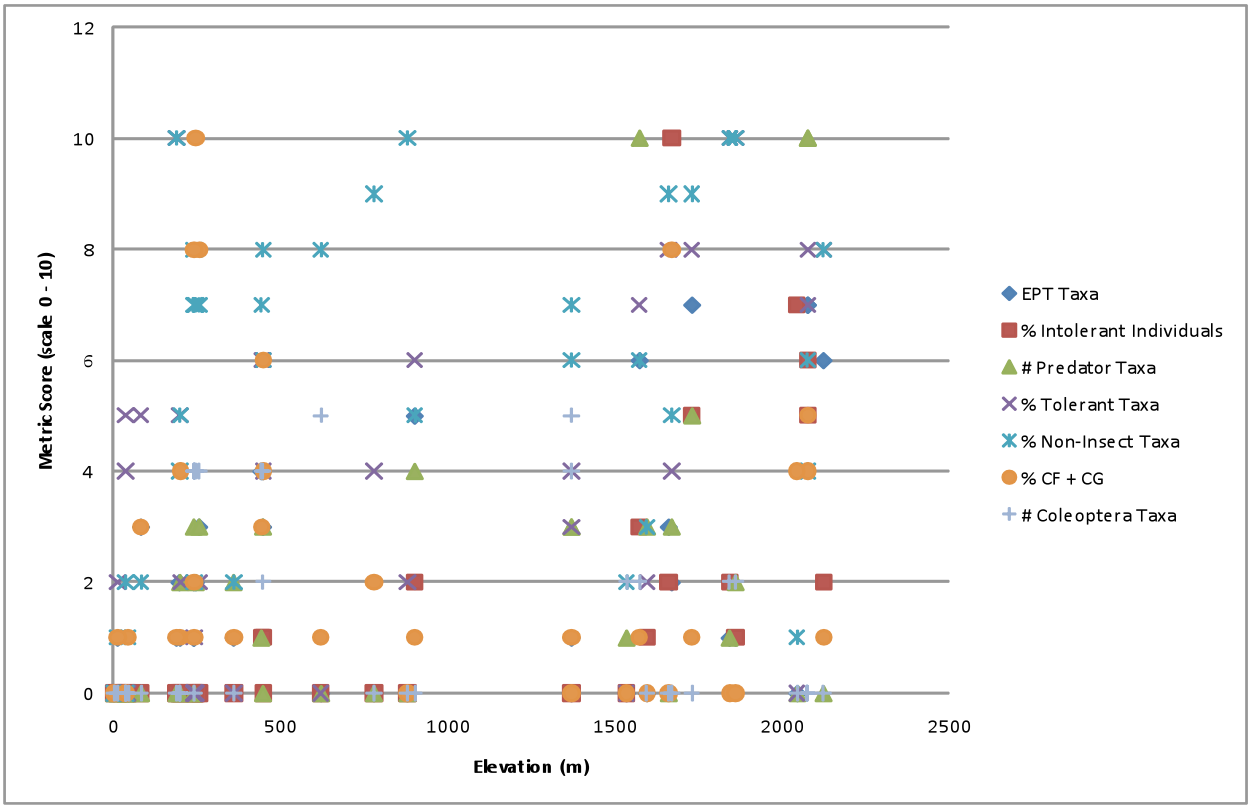

Figure 13. IBI metrics as a function of elevation.

Conclusion

This report gives the results from the third year of an ongoing five-year monitoring project to assess the quality of the waterways within Region 8.

BMI Community Structure - The low and mid elevation sites were dominated by the facultative and tolerant insects and non-insects. These included midge larvae Chironomidae, crustaceans *Hyalella* sp. and Ostracoda, worms Oligochaeta, as well as mayflies *Baetis* sp. High-elevations sites were not only dominated by the aforementioned organisms (with the exception of Oligochaeta and *Hyalella* sp.), but were also dominated by semi-intolerant blackfly larvae *Simulium* sp., intolerant blackfly larvae *Prosimulium* sp., and intolerant stoneflies *Malenka* sp., *Yoraperla* sp., and *Zapada* sp.

Chironomidae larvae are highly tolerant of impaired conditions and are a documented signature of urbanization (Wang and Lyons 2002). Although Chironomidae larvae were present at all sites, their presence was not entire determined by urbanization. Sites that were isolated from the influence of urbanization still exhibited similar levels of Chironomidae larvae when compared to sites surrounded by urbanization. Most Baetidae mayfly genera are moderately tolerant members of the EPT group of BMIs and have a preference for sediment-dominated streambeds, having no need for complex habitat with high volume of interstitial areas. They are, however, sensitive to contamination and low dissolved oxygen levels. The presence of stoneflies *Malenka* sp., *Yoraperla* sp., and *Zapada* sp. within high-elevation sites indicates relatively pristine habitat conditions for these sensitive organisms.

Physical/Habitat Quality and Chemical Characteristics – "Poor" scores for physical habitat condition of low elevation streams were primarily driven by the lack of epifaunal substrate cover coupled with channel alterations for flood control purposes; concrete-lined channels' physical habitat conditions scored higher than expected due to the lack of sediment within these systems, which is considered beneficial for inhabiting BMIs; on the contrary, concrete-lined channels lack micro-topography that many sensitive BMIs require to survive. "Marginal" scores for physical habitat condition of mid elevation streams were due to an increase in epifaunal substrate cover, when compared to low gradient streams. "Optimal" scores for physical habitat condition of high elevation streams were due to pristine habitat conditions, although a few locations were lacking in epifaunal substrate cover and had increased sedimentation.

The water quality characteristics were relatively consistent among sites with near neutral to moderately alkaline mean pH field values (7.28 to 10.45; Appendix C), more than adequate levels of mean dissolved oxygen (6.32 to 19.32; Appendix C), and highly variable conductivity values (0.053 to 2.800 mS/cm; Appendix C). Natural inland waters usually contain small amounts of dissolved mineral salts; low and high levels of dissolved salts can be harmful to living organisms not able to osmoregulate causing the uptake of water into the organism's cells which can be lethal. Surveys of inland fresh waters indicate that a good mix of fish fauna is found where conductivity values range between 0.150 and 0.500 mS/cm and that the upper tolerance limit for freshwater organisms is 2.000 mS/cm (McKee and Wolf 1971). Within this study, the highest levels of conductivity were found within our urban low elevation streams and are typical of systems with flows fed by urban influence.

SCC-IBI and Region 8 – While an IBI is an informative tool for assessing waterway condition, this multimetric technique is not without its limitations. When an IBI is developed, the individual metrics that comprise an IBI are generated for a specific region based on reference condition sites for that area. While Region 8 falls within the boundaries of the SCC-IBI, there were few sites from this area reflected in the developed SCC-IBI and this may partially explain the variability in IBI scores observed among the low gradient sites within Region 8. Moreover, the resultant IBI scores may not adequately reflect waterway condition or health. Many sites included in the developed SCC-IBI were located at high elevations and were also characterized as high gradient streams. However, many sites in Region 8 were low elevation, were characterized as low gradient, and many site reaches were located in channelized environments. Currently there is no developed IBI for low gradient, low elevation streams in this region, nor are channelized waterways included in the developed SCC-IBI.

Another important notation is that the SWAMP mandated sampling protocols include both a targeted riffle and multihabitat approach. The targeted riffle approach is used for high gradient streams, while the multihabitat approach is used at for low gradient streams. The multihabitat protocol may not be the best approach for these stream types, as many BMIs in this setting live on or near the bank margins. A 'margin-center-margin' protocol may better depict waterway condition for these site types.

Additionally, the SCC-IBI was developed by adjusting total counts of BMIs to 500 by means of Monte Carlo. This was necessary as the current SWAMP protocols require a sample of 600 BMIs, but the SCC-IBI was built using a 500 count. A few streams sampled during the 2008 bioassessment survey were whole-sorted and obtained fewer than 100 organisms; although IBI scores were generated for these locations, caution should be used when interpreting these scores being that they do not adhere to the statistical tools used to generate the SCC-IBI.

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Appendix A: Location Photos

Station: 405CTC480 Transect: A

Station: 801PCW048 Transect: A

Station: 801PCW171 Transect: A

Station: 801SAR165 Transect: A

Station: 801SAR351 Transect: A

Station: 801SAR528 Transect: A

Station: 801SDC178 Transect: A

Station: 801SDC504 Transect: A

Station: 801STC071 Transect: A

Station: 801STC142 Transect: A

Station: 801STC149 Transect: A

Station: 801TMW153 Transect: A

Station: 801XXX046 Transect: A

Station: 801XXX305 Transect: A

Station: 801CYC114 Transect: A

Station: 801PLC469 Transect: A

Station: 801TMW162 Transect: A

Station: 801XXX259 Transect: A

Station: 801EBC080 Transect: A

Station: 801EBC126 Transect: A

Station: 801FGC022 Transect: A

Station: 801HBC050 Transect: A

Station: 801MIC074 Transect: A

Station: 801MIC272 Transect: A

Station: 801MLC057 Transect: A

Station: 801PLC362 Transect: A

Station: 801SAN068 Transect: A

Station: 801SAR334 Transect: A

Station: 801XXX112 Transect: A

Station: 801XXX118 Transect: A

Station: 802HYC496 Transect: A

Station: 802INC155 Transect: A

Station: 802SWC270 Transect: A

Station: 802SWC535 Transect: A

Appendix B: Standard Operating Procedures

STANDARD OPERATING PROCEDURES FOR COLLECTING BENTHIC MACROINVERTEBRATE SAMPLES AND ASSOCIATED PHYSICAL AND CHEMICAL DATA FOR AMBIENT BIOASSESSMENTS IN CALIFORNIA (UPDATED 02/01/07) CAN BE DOWNLOADED FROM:

http://swamp.mpsl.mlml.calstate.edu/wp-content/uploads/2009/04/swamp_sop_bioassessment_collection_020107.pdf

Appendix C: Water Chemistry Data

Appendix C. Water chemistry data (including field and lab analyses).

