## Memorandum

June 6, 2013

From: Richard R. Luckey, High Plains Hydrology, LLC

To: Thad Kuntz, Adaptive Resources, Inc.

CC: Jesse Bradley, Nebraska Department of Natural Resources; Rod Horn, South Platte Natural Resources District

Subject: Lodgepole Creek streamflow

# Introduction

Lodgepole Creek originates on the east side of the Laramie Range in eastern Albany County in Wyoming west of the town of Federal. North Lodgepole Creek and Middle Lodgepole Creek join to form Lodgepole Creek at about 41°19'N; 105°12'W at about 6800 ft above sea level. Lodgepole Creek flows in a generally eastward direction and exits Wyoming at Pine Bluffs. It is about 150 mi long (excluding meanders) in Wyoming and is at an elevation of about 5000 ft where it enters Nebraska.

In Nebraska, Lodgepole Creek flows generally east and passes south of Bushnell, north of Kimball, and north of Dix in Kimball County. In Cheyenne County, Lodgepole Creek continues eastward south of Potter where it turns east-southeast and passes south of Sidney and then turns east and passes south of Lodgepole. In Deuel County, Lodgepole Creek turns southeastward, passes south of Chappell, and turns south toward the Colorado state line. It is about 100 mi long (excluding meanders) in Nebraska and is at an elevation of about 3570 ft where it enters Colorado. It flows about 5 mi in Colorado before emptying into the South Platte River near Ovid, Colorado.

Long-term daily streamflow of Lodgepole Creek in Nebraska was gaged by U.S. Geological Survey and Nebraska Department of Natural Resources at Bushnell (Kimball County) and at Ralton (Deuel County). Lodgepole Creek at Bushnell, Nebraska (USGS 06762500) was gaged beginning in October 1931 and data continues up to the present. Beginning in 1994, this station was moved and is called Lodgepole Creek above Oliver Reservoir (NDNR 00219500).

Lodgepole Creek at Ralton, Nebraska (USGS 06763500) was gaged beginning in July 1951 with the record ending in September 1979. Nebraska Department of Natural Resources reactivated this gage on October 1, 2001 (NDNR 06763500).

There were other streamflow stations on Lodgepole Creek at various times. In addition, Nebraska Department of Natural Resources made miscellaneous measurements at various places on Lodgepole Creek at various times. These data are described in more detail in the Data section of this memorandum.

Doug Hallum (Nebraska Department of Natural Resources, now with Nebraska Conservation and Survey Division of University of Nebraska) was instrumental in finding historical information for Lodgepole

Creek. He asked James Gilbert (Nebraska Department of Natural Resources) to compile data on Lodgepole Creek from the Department archives. Gilbert provided the Access database DNR_ArchiveSpotMeas_LodgepoleCr_072512.accdb with various measurements. That database, along with publically available data from Nebraska Department of Natural Resources and U.S. Geological Survey for the basis for this memorandum.

## Data

This memorandum is accompanied by a CD that contains the data discussed herein. The CD contains the original Access database discussed above as well as several Excel spreadsheets, one for each location. The data were also preserved in software independent comma separated values (*.csv) text files with the same name for possible future use. The CSV files only contain the data and do not contain graphs. For Bushnell and Ralton, only CSV files are available because these data came from a previous study.

The Excel file names contain a date in *yymmdd* format in the latter part of the name. This allowed for identification of the latest version of the file while previous versions were retained.

The Excel files contain headers for identification of the data. For sites where daily streamflow data are collected, worksheet *Data* contains raw data and worksheet *Charts* contain bar charts of various data. In worksheet *Data*, columns A-C contain station information, column D is year, column E is month, and columns F-AJ contains daily flows, in cubic feet per second. Column AL is mean monthly flow in cubic feet per second and column AO is total monthly flow in acre-feet. Column AU is water year and columns AV-BA are October-March mean monthly flows. When converted to CSV files, only worksheet *Data* is preserved.

For sites where only miscellaneous streamflow measurements are collected, worksheet *Data* contains raw data and worksheet *Charts* contains bar charts of various data. In worksheet *Data*, columns A-D contain location and measurement information, column G contains the date, and column L contains the flow, in cubic feet per second.

