4.0 CLIMATIC AND HYDROLOGIC CHARACTERIZATION OF THE ATHABASCA OIL SANDS REGION IN 2004

A general description of the 2004 climate and hydrology of the oil sands region, and comparison with long-term normals, is presented below to provide a context for the results of the 2004 RAMP monitoring program. The comparison is based on federal and provincial hydrologic monitoring stations because of the long history available at those stations.

Precipitation in the region was well below normal in 2004. Total precipitation during 2004 measured at Fort McMurray Airport over the water year (November 1, 2003 to October 31, 2004) was 298 mm. That total compares to a long-term average of 443 mm, and was the third lowest recorded since 1944, as shown on Figure 4-1. Distribution of the 2004 precipitation through the year is compared to average and extreme historical monthly values in Figure 4-2. Precipitation was well below average in November and December, above average in January, and near average during the remainder of the winter. Precipitation in May was well above average, and was concentrated toward the end of the month, resulting in brief high runoff in regional streams. The summer was very dry, but September precipitation was close to normal.

The annual runoff and maximum daily discharges observed at four selected regional Water Survery of Canada (WSC) streamflow stations are compared with historical values in Table 4-1.

Figure 4-1 Historical annual precipitation at Fort McMurray.

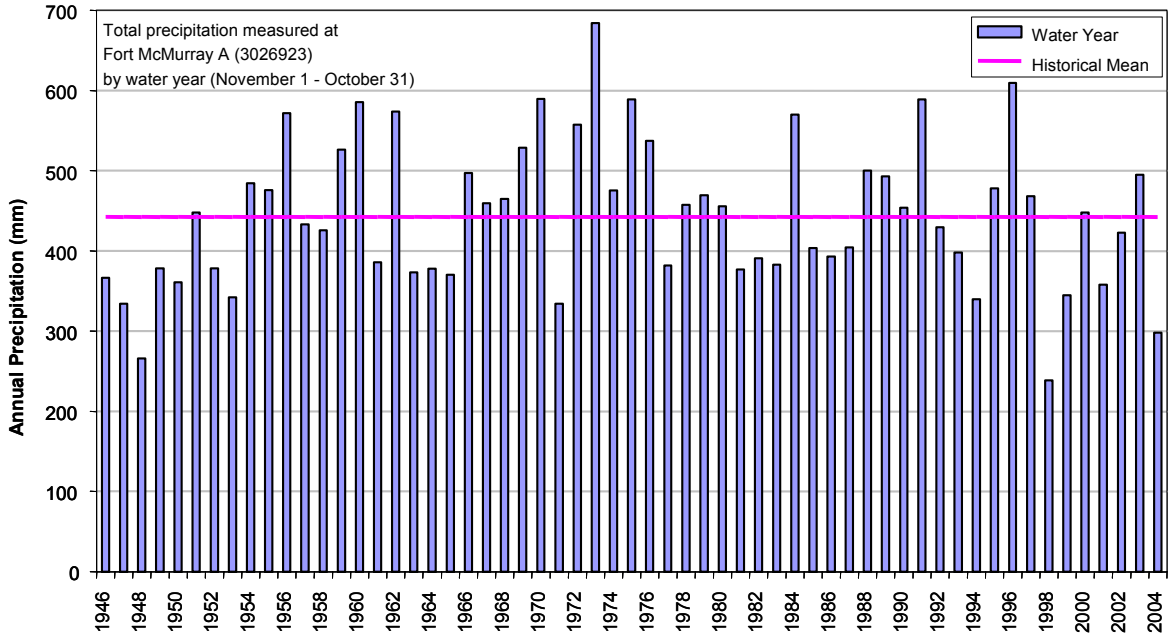

Figure 4-2 Monthly precipitation at Fort McMurray in 2004.