Elevation Strata (meters)	Site	Field Replicate	Lab Replicate	pH	Water Temp. (°C)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved O2 (mg/l)	Alkalinity	Ammonia-N (mg/L)	Dissolved Orthophosphate (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)
0 - 350	405C TC 480	1	R1	9.14	32.35	1.697	16.4	19.32	166	0.03	N/A	0.26	0.04
0 - 350	801P C W048	1	R1	10.45	28.76	1.418	5.2	N/A	86	0.04	0.0535	0.02	N/A
0 - 350	801P C W048	1	R2	N/A	N/A	1.449	5	N/A	N/A	N/A	N/A	N/A	N/A
0 - 350	801P C W171	1	R1	9.16	19.68	1.5	2.7	14.15	210	0.02	0.1007	0.03	N/A
0 - 350	801P C W171	1	R2	N/A	N/A	1.5	2.9	N/A	210	0.03	0.1109	0.03	N/A
0 - 350	801P C W171	2	R1	N/A	N/A	1.5	3.5	N/A	214	0.03	0.0983	0.02	N/A
0 - 350	801S AR 165	1	R1	8.29	33.9	0.908	33	6.76	220	0.04	1.4164	7.28	0.02
0 - 350	801S AR 165	1	R2	N/A	N/A	0.903	3.1	N/A	218	0.04	1.4725	7.16	0.02
0 - 350	801S AR 351	1	R1	8.02	32.37	0.92	9.9	6.39	200	0.03	1.8328	5.92	0.02
0 - 350	801S AR 351	1	R2	N/A	N/A	0.942	10.1	N/A	212	0.04	1.8206	5.91	0.02
0 - 350	801S AR 528	1	R1	7.86	17.07	0.9	129.6	8.9	N/A	0.14	0.9844	4.24	0.03
0 - 350	801S AR 528	1	R2	7.86	17.07	0.899	126	8.9	N/A	0.14	0.9623	4.17	0.03
0 - 350	801SD C 178	1	R1	8.22	19.1	2.04	18.1	N/A	276	0.05	0.3726	21.17	0.07
0 - 350	801SD C 178	1	R2	N/A	N/A	N/A	N/A	N/A	298	0.05	0.3534	21.37	0.07
0 - 350	801SD C 504	1	R1	8.93	29.3	1.365	2.1	15.84	208	0.04	0.5993	2.5	0.14
0 - 350	801SD C 504	1	R2	N/A	N/A	1.362	2.3	N/A	206	0.04	N/A	N/A	N/A
0 - 350	801ST C 071	1	R1	8.48	30.81	0.7	1.6	9.57	150	0.04	N/A	1.07	0.03
0 - 350	801ST C 071	2	R1	N/A	N/A	0.7	1.9	N/A	154	0.04	N/A	1.06	0.03
0 - 350	801ST C 142	1	R1	8.16	30.76	1.039	2.2	8.89	240	0.05	0.0462	0.51	0.02
0 - 350	801ST C 149	1	R1	7.51	22.32	1.004	N/A	8.45	250	0.03	0.101	1.77	0.03
0 - 350	801ST C 149	1	R2	N/A	N/A	N/A	N/A	N/A	N/A	0.04	0.0743	1.73	0.03
0 - 350	801TM W153	1	R1	8.3	23.2	1.24	3	11.38	188	0.08	0.0683	1.24	N/A
0 - 350	801TM W153	1	R2	N/A	N/A	1.221	3	N/A	230	0.08	0.0634	1.24	N/A
0 - 350	801XXX046	1	R1	7.81	28.24	2.8	4.6	8.79	312	0.05	0.0201	0.05	0.04
0 - 350	801XXX305	1	R1	8.59	22.29	1.7	11.9	11.38	284	0.03	0.1667	3.19	0.04
350 - 700	801C YC 114	1	R1	8.63	26.98	0.284	N/A	8.6	120	N/A	0.0376	0.03	N/A
350 - 700	801P LC 469	1	R1	8.83	28.54	0.318	3.3	9.23	124	N/A	0.0848	0.17	0.01
350 - 700	801P LC 469	2	R1	N/A	N/A	0.32	5	N/A	130	N/A	0.1023	0.16	0.02
350 - 700	801TM W162	1	R1	7.5	23.8	1.223	3.9	8.57	262	0.04	0.1601	2.28	0.02
350 - 700	801XXX259	1	R1	8.12	24.56	0.36	N/A	8.93	154	N/A	0.0182	1.12	0.02
350 - 700	802H YC 496	1	R1	7.65	25.57	0.152	1.4	6.92	70	N/A	N/A	N/A	N/A
350 - 700	802H YC 496	1	R2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
700 +	801E BC 080	1	R1	7.42	10.55	0.053	2	10.06	22	N/A	N/A	N/A	N/A
700 +	801E BC 080	2	R1	N/A	N/A	0.053	2.6	N/A	22	N/A	N/A	N/A	N/A
700 +	801E BC 126	1	R1	7.9	10.08	0.06	1	8.38	24	N/A	N/A	0.04	N/A
700 +	801F GC 022	1	R1	7.6	13.15	0.054	8.3	9.66	32	N/A	N/A	0.04	N/A
700 +	801F GC 022	1	R2	N/A	N/A	0.057	8.4	N/A	32	N/A	N/A	0.04	N/A
700 +	801H BC 050	1	R1	7.79	12.77	0.351	7.2	8.5	200	N/A	0.0162	0.04	N/A
700 +	801M IC 074	1	R1	8.43	20.37	0.254	N/A	7.43	122	N/A	0.0083	0.19	0.01
700 +	801M IC 272	1	R1	8.13	16.66	0.182	1.1	8.33	86	N/A	0.0089	0.13	0.01
700 +	801M IC 272	1	R2	N/A	N/A	0.182	1	N/A	N/A	N/A	N/A	0.13	0.01
700 +	801M LC 057	1	R1	8.1	14.14	0.227	0.5	10.43	110	0.06	0.004	0.22	N/A
700 +	801M LC 057	1	R2	N/A	N/A	0.229	0.5	N/A	110	0.06	0.003	0.22	N/A
700 +	801P LC 362	1	R1	8.28	18	0.3	N/A	8.65	148	0.05	N/A	0.32	0.01
700 +	801S AN 068	1	*	8.3	11.4	*	*	10.19	*	*	*	*	*
700 +	801S AR 334	1	R1	7.8	9.95	0.18	2.2	9.53	86	N/A	N/A	0.04	N/A
700 +	801S AR 334	1	R2	N/A	N/A	N/A	N/A	N/A	82	N/A	N/A	N/A	N/A
700 +	801XXX112	1	*	8.21	18.02	*	*	8.25	*	*	*	*	*
700 +	801XXX118	1	*	8.17	29.49	*	*	7.95	*	*	*	*	*
700 +	802IN C 155	1	R1	7.28	12.46	0.191	1.4	6.32	62	N/A	0.0158	N/A	N/A
700 +	802S WC 270	1	R1	7.48	22.54	0.183	N/A	6.39	98	N/A	0.036	N/A	N/A
700 +	802S WC 270	1	R2	N/A	N/A	0.184	N/A	N/A	98	N/A	0.031	N/A	N/A
700 +	802S WC 535	1	R1	7.77	15.26	0.164	N/A	8.67	66	N/A	0.0307	0.08	N/A
700 +	802S WC 535	1	R2	N/A	N/A	0.166	N/A	N/A	70	N/A	0.0238	0.08	N/A

*Note: lab data for sites highlighted in green were not provided by the analytical lab.

Appendix D: Benthic Macroinvertebrates Used for Calculating IBI Metrics

Table D1. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	405CTC480	801CYC114	801EBC080 1	801EBC080 2	801EBC126	801FGC022	801HBC050	801MIC074	801MIC272	801MLC057
Insecta Taxa												
Ephemeroptera												
Ameletus	0	cg				1		1				5
Baetidae	4	cg			1							
Baetis	5	cg		245	4	4	135	61	1	153	143	147
Callibaetis	9	cg										
Camelobaetidius	4	cg										
Cinygmula	4	sc						6				
Diphetor	4	cg				5		32				
Drunella	0	cg			1	1	4			1	14	15
Epeorus	0	sc		1			12	2			5	4
Ephemerella	1	cg									2	
Ephemerellidae	1	cg			2			4			1	
Ephemeroptera												
Fallceon	4	cg			3							
Fallceon quilleri	4	cg										
Heptageniidae	4	sc						3			1	
Ironodes	3	sc			11	2		10	1			
Leptohyphidae	4	cg										
Leptophlebia	2	cg			3							
Leptophlebiidae	2	cg				4						
Paraleptophlebia	4	cg			9							1
Rhithrogena	0	sc										
Serratella	2	cg									2	
Tricorythodes	4	cg		13								
Tricorythodes minutus	4	cg										
Odonata												
Anisoptera												
Argia	7	p		5								
Coenagrionidae	9	p										
Libellulidae	9	p										
Paltothemis	9	p										
Zygoptera												
Plecoptera												
Calineuria	1	p			3	1						8
Chloroperlidae	1	p										2
Claassenia	1	p										
Haploperla	1	p									1	3
Isoperla	2	p										
Malenka	2	sh			2	3		1	127			1
Nemouridae	2	sh			29	5	2	16				1
Plecoptera								1				
Sweltsa	1	p				1						
Yoraperla	1	sh			61	62						
Zapada	2	sh								1	2	
Hemiptera												
Corixidae	8	p										
Trichocorixa	8	p										
Trichoptera												
Agapetus	0	sc										
Brachycentridae	1							1				4
Farula	0	sc										
Glossosomatidae	0	sc										
Helicopsyche	3	sc		3								
Hydropsyche	4	cf		73								2
Hydropsychidae	4	cf						1				1
Hydroptila	6	ph										
Hydroptilidae	4	ph										
Lepidostoma	1	sh			4	6		2				1
Lepidostomatidae	1	sh				2						
Limnephilidae	4	sh						2				
Micrasema	1	mh			7	10		4				4
Neophylax	3	sc			1		1					
Ochrotrichia	4	ph		16								1
Parapsyche	0	p				1				2	2	
Philopotamidae	3	cf				1						
Polycentropus	6	p								1		
Psychoglypha	2	sh			1							
Psychomyia	2	cg									1	
Rhyacophila	0	p			6	5		3	4	1		14
Rhyacophilidae	0	p							2			
Tinodes	2	sc		1								
Trichoptera				1	3	1						1
Wormaldia	3	cf										
Coleoptera												
Dytiscidae	5	p					1					
Elmidae	4	cg										
Hydrobius	8	p										
Hydrophilidae	5	p										

