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A REPRODUCTIVE AND TROPHIC TRANSFER STUDY ASSOCIATED WITH SELENIUM CONCENTRATIONS IN THE UPPER MUD RIVER WATERSHED

A thesis submitted to the Graduate College of Marshall University

In partial fulfillment of the requirements for the degree of Master of Science in Environmental Science by Amanda Lee Wilson

> Approved by Dr. Scott Simonton, Committee Chair Dr. Mindy Armstead Michael Egnor

> > Marshall University

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Keywords: larval fish deformity, periphyton, selenium, trophic transfer

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ABSTRACT

Selenium in mining-related discharges has created concern in the Appalachian Region where coal is a significant resource. In West Virginia, evaluation of streams receiving mining discharges focused attention on the Mud River watershed where bioaccumulation of selenium was highest in preliminary surveys. Chronic exposure (mainly dietary) of mature female fish to selenium has the potential to cause developmental abnormalities in developing embryos due to the maternal transfer of selenium into the eggs. Literature suggests that factors affecting the bioaccumulation rate of selenium, and the concentration of selenium associated with the aforementioned effects are site-specific. The purpose of this study was to determine the whole-body selenium tissue concentration which is protective of aquatic life in the watershed as defined by the effective concentration resulting in greater than ten percent deformity (EC_{10}) . Further, this study was undertaken to evaluate whether whole-body tissue concentrations in fish in the watershed are within an acceptable range and to test a trophic transfer model which would allow monitoring of selenium whole-body fish tissue concentrations via modeling of the food chain using periphyton (algae) and water column selenium concentrations. By evaluating larval fish deformities within the Mud River watershed, it is demonstrated that a whole-body selenium value of 23.69 mg/kg dry weight (dw) selenium is the concentration shown to be protective of fish communities in this watershed. Whole-body fish tissue concentrations from streams sampled within the watershed generally show compliance with this safe level. Predicting the whole-body concentration using the trophic transfer model was successful for the streams evaluated except for Sites 1 and 2 where variable interactions and site variability reduced the

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models predictive ability. This analysis confirms the trophic transfer model as a useful predictive tool in this watershed.

INTRODUCTION

Mining-related discharges containing selenium have created concern in the Appalachian Region where coal is a significant resource. In West Virginia, evaluation of streams receiving mining discharges focused attention on the Mud River watershed where bioaccumulation of selenium was highest in preliminary surveys (WVDEP, 2009). Chronic exposure (mainly dietary) of mature female fish to selenium has the potential to cause developmental abnormalities in developing embryos due to the maternal transfer of selenium into the eggs (GEI Consultants, Golder Associates, Parametrix, & University of Saskatchewan, 2008). Fish population effects can be seen when developmental abnormalities reach levels which impair recruitment to the population. The level at which populations may be affected has been suggested to be abnormality rates of ten percent or greater (EC_{10}) (GEI Consultants et al., 2008). Factors affecting the bioaccumulation rate of selenium, and the concentration of selenium associated with the aforementioned effects are site-specific.

The purpose of this study was:

- to determine the whole-body selenium tissue concentration which is protective of aquatic life in the watershed as defined by the effective concentration resulting in greater than ten percent deformity (EC₁₀);
- to evaluate whether whole-body tissue concentrations in fish in the watershed are within an acceptable range based on the calculated EC₁₀; and
- to test a trophic transfer model which would allow monitoring of selenium whole-body fish tissue concentrations by modeling using periphyton and water column selenium concentrations.

Selenium-induced deformities can include spinal curvatures, missing or deformed fins, craniofacial deformities, and edema. Swelling of the yolk sac, or yolk sac edema, is also associated with selenium, but may not result in permanent abnormalities (Chapman, P.M., Adams W.J., Brooks M.L., Delos C.G., Luoma S.N., Maher W.A., Ohlendorf H.M., Presser T.S., & Shaw D.P., 2009), therefore only the teratogenic deformities were used in the EC_{10} evaluation. An EC_{10} value, the value at which 10% of the fish larval population is deformed, is the point which is considered to be protective of the population (GEI Consultants et al., 2008). Hypothesis testing statistics are not appropriate for ecological toxicity due to high variability of outcomes (GEI Consultants et al., 2008). A point estimation approach has more consistency in outcomes which allows for more accurate comparisons between different watersheds and fish species (GEI Consultants et al., 2008). Point estimations of both EC_{10} and EC_{20} have been used in estimating toxicity, however, EC_{10} is more conservative for a broad application use (GEI Consultants et al., 2008). DeForest et al. evaluated 22 studies involving 12 fish species across North America and concluded that an egg/ovary concentration of 20 mg Se/kg satisfied the EC₁₀ criteria (DeForest, D. K., Gilron, G., Armstrong, S. A., & Robertson, E. L., 2011).

As selenium uptake is known to occur primarily through the dietary exposure route, biological characterization has included each trophic level from algae (primary producers) through the primary consumers (macroinvertebrates) through the top consumers, generally fish. Reproductive health was evaluated in streams with varying selenium conditions by evaluation of fish larval deformity rates, and selenium accumulation was weighed in each trophic level of the community.

LITERATURE REVIEW

Selenium bioaccumulation is primarily through dietary exposure (Conley, J. M., Funk, D. H., & Buchwalter, D. B., 2009). Conley et al. (2009) also noted that dietary selenium concentrations, rather than dissolved selenium concentrations, were better at predicting the adult body burdens. Selenium is exposed to the parent fish through diet and is subsequently deposited in the eggs, particularly the yolks (Lemly, 1997).

When cells are carrying out protein synthesis, they cannot differentiate between sulfur and selenium due to the similar chemical structure of the two. When there is an excessive amount of selenium and it is substituted for sulfur, the chemical bonds are different and consequently the proteins and enzymes are dysfunctional (Lemly, 1997). A study published in 2001 (Brix, K. V., Volosin, J. S., Adams, W. J., Reash, R. J., Carlton, R. G., & McIntyre, D. O., 2001) indicated that the relationship between ambient sulfate water concentrations and acute selenate toxicity is substantial. Although acute toxicity will vary among species, sulfate is shown to inhibit selenate bioavailability due to the structural similarity of sulfate and selenite (Brix et al., 2001).

Speciation of selenium is important due to variations in toxicity and adsorption of the different selenium species (Goldberg, S., Martens, D.A., Forster, H.S., & Herbel, M.J., 2006). Selenomethionine is the most readily bioaccumulated and toxic organic form of selenium, followed by selenite and selenate, respectively (Lemly, 1997). Regardless of what form, the selenium is processed and included into the yolks as mostly seleno-amino acids, therefore terata can be caused by all forms of selenium (Lemly, 1997). Both hard and soft fish tissues can be deformed as well as some tissues not being produced at all (Lemly, 1997). Selenium toxicity may be effectively assessed in fish communities by the evaluation of teratogenesis. A study (Holm, J., Palace, V.P., Wautier, K., Evans, R.E., Baron, C.L., Podemski, C., Siwik, P., & Sterling, G., 2003) compared three different methods for evaluating larval deformities. Of the three methods, frequency analysis, a graduated severity index, and morphometric analysis, frequency analysis was found to be the quickest, most cost effective method (Holm et al., 2003). Additionally, data generated by the frequency analysis were more valuable in site-specific toxicity threshold derivation (Holm et al., 2003).

Because larval fish heavily rely on the selenium-laden yolk sac once they are hatched, selenium levels do not affect hatchability, but it does affect survival after hatching (Lemly, 1997). Based on studies of Centrarchidae and Cyprinidae, about 80% of teratogenically deformed larvae die regardless of the selenium levels whereas only 25% of juvenile and adult with these deformities die (Lemly, 1997). For this reason, Lemly recommends that larval fish should be utilized for these assessments more so than the juvenile or adult fish.

Lemly (1997) developed an index to assess the impacts to fish populations by examining the occurrence of teratogenic deformities in the larvae. Lemly suggested that less than 5% terata-induced population mortality was considered a negligible impact, a slight to moderate impact was between 5 and 20%, and greater than 20% was a major impact. Poor reproduction due to selenium-induced impacts, as opposed to varying water levels, predation, food shortage, and poor recruitment, can be verified by utilizing this index (Lemly, 1997). The biomagnifications step between water and primary producers is larger than that between primary producers to aquatic invertebrates (Conley et al., 2009). Conley et al. (2009) focused a study on selenium bioaccumulation in the mayfly, Centroptilum triangulifer, by allowing the selenium in periphyton which was then fed to the mayfly. The results suggested that, not only is this species a medium for selenium bioaccumulation through the trophic transfer, but it is potentially affected by the selenium exposure itself by growth and/or reproduction changes (Conley et al., 2009). In this study, however, only selenium as selenite was infused into the periphyton (Conley et al., 2009). Selenite is only one form of selenium and it is noted in the text that selenium bioaccumulation varies due to both different species' physiology as well as the geochemical forms of selenium (Conley et al., 2009). Bioaccumulation of metals is sitespecific and is influenced by water and sediment compositions, trophic relationships, habitat, stressor, receptor, active regulation of body burdens, and saturable uptake kinetics (Brix, K. V., Toll, J. E., Tear, L. M., DeForest, D. K., Adams, W. J., 2005).

The extent to which selenium adversely affects fish varies (Lohner, T. W., Reash, R. J., Willet, E. V., & Rose, L. A., 2001). These variations may be due to coal ash chemistry, receiving stream characteristics, population exposures, trophic status, habitat preference, and/or mobility (Lohner et al., 2001).

The study by Van Derveer and Canton (1997) indicates that selenium sediment concentration in lotic systems is directly related to sediment organic carbon. Moreover, organically rich streams have the potential to accumulate more selenium in sediments and organically poor streams have the potential to have higher selenium water concentrations (Van Derveer & Canton, 1997). It is also suggested that selenium standards or criteria protecting bioaccumulation in fish and wildlife should be based on modeling with particulate concentrations (Van Derveer & Canton, 1997).

Presser and Luoma (2010) developed a methodology for hypothesizing and measuring selenium concentrations bioaccumulated through the food chain. This model demonstrates safe selenium levels will fluctuate among ecosystems depending on the biogeochemical conditions and ecological pathways (Presser & Luoma, 2010).

RESEARCH METHODS

Site description

An evaluation of the condition of the biological communities and the extent to which elevated selenium levels may be affecting these communities was conducted in the Mud River watershed between 2009 and 2010. The watershed lies in the Cumberland Mountains of the Central Appalachian Plateau in West Virginia. Mining, forestry, and natural gas are the significant economic contributors in the watershed (USEPA, 2004; Woods, A.J., Omernik, J.M., & Brown, D.D., 1999). Coal mining has been ongoing in the basin since the completion of the Norfolk and Western Railroad in the late 1800s. Large scale surface mining (known as mountaintop mining) began in the early 1980s in response to the increased demand for low sulfur coal (USEPA, 2004). In this watershed, there is a strip of land approximately 5 miles wide which lies in the primary mountaintop mining area as described by the West Virginia Geological and Economic Survey. Multiple coal seams are horizontally bedded and most mines extract five or more seams. The primary physiography is unglaciated divided hills and mountains with abrupt slopes and narrow ridges and the primary geology is Pennsylvania sandstone, siltstone, shale and coal of the Pottsville Group and the Allegheny Formation (Woods et al., 1999).

Fish egg collection was conducted in five streams in the Mud River watershed are shown in **Table 1**, **Appendix A**, and periphyton was collected in six streams in the same watershed (**Table 2**, **Appendix A**).

Reproductive study methods

Eggs were collected in the watershed in spring 2009 and 2010 and each nest was reared in a laboratory with water from each site. After egg hatching in each tank, a subset of larvae was collected every 2 to 3 days until the majority became free swimming. Upon collection, larvae were transferred to labeled plastic jars with a small amount of water and placed in a freezer for 30-60 minutes to anesthetize prior to preserving them in a pre-buffered formalin solution (Formalin 10). After evaluating the larvae for deformities, they were transferred to a 70% ethanol solution for long-term storage.

Preserved larval fish specimens were observed using a dissecting microscope and evaluated for deformities. Each specimen was viewed and the number of the following types of deformities were observed:

- Craniofacial deformities that are associated with the head region (extension or reduction of jaw structure, malformations, eye diameter, etc.);
- Skeletal deformities associated with the notochord or spine (severe bends or curvature along the notochord);
- Yolk Sac Edema deformities associated in the yolk sac during larval development (accumulation of excess body fluid in the yolk sac);
- Finfold deformities associated among the fins (absence or malformation associated with any developed / developing fins); and

• Teratogenic – the sum of permanent developmental deformities that are not reversible, which are craniofacial, skeletal and finfold deformities.

The larval specimens were identified down to the lowest practical taxon. The following literature was used for the identification and deformity evaluation of larval specimens: Auer, N. A., & Great Lakes Fishery Commission's (1982) "Identification of Larval Fishes of the Great Lakes Basin with Emphasis on the Lake Michigan Drainage," Holm's (2003) "An Assessment of the Development and Survival of Wild Rainbow Trout (*Oncorhynchus mykiss*) and Brook Trout (*Salvelinus fontinalis*) Exposed to Elevated Selenium in an Area of Active Coal Mining", and Lemly's (1997) "A Teratogenic Deformity Index for Evaluating Impacts of Selenium on Fish Populations" along with other noted literature (Holm, J., Palace, V., Siwik, P., Sterling, G., Evans, R., Baron, C., Werner, J., & Wautier, K. 2005; Margulies, 1983).

At the time of egg collections, water samples and representative species of fish were collected in the aforementioned streams by use of an electro-backpack shocker. The water and fish were stored in ice and transported to BioChem Testing Laboratories for selenium and whole-body selenium tissue analysis, respectfully. Half of the detection limit was used for values resulting in non-detect levels of selenium, for both water and fish tissue.

Modeling methods

Periphyton sampling was conducted from summer 2009 through spring 2010, quarterly, in six mine-influenced streams. Unglazed 1-inch x 1-inch tiles were placed in sampling sites and periphyton was allowed to colonize. Four tiles were randomly collected at two week intervals for a total of four samples per season. Periphyton was

transported on ice and in dark containers and analyzed for selenium concentration $(\mu g/m^2)$, ash free dry weight (AFDW) (g/m^2) , and chlorophyll-a (mg/m^2) using laboratory methods EPA 6020, SM10300C.5, and SM10200-H, respectively. Any periphyton or water selenium measurements, as well as AFDW, which were below the detection limit were not used in the modeling. The detection limit for water concentration was 0.001 mg/L. The detection limit for periphyton concentration is based on the sample size and variable dilution volumes used in sampling processing. The detection limit for periphyton concentration ranged from $3.3 \ \mu g/m^2$ to $17.2 \ \mu g/m^2$. Non-detect values could have resulted from, not only low selenium levels, but also from scouring of the tiles during a high flow. Because the reason the measurements resulted in non-detect values is unknown, it would be inaccurate to include them in the data set. Furthermore, ratios calculated with half of the detection limit would be inaccurate and skew the fit of the model. Due to laboratory malfunction and stolen/washed out tiles various data points for all three parameters were missing throughout summer, winter and spring.

