Boundary Hydroelectric Project (FERC No. 2144)

Study No. 11

Productivity Assessment

Interim Report

Prepared for
Seattle City Light

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March 2008

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Study No. 11: Productivity Assessment
Interim Report
Boundary Hydroelectric Project (FERC No. 2144)

1 INTRODUCTION

Study No. 11, Productivity Assessment, is being conducted in support of the relicensing of the Boundary Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) No. 2144, as identified in the Revised Study Plan (RSP; SCL 2007) submitted by Seattle City Light (SCL) on February 14, 2007, and approved by the FERC in its Study Plan Determination letter dated March 15, 2007. This is the Interim Report for the 2007 study efforts of the Productivity Assessment.

Primary, or photosynthetic, production is the ultimate source of energy for food webs. In aquatic systems, primary producers are phytoplankton (suspended algae), periphyton (attached algae), and aquatic macrophytes (submersed or emergent, rooted and non-rooted vascular plants). Photosynthesis is dependent on light energy and utilization of that energy as growth is dependent on primary nutrients carbon, nitrogen, and phosphorus. Productivity is the rate of growth or, in the case of primary production, the rate of photosynthesis (conversion of inorganic carbon to organic carbon). For the purposes of Study 11, productivity was not measured directly, but its potential will be assessed relative to the net result of photosynthesis, standing crop or net production, as measured by chlorophyll *a* in phytoplankton and periphyton. Potential productivity of macrophytes, zooplankton, and benthic macroinvertebrates (BMI) will be evaluated relative to operations scenarios. Relative nutrient availability and light will also be used in this assessment of the production of the Boundary Reservoir and specifically how Boundary Dam operations affect net production within the Reservoir.

The descriptions and criteria for Habitat Suitability Curve (HSC)/Habitat Suitability Index (HSI)[1] review the physical constraints on macrophyte and periphyton production—substrate, water velocity, and depth. These criteria set limits on the physical conditions for macrophytic plants and periphytic algae to grow and include light availability (i.e., depth). However, the

[1] The abbreviation HSI is used in this document to refer to either HSI models or HSC, depending on the context. HSI models provide a quantitative relationship between numerous environmental variables and habitat suitability. An HSI model describes how well each habitat variable individually and collectively meets the habitat requirements of the target species and lifestage, under the structure of Habitat Evaluation Procedures (USFWS 1980). Alternatively, HSC are designed for use in the Instream Flow Incremental Methodology to quantify changes in habitat under various flow regimes (Bovee et al. 1998). HSC describes the instream suitability of habitat variables related only to stream hydraulics and channel structure. Both HSC and HSI models are scaled to produce an index between 0 (unsuitable habitat) and 1 (optimal habitat). Both models and habitat index curves are hypotheses of species-habitat relationships and are intended to provide indicators of habitat change, not to directly quantify or predict the abundance of target organisms. For the Boundary Project studies, HSC (i.e., depth and velocity) and HSI (i.e., light availability, duration of inundation and dewatering) models will be integrated to analyze the effects of operations scenarios.

nutrient regime determines if and how much growth will occur. Nutrient levels in Boundary Reservoir are low, due to the low concentration entering the Reservoir from upstream and the apparent lack of significant nutrient sources within the Boundary Reservoir drainage basin (Ecology 2005, SCL 2006). Nutrient levels are not part of the HSIs, because the low background levels will not be affected under operations scenarios.

The physical constraints on phytoplankton production are mixing and photic zone depths. Taken together, they determine how much light a vertically mixed phytoplankton will receive. In a well-mixed and deep water body, light may be insufficient for net production to occur, e.g., Lake Washington in winter. If, however, light is sufficient, the biomass produced will be directly related to nutrient content, which usually is phosphorus. Again, background nutrient levels in Boundary Reservoir are assumed constant with the HSI approach and phytoplankton production is expected to depend on Reservoir area and light availability as factors that control growth.

Productivity is a rate of production and is not being measured directly in this study. However, chlorophyll *a* concentration within phytoplankton is usually directly related to biomass and to productivity. Also, biomass/chlorophyll *a* is usually directly related to nutrient content, e.g., total phosphorus concentration. Biomass may also be impacted by zooplankton grazing in oligotrophic water, i.e., approximately 100 percent of net productivity may be consumed (Welch and Jacoby 2004). That may not occur in short residence time environments such as Boundary Reservoir, which has a residence time of approximately 1 to 4 days.

Secondary production includes zooplankton, benthic macroinvertebrates and fish. Zooplankton are more restricted by water residence time because their growth rates are slower. Nevertheless, environments with short residence times of 5 or less days (e.g., Duwamish River in Seattle) produce an increase in biomass of phytoplankton (70 micrograms per liter [μg/L]) and zooplankton densities (50 organisms/L), although such environments are nutrient-rich (Welch and Jacoby 2004) when compared to Boundary Reservoir.

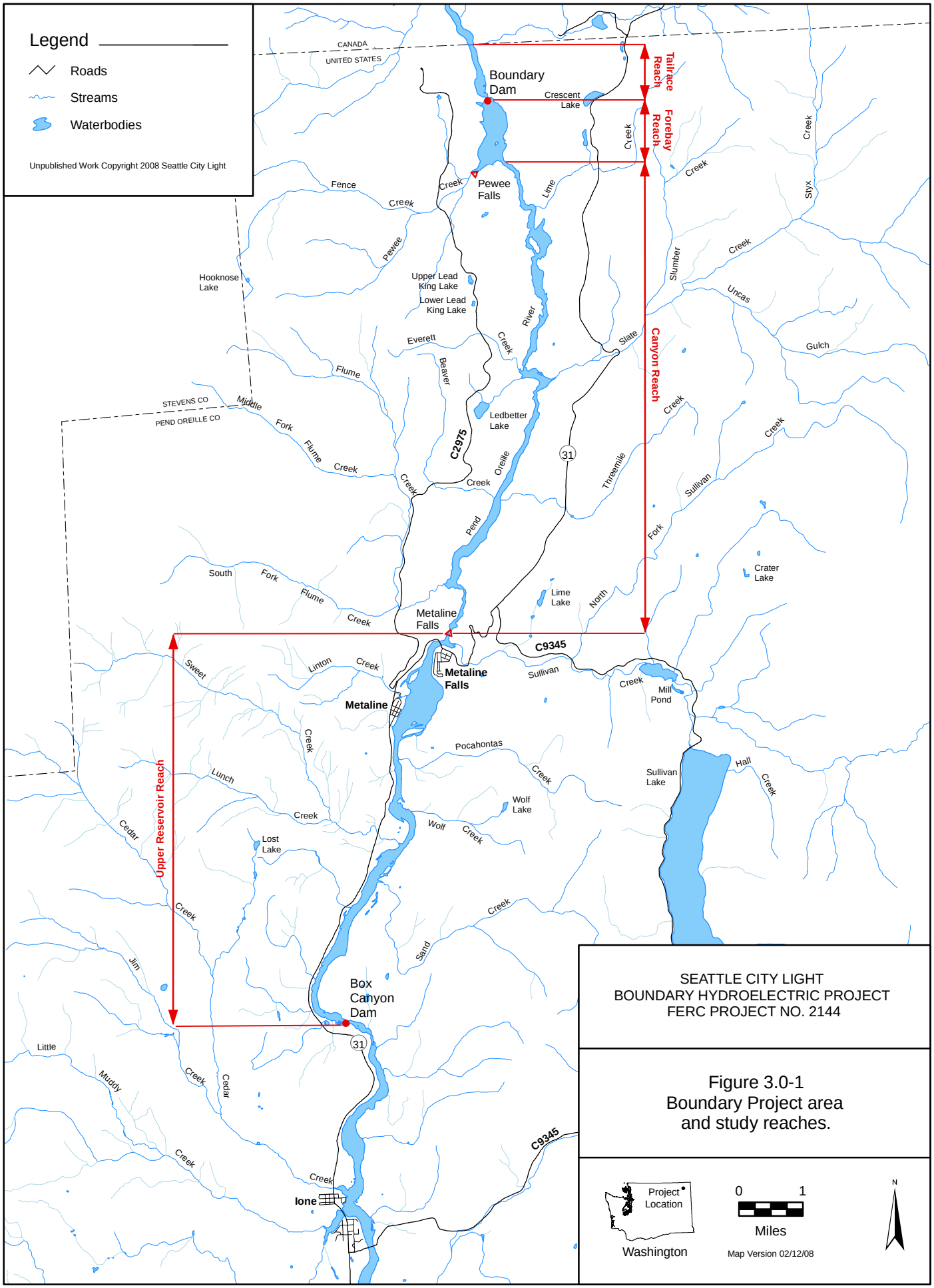
2 STUDY OBJECTIVES

The goal of the Productivity Assessment study is to determine the effects of current Project operations and operations scenarios on primary and secondary production in Boundary Reservoir. The objective of this study is to quantify indices of primary and secondary production in reaches of the Pend Oreille River within the Boundary Project area under hydraulic conditions expected from operations scenarios. The Productivity Assessment will consist of evaluating nutrients, phytoplankton, periphyton, and macrophytes as indices of primary production and zooplankton and BMI as indices of secondary production.

3 STUDY AREA

The study area encompasses Boundary Reservoir and the Boundary tailrace (Figure 3.0-1). The Aquatic Habitat Model (part of Study 7, Mainstem Aquatic Habitat Modeling Study), which will be used to evaluate the effects of operations scenarios on aquatic habitats and biota in the Pend Oreille River, will be developed for the Pend Oreille River between Box Canyon Dam (Project river mile [PRM] 34.5) downstream to the confluence with Red Bird Creek (PRM 13.1) below

Boundary Dam. For purposes of the Aquatic Habitat Model development and Productivity Assessment, four reaches have been identified to describe this area (Figure 3.0-1). The first reach (Upper Reservoir Reach) is from Box Canyon Dam downstream to Metaline Falls. This reach is wide and shallow with a gentle slope. The second reach (Canyon Reach) is from Metaline Falls downstream to the mouth of the canyon. This reach is characterized by a deep, narrow gorge with steep walls. The third reach (Forebay Reach) is from the mouth of the canyon downstream to Boundary Dam. This reach is relatively wide and deep. The last reach (Tailrace Reach) is from Boundary Dam downstream to the confluence with Red Bird Creek. This reach is regulated both by flow releases from Boundary Dam and the operations of British Columbia Hydro (BC Hydro) at Seven Mile Dam.



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FERC PROJECT NO. 2144

Figure 3.0-1
Boundary Project area
and study reaches.

4 METHODS

The effects of Project operations on aquatic production are assessed using six indices of production: nutrients, phytoplankton, periphyton, aquatic macrophytes, zooplankton, and BMI. No attempt will be made to integrate the six indices into a measurement of total Reservoir production. Each production component will be assessed as a potential percent change relative to existing Project operations, and each constituent will be evaluated and reported as a separate index of production. Two separate approaches are proposed for the assessment. The first approach will be used for the attached fauna (macrophytes, BMI, and periphyton). The second approach will be used for nutrients and planktonic fauna.

The methodology for macrophytes, BMI, and periphyton will be to calculate potential habitat indices for existing Project operations and operations scenarios using the Aquatic Habitat Model and the Scenario Tool. Data describing the physical and hydraulic characteristics of the Pend Oreille River were collected during the 2007 field season along transects. Potential habitat conditions are to be modeled under Study 7, Aquatic Habitat Modeling Study once all available information becomes available. Information on the response of macrophytes, BMI, and periphyton to changes in hydraulic conditions will be developed as part of the HSI component of Study 7 (see the Study 7 Interim Report [SCL 2008a]). Habitat suitability information (i.e., HSI curves) represents a functional relationship between the independent variables depth, velocity, substrate, and frequency of inundation/dewatering and the response of organisms to a gradient of the independent variable (suitability), which is expressed over a scale of 0.0 (poor) to 1.0 (best). Output from the Scenario Tool and the Hydraulic Routing Model component of Study 7 (see the Study 7 Interim Report [SCL 2008a]) will predict hourly flow and water surface elevations at transects within the Project area. The Aquatic Habitat Model will be used to predict depth and velocities within cells, or transect subdivisions. The HSI curves will be used in the aquatic habitat model to quantify the area of Pend Oreille River channel containing potentially suitable habitat. This process will be repeated to determine an index of potential productivity for each of the macrophyte, BMI, and periphyton indices under existing Project operations and for operations scenarios to be evaluated by the Technical Scenarios Team.

Productivity for nutrients, phytoplankton, and zooplankton will be estimated using measurements of upper and lower bounding conditions, and interpolation between those bounds to estimate productivity under operations scenarios. Measurements of nutrients, phytoplankton, and zooplankton will be collected in Boundary Reservoir under operational and environmental conditions experienced in 2007 and 2008. The measurements of Project conditions will represent one bounding condition and will be compared to measurements of conditions in the Box Canyon tailrace or the Box Canyon Reservoir as the other bounding condition. Box Canyon Reservoir is located immediately upstream of the Boundary Project and is exposed to a smaller range of pool level fluctuation. Measurement of productivity indices in areas exposed to either Boundary Reservoir or Box Canyon operations will represent a contrast in operational conditions, and the effects of Boundary Project operations scenarios will be interpolated between the two bounding scenarios.

The effects of Project operations on nutrients, phytoplankton, and zooplankton may vary between littoral habitats and deep water habitats. The littoral area is assumed to extend to the

euphotic depth below the maximum Reservoir drawdown for the time period under consideration. The euphotic depth represents the depth where light intensity falls to 1 percent of the surface light. The euphotic depth will be estimated as three times the depth of Secchi disk readings (McLellan and O'Connor 2001). In order to evaluate both littoral and deep water habitats, Boundary Reservoir will be subdivided into deep water and littoral habitats based on the seasonal Secchi disk readings and channel cross-section data available from the Mainstem Aquatic Habitat Model (see the Study 7 Interim Report [SCL 2008a]). One result from the Mainstem Aquatic Habitat Model will be estimates of the amount of deep water and littoral habitat area under operations scenarios. Measurements of nutrients, phytoplankton and zooplankton data will be collected in both littoral and deep water areas in Boundary Reservoir to represent one bounding condition. Measurements of nutrients, phytoplankton and zooplankton will also be collected in littoral and deep water habitats in the Box Canyon tailrace. Interpolation between the bounding conditions (Boundary Reservoir 2007/2008 operations compared to Box Canyon operations) may identify differences in the effects of Project operations between littoral and deep water habitats.

Macrophytes colonize littoral areas and supply food and shelter, which enhance invertebrate production. The effects of Project operations on littoral habitat productivity may also be affected by the presence or absence of submerged or emergent aquatic macrophytes. Measurements of nutrients, phytoplankton, and zooplankton will be collected in littoral areas outside of macrophyte beds as part of Study 5, Water Quality Constituent and Productivity Monitoring (SCL 2008b).

Specific steps for calculating macrophyte, BMI, and periphyton indices, and interpolating productivity indices for nutrients, phytoplankton, and zooplankton, are outlined below.

4.1. Data Collection and Compilation

Data have been collected and compiled as they become available from other Boundary Project relicensing studies to be used in the productivity analyses. Data have been compiled from the following: Study 5 (SCL 2008b); Study 6, Relationship of pH and Dissolved Oxygen to Macrophytes (SCL 2008c); and the Aquatic Habitat Model (Macrophytes, Periphyton, and Macroinvertebrates subsection) of Study 7 (SCL 2008a). Detailed sampling methods implemented for collecting nutrient, phytoplankton, zooplankton, periphyton, benthic invertebrate, and aquatic macrophyte data are outlined in the Study 5, Study 6, and Study 7 interim reports.

Nutrient, Secchi depth, phytoplankton, and zooplankton data will be provided by Study 5 (methods are described in the Study 5 Interim Report [SCL 2008b]). These data will be available at eight stations by season in deep water and littoral habitats (see Study 5 [SCL 2008b]). Nutrient data will be in concentration form, Secchi depth data will be in meters, phytoplankton abundance will be presented as chlorophyll *a* concentration, and zooplankton data will be in organisms per unit volume. Additional indices of zooplankton abundance, such as species composition and size, will be developed as described in Study 5 (SCL 2008b). These indices are available to supplement and interpret changes in zooplankton abundance measured as organisms per unit volume. Nutrient data will only be available in the deep water habitats, while phytoplankton and zooplankton data will be available in the deep water habitat and littoral

habitats without macrophytes. As described in the Study 5 Interim Report (SCL 2008b), zooplankton will be collected every 2-hours over a 24-hour cycle to provide an indication of diurnal and drift changes in the zooplankton community. Total phosphorus and total Kjeldahl nitrogen (TKN) will be representative of nutrient requirements for productivity.

An assessment of macrophytes will be conducted under Study 7, macrophyte HSI development subsection. This information will be used in the aquatic habitat model to estimate the potential colonization area for macrophytes under operations scenarios. This information will then be combined with the information under the present study to estimate aquatic productivity for littoral habitats by reach.

Periphyton and BMI data will be generated to support results from the Aquatic Habitat Model from Study 7 (Appendix 3 and Appendix 4) (SCL 2008a). This sub-study will provide HSI information, which will be used in the Aquatic Habitat Model to quantify the effects of Boundary Project operations on BMI and periphyton. This information will then be combined with the information under the present study to estimate aquatic productivity for littoral habitats by reach. It is assumed the BMI data will be summarized in number per unit area and periphyton data will be summarized in biomass or chlorophyll *a* per unit area.

4.2. Field Sampling

Field sampling was and will be conducted to collect additional production data to be used in the productivity analyses. Field samples of nutrients, phytoplankton, and zooplankton in the Box Canyon forebay in both the littoral and deep water regions for all seasons. Data will be collected in the deep water region and littoral region (see Study 5 Interim Report [SCL 2008b]). A description of completed sampling for 2007 and scheduled sampling for 2008 is described in Table 4.2-1.

4.3. Estimate Production for Macrophytes, BMI, and Periphyton: Calculation Methodology

Indices of aquatic production (weighted usable area) for macrophytes, BMI, and periphyton under existing Project operations and each alternative operational scenario will be calculated using HSI curves and the aquatic habitat model. Each production constituent will be calculated and reported separately by reach. Using the HSI curves and information on the depth and velocity, the Aquatic Habitat Model will identify a habitat preference for each cell of the model. Each of these cells will be combined to estimate a potential weighted useable area for macrophytes, BMI, and periphyton.

Table 4.2-1. Summary of water quality field work completed in 2007 and scheduled for 2008.

Parameter	2007		2008	
	Month/Season	Reach	Month/Season	Reach
Nutrients (TP, SRP, TKN)	May, June, July, August, September, November	Box Canyon Tailrace, Metaline, Canyon, Forebay, Boundary Tailrace	January, March	Box Canyon Tailrace, Metaline, Canyon, Forebay, Boundary Tailrace
Chlorophyll-a	May, June, July, August, September, November	Box Canyon Tailrace, Metaline, Canyon, Forebay, Boundary Tailrace	January, March	Box Canyon Tailrace, Metaline, Canyon, Forebay, Boundary Tailrace
Secchi Disk Depth	May, June, July, August, September, November	Box Canyon Tailrace, Metaline, Canyon, Forebay, Boundary Tailrace	January, March	Box Canyon Tailrace, Metaline, Canyon, Forebay, Boundary Tailrace
Turbidity	May, June, July, August, September, November	Metaline, Canyon, Forebay, Boundary Tailrace	January, March	Metaline, Canyon, Forebay, Boundary Tailrace
Periphyton & BMI	Spring, Summer, Fall	Box Canyon Reservoir, Metaline, Canyon,	Winter	Box Canyon Reservoir, Metaline, Canyon,
Macrophyte Abundance & Distribution	August	Box Canyon Tailrace, Metaline, Canyon, Forebay	Not scheduled	n/a
Zooplankton	May, June, July, August, September, November	Box Canyon Tailrace, Metaline, Canyon, Forebay, Boundary Tailrace	January, March	Box Canyon Tailrace, Metaline, Canyon, Forebay, Boundary Tailrace
24-Hour Zooplankton Drift	May, August	Box Canyon Tailrace, Boundary Tailrace	January	Box Canyon Tailrace, Boundary Tailrace

4.4. Estimate Nutrient Concentrations and Phytoplankton and Zooplankton Production: Interpolation Methodology

Indices of aquatic production will be calculated for the 2007/2008 operations. Data collected in Boundary Reservoir as described in Sections 4.1 and 4.2, along with estimates of the littoral and deep water areas from the aquatic habitat model and areas with and without macrophyte growth from the habitat mapping task, will be used to estimate indices of 2007/2008 nutrient concentration, production for phytoplankton, and zooplankton.

Aquatic production in Boundary Reservoir will be calculated under the minimum expected range of pool level fluctuations. Nutrient concentration and phytoplankton and zooplankton production will be calculated and reported on separately by littoral and deep water areas within each reach.

The 2007/2008 operations and minimum pool level fluctuation scenarios will be used to bound aquatic productivity estimates and assess the relative amount of production under other operations scenarios. Relative production for other scenarios can be estimated by scaling the production information by the area of deep and littoral regions calculated for operations scenarios in Study 7.

The above interpolation methodology for nutrients, phytoplankton, and zooplankton relies on productivity information that may vary either longitudinally in the Reservoir, in the deep water versus littoral regions of the Reservoir, or in areas with and without macrophytes. For the interpolation methodology to be effective, it is assumed that the longitudinal variation in productivity is significantly less than the variation in productivity between the deep water and littoral regions. Box Canyon tailrace data will be used to estimate productivity at different locations in the reservoir under the minimum reservoir fluctuation scenario. However, it may not be appropriate to use the Box Canyon forebay or tailrace data if the longitudinal variation is substantial because it may not be representative of different locations in Boundary Reservoir. As a result, if data collection efforts find the longitudinal variation in productivity is significant, the outlined methodology will be inconclusive. Under these circumstances, the productivity analysis will instead have to rely on the measured data and general productivity characterizations to assess productivity under operations scenarios.

4.5. Compilation of Results

Each of the nutrient, phytoplankton, and zooplankton indices will be assessed as a potential percent change and each constituent will be evaluated and reported as a separate index of productivity. No attempt will be made to integrate the six indices into a single measurement of Reservoir productivity, and the number of organisms potentially produced under each operational scenario will not be quantified.

Detailed methods for this step are currently being developed and will be based on results of the Summary of Existing Information, review and initial assessment of data collected in Studies 5 and 6, and refinement of modeling and HSI approaches under Study 7.

5 PRELIMINARY RESULTS

Only data collected prior to September 2007 are included in this interim report. Periphyton and BMI data collected during late August/early September were not included in this interim report due to laboratory turnaround times.

5.1. Nutrients

Nutrient (nitrogen and phosphorus) concentrations were evaluated relative to levels measured within the Reservoir and any changes in concentration from one Reservoir reach to another (Appendix 1). Phosphorus is likely the limiting nutrient for overall production within Boundary Reservoir and therefore be the focus for evaluations involving the relationship to biological response.

Monthly nutrient samples were collected during the 2007 field season as part of Study 5 and are scheduled to be collected during January and March of 2008 (Table 5.1-1). Water quality sampling is not scheduled to occur after March 2008. Samples from both the pelagic and littoral zones were collected at the surface of all eight sites within the Project area (Table 5.1-2) and analyzed for phosphorous (total phosphorus [Total-P] and soluble reactive phosphorus [SRP])

and TKN (i.e., the combination of organic and ammonia nitrogen). SRP is an indicator of the amount of biologically active dissolved phosphorus (orthophosphate) that is readily available for use by flora and fauna (Wetzel and Likens 1979, Welch 1992).

Table 5.1-1. Water quality sampling locations.

Sample Site	Project River Mile	Location Description
Box Canyon Tailrace (V7)	34.3	In Boundary Reservoir just downstream of Box Canyon Dam
Wolf Creek (V1)	30.4	Adjacent to Wolf Creek inlet (upstream of Metaline Falls)
Metaline Old (V2)	28.1	Old channel of the Pend Oreille River across from the city of Metaline (upstream of Metaline Falls)
Pend Oreille Mine (V3)	25.4	Downstream of Pend Oreille Mine (downstream of Metaline Falls)
Slate Creek (V4)	22.2	Downstream of Slate Creek across from campsite on left bank (downstream of Metaline Falls)
Everett Creek Island (V5)	20.4	Upstream of Everett Creek Island (downstream of Metaline Falls)
Boundary Reservoir Forebay (V6)	17.65	Boundary Forebay
Boundary Tailrace (V8)	16.7	Downstream of Boundary Dam

Table 5.1-2. Sampling dates during May to August 2007.

Sample Site	May	June	July	August
Box Canyon Tailrace (V7)	23	25	23	15
Wolf Creek (V1)	23	25	23	16
Metaline Old (V2)	23	25	23	16
Pend Oreille Mine (V3)	22	19	24	25
Slate Creek (V4)	22	20	24	25
Everett Creek Island (V5)	22	20	24	25
Boundary Reservoir Forebay (V6)	22	20	24	25
Boundary Tailrace (V8)	23	25	25	14

Figures 5.1-1 through 5.1-3 display the results of the nutrient analyses for Total-P, SRP, and TKN, respectively. Samples that were below the detection limits were graphed at the detection limits (i.e., <1 microgram per liter [µg/L] for SRP and 200 µg/L for TKN). Concentrations of phosphorous and nitrogen were low and often below detection limits for SRP and TKN. SRP was especially limited and near or below detection all the time, indicating a phosphorous-limited system. Total-P was higher in June in both tailraces than anywhere else in the Reservoir.

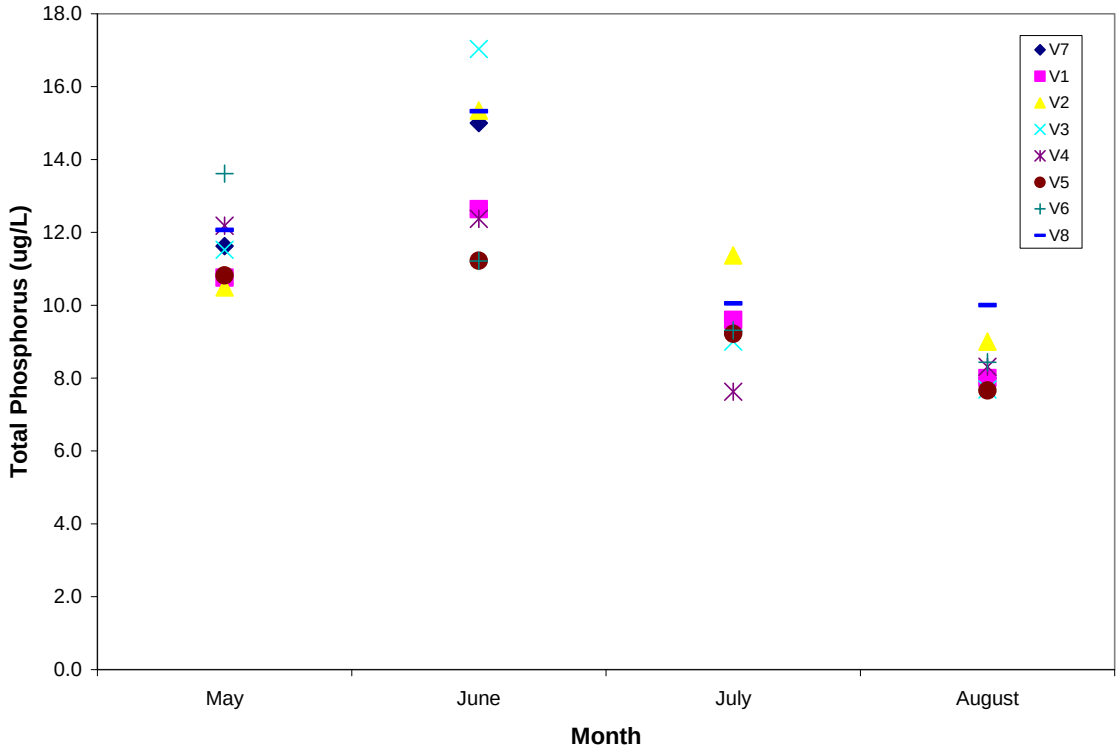

Figure 5.1-1. Total-phosphorus concentrations at Boundary Reservoir sites (May–August 2007).

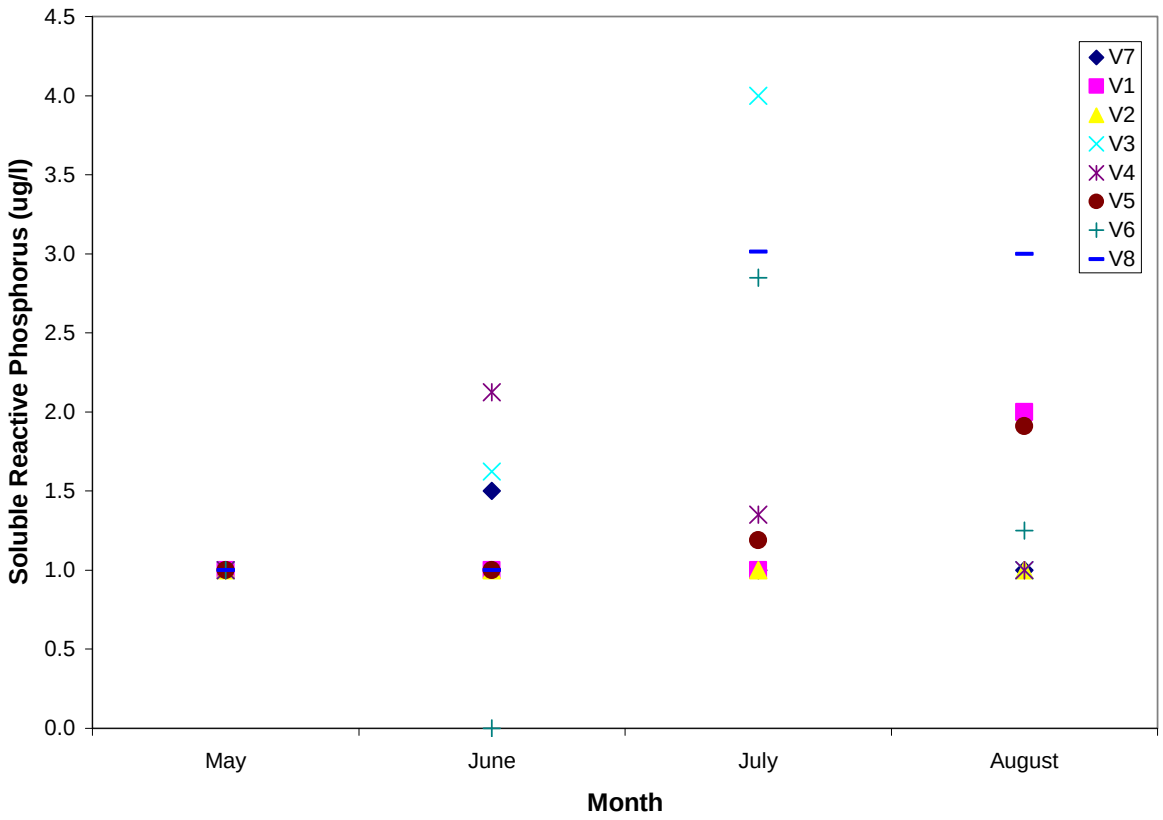

Figure 5.1-2. SRP (soluble reactive phosphorus) concentrations at Boundary Reservoir sites (May–August 2007).

