Stream Temperature Monitoring and the Development of Models to Predict Stream Temperatures in Priority Drainages in the East Slopes; 2004/2005 Technical Report.

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EXECUTIVE SUMMARY

In the south central East Slopes of Alberta, threats to brown trout (*Salmo trutta*), bull trout (*Salvelinus confluentus*), brook trout (*S. fontinalis*), rainbow trout (*Oncorhynchus mykiss*) cutthroat trout (*O. clarki*) and mountain whitefish (*Prosopium williamsoni*) from declining stream flows and increased stream temperatures has been recognized as an important issue to the management of these sportfish. Alberta Sustainable Resource Development (ASRD), Fisheries Management has expressed a desire to predict water temperatures in study streams prone to high temperature events, through the use of real-time stream temperature data readily available from the Alberta Environment (AENV) internet web site. Having the ability to predict stream temperatures would allow for proactive management of the fisheries in these waters by resource mangers.

The objectives of this project were to:

- Collect baseline stream temperature data from streams prone to high temperatures.
- Investigate the relationship between stream temperature data collected throughout a drainage in 2004 by the Alberta Conservation Association (ACA) and stream temperature data collected in 2004 at AENV real-time stream temperature-monitoring sites.
- Describe this relationship as a model for the prediction of stream temperatures throughout a drainage based on the real-time stream temperature data collected by AENV.
- Assess the predictive ability of the model using data obtained in 2003 by the ACA and ASRD and 2003 AENV real-time stream temperature data.

In the summer of 2004, the ACA collected data from 44 stream temperature monitoring sites. Stream temperature monitoring sites were located in the Red Deer River (n=25), Bow River (n=3) and Highwood River (n=16) drainages. Stream temperatures were collected using temperature data loggers placed in study streams at 30 km intervals and programmed to record stream temperatures every 15 minutes. Study streams were chosen based on the opinion of ASRD, or prior stream temperature monitoring indicating that high stream temperatures occur in a particular stream.

The relationship between ACA and AENV data was found to be strongly linear, therefore liner regression was selected as the most appropriate method to describe this relationship. Overall, the linear regression models developed here from ACA

and AENV data explain the relationship between ACA and AENV data sites very well. However, the goodness of fit of the models, and therefore their predictive ability, tends to decrease with increasing distance upstream on study streams.

Graphical analysis of the values predicted by the ACA models for 2003 and observed data from 2003 indicates that the model can successfully predict water temperature at a location in a drainage based on the water temperatures at the AENV real-time stream temperature-monitoring station. Model assessments have, however, only been conducted for five of the models developed in the project where 2003 stream temperature data was available. The remaining models have not been assessed, as no data is available for these assessments.

1.0 INTRODUCTION

The thermal regime of lotic systems is one of the most influential and important factors in determining the structure and dynamics of aquatic communities (Macan 1963; Vannote *et al*. 1980). As a result, stream temperature is also one of the most studied aspects of water quality. Many processes, such as stream nutrient cycling, individual physiological processes, metabolic rates, behaviour and life history strategies of most aquatic organisms are tightly coupled with stream temperature (Beschta *et al*. 1987; Allen 1995). Therefore, a shift in the thermal regime of a stream can decrease the fitness of aquatic species, or can render reaches of a stream uninhabitable (Nikolsky 1963; Patrick 1969; Wurtz 1969).

The heat energy added to a stream is defined as the heat load of the stream (Poole and Berman 2001). Stream heat load, heat flux and finally stream temperature is influenced and ultimately determined by internal and external drivers through complex interactions of the stream and the physical and biological characteristics of the stream channel and riparian zone (Smith 1975; Rishel *et al*. 1982; Poole and Berman 2001; Johnson 2004). Stream temperature is also dependent on stream discharge (Poole and Berman 2001). For instance, a stream with increased discharge will have a lower overall stream temperature compared to a stream with less discharge and the same heat load. Various anthropogenic practices such as the removal of riparian vegetation and the subsequent increase in solar radiation, the addition of thermal pollution from industrial processes, impoundment of moving waters, water withdrawls or other riparian and upland land practices that alter stream discharge patterns can effect the heat load and ultimately the thermal regime of a stream or stream reach (Brown 1969; Beschta *et al*. 1987; Teti 2004; Poole in Prep.).

Given the implications of stream temperature to aquatic biota, considerable attention has been given to the prediction of stream temperatures. To this end, various methods have been employed to predict stream water temperatures at landscape and local levels. Bartholow's (1991) landscape level models allow for the evaluation of stream temperature throughout a stream network. However, Bartholow's (1991) models require the collection of detailed model parameters, such as specific physical stream measurements, stream flow data, various meteorological parameters and average daily temperatures from certain locations in the study drainage. As acknowledged by Bartholow (1991) landscape level models are perhaps most useful for the prediction of stream temperature as a consequence of alterations in stream discharge regimes. The prediction of the temperature of small steams through a net energy balance model has been implemented by Brown (1969). This model indicates that the greatest influence on stream temperature is from incoming solar radiation. While the results of Brown (1969) appear to accurately predict stream temperatures, the model necessitates on-site meteorological measurements; precluding easy and cost-effective use of this technique at numerous sites within a watershed.

At the local level, the relationship between water temperature and ambient air temperature has been investigated by Cluis (1972), Kothandaraman (1972), Gillett and Long (1974), Heinz and Preud'homme (1993), and Stonemann and Jones (1996). This approach can be used to predict stream water temperature, however, there are often large distances between the location of air temperature-monitoring equipment and the location of stream water temperature prediction. This can result in greater unexplained variation on the prediction of stream temperatures. Other problems with this approach are that air temperature can fluctuate stochastically much more than water temperature, the time lag between air and water temperature increases as stream discharge increases (Heinz and Preud'homme 1993), and air temperature may not be able to accurately predict stream water temperatures in streams with predominantly internal temperature drivers, such as stream headwaters where stream temperatures are strongly effected by groundwater.

Increased understanding of the role temperature plays on aquatic organisms, and the acknowledgement of global climate change has produced considerable interest in the prediction of water temperatures. In the south central East Slopes Region of Alberta, declining stream flows and increased stream temperatures have been identified as threats to the conservation of brown trout (*Salmo trutta*), bull trout (*Salvelinus confluentus*), brook trout (*S. fontinalis*), rainbow trout (*Oncorhynchus mykiss*) cutthroat trout (*O. clarki*) and mountain whitefish (*Prosopium williamsoni*) in many streams prone to high temperature events. To proactively manage these priority sportfish populations, Alberta Sustainable Resource Development (ASRD), Fisheries Management has communicated the need to effectively and accurately predict water temperature at locations within a drainage. The purpose of this project was to develop predictive models using the relationship between data collected at intervals throughout a stream by ACA and data collected and made available on the internet in near real-time by AENV at real-time hydrometric stations. These models can be used to by fisheries management staff to scientifically support appropriate fisheries management responses. The specific objectives of this project were to:

- Collect baseline stream temperature data from streams prone to high temperatures.

- Investigate the relationship between stream temperature data collected throughout a drainage in 2004 by the Alberta Conservation Association (ACA) and stream temperature data collected in 2004 at Alberta Environment (AENV) real-time stream temperature-monitoring stations.
- Describe this relationship as a model for the prediction of stream temperatures throughout a drainage based on the real-time stream temperature data collected by AENV.
- Assess the predictive ability of the model using data obtained in 2003 by the ACA and ASRD and 2003 AENV real-time stream temperature data.

2.0 STUDY AREA

In the south central East Slopes, study streams (Figure 2.1) were identified in the Bow River, Red Deer River, and Highwood River drainages. Study streams were chosen through consultation with ASRD, Fisheries Management, and the ACA, based on prior stream temperature-monitoring data showing that high summer temperatures occurred in these streams, or on opinion of ASRD, Fisheries Management where stream temperature data were lacking.

Study streams arise from headwaters in the Rocky Mountain and Foothills natural regions (Strong and Leggat; 1992) and flow into the South Saskatchewan River via the Red Deer River and the Bow River. Headwater reaches of these streams contain cold water fishes such as bull trout, brook trout, brown trout, cutthroat trout, rainbow trout and mountain whitefish (Buchwald and Willis 2004; Wieliczko and McLeod 2000; (Wieliczko J. (December 2004) Personal communication). The lower reaches of study streams, sympatric communities of cold water and cool water sportfish species such as brown trout, northern pike (*Esox lucius*), walleye (*Sander vitreus*), burbot (*Lota lota*) and goldeye (*Hiodon alosoides*) can be found (Buchwald and Willis 2004; Wieliczko J. (December 2004) Personal communication).

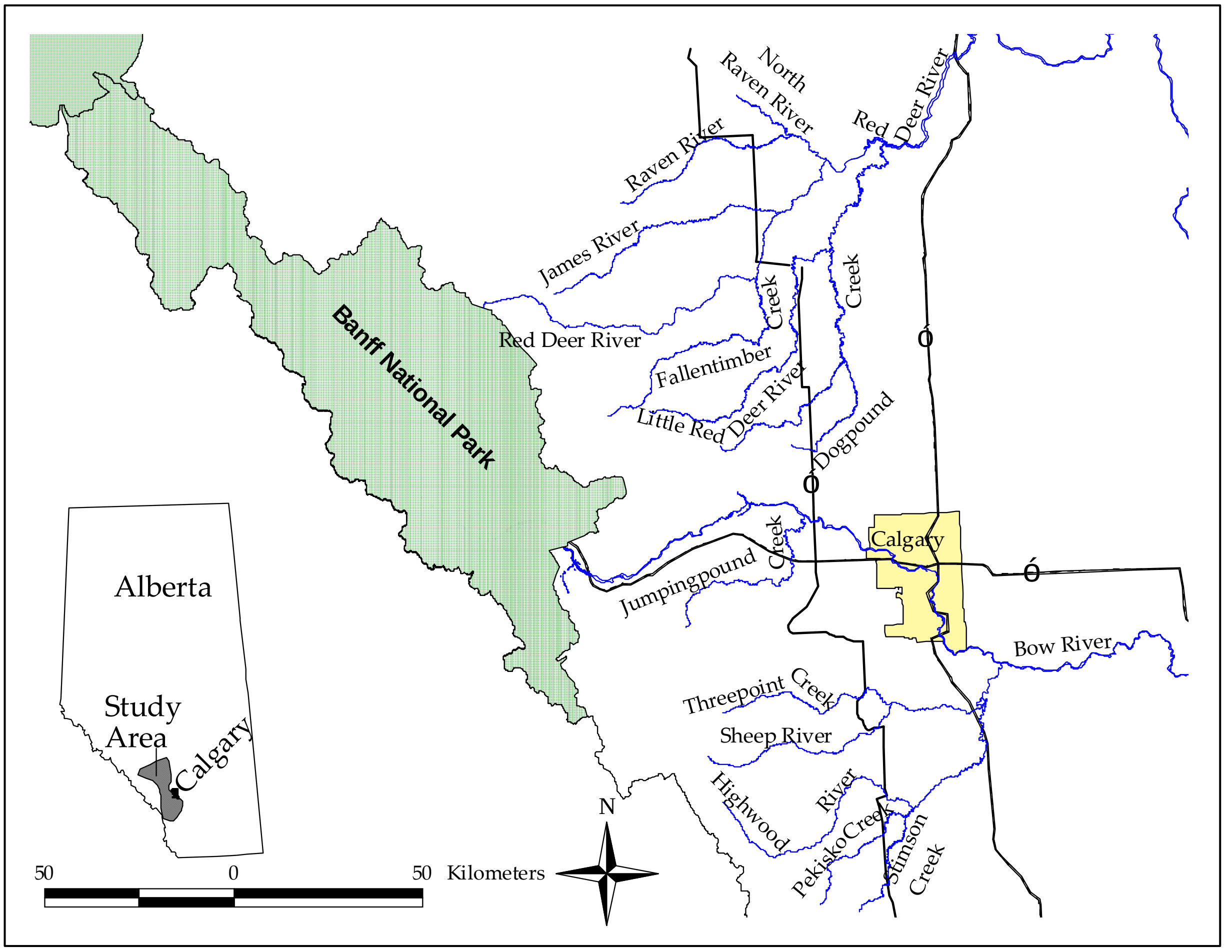


Figure 2.1 Study streams in south western Alberta where priority sportfish species (brown trout (*Salmo trutta*), bull trout (*Salvelinus confluentus*), brook trout (*S. fontinalis*), rainbow trout (*Oncorhynchus mykiss*) cutthroat trout (*O. clarki*) and mountain whitefish (*Prosopium williamsoni*)) may by limited by high summer stream temperatures.

3.0 MATERIALS AND METHODS

3.1 STREAM TEMPERATURE DATA

In the summer of 2004, the ACA deployed Onset Corporation Hobo Water Temp Pro temperature data loggers in study streams at 30 km intervals upstream from the mouth of a study stream (Figure 2.1). Data logger locations were determined using ArcView GIS software with an extension to add points evenly along a line. Data logger locations were accessed by road and then on foot. Where limited access precluded field placement of a data logger at its predetermined 30 km interval location, the data logger was placed in the stream at the closest possible location, either upstream or downstream where access was available. Data loggers were programmed to record temperature every 15 minutes. All data logger sites were geo-referenced in the field with a hand held GPS unit. The location of each data logger and the date it was deployed can be found in Appendix 1.

Data loggers were deployed in run or riffle sections of streams as these areas provide a better indication of average stream temperature as they are well mixed areas where inter-gravular flow tends to return to surface flow (Lewis 1999). Stream pools were avoided as pools may thermally stratify, therefore, giving less accurate information regarding the average heat load of the stream (Lewis 1999). Data loggers were tethered with aircraft cable to either a tree on the stream bank, a piece of steel fencing t-post pounded into the stream bank, or a piece of t-post pounded into the stream bed. To increase the likelihood that the data logger would remain submerged, data loggers were placed in the thalweg section of a run or riffle and weighted with 170 g lead fishing weights. Weights were added to a logger until there was sufficient mass to sink the logger and hold it on the stream bottom. Where possible, data loggers were placed under shade cover to minimize the influence of direct solar heating on the logger. To reduce the likelihood of the data loggers being found and tampered with by the public, aircraft tether cable and lead weights were painted with a dull green spray paint and the t-post and cable was hidden from view by covering it with vegetation, earth, rocks or woody debris.

Microsoft Excel spreadsheets containing stream temperature data collected by AENV real-time stream temperature-monitoring stations from the summer of 2003 and 2004 were obtained from AENV. Stream temperature data collected by ACA and ASRD during summer of 2003 were obtained for assessing the predictive ability of the models created in 2004.

3.2 DATA ANALYSIS

The relationship between the data collected throughout study streams in 2004 and the data collected at AENV real-time stream temperature-monitoring stations in 2004 was assessed by graphing real-time data on the x-axis and ACA study site data on the y-axis. If graphical analysis detected a linear relationship between the real-time and ACA data, further analysis of the data was performed using linear regression. Regression analysis was performed using the daily maximum water temperature of the ACA study site as the dependant variable and the corresponding daily maximum water temperature of the nearest AENV real-time monitoring station on the same stream, or in the same drainage, as the independent variable. All regression analysis was performed using Microsoft Excel 2000 (Microsoft Corporation). Study stream lengths, water body that the stream is a tributary to and the real-time temperature-monitoring station to be used the as independent variable for regression analysis are shown in Table 3.1.

Table 3.1 Study streams, mainstem stream lengths, water body that the stream is a tributary to, and AENV real-time stream temperature-monitoring station to be used as predictor for stream temperatures.

Stream	Stream length (km)	Tributary to	AENV real-time monitoring station to be used independent vraiable
North Raven River	37	Raven River	North Raven River near the Town of Raven
Raven River	119	Red Deer River	North Raven River near the Town of Raven
James River	102	Red Deer River	Little Red Deer River near the mouth
Fallentimber Creek	111	Red Deer River	Little Red Deer River near the mouth
Little Red Deer River	210	Red Deer River	Little Red Deer River near the mouth
Dogpound Creek	156	Little Red Deer River	Little Red Deer River near the mouth
Jumpingpound Creek	87	Bow River	Threepoint Creek near the Town of Millarville
Threepoint Creek	74	Sheep River	Threepoint Creek near the Town of Millarville
Sheep River	109	Highwood River	Highwood River near the Town of Aldersyde
Highwood River	162	Highwood River	Highwood River near the Town of Aldersyde
Stimson Creek	65	Pekisko Creek	Pekisko Creek near the Town of Longview
Pekisko Creek	58	Highwood River	Pekisko Creek near the Town of Longview

3.3 ASSESSMENT OF THE MODELS

Regression models created from 2004 data were assessed for their goodness of fit, or r-squared (r^2), and for their ability to predict daily maximum stream temperatures in 2003 using 2003 AENV data.

In the summer of 2003, the ACA and ASRD collected preliminary stream temperature data from various locations in the Red Deer River drainage (Alberta Conservation Association, unpublished data, Alberta Sustainable Resource Development, unpublished data). Five of these sites are in close proximity to the location of ACA stream temperature data collection sites in 2004. These five sites had been chosen to qualitatively assess the predictive ability of the models created in 2004 (Table 3.2 and Figure 3.1). To do this, AENV real-time data from 2003 was input into the models for 2004 locations (Table 3.2). The output of the model is the predicted daily maximum temperature for the site that the model was developed for. The daily maximum temperatures predicted by the model were then graphically compared with the actual daily maximums of temperature recorded in 2003. The locations of the 2003 ACA and ASRD temperature data sites and the 2004 ACA temperature data sites are shown in Figure 3.1.

Table 3.2 2004 linear regression models assessed, 2003 Alberta Conservation Association (ACA)or Alberta Sustainable Resource Development (ASRD) data site used to assess the model and Alberta Environment (AENV) real-time temperature monitoring station used as input data into the 2004 models.

2004 ACA temperature model location	ACA/ASRD 2003 data site	AENV real-time data station used as input data
Dogpound Creek km 0	ACA 932	Little Red Deer River near the mouth
Dogpound Creek km 30	ACA 930	Little Red Deer River near the mouth
Dogpound Creek km 90	ACA 5847	Little Red Deer River near the mouth
Little Red Deer River km 0	ACA467	Little Red Deer River near the mouth
Fallentimber Creek km 0	ASRD Fallentimber at Bergen	Little Red Deer River near the mouth

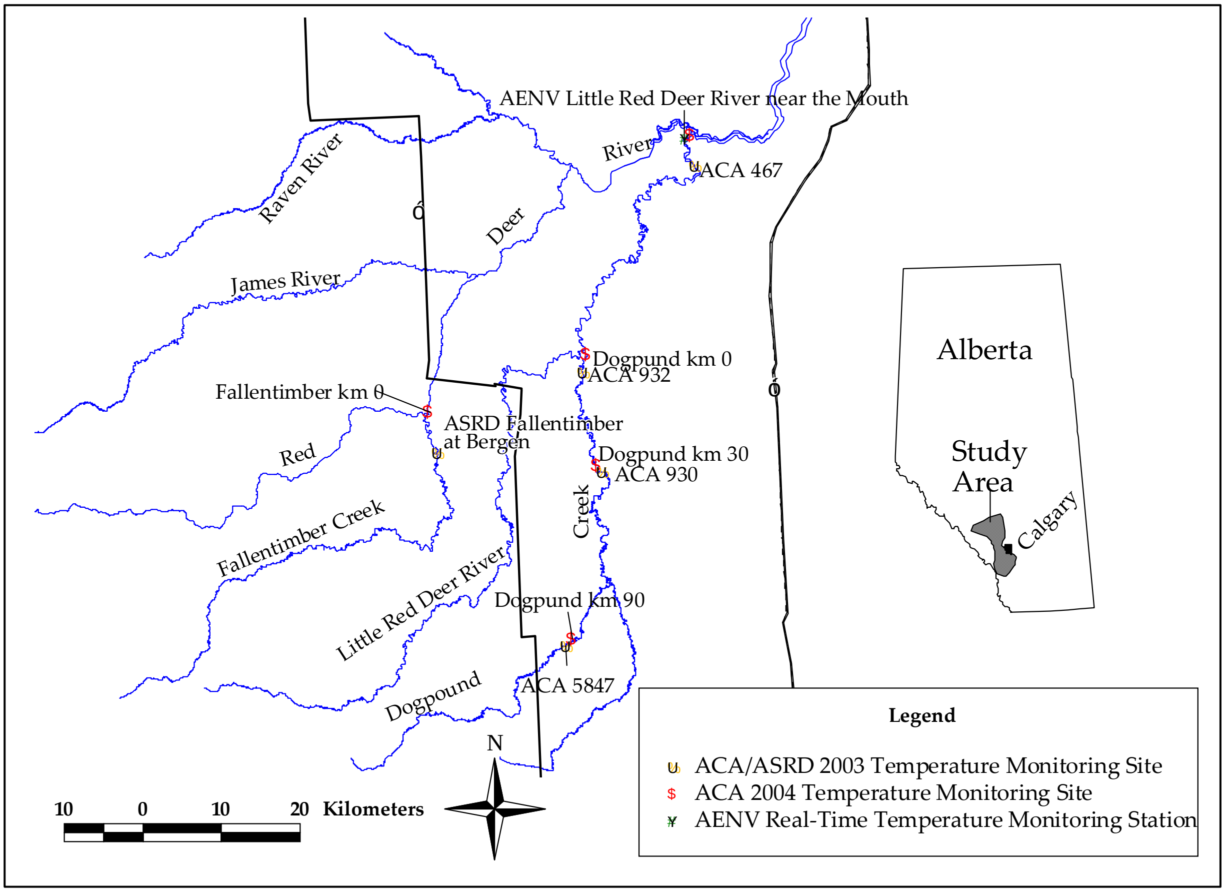


Figure 3.1 Location where 2004 linear regression models have been assessed, 2003 Alberta Conservation Association (ACA) and Alberta Sustainable Resource Development (ASRD) data collection sites used to assess the 2004 models and location of AENV real-time station on the Little Red Deer River near the mouth where data used as input data to the models was collected.

4.0 RESULTS

In the summer of 2004, 44 data loggers were deployed from July 5-18. All data loggers were recovered from the field from September 13-29, 2004. Data from these temperature loggers was off-loaded and stored in Microsoft Excel spreadsheets.

Stream temperature data and stream temperature models developed are presented here by drainage. Much of the results are very repetitive and readers are encouraged to focus on the drainages of greatest interest to their area of work. Included in each result section is a map that shows the location of the ACA temperature monitoring sites and the AENV real-time stream temperature monitoring station used to derive the regression equations, a figure presenting the daily maximum stream temperatures recorded in the summer of 2004 in a particular drainage. For each ACA temperature-monitoring site within a drainage, the relationship between the ACA data and the AENV real-time stream temperature monitoring station data is shown as a scatter plot. On each scatter plot, regression lines with 95% confidence intervals are shown. The regression equation and the model goodness of fit (r^2) are also shown on each plot of ACA and AENV data. The raw data from data loggers, including date, time and temperature can be found in Appendix 2 on the accompanying compact disk. The accompanying compact disk also includes Appendix 3, an interactive Microsoft Excel spreadsheet with the models for stream temperature prediction. Appendix 3 allows users to input temperature data and view the predicted stream temperature outputs in numerical and graphical format. Users are encouraged to read the instructions tab on this spreadsheet before using the temperature prediction models.

4.1 RAVEN RIVER AND NORTH RAVEN RIVER

Five temperature loggers were deployed by the ACA in the Raven and North Raven rivers in the summer of 2004 (Figure 4.1). Figure 4.1 also shows the location of the AENV real-time stream temperature-monitoring station on the Raven River near the Town of Raven. Daily maximum stream temperatures from July to September of 2004 at ACA stream temperature monitoring sites and at AENV real-time stream temperature-monitoring station on the Raven River near Raven are shown in Figure 4.2 and have been included in tabular format in Appendix 4. In general, daily maximum stream temperatures in the Raven River decreased upstream from the stream mouth (Figure 4.2). At all temperature-monitoring sites, the warmest stream temperatures were recorded on July 18, 2004.

The relationships between water temperature at the AENV real-time stream temperature-monitoring station on the Raven River and ACA temperature-monitoring sites on the Raven and North Raven rivers is shown in Figures 4.3 and

4.4. Included on Figures 4.3 and 4.4 are regression lines, model r^2 values, regression equations and 95% confidence intervals for the regression lines. The regression equations and model r^2 values for the daily maximum stream temperature at ACA temperature-monitoring sites regressed on the daily maximum stream temperature at AENV real-time stream temperature-monitoring station on the Raven River near Raven are displayed in Table 4.1. Regression equations shown in Table 4.1 can be used to predict the water temperature at the ACA monitoring site (y variable) given the water temperature at AENV real-time stream temperature-monitoring station on the Raven River near Raven (x variable).

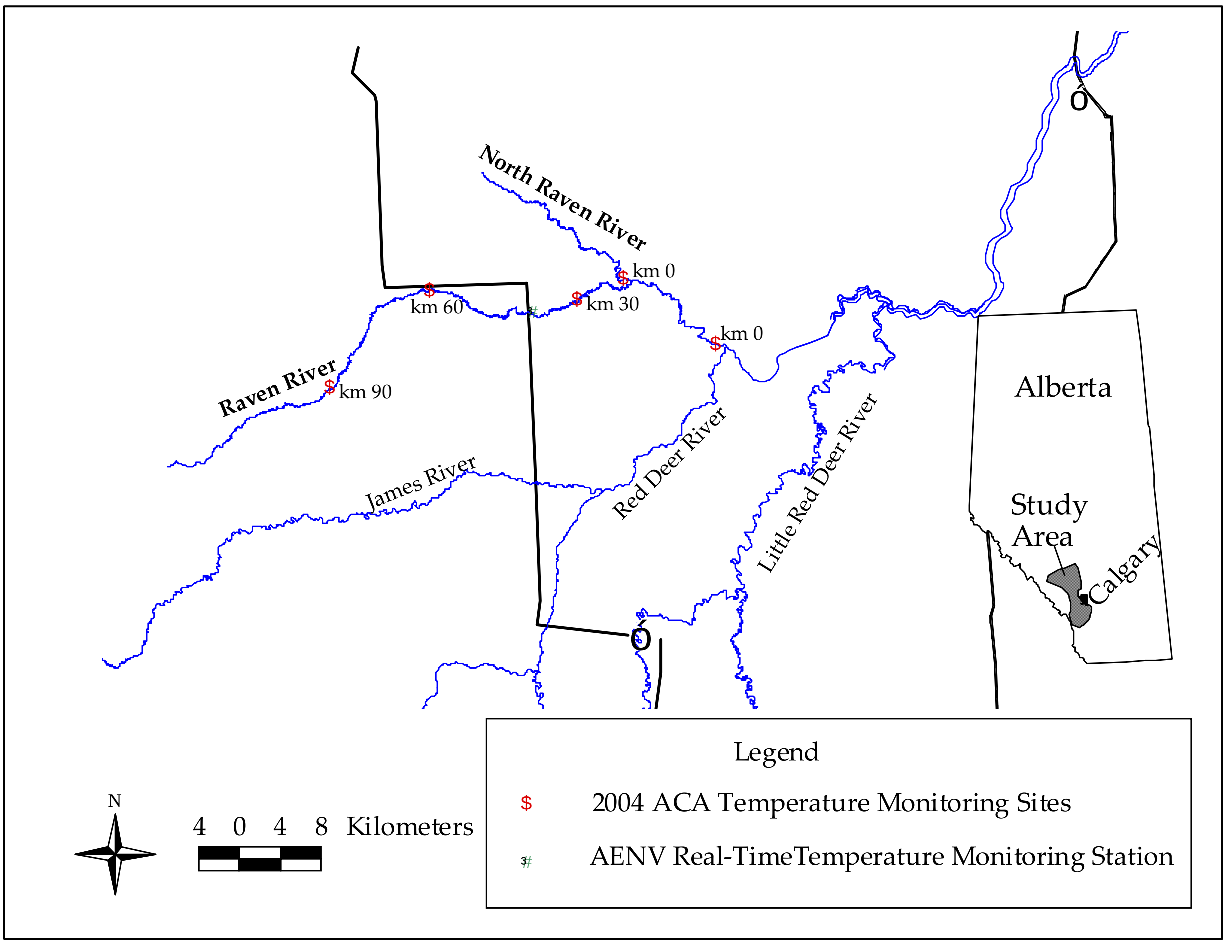


Figure 4.1 Location in south western Alberta of temperature data loggers deployed in the summer of 2004 by Alberta Conservation Association (ACA) in the Raven and North Raven rivers. Also shown is the location of the Alberta Environment (AENV) real-time monitoring station on the Raven River near the Town of Raven.

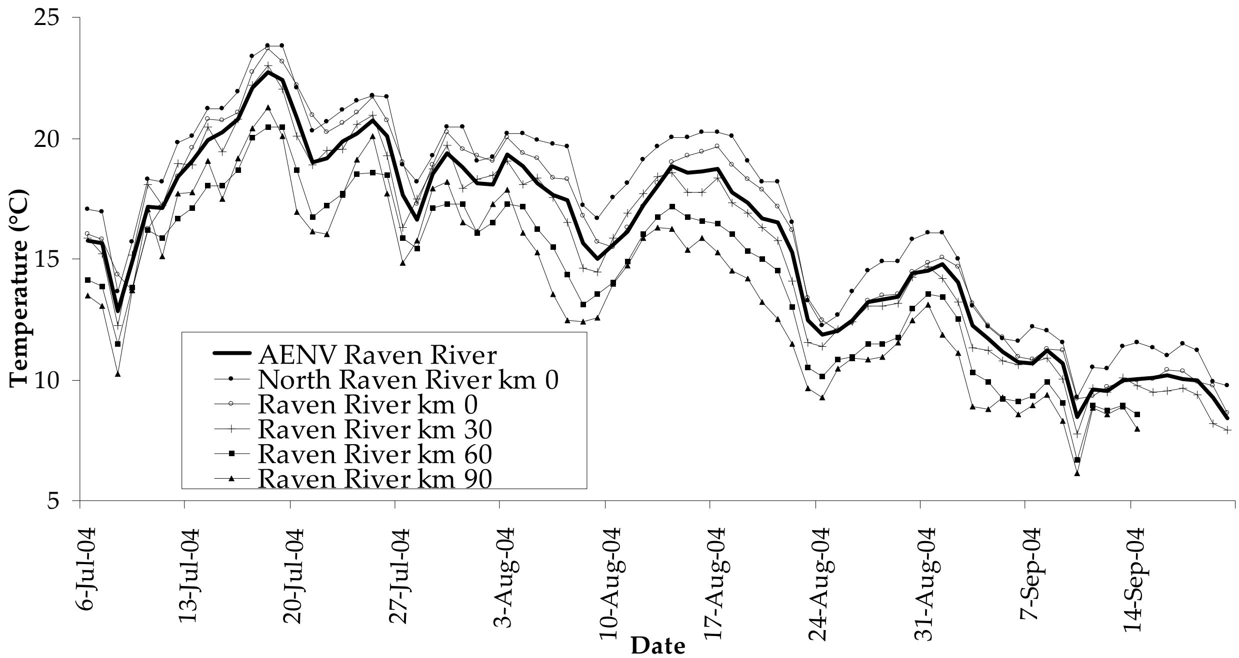


Figure 4.2 Daily maximum stream temperatures recorded from July to September, 2004 at Alberta Conservation Associations water temperature monitoring sites in the Raven and North Raven rivers and at Alberta Environment (AENV) Raven River real-time monitoring station near the Town of Raven.

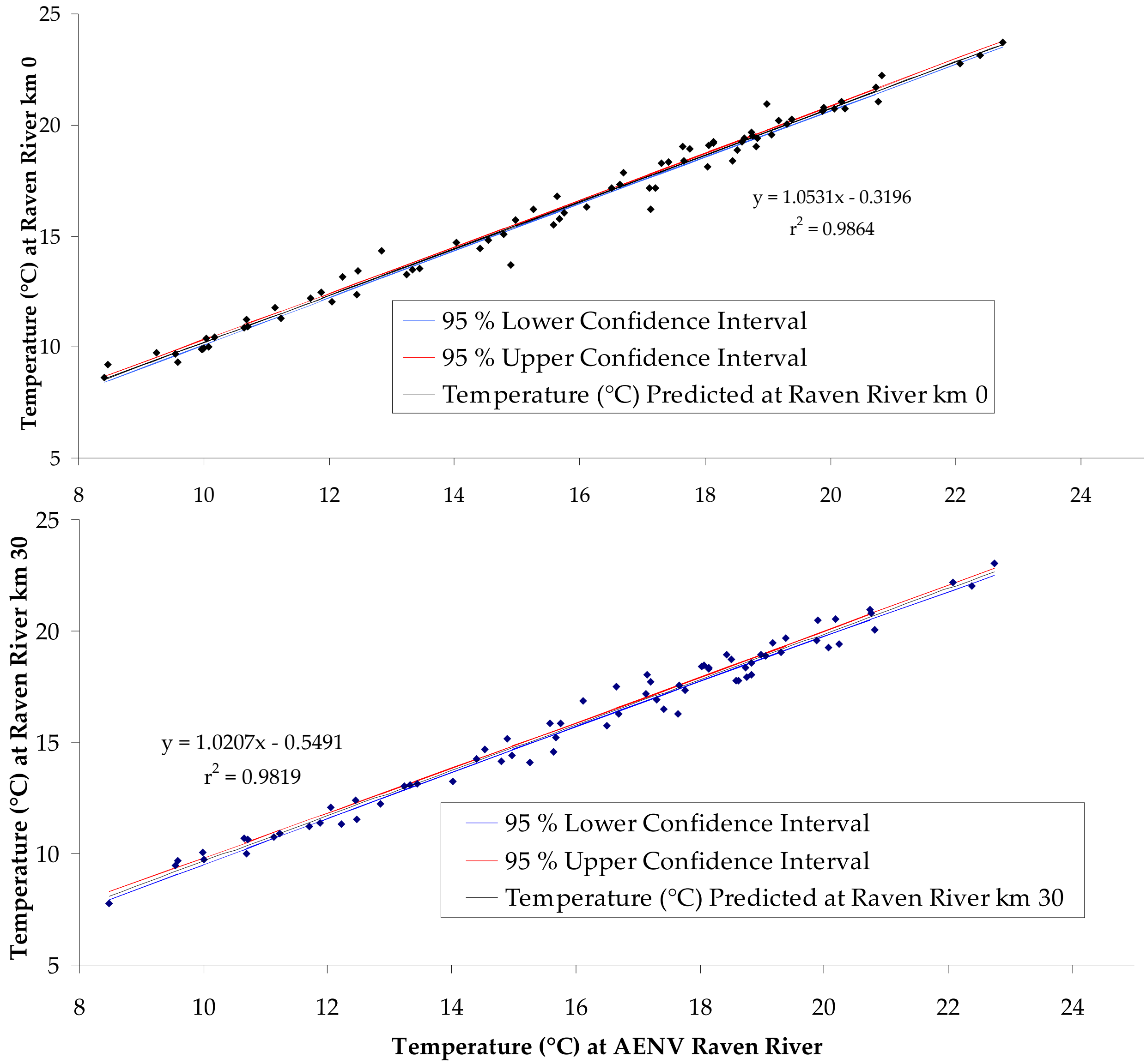
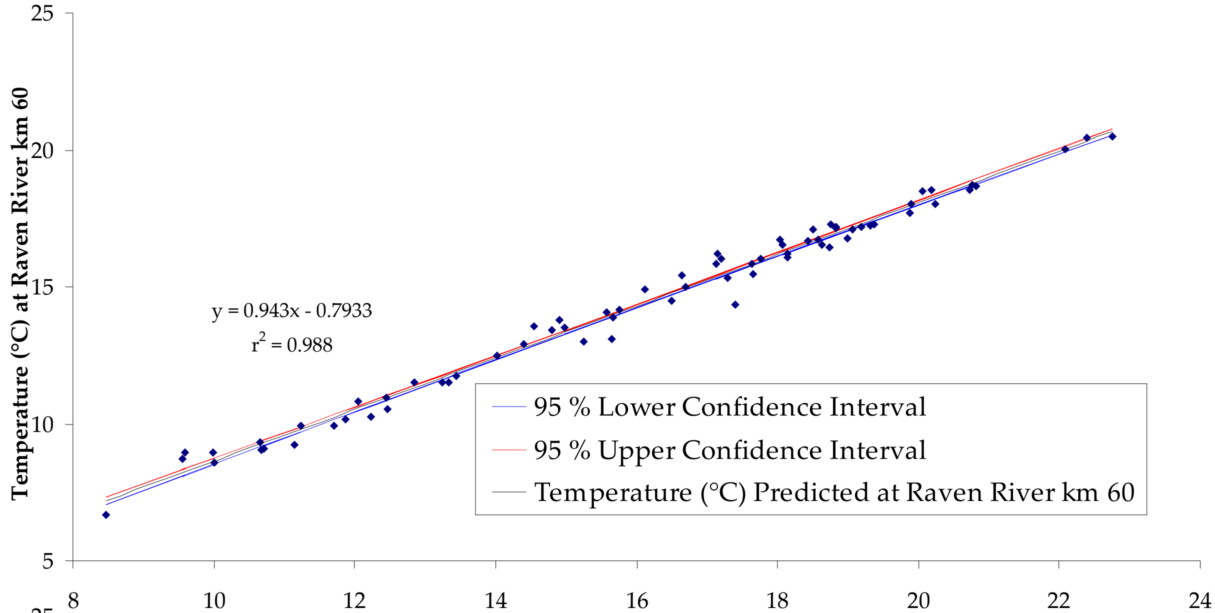


Figure 4.3 Relationship between water temperature at Alberta Environment (AENV) real-time monitoring station Raven River near the Town of Raven and Alberta Conservation Association stream temperature-monitoring sites Raven River km 0, km 30, km 60 and km 90 for the summer of 2004. Predicted temperature lines, regression models, model r^2 values and 95 % confidence intervals are shown for each temperature prediction.