To calculate the particulate selenium concentration (μ g/g) for a particular sampling event, the average periphyton selenium concentration (μ g/m² dw) from the four tiles was divided by the average dry weight (g/m³) (cf. AFDW) of the four tiles. In order to translate water-column selenium concentration to whole-body fish tissue concentration, several factors in each modeling event had to be selected. Selenium water column concentrations, which were sampled from summer 2009 through spring 2010, were used in the modeling. Both selenium water column and periphyton concentrations are shown in **Table 3, Appendix A**. Fish species, predator food web, trophic transfer functions for fish and invertebrates, and the operationally defined distribution coefficient (K_d) were all independently selected for each modeling event. Additionally, selenium uptake was presumed to be seasonal due to seasonal periphyton productivity. The equation used for modeling whole-body selenium fish tissue concentration via periphyton selenium concentration is as follows:

$$C_{water} = (C_{fish}) \div (TTF_{fish}) (K_d) (TTF_{invertebrate})$$

K_d was calculated as the ratio of the particulate concentration to the water-column concentration. The trophic transfer functions (TTFs) were selected from a summary of TTFs derived from field averages of multiple matched data sets from sites with similar food webs or regressions for a series of individual sites with similar food webs (Presser & Luoma, 2010). If an invertebrate-to-fish TTF was not available, a TTF_{fish} of 1.1 was used, which is a mean value based on a study of 25 fish species. Most fish species consume a mixed diet, with an inclination towards certain types of food. When selecting TTFs for the food of individual fish species, the preferred foods and the available foods for that particular location and season were taken into account. In order to have the most accurate TTF_{invertebrate}, prey fractions for each species' foods were incorporated in the equation. Species designations were found in the USEPA's Rapid Bioassessment Protocols for Streams and Rivers (Barbour, M.T., Gerritsen, J., Snyder, B. D., & Stribling, J. B., 1999). Common foods for each species were found in the Fish and Wildlife Service's Habitat Suitability Index Models (McMahon, 1982; Stuber, R.J., Gebhart, G., & Maughan, O.E., 1982; Trial, J.G., Stanley, J.G., Batcheller, M., Gebhart, G., Maughan, O.E., & Nelson, P.C., 1983). The prey fractions that were chosen take into

account, not only the preferred foods for each species, but the available foods in the Mud River watershed, the change in eating habits of each species as they mature, and the time for each species to mature. The United States Geological Survey's Habitat Suitability Index Models were referenced when choosing prey fractions for each of the modeled species. Prey fractions selected are shown in **Table 4**, **Appendix A**.

RESULTS

Reproductive study results

Average selenium fish tissue concentrations from each sampling site were compared with the percentage of teratogenic deformities found in larvae from the same site (**Table 5, Appendix A**). The highest average selenium fish tissue concentration and percent teratogenic deformities were both found in Sugartree Branch, while the lowest were both found in Upton Branch. Fish were not corrected for age, but all were adults of reproductive age.

From these evaluations the EC₁₀ in the Mud River watershed was found to be 23.69 mg/kg dw. The regression coefficient ($r^2 = 0.7427$) generated from this relationship is significant (**Figure 1, Appendix B**). Whole-body tissue concentrations ranged from 3.51 to 25.54 mg/kg dw in fish collected from the five sites in the watershed (**Appendix C**). These concentrations were generally below the projected EC₁₀ with the exception of the one creek chub concentration of 25.54 mg/kg dw.

Modeling results

Modeled whole-body fish tissue concentrations of creek chubs, green sunfish, and blacknose dace were compared to measured whole-body fish tissue concentrations of the same species collected contemporaneously with the periphyton collection in 2009

(**Tables 6-8, Appendix A**). In general, modeled and measured values showed good agreement. As **Figures 2-4, Appendix B** illustrate, the majority of the modeled whole-body selenium fish tissue concentrations follow the same trends for each sampling site as the measured data.

To evaluate modeling accuracy, modeled whole-body fish tissue concentrations of creek chubs, green sunfish, and blacknose dace were statistically compared to measured whole-body fish tissue concentrations of the same species. For each fish species and site, the modeled and measured data were ranked and a general linear model (GLM) two-way analysis of variance (ANOVA) was utilized to compare the data.

As shown in **Table 9**, **Appendix A**, there was no significant difference in the measured and modeled data for all three fish species. As expected, however, there was a significant difference between whole-body selenium fish tissue concentrations and the sampling sites. Although these data demonstrate the accuracy of the modeling, the interaction probability levels for creek chubs and green sunfish conveys that there is an interference between the sampling site and the measured versus modeled data. That is to say, there is a difference in the predictability of the model at the different sites, or some sites are more accurately modeled than others. Raw data for modeling calculations and statistics may be found in **Appendices C** and **D**, respectively.

DISCUSSION

The reproductive health of the streams was evaluated by comparing the percentage of deformed fish larvae to the whole-body selenium concentration (mg/kg dw) in each stream. Despite having sampled in streams substantially influenced by mining, efforts did not generate deformity rates higher than the 10% which is considered to be

protective of fish communities (GEI Consultants et al., 2008). As shown in **Table 5**, **Appendix A**, the deformity rates (teratogenic only - not including edema) were generally lower than the EC_{10} despite tissue concentrations greater than the whole-body screening level of 7.9 mg/kg dw (USEPA, 2004).

An ecosystem-scale model was developed to conceptualize and quantify the process of selenium moving through media in the food web of the Mud River watershed. By employing this type of modeling, dissolved selenium is related to bioaccumulated selenium by systematically quantifying each of the influential processes (Presser & Luoma, 2010). Translating selenium whole-body fish tissue concentrations to a dissolved selenium water column concentration can facilitate site-specific regulation, or show general comparisons among ecosystems (Presser & Luoma, 2010). Additionally, depending on the ecological pathways and biogeochemical conditions in the system, safe levels of dissolved selenium will vary among ecosystems (GEI Consultants et al., 2008). Ecosystem-scale modeling was utilized to predict whole-body selenium fish tissue concentrations from water column and periphyton in lotic systems, as shown in **Tables 6**-

8, Appendix A.

These results were then statistically compared to actual whole-body fish tissue concentrations. The modeled fish tissues were similar to measured values with no significant differences between in green sunfish, blacknose dace or creek chubs. As expected, due to the differences in selenium exposures, significant differences were noted between the sites. The significant interactions indicate additional evaluations would be beneficial to determine factors not included in the model which may be influencing variability in the model and selenium bioaccumulation.

The trophic-transfer modeling of selenium was found to successfully predict measured concentrations at Sites 4-6, and may be a useful tool in selenium regulation and monitoring. However, inconsistencies in the data were present and it would be beneficial to further evaluate these discrepancies to better understand selenium cycling in the watershed. Similarly, whereas the strong correlation indicates that the EC₁₀ for the lotic environment in the Mud River watershed is in the vicinity of 23.69 mg/kg dw, this estimate is based on a low number of data points. More data are necessary and would provide confidence in the relationship between selenium whole-body concentrations and teratogenic deformities.

Additional details from the study described herein can be found in "An Evaluation of the Effects of Selenium on Reproductive Success of Fish in Streams Receiving Coal Mining Discharges – 2010 (POTESTA, 2011a) and "Periphyton Report for the Streams of the Mud River Watershed" (POTESTA, 2011b).

CONCLUSIONS AND RECOMMENDATIONS

Although no deformity rates greater than 10% were measured, a fairly strong regression was generated by the data providing as site-specific screening value. The projected EC_{10} for whole-body fish tissue concentration, 23.69 mg/kg dw, was greater than tissue concentrations measured in most streams in the watershed and population level effects from selenium are not generally expected in lotic systems in the watershed. In one stream individual fish tissue concentrations slightly exceeded this number.

The reproductive study findings are consistent with a recent publication (Deforest et al., 2011) from Canada which summarized available data for developing selenium thresholds based on selenium egg/ovary concentrations. Deforest suggested that

sufficient data were available to support a threshold for toxicity and finds a conservative egg/ovary guideline of 20 mg/kg dw. This value is conservative as it represents the 5th percentile of the species sensitivity distribution and no species mean toxicity thresholds lower than this have been identified. When tissue concentrations exceed the threshold, site-specific studies should be conducted to evaluate potential risks (Deforest et al., 2011). Using a site-specific whole-body to egg/ovary selenium concentration conversion factor developed for the Mud River watershed (POTESTA , 2011a), the 23.69 mg/kg dw selenium whole-body concentration converts to a selenium egg/ovary concentration of 26.15 mg/kg dw.

Variation in measured and modeled data could be attributed to non-detect levels of selenium in both the periphyton and the water column. Non-detect values were not used in the calculations to possible erroneous assumptions skewing the data set. If the actual non-detect values were known and utilized in the modeling, there would be additional modeled data points with lower values and the statistical analyses would show more of a similarity between the measured and modeled data. Additional evaluations to determine factors which may be influencing variability in the model, and overall selenium bioaccumulation, are needed to gain better fitness at the range of site conditions.

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APPENDIX A

Location	Latitude (°)	Longitude (°)
Mud River	38.09474 N	81.97635 W
Mud River DS	38.09284 N	81.96379 W
Ballard Branch	38.07332 N	81.94968 W
Sugartree Branch	38.09068 N	81.94989 W
Berry Branch	38.10087 N	81.98917 W
Upton Branch	38.13567 N	82.04774 W

Table 1: Fish Egg Sampling Locations

Site ID	Location	Latitude (°)	Longitude (°)
1	Mud River upstream Ballard Branch	38.07103 N	81.95261 W
2	Ballard Branch	38.07261 N	81.94711 W
3	Stanley Fork	38.08472 N	81.95639 W
4	Sugartree Branch	38.09066 N	81.95040 W
5	Berry Branch	38.10496 N	81.97053 W
6	Mud River downstream Berry Branch	38.09997 N	81.99063 W

Table 2: Periphyton Sampling Locations Mud River WatershedSummer 2009 - Spring 2010

Se Water Column Concentrations (µg/L)								
Site ID	Summer 2009	Fall 2009	Winter 2010	Spring 2010				
1	6.2	3.3	nd	nd				
2	1.7	nd	nd	nd				
3	9.1	8.1	10.3	8.8				
4	15.7	14.2	19.7	18.9				
5	20.2	5.3	8.0	5.3				
6	19.9	14.0	10.5	6.1				
Avera	age Se Periphyto	on (Particulate)	Concentration R	anges (µg/g)				
Site ID	Summer 2009	Fall 2009	Winter 2010	Spring 2010				
1	2.8-25.6	nd-5.3	nd-7.8	nd-1.6				
2	4.7-5.8	nd	nd	0.6-0.8				
3	3.2	1.2-1.4	0.4-1.6	nd-0.5				
4	11.2-11.7	nd-10.3	2.6-3.6	missing tiles				
5	1.5-12.1	2.0-4.2	nd	0.8-2.3				
6	nd-0.3	2.5-8.8	1.8-2.6	nd-0.8				
nd = non-detect value								

Table 3: Model Input

Fish Species	Aquatic Insect	Crayfish	Fish	Zooplankton	Amphipod
Green Sunfish	35	25	25	15	
Creek Chub (fall, winter, & spring)	25		50		25
Creek Chub (summer)			100		
Blacknose Dace	85			15	

 Table 4: Prey fractions (%) used in the tropic transfer modeling

Collection location and date*	Taxa represented	Average Se fish tissue (mg/kg dw)	Total # of fry	% Yolk sac edema	Total % teratogenic deformities
Sugartree Branch	creek chub	18.24	577	0.17	6.59
Mud River	creek chub & striped shiner	7.61	335	0.60	5.97
Upton Branch	creek chub	7.03	1039	1.35	4.72
Berry Branch	creek chub	4.46	476	2.52	2.73
Berry Branch	white sucker **	1.36	407	0.25	0.25
Upton Branch	white sucker **	1.05	130	0.00	0.00
Berry Branch	creek chub	3.96	295	0.34	1.69
*From 2000 and 20)10 reproductive studies (PO)	TESTA 2011)		

*From 2009 and 2010 reproductive studies (POTESTA a, 2011).

**White suckers were not collected during the fish tissue sample collections but were present when spawning. Tissue concentrations for this species are represented by an average of all species for which data were available.

Table 5: Lotic deformity statistics from larval fish from the Mud River watershed

Site 1		Site 2		Sit	te 3	Sit	te 4	Site 5		Sit	e 6
Model	Measure	Model	Measure	Model	Measure	Model	Measure	Model	Measure	Model	Measure
33.79	2.79	7.66	2.77	4.28	13.26	14.84	13.19	15.91	4.99	0.46	3.05
3.72	3.84	6.22	2.74	2.07	10.48	15.48	13.69	1.99	4.41	15.57	3.03
9.45	2.76		2.55	2.41	9.08	18.26	5.52	7.47	3.50	4.37	2.10
	3.46		2.30	2.83	7.22	6.33	14.45	4.07	3.40	4.64	3.81
	3.84		2.28	0.70	11.63	4.62	14.14	3.51	3.76	3.10	3.56
	3.15		2.02	0.87	9.58		15.37	4.11	3.36	1.44	3.85
	3.89		2.74		12.83		15.04	1.38	4.92		3.24
	3.05		1.89		8.40		15.04		3.32		3.18

Table 6: Creek Chub Whole-Body Selenium Tissue Concentrations (mg/kg dw)

Sit	te 1	Sit	te 2	Sit	te 3	Sit	te 4	Sit	te 5	Sit	te 6
Model	Measure										
57.75	8.17	13.09	5.60	7.32	25.57	25.37	28.99	27.19	5.15	0.79	6.29
6.36	6.23	10.62	6.86	2.64	16.46	26.45	25.24	3.41	5.52	19.84	4.68
12.04	12.77		3.57	3.08	18.88	23.28	11.10	9.52	4.82	5.57	3.76
	8.20		5.19	3.61	22.21	8.07	9.15	5.19	4.06	5.91	6.20
	9.30		4.87	0.89	22.51	5.89	31.12	4.47	3.64	3.96	5.68
	7.40		17.64	1.11	27.29			5.23	3.88	1.84	6.30
	9.55		15.24		33.38			1.76	2.68		5.48
	6.84		2.52		16.39				12.06		5.92

Table 7: Green Sunfish Whole-Body Selenium Tissue Concentrations (mg/kg dw)
Sit	e 4	Sit	e 5
Model	Measure	Model	Measure
35.15	38.51	37.67	12.64
36.65	23.90	4.72	10.85
32.25	31.06	13.20	7.85
11.18		7.19	8.48
8.16		6.19	8.20
		7.25	9.70
		2.44	

