Evaluation of
Seven Castles Creek
Sediment Inflow
on the Fryingpan River

Prepared for:

Roaring Fork Conservancy
Basalt, Colorado

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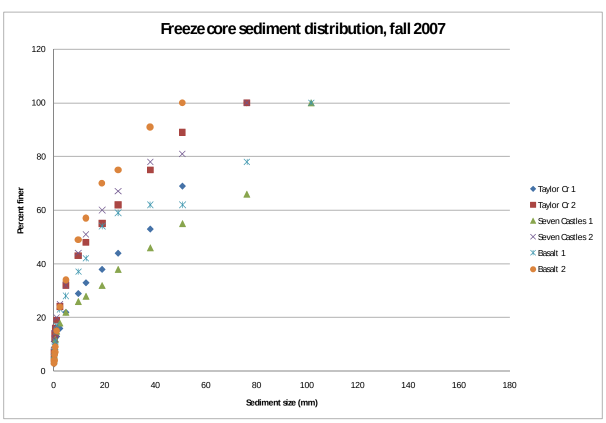

March 6, 2008

MILLER ECOLOGICAL CONSULTANTS, INC.

Executive Summary

In the summer of 2007 a rainstorm caused a large sediment inflow from Seven Castles Creek into the Fryingpan River and downstream into the Roaring Fork River. There were concerns expressed by the natural resource agencies and public regarding potential impacts to macroinvertebrates and fish habitat within the river. It was suggested that a flushing flow may be needed to remove the sediment and restore the function of the system. The objective of this study was to collect sediment distribution from freeze cores, quantify macroinvertebrates and qualitatively assess habitat to assist the agencies in determining whether a flushing flow was required prior to the natural high flow.

Three sites were selected for this study which were: just downstream of Taylor Creek, just downstream of Seven Castles Creek, and within the City of Basalt, all within the Fryingpan River. Taylor Creek and Basalt sites have previous data from the 2003 and supplemental studies that were used for comparison to the conditions after the August rainstorm.

Sediment distributions were assessed by using freeze core sampling. Two freeze cores were collected at each site and analyzed for sediment distributions. Macroinvertebrates were assessed with the same methods as previously applied which included three Hess samples collected at each location and standard metrics of diversity, evenness, density and biomass analyzed for each site. Habitat was visually assessed with the majority of the work being concentrated near Seven Castles Creek.

The freeze core analysis showed that sediment distribution at all sites ranged from fine to coarse material with no distinct differences between any of the sites. The freeze core sample at Taylor Creek showed a rounded cobble substrate (Figure ES-1). The Seven Castles site was more angular, likely due to the inflow of new sediment from Seven Castles Creek but the distribution was similar to other sites (Figure ES-2). Distribution by size show that the samples collected in 2007 are very comparable to the samples collected previously with the spawning study (Figures ES-3 and ES-4, Table ES-1).

Macroinvertebrate sampling resulted in the highest diversity and evenness at Taylor Creek and Basalt. The Seven Castles Creek site had the lower values for all metrics. Taylor Creek and Basalt were in the range that would be considered good and were very similar to the previous studies. The Seven Castles Creek site was rated as fair but within the same range as those seen in the previous study mainly at the site collected just downstream from the reservoir.

Habitat was assessed at Seven Castles Creek and at each of the other sites by visual observation. The large sediment delta at Seven Castles Creek has moved the Fryingpan River channel away from its previous channel location and into the riparian area. A new channel is being cut through the riparian vegetation and there are multiple channels for approximately 100 yards downstream from the confluence. This likely will result in a loss of vegetation within the riparian area, in particular the large cottonwood stand is now

being inundated. Those mature cottonwoods may die due to the change in channel and the flooding that is occurring in that area.

The results of the study show that the sediment distribution is similar to that observed prior to the event and that at all sites the sediment distribution is not extremely different. The fine material that is evident at some locations seems to be very locally distributed and limited to those local areas of small eddies along the bank or along the stream margin where it was deposited during the high water. Within the channel the substrate itself seems to be in the same condition or close to the same condition as prior to the event.

The macroinvertebrate community is lower in density than previously observed with the lowest density occurring near Seven Castles. However, the density, diversity and evenness show that the downstream condition near Basalt is not substantially different than the condition at Taylor Creek upstream of the inflow. The location at Seven Castle closest to the inflow is different from Taylor Creek but appears to be recovering with a variety of macroinvertebrates present at that site.

At this time it is recommended that no additional flushing flow occurs prior to the annual spring runoff and that any additional water, if available, should be applied at the natural peak. This will avoid impacts to invertebrates that would occur from runoff events that would be outside of the natural cycle. The riparian area with new channels is one location that may require some mechanical assistance in moving the channel back into its original location. It is likely that this channel migration occurred in the past, and especially prior to Reudi Reservoir. Historically, spring flows would have caused the channel to migrate back into its previous location and flushed out sediment from those areas. Since the peak flows are considerably less than historically experienced, it may be beneficial to mechanically move some of the material, especially the large rock at the confluence, to allow high flows to move downstream in the old channel location. In addition, the exposed fine sediment at the confluence with Seven Castles Creek could be a potential site for revegetation with young cottonwoods to establish a cottonwood gallery to replace the mature cottonwood gallery.

Conclusions

- The sediment inflow did have an immediate effect on the confluence area of Seven Castles Creek
- A new Fryingpan River channel was formed.
- The average of the Taylor Creek samples was only slightly coarser than the samples collected at Seven Castles Creek and Basalt.
- Seven Castles Creek had one of the coarsest samples collected of all six samples collected
- Macroinvertebrate results show reduced macroinvertebrates at all locations compared with the previous studies.
- The most impacted area appears to be the immediate vicinity of Seven Castles Creek.

- The impact appears to decrease with increased distance downstream from Seven Castles Creek.
- In the lower Fryingpan, the biota appear to be less impacted and in the same condition as the Taylor Creek reference site.

Recommendations

- A flushing flow outside of the normal runoff period is not recommended.
- Any flushing flow should coincide with the normal high flow.
- It is not likely to scour the large boulders deposited in the Fryingpan River with the normal high flow.
- This material will likely remain in place for many years unless it is mechanically removed.
- Mechanical removal may assist in placing the channel in its previous location and reduce impacts to the riparian area that is now flooded.
- An alternative would be to allow natural stabilization to occur in the new channel and use the new delta area for cottonwood and willow planting.

Figure ES-1. Taylor Creek Freeze Core

Figure ES-2. Seven Castles Freeze core.