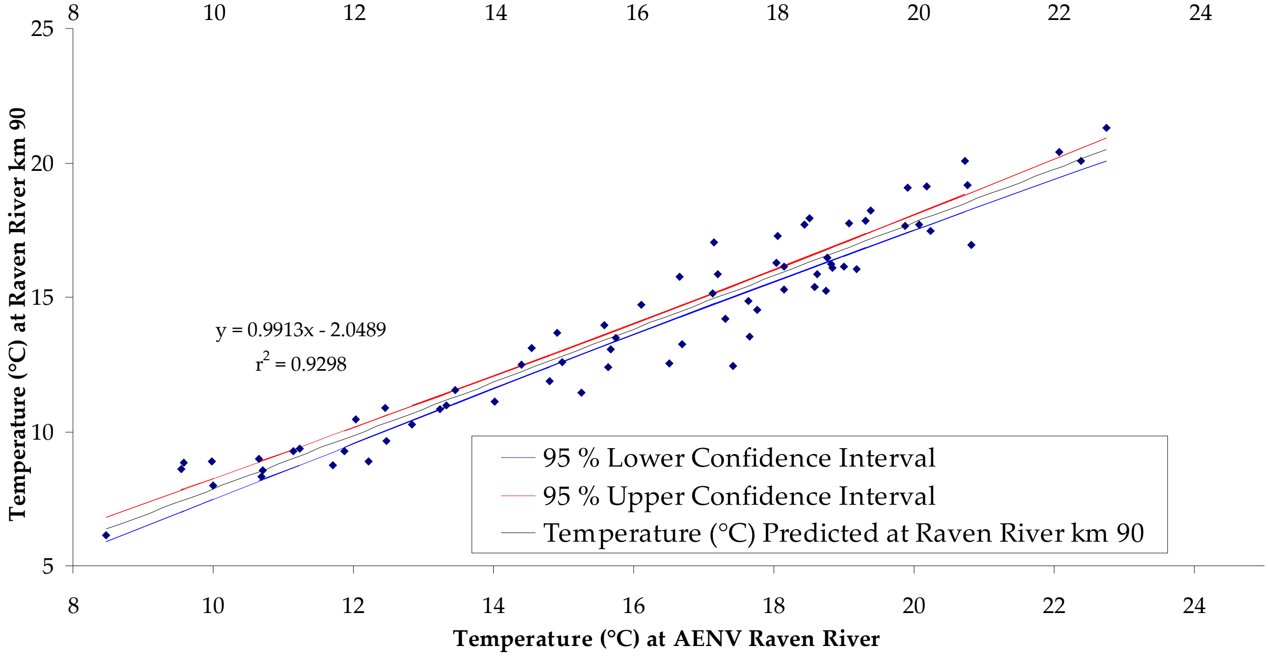


Figure 4.3 Cont.

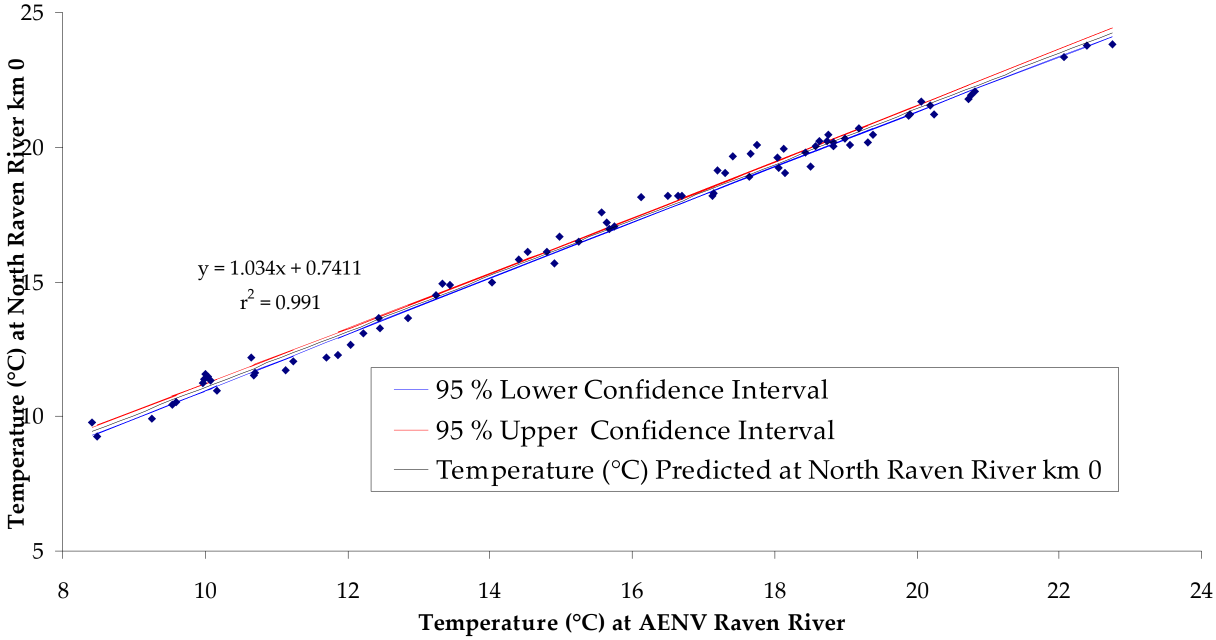


Figure 4.4 Relationship between water temperature at Alberta Environment (AENV) real-time monitoring station Raven River near the Town of Raven and Alberta Conservation Association stream temperature-monitoring site North Raven River km 0 for the summer of 2004. Predicted temperature line, regression model, model r^2 value and 95 % confidence intervals are shown for the temperature prediction.

Table 4.1 Regression models and model r^2 for Alberta Conservation Association (ACA) temperature-monitoring sites on the Raven and North Raven river.

ACA temperature-monitoring site	Regression equation	Model r^2
Raven River km 0	y = 1.0531x - 0.3196	0.9864
Raven River km 30	y = 1.0207x - 0.5491	0.9819
Raven River km 60	y = 0.943x - 0.7933	0.9880
Raven River km 90	y = 0.9913x - 2.0489	0.9298
North Raven River km 0	y = 1.034x + 0.7411	0.9910

4.2 JAMES RIVER

Three temperature loggers were deployed in the James River in the summer of 2004 (Figure 4.5). Figure 4.5 also show the location of the AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth. Daily maximum stream temperatures from July to September, 2004 at ACA stream temperature monitoring sites and at the AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth are shown in Figure 4.6 and have been included in tabular format in Appendix 5. In general, daily maximum stream temperatures in the James River decreased upstream from the stream mouth. In 2004, the warmest stream temperatures in the James River were recorded on the 18th (km 0 and 30) and 24th (km 60) of July.

The relationships between water temperature at the AENV real-time stream temperature-monitoring site on the Little Red Deer River near the mouth and ACA temperature-monitoring sites in the James River are shown in Figure 4.7. Included on Figure 4.7 are regression lines, model r^2 values, regression equations and 95% confidence intervals for the regression lines. The regression equations and model r^2 values for the daily maximum stream temperatures at ACA temperature-monitoring sites regressed on the daily maximum stream temperatures at the AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth are displayed in Table 4.2. Regression equations shown in Table 4.2 can be used to predict the water temperature at the ACA monitoring site (y variable) given the water temperature at AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth (x variable).

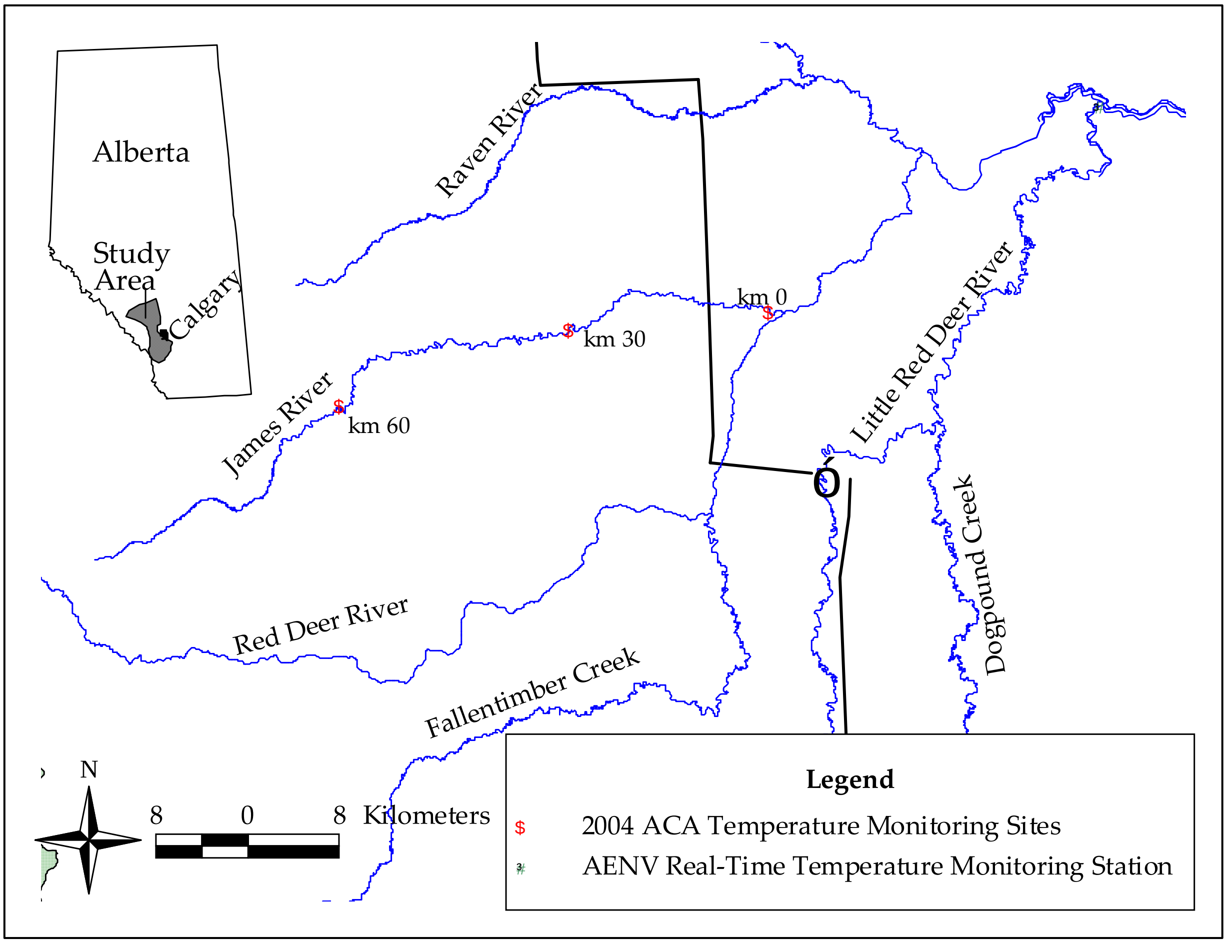


Figure 4.5 Location in south western Alberta of temperature data loggers deployed in the summer of 2004 by Alberta Conservation Association (ACA) in the James River. Also shown is the location of the Alberta Environment (AENV) real-time monitoring station on the Little Red Deer River near the mouth.

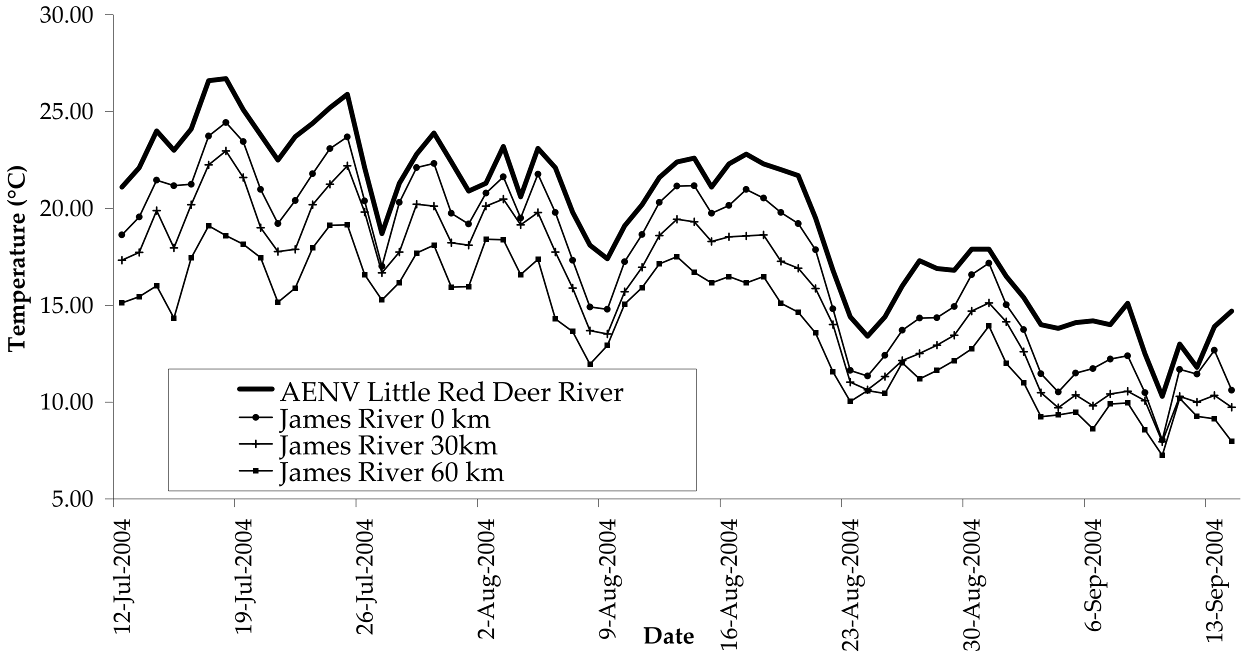


Figure 4.6 Daily maximum stream temperatures recorded from July to September, 2004 at Alberta Conservation Associations water temperature monitoring sites on the James River and at Alberta Environment (AENV) real-time stream temperature-monitoring station on the Little Red Deer River near the mouth.

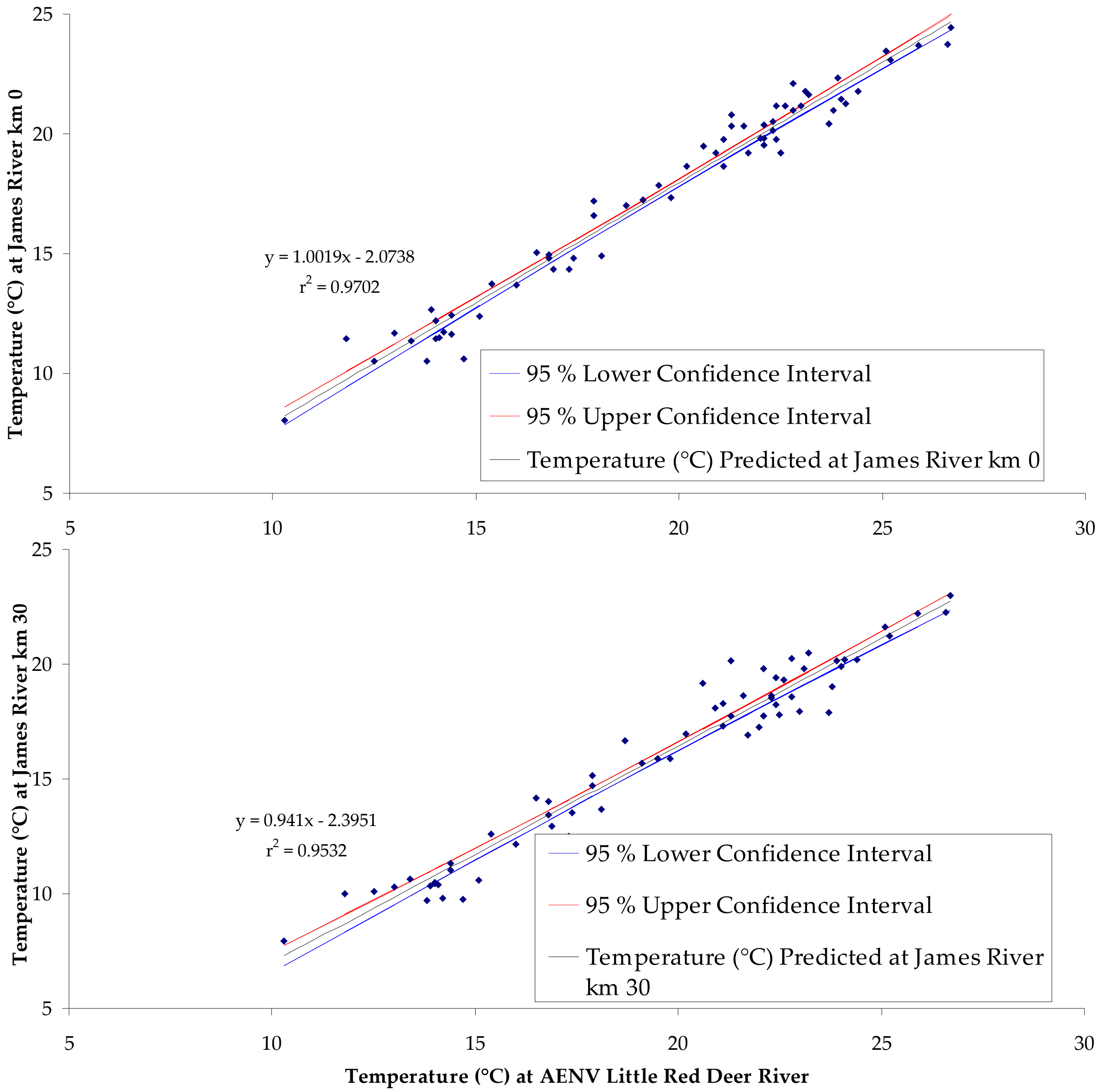


Figure 4.7 Relationship between water temperature at Alberta Environment (AENV) real-time monitoring station on the Little Red Deer River near the mouth and Alberta Conservation Association stream temperature-monitoring stations James River km 0, km 30 and km 60 for summer of 2004. Predicted temperature lines, regression models, model r^2 values and 95 % confidence intervals are shown for each temperature prediction.

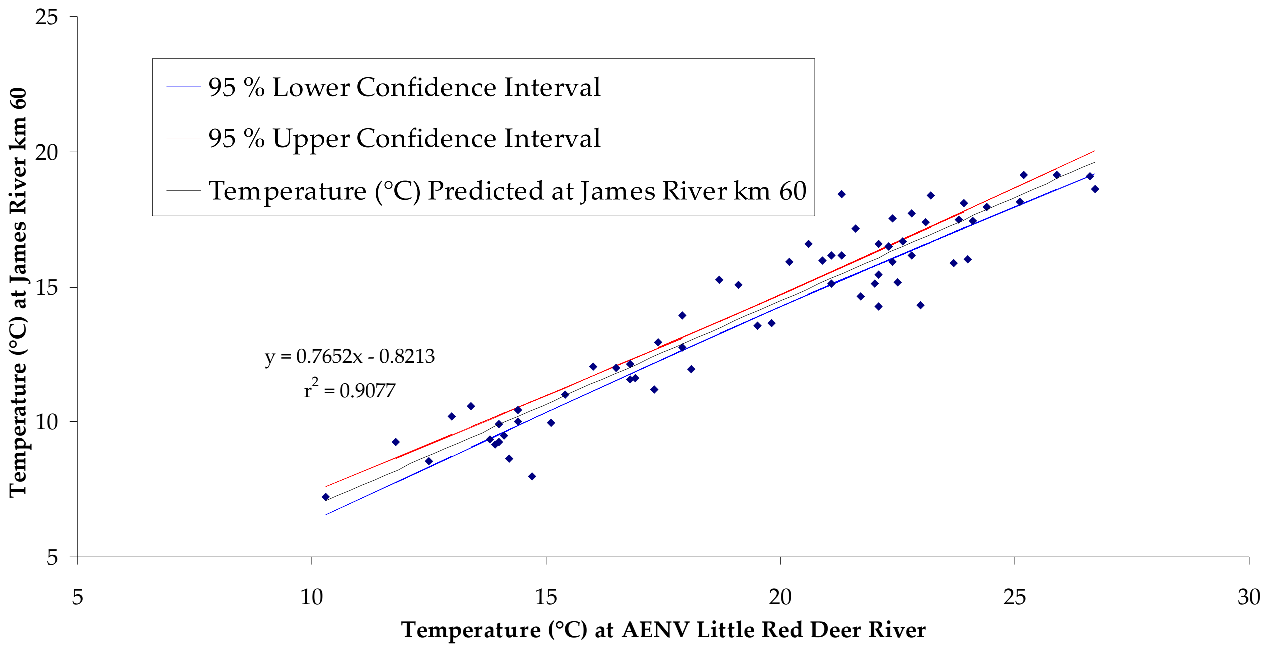


Figure 4.7 Cont.

Table 4.2 Regression models and model r^2 for Alberta Conservation Association (ACA) temperature-monitoring sites on the James River.

ACA temperature-monitoring site	Regression equation	Model r^2
James River km 0	y = 1.0019x - 2.0738	0.9702
James River km 30	y = 0.941x - 2.3951	0.9532
James River km 60	y = 0.7652x - 0.8213	0.9077

4.3 FALLENTIMBER CREEK

Four temperature loggers were deployed in the Fallentimber Creek in the summer of 2004 (Figure 4.8). Figure 4.8 also shows the location of the AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth. Daily maximum stream temperatures from July to September of 2004 at ACA stream temperature monitoring sites and at the AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth are shown in Figure 4.9 and have been included in tabular format in Appendix 6. In general, daily maximum stream temperatures in the Fallentimber Creek decreased upstream from the stream mouth (Figure 4.9). Stream temperatures recorded at Fallentimber Creek sites km 0 and km 30 tended to group together as did those at Fallentimber Creek sites km 60 and km 90. The warmest stream temperatures in Fallentimber Creek were recorded on July 18, 2004 at km 0 and km 30, July 17, 2004 at km 60 and July 2, 2004 at km 90.

The relationships between water temperature at the AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth and ACA temperature-monitoring sites on Fallentimber Creek are shown in Figure 4.10. Included on Figure 4.10 are regression lines, model r^2 values, regression equations and 95% confidence intervals for the regression lines. The regression equations and model r^2 values for the daily maximum stream temperatures at ACA temperature-monitoring sites regressed on the daily maximum stream temperatures at the AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth are displayed in Table 4.3. Regression equations shown in Table 4.3 can be used to predict the water temperature at the ACA monitoring site (y variable) given the water temperature at AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth (x variable).

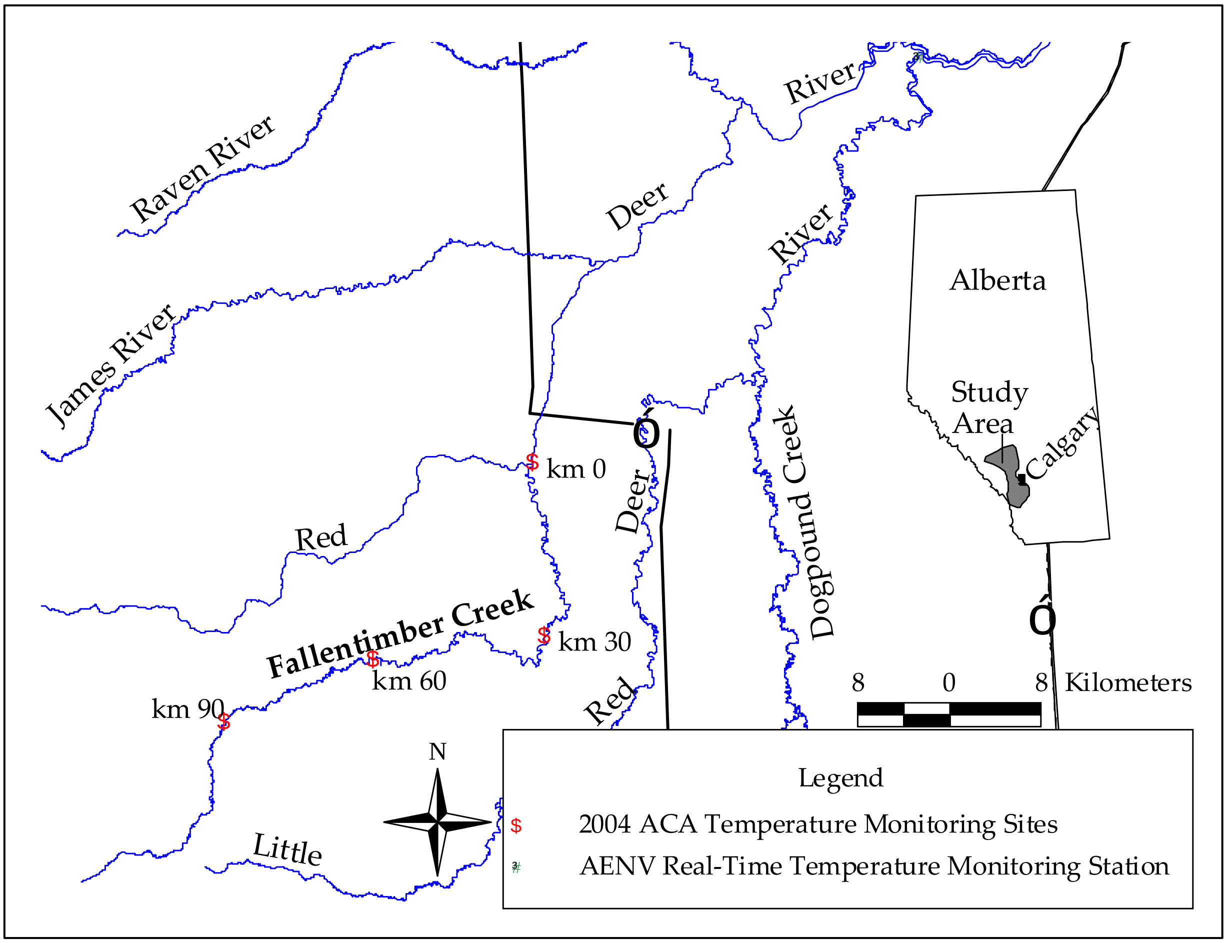


Figure 4.8 Location in south western Alberta of temperature data loggers deployed in the summer of 2004 by Alberta Conservation Association (ACA) in the Fallentimber Creek. Also shown is the location of the Alberta Environment (AENV) real-time monitoring station on the Little Red Deer River near the mouth.

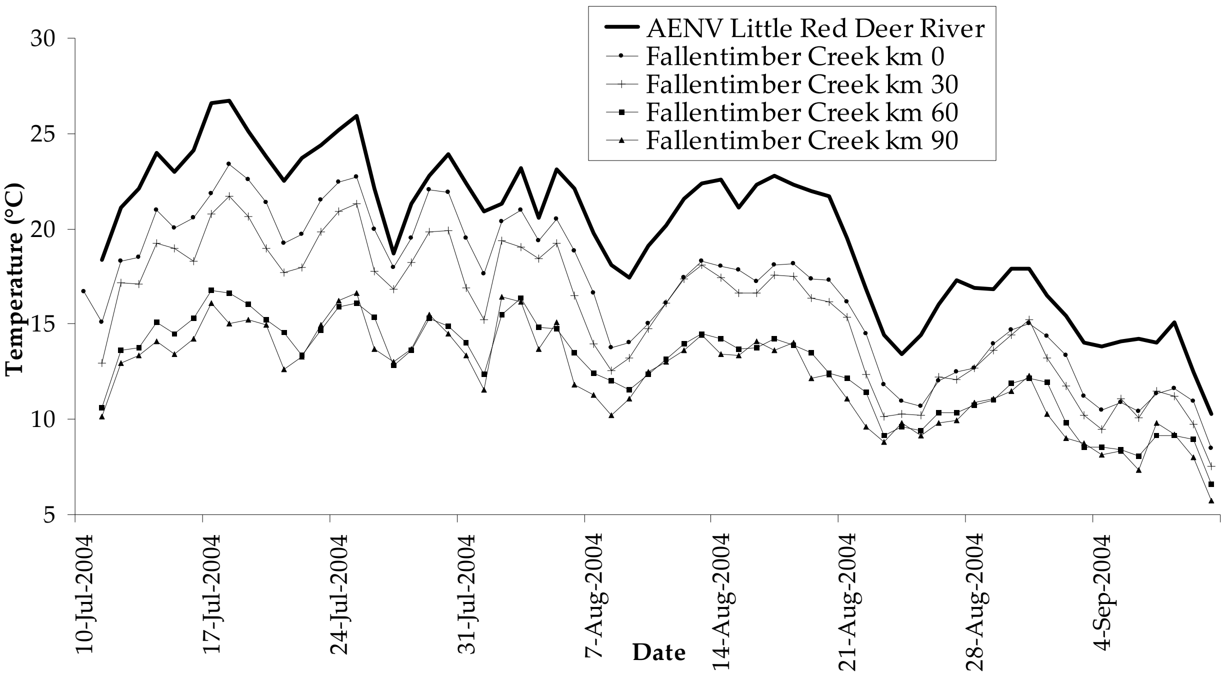


Figure 4.9 Daily maximum stream temperatures recorded from July to September, 2004 at Alberta Conservation Associations water temperature monitoring sites on the Fallentimber Creek and at Alberta Environment (AENV) real-time stream temperature-monitoring station on the Little Red Deer River near the mouth.

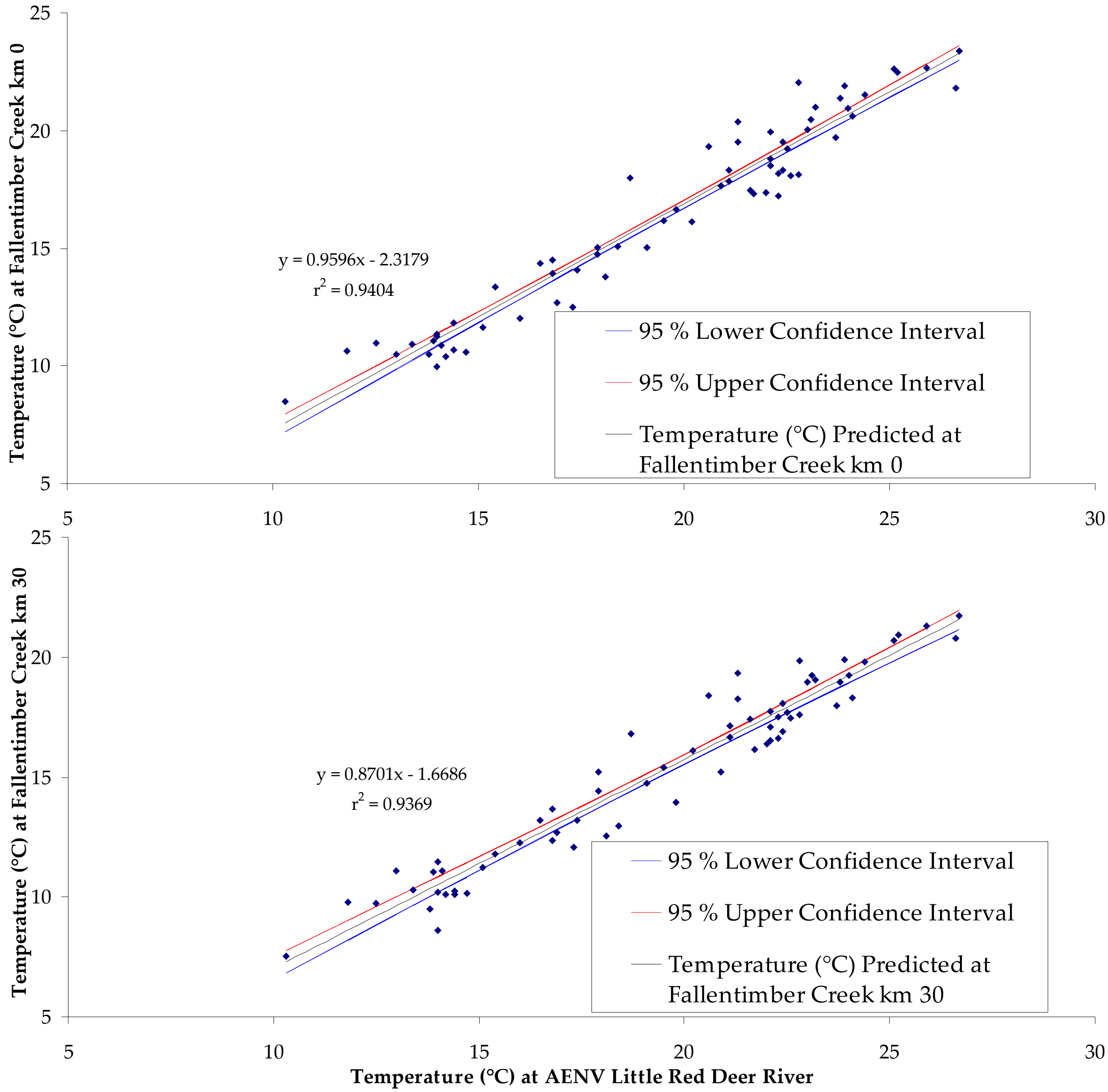


Figure 4.10 Relationship between water temperature at Alberta Environment (AENV) real-time monitoring station on the Little Red Deer River near the mouth and Alberta Conservation Association stream temperature-monitoring sites Fallentimber Creek km 0, km 30, km 60 and km 90 for summer of 2004. Predicted temperature lines, regression models, model r^2 values and 95 % confidence intervals are shown for each temperature prediction.

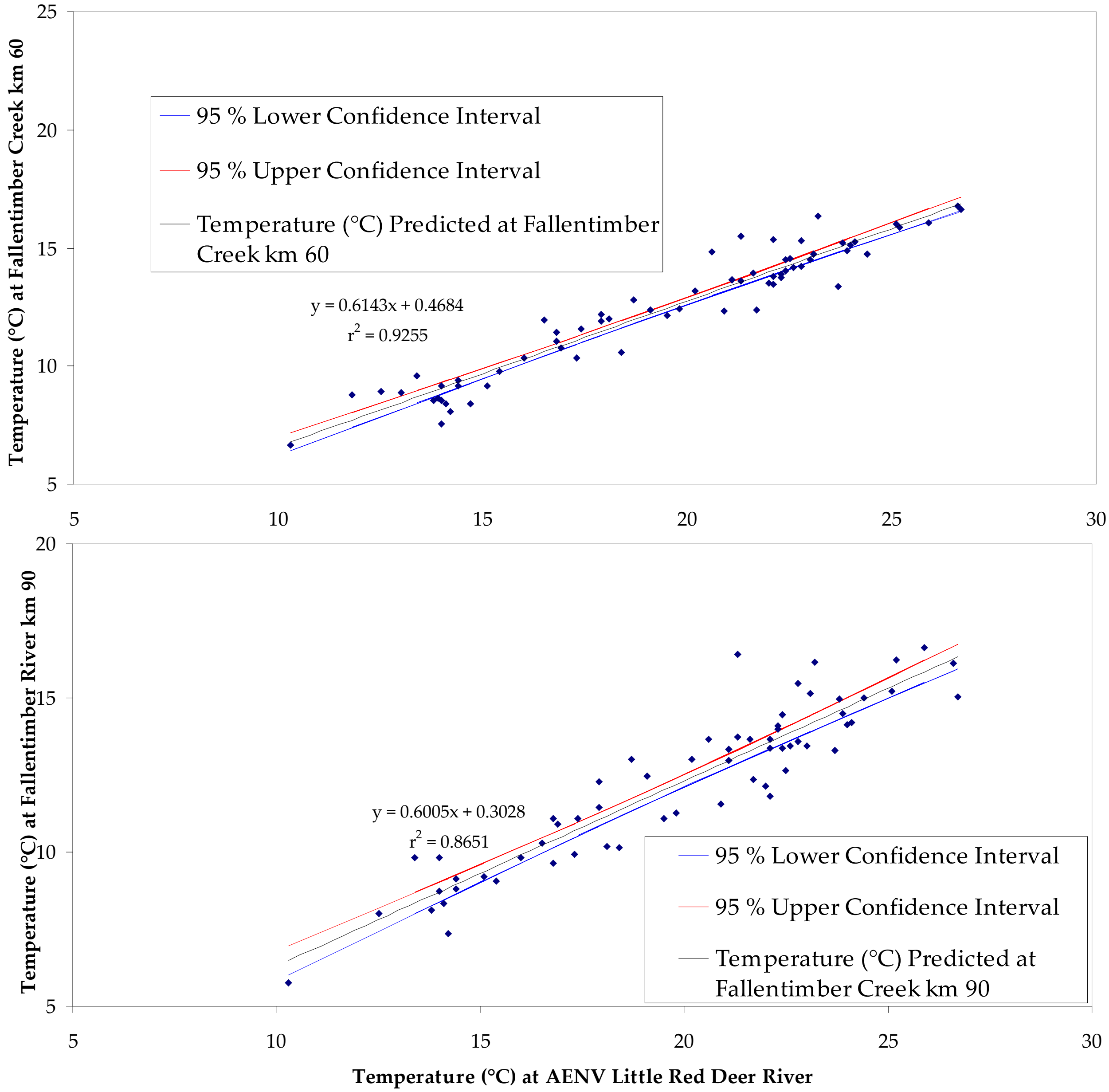


Figure 4.10 cont.