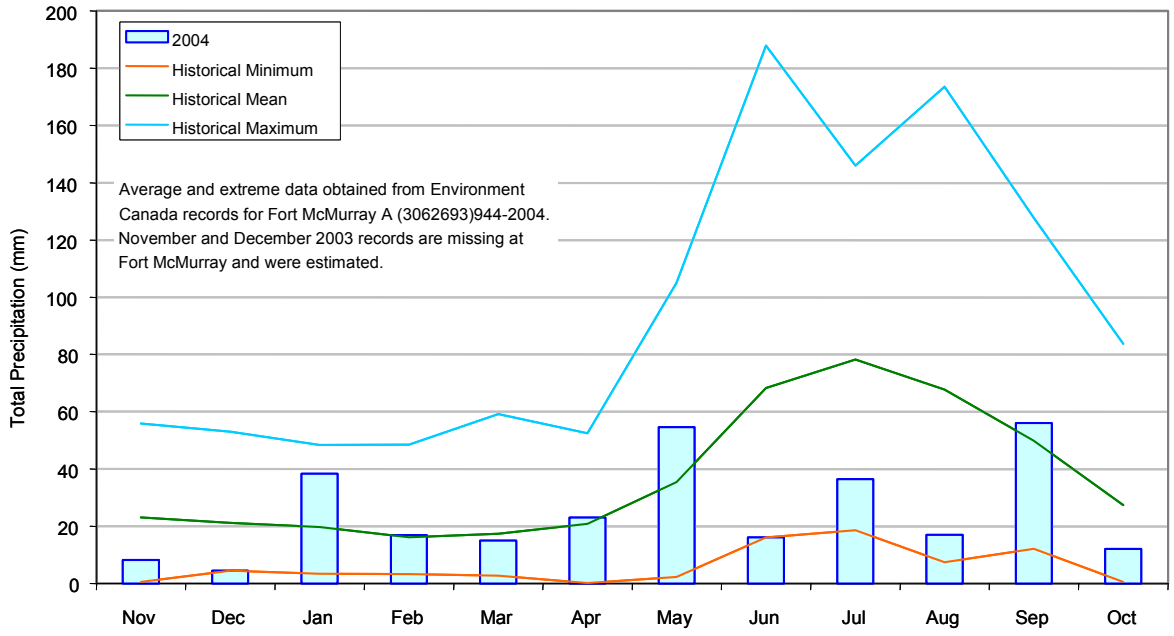

Table 4-1 2004 streamflow compared to historical values.

	Athabasca River below McMurray (07DA001)	Muskeg River near Fort McKay (07DA008)	Christina River near Chard (07CE002)	MacKay River near Fort McKay (07DB001)
Effective Drainage Area (km^2)	131,000	1,460	4,851	5,570
Period of Record	1957 - 2004	1974 - 2004	1982 - 2004	1972 - 2004
Annual Runoff Depth				
Historical mean (mm)	151	80.9[1]	79.0[1]	76.6[1]
2004 (mm)	136	52.1[1]	96.1[1]	29.3[1]
Annual Maximum Daily Discharge				
Historical mean (m^3/s)	2,490	25.7	75.9	126
2004 (m^3/s)	1,960	20.5	81.8	44.9

[1] Based on March 1 - October 31 volumes.

Flows in the Athabasca River measured at WSC station 07DA001 (Athabasca River below McMurray) were slightly below normal, with a total annual volume of 90% of the long-term average (Figure 4-3). In the past decade, only two years—1996 and 1997—have been above the long-term average.

Discharges in winter were very close to historical mean values, and in summer fluctuated between slightly above and well below the long-term average, as shown on Figure 4-4. The maximum daily discharge of 1,960 m^3/s was well below the mean annual flood (the mean of the series of annual maximum daily discharges) of 2,490 m^3/s.

In the Muskeg River basin, total runoff in 2004 was well below normal, at only 64% of the long-term average (Figure 4-5). However, more severe droughts have occurred seven times over the past thirty years. Discharges were close to normal in spring, peaked early in June in response to rainfall, then subsided to near record low levels for the rest of the summer and fall (Figure 4-6). The June peak was 20% less than the mean annual flood.

West of the Athabasca River, the MacKay River basin was even drier than the Muskeg basin. Runoff volume in the MacKay River basin was only 38% of normal, as shown in Figure 4-7. Rainfall at the end of May and early in June did produce some runoff response in the river, but barely enough to raise the river above its normal discharge for that time of the year. Throughout the summer, the river was nearly dry, with discharges less than 3 m^3/s from early July until mid-September (Figure 4-8). The June peak was only 36% of the mean annual flood.

In contrast, south of Fort McMurray in the Christina River basin, runoff was slightly above average in 2004. Historical annual runoff values are shown in Figure 4-9. The Christina River responded to the same rainstorm that affected the area north of Fort McMurray early in June, producing discharges well above average for the entire month of June, as shown in Figure 4-10. The June peak discharge was slightly greater than the mean annual flood.