Table 8: Blacknose Dace Whole-Body Selenium Tissue Concentrations (mg/kg dw)

Fish Species	Creek	Chubs	Green	Sunfish	Blacknose Dace				
Statistic	F-Ratio	Prob. Level	F-Ratio	Prob. Level	F-Ratio	Prob. Level			
Sampling Site	9.52	0.000001*	8.49	0.000004*	10.46	0.004878*			
Measured vs. Modeled	1.63	0.206502	1.12	0.293155	1.20	0.288110			
Interaction	11.48	0.000000*	8.43	0.000004*	0.00	0.961575			
*Term significant at alpha = 0.05									

 Table 9: Results of statistical comparisons of measured and modeled selenium concentrations in sampling sites in the Mud River watershed

APPENDIX B



Figure 1: Percent teratogenic deformities of larval fish in relation to selenium wholebody fish tissue concentrations



Figure 2: Whole-body creek chub selenium concentrations (green) plotted with modeled concentrations (blue)



Figure 3: Whole-body green sunfish selenium concentrations (green) plotted with modeled concentrations (blue)



Figure 4: Whole-body blacknose dace selenium concentrations (green) plotted with modeled concentrations (blue)

APPENDIX C

PART 1

Creek Chub Modeling

Summer 2													
							100%	fish diet only					
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate}	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Creek} Chub	TFF _{Fish}	C _{Creek Chub} (ug/g or mg/kg)					
	254.3	7.609											
1	230.2	17.696	25.6	67	4 120022	1 200	1 1	22 702					
1	225.0	4.957	23.0	0.2	4.129032	1.200	1.1	55.192					
	n/a	6.696											
	48.3	11.130											
2	64.6	11.739	5 00700	17	2 112158	1 200	1 1	7 650801					
2	58.0	5.826	3.00200	1./	5.415456	1.200	1.1	7.039601					
	n/a	10.565											
	204.1	83.087											
3	2 212.6		3 24287	0.1	0 356350	1 200	1 1	1 280585					
3	191.1	63.348	3.24207	9.1	0.550559	1.200	1.1	4.200303					
	n/a	63.217											
	45.7	8.000		15.7									
4	45.0	8.696	11 2441		0.716184	1.200	11	1/1 8/122					
-	142.2	5.391	11.2441	13.7	0.710104		1.1	17.0722					
	n⁄a	5.522											
	815.2	50.957											
5	163.0	27.913	12 0519	20.2	0 59663	1 200	11	15 90855					
5	111.5	20.304	12.0317	20.2	0.57005	1.200	1.1	15.70055					
	n/a	21.391											
	31.3	64.870											
6	86.7	69.130	0.6397	19.9	0.032146	1 200	11	0 844404					
0	1.7	61.391	0.0377	17.7	0.052140	1.200	1.1	0.011101					
	n/a	54.087											
	43.0	12.087											
7	45.7	7.043	4 93333	n/d	#VALUE!	1 200	11	#VALUE!					
	32.0	7.087	-1.755555	33 n/d	#VALUE!	1.200	1.1	II VIALUL:					
	n/a	6.391											

*Calculations which are based non-detect values are bolded and grey.

Summer 3													
							100%	fish diet only					
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate}	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Creek} Chub	TFF _{Fish}	C _{Creek Chub} (ug/g or mg/kg)					
	41.7	22.130											
1	39.8	13.783	2 22027	60	0.45409	1 200	1 1	2 702551					
1	48.9	12.565	2.82087	0.2	0.43498	1.200	1.1	5.725554					
	n/a	13.174											
	152.0	30.913											
2	37.2	10.435	4 70014	17	2 770083	1 200	1 1	6 216066					
2	32.6	12.652	4.70914	1./	2.170083	1.200	1.1	0.210000					
	n/a	8.783											
	161.1	0.022	ļ										
3	196.3	71.348	2 6314	91	0.289165	1 200	11	3 /73//0					
3	268.7	112.174	2.0314	7.1	0.207105	1.200	1.1	5.7/377/					
	n/a	133.696											
	182.0	23.739											
4	202.8	11.348	11 7255	157	0 74685	1 200	11	15 47772					
•	178.0	15.652	11.7255	10.7	0.71005	1.200	1.1	13.17772					
	n/a	13.261											
	56.7	24.913	-										
5	73.0	51.043	1 51054	20.2	0 074779	1 200	11	1 993919					
5	71.1	41.304	1.01001	20.2	0.07 1775	1.200		11,7,6,7,17					
	n/a	60.043											
	74.3	168.652	-										
6	72.4	411.652	0.3492	19.9	0.017548	1.200	1.1	0.46095					
Ũ	80.2	101.087	0.0.17		01017010	1.200		0110070					
	n/a	185.174											
	33.3	16.609											
7	29.3	11.783	2.26316	n/d	#VALUE!	1.200	1.1	#VALUE!					
/	21.5	11.652		0 1/0									
	n/a	9.522											

*Calculations which are based non-detect values are bolded and grey.

Fall 1													
							50%	25%	25%				
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water} - column (ug/L)	K _d (L/g)	TFF _{Creek} Chub	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Amphi}	C _{Creek Chub} (ug/g or mg/kg)			
	1.7	3.652		-									
1	1.7	4.565	0 22786	2.2	0.000252	1 200	11	20	0.0	0 5903153			
1	1.7	7.261	0.32760	5.5	0.099552	1.200	1.1	2.0	0.9	0.2003123			
	1.7	4.652											
	1.7	4.391											
2	1.7	3.348	0 47438	n/d	#VALUE!	1 200	11	2.8	0.9	#VALUE!			
2	1.7	3.087	0.47430	1/u		1.200	1.1	2.0	0.7	TIALUL.			
	1.7	3.087											
	1.7	2.957											
3	1.7	5.652	0.33289	8.1	0.041098	1.200	1.1	2.8	0.9	0.5892237			
	1.7	1.522		0.1	0.011020	1.200		2.0	0.7	01007 == 0.			
	1.7	9.696											
	21.5	4.522											
4	37.2	8.000	1.13167	14.2	0.079695	1.200	1.1	2.8	0.9	2.00305			
	1.7	34.826			0.0			2.0	0.9				
	1.7	7.435											
	54.8	16.957	4										
5	32.6	8.783	4.22147	5.3	0.796504	1.200	1.1	2.8	0.9	7.4720019			
	25.4	9.522											
	//.0	9.696											
	I. 7	5.1/4											
6	/1.1	3.652	6.83212	14	0.488009	1.200	1.1	2.8	0.9	12.092858			
	32.0	2.739	-										
	1./	4.000											
	28.0	6.000											
7	28.0	0.174 8.043	1.20836	n/d	#VALUE!	E! 1.200) 1.1	2.8	0.9	#VALUE!			
	1.7	5.043	+										
	1./	5.007											

*Calculations which are based non-detect values are bolded and grey.

Fall 2													
							50%	25%	25%				
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate}	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Creek} Chub	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Amphi}	C _{Creek Chub} (ug/g or mg/kg)			
	1.7	7.640											
1	1.7	5.640	0.24728	2.2	0.074063	1 200	1 1	28	0.0	0 /378561			
1	1.7	5.320	0.24738	5.5	0.074905	1.200	1.1	2.0	0.9	0.43/0301			
	1.7	8.080											
	1.7	6.760											
2	1.7	1.600	0 12168	n/d	#VALUE!	1 200	11	28	0.9	#WAT LIF!			
2	1.7	40.160	0.12100	n/u	# VALUE:	1.200	1.1	2.0	0.7	π VALUE.			
	1.7	5.720											
	1.7	12.640											
3	1.7	5.720	1 21088	81	0 149491	1 200	11	2.8	0.9	2.1432534			
5	22.2	10.080		0.1	0.149491	1.200	1.1		0.9	##110#001			
	26.7	14.680											
	39.8	9.760	4										
4	1.7	8.800	4.6548	14.2	0.327803	1.200	1.1	2.8	0.9	8.2390028			
	71.7	5.920											
	43.0	9.080											
	1.7	14.800	-										
5	73.7	16.520	1.18158	5.3	0.222939	1.200	1.1	2.8	0.9	2.0913888			
	1.7	59.000	-										
	48.9	16.240											
	44.3	26.000	+										
6	1./	28.240	0.55754	14	0.039824	1.200	1.1	2.8	0.9	0.9868447			
	3.4	39.080	-										
	24.0	7 160											
	1.7	2 520	+										
7	1.7	2.520	0.40146	n/d	#VALUE!	E! 1.200) 1.1	2.8	0.9	#VALUE!			
	1.7	3 880	+										
	1./	5.000											

*Calculations which are based non-detect values are bolded and grey.

Fall 3													
							50%	25%	25%				
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Creek} Chub	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Amphi}	C _{Creek Chub} (ug/g or mg/kg)			
1	88.0 35.2 34.6 131.1	6.208 42.750 1.292 3.875	5.33789	3.3	1.617541	1.200	1.1	2.8	0.9	9.448057			
2	40.4 38.5 53.5 26.7	6.750 6.125 4.500 5.417	6.98196	n/d	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!			
3	127.8 37.2 110.2 82.2	16.708 22.875 36.667 229.125	1.17034	8.1	0.144486	1.200	1.1	2.8	0.9	2.0714944			
4	100.4 108.3 48.3 108.9	7.083 7.167 6.708 14.500	10.3183	14.2	0.726641	1.200	1.1	2.8	0.9	18.263383			
5	134.3 112.8 103.0 150.0	27.125 33.208 142.958 14.292	2.29897	5.3	0.433768	1.200	1.1	2.8	0.9	4.0691756			
6	574.6 111.5 395.2 193.0	21.000 38.500 13.333 72.042	8.79619	14	0.628299	1.200	1.1	2.8	0.9	15.569254			
7	1.7 26.7 1.7 25.4	2.583 3.792 8.375 10.833	2.16836	n/d	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!			

*Calculations which are based non-detect values are bolded and grey.

Fall 4													
							50%	25%	25%				
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water} - column (ug/L)	K _d (L/g)	TFF _{Creek} Chub	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Amphi}	C _{Creek Chub} (ug/g or mg/kg)			
	31.3	51.292											
1	45.7	46.583	0.73776	3.3	0.223564	1.200	1.1	2.8	0.9	1.3058389			
	1.7	23.500											
	37.2	15.042											
2	30.0	17.375	1 78854	n/d	#VALUE!	1 200	11	2.8	0.9	#VALUE!			
2	30.0	13.042	1.7005-	11/U	π v ALUL.	1.200	1.1	2.0	0.7	TIALUL.			
	23.5	22.000											
	366.5	143.250											
3	101.7	241.708	1.36308	8.1	0.168281	1.200	1.1	2.8	0.9	2.4126456			
	90.7 379.6	209.085											
	55.4	77 750											
	185.2	54.917	1 00 11 1		<u> </u>	1 200		•	0.0				
4	120.7	0.022	1.99611	14.2	0.140571	1.200	1.1	2.8	0.9	3.5331218			
	129.8	113.333											
	81.5	94.375											
5	88.0	51.500	1.98065	5.3	0.373708	1.200	1.1	2.8	0.9	3,505758			
U	62.0	19.750	11,0000	010	0.070700	1.200			012	01000700			
	129.8	16.792											
	154.6	92.375											
6	122.0	27.833	2.46948	14	0.176392	1.200	1.1	2.8	0.9	4.3709876			
	121.3	41.125	-										
	1.7	26.125											
7	1.7	10.083	0.20704			1 200	1 1	2.0	0.0				
7	1.7	69.375	0.38704	n/d a	#VALUE!	E! 1.200	1.1	2.8	0.9	#VALUE!			
	43.0	18.417											

*Calculations which are based non-detect values are bolded and grey.

Winter 1													
							50%	25%	25%				
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Creek} Chub	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Amphi} pod	C _{Creek Chub} (ug/g or mg/kg)			
	5.5	0.826											
1	5.5	1.000	5 72026	m/d		1 200	1 1	20	0.0				
1	5.5	1.217	5./3030	n/a	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!			
	5.5	0.826											
	5.5	0.870											
2	5.5	1.391	1 1727	n/d		1 200	1 1	28	0.0				
2	5.5	1.130	4.4737	11/u	#VALUE!	1.200	1.1	2.0	0.9	#VALUE:			
	5.5	1.565											
	5.5	1.739											
3	5.5	1.304	1 1/636	10.3	0.402559	1 200	11	28	0.9	7 330053			
5	5.5	1.217	4.14050	10.5	0.402557	1.200	1.1	2.0	0.7	1.007000			
	5.5	1.087											
	13.0	5.565											
4	18.9	3.739	3 57708	197	0 181578	1 200	11	2.8	0.9	6 331438			
-	24.1	6.565	5.57700	17.7	0.101570	1.200	1.1	2.0	0.7	0.551450			
	11.1	2.913											
	n/a	n/a											
5	n/a	n/a	n/a	8	n/a	1 200	11	2.8	0.9	#VALUE!			
5	n/a	n/a	nu	0	ira	1.200		2.0	0.9	" THEOL			
	n/a	n/a											
	5.5	1.087											
6	5.5	1.130	3.42283	10.5	0.325984	1.200	1.1	2.8	0.9	6.058413			
Ũ	5.5	1.522		1010	01020701	1.200		2.0	0.12	00000120			
	5.5	2.739											
	5.5	0.435											
7	5.5	0.348	11.087	n/d	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!			
,	5.5	0.348	11.007	11 G		1.200		2.0	0.9				
	5.5	0.870											

*Calculations which are based non-detect values are bolded and grey.

Winter 2													
							50%	25%	25%				
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Creek} Chub	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Amphi} pod	C _{Creek Chub} (ug/g or mg/kg)			
1	17.0 21.5 29.3 20.9	3.217 2.739 1.652 3.783	7.78626	n/d	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!			
2	5.5 5.5 5.5 5.5	6.130 2.087 2.087 1.000	1.96155	n/d	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!			
3	22.2 30.0 56.1 48.9	67.609 4.652 8.565 17.391	1.60027	10.3	0.155366	1.200	1.1	2.8	0.9	2.83247			
4	81.5 80.9 125.2 99.1	33.043 21.826 70.913 22.304	2.61157	19.7	0.132567	1.200	1.1	2.8	0.9	4.622475			
5	5.5 15.0 5.5 5.5	2.522 1.609 4.957 2.304	2.77672	8	0.34709	1.200	1.1	2.8	0.9	4.9148			
6	22.2 13.0 17.6 18.9	6.174 6.217 7.174 7.826	2.61905	10.5	0.249433	1.200	1.1	2.8	0.9	4.635714			
7	5.5 5.5 5.5 5.5	2.783 2.304 4.087 3.043	1.81495	n/d	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!			

*Calculations which are based non-detect values are bolded and grey.

