

Draft Benthic Macroinvertebrate Sampling Program:  
El Dorado Irrigation District, Hydroelectric Project 184  
(El Dorado County, California)

June 4, 2002

*Prepared by:*



El Dorado Irrigation District  
2890 Mosquito Road  
Placerville, California 95667



**ECORP Consulting, Inc.**  
ENVIRONMENTAL CONSULTANTS

June 4, 2002

Scott Shewbridge  
El Dorado Irrigation District  
2890 Mosquito Rd.  
Placerville, Ca 95667

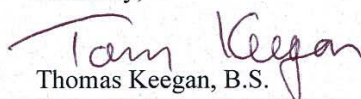
***Re: FERC Project 184, Benthic Macroinvertebrate Sampling Program***

As part of the relicensing of the El Dorado Hydroelectric Project, FERC 184-065 (Project 184), the El Dorado Irrigation District (EID) has contracted with ECORP Consulting, Inc. (ECORP) to conduct a third year of Benthic Macroinvertebrate sampling in 2001, process all samples collected in 2000 and 2001, and analyze the entire three year dataset. This study addresses Section 3.0 of the Scope of Work dated September 24, 2001, and amended on October 19, 2001. The current document is an interim product, presenting only the 1999 and 2001 draft dataset. Sample processing and metric calculation for the year 2000 samples is nearly complete. The Final Report will include a full analysis of all three years of data (1999, 2000, and 2001). Please find enclosed the Draft Benthic Macroinvertebrate Sampling Program, El Dorado Irrigation District, Hydroelectric Project 184. The file names are as follows:

- P184\_BMI\_20020604.doc
- P184\_BMI\_20020604.pdf
- P184\_BMI\_Tbl2\_20020603.xls
- P184\_BMI\_Tbl2\_20020603.pdf
- BMI\_Tbls3-8\_20020604.xls
- P184\_BMI\_Tbl3\_20020604.pdf
- P184\_BMI\_Tbl4\_20020604.pdf
- P184\_BMI\_Tbl5\_20020604.pdf
- P184\_BMI\_Tbl6\_20020604.pdf
- P184\_BMI\_Tbl7\_20020604.pdf
- P184\_BMI\_Tbl8\_20020604.pdf
- BMI\_T9,11,13\_20020603.xls
- BMI\_T9,11,13\_20020603.pdf
- BMI\_T10,12,14\_20020603.xls
- BMI\_T10,12,14\_20020603.pdf

Larry Travanti was the senior author of this document, assisted by Mark Beccio, Chris Sheehy, and me. If you have any questions, please call me at (916) 782-9100.

Sincerely,

  
Thomas Keegan, B.S.  
Senior Fisheries Scientist

CC: Richard Floch / Richard Floch and Associates

Attachment



## CONTENTS

## EID-FERC PROJECT 184

### BENTHIC MACRONINVERTEBRATE PROGRAM: RESULTS FROM INITIAL SAMPLE COLLECTION, 2001

1.0 Introduction.....	1
2.0 Methods.....	2
2.1 Study Sites .....	2
2.2 Data Collection .....	3
2.3 Data Analysis .....	4
3.0 Results.....	7
3.1 Study Sites .....	7
3.2 Species Composition and Metrics.....	17
4.0 Discussion.....	30
5.0 Summary.....	30

## TABLES

- Table 1 – Biological metrics used to describe macroinvertebrate (BMI) samples collected following the California Stream Bioassessment Procedure (CSBP).
- Table 2 – Benthic Macroinvertebrate Sampling Stations for the South Fork American River FERC Project 184, El Dorado Irrigation District
- Table 3 – Physical Habitat Quality Data for Benthic Macroinvertebrate Sties on South Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999.
- Table 4 – Physical Habitat Quality Data for Benthic Macroinvertebrate Sties on South Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 2001.
- Table 5 – Physical Habitat Quality Data for Benthic Macroinvertebrate Sties on Silver Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999.
- Table 6 – Physical Habitat Quality Data for Benthic Macroinvertebrate Sties on Silver Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 2001.
- Table 7 – Physical Habitat Quality Data for Benthic Macroinvertebrate Sties on South Fork American River Tributaries, El Dorado Irrigation District, FERC Project 184, Fall 1999.
- Table 8 – Physical Habitat Quality Data for Benthic Macroinvertebrate Sties on South Fork American River Tributaries, El Dorado Irrigation District, FERC Project 184, Fall 2001.

- Table 9 – CSBP Metrics Summary for Benthic Macroinvertebrate Sites on South Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999.
- Table 10 – CSBP Metrics Summary for Benthic Macroinvertebrate Sites on South Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 2001.
- Table 11 – CSBP Metrics Summary for Benthic Macroinvertebrate Sites on Silver Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999.
- Table 12 – CSBP Metrics Summary for Benthic Macroinvertebrate Sites on Silver Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 2001.
- Table 13 – CSBP Metrics Summary for Benthic Macroinvertebrate Sites on Diverted Tributary Section, El Dorado Irrigation District, FERC Project 184, Fall 1999.
- Table 14 – CSBP Metrics Summary for Benthic Macroinvertebrate Sites on Diverted Tributary Section, El Dorado Irrigation District, FERC Project 184, Fall 2001.

## FIGURES

- Figure 1 – Project 184 – BMI Survey Site Locations
- Figure 2 – Taxonomic Richness for Benthic Macroinvertebrate Sites on South Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 3 – Shannon – Weiner Diversity Index for Benthic Macroinvertebrate Sites on South Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 4 – EPT and Sensitive EPT Indices for Benthic Macroinvertebrate Sites on South Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 5 – Functional Feeding Group Indices for Benthic Macroinvertebrate Sites on South Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 6 – Tolerance Value Index for Benthic Macroinvertebrate Sites on South Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 7 – Tolerance Indices for Benthic Macroinvertebrate Sites on South Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 8 – Taxonomic Richness for Benthic Macroinvertebrate Sites on Silver Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 9 – Shannon – Weiner Diversity Index for Benthic Macroinvertebrate Sites on Silver Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 10 – EPT and Sensitive EPT Indices for Benthic Macroinvertebrate Sites on Silver Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.

- Figure 11 – Functional Feeding Group Indices for Benthic Macroinvertebrate Sites on Silver Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 12 – Tolerance Value Index for Benthic Macroinvertebrate Sites on Silver Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 13 – Tolerance Indices for Benthic Macroinvertebrate Sites on Silver Fork American River Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 14 – Taxonomic Richness for Benthic Macroinvertebrate Sites on Diverted Tributaries Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 15 – Shannon – Weiner Diversity Index for Benthic Macroinvertebrate Sites on Diverted Tributaries Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 16 – EPT and Sensitive EPT Indices for Benthic Macroinvertebrate Sites on Diverted Tributaries Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 17 – Functional Feeding Group Indices for Benthic Macroinvertebrate Sites on Diverted Tributaries Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 18 – Tolerance Value Index for Benthic Macroinvertebrate Sites on Diverted Tributaries Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.
- Figure 19 – Tolerance Indices for Benthic Macroinvertebrate Sites on Diverted Tributaries Section, El Dorado Irrigation District, FERC Project 184, Fall 1999 – 2001.

## APPENDICES

### Appendx A –

## **1.0 INTRODUCTION**

The El Dorado Hydroelectric Project, FERC 184-065 (Project 184) is a 21-megawatt (MW) project located on the South Fork American River (SFAR) in the counties of El Dorado, Alpine, and Amador, California. Project 184 components are set in both private lands and land administered by the El Dorado National Forest. Project 184 consists of four storage reservoirs, the El Dorado Diversion Dam, water conveyance facilities consisting of flumes and tunnels, several smaller diversions on tributaries to the SFAR, a forebay, penstock, and a powerhouse.

Water is released from the four storage reservoirs (Lake Aloha, Echo Lake, Silver Lake and Caples Lake) at seasonally varying volumes. At full project load, up to 165 cubic feet per second (cfs) of SFAR streamflow is diverted at the El Dorado Diversion Dam, located near the community of Kyburz, at an elevation of 3,911 feet above sea level. Water is diverted into a 22.3 mile-long water conveyance system, the El Dorado Canal, which terminates at the forebay. The canal descends more gradually than does the SFAR, with an elevation drop of approximately 110 feet, compared to approximately 2,000 feet in the SFAR. Seven smaller tributaries are diverted directly into the canal between the El Dorado Diversion Dam and the forebay, including: Carpenter Creek, No-Name Creek, Alder Creek, Mill Creek, Bull Creek, Ogilby Creek, and Esmeralda Creek.

Due to a major January 1997 storm, Project 184 suffered significant damage to the diversion dam, certain sections of the canal, and the powerhouse. Since then, Project 184 has remained inoperable for power generation; however, a temporary repair of the canal has allowed the diversion of approximately 40 cfs to the forebay for subsequent diversion into the EID water supply system for consumptive use.