Table 4.3 Regression models and model r^2 for Alberta Conservation Association (ACA) temperature-monitoring sites on the Fallentimber Creek .

ACA temperature-monitoring site	Regression equation	Model r^2
Fallentimber Creek km 0	y = 0.9596x - 2.3179	0.9404
Fallentimber Creek km 30	y = 0.8701x - 1.6686	0.9369
Fallentimber Creek km 60	y = 0.6143x + 0.4684	0.9255
Fallentimber Creek km 90	y = 0.6005x + 0.3028	0.8651

4.4 LITTLE RED DEER RIVER

Seven temperature loggers were deployed in the Little Red Deer River in the summer of 2004 (Figure 4.11). Figure 4.11 also shows the location of the AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth. Daily maximum stream temperatures from July to September of 2004 at ACA stream temperature monitoring sites and at the AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth are shown in Figure 4.12 and have been included in tabular format in Appendix 7. In general, daily maximum stream temperatures in the Little Red Deer River decreased upstream from the stream mouth (Figure 4.12). Stream temperatures recorded at Little Red Deer River km 0, km 30, km 60, and km 90 tended to form a group while the temperatures recorded at Little Red Deer River km 120, km 150 and km 180 tended to form another. After August 21, 2004 these groupings break down and stream temperatures appear to decrease uniformly with increased distance upstream. At Little Red Deer River km 0, km 30, km 150, and km 180 the warmest stream temperatures were recorded on July 18, 2004. At Little Red Deer River sites km 60 and km 90, the warmest stream temperatures were recorded on July 25, 2004. At Little Red Deer River site km 120 the warmest stream temperature was recorded on July 24, 2004.

The relationships between water temperature at the AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth and ACA temperature-monitoring sites on the Little Red Deer River are shown in Figure 4.13. Included on Figure 4.13 are regression lines, model r^2 values, regression equations and 95% confidence intervals for the regression lines. The regression equations and model r^2 values for the daily maximum stream temperatures at ACA temperature-monitoring sites regressed on the daily maximum stream temperatures at the AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth are displayed in Table 4.4. Regression equations shown in Table 4.4 can be used to predict the water temperature at the ACA monitoring site (y variable) given the water temperature at AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth (x variable).

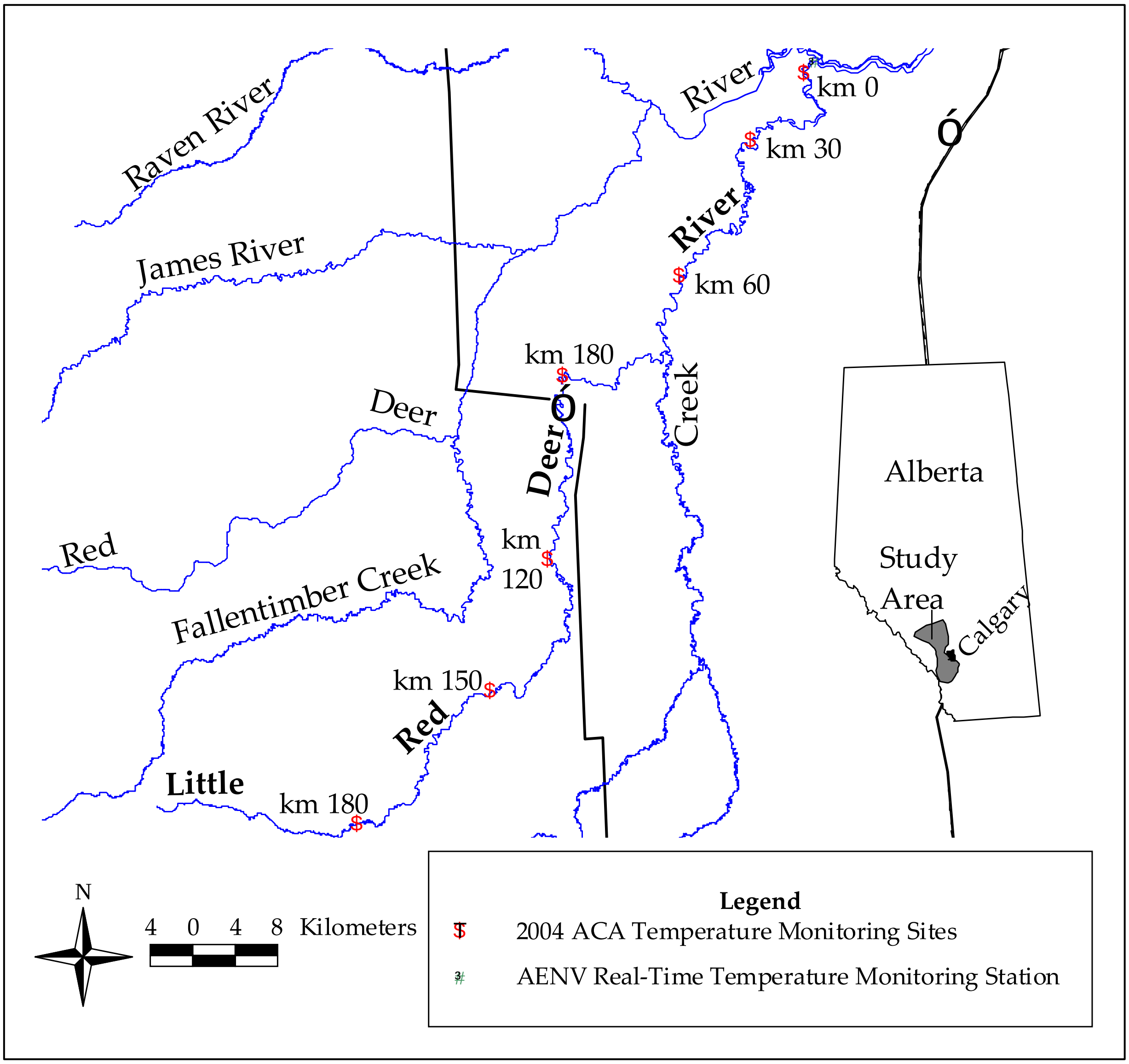


Figure 4.11 Location in south western Alberta of temperature data loggers deployed in the summer of 2004 by Alberta Conservation Association (ACA) in the Little Red Deer River. Also shown is the location of the Alberta Environment (AENV) real-time monitoring station on the Little Red Deer River near the mouth.

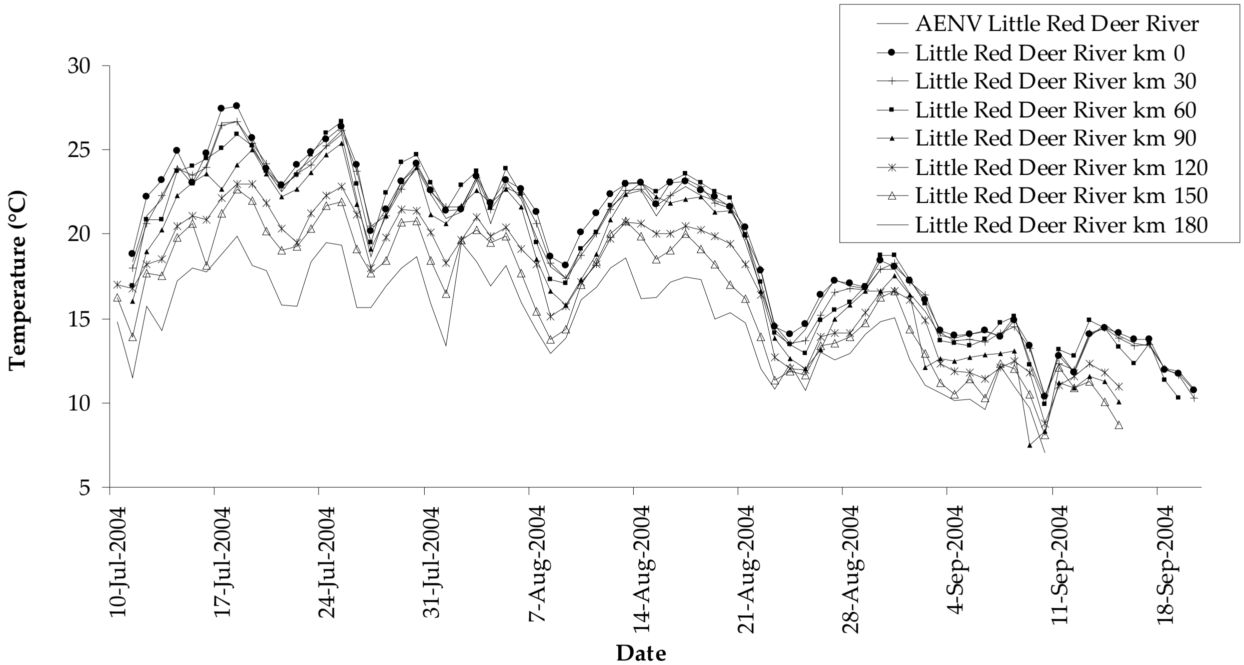


Figure 4.12 Daily maximum stream temperatures recorded from July to September, 2004 at Alberta Conservation Associations water temperature monitoring sites on the Little Red Deer River and at Alberta Environment (AENV) real-time stream temperature-monitoring station on the Little Red Deer River near the mouth.

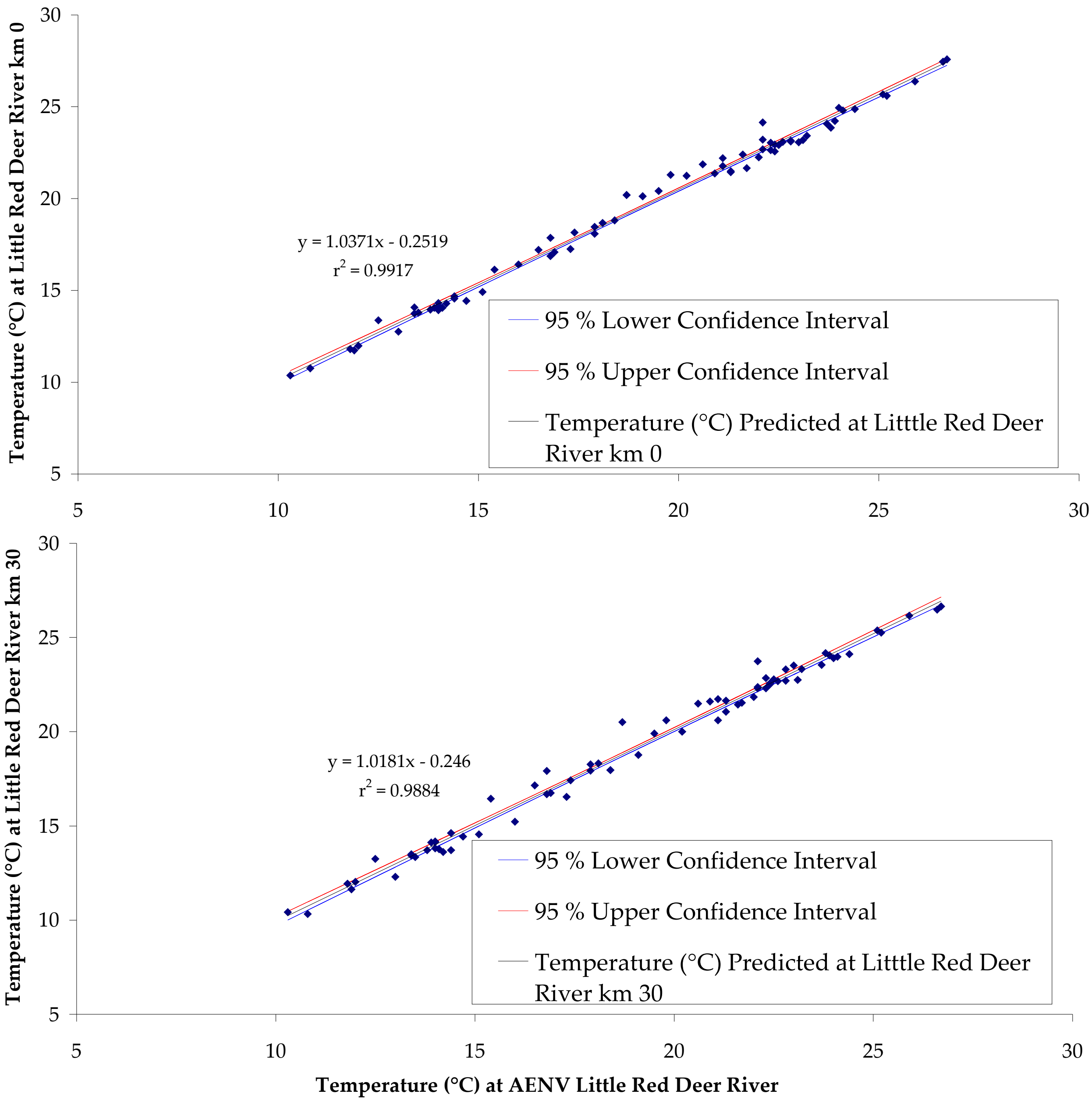


Figure 4.13 Relationship between water temperature at Alberta Environment (AENV) real-time monitoring station on the Little Red Deer River near the mouth and Alberta Conservation Association stream temperature-monitoring sites Little Red Deer River km 0, km 30, km 60, km 90, km 120, km 150, and km 180 for summer of 2004. Predicted temperature lines, regression models, model r^2 values and 95 % confidence intervals are shown for each temperature prediction.

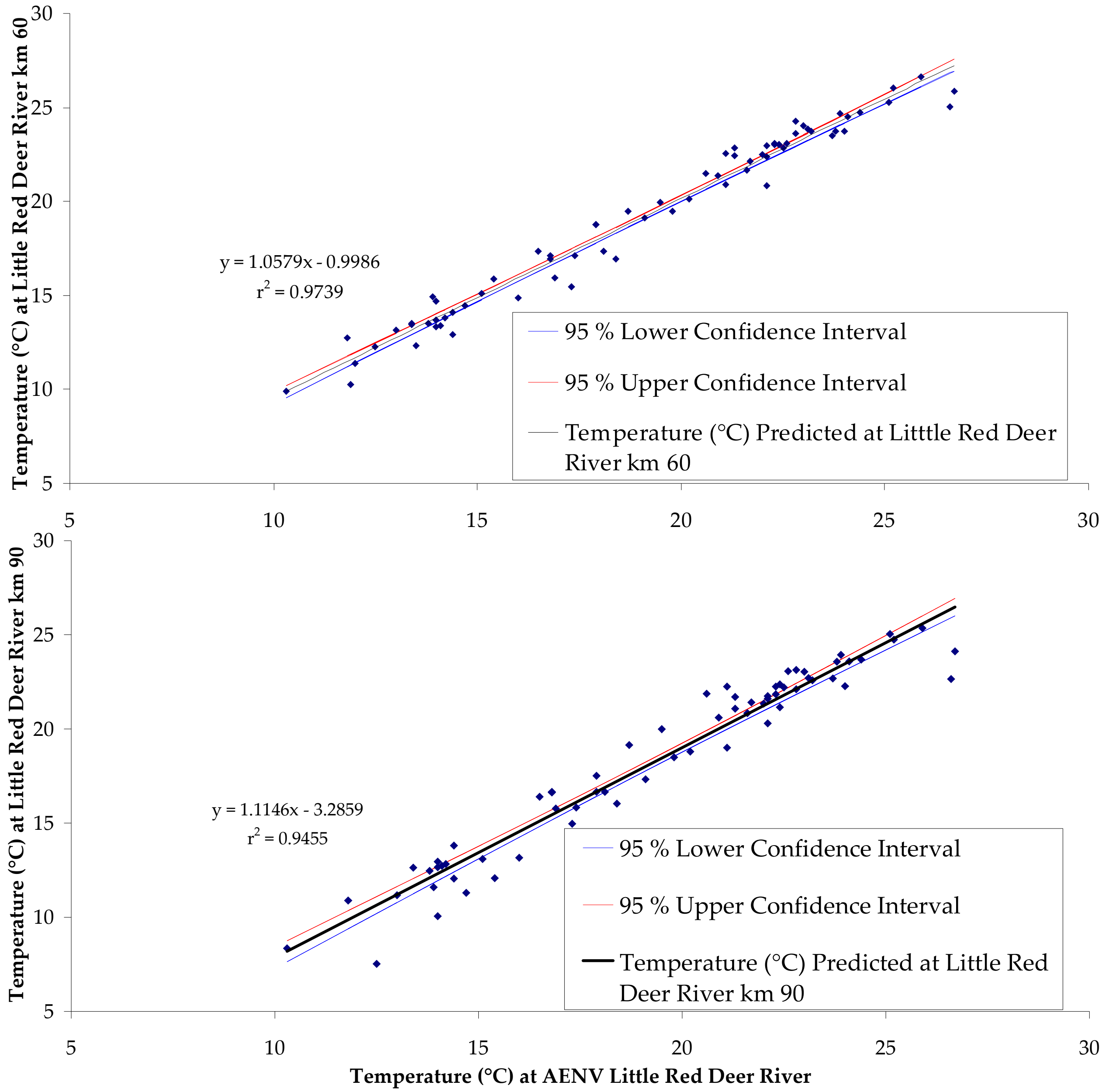
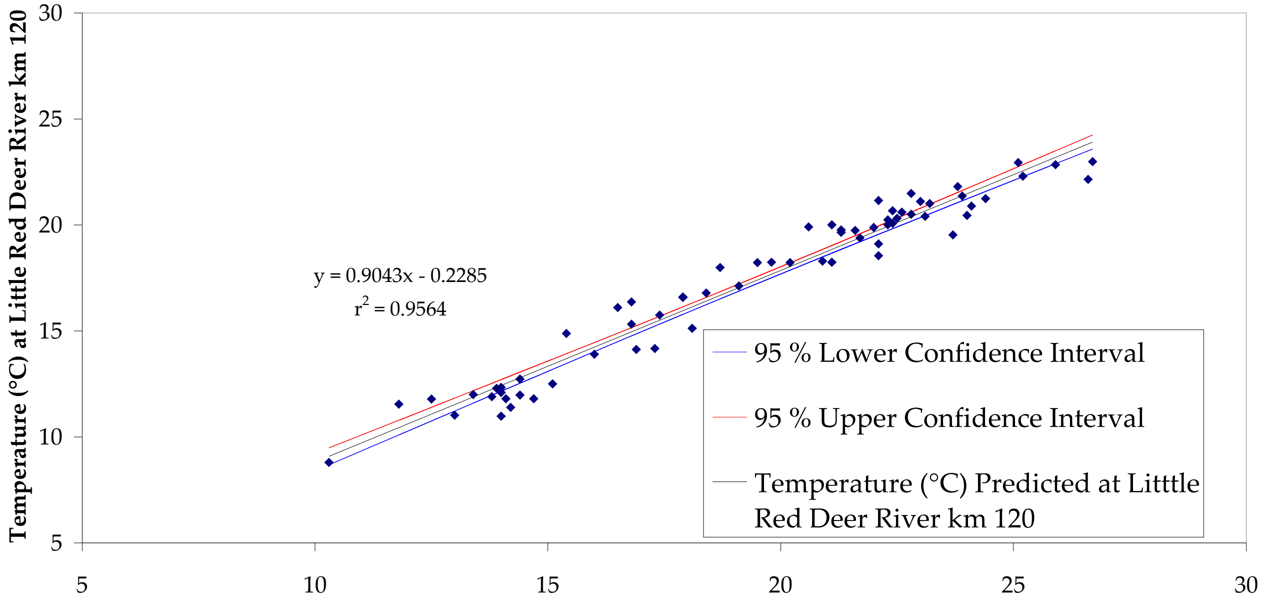


Figure 4.13 Cont.



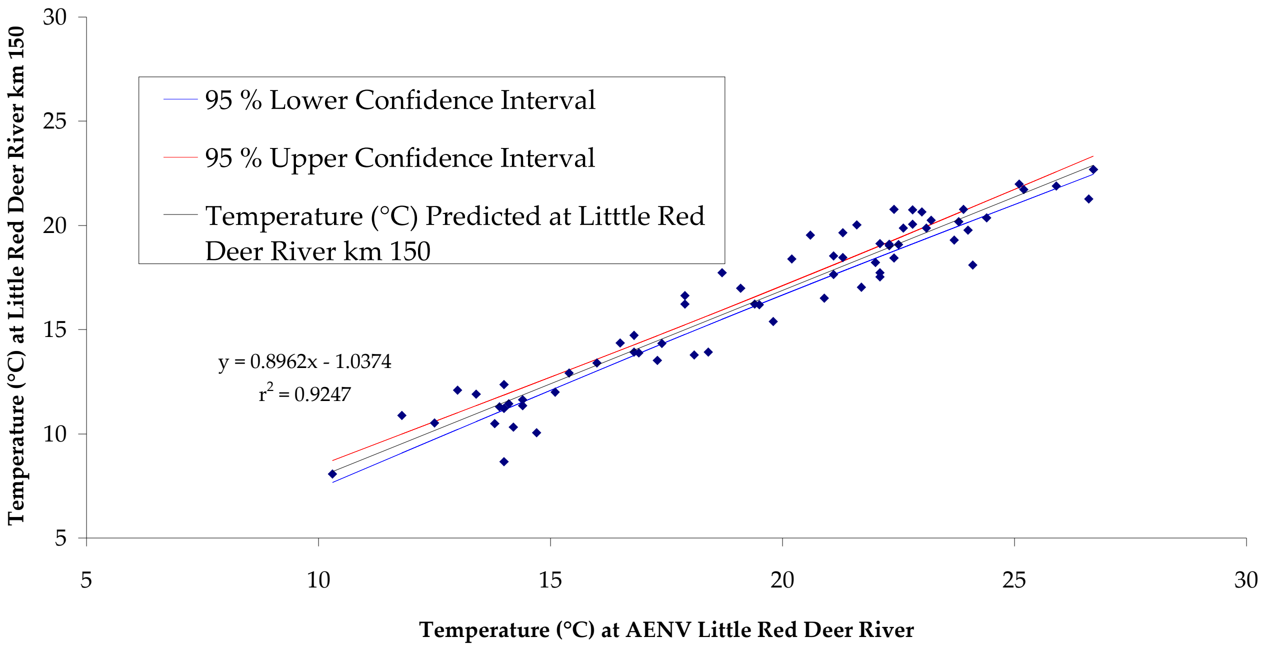


Figure 4.13 Cont.

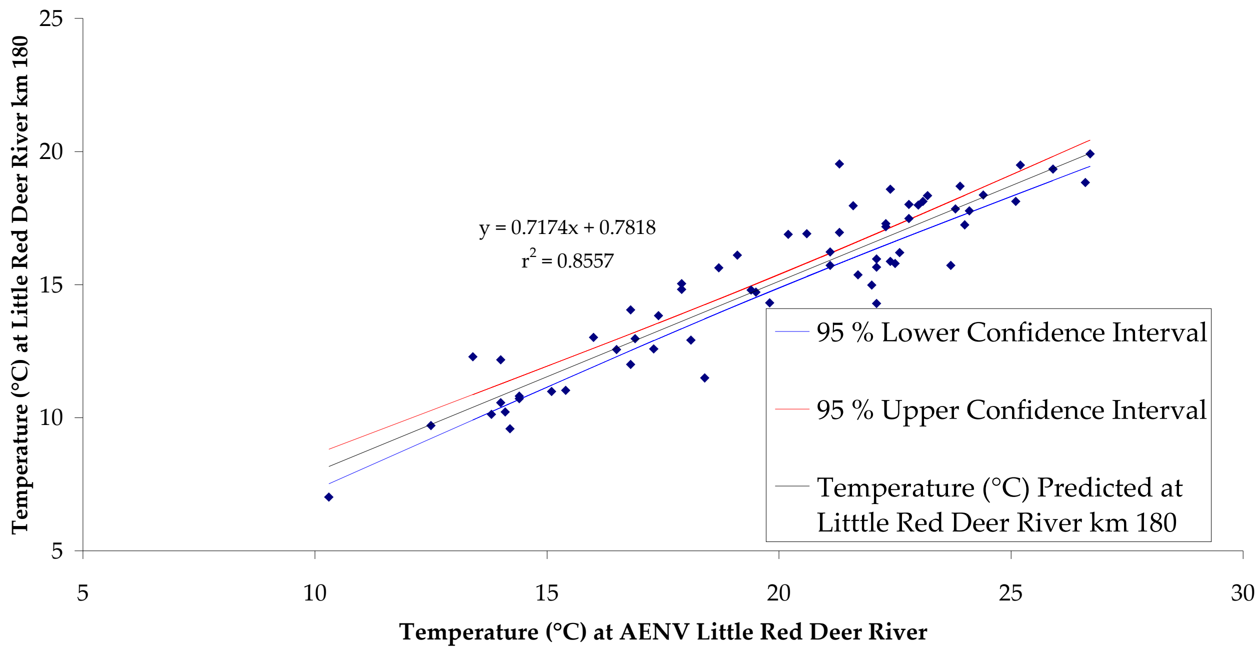


Figure 4.13 Cont.

Table 4.4 Regression models and model r^2 for Alberta Conservation Association (ACA) temperature-monitoring sites on the Little Red Deer River.

ACA temperature-monitoring site	Regression equation	Model r^2
Little Red Deer River km 0	y = 1.0371x - 0.2519	0.9917
Little Red Deer River km 30	y = 1.0181x - 0.246	0.9884
Little Red Deer River km 60	y = 1.0579x - 0.9986	0.9739
Little Red Deer River km 90	y = 1.1146x - 3.2859	0.9455
Little Red Deer River km 120	y = 0.9043x - 0.2285	0.9564
Little Red Deer River km 150	y = 0.8962x - 1.0374	0.9247
Little Red Deer River km 180	y = 0.7174x + 0.7818	0.8557

4.5 DOGPOUND CREEK

Six temperature loggers were deployed in Dogpound Creek in the summer of 2004 (Figure 4.14). Figure 4.14 also shows the location of the AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth. Daily maximum stream temperatures from July to September of 2004 at ACA stream temperature monitoring sites and at the AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth are shown in Figure 4.15 and have been included in tabular format in Appendix 8. In general, daily maximum stream temperatures in the Dogpound Creek decreased upstream from the stream mouth (Figure 4.15). Stream temperatures recorded in Dogpound Creek do not, however, decrease uniformly with distance upstream. The lower four sites on the Dogpound Creek group together, while the upper two sites on Dogpound Creek form a second grouping (Figure 4.15). The warmest stream temperatures in the Dogpound Creek were recorded at all sites on July 18, 2004.

The relationships between water temperature at the AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth and ACA temperature-monitoring sites on Dogpound Creek are shown in Figure 4.16. Included on Figure 4.16 are regression lines, model r^2 values, regression equations and 95% confidence intervals for the regression lines. The regression equations and model r^2 values for the daily maximum stream temperatures at ACA temperature-monitoring sites regressed on the daily maximum stream temperatures at the AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth are displayed in Table 4.5. Regression equations shown in Table 4.5 can be used to predict the water temperature at the ACA monitoring site (y variable) given the water temperature at AENV real-time stream temperature-monitoring station on the Little Red Deer River near the mouth (x variable).

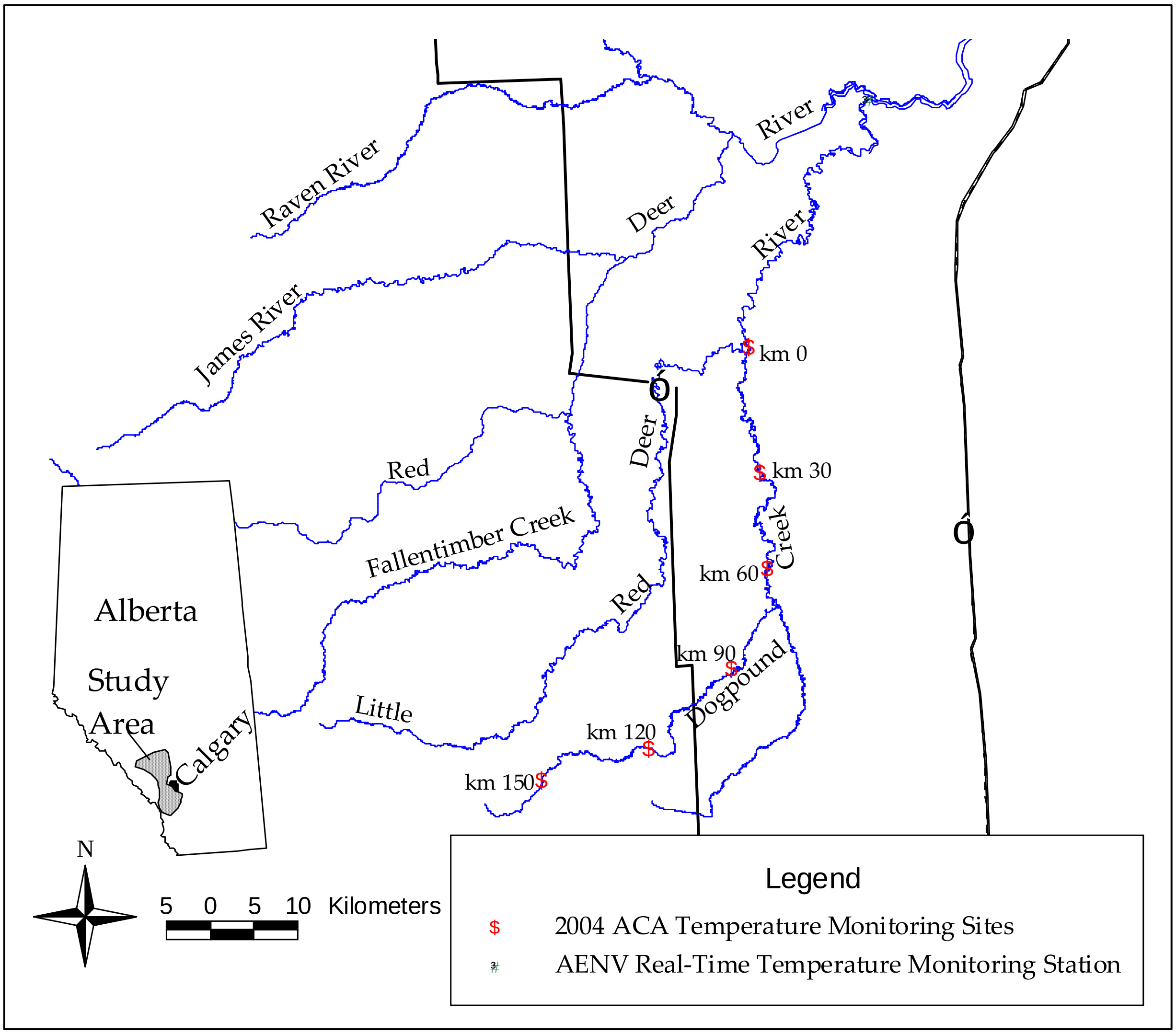


Figure 4.14 Location in south western Alberta of temperature data loggers deployed in the summer of 2004 by Alberta Conservation Association (ACA) in Dogpound Creek. Also shown is the location of the Alberta Environment (AENV) real-time monitoring station on the Little Red Deer River near the mouth.

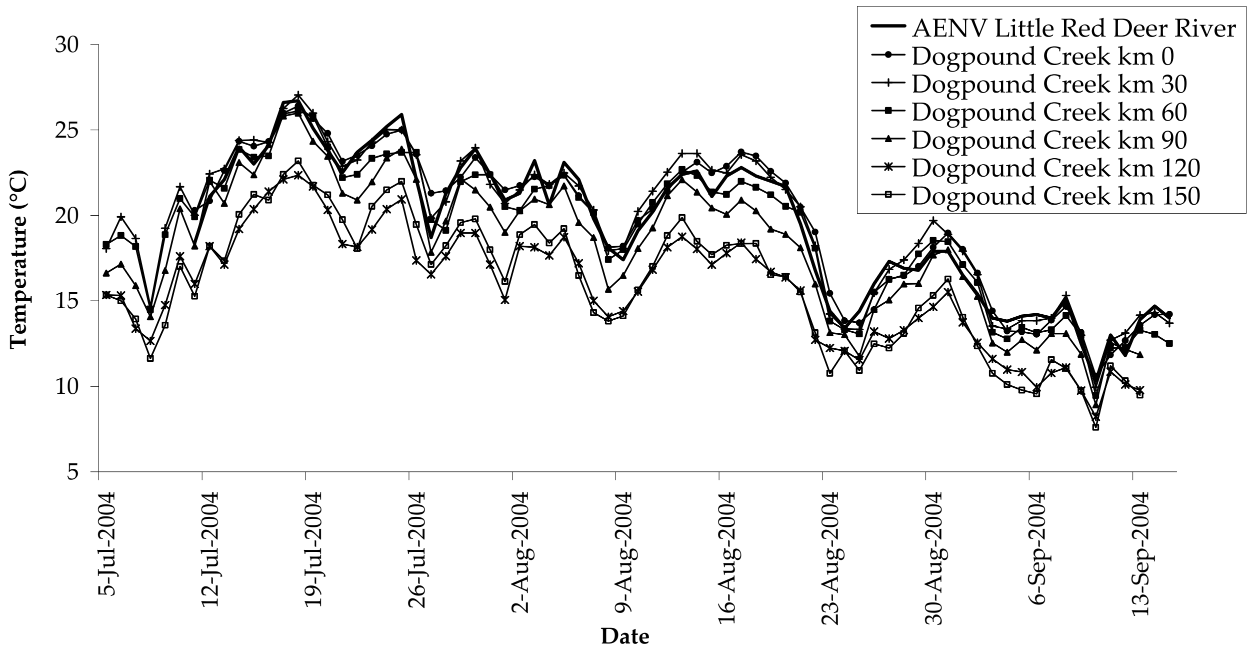


Figure 4.15 Daily maximum stream temperatures recorded from July to September, 2004 at Alberta Conservation Associations water temperature monitoring sites on Dogpound Creek and at Alberta Environment (AENV) real-time stream temperature-monitoring station on the Little Red Deer River near the mouth.