Winter 3													
							50%	25%	25%				
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Creek} Chub	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Amphi} pod	C _{Creek Chub} (ug/g or mg/kg)			
1	25.435 5.544 28.043 5.544	14.261 18.565 3.609 9.783	1.39699	n/d	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!			
2	5.544 5.544 5.544 5.544 5.544	10.174 6.043 2.565 10.348	0.7612	n/d	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!			
3	39.783 33.913 11.739 25.435	23.696 150.870 37.870 67.261	0.39639	10.3	0.038485	1.200	1.1	2.8	0.9	0.701617			
4	n/a n/a n/a n/a	n/a n/a n/a n/a	n/a	19.7	n/a	1.200	1.1	2.8	0.9	#VALUE!			
5	n/a n/a n/a n/a	n/a n/a n/a n/a	n/a	8	n/a	1.200	1.1	2.8	0.9	#VALUE!			
6	5.544 43.696 30.000 24.130	10.087 8.174 9.348 29.217	1.81905	10.5	0.173243	1.200	1.1	2.8	0.9	3.219721			
7	5.544 5.544 5.544 11.739	7.609 4.652 10.739 6.652	0.95675	n/d	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!			

*Calculations which are based non-detect values are bolded and grey.

Winter 4												
							50%	25%	25%			
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Creek} Chub	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Amphi} pod	C _{Creek Chub} (ug/g or mg/kg)		
1	5.5 20.2 44.3 37.8	6.696 29.522 44.000 46.174	0.85397	n/d	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!		
2	24.1 5.5 5.5 5.5	42.826 7.609 11.000 24.478	0.47444	n/d	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!		
3	40.4 5.5 67.2 68.5	14.000 16.043 244.174 42.391	0.57367	10.3	0.055697	1.200	1.1	2.8	0.9	1.015405		
4	n/a n/a n/a n/a	n/a n/a n/a n/a	n/a	19.7	n/a	1.200	1.1	2.8	0.9	#VALUE!		
5	n/a n/a n/a n/a	n/a n/a n/a n/a	n/a	8	n/a	1.200	1.1	2.8	0.9	#VALUE!		
6	26.7 80.9 26.7 65.2	26.130 20.696 45.043 21.913	1.75392	10.5	0.16704	1.200	1.1	2.8	0.9	3.104433		
7	34.6 34.6 33.3 37.2	29.870 7.391 39.522 32.130	1.28144	n/d	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!		

*Calculations which are based non-detect values are bolded and grey.

	Spring 1												
							50%	25%	25%				
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Creek} Chub	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Amphi} pod	C _{Creek Chub} (ug/g or mg/kg)			
	50.2	23.167											
1	5.5 42.4	12.083 21.125	1.56288	n/d	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!			
	32.6	27.292											
	26.1	15.583											
2	33.9	101.792	0 57416	n/d	#VALUE!	1 200	11	2.8	0.9	#VALUE!			
2	33.3	28.083	0.57110	Шü	" THEE.	1.200	1.1	2.0	0.9	n villet.			
	11.7	37.417											
	22.2	6.542											
3	17.0	8.250	1.29561	8.8	0.147229	1.200	1.1	2.8	0.9	2.293232			
	55	15.000											
	n/a	n/a											
	n/a	n/a	,	10.0	,	1.000	1.1	2.8					
4	n/a	n/a	n/a	18.9	n/a	1.200			0.9	#VALUE!			
	n/a	n/a											
	18.3	7.625											
5	12.4	5.708	2.31983	5.3	0.437703	1.200	1.1	2.8	0.9	4.106096			
-	13.7	5.250											
	12.4	5.875											
	5.5	6.042											
6	5.5	9.208	0.95372	6.1	0.156348	1.200	1.1	2.8	0.9	1.688085			
	5.5	3.458											
	11.7	20.792											
-	5.5	3.625	0.07110	(1		1 200		2.0	0.0				
1	5.5	11.833	0.87118	n/d	#VALUE!	1.200) 1.1	2.8	0.9	#VALUE!			
	16.3	8.667											

*Calculations which are based non-detect values are bolded and grey.

	Spring 2												
							50%	25%	25%				
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Creek} Chub	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Amphi}	C _{Creek Chub} (ug/g or mg/kg)			
	37.2	26.348											
1	5.5	6.522	1 56771	n/d	#MALTEL	1 200	1 1	20	0.0				
1	50.2	6.696	1.30771	11/d	#VALUE!	1.200	1.1	2.0	0.9	#VALUE:			
	33.9	41.348											
	35.2	57.913											
2	26.1	41.217	0.7606	n/d	#VALUE!	1 200	11	28	0.0				
2	40.4	39.870	0.7090	ii/u	# VALUE:	1.200	1.1	2.8	0.9	π VALUE:			
	39.1	44.043											
	30.0	91.087											
3	24.8	94.174	0.49028	8.8	0.055713	1 200	11	2.8	0.9	0 867789			
	33.3	24.957		0.0	0.055715	1.200	1.1	2.0	0.9	0.007707			
	42.4	55.826											
	n/a	n/a											
4	n/a	n/a	n/a	18.9	n/a	1.200	1.1	28	0.9	#VALUE!			
	n/a	n/a		1017		1.200		2.0	012				
	n/a	n/a											
	58.7	38.609											
5	52.2	94.957	0.779	5.3	0.146981	1.200	1.1	2.8	0.9	1.378829			
	84.1	162.957											
	73.0	47.565											
	67.8	130.478											
6	91.3	102.609	0.81578	6.1	0.133735	1.200	1.1	2.8	0.9	1.443936			
	32.6	28.391											
	94.6	89.478											
	5.5	3.08/											
7	5.5	2.652	1.00791	n/d	#VALUE!	1.200) 1.1	2.8	0.9	#VALUE!			
	5.5 5.5	5.007											
i	5.5	5.087			1								

*Calculations which are based non-detect values are bolded and grey.

	Spring 3												
							50%	25%	25%				
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Creek} Chub	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Amphi} pod	C _{Creek Chub} (ug/g or mg/kg)			
	5.5	1.783											
1	5.5	2.522	2 91760	m /d	#XZAT TICL	1 200	1.1	20	0.0	457 A T T TE?			
1	5.5	2.130	2.81709	n/a	#VALUE!	1.200	1.1	2.8	0.9	#VALUE:			
	5.5	1.435											
	n/a	n/a											
2	n/a	n/a	n/o	n/d	n/o	1 200	1 1	28	0.0				
2	n/a	n/a	IVa	11/u	IVa	1.200	1.1	2.0	0.9	#VALUE:			
	n/a	n/a											
	n/a	n/a											
3	n/a	n/a	n/a	88	n/a	1 200	11	2.8	0.9	#VALUE!			
	n/a	n/a	- Ma	0.0	11/a	1.200	1.1	2.0	0.7	T VALUE.			
	n/a	n/a											
	n/a	n/a											
4	n/a	n/a	n/a	18.9	n/a	1.200	1.1	28	0.9	#VALUE!			
•	n/a	n/a		10.9	nu			2.0	0.9	" THEOL			
	n/a	n/a											
	5.5	6.000											
5	5.5	2.435	2.21503	5.3	0.41793	1.200	1.1	2.8	0.9	3.9206			
-	12.4	3.739											
	13.7	4.609											
	n/a	n/a											
6	n/a	n/a	n/a	6.1	n/a	1.200	1.1	2.8	0.9	#VALUE!			
-	n/a	n/a											
	n/a	n/a											
	44.3	1.565											
7	5.5	2.870	6.37501	n/d	#VALUE!	1.200	0 1.1	2.8	0.9	#VALUE!			
-	5.5	2.957											
	5.5	2.174											

*Calculations which are based non-detect values are bolded and grey.

	Spring 4												
							50%	25%	25%				
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Creek} Chub	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Amphi} pod	C _{Creek Chub} (ug/g or mg/kg)			
1	16.3 15.7 20.2 15.0	17.217 10.522 6.565 7.565	1.60436	n/d	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!			
2	n/a n/a n/a n/a	n/a n/a n/a	n/a	n/d	n/a	1.200	1.1	2.8	0.9	#VALUE!			
3	n/a n/a n/a n/a	n/a n/a n/a n/a	n/a	8.8	n/a	1.200	1.1	2.8	0.9	#VALUE!			
4	n/a n/a n/a n/a	n/a n/a n/a n/a	n/a	18.9	n/a	1.200	1.1	2.8	0.9	#VALUE!			
5	33.9 5.5 35.9 16.3	10.696 37.522 22.391 21.652	0.99317	5.3	0.18739	1.200	1.1	2.8	0.9	1.757906			
6	n/a n/a n/a n/a	n/a n/a n/a n/a	n/a	6.1	n/a	1.200	1.1	2.8	0.9	#VALUE!			
7	12.4 5.5 5.5 5.5	7.130 5.087 6.261 4.957	1.23841	n/d	#VALUE!	1.200	1.1	2.8	0.9	#VALUE!			

*Calculations which are based non-detect values are bolded and grey.

PART 2

Green Sunfish Modeling

	Summer 2												
							35%	25%	25%	15%			
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Crayfis} h	TFF _{Fish}	TFF _{Zoopla}	C _{GS} (ug/g or mg/kg)		
	254.3	7.609											
1	230.2	17.696	25.6	60	4 120022	1 200	20	16	1 1	15	57 7526		
1	225.0	4.957	25.0	0.2	4.129032	1.200	2.0	1.0	1.1	1.5	51.1550		
	n/a	6.696											
	48.3	11.130											
2	64.6	11.739	5 80288	17	3 413458	1 200	28	16	1 1	15	13 0013		
2	58.0	5.826	5.00200	1.7	3.413436	1.200	2.0	1.0	1.1	1.5	15.0915		
	n/a	10.565											
	204.1	83.087											
2	212.6	40.261	2 24207	0.1	0 256250	1 200	20	16	1 1	15	7 215009		
5	191.1	63.348	5.24207	7.1	0.550559	1.200	2.0	1.0	1.1	1.5	7.515900		
	n/a	63.217											
	45.7	8.000											
4	45.0	8.696	11 2441	157	0.716184	1 200	28	16	1 1	15	25 36668		
4	142.2	5.391	11.2441	13.7	0./16184	1.200	2.8	1.6	1.1	1.5	23.30008		
	n/a	5.522											
	815.2	50.957											
5	163.0	27.913	12 05 10	20.2	0 59663	1 200	28	16	1 1	15	27 18015		
5	111.5	20.304	12.0519	20.2	0.59005	1.200	2.0	1.0	1.1	1.5	27.10915		
	n/a	21.391											
	31.3	64.870											
6	86.7	69.130	0.6307	10.0	0.032146	1 200	28	16	11	15	1 //316/		
0	1.7	61.391	0.0397	19.9	0.052140	1.200	2.0	1.0	1.1	1.5	1.993109		
	n/a	54.087											
	43.0	12.087											
7	45.7	7.043	1 03333	n/d	#VALUE!	1 200	28	16	11	15	#VALUE!		
/	32.0	7.087	4.93333	1/u	#VALUE!	E! 1.200	0 2.8	1.0	1.1	1.5	# VALUE!		
	n/a	6.391											

*Calculations which are based non-detect values are bolded and grey.

	Summer 3												
							35%	25%	25%	15%			
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Crayfis} h	TFF _{Fish}	TFF _{Zoopla}	C _{GS} (ug/g or mg/kg)		
	41.7	22.130											
1	39.8	13.783	2 82087	62	0.45408	1 200	28	16	1 1	15	6 363803		
1	48.9	12.565	2.82087	0.2	0.45496	1.200	2.0	1.0	1.1	1.5	0.303893		
	n/a	13.174											
	152.0	30.913											
2	37.2	10.435	4 70914	17	2 770083	1 200	28	16	11	15	10 62382		
2	32.6	12.652	4.70714	1.7	2.170005	1.200	2.0	1.0	1.1	1.5	10.02502		
	n/a	8.783											
	161.1	0.022											
3	196.3	71.348 2.631	2.6314	9.1 0.2891	0.289165	1.200	2.8	1.6	1.1	1.5	5.93644		
5	268.7	112.174	2.0511	<i></i>	0.207105	1.200	2.0	1.0		1.5	5.75011		
	n/a	133.696	-										
	182.0	23.739											
4	202.8	11.348	11.7255	15.7	0.74685	1.200	2.8	1.6	1.1	1.5	26.45283		
	178.0	15.652											
	n/a	13.261											
	56.7	24.913											
5	73.0	51.043	1.51054	20.2	0.074779	1.200	2.8	1.6	1.1	1.5	3.407788		
	71.1	41.304	-										
	n/a	60.043											
	74.3	168.652	-										
6	72.4	411.652	0.3492	19.9	0.017548	1.200	2.8	1.6	1.1	1.5	0.787806		
	80.2	101.087											
	n/a	185.174											
	33.3	16.609											
7	29.3 11.783 2.26316	2.26316	5 n/d	#VALUE!	1.200	0 2.8	1.6	1.1	1.5	#VALUE!			
	21.5	11.652	-		#VALUE!	E! 1.200	0 2.8						
	n/a	9.522											

*Calculations which are based non-detect values are bolded and grey.

	Fall 1											
							35%	25%	25%	15%		
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Crayfis} h	TFF _{Fish}	TFF _{Zoopla}	C _{GS} (ug/g or mg/kg)	
	1.7	3.652										
1	1.7	4.565	0 22796	2.2	0.0002521	1 200	20	1.6	1 1	15	0.7206562	
1	1.7	7.261	0.32780	5.5	0.0993321	1.200	2.0	1.0	1.1	1.5	0.7390302	
	1.7	4.652										
	1.7	4.391										
2	1.7	3.348	0 47438	n/d	#VALUE!	1 200	28	16	11	15	#WALLIE!	
2	1.7	3.087	0.47430	11/U	#VALUE:	1.200	2.0	1.0	1.1	1.5	π value:	
	1.7	3.087										
	1.7	2.957										
3	1.7	5.652	0 33280	8 1	0.0/10081	1 200	28	16	11	15	0.7510105	
3	1.7	1.522	0.33289	0.1	0.0410901	1.200	2.0	1.0	1.1	1.5	0.7510105	
	1.7	9.696										
	21.5	4.522										
4	37.2	8.000	1 13167	14.2	0 0796948	1 200	28	16	11	15	2 55304	
-	1.7	34.826	1.15107	14.2	0.0770740	1.200	2.0	1.0	1.1	1.5	2.55504	
	1.7	7.435										
	54.8	16.957										
5	32.6	8.783	4 22147	53	0 7965038	1 200	28	16	11	15	9 5236364	
5	25.4	9.522	7.22177	5.5	0.7905050	1.200	2.0	1.0	1.1	1.5	7.5250504	
	77.0	9.696										
	1.7	3.174	-									
6	71.1	5.652	6 83212	14	0 4880088	1 200	28	16	11	15	15 413269	
0	32.0	2.739	0.05212	14	0.4000000	1.200	2.0	1.0	1.1	1.5	15.715207	
	1.7	4.000										
	1.7	8.000										
7	28.0	6.174	1 20836	n/d	#VALUE!	1 200	2.8	16	11	15	#VALUE!	
,	1.7	8.043	1.20050	17.0	#VALUE!	! 1.200) 2.8	1.0	1.1	1.5	TTLUL:	
	1.7	5.087										

*Calculations which are based non-detect values are bolded and grey.