The El Dorado Irrigation District (EID) has contracted with ECORP Consulting, Inc. (ECORP) to conduct aquatic-oriented environmental studies in support of its application to the Federal Energy Regulatory Commission (FERC) for relicensing of Project 184. ECORP has been assigned the following study elements:

- General Fisheries Assessments
- Benthic Macroinvertebrate Surveys
- Amphibian and aquatic reptile surveys
- Water temperature modeling
- Stream geomorphology studies
- IFIM/Habitat Time Series
- Water Quality Assessments
- Bathymetry of Lake Aloha and other project reservoirs.

This draft document presents an analysis of data collected under the *Benthic Macroinvertebrate Surveys* element. Preliminary results of the benthic macroinvertebrate studies in project stream reaches are presented herein, including data collected from 30 benthic macroinvertebrate survey sites sampled in 1999 and 2001. Samples collected in 2000 are currently being processed. Data from Year 2000 samples will be integrated and analyzed with the 1999 and 2001 dataset and will be presented in the final report.

## **2.0 METHODS**

### **2.1 Study Sites**

Thirty sampling sites were selected for collection of benthic macroinvertebrate samples from 1999 through 2001 (Figure 1). The sites have been grouped into three sections for site results and data presentation. Section one sites are South Fork American River (SFAR) sites, including Strawberry Creek, Pyramid Creek and Echo Creek sites. Section two sites are Silver Fork American River (SUFAR) sites, including Sherman Canyon Creek, Caples Creek, Oyster Creek and Woods Creek. Section three sites are the small diverted tributaries that are located downstream of the SFAR Diversion Dam and that are at least partially diverted into the El Dorado Canal.



## 2.2 Data Collection

Samples were collected between October 18 and November 4 in 1999, and between September 26 and October 12 in 2000, by Cressy and Associates. In 2001, samples were collected between October 17 and November 14 by ECORP. During all three years, sampling was conducted following California Stream Bioassessment Program (CSBP) protocols for non-point source pollution ([www.dfg.ca.gov/cabw/cabwhome.html](http://www.dfg.ca.gov/cabw/cabwhome.html)). Microhabitat data were collected for each site by completing a CSBP “Physical/Habitat Quality” form. The form provides a rating scale from 0 to 20 to evaluate 10 categories of stream habitat quality (see Appendix A for information on categories). The overall score (possible range 0 to 200) for each site was calculated by summing all categories. The overall score is equivalent to the EPA’s “Physical Habitat Quality Score” (PHQ) which is used throughout the United States. There are four categories of physical condition:

- Optimal (150 to 200),
- Suboptimal (100 to 149),
- Marginal (50 to 99), and
- Poor (0 to 49).

Other data collected include: pH, water temperature, reach length, riffle length, riffle width, canopy cover, embeddedness, and substrate composition (percent bedrock, boulder, cobble, gravel and fines). Microhabitat data were collected using techniques outlined in U.S. Forest Service and CDFG habitat analysis protocols. Substrate complexity (SC) was derived by combining two habitat parameters on the PHQ data sheets: epifaunal substrate/available cover, and embeddedness. The range for SC is 0 to 40 with the following categories:

- Optimal (32 to 40),
- Suboptimal (22 to 31),
- Marginal (12 to 21), and
- Poor (0 to 11).

Five riffles were identified at each site, three of which were randomly selected to collect benthic macroinvertebrates samples. Within each selected riffle, a transect line was established that extended perpendicularly from bank to bank. Sampling began at the furthest downstream riffle

and progressed upstream. Three locations along each transect were chosen for sampling. When possible, two samples were taken on either side of the river, and one sample was taken from the center. Each sample location along the transect varied in velocity and water depth (< 0.61 meters) in an attempt to capture a diversity of organisms. At each sampling location, a D-shaped kick-net (1 ft height x 2 ft width) with standard mesh (0.5mm) was placed on the substrate. The substrate in a 1x2-foot area upstream of the net was inspected and scrubbed to dislodge organisms into the net. Without emptying the net, the same procedure was conducted at the two other locations along the transect. After the three points were sampled on the transect, the contents of the composite sample were emptied into a #35 sieve. All large twigs, leaves, and rocks were further inspected and washed to ensure all clinging organisms were removed. The composite sample was placed into a plastic jar with a label containing a unique sample ID number, date, location, reach number, riffle number, and collector's initials. Samples were preserved in a 10% buffered formalin solution. After the first sample was preserved, the process was repeated along the remaining two riffle transects. Chain of Custody forms were completed for the samples following completion of field sampling. The 1999 samples were sent to three different labs by Resource Insights and the results compiled and presented by ECORP. The 2000 and 2001 samples were logged into the ECORP lab and processed according to CSBP protocols, taxonomic level III. Standard taxonomic keys were used for identification.

### **2.3 Data Analysis**

CDFG protocols were used to calculate metrics. Data were entered into an MS Excel macroinvertebrate database supplied by Mr. Peter Ode of the CDFG, Water Pollution Control Laboratory. The database was designed to calculate 24 metrics preferred by the CDFG. These metrics are calculated and presented as either: percentage, count, and composite of the samples. Counts were enumerations of taxa composition by a single taxa, group of taxa (e.g., Baetidae), or taxa guild (e.g., functional feeding group). Percentages were a calculation of a taxa or group compared to total specimens in the sample. Composite analyses were calculated using established formulas: Shannon-Wiener Diversity Index (SDI), Sensitive EPT Index, and Weighted Tolerance Values (for additional information on these metrics see [www.dfg.ca.gov/cabw/cabwhome.html](http://www.dfg.ca.gov/cabw/cabwhome.html)).

The SDI is a measure of taxa richness and evenness. The SDI scale is logarithmic, and reaches its maximum value when all species are distributed evenly. The Sensitive EPT index compares the number of individuals in the orders Ephemeroptera, Plecoptera and Trichoptera with low tolerance values ( $<3$ ), to total numbers of individuals in the sample. When compared to the EPT index, the Sensitive EPT index provides an assessment of impairment. The Weighted Tolerance Value provides a site rating from 1 to 10 based on observed taxa composition and their assigned tolerance value. The Weighted Tolerance Value weighs highly tolerant taxa more heavily by multiplying the number of individuals in the taxa by their tolerance value. The CSBP provides a list of biological metrics and the response of each metric relative to disturbance (Table 1). When used to evaluate a study site relative to an “undisturbed” reference site, these metrics provide an indication of the general health of the aquatic system in question.

The Substrate composition value is the calculated mean of the three sampled transects. Due to the random selection process, substrate composition can differ from previous sampling events as there is little likelihood of sampling the same three transects.

The following metrics have been chosen for graphic presentation: Taxa Richness, Shannon-Weiner Diversity Index, EPT and Sensitive EPT Indices, Functional Feeding Groups, Tolerance Value, Tolerant and Intolerant Organisms. The Percentage of the Dominant Taxa metric is reported. However, many of the sites have different taxa dominant in the sample replicates; creating difficulty comparing control with affected sites.

Table 1. Biological metrics used to describe macroinvertebrate (BMI) samples collected following the California Stream Bioassessment Procedure (CSBP).

<b>Metric</b>	<b>Description</b>	<b>Response to impairment</b>
<u><b>Richness Measures</b></u>		
Total taxa / Taxa richness	TOTAL NUMBER OF TAXA (GENUS LEVEL)	Decrease
EPT taxa	Number of taxa in the Ephemeroptera, Plecoptera, and Trichoptera orders	Decrease
Ephemeroptera taxa	Number of mayfly taxa (genus or species)	Decrease
Plecoptera taxa	Number of stonefly taxa (genus or species)	Decrease
Trichoptera taxa	Number of caddisfly taxa (genus or species)	Decrease
<u><b>Composition Measures</b></u>		
EPT index	Percent composition of EPT taxa	Decrease
Sensitive EPT Index	Percent of EPT taxa with tolerance values of 0-3	Decrease
Shannon Diversity Index	Measure of sample diversity that incorporates richness and evenness (Margurran 1988)	Decrease
<u><b>Tolerance / Intolerance Measures</b></u>		
Tolerance value	Value between 0 and 10, weighted by abundance of individuals with designated pollution tolerances	Increase
Intolerant Organisms	Number of taxa that are highly intolerant of pollution (values 0-2)	Decrease
Percent tolerant	Percent of organisms that are highly tolerant of Organisms pollution (values of 8-10)	Increase
Percent Hydropsychidae	Percent of sample from the caddisfly family, Hydropsychidae (tolerance value = 4)	Increase
Percent Baetidae	Percent of sample from the mayfly family (tolerance value=4)	Increase
Percent dominant taxa	Percent of sample comprised of most common taxon	Increase
<u><b>Functional Feeding Groups</b></u>		
Percent collectors	Percent of macrobenthos that collect or gather fine Particulate matter	Increase
Percent filterers	Percent of macrobenthos that filter fine particulate Matter	Increase
Percent scrapers/grazers	Percent of macrobenthos that graze on periphyton	Variable
Percent predators	Percent of macrobenthos that feed on other organisms	Variable
Percent shredder	Percent of macrobenthos that shreds coarse particulate Matter	Decrease

Table recreated from California Stream Bioassessment Procedure (Protocol Brief for Biological and Physical/Habitat Assessment in Wadeable Streams), California Department of Fish and Game, Water Pollution Control Laboratory. May, 1999, these metrics compared to those at an “undisturbed” reference site provides an indication of the general health of the aquatic system in question.

