Evaluation of Benthic Macroinvertebrate Communities in the Vicinity of TVA's Kingston Fossil Plant, 2009 – 2010

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ACRONYMS AND ABBREVIATIONS

cfs	cubic feet per second
CRM	Clinch River Mile
EPT	Ephemeroptera, Plecoptera, and Trichoptera
ERM	Emory River Mile
KIF	Kingston Fossil Plant
m^2	square meter
msl	mean sea level
NONCOT	Non-Chironomid and Oligochaete Taxa
TRM	Tennessee River Mile
TVA	Tennessee Valley Authority

1. INTRODUCTION

This report summarizes the results from benthic macroinvertebrate community sampling conducted in response to an ash spill at the Tennessee Valley Authority's (TVA) Kingston Fossil Plant (KIF) in late December 2008. Data included in this report cover samples collected in January 2009, December 2009, and December 2010.

1.1 Kingston Fossil Plant Ash Spill

On December 22, 2008, a coal fly ash spill occurred at TVA's Kingston Fossil Plant, (KIF) allowing a large amount of fly ash to escape into the adjacent waters of the Emory River. Ash, a by-product of a coal-fired power plant, is stored in on-site containment cells. Failure of the dredge cell dike caused about 60 acres of ash in the 84-acre containment area to be displaced. At the time of the slide, the area contained about 9.4 million cubic yards of ash. The dike failure released about 5.4 million cubic yards of coal ash into the adjacent Swan Pond Embayment on the north side of the KIF property and the Emory River channel. Some of the ash that entered the Emory River extended as far as 3.2 miles upstream (~Emory River Mile [ERM] 5.8) of the plant. Immediately after the spill, the downstream extent of the bulk of ash appeared to be about ERM 1.0-1.5, with ash approximately 30 feet deep in the original river channel over an area of about one mile (ERM 2.0 to ERM 3.0). However, subsequent high flow events resulted in ash migrating as far downstream as Tennessee River Mile (TRM) 563 (~4 miles downstream of the Clinch River confluence with the Tennessee River, ~12 miles downstream of the site of the spill). From March 2009 through August 2010, TVA used a combination of hydraulic and mechanical dredging to recover approximately3.4 million cubic yards of ash from the Emory River. Dredging operations extended from about ERM 1.7 upstream to near ERM 6.0 (Figure 1). Most of the remaining ash is in the Swan Pond Embayment and will be recovered primarily by mechanical excavation.

2. STUDY AREA

The Kingston Fossil Plant is located on a peninsula formed by the confluence of the Emory and Clinch Rivers on Watts Bar Reservoir. The Clinch and Emory River confluence is approximately 4.5 river miles upstream of the confluence of the Tennessee and Clinch Rivers (Figure 2). The Emory River borders the KIF ash cells to the east; Swan Pond embayment is on the Emory River just north of the ash storage cells, 2.6 river miles above the confluence of the Emory and Clinch Rivers and approximately 0.7 miles upstream of the KIF cooling water intake (ERM 1.9). The heated water discharge from KIF is to the Clinch River, rather than the Emory, at about CRM 2.6.

Circulating water for KIF is supplied from the Emory and Clinch Rivers. Flow in the Emory River is unregulated (not controlled by an upstream flood storage dam or navigation structure),

but the Watts Bar Reservoir summer pool extends upstream to above Harriman, Tennessee (ERM 11). Although annual storm events often result in Emory River flow exceeding 40,000 cfs (USGS stream gage at Oakdale), typical stream flow is less than 1,000 cfs. At full operating capacity, the KIF intake draws approximately 2,200 cfs. Therefore, a majority of the water comes from the Clinch River. A submerged rock dam at CRM 3.8 deflects cooler Clinch River water into the Emory and the water is drawn upstream to the intake.

The river elevation near KIF is controlled by Watts Bar Dam (TRM 529.9) approximately 40 miles downstream of KIF. The summer pool elevation (May 15-October 31) for the Emory River at KIF is approximately 740 to 741 feet mean sea level (msl) and the winter pool elevation (December 1-March 31) is 735 to 737 feet msl. The Watts Bar annual spring reservoir fill period is April 1through May14.

Watts Bar is a large reservoir; the surface area varies between approximately 32,000 acres at the minimum winter pool level to 39,000 acres at the normal maximum summer pool level. Watts Bar Reservoir extends approximatly72 miles up the Tennessee River to Fort Loudoun Dam and approximately 61 miles up the Tennessee and Clinch Rivers to Melton Hill Dam. Watts Bar is a mainstream Tennessee River reservoir with an average annual discharge of about 27,000 cubic feet per second (cfs). Most of the water entering Watts Bar Reservoir (86 percent) comes from outside the immediate drainage area. The Tennessee and Little Tennessee Rivers (i.e., average annual discharge from Fort Loudoun Dam, 18,200 cfs) account for approximately 67 percent of the flow into the reservoir. The Clinch River (i.e., annual average discharge from Melton Hill Dam, 5,000 cfs) accounts for about 19 percent of the flow into the reservoir. The remaining 14 percent is contributed by local inflows.

Assessing ash-related impacts to the benthic macroinvertebrate communities in the vicinity of the KIF is complicated by the facts that the affected area extends into three river systems with significantly different characteristics (e.g., watershed size, geology, morphology, physical and chemical characteristics of water quality, etc.) and that in the vicinity of KIF each of these rivers is transitioning to varying degrees from more riverine conditions to more lacustrine conditions. Ideally, to reduce the influence of factors other than ash on the different types and numbers of organisms, comparisons would be made among benthic communities from similar areas of the reservoir. However, because of the complex hydrology and water chemistry, and habitat changing from riverine to lacustrine, there simply are no similar areas for comparison. For Kingston, the data from the “reference sites” provides insight to variability in the benthic assemblages not influenced by the presence of ash.

Potential upstream “reference sites” on the Emory and Clinch Rivers are in portions of each river that are mostly comprised of the old river channel. There is little or no submersed overbank area at those locations (especially at winter pool levels) so the lateral dimensions and cross-sectional

areas are more constant than in the area of the spill and further downstream. As the cross-sectional area increases in the downstream portion of each river (Figure 3), water velocities and turbulence decrease and deposition increases. The substrate becomes more silt-dominated along a general longitudinal gradient in each of the three rivers as the environment shifts from a more riverine to a more lacustrine environment. In the lower four miles of the Emory River, deposition of sands, coarse silts, and detritus has resulted in formation of large river-bars. In the lower Clinch River the substrate includes a significant proportion of finer silts. The physical nature and amounts of the naturally-occurring sediments in each river are important factors that must be taken into account when interpreting the structure and function of the benthic community, along with the nature and depths of ash that were deposited in those reaches.

3. METHODS

3.1 Field and Laboratory Procedures

Benthic macroinvertebrates assemblages were sampled in the Emory, Clinch, and Tennessee Rivers in January 2009, December 2009, and again in December 2011. At least one site in each river was located upstream of the spill and served as a "reference". The locations selected to act as "reference sites" are ERM 6.0, CRM 8.7 and 6.0, and TRM 573.9 (Figure 2). Eleven sites were initially selected for monitoring with additional locations added as recovery operations allowed access (Table 1). Two sites (ERM 4.1 and ERM 2.2) were added in December 2009, and two more sites (ERM 2.6 and ERM 3.0) were added in December 2011. Benthic macroinvertebrates also were sampled using the same methodology at TRM 560.8 but as part of a different monitoring plan. This station (TRM 560.8) was sampled in November of 2008, 2009, and 2010.

At each sampling location, a line-of-sight transect was established across the width of the stream or reservoir (i.e., perpendicular to the thalweg), and one Peterson (area per sample 0.11 m^2) or Ponar (area per sample 0.06 m^2) grab sample was collected at 10 equally spaced locations along this transect. For each sample, water depth and substrate composition were recorded. Visual assessments were made of the substrate type and presence of coal fly ash in each sample. The percent composition of the three dominant substrate types was recorded along with the presence (or absence) of coal fly ash in each sample (Table A-1). However, substrates from this area often are composites of fine silt, clay, and/or ash which could not be quantified in the field with consistency. Additionally, folding of the sampled material by these devices mixed the surface layers and made it difficult to quantify the thickness of ash. Furthermore, from the time of the initial sampling in January 2009 to December 2010, ash apparently was becoming more mixed with the parent material and/or overlain with new sediments and less frequently observed in distinct layers, making it increasingly more difficult to quantify the thickness of ash. An additional observation was added during the December 2010, sampling event to help in interpreting possible relationships between substrate and benthic macroinvertebrates results.

This was simply an estimate of the volume of substrate in a grab sample reported as the percentage of the dredge filled with substrate when the sample was retrieved. In some cases, when hard substrates (i.e., bedrock, boulder, cobble, hardpan clay) are encountered, it is necessary to make multiple attempts to collect a "good" grab sample. Once it is determined that a partially filled dredge is representative of the substrate in the area, a sample is processed.

Care was taken to collect samples only from the permanently wetted bottom portion of the reservoir (i.e., below the elevation of the minimum winter pool level). Each sample was washed through screens to remove finer materials; the remaining substrate was transferred into individual collection jars along with the benthic organisms and preserved with 10 percent buffered formalin solution. The benthic macroinvertebrate organisms were identified and enumerated by Pennington and Associates, Inc. Specimens were identified to the genus/species phylogenetic level, given their developmental stage and condition.

In the laboratory, all benthic samples were washed in a 120-micron mesh screen. After washing, if large numbers of individuals were present, the macroinvertebrates were transferred to a modified water splitter and split following standard quantitative techniques (Pennington and Associates, Inc. 2006). The organisms were removed from the detritus under 5x magnification and preserved in 85 percent ethanol. The organisms were identified to the lowest practical taxonomic level using available keys (Pennington and Associates, Inc. 2006) and counted. Identifications were made with a stereomicroscope (7X to 60X). Slide mounts were made of the chironomids, simuliids, oligochaetes and small crustaceans, and identifications were made with a compound microscope. The chironomids, simuliids, and oligochaetes were cleared for 24 hours in cold 10 percent potassium hydroxide. Temporary mounts were made in glycerin and the animals were returned to 80 percent ethanol after identification. When permanent mounts were desired, the organisms were transferred to 95 percent ethanol for 30 minutes and mounted in euperol.

3.2 Data analysis

Taxa of Copepoda, Collembola, Daphnids, Ostracoda, and Hydrozoa, present in the benthic fauna sampled were not included in the benthic analyses. Additionally, taxonomists often can identify certain specimens only at high taxonomic levels (e.g., family) because specimens may be damaged during collection or are too small (i.e., early instar) to have developed diagnostic characteristics. These damaged or early instar specimens may not be distinct from identifiable specimens and, therefore, are only enumerated as distinct taxa (i.e., taxa richness) if no other specimen(s) of the genera are identified at lower taxonomic levels in the same grab sample.

A variety of benthic macroinvertebrate community metrics were used to evaluate community structure for alterations potentially resulting from the ash spill. The following metrics were calculated and presented graphically to evaluate the results:

Abundance and Composition

- **Population Density** – The number of individuals in each sample, expressed as individuals per square meter.
- **Oligochaete Density and Composition** –Density and relative abundance of aquatic worms. Under certain types of stresses, abundance of oligochaetes may increase or decrease.
- **Chironomid Density and Composition** – Density and relative abundance of midge larva. Under certain types of stresses, abundance of chironomids may increase or decrease.
- **Hexagenia Density** – Density of the mayfly *Hexagenia*. In finer grained silt and clay sediments in TVA reservoirs, *Hexagenia* typically are the most common and abundant species among the orders of Ephemeroptera, Plecoptera and Trichoptera.
- **Sphaeriid Density** –Density of sphaeriid clams. Sphaeriid clams are one of the most common bivalves in TVA reservoirs.

Species Richness

- **Total Taxa Richness** – Total number of distinct taxa collected at a site. In general, increasing taxa richness reflects increasing water quality, habitat diversity, and habitat suitability.
- **Average Taxa richness** – Average number of distinct taxa represented in each sample at a site, i.e., average taxa richness along a sampling transect. Often, taxa richness will differ among the samples at a site. This metric is used as an evenness indicator.
- **Total EPT Richness** – Total number of distinct taxa within the generally pollution sensitive insect orders of Ephemeroptera, Plecoptera, and Trichoptera at a site. This index value will usually increase with increasing water quality, habitat diversity, and habitat stability in streams. A similar use is incorporated here despite expected lower numbers of these organisms in reservoirs than in streams.
- **Average EPT Richness** – Average number of distinct EPT taxa present in each samples at a site. This metric is used as an evenness indicator.
- **Non-Chironomid & Oligochaete Taxa** – Total number of distinct taxa other than chironomid and oligochaete taxa present at a site. It is similar to the Total Taxa Richness metric above, but it is not considered redundant with that metric. The Total Taxa Richness metric will be mostly chironomid and oligochaete taxa, whereas this metric highlights presence (survival) of any additional taxa and recognizes their presence as indicative of improved conditions compared to their absence.

4. RESULTS AND DISCUSSION

Appendix A contains the physical information for each Ponar/Peterson grab sample including the presence or absence of coal fly ash in the sample. Figures showing substrate composition and water depth, as well as, benthic macroinvertebrate population density and taxa richness, are provided in Appendix B. A list of species and counts for each sample is presented in Appendix C. Results for biological metrics calculated from data in Appendix C are provided in Table 4 and Figures 5 though 16.

4.1 Descriptions of Physical Characteristics

The physical characteristics are described sequentially for sites upstream to downstream in the Emory, Clinch, and Tennessee Rivers, respectively.

Emory River Mile 6.0

Emory River Mile 6.0 was selected as an upstream "reference" site in the Emory River because of the absence of coal fly ash in the substrate. Originally, ERM 5.0 was selected as the "reference" site on the Emory, but during the January 2009 sampling, significant amounts of ash were found, therefore an additional transect was added at ERM 6.0. This site (ERM 6.0) was similar to site ERM 5.0 in terms of depth and substrate type (fines, detritus, and sand), minus the coal fly ash (Table A-1, Figures B-1 to B-3). It is important to note that up to 6 inches of ash/native mix was observed in gravity core samples collected near ERM 6.0 during sub-bottom profiling and core sampling conducted during July and August 2009, but ash was not observed during the benthic surveys.

Emory River Mile 5.0

Emory River Mile 5.0 is approximately 2.5 miles upstream of the coal fly ash spill. This section of the river was up to 36 feet deep (Figures B-4 to B-6). The main channel encompasses most the width of the river at this site; therefore most samples were collected from comparable depths. During the January 2009 sampling event, fly ash was up to 4 inches deep in the deeper portion of the river at this site with only the right-most bank location not showing any indication of fly ash. The substrate was mostly ash and detritus, except adjacent to the right bank which was 50 to 90% sand. In December 2009 and 2010, ash comprised a majority (about 55 to 85%) of the substrate from the left bank to about mid-channel, followed by detritus. In December 2009, substrate toward the right bank was mostly gravel, sand, and detritus. In December 2010, substrate toward the right bank was mostly gravel/coal-like gravel and sand, but hardpan clay (95%) was encountered in the two samples closest to the right bank.

Emory River Mile 4.1

Emory River Mile 4.1 is located about 1.5 miles upstream of the ash release in the first major upstream bend in the river. This site was not sampled in January 2009. The December 2009, sampling transect crossed the downstream-most part of a shallow flat that encompasses a majority of the left descending side of the river and extends approximately one-half mile upstream. As a result, the depth was shallow (1 to 7.5 ft) at points along the transect (Figure B-7). Ash was not detected except at the deepest point (29 ft.) near the right bank; the substrate at that point was about 80% ash. Other than that sample, the substrate was sand, fines, and detritus. Sand comprised 35 to 55% of the substrate in six of the 10 samples on the transect. One sample adjacent to the deep channel was 100% detritus. Sampling during June 2010 for invertebrate bioaccumulation studies also found sand to be the predominant substrate in a large portion of the main channel area between Emory River miles 4.1 and 5.0. Therefore, *Hexagenia* were not very plentiful. In December 2010, only trace amounts of ash were detected in one sample (35% from the left bank) (Figure B-8). The substrate was mostly fines and detritus, each with percentages ranging from 0 to 95%. Sand was a dominant component of the substrate in only one sample.

Emory River Mile 3.0

Emory River Mile 3.0 is about 0.5 miles upstream of where ash entered the Emory River from Swan Pond Embayment and near the upstream extent of the area that had ash approximately 30 feet deep in original river channel. This site was not sampled until December 2010. This transect crossed a section of the river where the original channel was relatively narrow and bordered by a shallow overbank on the right descending side. Overall, this site was one of the shallowest of all sites sampled; seven of the 10 samples were taken in 5 feet or less water (Figure B-9). Substrate was extremely variable. Sand, hardpan clay, fines, detritus, and ash each comprised from 70 to 100% of the substrate in at least one sample. Ash was detected in four samples and comprised from 5 to 80% of the substrate, with the highest percentage found at the deepest point (~29ft) on the transect and adjacent to the right descending overbank. The two samples collected immediately adjacent to this one were 100% detritus – in the deep channel– and 100% hardpan clay on the shallower overbank. Beyond these sampling points, toward the right bank, the substrate was comprised mostly of fines (60 to 85%) mixed with ash (0 to 35%).

Emory River Mile 2.6

Transect Emory River Mile 2.6 (ERM 2.6) was added in December 2010. This transect crossed the Emory River perpendicular to the mouth of Swan Pond Embayment, where ash entered the river. The main channel runs along the right side of the river. Benthos was assumed to have been smothered by ash within this area of the river. However, there is a large sand bar mid-river that extends from approximately river mile 2.2 to mile 3.0. Portions of the sandbar are visible when Watts Bar is at winter pool level. The sandbar appears to have been a barrier to eastward

transport of the ash slide as it exited Swan Pond embayment, diverting it upstream and downstream instead. This significantly reduced the amount of ash that was deposited on the left (east) side of the river.

Sampling during the months of June through September 2009 for invertebrate bioaccumulation studies found that *Hexagenia* and other benthic organisms were plentiful in the area immediately across the river from Swan Pond Embayment that was protected by the mid-river sandbar. Substrate in that area varied from almost 100% silt to 100% sand, with ash present in trace amounts to an ash-silt or ash-sand mix constituting up to 100% of the sample. The abundance of *Hexagenia* and many other organisms appeared to vary in relation to the amount of sand present in a sample rather than the amount of ash.

The benthic community sampling transect extended across this sandbar, with five samples collected on each side (Figure 2). Ash, fines, and detritus were the dominant substrates (Figure B-10). Fines were the dominate substrate along the left bank – east of the sand bar– and ash generally dominated the substrate on the right side of the sand bar. Ash was observed in all samples, with the highest percentages (55 to 70%) found in the three samples nearest the right bank. This included samples collected at the two deepest points (~27 to 29 feet) on the transect and the right-most sample collected on a shallow (~7 feet) point at the mouth of Swan Pond Embayment. Other than these samples, ash typically comprised from 10 to 15% of the substrate, with the exception of one sample which was collected adjacent to main channel (55% from the left bank) and comprised of 90 percent detritus with only a trace amount of ash.

Emory River Mile 2.2

Emory River Mile 2.2 was sampled in December 2009 and 2010. It is located about 0.2 miles above the KIF intake and immediately upstream of the narrowest cross section within the lower reach of the Emory River. The main channel runs along the right side of the river. Water depth from the left side of the river to 55 to 65% across was 7 feet or less (Figure B-11). However, water depth starting about 70% across the channel was substantial different between the two sampling events. Water depths ranged from 9 to 18 feet in December 2009, and from 20 to 28 feet in December 2010 (Figure B-12). Since dredges were active near the site during the December 2009 sampling event, this difference in water depth was likely the result of the material being dredged for the channel between sampling events.

In 2009, starting at the left bank, the substrate was comprised of fines until about mid-channel, then substrate was a mix of fines, ash, and detritus. Ash was present in most samples, comprising from about 5% of the substrate toward the left bank to ~99% of the substrate toward the right bank. The two samples closest to the right bank were ~99% ash with no mixture of other substrate. The substrate was very similar in December 2010, except hardpan clay and gravel were encountered at 35% from the left bank and in the sample closest to the right bank.

Ash was present from about mid-channel to the right bank, comprising from 10 to 75% of the substrate. It is believed that the hardpan clay encountered at the right bank, and possibly at 35 percent across, was exposed due to dredging removing the fine sediments.

Emory River Mile 1.0

Emory River Mile 1.0 is approximately 1.5 miles downstream of where ash entered the river. Ash was found in most of the Ponar Grab samples at this site during the three sampling events (Figures B-13 to B-15). Ash, fines, and detritus were the dominant substrates. However, sand comprised 5 to 65% of the substrate in a few samples collected on right side of the river.

Clinch River Mile 8.7

Clinch River Mile 8.7 is the most upstream "reference" location in the Clinch River (Figure 1). This location, as with CRM 6.0, was deepest at the left bank and gradually lessened in depth near the right bank (Figures B-16 to B-18). No ash was present. In January 2009 and December 2010, the substrate was mostly (~70%) gravel and/or sand near the left bank, and generally increased in fines (0 to 70%) and detritus (0 to 40%) toward the right bank. The substrate was significantly different in December 2009. The substrate was predominately gravel, sand, and mollusk shells. Fines and detritus were only reported in two samples and crews noted difficulty in collecting samples due to firm substrate; multiple attempts were needed to collect samples between 35 and 65% across the channel.

This reach of the Clinch River is a transitional reach for which sediments deposit and scour over time depending on the magnitude of flow releases from Melton Hill dam and the water surface elevation control at Watts Bar Dam. It is believed that the relatively high flow releases (upwards of 20,000 cfs) from Melton Hill dam during the May 2009 and early December 2009 flow events resulted in conditions in the lower Clinch River (CRM 4 to 9) that eroded and transported fine sediments. Releases from Melton Hill Dam remained below 10,000 cfs from February 2010 until the December 2010 sampling event. Notably, in December 2010, hardpan clay was encountered in several samples and half of the Ponar Grabs were only 20 to 35% full.

Clinch River Mile 6.0

Clinch River at mile 6.0 is about 1.5 miles upstream of the Emory confluence. This site was deepest along the left bank (~40 ft.) and got gradually shallower to a depth of about 2 ft. on the right bank (Figures B-19 to B-21). No ash was found at this site. The substrate was mostly fine and detritus with lesser amounts of sand and gravel. Near the left bank, the substrate was comprised mostly of gravel, sand, and/or mollusk shell. From about mid-river to the right bank, fines and detritus comprised about 75 to 100% of the substrate. However, the fine substrate was often only a few inches deep in this reach.

Clinch River Mile 4.0

Clinch River mile 4.0 is directly downstream of the mouth of the Emory River. Ash was found in the deep mid-channel (20 to 30 ft) portion of the river each sampling period (Figures B-22 through B-24). The substrate in most samples was predominantly fines and detritus, with pockets of gravel and/or sand mixed. However, the substrate was 90 to 100 % detritus in three samples collected in locations about 50 to 70% across from the left bank in January 2009.

Clinch River Mile 3.0

The location at Clinch River Mile 3.0 is approximately 3.5 miles downstream of the coal fly ash spill. The mid-channel was fairly deep (30-35 ft.). The substrate across the channel was mostly fines or a mix of fines and ash, with small amounts of detritus (Figures B-25 through B-27). Ash was detected only along the left bank in January 2009. Ash was detected in most samples in December 2009 and 2010, with a significant composition of ash (up to 80%) occurring near the right bank.

Clinch River Mile 1.5

This site is approximately six miles downstream of the spill (ERM 2.5). Water depth across the channel was deep, up to 43 feet near the right bank (Figures B-28 through B-30). The substrate was mostly fines, typically about 80 to 90%, with some detritus. In January and December 2009, the composition of gravel increased toward the right descending side of the river (starting at about 70% across the channel), with gravel and mollusk shells immediately adjacent to the bank. However, in December 2010, a large area of bedrock and/or boulders was encountered from about mid-channel to the right bank, which resulted in the collection of only seven samples that sampling event.

Ash was not documented in any of the samples collected in January 2009, although it was likely present in some samples. Ash was detected in all samples collected in December 2009 and 2010, except where bedrock was encountered. A cross-channel transect was sampled at CRM 1.5 during a survey to determine the downstream extent of ash in May 2009. At that time, all samples were found to have about a half inch to one inch mix of ash and silt. Ash also was present in most substrate samples collected on multiple transects during a field collection in June 2009 for invertebrate bioaccumulation studies. During that sampling event, ash generally was documented as trace amounts. During a subsequent bioaccumulation collection in May 2010, the ash/silt composition ratio ranged from about 10/90 to 65/35.

Clinch River Mile 0.5

Clinch River Mile 0.5 was the downstream-most site sampled in the Clinch River, approximately 0.5 miles upstream of its confluence with the Tennessee River. Even though this site is about

seven miles downstream of the ash spill, ash was detected in most of the Ponar Grab samples during the January 2009 and December 2010 sampling events. However, the field crew did not document the presence or absence of ash in December 2009 (Figures B-31 to B-33).

The river was up to 40 feet deep near mid-channel, but there was fairly extensive overbank with water less than 10 feet deep. The substrate along the transect was mostly silt and clay, until over halfway (about 60% from the left descending bank) across the reservoir, then the composition of detritus increased significantly for the remainder of the transect, comprising 40 to 80% of the substrate.

Tennessee River Mile 573.9

Tennessee River Mile 573.9 was established as an upstream "reference" location in the Tennessee River (Figure 1). When compared to the downstream transect at TRM 566.3, TRM 573.9 was relatively shallow with the deepest areas (~35 to 40 ft) near the right bank (Table A-1). No ash was detected at this location and the substrate across the channel was fines, with lesser amounts of gravel, sand, and detritus.

Tennessee River Mile 566.3

The river transect established at Tennessee River Mile 566.3 was the most downstream location surveyed relative to the ash spill (Figure 1). There was a "dusting" of ash detected in two of the mid-channel Ponar Grab samples in January 2009 and in all but one sample in December 2010 (Table A-1). This transect was deep, up to 70 feet near mid-channel. The substrate was variable with a mixture of fines, sand, detritus, and gravel; fines were predominant.

Tennessee River Mile 560.8

This river transect was sampled as part of TVA's Valley-wide monitoring program in November of 2008, 2009, and 2010. Only two substrate types are determined during these surveys. The substrate across the channel was predominately fines (typically > 80%) with some detritus. No ash was detected at this location (Table A-1). Depth ranged from about 15 feet to 46 feet.

4.2 Site-wide Benthic Macroinvertebrate Assemblage

The assemblage of benthic macroinvertebrates in a reservoir is expected to be vastly different from that in a free-flowing river as the fauna often is dominated by chironomids and oligochaetes with limited abundance and diversity of other taxa. With 470 Ponar/Peterson dredge samples collected and upwards of 40,000 organisms indentified, chironomids comprised about 38% of the organisms collected, and oligochaetes comprised about 33%, followed by Sphaeriid clams (~10%) and *Hexagenia* (~9%) (Table 2, Figure 4). Together, these four taxonomic groups accounted for approximately 90% of total individuals collected. A total of 162 taxa were collected. Chironomid taxa (73) and oligochaete taxa (20) accounted for almost 58% of the total

taxa. The total number of EPT taxa was 17. Excluding *Hexagenia*, however, only 130 individual EPTs were collected.

4.3 Benthic Macroinvertebrate Density

4.3.1 Population Density

Average population densities at the 16 sites sampled ranged from approximately 350 to 3450 individuals/m^2 (Figure 5) over the three sampling events. Overall, the highest densities (~3450 and 3000 individuals/m^2) occurred in January 2009 at the upper-most sites on the Clinch River, "reference" sites CRM 8.7 and CRM 6.0. These sites had substantially higher population densities than other sites due to high numbers of oligochaetes at CRM 8.7 and oligochaetes and chironomids at CRM 6.0 (Figures 6 and 7, respectively). Both sites showed dramatic decreases (CRM 8.7, 83% and CRM 6.0, 68%) in densities from January to December 2009, with CRM 8.7 in December 2009 having the third lowest invertebrate density (582 individuals/m^2) among the sites sampled to date. Only ERM 6.0 and ERM 5.0 in December 2010 had lower densities. The population density at CRM 6.0 in December 2009 was near the median for all sites sampled that period.

There were obvious differences in the substrate between the January 2009 and December 2009 sampling events for both CRM 8.7 and CRM 6.0 (Figures B-16 through B-21). The substrates contained significantly more fines (silt/clay) during the initial sampling event than in December 2009. As previously pointed out, it is believed that relatively high flow releases (upwards of 20,000 cfs) from Melton Hill dam during May 2009 and early December 2009 resulted in conditions in the lower Clinch River (CRM's 4 to 9) that eroded and transported fine sediments. Although an average daily release of 20,000 cfs is not an unusually high flow event, it is roughly twice the volume observed in any of the preceding four years (2005-2008), which were years with lower than average flows. The four years of low flow conditions also may have allowed more fines to accumulate at CRM 6.0 and CRM 8.7 than in years with periodic high flow events. Moreover, these moderately high flow events would not affect the downstream locations to the same extent because the cross-sectional areas at these sites are up to three times greater (Figure 3) than at the upper Clinch River sites.

Population densities increased at CRM 8.7 and CRM 6.0 from December 2009 to December 2010, again due largely to high densities of oligochaetes and/or chironomids (Figures 6 and 7, respectively). Although population densities remained lower at both sites in 2010 than during the initial survey in January 2009, both sites had higher densities than other sites downstream in the Clinch River and very similar densities to those observed at sites in the lower Emory River (ERM 4.1 downstream to ERM 2.2). Equally important is that these observations illustrate the large "year-to-year" variations that can occur in benthic macroinvertebrate communities that were not affected by the ash spill.

Except for CRM 8.7 in December 2009, population densities were consistently the lowest (348 to 752 individuals/m^2) at "reference" site ERM 6.0 and at ERM 5.0 (Figure 5). Both sites were similar in depth and substrate type (sand, detritus, and gravel, minus the ash) and are more riverine than lower reaches of the Emory River. Low abundance of organisms at ERM 5.0 may be ash related, especially in January 2009, immediately following the ash spill. Samples from the left bank to 75 percent across the channel were comprised mostly of ash (90 to 95%) and the abundance of benthic macroinvertebrates per sample was relatively low, generally less than 500 individuals/m^2 (Figures B-4 to B-6). However, lower abundances were observed at both sites in December 2010, suggesting that other facts unrelated to ash, such as the riverine conditions and possibly substrate instability associated with higher rates of course particle deposition (sand and detritus) and high physical disturbances during extreme storm events may be influencing the benthic macroinvertebrate communities in this reach of the river.

Similar to the results at "reference" sites (CRM 8.7 and CRM 6.0) in the Clinch River, average population densities increased approximately two-fold between the December 2009 and December 2010 sampling events at ERM 4.1 and ERM 2.2; these sites were not sampled in January 2009 (Figure 5). These results suggest there is limited, if any, on-going adverse effects occurring at the population level.

The lower population densities at ERM 4.1 in December 2009 may be related to ash movement/dredging, as well as natural variability within the benthic community and/or sampling variability. For the ERM 4.1 site, the December 2009 transect crossed the downstream-most part of a shallow flat and resulted in shallower sampling depths near the left bank (3 samples) compared to the December 2010 survey which did not cross the shallow flat (Figure B-7). An obvious difference between the two sampling events was the composition of sand. Sand was a major component (30 to 55%) of the substrate in six of the 10 samples collected in December 2009 but was only a major component (95%) of one of 10 samples collected in December 2010. Many of the samples collected along the December 2009 transect contained a fewer number of invertebrates than the samples collected along the December 2010 transect (Figure B-8). This difference may have been related to the high composition of sand in December 2009. Ash was found in only one December 2009 sample (deepest point on the transect), and it was a major component of the substrate (80%). The sample contained almost 900 individuals/m^2 and eight taxa, which was higher than most samples collected at the two sites upstream on the Emory (ERM 5.0 and 6.0) and moderate to low compared to samples collected at other sites. Interestingly, the single high-sand sample in 2010 was collected in the same area (85% across) as the high-ash sample in 2009. The sample comprised mostly of sand had the lowest number of individuals and lowest number of taxa for samples collected at the ERM 4.1 site to date.

