Upper Grande Ronde Basin
Section 319
National Monitoring Program Project

Summary Report

Larry Whitney
Oregon Department of Environmental Quality
Laboratory Division
Watershed Assessment Section

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Executive Summary

This report describes the monitoring design and results from the Upper Grande Ronde Section 319 National Monitoring Program (NMP) project. Monitoring was conducted by Oregon Department of Environmental Quality (DEQ) from 1993 through 2005. The primary goal of this study was to evaluate the effectiveness of channel restoration efforts in McCoy Creek, a degraded meadow stream located in the Upper Grande Ronde Watershed. Results show livestock exclusion by itself may not result in improved habitat and recovery of sensitive aquatic life; however, restoration of meandering wet meadow channels can improve habitat and benefit sensitive aquatic life in a relatively short time frame (2-5 years).

Introduction

The Grande Ronde River system, located in the Blue Mountain ecoregion of northeast Oregon, has historically produced large runs of native spring Chinook salmon and summer steelhead trout. Since the early 1970's, these runs have declined substantially. Loss of spawning habitat and elevated stream temperatures are important factors affecting the decline of these fish stocks (Hafele, 1996). Livestock grazing, timber harvesting, road construction, and mining have contributed to habitat degradation and elevated stream temperatures in the Grande Ronde River system (Bach, 1995).

With funding from the United States Environmental Protection Agency (USEPA) Section 319 National Monitoring Program, Oregon DEQ conducted stream monitoring at selected locations in the Upper Grande Ronde watershed beginning in April 1993 and continuing through September, 2005. Study sites were selected across a range of land use practices, and monitoring evaluated stream conditions for chemical, physical, and biological parameters. The primary goal of this study was to evaluate the effectiveness of channel restoration efforts in McCoy Creek, a degraded meadow stream.

McCoy Creek flows into the McCoy Meadows area to join Meadow Creek, a major tributary to the Grande Ronde River. McCoy Meadows was historically a wetland meadow complex with sinuous stream channels, wetlands, backwater areas, ponds, and beaver colonies (Childs

2002). Beaver trapping, road construction, logging, channelization, and livestock grazing have altered the character and function of this wet meadow complex. In1968 and again in 1977 Lower McCoy Creek was relocated, straightened, and channelized to drain wetlands and maximize grazing land. This treatment produced a wide, shallow channel, and resulted in near elimination of out of bank stream flow and a decrease in meadow storage capacity and connectivity with cool ground water. Habitat was simplified, and water temperatures were elevated. The focus of restoration work has been to reverse the adverse effects of this treatment.

Restoration activities began in the McCoy Meadows area in 1988 with construction of fencing to keep grazing cattle out of the active stream channel. In 1995, the owners of McCoy Creek Meadows Ranch partnered with a multi-agency team to initiate a more aggressive watershed restoration project with goals of restoring water quality, fish and wildlife habitat, and wetland function in the McCoy Creek Meadows area**.** The resulting restoration work was extensive, and included channel restoration, bridge and culvert construction, and tree planting. Channel restoration was implemented in two phases. Phase 1 was completed in July, 1997, when a half mile section of the channelized creek was reintroduced into its historic meandering wet meadow channel in the upper meadow area (Figure 1). Phase 2 was completed in September, 2002, when an additional 1.2 mile section of channelized creek was diverted into a constructed meandering channel in the lower meadow area. A new bridge and culvert were constructed at the McIntyre road crossing in October, 2001. In addition, off channel pond habitats were created, and there was extensive riparian planting. This restoration work was administered by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). Other agencies involved were Bonneville Power Administration (BPA), Natural Resource Conservation Service (NRCS), Grande Ronde Model Watershed Program (GRMWP), Oregon Department of Fish and Wildlife (ODFW), DEQ, and EPA. Measures of success of restoration were improved stream habitat, reduced stream temperatures, and an increase in the number of trout.

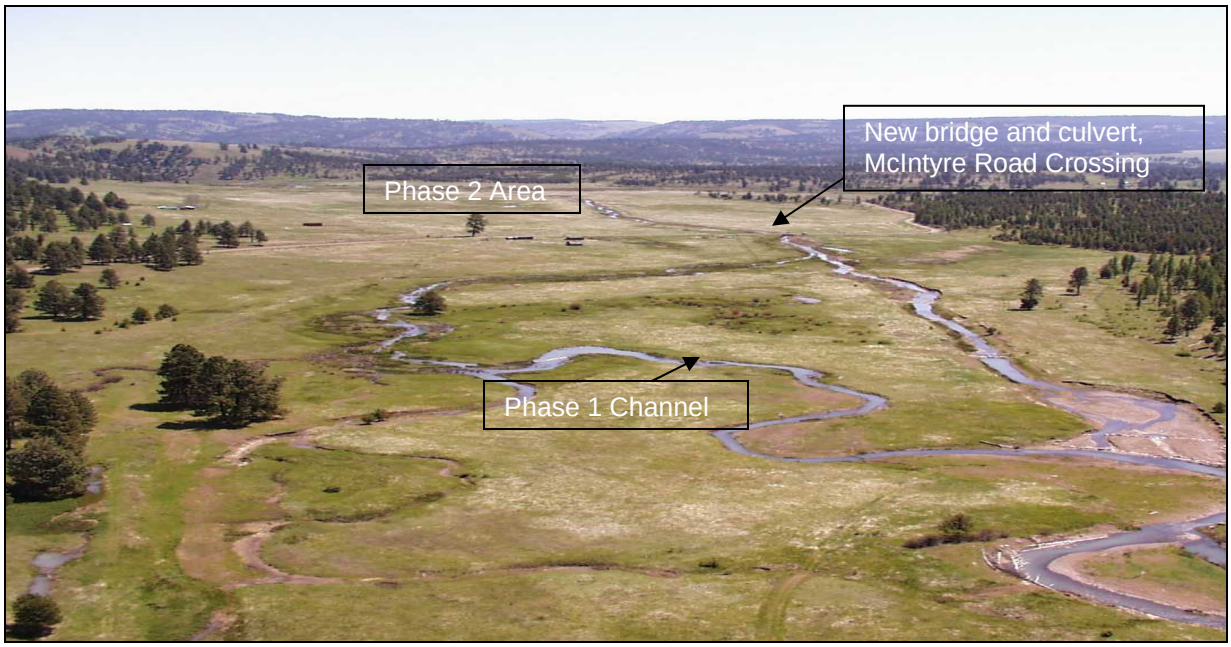

Figure 1. Downstream view of the McCoy Creek Meadows Restoration area following the Phase 1 channel diversion completed in July, 1997 (Childs 2002). This photograph was taken prior to the 2001 new bridge and culvert construction and the 2002 Phase 2 channel reconstruction. In the center of the photograph is the Phase 1 reintroduced meandering channel. The Phase 2 Channel reconstruction area, seen in the upper part of the photograph, is downstream from the McIntyre road crossing, which was the site of the bridge and culvert construction. The channelized creek is seen on the right, flowing toward the upper center of the photograph.

Study design

To assess the effectiveness of restoration efforts on McCoy Creek, a sampling design was implemented that included paired watersheds (USEPA, 1993), upstream and downstream monitoring, and reference sites. In addition to restoration effectiveness monitoring, this study offered the opportunity to assess stream conditions relative to different land use practices.

Altogether thirteen study reaches were selected on wadeable streams in five sub-basins of the upper Grande Ronde River. The reaches represent a range of conditions related to habitat type, land use, and management practices. Reach elevations ranged from 3300 to 4700 feet (Table 1 and Figure 2). The least disturbed reaches were found at higher elevations, and occurred in sub-basins with minimal or no grazing. The remaining reaches were located in sub-basins with varying levels of grazing use. Photographs and reach location data are listed in Appendices A and B.

Table 1. Grande Ronde NMP Study Reaches

Sub-basin	Study Reach	River Mile	Elevation (ft)	Habitat type, Land use, Management
McCoy Creek	McCoy Creek Lower #1	0.12 – 0.30	3350	Meadow, Grazing, Riparian fencing
McCoy Creek	McCoy Creek Lower #2	0.30 – 0.41	3360	Meadow, Grazing, Riparian fencing
McCoy Creek	McCoy Creek Lower Restored	0.12 – 0.80	3350	Meadow, Grazing, Riparian fencing, planting, channel reconstruction (Phase 2)
McCoy Creek	McCoy Creek Restored	0.95 – 1.45	3380	Meadow, Grazing, Riparian fencing and planting, channel restoration(Phase 1)
McCoy Creek	McCoy Creek Middle	2.00 – 2.08	3400	Forest/meadow, Grazing, Riparian fencing
McCoy Creek	McCoy Creek Upper	9.50 – 9.60	3750	Forest/meadow, Open grazing
Dark Canyon Creek	Dark Canyon Creek Lower	0.40 – 0.47	3300	Meadow, Open grazing
Dark Canyon Creek	Dark Canyon Creek Upper	3.00 – 3.07	3550	Forest, Open grazing
Limber Jim Creek	Limber Jim Creek Lower	0.40 – 0.47	4300	Meadow, Public recreation, cattle excluded
Limber Jim Creek	Limber Jim Creek Upper	3.20 – 3.26	4650	Forest, Public recreation, cattle excluded
Lookout Creek	Lookout Creek	3.00 – 3.07	4700	Forest, Open range, Minimal grazing
Meadow Creek	Meadow Creek Lower	2.30 – 2.41	3440	Meadow, Grazing, Riparian fencing
Meadow Creek	Meadow Creek Starkey	12.00 – 12.12	3770	Meadow, Seasonal grazing, Experimental forest with fencing

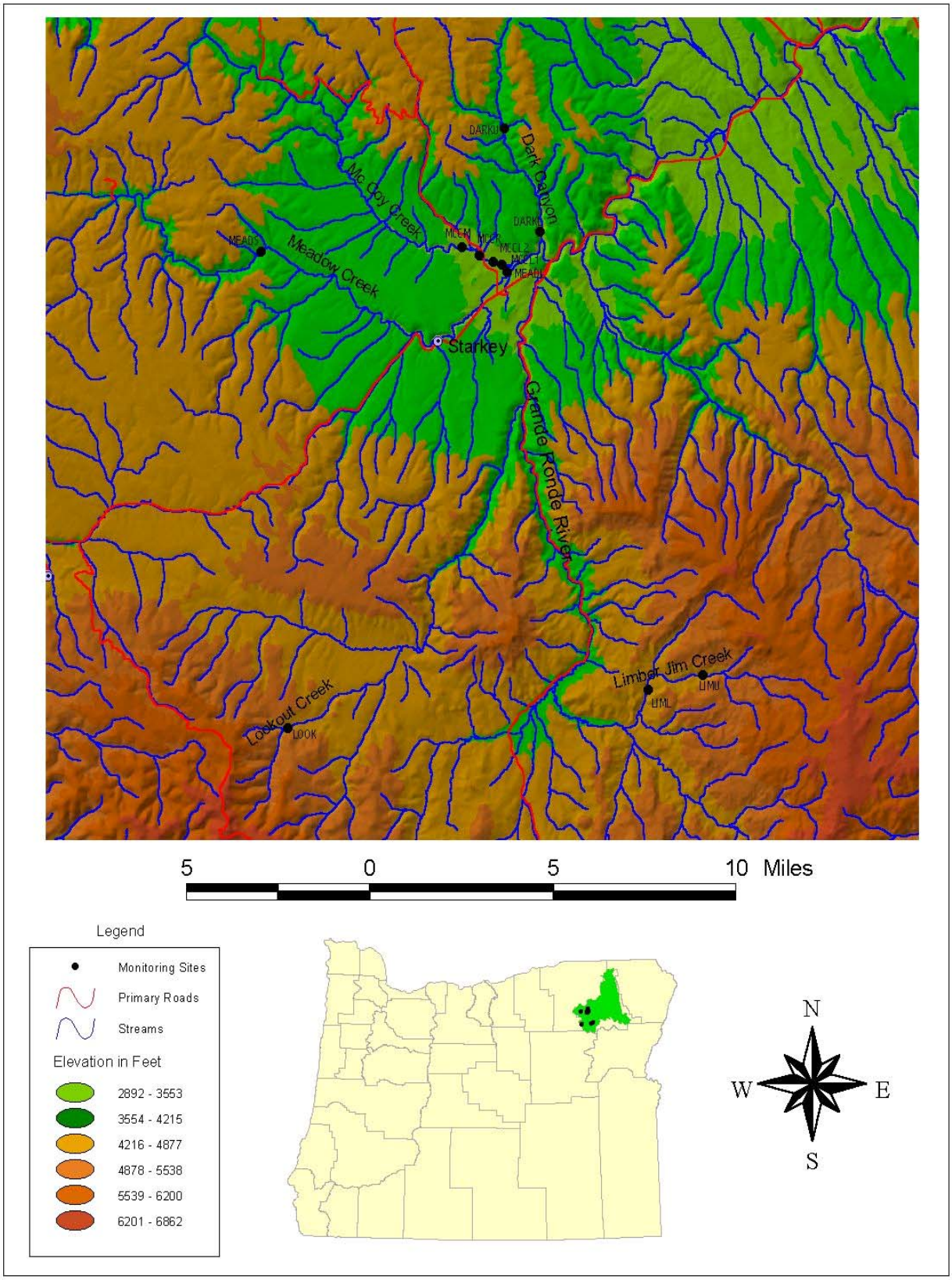

Figure 2. Grande Ronde National Monitoring Program Sites

Study reaches which were key in assessing the effectiveness of restoration efforts on McCoy Creek are listed in Table 2.

Table 2. Key study reaches, sample period, study design type, and treatment.

Study Reach	**Sample Period**	**Study Design Type**	**Treatment**
McCoy Creek Middle	1993 - 2005	Upstream, Before and After Treatments	Cattle excluded by fencing beginning in 1988. Forested habitat feeding into McCoy Meadows area.
McCoy Creek Lower #1 and #2	1993 – 2001	Down Stream, Before and After Phase 1 Treatment	Channelized with cattle excluded by fencing beginning in 1988. Diverted to Phase 2 reconstructed channel in 2002.
McCoy Creek Restored	1997 – 2005	Treated - Phase 1 Restoration	Section of historic meandering channel restored by diverting water from adjacent channelized section in 1997.
McCoy Creek Lower Reconstructed	2003 – 2005	Treated – Phase 2 Restoration	Reconstructed meandering channel. This section replaced McCoy Creek Lower #1 and #2 in 2002. Cattle remained excluded.
Dark Canyon Creek Lower	1993 - 2003	Paired Control - Before and After Treatments	Cattle grazing with no riparian fencing. Cattle used the active stream channel.
Meadow Creek Lower	1993 - 2005	Control - Before and After Treatments	Located in McCoy Meadows – Cattle excluded by fencing beginning in 1988.
Limber Jim Creek Lower	1993 - 2005	Reference – Before and After Treatments	Open meadow habitat in a sub-basin with grazing excluded and minimal human disturbance.

The paired watershed design compared monitoring results between treated and untreated sub-basins before, during, and after treatment (restoration). Management practices remained unchanged in the control or untreated sub-basins throughout the study period. The treatement subbasins were altered by channel restoration efforts. The control sub-basins account for year to year or seasonal variations. Paired data were collected in the control and treatment sub-basins before and after treatment. A change in the relationship between paired data after treatment can be interpreted as a response to restoration efforts in the treatment sub-basin.

McCoy Creek was the treatment sub-basin, and Dark Canyon Creek was selected as the control sub-basin. Dark Canyon Creek was selected because it was located in close proximity to McCoy Creek, and was similar in elevation and size. Both McCoy Creek and Dark Canyon Creek have histories of grazing and degraded habitat. The Dark Canyon sub-basin has been used for cattle grazing with no riparian fencing or other improvements. This use was unchanged throughout the duration of the study.

The Meadow Creek Lower study reach also provided a set of control data. This reach was located in McCoy Creek Meadows, just upstream from the McCoy Creek confluence. Lower Meadow Creek was fenced for livestock exclusion in 1988, as was Lower McCoy Creek. This remained unchanged throughout the duration of the study. However, Meadow Creek is larger than McCoy Creek, and upstream land use activities may have changed during the course of the study. Similarly, land use in the McCoy Creek sub-basin above the study area was beyond the control of this project.

For upstream (above restoration) and downstream (below restoration) comparisons, the McCoy Creek Middle site and the McCoy Creek Lower #1 and #2 sites bracketed the upper and lower boundaries of the restored (Phase 1) section of McCoy Creek. The Middle site remained unchanged through the study period, but the creek was diverted away from the Lower sites in 2002 during the Phase 2 channel reconstruction. Data from McCoy lower 1 and 2 sites represent conditions in the meadow area before phase 1 and phase 2 channel restoration. Figure 3 is a schematic diagram of the McCoy Meadows sites.

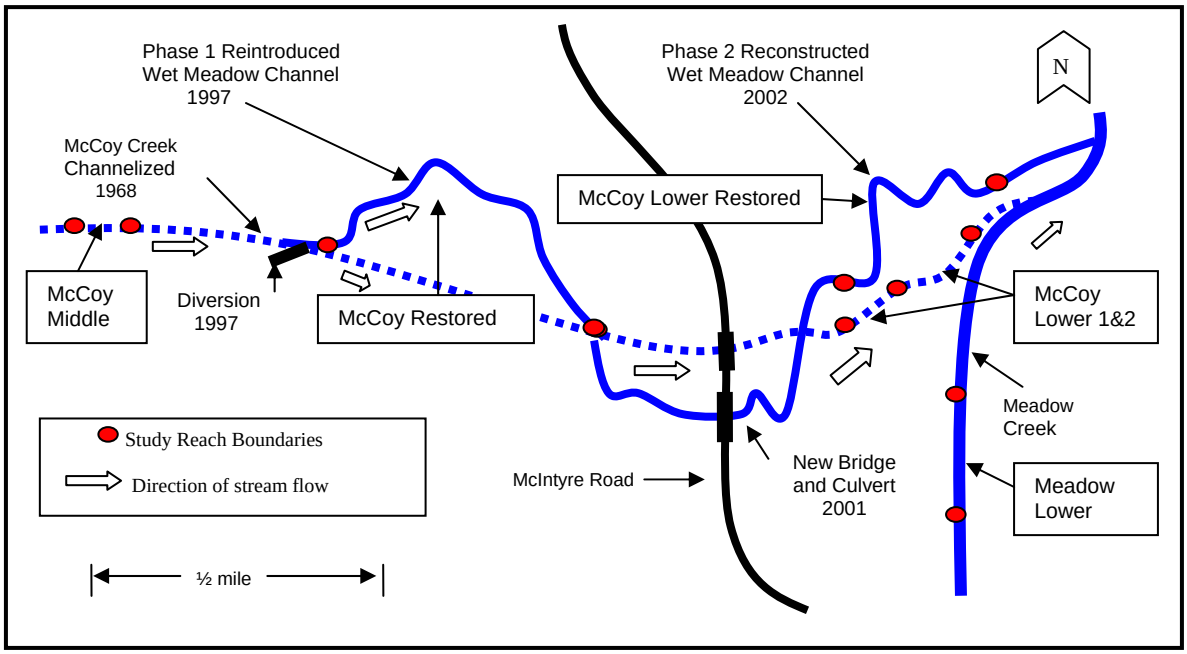

Figure 3. Schematic diagram of McCoy Creek Meadows Restoration area. The dashed line represents the channelizd creek channel. The solid line represents the restored channel. The heavier solid line is Meadow Creek. Study reaches are bracketed by dots. Site names appear in boxes.

Limber Jim and Lookout Creek sites provide data from least disturbed reaches and set reference benchmarks by which to evaluate the effects of land use and expected benefits of restoration. The Limber Jim Creek Lower Reach was the best available choice for reference comparisons because it was protected from grazing and located in meadow habitat similar to the McCoy Creek restoration area. The two other best reference candidate reaches, Limber Jim Creek Upper and Lookout Creek, were forested and at higher elevations.

Monitoring frequency and parameters

The study design called for regular monitoring of water chemistry, physical habitat, and benthic macroinvertebrates at each study reach three times per year: spring, summer, and fall. Typically, this sampling was conducted at all reaches within a four day period each season. Continuous monitoring equipment was deployed each spring to capture water and air temperature data spanning the spring through fall seasons. Fish snorkel surveys were conducted once each year in late July or early August when stream temperatures typically peaked. Additional supplemental monitoring included solar input (solar path) measurements, longitudinal temperature and channel profiles in conjunction with fish surveys, stream bank stability and pool quality surveys , fluorescent dye studies, and Proper Functioning Condition (PFC) surveys.

The number of sites and sampling frequency were modified as the study progressed (Table 3). The McCoy Creek Upper site was dropped early in the project (July, 1994) because it was found to be dry during the summer season. Sampling of the Dark Canyon Creek Upper site was terminated in April, 1998 because of access difficulties. Sampling of the Dark Canyon Creek Lower site ended in September, 2003 because of access problems. In 2002, the spring season was dropped monitoring at all study reaches, while continuous temperature and annual fish surveys continued as usual. This decision was based on several factors: First, the spring monitoring runs often resulted in incomplete data; High flows prohibited or limited complete in-stream sampling, and snow sometimes blocked access to higher elevation sites. Second, preliminary analyses showed spring data did not discriminate well between sites compared to summer and fall results. In 2005, monitoring frequency was reduced to a fall sample at five key sites, which were the McCoy Creek sites, Meadow Creek Lower, and Limber Jim Creek

Lower. The annual fish survey and continuous temperature monitoring were conducted as usual at these sites, and additional temperature and biological replicate sampling were done in 2005.

Table 3. Seasonal monitoring sites, start and end dates, and regular monitoring parameters. Note that two separate sites were created for the lower and upper boundaries of each reach: Transect 1, at the lower boundary, and Transect 6 at the upper boundary. For the purpose of data management, chemistry, habitat, macroinvertebrate, and fish results were associated with the lower boundary (transect 1) of each reach, while continuous temperature monitoring data were associated with the lower and upper boundaries separately.

Site Description	DEQ Site ID	Start date	End date	Chemistry	Habitat	Macro-invertebrates	Fish	Continuous temperature
Dark Canyon Creek Lower (Transect 1)	12059	Jun-93	Sep-03	X	X	X	X	X
Dark Canyon Creek Lower (Transect 6)	12221	Jun-93	Sep-03					X
Dark Canyon Creek Upper (Transect 1)	12060	Jun-93	Apr-98	X	X	X	X	X
Dark Canyon Creek Upper (Transect 6)	12228	Jun-93	Apr-98					X
Limber Jim Creek Lower (Transect 1)	12183	Sep-93	Sep-05	X	X	X	X	X
Limber Jim Creek Lower (Transect 6)	12374	Sep-93	Sep-05					X
Limber Jim Creek Upper (Transect 1)	12182	Sep-93	Sep-04	X	X	X	X	X
Limber Jim Creek Upper (Transect 6)	12373	Sep-93	Sep-04					X
Lookout Creek (Transect 1)	12181	Jul-93	Sep-04	X	X	X	X	X
Lookout Creek (Transect 6)	12372	Jul-93	Sep-04					X
McCoy Creek Lower #1 (Transect 1)	12053	Jun-93	Jun-02	X	X	X	X	X
McCoy Creek Lower #1 Restored (Transect 1)	29295	Jul-02	Sep-05	X	X	X	X	X
McCoy Creek Lower #1 Restored (Transect 6)	30899	Jun-03	Sep-05					X

McCoy Creek Lower #2 (Transect 1)	12054	Jun-93	Jun-02	X	X	X	X	X
McCoy Creek Lower #2 (Transect 6)	12689	Jun-93	Jun-02					X
McCoy Creek Middle (Transect 1)	12055	Jun-93	Sep-05	X	X	X	X	X
McCoy Creek Middle (Transect 6)	12219	Jun-93	Sep-05					X
McCoy Creek Restored (above Transect 3)	18737	Sep-97	Sep-05					X
McCoy Creek Restored (Transect 1)	12997	Sep-97	Sep-05	X	X	X	X	X
McCoy Creek Restored (Transect 3)	13054	Sep-97	Sep-05					X
McCoy Creek Restored (Transect 6)	20360	Sep-97	Sep-05					X
McCoy Creek Upper (Transect 1)	12056	Jun-93	Aug-94	X	X	X		
Meadow Creek Lower (Transect 1)	12057	Jun-93	Sep-05	X	X	X	X	X
Meadow Creek Lower (Transect 6)	12370	Jun-93	Sep-05					X
Meadow Creek Starkey (Transect 1)	12058	Jun-93	Sep-04	X	X	X	X	X
Meadow Creek Starkey (Transect 6)	12371	Jun-93	Sep-04					X

Monitoring methods

Each study reach consisted of a length of stream containing both riffle and pool habitat types. Six permanent cross channel sampling transects were established within each study reach. These transects delineated the study reaches, and were selectively located to capture representative riffle and pool habitat types. Transects were numbered 1 through 6, with transects 1 and 6 marking the lower and upper reach boundaries respectively. All monitoring was done within these boundaries.

Water Chemistry – Grab samples were collected and analyzed in the field for standard DEQ water quality variables. Additional samples were collected and transported to the DEQ laboratory for analysis. Field tests, sample collection and analyses were done in accordance with DEQ standard operating procedures (DEQ 2004).

Field tests included the following parameters: pH (-log10 hydrogen ion concentration), conductivity, temperature, dissolved oxygen (DO), turbidity, and percent saturation of dissolved oxygen (calculated).

Laboratory analyses included the following parameters: alkalinity as calcium carbonate, ammonia as nitrogen, five-day biochemical oxygen demand (BOD-5), calculated unionized ammonia as nitrogen, chemical oxygen demand, dissolved orthophosphate as phosphorous, nitrite/nitrate, total Kjeldahl nitrogen (TKN), total solids, total suspended solids, and turbidity.

Benthic macroinvertebrates – Riffle and pool habitats were sampled separately for benthic macroinvertebrates. Sample locations within each habitat type were selected using random numbers. Samples were collected using D frame kick nets with 500 micrometer mesh. Four two square foot areas were combined as one composite sample for each habitat type.
The composite samples were sub-sampled for a minimum of 500 individuals (300 prior to 1999). The sub-sampled individuals were identified typically to the genus or species level with the exception of chironomids, which were identified at the subfamily level.

Habitat – A group of habitat measurements were made at three points - left quarter, center, and right quarter - across each of the six transects delineating each study reach. These measurements included substrate composition as percent of the dominant three of the following components: bedrock, boulder (> 25.4 cm), cobble ($\leq$ 25.4 cm and >6.4 cm), gravel (< 6.4 cm and > 6 mm), sand (< 6mm and >2mm), silt (gritty), and clay (slick), substrate embeddedness as estimated percent, water depth, water velocity by flow meter, and cover or shade by densiometer. Four densiometer measurements were taken at each transect , covering the left bank, right bank, and middle (up-stream and down-stream directions).

Additional habitat monitoring included: wet width and bank full width at each transect, photographs at each transect (upstream, downstream, across), slope between transects by clinometer, aspect between transects by compass, and reach scale rapid bioassessment scoring (Plafkin *et al*.,1989). Flow velocities and depths were measured across one channel transect for the purpose of calculating discharge (cubic feet per second).

Fish Surveys - Snorkel surveys were conducted each year in late July or early August. Considering the sensitivity of the declining salmonid populations present, snorkeling was chosen as the most appropriate sampling technique. Compared to other options, such as electrofishing or netting, snorkeling is the least disruptive way of observing fish in the field (Helfman,1985).

Surveys were conducted by floating the length of each reach from the downstream boundary to the upstream boundary. Block nets were not used. Taxa present were identified, and numbers of individuals within each taxa were counted or estimated. Classification was limited to in-stream, visual identification.

Continuous Temperature Monitoring - Data loggers (thermographs) were placed at the lower and upper boundaries of each reach to measure continuous temperature. Loggers at the lower boundaries were permanent base multiple parameter installations with air and water temperature probes. Miniature loggers were placed in the stream to record water temperature at the upper boundaries.

During the initial 1993 field season, multiple parameter loggers were in place only at the lower boundaries of the McCoy Creek, Dark Canyon Creek, and Lower Meadow Creek sites. Beginning in1994 permanent installations were in place at the lower boundaries of all sites, and miniature loggers were deployed at the upper boundaries.

Initially, the multiple parameter loggers were programmed to log hourly maximum, minimum, and average water and air temperatures using data measured at five-second intervals. Beginning in 2002, these loggers were programmed to record at half hour intervals. The miniature data loggers recorded discrete water temperature values at half hour intervals.

Data quality assurance procedures included pre and post deployment equipment tests performed by the DEQ Laboratory and in stream field audits. Equipment not operating within manufacturer specified range was rejected (Appendix E). Results not within ±0.5 °C compared to a National Institute of Standards and Technology (NIST) registered reference thermometer were rejected.

Solar input (solar path) - Solar path data were collected at the McCoy Creek, Meadow Creek, Dark Canyon Creek, Limber Jim Creek, and Lookout Creek study sites between 1993 and 1996. In 1997, solar path data were collected at the McCoy Creek Restored site.

The Solar Pathfinder instrument is designed to determine the percentage of solar radiation blocked by permanent local features in the landscape like trees and hills. (Solar Pathfinder, 1995) The instrument is designed to provide data by which the average amount of solar radiation, expressed as percent of potential available radiation, can be calculated for a given location where measurements are taken. The amount of solar radiation for any calendar month can be calculated from measurements taken at any time during the calendar year.

Longitudinal channel profiles with fish surveys – To characterize trout habitat preferences relative to temperature and channel features, longitudinal channel profiles were conducted in conjunction with fish surveys. Trout locations and numbers of individuals were marked during the snorkel surveys. Longitudinal profile measurements were then taken at 3 meter intervals for wet width, maximum depth, and water temperature for the length of the study reach. The resulting data provided a longitudinal snapshot of width, depth, and temperature, with locations and numbers of trout.

These surveys were performed on Lower McCoy Creek in 2001 and 2003 before and after the Phase 2 channel reconstruction. The Limber Jim Lower reach was also surveyed in 2003 to provide reference data.

In 2005 longitudinal profiles were conducted in conjunction with the fish surveys on the McCoy Creek Middle, Restored, and Lower Restored reaches, as well as the Meadow Creek Lower and Limber Jim Lower sites.

Streambank Stability and Pool Quality surveys – Stream bank stability and pool quality are impacted by livestock grazing and affect fish productivity and abundance in terms of rearing space and cover, food production, water velocities, and temperature (Bauer, 1993).

Streambank stability surveys were performed at all study sites in 1995 and 1996.
The lengths of stream banks on both sides of the study reaches through the entire linear distance were measured and proportioned into four stability classes as follows: 1) mostly covered and stable (non-erosional), 2) mostly covered and unstable (vulnerable), 3) mostly uncovered and stable (vulnerable), 4) mostly uncovered and unstable (erosional). The composition of the streambanks relative to each of the four bank condition classes was calculated as a percentage of the total reach length.

Pool quality surveys were performed at all study sites in 1995 and 1996. In 1998, the McCoy Creek sites were surveyed. Surveys were based on methods by Hankin and Reeves (1988) as outlined by Bauer and Burton (1993).

The entire reach was surveyed from lower to upper boundaries. All pools encountered were evaluated and scored for the following five parameters: 1) residual depth, 2) substrate, 3) overhead cover, 4) submerged cover, and 5) bank cover. Each parameter was scored on a 0 to 2 scale based on specific criteria. Pool quality was then determined by summing the scores for the five parameters. Resulting pool quality ratings ranged from 0 to 10, with high scores indicating high quality pool habitat.

Fluorescent dye studies – Hydrologic studies using Rhodamine fluorescent dye as a tracer were performed on McCoy Creek and Dark Canyon creek in July, 1996. A slug of dye was injected into the stream at up-stream points within the study areas, and then sampled at down-stream points for fluorometric analysis. Results provided information on stream time of travel and dispersion within the study areas (USGS, 1986).

Proper Functioning Condition (PFC) Assessment – This is a qualitative method for assessing riparian-wetland areas, which considers hydrology, vegetation, and erosional/depositional attributes and processes (Prichard, 1998). A system is considered to be in Proper Functioning Condition when it is in a state of resiliency that will allow it to maintain functional integrity during high flow events.

PFC assessments were done on McCoy Creek and Dark Canyon Creek in August, 1998. A check list was used to arrive at a summary determination of the functional condition of the sites.

Data management and data analysis

Field and laboratory water chemistry test results and continuous water temperature data were reviewed and stored in the DEQ Laboratory Storage and Retrieval (LASAR) database. Habitat, Macroinvertebrate, and Fish data were entered into a separate ACCESS database managed by the DEQ Watershed Assessment Section. Supplemental monitoring results and data were managed separately by the project leader. Work to merge all data into LASAR is ongoing.

STATISTICA software was used for data analysis and graphing (Stat Soft Inc., 2004).

Water chemistry results were evaluated using a water quality index (WQI). This index was a modification of the Oregon Water Quality Index (OWQI) (Cude 2001). Parameters used were temperature, DO, BOD-5, pH, total solids, combined nitrogen (nitrate and ammonia), and total phosphorous. Each parameter was given a sub-index score based on specific criteria. Sub-index scores were then combined using a harmonic mean to develop an overall site index score for each sample set (Appendix D). Potential scores could range from 0 to 100, with higher scores indicating better water quality.

Temperature data were summarized using the seven day moving average of the daily maximum temperature. This is the standard statistic used in Oregon for state-wide water quality standards and assessments (OAR 2007). Other summary statistics generated included

daily and seasonal maximum and minimum temperatures and daily and seasonal temperature ranges (Appendix F).

Habitat variables that were measured multiple times during a site visit, such as substrate composition, embeddedness, or shade, were combined as a calculated mean value for each sample set (Appendix G). For example, the mean shade value for a summer monitoring event at Lookout Creek was the calculated mean of 24 separate measurements taken across 6 transects with 4 measurements per transect.

Macroinvertebrate data were evaluated using a predictive model developed by DEQ (Hubler, 2006). The Predictive Assessment Tool for Oregon (PREDATOR) consists of three regional models that assess the biological integrity of wadeable streams across Oregon. The model predicts the macroinvertebrate taxa expected sites in least disturbed or reference condition. Taxa observed at a given site are then compared to the taxa expected given reference conditions. The model output is the observed to expected ratio (O/E). Essentially, this is a "taxa loss" model. O/E scores lower than 1.0 represent a loss of common native reference taxa. Macroinvertebrate results were also assessed using macroinvertebrate inferred fine sediment and temperature models developed by DEQ to quantitatively assess substrate degradation and temperature pollution in Oregon streams (Huff et al, 2005). These models, which employ a reference condition approach, use weighted average inferences to reveal shifts in macroinvertebrate assemblage composition that implicate either substrate degradation (fine sediment pollution) or temperature pollution. A Sorenson dissimilarity index was computed to assess the time taken for the macroinvertebrate assemblage to stabilize following colonization of newly watered restored habitat (Yuan, Pers Comm, 2007).

Fish survey results were assessed in terms of species attributes developed for Pacific Northwest fishes (Zaroban *et a*l., 1999). These attributes are responsive to or indicative of human disturbance of aquatic habitat. Fish species were classified by origin, pollution tolerance, adult habitat, adult feeding, and water temperature preference.

Results

It is not practical to include all results associated with this project in this report. Statistical summaries of chemistry, temperature, habitat, fish, and macroinvertebrate data are included in the appendices. Also included are fish and macroinvertebrate taxa lists and counts. Water chemistry and continuous monitoring temperature data are stored in the DEQ Laboratory Storage and Retrieval database and are available online through the DEQ website. All other data are available upon request from the DEQ watershed assessment section.

Results Summary and Discussion

A number of technical reports have been written using results from this project. These detailed reports address questions regarding temperature, habitat, fish, macroinvertebrates, and restoration effectiveness. These reports are listed in Appendix B, and are available on-line at the DEQ website (http://www.deq.state.or.us/lab/techrpts/bioreports.htm).

This results summary is focused on presenting and discussing results to address two basic questions:

1. Did monitoring results show a response in stream conditions relative to different land use practices?
2. Did monitoring results show a response to demonstrate the effectiveness of restoration efforts on McCoy Creek?

The chemical, physical, and biological variables monitored were all interrelated. For example, water chemistry is affected by temperature, temperature is related to habitat conditions, and biological communities respond to a variety of physical and chemical variables. In this summary, results are presented separately by major monitoring categories – chemistry, temperature, habitat, macroinvertebrates, and fish.

Chemistry – The Oregon Water Quality Index integrates water chemistry parameters to generate a score that describes overall water quality (Cude, 2001). Water Quality Index

values (WQI) across all seasons and years for each of the study reaches are shown in Figure 4.

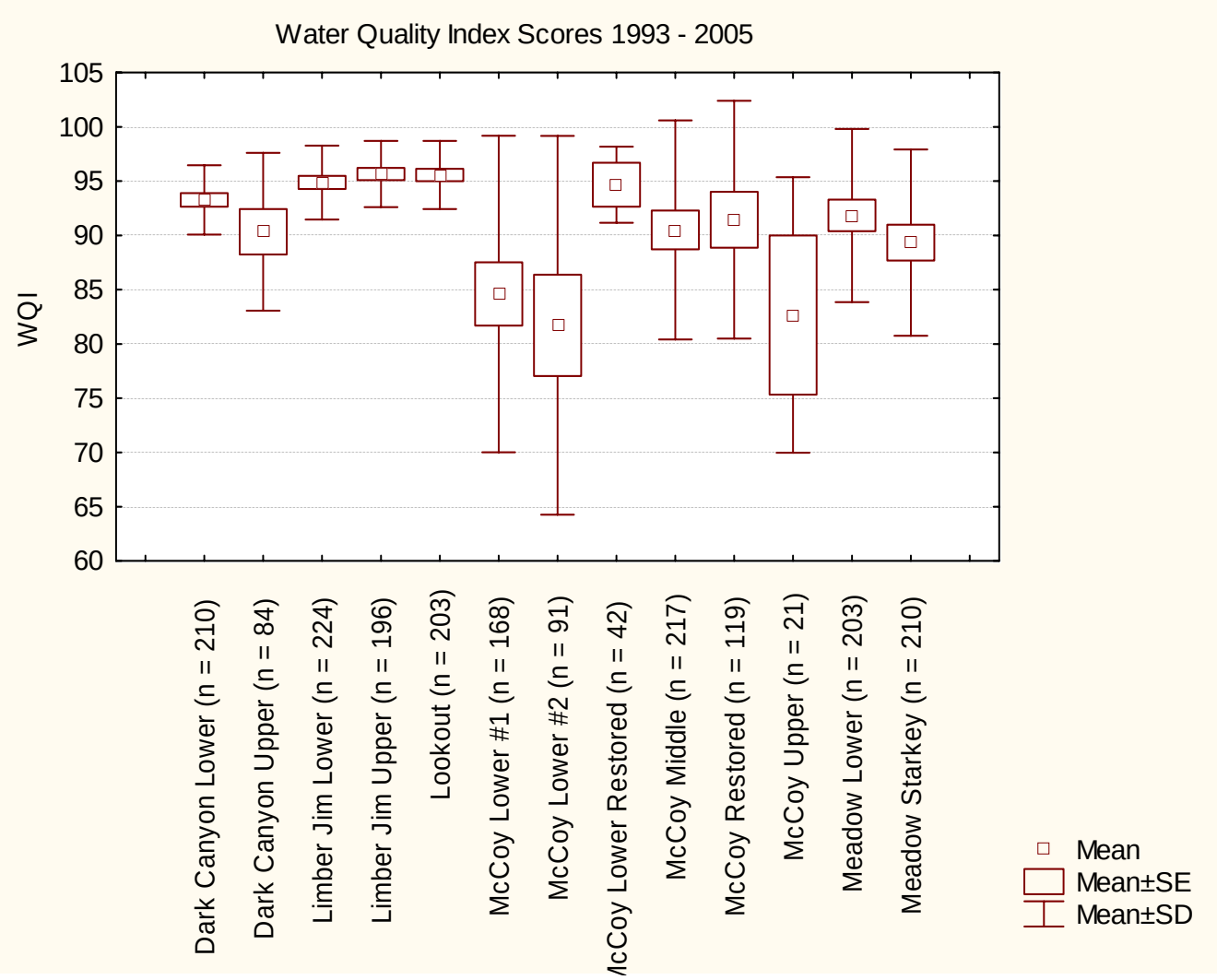

Figure 4. Mean Water Quality Index scores. Scores that are less than 60 indicate very poor water quality, 60 – 79 poor, 80 – 84 fair, 85 – 89 good, and 90 – 100 indicates excellent water quality. The number of data points (n) represented by each box varied based on the number of samples taken. For example, McCoy Upper was sampled only three times. Seven variables from each of the three water samples were used to calculate the WQI score, so the number of data points represented was twenty-one.

The highest water quality index scores with the least variability were seen at the Limber Jim, Lookout, Dark Canyon Lower, and McCoy Lower Restored study reaches. The Limber Jim and Lookout reaches were located in reference sub-basins with the least impact from grazing and other land use activities. These reaches were characterized by relatively deep and stable

channels, good riparian cover, and cool water temperatures. The Dark Canyon reach was heavily impacted by grazing and had a degraded channel, but was shaded by canyon walls and received substantial cool groundwater input from springs and seeps. The McCoy Lower Restored reach was not well shaded, but channel depth and connectivity with ground water were improved by the channel reconstruction completed in 2002. This reconstructed reach replaced the McCoy Lower #1 and #2 study reaches, where the lowest water quality scores and broadest ranges of variability were seen. Lower scores were also seen at the McCoy Upper reach, which was an open meadow with heavy grazing use.

Although there was a non-significant positive trend in water quality at the non-restored McCoy Lower #1 and #2 reaches, a plot of index scores over time shows no significant trends of increasing or decreasing water quality occurred at reference, control, or restored reaches during the Phase 1 and 2 restoration periods (1997 – 2005) (Figure 5). However, overall index scores for this period show the Lower McCoy #1 and #2 sites had good water quality, while the Restored and Lower Restored reaches were in the excellent water quality category. In this comparison, water quality improved in Lower McCoy Creek following channel restoration (Figure 6). It must be noted that the data available from the Lower Restored Reach was limited relative to the other sites used in this comparison.

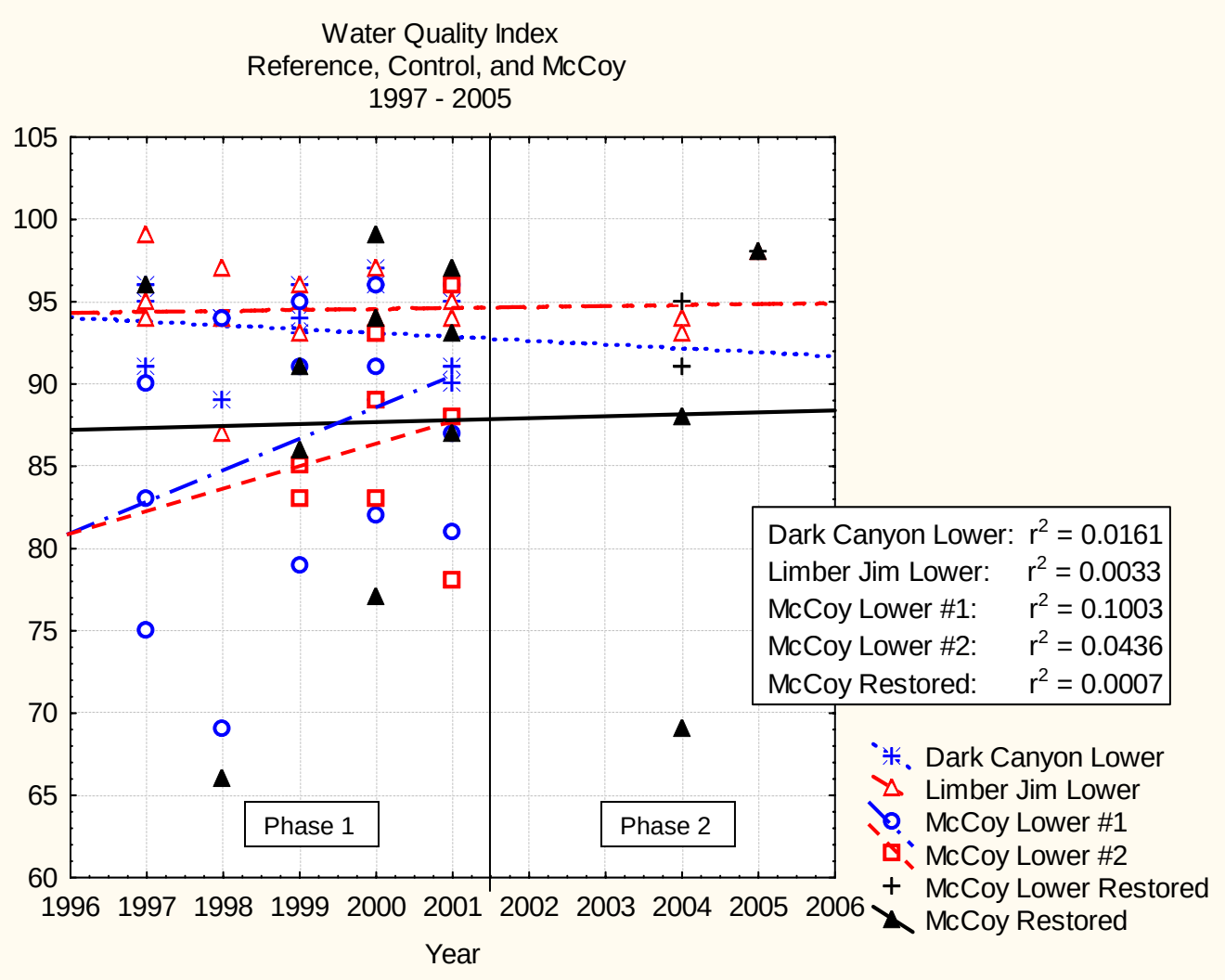

Figure 5. Water Quality Index scores from control (Dark Canyon), reference (Limber Jim), McCoy non-restored (Lower #1 and#2), and restored (Restored and Lower Restored) reaches during the phase 1 and phase 2 restoration periods. There was a non-significant increase in scores at the McCoy Lower #1 and #2 sites during the phase 1 period. No significant trends were seen at the other sites. Index scores were not calculated in 2002 and 2003 because of insufficient data. No trend analysis was done for the McCoy Lower Restored reach because scores spanned only two years – 2004 and 2005.