## 3.0 RESULTS

### 3.1 Study Sites

Table 2 lists the sites by river/stream with site designators, site description, elevation and dates sampled.

#### South Fork American River Section (10 sites)

The Physical Habitat and Water Quality parameters for the South Fork American River sites are reported in Table 3 for 1999 and Table 4 for 2001.

##### *Site SO-B1: South Fork American River – Below Diversion Dam*

The upper end of this 400 ft. reach is located downstream of the South Fork Diversion Dam, which was rebuilt in 2001 after being severely damaged in the 1997 flooding event. The top of the reach GPS coordinates were 10-S-0732964, UTM 4293906. Willow, alder, cedar, big-leaf maple, dogwood, sugar pine, Jeffrey pine, and white fir were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 103 (sub-optimal), and a mean SC score of 18 (marginal). The mean dominant stream substrate was boulder (46.7%). In 1999, this site received a mean PHQ score of 171 (optimal), and a mean SC score of 36 (optimal). The mean dominant stream substrate was cobble (70.0%).

##### *Site SO-B2: South Fork American River – at Kyberz Upstream of Diversion Dam*

The upper end of this 166 ft. reach is located approximately 1000 ft. upstream of the diversion dam. The top of the reach GPS coordinates were 10-S-0733226, UTM 4294098. Willow, alder, cedar, big-leaf maple, dogwood, sugar pine, Jeffrey pine, and white fir were the most abundant vegetation bordering the reach. This site received a mean PHQ score of 137 (sub-optimal), and a mean SC score of 26 (sub-optimal). The mean dominant stream substrate was boulder (40.0%).

In 1999, this site received a mean PHQ score of 171 (optimal), and a mean SC score of 35 (optimal). The mean dominant stream substrate was cobble (56.1%).

*Site SO-B3: South Fork American River – Upstream of Wildwood Way Bridge*

The bottom end of this 1000 ft. reach is located just upstream of the Wildwood Way Bridge. The bottom of the reach GPS coordinates were 10-S-0733711, UTM 4294492. Willow, alder, oak, Jeffrey pine, and white fir were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 77 (marginal), and a mean SC score of 18 (sub-optimal). The mean dominant stream substrate was cobble (35.0%). In 1999, this site received a mean PHQ score of 169 (optimal), and a mean SC score of 35 (optimal). The mean dominant stream substrate was cobble (61.7%).

*Site SO-B4: South Fork American River – at 42 Mile Tract*

The bottom end of this 271 ft. reach is located at lot 1 of 42 Mile Tract. No GPS coordinates were recorded at this site in 2001. Alder, cedar, willow, aspen, dogwood, and white fir were the most abundant vegetation bordering the reach. Lupine and grasses were present on the stream banks. In 2001, this site received a mean PHQ score of 116 (sub-optimal), and a mean SC score of 17 (sub-optimal). The mean dominant stream substrate was cobble (33.3%). In 1999, this site received a mean PHQ score of 163 (optimal), and a mean SC score of 36 (optimal). The mean dominant stream substrate was cobble (65.6%).

*Site SO-B5: South Fork American River – at Camp Sacramento*

The top end of this approximately 1,600 ft. reach is located just below the bridge at Camp Sacramento. No GPS coordinates were recorded at this site in 2001. Conifers, alder, willow, aspen, dogwood, were the most abundant vegetation bordering the reach. Herbaceous plants and grasses were present on the stream banks. In 2001, this site received a mean PHQ score of 108 (sub-optimal), and a mean SC score of 28 (sub-optimal). The mean dominant stream substrate

was boulder (46.7%). In 1999, this site received a mean PHQ score of 162 (optimal), and a mean SC score of 34 (optimal). The mean dominant stream substrate was cobble (53.3%).

*Site PY-B1: Pyramid Creek – Upstream of Highway 50 and Gaging Station*

This 229 ft. reach is located just upstream of the gaging station. GPS coordinates were 10-S-0750388, UTM 4299981. Alder, white fir, cedar, and dogwood were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 118 (sub-optimal), and a mean SC score of 17 (sub-optimal). The mean dominant stream substrate was cobble (41.7%). In 1999, this site received a mean PHQ score of 160 (optimal), and a mean SC score of 32 (optimal). The mean dominant stream substrate was cobble (81.7%).

*Sites SB-B1: Strawberry Creek*

This 225 ft. reach is upstream of lot 20. No GPS coordinates were recorded at this site in 2001. Willow, alder, dogwood, were the most abundant vegetation at this site. There was a sparse understory of herbaceous plants on the stream bank. In 2001, this site received a mean PHQ score of 112 (sub-optimal), and a mean SC score of 18 (sub-optimal). The mean dominant stream substrate was boulder (36.7%). In 1999, this site received a mean PHQ score of 167 (optimal), and a mean SC score of 35 (optimal). The mean dominant stream substrate was cobble (55.6%).

*Site EC-B3: Echo Creek – Above Upper Echo Lake*

This site is located upstream of Upper Echo Lake. GPS coordinates were 10-S-0753212, UTM 4303431. Alder and willow were the most abundant vegetation bordering the reach. In 2001, this site was completely dry and was not rated for physical habitat quality, substrate complexity, or substrate composition. In 1999, this site received a mean PHQ score of 171 (optimal), and a mean SC score of 39 (optimal). The mean dominant stream substrate was cobble (66.7%).

*Site EC-B2: Echo Creek – Below Lower Echo Lake*

This 149 ft reach is located below Lower Echo Lake upstream of the staff gage. No GPS coordinates were recorded in 2001. Willow, alder, manzanita and dogwood were the most abundant vegetation bordering the reach. A sparse understory of fern and grasses was present on both stream banks. In 2001, this site received a mean PHQ score of 103 (sub-optimal), and a mean SC score of 25 (sub-optimal). The mean dominant stream substrate was boulder (67.7%). In 1999, this site was dry and was not sampled or assessed for habitat quality.

*Site EC-B1: Echo Creek – at KOA Campground*

This 243 ft. reach is located approximately 100 m upstream of South Upper Truckee Road. No GPS coordinates were recorded at this site in 2001. Aspen, willow, and sparse herbaceous plants were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 137 (sub-optimal), and a mean SC score of 25 (sub-optimal). The mean dominant stream substrate was boulder (51.7%). In 1999, this site received a mean PHQ score of 157 (optimal), and a mean SC score of 35 (optimal). The mean dominant stream substrate was cobble (61.1%).

Silver Fork American River Section (6 sites)

The Physical Habitat and Water Quality parameters for the Silver Fork American River sites are reported in Table 4 or 1999 and Table 5 for 2001.

*Site SV-B1: Silver Fork American River at China Flat Campground*

This 524 ft. reach is located just downstream of the China Flat Campground. GPS coordinates were 10-S-0737349, UTM 4292841. Willow, alder, cedar, white fir, sugar pine, dogwood, aspen, and Indian rhubarb were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 139 (sub-optimal), and a mean SC score of 27 (sub-optimal). The mean dominant stream substrate was cobble (45.0%). In 1999, this site received a mean



PHQ score of 163 (optimal), and a mean SC score of 33 (optimal). The mean dominant stream substrate was cobble (65.0%).

*Site SV-B2: Silver Fork American River at China Flat Campground*

This 218 ft. reach is located just downstream of the China Flat Campground. GPS coordinates were not recorded at this site in 2001. Alder, snowberry, conifers, willow, herbaceous plants and grasses were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 149 (sub-optimal), and a mean SC score of 32 (optimal). The mean dominant stream substrate was boulder (36.7%). In 1999, this site received a mean PHQ score of 159 (optimal), and a mean SC score of 30 (sub-optimal). The mean dominant stream substrate was cobble (60.0%).