Population densities were lower at ERM 2.2 in December 2009 possibly because dredges were active in the area at the time of sampling (Figure 5). For example, two samples near the right descending bank were comprised of approximately 100 percent ash and had lower invertebrate

abundance and taxa richness (Figure B-11) than the other samples collected along the December 2009 transect. The December 2010 results were similar in that abundance and richness were low along the right side of the river, though large variations were evident in both indices among the samples collected. Moreover, water depth was about 10 feet deeper during the 2010 sampling event compared to December 2009 (Figures B-11 and B-12), presumably because additional material was dredged from the main channel between the two sampling events. Additionally, the substrate in the sample nearest the right bank in December 2010 was comprised of hardpan clay, gravel, and ash, and the sample only filled about 25 percent of the dredge, which is suggestive of dredging, but may also reflect scouring in this reach. Noteworthy, in both 2009 and 2010, was the high taxa richness (25-28 taxa) in samples collected immediately adjacent to the deeper channel and the high density (3100 to 6350 individuals/m^2) of invertebrates in samples collected mid-way on the transect. In fact, the abovementioned samples had the highest richness of all samples collected to date and densities were among the top 10 percent observed across all sites. Likewise, in December 2009, this site had the second highest taxa richness and had among the highest average densities of all sites sampled to date. Furthermore, the two additional sites (ERM 2.6 and ERM 3.0) sampled in the immediate spill area in December 2010 had equally high densities and richness (Figures B-9 and B-10). Combined, these observations suggest limited on-going effects of the ash spill on the benthic communities and that the benthic community is in process of recovering

With the exception of the lower densities at the upper most sites on the Emory River (ERM 6.0 and ERM 5.0) and the most downstream site (TRM 560.8) on the Tennessee River, there were no consistent spatial trends of increasing or decreasing population densities among sites in the Emory, Clinch or Tennessee Rivers. There was a similar temporal pattern in total densities among sites in the upper Clinch River (CRM 8.7 downstream to CRM 3.0) and the upper-most site in the Tennessee River (TRM 573.9), suggesting that populations might have responded to factors that extended across all sites (e.g., elevated flow). Densities decreased at these sites between January 2009 and December 2009, and then increased in December 2010. This pattern also is evident in oligochaete and chironomid densities, which typically account for a high percentage of the total number of organisms collected at each site. Likewise, this pattern is evident in taxa richness (Figure 12).

In general, there was not an obvious relationship among the sites exhibiting similar changes in average population density between sampling periods. On a percentage basis, there were relatively small differences in population densities (~10-25% between the maximum and minimum population densities) between sampling periods at the Emory River site ERM 1.0, Clinch River sites CRM 4.0 and CRM 0.5, and the most downstream site (TRM 560.8) on the Tennessee River. Moderate differences (~30 to 40%) in population densities were observed at ERM 6.0, CRM 3.0, CRM 1.5, TRM 573.9, and TRM 566.3. Larger differences (~45 to 55%) were observed at ERM 5.0, ERM 2.2, and ERM 4.1. As previously mentioned, the greatest

variation (68 to 83%) in population densities between sampling periods were found at CRM 6.0 and CRM 8.7, respectively.

Although limited years of data are available, the lower Emory River sites (ERM 4.1 downstream to ERM 1.0) certainly do not indicate a temporal trend of decreasing population densities. In December 2009, the lower Emory River sites (ERM 4.1, 2.2, and 1.0) had population densities generally similar to other sites on the Clinch and Tennessee Rivers, including upstream "reference" sites (Figure 5). In December 2010, these same Emory River sites, plus the sampling locations that were added nearest the site of the spill (ERM 3.0 and ERM 2.6), had population densities similar to or substantially greater than those observed at all other sites. In combination, these observations show no obvious patterns that suggest there are persistent adverse impacts from the ash spill.

4.3.2 Oligochaete Density and Composition

The average density of oligochaetes at the 16 sites sampled ranged from 43 to 2738 oligochaetes/m^2 over the three sample periods and generally showed the same pattern among sites and sample periods as population densities (Figure 6). As mentioned, oligochaete densities were highest at CRM 8.7 and CRM 6.0 in January 2009, comprising approximately 60 to 75 percent of the total population at these sites. These sites also had the largest variations in oligochaete densities between sampling events. Oligochaete densities decreased substantially at TRM 573.9 ("reference site") and TRM 566.3 over the three sampling events, and TRM 560.8 consistently had among the lowest densities of all sites. A comparison of spatial and temporal trends in oligochaete densities and composition revealed similar patterns among the two indices (Figures 6 and 8). Given the high degree of "year-to-year" variation in these indices at "reference sites" and the comparatively low variation at sites influenced by ash, no definitive conclusions can be made concerning ash-related affects.

4.3.3 Chironomid Density and Composition

The density of chironomids over the three sample periods has ranged from 80 to 1278 chironomids/m2, with the lowest densities (80 and 85 chironomids/m2) collected at ERM 5.0 in January 2009 and CRM 8.7 in December 2009, respectively (Figure 7). For the 14 sites sampled in more than one sample period, 11 sites had either slightly higher to substantially higher chironomid densities in December 2010. The highest chironomid densities in December 2010 occurred at sites in the lower Emory River (ERM 4.1 downstream to ERM 1.0) and upper Clinch River (CRM 8.7 downstream to CRM 4.0), and the lowest densities occurred at the upper Emory river sites (ERM 6.0 and ERM 5.0).

The composition of chironomids ranged from nine percent (CRM 8.7 in January 2009) to 79 percent (TRM 560.8 in November 2008) over the three sample periods (Figure 9). Spatial and temporal patterns in composition were very similar to those observed for population densities.

Exceptions were the high composition of chironomids at ERM 6.0, ERM 5.0 and TRM 560.8. Likewise, chironomids tended to make up a higher proportion of the macroinvertebrate assemblages at sites in the Emory River, including the reference site, and the most downstream site on the Tennessee River when compared to other sites. The higher percentages were due in part to the lower overall abundance of *Hexagenia* and sphaeriid clams in the Emory River and lower abundance of *Hexagenia* and oligochaetes at TRM 560.8.

4.3.4 Hexagenia Density

The mayfly *Hexagenia* also exhibited a wide range in density among sites and sample periods, but overall they were generally most abundant in the Clinch River downstream of the Emory River and at the upper-most site on Tennessee River and least abundant at sites in the upper Emory (ERM 6.0, ERM 5.0, ERM 4.1, ERM 3.0) (Figure 10). *Hexagenia* were present in generally similar abundances at locations in the lower Emory, lower Tennessee River, and at the Clinch River "reference sites". For each river, there are no consistent temporal trends in abundances among sites. The trend of increasing densities of *Hexagenia* in the downstream direction in the Emory and Clinch Rivers likely relates to differing benthic habitats. *Hexagenia* require silt-clay substrates that are soft enough to burrow into but rigid enough that the burrows don't collapse. For example, substrate in the Emory River reflects the upstream to downstream transition to more lacustrine conditions. The content of sand, gravel, and course detritus decreased moving downstream and the content of fines and ash increased. As previously mentioned, substrate instability associated with higher rates of course particle deposition (sand and detritus) and high physical disturbances during extreme storm events in the upper Emory River also likely results in lower overall abundances of benthic macroinvertebrates.

4.3.5 Sphaeriid Density

Abundance of sphaeriid clams *Musculium* and *Pisidium* exhibited spatial patterns similar to *Hexagenia*, with higher abundance generally at sites in the Clinch River downstream of the Emory and at sites in the Tennessee River (Figure 11). Overall, sphaeriid clams were least abundant at sites in the upper Emory (ERM 6.0 downstream to ERM 2.6) and upper Clinch River (CRM 8.0 and CRM 6.0). Sphaeriid clams were present in moderate abundance at ERM 2.2 and ERM 1.0 when compared to other sites. Similar to *Hexagenia*, these organisms may prefer finer-grained sediments, although they are found in many types of substrate.

Temporally, average sphaeriid clam abundance decreased at sites in the Emory and Clinch Rivers, including reference sites, and increased at sites in the Tennessee River. The declines of sphaeriid clams suggest some potential for site impairment exist. However, the fact that temporal patterns were similar among "reference sites" and those sites affected by ash, and the fact that densities are highly variable as evidenced by the wide error bars associated with the

results for each site, there is no clear evidence that the declines in densities are due to ash-related effects.

4.4 Taxa Richness

4.4.1 Total Taxa Richness

Benthic macroinvertebrate taxa richness ranged from 14 to 53 taxa over the three sampling events (Figure 12). Overall, site TRM 560.8 had the lowest richness, with 14 to 18 taxa represented. The highest richness (53) observed was for samples collected in December 2010, at CRM 4.0. Site CRM 4.0 also exhibited the most variation in richness with 36, 20, and 53 taxa represented in the three consecutive sampling events. A similar pattern, but to a lesser degree, was observed at several other sites, including both sites upstream of CRM 4.0 in the Clinch River. For example, consecutive sampling events at CRM 8.7 yielded 34, 25, and 43 taxa, respectively.

In December 2009, the highest number of taxa (47 and 45) were observed in samples collected at ERM 2.2 and 4.1,respectively, and this occurred during the time when dredging was in full swing in those general areas (Figure 12). There was a decrease (4 to 11 taxa) in taxa richness at both sites in December 2010, but the number of taxa (36 to 41) remained high relative richness values observed across all sites over the three sampling events. Likewise, sampling at ERM 3.0 and ERM 2.6 in December 2010 yielded high richness (36 and 38 taxa, respectively) compared to survey results to date.

For the 12 sites sampled during each of the three sampling events, taxa richness was lowest at eight sites in December 2009 and highest at eight sites in December 2010. The sites with higher richness in December 2010 included ERM 5.0 and ERM 1.0, several sites in the Clinch River (CRM 8.7, CRM 6.0, CRM 4.0, CRM 3.0, and CRM 1.5), and the most downstream site on the Tennessee River (TRM 560.8). Additionally, the five lower Emory River sites (ERM 4.1 downstream to ERM 1.0) and three upper Clinch River sites had higher taxa richness in December 2010 than other sites. Given these observation, there is no trend towards lower richness, suggesting that ash-related impacts are limited.

4.4.2 Average Taxa Richness

Average taxa richness ranged from 5.4 to 16.3 over the three sample periods and exhibited a pattern among sites and years similar to total richness (Figure 13). Overall, ERM 6.0, ERM 5.0, and TRM 560.8 had lower average richness than other sites. Average richness was highest at CRM 4.0 in December 2010, followed by CRM 6.0 in January 2009 and December 2010. These sites along with CRM 8.7 also exhibited the most variability in average richness among sample periods. Sites in the lower Emory River generally had average richness values similar to or

higher than other sites in the Clinch and Tennessee Rivers. There were no obvious trends that indicates ash-related effects.

4.4.3 EPT Taxa Richness

The number of EPT taxa present at the 16 sites sampled over the three sample periods ranged from only one to six(Figure 14). The highest number of EPT taxa collected was at ERM 4.1 in December 2009. Average EPT richness ranged from 0.4 to 1.7 and had a site-wide average of slightly less than one (0.93) EPT per sample. These results are in line with those from TVA's Valley-wide reservoir monitoring program, termed Vital Signs Monitoring. Average EPT richness at ERM 6.0 and ERM 5.0 was consistently among the lowest observed, but no other spatial or temporal trends were evident.

4.4.4 Non-Chironomid and Oligochaete Taxa Richness

Non-Chironomid and Oligochaete Taxa Richness (NONCOT) is the total number of distinct taxa other than chironomid and oligochaete taxa present in a sample. NONCOT values ranged from 3 to 19(Figure 15) and had a site-wide average of 11.4 taxa. NONCOT exhibited similar patterns among sites and years as taxa richness and average richness. However, the NONCOT values show that oligochaetes and chironomids account for a majority (generally 60 to 75%) of the taxa richness at each site. Overall, ERM 6.0 and ERM 5.0 had the lowest values for NONCOT. ERM 4.1 and ERM 2.6 had NONCOT values that were among the highest observed across all sites and were most similar to the Clinch River "reference sites" (CRM 8.7 and CRM 6.0). Sites ERM 3.0 and ERM 2.2 had NONCOT values (9 and 10, respectively) that were similar to the site-wide average.

5.0 SUMMARY

- Benthic macroinvertebrate community results from January and December 2009 and December 2010 were evaluated to assess potential effects from the Kingston ash spill. No historical benthic macroinvertebrate data were available for the affected environment and only nominal references sites exist upstream of the affected environment for comparison.

- Benthic macroinvertebrates within the original Emory River channel (excluding the overbank) in the immediate area of the spill (approximately Emory River mile 1.5 to 4.0), were undoubtedly affected by the ash spill. Benthic habitat in this area initially was most severely impacted by the depths of ash deposited, which ranged to almost 30 feet in places, then later by dredging to remove the ash.

- Macroinvertebrate density and taxa richness at sampling locations in the immediate area of the spill (ERM 4.0, ERM 3.0, ERM 2.6, ERM 2.2, and ERM 1.0) were similar to or substantially greater than other sites in the Emory, Clinch, and Tennessee Rivers during the three sample periods.

- Data from sites in the Emory River and sites in the Clinch River downstream of the Emory River did not indicate a trend of decreasing macroinvertebrate abundance or decreasing richness.

- Lower invertebrate density and taxa richness in some individual samples collected in the deeper portion of the channel at ERM 3.0, ERM 2.6 and ERM 2.2 likely reflect negative impacts of the spill and/or subsequent dredging operations. However, along these same transects existed areas that contained among the highest benthic macroinvertebrate densities and richness observed across all sites during the three sample periods.

6.0 CONCLUSION

Collectively, the benthic macroinvertebrate results suggest a lack of persistent adverse impacts from the ash spill. Substrate in the Emory, Clinch, and Tennessee Rivers in the vicinity of KIF was predominantly fines (silt and clay), or a mix of fines, sand, and detritus before the spill, therefore the ash released into these rivers did not result in the same degree of habitat alteration as would have occurred if ash was released into a natural stream with predominantly cobble/gravel substrate. Likewise, the benthic community that existed in the vicinity of KIF had already adapted to reservoir conditions and is composed predominantly of animals that tolerate/prefer soft substrates and, hence, are less sensitive to sedimentation.

Although benthic community differences among sites clearly exist, these differences appear to be primarily related to variations in channel morphology and the complexity of converging river systems with different hydrological, physical and chemical characteristics. These factors, coupled with inherent variation in benthic communities, suggest that there probably are no discernable or quantifiable effects of the ash spill on the benthic communities except, perhaps, for the original Emory River channel in the immediate area of the spill where ash was removed. Additionally, the degree of substrate heterogeneity within the dredge area could positively influence benthic macroinvertebrate abundance and richness. Therefore, a period of higher abundance and richness may precede reductions as substrate in the dredged areas continues to stabilize and/or become more homogeneous.

TABLES

Table 1. Summary of benthic macroinvertebrate sampling locations.

River Mile	January 2009	December 2009	December 2010	November 2008, 2009, 2010
ERM 6.0	X	X	X	
ERM 5.0	X	X	X	
ERM 4.1		X	X	
ERM 3.0			X	
ERM 2.6			X	
ERM 2.2		X	X	
ERM 1.0	X	X	X	
CRM 8.7	X	X	X	
CRM 6.0	X	X	X	
CRM 4.0	X	X	X	
CRM 3.0	X	X	X	
CRM 1.5	X	X	X	
CRM 0.5	X	X	X	
TRM 573.9	X	X	X	
TRM 566.3	X	X	X	
TRM 560.8				X

Table 2. Overall composition of the benthic macroinvertebrate assemblage in samples collected from the Emory, Clinch, and Tennessee Rivers, 2009-2010.

Taxa Group		**Number of Organisms**	**Number of Taxa**	**Composition**	
				Density	**Taxa**
EPTs	Mayfly	25	6	0.1%	3.7%
	Hexagenia	3,500	1	8.7%	0.6%
	Stonefly	5	2	0.0%	1.2%
	Caddisfly	100	8	0.2%	4.9%
Sphaeriid Clams		4,200	2	10.4%	1.2%
Oligochaetes		13,100	20	32.4%	12.3%
Chironomids		15,300	73	37.8%	45.1%
Other	*Corbicula*	500	1	1.2%	0.6%
	Snails	350	7	0.9%	4.3%
	Leeches	400	4	1.0%	2.5%
	Zebra Mussels	470	1	1.2%	0.6%
	Chaoborus	1,770	1	4.4%	0.6%
	Other	730	36	1.8%	22.2%
Total		**40,450**	**162**	**100%**	**100%**

Table 3. Results for Benthic Macroinvertebrate Community Metrics.

		River	Emory River														
		Site	ERM 6.0			ERM 5.0			ERM 4.1		ERM 3.0	ERM 2.6	ERM 2.2		ERM 1.0		
		Sample Period	1	2	3	1	2	3	2	3	3	3	2	3	1	2	3
Metric	Average Density	Population	752	737	452	587	733	348	988	2140	2183	2137	1315	2337	967	1108	1320
		Oligochaetes	273	110	48	344	43	58	255	507	1052	598	260	723	373	465	410
		Chironomids	375	415	227	84	383	213	552	1105	1003	1278	378	1068	320	318	792
		Hexagenia	9	12	5	7	35	8	10	35	20	62	168	160	35	115	40
		Sphaeriid clams	0	0	0	30	0	0	5	0	25	70	360	120	163	128	28
	Average Composition	% Oligochaetes	35	15	19	46	7	13	23	26	41	20	12	15	33	47	27
		% Chironomids	50	57	48	17	57	56	56	47	52	58	27	50	37	28	58
	Richness	Total Taxa Richness	26	23	23	23	22	27	45	41	36	38	47	36	23	24	35
		Average Taxa Richness	8.6	7.7	5.9	6.4	7.7	5.4	11.5	11.3	10.9	13.3	11.0	11.9	9.0	9.2	11.0
		Total EPT Taxa Richness	2	2	3	3	2	3	6	5	2	2	4	3	1	3	3
		Average EPT Taxa Richness	0.5	0.5	0.4	0.6	0.6	0.5	1.0	1.1	0.5	0.9	1.5	1.0	0.6	0.9	0.9
		Total NONCO Taxa	7	6	7	9	4	6	16	13	9	10	19	13	9	10	13

		River	Clinch River																	
		Site	CRM 8.7			CRM 6.0			CRM 4.0			CRM 3.0			CRM 1.5			CRM 0.5		
		Sample Period	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Metric	Average Density	Population	3448	582	1857	3013	972	2263	1652	1300	1643	1587	947	1207	1380	1230	981	1153	1328	1297
		Oligochaetes	2738	92	1025	1838	345	1040	550	57	527	190	70	160	150	333	217	302	362	228
		Chironomids	307	85	602	790	238	1030	393	325	702	575	318	573	420	380	488	388	425	517
		Hexagenia	147	0	20	145	88	98	150	278	188	345	140	245	292	252	176	147	225	280
		Sphaeriid clams	30	2	7	90	30	2	477	352	143	388	392	150	402	188	10	187	247	183
	Average Composition	% Oligochaetes	74	16	54	62	30	40	47	7	29	9	12	12	15	25	15	26	27	17
		% Chironomids	9	19	33	25	18	48	23	30	46	35	33	46	31	33	43	32	30	36
	Richness	Total Taxa Richness	34	25	43	36	34	43	35	21	53	25	19	27	17	20	26	34	24	31
		Average Taxa Richness	12.9	6.6	13.3	15.1	8.8	14.8	10.2	8.7	16.4	9.9	8.6	11.2	10.0	10.1	9.6	11.5	10.1	12.5
		Total EPT Taxa Richness	3	4	4	2	4	3	2	2	4	2	1	2	2	1	2	5	1	3
		Average EPT Taxa Richness	1.1	0.7	0.7	1.1	0.9	0.9	0.7	1.0	1.2	1.1	1.0	1.2	1.1	1.0	0.7	1.7	1.0	1.2
		Total NONCO Taxa	16	14	17	13	14	16	13	11	16	10	7	12	8	8	10	16	10	14

		River	Tennessee River								
		Site	TRM 573.9			TRM 566.3			TRM 560.8		
		Sample Period	1	2	3	1	2	3	1	2	3
Metric	Average Density	Population	1975	1285	1835	1998	1553	1315	828	897	930
		Oligochaetes	1120	173	95	1052	718	207	55	50	58
		Chironomids	460	263	467	550	498	602	650	400	435
		Hexagenia	68	262	375	105	142	223	30	98	58
		Sphaeriid clams	163	427	827	82	137	152	60	323	322
	Average Composition	% Oligochaetes	56	16	9	51	38	16	7	6	7
		% Chironomids	24	23	33	29	36	49	79	53	48
	Richness	Total Taxa Richness	31	31	24	35	20	26	15	14	18
		Average Taxa Richness	13.2	10.0	10.6	12.1	9.1	11.0	6.8	6.3	8.2
		Total EPT Taxa Richness	2	3	3	4	1	2	3	3	3
		Average EPT Taxa Richness	1.0	1.1	1.4	1.1	0.8	1.1	0.9	0.7	1.2
		Total NONCO Taxa	13	16	11	16	7	10	10	8	11

FIGURES

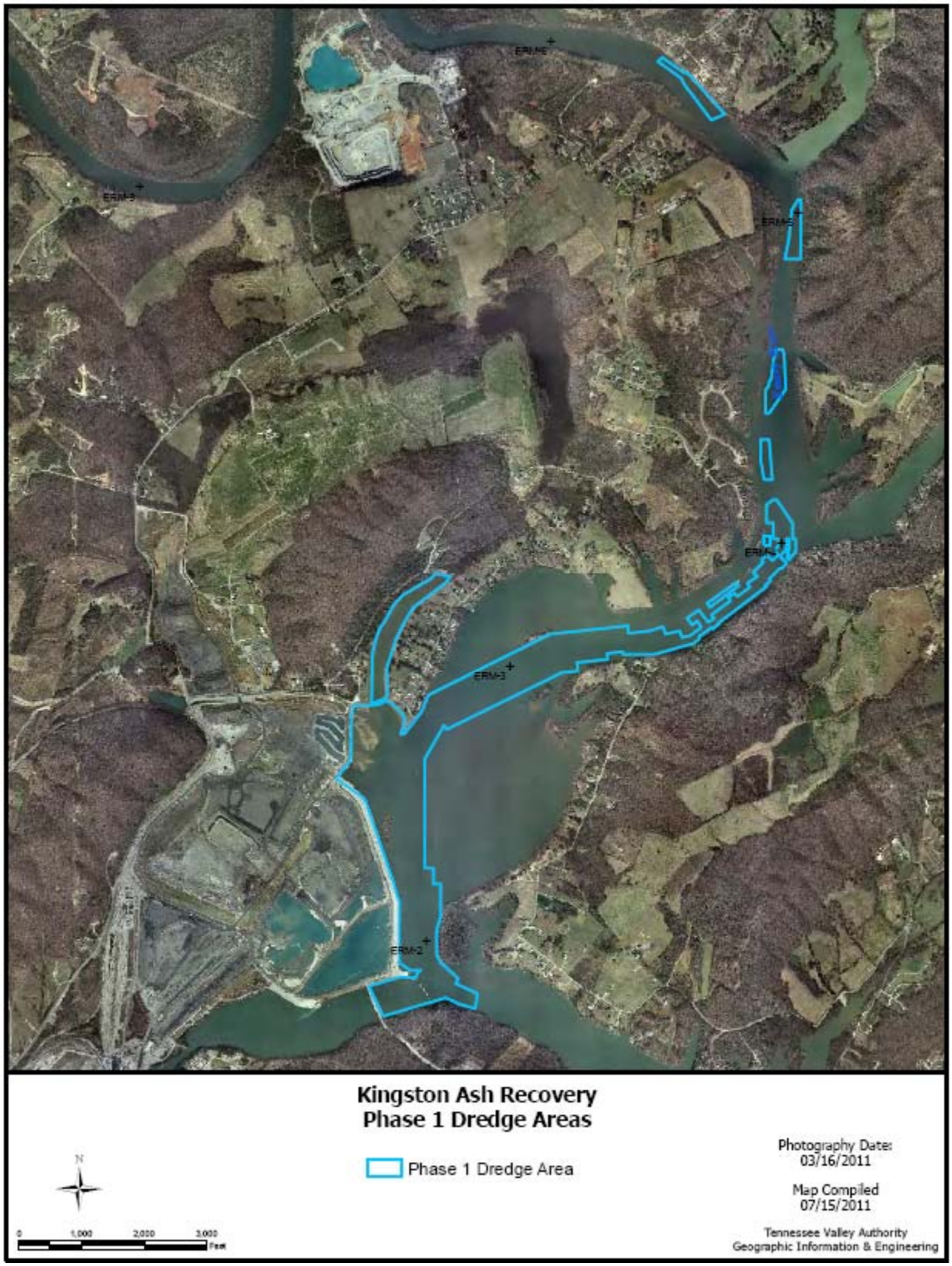

Figure 1. Kingston Ash Recovery Phase 1 dredge areas.

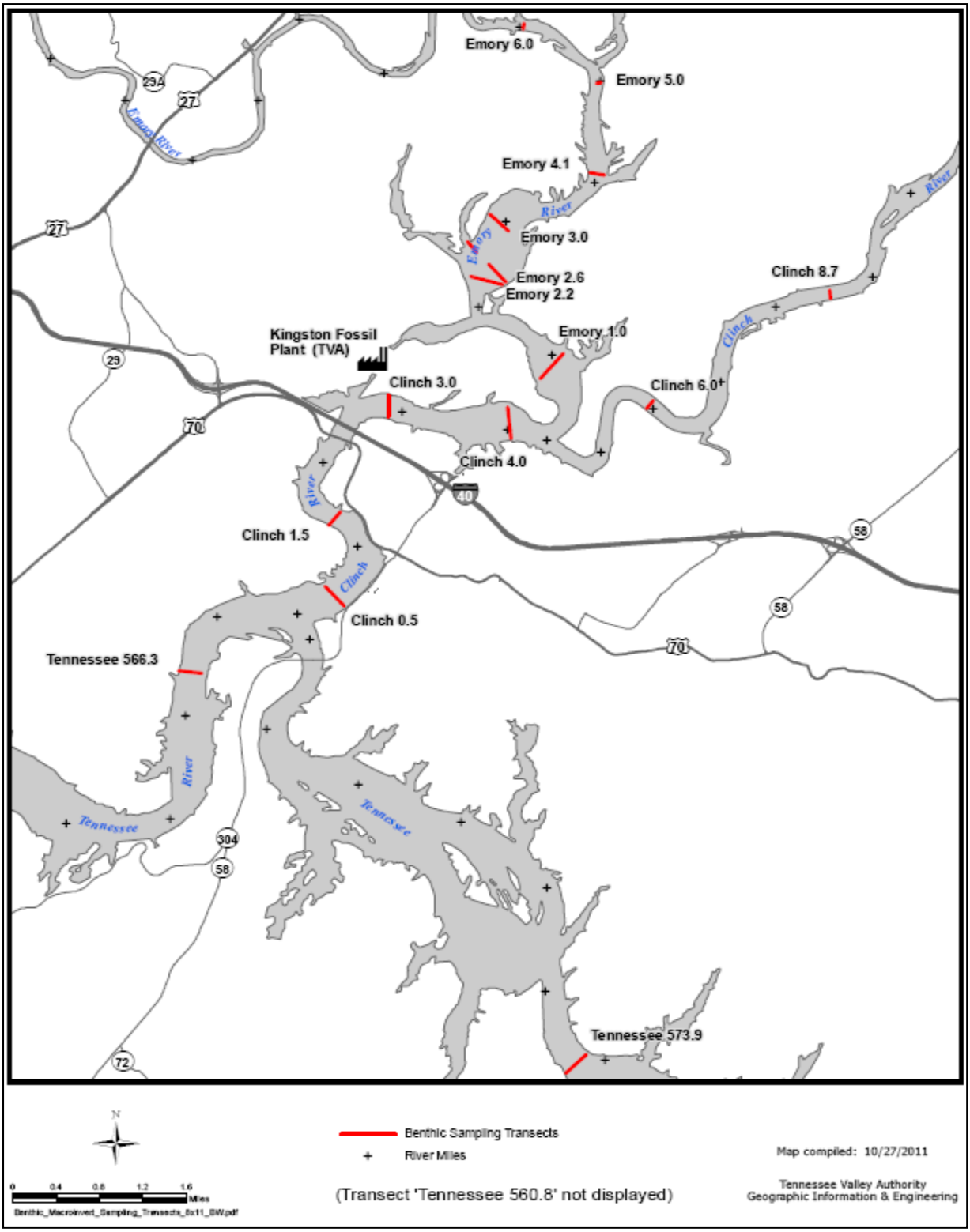

Figure 2. Reservoir benthic macroinvertebrate sampling locations in the Emory, Clinch, and Tennessee Rivers.

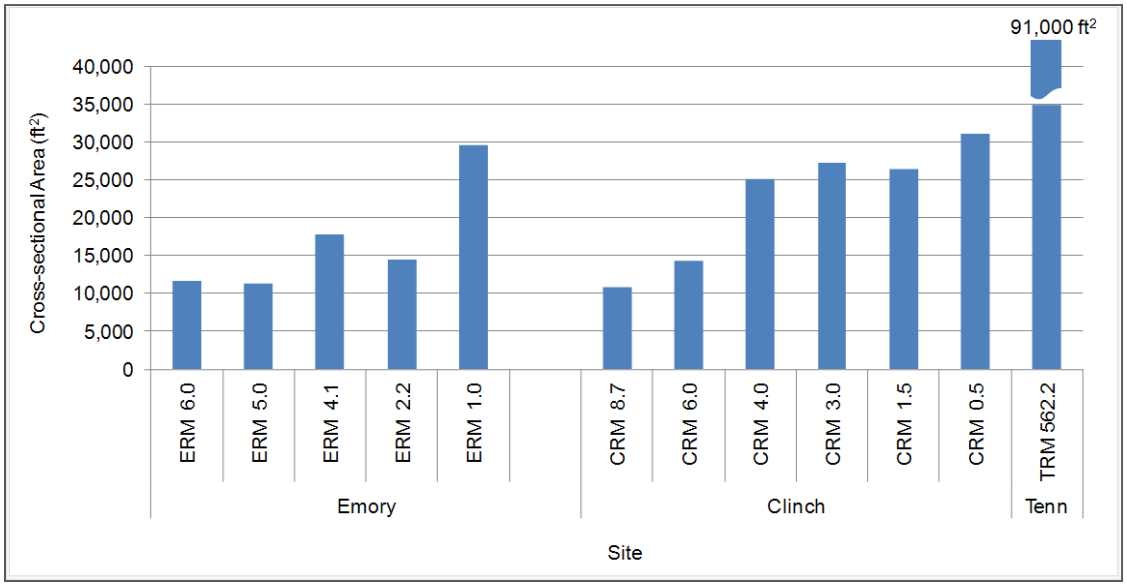

Figure 3. Reservoir cross-sectional areas at benthic macroinvertebrate sampling locations.

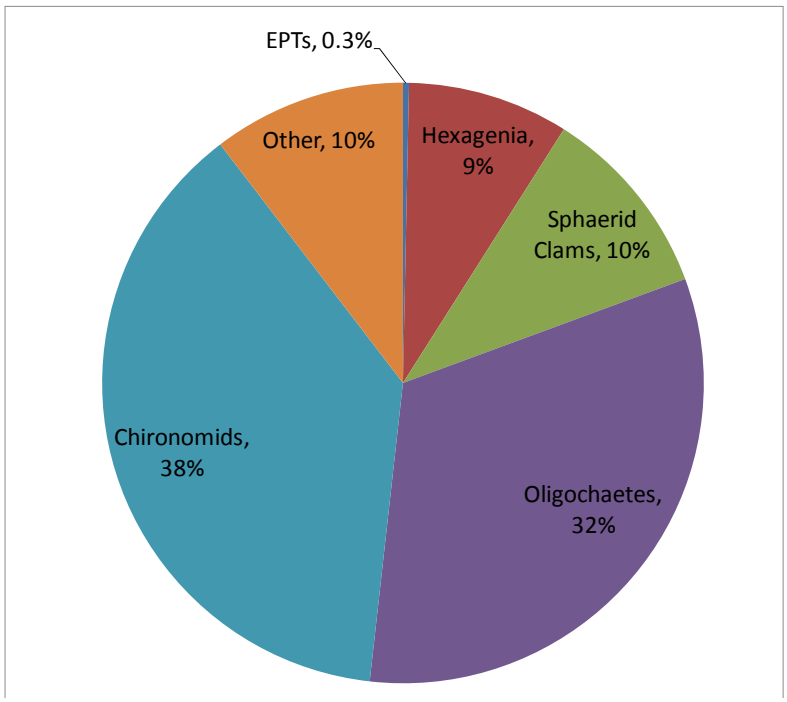

Figure 4. Overall composition of the benthic macroinvertebrate assemblage in samples collected from the Emory, Clinch, and Tennessee Rivers, 2009-2010.