Table D1 continued part 1. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	405CTC480	801CYC114	801EBC080 1	801EBC080 2	801EBC126	801FGC022	801HBC050	801MIC074	801MIC272	801MLC057
Hydroporus	5	p										
Hydrotrupes	5	p								2		
Laccophilus	5	p										
Liodessus	5	p										
Optioservus	4	sc		15								
Psephenus		sc		3								
Stictotarsus	5	p										
Diptera												
Aedes	8	cg										
Anopheles	8	cg										
Atylotus/Tabanus	5	p										
Bezzia/Palpomyia	6	p			1	1						
Blepharicera	0	sc										8
Blephariceridae	0	sc										
Brachycera												
Caloparyphus/Euparyphus	8	cg									1	1
Caudatella	1	cg				1					7	
Ceratopogonidae	6	p				1	1	1				
Chelifera/Metachela	6	p										10
Chironomidae	6	cg	113	35	230	206	95	327	293	23	123	92
Clinocera	6	p					1					
Cryptolabis	3	sh										12
Culicoides					1	1						
Dasyhelea	6	cg			1	1		1				
Dicranota	3	p			1	3		1				
Diptera									1			
Dixa	2	cg				2	1				1	
Dolichopodidae	4	p										
Empididae	6	p		2								
Ephydridae	6		1									
Euparyphus	8	cg		2								1
Glutops	3	p			1	2						
Hemerodromia	6	p		7								
Limnophila	3	sh				2						
Limnophora	6	p								5		
Maruina	2	sc		1								
Muscidae	6	p					5				1	
Nemotelus	8	cg										
Neoplasta	6	p			1							
Pericoma/Telmatoscopus	4	cg										
Probezzia	6	p										
Prosimulium	3	cf			1	3		4			120	
Psychodidae		cg										
Simuliidae	6	cf										
Simulium		cf		55	2	3	241	1	32	311	68	143
Stratiomyidae	8	cg		3								
Thaumaleidae		sc									2	
Tipula	4	om										
Tipulidae	3											4
Wiedemannia	6	p				1						2
Non-Insecta Taxa												
Acari	5	p		14	4							
Gastropoda												
Oligochaeta	5	cg	4		3	13	1	11	9		1	2
Ostracoda	8	cg	308	3	51	62		1	15		2	1
Turbellaria	4	p		1	3	4						
Amphipoda												
Amphipoda	4	cg										
Hyalella	8	cg	72									
Basommatophora												
Ferrissia	6	sc										
Menetus	6	sc										
Physa	8	sc	2	1								
Physidae	8	sc										
Canalipalpata												
Manayunkia												
Decapoda												
Procambarus	8	sh										
Trombidiformes												
Atractides	8	p			1							
Aturidae	5	p				1						
Estelloxus	8	p										
Hygrobates	8	p										
Lebertia	8	p			9	8		3	5			8
Mideopsis	5	p			2	2						
Pionidae					1							
Protzia	8	p			1							
Sperchon	8	p							1			

Table D1 continued part 2. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	405CTC480	801CYC114	801EBC080 1	801EBC080 2	801EBC126	801FGC022	801HBC050	801MIC074	801MIC272	801MLC057
Testudacarus	5	p			2							
Torrenticola	5	p			1	1						1
Wandesia	5	p			1							
Veneroida												
Corbicula	8	cf							9			
Pisidium	8	cf			31	67						
Sphaeriidae	8	cf										
TOTAL			**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**

Table D2. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	801PCW048	801PCW171 1	801PCW171 2	801PLC362	801PLC469 1	801PLC469 2	801SAN068	801SAR165	801SAR334	801SAR351	801SAR528
Insecta Taxa													
Ephemeroptera													
Ameletus	0	cg											
Baetidae	4	cg							2			2	
Baetis	5	cg				324	132	223	133	5	188		115
Callibaetis	9	cg											
Camelobaetidius	4	cg											1
Cinygmula	4	sc									1		
Diphetor	4	cg											
Drunella	0	cg				3			1		9		
Epeorus	0	sc				7			5		12		
Ephemerella	1	cg									3		
Ephemerellidae	1	cg											
Ephemeroptera													
Fallceon	4	cg											23
Fallceon quilleri	4	cg											
Heptageniidae	4	sc									1		
Ironodes	3	sc											
Leptohyphidae	4	cg										1	
Leptophlebia	2	cg											
Leptophlebiidae	2	cg							2		1		
Paraleptophlebia	4	cg							1				
Rhithrogena	0	sc									7		
Serratella	2	cg									2		
Tricorythodes	4	cg				7	2	8		6			107
Tricorythodes minutus	4	cg											
Odonata													
Anisoptera													
Argia	7	p											
Coenagrionidae	9	p											
Libellulidae	9	p											
Paltothemis	9	p					2						
Zygoptera													2
Plecoptera													
Calineuria	1	p				4			1				
Chloroperlidae	1	p									6		
Claassenia	1	p							2				
Haploperla	1	p											
Isoperla	2	p									2		
Malenka	2	sh											
Nemouridae	2	sh											
Plecoptera													
Sweltsa	1	p											
Yoraperla	1	sh											
Zapada	2	sh							1		4		
Hemiptera													
Corixidae	8	p											
Trichocorixa	8	p											
Trichoptera													
Agapetus	0	sc				6					1		
Brachycentridae	1												
Farula	0	sc							1				
Glossosomatidae	0	sc					2						
Helicopsyche	3	sc											
Hydropsyche	4	cf				9	43	13		3	10		71
Hydropsychidae	4	cf					2				3		2
Hydroptila	6	ph										2	29
Hydroptilidae	4	ph					12	22					3
Lepidostoma	1	sh				2			5				
Lepidostomatidae	1	sh							1				
Limnephilidae	4	sh						2					
Micrasema	1	mh				1	3		4				
Neophylax	3	sc											
Ochrotrichia	4	ph								4			
Parapsyche	0	p							2				
Philopotamidae	3	cf											
Polycentropus	6	p							2				
Psychoglypha	2	sh											
Psychomyia	2	cg											
Rhyacophila	0	p				3			1		6		
Rhyacophilidae	0	p											
Tinodes	2	sc					1						
Trichoptera						1	1		1				
Wormaldia	3	cf				1							
Coleoptera													
Dytiscidae	5	p											
Elmidae	4	cg						17					
Hydrobius	8	p											
Hydrophilidae	5	p					11						

Table D2 continued part 1. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	801PCW048	801PCW171 1	801PCW171 2	801PLC362	801PLC469 1	801PLC469 2	801SAN068	801SAR165	801SAR334	801SAR351	801SAR528
Hydroporus	5	p							1				
Hydrotrupes	5	p											
Laccophilus	5	p											
Liodessus	5	p											
Optioservus	4	sc					80	66					
Psephenus		sc											
Stictotarsus	5	p											
Diptera													
Aedes	8	cg											
Anopheles	8	cg											
Atylotus/Tabanus	5	p											
Bezzia/Palpomyia	6	p											
Blepharicera	0	sc							2				
Blephariceridae	0	sc							5				
Brachycera						1							
Caloparyphus/Euparyphus	8	cg				2				1			
Caudatella	1	cg									32		
Ceratopogonidae	6	p										1	
Chelifera/Metachela	6	p									1		
Chironomidae	6	cg	443	487	479	34	113	108	47	48	101	59	40
Clinocera	6	p									1		
Cryptolabis	3	sh											
Culicoides													
Dasyhelea	6	cg			2		3						
Dicranota	3	p	1				2		1				
Diptera											1		
Dixa	2	cg											
Dolichopodidae	4	p											
Empididae	6	p											1
Ephydridae	6			1	2								
Euparyphus	8	cg					15	12					
Glutops	3	p											
Hemerodromia	6	p					4	2				1	7
Limnophila	3	sh											
Limnophora	6	p											
Maruina	2	sc											
Muscidae	6	p											
Nemotelus	8	cg											
Neoplasta	6	p				1			1		1		
Pericoma/Telmatoscopus	4	cg											
Probezzia	6	p	1										
Prosimulium	3	cf											
Psychodidae		cg											
Simuliidae	6	cf	1			2		2	4				
Simulium		cf				74	2	9	232	5	105	3	
Stratiomyidae	8	cg					51	13					
Thaumaleidae		sc											
Tipula	4	om											
Tipulidae	3												
Wiedemannia	6	p				1			1				
Non-Insecta Taxa													
Acari	5	p											
Gastropoda													
Oligochaeta	5	cg	46	11	10	3	2	1	11				51
Ostracoda	8	cg	7	1	7	4	1		26	9			
Turbellaria	4	p				1							
Amphipoda													
Amphipoda	4	cg								1			
Hyalella	8	cg											
Basommatophora													
Ferrissia	6	sc								1			17
Menetus	6	sc											1
Physa	8	sc				1	7						
Physidae	8	sc	1										
Canalipalpata													
Manayunkia													2
Decapoda													
Procambarus	8	sh											1
Trombidiformes													
Atractides	8	p											
Aturidae	5	p											
Estelloxus	8	p							1				
Hygrobates	8	p						2	1				
Lebertia	8	p							1		1		
Mideopsis	5	p											
Pionidae													
Protzia	8	p											
Sperchon	8	p				7	6				1		13

Table D2 continued part 2. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	801PCW048	801PCW171 1	801PCW171 2	801PLC362	801PLC469 1	801PLC469 2	801SAN068	801SAR165	801SAR334	801SAR351	801SAR528
Testudacarus	5	p											
Torrenticola	5	p				1	3		1				
Wandesia	5	p											
Veneroida													
Corbicula	8	cf											14
Pisidium	8	cf											
Sphaeriidae	8	cf											
TOTAL			**500**	**500**	**500**	**500**	**500**	**500**	**500**	**83**	**500**	**69**	**500**

Table D3. BMI's collected, adjusted to counts of 500 via Monte Carlo method..