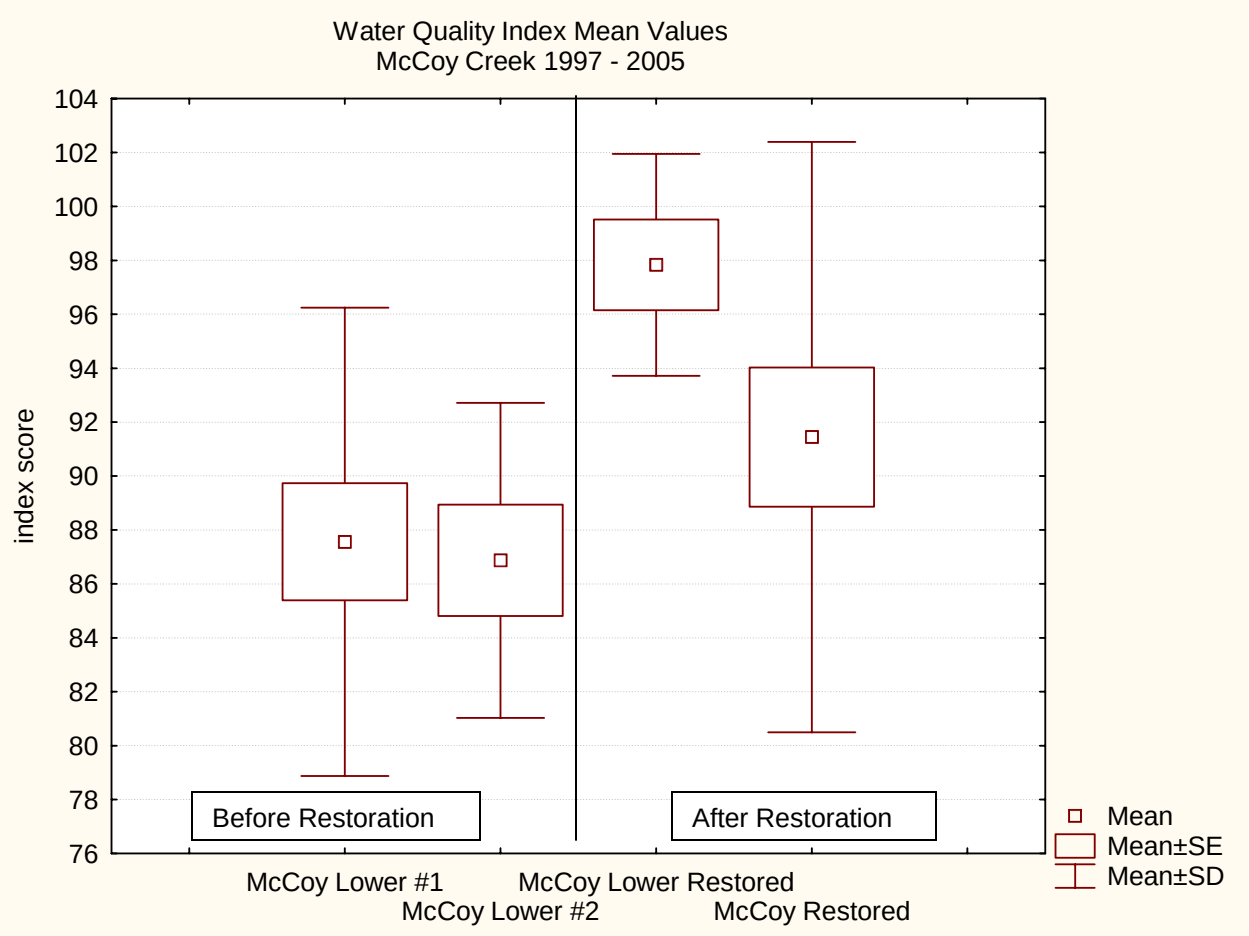

Figure 6. Water Quality Index scores in the McCoy Meadows area before and after channel restoration. Boxes represent standard error (SE), whiskers represent standard deviation (SD). Water was diverted into the Restored section in 1997 (phase 1). The Lower #1 and #2 reaches were replaced by the Lower Restored section in 2002 (phase 2). Water quality improved in the restored reaches.

Sub-index scores from all sites show temperature, dissolved oxygen (DO), BOD-5, and pH had the broadest range with scores ranging from very poor to excellent. Nitrogen and total phosphorous scores were less variable, ranging from fair to excellent. Total solids scores were all within the excellent category with little range in values (Figure 7).

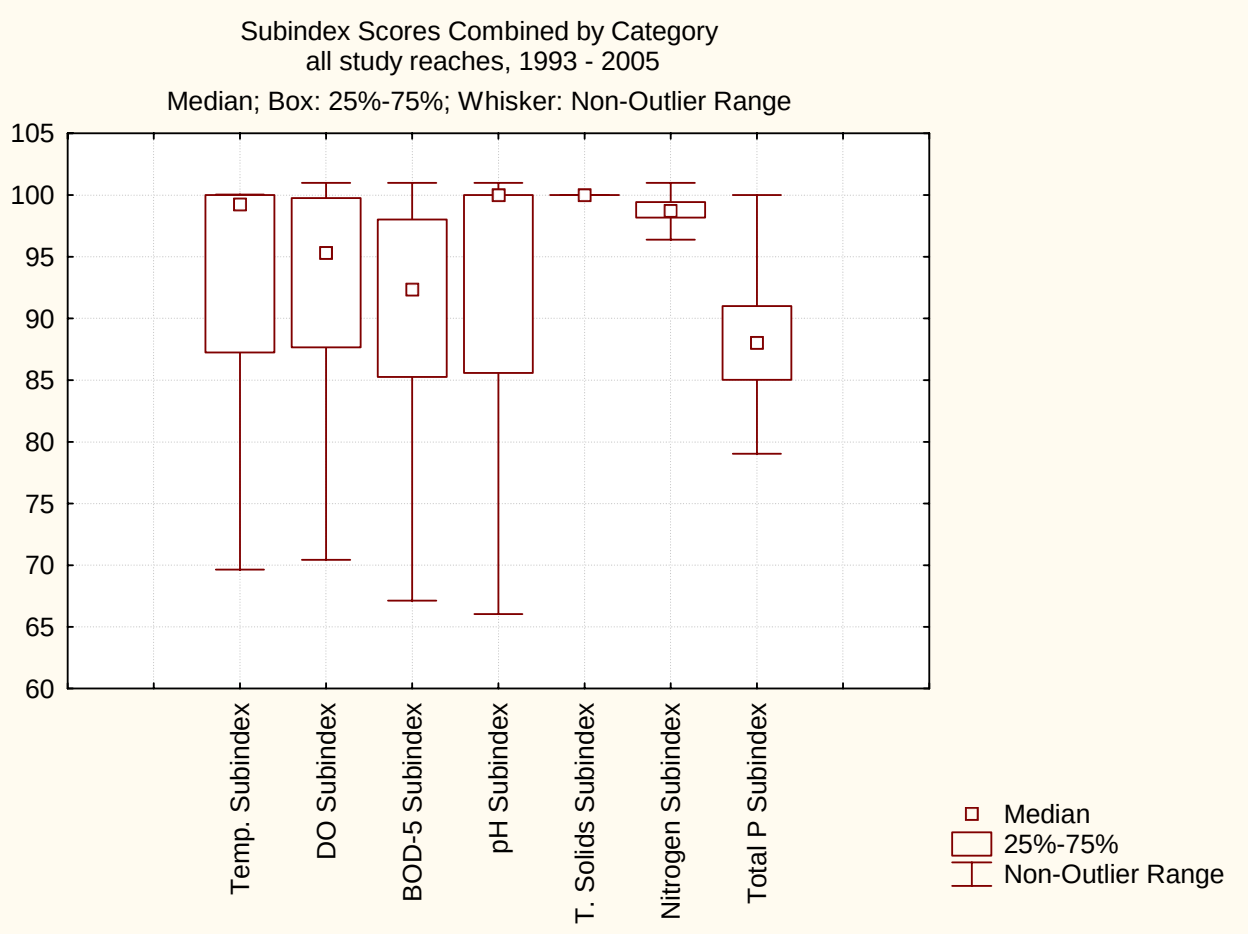

Figure 7. Water Quality Index sub-index scores from all sites 1993 through 2005.

The Grande Ronde River and some of its tributaries experience dissolved oxygen and pH water quality standards violations related to excessive periphyton growth. Excessive periphyton growth is related to a number of factors including elevated nutrient concentrations, high water temperature, excessive solar radiation, high width to depth ratios, and inadequate stream flows (DEQ, 2000). Chemistry results from this study fit this general relationship. A plot of sub-index scores for temperature, DO, pH, and BOD -5 by site (Figure 8) shows the broadest range and lowest scores occurred in the McCoy Creek and Meadow Creek sub-basins, where temperatures were high and degraded stream channels were generally shallow and wide, shade was minimal, and solar input was high. The BOD-5 sub-index represents the oxygen demanding capacity of organic material in the streams. The reaches with the highest and most stable sub-index scores were in the Limber Jim and Lookout Creek sub-basins, where water temperatures were cooler, channel width to depth ratios lower, and more riparian cover blocked solar input. Dark Canyon Creek was unique because, although its channel was

shallow and wide, it was shaded by steep, partly forested canyon walls and benefited from considerable inflow of cool ground water. The relatively high water quality index scores for Dark Canyon Creek point to cool water and shade as key factors influencing water quality in the study reaches.

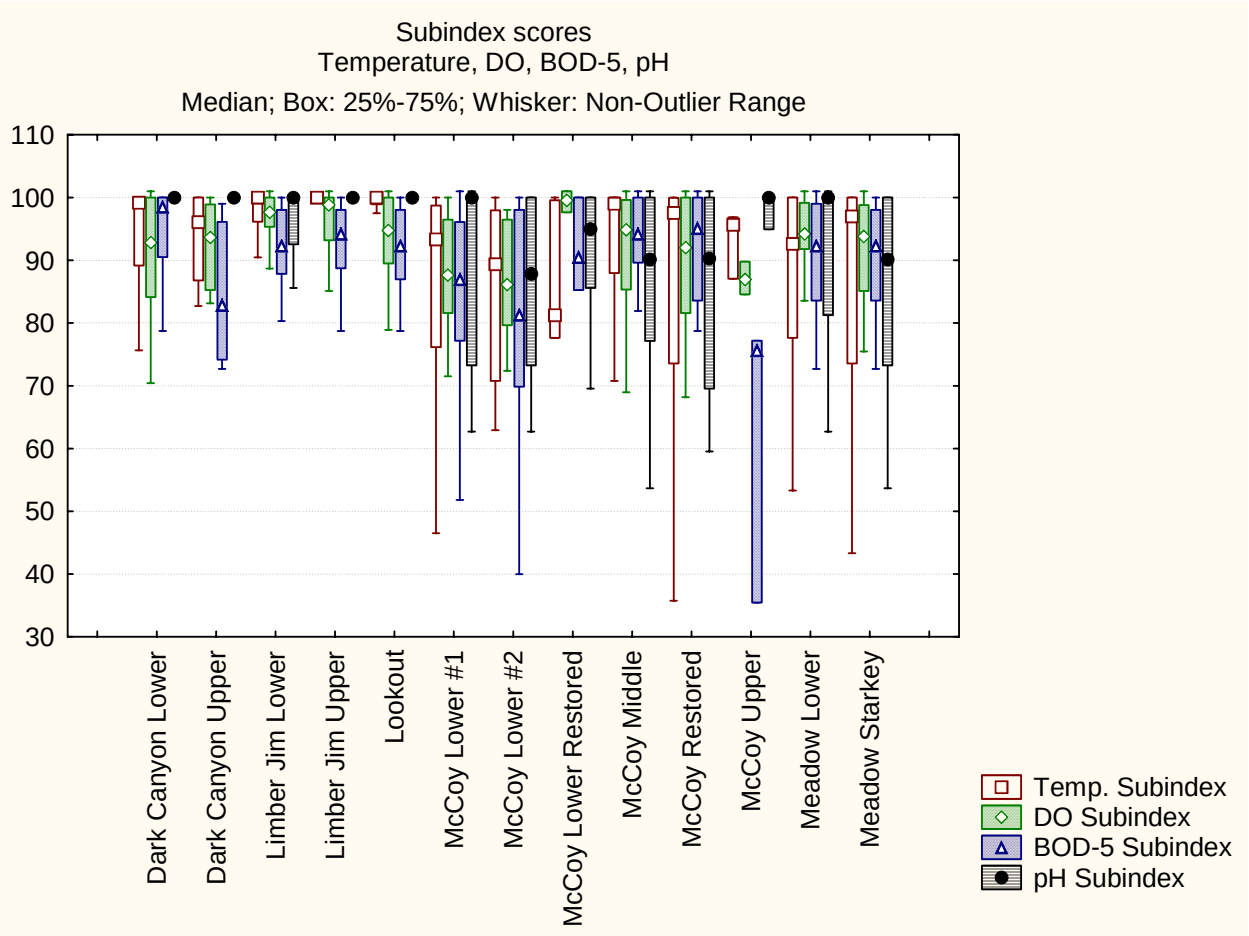

Figure 8. Temperature, dissolved oxygen, biochemical oxygen demand and pH subindex scores by study reach.

In summary - Water Quality Index scores ranged from fair to excellent. With the exception of Dark Canyon Creek, better water quality was seen in study reaches with minimal impact from grazing and other land use activities, while poorest water quality was seen in study reaches with heavy grazing use. The parameters most responsive to disturbance were temperature, DO, pH, and BOD. High index scores in Dark Canyon point to cool groundwater influx and shade as important factors affecting water quality. Water quality improved in McCoy Creek following restoration.

Temperature

Water temperature is an important variable affecting the health of aquatic ecosystems (Boyd, 1997). Oregon has developed water temperature standards to protect the health and integrity of aquatic ecosystems. The unit for all Oregon Water Quality Standards temperature criteria is the seven – day moving average of the daily maximum temperature. The average of the daily maximum stream temperatures for the seven warmest consecutive days is calculated and compared to the standard criteria. The numeric temperature criteria that apply to streams in the Upper Grande Ronde River Basin are presented in Table 4. These criteria are based on Fish Use Designations and Salmon and Steelhead Spawning use Designations as defined in the Oregon Adminisstrative Rules (OAR, 2007).

Table 4. Numeric water temperature criteria in the Upper Grande Ronde Basin.

Salmon and trout rearing and migration use	≤ 18.0 C
Core cold water habitat	≤ 16.0
Salmon and steelhead spawning use (January 1 through May 15)	≤ 13.0 C
Bull trout use	≤ 12.0 C

The core cold water habitat criterion of 16.0^{o}C applies to all sites in this study. In addition, Lookout Creek and Upper Limber Jim Creek are designated for bull trout use.

Mean maximum values for the 7- day moving average of the daily maximum water temperatures recorded at the thirteen study reaches are shown in Figure 9.

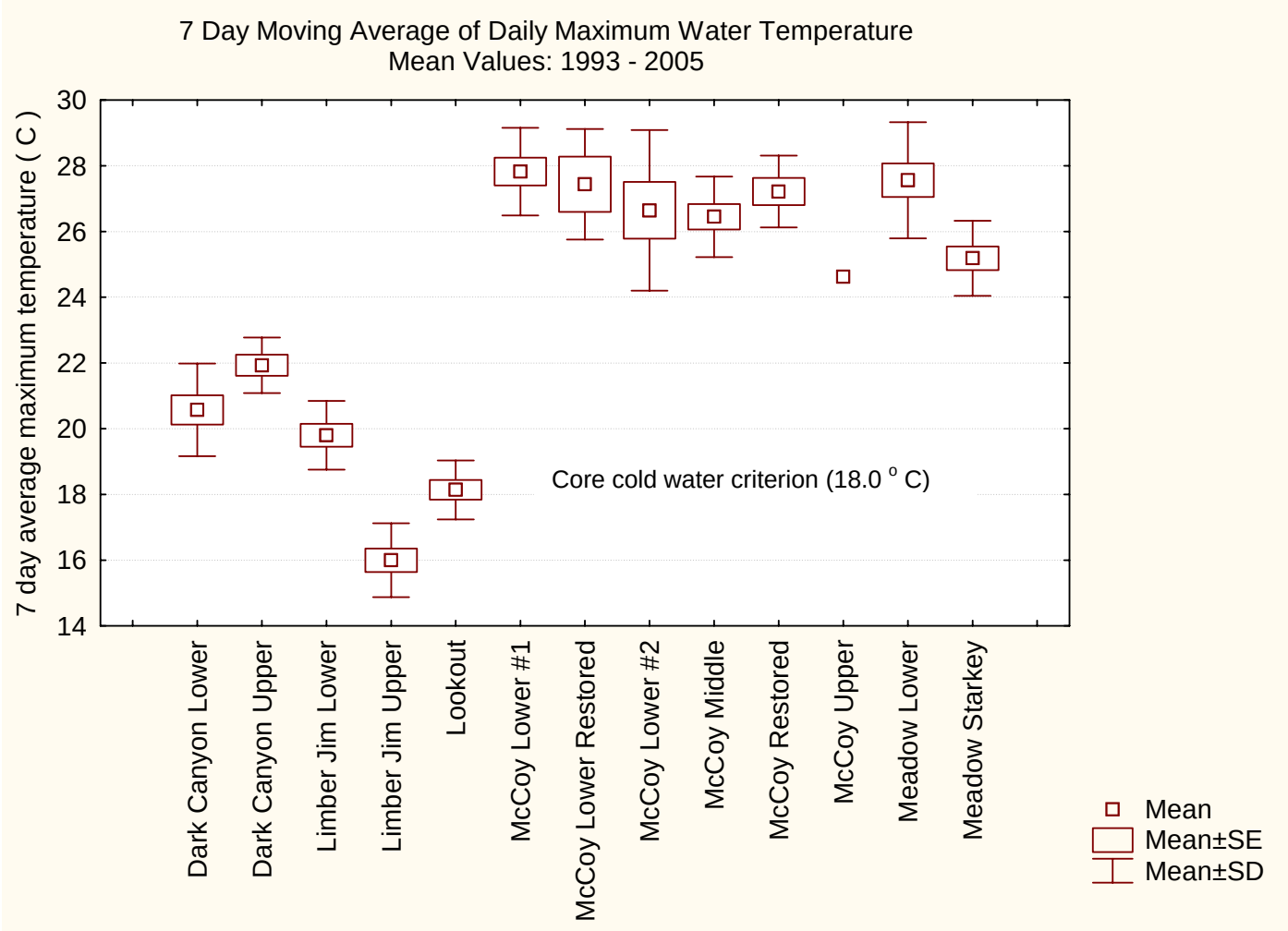

Figure 9. Mean seasonal maximum 7-day moving average of the daily maximum water temperatures measured at the lower boundary (transect 1) of the study reaches during the study period 1993 through 2005. The core cold water temperature standard criterion of 18.0 ^{o} C. was exceeded at all sites except Limber Jim Upper.

In the 7 day maximum statistic plot (Figure 9), two distinct groups of study reaches are seen: cooler sites with mean values below 23° C, and warmer sites with mean values above 24° C. The cooler sites include the Limber Jim and Lookout Creek reaches where disturbance was minimal, and Dark Canyon creek, where the channel was degraded by grazing, but received significant input from cool ground water. Fluorescent dye studies showed that ground water from springs and seeps was the primary source of water in the Lower Dark Canyon reach during summer low flow conditions. Warmer 7-day maximum temperatures occurred in the Meadow Creek and McCoy Creek sub-basins where channels were degraded by grazing and other activities.

A comparison of the 7-day maximum temperatures throughout the study period from the McCoy Creek reaches does not show a significant reduction or change in temperature before and after restoration (Figure 10). However, data show an apparent trend of decreasing temperature in McCoy Creek after channel diversion in 1997, while temperatures in the Dark Canyon control reach increased during this period (Figure 11).

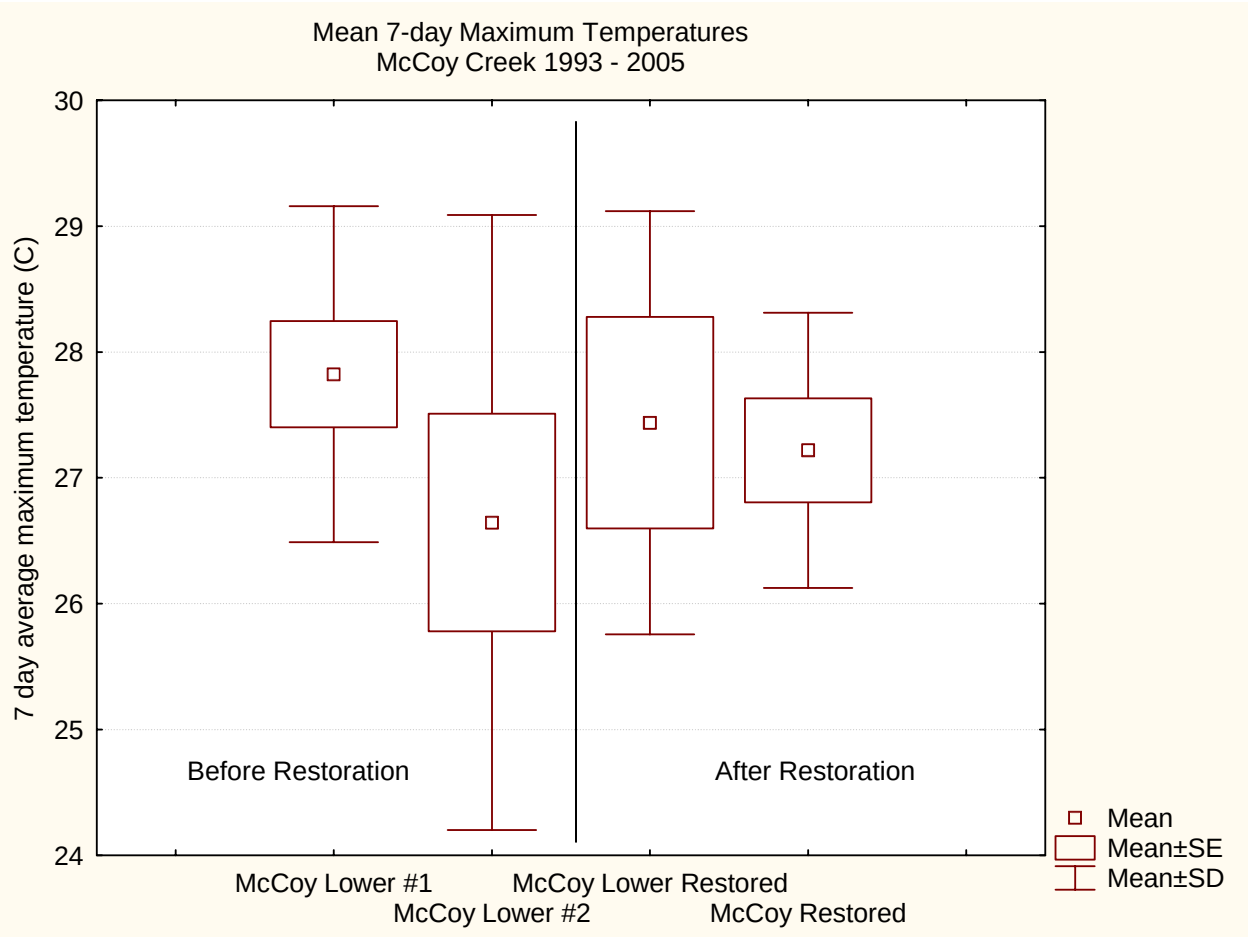

Figure 10. Mean 7 day moving average of the daily maximum water temperatures from the McCoy Creek Reaches before and after restoration. The 7-day maximum statistics show no significant change following restoration.

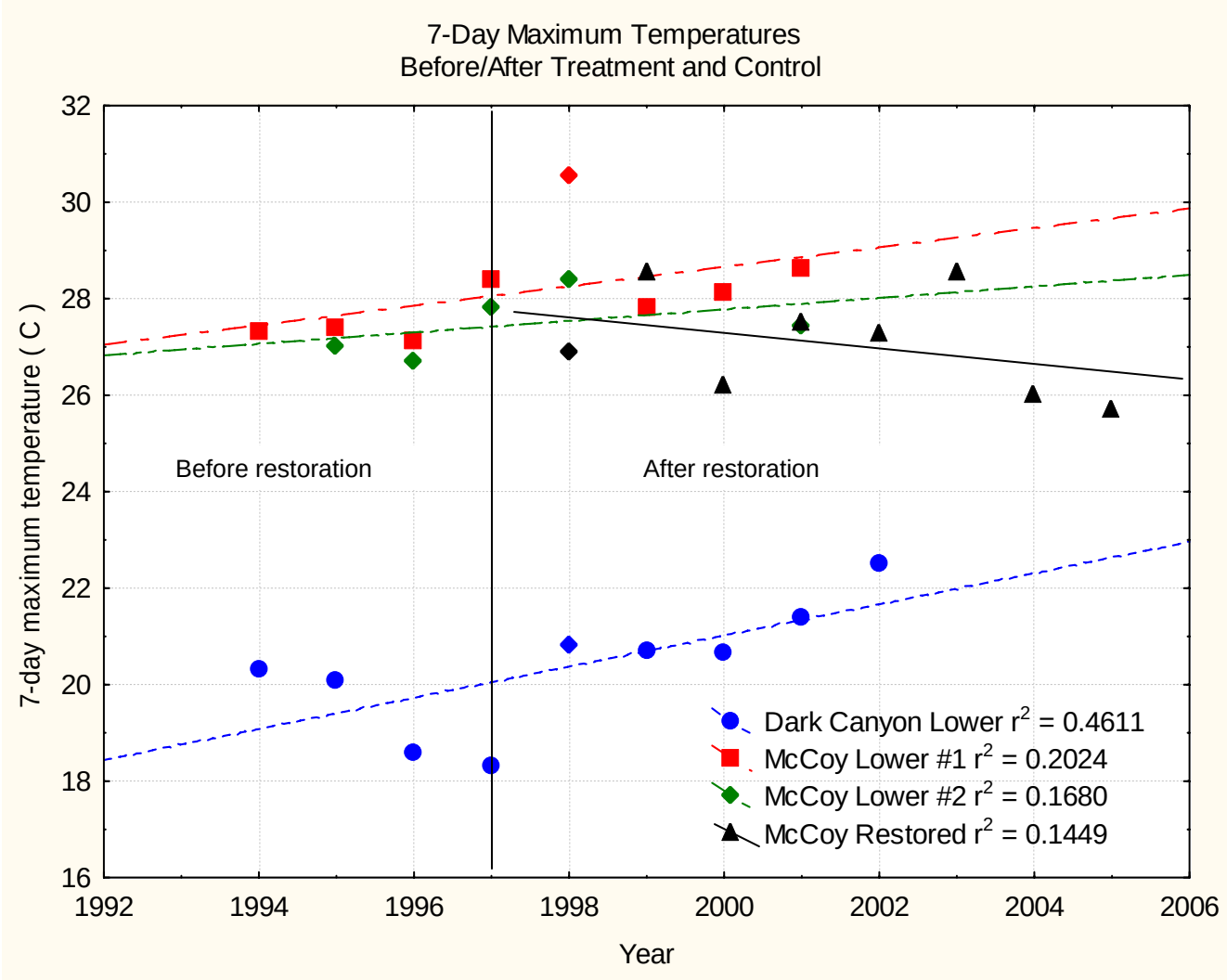

Figure 11. Seven day average of daily maximum temperature at control and treatment reaches over time. Temperature decreased in the McCoy Restored section after diversion in 1997. During this period, temperature increased in the channelized sections of Lower McCoy #1 and #2, and in Dark Canyon Lower, the control reach.

The 7-day maximum mean statistics shown in figures 9, 10, and 11 were calculated from temperature data collected in well mixed water flowing past the lower transect of each reach, and can be considered as reach–scale assessments. Additional temperature monitoring, which was done within the lower and upper boundaries of the reaches, shows considerable variability at the sub-reach scale. Sub-reach scale data are available from two sources: systematic random duplicate continuous monitoring conducted at selected sites in 2005 (Figure 12) , and longitudinal temperature profiles conducted at selected reaches in conjunction with fish

surveys (Table 5 and Figure 11).

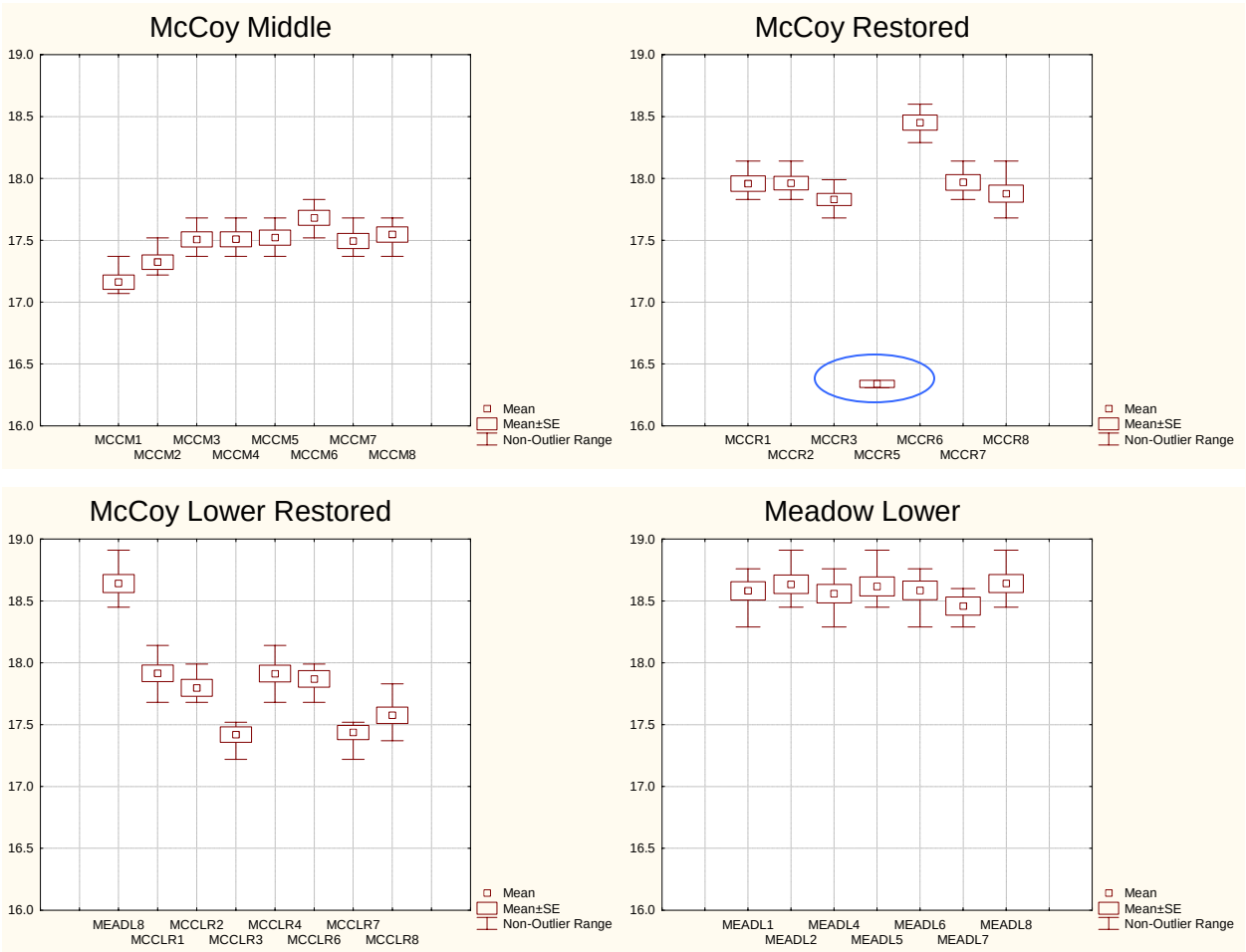

Figure 12. Sub-reach scale replicate continuous monitoring results from the McCoy Meadows area (2005). Each reach was divided into eight segments. One miniature temperature logger was positioned in each segment using random number pairs. Water temperatures were logged at half-hour intervals. The plots show calculated mean temperature values (not 7-day average maximum) with standard error boxes and non-outlier range whiskers for each logger. The vertical scale range of the plots is 16° C to 19° C.

The sub-reach scale results shown in Figure 10 show the greatest variability occurred in the McCoy Lower Restored and McCoy Restored Reaches, while the McCoy Middle and Meadow Lower Reaches had more uniform mean temperatures. The overall warmest temperatures were in the Meadow Lower Reach. While the McCoy Middle Reach had cooler mean temperatures in general, the coolest mean temperature (16.3^{o} C) was seen in the Restored Reach.

The above pattern can be explained in terms of shade, channel shape and gradient, and groundwater influx. The channels of the McCoy Middle and Meadow Lower Reaches were shallow and wide. Reduced channel width to depth ratio translates to less surface and bottom area exposed to heating by solar radiation. Exposure is also reduced by shade. In general, there is a clear positive correlation between shade, lower width to depth ratio, and cooler water temperature in the study reaches (Whitney, 2000). The cooler McCoy Middle Reach was shaded by riparian vegetation and a low ridge to the south. The Meadow Lower Reach had the least shade and highest temperatures. The more variable restored reaches were mostly open with some shade, but were narrower and deeper, with lower gradients. Cooler temperatures were recorded by thermographs located in or near deeper pools.

Following the 1997 diversion, discharge measurements showed the restored channel to be a gaining reach, suggesting the lower gradient improved connectivity with cooler groundwater (Whitney, 2000). Observations made during snorkel surveys confirmed areas of cold water influx, especially in the deeper pools (Whitney, 2002). This can be seen in the longitudinal temperature profile conducted during the 2005 fish survey (Figure 13).

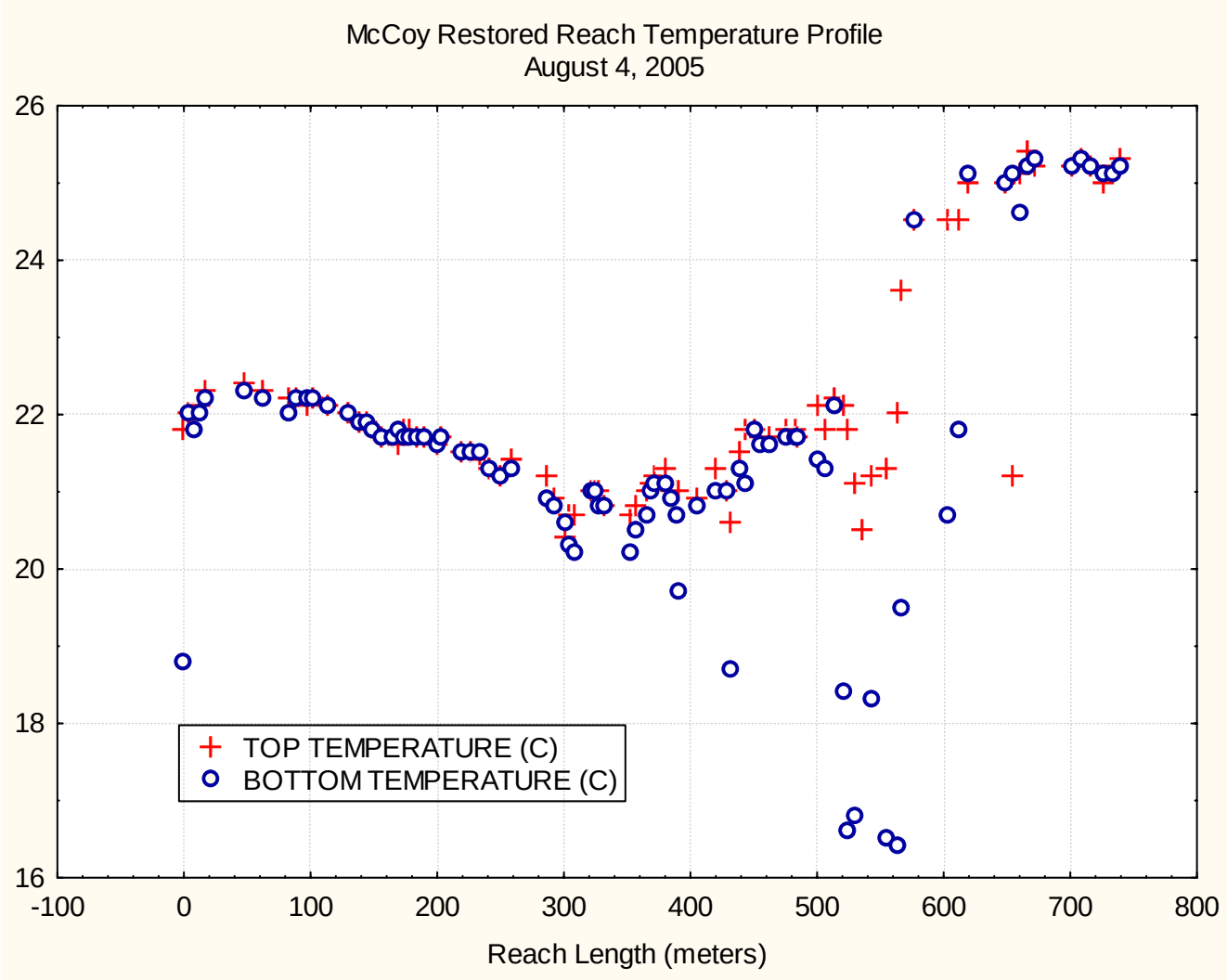

Figure 13. Longitudinal temperature profile through the entire McCoy Restored Reach. Temperatures were measured near the surface and bottom in the deepest part of the channel at 84 intervals from the bottom to the top of the study reach. The cooler bottom temperatures represent an influx of cooler ground water. Note the large area of cool water between 400 and 600 meters.

In summary – With the exception of Dark Canyon Creek, cooler temperatures were clearly associated with minimal impact from grazing and other land uses, while higher temperatures were associated with heavier use. Ground water influx influenced water temperature in Dark Canyon Creek and McCoy Creek. Channel shape, shade, and ground water connectivity were key factors influencing water temperature in the McCoy meadows. Temperature decreased over time in the McCoy Restored section after diversion in 1997, while temperatures increased in the non-restored Lower McCoy reaches as well as in the Dark Canyon control reach. Reach scale combined year results do not show a significant overall improvement (decrease) in

temperatures following restoration; however, sub-reach scale data show areas of cooler water were associated with deeper pools and ground water influx in the restored sections.

Habitat

Substrate composition, shade, width, depth, and velocities were measured at the sub-reach scale. In addition, habitat was assessed at the reach scale using a Rapid Bioassessment Protocol (RBP) matrix, modified from Plafkin *et al*., 1989. Because this method was intended to support biological survey data, parameters were weighted to reflect biological significance. Primary parameters evaluated in-stream habitat. Secondary parameters evaluated channel morphology features. Tertiary parameters evaluated riparian vegetation and bank structure and condition. The weighted scores were combined and expressed as percent of total possible score. Mean box plots of RBP habitat assessment scores for each study site are shown in Figure 14.

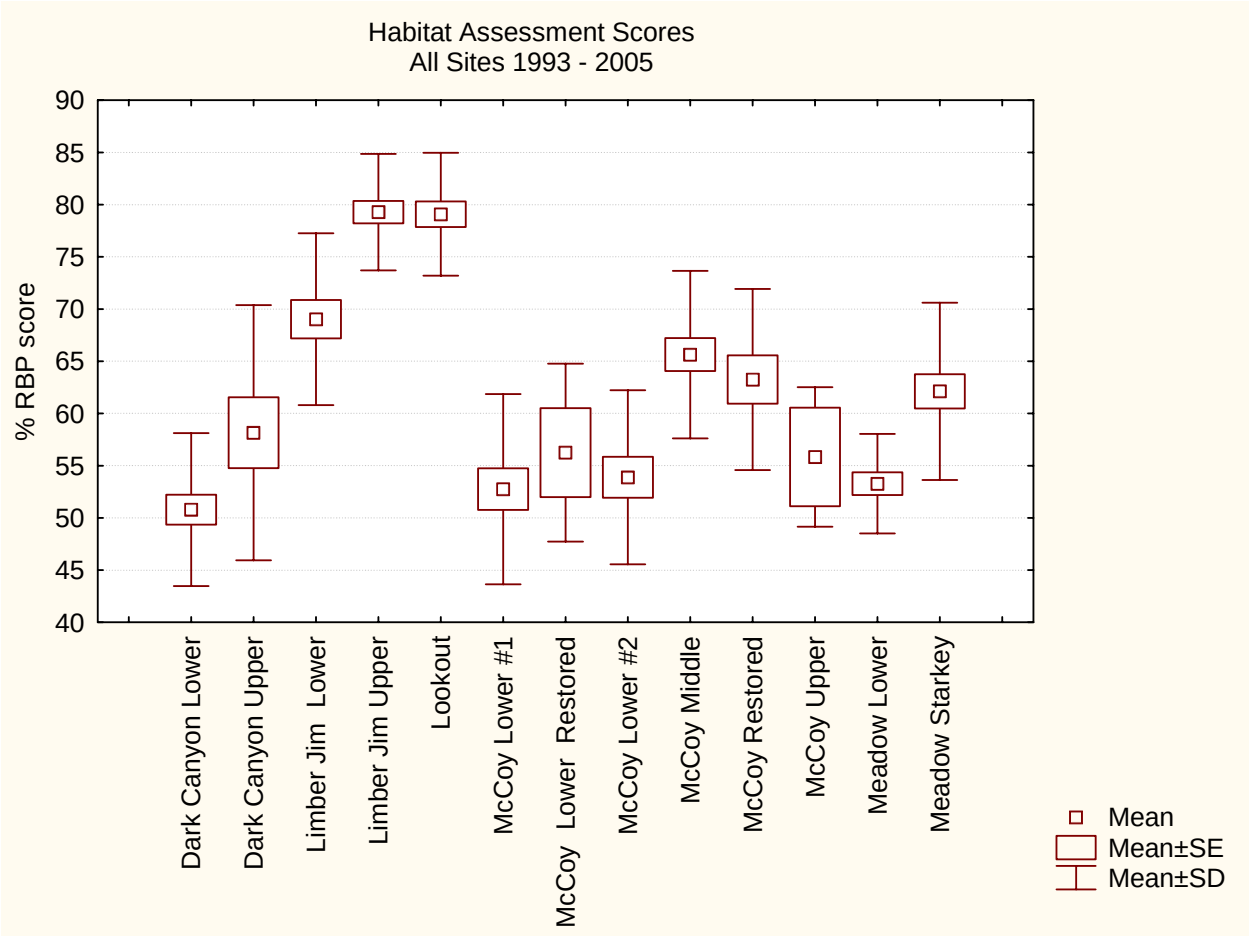

Figure 14. Habitat assessment scores.

In general, the habitat assessment scores corresponded to land use impacts and prevailing habitat types. The lowest scoring reaches, with scores below 60 percent had histories of heavy grazing. The highest scoring reaches (> 75), Limber Jim Upper and Lookout, were higher gradient sections located in forested areas with the least impact from grazing and other human activities. Four reaches had intermediate scores with mean values ranging between 70 and 60 percent: Limber Jim Lower, McCoy Middle, McCoy Restored, and Meadow Starkey. Except for the McCoy Restored reach, these were lower gradient meadow or forest-meadow habitats, with light to moderate impact from land use activities. The Restored reach had a history of heavy grazing, but benefited from relatively recent channel restoration and cattle exclusion. The Limber Jim Lower reach had the least impact from grazing, and was the best example reference conditions for this habitat type.

A before and after restoration comparison of habitat assessment scores shows improvement in the restored sections of McCoy Creek relative to reference conditions (Figure 15). This improvement is most notable in the McCoy Restored Reach, which was restored in 1997.