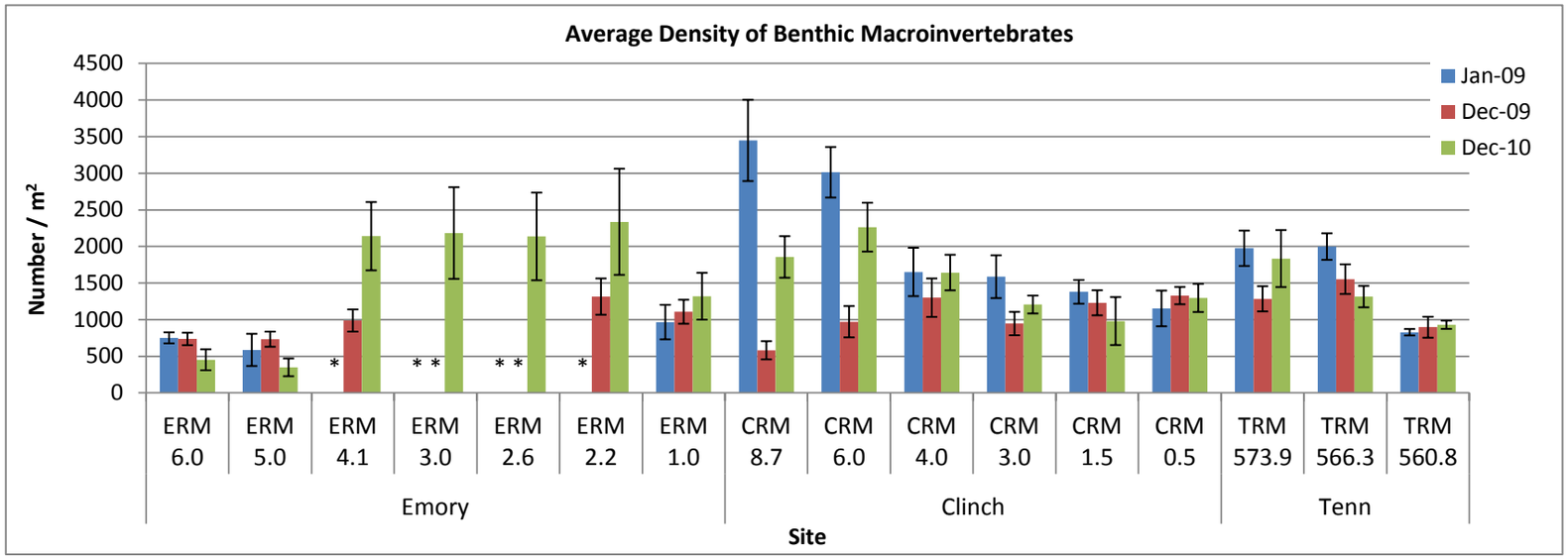

Figure 5. Average Density of Benthic Macroinvertebrates.

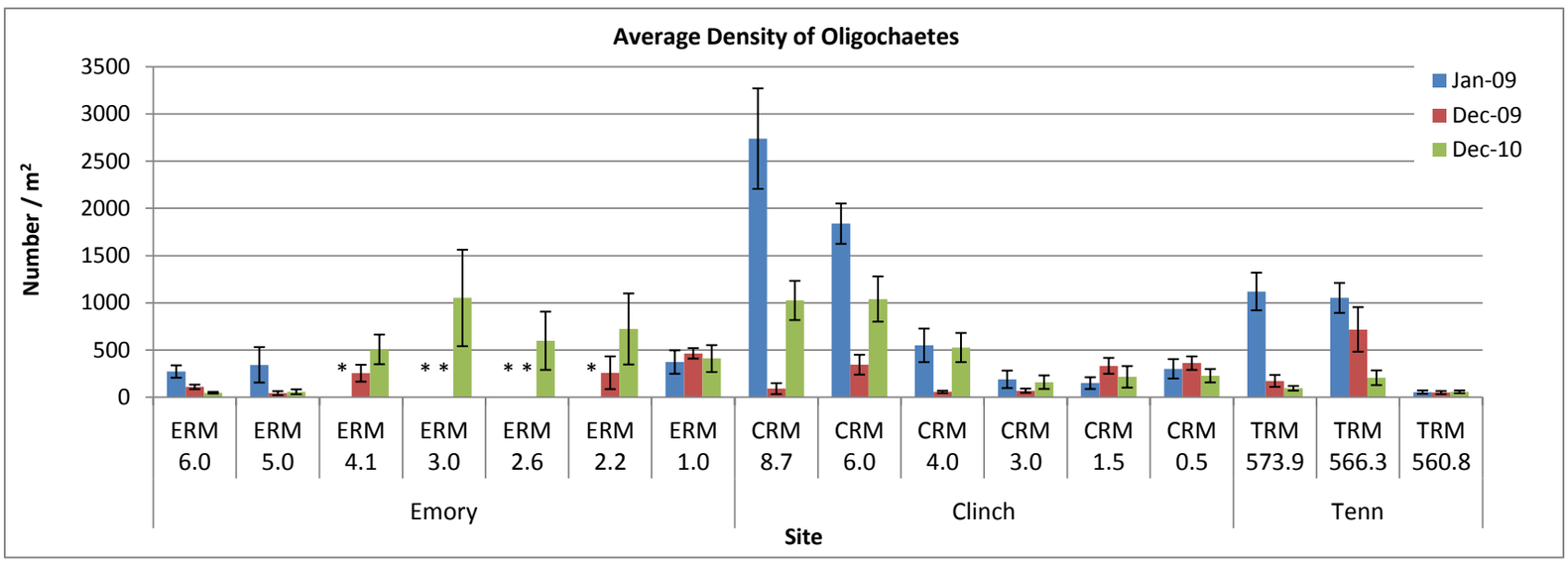

Figure 6. Average Density of Oligochaetes.

* Indicates a sampling event(s) (January, 2009 and/or December, 2009) in which a site was not sampled

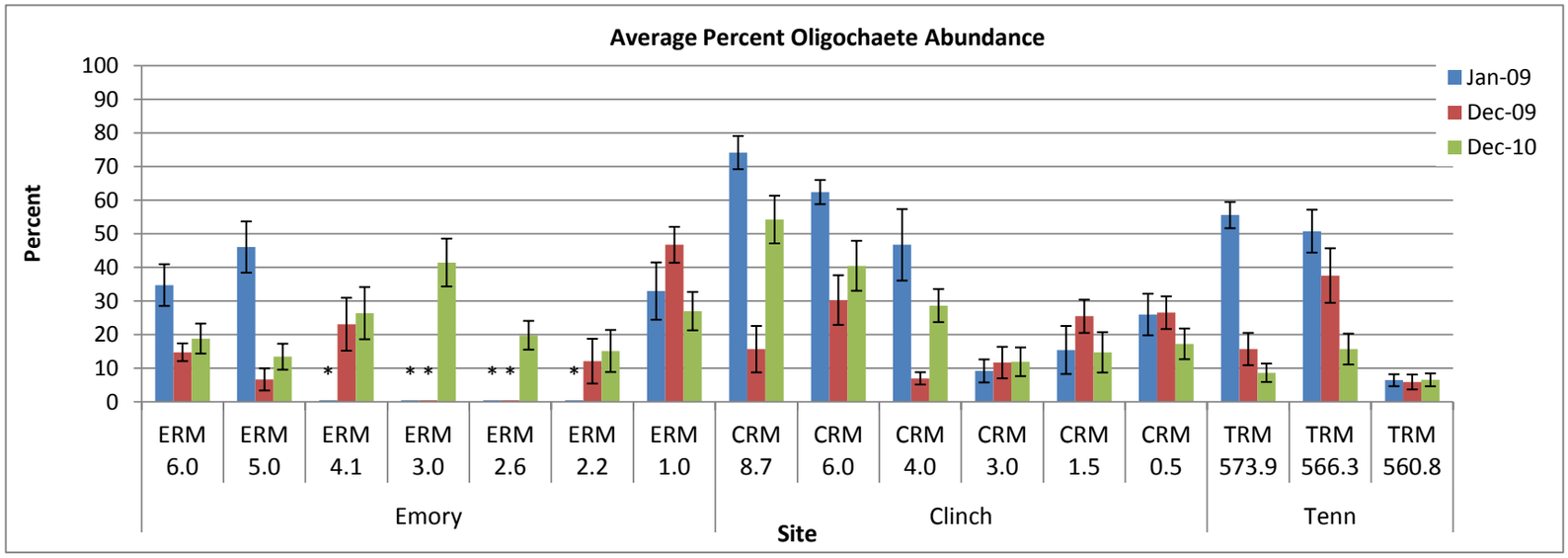

Figure 7. Average Percent Oligochaete Abundance.

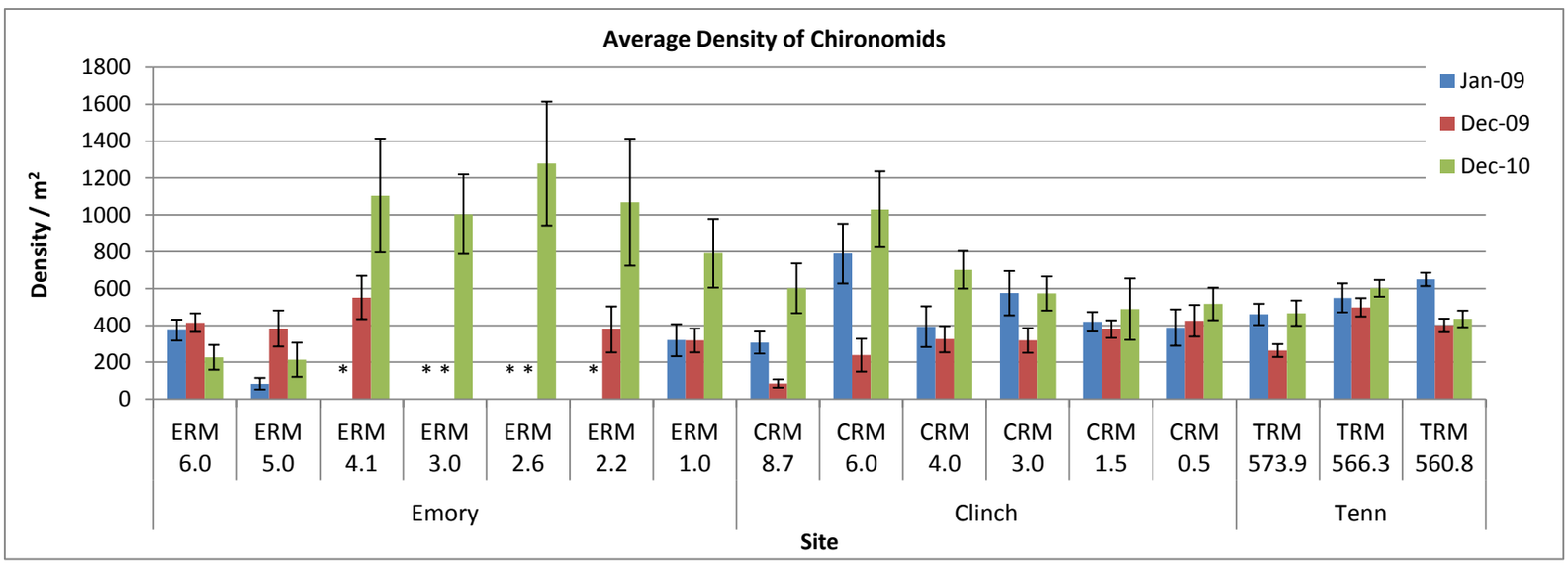

Figure 8. Average Density of Chironomids.

* Indicates a sampling event(s) (January, 2009 and/or December, 2009) in which a site was not sampled

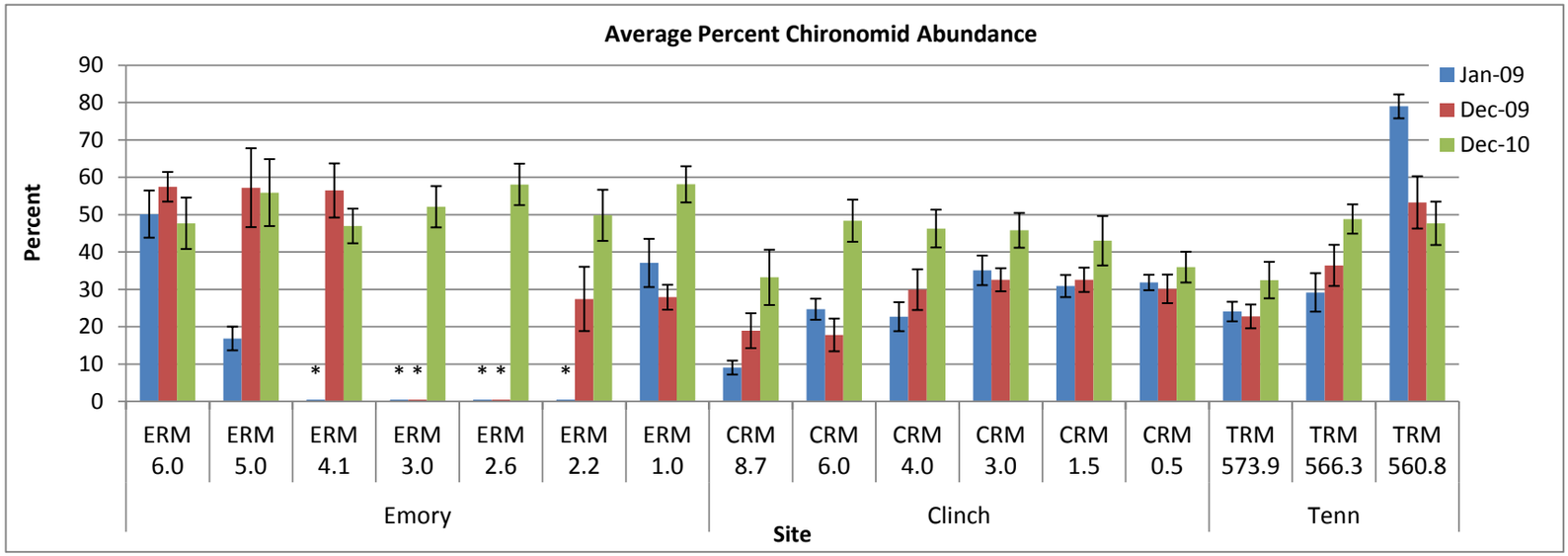

Figure 9. Average Percent Chironomid Abundance.

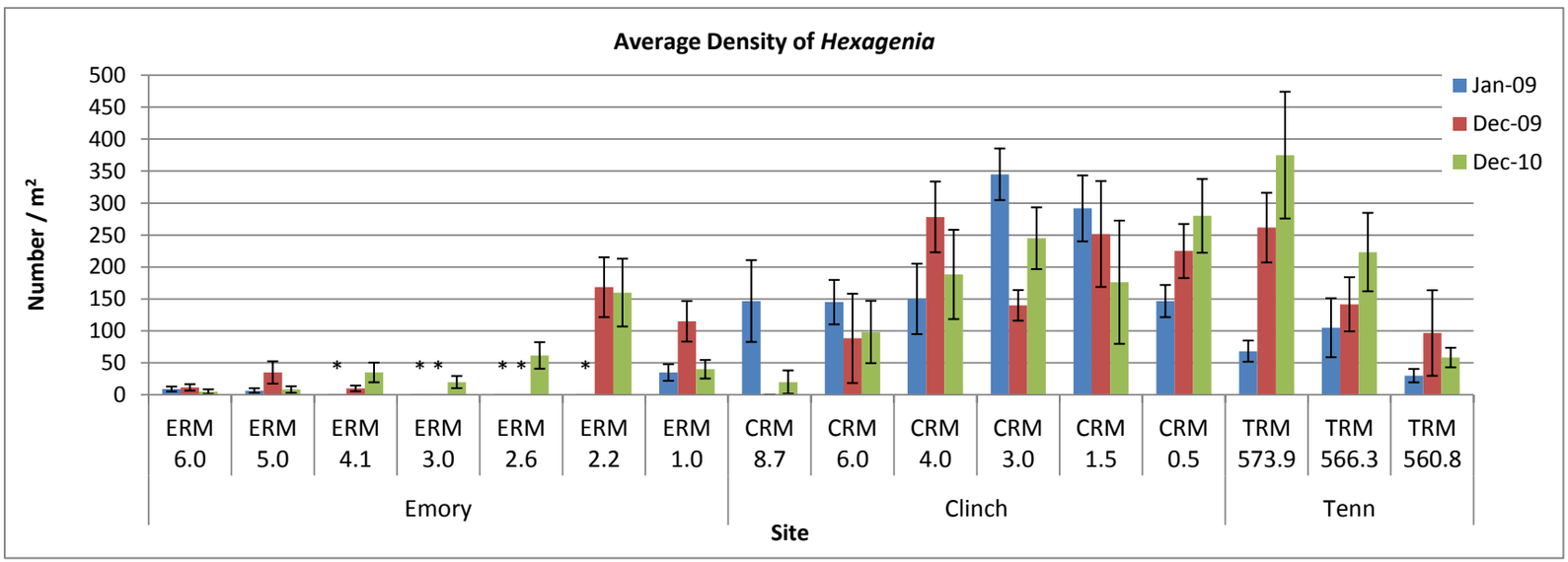

Figure 10. Average Density of *Hexagenia.*

* Indicates a sampling event(s) (January, 2009 and/or December, 2009) in which a site was not sampled

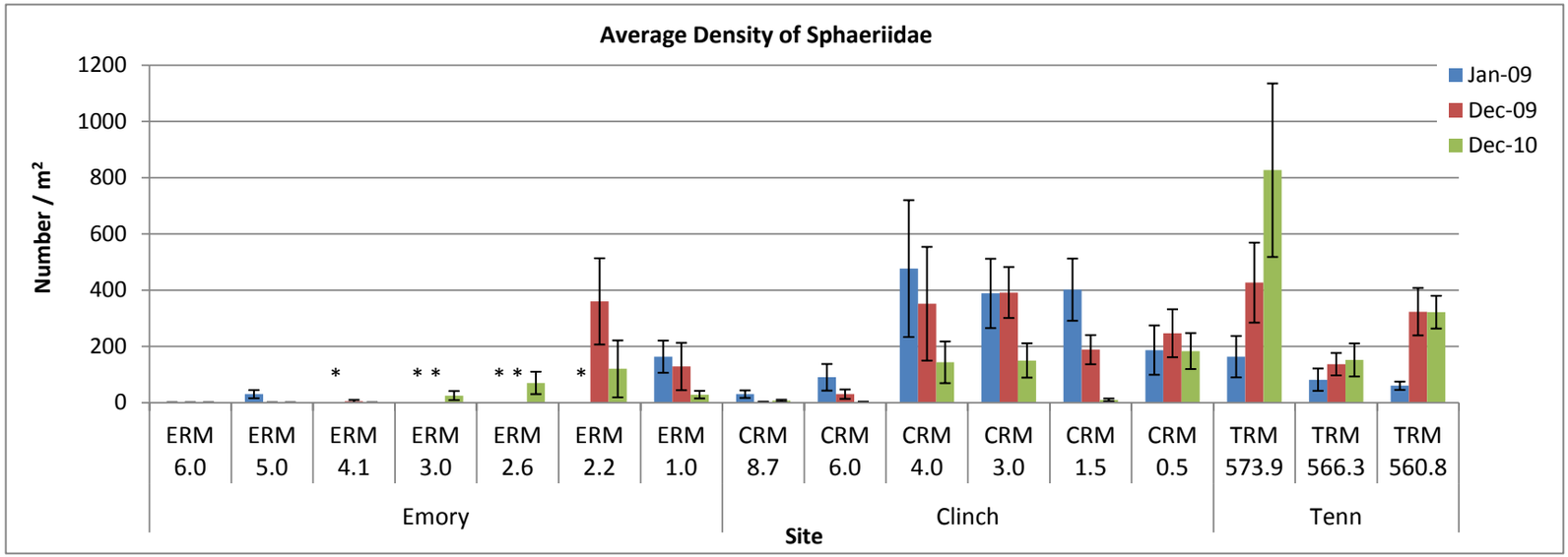

Figure 11. Average Density of Sphaeriidae.

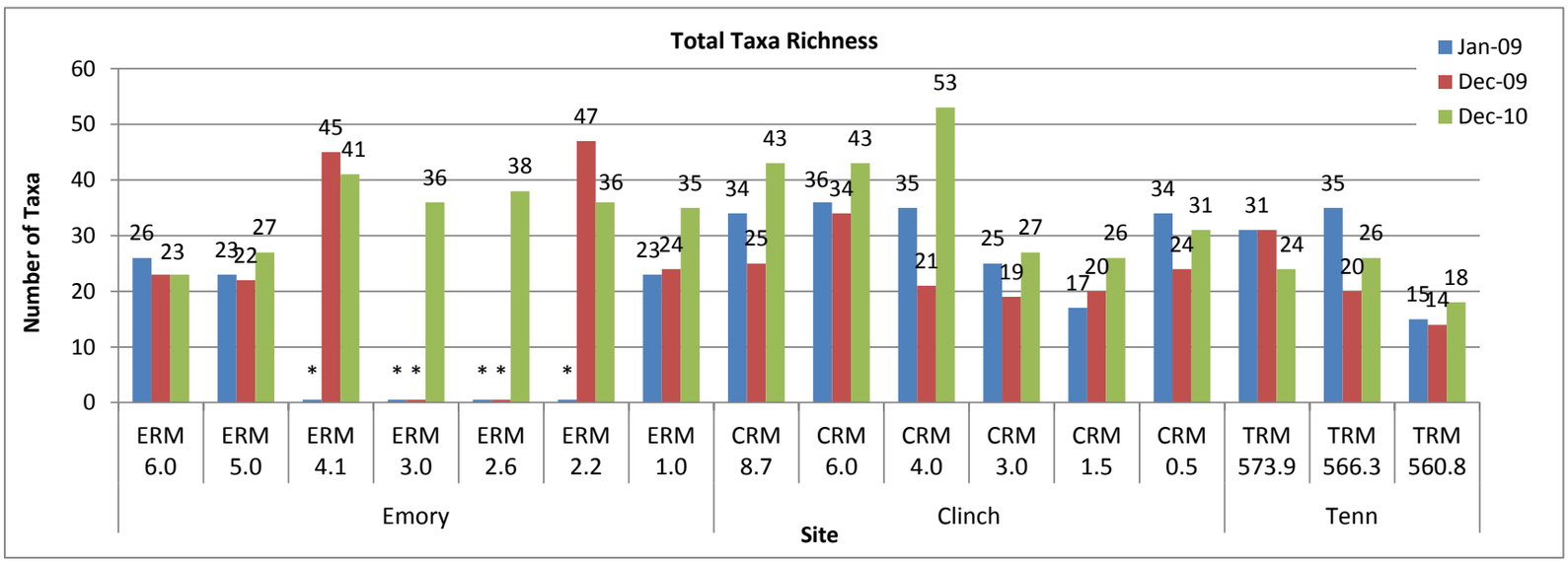

Figure 12. Total Taxa Richness.

* Indicates a sampling event(s) (January, 2009 and/or December, 2009) in which a site was not sampled

Figure 13. Average Taxa Richness.

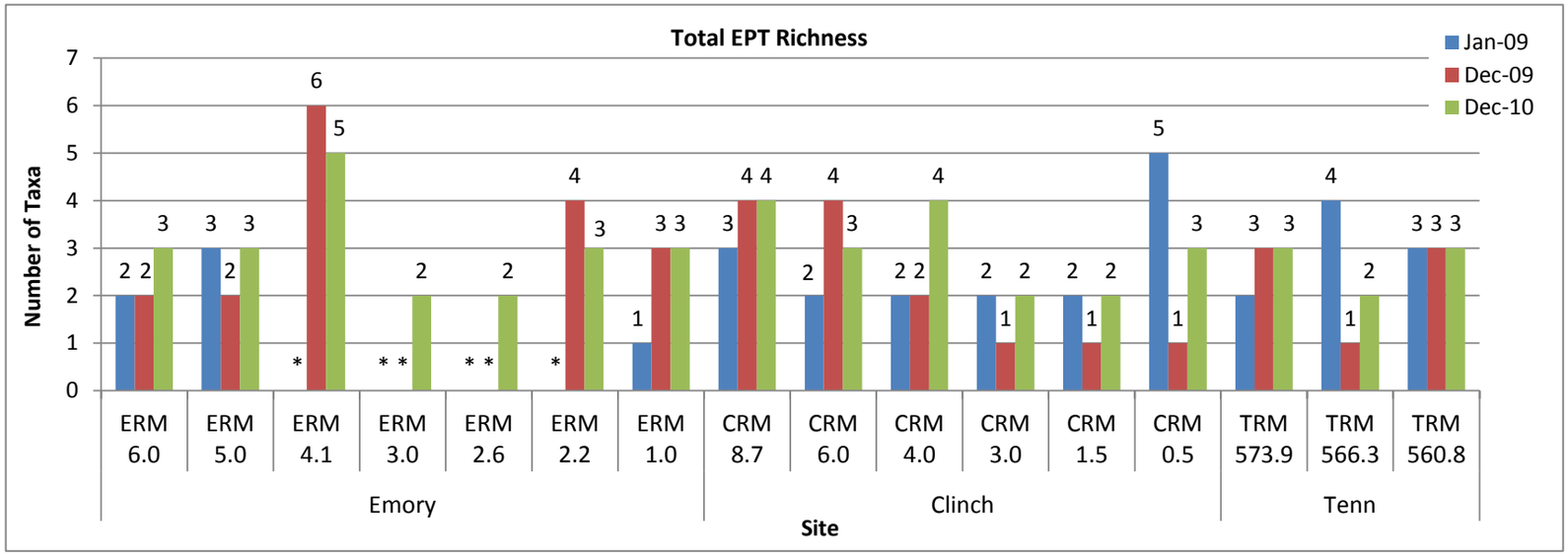

Figure 14. Total EPT Richness.

* Indicates a sampling event(s) (January, 2009 and/or December, 2009) in which a site was not sampled

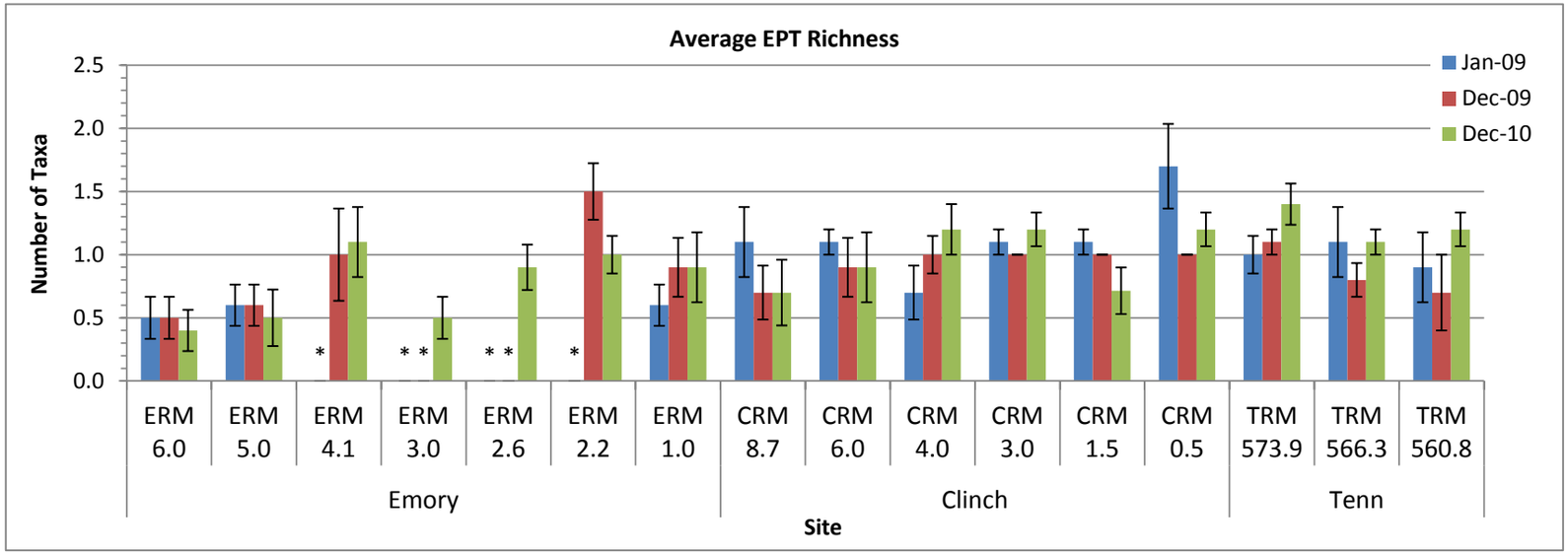

Figure 15. Average EPT Richness

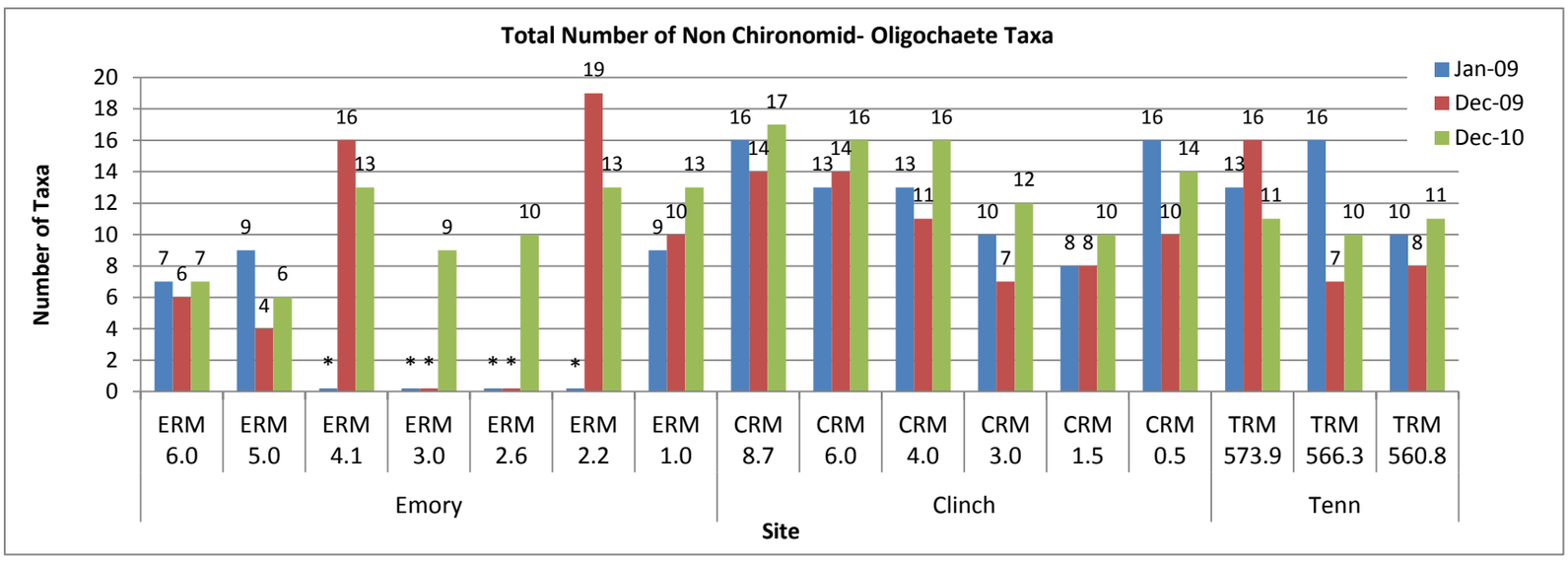

Figure 16. Total Number of Non-Chironomid and Oligochaete Taxa (NONCOT)

* Indicates a sampling event(s) (January, 2009 and/or December, 2009) in which a site was not sampled

Appendix A

Physical Characteristics of Benthic Macroinvertebrate Samples

Table A-1. Physical characteristics of benthic macroinvertebrate samples collected in the Emory, Clinch, and Tennessee Rivers, 2009-2010.