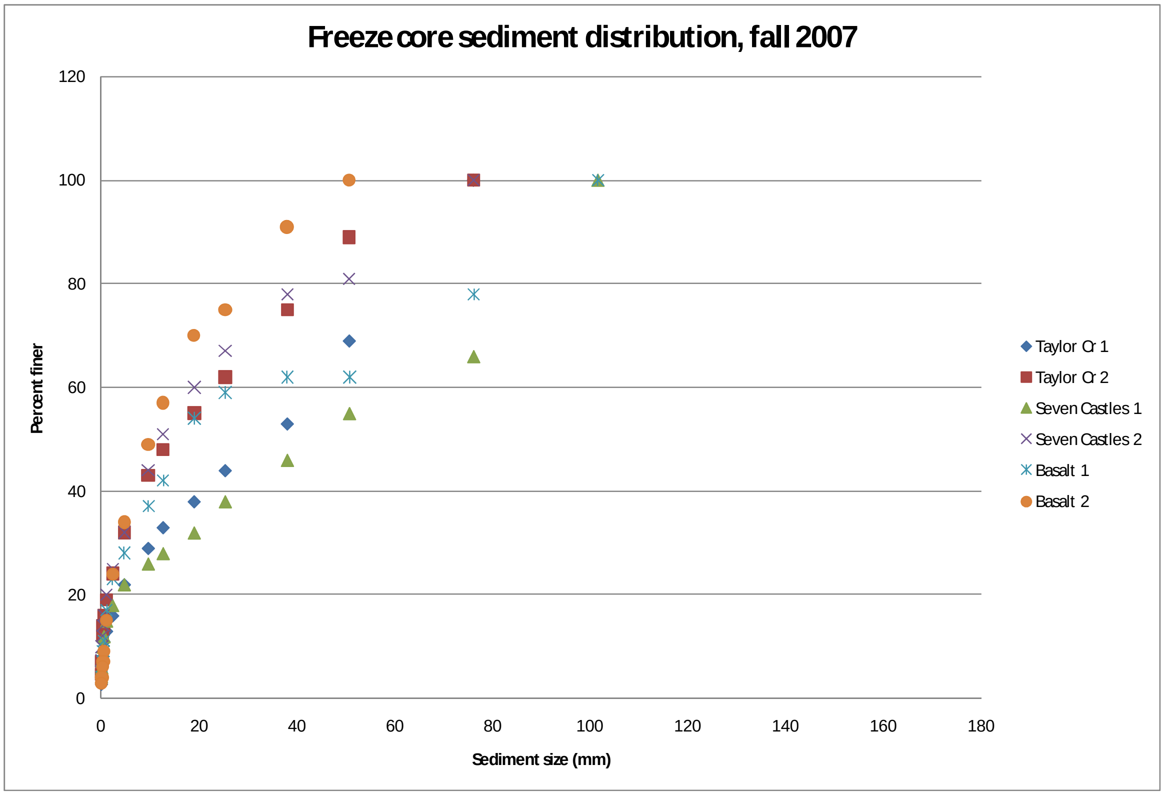

Figure ES-3. Freeze Core sediment size distribution for October 2007 samples.

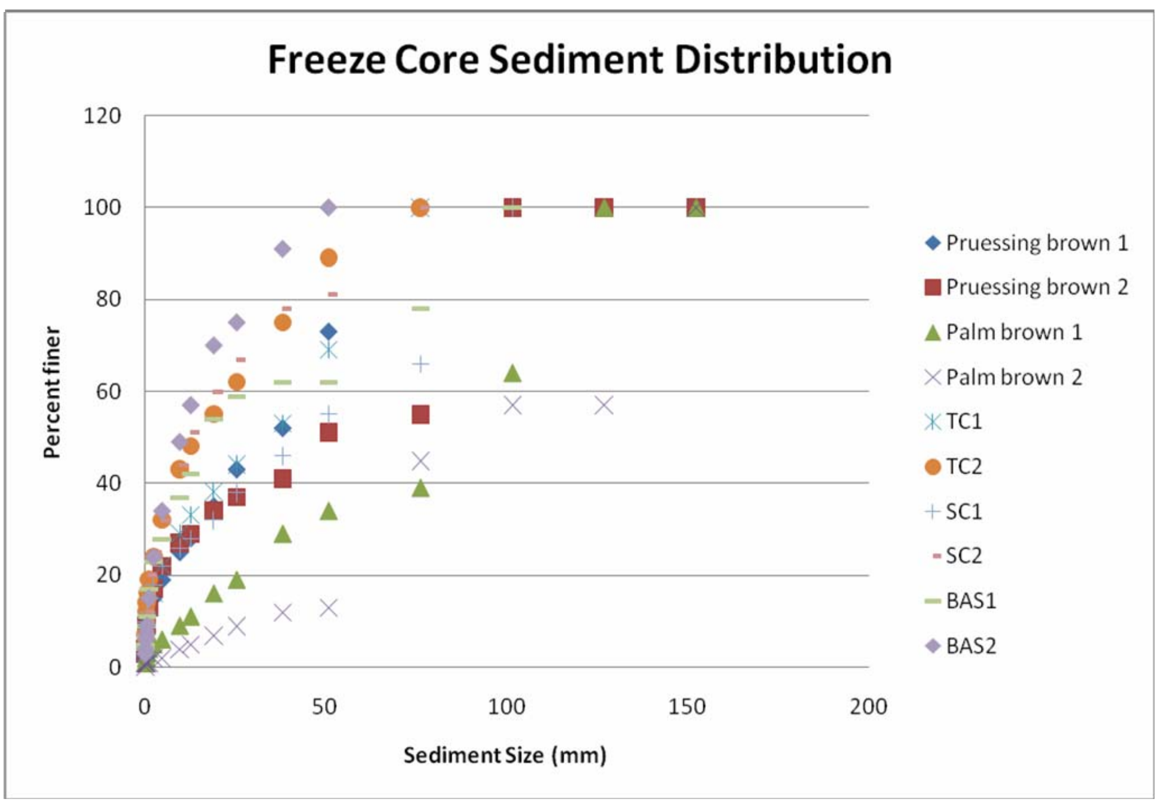

Figure ES-4. Freeze Core Sediment Size distribution comparison with previous study.

Table ES-1. Metrics and comparative values for macroinvertebrate samples collected during the fall season from riffle habitat in the Fryingpan River, Colorado.

Fall 2001	Diversity	Evenness	EPT	Taxa Richness	Density (#/m^2)	Biomass (g/m^2)
FPR-RES	2.29	0.453	19	33	16,509	1.3820
FPR-TC	3.76	0.701	23	41	10,318	2.4338
Fall 2002						
FPR-RES	2.34	0.478	14	30	28,220	2.0104
FPR-TC	3.35	0.639	19	38	17,530	2.4856
Fall 2003						
FPR-RES	2.49	0.508	14	30	31,665	1.8435
FPR-TC	3.39	0.656	18	36	15,792	3.2179
Fall 2004						
FPR-RES	2.33	0.515	12	23	20,161	1.4948
FPR-TC	3.44	0.656	20	38	15,332	3.0058
FPR-BAS	4.00	0.756	23	39	11,321	2.6318
Fall 2007						
FPR-TC	3.75	0.719	17	37	9229	3.682
FPR-SC	2.41	0.526	10	24	5742	1.514
FPR-BAS	3.37	0.687	16	30	3452	1.657

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INTRODUCTION

The objective of this study was to document conditions upstream and downstream from Seven Castles Creek which had a large sediment flow in August 2007. The objective of the study was to collect data for macroinvertebrates, instream sediment and general characteristics of habitat to compare with prior conditions collected by Miller Ecological Consultants, Inc. One hypothesis was that a high flow release could benefit the river and improve conditions for macroinvertebrates and, possibly, fish. It also was hypothesized that the large amount of sediment that entered the river impacted invertebrates and also could be detrimental to other biota.

METHODS

Core Samples

Methods for this study were identical to those used in the previous work. The sample sites were: 1) Taylor Creek, 2) just downstream of Seven Castles Creek, and 3) in Basalt (Figure 1). Two freeze core samples were collected at each site. Freeze cores used a freeze core apparatus (Figure 2) that consisted of a hollow tube and an internal jet to inject carbon dioxide below the stream bed surface. The carbon dioxide was injected for approximately 20 minutes, and then the steel rod was removed to extract the frozen material from the bed in one piece. These samples were then retained in buckets and transported to Terracon Laboratories in Fort Collins for a sediment sieve analysis. In addition, each sample was photographed as it was pulled to provide visual characteristics of those samples for comparison.