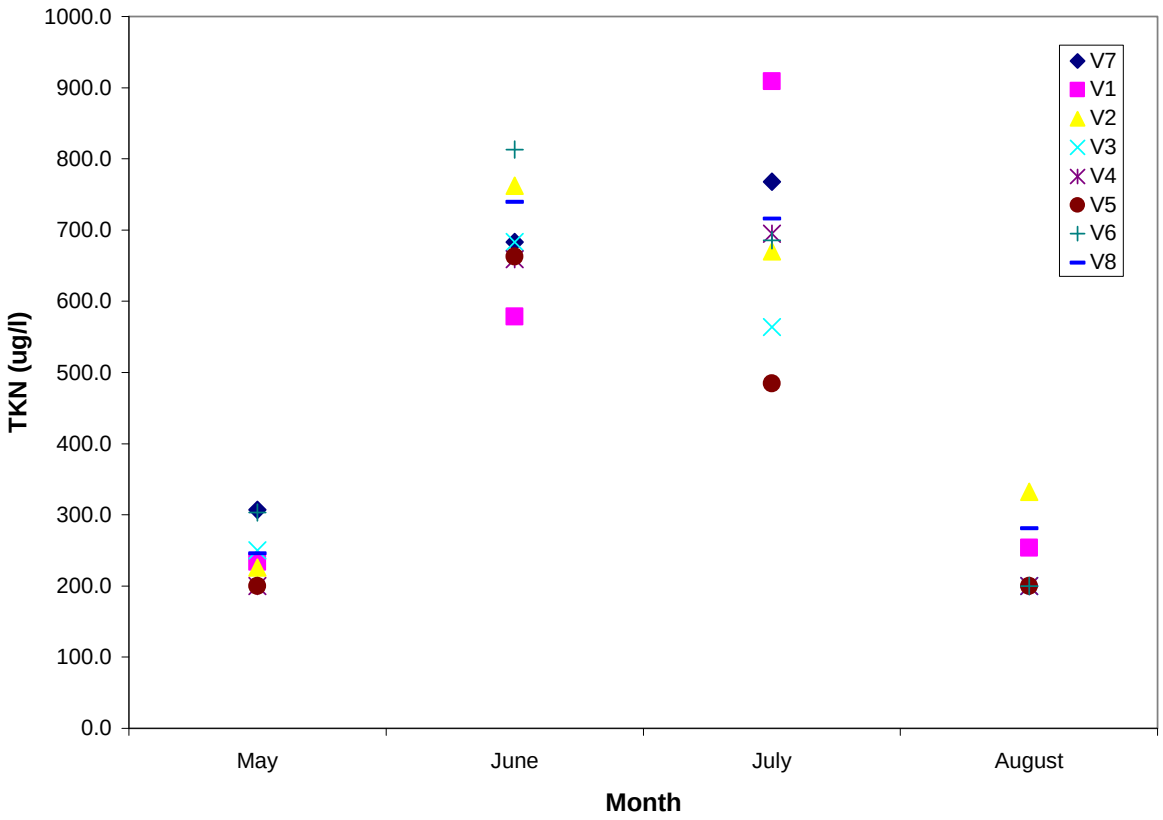

Figure 5.1-3. TKN (total Kjeldahl nitrogen) concentrations at Boundary Reservoir sites (May–August 2007).

A preliminary analysis was completed to determine the limiting nutrient concentrations within Boundary Reservoir. Determining the nitrogen to phosphorus (N:P) ratio of a waterbody is an acceptable method for determining the limiting nutrient of a system. If the N:P ratio is greater than the Redfield ratio (7.2:1 by weight), then a system is assumed to be phosphorus-limited (Welch and Jacoby 2004). Freshwater systems are usually phosphorus-limited unless they are located within very arid regions. Eutrophic lakes, those lakes with high productivity, tend to have low N:P ratios, around 10. Oligotrophic lakes, lakes with low productivity, have higher N:P ratios, around 70. Mesotrophic lakes, lakes with intermediate productivity, have N:P ratios around 20 to 30.

Boundary Reservoir N:P ratios were calculated based on the Total-P concentration and the TKN concentration at the surface of each site. Table 5.1-3 summarizes the N:P ratios calculated for each site within the Project area. N:P ratios within Boundary Reservoir and the tailrace varied from 16.4 to 94.7. Applying the Redfield ratio to the observed N:P ratios would indicate that Boundary Reservoir phytoplankton production is limited by the availability of phosphorus. This is especially true when considering the low concentrations of soluble reactive phosphorus observed. In a few instances, nitrogen concentrations were found to be below the lab detection limit of 200 µg/L. For these cases, the nitrogen concentration was set to the detection limit and the N:P ratio was calculated.

Boundary Reservoir N:P ratios indicate that phosphorus is the limiting nutrient within the system. N:P ratios calculated for the Project also indicate that the system is mesotrophic to oligotrophic, or has medium to low productivity.

Table 5.1-3. Boundary Reservoir N:P ratios from May to August 2007.

Site	Date	N:P Ratio
V1	5/23/2007	21.8
	6/25/2007	45.8
	7/23/2007	94.7
	8/16/2007	31.8
V2	5/23/2007	19.5 [1]
	6/25/2007	49.7
	7/23/2007	59.0
	8/16/2007	36.9
V3	5/22/2007	21.7
	6/19/2007	40.1
	7/24/2007	79.7
	8/25/2007	25.9 [1]
V4	5/22/2007	16.4 [1]
	6/20/2007	53.3
	7/24/2007	91.1
	8/25/2007	24.1 [1]
V5	5/22/2007	18.5 [1]
	6/20/2007	59.1
	7/24/2007	52.5
	8/25/2007	26.1 [1]
V6	5/22/2007	22.3
	6/20/2007	72.5
	7/24/2007	73.6
	8/25/2007	23.7 [1]
V7	5/23/2007	26.4
	6/25/2007	37.3
	7/23/2007	82.8
	8/15/2007	25.0 [1]
V8	5/23/2007	20.4
	6/25/2007	48.2
	7/25/2007	71.2
	8/14/2007	28.1

Notes:
1 Nitrogen was reported at below the detection limit; for calculation purposes the concentration of N was set to detection limit of 200 µg/L.

Final N:P ratios will be calculated for the Reservoir and each Reservoir reach once all the data have been collected to determine the extent of nutrient limitations within the system. Monthly nutrient concentrations will be presented in tabular form, along with means, maximums, and minimums for each station. Reservoir-wide summer mean, maximum, and minimum nutrient

concentrations will also be calculated as part of Study 5 and used to evaluate nutrient influence on Reservoir production.

5.2. Phytoplankton

Phytoplankton will be measured and evaluated as a function of chlorophyll *a* concentration. Field results for phytoplankton studies are found in Appendix 2. Light is included in this assessment as well as nutrients as limiting factors. Light is evaluated as a function of Secchi disk and turbidity, both of which parameters were measured in Study 5 (SCL 2008b). From Study 5, monthly chlorophyll *a* concentrations from all eight sampling locations are presented. These chlorophyll *a* concentrations include concentrations in both pelagic and littoral zones, surface, and 15-foot depths. Chlorophyll *a* concentrations at the surface will be compared to concentrations at 15 feet to determine if light availability is a limiting factor. Light availability is a critical component in production of phytoplankton communities. Depending on physical and biological properties in the water column, light attenuation will occur with increasing depth. If light availability is lower at greater depth, then rate of photosynthetic activity and phytoplankton production will be lower than nearer the surface. Relationships between chlorophyll *a*, phosphorus, Secchi disk, and turbidity will be determined.

Figure 5.2-1 presents chlorophyll *a* concentrations within the Project area at pelagic and littoral regions for May to August 2007. Chlorophyll *a* concentrations ranged from 0.9 µg/L in the littoral zone at Site V6 during August to 5.2 µg/L at 15 feet in the pelagic zone at Site V6 in June. There appears to be a decrease in chlorophyll *a* concentrations throughout the reservoir from June to July. This decrease is most likely due to a decline in inflow nutrient concentrations related to a decrease in flow or simply a decrease in inflow of phytoplankton from upstream. After preliminary analysis, chlorophyll *a* concentrations in the pelagic regions of the Reservoir do not seem to vary from concentrations found in the littoral regions of the Reservoir. There also does not seem to be a significant change in chlorophyll *a* concentrations longitudinally in the Reservoir.

Chlorophyll *a* concentrations found within Boundary Reservoir suggest that the system is oligotrophic to mesotrophic (SCL 2008b, Welch and Jacoby 2004). High flows and associated nutrients result in higher chlorophyll *a* concentrations in May and June than in July and August, suggesting higher productivity within the Reservoir during the spring runoff months or higher transfer from upstream production. During July and August, chlorophyll *a* concentrations decreased to below 2.8 µg/L, indicating that the reservoir is an oligotrophic or low productivity system.

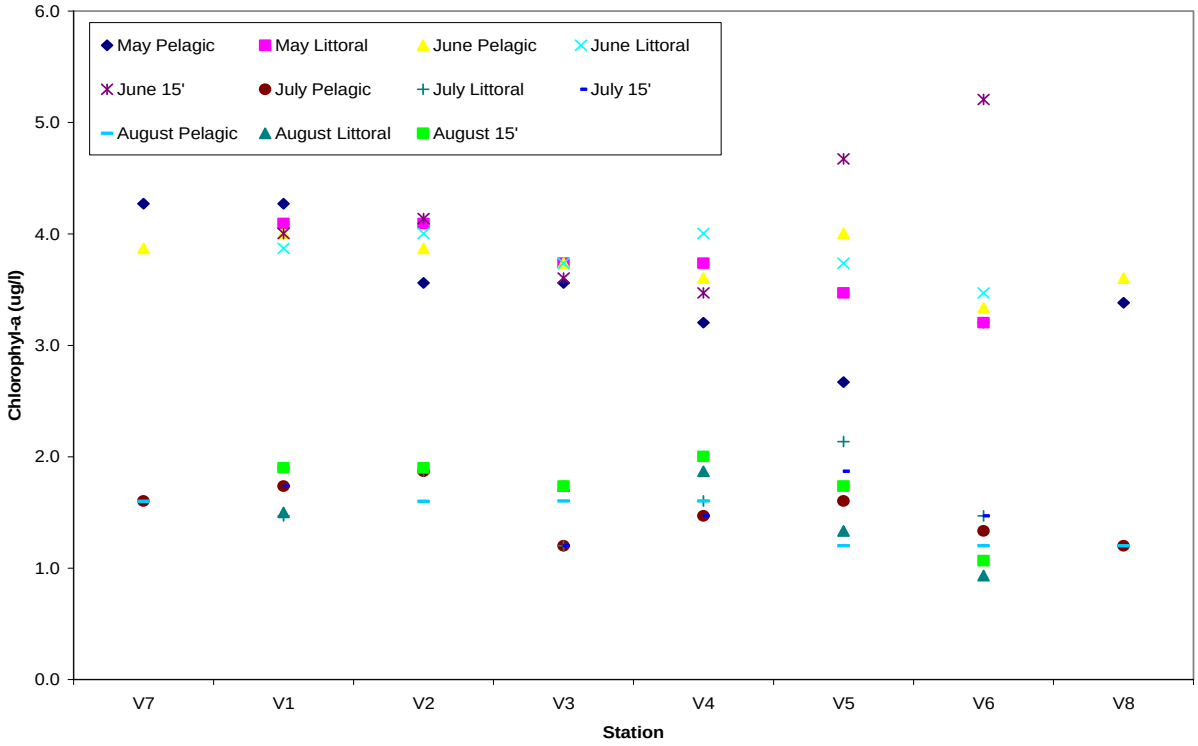

Figure 5.2-1. Boundary Reservoir chlorophyll *a* concentrations (May–August 2007).

Light is also a potential limiting factor to aquatic productivity. Secchi disk depth, an index of water clarity, was used as a measure of light and was compared to chlorophyll *a* concentrations. Secchi disk depths were measured at each site within the Project area during each sampling event. Mean Secchi disk depths were 2.0 meters (6.6 feet) for May, 1.8 meters (5.9 feet) for June, 4.4 meters (14.4 feet) for July and 5.1 meters (16.7 feet) for August. The mean Secchi disk depth measurements indicate that Boundary Reservoir is an oligotrophic to mesotrophic system, or a low to medium productive system. Carlson (1977) states that a summer mean Secchi disk depth of greater than 3.6 meters (11.8 feet) is characteristic of an oligotrophic waterbody.

The increasing trend in Secchi disk depth readings between May and August is most likely due to a decrease in chlorophyll *a* concentrations entering Boundary Reservoir from upstream. Figure 5.2-2 shows the relationship between Secchi disk depth and chlorophyll *a* concentrations in Boundary Reservoir and tailrace. The strong relationship between chlorophyll *a* concentrations and depth are confirmed by the high correlation coefficient (e.g., $R^2 = 81$ percent). This relationship demonstrated that chlorophyll *a* concentrations are greatest near the surface of the water and decline with increasing depth (Figure 5.2-2).

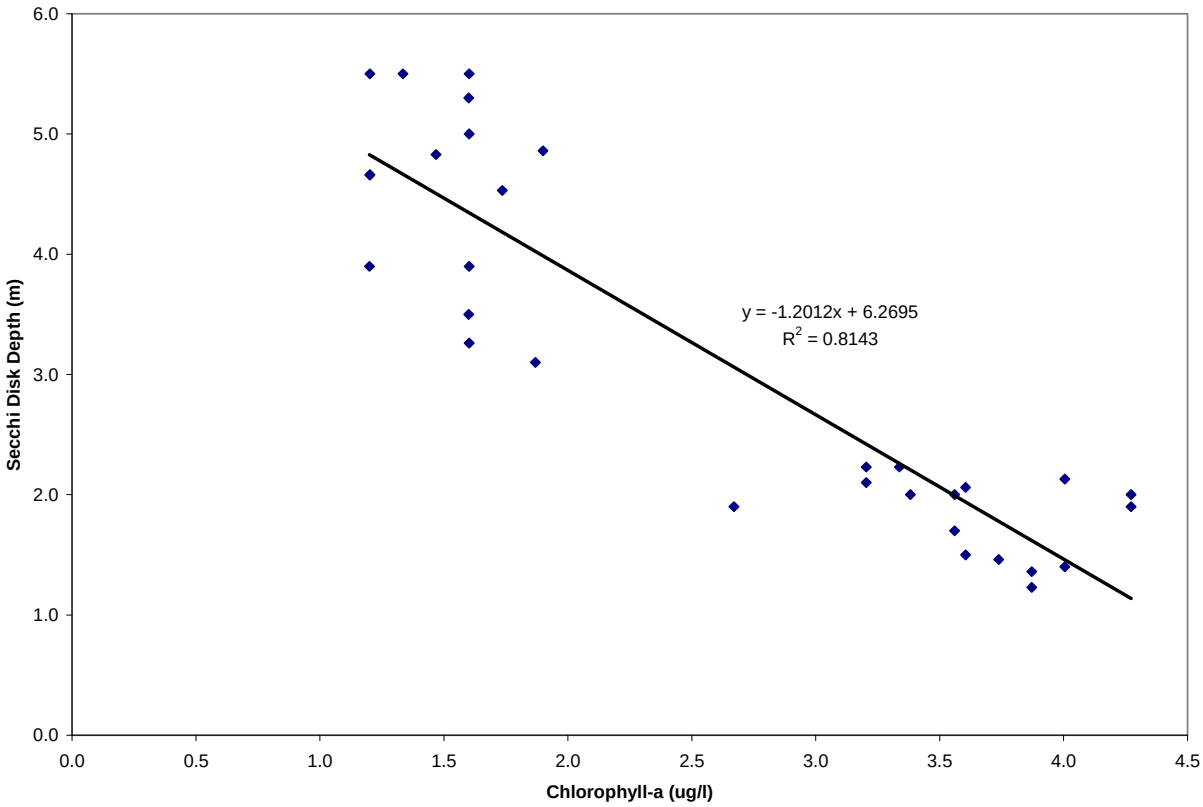

Figure 5.2-2. Relationship between Secchi disk depth and chlorophyll *a* concentration based on data collected in the Boundary Reservoir and tailrace (monthly readings, May–August 2007).

Turbidity also affects the availability of light through the water column. Turbidity measurements were collected in the littoral and pelagic regions of four sites (V1, V3, V6, and V8) within the Project area. Pelagic and littoral turbidity measurements were similar throughout the Boundary Reservoir with a possible decreasing trend from May to August. The higher turbidity measurements seen in May and June as compared to July and August are most likely due to higher inflows during the spring months. Figure 5.2-3 presents Boundary Reservoir pelagic and littoral turbidity averages and standard deviations. Further analysis will be conducted as all data become available.

5.3. Periphyton Communities

Appendix 3 of the Study 7 Interim Report (SCL 2008a) includes information and preliminary results for sampling events conducted up to September 1, 2007. Periphyton monitoring on hard substrate to this date has been conducted during two different seasons: *spring* and *summer*. Periphyton artificial substrate baskets were retrieved from both Boundary Reservoir and Box Canyon Reservoir after 8 weeks of exposure. *Spring* periphyton samples were retrieved at the end of May and *summer* samples retrieved the first of September (Appendix 3).

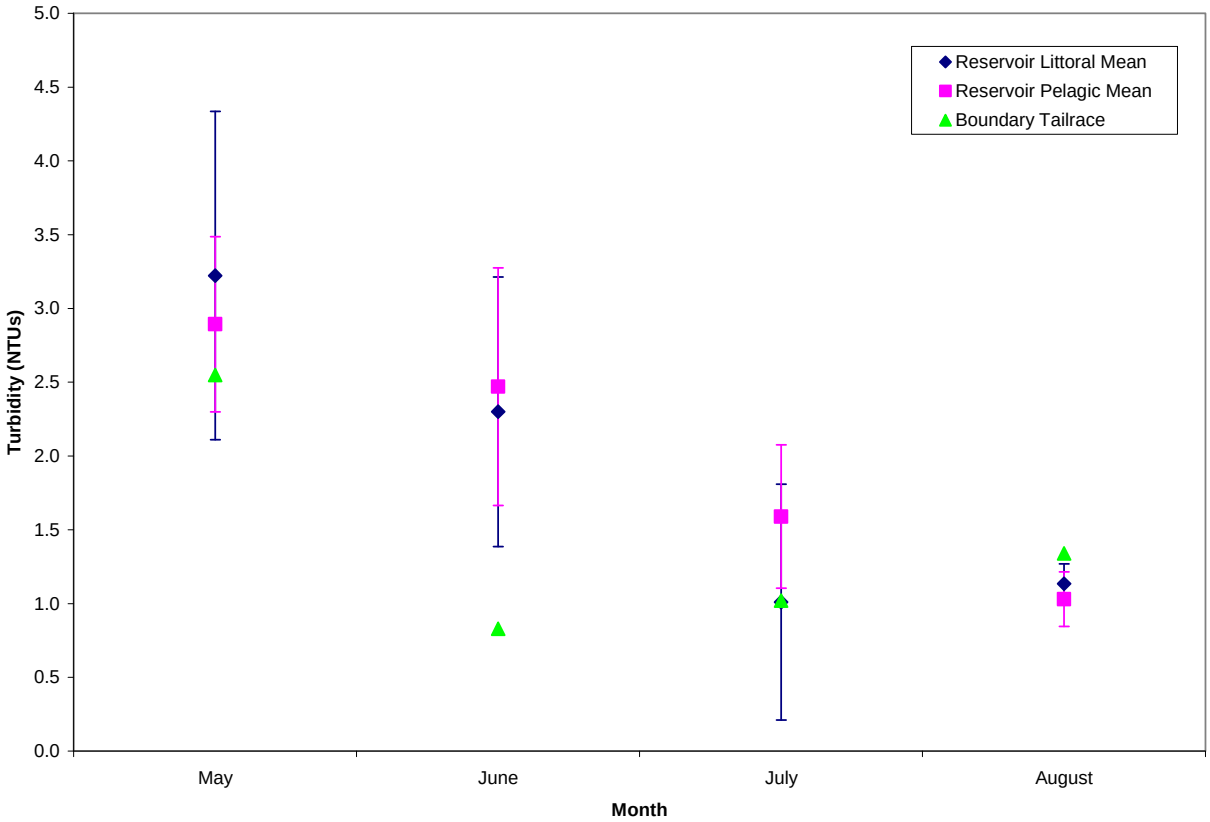

Figure 5.2-3. Boundary Reservoir turbidity measurements (monthly readings, May–August 2007).

As part of the experimental design, artificial substrate baskets were placed at elevations (2- and 5-foot elevation intervals) where baskets would be subject to dewatering due to fluctuations in pool surface elevations. This was done to help better understand the impacts of inundation and dewatering on periphyton growth in Boundary Reservoir. Samples that were dewatered at the time of retrieval during the *summer* were analyzed for chlorophyll *a* in order to determine whether viable chlorophyll *a* cells were present. It was determined from these analyses that samples collected from dewatered baskets have little viable chlorophyll *a* present and laboratory results were close to detection limits.

Site-specific periphyton data has also been collected for the fall season in Boundary and Box Canyon reservoirs. Hard substrate baskets were retrieved the first week of November 2007, but sample processing and taxonomic identification were not available for this interim report. Artificial hard substrate baskets were deployed for the winter season sampling event the first week of December 2007 and are scheduled to be retrieved at the beginning of February 2008. All periphyton data collected during 2007 and 2008 will be used along with results from the hydraulic model to validate the literature-based HSI curve. The hydraulic model being developed will provide information on water surface elevations, water velocities, and duration of inundation and dewatering that will be used in conjunction with the site-specific periphyton data collected to validate the periphyton HSI model for Boundary Reservoir. On the first deployment date, the water surface elevation in both Boundary and Box Canyon reservoirs were marked

using orange spray paint. These water marks were set as the zero mark for the remaining deployments and all baskets were placed at elevation intervals from these marks. The water surface elevation on the first day of deployment for Lower Boundary Reservoir and Upper Boundary Reservoir will be determined once the hydraulic model is complete. Date and time for establishment of the zero mark were recorded.

Figures presenting water surface elevations at each Boundary Reservoir treatment site during the sampling period will be added to the report once the data becomes available. The hydraulic routing model, which is currently being developed, will provide information on site-specific water surface elevations. Once the model is completed the water surface elevations at each treatment site will be used to better understand the periphyton biomass results. Hourly water surface elevations in Box Canyon Reservoir during sampling periods will also be presented in graphical form once the data are available. These data will not be available until field data collection efforts are completed in February 2008.

5.3.1. Vertical Treatment Sites

Figures 5.3-1 and 5.3-2 graphically present the average periphyton biomass (mg/m^2) at each vertical treatment site and elevation interval for samples collected in May and September respectively. Tables 5.3-1 and 5.3-2 summarize the periphyton biomass found in vertical treatment samples collected in May and September.

Average *spring* periphyton biomass concentrations at vertical treatment sites ranged from 1.44 to 3.86 milligrams per square meter (mg/m^2) for all elevation intervals. Due to water fluctuation, hard substrate baskets placed at the 2-foot and 5-foot elevation intervals in lower Boundary Reservoir were dewatered at the time of *spring* retrieval. Average *spring* periphyton biomass appears to be similar at vertical treatment sites in lower Boundary and Box Canyon Reservoirs. Both vertical treatment sites show a decrease (48 percent and 63 percent, respectively) in *spring* periphyton biomass as the elevation interval increases from 10 feet to 40 feet (Figure 5.2-1).

There was a larger variability in *summer* periphyton biomass at vertical treatment sites in Boundary and Box Canyon Reservoirs than spring biomass. Average *summer* periphyton biomass at vertical treatment sites ranged from 0.55 to 22.85 mg/m^2 for all elevation intervals. Baskets placed at the 2-foot elevation interval in Box Canyon were dewatered at the time of retrieval. The highest *summer* periphyton biomass for vertical treatment sites was seen at the 5-foot elevation interval in lower Boundary and Box Canyon Reservoirs (Figure 5.3-2). *Summer* periphyton biomass is higher at the lower Boundary Reservoir vertical site for all elevation intervals than at the vertical site in Box Canyon (Figure 5.3-2). There also appears to be a strong decreasing trend (95 percent reduction) in *summer* periphyton biomass at the vertical site in lower Boundary Reservoir with the exception of biomass found at the 10-foot elevation interval.

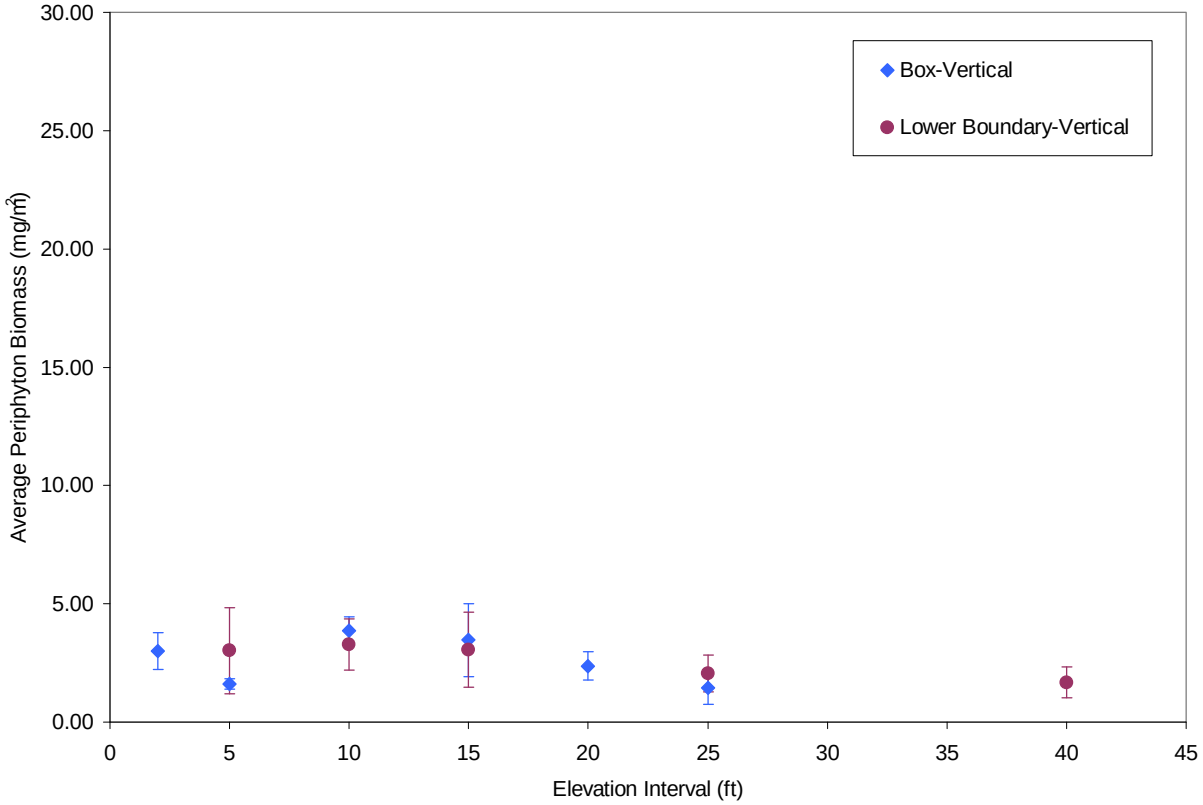

Figure 5.3-1. *Spring* average periphyton biomass for vertical sites retrieved May 2007.

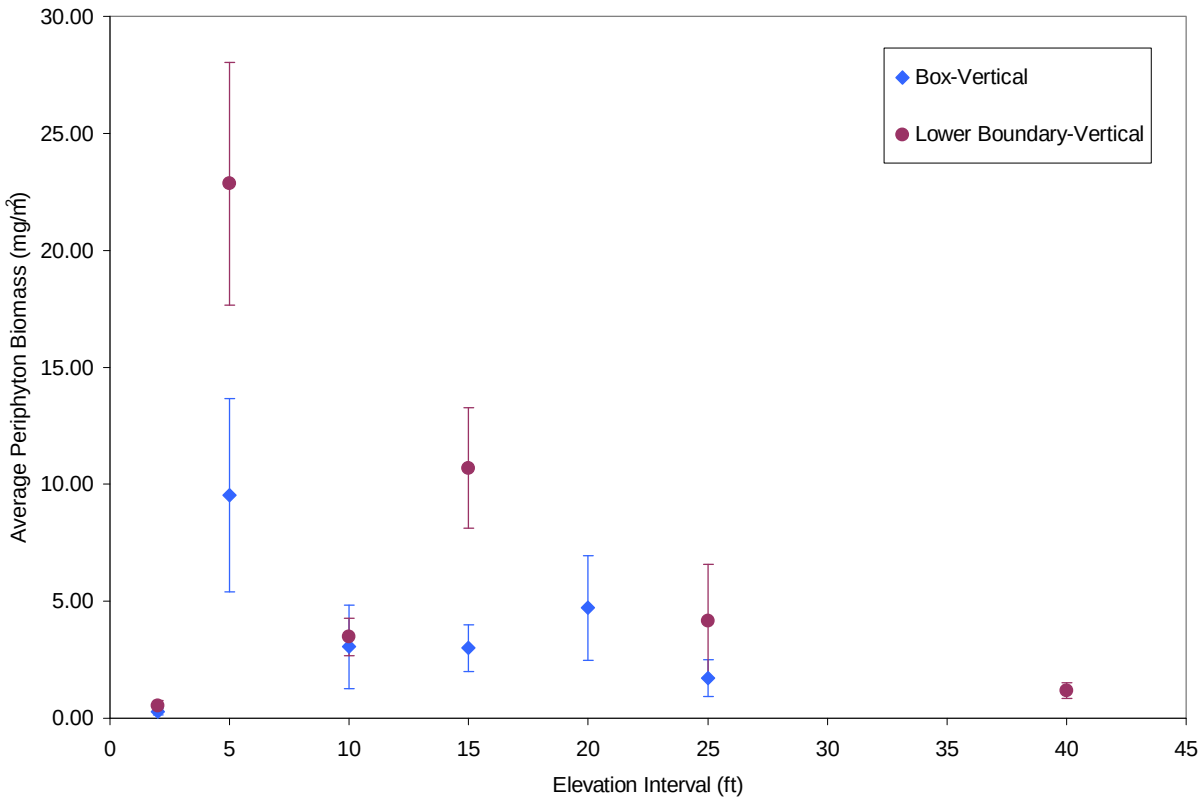

Figure 5.3-2. *Summer* average periphyton biomass for vertical sites retrieved September 2007.

Table 5.3-1. Summary of *spring* average periphyton biomass (standard deviations) for vertical treatment sites in Boundary and Box Canyon reservoirs May 2007.

Date	Elevation Interval	Average Periphyton Biomass (mg/m^2) with (Standard Deviations)	
		Lower Vertical	Box Vertical
May	2	- (DRY)	3.00 (0.79)
	5	3.02 (1.81)	1.62 (0.22)
	10	3.28 (1.07)	3.86 (0.58)
	15	3.05 (1.59)	3.47 (1.55)
	20	-	2.37 (0.59)
	25	2.06 (0.78)	1.44 (0.69)
	40	1.68 (0.65)	-

Table 5.3-2. Summary of *summer* average periphyton biomass (standard deviations) for vertical treatment sites in Boundary and Box Canyon reservoirs September 2007.

Date	Elevation Interval	Average Periphyton Biomass (mg/m^2) with (Standard Deviations)	
		Lower Vertical	Box Vertical
September	2	0.55 (0.21)	0.28 (DRY) (0.13)
	5	22.85 (5.19)	9.53 (4.13)
	10	3.48 (0.79)	3.05 (1.79)
	15	10.70 (2.57)	3.00 (0.99)
	20	-	4.71 (2.22)
	25	4.16 (2.43)	1.71 (0.78)
	40	1.19 (0.33)	-

5.3.2. Shoreline Treatment Sites

Figures 5.3-3 and 5.3-4 graphically present the average periphyton biomass (mg/m^2) at each shoreline treatment site and elevation interval for samples collected in May and September respectively. Tables 5.3-3 and 5.3-4 summarize the average periphyton biomass found in shoreline treatment samples collected in May and September.

Average *spring* periphyton biomass for shoreline sites ranged from 0.68 to 5.46 mg/m^2. Baskets placed at the 2-foot and 5-foot elevation intervals in lower Boundary Reservoir were dewatered at the time of retrieval. Baskets placed at the 2-foot elevation interval in upper Boundary Reservoir were also dewatered at the time of retrieval in May.

Upper Boundary Reservoir shoreline sites were slightly higher in periphyton biomass than lower Boundary and Box Canyon reservoir shoreline sites at elevation intervals of 10, 15, and 25 feet (Figure 5.3-3). *Spring* periphyton biomass at upper Boundary and Box Canyon Reservoir shoreline sites decreased (88 percent and 74 percent reduction, respectively) with increasing

elevation interval 10 to 40 feet. *Spring* periphyton biomass appears to stabilize at lower Boundary Reservoir shoreline sites deeper than the 10-foot elevation interval (Figure 5.2-3 and Table 5.2-3).