The locations below are organized in downstream order. Stream baseflow targets were selected only at selected stations and these are given in the Targets section of this memorandum.

### Nebraska-Wyoming State Line

Data for this location are stored in file Lodgepole_WY_line.120801.xlsx. This location had daily data for 01/01/1925 through 09/30/1931. No targets were selected for this location because it was too close to the model boundary to be useful.

### Bushnell

Data for this location are stored in file 06762500.csv. These data were obtained from Luckey and others (2001). This file contains October and November daily flow data for 1931-97, although later data are available. As noted above, this station was moved and later was called Above Oliver Reservoir.

Data for this location also are stored in file Lodgepole_Bushnell_120731.xlsx. This file contains daily for data for the following periods:

| |
|---|
| 01/01/1924 - 12/31/1925 |
| 03/01/1931 - 09/30/1954 |
| 10/01/1991 - 09/30/1993 |

### Kimball

Data for this location are stored in file Lodgepole_Kimball_120731.xlsx. This location had daily data for 01/01/1925 through 09/30/1931. This station was called both Near Kimball and North of Kimball at various times. This may be the same location, although that is not known by the author.

### Dix

Data for this location are stored in Lodgepole_Dix_120808.xlsx. This location had miscellaneous measurements for the following periods: 07/30/1923 - 10/09/1959 and 05/24/1983 - 10/45/1988. No targets were selected for Dix, although many of the measurements indicated that Lodgepole Creek at this location frequently had zero flow.

### Potter

Data for this location are stored in Lodgepole_Potter_130605.xlsx. This location had miscellaneous measurements for the following periods:

| |
|---|
| 11/06/1920 |
| 11/09/1924 - 08/13/1928 |
| 06/18/1935 |
| 06/14/1937 - 09/14/1960 |
| 10/13/1961 |
| 07/06/1981 |
| 06/02/1983 - 05/03/1989 |

No targets were selected for Potter, although many measurements indicated that Lodgepole Creek at this location frequently had zero flow.

### Brownson

Brownson is not show on many maps, but is a small populated place about 11 mi east of Potter. Data for this location are stored in Lodgepole_Brownson_120813.xlsx. This location had miscellaneous measurements for the following periods:

| |
|---|
| 07/13/1923 |
| 07/10/1934 |
| 01/13/1947 - 04/04/1963 |
| 05/08/1975 - 10/12/1988 |

### Sidney

Data for this location are stored in Lodgepole_Sidney_120731.xlsx. This location had daily data for 01/01/1924 through 09/30/1931. This location was called At Sidney, Near Sidney, and South of Sidney at various times. This may be the same location, although that is not known by the author.

### Sunol

Data for this location are stored in Lodgepole_Sunol_120808.xlsx. This location was called Sunol, At Sunol, Near Sunol, and South of Sunol at various times. This may be the same location, although that is not known by the author. This location had miscellaneous measurements for the following periods:

| |
|---|
| 07/12/1923 |
| 05/31/1928 - 06/13/1928 |
| 05/03/1935 - 09/25/1963 |
| 10/15/1974 - 08/16/1977 |
| 05/27/1983 - 10/19/1988 |

No targets were selected for Sunol because the data were too erratic to pick definitive targets and this location is not too far from Sidney. However, the majority of measurements at this location were less than 5 $ft^3/s$.

### Lodgepole

Data for this location are stored in Lodgepole_Lodgepole_120730.xlsx. This location had daily data for 01/01/1924 through 09/30/1931. This location was called Lodgepole; Lodgepole, One mile west; and At Lodgepole at various times. This may be the same location, although that is not known by the author. No targets were picked for this location because the year-to-year variation in flow was too great given the short period of record. However, in general there was a fall-to-spring increase in flow with flows generally in the 5-15 $ft^3/s$ range.