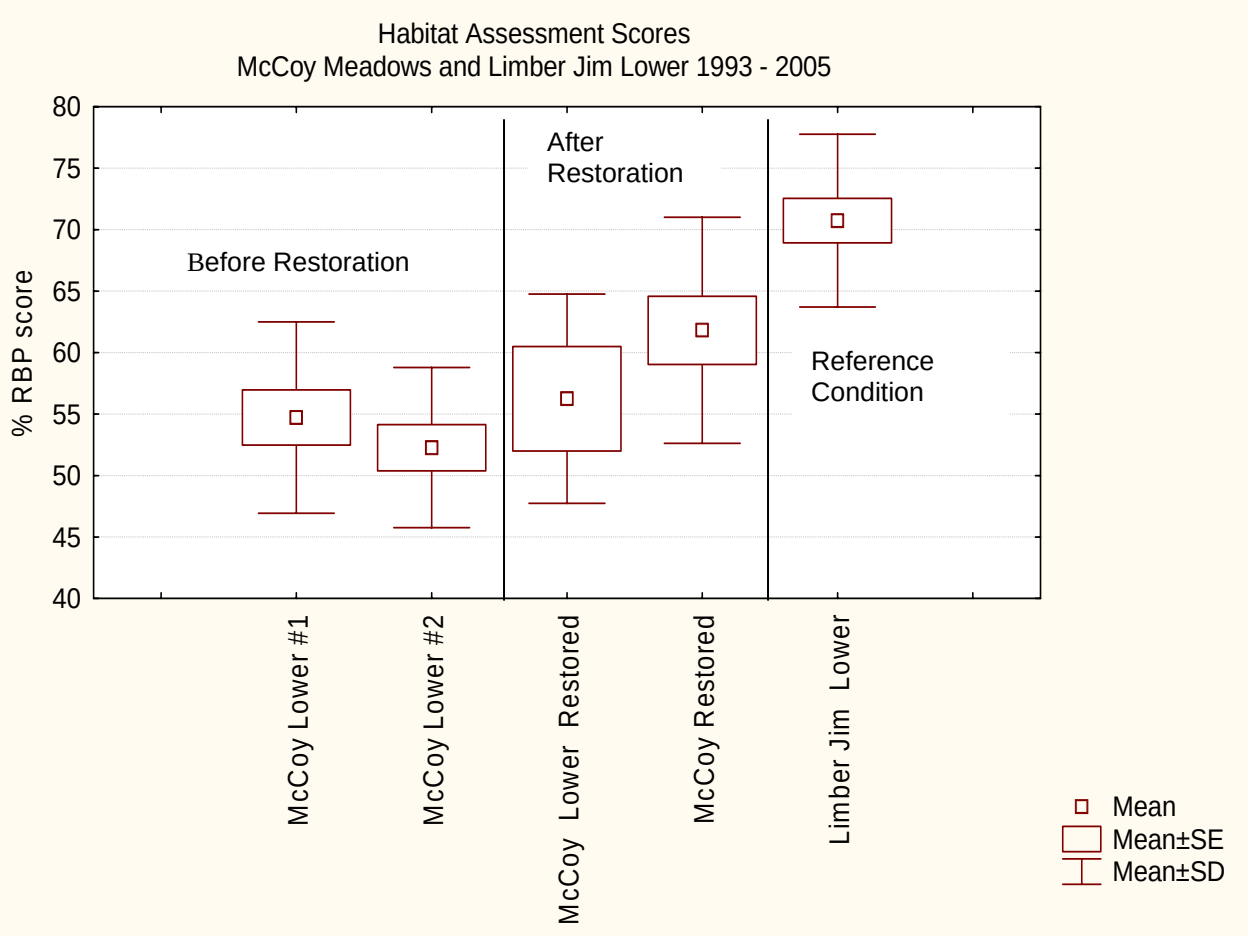

Figure15. Habitat assessment scores for McCoy Meadows reaches and Limber Jim Lower reach before and after restoration. Limber Jim Lower represents target reference conditions. Habitat in the restored sections improved following restoration.

Correlation analysis of habitat variables showed reach slope correlated best with habitat assessment scores (r^2= .67), followed by percent shade (r^2= .34) and width to depth ratio (r^2= .23). The higher gradient, forested reference reaches had the best habitat in general. In the lower gradient reaches located in meadow or forest-meadow habitat, more shade and a narrower, deeper channel correlated positively with overall habitat quality (Figure 16).

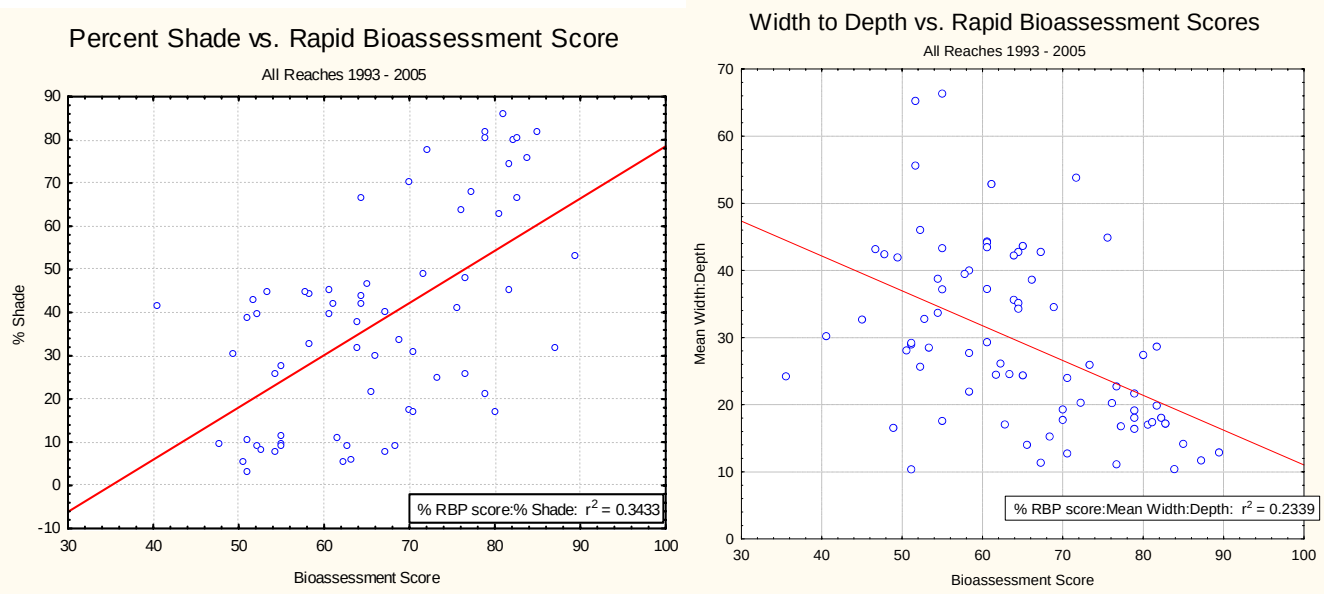

Figure 16. Percent shade (left plot) and mean width to depth ratio (right plot) relative to RBP habitat assessment score. More shade and a deeper, narrower channel shape corresponded to higher habitat scores.

An overall comparison of percent shade and width to depth values in McCoy Creek before and after restoration is shown in figure 17.

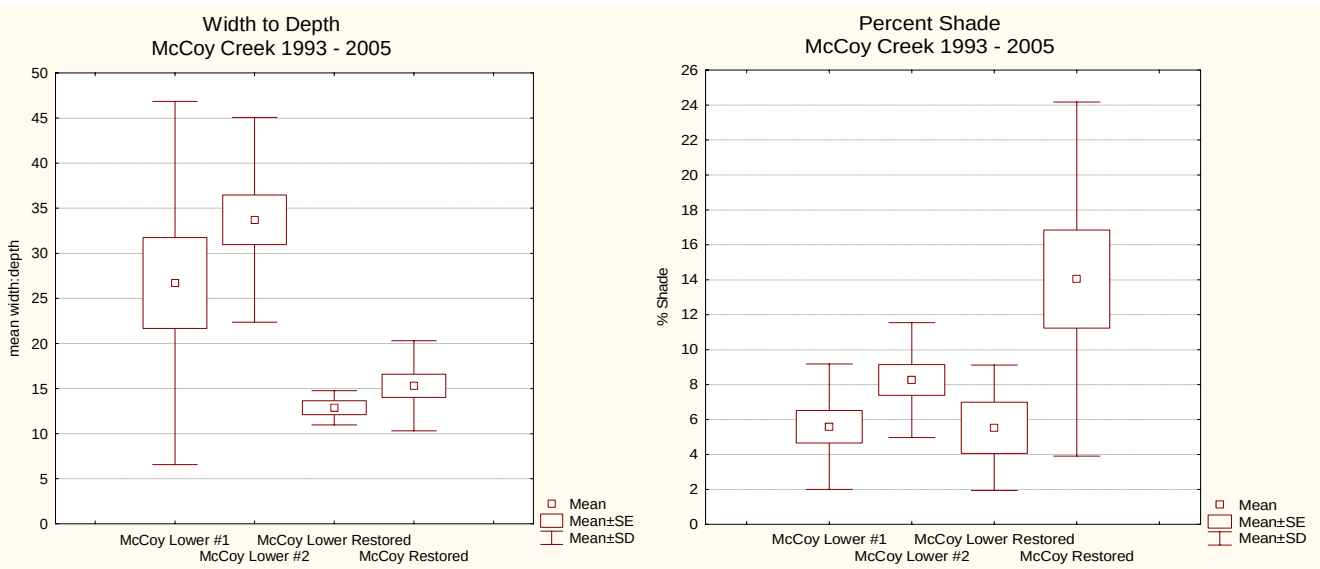

Figure 17. Width to depth (left plot) and percent shade (right plot) before and after restoration of McCoy Creek. A lower width to depth value corresponds to a narrower, deeper channel. Width to depth improved significantly in both the Restored and Lower Restored reaches. Shade improved in the Phase 1 Restored section, but not in the Phase 2 Lower Restored section.

Percent shade in the Restored reach compared to the non-restored McCoy Lower #1 and 2 reaches shows an overall improvement following the phase1 restoration; however, this shade decreased over time in a fluctuating pattern (Figure 18). Following the initial reintroduction of water into the historic meandering channel, existing willows thrived and provided increased shade. Additional planting by CTUIR focused primarily on establishing willows (*Salix spp*.) along the creek and ponderosa pine in the upland inclusions. Success rates have been variable – 20% survival overall for willows, and 50% for pine (Childs, Pers.Comm., 2007). Factors believed to be contributing to the poor success rates of plantings include seasonal fluctuations of the water table and depredation by big game (primarily elk). In addition, beavers moved into this new habitat and harvested riparian vegetation for food and dam construction. The beaver dams were beneficial in creating pool habitat for fish and elevating the water table, but over time the beavers depleted the available plants. In May, 2007, there was no evidence of recent beaver activity, and the shade producing willow plants remained depleted. However, there has been extensive re-colonization of native sedge and rush in the riparian area.

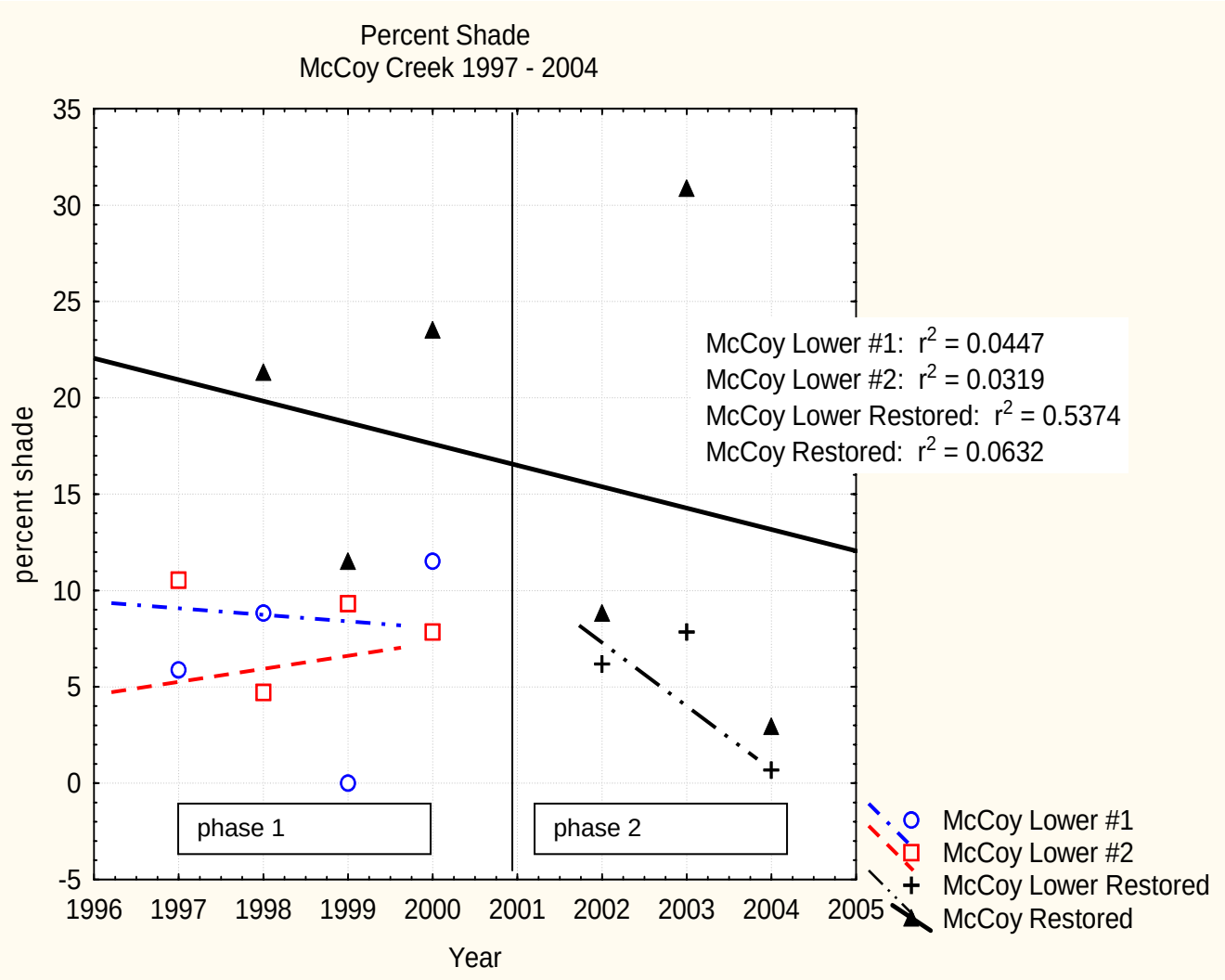

Figure 18. Percent shade in McCoy Lower #1 and #2, Restored, and Lower Restored reaches following phase 1 and phase 2 restorations. Each data point represents 24 densiometer measurements taken during each summer habitat survey, expressed as mean percent shade. Compared to the non-restored Lower #1 and #2 reaches, shade improved overall in the Restored reach, but not in the Lower restored reach. Note the fluctuating pattern in the Restored reach - high values one year with low values the next.

McCoy Creek width to depth ratios plotted against time are shown in Figure 19 below.

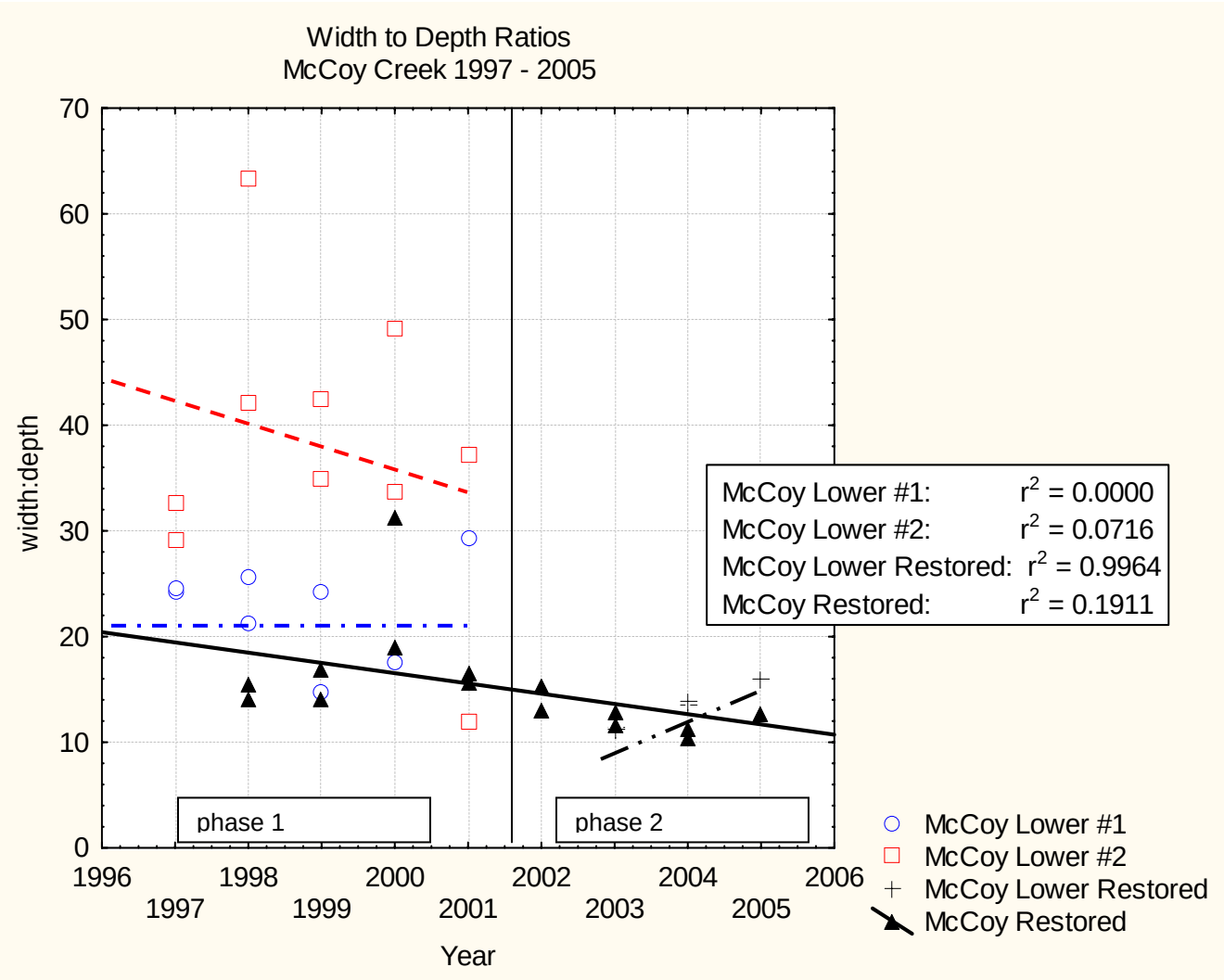

Figure 19. Width to depth ratios in McCoy Lower #1 and #2, Restored and Lower Restored reaches. Each data point represents mean values from measurements across 6 transects during summer and fall habitat assessments. Width to depth ratios in McCoy Restored were stable and improved (decreased) progressively following the phase 1 restoration. Width to depth increased slightly in the McCoy Lower Restored reach in the three years of monitoring following the phase 2 restoration.

Substrate composition was altered after restoration, particularly in the Phase 1 Restored reach. The lower gradient meandering channel bed had a higher percentage of sand and silt and a lower percentage of cobble and gravel than did the lower reaches prior to restoration (Figure 20). However, over time, spring flows flushed the new channel, and the percentage of cobble and gravel increased, while the percentage of finer materials decreased. As a result,

the substrate became less embedded (Figures 21 and 22). Embeddedness is the degree to which the larger cobble and gravel is surrounded by fine material and indicates suitability of the stream substrate as habitat for benthic macroinvertebrates and for fish spawning and egg incubation; Less embedded substrate is better habitat for aquatic life (Plafkin *et al*., 1999). Substrate conditions improved progressively following restoration.

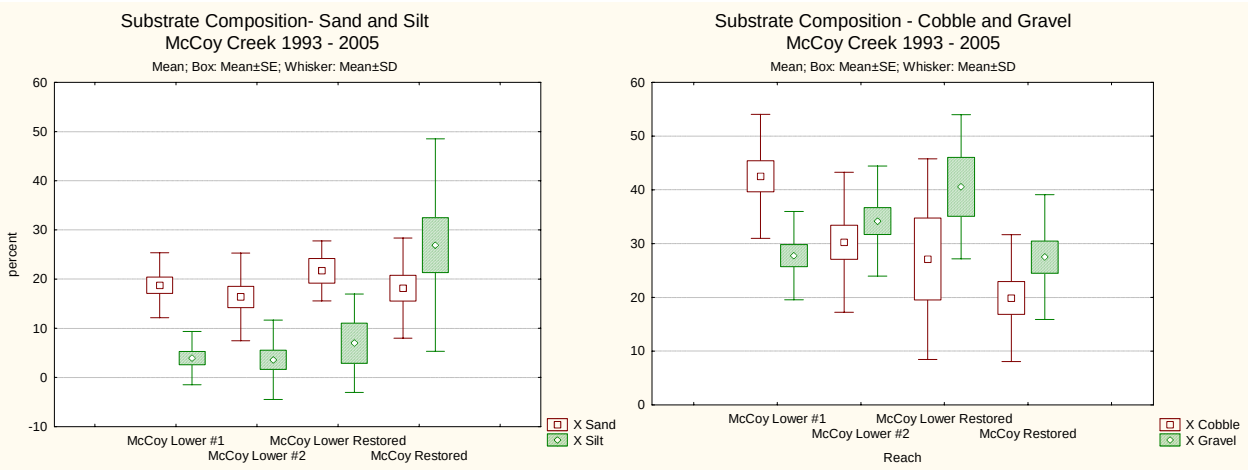

Figure 20. Substrate composition in McCoy Creek before and after restoration. Finer material (sand and silt) are shown at left, coarser material (Cobble and Gravel) are to the right. In the Phase 1 Restored reach, there was an overall increase in fine material (silt), while cobble and gravel decreased. In the Lower Restored section there was an overall decrease in cobble and gravel increased.

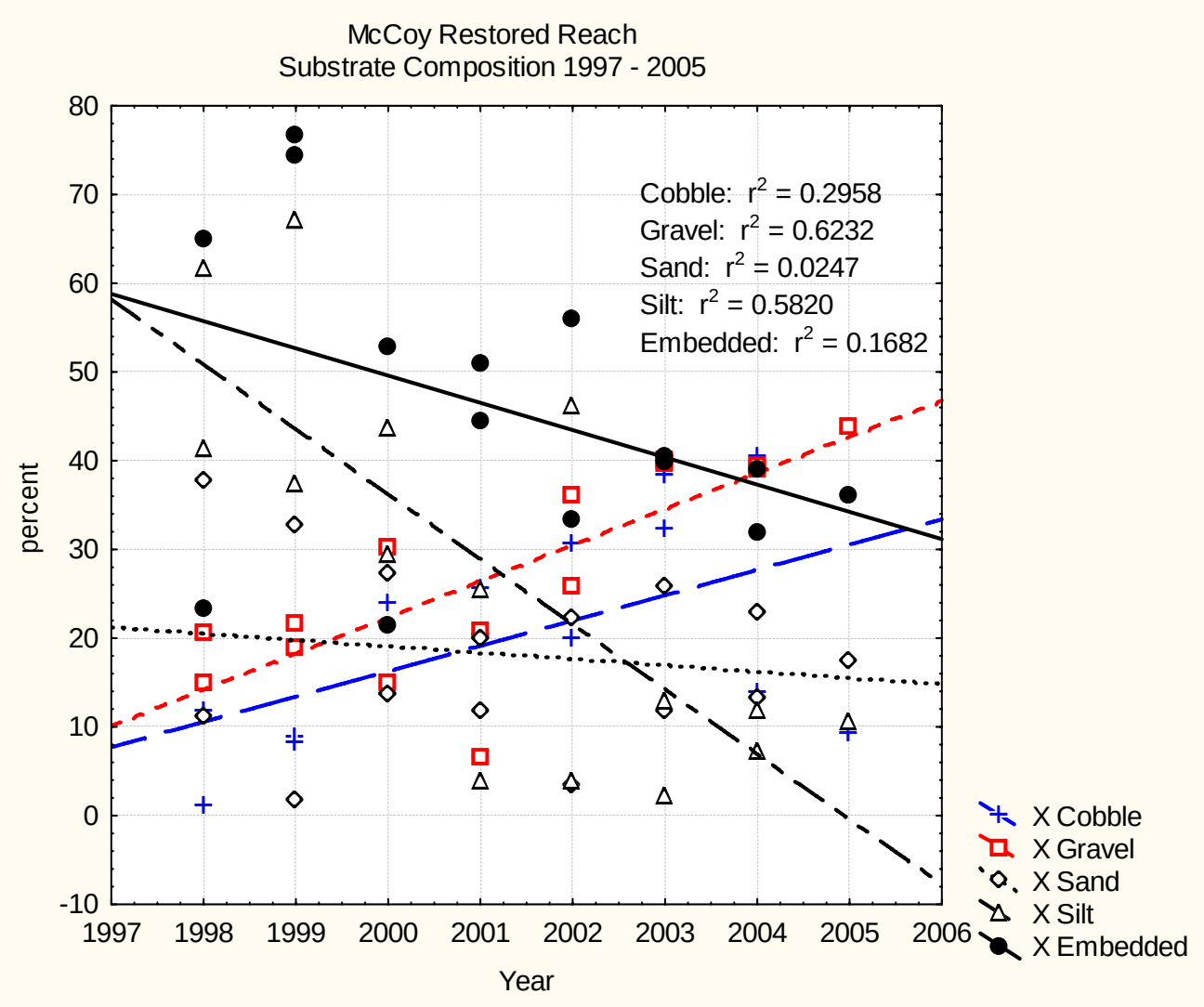

Figure 21. Substrate composition over time in the phase 1 Restored reach. Percent cobble and gravel increased while percent sand, silt, and embeddedness decreased over an eight year period.

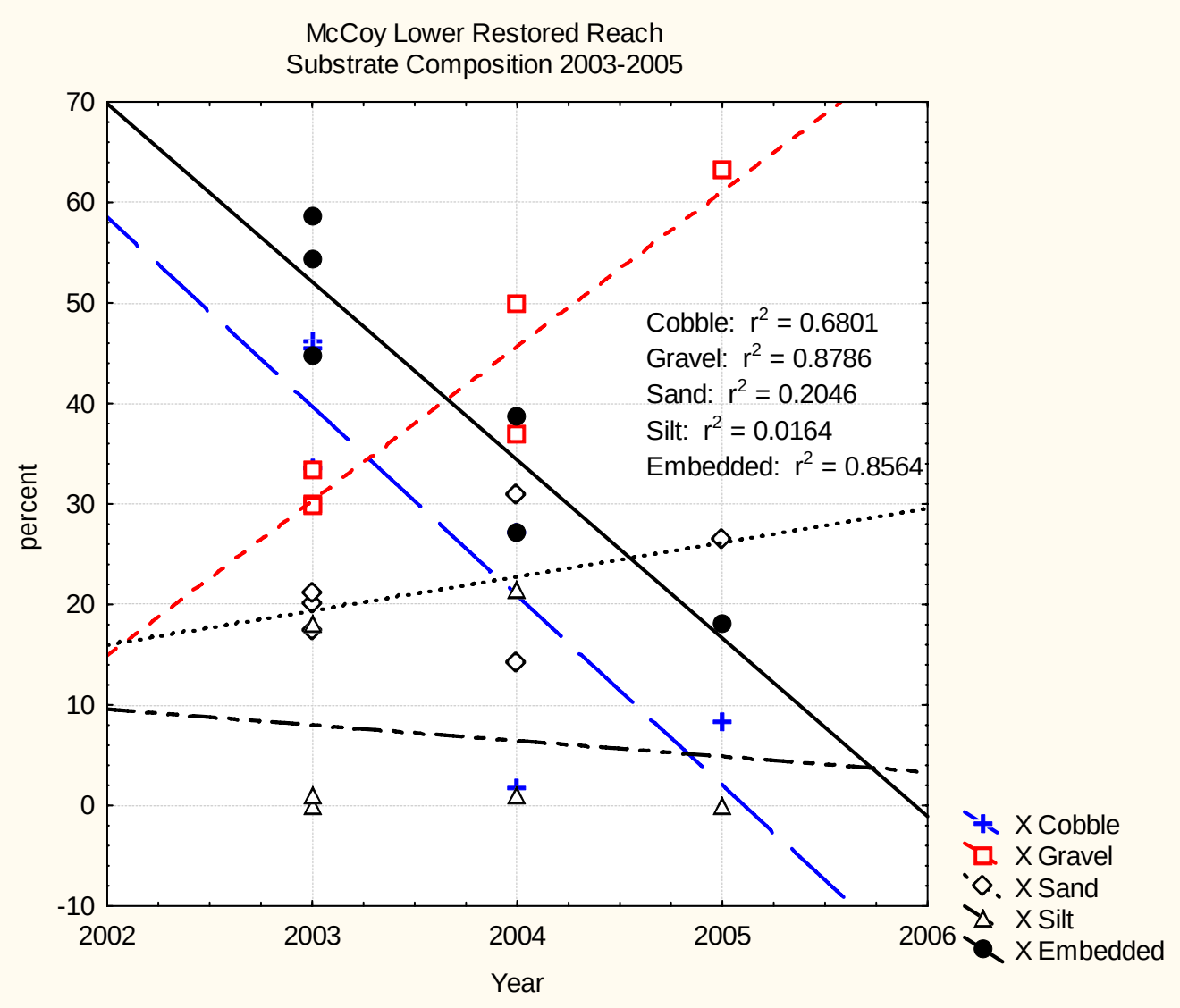

Figure 22. . Substrate composition over time in the phase 2 Lower Restored reach. Percent gravel increased, while percent cobble and embeddedness decreased over a three year period.

In 2007 the phase 1 Restored reach appeared to be stable and functioning well, while the phase 2 Lower Restored appeared to be less stable. Several headcuts have developed in the phase 2 section resulting in undesirable channel incision and degradation (Childs, Pers. Comm., 2007). The different character of these two restored reaches may be related in part to the methods by which they were created. The phase 1 (1997) Restored section was created by reintroducing flow into an existing historic meandering channel that had been abandoned as a result of channelization. This channel may have had inherent stability and potential for

improvement compared to the more problematic phase 2 (2002) Lower Restored reach, which was created by physically carving a new meandering channel.

In summary – Habitat quality was related to land use practices. Less disturbance from livestock grazing and other human activities such as channelization corresponded to better habitat. The highest habitat assessment scores occurred in the higher gradient forested reaches where mature conifers and shrubs in the riparian area provided cover and shade. Overall, percent shade and width to depth ratios were important variables relative to habitat quality, with more shade and a narrower deeper channel providing better habitat. Overall habitat quality improved in McCoy creek following restoration. Substrate condition improved progressively. The most influential variable in overall improvement following restoration was width to depth ratio. Width to depth ratio improved progressively in the phase 1 Restored reach.

Macroinvertebrates

Benthic macroinvertebrates are a diverse group of relatively long-lived, sedentary species that react strongly to human influences (Cairns and Pratt, 1993), and have been used widely in the assessment of water quality. The long life cycles (1-3 years typical) of benthic macroinvertebrates allow detection of temporal changes caused by perturbations, and their sedentary nature allows effective spatial analysis of pollutant or disturbance effects (Rosenberg and Reich, 1993). Aquatic insects, as well as other freshwater macroinvertebrates, occupy a central role in food chains and ecosystem processes, and serve as a link between their food (detritus plus microorganisms, algae, or vascular aquatic plants) and fish (Cummins and Merritt, 1996).

Early analysis of spring, summer, and fall macroinvertebrate samples from the Grande Ronde NMP sites, 1993 through 1996, showed seasonality to be an important consideration (Canale, 1998). There was a distinct change in macroinvertebrate assemblages at all sites between seasons. Based on modeling of reference conditions using the predictive model BORIS (Benthic evaluation of Oregon RIverS) (Canale, 1999), summer and fall data consistently distinguished between reference sites and all other sites, while spring samples did not discriminate well between sites. Spring assemblages at non-reference sites were within the

normal range of variation seen at reference sites, where summer and fall results showed clear differences between reference and non-reference sites.

Summer and fall macroinvertebrate data from 1993 through 2005 were scored using PREDATOR-2005, DEQ's most recent predictive model assessing biological integrity of Oregon streams using macroinvertebrates (Figure 16). The model predicts taxa expected to occur assuming least disturbed (reference) habitat conditions. Observed (collected) taxa were compared to a list of taxa expected to occur based on regional reference data. The model output is the observed to expected ratio (O/E). Scores of less than 1.0 represent a loss of common regional reference taxa. Limber Jim Upper and Lookout Creek had significantly higher scores compared to all other study reaches. Dark Canyon Lower, Meadow Starkey, and Limber Jim Lower had mean scores ranging from 0.9 to 1.0, while the remaining sites had mean scores between 0.7 and 0.9. This pattern is similar to the pattern seen using habitat assessment scores (Figure 14), and corresponds with land use related impairment. Dark Canyon Lower scored higher than expected, given the continued grazing and degraded habitat. Cool ground water influx and a predominance of large cobble may be important factors affecting the macroinvertebrate assemblage in the Dark Canyon Lower reach.

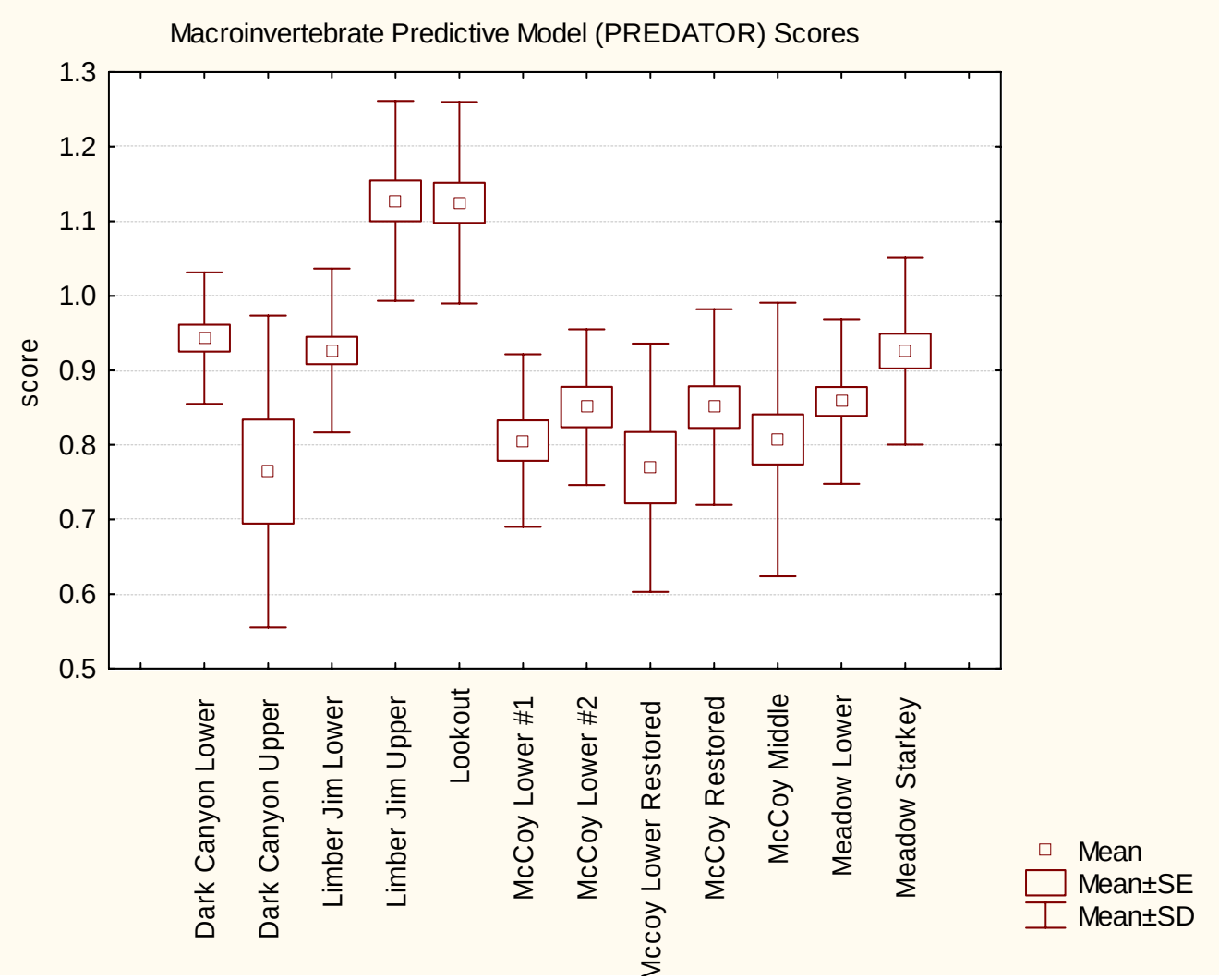

Figure 23. Macroinvertebrate predictive model (PREDATOR) mean scores.

The combined year PREDATOR model scores shown in Figure 23 showed no overall significant change or improvement in McCoy Creek following restoration, when comparing the restored sites to the pre-restoration McCoy Lower #1and #2 sites. However, the mean score for the phase 1 McCoy Restored reach (0.86) was higher than all other McCoy Creek reaches except the McCoy Lower #2 reach, which had a similar mean value.

A time series assessment of PREDATOR scores at key study sites is shown in figure 24 below.

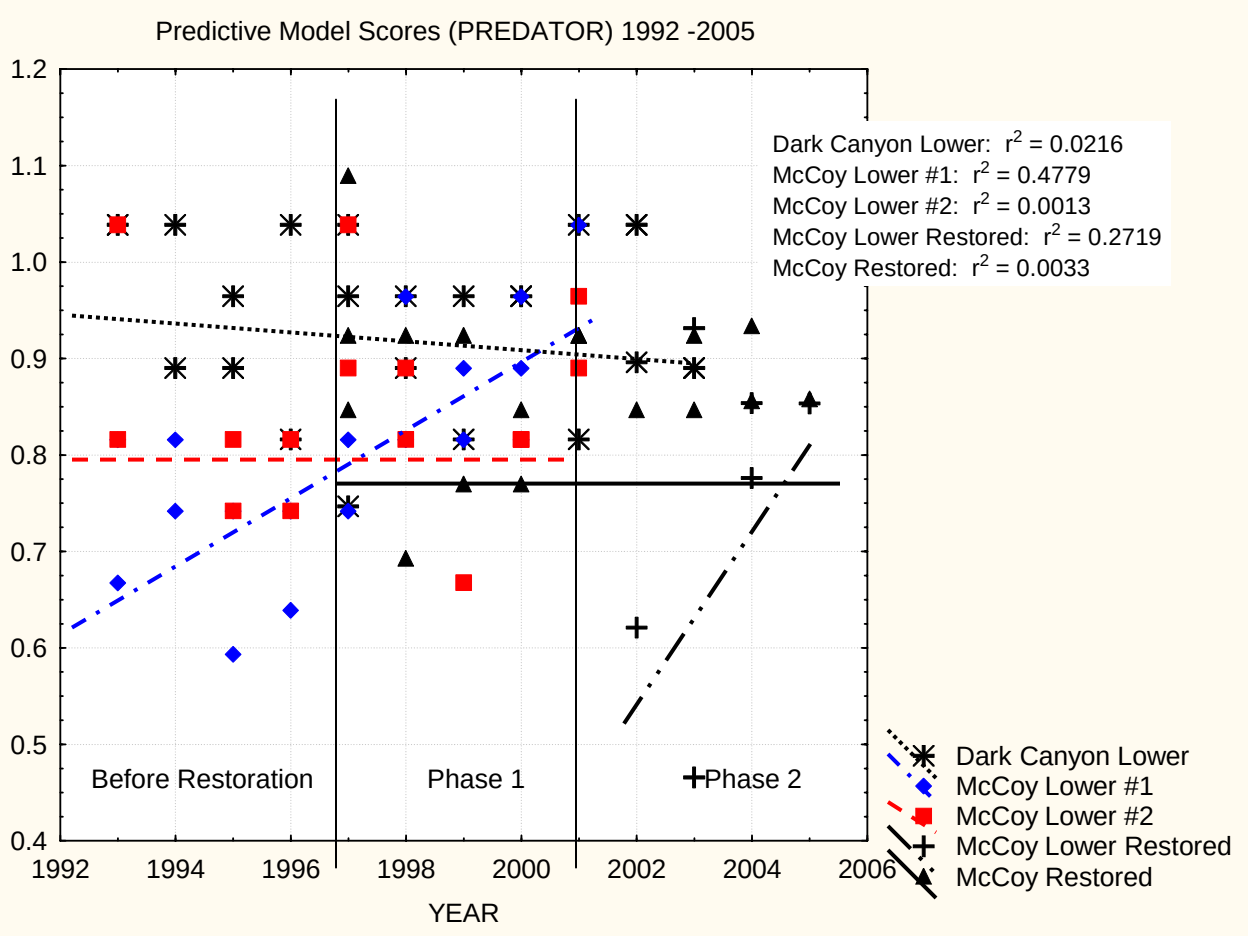

Figure 24. Predator scores across years for control (Dark Canyon Lower), before restoration (McCoy Lower #1 and #2), and after phase 1 and phase 2 restoration (McCoy Restored and Lower Restored) using summer and fall data. Increasing scores indicate a positive trend in observed taxa towards taxa expected in reference conditions (O/E).

No increasing or decreasing trend was seen at Dark Canyon (control), McCoy Lower #2 (before restoration), or the McCoy Restored Reach (treatment). However, a positive trend was seen in the Lower Restored Reach (treatment) following the phase 2 reconstruction, where scores were initially low (0.68 and 0.46 in 2002 an 2003) but increased to a level similar to the scores from the phase 1 Restored reach (0.86) by 2005. Also, there was a positive trend in scores at McCoy Creek Lower #1 before restoration. This trend may have been in response to beneficial effects of livestock fencing, which was in place on this section of the creek for 14 years prior to the phase 2 channel reconstruction, which was completed in 2002.

Although PREDATOR scores showed a mixed overall response in the observed macroinvertebrate taxa in the restored reaches relative to taxa expected in reference conditions (O/E), there was a notable response in macroinvertebrate taxa richness, and also in macroinvertebrate inferred fine sediment and macroinvertebrate inferred temperature values. Following restoration, taxa richness increased, macroinvertebrate inferred fine sediment increased, and macroinvertebrate inferred temperature decreased over time.

Taxa richness (the number of different macroinvertebrate taxa present) was higher at sites with higher quality habitat (Limber Jim Upper and Lower), and increased in the McCoy Creek Restored and Lower Restored reaches when compared to the pre-restoration McCoy Lower #1 and #2 reaches (Figure 25). Richness in the restored reaches increased progressively over time. Richness also increased over time, but to a lesser extent, in the McCoy Lower #1 and #2 reaches, where results were more variable (Figure 26). This increase in the Lower #1 and #2 reaches may have been in response to the effects of livestock exclusion fencing that had been in installed in 1988.

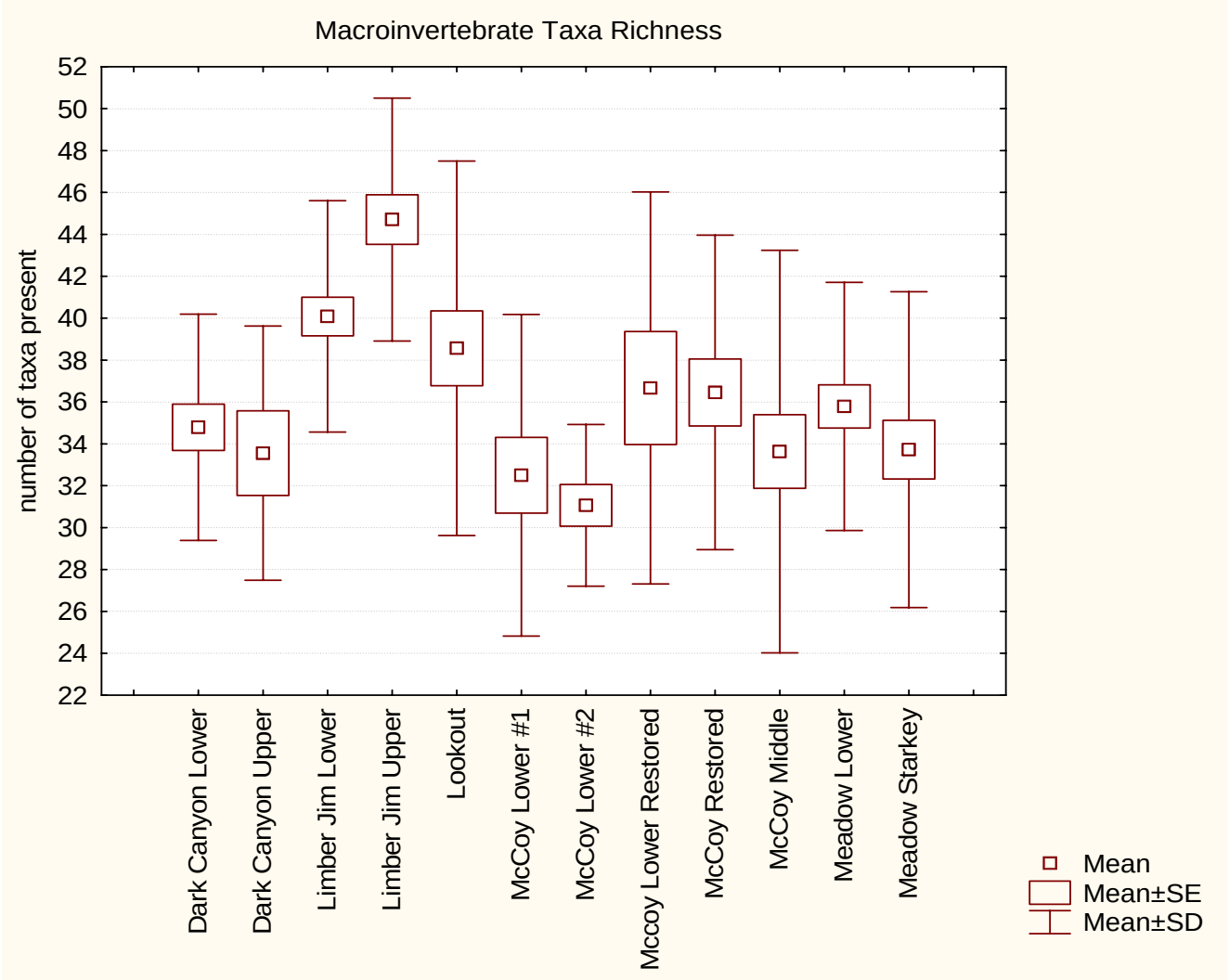

Figure 25. Macroinvertebrate taxa richness at all sites.