*Site SH-B1: Sherman Canyon Creek*

The top of this 300 ft. reach is approximately ½ mile upstream of the confluence with the Silver Fork American River. GPS coordinates at the bottom of the reach are 10-S-0737383, UTM 4292717. Willow, alder, cedar, and Indian rhubarb were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 92 (marginal), and a mean SC score of 14 (marginal). The mean dominant stream substrate was bedrock (58.3%). In 1999, this site received a mean PHQ score of 154 (optimal), and a mean SC score of 33 (optimal). The mean dominant stream substrate was cobble (46.1%).

*Site CA-B1: Caples Creek – Below Caples Dam and Weir*

The bottom of this 530 ft reach is below the weir, approximately 400 m below Caples Dam. No GPS coordinates were recorded in 2001. Willow, white fir, grasses and herbaceous plants were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 146 (sub-optimal), and a mean SC score of 29 (sub-optimal). The mean dominant stream substrate was cobble (35.0%). In 1999, this site received a mean PHQ score of 169 (optimal), and a mean SC score of 32 (optimal). The mean dominant stream substrate was cobble (49.4%).

*Site OY-B1: Oyster Creek – Below Highway 88 and Weather Station*

The bottom of this 175 ft reach is below Highway 88 and the weather station. GPS coordinates were not recorded at this site in 2001. Willow, alder, conifers, grasses and herbaceous plants were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 106 (sub-optimal), and a mean SC score of 12 (marginal). The mean dominant stream substrate was gravel (64.7%). In 1999, this site received a mean PHQ score of 150 (optimal), and a mean SC score of 24 (sub-optimal). The mean dominant stream substrate was gravel (73.3%).

*Site WC-B1: Woods Creek*

The upper end of this 184 ft. site is located upstream of Caples Lake. No GPS coordinates were recorded at this site in 2001. The site is accessed via ½ mile hike on a hiking trail. Willow, alder, aspen and various coniferous trees were the most abundant riparian vegetation bordering the reach; herbaceous plants including lupine were present along the stream banks. In 2001, this site received a mean PHQ score of 92 (marginal), and a mean SC score of 6 (poor). The mean dominant stream substrate was boulder (46.7%). Note: in 2001, this stream was not flowing when sampled. Sampling sites consisted of isolated pools. In 1999 this site received a mean PHQ score of 166 (optimal), and a mean SC score of 32 (optimal). The mean dominant stream substrate was gravel (81.1%),

Diverted Tributaries Section (14 sites)

The Physical Habitat and Water Quality parameters for the seven diverted tributaries are reported in Table 6 for 1999 and Table 7 for 2001.

*AR-B1: Alder Creek – Below Diversion at Cabins*

This 324 ft. reach is located downstream of the diversion at the cabins. GPS coordinates were 10-S-0731246, UTM 4293834. Alder, big leaf maple, and Jeffrey pine were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 118 (sub-optimal), and a mean SC score of 23 (sub-optimal). The mean dominant stream substrate was boulder (41.7%). In 1999, this site received a mean PHQ score of 154 (optimal), and a mean SC score of 33 (optimal). The mean dominant stream substrate was cobble (38.9%).

*AR-B2: Alder Creek – Above Diversion*

This 212 ft. reach is located upstream of the diversion off Hazel Valley Road. GPS coordinates were 10-S-0730188, UTM 4290964. Willow, *Ceanothus* sp., white fir, Jeffrey Pine, manzanita, Indian rhubarb, lupine, and other herbaceous plants were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 146 (sub-optimal), and a mean SC score of 32 (optimal). The mean dominant stream substrate was boulder (53.3%). In 1999, this site received a mean PHQ score of 171 (optimal), and a mean SC score of 32 (optimal). The mean dominant stream substrate was bedrock (30.6%).

*CR-B1: Carpenter Creek – Between South Fork American River and Diversion*

This 231 ft. reach is located between the SFAR and diversion ditch. GPS coordinates were 10-S-0732236, UTM 4293677. Alder, big leaf maple, dogwood, white fir, horsetails, and grasses were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 105 (sub-optimal), and a mean SC score of 20 (marginal). The mean dominant stream substrate was boulder (51.7%). In 1999, this site received a mean PHQ score of 159 (optimal), and a mean SC score of 33 (optimal). The mean dominant stream substrate was cobble (56.7%).

*CR-B2: Carpenter Creek – Above Diversion Ditch*

This 131 ft. reach is located just above the diversion ditch. GPS coordinates were 10-S-0732346, UTM 4293595. Alder, big leaf maple, white fir, Jeffrey pine, and incense were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 115 (sub-optimal), and a mean SC score of 25 (sub-optimal). The mean dominant stream substrate was boulder (60.0%). In 1999, this site received a mean PHQ score of 163 (optimal), and a mean SC score of 33 (optimal). The mean dominant stream substrate was cobble (57.2%).

*NN-B1: No Name Creek: at Cabin 30 – 30 Mile Tract*

This 240 ft. reach is located at Cabin 30 – 30 Mile Tract. The reach starts behind a cabin next to the creek. GPS coordinates at the top of the reach were 10-S-0731257, UTM 4293709. Big leaf maple, alder, cedar, Jeffrey pine, oak, white fir, and wild strawberry were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 95 (marginal), and a mean SC score of 19 (marginal). The mean dominant stream substrate was fines (45.0%). In 1999, this site received a mean PHQ score of 131 (sub-optimal), and a mean SC score of 22 (sub-optimal). The mean dominant stream substrate was cobble (43.9%).

*NN-B2: No Name Creek - Upstream of Diversion Canal at Fence*

This 150 ft. reach is upstream of the diversion canal, beginning just upstream of a wire fence. GPS coordinates at the top of the reach were 10-S-0731267, UTM 42933537. Big leaf maple, alder, cedar, Jeffrey pine, and white fir were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 106 (sub-optimal), and a mean SC score of 18 (marginal). The mean dominant stream substrate was boulder (51.7%). In 1999, this site received a mean PHQ score of 137 (sub-optimal), and a mean SC score of 23 (sub-optimal). The mean dominant stream substrate was cobble (40.6%).

*ML-B1: Mill Creek – Below Diversion Canal near Highway 50*

This 150 ft. reach is below the diversion canal near Highway 50. GPS coordinates at the bottom of the reach were 10-S-0726308, UTM 4294841. Alder, dogwood, Douglas fir, cedar, willow, and big leaf maple were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 113 (sub-optimal), and a mean SC score of 26 (sub-optimal). The mean dominant stream substrate was boulder (63.3%). In 1999, this site received a mean PHQ score of 158 (optimal), and a mean SC score of 34 (optimal). The mean dominant stream substrate was cobble (30.0%).

*ML-B2: Mill Creek – Above Diversion Canal at Gage Station*

This 104 ft. reach is located above the diversion canal at the gage station. GPS coordinates at the bottom of the reach were 10-S-0726447, UTM 4292987. Alder, cedar, white fir, sugar pine, Ponderosa pine, Indian rhubarb and other herbaceous were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 67 (marginal), and a mean SC score of 21 (marginal). The mean dominant stream substrate was boulder (50.0%). In 1999, this site received a mean PHQ score of 145 (sub-optimal), and a mean SC score of 30 (optimal). The mean dominant stream substrate was cobble (63.3%).

*BU-B1: Bull Creek – Below Diversion Canal*

This 200 ft. reach is below the diversion canal. GPS coordinates at the bottom of the reach were 10-S-0723055, UTM 4294324. Alder, dogwood, cedar, big leaf maple, ferns and other herbaceous plants were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 73 (marginal), and a mean SC score of 14 (marginal). The mean dominant stream substrate was fines (36.7%). In 1999, this site received a mean PHQ score of 152 (optimal), and a mean SC score of 27 (sub-optimal). The mean dominant stream substrate was cobble (49.4%).

*BU-B2: Bull Creek – Above Diversion Canal at Ditch Camp 2.*

This 190 ft. reach is located just upstream of the diversion canal. GPS coordinates at the top of the reach were 10-S-0723586, UTM 4293590. Alder, cedar, big leaf maple, white fir, and dogwood were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 99 (marginal), and a mean SC score of 15 (marginal). The mean dominant stream substrate was bedrock (46.7%). In 1999, this site received a mean PHQ score of 147 (sub-optimal), and a mean SC score of 25 (optimal). The mean dominant stream substrate was cobble (45.6%).

*OG-B1: Ogilby Creek – Below Diversion Canal*

This 190 ft. reach is located below the diversion canal. GPS coordinates at the bottom of the reach were 10-S-0718881, UTM 4293806. Alder, cedar, big leaf maple, Douglas fir, ferns, blackberry and other herbaceous plants were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 105 (sub-optimal), and a mean SC score of 21 (marginal). The mean dominant stream substrate was boulder (50.0%). In 1999, this site received a mean PHQ score of 140 (sub-optimal), and a mean SC score of 27 (sub-optimal). The mean dominant stream substrate was cobble (32.2%) and bedrock (32.2%).