Identified Taxa	Tol Val (TV)	Func Feed Grp	801SDC178	801SDC504	801STC071 1	801STC071 2	801STC142	801STC149	801TMW153	801TMW162	801XXX046	801XXX112
Insecta Taxa												
Ephemeroptera												
Ameletus	0	cg										
Baetidae	4	cg	1					1				
Baetis	5	cg			53	124	78	9	162	2	9	59
Callibaetis	9	cg						5				
Camelobaetidius	4	cg										
Cinygmula	4	sc										
Diphetor	4	cg										
Drunella	0	cg										
Epeorus	0	sc										
Ephemerella	1	cg										
Ephemerellidae	1	cg										
Ephemeroptera								3		2		
Fallceon	4	cg										
Fallceon quilleri	4	cg										
Heptageniidae	4	sc										
Ironodes	3	sc										
Leptohyphidae	4	cg						2				
Leptophlebia	2	cg										
Leptophlebiidae	2	cg										
Paraleptophlebia	4	cg										
Rhithrogena	0	sc										
Serratella	2	cg										
Tricorythodes	4	cg					16		46	4		
Tricorythodes minutus	4	cg										
Odonata												
Anisoptera								1				
Argia	7	p										
Coenagrionidae	9	p					1		5			
Libellulidae	9	p					1	2				
Paltothemis	9	p										
Zygoptera												
Plecoptera												
Calineuria	1	p										
Chloroperlidae	1	p										
Claassenia	1	p										
Haploperla	1	p										
Isoperla	2	p										
Malenka	2	sh										
Nemouridae	2	sh										
Plecoptera												
Sweltsa	1	p										
Yoraperla	1	sh										
Zapada	2	sh										
Hemiptera												
Corixidae	8	p		5	4	6				13		
Trichocorixa	8	p								2		
Trichoptera												
Agapetus	0	sc										
Brachycentridae	1											
Farula	0	sc										
Glossosomatidae	0	sc										
Helicopsyche	3	sc										
Hydropsyche	4	cf			4	2		1				20
Hydropsychidae	4	cf					3					
Hydroptila	6	ph						4				
Hydroptilidae	4	ph			27	3	2	8	156		1	
Lepidostoma	1	sh										
Lepidostomatidae	1	sh										
Limnephilidae	4	sh										
Micrasema	1	mh										
Neophylax	3	sc										
Ochrotrichia	4	ph					2	2				
Parapsyche	0	p										
Philopotamidae	3	cf										
Polycentropus	6	p				1						
Psychoglypha	2	sh										
Psychomyia	2	cg										
Rhyacophila	0	p										
Rhyacophilidae	0	p										
Tinodes	2	sc										4
Trichoptera								4	1	3		
Wormaldia	3	cf										
Coleoptera												
Dytiscidae	5	p					2	3				
Elmidae	4	cg										
Hydrobius	8	p										
Hydrophilidae	5	p						2				

Table D3 continued part 1. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	801SDC178	801SDC504	801STC071 1	801STC071 2	801STC142	801STC149	801TMW153	801TMW162	801XXX046	801XXX112
Hydroporus	5	p										
Hydrotrupes	5	p				3	1					
Laccophilus	5	p			2							
Liodessus	5	p			5	5						
Optioservus	4	sc										
Psephenus		sc										
Stictotarsus	5	p					4					
Diptera												
Aedes	8	cg				1						
Anopheles	8	cg					1					
Atylotus/Tabanus	5	p										
Bezzia/Palpomyia	6	p								1	40	
Blepharicera	0	sc										
Blephariceridae	0	sc										
Brachycera												
Caloparyphus/Euparyphus	8	cg	1	1	2		9	37	2		35	8
Caudatella	1	cg										
Ceratopogonidae	6	p										
Chelifera/Metachela	6	p										
Chironomidae	6	cg	181	46	372	303	125	229	46	227	288	316
Clinocera	6	p										
Cryptolabis	3	sh										
Culicoides												
Dasyhelea	6	cg	5				1	13				
Dicranota	3	p									6	
Diptera												
Dixa	2	cg										
Dolichopodidae	4	p	2			4						
Empididae	6	p										
Ephydridae	6							1			5	
Euparyphus	8	cg		1			8	4		1	3	
Glutops	3	p										
Hemerodromia	6	p										16
Limnophila	3	sh										
Limnophora	6	p								1		
Maruina	2	sc										
Muscidae	6	p	2					8			29	
Nemotelus	8	cg		2								
Neoplasta	6	p										
Pericoma/Telmatoscopus	4	cg	1							3	2	
Probezzia	6	p		6								
Prosimulium	3	cf										
Psychodidae		cg										
Simuliidae	6	cf					1					
Simulium		cf	5		23	27	1	12			8	12
Stratiomyidae	8	cg						1				
Thaumaleidae		sc										
Tipula	4	om			1							
Tipulidae	3		2									
Wiedemannia	6	p										5
Non-Insecta Taxa												
Acari	5	p										
Gastropoda				1								
Oligochaeta	5	cg	296					3		3		
Ostracoda	8	cg	3	407	4	8	28		65	214	14	
Turbellaria	4	p		1						4		
Amphipoda												
Amphipoda	4	cg	1	24					15		1	
Hyalella	8	cg										
Basommatophora												
Ferrissia	6	sc										
Menetus	6	sc										
Physa	8	sc		6	3	1	215		1			
Physidae	8	sc						140				
Canalipalpata												
Manayunkia												
Decapoda												
Procambarus	8	sh										
Trombidiformes												
Atractides	8	p						1			1	
Aturidae	5	p										
Estelloxus	8	p										
Hygrobates	8	p										
Lebertia	8	p										
Mideopsis	5	p										
Pionidae												
Protzia	8	p										
Sperchon	8	p				3	1	4	1	1	1	60

Table D3 continued part 2. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	801SDC178	801SDC504	801STC071 1	801STC071 2	801STC142	801STC149	801TMW153	801TMW162	801XXX046	801XXX112
Testudacarus	5	p										
Torrenticola	5	p										
Wandesia	5	p										
Veneroida												
Corbicula	8	cf								19		
Pisidium	8	cf										
Sphaeriidae	8	cf										
TOTAL			**500**	**500**	**500**	**491**	**500**	**500**	**500**	**500**	**443**	**500**

Table D4. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	801XXX118	801XXX259	801XXX305	802HYC496 1	802HYC496 2	802INC155	802SWC270	802SWC535
Insecta Taxa										
Ephemeroptera										
Ameletus	0	cg								
Baetidae	4	cg				1				
Baetis	5	cg	80	96	9	13	4	5	34	103
Callibaetis	9	cg								
Camelobaetidius	4	cg								
Cinygmula	4	sc								
Diphetor	4	cg								
Drunella	0	cg								
Epeorus	0	sc								1
Ephemerella	1	cg								
Ephemerellidae	1	cg								
Ephemeroptera										
Fallceon	4	cg								
Fallceon quilleri	4	cg				6	5			
Heptageniidae	4	sc								1
Ironodes	3	sc								
Leptohyphidae	4	cg								
Leptophlebia	2	cg								
Leptophlebiidae	2	cg						18		3
Paraleptophlebia	4	cg						2		
Rhithrogena	0	sc								
Serratella	2	cg								
Tricorythodes	4	cg								
Tricorythodes minutus	4	cg					1			
Odonata										
Anisoptera				3						
Argia	7	p								
Coenagrionidae	9	p	1							
Libellulidae	9	p								
Paltothemis	9	p								
Zygoptera										
Plecoptera										
Calineuria	1	p								
Chloroperlidae	1	p								
Claassenia	1	p								
Haploperla	1	p								
Isoperla	2	p								
Malenka	2	sh								
Nemouridae	2	sh								
Plecoptera										
Sweltsa	1	p						4		
Yoraperla	1	sh								
Zapada	2	sh						216		6
Hemiptera										
Corixidae	8	p								
Trichocorixa	8	p								
Trichoptera										
Agapetus	0	sc								
Brachycentridae	1									
Farula	0	sc								
Glossosomatidae	0	sc								
Helicopsyche	3	sc								
Hydropsyche	4	cf	4	2						
Hydropsychidae	4	cf								1
Hydroptila	6	ph					3			
Hydroptilidae	4	ph	2		12	5	1			
Lepidostoma	1	sh						6		
Lepidostomatidae	1	sh								
Limnephilidae	4	sh						5		
Micrasema	1	mh								
Neophylax	3	sc								
Ochrotrichia	4	ph	1			1	1			
Parapsyche	0	p						2		
Philopotamidae	3	cf								
Polycentropus	6	p								
Psychoglypha	2	sh								
Psychomyia	2	cg								
Rhyacophila	0	p								
Rhyacophilidae	0	p								
Tinodes	2	sc								
Trichoptera				1	3		1		1	
Wormaldia	3	cf								
Coleoptera										
Dytiscidae	5	p								
Elmidae	4	cg								
Hydrobius	8	p		9		1	3			
Hydrophilidae	5	p								

Table D4 continued part 1. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	801XXX118	801XXX259	801XXX305	802HYC496 1	802HYC496 2	802INC155	802SWC270	802SWC535
Hydroporus	5	p					2			
Hydrotrupes	5	p								
Laccophilus	5	p		2						
Liodessus	5	p								
Optioservus	4	sc								
Psephenus		sc								
Stictotarsus	5	p		17		20	5		4	
Diptera										
Aedes	8	cg								
Anopheles	8	cg								
Atylotus/Tabanus	5	p								1
Bezzia/Palpomyia	6	p				3	4			1
Blepharicera	0	sc								
Blephariceridae	0	sc								
Brachycera										
Caloparyphus/Euparyphus	8	cg	49	100						
Caudatella	1	cg								
Ceratopogonidae	6	p				1				
Chelifera/Metachela	6	p								
Chironomidae	6	cg	17	105	384	417	424	189	381	73
Clinocera	6	p						7	1	
Cryptolabis	3	sh								
Culicoides										
Dasyhelea	6	cg	4		1	3	16			
Dicranota	3	p	3					3		
Diptera						2	3			
Dixa	2	cg		1				1		
Dolichopodidae	4	p								
Empididae	6	p								
Ephydridae	6									
Euparyphus	8	cg	4	23	1					
Glutops	3	p				2				
Hemerodromia	6	p	1							
Limnophila	3	sh								
Limnophora	6	p								
Maruina	2	sc								
Muscidae	6	p				1	1		6	3
Nemotelus	8	cg								
Neoplasta	6	p								1
Pericoma/Telmatoscopus	4	cg								
Probezzia	6	p								
Prosimulium	3	cf								
Psychodidae		cg	1			1	2			
Simuliidae	6	cf								8
Simulium		cf	332	77		8	3	31	10	272
Stratiomyidae	8	cg		6		1			1	
Thaumaleidae		sc								
Tipula	4	om								
Tipulidae	3									
Wiedemannia	6	p								
Non-Insecta Taxa										
Acari	5	p					1			
Gastropoda										
Oligochaeta	5	cg			4	1	2	1	32	10
Ostracoda	8	cg	1	56	70	11	13	7	15	3
Turbellaria	4	p								
Amphipoda										
Amphipoda	4	cg			8					
Hyalella	8	cg								
Basommatophora										
Ferrissia	6	sc								
Menetus	6	sc								
Physa	8	sc		2	8		4		13	5
Physidae	8	sc								
Canalipalpata										
Manayunkia										
Decapoda										
Procambarus	8	sh								
Trombidiformes										
Atractides	8	p							1	
Aturidae	5	p								
Estelloxus	8	p						1		
Hygrobates	8	p				2				
Lebertia	8	p						1		1
Mideopsis	5	p								
Pionidae										
Protzia	8	p								
Sperchon	8	p					1			5