Average *summer* periphyton biomass ranged from 0.81 to 12.81 mg/m^2 for shoreline sites. Hard substrate baskets deployed at the 2-foot elevation interval in upper Boundary and Box Canyon reservoirs were dewatered at the time of retrieval at the end of August. Baskets deployed at the 5-foot elevation interval in upper Boundary Reservoir were also dewatered at the time of retrieval.

Overall *summer* periphyton chlorophyll *a* levels were larger and much more variable than chlorophyll *a* levels seen during the *spring*. This is especially true for periphyton chlorophyll *a* on baskets placed at the 5 foot elevation interval at shoreline sites in Lower Boundary and Box Canyon reservoirs (Figure 5.3-4). The highest periphyton chlorophyll *a* at the Upper Boundary shoreline site was seen at the 15 foot elevation interval. Some of this variability may be due to temporal exposure from artificial drawdowns in support of other studies during August 2007 limiting periphytic growth at the 5 foot and 10 foot elevation intervals. Some variability expressed as a bimodal pattern in the summer chlorophyll *a* concentrations indicate that periphyton growth is being affected by other factors and potential seasonal conditions beyond light. Additional analysis of the data will be attempted to try to isolate controlling factors once all of the periphyton data has been collected and available for comprehensive analysis relative to validation of the HSI curves.

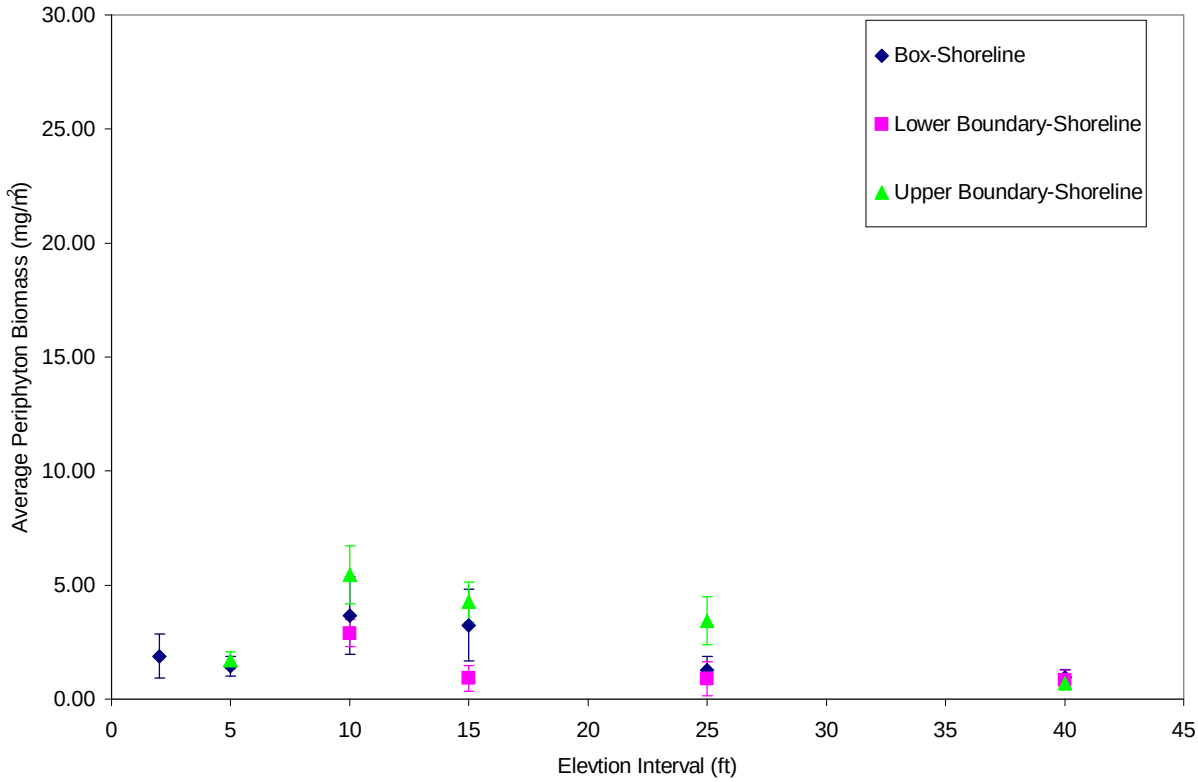

Figure 5.3-3. *Spring* average periphyton biomass for shoreline sites retrieved May 2007.

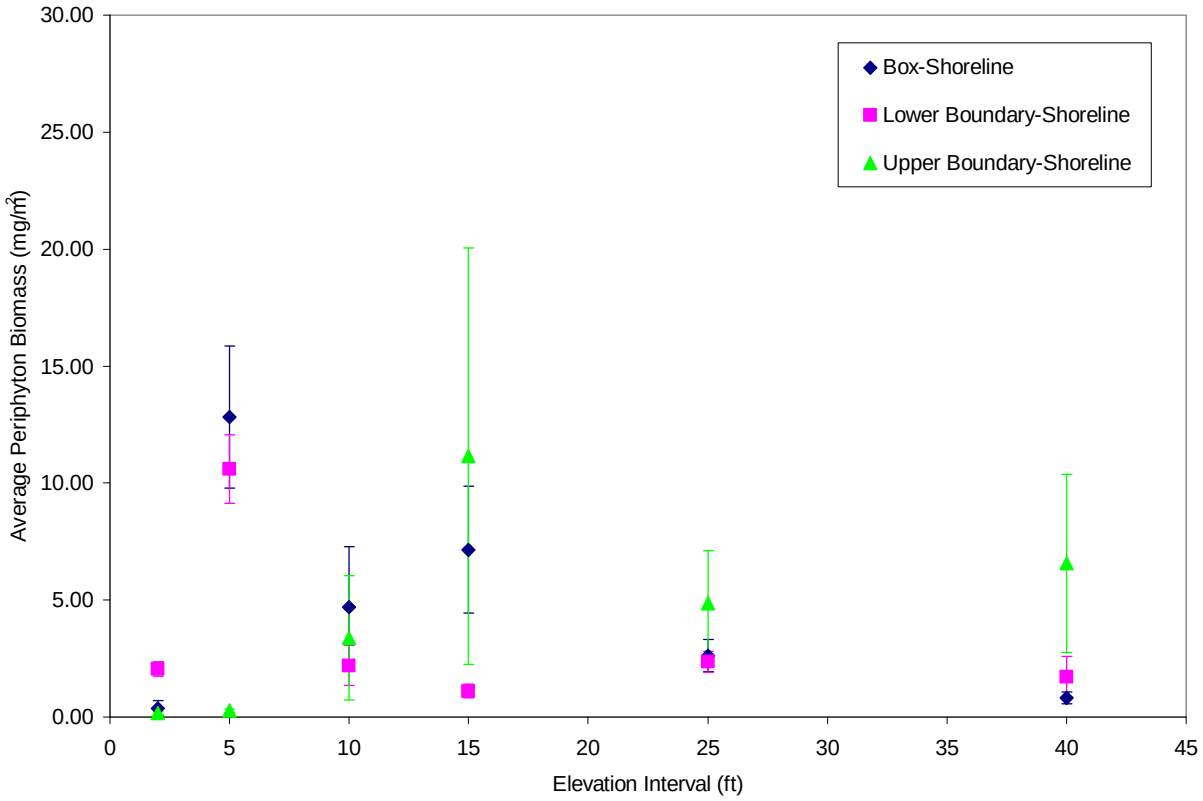

Figure 5.3-4. *Summer* average periphyton biomass for shoreline sites retrieved September 2007.

Table 5.3-3. Summary of *spring* average periphyton biomass (standard deviations) for shoreline treatment sites in Boundary and Box Canyon reservoirs May 2007.

Date	Elevation Interval	Average Periphyton Biomass (mg/m^2) with (Standard Deviations)		
		Lower Shoreline	Upper Shoreline	Box Shoreline
May	2	- (DRY)	- (DRY)	1.88 (0.96)
	5	- (DRY)	1.70 (0.37)	1.43 (0.43)
	10	2.89 (0.59)	5.46 (1.27)	3.65 (1.70)
	15	0.91 (0.56)	4.26 (0.88)	3.24 (1.57)
	20	-	-	-
	25	0.89 (0.75)	3.44 (1.05)	1.28 (0.59)
	40	0.85 (0.41)	0.68 (0.28)	0.95 (0.36)

Table 5.3-4. Summary of *summer* average periphyton biomass (standard deviations) for shoreline treatment sites in Boundary and Box Canyon reservoirs September 2007.

Date	Elevation Interval	Average Periphyton Biomass (mg/m^2) with (Standard Deviations)		
		Lower Shoreline	Upper Shoreline	Box Shoreline
September	2	2.05 (0.32)	0.17 (DRY) (0.05)	0.38 (DRY) (0.33)
	5	10.61 (1.46)	0.27 (DRY) (0.07)	12.81 (3.03)
	10	2.20 (0.85)	3.38 (2.65)	4.71 (2.58)
	15	1.11 (0.30)	11.15 (8.90)	7.14 (2.71)
	20	-	-	-
	25	2.37 (0.45)	4.86 (2.24)	2.62 (0.70)
	40	1.71 (0.88)	6.57 (3.82)	0.81 (0.25)

5.3.3. Periphyton Colonization Rates

Colonization baskets were deployed in Box Canyon Reservoir beginning July 6, 2007, and ending August 28, 2007, to determine summer periphyton colonization rates in a low water fluctuation area. Hard substrate baskets were deployed at time intervals of 8, 6, 4, and 2 weeks, 1 week, and 3 days. Winter colonization sampling has begun with the first colonization basket deployed during the first week of December 2007. Winter colonization baskets will continue to be deployed until January 30, 2008.

Average *summer* periphyton biomass collected from colonization baskets in Box Canyon Reservoir are shown in Figure 5.3-5 and summarized in Table 5.3-5. Average *summer* periphyton colonization rates were calculated by depth and are presented in Figure 5.3-6. A figure presenting hourly water surface elevations in Box Canyon Reservoir during the time colonization baskets were deployed will be incorporated into the report once the data are available. Water surface elevation data will be available after field data collection efforts are completed in February 2008.

Average *summer* periphyton biomass collected from colonization baskets ranged from 0.80 to 17.02 mg/m^2 at all elevation intervals (5, 15, and 25 feet). The highest periphyton biomass was seen at the 5-foot elevation interval and after 42 days (6 weeks) of exposure. The lowest periphyton biomass was seen at the 25-foot elevation interval after only 3 days of exposure. *Summer* periphyton colonization rates varied from 0.24 to 0.55 mg/m^2-day for baskets at the 5-foot elevation interval, 0.11 to 0.35 mg/m^2-day for baskets at the 15-foot elevation interval, and 0.04 to 0.27 mg/m^2-day for baskets at the 25-foot elevation interval. Average *summer* colonization rates were 0.38, 0.23, and 0.18 mg/m^2-day for baskets at 5-, 15-, and 25-foot elevation intervals, respectively. Overall, the average *summer* periphyton colonization for hard substrate in Box Canyon Reservoir was determined to be 0.26 mg/m^2-day.

The average colonization rates determined for *summer*, *winter*, and *spring* periods for Box Canyon Reservoir will be used along with water surface elevations obtained from the hydraulic model to validate the literature-based HSI model. Specifically, the colonization data collected will be used to validate the duration of inundation and dewatering portion of the periphyton HSI model.

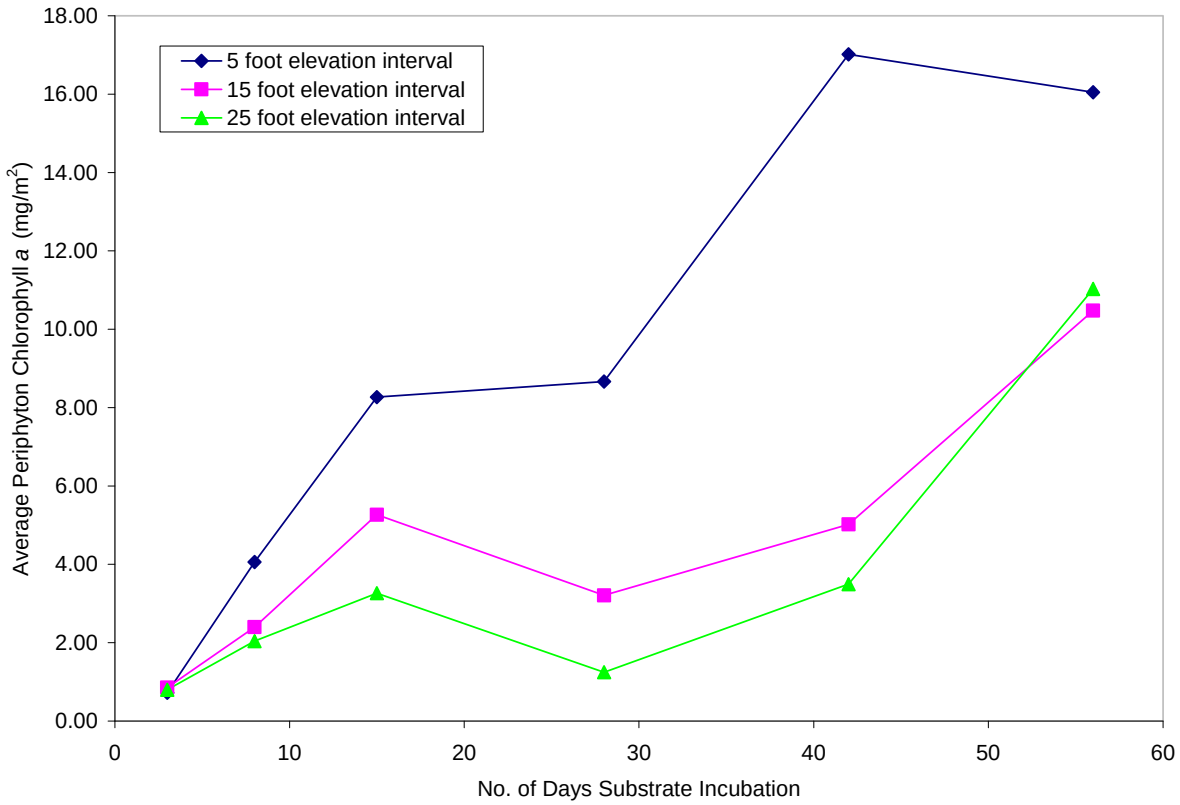

Figure 5.3-5. Average *summer* periphyton biomass collected at depths of 5, 15, and 25 feet in Box Canyon Reservoir after various days of incubation.

Table 5.3-5. Average *summer* periphyton biomass and colonization rates per elevation interval and number of days exposed in Box Canyon Reservoir.

Date Retrieved	No. of Days Exposed	Elevation Interval	Average Periphyton Biomass (mg/m^2)	Periphyton Colonization Rate (mg/m^2-day)
September	56	5	16.05	0.29
		15	10.47	0.19
		25	11.03	0.20
	42	5	17.02	0.41
		15	5.02	0.12
		25	3.50	0.08
	28	5	8.67	0.31
		15	3.21	0.11
		25	1.25	0.04
	15	5	8.27	0.55
		15	5.26	0.35
		25	3.27	0.22
	8	5	4.06	0.51
		15	2.40	0.30
		25	2.04	0.26
	3	5	0.72	0.24
		15	0.85	0.28
		25	0.80	0.27

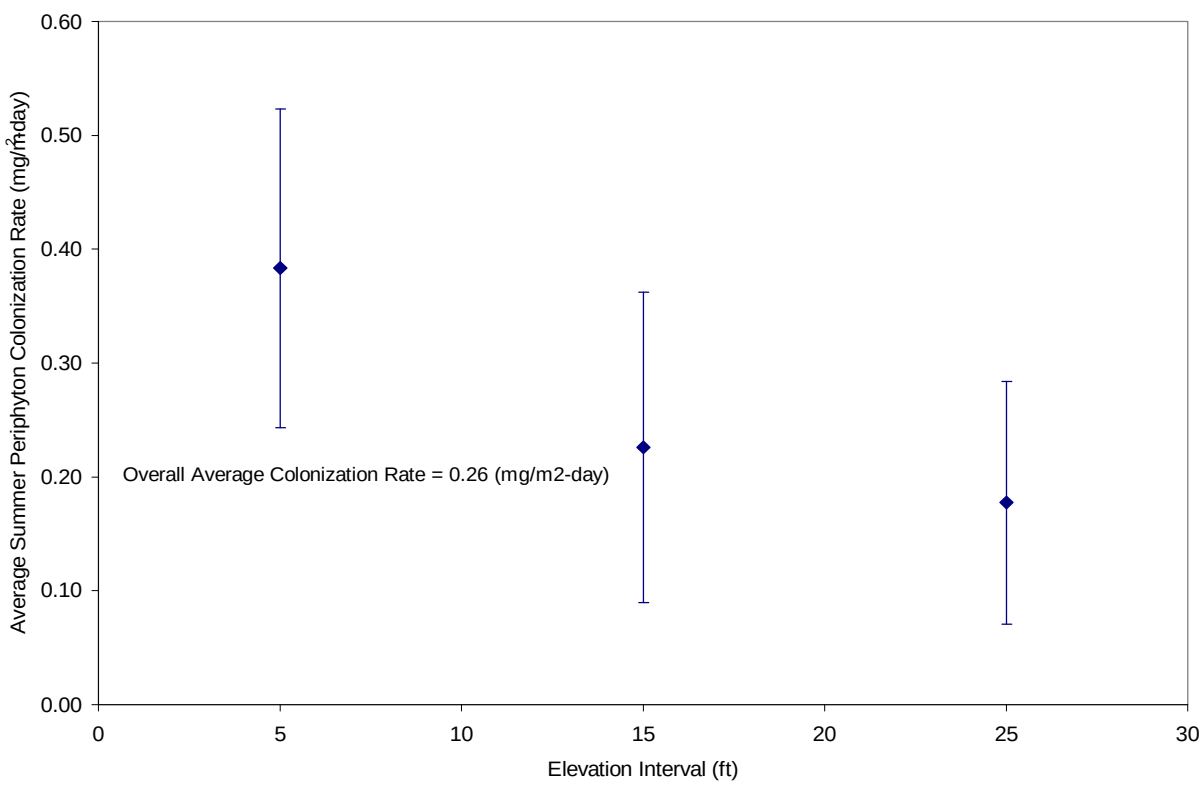

Figure 5.3-6. Average *summer* periphyton colonization rate, 2007.

5.4. Aquatic Macrophytes

Macrophyte coverage and density measurements as well as the corresponding HSI evaluations were conducted in Study 7. The results of Study 7 will be used as evaluation elements for macrophyte production relative to existing Project operations. Locations for macrophyte monitoring and extent of beds are described in detail in the Study 6 Interim Report (Section 4) (SCL 2008c). Table 5.4-1 summarizes the macrophyte species found in upper and lower Boundary Reservoir.

Table 5.4-1. Macrophyte species in Boundary Reservoir.

Scientific Name	Common Name	Status
Myriophyllum sibericum	northern milfoil	Native
Myriophyllum spicatum	Eurasian watermilfoil	Non-native invasive
Ceratophyllum demersum	Coontail	Native
Elodea canadensis	common waterweed	Native
Potamogeton crispus	curly pondweed	Non-native invasive
Potamogeton pectinatus	sago pondweed	Native
Potamogeton vaginatus	sheathing pondweed	Native
Potamogeton richardsonii	Richardson's pondweed	Native
Potamogeton zosteriformis	flat-stem pondweed	Native
Ranunculus aquatilis	white water buttercup	Native

Macrophyte beds covered 18.6 acres in the Canyon and Forebay reaches and 137.6 acres in Upper Reservoir Reach. Eurasian watermilfoil (*Potamogeton* species) and coontail were the dominant plant species found in Boundary Reservoir.

5.5. Zooplankton

Zooplankton densities and biomass measurements were conducted in Study 5. The results of this study will be used as evaluation elements for zooplankton production (see Appendix 5, Study 5 Interim Report [SCL 2008b]) relative to existing Project operations. Monthly zooplankton samples were collected in both the pelagic (vertical tows from bottom to surface) and littoral zones of the Reservoir. Seasonal zooplankton drift data were collected in June and August. Laboratory data for these samples are only partially complete to date. Once all zooplankton data are processed, detailed analysis of the data will be conducted and production assessments completed. In general, relative to the completed taxonomic identification data (see Tables 5.5-1 and 5.5-2), the following preliminary observations can be made:

- Rotifers make-up over 95 percent of the zooplankton numerical density, but only 30 to 70 percent of the zooplankton biomass.
- Copepods including nauplii (immatures) made up 2 to 5 percent of the zooplankton numerical density, but 30 to 70 percent of the zooplankton biomass.
- Cladocerans were relatively rare organisms accounting for less than 1 percent of the zooplankton numerical density, but because of their larger size were 0 to 19 percent of the zooplankton biomass

- Overall abundance of zooplankton is low and consistent with a low productivity system (oligotrophic), which is similar to the conclusion by McLellan and O'Connor (2001).

Direct comparisons to the McLellan and O'Connor (2001) study are difficult because in that study zooplankton were collected exclusively from the euphotic zone while this study sampled the total water column depth for the pelagic samples and fixed depth for the seasonal drift samples. Direct numerical comparison with these historical data is also made difficult because it was shown that the water column of Boundary Reservoir is completely mixed (Study 5) and this will likely have an effect on both phytoplankton and zooplankton distribution. Consequently, differences in results observed by McLellan and O'Connor (2001) and the current study may be explained, at least in part, by differences in the sampling protocols used.

Summary results of the 24-hour drift samples from June for the Boundary Tailrace station (V8) of this sampling effort are presented in Table 5.5-1, and the raw data are in Appendix 4 (Table A.4-1). These data reflect similar community structure as discussed above and below. A more thorough analysis of the zooplankton data as well as historical comparisons will be conducted as more data become available and presented in the 2008 report.

To date (June 2007) between 12 and 30 zooplankton species have been found in the analyzed samples. Overall total biomass was very low, varying between 4,000 and 34,000 µg/L. Total density was dominated by Rotifers as they make up on average 95 percent of the samples. Rotifers also dominate the total dry weight biomass of the samples as they make up, on average, 50 percent of the samples.

Comparison of hourly flow releases from Boundary Dam and the June 24-hour zooplankton biomass results did not show a differential pattern relative to existing Project operations (Figure 5.5-1). A group of interest, the cladocerans, occurred in very small numbers and biomass between consecutive time intervals (e.g., 0 organisms/m^3 – 351 organisms/m^3) making pattern discernment difficult. This is especially true when compared to the dominant zooplankton group (e.g., rotifers) that numbered between 425,000 organisms/m^3 to 1,240,000 organisms/m^3.

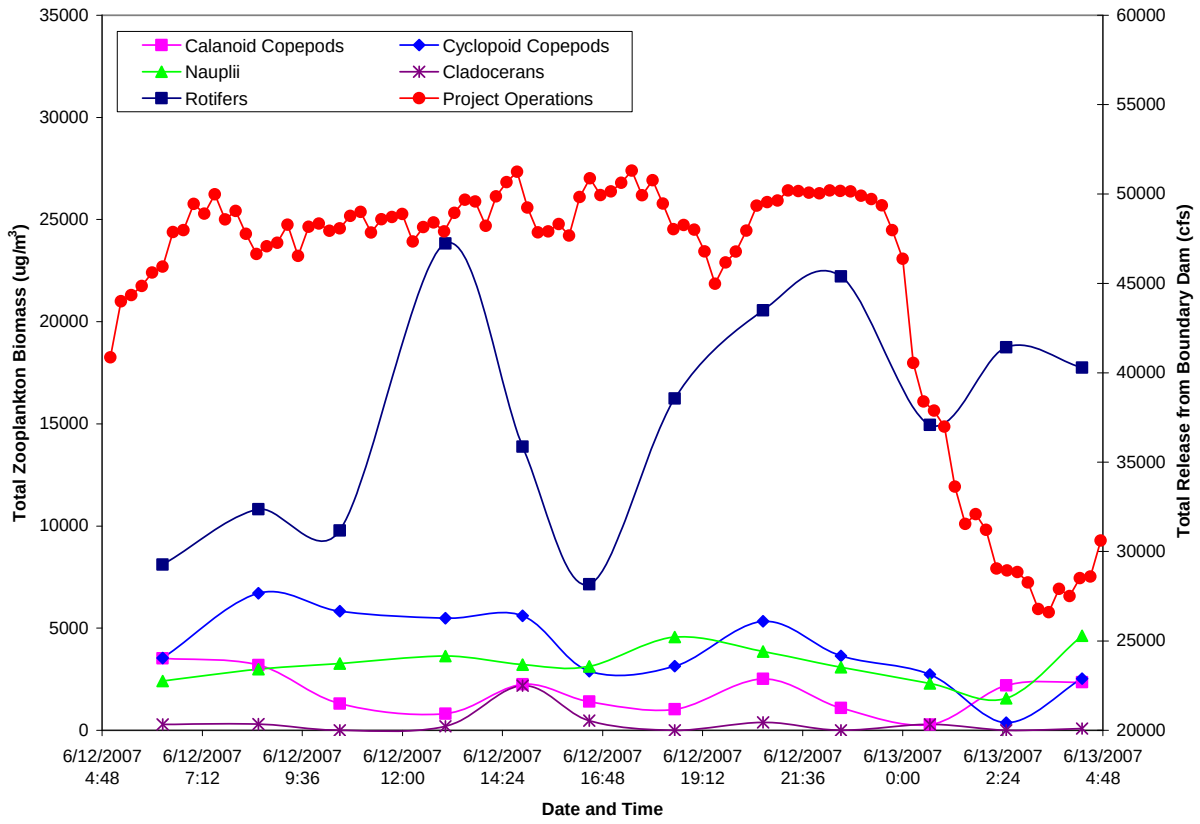

Figure 5.5-1. June 24-hour zooplankton biomass in Boundary Tailrace (V8) versus total flow releases from Boundary Dam.

Table 5.5-1. 24-Hour zooplankton density and biomass in Boundary Tailrace (Station V8), June 12-13, 2007.

Date	Time	Taxonomic Group	Total Density (%)	Total Dry Weight Biomass (%)
6/12/2007	6:15	Calanoid Copepods	0.26	19.71
		Cyclopoid Copepods	0.14	19.78
		Nauplii	2.08	13.48
		Cladocerans	0.00	1.60
		Rotifers	97.52	45.42
		Dipterans	0.00	0.00
6/12/2007	8:33	Calanoid Copepods	0.06	13.31
		Cyclopoid Copepods	0.36	27.92
		Nauplii	1.49	12.46
		Cladocerans	0.02	1.27
		Rotifers	98.08	45.04
		Dipterans	0.00	0.00
6/12/2007	10:30	Calanoid Copepods	0.05	6.50
		Cyclopoid Copepods	0.33	28.86
		Nauplii	2.00	16.19
		Cladocerans	0.00	0.00
		Rotifers	97.63	48.45
		Dipterans	0.00	0.00
6/12/2007	13:02	Calanoid Copepods	0.02	2.39
		Cyclopoid Copepods	0.26	16.14
		Nauplii	1.87	10.71
		Cladocerans	0.02	0.57
		Rotifers	97.83	70.19
		Dipterans	0.00	0.00
6/12/2007	14:53	Calanoid Copepods	0.05	8.30
		Cyclopoid Copepods	0.20	20.65
		Nauplii	1.44	11.83
		Cladocerans	0.04	8.04
		Rotifers	98.27	51.17
		Dipterans	0.00	0.00
6/12/2007	16:29	Calanoid Copepods	0.06	9.33
		Cyclopoid Copepods	0.29	19.26
		Nauplii	2.94	20.77
		Cladocerans	0.03	3.13
		Rotifers	96.68	47.51
		Dipterans	0.00	0.00
6/12/2007	18:32	Calanoid Copepods	0.04	4.11
		Cyclopoid Copepods	0.14	12.59
		Nauplii	1.89	18.26
		Cladocerans	0.00	0.00
		Rotifers	97.93	65.03
		Dipterans	0.00	0.00
6/12/2007	20:39	Calanoid Copepods	0.05	7.72
		Cyclopoid Copepods	0.13	16.35
		Nauplii	1.31	11.80
		Cladocerans	0.01	1.18
		Rotifers	98.51	62.96
		Dipterans	0.00	0.00

Table 5.5-1, continued…

Date	Time	Taxonomic Group	Total Density (%)	Total Dry Weight Biomass (%)
6/12/2007	22:31	Calanoid Copepods	0.01	3.64
		Cyclopoid Copepods	0.11	12.11
		Nauplii	0.99	10.26
		Cladocerans	0.00	0.00
		Rotifers	98.89	73.99
		Dipterans	0.00	0.00
6/13/2007	0:39	Calanoid Copepods	0.00	1.35
		Cyclopoid Copepods	0.06	13.29
		Nauplii	0.90	11.16
		Cladocerans	0.01	1.41
		Rotifers	99.03	72.80
		Dipterans	0.00	0.00
6/13/2007	2:29	Calanoid Copepods	0.07	9.58
		Cyclopoid Copepods	0.01	1.64
		Nauplii	0.54	6.83
		Cladocerans	0.00	0.00
		Rotifers	99.38	81.95
		Dipterans	0.00	0.00
6/13/2007	4:18	Calanoid Copepods	0.07	8.63
		Cyclopoid Copepods	0.07	9.24
		Nauplii	1.74	16.91
		Cladocerans	0.01	0.32
		Rotifers	98.11	64.91
		Dipterans	0.00	0.00
6/12/07 to 6/13/07	24-hr Average	Calanoid Copepods	0.06	7.88
		Cyclopoid Copepods	0.17	16.49
		Nauplii	1.60	13.39
		Cladocerans	0.01	1.46
		Rotifers	98.16	60.79
		Dipterans	0.00	0.00

Preliminary analysis of the population of zooplankton indicates that this community is limited somewhat to washout from Box Canyon Reservoir into the Project as illustrated by community structure similarity between consecutive stations within Boundary Reservoir (Table 5.5-2; raw data in Appendix 4, Tables A.4-2 through A.4-5). In addition, the populations are limited by low retention time in two ways: (1) the limited available food supply (phytoplankton primary producers) and (2) inadequate time available for zooplankton reproduction.

Table 5.5-2. Average zooplankton total density (%) in May 2007.

Date	Station	Taxonomic Group	Average Total Density (%)	Average Dry Weight Biomass (%)
5/23/2007	V7	% Calanoid Copepods	0.04	6.69
		% Cyclopoid Copepods	0.62	33.92
		% Nauplii	1.25	7.14
		% Cladocerans	0.06	6.26
		% Rotifers	98.04	45.99
		% Dipterans	0.00	0.00
5/23/2007	V1	% Calanoid Copepods	0.08	7.56
		% Cyclopoid Copepods	0.43	19.60
		% Nauplii	2.42	8.76
		% Cladocerans	0.07	9.96
		% Rotifers	97.00	54.12
		% Dipterans	0.00	0.00
5/22/2007	V4	% Calanoid Copepods	0.04	9.33
		% Cyclopoid Copepods	0.20	16.26
		% Nauplii	1.13	8.82
		% Cladocerans	0.10	3.43
		% Rotifers	98.53	62.17
		% Dipterans	0.00	0.00
5/22/2007	V5	% Calanoid Copepods	0.14	20.38
		% Cyclopoid Copepods	0.34	20.76
		% Nauplii	0.91	6.05
		% Cladocerans	0.01	0.67
		% Rotifers	98.60	52.14
		% Dipterans	0.00	0.00
5/22/2007	V6	% Calanoid Copepods	0.13	29.91
		% Cyclopoid Copepods	0.33	17.12
		% Nauplii	0.72	4.11
		% Cladocerans	0.04	1.58
		% Rotifers	98.78	47.28
		% Dipterans	0.00	0.00
5/23/2007	V8	% Calanoid Copepods	0.03	4.80
		% Cyclopoid Copepods	0.33	22.66
		% Nauplii	2.72	17.55
		% Cladocerans	0.00	0.00
		% Rotifers	96.92	54.99
		% Dipterans	0.00	0.00

5.6. Benthic Macroinvertebrates

BMI density measurements as well as the corresponding HSI evaluation were conducted in Study 7. The results of this study will be used as evaluation elements for BMI production relative to Project operations (Appendix 5). The Study 7 Interim Study Report, Appendix 4 (SCL 2008a), includes information and preliminary results for sampling events conducted through September 2007. This section presents preliminary results that compare BMI production between the vertical samples and shoreline samples. In addition, BMI production was described at locations under fluctuating pool conditions. Comparison of biomass among three areas was also discussed (e.g., lower Boundary Reservoir, upper Boundary Reservoir, and Box Canyon Reservoir).