The final effort for physical habitat was an onsite visit at Seven Castles Creek. The objective of this site visit was to document the area of fine sediment at the mouth of the creek and any conditions in the immediate vicinity that had changed channel conditions and habitat conditions at that location.

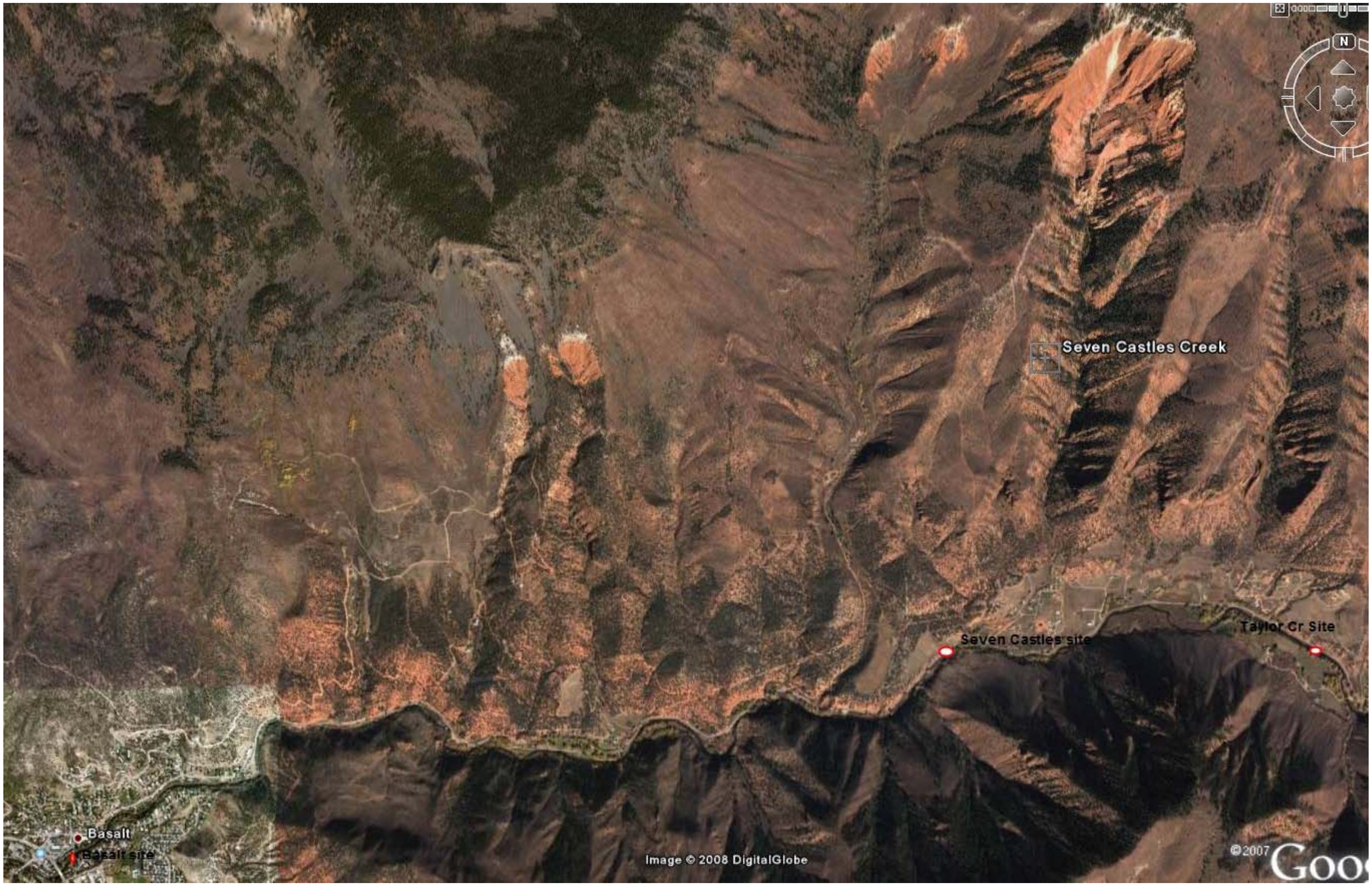

Figure 1. Fryingpan sediment study area (Source: Google)

Figure 2. Freeze core apparatus.

Macroinvertebrates

Selection of specific sampling locations was based on similarity of habitat characteristics. At each site, three replicate samples were taken in riffle habitat using a Hess Sampler with 500 μm mesh in order to provide quantitative macroinvertebrate data. An effort was made to take all samples in areas of similar size substrate and similar depth in order to avoid bias that may be associated with these variables. Substrate within the Hess Sampler was thoroughly agitated and individual rocks were scrubbed by hand to dislodge all benthic organisms. All macroinvertebrates were rinsed into sample jars and preserved in 70% ethanol solution. Each sample jar contained labels (with date, location and sample ID number) on the inside and outside of the jar. Samples were transported to the lab where they were sorted, enumerated and identified to the lowest practical taxonomic level (Merritt and Cummins 1996; Ward et al. 2002).

Macroinvertebrate population densities and species lists were developed for each site. Data were used in various indices to provide information regarding aquatic conditions. The following section provides a description of each index (metric) that was used in this study:

Shannon-Weaver diversity (diversity) and evenness (evenness) values were used to detect changes in macroinvertebrate community structure. In pristine waters, diversity values typically range from near 3.0 to 4.0. In polluted waters this value is generally less than 1.0. The overall evenness value ranges between 0.0 and 1.0, with values lower than 0.3 indicative of organic pollution (Ward et al. 2002). Diversity and Evenness are similar measurements because they both rely heavily on the numerical distribution of taxa, (although taxa richness also influences diversity). Both indices are designed to detect unbalance in communities (where a few species are represented by a large numbers of individuals). These situations are usually the result of pollution/disturbance-induced changes to the aquatic community. Diversity and Evenness were used in this study as a surrogate for water quality monitoring. They are not necessarily sensitive indicators of sediment related problems; however, some sediment-induced changes related to microhabitat availability might influence these values.

The Ephemeroptera, Plecoptera, Trichoptera (EPT) index was also employed to assist in the analysis of data. It is a direct measure of taxa richness among species that are generally considered to be sensitive to disturbances (Plafkin et al. 1989). Most macroinvertebrate species have specific habitat requirements. The value produced by this metric will indicate locations with preferred habitat as well as areas of disturbance or habitat modification. This value may vary spatially if a change in location results in a change in physical habitat features. The EPT index is reported as the total number of distinguishable taxa in the orders Ephemeroptera, Plecoptera and Trichoptera found at each site. Results provided by this metric will naturally vary among river systems, but are valuable when comparing samples taken from the same stream reach. The EPT index was used in analysis of this data to monitor the distribution of disturbance sensitive species.

Taxa richness was also reported for each location in the study area. This measurement is simply reported as the total number of identifiable taxa collected from each site. It is similar to the EPT index, except that it includes all aquatic macroinvertebrate species (including those that are thought to be tolerant to disturbance). Taxa richness is useful when describing differences in habitat complexity or aquatic conditions between rivers or site locations. Taxa richness values also provide an indication of habitat preference and complexity.