River	Site	Date	Sample Period	MM	YY	Sample #	% from Left Bank	Water Depth (feet)	Standardized Water Depth [1]	Reservoir Surface Elevation (feet)	Dredge % Full	Ash Detected	Depth of Ash (mm)	Bedrock	Boulder	Cobble	Gravel	Sand	Hardpan Clay	Fines	Mollusk Shell	Detritus	Woody Debris	Ash	Coal/Gravel	% Classified
Emory	ERM 6.0	01/22/2009	1	1	2009	1	5	8	6.2	737.43	.	No	.	0	0	0	0	0	0	75	0	20	0	0	0	95
Emory	ERM 6.0	01/22/2009	1	1	2009	2	15	7.5	5.7	737.43	.	No	.	0	0	0	0	50	0	40	0	10	0	0	0	100
Emory	ERM 6.0	01/22/2009	1	1	2009	3	25	22.7	20.9	737.43	.	No	.	0	0	0	0	50	0	35	0	15	0	0	0	100
Emory	ERM 6.0	01/22/2009	1	1	2009	4	35	33	31.2	737.43	.	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Emory	ERM 6.0	01/22/2009	1	1	2009	5	45	34	32.2	737.43	.	No	.	0	0	0	0	70	0	25	0	5	0	0	0	100
Emory	ERM 6.0	01/22/2009	1	1	2009	6	55	35	33.2	737.43	.	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Emory	ERM 6.0	01/22/2009	1	1	2009	7	65	28	26.2	737.43	.	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Emory	ERM 6.0	01/22/2009	1	1	2009	8	75	34	32.2	737.43	.	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Emory	ERM 6.0	01/22/2009	1	1	2009	9	85	35	33.2	737.43	.	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Emory	ERM 6.0	01/22/2009	1	1	2009	10	95	24	22.2	737.43	.	No	.	0	0	0	0	0	0	90	0	10	0	0	0	100
Emory	ERM 6.0	12/03/2009	2	12	2009	1	5	11.4	10.8	736.28	.	No	.	0	0	0	0	55	0	40	0	5	0	0	0	100
Emory	ERM 6.0	12/03/2009	2	12	2009	2	15	25.9	25.3	736.28	.	No	.	0	0	0	0	25	0	55	0	20	0	0	0	100
Emory	ERM 6.0	12/03/2009	2	12	2009	3	25	31.2	30.6	736.28	.	No	.	0	0	0	0	0	0	90	0	10	0	0	0	100
Emory	ERM 6.0	12/03/2009	2	12	2009	4	35	30.9	30.3	736.28	.	No	.	0	0	0	0	55	0	30	0	15	0	0	0	100
Emory	ERM 6.0	12/03/2009	2	12	2009	5	45	31.3	30.7	736.28	.	No	.	0	0	0	0	0	0	80	0	20	0	0	0	100
Emory	ERM 6.0	12/03/2009	2	12	2009	6	55	33.4	32.8	736.28	.	No	.	0	0	0	0	0	0	85	0	15	0	0	0	100
Emory	ERM 6.0	12/03/2009	2	12	2009	7	65	34	33.4	736.28	.	No	.	0	0	0	0	60	0	15	0	25	0	0	0	100
Emory	ERM 6.0	12/03/2009	2	12	2009	8	75	33.2	32.6	736.28	.	No	.	0	0	0	5	0	0	5	0	90	0	0	0	100
Emory	ERM 6.0	12/03/2009	2	12	2009	9	85	32.2	31.6	736.28	.	No	.	0	0	0	0	25	0	60	0	13	0	0	0	98
Emory	ERM 6.0	12/03/2009	2	12	2009	10	95	14.4	13.8	736.28	.	No	.	0	40	0	0	0	0	30	0	25	0	0	0	95
Emory	ERM 6.0	12/20/2010	3	12	2010	1	5	9.8	8.7	736.76	75	No	.	0	0	0	0	20	0	60	0	20	0	0	0	100
Emory	ERM 6.0	12/20/2010	3	12	2010	2	15	22.7	21.6	736.76	60	No	.	0	0	0	0	45	0	45	0	10	0	0	0	100
Emory	ERM 6.0	12/20/2010	3	12	2010	3	25	32.6	31.5	736.76	85	No	.	0	0	0	0	15	0	65	0	20	0	0	0	100
Emory	ERM 6.0	12/20/2010	3	12	2010	4	35	35	33.9	736.76	90	No	.	0	0	0	0	10	0	75	0	15	0	0	0	100
Emory	ERM 6.0	12/20/2010	3	12	2010	5	45	35.7	34.6	736.76	80	No	.	0	0	0	0	45	0	45	0	10	0	0	0	100
Emory	ERM 6.0	12/20/2010	3	12	2010	6	55	37.5	36.4	736.76	60	No	.	0	0	0	0	85	0	5	0	10	0	0	0	100
Emory	ERM 6.0	12/20/2010	3	12	2010	7	65	37.1	36.0	736.76	60	No	.	0	0	0	10	80	0	0	0	10	0	0	0	100
Emory	ERM 6.0	12/20/2010	3	12	2010	8	75	37.2	36.1	736.76	80	No	.	0	0	0	15	70	0	0	0	0	15	0	0	100
Emory	ERM 6.0	12/20/2010	3	12	2010	9	85	35.3	34.2	736.76	70	No	.	0	0	0	0	0	0	80	0	20	0	0	0	100
Emory	ERM 6.0	12/20/2010	3	12	2010	10	95	14	12.9	736.76	85	No	.	0	0	0	5	0	0	50	0	45	0	0	0	100
Emory	ERM 5.0	01/22/2009	1	1	2009	1	5	21	19.2	737.43	.	Yes	30	0	0	0	0	0	0	0	0	15	0	85	0	100
Emory	ERM 5.0	01/22/2009	1	1	2009	2	15	31	29.2	737.43	.	Yes	100	0	0	0	0	0	0	0	0	5	0	95	0	100
Emory	ERM 5.0	01/22/2009	1	1	2009	3	25	35	33.2	737.43	.	Yes	100	0	0	0	0	0	0	0	0	5	0	95	0	100
Emory	ERM 5.0	01/22/2009	1	1	2009	4	35	35	33.2	737.43	.	Yes	100	0	0	0	0	0	0	0	0	2	0	98	0	100
Emory	ERM 5.0	01/22/2009	1	1	2009	5	45	35	33.2	737.43	.	Yes	100	0	0	0	0	0	0	0	0	2	0	98	0	100
Emory	ERM 5.0	01/22/2009	1	1	2009	6	55	34	32.2	737.43	.	Yes	100	0	0	0	0	0	0	0	0	5	0	95	0	100
Emory	ERM 5.0	01/22/2009	1	1	2009	7	65	34	32.2	737.43	.	Yes	100	0	0	0	0	0	0	0	0	2	0	98	0	100
Emory	ERM 5.0	01/22/2009	1	1	2009	8	75	31	29.2	737.43	.	Yes	50	0	0	0	0	0	0	0	0	60	0	40	0	100
Emory	ERM 5.0	01/22/2009	1	1	2009	9	85	24	22.2	737.43	.	Yes	1	0	0	0	0	50	0	0	0	48	0	0	0	98
Emory	ERM 5.0	01/22/2009	1	1	2009	10	95	15	13.2	737.43	.	No	.	0	0	0	0	90	0	5	0	5	0	0	0	100
Emory	ERM 5.0	12/03/2009	2	12	2009	1	5	31.1	30.5	736.28	.	Yes	.	0	0	0	0	0	0	5	0	30	0	65	0	100

Table A-1, continued.

River	Site	Date	Sample Period	MM	YY	Sample #	% from Left Bank	Water Depth (feet)	Standardized Water Depth [1]	Reservoir Surface Elevation (feet)	Dredge % Full	Ash Detected	Depth of Ash (mm)	Bedrock	Boulder	Cobble	Gravel	Sand	Hardpan Clay	Fines	Mollusk Shell	Detritus	Woody Debris	Ash	Coal/Gravel	% Classified
Emory	ERM 5.0	12/03/2009	2	12	2009	2	15	33.1	32.5	736.28	.	Yes	.	0	0	0	5	0	0	0	0	20	0	70	0	95
Emory	ERM 5.0	12/03/2009	2	12	2009	3	25	35	34.4	736.28	.	Yes	.	0	0	0	0	0	0	5	0	25	0	70	0	100
Emory	ERM 5.0	12/03/2009	2	12	2009	4	35	35.4	34.8	736.28	.	Yes	.	0	0	0	0	0	0	5	0	20	0	75	0	100
Emory	ERM 5.0	12/03/2009	2	12	2009	5	45	35.4	34.8	736.28	.	Yes	.	0	0	0	0	0	0	5	0	40	0	55	0	100
Emory	ERM 5.0	12/03/2009	2	12	2009	6	55	33	32.4	736.28	.	No	.	0	0	0	55	0	0	30	0	10	0	0	0	95
Emory	ERM 5.0	12/03/2009	2	12	2009	7	65	31.6	31.0	736.28	.	No	.	0	0	0	35	30	0	0	0	35	0	0	0	100
Emory	ERM 5.0	12/03/2009	2	12	2009	8	75	29.7	29.1	736.28	.	No	.	0	0	0	45	35	0	0	0	15	0	0	0	95
Emory	ERM 5.0	12/03/2009	2	12	2009	9	85	24.1	23.5	736.28	.	No	.	0	0	0	0	35	0	20	0	40	0	0	0	95
Emory	ERM 5.0	12/03/2009	2	12	2009	10	95	15.8	15.2	736.28	.	No	.	0	0	0	0	65	0	35	0	0	0	0	0	100
Emory	ERM 5.0	12/15/2010	3	12	2010	1	5	18.6	17.5	736.76	90	Yes	.	0	0	0	0	0	0	0	0	40	0	60	0	100
Emory	ERM 5.0	12/15/2010	3	12	2010	2	15	35.2	34.1	736.76	90	Yes	.	0	0	0	0	0	0	0	0	15	0	85	0	100
Emory	ERM 5.0	12/15/2010	3	12	2010	3	25	37.2	36.1	736.76	90	Yes	.	0	0	0	0	0	0	0	0	15	0	85	0	100
Emory	ERM 5.0	12/15/2010	3	12	2010	4	35	35.6	34.5	736.76	100	Yes	.	0	0	0	0	0	0	0	0	20	0	80	0	100
Emory	ERM 5.0	12/15/2010	3	12	2010	5	45	35.1	34.0	736.76	80	Yes	.	0	0	0	0	75	0	0	0	0	0	0	25	100
Emory	ERM 5.0	12/15/2010	3	12	2010	6	55	32.8	31.7	736.76	50	No	.	0	0	0	0	50	0	0	0	0	0	0	50	100
Emory	ERM 5.0	12/15/2010	3	12	2010	7	65	31.1	30.0	736.76	30	No	.	0	0	0	0	60	0	0	0	0	0	0	40	100
Emory	ERM 5.0	12/15/2010	3	12	2010	8	75	27.4	26.3	736.76	40	No	.	0	0	0	0	60	0	0	0	0	0	0	40	100
Emory	ERM 5.0	12/15/2010	3	12	2010	9	85	21.3	20.2	736.76	20	No	.	0	0	0	0	5	95	0	0	0	0	0	0	100
Emory	ERM 5.0	12/15/2010	3	12	2010	10	95	12.5	11.4	736.76	30	No	.	0	0	0	0	0	95	0	0	5	0	0	0	100
Emory	ERM 4.1	12/16/2009	2	12	2009	1	5	13	11.0	737.68	.	No	.	0	0	0	0	0	0	90	0	10	0	0	0	100
Emory	ERM 4.1	12/16/2009	2	12	2009	2	15	5	3.0	737.68	.	No	.	0	0	0	0	0	0	30	0	70	0	0	0	100
Emory	ERM 4.1	12/16/2009	2	12	2009	3	25	3	1.0	737.68	.	No	.	0	0	0	0	30	0	40	0	15	0	0	0	85
Emory	ERM 4.1	12/16/2009	2	12	2009	4	35	9.5	7.5	737.68	.	No	.	0	0	0	0	55	0	25	0	15	0	0	0	95
Emory	ERM 4.1	12/16/2009	2	12	2009	5	45	14	12.0	737.68	.	No	.	0	0	0	0	35	0	40	0	15	0	0	0	90
Emory	ERM 4.1	12/16/2009	2	12	2009	6	55	16.5	14.5	737.68	.	No	.	0	0	0	0	0	0	0	0	100	0	0	0	100
Emory	ERM 4.1	12/16/2009	2	12	2009	7	65	23.3	21.3	737.68	.	No	.	0	0	0	0	40	0	0	0	60	0	0	0	100
Emory	ERM 4.1	12/16/2009	2	12	2009	8	75	27.5	25.5	737.68	.	No	.	0	0	0	0	50	0	20	0	30	0	0	0	100
Emory	ERM 4.1	12/16/2009	2	12	2009	9	85	31	29.0	737.68	.	Yes	.	0	0	0	0	0	0	10	0	10	0	80	0	100
Emory	ERM 4.1	12/16/2009	2	12	2009	10	95	9.1	7.1	737.68	.	No	.	0	0	5	0	45	0	50	0	0	0	0	0	100
Emory	ERM 4.1	12/06/2010	3	12	2010	1	5	14.1	10.5	739.2	40	No	.	0	0	0	10	0	0	70	0	19	0	0	0	99
Emory	ERM 4.1	12/06/2010	3	12	2010	2	15	16.3	12.7	739.2	100	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Emory	ERM 4.1	12/06/2010	3	12	2010	3	25	16.4	12.8	739.2	100	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Emory	ERM 4.1	12/06/2010	3	12	2010	4	35	16.4	12.8	739.2	100	Yes	.	0	0	0	0	0	0	80	0	20	0	0	0	100
Emory	ERM 4.1	12/06/2010	3	12	2010	5	45	15.9	12.3	739.2	100	No	.	0	0	0	0	0	0	60	0	40	0	0	0	100
Emory	ERM 4.1	12/06/2010	3	12	2010	6	55	17.1	13.5	739.2	95	No	.	0	0	0	0	0	0	55	0	45	0	0	0	100
Emory	ERM 4.1	12/06/2010	3	12	2010	7	65	25.4	21.8	739.2	100	No	.	0	0	0	0	0	0	15	0	85	0	0	0	100
Emory	ERM 4.1	12/06/2010	3	12	2010	8	75	26.3	22.7	739.2	100	No	.	0	0	0	0	0	0	5	0	95	0	0	0	100
Emory	ERM 4.1	12/06/2010	3	12	2010	9	85	31.9	28.3	739.2	65	No	.	0	0	0	0	95	0	0	0	0	0	0	5	100
Emory	ERM 4.1	12/06/2010	3	12	2010	10	95	5.5	1.9	739.2	45	No	.	0	0	0	0	5	45	0	0	20	0	0	0	70
Emory	ERM 3.0	12/09/2010	3	12	2010	1	5	3.3	1.0	737.97	10	No	.	0	0	0	0	0	85	15	0	0	0	0	0	100
Emory	ERM 3.0	12/09/2010	3	12	2010	2	15	3.4	1.1	737.97	40	No	.	0	0	0	0	70	0	25	0	5	0	0	0	100

Table A-1, continued.

River	Site	Date	Sample Period	MM	YY	Sample #	% from Left Bank	Water Depth (feet)	Standardized Water Depth [1]	Reservoir Surface Elevation (feet)	Dredge % Full	Ash Detected	Depth of Ash (mm)	Bedrock	Boulder	Cobble	Gravel	Sand	Hardpan Clay	Fines	Mollusk Shell	Detritus	Woody Debris	Ash	Coal/Gravel	% Classified
Emory	ERM 3.0	12/09/2010	3	12	2010	3	25	11.6	9.3	737.97	90	No	.	0	0	0	0	20	0	10	0	70	0	0	0	100
Emory	ERM 3.0	12/09/2010	3	12	2010	4	35	26	23.7	737.97	90	No	.	0	0	0	0	0	0	0	0	100	0	0	0	100
Emory	ERM 3.0	12/09/2010	3	12	2010	5	45	31	28.7	737.97	60	Yes	.	0	0	0	0	0	0	0	0	20	0	80	0	100
Emory	ERM 3.0	12/09/2010	3	12	2010	6	55	7.3	5.0	737.97	35	No	.	0	0	0	0	0	100	0	0	0	0	0	0	100
Emory	ERM 3.0	12/09/2010	3	12	2010	7	65	2.4	0.1	737.97	100	No	.	0	0	0	0	0	0	60	0	40	0	0	0	100
Emory	ERM 3.0	12/09/2010	3	12	2010	8	75	4.8	2.5	737.97	100	Yes	.	0	0	0	0	0	0	85	0	10	0	5	0	100
Emory	ERM 3.0	12/09/2010	3	12	2010	9	85	4.1	1.8	737.97	100	Yes	.	0	0	0	0	0	0	60	0	5	0	35	0	100
Emory	ERM 3.0	12/09/2010	3	12	2010	10	95	4.8	2.5	737.97	100	Yes	.	0	0	0	0	0	0	80	0	0	0	20	0	100
Emory	ERM 2.6	01/17/2011	3	1	2011	1	5	6.7	5.9	736.47	50	Yes	.	0	0	0	0	0	0	80	0	10	0	10	0	100
Emory	ERM 2.6	01/17/2011	3	1	2011	2	15	6.3	5.5	736.47	85	Yes	.	0	0	0	0	0	0	80	0	10	0	10	0	100
Emory	ERM 2.6	01/17/2011	3	1	2011	3	25	7.1	6.3	736.47	90	Yes	.	0	0	0	0	0	0	70	0	15	0	15	0	100
Emory	ERM 2.6	01/17/2011	3	1	2011	4	35	8.2	7.4	736.47	90	Yes	.	0	0	0	0	0	0	70	0	10	0	15	0	95
Emory	ERM 2.6	01/17/2011	3	1	2011	5	45	4	3.2	736.47	100	Yes	.	0	0	0	0	0	0	60	0	25	0	15	0	100
Emory	ERM 2.6	01/17/2011	3	1	2011	6	55	11.1	10.3	736.47	100	Yes	.	0	0	0	0	0	0	5	0	90	0	0	0	95
Emory	ERM 2.6	01/17/2011	3	1	2011	7	65	18.3	17.5	736.47	50	Yes	.	0	0	0	0	0	0	65	0	25	0	10	0	100
Emory	ERM 2.6	01/17/2011	3	1	2011	8	75	29.9	29.1	736.47	65	Yes	.	0	0	0	0	20	0	20	0	0	0	60	0	100
Emory	ERM 2.6	01/17/2011	3	1	2011	9	85	27.3	26.5	736.47	70	Yes	.	0	0	0	0	0	0	15	0	5	0	70	0	90
Emory	ERM 2.6	01/17/2011	3	1	2011	10	95	7.7	6.9	736.47	70	Yes	.	0	0	0	20	0	0	20	0	0	0	55	0	95
Emory	ERM 2.2	12/17/2009	2	12	2009	1	5	3	1.7	736.95	.	No	.	0	0	0	0	0	0	100	0	0	0	0	0	100
Emory	ERM 2.2	12/17/2009	2	12	2009	2	15	4.7	3.4	736.95	.	Yes	.	0	0	0	0	0	0	95	0	0	0	5	0	100
Emory	ERM 2.2	12/17/2009	2	12	2009	3	25	4.8	3.5	736.95	.	Yes	.	0	0	0	0	0	0	95	0	0	0	5	0	100
Emory	ERM 2.2	12/17/2009	2	12	2009	4	35	6.5	5.2	736.95	.	No	.	0	0	0	0	0	0	95	0	0	0	0	0	95
Emory	ERM 2.2	12/17/2009	2	12	2009	5	45	6.8	5.5	736.95	.	Yes	.	0	0	0	0	0	0	10	0	65	0	25	0	100
Emory	ERM 2.2	12/17/2009	2	12	2009	6	55	7.1	5.8	736.95	.	Yes	.	0	0	0	0	0	0	10	0	75	0	10	0	95
Emory	ERM 2.2	12/17/2009	2	12	2009	7	65	4.1	2.8	736.95	.	Yes	.	0	0	0	0	0	0	45	0	10	0	45	0	100
Emory	ERM 2.2	12/17/2009	2	12	2009	8	75	10.5	9.2	736.95	.	Yes	.	0	0	0	0	0	0	25	0	5	0	70	0	100
Emory	ERM 2.2	12/17/2009	2	12	2009	9	85	15.1	13.8	736.95	.	Yes	.	0	0	0	0	0	0	0	0	0	0	99	0	99
Emory	ERM 2.2	12/17/2009	2	12	2009	10	95	19.4	18.1	736.95	.	Yes	.	0	0	0	0	0	0	0	0	0	0	99	0	99
Emory	ERM 2.2	12/08/2010	3	12	2010	1	5	5	2.4	738.24	40	No	.	0	0	0	0	0	0	100	0	0	0	0	0	100
Emory	ERM 2.2	12/08/2010	3	12	2010	2	15	5.9	3.3	738.24	50	No	.	0	0	0	0	0	0	100	0	0	0	0	0	100
Emory	ERM 2.2	12/08/2010	3	12	2010	3	25	7.2	4.6	738.24	10	No	.	0	0	0	5	0	95	0	0	0	0	0	0	100
Emory	ERM 2.2	12/08/2010	3	12	2010	4	35	11.1	8.5	738.24	100	No	.	0	0	0	0	0	0	90	0	10	0	0	0	100
Emory	ERM 2.2	12/08/2010	3	12	2010	5	45	6.2	3.6	738.24	100	No	.	0	0	0	0	0	0	35	0	65	0	0	0	100
Emory	ERM 2.2	12/08/2010	3	12	2010	6	55	9.5	6.9	738.24	100	No	.	0	0	0	0	0	0	20	0	80	0	0	0	100
Emory	ERM 2.2	12/08/2010	3	12	2010	7	65	16.1	13.5	738.24	100	Yes	.	0	0	0	0	0	0	20	0	70	0	10	0	100
Emory	ERM 2.2	12/08/2010	3	12	2010	8	75	23.2	20.6	738.24	50	Yes	.	0	0	0	0	0	0	65	0	0	0	35	0	100
Emory	ERM 2.2	12/08/2010	3	12	2010	9	85	30.3	27.7	738.24	100	Yes	.	0	0	0	0	0	0	25	0	0	0	75	0	100
Emory	ERM 2.2	12/08/2010	3	12	2010	10	95	25.3	22.7	738.24	25	Yes	.	0	0	0	35	0	35	0	0	0	0	30	0	100
Emory	ERM 1.0	01/21/2009	1	1	2009	1	5	11	6.5	740.16	.	No	.	0	0	0	0	0	0	60	0	40	0	0	0	100
Emory	ERM 1.0	01/21/2009	1	1	2009	2	15	13.6	9.1	740.16	.	No	.	0	0	0	0	0	0	65	0	35	0	0	0	100
Emory	ERM 1.0	01/21/2009	1	1	2009	3	25	14	9.5	740.16	.	No	.	0	0	0	0	0	0	90	0	10	0	0	0	100

Table A-1, continued.

River	Site	Date	Sample Period	MM	YY	Sample #	% from Left Bank	Water Depth (feet)	Standardized Water Depth [1]	Reservoir Surface Elevation (feet)	Dredge % Full	Ash Detected	Depth of Ash (mm)	Bedrock	Boulder	Cobble	Gravel	Sand	Hardpan Clay	Fines	Mollusk Shell	Detritus	Woody Debris	Ash	Coal/Gravel	% Classified
Emory	ERM 1.0	01/21/2009	1	1	2009	4	35	29.4	24.9	740.16	.	Yes	55	0	0	0	0	0	0	0	0	15	0	85	0	100
Emory	ERM 1.0	01/21/2009	1	1	2009	5	45	22.5	18.0	740.16	.	Yes	15	0	0	0	0	0	0	55	0	15	0	20	0	90
Emory	ERM 1.0	01/21/2009	1	1	2009	6	55	17.6	13.1	740.16	.	Yes	25	0	0	0	0	0	0	55	0	15	0	30	0	100
Emory	ERM 1.0	01/21/2009	1	1	2009	7	65	13	8.5	740.16	.	Yes	45	0	0	0	0	0	0	20	0	20	0	50	0	90
Emory	ERM 1.0	01/21/2009	1	1	2009	8	75	12.1	7.6	740.16	.	Yes	11	0	0	0	0	0	0	30	0	25	0	45	0	100
Emory	ERM 1.0	01/21/2009	1	1	2009	9	85	10.9	6.4	740.16	.	Yes	35	0	0	0	0	0	0	25	0	20	0	55	0	100
Emory	ERM 1.0	01/21/2009	1	1	2009	10	95	9.6	5.1	740.16	.	Yes	1	0	0	0	0	0	0	93	0	5	0	0	0	98
Emory	ERM 1.0	12/01/2009	2	12	2009	1	5	8.7	8.5	735.88	.	Yes	.	0	0	0	15	0	0	20	0	0	0	60	0	95
Emory	ERM 1.0	12/01/2009	2	12	2009	2	15	5.5	5.3	735.88	.	Yes	.	0	0	0	0	0	0	5	0	10	0	85	0	100
Emory	ERM 1.0	12/01/2009	2	12	2009	3	25	6.7	6.5	735.88	.	Yes	.	0	0	0	0	0	0	10	0	10	0	80	0	100
Emory	ERM 1.0	12/01/2009	2	12	2009	4	35	21.7	21.5	735.88	.	Yes	.	0	0	0	0	0	0	5	0	60	0	35	0	100
Emory	ERM 1.0	12/01/2009	2	12	2009	5	45	18.2	18.0	735.88	.	Yes	.	0	0	0	0	0	0	35	0	10	0	55	0	100
Emory	ERM 1.0	12/01/2009	2	12	2009	6	55	13.3	13.1	735.88	.	Yes	.	0	0	0	0	0	0	60	0	25	0	15	0	100
Emory	ERM 1.0	12/01/2009	2	12	2009	7	65	11.2	11.0	735.88	.	No	.	0	0	0	0	0	0	75	0	25	0	0	0	100
Emory	ERM 1.0	12/01/2009	2	12	2009	8	75	8.4	8.2	735.88	.	No	.	0	0	0	0	15	0	50	0	30	0	0	0	95
Emory	ERM 1.0	12/01/2009	2	12	2009	9	85	6.5	6.3	735.88	.	Yes	.	0	0	0	0	0	0	65	0	10	0	20	0	95
Emory	ERM 1.0	12/01/2009	2	12	2009	10	95	4.5	4.3	735.88	.	Yes	.	0	0	0	0	0	0	30	0	40	0	30	0	100
Emory	ERM 1.0	12/06/2010	3	12	2010	1	5	10.8	7.2	739.2	50	Yes	.	0	0	0	5	0	0	25	0	0	0	70	0	100
Emory	ERM 1.0	12/06/2010	3	12	2010	2	15	8.9	5.3	739.2	75	Yes	.	0	0	0	0	0	0	45	0	0	0	55	0	100
Emory	ERM 1.0	12/06/2010	3	12	2010	3	25	7.1	3.5	739.2	100	Yes	.	0	0	0	0	0	0	50	0	0	0	50	0	100
Emory	ERM 1.0	12/06/2010	3	12	2010	4	35	8.5	4.9	739.2	100	Yes	.	0	0	0	0	0	0	60	0	0	0	40	0	100
Emory	ERM 1.0	12/06/2010	3	12	2010	5	45	24	20.4	739.2	75	Yes	.	0	0	0	0	5	0	85	0	0	0	10	0	100
Emory	ERM 1.0	12/06/2010	3	12	2010	6	55	12.1	8.5	739.2	75	No	.	0	0	0	0	20	0	75	0	5	0	0	0	100
Emory	ERM 1.0	12/06/2010	3	12	2010	7	65	7.9	4.3	739.2	75	No	.	0	0	0	0	65	0	30	0	5	0	0	0	100
Emory	ERM 1.0	12/06/2010	3	12	2010	8	75	4.2	0.6	739.2	100	Yes	.	0	0	0	0	0	0	80	0	10	0	10	0	100
Emory	ERM 1.0	12/06/2010	3	12	2010	9	85	7.5	3.9	739.2	100	Yes	.	0	0	0	0	0	0	75	0	20	0	5	0	100
Emory	ERM 1.0	12/06/2010	3	12	2010	10	95	6.7	3.1	739.2	100	Yes	.	0	0	0	0	0	0	100	0	0	0	0	0	100
Clinch	CRM 8.7	01/23/2009	1	1	2009	1	5	25.7	24.3	737.07	.	No	.	0	0	0	60	0	0	10	30	0	0	0	0	100
Clinch	CRM 8.7	01/23/2009	1	1	2009	2	15	31.2	29.8	737.07	.	No	.	0	0	0	60	40	0	0	0	0	0	0	0	100
Clinch	CRM 8.7	01/23/2009	1	1	2009	3	25	30.8	29.4	737.07	.	No	.	0	0	0	15	50	0	0	0	35	0	0	0	100
Clinch	CRM 8.7	01/23/2009	1	1	2009	4	35	31.8	30.4	737.07	.	No	.	0	0	0	70	0	0	25	5	0	0	0	0	100
Clinch	CRM 8.7	01/23/2009	1	1	2009	5	45	30.5	29.1	737.07	.	No	.	0	0	0	0	50	0	20	0	30	0	0	0	100
Clinch	CRM 8.7	01/23/2009	1	1	2009	6	55	21.7	20.3	737.07	.	No	.	0	0	0	0	15	0	65	0	25	0	0	0	105
Clinch	CRM 8.7	01/23/2009	1	1	2009	7	65	10.1	8.7	737.07	.	No	.	0	0	0	0	0	0	75	0	25	0	0	0	100
Clinch	CRM 8.7	01/23/2009	1	1	2009	8	75	7.2	5.8	737.07	.	No	.	0	0	0	0	0	0	75	0	25	0	0	0	100
Clinch	CRM 8.7	01/23/2009	1	1	2009	9	85	5.4	4.0	737.07	.	No	.	0	0	0	0	0	0	75	0	25	0	0	0	100
Clinch	CRM 8.7	01/23/2009	1	1	2009	10	95	4.5	3.1	737.07	.	No	.	0	0	0	0	35	0	50	0	15	0	0	0	100
Clinch	CRM 8.7	12/01/2009	2	12	2009	1	5	16.6	16.4	735.88	.	No	.	0	0	0	35	0	0	35	20	0	0	0	0	90
Clinch	CRM 8.7	12/01/2009	2	12	2009	2	15	22	21.8	735.88	.	No	.	0	0	0	60	10	0	0	25	0	0	0	0	95
Clinch	CRM 8.7	12/01/2009	2	12	2009	3	25	23.3	23.1	735.88	.	No	.	0	0	0	30	30	0	0	30	0	0	0	0	90
Clinch	CRM 8.7	12/01/2009	2	12	2009	4	35	23.8	23.6	735.88	.	No	.	0	0	0	70	0	0	0	25	0	0	0	0	95

Table A-1, continued.

River	Site	Date	Sample Period	MM	YY	Sample #	% from Left Bank	Water Depth (feet)	Standardized Water Depth [1]	Reservoir Surface Elevation (feet)	Dredge % Full	Ash Detected	Depth of Ash (mm)	Bedrock	Boulder	Cobble	Gravel	Sand	Hardpan Clay	Fines	Mollusk Shell	Detritus	Woody Debris	Ash	Coal/Gravel	% Classified
Clinch	CRM 8.7	12/01/2009	2	12	2009	5	45	25.7	25.5	735.88	.	No	.	0	0	0	10	5	0	0	80	0	0	0	0	95
Clinch	CRM 8.7	12/01/2009	2	12	2009	6	55	26.5	26.3	735.88	.	No	.	0	0	0	0	0	0	0	98	0	0	0	0	98
Clinch	CRM 8.7	12/01/2009	2	12	2009	7	65	27.6	27.4	735.88	.	No	.	0	0	0	85	10	0	0	2	0	0	0	0	97
Clinch	CRM 8.7	12/01/2009	2	12	2009	8	75	24.7	24.5	735.88	.	No	.	0	0	0	1	90	0	0	0	5	0	0	0	96
Clinch	CRM 8.7	12/01/2009	2	12	2009	9	85	17.9	17.7	735.88	.	No	.	0	0	0	0	60	0	10	0	25	0	0	0	95
Clinch	CRM 8.7	12/01/2009	2	12	2009	10	95	9.8	9.6	735.88	.	No	.	0	0	0	0	15	0	15	0	65	0	0	0	95
Clinch	CRM 8.7	12/15/2010	3	12	2010	1	5	8.2	7.1	736.76	20	No	.	0	0	0	0	0	20	70	0	10	0	0	0	100
Clinch	CRM 8.7	12/15/2010	3	12	2010	2	15	23	21.9	736.76	35	No	.	0	0	0	70	0	10	0	0	15	0	0	0	95
Clinch	CRM 8.7	12/15/2010	3	12	2010	3	25	26	24.9	736.76	35	No	.	0	0	0	75	0	0	10	0	5	0	0	0	90
Clinch	CRM 8.7	12/15/2010	3	12	2010	4	35	28	26.9	736.76	25	No	.	0	0	0	0	70	0	10	0	20	0	0	0	100
Clinch	CRM 8.7	12/15/2010	3	12	2010	5	45	26	24.9	736.76	45	No	.	0	0	0	0	5	0	60	0	30	0	0	0	95
Clinch	CRM 8.7	12/15/2010	3	12	2010	6	55	14.4	13.3	736.76	55	No	.	0	0	0	0	0	0	60	0	40	0	0	0	100
Clinch	CRM 8.7	12/15/2010	3	12	2010	7	65	4	2.9	736.76	85	No	.	0	0	0	0	0	0	60	1	35	0	0	0	96
Clinch	CRM 8.7	12/15/2010	3	12	2010	8	75	1.6	0.5	736.76	30	No	.	0	0	0	10	0	15	70	0	0	0	0	0	95
Clinch	CRM 8.7	12/15/2010	3	12	2010	9	85	1.4	0.3	736.76	80	No	.	0	0	0	0	0	0	60	0	40	0	0	0	100
Clinch	CRM 8.7	12/15/2010	3	12	2010	10	95	2.1	1.0	736.76	80	No	.	0	0	0	0	0	20	50	0	30	0	0	0	100
Clinch	CRM 6.0	01/22/2009	1	1	2009	1	5	41.5	39.7	737.43	.	No	.	0	0	0	45	0	0	50	5	0	0	0	0	100
Clinch	CRM 6.0	01/22/2009	1	1	2009	2	15	37.5	35.7	737.43	.	No	.	0	0	0	0	20	0	30	0	50	0	0	0	100
Clinch	CRM 6.0	01/22/2009	1	1	2009	3	25	32.6	30.8	737.43	.	No	.	0	0	0	45	0	0	20	0	35	0	0	0	100
Clinch	CRM 6.0	01/22/2009	1	1	2009	4	35	32.7	30.9	737.43	.	No	.	0	0	0	0	50	0	10	0	40	0	0	0	100
Clinch	CRM 6.0	01/22/2009	1	1	2009	5	45	31.6	29.8	737.43	.	No	.	0	0	0	0	20	0	40	0	35	0	0	0	95
Clinch	CRM 6.0	01/22/2009	1	1	2009	6	55	28.6	26.8	737.43	.	No	.	0	0	0	0	0	0	80	0	20	0	0	0	100
Clinch	CRM 6.0	01/22/2009	1	1	2009	7	65	20.6	18.8	737.43	.	No	.	0	0	0	0	0	0	85	0	15	0	0	0	100
Clinch	CRM 6.0	01/22/2009	1	1	2009	8	75	12.3	10.5	737.43	.	No	.	0	0	0	0	0	0	90	0	10	0	0	0	100
Clinch	CRM 6.0	01/22/2009	1	1	2009	9	85	6.9	5.1	737.43	.	No	.	0	0	0	0	0	0	85	0	15	0	0	0	100
Clinch	CRM 6.0	01/22/2009	1	1	2009	10	95	5.4	3.6	737.43	.	No	.	0	0	0	0	0	0	70	0	30	0	0	0	100
Clinch	CRM 6.0	12/03/2009	2	12	2009	1	5	28.3	27.7	736.28	.	No	.	0	0	0	25	0	0	50	25	0	0	0	0	100
Clinch	CRM 6.0	12/03/2009	2	12	2009	2	15	30.3	29.7	736.28	.	No	.	0	0	0	65	5	0	0	30	0	0	0	0	100
Clinch	CRM 6.0	12/03/2009	2	12	2009	3	25	31.8	31.2	736.28	.	No	.	0	0	0	80	10	0	0	10	0	0	0	0	100
Clinch	CRM 6.0	12/03/2009	2	12	2009	4	35	32.6	32.0	736.28	.	No	.	0	0	0	95	1	0	0	1	0	0	0	0	97
Clinch	CRM 6.0	12/03/2009	2	12	2009	5	45	32.3	31.7	736.28	.	No	.	0	0	0	95	1	0	0	1	0	0	0	0	97
Clinch	CRM 6.0	12/03/2009	2	12	2009	6	55	31.8	31.2	736.28	.	No	.	0	0	0	85	10	0	0	0	1	0	0	0	96
Clinch	CRM 6.0	12/03/2009	2	12	2009	7	65	24.9	24.3	736.28	.	No	.	0	0	0	0	15	0	10	0	76	0	0	0	101
Clinch	CRM 6.0	12/03/2009	2	12	2009	8	75	19.8	19.2	736.28	.	No	.	0	0	0	0	5	0	30	0	65	0	0	0	100
Clinch	CRM 6.0	12/03/2009	2	12	2009	9	85	9.3	8.7	736.28	.	No	.	0	0	0	0	5	0	50	0	55	0	0	0	110
Clinch	CRM 6.0	12/03/2009	2	12	2009	10	95	6.1	5.5	736.28	.	No	.	0	0	0	0	5	0	5	0	90	0	0	0	100
Clinch	CRM 6.0	12/09/2010	3	12	2010	1	5	29.3	27.0	737.97	10	No	.	0	0	0	85	0	0	0	15	0	0	0	0	100
Clinch	CRM 6.0	12/09/2010	3	12	2010	2	15	35.1	32.8	737.97	80	No	.	0	0	0	30	40	0	0	30	0	0	0	0	100
Clinch	CRM 6.0	12/09/2010	3	12	2010	3	25	33.2	30.9	737.97	50	No	.	0	0	0	30	40	0	0	30	0	0	0	0	100
Clinch	CRM 6.0	12/09/2010	3	12	2010	4	35	30.5	28.2	737.97	60	No	.	0	0	0	0	0	0	30	0	70	0	0	0	100
Clinch	CRM 6.0	12/09/2010	3	12	2010	5	45	17.9	15.6	737.97	60	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100

Table A-1, continued.