*OG-B2: Ogilby Creek – Above Diversion Canal*

This 280 ft. reach is located just above the diversion canal. GPS coordinates at the bottom of the reach were 10-S-0719962, UTM 4293261. Alder, cedar, big leaf maple, dogwood, white fir and herbaceous understory plants were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 96 (marginal), and a mean SC score of 20 (marginal). The mean dominant stream substrate was bedrock (42.3%). In 1999, this site received a mean PHQ score of 146 (sub-optimal), and a mean SC score of 24 (optimal). The mean dominant stream substrate was gravel (33.3%).

### *ES-B1: Esmeralda Creek – Below Diversion Canal*

This 130 ft. reach is located below the diversion canal. GPS coordinates were not recorded at this site in 2001. Alder, cedar, big leaf maple, dogwood, Douglas fir and ferns were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 98 (marginal), and a mean SC score of 20 (marginal). The mean dominant stream substrate was boulder (33.3%). In 1999, this site was dry and was not sampled or assessed for habitat quality.

### *ES-B2: Esmeralda Creek – Above Diversion Canal*

This 175 ft. reach is located above the diversion canal. GPS coordinates were not recorded at this site in 2001. Alder and big leaf maple were the most abundant vegetation bordering the reach. In 2001, this site received a mean PHQ score of 115 (sub-optimal), and a mean SC score of 21 (marginal). The mean dominant stream substrate was cobble (58.3%). In 1999, this site received a mean PHQ score of 151 (optimal), and a mean SC score of 29 (sub-optimal). The mean dominant stream substrate was cobble (72.8%).

## **3.2 Species Composition and Metrics**

Study site replicate data for 1999 are reported in Appendix A and Appendix B for 2001.

### South Fork American River Section (SFAR)

The site metric summaries of the South Fork American River Section for 1999 are in Table 9 and Table 10 for 2001.

#### *1999 Richness Measures*

The Taxonomic Richness was similar among the mainstem SFAR sites (Figure 2) with a range of 29.0 (SO-B4) to 35.7 (SO-B5). Pyramid Creek had Taxonomic Richness of 28.0. The control site on Strawberry Creek (SB-B1) had a Taxonomic Richness of 35.3. The Echo Creek site

below Echo Lake Dam (EC-B2) was not sampled in 1999. The lower Echo Creek site (EC-B1) had a Taxonomic Richness of 28.7 compared to the control site above Upper Echo Lake (EC-B3) of 22.0.

### *1999 Composition Measures*

Shannon-Weiner Diversity Index was similar among the mainstem SFAR sites (Figure 3) with a range of 2.5 (SO-B3) to 2.8 (SO-B5). Pyramid Creek SDI was 2.3 while the control site (SB-B1) had an SDI of 2.7. The lower Echo Creek site (EC-B1) had a SDI of 2.6 compared to the control site above Upper Echo Lake (EC-B3) of 2.1.

The EPT and Sensitive EPT Indices were similar among the SFAR sites (Figure 4), ranging from 68.0% and 50.9% (SO-B5) to 81.5% and 66.3% (SO-B2) for EPT, Sensitive EPT, respectively. Pyramid Creek (PY-B1) had an EPT Index of 36.3% and Sensitive EPT was 27.3%. The control site (SB-B1) had EPT and Sensitive EPT Indices of 85.6% and 77.1%, respectively. The lower Echo Creek site (EC-B1) had EPT and Sensitive EPT Indices of 52.9% and 30.6% compared to the control site (EC-B3) of 55.5% and 30.5%.

Three FFG metrics can sometimes indicate impairment: increases in Filterers, increases in Collectors, or decreases in Shredders. Filterers ranged from 7.9% (SO-B5) to 13.5% (SO-B1) at the SFAR sites (Figure 5). Pyramid Creek had 4.4% (PY-B1) Filterers. The Filterers were 9.7% at Strawberry Creek (SB-B1). The lower Echo Creek site (EC-B1) had 11.7% Filterers, compared to 2.0% for EC-B3, Upper Echo Creek. Collectors ranged from 25.9% (SO-B2) to 48.9% (SO-B4) at the SFAR sites. Pyramid Creek had 70.3% Collectors. The control site, Strawberry Creek (SB-B1) had 15.4% Collectors. Collectors at Echo Creek sites were 51.9% (EC-B1) and 43.2% (EC-B3). Shredders ranged from 2.1% (SO-B4) to 23.8% (SO-B2) at the SFAR sites. Pyramid Creek had 11.8% Shredders. Shredders were 4.8% at Strawberry Creek (SB-B1) control site. The lower Echo Creek site (EC-B1) had 16.8% Shredders compared to 16.1% for the control site (EC-B3).



### *1999 Tolerance Measures*

The Tolerance Value ranged from 2.0 (SO-B2) to 3.1 (SO-B5) at the SFAR sites (Figure 6). Pyramid Creek (PY-B1) was 5.4. The control site (SB-B1) had a Tolerance Value of 1.5. The Tolerance Value at lower Echo Creek (EC-B1) was 4.8, compared to upper Echo Creek control site (EC-B3) of 4.4.

Percent Tolerant Organisms ranged from 4.6% (SO-B2) to 13.4% (SO-B5) on the SFAR sites (Figure 7). Pyramid Creek had 28.3% Tolerant Organisms. Strawberry Creek Tolerant Organisms were 3.5%. Tolerant Organisms were 20.7% at lower Echo Creek (EC-B1) compared to 16.2% at upper Echo Creek (EC-B3).

Percent Intolerant Organisms ranged from 52.4% (SO-B5) to 69.3% (SO-B2). Intolerant Organisms were 27.3% in Pyramid Creek. The control site (SB-B1) had 78.6% Intolerant Organisms. Lower Echo Creek (EC-B1) had 30.7% Intolerant Organisms compared to 30.5% at upper Echo Creek (EC-B3).

The Dominant Taxa metric ranged from 18.2% (SO-B5) to 36.1% (SO-B3). Pyramid Creek (PY-B1) had 32.5% Dominant Taxa compared to Strawberry Creek (SB-B1) with 28.8%. The lower Echo Creek site had a Dominant Taxa of 19.3% (EC-B1) compared to the control site above Upper Echo Lake of 31.0% (EC-B3).

### *2001 Richness Measures*

The Taxonomic Richness was similar among the SFAR sites (see Figure 2) with a range of 31.7 (SO-B1) to 40.0 (SO-B4). Pyramid Creek had a Taxonomic Richness of 23.3. The control site on Strawberry Creek had a Taxonomic Richness of 36.0. The Echo Creek site above Upper Echo Lake Dam (EC-B3) was not sampled in 2001. The lower Echo Creek (EC-B1) site had a Taxonomic Richness of 28.0 and Upper Echo Creek site (EC-B2) below Echo Dam was 22.3.

### *2001 Composition Measures*

Shannon-Weiner Diversity Index was similar among the SFAR sites (see Figure 3) with a range of 2.7 (SO-B1 through SO-B3) to 3.0 (SO-B4 and SO-B5). Pyramid Creek SDI was 2.2 while the control site (SB-B1) had an SDI of 2.7. The lower Echo Creek site had a SDI of 2.1 (EC-B1) and Upper Echo Creek site below Echo Dam was 2.5 (EC-B2).

The EPT and Sensitive EPT Indices were similar among the SFAR sites (see Figure 4) ranging from 66.1% and 40.3% (SO-B4) to 75.5% (SO-B3) and 58.1% (SO-B1) for EPT, Sensitive EPT, respectively. Pyramid Creek (PY-B1) had an EPT Index of 42.3% and Sensitive EPT Index of 37.0%. The control site (SB-B1) had EPT and Sensitive EPT Indices of 77.6% and 70.9%, respectively. The lower Echo Creek site (EC-B1) had EPT and Sensitive EPT Indices of 92.8% and 81.9% and Upper Echo Creek site below Echo Dam (EC-B2) was 56.8% and 47.2%.

Filterers ranged from 9.2% (SO-B1) to 21.6% (SO-B4) at the SFAR sites (see Figure 5). Pyramid Creek (PY-B1) had 15.8% Filterers. The Filterers were 8.1% at Strawberry Creek (SB-B1). The lower Echo Creek site (EC-B1) had 7.2% Filterers compared to 26.3% for EC-B2. Collectors ranged from 24.1% (SO-B3) to 45.1% (SO-B4) at the SFAR sites. Pyramid Creek had 33.0% Collectors. The control site, Strawberry Creek (SB-B1) had 18.8% Collectors. Collectors at Echo Creek sites were 11.9% (EC-B1) and 28.1% (EC-B2). Shredders ranged from 1.1% (SO-B4) to 17.1% (SO-B2) at the SFAR sites. Pyramid Creek had 33.3% Shredders. Shredders were 9.0% at Strawberry Creek (SB-B1) control site. The lower Echo Creek site (EC-B1) had 56.3% Shredders and the upper Echo Creek below Echo Lake Dam (EC-B2) had 12.7% Shredders.