In summary, 2004 was below average in terms of precipitation and runoff in the oil sands region north of Fort McMurray. Except for high flows early in June in response to significant widespread rainfall over the region, streamflow was below normal throughout the year, and even the June peak was generally less than the mean annual flood. South of Fort McMurray, in the Christina River basin, runoff was slightly above average. Annual flow in the Athabasca River, although slightly below average, was higher than it has been since 1997.

Figure 4-3 Historical annual runoff in the Athabasca River basin.

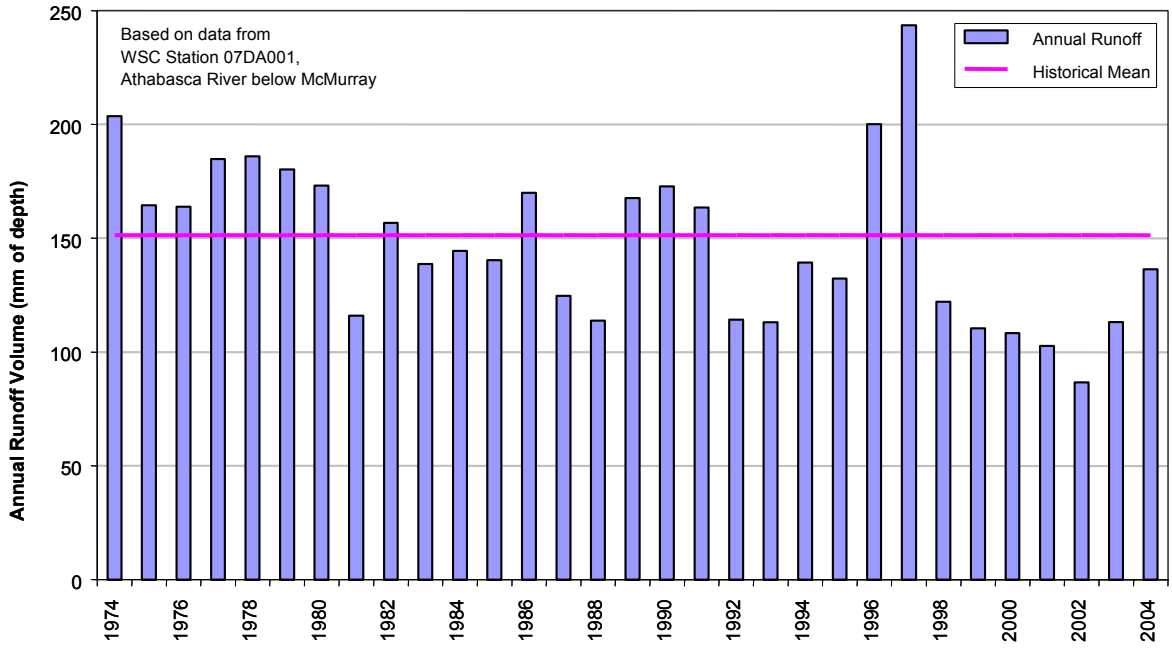

Figure 4-4 2004 hydrograph for the Athabasca River below Fort McMurray (07DA001) compared to historical values.