River	Site	Date	Sample Period	MM	YY	Sample #	% from Left Bank	Water Depth (feet)	Standardized Water Depth [1]	Reservoir Surface Elevation (feet)	Dredge % Full	Ash Detected	Depth of Ash (mm)	Bedrock	Boulder	Cobble	Gravel	Sand	Hardpan Clay	Fines	Mollusk Shell	Detritus	Woody Debris	Ash	Coal/Gravel	% Classified
Clinch	CRM 6.0	12/09/2010	3	12	2010	6	55	5.5	3.2	737.97	60	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Clinch	CRM 6.0	12/09/2010	3	12	2010	7	65	3.3	1.0	737.97	50	No	.	0	0	0	0	0	0	20	0	80	0	0	0	100
Clinch	CRM 6.0	12/09/2010	3	12	2010	8	75	2.9	0.6	737.97	50	No	.	0	0	0	0	0	0	20	0	80	0	0	0	100
Clinch	CRM 6.0	12/09/2010	3	12	2010	9	85	3	0.7	737.97	75	No	.	0	0	0	0	0	0	20	0	80	0	0	0	100
Clinch	CRM 6.0	12/09/2010	3	12	2010	10	95	2.7	0.4	737.97	50	No	.	0	0	0	30	0	0	0	0	70	0	0	0	100
Clinch	CRM 4.0	01/21/2009	1	1	2009	1	5	8	3.5	740.16	.	No	.	0	0	0	8	0	0	90	0	0	0	0	0	98
Clinch	CRM 4.0	01/21/2009	1	1	2009	2	15	25	20.5	740.16	.	No	.	0	0	0	0	0	0	90	0	10	0	0	0	100
Clinch	CRM 4.0	01/21/2009	1	1	2009	3	25	34	29.5	740.16	.	Yes	0.5	0	0	0	0	0	0	90	0	9	0	0	0	99
Clinch	CRM 4.0	01/21/2009	1	1	2009	4	35	35	30.5	740.16	.	Yes	2	0	0	0	0	0	0	90	0	10	0	0	0	100
Clinch	CRM 4.0	01/21/2009	1	1	2009	5	45	27	22.5	740.16	.	Yes	1	0	0	0	0	0	0	10	0	90	0	0	0	100
Clinch	CRM 4.0	01/21/2009	1	1	2009	6	55	4	-0.5	740.16	.	No	.	0	0	0	0	0	0	0	0	100	0	0	0	100
Clinch	CRM 4.0	01/22/2009	1	1	2009	7	65	6	1.5	740.16	.	No	.	0	0	0	0	0	0	0	0	100	0	0	0	100
Clinch	CRM 4.0	01/22/2009	1	1	2009	8	75	5.3	0.8	740.16	.	No	.	0	0	0	0	30	0	45	0	20	0	0	0	95
Clinch	CRM 4.0	01/22/2009	1	1	2009	9	85	5.2	0.7	740.16	.	No	.	0	0	0	0	50	0	30	0	20	0	0	0	100
Clinch	CRM 4.0	01/22/2009	1	1	2009	10	95	6.2	1.7	740.16	.	No	.	0	0	0	0	0	0	40	0	60	0	0	0	100
Clinch	CRM 4.0	12/03/2009	2	12	2009	1	5	6.3	5.7	736.28	.	No	.	0	0	0	0	0	0	60	30	0	0	0	0	90
Clinch	CRM 4.0	12/03/2009	2	12	2009	2	15	19.5	18.9	736.28	.	Yes	.	0	0	0	0	0	0	80	2	10	0	0	0	92
Clinch	CRM 4.0	12/03/2009	2	12	2009	3	25	23.8	23.2	736.28	.	Yes	.	0	0	0	0	2	0	70	0	25	0	0	0	97
Clinch	CRM 4.0	12/03/2009	2	12	2009	4	35	25.6	25.0	736.28	.	Yes	.	0	0	0	0	1	0	60	0	35	0	0	0	96
Clinch	CRM 4.0	12/03/2009	2	12	2009	5	45	26.1	25.5	736.28	.	Yes	.	0	0	0	0	1	0	60	0	35	0	0	0	96
Clinch	CRM 4.0	12/03/2009	2	12	2009	6	55	27.5	26.9	736.28	.	Yes	.	0	0	0	0	0	0	66	0	30	0	0	0	96
Clinch	CRM 4.0	12/03/2009	2	12	2009	7	65	27.3	26.7	736.28	.	Yes	.	0	0	0	0	0	0	80	0	15	0	1	0	96
Clinch	CRM 4.0	12/03/2009	2	12	2009	8	75	26	25.4	736.28	.	Yes	.	0	0	0	0	0	0	80	0	15	0	3	0	98
Clinch	CRM 4.0	12/03/2009	2	12	2009	9	85	21.9	21.3	736.28	.	Yes	.	0	0	0	0	0	0	90	0	5	0	2	0	97
Clinch	CRM 4.0	12/03/2009	2	12	2009	10	95	10.2	9.6	736.28	.	Yes	.	0	0	0	0	0	0	90	0	5	0	2	0	97
Clinch	CRM 4.0	12/08/2010	3	12	2010	1	5	4.3	1.7	738.24	40	No	.	0	0	0	70	0	0	30	0	0	0	0	0	100
Clinch	CRM 4.0	12/08/2010	3	12	2010	2	15	5.7	3.1	738.24	40	No	.	0	0	0	4	0	0	95	1	0	0	0	0	100
Clinch	CRM 4.0	12/08/2010	3	12	2010	3	25	5.7	3.1	738.24	40	No	.	0	0	0	1	0	0	98	1	0	0	0	0	100
Clinch	CRM 4.0	12/08/2010	3	12	2010	4	35	27	24.4	738.24	100	Yes	.	0	0	0	0	0	0	75	0	5	0	20	0	100
Clinch	CRM 4.0	12/08/2010	3	12	2010	5	45	28	25.4	738.24	100	Yes	.	0	0	0	0	0	0	18	0	2	0	80	0	100
Clinch	CRM 4.0	12/08/2010	3	12	2010	6	55	22	19.4	738.24	75	Yes	.	0	0	0	0	0	0	85	0	2	0	13	0	100
Clinch	CRM 4.0	12/08/2010	3	12	2010	7	65	20	17.4	738.24	100	No	.	0	0	0	0	0	0	60	0	40	0	0	0	100
Clinch	CRM 4.0	12/08/2010	3	12	2010	8	75	10.1	7.5	738.24	100	No	.	0	0	0	0	0	0	65	0	35	0	0	0	100
Clinch	CRM 4.0	12/08/2010	3	12	2010	9	85	4.1	1.5	738.24	100	No	.	0	0	0	0	0	0	50	0	50	0	0	0	100
Clinch	CRM 4.0	12/08/2010	3	12	2010	10	95	3.6	1.0	738.24	100	No	.	0	0	0	0	0	0	50	0	50	0	0	0	100
Clinch	CRM 3.0	01/21/2009	1	1	2009	1	5	7	2.5	740.16	.	Yes	1	0	0	0	0	0	0	90	0	5	0	0	0	95
Clinch	CRM 3.0	01/21/2009	1	1	2009	2	15	8	3.5	740.16	.	Yes	1	0	0	0	6	0	0	90	0	0	0	0	0	96
Clinch	CRM 3.0	01/21/2009	1	1	2009	3	25	25	20.5	740.16	.	Yes	0.5	0	0	0	0	0	0	95	0	5	0	0	0	100
Clinch	CRM 3.0	01/21/2009	1	1	2009	4	35	35	30.5	740.16	.	No	.	0	0	0	0	0	0	75	0	25	0	0	0	100
Clinch	CRM 3.0	01/21/2009	1	1	2009	5	45	39	34.5	740.16	.	No	.	0	0	0	0	0	0	60	0	40	0	0	0	100
Clinch	CRM 3.0	01/21/2009	1	1	2009	6	55	35	30.5	740.16	.	No	.	0	0	0	0	0	0	90	0	10	0	0	0	100

Table A-1, continued.

River	Site	Date	Sample Period	MM	YY	Sample #	% from Left Bank	Water Depth (feet)	Standardized Water Depth [1]	Reservoir Surface Elevation (feet)	Dredge % Full	Ash Detected	Depth of Ash (mm)	Bedrock	Boulder	Cobble	Gravel	Sand	Hardpan Clay	Fines	Mollusk Shell	Detritus	Woody Debris	Ash	Coal/Gravel	% Classified
Clinch	CRM 3.0	01/21/2009	1	1	2009	7	65	25	20.5	740.16	.	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Clinch	CRM 3.0	01/21/2009	1	1	2009	8	75	9	4.5	740.16	.	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Clinch	CRM 3.0	01/21/2009	1	1	2009	9	85	8	3.5	740.16	.	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Clinch	CRM 3.0	01/21/2009	1	1	2009	10	95	7	2.5	740.16	.	No	.	0	0	0	0	0	0	90	0	10	0	0	0	100
Clinch	CRM 3.0	12/03/2009	2	12	2009	1	5	7.1	6.5	736.28	.	Yes	.	0	0	0	0	0	0	95	0	0	0	1	0	96
Clinch	CRM 3.0	12/03/2009	2	12	2009	2	15	7.2	6.6	736.28	.	Yes	.	0	0	0	0	0	0	95	0	0	0	3	0	98
Clinch	CRM 3.0	12/03/2009	2	12	2009	3	25	7.5	6.9	736.28	.	Yes	.	0	0	0	0	0	0	60	3	0	0	30	0	93
Clinch	CRM 3.0	12/03/2009	2	12	2009	4	35	10.3	9.7	736.28	.	Yes	.	0	0	0	0	0	0	90	0	0	0	2	0	92
Clinch	CRM 3.0	12/03/2009	2	12	2009	5	45	19.8	19.2	736.28	.	Yes	.	0	0	0	0	0	0	95	1	2	0	0	0	98
Clinch	CRM 3.0	12/03/2009	2	12	2009	6	55	26.9	26.3	736.28	.	Yes	.	0	0	0	0	0	0	80	0	1	0	10	0	91
Clinch	CRM 3.0	12/03/2009	2	12	2009	7	65	30.4	29.8	736.28	.	Yes	.	0	0	0	0	0	0	50	0	1	0	45	0	96
Clinch	CRM 3.0	12/03/2009	2	12	2009	8	75	30.8	30.2	736.28	.	Yes	.	0	0	0	0	0	0	30	0	1	0	70	0	101
Clinch	CRM 3.0	12/03/2009	2	12	2009	9	85	29.9	29.3	736.28	.	Yes	.	0	0	0	0	0	0	15	0	1	0	80	0	96
Clinch	CRM 3.0	12/03/2009	2	12	2009	10	95	28.9	28.3	736.28	.	Yes	.	0	0	0	0	0	0	15	0	2	0	80	0	97
Clinch	CRM 3.0	12/08/2010	3	12	2010	1	5	11	8.4	738.24	60	No	.	0	0	0	0	5	0	85	0	5	0	0	0	95
Clinch	CRM 3.0	12/08/2010	3	12	2010	2	15	12.2	9.6	738.24	30	No	.	0	0	0	0	10	0	80	5	0	0	0	0	95
Clinch	CRM 3.0	12/08/2010	3	12	2010	3	25	31.9	29.3	738.24	90	Yes	.	0	0	0	0	5	0	90	0	5	0	0	0	100
Clinch	CRM 3.0	12/08/2010	3	12	2010	4	35	35.4	32.8	738.24	100	Yes	.	0	0	0	0	0	0	50	0	5	0	45	0	100
Clinch	CRM 3.0	12/08/2010	3	12	2010	5	45	36.2	33.6	738.24	100	Yes	.	0	0	0	0	0	0	85	0	10	0	5	0	100
Clinch	CRM 3.0	12/08/2010	3	12	2010	6	55	37.5	34.9	738.24	90	Yes	.	0	0	0	0	0	0	70	0	20	0	5	0	95
Clinch	CRM 3.0	12/08/2010	3	12	2010	7	65	30.3	27.7	738.24	75	Yes	.	0	0	0	0	0	0	85	0	5	0	10	0	100
Clinch	CRM 3.0	12/08/2010	3	12	2010	8	75	12.2	9.6	738.24	50	Yes	.	0	0	0	0	0	0	20	0	5	0	70	0	95
Clinch	CRM 3.0	12/08/2010	3	12	2010	9	85	10.8	8.2	738.24	90	Yes	.	0	0	0	0	0	0	5	0	5	0	90	0	100
Clinch	CRM 3.0	12/08/2010	3	12	2010	10	95	10.2	7.6	738.24	90	Yes	.	0	0	0	0	0	0	5	0	2	0	90	0	97
Clinch	CRM 1.5	01/20/2009	1	1	2009	1	5	5.5	2.9	738.22	.	No	.	0	0	0	25	30	0	30	0	0	0	0	0	85
Clinch	CRM 1.5	01/20/2009	1	1	2009	2	15	7	4.4	738.22	.	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Clinch	CRM 1.5	01/20/2009	1	1	2009	3	25	8	5.4	738.22	.	No	.	0	0	0	0	0	0	90	0	10	0	0	0	100
Clinch	CRM 1.5	01/20/2009	1	1	2009	4	35	10.2	7.6	738.22	.	No	.	0	0	0	0	0	0	50	0	50	0	0	0	100
Clinch	CRM 1.5	01/20/2009	1	1	2009	5	45	32	29.4	738.22	.	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Clinch	CRM 1.5	01/20/2009	1	1	2009	6	55	38	35.4	738.22	.	No	.	0	0	0	0	0	0	98	0	2	0	0	0	100
Clinch	CRM 1.5	01/20/2009	1	1	2009	7	65	40	37.4	738.22	.	No	.	0	0	0	0	0	0	95	4	0	0	0	0	99
Clinch	CRM 1.5	01/20/2009	1	1	2009	8	75	39	36.4	738.22	.	No	.	0	0	0	0	0	0	98	0	2	0	0	0	100
Clinch	CRM 1.5	01/20/2009	1	1	2009	9	85	41	38.4	738.22	.	No	.	0	0	0	0	0	0	96	4	0	0	0	0	100
Clinch	CRM 1.5	01/20/2009	1	1	2009	10	95	25	22.4	738.22	.	No	.	0	0	70	0	0	0	0	15	15	0	0	0	100
Clinch	CRM 1.5	12/03/2009	2	12	2009	1	5	7.4	6.8	736.28	.	Yes	.	0	0	0	0	0	0	85	0	15	0	0	0	100
Clinch	CRM 1.5	12/03/2009	2	12	2009	2	15	19.8	19.2	736.28	.	Yes	.	0	0	0	0	0	0	80	0	20	0	0	0	100
Clinch	CRM 1.5	12/03/2009	2	12	2009	3	25	24.7	24.1	736.28	.	Yes	.	0	0	0	0	0	0	90	0	10	0	0	0	100
Clinch	CRM 1.5	12/03/2009	2	12	2009	4	35	38.7	38.1	736.28	.	Yes	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Clinch	CRM 1.5	12/03/2009	2	12	2009	5	45	41.7	41.1	736.28	.	Yes	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Clinch	CRM 1.5	12/03/2009	2	12	2009	6	55	42.1	41.5	736.28	.	Yes	.	0	0	0	5	0	0	90	0	5	0	0	0	100
Clinch	CRM 1.5	12/03/2009	2	12	2009	7	65	41.7	41.1	736.28	.	Yes	.	0	0	0	35	0	0	60	0	5	0	0	0	100

Table A-1, continued.

River	Site	Date	Sample Period	MM	YY	Sample #	% from Left Bank	Water Depth (feet)	Standardized Water Depth [1]	Reservoir Surface Elevation (feet)	Dredge % Full	Ash Detected	Depth of Ash (mm)	Bedrock	Boulder	Cobble	Gravel	Sand	Hardpan Clay	Fines	Mollusk Shell	Detritus	Woody Debris	Ash	Coal/Gravel	% Classified
Clinch	CRM 1.5	12/03/2009	2	12	2009	8	75	43.2	42.6	736.28	.	Yes	.	0	0	0	5	0	0	90	0	5	0	0	0	100
Clinch	CRM 1.5	12/03/2009	2	12	2009	9	85	42.1	41.5	736.28	.	Yes	.	0	0	0	5	0	0	90	0	0	0	0	0	95
Clinch	CRM 1.5	12/03/2009	2	12	2009	10	95	27.8	27.2	736.28	.	Yes	.	0	0	0	20	0	0	70	5	0	0	0	0	95
Clinch	CRM 1.5	12/09/2010	3	12	2010	1	5	6.2	3.9	737.97	90	Yes	.	0	0	0	0	0	0	80	0	5	0	15	0	100
Clinch	CRM 1.5	12/09/2010	3	12	2010	2	15	9.3	7.0	737.97	75	Yes	.	0	0	0	0	0	0	70	0	15	0	15	0	100
Clinch	CRM 1.5	12/09/2010	3	12	2010	3	25	32.2	29.9	737.97	75	Yes	.	0	0	0	0	0	0	70	0	15	0	15	0	100
Clinch	CRM 1.5	12/09/2010	3	12	2010	4	35	40.5	38.2	737.97	60	Yes	.	0	0	0	40	0	0	50	0	0	0	10	0	100
Clinch	CRM 1.5	12/09/2010	3	12	2010	5	45	41.1	38.8	737.97	.	No	.	100	0	0	0	0	0	0	0	0	0	0	0	100
Clinch	CRM 1.5	12/09/2010	3	12	2010	6	55	43.8	41.5	737.97	.	No	.	95	0	0	0	0	0	0	5	0	0	0	0	100
Clinch	CRM 1.5	12/09/2010	3	12	2010	7	65	42.1	39.8	737.97	.	No	.	95	0	0	0	0	0	0	5	0	0	0	0	100
Clinch	CRM 1.5	12/09/2010	3	12	2010	8	75	44.6	42.3	737.97	0	No	.	100	0	0	0	0	0	0	0	0	0	0	0	100
Clinch	CRM 1.5	12/09/2010	3	12	2010	9	85	32.3	30.0	737.97	0	No	.	100	0	0	0	0	0	0	0	0	0	0	0	100
Clinch	CRM 1.5	12/09/2010	3	12	2010	10	95	21.2	18.9	737.97	0	No	.	100	0	0	0	0	0	0	0	0	0	0	0	100
Clinch	CRM 0.5	01/28/2009	1	1	2009	1	5	5.5	4.3	736.86	.	Yes	0.5	0	0	0	40	0	0	50	0	10	0	0	0	100
Clinch	CRM 0.5	01/28/2009	1	1	2009	2	15	8.2	7.0	736.86	.	Yes	0.5	0	0	0	35	0	0	60	0	0	0	0	0	95
Clinch	CRM 0.5	01/28/2009	1	1	2009	3	25	28.1	26.9	736.86	.	No	.	0	0	0	0	0	0	100	0	0	0	0	0	100
Clinch	CRM 0.5	01/28/2009	1	1	2009	4	35	36.7	35.5	736.86	.	Yes	0.5	0	0	0	0	0	0	96	0	3	0	0	0	99
Clinch	CRM 0.5	01/28/2009	1	1	2009	5	45	36.2	35.0	736.86	.	Yes	1	0	0	0	0	0	0	80	0	20	0	0	0	100
Clinch	CRM 0.5	01/28/2009	1	1	2009	6	55	28.3	27.1	736.86	.	Yes	0.5	0	0	0	0	0	0	90	0	10	0	0	0	100
Clinch	CRM 0.5	01/28/2009	1	1	2009	7	65	14.3	13.1	736.86	.	Yes	1	0	0	0	0	0	0	65	0	35	0	0	0	100
Clinch	CRM 0.5	01/28/2009	1	1	2009	8	75	7	5.8	736.86	.	Yes	1	0	0	0	0	0	0	20	0	80	0	0	0	100
Clinch	CRM 0.5	01/28/2009	1	1	2009	9	85	5.2	4.0	736.86	.	Yes	0.5	0	0	0	0	0	0	30	0	70	0	0	0	100
Clinch	CRM 0.5	01/28/2009	1	1	2009	10	95	6	4.8	736.86	.	No	.	0	0	0	0	0	0	5	0	95	0	0	0	100
Clinch	CRM 0.5	12/03/2009	2	12	2009	1	5	7.9	7.3	736.28	.	.	.	0	0	0	25	0	0	40	0	35	0	0	0	100
Clinch	CRM 0.5	12/03/2009	2	12	2009	2	15	20.9	20.3	736.28	.	.	.	0	0	0	25	0	0	70	0	0	0	0	0	95
Clinch	CRM 0.5	12/03/2009	2	12	2009	3	25	30.3	29.7	736.28	.	.	.	0	0	0	0	0	0	90	0	10	0	0	0	100
Clinch	CRM 0.5	12/03/2009	2	12	2009	4	35	39.8	39.2	736.28	.	.	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Clinch	CRM 0.5	12/03/2009	2	12	2009	5	45	40.1	39.5	736.28	.	.	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Clinch	CRM 0.5	12/03/2009	2	12	2009	6	55	36.8	36.2	736.28	.	.	.	0	0	0	0	0	0	60	0	40	0	0	0	100
Clinch	CRM 0.5	12/03/2009	2	12	2009	7	65	26.5	25.9	736.28	.	.	.	0	0	0	0	0	0	65	0	35	0	0	0	100
Clinch	CRM 0.5	12/03/2009	2	12	2009	8	75	10.8	10.2	736.28	.	.	.	0	0	0	0	0	0	40	0	60	0	0	0	100
Clinch	CRM 0.5	12/03/2009	2	12	2009	9	85	8	7.4	736.28	.	.	.	0	0	0	0	0	0	25	0	75	0	0	0	100
Clinch	CRM 0.5	12/03/2009	2	12	2009	10	95	7.3	6.7	736.28	.	.	.	0	0	0	0	0	0	20	0	80	0	0	0	100
Clinch	CRM 0.5	12/10/2010	3	12	2010	1	5	17.5	15.3	737.79	90	No	.	0	0	0	0	0	0	85	10	5	0	0	0	100
Clinch	CRM 0.5	12/10/2010	3	12	2010	2	15	25.5	23.3	737.79	90	Yes	.	0	0	0	5	0	0	90	0	5	0	0	0	100
Clinch	CRM 0.5	12/10/2010	3	12	2010	3	25	38.7	36.5	737.79	90	Yes	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Clinch	CRM 0.5	12/10/2010	3	12	2010	4	35	39.2	37.0	737.79	100	Yes	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Clinch	CRM 0.5	12/10/2010	3	12	2010	5	45	31.7	29.5	737.79	100	Yes	.	0	0	0	0	0	0	50	0	50	0	0	0	100
Clinch	CRM 0.5	12/10/2010	3	12	2010	6	55	13.2	11.0	737.79	85	Yes	.	0	0	0	0	0	0	45	0	45	0	10	0	100
Clinch	CRM 0.5	12/10/2010	3	12	2010	7	65	9.8	7.6	737.79	75	Yes	.	0	0	0	0	0	0	45	0	45	0	10	0	100
Clinch	CRM 0.5	12/10/2010	3	12	2010	8	75	9	6.8	737.79	90	Yes	.	0	0	0	0	0	0	45	0	45	0	10	0	100

Table A-1, continued.

River	Site	Date	Sample Period	MM	YY	Sample #	% from Left Bank	Water Depth (feet)	Standardized Water Depth [1]	Reservoir Surface Elevation (feet)	Dredge % Full	Ash Detected	Depth of Ash (mm)	Bedrock	Boulder	Cobble	Gravel	Sand	Hardpan Clay	Fines	Mollusk Shell	Detritus	Woody Debris	Ash	Coal/Gravel	% Classified
Clinch	CRM 0.5	12/10/2010	3	12	2010	9	85	8.6	6.4	737.79	75	Yes	.	0	0	0	0	0	0	45	0	45	0	10	0	100
Clinch	CRM 0.5	12/10/2010	3	12	2010	10	95	9.2	7.0	737.79	85	Yes	.	0	0	0	0	0	0	60	0	30	0	10	0	100
Tenn	TRM 573.9	01/27/2009	1	1	2009	1	5	16.5	15.4	736.76	.	No	.	0	0	0	0	0	0	95	4	0	0	0	0	99
Tenn	TRM 573.9	01/27/2009	1	1	2009	2	15	27	25.9	736.76	.	No	.	0	0	0	35	0	0	0	60	0	0	0	0	95
Tenn	TRM 573.9	01/27/2009	1	1	2009	3	25	36	34.9	736.76	.	No	.	0	0	0	5	0	0	90	5	0	0	0	0	100
Tenn	TRM 573.9	01/27/2009	1	1	2009	4	35	32.2	31.1	736.76	.	No	.	0	0	0	0	0	0	80	0	20	0	0	0	100
Tenn	TRM 573.9	01/27/2009	1	1	2009	5	45	20.7	19.6	736.76	.	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Tenn	TRM 573.9	01/27/2009	1	1	2009	6	55	6	4.9	736.76	.	No	.	0	0	0	0	92	0	0	3	5	0	0	0	100
Tenn	TRM 573.9	01/27/2009	1	1	2009	7	65	15	13.9	736.76	.	No	.	0	0	0	0	0	0	95	4	0	0	0	0	99
Tenn	TRM 573.9	01/27/2009	1	1	2009	8	75	33.1	32.0	736.76	.	No	.	0	0	0	0	0	0	87	3	10	0	0	0	100
Tenn	TRM 573.9	01/27/2009	1	1	2009	9	85	41.3	40.2	736.76	.	No	.	0	0	0	14	0	0	70	0	15	0	0	0	99
Tenn	TRM 573.9	01/27/2009	1	1	2009	10	95	43	41.9	736.76	.	No	.	0	0	0	20	0	0	50	0	25	0	0	0	95
Tenn	TRM 573.9	12/01/2009	2	12	2009	1	5	15.5	15.3	735.88	.	No	.	0	0	0	0	0	0	85	5	10	0	0	0	100
Tenn	TRM 573.9	12/01/2009	2	12	2009	2	15	37.8	37.6	735.88	.	No	.	0	0	0	15	0	0	75	0	10	0	0	0	100
Tenn	TRM 573.9	12/01/2009	2	12	2009	3	25	38.1	37.9	735.88	.	No	.	0	0	0	20	0	0	70	0	10	0	0	0	100
Tenn	TRM 573.9	12/01/2009	2	12	2009	4	35	38.6	38.4	735.88	.	No	.	0	0	0	15	40	0	45	0	0	0	0	0	100
Tenn	TRM 573.9	12/01/2009	2	12	2009	5	45	28.6	28.4	735.88	.	No	.	0	0	0	5	0	0	65	0	30	0	0	0	100
Tenn	TRM 573.9	12/01/2009	2	12	2009	6	55	15.5	15.3	735.88	.	No	.	0	0	0	0	45	0	50	0	5	0	0	0	100
Tenn	TRM 573.9	12/01/2009	2	12	2009	7	65	13.8	13.6	735.88	.	No	.	0	0	0	0	20	0	70	0	10	0	0	0	100
Tenn	TRM 573.9	12/01/2009	2	12	2009	8	75	33.5	33.3	735.88	.	No	.	0	0	0	0	0	0	90	0	10	0	0	0	100
Tenn	TRM 573.9	12/01/2009	2	12	2009	9	85	40.1	39.9	735.88	.	No	.	0	0	0	0	0	0	0	5	60	35	0	0	100
Tenn	TRM 573.9	12/01/2009	2	12	2009	10	95	36	35.8	735.88	.	No	.	0	0	0	5	0	0	65	0	30	0	0	0	100
Tenn	TRM 573.9	12/21/2010	3	12	2010	1	5	16.2	15.1	736.69	70	No	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Tenn	TRM 573.9	12/21/2010	3	12	2010	2	15	34.6	33.5	736.69	40	No	.	0	0	0	0	15	0	80	0	2	0	0	0	97
Tenn	TRM 573.9	12/21/2010	3	12	2010	3	25	36.5	35.4	736.69	50	No	.	0	0	0	15	15	0	70	0	0	0	0	0	100
Tenn	TRM 573.9	12/21/2010	3	12	2010	4	35	37.3	36.2	736.69	70	No	.	0	0	0	20	15	0	65	0	0	0	0	0	100
Tenn	TRM 573.9	12/21/2010	3	12	2010	5	45	24.7	23.6	736.69	70	No	.	0	0	0	15	15	0	70	0	0	0	0	0	100
Tenn	TRM 573.9	12/21/2010	3	12	2010	6	55	7	5.9	736.69	75	No	.	0	0	0	0	60	0	35	0	5	0	0	0	100
Tenn	TRM 573.9	12/21/2010	3	12	2010	7	65	15.4	14.3	736.69	80	No	.	0	0	0	0	10	0	80	0	10	0	0	0	100
Tenn	TRM 573.9	12/21/2010	3	12	2010	8	75	32.2	31.1	736.69	60	No	.	0	0	0	0	10	0	85	0	5	0	0	0	100
Tenn	TRM 573.9	12/21/2010	3	12	2010	9	85	38	36.9	736.69	50	No	.	0	0	0	10	0	0	80	0	10	0	0	0	100
Tenn	TRM 573.9	12/21/2010	3	12	2010	10	95	21.8	20.7	736.69	50	No	.	0	0	0	15	0	0	70	10	0	0	0	0	95
Tenn	TRM 566.3	01/27/2009	1	1	2009	1	5	5.1	3.9	736.79	.	No	.	0	0	0	0	0	0	80	0	20	0	0	0	100
Tenn	TRM 566.3	01/27/2009	1	1	2009	2	15	7.5	6.3	736.79	.	No	.	0	0	0	0	0	0	70	0	30	0	0	0	100
Tenn	TRM 566.3	01/27/2009	1	1	2009	3	25	10	8.8	736.79	.	No	.	0	0	0	0	0	0	85	0	15	0	0	0	100
Tenn	TRM 566.3	01/27/2009	1	1	2009	4	35	11.4	10.2	736.79	.	No	.	0	0	0	0	0	0	85	0	15	0	0	0	100
Tenn	TRM 566.3	01/27/2009	1	1	2009	5	45	44.3	43.1	736.79	.	Yes	0.5	0	0	0	0	0	0	90	0	9	0	0	0	99
Tenn	TRM 566.3	01/27/2009	1	1	2009	6	55	61	59.8	736.79	.	Yes	0.5	0	0	0	30	60	0	10	0	0	0	0	0	100
Tenn	TRM 566.3	01/27/2009	1	1	2009	7	65	71	69.8	736.79	.	No	.	0	0	0	45	50	0	5	0	0	0	0	0	100
Tenn	TRM 566.3	01/27/2009	1	1	2009	8	75	71	69.8	736.79	.	No	.	0	0	0	40	0	0	60	0	0	0	0	0	100
Tenn	TRM 566.3	01/27/2009	1	1	2009	9	85	51.9	50.7	736.79	.	No	.	0	0	0	9	0	0	90	0	0	0	0	0	99

Table A-1, continued.