Table D4 continued part 2. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	801XXX118	801XXX259	801XXX305	802HYC496 1	802HYC496 2	802INC155	802SWC270	802SWC535
Testudacarus	5	p								
Torrenticola	5	p								
Wandesia	5	p								
Veneroida										
Corbicula	8	cf						1	1	
Pisidium	8	cf								1
Sphaeriidae	8	cf								1
TOTAL			**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**

Appendix E: Benthic Macroinvertebrates Collected During the 2008 Survey (Raw Taxa Counts)

Table E1. BMI's collected during the 2008 sampling event

Identified Taxa	Tol Val (TV)	Func Feed Grp	405CTC480	801CYC114	801EBC080 1	801EBC080 2	801EBC126	801FGC022	801HBC050	801MIC074	801MIC272
Insecta Taxa											
Ephemeroptera											
Ameletus	0	cg				1		1			
Baetidae	4	cg			1						
Baetis	5	cg		286	4	6	160	74	2	194	163
Callibaetis	9	cg									
Camelobaetidius	4	cg									
Cinygmula	4	sc						7			
Diphetor	4	cg				6		36			
Drunella	0	cg			1	1	4			1	14
Epeorus	0	sc		2			14	2			5
Ephemerella	1	cg									2
Ephemerellidae	1	cg			2	1		4			2
Ephemeroptera											
Fallceon	4	cg			3						
Fallceon quilleri	4	cg									
Heptageniidae	4	sc						5			1
Ironodes	3	sc			12	2		10	1		
Leptohyphidae	4	cg									
Leptophlebia	2	cg			4						
Leptophlebiidae	2	cg				4					
Paraleptophlebia	4	cg			12						
Rhithrogena	0	sc									
Serratella	2	cg									2
Tricorythodes	4	cg		15							
Tricorythodes minutus	4	cg									
Odonata											
Anisoptera											
Argia	7	p		8							
Coenagrionidae	9	p									
Libellulidae	9	p									
Paltothemis	9	p									
Zygoptera											
Plecoptera											
Calineuria	1	p			3	1					
Chloroperlidae	1	p									
Claassenia	1	p									
Haploperla	1	p									1
Isoperla	2	p									
Malenka	2	sh			2	3		1	150		
Nemouridae	2	sh			33	5	2	17			
Perlidae											
Plecoptera					1			1			
Sweltsa	1	p				1					
Yoraperla	1	sh			68	73					
Zapada	2	sh								1	2
Hemiptera											
Corixidae	8	p									
Trichocorixa	8	p									
Trichoptera											
Agapetus	0	sc									
Brachycentridae	1							1			
Farula	0	sc									
Glossosomatidae	0	sc									
Helicopsyche	3	sc		4							
Hydropsyche	4	cf									
Hydropsyche/Ceratopsyche				95							
Hydropsychidae	4	cf						1			
Hydroptila	6	ph									
Hydroptilidae	4	ph									
Lepidostoma	1	sh			4	6		2			
Lepidostomatidae	1	sh				2					
Limnephilidae	4	sh						2			
Micrasema	1	mh			8	11		4			
Neophylax	3	sc			1		1	1			
Ochrotrichia	4	ph		16							
Parapsyche	0	p				1				3	2
Philopotamidae	3	cf				1					
Polycentropus	6	p								1	
Psychoglypha	2	sh			1						
Psychomyia	2	cg									1
Rhyacophila	0	p			6	6		4	4	2	
Rhyacophilidae	0	p							2		
Tinodes	2	sc		1							
Trichoptera				2	3	1					
Wormaldia	3	cf									

Table E1 continued part 1. BMI's collected during the 2008 sampling event

Identified Taxa	Tol Val (TV)	Func Feed Grp	405CTC480	801CYC114	801EBC080 1	801EBC080 2	801EBC126	801FGC022	801HBC050	801MIC074	801MIC272
Coleoptera											
Dytiscidae	5	p					1				
Elmidae	4	cg									
Hydrobius	8	p									
Hydrophilidae	5	p									
Hydroporus	5	p									
Hydrotrupes	5	p								2	
Laccophilus	5	p									
Liodessus	5	p									
Optioservus	4	sc		17							
Psephenus		sc		3							
Stictotarsus	5	p									
Diptera											
Aedes	8	cg									
Anopheles	8	cg									
Atylotus/Tabanus	5	p									
Bezzia/Palpomyia	6	p			1	2					1
Blepharicera	0	sc									
Blephariceridae	0	sc									
Brachycera											
Caloparyphus/Euparyphus	8	cg									1
Caudatella	1	cg			1	1					7
Ceratopogonidae	6	p				1	1	1			
Chelifera/Metachela	6	p									
Chironomidae	6	cg	137	48	258	230	102	386	355	33	147
Clinocera	6	p					1				
Cryptolabis	3	sh									
Culicoides					1	1					
Dasyhelea	6	cg			1	1		1			
Dicranota	3	p			1	5		2			
Diptera									1		
Dixa	2	cg				3	1				1
Dolichopodidae	4	p									
Empididae	6	p		2				1			
Ephydridae	6		1								
Euparyphus	8	cg		2							
Glutops	3	p			1	2					
Hemerodromia	6	p		8							
Limnophila	3	sh				2		1			
Limnophora	6	p								6	
Maruina	2	sc		1							
Muscidae	6	p					5				1
Nemotelus	8	cg									
Neoplasta	6	p			2						
Pericoma/Telmatoscopus	4	cg									
Probezzia	6	p									
Prosimulium	3	cf			1	3		4			133
Psychodidae		cg									
Simuliidae	6	cf									
Simulium		cf		60	2	4	275	2	41	370	84
Stratiomyidae	8	cg		4							
Thaumaleidae		sc									3
Tipula	4	om									
Tipulidae	3										
Wiedemannia	6	p				2					
Non-Insecta Taxa											
Acari	5	p		26	4						
Gastropoda											
Oligochaeta	5	cg	4		3	14	1	11	11		1
Ostracoda	8	cg	375	6	60	72		1	18		2
Turbellaria	4	p		1	3	4					
Amphipoda											
Amphipoda	4	cg									
Hyalella	8	cg	82								
Basommatophora											
Ferrissia	6	sc									
Menetus	6	sc									
Physa	8	sc	2	2							
Physidae	8	sc									
Canalipalpata											
Manayunkia											
Decapoda											
Procambarus	8	sh									
Trombidiformes											
Atractides	8	p			2						
Aturidae	5	p				1					
Estelloxus	8	p									

Table E1 continued part 2. BMI's collected during the 2008 sampling event

Identified Taxa	Tol Val (TV)	Func Feed Grp	405CTC480	801CYC114	801EBC080 1	801EBC080 2	801EBC126	801FGC022	801HBC050	801MIC074	801MIC272
Hygrobates	8	p									
Lebertia	8	p			13	8		3	6		
Mideopsis	5	p			2	2					
Pionidae					1						
Protzia	8	p			1						
Sperchon	8	p							1		
Testudacarus	5	p			2	1					
Torrenticola	5	p			1	1					
Wandesia	5	p			1						
Veneroida											
Corbicula	8	cf							14		
Pisidium	8	cf			34	74					
Sphaeriidae	8	cf									
TOTAL			601	609	565	566	568	586	606	613	576

Table E2. BMI's collected during the 2008 sampling event

Identified Taxa	Tol Val (TV)	Func Feed Grp	801MLC057	801PCW048	801PCW171 1	801PCW171 2	801PLC362	801PLC469 1	801PLC469 2	801SAN068	801SAR165	801SAR334
Insecta Taxa												
Ephemeroptera												
Ameletus	0	cg	8									
Baetidae	4	cg								2		
Baetis	5	cg	180				387	163	244	161	5	228
Callibaetis	9	cg										
Camelobaetidius	4	cg										
Cinygmula	4	sc										1
Diphetor	4	cg										
Drunella	0	cg	17				5			1		9
Epeorus	0	sc	5				7			5		14
Ephemerella	1	cg										3
Ephemerellidae	1	cg										
Ephemeroptera												
Fallceon	4	cg										
Fallceon quilleri	4	cg										
Heptageniidae	4	sc										1
Ironodes	3	sc										
Leptohyphidae	4	cg										
Leptophlebia	2	cg										
Leptophlebiidae	2	cg								2		1
Paraleptophlebia	4	cg	1							1		
Rhithrogena	0	sc										8
Serratella	2	cg										2
Tricorythodes	4	cg					10	2	10		6	
Tricorythodes minutus	4	cg										
Odonata												
Anisoptera												
Argia	7	p										
Coenagrionidae	9	p										
Libellulidae	9	p										
Paltothemis	9	p						2				
Zygoptera												
Plecoptera												
Calineuria	1	p	13				4			1		
Chloroperlidae	1	p	3									8
Claassenia	1	p								3		
Haploperla	1	p	3									
Isoperla	2	p										5
Malenka	2	sh	1									
Nemouridae	2	sh	1									
Perlidae												
Plecoptera												
Sweltsa	1	p										
Yoraperla	1	sh										
Zapada	2	sh								1		5
Hemiptera												
Corixidae	8	p										
Trichocorixa	8	p										
Trichoptera												
Agapetus	0	sc					8					1
Brachycentridae	1		4									
Farula	0	sc								1		
Glossosomatidae	0	sc						2				
Helicopsyche	3	sc										
Hydropsyche	4	cf	3									
Hydropsyche/Ceratopsyche							11	57	15		3	11
Hydropsychidae	4	cf	1					3				3
Hydroptila	6	ph										
Hydroptilidae	4	ph						13	24			
Lepidostoma	1	sh	1				2			6		
Lepidostomatidae	1	sh								1		
Limnephilidae	4	sh							3			
Micrasema	1	mh	4				1	3		4		
Neophylax	3	sc										
Ochrotrichia	4	ph	1								4	
Parapsyche	0	p								2		
Philopotamidae	3	cf										
Polycentropus	6	p					2			2		
Psychoglypha	2	sh										
Psychomyia	2	cg										
Rhyacophila	0	p	17				3			1		7
Rhyacophilidae	0	p								1		1
Tinodes	2	sc						2				
Trichoptera			1				2	1		1		
Wormaldia	3	cf					1					