### *2001 Tolerance Measures*

The Tolerance Value ranged from 2.2 (SO-B1) to 3.0 (SO-B5) at the SFAR sites (see Figure 6). Pyramid Creek (PY-B1) was 4.0. The control site (SB-B1) had a Tolerance Value of 1.6. The Tolerance Value at lower Echo Creek (EC-B1) was 1.8 and upper Echo Creek below Echo Lake Dam (EC-B2) of 3.5.

Percent Tolerant Organisms ranged from 0.9% (SO-B1) to 3.4% (SO-B3) at the SFAR sites (See Figure 7). Pyramid Creek had 2.3% Tolerant Organisms. Strawberry Creek Tolerant Organisms were 0.1%. Tolerant Organisms were 0.2% at lower Echo Creek (EC-B1) and 11.6% at upper Echo Creek below Echo Lake Dam (EC-B2).

Percent Intolerant Organisms ranged from 43.8% (SO-B4) to 58.5% (SO-B1) at the SFAR sites (see Figure 7). Intolerant Organisms were 37.2% in Pyramid Creek. The control site (SB-B1) had 72.6% Intolerant Organisms. Intolerant Organisms account for 73.1% at Lower Echo Creek (EC-B1) and 47.2% at upper Echo Creek below Echo Lake Dam (EC-B2).

The Dominant Taxa metric ranged from 15.9% (SO-B4) to 27.2% (SO-B3). Pyramid Creek (PY-B1) had 32.3% Dominant Taxa compared to Strawberry Creek (SB-B1) with 24.8%. The lower Echo Creek site had a Dominant Taxa of 43.0% (EC-B1) and Upper Echo Creek site below Echo Dam was 18.0% (EC-B2).

#### Silver Fork American River Section

The site metric summaries of the Silver Fork American River section for 1999 are in Table 11 and Table 12 for 2001.

#### *1999 Richness Measures*

The Taxonomic Richness of the SVFAR sites (Figure 8) ranged from 32.3 (SV-B2) to 34.0 (SV-B1). Caples Creek (CA-B1) had a Taxonomic Richness of 18.7 and Oyster Creek (OY-B1) was 32.0. The control sites ranged from 31.0 (WC-B1) to 34.7 (SH-B1).

### *1999 Composition Measures*

Shannon-Weiner Diversity Index was similar among the SVFAR sites (Figure 9) with a range of 2.7 (SV-B2) to 2.8 (SV-B1). Caples Creek SDI was 2.0 and Oyster Creek (OY-B1) was 2.4. The control sites ranged from 2.4 (WC-B1) to 2.8 (SH-B1).

The EPT and Sensitive EPT Indices for the SVFAR sites (Figure 10) ranged from 40.6% and 21.7% (SV-B2) to 75.7% and 53.4% (SV-B1) for EPT and Sensitive EPT, respectively. Caples Creek (CA-B1) had an EPT Index of 14.2% and Sensitive EPT was 13.7%; Oyster Creek EPT and Sensitive EPT were 80.8% and 20.8%, respectively. The control sites had EPT and Sensitive EPT indices ranging from 83.7% and 60.6% (SH-B1) to 87.8% and 48.9% (WC-B1), respectively.

Filterers ranged from 4.5% (SV-B2) to 14.5% (SV-B1) at the SVFAR sites (Figure 11). Caples Creek (CA-B1) had 42.9% Filterers and Oyster Creek (OY-B1) had 2.7%. The Filterers were 0.5% (WC-B1) and 6.4% (SH-B1) at the control sites. Collectors ranged from 33.2% (SV-B1) to 70.3% (SV-B2) at the SVFAR sites. Caples Creek had 37.5% Collectors and Oyster Creek (OY-B1) had 53.2%. The control sites, had 19.7% (SH-B1) and 25.3% (WC-B1) Collectors. Shredders ranged from 3.3% (SV-B2) to 9.9% (SV-B1) at the SVFAR sites. Caples Creek had 4.2% Shredders and Oyster Creek (OY-B1) had 3.5%. Shredders were 12.7% (WC-B1) and 14.4% (SH-B1) at the control sites.

### *1999 Tolerance Measures*

The Tolerance Value ranged from 2.7 (SV-B1) to 5.1 (SV-B2) at the SVFAR sites (Figure 12). Caples Creek (CA-B1) was 5.4 and Oyster Creek (OY-B1) was 3.9. The control sites had a Tolerance Values of 2.2 (SH-B1) and 2.9 (WC-B1).

Percent Tolerant Organisms ranged from 10.9% (SV-B1) to 22.4% (SV-B2) at the SVFAR sites (Figure 13). Caples Creek had 24.3% Tolerant Organisms and Oyster Creek had 1.2%. The control sites had 2.2% (SH-B1) and 2.4% (WC-B1) Tolerant Organisms.

Percent Intolerant Organisms ranged from 21.9% (SV-B2) to 54.9% (SV-B1). Intolerant Organisms were 13.7% in Caples Creek and 16.7% in Oyster Creek. The control sites were 47.8% (WC-B1) and 61.2% (SH-B1) Intolerant Organisms.

The Dominant Taxa metric ranged from 19.7% (SV-B1) to 22.9% (SV-B2). Caples Creek had 35.4% Dominant Taxa and Oyster Creek had 30.7% Dominant Taxa. The control sites ranged from 22.9% (SH-B1) to 26.1% (WC-B1).

#### *2001 Richness Measures*

The Taxonomic Richness of the SVFAR section (see Figure 8) ranged from 29.3 (SV-B2) to 36.0 (SV-B1). Caples Creek had a Taxonomic Richness of 23.0 and Oyster Creek was 33.0. The control sites ranged from 26.7 (WC-B1) to 39.0 (SH-B1).

#### *2001 Composition Measures*

Shannon-Weiner Diversity Index at the SVFAR sites (see Figure 9) ranged from 2.4 (SV-B2) to 3.0 (SV-B1). Caples Creek SDI was 2.2 and Oyster Creek was 2.5. The control sites ranged from 2.4 (WC-B1) to 3.0 (SH-B1).

The EPT and Sensitive EPT Indices for the SVFAR sites (see Figure 19) ranged from 23.2 % and 10.2% (SV-B2) to 65.8% and 45.8% (SV-B1). Caples Creek had an EPT Index of 35.2% and Sensitive EPT was 33.9%; Oyster Creek values were 81.5% and 33.7%, respectively. The control sites had EPT and Sensitive EPT Indices ranging from 74.0% and 53.6% (SH-B1) to 26.9% and 21.6% (WC-B1).

Filterers ranged from 14% (SV-B2) to 18.3% (SV-B1) at the SVFAR sites (see Figure 11). Caples Creek had 38.3% Filterers and Oyster Creek had 9.1%. The Filterers were 20.0% (WC-B1) and 9.1% (SH-B1) at the control sites. Collectors ranged from 21.8% (SV-B1) to 70.8% (SV-B2) at the SVFAR sites. Caples Creek had 25.9% Collectors and Oyster Creek had 58.3%.

The control site had 23.7% (SH-B1) and 30.1% (WC-B1) Collectors. Shredders ranged from 2.8% (SV-B2) to 6.1% (SV-B1) at the SVFAR sites. Caples Creek had 10.8% Shredders and Oyster Creek had 2.3%. Shredders were 4.6% (WC-B1) and 17.6% (SH-B1) at the control sites.

### *2001 Tolerance Measures*

The Tolerance Value ranged from 2.7 (SV-B1) to 6.3 (SV-B2) at the SVFAR sites (see Figure 12). Caples Creek was 4.8 and Oyster Creek was 3.5. The control sites had Tolerance Values of 2.4 (SH-B1) and 4.4 (WC-B1).

Percent Tolerant Organisms ranged from 1.6% (SV-B1) to 56.1% (SV-B2) at the SVFAR sites (see Figure 13). Caples Creek had 34.9% Tolerant Organisms and Oyster Creek was 1.0%. The control sites had 0.2% (SH-B1) and 2.3% (WC-B1) Tolerant Organisms.

Percent Intolerant Organisms ranged from 10.3% (SV-B2) to 48.9% (SV-B1). Intolerant Organisms were 33.0% in Caples Creek and 33.8% in Oyster Creek. Intolerant Organisms at the control sites were 22.4% (WC-B1) and 53.1% (SH-B1).