A measure of macroinvertebrate standing crop at each site was determined using density and biomass. Macroinvertebrate density was reported as the mean number of macroinvertebrates/m^2 found at each location. Biomass was reported as the mean dry weight of macroinvertebrates/m^2 at each site location. Biomass values were obtained by drying macroinvertebrates from each sample in an oven at 100° C for 24-hours or until all water content had evaporated (no decrease in weight could be detected). Biomass values offer production related information in terms of quantitative weight of macroinvertebrates produced at each site. Density and biomass provide a means of measuring and comparing standing crop and provide an indication of productivity for the macroinvertebrate portion of the food web at each sampling location.

The final metric used in this study was an analysis of macroinvertebrate functional feeding groups. This process provides a measurement of macroinvertebrate community function as opposed to other metrics that measure community structure. Aquatic macroinvertebrates were categorized according to feeding strategy to determine the relative proportion of various groups. Taxa were placed into functional feeding groups based on acquisition of nutritional resources (Merritt and Cummins 1996; Ward et al. 2002). The proportion of certain functional feeding groups in the macroinvertebrate community can provide insight to various types of stress in river systems (Ward et al. 2002). River ecosystems that provide a variety of feeding opportunities usually maintain good representation of each corresponding functional feeding group. Numerous variables (including habitat quality) may affect the proportions of certain functional feeding groups.

A measure of functional feeding groups is often recommended as part of benthic macroinvertebrate analysis and evaluation (Ward et al. 2002). Taxa were classified by trophic association and percent composition was calculated for each site. Typically the Collector-Gatherer group is dominant in western streams, but other groups should be well represented.

Statistical analysis on individual sample metrics was accomplished with the Statistica 7.0 software (Statsoft 2004). Mean and 95% confidence intervals were calculated and graphed.

RESULTS

The freeze core analysis was completed at all three sites on October 22 and October 23, 2007. The Taylor Creek site had two samples with a distribution of large to fine material. Sediment size distributions were all smaller than 3 inches and the fine sediment of 9.6 mm and less for the two samples was 29% and 43% respectively (Table 1). The freeze cores at both sites show a mixed deposition of both fine and coarse material from the surface to the full depth pulled. Samples of approximately 8 inches deep were pulled for both cores (Figures 3 and 4).

The Seven Castles Creek site was sampled approximately 100 meters downstream from the confluence with Seven Castles Creek in a shallow riffle area that had evidence of fine sediment deposits. The distributions of fine material were similar to those shown at Taylor Creek upstream of any sediment inflow with the fine material of 9.6 mm and smaller being distributed as 26% and 44% of each of the cores. This is almost identical to the Taylor Creek sample. Differences at Seven Castle Creek were that the material sampled was more angular but also contained a well mixed distribution of fine material to coarse throughout the sample (Figures 5 and 6).

Table 1. Sediment Size distribution for samples collected October 22 and 23, 2007.

Sediment size (mm)	Taylor Cr 1	Taylor Cr 2	Seven Castles 1	Seven Castles 2	Basalt 1	Basalt 2
152.4						
127						
101.6			100		100	
76.200	100	100	66	100	78	
50.800	69	89	55	81	62	100
38.100	53	75	46	78	62	91
25.400	44	62	38	67	59	75
19.050	38	55	32	60	54	70
12.700	33	48	28	51	42	57
9.660	29	43	26	44	37	49
4.750	22	32	22	32	28	34
2.360	16	24	18	25	23	24
1.120	13	19	15	20	17	15
0.600	11	16	12	16	11	9
0.425	9	14	10	14	9	7
0.300	7	12	8	12	7	6
0.150	4	7	6	10	5	4
0.075	2.8	4.6	4.3	7.4	4.1	2.9

Figure 3. Taylor Creek freeze core 1.

Figure 4. Taylor Creek freeze core 2.

Figure 5. Seven Castles Creek freeze core 1.

Figure 6. Seven Castles Creek freeze core 2.

The freeze core sampling at Basalt was collected behind the Taylor Creek Fly Shop at a location that had been sampled for invertebrates during the previous study. There was evidence at this site of fine as well as coarse material. The surface material at this location was much coarser and made it more difficult to obtain large freeze core samples. The distribution for the fine material was similar to all the other sites with distributions of the 9.6 mm and smaller of 37% and 49% of the sample. These samples had more rounded coarse material than the Seven Castles Creek material (Figures 7 and 8). Also at Basalt, it was noted that the structures on the banks that create the large boulder wing dams retain sediment and had fine sediment deposits from the sediment event (Figure 9).

Figure 7. Basalt freeze core 1.

Figure 8. Basalt Creek freeze core 2.

Figure 9. Sediment deposits at Basalt.

Habitat conditions at Seven Castles Creek were investigated with visual observation and measurement of the delta area formed by the sediment flow. A channel had been excavated from Seven Castles Creek down to the Fryingpan River to allow Seven Castles Creek to flow (Figure 10). On the east side of the Fryingpan River very fine sediment was still in evidence and had not been flushed out of the system. Nearer to the Fryingpan River, there was large boulder size material in the streambed where the active channel had been previous to the sediment inflow. This material is extremely large and is approximately 4 feet higher than the old streambed. This deposit pushed the channel away from Seven Castles confluence and to the bedrock bank on the west side of the river (Figure 10). There is a large area of fine sediment still remaining on the side of the Fryingpan River closest to the road. This material area is approximately 50 feet across and approximately 150 feet linear distance along the stream (Figure 11).

Figure 10. Seven Castles Creek confluence.

Figure 11. Sediment deposits at Seven Castles Creek.

The rock debris at the confluence of Seven Castles Creek and the Fryingpan River has impounded a large pool upstream of this structure and forced a new channel on the west side of the river (Figure 12). This new channel is cutting through the riparian area and will likely cause the mortality of some of the vegetation in this area as it stabilizes (Figure 13). This area likely had river channels historically but not since the reduction in high flows since the construction of Reudi Reservoir. It is likely that over time the channel would have migrated back and forth with other historical sediment events. Aerial photography viewed in this area shows that there are some remnant channels throughout this valley bottom that have occurred over time.

The vegetation within the riparian area where the new channels is located appear to be even-aged cottonwoods approximately 40 years old or older. Few if any young cottonwoods were observed in the riparian area. It appears that the flows in this area have not been sufficient to regenerate cottonwood growth and that the even age stand in some areas has also given way to spruce that have come into the area due to lack of inundation and a more upland condition (Figure 13). The Fryingpan River channel prior to the sediment inflow was near the highway (Figure 14). The channel has moved south after the sediment inflow (Figure 15).

Figure 12. Rock debris at Seven Castles Creek.

Figure 13. New channel at Seven Castles Creek.

Figure 14. Aerial view of Seven Castles Creek before the sediment inflow (Source: Google)

Figure 15. Seven Castles Creek confluence and Fryingpan channel after sediment flow.

Macroinvertebrates

The macroinvertebrate sampling in the Fryingpan in Fall 2007 shows that there are some differences among the three sites samples, Taylor Creek, Seven Castles and Basalt. The reference site for this analysis was Taylor Creek which is upstream of the Seven Castles inflow. That site has the highest values for diversity, evenness, EPT, taxa richness, density and biomass (Table 2). The other sites, Seven Castles and Basalt, show both similarities and differences with the Taylor Creek reference site. The density values for Seven Castles Creek are intermediate between Basalt and the Taylor Creek site (Figure 16). Biomass for Seven Castles is similar to Basalt and both are slightly lower than the Taylor Creek site (Figure 17). Diversity values for Seven Castles are less than both Basalt and Taylor Creek and there are no differences statistically between Taylor Creek and Basalt (Figure 18). The EPT values are the most similar of all three sites. Seven Castles, however, is slightly lower for EPT values both mean and confidence interval than either Basalt or Taylor Creek. The Basalt site is not significantly different than the Taylor Creek reference site (Figure 19).