Table E2 continued part 1. BMI's collected during the 2008 sampling event

Identified Taxa	Tol Val (TV)	Func Feed Grp	801MLC057	801PCW048	801PCW171 1	801PCW171 2	801PLC362	801PLC469 1	801PLC469 2	801SAN068	801SAR165	801SAR334
Coleoptera												
Dytiscidae	5	p										
Elmidae	4	cg							17			
Hydrobius	8	p										
Hydrophilidae	5	p						11				
Hydroporus	5	p								2		
Hydrotrupes	5	p										
Laccophilus	5	p										
Liodessus	5	p										
Optioservus	4	sc						88	70			
Psephenus		sc										
Stictotarsus	5	p										
Diptera												
Aedes	8	cg										
Anopheles	8	cg										
Atylotus/Tabanus	5	p										
Bezzia/Palpomyia	6	p										
Blepharicera	0	sc	9							2		
Blephariceridae	0	sc								5		
Brachycera							1					
Caloparyphus/Euparyphus	8	cg	1				3				1	
Caudatella	1	cg										42
Ceratopogonidae	6	p										
Chelifera/Metachela	6	p	11									1
Chironomidae	6	cg	115	502	594	579	38	143	115	60	48	119
Clinocera	6	p										2
Cryptolabis	3	sh	15									
Culicoides												
Dasyhelea	6	cg				2		4				
Dicranota	3	p		1				2		2		
Diptera												1
Dixa	2	cg										
Dolichopodidae	4	p										
Empididae	6	p										
Ephydridae	6				1	2						
Euparyphus	8	cg	1					19	14			
Glutops	3	p										
Hemerodromia	6	p						4	3			
Limnophila	3	sh										
Limnophora	6	p					1					
Maruina	2	sc										
Muscidae	6	p										
Nemotelus	8	cg										
Neoplasta	6	p					1			1		1
Pericoma/Telmatoscopus	4	cg										
Probezzia	6	p		1								
Prosimulium	3	cf										
Psychodidae		cg										
Simuliidae	6	cf		1			2		2	4		
Simulium		cf	162				85	2	11	281	5	124
Stratiomyidae	8	cg						61	14			
Thaumaleidae		sc										
Tipula	4	om										
Tipulidae	3		4									
Wiedemannia	6	p	2				1			1		
Non-Insecta Taxa												
Acari	5	p										
Gastropoda												
Oligochaeta	5	cg	3	47	11	10	3	2	1	13		
Ostracoda	8	cg	2	8	1	8	6	1		28	9	
Turbellaria	4	p					1					
Amphipoda												
Amphipoda	4	cg									1	
Hyalella	8	cg										
Basommatophora												
Ferrissia	6	sc									1	
Menetus	6	sc										
Physa	8	sc					1	7				
Physidae	8	sc		1								
Canalipalpata												
Manayunkia												
Decapoda												
Procambarus	8	sh										
Trombidiformes												
Atractides	8	p										
Aturidae	5	p										
Estelloxus	8	p								1		

Table E2 continued part 2. BMI's collected during the 2008 sampling event

Identified Taxa	Tol Val (TV)	Func Feed Grp	801MLC057	801PCW048	801PCW171 1	801PCW171 2	801PLC362	801PLC469 1	801PLC469 2	801SAN068	801SAR165	801SAR334
Hygrobates	8	p							2	1		
Lebertia	8	p	10							1		1
Mideopsis	5	p										
Pionidae												
Protzia	8	p										
Sperchon	8	p					9	7				1
Testudacarus	5	p										
Torrenticola	5	p	1				1	3		1		
Wandesia	5	p										
Veneroida												
Corbicula	8	cf										
Pisidium	8	cf										1
Sphaeriidae	8	cf										
TOTAL			600	561	607	601	596	602	545	599	83	601

Table E3. BMI's collected during the 2008 sampling event

Identified Taxa	Tol Val (TV)	Func Feed Grp	801SAR351	801SAR528	801SDC178	801SDC504	801STC071 1	801STC071 2	801STC142	801STC149	801TMW153
Insecta Taxa											
Ephemeroptera											
Ameletus	0	cg									
Baetidae	4	cg	2		1				2	1	
Baetis	5	cg		139			58	124	105	9	183
Callibaetis	9	cg								5	
Camelobaetidius	4	cg		1							
Cinygmula	4	sc									
Diphetor	4	cg									
Drunella	0	cg									
Epeorus	0	sc									
Ephemerella	1	cg									
Ephemerellidae	1	cg									
Ephemeroptera										3	
Fallceon	4	cg		29							
Fallceon quilleri	4	cg									
Heptageniidae	4	sc									
Ironodes	3	sc									
Leptohyphidae	4	cg	1							2	
Leptophlebia	2	cg									
Leptophlebiidae	2	cg									
Paraleptophlebia	4	cg									
Rhithrogena	0	sc									
Serratella	2	cg									
Tricorythodes	4	cg		121			1		20		54
Tricorythodes minutus	4	cg									
Odonata											
Anisoptera										1	
Argia	7	p									
Coenagrionidae	9	p							1		6
Libellulidae	9	p							1	2	
Paltothemis	9	p									
Zygoptera				2							
Plecoptera											
Calineuria	1	p									
Chloroperlidae	1	p									
Claassenia	1	p									
Haploperla	1	p									
Isoperla	2	p									
Malenka	2	sh									
Nemouridae	2	sh									
Perlidae											
Plecoptera											
Sweltsa	1	p									
Yoraperla	1	sh									
Zapada	2	sh									
Hemiptera											
Corixidae	8	p				5	4	6			
Trichocorixa	8	p									
Trichoptera											
Agapetus	0	sc									
Brachycentridae	1										
Farula	0	sc									
Glossosomatidae	0	sc									
Helicopsyche	3	sc									
Hydropsyche	4	cf		82				2			
Hydropsyche/Ceratopsyche							4		1	2	1
Hydropsychidae	4	cf		3					4		
Hydroptila	6	ph	2	31						4	
Hydroptilidae	4	ph		4			32	3	2	8	183
Lepidostoma	1	sh									
Lepidostomatidae	1	sh									
Limnephilidae	4	sh									
Micrasema	1	mh									
Neophylax	3	sc									
Ochrotrichia	4	ph							4	3	
Parapsyche	0	p									
Philopotamidae	3	cf									
Polycentropus	6	p						1			
Psychoglypha	2	sh									
Psychomyia	2	cg									
Rhyacophila	0	p									
Rhyacophilidae	0	p									
Tinodes	2	sc									
Trichoptera										4	1
Wormaldia	3	cf									

Table E3 continued part 1. BMI's collected during the 2008 sampling event

Identified Taxa	Tol Val (TV)	Func Feed Grp	801SAR351	801SAR528	801SDC178	801SDC504	801STC071 1	801STC071 2	801STC142	801STC149	801TMW153
Coleoptera											
Dytiscidae	5	p							2	3	
Elmidae	4	cg									
Hydrobius	8	p									
Hydrophilidae	5	p								2	
Hydroporus	5	p									
Hydrotrupes	5	p						3	1		
Laccophilus	5	p					2				
Liodessus	5	p					5	5			
Optioservus	4	sc									
Psephenus		sc									
Stictotarsus	5	p							4		
Diptera											
Aedes	8	cg						1			
Anopheles	8	cg							1		
Atylotus/Tabanus	5	p									
Bezzia/Palpomyia	6	p									
Blepharicera	0	sc									
Blephariceridae	0	sc									
Brachycera											
Caloparyphus/Euparyphus	8	cg			1	1	2		11	39	2
Caudatella	1	cg									
Ceratopogonidae	6	p	1								
Chelifera/Metachela	6	p									
Chironomidae	6	cg	59	49	216	62	447	303	168	236	57
Clinocera	6	p									
Cryptolabis	3	sh									
Culicoides											
Dasyhelea	6	cg			5				1	16	
Dicranota	3	p			1						
Diptera											
Dixa	2	cg									
Dolichopodidae	4	p			3	2		4			
Empididae	6	p		1							
Ephydridae	6									1	
Euparyphus	8	cg				1			11	5	
Glutops	3	p									
Hemerodromia	6	p	1	10							
Limnophila	3	sh									
Limnophora	6	p					1				
Maruina	2	sc									
Muscidae	6	p		1	2					8	
Nemotelus	8	cg				3					
Neoplasta	6	p									
Pericoma/Telmatoscopus	4	cg			1	1					
Probezzia	6	p				6					
Prosimulium	3	cf									
Psychodidae		cg									
Simuliidae	6	cf							2		
Simulium		cf	3		5		27	27	1	13	
Stratiomyidae	8	cg								1	
Thaumaleidae		sc									
Tipula	4	om					2				
Tipulidae	3				2						
Wiedemannia	6	p									
Non-Insecta Taxa											
Acari	5	p									
Gastropoda						1					
Oligochaeta	5	cg		54	354					3	
Ostracoda	8	cg			5	486	4	8	35		79
Turbellaria	4	p				1					
Amphipoda											
Amphipoda	4	cg			1	29					17
Hyalella	8	cg									
Basommatophora											
Ferrissia	6	sc		22							
Menetus	6	sc		1							
Physa	8	sc				6	3	1	271		1
Physidae	8	sc								146	
Canalipalpata											
Manayunkia				3							
Decapoda											
Procambarus	8	sh		1							
Trombidiformes											
Atractides	8	p								1	
Aturidae	5	p									
Estelloxus	8	p									

Table E3 continued part 2. BMI's collected during the 2008 sampling event

Identified Taxa	Tol Val (TV)	Func Feed Grp	801SAR351	801SAR528	801SDC178	801SDC504	801STC071 1	801STC071 2	801STC142	801STC149	801TMW153
Hygrobates	8	p									
Lebertia	8	p									
Mideopsis	5	p									
Pionidae											
Protzia	8	p									
Sperchon	8	p		16				3	4	4	1
Testudacarus	5	p									
Torrenticola	5	p									
Wandesia	5	p									
Veneroida											
Corbicula	8	cf		19							1
Pisidium	8	cf									
Sphaeriidae	8	cf									
TOTAL			69	589	597	604	592	491	652	522	586