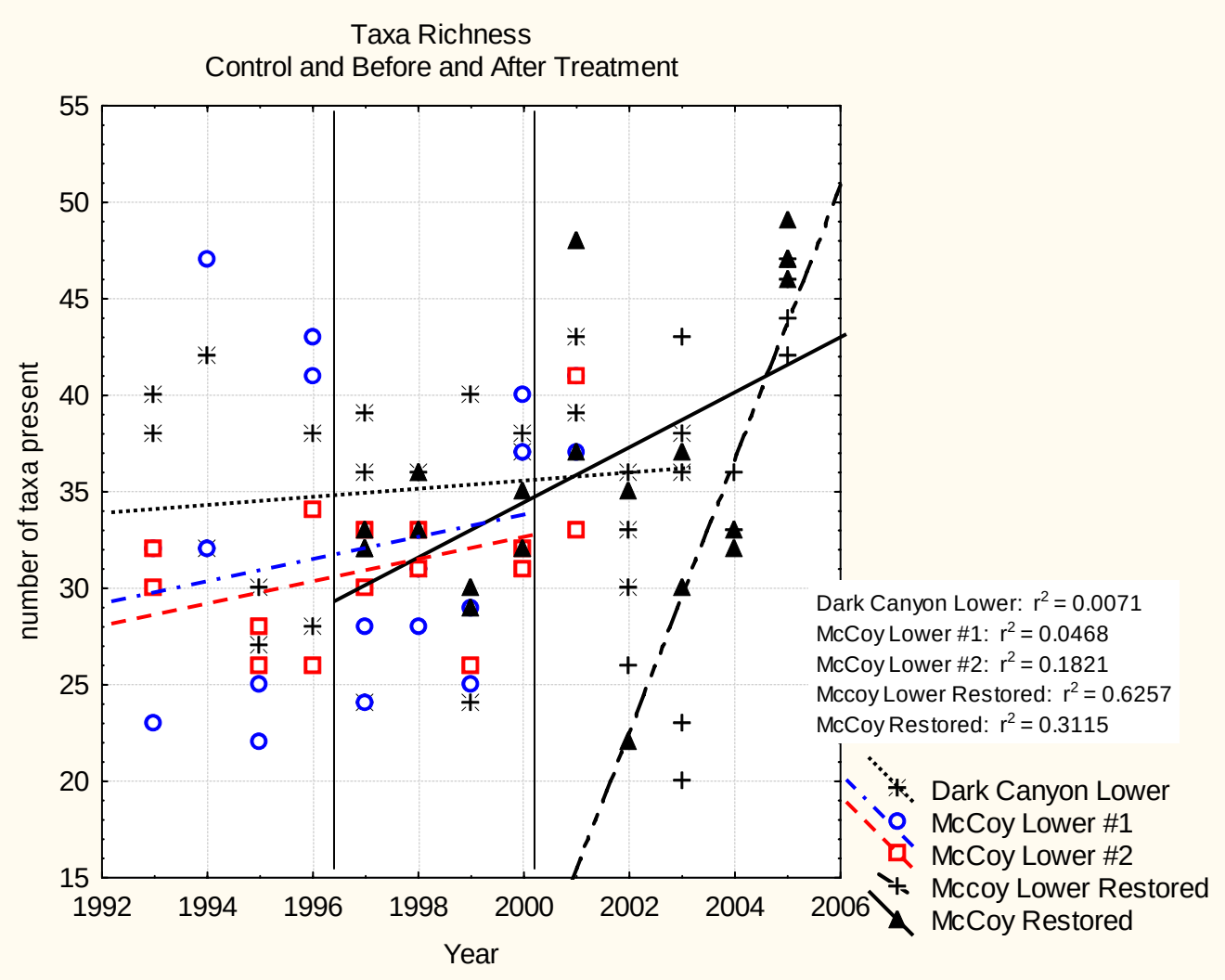

Figure 26. Taxa richness over time in the control reach (Dark Canyon Lower) and in McCoy Creek before and after phase 1 and phase 2 restoration.

Generally, increased macroinvertebrte taxa richness is associated with improved water quality and substrate diversity (Bauer and Burton, 1993). However, since this restoration project involved watering completely new channels, it is likely the taxa increase was also due to colonization of the newly available habitat. A comparison of paired macroinvertebrate results from McCoy Creek Middle (used as an upstream control site) and the phase 1 McCoy Restored reach shows that immediately after restoration the difference in the macroinvertebrate assemblages at these two sites was relatively high. However, over time the assemblages became more similar. Dissimilarity analysis shows that, relative to the McCoy Middle Reach, the macroinvertebrte assemblage in the Restored reach was stabilizing or

changing over the initial 3-5 years of colonization following the 1997 diversion of water into the historic meandering channel (Figure 27).

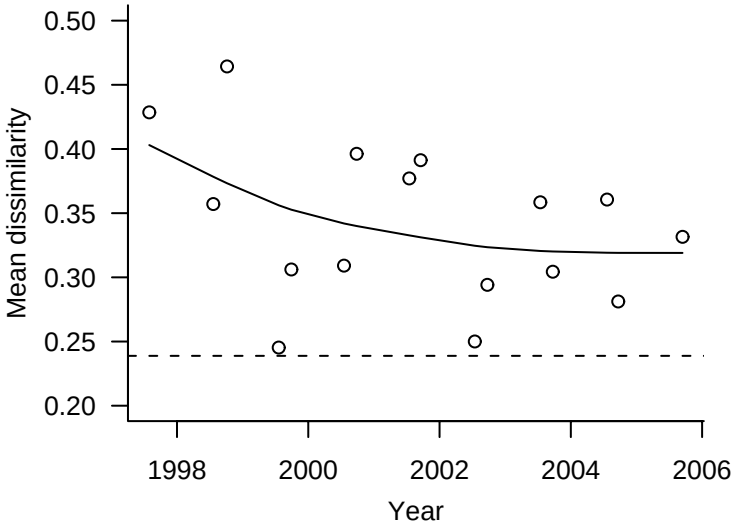

Figure 27. Mean Sorensen dissimilarity between the upstream control site (McCoy Middle) and the phase 1 restoration site (McCoy Restored). The solid line shows a nonparametric curve fit through the data. This line begins to flatten around 2002, five years after the restoration. The dashed line shows mean within-site dissimilarity in the upstream control site. This line provides a lower bound to expectations regarding the dissimilarity between the control site and the restoration site (Yuan, Pers. comm., 2007).

Macroinvertebrate data were also assessed using inference models developed by DEQ to quantatively evaluate fine sediment and temperature stresses in Oregon streams. These models employ a reference condition approach and use weighted average inferences to reveal shifts in macroinvertebrate assemblage composition relative to fine sediment and temperature in streams. Results showed an overall increase in fine sediment scores and a decreasing trend in inferred temperature in the restored sections following restoration.

Combined year macroinvertebrate inferred sediment mean values are shown in Figure 28.

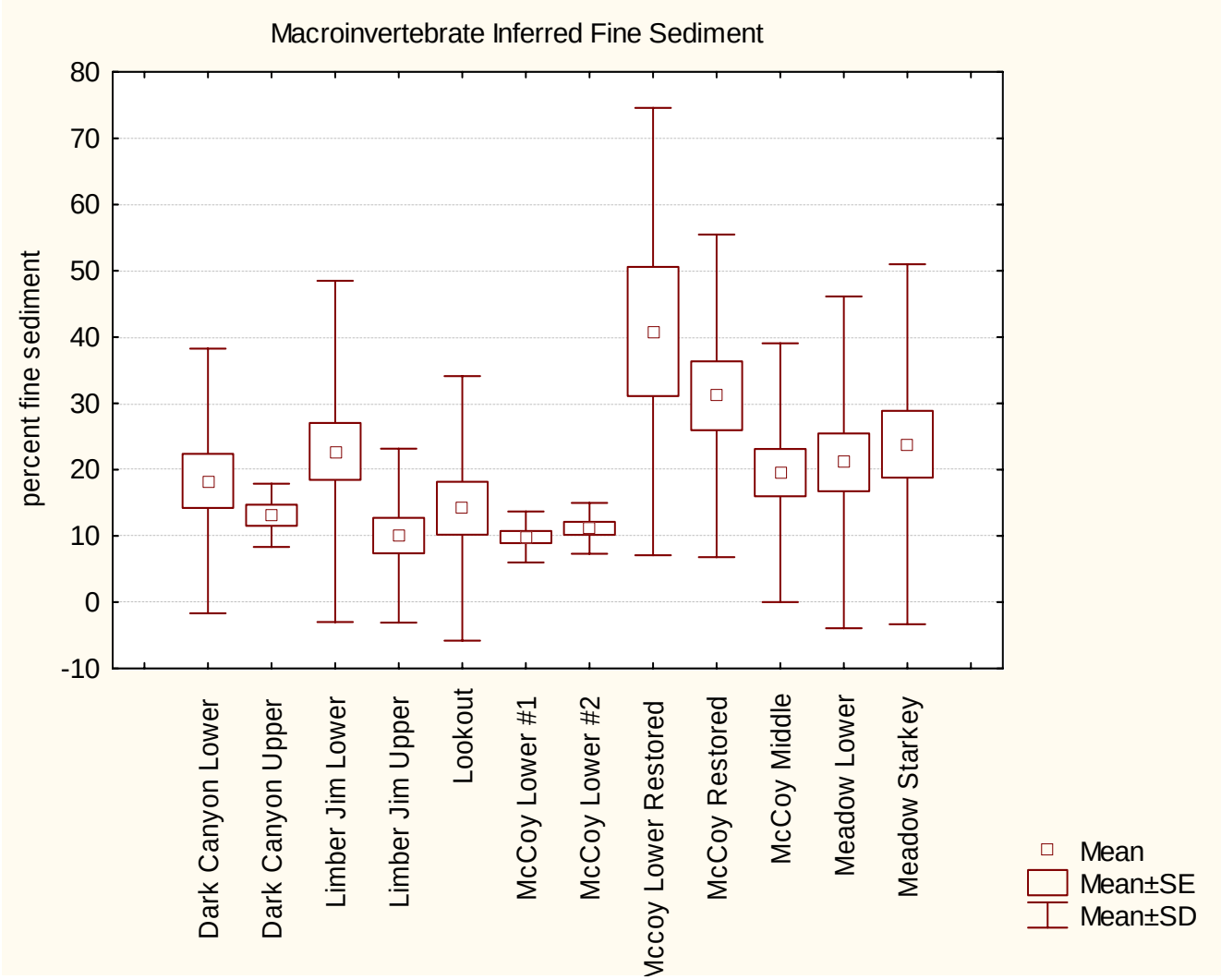

Figure 28. Macroinvertebrate inferred fine sediment mean values for all sites, 1993 through 2005. Compared to the pre-restoration McCoy Lower #1 and #2 sites, the macroinvertebrate inferred proportion of fine sediment was significantly higher in the restored reaches.

Increased sedimentation is generally associated with disturbance related erosion and substrate degradation. Many benthic macroinvertebrates respond negatively to increased levels of sedimentation, which can cause filling of interstitial spaces, disrupt filter feeding, increase drift, and impede foraging and mobility (Huff *et al*., 2006). In general, lower sediment values are expected to correspond to higher quality habitat; however, this was not necessarily the case with the sites in this study. The Dark Canyon and McCoy Lower #1 and #2 reaches had low quality habitat resulting from grazing and other human activities, yet inferred sediment mean values were low (approximately 10%) in these reaches compared with the Limber Jim

Lower reference site (approximately 22%) , which had high habitat quality. The Lower McCoy Creek sites were described as being sediment poor during the Proper Functioning Condition (PFC) surveys conducted in 1998 (Wiley, Hafele, and Grover-Wier, 1998) . It was noted that in the Lower McCoy #1 and #2 reaches minimal deposition of fine material limited the establishment and growth of rushes and sedges, which stabilize banks and provide cover and improved habitat for aquatic life; this limitation contributed to the very slow observed response to the potential benefits of livestock exclusion fencing in this section of the creek. On the other hand, rushes and sedges were well established in the restored wet meadow section of the phase 1 McCoy Restored Reach, where sediment values were higher (approximately 30%), and channels were functioning well. Following the phase 2 channel reconstruction, the McCoy Lower Restored Reach had inferred sediment values higher than all other sites (approximate mean of 40%). This may be an indication of erosion related to incision and down-cutting observed to be occurring between the study reach and the McIntyre road crossing (Childs, Pers. Comm., 2007).

A plot of inferred sediment values across years shows that the high mean sediment values in the restored reaches were influenced by exceptionally high results in 2003 and 2004 at the Lower Restored Reach, and in 2004 at the Restored Site (Figure 29). Inferred sediment values were also notably higher at all other sites sampled in 2004, including Limber Jim, Lookout, and the Meadow Creek reaches, as well as the McCoy Creek Middle reach. This suggests that the high 2004 inferred sediment values were related to variables other than the effects of channel restoration in McCoy Creek.

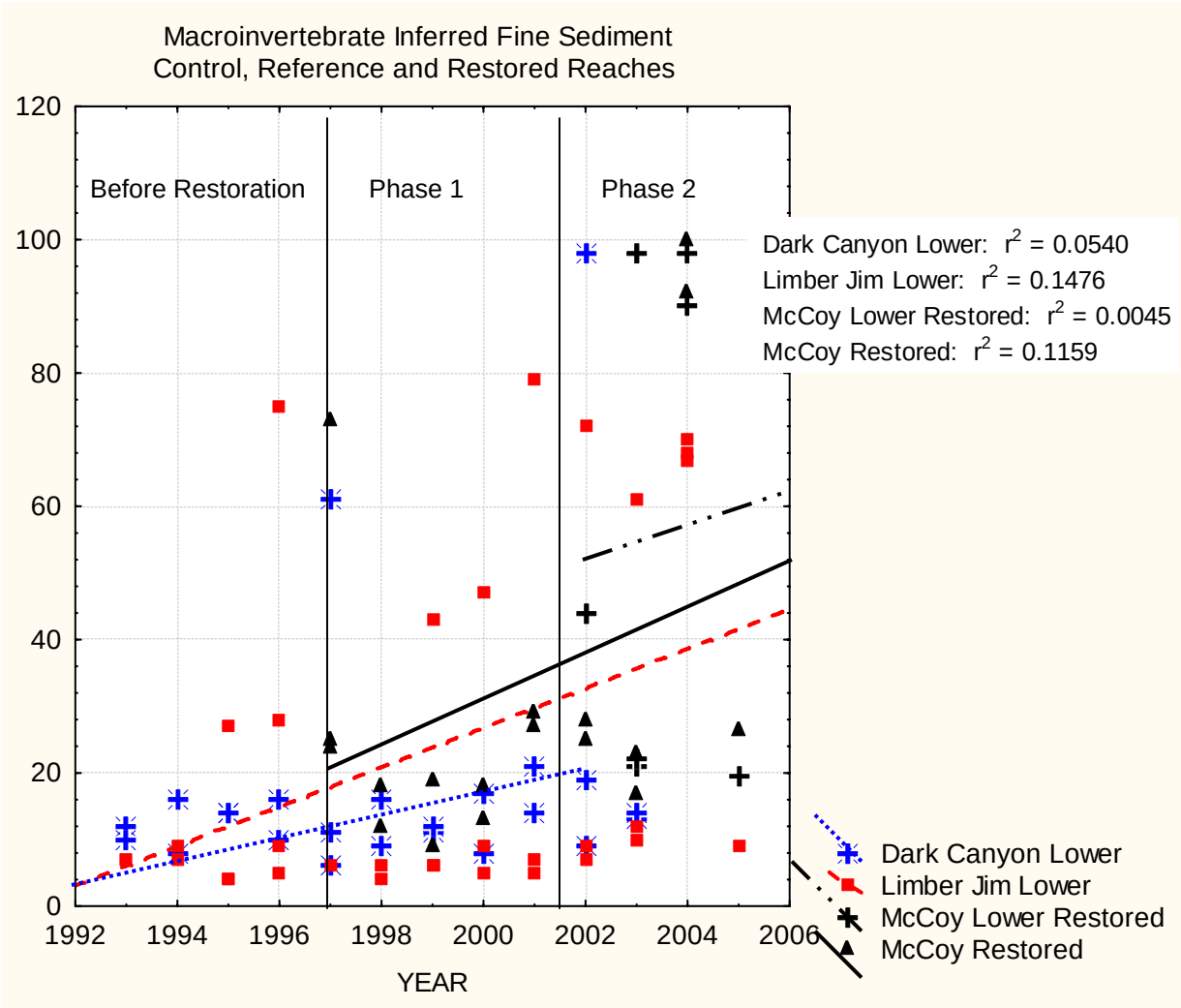

Figure 29. Macroinvertebrate inferred fine sediment values for control (Dark Canyon Lower), reference (Limber Jim Lower) and restored (McCoy Lower Restored and Lower Restored) reaches. High values were seen at all sites in 2004. There was an increasing trend in inferred sediment values at control, reference, and the restored reaches, suggesting that, although sediment values were higher in the restored reaches, the apparent positive trend in macroinvertebrate inferred sediment may not be linked to the effects of restoration. Note the lower sediment values at the McCoy Restored and Lower Restored Reaches in 2005, the final year in the time series.

Combined year macroinvertebrate inferred temperature values are shown below in Figure 30. In general, the pattern of inferred temperatures was similar to that of the measured 7-day maximum temperatures, shown previously in the temperature results discussion (Figure 9). Warmer inferred temperatures occurred in the McCoy and Meadow Creeks, while cooler temperatures occurred in Lookout, Limber Jim and Dark Canyon Creeks. Compared to pre-

restoration temperatures in McCoy Lower #1 and #2 reaches, there was an overall decrease in inferred temperature in the phase 2 McCoy Lower Restored reach.

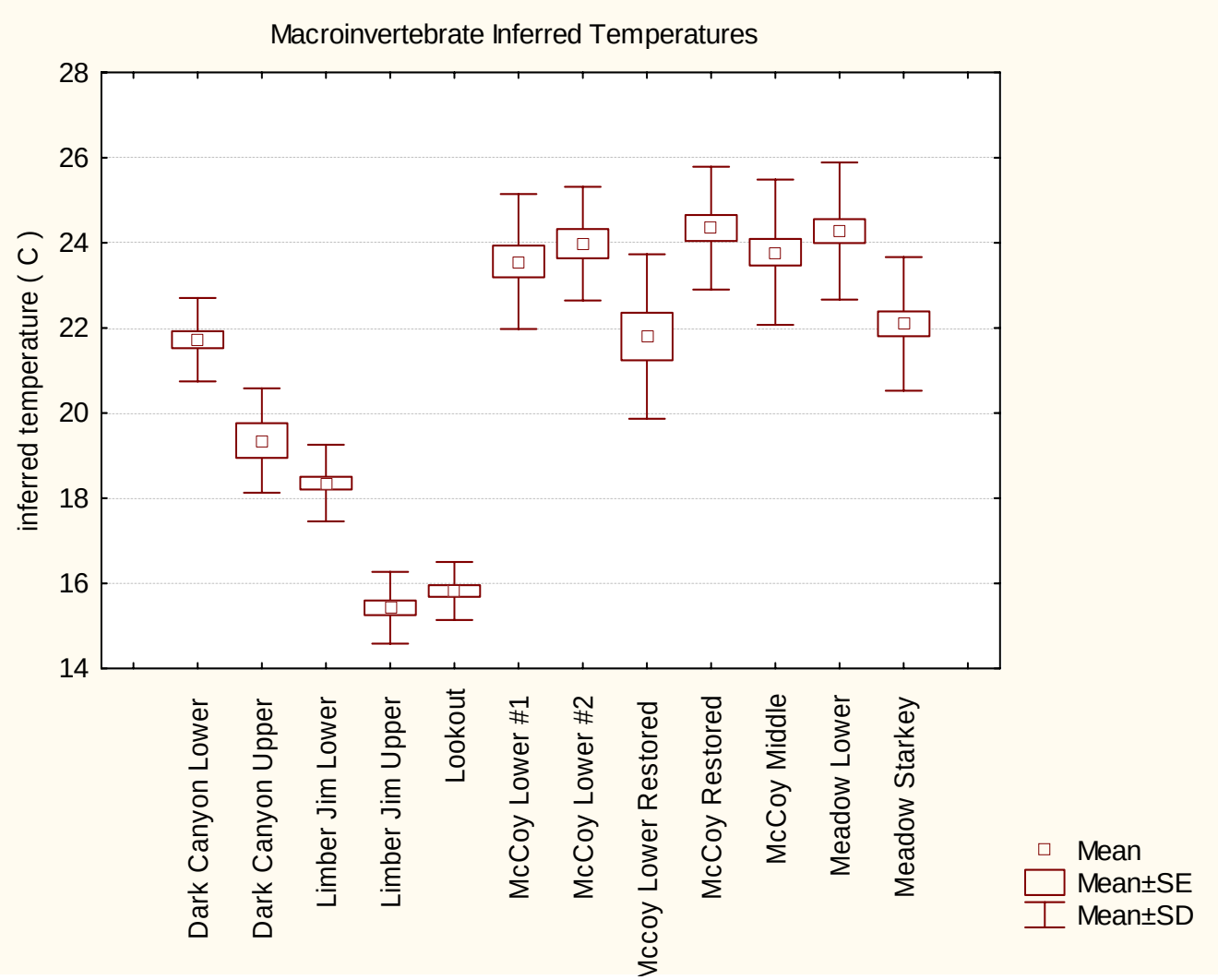

Figure 30. Combined year macroinvertebrate inferred temperatures for all study reaches.

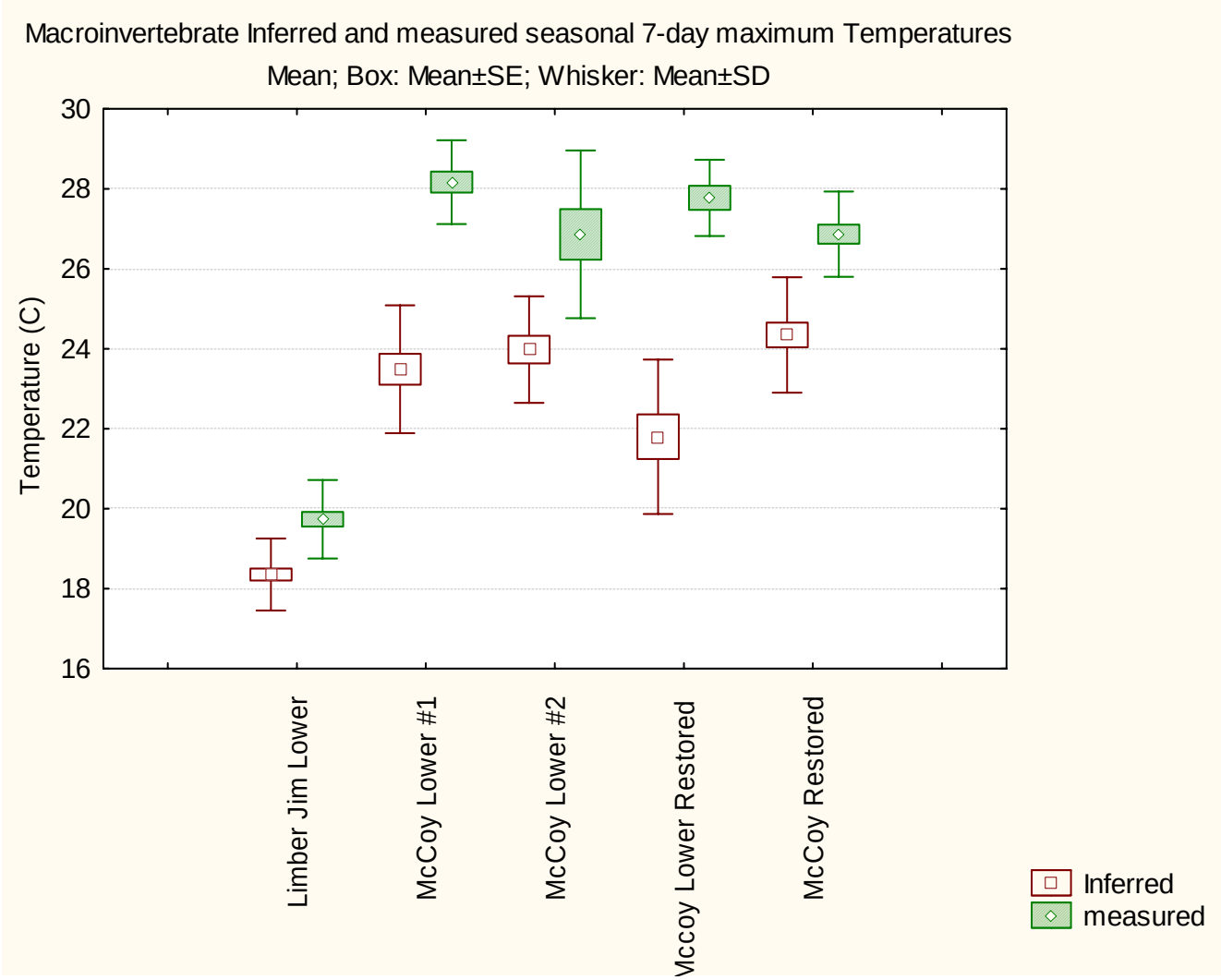

Figure 31. A comparison of macroinvertebrate inferred and measured 7-day seasonal maximum temperatures. Inferred temperatures were calculated from a weighted-averaging model using only macroinvertebrate data. Seasonal maximum temperatures were measured using continuous data loggers.

The macroinvertebrate inferred temperatures are a measure of macroinvertebrate assemblage temperature preferences. These values can be used to infer temperature directly, but more accurately reflect the optimal conditions for a given assemblage (Hubler, Pers. Comm., 2007). In the comparison shown in Figure 31, inferred temperatures were consistently lower than measured seasonal 7- day maximum temperatures. In the McCoy Creek restored reaches, the Lower Restored reach had one of the highest measured seasonal 7-day maximum and the lowest macroinvertebrate inferred temperature. One possible explanation for these differences is that the macroinvertebrate assemblages were responding to temperatures of the benthos and hyporheic zone, where the cooling effect of groundwater influx was more

pronounced than in the water column, where temperatures were measured using data loggers. If this was the case, then the data suggests that the cooling effects of ground water influx increased (improved) in the Lower Restored reach following restoration, when compared to pre -restoration data from McCoy Lower #1 and #2 reaches. Regardless of the explanation, inferred temperature results indicate temperatures were reduced (improved) in the McCoy Lower Restored reach.

While no overall decrease in temperature was seen in the combined year results from the phase1 Restored reach, inferred temperatures did decrease progressively over time within this reach as well as within the lower restored reach (Figure 32).

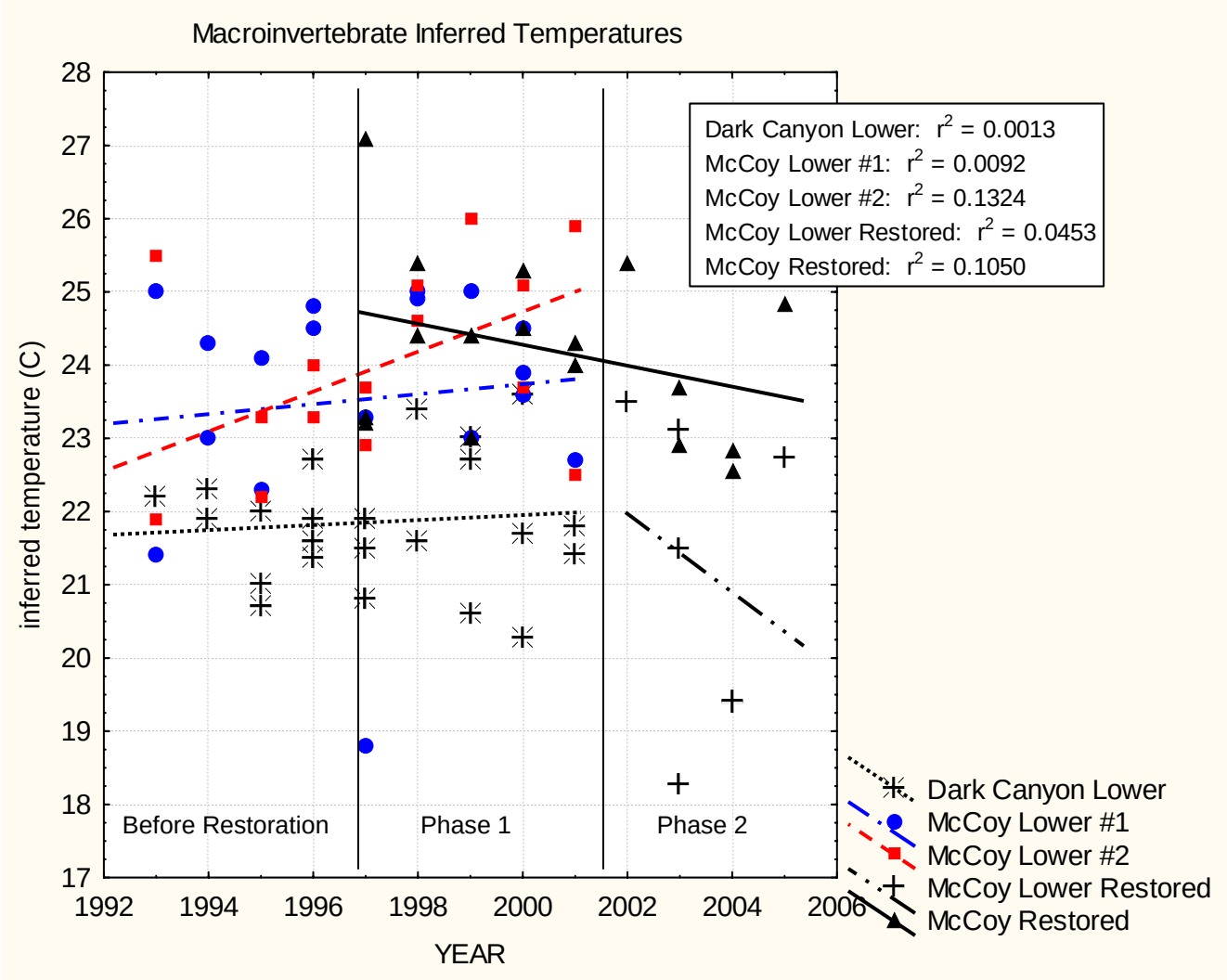

Figure 32. Macroinvertebrate inferred temperatures over time for control (Dark Canyon Lower), before restoration (McCoy Lower #1 and #2), and restored reaches (McCoy Lower Restored and McCoy Restored). While temperatures increased in the McCoy Lower #1 and #2 reaches prior to restoration, temperatures decreased over time in the restored reaches. There was no apparent trend in inferred temperature at the Dark Canyon control site.

In summary – Macroinvertebrate assemblages changed at all sites between seasons. Summer and fall data consistently discriminated between reference sites and all other sites, while spring data did not discriminate well between sites. Predictive model scores corresponded to land use related impairment, with higher scores occurring at sites with less impairment. Dark Canyon Creek scored higher than expected, given the degraded habitat. Following restoration, macroinvertebrate taxa richness increased, macroinvertebrate inferred sediment increased, and macroinvertebrate inferred temperature decreased in McCoy creek. The macroinvertebrate assemblage was changing over the initial 3–5 years of colonization in

the McCoy Restored reach. Increased inferred sediment following restoration can be considered to be a positive result in a sediment poor system. Macroinvertebrate inferred temperature decreased (improved) overall in the Lower Restored Reach and over time in the Restored reach.

Fish

Fish assemblages integrate physical and chemical habitat conditions, and are used to evaluate water resources in the Pacific Northwest (Zaroban *et al*., 1999). Fish assemblages are useful in evaluating biotic integrity defined as the ability of an aquatic ecosystem to support a balanced community of organisms having a species composition comparable to that of natural habitats within the region (Karr and Dudly, 1981). Fish assemblages accurately integrate hydrology, water quality, biological interactions, physical habitat structure, and energy resources and are useful for evaluating the effects of human activity on particular sites or across entire regions (Karr, 1981). Chinook salmon and steelhead trout are the native fish species the that restoration efforts were designed to benefit.

Zaroban *et al*. (1999) developed a set of species attributes for Pacific Northwest fishes believed to be "responsive to or indicative of human disturbance". Fish species were classified by origin, pollution tolerance, adult habitat, adult feeding, and water temperature preference. Ten fish taxa were identified and quantified during the study period. The taxa identified along with classifications of origin, pollution tolerance, and water temperature preferences are listed in Table 5.

Table 5. Classification of fish observed at the Grande Ronde NMP sites 1994 through 2005 (classification attributes from Zaroban *et al*., 1999).

Family *Genus species*	Common Name	Origin	Pollution Tolerance	Temperature Preference
Catostomidae				
Catostomus spp.	Sucker	Native	Intermediate, tolerant	Cool
Centrarchidae				
Lepomis spp.	Sunfish	Alien	Tolerant	Warm
Cottidae				
Cottus spp.	Sculpin	Native	Intermediate, sensitive	Cool,cold
Cyprinidae				
Rhinicthys spp.	Dace	Native	Intermediate	Cool

Richardsonius baleatus	Redside shiner	Native	Intermediate	Cool
Ptychocheilus oregonesis	Northern pikeminnow	Native	Tolerant	Cool
Ictaluridae				
Ictaluris spp.	Bullhead	Alien	Tolerant	Warm
Salmonidae				
Salvelinus fontinalis	Brooktrout	Alien	Intermediate	Cold
Onchorhynchus mykiss	Rainbow trout	Native	Sensitive	Cold
Onchorhynchus tshawytscha	Chinook salmon	Native	Sensitive	Cold

The species attributes given in Table 5 reflect species preferences to stream conditions and possible responses to human disturbance, and are useful in interpreting the fish survey results. Native taxa are those species believed to have been present prior to European settlement. Alien taxa are those species that have been introduced through human intervention. Sensitive species are greatly reduced or disappear in association with disturbance, such as increased water temperature, increased turbidity and siltation, and reduced concentrations of dissolved oxygen. Tolerant species can survive increased water temperature, turbidity and siltation, and decreased dissolved oxygen and in fact often increase in abundance with disturbance. Intermediate species are neither tolerant nor sensitive to disturbance, but are typically replaced by tolerant species in situations of increasing disturbance. Intermediate species may be useful indicators of moderate disturbance to high quality waters or to disturbance that is mostly associated with alteration of physical habitat. The temperature classifications (warm water, cool water, and cold water) were determined by Zaroban *et al*. (1999) using species ranges, spawning seasons, spawning temperatures, and physiological optima.

For the purpose of analysis and comparison of results based on tolerance classifications, sculpin numbers were not used because identification was at the genus level, and some species of sculpin are classified as sensitive, while other sculpin species are classified as intermediate. Other than sculpin, the only sensitive taxa observed were juvenile steelhead trout or resident rainbow trout, and one juvenile chinook salmon, which was observed in 1994 in Lookout Creek. A comparison of fish assemblages by study reach, based on pollution tolerance classifications, is shown in figure 33.

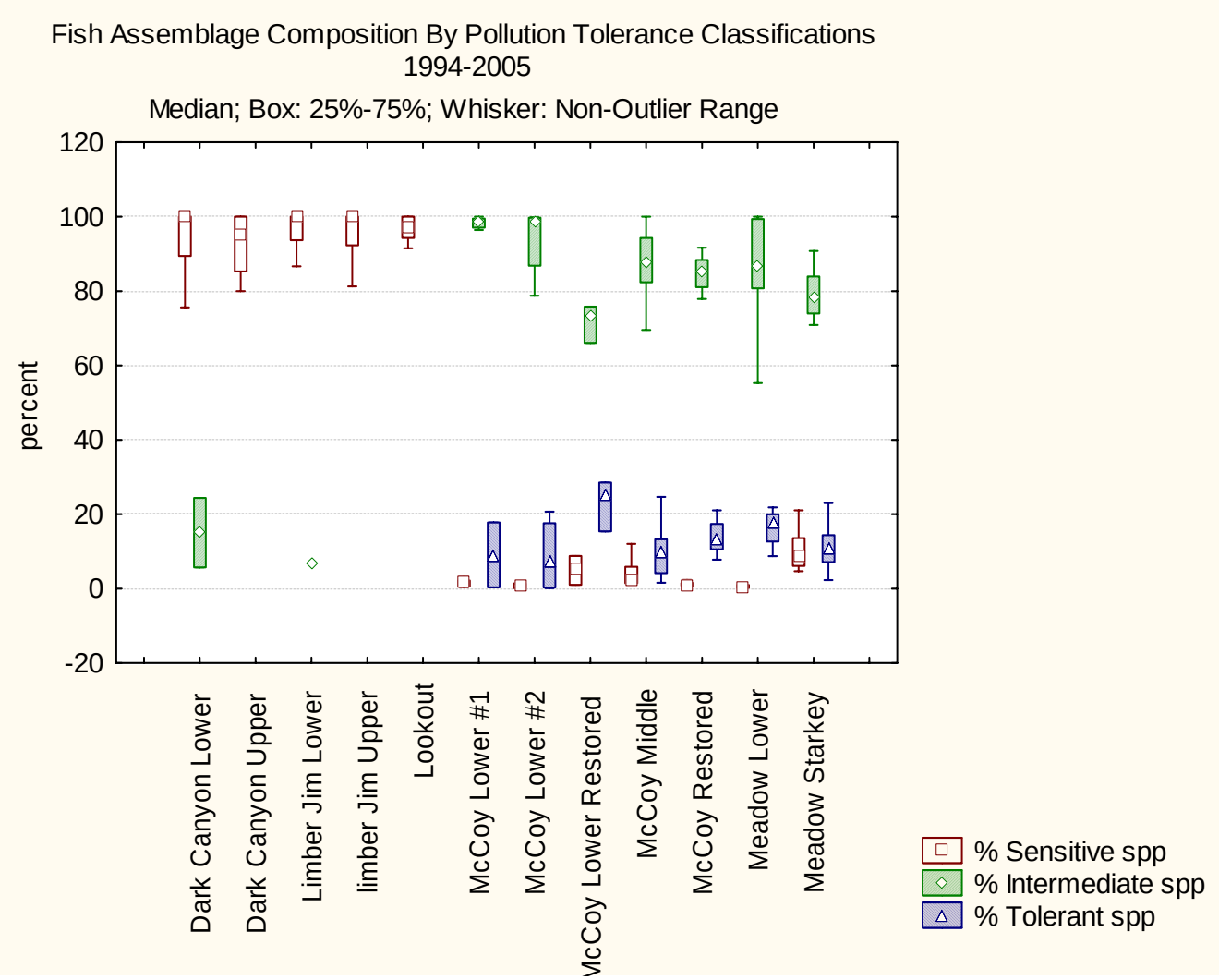

Figure 33. Fish assemblage composition at study reaches based on pollution tolerance classifications.

The reference reaches and Dark Canyon reaches were populated almost entirely by sensitive rainbow trout or juvenile steelhead trout. Whether the rainbows were resident or juvenile steelhead is unknown. The assemblages in the Meadow Creek and McCoy Creek reaches were dominated by intermediate species, and populated to a lesser extent by tolerant taxa and low percentages of trout. This pattern is similar to the patterns seen in the chemistry, temperature, macroinvertebrate, and habitat results; with the exception of Dark Canyon Creek, clear discrimination was seen relative to land use and management. Sensitive fish species were associated with less disturbed habitat, while intermediate and tolerant species dominated more disturbed habitats.

Abundance and species composition varied widely among sites and were strongly associated with a gradient of maximum water temperature and to a lesser extent with habitat quality. (Whitney and Hafele, 2006). These values are summarized in Table 6.

Table 6. Mean Values for Seasonal Maximum Temperature, Habitat Score, Fish Abundance, and Fish Species Composition by Site, 1994 – 1999. Sites are listed in descending order based on water temperature (from Whitney and Hafele 2006).

SITE	Temperature 7- day max. (C) *	Habitat Score (%) **	Abundance (fish/mile)	Sensitive Species (%) ***	Intermediate Species (%) ***	Tolerant Species (%) ***
Limber Jim Upper	15.9	79.0	288	96.3	0.0	0.0
Lookout	18.3	80.0	1218	96.7	0.0	0.0
Limber Jim Lower	19.4	63.5	865	94.7	0.6	0.0
Dark Canyon Lower	20.4	53.4	393	83.8	3.3	0.0
Dark Canyon Upper	22.0	54.7	765	92.6	0.0	0.0
Meadow Starkey	25.1	58.7	5670	10.8	77.6	11.1
McCoy Lower #2	26.4	54.8	7637	0.6	93.6	5.8
McCoy Middle	26.7	59.3	6291	3.5	87.6	8.7
McCoy Restored	27.1	59.6	5614	1.2	84.9	13.9
Meadow Lower	27.7	47.9	10974	0.5	87.2	12.1
McCoy Lower Restored	28.1	59.4	5242	5.1	71.8	23.0
McCoy Lower #1	28.2	54.9	4728	1.4	96.3	2.3

* seven day moving average of the daily maximum temperature using continuous temperature recorders
** scores based on modified EPA Rapid Bioassesment Protocols expressed as % possible total score
*** percent of all taxa observed. Species composition was calculated from total abundance. However, Cottidae species were not classified for tolerance, thus the sum of composition is less than 100 %.

The sites dominated by sensitive salmonids were located in the Limber Jim Creek and Lookout Creek sub-basins, where water temperatures were cool and habitat quality was high. The sites dominated by intermediate and tolerant taxa were in McCoy Creek and Meadow Creek sub-basins where habitat quality was reduced and water temperatures were warmer. Greater fish abundance was observed at these more disturbed sites where production was boosted by warmer temperatures and increased nutrient input, and conditions favored the success of more tolerant species. The one exception to this pattern is seen in the results from Dark Canyon Creek where riparian and channel conditions were degraded, but water temperatures remained cool during the summer season due primarily to ground water inflow (Whitney, 2000). Although habitat quality was poor, this site was populated primarily by sensitive salmonids. This points to the importance of water temperature as it affects fish assemblage composition. The abundance of fish in Dark Canyon, however, was low.

Analysis of environmental variables associated with fish assemblage compositions at Grande Ronde NMP sites has shown water temperature to be the most significant explanatory variable (Drake, 1999). Correlation analysis of fifty environmental variables indicated channel and riparian characteristics related to disturbance and elevated stream temperatures, such as width, depth, and shade, as well as water quality variables indicative of disturbance, particularly the nitrogen:phosphorous ratio (total inorganic nitrogen:ortho phosphate) were also related to fish species composition. Water temperature, expressed as the 7-day moving average seasonal maximum temperature, correlated most strongly with the composition of fish assemblages. This relationship of water temperature and species composition is illustrated in Figure 34.

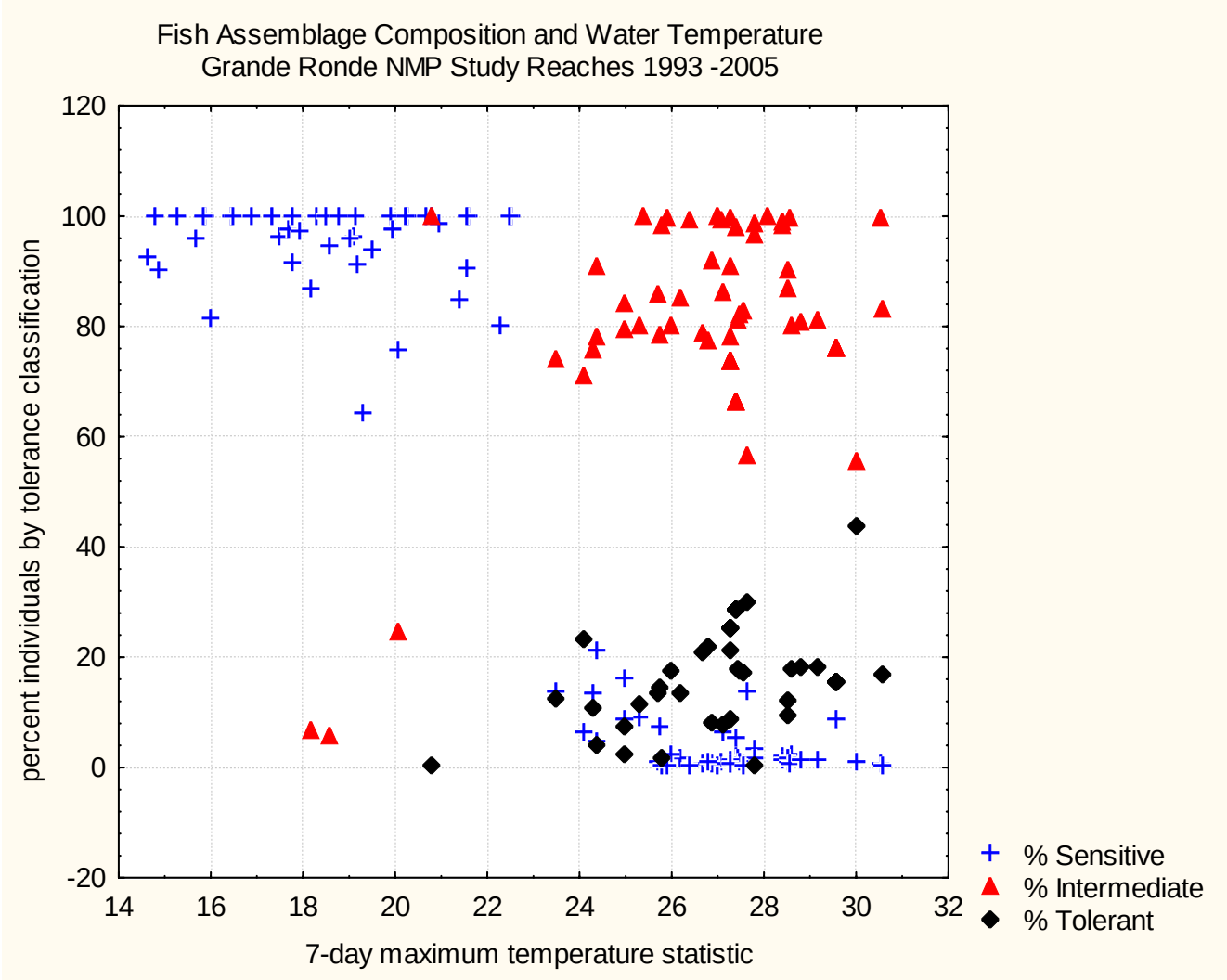

Figure 34. Fish assemblage composition relative to water temperature. Fish surveys were timed to take place during the week of typical seasonal maximum temperatures.