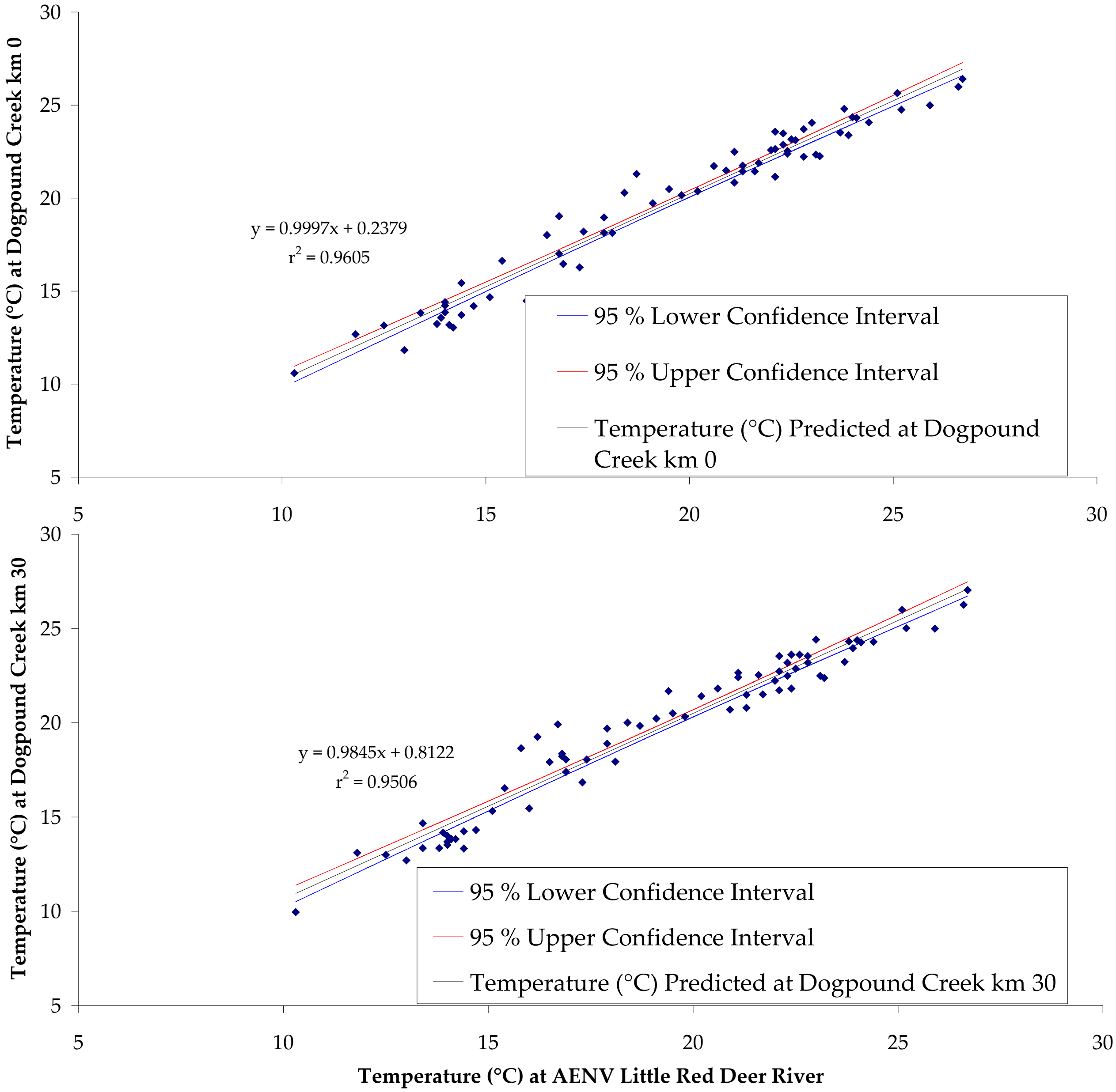


Figure 4.16 Relationship between water temperature at Alberta Environment (AENV) real-time monitoring station on the Little Red Deer River near the mouth and Alberta Conservation Association stream temperature-monitoring sites Dogpound Creek km 0, km 30, km 60, km 90, km 120, and km 150 for summer of 2004. Predicted temperature lines, regression models, model r^2 values and 95 % confidence intervals are shown for each temperature prediction.

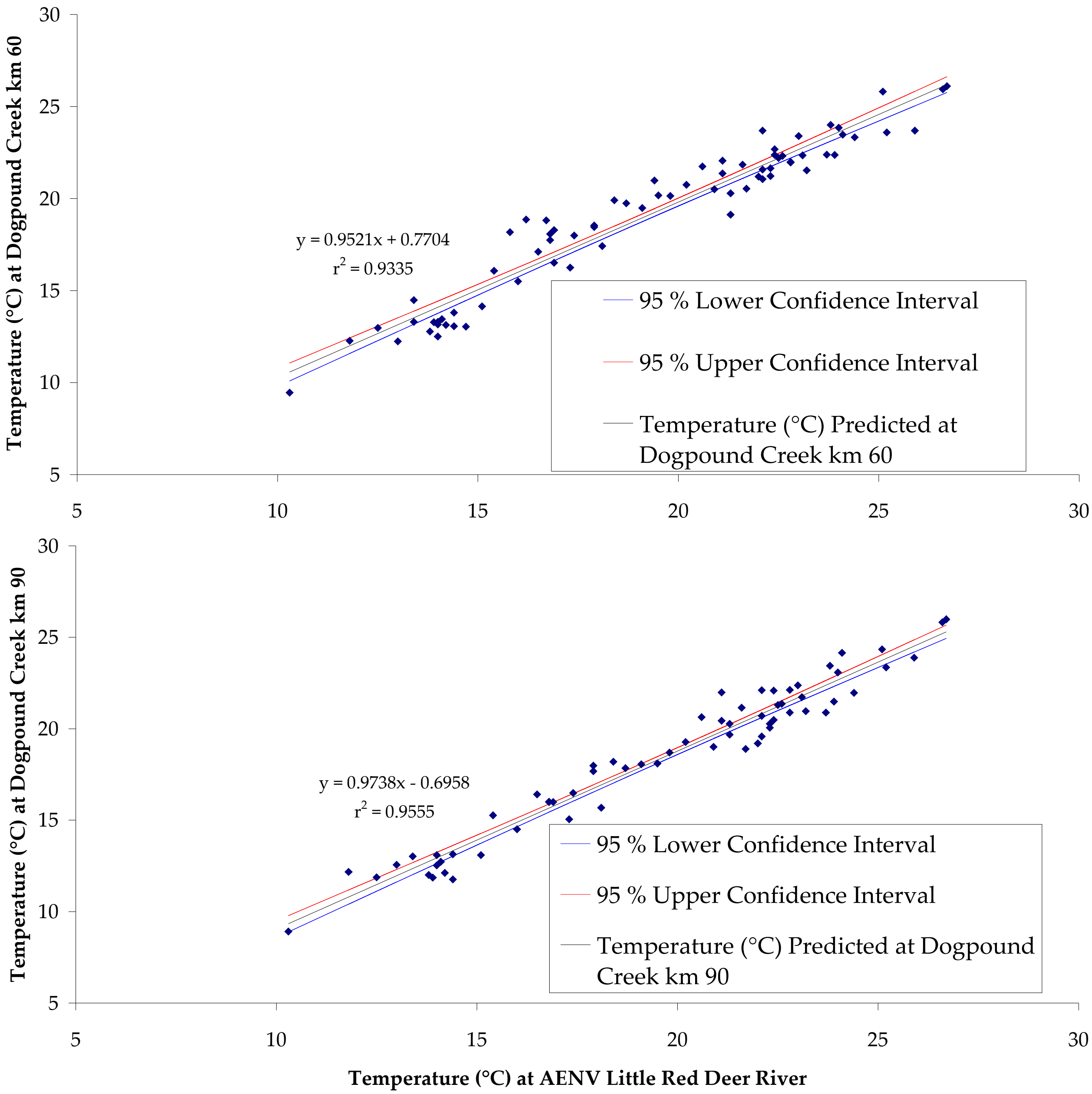
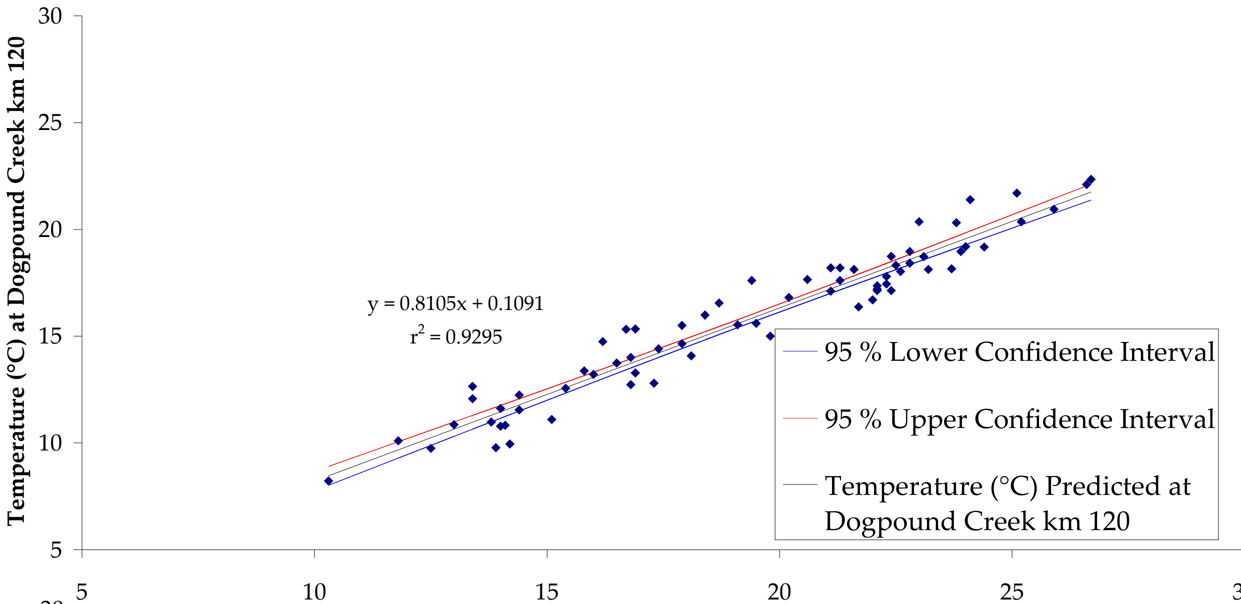


Figure 4.16 Cont.



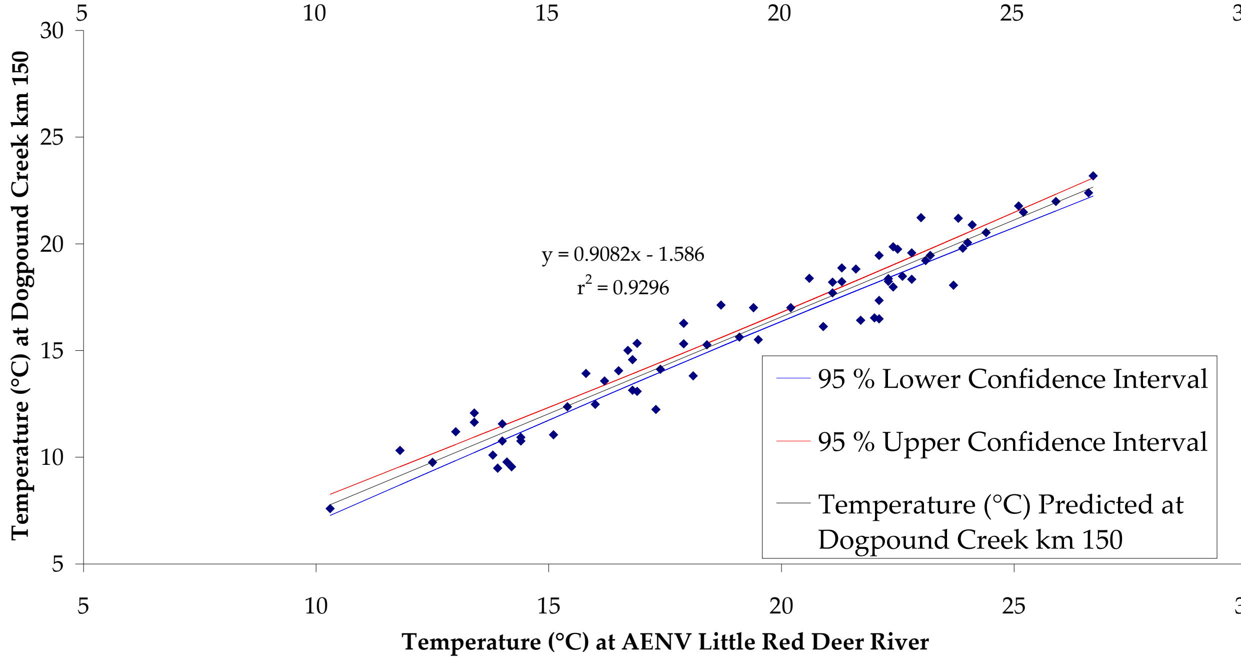


Figure 4.16 Cont.

Table 4.5 Regression models and model r^2 for Alberta Conservation Association (ACA) temperature-monitoring sites on the Dogpound Creek.

ACA temperature-monitoring site	Regression equation	Model r^2
Dogpound Creek km 0	y = 0.9997x + 0.2379	0.9605
Dogpound Creek km 30	y = 0.9845x + 0.8122	0.9506
Dogpound Creek km 60	y = 0.9521x + 0.7704	0.9335
Dogpound Creek km 90	y = 0.9738x - 0.6958	0.9555
Dogpound Creek km 120	y = 0.8105x + 0.1091	0.9295
Dogpound Creek km 150	y = 0.9082x - 1.586	0.9296

4.6 JUMPINGPOUND CREEK

Three temperature loggers were deployed in Jumpingpound Creek in the summer of 2004 (Figure 4.17). Daily maximum stream temperatures from July to September of 2004 at ACA stream temperature monitoring sites are shown in Figure 4.18 and have been included in tabular format in Appendix 9. To date, no AENV real-time temperature-monitoring station has been established on the Jumpingpound Creek. The nearest AENV real-time monitoring station to Jumpingpound Creek in the Bow River drainage is Threepoint Creek near the Town of Millarville (Figure 4.17). Therefore, this AENV real-time temperature monitoring station was selected to be used as a predictor of temperature in the Jumpingpound Creek drainage. The AENV real-time temperature-monitoring station on Threepoint Creek near Millarville did not record data from July 11-29, 2004. The reason for this discontinuity is uncertain. Daily maximum water temperature data that was obtained from AENV real-time temperature-monitoring station on Threepoint Creek near Millarville are shown in Figure 4.18. In general, daily maximum stream temperatures in the Jumpingpound Creek decreased upstream from the stream mouth. The warmest stream temperatures in the Jumpingpound Creek were recorded at all sites on July 18, 2004.

The relationships between water temperature at the AENV real-time stream temperature-monitoring station on Threepoint Creek near Millarville and ACA temperature-monitoring sites on Jumpingpound Creek are shown in Figure 4.19. Included on Figure 4.19 are regression lines, model r^2 values, regression equations and 95% confidence intervals for the regression lines. The regression equations and model r^2 values for the daily maximum stream temperatures at ACA temperature-monitoring sites regressed on the daily maximum stream temperatures at the AENV real-time stream temperature-monitoring station on Threepoint Creek near Millarville are displayed in Table 4.6. Regression equations shown in Table 4.6 can be used to predict the water temperature at the ACA monitoring site (y variable) given the water temperature at AENV real-time stream temperature-monitoring station on Threepoint Creek near Millarville (x variable).

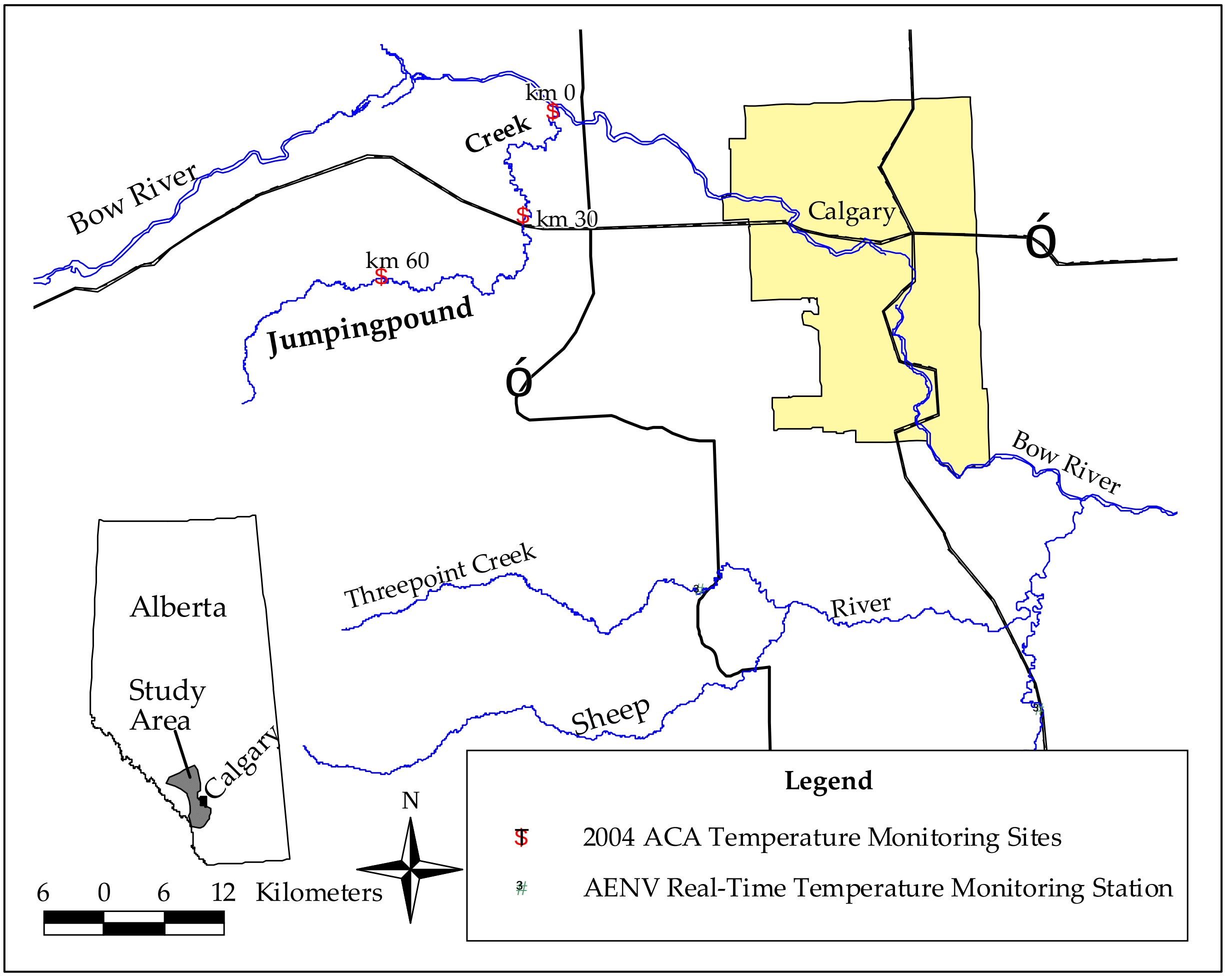


Figure 4.17 Location in south western Alberta of temperature data loggers deployed in the summer of 2004 by Alberta Conservation Association (ACA) in Jumpingpound Creek. Also shown is the location of the Alberta Environment (AENV) real-time monitoring station on Threepoint Creek near the Town of Millarville.

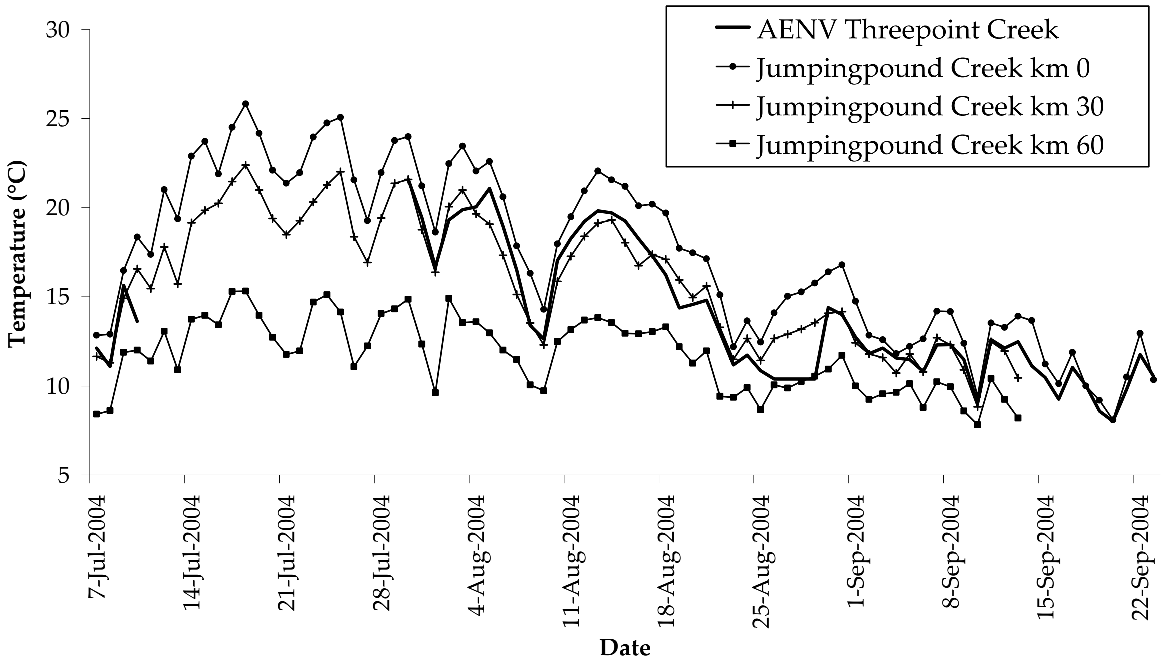


Figure 4.18 Daily maximum stream temperatures recorded from July to September, 2004 at Alberta Conservation Associations water temperature monitoring sites on Jumpingpound Creek and at Alberta Environment (AENV) real-time stream temperature-monitoring station on Threepoint Creek near the Town of Millarville. Data for AENV real-time stream temperature-monitoring station on Threepoint Creek near Millarville was not reported from July 11-29, 2004.

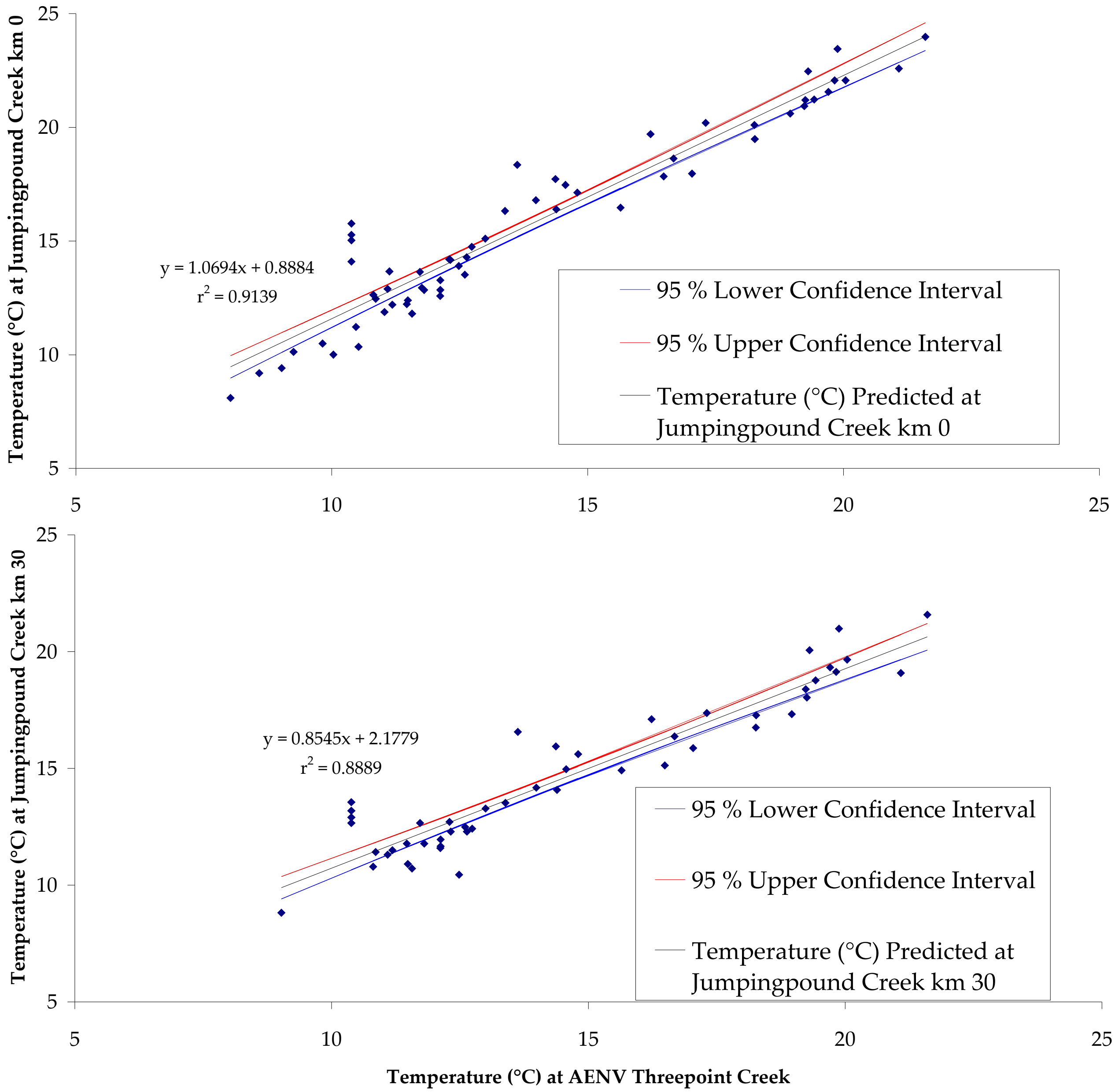


Figure 4.19 Relationship between water temperature at Alberta Environment (AENV) real-time stream temperature-monitoring station on Threepoint Creek near the Town of Millarville and Alberta Conservation Association stream temperature-monitoring sites Jumpingpound Creek km 0, km 30, and km 60 for summer of 2004. Predicted temperature lines, regression models, model r^2 values and 95 % confidence intervals are shown for each temperature prediction.

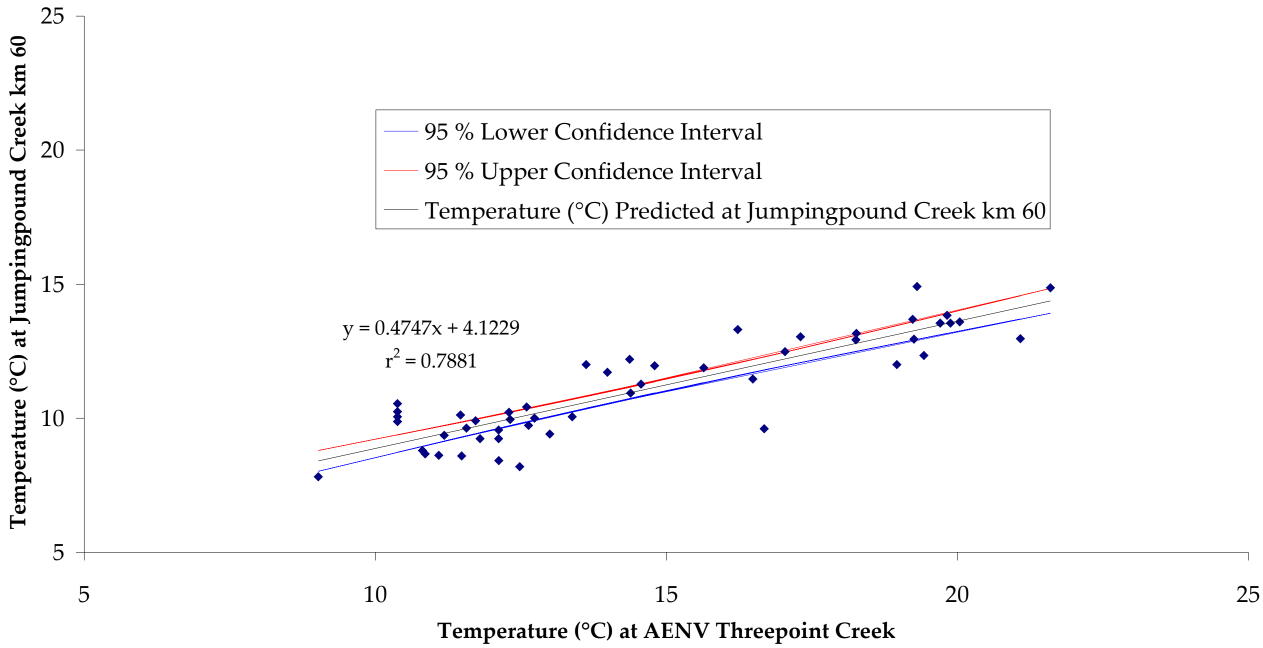


Figure 4.19 Cont.

Table 4.6 Regression models and model r^2 for Alberta Conservation Association (ACA) temperature-monitoring sites on Jumpingpound Creek.

ACA temperature-monitoring site	Regression equation	Model r^2
Jumpingpound Creek km 0	y = 1.0694x + 0.8884	0.9139
Jumpingpound Creek km 30	y = 0.8545x + 2.1779	0.8889
Jumpingpound Creek km 60	y = 0.4747x + 4.1229	0.7881

4.7 THREEPOINT CREEK

Three temperature loggers were deployed in Threepoint Creek in the summer of 2004 (Figure 4.20). Figure 4.20 also shows the location of the AENV real-time stream temperature-monitoring station on Threepoint Creek near the Town of Millarville. Daily maximum stream temperatures from July to September of 2004 at ACA stream temperature monitoring sites and at the AENV real-time stream temperature-monitoring station on Threepoint Creek near Millarville are shown in Figure 4.21 and have been included in tabular format in Appendix 10. The AENV real-time temperature-monitoring station on Threepoint Creek near the Town of Millarville did not record data from July 11-29, 2004. The reason for this discontinuity is uncertain. In general, daily maximum stream temperatures in Threepoint Creek decreased upstream from the stream mouth (Figure 4.21). The warmest stream temperatures in Threepoint Creek were recorded on July 25, 2004 at km 0, August 4, 2004 at km 30 and on July 18, 2004 at km 60.

The relationships between water temperature at the AENV real-time stream temperature-monitoring station on Threepoint Creek near Millarville and ACA temperature-monitoring sites on Threepoint Creek are shown in Figure 4.22. Included on Figure 4.22 are regression lines, model r^2 values, regression equations and 95% confidence intervals for the regression lines. The regression equations and model r^2 values for the daily maximum stream temperatures at ACA temperature-monitoring sites regressed on the daily maximum stream temperatures at the AENV real-time stream temperature-monitoring station on Threepoint Creek near Millarville are displayed in Table 4.7. Regression equations shown in Table 4.7 can be used to predict the water temperature at the ACA monitoring site (y variable) given the water temperature at AENV real-time stream temperature-monitoring station on Threepoint Creek near Millarville (x variable).

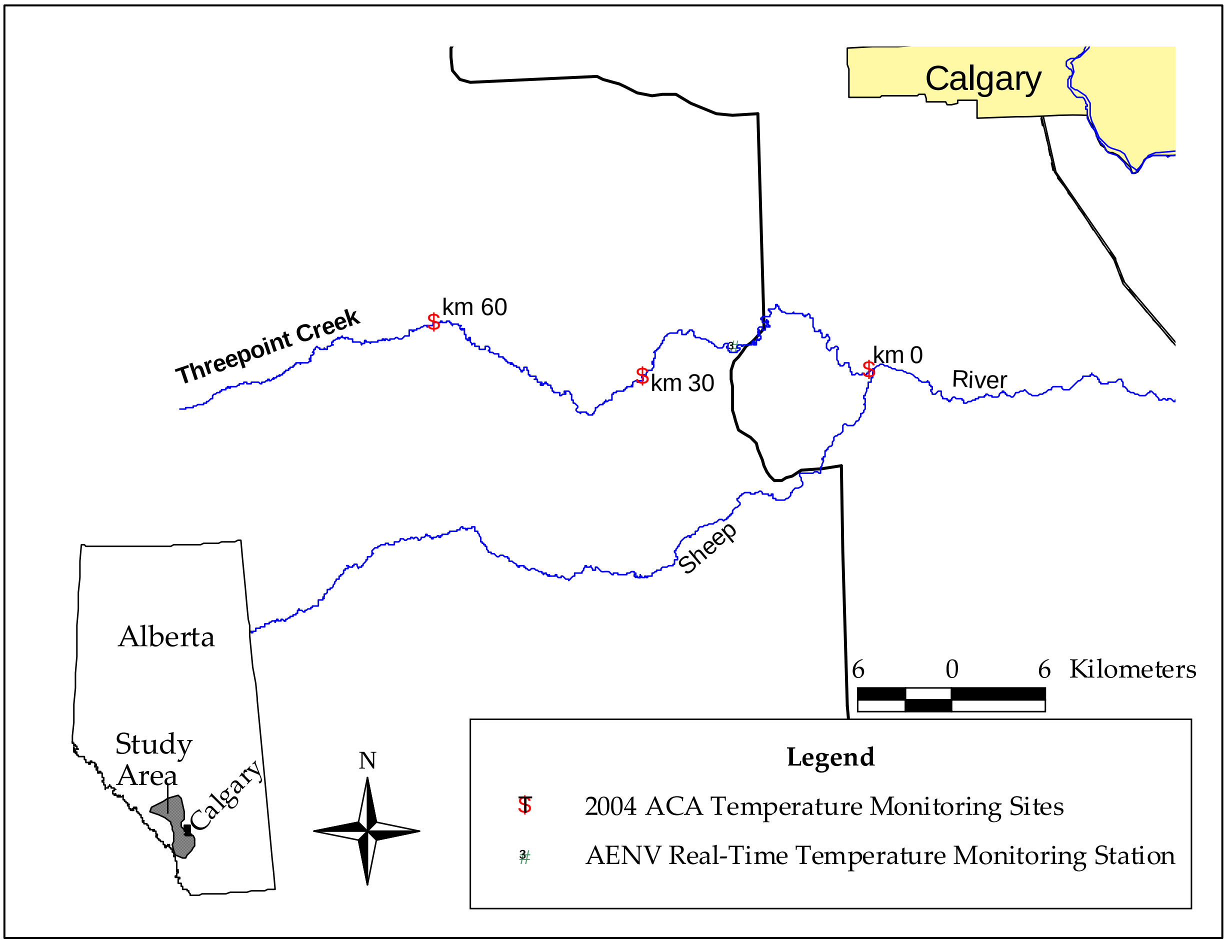


Figure 4.20 Location in south western Alberta of temperature data loggers deployed in the summer of 2004 by Alberta Conservation Association (ACA) in Threepoint Creek. Also shown is the location of the Alberta Environment (AENV) real-time monitoring station on Threepoint Creek near the Town of Millarville.

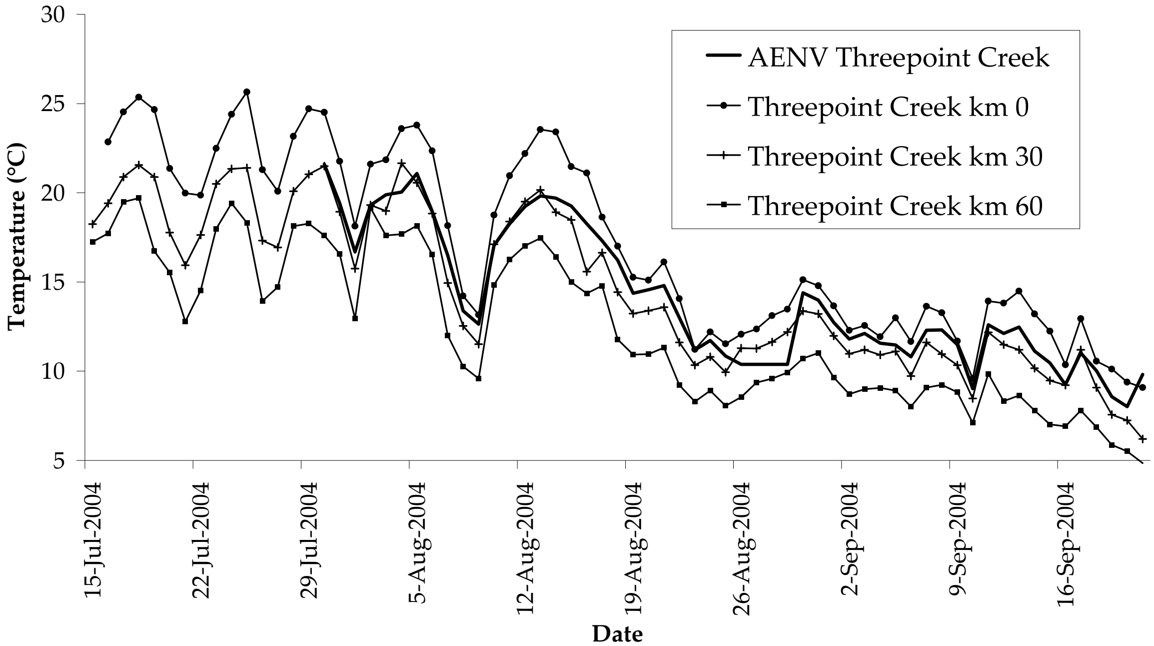


Figure 4.21 Daily maximum stream temperatures recorded from July to September, 2004 at Alberta Conservation Associations water temperature monitoring sites on Threepoint Creek and at Alberta Environment (AENV) real-time stream temperature-monitoring station on Threepoint Creek near the Town of Millarville. Data for AENV real-time stream temperature-monitoring station on Threepoint Creek near Millarville was not reported from July 11-29, 2004.