Table E4. BMI's collected during the 2008 sampling event

Identified Taxa	Tol Val (TV)	Func Feed Grp	801TMW162	801XXX046	801XXX112	801XXX118	801XXX259	801XXX305	802HYC4961	802HYC4962	802INC155
Insecta Taxa											
Ephemeroptera											
Ameletus	0	cg									
Baetidae	4	cg							1		
Baetis	5	cg	2	9	68	89	113	10	16	6	12
Callibaetis	9	cg									
Camelobaetidius	4	cg									
Cinygmula	4	sc									
Diphetor	4	cg									
Drunella	0	cg									
Epeorus	0	sc									
Ephemerella	1	cg									
Ephemerellidae	1	cg									
Ephemeroptera			2								
Fallceon	4	cg									
Fallceon quilleri	4	cg							6	6	
Heptageniidae	4	sc									
Ironodes	3	sc									
Leptohyphidae	4	cg									
Leptophlebia	2	cg									
Leptophlebiidae	2	cg									24
Paraleptophlebia	4	cg									3
Rhithrogena	0	sc									
Serratella	2	cg									
Tricorythodes	4	cg	4								
Tricorythodes minutus	4	cg								1	
Odonata											
Anisoptera							3				
Argia	7	p									
Coenagrionidae	9	p				1					
Libellulidae	9	p									
Paltothemis	9	p									
Zygoptera											
Plecoptera											
Calineuria	1	p									
Chloroperlidae	1	p									
Claassenia	1	p									
Haploperla	1	p									
Isoperla	2	p									
Malenka	2	sh									
Nemouridae	2	sh									
Perlidae											
Plecoptera											
Sweltsa	1	p									5
Yoraperla	1	sh									
Zapada	2	sh									258
Hemiptera											
Corixidae	8	p	13								
Trichocorixa	8	p	2								
Trichoptera											
Agapetus	0	sc									
Brachycentridae	1										
Farula	0	sc									
Glossosomatidae	0	sc									
Helicopsyche	3	sc									
Hydropsyche	4	cf									
Hydropsyche/Ceratopsyche					23	4	2				
Hydropsychidae	4	cf									
Hydroptila	6	ph								3	
Hydroptilidae	4	ph		1		2		16	7	2	1
Lepidostoma	1	sh									7
Lepidostomatidae	1	sh									
Limnephilidae	4	sh									5
Micrasema	1	mh									
Neophylax	3	sc									
Ochrotrichia	4	ph				1			1	1	
Parapsyche	0	p									2
Philopotamidae	3	cf									
Polycentropus	6	p									
Psychoglypha	2	sh									
Psychomyia	2	cg									
Rhyacophila	0	p									
Rhyacophilidae	0	p									
Tinodes	2	sc			4						
Trichoptera			3				1	3		1	
Wormaldia	3	cf									

Table E4 continued part 1. BMI's collected during the 2008 sampling event

Identified Taxa	Tol Val (TV)	Func Feed Grp	801TMW162	801XXX046	801XXX112	801XXX118	801XXX259	801XXX305	802HYC4961	802HYC4962	802INC155
Coleoptera											
Dytiscidae	5	p									
Elmidae	4	cg									
Hydrobius	8	p					11		1	4	
Hydrophilidae	5	p									
Hydroporus	5	p								2	
Hydrotrupes	5	p									
Laccophilus	5	p					2				
Liodessus	5	p									
Optioservus	4	sc									
Psephenus		sc									
Stictotarsus	5	p					19		23	9	
Diptera											
Aedes	8	cg									
Anopheles	8	cg									
Atylotus/Tabanus	5	p									
Bezzia/Palpomyia	6	p	1	40					4	6	
Blepharicera	0	sc									
Blephariceridae	0	sc									
Brachycera											
Caloparyphus/Euparyphus	8	cg		35	8	62	113				
Caudatella	1	cg									
Ceratopogonidae	6	p							1		
Chelifera/Metachela	6	p									
Chironomidae	6	cg	258	288	375	19	121	455	505	492	222
Clinocera	6	p									7
Cryptolabis	3	sh									
Culicoides											
Dasyhelea	6	cg				4		1	3	18	
Dicranota	3	p		6		3					3
Diptera									2	3	
Dixa	2	cg				1	1				1
Dolichopodidae	4	p									
Empididae	6	p									
Ephydridae	6			5							
Euparyphus	8	cg	1	3		8	24	1			
Glutops	3	p							2		
Hemerodromia	6	p			17	2					
Limnophila	3	sh									
Limnophora	6	p	1								
Maruina	2	sc									
Muscidae	6	p		29					1	1	1
Nemotelus	8	cg									
Neoplasta	6	p									
Pericoma/Telmatoscopus	4	cg	3	2							
Probezzia	6	p									
Prosimulium	3	cf									
Psychodidae		cg				1			1	2	
Simuliidae	6	cf									
Simulium		cf		8	16	402	87		9	3	35
Stratiomyidae	8	cg					6		1		
Thaumaleidae		sc									
Tipula	4	om									
Tipulidae	3										
Wiedemannia	6	p			7						
Non-Insecta Taxa											
Acari	5	p								1	
Gastropoda											
Oligochaeta	5	cg	3					4	1	2	1
Ostracoda	8	cg	249	14		2	70	80	12	17	7
Turbellaria	4	p	5								
Amphipoda											
Amphipoda	4	cg		1				9			
Hyalella	8	cg									
Basommatophora											
Ferrissia	6	sc									
Menetus	6	sc									
Physa	8	sc					2	9		4	
Physidae	8	sc									
Canalipalpata											
Manayunkia											
Decapoda											
Procambarus	8	sh									
Trombidiformes											
Atractides	8	p		1							
Aturidae	5	p									
Estelloxus	8	p									1

Table E4 continued part 2. BMI's collected during the 2008 sampling event

Identified Taxa	Tol Val (TV)	Func Feed Grp	801TMW162	801XXX046	801XXX112	801XXX118	801XXX259	801XXX305	802HYC4961	802HYC4962	802INC155
Hygrobates	8	p							2		
Lebertia	8	p									1
Mideopsis	5	p									
Pionidae											
Protzia	8	p									
Sperchon	8	p	1	1	73					1	
Testudacarus	5	p									
Torrenticola	5	p							1		
Wandesia	5	p									
Veneroida											
Corbicula	8	cf	29								2
Pisidium	8	cf									
Sphaeriidae	8	cf									
TOTAL			577	443	591	601	575	588	600	585	598

Table E5. BMI's collected during the 2008 sampling event

Identified Taxa	Tol Val (TV)	Func Feed Grp	802SWC270	802SWC535
Insecta Taxa				
Ephemeroptera				
Ameletus	0	cg		
Baetidae	4	cg		
Baetis	5	cg	34	131
Callibaetis	9	cg		
Camelobaetidius	4	cg		
Cinygmula	4	sc		
Diphetor	4	cg		
Drunella	0	cg		
Epeorus	0	sc		2
Ephemerella	1	cg		
Ephemerellidae	1	cg		
Ephemeroptera				
Fallceon	4	cg		
Fallceon quilleri	4	cg		
Heptageniidae	4	sc		2
Ironodes	3	sc		
Leptohyphidae	4	cg		
Leptophlebia	2	cg		
Leptophlebiidae	2	cg		4
Paraleptophlebia	4	cg		
Rhithrogena	0	sc		
Serratella	2	cg		
Tricorythodes	4	cg		
Tricorythodes minutus	4	cg		
Odonata				
Anisoptera				
Argia	7	p		
Coenagrionidae	9	p		
Libellulidae	9	p		
Paltothemis	9	p		
Zygoptera				
Plecoptera				
Calineuria	1	p		
Chloroperlidae	1	p		
Claassenia	1	p		
Haploperla	1	p		
Isoperla	2	p		
Malenka	2	sh		
Nemouridae	2	sh		
Perlidae				1
Plecoptera				
Sweltsa	1	p		
Yoraperla	1	sh		
Zapada	2	sh		7
Hemiptera				
Corixidae	8	p		
Trichocorixa	8	p		
Trichoptera				
Agapetus	0	sc		
Brachycentridae	1			
Farula	0	sc		
Glossosomatidae	0	sc		
Helicopsyche	3	sc		
Hydropsyche	4	cf		1
Hydropsyche/Ceratopsyche				
Hydropsychidae	4	cf		1
Hydroptila	6	ph		
Hydroptilidae	4	ph		
Lepidostoma	1	sh		
Lepidostomatidae	1	sh		
Limnephilidae	4	sh		
Micrasema	1	mh		
Neophylax	3	sc		
Ochrotrichia	4	ph		
Parapsyche	0	p		
Philopotamidae	3	cf		
Polycentropus	6	p		
Psychoglypha	2	sh		
Psychomyia	2	cg		
Rhyacophila	0	p		
Rhyacophilidae	0	p		
Tinodes	2	sc		
Trichoptera			1	
Wormaldia	3	cf		