Results for each location in the following figures are reported with and without *Hydra* sp. biomass. *Hydra* sp. was found in large numbers, in some cases, and represented a substantial portion of the biomass for a BMI sample at select depths. *Hydra* sp. is not primary forage food of fish and, therefore, does not represent the target component of the food chain intended for examination in the BMI production estimate. The presence of *Hydra* sp. may be an artifact of the artificial substrate sampling device and represents establishment of an artificial environment in which this species would not normally colonize. The reporting of results for biomass with and without *Hydra* sp. under each depth and site location is intended to examine how interpretations for BMI production might differ given incidental presence of *Hydra* sp. An additional study is recommended for 2008 to compare the invertebrate production in the artificial substrate samplers with production on natural hard substrate at shoreline sites in all three Reservoirs. The study will evaluate any differences in BMI community structure and biomass that may result from altered conditions caused by the sampling baskets.

5.6.1. Vertical

Specific BMI biomass results for May 2007 for the lower Boundary Reservoir hard substrate, vertical treatment site are shown in Figure 5.6-1. Samples were collected in lower Boundary and Box Canyon reservoirs to describe the response of BMI to a range of pool level fluctuations. There was no vertical cliff habitat in the upper Boundary Reservoir and sampling was limited to the vertical cliff habitat found in the lower Boundary Reservoir and Box Canyon Reservoir. Results for biomass estimates in the lower Boundary Reservoir showed that maximum production occurred at deeper elevation intervals (e.g., maximum biomass estimates including *Hydra* sp. occurred at 15 foot and 25 foot elevation intervals) (Figure 5.6-1). Results for biomass estimates in Box Canyon Reservoir showed that production estimates including *Hydra* sp. had the same pattern from shallow to deeper elevation intervals (Figure 5.6-2). However, the biomass estimates including *Hydra* sp. were several times larger than BMI estimates excluding *Hydra* sp. in the production estimate.

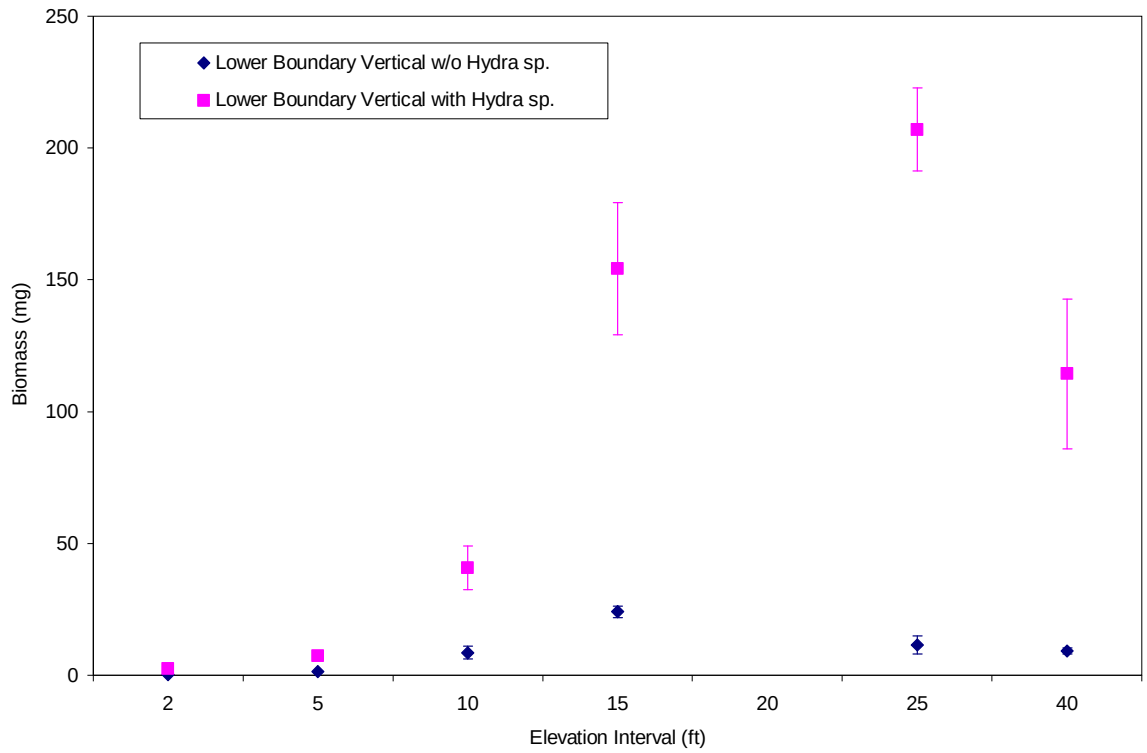

Figure 5.6-1. Benthic macroinvertebrate biomass at lower Boundary Reservoir vertical treatment site with and without *Hydra* sp., May 2007.

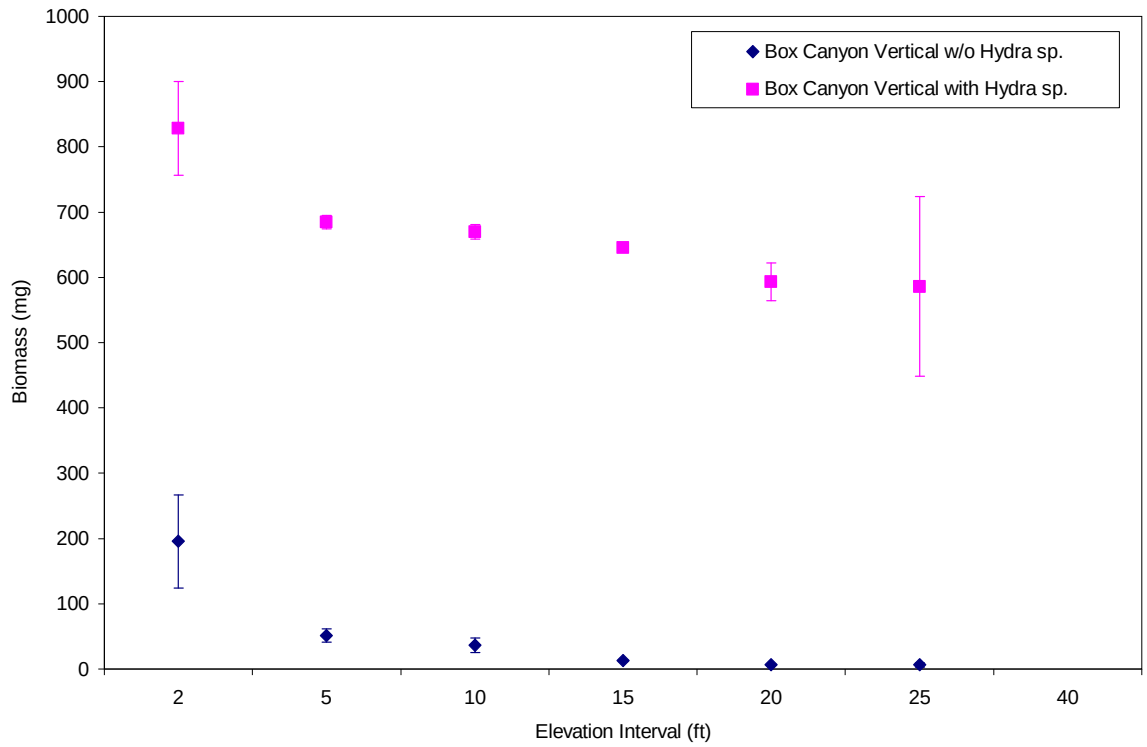

Figure 5.6-2. Benthic macroinvertebrate biomass at Box Canyon Reservoir vertical treatment site with and without *Hydra* sp., May 2007.

5.6.2. Shoreline

Biomass results for BMI production for May 2007 from shoreline hard substrates were analyzed for lower Boundary Reservoir, upper Boundary Reservoir, and Box Canyon Reservoir. Biomass estimates for BMI at lower Boundary Reservoir shoreline treatment sites indicated that production increased from intermediate elevation intervals (e.g., 15 feet) through the deepest elevation interval sampled (e.g., 40 feet). In addition, mean biomass estimates with and without *Hydra* sp. inclusion were the same at all elevation intervals except at 25 feet (Figure 5.6-3).

Upper Boundary Reservoir production showed that maximum biomass (with and without *Hydra* sp. inclusion) occurred at the intermediate elevation interval (e.g., 15 feet and 25 feet) (Figure 5.6-4). The pattern for production of BMI at shoreline treatment sites was the same for estimates with and without *Hydra* sp. inclusion at each elevation interval. This pattern was similar to the pattern observed at the Box Canyon vertical treatment site where depth was not a likely factor that influenced production levels of *Hydra* sp.

Production estimates for Box Canyon Reservoir shoreline treatment sites showed the same direction of change at successive elevation intervals for both with and without *Hydra* sp. inclusion (Figure 5.6-5). Similarly, the biomass estimates at the Box Canyon Reservoir shoreline treatment sites were higher near the shallow elevation intervals and declined at depth. The availability of hard substrate (e.g., vertical or shoreline) appears to be an important factor for influencing BMI production. Production estimates were greatest at upper Boundary Reservoir and Box Canyon Reservoir sites and again lowest for lower Boundary Reservoir sites (e.g., approximately 10 times less biomass at corresponding elevation intervals).

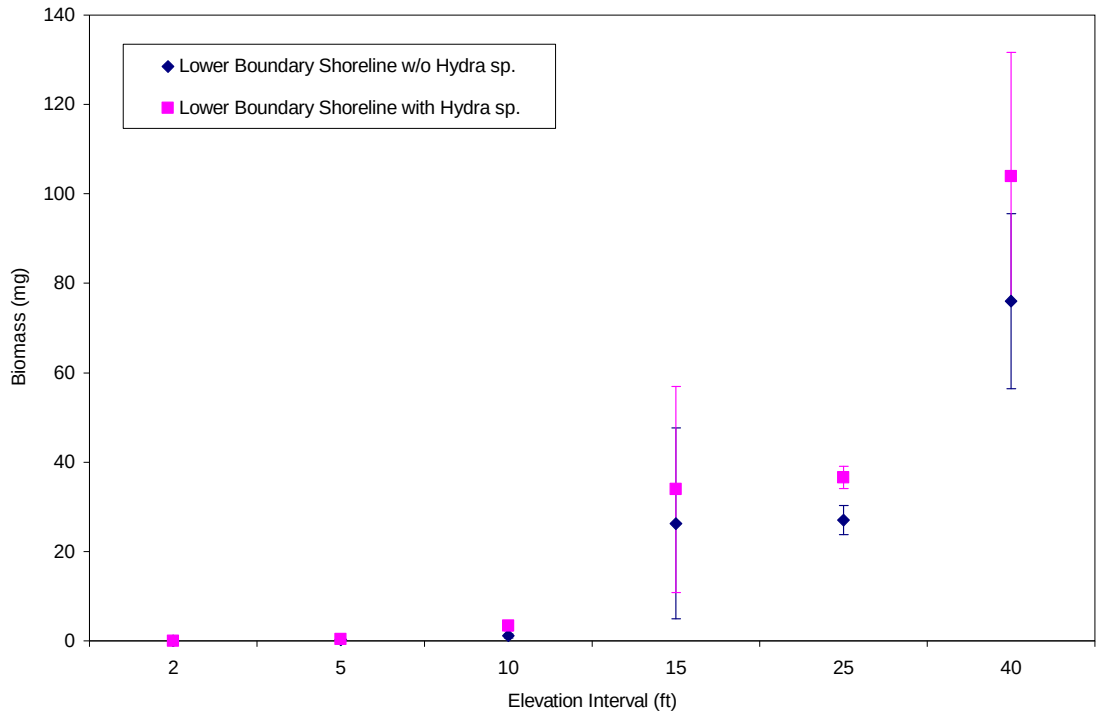

Figure 5.6-3. Benthic macroinvertebrate biomass at lower Boundary Reservoir shoreline treatment sites with and without *Hydra* sp., May 2007.

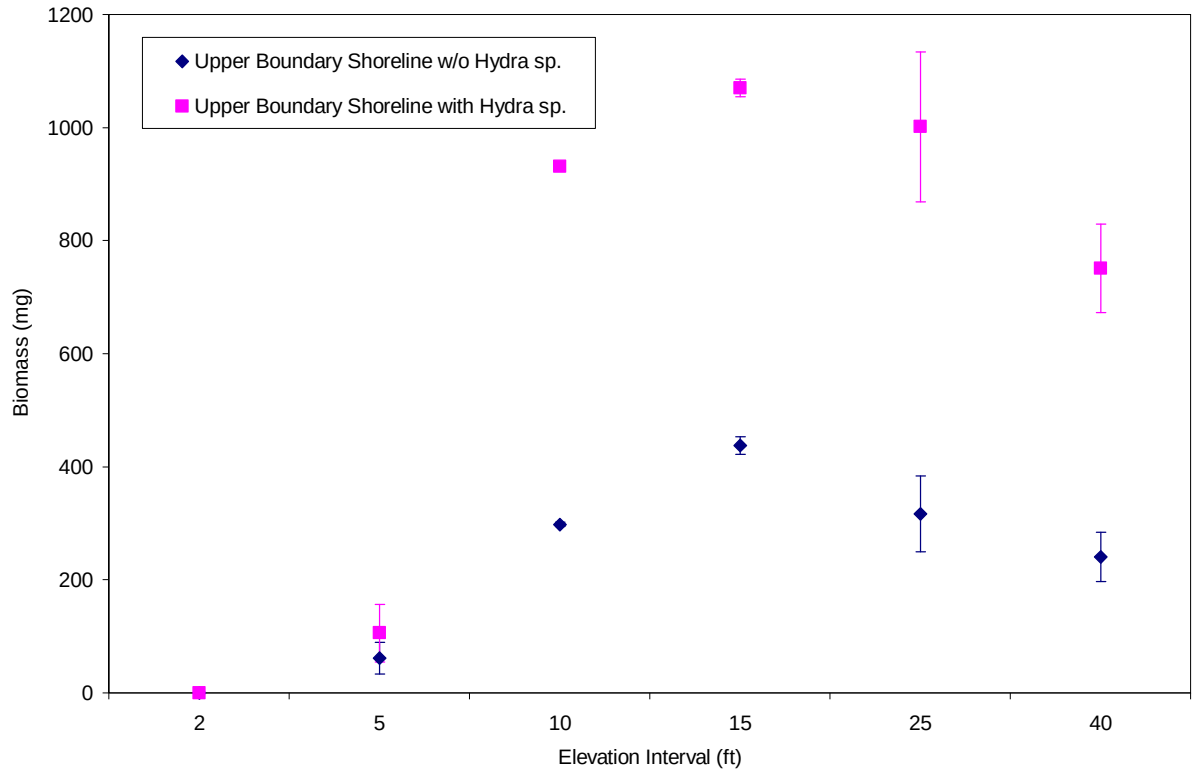

Figure 5.6-4. Benthic macroinvertebrate biomass at upper Boundary Reservoir shoreline treatment sites with and without *Hydra* sp., May 2007.

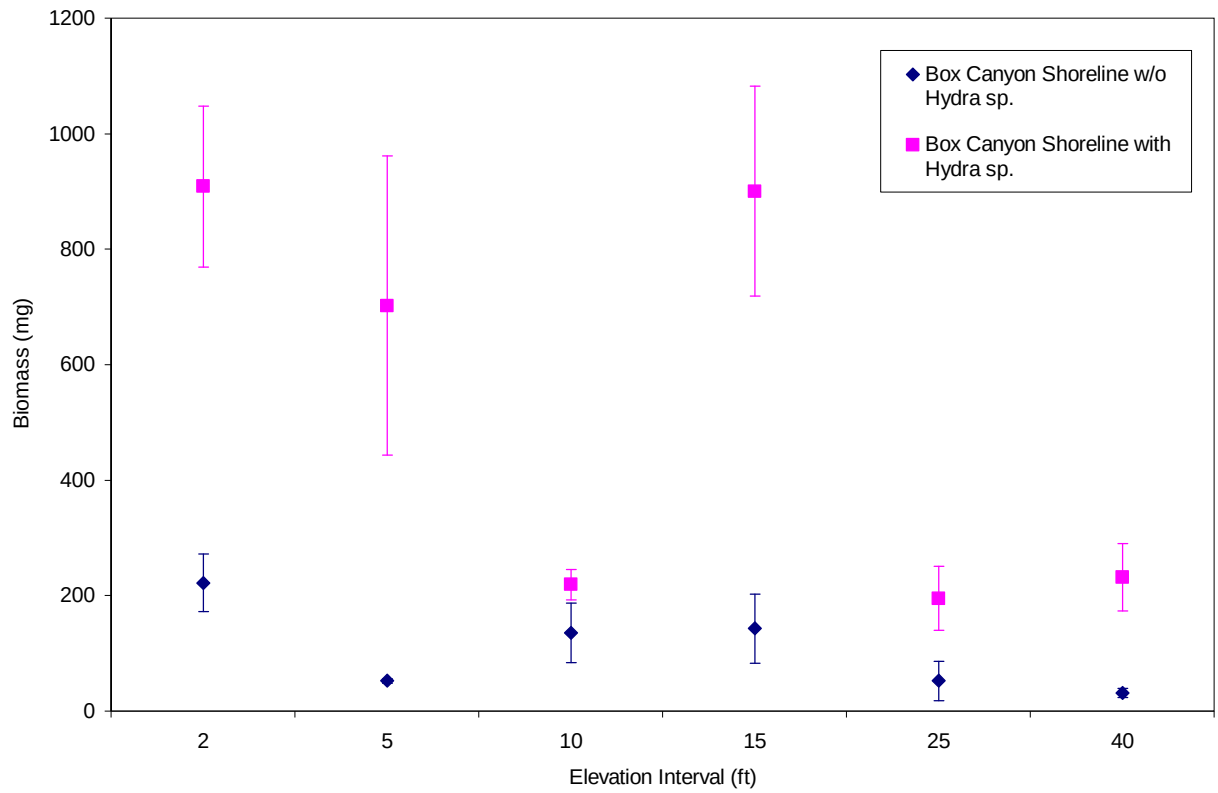

Figure 5.6-5. Benthic macroinvertebrate biomass at Box Canyon Reservoir shoreline treatment sites with and without *Hydra* sp., May 2007.

5.6.3. Soft Substrate Sampling

Biomass results for BMI production estimates for May 2007 soft substrate sampling at lower Boundary Reservoir, upper Boundary Reservoir, and Box Canyon Reservoir were three to ten times lower that at hard substrate site categories. In contrast to the hard substrate sampling sites, differences in biomass estimates with and without *Hydra* sp. inclusion are not substantially different. This substrate type does not appear to favor colonization of artificial substrates differentially as was observed for the hard substrate sampling conditions.

Lower Boundary Reservoir biomass estimates peaked at intermediate depths (e.g., 25 feet) and were less than 10 mg in the upper 10 feet of the elevation intervals sampled (Figure 5.6-6). The peak biomass estimates were highest at soft substrate sampling sites at the shallowest elevation interval (e.g., 2 feet) at upper Boundary Reservoir sites (Figure 5.6-7). Biomass estimates for benthic macroinvertebrates at Box Canyon Reservoir were greatest at shallow and intermediate elevation intervals (Figure 5.6-8). The pattern of BMI biomass estimate fluctuation in soft substrates at 6 successive elevation intervals at Box Canyon Reservoir sites was the same observed for shoreline treatment sites. Factors affecting shoreline communities may be sufficiently similar to influence production of BMI, regardless of substrate type.

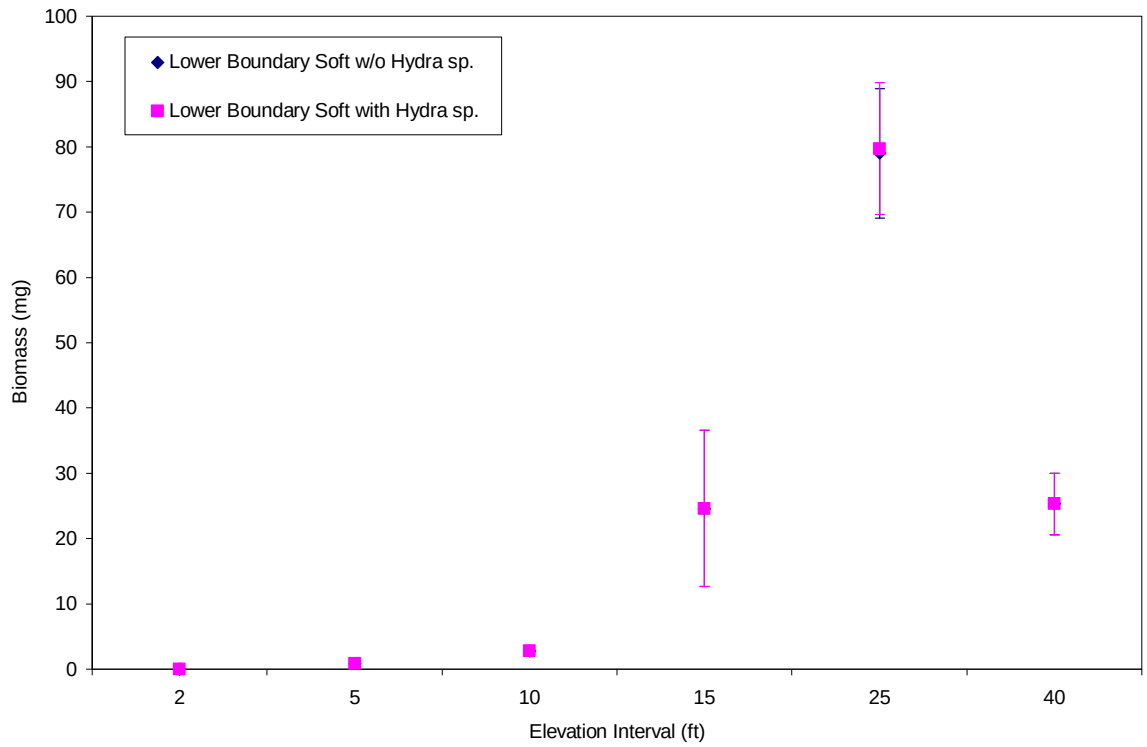

Figure 5.6-6. Benthic macroinvertebrate biomass at lower Boundary Reservoir soft substrate treatment sites with and without *Hydra* sp., May 2007.

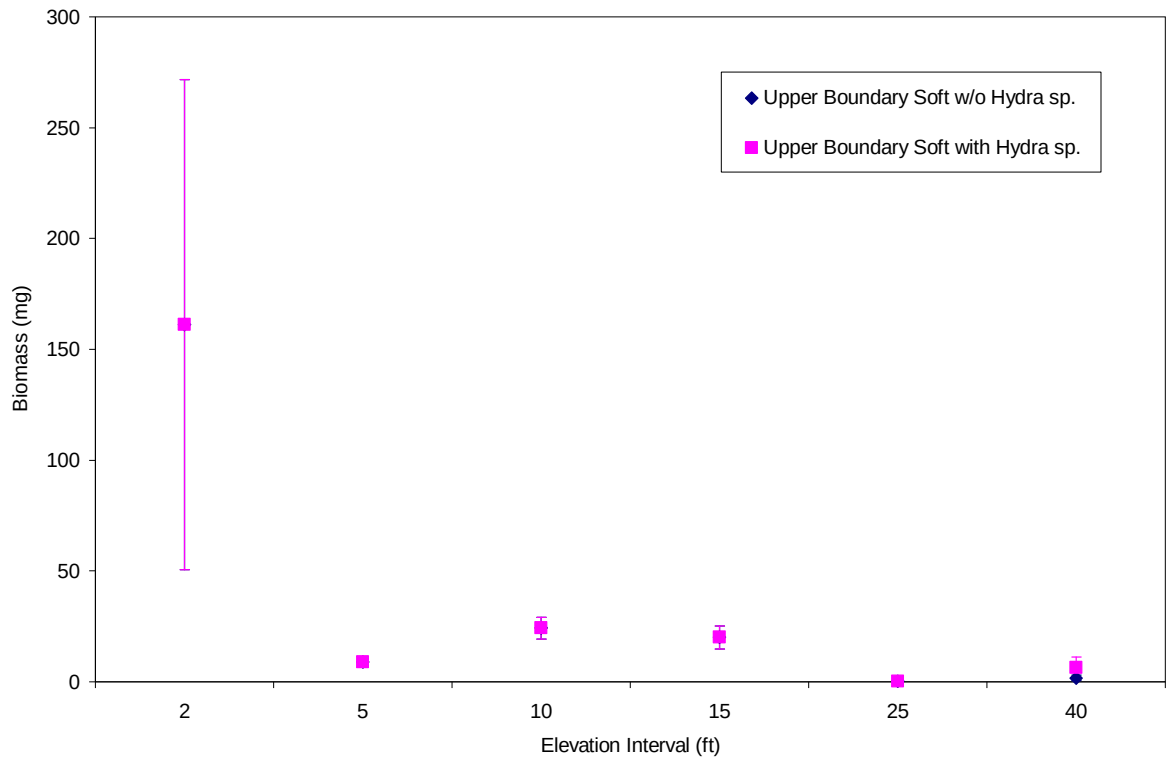

Figure 5.6-7. Benthic macroinvertebrate biomass at upper Boundary Reservoir soft substrate treatment sites with and without *Hydra* sp., May 2007.

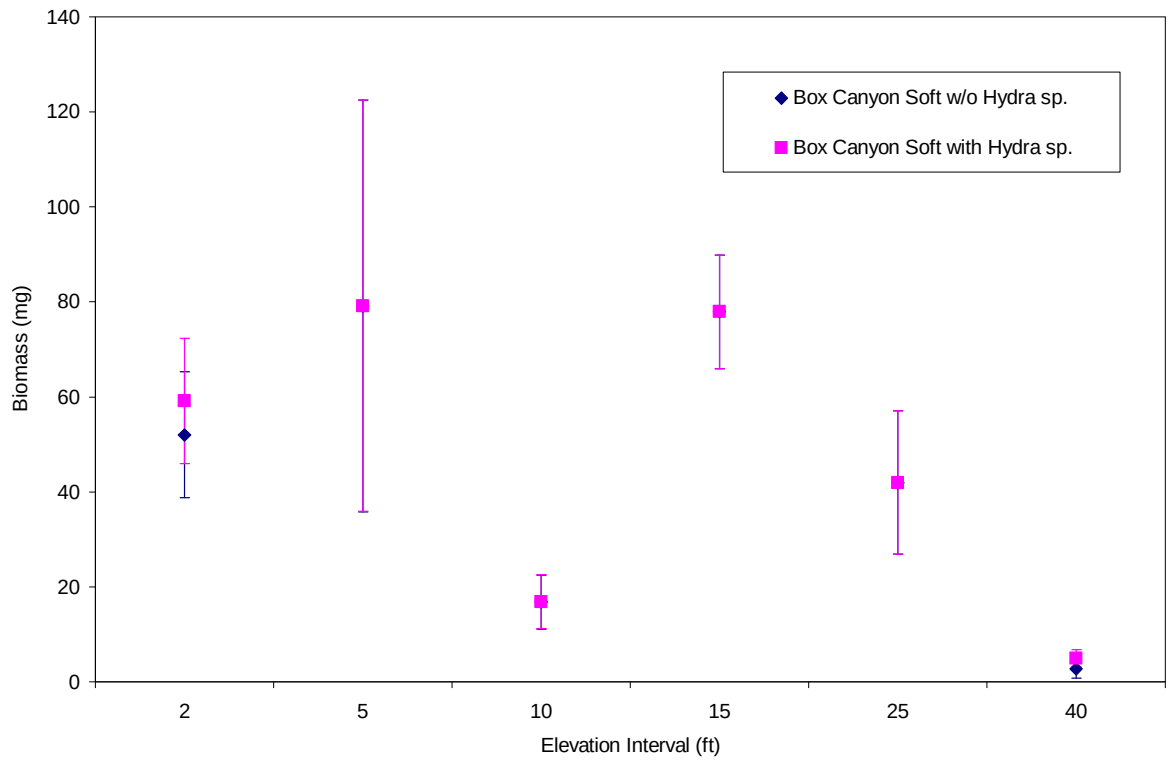

Figure 5.6-8. Benthic macroinvertebrate biomass at Box Canyon Reservoir soft substrate treatment sites with and without *Hydra* sp., May 2007.

6 SUMMARY

Potential limiting factors to production (specifically light, nutrient concentrations, and reservoir retention time) were compared to chlorophyll *a* concentrations and zooplankton densities. More detailed analysis will be conducted after results are available when sampling is concluded in March 2008.

Light may be limiting productivity seasonally and in deeper zones of the reservoir. Nutrients (specifically phosphorus) were observed to be limited within the system; concentrations of phosphorous and nitrogen were often below detection limits for SRP and TKN. N:P ratios that were calculated for the Project indicate that the system was phosphorus limited and mesotrophic to oligotrophic. Retention time may be a major limiting factor to production in the Project area. When reservoir retention time is less than 3 days, phytoplankton production is limited (Uhlmann 1971); Boundary Reservoir has an average retention time of less than 2 days. However, Boundary Reservoir has little storage capacity and no influence on incoming flow levels; consequently, there is little opportunity to modify retention time.

Chlorophyll *a* concentrations measured within Boundary Reservoir also indicate that the system is oligotrophic to mesotrophic. During spring runoff in May and June, increased nutrient levels from upstream of the Project area cause chlorophyll *a* concentrations to be higher than in July

and August. During July and August, chlorophyll *a* concentrations decrease to below 2.8 µg/L, which is indicative of an oligotrophic or low productivity system.

The zooplankton community is likely limited by food availability (phytoplankton) in the Project area, which is dictated to a large degree by input from Box Canyon Reservoir. Population size is also limited by short retention time in Boundary Reservoir, which flushes zooplankton from the reservoir at a rate faster than they can reproduce.

Preliminary analysis of patterns were identified for BMI production at sampling locations. First, inclusion of *Hydra* sp. in biomass estimates could influence interpretation of results in lower Boundary Reservoir vertical substrate samples. For example, a similar pattern in BMI production at elevation intervals greater than 10 feet was observed between Box Canyon Reservoir and lower Boundary Reservoir when excluding *Hydra* sp. biomass. However, vertical substrate production estimates when including *Hydra* sp. were greater in Box Canyon Reservoir than in lower Boundary Reservoir.

In summary, the productivity of Boundary Reservoir appears to be governed by the physical characteristics, hydrology and limited nutrients in the reservoir. Phytoplankton production is limited by the low retention time, low nutrients, and limited light, and zooplankton production is limited by the reduced primary production and retention time.

Details of HSI model development for macrophytes, periphyton, and BMIs are described in the Study 7 Interim Report (SCL 2008a). The individual HSI models will be used as indicators for intensity of production. Preliminary comparisons for production between contiguous reaches and among similar trophic levels (e.g., phytoplankton comparisons, chlorophyll *a* comparisons or macrophyte HSI comparisons) will assist in determining if any factors have a cumulative influence in the downstream direction. In addition, future reports will determine if these factors are influenced by existing Project operations and indicate how they affect production in each of the reaches.

HSI indicator scores and ranges from temporal observations that are generated from Study 5 (SCL 2008b), Study 6 (SCL 2008c), and Study 7 (SCL 2008a) will be summarized in the 2008 report. These are three of the six indicators that will be used to relate: factors that influence production, production estimates for each of the trophic levels (and indicators), longitudinal comparisons throughout the Boundary Reservoir study area, and production estimates for operations scenarios.

7 VARIANCES FROM FERC-APPROVED STUDY PLAN AND PROPOSED MODIFICATIONS

There was one minor variance from the FERC-approved study plan that involved BMI sampling for soft substrate in the Upper Reservoir Reach. Velocity conditions at the 40-foot depth prevented the collection of a viable soft sediment BMI sample either because the soft sediment had been washed away, or because the sediment was washed out of the petite ponar during retrieval. Repeated sampling in the area of the BMI sample site did not produce a viable sample. Rather than change the location of the sample (which would have changed the physical habitat

data analysis point), the 40-foot depth sample was not collected at this location in September. Although all samples are considered valuable, initial literature review suggested that while BMI may be found at 40 feet and deeper, the most suitable habitat is found at shallower depths. As such, the removal of one of the 40-foot depth seasonal samples would not greatly affect the ability to evaluate macroinvertebrates in a system of moderate pool fluctuation, such as the Upper Reservoir Reach.