The functional feeding groups are dominated by collector-gatherers which is typical of Colorado streams (Table 4). No scrapers were found at the Seven Castles site, which is consistent with the reduction in some of the other indices and may be due to the degree of disturbance at this location.

The overall findings for macroinvertebrates, density, diversity, biomass and EPT show that there are differences that could have been from the Seven Castles inflow and this is shown by the low values at Seven Castles Creek for most of the indices tested. There does seem to be a lower impact or in some cases no detectable impact at Basalt from the inflow. This was also seen during the physical observations at the site. The values for diversity at Basalt are in the good range; the value at the Seven Castles site is higher than would be observed in a polluted or poor condition but not in the good range. This probably is indicative of the recovery that is occurring naturally and one would expect that over time the Seven Castles Creek would be at the same level as Taylor Creek and

Basalt. Both sites downstream of Taylor Creek are showing that there is a relatively intact macroinvertebrate community. The density and biomass at all locations should be adequate to support a healthy trout population. The number per square meter for Seven Castles Creek and also the Basalt site is lower than were sampled in the past but Taylor Creek is also lower in density than previously samplings other than 2001 (Table 2). The 2001 Taylor Creek density was approximately 10,000 invertebrates per meter^2. Biomass in grams per meter^2 is in the range that was observed in the previous samplings at upstream sites for just below the reservoir and Taylor Creek. Seven Castles Creek site had a high number of small mayflies which resulted in a high density but lower biomass than the Basalt site (Appendix A).

The invertebrate community takes some time to recover after a catastrophic event and mobilization of substrate. This has been shown in our other studies in the Colorado River and approximately one to two months post-event is required for invertebrates to repopulate. We would expect that by Spring 2008, densities and biomass would be somewhat higher than now. One recommendation would be to resample these sites in spring prior to runoff to determine if conditions have improved and determine if a higher than normal peak release would be beneficial.

Table 2. Metrics and comparative values for macroinvertebrate samples collected during the fall season from riffle habitat in the Fryingpan River, Colorado.

Fall 2001	Diversity	Evenness	EPT	Taxa Richness	Density (#/m^2)	Biomass (g/m^2)
FPR-RES	2.29	0.453	19	33	16,509	1.3820
FPR-TC	3.76	0.701	23	41	10,318	2.4338
Fall 2002						
FPR-RES	2.34	0.478	14	30	28,220	2.0104
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FPR-SC	2.41	0.526	10	24	5742	1.514
FPR-BAS	3.37	0.687	16	30	3452	1.657

Table 3. Functional feeding groups for Fryingpan River Sites, October 22, 2007.

Site	Collector-Filterer	Collector-Gatherer	Predator	Scraper	Shedder
Taylor Creek	11.70%	71.10%	9.50%	2.20%	5.60%
Seven Castle	16.20%	78.00%	5.70%	0.00%	10.00%
Basalt	16.40%	70.90%	7.00%	5.10%	0.60%

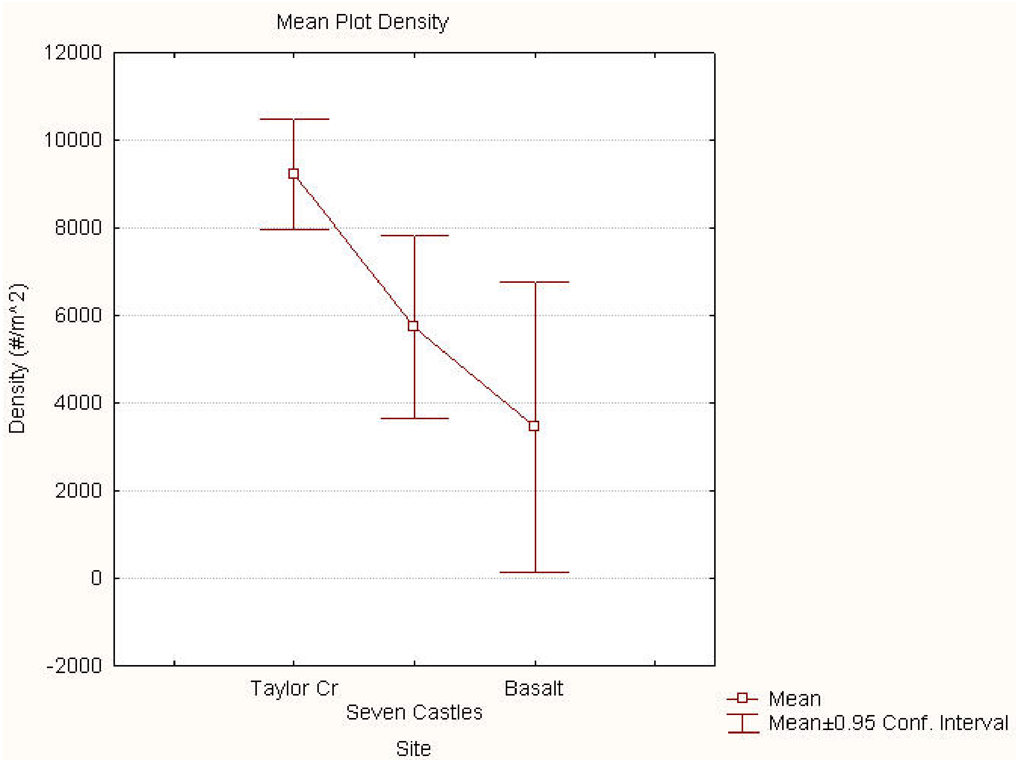

Figure 16. Comparison of macroinvertebrate density, October 2007.

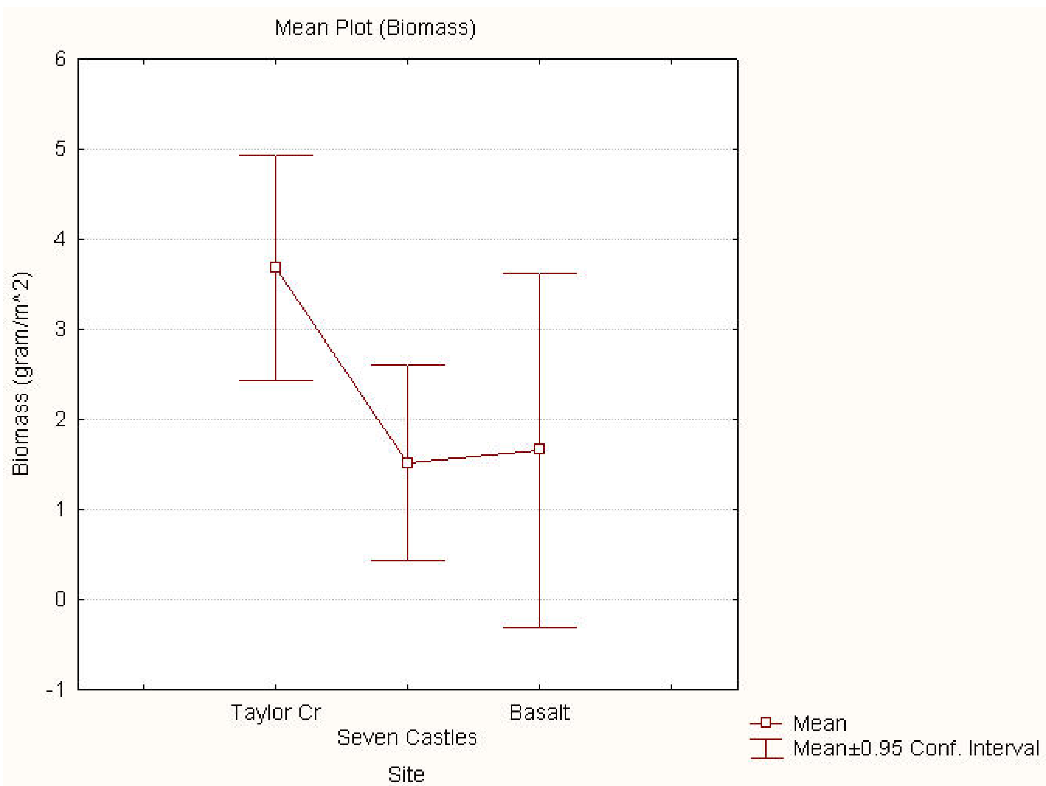

Figure 17. Comparison of macroinvertebrate biomass, October 2007.