Table E5 continued part 1. BMI's collected during the 2008 sampling event

Identified Taxa	Tol Val (TV)	Func Feed Grp	802SWC270	802SWC535
Coleoptera				
Dytiscidae	5	p		
Elmidae	4	cg		
Hydrobius	8	p		
Hydrophilidae	5	p		
Hydroporus	5	p		
Hydrotrupes	5	p		
Laccophilus	5	p		
Liodessus	5	p		
Optioservus	4	sc		
Psephenus		sc		
Stictotarsus	5	p	4	
Diptera				
Aedes	8	cg		
Anopheles	8	cg		
Atylotus/Tabanus	5	p		1
Bezzia/Palpomyia	6	p		1
Blepharicera	0	sc		
Blephariceridae	0	sc		
Brachycera				
Caloparyphus/Euparyphus	8	cg		
Caudatella	1	cg		
Ceratopogonidae	6	p		
Chelifera/Metachela	6	p		
Chironomidae	6	cg	381	93
Clinocera	6	p	1	
Cryptolabis	3	sh		
Culicoides				
Dasyhelea	6	cg		
Dicranota	3	p		
Diptera				
Dixa	2	cg		
Dolichopodidae	4	p		
Empididae	6	p		
Ephydridae	6			
Euparyphus	8	cg		
Glutops	3	p		
Hemerodromia	6	p		
Limnophila	3	sh		
Limnophora	6	p		
Maruina	2	sc		
Muscidae	6	p	6	5
Nemotelus	8	cg		
Neoplasta	6	p		1
Pericoma/Telmatoscopus	4	cg		
Probezzia	6	p		
Prosimulium	3	cf		
Psychodidae		cg		
Simuliidae	6	cf		12
Simulium		cf	10	326
Stratiomyidae	8	cg	1	
Thaumaleidae		sc		
Tipula	4	om		
Tipulidae	3			
Wiedemannia	6	p		
Non-Insecta Taxa				
Acari	5	p		
Gastropoda				
Oligochaeta	5	cg	32	11
Ostracoda	8	cg	15	4
Turbellaria	4	p		
Amphipoda				
Amphipoda	4	cg		
Hyalella	8	cg		
Basommatophora				
Ferrissia	6	sc		
Menetus	6	sc		
Physa	8	sc	13	7
Physidae	8	sc		
Canalipalpata				
Manayunkia				
Decapoda				
Procambarus	8	sh		
Trombidiformes				
Atractides	8	p	1	1
Aturidae	5	p		
Estelloxus	8	p		

Table E5 continued part 2. BMI's collected during the 2008 sampling event

Identified Taxa	Tol Val (TV)	Func Feed Grp	802SWC270	802SWC535
Hygrobates	8	p		
Lebertia	8	p		1
Mideopsis	5	p		
Pionidae				
Protzia	8	p		
Sperchon	8	p		6
Testudacarus	5	p		
Torrenticola	5	p		
Wandesia	5	p		
Veneroida				
Corbicula	8	cf	1	
Pisidium	8	cf		1
Sphaeriidae	8	cf		2
TOTAL			500	621

Appendix F: Chironomidae SAFIT Standard Taxonomic Effort Level II Identifications

Table F1. Chironomidae SAFIT Level II Identifications.

Identified Taxa	405CTC480	801CYC114	801EBC080 1	801EBC080 2	801EBC126	801FGC022	801HBC050	801MIC074	801MIC272	801MLC057
Insecta Taxa										
Diptera										
Chironomidae	137	4	218	18		364	113	1	15	39
Ablabesmyia										
Apedilum										
Boreochlus										
Brillia			6	7	23	2	12	5		18
Cardiocladius									1	
Chironomus										
Corynoneura				7	1		6			1
Cricotopus						2	1			1
Cricotopus Bicinctus Gr.		1								
Cricotopus Nostococladius				8		1				
Cricotopus Trifascia Gr.		2								
Cryptochironomus										
Diamesa					1				2	
Dicrotendipes		2					2	1		
Eukiefferiella		4	2	19	7		21	16	67	7
Krenosmittia										2
Labrundinea										
Macropelopia			1							
Micropsectra			2	2	18	2	55		4	8
Microtendipes										
Microtendipes Rydalensis Gr.			1	1						
Nilotanypus										
Odontomesa							3			
Orthocladius Complex					17		3		16	8
Orthocladius Symposiocladius			1							
Pagastia			5	5	2		8	9	12	8
Paracladopelma										
Parametriocnemus			1	11				1		2
Paraphaenocladius			5							
Paratendipes				13			15			
Parorthocladius					2					
Pentaneura										
Polypedilum		2					5			
Procladius										
Prodiamesa				5			6			
Psectrocladius										
Pseudochironomus		11								
Pseudodiamesa					9	3	1			
Pseudosmittia										
Rheocricotopus			3							
Rheotanytarsus		16		9		2			1	
Saetheria										
Synorthocladius										1
Tanypodinae - early instar										
Tanytarsus										
Tanytarsus limneticus										
Thienemanniella		1		2	1		3			
Thienemannimyia Gr.		5	1							2
Tribelos										
Tvetenia Bavarica Gr.			3	33	8	1	11		29	18
TOTAL	**137**	**48**	**249**	**140**	**89**	**377**	**265**	**33**	**147**	**115**

Table F2. Chironomidae SAFIT Level II Identifications.

Identified Taxa	801PCW048	801PCW171 1	801PCW171 2	801PLC362	801PLC469 1	801PLC469 2	801SAN068	801SAR165	801SAR334	801SAR351	801SAR528
Insecta Taxa											
Diptera											
Chironomidae	27	26	4	2	34		5	2	17		13
Ablabesmyia						2					
Apedilum						24					
Boreochlus							1				
Brillia				3			27		8		
Cardiocladius				1							
Chironomus						1		1			
Corynoneura						1			3		
Cricotopus	431	23	237	3	12	7		2			1
Cricotopus Bicinctus Gr.											2
Cricotopus Nostococladius									3		
Cricotopus Trifascia Gr.					4						
Cryptochironomus					1						8
Diamesa											
Dicrotendipes	24	354	316		18	4					2
Eukiefferiella				13	13		3		19		4
Krenosmittia											
Labrundinea						3					
Macropelopia											
Micropsectra						1	8		1		
Microtendipes						1					
Microtendipes Rydalensis Gr.											
Nilotanypus											
Odontomesa									1		
Orthocladius Complex	2			1		3			12		
Orthocladius Symposiocladius											
Pagastia							1		12		
Paracladopelma						2					
Parametriocnemus				3		4	2		1		
Paraphaenocladius											
Paratendipes									2		
Parorthocladius									2		
Pentaneura				1		5		4			
Polypedilum					4						11
Procladius											
Prodiamesa											
Psectrocladius						55					
Pseudochironomus					12	12		1			
Pseudodiamesa									6		
Pseudosmittia											
Rheocricotopus					2						1
Rheotanytarsus				2	14	1	2	25	5		7
Saetheria								12		6	
Synorthocladius											
Tanypodinae - early instar						1					
Tanytarsus		11	22	3	1	3					
Tanytarsus limneticus											
Thienemanniella				1					1		
Thienemannimyia Gr.				4	28	4		1			
Tribelos				1		4					
Tvetenia Bavarica Gr.									26		
TOTAL	**484**	**414**	**579**	**38**	**143**	**138**	**49**	**48**	**119**	**6**	**49**

Table F3. Chironomidae SAFIT Level II Identifications.

Identified Taxa	801SDC178	801SDC504	801STC071 1	801STC071 2	801STC142	801STC149	801TMW153	801TMW162	801XXX046	801XXX112
Insecta Taxa										
Diptera										
Chironomidae	13			36	14	85	1	11	249	35
Ablabesmyia										
Apedilum			2	2		1			4	
Boreochlus										
Brillia									2	
Cardiocladius										38
Chironomus		42	24	1		2		28	2	
Corynoneura								1		
Cricotopus	67	12	41	53		1		2	5	55
Cricotopus Bicinctus Gr.	5			2					1	
Cricotopus Nostococladius										
Cricotopus Trifascia Gr.										
Cryptochironomus	1		7							
Diamesa										
Dicrotendipes	14	5	345	151		66		1		
Eukiefferiella				3	4	6			3	21
Krenosmittia										
Labrundinea										
Macropelopia										
Micropsectra					5				11	
Microtendipes										
Microtendipes Rydalensis Gr.										
Nilotanypus										
Odontomesa										
Orthocladius Complex	3			15					3	5
Orthocladius Symposiocladius										
Pagastia										
Paracladopelma						2			4	
Parametriocnemus					8	2		15	1	
Paraphaenocladius										
Paratendipes										
Parorthocladius										
Pentaneura					5	1	8	3		
Polypedilum							24	16	1	1
Procladius					1		1			
Prodiamesa										
Psectrocladius										
Pseudochironomus	11	2	1	14	4	23				
Pseudodiamesa										
Pseudosmittia										
Rheocricotopus						14	14	18		
Rheotanytarsus			1	1	34			2		19
Saetheria										
Synorthocladius										
Tanypodinae - early instar									1	
Tanytarsus	3	1	27	16		16	2	118	1	
Tanytarsus limneticus			1							
Thienemanniella										
Thienemannimyia Gr.					3	13				12
Tribelos						4	7	43		
Tvetenia Bavarica Gr.										
TOTAL	**117**	**62**	**449**	**294**	**78**	**236**	**57**	**258**	**288**	**186**

Table F4. Chironomidae SAFIT Level II Identifications.

Identified Taxa	801XXX118	801XXX259	801XXX305	802HYC496 1	802HYC496 2	802INC155	802SWC270	802SWC535
Insecta Taxa								
Diptera								
Chironomidae	1	111	92	173	345		65	
Ablabesmyia				2	2		1	
Apedilum	1			43	24		27	1
Boreochlus								
Brillia				1		35		11
Cardiocladius								1
Chironomus			13		1	17		
Corynoneura				5	1	8	5	15
Cricotopus	3		113	36	7			
Cricotopus Bicinctus Gr.			1					
Cricotopus Nostococladius								
Cricotopus Trifascia Gr.								2
Cryptochironomus			6					
Diamesa								
Dicrotendipes		2	165	27	4			
Eukiefferiella	4							7
Krenosmittia								
Labrundinea					3			
Macropelopia								
Micropsectra					1	17	5	3
Microtendipes				7	1		24	
Microtendipes Rydalensis Gr.								4
Nilotanypus	1							
Odontomesa								
Orthocladius Complex				3	3			
Orthocladius Symposiocladius				1				
Pagastia								
Paracladopelma					2		9	
Parametriocnemus	2			9	4	57		5
Paraphaenocladius								
Paratendipes						14		
Parorthocladius								
Pentaneura		2	1	3	5		27	4
Polypedilum						1	2	1
Procladius								
Prodiamesa						14		6
Psectrocladius				74	55		7	
Pseudochironomus	1		11	11	12			
Pseudodiamesa								
Pseudosmittia	1							
Rheocricotopus								2
Rheotanytarsus	2		15	37	1		2	8
Saetheria								
Synorthocladius								2
Tanypodinae - early instar					1		2	1
Tanytarsus			28	5	3	22	1	
Tanytarsus limneticus								
Thienemanniella				2				1
Thienemannimyia Gr.	2	6	1	18	4	9	23	7
Tribelos				3	4	1	18	14
Tvetenia Bavarica Gr.	1					27	1	1
TOTAL	**19**	**121**	**446**	**460**	**483**	**222**	**219**	**96**