Measurements of productivity for nutrients, phytoplankton, and zooplankton were described in the RSP (SCL 2007) and were to be estimated using measurements of upper and lower bounding conditions, and interpolation between those bounds to estimate productivity under operations scenarios. The measurements of Boundary Project conditions during the 2007 sampling effort could include measurements from the Box Canyon tailrace or the Box Canyon Reservoir to represent one bounding condition.

During 2007, sampling occurred only at Box Canyon tailrace to characterize the influx of nutrient concentrations, phytoplankton production, and zooplankton production into Boundary Reservoir. The Box Canyon tailrace represents an area of the Reservoir with low pool level fluctuations and is least affected by Boundary Project operations.

Additional sampling is recommended in 2008 to compare the periphyton and BMI found in the artificial substrate samplers with periphyton and BMI communities on natural hard substrate at shoreline sites in the Canyon and Upper Reservoir reaches as well as in Box Canyon Reservoir. The artificial samplers may create a protected environment over that of natural rock substrate that potentially alters the BMI community structure in favor of those species that prefer slower water velocities. Altered velocity conditions may also artificially increase periphyton biomass. Results from this additional study would be used to verify the validation of HSI curves (see Study 7) and to test the hypothesis that the influence of velocity on periphyton growth and BMI communities is adequately described both for Physical Habitat Model (Study 7) and for the productivity assessment of Boundary Reservoir.

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Appendix 1. Nutrient Data

Table A.1-1. Laboratory water quality data from Boundary Reservoir (May–August 2007).

Sample Location	Date	Sample ID	Total Phosphorus (µg/L)	SRP (µg/L)	TKN (µg/L)
V1	5/23/2007	SURF-PEL	10.75	<1.0	233.98
V1	6/25/2007	SURF-PEL	12.64	<1.0	578.75
V1	7/23/2007	SURF-PEL	9.60	<1.0	909.07
V1	8/16/2007	SURF-PEL	8.00	2.00	254.00
V2	5/23/2007	SURF-PEL	10.27	<1.0	<200
V2	5/23/2007	SURF-PEL DUP	10.70	<1.0	226.04
V2	6/25/2007	SURF-PEL	15.34	<1.0	762.41
V2	7/23/2007	SURF-PEL	11.37	<1.0	670.38
V2	8/16/2007	SURF-PEL	9.00	<1.0	332.00
V3	5/22/2007	SURF-PEL	11.52	<1.0	250.29
V3	6/19/2007	SURF-PEL	17.04	1.62	683.43
V3	7/24/2007	SURF-PEL	9.14	<1.0	727.82
V3	7/24/2007	SURF-PEL DUP	8.53	6.94	400.95
V3	8/25/2007	SURF-PEL	7.72	<1.0	<200
V3	8/25/2007	SURF-PEL-DUP	7.66	<1.0	<200
V4	5/22/2007	SURF-PEL	12.18	<1.0	<200
V4	6/20/2007	SURF-PEL	12.37	2.12	658.95
V4	7/24/2007	SURF-PEL	7.63	1.35	694.81
V4	8/25/2007	SURF-PEL	8.31	<1.0	<200
V5	5/22/2007	SURF-PEL	10.82	<1.0	<200
V5	6/20/2007	SURF-PEL	11.22	<1.0	662.75
V5	7/24/2007	SURF-PEL	9.22	1.19	484.22
V5	8/25/2007	SURF-PEL	7.66	1.91	<200
V6	5/22/2007	SURF-PEL	13.61	<1.0	303.17
V6	6/20/2007	SURF-PEL	11.22	--	812.84
V6	7/24/2007	SURF-PEL	9.31	2.85	685.51
V6	8/25/2007	SURF-PEL	8.43	1.25	<200
V7	5/23/2007	SURF-PEL	11.62	<1.0	306.69
V7	6/25/2007	SURF-PEL	16.28	<1.0	607.67
V7	6/25/2007	SURF-PEL DUP	13.72	2.01	758.87
V7	7/23/2007	SURF-PEL	9.28	<1.0	768.13
V7	8/14/2007	SURF-PEL	8.00	<1.0	<200
V8	5/23/2007	SURF-PEL	12.07	<1.0	245.89
V8	6/25/2007	SURF-PEL	15.32	<1.0	739.25
V8	7/25/2007	SURF-SHORE	10.05	3.01	715.68
V8	8/14/2007	SURF-PEL	10.00	3.00	281.00

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Appendix 2. Phytoplankton Data

Table A.2-1. Laboratory water quality data from Boundary Reservoir (May–August 2007).

Sample Location	Date	Sample ID	Chloro *a* (µg/L)	Phaeo_a (µg/L)
V1	5/23/2007	SURF-LITT	4.094	1.4
V1	5/23/2007	SURF-PEL	4.272	1.1
V1	6/25/2007	15FT-PEL	4.005	1.4
V1	6/25/2007	SURF-LITT	3.872	1.3
V1	6/25/2007	SURF-PEL	4.005	1.7
V1	7/23/2007	15FT-PEL	1.736	1.2
V1	7/23/2007	SURF-LITT	1.469	1.3
V1	7/23/2007	SURF-PEL	1.736	1.2
V1	8/16/2007	15FT-PEL	1.900	0.7
V1	8/16/2007	SURF-LITT	1.500	0.9
V1	8/16/2007	SURF-PEL	1.900	0.7
V2	5/23/2007	SURF-LITT	4.094	1.0
V2	5/23/2007	SURF-LITT DUP	3.916	0.9
V2	5/23/2007	SURF-PEL	3.560	1.4
V2	5/23/2007	SURF-PEL DUP	3.560	1.5
V2	6/25/2007	15FT-PEL	4.139	1.6
V2	6/25/2007	SURF-LITT	4.005	1.2
V2	6/25/2007	SURF-PEL	3.872	1.0
V2	7/23/2007	15FT PEL	1.869	1.2
V2	7/23/2007	SURF-LITT	1.869	1.0
V2	7/23/2007	SURF-PEL	1.869	0.7
V2	8/16/2007	15FT-PEL	1.900	0.8
V2	8/16/2007	SURF-LITT	1.900	0.6
V3	5/22/2007	SURF-LITT	3.738	1.0
V3	5/22/2007	SURF-PEL	3.560	1.1
V3	6/19/2007	15FT-PEL	3.605	1.5
V3	6/19/2007	SURF-LITT	3.738	1.7
V3	6/19/2007	SURF-PEL	3.738	1.5
V3	7/24/2007	15FT-PEL	1.202	1.2
V3	7/24/2007	15FT-PEL DUP	1.335	1.1
V3	7/24/2007	SURF-LITT	1.202	1.2
V3	7/24/2007	SURF-LITT DUP	1.335	1.2
V3	7/24/2007	SURF-PEL	1.202	1.1
V3	7/24/2007	SURF-PEL DUP	1.335	0.9
V3	8/25/2007	15FT-PEL	1.736	1.0
V3	8/25/2007	15FT-PEL-DUP	1.869	0.8
V3	8/25/2007	SURF-LITT	1.736	0.9
V3	8/25/2007	SURF-LITT-DUP	1.602	1.2
V3	8/25/2007	SURF-PEL	1.602	1.0
V3	8/25/2007	SURF-PEL-DUP	1.869	0.8
V4	5/22/2007	SURF-LITT	3.738	1.5
V4	5/22/2007	SURF-PEL	3.204	1.8
V4	6/20/2007	15FT-PEL	3.471	1.8
V4	6/20/2007	SURF-LITT	4.005	1.9
V4	6/20/2007	SURF-PEL	3.605	1.5
V4	7/24/2007	15FT-PEL	1.469	1.3
V4	7/24/2007	SURF-LITT	1.602	0.8
V4	7/24/2007	SURF-PEL	1.469	1.1

Table A.2-1, continued…

Sample Location	Date	Sample ID	Chloro *a* (µg/L)	Phaeo_a (µg/L)
V4	8/25/2007	15FT-PEL	2.003	0.7
V4	8/25/2007	SURF-LITT	1.869	0.7
V4	8/25/2007	SURF-PEL	1.602	0.9
V5	5/22/2007	SURF-LITT	3.471	1.0
V5	5/22/2007	SURF-PEL	2.670	1.8
V5	6/20/2007	15FT-PEL	4.673	1.7
V5	6/20/2007	SURF-LITT	3.738	1.4
V5	6/20/2007	SURF-PEL	4.005	1.3
V5	7/24/2007	15FT-PEL	1.869	1.1
V5	7/24/2007	SURF-LITT	2.136	0.9
V5	7/24/2007	SURF-PEL	1.602	1.4
V5	8/25/2007	15FT-PEL	1.736	0.8
V5	8/25/2007	SURF-LITT	1.335	0.5
V5	8/25/2007	SURF-PEL	1.202	0.8
V6	5/22/2007	SURF-LITT	3.204	0.9
V6	5/22/2007	SURF-PEL	3.204	0.7
V6	6/20/2007	15FT-PEL	5.207	1.7
V6	6/20/2007	SURF-LITT	3.471	1.1
V6	6/20/2007	SURF-PEL	3.338	1.5
V6	7/24/2007	15FT-PEL	1.469	1.3
V6	7/24/2007	SURF-LITT	1.469	0.9
V6	7/24/2007	SURF-PEL	1.335	1.1
V6	8/25/2007	15FT-PEL	1.068	0.3
V6	8/25/2007	SURF-LITT	0.935	0.3
V6	8/25/2007	SURF-PEL	1.202	0.6
V7	5/23/2007	SURF-MID	4.272	1.1
V7	6/25/2007	SURF-MID	3.872	1.8
V7	6/25/2007	SURF-MID DUP	4.272	1.4
V7	7/23/2007	SURF-MID	1.602	1.3
V8	5/23/2007	SURF-MID	3.382	1.1
V8	6/25/2007	SURF-MID	3.605	1.5
V8	7/25/2007	SURF-SHORE	1.202	1.4

Appendix 3. Periphyton Data

Table A.3-1. Periphyton hard substrate and colonization data.

Date	Site	Reservoir Location	Type of Site	Depth (ft)	Chl *a* (µg/L)
5/29/2007	LV3-2A	Lower	Vertical	2	-
5/29/2007	LV3-2B	Lower	Vertical	2	-
5/29/2007	LV3-2C	Lower	Vertical	2	-
5/29/2007	LV3-5A	Lower	Vertical	5	24
5/29/2007	LV3-5B	Lower	Vertical	5	27
5/29/2007	LV3-5C	Lower	Vertical	5	64
5/29/2007	LV3-10A	Lower	Vertical	10	56
5/29/2007	LV3-10B	Lower	Vertical	10	53
5/29/2007	LV3-10C	Lower	Vertical	10	49
5/29/2007	LV3-15A	Lower	Vertical	15	77
5/29/2007	LV3-15B	Lower	Vertical	15	45
5/29/2007	LV3-15C	Lower	Vertical	15	35
5/29/2007	LV3-25A	Lower	Vertical	25	32
5/29/2007	LV3-25B	Lower	Vertical	25	24
5/29/2007	LV3-25C	Lower	Vertical	25	40
5/29/2007	LV3-40A	Lower	Vertical	40	29
5/29/2007	LV3-40B	Lower	Vertical	40	13
5/29/2007	LV3-40C	Lower	Vertical	40	27
5/29/2007	LSA2-2A	Lower	Shoreline	2	-
5/29/2007	LSA2-2B	Lower	Shoreline	2	-
5/29/2007	LSA2-2C	Lower	Shoreline	2	-
5/29/2007	LSA2-5A	Lower	Shoreline	5	-
5/29/2007	LSA2-5B	Lower	Shoreline	5	-
5/29/2007	LSA2-5C	Lower	Shoreline	5	-
5/29/2007	LSA2-10A	Lower	Shoreline	10	48
5/29/2007	LSA2-10B	Lower	Shoreline	10	80
5/29/2007	LSA2-10C	Lower	Shoreline	10	37
5/29/2007	LSA2-15A	Lower	Shoreline	15	27
5/29/2007	LSA2-15B	Lower	Shoreline	15	8.0
5/29/2007	LSA2-15C	Lower	Shoreline	15	16
5/29/2007	LSA2-25A	Lower	Shoreline	25	21
5/29/2007	LSA2-25B	Lower	Shoreline	25	16
5/29/2007	LSA2-25C	Lower	Shoreline	25	2.7
5/29/2007	LSA2-40A	Lower	Shoreline	40	11
5/29/2007	LSA2-40B	Lower	Shoreline	40	11
5/29/2007	LSA2-40C	Lower	Shoreline	40	19
5/30/2007	USD-2A	Upper	Shoreline	2	-
5/30/2007	USD-2B	Upper	Shoreline	2	-
5/30/2007	USD-2C	Upper	Shoreline	2	-
5/30/2007	USD-5A	Upper	Shoreline	5	24
5/30/2007	USD-5B	Upper	Shoreline	5	48
5/30/2007	USD-5C	Upper	Shoreline	5	29
5/30/2007	USD-10A	Upper	Shoreline	10	112
5/30/2007	USD-10B	Upper	Shoreline	10	83
5/30/2007	USD-10C	Upper	Shoreline	10	155

Table A.3-1, continued…

Date	Site	Reservoir Location	Type of Site	Depth (ft)	Chl *a* (µg/L)
5/30/2007	USD-15A	Upper	Shoreline	15	96
5/30/2007	USD-15B	Upper	Shoreline	15	64
5/30/2007	USD-15C	Upper	Shoreline	15	67
5/30/2007	USD-25A	Upper	Shoreline	25	72
5/30/2007	USD-25B	Upper	Shoreline	25	32
5/30/2007	USD-25C	Upper	Shoreline	25	96
5/30/2007	USD-40A	Upper	Shoreline	40	16
5/30/2007	USD-40B	Upper	Shoreline	40	5.3
5/30/2007	USD-40C	Upper	Shoreline	40	21
5/31/2007	BCV1-2A	Box	Vertical	2	32
5/31/2007	BCV1-2B	Box	Vertical	2	61
5/31/2007	BCV1-2C	Box	Vertical	2	75
5/31/2007	BCV1-5A	Box	Vertical	5	67
5/31/2007	BCV1-5B	Box	Vertical	5	40
5/31/2007	BCV1-5C	Box	Vertical	5	24
5/31/2007	BCV1-10A	Box	Vertical	10	69
5/31/2007	BCV1-10B	Box	Vertical	10	56
5/31/2007	BCV1-10C	Box	Vertical	10	75
5/31/2007	BCV1-15A	Box	Vertical	15	45
5/31/2007	BCV1-15B	Box	Vertical	15	53
5/31/2007	BCV1-15C	Box	Vertical	15	32
5/31/2007	BCV1-20A	Box	Vertical	20	75
5/31/2007	BCV1-20B	Box	Vertical	20	43
5/31/2007	BCV1-20C	Box	Vertical	20	64
5/31/2007	BCV1-25A	Box	Vertical	25	27
5/31/2007	BCV1-25B	Box	Vertical	25	45
5/31/2007	BCV1-25C	Box	Vertical	25	19
5/31/2007	BCS1-2A	Box	Shoreline	2	27
5/31/2007	BCS1-2B	Box	Shoreline	2	40
5/31/2007	BCS1-2C	Box	Shoreline	2	24
5/31/2007	BCS1-5A	Box	Shoreline	5	32
5/31/2007	BCS1-5B	Box	Shoreline	5	19
5/31/2007	BCS1-5C	Box	Shoreline	5	19
5/31/2007	BCS1-10A	Box	Shoreline	10	93
5/31/2007	BCS1-10B	Box	Shoreline	10	35
5/31/2007	BCS1-10C	Box	Shoreline	10	85
5/31/2007	BCS1-15A	Box	Shoreline	15	59
5/31/2007	BCS1-15B	Box	Shoreline	15	35
5/31/2007	BCS1-15C	Box	Shoreline	15	48
5/31/2007	BCS1-25A	Box	Shoreline	25	21
5/31/2007	BCS1-25B	Box	Shoreline	25	16
5/31/2007	BCS1-25C	Box	Shoreline	25	21
5/31/2007	BCS1-40A	Box	Shoreline	40	19
5/31/2007	BCS1-40B	Box	Shoreline	40	16
5/31/2007	BCS1-40C	Box	Shoreline	40	13
8/30/2007	LV3-2A	Lower	Vertical	2	11

Table A.3-1, continued…

Date	Site	Reservoir Location	Type of Site	Depth (ft)	Chl *a* (µg/L)
8/30/2007	LV3-2B	Lower	Vertical	2	13
8/30/2007	LV3-2C	Lower	Vertical	2	5.3
8/30/2007	LV3-5A	Lower	Vertical	5	742
8/30/2007	LV3-5B	Lower	Vertical	5	465
8/30/2007	LV3-5C	Lower	Vertical	5	433
8/30/2007	LV3-10A	Lower	Vertical	10	77
8/30/2007	LV3-10B	Lower	Vertical	10	59
8/30/2007	LV3-10C	Lower	Vertical	10	53
8/30/2007	LV3-15A	Lower	Vertical	15	374
8/30/2007	LV3-15B	Lower	Vertical	15	128
8/30/2007	LV3-15C	Lower	Vertical	15	254
8/30/2007	LV3-25A	Lower	Vertical	25	83
8/30/2007	LV3-25B	Lower	Vertical	25	48
8/30/2007	LV3-25C	Lower	Vertical	25	101
8/30/2007	LV3-40A	Lower	Vertical	40	27
8/30/2007	LV3-40B	Lower	Vertical	40	19
8/30/2007	LV3-40C	Lower	Vertical	40	24
8/30/2007	LSA2-2A	Lower	Shoreline	2	53
8/30/2007	LSA2-2B	Lower	Shoreline	2	45
8/30/2007	LSA2-2C	Lower	Shoreline	2	48
8/30/2007	LSA2-5A	Lower	Shoreline	5	150
8/30/2007	LSA2-5B	Lower	Shoreline	5	304
8/30/2007	LSA2-5C	Lower	Shoreline	5	296
8/30/2007	LSA2-10A	Lower	Shoreline	10	35
8/30/2007	LSA2-10B	Lower	Shoreline	10	64
8/30/2007	LSA2-10C	Lower	Shoreline	10	48
8/30/2007	LSA2-15A	Lower	Shoreline	15	16
8/30/2007	LSA2-15B	Lower	Shoreline	15	32
8/30/2007	LSA2-15C	Lower	Shoreline	15	24
8/30/2007	LSA2-25A	Lower	Shoreline	25	72
8/30/2007	LSA2-25B	Lower	Shoreline	25	43
8/30/2007	LSA2-25C	Lower	Shoreline	25	43
8/30/2007	LSA2-40A	Lower	Shoreline	40	32
8/30/2007	LSA2-40B	Lower	Shoreline	40	53
8/30/2007	LSA2-40C	Lower	Shoreline	40	24
8/30/2007	USD-2A	Upper	Shoreline	2	2.7
8/30/2007	USD-2B	Upper	Shoreline	2	5.3
8/30/2007	USD-2C	Upper	Shoreline	2	2.7
8/30/2007	USD-5A	Upper	Shoreline	5	5.3
8/30/2007	USD-5B	Upper	Shoreline	5	5.3
8/30/2007	USD-5C	Upper	Shoreline	5	5.3
8/30/2007	USD-10A	Upper	Shoreline	10	107
8/30/2007	USD-10B	Upper	Shoreline	10	45
8/30/2007	USD-10C	Upper	Shoreline	10	21
8/30/2007	USD-15A	Upper	Shoreline	15	43
8/30/2007	USD-15B	Upper	Shoreline	15	152

Table A.3-1, continued…

Date	Site	Reservoir Location	Type of Site	Depth (ft)	Chl *a* (µg/L)
8/30/2007	USD-15C	Upper	Shoreline	15	491
8/30/2007	USD-25A	Upper	Shoreline	25	128
8/30/2007	USD-25B	Upper	Shoreline	25	144
8/30/2007	USD-25C	Upper	Shoreline	25	48
8/30/2007	USD-40A	Upper	Shoreline	40	120
8/30/2007	USD-40B	Upper	Shoreline	40	96
8/30/2007	USD-40C	Upper	Shoreline	40	64
9/1/2007	BCV1-2A	Box	Vertical	2	5.3
9/1/2007	BCV1-2B	Box	Vertical	2	5.3
9/1/2007	BCV1-2C	Box	Vertical	2	2.7
9/1/2007	BCV1-5A	Box	Vertical	5	134
9/1/2007	BCV1-5B	Box	Vertical	5	158
9/1/2007	BCV1-5C	Box	Vertical	5	222
9/1/2007	BCV1-10A	Box	Vertical	10	48
9/1/2007	BCV1-10B	Box	Vertical	10	32
9/1/2007	BCV1-10C	Box	Vertical	10	117
9/1/2007	BCV1-15A	Box	Vertical	15	53
9/1/2007	BCV1-15B	Box	Vertical	15	35
9/1/2007	BCV1-15C	Box	Vertical	15	29
9/1/2007	BCV1-20A	Box	Vertical	20	56
9/1/2007	BCV1-20B	Box	Vertical	20	123
9/1/2007	BCV1-20C	Box	Vertical	20	104
9/1/2007	BCV1-25A	Box	Vertical	25	45
9/1/2007	BCV1-25B	Box	Vertical	25	27
9/1/2007	BCV1-25C	Box	Vertical	25	35
9/1/2007	BCS1-2A	Box	Shoreline	2	2.7
9/1/2007	BCS1-2B	Box	Shoreline	2	5.3
9/1/2007	BCS1-2C	Box	Shoreline	2	8
9/1/2007	BCS1-5A	Box	Shoreline	5	401
9/1/2007	BCS1-5B	Box	Shoreline	5	211
9/1/2007	BCS1-5C	Box	Shoreline	5	342
9/1/2007	BCS1-10A	Box	Shoreline	10	93
9/1/2007	BCS1-10B	Box	Shoreline	10	134
9/1/2007	BCS1-10C	Box	Shoreline	10	37
9/1/2007	BCS1-15A	Box	Shoreline	15	254
9/1/2007	BCS1-15B	Box	Shoreline	15	85
9/1/2007	BCS1-15C	Box	Shoreline	15	77
9/1/2007	BCS1-25A	Box	Shoreline	25	64
9/1/2007	BCS1-25B	Box	Shoreline	25	53
9/1/2007	BCS1-25C	Box	Shoreline	25	77
9/1/2007	BCS1-40A	Box	Shoreline	40	13
9/1/2007	BCS1-40B	Box	Shoreline	40	11
9/1/2007	BCS1-40C	Box	Shoreline	40	16
8/31/2007	C0706-5A	Box	Colonization	5	438
8/31/2007	C0706-5B	Box	Colonization	5	352
8/31/2007	C0706-5C	Box	Colonization	5	384

Table A.3-1, continued…

Date	Site	Reservoir Location	Type of Site	Depth (ft)	Chl *a* (µg/L)
8/31/2007	C0706-15A	Box	Colonization	15	320
8/31/2007	C0706-15B	Box	Colonization	15	24
8/31/2007	C0706-15C	Box	Colonization	15	112
8/31/2007	C0706-25A	Box	Colonization	25	32
8/31/2007	C0706-25B	Box	Colonization	25	302
8/31/2007	C0706-25C	Box	Colonization	25	176
8/31/2007	C0720-5A	Box	Colonization	5	417
8/31/2007	C0720-5B	Box	Colonization	5	291
8/31/2007	C0720-5C	Box	Colonization	5	758
8/31/2007	C0720-15A	Box	Colonization	15	93
8/31/2007	C0720-15B	Box	Colonization	15	56
8/31/2007	C0720-15C	Box	Colonization	15	93
8/31/2007	C0720-25A	Box	Colonization	25	45
8/31/2007	C0720-25B	Box	Colonization	25	88
8/31/2007	C0720-25C	Box	Colonization	25	53
8/31/2007	C0803-5A	Box	Colonization	5	109
8/31/2007	C0803-5B	Box	Colonization	5	230
8/31/2007	C0803-5C	Box	Colonization	5	150
8/31/2007	C0803-15A	Box	Colonization	15	85
8/31/2007	C0803-15B	Box	Colonization	15	80
8/31/2007	C0803-15C	Box	Colonization	15	56
8/31/2007	C0803-25A	Box	Colonization	25	19
8/31/2007	C0803-25B	Box	Colonization	25	19
8/31/2007	C0803-25C	Box	Colonization	25	40
8/31/2007	C0816-5A	Box	Colonization	5	136
8/31/2007	C0816-5B	Box	Colonization	5	214
8/31/2007	C0816-5C	Box	Colonization	5	187
8/31/2007	C0816-15A	Box	Colonization	15	139
8/31/2007	C0816-15B	Box	Colonization	15	32
8/31/2007	C0816-15C	Box	Colonization	15	85
8/31/2007	C0816-25A	Box	Colonization	25	37
8/31/2007	C0816-25B	Box	Colonization	25	48
8/31/2007	C0816-25C	Box	Colonization	25	51
8/31/2007	C0823-5A	Box	Colonization	5	96
8/31/2007	C0823-5B	Box	Colonization	5	75
8/31/2007	C0823-5C	Box	Colonization	5	91
8/31/2007	C0823-15A	Box	Colonization	15	56
8/31/2007	C0823-15B	Box	Colonization	15	29
8/31/2007	C0823-15C	Box	Colonization	15	19
8/31/2007	C0823-25A	Box	Colonization	25	24
8/31/2007	C0823-25B	Box	Colonization	25	32
8/31/2007	C0823-25C	Box	Colonization	25	59
8/31/2007	C0828-5A	Box	Colonization	5	16
8/31/2007	C0828-5B	Box	Colonization	5	13
8/31/2007	C0828-5C	Box	Colonization	5	8
8/31/2007	C0828-15A	Box	Colonization	15	13

Table A.3-1, continued…

Date	Site	Reservoir Location	Type of Site	Depth (ft)	Chl *a* (µg/L)
8/31/2007	C0828-15B	Box	Colonization	15	11
8/31/2007	C0828-15C	Box	Colonization	15	13
8/31/2007	C0828-25A	Box	Colonization	25	16
8/31/2007	C0828-25B	Box	Colonization	25	16
8/31/2007	C0828-25C	Box	Colonization	25	8

Appendix 4. Zooplankton Data

Table A.4-1. Seasonal zooplankton drift data from Boundary Reservoir Site V8 June 2007.

BOUNDARY RESERVOIR STUDY 5 *WATER Environmental Services, Inc.*
ZOOPLANKTON DATA
STATION: V8-1 **NOTE: Zoop net diam 8in**
DATE: 12 JUN 07

Taxon	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid		0.6-0.7	1,070	0	2.5	2,675	
Leptodiaptomus ashlandi	1.16	1.47	107	6	10	642	
Epischura nevadensis	2.17	2.40	9	18	28	203	
Order Cyclopoida							
Diacyclops bicuspidatus thomasi	1.00	1.26	642	2.5	5.5	3,531	
Nauplii (cal+cyc)		<.3	9,630	0	0.25	2,408	
Class Branchiopoda(cladocerans)							
Daphnia sp.		1.47	4	8	15	66	tall pt helmet
Leptodora kindtii		3.0-5.0	4	0	50	220	body torn
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	2,140	0	0.02	43	
Keratella cochlearis		0.16	342,404	0	0.01	3,424	
Keratella earlinae		0.21	51,361	0	0.02	1,027	
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer(small)		0.11	1,070	0	0.02	21	pink color
Polyarthra sp. (small)		0.10	2,140	0	0.02	43	
Synchaeta sp.		0.21	40,661	0	0.08	3,253	body contracted
Synchaeta sp.		0.15	10,700	0	0.025	268	body contracted
Type 3 (mostly malleoramates)							
Others							
Undeter rotifer 2		0.14	1,070	0	0.03	32	long toes
	Total #/m3	**Density #/L**				**Total Dry Wt. Biomass ug/m3**	**ug/L**
	463,012	**463.01**				**17,856**	**17.86**
% Calanoid Copepods	0.26					19.71	
% Cyclopoid Copepods	0.14					19.78	
% Nauplii	2.08					13.48	
% Cladocerans	0.00					1.60	
% Rotifers	97.52					45.42	
% Dipterans	0.00					0.00	
Number of species in sample	**12**						

Table A.4-1, continued…

BOUNDARY RESERVOIR STUDY 5 *WATER Environmental Services, Inc.*
ZOOPLANKTON DATA
STATION: V8-2 **NOTE: Zoop net diam 8in**
DATE: 12 JUN 07

Taxon	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid		0.6-0.7	240	0	2.5	599	
Leptodiaptomus ashlandi	1.16	1.47	240	6	10	2,395	
Epischura nevadensis	2.10	2.24	9	18	28	203	
Order Cyclopoida							
Copepodid		0.6-0.7	2,395	0	2	4,791	
Diacyclops bicuspidatus thomasi	1.00	1.26	479	2.5	5.5	1,916	
Nauplii (cal+cyc)		<.3	11,977	0	0.25	2,994	
Class Branchiopoda(cladocerans)							
Bosmina longirostris (juv)		0.28	120	0	0.7	84	
Leptodora kindtii		3.0-5.0	4	0	50	220	body torn
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	20,361	0	0.02	407	
Keratella cochlearis		0.16	603,646	0	0.01	6,036	
Keratella earlinae		0.21	97,015	0	0.02	1,940	
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer(small)		0.11	2,395	0	0.02	48	pink color
Polyarthra sp. (small)		0.10	4,791	0	0.02	96	
Polyarthra sp.		0.14	3,593	0	0.05	180	appen pr not evid
Synchaeta sp.		0.21	11,977	0	0.08	958	body contracted
Synchaeta sp.		0.15	37,129	0	0.025	928	body contracted
Type 3 (mostly malleoramates)							
Others							
Undeter rotifer 1		0.10	7,186	0	0.03	216	body contracted
Undeter rotifer 2		0.12	1,198	0	0.01	12	long toes
	Total #/m3	**Density #/L**				**Total Dry Wt. ug/m3**	**Biomass ug/L**
	804,755	**804.75**				**24,024**	**24.02**
% Calanoid Copepods	0.06					13.31	
% Cyclopoid Copepods	0.36					27.92	
% Nauplii	1.49					12.46	
% Cladocerans	0.02					1.27	
% Rotifers	98.08					45.04	
% Dipterans	0.00					0.00	
Number of species in sample	**13**						

Table A.4-1, continued…

BOUNDARY RESERVOIR STUDY 5 *WATER Environmental Services, Inc.*
ZOOPLANKTON DATA
STATION: V8-3 **NOTE: Zoop net diam 8in**
DATE: 12 JUN 07

Taxon	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid		0.6-0.7	238	0	2.5	594	
Leptodiaptomus ashlandi	1.16	1.47	59	6	10	594	
Epischura nevadensis	2.10	2.31	4	18	28	123	
Order Cyclopoida							
Copepodid		0.6-0.7	1,427	0	2	2,853	
Diacyclops bicuspidatus thomasi	1.00	1.10	713	2.5	5	2,972	
Nauplii (cal+cyc)		<.3	13,078	0	0.25	3,269	
Class Branchiopoda(cladocerans)							
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	32,100	0	0.02	642	
Keratella cochlearis		0.16	442,272	0	0.01	4,423	
Keratella earlinae		0.21	66,579	0	0.02	1,332	
Keratella quadrata complex(small)		0.13	1,189	0	0.027	32	
Keratella quadrata		0.20	1,189	0	0.13	155	
Monostyla (Lecane) sp.		0.90	1,189	0	0.005	6	1 toe
Notholca foliacea		0.14	1,189	0	0.01	12	
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer		0.14	1,189	0	0.04	48	pink color
Polyarthra sp. (small)		0.10	3,567	0	0.02	71	
Polyarthra sp.		0.13	3,567	0	0.04	143	appen pr not evid
Synchaeta sp.		0.21	13,078	0	0.08	1,046	body contracted
Synchaeta sp.		0.15	60,634	0	0.025	1,516	body contracted
Type 3 (mostly malleoramates)							
Others							
Undeter rotifer 1		0.10	11,889	0	0.03	357	body contracted
	Total #/m3	**Density #/L**				**Total Dry Wt. Biomass ug/m3**	**ug/L**
	655,150	**655.15**				**20,188**	**20.19**
% Calanoid Copepods	0.05					6.50	
% Cyclopoid Copepods	0.33					28.86	
% Nauplii	2.00					16.19	
% Cladocerans	0.00					0.00	
% Rotifers	97.63					48.45	
% Dipterans	0.00					0.00	
Number of species in sample	**14**						