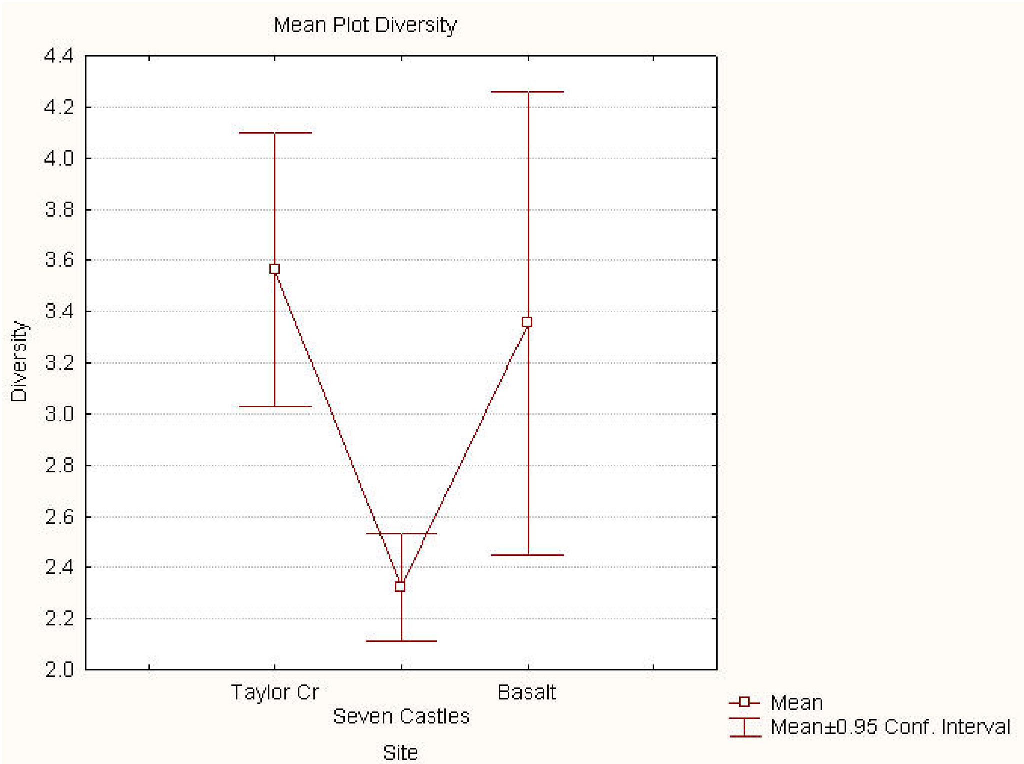

Figure 18. Comparison of macroinvertebrate diversity, October 2007.

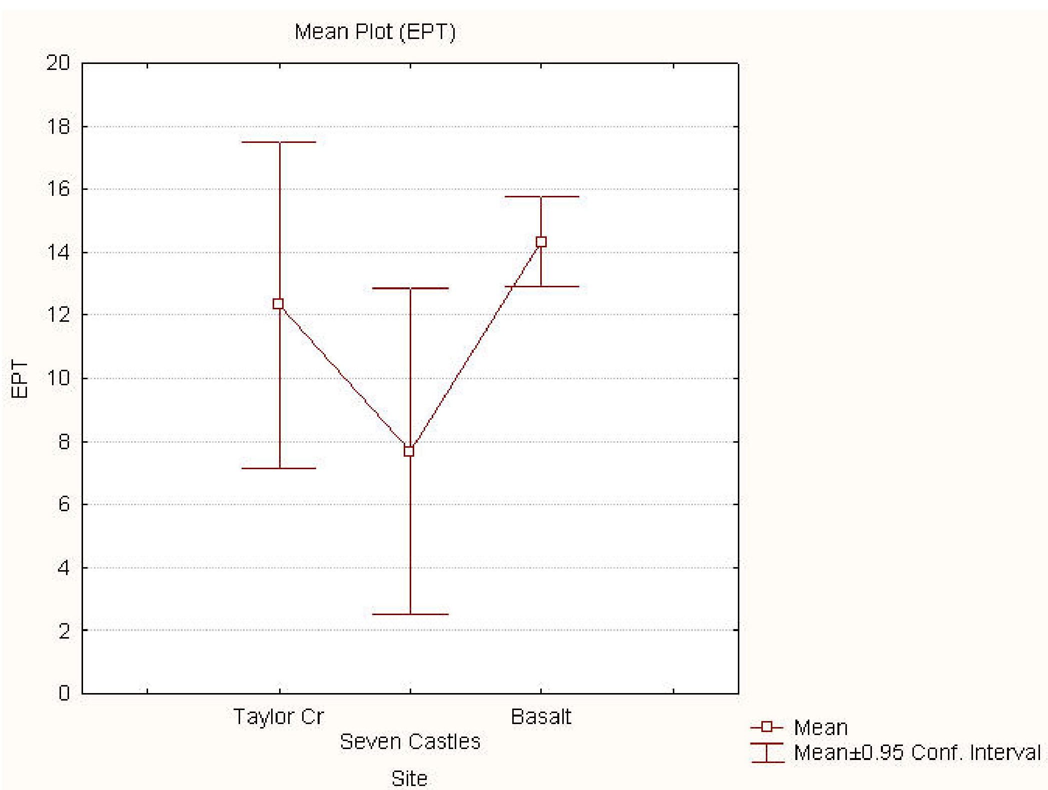

Figure 19. Comparison of macroinvertebrate EPT values, October 2007.

DISCUSSION AND CONCLUSIONS

The data obtained for the Fryingpan River in October 2007 shows sediment conditions both upstream and downstream of the event similar to those investigated in the previous freeze core sampling. Freeze core distributions for the October 2007 samples show that the fine material concentrations are similar both upstream and downstream of Seven Castles Creek. Taylor Creek samples were only slightly coarser than the samples collected at Seven Castles Creek and Basalt. Seven Castles Creek in fact had one of the coarsest samples collected of all six samples collected (Figure 20). In comparing the freeze core samples of 2007 with those previously collected during spawning studies, all spawning studies were collected upstream of the Seven Castles Creek confluence and these were in constructed redds and then pulled at the end of what would have been the incubation period. The sample distributions for the cores of these areas again show that the sampling for most of those areas was bounding the sediment conditions collected in 2007 (Figure 21). There is a range of sediment sizes as well as percent distributions with one of the Basalt samples showing a finer sediment distribution than the others. This may be because the large surface substrate, cobble and boulder size, does not adhere to the freeze core as well as the fine sediment and the small sample size collected was mainly the fine material that could be extracted.