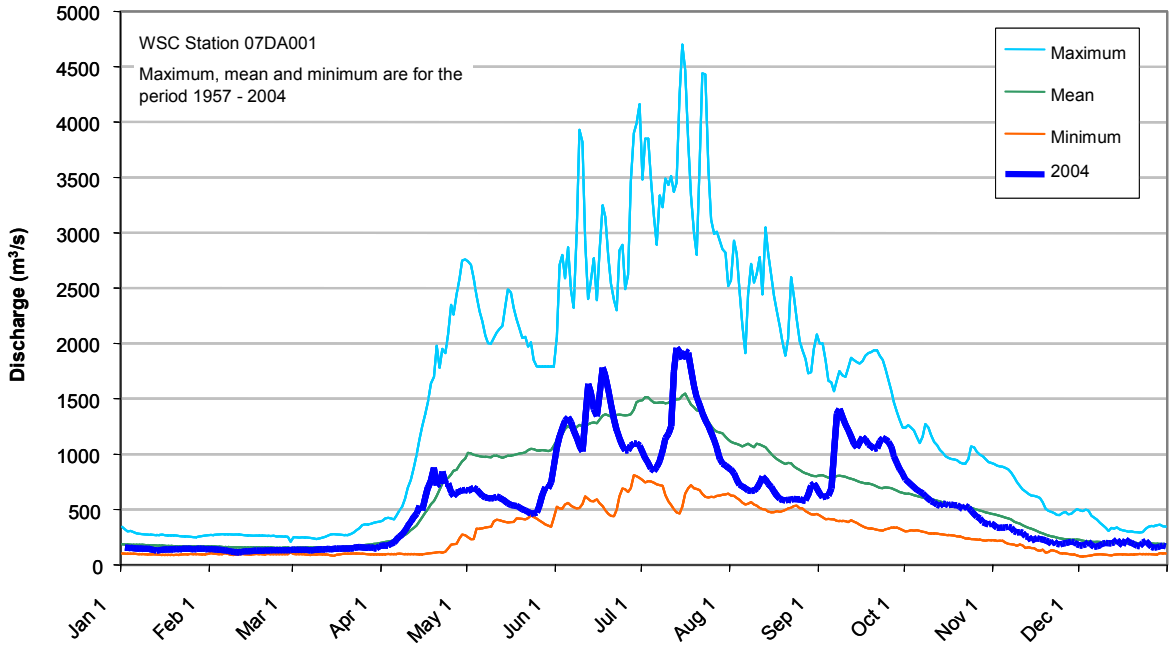

Figure 4-5 Historical annual runoff in the Muskeg River basin.

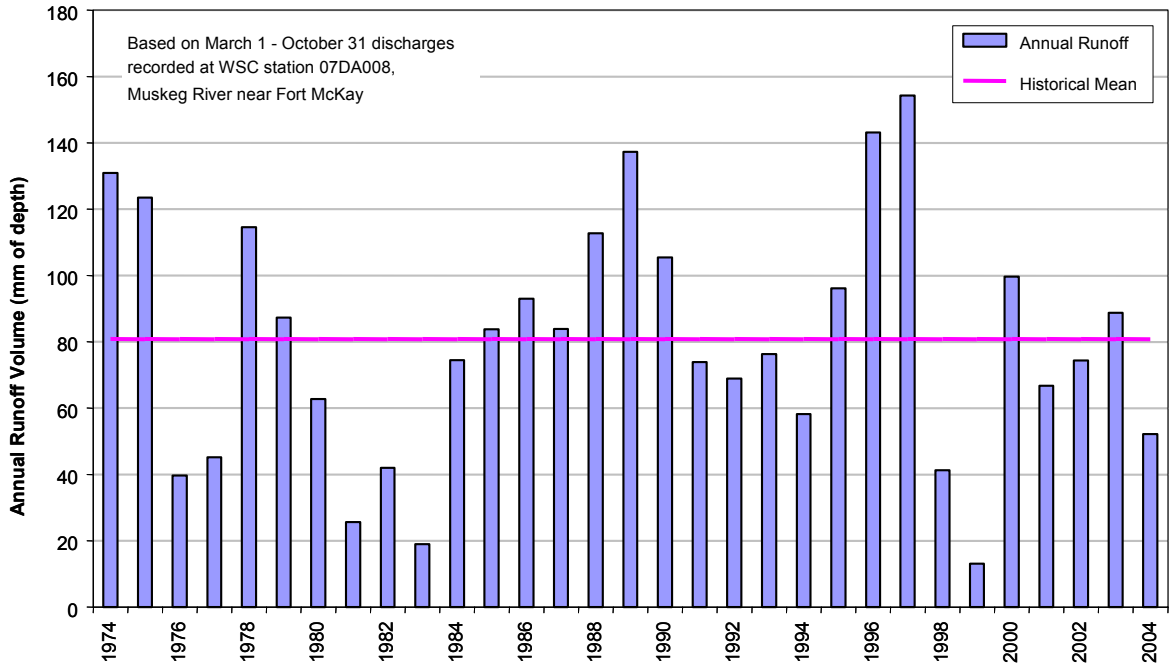

Figure 4-6 2004 discharge hydrograph at S7 - Muskeg River near Fort McKay (07DA008) compared to historical values.