Table A.4-1, continued…

BOUNDARY RESERVOIR STUDY 5 *WATER Environmental Services, Inc.*
ZOOPLANKTON DATA
STATION: V8-4 **NOTE: Zoop net diam 8in**
DATE: 12 JUN 07

Taxon	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid		0.6-0.7	112	0	2.5	280	
Leptodiaptomus ashlandi	1.16	1.47	40	6	10	396	
Epischura nevadensis	1.75	1.75	9	14	16	134	
Order Cyclopoida							
Copepodid		0.6-0.7	1,342	0	2	2,684	
Diacyclops bicuspidatus thomasi	1.00	1.10	671	2.5	5	2,796	
Nauplii (cal+cyc)		<.3	14,540	0	0.25	3,635	
Class Branchiopoda(cladocerans)							
Daphnia (juv)		1.20	9	0	5	44	high pt helmet
Daphnia sp.		1.54	4	8	16	72	rounded helmet
Bosmina longirostris (juv)		0.28	112	0	0.7	78	
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	22,369	0	0.02	447	
Keratella cochlearis		0.16	561,462	0	0.01	5,615	
Keratella earlinae		0.21	78,292	0	0.02	1,566	
Keratella quadrata		0.14	1,118	0	0.03	34	
Monostyla (Lecane) sp.		0.90	1,118	0	0.005	6	1 toe
Notholca foliacea		0.17	1,118	0	0.014	16	
Type 2 (mostly illoricate virgates/incudates)							
Asplanchna sp.		0.90	1,118	0	10.4	11,632	
Gastropus stylifer(small)		0.10	2,237	0	0.02	45	pink color
Polyarthra sp. (small)		0.10	5,592	0	0.02	112	
Polyarthra sp.		0.13	2,237	0	0.04	89	appen pr not evid
Synchaeta sp.		0.21	40,264	0	0.08	3,221	body contracted
Synchaeta sp.		0.15	41,383	0	0.025	1,035	body contracted
Type 3 (mostly malleoramates)							
Conochilus sp. (small)		0.10	1,118	0	0.01	11	
Others							

	Total #/m3	**Density #/L**	**Total Dry Wt. Biomass ug/m3**	**ug/L**
	776,266	**776.27**	**33,946**	**33.95**
% Calanoid Copepods	0.02		2.39	
% Cyclopoid Copepods	0.26		16.14	
% Nauplii	1.87		10.71	
% Cladocerans	0.02		0.57	
% Rotifers	97.83		70.19	
% Dipterans	0.00		0.00	
Number of species in sample	**17**			

Table A.4-1, continued…

BOUNDARY RESERVOIR STUDY 5 *WATER Environmental Services, Inc.*
ZOOPLANKTON DATA
STATION: V8-5 **NOTE: Zoop net diam 8in**
DATE: 12 JUN 07

Taxon	Ave lngth male(mm)	fem (mm)	Ave lngth #/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid		0.6-0.7	350	0	2.5	875	
Leptodiaptomus ashlandi	1.26	1.47	117	6	10	1,167	
Epischura nevadensis	1.75	2.10	9	14	24	210	
Order Cyclopoida							
Copepodid		0.6-0.7	1,050	0	2	2,100	
Diacyclops bicuspidatus thomasi	1.00	1.26	700	2.5	5.5	3,501	
Nauplii (cal+cyc)		<.3	12,836	0	0.25	3,209	
Class Branchiopoda(cladocerans)							
Daphnia sp.		1.54	117	8	16	1,867	mod helmet w/small pt
Bosmina longirostris (juv)		0.28	117	0	0.7	82	
Alona sp.		0.56	117	0	2	233	
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	28,005	0	0.02	560	
Keratella cochlearis		0.16	665,125	0	0.01	6,651	
Keratella earlinae		0.21	75,848	0	0.02	1,517	
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer		0.14	2,334	0	0.04	93	pink color
Gastropus stylifer(small)		0.10	2,334	0	0.02	47	pink color
Polyarthra sp. (small)		0.10	3,501	0	0.02	70	
Polyarthra sp.		0.13	1,167	0	0.04	47	appen pr not evid
Synchaeta sp.		0.21	44,342	0	0.08	3,547	body contracted
Synchaeta sp.		0.15	47,842	0	0.025	1,196	body contracted
Type 3 (mostly malleoramates)							
Conochilus sp. (small)		0.12	1,167	0	0.01	12	
Others							
Undeter rotifer 1		0.10	4,668	0	0.03	140	body contracted
	Total #/m3	**Density #/L**				**Total Dry Wt. Biomass ug/m3**	**ug/L**
	891,744	**891.74**				**27,124**	**27.12**
% Calanoid Copepods	0.05					8.30	
% Cyclopoid Copepods	0.20					20.65	
% Nauplii	1.44					11.83	
% Cladocerans	0.04					8.04	
% Rotifers	98.27					51.17	
% Dipterans	0.00					0.00	
Number of species in sample	**14**						

Table A.4-1, continued…

WATER Environmental Services, Inc.

BOUNDARY RESERVOIR STUDY 5
ZOOPLANKTON DATA
STATION: V8-6 **NOTE: Zoop net diam 8in**

DATE: 12 JUN 07

Taxon	Ave lngth male(mm)	fem (mm)	Ave lngth #/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid		0.6-0.7	114	0	2.5	284	
Leptodiaptomus ashlandi	1.26	1.33	114	6	8	909	
Epischura nevadensis	1.75	2.15	9	14	24	211	
Order Cyclopoida							
Copepodid		0.6-0.7	1,136	0	2	2,272	
Diacyclops bicuspidatus thomasi	1.00	1.26	114	2.5	5.5	625	
Nauplii (cal+cyc)		<.3	12,497	0	0.25	3,124	
Class Branchiopoda(cladocerans)							
Daphnia (juv)		1.00	4	0	5	22	broken carapace
Alona sp.		0.56	114	0	2	227	
Leptodora kindtii		3.0-5.0	4	0	50	222	body torn
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	13,633	0	0.02	273	
Keratella cochlearis		0.16	255,614	0	0.01	2,556	
Keratella earlinae		0.21	79,524	0	0.02	1,590	
Monostyla (Lecane) sp.		0.90	1,136	0	0.005	6	1 toe
Notholca foliacea		0.15	1,136	0	0.01	11	
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer(small)		0.10	5,680	0	0.02	114	pink color
Polyarthra sp. (small)		0.10	1,136	0	0.02	23	
Synchaeta sp.		0.21	22,721	0	0.08	1,818	body contracted
Synchaeta sp.		0.15	28,402	0	0.025	710	body contracted
Type 3 (mostly malleoramates)							
Others							
Undeter rotifer 2		0.15	1,136	0	0.02	23	long toes
Undeter rotifer 3		0.13	1,136	0	0.02	23	
	Total #/m3	**Density #/L**				**Total Dry Wt. Biomass ug/m3**	**ug/L**
	425,360	**425.36**				**15,042**	**15.04**
% Calanoid Copepods	0.06					9.33	
% Cyclopoid Copepods	0.29					19.26	
% Nauplii	2.94					20.77	
% Cladocerans	0.03					3.13	
% Rotifers	96.68					47.51	
% Dipterans	0.00					0.00	
Number of species in sample	**16**						

Table A.4-1, continued…

BOUNDARY RESERVOIR STUDY 5 *WATER Environmental Services, Inc.*
ZOOPLANKTON DATA
STATION: V8-7 **NOTE: Zoop net diam 8in**
DATE: 12 JUN 07

Taxon	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid		0.6-0.7	384	0	2.5	960	
Epischura nevadensis	1.80	2.15	4	15	24	66	
Order Cyclopoida							
Copepodid		0.6-0.7	960	0	2	1,920	
Diacyclops bicuspidatus thomasi	1.00	1.26	432	2.5	5.5	1,224	
Nauplii (cal+cyc)		<.3	18,239	0	0.25	4,560	
Class Branchiopoda(cladocerans)							
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	22,078	0	0.02	442	
Keratella cochlearis		0.16	662,351	0	0.01	6,624	
Keratella earlinae		0.21	86,394	0	0.02	1,728	
Notholca foliacea		0.17	960	0	0.014	13	
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer		0.13	960	0	0.035	34	pink color
		0.10	2,880	0	0.02	58	pink color
Polyarthra sp. (small)		0.10	47,996	0	0.02	960	
Polyarthra sp.		0.14	6,720	0	0.05	336	appen pr not evid
Polyarthra sp.		0.20	960	0	0.11	106	appen pr not evid
Synchaeta sp.		0.21	52,796	0	0.08	4,224	body contracted
Synchaeta sp.		0.15	43,197	0	0.025	1,080	body contracted
Type 3 (mostly malleoramates)							
Others							
Undeter rotifer 1		0.10	19,199	0	0.03	576	body contracted
Undeter rotifer 4		0.35	960	0	0.06	58	cylin body,2 toes
	Total Density					**Total Dry Wt. Biomass**	
	#/m3	**#/L**				**ug/m3**	**ug/L**
	967,469	**967.47**				**24,966**	**24.97**
% Calanoid Copepods	0.04					4.11	
% Cyclopoid Copepods	0.14					12.59	
% Nauplii	1.89					18.26	
% Cladocerans	0.00					0.00	
% Rotifers	97.93					65.03	
% Dipterans	0.00					0.00	
Number of species in sample	**14**						

Table A.4-1, continued…

BOUNDARY RESERVOIR STUDY 5 *WATER Environmental Services, Inc.*
ZOOPLANKTON DATA
STATION: V8-8 **NOTE: Zoop net diam 8in**
DATE: 12 JUN 07

Taxon	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid		0.6-0.7	330	0	2.5	826	
Leptodiaptomus ashlandi	1.12	1.26	210	5	8	1,352	
Epischura nevadensis	1.90	2.15	18	15	24	343	
Order Cyclopoida							
Copepodid		0.6-0.7	881	0	2	1,761	
Diacyclops bicuspidatus thomasi	1.00	1.35	661	2.5	6	3,578	
Nauplii (cal+cyc)		<.3	15,412	0	0.25	3,853	
Class Branchiopoda(cladocerans)							
Ceriodaphnia sp.		0.60	110	0	3.5	385	
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	16,513	0	0.02	330	
Keratella cochlearis		0.16	864,157	0	0.01	8,642	
Keratella earlinae		0.21	94,672	0	0.02	1,893	
Monostyla (Lecane) sp.		0.90	1,101	0	0.005	6	1 toe
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer(small)		0.10	3,303	0	0.02	66	pink color
Polyarthra sp. (small)		0.10	52,840	0	0.02	1,057	
Polyarthra sp.		0.15	12,109	0	0.06	727	appen pr not evid
Synchaeta sp.		0.21	88,067	0	0.08	7,045	body contracted
Synchaeta sp.		0.15	17,613	0	0.025	440	body contracted
Type 3 (mostly malleoramates)							
Conochilus sp.		0.20	1,101	0	0.025	28	
Others							
Undeter rotifer 1		0.10	11,008	0	0.03	330	body contracted
	Total Density					**Total Dry Wt. Biomass**	
	#/m3	**#/L**				**ug/m3**	**ug/L**
	1,180,105	**1180.10**				**32,662**	**32.66**
% Calanoid Copepods	0.05					7.72	
% Cyclopoid Copepods	0.13					16.35	
% Nauplii	1.31					11.80	
% Cladocerans	0.01					1.18	
% Rotifers	98.51					62.96	
% Dipterans	0.00					0.00	
Number of species in sample	**14**						

Table A.4-1, continued…

BOUNDARY RESERVOIR STUDY 5 *WATER Environmental Services, Inc.*
ZOOPLANKTON DATA
STATION: V8-9 **NOTE: Zoop net diam 8in**
DATE: 12 JUN 07

Taxon	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Leptodiaptomus ashlandi	1.12	1.26	123	5	8	986	
Epischura nevadensis	1.90	2.10	4	15	24	106	
Order Cyclopoida							
Copepodid		0.6-0.7	986	0	2	1,973	
Diacyclops bicuspidatus thomasi	1.00	1.25	370	2.5	5.5	1,664	
Nauplii (cal+cyc)		<.3	12,329	0	0.25	3,082	
Class Branchiopoda(cladocerans)							
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	36,988	0	0.02	740	
Keratella cochlearis		0.16	838,397	0	0.01	8,384	
Keratella earlinae		0.21	106,033	0	0.02	2,121	
Notholca foliacea		0.15	2,466	0	0.01	25	
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer(small)		0.10	8,631	0	0.02	173	pink color
Polyarthra sp. (small)		0.10	59,181	0	0.02	1,184	
Polyarthra sp.		0.15	14,795	0	0.06	888	appen pr not evid
Synchaeta sp.		0.21	83,840	0	0.08	6,707	body contracted
Synchaeta sp.		0.15	55,482	0	0.025	1,387	body contracted
Type 3 (mostly malleoramates)							
Others							
Undeter rotifer 1		0.10	18,494	0	0.03	555	body contracted
Undeter rotifer 3		0.14	1,233	0	0.046	57	ellipsoidal body
	Total Density					**Total Dry Wt. Biomass**	
	#/m3	**#/L**				**ug/m3**	**ug/L**
	1,239,353	**1239.35**				**30,030**	**30.03**
% Calanoid Copepods	0.01					3.64	
% Cyclopoid Copepods	0.11					12.11	
% Nauplii	0.99					10.26	
% Cladocerans	0.00					0.00	
% Rotifers	98.89					73.99	
% Dipterans	0.00					0.00	
Number of species in sample	**13**						

Table A.4-1, continued…

BOUNDARY RESERVOIR STUDY 5 *WATER Environmental Services, Inc.*
ZOOPLANKTON DATA
STATION: V8-10 **NOTE: Zoop net diam 8in**
DATE: 12 JUN 07

Taxon	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Leptodiaptomus ashlandi	1.12	1.33	9	5	9	62	
Epischura nevadensis	1.75	1.90	13	14	21	216	
Order Cyclopoida							
Copepodid		0.6-0.7	104	0	2	208	
Diacyclops bicuspidatus thomasi	1.00	1.26	458	2.5	5.5	2,519	
Nauplii (cal+cyc)		<.3	9,159	0	0.25	2,290	
Class Branchiopoda(cladocerans)							
Alona sp.		0.35	104	0	1.5	156	
Sida crystallina		1.90	4	0	30	132	
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	13,738	0	0.02	275	
Keratella cochlearis		0.16	764,773	0	0.01	7,648	
Keratella earlinae		0.21	74,417	0	0.02	1,488	
Keratella serrulata		0.17	1,145	0	0.07	80	
Notholca foliacea		0.15	1,145	0	0.01	11	
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer(small)		0.10	5,724	0	0.02	114	pink color
Polyarthra sp. (small)		0.10	53,809	0	0.02	1,076	
Polyarthra sp.		0.15	11,449	0	0.06	687	appen pr not evid
Synchaeta sp.		0.21	28,622	0	0.08	2,290	body contracted
Synchaeta sp.		0.15	37,781	0	0.025	945	body contracted
Type 3 (mostly malleoramates)							
Others							
Undeter rotifer 1		0.10	9,159	0	0.03	275	body contracted
Undeter rotifer 3		0.14	1,145	0	0.046	53	
	Total Density					**Total Dry Wt. Biomass**	
	#/m3	**#/L**				**ug/m3**	**ug/L**
	1,012,758	**1012.76**				**20,525**	**20.52**
% Calanoid Copepods	0.00					1.35	
% Cyclopoid Copepods	0.06					13.29	
% Nauplii	0.90					11.16	
% Cladocerans	0.01					1.41	
% Rotifers	99.03					72.80	
% Dipterans	0.00					0.00	
Number of species in sample	**16**						

Table A.4-1, continued…

BOUNDARY RESERVOIR STUDY 5 *WATER Environmental Services, Inc.*
ZOOPLANKTON DATA
STATION: V8-11 **NOTE: Zoop net diam 8in**
DATE: 12 JUN 07

Taxon	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid		0.6-0.7	750	0	2.5	1,876	
Leptodiaptomus ashlandi	1.12	1.40	2	5	10	18	
Epischura nevadensis	2.10	1.75	18	18	16	298	
Order Cyclopoida							
Diacyclops bicuspidatus thomasi	1.00	1.35	63	2.5	6	375	
Nauplii (cal+cyc)		<.3	6,253	0	0.25	1,563	
Class Branchiopoda(cladocerans)							
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	25,011	0	0.02	500	
Keratella cochlearis		0.16	850,374	0	0.01	8,504	
Keratella earlinae		0.21	97,543	0	0.02	1,951	
Notholca foliacea		0.15	3,752	0	0.01	38	
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer(small)		0.10	5,002	0	0.02	100	pink color
Polyarthra sp. (small)		0.10	26,262	0	0.02	525	
Polyarthra sp.		0.14	8,754	0	0.05	438	appen pr not evid
Synchaeta sp.		0.21	65,029	0	0.08	5,202	body contracted
Synchaeta sp.		0.15	51,273	0	0.025	1,282	body contracted
Type 3 (mostly malleoramates)							
Others							
Undeter rotifer 1		0.10	6,253	0	0.03	188	body contracted
Undeter rotifer 3		0.14	1,251	0	0.015	19	
	Total Density					**Total Dry Wt. Biomass**	
	#/m3	**#/L**				**ug/m3**	**ug/L**
	1,147,587	**1147.59**				**22,875**	**22.88**
% Calanoid Copepods	0.07					9.58	
% Cyclopoid Copepods	0.01					1.64	
% Nauplii	0.54					6.83	
% Cladocerans	0.00					0.00	
% Rotifers	99.38					81.95	
% Dipterans	0.00					0.00	
Number of species in sample	**13**						

Table A.4-1, continued…

BOUNDARY RESERVOIR STUDY 5 *WATER Environmental Services, Inc.*
ZOOPLANKTON DATA
STATION: V8-12 **NOTE: Zoop net diam 8in**
DATE: 12 JUN 07

Taxon	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid		0.6-0.7	616	0	2.5	1,541	
Copepodid (Epischura)		<1.4	4	0	10	44	
Leptodiaptomus ashlandi	1.12	1.16	62	5	6	370	
Epischura nevadensis	2.10	2.24	18	18	28	405	
Order Cyclopoida							
Copepodid		0.6-0.7	370	0	2	740	
Diacyclops bicuspidatus thomasi	1.00	1.35	370	2.5	6	1,788	
Nauplii (cal+cyc)		<.3	18,494	0	0.25	4,624	
Class Branchiopoda(cladocerans)							
Bosmina longirostris (juv)		0.28	123	0	0.7	86	
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	27,125	0	0.02	542	
Keratella cochlearis		0.16	742,228	0	0.01	7,422	
Keratella earlinae		0.21	138,089	0	0.02	2,762	
Keratella quadrata complex(small)		0.13	1,233	0	0.027	33	
Keratella crassa		0.21	1,233	0	0.025	31	
Monostyla (Lecane) sp.		0.90	1,233	0	0.005	6	1 toe
Notholca foliacea		0.15	1,233	0	0.01	12	
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer(small)		0.10	9,863	0	0.02	197	pink color
Polyarthra sp. (small)		0.10	7,398	0	0.02	148	
Polyarthra sp.		0.16	2,466	0	0.08	197	appen pr not evid
Synchaeta sp.		0.21	65,346	0	0.08	5,228	body contracted
Synchaeta sp.		0.15	39,454	0	0.025	986	body contracted
Type 3 (mostly malleoramates)							
Others							
Undeter rotifer 1		0.10	6,165	0	0.03	185	body contracted

	Total Density #/m3	**#/L**	**Total Dry Wt. Biomass ug/m3**	**ug/L**
	1,063,122	**1063.12**	**27,348**	**27.35**
% Calanoid Copepods	0.07		8.63	
% Cyclopoid Copepods	0.07		9.24	
% Nauplii	1.74		16.91	
% Cladocerans	0.01		0.32	
% Rotifers	98.11		64.91	
% Dipterans	0.00		0.00	
Number of species in sample	**16**			

Table A.4-1, continued…

Seattle City Light - Boundary Hydroelectric Project (FERC No. 2144)								
Study No. 5, Water Quality Constituent and Productivity Monitoring								
I. General Information								
Samplers: SB, JW, AB, DC, DS, ES, RT				Time 24-HR Period Began: 6:00 am				
Date: 6/12/07 to 6/13/07				Weather/Temp: Sunny, 50 degrees				
Station I.D.: V8 Boundary Dam Tailrace				Photo Numbers:				
II. WQ In-Situ Sampling Information								
Reservoir Depth at Station (m): 14.7 ft								
Secchi Depth (m):	1st:	1.6	2nd:	1.8	3rd:	1.6	Avg:	1.6666667
III. WQ Grab Samples								
Zooplankton								
Sample	Start Time	End Time	Sample ID					
V8-1	6:15 AM	6:36 AM	ZOOP 1-V8					
V8-2	8:33 AM	8:53 AM	ZOOP 2-V8					
V8-3	10:30 AM	10:50 AM	ZOOP 3-V8					
V8-4	1:02 PM	1:22 PM	ZOOP 4-V8					
V8-5	2:53 PM	3:13 PM	ZOOP 5-V8					
V8-6	4:29 PM	4:49 PM	ZOOP 6-V8					
V8-7	6:32 PM	6:52 PM	ZOOP 7-V8					
V8-8	8:39 PM	8:59 PM	ZOOP 8-V8					
V8-9	10:31 PM	10:51 PM	ZOOP 9-V8					
V8-10	12:39 AM	12:59 AM	ZOOP 10-V8					
V8-11	2:29 AM	2:49 AM	ZOOP 11-V8					
V8-12	4:18 AM	4:38 AM	ZOOP 12-V8					
IV. General Notes/Observations								
Zooplankton tube was lowered to 5 ft according to gage on winch which was set at 0 when end of tube just touching the water. For Zoop #4, started at 12:15pm but cable got caught in winch had to go back to shore to fix. Moved boom forward so weight was more out in front								

Table A.4-2. Monthly Zooplankton Water Column Tow Data from Boundary Reservoir Site V1 May 2007.

BOUNDARY RESERVOIR STUDY 5 *WATER Environmental Services, Inc.*
ZOOPLANKTON DATA
STATION: V1-PEL MID 1 **NOTE: Zoop net diam 130mm; tow=4 m**
DATE: 23 May 07

Taxon	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid (diaptomid)		1.00	178	0	5	892	late instar
Leptodiaptomus ashlandi	1.33	1.40	39	7	10	386	
Order Cyclopoida							
Copepodid		0.6-0.7	594	0	2	1,189	
Diacyclops bicuspidatus thomasi	1.00	1.12	693	2.5	4	2,477	
Nauplii (cal+cyc)		<.3	4,954	0	0.25	1,238	
Class Branchiopoda(cladocerans)							
Bosmina longirostris (tenta)		0.35	99	0	1.2	119	
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	6,935	0	0.02	139	
Keratella cochlearis		0.16	144,644	0	0.01	1,446	
Keratella earlinae		0.21	10,898	0	0.02	218	
Notholca foliacea		0.17	2,972	0	0.014	42	
Type 2 (mostly illoricate virgates/incudates)							
Gastropus sp.		0.12	991	0	0.05	50	
Gastropus stylifer(small)		0.11	991	0	0.02	20	pink color
Polyarthra sp. (small)		0.10	7,926	0	0.025	198	
Polyarthra sp.		0.14	17,833	0	0.05	892	appen pr not evid
Synchaeta sp.		0.21	14,861	0	0.08	1,189	body contracted
Synchaeta sp.		0.12	19,814	0	0.02	396	body contracted
Type 3 (mostly malleoramates)							
Others							

	Total Density #/m3	#/L	**Total Dry Wt. Biomass** ug/m3	ug/L
	234,421	**234.42**	**10,890**	**10.89**
% Calanoid Copepods	0.09		11.74	
% Cyclopoid Copepods	0.55		33.66	
% Nauplii	2.11		11.37	
% Cladocerans	0.04		1.09	
% Rotifers	97.20		42.14	
% Dipterans	0.00		0.00	
Number of species in sample	**12**			

Table A.4-2, continued…

BOUNDARY RESERVOIR STUDY 5 *WATER Environmental Services, Inc.*
ZOOPLANKTON DATA
STATION: V1-PEL MID 2 **NOTE: Zoop net diam 8in**
DATE: 23 May 07

Taxon	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid (diaptomid)		1.00	102	0	5	509	late instar
Leptodiaptomus ashlandi	1.26	1.40	102	6	10	611	
Order Cyclopoida							
Copepodid		0.6-0.7	916	0	2	1,832	
Nauplii (cal+cyc)		<.3	8,142	0	0.25	2,036	
Class Branchiopoda(cladocerans)							
Bosmina longirostris (tenta)		0.40	102	0	1.2	122	
Eurycercus lamelatus		1.00	204	0	30	6,107	
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	13,231	0	0.02	265	
Keratella cochlearis		0.16	184,222	0	0.01	1,842	
Keratella earlinae		0.21	14,249	0	0.02	285	
Keratella serrulata		0.17	1,018	0	0.025	25	
Notholca acuminata v. extensa/N. caudata		0.28	1,018	0	0.055	56	term spine broken
Type 2 (mostly illoricate virgates/incudates)							
Asplanchna sp.		0.90	1,018	0	16	16,285	
Cephalodella sp.		0.25	1,018	0	0.085	87	
Gastropus stylifer		0.12	1,018	0	0.04	41	pink color
Polyarthra sp. (small)		0.10	14,249	0	0.025	356	
Polyarthra sp.		0.14	28,498	0	0.05	1,425	appen pr not evid
Synchaeta sp.		0.21	10,178	0	0.08	814	body contracted
Synchaeta sp.		0.12	19,338	0	0.02	387	body contracted
Type 3 (mostly malleoramates)							
Others							

	Total Density #/m3	#/L	Total Dry Wt. Biomass ug/m3	ug/L
	298,623	**298.62**	**33,084**	**33.08**
% Calanoid Copepods	0.07		3.38	
% Cyclopoid Copepods	0.31		5.54	
% Nauplii	2.73		6.15	
% Cladocerans	0.10		18.83	
% Rotifers	96.80		66.10	
% Dipterans	0.00		0.00	
Number of species in sample	**15**			

Table A.4-3. Monthly Zooplankton Water Column Tow Data from Boundary Reservoir Site V4 May 2007.

BOUNDARY RESERVOIR STUDY 5 ***WATER Environmental Services, Inc.***
ZOOPLANKTON DATA
STATION: V4-PEL MID 1 **NOTE: Zoop net diam 8in**
DATE: 22 May 07

Taxon	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Leptodiaptomus ashlandi	1.33	1.40	68	7	10	479	
Epischura nevadensis	2.10	2.17	2	18	24	52	
Order Cyclopoida							
Copepodid		0.6-0.7	342	0	2	684	
Diacyclops bicuspidatus thomasi	1.00	1.26	34	3	5.5	188	
Nauplii (cal+cyc)		<.3	2,734	0	0.25	684	
Class Branchiopoda(cladocerans)							
small chydorid		0.42	34	0	2	68	
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	5,469	0	0.02	109	
Keratella cochlearis		0.16	112,793	0	0.01	1,128	
Keratella crassa		0.23	342	0	0.02	7	
Keratella earlinae		0.21	7,520	0	0.02	150	
Monostyla (Lecane) sp.		0.13	1,367	0	0.01	14	1 toe
Type 2 (mostly illoricate virgates/incudates)							
Gastropus sp.		0.13	2,051	0	0.04	82	
Polyarthra sp. (small)		0.10	3,418	0	0.02	68	
Polyarthra sp.		0.14	13,672	0	0.05	684	appen pr not evid
Synchaeta sp.		0.21	8,887	0	0.08	711	body contracted
Synchaeta sp.		0.15	11,621	0	0.025	291	body contracted
Type 3 (mostly malleoramates)							
Filinia sp.		0.14	684	0	0.03	21	
Others							
Undeter rotifer 1		0.10	9,570	0	0.03	287	body contracted
	Total Density					**Total Dry Wt. Biomass**	
	#/m3	**#/L**				**ug/m3**	**ug/L**
	180,607	**180.61**				**5,705**	**5.70**
% Calanoid Copepods	0.04					9.29	
% Cyclopoid Copepods	0.21					15.28	
% Nauplii	1.51					11.98	
% Cladocerans	0.02					1.20	
% Rotifers	98.22					62.25	
% Dipterans	0.00					0.00	
Number of species in sample	**15**						

Table A.4-3, continued…

BOUNDARY RESERVOIR STUDY 5 *WATER Environmental Services, Inc.*
ZOOPLANKTON DATA
STATION: V4-PEL MID 2 **NOTE: Zoop net diam 8in**
DATE: 22 May 07

Taxon	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt. ug/male	Estim. Dry wt. ug/fem	ug/m3	Comments
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid (diaptomid)		1.00	57	0	5	285	
Leptodiaptomus ashlandi	1.33	1.40	11	7	10	103	
Epischura nevadensis	2.10	2.17	8	18	24	137	
Order Cyclopoida							
Copepodid		0.6-0.7	222	0	2	444	
Diacyclops bicuspidatus thomasi	1.00	1.26	95	3	5.5	523	
Nauplii (cal+cyc)		<.3	1,268	0	0.25	317	
Class Branchiopoda(cladocerans)							
Chydorus sp.		0.28	317	0	1	317	
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina		0.21	6,341	0	0.02	127	
Keratella cochlearis		0.16	104,619	0	0.01	1,046	
Keratella earlinae		0.21	10,779	0	0.02	216	
Keratella quadrata complex(small)		0.13	1,268	0	0.027	34	
Notholca foliacea		0.17	1,268	0	0.014	18	
Notholca squamula/michiganensis compl.		0.14	634	0	0.02	13	lorica poster round
Type 2 (mostly illoricate virgates/incudates)							
Cephalodella sp.		0.15	317	0	0.03	10	
Gastropus stylifer		0.13	1,268	0	0.04	51	
Gastropus stylifer(small)		0.10	1,268	0	0.02	25	pink color
Polyarthra sp. (small)		0.10	2,536	0	0.02	51	
Polyarthra sp.		0.14	16,485	0	0.05	824	appen pr not evid
Synchaeta sp.		0.21	8,243	0	0.08	659	body contracted
Synchaeta sp.		0.15	5,707	0	0.025	143	body contracted
Type 3 (mostly malleoramates)							
Filinia sp.		0.14	634	0	0.03	19	
Others							
Undeter rotifer 1		0.10	7,609	0	0.03	228	body contracted
Undeter rotifer 2		0.23	317	0	0.06	19	2 small toes
	Total Density					**Total Dry Wt. Biomass**	
	#/m3	**#/L**				**ug/m3**	**ug/L**
	171,271	**171.27**				**5,608**	**5.61**
% Calanoid Copepods	0.04					9.36	
% Cyclopoid Copepods	0.19					17.24	
% Nauplii	0.74					5.65	
% Cladocerans	0.19					5.65	
% Rotifers	98.84					62.09	
% Dipterans	0.00					0.00	
Number of species in sample	**18**						

Table A.4-4. Monthly Zooplankton Water Column Tow Data from Boundary Reservoir Site V5 May 2007.