	Fall 2											
							35%	25%	25%	15%		
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate}	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Crayfis} h	TFF _{Fish}	TFF _{Zoopla}	C _{GS} (ug/g or mg/kg)	
	1.7	7.640										
1	1.7	5.640	0.24729	2.2	0.0740625	1 200	20	1.6	1 1	15	0 550001	
1	1.7	5.320	0.24738	3.3	0.0749625	1.200	2.8	1.0	1.1	1.5	0.558081	
	1.7	8.080										
	1.7	6.760										
2	1.7	1.600	0 12168	n/d	#WALLE!	1 200	28	16	11	15	#WALLIE!	
2	1.7	40.160	0.12108	11/U	#VALUE:	1.200	2.0	1.0	1.1	1.5	# VALUE:	
	1.7	5.720										
	1.7	12.640										
3	1.7	5.720	1 21088	Q 1	0 1/0/011	1 200	28	16	1 1	15	2 7217200	
3	22.2	10.080	1.21000	0.1	0.1494911	1.200	2.0	1.0	1.1	1.5	2.1311377	
	26.7	14.680										
	39.8	9.760										
4	1.7	8.800	4 6548	14.2	0 3278031	1 200	28	16	11	15	10 501237	
-	71.7	5.920	4.0540	14.2	0.5270051	1.200	2.0	1.0	1.1	1.5	10.301237	
	43.0	9.080										
	1.7	14.800										
5	73.7	16.520	1 18158	53	0 2229388	1 200	28	16	11	15	2 6656345	
5	1.7	59.000	1.10150	5.5	0.222/300	1.200	2.0	1.0	1.1	1.5	2.0050545	
	48.9	16.240										
	44.3	26.000										
6	1.7	28.240	0 55754	14	0.0398242	1 200	28	16	11	15	1 2578088	
0	3.4	39.080	0.55754	14	0.0370242	1.200	2.0	1.0	1.1	1.5	1.2570000	
	24.8	39.640										
	1.7	7.160										
7	1.7	2.520	0.40146	n/d	#VALUE!	1.200	2.8	1.6	1.1	1.5	#VALUE!	
,	1.7	2.880	0.40140	1/ 0	" THEEL	1.200	2.0	1.0	1.1	1.5	" TILUL:	
	1.7	3.880										

*Calculations which are based non-detect values are bolded and grey.

	Fall 3											
							35%	25%	25%	15%		
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Crayfis} h	TFF _{Fish}	TFF _{Zoopla}	C _{GS} (ug/g or mg/kg)	
	88.0	6.208										
1	35.2	42.750	5 22700	2.2	1 617541	1 200	20	1.6	1 1	15	12 042260	
1	34.6	1.292	3.33769	5.5	1.01/341	1.200	2.0	1.0	1.1	1.5	12.042209	
	131.1	3.875										
	40.4	6.750										
2	38.5	6.125	6 98 196	n/d	#VALUE!	1 200	28	16	11	15	#VALUE!	
2	53.5	4.500	0.98190	n/u	π VALUE:	1.200	2.0	1.0	1.1	1.5	π value:	
	26.7	5.417										
	127.8	16.708										
3 3	37.2	22.875	1 17034	8 1	0 1444850	1 200	28	16	11	15	2 6402776	
5	110.2	36.667	1.17054	0.1	0.1444039	1.200	2.0	1.0	1.1	1.5	2.0402770	
	82.2	229.125										
	100.4	7.083										
4	108.3	7.167	10 3183	14.2	0 7266405	1 200	28	16	11	15	23 278075	
-	48.3	6.708	10.5105	14.2	0.7200403	1.200	2.0	1.0	1.1	1.5	23.270075	
	108.9	14.500										
	134.3	27.125										
5	112.8	33.208	2 29897	53	0.4337678	1 200	28	16	11	15	5 1864746	
5	103.0	142.958	2.29097	5.5	0.4337070	1.200	2.0	1.0	1.1	1.5	5.1004740	
	150.0	14.292										
	574.6	21.000										
6	111.5	38.500	8 79619	14	0 6282992	1 200	28	16	11	15	19 844202	
0	395.2	13.333	0.79019	14	0.0202772	1.200	2.0	1.0	1.1	1.5	17.044202	
	193.0	72.042										
	1.7	2.583										
7	26.7	3.792	2 16836	n/d	#VALUE!	1 200	28	16	11	1.5	#VALUE!	
,	1.7	8.375	2.10050	n/u	#VALUE!	! 1.200) 2.8	1.0	1.1	1.5	n vrieue:	
	25.4	10.833										

*Calculations which are based non-detect values are bolded and grey.

	Fall 4											
							35%	25%	25%	15%		
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water} - column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Crayfis} h	TFF _{Fish}	TFF _{Zoopla}	C _{GS} (ug/g or mg/kg)	
	31.3	51.292										
1	45.7	33.792	0 72776	2.2	0.0005642	1 200	20	1.6	1 1	15	1 6642012	
1	35.9	46.583	0.75770	3.3	0.2255045	1.200	2.8	1.0	1.1	1.5	1.0043913	
	1.7	23.500										
	37.2	15.042										
2	30.0	17.375	1 78854	n/d	#WALLE!	1 200	28	16	1 1	15	#WALLIE!	
2	30.0	13.042	1.78654	11/U	#VALUE:	1.200	2.0	1.0	1.1	1.5	# VALUE:	
	23.5	22.000										
	366.5	143.250										
3	101.7	241.708	1 36308	Q 1	0 1682811	1 200	28	16	1 1	15	3 0751000	
5	90.7	209.083	1.50500	0.1	0.1002011	1.200	2.0	1.0	1.1	1.5	5.0751009	
	379.6	94.458										
	55.4	77.750										
4	185.2	54.917	1 00611	14.2	0 1405714	1 200	28	16	1 1	15	4 5032331	
4	120.7	0.022	1.99011	14.2	0.1403714	1.200	2.0	1.0	1.1	1.5	4.3032331	
	129.8	113.333										
	81.5	94.375										
5	88.0	51.500	1 08065	53	0 2727084	1 200	28	16	1 1	15	1 168356	
5	62.0	19.750	1.98003	5.5	0.3737084	1.200	2.0	1.0	1.1	1.5	4.406550	
	129.8	16.792										
	154.6	92.375										
6	122.6	18.250	2 16918	14	0 1763018	1 200	28	16	1 1	15	5 5711571	
0	45.0	27.833	2.40940	14	0.1705910	1.200	2.0	1.0	1.1	1.5	5.5711571	
	121.3	41.125										
	1.7	26.125										
7	1.7	10.083	0 38704	n/d	#VALUE!	1 200	28	16	11	15	#VALUE!	
'	1.7	69.375	0.30704	ii/u	" VALUE!	1.200	2.0	1.0	1.1	1.5	" (ALUE:	
	43.0	18.417										

*Calculations which are based non-detect values are bolded and grey.

	Winter 1											
							35%	25%	25%	15%		
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Crayfis} h	TFF _{Fish}	TFF _{Zoopla}	C _{GS} (ug/g or mg/kg)	
	5.5	0.826										
1	5.5	1.000	5 72026	m/d		1 200	20	1.6	1 1	1.5	#\$7 A T TIT?!	
1	5.5	1.217	5.75050	11/u	#VALUE:	1.200	2.0	1.0	1.1	1.5	#VALUE:	
	5.5	0.826										
	5.5	0.870										
2	5.5	1.391	4 4737	n/d	#VALUE!	1 200	28	16	11	15	#VALUE!	
2	5.5	1.130	4.4737	n/u	π VALUE:	1.200	2.0	1.0	1.1	1.5	π VALUE.	
	5.5	1.565										
	5.5	1.739										
3	5.5	1.304	4 14636	10.3	0.402559	1 200	28	16	11	15	9 354183	
5	5.5	1.217	4.14050	10.5	0.402555	1.200	2.0	1.0	1.1	1.5	7.554105	
	5.5	1.087										
	13.0	5.565	-									
4	18.9	3.739	3 57708	197	0 181578	1 200	28	16	11	15	8 0699	
-	24.1	6.565	5.57700	17.7	0.101570	1.200	2.0	1.0	1.1	1.5	0.0077	
	11.1	2.913										
	n/a	n/a										
5	n/a	n/a	n/a	8	n/a	1 200	2.8	16	11	15	#VALUE!	
5	n/a	n/a	nu	0	ira	1.200	2.0	1.0		1.5	" THEOL	
	n/a	n/a										
	5.5	1.087										
6	5.5	1.130	3 42283	10.5	0 325984	1 200	2.8	16	11	15	7.7219095	
Ŭ	5.5	1.522	2.12200	10.5	0.020704	1.200	2.0	1.0		1.5		
	5.5	2.739										
	5.5	0.435										
7	5.5	0.348	11.087	n/d	#VALUE!	1.200	0 2.8	1.6	1.1	1.5	#VALUE!	
	5.5	0.348	11.007		#VALUE!	5! 1.200				1.0		
	5.5	0.870										

*Calculations which are based non-detect values are bolded and grey.

	Winter 2												
							35%	25%	25%	15%			
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Crayfis} h	TFF _{Fish}	TFF _{Zoopla}	C _{GS} (ug/g or mg/kg)		
	17.0	3.217		-									
1	21.5	2.739	7 79 (2)			1 200	2.0	1.0	1 1	1.5			
1	29.3	1.652	1.18626	n/a	#VALUE!	1.200	2.8	1.0	1.1	1.5	#VALUE!		
	20.9	3.783											
	5.5	6.130											
2	5.5	2.087	1 06155	n/d		1 200	20	16	1 1	1.5	#\$7 A T TIE?		
2	5.5	2.087	1.90155	n/a	#VALUE!	1.200	2.8	1.0	1.1	1.5	#VALUE:		
	5.5	1.000											
	22.2	67.609											
3	30.0	4.652	1 60027	10.2	0 155266	1 200	20	16	1 1	1.5	2 6101002		
	56.1	8.565	1.00027	10.5	0.155500	1.200	2.0	1.0	1.1	1.5	5.0101992		
	48.9	17.391											
	81.5	33.043											
4	80.9	21.826	2 61157	10.7	0 122567	1 200	28	16	1 1	15	5 801607		
4	125.2	70.913	2.01157	19.7	0.132567	1.200	2.8	1.6	1.1	1.5	5.891097		
	99.1	22.304											
	5.5	2.522											
5	15.0	1.609	2 77672	8	0.34700	1 200	28	16	11	1.5	6 2642877		
5	5.5	4.957	2.77072	0	0.54709	1.200	2.0	1.0	1.1	1.5	0.2072077		
	5.5	2.304											
	22.2	6.174											
6	13.0	6.217	2 61005	10.5	0.240433	1 200	28	16	11	15	5 0085714		
0	17.6	7.174	2.01905	10.5	0.249433	1.200	2.0	1.0	1.1	1.5	5.9005714		
	18.9	7.826											
	5.5	2.783											
7	5.5	2.304	1 81495	n/d	#VALUE!	1 200	0 2.8	16	11	15	#VALUE!		
,	5.5	4.087	1.01475	ii u	#VALUE!	.! 1.200		1.6	1.1	1.5	n (milliolli)		
	5.5	3.043											

*Calculations which are based non-detect values are bolded and grey.

Winter 3											
							35%	25%	25%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Crayfis} h	TFF _{Fish}	TFF _{Zoopla}	C _{GS} (ug/g or mg/kg)
1	25.435	14.261		n/d			2.8	1.6	1.1	1.5	#VALUE!
	5.544	18.565	1 20600			1.200					
	28.043	3.609	1.39099		#VALUE!						
	5.544	9.783									
	5.544	10.174			#VALUE!		2.8	1.6	1.1	1.5	#VALUE!
2	5.544	6.043	0.7612	n/d		1.200					
2	5.544	2.565	0.7012								
	5.544	10.348									
	39.783	23.696		10.3	0.038485	1.200	2.8	1.6	1.1	1.5	
3	33.913	150.870	0.39639								0 894264
	11.739	37.870									0.09 1201
	25.435	67.261									
	n/a	n/a	n/a	19.7	n/a	1.200	2.8	1.6		1.5	#VALUE!
4	n/a	n/a							1.1		
•	n/a	n/a									
	n/a	n/a									
	n/a	n/a		8	n/a	1.200	2.8	1.6	1.1	1.5	
5	n/a	n/a	n/a								#VALUE!
Ũ	n/a	n/a									
	n/a	n/a									
	5.544	10.087			0 173243						
6	43.696	8.174	1.81905	10.5		1 200	2.8	1.6 1.1	1.1	15	4.1037805
	30.000	9.348	1.01705						1.1		111007000
	24.130	29.217									
	5.544	7.609		n/d	#VALUE!	1.200	2.8	1.6	1.1	1.5	
7	5.544	4.652	0.95675								#VALUE!
	5.544	10.739									II TIMUULII
	11.739	6.652									

*Calculations which are based non-detect values are bolded and grey.

Winter 4											
							35%	25%	25%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Crayfis} h	TFF _{Fish}	TFF _{Zoopla}	C _{GS} (ug/g or mg/kg)
	5.5	6.696									
1	20.2	29.522	0.95207	n/d		1.200	2.0	1.6		1.5	#VALUE!
1	44.3	44.000	0.85397		#VALUE!		2.8	1.0	1.1		
	37.8	46.174									
	24.1	42.826	0.47444				2.8	1.6	1.1	1.5	#VALUE!
2	5.5	7.609		n/d	#VALUE!	1.200					
2	5.5	11.000									
	5.5	24.478									
3	40.4	14.000		10.3	0.055697		2.8		1.1	1.5	
	5.5	16.043	0.57367			1.200		1.6			1 20/2105
	67.2	244.174									1.4/14105
	68.5	42.391									
	n/a	n/a		19.7	n⁄a	1.200	2.8	1.6		1.5	#VALUE!
4	n/a	n/a	n/a						1.1		
-	n/a	n/a									
	n/a	n/a									
	n/a	n/a	n/a	8	n/a	1.200	2.8	1.6	1.1	1.5	
5	n/a	n/a									#VALUE!
5	n/a	n/a									
	n/a	n/a									
	26.7	26.130			0 16704						
6	80.9	20.696	1.75392	10.5		1 200	2.8	1.6	1.1	1.5	3.9568361
	26.7	45.043	1.15572	10.0	0110701	1.200	2.0		1.1	110	5.7500501
	65.2	21.913									
7	34.6	29.870	1.28144	n/d	#VALUE!	1.200	2.8	1.6	1.1	1.5	
	34.6	7.391									#VALUE!
	33.3	39.522									
	37.2	32.130									

*Calculations which are based non-detect values are bolded and grey.