### Chappell

Data for this location are stored in Lodgepole_Chappell_120813.xlsx. There are data for both Chappell and Near Chappell, with the former being more common. These locations are not the same because there are sometimes measurements on the same date for both locations. However, the locations are probably close enough together to be considered the same for this analysis. This location had miscellaneous measurements for the following periods:

| |
|---|
| 10/18/1900 |
| 7/12/1923 - 11/16/1923 |
| 06/13/1925 - 09/25/1963 |
| 05/27/1983 - 10/19/1988 |

No targets were selected for Chappell because the data were so erratic. Most measurements ranged from 0-20 $ft^3/s$, although some were higher. Winter flows were frequently less than 5 $ft^3/s$, but not always. Flows seem to be higher in the 1940s and 1950s.

### Ralton

Data for this location are stored in Lodgepole_Ralton.xlsx (no date in name) and 06763500.csv. The latter file was obtained from Luckey and others (2001). Both files contain daily data. The former file contains data for 02/01/1927 through 09/30/1931 and 10/01/1951 through 09/30/1954 and the latter file contains data for 10/01/1951 through 11/30/1978. The latter file contains data for only October and November, although data for other months are available.

## Targets

Stream baseflow targets were selected for five locations along Lodgepole Creek. These locations were selected based on the quality of the data and to give a reasonable areal distribution of targets.

### Bushnell

The steam baseflow targets for Bushnell were selected by plotting monthly streamflow and examining the October-March streamflow, ignoring months with anomalously high streamflow. Figure 1 shows streamflow for 1930-54 before there was substantial ground-water development in Lodgepole valley. The graphs show a frequent rise in streamflow over the October-March period. For each of the six-month periods, an average streamflow, rounded to the nearest 5 $ft^3/s$ was selected and marked on the graphs. Based on all these values, and the observation that streamflow rose over the winter, a fall baseflow target of 12 $ft^3/s$ and a spring baseflow target of 14 $ft^3/s$ was selected.

### Kimball

The steam baseflow targets for Kimball were selected by plotting monthly streamflow and examining the October-March streamflow. Figure 2 shows streamflow for 1925-31. This location had only six years of record, so picking stream baseflow targets were difficult. For each of the six-month periods, an

average streamflow, rounded to the nearest 5 $ft^3/s$ was selected and marked on the graphs. In two years, 1926-27 and 1931-31, streamflow rose over the October-March period. In one year, 1927-28, streamflow declined over the October-March period. For the remaining three years, streamflow was approximately steady over the October-March period. Based on all these values, a baseflow target of 12 $ft^3/s$ was selected for both fall and spring.

### Brownson

The stream baseflow targets for Brownson were selected by plotting miscellaneous streamflow measurements. Figure 3 shows streamflow measurements for 1946-87. The measurements before April 1963 show more zero values than the measurements after May 1975. It is not known what caused this apparent change in the low flow streamflow regime. To obtain stream baseflow targets, the median flow for 1975-88 was computed and rounded to the nearest 0.5 $ft^3/s$. This resulted in a baseflow target of 1.5 $ft^3/s$ for both spring and fall.

### Sidney

The stream baseflow targets for Sidney were selected by plotting monthly streamflow and examining the October-March streamflow. Figure 4 shows streamflow for 1924-31. For each of the six-month periods, an average streamflow, rounded to the nearest 1 $ft^3/s$ was selected and marked on the graphs. The streamflow appeared to be generally steady for the October-March period for most year, so a single target was chosen. Based on the October-March data, a baseflow target of 3 $ft^3/s$ was chosen for both spring and fall.

### Ralton

The stream baseflow targets for Ralton were selected by plotting monthly streamflow and examining the October-March streamflow. Figure 5 shows streamflow for 1951-71. For each of the six-month periods, an average streamflow, rounded to the nearest 5 $ft^3/s$, was selected and marked on the graphs. The graphs show a small rise in streamflow over the October-March period in many years. Based on all these values, and the observation that streamflow rose slightly over the winter, a fall baseflow target of 7 $ft^3/s$ and a stream baseflow target of 9 $ft^3/s$ was selected.