Water temperature influences the metabolism, behavior, reproduction, and survival of fish. The sensitive species represented in Figure 23, juvenile rainbow trout, are coldwater fish with definite temperature requirements (Huff *et al*., 2005). Experimental data show temperatures exceeding 23 – 25 ^{o}C are life threatening to most salmonids. (Bjorn and Reiser,1991). Sub-lethal effects of elevated stream temperatures on juvenile rearing salmonids include increased incidence of disease, reduced growth rate, increased competition for limited habitat and food, and reduced ability to compete with other species that are better adapted to higher temperatures.

Results from the Grande Ronde snorkel surveys agree with experimental temperature limits. Figure 34 shows salmonids dominated the fish assemblages at sites with average 7 day maximum temperatures below 23° C. At sites with average 7 day maximum temperatures exceeding 23° C, salmonid numbers were dramatically reduced.

Salmonids respond to temperature patterns by moving up stream or down stream when water temperature becomes unsuitable (Bjorn and Reiser,1991). This behavior was evident in the distribution of trout during the snorkel surveys, which were conducted during seasonal maximum temperature conditions. At the cooler study sites, particularly Limber Jim Creek and Lookout Creek where temperatures did not exceed 20° C, trout distribution was relatively even throughout the study reaches, with fish holding in areas where cover was provided by habitat attributes such as undercut banks, boulders, broken water, pools, large wood, and overhanging vegetation. At sites where maximum temperatures approached or exceeded thermal limits (24° C – 30° C) trout were observed only in small areas where water temperatures were cooler due to ground water inflow or thermal stratification in pools. This was particularly evident at the Meadow Creek and McCoy Creek sites. In McCoy Creek, where temperatures have exceeded 28° C, pockets of thermal refugia (isolated areas where conditions permit fish to escape harmful temperature and survive) were measured to be as much as 4 degrees C cooler than the surrounding ambient stream temperature. Overall fish abundance increased in the McCoy Creek Restored and Lower Restored reaches, and, although pollution tolerant and intermediate species continued to dominate the fish assemblages, before and after channel restoration comparisons show an overall increase in the number of trout in the restored sections (Figure 35).

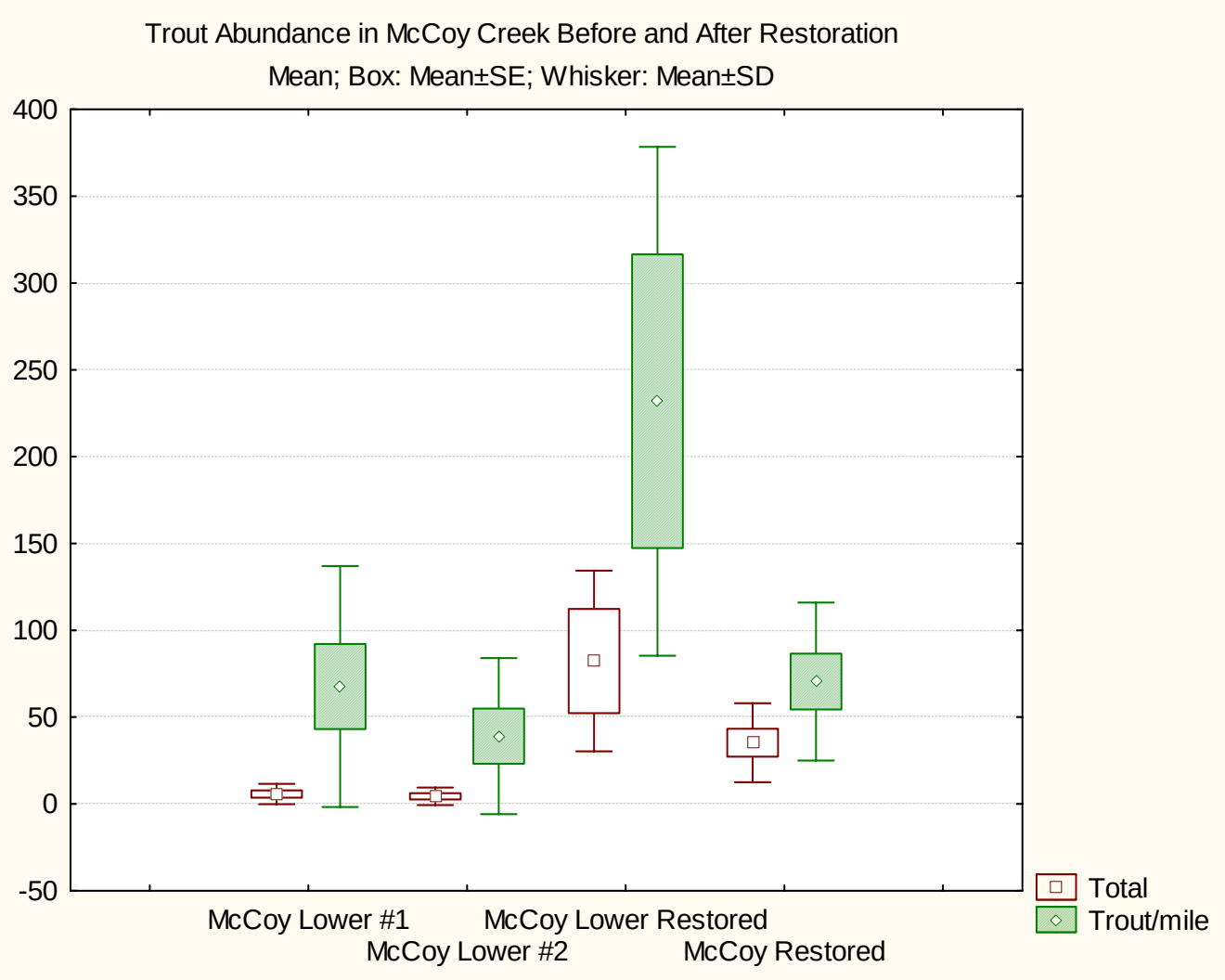

Figure 35. Mean number of trout (total number of trout and trout /mile) in McCoy Creek reaches over combined years before and after restoration.

In the combined year comparison shown in Figure 34, total trout numbers increased in both restored reaches when compared to the Lower #1 and #2 reaches. Trout per mile increased significantly in the Lower restored reach, while trout per mile numbers in the restored reach were similar to McCoy Lower #1 and greater than McCoy Lower #2.

The number of trout counted each year in all of the McCoy Creek reaches are shown in Figure 36.

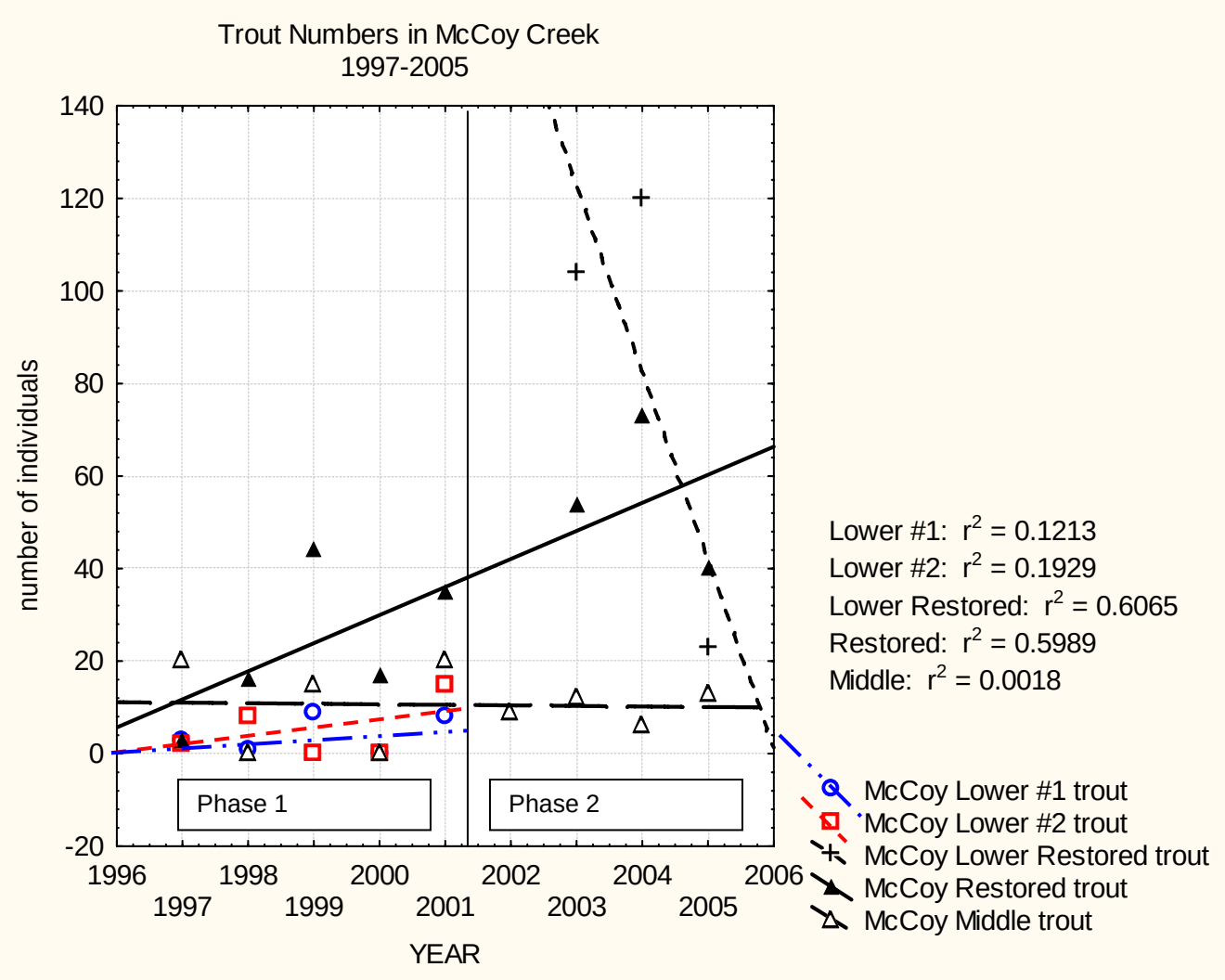

Figure 36. Trout counted in McCoy Creek following the Phase 1 and phase 2 restoration.

Data show trout numbers increased progressively over a nine year period in the Restored reach, while only a slight apparent increase was seen in the Lower #1 and #2 reaches from 1997 - 2001, and no trend was evident in the McCoy Middle reach over the 9 year period. A negative trend was seen over three years in the Lower Restored reach, where trout numbers were initially high in 2003 and 2004, but were low in 2005.

In summary – Fish species composition based on pollution tolerance classifications clearly discriminated study sites relative to land use practices. With the exception of Dark Canyon Creek, sensitive species were associated with less disturbed habitat, while intermediate species were associated with more disturbed habitat. Dark Canyon Creek had poor habitat but cool water due to extensive ground water influx. Water temperature is the best explanatory

variable relative to species composition. Where 7-day maximum temperatures were greater than 23° C, fish assemblages were dominated by intermediate and tolerant taxa, and pockets of temperature refugia became critical to the survival of sensitive salmonids. Although tolerant and intermediate taxa continued to dominate McCoy Creek following restoration, the number of trout in the phase -1 restored section increased progressively following restoration. Improved pool habitat and ground water influx provided important temperature refugia for summer rearing trout in the restored sections of McCoy Creek.

Summary and Conclusions

Results showed a clear response in stream conditions relative to land use practices and an overall improvement in McCoy Creek as a result of the channel restoration efforts.

Sites with minimal land use were associated with higher quality habitat, and were characterized by narrower, deeper channels with more shade, cooler water temperatures, and better water quality when compared to sites with histories of land use such as livestock grazing and channelization. Macroinvertebrate assemblages at the sites with minimal use compared more closely to regional reference site expectations, and these sites were populated primarily by rainbow trout, while sites with heavier use were populated by more tolerant fish species.

Fish results from Dark Canyon Creek, where habitat was poor but water temperature was cool due to extensive cool ground water influx, demonstrated the importance of water temperature as it affected fish species composition. Results from all sites showed that numbers of rainbow trout declined sharply when yearly seven day average water temperatures exceeded 23° C, and that areas of cool water refuge became important for trout survival as temperatures increased.

Although there was an apparent gradual improvement in McCoy Creek after livestock fencing was in place, the healing process was slow. Habitat quality remained poor. The channel remained simplified, shallow and wide, with little riparian vegetation providing cover and shade. Water temperatures were high, and little cool water refuge was available for trout survival. However, following the 1997 phase 1 and the 2002 phase 2 channel restoration efforts,

improvements were clearly achieved. Water quality improved following restoration. Habitat was clearly improved; the narrower, deeper channel and elevated water table renewed wet meadow functionality and created more areas of complex habitat and cool water refuge for fish and other aquatic life.

While chemistry and habitat results clearly showed improvement in McCoy Creek following restoration, temperature, macroinvertebrate, and fish results were more ambiguous. Reach scale temperature data from well mixed water column measurements did not show overall improvement in the combined years following restoration; however, sub-reach scale profiles showed improvement in cool water habitat associated with pools and ground water influx. Additionally, temperature decreased over time in the phase 1 restored reach, while temperatures increased in non restored reaches and in the study control reach during the same time period. The macroinvertbrate response to restoration was an increase in abundance and taxa richness; however, the assemblage was changing or adjusting over the initial 3 to 5 years following restoration, so it was difficult to determine if the response was simply due to colonization of new habitat or an indication of improvement. Fish assemblage composition did not change notably in McCoy Creek following restoration; however, the number of trout in the phase 1 restored section increased progressively over time.

Results from this study suggest the following conclusions:

- Livestock exclusion by itself may not result in improved habitat and recovery of sensitive aquatic life.
- Restoration of meandering wet meadow channels can improve habitat and benefit sensitive aquatic life in a relatively short time frame (2-5 years).
- Water temperature and areas of temperature refuge can be critical to the survival of salmonids through summer rearing periods.
- Improvements may not be detected using reach scale water column temperature measurements. Smaller scale quantification of thermal refugia may be more appropriate.
- Macroinvertebrate assemblages responded to habitat and water quality conditions and showed improving trends following restoration. Due to initial colonization of new habitat, however, macroinvertebrates may require 2-5 years to establish a stable assemblage.

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Appendices

Appendix A. Site Photographs

Dark Canyon Lower. July 2004.

Limber Jim Upper. July 2004.

Limber Jim Lower. July 2004

Lookout. July 2004.

McCoy Lower #1. July 2000

McCoy Lower Restored. July 2004.

McCoy Restored. July 2004.

McCoy Middle. July 2004

Meadow Creek Lower Reach. July 2004

Meadow Starkey. July 2004.

Appendix B. Site Metadata

Grande Ronde NMP study site metadata

Site Description	Latitude degrees	Longitude degrees	Elevation (ft)	River Mile	Hydrologic Unit Code
Dark Canyon Creek Lower (Transect 1)	45.275	-118.3828	3350	0.40	170601040205
Dark Canyon Creek Lower (Transect 6)	45.278	-118.382	3354	0.47	170601040205
Dark Canyon Creek Upper (Transect 1)	45.3139	-118.4031	3550	3.00	170601040205
Dark Canyon Creek Upper (Transect 6)	45.3147	-118.4037	3555	3.07	170601040205
Limber Jim Creek Lower (Transect 1)	45.1026	-118.3307	4300	1.02	170601040102
Limber Jim Creek Lower (Transect 2)	45.1029	118.3309			170601040102
Limber Jim Creek Lower (Transect 3)	45.1032	118.3309			170601040102
Limber Jim Creek Lower (Transect 4)	45.1034	118.3310			170601040102
Limber Jim Creek Lower (Transect 5)	45.1081	118.3304			170601040102
Limber Jim Creek Lower (Transect 6)	45.1037	-118.3305	4424	1.26	170601040102
Limber Jim Creek Upper (Transect 1)	45.1072	-118.2939	4650	3.20	170601040102
Limber Jim Creek Upper (Transect 2)	45.1077	118.2937			170601040102
Limber Jim Creek Upper (Transect 3)	45.1078	118.2936			170601040102
Limber Jim Creek Upper (Transect 4)	45.1079	118.2934			170601040102
Limber Jim Creek Upper (Transect 5)	45.1081	188.2934			170601040102
Limber Jim Creek Upper (Transect 6)	45.1083	-118.2932	4655	3.26	170601040102
Lookout Creek (Transect 1)	45.0909	-188.5333	4700	3.00	170601040106
Lookout Creek (Transect 2)	45.0908	118.5332			170601040106
Lookout Creek (Transect 3)	45.0908	118.5333			170601040106
Lookout Creek (Transect 4)	45.0905	118.5334			170601040106
Lookout Creek (Transect 5)	45.0906	118.5335			170601040106
Lookout Creek (Transect 6)	45.0906	-118.5338	4710	3.07	170601040106
McCoy Creek Lower #1 (Transect 1)	45.2624	-118.4025	3378	0.12	170601040204
McCoy Creek Lower Restored (Transect 1)	45.2634	-118.4011	3372	0.09	170601040204

Site Description	Latitude degrees	Longitude degrees	Elevation (ft)	River Mile	Hydrologic Unit Code
McCoy Creek Lower Restored (Transect 2)	45.2635	118.4018			170601040204
McCoy Creek Lower Restored (Transect 3)	45.2637	118.4019			170601040204
McCoy Creek Lower Restored (Transect 4)	45.2638	118.4012			170601040204
McCoy Creek Lower Restored (Transect 5)	45.2642	118.4026			170601040204
McCoy Creek Lower Restored (Transect 6)	45.2625	-118.4029	3380	0.20	170601040204
McCoy Creek Lower #2 (Transect 1)	45.2627	-118.4043	3380	0.30	170601040204
McCoy Creek Lower #2 (Transect 6)	45.263	-118.4065	3385	0.41	170601040204
McCoy Creek Middle (Transect 1)	45.2699	-118.4292	3550	2.00	170601040204
McCoy Creek Middle (Transect 2)	45.2698	118.4295			170601040204
McCoy Creek Middle (Transect 3)	45.2702	118.4299			170601040204
McCoy Creek Middle (Transect 4)	45.2701	118.4300			170601040204
McCoy Creek Middle (Transect 5)	45.2703	118.4302			170601040204
McCoy Creek Middle (Transect 6)	45.2701	-118.4298	3555	2.08	170601040204
McCoy Creek Restored (Transect 1)	45.2665	-118.4178	3440	0.95	170601040204
McCoy Creek Restored (Transect 2)	45.2671	118.4179			170601040204
McCoy Creek Restored (Transect 3)	45.2688	-118.4193	3460	1.20	170601040204
McCoy Creek Restored (above Transect 3)	45.2691	-118.4212	3470	1.25	170601040204
McCoy Creek Restored (Transect 4)	45.2691	118.4204			170601040204
McCoy Creek Restored (Transect 5)	45.2689	118.4225			170601040204
McCoy Creek Restored (Transect 6)	45.2693	-118.4232	3480	1.45	170601040204

Site Description	Latitude degrees	Longitude degrees	Elevation (ft)	River Mile	Hydrologic Unit Code
McCoy Creek Upper (Transect 1)	45.3394	118.5461	3750	9.50	170601040203
Meadow Creek Lower (Transect 1)	45.2608	118.4019	3380	2.30	170601040206
Meadow Creek Lower (Transect 2)	45.2608	118.4015			170601040206
Meadow Creek Lower (Transect 3)	45.2604	118.4015			170601040206
Meadow Creek Lower (Transect 4)	45.2603	118.4019			170601040206
Meadow Creek Lower (Transect 5)	45.2601	118.4023			170601040206
Meadow Creek Lower (Transect 6)	45.2597	-118.4026	3389	2.41	170601040206
Meadow Creek Starkey (Transect 1)	45.2699	-118.5295	3770	12.0	170601040202
Meadow Creek Starkey (Transect 2)	45.2702	118.5303			170601040202
Meadow Creek Starkey (Transect 3)	45.2704	118.5305			170601040202
Meadow Creek Starkey (Transect 4)	45.2709	118.5317			170601040202
Meadow Creek Starkey (Transect 5)	45.2717	118.5320			170601040202
Meadow Creek Starkey (Transect 6)	45.2709	-118.5321	3780	12.1	170601040202

Appendix C. DEQ Technical Reports

http://www.deq.state.or.us/lab/techrpts/bioreports.htm

Grande Ronde National Monitoring Program Project Temperature Monitoring Summary Report 1993 - 1998

Bio2000-01 **PDF 1.1mb**

Elevated stream temperatures have been identified as an important factor affecting declining salmon and steelhead populations in the Grande Ronde River watershed, located in the Blue Mountain ecoregion of northeast Oregon. This report summarizes water temperature data collected by DEQ biomonitoring staff at eleven study sites located in the Upper Grande Ronde watershed. Environmental variables related to stream temperature and the effect of stream channel restoration on water temperature are discussed.

Grande Ronde Section 319 National Monitoring Program Project Fish Survey Report 1994-1999

Bio2000-06 **PDF**

This report summarizes methods and results of fish surveys conducted by DEQ biomonitoring staff at Grande Ronde NMP sites from 1994 through 1999. The sites are located on wadeable streams in five sub-basins of the Upper Grande Ronde River in northeast Oregon. Fish taxa observed are listed and quantified. The relationship between site conditions and fish assemblages and the affect of channel restoration on species composition are discussed.

Analysis of Macroinvertebrate Data from the Grande Ronde Long Term 319 NPS Project 1993-1996

Bio-006 **PDF**

This report examines macroinvertebrate data collected from the period 1993 to 1996. It is hoped that these initial four years of data collection will satisfy three objectives:

> establish the prevailing biological integrity of each of the study sites;
> examine the effect of seasonal variation on macroinvertebrate data; and
> determine the range in "natural" variability at reference sites

Multivariate Analysis of Fish and Environmental Factors in the Grande Ronde Basin of Northeastern Oregon

Bio-012 **PDF**

The report assesses the fish data and habitat data collected from ten tributaries in the Upper Grande Ronde basin from 1993 to 1998. The analysis used a multivariate approach to determine habitat and water chemistry variables that have significant effects on fish communities

Appendix D. Water Quality Index Scores

All water chemistry results are available as stored in the DEQ Laboratory Analysis Storage and Retrieval (LASAR) database. These data were summarized using water quality index scores and sub-index scores for key parameters. The sub-index and index scores are listed in this appendix.

Water quality index scores (WQI), including sub-index scores. * indicates data were incomplete or not available for index calculations. Data are listed by site in alphabetical order, then by year from 1993 through 2005.

Site Description	Survey Date	Temp. Score	DO Score	BOD-5 Score	pH Score	Total Solids Score	Nitrogen Score	Total P Score	WQI Score
Dark Canyon Creek Lower	6/22/93	99.9	96.2	85.3	100.0	100.0	99.1	85.0	94.0
Dark Canyon Creek Lower	9/28/93	100.0	97.6	100.0	100.0	100.0	98.2	91.0	98.0
Dark Canyon Creek Lower	4/4/94	100.0	96.5	100.0	100.0	100.0	97.7	73.0	94.0
Dark Canyon Creek Lower	4/4/94	100.0	90.9	100.0	100.0	100.0	95.9	70.0	92.0
Dark Canyon Creek Lower	7/18/94	72.5	83.6	94.2	66.0	100.0	98.6	88.0	83.0
Dark Canyon Creek Lower	9/19/94	94.6	98.8	100.0	100.0	100.0	98.2	91.0	97.0
Dark Canyon Creek Lower	7/24/95	84.4	86.0	100.0	100.0	100.0	97.3	88.0	93.0
Dark Canyon Creek Lower	9/26/95	96.7	91.8	96.1	94.9	98.6	97.7	91.0	95.0
Dark Canyon Creek Lower	4/22/96	100.0	100.0	99.0	85.6	100.0	98.2	82.0	94.0
Dark Canyon Creek Lower	7/22/96	78.6	84.1	99.0	100.0	100.0	98.2	88.0	91.0
Dark Canyon Creek Lower	9/24/96	99.8	81.1	99.0	100.0	100.0	97.7	88.0	94.0
Dark Canyon Creek Lower	5/1/97	100.0	100.0	96.1	100.0	100.0	98.6	82.0	96.0
Dark Canyon Creek Lower	7/30/97	84.0	76.6	98.0	100.0	100.0	96.4	88.0	91.0
Dark Canyon Creek Lower	9/24/97	98.7	83.2	98.0	100.0	100.0	98.2	91.0	95.0
Dark Canyon Creek Lower	4/22/98	100.0	99.8	88.7	100.0	100.0	98.2	79.0	94.0
Dark Canyon Creek Lower	7/20/98	77.7	77.8	100.0	100.0	100.0	97.7	85.0	89.0
Dark Canyon Creek Lower	10/8/98	100.0	86.6	100.0	81.3	100.0	99.1	94.0	94.0
Dark Canyon Creek Lower	4/26/99	100.0	100.0	88.7	85.7	100.0	99.4	85.0	93.0
Dark Canyon Creek Lower	7/19/99	93.3	83.2	99.0	100.0	100.0	97.8	91.0	94.0
Dark Canyon Creek Lower	9/27/99	100.0	89.5	99.0	100.0	100.0	97.7	88.0	96.0
Dark Canyon Creek Lower	5/4/00	100.0	99.8	90.5	100.0	100.0	99.0	85.0	96.0
Dark Canyon Creek Lower	7/20/00	94.6	93.2	99.0	100.0	100.0	99.1	94.0	97.0
Dark Canyon Creek Lower	9/26/00	99.3	92.5	67.1	100.0	100.0	98.4	85.0	89.0
Dark Canyon Creek Lower	5/1/01	100.0	100.0	87.0	100.0	100.0	99.4	82.0	95.0
Dark Canyon Creek Lower	7/17/01	89.2	70.4	96.1	100.0	98.6	97.1	91.0	90.0
Dark Canyon Creek Lower	9/19/01	96.8	89.5	78.7	90.1	97.1	97.9	91.0	91.0
Dark Canyon Creek Lower	7/16/02	65.5	*	96.1	100.0	100.0	*	88.0	*
Dark Canyon Creek Lower	9/24/02	99.0	*	83.6	100.0	98.6	*	79.0	*
Dark Canyon Creek Lower	7/15/03	75.6	*	99.0	100.0	100.0	*	91.0	*
Dark Canyon Creek Lower	9/23/03	99.7	*	100.0	85.6	100.0	*	88.0	*
Dark Canyon Creek Upper	6/22/93	100.0	98.0	78.7	100.0	100.0	99.1	85.0	93.0
Dark Canyon Creek Upper	9/28/93	90.5	83.6	77.2	100.0	100.0	98.6	82.0	89.0

Site Description	Survey Date	Temp. Score	DO Score	BOD-5 Score	pH Score	Total Solids Score	Nitrogen Score	Total P Score	WQI Score
Dark Canyon Creek Upper	7/18/94	83.1	95.3	87.0	100.0	100.0	99.5	85.0	92.0
Dark Canyon Creek Upper	9/19/94	96.5	86.9	35.5	100.0	100.0	94.6	88.0	69.0
Dark Canyon Creek Upper	7/24/95	83.1	83.2	72.7	100.0	100.0	99.5	85.0	87.0
Dark Canyon Creek Upper	4/23/96	100.0	100.0	99.0	100.0	100.0	99.1	76.0	95.0
Dark Canyon Creek Upper	7/22/96	95.7	87.7	98.0	100.0	100.0	99.5	82.0	94.0
Dark Canyon Creek Upper	9/24/96	100.0	83.6	72.7	100.0	100.0	99.5	85.0	90.0
Dark Canyon Creek Upper	5/1/97	100.0	100.0	94.2	100.0	100.0	99.5	85.0	96.0
Dark Canyon Creek Upper	7/30/97	82.7	92.0	98.0	100.0	100.0	98.6	79.0	92.0
Dark Canyon Creek Upper	9/24/97	95.0	97.6	75.7	100.0	100.0	95.1	82.0	91.0
Dark Canyon Creek Upper	4/22/98	100.0	99.8	92.3	100.0	100.0	99.5	82.0	96.0
Limber Jim Creek Lower	9/30/93	100.0	96.5	90.5	94.9	100.0	98.6	85.0	95.0
Limber Jim Creek Lower	4/4/94	100.0	95.3	100.0	100.0	94.3	98.2	64.1	90.0
Limber Jim Creek Lower	7/19/94	85.2	84.1	94.2	100.0	100.0	99.1	85.0	92.0
Limber Jim Creek Lower	9/19/94	100.0	95.3	94.2	100.0	100.0	99.1	88.0	96.0
Limber Jim Creek Lower	4/19/95	100.0	89.8	83.6	100.0	98.6	98.6	73.0	90.0
Limber Jim Creek Lower	9/27/95	100.0	94.2	92.3	85.6	100.0	98.6	88.0	94.0
Limber Jim Creek Lower	4/23/96	100.0	100.0	90.5	100.0	100.0	98.2	79.0	94.0
Limber Jim Creek Lower	7/22/96	83.1	95.3	99.0	100.0	100.0	98.6	85.0	94.0
Limber Jim Creek Lower	7/23/96	90.5	97.6	99.0	69.5	100.0	98.6	85.0	89.0
Limber Jim Creek Lower	4/30/97	100.0	100.0	92.3	100.0	100.0	98.6	82.0	95.0
Limber Jim Creek Lower	4/30/97	100.0	100.0	92.3	100.0	100.0	98.6	100.0	99.0
Limber Jim Creek Lower	7/29/97	91.4	97.6	94.2	94.9	100.0	97.3	85.0	94.0
Limber Jim Creek Lower	9/24/97	100.0	98.8	98.0	90.1	100.0	99.1	91.0	96.0
Limber Jim Creek Lower	4/20/98	100.0	100.0	80.3	100.0	91.5	98.6	64.1	87.0
Limber Jim Creek Lower	7/22/98	95.0	97.6	87.0	100.0	100.0	99.1	85.0	94.0
Limber Jim Creek Lower	10/7/98	100.0	97.2	100.0	94.9	100.0	98.6	88.0	97.0
Limber Jim Creek Lower	4/28/99	100.0	100.0	83.6	100.0	100.0	99.4	79.0	93.0
Limber Jim Creek Lower	7/20/99	95.7	95.3	94.2	100.0	100.0	99.4	85.0	95.0
Limber Jim Creek Lower	9/28/99	100.0	96.5	88.7	100.0	100.0	99.3	88.0	96.0
Limber Jim Creek Lower	5/4/00	100.0	98.4	98.0	100.0	100.0	99.4	85.0	97.0
Limber Jim Creek Lower	7/19/00	99.4	94.2	87.0	100.0	100.0	99.4	85.0	94.0
Limber Jim Creek Lower	9/27/00	100.0	98.8	88.7	81.3	100.0	99.0	91.0	93.0
Limber Jim Creek Lower	5/2/01	100.0	100.0	87.0	100.0	100.0	98.1	79.0	94.0
Limber Jim Creek Lower	7/18/01	100.0	96.2	98.0	85.6	100.0	99.4	91.0	95.0
Limber Jim Creek Lower	9/19/01	99.7	97.6	88.7	90.1	100.0	99.0	88.0	94.0
Limber Jim Creek Lower	7/17/02	86.7	*	98.0	100.0	100.0	*	88.0	*
Limber Jim Creek Lower	9/25/02	100.0	*	94.2	94.9	100.0	*	88.0	*
Limber Jim Creek Lower	7/16/03	92.0	*	96.1	90.1	100.0	*	88.0	*
Limber Jim Creek Lower	9/24/03	100.0	*	81.9	94.9	100.0	*	88.0	*
Limber Jim Creek Lower	7/21/04	96.7	88.7	85.3	94.9	100.0	99.4	88.0	93.0
Limber Jim Creek Lower	9/22/04	100.0	97.6	90.5	85.6	100.0	99.4	88.0	94.0
Limber Jim Creek Lower	9/13/05	100.0	100.0	100.0	100.0	100.0	99.4	91.0	98.0
Limber Jim Creek Upper	9/30/93	100.0	100.0	64.5	100.0	100.0	97.7	88.0	89.0
Limber Jim Creek Upper	4/5/94	100.0	87.7	100.0	77.2	100.0	98.6	73.0	89.0
Limber Jim Creek Upper	7/19/94	99.9	85.1	96.1	100.0	100.0	98.6	88.0	95.0
Limber Jim Creek Upper	7/24/95	100.0	90.3	100.0	100.0	100.0	99.1	85.0	96.0
Limber Jim Creek Upper	9/27/95	100.0	98.8	96.1	85.6	100.0	99.1	88.0	95.0
Limber Jim Creek Upper	4/24/96	100.0	100.0	94.2	94.9	100.0	98.6	85.0	96.0

Site Description	Survey Date	Temp. Score	DO Score	BOD-5 Score	pH Score	Total Solids Score	Nitrogen Score	Total P Score	WQI Score
Limber Jim Creek Upper	7/23/96	99.3	93.2	99.0	100.0	100.0	98.2	88.0	97.0
Limber Jim Creek Upper	9/25/96	100.0	100.0	88.7	100.0	100.0	98.2	88.0	96.0
Limber Jim Creek Upper	4/30/97	100.0	100.0	96.1	100.0	100.0	98.6	88.0	97.0
Limber Jim Creek Upper	7/29/97	99.6	93.2	92.3	100.0	100.0	98.6	85.0	95.0
Limber Jim Creek Upper	9/24/97	100.0	96.7	98.0	100.0	100.0	98.2	88.0	97.0
Limber Jim Creek Upper	4/22/98	100.0	97.6	81.9	100.0	100.0	99.1	73.0	91.0
Limber Jim Creek Upper	7/22/98	95.5	87.8	98.0	100.0	94.3	99.1	85.0	94.0
Limber Jim Creek Upper	10/7/98	100.0	100.0	100.0	100.0	100.0	98.6	88.0	98.0
Limber Jim Creek Upper	4/28/99	100.0	100.0	78.7	100.0	100.0	99.4	82.0	93.0
Limber Jim Creek Upper	7/20/99	100.0	87.7	100.0	100.0	100.0	97.2	88.0	96.0
Limber Jim Creek Upper	9/28/99	100.0	96.5	92.3	100.0	100.0	99.4	88.0	96.0
Limber Jim Creek Upper	5/3/00	100.0	99.5	96.1	100.0	100.0	99.4	85.0	97.0
Limber Jim Creek Upper	7/19/00	99.3	93.2	99.0	100.0	100.0	99.4	85.0	96.0
Limber Jim Creek Upper	9/27/00	100.0	100.0	85.3	85.6	100.0	99.4	91.0	94.0
Limber Jim Creek Upper	5/2/01	100.0	100.0	80.3	100.0	100.0	99.0	82.0	93.0
Limber Jim Creek Upper	7/18/01	100.0	98.0	94.2	85.6	100.0	99.4	91.0	95.0
Limber Jim Creek Upper	9/19/01	100.0	98.8	90.5	94.9	100.0	98.1	88.0	95.0
Limber Jim Creek Upper	7/17/02	99.8	*	96.1	100.0	100.0	*	88.0	*
Limber Jim Creek Upper	9/25/02	100.0	*	88.7	100.0	100.0	*	88.0	*
Limber Jim Creek Upper	7/16/03	100.0	*	98.0	100.0	100.0	*	88.0	*
Limber Jim Creek Upper	9/24/03	100.0	*	87.0	100.0	100.0	*	88.0	*
Limber Jim Creek Upper	7/21/04	100.0	95.6	85.3	100.0	100.0	99.0	88.0	95.0
Limber Jim Creek Upper	9/22/04	100.0	92.0	94.2	94.9	100.0	99.4	88.0	95.0
Lookout Creek	9/29/93	100.0	95.6	92.3	100.0	100.0	97.7	91.0	96.0
Lookout Creek	4/5/94	100.0	90.9	100.0	94.9	100.0	90.8	88.0	95.0
Lookout Creek	7/20/94	97.5	93.1	85.3	100.0	100.0	98.6	91.0	95.0
Lookout Creek	9/19/94	99.9	86.9	94.2	100.0	100.0	98.6	91.0	95.0
Lookout Creek	7/24/95	99.1	97.6	100.0	100.0	100.0	97.7	91.0	98.0
Lookout Creek	9/26/95	99.9	96.5	62.0	100.0	100.0	99.1	94.0	89.0
Lookout Creek	4/23/96	100.0	100.0	92.3	100.0	100.0	85.9	79.0	93.0
Lookout Creek	7/22/96	97.5	84.6	78.7	100.0	100.0	98.6	94.0	92.0
Lookout Creek	9/24/96	100.0	98.4	94.2	85.6	100.0	98.6	91.0	95.0
Lookout Creek	4/29/97	100.0	100.0	98.0	100.0	100.0	89.1	91.0	97.0
Lookout Creek	4/29/97	100.0	100.0	98.0	100.0	100.0	89.1	100.0	98.0
Lookout Creek	7/29/97	97.8	87.8	85.3	100.0	100.0	97.7	79.0	91.0
Lookout Creek	9/23/97	100.0	95.0	98.0	100.0	100.0	99.1	91.0	97.0
Lookout Creek	4/22/98	100.0	97.6	80.3	100.0	100.0	88.3	82.0	91.0
Lookout Creek	7/23/98	99.0	89.5	87.0	100.0	100.0	97.7	91.0	94.0
Lookout Creek	10/7/98	100.0	90.3	100.0	100.0	100.0	98.6	94.0	97.0
Lookout Creek	7/20/99	93.3	90.9	94.2	100.0	100.0	98.1	91.0	95.0
Lookout Creek	9/28/99	100.0	94.4	98.0	100.0	100.0	99.3	91.0	97.0
Lookout Creek	5/3/00	100.0	99.5	88.7	100.0	100.0	93.3	88.0	95.0
Lookout Creek	7/19/00	91.4	78.9	99.0	100.0	100.0	99.1	88.0	93.0
Lookout Creek	9/27/00	100.0	89.5	78.7	81.3	100.0	99.4	88.0	90.0
Lookout Creek	5/1/01	100.0	100.0	92.3	100.0	100.0	94.6	91.0	97.0
Lookout Creek	7/18/01	98.9	86.0	98.0	100.0	100.0	99.4	91.0	96.0
Lookout Creek	9/19/01	99.8	92.5	87.0	100.0	100.0	98.5	94.0	96.0
Lookout Creek	7/17/02	88.1	*	98.0	100.0	100.0	*	91.0	*

Site Description	Survey Date	Temp. Score	DO Score	BOD-5 Score	pH Score	Total Solids Score	Nitrogen Score	Total P Score	WQI Score
Lookout Creek	9/25/02	100.0	*	92.3	100.0	100.0	*	94.0	*
Lookout Creek	7/16/03	88.1	*	88.7	100.0	100.0	*	91.0	*
Lookout Creek	9/24/03	100.0	*	88.7	100.0	100.0	*	88.0	*
Lookout Creek	7/22/04	100.0	87.8	96.1	100.0	100.0	99.4	91.0	96.0
Lookout Creek	9/22/04	100.0	89.5	88.7	100.0	100.0	99.0	91.0	95.0
McCoy Creek Lower #1	6/23/93	94.6	97.6	40.0	100.0	100.0	98.6	85.0	74.0
McCoy Creek Lower #1	9/27/93	93.3	82.6	65.8	81.3	100.0	94.2	85.0	84.0
McCoy Creek Lower #1	4/6/94	100.0	96.5	74.2	100.0	100.0	98.6	79.0	91.0
McCoy Creek Lower #1	7/18/94	91.1	88.7	94.2	100.0	100.0	98.6	94.0	95.0
McCoy Creek Lower #1	9/19/94	88.1	75.9	77.2	100.0	98.6	98.6	88.0	88.0
McCoy Creek Lower #1	9/25/95	93.3	71.5	75.7	73.3	98.6	99.1	85.0	83.0
McCoy Creek Lower #1	4/22/96	100.0	97.6	92.3	100.0	100.0	98.2	76.0	94.0
McCoy Creek Lower #1	7/24/96	10.0	86.6	99.0	73.3	100.0	97.7	91.0	26.0
McCoy Creek Lower #1	9/23/96	98.1	84.6	51.8	81.3	98.6	98.2	82.0	79.0
McCoy Creek Lower #1	4/28/97	100.0	98.0	68.5	100.0	98.6	98.6	82.0	90.0
McCoy Creek Lower #1	7/28/97	46.5	81.6	98.0	69.5	100.0	98.2	88.0	75.0
McCoy Creek Lower #1	9/22/97	76.2	81.6	83.6	69.5	100.0	97.7	88.0	83.0
McCoy Creek Lower #1	4/20/98	99.9	98.8	92.3	100.0	98.6	98.6	79.0	94.0
McCoy Creek Lower #1	7/21/98	36.6	80.6	100.0	81.3	100.0	98.6	88.0	69.0
McCoy Creek Lower #1	10/5/98	98.7	91.8	*	*	100.0	99.1	94.0	*
McCoy Creek Lower #1	4/27/99	100.0	100.0	88.7	100.0	100.0	99.4	82.0	95.0
McCoy Creek Lower #1	7/19/99	54.8	85.6	83.6	73.3	100.0	98.6	88.0	79.0
McCoy Creek Lower #1	9/27/99	96.7	82.6	96.1	77.2	100.0	99.4	91.0	91.0
McCoy Creek Lower #1	5/1/00	84.4	93.1	87.0	100.0	100.0	99.4	82.0	91.0
McCoy Creek Lower #1	5/1/00	84.4	93.1	87.0	100.0	100.0	99.4	82.0	91.0
McCoy Creek Lower #1	7/17/00	66.1	87.7	96.1	62.7	100.0	98.7	88.0	82.0
McCoy Creek Lower #1	9/25/00	93.3	94.2	96.1	100.0	100.0	98.5	91.0	96.0
McCoy Creek Lower #1	4/30/01	100.0	97.6	100.0	100.0	100.0	97.2	82.0	96.0
McCoy Creek Lower #1	7/16/01	83.1	80.6	83.6	81.3	98.6	98.7	91.0	87.0
McCoy Creek Lower #1	9/17/01	71.4	74.1	85.3	66.0	100.0	98.5	91.0	81.0
McCoy Creek Lower #2	6/23/93	94.6	97.6	40.0	100.0	100.0	98.6	85.0	74.0
McCoy Creek Lower #2	9/27/93	87.1	78.7	46.0	81.3	100.0	98.6	91.0	75.0
McCoy Creek Lower #2	4/6/94	100.0	96.5	75.7	100.0	100.0	97.3	79.0	91.0
McCoy Creek Lower #2	4/22/96	100.0	97.6	99.0	100.0	100.0	98.2	76.0	95.0
McCoy Creek Lower #2	7/24/96	10.0	86.6	99.0	73.3	100.0	97.7	91.0	26.0
McCoy Creek Lower #2	9/23/96	98.0	84.6	72.7	85.6	100.0	98.2	85.0	88.0
McCoy Creek Lower #2	7/19/99	62.9	81.6	98.0	73.3	100.0	98.7	88.0	83.0
McCoy Creek Lower #2	9/27/99	97.5	72.4	75.7	77.2	100.0	99.4	91.0	85.0
McCoy Creek Lower #2	5/1/00	84.4	95.3	94.2	100.0	100.0	99.4	82.0	93.0
McCoy Creek Lower #2	7/17/00	70.8	90.9	98.0	62.7	100.0	98.7	88.0	83.0
McCoy Creek Lower #2	9/25/00	91.7	85.6	69.9	100.0	100.0	98.3	91.0	89.0
McCoy Creek Lower #2	4/30/01	100.0	98.0	100.0	100.0	100.0	99.4	79.0	96.0
McCoy Creek Lower #2	7/16/01	80.5	79.7	87.0	90.1	100.0	99.2	88.0	88.0
McCoy Creek Lower #2	9/17/01	69.6	73.2	68.5	66.0	100.0	97.6	91.0	78.0
McCoy Creek Lower #1 Restored	9/23/02	84.4	*	85.3	85.6	100.0	*	88.0	*
McCoy Creek Lower #1 Restored	7/14/03	30.4	*	90.5	94.9	100.0	*	88.0	*
McCoy Creek Lower #1 Restored	9/22/03	78.1	*	100.0	69.5	100.0	*	88.0	*
McCoy Creek Lower #1 Restored	7/20/04	77.7	87.7	90.5	100.0	100.0	99.0	91.0	91.0