River	Site	Date	Sample Period	MM	YY	Sample #	% from Left Bank	Water Depth (feet)	Standardized Water Depth [1]	Reservoir Surface Elevation (feet)	Dredge % Full	Ash Detected	Depth of Ash (mm)	Bedrock	Boulder	Cobble	Gravel	Sand	Hardpan Clay	Fines	Mollusk Shell	Detritus	Woody Debris	Ash	Coal/Gravel	% Classified
Tenn	TRM 566.3	01/27/2009	1	1	2009	10	95	37.3	36.1	736.79	.	No	.	0	0	0	0	30	0	50	0	20	0	0	0	100
Tenn	TRM 566.3	12/01/2009	2	12	2009	1	5	9.6	9.4	735.88	.	.	.	0	0	0	0	0	0	60	0	40	0	0	0	100
Tenn	TRM 566.3	12/01/2009	2	12	2009	2	15	12.7	12.5	735.88	.	.	.	0	0	0	0	0	0	50	0	50	0	0	0	100
Tenn	TRM 566.3	12/01/2009	2	12	2009	3	25	30.1	29.9	735.88	.	.	.	0	0	0	0	0	0	50	0	50	0	0	0	100
Tenn	TRM 566.3	12/01/2009	2	12	2009	4	35	55.8	55.6	735.88	.	.	.	0	0	0	5	0	0	65	0	30	0	0	0	100
Tenn	TRM 566.3	12/01/2009	2	12	2009	5	45	62.3	62.1	735.88	.	.	.	0	0	0	10	45	0	45	0	0	0	0	0	100
Tenn	TRM 566.3	12/01/2009	2	12	2009	6	55	67.1	66.9	735.88	.	.	.	0	0	0	40	45	0	15	0	0	0	0	0	100
Tenn	TRM 566.3	12/01/2009	2	12	2009	7	65	63.8	63.6	735.88	.	.	.	0	0	0	50	25	0	25	0	0	0	0	0	100
Tenn	TRM 566.3	12/01/2009	2	12	2009	8	75	61.8	61.6	735.88	.	.	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Tenn	TRM 566.3	12/01/2009	2	12	2009	9	85	54.8	54.6	735.88	.	.	.	0	0	0	0	0	0	95	0	5	0	0	0	100
Tenn	TRM 566.3	12/01/2009	2	12	2009	10	95	34.8	34.6	735.88	.	.	.	0	0	0	0	0	0	50	0	40	10	0	0	100
Tenn	TRM 566.3	12/15/2010	3	12	2010	1	5	8.7	7.6	736.76	50	Yes	.	0	0	0	0	0	0	45	0	45	0	10	0	100
Tenn	TRM 566.3	12/15/2010	3	12	2010	2	15	12.4	11.3	736.76	60	Yes	.	0	0	0	0	0	0	70	0	20	0	10	0	100
Tenn	TRM 566.3	12/15/2010	3	12	2010	3	25	16.4	15.3	736.76	35	No	.	0	0	0	0	0	80	15	0	5	0	0	0	100
Tenn	TRM 566.3	12/15/2010	3	12	2010	4	35	29.4	28.3	736.76	60	Yes	.	0	0	0	0	15	0	70	0	0	0	15	0	100
Tenn	TRM 566.3	12/15/2010	3	12	2010	5	45	54.6	53.5	736.76	60	Yes	.	0	0	0	0	40	0	20	0	0	0	30	0	90
Tenn	TRM 566.3	12/15/2010	3	12	2010	6	55	63.3	62.2	736.76	100	Yes	.	0	0	0	0	70	0	20	0	0	0	10	0	100
Tenn	TRM 566.3	12/15/2010	3	12	2010	7	65	64.2	63.1	736.76	100	Yes	.	0	0	0	20	0	0	60	0	0	0	20	0	100
Tenn	TRM 566.3	12/15/2010	3	12	2010	8	75	57.1	56.0	736.76	100	Yes	.	0	0	0	10	0	0	65	0	0	0	25	0	100
Tenn	TRM 566.3	12/15/2010	3	12	2010	9	85	52.2	51.1	736.76	70	Yes	.	0	0	0	5	0	0	75	0	0	0	20	0	100
Tenn	TRM 566.3	12/15/2010	3	12	2010	10	95	43	41.9	736.76	100	Yes	.	0	0	0	40	0	0	40	0	0	0	20	0	100
Tenn	TRM 560.8	11/09/2010	3	11	2010	1	5	23.5	19.7	739.45	.	.	.	0	0	0	0	0	0	98	0	2	0	0	0	100
Tenn	TRM 560.8	11/09/2010	3	11	2010	2	15	21.1	17.3	739.45	.	.	.	0	0	0	0	0	0	98	0	2	0	0	0	100
Tenn	TRM 560.8	11/09/2010	3	11	2010	3	25	20.8	17.0	739.45	.	.	.	0	0	0	0	0	0	98	0	2	0	0	0	100
Tenn	TRM 560.8	11/09/2010	3	11	2010	4	35	32.5	28.7	739.45	.	.	.	0	0	0	0	0	0	98	0	2	0	0	0	100
Tenn	TRM 560.8	11/09/2010	3	11	2010	5	45	38.2	34.4	739.45	.	.	.	0	0	0	0	0	0	98	0	2	0	0	0	100
Tenn	TRM 560.8	11/09/2010	3	11	2010	6	55	43.3	39.5	739.45	.	.	.	0	0	0	0	0	0	98	0	2	0	0	0	100
Tenn	TRM 560.8	11/09/2010	3	11	2010	7	65	45.1	41.3	739.45	.	.	.	0	0	0	0	0	0	98	0	2	0	0	0	100
Tenn	TRM 560.8	11/09/2010	3	11	2010	8	75	46.9	43.1	739.45	.	.	.	0	0	0	0	0	0	98	0	2	0	0	0	100
Tenn	TRM 560.8	11/09/2010	3	11	2010	9	85	46.5	42.7	739.45	.	.	.	0	0	0	0	0	0	98	0	2	0	0	0	100
Tenn	TRM 560.8	11/09/2010	3	11	2010	10	95	21.1	17.3	739.45	.	.	.	0	0	0	40	50	0	0	0	0	0	0	0	90

1). Field measured water depths were standardardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

Appendix B

Graphical Presentations of Physical Characteristics and Benthic Macroinvertebrate Population Density and Taxa Richness

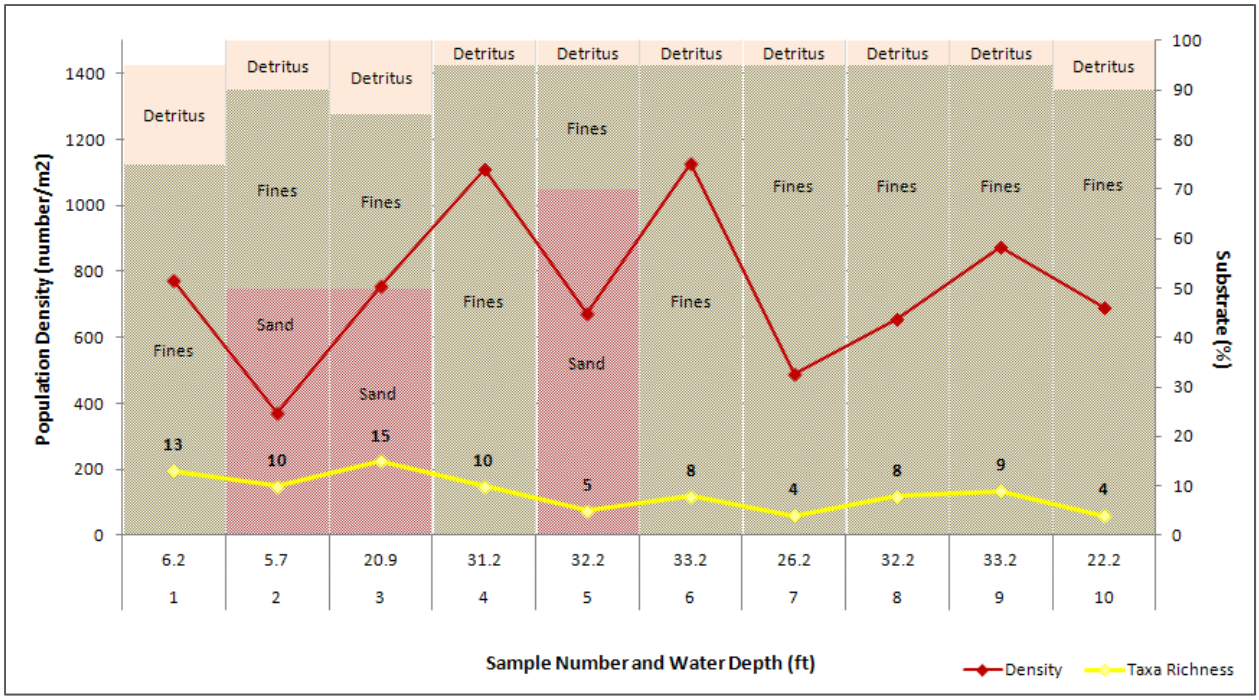

Figure B-1. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collect at ERM 6.0 in January 2009.

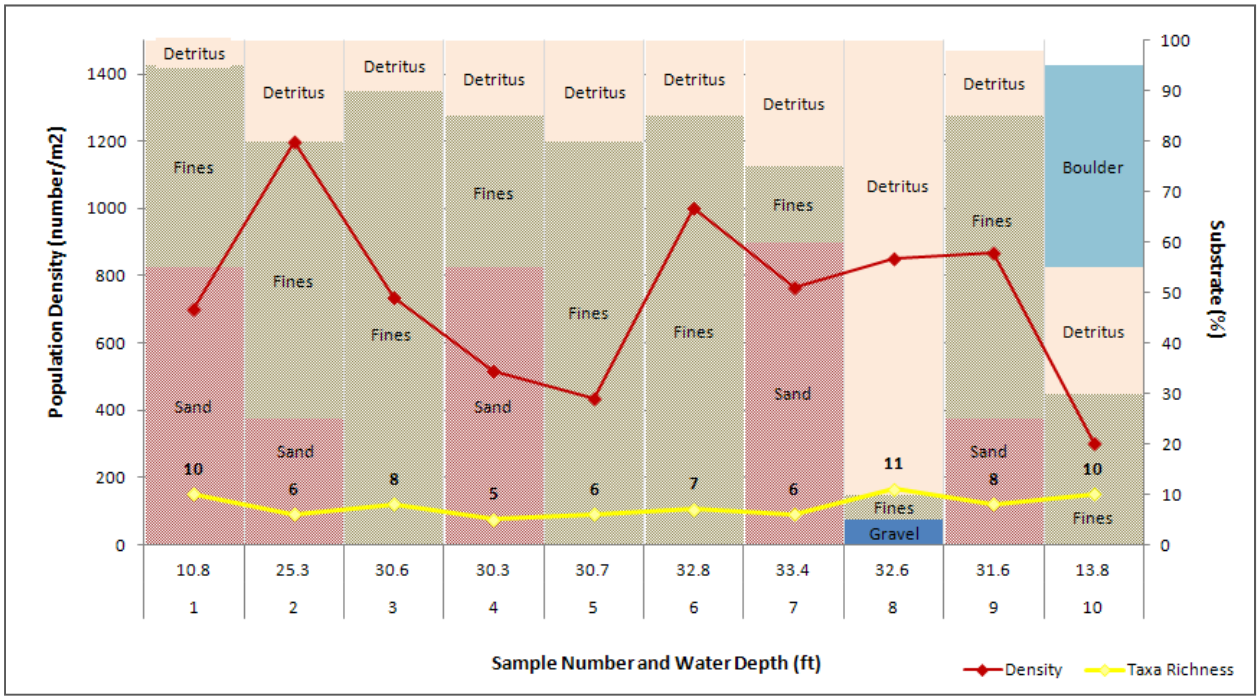

Figure B-2. Physcial characteristics (substrate composition and water depth*) and benthic macroivertebrate population density and taxa richness for each sample collected at ERM 6.0 in December 2009.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

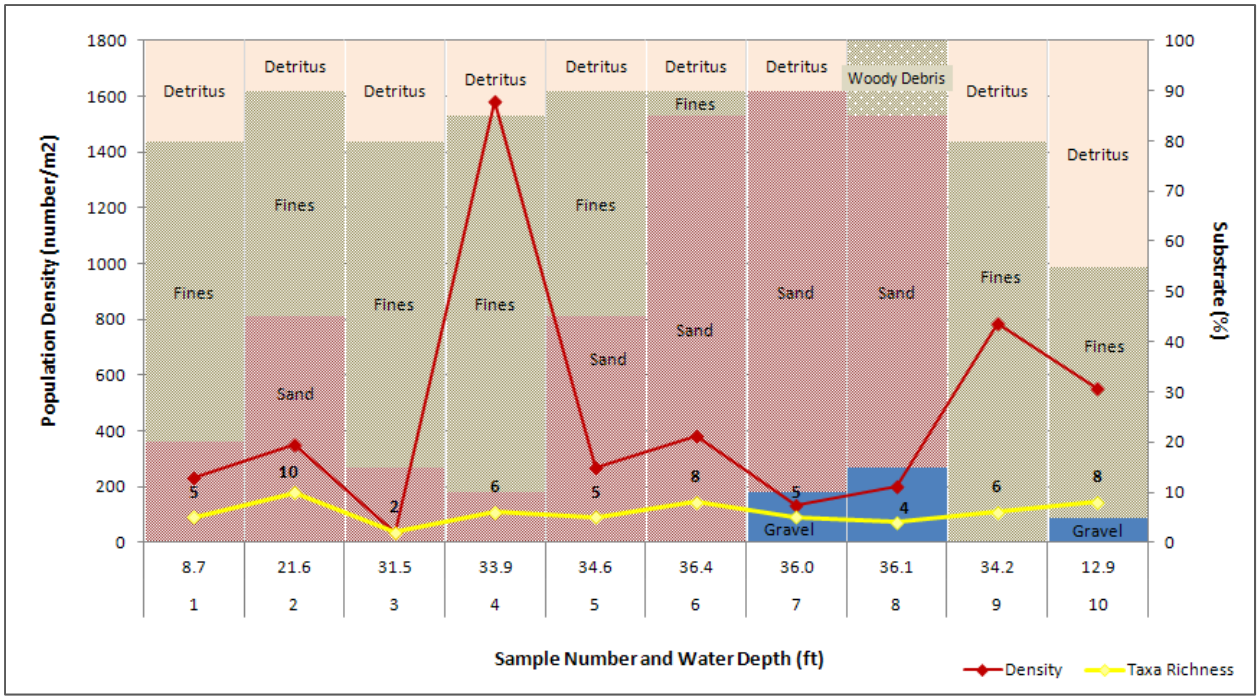

Figure B-3 Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at ERM 6.0 in December 2010.

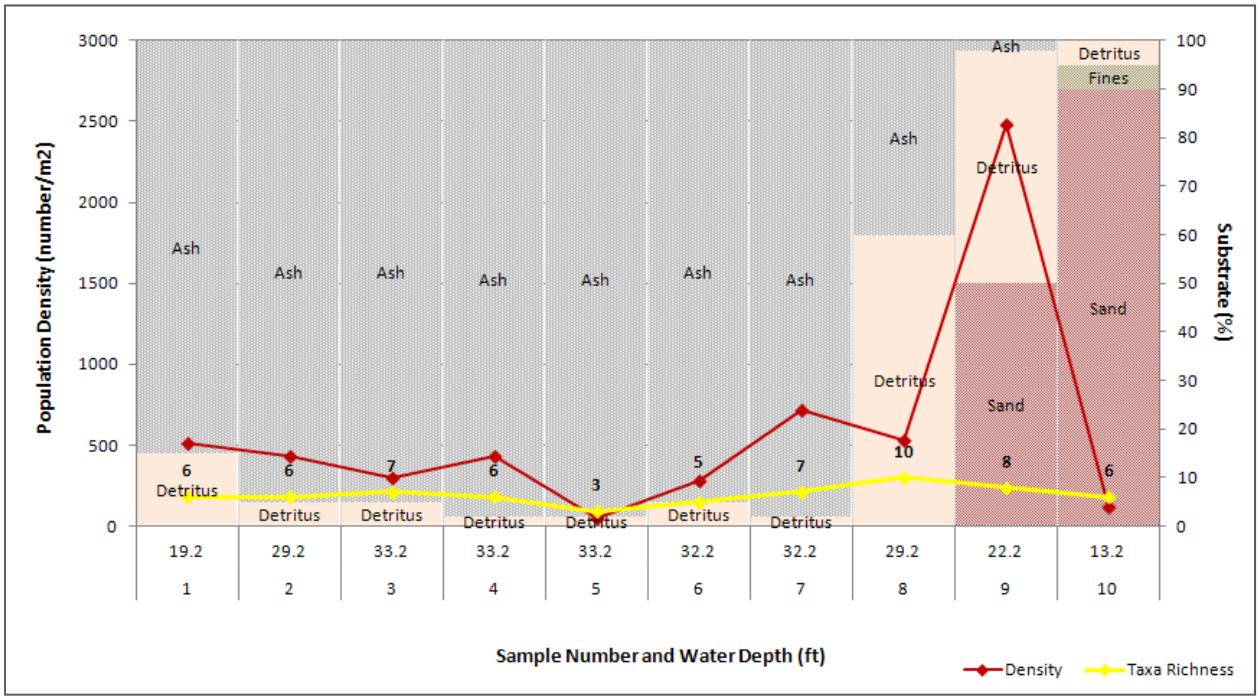

Figure B-4. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at ERM 5.0 in January 2009.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

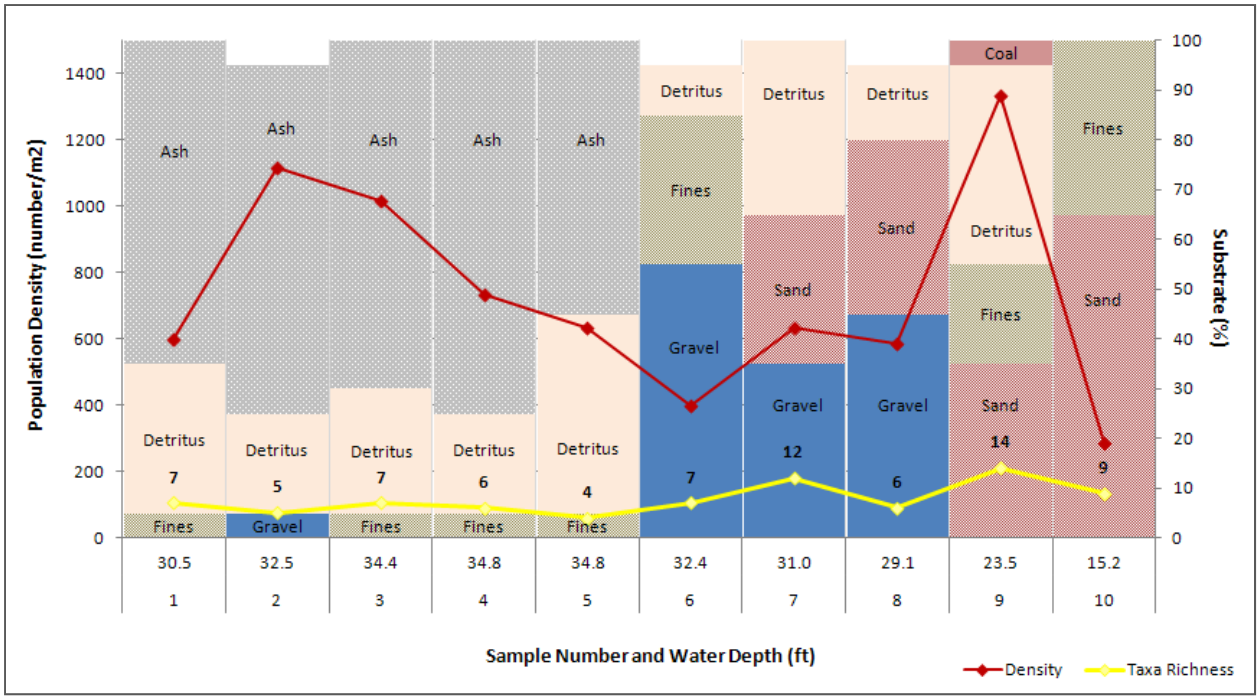

Figure B-5. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at ERM 5.0 in December 2009.

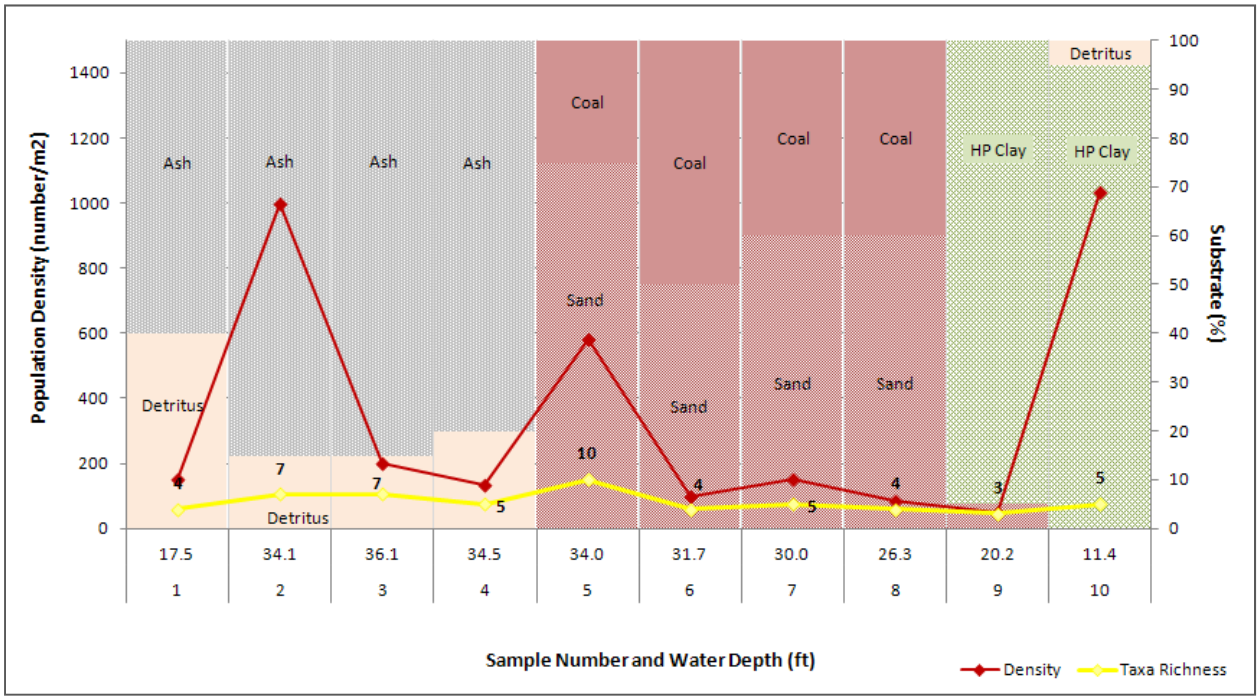

Figure B-6. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at ERM 5.0 in December 2010.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

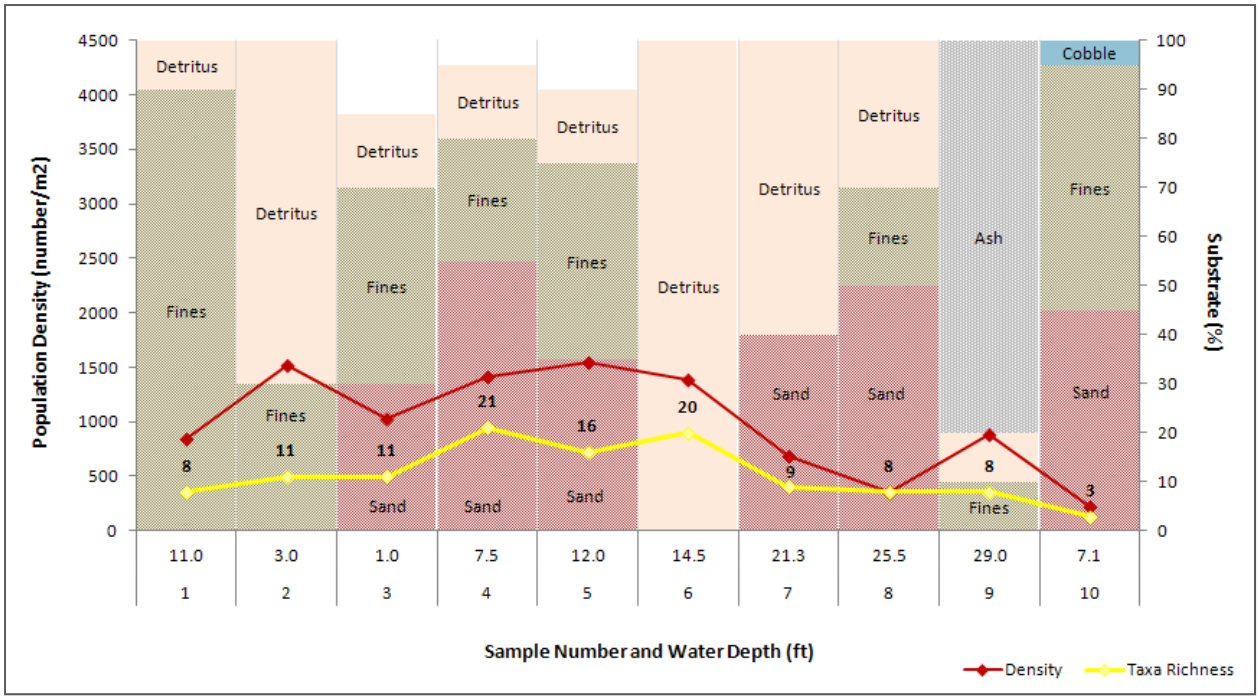

Figure B-7. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at ERM 4.1 in December 2009.

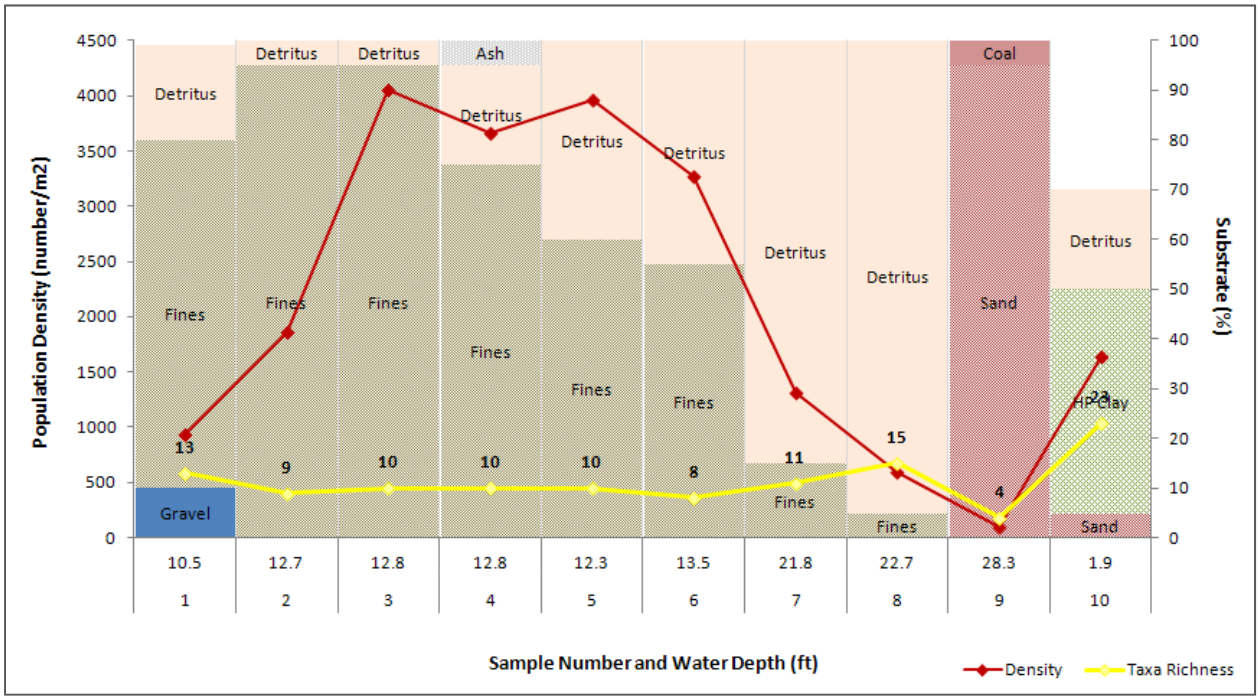

Figure B-8. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at ERM 4.1 in December 2010.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

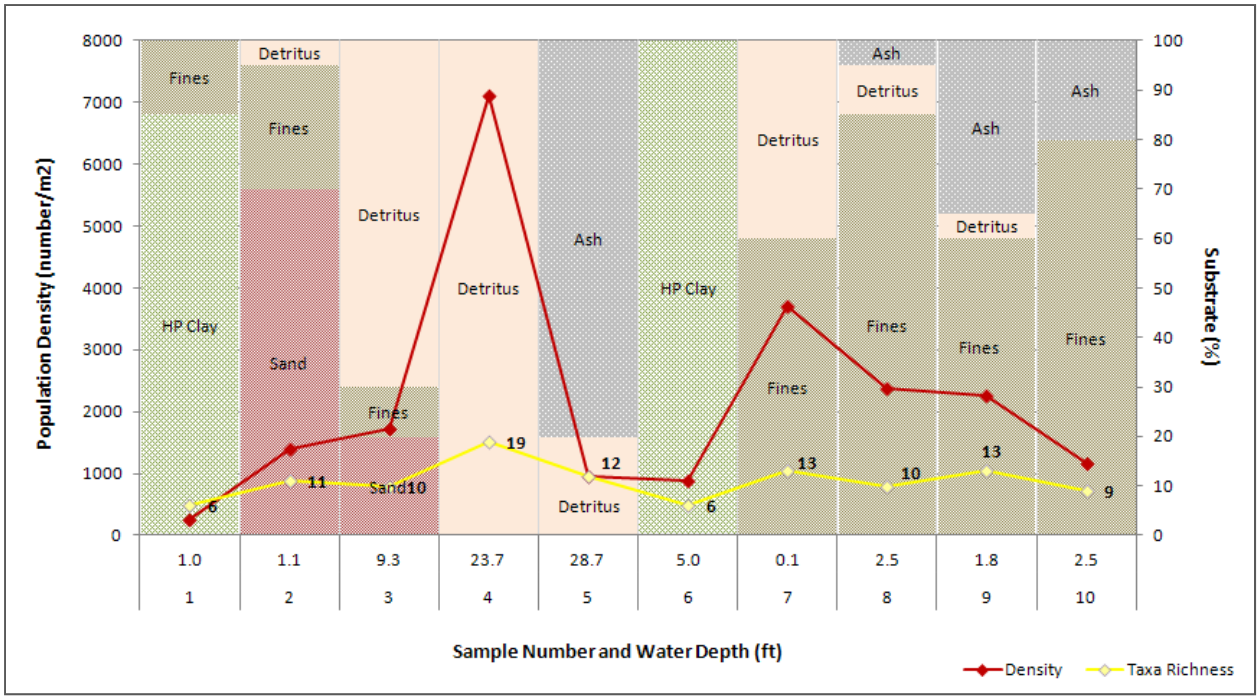

Figure B-9. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at ERM 3.0 in December 2010.