## References Cited

Luckey, R.R., Carney, C.P., and Peterson, S.M., 2001, Estimated groundwater discharge to streams from the High Plains aquifer in the western model unit of the Cooperative Hydrology Study area for the period prior to major groundwater irrigation: Cooperative Hydrology Study, 20 p.

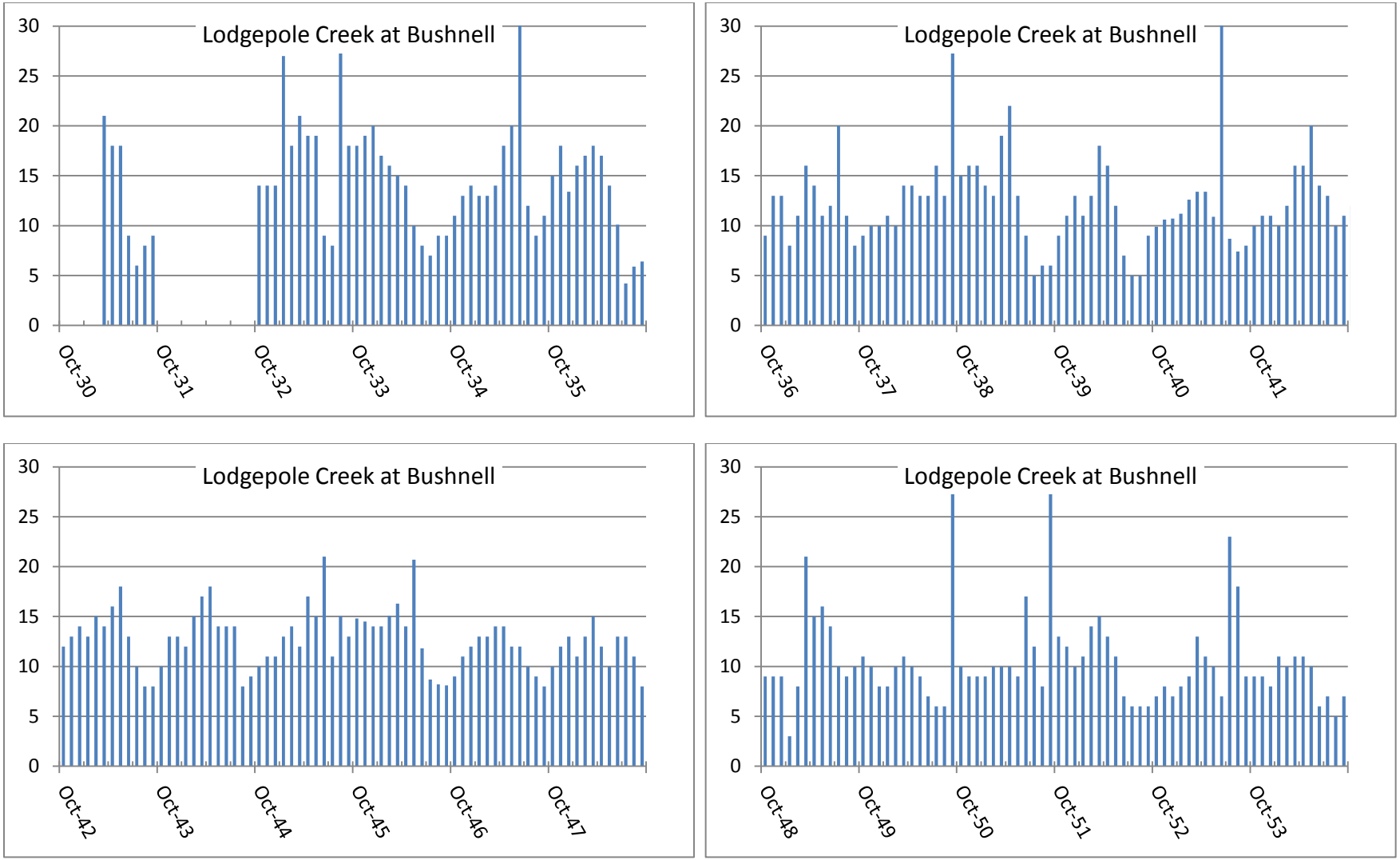


Figure 1. Monthly streamflow for Lodgepole Creek at Bushnell for October 1930 through September 1954. Vertical axis is streamflow, in cubic feet per second.