BOUNDARY RESERVOIR STUDY 5								***WATER Environmental Services, Inc.***				
ZOOPLANKTON DATA												
STATION: V5-PEL MID 1								**NOTE: Zoop net diam 8in**				
DATE: 22 May 07												
									Estim.	**Estim.**		
	sample	**sample**	**sample**			**Ave lngth**	**Ave lngth**		**Dry wt.**	**Dry wt.**		
Taxon	**#male/ml**	**#fem/ml**	**total #/ml**	**Factor**	**# species**	**male(mm)**	**fem (mm)**	**#/m3**	**ug/male**	**ug/fem**	**ug/m3**	**Comments**
PHYLUM ARTHROPODA				254.08								
Subphylum Crustacea												
Subclass Copepoda												
Order Calanoida												
Copepodid	0	0.9	0.90	254.08	0.00		0.6-0.7	229	0	2.5	572	*Diap/Epischura*
Copepodid (Epischura)	0	0	0.00	254.08			<1.4	0	0	10	0	
Hesperodiaptomus franciscanus	0	0	0.00	254.08	0.00		1.96	0	14	22	0	
Onychodiaptomus hesperus	0	0	0.00	254.08	0.00	1.40	1.47	0	5.5	8.3	0	
Skistodiaptomus oregonensis	0	0	0.00	254.08	0.00	1.30	1.50	0	6.6	12	0	
Leptodiaptomus ashlandi	0.2	0	0.20	254.08	1.00	1.20	1.40	51	6	10	305	
Leptodiaptomus sicilis	0	0	0.00	254.08	0.00			0	6.5	14.3	0	
Leptodiaptomus signacauda	0	0	0.00	254.08	0.00			0	10	12	0	
Epischura nevadensis	0	0.1	0.10	254.08	1.00	2.10	1.50	25	10	24	610	young females
Order Cyclopoida												
Copepodid	0	2	2.00	254.08	0.00		0.6-0.7	508	0	2	1,016	
Orthocyclops modestus	0	0	0.00	254.08	0.00	0.90	1.05	0	3	5	0	
Acanthocyclops vernalis	0	0	0.00	254.08	0.00		1.61	0	3	16.8	0	
Diacyclops bicuspidatus thomasi	0	0.2	0.20	254.08	1.00	1.00	1.00	51	3	4	203	
Mesocyclops edax	0	0	0.00	254.08	0.00	1.20	1.68	0	4.4	40	0	
Macrocyclops fuscus	0	0	0.00	254.08	0.00			0	10	40	0	
Eucyclops agilis	0	0	0.00	254.08	0.00			0	2.5	8	0	
Nauplii (cal+cyc)	0	6	6.00	254.08			<.3	1,525	0	0.25	381	
Class Branchiopoda(cladocerans)												
Daphnia (juv)	0	0	0.00	254.08			<1.0	0	0	5	0	sml pt helmt
Daphnia pulex/pulicaria group	0	0	0.00	254.08	0.00		1.50	0	0	16	0	
Daphnia shodleri-like	0	0	0.00	254.08	0.00		1.75	0	0	30	0	
Daphnia rosea	0	0	0.00	254.08	0.00	1.05	1.47	0	5	10	0	
Daphnia sp. (thorata?)	0	0	0.00	254.08	0.00		1.61	0	8	25	0	
Daphnia galeata mendotae	0	0	0.00	254.08	0.00		2.00	0	8	30	0	tall pt helmet
Holopedium gibberum	0	0	0.00	254.08	0.00		1.40	0	0	25	0	
Ceriodaphnia lacustris	0	0	0.00	254.08	0.00			0	0	4	0	
Bosmina longirostris (adult)	0	0	0.00	254.08	0.00		0.40	0	0	1.7	0	
Bosmina longirostris (juv)	0	0	0.00	254.08	0.00		0.28	0	0	0.7	0	
Chydorus sphaericus	0	0	0.00	254.08	0.00		0.28	0	0	0.65	0	
Diaphanosoma birgei	0	0	0.00	254.08	0.00		1.40	0	0	17	0	
Diaphanosoma birgei (juv)	0	0	0.00	254.08	0.00	1.05	1.00	0	0	5	0	
Alona sp.	0	0.1	0.10	254.08	1.00		0.55	25	0	2	51	
small chydorid	0	0	0.00	254.08	0.00		0.42	0	0	2	0	
Polyphemus pediculus	0	0	0.00	254.08	0.00			0	0	19.77	0	
Leptodora kindtii	0	0	0.00	254.08	0.00		10.00+	0	0	100	0	
Sida crystallina (juvenile)	0	0	0.00	254.08	0.00		1.00	0	0	8	0	
Class Insecta												
Order Diptera												
Chaoborus sp. (small)	0	0	0.00	254.08	0.00		4.20	0	0	50	0	
Chaoborus sp. (robust)	0	0	0.00	254.08	0.00		10.00	0	0	300	0	
PHYLUM ROTIFERA												
Type 1 (mostly loricated malleates)												
Brachionus sp.	0	0	0.00	254.08	0.00			0	0	0.0749	0	
Euchlanis sp.	0	0	0.00	254.08	0.00			0	0	0.0749	0	
Kellicottia bostoniensis	0	0	0.00	254.08	0.00			0	0	0.0096	0	
Kellicottia longispina	0	8	8.00	254.08	1.00		0.21	2,033	0	0.02	41	
Keratella cochlearis	0	396	396.00	254.08	1.00		0.16	100,617	0	0.01	1,006	
Keratella crassa	0	0	0.00	254.08	0.00		0.23	0	0	0.02	0	
Keratella earlinae	0	30	30.00	254.08	1.00		0.21	7,623	0	0.02	152	
Keratella quadrata complex(small)	0	2	2.00	254.08	1.00		0.13	508	0	0.027	14	
Keratella quadrata	0	0	0.00	254.08	0.00		0.20	0	0	0.13	0	
Keratella taurocephala	0	0	0.00	254.08	0.00		0.26	0	0	0.025	0	
Lecane sp.	0	1	1.00	254.08	1.00		0.15	254	0	0.01	3	2 toes
Lepadella sp.	0	0	0.00	254.08	0.00		0.16	0	0	0.011	0	
Monostyla (Lecane) sp.	0	3	3.00	254.08	1.00		0.14	762	0	0.01	8	1 toe
Mytilina sp.	0	0	0.00	254.08	0.00			0	0	0.009	0	
Notholca foliacea	0	1	1.00	254.08	1.00		0.15	254	0	0.01	3	
Notholca squamula/michiganensis compl.	0	2	2.00	254.08	1.00		0.14	508	0	0.025	13	lorica wrinkles not evid
Notholca acuminata(tenta)	0	1	1.00	254.08	1.00		0.22	254	0	0.03	8	short md post ext
Platyias sp.	0	0	0.00	254.08	0.00			0	0	0.009	0	
Trichotria sp.	0	0	0.00	254.08	0.00			0	0	0.02	0	
Type 2 (mostly illoricate virgates/incudates)												
Ascomorpha sp.	0	0	0.00	254.08	0.00		0.12	0	0	0.023	0	
Ascomorphella volvocicola	0	0	0.00	254.08	0.00			0	0	0.023	0	
Asplanchna sp.	0	0	0.00	254.08	0.00		0.63	0	0	4	0	
Asplanchna sp.	0	0	0.00	254.08	0.00		0.42	0	0	1.2	0	
Asplanchna sp.	0	0	0.00	254.08			0.49	0	0	2.2	0	
Cephalodella sp.	0	1	1.00	254.08	1.00		0.20	254	0	0.05	13	
Gastropus sp.	0	0	0.00	254.08	0.00		0.13	0	0	0.04	0	
Gastropus stylifer	0	4	4.00	254.08	1.00		0.13	1,016	0	0.03	30	
Gastropus stylifer(small)	0	2	2.00	254.08	0.00		0.11	508	0	0.02	10	pink color
Ploesoma sp.	0	0	0.00	254.08	0.00		0.20	0	0	0.1	0	
Polyarthra sp. (small)	0	2	2.00	254.08	1.00		0.10	508	0	0.022	11	
Polyarthra sp.	0	50	50.00	254.08	1.00		0.14	12,704	0	0.05	635	appen pr not evid
Polyarthra sp. B	0	0	0.00	254.08	0.00		0.18	0	0	0.09	0	
Polyarthra vulgaris	0	0	0.00	254.08	0.00			0	0	0.1015	0	
Synchaeta sp.	0	31	31.00	254.08	1.00		0.21	7,877	0	0.08	630	body contracted
Synchaeta sp.	0	6	6.00	254.08			0.15	1,525	0	0.025	38	body contracted
Trichocerca cylindrica	0	0	0.00	254.08	0.00		0.46	0	0	0.16	0	
Trichocerca similis	0	0	0.00	254.08	0.00			0	0	1	0	
Trichocerca sp. B	0	0	0.00	254.08	0.00		0.21	0	0	0.024	0	
Trichocerca sp. C	0	0	0.00	254.08	0.00		0.08	0	0	0.006	0	
Type 3 (mostly malleoramates)												
Collotheca sp.	0	0	0.00	254.08	0.00		0.21	0	0	0.01	0	
Conochilus sp.	0	0	0.00	254.08	0.00		0.22	0	0	0.03	0	
Conochilus sp. (small)	0	0	0.00	254.08	0.00		0.10	0	0	0.01	0	
Filinia sp.	0	1	1.00	254.08	1.00		0.14	254	0	0.03	8	
Hexarthra sp.	0	0	0.00	254.08	0.00			0	0	0.023	0	
Pompholyx sp.	0	0	0.00	254.08	0.00		0.09	0	0	0.01	0	
Testudinella sp.	0	0	0.00	254.08	0.00			0	0	0.023	0	
Others												
Undeter rotifer 1	0	40	40.00	254.08	1.00		0.10	10,163	0	0.03	305	body contracted
Undeter rotifer 2	0	0	0.00	254.08	0.00			0	0	1	0	
Undeter rotifer 3	0	0	0.00	254.08	0.00			0	0	0.015	0	
Undeter rotifer 4	0	0	0.00	254.08	0.00			0	0	1	0	
						Total	**Density**				**Total Dry Wt. Biomass**	
						#/m3	**#/L**				**ug/m3**	**ug/L**
						150,036	**150.04**				**6,064**	**6.06**
% Calanoid Copepods						0.20					24.51	
% Cyclopoid Copepods						0.37					20.11	
% Nauplii						1.02					6.28	
% Cladocerans						0.02					0.84	
% Rotifers						98.39					48.26	
% Dipterans						0.00	100.00				0.00	100.00
Number of species in sample						**20**						

Table A.4-4, continued…

BOUNDARY RESERVOIR STUDY 5								***WATER Environmental Services, Inc.***				
ZOOPLANKTON DATA												
STATION: V5-PEL MID 2								**NOTE: Zoop net diam 8in**				
DATE: 22 May 07												
									Estim.	**Estim.**		
	sample	**sample**	**sample**			**Ave lngth**	**Ave lngth**		**Dry wt.**	**Dry wt.**		
Taxon	**#male/ml**	**#fem/ml**	**total #/ml**	**Factor**	**# species**	**male(mm)**	**fem (mm)**	**#/m3**	**ug/male**	**ug/fem**	**ug/m3**	**Comments**
PHYLUM ARTHROPODA				157.89								
Subphylum Crustacea												
Subclass Copepoda												
Order Calanoida												
Copepodid (diaptomid)	0	0.18	0.18	157.89	0.00		1.00	28	0	5	142	
Copepodid (Epischura)	0	0	0.00	157.89			<1.4	0	0	10	0	
Hesperodiaptomus franciscanus	0	0	0.00	157.89	0.00		1.96	0	14	22	0	
Onychodiaptomus hesperus	0	0	0.00	157.89	0.00	1.40	1.47	0	5.5	8.3	0	
Skistodiaptomus oregonensis	0	0	0.00	157.89	0.00	1.30	1.50	0	6.6	12	0	
Leptodiaptomus ashlandi	0	0.4	0.40	157.89	1.00	1.33	1.47	63	7	10	632	
Leptodiaptomus sicilis	0	0	0.00	157.89	0.00			0	6.5	14.3	0	
Leptodiaptomus signacauda	0	0	0.00	157.89	0.00			0	10	12	0	
Epischura nevadensis	0	0	0.00	157.89	0.00	2.10	2.17	0	18	24	0	
Order Cyclopoida												
Copepodid	0	2.4	2.40	157.89	0.00		0.6-0.7	379	0	2	758	
Orthocyclops modestus	0	0	0.00	157.89	0.00	0.90	1.05	0	3	5	0	
Acanthocyclops vernalis	0	0	0.00	157.89	0.00		1.61	0	3	16.8	0	
Diacyclops bicuspidatus thomasi	0	0.3	0.30	157.89	1.00	1.00	1.26	47	3	5.5	261	
Mesocyclops edax	0	0	0.00	157.89	0.00	1.20	1.68	0	4.4	40	0	
Macrocyclops fuscus	0	0	0.00	157.89	0.00			0	10	40	0	
Eucyclops agilis	0	0	0.00	157.89	0.00			0	2.5	8	0	
Nauplii (cal+cyc)	0	7	7.00	157.89			<.3	1,105	0	0.25	276	
Class Branchiopoda(cladocerans)												
Daphnia (juv)	0	0	0.00	157.89			<1.0	0	0	5	0	sml pt helmt
Daphnia pulex/pulicaria group	0	0	0.00	157.89	0.00		1.50	0	0	16	0	
Daphnia shodleri-like	0	0	0.00	157.89	0.00		1.75	0	0	30	0	
Daphnia rosea	0	0	0.00	157.89	0.00	1.05	1.47	0	5	10	0	
Daphnia sp. (thorata?)	0	0	0.00	157.89	0.00		1.61	0	8	25	0	
Daphnia galeata mendotae	0	0	0.00	157.89	0.00		2.00	0	8	30	0	tall pt helmet
Holopedium gibberum	0	0	0.00	157.89	0.00		1.40	0	0	25	0	
Ceriodaphnia lacustris	0	0	0.00	157.89	0.00			0	0	4	0	
Bosmina longirostris (tenta)	0	0.1	0.10	157.89	1.00		0.39	16	0	1.5	24	
Bosmina longirostris (juv)	0	0	0.00	157.89	0.00		0.28	0	0	0.7	0	
Chydorus sp.	0	0	0.00	157.89	0.00		0.28	0	0	1	0	
Diaphanosoma birgei	0	0	0.00	157.89	0.00		1.40	0	0	17	0	
Diaphanosoma birgei (juv)	0	0	0.00	157.89	0.00	1.05	1.00	0	0	5	0	
Alona quadrangularis	0	0	0.00	157.89	0.00			0	0	6	0	
small chydorid	0	0	0.00	157.89	0.00		0.42	0	0	2	0	
Polyphemus pediculus	0	0	0.00	157.89	0.00			0	0	19.77	0	
Leptodora kindtii	0	0	0.00	157.89	0.00		10.00+	0	0	100	0	
Sida crystallina (juvenile)	0	0	0.00	157.89	0.00		1.00	0	0	8	0	
Class Insecta												
Order Diptera												
Chaoborus sp. (small)	0	0	0.00	157.89	0.00		4.20	0	0	50	0	
Chaoborus sp. (robust)	0	0	0.00	157.89	0.00		10.00	0	0	300	0	
PHYLUM ROTIFERA												
Type 1 (mostly loricated malleates)												
Brachionus sp.	0	0	0.00	157.89	0.00			0	0	0.0749	0	
Euchlanis sp.	0	0	0.00	157.89	0.00			0	0	0.0749	0	
Kellicottia bostoniensis	0	0	0.00	157.89	0.00			0	0	0.0096	0	
Kellicottia longispina	0	20	20.00	157.89	1.00		0.21	3,158	0	0.02	63	
Keratella cochlearis	0	649	649.00	157.89	1.00		0.16	102,474	0	0.01	1,025	
Keratella crassa	0	0	0.00	157.89	0.00		0.23	0	0	0.02	0	
Keratella earlinae	0	32	32.00	157.89	1.00		0.21	5,053	0	0.02	101	
Keratella quadrata complex(small)	0	5	5.00	157.89	1.00		0.13	789	0	0.027	21	
Keratella quadrata	0	0	0.00	157.89	0.00		0.20	0	0	0.13	0	
Keratella taurocephala	0	0	0.00	157.89	0.00		0.26	0	0	0.025	0	
Lecane sp.	0	0	0.00	157.89	0.00			0	0	0.009	0	2 toes
Lepadella sp.	0	0	0.00	157.89	0.00		0.16	0	0	0.011	0	
Monostyla (Lecane) sp.	0	2	2.00	157.89	1.00		0.13	316	0	0.01	3	1 toe
Mytilina sp.	0	0	0.00	157.89	0.00			0	0	0.009	0	
Notholca foliacea	0	4	4.00	157.89	1.00		0.15	632	0	0.01	6	
Notholca squamula/michiganensis compl.	0	0	0.00	157.89	0.00		0.14	0	0	0.02	0	lorica poster round
Platyias sp.	0	0	0.00	157.89	0.00			0	0	0.009	0	
Trichotria sp.	0	0	0.00	157.89	0.00			0	0	0.02	0	
Type 2 (mostly illoricate virgates/incudates)												
Ascomorpha sp.	0	0	0.00	157.89	0.00		0.12	0	0	0.023	0	
Ascomorphella volvocicola	0	0	0.00	157.89	0.00			0	0	0.023	0	
Asplanchna sp.	0	0	0.00	157.89	0.00		0.63	0	0	4	0	
Asplanchna sp.	0	0	0.00	157.89	0.00		0.42	0	0	1.2	0	
Asplanchna sp.	0	1	1.00	157.89	1.00		0.49	158	0	1.8	284	
Cephalodella sp.	0	3	3.00	157.89	1.00		0.20	474	0	0.05	24	
Gastropus sp.	0	0	0.00	157.89	0.00		0.13	0	0	0.04	0	
Gastropus stylifer	0	4	4.00	157.89	1.00		0.12	632	0	0.04	25	
Gastropus stylifer(small)	0	0	0.00	157.89	0.00		0.10	0	0	0.02	0	pink color
Ploesoma sp.	0	0	0.00	157.89	0.00		0.20	0	0	0.1	0	
Polyarthra sp. (small)	0	6	6.00	157.89	1.00		0.10	947	0	0.02	19	
Polyarthra sp.	0	45	45.00	157.89	1.00		0.14	7,105	0	0.05	355	appen pr not evid
Polyarthra sp. B	0	0	0.00	157.89	0.00		0.18	0	0	0.09	0	
Polyarthra vulgaris	0	0	0.00	157.89	0.00			0	0	0.1015	0	
Synchaeta sp.	0	43	43.00	157.89	1.00		0.21	6,789	0	0.08	543	body contracted
Synchaeta sp.	0	8	8.00	157.89			0.15	1,263	0	0.025	32	body contracted
Trichocerca cylindrica	0	0	0.00	157.89	0.00		0.46	0	0	0.16	0	
Trichocerca similis	0	0	0.00	157.89	0.00			0	0	1	0	
Trichocerca sp. B	0	0	0.00	157.89	0.00		0.21	0	0	0.024	0	
Trichocerca sp. C	0	0	0.00	157.89	0.00		0.08	0	0	0.006	0	
Type 3 (mostly malleoramates)												
Collotheca sp.	0	0	0.00	157.89	0.00		0.21	0	0	0.01	0	
Conochilus sp.	0	0	0.00	157.89	0.00		0.22	0	0	0.03	0	
Conochilus sp. (small)	0	0	0.00	157.89	0.00		0.10	0	0	0.01	0	
Filinia sp.	0	1	1.00	157.89	1.00		0.21	158	0	0.08	13	
Hexarthra sp.	0	0	0.00	157.89	0.00			0	0	0.023	0	
Pompholyx sp.	0	0	0.00	157.89	0.00		0.09	0	0	0.01	0	
Testudinella sp.	0	0	0.00	157.89	0.00			0	0	0.023	0	
Others												
Undeter rotifer 1	0	32	32.00	157.89	1.00		0.10	5,053	0	0.03	152	body contracted
Undeter rotifer 2	0	0	0.00	157.89	0.00		0.23	0	0	0.06	0	2 small toes
Undeter rotifer 3	0	0	0.00	157.89	0.00			0	0	0.015	0	
Undeter rotifer 4	0	0	0.00	157.89	0.00			0	0	1	0	
						Total	**Density**				**Total Dry Wt. Biomass**	
						#/m3	**#/L**				**ug/m3**	**ug/L**
						136,639	**136.64**				**4,758**	**4.76**
% Calanoid Copepods						0.07					16.26	
% Cyclopoid Copepods						0.31					21.40	
% Nauplii						0.81					5.81	
% Cladocerans						0.01					0.50	
% Rotifers						98.80					56.03	
% Dipterans						0.00	100.00				0.00	100.00
Number of species in sample						**17**						

Table A.4-5. Monthly Zooplankton Water Column Tow Data Boundary Reservoir Site V6 May 2007.

BOUNDARY RESERVOIR STUDY 5								***WATER Environmental Services, Inc.***				
ZOOPLANKTON DATA												
STATION: V6-PEL MID1								**NOTE: Zoop net diam 8in**				
DATE: 22 May 07												
									Estim.	**Estim.**		
	sample	**sample**	**sample**			**Ave lngth**	**Ave lngth**		**Dry wt.**	**Dry wt.**		
Taxon	**#male/ml**	**#fem/ml**	**total #/ml**	**Factor**	**# species**	**male(mm)**	**fem (mm)**	**#/m3**	**ug/male**	**ug/fem**	**ug/m3**	**Comments**
PHYLUM ARTHROPODA				128.26								
Subphylum Crustacea												
Subclass Copepoda												
Order Calanoida												
Copepodid	0	0.1	0.10	128.26	0.00		0.6-0.7	13	0	2.5	32	*Diap/Epischura*
Copepodid (Epischura)	0	0	0.00	128.26			<1.4	0	0	10	0	
Hesperodiaptomus franciscanus	0	0	0.00	128.26	0.00		1.96	0	14	22	0	
Onychodiaptomus hesperus	0	0	0.00	128.26	0.00	1.40	1.47	0	5.5	8.3	0	
Skistodiaptomus oregonensis	0	0	0.00	128.26	0.00	1.30	1.50	0	6.6	12	0	
Leptodiaptomus ashlandi	0.5	0.2	0.70	128.26	1.00	1.26	1.47	90	7	10	705	
Leptodiaptomus sicilis(tenta)	0.1	0	0.10	128.26	1.00	1.61		13	15	14.3	192	
Leptodiaptomus signacauda	0	0	0.00	128.26	0.00			0	10	12	0	
Epischura nevadensis	0	0.2	0.20	128.26	1.00	2.10	2.00	26	20	24	616	
Order Cyclopoida												
Copepodid	0	1.8	1.80	128.26	0.00		0.6-0.7	231	0	2	462	
Orthocyclops modestus	0	0	0.00	128.26	0.00	0.90	1.05	0	3	5	0	
Acanthocyclops vernalis	0	0	0.00	128.26	0.00		1.61	0	3	16.8	0	
Diacyclops bicuspidatus thomasi	0.1	0.1	0.20	128.26	1.00	1.00	1.00	26	2.5	4	83	
Mesocyclops edax	0	0	0.00	128.26	0.00	1.20	1.68	0	4.4	40	0	
Macrocyclops fuscus	0	0	0.00	128.26	0.00			0	10	40	0	
Eucyclops agilis	0	0	0.00	128.26	0.00			0	2.5	8	0	
Nauplii (cal+cyc)	0	6	6.00	128.26			<.3	770	0	0.25	192	
Class Branchiopoda(cladocerans)												
Daphnia (juv)	0	0	0.00	128.26			<1.0	0	0	5	0	sml pt helmt
Daphnia pulex/pulicaria group	0	0	0.00	128.26	0.00		1.50	0	0	16	0	
Daphnia shodleri-like	0	0	0.00	128.26	0.00		1.75	0	0	30	0	
Daphnia rosea	0	0	0.00	128.26	0.00	1.05	1.47	0	5	10	0	
Daphnia sp. (thorata?)	0	0	0.00	128.26	0.00		1.61	0	8	25	0	
Daphnia galeata mendotae	0	0	0.00	128.26	0.00		2.00	0	8	30	0	tall pt helmet
Holopedium gibberum	0	0	0.00	128.26	0.00		1.40	0	0	25	0	
Ceriodaphnia lacustris	0	0	0.00	128.26	0.00			0	0	4	0	
Bosmina longirostris (tenta)	0	0.18	0.18	128.26	1.00		0.40	23	0	1.5	35	
Bosmina longirostris (juv)	0	0.2	0.20	128.26	0.00		0.28	26	0	0.7	18	
Chydorus sphaericus	0	0	0.00	128.26	0.00		0.28	0	0	0.65	0	
Diaphanosoma birgei	0	0	0.00	128.26	0.00		1.40	0	0	17	0	
Diaphanosoma birgei (juv)	0	0	0.00	128.26	0.00	1.05	1.00	0	0	5	0	
Alona sp.	0	0.1	0.10	128.26	1.00		0.70	13	0	4	51	
small chydorid	0	0.1	0.10	128.26	1.00		0.40	13	0	2	26	
Polyphemus pediculus	0	0	0.00	128.26	0.00			0	0	19.77	0	
Leptodora kindtii	0	0	0.00	128.26	0.00		10.00+	0	0	100	0	
Sida crystallina (juvenile)	0	0	0.00	128.26	0.00		1.00	0	0	8	0	
Class Insecta												
Order Diptera												
Chaoborus sp. (small)	0	0	0.00	128.26	0.00		4.20	0	0	50	0	
Chaoborus sp. (robust)	0	0	0.00	128.26	0.00		10.00	0	0	300	0	
PHYLUM ROTIFERA												
Type 1 (mostly loricated malleates)												
Brachionus sp.	0	0	0.00	128.26	0.00			0	0	0.0749	0	
Euchlanis sp.	0	0	0.00	128.26	0.00			0	0	0.0749	0	
Kellicottia bostoniensis	0	0	0.00	128.26	0.00			0	0	0.0096	0	
Kellicottia longispina	0	22	22.00	128.26	1.00		0.21	2,822	0	0.02	56	
Keratella cochlearis	0	510	510.00	128.26	1.00		0.16	65,414	0	0.01	654	
Keratella cochlearis (robust)	0	0	0.00	128.26	0.00		0.21	0	0	0.02	0	
Keratella earlinae	0	60	60.00	128.26	1.00		0.21	7,696	0	0.02	154	
Keratella quadrata complex(small)	0	4	4.00	128.26	1.00		0.13	513	0	0.027	14	
Keratella quadrata	0	0	0.00	128.26	0.00		0.20	0	0	0.13	0	
Keratella taurocephala	0	0	0.00	128.26	0.00		0.26	0	0	0.025	0	
Lecane sp.	0	2	2.00	128.26	1.00		0.11	257	0	0.005	1	2 toes
Lepadella sp.	0	0	0.00	128.26	0.00		0.16	0	0	0.011	0	
Monostyla (Lecane) sp.	0	2	2.00	128.26	1.00		0.13	257	0	0.01	3	1 toe
Mytilina sp.	0	0	0.00	128.26	0.00			0	0	0.009	0	
Notholca foliacea	0	4	4.00	128.26	1.00		0.17	513	0	0.014	7	
Notholca squamula/michiganensis compl.	0	2	2.00	128.26	1.00		0.14	257	0	0.02	5	lorica wrinkles not evid
Platyias sp.	0	0	0.00	128.26	0.00			0	0	0.009	0	
Trichotria sp.	0	0	0.00	128.26	0.00			0	0	0.02	0	
Type 2 (mostly illoricate virgates/incudates)												
Ascomorpha sp.	0	0	0.00	128.26	0.00		0.12	0	0	0.023	0	
Ascomorphella volvocicola	0	0	0.00	128.26	0.00			0	0	0.023	0	
Asplanchna sp.	0	0	0.00	128.26	0.00		0.63	0	0	4	0	
Asplanchna sp.	0	0	0.00	128.26	0.00		0.42	0	0	1.2	0	
Asplanchna sp.	0	0	0.00	128.26			0.49	0	0	2.2	0	
Cephalodella sp.	0	0	0.00	128.26	0.00		0.19	0	0	0.05	0	
Gastropus stylifer	0	4	4.00	128.26	1.00		0.14	513	0	0.04	21	pink color
Gastropus stylifer	0	0	0.00	128.26	0.00		0.13	0	0	0.03	0	
Gastropus stylifer(small)	0	0	0.00	128.26	0.00		0.11	0	0	0.02	0	pink color
Ploesoma sp.	0	0	0.00	128.26	0.00		0.20	0	0	0.1	0	
Polyarthra sp. (small)	0	6	6.00	128.26	1.00		0.10	770	0	0.02	15	
Polyarthra sp.	0	52	52.00	128.26	1.00		0.14	6,670	0	0.05	333	appen pr not evid
Polyarthra sp.	0	0	0.00	128.26	0.00		0.17	0	0	0.08	0	appen pr not evid
Polyarthra vulgaris	0	0	0.00	128.26	0.00			0	0	0.1015	0	
Synchaeta sp.	0	40	40.00	128.26	1.00		0.21	5,130	0	0.08	410	body contracted
Synchaeta sp.	0	6	6.00	128.26			0.15	770	0	0.025	19	body contracted
Synchaeta sp.	0	10	10.00	128.26	1.00		0.12	1,283	0	0.02	26	body contracted
Trichocerca cylindrica	0	0	0.00	128.26	0.00		0.46	0	0	0.16	0	
Trichocerca similis	0	0	0.00	128.26	0.00			0	0	1	0	
Trichocerca sp. B	0	0	0.00	128.26	0.00		0.21	0	0	0.024	0	
Trichocerca sp. C	0	0	0.00	128.26	0.00		0.08	0	0	0.006	0	
Type 3 (mostly malleoramates)												
Collotheca sp.	0	0	0.00	128.26	0.00		0.21	0	0	0.01	0	
Conochilus sp.	0	0	0.00	128.26	0.00		0.22	0	0	0.03	0	
Conochilus sp. (small)	0	0	0.00	128.26	0.00		0.10	0	0	0.01	0	
Filinia sp.	0	1	1.00	128.26	1.00		0.21	128	0	0.08	10	
Filinia sp.	0	1	1.00	128.26	0.00		0.14	128	0	0.03	4	
Hexarthra sp.	0	0	0.00	128.26	0.00			0	0	0.023	0	
Pompholyx sp.	0	0	0.00	128.26	0.00		0.09	0	0	0.01	0	
Testudinella sp.	0	0	0.00	128.26	0.00			0	0	0.023	0	
Others												
Undeter rotifer 1	0	50	50.00	128.26	1.00		0.10	6,413	0	0.03	192	body contracted
Undeter rotifer 2	0	0	0.00	128.26	0.00		0.21	0	0	0.25	0	body contracted
Undeter rotifer 3	0	0	0.00	128.26	0.00			0	0	0.015	0	
Undeter rotifer 4	0	0	0.00	128.26	0.00			0	0	1	0	
						Total	**Density**				**Total Dry Wt. Biomass**	
						#/m3	**#/L**				**ug/m3**	**ug/L**
						100,773	**100.77**				**4,338**	**4.34**
% Calanoid Copepods						0.14					35.63	
% Cyclopoid Copepods						0.25					12.57	
% Nauplii						0.76					4.43	
% Cladocerans						0.07					2.99	
% Rotifers						98.77					44.39	
% Dipterans						0.00	100.00				0.00	100.00
Number of species in sample						**22**						