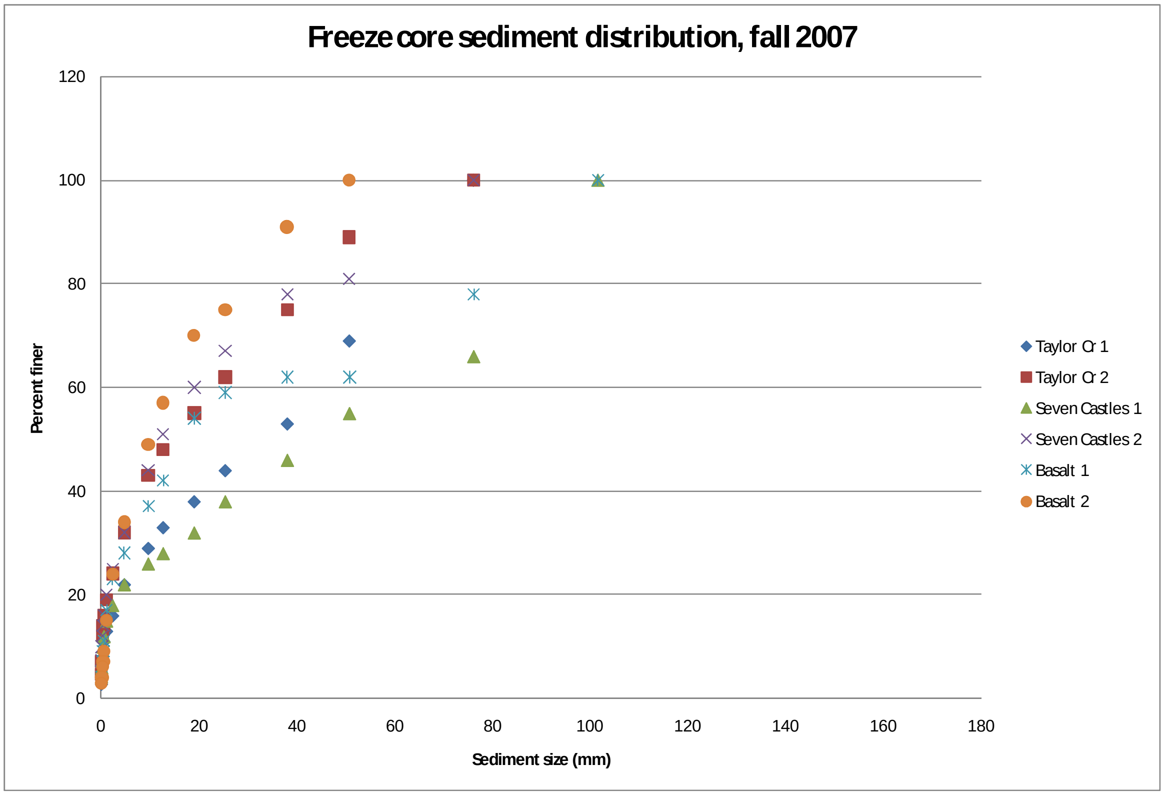

Figure 20. Freeze core sediment size distribution for October 2007 samples.

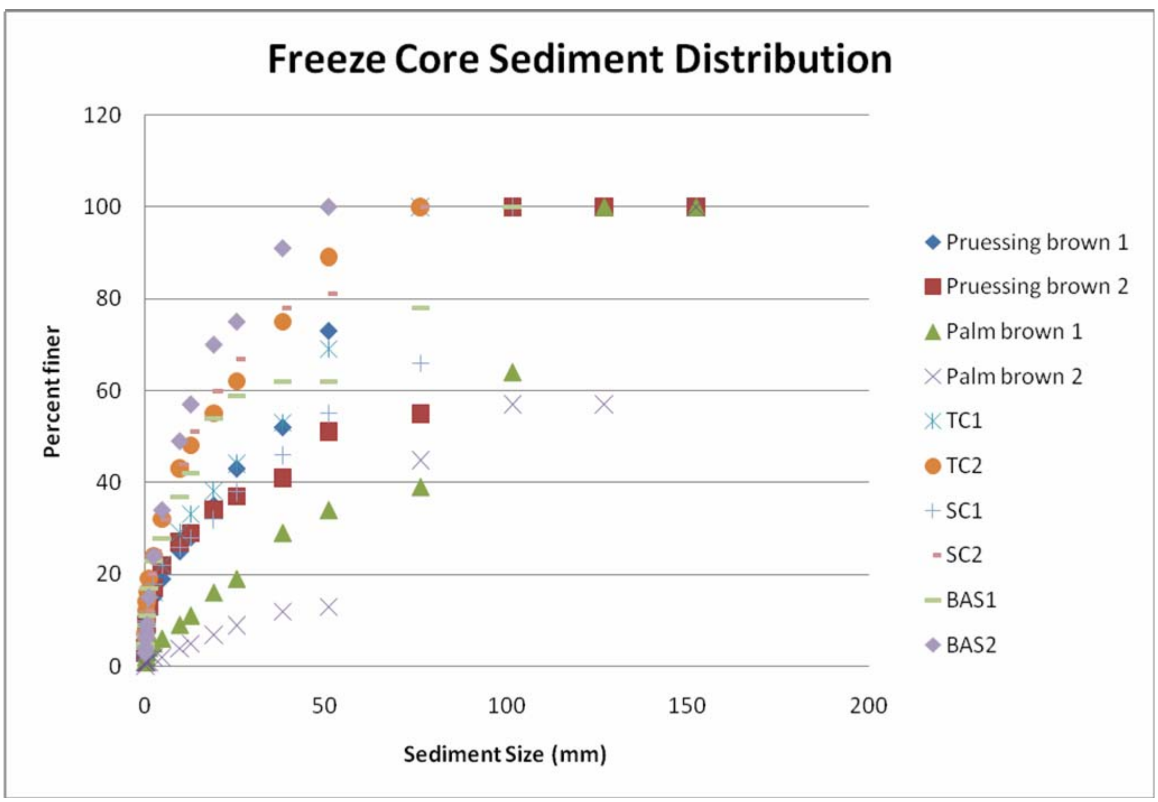

Figure 21. Freeze core sediment size distribution comparison with previous study.

In conclusion, it appears that the sediment event did have an immediate effect on the confluence area of Seven Castles Creek with new Fryingpan River channel being formed. The resultant effect on stream conditions downstream of Seven Castles Creek does show some impact on macroinvertebrates but the impact appears to decrease with increased distance downstream from seven Castles Creek. The macroinvertebrate results show reduced macroinvertebrates at all locations compared with the previous studies. It is uncertain at this time why those indices are slightly reduced riverwide. The most impacted area appears to be the immediate vicinity of Seven Castles Creek.

It would appear that the river and biota are recovering from the sediment flow. The immediate area of Seven Castles is the most impacted area within the Fryingpan River. In the immediate vicinity of Seven Castles Creek, there are impacts to the river channel and the biota. In the lower Fryingpan, the biota appear to be less impacted and in the same condition as the Taylor Creek reference site.

Based on the conditions at this time, a flushing flow outside of the normal runoff period is not recommended. Any flushing flow should coincide with the normal high flow. It is not likely to scour the large boulders deposited in the Fryingpan River channel with the normal high flow. This material will likely remain in place for many years unless it is mechanically removed. Mechanical removal may assist in placing the channel in its previous location and reduce impacts to the riparian area that is now flooded. An alternative would be to allow natural stabilization to occur in the new channel and use the new delta area for cottonwood and willow planting.