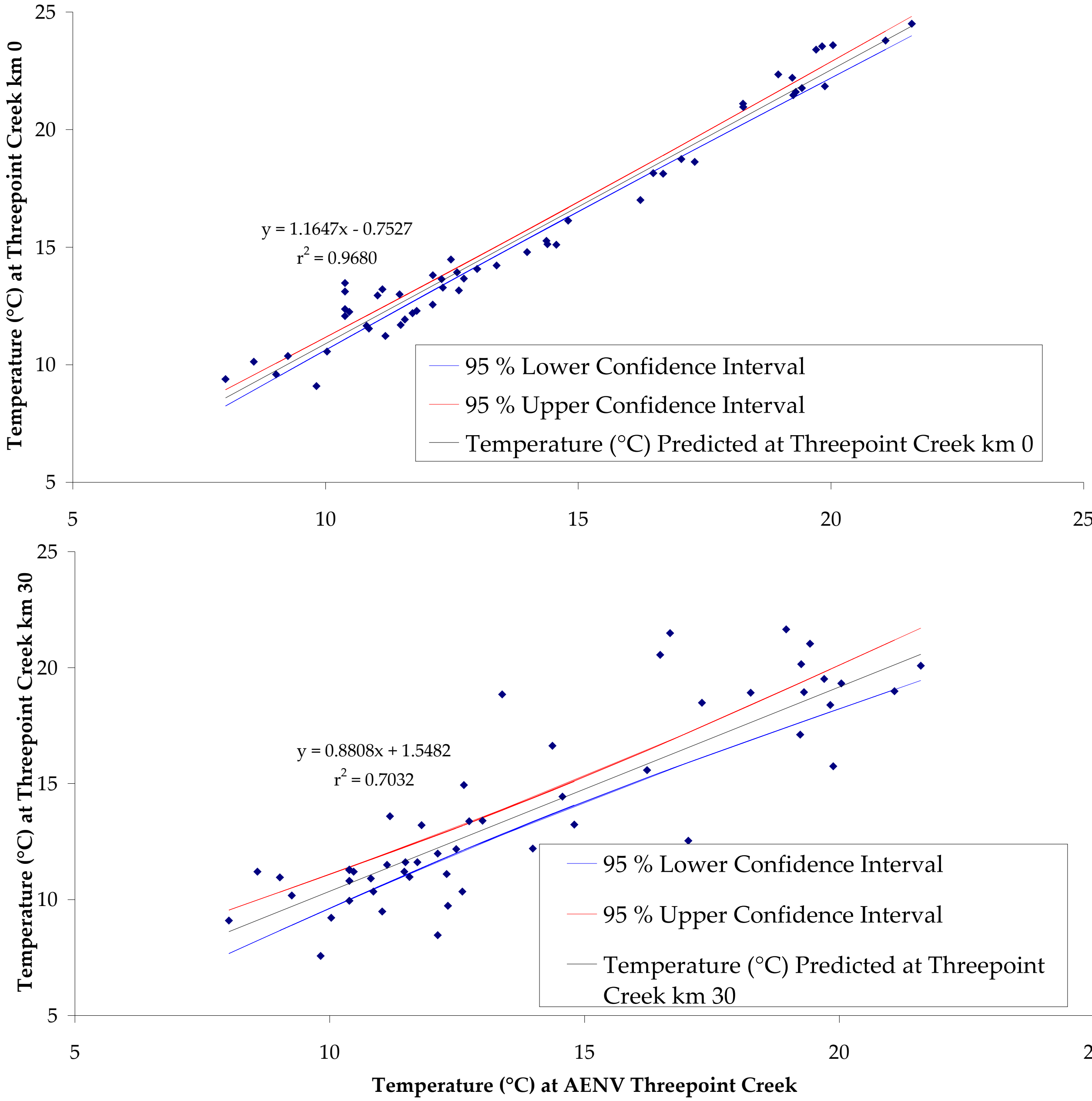


Figure 4.22 Relationship between water temperature at Alberta Environment (AENV) real-time stream temperature-monitoring station on Threepoint Creek near the Town of Millarville and Alberta Conservation Association stream temperature-monitoring sites Threepoint Creek km 0, km 30, and km 60 for summer of 2004. Predicted temperature lines, regression models, model r^2 values and 95 % confidence intervals are shown for each temperature prediction.

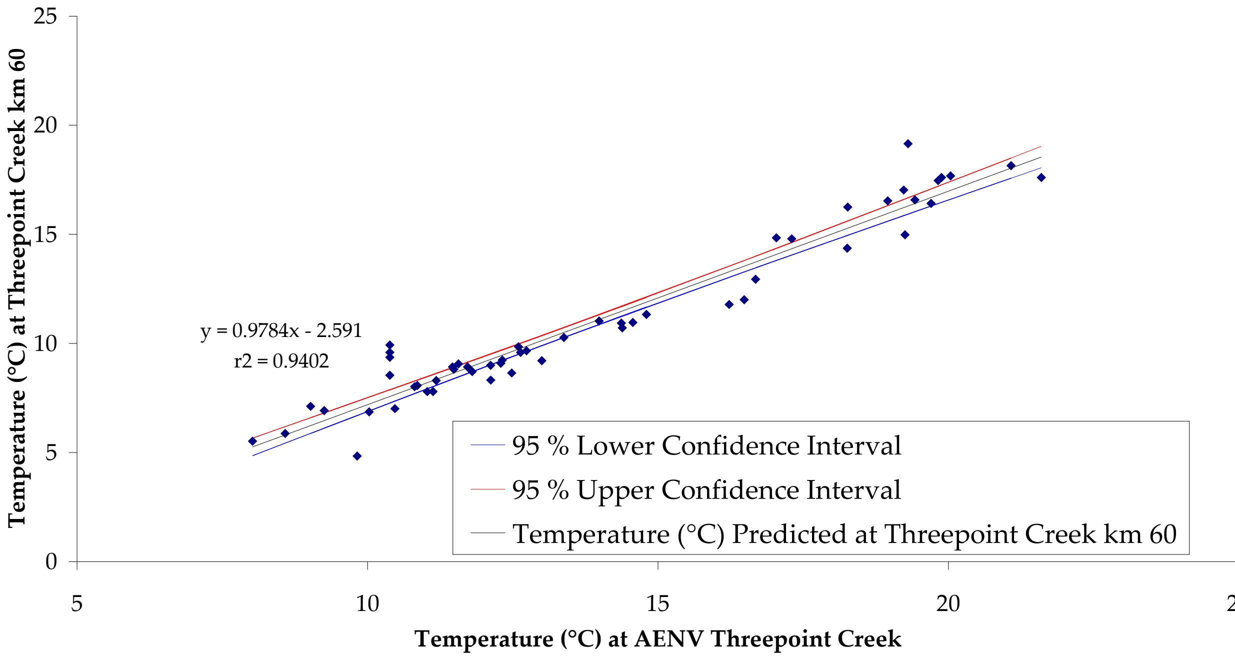


Figure 4.22 Cont .

Table 4.7 Regression models and model r^2 for Alberta Conservation Association (ACA) temperature-monitoring sites on Threepoint Creek.

ACA temperature-monitoring site	Regression equation	Model r^2
Threepoint Creek km 0	y = 1.1647x - 0.7527	0.9680
Threepoint Creek km 30	y = 0.8808x + 1.5482	0.7032
Threepoint Creek km 60	y = 0.9784x - 2.591	0.9402

4.8 SHEEP RIVER

Three temperature loggers were deployed in the Sheep River in the summer of 2004 (Figure 4.23). Daily maximum stream temperatures from July to September of 2004 at ACA stream temperature monitoring sites are shown in Figure 4.24 and have been included in tabular format in Appendix 11. The AENV real-time monitoring station on the Sheep River near the Town of Black Diamond did not record data during the summer of 2004 due to technical difficulties. Therefore, the AENV real-time monitoring station on the Highwood River near the Town of Aldersyde has been used as a reference station for the ACA temperature sites on the Sheep River (Figure 4.23). Daily maximum water temperature data from the AENV real-time temperature-monitoring station on Highwood River near Aldersyde is shown in Figure 4.24. In general, daily maximum stream temperatures in the Sheep River drainage decreased upstream from the stream mouth. The warmest stream temperatures in the Sheep River drainage were recorded at Sheep River km 0 and km 30 on July 18, 2004 and on July 29, 2004 at Sheep River km 60.

The relationships between water temperature at the AENV real-time stream temperature-monitoring station on the Highwood River near Aldersyde and ACA temperature-monitoring sites on the Sheep River are shown in Figure 4.25. Included on Figure 4.25 are regression lines, model r^2 values, regression equations and 95% confidence intervals for the regression lines. The regression equations and model r^2 values for the daily maximum stream temperatures at ACA temperature-monitoring sites regressed on the daily maximum stream temperatures at the AENV real-time stream temperature-monitoring station on the Highwood River near Aldersyde are displayed in Table 4.8. Regression equations shown in Table 4.8 can be used to predict the water temperature at the ACA monitoring site (y variable) given the water temperature at AENV real-time stream temperature-monitoring station on Highwood River near Aldersyde (x variable).

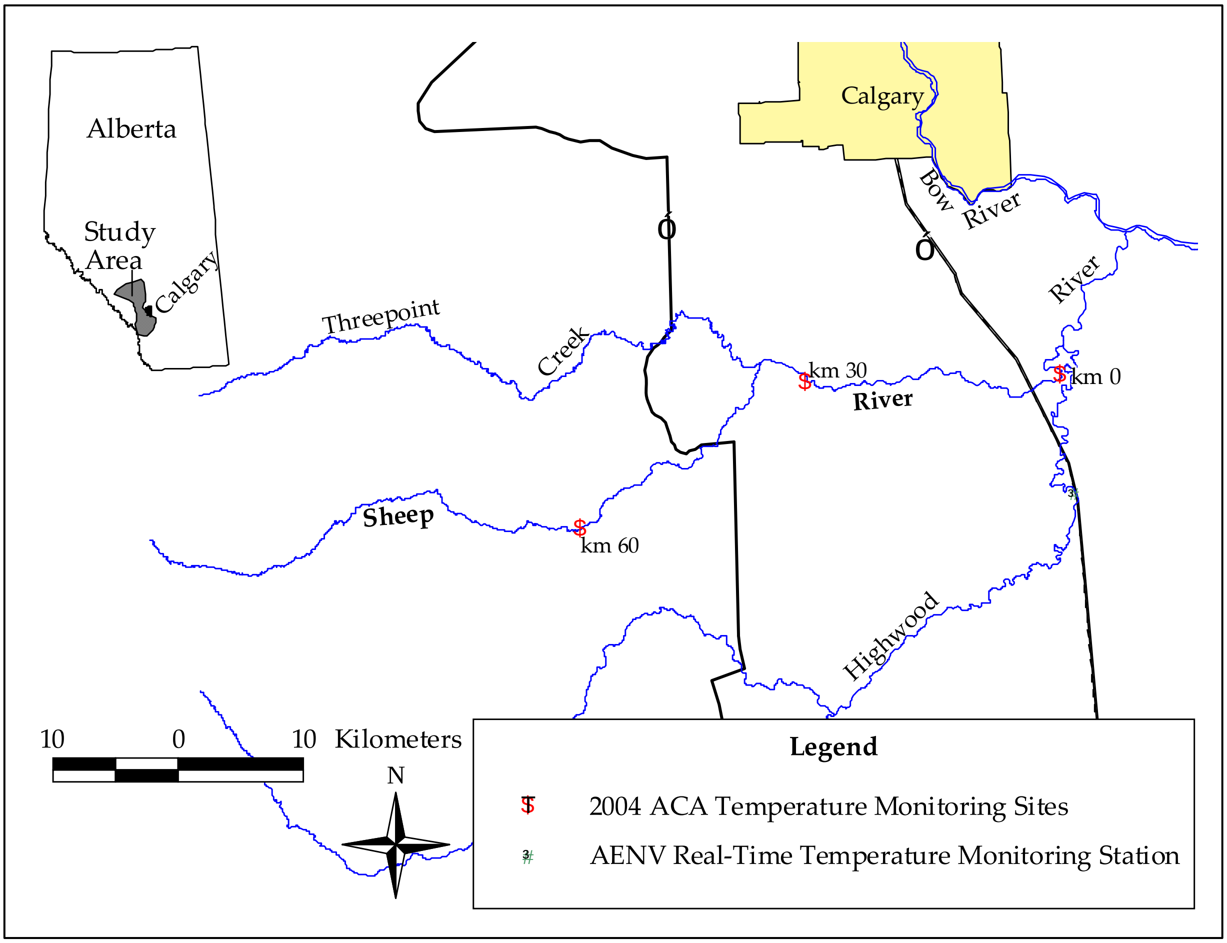


Figure 4.23 Location in south western Alberta of temperature data loggers deployed in the summer of 2004 by Alberta Conservation Association (ACA) in the Sheep River. Also shown is the location of the Alberta Environment (AENV) real-time monitoring station on the Highwood River the Town of Aldersyde.

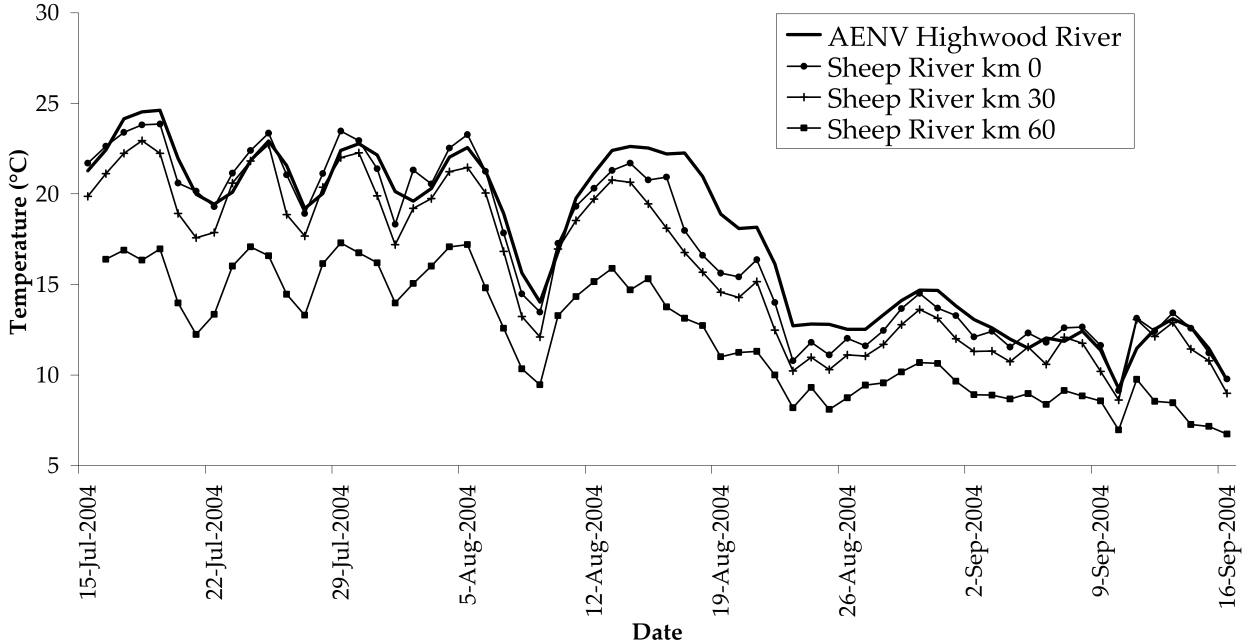


Figure 4.24 Daily maximum stream temperatures recorded from July to September, 2004 at Alberta Conservation Associations water temperature monitoring sites on the Sheep River and at Alberta Environment (AENV) real-time stream temperature-monitoring station on the Highwood River near the Town of Aldersyde.

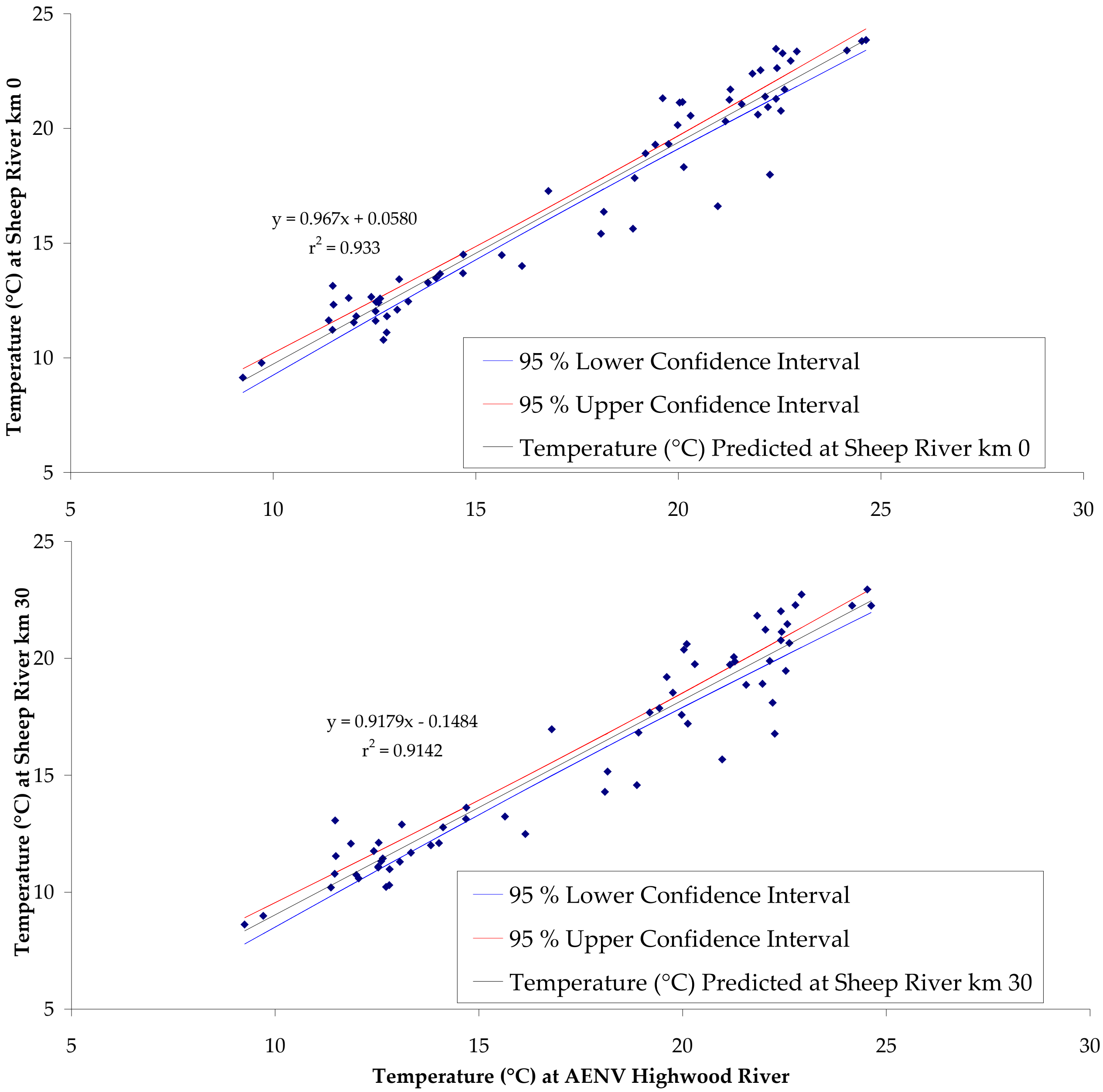


Figure 4.25 Relationship between water temperature at Alberta Environment (AENV) real-time stream temperature-monitoring station on the Highwood River near the Town of Aldersyde and Alberta Conservation Association stream temperature-monitoring sites on the Sheep River km 0, km 30, and km 60 for summer of 2004. Predicted temperature lines, regression models, model r^2 values and 95 % confidence intervals are shown for each temperature prediction.

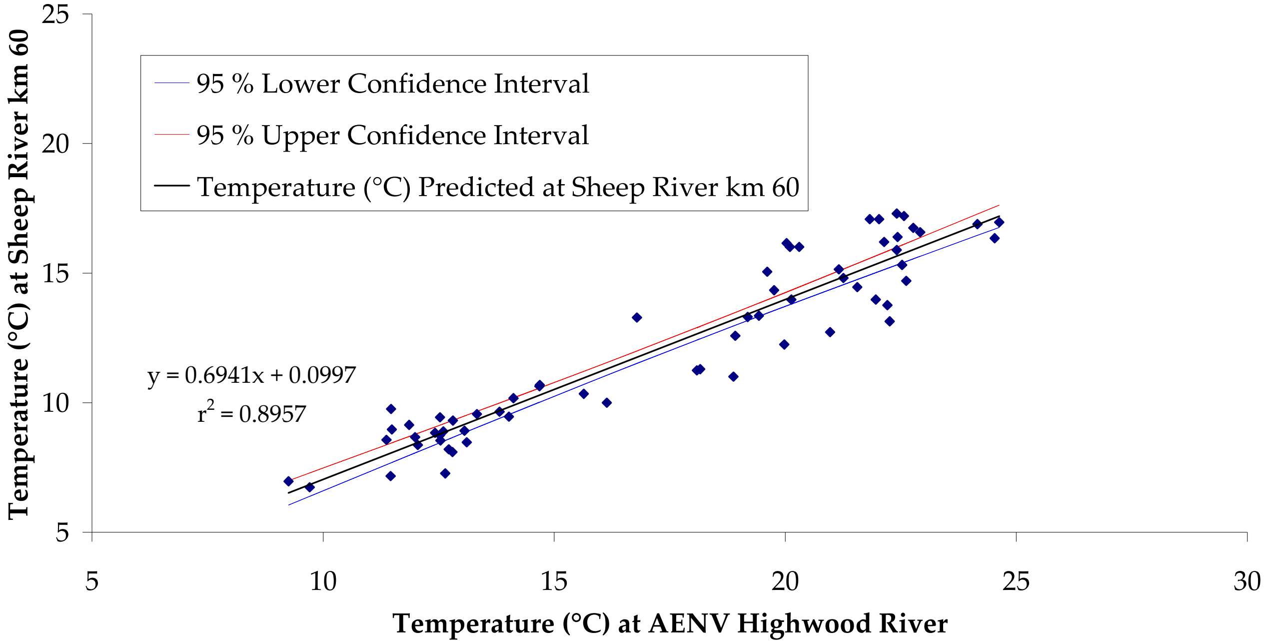


Figure 4.25 Cont.

Table 4.8 Regression models and model r^2 for Alberta Conservation Association (ACA) temperature-monitoring sites on the Sheep River.

ACA temperature-monitoring site	Regression equation	Model r^2
Sheep River km 0	y = 0.967x + 0.058	0.9330
Sheep River km 30	y = 0.9179x - 0.1484	0.9142
Sheep River km 60	y = 0.6941x + 0.0997	0.8957

4.9 HIGHWOOD RIVER

Six temperature loggers were deployed in the Highwood River in the summer of 2004 (Figure 4.26). Figure 4.26 also shows the location of the AENV real-time stream temperature-monitoring station on the Highwood River near the Town of Aldersyde. Daily maximum stream temperatures from July to September of 2004 at ACA stream temperature monitoring sites and at the AENV real-time stream temperature-monitoring station on the Highwood River near Aldersyde are shown in Figure 4.27 and have been included in tabular format in Appendix 12. In general, daily maximum stream temperatures in the Highwood River drainage decreased upstream from the stream mouth (Figure 4.27). Stream temperatures recorded in the Highwood River drainage do not decrease uniformly with distance upstream. Instead, stream temperatures at the lower three sites on the Highwood River tend to group together while the temperatures at the remaining three sites decreased uniformly with distance upstream. The warmest stream temperatures recorded in the Highwood River were on July 18, 2004 at km 0, km 30, km 60 and km 90, August 14, 2004 at km 120 and August 2, 2004 at km 150.

The relationships between water temperature at the AENV real-time stream temperature-monitoring station on the Highwood River near Aldersyde and ACA temperature-monitoring sites on the Highwood River are shown in Figure 4.28. Included on Figure 4.28 are regression lines, model r^2 values, regression equations and 95% confidence intervals for the regression lines. The regression equations and model r^2 values for the daily maximum stream temperatures at ACA temperature-monitoring sites regressed on the daily maximum stream temperatures at the AENV real-time stream temperature-monitoring station on the Highwood River near Aldersyde are displayed in Table 4.9. Regression equations shown in Table 4.9 can be used to predict the water temperature at the ACA monitoring site (y variable) given the water temperature at AENV real-time stream temperature-monitoring station on the Highwood River near Aldersyde (x variable).

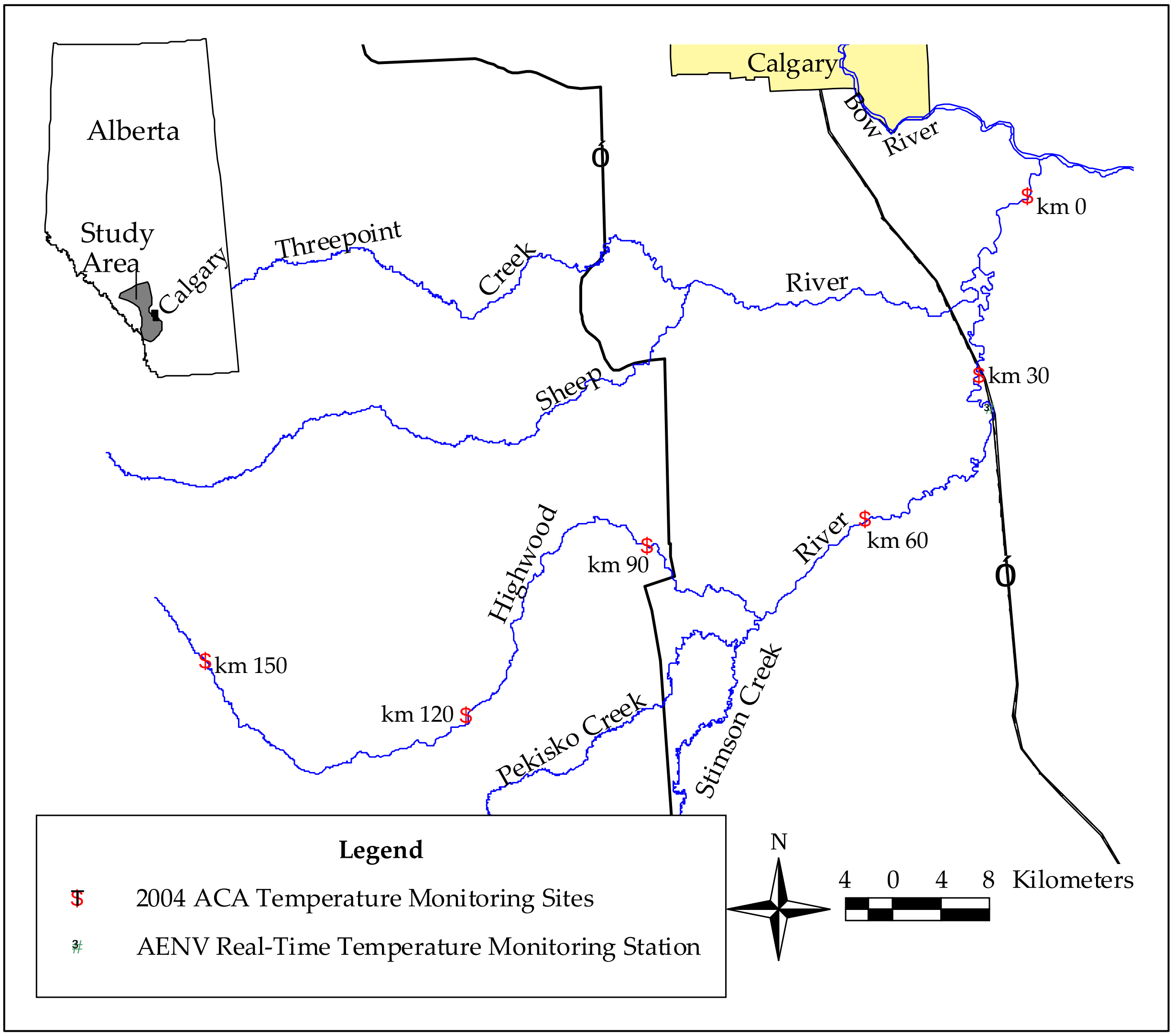


Figure 4.26 Location in south western Alberta of temperature data loggers deployed in the summer of 2004 by Alberta Conservation Association (ACA) in the Highwood River. Also shown is the location of the Alberta Environment (AENV) real-time monitoring station on the Highwood River the Town of Aldersyde.

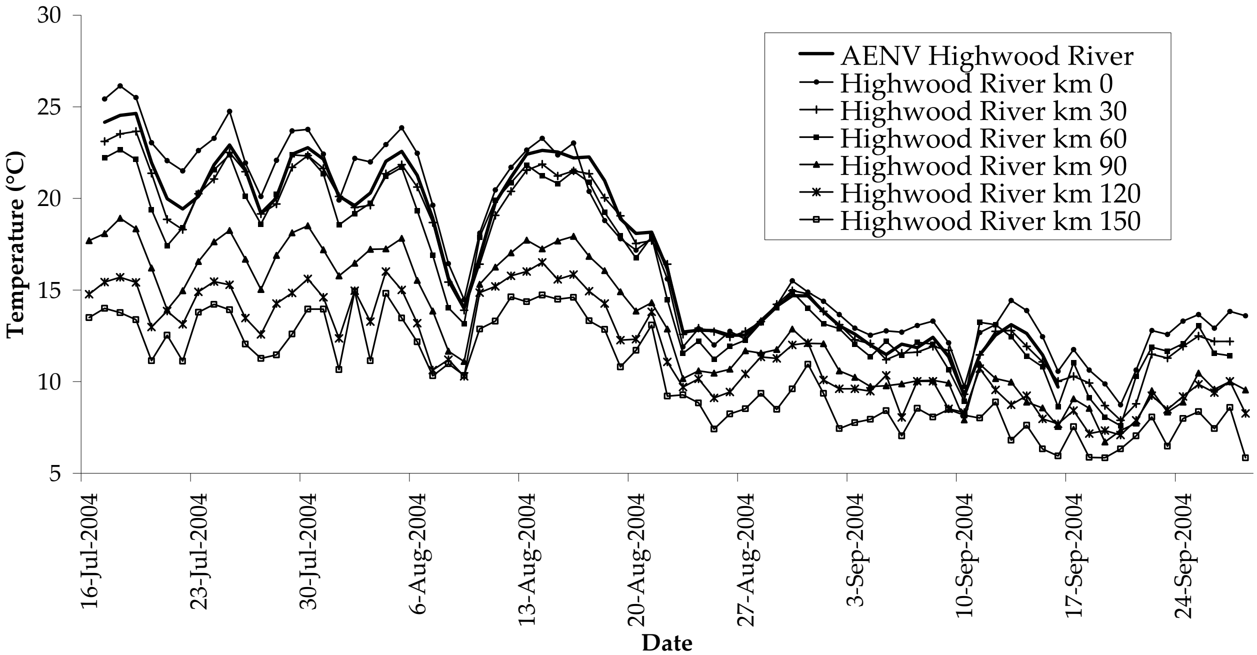


Figure 4.27 Daily maximum stream temperatures recorded from July to September, 2004 at Alberta Conservation Associations water temperature monitoring sites on the Highwood River and at Alberta Environment (AENV) real-time stream temperature-monitoring station on the Highwood River near the Town of Aldersyde.

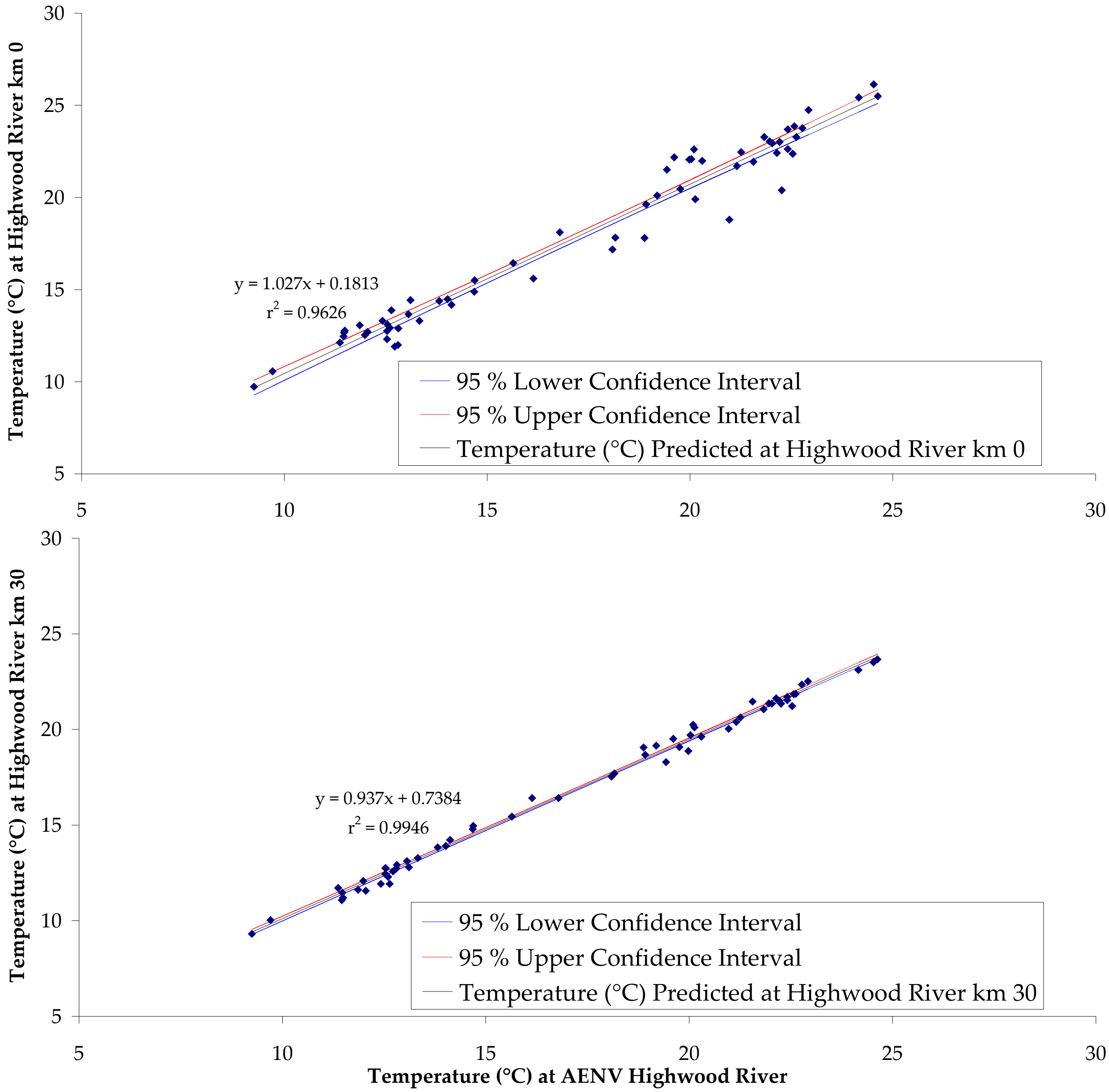


Figure 4.28 Relationship between water temperature at Alberta Environment (AENV) real-time monitoring station on the Highwood River near the Town of Aldersyde and Alberta Conservation Association stream temperature-monitoring sites Highwood River km 0, km 30, km 60, km 90, km 120, and km 150 for summer of 2004. Predicted temperature lines, regression models, model r^2 values and 95 % confidence intervals are shown for each temperature prediction.