Table A.4-5, continued…

BOUNDARY RESERVOIR STUDY 5								***WATER Environmental Services, Inc.***				
ZOOPLANKTON DATA												
STATION: V6-PEL MID2								**NOTE: Zoop net diam 8in**				
DATE: 22 May 07												
									Estim.	**Estim.**		
	sample	**sample**	**sample**			**Ave lngth**	**Ave lngth**		**Dry wt.**	**Dry wt.**		
Taxon	**#male/ml**	**#fem/ml**	**total #/ml**	**Factor**	**# species**	**male(mm)**	**fem (mm)**	**#/m3**	**ug/male**	**ug/fem**	**ug/m3**	**Comments**
PHYLUM ARTHROPODA				114.11								
Subphylum Crustacea												
Subclass Copepoda												
Order Calanoida												
Copepodid	0	0.2	0.20	114.11	0.00		0.6-0.7	23	0	2.5	57	*Diap/Epischura*
Copepodid (Epischura)	0	0	0.00	114.11			<1.4	0	0	10	0	
Hesperodiaptomus franciscanus	0	0	0.00	114.11	0.00		1.96	0	14	22	0	
Onychodiaptomus hesperus	0	0	0.00	114.11	0.00	1.40	1.47	0	5.5	8.3	0	
Skistodiaptomus oregonensis	0	0	0.00	114.11	0.00	1.30	1.50	0	6.6	12	0	
Leptodiaptomus ashlandi	0.5	0.2	0.70	114.11	1.00	1.26	1.47	80	7	10	628	
Leptodiaptomus sicilis(tenta)	0	0	0.00	114.11	0.00	1.61		0	15	14.3	0	
Leptodiaptomus signacauda	0	0	0.00	114.11	0.00			0	10	12	0	
Epischura nevadensis	0.1	0.1	0.20	114.11	1.00	2.10	1.75	23	20	16	411	
Order Cyclopoida												
Copepodid	0	2.4	2.40	114.11	0.00		0.6-0.7	274	0	2	548	
Orthocyclops modestus	0	0	0.00	114.11	0.00	0.90	1.05	0	3	5	0	
Acanthocyclops vernalis	0	0	0.00	114.11	0.00		1.61	0	3	16.8	0	
Diacyclops bicuspidatus thomasi	0.4	0.7	1.10	114.11	1.00	1.00	1.00	126	2.5	4	434	
Mesocyclops edax	0	0	0.00	114.11	0.00	1.20	1.68	0	4.4	40	0	
Macrocyclops fuscus	0	0	0.00	114.11	0.00			0	10	40	0	
Eucyclops agilis	0	0	0.00	114.11	0.00			0	2.5	8	0	
Nauplii (cal+cyc)	0	6	6.00	114.11			<.3	685	0	0.25	171	
Class Branchiopoda(cladocerans)												
Daphnia (juv)	0	0	0.00	114.11			<1.0	0	0	5	0	sml pt helmt
Daphnia pulex/pulicaria group	0	0	0.00	114.11	0.00		1.50	0	0	16	0	
Daphnia shodleri-like	0	0	0.00	114.11	0.00		1.75	0	0	30	0	
Daphnia rosea	0	0	0.00	114.11	0.00	1.05	1.47	0	5	10	0	
Daphnia sp. (thorata?)	0	0	0.00	114.11	0.00		1.61	0	8	25	0	
Daphnia galeata mendotae	0	0	0.00	114.11	0.00		2.00	0	8	30	0	tall pt helmet
Holopedium gibberum	0	0	0.00	114.11	0.00		1.40	0	0	25	0	
Ceriodaphnia lacustris	0	0	0.00	114.11	0.00			0	0	4	0	
Bosmina longirostris (tenta)	0	0	0.00	114.11	0.00		0.40	0	0	1.5	0	
Bosmina longirostris (juv)	0	0.1	0.10	114.11	1.00		0.28	11	0	0.7	8	
Chydorus sphaericus	0	0	0.00	114.11	0.00		0.28	0	0	0.65	0	
Diaphanosoma birgei	0	0	0.00	114.11	0.00		1.40	0	0	17	0	
Diaphanosoma birgei (juv)	0	0	0.00	114.11	0.00	1.05	1.00	0	0	5	0	
Alona sp.	0	0	0.00	114.11	0.00		0.70	0	0	4	0	
small chydorid	0	0	0.00	114.11	0.00		0.40	0	0	2	0	
Polyphemus pediculus	0	0	0.00	114.11	0.00			0	0	19.77	0	
Leptodora kindtii	0	0	0.00	114.11	0.00		10.00+	0	0	100	0	
Sida crystallina (juvenile)	0	0	0.00	114.11	0.00		1.00	0	0	8	0	
Class Insecta												
Order Diptera												
Chaoborus sp. (small)	0	0	0.00	114.11	0.00		4.20	0	0	50	0	
Chaoborus sp. (robust)	0	0	0.00	114.11	0.00		10.00	0	0	300	0	
PHYLUM ROTIFERA												
Type 1 (mostly loricated malleates)												
Brachionus sp.	0	0	0.00	114.11	0.00			0	0	0.0749	0	
Euchlanis sp.	0	0	0.00	114.11	0.00			0	0	0.0749	0	
Kellicottia bostoniensis	0	0	0.00	114.11	0.00			0	0	0.0096	0	
Kellicottia longispina	0	16	16.00	114.11	1.00		0.21	1,826	0	0.02	37	
Keratella cochlearis	0	532	532.00	114.11	1.00		0.16	60,706	0	0.01	607	
Keratella cochlearis (robust)	0	0	0.00	114.11	0.00		0.21	0	0	0.02	0	
Keratella earlinae	0	60	60.00	114.11	1.00		0.21	6,847	0	0.02	137	
Keratella quadrata complex(small)	0	8	8.00	114.11	1.00		0.13	913	0	0.027	25	
Keratella quadrata	0	2	2.00	114.11	1.00		0.18	228	0	0.1	23	
Keratella taurocephala	0	0	0.00	114.11	0.00		0.26	0	0	0.025	0	
Lecane sp.	0	0	0.00	114.11	0.00		0.11	0	0	0.005	0	2 toes
Lepadella sp.	0	0	0.00	114.11	0.00		0.16	0	0	0.011	0	
Monostyla (Lecane) sp.	0	2	2.00	114.11	1.00		0.13	228	0	0.01	2	1 toe
Mytilina sp.	0	0	0.00	114.11	0.00			0	0	0.009	0	
Notholca foliacea	0	2	2.00	114.11	1.00		0.17	228	0	0.014	3	
Notholca squamula/michiganensis compl.	0	0	0.00	114.11	0.00		0.14	0	0	0.02	0	lorica wrinkles not evid
Platyias sp.	0	0	0.00	114.11	0.00			0	0	0.009	0	
Trichotria sp.	0	0	0.00	114.11	0.00			0	0	0.02	0	
Type 2 (mostly illoricate virgates/incudates)												
Ascomorpha sp.	0	0	0.00	114.11	0.00		0.12	0	0	0.023	0	
Ascomorphella volvocicola	0	0	0.00	114.11	0.00			0	0	0.023	0	
Asplanchna sp.	0	0.1	0.10	114.11	1.00		1.26	11	0	13	148	
Asplanchna sp.	0	0.1	0.10	114.11	0.00		0.70	11	0	5.5	63	
Asplanchna sp.	0	0	0.00	114.11			0.49	0	0	2.2	0	
Cephalodella sp.	0	2	2.00	114.11	1.00		1.19	228	0	0.05	11	
Gastropus stylifer	0	2	2.00	114.11	1.00		0.14	228	0	0.04	9	pink color
Gastropus stylifer	0	0	0.00	114.11	0.00		0.13	0	0	0.03	0	
Gastropus stylifer(small)	0	4	4.00	114.11	0.00		0.11	456	0	0.02	9	pink color
Ploesoma sp.	0	0	0.00	114.11	0.00		0.20	0	0	0.1	0	
Polyarthra sp. (small)	0	18	18.00	114.11	1.00		0.10	2,054	0	0.02	41	
Polyarthra sp.	0	72	72.00	114.11	1.00		0.14	8,216	0	0.05	411	appen pr not evid
Polyarthra sp.	0	0	0.00	114.11	0.00		0.17	0	0	0.08	0	appen pr not evid
Polyarthra vulgaris	0	0	0.00	114.11	0.00			0	0	0.1015	0	
Synchaeta sp.	0	44	44.00	114.11	1.00		0.21	5,021	0	0.08	402	body contracted
Synchaeta sp.	0	22	22.00	114.11			0.15	2,510	0	0.025	63	body contracted
Synchaeta sp.	0	18	18.00	114.11	1.00		0.12	2,054	0	0.02	41	body contracted
Trichocerca cylindrica	0	0	0.00	114.11	0.00		0.46	0	0	0.16	0	
Trichocerca similis	0	0	0.00	114.11	0.00			0	0	1	0	
Trichocerca sp. B	0	0	0.00	114.11	0.00		0.21	0	0	0.024	0	
Trichocerca sp. C	0	0	0.00	114.11	0.00		0.08	0	0	0.006	0	
Type 3 (mostly malleoramates)												
Collotheca sp.	0	0	0.00	114.11	0.00		0.21	0	0	0.01	0	
Conochilus sp.	0	0	0.00	114.11	0.00		0.22	0	0	0.03	0	
Conochilus sp. (small)	0	0	0.00	114.11	0.00		0.10	0	0	0.01	0	
Filinia sp.	0	0	0.00	114.11	0.00		0.21	0	0	0.08	0	
Filinia sp.	0	2	2.00	114.11	1.00		0.14	228	0	0.03	7	
Hexarthra sp.	0	0	0.00	114.11	0.00			0	0	0.023	0	
Pompholyx sp.	0	0	0.00	114.11	0.00		0.09	0	0	0.01	0	
Testudinella sp.	0	0	0.00	114.11	0.00			0	0	0.023	0	
Others												
Undeter rotifer 1	0	68	68.00	114.11	1.00		0.10	7,759	0	0.03	233	body contracted
Undeter rotifer 2	0	0	0.00	114.11	0.00		0.21	0	0	0.25	0	body contracted
Undeter rotifer 3	0	0	0.00	114.11	0.00			0	0	0.015	0	
Undeter rotifer 4	0	0	0.00	114.11	0.00			0	0	1	0	
						Total	**Density**				**Total Dry Wt. Biomass**	
						#/m3	**#/L**				**ug/m3**	**ug/L**
						100,975	**100.97**				**4,527**	**4.53**
% Calanoid Copepods						0.12					24.20	
% Cyclopoid Copepods						0.40					21.68	
% Nauplii						0.68					3.78	
% Cladocerans						0.01					0.18	
% Rotifers						98.79					50.17	
% Dipterans						0.00	100.00				0.00	100.00
Number of species in sample						**20**						

Table A.4-6. Monthly Zooplankton Water Column Tow Data from Boundary Reservoir Site V7 May 2007.

BOUNDARY RESERVOIR STUDY 5								***WATER Environmental Services, Inc.***				
ZOOPLANKTON DATA												
STATION: V7-PEL MID1								**NOTE: Zoop net diam 8in**				
DATE: 23 May 07												
									Estim.	**Estim.**		
	sample	**sample**	**sample**			**Ave lngth**	**Ave lngth**		**Dry wt.**	**Dry wt.**		
Taxon	**#male/ml**	**#fem/ml**	**total #/ml**	**Factor**	**# species**	**male(mm)**	**fem (mm)**	**#/m3**	**ug/male**	**ug/fem**	**ug/m3**	**Comments**
PHYLUM ARTHROPODA				1733.75								
Subphylum Crustacea												
Subclass Copepoda												
Order Calanoida												
Copepodid	0	0.1	0.10	1733.75	0.00		0.6-0.7	173	0	2.5	433	
Copepodid (Epischura)	0	0	0.00	1733.75			<1.4	0	0	10	0	
Hesperodiaptomus franciscanus	0	0	0.00	1733.75	0.00		1.96	0	14	22	0	
Onychodiaptomus hesperus	0	0	0.00	1733.75	0.00	1.40	1.47	0	5.5	8.3	0	
Skistodiaptomus oregonensis	0	0	0.00	1733.75	0.00	1.30	1.50	0	6.6	12	0	
Leptodiaptomus ashlandi	0	0.1	0.10	1733.75	1.00	1.05	1.40	173	5	10	1,734	
Leptodiaptomus sicilis	0	0	0.00	1733.75	0.00			0	6.5	14.3	0	
Leptodiaptomus signacauda	0	0	0.00	1733.75	0.00			0	10	12	0	
Epischura nevadensis	0	0	0.00	1733.75	0.00	2.10	2.17	0	20	30	0	
Order Cyclopoida												
Copepodid	0	1.6	1.60	1733.75	0.00		0.6-0.7	2,774	0	2	5,548	
Orthocyclops modestus	0	0	0.00	1733.75	0.00	0.90	1.05	0	3	5	0	
Acanthocyclops vernalis	0	0	0.00	1733.75	0.00		1.61	0	3	16.8	0	
Diacyclops bicuspidatus thomasi	0.1	0.2	0.30	1733.75	1.00	1.00	1.00	520	2.5	4	1,820	
Mesocyclops edax	0	0	0.00	1733.75	0.00	1.20	1.68	0	4.4	40	0	
Macrocyclops fuscus	0	0	0.00	1733.75	0.00			0	10	40	0	
Eucyclops agilis	0	0	0.00	1733.75	0.00			0	2.5	8	0	
Nauplii (cal+cyc)	0	2	2.00	1733.75			<.3	3,467	0	0.25	867	
Class Branchiopoda(cladocerans)												
Daphnia (juv)	0	0	0.00	1733.75			<1.0	0	0	5	0	sml pt helmt
Daphnia pulex/pulicaria group	0	0	0.00	1733.75	0.00		1.50	0	0	16	0	
Daphnia shodleri-like	0	0	0.00	1733.75	0.00		1.75	0	0	30	0	
Daphnia rosea	0	0	0.00	1733.75	0.00	1.05	1.47	0	5	10	0	
Daphnia sp. (thorata?)	0	0	0.00	1733.75	0.00		1.61	0	8	25	0	
Daphnia galeata mendotae	0	0	0.00	1733.75	0.00		2.00	0	8	30	0	tall pt helmet
Holopedium gibberum	0	0	0.00	1733.75	0.00		1.40	0	0	25	0	
Ceriodaphnia lacustris	0	0	0.00	1733.75	0.00			0	0	4	0	
Bosmina longirostris (tenta)	0	0.18	0.18	1733.75	1.00		0.35	312	0	1.2	374	
Bosmina longirostris (juv)	0	0	0.00	1733.75	0.00		0.28	0	0	0.7	0	
Chydorus sphaericus	0	0	0.00	1733.75	0.00		0.28	0	0	0.65	0	
Diaphanosoma birgei	0	0	0.00	1733.75	0.00		1.40	0	0	17	0	
Diaphanosoma birgei (juv)	0	0	0.00	1733.75	0.00	1.05	1.00	0	0	5	0	
Alona quadrangularis	0	0	0.00	1733.75	0.00			0	0	6	0	
Acroperus sp.	0	0	0.00	1733.75	0.00		0.77	0	0	6	0	
Polyphemus pediculus	0	0	0.00	1733.75	0.00			0	0	19.77	0	
Leptodora kindtii	0	0	0.00	1733.75	0.00		10.00+	0	0	100	0	
Sida crystallina (juvenile)	0	0	0.00	1733.75	0.00		1.00	0	0	8	0	
Class Insecta												
Order Diptera												
Chaoborus sp. (small)	0	0	0.00	1733.75	0.00		4.20	0	0	50	0	
Chaoborus sp. (robust)	0	0	0.00	1733.75	0.00		10.00	0	0	300	0	
PHYLUM ROTIFERA												
Type 1 (mostly loricated malleates)												
Brachionus sp.	0	0	0.00	1733.75	0.00			0	0	0.0749	0	
Euchlanis sp.	0	0	0.00	1733.75	0.00			0	0	0.0749	0	
Kellicottia bostoniensis	0	0	0.00	1733.75	0.00			0	0	0.0096	0	
Kellicottia longispina	0	7	7.00	1733.75	1.00		0.21	12,136	0	0.02	243	
Keratella cochlearis	0	186	186.00	1733.75	1.00		0.16	322,477	0	0.01	3,225	
Keratella cochlearis (robust)	0	0	0.00	1733.75	0.00		0.21	0	0	0.02	0	
Keratella earlinae	0	20	20.00	1733.75	1.00		0.21	34,675	0	0.02	693	
Keratella quadrata complex(small)	0	0	0.00	1733.75	0.00		0.13	0	0	0.027	0	
Keratella quadrata	0	1	1.00	1733.75	1.00		0.20	1,734	0	0.15	260	
Keratella taurocephala	0	0	0.00	1733.75	0.00		0.26	0	0	0.025	0	
Lecane sp.	0	0	0.00	1733.75	0.00			0	0	0.009	0	2 toes
Lepadella sp.	0	0	0.00	1733.75	0.00		0.16	0	0	0.011	0	
Monostyla (Lecane) sp.	0	1	1.00	1733.75	1.00		0.13	1,734	0	0.01	17	1 toe
Mytilina sp.	0	0	0.00	1733.75	0.00			0	0	0.009	0	
Notholca foliacea	0	5	5.00	1733.75	1.00		0.15	8,669	0	0.01	87	
Notholca squamula/michiganensis compl.	0	0	0.00	1733.75	0.00		0.14	0	0	0.009	0	lorica wrinkles not evid
Platyias sp.	0	0	0.00	1733.75	0.00			0	0	0.009	0	
Trichotria sp.	0	0	0.00	1733.75	0.00			0	0	0.02	0	
Type 2 (mostly illoricate virgates/incudates)												
Ascomorpha sp.	0	0	0.00	1733.75	0.00		0.12	0	0	0.023	0	
Ascomorphella volvocicola	0	0	0.00	1733.75	0.00			0	0	0.023	0	
Asplanchna sp.	0	0	0.00	1733.75	0.00		0.63	0	0	4	0	
Asplanchna sp.	0	0	0.00	1733.75	0.00		0.42	0	0	1.2	0	
Asplanchna sp.	0	0	0.00	1733.75			0.49	0	0	2.2	0	
Cephalodella sp.	0	0	0.00	1733.75	0.00		0.19	0	0	0.05	0	
Gastropus sp.	0	0	0.00	1733.75	0.00		0.14	0	0	0.04	0	
Gastropus stylifer	0	0	0.00	1733.75	0.00		0.13	0	0	0.03	0	
Gastropus stylifer(small)	0	0	0.00	1733.75	0.00		0.11	0	0	0.02	0	pink color
Ploesoma sp.	0	0	0.00	1733.75	0.00		0.20	0	0	0.1	0	
Polyarthra sp. (small)	0	6	6.00	1733.75	1.00		0.10	10,402	0	0.02	208	
Polyarthra sp.	0	38	38.00	1733.75	1.00		0.14	65,882	0	0.05	3,294	appen pr not evid
Polyarthra sp.	0	0	0.00	1733.75	0.00		0.17	0	0	0.08	0	appen pr not evid
Polyarthra vulgaris	0	0	0.00	1733.75	0.00			0	0	0.1015	0	
Synchaeta sp.	0	17	17.00	1733.75	1.00		0.21	29,474	0	0.08	2,358	body contracted
Synchaeta sp.	0	6	6.00	1733.75			0.15	10,402	0	0.025	260	body contracted
Synchaeta sp.	0	0	0.00	1733.75	0.00		0.12	0	0	0.02	0	body contracted
Trichocerca cylindrica	0	0	0.00	1733.75	0.00		0.46	0	0	0.16	0	
Trichocerca similis	0	0	0.00	1733.75	0.00			0	0	1	0	
Trichocerca sp. B	0	0	0.00	1733.75	0.00		0.21	0	0	0.024	0	
Trichocerca sp. C	0	0	0.00	1733.75	0.00		0.08	0	0	0.006	0	
Type 3 (mostly malleoramates)												
Collotheca sp.	0	0	0.00	1733.75	0.00		0.21	0	0	0.01	0	
Conochilus sp.	0	0	0.00	1733.75	0.00		0.22	0	0	0.03	0	
Conochilus sp. (small)	0	0	0.00	1733.75	0.00		0.10	0	0	0.01	0	
Filinia sp.	0	0	0.00	1733.75	0.00		0.14	0	0	0.03	0	
Hexarthra sp.	0	0	0.00	1733.75	0.00			0	0	0.023	0	
Pompholyx sp.	0	0	0.00	1733.75	0.00		0.09	0	0	0.01	0	
Testudinella sp.	0	0	0.00	1733.75	0.00			0	0	0.023	0	
Others												
Undeter rotifer 1	0	13	13.00	1733.75	1.00		0.10	22,539	0	0.03	676	body contracted
Undeter rotifer 2	0	0	0.00	1733.75	0.00		0.21	0	0	0.25	0	body contracted
Undeter rotifer 3	0	0	0.00	1733.75	0.00			0	0	0.015	0	
Undeter rotifer 4	0	0	0.00	1733.75	0.00			0	0	1	0	
						Total	**Density**				**Total Dry Wt. Biomass**	
						#/m3	**#/L**				**ug/m3**	**ug/L**
						527,544	**527.54**				**22,098**	**22.10**
% Calanoid Copepods						0.07					9.81	
% Cyclopoid Copepods						0.62					33.34	
% Nauplii						0.66					3.92	
% Cladocerans						0.06					1.69	
% Rotifers						98.59					51.23	
% Dipterans						0.00	100.00				0.00	100.00
Number of species in sample						**13**						

Table A.4-6, continued…

BOUNDARY RESERVOIR STUDY 5								***WATER Environmental Services, Inc.***				
ZOOPLANKTON DATA												
STATION: V7-PEL MID2								**NOTE: Zoop net diam 8in**				
DATE: 23 May 07												
									Estim.	**Estim.**		
	sample	**sample**	**sample**			**Ave lngth**	**Ave lngth**		**Dry wt.**	**Dry wt.**		
Taxon	**#male/ml**	**#fem/ml**	**total #/ml**	**Factor**	**# species**	**male(mm)**	**fem (mm)**	**#/m3**	**ug/male**	**ug/fem**	**ug/m3**	**Comments**
PHYLUM ARTHROPODA				1702.79								
Subphylum Crustacea												
Subclass Copepoda												
Order Calanoida												
Copepodid	0	0	0.00	1702.79	0.00		0.6-0.7	0	0	2.5	0	
Copepodid (Epischura)	0	0	0.00	1702.79			<1.4	0	0	10	0	
Hesperodiaptomus franciscanus	0	0	0.00	1702.79	0.00		1.96	0	14	22	0	
Onychodiaptomus hesperus	0	0	0.00	1702.79	0.00	1.40	1.47	0	5.5	8.3	0	
Skistodiaptomus oregonensis	0	0	0.00	1702.79	0.00	1.30	1.50	0	6.6	12	0	
Leptodiaptomus ashlandi	0	0.0145	0.01	1702.79	1.00	1.05	1.47	25	5	10	247	
Leptodiaptomus sicilis	0	0	0.00	1702.79	0.00			0	6.5	14.3	0	
Leptodiaptomus signacauda	0	0	0.00	1702.79	0.00			0	10	12	0	
Epischura nevadensis	0.0036	0.011	0.01	1702.79	1.00	2.10	2.24	25	18	28	635	
Order Cyclopoida												
Copepodid	0	1.5	1.50	1702.79	0.00		0.6-0.7	2,554	0	2	5,108	
Orthocyclops modestus	0	0	0.00	1702.79	0.00	0.90	1.05	0	3	5	0	
Acanthocyclops vernalis	0	0	0.00	1702.79	0.00		1.61	0	3	16.8	0	
Diacyclops bicuspidatus thomasi	0	0.5	0.50	1702.79	1.00	1.00	1.00	851	2.5	4	3,406	
Mesocyclops edax	0	0	0.00	1702.79	0.00	1.20	1.68	0	4.4	40	0	
Macrocyclops fuscus	0	0	0.00	1702.79	0.00			0	10	40	0	
Eucyclops agilis	0	0	0.00	1702.79	0.00			0	2.5	8	0	
Nauplii (cal+cyc)	0	6	6.00	1702.79			<.3	10,217	0	0.25	2,554	
Class Branchiopoda(cladocerans)												
Daphnia (juv)	0	0	0.00	1702.79			<1.0	0	0	5	0	sml pt helmt
Daphnia pulex/pulicaria group	0	0	0.00	1702.79	0.00		1.50	0	0	16	0	
Daphnia shodleri-like	0	0	0.00	1702.79	0.00		1.75	0	0	30	0	
Daphnia rosea	0	0	0.00	1702.79	0.00	1.05	1.47	0	5	10	0	
Daphnia sp.	0	0.1	0.10	1702.79	1.00		1.40	170	8	15	2,554	small females
Daphnia galeata mendotae	0	0	0.00	1702.79	0.00		2.00	0	8	30	0	tall pt helmet
Holopedium gibberum	0	0	0.00	1702.79	0.00		1.40	0	0	25	0	
Ceriodaphnia lacustris	0	0	0.00	1702.79	0.00			0	0	4	0	
Bosmina longirostris (tenta)	0	0	0.00	1702.79	0.00		0.35	0	0	1.2	0	
Bosmina longirostris (juv)	0	0.1	0.10	1702.79	1.00		0.28	170	0	0.7	119	
Chydorus sphaericus	0	0	0.00	1702.79	0.00		0.28	0	0	0.65	0	
Diaphanosoma birgei	0	0	0.00	1702.79	0.00		1.40	0	0	17	0	
Diaphanosoma birgei (juv)	0	0	0.00	1702.79	0.00	1.05	1.00	0	0	5	0	
Alona quadrangularis	0	0	0.00	1702.79	0.00			0	0	6	0	
Acroperus sp.	0	0	0.00	1702.79	0.00		0.77	0	0	6	0	
Polyphemus pediculus	0	0	0.00	1702.79	0.00			0	0	19.77	0	
Leptodora kindtii	0	0	0.00	1702.79	0.00		10.00+	0	0	100	0	
Sida crystallina (juvenile)	0	0	0.00	1702.79	0.00		1.00	0	0	8	0	
Class Insecta												
Order Diptera												
Chaoborus sp. (small)	0	0	0.00	1702.79	0.00		4.20	0	0	50	0	
Chaoborus sp. (robust)	0	0	0.00	1702.79	0.00		10.00	0	0	300	0	
PHYLUM ROTIFERA												
Type 1 (mostly loricated malleates)												
Brachionus sp.	0	0	0.00	1702.79	0.00			0	0	0.0749	0	
Euchlanis sp.	0	0	0.00	1702.79	0.00			0	0	0.0749	0	
Kellicottia bostoniensis	0	0	0.00	1702.79	0.00			0	0	0.0096	0	
Kellicottia longispina	0	10	10.00	1702.79	1.00		0.21	17,028	0	0.02	341	
Keratella cochlearis	0	214	214.00	1702.79	1.00		0.16	364,396	0	0.01	3,644	
Keratella cochlearis (robust)	0	1	1.00	1702.79	0.00		0.21	1,703	0	0.02	34	
Keratella earlinae	0	22	22.00	1702.79	1.00		0.21	37,461	0	0.02	749	
Keratella quadrata complex(small)	0	1	1.00	1702.79	1.00		0.13	1,703	0	0.027	46	
Keratella quadrata	0	0	0.00	1702.79	0.00		0.20	0	0	0.15	0	
Keratella taurocephala	0	0	0.00	1702.79	0.00		0.26	0	0	0.025	0	
Lecane sp.	0	0	0.00	1702.79	0.00			0	0	0.009	0	2 toes
Lepadella sp.	0	0	0.00	1702.79	0.00		0.16	0	0	0.011	0	
Monostyla (Lecane) sp.	0	1	1.00	1702.79	1.00		0.13	1,703	0	0.01	17	1 toe
Mytilina sp.	0	0	0.00	1702.79	0.00			0	0	0.009	0	
Notholca foliacea	0	2	2.00	1702.79	1.00		0.15	3,406	0	0.01	34	
Notholca squamula/michiganensis compl.	0	0	0.00	1702.79	0.00		0.14	0	0	0.009	0	lorica wrinkles not evid
Platyias sp.	0	0	0.00	1702.79	0.00			0	0	0.009	0	
Trichotria sp.	0	0	0.00	1702.79	0.00			0	0	0.02	0	
Type 2 (mostly illoricate virgates/incudates)												
Ascomorpha sp.	0	0	0.00	1702.79	0.00		0.12	0	0	0.023	0	
Ascomorphella volvocicola	0	0	0.00	1702.79	0.00			0	0	0.023	0	
Asplanchna sp.	0	0	0.00	1702.79	0.00		0.63	0	0	4	0	
Asplanchna sp.	0	0	0.00	1702.79	0.00		0.42	0	0	1.2	0	
Asplanchna sp.	0	0	0.00	1702.79			0.49	0	0	2.2	0	
Cephalodella sp.	0	0	0.00	1702.79	0.00		0.19	0	0	0.05	0	
Gastropus stylifer	0	3	3.00	1702.79	1.00		0.14	5,108	0	0.04	204	
Gastropus stylifer	0	0	0.00	1702.79	0.00		0.13	0	0	0.03	0	
Gastropus stylifer(small)	0	2	2.00	1702.79	0.00		0.11	3,406	0	0.02	68	pink color
Ploesoma sp.	0	0	0.00	1702.79	0.00		0.20	0	0	0.1	0	
Polyarthra sp. (small)	0	11	11.00	1702.79	1.00		0.10	18,731	0	0.02	375	
Polyarthra sp.	0	25	25.00	1702.79	1.00		0.14	42,570	0	0.05	2,128	appen pr not evid
Polyarthra sp.	0	0	0.00	1702.79	0.00		0.17	0	0	0.08	0	appen pr not evid
Polyarthra vulgaris	0	0	0.00	1702.79	0.00			0	0	0.1015	0	
Synchaeta sp.	0	13	13.00	1702.79	1.00		0.21	22,136	0	0.08	1,771	body contracted
Synchaeta sp.	0	2	2.00	1702.79			0.15	3,406	0	0.025	85	body contracted
Synchaeta sp.	0	0	0.00	1702.79	0.00		0.12	0	0	0.02	0	body contracted
Trichocerca cylindrica	0	0	0.00	1702.79	0.00		0.46	0	0	0.16	0	
Trichocerca similis	0	0	0.00	1702.79	0.00			0	0	1	0	
Trichocerca sp. B	0	0	0.00	1702.79	0.00		0.21	0	0	0.024	0	
Trichocerca sp. C	0	0	0.00	1702.79	0.00		0.08	0	0	0.006	0	
Type 3 (mostly malleoramates)												
Collotheca sp.	0	0	0.00	1702.79	0.00		0.21	0	0	0.01	0	
Conochilus sp.	0	0	0.00	1702.79	0.00		0.22	0	0	0.03	0	
Conochilus sp. (small)	0	0	0.00	1702.79	0.00		0.10	0	0	0.01	0	
Filinia sp.	0	0	0.00	1702.79	0.00		0.14	0	0	0.03	0	
Hexarthra sp.	0	0	0.00	1702.79	0.00			0	0	0.023	0	
Pompholyx sp.	0	0	0.00	1702.79	0.00		0.09	0	0	0.01	0	
Testudinella sp.	0	0	0.00	1702.79	0.00			0	0	0.023	0	
Others												
Undeter rotifer 1	0	11	11.00	1702.79	1.00		0.10	18,731	0	0.03	562	body contracted
Undeter rotifer 2	0	0	0.00	1702.79	0.00		0.21	0	0	0.25	0	body contracted
Undeter rotifer 3	0	0	0.00	1702.79	0.00			0	0	0.015	0	
Undeter rotifer 4	0	0	0.00	1702.79	0.00			0	0	1	0	
						Total Density					**Total Dry Wt. Biomass**	
						#/m3	**#/L**				**ug/m3**	**ug/L**
						555,498	**555.50**				**24,682**	**24.68**
% Calanoid Copepods						0.01					3.57	
% Cyclopoid Copepods						0.61					34.50	
% Nauplii						1.84					10.35	
% Cladocerans						0.06					10.83	
% Rotifers						97.48					40.75	
% Dipterans						0.00	100.00				0.00	100.00
Number of species in sample						**16**						

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Appendix 5. Benthic Macroinvertebrate Data

Table A.5-1. Results from May 2007 vertical hard substrate sampling.

Depth (feet)	Lower Boundary Reservoir Biomass (mg)	Box Canyon Reservoir Biomass (mg)
2	2.534	828.427
5	7.266	684.360
10	40.749	669.473
15	154.323	645.789
20*		593.176
25	207.040	586.233
40	114.330	

*A 40-foot sample was not collect at Box Canyon, so an additional sample was collected at 20 feet.

Table A.5-2. Results from May 2007 shoreline hard substrate sampling.

Depth (feet)	Lower Boundary Reservoir Biomass (mg)	Upper Boundary Reservoir Biomass (mg)	Box Canyon Reservoir Biomass (mg)
2	0.000	0.111	908.592
5	0.363	106.173	702.097
10	3.404	931.241	219.311
15	33.906	1070.344	900.357
25	36.528	1001.373	195.145
40	103.920	751.283	231.591

Table A.5-3. Results from May 2007 soft substrate sampling.

Depth (feet)	Lower Boundary Reservoir Biomass (mg)	Upper Boundary Reservoir Biomass (mg)	Box Canyon Reservoir Biomass (mg)
2	0.000	161.200	59.167
5	0.880	8.860	79.205
10	2.817	24.218	16.881
15	24.596	20.086	77.929
25	79.722	0.195	41.949
40	25.290	6.429	4.942

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