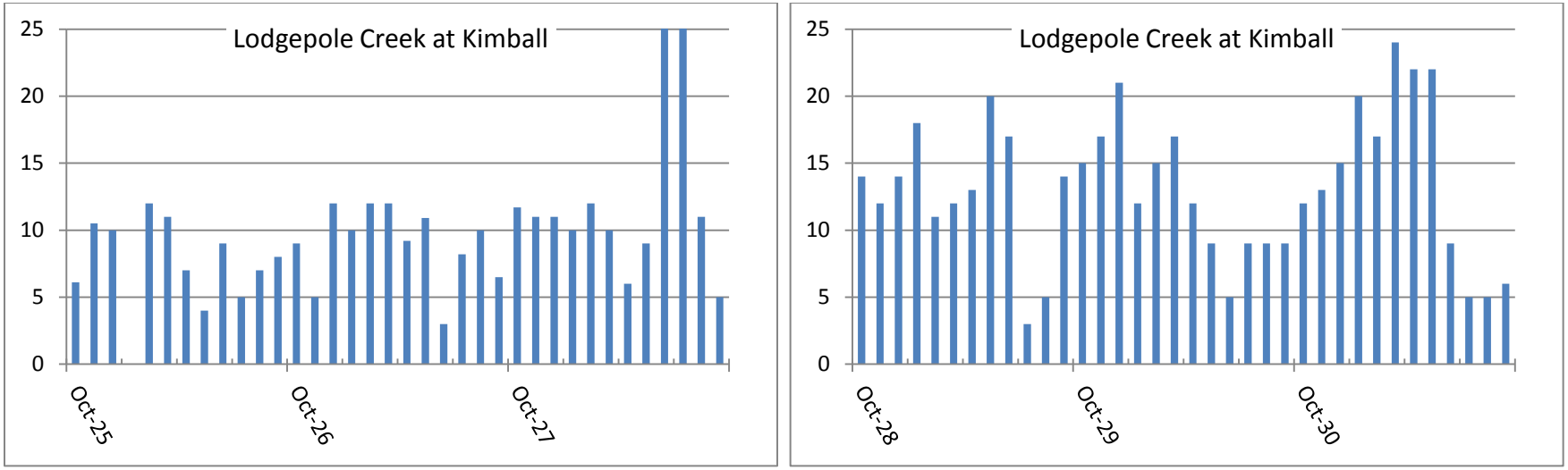


Figure 2. Monthly streamflow for Lodgepole Creek at Kimball for October 1925 through September 1931. Vertical axis is streamflow, in cubic feet per second.