The Dominant Taxa metric ranged from 14.3% (SV-B1) to 36.5% (SV-B2). Caples Creek had 30.0% Dominant Taxa and Oyster Creek had 26.9%. The control sites ranged from 16.0% (SH-B1) to 28.6% (WC-B1).

### Diverted Tributaries Section

The control sites are the sites above the diversion structures at each tributary. The comparison is between above (sites with B2 designation) and below (sites with B1 designation) the diversion structure on the seven sampled tributaries. The site metric summaries of the Diverted Tributaries are in Table 13 (1999) and Table 14 (2001).

### *1999 Richness Measures*

The richness measures for the diverted tributaries are presented in Figure 14 and the following table.

	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>
<b>Stream</b>	<b>Taxa Richness</b>	<b>Taxa Richness</b>	<b>Shannon- Weiner Diversity Index</b>	<b>Shannon- Weiner Diversity Index</b>	<b>Dominant Taxa Percent</b>	<b>Dominant Taxa Percent</b>
Alder Creek	39.3	27.0	2.9	1.8	17.2	49.2
Carpenter Creek	41.7	39.3	3.2	2.8	13.4	25.2
No-Name Creek	39.0	45.3	2.9	3.0	18.7	19.3
Mill Creek	33.7	32.3	2.7	2.6	23.1	27.3
Bull Creek	48.3	38.7	3.3	2.9	15.3	20.4
Ogilby Creek	35.3	41.0	2.8	2.9	23.6	23.6
Esmeralda Creek	33.0	NS	2.6	NS	18.4	NS

The sites with higher Taxonomic Richness values below diversion than above the diversion were NN-B1 and OG-B1.

### *1999 Composition Measures*

The Shannon-Weiner Diversity Index for the diverted tributaries are illustrated in Figure 15 and listed in the following table :

	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>
<b>Stream</b>	<b>Shannon-Weiner Diversity Index</b>	<b>Shannon-Weiner Diversity Index</b>
Alder Creek	2.9	1.8
Carpenter Creek	3.2	2.8
No-Name Creek	2.9	3.0
Mill Creek	2.7	2.6
Bull Creek	3.3	2.9
Ogilby Creek	2.8	2.9
Esmeralda Creek	2.6	NS

Shannon-Weiner Diversity index was higher for above diversion sites at four of the sites.

The percentage of EPT and Sensitive EPT taxa for the lower tributaries are illustrated in Figure 16 and the values presented in the following table.

	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>
<b>Stream</b>	<b>EPT Index</b>	<b>EPT Index</b>	<b>Sensitive EPT Index</b>	<b>Sensitive EPT Index</b>
Alder Creek	80.6	92.5	53.6	83.0
Carpenter Creek	64.6	80.0	39.2	51.6
No-Name Creek	71.9	64.6	52.7	45.4
Mill Creek	72.0	82.2	39.4	56.9
Bull Creek	64.0	53.7	30.0	17.6
Ogilby Creek	61.1	76.4	23.5	51.3
Esmeralda Creek	63.4	NS	30.7	NS

Only two below diversion sites have lower values as compared to above diversion sites for the EPT Indices: No-Name and Bull Creeks.

The FFG metrics are illustrated in Figure 17. The following table compares these three metrics of the Functional Feeding Groups.

	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>
<b>Stream</b>	<b>Filterers</b>	<b>Filterers</b>	<b>Collectors</b>	<b>Collectors</b>	<b>Shredders</b>	<b>Shredders</b>
Alder Creek	10.2	5.0	25.1	7.5	14.7	19.6
Carpenter Creek	7.1	5.0	41.0	29.6	12.8	23.7
No-Name Creek	3.4	3.4	27.7	31.6	19.1	32.9
Mill Creek	4.9	11.6	32.2	16.5	13.6	3.1
Bull Creek	1.9	2.7	37.2	50.4	11.0	5.9
Ogilby Creek	3.6	7.7	43.7	27.5	8.8	5.4
Esmeralda Creek	1.1	NS	46.3	NS	6.1	NS



### 1999 Tolerance Measures

The Tolerance Value metric is graphically presented in Figure 18 and Figure 19 is a graphic of the percentage of Tolerant and Intolerant Organisms. The following table compares these Tolerance Measures for the lower diverted tributary sites.

	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>
<b>Stream</b>	<b>Tolerance Value</b>	<b>Tolerance Value</b>	<b>Tolerant Organisms (%)</b>	<b>Tolerant Organisms (%)</b>	<b>Intolerant Organisms (%)</b>	<b>Intolerant Organisms (%)</b>
Alder Creek	2.6	1.6	4.9	1.0	53.3	82.9
Carpenter Creek	3.4	2.8	7.8	4.7	39.3	51.2
No-Name Creek	2.6	3.2	3.8	6.3	53.0	45.8
Mill Creek	3.5	2.3	6.4	1.2	39.3	56.9
Bull Creek	3.5	4.2	4.3	9.2	30.2	18.1
Ogilby Creek	3.9	2.7	10.5	3.1	23.9	49.6
Esmeralda Creek	3.5	NS	6.1	NS	30.3	NS

The Dominant Taxa percentage of the diverted tributaries is listed in the following table:

	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>
<b>Stream</b>	<b>Dominant Taxa Percent</b>	<b>Dominant Taxa Percent</b>
Alder Creek	17.2	49.2
Carpenter Creek	13.4	25.2
No-Name Creek	18.7	19.3
Mill Creek	23.1	27.3
Bull Creek	15.3	20.4
Ogilby Creek	23.6	23.6
Esmeralda Creek	18.4	NS

Dominant Taxa percentage was higher for below diversion sites.

### *2001 Richness Measures*

The richness measures for the lower tributaries are presented in the following table (see Figure 14).

	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>
<b>Stream</b>	<b>Taxa Richness</b>	<b>Taxa Richness</b>	<b>Shannon- Weiner Diversity Index</b>	<b>Shannon- Weiner Diversity Index</b>	<b>Dominant Taxa Percent</b>	<b>Dominant Taxa Percent</b>
Alder Creek	40.7	27.7	2.8	2.4	25.8	27.6
Carpenter Creek	44.7	41.3	3.1	3.0	14.0	24.9
No-Name Creek	39.7	35.3	3.0	2.7	17.0	28.0
Mill Creek	30.3	31.7	2.5	2.3	27.2	39.5
Bull Creek	49.7	44.3	3.2	3.1	16.4	15.5
Ogilby Creek	46.0	54.7	3.2	3.2	16.6	18.2
Esmeralda Creek	36.7	45.3	2.8	3.2	20.3	16.4

The sites with higher Taxonomic Richness values below diversion compared with above diversion were NN-B1 and OG-B1. Dominant Taxa percentage was higher for below diversion sites.

### *2001 Composition Measures*

The Shannon-Weiner Diversity Index values are listed for the diverted tributaries in the following table (see Figure 15):

	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>
<b>Stream</b>	<b>Shannon-Weiner Diversity Index</b>	<b>Shannon-Weiner Diversity Index</b>
Alder Creek	2.8	2.4
Carpenter Creek	3.1	3.0
No-Name Creek	3.0	2.7
Mill Creek	2.5	2.3
Bull Creek	3.2	3.1
Ogilby Creek	3.2	3.2
Esmeralda Creek	2.8	3.2

Shannon-Weiner Diversity index was higher above diversion sites at four of the tributaries.

The percentage of EPT and Sensitive EPT taxa for the diverted tributaries is presented in the following table (see Figure 16):

	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>
<b>Stream</b>	<b>EPT Index</b>	<b>EPT Index</b>	<b>Sensitive EPT Index</b>	<b>Sensitive EPT Index</b>
Alder Creek	76.7	72.2	59.5	61.1
Carpenter Creek	76.8	75.4	54.7	57.6
No-Name Creek	60.8	48.7	33.8	33.0
Mill Creek	65.5	49.0	42.5	44.4
Bull Creek	42.8	50.7	32.9	24.6
Ogilby Creek	56.1	73.9	33.1	55.9
Esmeralda Creek	66.9	59.8	33.0	31.4

Only two below diversion sites have lower values for the EPT Indices: No-Name and Bull Creeks.

The following table compares these three metrics of the Functional Feeding Groups (see Figure 17):

	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>
<b>Stream</b>	<b>Filterers</b>	<b>Filterers</b>	<b>Collectors</b>	<b>Collectors</b>	<b>Shredders</b>	<b>Shredders</b>
Alder Creek	4.3	5.2	15.8	20.5	13.9	15.6
Carpenter Creek	4.7	2.3	36.3	26.1	10.9	6.6
No-Name Creek	4.6	5.1	38.4	44.0	13.0	27.4
Mill Creek	8.5	3.4	40.0	25.7	29.3	7.0
Bull Creek	12.8	3.4	27.6	51.6	18.8	9.5
Ogilby Creek	3.0	3.5	49.8	28.0	14.7	7.9
Esmeralda Creek	6.8	5.9	29.4	35.5	15.8	10.3

## 2001 Tolerance Measures

The following table compares the Tolerance Measures for the diverted tributary sites (see Figure 18 and Figure 19).