Spring 1											
							35%	25%	25%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Crayfis} h	TFF _{Fish}	TFF _{Zoopla}	C _{GS} (ug/g or mg/kg)
1	50.2	23.167		n/d		1.200	2.9	1.6	1.1	1.5	
	5.5	12.083	1 56200								HAZAT THE
1	42.4	21.125	1.50288	n/u	#VALUE!		2.0	1.0			#VALUE:
	32.6	27.292									
	26.1	15.583					2.8	1.6	1.1	1.5	
2	33.9	101.792	0.57416	n/d	#VALUE!	1.200					#VALUE!
2	33.3	28.083	0.37410								
	11.7	37.417									
	22.2	6.542		8.8	0.1472285	1.200		1.6	1.1	1.5	
3	17.0	8.250	1.29561				2.8				2 0228086
	11.7	13.750									2.7220700
	5.5	15.000									
	n/a	n/a		18.9	n/a	1.200	2.8	1.6	1.1		#VALUE!
4	n/a	n/a	n/a							15	
-	n/a	n/a	in a							1.5	
	n/a	n/a									
	18.3	7.625	2 31983	5.3	0.4377034	1.200	2.8	1.6	1.1	1.5	5.2335323
5	12.4	5.708									
5	13.7	5.250	2.51905								
	12.4	5.875									
	5.5	6.042									
6	5.5	9.208	0.95372	61	0 1563476	1 200	2.8	1.6	1.1	15	2.1515933
	5.5	4.542	0.95572	0.1	0.12021/0	1.200	2.0			1.5	4.1010/00
	5.5	3.458									
	11.7	20.792			#VALUE!		2.8	1.6	1.1	15	
7	5.5	3.625	0.87118	n/d		1.200					#VALUE!
,	5.5	11.833	0.07110				2.0			1.5	
	16.3	8.667									

*Calculations which are based non-detect values are bolded and grey.

Spring 2											
							35%	25%	25%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Crayfis} h	TFF _{Fish}	TFF _{Zoopla}	C _{GS} (ug/g or mg/kg)
1	37.2	26.348		n/d		1 200	2.8	16	1.1	1.5	
	5.5	6.522	1 56771								
1	50.2	6.696	1.30771	ii/u	#VALUE!	1.200	2.0	1.0	1.1	1.5	# VALUE:
	33.9	41.348									
	35.2	57.913				1.200					
2	26.1	41.217	0.7696	n/d	#VALUE!		2.8	1.6	1.1	1.5	#VALUE!
2	40.4	39.870	0.7090								
	39.1	44.043									
3	30.0	91.087		8.8	0.0557132		2.8		1.1	1.5	1.1060631
	24.8	94.174	0.49028			1.200		1.6			
	33.3	24.957									
	42.4	55.826									
	n/a	n/a		18.9	n/a	1.200	2.8	1.6	1.1	1.5	#VALUE!
4	n/a	n/a	n/a								
-	n/a	n/a									
	n/a	n/a									
	58.7	38.609		5.3	0.146981	1.200	2.8	1.6	1.1	1.5	1.7574223
5	52.2	94.957	0.779								
U	84.1	162.957	0., / >								
	73.0	47.565									
	67.8	130.478									
6	91.3	102.609	0.81578	6.1	0.1337349	1.200	2.8	1.6	1.1	1.5	1 8404063
0	32.6	28.391	0.01570	0.1		1.200			1.1	1.0	
	94.6	89.478									
7	5.5	3.087	1.00791		#VALUE!	1.200	2.8	1.6	1.1	1.5	
	5.5	2.652		n/d							#VALUE!
	5.5	11.174									
	5.5	5.087									

*Calculations which are based non-detect values are bolded and grey.
	Spring 3										
							35%	25%	25%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Crayfis} h	TFF _{Fish}	TFF _{Zoopla}	C _{GS} (ug/g or mg/kg)
	5.5	1.783									
1	5.5	2.522	2 91760	m/d		1 200	20	1.6	1.1	1.5	HAZAT THE
1	5.5	2.130	2.01709	11/u	#VALUE!	1.200	2.0	1.0	1.1	1.5	#VALUE:
	5.5	1.435									
	n/a	n/a									
2	n/a	n/a	n/a	n/d	n/a	1 200	28	16	11	15	#VALUE!
2	n/a	n/a	11/4	n/u	11/a	1.200	2.0	1.0	1.1	1.5	# VALUE.
	n/a	n/a									
	n/a	n/a	-								
3	n/a	n/a	n/a	8.8	n/a	1 200	2.8	16	11	15	#VALUE!
5	n/a	n/a	Iva	0.0	11/a	1.200	2.0	1.0	1.1	1.5	II VILLOL.
	n/a	n/a									
	n/a	n/a									
4	n/a	n/a	n/a	18.9	n/a	1 200	2.8	16	11	15	#VALUE!
	n/a	n/a	in u	10.9	iru	1.200	2.0	1.0	1.1	1.5	" THECH
	n/a	n/a									
	5.5	6.000	_								
5	5.5	2.435	2.21503	5.3	0.4179299	1.200	2.8	1.6	1.1	1.5	4.9971043
	12.4	3.739									
	13.7	4.609									
	n/a	n/a	-								
6	n/a	n/a	n/a	6.1	n/a	1.200	2.8	1.6	1.1	1.5	#VALUE!
	n/a	n/a	-								
	n/a	n/a									
	44.3	1.565	4								
7	5.5	2.870	6.37501	n/d	#VALUE!	1.200	2.8	1.6	1.1	1.5	#VALUE!
	5.5	2.957	-								
	5.5	2.174									

*Calculations which are based non-detect values are bolded and grey.

	Spring 4										
							35%	25%	25%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Crayfis} h	TFF _{Fish}	TFF _{Zoopla}	C _{GS} (ug/g or mg/kg)
	16.3	17.217									
1	15.7	10.522	1 60/26	n/d	#VALUE!	1 200	20	16	1 1	1.5	
1	20.2	6.565	1.00430	11/u	#VALUE!	1.200	2.0	1.0	1.1	1.5	# VALUE:
	15.0	7.565									
	n/a	n/a									
2	n/a	n/a	n/a	n/d	n/a	1 200	28	16	11	1.5	#VALUE!
2	n/a	n/a	11/4	n/u	11/a	1.200	2.0	1.0	1.1	1.5	n v ALCL.
	n/a	n/a									
	n/a	n/a	-								
3	n/a	n/a	n/a	88	n/a	1 200	2.8	16	11	15	#VALUE!
5	n/a	n/a	Πνα	0.0	11/a	1.200	2.0	1.0	1.1	1.5	n villet.
	n/a	n/a									
	n/a	n/a									
4	n/a	n/a	n/a	18.9	n/a	1 200	2.8	16	11	15	#VALUE!
	n/a	n/a	in u	10.9	ina	1.200	2.0	1.0		1.5	" THECH
	n/a	n/a									
	33.9	10.696	_								
5	5.5	37.522	0.99317	5.3	0.18739	1.200	2.8	1.6	1.1	1.5	2.2405849
	35.9	22.391									
	16.3	21.652									
	n/a	n/a	-								
6	n/a	n/a	n/a	6.1	n/a	1.200	2.8	1.6	1.1	1.5	#VALUE!
	n/a	n/a	-								
	n/a	n/a									
	12.4	7.130	4								
7	5.5	5.087	1.23841	n/d	#VALUE!	1.200	2.8	1.6	1.1	1.5	#VALUE!
	5.5	6.261	-								
	5.5	4.957									

*Calculations which are based non-detect values are bolded and grey.

PART 3

Blacknose Dace Modeling

				Sun	ımer 2				
							85%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water} - column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Zoopla}	C _{BDace} (ug/g or mg/kg)
	254.3	7.609							
1	230.2	17.696	25.6	62	4 120022	1 200	28	15	80.0256
1	225.0	4.957	23.0	0.2	4.129032	1.200	2.0	1.5	80.0230
	n/a	6.696							
	48.3	11.130							
2	64.6	11.739	5 00200	17	2 112158	1 200	28	15	18 1208
2	58.0	5.826	3.00200	1.7	5.415456	1.200	2.0	1.5	10.1390
	n/a	10.565							
	204.1	83.087							
3	212.6	40.261	3 24287	0.1	0 356359	1 200	28	15	10 1372
5	191.1	63.348	3.24287	9.1	0.550559	1.200	2.0	1.5	10.1372
	n⁄a	63.217							
	45.7	8.000							
4	45.0	8.696	11 2441	157	0 716184	1 200	28	15	35 14904
-	142.2	5.391	11.2771	15.7	0.710104	1.200	2.0	1.5	55.14704
	n/a	5.522							
	815.2	50.957							
5	163.0	27.913	12 0519	20.2	0 59663	1 200	2.8	15	37 67433
5	111.5	20.304	12.0317	20.2	0.57005	1.200	2.0	1.5	57.07455
	n/a	21.391							
	31.3	64.870							
6	86.7	69.130	0.6397	199	0.032146	1 200	2.8	15	1 999703
0	1.7	61.391	0.0577	17.7	0.052110	1.200	2.0	1.5	1.777705
	n/a	54.087							
	43.0	12.087							
7	45.7	7.043	4 93333	n/d	#VALUE!	1 200	2.8	15	#VALUE!
7	32.0	7.087		n/d ÷	#VALUE!	1.200	2.0	1.5	
	n/a	6.391							

*Calculations which are based non-detect values are bolded and grey.

	Summer 3									
							85%	15%		
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	$FF_{Aquatic Ins}$	TFF _{Zoopla}	C _{BDace} (ug/g or mg/kg)	
	41.7	22.130								
1	39.8	13.783	2 02007	60	0 45 409	1 200	20	15	0 010051	
1	48.9	12.565	2.82087	0.2	0.43498	1.200	2.0	1.3	0.010034	
	n/a	13.174								
	152.0	30.913								
2	37.2	10.435	4 70014	17	2 770082	1 200	28	15	14 72078	
2	32.6	12.652	4.70914	1./	2.770085	1.200	2.0	1.3	14.72078	
	n/a	8.783								
	161.1	0.022								
3	196.3	71.348	2 6314	0.1	0 289165	1 200	28	15	8 225758	
5	268.7	112.174	2.0314	9.1	0.207105	1.200	2.0	1.5	0.223730	
	n/a	133.696								
	182.0	23.739								
4	202.8	11.348	11 7255	157	0 74685	1 200	2.8	15	36 65405	
	178.0	15.652	11.7255	10.7	0.74005	1.200	2.0	1.5	50.05405	
	n/a	13.261								
	56.7	24.913								
5	73.0	51.043	1.51054	20.2	0.074779	1.200	2.8	1.5	4.721962	
C	71.1	41.304		_0	0.07.177	1.200		110		
	n/a	60.043								
	74.3	168.652	-							
6	72.4	411.652	0.3492	19.9	0.017548	1.200	2.8	1.5	1.091614	
-	80.2	101.087								
	n/a	185.174								
	33.3	16.609								
7	29.3	11.783	2.26316	n/d	#VALUE!	E! 1.200	2.8	1.5	#VALUE!	
	21.5	11.652		n/d	#VALUE!					
	n/a	9.522								

*Calculations which are based non-detect values are bolded and grey.

	Fall 1								
							85%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Zoopla}	C _{BDace} (ug/g or mg/kg)
	1.7	3.652							
1	1.7	4.565	0 22786	2.2	0.000352	1 200	20	15	1 02/206
1	1.7	7.261	0.32780	5.5	0.099332	1.200	2.0	1.5	1.024090
	1.7	4.652							
	1.7	4.391							
2	1.7	3.348	0.47438	n/d	#VALUE!	1 200	28	15	#WALTE!
2	1.7	3.087	0.47430	1/u	π VALUE:	1.200	2.0	1.5	π value:
	1.7	3.087							
	1.7	2.957							
3	1.7	5.652	0 33289	8 1	0.041098	1 200	28	15	1.0/0629
5	1.7	1.522	0.33207	0.1	0.041070	1.200	2.0	1.5	1.040027
	1.7	9.696							
	21.5	4.522							
4	37.2	8.000	1 13167	14.2	0 079695	1 200	2.8	15	3 53759
•	1.7	34.826	1110107	1 1.2	0.079095	1.200	2.0	1.5	5.55757
	1.7	7.435							
	54.8	16.957							
5	32.6	8.783	4 22147	53	0 796504	1 200	2.8	15	13 19632
5	25.4	9.522	1.22117	5.5	0.770501	1.200	2.0	1.5	15.17052
	77.0	9.696							
	1.7	3.174							
6	71.1	5.652	6 83212	14	0 488009	1 200	2.8	15	21 35722
Ŭ	32.0	2.739	0.00212	* '	0.100009	1.200	2.0	1.0	-1.00/22
	1.7	4.000							
	1.7	8.000							
7	28.0	6.174	1.20836	n/d	#VALUE!	1.200	2.8	1.5	#VALUE!
7	1.7	8.043	1.20000	11 4		1.200	2.0	1.0	
	1.7	5.087							

*Calculations which are based non-detect values are bolded and grey.

	Fall 2								
							85%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water} - column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Zoopla}	C _{BDace} (ug/g or mg/kg)
	1.7	7.640							
1	1.7	5.640	0 24728	2.2	0.074063	1 200	20	15	0 772208
1	1.7	5.320	0.24736	5.5	0.074903	1.200	2.0	1.5	0.113290
	1.7	8.080							
	1.7	6.760							
2	1.7	1.600	0 12168	n/d	#VALUE!	1 200	28	15	#WALTE!
2	1.7	40.160	0.12100	n/u	π VALUE:	1.200	2.0	1.5	π value:
	1.7	5.720							
	1.7	12.640							
3	1.7	5.720	1 21088	8 1	0 1/19/191	1 200	28	15	3 785203
5	22.2	10.080	1.21000	0.1	0.147471	1.200	2.0	1.5	5.705205
	26.7	14.680							
	39.8	9.760							
4	1.7	8.800	4 6548	14.2	0 327803	1 200	2.8	15	14 55092
-	71.7	5.920	4.0540	17.2	0.527805	1.200	2.0	1.5	17.55072
	43.0	9.080							
	1.7	14.800							
5	73.7	16.520	1 18158	53	0 222939	1 200	2.8	15	3 693605
5	1.7	59.000	1.10150	5.5	0.222/3/	1.200	2.0	1.5	5.075005
	48.9	16.240							
	44.3	26.000							
6	1.7	28.240	0.55754	14	0.039824	1.200	2.8	1.5	1.742868
Ũ	3.4	39.080	0.00701		0.037021	1.200	2.0	1.0	1.7 12000
	24.8	39.640							
	1.7	7.160							
7	1.7	2.520	0.40146	n/d	#VALUE!	1.200	2.8	1.5	#VALUE!
7	1.7	2.880		n/d	#VALUE!	. 1.200	2.0	1.0	
	1.7	3.880							

*Calculations which are based non-detect values are bolded and grey.