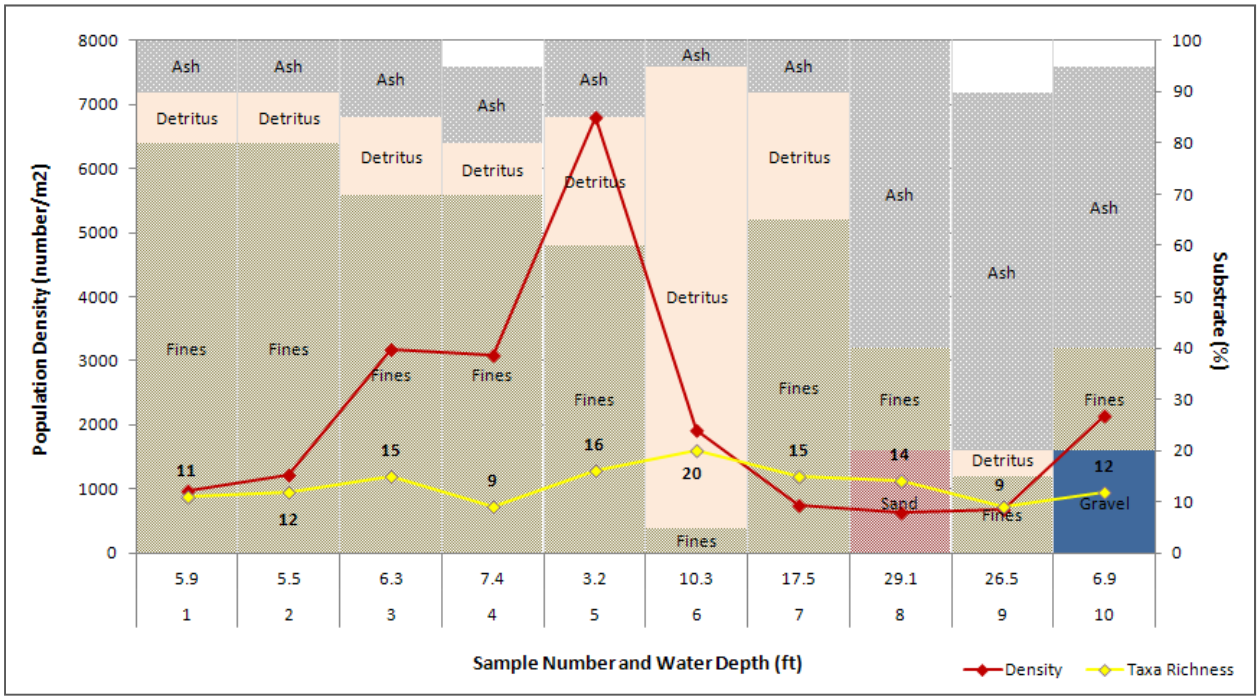

Figure B-10. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at ERM 2.6 in December 2010.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

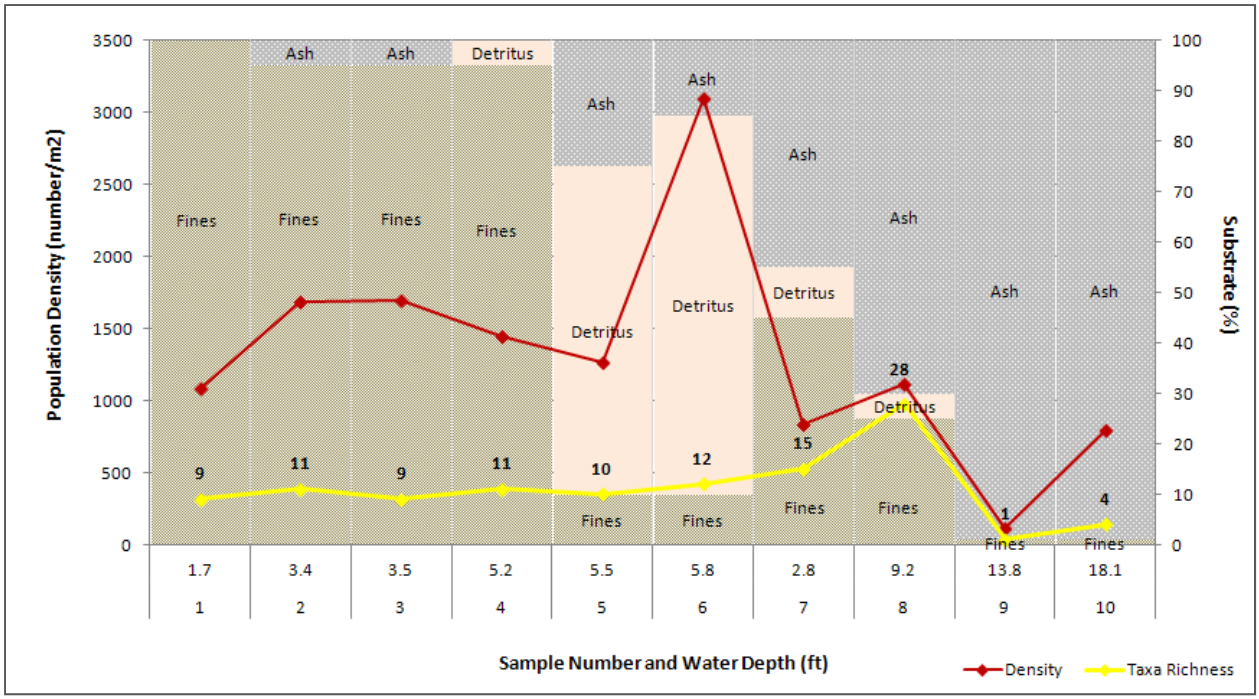

Figure B-11. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at ERM 2.2 in December 2009.

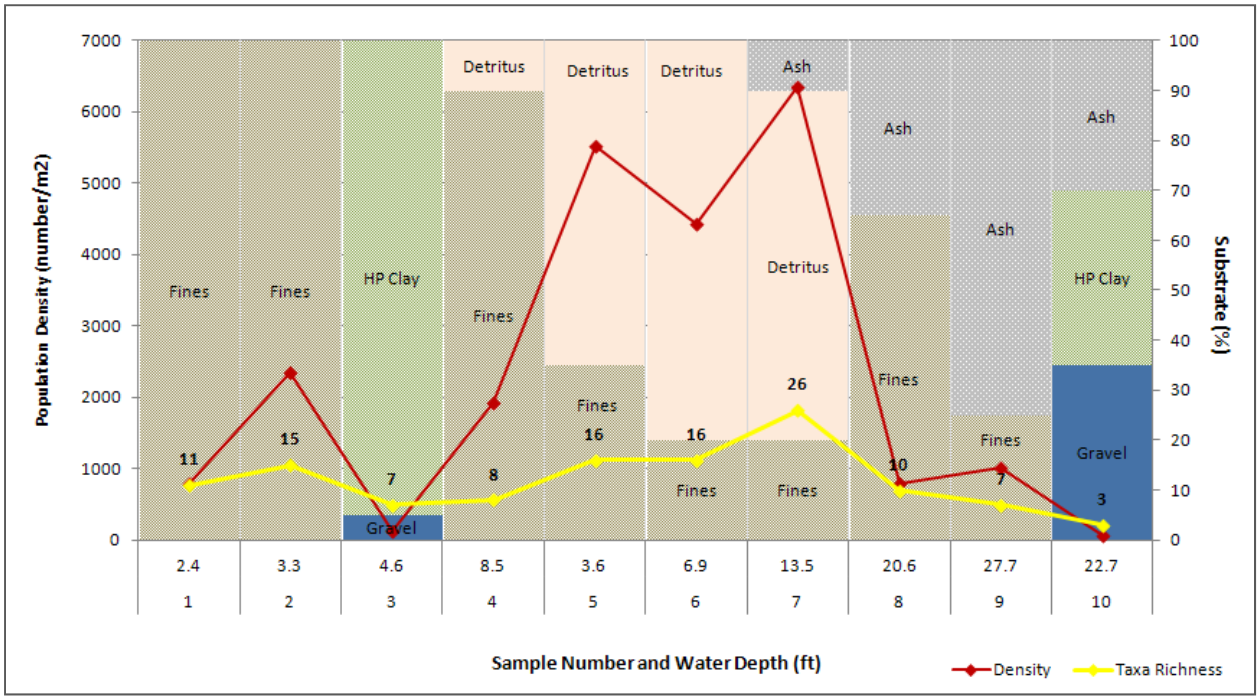

Figure B-12. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at ERM 2.2 in December 2010.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

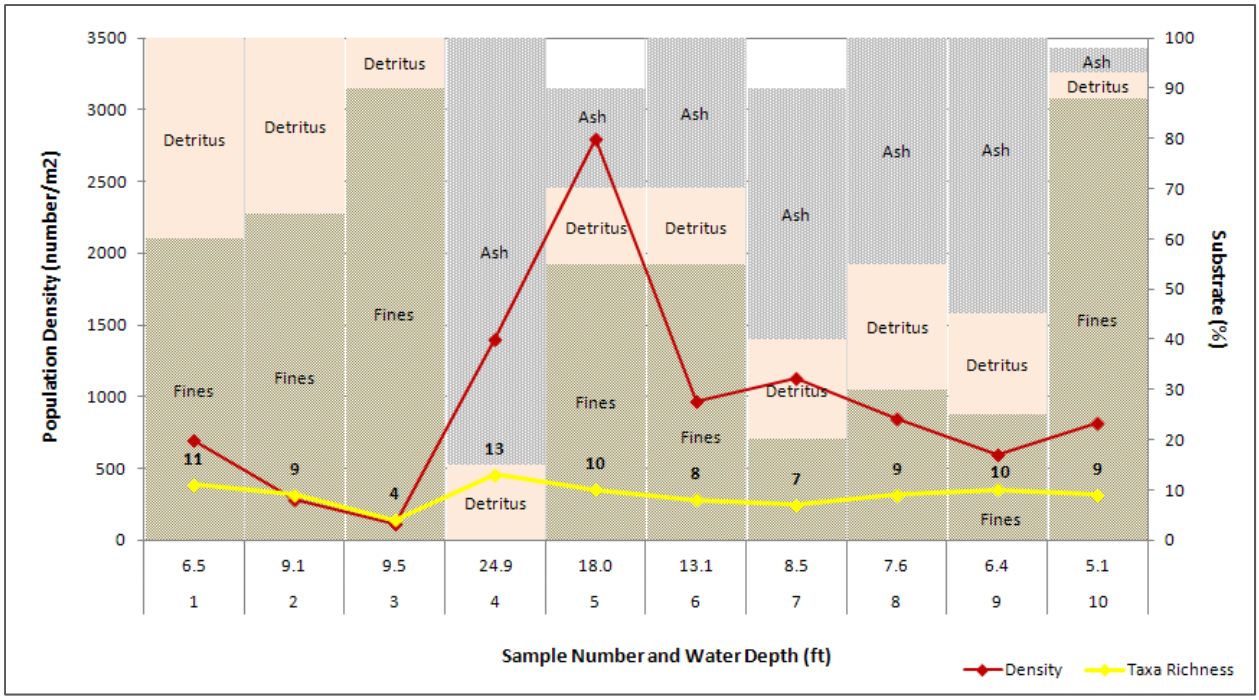

Figure B-13. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at ERM 1.0 in January 2009.

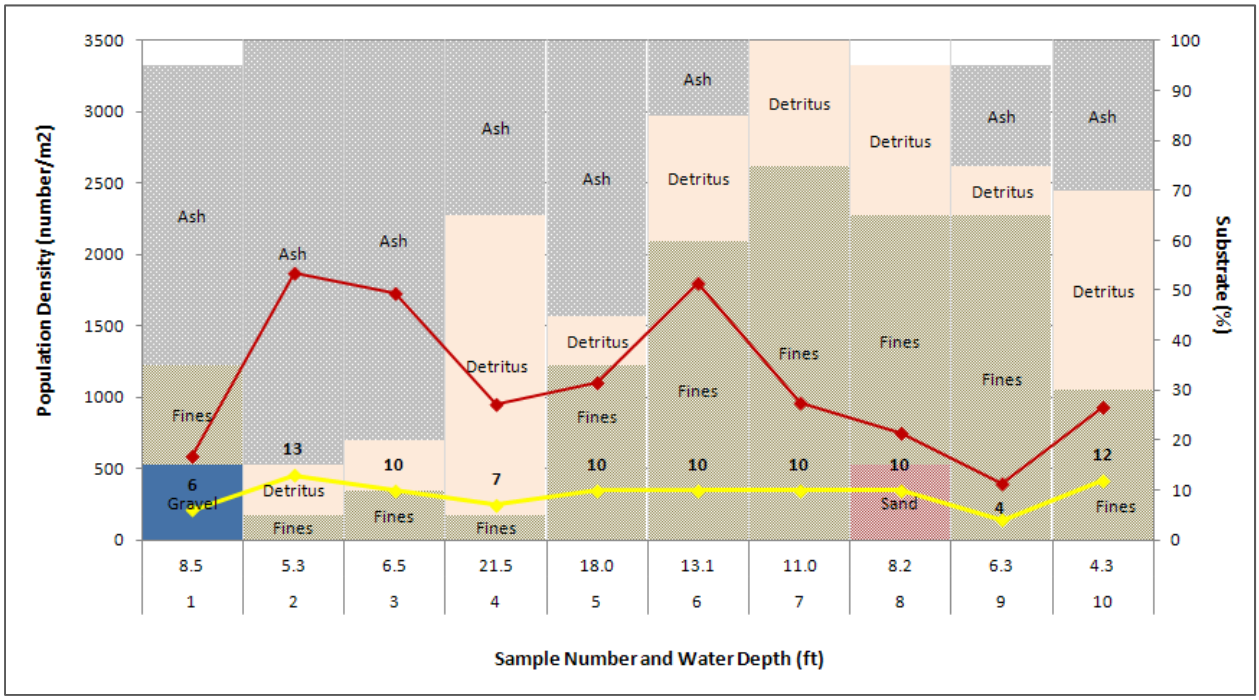

Figure B-14. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at ERM 1.0 in December 2009.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

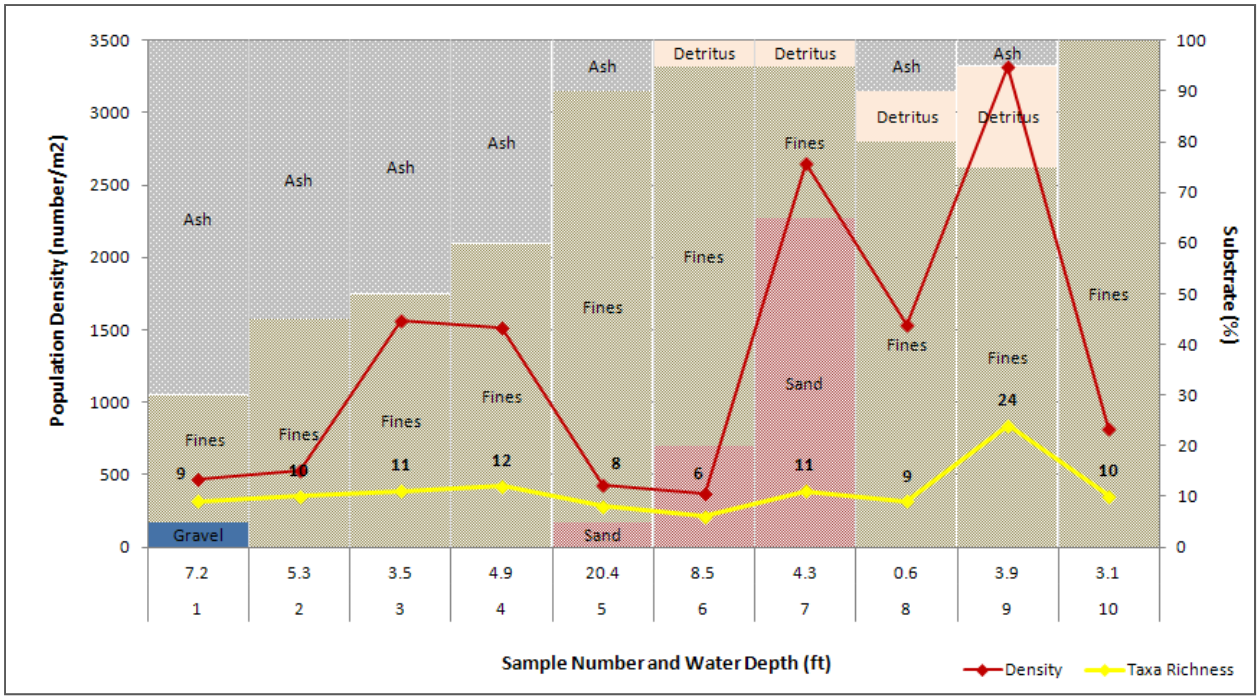

Figure B-15. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at ERM 1.0 in December 2010.

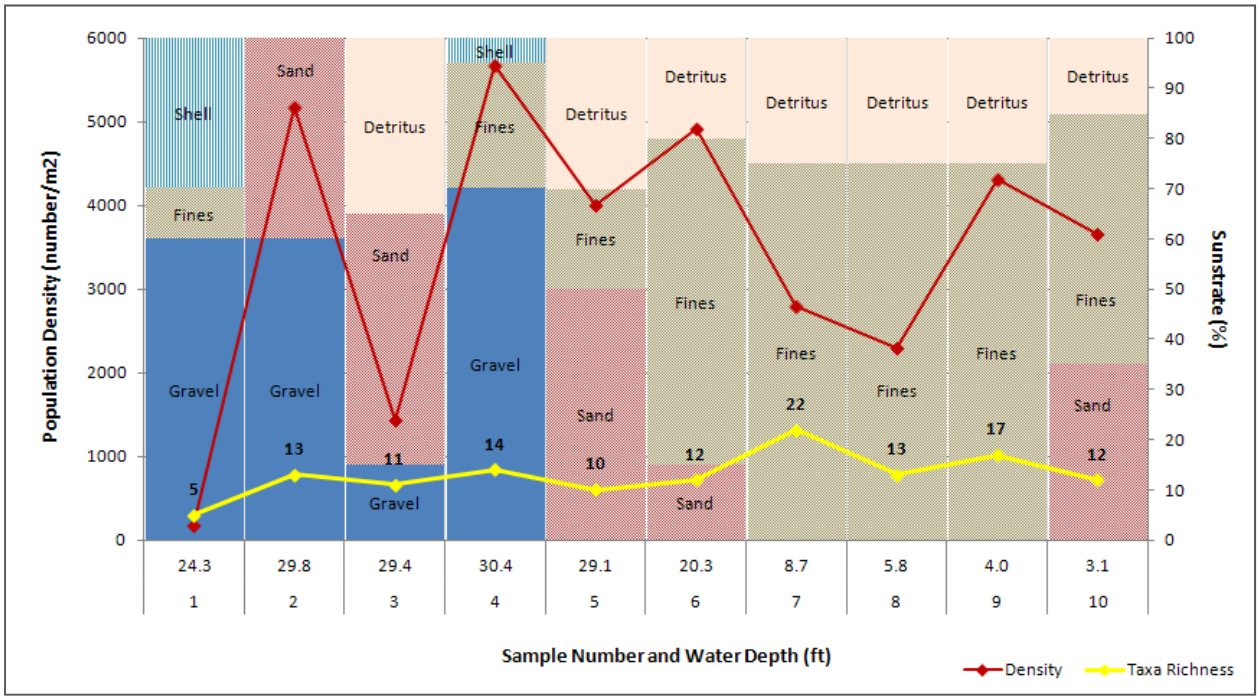

Figure B-16. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 8.7 in January 2009.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

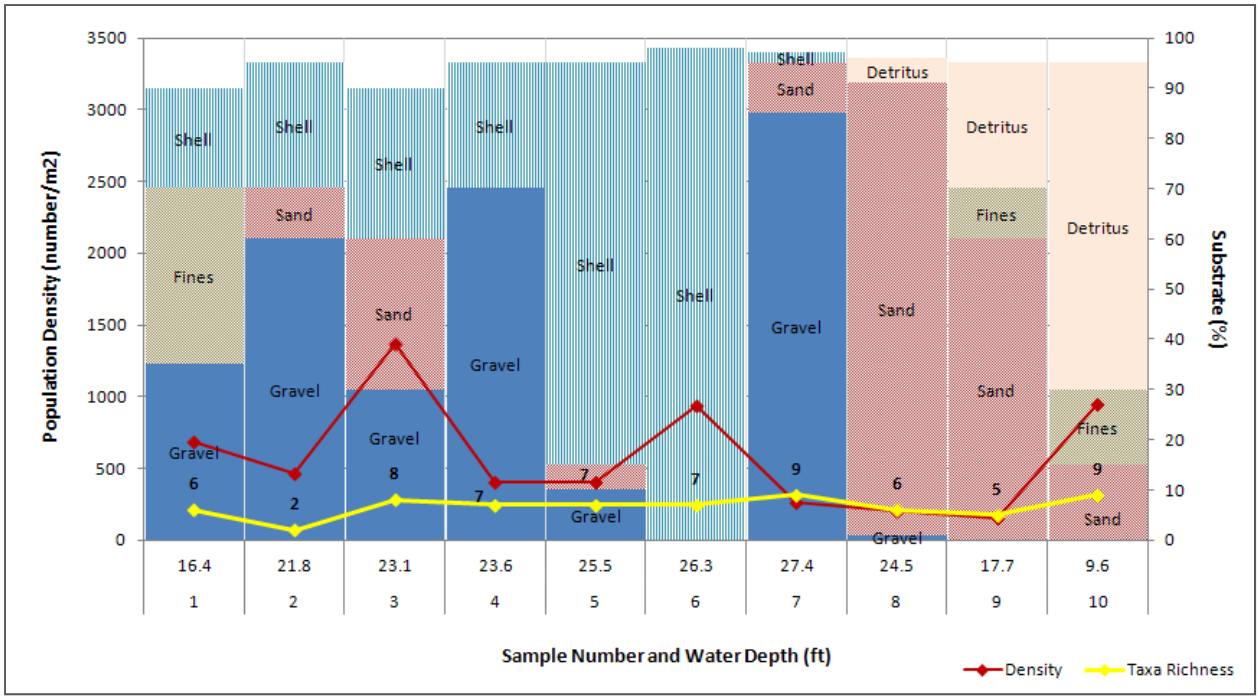

Figure B-17. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 8.7 in December 2009.

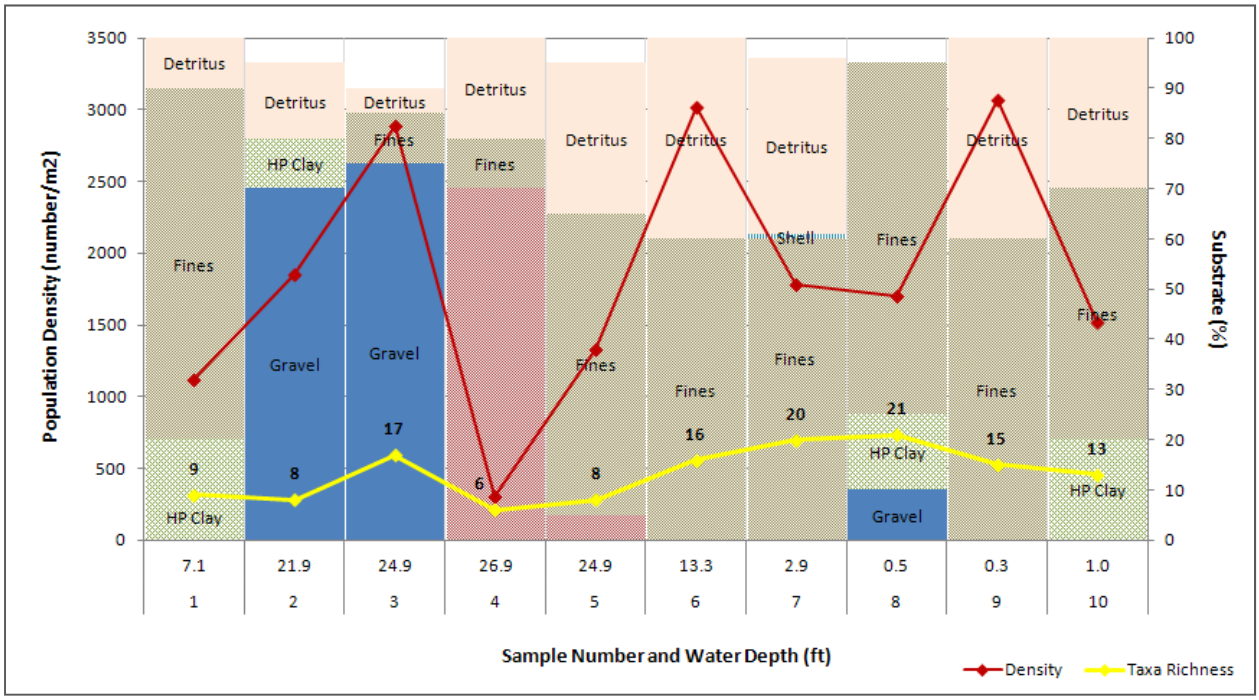

Figure B-18. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 8.7 in December 2010.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

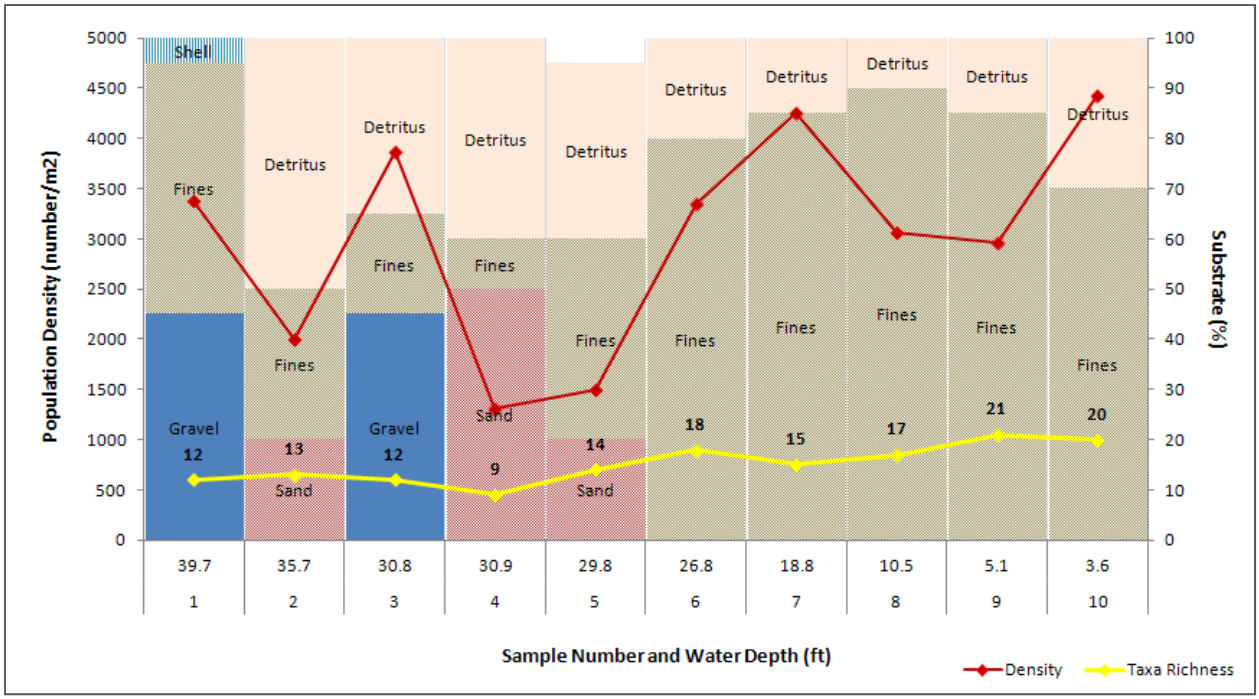

Figure B-19. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 6.0 in January 2009.

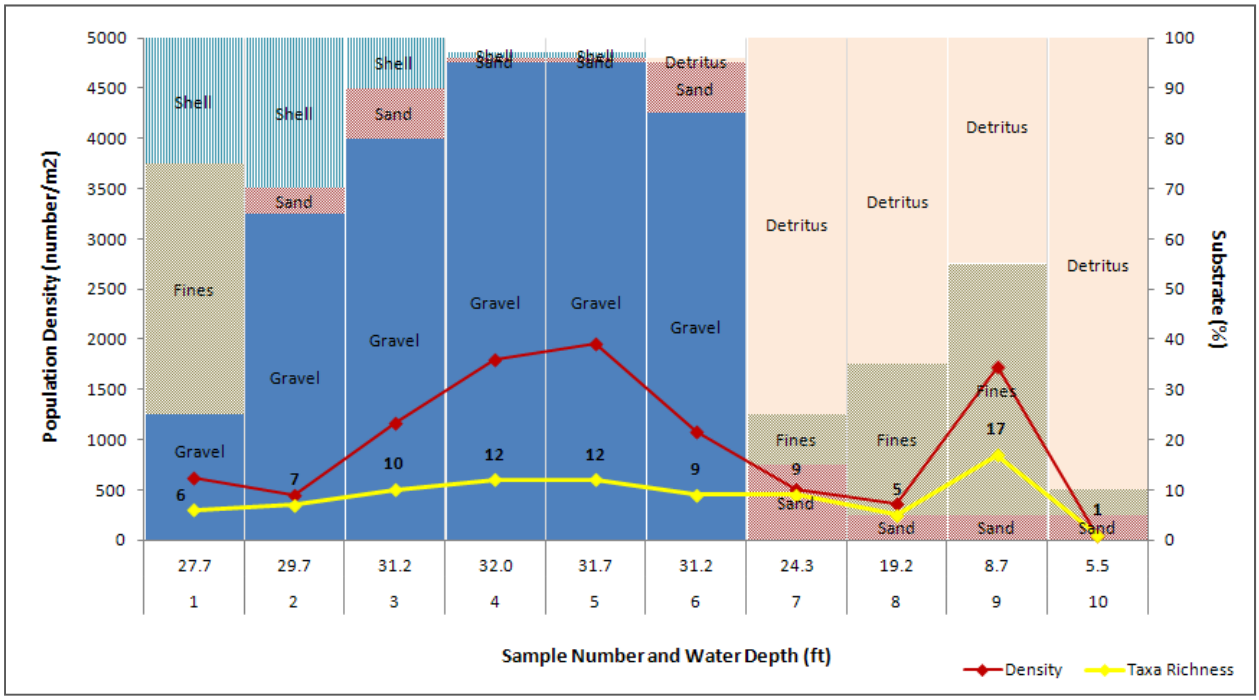

Figure B-20. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 6.0 in December 2009.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

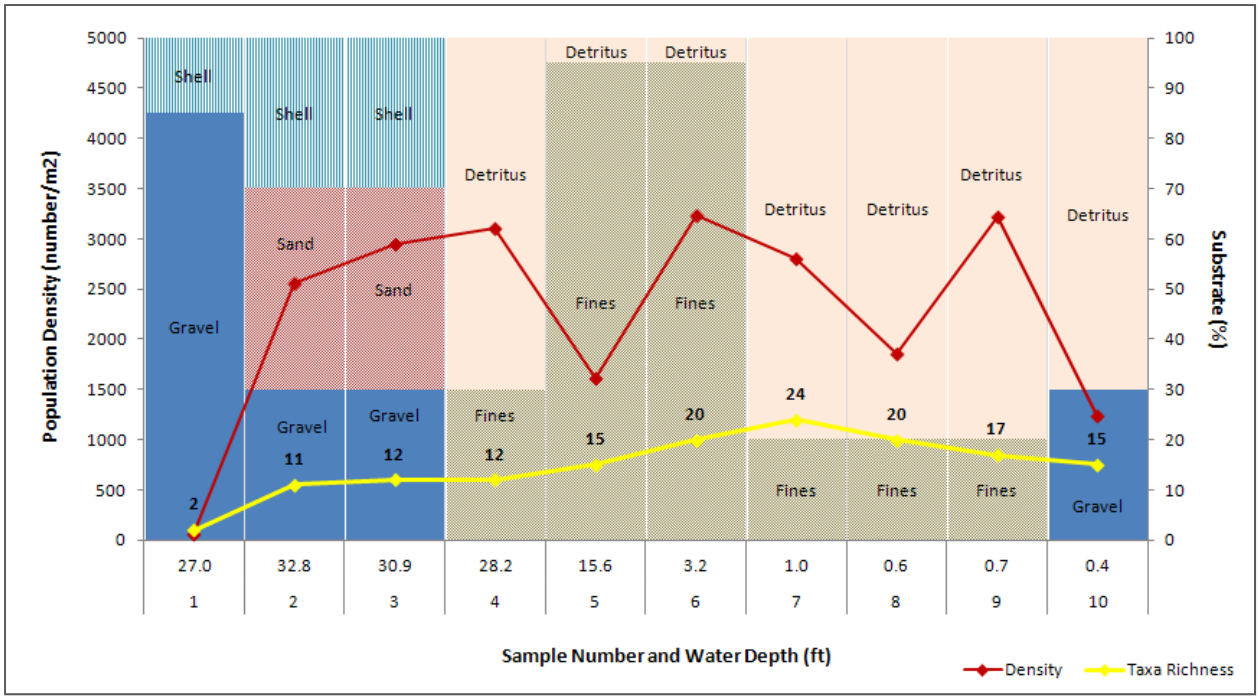

Figure B-21. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 6.0 in December 2010.