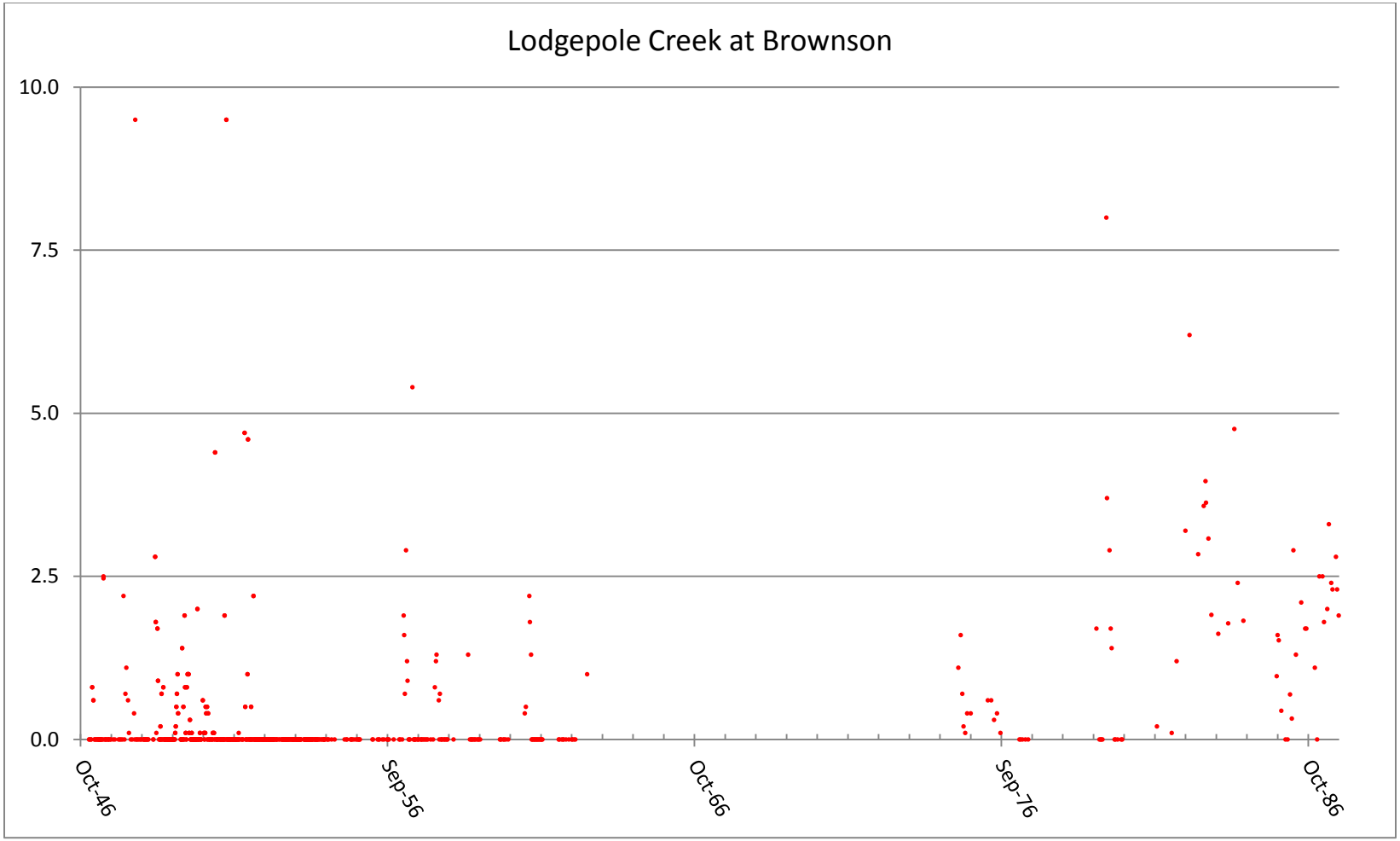


Figure 3. Miscellaneous streamflow measurements for Lodgepole Creek at Brownson for October 1946 through September 1987. Vertical axis is streamflow, in cubic feet per second.