Site Description	Survey Date	Temp. Score	DO Score	BOD-5 Score	pH Score	Total Solids Score	Nitrogen Score	Total P Score	WQI Score
McCoy Creek Lower #1 Restored	9/21/04	99.6	97.6	85.3	94.9	100.0	99.9	91.0	95.0
McCoy Creek Lower #1 Restored	9/14/05	100.0	98.0	100.0	100.0	99.4	99.4	91.0	98.0
McCoy Creek Middle	6/23/93	100.0	96.7	36.9	94.9	100.0	98.2	88.0	71.0
McCoy Creek Middle	9/28/93	98.8	93.1	81.9	81.3	100.0	96.8	91.0	91.0
McCoy Creek Middle	4/4/94	100.0	95.3	100.0	100.0	100.0	98.6	70.0	93.0
McCoy Creek Middle	7/18/94	33.1	74.2	90.5	81.3	100.0	97.7	91.0	64.0
McCoy Creek Middle	9/19/94	100.0	85.1	100.0	100.0	100.0	97.3	94.0	96.0
McCoy Creek Middle	7/24/95	100.0	98.8	100.0	59.5	98.6	96.8	88.0	87.0
McCoy Creek Middle	9/26/95	95.7	69.0	83.6	81.3	98.6	99.1	94.0	87.0
McCoy Creek Middle	4/23/96	100.0	99.8	98.0	100.0	100.0	98.6	79.0	96.0
McCoy Creek Middle	7/23/96	88.8	92.0	94.2	94.9	98.6	96.8	94.0	94.0
McCoy Creek Middle	9/24/96	100.0	85.6	90.5	73.3	100.0	98.6	94.0	90.0
McCoy Creek Middle	4/29/97	100.0	98.4	94.2	100.0	98.6	99.1	82.0	95.0
McCoy Creek Middle	7/31/97	88.5	78.7	94.2	73.3	98.6	97.7	91.0	87.0
McCoy Creek Middle	9/23/97	92.8	90.3	92.3	77.2	100.0	98.6	91.0	91.0
McCoy Creek Middle	4/21/98	98.4	98.8	88.7	100.0	100.0	98.2	79.0	94.0
McCoy Creek Middle	7/21/98	35.7	71.7	100.0	77.2	98.6	97.7	88.0	67.0
McCoy Creek Middle	10/6/98	99.0	94.4	*	*	100.0	98.2	94.0	*
McCoy Creek Middle	4/27/99	100.0	99.5	87.0	100.0	100.0	99.4	82.0	95.0
McCoy Creek Middle	7/21/99	78.6	86.6	100.0	100.0	98.6	99.0	88.0	92.0
McCoy Creek Middle	9/27/99	100.0	94.2	98.0	90.1	100.0	99.2	91.0	96.0
McCoy Creek Middle	5/2/00	99.0	98.8	94.2	100.0	100.0	99.0	82.0	95.0
McCoy Creek Middle	7/18/00	53.3	81.1	99.0	53.7	100.0	99.0	91.0	74.0
McCoy Creek Middle	9/26/00	100.0	98.8	90.5	90.1	100.0	99.2	94.0	96.0
McCoy Creek Middle	5/1/01	100.0	100.0	100.0	100.0	100.0	99.4	82.0	97.0
McCoy Creek Middle	7/17/01	87.4	84.6	99.0	100.0	98.6	98.4	91.0	94.0
McCoy Creek Middle	9/18/01	99.0	89.8	85.3	81.3	98.6	99.0	94.0	92.0
McCoy Creek Middle	7/16/02	38.3	*	98.0	94.9	100.0	*	94.0	*
McCoy Creek Middle	9/24/02	99.5	*	87.0	85.6	100.0	*	94.0	*
McCoy Creek Middle	7/15/03	70.8	*	94.2	81.3	100.0	*	94.0	*
McCoy Creek Middle	9/23/03	99.0	*	*	90.1	100.0	*	94.0	*
McCoy Creek Middle	7/20/04	44.1	81.6	88.7	59.5	100.0	99.2	94.0	71.0
McCoy Creek Middle	9/21/04	99.8	99.8	90.5	73.3	100.0	99.4	97.0	93.0
McCoy Creek Middle	9/13/05	96.5	100.0	100.0	73.3	100.0	98.1	94.0	93.0
McCoy Creek Restored	9/25/97	100.0	93.2	96.1	100.0	100.0	99.1	88.0	96.0
McCoy Creek Restored	7/22/98	35.7	81.6	83.6	66.0	100.0	98.2	91.0	66.0
McCoy Creek Restored	10/6/98	98.9	90.9	*	*	100.0	99.1	94.0	*
McCoy Creek Restored	7/22/99	73.5	76.8	78.7	100.0	100.0	98.1	88.0	86.0
McCoy Creek Restored	9/29/99	99.8	77.8	90.5	85.6	100.0	99.4	91.0	91.0
McCoy Creek Restored	5/1/00	100.0	93.8	87.0	100.0	100.0	99.0	85.0	94.0
McCoy Creek Restored	7/19/00	55.5	86.6	96.1	59.5	100.0	99.2	91.0	77.0
McCoy Creek Restored	9/26/00	100.0	100.0	98.0	100.0	100.0	99.4	97.0	99.0
McCoy Creek Restored	5/1/01	100.0	100.0	100.0	100.0	100.0	99.4	82.0	97.0
McCoy Creek Restored	7/17/01	80.5	71.5	78.7	100.0	98.6	99.4	94.0	87.0
McCoy Creek Restored	9/18/01	97.0	89.8	88.7	85.6	98.6	99.2	94.0	93.0
McCoy Creek Restored	7/16/02	11.9	*	96.1	66.0	98.6	*	94.0	*
McCoy Creek Restored	9/24/02	100.0	*	94.2	94.9	100.0	*	94.0	*
McCoy Creek Restored	7/15/03	81.8	*	78.7	77.2	100.0	*	94.0	*

Site Description	Survey Date	Temp. Score	DO Score	BOD-5 Score	pH Score	Total Solids Score	Nitrogen Score	Total P Score	WQI Score
McCoy Creek Restored	9/23/03	98.1	*	*	69.5	100.0	*	94.0	*
McCoy Creek Restored	7/20/04	40.8	68.2	100.0	62.7	100.0	98.5	94.0	69.0
McCoy Creek Restored	9/21/04	96.5	84.6	80.3	73.3	98.6	99.4	97.0	88.0
McCoy Creek Restored	9/14/05	98.2	99.2	100.0	94.9	100.0	99.4	94.0	98.0
McCoy Creek Upper	6/24/93	87.1	89.8	35.5	94.9	100.0	99.1	82.0	68.0
McCoy Creek Upper	9/29/93	95.7	84.6	75.7	100.0	100.0	96.4	85.0	90.0
McCoy Creek Upper	7/18/94	96.8	86.9	77.2	100.0	97.1	95.1	82.0	90.0
Meadow Creek Lower	6/24/93	97.5	93.2	41.6	100.0	100.0	98.6	85.0	75.0
Meadow Creek Lower	9/28/93	93.3	89.5	77.2	77.2	100.0	96.8	94.0	88.0
Meadow Creek Lower	4/6/94	100.0	95.3	72.7	100.0	100.0	95.5	79.0	90.0
Meadow Creek Lower	7/18/94	73.5	80.6	77.2	94.9	100.0	98.6	94.0	87.0
Meadow Creek Lower	9/19/94	92.0	88.7	100.0	100.0	98.6	99.1	91.0	95.0
Meadow Creek Lower	4/22/96	100.0	98.8	99.0	100.0	100.0	98.2	76.0	95.0
Meadow Creek Lower	7/24/96	34.9	77.8	88.7	85.6	100.0	96.8	94.0	67.0
Meadow Creek Lower	9/23/96	99.9	93.1	99.0	100.0	100.0	98.6	94.0	98.0
Meadow Creek Lower	4/28/97	100.0	99.2	94.2	100.0	100.0	98.6	82.0	96.0
Meadow Creek Lower	7/28/97	62.9	94.2	99.0	100.0	98.6	96.8	88.0	88.0
Meadow Creek Lower	9/22/97	90.5	91.0	88.7	94.9	100.0	98.6	94.0	94.0
Meadow Creek Lower	4/20/98	100.0	98.8	92.3	100.0	100.0	99.1	82.0	95.0
Meadow Creek Lower	7/21/98	53.3	94.2	100.0	100.0	100.0	98.2	91.0	84.0
Meadow Creek Lower	10/6/98	99.9	96.5	*	*	100.0	98.6	97.0	*
Meadow Creek Lower	4/27/99	100.0	100.0	90.5	100.0	100.0	98.1	85.0	96.0
Meadow Creek Lower	7/22/99	87.1	92.0	92.3	100.0	97.1	97.8	91.0	94.0
Meadow Creek Lower	9/29/99	100.0	93.1	99.0	85.6	100.0	99.2	94.0	95.0
Meadow Creek Lower	5/1/00	95.7	92.5	88.7	100.0	100.0	99.4	82.0	93.0
Meadow Creek Lower	7/17/00	71.9	91.8	98.0	62.7	100.0	98.8	91.0	84.0
Meadow Creek Lower	9/26/00	100.0	100.0	85.3	100.0	100.0	98.8	94.0	96.0
Meadow Creek Lower	4/30/01	100.0	97.6	100.0	100.0	100.0	99.4	82.0	96.0
Meadow Creek Lower	7/16/01	65.5	83.6	80.3	77.2	100.0	98.7	91.0	83.0
Meadow Creek Lower	9/17/01	79.6	85.6	80.3	62.7	98.6	98.8	94.0	83.0
Meadow Creek Lower	7/16/02	77.7	*	92.3	100.0	100.0	*	94.0	*
Meadow Creek Lower	9/23/02	85.2	*	83.6	66.0	100.0	*	94.0	*
Meadow Creek Lower	7/14/03	24.8	*	96.1	81.3	100.0	*	91.0	*
Meadow Creek Lower	9/22/03	81.4	*	100.0	66.0	100.0	*	91.0	*
Meadow Creek Lower	7/20/04	81.4	92.0	75.7	100.0	100.0	99.4	94.0	90.0
Meadow Creek Lower	9/21/04	100.0	100.0	92.3	90.1	100.0	99.9	97.0	97.0
Meadow Creek Lower	9/12/05	98.4	98.8	100.0	66.0	98.6	99.3	94.0	91.0
Meadow Creek Starkey	6/24/93	83.1	84.1	50.8	100.0	100.0	99.1	91.0	80.0
Meadow Creek Starkey	9/28/93	100.0	89.8	100.0	100.0	100.0	98.2	97.0	98.0
Meadow Creek Starkey	4/7/94	100.0	93.1	72.7	94.9	100.0	98.6	79.0	89.0
Meadow Creek Starkey	7/20/94	55.5	75.9	77.2	59.5	100.0	99.1	94.0	74.0
Meadow Creek Starkey	9/21/94	100.0	93.8	88.7	85.6	100.0	98.6	94.0	94.0
Meadow Creek Starkey	7/24/95	50.4	75.5	100.0	69.5	100.0	96.8	88.0	76.0
Meadow Creek Starkey	4/24/96	100.0	100.0	90.5	100.0	100.0	97.7	73.0	93.0
Meadow Creek Starkey	7/23/96	43.3	82.6	98.0	53.7	100.0	98.2	94.0	70.0
Meadow Creek Starkey	9/24/96	99.7	83.6	80.3	56.5	100.0	98.2	94.0	82.0
Meadow Creek Starkey	4/28/97	100.0	97.6	92.3	100.0	100.0	98.2	100.0	98.0
Meadow Creek Starkey	5/1/97	100.0	97.6	92.3	100.0	100.0	98.2	91.0	97.0

Site Description	Survey Date	Temp. Score	DO Score	BOD-5 Score	pH Score	Total Solids Score	Nitrogen Score	Total P Score	WQI Score
Meadow Creek Starkey	7/30/97	58.3	81.1	94.2	53.7	100.0	96.8	82.0	74.0
Meadow Creek Starkey	9/24/97	98.1	95.3	100.0	77.2	100.0	99.1	94.0	94.0
Meadow Creek Starkey	4/22/98	100.0	97.6	87.0	100.0	100.0	98.6	88.0	95.0
Meadow Creek Starkey	7/23/98	80.0	84.6	81.9	66.0	100.0	98.6	94.0	84.0
Meadow Creek Starkey	10/8/98	100.0	100.0	100.0	100.0	100.0	99.1	97.0	99.0
Meadow Creek Starkey	4/28/99	100.0	100.0	83.6	100.0	100.0	99.4	88.0	95.0
Meadow Creek Starkey	7/22/99	73.5	90.9	94.2	85.6	100.0	98.1	91.0	89.0
Meadow Creek Starkey	9/30/99	100.0	97.6	98.0	94.9	100.0	99.3	94.0	98.0
Meadow Creek Starkey	5/1/00	93.1	89.5	96.1	100.0	100.0	99.4	88.0	95.0
Meadow Creek Starkey	7/18/00	89.2	95.6	94.2	77.2	100.0	99.2	94.0	92.0
Meadow Creek Starkey	9/27/00	97.0	92.5	92.3	85.6	100.0	99.4	94.0	94.0
Meadow Creek Starkey	5/1/01	100.0	98.8	98.0	100.0	100.0	98.5	88.0	97.0
Meadow Creek Starkey	7/17/01	72.5	93.1	92.3	73.3	100.0	99.4	94.0	87.0
Meadow Creek Starkey	9/18/01	87.4	85.1	88.7	73.3	100.0	98.5	94.0	88.0
Meadow Creek Starkey	7/18/02	78.6	*	94.2	81.3	100.0	*	94.0	*
Meadow Creek Starkey	9/24/02	100.0	*	77.2	90.1	100.0	*	94.0	*
Meadow Creek Starkey	7/15/03	32.2	*	99.0	66.0	100.0	*	94.0	*
Meadow Creek Starkey	9/24/03	92.2	*	75.7	94.9	100.0	*	94.0	*
Meadow Creek Starkey	7/19/04	52.6	89.8	88.7	100.0	100.0	99.3	94.0	83.0
Meadow Creek Starkey	9/20/04	100.0	95.3	90.5	100.0	100.0	99.4	97.0	97.0

Appendix E. Water Temperature Equipment Specifications

Temperature monitoring equipment specifications:

Multiple parameter loggers (Unidata, 1992):

accuracy: 1.0% of range (0-50 C)

resolution: 0.4% of range (-1 to 40 C)

Miniature loggers (Onset, 1993):

accuracy: +/- 0.2 C

resolution: 0.16 C at 15 C (–5 to 37 C)

Miniature loggers (Vemco, 1998):

accuracy: +/- 0.2 C

resolution: 0.1 C (–5 to 35 C)

Appendix F. Water Temperature Statistics

Water Temperature Statistics: maximum seasonal values for maximum, minimum (lowest temperature), daily range, and moving 7 day average of the daily maximum temperature, minimum temperature, and temperature range.

Site	Year	Max. Temp. (C)	Min. Temp. (C)	Max. Daily Range (C)	7 day avg. max. Temp. (C)	7 day avg. min. Temp. (C)	7 day avg. Daily Range (C)
McCoy Creek Lower #1 (Transect 1)	1993	25.4	5.0	12.5	24.8	13.6	11.2
McCoy Creek Lower #1 (Transect 1)	1994	28.4	8.0	16.5	27.3	13.1	14.3
McCoy Creek Lower #1 (Transect 1)	1995	28.5	3.9	17.5	27.4	11.6	15.8
McCoy Creek Lower #1 (Transect 1)	1996	28.5	4.1	16.8	27.1	12.2	14.9
McCoy Creek Lower #1 (Transect 1)	1997	29.7	6.3	16.6	28.4	13.2	15.1
McCoy Creek Lower #1 (Transect 1)	1998	30.5	7.9	17.6	29.6	13.8	15.8
McCoy Creek Lower #1 (Transect 1)	1999	29.8	4.7	18.5	27.9	11.0	16.9
McCoy Creek Lower #1 (Transect 1)	2000	30.1	2.6	16.6	28.1	7.5	15.6
McCoy Creek Lower #1 (Transect 1)	2001	30.5	2.2	16.0	28.6	4.6	14.1
McCoy Creek Lower #1 (Transect 1)	2002	30.9	6.3	15.9	29.1	8.3	14.3
McCoy Creek Lower #2 (Transect 1)	1994	29.4	7.8	17.4	28.4	12.2	16.2
McCoy Creek Lower #2 (Transect 1)	1995	28.3	3.9	17.0	27.0	11.6	15.4
McCoy Creek Lower #2 (Transect 1)	1996	27.9	4.0	15.6	26.7	12.3	14.4
McCoy Creek Lower #2 (Transect 1)	1997	29.4	5.8	17.0	27.8	12.6	15.1
McCoy Creek Lower #2 (Transect 1)	1998	29.8	7.8	16.9	28.4	14.8	13.6
McCoy Creek Lower #2 (Transect 1)	1999	21.3	5.8	12.1	20.8	11.5	9.4
McCoy Creek Lower #2 (Transect 1)	2001	28.9	2.6	15.9	27.4	4.6	14.1
McCoy Creek Lower #2 (Transect 1)	2002	27.8	8.4	15.1	26.7	9.5	13.3
McCoy Creek Middle (Transect 1)	1996	27.9	3.8	13.4	26.4	15.2	11.1
McCoy Creek Middle (Transect 1)	1998	28.6	8.8	12.5	27.6	16.5	11.1
McCoy Creek Middle (Transect 1)	1999	27.6	2.3	13.7	25.6	14.9	10.7
McCoy Creek Middle (Transect 1)	2000	26.8	3.4	12.8	25.5	6.8	11.7
McCoy Creek Middle (Transect 1)	2001	28.2	1.2	14.0	26.4	3.7	12.3
McCoy Creek Middle (Transect 1)	2002	30.1	4.0	14.0	28.7	6.8	12.3
McCoy Creek Middle (Transect 1)	2003	26.8	6.9	12.8	25.7	7.6	11.2
McCoy Creek Middle (Transect 1)	2004	27.5	6.0	11.9	26.7	7.6	10.9
McCoy Creek Middle (Transect 1)	2005	25.9	6.7	12.9	24.5	8.7	10.7
McCoy Creek Middle (Transect 1)	2005	26.9	6.5	13.4	25.5	8.7	11.5
McCoy Creek Middle (Transect 1)	2005	27.1	7.4	13.4	25.7	9.5	11.6
McCoy Creek Middle (Transect 1)	2005	25.9	6.7	12.9	24.5	8.7	10.7
McCoy Creek Middle (Transect 1)	2005	26.8	6.7	13.3	25.4	8.8	11.3
McCoy Creek Middle (Transect 1)	2005	26.1	6.5	13.1	24.8	8.8	10.9
McCoy Creek Middle (Transect 1)	2005	27.1	6.7	13.4	25.7	8.9	11.6
McCoy Creek Middle (Transect 1)	2005	26.9	6.5	13.3	25.4	8.7	11.5
McCoy Creek Upper (Transect 1)	1994	25.1	5.8	16.1	24.6	10.0	14.6
Meadow Creek Lower (Transect 1)	1993	25.8	5.2	11.0	25.3	15.5	9.7
Meadow Creek Lower (Transect 1)	1994	27.9	8.4	13.7	27.3	16.1	11.2
Meadow Creek Lower (Transect 1)	1995	27.9	7.5	13.4	26.4	14.6	11.8
Meadow Creek Lower (Transect 1)	1996	27.1	7.8	12.2	25.8	16.6	9.2
Meadow Creek Lower (Transect 1)	1997	26.8	11.3	11.3	25.4	18.8	6.7
Meadow Creek Lower (Transect 1)	1998	28.6	10.0	10.8	27.5	18.1	9.5
Meadow Creek Lower (Transect 1)	2000	27.9	4.3	12.0	26.8	7.7	11.1
Meadow Creek Lower (Transect 1)	2001	29.0	2.9	13.7	27.6	5.2	12.2

Site	Year	Max. Temp. (C)	Min. Temp. (C)	Max. Daily Range (C)	7 day avg. max. Temp. (C)	7 day avg. min. Temp. (C)	7 day avg. Daily Range (C)
Meadow Creek Lower (Transect 1)	2002	31.8	3.3	15.5	30.6	6.4	13.6
Meadow Creek Lower (Transect 1)	2003	30.9	7.3	15.2	30.0	8.1	14.2
Meadow Creek Lower (Transect 1)	2004	30.5	5.6	14.3	29.2	7.5	12.9
Meadow Creek Lower (Transect 1)	2005	29.4	7	17	28.8	9.2	15.2
Meadow Creek Lower (replicate 1)	2005	29.4	6.8	16.7	28.7	9.1	15
Meadow Creek Lower (replicate 2)	2005	29.6	7	16.9	29	9.2	15.2
Meadow Creek Lower (replicate 3)	2005	29.6	6.8	17	29	8.8	15.3
Meadow Creek Lower (replicate 4)	2005	29.4	7	17	28.8	9.2	15.2
Meadow Creek Lower (replicate 5)	2005	30.2	6.7	17.4	29.4	8.8	15.8
Meadow Creek Lower (replicate 6)	2005	29.8	6.8	17	29.1	9	15.3
Meadow Creek Starkey (Transect1)	1994	25.4	7.1	12.4	25.0	15.7	9.4
Meadow Creek Starkey (Transect1)	1996	25.8	3.8	11.6	24.3	14.5	9.8
Meadow Creek Starkey (Transect1)	1997	25.4	7.1	11.3	24.4	16.1	8.3
Meadow Creek Starkey (Transect1)	1998	27.1	7.9	11.6	26.3	15.8	10.5
Meadow Creek Starkey (Transect1)	1999	25.6	1.9	13.5	24.0	12.7	11.3
Meadow Creek Starkey (Transect1)	2000	26.4	3.1	12.6	25.3	5.4	11.2
Meadow Creek Starkey (Transect1)	2001	26.4	1.5	13.0	25.0	3.5	11.6
Meadow Creek Starkey (Transect1)	2002	29.0	3.1	13.8	27.7	5.7	11.7
Meadow Creek Starkey (Transect1)	2003	26.8	6.7	13.0	25.8	7.1	11.2
Meadow Creek Starkey (Transect1)	2004	25.8	6.0	11.0.	24.1	7.6	10.0
Dark Canyon Creek Lower (Transect 1)	1993	21.7	7.1	9.4	21.4	13.4	8.1
Dark Canyon Creek Lower (Transect 1)	1994	20.8	7.8	9.8	20.3	15.5	4.8
Dark Canyon Creek Lower (Transect 1)	1995	21.2	8.4	9.1	19.5	13.9	5.7
Dark Canyon Creek Lower (Transect 1)	1996	19.4	8.4	9.1	18.6	16.1	2.5
Dark Canyon Creek Lower (Transect 1)	1997	18.9	10.6	6.1	18.3	16.2	2.2
Dark Canyon Creek Lower (Transect 1)	1998	21.7	11.3	7.7	20.8	14.7	6.1
Dark Canyon Creek Lower (Transect 1)	2000	21.4	7.8	10.5	20.7	9.6	9.2
Dark Canyon Creek Lower (Transect 1)	2001	22.3	5.2	11.3	21.4	7.0	10.0
Dark Canyon Creek Lower (Transect 1)	2002	23.2	5.6	11.2	22.5	7.8	9.9
Dark Canyon Creek Lower (Transect 1)	2003	22.6	8.4	10.7	22.2	10.0	9.9
Dark Canyon Creek Upper (Transect 1)	1993	21.4	4.9	10.8	20.8	10.6	10.2
Dark Canyon Creek Upper (Transect 1)	1994	22.3	6.5	12.5	21.6	10.5	11.2
Dark Canyon Creek Upper (Transect 1)	1996	23.2	4.1	12.8	22.3	10.1	12.2
Dark Canyon Creek Upper (Transect 1)	1997	23.1	7.1	12.4	22.5	11.9	10.6
Dark Canyon Creek Upper (Transect 1)	1998	23.8	7.9	12.5	23.3	11.5	11.8
Dark Canyon Creek Upper (Transect 1)	1999	22.7	5.6	13.6	21.6	9.1	12.5
Dark Canyon Creek Upper (Transect 1)	2000	21.9	5.8	12.3	21.3	6.6	11.9
Lookout Creek (Transect 1)	1994	16.8	6.9	6.6	16.5	10.9	5.6
Lookout Creek (Transect 1)	1996	18.3	4.0	8.7	17.8	10.4	7.4
Lookout Creek (Transect 1)	1997	18.3	5.8	8.4	17.7	10.9	6.8
Lookout Creek (Transect 1)	1998	20.0	7.9	7.6	18.3	11.8	6.5
Lookout Creek (Transect 1)	1999	18.8	3.8	9.8	17.7	10.1	7.5
Lookout Creek (Transect 1)	2000	19.4	4.0	9.4	18.8	5.8	8.1
Lookout Creek (Transect 1)	2001	19.1	4.7	9.7	17.9	5.5	9.0
Lookout Creek (Transect 1)	2002	20.0	4.0	9.4	19.5	4.8	8.1
Lookout Creek (Transect 1)	2003	19.4	5.6	8.8	19.0	6.0	8.2
Limber Jim Creek Upper (Transect 1)	1994	16.6	4.7	5.7	15.9	11.0	4.8
Limber Jim Creek Upper (Transect 1)	1996	15.6	1.7	6.6	15.3	10.4	5.0
Limber Jim Creek Upper (Transect 1)	1997	17.0	4.9	6.2	16.0	11.2	4.8
Limber Jim Creek Upper (Transect 1)	1998	16.6	5.2	6.0	15.7	10.0	5.7
Limber Jim Creek Upper (Transect 1)	1999	15.5	1.7	7.7	14.5	9.7	4.8
Limber Jim Creek Upper (Transect 1)	2000	19.7	1.9	8.9	18.5	3.7	6.8
Limber Jim Creek Upper (Transect 1)	2001	17.1	3.3	7.4	15.9	4.4	6.7

Site	Year	Max. Temp. (C)	Min. Temp. (C)	Max. Daily Range (C)	7 day avg. max. Temp. (C)	7 day avg. min. Temp. (C)	7 day avg. Daily Range (C)
Limber Jim Creek Upper (Transect 1)	2002	17.8	2.9	8.0	16.9	3.7	6.7
Limber Jim Creek Upper (Transect 1)	2003	17.1	3.6	7.3	16.5	4.2	6.5
Limber Jim Creek Upper (Transect 1)	2004	16.1	4.0	6.6	14.9	5.5	6.1
Limber Jim Creek Lower (Transect 1)	1994	20.6	4.4	10.8	19.9	11.3	8.7
Limber Jim Creek Lower (Transect 1)	1996	20.0	0.4	10.4	19.3	10.4	8.9
Limber Jim Creek Lower (Transect 1)	1999	19.9	0.7	10.1	18.9	10.0	8.9
Limber Jim Creek Lower (Transect 1)	2000	22.9	0.5	12.6	21.6	2.7	10.7
Limber Jim Creek Lower (Transect 1)	2001	21.1	3.8	10.8	19.9	5.0	9.5
Limber Jim Creek Lower (Transect 1)	2002	21.4	1.7	9.7	20.2	3.6	9.1
Limber Jim Creek Lower (Transect 1)	2003	22.0	3.6	10.0	21.0	4.5	9.3
Limber Jim Creek Lower (Transect 1)	2004	20.0	2.4	8.5	18.2	4.1	7.3
Limber Jim Creek Lower (Transect 1)	2005	19.9	3.5	10.5	19.2	5.3	9.3
Limber Jim Creek Lower (replicate1)	2005	19.9	3.5	10.5	19.2	5.3	9.3
Limber Jim Creek Lower (replicate 2)	2005	19.5	3.4	10.3	19	4.8	9.7
Limber Jim Creek Lower (replicate 3)	2005	21.4	3.2	11.7	20.4	5	11
Limber Jim Creek Lower (replicate 4)	2005	19.9	3.1	10.5	19.2	4.6	9.6
Limber Jim Creek Lower (replicate 5)	2005	20.0	4.4	10.5	19.2	6.2	9.6
Limber Jim Creek Lower (replicate 7)	2005	19.9	3.2	10.1	19.2	4.7	9.6
Limber Jim Creek Lower (replicate 6)	2005	19.9	3.2	10.3	19.1	5	9.4
McCoy Creek Middle (Transect 6)	1993	26.5	3.3	12.5	25.8	14.3	11.4
McCoy Creek Middle (Transect 1)	1994	28.6	8.4	14.3	27.4	15.4	12.0
McCoy Creek Middle (Transect 6)	1994	28.1	8.1	14.5	27.2	15.0	12.2
McCoy Creek Middle (Transect 6)	1995	28.1	4.9	14.6	26.5	13.6	12.9
McCoy Creek Middle (Transect 6)	1996	28.3	3.2	14.0	27.0	14.6	12.3
McCoy Creek Middle (Transect 6)	1997	28.3	5.5	12.8	27.0	16.0	11.0
McCoy Creek Middle (Transect 6)	1998	29.8	8.3	13.5	28.5	16.3	12.2
McCoy Creek Middle (Transect 6)	1999	27.8	2.5	14.4	25.9	15.0	11.0
McCoy Creek Middle (Transect 6)	1999	27.3	1.3	14.8	25.7	13.7	12.0
McCoy Creek Middle (Transect 6)	2000	27.3	2.5	13.7	26.2	5.8	12.7
McCoy Creek Middle (Transect 6)	2000	19.7	3.4	9.2	19.0	4.9	8.4
McCoy Creek Middle (Transect 6)	2001	28.9	2.5	14.3	27.1	4.9	12.7
McCoy Creek Middle (Transect 6)	2002	30.4	2.8	14.0	28.9	5.8	12.3
McCoy Creek Middle (Transect 6)	2003	27.8	6.7	13.7	26.8	7.3	12.2
McCoy Creek Middle (Transect 6)	2004	28.0	5.2	12.7	26.8	7.0	11.5
McCoy Creek Middle (Transect 6)	2005	27.3	6.5	13.6	25.9	8.7	11.8
Dark Canyon Creek Lower (Transect 6)	1994	21.9	8.6	8.9	21.3	15.1	6.2
Dark Canyon Creek Lower (Transect 6)	1995	22.6	8.3	9.3	21.4	13.4	8.0
Dark Canyon Creek Lower (Transect 6)	1996	23.7	6.3	10.4	22.8	13.6	9.1
Dark Canyon Creek Lower (Transect 6)	1997	27.8	8.7	12.1	23.4	14.7	8.7
Dark Canyon Creek Lower (Transect 6)	1998	26.1	8.6	11.9	25.2	15.4	9.8
Dark Canyon Creek Lower (Transect 6)	1999	25.4	4.1	13.2	24.2	12.1	12.2
Dark Canyon Creek Lower (Transect 6)	2000	25.9	5.2	12.5	25.2	6.9	11.9
Dark Canyon Creek Lower (Transect 6)	2001	26.1	2.9	13.5	25.1	4.4	12.4
Dark Canyon Creek Lower (Transect 6)	2002	28.2	3.8	14.6	27.0	6.1	13.2
Dark Canyon Creek Lower (Transect 6)	2003	0.0	0.0	0.0	0.0	0.0	0.0
Dark Canyon Creek Lower (Transect 6)	1994	21.4	6.1	11.9	20.5	11.7	8.8
Dark Canyon Creek Lower (Transect 6)	1995	21.6	7.1	11.1	20.8	11.1	9.8
Dark Canyon Creek Lower (Transect 6)	1996	23.2	5.3	12.6	22.3	10.5	11.8
Dark Canyon Creek Lower (Transect 6)	1997	23.6	7.7	12.8	22.9	12.4	10.5
Meadow Creek Lower (Transect 6)	1996	26.9	5.5	12.5	25.7	15.9	9.7
Meadow Creek Lower (Transect 6)	1997	26.6	9.2	12.4	25.6	18.2	7.4
Meadow Creek Lower (Transect 6)	1998	29.4	9.3	12.7	28.2	17.2	11.0
Meadow Creek Lower (Transect 6)	1999	28.0	2.8	14.4	26.5	14.3	12.1

Site	Year	Max. Temp. (C)	Min. Temp. (C)	Max. Daily Range (C)	7 day avg. max. Temp. (C)	7 day avg. min. Temp. (C)	7 day avg. Daily Range (C)
Meadow Creek Lower (Transect 6)	2000	28.0	3.4	12.3	26.9	6.7	11.6
Meadow Creek Lower (Transect 6)	2002	0.0	0.0	0.0	0.0	0.0	0.0
Meadow Creek Lower (Transect 6)	2003	29.3	7.0	15.3	28.7	7.7	13.9
Meadow Creek Lower (Transect 6)	2004	30.4	5.0	14.3	29.0	6.9	13.3
Meadow Creek Lower (Transect 6)	2005	29.6	7.1	16.5	28.8	9.5	14.8
Meadow Creek Starkey (Transect 6)	1995	25.8	4.6	12.6	24.4	13.1	11.3
Meadow Creek Starkey (Transect 6)	1996	26.4	3.0	13.1	25.5	14.0	11.5
Meadow Creek Starkey (Transect 6)	1997	27.1	6.1	12.5	25.9	15.6	10.3
Meadow Creek Starkey (Transect 6)	1998	28.4	7.0	13.6	27.4	15.0	12.4
Meadow Creek Starkey (Transect 6)	2000	28.0	2.6	13.8	27.1	4.8	13.2
Meadow Creek Starkey (Transect 6)	2001	28.5	1.9	14.0	27.1	3.8	12.4
Meadow Creek Starkey (Transect 6)	2002	30.7	3.4	15.5	29.2	6.0	13.2
Meadow Creek Starkey (Transect 6)	2003	29.1	6.4	14.0	28.1	6.8	13.2
Meadow Creek Starkey (Transect 6)	2004	28.4	5.2	13.4	27.0	6.9	12.5
Lookout Creek (Transect 6)	1995	17.5	4.6	8.2	16.7	9.3	7.4
Lookout Creek (Transect 6)	1996	18.3	3.5	8.8	17.6	10.0	7.6
Lookout Creek (Transect 6)	1997	18.8	5.9	8.5	18.1	11.1	7.0
Lookout Creek (Transect 6)	2003	20.0	5.5	9.3	19.6	6.0	8.7
Limber Jim Creek Upper (Transect 6)	1995	14.6	4.1	5.6	14.0	9.8	4.3
Limber Jim Creek Upper (Transect 6)	1996	30.9	3.0	24.5	19.4	14.7	4.7
Limber Jim Creek Upper (Transect 6)	1997	16.2	4.9	5.9	15.0	11.1	3.9
Limber Jim Creek Upper (Transect 6)	1998	16.6	4.6	6.6	15.6	9.9	5.7
Limber Jim Creek Upper (Transect 6)	1999	15.5	1.9	7.7	14.5	9.8	4.8
Limber Jim Creek Upper (Transect 6)	2000	18.0	1.3	7.1	16.9	3.4	6.0
Limber Jim Creek Upper (Transect 6)	2002	17.5	2.8	7.8	16.8	3.6	6.7
Limber Jim Creek Upper (Transect 6)	2003	17.1	3.5	7.1	16.4	4.1	6.6
Limber Jim Creek Upper (duplicate 6)	2004	16.2	4.1	6.7	15.0	5.5	6.2
Limber Jim Creek Upper (Transect 6)	2004	16.0	4.0	6.7	14.9	5.5	6.1
Limber Jim Creek Lower (Transect 6)	1995	17.3	2.0	9.2	15.7	7.7	8.0
Limber Jim Creek Lower (Transect 6)	1996	19.4	3.0	10.0	19.0	10.4	8.5
Limber Jim Creek Lower (Transect 6)	1997	20.6	4.0	9.3	19.1	11.1	8.0
Limber Jim Creek Lower (Transect 6)	1999	19.5	-0.1	10.4	18.6	9.6	9.0
Limber Jim Creek Lower (Transect 6)	2000	22.6	0.2	11.2	21.3	2.0	10.4
Limber Jim Creek Lower (Transect 6)	2002	20.8	0.7	9.8	19.9	3.0	9.1
Limber Jim Creek Lower (Transect 6)	2003	21.6	3.2	10.4	20.6	3.6	9.7
Limber Jim Creek Lower (Transect 6)	2005	19.4	3.2	9.8	18.8	5	9
McCoy Creek Lower #2 (Transect 6)	1995	25.4	4.5	15.3	23.7	10.0	13.7
McCoy Creek Lower #2 (Transect 6)	1997	27.6	6.5	15.1	26.3	12.8	13.5
McCoy Creek Lower #2 (Transect 6)	1998	28.7	8.3	16.1	27.5	13.7	13.8
McCoy Creek Restored (Transect 1)	1998	28.5	9.2	12.5	27.1	17.5	9.5
McCoy Creek Restored (Transect 1)	2000	28.2	3.8	13.1	27.5	7.3	11.3
McCoy Creek Restored (Transect 1)	2001	28.6	5.6	12.8	27.3	6.7	11.1
McCoy Creek Restored (Transect 1)	2002	30.1	3.8	13.1	28.4	6.4	11.9
McCoy Creek Restored (Transect 1)	2003	29.3	7.7	12.8	28.5	8.4	11.8
McCoy Creek Restored (Transect 1)	2004	27.5	6.7	12.0	26.0	8.3	10.8
McCoy Creek Restored (Transect 1)	2005	26.6	8.7	11.8	25.7	10.6	10.2
McCoy Creek Restored (replicate 1)	2005	28.2	7.7	18	27.3	9.2	13.5
McCoy Creek Restored (replicate 2)	2005	26.6	8.7	11.8	25.7	10.6	10.2
McCoy Creek Restored (replicate 3)	2005	26.1	9.5	11.7	24.5	10.6	9.9
McCoy Creek Restored (replicate 6)	2005	28.2	9.5	13.2	26.7	10.8	11.3
McCoy Creek Restored (Transect 3)	1997	25.1	13.5	7.7	23.9	16.9	7.0
McCoy Creek Restored (Transect 3)	1998	29.3	9.9	12.8	27.8	17.3	10.5
McCoy Creek Restored (Transect 3)	1999	26.9	2.6	12.5	25.5	15.4	10.1

Site	Year	Max. Temp. (C)	Min. Temp. (C)	Max. Daily Range (C)	7 day avg. max. Temp. (C)	7 day avg. min. Temp. (C)	7 day avg. Daily Range (C)
McCoy Creek Restored (Transect 3)	2000	26.9	6.1	12.2	25.5	9.0	11.3
McCoy Creek Restored (Transect 3)	2001	27.5	4.6	12.3	25.8	5.8	10.7
McCoy Creek Restored (Transect 3)	2002	28.2	5.5	11.7	26.9	7.3	9.7
McCoy Creek Restored (Transect 3)	2003	0.0	0.0	0.0	0.0	0.0	0.0
McCoy Creek Restored (Transect 3)	2004	26.6	7.5	10.4	24.7	9.2	8.6
McCoy Creek Restored (above Transect 3)	1998	24.9	8.9	12.1	23.4	16.9	6.5
McCoy Creek Restored (above Transect 3)	1999	25.9	5.0	12.3	23.3	15.2	8.1
McCoy Creek Restored (above Transect 3)	2000	22.9	5.8	9.4	21.3	8.4	8.0
McCoy Creek Restored (above Transect 3)	2001	16.6	4.3	4.5	16.0	5.5	3.6
McCoy Creek Restored (above Transect 3)	2003	25.1	7.3	10.9	23.8	8.2	10.0
McCoy Creek Restored (Transect 6)	1997	28.4	12.0	12.4	26.9	16.1	10.8
McCoy Creek Restored (Transect 6)	1998	29.3	7.8	13.4	28.0	17.6	10.4
McCoy Creek Restored (Transect 6)	1999	28.2	1.9	14.4	26.6	13.7	12.9
McCoy Creek Restored (Transect 6)	2000	28.5	2.5	13.5	27.5	5.4	12.7
McCoy Creek Restored (Transect 6)	2002	31.1	2.8	14.5	29.7	5.6	13.3
McCoy Creek Restored (Transect 6)	2003	30.7	6.8	14.5	29.2	7.5	13.3
McCoy Creek Restored (Transect 6)	2005	28.7	6.7	14.8	27.8	8.6	13.9
McCoy Creek Lower Restored (Transect 1)	2002	30.4	4.6	12.8	25.5	6.9	11.7
McCoy Creek Lower Restored (Transect 1)	2003	30.5	9.4	14.9	29.6	10.3	13.8
McCoy Creek Lower Restored (Transect 1)	2004	28.6	6.3	14.0	27.4	7.8	13.3
McCoy Creek Lower Restored (Transect 1)	2005	28.0	7.7	15.6	27.3	9.9	14.1
McCoy Creek Lower Restored (replicate 1)	2005	26.6	9.8	14	25.7	10.8	12.6
McCoy Creek Lower Restored (replicate 2)	2005	28.0	7.4	15.5	27.2	9.3	13.9
McCoy Creek Lower Restored (replicate 3)	2005	27.6	7.6	15.3	26.5	9.5	13.7
McCoy Creek Lower Restored (replicate 4)	2005	28.2	7.3	13	26.9	9.1	11.5
McCoy Creek Lower Restored (replicate 5)	2005	28.0	7.7	15.8	27.3	9.6	14
McCoy Creek Lower Restored (replicate 7)	2005	28.0	7.3	15.8	27.2	9.1	14.1
McCoy Creek Lower Restored (replicate 8)	2005	27.3	7.4	15.5	26.6	9.1	13.8
McCoy Creek Lower Restored (Transect 6)	2003	29.1	7.7	15.0	28.0	8.3	13.8
McCoy Creek Lower Restored (Transect 6)	2004	28.0	6.8	13.3	26.8	8.0	12.6
McCoy Creek Lower Restored (Transect 6)	2005	27.3	7.4	15.5	26.6	9.1	13.8

Appendix G. Habitat Statistics

Habitat statistics are listed by site, by year, and by season in two parts: Part 1 lists mean wet width, mean depth, mean width:depth, and mean velocity. Part 2 lists substrate composition, embeddedness, and shade as percentages.

Part 1.