	Fall 3								
							85%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Zoopla}	C _{BDace} (ug/g or mg/kg)
	88.0	6.208							
1	35.2	42.750	5 22780	2.2	1 617541	1 200	28	15	16 68622
1	34.6	1.292	5.55769	5.5	1.01/341	1.200	2.0	1.5	10.06025
	131.1	3.875							
	40.4	6.750							
2	38.5	6.125	6 08106	n/d	#WALLE!	1 200	28	15	#WALTE!
2	53.5	4.500	0.98190	n/u	#VALUE:	1.200	2.0	1.5	# VALUE:
	26.7	5.417							
	127.8	16.708							
3	37.2	22.875	1 17034	8 1	0 144486	1 200	28	15	3 658/17
5	110.2	36.667	1.17054	0.1	0.144460	1.200	2.0	1.5	5.05647
	82.2	229.125							
	100.4	7.083							
4	108.3	7.167	10 3183	14.2	0 726641	1 200	28	15	32 25/199
-	48.3	6.708	10.5105	17.2	0.720041	1.200	2.0	1.5	52.25777
	108.9	14.500							
	134.3	27.125							
5	112.8	33.208	2 29897	53	0 433768	1 200	2.8	15	7 186578
5	103.0	142.958	2.27077	5.5	0.433700	1.200	2.0	1.5	/.1005/0
	150.0	14.292							
	574.6	21.000							
6	111.5	38.500	8 79619	14	0 628299	1 200	2.8	15	27 49689
0	395.2	13.333	0.79019	14	0.020277	1.200	2.0	1.5	27.47007
	193.0	72.042							
	1.7	2.583							
7	26.7	3.792	2 16836	n/d	#VALUE!	.! 1.200) 2.8	15	#VALUE!
7	1.7	8.375	2.10050	n/d	#VALUE!			1.5	" TILUL:
	25.4	10.833							

*Calculations which are based non-detect values are bolded and grey.

	Fall 4								
							85%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water} - column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Zoopla}	C _{BDace} (ug/g or mg/kg)
	31.3	51.292							
1	45.7	33.792	0 72776	2.2	0 222564	1 200	28	15	2 206244
1	35.9	46.583	0.73770	5.5	0.225504	1.200	2.0	1.5	2.300244
	1.7	23.500							
	37.2	15.042							
2	30.0	17.375	1 70051	n/d		1 200	28	15	
Z	30.0	13.042	1./0034	n/u	#VALUE!	1.200	2.0	1.5	#VALUE!
	23.5	22.000							
	366.5	143.250							
2	101.7	241.708	1 26200	01	0 169291	1 200	20	15	1 260079
3	90.7	209.083	1.30308	8.1	0.106261	1.200	2.0	1.5	4.200978
	379.6	94.458							
	55.4	77.750							
4	185.2	54.917	1 00611	14.2	0 140571	1 200	28	15	6 220852
4	120.7	0.022	1.99011	14.2	0.140571	1.200	2.8	1.5	0.239032
	129.8	113.333							
	81.5	94.375							
5	88.0	51.500	1 09065	53	0 272708	1 200	28	15	6 101525
5	62.0	19.750	1.98003	5.5	0.373708	1.200	2.0	1.5	0.191525
	129.8	16.792							
	154.6	92.375							
6	122.6	18.250	2 160 18	14	0 176302	1 200	28	15	7 710600
U	45.0	27.833	2.40740	14	0.170392	1.200	2.0	1.5	1.119009
	121.3	41.125							
	1.7	26.125							
7	1.7	10.083	0.38704	n/d	#VALUE!	1 200	28	15	#VALTE!
7	1.7	69.375	0.36704	11/u	π VALUE!	1.200	2.0	1.5	π (ALUE:
	43.0	18.417							

*Calculations which are based non-detect values are bolded and grey.

Winter 1									
							85%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate}	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Zoopla}	C _{BDace} (ug/g or mg/kg)
	5.5	0.826							
1	5.5	1.000	5 72026	n/d		1 200	20	15	
1	5.5	1.217	5.75050	n/u	#VALUE!	1.200	2.0	1.5	# VALUE!
	5.5	0.826							
	5.5	0.870							
2	5.5	1.391	1 1737	n/d	#VALUE!	1 200	28	15	#WALTE!
2	5.5	1.130	4.4737	n/u	#VALUE:	1.200	2.0	1.5	# VALUE:
	5.5	1.565							
	5.5	1.739							
3	5.5	1.304	1 1/636	10.3	0.402559	1 200	2.8	15	12 96151/
5	5.5	1.217	4.14050	10.5	0.402337	1.200	2.0	1.5	12.701314
	5.5	1.087							
	13.0	5.565							
4	18.9	3.739	3 57708	197	0 1815778	1 200	2.8	15	11 181963
•	24.1	6.565	5.57700	17.7	0.1013770	1.200	2.0	1.5	11.101/05
	11.1	2.913							
	n/a	n/a							
5	n/a	n/a	n/a	8	n/a	1.200	2.8	1.5	#VALUE!
C	n/a	n/a		0		1.200		110	
	n/a	n/a							
	5.5	1.087							
6	5.5	1.130	3.42283	10.5	0.325984	1.200	2.8	1.5	10.699774
-	5.5	1.522							
	5.5	2.739							
	5.5	0.435							
7	5.5	0.348	11.087	n/d	#VALUE!	1.200	2.8	1.5	#VALUE!
-	5.5	0.348							
	5.5	0.870							

*Calculations which are based non-detect values are bolded and grey.

	Winter 2								
							85%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate}	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Zoopla}	C _{BDace} (ug/g or mg/kg)
	17.0	3.217							
1	21.5	2.739	7 78676	n/d		1 200	20	15	
1	29.3	1.652	1.18020	11/u	#VALUE!	1.200	2.0	1.5	# VALUE!
	20.9	3.783							
	5.5	6.130							
2	5.5	2.087	1 96155	n/d	#VALUE!	1 200	2.8	15	#VALUE!
2	5.5	2.087	1.90133	n/u	π VALUE:	1.200	2.0	1.5	π VALUE:
	5.5	1.000							
	22.2	67.609							
3	30.0	4.652	1 60027	10.3	0 1553656	1 200	2.8	15	5 002/1303
5	56.1	8.565	1.00027	10.5	0.1555050	1.200	2.0	1.5	5.002+505
	48.9	17.391							
	81.5	33.043							
4	80.9	21.826	2.61157	197	0 1325669	1 200	2.8	15	8 163761
	125.2	70.913	2.01157	17.1	0.152500)	1.200	2.0	1.5	0.105701
	99.1	22.304							
	5.5	2.522							
5	15.0	1.609	2.77672	8	0.3470904	1.200	2.8	1.5	8.680037
C	5.5	4.957		Ũ	0.0170701	1.200		110	01000007
	5.5	2.304							
	22.2	6.174	-						
6	13.0	6.217	2.61905	10.5	0.2494331	1.200	2.8	1.5	8.1871429
-	17.6	7.174							
	18.9	7.826							
	5.5	2.783							
7	5.5	2.304	1.81495	n/d	#VALUE!	1.200	2.8	1.5	#VALUE!
	5.5	4.087				1.200			
	5.5	3.043							

*Calculations which are based non-detect values are bolded and grey.

Winter 3									
							85%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Zoopla}	C _{BDace} (ug/g or mg/kg)
	25.435	14.261							
1	5.544	18.565	1 20600	n/d		1 200	20	15	
1	28.043	3.609	1.39099	n/a	#VALUE!	1.200	2.0	1.5	#VALUE!
	5.544	9.783							
	5.544	10.174							
2	5.544	6.043	0.7612	n/d		1 200	20	15	
Z	5.544	2.565	0.7012	n/d	#VALUE!	1.200	2.8	1.5	#VALUE!
	5.544	10.348							
	39.783	23.696							
2	33.913	150.870	0.20620	10.2	0.0204040	1 200	2.0	15	1 2201264
3	11.739	37.870	0.39039	10.5	0.0384848	1.200	2.8	1.5	1.2391204
	25.435	67.261							
	n/a	n/a							
4	n/a	n/a	n/a	10.7	n/a	1 200	28	15	#WALTE!
4	n/a	n/a	IVa	19.7	11/a	1.200	2.0	1.5	π VALUE:
	n/a	n/a							
	n/a	n/a							
5	n/a	n/a	n/a	8	n/a	1 200	2.8	15	#VALUE!
5	n/a	n/a	11/4	0	11/ a	1.200	2.0	1.5	TALUL:
	n/a	n/a							
	5.544	10.087							
6	43.696	8.174	1 81905	10.5	0 173243	1 200	2.8	15	5 6863554
0	30.000	9.348	1.01905	10.5	0.175215	1.200	2.0	1.5	5100055551
	24.130	29.217							
	5.544	7.609							
7	5.544	4.652	0 95675	n/d	#VALUE!	E! 1.200	2.8	15	#VALUE!
7	5.544	10.739	0.95675	11 G	", Theorem		2.0	1.5	
	11.739	6.652							

*Calculations which are based non-detect values are bolded and grey.

Winter 4									
							85%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Zoopla}	C _{BDace} (ug/g or mg/kg)
	5.5	6.696							
1	20.2	29.522	0.85207	n/d		1 200	20	15	
1	44.3	44.000	0.83397	11/u	#VALUE!	1.200	2.0	1.5	# VALUE!
	37.8	46.174							
	24.1	42.826							
2	5.5	7.609	0.47444	n/d	#VALUE!	1 200	28	15	#WALTE!
2	5.5	11.000	0.4/444	n/u	π VALUE:	1.200	2.0	1.5	π VALUE:
	5.5	24.478							
	40.4	14.000							
3	5.5	16.043	0 57367	10.3	0.0556966	1 200	2.8	15	1 7933077
5	67.2	244.174	0.57507	10.5	0.0550900	1.200	2.0	1.5	1.7955077
	68.5	42.391							
	n/a	n/a							
4	n/a	n/a	n/a	197	n/a	1 200	2.8	15	#VALUE!
	n/a	n/a	nu	17.1	ira	1.200	2.0	1.5	" THEOL:
	n/a	n/a							
	n/a	n/a							
5	n/a	n/a	n/a	8	n/a	1.200	2.8	1.5	#VALUE!
C	n/a	n/a		Ũ		1.200		110	
	n/a	n/a							
	26.7	26.130							
6	80.9	20.696	1.75392	10.5	0.1670397	1.200	2.8	1.5	5.4827436
	26.7	45.043							
	65.2	21.913							
	34.6	29.870							
7	34.6	7.391	1.28144	n/d	#VALUE!	E! 1.200	2.8	1.5	#VALUE!
	33.3	39.522		4 n/d	#VALUE!				
	37.2	32.130							

*Calculations which are based non-detect values are bolded and grey.

Spring 1									
							85%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Zoopla}	C _{BDace} (ug/g or mg/kg)
	50.2	23.167							
1	5.5	12.083	1 5 6 2 9 9			1 200	20	15	#37AT T 1171
1	42.4	21.125	1.30288	n/d	#VALUE!	1.200	2.8	1.5	#VALUE!
	32.6	27.292							
	26.1	15.583							
2	33.9	101.792	0.57416	n/d	#VALUE!	1 200	28	15	
2	33.3	28.083	0.37410	n/a	#VALUE!	1.200	2.8	1.5	#VALUE!
	11.7	37.417							
	22.2	6.542							
3	17.0	8.250	1 20561	88	0.1472285 1.200	1 200	28	15	4 0500802
5	11.7	13.750	1.29301	0.0		1.200	2.0	1.5	4.0300602
	5.5	15.000							
	n/a	n/a		18.0	n/a	1.200			
4	n/a	n/a	n/a				2.8	1.5	#VALUE!
-	n/a	n/a	IVa	10.7					II VILOL.
	n/a	n/a							
	18.3	7.625							
5	12.4	5.708	2 31983	53	0 4377034	1 200	2.8	15	7 2517828
5	13.7	5.250	2.51705	5.5	0.1577051	1.200	2.0	1.5	7.2317020
	12.4	5.875							
	5.5	6.042							
6	5.5	9.208	0.95372	6.1	0.1563476	1.200	2.8	1.5	2.9813301
5	5.5	4.542	5.55572			1.200		1.0	
	5.5	3.458							
	11.7	20.792							
7	5.5	3.625	0.87118	n/d	#VALUE!	1.200	2.8	1.5	#VALUE!
,	5.5	11.833	5.0,110			1.200		1.0	
	16.3	8.667							

*Calculations which are based non-detect values are bolded and grey.

Spring 2									
							85%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Zoopla}	C _{BDace} (ug/g or mg/kg)
	37.2	26.348							
1	5.5	6.522	1 56771	n/d		1 200	20	15	
1	50.2	6.696	1.30//1	0771 174	#VALUE!	1.200	2.0	1.5	#VALUE!
	33.9	41.348							
	35.2	57.913							
2	26.1	41.217	0.7606	n/d		1 200	28	15	
2	40.4	39.870	0.7090	n/a	#VALUE!	1.200	2.8	1.5	#VALUE!
	39.1	44.043							
	30.0	91.087							
2	24.8	94.174	0 40028	8.8	0.0557132	1 200	2.8	1.5	1 5226024
5	33.3	24.957	0.49028			1.200			1.5520054
	42.4	55.826							
	n/a	n/a		19.0	n/a	1.200	2.8	1.5	
4	n/a	n/a	n/o						#WALTE!
4	n/a	n/a	11/a	10.9					TALUL:
	n/a	n/a							
	58.7	38.609							
5	52.2	94.957	0.770	53	0 1/6081	1 200	28	15	2 4251516
5	84.1	162.957	0.779	5.5	0.140701	1.200	2.0	1.5	2.4331310
	73.0	47.565							
	67.8	130.478							
6	91.3	102.609	0.81578	61	0 1337349	1 200	28	15	2 5501375
0	32.6	28.391	0.01570	0.1	0.1337347	1.200	2.0	1.5	2.3301373
	94.6	89.478							
	5.5	3.087							
7	5.5	2.652	1 00791	n/d	#VALUE!	1 200	28	15	#VALUE!
/	5.5	11.174	1.00771	11/G		1.200	2.0	1.5	" VALUE:
	5.5	5.087							

*Calculations which are based non-detect values are bolded and grey.