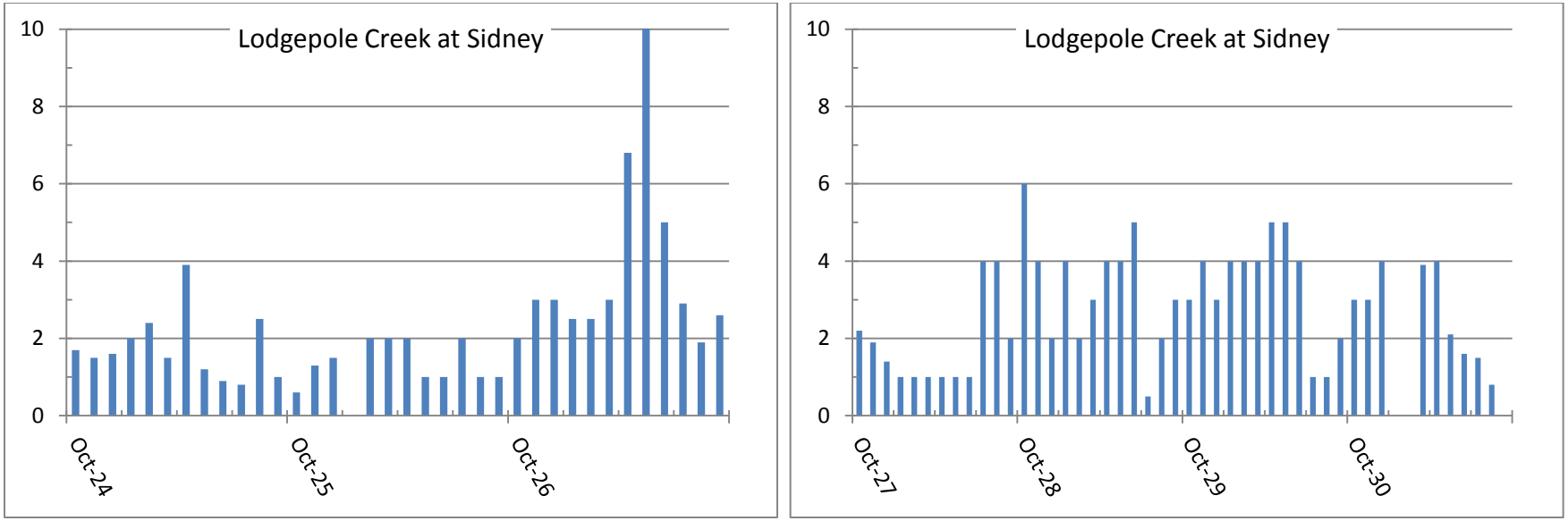


Figure 4. Monthly streamflow for Lodgepole Creek at Sidney for October 1924 through September 1931. Vertical axis is streamflow, in cubic feet per second.

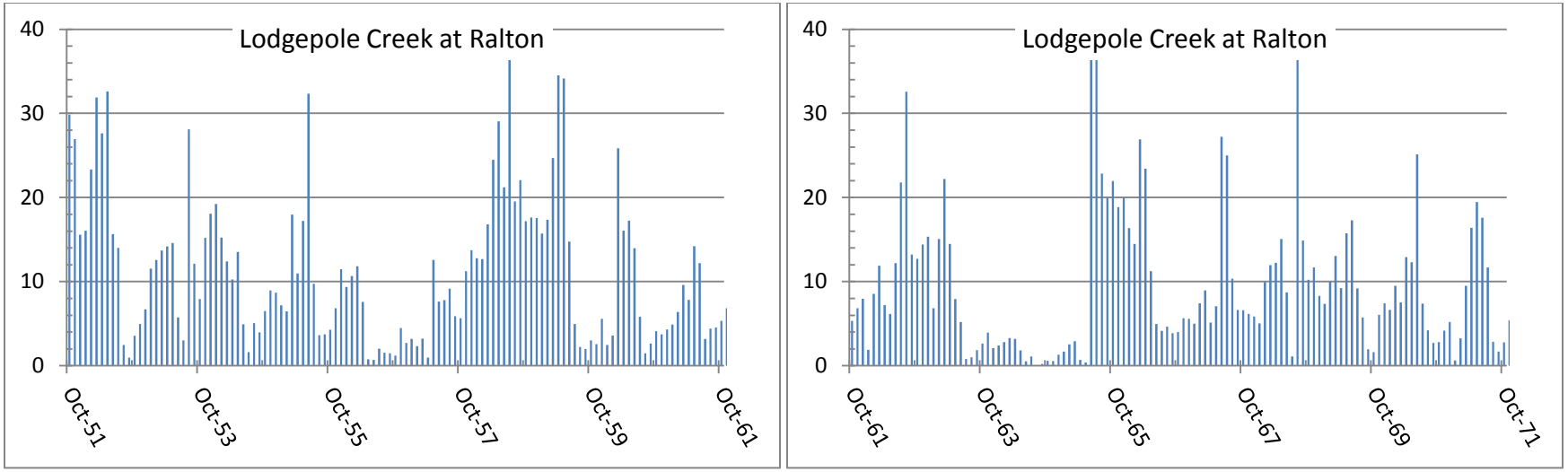


Figure 5. Monthly streamflow for Lodgepole Creek at Ralton for October 1951 through September 1971. Vertical axis is streamflow, in cubic feet per second.