Site	Year	Season	Mean Wet Width (ft.)	Mean Depth (ft.)	Mean Width:Depth	Mean Velocity (ft/sec)
McCoy Creek Lower #1	1993	Spring	15.8	0.8	19.0	1.55
McCoy Creek Lower #1	1994	Spring	22.5	1.5	15.1	3.23
McCoy Creek Lower #1	1995	Spring	26.0	1.5	16.9	2.43
McCoy Creek Lower #1	1996	Spring	22.4	1.3	17.4	2.06
McCoy Creek Lower #1	1997	Spring	23.5	1.9	12.2	3.51
McCoy Creek Lower #1	1998	Spring	20.8	1.4	15.0	2.30
McCoy Creek Lower #1	1999	Spring	21.8	1.6	13.6	2.30
McCoy Creek Lower #1	2000	Spring	25.9	1.1	23.8	1.39
McCoy Creek Lower #1	2001	Spring	20.1	1.5	13.4	2.05
McCoy Creek Lower #2	1993	Spring	19.8	0.8	26.0	1.18
McCoy Creek Lower #2	1994	Spring	24.7	1.4	17.2	2.78
McCoy Creek Lower #2	1995	Spring	28.5	1.4	21.0	2.43
McCoy Creek Lower #2	1996	Spring	22.8	1.3	18.0	1.94
McCoy Creek Lower #2	1997	Spring	27.7	2.0	14.0	2.62
McCoy Creek Lower #2	1998	Spring	23.7	1.3	18.7	2.00
McCoy Creek Lower #2	1999	Spring	27.3	1.1	26.0	2.26
McCoy Creek Lower #2	2000	Spring	24.4	0.7	34.6	1.24
McCoy Creek Lower #2	2001	Spring	29.8	1.4	21.6	2.53
McCoy Creek Middle	1993	Spring	26.3	0.9	28.6	0.69
McCoy Creek Middle	1994	Spring	30.8	1.5	20.7	1.73
McCoy Creek Middle	1995	Spring	29.5	1.5	19.6	1.80
McCoy Creek Middle	1996	Spring	28.8	1.2	23.1	1.72
McCoy Creek Middle	1997	Spring	30.7	1.6	19.6	
McCoy Creek Middle	1998	Spring	26.2	1.1	23.5	1.80
McCoy Creek Middle	1999	Spring	25.7	1.2	22.0	1.84
McCoy Creek Middle	2000	Spring	24.2	0.8	30.4	1.06
McCoy Creek Middle	2001	Spring	25.4	1.3	19.7	2.01
McCoy Creek Upper	1993	Spring	18.1	0.8	24.0	0.75
Meadow Creek Lower	1993	Spring	25.0	1.0	24.5	1.53
Meadow Creek Lower	1994	Spring	45.5	1.8	25.6	3.36
Meadow Creek Lower	1995	Spring	42.5	1.6	26.4	2.91
Meadow Creek Lower	1996	Spring	56.3	2.2	25.5	2.34
Meadow Creek Lower	1997	Spring	58.3	1.8	32.2	2.85
Meadow Creek Lower	1998	Spring	56.7	1.6	35.1	2.35
Meadow Creek Lower	1999	Spring	44.8	1.3	34.7	2.91
Meadow Creek Lower	2000	Spring	36.2	1.1	31.7	1.72
Meadow Creek Lower	2001	Spring	51.7	1.4	35.7	2.37
Meadow Creek Starkey	1993	Spring	36.1	0.9	41.9	0.85

Site	Year	Season	Mean Wet Width (ft.)	Mean Depth (ft.)	Mean Width:Depth	Mean Velocity (ft/sec)
Meadow Creek Starkey	1994	Spring	34.0	1.6	21.0	2.69
Meadow Creek Starkey	1995	Spring	32.3	1.3	24.2	1.76
Meadow Creek Starkey	1996	Spring	42.8	2.2	19.9	2.98
Meadow Creek Starkey	1997	Spring	33.8	1.6	21.4	2.28
Meadow Creek Starkey	1998	Spring	36.2	1.6	22.5	2.63
Meadow Creek Starkey	1999	Spring	35.0	1.3	26.1	2.78
Meadow Creek Starkey	2000	Spring	26.3	1.0	26.4	1.36
Meadow Creek Starkey	2001	Spring	34.0	1.4	23.6	2.55
Meadow Creek Starkey	2001	Spring	28.6	1.3	21.3	2.59
Dark Canyon Creek Lower	1993	Spring	16.3	0.7	24.7	0.73
Dark Canyon Creek Lower	1994	Spring	22.7	1.3	17.0	2.78
Dark Canyon Creek Lower	1995	Spring	20.4	0.8	26.2	1.96
Dark Canyon Creek Lower	1995	Spring	21.8	0.8	28.2	1.81
Dark Canyon Creek Lower	1996	Spring	26.7	0.9	30.3	2.32
Dark Canyon Creek Lower	1997	Spring	25.3	1.0	25.1	2.23
Dark Canyon Creek Lower	1998	Spring	39.3	1.0	37.8	2.27
Dark Canyon Creek Lower	1999	Spring	55.5	1.1	52.6	2.55
Dark Canyon Creek Lower	2000	Spring	20.8	0.5	45.4	1.30
Dark Canyon Creek Lower	2001	Spring	20.7	0.9	24.1	3.09
Dark Canyon Creek Upper	1993	Spring	15.4	0.7	22.0	0.68
Dark Canyon Creek Upper	1994	Spring	24.5	1.2	19.7	2.90
Dark Canyon Creek Upper	1995	Spring	17.7	0.9	19.2	1.49
Dark Canyon Creek Upper	1996	Spring	20.2	1.1	18.3	1.17
Dark Canyon Creek Upper	1997	Spring	19.8	1.1	17.4	1.98
Dark Canyon Creek Upper	1998	Spring	17.9	1.2	15.6	2.38
Lookout Creek	1994	Spring	9.5	1.0	9.2	1.36
Lookout Creek	1995	Spring	10.3	0.9	11.9	1.40
Lookout Creek	1996	Spring	38.5			
Lookout Creek	1997	Spring	16.1	1.4	11.3	2.42
Lookout Creek	2000	Spring	16.7	1.4	11.9	2.54
Lookout Creek	2001	Spring	15.1	1.4	10.8	2.18
Limber Jim Creek Upper	1994	Spring	11.3	0.9	12.0	1.82
Limber Jim Creek Upper	1995	Spring	11.4	0.8	14.7	1.80
Limber Jim Creek Upper	1996	Spring	13.3	1.0	13.9	2.41
Limber Jim Creek Upper	1997	Spring	14.8	1.2	12.0	3.33
Limber Jim Creek Upper	1998	Spring	11.1	0.9	12.6	1.90
Limber Jim Creek Upper	1999	Spring	15.9	1.1	15.1	2.65
Limber Jim Creek Upper	2000	Spring	14.8	1.0	14.5	2.75
Limber Jim Creek Upper	2001	Spring	12.1	1.1	11.4	2.82
Limber Jim Creek Lower	1994	Spring	17.2	1.1	15.1	2.21
Limber Jim Creek Lower	1995	Spring	21.9	0.9	25.6	1.06
Limber Jim Creek Lower	1996	Spring	26.3	1.1	24.9	
Limber Jim Creek Lower	1996	Spring				
Limber Jim Creek Lower	1997	Spring		1.5		3.36
Limber Jim Creek Lower	1998	Spring	16.1	1.1	15.0	2.77
Limber Jim Creek Lower	1999	Spring	17.5	1.1	16.0	3.03
Limber Jim Creek Lower	2000	Spring	18.6	1.1	16.4	2.97

Site	Year	Season	Mean Wet Width (ft.)	Mean Depth (ft.)	Mean Width:Depth	Mean Velocity (ft/sec)
Limber Jim Creek Lower	2001	Spring	20.0	1.1	17.6	2.76
McCoy Creek Restored	1998	Spring	30.8	1.7	17.6	1.41
McCoy Creek Restored	1999	Spring	25.0	1.5	16.3	1.82
McCoy Creek Restored	2000	Spring	20.7	1.4	15.0	1.04
McCoy Creek Restored	2001	Spring	39.0	2.0	19.3	2.17
McCoy Creek Lower #1	1994	Summer	16.3	0.7	21.9	0.24
McCoy Creek Lower #1	1995	Summer	15.1	0.9	17.1	0.41
McCoy Creek Lower #1	1996	Summer	13.7	0.7	19.8	0.32
McCoy Creek Lower #1	1997	Summer	17.5	0.7	24.6	0.33
McCoy Creek Lower #1	1998	Summer	18.2	0.7	25.6	0.48
McCoy Creek Lower #1	1999	Summer	16.9	0.7	24.2	0.23
McCoy Creek Lower #1	2000	Summer	16.7	0.9	17.6	0.27
McCoy Creek Lower #1	2001	Summer	22.8	0.8	29.3	0.22
McCoy Creek Lower #2	1994	Summer	17.3	0.5	32.8	0.31
McCoy Creek Lower #2	1995	Summer	17.2	0.7	26.1	0.36
McCoy Creek Lower #2	1996	Summer	16.1	0.7	23.0	0.31
McCoy Creek Lower #2	1997	Summer	17.2	0.6	29.2	0.23
McCoy Creek Lower #2	1998	Summer	18.8	0.3	63.4	0.50
McCoy Creek Lower #2	1999	Summer	16.2	0.4	42.4	0.31
McCoy Creek Lower #2	2000	Summer	15.2	0.5	33.7	0.29
McCoy Creek Lower #2	2001	Summer	27.1	0.7	37.3	0.32
McCoy Creek Middle	1994	Summer	19.6	0.6	31.9	0.23
McCoy Creek Middle	1995	Summer	21.0	0.7	28.6	0.16
McCoy Creek Middle	1996	Summer	18.8	0.4	44.3	0.40
McCoy Creek Middle	1997	Summer	17.7	0.5	35.6	0.31
McCoy Creek Middle	1998	Summer	16.4	0.5	35.2	0.26
McCoy Creek Middle	1999	Summer	20.2	0.4	53.8	0.21
McCoy Creek Middle	2000	Summer	16.0	0.4	36.6	0.32
McCoy Creek Middle	2001	Summer	18.9	0.4	43.2	0.37
McCoy Creek Middle	2002	Summer	18.6	0.4	44.9	0.40
McCoy Creek Middle	2003	Summer	18.7	0.4	42.7	0.28
McCoy Creek Middle	2004	Summer	17.9	0.5	34.3	0.43
McCoy Creek Upper	1994	Summer	10.2	0.4	27.1	0.00
Meadow Creek Lower	1994	Summer	15.8	0.7	23.2	0.60
Meadow Creek Lower	1995	Summer	21.5	0.9	24.5	0.76
Meadow Creek Lower	1996	Summer	19.0	1.5	12.7	0.27
Meadow Creek Lower	1997	Summer	28.8	1.3	22.8	0.30
Meadow Creek Lower	1998	Summer	25.2	0.9	28.1	0.42
Meadow Creek Lower	1999	Summer	23.4	0.9	26.2	0.58
Meadow Creek Lower	2000	Summer	26.9	0.5	52.1	0.68
Meadow Creek Lower	2001	Summer	20.1	0.5	44.2	0.56
Meadow Creek Lower	2002	Summer	20.6	0.6	37.2	0.56
Meadow Creek Lower	2003	Summer	23.4	0.4	66.4	0.80
Meadow Creek Lower	2004	Summer	33.7	0.7	48.9	0.83
Meadow Creek Starkey	1994	Summer	25.8	0.6	43.7	0.58
Meadow Creek Starkey	1995	Summer	21.9	0.8	28.5	0.27
Meadow Creek Starkey	1996	Summer	23.2	0.8	30.2	0.18

Site	Year	Season	Mean Wet Width (ft.)	Mean Depth (ft.)	Mean Width:Depth	Mean Velocity (ft/sec)
Meadow Creek Starkey	1997	Summer	26.0	0.7	40.0	0.34
Meadow Creek Starkey	1998	Summer	25.2	0.6	43.5	0.31
Meadow Creek Starkey	1999	Summer	23.7	0.5	48.2	0.34
Meadow Creek Starkey	2000	Summer	24.1	0.6	42.2	0.38
Meadow Creek Starkey	2001	Summer	37.5	0.6	65.2	0.28
Meadow Creek Starkey	2002	Summer	22.2	0.6	34.6	0.41
Meadow Creek Starkey	2003	Summer	22.2	0.5	42.8	1.09
Meadow Creek Starkey	2004	Summer	25.5	0.6	39.5	0.69
Dark Canyon Creek Lower	1994	Summer	16.0	0.4	41.9	0.20
Dark Canyon Creek Lower	1995	Summer	15.2	0.4	43.3	0.37
Dark Canyon Creek Lower	1996	Summer	13.0	0.3	39.5	0.27
Dark Canyon Creek Lower	1997	Summer	14.0	0.3	46.0	0.26
Dark Canyon Creek Lower	1998	Summer	11.8	0.3	38.6	0.34
Dark Canyon Creek Lower	1999	Summer	13.2	0.3	46.5	0.28
Dark Canyon Creek Lower	2000	Summer	13.2	0.2	55.6	0.26
Dark Canyon Creek Lower	2001	Summer	8.0	0.2	32.7	0.34
Dark Canyon Creek Lower	2002	Summer	9.9	0.3	38.8	0.37
Dark Canyon Creek Lower	2003	Summer	13.8	0.3	52.9	0.33
Dark Canyon Creek Upper	1994	Summer	13.2	0.5	27.7	0.08
Dark Canyon Creek Upper	1995	Summer	13.0	0.4	30.3	0.22
Dark Canyon Creek Upper	1996	Summer	10.4	0.4	26.3	0.23
Dark Canyon Creek Upper	1997	Summer	11.0	0.4	29.0	0.16
Lookout Creek	1994	Summer	6.8	0.6	11.7	0.36
Lookout Creek	1995	Summer	6.9	0.5	12.9	0.54
Lookout Creek	1996	Summer	6.4	0.5	12.3	
Lookout Creek	1997	Summer	6.6	0.6	11.1	0.35
Lookout Creek	1998	Summer	8.3	0.4	19.8	1.50
Lookout Creek	1999	Summer	8.5	0.4	20.2	0.55
Lookout Creek	2000	Summer	7.2	0.4	17.2	0.67
Lookout Creek	2001	Summer	7.0	0.3	24.3	0.94
Lookout Creek	2002	Summer	6.0	0.4	14.2	0.81
Lookout Creek	2003	Summer	7.4	0.4	18.1	0.56
Lookout Creek	2004	Summer	6.8	0.4	16.8	0.62
Limber Jim Creek Upper	1994	Summer	11.0	0.6	17.0	0.87
Limber Jim Creek Upper	1995	Summer	10.5	0.5	20.3	1.13
Limber Jim Creek Upper	1996	Summer	10.8	0.5	22.6	1.04
Limber Jim Creek Upper	1997	Summer	11.2	0.6	17.9	0.89
Limber Jim Creek Upper	1998	Summer	11.2	1.1	10.4	1.27
Limber Jim Creek Upper	1999	Summer	10.8	0.6	18.1	0.94
Limber Jim Creek Upper	2000	Summer	11.1	0.6	17.7	0.64
Limber Jim Creek Upper	2001	Summer	10.2	0.5	21.7	0.69
Limber Jim Creek Upper	2002	Summer	10.1	0.6	17.2	0.92
Limber Jim Creek Upper	2003	Summer	11.6	0.6	19.1	0.89
Limber Jim Creek Upper	2004	Summer	10.7	0.6	17.4	0.99
Limber Jim Creek Lower	1994	Summer	14.3	0.7	20.0	0.86
Limber Jim Creek Lower	1995	Summer	14.3	0.6	25.0	1.21
Limber Jim Creek Lower	1996	Summer	13.7	0.7	18.5	0.00

Site	Year	Season	Mean Wet Width (ft.)	Mean Depth (ft.)	Mean Width:Depth	Mean Velocity (ft/sec)
Limber Jim Creek Lower	1996	Summer	13.8	0.8	17.2	0.00
Limber Jim Creek Lower	1997	Summer	11.5	0.6	19.3	0.99
Limber Jim Creek Lower	1998	Summer	15.3	0.7	22.7	1.20
Limber Jim Creek Lower	2000	Summer	12.8	0.5	27.4	0.98
Limber Jim Creek Lower	2001	Summer	14.7	0.7	22.0	0.82
Limber Jim Creek Lower	2002	Summer	14.0	0.9	16.4	3.77
Limber Jim Creek Lower	2003	Summer	12.9	0.5	26.0	1.07
Limber Jim Creek Lower	2004	Summer	14.3	0.6	24.0	1.30
McCoy Creek Restored	1998	Summer	19.7	1.4	14.0	0.17
McCoy Creek Restored	1999	Summer	17.8	1.1	16.8	0.34
McCoy Creek Restored	2000	Summer	15.6	0.8	18.9	0.24
McCoy Creek Restored	2001	Summer	12.0	0.7	16.6	0.34
McCoy Creek Restored	2002	Summer	8.4	0.6	15.3	0.54
McCoy Creek Restored	2003	Summer	10.7	0.8	12.8	0.32
McCoy Creek Restored	2004	Summer	9.5	0.9	10.4	0.57
McCoy Creek Lower Restored	2003	Summer	8.5	0.8	11.3	0.35
McCoy Creek Lower Restored	2003	Summer	11.7	1.0	11.4	0.36
McCoy Creek Lower Restored	2004	Summer	14.2	1.1	13.5	0.40
McCoy Creek Lower #1	1993	Fall	13.3	0.6	21.8	0.30
McCoy Creek Lower #1	1994	Fall	13.3	0.6	22.9	0.35
McCoy Creek Lower #1	1995	Fall	13.8	0.7	18.7	0.10
McCoy Creek Lower #1	1996	Fall	14.3	0.6	22.6	0.21
McCoy Creek Lower #1	1997	Fall	15.8	0.7	24.3	0.22
McCoy Creek Lower #1	1998	Fall	16.5	0.8	21.3	0.22
McCoy Creek Lower #1	1999	Fall	11.3	0.8	14.7	0.24
McCoy Creek Lower #1	2000	Fall		0.8		0.10
McCoy Creek Lower #1	2001	Fall	14.8	0.9	15.7	0.22
McCoy Creek Lower #2	1993	Fall	16.8	0.6	28.7	0.40
McCoy Creek Lower #2	1994	Fall	13.7	0.5	28.2	0.25
McCoy Creek Lower #2	1995	Fall	15.8	0.6	26.6	0.07
McCoy Creek Lower #2	1996	Fall	16.0	0.5	31.1	0.16
McCoy Creek Lower #2	1997	Fall	15.7	0.5	32.7	0.23
McCoy Creek Lower #2	1998	Fall	16.2	0.4	42.1	0.30
McCoy Creek Lower #2	1999	Fall	14.8	0.4	34.9	0.15
McCoy Creek Lower #2	2000	Fall	16.5	0.3	49.2	0.30
McCoy Creek Lower #2	2001	Fall	12.6	1.1	11.9	0.23
McCoy Creek Middle	1993	Fall	18.8	0.6	31.2	0.19
McCoy Creek Middle	1994	Fall	19.8	0.6	33.3	0.20
McCoy Creek Middle	1995	Fall	20.8	0.6	37.8	0.18
McCoy Creek Middle	1996	Fall	18.9	0.5	40.2	0.16
McCoy Creek Middle	1997	Fall	18.5	0.4	44.2	0.14
McCoy Creek Middle	1998	Fall	18.2	0.4	41.9	0.29
McCoy Creek Middle	1999	Fall	15.8	0.5	32.9	0.09
McCoy Creek Middle	2000	Fall	21.7	0.5	47.2	0.38
McCoy Creek Middle	2002	Fall	15.7	0.4	36.2	0.27
McCoy Creek Middle	2003	Fall	15.6	0.4	37.5	0.29
McCoy Creek Middle	2004	Fall	17.2	0.5	35.8	0.31

Site	Year	Season	Mean Wet Width (ft.)	Mean Depth (ft.)	Mean Width:Depth	Mean Velocity (ft/sec)
McCoy Creek Middle	2005	Fall	16.4	0.4	36.7	0.12
McCoy Creek Upper	1993	Fall	7.3	0.4	16.7	
Meadow Creek Lower	1993	Fall	23.4	0.8	28.0	0.77
Meadow Creek Lower	1994	Fall	15.7	0.8	20.1	0.44
Meadow Creek Lower	1995	Fall	20.1	0.7	29.8	0.70
Meadow Creek Lower	1996	Fall	26.4	1.3	21.0	0.36
Meadow Creek Lower	1997	Fall	28.3	0.9	32.8	0.66
Meadow Creek Lower	1998	Fall	26.7	0.9	28.7	0.56
Meadow Creek Lower	1999	Fall	28.5	0.6	48.5	0.38
Meadow Creek Lower	2000	Fall	20.4	0.7	30.0	0.39
Meadow Creek Lower	2001	Fall	26.6	0.4	63.1	0.63
Meadow Creek Lower	2002	Fall	22.2	0.5	47.2	0.67
Meadow Creek Lower	2003	Fall	21.7	0.4	52.9	1.09
Meadow Creek Lower	2004	Fall	31.7	0.5	61.5	0.80
Meadow Creek Lower	2005	Fall	29.9	0.5	61.2	0.42
Meadow Creek Starkey	1993	Fall	28.0	0.6	43.2	0.43
Meadow Creek Starkey	1994	Fall	24.8	0.6	42.9	0.25
Meadow Creek Starkey	1995	Fall	20.2	0.7	28.1	0.36
Meadow Creek Starkey	1996	Fall	26.4	0.7	38.0	0.24
Meadow Creek Starkey	1997	Fall	24.5	0.7	35.6	0.32
Meadow Creek Starkey	1998	Fall	24.9	0.6	40.7	0.37
Meadow Creek Starkey	1999	Fall	22.8	0.6	39.7	0.31
Meadow Creek Starkey	2000	Fall	14.6	0.5	26.6	0.41
Meadow Creek Starkey	2001	Fall	23.2	0.5	42.9	0.30
Meadow Creek Starkey	2002	Fall	21.4	0.9	24.4	0.83
Meadow Creek Starkey	2003	Fall	21.6	0.5	41.1	0.44
Meadow Creek Starkey	2004	Fall	22.6	0.6	38.2	0.53
Dark Canyon Creek Lower	1993	Fall	15.0	0.4	33.5	0.11
Dark Canyon Creek Lower	1994	Fall	13.8	0.4	37.7	0.10
Dark Canyon Creek Lower	1995	Fall	15.8	0.3	47.5	0.17
Dark Canyon Creek Lower	1996	Fall	10.5	0.3	32.3	0.12
Dark Canyon Creek Lower	1997	Fall	10.3	0.2	46.7	0.13
Dark Canyon Creek Lower	1998	Fall	11.2	0.3	41.2	0.23
Dark Canyon Creek Lower	1999	Fall	13.7	0.2	83.0	0.09
Dark Canyon Creek Lower	2000	Fall	9.7	0.5	20.1	0.06
Dark Canyon Creek Lower	2001	Fall	16.3	0.4	39.9	0.27
Dark Canyon Creek Lower	2001	Fall	9.7	0.2	51.8	0.17
Dark Canyon Creek Lower	2002	Fall	7.1	0.2	31.2	0.18
Dark Canyon Creek Lower	2003	Fall	7.8	0.2	41.6	0.29
Dark Canyon Creek Upper	1993	Fall	11.8	0.4	31.6	0.23
Dark Canyon Creek Upper	1994	Fall	10.3	0.4	25.8	
Dark Canyon Creek Upper	1995	Fall	9.9	0.7	15.1	0.00
Dark Canyon Creek Upper	1996	Fall	7.3	0.3	28.9	0.05
Dark Canyon Creek Upper	1997	Fall	7.7	0.3	26.7	0.01
Lookout Creek	1993	Fall	9.0	0.9	10.5	0.43
Lookout Creek	1994	Fall	6.3	0.5	13.9	0.21
Lookout Creek	1995	Fall	6.5	0.6	11.6	0.37

Site	Year	Season	Mean Wet Width (ft.)	Mean Depth (ft.)	Mean Width:Depth	Mean Velocity (ft/sec)
Lookout Creek	1996	Fall	5.5	0.4	12.7	0.37
Lookout Creek	1997	Fall	5.6	0.4	14.8	0.69
Lookout Creek	1998	Fall	6.2	0.5	12.5	0.45
Lookout Creek	1999	Fall	6.3	0.5	13.7	0.29
Lookout Creek	2000	Fall	8.2	0.4	21.0	0.27
Lookout Creek	2001	Fall	6.0	0.3	21.9	0.53
Lookout Creek	2002	Fall	6.2	0.3	21.7	0.55
Lookout Creek	2003	Fall	5.0	0.3	19.0	0.52
Lookout Creek	2004	Fall	5.8	0.4	13.9	0.51
Limber Jim Creek Upper	1993	Fall	10.3	0.6	17.7	0.64
Limber Jim Creek Upper	1994	Fall	9.8	0.5	21.9	0.48
Limber Jim Creek Upper	1995	Fall	10.9	0.4	26.7	0.73
Limber Jim Creek Upper	1996	Fall	10.3	0.5	21.6	0.77
Limber Jim Creek Upper	1997	Fall	11.6	0.5	25.4	0.56
Limber Jim Creek Upper	1998	Fall	14.9	0.6	26.5	0.65
Limber Jim Creek Upper	1999	Fall	10.3	0.5	21.4	0.27
Limber Jim Creek Upper	2000	Fall	9.8	0.5	21.7	0.46
Limber Jim Creek Upper	2001	Fall	10.5	0.5	22.4	0.55
Limber Jim Creek Upper	2002	Fall	9.7	0.5	19.5	
Limber Jim Creek Upper	2003	Fall	10.6	0.5	22.3	0.51
Limber Jim Creek Upper	2004	Fall	10.0	0.5	20.2	0.71
Limber Jim Creek Lower	1993	Fall	14.8	0.7	21.7	0.80
Limber Jim Creek Lower	1994	Fall	12.8	0.6	21.9	0.52
Limber Jim Creek Lower	1995	Fall	11.6	0.6	19.4	1.21
Limber Jim Creek Lower	1996	Fall	12.8	0.5	26.3	0.65
Limber Jim Creek Lower	1998	Fall	14.2	0.6	25.7	0.02
Limber Jim Creek Lower	1999	Fall	14.2	0.4	31.9	0.65
Limber Jim Creek Lower	2000	Fall	13.5	0.7	19.4	0.69
Limber Jim Creek Lower	2001	Fall	12.0	0.4	29.6	0.64
Limber Jim Creek Lower	2002	Fall	14.8	0.3	51.6	1.12
Limber Jim Creek Lower	2003	Fall	11.4	0.4	26.1	0.76
Limber Jim Creek Lower	2004	Fall	11.5	0.4	29.8	1.05
Limber Jim Creek Lower	2005	Fall	11.3	0.5	24.9	0.58
McCoy Creek Restored	1998	Fall	20.5	1.3	15.5	0.12
McCoy Creek Restored	1999	Fall	17.3	1.2	14.0	0.05
McCoy Creek Restored	2000	Fall	19.2	0.6	31.3	0.22
McCoy Creek Restored	2001	Fall	12.4	0.8	15.6	0.27
McCoy Creek Restored	2002	Fall	10.6	0.8	12.9	0.28
McCoy Creek Restored	2003	Fall	9.2	0.8	11.5	0.34
McCoy Creek Restored	2004	Fall	9.7	0.9	11.3	0.35
McCoy Creek Restored	2005	Fall	9.9	0.8	12.7	0.27
McCoy Creek Lower Restored	2003	Fall	10.1	0.9	11.3	0.31
McCoy Creek Lower Restored	2004	Fall	10.9	0.8	13.8	0.35
McCoy Creek Lower Restored	2005	Fall	9.3	0.6	16.0	0.15

Appendix G. Habitat Statistics

Part 2.

Site	Year	Season	% Bedrock	% Boulder	% Cobble	% Gravel	% Sand	% Silt	% Clay	% Embedded	% Shade
McCoy Creek Lower #1	1993	Spring	2.2	2.8	43.9	26.4	13.3	2.2	0.0	35.6	3.4
McCoy Creek Lower #1	1994	Spring	0.0	3.3	46.1	35.0	13.9	0.0	0.0	30.8	0.7
McCoy Creek Lower #1	1995	Spring	0.0	3.2	33.9	33.3	20.6	0.0	0.0	48.9	3.9
McCoy Creek Lower #1	1996	Spring	0.0	0.0	27.8	23.9	9.4	0.0	1.7	30.8	9.7
McCoy Creek Lower #1	1997	Spring									0.0
McCoy Creek Lower #1	1998	Spring	0.0	0.0	72.2	19.4	8.9	0.0	0.0	6.4	4.9
McCoy Creek Lower #1	1999	Spring									0.5
McCoy Creek Lower #1	2000	Spring	0.0	1.1	50.0	32.8	10.0	0.6	0.0	21.8	9.1
McCoy Creek Lower #1	2001	Spring									
McCoy Creek Lower #2	1993	Spring	0.0	3.3	34.2	37.5	11.2	5.6	0.0	42.8	4.7
McCoy Creek Lower #2	1994	Spring	0.0	0.0	30.4	34.3	26.5	0.0	0.0	47.8	6.1
McCoy Creek Lower #2	1995	Spring	0.0	1.7	25.0	40.6	17.2	4.4	0.0	32.1	2.5
McCoy Creek Lower #2	1996	Spring	0.0	0.3	17.5	48.9	24.7	3.9	0.0		5.4
McCoy Creek Lower #2	1997	Spring									
McCoy Creek Lower #2	1998	Spring	0.0	0.0	67.2	19.4	7.8	0.0	3.9	16.1	5.6
McCoy Creek Lower #2	1999	Spring									6.5
McCoy Creek Lower #2	2000	Spring	0.0	5.6	38.9	27.8	8.3	1.1	0.0	18.7	6.2
McCoy Creek Lower #2	2001	Spring									
McCoy Creek Middle	1993	Spring	0.0	7.2	27.2	36.4	15.8	2.2	0.0	33.1	38.0
McCoy Creek Middle	1994	Spring	0.0	2.8	22.2	44.4	25.0	0.0	0.0		28.7
McCoy Creek Middle	1995	Spring	0.0	4.1	20.6	33.9	20.0	10.0	0.0	52.9	38.5
McCoy Creek Middle	1996	Spring	0.0	2.2	23.5	43.3	18.3	3.5	0.0	37.2	49.5
McCoy Creek Middle	1997	Spring									
McCoy Creek Middle	1998	Spring	0.0	0.0	36.1	57.1	7.2	0.0	0.0	9.4	18.6
McCoy Creek Middle	1999	Spring									29.2
McCoy Creek Middle	2000	Spring	0.0	7.1	50.0	31.9	10.3	0.0	0.0	18.1	50.5
McCoy Creek Middle	2001	Spring									0.0
McCoy Creek Upper	1993	Spring	0.0	0.8	28.9	36.7	11.8	15.0	0.0	50.8	8.3
Meadow Creek Lower	1993	Spring	0.0	0.3	42.2	31.7	7.5	5.8	0.0	41.1	3.4
Meadow Creek Lower	1994	Spring	0.0	0.0	51.1	48.9	0.0	0.0	0.0	25.0	2.5
Meadow Creek Lower	1995	Spring	0.0	1.7	42.2	30.6	15.0	0.0	0.0	49.4	0.7
Meadow Creek Lower	1996	Spring	0.0	1.9	29.4	39.2	15.8	1.1	0.0		1.2
Meadow Creek Lower	1997	Spring									
Meadow Creek Lower	1998	Spring	0.0	0.0	29.4	50.0	13.1	6.1	0.0	13.4	5.9
Meadow Creek Lower	1999	Spring									5.9
Meadow Creek Lower	2000	Spring	0.0	9.4	46.1	28.9	4.4	0.6	0.0	27.1	11.0
Meadow Creek Lower	2001	Spring									
Meadow Creek Starkey	1993	Spring	3.9	8.1	28.3	34.2	13.3	2.2	0.0	38.5	32.3
Meadow Creek Starkey	1994	Spring	1.8	19.1	38.5	31.8	6.4	0.0	0.0	50.0	44.3
Meadow Creek Starkey	1995	Spring	0.0	18.3	40.0	25.0	3.9	0.6	0.0	26.9	42.1
Meadow Creek Starkey	1996	Spring									36.8
Meadow Creek Starkey	1997	Spring									
Meadow Creek Starkey	1998	Spring	3.3	5.6	42.2	33.3	13.3	0.0	0.0		47.3
Meadow Creek Starkey	1999	Spring									0.0

Site	Year	Season	% Bedrock	% Boulder	% Cobble	% Gravel	% Sand	% Silt	% Clay	% Embedded	% Shade
Meadow Creek Starkey	2000	Spring	0.0	3.3	38.3	46.7	8.8	0.0	0.0	20.6	29.4
Meadow Creek Starkey	2001	Spring									
Meadow Creek Starkey	2001	Spring									
Dark Canyon Creek Lower	1993	Spring	0.0	5.3	44.2	25.0	15.2	0.0	0.0	26.9	22.3
Dark Canyon Creek Lower	1994	Spring	2.8	24.1	50.2	22.9	0.0	0.0	0.0		24.3
Dark Canyon Creek Lower	1995	Spring	0.0	6.1	32.8	37.2	13.3	0.0	0.0	36.1	40.7
Dark Canyon Creek Lower	1995	Spring	0.0	11.1	41.1	29.4	7.2	0.0	0.0	33.3	30.9
Dark Canyon Creek Lower	1996	Spring	0.0	4.4	62.8	20.0	8.1	2.8	0.0	16.1	37.5
Dark Canyon Creek Lower	1997	Spring									
Dark Canyon Creek Lower	1998	Spring	0.0	8.9	56.1	22.2	9.4	2.2	0.0	8.8	26.6
Dark Canyon Creek Lower	1999	Spring	0.0	2.8	50.0	28.2	2.8	20.0	0.0	42.2	30.9
Dark Canyon Creek Lower	2000	Spring	0.0	1.1	28.9	48.9	16.7	0.0	0.0		31.9
Dark Canyon Creek Lower	2001	Spring									
Dark Canyon Creek Upper	1993	Spring	4.7	9.7	46.7	19.7	13.0	1.7	0.0	20.4	32.3
Dark Canyon Creek Upper	1994	Spring	0.0	10.2	36.6	16.3	1.1	0.0	0.0	25.0	37.2
Dark Canyon Creek Upper	1995	Spring	0.0	17.6	51.1		4.4	0.0	0.0	33.3	44.1
Dark Canyon Creek Upper	1996	Spring	0.0	16.8	59.4	13.9	5.6	0.0	0.0	29.7	49.0
Dark Canyon Creek Upper	1997	Spring									
Dark Canyon Creek Upper	1998	Spring	0.0	28.3	37.2	13.3	8.8	0.0	0.0		34.8
Lookout Creek	1994	Spring	0.0	0.0	18.9	38.9	36.7	0.0	0.0	62.5	33.1
Lookout Creek	1995	Spring	0.0	0.0	26.8	45.3	26.1	0.0	0.0	26.1	44.8
Lookout Creek	1996	Spring									
Lookout Creek	1997	Spring									
Lookout Creek	2000	Spring	0.0	0.0	10.0	51.1	31.1	8.8	0.0	26.7	42.9
Lookout Creek	2001	Spring									
Limber Jim Creek Upper	1994	Spring	0.0	0.6	30.6	22.4	35.7	0.0	0.0	60.0	62.7
Limber Jim Creek Upper	1995	Spring	0.0	5.0	42.9	26.7	16.1	5.6	0.0	32.2	79.4
Limber Jim Creek Upper	1996	Spring	0.0	0.0	22.8	35.9	30.3	5.6	0.0	36.9	79.4
Limber Jim Creek Upper	1997	Spring									
Limber Jim Creek Upper	1998	Spring	0.0	2.8	48.9	26.7	17.9	1.9	0.0	10.0	74.2
Limber Jim Creek Upper	1999	Spring									
Limber Jim Creek Upper	2000	Spring	0.0	0.0	41.1	36.7	20.6	0.0	0.0	17.8	56.4
Limber Jim Creek Upper	2001	Spring									
Limber Jim Creek Lower	1994	Spring	0.0	0.0	18.1	35.0	28.9	2.8	0.0	55.9	5.6
Limber Jim Creek Lower	1995	Spring	0.0	4.7	23.1	32.9	27.5	5.3	0.0	44.2	13.2
Limber Jim Creek Lower	1996	Spring	0.0	1.1	22.2	36.7	23.9	11.7	0.0	40.0	3.4
Limber Jim Creek Lower	1996	Spring									
Limber Jim Creek Lower	1997	Spring									
Limber Jim Creek Lower	1998	Spring	0.0	0.0	43.9	41.8	15.6	0.0	0.0	12.0	7.8
Limber Jim Creek Lower	1999	Spring									11.5
Limber Jim Creek Lower	2000	Spring	0.0	0.0	27.8	45.6	19.4	4.4	0.0	22.2	11.3
Limber Jim Creek Lower	2001	Spring									
McCoy Creek Restored	1998	Spring	0.0	0.0	17.9	4.7	7.9	25.3	51.8	34.2	1.5
McCoy Creek Restored	1999	Spring									0.7
McCoy Creek Restored	2000	Spring	0.0	0.0	14.4	21.7	17.6	23.3	0.0	16.9	4.7
McCoy Creek Restored	2001	Spring									
McCoy Creek Lower #1	1994	Summer	0.0	4.7	29.2	30.6	25.3	1.9	0.0	61.3	2.5
McCoy Creek Lower #1	1995	Summer	0.0	5.0	39.4	28.9	15.0	3.9	0.0	58.7	8.8

Site	Year	Season	% Bedrock	% Boulder	% Cobble	% Gravel	% Sand	% Silt	% Clay	% Embedded	% Shade
McCoy Creek Lower #1	1996	Summer	0.0	0.0	27.6	25.0	29.4	8.9	0.0	63.3	5.1
McCoy Creek Lower #1	1997	Summer	0.0		66.9	18.6	10.0	0.0	4.2	22.6	5.9
McCoy Creek Lower #1	1998	Summer	0.0	1.1	57.8	22.2	15.9	1.1	0.0	42.4	8.8
McCoy Creek Lower #1	1999	Summer	0.0	0.0	35.0	27.8	15.6	5.0	0.0	41.1	
McCoy Creek Lower #1	2000	Summer	0.0	0.0	46.9	20.6	33.3	0.0	0.0		11.5
McCoy Creek Lower #1	2001	Summer	3.9	0.0	43.9	14.4	20.0	0.0	0.0	35.9	
McCoy Creek Lower #2	1994	Summer	0.0	3.9	23.3	31.7	18.9	0.8	0.0	61.3	8.2
McCoy Creek Lower #2	1995	Summer	0.0	10.4	37.5	24.7	8.8	1.1	0.0	60.7	5.3
McCoy Creek Lower #2	1996	Summer	0.0	0.0	25.6	43.9	27.2	0.0	0.0	48.9	11.0
McCoy Creek Lower #2	1997	Summer	0.0	2.2	10.0	51.1	32.5	0.0	0.0	51.7	10.5
McCoy Creek Lower #2	1998	Summer	0.0	0.0	49.4	22.2	11.7	0.0	0.0	35.3	4.7
McCoy Creek Lower #2	1999	Summer	0.0	0.0	31.8	36.7	20.0	0.0	0.0	35.0	9.3
McCoy Creek Lower #2	2000	Summer	0.0	0.0	44.4	37.5	15.3	0.0	0.0	40.0	7.8
McCoy Creek Lower #2	2001	Summer	5.0	0.0	30.0	32.8	21.8	1.7	0.0	23.3	
McCoy Creek Middle	1994	Summer	0.0	9.7	34.1	32.2	16.1	0.0	0.0	50.0	35.8
McCoy Creek Middle	1995	Summer	2.9	5.0	10.8	41.4	15.8	1.7	0.0	26.7	45.3
McCoy Creek Middle	1996	Summer	0.0	1.1	12.5	36.4	30.6	7.6	0.0	51.7	45.3
McCoy Creek Middle	1997	Summer	0.0	1.1	18.9	50.0	23.6	0.0	0.0	32.8	31.6
McCoy Creek Middle	1998	Summer	1.1	0.3	28.6	45.6	18.3	0.0	0.0	40.8	43.6
McCoy Creek Middle	1999	Summer	0.0	1.7	33.9	33.3	14.4	5.0	0.0	23.6	49.0
McCoy Creek Middle	2000	Summer	0.0	10.0	51.7	27.2	9.4	0.0	0.0	25.0	44.8
McCoy Creek Middle	2001	Summer	3.3	38.3	46.7	3.1	3.1	0.0	0.0	21.7	
McCoy Creek Middle	2002	Summer	0.0	12.2	55.0	27.2	3.5	1.1	0.0	26.7	41.2
McCoy Creek Middle	2003	Summer	0.0	16.7	46.4	30.8	5.6	0.0	0.0	20.8	66.4
McCoy Creek Middle	2004	Summer	0.0	1.1	27.8	51.1	18.9	0.0	0.0	25.6	41.9
McCoy Creek Upper	1994	Summer	0.0	0.0	16.9	20.8	8.6	0.0	0.0	42.2	20.1
Meadow Creek Lower	1994	Summer	0.7	1.0	38.3	37.2	11.9	0.0		55.0	2.7
Meadow Creek Lower	1995	Summer	0.0	5.8	47.8	29.4	9.7	0.0	0.0	15.6	10.8
Meadow Creek Lower	1996	Summer	0.0	0.0	24.3	27.8	25.0	14.4		63.9	5.1
Meadow Creek Lower	1997	Summer	0.0	8.9	34.4	40.0	7.5	10.0	0.0	36.7	14.7
Meadow Creek Lower	1998	Summer	0.0	11.7	49.4	26.1	9.4	1.1	0.0	43.3	5.4
Meadow Creek Lower	1999	Summer	0.0	0.0	26.7	45.0	8.9	8.1	0.0	32.2	9.3
Meadow Creek Lower	2000	Summer	0.0	1.1	51.9	36.7	10.6	0.0	0.0	32.8	5.9
Meadow Creek Lower	2001	Summer	0.0	0.0	33.9	27.8	18.1	0.0	0.0	32.2	
Meadow Creek Lower	2002	Summer	3.3	6.4	51.2	33.1	6.4	0.0	0.0	30.8	9.3
Meadow Creek Lower	2003	Summer	4.4	6.3	52.8	31.7	12.2	0.0	0.0	18.6	8.9
Meadow Creek Lower	2004	Summer	0.0	0.0	31.7	46.7	12.2	2.2	0.0	29.7	0.7
Meadow Creek Starkey	1994	Summer	5.6	4.4	25.6	40.0	16.1	0.0	0.0	41.8	46.6
Meadow Creek Starkey	1995	Summer	5.6	5.6	26.1	35.0	14.4	0.0	0.0	20.3	44.8
Meadow Creek Starkey	1996	Summer	0.0	1.7	24.0	29.2	27.2	5.9	0.0	59.4	41.4
Meadow Creek Starkey	1997	Summer	0.0	6.1	28.9	57.2	0.0	1.7	0.0	44.4	44.3
Meadow Creek Starkey	1998	Summer	0.0	11.1	55.0	24.2	7.5	0.0	0.0	25.0	39.7
Meadow Creek Starkey	1999	Summer	3.3	1.7	36.1	23.3	8.9	13.9	0.0	30.6	34.1
Meadow Creek Starkey	2000	Summer	0.0	1.4	53.9	27.8	15.3	0.0	0.0	28.9	37.7
Meadow Creek Starkey	2001	Summer	7.2	5.0	46.7	4.4	6.5	0.0	0.0	23.3	
Meadow Creek Starkey	2002	Summer	0.0	18.1	46.4	28.9	3.9	1.7	0.0	44.7	33.6
Meadow Creek Starkey	2003	Summer	0.0	10.0	55.6	26.9	7.7	0.0	0.0	21.4	40.2
Meadow Creek Starkey	2004	Summer	0.0	15.0	45.0	24.4	8.2	0.0	0.0	34.7	44.8

Site	Year	Season	% Bedrock	% Boulder	% Cobble	% Gravel	% Sand	% Silt	% Clay	% Embedded	% Shade
Dark Canyon Creek Lower	1994	Summer	0.3	4.1	38.9	28.1	6.7	0.0	0.0	53.9	30.4
Dark Canyon Creek Lower	1995	Summer	0.0	5.0	52.2	28.6	1.9	0.6	0.0	59.4	27.4
Dark Canyon Creek Lower	1996	Summer	0.0	6.7	43.3	29.4	11.7	0.0	0.0	20.0	29.9
Dark Canyon Creek Lower	1997	Summer	0.0	1.7	35.6	62.8	0.0	0.0	0.0	25.6	39.4
Dark Canyon Creek Lower	1998	Summer	0.0	8.3	50.6	35.8	9.7			50.6	29.9
Dark Canyon Creek Lower	1999	Summer	0.0	8.6	40.6	30.0	16.1	0.0	0.0	30.6	35.5
Dark Canyon Creek Lower	2000	Summer	0.0	1.7	53.3	23.9	8.3	15.0	0.0	46.1	42.9
Dark Canyon Creek Lower	2001	Summer	1.7	18.1	53.3	5.9	5.6	0.0	0.0	26.9	
Dark Canyon Creek Lower	2002	Summer	0.0	7.2	59.2	25.8	1.1	6.7	0.0	25.6	25.7
Dark Canyon Creek Lower	2003	Summer	0.0	17.2	50.6	27.5	3.2	1.1	0.0	25.0	41.9
Dark Canyon Creek Upper	1994	Summer	6.1	7.2	49.4	20.0	0.0	7.8	0.0	29.4	32.8
Dark Canyon Creek Upper	1995	Summer	0.0	26.1	40.6	20.3	4.2	1.7	0.0	57.1	40.9
Dark Canyon Creek Upper	1996	Summer	6.7	7.1	21.7	23.3	30.6	0.0	0.0	43.6	46.1
Dark Canyon Creek Upper	1997	Summer	0.0	8.9	37.8	52.2	0.6	0.0	0.0	30.0	38.7
Lookout Creek	1994	Summer	0.0	0.0	10.8	60.8	25.6	0.0	0.0	28.9	31.9
Lookout Creek	1995	Summer	0.0	0.0	17.8	54.4	23.2	4.4	1.7	18.9	53.2
Lookout Creek	1996	Summer	0.0	0.0	8.0	61.1	27.8	0.0	0.0	16.9	63.0
Lookout Creek	1997	Summer	0.0	0.0	10.0	73.9	18.3	0.6	0.0	21.4	47.8
Lookout Creek	1998	Summer	0.0	0.0	35.6	25.6	5.0	0.0	0.0	12.9	74.4
Lookout Creek	1999	Summer	0.0	0.0	21.7		17.8	1.7	0.0	17.8	63.7
Lookout Creek	2000	Summer	0.0	0.0	49.4	35.6	12.8	2.2	0.0	12.1	66.6
Lookout Creek	2001	Summer	0.0	0.0	46.1	14.4	15.9	0.0	0.0	11.7	
Lookout Creek	2002	Summer	0.0		35.6	47.2	17.6	0.0	0.0	25.7	81.6
Lookout Creek	2003	Summer	0.0	0.0	12.2	62.2	24.4	0.0	0.0	25.1	80.1
Lookout Creek	2004	Summer	0.0	0.0	6.1	63.9	30.0	0.0	0.0	36.7	67.6
Limber Jim Creek Upper	1994	Summer	0.0	1.1	40.0	22.8	27.8	0.0	0.0	22.5	62.7
Limber Jim Creek Upper	1995	Summer	0.0	0.8	36.7	36.9	20.8	0.0	0.0	37.5	77.7
Limber Jim Creek Upper	1996	Summer	0.0	0.0	25.3	32.8	32.2	0.0	0.0	34.4	80.6
Limber Jim Creek Upper	1997	Summer	0.0	0.0	42.9	23.3	35.0	0.0	0.0	43.1	61.7
Limber Jim Creek Upper	1998	Summer	0.0	0.6	42.2	23.9	33.1	0.0	0.0	38.8	75.7
Limber Jim Creek Upper	1999	Summer	0.0	0.0	23.9	36.7	21.4	0.0	0.0	33.8	79.6
Limber Jim Creek Upper	2000	Summer	0.0	0.0	40.3	30.6	24.5	4.4	0.0	37.5	70.1
Limber Jim Creek Upper	2001	Summer	3.3	0.0	36.1	8.8	17.8	0.0	0.0	40.0	
Limber Jim Creek Upper	2002	Summer	0.0	4.4	152.8	33.3	17.2	0.6	0.0	30.6	80.1
Limber Jim Creek Upper	2003	Summer	0.0	3.9	45.0	26.7	21.7	2.8	0.0	46.8	81.8
Limber Jim Creek Upper	2004	Summer	0.0	0.0	22.8	46.1	28.9	2.2	0.0	31.1	86.0
Limber Jim Creek Lower	1994	Summer	0.0	1.1	30.0	26.1	43.3	0.0	0.0	40.6	10.0
Limber Jim Creek Lower	1995	Summer	0.0	3.3	32.8	44.2	16.5	0.0	0.0	39.1	16.9
Limber Jim Creek Lower	1996	Summer	0.0	2.4	19.3	41.9	25.7	1.4	0.0	25.0	21.9
Limber Jim Creek Lower	1996	Summer	0.0	2.4	17.6	41.9	29.5	1.4	0.0	34.6	14.9
Limber Jim Creek Lower	1997	Summer	0.0	2.2	22.8	49.4	23.1	1.1	0.0	40.0	17.2
Limber Jim Creek Lower	1998	Summer	0.0	8.2	45.3	28.9	14.7	0.0	0.0	18.2	25.7
Limber Jim Creek Lower	2000	Summer	0.0	1.1	48.6	36.7	10.8	3.9	0.0	28.6	16.7
Limber Jim Creek Lower	2001	Summer	0.0	0.0	31.9	22.9	22.2	0.0	0.0	35.6	
Limber Jim Creek Lower	2002	Summer	0.0	0.0	22.8	58.9	21.1	11.1	0.0	28.8	21.1
Limber Jim Creek Lower	2003	Summer	0.0	11.9	41.4	33.6	12.6	0.0	0.0	23.9	25.0
Limber Jim Creek Lower	2004	Summer	0.0	0.0	27.8	47.2	25.6	1.1	0.0	36.1	16.7
McCoy Creek Restored	1998	Summer	0.0	0.0	1.1	20.6	37.8	41.4	0.0	65.0	21.3