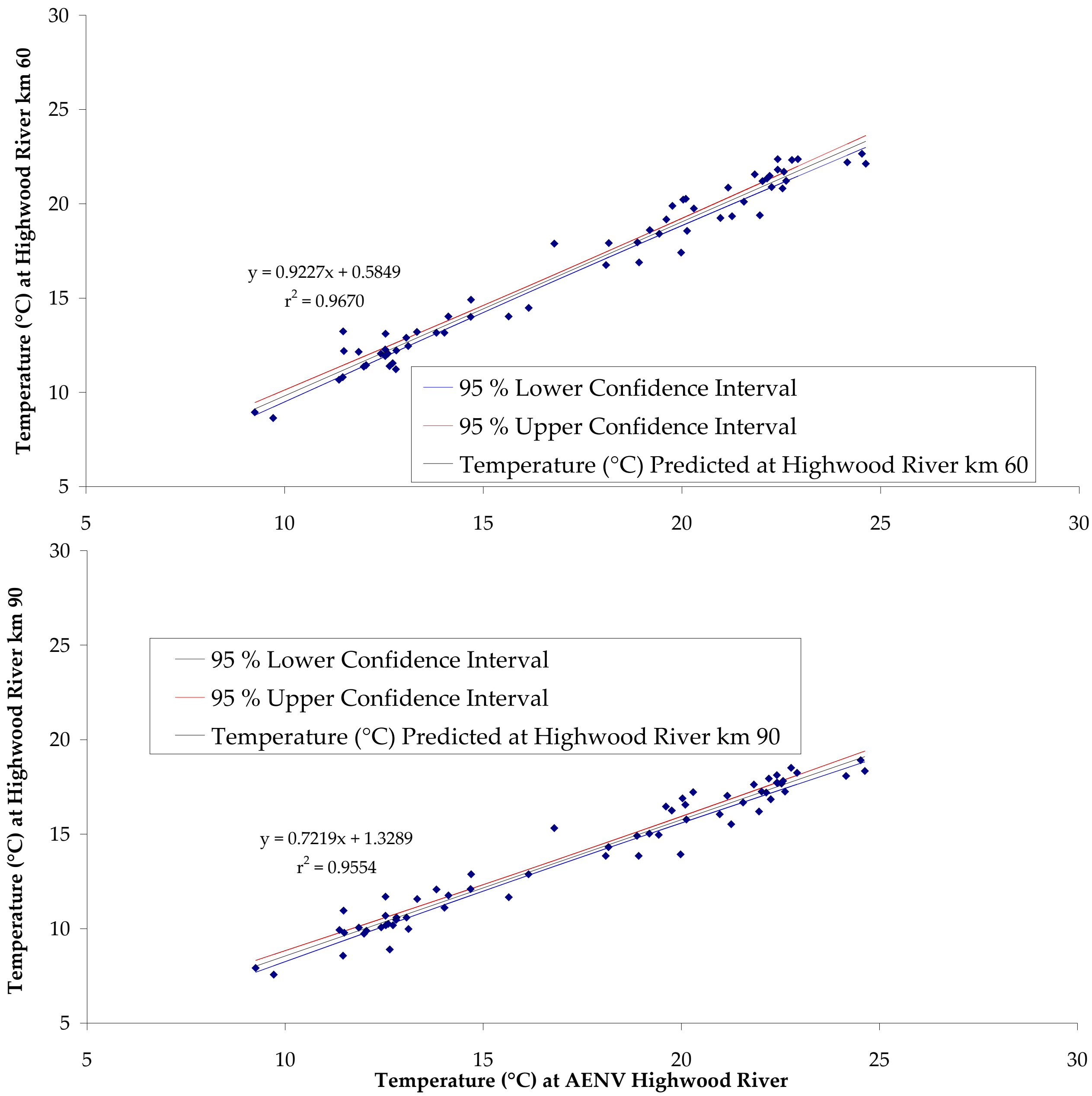


Figure 4.28 Cont.

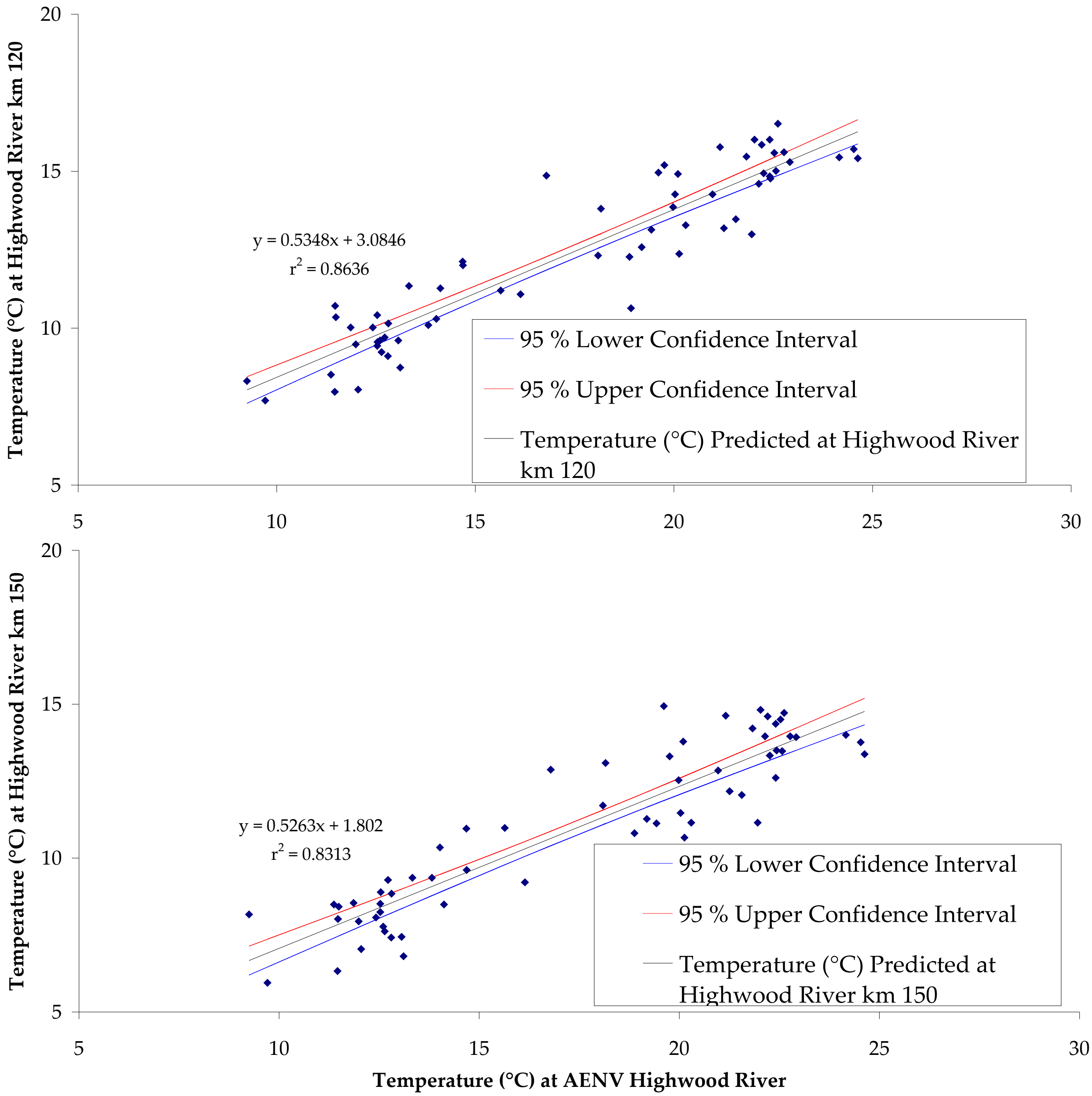


Figure 4.28 Cont.

Table 4.9 Regression models and model r^2 for Alberta Conservation Association (ACA) temperature-monitoring sites on the Highwood River drainage.

ACA temperature-monitoring site	Regression equation	Model r^2
Highwood River km 0	y = 1.027x + 0.1813	0.9626
Highwood River km 30	y = 0.937x + 0.7384	0.9946
Highwood River km 60	y = 0.9227x + 0.5849	0.9670
Highwood River km 90	y = 0.7219x + 1.3289	0.9554
Highwood River km 120	y = 0.5348x + 3.0846	0.8636
Highwood River km 150	y = 0.5263x + 1.802	0.8313

4.10 PEKISKO CREEK AND STIMSON CREEK

In the summer of 2004, two temperature loggers were deployed in Stimson Creek and two temperature loggers were deployed in Pekisko Creek (Figure 4.29). Figure 4.29 also shows the location of the AENV real-time stream temperature-monitoring station on Pekisko Creek the near Town of Longview. Daily maximum stream temperatures from July to September of 2004 at ACA stream temperature monitoring sites and at the AENV real-time stream temperature-monitoring station on Pekisko Creek near Longview are shown in Figure 4.30 and have been included in tabular format in Appendix 13. In general, daily maximum stream temperatures in Pekisko and Stimson creeks decreased upstream from stream mouths (Figure 4.30). The warmest stream temperatures on Pekisko Creek were recorded at km 0 and km 30 on July 19, 2004 and July 18, 2004 respectively. The warmest stream temperatures on Stimson Creek were recorded at km 0 and km 30 on July 18, 2004 and August 14, 2004 respectively.

The relationships between water temperature at the AENV real-time stream temperature-monitoring station on the Pekisko Creek near Longview and ACA temperature-monitoring sites on Pekisko and Stimson creeks are shown in Figures 4.31 and 4.32. Included on Figures 4.31 and 4.32 are regression lines, model r^2 values, regression equations and 95% confidence intervals for the regression lines. The regression equations and model r^2 values for the daily maximum stream temperatures at ACA temperature-monitoring sites regressed on the daily maximum stream temperatures at the AENV real-time stream temperature-monitoring station on Pekisko Creek near Longview are displayed in Table 4.10. Regression equations shown in Table 4.10 can be used to predict the water temperature at the ACA monitoring site (y variable) given the water temperature at AENV real-time stream temperature-monitoring station on Pekisko Creek near Longview (x variable).

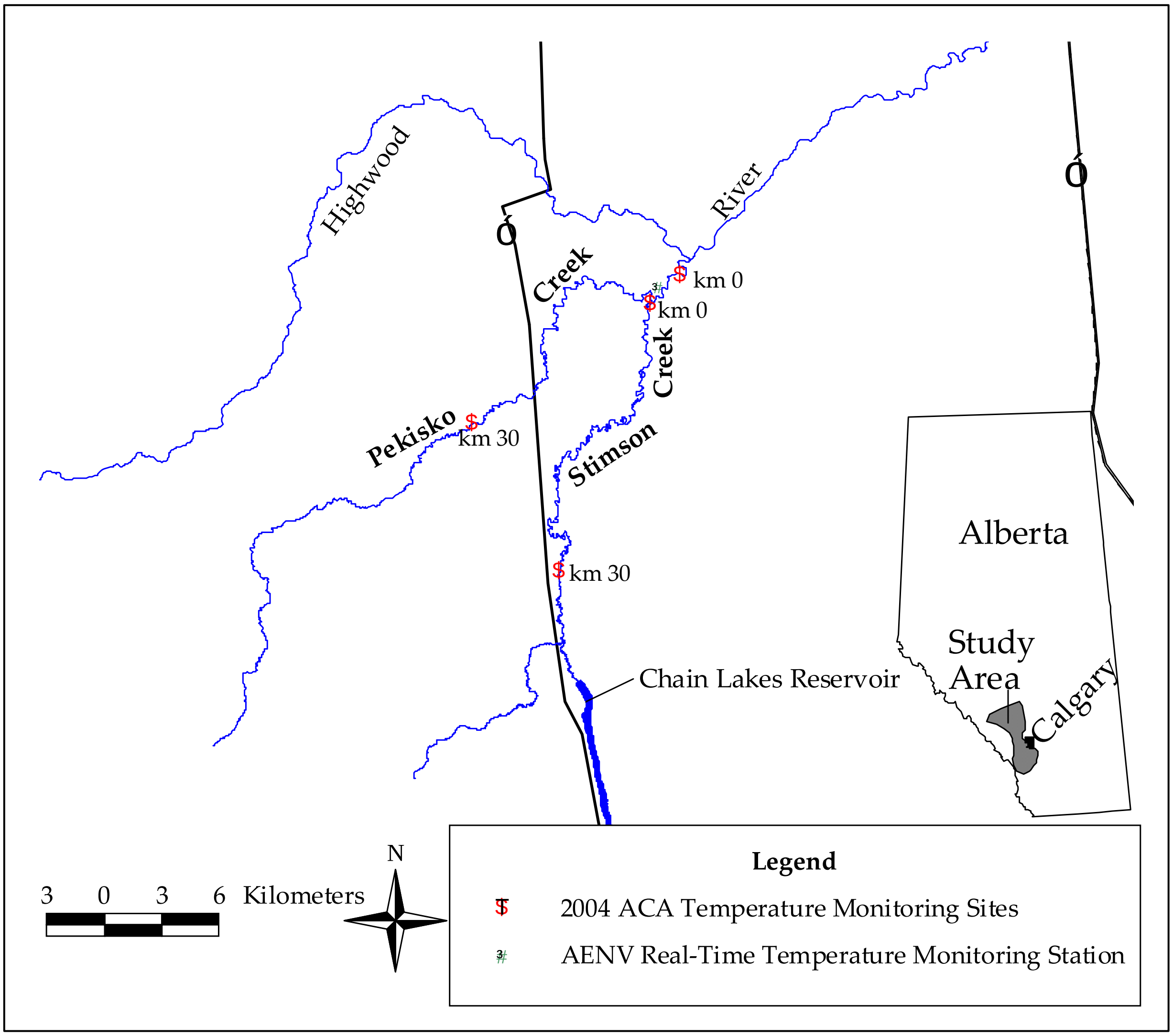


Figure 4.29 Location in south western Alberta of temperature data loggers deployed in the summer of 2004 by Alberta Conservation Association (ACA) in Pekisko and Stimson creeks. Also shown is the location of the Alberta Environment (AENV) real-time monitoring station on Pekisko Creek near the Town of Longview.

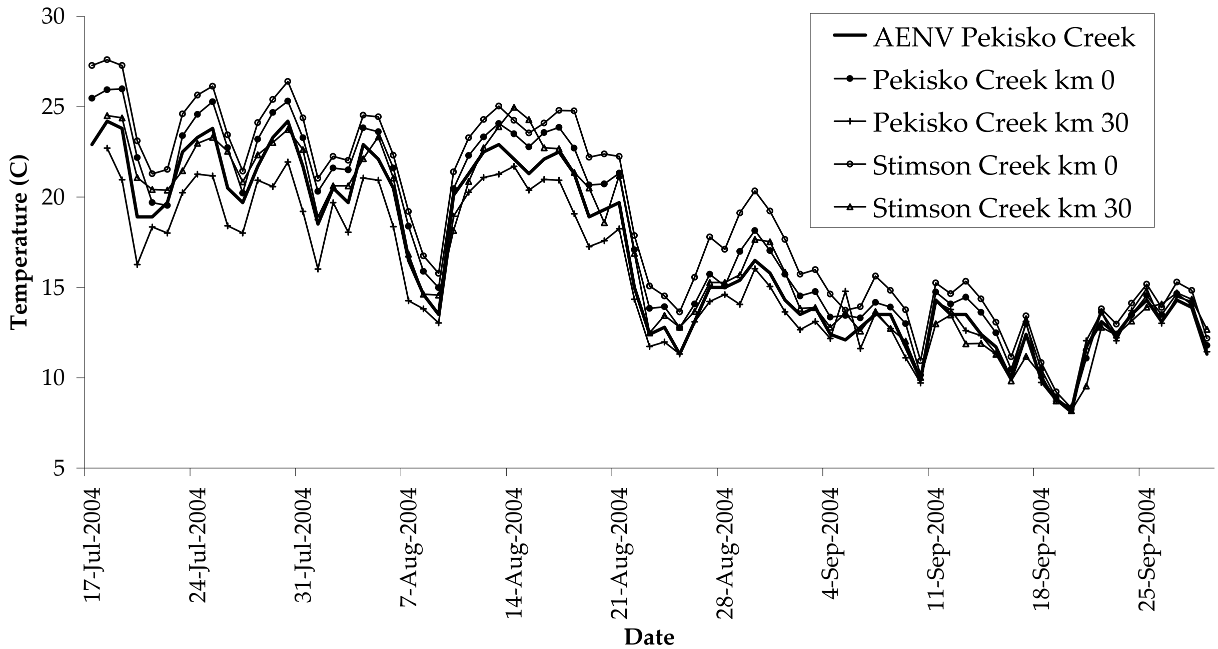


Figure 4.30 Daily maximum stream temperatures recorded from July to September, 2004 at Alberta Conservation Associations water temperature monitoring sites on Pekisko and Stimson creeks and at Alberta Environment (AENV) real-time stream temperature-monitoring station on Pekisko Creek near the Town of Longview.

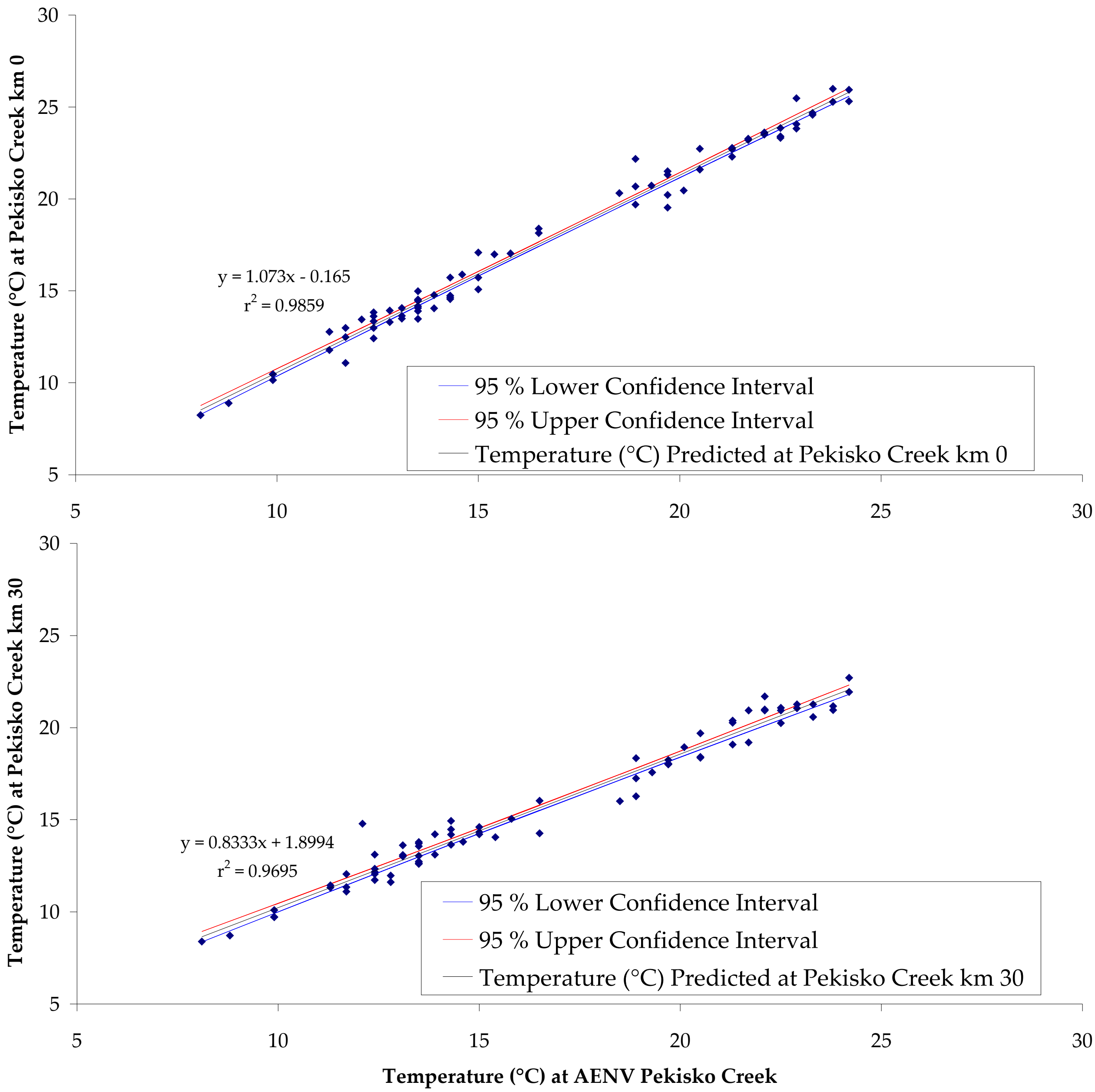


Figure 4.31 Relationship between water temperature at Alberta Environment (AENV) real-time monitoring station on Pekisko Creek near the Town of Longview and Alberta Conservation Association stream temperature-monitoring sites Pekisko Creek km 0, and km 30 for summer of 2004. Predicted temperature lines, regression models, model r^2 values and 95 % confidence intervals are shown for each temperature prediction.

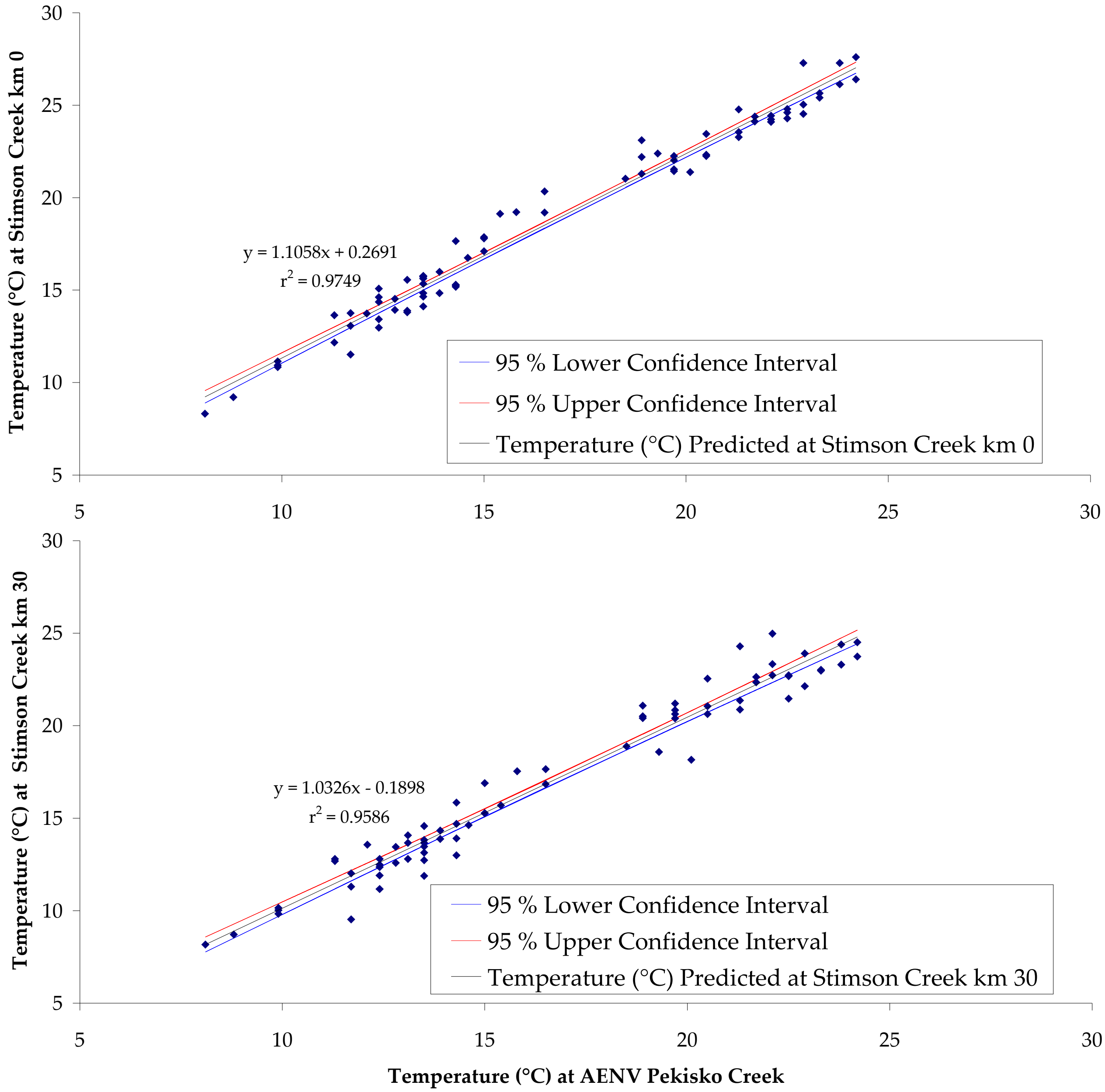


Figure 4.32 Relationship between water temperature at Alberta Environment (AENV) real-time monitoring station on Pekisko Creek near the Town of Longview and Alberta Conservation Association stream temperature-monitoring sites Stimson Creek km 0, and km 30 for summer of 2004. Predicted temperature lines, regression models, model r^2 values and 95 % confidence intervals are shown for each temperature prediction.

Table 4.10 Regression models and model r^2 for Alberta Conservation Association (ACA) temperature-monitoring sites on Pekisko and Stimson creeks.

ACA temperature-monitoring site	Regression equation	Model r^2
Pekisko Creek km 0	y = 1.073x - 0.165	0.9859
Pekisko Creek km 30	y = 0.8333x + 1.8994	0.9695
Stimson Creek km 0	y = 1.1058x + 0.2691	0.9749
Stimson Creek km 30	y = 1.0326x - 0.1898	0.9586

4.11 ASSESSMENT OF THE MODELS

The ability of five of the regression models developed in 2004 to predict stream temperatures has been assessed. The daily maximum stream temperatures from July 24 to September 24, 2003 have been predicted by the regression models developed here for Dogpound Creek km 0, km 30 and km 90, Little Red Deer River km 0, and Fallentimber Creek km 0. Regression models predicted the daily maximum stream temperature at these sites using the daily maximum stream temperatures from July 24 to September 24, 2003 at AENV real-time monitoring station on the Little Red Deer River near the mouth as input data (regression independent variable). Predicted temperatures at Dogpound Creek km 0, km 30 and km 90, Little Red Deer River km 0, and Fallentimber Creek km 0 are shown in Figure 4.33 and 4.34. Figures 4.33 and 4.34 also show the daily maximums of stream temperature recorded in 2003 by ACA or ASRD at the site that is in close proximity to the 2004 ACA site.

Of the five models assessed, the three Dogpound Creek models predicted daily maximum temperatures more accurately than the Little Red Deer River km 0 and Fallentimber River km 0 models. The Little Red deer River km 0 had the greatest daily range (5.9 °C) between predicted and actual temperature than at any other site. The daily maximum predicted by the models for the Little Red Deer River km 0 and the Fallentimber Creek km 0 appear to lag behind the observed daily maximum temperatures by approximately one day (Figure 4.34). In general the models appear to satisfactorily predict temperatures at the sites tested.

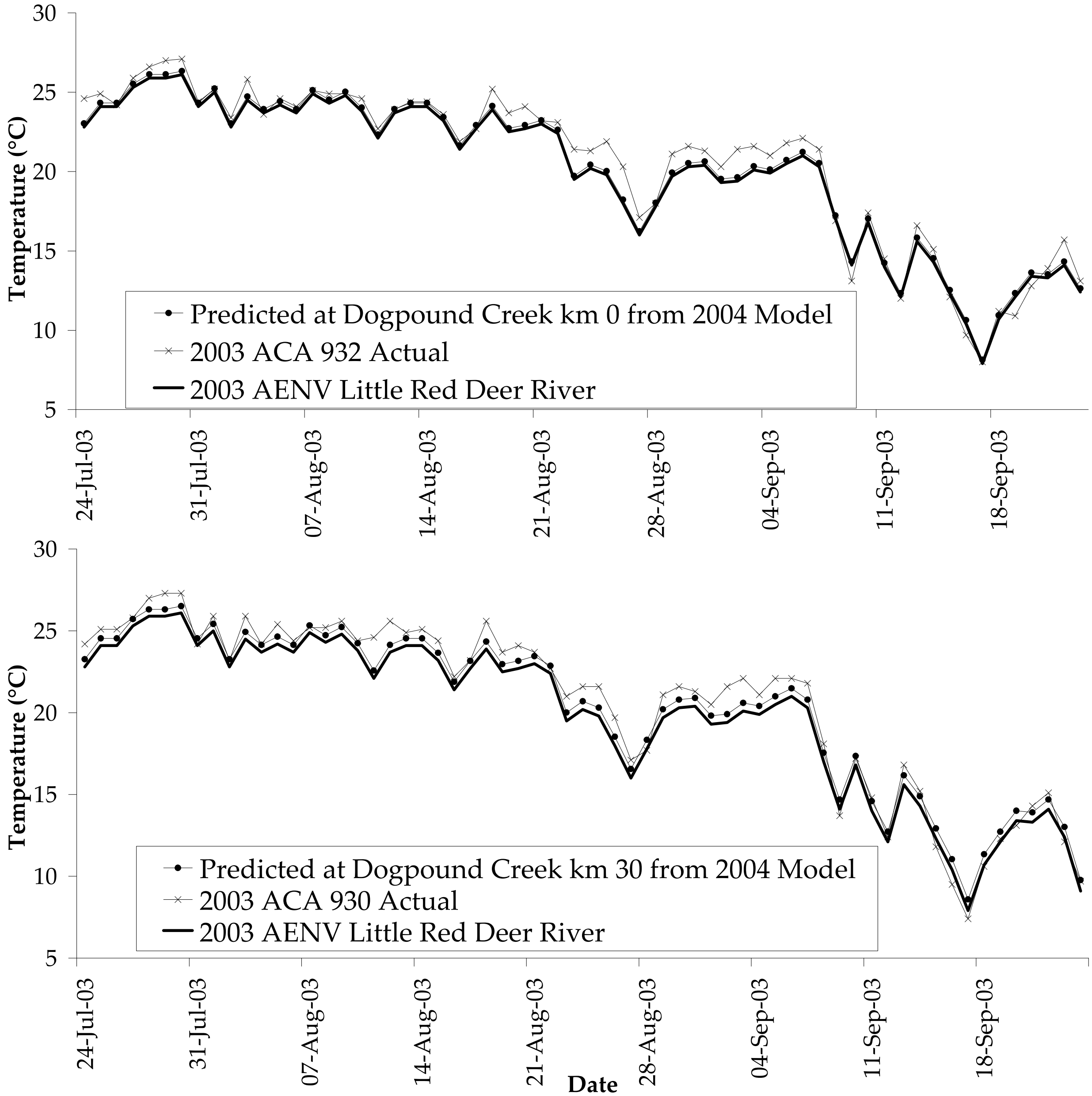


Figure 4.33 Daily maximum temperatures predicted at Dogpound Creek km 0, km 30 and km 90 using 2004 models with 2003 Alberta Environment (AENV) real-time monitoring station on the Little Red Deer River near the mouth as the input variable. Daily maximum temperatures recorded in 2003 at AENV real-time monitoring station on the Little Red Deer River near the mouth and the Alberta Conservation Association (ACA) temperature-monitoring sites in close proximity to 2004 sites are also shown.

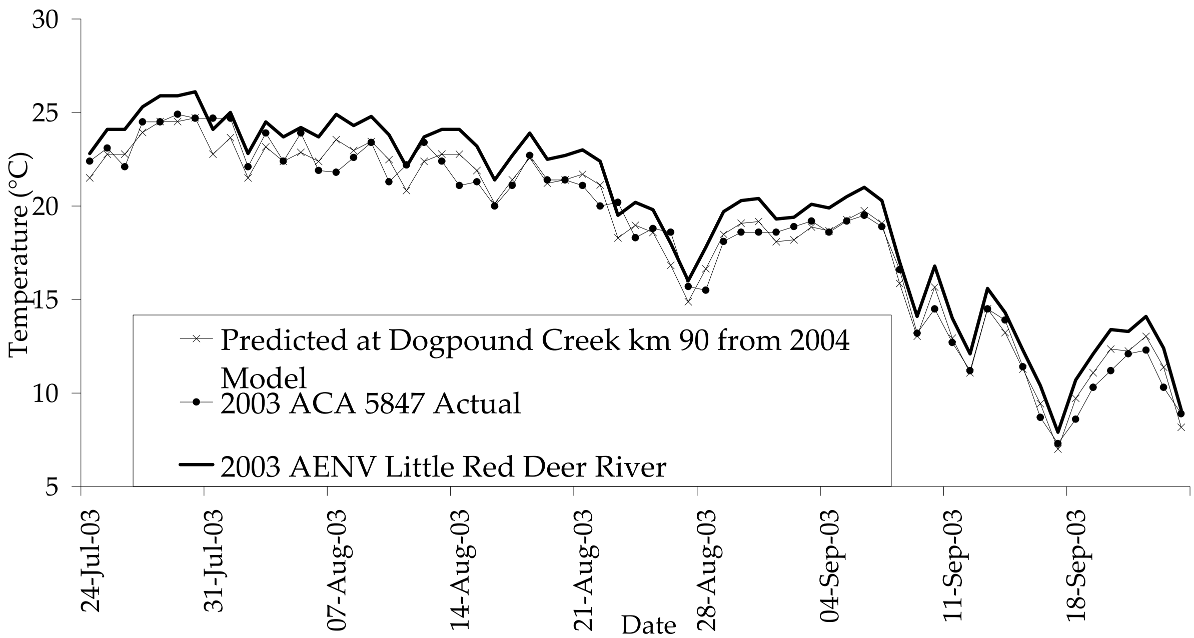


Figure 4.33 Cont.

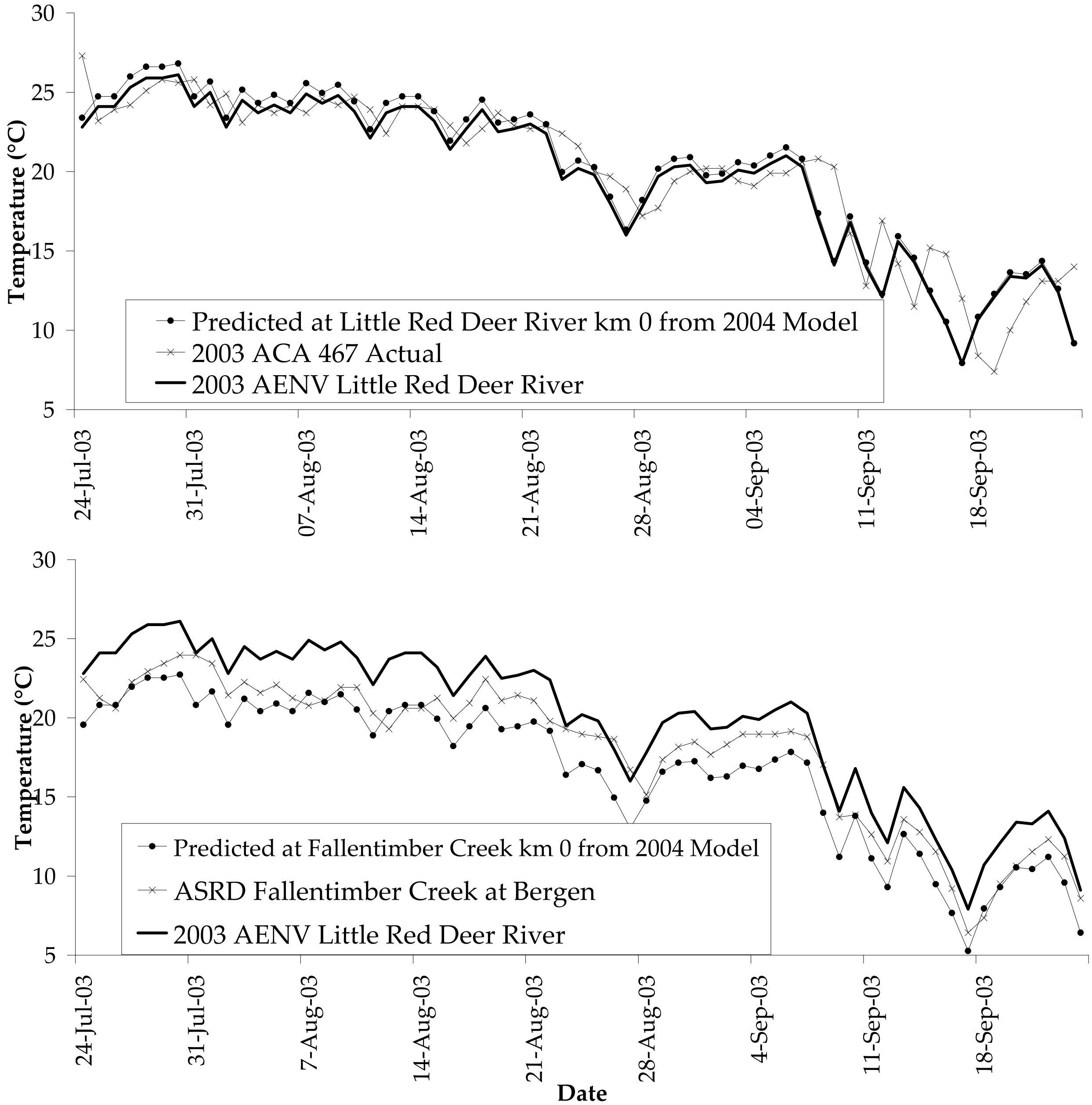


Figure 4.34 Daily maximum temperatures predicted at Little Red Deer River km 0 and Fallentimber Creek km 0 using 2004 models with 2003 Alberta Environment (AENV) real-time monitoring station on the Little Red Deer River near the mouth as the input variable. Daily maximum temperatures recorded in 2003 at AENV real-time monitoring station on the Little Red Deer River near the mouth and the Alberta Conservation Association (ACA) temperature-monitoring sites in close proximity to 2004 sites are also shown

5.0 DISCUSSION

The models presented here allow for accurate prediction of water temperature at remote locations from readily available online real-time temperature monitoring data. This ability to accurately predict water temperatures provides fisheries managers with a tool to proactively manage sportfish population in streams that are prone to high temperature events during the summer. This management tool would be best used to develop policy aimed at reducing additive mortality on fish due to angler induced stress on fish during high temperature periods.