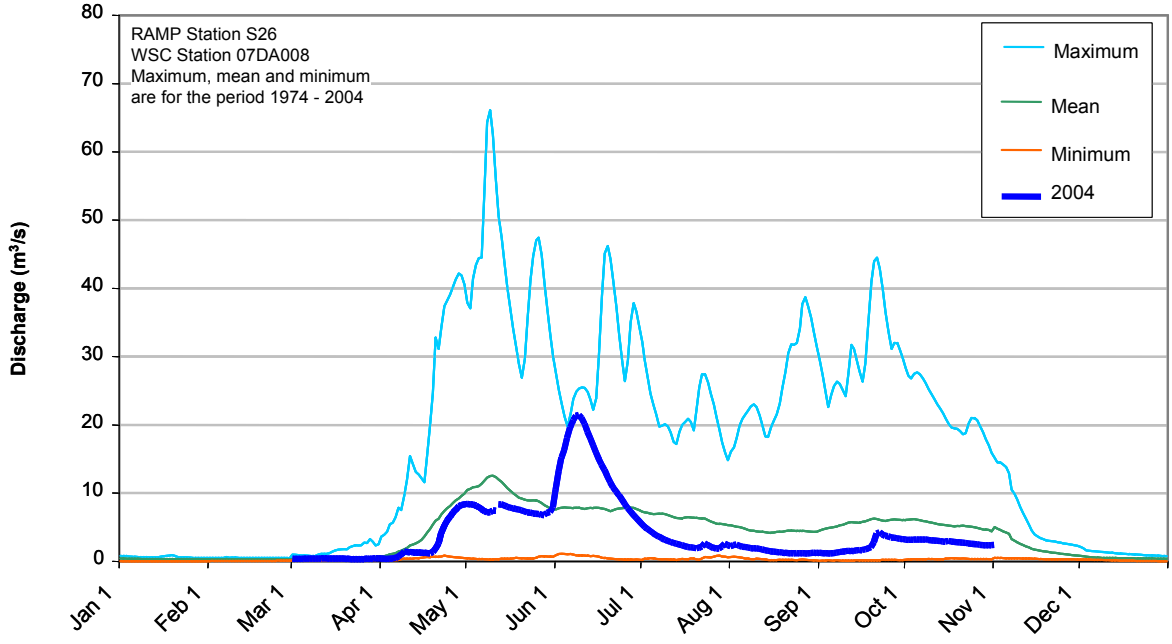

Figure 4-7 Historical annual runoff in the MacKay River basin.