Site	Year	Season	% Bedrock	% Boulder	% Cobble	% Gravel	% Sand	% Silt	% Clay	% Embedded	% Shade
McCoy Creek Restored	1999	Summer	0.0	0.0	8.2	18.9	1.7	66.9	0.0	76.7	11.5
McCoy Creek Restored	2000	Summer	0.0	0.0	23.9	15.0	27.2	29.4	0.0	21.5	23.5
McCoy Creek Restored	2001	Summer	0.0	0.0	20.4	20.7	19.9	3.9	0.0	44.4	
McCoy Creek Restored	2002	Summer	0.0	0.0	20.0	36.1	22.2	3.9	0.0	33.3	8.8
McCoy Creek Restored	2003	Summer	0.0	1.1	32.4	39.7	25.8	2.2	0.0	39.8	30.9
McCoy Creek Restored	2004	Summer	0.0	0.0	13.9	39.4	22.8	11.7	0.0	38.9	2.9
McCoy Creek Lower #1 Restored	2003	Summer	0.0	5.6	46.3	33.3	20.0	0.0	0.0	44.7	6.2
McCoy Creek Lower #1 Restored	2003	Summer	0.0	0.0	45.6	30.0	21.1	1.1	0.0	58.6	7.8
McCoy Creek Lower #1 Restored	2004	Summer	0.0	0.0	1.8	37.0	30.9	21.5	0.0	38.8	0.7
McCoy Creek Lower #1	1993	Fall	1.7	0.0	37.2	37.5	12.5	3.9	0.0	49.7	3.2
McCoy Creek Lower #1	1994	Fall	0.0	1.1	42.2	33.6	16.1	5.9	0.0	39.2	3.7
McCoy Creek Lower #1	1995	Fall	0.0	3.9	32.9	43.9	15.6	1.4	1.4	26.8	11.8
McCoy Creek Lower #1	1996	Fall	0.0	0.0	37.5	32.8	16.8	9.4	0.0	68.3	4.9
McCoy Creek Lower #1	1997	Fall	0.0	0.0	63.9	19.7	13.2	1.1	2.4	16.9	
McCoy Creek Lower #1	1998	Fall	0.0	0.6	45.0	36.1	14.4	0.0	3.3	35.0	7.4
McCoy Creek Lower #1	1999	Fall	0.0	0.0	34.2	33.3	26.9	0.0	0.0	33.3	4.4
McCoy Creek Lower #1	2000	Fall	0.0	0.0	40.6	19.4	20.0	20.6	0.0	60.0	5.9
McCoy Creek Lower #1	2001	Fall	0.0	3.3	47.8	15.0	8.9	0.0	0.0	37.2	
McCoy Creek Lower #2	1993	Fall	0.0	3.3	35.2	26.3	15.2	10.6	0.0	41.2	0.2
McCoy Creek Lower #2	1994	Fall	0.0	0.0	41.1	39.2	6.1	0.0	0.0	34.4	9.7
McCoy Creek Lower #2	1995	Fall	0.0	4.4	19.4	41.1	6.9	0.0	3.6	43.0	12.6
McCoy Creek Lower #2	1996	Fall	0.0	0.0	2.5	34.4	28.2	15.6	0.0	68.7	8.5
McCoy Creek Lower #2	1997	Fall	0.0	0.0	28.3	47.8	23.3	0.0	0.0	48.1	
McCoy Creek Lower #2	1998	Fall	0.0	0.0	49.0	41.0	8.2	1.3	0.0	28.7	11.2
McCoy Creek Lower #2	1999	Fall	0.0	0.0	32.2	33.9	23.9	0.0	9.4	45.0	5.9
McCoy Creek Lower #2	2000	Fall	0.0	0.6	37.3	28.3	6.1	30.0	0.0	55.6	10.5
McCoy Creek Lower #2	2001	Fall	0.0	2.8	17.2	8.8	4.1	0.0	0.0	39.4	
McCoy Creek Middle	1993	Fall	0.0	1.1	35.6	56.1	5.3	2.1	0.0	16.5	42.4
McCoy Creek Middle	1994	Fall	5.6	11.2	40.6	33.9	3.9	5.3	0.0	37.8	23.0
McCoy Creek Middle	1995	Fall	1.7	9.4	55.0	33.3	1.4	0.0	0.0	14.2	35.8
McCoy Creek Middle	1996	Fall	7.2	1.7	13.3	66.1	12.4	1.1	0.0	23.9	45.3
McCoy Creek Middle	1997	Fall	0.0	8.2	44.4	28.9	14.7	0.0	0.0	32.2	33.3
McCoy Creek Middle	1998	Fall	0.0	3.6	30.6	51.1	9.4	0.0	0.0	25.3	38.7
McCoy Creek Middle	1999	Fall	0.0	3.9	33.1	50.0	12.9	0.0	0.0	26.7	49.7
McCoy Creek Middle	2000	Fall	0.0	0.0	19.4	45.6	8.3	25.3	0.0	47.8	34.7
McCoy Creek Middle	2002	Fall	0.0	16.8	47.9	35.0	0.6	5.6	0.0	24.4	47.8
McCoy Creek Middle	2003	Fall	0.0	11.9	51.7	28.9	4.4	3.5	0.0	25.8	51.5
McCoy Creek Middle	2004	Fall	0.0	11.1	42.8	41.7	3.9	0.0	0.0	30.8	46.8
McCoy Creek Middle	2005	Fall	0.0	5.6	32.2	40.0	10.0	5.3	0.0	16.4	45.6
McCoy Creek Upper	1993	Fall	0.0	0.3	34.7	41.1	1.1	0.6	0.0	33.1	10.5
Meadow Creek Lower	1993	Fall	0.0	2.0	48.9	31.7	3.3	4.4	0.0	29.4	4.7
Meadow Creek Lower	1994	Fall	0.0	3.9	37.1	48.3	5.0	0.0	0.0	28.3	6.1
Meadow Creek Lower	1995	Fall	0.0	1.7	39.4	37.2	12.1	0.0	0.0	39.4	4.9
Meadow Creek Lower	1996	Fall	1.1	0.6	30.9	42.8	18.1	5.6	0.0	35.3	1.5
Meadow Creek Lower	1997	Fall	0.0	1.7	51.1	35.3	9.4	1.7	0.0	19.1	
Meadow Creek Lower	1998	Fall	1.7	3.9	33.1	48.6	15.0	0.0	0.0	58.8	15.9
Meadow Creek Lower	1999	Fall	0.0	0.0	46.1	44.4	9.4	0.0	0.0	25.6	5.1
Meadow Creek Lower	2000	Fall	0.0	1.8	22.8	50.6	1.8	22.2	0.0	62.8	8.8

Site	Year	Season	% Bedrock	% Boulder	% Cobble	% Gravel	% Sand	% Silt	% Clay	% Embedded	% Shade
Meadow Creek Lower	2001	Fall	2.8	2.2	56.1	1.7	1.7	0.0	0.0	30.0	
Meadow Creek Lower	2002	Fall	0.0	1.9	51.7	39.4	29.7	0.0	0.0	36.7	13.3
Meadow Creek Lower	2003	Fall	0.0	3.9	56.9	31.7	6.9	0.0	0.0	29.4	12.0
Meadow Creek Lower	2004	Fall	0.0	3.9	38.6	45.0	8.6	0.0	0.0	40.3	6.4
Meadow Creek Lower	2005	Fall	0.0	0.0	23.9	69.7	1.9	4.4	0.0	7.8	2.0
Meadow Creek Starkey	1993	Fall	8.3	8.3	33.3	36.7	5.9	0.6	0.0	49.2	35.3
Meadow Creek Starkey	1994	Fall	10.0	11.1	36.1	25.0	5.0	0.0	0.0	21.8	31.9
Meadow Creek Starkey	1995	Fall	9.4	7.7	22.6	46.7	8.8	0.0	0.0	30.3	38.2
Meadow Creek Starkey	1996	Fall	2.8	7.2	35.6	39.4	4.7	5.0	0.0	16.1	37.0
Meadow Creek Starkey	1997	Fall	7.2	0.6	50.8	23.5	15.6	2.5	0.0	28.5	30.6
Meadow Creek Starkey	1998	Fall	0.0	2.8	46.9	32.5	14.2	0.0	0.0	38.1	34.5
Meadow Creek Starkey	1999	Fall	0.0	0.6	41.4	32.4	22.8	0.0	0.0	30.8	33.3
Meadow Creek Starkey	2000	Fall	0.0	0.0	29.4	38.9	7.6	23.9	0.0	35.0	38.7
Meadow Creek Starkey	2001	Fall	2.8	3.3	18.3	36.5	27.8	1.1	0.0	26.7	
Meadow Creek Starkey	2002	Fall	1.1	0.8	96.9	24.4	3.1	2.2	0.0	28.1	38.2
Meadow Creek Starkey	2003	Fall	0.0	10.0	55.6	23.9	4.4	5.6	0.0	31.4	40.4
Meadow Creek Starkey	2004	Fall	0.0	7.5	44.7	39.7	6.1	0.0	0.0	31.1	40.7
Dark Canyon Creek Lower	1993	Fall	0.0	6.1	51.1	30.3	1.4	6.1	0.0	41.9	19.6
Dark Canyon Creek Lower	1994	Fall	0.0	11.2	36.7	17.8	4.4	22.8	0.0	59.4	19.8
Dark Canyon Creek Lower	1995	Fall	0.0	21.9	48.3	24.2	1.7	0.0	0.0	27.5	31.4
Dark Canyon Creek Lower	1996	Fall	0.0	1.4	53.3	27.8	6.7	3.9	0.0	39.2	29.9
Dark Canyon Creek Lower	1997	Fall	0.0	0.0	71.4	20.0	8.1	0.0	0.0	16.4	33.8
Dark Canyon Creek Lower	1998	Fall	0.0	0.0	62.2	32.8	3.9	0.0	0.0	31.7	26.0
Dark Canyon Creek Lower	1999	Fall	0.0	5.3	61.1	28.1	5.0	0.0	0.0	18.3	35.8
Dark Canyon Creek Lower	2000	Fall	0.0	0.0	27.2	33.3	7.2	60.6	0.0	39.3	30.4
Dark Canyon Creek Lower	2001	Fall	2.9	1.7	30.0	27.2	12.2	0.0	0.0	23.5	
Dark Canyon Creek Lower	2001	Fall	3.3	13.3	54.4	0.6	0.6	0.0	0.0	26.7	
Dark Canyon Creek Lower	2002	Fall	0.0	28.7	57.8	25.0	1.7	0.0	0.0	27.8	42.4
Dark Canyon Creek Lower	2003	Fall	0.0	14.4	55.6	23.9	0.0	5.0	0.0	22.5	41.2
Dark Canyon Creek Upper	1993	Fall	6.1	4.7	41.4	31.4	1.4	0.0	0.0	35.0	33.3
Dark Canyon Creek Upper	1994	Fall	8.3	13.8	45.8	20.0	1.7	0.0	0.0	20.3	30.1
Dark Canyon Creek Upper	1995	Fall	5.6	11.4	32.2	25.9	8.3	0.0	0.0	51.1	42.1
Dark Canyon Creek Upper	1996	Fall	3.9	4.2	38.2	35.0	0.3	15.0	0.0	59.4	34.1
Dark Canyon Creek Upper	1997	Fall	5.6	20.6	45.0	21.1	5.0	0.0	0.0	60.0	
Lookout Creek	1993	Fall	0.0	0.0	22.8	51.4	19.3	9.4	0.0	53.9	41.9
Lookout Creek	1994	Fall	0.0	0.0	18.9	53.9	19.4	0.0	0.0	41.2	38.2
Lookout Creek	1995	Fall	0.0	0.0	6.4	73.3	15.6	0.0	2.2	24.7	52.2
Lookout Creek	1996	Fall	0.0	0.0	2.2	80.6	15.0	2.8	0.0	16.1	67.6
Lookout Creek	1997	Fall	0.0	0.0	11.7	70.3	16.4	0.0	0.0	30.6	50.2
Lookout Creek	1998	Fall	0.0	0.0	7.2	76.7	16.1	0.0	0.0	23.2	50.0
Lookout Creek	1999	Fall	0.0	0.0	5.0	72.5	22.2	0.0	0.0	17.8	51.9
Lookout Creek	2000	Fall	0.0	0.0	0.0	63.3	22.8	13.9	0.0	12.2	59.0
Lookout Creek	2001	Fall	0.0	0.0	0.6	77.2	19.4	0.0	0.0	20.6	
Lookout Creek	2002	Fall	0.0	0.0	45.0	36.9	11.1	2.8	0.0	15.8	77.4
Lookout Creek	2003	Fall	0.0	0.0	9.2	73.3	16.9	0.6	0.0	21.3	70.1
Lookout Creek	2004	Fall	0.0	0.0	2.8	56.1	8.9	18.3	0.0	60.0	79.1
Limber Jim Creek Upper	1993	Fall	0.0	5.0	34.2	27.8	24.7	0.0	0.0	41.1	68.8
Limber Jim Creek Upper	1994	Fall	0.0	3.3	35.6	25.6	26.1	2.8	0.0	50.0	65.4

Site	Year	Season	% Bedrock	% Boulder	% Cobble	% Gravel	% Sand	% Silt	% Clay	% Embedded	% Shade
Limber Jim Creek Upper	1995	Fall	0.0	3.9	47.6	32.9	13.9	0.6	0.0	24.7	73.0
Limber Jim Creek Upper	1996	Fall	0.0	0.0	26.5	36.7	23.3	4.4	0.0	40.9	71.8
Limber Jim Creek Upper	1997	Fall	0.0	0.0	45.0	23.1	28.1	2.2	0.0	22.2	
Limber Jim Creek Upper	1998	Fall	0.0	1.1	29.4	25.6	22.8	0.0	0.0	23.3	60.5
Limber Jim Creek Upper	1999	Fall	0.0	0.0	38.3	33.3	28.9	0.0	0.0	32.9	76.0
Limber Jim Creek Upper	2000	Fall	0.0	0.0	28.8	32.8	31.1	5.6	0.0	44.4	61.0
Limber Jim Creek Upper	2001	Fall	0.0	0.0	23.9	28.1	34.1	2.2	0.0	38.9	
Limber Jim Creek Upper	2002	Fall	6.1	2.8	38.6	26.7	11.9	5.6	0.0	32.5	83.1
Limber Jim Creek Upper	2003	Fall	0.0	5.9	45.6	23.9	20.6	2.2	0.0	30.8	79.9
Limber Jim Creek Upper	2004	Fall	0.0	0.0	25.6	46.7	21.2	1.1	0.0	50.1	89.2
Limber Jim Creek Lower	1993	Fall	0.0	0.0	31.7	31.7	15.3	19.4	0.0	53.3	15.7
Limber Jim Creek Lower	1994	Fall	0.0	1.2	20.0	36.1	27.5	9.4	0.0	43.8	8.8
Limber Jim Creek Lower	1995	Fall	0.0	4.2	52.2	27.2	5.6	7.2	0.0	29.7	10.8
Limber Jim Creek Lower	1996	Fall	0.0	0.0	17.8	60.0	17.2	6.1	0.0	30.8	10.8
Limber Jim Creek Lower	1998	Fall	0.0	0.0	23.8	49.4	24.4	0.0	0.0	35.8	20.3
Limber Jim Creek Lower	1999	Fall	0.0	0.0	30.6	50.0	18.9	0.0	0.0	31.8	23.8
Limber Jim Creek Lower	2000	Fall	0.0	0.0	26.1	25.3	18.3	25.0		34.0	25.9
Limber Jim Creek Lower	2001	Fall	0.0	0.0	23.9	27.2	28.9	0.0	0.0	35.6	
Limber Jim Creek Lower	2002	Fall	0.0	23.5	48.9	25.6	8.8	0.0	0.0	32.9	10.0
Limber Jim Creek Lower	2003	Fall	0.0	8.9	46.7	33.3	8.9	2.2	0.0	29.1	22.3
Limber Jim Creek Lower	2004	Fall	0.0	1.1	35.0	40.6	6.1	7.2	0.0	48.2	13.5
Limber Jim Creek Lower	2005	Fall	0.0	0.0	23.9	57.2	15.0	2.8	0.0	17.1	8.8
McCoy Creek Restored	1998	Fall	0.0	0.0	11.7	15.0	11.2	61.7	0.0	23.3	23.3
McCoy Creek Restored	1999	Fall	0.0	0.0	8.8	21.7	32.8	37.2	0.0	74.4	8.3
McCoy Creek Restored	2000	Fall	0.0	0.0	13.6	30.3	13.6	43.6	0.0	52.9	2.0
McCoy Creek Restored	2001	Fall	0.0	0.0	25.6	6.5	11.8	25.3	0.0	50.8	
McCoy Creek Restored	2002	Fall	0.0	2.0	30.6	25.9	3.3	46.0	0.0	56.0	3.7
McCoy Creek Restored	2003	Fall	0.0	0.0	38.3	40.0	11.7	12.8	0.0	40.4	22.1
McCoy Creek Restored	2004	Fall	0.0	0.0	40.6	38.9	13.3	7.2	0.0	31.9	22.3
McCoy Creek Restored	2005	Fall	0.0	0.0	9.2	43.9	17.5	10.6	10.8	36.1	2.0
McCoy Creek Lower #1 Restored	2003	Fall	0.0	4.2	33.6	29.8	17.4	18.0	0.0	54.4	9.9
McCoy Creek Lower #1 Restored	2004	Fall	0.0	6.7	27.2	50.0	14.1	1.1	0.0	27.1	6.9
McCoy Creek Lower #1 Restored	2005	Fall	0.0	1.7	8.3	63.3	26.5	0.0	0.0	18.1	1.7

Appendix H. Macroinvertebrate Taxa and Counts

Taxa listed are taxa used in analyses using DEQ's predictive model, PREDATOR. The Total count is the total number of individuals in each taxon counted combined from all sites. The list is divided into two parts: Part 1 includes the Dark Canyon Creek, Limber Jim Creek, and Lookout Creek sites. Part 2 includes the McCoy Creek and Meadow Creek sites.

Part 1. Dark Canyon Lower (DARKL), Dark Canyon Upper (DARKU), Limber Jim Lower (LIML), Limber Jim Upper (LIMU), and Lookout (LOOK).

TAXON	Total count	DARKL	DARKU	LIML	LIMU	LOOK
Acentrella	758	42	5	31	4	17
Agapetus	11		1	8		1
Agraylea	39			27	12	
Alloperla	8				8	
Ameletus	533	22	19	46	44	178
Amiocentrus	413		31	116	100	145
Amphizoa	1			1		
Ampumixis	13			6		3
Anagapetus	1		1			
Antocha	1578	95	35	662	49	17
Apatania	38	4		21		13
Arctopsyche	139			9	130	
Atherix	550	18	18	21		1
Attenella	82	1				
Baetis	5788	297	276	964	927	1061
Blephariceridae	158	27	53		2	
Brachycentrus	570	1		73	135	6
Caenis	23					
Calineuria	2867	658	58	28	13	11
Callibaetis	11					
Capniidae	1225	20	4	56	176	37
Caudatella	212			97	112	3
Centroptilum	312	40	3	1		4
Ceratopogoninae	397	10	4	46	26	56
*Chelifera_*	98	8	1	9	66	8
Cheumatopsyche	463	126	2			
Chimarra	20					
Chironominae	17443	1627	172	1049	1773	1037
Chyrandra_centralis	1				1	
Cinygma	3					3
Cinygmula	4368	180	321	1155	757	1267
Claassenia	13			9		
Cleptelmis	619	6		245	218	70
Clinocera	43	11	3	6	6	
Cnidaria	7					
Coenagrionidae	635	1				

TAXON	Total count	DARKL	DARKU	LIML	LIMU	LOOK
Cryptolabis	242	17				
Cultus	17		4	4	2	7
Dasyheleinae	2					
Despaxia	98			25	39	28
Deuterophlebia	50	12	2			
Diamesinae	1454	33	9	93	249	297
Dicosmoecus	259	28	1	12		24
Dicranota	132	9	8	32	44	17
Diphetor_hageni	1747	135	17	131	16	132
Diura	4			2	1	1
Dixa	22	17	2		1	
Dixella	2					
Dolichopodidae	10					
Dolophilodes	125			4	86	17
Doroneuria	217			23	155	37
Drunella_coloradensis/flavilinea	291	62	1	10	6	1
Drunella_doddsi	565	10	20	53	126	344
Drunella_grandis	217			73	17	97
Drunella_spinifera	138			9	40	89
Dubiraphia	22	2				
Dytiscidae	247	51	77	11	8	14
Ecclisomyia	37		3		18	15
Epeorus	3124	442	58	173	210	32
Ephemerella	3014	133	754	281	79	183
Ephydridae	28	10				
Fallceon_quilleri	10					
Ferrissia	313					
Forcipomyiinae	5			1		4
Gammarus	1		1			
Glossosoma	942	19		350	238	94
Glutops	411			271	139	
Gomphidae	1405					
Haliplidae	307	35	1			
Haploperla	3					
Helicopsyche	3709	4				
Hemerodromia	190	16		1	6	
Heptagenia	21					
Hesperoconopa	2	2				
Hesperoperla	368	32	4	101	93	137
Hesperophylax	7	1	4			
Heterlimnius	1675	3	15	269	361	957
Hexatoma	938	49	26	6	24	68
Hirudinea	17	1		1		
Homophylax	1			1		
Hyalella	105		2			
Hydraenidae	17		1	2		

TAXON	Total count	DARKL	DARKU	LIML	LIMU	LOOK
Hydrobiidae	3				3	
Hydrophilidae	21		1	6		
Hydropsyche	4212	660	199	384	94	15
Hydroptila	432	177	13	60	1	9
Ironodes	59			8	27	8
Isoperla	164	46	18	1		
Kathroperla	4				4	
Kogotus	1					1
Lara	7			2	5	
Lepidostoma	12252	905	211	12	36	61
Leptophlebiidae	4833	233	78	272	278	661
Leucotrichia	18					
Limnephilus	4					
Limnophila	277	46		3	7	1
Limonia	1					
Lymnaeidae	36			1		
Malenka	50	3	8	14	7	14
Maruina	222	14				
Megarcys	56	9				47
Micrasema	558	1	4	126	265	150
Microcylloepus	3			1		
Molophilus	2			1		
Moselia	1					
Muscidae	10	2	3			
Narpus	103		2	61	20	12
Nematoda	491	17	4	89	28	16
Nematomorpha	1					
Neophylax	178	68	30	9	3	5
Neotrichia	40	8		1		
Nixe/Leucocruta	2442	140	78			
Ochrotrichia	152	2	13	81	2	1
Oecetis	181	4				
Oligochaeta	3849	477	11	788	340	146
Oligophlebodes	38					5
Onocosmoecus	41	4	1	3	3	12
Optioservus	8581	849	147	1149	42	82
Ordobrevia	2654	910		1	3	1
Oreogeton	6					6
Orthocladiinae	14033	1459	1162	4012	1496	1196
Ostracoda	46			2	28	1
Paraleuctra	13	2		3	7	
Paraperla	97	20		4	58	7
Parapsyche	19		1		4	14
Pedicia	2					2
Pericoma/Telmatoscopus	1086	1	1	894	86	102
Perlinodes	80	28	1	5	1	

TAXON	Total count	DARKL	DARKU	LIML	LIMU	LOOK
Perlomyia	1				1	
Petrophila	101					
Physa	534	69			7	
Pisidiidae	787	61	1	11	7	52
Planorbidae	784					
Plumiperla	43		1	12	4	23
Podmosta	1022	28	42	110	11	143
Polycentropodidae	11	8	3			
Procloeon	8	2				
Prosimulium	978	101	378	73	46	33
Prostoia	737	39	23	38	3	293
Psephenus	6249	12		27		1
Psychoda	341			341		
Psychoglypha	49	9		15	6	
Psychomyia	11			6		
Pteronarcella	5	3		1		
Pteronarcys	233	117		33	1	
Ptilodactylidae	1					
Ptychopteridae	1					1
Rhabdomastix	4			2		2
Rhithrogena	5268	42		92	213	168
Rhyacophila	1431	6	77	459	506	359
Rickera	2		1			1
Serratella	853	114	46	299	105	199
Sialis	171	5	5	76	2	
Simulium	2345	34	18	462	83	86
Skwala	1364	38	71	120	84	120
Staphylinidae	1					1
Stenonema	4	4				
Suwallia	291	26	13	47	10	90
Sweltsa	2827	460	128	128	268	704
Tabanidae	122	31	8			
Taeniopterygidae	286			6	27	53
Tanypodinae	1788	164	303	48	127	307
Timpanoga_hecuba	45	5	12	11		2
Tipula	14	8			1	
Tricorythodes	3153	10		13		1
Trombidiformes	2044	211	61	328	60	152
Turbellaria	160	16	23	16	32	70
Twinnia	15			1	1	13
Unionidae	2					
Visoka	226		2	12	161	51
Wiedemannia	11	1		8	1	
Wormaldia	402	97	27	21	6	5
Yoraperla	56				6	47
Zaitzevia	8208	981	166	1120	58	111

TAXON	Total count	DARKL	DARKU	LIML	LIMU	LOOK
Zapada	3255	458	78	602	691	617

Appendix H. Macroinvertebrate Taxa and Counts

Part 2. McCoy Lower #1 (MCCL1), McCoy Lower #2 (MCCL2), McCoy Lower Restored (MCCLR), McCoy Middle (MCCM), McCoy Restored (MCCR), Meadow Lower (MEADL), Meadow Starkey (MEADS).

TAXON	Total count	MCCL1	MCCL2	MCCLR	MCCM	MCCR	MEADL	MEADS
Acentrella	758	68	91	2	148	46	131	173
Agapetus	11							1
Agraylea	39							
Alloperla	8							
Ameletus	533	92	16		46	29	16	25
Amiocentrus	413	3						18
Amphizoa	1							
Ampumixis	13					4		
Anagapetus	1							
Antocha	1578	139	92	16	165	36	121	151
Apatania	38							
Arctopsyche	139							
Atherix	550	9	14		45		5	419
Attenella	82	16	14	1	5		16	29
Baetis	5788	259	508	23	496	317	348	312
Blephariceridae	158	5	8		27	4	6	26
Brachycentrus	570	3	188	1			163	
Caenis	23				16	6		1
Calineuria	2867	209	495	32	491	160	182	530
Callibaetis	11			1	1	3		6
Capniidae	1225	121	137	1	191	336	80	66
Caudatella	212							
Centroptilum	312	2	2	1	164	5	27	63
Ceratopogoninae	397	10	13	35	23	40	66	68
*Chelifera_*	98					1	3	2
Cheumatopsyche	463	3	47	26	45	196	12	6
Chimarra	20			1			19	
Chironominae	17443	729	392	2060	1884	1597	1935	3188
Chyrandra_centralis	1							
Cinygma	3							
Cinygmula	4368	77	163		131	91	65	161
Claassenia	13						4	
Cleptelmis	619	20	1	1	3	25		30
Clinocera	43		1		3		1	12
Cnidaria	7	1	1				5	
Coenagrionidae	635	84	4	28	360	103	55	
Cryptolabis	242	46		6	11		15	147
Cultus	17							

TAXON	Total count	MCCL1	MCCL2	MCCLR	MCCM	MCCR	MEADL	MEADS
Dasyheleinae	2			2				
Despaxia	98				4			2
Deuterophlebia	50	4	1		1		7	23
Diamesinae	1454	259	130	4	18	37	246	79
Dicosmoecus	259	33	43	1	34	42	11	30
Dicranota	132		9		1	4	2	6
Diphetor_hageni	1747	146	102	53	235	145	302	333
Diura	4							
Dixa	22				1		1	
Dixella	2					2		
Dolichopodidae	10	1	2	1				6
Dolophilodes	125						18	
Doroneuria	217		1					1
Drunella_coloradensis/flavilinea	291	18	35		24	9	4	121
Drunella_doddsi	565	4				2	3	3
Drunella_grandis	217	2			1	27		
Drunella_spinifera	138							
Dubiraphia	22		6				14	
Dytiscidae	247	21	3	3	3	8	46	2
Ecclisomyia	37						1	
Epeorus	3124	231	179	24	1031	167	286	291
Ephemerella	3014	324	121	207	78	82	325	447
Ephydridae	28	5	1		2	3	6	1
Fallceon_quilleri	10			10				
Ferrissia	313	85	3	3	169	32	16	5
Forcipomyiinae	5							
Gammarus	1							
Glossosoma	942	15	93	3	43	55	21	11
Glutops	411							1
Gomphidae	1405	112	56	468	217	299	231	22
Haliplidae	307	3	218	4	2	5	15	24
Haploperla	3							3
Helicopsyche	3709	487	271	282	911	1014	653	87
Hemerodromia	190	57		7	28	8	20	47
Heptagenia	21				21			
Hesperoconopa	2							
Hesperoperla	368							1
Hesperophylax	7	1				1		
Heterlimnius	1675	18	13	1	22	4		12
Hexatoma	938	148	118	22	259	54	108	56
Hirudinea	17		1	3		11		
Homophylax	1							
Hyalella	105	50	2	10	1	38	2	
Hydraenidae	17				9	3	1	1
Hydrobiidae	3							
Hydrophilidae	21	8	1		1	3		1
Hydropsyche	4212	288	177	169	314	262	564	1086
Hydroptila	432	8	9	28	8	37	69	13

TAXON	Total count	MCCL1	MCCL2	MCCLR	MCCM	MCCR	MEADL	MEADS
Ironodes	59	7				9		
Isoperla	164	31	15		2	2	19	30
Kathroperla	4							
Kogotus	1							
Lara	7							
Lepidostoma	12252	2434	1477	4	2187	448	2086	2391
Leptophlebiidae	4833	274	279	203	825	503	732	495
Leucotrichia	18				6			12
Limnephilus	4					4		
Limnophila	277	5	6		27	8	12	162
Limonia	1							1
Lymnaeidae	36			21		12	1	1
Malenka	50		2				1	1
Maruina	222	68			108			32
Megarcys	56							
Micrasema	558	7		2				3
Microcylloepus	3		1				1	
Molophilus	2					1		
Moselia	1					1		
Muscidae	10					3	1	1
Narpus	103	1	1	2	1		2	1
Nematoda	491	44	94	2	3	24	18	152
Nematomorpha	1				1			
Neophylax	178	34	2			1	4	22
Neotrichia	40		1		18			12
Nixe/Leucocruta	2442	540	311	5	533	108	498	229
Ochrotrichia	152	5	3		3	27	7	8
Oecetis	181	15	66	10	1		84	1
Oligochaeta	3849	269	471	105	386	357	199	300
Oligophlebodes	38							33
Onocosmoecus	41	1			6	6	2	3
Optioservus	8581	1049	1046	814	1195	778	830	600
Ordobrevia	2654	224	139	2	49	14	618	693
Oreogeton	6							
Orthocladiinae	14033	691	458	495	505	501	1157	901
Ostracoda	46					12		3
Paraleuctra	13		1					
Paraperla	97	3			2		1	2
Parapsyche	19							
Pedicia	2							
Pericoma/Telmatoscopus	1086	2						
Perlinodes	80	1			1			43
Perlomyia	1							
Petrophila	101	11	2	3	35	1	14	35
Physa	534	58	22	19	245	47	55	12
Pisidiidae	787	50	300	1	231	50	7	16
Planorbidae	784	107	171	101	1	311	93	
Plumiperla	43	1					2	

TAXON	Total count	MCCL1	MCCL2	MCCLR	MCCM	MCCR	MEADL	MEADS
Podmosta	1022	57	198		184		124	125
Polycentropodidae	11							
Procloeon	8			4	1			1
Prosimulium	978	57	55		7	27	65	136
Prostoia	737	82	17		52	49	51	90
Psephenus	6249	1014	694	189	1496	659	2033	124
Psychoda	341							
Psychoglypha	49	13						6
Psychomyia	11				5			
Pteronarcella	5						1	
Pteronarcys	233	1	4	1	42	9	4	21
Ptilodactylidae	1							1
Ptychopteridae	1							
Rhabdomastix	4							
Rhithrogena	5268	350	389	541	1319	804	1244	106
Rhyacophila	1431	2	6		2	10	2	2
Rickera	2							
Serratella	853	7	28		1	19	4	31
Sialis	171		1		44			38
Simulium	2345	227	290	243	159	332	257	154
Skwala	1364	220	279	48	60	33	257	34
Staphylinidae	1							
Stenonema	4							
Suwallia	291	29	25		11	10	4	26
Sweltsa	2827	66	279	8	251	91	102	342
Tabanidae	122	5	2	6	9	3	2	56
Taeniopterygidae	286	12	1	22	26	120	11	8
Tanypodinae	1788	208	84	66	87	148	123	123
Timpanoga_hecuba	45	4	7		1			3
Tipula	14				1	2	1	1
Tricorythodes	3153	335	467	72	488	690	786	291
Trombidiformes	2044	118	137	164	218	126	258	211
Turbellaria	160		1				2	
Twinnia	15							
Unionidae	2				2			
Visoka	226							
Wiedemannia	11					1		
Wormaldia	402		2		60	10	12	162
Yoraperla	56							3
Zaitzevia	8208	778	670	130	934	494	1654	1112
Zapada	3255	62	13	13	225	173	52	271

Appendix I. Fish Taxa and Counts

Fish species and numbers of individuals observed during snorkel surveys at Grande Ronde NMP sites 1994 through 2005.

Abbreviations	Common names	Taxa	Abbreviations	Common names	Taxa
Ict neb	brown bullhead	Ictaluris nebulosus	Cot spp.	sculpin	Cottus spp.
Rhi spp.	dace	Rhinicthys spp.	Cat spp.	sucker	Catostomus spp.
Onc myk	rainbow trout	Oncorhynchus myskiss	Pty ore	pikeminnow	Ptychocheilus oregonesis
Ric bal	redside shiner	Richardsonius baleatus	Lep spp.	sunfish	Lepomis spp.
			Sal font	brook trout	Salvelinus fontinalis

Site Description	Survey Date	Ict neb	Rhi spp	Pty ore	Onc myk	Ric bal	Cot spp.	Cat spp	Sal font	Lep mac
Dark Canyon Creek Lower	7/28/94	0	0	0	57	0	0	0	0	0
Dark Canyon Creek Lower	8/8/95	0	20	0	62	0	0	0	0	0
Dark Canyon Creek Lower	8/6/96	0	0	0	33	0	0	2	0	0
Dark Canyon Creek Lower	8/19/97	0	0	0	22	0	0	0	0	0
Dark Canyon Creek Lower	6/24/98	0	1	0	0	0	0	0	0	0
Dark Canyon Creek Lower	8/4/98	0	0	0	12	0	0	0	0	0
Dark Canyon Creek Lower	8/3/99	0	0	0	0	0	0	0	0	0
Dark Canyon Creek Lower	8/2/00	0	0	0	0	0	0	0	0	0
Dark Canyon Creek Lower	8/2/01	0	0	0	11	0	2	0	0	0
Dark Canyon Creek Lower	8/8/02	0	0	0	37	0	0	0	0	0
Dark Canyon Creek Lower	7/30/03	0	0	0	58	0	0	0	0	0
Dark Canyon Creek Upper	7/28/94	0	0	0	42	0	0	0	0	0
Dark Canyon Creek Upper	8/8/95	0	0	0	76	0	8	0	0	0
Dark Canyon Creek Upper	8/6/96	0	0	0	4	0	1	0	0	0
Dark Canyon Creek Upper	8/19/97	0	0	0	71	0	0	0	0	0
Dark Canyon Creek Upper	6/24/98	0	0	0	1	0	0	0	0	0
Limber Jim Creek Lower	9/21/94	0	0	0	51	0	0	0	0	0
Limber Jim Creek Lower	8/9/95	0	0	0	58	0	0	0	0	0
Limber Jim Creek Lower	8/7/96	0	0	0	27	0	15	0	0	0
Limber Jim Creek Lower	8/20/97	0	0	0	51	0	2	0	0	0
Limber Jim Creek Lower	8/5/98	0	0	0	55	0	0	0	0	0
Limber Jim Creek Lower	8/4/99	0	0	0	41	0	0	0	0	0
Limber Jim Creek Lower	8/1/00	0	0	0	65	0	0	0	0	0
Limber Jim Creek Lower	8/1/01	0	0	0	71	0	0	0	0	0
Limber Jim Creek Lower	8/9/02	0	0	0	71	0	0	0	0	0
Limber Jim Creek Lower	7/29/03	0	0	0	63	0	1	0	0	0
Limber Jim Creek Lower	8/4/04	0	0	0	13	0	1	0	1	0
Limber Jim Creek Lower	8/2/05	0	0	0	62	0	6	0	0	0
Limber Jim Creek Upper	9/21/94	0	0	0	14	0	0	0	0	0
Limber Jim Creek Upper	8/9/95	0	0	0	12	0	1	0	0	0
Limber Jim Creek Upper	8/7/97	0	0	0	21	0	0	0	0	0
Limber Jim Creek Upper	8/20/97	0	0	0	13	0	3	0	0	0
Limber Jim Creek Upper	6/23/98	0	0	0	3	0	0	0	0	0
Limber Jim Creek Upper	8/5/98	0	0	0	23	0	1	0	0	0
Limber Jim Creek Upper	8/4/99	0	0	0	27	0	0	0	0	0
Limber Jim Creek Upper	8/1/00	0	0	0	15	0	0	0	0	0
Limber Jim Creek Upper	8/1/01	0	0	0	16	0	0	0	0	0
Limber Jim Creek Upper	8/9/02	0	0	0	9	0	0	0	0	0
Limber Jim Creek Upper	7/29/03	0	0	0	19	0	0	0	0	0
Limber Jim Creek Upper	8/4/04				9		1	0	0	0

Site Description	Survey Date	Ict neb	Rhi spp	Pty ore	Onc myk	Ric bal	Cot spp.	Cat spp	Sal font	Lep mac
Lookout Creek	7/26/94	0	0	0	34	0	0	0	0	0
Lookout Creek	8/9/95	0	0	0	74	0	3	0	0	0
Lookout Creek	8/7/96	0	0	0	43	0	4	0	0	0
Lookout Creek	8/20/97	0	0	0	73	0	2	0	0	0
Lookout Creek	8/5/98	0	0	0	38	0	1	0	0	0
Lookout Creek	8/4/99	0	0	0	97	0	0	0	0	0
Lookout Creek	8/1/00	0	0	0	126	0	0	0	0	0
Lookout Creek	7/30/01	0	0	0	69	0	2	0	0	0
Lookout Creek	8/7/02	0	0	0	120	0	8	0	0	0
Lookout Creek	7/30/03	0	0	0	161	0	7	0	0	0
Lookout Creek	8/4/04	0	0	0	33	0	2	0	0	0
MCCL2abv994	8/3/99	0	288	72	29	328	0	365	0	0
McCoy Creek Lower #1	7/27/94	0	120	0	5	700	0	0	0	0
McCoy Creek Lower #1	8/7/95	0	138	0	18	800	4	0	0	0
McCoy Creek Lower #1	8/5/96	0	0	0	2	150	0	100	0	0
McCoy Creek Lower #1	8/18/97	0	90	0	3	70	0	0	0	0
McCoy Creek Lower #1	6/22/98	0	1	0	0	40	0	0	0	0
McCoy Creek Lower #1	8/4/98	0	25	0	1	205	0	10	0	0
McCoy Creek Lower #1	8/2/99	1	1	0	9	160	0	108	0	0
McCoy Creek Lower #1	7/31/00	0	20	0	0	100	0	10	0	0
McCoy Creek Lower #1	8/1/01	0	3	65	8	200	0	89	0	0
McCoy Creek Lower #1	8/7/02	*	*	*	*	*	*	*	*	*
McCoy Creek Lower Restored	7/29/03	0	60	183	104	538	0	301	0	0
McCoy Creek Lower Restored	8/3/04		198	495	120	919		342	0	135
McCoy Creek Lower Restored	8/2/05		384	548	23	942	5	283	0	3
McCoy Creek Lower #2	8/7/95	0	520	0	2	710	0	0	0	0
McCoy Creek Lower #2	8/5/96	200	35	0	5	370	0	355	0	0
McCoy Creek Lower #2	8/18/97	0	20	0	2	110	0	0	0	0
McCoy Creek Lower #2	6/22/98	0	6	0	8	600	0	36	0	0
McCoy Creek Lower #2	8/4/98	0		0	8	600	0	36	0	0
McCoy Creek Lower #2	8/2/99	0	46	2	0	250	0	334	0	0
McCoy Creek Lower #2	7/31/00	0	45	15	0	105	0	40	0	0
McCoy Creek Lower #2	8/1/01	0	270	185	15	440	0	140	0	0
McCoy Creek Lower #2	8/7/02	*	*	*	*	*	*	*	*	*
McCoy Creek Middle	7/27/94	2	30	7	6	470	0	47	0	0
McCoy Creek Middle	8/8/95	0	240	60	20	1040	0	120	0	0
McCoy Creek Middle	8/5/96	0	0	20	7	128	0	80	0	0
McCoy Creek Middle	8/20/97	0	6	0	20	88	2	50	0	0
McCoy Creek Middle	8/3/98	0	0	0	0	620	0	30	0	0
McCoy Creek Middle	8/3/99	0	30	23	15	105	0	0	0	0
McCoy Creek Middle	7/31/00	0	23	50	0	244	0	70	0	0
McCoy Creek Middle	7/31/01	0	85	60	20	140	0	35	0	0
McCoy Creek Middle	8/7/02	0	28	25	9	198	2	337	0	0
McCoy Creek Middle	7/28/03	0	26	60	12	79	2	64	0	0
McCoy Creek Middle	8/3/04	0	70	40	6	215	0	30	0	0
McCoy Creek Middle	8/3/05	1	204	46	13	414		14	0	0
McCoy Creek Restored	8/19/97	1	32	40	3	325	0	125	0	0
McCoy Creek Restored	6/24/98	0	20	5	40	160	0	12	0	0
McCoy Creek Restored	8/3/98	122	21	73	16	1570	0	330	0	0
McCoy Creek Restored	8/3/99	8	390	357	44	1325	2	610	0	0
McCoy Creek Restored	7/31/00	0	190	389	17	1270	0	380	0	0
McCoy Creek Restored	8/1/01	0	209	690	35	1551	0	792	0	0
McCoy Creek Restored	8/7/02	*	*	*	*	*	*	*	*	*

Site Description	Survey Date	Ict neb	Rhi spp	Pty ore	Onc myk	Ric bal	Cot spp.	Cat spp	Sal font	Lep mac
McCoy Creek Restored	7/29/03	2	900	450	54	2070	0	295	0	0
McCoy Creek Restored	8/3/04		1087	536	73	966		417	0	3
McCoy Creek Restored	8/3/05	14	747	612	40	2757	2	511	0	3
Meadow Creek Lower	7/27/94	0	580	150	11	900	0	75	0	0
Meadow Creek Lower	8/8/95	0	440	0	4	1160	8	0	0	0
Meadow Creek Lower	8/5/96	0	60	24	4	1320	1	152	0	0
Meadow Creek Lower	8/18/97	0	0	0	0	1080	0	0	0	0
Meadow Creek Lower	6/23/98	0	0	0	5	1085	1	65	0	0
Meadow Creek Lower	8/4/98	0	0	0	5	1085	1	65	0	0
Meadow Creek Lower	8/2/99	0	3	0	1	467	1	29	0	0
Meadow Creek Lower	7/31/00	0	110	215	10	275	0	375	0	0
Meadow Creek Lower	8/1/01	0	45	254	2	950		227	0	0
Meadow Creek Lower	8/6/02	0	87	149	2	530	0	128	0	0
Meadow Creek Lower	7/29/03	0	80	800	17	820	0	110	0	0
Meadow Creek Lower	8/3/04	0	96	111	7	370	0	35	0	0
Meadow Creek Lower	8/3/05	0	271	287	21	1003	0	0	0	0
Meadow Creek Starkey	9/22/94	0	99	8	55	170	8	5	0	0
Meadow Creek Starkey	8/9/95	0	1032	66	82	390	12	156	0	0
Meadow Creek Starkey	8/6/96	0	205	69	87	250	3	40	0	0
Meadow Creek Starkey	8/19/97	0	94	0	71	104	3	65	0	0
Meadow Creek Starkey	6/24/98	0	4	0	11	1000	0	4	0	0
Meadow Creek Starkey	8/5/98	0	50	70	57	450	2	300	0	0
Meadow Creek Starkey	8/4/99	0	192	113	123	230	0	249	0	0
Meadow Creek Starkey	8/1/00	0	85	70	56	180	0	235	0	0
Meadow Creek Starkey	8/1/01	0	53	36	44	235	1	134	0	0
Meadow Creek Starkey	8/7/02	0	2	55	25	59	0	43	0	0
Meadow Creek Starkey	7/30/03	0	48	70	35	270	0	64	0	0
Meadow Creek Starkey	8/3/04	0	124	135	36	146	0	146	0	0

* Survey was not completed due to in-channel construction in progress.