The relationship between stream temperature data collected in 2004 at AENV real-time stream temperature-monitoring stations and at ACA temperature-monitoring sites was linear through the temperature range that these data were collected. The goodness of fit of the linear regression models developed in this report have shown that these models capably describe the relationship between AENV real-time temperature stations and data collected throughout a drainage. Within a drainage, the slope of the regressions lines generally decrease with distance upstream. This essentially means that the daily maximum stream temperature decreases with distance upstream in a drainage. The slopes of the regression lines (rate of temperature change) do not always decrease uniformly with distance upstream. For example, while the slopes of the regression lines created for Fallentimber Creek decrease with distance upstream (Table 4.3), they tended to form two groupings (km 0 and km 30 in one group and km 60 and km 90 in a second), each with similar slopes. This relationship can be seen in the observed data from the Fallentimber drainage (Figure 4.6) where the temperature lines of Fallentimber Creek km 0 and km 30 group together as do the lines of km 60 and km 90. It is unclear what is causing this grouping of temperatures recorded at these sites. However, this may be of importance in determining if certain anthropogenic practices are responsible for sharp increases in stream temperatures.

The models developed in 2004 have been assessed by the goodness of fit of the model, and by the graphical analyses of the models predicted values. The r^2 value for the models created measures the level of variation in the observed values of y (the daily maximum temperature data collected by ACA in 2004) that is explained by the regression equation of the form $y=\alpha x+\beta$. Where α is the slope of the line and β is the y intercept. The remainder of the variation, $1-r^2$ is variation that cannot be explained by the regression models. Therefore, regression equations with high r^2 values have a strong relationship between the daily maximum temperature observed at an individual ACA monitoring site and the daily maximum temperature at the AENV real-time station that model used to develop the model. For most of the models created in 2004, the r^2 values were above 0.90 (n=37), and often above 0.95. Models with r^2 values above 0.90 are arbitrarily considered to adequately explain the variation in temperature data, while the seven models with r^2 values below 0.90 have been singled out and the possible reasons for a lower r^2 value explained. At Threepoint Creek km 30, the low r^2 value of the model may be explained by the wide variation or scatter (Figure 5.15) between the ACA data and the AENV real-time monitoring station on Threepoint Creek. The greater variation observed at this site may be explained by run off events leading to bed load movement and subsequently the burial of the ACA temperature data logger at Threepoint Creek km 30. This may have created weakened the relationship between the ACA data collected at this site and the data obtained from the AENV real-time stream temperature-monitoring station on Threepoint Creek near Millarville. Four models where the r^2 values were below 0.90 were at Fallentimber Creek km 90, little Red Deer River km 180, Highwood River km 120 and Highwood River km 150. These four locations are all in the upstream-most reaches of study streams. The AENV real-time station used to create the models for these sites is located at the mouth of the Little Red Deer and Highwood rivers respectively. Therefore, the lower r^2 values may be explained in the upper most reaches of these streams by the temperature in these reaches being driven by more internal or local drivers, while the temperatures in the lower reaches, closer to the AENV real-time monitoring station, are driven more by external environmental factors (Poole and Berman 2001). The two remaining sites with r^2 values below 0.90 are Jumpingpound Creek km 30 and km 60. The reduction in the explainable variation in observed daily maximum temperature data at these two sites may be explained by the fact that the AENV real-time temperature-monitoring station used to create the models at these two sites was the AENV real-time stream temperature-monitoring station on Threepoint Creek near Millarville. The distance between ACA and AENV sites (48 km from AENV Threepoint Creek near Millarville to the mouth of Jumpingpound Creek) and the fact that they are in different drainages may be leading to the weaker relationship between the ACA sites and the AENV station. Using the models r^2 values to assess the goodness of fit, and subsequently the predictive ability of the models developed here suggests that models are more robust in the mid to lower reaches of a drainage. The results of this project also suggests that models are also more to have a higher r^2 when using AENV real-time monitoring data from the same drainage.

Based on the five models tested with 2003 data, the between year predictive ability appears to be quite good. The models were able to predict the both the magnitude and timing of flucuations in the daily maximum temperatures as seen in the 2003 ACA/ASRD data used to assess the models. Real-time predictive ability of these models ability is, however contingent upon continued stream temperature-monitoring and reporting by AENV. The ability of the models created in this report to predict temperatures has only been tested at five locations. Therefore, the ability of the models to predict at untested sites is unknown and must be used with caution. Specifically, the models ability to predict temperatures in the upper reaches of a drainage needs to be assessed through further data collected and model assessment. The effect of inter-year environmental variability on the predictive ability of these models also needs to be assessed through further data collection.

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7.0 APPENDICES

7.1 APPENDIX 1. STREAM NAME, UNIVERSAL TRANSVERSE MERCATOR LOCATION (NORTH AMERICAN DATUM 1983) OF STREAM TEMPERATURE LOGGER AND DATE OF DEPLOYMENT OF STREAM TEMPERATURE LOGGERS DEPLOYED BY ALBERTA CONSERVATION ASSOCIATION IN THE SUMMER OF 2004.

Logger location	Easting	Northing	Date Deployed
Dogpound Creek km 0	682491	5743800	5-Jul-04
Dogpound Creek km 30	683812	5729672	5-Jul-04
Dogpound Creek km 60	684606	5718722	5-Jul-04
Dogpound Creek km 90	680586	5707490	5-Jul-04
Dogpound Creek km 120	671244	5698467	5-Jul-04
Dogpound Creek km 150	659031	5694888	5-Jul-04
Fallentimber Creek km 0	662321	5736543	10-Jul-04
Fallentimber Creek km 30	663368	5721406	11-Jul-04
Fallentimber Creek km 60	648404	5719401	11-Jul-04
Fallentimber Creek km 90	635485	5713967	11-Jul-04
Highwood River km 0	725991	5631470	17-Jul-04
Highwood River km 30	721974	5616529	17-Jul-04
Highwood River km 60	712576	5604545	17-Jul-04
Highwood River km 90	694325	5602246	16-Jul-04
Highwood River km 120	679335	5588224	16-Jul-04
Highwood River km 150	657646	5592654	16-Jul-04
James River km 0	667188	5753829	12-Jul-04
James River km 30	649758	5752267	12-Jul-04
James River km 60	629811	5745688	12-Jul-04
Jumpingpound Creek km 0	674359	5673312	7-Jul-04
Jumpingpound Creek km 30	671455	5662812	7-Jul-04
Jumpingpound Creek km 60	657335	5656755	7-Jul-04
Little Red Deer River km 0	695745	5771885	11-Jul-04
Little Red Deer River km 30	690045	5764529	11-Jul-04
Little Red Deer River km 60	683322	5751577	11-Jul-04
Little Red Deer River km 90	672212	5742169	11-Jul-04
Little Red Deer River km 120	670874	5724702	10-Jul-04
Little Red Deer River km 150	665366	5712236	10-Jul-04
Little Red Deer River km 180	652812	5699679	10-Jul-04

Logger location	Easting	Northing	Date Deployed
North Raven River km 0	670670	5774675	6-Jul-04
Raven River km 0	679563	5768263	6-Jul-04
Raven River km 30	666073	5772594	6-Jul-04
Raven River km 60	651611	5773534	6-Jul-04
Raven River km 90	641985	5764006	6-Jul-04
Sheep River km 0	721745	5623250	15-Jul-04
Sheep River km 30	701502	5622651	15-Jul-04
Sheep River km 60	683573	5611006	15-Jul-04
Threepoint Creek km 0	697639	5624091	16-Jul-04
Threepoint Creek km 30	683093	5623709	15-Jul-04
Threepoint Creek km 60	669697	5627191	15-Jul-04
Pekisko Creek km 0	703274	5595366	17-Jul-04
Pekisko Creek km 30	692468	5587665	18-Jul-04
Stimson Creek km 0	701715	5593922	17-Jul-04
Stimson Creek km 30	696970	5579992	18-Jul-04
Stimson Creek km 45	695675	5573314	18-Jul-04

7.2 APPENDIX 2. STREAM TEMPERATURE (°C) DATA COLLECTED BY ALBERTA CONSERVATION ASSOCIATION IN THE SUMMER OF 2004 IN THE RED DEER, BOW AND HIGHWOOD RIVER DRAINAGES. INCLUDED IS DATE AND TIME OF TEMPERATURE READINGS.

7.3 APPENDIX 3. INTERACTIVE MODELS FOR THE PREDICTION OF STREAM TEMPERATURES. MODELS ARE ARRANGED BY STREAM DRAINAGE. INCLUDED IS INSTRUCTIONS FOR THE USE OF THE MODELS.

Note, Appendix 2 and Appendix 3 are on the accompanying compact disk.

7.4 APPENDIX 4. DAILY MAXIMUM STREAM TEMPERATURES (°C) RECORDED FROM JULY TO SEPTEMBER, 2004 IN THE RAVEN AND NORTH RAVEN RIVERS AT ALBERTA CONSERVATION ASSOCIATION (ACA) STREAM TEMPERATURE MONITORING SITES AND AT ALBERTA ENVIRONMENT (AENV) REAL-TIME STREAM TEMPERATURE-MONITORING STATION ON THE RAVEN RIVER NEAR THE TOWN OF RAVEN.

Date	ACA Raven River km 0	ACA Raven River km 30	ACA Raven River km 60	ACA Raven River km 90	ACA North Raven River km 0	AENV Raven River
6-Jul-04	16.03	15.87	14.15	13.50	17.03	15.75
7-Jul-04	15.80	15.22	13.88	13.04	16.96	15.67
8-Jul-04	14.34	12.22	11.49	10.25	13.67	12.85
9-Jul-04	13.69	15.18	13.79	13.69	15.68	14.91
10-Jul-04	16.23	18.06	16.20	17.03	18.27	17.14
11-Jul-04	17.15	17.20	15.84	15.13	18.20	17.12
12-Jul-04	18.39	18.96	16.68	17.72	19.82	18.43
13-Jul-04	19.58	18.87	17.11	17.75	20.10	19.07
14-Jul-04	20.77	20.46	18.03	19.08	21.20	19.90
15-Jul-04	20.72	19.44	18.03	17.49	21.22	20.24
16-Jul-04	21.03	20.79	18.70	19.15	21.94	20.77
17-Jul-04	22.75	22.20	20.01	20.41	23.35	22.08
18-Jul-04	23.71	23.02	20.48	21.29	23.81	22.75
19-Jul-04	23.14	22.03	20.44	20.08	23.79	22.39
20-Jul-04	22.20	20.06	18.68	16.94	22.06	20.82
21-Jul-04	20.96	18.91	16.75	16.15	20.32	18.99
22-Jul-04	20.22	19.46	17.20	16.03	20.67	19.18
23-Jul-04	20.63	19.56	17.68	17.65	21.15	19.88
24-Jul-04	21.06	20.56	18.53	19.13	21.53	20.18
25-Jul-04	21.68	20.94	18.56	20.06	21.77	20.73
26-Jul-04	20.75	19.27	18.49	17.72	21.70	20.07
27-Jul-04	19.01	16.30	15.84	14.84	18.91	17.65
28-Jul-04	17.30	17.49	15.41	15.77	18.18	16.65
29-Jul-04	18.89	18.72	17.11	17.92	19.27	18.51
30-Jul-04	20.25	19.70	17.30	18.20	20.48	19.38
31-Jul-04	19.53	17.92	17.30	16.49	20.48	18.76
1-Aug-04	19.25	18.30	16.08	16.15	19.03	18.14
2-Aug-04	19.06	18.44	16.53	17.30	19.22	18.06
3-Aug-04	20.03	19.06	17.25	17.84	20.20	19.31

Date	ACA Raven River km 0	ACA Raven River km 30	ACA Raven River km 60	ACA Raven River km 90	ACA North Raven River km 0	AENV Raven River
4-Aug-04	19.39	18.06	17.15	16.11	20.17	18.83
5-Aug-04	19.18	18.34	16.23	15.29	19.94	18.14
6-Aug-04	18.37	17.56	15.46	13.55	19.75	17.66
7-Aug-04	18.32	16.51	14.36	12.44	19.67	17.41
8-Aug-04	16.80	14.60	13.09	12.39	17.20	15.64
9-Aug-04	15.72	14.43	13.52	12.58	16.68	14.98
10-Aug-04	15.49	15.84	14.05	13.95	17.56	15.58
11-Aug-04	16.32	16.87	14.91	14.72	18.15	16.12
12-Aug-04	17.15	17.70	16.03	15.84	19.13	17.20
13-Aug-04	18.13	18.39	16.73	16.30	19.63	18.04
14-Aug-04	19.01	18.56	17.18	16.23	20.03	18.83
15-Aug-04	19.25	17.77	16.73	15.37	20.03	18.58
16-Aug-04	19.41	17.77	16.56	15.84	20.22	18.62
17-Aug-04	19.67	18.37	16.46	15.25	20.22	18.74
18-Aug-04	18.91	17.32	16.01	14.53	20.08	17.76
19-Aug-04	18.27	16.89	15.32	14.19	19.06	17.30
20-Aug-04	17.84	16.30	15.01	13.23	18.18	16.70
21-Aug-04	17.18	15.75	14.51	12.53	18.18	16.51
22-Aug-04	16.20	14.10	13.02	11.47	16.51	15.25
23-Aug-04	13.40	11.54	10.52	9.63	13.28	12.46
24-Aug-04	12.46	11.37	10.15	9.29	12.27	11.87
25-Aug-04	12.03	12.07	10.83	10.47	12.65	12.04
26-Aug-04	12.36	12.41	10.96	10.88	13.64	12.45
27-Aug-04	13.28	13.04	11.49	10.83	14.51	13.24
28-Aug-04	13.47	13.06	11.49	10.96	14.91	13.33
29-Aug-04	13.55	13.16	11.76	11.54	14.89	13.45
30-Aug-04	14.46	14.27	12.92	12.49	15.82	14.40
31-Aug-04	14.84	14.70	13.55	13.11	16.11	14.54
1-Sep-04	15.06	14.17	13.43	11.86	16.11	14.80
2-Sep-04	14.70	13.23	12.51	11.10	14.98	14.03
3-Sep-04	13.19	11.35	10.27	8.89	13.06	12.23
4-Sep-04	12.22	11.22	9.93	8.77	12.17	11.70
5-Sep-04	11.78	10.76	9.24	9.29	11.71	11.14
6-Sep-04	10.93	10.61	9.09	8.54	11.61	10.71
7-Sep-04	10.86	10.71	9.31	8.97	12.20	10.66
8-Sep-04	11.27	10.88	9.93	9.36	12.03	11.23
9-Sep-04	11.22	10.03	9.06	8.30	11.52	10.68

Date	ACA Raven River km 0	ACA Raven River km 30	ACA Raven River km 60	ACA Raven River km 90	ACA North Raven River km 0	AENV Raven River
10-Sep-04	9.21	7.75	6.69	6.13	9.26	8.48
11-Sep-04	9.31	9.66	8.94	8.84	10.52	9.59
12-Sep-04	9.71	9.46	8.72	8.59	10.44	9.55
13-Sep-04	9.93	10.08	8.97	8.89	11.39	9.98
14-Sep-04	9.95	9.73	8.59	8.00	11.57	10.00
15-Sep-04	10.03	9.49	Data NA	Data NA	11.32	10.07
16-Sep-04	10.42	9.56	Data NA	Data NA	10.98	10.17
17-Sep-04	10.37	9.63	Data NA	Data NA	11.49	10.04
18-Sep-04	9.93	9.36	Data NA	Data NA	11.22	9.97
19-Sep-04	9.73	8.17	Data NA	Data NA	9.90	9.26
20-Sep-04	8.64	7.92	Data NA	Data NA	9.78	8.42

7.5 APPENDIX 5. DAILY MAXIMUM STREAM TEMPERATURES (°C) RECORDED FROM JULY TO SEPTEMBER, 2004 IN THE JAMES RIVER AT ALBERTA CONSERVATION ASSOCIATION (ACA) STREAM TEMPERATURE MONITORING SITES AND AT ALBERTA ENVIRONMENT (AENV) REAL-TIME STREAM TEMPERATURE-MONITORING STATION ON THE LITTLE RED DEER RIVER NEAR THE MOUTH.

Date	ACA James River km 0	ACA James River km 30	ACA James River km 60	AENV Little Red Deer River
11-Jul-04	18.63	17.32	15.13	21.10
12-Jul-04	19.56	17.72	15.44	22.10
13-Jul-04	21.46	19.89	16.01	24.00
14-Jul-04	21.18	17.96	14.34	23.00
15-Jul-04	21.25	20.20	17.44	24.10
16-Jul-04	23.74	22.25	19.10	26.60
17-Jul-04	24.44	22.97	18.60	26.70
18-Jul-04	23.45	21.60	18.15	25.10
19-Jul-04	20.98	19.01	17.46	23.80
20-Jul-04	19.22	17.77	15.15	22.50
21-Jul-04	20.41	17.89	15.89	23.70
22-Jul-04	21.80	20.20	17.96	24.40
23-Jul-04	23.09	21.25	19.13	25.20
24-Jul-04	23.69	22.20	19.15	25.90
25-Jul-04	20.39	19.82	16.58	22.10
26-Jul-04	17.01	16.68	15.27	18.70
27-Jul-04	20.32	17.75	16.18	21.30
28-Jul-04	22.11	20.22	17.70	22.80
29-Jul-04	22.32	20.13	18.11	23.90
30-Jul-04	19.75	18.22	15.94	22.40
31-Jul-04	19.20	18.11	15.96	20.90
1-Aug-04	20.79	20.13	18.41	21.30
2-Aug-04	21.63	20.48	18.39	23.20
3-Aug-04	19.51	19.15	16.58	20.60
4-Aug-04	21.77	19.79	17.37	23.10
5-Aug-04	19.79	17.75	14.29	22.10
6-Aug-04	17.32	15.89	13.64	19.80
7-Aug-04	14.91	13.69	11.95	18.10
8-Aug-04	14.79	13.52	12.92	17.40
9-Aug-04	17.25	15.70	15.06	19.10

Date	ACA James River km 0	ACA James River km 30	ACA James River km 60	AENV Little Red Deer River
10-Aug-04	18.65	16.96	15.92	20.20
11-Aug-04	20.32	18.60	17.13	21.60
12-Aug-04	21.15	19.44	17.51	22.40
13-Aug-04	21.18	19.32	16.70	22.60
14-Aug-04	19.75	18.30	16.15	21.10
15-Aug-04	20.15	18.53	16.49	22.30
16-Aug-04	20.98	18.58	16.15	22.80
17-Aug-04	20.53	18.63	16.49	22.30
18-Aug-04	19.79	17.27	15.10	22.00
19-Aug-04	19.22	16.92	14.65	21.70
20-Aug-04	17.87	15.87	13.57	19.50
21-Aug-04	14.82	14.00	11.57	16.80
22-Aug-04	11.64	11.03	10.03	14.40
23-Aug-04	11.35	10.64	10.59	13.40
24-Aug-04	12.41	11.32	10.44	14.40
25-Aug-04	13.71	12.15	12.03	16.00
26-Aug-04	14.34	12.51	11.20	17.30
27-Aug-04	14.36	12.94	11.64	16.90
28-Aug-04	14.94	13.45	12.15	16.80
29-Aug-04	16.58	14.70	12.75	17.90
30-Aug-04	17.18	15.13	13.93	17.90
31-Aug-04	15.03	14.15	12.00	16.50
1-Sep-04	13.74	12.61	11.01	15.40
2-Sep-04	11.47	10.49	9.24	14.00
3-Sep-04	10.52	9.71	9.34	13.80
4-Sep-04	11.49	10.37	9.49	14.10
5-Sep-04	11.73	9.81	8.62	14.20
6-Sep-04	12.22	10.42	9.90	14.00
7-Sep-04	12.39	10.57	9.95	15.10
8-Sep-04	10.49	10.08	8.57	12.50
9-Sep-04	8.05	7.95	7.24	10.30
10-Sep-04	11.69	10.30	10.20	13.00
11-Sep-04	11.44	10.00	9.26	11.80
12-Sep-04	12.68	10.35	9.14	13.90
13-Sep-04	10.61	9.73	7.97	14.70

7.6 APPENDIX 6. DAILY MAXIMUM STREAM TEMPERATURES (°C) RECORDED FROM JULY TO SEPTEMBER, 2004 IN THE FALLENTIMBER CREEK AT ALBERTA CONSERVATION ASSOCIATION (ACA) STREAM TEMPERATURE MONITORING SITES AND AT ALBERTA ENVIRONMENT (AENV) REAL-TIME STREAM TEMPERATURE-MONITORING STATION ON THE LITTLE RED DEER RIVER NEAR THE MOUTH.

Date	ACA Fallentimber Creek km 0	ACA Fallentimber Creek km 30	ACA Fallentimber Creek km 60	ACA Fallentimber Creek km 90	AENV Little Red Deer River
10-Jul-04	16.73	Data NA	Data NA	Data NA	19.40
11-Jul-04	15.08	12.94	10.59	10.15	18.40
12-Jul-04	18.32	17.15	13.64	12.97	21.10
13-Jul-04	18.51	17.08	13.79	13.35	22.10
14-Jul-04	20.96	19.22	15.10	14.12	24.00
15-Jul-04	20.06	18.96	14.48	13.43	23.00
16-Jul-04	20.60	18.32	15.27	14.22	24.10
17-Jul-04	21.82	20.77	16.77	16.13	26.60
18-Jul-04	23.40	21.72	16.63	15.03	26.70
19-Jul-04	22.61	20.67	16.03	15.22	25.10
20-Jul-04	21.37	18.96	15.20	14.96	23.80
21-Jul-04	19.25	17.68	14.53	12.63	22.50
22-Jul-04	19.70	17.99	13.38	13.28	23.70
23-Jul-04	21.51	19.82	14.72	14.98	24.40
24-Jul-04	22.47	20.91	15.89	16.25	25.20
25-Jul-04	22.68	21.29	16.08	16.63	25.90
26-Jul-04	19.96	17.75	15.37	13.67	22.10
27-Jul-04	17.96	16.82	12.82	13.02	18.70
28-Jul-04	19.51	18.25	13.62	13.71	21.30
29-Jul-04	22.06	19.87	15.32	15.49	22.80
30-Jul-04	21.89	19.89	14.86	14.48	23.90
31-Jul-04	19.53	16.92	14.03	13.35	22.40
1-Aug-04	17.65	15.20	12.34	11.54	20.90
2-Aug-04	20.37	19.34	15.49	16.42	21.30
3-Aug-04	20.98	19.06	16.37	16.15	23.20
4-Aug-04	19.34	18.41	14.84	13.67	20.60
5-Aug-04	20.48	19.25	14.75	15.13	23.10
6-Aug-04	18.82	16.51	13.47	11.81	22.10
7-Aug-04	16.65	13.93	12.44	11.27	19.80
8-Aug-04	13.76	12.53	12.00	10.20	18.10
9-Aug-04	14.05	13.21	11.57	11.10	17.40

Date	ACA Fallentimber Creek km 0	ACA Fallentimber Creek km 30	ACA Fallentimber Creek km 60	ACA Fallentimber Creek km 90	AENV Little Red Deer River
10-Aug-04	15.03	14.75	12.36	12.46	19.10
11-Aug-04	16.13	16.08	13.16	13.02	20.20
12-Aug-04	17.46	17.39	13.95	13.64	21.60
13-Aug-04	18.30	18.08	14.51	14.46	22.40
14-Aug-04	18.06	17.44	14.19	13.43	22.60
15-Aug-04	17.82	16.65	13.67	13.33	21.10
16-Aug-04	17.23	16.61	13.76	14.10	22.30
17-Aug-04	18.11	17.58	14.22	13.59	22.80
18-Aug-04	18.15	17.49	13.91	14.00	22.30
19-Aug-04	17.34	16.39	13.50	12.15	22.00
20-Aug-04	17.30	16.15	12.39	12.36	21.70
21-Aug-04	16.18	15.39	12.15	11.08	19.50
22-Aug-04	14.51	12.36	11.44	9.63	16.80
23-Aug-04	11.81	10.12	9.16	8.82	14.40
24-Aug-04	10.93	10.30	9.58	9.83	13.40
25-Aug-04	10.69	10.25	9.41	9.14	14.40
26-Aug-04	12.03	12.24	10.32	9.83	16.00
27-Aug-04	12.51	12.07	10.35	9.93	17.30
28-Aug-04	12.68	12.70	10.76	10.91	16.90
29-Aug-04	13.93	13.64	11.03	11.10	16.80
30-Aug-04	14.72	14.41	11.90	11.47	17.90
31-Aug-04	15.03	15.22	12.17	12.29	17.90
1-Sep-04	14.34	13.21	11.93	10.30	16.50
2-Sep-04	13.38	11.78	9.78	9.04	15.40
3-Sep-04	11.25	10.22	8.54	8.72	14.00
4-Sep-04	10.49	9.51	8.54	8.12	13.80
5-Sep-04	10.88	11.08	8.39	8.32	14.10
6-Sep-04	10.39	10.10	8.07	7.37	14.20
7-Sep-04	11.35	11.47	9.14	9.81	14.00
8-Sep-04	11.64	11.25	9.14	9.19	15.10
9-Sep-04	10.96	9.73	8.94	8.02	12.50
10-Sep-04	8.49	7.54	6.64	5.75	10.30
11-Sep-04	10.47	11.08	8.87	Data NA	13.00
12-Sep-04	10.64	9.76	8.77	Data NA	11.80
13-Sep-04	11.08	11.05	8.64	Data NA	13.90
14-Sep-04	10.57	10.15	8.42	Data NA	14.70
15-Sep-04	9.95	8.59	7.54	Data NA	14.00

7.7 APPENDIX 7. DAILY MAXIMUM STREAM TEMPERATURES (°C) RECORDED FROM JULY TO SEPTEMBER, 2004 IN THE LITTLE RED DEER RIVER AT ALBERTA CONSERVATION ASSOCIATION (ACA) STREAM TEMPERATURE MONITORING SITES AND AT ALBERTA ENVIRONMENT (AENV) REAL-TIME STREAM TEMPERATURE-MONITORING STATION ON THE LITTLE RED DEER RIVER NEAR THE MOUTH.

Date	Little Red Deer River km 0	Little Red Deer River km 30	Little Red Deer River km 60	Little Red Deer River km 90	Little Red Deer River km 120	Little Red Deer River km 150	Little Red Deer River km 180	AENV Little Red Deer River
11-Jul-04	18.82	17.96	16.96	16.03	16.80	13.93	11.49	18.40
12-Jul-04	22.20	20.60	20.89	19.01	18.25	17.65	15.72	21.10
13-Jul-04	23.21	22.30	20.84	20.29	18.56	17.53	14.29	22.10
14-Jul-04	24.94	23.91	23.71	22.27	20.46	19.77	17.25	24.00
15-Jul-04	23.06	23.52	24.00	23.04	21.10	20.65	17.99	23.00
16-Jul-04	24.80	23.98	24.51	23.59	20.89	18.11	17.77	24.10
17-Jul-04	27.46	26.48	25.07	22.66	22.15	21.27	18.84	26.60
18-Jul-04	27.58	26.65	25.89	24.12	22.99	22.68	19.91	26.70
19-Jul-04	25.67	25.38	25.26	25.04	22.94	21.99	18.13	25.10
20-Jul-04	23.86	24.17	23.74	23.57	21.82	20.17	17.84	23.80
21-Jul-04	22.92	22.78	22.82	22.20	20.32	19.08	15.80	22.50
22-Jul-04	24.07	23.55	23.52	22.68	19.53	19.29	15.72	23.70
23-Jul-04	24.87	24.12	24.75	23.69	21.25	20.37	18.37	24.40
24-Jul-04	25.60	25.26	26.01	24.75	22.30	21.72	19.48	25.20
25-Jul-04	26.38	26.16	26.65	25.36	22.85	21.89	19.34	25.90
26-Jul-04	24.15	23.74	22.99	21.75	21.15	19.13	15.65	22.10
27-Jul-04	20.20	20.51	19.48	19.15	17.99	17.72	15.63	18.70
28-Jul-04	21.49	21.06	22.42	21.08	19.77	18.46	16.96	21.30
29-Jul-04	23.11	22.71	24.29	23.14	21.49	20.75	18.01	22.80
30-Jul-04	24.22	24.05	24.68	23.93	21.37	20.77	18.70	23.90
31-Jul-04	22.56	22.51	23.04	21.15	20.08	18.44	15.87	22.40
1-Aug-04	21.37	21.60	21.37	20.60	18.30	16.51	13.38	20.90
2-Aug-04	21.44	21.65	22.87	21.70	19.65	19.65	19.53	21.30
3-Aug-04	23.42	23.33	23.76	22.59	21.01	20.25	18.34	23.20
4-Aug-04	21.87	21.49	21.51	21.87	19.91	19.53	16.92	20.60
5-Aug-04	23.18	22.75	23.86	22.71	20.41	19.87	18.13	23.10
6-Aug-04	22.68	22.37	22.37	21.60	19.10	17.72	15.96	22.10
7-Aug-04	21.29	20.60	19.48	18.49	18.25	15.39	14.31	19.80
8-Aug-04	18.68	18.32	17.34	16.65	15.13	13.79	12.92	18.10
9-Aug-04	18.15	17.42	17.11	15.82	15.75	14.34	13.83	17.40

Date	Little Red Deer River km 0	Little Red Deer River km 30	Little Red Deer River km 60	Little Red Deer River km 90	Little Red Deer River km 120	Little Red Deer River km 150	Little Red Deer River km 180	AENV Little Red Deer River
10-Aug-04	20.13	18.77	19.10	17.32	17.13	16.99	16.11	19.10
11-Aug-04	21.25	20.01	20.10	18.79	18.22	18.39	16.89	20.20
12-Aug-04	22.39	21.44	21.68	20.84	19.75	20.03	17.96	21.60
13-Aug-04	22.94	22.56	23.04	22.37	20.67	20.77	18.58	22.40
14-Aug-04	23.09	22.68	23.09	23.06	20.60	19.87	16.20	22.60
15-Aug-04	21.77	21.72	22.54	22.25	20.01	18.53	16.23	21.10
16-Aug-04	23.04	22.30	23.11	21.84	20.01	19.03	17.18	22.30
17-Aug-04	23.16	23.30	23.62	22.11	20.51	20.06	17.49	22.80
18-Aug-04	22.63	22.85	23.04	22.25	20.25	19.10	17.30	22.30
19-Aug-04	22.25	21.84	22.49	21.34	19.89	18.22	14.98	22.00
20-Aug-04	21.65	21.53	22.15	21.41	19.39	17.03	15.37	21.70
21-Aug-04	20.41	19.91	19.94	19.98	18.22	16.20	14.72	19.50
22-Aug-04	17.87	17.92	17.13	16.63	16.37	13.93	12.00	16.80
23-Aug-04	14.55	14.63	14.12	13.81	12.73	11.35	10.81	14.40
24-Aug-04	14.07	13.50	13.45	12.63	12.00	11.90	12.29	13.40
25-Aug-04	14.67	13.71	12.90	12.05	11.98	11.64	10.71	14.40
26-Aug-04	16.42	15.22	14.89	13.16	13.91	13.40	13.02	16.00
27-Aug-04	17.25	16.53	15.46	14.96	14.17	13.52	12.58	17.30
28-Aug-04	17.08	16.75	15.96	15.77	14.12	13.88	12.97	16.90
29-Aug-04	16.87	16.68	16.96	16.65	15.32	14.72	14.05	16.80
30-Aug-04	18.46	17.94	18.77	16.65	16.58	16.23	14.82	17.90
31-Aug-04	18.08	18.27	18.77	17.51	16.61	16.63	15.03	17.90
1-Sep-04	17.20	17.15	17.34	16.39	16.11	14.36	12.56	16.50
2-Sep-04	16.13	16.44	15.89	12.07	14.89	12.92	11.03	15.40
3-Sep-04	14.31	14.15	13.71	12.65	12.34	11.22	10.57	14.00
4-Sep-04	13.95	13.71	13.50	12.46	11.90	10.49	10.12	13.80
5-Sep-04	14.05	13.76	13.38	12.73	11.81	11.44	10.22	14.10
6-Sep-04	14.29	13.62	13.79	12.82	11.39	10.32	9.58	14.20
7-Sep-04	13.93	14.17	14.72	12.94	12.10	12.36	12.17	14.00
8-Sep-04	14.91	14.55	15.10	13.09	12.51	12.00	10.98	15.10
9-Sep-04	13.38	13.26	12.27	7.52	11.78	10.52	9.71	12.50
10-Sep-04	10.37	10.42	9.93	8.34	8.79	8.07	7.02	10.30
11-Jul-04	12.75	12.29	13.16	11.18	11.03	12.10	Data NA	13.00
12-Jul-04	11.81	11.93	12.75	10.88	11.54	10.88	Data NA	11.80
13-Jul-04	14.05	14.12	14.91	11.59	12.29	11.30	Data NA	13.90
14-Jul-04	14.43	14.43	14.46	11.30	11.81	10.05	Data NA	14.70
15-Jul-04	14.15	13.81	13.33	10.05	10.98	8.67	Data NA	14.00
16-Jul-04	13.79	13.35	12.34	Data NA	Data NA	Data NA	Data NA	13.50
17-Sep-04	13.74	13.43	13.50	Data NA	Data NA	Data NA	Data NA	13.40

Date	Little Red Deer River km 0	Little Red Deer River km 30	Little Red Deer River km 60	Little Red Deer River km 90	Little Red Deer River km 120	Little Red Deer River km 150	Little Red Deer River km 180	AENV Little Red Deer River
18-Sep-04	11.98	12.03	11.37	Data NA	Data NA	Data NA	Data NA	12.00
19-Sep-04	11.73	11.64	10.27	Data NA	Data NA	Data NA	Data NA	11.90
20-Sep-04	10.76	10.32	Data NA	Data NA	Data NA	Data NA	Data NA	10.80

7.8 APPENDIX 8. DAILY MAXIMUM STREAM TEMPERATURES (°C) RECORDED FROM JULY TO SEPTEMBER, 2004 IN THE DOGPOUND CREEK AT ALBERTA CONSERVATION ASSOCIATION (ACA) STREAM TEMPERATURE MONITORING SITES AND AT ALBERTA ENVIRONMENT (AENV) REAL-TIME STREAM TEMPERATURE-MONITORING STATION ON THE LITTLE RED DEER RIVER NEAR THE MOUTH.