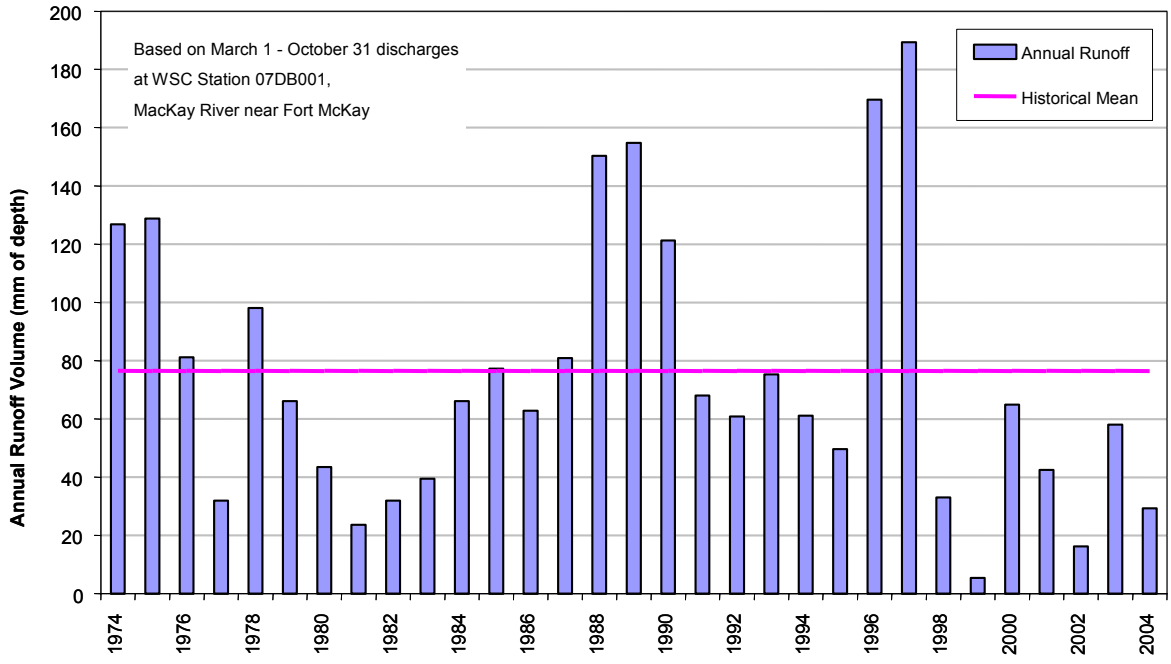

Figure 4-8 2004 discharge hydrograph on the MacKay River near Fort McKay (07DB001) compared to historical values.

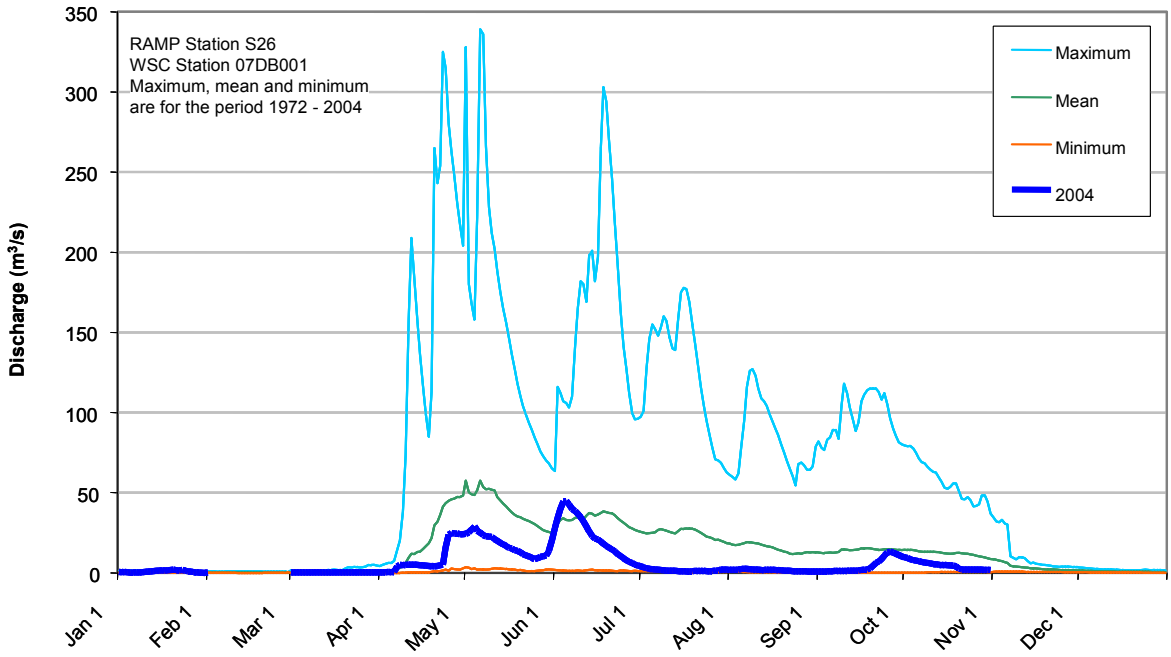

Figure 4-9 Historical annual runoff in the Christina River basin.