Spring 3									
							85%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Zoopla}	C _{BDace} (ug/g or mg/kg)
	5.5	1.783							
1	5.5	2.522	2 91760	n/d		1 200	20	1.5	#MALTEL
1	5.5	2.130	2.81709	n/d	#VALUE!	1.200	2.8	1.5	#VALUE!
	5.5	1.435							
	n/a	n/a							
2	n/a	n/a	n/a	n/d	n/a	1 200	28	15	#VALUE!
2	n/a	n/a	11/a	1/u	IVa	1.200	2.0	1.5	# VALUE:
	n/a	n/a							
	n/a	n/a		8.8	n/a				
3	n/a	n/a	n/a			1 200	2.8	15	#VALUE!
5	n/a	n/a	IVa			1.200	2.0	1.5	II VI LOL.
	n/a	n/a							
	n/a	n/a	-	18.0	n/a	1.200			
4	n/a	n/a	n/a				2.8	15	#VALUE!
	n/a	n/a	11 a	10.9	ii u	1.200	2.0	1.5	n vi LoL.
	n/a	n/a							
	5.5	6.000	-						
5	5.5	2.435	2 21503	53	0 4179299	1 200	2.8	15	6 9241791
5	12.4	3.739	2.21000	0.0	0.1177277	1.200	2.0	1.0	0.7211771
	13.7	4.609							
	n/a	n/a	-						
6	n/a	n/a	n/a	6.1	n/a	1.200	2.8	1.5	#VALUE!
-	n/a	n/a							
	n/a	n/a							
	44.3	1.565	-						
7	5.5	2.870	6.37501	n/d	#VALUE!	1.200	2.8	1.5	#VALUE!
	5.5	2.957		•					
	5.5	2.174							

*Calculations which are based non-detect values are bolded and grey.

	Spring 4								
							85%	15%	
Site	Se (ug/m2)	Dry Weight (g/m2)	C _{particulate} (ug/g)	C _{water-} column (ug/L)	K _d (L/g)	TFF _{Fish}	TFF _{Aquati} c Insect	TFF _{Zoopla}	C _{BDace} (ug/g or mg/kg)
	16.3	17.217							
1	15.7	10.522	1 (042)			1 200	2.9	1.5	
1	20.2	6.565	1.60436	n/d	#VALUE!	1.200	2.8	1.5	#VALUE!
	15.0	7.565							
	n/a	n/a							
2	n/a	n/a	n/a	n/d	n/a	1 200	28	15	#WALTE!
2	n/a	n/a	11/a	1/u	IVa	1.200	2.0	1.5	# VALUE:
	n/a	n/a							
	n/a	n/a							
3	n/a	n/a	n/a	8.8	n/a	1 200	2.8	15	#VALUE!
5	n/a	n/a	n/a	0.0		1.200	2.0 1.0	1.5	n vi LOL.
	n/a	n/a							
	n/a	n/a	-	18.9			2.8		
4	n/a	n/a	n/a		n/a	1.200		1.5	#VALUE!
	n/a	n/a		100		1.200		110	ii i i i iii ii ii ii ii ii ii ii ii ii
	n/a	n/a							
	33.9	10.696							
5	5.5	37.522	0.99317	5.3	0.18739	1.200	2.8	1.5	3.1046402
	35.9	22.391	-						
	16.3	21.652							
	n/a	n/a	-						
6	n/a	n/a	n/a	6.1	n/a	1.200	2.8	1.5	#VALUE!
	n/a	n/a	-						
	n/a	n/a							
	12.4	/.130							
7	5.5 5.5	5.08/	1.23841	n/d	#VALUE!	1.200	2.8	1.5	#VALUE!
	5.5	0.201	-						
	3.3	4.737							

*Calculations which are based non-detect values are bolded and grey.

APPENDIX D

PART 1

Creek Chub Statistics

		Se (mg/kg	
Site	Treatment	dw)	Rank
1	Modeled	33.792	1
1	Modeled	3.723554	43
1	Modeled	9.448057	19
2	Modeled	7.659801	22
2	Modeled	6.216066	26
3	Modeled	4.280585	34
3	Modeled	2.071494	69
3	Modeled	2.412646	65
3	Modeled	2.83247	58
3	Modeled	0.701617	76
3	Modeled	0.867789	75
4	Modeled	14.8422	9
4	Modeled	15.47772	5
4	Modeled	18.26338	2
4	Modeled	6.331438	25
4	Modeled	4.622475	31
5	Modeled	15.90855	3
5	Modeled	1.993919	71
5	Modeled	7.472002	23
5	Modeled	4.069176	36
5	Modeled	3.505758	45
5	Modeled	4.106096	35
5	Modeled	1.378829	74
6	Modeled	0.46095	77
6	Modeled	15.56925	4
6	Modeled	4.370988	33
6	Modeled	4.635714	30
6	Modeled	3.104433	54
6	Modeled	1.443936	73
1	Measured	2.791045	59
1	Measured	3.836538	40
1	Measured	2.755556	61
1	Measured	3.461538	47
1	Measured	3.839806	39
1	Measured	3.150754	53
1	Measured	3.893939	37
1	Measured	3.052632	55
2	Measured	2.768473	60
2	Measured	2.736607	63
2	Measured	2.552511	64
2	Measured	2.296117	66
2	Measured	2.275701	67
2	Measured	2.018018	70
2	Measured	2.743590	62
2	Measured	1.894273	72

		Se (mg/kg	
Site	Treatment	dw)	Rank
3	Measured	13.258621	13
3	Measured	10.483471	17
3	Measured	9.082353	20
3	Measured	7.219626	24
3	Measured	11.634361	16
3	Measured	9.583710	18
3	Measured	12.834146	15
3	Measured	8.395455	21
4	Measured	13.192913	14
4	Measured	13.685185	12
4	Measured	5.515021	27
4	Measured	14.452206	10
4	Measured	14.140496	11
4	Measured	15.365462	6
4	Measured	15.043478	7
4	Measured	15.043478	7
5	Measured	4.985577	28
5	Measured	4.412371	32
5	Measured	3.495798	46
5	Measured	3.403846	48
5	Measured	3.763736	42
5	Measured	3.364162	49
5	Measured	4.917476	29
5	Measured	3.319249	50
6	Measured	3.051020	56
6	Measured	3.029046	57
6	Measured	2.097166	68
6	Measured	3.805263	41
6	Measured	3.556757	44
6	Measured	3.846154	38
6	Measured	3.239437	51
6	Measured	3.184783	52

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Rank

Expected Mean Squares Section

Source		Term	Denominator	Expected
Term	DF	Fixed?	Term	Mean Square
A: Site	5	Yes	S(AB)	S+bsA
B: Treatment	1	Yes	S(AB)	S+asB
AB	5	Yes	S(AB)	S+sAB
S(AB)	65	No		S

Note: Expected Mean Squares are for the balanced cell-frequency case.

Analysis of Variance Table

Source		Sum of	Mean		Prob	Power
Term	DF	Squares	Square	F-Ratio	Level	
	(Alpł	na=0.05)	•			
A: Site	5	9501.208	1900.242	9.52	0.000001*	0.999893
B: Treatment	1	325.0287	325.0287	1.63	0.206502	0.241740
AB	5	11460.24	2292.047	11.48	0.000000*	0.999992
S	65	12976.12	199.6326			
Total (Adjusted)	76	38100.99				
Total	77					

* Term significant at alpha = 0.05

Means and Standard Error Section

			Standard
Term	Count	Mean	Error
All	77	36.99166	
A: Site			
1	11	34.9375	4.260096
2	10	44.75	4.468026
3	14	40.41667	3.776171
4	13	13.075	3.918718
5	15	40.75	3.648128
6	14	48.02083	3.776171
B: Treatment			
Measured	48	39.25	2.039366
Modeled	29	34.73333	2.623715
AB: Site, Treatment			
1,Measured	8	48.875	4.995405
1,Modeled	3	21	8.157462
2,Measured	8	65.5	4.995405
2,Modeled	2	24	9.990809
3,Measured	8	18	4.995405
3,Modeled	6	62.83333	5.768197
4,Measured	8	11.75	4.995405
4,Modeled	5	14.4	6.318743
5,Measured	8	40.5	4.995405
5,Modeled	7	41	5.340312
6,Measured	8	50.875	4.995405
6,Modeled	6	45.16667	5.768197

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Database	
Response	Rank

Plots Section



PART 2

Green Sunfish Statistics

		Se (mg/kg	
Site	Treatment	dw)	Rank
1	Modeled	57.7536	1
1	Modeled	6.363893	37
1	Modeled	12.04227	23
2	Modeled	13.0913	20
2	Modeled	10.62382	25
3	Modeled	7.315908	34
3	Modeled	2.640278	68
3	Modeled	3.075101	66
3	Modeled	3.610199	63
3	Modeled	0.894264	73
3	Modeled	1.106063	72
4	Modeled	25.36668	9
4	Modeled	26.45283	7
4	Modeled	23.27807	11
4	Modeled	8.0699	32
4	Modeled	5.891697	44
5	Modeled	27.18915	6
5	Modeled	3.407788	65
5	Modeled	9.523636	27
5	Modeled	5.186475	51
5	Modeled	4.468356	57
5	Modeled	5.233532	50
5	Modeled	1.757422	71
6	Modeled	0.787806	74
6	Modeled	19.8442	14
6	Modeled	5.571157	47
6	Modeled	5.908571	43
6	Modeled	3.956836	59
6	Modeled	1.840406	70
1	Measured	8.174468	31
1	Measured	6.232673	40
1	Measured	12.769231	21
1	Measured	8.195238	30
1	Measured	9.299145	28
1	Measured	7.398230	33
1	Measured	9.551220	26
1	Measured	6.836538	36
2	Measured	5.602740	46
2	Measured	6.857820	35
2	Measured	3.5/425/	64
2	Measured	5.1862/5	52
2	Measured	4.872549	54
2	Measured	17.636905	16
2	Measured	15.238342	19
2	Measured	2.515625	69

		Se (mg/kg	
Site	Treatment	dw)	Rank
3	Measured	25.570281	8
3	Measured	16.460967	17
3	Measured	18.881890	15
3	Measured	22.209402	13
3	Measured	22.514423	12
3	Measured	27.287554	5
3	Measured	33.375610	2
3	Measured	16.385714	18
4	Measured	28.986111	4
4	Measured	25.237354	10
4	Measured	11.095833	24
4	Measured	9.150000	29
4	Measured	31.122449	3
5	Measured	5.145455	53
5	Measured	5.524378	48
5	Measured	4.820259	55
5	Measured	4.061404	58
5	Measured	3.639269	62
5	Measured	3.875556	60
5	Measured	2.682464	67
5	Measured	12.058559	22
6	Measured	6.291667	39
6	Measured	4.681102	56
6	Measured	3.756098	61
6	Measured	6.201754	41
6	Measured	5.679487	45
6	Measured	6.299107	38
6	Measured	5.481818	49
6	Measured	5.921488	42

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Rank

Expected Mean Squares Section

Source		Term	Denominator	Expected
Term	DF	Fixed?	Term	Mean Square
A: Site	5	Yes	S(AB)	S+bsA
B: Treatment	1	Yes	S(AB)	S+asB
AB	5	Yes	S(AB)	S+sAB
S(AB)	62	No		S

Note: Expected Mean Squares are for the balanced cell-frequency case.

Analysis of Variance Table

Source		Sum of	Mean		Prob	Power
Term	DF	Squares	Square	F-Ratio	Level	
	(Alpł	na=0.05)				
A: Site	5	9496.721	1899.344	8.49	0.000004*	0.999576
B: Treatment	1	251.5027	251.5027	1.12	0.293155	0.181138
AB	5	9433.366	1886.673	8.43	0.000004*	0.999545
S	62	13871.96	223.7413			
Total (Adjusted)	73	33762.5				
Total	74					

* Term significant at alpha = 0.05

Means and Standard Error Section

			Standard
Term	Count	Mean	Error
All	74	35.31091	
A: Site			
1	11	25.47917	4.510002
2	10	33.4375	4.73013
3	14	36.95833	3.99769
4	10	17.3	4.73013
5	15	49.91964	3.862135
6	14	48.77083	3.99769
B: Treatment			
Measured	45	33.29167	2.229805
Modeled	29	37.33016	2.777628
AB: Site, Treatment			
1,Measured	8	30.625	5.288446
1,Modeled	3	20.33333	8.635997
2,Measured	8	44.375	5.288446
2,Modeled	2	22.5	10.57689
3,Measured	8	11.25	5.288446
3,Modeled	6	62.66667	6.106572
4,Measured	5	14	6.689415
4,Modeled	5	20.6	6.689415
5,Measured	8	53.125	5.288446
5,Modeled	7	46.71429	5.653587
6,Measured	8	46.375	5.288446
6,Modeled	6	51.16667	6.106572

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PART 3

Blacknose Dace Statistics

		Se (mg/kg	
Site	Treatment	dw)	Rank
4	Modeled	35.14904	4
4	Modeled	36.65405	3
4	Modeled	32.25499	5
4	Modeled	11.18196	10
4	Modeled	8.163761	15
5	Modeled	37.67433	2
5	Modeled	4.721962	20
5	Modeled	13.19632	8
5	Modeled	7.186578	18
5	Modeled	6.191525	19
5	Modeled	7.251783	17
5	Modeled	2.435152	21
4	Measured	38.506276	1
4	Measured	23.901709	7
4	Measured	31.058608	6
5	Measured	12.638655	9
5	Measured	10.849206	11
5	Measured	7.852941	16
5	Measured	8.477032	13
5	Measured	8.197080	14
5	Measured	9.698565	12

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Expected Mean Squares Section

Source		Term	Denominator	Expected
Term	DF	Fixed?	Term	Mean Square
A: Site	1	Yes	S(AB)	S+bsA
B: Treatment	1	Yes	S(AB)	S+asB
AB	1	Yes	S(AB)	S+sAB
S(AB)	17	No	、 ,	S

Note: Expected Mean Squares are for the balanced cell-frequency case.

Analysis of Variance Table

Source		Sum of	Mean		Prob	Power
Term	DF	Squares	Square	F-Ratio	Level	
	(Alph	na=0.05)	-			
A: Site	1	282.5957	282.5957	10.46	0.004878*	0.861418
B: Treatment	1	32.49397	32.49397	1.20	0.288110	0.178981
AB	1	0.0645951	0.0645951	0.00	0.961575	0.050244
S	17	459.3667	27.02157			
Total (Adjusted)	20	770				
Total	21					

* Term significant at alpha = 0.05

Means and Standard Error Section

Term All	Count 21	Mean 9.891666	Standard Error
A: Site			
4	8	6.033333	1.837851
5	13	13.75	1.441729
B: Treatment			
Measured	9	8.583333	1.732742
Modeled	12	11.2	1.500599
AB: Site, Treatment			
4,Measured	3	4.666667	3.001198
4,Modeled	5	7.4	2.324718
5,Measured	6	12.5	2.122168
5,Modeled	7	15	1.964745

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