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APPENDIX A – MACROINVERTEBRATE DATA

Table A-1. Macroinvertebrate data for Taylor Creek site.

TAYLOR CREEK				
10/22/2007			Sample	
		1	2	3
	Group	Rep 1	Rep 2	Rep 3
EPHEMEROPTERA				
Baetis sp.	cg	113	92	71
Cinygmula sp.	cg	17	27	23
Drunella grandis	pr	10	9	13
Epeorus sp.	cg		1	
Ephemerella inermis / infrequens	sh	72	28	31
Paraleptophlebia sp.	cg	26	11	43
PLECOPTERA				
Diura sp.	sc			1
Hesperoperla pacifica	pr	1		7
Isoperla fulva	pr	2		
Skwala sp.	sc		1	1
Zapada cinctipes	sh	3		
COLEOPTERA				
Heterlimnius corpulantus (A)	cg	1		5
Heterlimnius corpulantus (L)	cg	71	58	47
Narpus concolor	cg		1	
Optioservus sp(A)	cg	2		1
Optioservus sp(L)	cg	9	23	32
DIPTERA-CHIRONOMIDAE				
Diamesinae	cg	5	1	2
Orthocladiinae	cg	22	39	124
Tanytarsini	cf			1
DIPTERA				
Antocha sp.	cg	21	8	22
Athrix pacypus	pr			
Chelifera sp.	pr	1	1	
Clinocera sp.	pr			
Dicronota sp.	pr	1	1	
Simulium sp.	cf			
TRICHOPTERA				
Arctopsyche grandis	cf	14		1
Brachycentrus americanus	cf	9		4
Dolophilodes sp.	cf			
Glossosoma sp.	sc	29	1	5
Hydropsyche sp.	cf			
Lepidostoma sp.	cg	187	72	76
Oligophlebodes minuta	sc	6	5	3
Rhyacophila brunnea	pr	1		
Rhyacophila coloradensis	pr			
ANNELIDA				
Helobdella stagnalis	pr		1	
Nematoda	pr	8	5	1
Oligochaeta Naididae	cg	118	175	153
Polycelis coronata	pr	62	14	74
ACARI				
Lebertia sp.	p	3	5	4
Sperchon sp.	pr	1	3	
	pr			
CRUSTACEA				
Ostracoda	cg	5	2	3
Pisidium sp	cf	22	172	59
OTHER ORGANISMS				
Hyalella azteca	cg	1		
Totals		843	756	807

Table A-2. Macroinvertebrate data for Seven Castles Creek site.

SEVEN CASTLE

10/22/2007		Sample			
		1	2	3	
	Group	Rep 1	Rep 2	Rep 3	Total
EPHEMEROPTERA					
Baetis sp.	cg	258	217	274	749
Cinygmula sp.	cg	2	1	4	7
Drunella grandis	pr		1	1	2
Epeorus sp.	cg			1	1
Ephemerella inermis / infrequens	sh		1	1	2
Paraleptophlebia sp.	cg	3		1	4
PLECOPTERA					
Diura sp.	sc				
Hesperoperla pacifica	pr				
Isoperla fulva	pr				
Skwala sp.	sc				
Zapada cinctipes	sh				
COLEOPTERA					
Heterlimnius corpulantus (A)	cg	1			1
Heterlimnius corpulantus (L)	cg	2	4		6
Narpus concolor	cg				
Optioservus sp(A)	cg		1		1
Optioservus sp(L)	cg		1		1
DIPTERA-CHIRONOMIDAE					
Diamesinae	cg	12	20	22	54
Orthocladiinae	cg	87	81	96	264
Tanytarsini	cf				
DIPTERA					
Antocha sp.	cg	3	2	1	6
Athrix pacypus	pr				
Chelifera sp.	pr				
Clinocera sp.	pr				
Dicronota sp.	pr				
Simulium sp.	cf	136	38	29	203
TRICHOPTERA					
Arctopsyche grandis	cf	8	1	11	20
Brachycentrus americanus	cf	10		5	15
Dolophilodes sp.	cf				
Glossosoma sp.	sc				
Hydropsyche sp.	cf				
Lepidostoma sp.	cg	3		1	4
Oligophlebodes minuta	sc				
Rhyacophila brunnea	pr				
Rhyacophila coloradensis	pr	12	17	15	44
ANNELIDA					
Helobdella stagnalis	pr				
Nematoda	pr	8	12	3	23
Oligochaeta Naididae	cg	15	21	33	69
Polycelis coronata	pr	4	2		6
ACARI					
Lebertia sp.	pr	1			1
Sperchon sp.	pr		5	4	9
CRUSTACEA					
Pisidium sp	cf	5			5
Ostracoda	cg				
OTHER ORGANISMS					
Hyalella azteca	cg				
Totals		570	425	502	1497

Table A-3. Macroinvertebrate data for Basalt site.

BASALT						
10/22/2007			Sample			
		1	2	3		
	Group	Rep 1	Rep 2	Rep 3	Total	
EPHEMEROPTERA						
Baetis sp.	cg	27	31	15	73	
Cinygmula sp.	cg	2	2	1	5	
Drunella grandis	pr		5	4	9	
Epeorus sp.	cg					
Ephemerella inermis / infrequens	sh	1	2	2	5	
Paraleptophlebia sp.	cg	2	4	4	10	
PLECOPTERA						
Diura sp.	sc					
Hesperoperla pacifica	pr	1	2	3	6	
Isoperla fulva	pr	2	6	7	15	
Skwala sp.	sc	1	1	1	3	
Zapada cinctipes	sh					
COLEOPTERA						
Heterlimnius corpulantus (A)	cg		1	1	2	
Heterlimnius corpulantus (L)	cg	1	1		2	
Optioservus sp(A)	cg					
Optioservus sp(L)	cg	4	16	11	31	
Narpus concolor	cg					
DIPTERA-CHIRONOMIDAE						
Diamesinae	cg	8	8	7	23	
Orthocladiinae	cg	13	23	32	68	
Tanytarsini	cf					
DIPTERA						
Antocha sp.	cg	21	29	53	103	
Athrix pacypus	pr		1	1	2	
Chelifera sp.	pr					
Clinocera sp.	pr		1		1	
Dicronota sp.	pr					
Simulium sp.	cf	1	0	1	2	
TRICHOPTERA						
Arctopsyche grandis	cf	4	11	16	31	
Brachycentrus americanus	cf	14	26	52	92	
Dolophilodes sp.	cf	1			1	
Glossosoma sp.	sc	14	21	4	39	
Hydropsyche sp.	cf	8	5	9	22	
Oligophlebodes minuta	sc	0	3	1	4	
Rhyacophila brunnea	pr	3	3	5	11	
Rhyacophila coloradensis	pr	4		1	5	
Lepidostoma sp.	cg					
ANNELIDA						
Helobdella stagnalis	pr					
Nematoda	pr	1		1	2	
Oligochaeta Naididae	cg	29	155	137	321	
Polycelis coronata	pr	2		1	3	
ACARI						
Lebertia sp.	pr	1	2	2	5	
Sperchon sp.	pr	2		2	4	
CRUSTACEA						
Ostracoda	cg					
Pisidium sp	cf					
OTHER ORGANISMS						
Hyalella azteca	cg					
Totals		167	359	374		

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