Date	ACA Dogpound Creek km 0	ACA Dogpound Creek km 30	ACA Dogpound Creek km 60	ACA Dogpound Creek km 90	ACA Dogpound Creek km 120	ACA Dogpound Creek km 150	AENV Little Red Deer River
5-Jul-04	Data NA	18.06	18.30	16.63	15.34	15.34	16.9
6-Jul-04	Data NA	19.91	18.82	17.15	15.32	15.01	16.7
7-Jul-04	Data NA	18.65	18.18	15.89	13.38	13.93	15.8
8-Jul-04	Data NA	14.67	14.48	14.07	12.65	11.64	13.4
9-Jul-04	Data NA	19.25	18.87	16.77	14.75	13.57	16.2
10-Jul-04	Data NA	21.68	20.98	20.39	17.61	17.01	19.4
11-Jul-04	20.29	20.01	19.91	18.20	15.99	15.27	18.40
12-Jul-04	20.84	22.42	22.06	21.99	18.20	18.20	21.10
13-Jul-04	22.63	22.73	21.58	20.70	17.13	17.34	22.10
14-Jul-04	24.34	24.39	23.86	23.09	19.20	20.06	24.00
15-Jul-04	24.05	24.41	23.40	22.37	20.37	21.22	23.00
16-Jul-04	24.32	24.27	23.47	24.15	21.39	20.89	24.10
17-Jul-04	25.99	26.26	25.94	25.82	22.11	22.39	26.60
18-Jul-04	26.40	27.04	26.11	25.99	22.35	23.18	26.70
19-Jul-04	25.65	25.99	25.82	24.34	21.70	21.77	25.10
20-Jul-04	24.80	24.32	24.00	23.45	20.32	21.20	23.80
21-Jul-04	23.16	22.87	22.20	21.29	18.32	19.75	22.50
22-Jul-04	23.52	23.23	22.39	20.89	18.15	18.06	23.70
23-Jul-04	24.07	24.29	23.33	21.96	19.18	20.53	24.40
24-Jul-04	24.75	25.02	23.59	23.35	20.37	21.49	25.20
25-Jul-04	24.99	24.99	23.69	23.88	20.94	21.99	25.90
26-Jul-04	23.57	23.55	23.69	22.11	17.37	19.46	22.10
27-Jul-04	21.29	19.84	19.75	17.84	16.56	17.13	18.70
28-Jul-04	21.44	20.79	19.13	19.67	17.61	18.22	21.30
29-Jul-04	22.23	23.18	21.96	22.13	18.96	19.58	22.80
30-Jul-04	23.38	23.95	22.37	21.49	18.96	19.79	23.90
31-Jul-04	22.39	21.82	22.37	20.48	17.13	17.99	22.40
1-Aug-04	21.49	20.70	20.51	19.01	15.06	16.13	20.90

Date	ACA Dogpound Creek km 0	ACA Dogpound Creek km 30	ACA Dogpound Creek km 60	ACA Dogpound Creek km 90	ACA Dogpound Creek km 120	ACA Dogpound Creek km 150	AENV Little Red Deer River
2-Aug-04	21.75	21.49	20.29	20.27	18.20	18.87	21.30
3-Aug-04	22.25	22.37	21.53	20.96	18.13	19.46	23.20
4-Aug-04	21.72	21.82	21.75	20.63	17.65	18.39	20.60
5-Aug-04	22.35	22.49	22.35	21.72	18.72	19.22	23.10
6-Aug-04	21.15	21.72	21.06	19.58	17.20	16.49	22.10
7-Aug-04	20.15	20.32	20.15	18.70	15.01	14.31	19.80
8-Aug-04	18.13	17.94	17.42	15.68	14.07	13.81	18.10
9-Aug-04	18.20	18.06	17.99	16.49	14.41	14.12	17.40
10-Aug-04	19.72	20.22	19.48	18.06	15.53	15.63	19.10
11-Aug-04	20.37	21.41	20.75	19.27	16.82	17.01	20.20
12-Aug-04	21.44	22.54	21.84	21.15	18.13	18.82	21.60
13-Aug-04	22.54	23.62	22.68	22.08	18.75	19.87	22.40
14-Aug-04	23.11	23.62	22.32	21.37	18.03	18.49	22.60
15-Aug-04	22.49	22.66	21.37	20.44	17.11	17.70	21.10
16-Aug-04	22.87	22.49	21.22	20.06	17.80	18.25	22.30
17-Aug-04	23.71	23.55	21.99	20.89	18.41	18.34	22.80
18-Aug-04	23.47	23.18	21.65	20.27	17.44	18.37	22.30
19-Aug-04	22.59	22.23	21.20	19.20	16.70	16.53	22.00
20-Aug-04	21.89	21.51	20.53	18.89	16.37	16.42	21.70
21-Aug-04	20.48	20.51	20.17	18.11	15.61	15.51	19.50
22-Aug-04	19.03	18.22	18.08	15.99	12.73	13.14	16.80
23-Aug-04	15.44	14.24	13.81	13.14	12.24	10.76	14.40
24-Aug-04	13.83	13.35	13.31	13.02	12.07	12.07	13.40
25-Aug-04	13.71	13.33	13.06	11.76	11.54	10.93	14.40
26-Aug-04	14.48	15.46	15.51	14.51	13.21	12.49	16.00
27-Aug-04	16.27	16.84	16.25	15.06	12.80	12.24	17.30
28-Aug-04	16.46	17.39	16.51	15.99	13.28	13.09	16.90
29-Aug-04	17.01	18.37	17.75	16.01	14.00	14.58	16.80
30-Aug-04	18.13	19.70	18.53	17.68	14.65	15.32	17.90
31-Aug-04	18.96	18.89	18.46	17.99	15.51	16.27	17.90
1-Sep-04	18.01	17.92	17.11	16.42	13.74	14.05	16.50
2-Sep-04	16.63	16.53	16.08	15.27	12.56	12.36	15.40
3-Sep-04	14.41	13.52	13.16	12.53	11.61	10.76	14.00
4-Sep-04	13.23	13.35	12.78	12.00	10.98	10.10	13.80
5-Sep-04	13.19	13.83	13.45	12.73	10.83	9.78	14.10
6-Sep-04	13.04	13.83	13.14	12.12	9.95	9.56	14.20

Date	ACA Dogpound Creek km 0	ACA Dogpound Creek km 30	ACA Dogpound Creek km 60	ACA Dogpound Creek km 90	ACA Dogpound Creek km 120	ACA Dogpound Creek km 150	AENV Little Red Deer River
7-Sep-04	13.86	14.00	13.31	13.09	10.79	11.57	14.00
8-Sep-04	14.67	15.32	14.15	13.09	11.10	11.05	15.10
9-Sep-04	13.16	12.99	12.97	11.88	9.76	9.76	12.50
10-Sep-04	10.59	9.95	9.46	8.92	8.22	7.59	10.30
11-Sep-04	11.83	12.70	12.24	12.56	10.86	11.20	13.00
12-Sep-04	12.68	13.11	12.27	12.17	10.10	10.32	11.80
13-Sep-04	13.57	14.17	13.28	11.86	9.78	9.49	13.90
14-Sep-04	14.19	14.31	13.04	Data NA	Data NA	Data NA	14.70

7.9 APPENDIX 9. DAILY MAXIMUM STREAM TEMPERATURES (°C) RECORDED FROM JULY TO SEPTEMBER, 2004 IN THE JUMPINGPOUND CREEK AT ALBERTA CONSERVATION ASSOCIATION (ACA) STREAM TEMPERATURE MONITORING SITES AND AT ALBERTA ENVIRONMENT (AENV) REAL-TIME STREAM TEMPERATURE-MONITORING STATION ON THREEPOINT CREEK NEAR THE TOWN OF MILLARVILLE.

Date	ACA Jumpingpound Creek km 0	ACA Jumpingpound Creek km 30	ACA Jumpingpound Creek km 60	AENV Threepoint Creek
07-Jul-04	12.85	11.66	8.42	12.12
08-Jul-04	12.90	11.30	8.62	11.09
09-Jul-04	16.46	14.91	11.88	15.65
10-Jul-04	18.34	16.56	12.00	13.62
11-Jul-04	17.37	15.46	11.39	Data NA
12-Jul-04	21.01	17.80	13.06	Data NA
13-Jul-04	19.37	15.72	10.91	Data NA
14-Jul-04	22.90	19.15	13.74	Data NA
15-Jul-04	23.71	19.84	13.95	Data NA
16-Jul-04	21.89	20.25	13.43	Data NA
17-Jul-04	24.51	21.46	15.29	Data NA
18-Jul-04	25.82	22.39	15.32	Data NA
19-Jul-04	24.17	20.98	13.95	Data NA
20-Jul-04	22.11	19.39	12.73	Data NA
21-Jul-04	21.37	18.49	11.76	Data NA
22-Jul-04	21.96	19.27	11.95	Data NA
23-Jul-04	23.95	20.32	14.70	Data NA
24-Jul-04	24.75	21.27	15.10	Data NA
25-Jul-04	25.07	22.01	14.15	Data NA
26-Jul-04	21.56	18.37	11.08	Data NA
27-Jul-04	19.27	16.92	12.24	Data NA
28-Jul-04	21.96	19.41	14.05	Data NA
29-Jul-04	23.76	21.37	14.31	Data NA
30-Jul-04	23.98	21.58	14.86	21.60
31-Jul-04	21.22	18.77	12.34	19.43
01-Aug-04	18.63	16.37	9.61	16.68
02-Aug-04	22.47	20.06	14.91	19.31
03-Aug-04	23.45	20.98	13.55	19.88
04-Aug-04	22.06	19.65	13.59	20.04

Date	ACA Jumpingpound Creek km 0	ACA Jumpingpound Creek km 30	ACA Jumpingpound Creek km 60	AENV Threepoint Creek
05-Aug-04	22.59	19.08	12.97	21.08
06-Aug-04	20.60	17.32	12.00	18.96
07-Aug-04	17.84	15.13	11.47	16.49
08-Aug-04	16.32	13.52	10.05	13.38
09-Aug-04	14.29	12.29	9.73	12.64
10-Aug-04	17.96	15.87	12.49	17.04
11-Aug-04	19.48	17.27	13.16	18.27
12-Aug-04	20.94	18.39	13.69	19.23
13-Aug-04	22.06	19.13	13.83	19.83
14-Aug-04	21.56	19.32	13.55	19.71
15-Aug-04	21.20	18.03	12.94	19.25
16-Aug-04	20.10	16.75	12.92	18.26
17-Aug-04	20.20	17.37	13.04	17.31
18-Aug-04	19.70	17.11	13.31	16.23
19-Aug-04	17.72	15.94	12.20	14.37
20-Aug-04	17.46	14.96	11.27	14.57
21-Aug-04	17.13	15.61	11.95	14.80
22-Aug-04	15.10	13.28	9.41	13.00
23-Aug-04	12.20	11.49	9.36	11.18
24-Aug-04	13.64	12.65	9.90	11.72
25-Aug-04	12.46	11.42	8.67	10.86
26-Aug-04	14.10	12.65	10.05	10.39
27-Aug-04	15.03	12.90	9.88	10.39
28-Aug-04	15.27	13.19	10.25	10.39
29-Aug-04	15.77	13.55	10.54	10.39
30-Aug-04	16.39	14.07	10.93	14.39
31-Aug-04	16.80	14.17	11.71	13.99
01-Sep-04	14.75	12.41	10.00	12.74
02-Sep-04	12.85	11.78	9.24	11.80
03-Sep-04	12.58	11.59	9.56	12.12
04-Sep-04	11.81	10.71	9.63	11.57
05-Sep-04	12.22	11.78	10.12	11.47
06-Sep-04	12.63	10.79	8.79	10.81
07-Sep-04	14.19	12.70	10.22	12.30
08-Sep-04	14.17	12.29	9.95	12.32
09-Sep-04	12.39	10.91	8.59	11.49
10-Sep-04	9.41	8.82	7.82	9.02

Date	ACA Jumpingpound Creek km 0	ACA Jumpingpound Creek km 30	ACA Jumpingpound Creek km 60	AENV Threepoint Creek
11-Sep-04	13.52	12.49	10.42	12.60
12-Sep-04	13.28	11.95	9.24	12.12
13-Sep-04	13.91	10.44	8.20	12.48
14-Sep-04	13.67	Data NA	Data NA	11.13
15-Sep-04	11.22	Data NA	Data NA	10.47
16-Sep-04	10.12	Data NA	Data NA	9.26
17-Sep-04	11.88	Data NA	Data NA	11.03
18-Sep-04	10.00	Data NA	Data NA	10.03
19-Sep-04	9.19	Data NA	Data NA	8.58
20-Sep-04	8.10	Data NA	Data NA	8.02
21-Sep-04	10.49	Data NA	Data NA	9.82
22-Sep-04	12.94	Data NA	Data NA	11.76
23-Sep-04	10.35	Data NA	Data NA	10.52

7.10 APPENDIX 10. DAILY MAXIMUM STREAM TEMPERATURES (°C) RECORDED FROM JULY TO SEPTEMBER, 2004 IN THE THREEPOINT CREEK AT ALBERTA CONSERVATION ASSOCIATION (ACA) STREAM TEMPERATURE MONITORING SITES AND AT ALBERTA ENVIRONMENT (AENV) REAL-TIME STREAM TEMPERATURE-MONITORING STATION ON THREEPOINT CREEK NEAR THE TOWN OF MILLARVILLE.

Date	ACA Threepoint Creek km 0	ACA Threepoint Creek km 30	ACA Threepoint Creek km 60	AENV Threepoint Creek
15-Jul-04		18.25	17.25	Data NA
16-Jul-04	22.85	19.41	17.72	Data NA
17-Jul-04	24.53	20.89	19.48	Data NA
18-Jul-04	25.36	21.56	19.70	Data NA
19-Jul-04	24.65	20.89	16.73	Data NA
20-Jul-04	21.37	17.77	15.53	Data NA
21-Jul-04	19.98	15.94	12.78	Data NA
22-Jul-04	19.87	17.63	14.53	Data NA
23-Jul-04	22.49	20.51	17.99	Data NA
24-Jul-04	24.39	21.34	19.41	Data NA
25-Jul-04	25.65	21.39	18.32	Data NA
26-Jul-04	21.29	17.32	13.93	Data NA
27-Jul-04	20.08	16.94	14.72	Data NA
28-Jul-04	23.16	20.08	18.13	Data NA
29-Jul-04	24.70	21.03	18.27	Data NA
30-Jul-04	24.51	21.49	17.61	21.60
31-Jul-04	21.77	18.94	16.58	19.43
01-Aug-04	18.13	15.75	12.94	16.68
02-Aug-04	21.60	19.32	19.15	19.31
03-Aug-04	21.84	18.99	17.61	19.88
04-Aug-04	23.59	21.65	17.68	20.04
05-Aug-04	23.79	20.56	18.15	21.08
06-Aug-04	22.35	18.84	16.53	18.96
07-Aug-04	18.15	14.94	12.00	16.49
08-Aug-04	14.22	12.53	10.27	13.38
09-Aug-04	13.16	11.52	9.58	12.64
10-Aug-04	18.75	17.11	14.84	17.04
11-Aug-04	20.96	18.39	16.25	18.27
12-Aug-04	22.20	19.51	17.03	19.23
13-Aug-04	23.55	20.15	17.46	19.83

Date	ACA Threepoint Creek km 0	ACA Threepoint Creek km 30	ACA Threepoint Creek km 60	AENV Threepoint Creek
14-Aug-04	23.40	18.91	16.42	19.71
15-Aug-04	21.46	18.49	14.98	19.25
16-Aug-04	21.10	15.58	14.36	18.26
17-Aug-04	18.63	16.63	14.79	17.31
18-Aug-04	17.01	14.43	11.78	16.23
19-Aug-04	15.27	13.23	10.93	14.37
20-Aug-04	15.10	13.40	10.96	14.57
21-Aug-04	16.13	13.59	11.32	14.80
22-Aug-04	14.07	11.61	9.21	13.00
23-Aug-04	11.22	10.35	8.30	11.18
24-Aug-04	12.20	10.81	8.92	11.72
25-Aug-04	11.54	9.95	8.07	10.86
26-Aug-04	12.07	11.30	8.54	10.39
27-Aug-04	12.36	11.27	9.36	10.39
28-Aug-04	13.11	11.64	9.58	10.39
29-Aug-04	13.47	12.20	9.93	10.39
30-Aug-04	15.13	13.38	10.71	14.39
31-Aug-04	14.79	13.21	11.03	13.99
01-Sep-04	13.67	11.98	9.66	12.74
02-Sep-04	12.29	10.98	8.72	11.80
03-Sep-04	12.56	11.20	8.99	12.12
04-Sep-04	11.93	10.91	9.06	11.57
05-Sep-04	12.99	11.10	8.92	11.47
06-Sep-04	11.66	9.73	8.02	10.81
07-Sep-04	13.64	11.61	9.09	12.30
08-Sep-04	13.28	10.96	9.24	12.32
09-Sep-04	11.69	10.35	8.82	11.49
10-Sep-04	9.58	8.47	7.12	9.02
11-Sep-04	13.93	12.17	9.85	12.60
12-Sep-04	13.81	11.49	8.32	12.12
13-Sep-04	14.48	11.20	8.64	12.48
14-Sep-04	13.21	10.17	7.80	11.13
15-Sep-04	12.24	9.49	7.02	10.47
16-Sep-04	10.37	9.21	6.91	9.26
17-Sep-04	12.94	11.20	7.80	11.03
18-Sep-04	10.57	9.09	6.86	10.03
19-Sep-04	10.12	7.57	5.87	8.58
20-Sep-04	9.39	7.24	5.51	8.02

Date	ACA Threepoint Creek km 0	ACA Threepoint Creek km 30	ACA Threepoint Creek km 60	AENV Threepoint Creek
21-Sep-04	9.09	6.20	4.84	9.82

7.11 APPENDIX 11. DAILY MAXIMUM STREAM TEMPERATURES (°C) RECORDED FROM JULY TO SEPTEMBER, 2004 IN THE SHEEP RIVER AT ALBERTA CONSERVATION ASSOCIATION (ACA) STREAM TEMPERATURE MONITORING SITES AND AT ALBERTA ENVIRONMENT (AENV) REAL-TIME STREAM TEMPERATURE-MONITORING STATION ON THE HIGHWOOD RIVER NEAR THE TOWN OF ALDERSYDE.

Date	ACA Sheep River km 0	ACA Sheep River km 30	ACA Sheep River km 60	AENV Highwood River
15-Jul-04	21.70	19.87		21.28
16-Jul-04	22.63	21.13	16.39	22.43
17-Jul-04	23.40	22.25	16.89	24.16
18-Jul-04	23.81	22.94	16.34	24.53
19-Jul-04	23.86	22.25	16.96	24.63
20-Jul-04	20.60	18.91	13.98	21.96
21-Jul-04	20.15	17.58	12.24	19.98
22-Jul-04	19.29	17.87	13.35	19.43
23-Jul-04	21.15	20.60	16.01	20.10
24-Jul-04	22.39	21.82	17.08	21.83
25-Jul-04	23.35	22.73	16.58	22.92
26-Jul-04	21.06	18.87	14.46	21.56
27-Jul-04	18.91	17.68	13.31	19.19
28-Jul-04	21.13	20.37	16.15	20.03
29-Jul-04	23.47	22.01	17.30	22.41
30-Jul-04	22.94	22.27	16.75	22.77
31-Jul-04	21.39	19.89	16.20	22.14
1-Aug-04	18.32	17.20	13.98	20.13
2-Aug-04	21.32	19.20	15.06	19.61
3-Aug-04	20.56	19.75	16.01	20.30
4-Aug-04	22.54	21.22	17.08	22.03
5-Aug-04	23.28	21.46	17.20	22.57
6-Aug-04	21.25	20.06	14.82	21.26
7-Aug-04	17.84	16.82	12.58	18.92
8-Aug-04	14.48	13.23	10.35	15.64
9-Aug-04	13.47	12.10	9.46	14.02
10-Aug-04	17.27	16.96	13.28	16.79
11-Aug-04	19.32	18.53	14.34	19.76
12-Aug-04	20.32	19.72	15.15	21.16
13-Aug-04	21.29	20.77	15.89	22.41
14-Aug-04	21.70	20.65	14.70	22.62
15-Aug-04	20.77	19.46	15.32	22.53

Date	ACA Sheep River km 0	ACA Sheep River km 30	ACA Sheep River km 60	AENV Highwood River
16-Aug-04	20.94	18.11	13.76	22.21
17-Aug-04	17.99	16.77	13.14	22.26
18-Aug-04	16.61	15.68	12.73	20.97
19-Aug-04	15.63	14.58	11.01	18.88
20-Aug-04	15.41	14.29	11.25	18.09
21-Aug-04	16.37	15.15	11.30	18.16
22-Aug-04	14.00	12.49	10.00	16.14
23-Aug-04	10.79	10.22	8.20	12.72
24-Aug-04	11.81	10.98	9.31	12.81
25-Aug-04	11.10	10.30	8.10	12.80
26-Aug-04	12.03	11.10	8.74	12.53
27-Aug-04	11.61	11.05	9.44	12.53
28-Aug-04	12.46	11.69	9.56	13.33
29-Aug-04	13.67	12.78	10.17	14.12
30-Aug-04	14.51	13.62	10.69	14.69
31-Aug-04	13.69	13.14	10.64	14.68
1-Sep-04	13.28	12.00	9.66	13.82
2-Sep-04	12.10	11.30	8.92	13.06
3-Sep-04	12.41	11.32	8.89	12.60
4-Sep-04	11.54	10.74	8.67	11.99
5-Sep-04	12.32	11.54	8.97	11.49
6-Sep-04	11.81	10.59	8.37	12.05
7-Sep-04	12.61	12.07	9.14	11.86
8-Sep-04	12.65	11.76	8.84	12.42
9-Sep-04	11.64	10.20	8.57	11.37
10-Sep-04	9.14	8.62	6.97	9.25
11-Sep-04	13.14	13.06	9.76	11.47
12-Sep-04	12.44	12.12	8.54	12.54
13-Sep-04	13.43	12.90	8.47	13.11
14-Sep-04	12.58	11.44	7.27	12.64
15-Sep-04	11.22	10.79	7.17	11.46
16-Sep-04	9.78	8.99	6.74	9.71
17-Sep-04	Data NA	Data NA	8.00	Data NA
18-Sep-04	Data NA	Data NA	6.94	Data NA
19-Sep-04	Data NA	Data NA	5.90	Data NA
20-Sep-04	Data NA	Data NA	5.64	Data NA
21-Sep-04	Data NA	Data NA	6.91	Data NA
22-Sep-04	Data NA	Data NA	8.30	Data NA
23-Sep-04	Data NA	Data NA	7.52	Data NA
24-Sep-04	Data NA	Data NA	7.90	Data NA
25-Sep-04	Data NA	Data NA	8.89	Data NA

Date	ACA Sheep River km 0	ACA Sheep River km 30	ACA Sheep River km 60	AENV Highwood River
26-Sep-04	Data NA	Data NA	8.54	Data NA
27-Sep-04	Data NA	Data NA	8.05	Data NA

7.12 APPENDIX 12. DAILY MAXIMUM STREAM TEMPERATURES (°C) RECORDED FROM JULY TO SEPTEMBER, 2004 IN THE HIGHWOOD RIVER AT ALBERTA CONSERVATION ASSOCIATION (ACA) STREAM TEMPERATURE MONITORING SITES AND AT ALBERTA ENVIRONMENT (AENV) REAL-TIME STREAM TEMPERATURE-MONITORING STATION ON THE HIGHWOOD RIVER NEAR THE TOWN OF ALDERSYDE.

Date	ACA Highwood River km 0	ACA Highwood River km 30	ACA Highwood River km 60	ACA Highwood River km 90	ACA Highwood River km 120	ACA Highwood River km 150	AENV Highwood River
16-Jul-04	Data NA	Data NA	Data NA	17.70	14.77	13.50	22.43
17-Jul-04	25.43	23.11	22.20	18.08	15.44	14.00	24.16
18-Jul-04	26.13	23.52	22.66	18.91	15.70	13.76	24.53
19-Jul-04	25.50	23.67	22.13	18.34	15.41	13.38	24.63
20-Jul-04	23.04	21.37	19.39	16.20	12.99	11.15	21.96
21-Jul-04	22.06	18.87	17.42	13.93	13.86	12.53	19.98
22-Jul-04	21.51	18.30	18.41	14.96	13.14	11.13	19.43
23-Jul-04	22.61	20.25	20.27	16.56	14.91	13.79	20.10
24-Jul-04	23.28	21.06	21.56	17.63	15.46	14.22	21.83
25-Jul-04	24.75	22.51	22.37	18.25	15.29	13.93	22.92
26-Jul-04	21.94	21.46	20.10	16.68	13.47	12.05	21.56
27-Jul-04	20.10	19.15	18.60	15.03	12.58	11.27	19.19
28-Jul-04	22.08	19.70	20.22	16.89	14.27	11.47	20.03
29-Jul-04	23.69	21.70	22.37	18.13	14.84	12.61	22.41
30-Jul-04	23.76	22.35	22.32	18.51	15.61	13.95	22.77
31-Jul-04	22.42	21.63	21.34	17.20	14.60	13.95	22.14
1-Aug-04	19.91	20.10	18.56	15.77	12.36	10.66	20.13
2-Aug-04	22.18	19.51	19.18	16.46	14.96	14.94	19.61
3-Aug-04	21.99	19.63	19.75	17.23	13.28	11.15	20.30
4-Aug-04	22.94	21.34	21.20	17.25	16.01	14.82	22.03
5-Aug-04	23.86	21.84	21.70	17.82	15.01	13.47	22.57
6-Aug-04	22.47	20.63	19.34	15.53	13.19	12.17	21.26
7-Aug-04	19.63	18.68	16.89	13.86	10.64	10.32	18.92
8-Aug-04	16.44	15.44	14.03	11.66	11.20	10.98	15.64
9-Aug-04	14.48	13.91	13.16	11.10	10.30	10.35	14.02
10-Aug-04	18.11	16.42	17.89	15.32	14.86	12.87	16.79
11-Aug-04	20.46	19.08	19.89	16.25	15.20	13.31	19.76

Date	ACA Highwood River km 0	ACA Highwood River km 30	ACA Highwood River km 60	ACA Highwood River km 90	ACA Highwood River km 120	ACA Highwood River km 150	AENV Highwood River
12-Aug-04	21.70	20.39	20.87	17.03	15.77	14.63	21.16
13-Aug-04	22.63	21.53	21.82	17.72	16.01	14.36	22.41
14-Aug-04	23.28	21.87	21.22	17.25	16.51	14.72	22.62
15-Aug-04	22.37	21.22	20.82	17.68	15.58	14.51	22.53
16-Aug-04	23.02	21.51	21.49	17.94	15.84	14.60	22.21
17-Aug-04	20.39	21.34	20.89	16.84	14.94	13.33	22.26
18-Aug-04	18.79	20.03	19.25	16.06	14.27	12.85	20.97
19-Aug-04	17.80	19.06	17.96	14.91	12.27	10.81	18.88
20-Aug-04	17.18	17.53	16.75	13.86	12.32	11.71	18.09
21-Aug-04	17.82	17.70	17.92	14.31	13.81	13.09	18.16
22-Aug-04	15.61	16.42	14.48	12.87	11.08	9.21	16.14
23-Aug-04	11.90	12.58	11.54	10.17	9.71	9.29	12.72
24-Aug-04	12.90	12.92	12.22	10.59	10.15	8.84	12.81
25-Aug-04	12.00	12.73	11.22	10.47	9.11	7.42	12.80
26-Aug-04	12.75	12.44	11.93	10.69	9.44	8.25	12.53
27-Aug-04	12.32	12.75	12.27	11.69	10.42	8.52	12.53
28-Aug-04	13.31	13.28	13.21	11.57	11.35	9.36	13.33
29-Aug-04	14.17	14.22	14.03	11.76	11.27	8.49	14.12
30-Aug-04	15.51	14.96	14.91	12.87	12.00	9.61	14.69
31-Aug-04	14.89	14.79	14.00	12.10	12.12	10.96	14.68
1-Sep-04	14.39	13.83	13.16	12.07	10.10	9.36	13.82
2-Sep-04	13.67	13.11	12.90	10.59	9.61	7.44	13.06
3-Sep-04	12.92	12.29	12.05	10.25	9.61	7.77	12.60
4-Sep-04	12.53	12.07	11.37	9.73	9.49	7.95	11.99
5-Sep-04	12.78	11.20	12.20	9.78	10.35	8.42	11.49
6-Sep-04	12.70	11.57	11.44	9.88	8.05	7.04	12.05
7-Sep-04	13.06	11.61	12.15	10.05	10.03	8.54	11.86
8-Sep-04	13.31	11.93	12.05	10.08	10.03	8.07	12.42
9-Sep-04	12.12	11.71	10.66	9.93	8.52	8.49	11.37
10-Sep-04	9.73	9.31	8.94	7.92	8.32	8.17	9.25
11-Sep-04	12.68	11.47	13.23	10.96	10.71	8.02	11.47
12-Sep-04	13.11	12.75	13.11	10.17	9.56	8.89	12.54
13-Sep-04	14.43	12.80	12.46	9.98	8.74	6.81	13.11
14-Sep-04	13.88	11.93	11.39	8.89	9.24	7.62	12.64
15-Sep-04	12.46	11.08	10.81	8.57	7.97	6.33	11.46
16-Sep-04	10.57	10.03	8.64	7.57	7.70	5.95	9.71

Date	ACA Highwood River km 0	ACA Highwood River km 30	ACA Highwood River km 60	ACA Highwood River km 90	ACA Highwood River km 120	ACA Highwood River km 150	AENV Highwood River
17-Sep-04	11.76	10.30	11.03	9.06	8.42	7.54	Data NA
18-Sep-04	10.64	9.93	9.11	8.54	7.17	5.87	Data NA
19-Sep-04	9.88	8.69	8.07	6.71	7.34	5.85	Data NA
20-Sep-04	8.74	7.90	7.59	7.34	7.09	6.33	Data NA
21-Sep-04	10.64	8.79	10.30	7.75	7.90	7.04	Data NA
22-Sep-04	12.80	11.49	11.88	9.51	9.24	8.07	Data NA
23-Sep-04	12.58	11.30	11.66	8.34	8.49	6.48	Data NA
24-Sep-04	13.31	11.93	12.07	8.89	9.19	8.00	Data NA
25-Sep-04	13.67	12.49	13.04	10.47	9.85	8.37	Data NA
26-Sep-04	12.92	12.20	11.54	9.58	9.41	7.44	Data NA
27-Sep-04	13.83	12.20	11.42	10.00	10.03	8.59	Data NA
28-Sep-04	13.59	Data NA	Data NA	9.56	8.27	5.85	Data NA

7.13 APPENDIX 13. DAILY MAXIMUM STREAM TEMPERATURES (°C) RECORDED FROM JULY TO SEPTEMBER, 2004 IN PEKISKO AND STIMSON CREEKS AT ALBERTA CONSERVATION ASSOCIATION (ACA) STREAM TEMPERATURE MONITORING SITES AND AT ALBERTA ENVIRONMENT (AENV) REAL-TIME STREAM TEMPERATURE-MONITORING STATION ON THE PEKISKO NEAR THE TOWN OF LONGVIEW.

Date	ACA Highwood River km 0	ACA Highwood River km 30	ACA Highwood River km 60	ACA Highwood River km 90	ACA Highwood River km 120	ACA Highwood River km 150	AENV Highwood River
16-Jul-04	Data NA	Data NA	Data NA	17.70	14.77	13.50	22.43
17-Jul-04	25.43	23.11	22.20	18.08	15.44	14.00	24.16
18-Jul-04	26.13	23.52	22.66	18.91	15.70	13.76	24.53
19-Jul-04	25.50	23.67	22.13	18.34	15.41	13.38	24.63
20-Jul-04	23.04	21.37	19.39	16.20	12.99	11.15	21.96
21-Jul-04	22.06	18.87	17.42	13.93	13.86	12.53	19.98
22-Jul-04	21.51	18.30	18.41	14.96	13.14	11.13	19.43
23-Jul-04	22.61	20.25	20.27	16.56	14.91	13.79	20.10
24-Jul-04	23.28	21.06	21.56	17.63	15.46	14.22	21.83
25-Jul-04	24.75	22.51	22.37	18.25	15.29	13.93	22.92
26-Jul-04	21.94	21.46	20.10	16.68	13.47	12.05	21.56
27-Jul-04	20.10	19.15	18.60	15.03	12.58	11.27	19.19
28-Jul-04	22.08	19.70	20.22	16.89	14.27	11.47	20.03
29-Jul-04	23.69	21.70	22.37	18.13	14.84	12.61	22.41
30-Jul-04	23.76	22.35	22.32	18.51	15.61	13.95	22.77
31-Jul-04	22.42	21.63	21.34	17.20	14.60	13.95	22.14
01-Aug-04	19.91	20.10	18.56	15.77	12.36	10.66	20.13
02-Aug-04	22.18	19.51	19.18	16.46	14.96	14.94	19.61
03-Aug-04	21.99	19.63	19.75	17.23	13.28	11.15	20.30
04-Aug-04	22.94	21.34	21.20	17.25	16.01	14.82	22.03
05-Aug-04	23.86	21.84	21.70	17.82	15.01	13.47	22.57
06-Aug-04	22.47	20.63	19.34	15.53	13.19	12.17	21.26
07-Aug-04	19.63	18.68	16.89	13.86	10.64	10.32	18.92
08-Aug-04	16.44	15.44	14.03	11.66	11.20	10.98	15.64
09-Aug-04	14.48	13.91	13.16	11.10	10.30	10.35	14.02
10-Aug-04	18.11	16.42	17.89	15.32	14.86	12.87	16.79
11-Aug-04	20.46	19.08	19.89	16.25	15.20	13.31	19.76
12-Aug-04	21.70	20.39	20.87	17.03	15.77	14.63	21.16
13-Aug-04	22.63	21.53	21.82	17.72	16.01	14.36	22.41
14-Aug-04	23.28	21.87	21.22	17.25	16.51	14.72	22.62

Date	ACA Highwood River km 0	ACA Highwood River km 30	ACA Highwood River km 60	ACA Highwood River km 90	ACA Highwood River km 120	ACA Highwood River km 150	AENV Highwood River
15-Aug-04	22.37	21.22	20.82	17.68	15.58	14.51	22.53
16-Aug-04	23.02	21.51	21.49	17.94	15.84	14.60	22.21
17-Aug-04	20.39	21.34	20.89	16.84	14.94	13.33	22.26
18-Aug-04	18.79	20.03	19.25	16.06	14.27	12.85	20.97
19-Aug-04	17.80	19.06	17.96	14.91	12.27	10.81	18.88
20-Aug-04	17.18	17.53	16.75	13.86	12.32	11.71	18.09
21-Aug-04	17.82	17.70	17.92	14.31	13.81	13.09	18.16
22-Aug-04	15.61	16.42	14.48	12.87	11.08	9.21	16.14
23-Aug-04	11.90	12.58	11.54	10.17	9.71	9.29	12.72
24-Aug-04	12.90	12.92	12.22	10.59	10.15	8.84	12.81
25-Aug-04	12.00	12.73	11.22	10.47	9.11	7.42	12.80
26-Aug-04	12.75	12.44	11.93	10.69	9.44	8.25	12.53
27-Aug-04	12.32	12.75	12.27	11.69	10.42	8.52	12.53
28-Aug-04	13.31	13.28	13.21	11.57	11.35	9.36	13.33
29-Aug-04	14.17	14.22	14.03	11.76	11.27	8.49	14.12
30-Aug-04	15.51	14.96	14.91	12.87	12.00	9.61	14.69
31-Aug-04	14.89	14.79	14.00	12.10	12.12	10.96	14.68
01-Sep-04	14.39	13.83	13.16	12.07	10.10	9.36	13.82
02-Sep-04	13.67	13.11	12.90	10.59	9.61	7.44	13.06
03-Sep-04	12.92	12.29	12.05	10.25	9.61	7.77	12.60
04-Sep-04	12.53	12.07	11.37	9.73	9.49	7.95	11.99
05-Sep-04	12.78	11.20	12.20	9.78	10.35	8.42	11.49
06-Sep-04	12.70	11.57	11.44	9.88	8.05	7.04	12.05
07-Sep-04	13.06	11.61	12.15	10.05	10.03	8.54	11.86
08-Sep-04	13.31	11.93	12.05	10.08	10.03	8.07	12.42
09-Sep-04	12.12	11.71	10.66	9.93	8.52	8.49	11.37
10-Sep-04	9.73	9.31	8.94	7.92	8.32	8.17	9.25
11-Sep-04	12.68	11.47	13.23	10.96	10.71	8.02	11.47
12-Sep-04	13.11	12.75	13.11	10.17	9.56	8.89	12.54
13-Sep-04	14.43	12.80	12.46	9.98	8.74	6.81	13.11
14-Sep-04	13.88	11.93	11.39	8.89	9.24	7.62	12.64
15-Sep-04	12.46	11.08	10.81	8.57	7.97	6.33	11.46
16-Sep-04	10.57	10.03	8.64	7.57	7.70	5.95	9.71
17-Sep-04	11.76	10.30	11.03	9.06	8.42	7.54	Data NA
18-Sep-04	10.64	9.93	9.11	8.54	7.17	5.87	Data NA
19-Sep-04	9.88	8.69	8.07	6.71	7.34	5.85	Data NA
20-Sep-04	8.74	7.90	7.59	7.34	7.09	6.33	Data NA
21-Sep-04	10.64	8.79	10.30	7.75	7.90	7.04	Data NA
22-Sep-04	12.80	11.49	11.88	9.51	9.24	8.07	Data NA

Date	ACA Highwood River km 0	ACA Highwood River km 30	ACA Highwood River km 60	ACA Highwood River km 90	ACA Highwood River km 120	ACA Highwood River km 150	AENV Highwood River
23-Sep-04	12.58	11.30	11.66	8.34	8.49	6.48	Data NA
24-Sep-04	13.31	11.93	12.07	8.89	9.19	8.00	Data NA
25-Sep-04	13.67	12.49	13.04	10.47	9.85	8.37	Data NA
26-Sep-04	12.92	12.20	11.54	9.58	9.41	7.44	Data NA
27-Sep-04	13.83	12.20	11.42	10.00	10.03	8.59	Data NA
28-Sep-04	13.59	Data NA	Data NA	9.56	8.27	5.85	Data NA