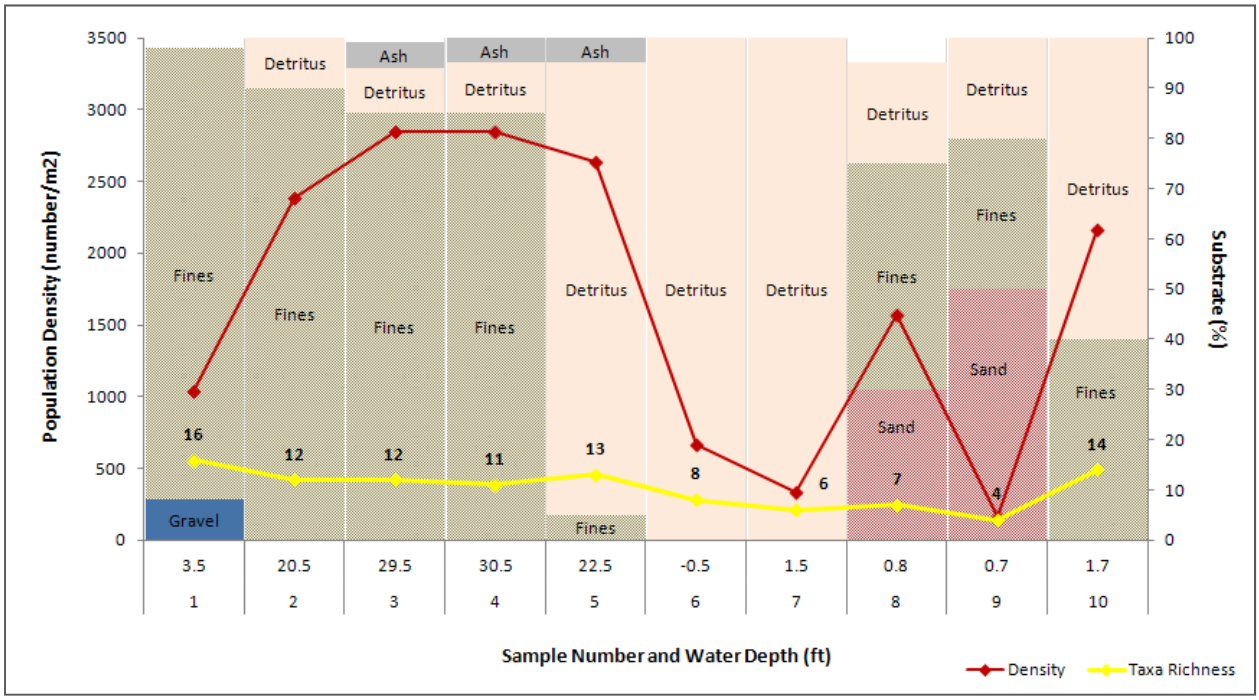

Figure B-22. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 4.0 in January 2009.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

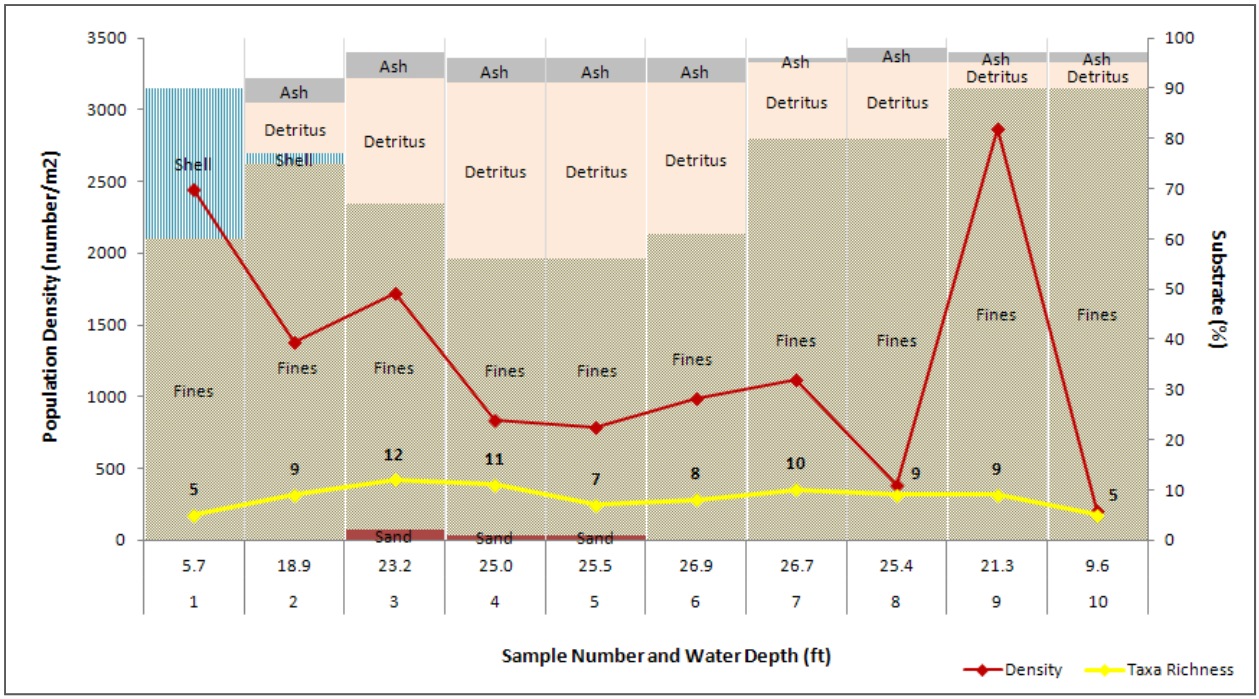

Figure B-23. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 4.0 in December 2009.

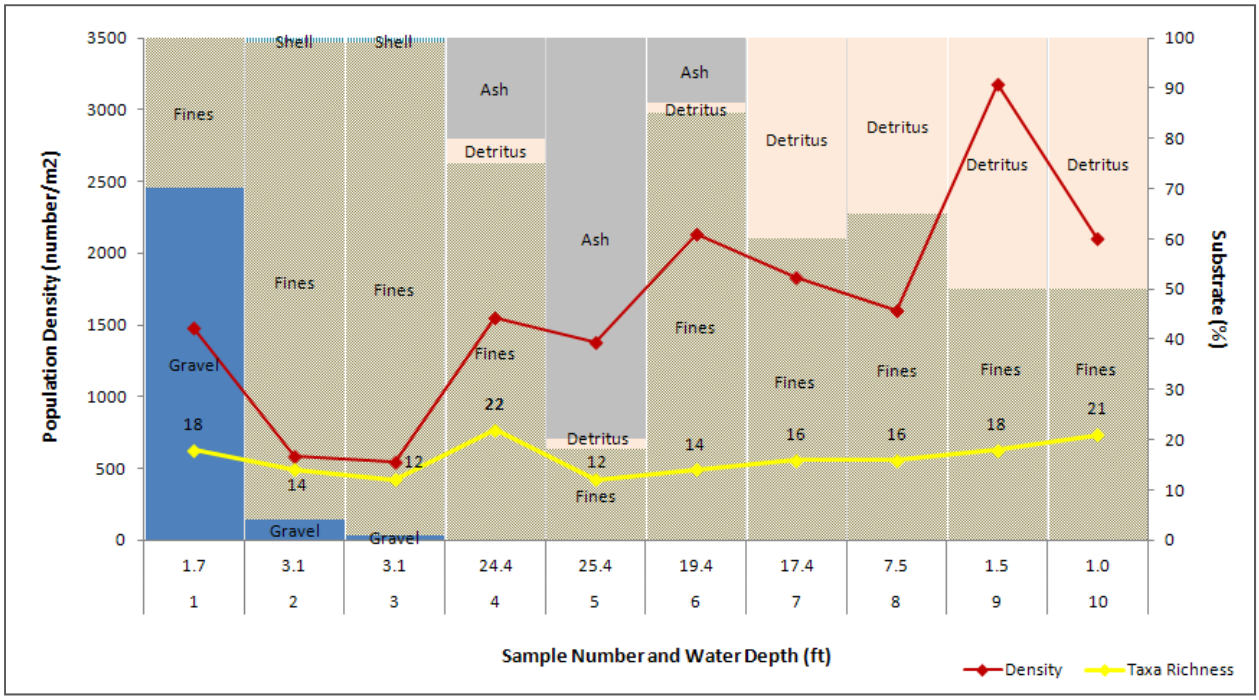

Figure B-24. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 4.0 in December 2010.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

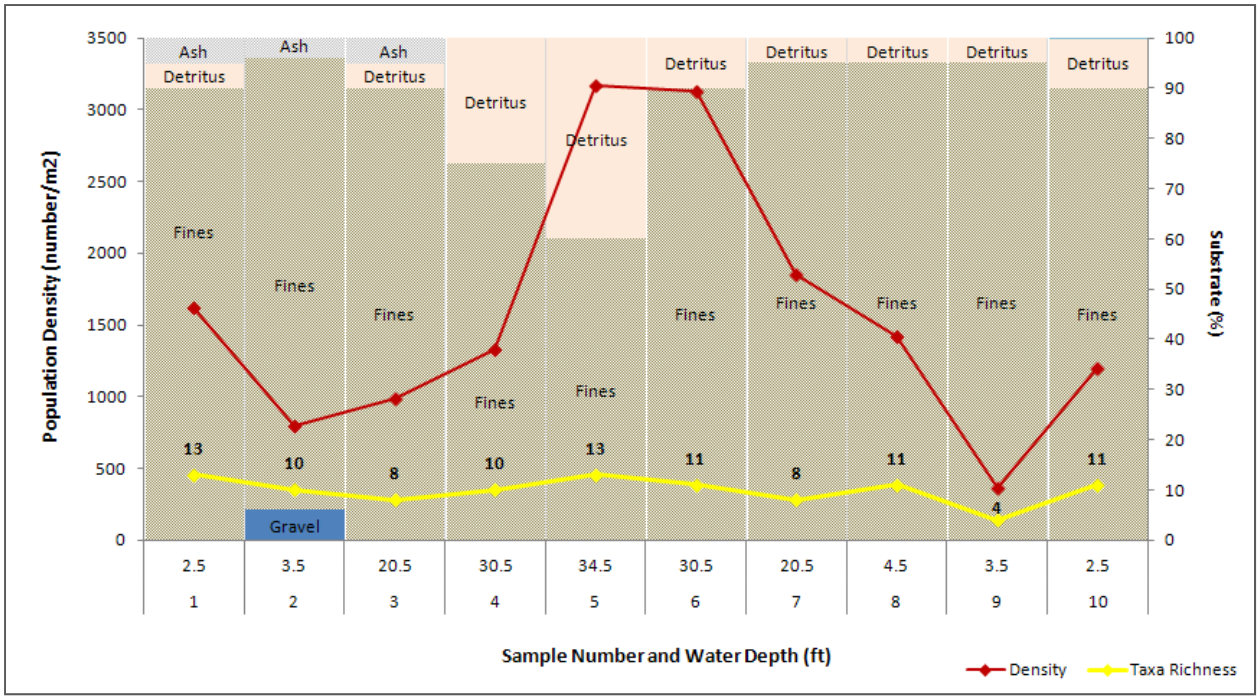

Figure B-25. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 3.0 in January 2009.

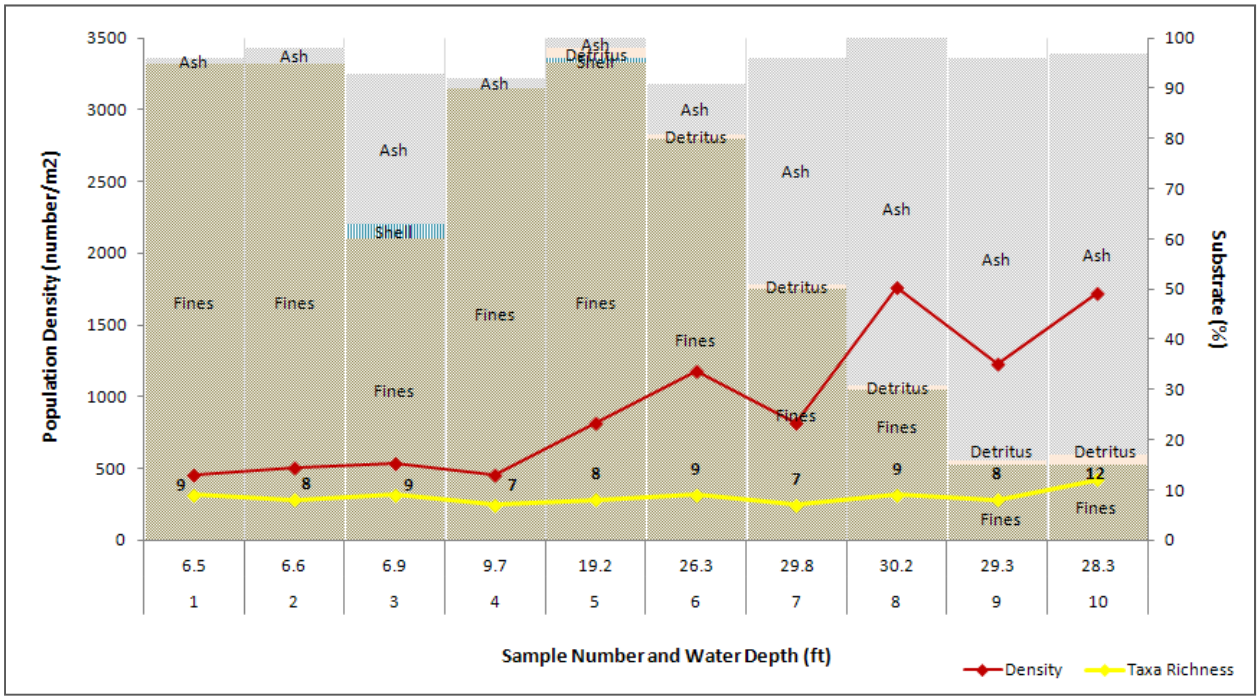

Figure B-26. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 3.0 in December 2009.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

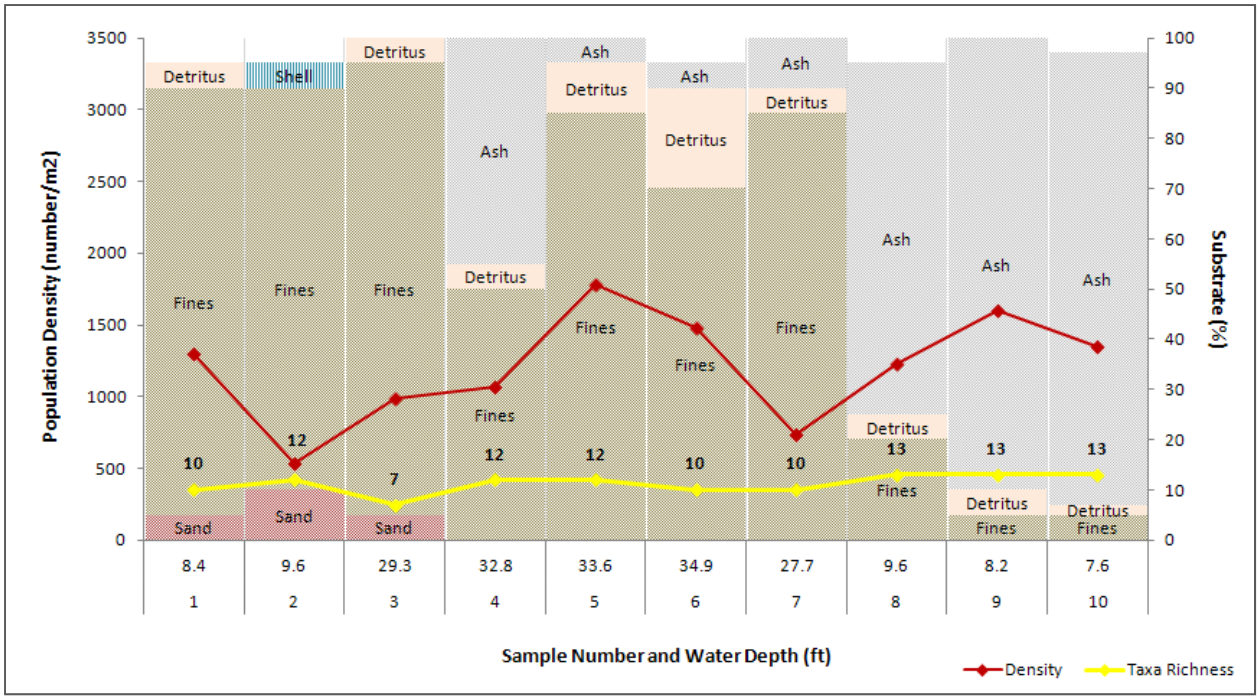

Figure B-27. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 3.0 in December 2010.

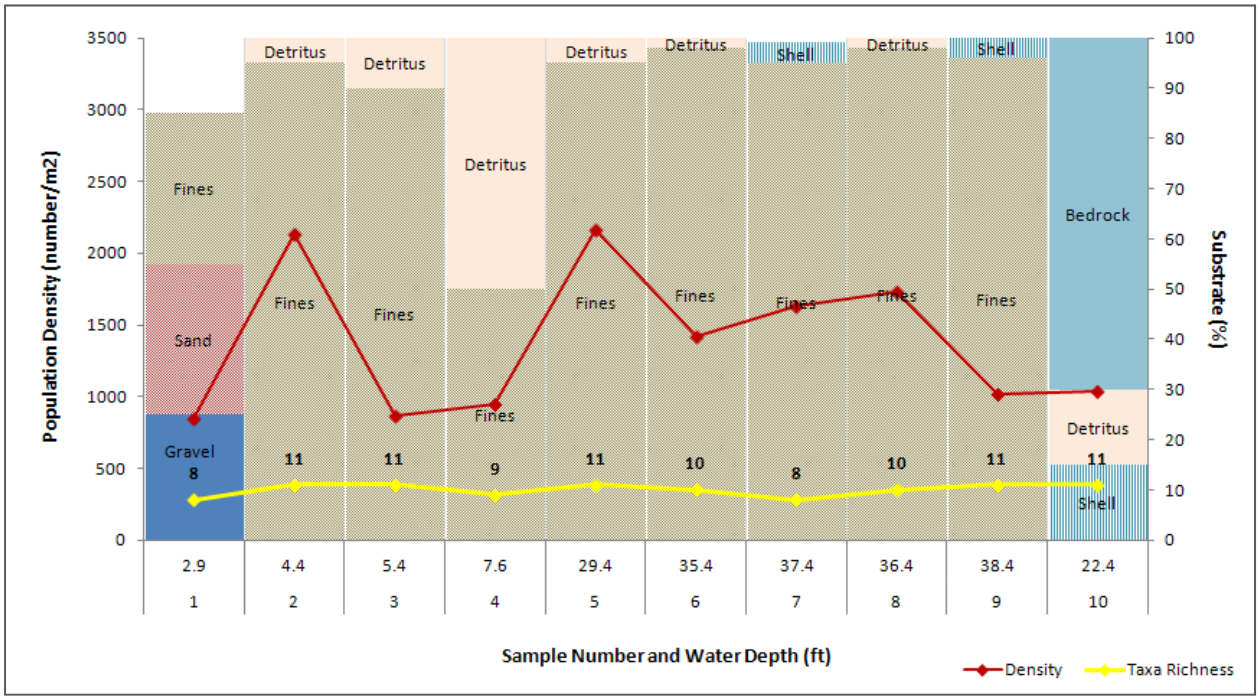

Figure B-28. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 1.5 in January 2009.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

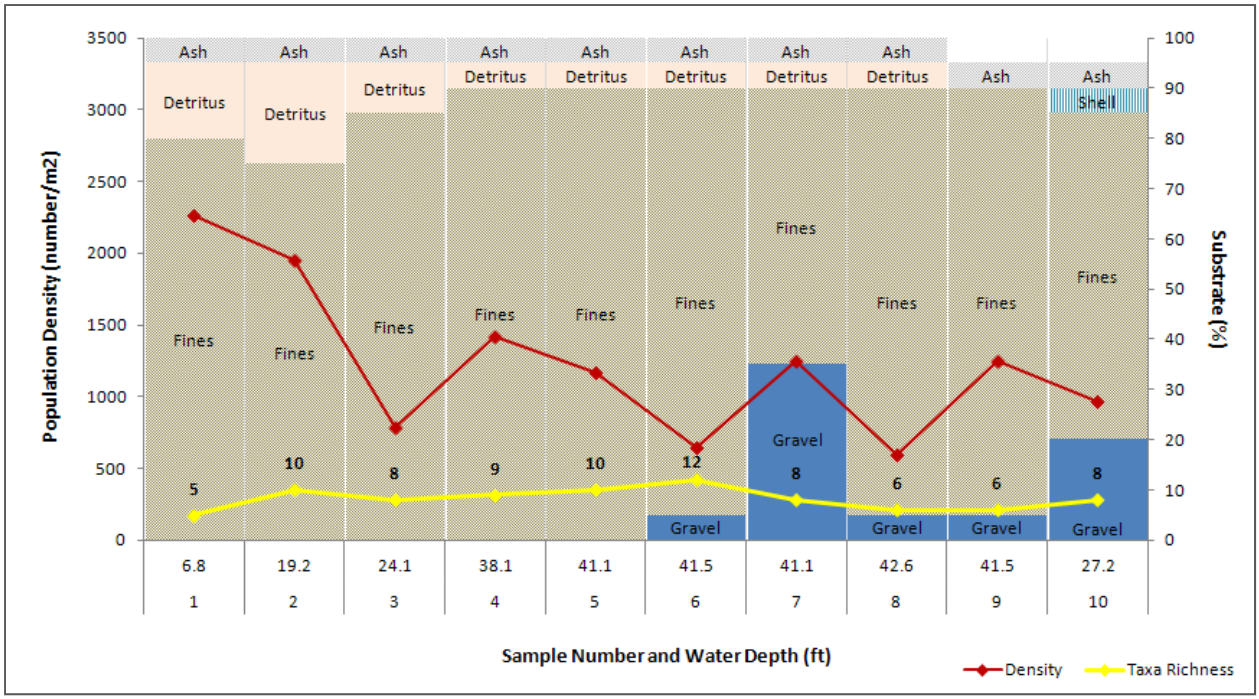

Figure B-29. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 1.5 in December 2009.

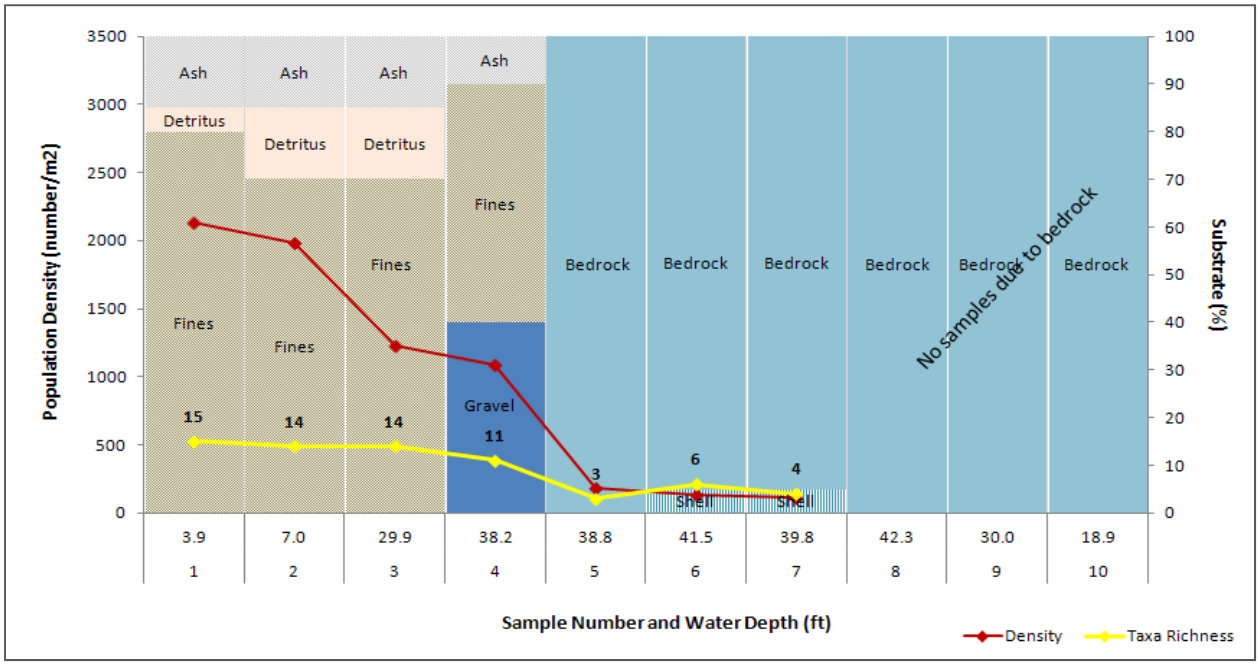

Figure B-30. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 1.5 in December 2010.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

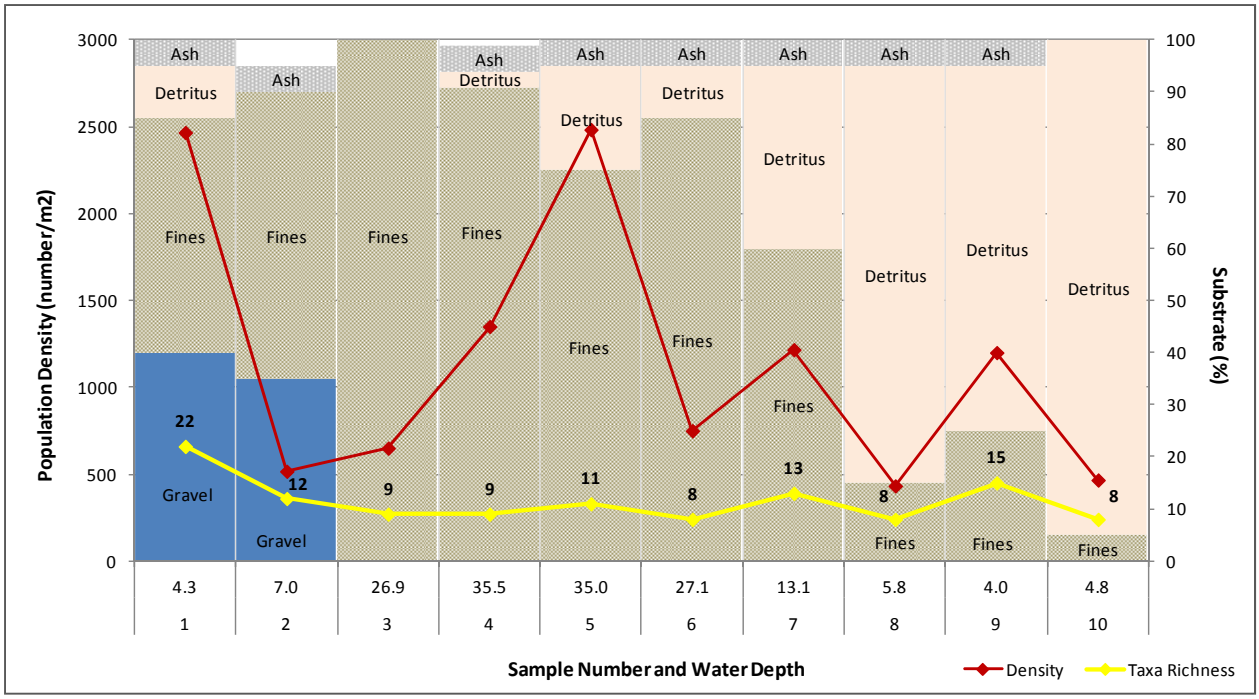

Figure B-31. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 0.5 in January 2009.

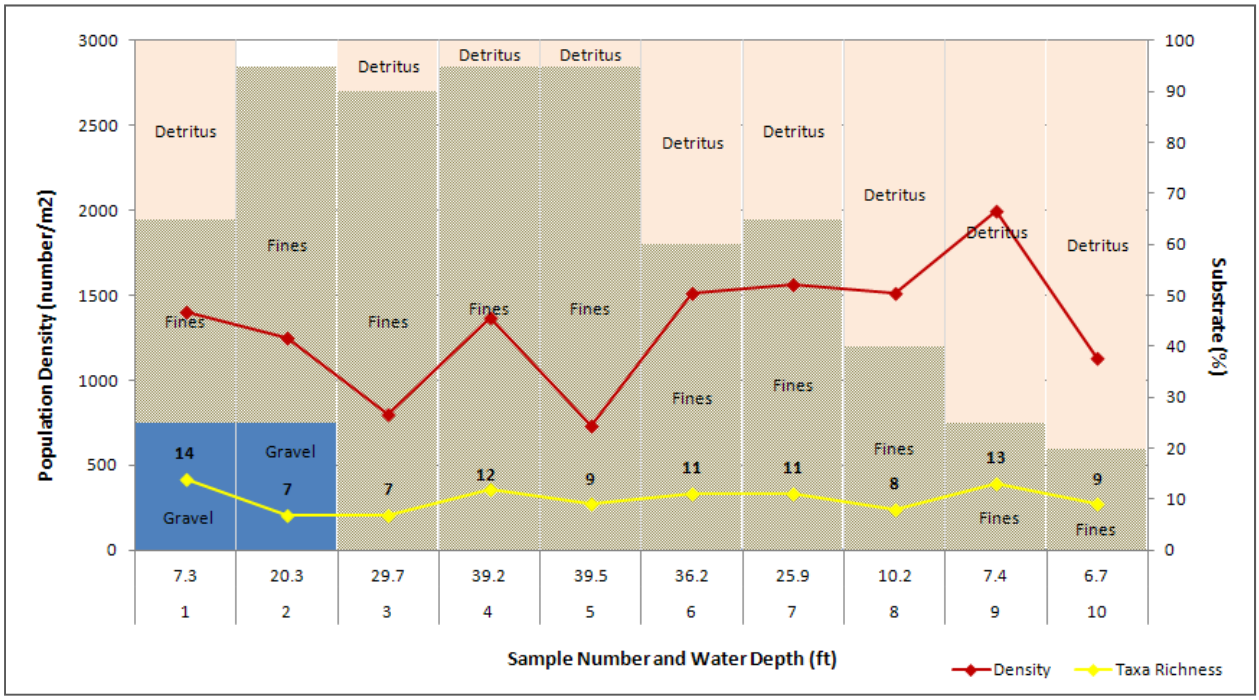

Figure B-32. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 0.5 in December 2009.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.

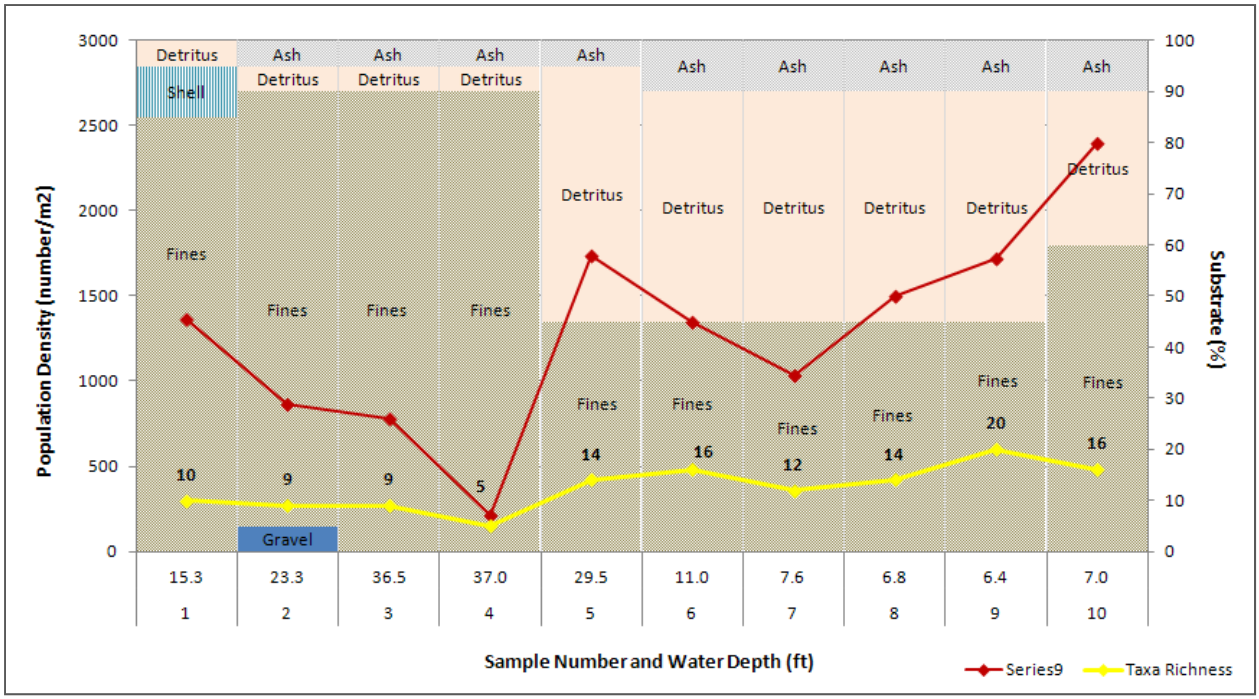

Figure B-33. Physcial characteristics (substrate composition and water depth*) and benthic macroinvertebrate population density and taxa richness for each sample collected at CRM 0.5 in December 2010.

* Field measured water depths were standardized to the lowest pool elevation (735.63 ft.) observed during 2008 through 2010.