	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>
<b>Stream</b>	<b>Tolerance Value</b>	<b>Tolerance Value</b>	<b>Tolerant Organisms (%)</b>	<b>Tolerant Organisms (%)</b>	<b>Intolerant Organisms (%)</b>	<b>Intolerant Organisms (%)</b>
Alder Creek	2.2	2.4	1.6	3.2	59.5	60.5
Carpenter Creek	2.6	2.7	1.5	9.3	55.4	56.6
No-Name Creek	3.3	3.5	4.1	5.6	35.0	34.7
Mill Creek	3.4	3.0	8.2	9.7	42.5	44.6
Bull Creek	3.4	3.9	2.8	10.0	33.8	25.0
Ogilby Creek	3.2	2.6	5.3	5.9	37.8	54.9
Esmeralda Creek	3.3	3.4	1.5	5.4	31.9	31.2

The Dominant Taxa percentages for the diverted tributaries are listed in the following table:

	<b>B2 sites (Above DS)</b>	<b>B1 sites (Below DS)</b>
<b>Stream</b>	<b>Dominant Taxa Percent</b>	<b>Dominant Taxa Percent</b>
Alder Creek	25.8	27.6
Carpenter Creek	14.0	24.9
No-Name Creek	17.0	28.0
Mill Creek	27.2	39.5
Bull Creek	16.4	15.5
Ogilby Creek	16.6	18.2
Esmeralda Creek	20.3	16.4

## 4.0 DISCUSSION

Discussion will be added with inclusion of the 2000 data.

## 5.0 SUMMARY

The following items are preliminary results. The 2000 data will be added and should provide a better understanding of the trends seen in the 1999 and 2001 data.

## **South Fork American River Section**

- Taxonomic Richness is similar among mainstem sites, with a slight decrease in Taxonomic Richness below the SFAR Diversion Dam.
- Taxonomic Richness is lower at the high elevation sites (both control and affected), Echo Creek and Pyramid Creek.
- The EPT and Sensitive EPT indices are higher below the SFAR Diversion Dam and tend to decline with distance upstream on the South Fork American River.
- The EPT and Sensitive EPT Indices are lowest at Pyramid Creek and highest at the control site, Strawberry Creek.
- The Echo Creek control site (EC-B3) and the site below Echo Lake Dam (EC-B2) have the lowest EPT and Sensitive EPT Indices, likely a combination of elevation and seasonal hydrology.
- Yearly differences in the EPT and Sensitive EPT indices are apparent at the SFAR sites.
- The Shannon-Weiner Diversity Index is similar among sites and is comparable to the control sites (SB-B1).
- Pyramid Creek has the lowest Shannon-Weiner Diversity Index value.
- The 2001 Shannon-Weiner Diversity Index values tend to be slightly higher than those in 1999.
- The highest percentage of Intolerant Organisms was observed at the control site, Strawberry Creek.
- Pyramid Creek had the lowest percentage of Intolerant Organisms.
- The percentage of Intolerant Organisms were generally lower in 2001 than observed for 1999.
- The percentage of Tolerant Organisms is generally similar during the SFAR sites (SO-B3 to SO-B5), but is lower at the sites above and below the SFAR Diversion Dam.
- Pyramid Creek had the highest percentage of Tolerant Organisms in 1999, but was similar to the SFAR sites in 2001.
- Strawberry Creek (control) had the lowest percentage of Tolerant Organisms.

- Tolerant Organisms were most abundant at the lower Echo Creek site (EC-B1) in 1999 but were very low in 2001.
- The upper Echo Creek sites (both control and affected), have higher percentage of Tolerant Organisms than are found at the SFAR sites.
- The Tolerance Value was lowest below the SFAR Diversion Dam and slightly increases with distance upstream.
- Filterers varied among sites in the SFAR and increased in percentage at the sites (SO-B2-SO-B5) above the SFAR Diversion Dam.
- Pyramid Creek had the lowest percentage of Filterers in 1999, but was among the sites with the highest percentage of Filterers in 2001.
- Filterers decreased in percentage at the Strawberry Creek control site and were lowest at this site in 2001.
- Collectors were highest at the upper SFAR sites (SO-B4 to SO-B5) and similar among the other SFAR sites (SO-B1 to SO-B3).
- Pyramid Creek had the highest percentage of Collectors in 1999, but decreased in 2001.
- Strawberry Creek (control) had the lowest percentage of Collectors of all sites.
- The percentage of Collectors was variable among the Echo Creek sites.
- Shredders were generally lower at Strawberry Creek than observed at the SFAR sites.
- Pyramid Creek had higher percentage of Shredders than the control site and had the highest percentage in 2001.
- Shredders were also higher at the lower Echo Creek site (EC-B1).

### **Silver Fork American River Section**

- Taxonomic Richness was lowest at the sites (SV-B2 and CA-B1) downstream of the dams.
- Taxonomic Richness was similar at the lower Silver Fork American River site (SV-B1) to the control site (SH-B1) at Sherman Canyon Creek.
- Oyster Creek had higher Taxonomic Richness than Woods Creek (control Site).

- Caples Creek (CA-B1) and the Silver Fork American River (SV-B2) had the lowest EPT and Sensitive EPT values.
- Sherman Canyon Creek (control) had the highest percentage of Sensitive EPT taxa.
- Oyster Creek had an EPT Index similar to the control site, but the Sensitive EPT index was variable.
- The EPT and Sensitive EPT Indices declined at the Woods Creek site in 2001, an effect of decreased flow.
- The SDI was similar between the lower Silver Fork American River site (SV-B1) and the control site (SH-B1).
- The SDI value was the lowest at Caples Creek site.
- Oyster Creek and Woods Creek had similar SDI values.
- The Tolerance Value was highest at the sites below dams (SV-B2 and CA-B1).
- Sherman Canyon Creek had the lowest Tolerance Value of all sites in the Silver Fork American River section.
- The Tolerance Value at Oyster Creek was similar to the value at Woods Creek.
- The percentage of Tolerant Organisms was highest at the sites below dams (SV-B2 and CA-B1).
- Sherman Canyon Creek (control) had the lowest percentage of Tolerant Organisms.
- Woods Creek (control) and Oyster Creek had similar values for Intolerant Organisms.
- The levels for Intolerant Organisms were lower in 2001 at the lower Silver Fork American River site (SO-B1), but were approaching the levels at the control site (SH-B1).
- Intolerant Organisms were lowest at the sites below dams (SV-B2 and CA-B1).
- Sherman Canyon Creek (control) had the highest percentage of Intolerant Organisms.
- Intolerant Organisms declined between 1999 and 2001.
- Filterers were highest at Caples Creek.
- Filterers generally increased from 1999 to 2001.
- Filterers were lowest at Sherman Canyon Creek (control) in 2001, and were second lowest to SV-B2 (Silver Fork below dam) in 1999.

- Collectors were highest at the Silver Fork American River site (SV-B2) nearest the dam, followed by Oyster Creek.
- Collectors were lowest at Sherman Canyon Creek (control) in 1999, and were second lowest to the Silver Fork American River site (SV-B1) in 2001.
- Shredders were higher at the control sites (SH-B1 and WC-B1) than project affected sites in the Silver Fork American River Section.

### **Diverted Tributaries**

- Taxa Richness at the larger tributaries (Alder, Carpenter and Mill Creeks) was generally lower below the diversion structure.
- The smaller tributaries (No-Name, Bull, Ogilby and Esmeralda Creeks) generally had higher Taxa Richness values below the diversion structure (except NN and BU in 2001)
- SDI values were generally lower below the diversion structure, except at Ogilby and Esmeralda Creeks.
- The Sensitive EPT Index is generally higher below the diversion structures, except Bull Creek and Esmeralda Creek.
- Filterers were highly variable, but were lower below the diversion at Carpenter Creek both years.
- Collectors were higher below the diversion structures at No-Name and Bull Creeks.
- Shredders were lower below the diversion structures at Mill, Bull, Ogilby, and Esmeralda creeks.
- Shredders were higher below the diversion at Alder Creek and No-Name Creek.
- Tolerance Values were highly variable, but were lower below the diversion structure on Mill and Ogilby Creeks.
- Tolerant Organism values were highly variable, except at Bull and No-Name Creeks where sites below the diversion structure had higher percentages of Tolerant Organisms.
- Intolerant Organisms were generally higher below the diversion structure, except for Bull Creek where Intolerant organisms were higher above the diversion.