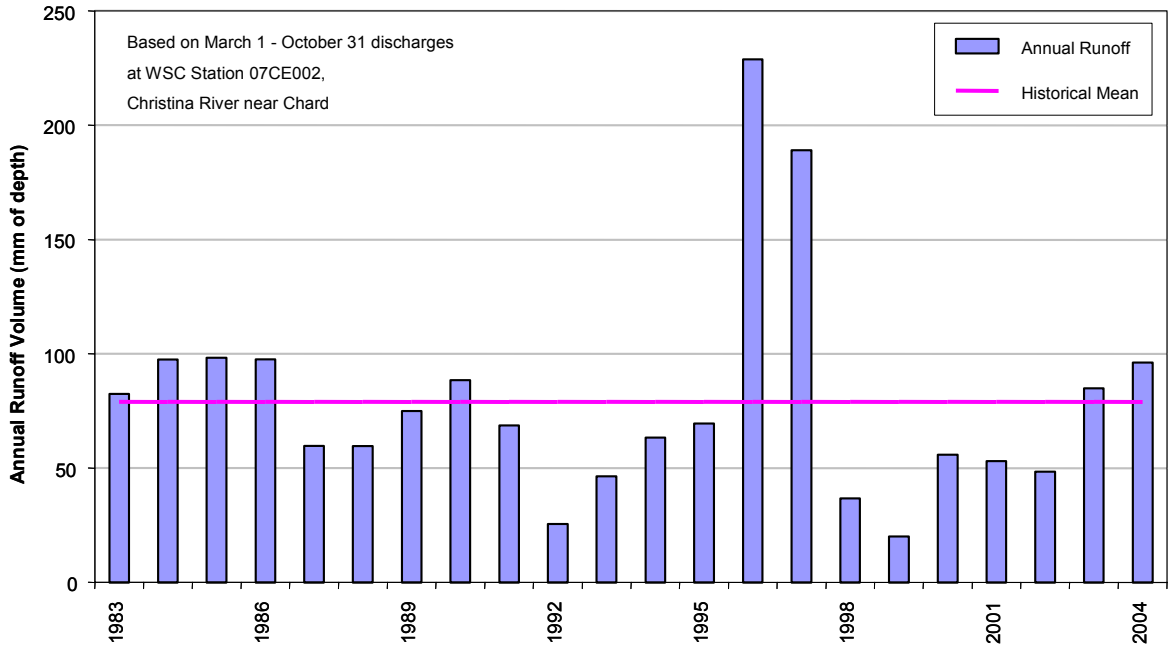
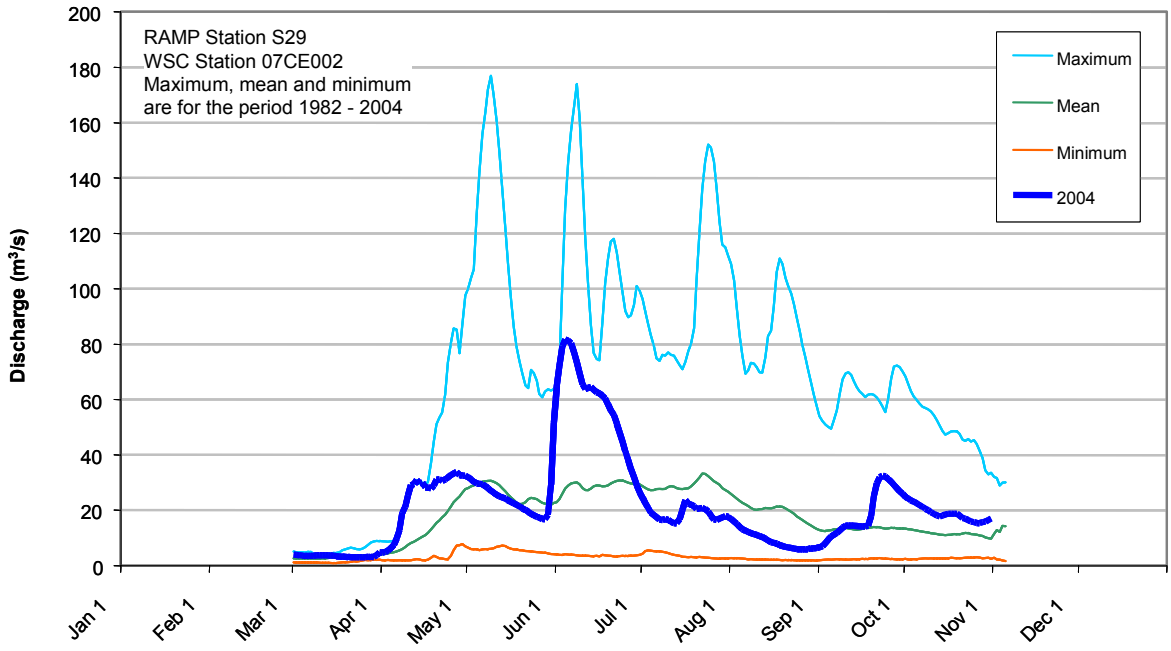
Figure 4-10 2004 discharge hydrograph on the Christina River near Chard (07CE002) compared to historical values.